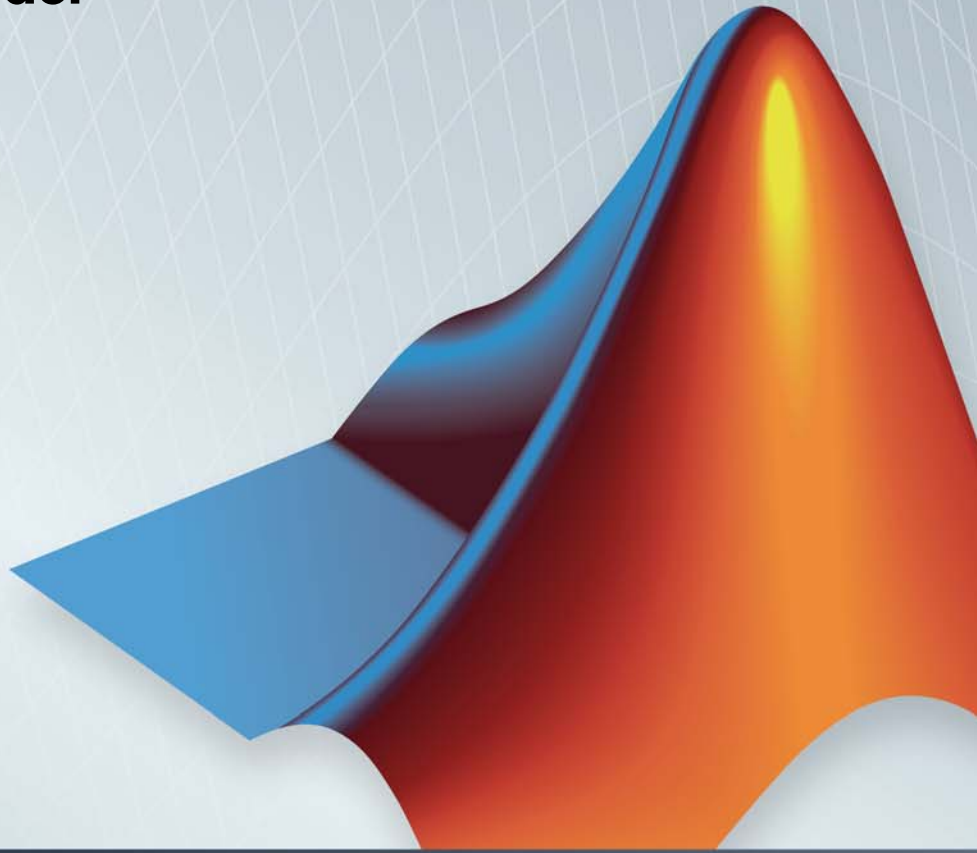


Embedded Coder[®]

Reference

R2014a



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The MathWorks, Inc.
3 Apple Hill Drive
Natick, MA 01760-2098

For contact information about worldwide offices, see the MathWorks Web site.

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March 2014 Online only

New for Version 6.0 (Release 2011a)
Revised for Version 6.1 (Release 2011b)
Revised for Version 6.2 (Release 2012a)
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Revised for Version 6.4 (Release 2013a)
Revised for Version 6.5 (Release 2013b)
Revised for Version 6.6 (Release 2014a)

Check Bug Reports for Issues and Fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase “Incorrect Code Generation” to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

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Alphabetical List

activate

Purpose	Mark file, project, or build configuration as active
Syntax	<code>IDE_Obj.activate('objectname', 'type')</code>
IDEs	This function supports the following IDEs: <ul style="list-style-type: none">• Analog Devices™ VisualDSP++®• Green Hills® MULTI®• Texas Instruments™ Code Composer Studio™ v3
Description	<p>Use the <code>IDE_Obj.activate('objectname', 'type')</code> method to make a project file or build configuration active in the MATLAB® session.</p> <p>When you make a project, file, or build configuration active, methods you invoke on the IDE handle object apply to that project, file, or build configuration.</p>
Input Arguments	<p>IDE_Obj</p> <p>For <code>IDE_Obj</code>, enter the name of the IDE handle object you created using a constructor function.</p> <p>objectname</p> <p>For <code>objectname</code>, enter the name of the project file or build configuration to make active.</p> <p>For project files, enter the full file name including the extension.</p> <p>For build configurations, enter 'Debug', 'Release', or 'Custom'. Before using the <code>activate</code> method on a build configuration, activate the project that contains the build configuration. For more information about configurations, see “Configuration” on page 3-128.</p> <p>type</p> <p>For <code>type</code>, enter the type of object to make active. If you omit the <code>type</code> argument, <code>type</code> defaults to 'project'. Enter one of the following strings for <code>type</code>:</p>

- 'project' — Makes a specified project active.
- 'buildcfg' — Make a specified build configuration active

IDE support for *type*

	CCS	MULTI	VisualDSP++
'project'	Yes	Yes	Yes
'buildcfg'	Yes		Yes

Examples

After using a constructor to create the IDE handle object, h, open several projects, make the first one active, and build the project:

```
h.open('c:\temp\myproj1')
h.open('c:\temp\myproj2')
h.open('c:\temp\myproj3')
h.activate('c:\temp\myproj1', 'project')
h.build
```

After making a project active, make the 'debug' configuration active:

```
h.activate('debug', 'buildcfg')
```

See Also

build | new | remove

cgv.CGV.activateConfigSet

Purpose Activate configuration set of model

Syntax `cgvObj.activateConfigSet(configSetName)`

Description `cgvObj.activateConfigSet(configSetName)` specifies the active configuration set for the model, only while the model is executed by `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. `configSetName` is the name of a configuration set object, `Simulink.ConfigSet`, which already exists in the model. The original configuration set for the model is restored after execution of the `cgv.CGV` object.

Examples Before calling `cgv.CGV.run` on a `cgv.CGV` object for a model, the model must already contain the named configuration set. After creating the `cgv.CGV` object for a model, you can use `cgv.CGV.activateConfigSet` to activate a configuration set in the model when the `cgv.CGV` object simulates the model.

```
configObj = Simulink.ConfigSet;
attachConfigSet('rtwdemo_cgv', configObj);
cgvObj = cgv.CGV('rtwdemo_cgv');
cgvObj.activateConfigSet(configObj.Name);
```

How To

- “About Model Configurations”
- “Programmatic Code Generation Verification”

Purpose

Add files to active project in IDE

Syntax

```
IDE_Obj.add(filename, filetype)
```

IDEs

This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

Description

Use `IDE_Obj.add(filename, filetype)` to add an existing file to the active project in the IDE. Using the add function is equivalent to selecting **Project > Add Files to Project** in the IDE.

Before using add:

- Use the constructor function for your IDE to create an IDE handle object, such as `IDE_Obj`.
- Create or open a project using the `new` or `open` methods.
- Make the project active in the IDE using the `activate` method.

You can add file types your IDE supports to your project. Consult the documentation for your IDE for detailed information about supported file types.

Supported File Types and Extensions

File Type	Extensions Supported	CCS IDE Project Folder
C/C++ source files	.c, .cpp, .cc, .cxx, .sa, .h, .hpp, .hxx	Source
Assembly source files	.a*, .s* (excluding .sa), .dsp	Source
Object and library files	.o*, .lib, .doj, .dlb	Libraries

Supported File Types and Extensions (Continued)

File Type	Extensions Supported	CCS IDE Project Folder
Linker command file	.cmd, .ldf	Project Name
VDK support file	.vdk	Not applicable
DSP/BIOS file (only with CCS IDE)	.tcf	DSP/BIOS Config

Note CCS IDE drops files in the project folder, indicated in the right-most column of the preceding table.

Input Arguments

`add` places the file specified by *filename* in the active project in the IDE.

IDE_Obj

IDE_Obj is a handle for an instance of the IDE. Before using a method, the constructor function for your IDE to create *IDE_Obj*.

filename

filename is the name of the file to add to the active IDE project.

If you supply a filename without a path or relative path, your coder product searches the IDE working folder first. It then searches the folders on your MATLAB path. Add supported file types shown in the preceding table.

filetype

filetype is an optional argument that specifies the file type. For example, 'lib', 'src', 'header'.

Examples

Start by creating an IDE handle object, such as `IDE_Obj` using the constructor for your IDE. Then enter the following commands:


```
IDE_Obj.new('myproject','project'); % Create a new project.
```

```
IDE_Obj.add('sourcefile.c'); % Add a C source file.
```

See Also

`activate` | `cd` | `new` | `open` | `remove`

add

Purpose

Add property to AUTOSAR element

Syntax

```
add(arProps,parentPath,property,name)
add(arProps,parentPath,property,name,childproperty,value)
```

Description

`add(arProps,parentPath,property,name)` adds a composite child element with the specified name to the AUTOSAR element at `parentPath`, under the specified property.

`add(arProps,parentPath,property,name,childproperty,value)` sets the value of a specified property of the added child property element.

Input Arguments

arProps - AUTOSAR properties information for a model
handle

AUTOSAR properties information for a model, previously returned by `arProps = autosar.api.getAUTOSARProperties(model)`. `model` is a handle or string representing the model name.

Example: `arProps`

parentPath - Path to a parent AUTOSAR element

string

Path to a parent AUTOSAR element to which to add a specified child property element.

Example: `'Input'`

property - Type of property

string

Type of property to add, among valid properties for the AUTOSAR element.

Example: `'DataElements'`

name - Name of child property element

string

Name of the child property element to add.

Example: 'DE1'

childproperty,value - Child property and value

name string, value

Child property to set, and its value. Table “Properties of AUTOSAR Elements” lists properties that are associated with AUTOSAR elements.

Example: 'Name', 'event1'

Examples

Add Data Element to Sender Interface

Add data element DE3 to sender interface Interface1.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
add(arProps,'Interface1','DataElements','DE3');
get(arProps,'Interface1','DataElements')

ans =

    'Interface1/DE1'    'Interface1/DE2'    'Interface1/DE3'
```

Add Mode Group to Mode-Switch Interface

Using a fully qualified path, add a mode-switch interface and set the `IService` property to `true`. Add mode group `mgModes` to the mode-switch interface using the composite property `ModeGroup`.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addMSInterface(arProps,'/pkg/if/Interface3','IService',true);
ifPaths=find(arProps,[],'ModeSwitchInterface','PathType','FullyQualified')

ifPaths =

    '/pkg/if/Interface3'
```

add

```
add(arProps, '/pkg/if/Interface3', 'ModeGroup', 'mgModes');
```

See Also

delete

Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

Purpose

Add baseline file for comparison

Syntax

```
cgvObj.addBaseline(inputName,baselineFile)  
cgvObj.addBaseline(inputName,baselineFile,toleranceFile)
```

Description

`cgvObj.addBaseline(inputName,baselineFile)` associates a baseline data file to an `inputName` in `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. If a baseline file is present, when you call `cgv.CGV.run`, `cgvObj` automatically compares baseline data to the result data of the current execution of `cgvObj`.

`cgvObj.addBaseline(inputName,baselineFile,toleranceFile)` includes an optional tolerance file to apply when comparing the baseline data to the result data of the current execution of `cgvObj`.

Input Arguments

inputName

A unique numeric or character identifier assigned to the input data associated with `baselineFile`

baselineFile

A MAT-file containing baseline data

toleranceFile

File containing the tolerance specification, which is created using `cgv.CGV.createToleranceFile`

Examples

A typical workflow for defining baseline data in a `cgv.CGV` object and then comparing the baseline data to the execution data is as follows:

- 1 Create a `cgv.CGV` object for a model.
- 2 Add input data to the `cgv.CGV` object by calling `cgv.CGV.addInputData`.
- 3 Add the baseline file to the `cgv.CGV` object by calling `cgv.CGV.addBaseline`, which associates the `inputName` for input

cgv.CGV.addBaseline

data in the `cgv.CGV` object with input data stored in the `cgv.CGV` object as the baseline data.

- 4 Run the `cgv.CGV` object by calling `cgv.CGV.run`, which automatically compares the baseline data to the result data in this execution.
- 5 Call `cgv.CGV.getStatus` to determine the results of the comparison.

See Also

`cgv.CGV.addInputData` | `cgv.CGV.run` |
`cgv.CGV.createToleranceFile` | `cgv.CGV.getStatus`

How To

- “Verify Numerical Equivalence with CGV”

Purpose Add callback function to execute before executing input data in object

Syntax `cgvObj.addHeaderReportFcn(CallbackFcn)`

Description `cgvObj.addHeaderReportFcn(CallbackFcn)` adds a callback function to `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. `cgv.CGV.run` calls `CallbackFcn` before executing input data included in `cgvObj`. The callback function signature is:

```
CallbackFcn(cgvObj)
```

Examples The callback function, `HeaderReportFcn`, is added to `cgv.CGV` object, `cgvObj`

```
cgvObj.addHeaderReportFcn(@HeaderReportFcn);
```

where `HeaderReportFcn` is defined as:

```
function HeaderReportFcn(cgvObj)
...
end
```

See Also `cgv.CGV.run`

How To • “Callbacks for Customized Model Behavior”

cgv.CGV.addPostExecFcn

Purpose Add callback function to execute after each input data file is executed

Syntax `cgvObj.addPostExecFcn(CallbackFcn)`

Description `cgvObj.addPostExecFcn(CallbackFcn)` adds a callback function to `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. `cgv.CGV.run` calls `CallbackFcn` after each input data file is executed for the model. The callback function signature is:

`CallbackFcn(cgvObj, inputIndex)`

`inputIndex` is a unique numerical identifier associated with input data in the `cgvObj`.

Examples The callback function, `PostExecutionFcn`, is added to `cgv.CGV` object, `cgvObj`

```
cgvObj.addPostExecFcn(@PostExecutionFcn);
```

where `PostExecutionFcn` is defined as:

```
function PostExecutionFcn(cgvObj, inputIndex)
...
end
```

See Also `cgv.CGV.run`

How To • “Callbacks for Customized Model Behavior”

Purpose	Add callback function to execute after each input data file executes
Syntax	<code>cgvObj.addPostExecReportFcn(CallbackFcn)</code>
Description	<p><code>cgvObj.addPostExecReportFcn(CallbackFcn)</code> adds a callback function to <code>cgvObj</code>. <code>cgvObj</code> is a handle to a <code>cgv.CGV</code> object. <code>cgv.CGV.run</code> calls <code>CallbackFcn</code> after each input data file is executed for the model. The callback function signature is:</p> <pre>CallbackFcn(cgvObj, inputIndex)</pre> <p><code>inputIndex</code> is a unique numeric identifier associated with input data in the <code>cgvObj</code>.</p>
Examples	<p>The callback function, <code>PostExecutionReportFcn</code>, is added to <code>cgv.CGV</code> object, <code>cgvObj</code></p> <pre>cgvObj.addPostExecReportFcn(@PostExecutionReportFcn);</pre> <p>where <code>PostExecutionReportFcn</code> is defined as:</p> <pre>function PostExecutionReportFcn(cgvObj, inputIndex) ... end</pre>
See Also	<code>cgv.CGV.run</code>
How To	<ul style="list-style-type: none">• “Callbacks for Customized Model Behavior”

cgv.CGV.addPreExecFcn

Purpose Add callback function to execute before each input data file executes

Syntax `cgvObj.addPreExecFcn(CallbackFcn)`

Description `cgvObj.addPreExecFcn(CallbackFcn)` adds a callback function to `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. `cgv.CGV.run` calls `CallbackFcn` before executing each input data file in `cgvObj`. The callback function signature is:

`CallbackFcn(cgvObj, inputIndex)`

`inputIndex` is a unique numeric identifier associated with input data in `cgvObj`.

Examples The callback function, `PreExecutionFcn`, is added to `cgv.CGV` object, `cgvObj`

```
cgvObj.addPreExecFcn(@PreExecutionFcn);
```

where `PreExecutionFcn` is defined as:

```
function PreExecutionFcn(cgvObj, inputIndex)
...
end
```

See Also `cgv.CGV.run`

How To • “Callbacks for Customized Model Behavior”

Purpose Add callback function to execute before each input data file executes

Syntax `cgvObj.addPreExecReportFcn(CallbackFcn)`

Description `cgvObj.addPreExecReportFcn(CallbackFcn)` adds a callback function to `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. `cgv.CGV.run` calls `CallbackFcn` before executing each input data file in `cgvObj`. The callback function signature is:

`CallbackFcn(cgvObj, inputIndex)`

`inputIndex` is a unique numerical identifier associated with input data in `cgvObj`.

Examples The callback function, `PreExecutionReportFcn`, is added to `cgv.CGV` object, `cgvObj`

```
cgvObj.addPreExecReportFcn(@PreExecutionReportFcn);
```

where `PreExecutionReportFcn` is defined as:

```
function PreExecutionReportFcn(cgvObj, inputIndex)
...
end
```

See Also `cgv.CGV.run`

How To • “Callbacks for Customized Model Behavior”

cgv.CGV.addTrailerReportFcn

Purpose Add callback function to execute after the input data executes

Syntax `cgvObj.addTrailerReportFcn(CallbackFcn)`

Description `cgvObj.addTrailerReportFcn(CallbackFcn)` adds a callback function to `cgvObj`. `cgvObj` is a handle to a `cgv.CGV` object. `cgv.CGV.run` executes the input data files in `cgvObj` and then calls `CallbackFcn`. The callback function signature is:

```
CallbackFcn(cgvObj)
```

Examples The callback function, `TrailerReportFcn`, is added to `cgv.CGV` object, `cgvObj`

```
cgvObj.addTrailerReportFcn(@TrailerReportFcn);
```

where `TrailerReportFcn` is defined as:

```
function TrailerReportFcn(cgvObj)
...
end
```

See Also `cgv.CGV.run`

How To • “Callbacks for Customized Model Behavior”

Purpose Files and folders in current IDE window

Syntax `IDE_Obj.dir`
`d=IDE_Obj.dir`

IDEs This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

Description `IDE_Obj.dir` lists the files and folders in the IDE working folder, where `IDE_Obj` is the object that references the IDE. `IDE_Obj` can be either a single object, or a vector of objects. When `IDE_Obj` is a vector, `dir` returns the files and folders referenced by each object.

`d=IDE_Obj.dir` returns the list of files and folders as an M-by-1 structure in `d` with the fields for each file and folder shown in the following table.

Field Name	Description
<code>name</code>	Name of the file or folder.
<code>date</code>	Date of most recent file or folder modification.
<code>bytes</code>	Size of the file in bytes. Folders return 0 for the number of bytes.
<code>isdirectory</code>	0 if it is a file, 1 if it is a folder.
<code>datenum</code>	Code Composer Studio IDE also returns the modification date as a MATLAB serial date number.

To view the entries in structure `d`, use an index in the syntax at the MATLAB prompt, as shown by the following examples.

- `d(3)` returns the third element in the structure.

dir

- `d(10)` returns the tenth element in the structure `d`.
- `d(4).date` returns the date field value for the fourth structure element.

See Also

`cd` | `open`

Purpose Add header file to array of header files for code replacement table entry

Syntax `addAdditionalHeaderFile(hEntry, headerFile)`

Arguments

hEntry
Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as `hEntry = RTW.Tf1CFunctionEntry` or `hEntry = RTW.Tf1COperationEntry`.

headerFile
String specifying an additional header file.

Description The `addAdditionalHeaderFile` function adds a specified additional header file to the array of additional header files for a code replacement table entry.

Examples In the following example, the `addAdditionalHeaderFile` function is used along with `addAdditionalIncludePath`, `addAdditionalSourceFile`, and `addAdditionalSourcePath` to fully specify additional header and source files for a code replacement table entry.

```
% Path to external header and source files
libdir = fullfile('${MATLAB_ROOT}','..', '..', 'lib');

op_entry = RTW.Tf1COperationEntry;
.
.
.
addAdditionalHeaderFile(op_entry, 'all_additions.h');
addAdditionalIncludePath(op_entry, fullfile(libdir, 'include'));

addAdditionalSourceFile(op_entry, 'all_additions.c');
addAdditionalSourcePath(op_entry, fullfile(libdir, 'src'));
```

addAdditionalHeaderFile

See Also

[addAdditionalIncludePath](#) | [addAdditionalSourceFile](#) | [addAdditionalSourcePath](#)

How To

- “Specify Build Information for Code Replacements”
- “Introduction to Code Replacement Libraries”

Purpose	Add include path to array of include paths for code replacement table entry
Syntax	<code>addAdditionalIncludePath(hEntry, path)</code>
Arguments	<p><i>hEntry</i> Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as <code>hEntry = RTW.Tf1CFunctionEntry</code> or <code>hEntry = RTW.Tf1COperationEntry</code>.</p> <p><i>path</i> String specifying the full path to an additional header file. The string can include tokens (for example, <code>\$myfolder\$</code>, where <code>myfolder</code> is a variable defined as a string or cell array of strings in the MATLAB workspace).</p>
Description	The <code>addAdditionalIncludePath</code> function adds a specified additional include path to the array of additional include paths for a code replacement table entry.
Examples	<p>In the following example, the <code>addAdditionalIncludePath</code> function is used along with <code>addAdditionalHeaderFile</code>, <code>addAdditionalSourceFile</code>, and <code>addAdditionalSourcePath</code> to fully specify additional header and source files for a code replacement table entry.</p> <pre>% Path to external header and source files libdir = fullfile('\${MATLAB_ROOT}','..', '..', 'lib'); op_entry = RTW.Tf1COperationEntry; . . . addAdditionalHeaderFile(op_entry, 'all_additions.h'); addAdditionalIncludePath(op_entry, fullfile(libdir, 'include'));</pre>

addAdditionalIncludePath

```
addAdditionalSourceFile(op_entry, 'all_additions.c');  
addAdditionalSourcePath(op_entry, fullfile(libdir, 'src'));
```

See Also

[addAdditionalHeaderFile](#) | [addAdditionalSourceFile](#) |
[addAdditionalSourcePath](#)

How To

- “Specify Build Information for Code Replacements”
- “Introduction to Code Replacement Libraries”

Purpose Add link object to array of link objects for code replacement table entry

Syntax `addAdditionalLinkObj(hEntry, linkObj)`

Arguments

hEntry
Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as `hEntry = RTW.Tf1CFunctionEntry` or `hEntry = RTW.Tf1COperationEntry`.

linkObj
String specifying an additional link object.

Description The `addAdditionalLinkObj` function adds a specified additional link object to the array of additional link objects for a code replacement table entry.

Examples In the following example, the `addAdditionalLinkObj` function is used along with `addAdditionalLinkObjPath` to fully specify an additional link object file for a code replacement table entry.

```
% Path to external object files
libdir = fullfile('${MATLAB_ROOT}','..', '..', 'lib');

op_entry = RTW.Tf1COperationEntry;
...
addAdditionalLinkObj(op_entry, 'addition.o');
addAdditionalLinkObjPath(op_entry, fullfile(libdir, 'bin'));
```

See Also `addAdditionalLinkObjPath`

How To

- “Specify Build Information for Code Replacements”
- “Introduction to Code Replacement Libraries”

addAdditionalLinkObjPath

Purpose	Add link object path to array of link object paths for code replacement table entry
Syntax	<code>addAdditionalLinkObjPath(<i>hEntry</i>, <i>path</i>)</code>
Arguments	<p><i>hEntry</i> Handle to a code replacement table entry previously returned by instantiating a code replacement entry class, such as <code>hEntry = RTW.Tf1CFunctionEntry</code> or <code>hEntry = RTW.Tf1COperationEntry</code>.</p> <p><i>path</i> String specifying the full path to an additional link object. The string can include tokens (for example, <code>\$myfolder\$</code>, where <code>myfolder</code> is a variable defined as a string or cell array of strings in the MATLAB workspace).</p>

Description The `addAdditionalLinkObjPath` function adds a specified additional link object path to the array of additional link object paths for a code replacement table entry.

Examples In the following example, the `addAdditionalLinkObjPath` function is used along with `addAdditionalLinkObj` to fully specify an additional link object file for a code replacement table entry.

```
% Path to external object files
libdir = fullfile('${MATLAB_ROOT}','..', '..', 'lib');

op_entry = RTW.Tf1COperationEntry;
...
addAdditionalLinkObj(op_entry, 'addition.o');
addAdditionalLinkObjPath(op_entry, fullfile(libdir, 'bin'));
```

See Also `addAdditionalLinkObj`

How To

- “Specify Build Information for Code Replacements”
- “Introduction to Code Replacement Libraries”

Purpose Add source file to array of source files for code replacement table entry

Syntax `addAdditionalSourceFile(hEntry, sourceFile)`

Arguments

hEntry
Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as `hEntry = RTW.Tf1CFunctionEntry` or `hEntry = RTW.Tf1COperationEntry`.

sourceFile
String specifying an additional source file.

Description The `addAdditionalSourceFile` function adds a specified additional source file to the array of additional source files for a code replacement table entry.

Examples In the following example, the `addAdditionalSourceFile` function is used along with `addAdditionalHeaderFile`, `addAdditionalIncludePath`, and `addAdditionalSourcePath` to fully specify additional header and source files for a code replacement table entry.

```
% Path to external header and source files
libdir = fullfile('${MATLAB_ROOT}','..', '..', 'lib');

op_entry = RTW.Tf1COperationEntry;
.
.
.
addAdditionalHeaderFile(op_entry, 'all_additions.h');
addAdditionalIncludePath(op_entry, fullfile(libdir, 'include'));

addAdditionalSourceFile(op_entry, 'all_additions.c');
addAdditionalSourcePath(op_entry, fullfile(libdir, 'src'));
```

addAdditionalSourceFile

See Also

`addAdditionalHeaderFile` | `addAdditionalIncludePath` | `addAdditionalSourcePath`

How To

- “Specify Build Information for Code Replacements”
- “Introduction to Code Replacement Libraries”

Purpose	Add source path to array of source paths for code replacement table entry
Syntax	<code>addAdditionalSourcePath(<i>hEntry</i>, <i>path</i>)</code>
Arguments	<p><i>hEntry</i></p> <p>Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as <code>hEntry = RTW.Tf1CFunctionEntry</code> or <code>hEntry = RTW.Tf1COperationEntry</code>.</p> <p><i>path</i></p> <p>String specifying the full path to an additional source file. The string can include tokens (for example, <code>\$myfolder\$</code>, where <code>myfolder</code> is a variable defined as a string or cell array of strings in the MATLAB workspace).</p>
Description	The <code>addAdditionalSourcePath</code> function adds a specified additional source file path to the array of additional source file paths for a code replacement table.
Examples	<p>In the following example, the <code>addAdditionalSourcePath</code> function is used along with <code>addAdditionalHeaderFile</code>, <code>addAdditionalIncludePath</code>, and <code>addAdditionalSourceFile</code> to fully specify additional header and source files for a code replacement table entry.</p> <pre>% Path to external header and source files libdir = fullfile('\${MATLAB_ROOT}','..', '..', 'lib'); op_entry = RTW.Tf1COperationEntry; . . . addAdditionalHeaderFile(op_entry, 'all_additions.h'); addAdditionalIncludePath(op_entry, fullfile(libdir, 'include'));</pre>

addAdditionalSourcePath

```
addAdditionalSourceFile(op_entry, 'all_additions.c');  
addAdditionalSourcePath(op_entry, fullfile(libdir, 'src'));
```

See Also

[addAdditionalHeaderFile](#) | [addAdditionalIncludePath](#) |
[addAdditionalSourceFile](#)

How To

- “Specify Build Information for Code Replacements”
- “Introduction to Code Replacement Libraries”

RTW.ModelSpecificCPrototype.addArgConf

Purpose

Add argument configuration information for Simulink model port to model-specific C function prototype

Syntax

```
addArgConf(obj, portName, category, argName, qualifier)
```

Description

`addArgConf(obj, portName, category, argName, qualifier)` method adds argument configuration information for a port in your ERT-based Simulink® model to a model-specific C function prototype. You specify the name of the model port, the argument category ('Value' or 'Pointer'), the argument name, and the argument type qualifier (for example, 'const').

The order of `addArgConf` calls determines the argument position for the port in the function prototype, unless you change the order by other means, such as the `RTW.ModelSpecificCPrototype.setArgPosition` method.

If a port has an existing argument configuration, subsequent calls to `addArgConf` with the same port name overwrite the previous argument configuration of the port.

Input Arguments

<i>obj</i>	Handle to a model-specific C prototype function control object previously returned by <i>obj</i> = <code>RTW.ModelSpecificCPrototype</code> or <i>obj</i> = <code>RTW.getFunctionSpecification(modelName)</code> .
<i>portName</i>	String specifying the unqualified name of an inport or outport in your Simulink model.
<i>category</i>	String specifying the argument category, either 'Value' or 'Pointer'.
<i>argName</i>	String specifying a valid C identifier.
<i>qualifier</i>	String specifying the argument type qualifier: 'none', 'const', 'const *', or 'const * const'.

RTW.ModelSpecificCPrototype.addArgConf

Examples

In the following example, you use the `addArgConf` method to add argument configuration information for ports `Input` and `Output` in an ERT-based version of `rtwdemo_counter`. After executing these commands, click the **Configure Model Functions** button on the **Interface** pane of the Configuration Parameters dialog box to open the Model Interface dialog box and confirm that the `addArgConf` commands succeeded.

```
rtwdemo_counter
set_param(gcs, 'SystemTargetFile', 'ert.tlc')

%% Create a function control object
a=RTW.ModelSpecificCPrototype

%% Add argument configuration information for Input and Output ports
addArgConf(a, 'Input', 'Pointer', 'inputArg', 'const *')
addArgConf(a, 'Output', 'Pointer', 'outputArg', 'none')

%% Attach the function control object to the model
attachToModel(a,gcs)
```

Alternatives

You can specify the argument configuration information in the Model Interface dialog box. See “Configure Function Prototypes Using Graphical Interfaces” in the Embedded Coder® documentation.

See Also

`RTW.ModelSpecificCPrototype.attachToModel`

How To

- “Function Prototype Control”

Purpose	Add checks				
Syntax	<code>addCheck(obj, checkID)</code>				
Description	<code>addCheck(obj, checkID)</code> includes the check, <code>checkID</code> , in the Code Generation Advisor. When a user selects the objective, the Code Generation Advisor includes the check, unless another objective with a higher priority excludes the check.				
Input Arguments	<table><tr><td><code>obj</code></td><td>Handle to a code generation objective object previously created.</td></tr><tr><td><code>checkID</code></td><td>Unique identifier of the check that you add to the new objective.</td></tr></table>	<code>obj</code>	Handle to a code generation objective object previously created.	<code>checkID</code>	Unique identifier of the check that you add to the new objective.
<code>obj</code>	Handle to a code generation objective object previously created.				
<code>checkID</code>	Unique identifier of the check that you add to the new objective.				
Examples	<p>Add the Identify questionable code instrumentation (data I/O) check to the objective.</p> <pre>addCheck(obj, 'mathworks.codegen.CodeInstrumentation');</pre>				
See Also	<code>Simulink.ModelAdvisor</code>				
How To	<ul style="list-style-type: none">• “Create Custom Objectives”• “About IDs”				

addComplexTypeAlignment

Purpose	Specify alignment boundary of a complex type
Syntax	<code>addComplexTypeAlignment(<i>hDataAlign</i>, <i>baseType</i>, <i>alignment</i>)</code>
Arguments	<p><i>hDataAlign</i> Handle to a data alignment object, previously returned by <code>hDataAlign = RTW.DataAlignment</code>.</p> <p><i>baseType</i> String specifying a built-in data type such as <code>int8</code> or <code>long</code>.</p> <p><i>alignment</i> A positive integer that is a power of 2 and does not exceed 128. This value specifies the alignment boundary.</p>

Description The `addComplexTypeAlignment` function specifies the alignment boundary of real and complex data members of a complex type. The starting memory address of the real and imaginary part of complex variables produced by the code generator with the specified type are a multiple of the specified alignment boundary. The code generator replaces operations in generated code if a code replacement table entry has a complex argument with a data alignment requirement that is less than or equal to the alignment boundary value and the entry satisfies all other code replacement match criteria.

To use this function, your code replacement library registration file must include additional compiler data alignment information, such as alignment syntax.

Examples Specify a 16-byte alignment boundary for complex `int8` types by adding the following lines of code to your code replacement library registration file.

```
da = RTW.DataAlignment;  
addComplexTypeAlignment(da, 'int8', 16);
```

How To

- “Provide Data Alignment Specifications for Compilers”

- “Configure Data Alignment for Function Implementations”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

addConceptualArg

Purpose	Add conceptual argument to array of conceptual arguments for code replacement table entry
Syntax	<code>addConceptualArg(hEntry, arg)</code>
Arguments	<p><i>hEntry</i> Handle to a code replacement table entry previously returned by instantiating a code replacement entry class, such as <i>hEntry</i> = RTW.Tf1CFunctionEntry or <i>hEntry</i> = RTW.Tf1COperationEntry.</p> <p><i>arg</i> Argument, such as returned by <i>arg</i> = <code>getTf1ArgFromString(name, datatype)</code>, to be added to the array of conceptual arguments for the code replacement table entry.</p>

Description The `addConceptualArg` function adds a specified conceptual argument to the array of conceptual arguments for a code replacement table entry.

Examples In the following example, the `addConceptualArg` function is used to add conceptual arguments for the output port and the two input ports for an addition operation.

```
hLib = RTW.Tf1Table;

% Create entry for addition of built-in uint8 data type
op_entry = RTW.Tf1COperationEntry;
op_entry.setTf1COperationEntryParameters( ...
    'Key', 'RTW_OP_ADD', ...
    'Priority', 90, ...
    'SaturationMode', 'RTW_SATURATE_ON_OVERFLOW', ...
    'RoundingModes', {'RTW_ROUND_UNSPECIFIED'}, ...
    'ImplementationName', 'u8_add_u8_u8', ...
    'ImplementationHeaderFile', 'u8_add_u8_u8.h', ...
    'ImplementationSourceFile', 'u8_add_u8_u8.c' );

arg = hLib.getTf1ArgFromString('y1', 'uint8');
```

```
arg.IOType = 'RTW_IO_OUTPUT';
op_entry.addConceptualArg( arg );

arg = hLib.getTflArgFromString('u1','uint8');
op_entry.addConceptualArg( arg );

arg = hLib.getTflArgFromString('u2','uint8');
op_entry.addConceptualArg( arg );

op_entry.copyConceptualArgsToImplementation();

hLib.addEntry( op_entry );
```

See Also

getTflArgFromString

How To

- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

addDWorkArg

Purpose Add DWork argument for semaphore entry in code replacement table

Syntax `addDWorkArg(hEntry, arg)`

Arguments

hEntry
Handle to a code replacement table entry previously returned by instantiating a code replacement semaphore table entry class, using *hEntry* = RTW.Tf1CSemaphoreEntry.

arg
Argument, such as returned by *arg* = `getTf1DWorkFromString(name, datatype)`, to be added to the arguments for the code replacement table entry.

Description The `addDWorkArg` function adds a specified DWork argument to the arguments for a semaphore entry in a code replacement table.

Examples In the following example, the `addDWorkArg` function is used to add a DWork argument named `d1` to the arguments for a semaphore entry in a code replacement table.

```
hLib = RTW.Tf1Table;  
sem_entry = RTW.Tf1CSemaphoreEntry;  
. . .  
% DWork Arg  
  
arg = hLib.getTf1DWorkFromString('d1','void*');  
sem_entry.addDWorkArg( arg );  
  
hLib.addEntry( sem_entry );
```

See Also `getTf1DWorkFromString`

How To

- “Map Semaphore or Mutex Operations to Application Implementations”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

cgv.CGV.addConfigSet

Purpose Add configuration set

Syntax

```
cgvObj.addConfigSet(configSet)
cgvObj.addConfigSet('configSetName')
cgvObj.addConfigSet('file', 'configSetFileName')
cgvObj.addConfigSet('file', 'configSetFileName', 'variable',
    'configSetName')
```

Description `cgvObj.addConfigSet(configSet)` is an optional method that adds the configuration set to the object. `cgvObj` is a handle to a `cgv.CGV` object. `configSet` is a variable that specifies a configuration set.

`cgvObj.addConfigSet('configSetName')` is an optional method that adds the configuration set to the object. `configSetName` is a string that specifies the name of the configuration set in the workspace.

`cgvObj.addConfigSet('file', 'configSetFileName')` is an optional method that adds the configuration set to the object. `configSetFileName` is a string that specifies the name of the file that contains only one configuration set.

`cgvObj.addConfigSet('file', 'configSetFileName', 'variable', 'configSetName')` is an optional method that adds the configuration set to the object. The file contains one or more configuration sets. Specify the name of the configuration set to use.

This method replaces the configuration parameter values in the model with the values from the configuration set that you add. The object applies the configuration set when you call the run method. You can add only one configuration set for each `cgv.CGV` object.

How To

- “Programmatic Code Generation Verification”
- “About Model Configurations”

Purpose	Add table entry to collection of table entries registered in code replacement table
Syntax	<code>addEntry(<i>hTable</i>, <i>entry</i>)</code>
Arguments	<p><i>hTable</i> Handle to a code replacement table previously returned by <i>hTable</i> = RTW.Tf1Table.</p> <p><i>entry</i> Handle to a function or operator entry that you have constructed after calling <i>hEntry</i> = RTW.Tf1CFunctionEntry or <i>hEntry</i> = RTW.Tf1COperationEntry</p>

Description The addEntry function adds a function or operator entry that you have constructed to the collection of table entries registered in a code replacement table.

Examples In the following example, the addEntry function is used to add an operator entry to a code replacement table after the entry is constructed.

```
hLib = RTW.Tf1Table;

% Create an entry for addition of built-in uint8 data type
op_entry = RTW.Tf1COperationEntry;
op_entry.setTf1COperationEntryParameters( ...
    'Key',          'RTW_OP_ADD', ...
    'Priority',     90, ...
    'SaturationMode', 'RTW_SATURATE_ON_OVERFLOW', ...
    'RoundingModes', {'RTW_ROUND_UNSPECIFIED'}, ...
    'ImplementationName', 'u8_add_u8_u8', ...
    'ImplementationHeaderFile', 'u8_add_u8_u8.h', ...
    'ImplementationSourceFile', 'u8_add_u8_u8.c' );

arg = hLib.getTf1ArgFromString('y1','uint8');
arg.IOType = 'RTW_IO_OUTPUT';
op_entry.addConceptualArg( arg );
```

addEntry

```
arg = hLib.getTf1ArgFromString('u1', 'uint8');
op_entry.addConceptualArg( arg );

arg = hLib.getTf1ArgFromString('u2', 'uint8');
op_entry.addConceptualArg( arg );

op_entry.copyConceptualArgsToImplementation();

addEntry(hLib, op_entry);
```

How To

- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

Purpose	Add input data
Syntax	<code>cgvObj.addInputData(inputName, inputDataFile)</code>
Description	<code>cgvObj.addInputData(inputName, inputDataFile)</code> adds an input data file to <code>cgvObj</code> . <code>cgvObj</code> is a handle to a <code>cgv.CGV</code> object. <code>inputName</code> is a unique identifier, which <code>cgvObj</code> associates with the input data in <code>inputDataFile</code> .
Tips	<ul style="list-style-type: none">• When calling <code>addInputData</code> you can modify configuration parameters by including their settings in the input file, <code>inputDataFile</code>.• If you omit calling <code>addInputData</code> before executing the model, the <code>cgv.CGV</code> object runs once using data in the base workspace.• The <code>cgvObj</code> uses the <code>inputName</code> to identify the input data associated with output data and output data files. <code>cgvObj</code> passes <code>inputName</code> to a callback function to identify the input data that the callback function uses.
Input Arguments	<p>inputName</p> <p><code>inputName</code> is a unique numeric or character identifier, which is associated with the input data in <code>inputDataFile</code>.</p> <p>inputDataFile</p> <p><code>inputDataFile</code> is an input data file, with or without the <code>.mat</code> extension. <code>cgvObj</code> uses the input data when the model executes during <code>cgv.CGV.run</code>. If the input file is in the working folder, the <code>cgvObj</code> does not require the path. <code>addInputData</code> does not qualify that the contents of <code>inputDataFile</code> relate to the inputs of the model. Data that is not used by the model will not throw a warning or error.</p>
See Also	<code>cgv.CGV.run</code>
How To	<ul style="list-style-type: none">• “Verify Numerical Equivalence with CGV”

addMSInterface

Purpose

Add AUTOSAR mode-switch interface

Syntax

```
addMSInterface(arProps,qName)
addMSInterface(arProps,qName,property,value)
```

Description

`addMSInterface(arProps,qName)` adds mode-switch interface `qName` to the AUTOSAR configuration for a model.

`addMSInterface(arProps,qName,property,value)` sets the value of a specified property of the added mode-switch interface.

Input Arguments

arProps - AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by `arProps = autosar.api.getAUTOSARProperties(model)`. `model` is a handle or string representing the model name.

Example: `arProps`

qName - Name of mode-switch interface

string

Name and fully qualified path of the mode-switch interface to add.

Example: `'/A/B/C/myInterface1 '`

property,value - Mode-switch interface property and value

name string, value

Mode-switch interface property to set, and its value. Table “Properties of AUTOSAR Elements” lists properties that are associated with AUTOSAR elements.

Example: `'IsService',true`

Examples

Add Mode-Switch Interface, Set IsService, and Add Mode Group

Using a fully qualified path, add a mode-switch interface and set the `IsService` property to `true`. Add mode group `mgModes` to the mode-switch interface using the composite property `ModeGroup`.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addMSInterface(arProps,'/pkg/if/Interface3','IsService',true);
ifPaths=find(arProps,[],'ModeSwitchInterface','PathType','FullyQualified')

ifPaths =

    '/pkg/if/Interface3'

add(arProps,'/pkg/if/Interface3','ModeGroup','mgModes');
```

See Also

`delete`

Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

rtw.codegenObjectives.Objective.addParam

Purpose Add parameters

Syntax `addParam(obj, paramName, value)`

Description `addParam(obj, paramName, value)` adds a parameter to the objective, and defines the value of the parameter that the Code Generation Advisor verifies in **Check model configuration settings against code generation objectives**.

Input Arguments	<i>obj</i>	Handle to a code generation objective object previously created.
	<i>paramName</i>	Parameter that you add to the objective.
	<i>value</i>	Value of the parameter.

Examples Add Inlineparameters to the objective, and specify the parameter value as on.

```
addParam(obj, 'InlineParams', 'on');
```

See Also `get_param`

How To

- “Create Custom Objectives”
- “Parameter Command-Line Information Summary”

Purpose Add files required by model

Syntax `cgvObj.addPostLoadfiles({FileList})`

Description `cgvObj.addPostLoadfiles({FileList})` is an optional method that adds a list of MATLAB and MAT-files to the object. `cgvObj` is a handle to a `cgv.CGV` object. `cgvObj` executes and loads the files after opening the model and before running tests. `FileList` is a cell array of names of MATLAB and MAT-files in the testing directory that the model requires to run.

Note Subsequent `cgvObj.addPostLoadFiles` calls to the same `cgv.CGV` object replaces the list of MATLAB and MAT-files of that object.

How To

- “Verify Numerical Equivalence with CGV”
- “Callbacks for Customized Model Behavior”

address

Purpose Memory address and page value of symbol in IDE

Syntax `a = IDE_Obj.address(symbol, scope)`

IDEs This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

Description The `a = IDE_Obj.address(symbol, scope)` method returns the memory address of the first matching symbol in the symbol table of the most recently loaded program.

Because the `address` method returns the `address` and `page` values as a structure, your programs can use the values directly. For example, the `IDE_Obj.read` and `IDE_Obj.write` can use `a` as an input.

If the `address` method does not find the symbol in the symbol table, it generates a warning and returns a null value.

Input Arguments

a

Use `a` as a variable to capture the return values from the `address` method.

IDE_Obj

`IDE_Obj` is a handle for an instance of the IDE. Before using a method, use the constructor function for your IDE to create `IDE_Obj`.

symbol

`symbol` is the name of the symbol for which you are getting the memory address and page values.

Symbol names are case sensitive.

For `address` to return an address, the symbol must be a valid entry in the symbol table. If the `address` method does not find the symbol, it generates a warning and leaves a empty.

scope

Optionally, you set the scope of the address method. Enter 'local' or 'global'. Use 'local' when the current scope of the program is the desired function scope. If you omit the `scope` argument, the address method uses 'local' by default.

Output Arguments

If the `address` method does not find the symbol, it generates a warning and does not return a value for `a`.

The `address` method only returns address information for the first matching symbol in the symbol table.

For Code Composer Studio

The return value, `a`, is a numeric array with the symbol's address offset, `a(1)`, and page, `a(2)`.

With TI C6000™ processors, the memory page value is 0.

For MULTI

With `MULTI`, `address` requires a linker command file (`lcf`) in your project.

The return value, `a`, is a numeric array with the symbol's address offset, `a(1)`, and page, `a(2)`.

For VisualDSP++

With `VisualDSP++`, `address` requires a linker command file (`lcf`) in your project.

The return value `a` is a numeric array with the symbol's start address, `a(1)`, and memory type, `a(2)`.

Examples

After you load a program to your processor, `address` lets you read and write to specific entries in the symbol table for the program. For

address

example, the following function reads the value of symbol `'ddat'` from the symbol table in the IDE.

```
ddatv = IDE_Obj.read(IDE_Obj.address('ddat'),'double',4)
```

`ddat` is an entry in the current symbol table. `address` searches for the string `ddat` and returns a value when it finds a match. `read` returns `ddat` to MATLAB software as a double-precision value as specified by the string `'double'`.

To change values in the symbol table, use `address` with `write`:

```
IDE_Obj.write(IDE_Obj.address('ddat'),double([pi 12.3 exp(-1)...  
sin(pi/4)]))
```

After executing this write operation, `ddat` contains double-precision values for π , 12.3, e^{-1} , and $\sin(\pi/4)$. Use `read` to verify the contents of `ddat`:

```
ddatv = IDE_Obj.read(IDE_Obj.address('ddat'),'double',4)
```

MATLAB software returns

```
ddatv =
```

```
    3.1416    12.3    0.3679    0.7071
```

See Also

[load](#) | [read](#) | [symbol](#) | [write](#)

Purpose	Add AUTOSAR sender-receiver interface
Syntax	<code>addSRInterface(arProps,qName)</code> <code>addSRInterface(arProps,qName,property,value)</code>
Description	<p><code>addSRInterface(arProps,qName)</code> adds sender-receiver interface <code>qName</code> to the AUTOSAR configuration for a model.</p> <p><code>addSRInterface(arProps,qName,property,value)</code> sets the value of a specified property of the added sender-receiver interface.</p>
Input Arguments	<p>arProps - AUTOSAR properties information for a model handle</p> <p>AUTOSAR properties information for a model, previously returned by <code>arProps = autosar.api.getAUTOSARProperties(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p>Example: <code>arProps</code></p> <p>qName - Name of sender-receiver interface string</p> <p>Name and fully qualified path of the sender-receiver interface to add.</p> <p>Example: <code> '/A/B/C/myInterface1 '</code></p> <p>property,value - Sender-receiver interface property and value name string, value</p> <p>Sender-receiver interface property to set, and its value. Table “Properties of AUTOSAR Elements” lists properties that are associated with AUTOSAR elements.</p> <p>Example: <code> 'IsService',true</code></p>

addSRInterface

Examples

Add Sender-Receiver Interface and Set IsService Property

Using a fully qualified path, add a sender-receiver interface and set the IsService property to true.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addSRInterface(arProps,'/pkg/if/Interface3','IsService',true);
ifPaths=find(arProps,[],'SenderReceiverInterface',...
    'IsService',true,'PathType','FullyQualified')

ifPaths =

    '/pkg/if/Interface3'
```

See Also

delete

Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

Purpose

Create handle object to interact with VisualDSP++ IDE

Syntax

```
IDE_Obj = adivdsp
IDE_Obj = adivdsp('propname1',propvalue1,'propname2',propvalue2,
,'timeout',value)
IDE_Obj = adivdsp('my_session')
```

Note The output object name (left side argument) you provide for adivdsp cannot begin with an underscore, such as `_IDE_Obj`.

IDEs

This function supports the following IDEs:

- Analog Devices VisualDSP++

Description

If the IDE is not running, `IDE_Obj = adivdsp` opens the VisualDSP++ software for the most recent active session. After that, it creates an object, `IDE_Obj`, that references the newly opened session. If the IDE is running, `adivdsp` returns object `IDE_Obj` that connects to the active session in the IDE.

`adivdsp` creates an interface between MATLAB software and Analog Devices VisualDSP++ software. The first time you use `adivdsp`, supply a session name as an input argument (refer to the next syntax).

```
IDE_Obj =
adivdsp('sessionname','name','procnum','number',...)
returns an object handle IDE_Obj that you use to interact with a
processor in the IDE from MATLAB.
```

Use the debug methods with this object to access memory and control the execution of the processor.

The `adivdsp` function interprets input arguments as object property definitions. Each property definition consists of a property name followed by the desired property value (often called a *PV*, or *property name/property value*, pair). Although you can define a number of `adivdsp` object properties when you create the object, there are several important properties that you must provide during object construction.

These properties must be delineated when you create the object. The required input arguments are as follows:

- `sessionname` — Specifies the session to connect to. This session must exist in the session list. `adivdsp` does not create new sessions. The resulting object refers to a processor in `sessionname`. To see the list of sessions, use `listsessions` at the MATLAB command prompt.
- `procnum`— Specifies the processor to connect to in `sessionname`. The `adivdsp` object only supports connecting to processor 0. As such, the default value for `procnum` is 0 for the first processor on the board. If you omit the `procnum` argument, `adivdsp` connects to the first processor.

After you build the `adivdsp` object `IDE_Obj`, you can review the object property values with `get`, but you cannot modify the `sessionname` and `procnum` property values.

To connect to the active session in IDE, omit the `sessionname` property in the syntax. If you do not pass `sessionname` as an input argument, the object defaults to the active session in the IDE.

Use `listsessions` to determine the number for the desired DSP processor. If your IDE session is single processor or to connect to processor zero, you can omit the `procnum` property definition. If you omit the `procnum` argument, `procnum` defaults to 0 (zero-based).

```
IDE_Obj =  
adivdsp('propname1',propvalue1,'propname2',propvalue2,  
, 'timeout', value) sets the global time-out value to value in IDE_Obj.  
MATLAB waits for the specified time-out value to get a response from  
the IDE application. If the IDE does not respond within the allotted  
time-out period, MATLAB exits from the evaluation of this function.
```

If the session exists in the session list and the IDE is not already running, `IDE_Obj = adivdsp('my_session')` connects to `my_session`. In this case, MATLAB starts VisualDSP++ IDE for the session named `my_session`.

The following list shows some other possible cases and results of using `adivdsp` to construct an object that refers to `my_session`.

- If `my_session` does not exist in the session list and the IDE is not already running, MATLAB returns an error stating that `my_session` does not exist in the session list.
- When `my_session` is the current active session and the IDE is already running, MATLAB connects to the IDE for this session.
- If `my_session` is not the current active session, but exists in the session list, and the IDE is already running, MATLAB displays a dialog box asking if you want to switch to `my_session`. If you choose to switch to `my_session`, the existing handles you have to other sessions in the IDE become invalid. To connect to the other sessions you use `adivdsp` to recreate the objects for those sessions.
- If `my_session` does not exist in the session list and the IDE is already running, MATLAB returns an error, explaining that the session `my_session` does not exist in the session list.

Examples

These examples show some of the operation of `adivdsp`.

```
IDE_Obj = adivdsp('sessionname','my_session','procnum',0);
```

returns a handle to the first DSP processor for session `my_session`.

`IDE_Obj = adivdsp` without input arguments constructs the object `IDE_Obj` with the default property values, returning a handle to the first DSP processor for the active session in the IDE.

```
IDE_Obj = adivdsp('sessionname','my_session');
```

returns a handle to the first DSP processor for the session `my_session`.

See Also

`listsessions`

adivdspsetup

Purpose Configure your coder product to interact with VisualDSP++ IDE

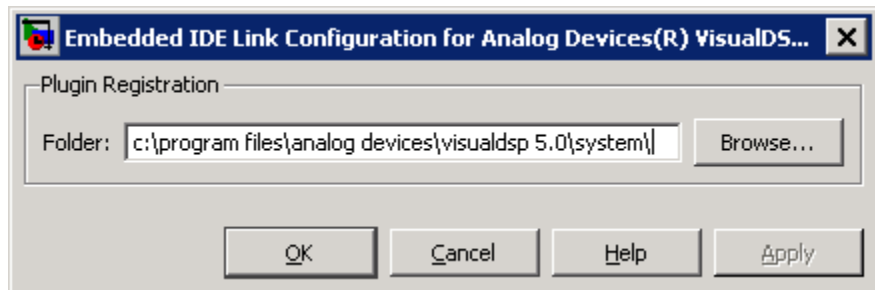
Syntax `adivdspsetup`

IDEs This function supports the following IDEs:

- Analog Devices VisualDSP++

Description Enter `adivdspsetup` at the MATLAB command line when you are setting up your coder product to interact with VisualDSP++ for the first time. This action displays a dialog box to specify where to install a plug-in for VisualDSP++. The default value for **Folder** is the VisualDSP++ `system` folder. You can specify folders for which you have write access. When you click **OK**, the software adds the plug-in to the folder and registers the plug-in with the VisualDSP++ IDE.

Examples **1** At the MATLAB command line, enter: `adivdspsetup`. This action opens the following dialog box:



2 Click **Browse**, locate the `system` folder for VisualDSP++, and click **OK**. This action registers the MathWorks plugin to the VisualDSP++ IDE.

See Also `adivdsp`

Purpose Run application on processor to breakpoint

Syntax `IDE_Obj.animate`

IDEs This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

Description `IDE_Obj.animate` starts the processor application, which runs until it encounters a breakpoint in the code. At the breakpoint, application execution halts and CCS Debugger returns data to the IDE to update the windows not connected to probe points. After updating the display, the application resumes execution and runs until it encounters another breakpoint. The run-break-resume process continues until you stop the application from MATLAB software with the `halt` function or from the IDE.

While running scripts or files in MATLAB software, you can use `animate` to update the IDE with information as your script or program runs.

Using `animate` with Multiprocessor Boards

When you use `animate` with a `ticcs` object `IDE_Obj` that comprises more than one processor, such as an OMAP processor, the method applies to each processor in your `IDE_Obj` object. This action causes each processor to run a loaded program just as it does for the single processor case.

See Also `halt` | `restart` | `run`

arxml.importer

Purpose	Import AUTOSAR component XML																		
Description	You can use methods of the <code>arxml.importer</code> class to import AUTOSAR components in a controlled manner. For example, you can parse an AUTOSAR software component description file exported by DaVinci System Architect (from Vector Informatik GmbH), and import the component into a Simulink model for subsequent configuration, code generation, and export to XML.																		
Construction	<code>arxml.importer</code> Construct <code>arxml.importer</code> object																		
Methods	<table><tr><td><code>createCalibrationComponentObjects</code></td><td>Create Simulink calibration objects from AUTOSAR calibration component</td></tr><tr><td><code>createComponentAsModel</code></td><td>Create AUTOSAR atomic software component as Simulink model</td></tr><tr><td><code>getApplicationComponentNames</code></td><td>Get list of application software component names</td></tr><tr><td><code>getCalibrationComponentNames</code></td><td>Get calibration component names</td></tr><tr><td><code>getClientServerInterfaceNames</code></td><td>Get list of client-server interfaces</td></tr><tr><td><code>getComponentNames</code></td><td>Get application and sensor/actuator software component names</td></tr><tr><td><code>getDependencies</code></td><td>Get list of XML dependency files</td></tr><tr><td><code>getFile</code></td><td>Return software component XML file name</td></tr><tr><td><code>getSensorActuatorComponentNames</code></td><td>Get list of sensor/actuator software component names</td></tr></table>	<code>createCalibrationComponentObjects</code>	Create Simulink calibration objects from AUTOSAR calibration component	<code>createComponentAsModel</code>	Create AUTOSAR atomic software component as Simulink model	<code>getApplicationComponentNames</code>	Get list of application software component names	<code>getCalibrationComponentNames</code>	Get calibration component names	<code>getClientServerInterfaceNames</code>	Get list of client-server interfaces	<code>getComponentNames</code>	Get application and sensor/actuator software component names	<code>getDependencies</code>	Get list of XML dependency files	<code>getFile</code>	Return software component XML file name	<code>getSensorActuatorComponentNames</code>	Get list of sensor/actuator software component names
<code>createCalibrationComponentObjects</code>	Create Simulink calibration objects from AUTOSAR calibration component																		
<code>createComponentAsModel</code>	Create AUTOSAR atomic software component as Simulink model																		
<code>getApplicationComponentNames</code>	Get list of application software component names																		
<code>getCalibrationComponentNames</code>	Get calibration component names																		
<code>getClientServerInterfaceNames</code>	Get list of client-server interfaces																		
<code>getComponentNames</code>	Get application and sensor/actuator software component names																		
<code>getDependencies</code>	Get list of XML dependency files																		
<code>getFile</code>	Return software component XML file name																		
<code>getSensorActuatorComponentNames</code>	Get list of sensor/actuator software component names																		

setDependencies

Set XML file dependencies

setFile

Set software component XML file name

updateModel

Merge XML changes into associated mapped Simulink model

Copy Semantics

Handle. To learn how this affects your use of the class, see Copying Objects in the MATLAB Programming Fundamentals documentation.

arxml.importer

Purpose Construct `arxml.importer` object

Syntax
`importerObj = arxml.importer(filename)`
`importerObj = arxml.importer({filename1,filename2,...,filenameN})`

Description
`importerObj = arxml.importer(filename)` constructs an `arxml.importer` object and parses the AUTOSAR information contained in the XML file specified by `filename`.
`importerObj = arxml.importer({filename1,filename2,...,filenameN})` constructs an `arxml.importer` object and parses the AUTOSAR information contained in the XML files that are specified in the cell array. The cell array format allows you to specify multiple XML files that are required for an AUTOSAR import operation in one function call.

Input Arguments	<code>filename</code>	Name of XML file containing AUTOSAR information.
	<code>{filename1,filename2,...,filenameN}</code>	Cell array of names of XML files containing AUTOSAR information.

Output Arguments	<code>importer_obj</code>	Handle to newly created <code>arxml.importer</code> object.
-------------------------	---------------------------	-------------------------------------------------------------

Examples Specify the set of XML files required for an AUTOSAR import operation in one function call:

```
x = arxml.importer({'AtomicSensorComponentTypes.arxml', ...  
                  'DataTypes.arxml', 'MiscDefs.arxml'})
```

Specify a primary XML file containing AUTOSAR information. Use the `arxml.importer.getDependencies` method to specify other required XML files:

```
x = arxml.importer('AtomicSensorComponentTypes.arxml')
x.setDependencies({'DataTypes.arxml', 'MiscDefs.arxml'});
```

See Also

`arxml.importer.getDependencies`

How To

- “Import AUTOSAR Software Component”

RTW.ModelCPPClass.attachToModel

Purpose Attach model-specific C++ class interface to loaded ERT-based Simulink model

Syntax `attachToModel(obj, modelName)`

Description `attachToModel(obj, modelName)` attaches a model-specific C++ class interface to a loaded ERT-based Simulink model.

Input Arguments

<i>obj</i>	Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.ModelCPPArgsClass</code> or <code>obj = RTW.ModelCPPVoidClass</code> .
<i>modelName</i>	String specifying the name of a loaded ERT-based Simulink model to which the object is going to be attached.

Alternatives The **Configure C++ Class Interface** button on the **Interface** pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. Once you validate and apply your changes, you can generate code based on your C++ class interface modifications. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation.

How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

RTW.ModelSpecificCPrototype.attachToModel

Purpose	Attach model-specific C function prototype to loaded ERT-based Simulink model				
Syntax	<code>attachToModel(obj, modelName)</code>				
Description	<code>attachToModel(obj, modelName)</code> attaches a model-specific C function prototype to a loaded ERT-based Simulink model.				
Input Arguments	<table><tr><td><i>obj</i></td><td>Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code>.</td></tr><tr><td><i>modelName</i></td><td>String specifying the name of a loaded ERT-based Simulink model to which the object is going to be attached.</td></tr></table>	<i>obj</i>	Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> .	<i>modelName</i>	String specifying the name of a loaded ERT-based Simulink model to which the object is going to be attached.
<i>obj</i>	Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> .				
<i>modelName</i>	String specifying the name of a loaded ERT-based Simulink model to which the object is going to be attached.				
Alternatives	Click the Configure Model Functions button on the Code Generation > Interface pane of the Configuration Parameters dialog box for flexible control over the model function prototypes that are generated for your model. Once you validate and apply your changes, you can generate code based on your function prototype modifications. See “Configure Function Prototypes Using Graphical Interfaces” in the Embedded Coder documentation.				
How To	<ul style="list-style-type: none">• “Function Prototype Control”				

autosar.api.create

Purpose Create AUTOSAR component for Simulink model

Syntax
`autosar.api.create(model)`
`autosar.api.create(model,mode)`

Description `autosar.api.create(model)` creates AUTOSAR properties and Simulink to AUTOSAR mapping for `model`.

`autosar.api.create(model,mode)` additionally specifies whether to map model inports and outports with default settings for corresponding AUTOSAR properties.

Input Arguments

model - Model for which to create AUTOSAR properties and mapping
`handle` | `string`

Model for which to create AUTOSAR properties and Simulink to AUTOSAR mapping, specified as a handle or string representing the model name.

Example: ``my_model'`

mode - Whether to map model inports and outports with default settings
`init (default)` | `default`

Specify `default` to map model inports and outports with default settings for corresponding AUTOSAR properties.

Example: ``default'`

Examples **Create Default AUTOSAR Properties and Mapping**

Create AUTOSAR properties and Simulink to AUTOSAR mapping for a model. Map the model inports and outports with default settings for corresponding AUTOSAR properties.

```
rtwdemo_autosar_multirunnables
```

```
autosar.api.create('rtwdemo_autosar_multirunnables', 'default');
```

See Also

`autosar_ui_launch`

Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

AUTOSAR.DualScaledParameter

Purpose Specify computation method, calibration value, data type, and other properties of AUTOSAR dual-scaled parameter

Description This class extends the `AUTOSAR.Parameter` class so that you can define an object that stores two scaled values of the same physical value. For example, for temperature measurement, you can store a Fahrenheit scale and a Celsius scale with conversion defined by a computational method that you provide. Given one scaled value, the `AUTOSAR.DualScaledParameter` can compute the other scaled value using the computational method.

A dual-scaled parameter has:

- A calibration value. The value that you prefer to use.
- A main value. The real-world value that Simulink uses.
- An internal stored integer value. The value that is used in the embedded code.

You can use `AUTOSAR.DualScaledParameter` objects in your model for both simulation and code generation. The parameter computes the internal value before code generation via the computational method. This offline computation results in leaner generated code.

If you provide the calibration value, the parameter computes the main value using the computational method. This method can be a first-order rational function.

$$y = \frac{ax + b}{cx + d}$$

- x is the calibration value.
- y is the main value.
- a and b are the coefficients of the CalToMain compute numerator.
- c and d are the coefficients of the CalToMain compute denominator.

If you provide the calibration minimum and maximum values, the parameter computes minimum and maximum values of the main value. Simulink performs range checking of parameter values. The software alerts you when the parameter object value lies outside a range that corresponds to its specified minimum and maximum values and data type.

You can use the AUTOSAR.DualScaledParameter dialog box to define an AUTOSAR.DualScaledParameter object. To open the dialog box:

- 1** In the Model Explorer, select the base workspace or a model workspace and select **Add > Add Custom**.
- 2** In the Model Explorer — Select Object dialog box, set **Object class** to AUTOSAR.DualScaledParameter.

AUTOSAR.DualScaledParameter

Property Dialog Box

Main Attributes Tab

The screenshot shows a dialog box titled "AUTOSAR.DualScaledParameter: param" with two tabs: "Calibration Attributes" and "Main Attributes". The "Main Attributes" tab is active. The dialog contains the following fields and controls:

- Value:** A text input field containing "[]".
- Data type:** A dropdown menu set to "auto" with a ">>" button to its right.
- Dimensions:** A text input field containing "[0 0]".
- Complexity:** A text input field containing "real".
- Minimum:** A text input field containing "[]".
- Maximum:** A text input field containing "[]".
- Units:** An empty text input field.
- Code generation options:** A section containing:
 - Storage class:** A dropdown menu set to "Auto".
 - Alignment:** A text input field containing "-1".
- Description:** A large empty text area.

At the bottom of the dialog are four buttons: "OK", "Cancel", "Help", and "Apply".

AUTOSAR.DualScaledParameter

This tab shows the properties inherited from the `AUTOSAR.Parameter` class. For more information, see `AUTOSAR.Parameter`.

AUTOSAR.DualScaledParameter

Calibration Attributes Tab

The screenshot shows a dialog box titled "AUTOSAR.DualScaledParameter: param" with a close button (X) in the top right corner. The dialog has two tabs: "Calibration Attributes" (selected) and "Main Attributes".

Under the "Calibration Attributes" tab, the following fields are visible:

- Calibration value: []
- Calibration minimum: [] Calibration maximum: []
- CalToMain compute numerator: []
- CalToMain compute denominator: []
- Calibration name: "
- Calibration units: "
- SwCalibrationAccess: ReadWrite (dropdown menu)

Below these fields is a "Parameter validation" section containing:

- Is configuration valid: true
- A large text area for the diagnostic message, currently containing ""

At the bottom of the dialog, there are four buttons: OK, Cancel, Help, and Apply.

Calibration value

Calibration value of the parameter. The value that you prefer to use. The default value is [] (unspecified). Specify a finite, real, double value.

Before specifying **Calibration value**, you must specify **CalToMain numerator** and **CalToMain denominator** to define the computational method. The parameter uses the computational method and the calibration value to calculate the real-world value that Simulink uses.

Calibration minimum

Minimum value for the calibration parameter. The default value is [] (unspecified). Specify a finite, real, double scalar value.

Before specifying **Calibration minimum**, you must specify **CalToMain numerator** and **CalToMain denominator** to define the computational method. The parameter uses the computational method and the calibration minimum value to calculate the minimum or maximum value that Simulink uses. A first order rational function is strictly monotonic, either increasing or decreasing. If it is increasing, setting the calibration minimum sets the main minimum value. If it is decreasing, setting the calibration minimum sets the main maximum.

If the parameter value is less than the minimum value or if the minimum value is outside the range of the parameter data type, Simulink generates a warning. In these cases, when updating the diagram or starting a simulation, Simulink generates an error.

Calibration maximum

Maximum value for the calibration parameter can have. The default value is [] (unspecified). Specify a finite, real double scalar value.

Before specifying **Calibration maximum**, you must specify **CalToMain numerator** and **CalToMain denominator** to define the computational method. The parameter uses the

computational method and the calibration maximum value to calculate the corresponding maximum or minimum value that Simulink uses. A first order rational function is strictly monotonic, either increasing or decreasing. If it is increasing, setting the calibration maximum sets the main maximum value. If it is decreasing, setting the calibration maximum sets the main minimum.

If the parameter value is less than the minimum value or if the minimum value is outside the range of the parameter data type, Simulink generates a warning. In these cases, when updating the diagram or starting a simulation, Simulink generates an error.

Cal2Main compute numerator

Specify the numerator coefficients a and b of the first-order linear equation:

$$y = \frac{ax + b}{cx + d}$$

The default value is [] (unspecified). Specify finite, real double scalar values for a and b. For example, [1 1] or, for reciprocal scaling, 1.

Once you have applied **Cal2Main compute numerator**, you cannot change it.

Cal2Main compute denominator

Specify the denominator coefficients c and c of the first-order linear equation:

$$y = \frac{ax + b}{cx + d}$$

The default value is [] (unspecified). Specify finite, real, double scalar values for c and d. For example, [1 1].

Once you have applied **Cal2Main compute denominator**, you cannot change it.

Calibration name

Specify the name of the calibration parameter. The default value is `' '`. Specify a string value, for example, `'T1'`.

Calibration units

Specify the measurement units for this calibration value. This field is intended for use in documenting this parameter. The default value is `' '`. Specify a string value, for example, `'Seconds'`.

Is configuration valid

Simulink indicates whether the configuration is valid. The default value is `true`. If Simulink detects an issue with the configuration, it sets this field to `false` and provides information in the **Diagnostic message** field. You cannot set this field.

Diagnostic message

If you specify invalid parameter settings, Simulink displays a message in this field. Use the diagnostic information to help you fix an invalid configuration issue. You cannot set this field.

Properties

Name	Access	Description
CalibrationValue	RW	Calibration value of this parameter. (Calibration value)
CalibrationMin	RW	Calibration minimum value of this parameter. (Calibration minimum)
CalibrationMax	RW	Calibration maximum value of this parameter. (Calibration maximum)

AUTOSAR.DualScaledParameter

Name	Access	Description
CalToMainCompuNumerator	RW	Numerator coefficients of the computational method. (CalToMain compute numerator) Once you have applied CalToMainCompuNumerator, you cannot change it.
CalToMainCompuDenominator	RW	Denominator coefficients of the computational method. (CalToMain compute denominator) Once you have applied CalToMainCompuDenominator, you cannot change it.
CalibrationName	RW	Name of the calibration parameter. (Calibration name)
CalibrationDocUnits	RW	Measurement units for this calibration parameter's value. (Calibration units)
IsConfigurationValid	RO	Information about validity of configuration. (Is configuration valid)
DiagnosticMessage	RO	If the configuration is invalid, diagnostic information to help you fix the issue. (Diagnostic message)

Examples

Create and Update a Dual-Scaled Parameter

Create an AUTOSAR.DualScaledParameter object that stores a value as both time and frequency.

```
T1Rec = AUTOSAR.DualScaledParameter;
```

Set the computational method.

```
T1Rec.CalToMainCompuNumerator = [1];  
T1Rec.CalToMainCompuDenominator = [1 0];
```

This computational method specifies that the value used by Simulink is the reciprocal of the value that you want to use.

Set the value that you want to see.

```
T1Rec.CalibrationValue = 1/7
```

```
T1Rec =
```

```
DualScaledParameter with properties:
```

```
    CalibrationValue: 0.1429
    CalibrationMin: []
    CalibrationMax: []
    CalToMainCompuNumerator: 1
    CalToMainCompuDenominator: [1 0]
    CalibrationName: ''
    CalibrationDocUnits: ''
    IsConfigurationValid: 1
    DiagnosticMessage: ''
    Value: 7
    CoderInfo: [1x1 Simulink.CoderInfo]
    Description: ''
    DataType: 'auto'
    Min: []
    Max: []
    DocUnits: ''
    Complexity: 'real'
    Dimensions: [1 1]
```

The `AUTOSAR.DualScaledParameter` calculates `T1Rec.Value` which is the value that Simulink uses. `T1Rec.CalibrationValue` is `1/7`, so `T1Rec.Value` is `7`.

Name this value and specify the units.

```
T1Rec.CalibrationName = 'T1';
```

AUTOSAR.DualScaledParameter

```
T1Rec.CalibrationDocUnits = 'Seconds';
```

Set calibration minimum and maximum values.

```
T1Rec.CalibrationMin = 0.001;
```

```
T1Rec.CalibrationMax = 1;
```

If you specify a value outside this allowable range, Simulink generates a warning.

Specify the units that Simulink uses.

```
T1Rec.DocUnits = 'Hertz';
```

Open the AUTOSAR.DualScaledParameter dialog box.

```
open T1Rec
```

AUTOSAR.DualScaledParameter

The screenshot shows a dialog box titled "AUTOSAR.DualScaledParameter: T1Rec". It has two tabs: "Calibration Attributes" (selected) and "Main Attributes". The "Calibration Attributes" tab contains the following fields:

- Calibration value: 10
- Calibration minimum: 0.001
- Calibration maximum: 1
- CalToMain compute numerator: 1
- CalToMain compute denominator: [1 0]
- Calibration name: 'T1'
- Calibration units: 'Seconds'
- SwCalibrationAccess: ReadWrite (dropdown menu)

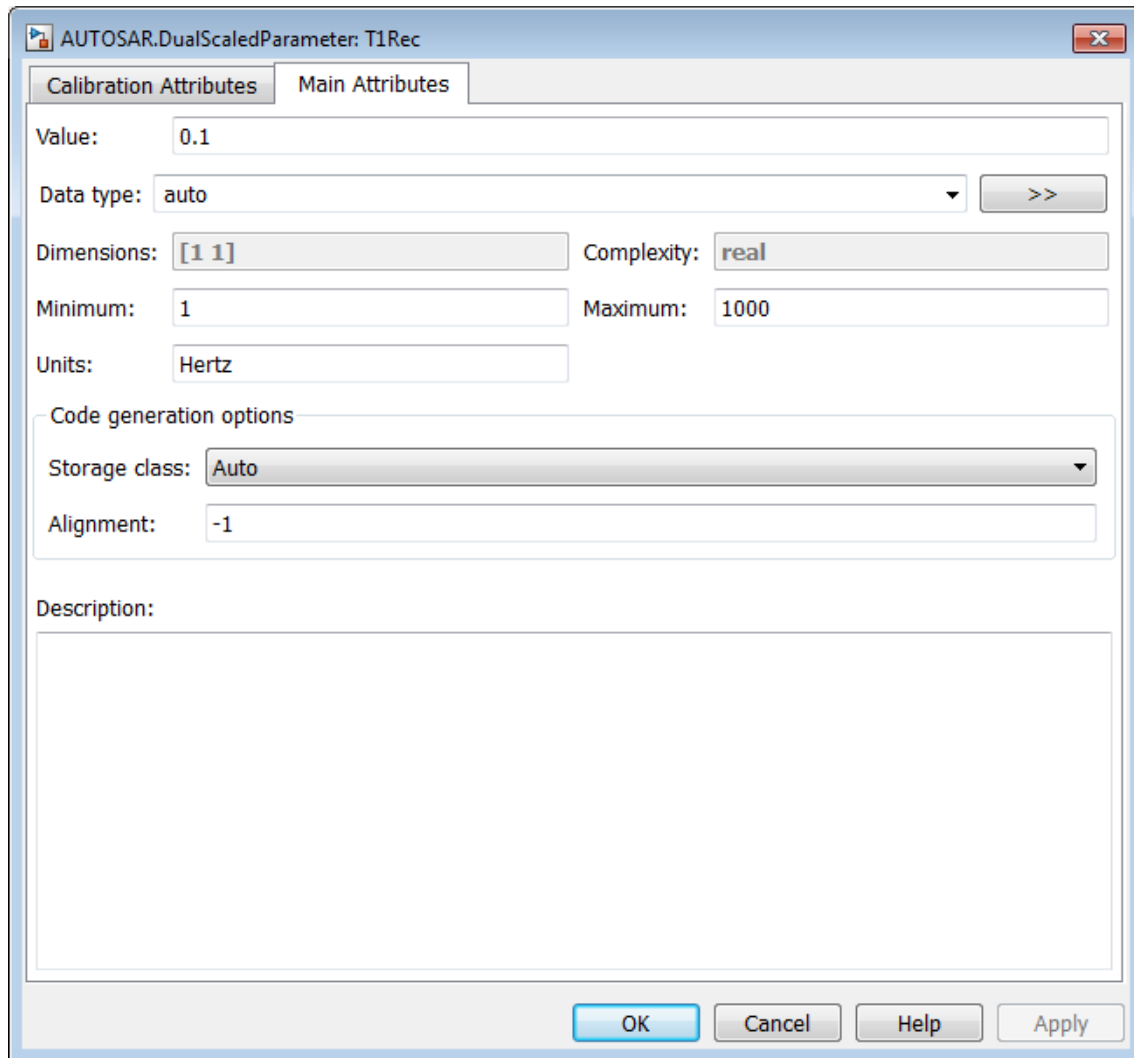
Below these fields is a "Parameter validation" section with a label "Is configuration valid:" and a text box containing "true". Below that is a "Diagnostic message:" label and a large empty text area.

At the bottom of the dialog are four buttons: "OK", "Cancel", "Help", and "Apply".

The **Calibration Attributes** tab displays the calibration value and the computational method that you specified.

AUTOSAR.DualScaledParameter

In the dialog box, click the **Main Attributes** tab.



This tab displays information about the value used by Simulink.

Configure ARXML Settings

Create a dual-scaled parameter. Configure its storage class so that when you generate code, the generated ARXML file includes the dual-scaled parameter.

Create a dual-scaled parameter.

```
T1Rec = AUTOSAR.DualScaledParameter;  
T1Rec.CalToMainCompuNumerator = [1];  
T1Rec.CalToMainCompuDenominator = [1 0];  
T1Rec.CalibrationValue = 1/7;  
T1Rec.CalibrationName = 'T1';  
T1Rec.CalibrationDocUnits = 'Seconds';  
T1Rec.CalibrationMin = 0.001;  
T1Rec.CalibrationMax = 1
```

```
T1Rec =
```

```
DualScaledParameter with properties:
```

```
    CalibrationValue: 0.142857142857143  
    CalibrationMin: 1.0000000000000000e-03  
    CalibrationMax: 1  
    CalToMainCompuNumerator: 1  
    CalToMainCompuDenominator: [1 0]  
    CalibrationName: 'T1'  
    CalibrationDocUnits: 'Seconds'  
    IsConfigurationValid: 1  
    DiagnosticMessage: ''  
    Value: 7  
    CoderInfo: [1x1 Simulink.CoderInfo]  
    Description: ''  
    DataType: 'auto'  
    Min: 1  
    Max: 1000  
    DocUnits: ''  
    Complexity: 'real'
```

AUTOSAR.DualScaledParameter

Dimensions: [1 1]

Set the storage class of the parameter so that the generated ARXML file includes the parameter.

```
T1Rec.RTWInfo.StorageClass = 'Custom';  
T1Rec.RTWInfo.CustomStorageClass = 'InternalCalPrm';
```

You can now use the parameter in a Simulink model. If you configure the model for AUTOSAR and enable the code generation report, when you generate code for the model, Embedded Coder generates an ARXML file that contains information about the dual-scaled parameter.

See Also [AUTOSAR.Parameter](#)

Concepts

- Class Attributes
- Property Attributes

Purpose

Specify value, data type, code generation options, other properties of parameter

Description

With this class, you can create workspace objects for modeling AUTOSAR calibration parameters. You can create an `AUTOSAR.Parameter` object in the base MATLAB workspace.

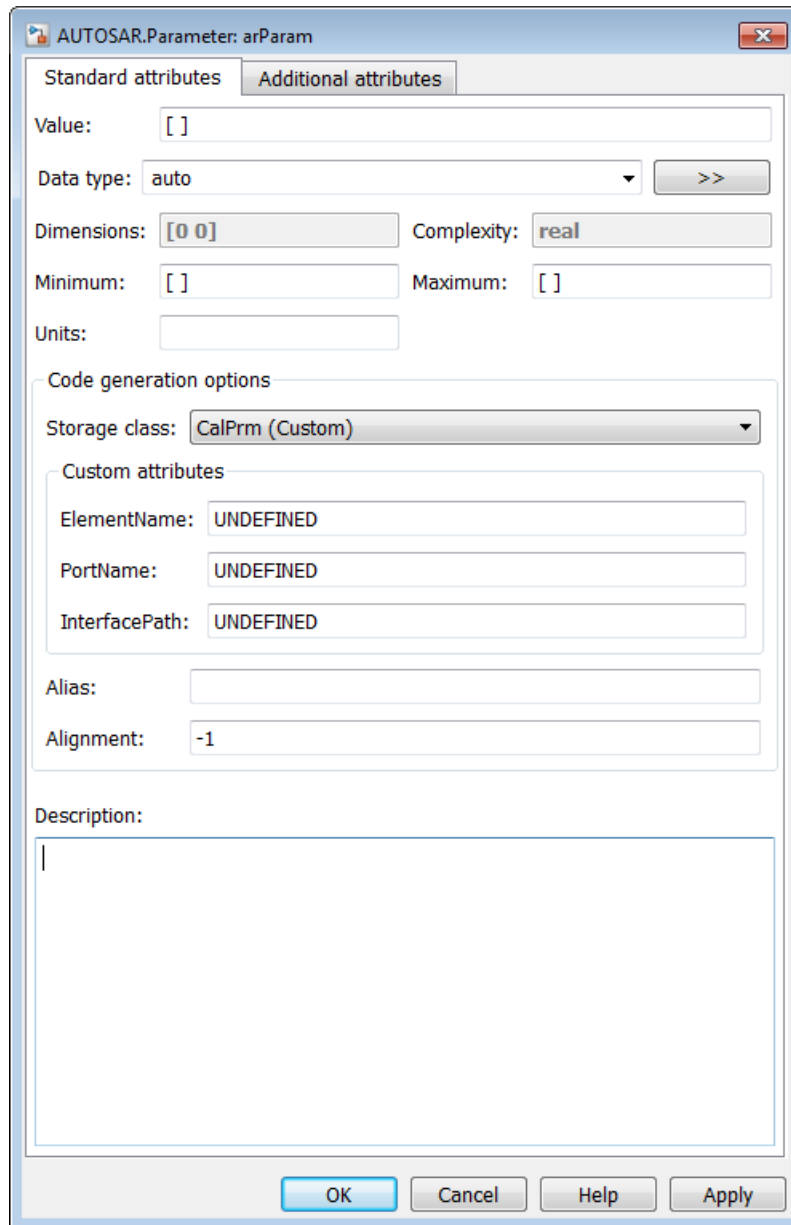
This class extends the `Simulink.Parameter` class. With parameter objects, you can specify the value of a parameter and other information about the parameter, such as its purpose, its dimensions, or its minimum and maximum values. Some Simulink products use this information, for example, to determine whether the parameter is tunable (see “Tunable Parameters”).

Simulink performs range checking of parameter values. The software alerts you when the parameter object value lies outside a range that corresponds to its specified minimum and maximum values and data type. For more information, see the `Simulink.Parameter` reference page.

You can use the `AUTOSAR.Parameter` dialog box to define an `AUTOSAR.Parameter` object. To open the dialog box:

- 1** In Model Explorer, select the base workspace. Select **Add > Add Custom**.
- 2** In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR.Parameter`. Optionally, you can modify the default object name. Click **OK**.

AUTOSAR.Parameter



Property Dialog Box

The Simulink.Parameter reference page describes the dialog box parameters in detail. The AUTOSAR.Parameter class extends the

Simulink.Parameter class with the following additional selections for the **Storage class** parameter:

- **CalPrm (Custom)** — Calibration parameters belong to a calibration component which can be accessed by multiple AUTOSAR Software Components. Selecting this storage class enables the parameters **ElementName**, **PortName**, **InterfacePath**, **Alias**, and **SwCalibrationAccess**.
 - Optionally, you can use **ElementName**, **PortName**, and **InterfacePath** to associate the calibration parameter with a specific AUTOSAR element, AUTOSAR port, or AUTOSAR interface.
 - Optionally, you can use **Alias** to specify an identifier to represent the parameter in generated code.
 - **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as **NotAccessible**, **ReadOnly**, or **ReadWrite**.
- **InternalCalPrm (Custom)** — Internal calibration parameters are defined and accessed by only one AUTOSAR software component. Selecting this storage class enables the parameters **PerInstanceBehavior** and **Alias**.
 - **PerInstanceBehavior** allows you to specify Parameter shared by all instances of the Software Component or Each instance of the Software Component has its own copy of the parameter.
 - Optionally, you can use **Alias** to specify an identifier to represent the parameter in generated code.
 - **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as **NotAccessible**, **ReadOnly**, or **ReadWrite**.

AUTOSAR.Parameter

Note These **Storage class** selections require inline parameters to be enabled for code generation.

- **SystemConstant (Custom)** — Allows you to control the storage of a systemwide constant in generated code. Selecting this storage class enables the parameters **Alias** and **SwCalibrationAccess**.
 - Optionally, you can use **Alias** to specify an identifier to represent the parameter in generated code.
 - **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as **NotAccessible**, **ReadOnly**, or **ReadWrite**.

For more information, see “Tunable Parameter Storage”, “Model AUTOSAR Calibration Parameters”, “Configure AUTOSAR Calibration Parameters”, “Variation Point Proxies”, and “Configure AUTOSAR Variation Point Proxies”.

See Also

- `Simulink.Parameter`
- `AUTOSAR.DualScaledParameter`
- `AUTOSAR4.Parameter`

Purpose Specify data type, code generation options, other attributes of signal

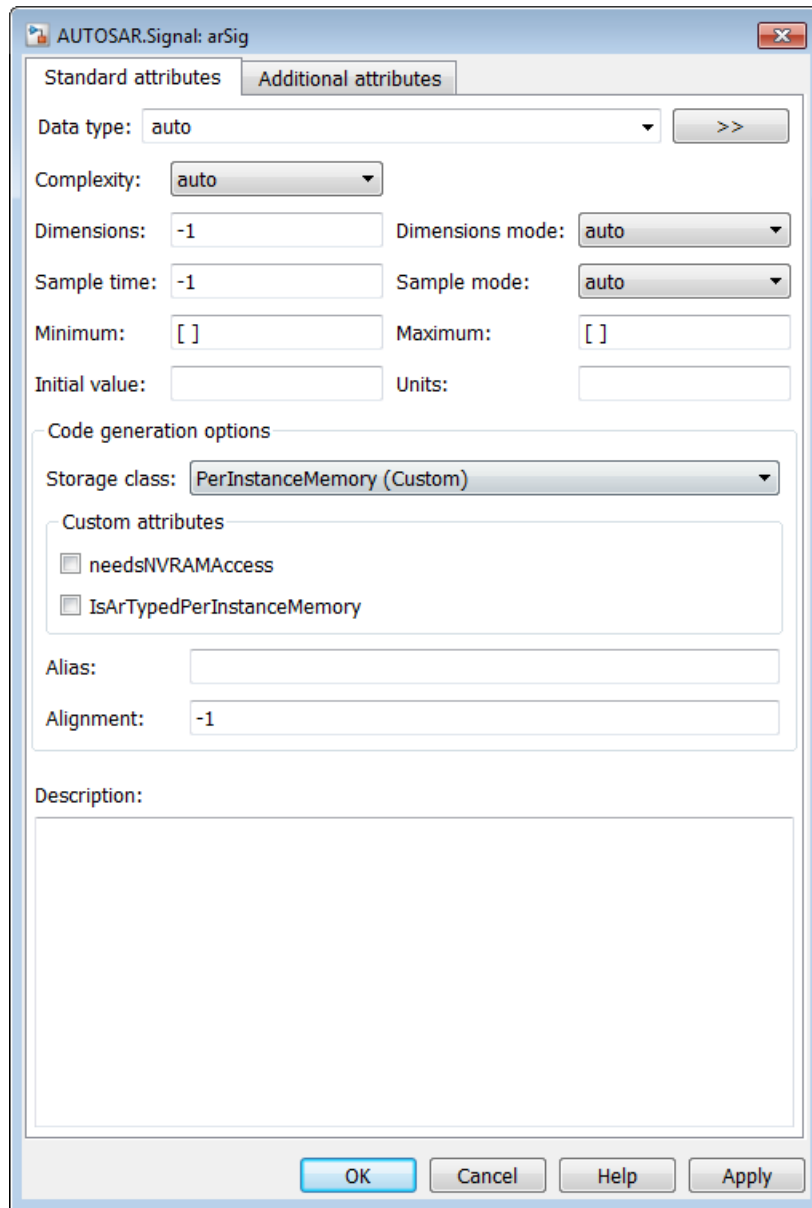
Description With this class, you can create workspace objects for modeling per-instance memory for AUTOSAR runnables. You can create an `AUTOSAR.Signal` object in the base MATLAB workspace.

This class extends the `Simulink.Signal` class. With signal objects, you can assign or validate the attributes of a signal or discrete state, such as its data type, numeric type, dimensions, and so on. For more information, see the `Simulink.Signal` reference page.

You can use the `AUTOSAR.Signal` dialog box to define an `AUTOSAR.Signal` object. To open the dialog box:

- 1** In Model Explorer, select the base workspace. Select **Add > Add Custom**.
- 2** In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR.Signal`. Optionally, you can modify the default object name. Click **OK**.

AUTOSAR.Signal



Property Dialog Box

The Simulink.Signal reference page describes the dialog box parameters in detail. The AUTOSAR.Signal class extends the

`Simulink.Signal` class with the following additional selection for the **Storage class** parameter:

- `PerInstanceMemory` (Custom) — AUTOSAR per-instance memory is instance-specific global memory within an AUTOSAR software component. An AUTOSAR run-time environment generator allocates this memory and provides an API through which you access this memory. Selecting this storage class enables the parameters **needsNVRAMAccess**, **IsArTypedPerInstanceMemory**, **Alias**, and **SwCalibrationAccess**.
 - **needsNVRAMAccess** allows you to specify whether the AUTOSAR signal needs access to nonvolatile RAM on a processor. Depending on the AUTOSAR schema selected for your model, this setting potentially impacts the XML output for your model.
 - **IsArTypedPerInstanceMemory** allows you to specify whether to use AUTOSAR-typed per-instance memory (introduced in AUTOSAR schema version 4.0), rather than C-typed per-instance memory.
 - Optionally, you can use **Alias** to specify an identifier to represent the signal in generated code.
 - **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as `NotAccessible`, `ReadOnly`, or `ReadWrite`.

After you create an `AUTOSAR.Signal` object, you can reference it in a Data Store Memory block. For more information, see Data Store Memory, “Model AUTOSAR Per-Instance Memory”, and “Configure AUTOSAR Per-Instance Memory”.

See Also

- `Simulink.Signal`
- `AUTOSAR4.Signal`

autosar_ui_launch

Purpose Open Configure AUTOSAR Interface dialog box

Syntax `autosar_ui_launch(model)`

Description `autosar_ui_launch(model)` opens the Configure AUTOSAR Interface dialog box with settings for the specified open model.

Note Configuring an AUTOSAR interface requires an Embedded Coder license. If Embedded Coder is not licensed, the Configure AUTOSAR Interface dialog box runs in read-only mode.

Input Arguments

model - Model for which to display AUTOSAR interface configuration settings

`handle | string`

Model for which to display AUTOSAR interface configuration settings, specified as a handle or string representing the model name.

Example: ``rtwdemo_autosar_multirunnables'`

Examples

Display AUTOSAR Interface Configuration Settings for Example Model

Open the AUTOSAR Interface Configuration dialog box with settings for an AUTOSAR example model.

```
rtwdemo_autosar_multirunnables
autosar_ui_launch('rtwdemo_autosar_multirunnables')
```

See Also

`autosar.api.create`

Related Examples

- “Configure the AUTOSAR Interface”

Purpose

Specify value, data type, code generation options, other properties of parameter

Description

With this class, you can create workspace objects for mapping internal global parameters to AUTOSAR Memory Sections. You can create an `AUTOSAR4.Parameter` object in the base MATLAB workspace.

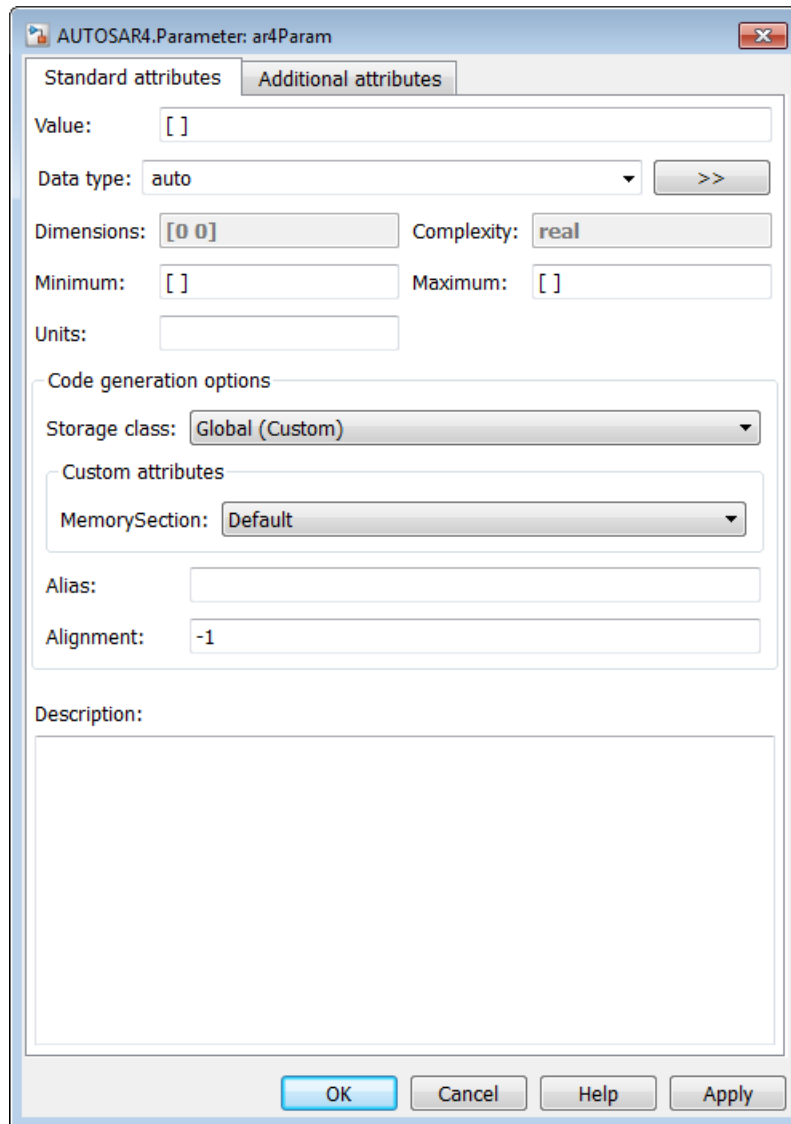
This class extends the `Simulink.Parameter` class. With parameter objects, you can specify the value of a parameter and other information about the parameter, such as its purpose, its dimensions, or its minimum and maximum values. Some Simulink products use this information, for example, to determine whether the parameter is tunable (see “Tunable Parameters”).

Simulink performs range checking of parameter values. The software alerts you when the parameter object value lies outside a range that corresponds to its specified minimum and maximum values and data type. For more information, see the `Simulink.Parameter` reference page.

You can use the `AUTOSAR4.Parameter` dialog box to define an `AUTOSAR4.Parameter` object. To open the dialog box:

- 1** In Model Explorer, select the base workspace. Select **Add > Add Custom**.
- 2** In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR4.Parameter`. Optionally, you can modify the default object name. Click **OK**.

AUTOSAR4.Parameter



Property Dialog Box

The Simulink.Parameter reference page describes the dialog box parameters in detail. The AUTOSAR4.Parameter class extends the

Simulink.Parameter class with the following additional selections for the **Storage class** parameter:

- **Global (Custom)** — Allows you to map internal global parameters to AUTOSAR Memory Sections. Selecting this storage class enables the parameters **MemorySection**, **Alias**, and **SwCalibrationAccess**.
 - **MemorySection** allows you to explicitly select AUTOSAR Memory Section VAR or CAL, or accept the Default.
 - Optionally, you can use **Alias** to specify an identifier to represent the signal in generated code.
 - **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as **NotAccessible**, **ReadOnly**, or **ReadWrite**.

For more information, see “Model AUTOSAR Static and Constant Memory” and “Configure AUTOSAR Static or Constant Memory”.

See Also

- Simulink.Parameter
- AUTOSAR.Parameter
- AUTOSAR.DualScaledParameter

AUTOSAR4.Signal

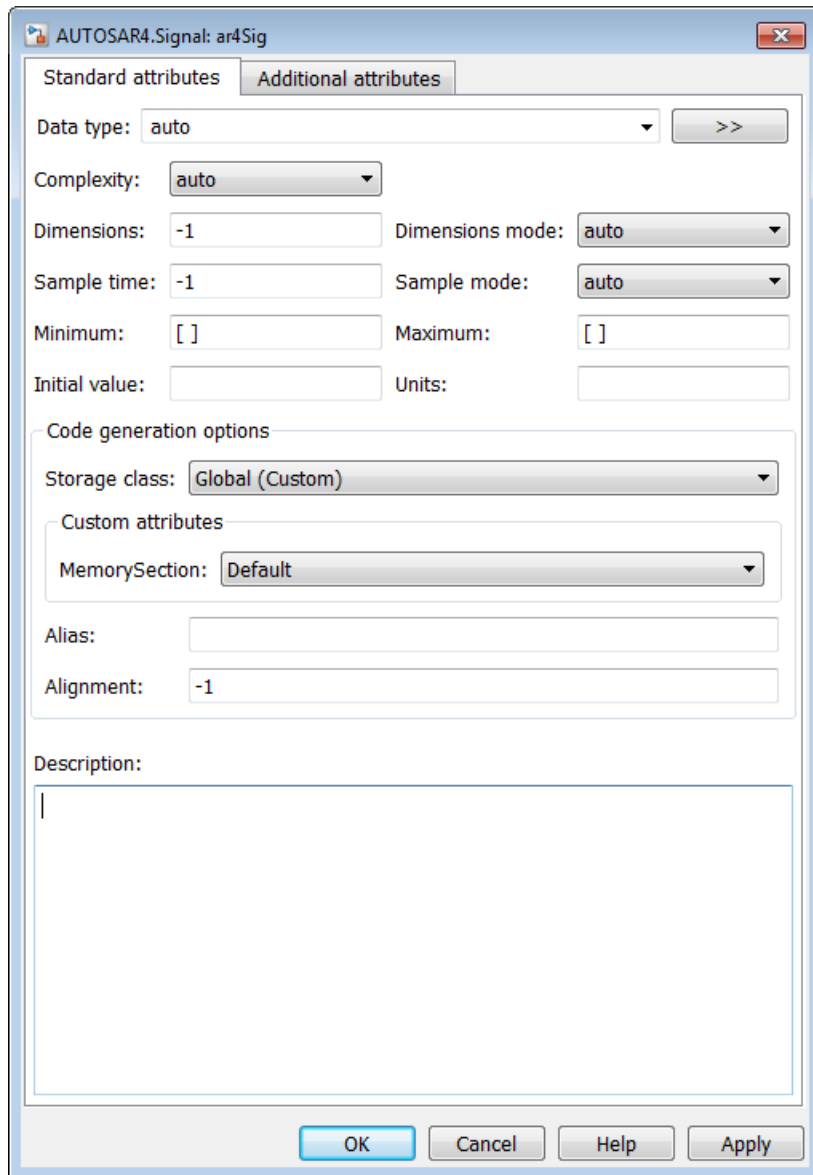
Purpose Specify data type, code generation options, other attributes of signal

Description With this class, you can create workspace objects for mapping internal global signals to AUTOSAR Memory Sections. You can create an `AUTOSAR4.Signal` object in the base MATLAB workspace.

This class extends the `Simulink.Signal` class. With signal objects, you can assign or validate the attributes of a signal or discrete state, such as its data type, numeric type, dimensions, and so on. For more information, see the `Simulink.Signal` reference page.

You can use the `AUTOSAR4.Signal` dialog box to define an `AUTOSAR4.Signal` object. To open the dialog box:

- 1** In Model Explorer, select the base workspace. Select **Add > Add Custom**.
- 2** In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR4.Signal`. Optionally, you can modify the default object name. Click **OK**.



Property Dialog Box

The `Simulink.Signal` reference page describes the dialog box parameters in detail. The `AUTOSAR4.Signal` class extends the

AUTOSAR4.Signal

Simulink.Signal class with the following additional selection for the **Storage class** parameter:

- **Global (Custom)** — Allows you to map internal global signals to AUTOSAR Memory Sections. Selecting this storage class enables the parameters **MemorySection**, **Alias**, and **SwCalibrationAccess**.
 - **MemorySection** allows you to explicitly select AUTOSAR Memory Section VAR or CAL, or accept the Default.
 - Optionally, you can use **Alias** to specify an identifier to represent the signal in generated code.
 - **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as **NotAccessible**, **ReadOnly**, or **ReadWrite**.

For more information, see “Model AUTOSAR Static and Constant Memory” and “Configure AUTOSAR Static or Constant Memory”.

See Also

- Simulink.Signal
- AUTOSAR.Signal

Purpose

Build or rebuild current project

Syntax

```
[result,numwarns]=IDE_Obj.build(timeout)  
IDE_Obj.build('all')
```

IDEs

This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

Description

[result,numwarns]=*IDE_Obj*.build(timeout) incrementally builds the active project. Incremental builds recompile only source files in your project that you changed or added after the most recent build. build uses the file time stamp to determine whether to recompile a file. After recompiling the source files, build links the object files to make a new program file.

The value of `result` is 1 when the build process completes. The value of `numwarns` is the number of compilation warnings generated from the build process.

The *timeout* argument defines the number of seconds MATLAB waits for the IDE to complete the build process. If the IDE exceeds the timeout period, this method returns a timeout error immediately. The timeout error does not terminate the build process in the IDE. The IDE continues the build process. The timeout error indicates that the build process did not complete before the specified timeout period expired. If you omit the *timeout* argument, the build method uses a default value of 1000 seconds.

IDE_Obj.build('all') rebuilds the files in the active project.

See Also

isrunning | open

ccsboardinfo

Purpose Information about boards and simulators known to IDE

Syntax `ccsboardinfo`
`boards = ccsboardinfo`

IDEs This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

Description `ccsboardinfo` returns configuration information about each board and processor installed and recognized by CCS. When you issue the function, `ccsboardinfo` returns the following information about each board or simulator.

Installed Board Configuration Data	Configuration Item Name	Description
Board number	<code>boardnum</code>	The number CCS assigns to the board or simulator. Board numbering starts at 0 for the first board. You also use <code>boardnum</code> when you create a link to the IDE.
Board name	<code>boardname</code>	The name assigned to the board or simulator. Usually, the name is the board model name, such as TMS320C67xx evaluation module. If you are using a simulator, the name tells you which processor the simulator matches, such as C67xx simulator. If you renamed the board during setup, this item displays the board name.

Installed Board Configuration Data	Configuration Item Name	Description
Processor number	procnum	The number assigned by CCS to the processor on the board or simulator. When the board contains more than one processor, CCS assigns a number to each processor, numbering from 0 for the first processor on the first board. For example, when you have two boards, the first processor on the first board is procnum=0, and the first and second processors on the second board are procnum=1 and procnum=2. You also use this property when you create a link to the IDE.
Processor name	procname	Provides the name of the processor. Usually the name is CPU, unless you assign a different name.
Processor type	proctype	Gives the processor model, such as TMS320C6x1x for the C6xxx series processors.

Each row in the table that you see displayed represents one digital signal processor, either on a board or simulator. As a consequence, you use the information in the table in the function `ticcs` to identify a selected board in your PC.

`boards = ccsboardinfo` returns the configuration information about your installed boards in a slightly different manner. Rather than return the table of the information, the method returns a list of board names and numbers. In that list, each board has a structure named `proc` that contains processor information. For example

```
boards = ccsboardinfo
```

```
returns
```

```
boards =
```

```
        name: 'C6xxx Simulator (Texas Instruments)'  
number: 0  
proc: [1x1 struct]
```

where the structure `proc` contains the processor information for the C6xxx simulator board:

```
boards.proc
```

```
ans =
```

```
        name: 'CPU'  
number: 0  
type: 'TMS320C6200'
```

Reviewing the output from both function syntaxes shows that the configuration information is the same.

To connect with a specific board when you create an IDE handle object, combine this syntax with the dot notation for accessing elements in a structure. Use the `boardnum` and `procnum` properties in the `boards` structure. For example, when you enter

```
boards = ccsboardinfo;
```

`boards(1).name` returns the name of your second installed board and `boards(1).proc(2).name` returns the name of the second processor on the second board. To create a link to the second processor on the second board, use

```
IDE_Obj = ticcs('boardnum',boards(1).number,'procnum',...  
boards(1).proc(2).name);
```

Examples

On a PC with both a simulator and a DSP Starter Kit (DSK) board installed,

```
ccsboardinfo
```

returns something like the following table. Your display may differ slightly based on what you called your boards when you configured them in CCS Setup Utility:

Board Num	Board Name	Proc Num	Processor Name	Processor Type
1	C6xxx Simulator (Texas Instrum ..	0	CPU	TMS320C6200
0	DSK (Texas Instruments)	0	CPU_3	TMS320C6x1x

When you have one or more boards that have multiple CPUs, ccsboardinfo returns the following table, or one like it:

Board Num	Board Name	Proc Num	Processor Name	Processor Type
2	C6xxx Simulator (Texas Instrum .0	0	CPU	TMS320C6200
1	C6xxx EVM (Texas Instrum ...	1	CPU_Primary	TMS320C6200
1	C6xxx EVM (Texas Instrum ...	0	CPU_Secondary	TMS320C6200
0	C64xx Simulator (Texas Instru...0	0	CPU	TMS320C64xx

In this example, board number 1 returns two defined CPUs: CPU_Primary and CPU_Secondary. The C6xxx does not in fact have two CPUs; a second CPU is defined for this example.

To show the boards = ccsboardinfo syntax, this example assumes a PC with two boards installed, one of which has three CPUs.

Enter the following command:

```
ccsboardinfo
```

This command generates a list of boards. For example:

Board Num	Board Name	Proc Num	Processor Name	Processor Type
1	C6xxx Simulator (Texas Instrum .0	0	CPU	TMS320C6211

```
0 C62xx DSK (Texas Instruments) 2 CPU_3 TMS320C6x1x
0 C62xx DSK (Texas Instruments) 1 CPU_4_1 TMS320C6x1x
0 C62xx DSK (Texas Instruments) 0 CPU_4_2 TMS320C6x1x
```

Now enter

```
boards = ccsboardinfo
```

MATLAB software returns

```
boards=
2x1 struct array with fields
    name
    number
    proc
```

showing that you have two boards in your PC.

Use the dot notation to determine the names of the boards:

```
boards.name
```

returns

```
ans=
C6xxx Simulator (Texas Instruments)
```

```
ans=
C62xx DSK (Texas Instruments)
```

To identify the processors on each board, again use the dot notation to access the processor information. You have two boards (numbered 0 and 1). Board 0 has three CPUs defined for it. To determine the type of the second processor on board 0 (the board whose boardnum = 0), enter

```
boards(2).proc(1)
```

which returns

```
ans=  
  name: 'CPU_3'  
  number: 1  
  type: 'TMS320C6x1x'
```

Recall that

```
boards(2).proc
```

gives you this information about the board

```
ans=  
3x1 struct array with fields:  
  name  
  number  
  type
```

indicating that this board has three processors (the 3x1 array).

The dot notation is useful for accessing the contents of a structure when you create a link to the IDE. When you use `ticcs` to create your CCS link, you can use the dot notation to tell the IDE which processor you are using.

```
IDE_Obj = ticcs('boardnum',boards(1).proc(1))
```

See Also

`info | ticcs`

Purpose Set working folder in IDE

Syntax `wd=IDE_Obj.cd`
`IDE_Obj.cd(folder)`

IDEs This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

Description `wd=IDE_Obj.cd` assigns the IDE working folder to the variable, `wd`, which you reference via the IDE handle object, `IDE_Obj`.

`IDE_Obj.cd(folder)` sets the IDE working folder to 'folder'. 'folder' can be a path string relative to your working folder, or an absolute path. The intended folder must exist. `cd` does not create a folder. Setting the IDE folder does not change your MATLAB Current Folder.

`cd` alters the default folder for `open` and `load`. Loading a new workspace file also changes the working folder for the IDE.

See Also `dir` | `load` | `open`

Purpose	Verify numerical equivalence of results
Description	<p>Executes a model in different environments such as, simulation, Software-In-the-Loop (SIL), or Processor-In-the-Loop (PIL) and stores numerical results. Using the <code>cgv.CGV</code> class methods, you can create a script to verify that the model and the generated code produce numerically equivalent results.</p> <p><code>cgv.CGV</code> and <code>cgv.Config</code> use two of the same properties. Before executing a <code>cgv.CGV</code> object, use <code>cgv.Config</code> to verify the model configured for the mode of execution that you specify. If the top model is set to normal simulation mode, referenced models set to PIL mode are changed to Accelerator mode.</p>
Construction	<p><code>cgvObj = cgv.CGV(model_name)</code> creates a handle to a code generation verification object using the default parameter values. <code>model_name</code> is the name of the model that you are verifying.</p> <p><code>cgvObj = cgv.CGV(model_name, Name, Value)</code> constructs the object using the parameter values, specified as <code>Name, Value</code> pair arguments. Parameter names and values are not case sensitive.</p>
Input Arguments	
model_name	Name of the model that you are verifying.
Name-Value Pair Arguments	Optional comma-separated pairs of <code>Name, Value</code> arguments, where <code>Name</code> is the argument name and <code>Value</code> is the corresponding value. <code>Name</code> must appear inside single quotes (' '). You can specify several name-value pair arguments in a variety of orders, such as <code>Name1, Value1, , NameN, ValueN</code> .
ComponentType	Define the SIL or PIL approach

Value	Description
topmodel (default)	Top-model SIL or PIL simulation and standalone code interface mode.
modelblock	Model block SIL or PIL simulation and model reference target code interface mode.

If mode of execution is simulation (Connectivity is `sim`), choosing either value for `ComponentType` does not alter simulation results.

Default: topmodel

Connectivity

Specify mode of execution

Value	Description
sim or normal (default)	Mode of execution is Normal simulation.
sil	Mode of execution is SIL.
pil	Mode of execution is PIL.

Properties

Description

Specify a description of the object.

Default: ' ' (null string)

Name

Specify a name for the object.

Default: ' ' (null string)

Methods

activateConfigSet	Activate configuration set of model
addBaseline	Add baseline file for comparison
addConfigSet	Add configuration set
addHeaderReportFcn	Add callback function to execute before executing input data in object
addInputData	Add input data
addPostExecuteFcn	Add callback function to execute after each input data file is executes
addPostExecuteReportFcn	Add callback function to execute after each input data file executes
addPostLoadFiles	Add files required by model
addPreExecFcn	Add callback function to execute before each input data file executes
addPreExecReportFcn	Add callback function to execute before each input data file executes
addTrailerReportFcn	Add callback function to execute after the input data executes
compare	Compare signal data
copySetup	Create copy of object
createToleranceFile	Create file correlating tolerance information with signal names
getOutputData	Get output data
getSavedSignals	Display list of signal names to command line

<code>getStatus</code>	Return execution status
<code>plot</code>	Create plot for signal or multiple signals
<code>run</code>	Execute CGV object
<code>setMode</code>	Specify mode of execution
<code>setOutputDir</code>	Specify folder
<code>setOutputFile</code>	Specify output data file name

Copy Semantics

Handle. To learn how handle classes change copy operations, see Copying Objects in the MATLAB Programming Fundamentals documentation.

Examples

The general workflow for testing a model for numerical equivalence using the `cgv.CGV` class is to:

- 1 Create a `cgv.CGV` object, `cgvObj`, for each mode of execution and use the `cgv.CGV` set up methods to configure the model for each execution. The set up methods are:
 - `addInputData`
 - `addPostLoadFiles`
 - `setOutputDir`
 - `setOutputFile`
 - `addCallback`
 - `addConfigSet`
- 2 Run the model for each mode of execution using the `cgvObj.run` method.
- 3 Use the `cgv.CGV` access methods to get and evaluate the data. The access methods are:
 - `getOutputData`

- `getSavedSignals`
- `plot`
- `compare`

An object should be run only once. After the object is run, the set up methods are not used for that object. You then use the access methods for verifying the numerical equivalence of the results.

See Also

`cgv.Config`

How To

- “Verify Numerical Equivalence with CGV”
- Using Code Generation Verification

Purpose

Check and modify model configuration parameter values

Description

Creates a handle to a `cgv.Config` object that supports checking and optionally modifying models for compatibility with various modes of execution that use generated code, such as, Software-In-the-Loop (SIL) or Processor-In-the-Loop (PIL).

To execute the model in the mode that you specify, you might need to make additional modifications to the configuration parameter values or the model beyond those configured by the `cgv.Config` object.

By default, `cgv.Config` modifies configuration parameter values to the values that it recommends, but does not save the model. Alternatively, you can use `cgv.Config` parameters to modify the default specification. For more information, see the properties, `ReportOnly` and `SaveModel`.

If you use `cgv.Config` to modify a model, do not use referenced configuration sets in that model. If a model uses a referenced configuration set, update the model with a copy of the configuration set, by using the `Simulink.ConfigSetRef.getRefConfigSet` method.

If you use `cgv.Config` on a model that executes a callback function, the callback function might modify configuration parameter values each time the model loads. The callback function might revert changes that `cgv.Config` made. If this change occurs, the model might not be set up for SIL or PIL. For more information, see “Callbacks for Customized Model Behavior”.

Construction

`cfgObj = cgv.Config(model_name)` creates a handle to a `cgv.Config` object, `cfgObj`, using default values for properties. `model_name` is the name of the model that you are checking and optionally configuring.

`cfgObj = cgv.Config(model_name, Name, Value)` constructs the object using options, specified as parameter name and value pairs. Parameter names and values are not case sensitive.

`Name` can also be a property name and `Value` is the corresponding value. `Name` must appear inside single quotes (`'`). You can specify several name-value pair arguments in a variety of orders, such as `Name1, Value1, , NameN, ValueN`.

Properties

CheckOutputs

Specify whether to compile the model and check that the model outputs configuration is compatible with the `cgv.CGV` object. If your script fixes errors reported by `cgv.Config`, you can set `CheckOutputs` to `off`.

Value	Description
on (default)	Compile the model and check the model outputs configuration
off	Do not compile the model or check the model outputs configuration

ComponentType

Define the SIL or PIL approach

If mode of execution is simulation (`connectivity` is `sim`), choosing either value for `ComponentType` does not alter simulation results. However, `cgv.Config` recommends configuration parameter values based on the value of `ComponentType`.

Value	Description
topmodel (default)	Top-model SIL or PIL simulation and standalone code interface mode.
modelblock	Model block SIL or PIL simulation and model reference target code interface mode.

Connectivity

Specify mode of execution

Value	Description
sim (default)	Mode of execution is simulation. Recommends changes to a subset of the configuration parameters that SIL and PIL targets require.
sil	Mode of execution is SIL. Requires that the system target file is set to 'ert.tlc' and that you do not use your own external target. Recommends changes to the configuration parameters that SIL targets require.
pil	Mode of execution is PIL with custom connectivity that you provide using the PIL Connectivity API. Recommends changes to the configuration parameters that PIL targets with custom connectivity require.

LogMode

Specify the **Signal Logging** and **Output** parameters on the **Data Import/Export** pane of the Configuration Parameters dialog box.

Value	Description
SignalLogging	<p>Log signal data to a MATLAB workspace variable during execution.</p> <p>This parameter selects the Data Import/Export > Signal logging parameter in the Configuration Parameters dialog box.</p>
SaveOutput	<p>Save output data to a MATLAB workspace variable during execution.</p> <p>This parameter selects Data Import/Export > Output parameter in the Configuration Parameters dialog box.</p> <p>The Output parameter does not save bus outputs.</p>

ReportOnly

The ReportOnly property specifies whether cgv.Config modifies the recommended values of the configuration parameters of the model.

If you set ReportOnly to on, SaveModel must be off.

cgv.Config

Value	Description
off (default)	cgv.Config automatically modifies the configuration parameter values that it recommends for the model.
on	cgv.Config does not modify the configuration parameter values that it recommends for the model.

SaveModel

Specify whether to save the model with the configuration parameter values recommended by cgv.Config.

If you set SaveModel to 'on', ReportOnly must be 'off'.

Value	Description
off (default)	Do not save the model.
on	Save the model in the working folder.

Methods

configModel	Determine and change configuration parameter values
displayReport	Display results of comparing configuration parameter values
getReportData	Return results of comparing configuration parameter values

Copy Semantics

Handle. To learn how handle classes change copy operations, see Copying Objects in the MATLAB Programming Fundamentals documentation.

Examples

Configure the `rtwdemo_iec61508` model for top-model SIL. Then view the changes at the MATLAB Command Window:

```
% Create a cgv.Config object and configure the model for top-model SIL.
cgvCfg = cgv.Config('rtwdemo_iec61508', 'LogMode', 'SaveOutput', ...
    'connectivity', 'sil');
cgvCfg.configModel();
% Display the results of what the cgv.Config object changed.
cgvCfg.displayReport();
% Close the rtwdemo_iec61508 model.
bdclose('rtwdemo_iec61508');
```

See Also

`cgv.CGV`

How To

- “Programmatic Code Generation Verification”

coder.replace

Purpose Replace current MATLAB function implementation with code replacement library function in generated code

Syntax

```
coder.replace()  
coder.replace('-errorifnoreplacement')  
coder.replace('-warnifnoreplacement')
```

Description `coder.replace()` replaces the current function implementation with a code replacement library function. If a match is not found in the code replacement library, code is generated without a replacement for the current function. `coder.replace` is a code generation function. It does not alter MATLAB code or MEX function generation.

During code generation, if you include `coder.replace` in a MATLAB function, `fcn`, it performs a code replacement library lookup for the following function signature:

```
[y1_type, y2_type, ..., yn_type]=fcn(x1_type, x2_type, ..., xn_type)
```

`y1_type, y2_type, ..., yn_type` are the data types of the outputs of MATLAB function `fcn`. `x1_type, x2_type, ..., xn_type` are the data types of the inputs of `fcn`. `coder.replace` derives the output types of the function based on the implementation in the MATLAB function. At code generation, the contents of `fcn` are discarded and replaced with a function call that is registered in the code replacement library as a replacement for `fcn`.

`coder.replace('-errorifnoreplacement')` replaces the current function implementation with a code replacement library function. If a match is not found, code generation stops. An error message describing the code replacement library lookup failure is generated.

`coder.replace('-warnifnoreplacement')` replaces the current function implementation with a code replacement library function. If match is not found, code is generated for the current function. A warning describing the code replacement library lookup failure is generated during code generation.

Tips

- `coder.replace` is a code generation function. It does not alter MATLAB code or MEX function generation.
- Do not use multiple `coder.replace` statements inside a function.
- You cannot use `coder.replace` within conditional expressions and loops.
- `coder.replace` does not support replacements that require data alignment.
- `varargin` and `varargout` are not supported.
- You cannot use `coder.replace` to replace MATLAB functions that have variable-size inputs.
- `coder.replace` requires an Embedded Coder license.
- `coder.replace` disregards saturation and rounding modes when looking up function replacements in a code replacement library.

Examples

Replace a MATLAB function with custom code

Replace a MATLAB function with a custom implementation that is registered in the code replacement library.

- 1 Write a MATLAB function, `calculate`, that you want to replace with a custom implementation, `replacement_calculate_impl.c`, in the generated code.

```
function y = calculate(x)
% Search in the code replacement library for replacement
% and use replacement function if available
% Error if not found
    coder.replace('-errorifnoreplacement');
    y = sqrt(x);
end
```

- 2 Write a MATLAB function, `top_function`, that calls `calculate`
- ```
function out = top_function(in)
```

```
 p = calculate(in);
 out = exp(p);
end
```

- 3 Create a file named `cr1_table_calculate.m` that describes the function entries for a code replacement table. The replacement function `replacement_calculate_impl.c` and header file `replacement_calculate_impl.h` must be on the path.

```
hLib = RTW.TflTable;

%----- entry: calculate -----
hEnt = RTW.TflCFunctionEntry;
hEnt.setTflCFunctionEntryParameters(...
 'Key', 'calculate', ...
 'Priority', 100, ...
 'ImplementationName', 'replacement_calculate_impl', ...
 'ImplementationHeaderFile', 'replacement_calculate_impl.h', ...
 'ImplementationSourceFile', 'replacement_calculate_impl.c')
% Conceptual Args

arg = hEnt.getTflArgFromString('y1','double');
arg.IOType = 'RTW_IO_OUTPUT';
hEnt.addConceptualArg(arg);

arg = hEnt.getTflArgFromString('u1','double');
hEnt.addConceptualArg(arg);

% Implementation Args

arg = hEnt.getTflArgFromString('y1','double');
arg.IOType = 'RTW_IO_OUTPUT';
hEnt.Implementation.setReturn(arg);

arg = hEnt.getTflArgFromString('u1','double');
hEnt.Implementation.addArgument(arg);
```

```
%arg = hEnt.getTflArgFromString('y1','double*');
%arg.IOType = 'RTW_IO_OUTPUT';
%hEnt.Implementation.addArgument(arg);

hLib.addEntry(hEnt);
```

**4** Create an `rtwTargetInfo` file:

```
function rtwTargetInfo(tr)
% rtwTargetInfo function to register a code
% replacement library (CRL)
% for use with codegen

% Register the CRL defined in local function locCrlRegFcn
tr.registerTargetInfo(@locCrlRegFcn);

end % End of RTWTARGETINFO
```

**5** Create a `locCrlRegFcn` file:

```
function thisCrl = locCrlRegFcn

% Instantiate a CRL registry entry
thisCrl = RTW.TflRegistry;

% Define the CRL properties
thisCrl.Name = 'My calculate Example';
thisCrl.Description = 'Demonstration of function replacement';
thisCrl.TableList = {'crl_table_calculate'};
thisCrl.BaseTfl = 'C89/C90 (ANSI)';
thisCrl.TargetHWDeviceType = {'*'};

end % End of LOCCRLREGFCN
```

**6** Refresh registration information. At the MATLAB command line, enter:

```
RTW.TargetRegistry.getInstance('reset');
```

- 7 Create a code generation configuration object.

```
cfg =coder.config('lib');
```

- 8 Specify the name of the code replacement library to use.

```
cfg.CodeReplacementLibrary='My calculate Example';
```

- 9 Generate code for top\_function specifying that input in is double.

```
codegen -report -config cfg top_function -args {double(10)}
```

Because the data type of `x` and `y` is `double`, `coder.replace` searches for `double = calculate(double)` in the Code Replacement Library. If it finds a match, `codegen` generates the following code:

```
real_T top_function(real_T in)
{
 real_T p;
 p = replacement_calculate_impl(in);
 return exp(p);
}
```

In the generated code, the replacement function `replacement_calculate_impl` replaces the MATLAB function `calculate`.

## See Also

`codegen`

## Related Examples

- “Replace MATLAB Function Block Code with Custom Code”
- “Specify In-Place Code Replacement”
- “Register a Code Replacement Library with MATLAB Coder™ Software (`rtwTargetInfo`)”
- “Register a Library with Simulink Software (`sl_customization`)”
- “Code Replacement Table Examples”



## **Concepts**

- “Introduction to Code Replacement Libraries”
- “Replace MATLAB Functions With Custom Code Using `coder.replace`”

## Purpose

Compare signal data

## Syntax

```
[matchNames, matchFigures, mismatchNames,
 mismatchFigures] = cgv.CGV.compare(data_set1,
 data_set2)
[matchNames, matchFigures, mismatchNames,
 mismatchFigures] = cgv.CGV.compare(data_set1, data_set2,
 'Plot', param_value)
[matchNames, matchFigures, mismatchNames,
 mismatchFigures] = cgv.CGV.compare(data_set1, data_set2,
 'Plot', 'none', 'Signals', signal_list, 'ToleranceFile',
 file_name)
```

## Description

[matchNames, matchFigures, mismatchNames, mismatchFigures] = cgv.CGV.compare(data\_set1, data\_set2) compares data from two data sets which have common signal names between both executions. Possible outputs of the cgv.CGV.compare function are matched signal names, figure handles to the matched signal names, mismatched signal names, and figure handles to the mismatched signal names. By default, cgv.CGV.compare looks at the signals which have a common name between both executions.

[matchNames, matchFigures, mismatchNames, mismatchFigures] = cgv.CGV.compare(data\_set1, data\_set2, 'Plot', param\_value) compares the signals and plots the signals according to param\_value.

[matchNames, matchFigures, mismatchNames, mismatchFigures] = cgv.CGV.compare(data\_set1, data\_set2, 'Plot', 'none', 'Signals', signal\_list, 'ToleranceFile', file\_name) compares only the given signals and does not produce plots.

## Input Arguments

### **data\_set1, data\_set2**

Output data from a model. After running the model, use the cgv.CGV.getOutputData function to get the data. The cgv.CGV.getOutputData function returns a cell array of the output signal names.

**varargin**

Variable number of parameter name and value pairs.

**varargin  
Parameters**

You can specify the following argument properties for the `cgv.CGV.compare` function using parameter name and value argument pairs. These parameters are optional.

**Plot(optional)**

Designates which comparison data to plot. The value of this parameter must be one of the following:

- 'match': plot the comparison of the matched signals from the two data sets
- 'mismatch' (default): plot the comparison of the mismatched signals from the two datasets
- 'none': do not produce a plot

**Signals(optional)**

A cell array of strings, where each string is a signal name in the output data. Use `cgv.CGV.getSavedSignals` to view the list of available signal names in the output data. `signal_list` can contain an individual signal or multiple signals. The syntax for an individual signal name is:

```
signal_list = {'log_data.subsystem_name.Data(:,1)'};
```

The syntax for multiple signal names is:

```
signal_list = {'log_data.block_name.Data(:,1)', ...
 'log_data.block_name.Data(:,2)', ...
 'log_data.block_name.Data(:,3)', ...
 'log_data.block_name.Data(:,4)'};
```

If a model component contains a space or newline character, MATLAB adds parentheses and a single quote to the name of the component. For example, if a section of the signal has a space, 'block name', MATLAB displays the signal name as:

```
log_data('block name').Data(:,1)
```

To use the signal name as input to a CGV function, 'block name' must have two single quotes. For example:

```
signal_list = {'log_data(''block name'').Data(:,1)'} }
```

If `Signals` is not present, the signals are compared.

`Tolerancefile`(optional)

Name for the file created by the `cgv.CGV.createToleranceFile` function. The file contains the signal names and the associated tolerance parameter name and value pair for comparing the data.

## Output Arguments

Depending on the data and the parameters, the following output arguments might be empty.

### **match\_names**

Cell array of matching signal names.

### **match\_figures**

Array of figure handles for matching signals

### **mismatch\_names**

Cell array of mismatching signal names

### **mismatch\_figures**

Array of figure handles for mismatching signals

## How To

- “Verify Numerical Equivalence with CGV”

**Purpose**

Determine and change configuration parameter values

**Syntax**

`cfgObj.configModel()`

**Description**

`cfgObj.configModel()` determines the recommended values for the configuration parameters in the model. `cfgObj` is a handle to a `cgv.Config` object. The `ReportOnly` property of the object determines whether `configModel` changes the configuration parameter values.

**How To**

- “About Model Configurations”
- “Programmatic Code Generation Verification”

# checkEnvSetup

---

**Purpose** Configure your coder product to interact with Code Composer Studio

**Syntax** `checkEnvSetup(ide, boardproc, action)`

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3
- Texas Instruments Code Composer Studio v4
- Texas Instruments Code Composer Studio v5

**Description** The `checkEnvSetup` function is only useful for validating the toolchain when the **System target file** parameter is set to `idelink_ert.tlc` or `idelink_grt.tlc`. Do not use `checkEnvSetup` when **System target file** is set to `ert.tlc`. The System target file parameter is located on the Code Generation pane in the Configuration Parameters dialog box. For more information, see “System target file”.

Before using Embedded Coder software with Texas Instruments Code Composer Studio IDE for the first time, use the `checkEnvSetup` function to verify that you have the required third-party tools, as described in:

- “Compare Version Numbers of Installed vs. Required Tools” on page 1-126
- “Set the Environment Variables” on page 1-127.

Run `checkEnvSetup` again whenever you configure CCS IDE to interact with a new board or processor, or upgrade the related third-party tools.

The syntax for this function is: `checkEnvSetup(ide, boardproc, action)`:

- For the *ide* argument, enter the IDE you want to check:
  - 'ccs' checks the setup for Code Composer Studio v3
  - 'ccsv4' checks the setup for Code Composer Studio v4
  - 'ccsv5' checks the setup for Code Composer Studio v5

- For the *boardproc* argument, enter the name of a supported board or processor. You can get these names from the **Processor** parameter on the Target Hardware Resources tab (see related link at bottom of topic). For example, enter: 'F2812'.
- For the *action* argument, specify the action you want this function to perform:
  - 'list' lists the required third-party tools and version numbers.
  - 'check' lists the required third-party tools and the ones on your development system. If tools are missing, install them. If the version numbers do not match, install the required version.
  - 'setup' creates environment variables that point to the installation folders of the third-party tools. This action is required.

If your tools do not meet the requirements, the function advises you. If path information is incomplete, the function prompts you to enter path information for specific tools.

If you omit the *action* argument, the method defaults to 'setup'.

If *action* is 'list' or 'check', the checkEnvSetup function returns an output argument that contains the third-party tool information. You can assign that output argument to a variable. When *action* is 'setup', the checkEnvSetup function does not return an output argument.

## Examples

### Get Information About Required Tools

To find out which third-party tools your board requires, including version numbers, use 'list' as the third argument.

```
checkEnvSetup('ccs', 'F2808 eZdsp', 'list')
```

1. CCS (Code Composer Studio)  
Required version: 3.3.82.13  
Required for : Automation and Code Generation
2. CGT (Texas Instruments C2000 Code Generation Tools)  
Required version: 5.2.1

# checkEnvSetup

---

```
Required for : Code generation

3. DSP/BIOS (Real Time Operating System)
Required version: 5.33.05
Required for : Real-Time Data Exchange (RTDX)

4. Flash Tools (TMS320C2808 Flash APIs)
Required version: 3.02
Required for : Flash Programming
Required environment variables (name, value):
(FLASH_2808_API_INSTALLDIR, "<Flash Tools (TMS320C2808 Flash APIs) installation folder>")
```

## Compare Version Numbers of Installed vs. Required Tools

To compare “Your version” of the installed third-party tools with the “Required version”, use 'check' as the third argument.

To resolve differences between the two version numbers, install the required software versions. Using versions of the software that are different from the required version can produce unexpected results.

```
checkEnvSetup('ccs', 'c6416', 'check')
```

```
1. CCS (Code Composer Studio)
Your version : 3.3.38.2
Required version: 3.3.82.13
Required for : Automation and Code Generation

2. CGT (Code Generation Tools)
Your version : 6.0.8
Required version: 6.1.10
Required for : Code generation

3. DSP/BIOS (Real Time Operating System)
Your version :
Required version: 5.33.05
Required for : Code generation
```



```
4. Texas Instruments IMGLIB (TMS320C64x)
Your version : 1.04
Required version: 1.04
Required for : CRL block replacement
C64X_IMGLIB_INSTALLDIR="E:\apps\TexasInstruments\C6400\imglib_v104b"
```

## Set the Environment Variables

After verifying that you have the required versions of the third-party tools, set the environment variables. Use 'setup' as the *action* argument, or omit the *action* argument.

This step is required before Embedded Coder software can use Texas Instruments Code Composer Studio to build and run an executable.

```
checkEnvSetup('ccs', 'dm6437evm')
```

```
1. Checking CCS (Code Composer Studio) version
Required version: 3.3.82.13
Required for : Automation and Code Generation
Your Version : 3.3.38.13

2. Checking CGT (Code Generation Tools) version
Required version: 6.1.10
Required for : Code generation
Your Version : 6.1.10

3. Checking DSP/BIOS (Real Time Operating System) version
Required version: 5.33.05
Required for : Code generation
Your Version : 5.33.05

4. Checking Texas Instruments IMGLIB (C64x+) version
Required version: 2.0.1
Required for : CRL block replacement
Your Version : 2.0.1
Setting environment variable "C64XP_IMGLIB_INSTALLDIR"
to "E:\apps\TexasInstruments\C64Plus\imglib_v201"
```

# checkEnvSetup

---

```
5. Checking DM6437EVM DVSDK (Digital Video Software Developers Kit) version
Required version: 1.01.00.15
Required for : Code generation
Your Version : 1.01.00.15
Setting environment variable "DVSDK_EVMDM6437_INSTALLDIR" to "C:\[...]"
Setting environment variable "CSLR_DM6437_INSTALLDIR" to "C:\dvsd[...]"
Setting environment variable "PSP_EVMDM6437_INSTALLDIR" to "C:\dv[...]"
Setting environment variable "NDK_INSTALL_DIR" to "C:\dvsdk_1_01_[...]"
```

## See Also

“System target file” | “Code Generation: Target Hardware Resources Pane” on page 3-152

## How To

- “Configure the Build Process”

**Purpose**

Close project in IDE window

**Syntax**

```
IDE_Obj.close(filename, 'project')
```

**IDEs**

This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description**

Use `IDE_Obj.close(filename, 'project')` to close a specific project, projects, or the active open project.

For the *filename* argument:

- To close the project files, enter 'all'.
- To close a specific project, enter the project file name, such as 'myProj'. If the file is not an open file in the IDE, MATLAB returns a warning message.
- To close the active project, enter [].

With the VisualDSP++ IDE, to close the current project group (if *filename* is 'all' or []), replace 'project' with 'projectgroup'.

---

**Note**

- The open method does not support the 'text' argument.
  - Save changes to your files and projects in the IDE before you use `close`. The `close` method does not save changes, nor does it prompt you to save changes, before it closes the project.
- 

**Examples**

To close the open project files:

```
IDE_Obj.close('all', 'project')
```

# close

---

To close the open project, myProj:

```
IDE_Obj.close('myProj', 'project')
```

To close the active open project:

```
IDE_Obj.close([], 'project')
```

With the VisualDSP++ IDE, to close the open project groups:

```
IDE_Obj.close('all', 'projectgroup')
```

With the VisualDSP++ IDE, to close the active project group:

```
IDE_Obj.close([], 'projectgroup')
```

## See Also

add | open | save

## Purpose

Represent code generation template for MATLAB Coder

## Description

Create a `coder.MATLABCodeTemplate` object from a code generation template (CGT) file. You can use this file to customize the code generation output for MATLAB Coder. If a CGT file is not provided, the `coder.MATLABCodeTemplate` object is created from the default template file `matlabroot/toolbox/coder/matlabcoder/templates/matlabcoder_default_tem`

## Construction

`newObj = coder.MATLABCodeTemplate()` creates a `coder.MATLABCodeTemplate` object from the default code generation template (CGT) file `matlabroot/toolbox/coder/matlabcoder/templates/matlabcoder_default_tem`

`newObj = coder.MATLABCodeTemplate(CGTFile)` creates a `coder.MATLABCodeTemplate` object from the code generation template file `CGTFile`. If the file is not on the MATLAB path, specify a full path to the file.

## Input Arguments

### CGTFile

Name of code generation template file

### Data Types

char

**Default:** empty

## Methods

|                               |                                                 |
|-------------------------------|-------------------------------------------------|
| <code>emitSection</code>      | Emit output string for template section         |
| <code>getCurrentTokens</code> | Get current tokens                              |
| <code>getTokenValue</code>    | Get value of token                              |
| <code>setTokenValue</code>    | Set value of token for code generation template |

# coder.MATLABCodeTemplate

---

## Copy Semantics

Handle. To learn how handle classes affect copy operations, see Copying Objects in the MATLAB documentation.

## Examples

```
newObj = coder.MATLABCodeTemplate()

newObj =

 MATLABCodeTemplate with properties:

 CGTFile: 'matlabcoder_default_template.cgt'

newObj = coder.MATLABCodeTemplate('custom_matlabcoder_template.cgt')

newObj =

 MATLABCodeTemplate with properties:

 CGTFile: 'custom_matlabcoder_template.cgt'
```

## See Also

```
coder.MATLABCodeTemplate.setTokenValue |
coder.MATLABCodeTemplate.getTokenValue |
coder.MATLABCodeTemplate.getCurrentTokens |
coder.MATLABCodeTemplate.emitSection
```

## Related Examples

- “Generate Custom File and Function Banners for C and C++ Code”

## Concepts

- “Code Generation Template (CGT) Files for MATLAB”

**Purpose** Define size and number of RTDX channel buffers

**Syntax** `configure(rx,length,num)`

---

**Note** `configure` produces a warning on C5000™ processors and will be removed from a future version of the software.

---

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `configure(rx,length,num)` sets the size of each main (host) buffer, and the number of buffers associated with `rx`. Input argument `length` is the size in bytes of each channel buffer and `num` is the number of channel buffers to create.

Main buffers must be at least 1024 bytes, with the maximum defined by the largest message. On 16-bit processors, the main buffer must be 4 bytes larger than the largest message. On 32-bit processors, set the buffer to be 8 bytes larger than the largest message. By default, `configure` creates four, 1024-byte buffers. Independent of the value of `num`, the IDE allocates one buffer for each processor.

Use CCS to check the number of buffers and the length of each one.

**Examples** Create a default link to CCS and configure six main buffers of 4096 bytes each for the link.

```
IDE_Obj=ticcs % Create the CCS link with default values.
```

```
TICCS Object:
```

```
API version : 1.0
Processor type : C67
Processor name : CPU
Running? : No
Board number : 0
Processor number : 0
```

# configure

---

```
Default timeout : 10.00 secs

RTDX channels : 0

rx=IDE_Obj.rtdx % Create an alias to the rtdx portion.

RTDX channels : 0

configure(rx,4096,6) % Use the alias rx to configure the length
 % and number of buffers.
```

After you configure the buffers, use the RTDX™ tools in the IDE to verify the buffers.

## See Also

[readmat](#) | [readmsg](#) | [write](#) | [writemsg](#)



---

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Connect IDE to processor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Syntax</b>      | <pre>IDE_Obj.connect() IDE_Obj.connect(debugconnection) IDE_Obj.connect(...,timeout)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>IDEs</b>        | This function supports the following IDEs: <ul style="list-style-type: none"><li>• Green Hills MULTI</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b> | <p><i>IDE_Obj.connect()</i> connects the IDE to the processor hardware or simulator. <i>IDE_Obj</i> is the IDE handle.</p> <p><i>IDE_Obj.connect(debugconnection)</i> connects the IDE to the processor using the debug connection you specify in <i>debugconnection</i>. Enter <i>debugconnection</i> as a string enclosed in single quotation marks. <i>IDE_Obj</i> is the IDE handle. Refer to Examples to see this syntax in use.</p> <p><i>IDE_Obj.connect(...,timeout)</i> adds the optional parameter <i>timeout</i> that defines how long, in seconds, MATLAB waits for the specified connection process to complete. If the time-out period expires before the process returns a completion message, MATLAB generates an error and returns. Usually the program connection process works in spite of the error message</p> |
| <b>Examples</b>    | <p>The input argument string <i>debugconnection</i> specify the processor to connect to with the IDE. This example connects to the Freescale™ MPC5554 simulator. The <i>debugconnection</i> string is <code>simppc -fast -dec -rom_use_entry -cpu=ppc5554</code>.</p> <pre>IDE_Obj.connect('simppc -fast -dec -rom_use_entry -cpu=ppc5554')</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>See Also</b>    | <code>load</code>   <code>run</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

# cgv.CGV.copySetup

---

**Purpose** Create copy of `cgv.CGV` object

**Syntax** `cgvObj2 = cgvObj1.copySetup()`

**Description** `cgvObj2 = cgvObj1.copySetup()` creates a copy of a `cgv.CGV` object, `cgvObj1`. The copied object, `cgvObj2`, has the same configuration as `cgvObj1`, but does not copy results of the execution.

**Tips**

- You can use this method to make a copy of a `cgv.CGV` object and then modify the object to run in a different mode by calling `cgv.CGV.setMode`.
- If you have a `cgv.CGV` object, which reported errors or failed at execution, you can use this method to copy the object and rerun it. The copied object has the same configuration as the original object, therefore you might want to modify the location of the output files by calling `cgv.CGV.setOutputDir`. Otherwise, during execution, the copied `cgv.CGV` object overwrites the output files.

**Examples** Make a copy of a `cgv.CGV` object, set it to run in a different mode, then run and compare the objects in a `cgv.Batch` object.

```
cgvModel = 'rtwdemo_cgv';
cgvObj1 = cgv.CGV(cgvModel, 'connectivity', 'sim');
cgvObj1.run();
cgvObj2 = cgvObj1.copySetup()
cgvObj2.setMode('sil');
cgvObj2.run();
```

**See Also** `cgv.CGV.run`

**How To**

- “Verify Numerical Equivalence with CGV”

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Copy conceptual argument specifications to matching implementation arguments for code replacement table entry                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Syntax</b>      | <code>copyConceptualArgsToImplementation(<i>hEntry</i>)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Arguments</b>   | <i>hEntry</i><br>Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as <code>hEntry = RTW.Tf1CFunctionEntry</code> or <code>hEntry = RTW.Tf1COperationEntry</code> .                                                                                                                                                                                                                                                                                                      |
| <b>Description</b> | <p>The <code>copyConceptualArgsToImplementation</code> function provides a quick way to copy conceptual argument specifications to matching implementation arguments. This function can be used when the conceptual arguments and the implementation arguments are the same for a code replacement table entry.</p> <p>For arguments with an unsized type, such as <code>integer</code>, the code generator determines the size of the argument values based on hardware implementation configuration settings of the MATLAB code or model.</p> |
| <b>Examples</b>    | <p>In the following example, the <code>copyConceptualArgsToImplementation</code> function is used to copy conceptual argument specifications to matching implementation arguments for an addition operation.</p>                                                                                                                                                                                                                                                                                                                                |

```
hLib = RTW.Tf1Table;

% Create an entry for addition of built-in uint8 data type
op_entry = RTW.Tf1COperationEntry;
op_entry.setTf1COperationEntryParameters(...
 'Key', 'RTW_OP_ADD', ...
 'Priority', 90, ...
 'SaturationMode', 'RTW_SATURATE_ON_OVERFLOW', ...
 'RoundingModes', {'RTW_ROUND_UNSPECIFIED'}, ...
 'ImplementationName', 'u8_add_u8_u8', ...
 'ImplementationHeaderFile', 'u8_add_u8_u8.h', ...
```

# copyConceptualArgsToImplementation

---

```
 'ImplementationSourceFile', 'u8_add_u8_u8.c');

 arg = hLib.getTf1ArgFromString('y1', 'uint8');
 arg.IOType = 'RTW_IO_OUTPUT';
 op_entry.addConceptualArg(arg);

 arg = hLib.getTf1ArgFromString('u1', 'uint8');
 op_entry.addConceptualArg(arg);

 arg = hLib.getTf1ArgFromString('u2', 'uint8');
 op_entry.addConceptualArg(arg);

 op_entry.copyConceptualArgsToImplementation();

 hLib.addEntry(op_entry);
```

## How To

- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

## Purpose

Create conceptual argument from specified properties and add to conceptual arguments for code replacement table entry

## Syntax

```
arg = createAndAddConceptualArg(hEntry, argType, varargin)
```

## Input Arguments

*hEntry*

Handle to a code replacement table entry previously returned by instantiating a code replacement table entry class, such as *hEntry* = RTW.Tf1CFunctionEntry or *hEntry* = RTW.Tf1COperationEntry.

*argType*

String specifying the argument type to create: 'RTW.Tf1ArgNumeric' for numeric or 'RTW.Tf1ArgMatrix' for matrix.

*varargin*

Parameter/value pairs for the conceptual argument. See varargin Parameters.

## varargin Parameters

The following argument properties can be specified to the createAndAddConceptualArg function using parameter/value argument pairs. For example,

```
createAndAddConceptualArg(..., 'DataTypeMode', 'double', ...);
```

Name

String specifying the argument name, for example, 'y1' or 'u1'.

IOType

String specifying the I/O type of the argument: 'RTW\_IO\_INPUT' for input or 'RTW\_IO\_OUTPUT' for output. The default is 'RTW\_IO\_INPUT'.

IsSigned

Boolean value that, when set to true, indicates that the argument is signed. The default is true.

# createAndAddConceptualArg

---

## WordLength

Integer specifying the word length, in bits, of the argument. The default is 16.

## CheckSlope

Boolean flag that, when set to `true` for a fixed-point argument, causes code replacement request processing to check that the slope value of the argument exactly matches the call-site slope value. The default is `true`.

Specify `true` if you are matching a specific [slope bias] scaling combination or a specific binary-point-only scaling combination on fixed-point operator inputs and output. Specify `false` if you are matching relative scaling or relative slope and bias values across fixed-point operator inputs and output.

## CheckBias

Boolean flag that, when set to `true` for a fixed-point argument, causes code replacement request processing to check that the bias value of the argument exactly matches the call-site bias value. The default is `true`.

Specify `true` if you are matching a specific [slope bias] scaling combination or a specific binary-point-only scaling combination on fixed-point operator inputs and output. Specify `false` if you are matching relative scaling or relative slope and bias values across fixed-point operator inputs and output.

## DataTypeMode

String specifying the data type mode of the argument: `'boolean'`, `'double'`, `'single'`, `'Fixed-point: binary point scaling'`, or `'Fixed-point: slope and bias scaling'`. The default is `'Fixed-point: binary point scaling'`.

---

**Note** You can specify either `DataType` (with `Scaling`) or `DataTypeMode`, but do not specify both.

---

## DataType

String specifying the data type of the argument: 'boolean', 'double', 'single', or 'Fixed'. The default is 'Fixed'.

## Scaling

String specifying the data type scaling of the argument: 'BinaryPoint' for binary-point scaling or 'SlopeBias' for slope and bias scaling. The default is 'BinaryPoint'.

## Slope

Floating-point value specifying the slope of the argument, for example, 15.0. The default is 1.

If you are matching a specific [slope bias] scaling combination on fixed-point operator inputs and output, specify either this parameter or a combination of the SlopeAdjustmentFactor and FixedExponent parameters

## SlopeAdjustmentFactor

Floating-point value specifying the slope adjustment factor (F) part of the slope,  $F2^E$ , of the argument. The default is 1.0.

If you are matching a specific [slope bias] scaling combination on fixed-point operator inputs and output, specify either the Slope parameter or a combination of this parameter and the FixedExponent parameter.

## FixedExponent

Integer value specifying the fixed exponent (E) part of the slope,  $F2^E$ , of the argument. The default is -15.

If you are matching a specific [slope bias] scaling combination on fixed-point operator inputs and output, specify either the Slope parameter or a combination of this parameter and the SlopeAdjustmentFactor parameter.

## Bias

Floating-point value specifying the bias of the argument, for example, 2.0. The default is 0.0.

# createAndAddConceptualArg

---

Specify this parameter if you are matching a specific [slope bias] scaling combination on fixed-point operator inputs and output.

## FractionLength

Integer value specifying the fraction length for the argument, for example, 3. The default is 15.

Specify this parameter if you are matching a specific binary-point-only scaling combination on fixed-point operator inputs and output.

## BaseType

String specifying the base data type for which a matrix argument is valid, for example, 'double'.

## DimRange

Dimensions for which a matrix argument is valid, for example, [2 2]. You can also specify a range of dimensions specified in the format [Dim1Min Dim2Min ... DimNMin; Dim1Max Dim2Max ... DimNMax]. For example, [2 2; inf inf] means a two-dimensional matrix of size 2x2 or larger.

## Output Arguments

Handle to the created conceptual argument. Specifying the return argument in the `createAndAddConceptualArg` function call is optional.

## Description

The `createAndAddConceptualArg` function creates a conceptual argument from specified properties and adds the argument to the conceptual arguments for a code replacement table entry.

## Examples

In the following example, the `createAndAddConceptualArg` function is used to specify conceptual output and input arguments for a code replacement operator entry.

```
op_entry = RTW.Tf1COperationEntry;
. . .
createAndAddConceptualArg(op_entry, 'RTW.Tf1ArgNumeric', ...
```



```
'Name', 'y1', ...
'IOType', 'RTW_IO_OUTPUT', ...
'IsSigned', true, ...
'WordLength', 32, ...
'FractionLength', 0);

createAndAddConceptualArg(op_entry, 'RTW.Tf1ArgNumeric',...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT',...
 'IsSigned', true,...
 'WordLength', 32, ...
 'FractionLength', 0);

createAndAddConceptualArg(op_entry, 'RTW.Tf1ArgNumeric',...
 'Name', 'u2', ...
 'IOType', 'RTW_IO_INPUT',...
 'IsSigned', true,...
 'WordLength', 32, ...
 'FractionLength', 0);
```

The following examples show some common type specifications using `createAndAddConceptualArg`.

```
% uint8:
createAndAddConceptualArg(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'IsSigned', false, ...
 'WordLength', 8, ...
 'FractionLength', 0);

% single:
createAndAddConceptualArg(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'DataTypeMode', 'single');
```

# createAndAddConceptualArg

---

```
% double:
createAndAddConceptualArg(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'DataTypeMode', 'double');

% boolean:
createAndAddConceptualArg(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'DataTypeMode', 'boolean');

% Fixed-point using binary-point-only scaling:
createAndAddConceptualArg(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'CheckSlope', true, ...
 'CheckBias', true, ...
 'DataTypeMode', 'Fixed-point: binary point scaling', ...
 'IsSigned', true, ...
 'WordLength', 32, ...
 'FractionLength', 28);

% Fixed-point using [slope bias] scaling:
createAndAddConceptualArg(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'CheckSlope', true, ...
 'CheckBias', true, ...
 'DataTypeMode', 'Fixed-point: slope and bias scaling', ...
 'IsSigned', true, ...
 'WordLength', 16, ...
 'Slope', 15, ...
 'Bias', 2);
```

For examples of fixed-point arguments that use relative scaling or relative slope/bias values, see “Create Fixed-Point Operator Entries

for Net Slopes (Multiplication and Division)” and “Create Fixed-Point Operator Entries for Equal Slope and Zero Net Bias (Addition and Subtraction)” in the Embedded Coder documentation.

## **How To**

- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

# createAndAddImplementationArg

---

**Purpose** Create implementation argument from specified properties and add to implementation arguments for code replacement table entry

**Syntax** `arg = createAndAddImplementationArg(hEntry, argType,  
varargin)`

**Input Arguments** *hEntry* Handle to a code replacement table entry previously returned by instantiating a code replacement entry class, such as *hEntry* = RTW.Tf1CFunctionEntry or *hEntry* = RTW.Tf1COperationEntry.

*argType* String specifying the argument type to create:  
'RTW.Tf1ArgNumeric' for numeric.

*varargin* Parameter/value pairs for the implementation argument. See varargin Parameters.

**varargin Parameters** The following argument properties can be specified to the createAndAddImplementationArg function using parameter/value argument pairs. For example,

```
createAndAddImplementationArg(..., 'DataTypeMode', 'double', ...);
```

**Name** String specifying the argument name, for example, 'u1'.

**IOType** String specifying the I/O type of the argument: 'RTW\_IO\_INPUT' for input.

**IsSigned** Boolean value that, when set to true, indicates that the argument is signed. The default is true.

**WordLength** Integer specifying the word length, in bits, of the argument. The default is 16.

## DataTypeMode

String specifying the data type mode of the argument: 'boolean', 'double', 'single', 'Fixed-point: binary point scaling', or 'Fixed-point: slope and bias scaling'. The default is 'Fixed-point: binary point scaling'.

---

**Note** You can specify either `DataType` (with `Scaling`) or `DataTypeMode`, but do not specify both.

---

## DataType

String specifying the data type of the argument: 'boolean', 'double', 'single', or 'Fixed'. The default is 'Fixed'.

## Scaling

String specifying the data type scaling of the argument: 'BinaryPoint' for binary-point scaling or 'SlopeBias' for slope and bias scaling. The default is 'BinaryPoint'.

## Slope

Floating-point value specifying the slope of the argument, for example, 15.0. The default is 1.

You can optionally specify either this parameter or a combination of the `SlopeAdjustmentFactor` and `FixedExponent` parameters, but do not specify both.

## SlopeAdjustmentFactor

Floating-point value specifying the slope adjustment factor (F) part of the slope,  $F2^E$ , of the argument. The default is 1.0.

You can optionally specify either the `Slope` parameter or a combination of this parameter and the `FixedExponent` parameter, but do not specify both.

## FixedExponent

Integer value specifying the fixed exponent (E) part of the slope,  $F2^E$ , of the argument. The default is -15.

# createAndAddImplementationArg

---

You can optionally specify either the `Slope` parameter or a combination of this parameter and the `SlopeAdjustmentFactor` parameter, but do not specify both.

## Bias

Floating-point value specifying the bias of the argument, for example, 2.0. The default is 0.0.

## FractionLength

Integer value specifying the fraction length of the argument, for example, 3. The default is 15.

## Value

Constant value specifying the initial value of the argument. The default is 0.

Use this parameter only to set the value of injected constant input arguments, such as arguments that pass fraction-length values or flag values, in an implementation function signature. Do not use it for standard generated input arguments such as `u1`, `u2`, and so on. You can supply a constant input argument that uses this parameter anywhere in the implementation function signature, except as the return argument.

You can inject constant input arguments into the implementation signature for code replacement table entries, but if the argument values or the number of arguments required depends on compile-time information, you should use custom matching. For more information, see “Refine Matching and Replacement Using Custom Entries” in the Embedded Coder documentation.

## Output Arguments

Handle to the created implementation argument. Specifying the return argument in the `createAndAddImplementationArg` function call is optional.

## Description

The `createAndAddImplementationArg` function creates an implementation argument from specified properties and adds the

argument to the implementation arguments for a code replacement table entry.

Implementation arguments must describe fundamental numeric data types, such as `double`, `single`, `int32`, `int16`, `int8`, `uint32`, `uint16`, `uint8`, `boolean`, or `'logical'` (not fixed-point data types).

## Examples

In the following example, the `createAndAddImplementationArg` function is used along with the `createAndSetCImplementationReturn` function to specify the output and input arguments for an operator implementation.

```
op_entry = RTW.Tf1COperationEntry;
.
.
.
createAndSetCImplementationReturn(op_entry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'IsSigned', true, ...
 'WordLength', 32, ...
 'FractionLength', 0);

createAndAddImplementationArg(op_entry, 'RTW.Tf1ArgNumeric',...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT',...
 'IsSigned', true,...
 'WordLength', 32, ...
 'FractionLength', 0);

createAndAddImplementationArg(op_entry, 'RTW.Tf1ArgNumeric',...
 'Name', 'u2', ...
 'IOType', 'RTW_IO_INPUT',...
 'IsSigned', true,...
 'WordLength', 32, ...
 'FractionLength', 0);
```

# createAndAddImplementationArg

---

The following examples show some common type specifications using `createAndAddImplementationArg`.

```
% uint8:
createAndAddImplementationArg(hEntry, 'RTW.TflArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'IsSigned', false, ...
 'WordLength', 8, ...
 'FractionLength', 0);
```

```
% single:
createAndAddImplementationArg(hEntry, 'RTW.TflArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'DataTypeMode', 'single');
```

```
% double:
createAndAddImplementationArg(hEntry, 'RTW.TflArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'DataTypeMode', 'double');
```

```
% boolean:
createAndAddImplementationArg(hEntry, 'RTW.TflArgNumeric', ...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT', ...
 'DataTypeMode', 'boolean');
```

## See Also

`createAndSetCImplementationReturn`

## How To

- “Code Replacement Table Examples”



# createAndSetCImplementationReturn

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>             | Create implementation return argument from specified properties and add to implementation for code replacement table entry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Syntax</b>              | <pre>arg = createAndSetCImplementationReturn(hEntry, argType,     varargin)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Input Arguments</b>     | <p><i>hEntry</i><br/>Handle to a code replacement table entry previously returned by instantiating a code replacement entry class, such as <i>hEntry</i> = RTW.Tf1CFunctionEntry or <i>hEntry</i> = RTW.Tf1COperationEntry.</p> <p><i>argType</i><br/>String specifying the argument type to create:<br/>'RTW.Tf1ArgNumeric' for numeric.</p> <p><i>varargin</i><br/>Parameter/value pairs for the implementation return argument. See varargin Parameters.</p>                                                                                                                                                                                                                 |
| <b>varargin Parameters</b> | <p>The following argument properties can be specified to the createAndSetCImplementationReturn function using parameter/value argument pairs. For example,</p> <pre>createAndSetCImplementationReturn(..., 'DataTypeMode', 'double', ...);</pre> <p><b>Name</b><br/>String specifying the argument name, for example, 'y1'.</p> <p><b>IOType</b><br/>String specifying the I/O type of the argument: 'RTW_IO_OUTPUT' for output.</p> <p><b>IsSigned</b><br/>Boolean value that, when set to true, indicates that the argument is signed. The default is true.</p> <p><b>WordLength</b><br/>Integer specifying the word length, in bits, of the argument. The default is 16.</p> |

# createAndSetCImplementationReturn

---

## DataTypeMode

String specifying the data type mode of the argument: 'boolean', 'double', 'single', 'Fixed-point: binary point scaling', or 'Fixed-point: slope and bias scaling'. The default is 'Fixed-point: binary point scaling'.

---

**Note** You can specify either `DataType` (with `Scaling`) or `DataTypeMode`, but do not specify both.

---

## DataType

String specifying the data type of the argument: 'boolean', 'double', 'single', or 'Fixed'. The default is 'Fixed'.

## Scaling

String specifying the data type scaling of the argument: 'BinaryPoint' for binary-point scaling or 'SlopeBias' for slope and bias scaling. The default is 'BinaryPoint'.

## Slope

Floating-point value specifying the slope for a fixed-point argument, for example, 15.0. The default is 1.

You can optionally specify either this parameter or a combination of the `SlopeAdjustmentFactor` and `FixedExponent` parameters, but do not specify both.

## SlopeAdjustmentFactor

Floating-point value specifying the slope adjustment factor (F) part of the slope,  $F2^E$ , of the argument. The default is 1.0.

You can optionally specify either the `Slope` parameter or a combination of this parameter and the `FixedExponent` parameter, but do not specify both.

## FixedExponent

Integer value specifying the fixed exponent (E) part of the slope,  $F2^E$ , of the argument. The default is -15.

# createAndSetCImplementationReturn

---

You can optionally specify either the Slope parameter or a combination of this parameter and the SlopeAdjustmentFactor parameter, but do not specify both.

## Bias

Floating-point value specifying the bias of the argument, for example, 2.0. The default is 0.0.

## FractionLength

Integer value specifying the fraction length of the argument, for example, 3. The default is 15.

## Output Arguments

Handle to the created implementation return argument. Specifying the return argument in the createAndSetCImplementationReturn function call is optional.

## Description

The createAndSetCImplementationReturn function creates an implementation return argument from specified properties and adds the argument to the implementation for a code replacement table.

Implementation return arguments must describe fundamental numeric data types, such as double, single, int32, int16, int8, uint32, uint16, uint8, or boolean (not fixed-point data types).

## Examples

In the following example, the createAndSetCImplementationReturn function is used along with the createAndAddImplementationArg function to specify the output and input arguments for an operator implementation.

```
op_entry = RTW.Tf1COperationEntry;
.
.
.
createAndSetCImplementationReturn(op_entry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'IsSigned', true, ...
 'WordLength', 32, ...
```

# createAndSetCImplementationReturn

---

```
 'FractionLength', 0);

createAndAddImplementationArg(op_entry, 'RTW.Tf1ArgNumeric',...
 'Name', 'u1', ...
 'IOType', 'RTW_IO_INPUT',...
 'IsSigned', true,...
 'WordLength', 32, ...
 'FractionLength', 0);

createAndAddImplementationArg(op_entry, 'RTW.Tf1ArgNumeric',...
 'Name', 'u2', ...
 'IOType', 'RTW_IO_INPUT',...
 'IsSigned', true,...
 'WordLength', 32, ...
 'FractionLength', 0);
```

The following examples show some common type specifications using `createAndSetCImplementationReturn`.

```
% uint8:
createAndSetCImplementationReturn(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'IsSigned', false, ...
 'WordLength', 8, ...
 'FractionLength', 0);

% single:
createAndSetCImplementationReturn(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'DataTypeMode', 'single');

% double:
createAndSetCImplementationReturn(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
```

# createAndSetCImplementationReturn

---

```
 'DataTypeMode', 'double');

% boolean:
createAndSetCImplementationReturn(hEntry, 'RTW.Tf1ArgNumeric', ...
 'Name', 'y1', ...
 'IOType', 'RTW_IO_OUTPUT', ...
 'DataTypeMode', 'boolean');
```

## See Also

[createAndAddImplementationArg](#)

## How To

- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

# arxml.importer.createCalibrationComponentObjects

---

**Purpose** Create Simulink calibration objects from AUTOSAR calibration component

**Syntax** `importerObj.createCalibrationComponentObjects(ComponentName)`  
`success = importerObj.createCalibrationComponentOb`  
`jects(ComponentName,Property1,Value1,Property2,Value2,...)`

**Description** `importerObj.createCalibrationComponentObjects(ComponentName)` creates Simulink calibration objects from an AUTOSAR calibration component. This imports your parameters into the MATLAB base workspace or a Simulink data dictionary and you can then assign them to block parameters in your Simulink model.

You can also specify optional property/value pairs when creating the Simulink calibration objects:

```
success = importerObj.createCalibrationComponentOb
jects(ComponentName,Property1,Value1,Property2,Value2,...)
```

## Input Arguments

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>componentName</code>     | Absolute short name path of calibration parameter component.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>PropertyN, ValueN</code> | Optional property/value pairs. You can specify values for the following properties: <ul style="list-style-type: none"><li>'CreateSimulinkObject'<br/>true (default) or false. If true, the function creates <code>Simulink.AliasType</code> and <code>Simulink.NumericType</code> data objects corresponding to the AUTOSAR data types in the XML file.</li><li>'DataDictionary'<br/>String specifying an existing Simulink data dictionary into which to import calibration objects corresponding to</li></ul> |

# arxml.importer.createCalibrationComponentObjects

---

AUTOSAR data types in the XML file.  
The model becomes associated with the  
specified data dictionary.

## Output Arguments

*success*

True if function is successful. False otherwise.

## Examples

Create calibration objects from an AUTOSAR calibration component and import them into the MATLAB base workspace:

```
obj = arxml.importer('mySWC.arxml');
obj.createCalibrationComponentObjects('/ComponentType/MyCalibComp1')
```

Create calibration objects from an AUTOSAR calibration component and import them into the existing Simulink data dictionary `ardata.sldd`:

```
obj = arxml.importer('mySWC.arxml');
obj.createCalibrationComponentObjects('/ComponentType/MyCalibComp1',...
 'DataDictionary','ardata.sldd')
```

## How To

- “Import AUTOSAR Software Component”

# arxml.importer.createComponentAsModel

---

**Purpose** Create AUTOSAR atomic software component as Simulink model

**Syntax**

```
importerObj.createComponentAsModel(ComponentName)
[modelH,success] =
importerObj.createComponentAsModel(ComponentName,
 Property1,Value1,Property2,Value2,...)
```

**Description** *importerObj*.createComponentAsModel(*ComponentName*) creates a Simulink model corresponding to the AUTOSAR atomic software component 'COMPONENT' described in the XML file imported by the arxml.importer object *importerObj*.

You can also specify optional property/value pairs when creating this Simulink model:

```
[modelH,success] =
importerObj.createComponentAsModel(ComponentName,
Property1,Value1,Property2,Value2,...)
```

## Input Arguments

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>ComponentName</i>             | Absolute short name path of the atomic software component.                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>PropertyN</i> , <i>ValueN</i> | Optional property/value pairs. You can specify values for the following properties: <ul style="list-style-type: none"><li>'AutoSave'<br/>true or false (default). If true, the function automatically saves the generated Simulink model.</li><li>'CreateInternalBehavior'<br/>true or false (default). If true, the function automatically imports the internal behavior of a multi-runnable AUTOSAR software component into the Simulink model. The importer:</li></ul> |



- Adds subsystem blocks in the model and maps them to corresponding runnables imported from the AUTOSAR software component.
- Adds signal lines in the model and maps them to corresponding interrunable variables (IRVs) imported from the AUTOSAR software component.

'CreateSimulinkObject'

true (default) or false. If true, the function creates `Simulink.AliasType` and `Simulink.NumericType` data objects corresponding to the AUTOSAR data types in the XML file.

'InitializationRunnable'

String specifying the name of an existing runnable as the initialization runnable for the component.

'DataDictionary'

String specifying an existing Simulink data dictionary into which to import data objects corresponding to AUTOSAR data types in the XML file. The model becomes associated with the specified data dictionary.

'NameConflictAction'

'overwrite' (default) or  
'makenameunique' or 'error'.

Use this property to determine the action if a Simulink model with the same name as the component already exists.

# arxml.importer.createComponentAsModel

---

## Output Arguments

|                |                                                             |
|----------------|-------------------------------------------------------------|
| <i>modelH</i>  | Model handle.                                               |
| <i>success</i> | True if the function is successful. Otherwise, it is false. |

## Examples

Import an AUTOSAR software component and map it into a new Simulink model:

```
obj = arxml.importer('mySWC.arxml');
obj.createComponentAsModel('/pkg/swc')
```

Import an AUTOSAR software component into a new model, and import data objects for AUTOSAR data into the existing Simulink data dictionary *ardata.sldd*:

```
obj = arxml.importer('mySWC.arxml');
obj.createComponentAsModel('/pkg/swc','DataDictionary','ardata.sldd')
```

Automatically import the internal behavior of a multi-runnable AUTOSAR software component into a Simulink model:

```
obj = arxml.importer('mySWC.arxml');
obj.createComponentAsModel('/pkg/swc','CreateInternalBehavior',true)
```

Import an AUTOSAR software component and designate *Runnable1* as the initialization runnable.

```
obj = arxml.importer('mySWC.arxml');
obj.createComponentAsModel('/pkg/swc','InitializationRunnable','Runnable1')
```

## How To

- “Import AUTOSAR Software Component”

**Purpose** Create file correlating tolerance information with signal names

**Syntax** `cgvObj.createToleranceFile(file_name , signal_list, tolerance_list)`

**Description** `cgvObj.createToleranceFile(file_name , signal_list, tolerance_list)` creates a MATLAB file, named `file_name`, containing the tolerance specification for each output signal name in `signal_list`. Each signal name in the `signal_list` corresponds to the same location of a parameter name and value pair in the `tolerance_list`.

## Input Arguments

### **file\_name**

Name for the file containing the tolerance specification for each signal. Use this file as input to `cgv.CGV.compare` and `cgv.Batch.addTest`.

### **signal\_list**

A cell array of strings, where each string is a signal name for data from the model. Use `cgv.CGV.getSavedSignals` to view the list of available signal names in the output data. `signal_list` can contain an individual signal or multiple signals. The syntax for an individual signal name is:

```
signal_list = {'log_data.subsystem_name.Data(:,1)'};
```

The syntax for multiple signal names is:

```
signal_list = {'log_data.block_name.Data(:,1)', ...
'log_data.block_name.Data(:,2)', ...
'log_data.block_name.Data(:,3)', ...
'log_data.block_name.Data(:,4)'};
```

To specify a global tolerance for the signals, include the reserved signal name, `'global_tolerance'`, in `signal_list`. Assign a global tolerance value in the associated `tolerance_list`. If `signal_list` contains other signals, their associated tolerance

value overrides the global tolerance value. In this example, the global tolerance is a relative tolerance of 0.02.

```
signal_list = {'global_tolerance',...
'log_data.block_name.Data(:,1)',...
'log_data.block_name.Data(:,2)'};

tolerance_list = {'relative', 0.02},...
{'relative', 0.015},{'absolute', 0.05}};
```

---

**Note** If a model component contains a space or newline character, MATLAB adds parentheses and a single quote to the name of the component. For example, if a substring of the signal name has a space, 'block name', MATLAB displays the signal name as:

```
log_data.('block name').Data(:,1)
```

To use the signal name as input to a CGV function, 'block name' must have two single quotes in the `signal_list`. For example:

```
signal_list = {'log_data.('block name').Data(:,1)'}

```

---

## tolerance\_list

Cell array of cell arrays. Each element of the outer cell array is a cell array containing a parameter name and value pair for the type of tolerance and its value. Possible parameter names are 'absolute' | 'relative' | 'function'. There is a one-to-one mapping between each parameter name and value pair in the `tolerance_list` and a signal name in the `signal_list`. For example, a `tolerance_list` for a `signal_list` containing four signals might look like the following:

```
tolerance_list = {'relative', 0.02},{'absolute', 0.06},...
{'relative', 0.015},{'absolute', 0.05}};
```

## How To

- “Verify Numerical Equivalence with CGV”

# delete

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Delete AUTOSAR element                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Syntax</b>          | <code>delete(arProps,elementPath)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>     | <code>delete(arProps,elementPath)</code> deletes the AUTOSAR element at <code>elementPath</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Input Arguments</b> | <p><b>arProps - AUTOSAR properties information for a model</b><br/>handle</p> <p>AUTOSAR properties information for a model, previously returned by <code>arProps = autosar.api.getAUTOSARProperties(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>arProps</code></p> <p><b>elementPath - Path to AUTOSAR element</b><br/>string</p> <p>Path to the AUTOSAR element to delete.</p> <p><b>Example:</b> <code>'Input'</code></p>                                             |
| <b>Examples</b>        | <p><b>Delete Sender-Receiver Interface</b></p> <p>Delete the sender-receiver interface <code>Interface1</code> from the AUTOSAR configuration for a model.</p> <pre>rtwdemo_autosar_multirunnables arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables'); ifPaths=find(arProps,[],'SenderReceiverInterface','PathType','FullyQualified')  ifPaths =      '/pkg/if/Interface1'    '/pkg/if/Interface2'  delete(arProps,'Interface1'); ifPaths=find(arProps,[],'SenderReceiverInterface','PathType','FullyQualified')</pre> |

```
ifPaths =

 '/pkg/if/Interface2'
```

**See Also**

add

**Related  
Examples**

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# disable

---

**Purpose** Disable RTDX interface, specified channel, or RTDX channels

---

**Note** Support for `disable` on C5000 processors will be removed in a future version.

---

**Syntax**

```
disable(rx, 'channel')
disable(rx, 'all')
disable(rx)
```

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `disable(rx, 'channel')` disables the open channel specified by the string `channel`, for `rx`. Input argument `rx` represents the RTDX portion of the associated link to the IDE.

`disable(rx, 'all')` disables the open channels associated with `rx`.

`disable(rx)` disables the RTDX interface for `rx`.

### Important Requirements for Using `disable`

On the processor side, `disable` depends on RTDX to disable channels or the interface. To use `disable`, meet the following requirements:

- 1 The processor must be running a program.
- 2 You enabled the RTDX interface.
- 3 Your processor program polls periodically.

**Examples** When you have opened and used channels to communicate with a processor, disable the channels and RTDX before ending your session. Use `disable` to switch off open channels and disable RTDX, as follows:

```
disable(IDE_Obj.rtdx, 'all') % Disable the open RTDX channels.
```



`disable(IDE_Obj.rtdx)`      % Disable RTDX interface.

## See Also

`close` | `enable` | `open`

# display (IDE Object)

---

**Purpose** Properties of IDE handle

**Syntax** `IDE_Obj.display()`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.display()` displays the properties and property values of the IDE handle `IDE_Obj`.

For example, after you creating `IDE_Obj` with a constructor, using the `display` method with `IDE_Obj` returns a set of properties and values:

```
IDE_Obj.display
```

```
IDE Object:
Property1 : valuea
Property2 : valueb
Property3 : valuec
Property4 : valued
```

**See Also** `get`

**Purpose** Generate message that describes how to open code execution profiling report

**Syntax** `myExecutionProfile`  
`myExecutionProfile.display`

**Description** `myExecutionProfile` or `myExecutionProfile.display` generates a message that describes how you can open the code execution profiling report.

`myExecutionProfile` is a workspace variable, specified through the configuration parameter `CodeExecutionProfileVariable` and generated by a simulation.

**See Also** report

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”

# cgv.Config.displayReport

---

- Purpose**            Display results of comparing configuration parameter values
- Syntax**            `cfgObj.displayReport()`
- Description**        `cfgObj.displayReport()` displays the results at the MATLAB Command Window of comparing the configuration parameter values for the model with the values that the object recommends. `cfgObj` is a handle to a `cgv.Config` object.
- How To**            • “Verify Numerical Equivalence Between Two Modes of Execution of a Model”

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Emit output string for template section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Syntax</b>          | <code>emitSection(sectionName,isCPPComment)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>     | <code>emitSection(sectionName,isCPPComment)</code> emits the output string of a template section. Specify <code>sectionName</code> as one of the following: <ul style="list-style-type: none"><li>• FileBanner</li><li>• FileTrailer</li><li>• FunctionBanner</li></ul>                                                                                                                                                                                                                                                                                                                                          |
| <b>Input Arguments</b> | <b>sectionName</b><br>Name of template section to emit<br><b>isCPPComment</b><br>Boolean value specifying use of CPP comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Examples</b>        | Create a <code>coder.MATLABCodeTemplate</code> object with the default template. Set values for the default tokens and emit the sections. <pre>newObj = coder.MATLABCodeTemplate % use default template fileN = 'myfilename.c'; newObj.setTokenValue('FileName', fileN) newObj.setTokenValue('FunctionDescription',...                     'This is a function description') newObj.setTokenValue('Argument',...                     sprintf('int a, \nfloat b, \nchar c\n')) newObj.emitSection('FileBanner', false) newObj.emitSection('FunctionBanner', false) newObj.emitSection('FileTrailer', false)</pre> |
| <b>See Also</b>        | <code>coder.MATLABCodeTemplate.setTokenValue</code>  <br><code>coder.MATLABCodeTemplate.getTokenValue</code>  <br><code>coder.MATLABCodeTemplate.getCurrentTokens</code>                                                                                                                                                                                                                                                                                                                                                                                                                                         |

# **coder.MATLABCodeTemplate.emitSection**

---

## **Related Examples**

- “Generate Custom File and Function Banners for C and C++ Code”

## **Concepts**

- “Code Generation Template (CGT) Files for MATLAB”

**Purpose** Enable RTDX interface, specified channel, or RTDX channels

---

**Note** Support for enable on C5000 processors will be removed in a future version.

---

**Syntax**

```
enable(rx, 'channel')
enable(rx, 'all')
enable(rx)
```

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `enable(rx, 'channel')` enables the open channel specified by the string `channel`, for RTDX link `rx`. The input argument `rx` represents the RTDX portion of the associated link to the IDE.

`enable(rx, 'all')` enables the open channels associated with `rx`.

`enable(rx)` enables the RTDX interface for `rx`.

### Important Requirements for Using enable

On the processor side, `enable` depends on RTDX to enable channels. To use `enable`, meet the following requirements:

- 1** The processor must be running a program when you enable the RTDX interface. When the processor is not running, the state defaults to disabled.
- 2** Enable the RTDX interface before you enable individual channels.
- 3** Channels must be open.
- 4** Your processor program must poll periodically.
- 5** Using code in the program running on the processor to enable channels overrides the default disabled state of the channels.

# enable

---

## Examples

To use channels to RTDX, you must both open and enable the channels:

```
IDE_Obj = ticcs; % Create a new connection to the IDE.
enable(IDE_Obj.rtdx) % Enable the RTDX interface.
open(IDE_Obj.rtdx, 'inputchannel', 'w') % Open a channel for sending
 % data to the processor.
enable(IDE_Obj.rtdx, 'inputchannel') % Enable the channel so you can use
 % it.
```

## See Also

[disable](#) | [open](#)



---

|                    |                                                                                                                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Enable C++ support for function entry in code replacement table                                                                                                                                                                                                                        |
| <b>Syntax</b>      | <code>enableCPP(<i>hEntry</i>)</code>                                                                                                                                                                                                                                                  |
| <b>Arguments</b>   | <i>hEntry</i><br>Handle to a code replacement function entry previously returned by <code>hEntry = RTW.Tf1CFunctionEntry</code> or <code>hEntry = MyCustomFunctionEntry</code> , where <code>MyCustomFunctionEntry</code> is a class derived from <code>RTW.Tf1CFunctionEntry</code> . |
| <b>Description</b> | The <code>enableCPP</code> function enables C++ support for a function entry in a code replacement table. This allows you to specify a C++ name space for the implementation function defined in the entry (see the <code>setNameSpace</code> function).                               |

---

**Note** When you register a code replacement library containing C++ function entries, you must specify the value `{ 'C++' }` for the `LanguageConstraint` property of the code replacement registry entry. For more information, see “Register Code Replacement Libraries”.

---

**Examples** In the following example, the `enableCPP` function is used to enable C++ support, and then the `setNameSpace` function is called to set the name space for the `sin` implementation function to `std`.

```
fcn_entry = RTW.Tf1CFunctionEntry;
fcn_entry.setTf1CFunctionEntryParameters(...
 'Key', 'sin', ...
 'Priority', 100, ...
 'ImplementationName', 'sin', ...
 'ImplementationHeaderFile', 'cmath');

fcn_entry.enableCPP();
fcn_entry.setNameSpace('std');
```

**See Also** `registerCPPFunctionEntry` | `setNameSpace`

## **How To**

- “Map Math Functions to Application-Specific Implementations”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

**Purpose** Exclude checks

**Syntax** `excludeCheck(obj, checkID)`

**Description** `excludeCheck(obj, checkID)` excludes a check from the Code Generation Advisor when a user specifies the objective. When a user selects multiple objectives, if the user specifies an additional objective that includes this check as a higher priority objective, the Code Generation Advisor displays this check.

**Input Arguments**

|                |                                                                         |
|----------------|-------------------------------------------------------------------------|
| <i>obj</i>     | Handle to a code generation objective object previously created.        |
| <i>checkID</i> | Unique identifier of the check that you exclude from the new objective. |

**Examples** Exclude the **Identify questionable code instrumentation (data I/O)** check from the objective.

```
excludeCheck(obj, 'mathworks.codegen.CodeInstrumentation');
```

**See Also** Simulink.ModelAdvisor

**How To**

- “Create Custom Objectives”
- “About IDs”

# find

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Find AUTOSAR elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax</b>          | <pre>paths=find(arProps,rootPath,category) paths=find(arProps,rootPath,category,'PathType',value) paths=find(arProps,rootPath,category,property,value)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>     | <p><code>paths=find(arProps,rootPath,category)</code> returns paths to AUTOSAR elements matching <code>category</code>, starting at path <code>rootPath</code>.</p> <p><code>paths=find(arProps,rootPath,category,'PathType',value)</code> specifies whether the returned paths are fully qualified or partially qualified.</p> <p><code>paths=find(arProps,rootPath,category,property,value)</code> specifies a constraining value on a property of the specified category of elements, narrowing the search.</p>                                                                                                                                                                                                                  |
| <b>Input Arguments</b> | <p><b>arProps - AUTOSAR properties information for a model</b><br/>handle</p> <p>AUTOSAR properties information for a model, previously returned by <code>arProps = autosar.api.getAUTOSARProperties(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>arProps</code></p> <p><b>rootPath - Starting point of the search</b><br/>string</p> <p>Path specifying the starting point at which to look for the specified type of AUTOSAR elements. <code>[]</code> indicates the root of the component.</p> <p><b>Example:</b> <code>[]</code></p> <p><b>category - Type of AUTOSAR element</b><br/>string</p> <p>Type of AUTOSAR element for which to return paths.</p> |

**Example:** 'SenderReceiverInterface'

**'PathType',value - Whether the returned paths are fully qualified or partially qualified**

`PartiallyQualified' (default) | `FullyQualified'

Specify FullyQualified to return fully qualified paths.

**Example:** 'PathType', 'FullyQualified'

**property,value - Property and value**

name string, value

Valid property of the specified category of elements, and a value to match for that property in the search. Table “Properties of AUTOSAR Elements” lists properties that are associated with AUTOSAR elements.

**Example:** 'IsService', true

## Output Arguments

**paths - Return structure**

cell array of strings

Structure to which paths are returned.

**Example:** ifPaths

## Examples

**Find Sender-Receiver Interfaces That Are Not Services**

For a model, find sender-receiver interfaces for which the property IsService is false and return fully qualified paths.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
ifPaths=find(arProps,[],'SenderReceiverInterface',...
 'IsService',false,'PathType','FullyQualified')

ifPaths =

 '/pkg/if/Interface1' '/pkg/if/Interface2'
```

## Find Mode-Switch Interface Paths

For a model, add a mode-switch interface and then use `find` to list paths for mode-switch interfaces in the model.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addMSInterface(arProps,'/pkg/if/Interface3','IsService',true);
ifPaths=find(arProps,[],'ModeSwitchInterface','PathType','FullyQualified')
```

```
ifPaths =

 '/pkg/if/Interface3'
```

### See Also

[add](#) | [delete](#) | [get](#) | [set](#)

### Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

**Purpose**

Flush data or messages from specified RTDX channels

---

**Note** flush support for C5000 processors will be removed in a future version.

---

**Syntax**

```
flush(rx,channel,num,timeout)
flush(rx,channel,num)
flush(rx,channel,[],timeout)
flush(rx,channel)
flush(rx,'all')
```

**IDEs**

This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description**

`flush(rx,channel,num,timeout)` removes *num* oldest data messages from the RTDX channel queue specified by *channel* in *rx*. To determine how long to wait for the function to complete, `flush` uses *timeout* (in seconds) rather than the global timeout period stored in *rx*. `flush` applies the timeout processing when it flushes the last message in the channel queue, because the flush function performs a read to advance the read pointer past the last message. Use this calling syntax only when you specify a channel configured for read access.

`flush(rx,channel,num)` removes the *num* oldest messages from the RTDX channel queue in *rx* specified by the string *channel*. `flush` uses the global timeout period stored in *rx* to determine how long to wait for the process to complete. Compare this to the previous syntax that specifies the timeout period. Use this calling syntax only when you specify a channel configured for read access.

`flush(rx,channel,[],timeout)` removes the data messages from the RTDX channel queue specified by *channel* in *rx*. To determine how long to wait for the function to complete, `flush` uses *timeout* (in seconds) rather than the global timeout period stored in *rx*. `flush` applies the timeout processing when it flushes the last message in the

# flush

---

channel queue, because `flush` performs a read to advance the read pointer past the last message. Use this calling syntax only when you specify a channel configured for read access.

`flush(rx,channel)` removes the pending data messages from the RTDX channel queue specified by *channel* in *rx*. Unlike the preceding syntax options, you use this statement to remove messages for both read-configured and write-configured channels.

`flush(rx,'all')` removes the data messages from the RTDX channel queues.

When you use `flush` with a write-configured RTDX channel, your coder product sends the messages in the write queue to the processor. For read-configured channels, `flush` removes one or more messages from the queue depending on the input argument *num* you supply and disposes of them.

## Examples

To show how to use `flush`, this example writes data to the processor over the input channel, then uses `flush` to remove a message from the read queue for the output channel:

```
IDE_Obj = ticcs;
rx = IDE_Obj.rtdx;
open(rx,'ichan','w');
enable(rx,'ichan');
open(rx,'ochan','r');
enable(rx,'ochan');
indata = 1:10;
writemsg(rx,'ichan',int16(indata));
flush(rx,'ochan',1);
```

Now flush the remaining messages from the read channel:

```
flush(rx,'ochan','all');
```

## See Also

[enable](#) | [open](#)



---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get property of AUTOSAR element                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Syntax</b>           | <code>pValue=get(arProps,elementPath,property)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>      | <code>pValue=get(arProps,elementPath,property)</code> returns the value of the property of the AUTOSAR element at <code>elementPath</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Input Arguments</b>  | <p><b>arProps - AUTOSAR properties information for a model</b><br/>handle</p> <p>AUTOSAR properties information for a model, previously returned by <code>arProps = autosar.api.getAUTOSARProperties(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>arProps</code></p> <p><b>elementPath - Path to AUTOSAR element</b><br/>string</p> <p>Path to the AUTOSAR element for which to return the value of a property.</p> <p><b>Example:</b> <code>'Input'</code></p> <p><b>property - Type of property</b><br/>string</p> <p>Type of property to add for which to return a value, among valid properties for the AUTOSAR element.</p> <p><b>Example:</b> <code>'IsService'</code></p> |
| <b>Output Arguments</b> | <p><b>pValue - Return value</b><br/>value of property   path to composite property or property that references other properties</p> <p>Variable that returns the value of the specified AUTOSAR property. For composite properties or properties that reference other properties, the return value is the path to the property.</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |

Example: ifPaths

## Examples

### Get Value of IsService Property of Sender-Receiver Interface

For a model, get the value of the `IsService` property for the sender-receiver interface `Interface1`. The variable `IsService` returns `false` (0), indicating that the sender-receiver interface is not a service.

```
rtwdemo_autosar_multirunnables
arPropInfo=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
isService=get(arProps, 'Interface1', 'IsService')
```

```
isService =
```

```
0
```

## See Also

[set](#)

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# arxml.importer.getApplicationComponentNames

---

## Purpose

Get list of application software component names

## Syntax

```
applicationSoftwareComponentNames =
importerObj.getApplicationComponentNames
```

## Description

*applicationSoftwareComponentNames* = *importerObj*.getApplicationComponentNames returns the names of application software component names found in the XML files associated with *importerObj*, an *arxml.importer* object.

## Output Arguments

*applicationSoftwareComponentNames*

Cell array of strings. Each element is absolute short-name path of corresponding application software component:

```
 '/root_package_name[/sub_package_name]/component_short_name'
```

## See Also

[arxml.importer.getSensorActuatorComponentNames](#) | [arxml.importer.getComponentNames](#)

## How To

- “Import AUTOSAR Software Component”

# RTW.ModelCPPArgsClass.getArgCategory

---

**Purpose** Get argument category for Simulink model port from model-specific C++ class interface

**Syntax** `category = getArgCategory(obj, portName)`

**Description** `category = getArgCategory(obj, portName)` gets the category — 'Value', 'Pointer', or 'Reference' — of the argument corresponding to a specified Simulink model inport or outport from a specified model-specific C++ class interface.

## Input Arguments

|                 |                                                                                                                                                                           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <i>portName</i> | String specifying the name of an inport or outport in your Simulink model.                                                                                                |

## Output Arguments

|                 |                                                                                                                       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------|
| <i>category</i> | String specifying the argument category — 'Value', 'Pointer', or 'Reference' — for the specified Simulink model port. |
|-----------------|-----------------------------------------------------------------------------------------------------------------------|

## Alternatives

To view argument categories in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument categories. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”

# RTW.ModelCPPArgsClass.getArgCategory

---

- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.getArgCategory

---

**Purpose** Get argument category for Simulink model port from model-specific C function prototype

**Syntax** `category = getArgCategory(obj, portName)`

**Description** `category = getArgCategory(obj, portName)` gets the category, 'Value' or 'Pointer', of the argument corresponding to a specified Simulink model inport or outport from a specified model-specific C function prototype.

**Input Arguments**

|                 |                                                                                                                                                    |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
| <i>portName</i> | String specifying the name of an inport or outport in your Simulink model.                                                                         |

**Output Arguments**

|                 |                                                                                                       |
|-----------------|-------------------------------------------------------------------------------------------------------|
| <i>category</i> | String specifying the argument category, 'Value' or 'Pointer', for the specified Simulink model port. |
|-----------------|-------------------------------------------------------------------------------------------------------|

**Alternatives** Click the **Get Default Configuration** button in the Model Interface dialog box to get argument categories. See “Model Specific C Prototypes View” in the Embedded Coder documentation.

**How To**

- “Function Prototype Control”

**Purpose** Get argument name for Simulink model port from model-specific C++ class interface

**Syntax** `argName = getArgName(obj, portName)`

**Description** `argName = getArgName(obj, portName)` gets the argument name corresponding to a specified Simulink model inport or outport from a specified model-specific C++ class interface.

## Input Arguments

*obj* Handle to a model-specific C++ class interface control object, such as a handle previously returned by `obj = RTW.getClassInterfaceSpecification(modelName)`.

*portName* String specifying the name of an inport or outport in your Simulink model.

## Output Arguments

*argName* String specifying the argument name for the specified Simulink model port.

## Alternatives

To view argument names in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument names. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”

# RTW.ModelCPPArgsClass.getArgName

---

- “C++ Class Interface Control”



# RTW.ModelSpecificCPrototype.getArgName

---

|                         |                                                                                                                                                                                             |                                                                                                                                                    |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get argument name for Simulink model port from model-specific C function prototype                                                                                                          |                                                                                                                                                    |
| <b>Syntax</b>           | <code>argName = getArgName(obj, portName)</code>                                                                                                                                            |                                                                                                                                                    |
| <b>Description</b>      | <code>argName = getArgName(obj, portName)</code> gets the argument name corresponding to a specified Simulink model inport or outport from a specified model-specific C function prototype. |                                                                                                                                                    |
| <b>Input Arguments</b>  | <code>obj</code>                                                                                                                                                                            | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
|                         | <code>portName</code>                                                                                                                                                                       | String specifying the name of an inport or outport in your Simulink model.                                                                         |
| <b>Output Arguments</b> | <code>argName</code>                                                                                                                                                                        | String specifying the argument name for the specified Simulink model port.                                                                         |
| <b>Alternatives</b>     | Click the <b>Get Default Configuration</b> button in the Model Interface dialog box to get argument names. See “Model Specific C Prototypes View” in the Embedded Coder documentation.      |                                                                                                                                                    |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                              |                                                                                                                                                    |

# RTW.ModelCPPArgsClass.getArgPosition

---

**Purpose** Get argument position for Simulink model port from model-specific C++ class interface

**Syntax** `position = getArgPosition(obj, portName)`

**Description** `position = getArgPosition(obj, portName)` gets the position — 1 for first, 2 for second, etc. — of the argument corresponding to a specified Simulink model inport or outputport from a specified model-specific C++ class interface.

## Input Arguments

|                       |                                                                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>obj</code>      | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <code>portName</code> | String specifying the name of an inport or outputport in your Simulink model.                                                                                             |

## Output Arguments

|                       |                                                                                                                                                                                         |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>position</code> | Integer specifying the argument position — 1 for first, 2 for second, etc. — for the specified Simulink model port. Without an argument for the specified port, the function returns 0. |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Alternatives

To view argument positions in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument positions. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.getArgPosition

---

**Purpose** Get argument position for Simulink model port from model-specific C function prototype

**Syntax** `position = getArgPosition(obj, portName)`

**Description** `position = getArgPosition(obj, portName)` gets the position — 1 for first, 2 for second, etc. — of the argument corresponding to a specified Simulink model inport or output from a specified model-specific C function prototype.

**Input Arguments**

|                       |                                                                                                                                                    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>obj</code>      | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
| <code>portName</code> | String specifying the name of an inport or output in your Simulink model.                                                                          |

**Output Arguments**

|                       |                                                                                                                                                                                         |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>position</code> | Integer specifying the argument position — 1 for first, 2 for second, etc. — for the specified Simulink model port. Without an argument for the specified port, the function returns 0. |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Alternatives** Click the **Get Default Configuration** button in the Model Interface dialog box to get argument positions. See “Model Specific C Prototypes View” in the Embedded Coder documentation.

**How To**

- “Function Prototype Control”

# RTW.ModelCPPArgsClass.getArgQualifier

---

**Purpose** Get argument type qualifier for Simulink model port from model-specific C++ class interface

**Syntax** `qualifier = getArgQualifier(obj, portName)`

**Description** `qualifier = getArgQualifier(obj, portName)` gets the type qualifier — 'none', 'const', 'const \*', 'const \* const', or 'const &' — of the argument corresponding to a specified Simulink model inport or outport from a specified model-specific C++ class interface.

## Input Arguments

*obj* Handle to a model-specific C++ class interface control object, such as a handle previously returned by `obj = RTW.getClassInterfaceSpecification(modelName)`.

*portName* String specifying the name of an inport or outport in your Simulink model.

## Output Arguments

*qualifier* String specifying the argument type qualifier — 'none', 'const', 'const \*', 'const \* const', or 'const &' — for the specified Simulink model port.

## Alternatives

To view argument qualifiers in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument qualifiers. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

# RTW.ModelCPPArgsClass.getArgQualifier

---

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.getArgQualifier

---

|                         |                                                                                                                                                                                                                                                                       |                                                                                                                                                    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get argument type qualifier for Simulink model port from model-specific C function prototype                                                                                                                                                                          |                                                                                                                                                    |
| <b>Syntax</b>           | <code>qualifier = getArgQualifier(obj, portName)</code>                                                                                                                                                                                                               |                                                                                                                                                    |
| <b>Description</b>      | <code>qualifier = getArgQualifier(obj, portName)</code> gets the type qualifier — 'none', 'const', 'const *', or 'const * const'— of the argument corresponding to a specified Simulink model inport or outport from a specified model-specific C function prototype. |                                                                                                                                                    |
| <b>Input Arguments</b>  | <code>obj</code>                                                                                                                                                                                                                                                      | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
|                         | <code>portName</code>                                                                                                                                                                                                                                                 | String specifying the name of an inport or outport in your Simulink model.                                                                         |
| <b>Output Arguments</b> | <code>qualifier</code>                                                                                                                                                                                                                                                | String specifying the argument type qualifier — 'none', 'const', 'const *', or 'const * const'— for the specified Simulink model port.             |
| <b>Alternatives</b>     | Click the <b>Get Default Configuration</b> button in the Model Interface dialog box to get argument qualifiers. See “Model Specific C Prototypes View” in the Embedded Coder documentation.                                                                           |                                                                                                                                                    |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                                                                                                        |                                                                                                                                                    |

# getbuilddopt

---

**Purpose** Generate structure of build tools and options

**Syntax** `bt=IDE_Obj.getbuilddopt`  
`cs=IDE_Obj.getbuilddopt(file)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Texas Instruments Code Composer Studio v3

**Description** `bt=IDE_Obj.getbuilddopt` returns an array of structures in `bt`. Each structure includes an entry for each defined build tool. This list of build tools comes from the active project and active build configuration. Included in the structure is a string that describes the command-line tool options. `bt` uses the following format for elements in the structures:

- `bt(n).name` — Name of the build tool.
- `bt(n).optstring` — command-line switches for build tool in `bt(n)`.

`cs=IDE_Obj.getbuilddopt(file)` returns a string of build options for the source file specified by *file*. *file* must exist in the active project. The resulting `cs` string comes from the active build configuration. The type of source file (from the file extension) defines the build tool used by the `cs` string.



# arxml.importer.getCalibrationComponentNames

---

**Purpose** Get calibration component names

**Syntax** `calibrationComponentNames =  
importerObj.getCalibrationComponentNames`

**Description** `calibrationComponentNames =  
importerObj.getCalibrationComponentNames` returns the list of calibration component names found in the XML files associated with the `arxml.importer` object, `importerObj`.

**Output Arguments**

|                                        |                                                                                                                                    |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <code>calibrationComponentNames</code> | Cell array of strings in which each element is the absolute short name path of the corresponding calibration parameter component : |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|

`'/root_package_name[/sub_package_name]/component_short_name'`

**How To**

- “Import AUTOSAR Software Component”

# RTW.ModelCPPClass.getClassName

---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                           |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get class name from model-specific C++ class interface                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                           |
| <b>Syntax</b>           | <code>clsName = getClassName(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                           |
| <b>Description</b>      | <code>clsName = getClassName(obj)</code> gets the name of the class described by the specified model-specific C++ class interface.                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                           |
| <b>Input Arguments</b>  | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <i>clsName</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A string specifying the name of the class described by the specified model-specific C++ class interface.                                                                  |
| <b>Alternatives</b>     | To view the model class name in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, which displays the model class name and allows you to display and configure the step method for your model class. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation. |                                                                                                                                                                           |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li><li>• “C++ Class Interface Control”</li></ul>                                                                                                                                                                                                                                                                                         |                                                                                                                                                                           |

# arxml.importer.getClientServerInterfaceNames

---

## Purpose

Get list of client-server interfaces

## Syntax

```
interfaceNames = importerObj.getClientServerInterfaceNames
```

## Description

*interfaceNames* = *importerObj*.getClientServerInterfaceNames returns the names of client-server interfaces found in the XML files associated with *importerObj*, an `arxml.importer` object.

## Output Arguments

*interfaceNames* Cell array of strings. Each element is absolute short-name path of corresponding client-server interface:

```
'/root_package_name[/sub_package_name]
/client_server_interface_short_name'
```

## How To

- “Model AUTOSAR Communication”
- “Import AUTOSAR Software Component”
- “Configure AUTOSAR Client-Server Communication”

# arxml.importer.getComponentNames

---

**Purpose** Get application and sensor/actuator software component names

**Syntax** `componentNames = importerObj.getComponentNames`

**Description** `componentNames = importerObj.getComponentNames` returns the list of application and sensor/actuator software component names in the XML file associated with the `arxml.importer` object, *importerObj*.

---

**Note** `getComponentNames` finds only the application and sensor/actuator software components defined in the XML file specified when constructing the `arxml.importer` object or the XML file specified by the method `setFile`. The application software components and sensor/actuator software components described in the XML file dependencies are ignored.

---

**Output Arguments**

|                             |                                                                                                                                                                        |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>componentNames</code> | Cell array of strings in which each element is the absolute short name path of the corresponding application software component or sensor/actuator software component: |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

`'/root_package_name[/sub_package_name]/component_short_name'`

**See Also** `arxml.importer.getSensorActuatorComponentNames` | `arxml.importer.getApplicationComponentNames`

**How To**

- “Import AUTOSAR Software Component”

# coder.MATLABCodeTemplate.getCurrentTokens

---

|                         |                                                                                                                                                                                                                                                                                                         |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get current tokens                                                                                                                                                                                                                                                                                      |
| <b>Syntax</b>           | <code>currentTokens = getCurrentTokens()</code>                                                                                                                                                                                                                                                         |
| <b>Description</b>      | <code>currentTokens = getCurrentTokens()</code> returns list of current tokens in the <code>MATLABCodeTemplate</code> object                                                                                                                                                                            |
| <b>Output Arguments</b> | <p><b>currentTokens - Current tokens</b><br/>cell array of strings</p> <p>A list of current tokens in the <code>MATLABCodeTemplate</code> object, returned as a cell array of strings.</p>                                                                                                              |
| <b>Examples</b>         | <p>Create a <code>MATLABCodeTemplate</code> object with the default template, then list its tokens.</p> <pre>newObj = coder.MATLABCodeTemplate;<br/>% Creates a MATLABCodeTemplate object from the default template<br/>newObj.getCurrentTokens()<br/>% Returns a list of tokens for the template</pre> |
| <b>See Also</b>         | <code>coder.MATLABCodeTemplate.setTokenValue</code>  <br><code>coder.MATLABCodeTemplate.getTokenValue</code>  <br><code>coder.MATLABCodeTemplate.emitSection</code>                                                                                                                                     |
| <b>Related Examples</b> | <ul style="list-style-type: none"><li>“Generate Custom File and Function Banners for C and C++ Code”</li></ul>                                                                                                                                                                                          |
| <b>Concepts</b>         | <ul style="list-style-type: none"><li>“Code Generation Template (CGT) Files for MATLAB”</li></ul>                                                                                                                                                                                                       |

# getDataTransfer

---

**Purpose** Get AUTOSAR mapping information for Simulink data transfer line

**Syntax** [arIrvName,arDataAccessMode]=getDataTransfer(s1Map,  
s1DataTransferName)

**Description** [arIrvName,arDataAccessMode]=getDataTransfer(s1Map,  
s1DataTransferName) returns the values of the AUTOSAR  
inter-runnable variable arIrvName and AUTOSAR data access mode  
arDataAccessMode that are mapped to Simulink data transfer line  
s1DataTransferName.

**Input Arguments** **s1Map - Simulink to AUTOSAR mapping information for a model**  
handle

Simulink to AUTOSAR mapping information for a model, previously  
returned by `s1Map = autosar.api.getSimulinkMapping(model)`.  
`model` is a handle or string representing the model name.

**Example:** s1Map

**s1DataTransferName - Name of model data transfer line**  
string

Name of the model data transfer line for which to return AUTOSAR  
mapping information.

**Example:** 'irv4'

**Output Arguments** **arIrvName - Name of AUTOSAR inter-runnable variable**  
string

Variable that returns the name of AUTOSAR inter-runnable variable  
mapped to the specified Simulink data transfer line.

**Example:** arIrvName

**arDataAccessMode - Value of AUTOSAR data access mode**  
string

Variable that returns the value of the AUTOSAR data access mode mapped to the specified Simulink data transfer line. The value is Implicit or Explicit.

**Example:** arDataAccessMode

## Examples

### Get AUTOSAR Mapping Information for Model Data Transfer Line

Get AUTOSAR mapping information for a data transfer line in the example model `rtwdemo_autosar_multirunnables`. The model has data transfer lines named `irv1`, `irv2`, `irv3`, and `irv4`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,'irv4')
```

```
arIrvName =
```

```
IRV4
```

```
arDataAccessMode =
```

```
Implicit
```

## See Also

`mapDataTransfer`

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# RTW.ModelCPPClass.getDefaultConf

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                               |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Get default configuration information for model-specific C++ class interface from Simulink model                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                               |
| <b>Syntax</b>          | <code>getDefaultConf(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                               |
| <b>Description</b>     | <p><code>getDefaultConf(obj)</code> initializes the specified model-specific C++ class interface to a default configuration, based on information from the ERT-based Simulink model to which the interface is attached. On the first invocation, class and step method names and step method properties are set to default values. On subsequent invocations, only step method properties are reset to default values.</p> <p>Before calling this function, you must call <code>attachToModel</code>, to attach the C++ class interface to a loaded model.</p>                                                                                                                                                                                                 |                                                                                                                                                                                               |
| <b>Input Arguments</b> | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.ModelCPPArgsClass</code> or <code>obj = RTW.ModelCPPVoidClass</code> . |
| <b>Alternatives</b>    | To view C++ class interface default configuration information in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the <b>Get Default Configuration</b> button to display default configuration information. In the void-void step method view, you can see the default configuration information without clicking a button. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation. |                                                                                                                                                                                               |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                               |



- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.getDefaultConf

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                                                                        |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Get default configuration information for model-specific C function prototype from Simulink model                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                                                                                                                                        |
| <b>Syntax</b>          | <code>getDefaultConf(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                        |
| <b>Description</b>     | <p><code>getDefaultConf(obj)</code> invokes the specified model-specific C function prototype to initialize the properties and the step function name of the function argument to a default configuration based on information from the ERT-based Simulink model to which it is attached. If you invoke the command again, only the properties of the function argument are reset to default values.</p> <p>Before calling this function, you must call <code>attachToModel</code>, to attach the function prototype to a loaded model.</p> |            |                                                                                                                                        |
| <b>Input Arguments</b> | <table><tr><td><i>obj</i></td><td>Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code>.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                   | <i>obj</i> | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> . |
| <i>obj</i>             | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> .                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                                                                                                        |
| <b>Alternatives</b>    | Click the <b>Get Default Configuration</b> button in the Model Interface dialog box to get the default configuration. See “Model Specific C Prototypes View” in the Embedded Coder documentation.                                                                                                                                                                                                                                                                                                                                           |            |                                                                                                                                        |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Function Prototype Control”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                        |

|                         |                                                                                                                                                                                 |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get list of XML dependency files                                                                                                                                                |
| <b>Syntax</b>           | <i>Dependencies</i> = <i>importerObj</i> .getDependencies                                                                                                                       |
| <b>Description</b>      | <i>Dependencies</i> = <i>importerObj</i> .getDependencies returns the list of XML dependency files associated with the <code>arxml.importer</code> object, <i>importerObj</i> . |
| <b>Output Arguments</b> | <i>Dependencies</i> Cell array of strings.                                                                                                                                      |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Import AUTOSAR Software Component”</li></ul>                                                                                           |

# arxml.importer.getFile

---

**Purpose** Return software component XML file name

**Syntax** `filename = importerObj.getFile`

**Description** `filename = importerObj.getFile` returns the name of the main software component XML file associated with the `arxml.importer` object, `importerObj`.

**Output Arguments**

|                       |               |
|-----------------------|---------------|
| <code>filename</code> | XML file name |
|-----------------------|---------------|

**Examples** Get the name of the main software component file associated with an `arxml.importer` object.

```
>> obj = arxml.importer({'control_system_component.arxml', ...
 'control_system_interface.arxml', ...
 'control_system_datatype.arxml'})
```

```
obj =
```

```
The file "H:\wrk\control_system_component.arxml" contains:
```

```
 1 Application-Software-Component-Type:
 '/ComponentType/controlSystem'
```

```
 0 Sensor-Actuator-Software-Component-Type.
```

```
 0 CalPrm-Component-Type.
```

```
 0 Client-Server-Interface.
```

```
>> obj.getFile
```

```
ans =
```

```
H:\wrk\control_system_component.arxml
```

```
>>
```

**See Also** `arxml.importer.setFile`

## How To

- “Import AUTOSAR Software Component”

# getFunction

---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get AUTOSAR mapping information for Simulink entry-point function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Syntax</b>           | <code>arRunnableName=getFunction(s1Map,s1FcnName)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>      | <code>arRunnableName=getFunction(s1Map,s1FcnName)</code> returns the value of the AUTOSAR runnable <code>arRunnableName</code> mapped to the Simulink entry-point function <code>s1FcnName</code> .                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Input Arguments</b>  | <p><b>s1Map - Simulink to AUTOSAR mapping information for a model handle</b><br/>Simulink to AUTOSAR mapping information for a model, previously returned by <code>s1Map = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>s1Map</code></p> <p><b>s1FcnName - Name of model entry point function</b><br/>string<br/>Name of the model entry point function for which to return AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'InitializeFunction'</code></p> |
| <b>Output Arguments</b> | <p><b>arRunnableName - Name of AUTOSAR runnable</b><br/>string<br/>Variable that returns the name of the AUTOSAR runnable mapped to the specified model entry-point function.</p> <p><b>Example:</b> <code>arRunnableName</code></p>                                                                                                                                                                                                                                                                                                                                      |
| <b>Examples</b>         | <p><b>Get AUTOSAR Mapping Information for Model Entry-Point Function</b></p> <p>Get AUTOSAR mapping information for a model entry point function in the example model <code>rtwdemo_autosar_multirunnables</code>. The model has an initialization entry-point function named <code>InitializeFunction</code></p>                                                                                                                                                                                                                                                         |

and three exported entry-point functions named `Runnable1`, `Runnable2`, and `Runnable3`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
arRunnableName=getFunction(slMap,'InitializeFunction')
```

```
arRunnableName =
```

```
Runnable_Init
```

## See Also

`mapFunction`

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# RTW.ModelSpecificCPrototype.getFunctionName

---

|                         |                                                                                                                                                                                        |                                                                                                                                                                    |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get function name from model-specific C function prototype                                                                                                                             |                                                                                                                                                                    |
| <b>Syntax</b>           | <code>fcnName = getFunctionName(obj, fcnType)</code>                                                                                                                                   |                                                                                                                                                                    |
| <b>Description</b>      | <code>fcnName = getFunctionName(obj, fcnType)</code> gets the name of the step or initialize function described by the specified model-specific C function prototype.                  |                                                                                                                                                                    |
| <b>Input Arguments</b>  | <code>obj</code>                                                                                                                                                                       | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modelName)</code> .                 |
|                         | <code>fcnType</code>                                                                                                                                                                   | Optional string specifying which function name to get. Valid strings are 'step' and 'init'. If <code>fcnType</code> is not specified, gets the step function name. |
| <b>Output Arguments</b> | <code>fcnName</code>                                                                                                                                                                   | A string specifying the name of the function described by the specified model-specific C function prototype.                                                       |
| <b>Alternatives</b>     | Click the <b>Get Default Configuration</b> button in the Model Interface dialog box to get function names. See “Model Specific C Prototypes View” in the Embedded Coder documentation. |                                                                                                                                                                    |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                         |                                                                                                                                                                    |



|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get AUTOSAR mapping information for Simulink inport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Syntax</b>           | <code>[arPortName,arDataElementName,arDataAccessMode]=getInport(sIMap,slPortName)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>      | <code>[arPortName,arDataElementName,arDataAccessMode]=getInport(sIMap,slPortName)</code> returns the values of the AUTOSAR port <code>arPortName</code> , AUTOSAR data element <code>arDataElementName</code> , and AUTOSAR data access mode <code>arDataAccessMode</code> mapped to Simulink inport <code>slPortName</code> .                                                                                                                                                                                                              |
| <b>Input Arguments</b>  | <p><b>sIMap - Simulink to AUTOSAR mapping information for a model</b><br/>handle</p> <p>Simulink to AUTOSAR mapping information for a model, previously returned by <code>sIMap = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>sIMap</code></p> <p><b>slPortName - Name of model inport</b><br/>string</p> <p>Name of the model inport for which to return AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'Input'</code></p> |
| <b>Output Arguments</b> | <p><b>arPortName - Name of AUTOSAR port</b><br/>string</p> <p>Variable that returns the name of the AUTOSAR port mapped to the specified Simulink inport.</p> <p><b>Example:</b> <code>arPortName</code></p> <p><b>arDataElementName - Name of AUTOSAR data element</b><br/>string</p>                                                                                                                                                                                                                                                      |

# getInport

---

Variable that returns the name of the AUTOSAR data element mapped to the specified Simulink inport.

**Example:** arDataElementName

## **arDataAccessMode - Value of AUTOSAR data access mode**

string

Variable that returns the value of the AUTOSAR data access mode mapped to the specified Simulink inport. The value can be ImplicitReceive, ExplicitReceive, QueuedExplicitReceive, ErrorStatus, or ModeReceive.

**Example:** arDataAccessMode

## **Examples**

### **Get AUTOSAR Mapping Information for Model Inport**

Get AUTOSAR mapping information for a model inport in the example model rtwdemo\_autosar\_multirunnable. The model has an inport named RPort\_DE1.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap, 'RPort_DE1')
```

```
arPortName =
```

```
RPort
```

```
arDataElementName =
```

```
DE1
```

```
arDataAccessMode =
```

```
ImplicitReceive
```

**See Also**

mapInport

**Related Examples**

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# Name

---

**Purpose** Get name of profiled code section

**Syntax** `SectionName = NthSectionProfile.Name`

**Description** `SectionName = NthSectionProfile.Name` returns the name that identifies the profiled code section.

The software generates an identifier based on the model entity that corresponds to the profiled section of code.

`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** **`SectionName`**  
Name that identifies profiled code section

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Number` | `NumCalls` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `ExecutionTimeInTicks` | `MaximumExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `MaximumSelfTimeInTicks` | `TotalSelfTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `MaximumTurnaroundTimeCallNum` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                           |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get name space from model-specific C++ class interface                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                           |
| <b>Syntax</b>           | <code>nsName = getNamespace(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                           |
| <b>Description</b>      | <code>nsName = getNamespace(obj)</code> gets the name space of the class described by the specified model-specific C++ class interface.                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                           |
| <b>Input Arguments</b>  | <code>obj</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <code>nsName</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string specifying the name space of the class described by the specified model-specific C++ class interface.                                                            |
| <b>Alternatives</b>     | To view the model name space in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, which displays the model class name and name space and allows you to display and configure the step method for your model class. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation. |                                                                                                                                                                           |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li><li>• “C++ Class Interface Control”</li></ul>                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                           |

# RTW.ModelCPPClass.getNumArgs

---

**Purpose** Get number of step method arguments from model-specific C++ class interface

**Syntax** `num = getNumArgs(obj)`

**Description** `num = getNumArgs(obj)` gets the number of arguments for the step method described by the specified model-specific C++ class interface.

**Input Arguments**

|                  |                                                                                                                                                                           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>obj</code> | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Output Arguments**

|                  |                                                            |
|------------------|------------------------------------------------------------|
| <code>num</code> | An integer specifying the number of step method arguments. |
|------------------|------------------------------------------------------------|

**Alternatives** To view the number of step method arguments in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display the step method arguments. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

**How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.getNumArgs

---

|                         |                                                                                                                                                                                   |                                                                                                                                                    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get number of function arguments from model-specific C function prototype                                                                                                         |                                                                                                                                                    |
| <b>Syntax</b>           | <code>num = getNumArgs(obj)</code>                                                                                                                                                |                                                                                                                                                    |
| <b>Description</b>      | <code>num = getNumArgs(obj)</code> gets the number of function arguments for the function described by the specified model-specific C function prototype.                         |                                                                                                                                                    |
| <b>Input Arguments</b>  | <code>obj</code>                                                                                                                                                                  | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <code>num</code>                                                                                                                                                                  | An integer specifying the number of function arguments.                                                                                            |
| <b>Alternatives</b>     | Click the <b>Get Default Configuration</b> button in the Model Interface dialog box to get arguments. See “Model Specific C Prototypes View” in the Embedded Coder documentation. |                                                                                                                                                    |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                    |                                                                                                                                                    |

# NumCalls

---

**Purpose** Total number of calls to profiled code section

**Syntax** `TotalNumCalls = NthSectionProfile.NumCalls`

**Description** `TotalNumCalls = NthSectionProfile.NumCalls` returns the total number of calls to the profiled code section over the entire simulation. `NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** `TotalNumCalls`  
Total number of calls

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Name` | `Number` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `ExecutionTimeInTicks` | `MaximumExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `MaximumSelfTimeInTicks` | `TotalSelfTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `MaximumTurnaroundTimeCallNum` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”



|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get AUTOSAR mapping information for Simulink output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Syntax</b>           | <code>[arPortName,arDataElementName,arDataAccessMode]=getOutport(s1Map,s1PortName)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>      | <code>[arPortName,arDataElementName,arDataAccessMode]=getOutport(s1Map,s1PortName)</code> returns the values of the AUTOSAR provider port <code>arPortName</code> , AUTOSAR data element <code>arDataElementName</code> , and AUTOSAR data access mode <code>arDataAccessMode</code> mapped to Simulink output <code>s1PortName</code> .                                                                                                                                                                                                     |
| <b>Input Arguments</b>  | <p><b>s1Map - Simulink to AUTOSAR mapping information for a model</b><br/>handle</p> <p>Simulink to AUTOSAR mapping information for a model, previously returned by <code>s1Map = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>s1Map</code></p> <p><b>s1PortName - Name of model output</b><br/>string</p> <p>Name of the model output for which to return AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'Output'</code></p> |
| <b>Output Arguments</b> | <p><b>arPortName - Name of AUTOSAR port</b><br/>string</p> <p>Variable that returns the name of the AUTOSAR port mapped to the specified Simulink output.</p> <p><b>Example:</b> <code>arPortName</code></p> <p><b>arDataElementName - Name of AUTOSAR data element</b><br/>string</p>                                                                                                                                                                                                                                                       |

Variable that returns the name of the AUTOSAR data element mapped to the specified Simulink outputport.

**Example:** arDataElementName

## **arDataAccessMode - Value of AUTOSAR data access mode**

string

Variable that returns the value of the AUTOSAR data access mode mapped to the specified Simulink outputport. The value can be ImplicitSend or ExplicitSend.

**Example:** arDataAccessMode

## **Examples**

### **Get AUTOSAR Mapping Information for Model Outputport**

Get AUTOSAR mapping information for a model outputport in the example model rtwdemo\_autosar\_multirunnables. The model has an outputport named PPort\_DE1.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
[arPortName,arDataElementName,arDataAccessMode]=getOutputport(slMap,'PPort_DE1')
```

```
arPortName =
```

```
PPort
```

```
arDataElementName =
```

```
DE1
```

```
arDataAccessMode =
```

```
ImplicitSend
```

## **See Also**

mapOutputport

**Related  
Examples**

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

## cgv.CGV.getOutputData

---

**Purpose** Get output data

**Syntax** `out = cgvObj.getOutputData(InputIndex)`

**Description** `out = cgvObj.getOutputData(InputIndex)` is the method that you use to retrieve the output data that the object creates during execution of the model. `out` is the output data that the object returns. `cgvObj` is a handle to a `cgv.CGV` object. `InputIndex` is a unique numeric identifier that specifies which output data to retrieve. The `InputIndex` is associated with specific input data.

**How To**

- “Verify Numerical Equivalence with CGV”

# RTW.ModelSpecificCPrototype.getPreview

---

|                         |                                                                                                                                                                                                                                          |                                                                                                                                                                   |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get model-specific C function prototype code preview                                                                                                                                                                                     |                                                                                                                                                                   |
| <b>Syntax</b>           | <code>preview = getPreview(obj, fcnType)</code>                                                                                                                                                                                          |                                                                                                                                                                   |
| <b>Description</b>      | <code>preview = getPreview(obj, fcnType)</code> gets the model-specific C function prototype code preview.                                                                                                                               |                                                                                                                                                                   |
| <b>Input Arguments</b>  | <code>obj</code>                                                                                                                                                                                                                         | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.getFunctionSpecification(modeName)</code> .                 |
|                         | <code>fcnType</code>                                                                                                                                                                                                                     | Optional. String specifying which function to preview. Valid strings are 'step' and 'init'. If <code>fcnType</code> is not specified, previews the step function. |
| <b>Output Arguments</b> | <code>preview</code>                                                                                                                                                                                                                     | String specifying the function prototype for the step or initialization function.                                                                                 |
| <b>Alternatives</b>     | Use the <b>Step function preview</b> subpane in the Model Interface dialog box to preview how your step function prototype is interpreted in generated code. See “Model Specific C Prototypes View” in the Embedded Coder documentation. |                                                                                                                                                                   |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                                                                           |                                                                                                                                                                   |

# cgv.Config.getReportData

---

**Purpose** Return results of comparing configuration parameter values

**Syntax** `rpt_data = cfgObj.getReportData()`

**Description** `rpt_data = cfgObj.getReportData()` compares the original configuration parameter values with the values that the object recommends. `cfgObj` is a handle to a `cgv.Config` object. Returns a cell array of strings with the model, parameter, previous value, and recommended or new value.

**How To**

- “Verify Numerical Equivalence with CGV”

**Purpose** Display list of signal names to command line

**Syntax** `signal_list = cgVObj.getSavedSignals(simulation_data)`

**Description** `signal_list = cgVObj.getSavedSignals(simulation_data)` returns a cell array, `signal_list`, of the output signal names of the data elements from the input data set, `simulation_data`. `simulation_data` is the output data stored in the CGV object, `cgVObj`, when you execute the model.

- Tips**
- After executing your model, use the `cgv.CGV.getOutputData` function to get the output data used as the input argument to the `cgVObj.getSavedSignals` function.
  - Use names from the output signal list at the command line or as input arguments to other CGV functions, for example, `cgv.CGV.createToleranceFile`, `cgv.CGV.compare`, and `cgv.CGV.plot`.

- How To**
- “Verify Numerical Equivalence with CGV”

# Number

---

**Purpose** Get number that uniquely identifies profiled code section

**Syntax** `SectionNumber = NthSectionProfile.Number`

**Description** `SectionNumber = NthSectionProfile.Number` returns a number that uniquely identifies the profiled code section, for example, in the code execution profiling report.

`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** **`SectionNumber`**  
Number of profiled code section

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Name` | `NumCalls` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `ExecutionTimeInTicks` | `MaximumExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `MaximumSelfTimeInTicks` | `TotalSelfTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `MaximumTurnaroundTimeCallNum` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”



|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get array of <code>coder.profile.ExecutionTimeSection</code> objects for profiled code sections                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Syntax</b>           | <pre><i>NthSectionProfile</i> = <i>myExecutionProfile</i>.Sections(<i>N</i>) <i>No_of_Sections</i> = length(<i>myExecutionProfile</i>.Sections)</pre>                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>      | <p><i>NthSectionProfile</i> = <i>myExecutionProfile</i>.Sections(<i>N</i>) returns an <code>coder.profile.ExecutionTimeSection</code> object for the <i>N</i>th profiled code section.</p> <p><i>No_of_Sections</i> = length(<i>myExecutionProfile</i>.Sections) returns the number of code sections for which profiling data is available.</p> <p><i>myExecutionProfile</i> is a workspace variable generated by a simulation.</p> <p>Use <code>coder.profile.ExecutionTimeSection</code> methods to extract profiling information from the returned object.</p> |
| <b>Input Arguments</b>  | <p><i>N</i></p> <p>Index of code section for which profiling data is required</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Output Arguments</b> | <p><i>NthSectionProfile</i></p> <p><code>coder.profile.ExecutionTimeSection</code> object that contains profiling information</p> <p><i>No_of_Sections</i></p> <p>Number of code sections with profiling data</p>                                                                                                                                                                                                                                                                                                                                                 |
| <b>See Also</b>         | <p>TimerTicksPerSecond   display   report   Name   Number   NumCalls<br/>   MaximumExecutionTimeCallNum   MaximumSelfTimeCallNum<br/>   ExecutionTimeInTicks   MaximumExecutionTimeInTicks<br/>   TotalExecutionTimeInTicks   SelfTimeInTicks  <br/> MaximumSelfTimeInTicks   TotalSelfTimeInTicks  <br/> MaximumTurnaroundTimeInTicks   MaximumTurnaroundTimeCallNum  <br/> TurnaroundTimeInTicks   TotalTurnaroundTimeInTicks</p>                                                                                                                               |

# Sections

---

## **How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”

# arxml.importer.getSensorActuatorComponentNames

---

**Purpose** Get list of sensor/actuator software component names

**Syntax** `sensoractuatorSoftwareComponentNames = importerObj.getSensorActuatorComponentNames`

**Description** `sensoractuatorSoftwareComponentNames = importerObj.getSensorActuatorComponentNames` returns the names of sensor/actuator software component names found in the XML files associated with `importerObj`, an `arxml.importer` object.

**Output Arguments**

|                                                   |                                                                                                                                                                                                       |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>sensoractuatorSoftwareComponentNames</code> | Cell array of strings. Each element is absolute short-name path of corresponding sensor/actuator software component:<br><br><code>'/root_package_name[/sub_package_name]/component_short_name'</code> |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**See Also** `arxml.importer.getApplicationComponentNames` | `arxml.importer.getComponentNames`

**How To** • “Import AUTOSAR Software Component”

# cgv.CGV.getStatus

---

**Purpose** Return execution status

**Syntax**  
`status = cgvObj.getStatus()`  
`status = cgvObj.getStatus(inputName)`

**Description**  
`status = cgvObj.getStatus()` returns the execution status of *cgvObj*. *cgvObj* is a handle to a *cgv.CGV* object.  
`status = cgvObj.getStatus(inputName)` returns the status of a single execution for *inputName*.

**Input Arguments**  
**inputName**  
*inputName* is a unique numeric or character identifier associated with input data, which is added to the *cgv.CGV* object using *cgv.CGV.addInputData*.

**Output Arguments**  
**status**  
If *inputName* is provided, *status* is the result of the execution of input data associated with *inputName*.

| Value     | Description                                                                                                          |
|-----------|----------------------------------------------------------------------------------------------------------------------|
| none      | Execution has not run.                                                                                               |
| pending   | Execution is currently running.                                                                                      |
| completed | Execution ran to completion without errors and output data is available.                                             |
| passed    | Baseline data was provided. Execution ran to completion and comparison to the baseline data returned no differences. |

| Value  | Description                                                                                                        |
|--------|--------------------------------------------------------------------------------------------------------------------|
| error  | Execution produced an error.                                                                                       |
| failed | Baseline data was provided. Execution ran to completion and comparison to the baseline data returned a difference. |

If `inputName` is not provided, the following pseudocode describes the return status:

```
if (all executions return 'passed')
 status = 'passed'
else if (all executions return 'passed' or 'completed')
 status = 'completed'
else if (an execution returns 'error')
 status = 'error'
else if (an execution returns 'failed')
 status = 'failed'
else if (an execution returns 'none' or 'pending')
 status = 'none'
```

## See Also

[cgv.CGV.addInputData](#) | [cgv.CGV.run](#) | [cgv.CGV.addBaseline](#)

## How To

- “Verify Numerical Equivalence with CGV”

# RTW.ModelCPPClass.getStepMethodName

---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                           |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get step method name from model-specific C++ class interface                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                           |
| <b>Syntax</b>           | <code>fcnName = getStepMethodName(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                           |
| <b>Description</b>      | <code>fcnName = getStepMethodName(obj)</code> gets the name of the step method described by the specified model-specific C++ class interface.                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                           |
| <b>Input Arguments</b>  | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <i>fcnName</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A string specifying the name of the step method described by the specified model-specific C++ class interface.                                                            |
| <b>Alternatives</b>     | To view the step method name in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, which displays the step method name and allows you to display and configure the step method for your model class. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation. |                                                                                                                                                                           |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li><li>• “C++ Class Interface Control”</li></ul>                                                                                                                                                                                                                                                                                         |                                                                                                                                                                           |

**Purpose** Create code replacement argument based on specified name and built-in data type

**Syntax** `arg = getTflArgFromString(hTable, name, datatype)`

**Input Arguments**

*hTable*

Handle to a code replacement table previously returned by *hTable* = RTW.TflTable.

*name*

String specifying the name to use for the code replacement argument, for example, 'y1'.

*datatype*

String specifying a built-in data type or a fixed-point data type to use for the code replacement argument:

- Valid built-in data types are 'integer', 'int8', 'int16', 'int32', 'long', 'long\_long', 'uinteger', 'uint8', 'uint16', 'uint32', 'ulong', 'ulong\_long', 'single', 'double', 'boolean', and 'logical'.
- You can specify fixed-point data types using the `fixdt` function from Fixed-Point Designer™ software; for example, 'fixdt(1,16,2)'.

**Output Arguments**

Handle to the created code replacement argument, which can be specified to the `addConceptualArg` function. See the example below.

**Description**

The `getTflArgFromString` function creates a code replacement argument that is based on a specified name and built-in data type.

---

**Note** The `IOType` property of the created argument defaults to 'RTW\_IO\_INPUT', indicating an input argument. For an output argument, you must change the `IOType` value to 'RTW\_IO\_OUTPUT' by directly assigning the argument property. See the example below.

---

# getTflArgFromString

---

## Examples

In the following example, `getTflArgFromString` is used to create an `int16` output argument named `y1`, which is then added as a conceptual argument for a code replacement table entry.

```
hLib = RTW.TflTable;
op_entry = RTW.TflCOperationEntry;
.
.
.
arg = hLib.getTflArgFromString('y1', 'int16');
arg.IOType = 'RTW_IO_OUTPUT';
op_entry.addConceptualArg(arg);
```

## See Also

`addConceptualArg`

## How To

- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”



|                         |                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Create code replacement DWork argument for semaphore entry based on specified name and data type                                                                                                                                                                                                                                                                                                   |
| <b>Syntax</b>           | <code>arg = getTf1DWorkFromString(hTable, name, datatype)</code>                                                                                                                                                                                                                                                                                                                                   |
| <b>Input Arguments</b>  | <p><i>hTable</i><br/>Handle to a code replacement table previously returned by <i>hTable</i> = RTW.Tf1Table.</p> <p><i>name</i><br/>String specifying the name to use for the code replacement DWork argument, for example, 'd1'.</p> <p><i>datatype</i><br/>String specifying a data type to use for the code replacement DWork argument. Currently, you must specify 'void*'. </p>               |
| <b>Output Arguments</b> | Handle to the created code replacement argument, which can be specified to the addDWorkArg function. See the example below.                                                                                                                                                                                                                                                                        |
| <b>Description</b>      | The getTf1DWorkFromString function creates a code replacement DWork argument, based on a specified name and data type, for a semaphore entry in a code replacement table.                                                                                                                                                                                                                          |
| <b>Examples</b>         | <p>In the following example, getTf1DworkFromString is used to create a void* argument named d1. The argument is then added as a DWork argument for a semaphore entry in a code replacement table.</p> <pre>hLib = RTW.Tf1Table;<br/>sem_entry = RTW.Tf1CSemaphoreEntry;<br/>. . .<br/>% DWork Arg<br/><br/>arg = hLib.getTf1DWorkFromString('d1','void*');<br/>sem_entry.addDWorkArg( arg );</pre> |

# getTfIDWorkFromString

---

```
.
. .
hLib.addEntry(sem_entry);
```

## See Also

addDWorkArg

## How To

- “Map Semaphore or Mutex Operations to Application Implementations”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get simulation time for code section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Syntax</b>           | <code>SimTime = NthSectionProfile.Time</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>      | <code>SimTime = NthSectionProfile.Time</code> returns a simulation time vector that corresponds to the execution time measurements for the code section.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Input Arguments</b>  | <b>NthSectionProfile - coder.profile.ExecutionTimeSection</b><br>object<br><br>Object generated by the <code>coder.profile.ExecutionTime</code> property Sections.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Output Arguments</b> | <b>SimTime - Simulation time</b><br>double<br><br>Simulation time, in seconds, for section of code. Returned as a vector.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Examples</b>         | <b>Get Simulation Time for Code Section</b><br><br>Run a simulation with a model that is configured to generate a workspace variable with execution time measurements.<br><br><pre>rtwdemo_sil_topmodel;<br/>set_param('rtwdemo_sil_topmodel',...<br/>          'CodeExecutionProfiling', 'on');<br/>set_param('rtwdemo_sil_topmodel',...<br/>          'SimulationMode', 'software-in-the-loop (SIL)');<br/>set_param('rtwdemo_sil_topmodel',...<br/>          'CodeProfilingInstrumentation', 'on');<br/>set_param('rtwdemo_sil_topmodel',...<br/>          'CodeProfilingSaveOptions', 'AllData');<br/>sim('rtwdemo_sil_topmodel');</pre><br>The simulation generates the workspace variable <code>executionProfile</code> (default). |

# Time

---

At the end of the simulation, get profile for the seventh code section.

```
SeventhSectionProfile = executionProfile.Sections(7);
```

Get vector representing simulation time for code section.

```
simulation_time_vector = SeventhSectionProfile.Time;
```

## See Also

[Sections](#) | [ExecutionTimeInTicks](#) | [ExecutionTimeInSeconds](#)

## Concepts

- “Configure Code Execution Profiling for SIL and PIL”
- “Analyze Code Execution Data”

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Display invocations of code sections over execution timeline                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Syntax</b>          | <code>executionProfile.timeline</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>     | <code>executionProfile.timeline</code> displays invocations of each profiled code section over the execution timeline.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Input Arguments</b> | <p><b>executionProfile</b> - <code>coder.profile.ExecutionTime</code> object</p> <p>When you run a simulation with code execution profiling, the software generates <code>executionProfile</code> as a workspace variable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Examples</b>        | <p><b>Display Code Section Invocations</b></p> <p>Run a simulation with a model that is configured to generate a workspace variable with execution time measurements.</p> <pre>rtwdemo_sil_topmodel; set_param('rtwdemo_sil_topmodel',...           'CodeExecutionProfiling', 'on'); set_param('rtwdemo_sil_topmodel',...           'SimulationMode', 'software-in-the-loop (SIL)'); set_param('rtwdemo_sil_topmodel',...           'CodeProfilingInstrumentation', 'on'); set_param('rtwdemo_sil_topmodel',...           'CodeProfilingSaveOptions', 'AllData'); sim('rtwdemo_sil_topmodel');</pre> <p>The simulation generates the workspace variable <code>executionProfile</code> (default).</p> <p>At the end of the simulation, open a code execution report.</p> <pre>executionProfile.report</pre> <p>Under <b>Profiled Sections of Code</b>, in the <b>Model</b> column, expand all nodes. You see profile information for eight code sections. For example,</p> |

# timeline

the task `rtwdemo_sil_topmodel_step` and functions `CounterTypeA` and `CounterTypeB`.

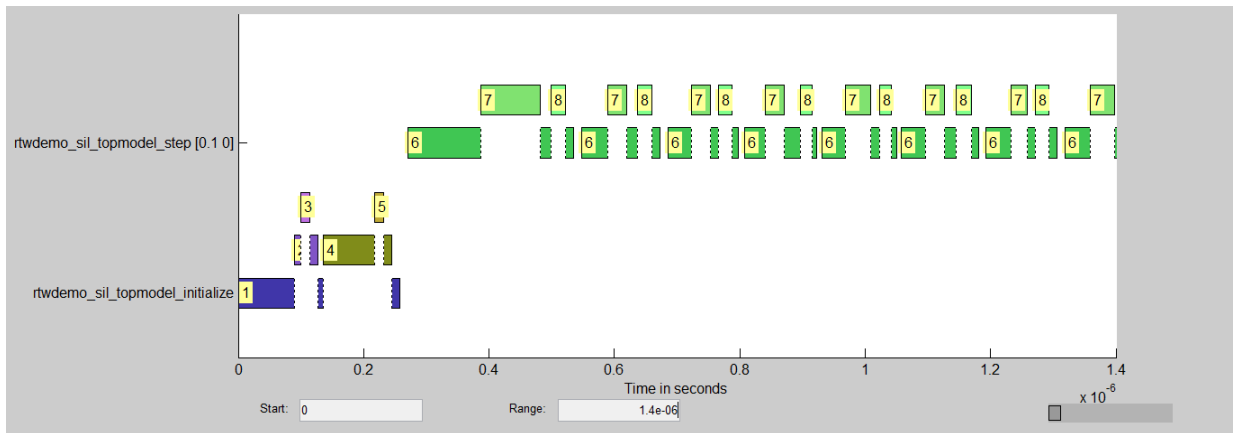
## 2. Profiled Sections of Code

| Model                                                   | Maximum Execution Time | Average Execution Time | Maximum Self Time | Average Self Time | Calls |  |
|---------------------------------------------------------|------------------------|------------------------|-------------------|-------------------|-------|--|
| [ - ] <a href="#">rtwdemo_sil_topmodel_initialize</a>   | 257                    | 257                    | 111               | 111               | 1     |  |
| [ - ] <a href="#">CounterTypeA</a>                      | 38                     | 38                     | 23                | 23                | 1     |  |
| <a href="#">CounterTypeA</a>                            | 15                     | 15                     | 15                | 15                | 1     |  |
| [ - ] <a href="#">CounterTypeB</a>                      | 109                    | 109                    | 94                | 94                | 1     |  |
| <a href="#">CounterTypeB</a>                            | 15                     | 15                     | 15                | 15                | 1     |  |
| [ - ] <a href="#">rtwdemo_sil_topmodel_step [0.1 0]</a> | 265                    | 121                    | 147               | 61                | 101   |  |
| <a href="#">CounterTypeA</a>                            | 94                     | 36                     | 94                | 36                | 101   |  |
| <a href="#">CounterTypeB</a>                            | 37                     | 24                     | 37                | 24                | 101   |  |


Display code section invocations.

```
executionProfile.timeline
```

In the Execution Profile window, you see numbered horizontal bars that represent invocations of the code sections.



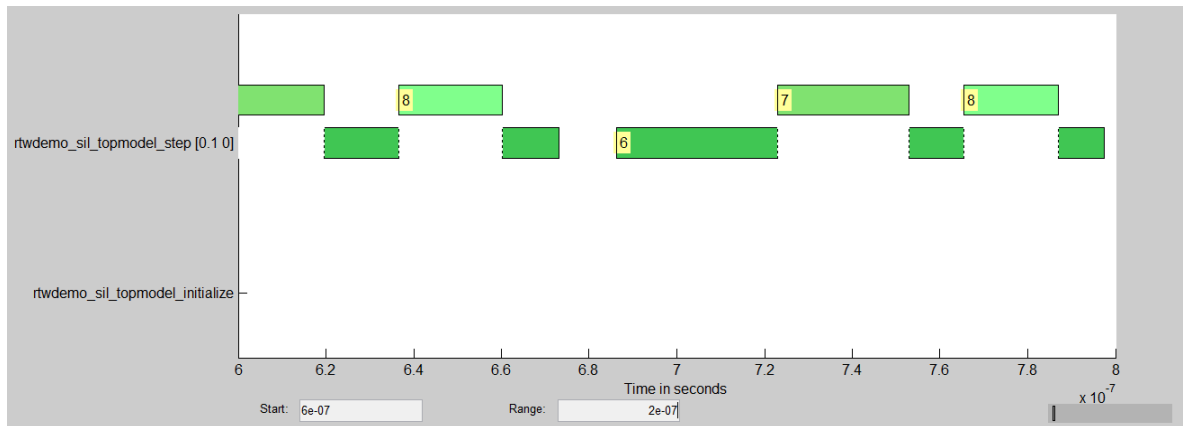
For example, the blue bars show when the first section, `rtwdemo_sil_topmodel_initialize`, is invoked.

To see the first code section, in the first row of the Code Execution Profiling Report, click the icon .

The Code Generation Report displays the function call.

```
64 PROFILE_START_TASK_SECTION(10);
65 rtwdemo_sil_topmodel_initialize();
66 PROFILE_END_TASK_SECTION(10);
```

To see what code sections are invoked over a specific time period, use the **Start** and **Range** fields of the Execution Profile window. For example, in the **Start** and **Range** fields, enter `6e-07` and `2e-07` respectively. Then press **Enter**.



Between  $0.6 \mu\text{s}$  and  $0.8 \mu\text{s}$ , you see that the task `rtwdemo_sil_topmodel_step` (code section 6) and the functions `CounterTypeA` (code section 7) and `CounterTypeB` (code section 8) are invoked.

On the bottom right of the Execution Profile window, the indicator shows what portion of the execution timeline is being displayed.

# timeline

---

**See Also** report

- Concepts**
- “Configure Code Execution Profiling for SIL and PIL”
  - “View and Compare Code Execution Times”



**Purpose** Get and set number of timer ticks per second

**Syntax** `TimerTicksOneSecond = myExecutionProfile.TimerTicksPerSecond`  
`myExecutionProfile.TimerTicksPerSecond(TimerTicksOneSec)`

**Description** `TimerTicksOneSecond = myExecutionProfile.TimerTicksPerSecond` returns the number of timer ticks per second. For example, if the timer runs at 1 MHz, then the number of ticks per second is  $10^6$ .  
`myExecutionProfile.TimerTicksPerSecond(TimerTicksOneSec)` sets the number of timer ticks per second. Use this method if the “Create a Connectivity Configuration for a Target” does not specify this value.  
`myExecutionProfile` is a workspace variable generated by a simulation.

---

**Tip** You can calculate the execution time in seconds using the formula  $ExecutionTimeInSecs = ExecutionTimeInTicks / TimerTicksPerSecond$ .

---

**Input Arguments** `TimerTicksOneSec`  
Number of timer ticks per second

**Output Arguments** `TimerTicksOneSecond`  
Number of timer ticks per second

**See Also** Sections | display | report | Name | Number | NumCalls | MaximumExecutionTimeCallNum | MaximumSelfTimeCallNum | ExecutionTimeInTicks | MaximumExecutionTimeInTicks | TotalExecutionTimeInTicks | SelfTimeInTicks | MaximumSelfTimeInTicks | TotalSelfTimeInTicks | MaximumTurnaroundTimeInTicks | MaximumTurnaroundTimeCallNum | TurnaroundTimeInTicks | TotalTurnaroundTimeInTicks

# TimerTicksPerSecond

---

## How To

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”

# coder.MATLABCodeTemplate.getTokenValue

|                         |                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get value of token                                                                                                                                                                                                                                                                                                                                                             |
| <b>Syntax</b>           | <code>tokenValue = getTokenValue(tokenName)</code>                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>      | <code>tokenValue = getTokenValue(tokenName)</code> returns the value of the specified token.                                                                                                                                                                                                                                                                                   |
| <b>Input Arguments</b>  | <b>tokenName</b><br>Name of token<br><br><b>Default:</b> empty                                                                                                                                                                                                                                                                                                                 |
| <b>Output Arguments</b> | <b>tokenValue - Token value</b><br>string<br><br>The current value of <code>tokenName</code> , returned as a string.                                                                                                                                                                                                                                                           |
| <b>Examples</b>         | Create a <code>MATLABCodeTemplate</code> object with the default template, then get the value for a token.<br><br><pre>newObj = coder.MATLABCodeTemplate;<br/>% Creates a MATLABCodeTemplate object from the default template<br/>newObj.getCurrentTokens()<br/>% Get list of current tokens<br/>newObj.getTokenValue('MATLABCoderVersion')<br/>% Check value of a token</pre> |
| <b>See Also</b>         | <code>coder.MATLABCodeTemplate.setTokenValue</code>  <br><code>coder.MATLABCodeTemplate.getCurrentTokens</code>  <br><code>coder.MATLABCodeTemplate.emitSection</code>                                                                                                                                                                                                         |
| <b>Related Examples</b> | <ul style="list-style-type: none"><li>“Generate Custom File and Function Banners for C and C++ Code”</li></ul>                                                                                                                                                                                                                                                                 |
| <b>Concepts</b>         | <ul style="list-style-type: none"><li>“Code Generation Template (CGT) Files for MATLAB”</li></ul>                                                                                                                                                                                                                                                                              |

# ghsmulti

---

**Purpose** Create handle object to interact with MULTI IDE

**Syntax**

```
IDE_Obj = ghsmulti
IDE_Obj=ghsmulti('propertyname1',propertyvalue1,'propertyname2',...
propertyvalue2,'timeout',value)
```

---

**Note** The output object name you provide for ghsmulti cannot begin with an underscore, such as `_IDE_Obj`.

---

**IDEs** This function supports the following IDEs:

- Green Hills MULTI

**Description** `IDE_Obj = ghsmulti` returns object `IDE_Obj` that communicates with a target processor. Before you use this command for the first time, use `ghsmulticonfig` to configure your MULTI software installation to identify the location of your MULTI software, your processor configuration, your debug server, and the host name and port number of the service.

`ghsmulti` creates an interface between MATLAB and Green Hills MULTI.

The first time you use `ghsmulti`, supply the properties and property values shown in following table as input arguments.

| Property Name | Default Value | Description                                                                                                                                                                  |
|---------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| hostname      | localhost     | Specifies the name of the machine hosting the service. The default host name indicates that the service is on the local PC. Replace <code>localhost</code> with the name you |

| Property Name | Default Value | Description                                                                                                                                                                        |
|---------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |               | entered as the <b>Host name</b> when you ran <code>ghsmulticonfig</code> .                                                                                                         |
| portnum       | 4444          | Specifies the port to connect to the service on the host machine. Replace portnum with the number you entered as the <b>Port number</b> when you ran <code>ghsmulticonfig</code> . |

When you invoke `ghsmulti`, it starts a service on your localhost. If you selected the **Show server status window** option when you ran `ghsmulticonfig`, the service appears in your Microsoft® Windows® task bar. If you clear **Show server status window**, the service does not appear.

Parameters that you pass as input arguments to `ghsmulti` are interpreted as object property definitions. Each property definition consists of a property name followed by the desired property value (often called a *PV*, or *property name/property value*, pair).

```
IDE_Obj =
ghsmulti('hostname', 'name', 'portnum', 'number', ...) returns a
ghsmulti object IDE_Obj that you use to interact with a processor in
the IDE from the MATLAB command prompt. If you enter a hostname
or portnum that are not the same as the ones you provided when
you configured your MULTI installation, the software returns
an error that it could not connect to the specified host and
port and does not create the object.
```

You use the debugging methods with this object to access memory and control the execution of the processor. `ghsmulti` also enables you to create an array of objects for a multiprocessor board, where each object refers to one processor on the board. When `IDE_Obj` is an array of objects, a method called with `IDE_Obj` as an input argument is sent sequentially to the processors connected to the `ghsmulti` object. Green Hills MULTI provides the communication between the IDE and the processor.

After you build the `ghsmulti` object `IDE_Obj`, you can review the object property values with `get`, but you cannot modify the `hostname` and `portnum` property values. You can use `set` to change the value of other properties.

`IDE_Obj=ghsmulti('propertyname1',propertyvalue1,'propertyname2',...propertyvalue2,'timeout',value)` sets the global time-out value in seconds to `value` in `IDE_Obj`. MATLAB waits for the specified time-out period to get a response from the IDE application. If the IDE does not respond within the allotted time-out period, MATLAB exits from the evaluation of this function.

## Examples

This example shows how to use `ghsmulti` with default values.

```
IDE_Obj = ghsmulti('hostname','localhost','portnum',4444);
```

returns a handle to the default host and port number—`localhost` and `4444`.

```
IDE_Obj = ghsmulti('hostname','localhost','portnum',4444)
```

MULTI Object:

```
Host Name : localhost
Port Num : 4444
Default timeout : 10.00 secs
MULTI Dir : C:\ghs\multi500\ppc\
```

## See Also

`ghsmulticonfig`

**Purpose** Configure coder product to interact with MULTI IDE

**Syntax** ghsmulticonfig

**IDEs** This function supports the following IDEs:

- Green Hills MULTI

**Description** ghsmulticonfig launches the **IDE Link Configuration for Green Hills MULTI** dialog to specify information about MULTI.

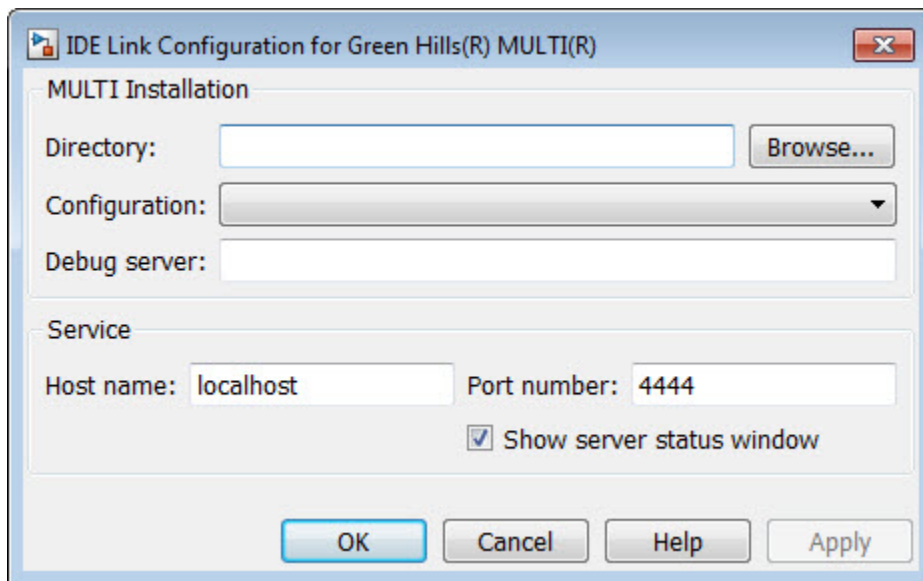
Use this dialog after installing support for Green Hills MULTI, as described in “Install Support for Green Hills MULTI IDE”.

---

**Note** The configuration dialog box is the only place you set the host name and port number configuration.

---

Enter values for each of parameters in the dialog box.



## Directory

Enter the full path to your Green Hills MULTI executable, `multi.exe`. To search for the executable file, click **Browse**.

If you do not provide the path to the executable file, the software returns an error message that it could not find `multi.exe` in the specified folder.

## Configuration

Select the primary processor family for which you develop projects in MULTI. This corresponds to a `.tgt` file you select before you can download and execute code. Select your family file from the list. In many cases, the `family_standalone.tgt` option is the best choice. For example, if you develop on the MPC7400, you could select `ppc_standalone.tgt`. The software stores your selection.

If you change processors, use `ghsmultisetup` to change this setting.



**Debug server**

Enter the name of your debug connection. The software uses this connection to specify options about the processor, such as processor to use, board support library, and processor endianness. For more information about the Debug server, refer to your Green Hills MULTI documentation.

For example, if you are using the Freescale MPC7448 simulator, you could enter the string `simppc -cpu=ppc7448 -dec -rom_use_entry`. Valid strings for specifying simulators in **Debug server** appear in the following table.

| Processor    | Type             | Configuration       | Debug Server Parameter String                                                |
|--------------|------------------|---------------------|------------------------------------------------------------------------------|
| ARM          | Simulator        | arm_standalone.tgt  | simarm -cpu=arm9                                                             |
| MPC7400      | Simulator        | ppc_standalone.tgt  | simppc -cpu=7400 -dec                                                        |
| BlackFin 537 | Simulator        | bf_standalone.tgt   | simbf -cpu=bf537 -fast                                                       |
| Renesas V850 | Simulator        | v800_standalone.tgt | sim850 -cpu=v850                                                             |
| Renesas V850 | Renesas Minicube | v800_standalone.tgt | 850eserv2 -minicube -noiop -df=C:/ghs/multi505/v850e/df3707.800 -id ffffffff |

For information about using hardware in your development work, refer to *Connecting to Your Target* in the MULTI documentation. The string you specify for **Debug server** can be the name of the connection if you have one configured in the Connection Organizer in MULTI IDE.

**Host name**

Specify the name of the machine that runs the service. Enter `localhost` if the service runs on your PC. `localhost` is the only supported host name.

**Port number**

Specify the port the service uses to communicate with MULTI. The default port number is 4444. If you change the port value, verify that the port is available for use. If the port you assign is not available, the software returns an error when you try to create a `ghsmulti` object.

**Show server status window**

Select this option to display the service status in the Microsoft Windows Task bar. Clearing the option removes the service from the task bar. Best practice is to select this option. Keeping this option selected enables the software to shut down the communication services for Green Hills MULTI completely.

**Purpose**

Halt program execution by processor

**Syntax**

```
IDE_Obj.halt
IDE_Obj.halt(timeout)
```

**IDEs**

This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description**

*IDE\_Obj*.halt stops the program running on the processor. After you issue this command, MATLAB waits for a response from the processor that the processor has stopped. By default, the wait time is 10 seconds. If 10 seconds elapses before the response arrives, MATLAB returns an error. In this syntax, the timeout period defaults to the global timeout period specified in *IDE\_Obj*. Use *IDE\_Obj*.get to determine the global timeout period. However, the processor usually stops in spite of the error message.

To resume processing after you halt the processor, use *run*. Also, the *IDE\_Obj*.read('pc') function can determine the memory address where the processor stopped after you use *halt*.

*IDE\_Obj*.halt(timeout) immediately stops program execution by the processor. After the processor stops, *halt* returns to the host. *timeout* defines, in seconds, how long the host waits for the processor to stop running. If the processor does not stop within the specified timeout period, the routine returns with a timeout error.

**Examples**

Use one of the provided example programs to show how *halt* works. Load and run one of the example projects. At the MATLAB prompt, check whether the program is running on the processor.

```
IDE_Obj.isrunning
```

# halt

---

```
ans =

 1

IDE_Obj.isrunning % Alternate syntax for checking the run status.

ans =

 1
IDE_Obj.halt % Stop the running application on the processor.
IDE_Obj.isrunning

ans =

 0
```

Issuing the halt stops the process on the processor. Checking in the IDE confirms that the process has stopped.

## See Also

`isrunning` | `reset` | `run`

**Purpose**

Information about processor

**Syntax**

```
adf=IDE_Obj.info
adf = IDE_Obj.info
adf = info(rx)
adf = IDE_Obj.info
adf = info(rx)
```

**IDEs**

This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description**

`adf=IDE_Obj.info` returns debugger or processor properties associated with the IDE handle object, `IDE_Obj`.

**Using info with Multiprocessor Boards**

For multiprocessor targets, the `info` method returns properties for each processor with the array.

**Examples**

Using `info` with `IDE_Obj`, which is associated with 1 processor:

```
oinfo = IDE_Obj.info;
```

Using `info` with `IDE_Obj`, which is associated with 2 processors:

```
oinfo = IDE_Obj.info; % Returns a 1x2 array of infor struct
```

**Using info with MULTI IDE**

Before using `info`, open a program in the MULTI IDE debugger. When you use `info` with an IDE handle object for the MULTI IDE, the `info` method returns the following information.

| <b>Structure Element</b> | <b>Data Type</b> | <b>Description</b>                                                                                                                      |
|--------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| adf.CurBrkPt             | String           | When the debugger is stopped at a breakpoint, the field reports the index of the breakpoint. Otherwise, this value is -1.               |
| adf.File                 | String           | Name of the current file shown in the debugger source pane.                                                                             |
| adf.Line                 | Integer          | Line number of the cursor position in the file in the debugger source pane. If a file is not open in the source pane, this value is -1. |
| adf.MultiDir             | String           | Full path to your IDE installation the root folder).<br>For example<br>'C:\ghs5_01'                                                     |
| adf.PID                  | Double           | Process ID from the debug server in the IDE.                                                                                            |
| adf.Procedure            | String           | Current procedure in the debugger source pane.                                                                                          |
| adf.Process              | Double           | Program number, defined by the IDE, of the current program.                                                                             |
| adf.Remote               | String           | Status of the remote connection, either <b>Connected</b> or <b>Not connected</b> .                                                      |
| adf.Selection            | String           | The string highlighted in the debugger. If a string is not highlighted, this value is 'null'.                                           |

| Structure Element | Data Type | Description                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| adf.State         | String    | <p>State of the loaded program. The possible reported states appear in the following list:</p> <ul style="list-style-type: none"> <li>• About to resume</li> <li>• Dying</li> <li>• Just executed</li> <li>• Just forked</li> <li>• No child</li> <li>• Running</li> <li>• Stopped</li> <li>• Zombied</li> </ul> <p>For details about the states and their definitions, refer to your IDE debugger documentation.</p> |
| adf.Target        | Double    | Unique identifier the indicates the processor family and variant.                                                                                                                                                                                                                                                                                                                                                     |
| adf.TargetOS      | Double    | Real-time operating system on the processor if one exists. Provides both the major and minor revision information.                                                                                                                                                                                                                                                                                                    |
| adf.TargetSeries  | Double    | Whether the processor belongs to a series of processors. For details about the processor series, refer to your IDE debugger documentation.                                                                                                                                                                                                                                                                            |

`info` returns valid information when the IDE debugger is connected to processor hardware or a simulator.

### Examples

On a PC with a simulator configured in the IDE, `info` returns the following configuration information after stopping a running simulation:

```
adf=info(test_obj1)
```

```
adf =

 CurBrkPt: 0
 File: '...\Compute_Sum_and_Diff_multilink\Compute_Sum_and_Diff_main.c'
 Line: 3
 MultiDir: 'C:\ghs5_01'
 PID: 2380
 Procedure: 'main'
 Process: 0
 Remote: 'Connected'
 Selection: '(null)'
 State: 'Stopped'
 Target: 4325392
 TargetOS: [2x1 double]
 TargetSeries: 3
```

When you create an IDE handle, the response from `info` looks like the following before you load a project.

```
adf=info(test_obj2)

test_obj2 =

 CurBrkPt: []
 File: []
 Line: []
 MultiDir: []
 PID: []
 Procedure: []
 Process: []
 Remote: []
 Selection: []
 State: []
 Target: []
 TargetOS: []
 TargetSeries: []
```



## Using info with CCS IDE

`adf = IDE_Obj.info` returns the property names and property values associated with the processor accessed by `IDE_Obj`. `adf` is a structure containing the following information elements and values.

| Structure Element            | Data Type | Description                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>adf.procname</code>    | String    | Processor name as defined in the CCS setup utility. In multiprocessor systems, this name reflects the specific processor associated with <code>IDE_Obj</code> .                                                                                                                                                                                                                                                 |
| <code>adf.isbigendian</code> | Boolean   | Value describing the byte ordering used by the processor. When the processor is big-endian, this value is 1. Little-endian processors return 0.                                                                                                                                                                                                                                                                 |
| <code>adf.family</code>      | Integer   | Three-digit integer that identifies the processor family, ranging from 000 to 999. For example, 320 for Texas Instruments digital signal processors.                                                                                                                                                                                                                                                            |
| <code>adf.subfamily</code>   | Decimal   | Decimal representation of the hexadecimal identification value that TI assigns to the processor to identify the processor subfamily. IDs range from 0x000 to 0x3822. Use <code>dec2hex</code> to convert the value in <code>adf.subfamily</code> to standard notation. For example<br><br><code>dec2hex(adf.subfamily)</code><br><br>produces '67' when the processor is a member of the 67xx processor family. |
| <code>adf.timeout</code>     | Integer   | Default timeout value MATLAB software uses when transferring data to and from CCS. Functions that use a timeout value have an optional <code>timeout</code> input argument. When you omit the optional argument, MATLAB software uses 10s as the default value.                                                                                                                                                 |

`adf = info(rx)` returns `info` as a cell array containing the names of your open RTDX channels.

## Examples

On a PC with a simulator configured in CCS IDE, `info` returns the configuration for the processor being simulated:

```
IDE_Obj.info

ans =

 procname: 'CPU'
 isbigendian: 0
 family: 320
 subfamily: 103
 timeout: 10
```

This example simulates the TMS320C62xx processor running in little-endian mode. When you use CCS Setup Utility to change the processor from little-endian to big-endian, `info` shows the change.

```
IDE_Obj.info

ans =

 procname: 'CPU'
 isbigendian: 1
 family: 320
 subfamily: 103
 timeout: 10
```

If you have two open channels, `chan1` and `chan2`,

```
adf = info(rx)

returns

adf =
'chan1'
'chan2'
```

where `adf` is a cell array. You can dereference the entries in `adf` to manipulate the channels. For example, you can close a channel by dereferencing the channel in `adf` in the `close` function syntax.

```
close(rx.adf{1,1})
```

### Using info with VisualDSP++ IDE

`adf = IDE_Obj.info` returns the property names and property values associated with the processor accessed by `IDE_Obj`. The `adf` variable is a structure containing the following information elements and values.

| Structure Element         | Data Type | Description                                                                                                                                                     |
|---------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>adf.procname</code> | String    | Processor name as defined in the CCS setup utility. In multiprocessor systems, this name reflects the specific processor associated with <code>IDE_Obj</code> . |
| <code>adf.proctype</code> | String    | String with the type of the DSP processor. The type property is the processor type like "ADSP-21065L" or "ADSP-2181".                                           |
| <code>adf.revision</code> | String    | String with the silicon revision string of the processor.                                                                                                       |

`adf = info(rx)` returns `info` as a cell array containing the names of your open RTDX channels.

### Examples

When you have an `adivdsp` object `IDE_Obj`, `info` provides information about the object:

```
IDE_Obj = adivdsp('sessionname','Testsession')
```

ADIVDSP Object:

```
Session name : Testsession
Processor name : ADSP-BF533
Processor type : ADSP-BF533
Processor number : 0
Default timeout : 10.00 secs
```

```
objinfo = IDE_Obj.info

objinfo =
 procname: 'ADSP-BF533'
 proctype: 'ADSP-BF533'
 revision: ''

objinfo.procname

ans =

ADSP-BF533
```

## See Also

```
dec2hex | get | set
```

**Purpose** Insert debug point in file

**Syntax** `IDE_Obj.insert(addr,type,timeout)`  
`IDE_Obj.insert(addr)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.insert(addr,type,timeout)` places a debug point at the provided address of the processor. The `IDE_Obj` handle defines the processor that will receive the new debug point. The debug point location is defined by `addr`, the desired memory address. The IDEs support several types of debug points. Refer to your IDE help documentation for information on their respective behavior. The following table shows which debug types each IDE supports.

|                      | <b>CCS IDE</b> | <b>MULTI</b> | <b>VisualDSP++</b> |
|----------------------|----------------|--------------|--------------------|
| 'break'<br>(default) | Yes            | Yes          | Yes                |
| 'watch'              |                | Yes          |                    |
| 'probe'              | Yes            |              |                    |

The `timeout` parameter defines how long to wait (in seconds) for the insert to complete. If this period is exceeded, the routine returns immediately with a timeout error. In general the action (insert) still occurs, but the timeout value gave insufficient time to verify the completion of the action.

`IDE_Obj.insert(addr)` same as the preceding example, except the `timeout` value defaults to the timeout property specified by the `IDE_Obj` object. Use `IDE_Obj.get('timeout')` to examine this default timeout value.

# insert

---

*IDE\_Obj.insert(file,line)* same as the preceding example, except the timeout value defaults to the timeout property specified by the *IDE\_Obj* object. Use *IDE\_Obj.get('timeout')* to examine this default timeout value.

## See Also

address | run

**Purpose** Determine whether RTDX link is enabled for communications

---

**Note** Support for `isenabled` on C5000 processors will be removed in a future version.

---

**Syntax** `isenabled(rx, 'channel')`  
`isenabled(rx)`

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `isenabled(rx, 'channel')` returns `ans=1` when the RTDX channel specified by string `'channel'` is enabled for read or write communications. When `'channel'` has not been enabled, `isenabled` returns `ans=0`.

`isenabled(rx)` returns `ans=1` when RTDX has been enabled, independent of a channel. When you have not enabled RTDX you get `ans=0` back.

### Important Requirements for Using `isenabled`

On the processor side, `isenabled` depends on RTDX to determine and report the RTDX status. Therefore the you must meet the following requirements to use `isenabled`.

- 1** The processor must be running a program when you query the RTDX interface.
- 2** You must enable the RTDX interface before you check the status of individual channels or the interface.
- 3** Your processor program must be polling periodically for `isenabled` to work.

# isenabled

---

---

**Note** For `isenabled` to return valid results, your processor must be running a loaded program. When the processor is not running, `isenabled` returns a status that may not represent the true state of the channels or RTDX.

---

## Examples

With a program loaded on your processor, you can determine whether RTDX channels are ready for use. Restart your program to be sure it is running. The processor must be running for `isenabled` and `enabled` to function. This example creates a `ticcs` object `IDE_Obj` to begin.

```
IDE_Obj.restart
IDE_Obj.run('run');
IDE_Obj.rtdx.enable('ichan');
IDE_Obj.rtdx.isenabled('ichan')
```

MATLAB software returns 1 indicating that your channel 'ichan' is enabled for RTDX communications. To determine the mode for the channel, use `IDE_Obj.rtdx` to display the properties of object `IDE_Obj.rtdx`.

## See Also

`clear` | `disable` | `enable`



**Purpose** Determine whether specified memory block can read MATLAB software

---

**Note** Support for `isreadable(rx, 'channel')` on C5000 processors will be removed in a future version.

---

**Syntax**

```
IDE_Obj.isreadable(address, 'datatype', count)
IDE_Obj.isreadable(address, 'datatype')
isreadable(rx, 'channel')
```

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.isreadable(address, 'datatype', count)` returns 1 if the processor referred to by `IDE_Obj` can read the memory block defined by the `address`, `count`, and `datatype` input arguments. When the processor cannot read a portion of the specified memory block, `isreadable` returns 0. You use the same memory block specification for this function as you use for the `read` function.

The data block being tested begins at the memory location defined by `address`. `count` determines the number of values to be read. `datatype` defines the format of data stored in the memory block. `isreadable` uses the `datatype` string to determine the number of bytes to read per stored value. For details about each input parameter, read the following descriptions.

`address` — `isreadable` uses `address` to define the beginning of the memory block to read. You provide values for `address` as either decimal or hexadecimal representations of a memory location in the processor. The full address at a memory location consists of two parts: the offset and the memory page, entered as a vector `[location, page]`, a string, or a decimal value.

When the processor has only one memory page, as is true for many digital signal processors, the page portion of the memory address is 0. By default, `ticcs` sets the page to 0 at creation if you omit the page

property as an input argument. For processors that have one memory page, setting the page value to 0 lets you specify memory locations in the processor using the memory location without the page value.

## Examples of Address Property Values

| Property Value | Address Type | Interpretation                                                          |
|----------------|--------------|-------------------------------------------------------------------------|
| '1F'           | String       | Location is 31 decimal on the page referred to by <i>IDE_Obj.page</i>   |
| 10             | Decimal      | Address is 10 decimal on the page referred to by <i>IDE_Obj.page</i>    |
| [18,1]         | Vector       | Address location 10 decimal on memory page 1 ( <i>IDE_Obj.page</i> = 1) |

To specify the address in hexadecimal format, enter the *address* property value as a string. `isreadable` interprets the string as the hexadecimal representation of the desired memory location. To convert the hex value to a decimal value, the function uses `hex2dec`. When you use the string option to enter the address as a hex value, you cannot specify the memory page. For string input, the memory page defaults to the page specified by *IDE\_Obj.page*.

*count* — A numeric scalar or vector that defines the number of *datatype* values to test for being readable. To produce parallel structure with `read`, *count* can be a vector to define multidimensional data blocks. This function tests a block of data whose size is the product of the dimensions of the input vector.

*datatype* — A string that represents a MATLAB software data type. The total memory block size is derived from the value of *count* and the *datatype* you specify. *datatype* determines how many bytes to check for each memory value. `isreadable` supports the following data types.

| <b>datatype String</b> | <b>Number of Bytes/Value</b> | <b>Description</b>                     |
|------------------------|------------------------------|----------------------------------------|
| 'double'               | 8                            | Double-precision floating point values |
| 'int8'                 | 1                            | Signed 8-bit integers                  |
| 'int16'                | 2                            | Signed 16-bit integers                 |
| 'int32'                | 4                            | Signed 32-bit integers                 |
| 'single'               | 4                            | Single-precision floating point data   |
| 'uint8'                | 1                            | Unsigned 8-bit integers                |
| 'uint16'               | 2                            | Unsigned 16-bit integers               |
| 'uint32'               | 4                            | Unsigned 32-bit integers               |

Like the `iswritable`, `write`, and `read` functions, `isreadable` checks for valid address values. Illegal address values would be an address space larger than the available space for the processor:

- $2^{32}$  for the C6xxx series
- $2^{16}$  for the C5xxx series

When the function identifies an illegal address, it returns an error message stating that the address values are out of range.

`IDE_Obj.isreadable(address, 'datatype')` returns 1 if the processor referred to by `IDE_Obj` can read the memory block defined by the `address`, and `datatype` input arguments. When the processor cannot read a portion of the specified memory block, `isreadable` returns 0. Notice that you use the same memory block specification for this function as you use for the `read` function. The data block being tested begins at the memory location defined by `address`. When you omit the `count` option, `count` defaults to one.

`isreadable(rx, 'channel')` returns a 1 when the RTDX channel specified by the string `channel`, associated with link `rx`, is configured for read operation. When `channel` is not configured for reading, `isreadable` returns 0.

# isreadable

---

Like the `iswritable`, `read`, and `write` functions, `isreadable` checks for valid address values. Illegal address values are address spaces larger than the available space for the processor:

- $2^{32}$  for the C6xxx series
- $2^{16}$  for the C5xxx series

When the function identifies an illegal address, it returns an error message stating that the address values are out of range.

---

**Note** `isreadable` relies on the memory map option in the IDE. If you did not define the memory map for the processor in the IDE, `isreadable` does not produce useful results. Refer to your Texas Instruments Code Composer Studio documentation for information on configuring memory maps.

---

## Examples

When you write scripts to run models in the MATLAB environment and the IDE, the `isreadable` function is very useful. Use `isreadable` to check that the channel from which you are reading is configured.

```
IDE_Obj = ticcs;
rx = IDE_Obj.rtdx;

% Define read and write channels to the processor linked by IDE_Obj.
open(rx, 'ichannel', 'r');s
open(rx, 'ochannel', 'w');
enable(rx, 'ochannel');
enable(rx, 'ichannel');

isreadable(rx, 'ochannel')
ans=
 0
isreadable(rx, 'ichannel')
ans=
 1
```

Now that your script knows that it can read from `ichannel`, it proceeds to read messages as required.

**See Also**

`hex2dec` | `iswritable` | `read`

# isrtdxcapable

---

**Purpose** Determine whether processor supports RTDX

---

**Note** Support for `isrtdxcapable` on C5000 processors will be removed in a future version.

---

**Syntax** `b=IDE_Obj.isrtdxcapable`

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `b=IDE_Obj.isrtdxcapable` returns `b=1` when the processor referenced by object `IDE_Obj` supports RTDX. When the processor does not support RTDX, `isrtdxcapable` returns `b=0`.

## Using isrtdxcapable with Multiprocessor Boards

When your board contains more than one processor, `isrtdxcapable` checks each processor on the processor, as defined by the `IDE_Obj` object, and returns the RTDX capability for each processor on the board. In the returned variable `b`, you find a vector that contains the information for each accessed processor.

**Examples** Create a link to your C6711 DSK. Test to see if the processor on the board supports RTDX.

```
IDE_Obj=ticcs; %Assumes you have one board and it is the C6711 DSK.
b=IDE_Obj.isrtdxcapable
b =
 1
```

**Purpose** Determine whether processor is executing process

**Syntax** `IDE_Obj.isrunning`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.isrunning` returns 1 when the processor is executing a program. When the processor is halted, `isrunning` returns 0.

**Examples** `isrunning` lets you determine whether the processor is running. After you load a program to the processor, use `isrunning` to verify that the program is running.

```
IDE_Obj.load('program.exe', 'program')
IDE_Obj.run
IDE_Obj.isrunning
```

```
ans =
```

```
 1
IDE_Obj.halt
IDE_Obj.isrunning
```

```
ans =
```

```
 0
```

**See Also** `halt` | `load` | `run`

# isVisible

---

**Purpose** Determine whether IDE appears on desktop

**Syntax** `IDE_Obj.isVisible`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.isVisible` returns 1 if the IDE is running on the desktop and the window is open. If the IDE is not running or is running in the background, this method returns 0.

**Examples** First use a constructor to create an IDE handle object and start the IDE. To determine if the IDE is visible:

```
IDE_Obj.isVisible #determine if the ide is visible
```

```
ans =
```

```
1
```

```
IDE_Obj.visible(0) #make the ide invisible
```

```
IDE_Obj.isVisible #determine if the ide is visible
```

```
ans =
```

```
0
```

Notice that the IDE is not visible on your desktop. Recall that MATLAB software did not open the IDE. When you close MATLAB software with the IDE in this invisible state, the IDE remains running in the background. To close it, perform either of the following tasks:

- Open MATLAB software. Create a link to the IDE. Use the new link to make the IDE visible. Close the IDE.
- Open Microsoft Windows Task Manager. Click **Processes**. Find and highlight `IDE_Obj_app.exe`. Click **End Task**.



**See Also**

info | visible

# iswritable

---

**Purpose** Determine whether MATLAB can write to specified memory block

---

**Note** Support for `iswritable(rx, 'channel')` on C5000 processors will be removed in a future version.

---

**Syntax**

```
IDE_Obj.iswritable(address, 'datatype', count)
IDE_Obj.iswritable(address, 'datatype')
iswritable(rx, 'channel')
```

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.iswritable(address, 'datatype', count)` returns 1 if MATLAB software can write to the memory block defined by the `address`, `count`, and `datatype` input arguments on the processor referred to by `IDE_Obj`. When the processor cannot write to a portion of the specified memory block, `iswritable` returns 0. You use the same memory block specification for this function as you use for the `write` function.

The data block being tested begins at the memory location defined by `address`. `count` determines the number of values to write. `datatype` defines the format of data stored in the memory block. `iswritable` uses the `datatype` parameter to determine the number of bytes to write per stored value. For details about each input parameter, read the following descriptions.

`address` — `iswritable` uses `address` to define the beginning of the memory block to write to. You provide values for `address` as either decimal or hexadecimal representations of a memory location in the processor. The full address at a memory location consists of two parts: the offset and the memory page, entered as a vector `[location, page]`, a string, or a decimal value. When the processor has only one memory page, as is true for many digital signal processors, the page portion

of the memory address is 0. By default, `ticcs` sets the page to 0 at creation if you omit the page property as an input argument.

For processors that have one memory page, setting the page value to 0 lets you specify memory locations in the processor using the memory location without the page value.

### Examples of Address Property Values

| Property Value | Address Type | Interpretation                                                                 |
|----------------|--------------|--------------------------------------------------------------------------------|
| 1F             | String       | Location is 31 decimal on the page referred to by <code>IDE_Obj.page</code>    |
| 10             | Decimal      | Address is 10 decimal on the page referred to by <code>IDE_Obj.page</code>     |
| [18,1]         | Vector       | Address location 10 decimal on memory page 1 ( <code>IDE_Obj.page = 1</code> ) |

To specify the address in hexadecimal format, enter the address property value as a string. `iswritable` interprets the string as the hexadecimal representation of the desired memory location. To convert the hex value to a decimal value, the function uses `hex2dec`. When you use the string option to enter the address as a hex value, you cannot specify the memory page. For string input, the memory page defaults to the page specified by `IDE_Obj.page`.

`count` — A numeric scalar or vector that defines the number of `datatype` values to test for being writable. To produce parallel structure with `write`, `count` can be a vector to define multidimensional data blocks. This function tests a block of data whose size is the total number of elements in matrix specified by the input vector. If `count` is the vector `[10 10 10]`, then:

```
IDE_Obj.iswritable(31,[10 10 10])
```

# iswritable

---

`iswritable` writes 1000 values (10\*10\*10) to the processor. For a two-dimensional matrix defined with `count` as

```
IDE_Obj.iswritable(31,[5 6])
```

`iswritable` writes 30 values to the processor.

`datatype` — a string that represents a MATLAB data type. The total memory block size is derived from the value of `count` and the specified `datatype`. `datatype` determines how many bytes to check for each memory value. `iswritable` supports the following data types.

| <b>datatype String</b> | <b>Description</b>                     |
|------------------------|----------------------------------------|
| 'double'               | Double-precision floating point values |
| 'int8'                 | Signed 8-bit integers                  |
| 'int16'                | Signed 16-bit integers                 |
| 'int32'                | Signed 32-bit integers                 |
| 'single'               | Single-precision floating point data   |
| 'uint8'                | Unsigned 8-bit integers                |
| 'uint16'               | Unsigned 16-bit integers               |
| 'uint32'               | Unsigned 32-bit integers               |

`IDE_Obj.iswritable(address, 'datatype')` returns 1 if the processor referred to by `IDE_Obj` can write to the memory block defined by the `address`, and `count` input arguments. When the processor cannot write a portion of the specified memory block, `iswritable` returns 0. Notice that you use the same memory block specification for this function as you use for the `write` function. The data block tested begins at the memory location defined by `address`. When you omit the `count` option, `count` defaults to one.

---

**Note** `iswritable` relies on the memory map option in the IDE. If you did not define the memory map for the processor in the IDE, this function does not produce useful results. Refer to your Texas Instruments Code Composer Studio documentation for information on configuring memory maps.

---

Like the `isreadable`, `read`, and `write` functions, `iswritable` checks for valid address values. Illegal address values would be an address space larger than the available space for the processor:

- $2^{32}$  for the C6xxx series
- $2^{16}$  for the C5xxx series

When the function identifies an illegal address, it returns an error message stating that the address values are out of range.

`iswritable(rx, 'channel')` returns a Boolean value signifying whether the RTDX channel specified by `channel` and `rx`, is configured for write operations.

## Examples

When you write scripts to run models in MATLAB software and the IDE, the `iswritable` function is very useful. Use `iswritable` to check that the channel to which you are writing to is indeed configured.

```
IDE_Obj = ticcs;
rx = IDE_Obj.rtdx;

% Define read and write channels to the processor linked by IDE_Obj.
open(rx, 'ichannel', 'r');
open(rx, 'ochannel', 'w');
enable(rx, 'ochannel');
enable(rx, 'ichannel');

iswritable(rx, 'ochannel')
ans=
1
```

# iswritable

---

```
iswritable(rx, 'ichannel')
ans=
0
```

Now that your script knows that it can write to 'ichannel', it proceeds to write messages as required.

## See Also

[hex2dec](#) | [isreadable](#) | [read](#)

**Purpose**

Information listings from IDE

**Syntax**

```
IDE_Obj.infolist = list('type')
IDE_Obj.infolist = list('type', typename)
```

**IDEs**

This function supports the following IDEs:

- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description****Using list with MULTI**

`infolist = IDE_Obj.list(type)` reads information about your the IDE project and returns it in *infolist*. Different types of information and return formats are possible depending on the input arguments you supply to the `list` function call.

---

**Note** `list` does not recognize or return information about variables that you declare in your code but that are not used or initialized.

---

The *type* argument specifies which information listing to return. To determine the information that `list` returns, use one of the entries in the following table.

| <b>type String</b> | <b>Description</b>                                         |
|--------------------|------------------------------------------------------------|
| <b>project</b>     | Return information about the current project in the IDE    |
| <b>variable</b>    | Return information about one or more embedded variables    |
| <b>function</b>    | Return details about one or more functions in your project |

`list` returns dynamic the IDE information that you can alter. Returned listings represent snapshots of the current the IDE configuration

# list

---

only. Be aware that earlier copies of `infolist` might contain stale information.

`infolist = IDE_Obj.list('project')` returns a vector of structures that contain project information in the format shown in the following table.

| <b>infolist Structure Element</b>        | <b>Description</b>                                                                                                                                                 |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>infolist(1).name</code>            | Project file name (with path).                                                                                                                                     |
| <code>infolist(1).primary</code>         | Configuration file used for the project. For more information, refer to <code>new</code> .                                                                         |
| <code>infolist(1).compileroptions</code> | Compiler options string for the project.                                                                                                                           |
| <code>infolist(1).srcfiles</code>        | Vector of structures that describes project source files. Each structure contains the name and path for each source file— <code>infolist(1).srcfiles.name</code> . |
| <code>infolist(1).type</code>            | Shows the project type, either <code>project</code> or <code>projlib</code> . For more information, refer to <code>new</code> .                                    |
| <code>infolist(2)....</code>             | ...                                                                                                                                                                |
| <code>infolist(n)....</code>             | ...                                                                                                                                                                |

`infolist = IDE_Obj.list('variable')` returns a structure of structures that contains information on the local variables within scope. The list also includes information on the global variables. If a local variable has the same symbol name as a global variable, `list` returns the local variable information.

`infolist = IDE_Obj.list('variable',varname)` returns information about the specified variable `varname`.



`infolist = IDE_Obj.list('variable',varnamelist)` returns information about variables in a list specified by `varnamelist`. The information returned in each structure follows the format in the following table.

| infolist Structure Element                | Description                                                                            |
|-------------------------------------------|----------------------------------------------------------------------------------------|
| <code>infolist.varname(1).name</code>     | Symbol name.                                                                           |
| <code>infolist.varname(1).isglobal</code> | Indicates whether symbol is global or local.                                           |
| <code>infolist.varname(1).location</code> | Information about the location of the symbol.                                          |
| <code>infolist.varname(1).size</code>     | Size per dimension.                                                                    |
| <code>infolist.varname(1).uclass</code>   | IDE handle class that matches the type of this symbol.                                 |
| <code>infolist.varname(1).bitsize</code>  | Size in bits. More information is added to the structure depending on the symbol type. |
| <code>infolist.(varname1).type</code>     | Data type of symbol.                                                                   |
| <code>infolist.varname(2)....</code>      | ...                                                                                    |
| <code>infolist.varname(n)....</code>      | ...                                                                                    |

`list` uses the variable name as the field name to refer to the structure information for the variable.

`infolist = IDE_Obj.list('globalvar')` returns a structure that contains information on the global variables.

`infolist = IDE_Obj.list('globalvar',varname)` returns a structure that contains information on the specified global variable.

`infolist = IDE_Obj.list('globalvar',varnamelist)` returns a structure that contains information on global variables in the list. The returned information follows the same format as the syntax `infolist = IDE_Obj.list('variable',...)`.

# list

---

`infolist = IDE_Obj.list('function')` returns a structure that contains information on the functions in the embedded program.

`infolist = IDE_Obj.list('function',functionname)` returns a structure that contains information on the specified function `functionname`.

`infolist = IDE_Obj.list('function',functionnamelist)` returns a structure that contains information on the specified functions in `functionnamelist`. The returned information follows the following format when you specify option type as **function**.

| <b>infolist Structure Element</b>               | <b>Description</b>                                                                   |
|-------------------------------------------------|--------------------------------------------------------------------------------------|
| <code>infolist.functionname(1).name</code>      | Function name                                                                        |
| <code>infolist.functionname(1).filename</code>  | Name of file where function is defined                                               |
| <code>infolist.functionname(1).address</code>   | Relevant address information such as start address and end address                   |
| <code>infolist.functionname(1).funcvar</code>   | Variables local to the function                                                      |
| <code>infolist.functionname(1).uclass</code>    | IDE handle class that matches the type of this symbol— <b>function</b>               |
| <code>infolist.functionname(1).funcdecl</code>  | Function declaration—where information such as the function return type is contained |
| <code>infolist.functionname(1).islibfunc</code> | Determine if the library is a function                                               |

| infolist Structure Element                     | Description                                  |
|------------------------------------------------|----------------------------------------------|
| <code>infolist.functionname(1).linepos</code>  | Start and end line positions of function     |
| <code>infolist.functionname(1).funcinfo</code> | Miscellaneous information about the function |
| <code>infolist.functionname(2)...</code>       | ...                                          |
| <code>infolist.functionname(n)...</code>       | ...                                          |

To refer to the function structure information, `list` uses the function name as the field name.

`IDE_Obj.infolist = list('type')` returns a structure that contains information on the defined data types in the embedded program. This method includes struct, enum and union data types and excludes typedefs. The name of a defined type is its C struct tag, enum tag or union tag. If the C tag is not defined, it is referred to by the IDE compiler as '\$faken' where *n* is an assigned number.

`IDE_Obj.infolist = list('type', typename)` returns a structure that contains information on the specified defined data type.

`IDE_Obj.infolist = list('type', typenamelist)` returns a structure that contains information on the specified defined data types in the list. The returned information follows the following format when you specify option type as **type**.

| infolist Structure Element               | Description                                                                                                   |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <code>infolist.typename(1).type</code>   | Type name.                                                                                                    |
| <code>infolist.typename(1).size</code>   | Size of this type.                                                                                            |
| <code>infolist.typename(1).uclass</code> | IDE handle class that matches the type of this symbol. Additional information is added depending on the type. |

| infolist Structure Element | Description |
|----------------------------|-------------|
| infolist.typeName(2)...    | ...         |
| infolist.typeName(n)...    | ...         |

For the field name, `list` uses the type name to refer to the type structure information.

The following list provides important information about variable and field names:

- When a variable name, type name, or function name is not a valid MATLAB structure field name, `list` replaces or modifies the name so it becomes valid.
- In field names that contain the invalid dollar character \$, `list` replaces the \$ with DOLLAR.
- Changing the MATLAB field name does not change the name of the embedded symbol or type.

### Examples

This first example shows `list` used with a variable, providing information about the variable `varname`. Notice that the invalid field name `_with_underscore` gets changed to `Q_with_underscore`. To make the invalid name valid, `list` inserts the character Q before the name.

```
varname1 = '_with_underscore'; % Invalid fieldname.
IDE_Obj.list('variable',varname1);
ans =
```

```
 Q_with_underscore : [varinfo]
ans. Q_with_underscore
ans=
```

```
 name: '_with_underscore'
isglobal: 0
location: [1x62 char]
 size: 1
 uclass: 'numeric'
```

```

 type: 'int'
 bitsize: 16

```

To show how to use `list` with a defined C type, variable `typename1` includes the `type` argument. Because valid field names cannot contain the `$` character, `list` changes the `$` to `DOLLAR`.

```

typename1 = '$fake3'; % Name of defined C type with no tag.
IDE_Obj.list('type',typename1);
ans =

```

```

 DOLLARfake0 : [typeinfo]

```

```

ans.DOLLARfake0=

```

```

 type: 'struct $fake0'
 size: 1
 uclass: 'structure'
 sizeof: 1
 members: [1x1 struct]

```

When you request information about a project in the IDE, you see a listing like the following that includes structures containing details about your project.

```

projectinfo=IDE_Obj.list('project')

```

```

projectinfo =

```

```

 name: 'D:\Work\c6711dskafxr_c6000_rtw\c6711dskafxr.pjt'
 type: 'project'
 targettype: 'TMS320C67XX'
 srcfiles: [69x1 struct]
 buildcfg: [3x1 struct]

```

## Using list with CCS IDE

`infolist = IDE_Obj.list(type)` reads information about your CCS session and returns it in `infolist`. Different types of information and return formats apply depending on the input arguments you supply to the `list` function call. The `type` argument specifies which information listing to return. To determine the information that `list` returns, use one of the following as the `type` parameter string:

- **project** — Tell `list` to return information about the current project in CCS.
- **variable** — Tell `list` to return information about one or more embedded variables.
- **globalvar** — Tell `list` to return information about one or more global embedded variables.
- **function** — Tell `list` to return details about one or more functions in your project.

The `list` function returns dynamic CCS information that can be altered by the user. Returned listings represent snapshots of the current CCS configuration only. Be aware that earlier copies of `infolist` might contain stale information.

Also, `list` may report incorrect information when you make changes to variables from MATLAB software. To report variable information, `list` uses the CCS API, which only knows about variables in CCS. Your changes from MATLAB software do not appear through the API and `list`. For example, the following operations return incorrect or old data information from `list`.

Suppose your original prototype is

```
unsigned short tgtFunction7(signed short signedShortArray1[]);
```

After creating the function object `fcnObj`, perform a `declare` operation with this string to change the declaration:

```
unsigned short tgtFunction7(unsigned short signedShortArray1[]);
```

Now try using `list` to return information about `signedShortArray1`.

```
list(fcnObj, 'signedShortArray1')

address: [3442 1]
location: [1x66 char]
 size: 1
bitsize: 16
reftype: 'short'
referent: [1x1 struct]
member_pts_to_same_struct: 0
 name: 'signedShortArray1'
```

You get this outcome because `list` uses the CCS API to query information about a particular variable. As far as the API is concerned, the first input variable is a `short*`. Changing the declaration does not change anything.

When you specify option type as **project**, for example `infolist = IDE_Obj.list('project')`, the method returns a vector of structures that contain project information in the following format.

| <b>infolist Structure Element</b>     | <b>Description</b>                                                                                                                                                  |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>infolist(1).name</code>         | Project file name (with path).                                                                                                                                      |
| <code>infolist(1).type</code>         | Project type — <code>project</code> , <code>projlib</code> , or <code>project</code> , refer to <code>new</code> .                                                  |
| <code>infolist(1).procesortype</code> | String description of processor CPU.                                                                                                                                |
| <code>infolist(1).srcfiles</code>     | Vector of structures that describes project source files. Each structure contains the name and path for each source file — <code>infolist(1).srcfiles.name</code> . |

| infolist Structure Element        | Description                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>infolist(1).buildcfg</code> | Vector of structures that describe build configurations, each with the following entries: <ul style="list-style-type: none"> <li>• <code>infolist(1).buildcfg.name</code> — the build configuration name.</li> <li>• <code>infolist(1).buildcfg.outpath</code> — the default folder for storing the build output.</li> </ul> |
| <code>infolist(2)....</code>      | ...                                                                                                                                                                                                                                                                                                                          |
| <code>infolist(n)....</code>      | ...                                                                                                                                                                                                                                                                                                                          |

`infolist = IDE_Obj.list('variable')` returns a structure of structures that contains information on the local variables within scope. The list also includes information on the global variables. However, that if a local variable has the same symbol name as a global variable, `list` returns the information about the local variable.

`infolist = IDE_Obj.list('variable',varname)` returns information about the specified variable `varname`.

`infolist = IDE_Obj.list('variable',varnamelist)` returns information about variables in a list specified by `varnamelist`. The information returned in each structure follows the following format when you specify option `type` as **variable**.

| infolist Structure Element                | Description                                   |
|-------------------------------------------|-----------------------------------------------|
| <code>infolist.varname(1).name</code>     | Symbol name.                                  |
| <code>infolist.varname(1).isglobal</code> | Indicates whether symbol is global or local.  |
| <code>infolist.varname(1).location</code> | Information about the location of the symbol. |
| <code>infolist.varname(1).size</code>     | Size per dimension.                           |



| <b>infolist Structure Element</b>        | <b>Description</b>                                                                     |
|------------------------------------------|----------------------------------------------------------------------------------------|
| <code>infolist.varname(1).uclass</code>  | ticcs object class that matches the type of this symbol.                               |
| <code>infolist.varname(1).bitsize</code> | Size in bits. More information is added to the structure depending on the symbol type. |
| <code>infolist.varname(2)....</code>     | ...                                                                                    |
| <code>infolist.varname(n)....</code>     | ...                                                                                    |

`list` uses the variable name as the field name to refer to the structure information for the variable.

`infolist = IDE_Obj.list('globalvar')` returns a structure that contains information on the global variables.

`infolist = IDE_Obj.list('globalvar',varname)` returns a structure that contains information on the specified global variable.

`infolist = IDE_Obj.list('globalvar',varnamelist)` returns a structure that contains information on global variables in the list. The returned information follows the same format as the syntax `infolist = IDE_Obj.list('variable',...)`.

`infolist = IDE_Obj.list('function')` returns a structure that contains information on the functions in the embedded program.

`infolist = IDE_Obj.list('function',functionname)` returns a structure that contains information on the specified function `functionname`.

`infolist = IDE_Obj.list('function',functionnamelist)` returns a structure that contains information on the specified functions in `functionnamelist`. The returned information follows the following format when you specify option type as **function**.

# list

---

| <b>infolist Structure Element</b>               | <b>Description</b>                                                                     |
|-------------------------------------------------|----------------------------------------------------------------------------------------|
| <code>infolist.functionname(1).name</code>      | Function name                                                                          |
| <code>infolist.functionname(1).filename</code>  | Name of file where function is defined                                                 |
| <code>infolist.functionname(1).address</code>   | Relevant address information such as start address and end address                     |
| <code>infolist.functionname(1).funcvar</code>   | Variables local to the function                                                        |
| <code>infolist.functionname(1).uclass</code>    | <code>ticcs</code> object class that matches the type of this symbol — <b>function</b> |
| <code>infolist.functionname(1).funcdecl</code>  | Function declaration — where information such as the function return type is contained |
| <code>infolist.functionname(1).islibfunc</code> | Determine if the library is a function                                                 |
| <code>infolist.functionname(1).linepos</code>   | Start and end line positions of function                                               |
| <code>infolist.functionname(1).funcinfo</code>  | Miscellaneous information about the function                                           |
| <code>infolist.functionname(2)...</code>        | ...                                                                                    |
| <code>infolist.functionname(n)...</code>        | ...                                                                                    |

To refer to the function structure information, `list` uses the function name as the field name.

The following list provides important information about variable and field names:

- When a variable name, type name, or function name is not a valid MATLAB software structure field name, `list` replaces or modifies the name so it becomes valid.
- In field names that contain the invalid dollar character \$, `list` replaces the \$ with `DOLLAR`.
- Changing the MATLAB software field name does not change the name of the embedded symbol or type.

### Examples

To show how to use `list` with a defined C type, variable `typename1` includes the `type` argument. Because valid field names cannot contain the \$ character, `list` changes the \$ to `DOLLAR`.

```
typename1 = '$fake3'; % name of defined C type with no tag
IDE_Obj.list('type',typename1);
ans =
```

```
 DOLLARfake0 : [typeinfo]
```

```
ans.DOLLARfake0=
```

```
 type: 'struct $fake0'
 size: 1
 uclass: 'structure'
 sizeof: 1
 members: [1x1 struct]
```

When you request information about a project in `CCS`, you see a listing like the following that includes structures containing details about your project.

```
projectinfo=IDE_Obj.list('project')
```

```
projectinfo =
```

# list

---

```
name: 'D:\Work\c6711dskafxr_c6000_rtw\c6711dskafxr.pjt'
type: 'project'
processortype: 'TMS320C67XX'
srcfiles: [69x1 struct]
buildcfg: [3x1 struct]
```

## See Also

[info](#)

**Purpose**

List existing sessions

**Syntax**

```
list = listsessions
list = listsessions('verbose')
```

**IDEs**

This function supports the following IDEs:

- Analog Devices VisualDSP++

**Description**

`list = listsessions` returns `list` that contains a listing of the sessions by name currently in the development environment.

`list = listsessions('verbose')` adds the optional input argument `verbose`. When you include the `verbose` argument, `listsessions` returns a cell array that contains one row for each existing session. Each row has three columns — processor type, platform name, and processor name.

**See Also**

`adivdsp`

# load

---

**Purpose** Load program file onto processor

**Syntax** `IDE_Obj.load(filename,timeout)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.load(filename,timeout)` loads the file specified by the *filename* argument to the processor.

The *filename* argument can include a full path to the file, or the name of a file in the IDE working folder.

With the VisualDSP++, MULTI, and Code Composer Studio IDEs, you can use the `cd` method to check or modify the IDE working folder.

For MULTI, you can add an *option* argument after *filename* to specify options for the 'prepare\_target' command in MULTI debugger. Refer to the MULTI documentation for information on 'prepare\_target'.

Only use `load` with program files created by the IDE build process.

The *timeout* argument defines the number of seconds MATLAB waits for the load process to complete. If the time-out period expires before the load process returns a completion message, MATLAB generates an error and returns. Usually the program load process works in spite of the error message.

If you omit the *timeout* argument, `load` uses the `timeout` property of the IDE handle object, which you can get by entering `IDE_Obj.get('timeout')`.

**Examples** `IDE_Obj.load(programfile)`  
`run(id)`

**See Also** `cd` | `dir` | `open`

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get execution time in seconds for profiled section of code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Syntax</b>           | <code>ExecutionTimes = NthSectionProfile.ExecutionTimeInSeconds</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>      | <p><code>ExecutionTimes = NthSectionProfile.ExecutionTimeInSeconds</code> returns a vector of execution times, measured in seconds, for the profiled section of code. Each element of <code>ExecutionTimes</code> contains the difference between the timer reading at the start and the end of the section.</p> <p>If you set the <code>CodeProfilingSaveOptions</code> parameter to 'SummaryOnly', <code>NthSectionProfile.ExecutionTimeInSeconds</code> returns an empty array. To change that parameter, open the Configuration Parameters dialog box by pressing <b>Ctrl+E</b>, open the <b>Verification</b> pane under <b>Code Generation</b>, and change the <b>Save options</b> parameter to All measurement and analysis data.</p> |
| <b>Input Arguments</b>  | <p><b>NthSectionProfile - coder.profile.ExecutionTimeSection</b><br/>object</p> <p>Object generated by the <code>coder.profile.ExecutionTime</code> property Sections.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Output Arguments</b> | <p><b>ExecutionTimes - Execution time measurements</b><br/>double</p> <p>Execution times, in seconds, for section of code. Returned as a vector.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Examples</b>         | <p><b>Get Execution Times for Code Section</b></p> <p>Run a simulation with a model that is configured to generate a workspace variable with execution time measurements.</p> <pre>rtwdemo_sil_topmodel;<br/>set_param('rtwdemo_sil_topmodel', 'CodeExecutionProfiling', 'on');<br/>set_param('rtwdemo_sil_topmodel', 'SimulationMode', 'software-in-the-loop (SIL)');<br/>set_param('rtwdemo_sil_topmodel', 'CodeProfilingInstrumentation', 'on');<br/>set_param('rtwdemo_sil_topmodel', 'CodeProfilingSaveOptions', 'AllData');</pre>                                                                                                                                                                                                     |

# ExecutionTimeInSeconds

---

```
sim('rtwdemo_sil_topmodel');
```

The simulation generates the workspace variable `executionProfile` (default).

At the end of the simulation, get the profile for the seventh code section.

```
SeventhSectionProfile = executionProfile.Sections(7);
```

Get vector of execution times for the code section.

```
time_vector = SeventhSectionProfile.ExecutionTimeInSeconds;
```

## See Also

[Sections](#) | [ExecutionTimeInTicks](#)

## Concepts

- “Configure Code Execution Profiling for SIL and PIL”
- “Analyze Code Execution Data”



|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get execution times in timer ticks for profiled section of code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Syntax</b>           | <code>ExecutionTimes = NthSectionProfile.ExecutionTimeInTicks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>      | <p><code>ExecutionTimes = NthSectionProfile.ExecutionTimeInTicks</code> returns a vector of execution times, measured in timer ticks, for the profiled section of code. Each element of <code>ExecutionTimes</code> contains the difference between the timer reading at the start and the end of the section. The data type of the arrays is the same as the data type of the timer used on the target, which allows you to infer the maximum range of the timer measurements.</p> <p><code>NthSectionProfile</code> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code>.</p> <p>If you set the <code>CodeProfilingSaveOptions</code> parameter to 'SummaryOnly', <code>NthSectionProfile.ExecutionTimeInTicks</code> returns an empty array. To change that parameter, open the Configuration Parameters dialog by pressing <b>Ctrl+E</b>, open the <b>Verification</b> pane under <b>Code Generation</b>, and change the <b>Save options</b> parameter to All measurement and analysis data.</p> |
|                         | <hr/> <p><b>Tip</b> You can calculate the execution time in seconds using the formula <math>ExecutionTimeInSecs = ExecutionTimeInTicks / TimerTicksPerSecond</math></p> <hr/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Output Arguments</b> | <p><b><code>ExecutionTimes</code></b><br/>Vector of execution times, in timer ticks, for profiled section of code</p> <p><b><code>SelfExecutionTimes</code></b><br/>Vector of execution times, in timer ticks, for profiled section of code but excluding time spent in child functions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>See Also</b>         | <code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

# ExecutionTimeInTicks

---

MaximumSelfTimeCallNum | MaximumExecutionTimeInTicks  
| TotalExecutionTimeInTicks | SelfTimeInTicks |  
MaximumSelfTimeInTicks | TotalSelfTimeInTicks |  
MaximumTurnaroundTimeInTicks | MaximumTurnaroundTimeCallNum |  
TurnaroundTimeInTicks | TotalTurnaroundTimeInTicks

## How To

- “Configure Code Execution Profiling for SIL and PIL”
- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”

# MaximumExecutionTimeCallNum

---

**Purpose** Get the call number at which maximum number of timer ticks occurred

**Syntax** `MaxTicksCallNum =  
NthSectionProfile.MaximumExecutionTimeCallNum`

**Description** `MaxTicksCallNum =  
NthSectionProfile.MaximumExecutionTimeCallNum` returns the call number at which the maximum number of timer ticks was recorded in a single invocation of the profiled code section during a simulation.  
`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property Sections.

**Output Arguments** `MaxTicksCallNum`  
Call number at which the maximum number of timer ticks occurred for a single invocation of the profiled code section

**See Also** `Sections | TimerTicksPerSecond | display | report | Name | ExecutionTimeInTicks | Number | NumCalls | MaximumSelfTimeCallNum | ExecutionTimeInTicks | MaximumExecutionTimeInTicks | TotalExecutionTimeInTicks | SelfTimeInTicks | MaximumSelfTimeInTicks | TotalSelfTimeInTicks | MaximumTurnaroundTimeInTicks | MaximumTurnaroundTimeCallNum | TurnaroundTimeInTicks | TotalTurnaroundTimeInTicks`

**How To**

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- “View and Compare Code Execution Times”

# MaximumExecutionTimeInTicks

---

**Purpose** Get maximum number of timer ticks for single invocation of profiled code section

**Syntax** `MaxTicks = NthSectionProfile.MaximumExecutionTimeInTicks`

**Description** `MaxTicks = NthSectionProfile.MaximumExecutionTimeInTicks` returns the maximum number of timer ticks recorded in a single invocation of the profiled code section during a simulation.  
`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** `MaxTicks`  
Maximum number of timer ticks for single invocation of profiled code section

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Name` | `ExecutionTimeInTicks` | `Number` | `NumCalls` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `ExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `MaximumSelfTimeInTicks` | `TotalSelfTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `MaximumTurnaroundTimeCallNum` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `MaximumTurnaroundTimeCallNum` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

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|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get total number of timer ticks recorded for profiled code section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Syntax</b>           | <code>TotalTicks = NthSectionProfile.TotalExecutionTimeInTicks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>      | <p><code>TotalTicks = NthSectionProfile.TotalExecutionTimeInTicks</code> returns the total number of timer ticks recorded for the profiled code section over the entire simulation.</p> <p><code>NthSectionProfile</code> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code>.</p>                                                                                                                                                                                                                                     |
| <b>Output Arguments</b> | <p><b>TotalTicks</b></p> <p>Total number of timer ticks for profiled code section</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>See Also</b>         | <code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>   <code>MaximumSelfTimeCallNum</code>   <code>ExecutionTimeInTicks</code>   <code>MaximumExecutionTimeInTicks</code>   <code>SelfTimeInTicks</code>   <code>MaximumSelfTimeInTicks</code>   <code>TotalSelfTimeInTicks</code>   <code>MaximumTurnaroundTimeInTicks</code>   <code>MaximumTurnaroundTimeCallNum</code>   <code>TurnaroundTimeInTicks</code>   <code>TotalTurnaroundTimeInTicks</code> |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “View and Compare Code Execution Times”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                 |

# SelfTimeInTicks

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|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get number of timer ticks recorded for profiled code section, excluding time spent in child functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Syntax</b>           | <code>SelfTicks = NthSectionProfile.SelfTimeInTicks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>      | <p><code>SelfTicks = NthSectionProfile.SelfTimeInTicks</code> returns the number of timer ticks recorded for the profiled code section. However, this number excludes the time spent in calls to child functions.</p> <p><code>NthSectionProfile</code> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code>.</p>                                                                                                                                                                                                                                                     |
| <b>Output Arguments</b> | <p><b><code>SelfTicks</code></b></p> <p>Number of timer ticks for profiled code section, excluding periods in child functions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>See Also</b>         | <code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>ExecutionTimeInTicks</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>   <code>MaximumSelfTimeCallNum</code>   <code>ExecutionTimeInTicks</code>   <code>MaximumExecutionTimeInTicks</code>   <code>TotalExecutionTimeInTicks</code>   <code>MaximumSelfTimeInTicks</code>   <code>TotalSelfTimeInTicks</code>   <code>MaximumTurnaroundTimeInTicks</code>   <code>MaximumTurnaroundTimeCallNum</code>   <code>TurnaroundTimeInTicks</code>   <code>TotalTurnaroundTimeInTicks</code> |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “View and Compare Code Execution Times”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get the call number at which the maximum number of timer ticks occurred, excluding time spent in child functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax</b>           | <i>MaxSelfTicksCallNum</i> = <i>NthSectionProfile</i> .MaxSelfTimeCallNum                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>      | <i>MaxSelfTicksCallNum</i> = <i>NthSectionProfile</i> .MaxSelfTimeCallNum returns the call number at which the maximum number of self-time ticks occurred for the profiled code section.<br><br><i>NthSectionProfile</i> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code> .                                                                                                                                                                                                                                                                                |
| <b>Output Arguments</b> | <b><i>MaxSelfTicksCallNum</i></b><br>Call number at which the maximum number of self-time ticks occurred for profiled code section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>See Also</b>         | <code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>ExecutionTimeInTicks</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>   <code>ExecutionTimeInTicks</code>   <code>MaximumExecutionTimeInTicks</code>   <code>TotalExecutionTimeInTicks</code>   <code>SelfTimeInTicks</code>   <code>MaximumSelfTimeInTicks</code>   <code>TotalSelfTimeInTicks</code>   <code>MaximumTurnaroundTimeInTicks</code>   <code>MaximumTurnaroundTimeCallNum</code>   <code>TurnaroundTimeInTicks</code>   <code>TotalTurnaroundTimeInTicks</code> |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “View and Compare Code Execution Times”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                        |

# MaximumSelfTimeInTicks

---

**Purpose** Get the maximum number of timer ticks allowed to be recorded for profiled code section, excluding time spent in child functions

**Syntax** `MaxSelfTicks = NthSectionProfile.MaximumSelfTimeInTicks`

**Description** `MaxSelfTicks = NthSectionProfile.MaximumSelfTimeInTicks` returns the maximum number of timer ticks allowed to be recorded for the profiled code section. This number excludes the time spent in calls to child functions.

`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** `MaxSelfTicks`  
Maximum number of timer ticks for profiled code section, excluding periods in child functions

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Name` | `ExecutionTimeInTicks` | `Number` | `NumCalls` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `ExecutionTimeInTicks` | `MaximumExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `TotalSelfTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `MaximumTurnaroundTimeCallNum` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”



|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get total number of timer ticks recorded for profiled code section, excluding time spent in child functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Syntax</b>           | <code>TotalSelfTicks = NthSectionProfile.TotalSelfTimeInTicks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>      | <p><code>TotalSelfTicks = NthSectionProfile.TotalSelfTimeInTicks</code> returns the total number of timer ticks recorded for the profiled code section over the entire simulation. However, this number excludes the time spent in calls to child functions.</p> <p><code>NthSectionProfile</code> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code>.</p>                                                                                                                                                                                                            |
| <b>Output Arguments</b> | <p><b><code>TotalSelfTicks</code></b></p> <p>Total number of timer ticks for profiled code section, excluding periods in child functions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>See Also</b>         | <p><code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>ExecutionTimeInTicks</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>   <code>MaximumSelfTimeCallNum</code>   <code>ExecutionTimeInTicks</code>   <code>MaximumExecutionTimeInTicks</code>   <code>TotalExecutionTimeInTicks</code>   <code>SelfTimeInTicks</code>   <code>MaximumSelfTimeInTicks</code>   <code>MaximumTurnaroundTimeInTicks</code>   <code>MaximumTurnaroundTimeCallNum</code>   <code>TurnaroundTimeInTicks</code>   <code>TotalTurnaroundTimeInTicks</code></p> |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “View and Compare Code Execution Times”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

# MaximumTurnaroundTimeInTicks

---

**Purpose** Get maximum number of timer ticks between start and finish of a single invocation of profiled code section

**Syntax** `MaxTicks = NthSectionProfile.MaximumTurnaroundTimeInTicks`

**Description** `MaxTicks = NthSectionProfile.MaximumTurnaroundTimeInTicks` returns the maximum number of timer ticks recorded between the start and finish of a single invocation of the profiled code section during a simulation. Unless the code is pre-empted, this is the same as the maximum execution time.

`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** `MaxTurnaroundTicks`  
Maximum number of timer ticks between start and finish of a single invocation of profiled code section

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Name` | `Number` | `NumCalls` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `MaximumTurnaroundTimeCallNum` | `ExecutionTimeInTicks` | `MaximumExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `MaximumSelfTimeInTicks` | `TotalSelfTimeInTicks` | `TurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get call number of the maximum number of timer ticks between start and finish of a single invocation of profiled code section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax</b>           | <pre>MaxTurnaroundTicksCallNum =<br/>NthSectionProfile.MaximumTurnaroundTimeCall<br/>  1Num</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>      | <p><i>MaxTurnaroundTicksCallNum</i> = <i>NthSectionProfile.MaximumTurnaroundTimeCall 1Num</i> returns the call number in which the maximum number of timer ticks was recorded between start and finish of a single invocation of the profiled code section during a simulation. Unless the code is pre-empted, this is the same as the maximum execution time.</p> <p><i>NthSectionProfile</i> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code>.</p>                                                                    |
| <b>Output Arguments</b> | <p><i>MaxTurnaroundTicksCallNum</i></p> <p>Call number of the maximum number of timer ticks between start and finish of a single invocation of profiled code section</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>See Also</b>         | <p><code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>   <code>MaximumSelfTimeCallNum</code>   <code>ExecutionTimeInTicks</code>   <code>MaximumExecutionTimeInTicks</code>   <code>TotalExecutionTimeInTicks</code>   <code>SelfTimeInTicks</code>   <code>MaximumSelfTimeInTicks</code>   <code>TotalSelfTimeInTicks</code>   <code>TurnaroundTimeInTicks</code>   <code>MaximumTurnaroundTimeInTicks</code>   <code>TotalTurnaroundTimeInTicks</code></p> |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “View and Compare Code Execution Times”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                     |

# TurnaroundTimeInTicks

---

**Purpose** Get number of timer ticks between start and finish of the profiled code section

**Syntax** `TurnaroundTicks = NthSectionProfile.TurnaroundTimeInTicks`

**Description** `TurnaroundTicks = NthSectionProfile.TurnaroundTimeInTicks` returns the number of timer ticks recorded between the start and finish of the profiled code section. Unless the code is pre-empted, this is the same as the execution time.

`NthSectionProfile` is a `coder.profile.ExecutionTimeSection` object generated by the `coder.profile.ExecutionTime` property `Sections`.

**Output Arguments** `TurnaroundTicks`  
Number of timer ticks between start and finish of the profiled code section

**See Also** `Sections` | `TimerTicksPerSecond` | `display` | `report` | `Name` | `Number` | `NumCalls` | `MaximumExecutionTimeCallNum` | `MaximumSelfTimeCallNum` | `MaximumTurnaroundTimeCallNum` | `ExecutionTimeInTicks` | `MaximumExecutionTimeInTicks` | `TotalExecutionTimeInTicks` | `SelfTimeInTicks` | `MaximumSelfTimeInTicks` | `TotalSelfTimeInTicks` | `MaximumTurnaroundTimeInTicks` | `TotalTurnaroundTimeInTicks`

**How To**

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- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get total number of timer ticks between start and finish of the profiled code section over the entire simulation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Syntax</b>           | <pre>TotalTurnaroundTicks =<br/>NthSectionProfile.TotalTurnaroundTimeInTicks</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>      | <p><i>TotalTurnaroundTicks</i> =<br/><i>NthSectionProfile.TotalTurnaroundTimeInTicks</i> returns the total number of timer ticks recorded between the start and finish of the profiled code section over the entire simulation. Unless the code is pre-empted, this is the same as the total execution time.</p> <p><i>NthSectionProfile</i> is a <code>coder.profile.ExecutionTimeSection</code> object generated by the <code>coder.profile.ExecutionTime</code> property <code>Sections</code>.</p>                                                                                                                        |
| <b>Output Arguments</b> | <p><b><i>TotalTurnaroundTicks</i></b></p> <p>Total number of timer ticks between start and finish of the profiled code section over the entire simulation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>See Also</b>         | <p><code>Sections</code>   <code>TimerTicksPerSecond</code>   <code>display</code>   <code>report</code>   <code>Name</code>   <code>Number</code>   <code>NumCalls</code>   <code>MaximumExecutionTimeCallNum</code>   <code>MaximumSelfTimeCallNum</code>   <code>MaximumTurnaroundTimeCallNum</code>   <code>ExecutionTimeInTicks</code>   <code>MaximumExecutionTimeInTicks</code>   <code>TotalExecutionTimeInTicks</code>   <code>SelfTimeInTicks</code>   <code>MaximumSelfTimeInTicks</code>   <code>TotalSelfTimeInTicks</code>   <code>TurnaroundTimeInTicks</code>   <code>MaximumTurnaroundTimeInTicks</code></p> |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “Configure Code Execution Profiling for SIL and PIL”</li><li>• “View and Compare Code Execution Times”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                       |

# mapDataTransfer

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|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Map Simulink data transfer line to AUTOSAR inter-runnable variable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Syntax</b>          | <code>mapDataTransfer(s1Map, s1DataTransferName, arIrvName, arDataAccessMode)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>     | <code>mapDataTransfer(s1Map, s1DataTransferName, arIrvName, arDataAccessMode)</code> maps the Simulink data transfer line <code>s1DataTransferName</code> to AUTOSAR inter-runnable variable <code>arIrvName</code> and AUTOSAR data access mode <code>arDataAccessMode</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Input Arguments</b> | <p><b>s1Map - Simulink to AUTOSAR mapping information for a model handle</b></p> <p>Simulink to AUTOSAR mapping information for a model, previously returned by <code>s1Map = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>s1Map</code></p> <p><b>s1DataTransferName - Name of model data transfer line</b></p> <p>string</p> <p>Name of the model data transfer line for which to set AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'irv4'</code></p> <p><b>arIrvName - Name of AUTOSAR inter-runnable variable</b></p> <p>string</p> <p>Name of the AUTOSAR inter-runnable variable to which to map the specified Simulink data transfer line.</p> <p><b>Example:</b> <code>'IRV4'</code></p> <p><b>arDataAccessMode - Value of AUTOSAR data access mode</b></p> <p>string</p> <p>Value of the AUTOSAR data access mode to which to map the specified Simulink data transfer line. The value can be <code>Implicit</code> or <code>Explicit</code>.</p> |

Example: 'Explicit'

## Examples

### Set AUTOSAR Mapping Information for Model Data Transfer Line

Set AUTOSAR mapping information for a data transfer line in the example model `rtwdemo_autosar_multirunnables`. The model has data transfer lines named `irv1`, `irv2`, `irv3`, and `irv4`. This example changes the AUTOSAR data access mode for `irv4` from `Implicit` to `Explicit`

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapDataTransfer(slMap,'irv4','IRV4','Explicit');
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,'irv4')
```

```
arIrvName =
```

```
IRV4
```

```
arDataAccessMode =
```

```
Explicit
```

## See Also

`getDataTransfer`

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# mapFunction

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|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Map Simulink entry-point function to AUTOSAR runnable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Syntax</b>          | <code>mapFunction(s1Map,s1FcnName,arRunnableName)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>     | <code>mapFunction(s1Map,s1FcnName,arRunnableName)</code> maps the Simulink entry-point function <code>s1FcnName</code> to the AUTOSAR runnable <code>arRunnableName</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Input Arguments</b> | <p><b>s1Map - Simulink to AUTOSAR mapping information for a model handle</b><br/>Simulink to AUTOSAR mapping information for a model, previously returned by <code>s1Map = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>s1Map</code></p> <p><b>s1FcnName - Name of model entry point function</b><br/>string<br/>Name of the model entry point function for which to set AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'InitializeFunction'</code></p> <p><b>arRunnableName - Name of AUTOSAR runnable</b><br/>string<br/>Name of the AUTOSAR runnable to which to map the specified model entry-point function.</p> <p><b>Example:</b> <code>'Runnable_Init'</code></p> |
| <b>Examples</b>        | <p><b>Set AUTOSAR Mapping Information for Model Entry-Point Function</b></p> <p>Set AUTOSAR mapping information for a model entry point function in the example model <code>rtwdemo_autosar_multirunnables</code>. The model has an initialization entry-point function named <code>InitializeFunction</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



and three exported entry-point functions named Runnable1, Runnable2, and Runnable3.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapFunction(slMap, 'InitializeFunction', 'Runnable_Init');
arRunnableName=getFunction(slMap, 'InitializeFunction')
```

```
arRunnableName =
```

```
Runnable_Init
```

## See Also

`getFunction`

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# mapInport

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Map Simulink inport to AUTOSAR port                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Syntax</b>          | <code>mapInport(s1Map, s1PortName, arPortName, arDataElementName, arDataAccessMode)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>     | <code>mapInport(s1Map, s1PortName, arPortName, arDataElementName, arDataAccessMode)</code> maps the Simulink inport <code>s1PortName</code> to the AUTOSAR data element <code>arDataElementName</code> at AUTOSAR receiver port <code>arPortName</code> . The AUTOSAR data access mode for the receiver port is set to <code>arDataAccessMode</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Input Arguments</b> | <p><b>s1Map - Simulink to AUTOSAR mapping information for a model handle</b><br/>Simulink to AUTOSAR mapping information for a model, previously returned by <code>s1Map = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>s1Map</code></p> <p><b>s1PortName - Name of model inport</b><br/>string<br/>Name of the model inport for which to set AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'Input'</code></p> <p><b>arPortName - Name of AUTOSAR port</b><br/>string<br/>Name of the AUTOSAR port to which to map the specified Simulink inport.</p> <p><b>Example:</b> <code>'Input'</code></p> <p><b>arDataElementName - Name of AUTOSAR data element</b><br/>string</p> |

Name of the AUTOSAR data element to which to map the specified Simulink inport.

**Example:** 'Input'

**arDataAccessMode - Value of AUTOSAR data access mode**

string

Value of the AUTOSAR data access mode to which to map the specified Simulink inport. The value can be `ImplicitReceive`, `ExplicitReceive`, `QueuedExplicitReceive`, `ErrorStatus`, or `ModeReceive`.

**Example:** 'ExplicitReceive'

## Examples

### Set AUTOSAR Mapping Information for Model Inport

Set AUTOSAR mapping information for a model inport in the example model `rtwdemo_autosar_multirunnables`. The model has an inport named `RPort_DE1`. This example changes the AUTOSAR data access mode for `RPort_DE1` from `ImplicitReceive` to `ExplicitReceive`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapInport(slMap, 'RPort_DE1', 'RPort', 'DE1', 'ExplicitReceive');
[arPortName, arDataElementName, arDataAccessMode]=getInport(slMap, 'RPort_DE1')
```

```
arPortName =
```

```
RPort
```

```
arDataElementName =
```

```
DE1
```

```
arDataAccessMode =
```

```
ExplicitReceive
```

# mapInport

---

## See Also

`getInport`

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Map Simulink output to AUTOSAR port                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Syntax</b>          | <code>mapOutput(s1Map, s1PortName, arPortName, arDataElementName, arDataAccessMode)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>     | <code>mapOutput(s1Map, s1PortName, arPortName, arDataElementName, arDataAccessMode)</code> maps the Simulink output <code>s1PortName</code> to the AUTOSAR data element <code>arDataElementName</code> at AUTOSAR provider port <code>arPortName</code> . The AUTOSAR data access mode for the provider port is set to <code>arDataAccessMode</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Input Arguments</b> | <p><b>s1Map - Simulink to AUTOSAR mapping information for a model</b><br/>handle</p> <p>Simulink to AUTOSAR mapping information for a model, previously returned by <code>s1Map = autosar.api.getSimulinkMapping(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>s1Map</code></p> <p><b>s1PortName - Name of model output</b><br/>string</p> <p>Name of the model output for which to set AUTOSAR mapping information.</p> <p><b>Example:</b> <code>'Output'</code></p> <p><b>arPortName - Name of AUTOSAR port</b><br/>string</p> <p>Name of the AUTOSAR port to which to map the specified Simulink output.</p> <p><b>Example:</b> <code>'Output'</code></p> <p><b>arDataElementName - Name of AUTOSAR data element</b><br/>string</p> |

Name of the AUTOSAR data element to which to map the specified Simulink output.

**Example:** 'Output'

## **arDataAccessMode - Value of AUTOSAR data access mode**

string

Value of the AUTOSAR data access mode to which to map the specified Simulink output. The value can be ImplicitSend or ExplicitSend.

**Example:** 'ExplicitSend'

## **Examples**

### **Set AUTOSAR Mapping Information for Model Output**

Set AUTOSAR mapping information for a model output in the example model `rtwdemo_autosar_multirunnables`. The model has an output named `PPort_DE1`. This example changes the AUTOSAR data access mode for `PPort_DE1` from `ImplicitSend` to `ExplicitSend`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapOutput(slMap, 'PPort_DE1', 'PPort', 'DE1', 'ExplicitSend');
[arPortName, arDataElementName, arDataAccessMode]=getOutput(slMap, 'PPort_DE1')
```

```
arPortName =
```

```
PPort
```

```
arDataElementName =
```

```
DE1
```

```
arDataAccessMode =
```

```
ExplicitSend
```

**See Also**

getOutputport

**Related Examples**

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# rtw.codegenObjectives.Objective.modifyInheritedParam

---

**Purpose** Modify inherited parameter values

**Syntax** `modifyInheritedParam(obj, paramName, value)`

**Description** `modifyInheritedParam(obj, paramName, value)` changes the value of an inherited parameter that the Code Generation Advisor verifies in **Check model configuration settings against code generation objectives**. Use this method when you create a new objective from an existing objective.

|                        |                  |                                                                  |
|------------------------|------------------|------------------------------------------------------------------|
| <b>Input Arguments</b> | <i>obj</i>       | Handle to a code generation objective object previously created. |
|                        | <i>paramName</i> | Parameter that you modify in the objective.                      |
|                        | <i>value</i>     | Value of the parameter.                                          |

**Examples** Change the value of `InlineParameters` to off in the objective.

```
modifyInheritedParam(obj, 'InlineParams', 'off');
```

**See Also** `get_param`

**How To**

- “Create Custom Objectives”
- “Parameter Command-Line Information Summary”



**Purpose** Number of messages in read-enabled channel queue

---

**Note** Support for msgcount on C5000 processors will be removed in a future version.

---

**Syntax** msgcount(rx, 'channel')

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** msgcount(rx, 'channel') returns the number of unread messages in the read-enabled queue specified by channel for the RTDX interface rx. You cannot use msgcount on channels configured for write access.

**Examples** If you have created and loaded a program to the processor, you can write data to the processor, then use msgcount to determine the number of messages in the read queue.

- 1 Create and load a program to the processor.
- 2 Write data to the processor from MATLAB software.

```
indata=1:100;
writemsg(IDE_Obj.rtdx,'ichannel', int32(indata));
```

- 3 Use msgcount to determine the number of messages available in the queue.

```
num_of_msgs = msgcount(IDE_Obj.rtdx,'ichannel')
```

**See Also** read | readmat | readmsg

**Purpose** Create project, library, or build configuration in IDE

**Syntax** `IDE_Obj.new('name', 'type')`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.new('name', 'type')` creates a project, library, or build configuration in the IDE.

The `name` argument specifies the name of the new project, library, or build configuration

The `type` argument specifies whether to create a project, library, or build configuration. The options are:

- 'project' — Executable project. Sometimes this file is called a “DSP executable file”.
- 'projlib' — Library project.
- 'projext' — External make project. Only the CCS IDE supports this option.
- 'buildcfg' — Build configuration in the active project. Only the VisualDSP++ and CCS IDEs support this option.

When `type` is 'project' or 'projlib', `name` can include the full path to the new file. You can use the path to differentiate two files with the same name. If you omit the path, the new method creates the file or project in the current IDE working folder.

If you omit the `type` argument, and the `name` argument does not include a file extension, `type` defaults to 'project'.

When `type` is 'buildcfg', use a unique name to differentiate the build configuration from other build configurations in the active project.

The new method does not support 'text' as a *type* argument.

**Examples**

```
IDE_Obj.new('my_project','project') #Create an IDE project, 'my_project.gpj'
IDE_Obj.new('my_build_config','buildcfg') #Create a build configuration.
```

**See Also**

[activate](#) | [close](#)

# open

---

**Purpose** Open project in IDE

**Syntax** `IDE_Obj.open(filename, filetype, timeout)`  
`IDE_Obj.open(myproject)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.open(filename, filetype, timeout)` opens a project in the IDE.

Use the *filename* argument to specify the file name, including the file name extension. If the *filename* does not include a file name extension, you can specify the file type using the *filetype* argument. If the file does not exist in the current project or folder path, MATLAB returns a warning and returns control to MATLAB.

For the optional *filetype* argument, you can specify the following types.

|                                              | <b>CCS IDE</b>        | <b>MULTI IDE</b> | <b>VisualDSP++ IDE</b> |
|----------------------------------------------|-----------------------|------------------|------------------------|
| 'project' — Project files                    | Yes                   | Yes              | Yes                    |
| 'ProjectGroup' — Project group files         | No                    | No               | Yes                    |
| 'program' — Target program file (executable) | No. Use load instead. | Yes              | No                     |

If you omit the *filetype* argument, *filetype* defaults to 'project'.

---

The optional *timeout* argument determines the number of seconds MATLAB waits for the IDE to finish opening the file before returning an error. If you omit the *timeout* argument, the open method uses the timeout property of the IDE handle object (IDE\_Obj) instead. The timeout error does not terminate the loading process on the IDE.

---

**Note** The open method does not support the 'text', 'program', or 'workspace' arguments.

---

**Examples**

IDE\_Obj.open(myproject) opens the myproject project in the IDE.

**See Also**

cd | dir | load | new

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Create plot for signal or multiple signals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Syntax</b>          | <pre>[signal_names, signal_figures] = cgv.CGV.plot(data_set) [signal_names, signal_figures] = cgv.CGV.plot(data_set, 'Signals',     signal_list)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>     | <p>[signal_names, signal_figures] = cgv.CGV.plot(data_set) create a plot for each signal in the data_set.</p> <p>[signal_names, signal_figures] = cgv.CGV.plot(data_set, 'Signals', signal_list) create a plot for each signal in the value of 'Signals' and return the names and figure handles for the given signal names.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Input Arguments</b> | <p><b>data_set</b></p> <p>Output data from a model. After running the model, use the cgv.CGV.getOutputData function to get the data. The cgv.CGV.getOutputData function returns a cell array of the output signal names.</p> <p><b>'Signals', signal_list</b></p> <p>Parameter/value argument pair specifying the signal or signals to plot. The value for this parameter can be an individual signal name, or a cell array of strings, where each string is a signal name in the data_set. Use cgv.CGV.getSavedSignals to view the list of available signal names in the data_set. The syntax for an individual signal name is:</p> <pre>signal_list = {'log_data.subsystem_name.Data(:,1)'}  The syntax for a list of signal names is:</pre> <pre>signal_list = {'log_data.block_name.Data(:,1)', ...     'log_data.block_name.Data(:,2)', ...     'log_data.block_name.Data(:,3)', ...     'log_data.block_name.Data(:,4)'};</pre> |

If a component of your model contains a space or newline character, MATLAB adds parentheses and a single quote to the name of the component. For example, if a section of the signal has a space, 'block name', MATLAB displays the signal name as:

```
log_data('block name').Data(:,1)
```

To use the signal name as input to a CGV function, 'block name' must have two single quotes. For example:

```
signal_list = {'log_data(''block name'').Data(:,1)'};
```

## Output Arguments

Depending on the data, one or more of the following parameters might be empty:

### **signal\_names**

Cell array of signal names

### **signal\_figures**

Array of figure handles for signals

## How To

- “Verify Numerical Equivalence with CGV”

# profile

---

**Purpose** Generate real-time execution or stack profiling report

**Syntax** `IDE_Obj.profile(type,action,timeout)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** Use `IDE_Obj.profile(type,action,timeout)` to generate real-time execution or stack profiling report.

Create the `IDE_Obj` IDE handle object using a constructor function before you use the `profile` method.

The `type` argument determines the type of profile to generate. The following types are available for the IDEs specified.

|                                   | <b>CCS IDE</b> | <b>MULTI IDE</b> | <b>VisualDSP++ IDE</b> |
|-----------------------------------|----------------|------------------|------------------------|
| 'execution' — Execution profiling | Yes            | Yes              | Yes                    |
| 'stack' — Stack profiling         | Yes            |                  | Yes                    |

To get a real-time task execution profile report in HTML and graphical plot forms, set the `type` argument to 'execution' and omit the `action` argument, which defaults to 'report'. For more information, see “Perform Execution Time Profiling for IDE and Toolchain Targets”.

To prepare the stack memory on the processor for profiling, set the `type` argument to 'stack', and set the `action` argument to 'setup'. This action writes a repetitive series of known values to the stack memory. For more information, see “Perform Stack Profiling with IDE and Toolchain Targets”.



After preparing the stack memory, to measure and report the percentage of stack usage, set the *type* argument to 'stack', and set the *action* argument to 'report'.

If you omit the *action* argument, *action* defaults to 'report'.

The optional *timeout* argument determines the number of seconds MATLAB waits for the IDE to finish profiling before returning an error. If you omit the *timeout* argument, the open method uses the timeout property of the IDE handle object (IDE\_Obj) instead.

---

**Note** You can use real-time task execution profiling with hardware only. Simulators do not support the profiling feature.

---

## Examples

To use `profile` to assess how your program executes in real-time, complete the following tasks with a Simulink model:

- 1 Open the model configuration parameters (**Ctrl+E**).
- 2 Select the Coder Target pane.
- 3 Under the Tool Chain Automation tab, enable **Profile real-time execution**.
- 4 Build your model.

```
IDE_Obj.build
```

- 5 Load your program to the processor.

```
IDE_Obj.load('c:\work\sumdiff.out')
```

- 6 For stack profiling, initialize the stack to a known state. (For execution profiling, skip this step.)

```
IDE_Obj.profile('stack','setup')
```

With the **setup** input argument, `profile` writes a known pattern into the addresses that compose the stack. For C6000 processors, the pattern is A5. For C2000™ and C5000 processors, the pattern is A5A5 to account for the address size. As long as your application does not write the same pattern to the system stack, `profile` can report the stack usage.

**7** Run the program on the processor.

```
IDE_Obj.run
```

**8** Stop the running program.

```
IDE_Obj.halt
```

**9** To get the profiling reports enter one of the following commands:

```
IDE_Obj.profile('stack','report') #Get stack profiling report
IDE_Obj.profile('execution') #Get execution profiling report
```

The HTML report contains the sections described in the following table.

| Section Heading                                              | Description                                                                                                                                                                 |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Worst case task turnaround times                             | Maximum task turnaround time for each task since model execution started.                                                                                                   |
| Maximum number of concurrent overruns for each task          | Maximum number of concurrent task overruns since model execution started.                                                                                                   |
| Analysis of profiling data recorded over <i>nnn</i> seconds. | Profiling data was recorded over <i>nnn</i> seconds. The recorded data for task turnaround times and task execution times is presented in the table following this heading. |

*Task turnaround time* is the elapsed time between starting and finishing the task. If the task is not preempted, task turnaround time equals the task execution time.

---

*Task execution time* is the time between task start and finish when the task is actually running. It does not include time during which the task may have been preempted by another task.

---

**Note** Task execution time cannot be measured directly. Task profiling infers the execution time from the task start and finish times, and the intervening periods during which the task was preempted by another task.

---

The execution time calculations do not account for processor time consumed by the scheduler while switching tasks. In cases where preemption occurs, the reported task execution times overestimate the true task execution time.

*Task overruns* occur when a timer task does not complete before the same task is scheduled to run again. Depending on how you configure the real-time scheduler, a task overrun may be handled as a real-time failure. Alternatively, you might allow a small number of task overruns to accommodate cases where a task occasionally takes longer than normal to complete. If a task overrun occurs, and the same task is scheduled to run again before the first overrun has been cleared, concurrent task overruns are said to have occurred.

## See Also

load | run

# read

---

**Purpose** Read data from processor memory

**Syntax**

```
mem=IDE_Obj.read(address)
mem=IDE_Obj.read(...,datatype)
mem=IDE_Obj.read(...,count)
mem=IDE_Obj.read(...,memorytype)
mem=IDE_Obj.read(...,timeout)
```

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `mem=IDE_Obj.read(address)` returns a block of data values from the memory space of the processor referenced by `IDE_Obj`. The block to read begins from the DSP memory location given by the *address* argument. The data is read starting from *address* without regard to type-alignment boundaries in the processor. Conversely, the byte ordering defined by the data type is automatically applied.

The *address* argument is a decimal or hexadecimal representation of a memory address in the processor. The full memory address consist of two parts:

- The start address
- The memory type

You can define the memory type value can be explicitly using a numeric vector representation of the address.

Alternatively, the `IDE_Obj` object has a default memory type value that is applied if the memory type value is not explicitly incorporated in the passed address parameter. In DSP processors with only a single memory type, it is possible to specify addresses using the abbreviated (implied memory type) format by setting the `IDE_Obj` object memory type value to zero.

---

**Note** You cannot read data from processor memory while the processor is running.

---

Provide the *address* argument either as a numerical value that is a decimal representation of the DSP memory address, or as a string that `read` converts to the decimal representation of the start address. (Refer to function `hex2dec` in the *MATLAB Function Reference*. `read` uses `hex2dec` to convert the hexadecimal string to a decimal value).

The examples in the following table show how `read` uses the `address` parameter.

| address<br>Parameter Value | Description                                                                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 131082                     | Decimal address specification. The memory start address is 131082 and memory type is 0. This action is the same as specifying [131082 0].                    |
| [131082 1]                 | Decimal address specification. The memory start address is 131082 and memory type is 1.                                                                      |
| '2000A'                    | Hexadecimal address specification provided as a string entry. The memory start address is 131082 (converted to the decimal equivalent) and memory type is 0. |

It is possible to specify `address` as a cell array. You can use a combination of numbers and strings for the start address and memory type values. For example, the following are valid addresses from cell array `myaddress`:

```
myaddress1 myaddress1{1}=131072;
myaddress1{2}='Program(PM) Memory';

myaddress2 myaddress2{1}='20000';
myaddress2{2}='Program(PM) Memory';
```

# read

```
myaddress3 myaddress3{1}=131072; myaddress3{2}=0;
```

`mem=IDE_Obj.read(...,datatype)` where the input argument `datatype` defines the interpretation of the raw values read from DSP memory. Parameter `datatype` specifies the data format of the raw memory image. The data is read starting from `address` without regard to data type alignment boundaries in the processor. The byte ordering defined by the data type is automatically applied. This syntax supports the following MATLAB data types.

| <b>MATLAB Data Type</b> | <b>Description</b>                           |
|-------------------------|----------------------------------------------|
| <code>double</code>     | IEEE double-precision floating point value   |
| <code>single</code>     | IEEE single-precision floating point value   |
| <code>uint8</code>      | 8-bit unsigned binary integer value          |
| <code>uint16</code>     | 16-bit unsigned binary integer value         |
| <code>uint32</code>     | 32-bit unsigned binary integer value         |
| <code>int8</code>       | 8-bit signed two's complement integer value  |
| <code>int16</code>      | 16-bit signed two's complement integer value |
| <code>int32</code>      | 32-bit signed two's complement integer value |

The `read` method does not coerce data type alignment. Some combinations of `address` and `datatype` will be difficult for the processor to use.

`mem=IDE_Obj.read(...,count)` adds the `count` input parameter that defines the dimensions of the returned data block `mem`. To read a block

of multiple data values. Specify `count` to determine how many values to read from `address`. `count` can be a scalar value that causes `read` to return a column vector that has `count` values. You can perform multidimensional reads by passing a vector for `count`. The elements in the input vector of `count` define the dimensions of the returned data matrix. The memory is read in column-major order. `count` defines the dimensions of the returned data array `mem` as shown in the following table.

- `n` — Read `n` values into a column vector.
- `[m,n]` — Read `m`-by-`n` values into `m` by `n` matrix in column-major order.
- `[m,n,...]` — Read a multidimensional matrix `m`-by-`n`-by...of values into an `m`-by-`n`-by...array.

To read a block of multiple data values, specify the input argument `count` that determines how many values to read from `address`.

`mem=IDE_Obj.read(...,memorytype)` adds an optional input argument `memorytype`. Object `IDE_Obj` has a default memory type value 0 that `read` applies if the memory type value is not explicitly incorporated into the passed address parameter.

In processors with only a single memory type, it is possible to specify addresses using the implied memory type format by setting the `IDE_Obj.memorytype` property value to zero.

### Using read with MULTI

Blackfin and SHARC use different memory types. Blackfin processors have one memory type. SHARC processors provide five types. The following table shows the memory types for both processor families.

| String Entry for memorytype | Numerical Entry for memorytype | Processor Support  |
|-----------------------------|--------------------------------|--------------------|
| 'program(pm) memory'        | 0                              | Blackfin and SHARC |
| 'data(dm) memory'           | 1                              | SHARC              |

# read

---

| String Entry for memorytype     | Numerical Entry for memorytype | Processor Support |
|---------------------------------|--------------------------------|-------------------|
| 'data(dm) short word memory'    | 2                              | SHARC             |
| 'external data(dm) byte memory' | 3                              | SHARC             |
| 'boot(prom) memory'             | 4                              | SHARC             |

`mem=IDE_Obj.read(...,timeout)` adds the optional parameter *timeout* that defines how long, in seconds, MATLAB waits for the specified read process to complete. If the time-out period expires before the read process returns a completion message, MATLAB returns an error and returns. Usually the read process works in spite of the error message.

## Examples

This example reads one 16-bit integer from memory on the processor.

```
mlvar = IDE_Obj.read(131072,'int16')
```

131072 is the decimal address of the data to read.

You can read more than one value at a time. This read command returns 100 32-bit integers from the address 0x20000 and plots the result in MATLAB.

```
data = IDE_Obj.read('20000','int32',100)
plot(double(data))
```

## See Also

`write`



**Purpose** Matrix of data from RTDX channel

---

**Note** Support for readmat on C5000 processors will be removed in a future version.

---

**Syntax**

```
data = readmat(rx,channelname,'datatype',siz,timeout)
data = readmat(rx,channelname,'datatype',siz)
```

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `data = readmat(rx,channelname,'datatype',siz,timeout)` reads a matrix of data from an RTDX channel configured for read access. `datatype` defines the type of data to read, and `channelname` specifies the queue to read. `readmat` reads the desired data from the RTDX link specified by `rx`.

Before you read from a channel, open and enable the channel for read access.

Replace `channelname` with the string you specified when you opened the desired channel. `channelname` must identify a channel that you defined in the program loaded on the processor.

You cannot read data from a channel you have not opened and configured for read access. To determine which channels exist for the loaded program, use the RTDX tools provided in the IDE.

`data` contains a matrix whose dimensions are given by the input argument vector `siz`, where `siz` can be a vector of two or more elements. To operate, the number of elements in the output matrix `data` must be an integral number of channel messages.

When you omit the `timeout` input argument, `readmat` reads messages from the specified channel until the output matrix is full or the global `timeout` period specified in `rx` elapses.

---

**Caution** If the timeout period expires before the output data matrix is fully populated, you lose the messages read from the channel to that point.

---

MATLAB software supports reading five data types with `readmat`.

| <b>datatype String</b> | <b>Data Format</b>                               |
|------------------------|--------------------------------------------------|
| 'double'               | Double-precision floating point values. 64 bits. |
| 'int16'                | 16-bit signed integers                           |
| 'int32'                | 32-bit signed integers                           |
| 'single'               | Single-precision floating point values. 32 bits. |
| 'uint8'                | Unsigned 8-bit integers                          |

`data = readmat(rx,channelname,'datatype',siz)` reads a matrix of data from an RTDX channel configured for read access. `datatype` defines the type of data to read, and `channelname` specifies the queue to read. `readmat` reads the desired data from the RTDX link specified by `rx`.

## Examples

In this data read and write example, you write data to the processor through the IDE. You can then read the data back in two ways — either through `read` or through `readmsg`.

To duplicate this example you need to have a program loaded on the processor. The channels listed in this example, `ichannel` and `ochannel`, must be defined in the loaded program. If the current program on the processor defines different channels, replace the listed channels with your current ones.

```
IDE_Obj = ticcs;
rx = IDE_Obj.rtdx;
open(rx,'ichannel','w');
enable(rx,'ichannel');
```

```
open(rx, 'ochannel', 'r');
enable(rx, 'ochannel');
indata = 1:25; % Set up some data.
IDE_Obj.write(0, indata, 30);
outdata=IDE_Obj.read(0, 'double', 25, 10)
```

```
outdata =
 Columns 1 through 13
 1 2 3 4 5 6 7 8 9 10 11 12 13
 Columns 14 through 25
 14 15 16 17 18 19 20 21 22 23 24 25
```

Now use RTDX to read the data into a 5-by-5 array called out\_array.

```
out_array = readmat('ochannel', 'double', [5 5])
```

## See Also

[readmsg](#) | [writemsg](#)

# readmsg

---

## Purpose

Read messages from specified RTDX channel

---

**Note** Support for readmsg on C5000 processors will be removed in a future version.

---

## Syntax

```
data = readmsg(rx,channelname,'datatype',siz,nummsgs,timeout)
data = readmsg(rx,channelname,'datatype',siz,nummsgs)
data = readmsg(rx,channelname,datatype,siz)
data = readmsg(rx,channelname,datatype,nummsgs)
data = readmsg(rx,channelname,datatype)
```

## IDEs

This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

## Description

```
data = readmsg(rx,channelname,'datatype',siz,nummsgs,timeout)
```

reads nummsgs from a channel associated with rx. channelname identifies the channel queue, which must be configured for read access. Each message is the same type, defined by datatype. nummsgs can be an integer that defines the number of messages to read from the specified queue, or all to read the messages present in the queue when you call the readmsg function.

Each read message becomes an output matrix in data, with dimensions specified by the elements in vector siz. For example, when siz is [m n], reading 10 messages (nummsgs equal 10) creates 10 m-by-n matrices in data. Each output matrix in data must have the same number of elements (m x n) as the number of elements in each message.

You must specify the type of messages you are reading by including the datatype argument. datatype supports strings that define the type of data you are expecting, as shown in the following table.

| <b>datatype String</b> | <b>Specified Data Type</b>                       |
|------------------------|--------------------------------------------------|
| 'double'               | Floating point data, 64-bits (double-precision). |
| 'int16'                | Signed 16-bit integer data.                      |
| 'int32'                | Signed 32-bit integers.                          |
| 'single'               | Floating-point data, 32-bits (single-precision). |
| 'uint8'                | Unsigned 8-bit integers.                         |

When you include the `timeout` input argument in the function, `readmsg` reads messages from the specified queue until it receives `nummsgs`, or until the period defined by `timeout` expires while `readmsg` waits for more messages to be available.

When the desired number of messages is not available in the queue, `readmsg` enters a wait loop and stays there until more messages become available or `timeout` seconds elapse. The `timeout` argument overrides the global timeout specified when you create `rx`.

`data = readmsg(rx,channelname,'datatype',siz,nummsgs)` reads `nummsgs` from a channel associated with `rx`. `channelname` identifies the channel queue, which must be configured for read access. Each message is the same type, defined by `datatype`. `nummsgs` can be an integer that defines the number of messages to read from the specified queue, or `all` to read the messages present in the queue when you call the `readmsg` function.

Each read message becomes an output matrix in `data`, with dimensions specified by the elements in vector `siz`. When `siz` is `[m n]`, reading 10 messages (`nummsgs` equal 10) creates 10 `n`-by-`m` matrices in `data`.

Each output matrix in `data` must have the same number of elements (`m x n`) as the number of elements in each message.

You must specify the type of messages you are reading by including the `datatype` argument. `datatype` supports six strings that define the type of data you are expecting.

# readmsg

---

`data = readmsg(rx,channelname,datatype,siz)` reads one data message because `nummsgs` defaults to one when you omit the input argument. `readmsg` returns the message as a row vector in `data`.

`data = readmsg(rx,channelname,datatype,nummsgs)` reads the number of messages defined by `nummsgs`. `data` becomes a cell array of row matrices, `data = {msg1,msg2,...,msg(nummsgs)}`, because `siz` defaults to `[1,nummsgs]`; each returned message becomes one row matrix in the cell array.

Each row matrix contains one element for each data value in the current message `msg# = [element(1), element(2),...,element(l)]` where `l` is the number of data elements in message. In this syntax, the read messages can have different lengths, unlike the previous syntax options.

`data = readmsg(rx,channelname,datatype)` reads one data message, returning a row vector in `data`. The optional input arguments—`nummsgs`, `siz`, and `timeout`—use their default values.

In the calling syntaxes for `readmsg`, you can set `siz` and `nummsgs` to empty matrices, causing them to use their default values—`nummsgs = 1` and `siz = [1,1]`, where `l` is the number of data elements in the read message.

---

**Caution** If the timeout period expires before the output data matrix is fully populated, you lose the messages read from the channel to that point.

---

## Examples

```
IDE_Obj = ticcs;
rx = IDE_Obj.rtdx;
open(rx,'ichannel','w');
enable(rx,'ichannel');
open(rx,'ochannel','r');
enable(rx,'ochannel');
indata = 1:25; % Set up some data.
IDE_Obj.write(0,indata,30);
outdata=IDE_Obj.read(0,'double',25,10)
```

```
outdata =
 Columns 1 through 13
 1 2 3 4 5 6 7 8 9 10 11 12 13
 Columns 14 through 25
 14 15 16 17 18 19 20 21 22 23 24 25
```

Now use `RTDX` to read the messages into a 4-by-5 array called `out_array`.

```
number_msgs = msgcount(rx,'ochannel') % Check number of msgs
 % in read queue.
out_array = IDE_Obj.rtdx.readmsg('ochannel','double',[4 5])
```

## See Also

[read](#) | [readmat](#) | [writemsg](#)

# rtw.codegenObjectives.Objective.register

---

|                        |                                                                                                                                                                               |            |                                                                  |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------|
| <b>Purpose</b>         | Register objective                                                                                                                                                            |            |                                                                  |
| <b>Syntax</b>          | <code>register(obj)</code>                                                                                                                                                    |            |                                                                  |
| <b>Description</b>     | <code>register(obj)</code> registers <i>obj</i> Register and add <i>obj</i> to the end of the list of available objectives that you can use with the Code Generation Advisor. |            |                                                                  |
| <b>Input Arguments</b> | <table><tr><td><i>obj</i></td><td>Handle to a code generation objective object previously created.</td></tr></table>                                                          | <i>obj</i> | Handle to a code generation objective object previously created. |
| <i>obj</i>             | Handle to a code generation objective object previously created.                                                                                                              |            |                                                                  |
| <b>Examples</b>        | Register the objective:<br><br><code>register(obj);</code>                                                                                                                    |            |                                                                  |
| <b>See Also</b>        | <code>DASudio.CustomizationManager.ObjectiveCustomizer</code>                                                                                                                 |            |                                                                  |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Create Custom Objectives”</li><li>• “Registering Customizations”</li></ul>                                                           |            |                                                                  |



**Purpose** Create function entry based on specified parameters and register in code replacement table

**Syntax**

```
entry = registerCFunctionEntry(hTable, priority,
 numInputs, functionName,
 inputType, implementationName,
 outputType, headerFile,
 genCallback, genFileName)
```

**Input Arguments**

*hTable*  
Handle to a code replacement table previously returned by *hTable* = RTW.Tf1Table.

*priority*  
Positive integer specifying the function entry's search priority, 0-100, relative to other entries of the same function name and conceptual argument list within this table. Highest priority is 0, and lowest priority is 100. If the table provides two implementations for a function, the implementation with the higher priority will shadow the one with the lower priority.

*numInputs*  
Positive integer specifying the number of input arguments.

*functionName*  
String specifying the name of the function to be replaced. The name must match one of the functions supported for replacement:

| Math Functions                                                                                                  |      |       |       |
|-----------------------------------------------------------------------------------------------------------------|------|-------|-------|
| <b>Note</b> For detailed support information, see “Map Math Functions to Application-Specific Implementations”. |      |       |       |
| abs                                                                                                             | acos | acosh | asin  |
| asinh                                                                                                           | atan | atan2 | atanh |

# registerCFunctionEntry

|                                                        |             |          |                          |
|--------------------------------------------------------|-------------|----------|--------------------------|
| ceil                                                   | cos         | cosh     | exactrSqrt               |
| exp                                                    | fix         | floor    | frexp                    |
| hypot                                                  | ldexp       | ln       | log                      |
| log10                                                  | max         | min      | mod/fmod                 |
| pow                                                    | rem         | round    | rSqrt                    |
| saturate                                               | sign        | signPow  | sin                      |
| sincos                                                 | sinh        | sqrt     | round                    |
| tan                                                    | tanh        |          |                          |
| <b>Memory Utility Functions</b>                        |             |          |                          |
| memcmp                                                 | memcpy      | memset   | memset2zero <sup>1</sup> |
| <b>Nonfinite Support Utility Functions<sup>2</sup></b> |             |          |                          |
| getInf                                                 | getMinusInf | getNaN   | isInf <sup>3</sup>       |
| isNaN <sup>3</sup>                                     |             |          |                          |
| <b>Lookup Table Functions<sup>2</sup></b>              |             |          |                          |
| interp1D                                               | interp4D    | lookup2D | lookup5D                 |
| interp2D                                               | interp5D    | lookup3D | lookupND_Direct          |
| interp3D                                               | lookup1D    | lookup4D | prelookup                |

<sup>1</sup> Some target processors provide optimized `memset` functions for you to set memory to zero. The code replacement library API supports replacing `memset` to zero functions with more efficient target-specific functions.

<sup>2</sup> Code replacement is supported for Simulink code generation only.

<sup>3</sup> Replacement of `isInf` and `isNaN` is supported only for complex floating-point inputs.

## *inputType*

String specifying the data type of the input arguments, for example, 'double'. (This function requires that the input arguments are of the same type.)

## *implementationName*

String specifying the name of your implementation. For example, if *functionName* is 'sqrt', *implementationName* can be 'sqrt' or a different name of your choosing.

## *outputType*

String specifying the data type of the return argument, for example, 'double'.

## *headerFile*

String specifying the header file in which the implementation function is declared, for example, '<math.h>'.

## *genCallback*

String specifying '' or 'RTW.copyFileToBuildDir'. If you specify 'RTW.copyFileToBuildDir', and if this function entry is matched and used, the function RTW.copyFileToBuildDir will be called after code generation to copy additional header, source, or object files that you have specified for this function entry to the build directory. For more information, see “Specify Build Information for Code Replacements” in the Embedded Coder documentation.

## *genFileName*

String specifying ''. (This argument is for use only by MathWorks developers.)

## **Output Arguments**

Handle to the created code replacement function entry. Specifying the return argument in the registerCFunctionEntry function call is optional.

## **Description**

The registerCFunctionEntry function provides a quick way to create and register a code replacement function entry. This function can be used only if your function entry meets the following conditions:

- The input arguments are of the same type.
- The input argument names and the return argument name follow the default Simulink naming convention:
  - For input argument names, u1, u2, ..., un

# registerCFunctionEntry

---

- For return argument, y1

## Examples

In the following example, the `registerCFunctionEntry` function is used to create a function entry for `sqrt` in a code replacement table.

```
hLib = RTW.Tf1Table;

hLib.registerCFunctionEntry(100, 1, 'sqrt', 'double', 'sqrt', ...
 'double', '<math.h>', '', '');
```

## See Also

`registerCPromotableMacroEntry`

## How To

- “Alternative Method for Creating Function Entries”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

## Purpose

Create C++ function entry based on specified parameters and register in code replacement table

## Syntax

```
entry = registerCPPFunctionEntry(hTable, priority,
 numInputs, functionName,
 inputType, implementationName,
 outputType, headerFile,
 genCallback, genFileName,
 nameSpace)
```

## Input Arguments

*hTable*

Handle to a code replacement table previously returned by *hTable* = RTW.Tf1Table.

*priority*

Positive integer specifying the function entry's search priority, 0-100, relative to other entries of the same function name and conceptual argument list within this table. Highest priority is 0, and lowest priority is 100. If the table provides two implementations for a function, the implementation with the higher priority will shadow the one with the lower priority.

*numInputs*

Positive integer specifying the number of input arguments.

*functionName*

String specifying the name of the function to be replaced. The name must match one of the functions supported for replacement:

### Math Functions

**Note** For detailed support information, see “Map Math Functions to Application-Specific Implementations”.

|       |      |       |       |
|-------|------|-------|-------|
| abs   | acos | acosh | asin  |
| asinh | atan | atan2 | atanh |

# registerCPPFunctionEntry

|                                                        |             |          |                          |
|--------------------------------------------------------|-------------|----------|--------------------------|
| ceil                                                   | cos         | cosh     | exactrSqrt               |
| exp                                                    | fix         | floor    | frexp                    |
| hypot                                                  | ldexp       | ln       | log                      |
| log10                                                  | max         | min      | mod/fmod                 |
| pow                                                    | rem         | round    | rSqrt                    |
| saturate                                               | sign        | signPow  | sin                      |
| sincos                                                 | sinh        | sqrt     | round                    |
| tan                                                    | tanh        |          |                          |
| <b>Memory Utility Functions</b>                        |             |          |                          |
| memcmp                                                 | memcpy      | memset   | memset2zero <sup>1</sup> |
| <b>Nonfinite Support Utility Functions<sup>2</sup></b> |             |          |                          |
| getInf                                                 | getMinusInf | getNaN   | isInf <sup>3</sup>       |
| isNaN <sup>3</sup>                                     |             |          |                          |
| <b>Lookup Table Functions<sup>2</sup></b>              |             |          |                          |
| interp1D                                               | interp4D    | lookup2D | lookup5D                 |
| interp2D                                               | interp5D    | lookup3D | lookupND_Direct          |
| interp3D                                               | lookup1D    | lookup4D | prelookup                |

<sup>1</sup> Some target processors provide optimized `memset` functions for you to set memory to zero. The code replacement library API supports replacing `memset` to zero functions with more efficient target-specific functions.

<sup>2</sup> Code replacement is supported for Simulink code generation only.

<sup>3</sup> Replacement of `isInf` and `isNaN` is supported only for complex floating-point inputs.

## *inputType*

String specifying the data type of the input arguments, for example, 'double'. (This function requires that the input arguments are of the same type.)

*implementationName*

String specifying the name of your implementation. For example, if *functionName* is 'sqrt', *implementationName* can be 'sqrt' or a different name of your choosing.

*outputType*

String specifying the data type of the return argument, for example, 'double'.

*headerFile*

String specifying the header file in which the implementation function is declared, for example, '<math.h>'.

*genCallback*

String specifying '' or 'RTW.copyFileToBuildDir'. If you specify 'RTW.copyFileToBuildDir', and if this function entry is matched and used, the function RTW.copyFileToBuildDir will be called after code generation to copy additional header, source, or object files that you have specified for this function entry to the build directory. For more information, see “Specify Build Information for Code Replacements” in the Embedded Coder documentation.

*genFileName*

String specifying ''. (This argument is for use only by MathWorks developers.)

*nameSpace*

String specifying the C++ name space in which the implementation function is defined. If this function entry is matched, the software emits the name space in the generated function code (for example, `std::sin(tf1_cpp_U.In1)`). If you specify '', the software does not emit a name space designation in the generated code.

## Output Arguments

Handle to the created C++ function entry. Specifying the return argument in the registerCPPFunctionEntry function call is optional.

## Description

The registerCPPFunctionEntry function provides a quick way to create and register a code replacement C++ function entry. This

# registerCPPFunctionEntry

---

function can be used only if your C++ function entry meets the following conditions:

- The input arguments are of the same type.
- The input argument names and the return argument name follow the default Simulink naming convention:
  - For input argument names, *u1*, *u2*, ..., *un*
  - For return argument, *y1*

---

**Note** When you register a code replacement library containing C++ function entries, you must specify the value { 'C++' } for the `LanguageConstraint` property of the library registry entry. For more information, see “Register Code Replacement Libraries”.

---

## Examples

In the following example, the `registerCPPFunctionEntry` function is used to create a C++ function entry for `sin` in a code replacement table.

```
hLib = RTW.Tf1Table;

hLib.registerCPPFunctionEntry(100, 1, 'sin', 'single', 'sin', ...
 'single', 'cmath', '', '', 'std');
```

## See Also

`enableCPP` | `setNameSpace`

## How To

- “Alternative Method for Creating Function Entries”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”



## Purpose

Create promotable code replacement macro entry based on specified parameters and register in code replacement table (for abs function replacement only)

## Syntax

```
entry = registerCPromotableMacroEntry(hTable, priority,
 numInputs, functionName,
 inputType, implementationName,
 outputType, headerFile,
 genCallback, genFileName)
```

## Input Arguments

*hTable*

Handle to a code replacement table previously returned by *hTable* = RTW.Tf1Table.

*priority*

Positive integer specifying the function entry's search priority, 0-100, relative to other entries of the same function name and conceptual argument list within this table. Highest priority is 0, and lowest priority is 100. If the table provides two implementations for a function, the implementation with the higher priority will shadow the one with the lower priority.

*numInputs*

Positive integer specifying the number of input arguments.

*functionName*

String specifying the name of the function to be replaced. Specify 'abs'. (This function should be used only for abs function replacement.)

*inputType*

String specifying the data type of the input arguments, for example, 'double'. (This function requires that the input arguments are of the same type.)

*implementationName*

String specifying the name of your implementation. For example, assuming *functionName* is 'abs', *implementationName* can be 'abs' or a different name of your choosing.

# registerCPromotableMacroEntry

---

## *outputType*

String specifying the data type of the return argument, for example, 'double'.

## *headerFile*

String specifying the header file in which the implementation function is declared, for example, '<math.h>'.

## *genCallback*

String specifying '' or 'RTW.copyFileToBuildDir'. If you specify 'RTW.copyFileToBuildDir', and if this function entry is matched and used, the function RTW.copyFileToBuildDir will be called after code generation to copy additional header, source, or object files that you have specified for this function entry to the build directory. For more information, see “Specify Build Information for Code Replacements” in the Embedded Coder documentation.

## *genFileName*

String specifying ''. (This argument is for use only by MathWorks developers.)

## **Output Arguments**

Handle to the created promotable macro entry. Specifying the return argument in the registerCPromotableMacroEntry function call is optional.

## **Description**

The registerCPromotableMacroEntry function creates a promotable macro entry based on specified parameters and registers the entry in the code replacement table. A promotable macro entry will promote the output data type based on the target word size.

This function provides a quick way to create and register a promotable macro entry. This function can be used only if your code replacement function entry meets the following conditions:

- The input arguments are of the same type.
- The input argument names and the return argument name follow the default Simulink naming convention:
  - For input argument names,  $u_1$ ,  $u_2$ , ...,  $u_n$

- For return argument, y1

---

**Note** This function should be used only for `abs` function replacement. Other functions supported for replacement should use `registerCFunctionEntry`.

---

## Examples

In the following example, the `registerCPromotableMacroEntry` function is used to create a function entry for `abs` in a code replacement table.

```
hLib = RTW.Tf1Table;

hLib.registerCPromotableMacroEntry(100, 1, 'abs', 'double', 'abs_prime', ...
 'double', '<math_prime.h>', '', '');
```

## See Also

`registerCFunctionEntry`

## How To

- “Alternative Method for Creating Function Entries”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

# regread

---

## Purpose

Values from processor registers

## Syntax

```
reg=IDE_Obj.regread('regname','represent',timeout)
reg = IDE_Obj.regread('regname','represent')
reg = IDE_Obj.regread('regname')
```

## IDEs

This function supports the following IDEs:

- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

## Description

`reg=IDE_Obj.regread('regname','represent',timeout)` reads the data value in the `regname` register of the target processor and returns the value in `reg` as a double-precision value. For convenience, `regread` converts each return value to the MATLAB `double` datatype. Making this conversion lets you manipulate the data in MATLAB. String `regname` specifies the name of the source register on the target. The IDE handle, `IDE_Obj`, defines the target to read from. Valid entries for `regname` depend on your target processor.

---

**Note** `regread` does not read 64-bit registers, like the `cycle` register on Blackfin processors.

---

Register names are not case-sensitive — `a0` is the same as `A0`.

For example, MPC5500 processors provide the following register names that are valid entries for `regname`.

| Register Names      | Register Contents      |
|---------------------|------------------------|
| 'acc'               | Accumulator A register |
| sprg0 through sprg7 | SPR registers          |

For example, TMS320C6xxx processors provide the following register names that are valid entries for `regname`.

| Register Names                    | Register Contents                      |
|-----------------------------------|----------------------------------------|
| A0, A1, A2, ..., A15              | General purpose A registers            |
| B0, B1, B2, ..., B15              | General purpose B registers            |
| PC, ISTP, IFR, IRP, NRP, AMR, CSR | Other general purpose 32-bit registers |
| A1:A0, A2:A1, ..., B15:B14        | 64-bit general purpose register pairs  |

**Note** Use read (called a direct memory read) to read memory-mapped registers.

The `represent` input argument defines the format of the data stored in `regname`. Input argument `represent` takes one of three input strings.

| represent String | Description                                                                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| '2scomp'         | Source register contains a signed integer value in two's complement format. This is the default setting when you omit the <code>represent</code> argument.                     |
| 'binary'         | Source register contains an unsigned binary integer.                                                                                                                           |
| 'ieee'           | Source register contains a floating point 32-bit or 64-bit value in IEEE floating-point format. Use this only when you are reading from 32 and 64 bit registers on the target. |

To limit the time that `regread` spends transferring data from the target processor, the optional argument `timeout` tells the data transfer process to stop after `timeout` seconds. `timeout` is defined as the number of seconds allowed to complete the read operation. You might find this useful for limiting prolonged data transfer operations. If you omit the `timeout` argument, `regread` defaults to the global time-out defined in `IDE_Obj`.

`reg = IDE_Obj.regread('regname', 'represent')` does not set the global time-out value. The time-out value in `IDE_Obj` applies.

`reg = IDE_Obj.regread('regname')` does not define the format of the data in `regname`.

## Reading and Writing Register Values

Register variables can be difficult to read and write because the registers which hold their value are not dedicated to storing just the variable values.

Registers are used as temporary storage locations during execution. When this temporary storage process occurs, the value of the variable is temporarily stored somewhere on the stack and returned later. Therefore, getting the values of register variables during program execution may return unexpected answers.

Values that you write to register variables and local variables during intermediate times in program operation may not get reflected in the register.

To see if the result is consistent, write a line of code that uses the variable. For example:

```
register int a = 100;
int b;
...
b = a + 2;
```

Reading the register assigned to `a` may return an incorrect value for `a` but if `b` returns the expected 102 result, nothing is wrong with the code or the software.

## Examples

### For MULTI IDE

For the MPC5554 processor, most registers are memory-mapped and consequently are available using `read` and `write`. However, use `regread` to read the PC register. The following command shows how to read the PC register. To identify the target, `IDE_Obj` is the IDE handle.

```
IDE_Obj.regread('PC','binary')
```

To tell MATLAB what data type you are reading, the string `binary` indicates that the PC register contains a value stored as an unsigned binary integer.

In response, MATLAB displays

```
ans =

 33824
```

For processors in the Blackfin family, `regread` lets you access processor registers directly. To read the value in general purpose register cycles, type the following function.

```
treg = IDE_Obj.regread('cycles','2scomp');
```

`treg` now contains the two's complement representation of the value in A0.

### For CCS IDE

For the C5xxx processor family, most registers are memory-mapped and consequently are available using `read` and `write`. However, use `regread` to read the PC register. The following command shows how to read the PC register. To identify the processor, `IDE_Obj` is a link for CCS IDE.

```
IDE_Obj.regread('PC','binary')
```

To tell MATLAB software what datatype you are reading, the string `binary` indicates that the PC register contains a value stored as an unsigned binary integer.

In response, MATLAB software displays

```
ans =

 33824
```

# regread

---

For processors in the C6xxx family, `regread` lets you access processor registers directly. To read the value in general purpose register A0, type the following function.

```
treg = IDE_Obj.regread('A0', '2scomp');
```

`treg` now contains the two's complement representation of the value in A0.

Now read the value stored in register B2 as an unsigned binary integer, by typing

```
IDE_Obj.regread('B2', 'binary');
```

## See Also

`read` | `regwrite` | `write`



**Purpose**

Write data values to registers on processor

**Syntax**

```
IDE_Obj.regwrite('regname',value,'represent',timeout)
IDE_Obj.regwrite('regname',value,'represent')
IDE_Obj.regwrite('regname',value,)
```

**IDEs**

This function supports the following IDEs:

- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description**

`IDE_Obj.regwrite('regname',value,'represent',timeout)` writes the data in `value` to the `regname` register of the target processor. `regwrite` converts `value` from its representation in the MATLAB workspace to the representation specified by `represent`. The `represent` input argument defines the format of the data when it is stored in `regname`. Input argument `represent` takes one of three input strings.

| represent String | Description                                                                                                                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| '2scomp'         | Write value to the destination register as a signed integer value in two's complement format. This is the default setting when you omit the <code>represent</code> argument.                     |
| 'binary'         | Write value to the destination register as an unsigned binary integer.                                                                                                                           |
| 'ieee'           | Write value to the destination registers as a floating point 32-bit or 64-bit value in IEEE floating-point format. Use this only when you are writing to 32- and 64-bit registers on the target. |

---

**Note** Use `write` to write memory-mapped registers. This action is also called a *direct memory write*.

---

# regwrite

---

String `regname` specifies the name of the destination register on the target. IDE handle, `IDE_Obj` defines the target to write value to. Valid entries for `regname` depend on your target processor. Register names are not case-sensitive — `a0` is the same as `A0`.

For example, MPC5500 processors provide the following register names that are valid entries for `regname`.

| Register Names | Register Contents      |
|----------------|------------------------|
| 'acc'          | Accumulator A register |
| sprg0          | SPR registers          |

For example, C6xxx processors provide the following register names that are valid entries for `regname`.

| Register Names                     | Register Contents                      |
|------------------------------------|----------------------------------------|
| A0, A1, A2,..., A15                | General purpose A registers            |
| B0, B1, B2,..., B15                | General purpose B registers            |
| PC, ISTOP, IFR, IRP, NRP, AMR, CSR | Other general purpose 32-bit registers |
| A1:A0, A2:A1,..., B15:B14          | 64-bit general purpose register pairs  |

Other processors provide other register sets. Refer to the documentation for your target processor to determine the registers for the processor.

To limit the time that `regwrite` spends transferring data to the target processor, the optional argument `timeout` tells the data transfer process to stop after `timeout` seconds. `timeout` is defined as the number of seconds allowed to complete the write operation. You might find this useful for limiting prolonged data transfer operations.

If you omit the `timeout` input argument in the syntax, `regwrite` defaults to the global time-out defined in `IDE_Obj`. If the write operation exceeds the time specified, `regwrite` returns with a time-out error. Generally, time-out errors do not stop the register write process. The

write process stops while waiting for the IDE to respond that the write operation is complete.

`IDE_Obj.regwrite('regname',value,'represent')` omits the `timeout` input argument and does not change the time-out value specified in `IDE_Obj`.

`IDE_Obj.regwrite('regname',value,)` omits the `represent` input argument. Writing the data does not reformat the data written to `regname`.

### Reading and Writing Register Values

Register variables can be difficult to read and write because the registers which hold their value are not dedicated to storing just the variable values.

Registers are used as temporary storage locations during execution. When this temporary storage process occurs, the value of the variable is temporarily stored somewhere on the stack and returned later. Therefore, getting the values of register variables during program execution may return unexpected answers.

Values that you write to register variables and local variables during intermediate times in program operation may not get reflected in the register.

To see if the result is consistent, write a line of code that uses the variable. For example:

```
register int a = 100;
int b;
...
b = a + 2;
```

Reading the register assigned to `a` may return an incorrect value for `a` but if `b` returns the expected 102 result, nothing is wrong with the code or the software.

# regwrite

---

## Examples

To write a new value to the PC register on a C5xxx family processor, enter

```
IDE_Obj.regwrite('pc',hex2dec('100'),'binary')
```

specifying that you are writing the value 256 (the decimal value of 0x100) to register pc as binary data.

To write a 64-bit value to a register pair, such as B1:B0, the following syntax specifies the value as a string, representation, and target registers.

```
IDE_Obj.regwrite('b1:b0',hex2dec('1010'),'ieee')
```

Registers B1:B0 now contain the value 4112 in double-precision format.

## See Also

read | regread | write

**Purpose** Reload most recent program file to processor signal processor

**Syntax**

```
s = IDE_Obj.reload(timeout)
s = IDE_Obj.reload
```

**IDEs** This function supports the following IDEs:

- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `s = IDE_Obj.reload(timeout)` resends the most recently loaded program file to the processor. If you have not loaded a program file in the current session (so there is no previously loaded file), `reload` returns the null entry `[]` in `s` indicating that it could not load a file to the processor. Otherwise, `s` contains the full path name to the program file. After you reset your processor or after an event produces changes in your processor memory, use `reload` to restore the program file to the processor for execution.

To limit the time the IDE spends trying to reload the program file to the processor, `timeout` specifies how long the load process can take. If the load process exceeds the timeout limit, the IDE stops trying to load the program file and returns an error stating that the time period expired. Exceeding the allotted time for the reload operation usually indicates that the reload was complete but the IDE did not receive confirmation before the timeout period passed.

`s = IDE_Obj.reload` reloads the most recent program file, using the `timeout` value set when you created link `IDE_Obj`, the global timeout setting.

### Using reload with Multiprocessor Boards

When your board contains more than one processor, `reload` calls the reloading function for each processor represented by `IDE_Obj`, reloading the most recently loaded program on each processor.

This action is the same as calling `reload` for each processor individually through IDE handle objects for each one.

# reload

---

## Examples

After you create an object that connects to the IDE, use the available methods to reload your most recently loaded project. If you have not loaded a project in this session, `reload` returns an error and an empty value for `s`. Loading a project eliminates the error. First, create an IDE handle object, such as `IDE_Obj`, using the constructor for your IDE.

```
s=IDE_Obj.reload(23)
Warning: No action taken - load a valid Program file before
you reload...

s =

 ''

IDE_Obj.open('D:\ti\tutorial\sim62xx\gelsolid\hellodsp.pjt', 'project')

IDE_Obj.build

IDE_Obj.load('hellodsp.pjt') #This file extension varies by IDE
IDE_Obj.halt
s=IDE_Obj.reload(23)

s =

D:\ti\tutorial\sim62xx\gelsolid\Debug\hellodsp.out

cd | load | open
```

## See Also

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Remove file, project, or breakpoint                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Syntax</b>          | <pre>IDE_Obj.remove(filename, filetype) IDE_Obj.remove(addr, debugtype, timeout) IDE_Obj.remove(filename, line, debugtype, timeout) IDE_Obj.remove(all, break)</pre>                                                                                                                                                                                                                                                                                    |
| <b>IDEs</b>            | This function supports the following IDEs: <ul style="list-style-type: none"><li>• Analog Devices VisualDSP++</li><li>• Green Hills MULTI</li><li>• Texas Instruments Code Composer Studio v3</li></ul>                                                                                                                                                                                                                                                 |
| <b>Description</b>     | <p><i>IDE_Obj.remove(filename, filetype)</i> deletes a file from the active project in the IDE or deletes the project.</p> <p><i>IDE_Obj.remove(addr, debugtype, timeout)</i> removes a debug point from an address in the program.</p> <p><i>IDE_Obj.remove(filename, line, debugtype, timeout)</i> removes a debug point from a line in a source file.</p> <p><i>IDE_Obj.remove(all, break)</i> removes the breakpoints and waits for completion.</p> |
| <b>Input Arguments</b> | <p><b>IDE_Obj</b></p> <p>Enter the name of the IDE link handle for your IDE. Create an IDE link handle before you use the remove method. .</p> <p><b>filename</b></p> <p>Replace <i>filename</i> with the name of the file you are removing, or the source file from which you are removing debug points. If the file is not located in the active project, MATLAB returns a warning instead of completing the action.</p> <p><b>filetype</b></p>       |

## remove

---

To remove a project, enter 'project'. To remove a source file, enter 'text'.

**Default:** 'text'

### **addr**

Enter the memory address of the debug point. Enter 'all' to remove the breakpoints.

### **debugtype**

Enter the type of debug point to remove. The IDE provide several types of debug points. Refer to the IDE help documentation for information on their respective behavior.

**Default:** 'break' (breakpoint)

### **line**

Enter the line number of the debug point located in a file.

### **timeout**

Enter a time limit, in seconds, for the method to complete an action.

## **Examples**

After you have a project in the IDE, you can delete files from it using `remove` from the MATLAB software command line. For example, build a project and load the resulting `.out` file. With the project build complete, load your `.out` file by typing

```
IDE_Obj.load('filename.out')
```

Now remove one file from your project

```
IDE_Obj.remove('filename')
```

You see in the IDE that the file no longer appears.



**See Also**

add | cd | open

# rtw.codegenObjectives.Objective.removeInheritedCheck

---

**Purpose** Remove inherited checks

**Syntax** `removeInheritedCheck(obj, checkID)`

**Description** `removeInheritedCheck(obj, checkID)` removes an inherited check from the objective definition. Use this method when you create a new objective from an existing objective.

When the user selects multiple objectives, if another selected objective includes this check, the Code Generation Advisor displays the check.

|                        |                |                                                                        |
|------------------------|----------------|------------------------------------------------------------------------|
| <b>Input Arguments</b> | <i>obj</i>     | Handle to a code generation objective object previously created.       |
|                        | <i>checkID</i> | Unique identifier of the check that you remove from the new objective. |

**Examples** Remove the **Identify questionable code instrumentation (data I/O)** check from the objective.

```
removeInheritedCheck(obj, 'mathworks.codegen.CodeInstrumentation');

)
```

**See Also** `Simulink.ModelAdvisor`

**How To**

- “Create Custom Objectives”
- “About IDs”

# rtw.codegenObjectives.Objective.removeInheritedParam

---

**Purpose** Remove inherited parameters

**Syntax** `removeInheritedParam(obj, paramName)`

**Description** `removeInheritedParam(obj, paramName)` removes an inherited parameter from this objective. Use this method when you create a new objective from an existing objective.

When the user selects multiple objectives, if another objective includes the parameter, the Code Generation Advisor reviews the parameter value using **Check model configuration settings against code generation objectives**.

## Input Arguments

*obj* Handle to a code generation objective object previously created.

*paramName* Parameter that you want to remove from the objective.

## Examples

Remove Inlineparameters from the objective.

```
removeInheritedParam(obj, 'InlineParams');
```

## See Also

`get_param`

## How To

- “Create Custom Objectives”
- “Parameter Command-Line Information Summary”

# report

---

**Purpose** Open code execution profiling report and specify display of time measurements.

**Syntax**

```
myExecutionProfile.report
myExecutionProfile.report(Name1, Value1,
Name2, Value2, ...)
myExecutionProfile.report('Units', 'Seconds',
'ScaleFactor', '1e-06',
'NumericFormat', '%0.3f')
```

**Description** When you run a SIL or PIL simulation with code execution profiling, the software generates the workspace variable *myExecutionProfile*, specified in **Configuration Parameters > Code Generation > Verification > Workspace variable**.

*myExecutionProfile.report* opens the code execution profiling report using default display options.

*myExecutionProfile.report*(Name1, Value1, Name2, Value2, ...) opens the report with display options specified by the name-value *string* pairs.

For example, to display time in microseconds ( $10^{-6}$  seconds) with a precision of three decimal places, use the following command:

```
myExecutionProfile.report('Units', 'Seconds',
'ScaleFactor', '1e-06', 'NumericFormat', '%0.3f')
```

| Name-Value Pair                        | Details                                                                                                                                                                                                                                                                                     |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Units', 'Seconds' or 'Units', 'Ticks' | Time measurements displayed in seconds or timer ticks.Default: <ul style="list-style-type: none"><li>• SIL simulation on Windows — Seconds</li><li>• SIL simulation on non-Windows — Timer ticks</li><li>• PIL simulation — Seconds, if number of timer ticks per second has been</li></ul> |

| Name-Value Pair                    | Details                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                    | specified by the target connectivity configuration. Otherwise, ticks.                                                                                                                                                                                                                                                                                              |
| 'ScaleFactor', <i>Value</i>        | Scale factor for displayed measurements. For example, to display measurements in microseconds, use the name-value pair 'ScaleFactor', '1e-6'. <i>Value</i> must be a string representation of a number that is a power of 10. For example, '1', '1e-6', or '1e-9'. Default value is '1e-9'. To specify the scale factor, you must also specify 'Units', 'Seconds'. |
| 'NumericFormat', <i>Convention</i> | Numeric format for displayed measurements. Use the <i>decimal</i> convention utilized by the ANSI <sup>®</sup> C function <code>sprintf</code> , for example, '%1.2f'. Default is '%0.0f'. To specify the numeric format, you must also specify 'Units', 'Seconds'.                                                                                                |

**See Also**

display

**How To**

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”

# reset

---

**Purpose** Stop program execution and reset processor

**Syntax** `IDE_Obj.reset(timeout)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj.reset(timeout)` stops the program executing on the processor and asynchronously performs a processor reset, returning the processor register contents to their power-up settings. `reset` returns immediately after the processor halt.

The optional *timeout* argument sets the number of seconds MATLAB waits for the processor to halt. If you omit the *timeout* argument, *timeout* defaults to the *timeout* value of the IDE handle object.

**See Also** `halt` | `load` | `run`

---

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Reload most recent program file to processor signal processor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Syntax</b>      | <code>IDE_Obj.restart</code><br><code>IDE_Obj.restart(timeout)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>IDEs</b>        | This function supports the following IDEs: <ul style="list-style-type: none"><li>• Green Hills MULTI</li><li>• Texas Instruments Code Composer Studio v3</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b> | <p><code>IDE_Obj.restart</code> issues a restart command in the IDE debugger. The behavior of the restart process depends on the processor. Refer to the documentation for your IDE for details about using restart with various processors.</p> <p>When <code>IDE_Obj</code> is an array that contains more than one processor, each processor calls <code>restart</code> in sequence.</p> <p><code>IDE_Obj.restart(timeout)</code> adds the optional <code>timeout</code> input argument. <code>timeout</code> defines an upper limit in seconds on the period the restart routine waits for completion of the restart process. If the time-out period is exceeded, <code>restart</code> returns control to MATLAB with a time-out error. In general, <code>restart</code> causes the processor to initiate a restart, even if the time-out period expires. The time-out error indicates that the restart confirmation was not received before the time-out period elapsed.</p> |
| <b>See Also</b>    | <code>halt</code>   <code>isrunning</code>   <code>run</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

# rtIOStreamClose

---

**Purpose** Shut down communications channel with remote processor

**Syntax** `int rtIOStreamClose(int streamID)`

**Arguments** *streamID*  
A handle to the stream that was returned by a previous call to `rtIOStreamOpen`.

**Description** `int rtIOStreamClose(int streamID)`  
Call this function to shut down the communications channel and clean up associated resources.

A return value of zero indicates success. `RTIOSTREAM_ERROR` indicates an error.

`RTIOSTREAM_ERROR` is defined in `rtiostream.h` as:

```
#define RTIOSTREAM_ERROR (-1)
```

**See Also** `rtIOStreamOpen` | `rtIOStreamSend` | `rtIOStreamRecv` | `rtiostream_wrapper`

**How To**

- “Create a Connectivity Configuration for a Target”
- `rtwdemo_rtiostream_script`
- `rtwdemo_custom_pil_script`



|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Initialize communications channel with remote processor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Syntax</b>      | <code>int rtIOStreamOpen(int argc, void * argv[ ])</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Arguments</b>   | <p><i>argc</i><br/>Integer argument count, i.e., the number of parameters in <code>argv[ ]</code></p> <p><i>argv[ ]</i><br/>An array of pointers to parameters; typically these are null-terminated string parameters, however, this is allowed to be implementation dependent.</p>                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b> | <p><code>int rtIOStreamOpen(int argc, void * argv[ ])</code></p> <p>This function initializes a communication stream to allow exchange of data between host and target.</p> <p>The input parameters allows driver-specific parameters to be passed to the communications driver.</p> <p>If able to initialize a communication stream, the function returns a nonnegative integer greater than zero, representing a stream handle. A return value of <code>RTIOSTREAM_ERROR</code> indicates an error.</p> <p><code>RTIOSTREAM_ERROR</code> is defined in <code>rtiostream.h</code> as:</p> <pre>#define RTIOSTREAM_ERROR (-1)</pre> |
| <b>See Also</b>    | <code>rtIOStreamSend</code>   <code>rtIOStreamRecv</code>   <code>rtIOStreamClose</code>   <code>rtiostream_wrapper</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>How To</b>      | <ul style="list-style-type: none"><li>• “Create a Connectivity Configuration for a Target”</li><li>• <code>rtwdemo_rtiostream_script</code></li><li>• <code>rtwdemo_custom_pil_script</code></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                              |

# rtIOStreamRecv

---

**Purpose** Receive data from remote processor

**Syntax** `int rtIOStreamRecv(int streamID, void * dst, size_t size, size_t * sizeRecvd)`

**Arguments**

*streamID*  
A handle to the stream that was returned by a previous call to `rtIOStreamOpen`.

*size*  
Size of data to copy into the buffer. For byte-addressable architectures, `size` is measured in bytes. Some DSP architectures are not byte-addressable. In these cases, `size` is measured in number of WORDs, where `sizeof(WORD) == 1`.

*dst*  
A pointer to the start of the buffer where received data must be copied.

*sizeRecvd*  
The number of units of data received and copied into the buffer `dst` (zero if data was not copied).

**Description** `int rtIOStreamRecv(int streamID, void * dst, size_t size, size_t * sizeRecvd)`

This function receives data over a communication channel with a remote processor.

A return value of zero indicates success. `RTIOSTREAM_ERROR` indicates an error.

`RTIOSTREAM_ERROR` is defined in `rtiostream.h` as:

```
#define RTIOSTREAM_ERROR (-1)
```

See also `rtiostreamSend` for implementation and performance considerations.

**See Also**

[rtIOStreamSend](#) | [rtIOStreamOpen](#) | [rtIOStreamClose](#) | [rtIOStream\\_wrapper](#)

**How To**

- “Create a Connectivity Configuration for a Target”
- [rtwdemo\\_rtiostream\\_script](#)
- [rtwdemo\\_custom\\_pil\\_script](#)

# rtIOStreamSend

---

**Purpose** Send data to remote processor

**Syntax** `int rtIOStreamSend(int streamID,const void * src,size_t size,  
size_t * sizeSent)`

**Arguments**

*streamID*  
A handle to the stream that was returned by a previous call to `rtIOStreamOpen`.

*src*  
A pointer to the start of the buffer containing an array of data to transmit

*size*  
Size of data to transmit. For byte-addressable architectures, *size* is measured in bytes. Some DSP architectures are not byte-addressable. In these cases, *size* is measured in number of WORDs, where `sizeof(WORD) == 1`.

*sizeSent*  
Size of data actually transmitted (less than or equal to *size*), or zero if data was not transmitted

**Description** `int rtIOStreamSend(int streamID,const void * src,size_t  
size, size_t * sizeSent)`

This function sends data over a communication stream with a remote processor.

A return value of zero indicates success.`RTIOSTREAM_ERROR` indicates an error.

`RTIOSTREAM_ERROR` is defined in `rtiostream.h` as:

```
#define RTIOSTREAM_ERROR (-1)
```

## Implementation and Performance Considerations

The API for `rtIOStream` functions is designed to be independent of the physical layer across which the data is sent. Possible physical layers include RS232, Ethernet, or Controller Area Network (CAN). The choice of physical layer affects the achievable data rates for the host-target communication.

For a processor-in-the-loop (PIL) application there is no minimum data rate requirement. However, the higher the data rate, the faster the simulation will run.

In general, a communications device driver will require additional hardware-specific or channel-specific configuration parameters. For example:

- A CAN channel may require specification of which available CAN Node should be used.
- A TCP/IP channel may require a port or static IP address to be configured.
- A CAN channel may require the CAN message ID and priority to be specified.

It is the responsibility of the user who implements the `rtIOStream` driver functions to provide this configuration data, for example by hard-coding it, or by supplying arguments to `rtIOStreamOpen`.

## See Also

`rtIOStreamOpen` | `rtIOStreamClose` | `rtIOStreamRecv` | `rtiostream_wrapper`

## How To

- “Create a Connectivity Configuration for a Target”
- `rtwdemo_rtiostream_script`
- `rtwdemo_custom_pil_script`

# rtiostream\_wrapper

---

**Purpose** Test rtiostream shared library methods

**Syntax**

```
STATION_ID = rtiostream_wrapper(SHARED_LIB,'open')
STATION_ID =
rtiostream_wrapper(SHARED_LIB,'open',p1, v1, p2, v2,
 ...)
[RES,SIZE_SENT] = rtiostream_wrapper(SHARED_LIB,'send',ID,
DATA,
 SIZE)
[RES, DATA_RECVD, SIZE_RECVD] =
rtiostream_wrapper(SHARED_LIB,'recv',
 ID, SIZE)
RES = rtiostream_wrapper(SHARED_LIB,'close',ID)
rtiostream_wrapper(SHARED_LIB, 'unloadlibrary')
```

**Description** rtiostream\_wrapper enables you to access the methods of an rtiostream shared library from MATLAB code, for testing purposes.

`STATION_ID = rtiostream_wrapper(SHARED_LIB,'open')` opens an rtiostream communication channel through a shared library, and returns a handle to the channel.

`STATION_ID = rtiostream_wrapper(SHARED_LIB,'open',p1, v1, p2, v2, ...)` opens an rtiostream communication channel through a shared library. `p1, v1, ...` are additional parameter value pairs used when opening an rtiostream communication channel through a shared library. These arguments are implementation-dependent, that is, they are specific to the shared library being called.

`[RES,SIZE_SENT] = rtiostream_wrapper(SHARED_LIB,'send',ID, DATA, SIZE)` sends `DATA` into the communication channel with handle `ID`, and attempts to send `SIZE` bytes.

`[RES, DATA_RECVD, SIZE_RECVD] = rtiostream_wrapper(SHARED_LIB,'recv', ID, SIZE)` receives up to `SIZE` bytes of `DATA` from the communication channel with handle `ID`.

`RES = rtiostream_wrapper(SHARED_LIB,'close',ID)` closes the communication channel with handle `ID`.

`rtiostream_wrapper(SHARED_LIB, 'unloadlibrary')` unloads the *SHARED\_LIB*, clearing persistent data.

## Input Arguments

### **SHARED\_LIB**

Name of shared library that implements the required `rtIOStream` functions `rtIOStreamOpen`, `rtIOStreamSend`, `rtIOStreamRecv`, and `rtIOStreamClose`. Must be on system path.

Specify shared library:

- *libTCP/IP* — For TCP/IP communication. Value of *libTCP/IP* depends on your operating system. See `rtwdemo_rtiostream_script`.
- `'libmwrrtiostreamserial.dll'` — For serial communication.

### **open**

Open communication channel

### **send**

Send data into communication channel with handle *ID*

### **ID**

Communication channel handle

### **DATA**

Data to be sent

### **SIZE**

Size of requested data in bytes

### **recv**

Receive data from communication channel with handle *ID*

### **close**

Close communication channel with handle *ID*

## **unloadlibrary**

Unload *SHARED\_LIB*

## **Name-Value Pair Arguments for TCP/IP Communication**

*p1, v1, ...* are optional comma-separated pairs of *Name, Value* arguments, where *Name* is the argument name and *Value* is the corresponding value. *Name* must appear inside single quotes (' '). You can specify several name-value pair arguments in any order as *Name1, Value1, ..., NameN, ValueN*

The shared library must be *libTCP/IP*.

## **-client**

Open *rtiostream* channel as TCP/IP server or client:

- 0 — TCP/IP server
- 1 — TCP/IP client

## **-port**

Specify port number.

## **-hostname**

Specify identifier for host computer, for example, 'localhost'.

## **-blocking**

Specify behavior of call to receive data (call uses input argument *recv*):

- 0 — Polling mode. If data is available, call returns with data. If data is not available, call returns without waiting.
- 1 — Blocking mode. If data is available, call returns with data. If data is not available, call waits for data. Use *recv\_timeout\_secs* to specify the waiting period.



The default is 0 unless the preprocessor macro define `VXWORKS` exists. In this case, the default is 1.

## **-rcv\_timeout\_secs**

Specify, in seconds, waiting period of call to receive data:

- $X$ , an integer greater than zero — Wait for  $X$  seconds.
- 0 — No waiting period.
- -3 — Wait 10 ms.
- -2 — Wait for default period.
- -1 — Wait indefinitely.

The default for client connections is to wait 1 second. The default for server connections is to wait indefinitely.

## **Name-Value Pair Arguments for Serial Communication**

$p1, v1, \dots$  are optional comma-separated pairs of `Name, Value` arguments, where `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (' '). You can specify several name-value pair arguments in any order as `Name1, Value1, , NameN, ValueN`

The shared library must be 'libmwr Niestreamserial.dll'.

## **-port**

Specify COM port string for serial communication. You must specify bit rate using `-baud`.

## **-baud**

Specify bit rate for serial communication port.

## **Output Arguments**

### ***STATION\_ID***

Handle to communication channel. If attempt is unsuccessful, value is -1.

# rtiostream\_wrapper

---

## **RES**

Error flag:

- -1 — Error occurred
- 0 — No error

## **SIZE\_SENT**

Number of bytes accepted by communication channel. Can be less than *SIZE*, that is, the requested number of bytes to send.

## **DATA\_RECVD**

Data received

## **SIZE\_RECVD**

Number of bytes received from channel. Can be less than *SIZE*, that is, the requested number of bytes to send.

## **Examples**

The following examples open communication channels using the supplied TCP/IP and serial communication drivers.

Open `rtiostream` channel `stationA` as a TCP/IP server:

```
stationA = rtiostream_wrapper('libmwrtiostreamtcpip.dll', 'open', ...
 '-client', '0', ...
 '-blocking', '0', ...
 '-port', port_number);
```

Opens `rtiostream` channel `StationB` as a TCP/IP client:

```
stationB = rtiostream_wrapper('libmwrtiostreamtcpip.dll', 'open', ...
 '-client', '1', ...
 '-blocking', '0', ...
 '-port', port_number, ...
 '-hostname', 'localhost');
```

If you use the supplied host-side driver for serial communications (as an alternative to the drivers for TCP/IP), specify the bit rate when you open a channel with a specific port. For example, open channel `stationA` with port `COM1` and bit rate of 9600:

```
stationA = rtiostream_wrapper('libmwrtiostreamserial.dll','open',...
 '-port','COM1',...
 '-baud','9600');
```

## See Also

[rtIOStreamOpen](#) | [rtIOStreamSend](#) | [rtIOStreamRecv](#) | [rtIOStreamClose](#)

## How To

- “Create a Connectivity Configuration for a Target”
- `rtwdemo_rtiostream_script`
- `rtwdemo_custom_pil_script`

# rtw.codegenObjectives.Objective

---

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|-----------------------|----------------|---------------------------|----------------|-----------------------------------|-----------------------------------|-----------------------|--------------------|-----------------------------------|-------------------------|-----------------------------------|-----------------------------|-------------------------------|------------------------|
| <b>Purpose</b>                    | Customize code generation objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <b>Description</b>                | An <code>rtw.codegenObjectives.Objective</code> object creates a code generation objective.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <b>Construction</b>               | <code>rtw.codegenObjectives.Objective</code> Create custom code generation objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <b>Methods</b>                    | <table><tr><td><code>addCheck</code></td><td>Add checks</td></tr><tr><td><code>addParam</code></td><td>Add parameters</td></tr><tr><td><code>excludeCheck</code></td><td>Exclude checks</td></tr><tr><td><code>modifyInheritedParam</code></td><td>Modify inherited parameter values</td></tr><tr><td><code>register</code></td><td>Register objective</td></tr><tr><td><code>removeInheritedCheck</code></td><td>Remove inherited checks</td></tr><tr><td><code>removeInheritedParam</code></td><td>Remove inherited parameters</td></tr><tr><td><code>setObjectiveName</code></td><td>Specify objective name</td></tr></table> | <code>addCheck</code> | Add checks | <code>addParam</code> | Add parameters | <code>excludeCheck</code> | Exclude checks | <code>modifyInheritedParam</code> | Modify inherited parameter values | <code>register</code> | Register objective | <code>removeInheritedCheck</code> | Remove inherited checks | <code>removeInheritedParam</code> | Remove inherited parameters | <code>setObjectiveName</code> | Specify objective name |
| <code>addCheck</code>             | Add checks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>addParam</code>             | Add parameters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>excludeCheck</code>         | Exclude checks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>modifyInheritedParam</code> | Modify inherited parameter values                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>register</code>             | Register objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>removeInheritedCheck</code> | Remove inherited checks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>removeInheritedParam</code> | Remove inherited parameters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <code>setObjectiveName</code>     | Specify objective name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <b>Copy Semantics</b>             | Handle. To learn how this affects your use of the class, see Copying Objects in the MATLAB Programming Fundamentals documentation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |
| <b>Examples</b>                   | <p>Create a custom objective named <code>Reduce RAM Example</code>. The following code is the contents of the <code>sl_customization.m</code> file that you create.</p> <pre>function sl_customization(cm) %SL_CUSTOMIZATION objective customization callback  objCustomizer = cm.ObjectiveCustomizer; index = objCustomizer.addCallbackObjFcn(@addObjectives); objCustomizer.callbackFcn{index}();</pre>                                                                                                                                                                                                                        |                       |            |                       |                |                           |                |                                   |                                   |                       |                    |                                   |                         |                                   |                             |                               |                        |

```
end

function addObjectives

% Create the custom objective
obj = rtw.codegenObjectives.Objective('ex_ram_1');
setObjectiveName(obj, 'Reduce RAM Example');

% Add parameters to the objective
addParam(obj, 'InlineParams', 'on');
addParam(obj, 'BooleanDataType', 'on');
addParam(obj, 'OptimizeBlockIOStorage', 'on');
addParam(obj, 'EnhancedBackFolding', 'on');
addParam(obj, 'BooleansAsBitFields', 'on');

% Add additional checks to the objective
% The Code Generation Advisor automatically includes 'Check model
% configuration settings against code generation objectives' in every
% objective.
addCheck(obj, 'mathworks.design.UnconnectedLinesPorts');
addCheck(obj, 'mathworks.design.Update');

%Register the objective
register(obj);

end
```

## See Also

DASstudio.CustomizationManager.ObjectiveCustomizer

## How To

- “Create Custom Objectives”

# rtw.codegenObjectives.Objective

---

**Purpose** Create custom code generation objectives

**Syntax**

```
obj = rtw.codegenObjectives.Objective('objID')
obj = rtw.codegenObjectives.Objective('objID',
 'base_objID')
```

**Description** `obj = rtw.codegenObjectives.Objective('objID')` creates an objective object, `obj`.

`obj = rtw.codegenObjectives.Objective('objID', 'base_objID')` creates an object, `obj`, for a new objective that is identical to an existing objective. You can then modify the new objective to meet your requirements.

## Input Arguments

|                         |                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>objID</code>      | A permanent, unique identifier for the objective. <ul style="list-style-type: none"><li>You must have<ul style="list-style-type: none"><li><code>objID</code>.</li><li>The value of <code>objID</code> must remain constant.</li><li>When you refresh your customizations, if <code>objID</code> is not unique, Simulink generates an error.</li></ul></li></ul> |
| <code>base_objID</code> | The identifier of the objective that you want to base the new objective on.                                                                                                                                                                                                                                                                                      |

## Examples

Create a new objective:

```
obj = rtw.codegenObjectives.Objective('ex_ram_1');
```

Create a new objective based on the existing Execution efficiency objective:

```
obj = rtw.codegenObjectives.Objective('ex_my_efficiency_1', 'Execution efficiency');
```

## How To

- “Create Custom Objectives”

# RTW.configSubsystemBuild

---

**Purpose** Configure C function prototype or C++ class interface for right-click build of specified subsystem

**Syntax** RTW.configSubsystemBuild(*block*)

**Description** RTW.configSubsystemBuild(*block*) opens a graphical user interface where you can configure either C function prototype information or C++ class interface information for right-click builds of a specified nonvirtual subsystem. A dialog box opens based on the **Language** and **Code interface packaging** values selected for your model on the **Code Generation** and **Code Generation > Interface** panes of the Configuration Parameters dialog box.

To configure and generate C++ class interfaces for a nonvirtual subsystem, you must

- Select the system target file `ert.tlc` for the model.
- Select the **Language** parameter value C++ for the model.
- Select the **Code interface packaging** parameter value C++ class for the model.
- Make sure that the subsystem is convertible to a Model block using the function `Simulink.SubSystem.convertToModelReference`. For referenced model conversion requirements, see the Simulink reference page `Simulink.SubSystem.convertToModelReference`.

**Input Arguments**

|              |                                                                                            |
|--------------|--------------------------------------------------------------------------------------------|
| <i>block</i> | String specifying the name of a nonvirtual subsystem block in an ERT-based Simulink model. |
|--------------|--------------------------------------------------------------------------------------------|

**How To**

- “Configure Function Prototypes for Nonvirtual Subsystems”
- “Function Prototype Control”
- “Configure C++ Class Interfaces for Nonvirtual Subsystems”
- “C++ Class Interface Control”



## Purpose

Provide parameters to each target connectivity component

## Syntax

```
componentArgs = rtw.connectivity.ComponentArgs (componentPath,
 componentCodePath, componentCodeName, applicationCodePath)
```

## Description

Syntax of constructor ComponentArgs:

```
componentArgs = rtw.connectivity.ComponentArgs
(componentPath, componentCodePath, componentCodeName,
applicationCodePath)
```

You can use the methods of this class to get information about the source component (e.g., the referenced model under test) and the target application (e.g., the PIL application).

For methods, see the following table.

| Method               | Syntax and Description                                                                                                                                                           |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| getComponentPath     | <pre>componentPath =<br/>obj.getComponentPath</pre>                                                                                                                              |
|                      | Returns the Simulink system path of the source component (e.g., the path of the referenced model that is under test).                                                            |
| getComponentCodePath | <pre>componentCodePath =<br/>obj.getComponentCodePath</pre>                                                                                                                      |
|                      | Returns the Embedded Coder code generation directory path associated with the source component (e.g., the code generation directory of the referenced model that is under test). |

## rtw.connectivity.ComponentArgs

---

| Method                 | Syntax and Description                                                                                                  |
|------------------------|-------------------------------------------------------------------------------------------------------------------------|
| getComponentCodeName   | <code>componentCodeName = obj.getComponentCodeName</code>                                                               |
|                        | Returns the component name used for code generation.                                                                    |
| getApplicationCodePath | <code>applicationCodePath = obj.getApplicationCodePath</code>                                                           |
|                        | Returns the directory path associated with the target application (e.g., the path associated with the PIL application). |

See `rtw.connectivity.Config` for more information.

### See Also

`rtw.connectivity.Config`

### How To

- “Create a Connectivity Configuration for a Target”

**Purpose** Define connectivity implementation, comprising builder, launcher, and communicator components

**Syntax** `rtw.connectivity.Config(componentArgs, builder, launcher, communicator)`

**Description**

| Constructor | Description                                                                        |
|-------------|------------------------------------------------------------------------------------|
| Config      | Wrapper for the connectivity component classes builder, launcher and communicator. |

| Constructor Arguments |                                                                                                 |
|-----------------------|-------------------------------------------------------------------------------------------------|
| componentArgs         | rtw.connectivity.ComponentArgs object.                                                          |
| builder               | rtw.connectivity.Builder, for example, rtw.connectivity.MakefileBuilder object.                 |
| launcher              | rtw.connectivity.Launcher object.                                                               |
| communicator          | rtw.connectivity.Communicator, for example rtw.connectivity.-RtIOStreamHostCommunicator object. |

Constructor syntax:

```
rtw.connectivity.Config(componentArgs, builder, launcher, communicator)
```

To define a connectivity implementation:

- 1 You must create a subclass of `rtw.connectivity.Config` that creates instances of your connectivity component classes:

- `rtw.connectivity.MakefileBuilder`
- `rtw.connectivity.Launcher`
- `rtw.connectivity.RtIOStreamHostCommunicator`

You can see an example `ConnectivityConfig.m`, used in `rtwdemo_custom_pil_script`.

- 2 Define the constructor for your subclass as follows:

```
function this = MyConfig(componentArgs)
```

When Simulink creates an instance of your subclass of `rtw.connectivity.Config`, it provides an instance of the `rtw.connectivity.ComponentArgs` class as the only constructor argument. If you want to test your subclass of `rtw.connectivity.Config` manually, you may want to create an `rtw.connectivity.ComponentArgs` object to pass as a constructor argument.

- 3 After instantiating the builder, launcher and communicator objects in your subclass, call the constructor of the superclass `rtw.connectivity.Config` to define your complete target connectivity configuration. For example:

```
% Call superclass constructor to register components
this@rtw.connectivity.Config(componentArgs,...
builder, launcher, communicator);
```

- 4 Optionally, for execution time profiling, use the `setTimer` method to register your hardware timer. For example, if you specified the timer in a code replacement table, insert the following line:

```
this.setTimer('MyCr1Table')
```

*MyCr1Table* is the name of the code replacement table, which must be in a location on the MATLAB search path.

Register your subclass name, for example, `MyPIL.ConnectivityConfig` to Simulink by using the class `rtw.connectivity.ConfigRegistry`. This uses the `sl_customization.m` mechanism to register your connectivity configuration.

The PIL infrastructure instantiates your subclass as required. The `sl_customization.m` mechanism helps in specifying a suitable connectivity configuration for use with a particular PIL component (and its configuration set). The subclass can also perform additional validation on construction. For example, you can use the `componentPath` returned by the `getComponentPath` method of the `componentArgs` constructor argument to query and validate parameters associated with the PIL component under test.

For supported hardware implementation settings and other support information, see “SIL and PIL Simulation Support and Limitations”.

## See Also

`rtw.connectivity.MakefileBuilder` | `rtw.connectivity.Launcher`  
| `rtw.connectivity.RtIOStreamHostCommunicator` |  
`rtw.connectivity.ComponentArgs`

## How To

- “Create a Connectivity Configuration for a Target”
- `rtwdemo_custom_pil_script`
- “Specify Hardware Timer”

# rtw.connectivity.ConfigRegistry

---

**Purpose** Register connectivity configuration

**Syntax**  
`config = rtw.connectivity.ConfigRegistry`  
`config = rtw.connectivity.ConfigRegistry`

**Description** Use this class to register your connectivity configuration with Simulink by using the `sl_customization.m` mechanism. The connectivity configuration is registered by a call to `registerTargetInfo` inside a `sl_customization.m` file.

Create or add to your `sl_customization.m` file as shown in the “Examples” on page 1-406 section, and place the file on the MATLAB path. Simulink software reads the `sl_customization.m` when it starts, and registers your connectivity configuration. This step also defines the set of Simulink models that the new connectivity configuration is compatible with.

A connectivity configuration must have a unique name and be associated with a connectivity implementation class (a subclass of `rtw.connectivity.Config`). The properties of the configuration (for example, `SystemTargetFile`) define the set of Simulink models that the connectivity implementation class is compatible with. The properties are shown in the following table.

## Properties of `rtw.connectivity.ConfigRegistry`

| Property Name            | Description                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------|
| <code>ConfigName</code>  | Unique string name for this configuration                                                                         |
| <code>ConfigClass</code> | Full class name of the connectivity implementation (e.g. <code>rtw.pil.myConnectivityConfig</code> ) to register. |

## Properties of rtw.connectivity.ConfigRegistry (Continued)

| Property Name    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SystemTargetFile | <p>Cell array of strings listing System Target Files that support this ConfigRegistry. An empty cell array matches any System Target File. The model's SystemTargetFile configuration parameter is validated against this cell array to determine if this ConfigRegistry is valid for use.</p>                                                                                                                                                                                                                                                             |
| TemplateMakefile | <p>Cell array of strings listing Template Makefiles that support this ConfigRegistry. An empty cell array matches any Template Makefile and nonmakefile based targets (GenerateMakefile: off). The model's TemplateMakefile configuration parameter is validated against this cell array to determine if this ConfigRegistry is valid for use.</p> <hr/> <p><b>Note</b> If you use a toolchain to build the generated code, do not specify the TemplateMakefile configuration parameter. Instead, specify the Toolchain configuration parameter.</p> <hr/> |

# rtw.connectivity.ConfigRegistry

## Properties of rtw.connectivity.ConfigRegistry (Continued)

| Property Name      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Toolchain          | <p>Cell array of strings listing toolchains that support this ConfigRegistry. An empty cell array matches any toolchain. The model's Toolchain configuration parameter is validated against this cell array to determine if this ConfigRegistry is valid for use.</p> <hr/> <p><b>Note</b> If you do not use a toolchain to build the generated code, do not specify the Toolchain configuration parameter. Instead, specify the TemplateMakefile configuration parameter.</p> <hr/> |
| TargetHWDeviceType | <p>Cell array of strings listing Hardware Device Types that support this ConfigRegistry. An empty cell array matches any Hardware Device Type. The model's TargetHWDeviceType configuration parameter is validated against this cell array to determine if this ConfigRegistry is valid for use.</p>                                                                                                                                                                                 |

### Examples

The following code shows an example `s1_customization.m` registration. You must use the `s1_customization.m` file structure shown in the example following. You must call the `registerTargetInfo` function exactly as shown.



```
function sl_customization(cm)
% SL_CUSTOMIZATION for PIL connectivity config:...
% mypil.ConnectivityConfig

% Copyright 2008 The MathWorks, Inc.

cm.registerTargetInfo(@loc_createConfig);

% local function
function config = loc_createConfig

config = rtw.connectivity.ConfigRegistry;
config.ConfigName = 'My PIL Example';
config.ConfigClass = 'mypil.ConnectivityConfig';

% match only ert.tlc
config.SystemTargetFile = {'ert.tlc'};

% If you use a toolchain to build your generated code
% you must specify the config.Toolchain property to match
% your Simulink model toolchain setting
% Otherwise, for a non-toolchain approach, match the TMF
config.TemplateMakefile = {'ert_default_tmf' ...
 'ert_unix.tmf', ...
 'ert_vc.tmf', ...
 'ert_vcx64.tmf', ...
 'ert_lcc.tmf'};

% match regular 32-bit machines and Custom for e.g. ...
% 64-bit Linux
config.TargetHWDeviceType = {'Generic->32-bit x86 ...
 compatible'
 'Generic->Custom'};
```

You must configure the file to perform the following steps when Simulink software starts:

# rtw.connectivity.ConfigRegistry

---

- 1 Create an instance of the `rtw.connectivity.ConfigRegistry` class. For example,

```
config = rtw.connectivity.ConfigRegistry;
```

- 2 Assign a connectivity configuration name to the `ConfigName` property of the object. For example,

```
config.ConfigName = 'My PIL Example';
```

- 3 Associate the connectivity configuration with the connectivity API implementation (created in step 1). For example,

```
config.ConfigClass = 'mypil.ConnectivityConfig';
```

- 4 Define compatible models for this target connectivity configuration, by setting the `SystemTargetFile`, `TemplateMakefile` (non-toolchain approach) and `TargetHWDeviceType` properties of the object. For example,

```
% match only ert.tlc
config.SystemTargetFile = {'ert.tlc'};

% match the TMF
config.TemplateMakefile = {'ert_default_tmf' ...
 'ert_unix.tmf', ...
 'ert_vc.tmf', ...
 'ert_vcx64.tmf', ...
 'ert_lcc.tmf'};

% match regular 32-bit machines and Custom for e.g. ...
% 64-bit Linux
config.TargetHWDeviceType = {'Generic->32-bit x86 ...
 compatible'
 'Generic->Custom'};
```

## See Also

`rtw.connectivity.Config`

## How To

- “Create a Connectivity Configuration for a Target”
- rtwdemo\_custom\_pil\_script

# rtw.connectivity.Launcher

---

**Purpose** Control downloading, starting and resetting of a target application

**Syntax** `rtw.connectivity.Launcher(componentArgs)`

## Description

| Constructor | Description                                              |
|-------------|----------------------------------------------------------|
| Launcher    | Controls execution of an application on target hardware. |

`rtw.connectivity.Launcher(componentArgs)` controls the download, start and reset of an application, for example, a PIL application.

You can also use `rtw.connectivity.Launcher(componentArgs, builder)`, which provides the Launcher access to a Builder object through the `getBuilder` method. However, support for this approach will cease in a future release.

You must make a subclass and implement the `startApplication` and `stopApplication` methods.

You can implement a destructor method that cleans up resources (for example, a handle to a third-party download tool) when this object is cleared from memory. There is significant flexibility in how the `startApplication` and `stopApplication` methods can be implemented.

For methods, see the following table.

| Method           | Syntax and Description                                                                              |
|------------------|-----------------------------------------------------------------------------------------------------|
| getComponentArgs | <code>componentArgs = obj.getComponentArgs</code>                                                   |
|                  | Returns the <code>rtw.connectivity.ComponentArgs</code> object associated with the Launcher object. |
| setExe           | <code>setExe(exe)</code>                                                                            |
|                  | Specify the application to run on the target                                                        |

| Method           | Syntax and Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| getExe           | <code>exe=getExe()</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                  | Returns the application running on the target                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| startApplication | <code>obj.startApplication</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                  | <p>Abstract method that you must implement in a subclass.</p> <p>Called by Simulink to start execution of the target application.</p> <p>Simulink calls the <code>setExe</code> method, which specifies the target application to launch. To obtain this application, use the <code>getExe</code> method. For example:</p> <pre>exe = getExe()</pre> <p>The <code>startApplication</code> method must reset the application to its initial state by ensuring that external and static (global) variables are zero initialized.</p> |
| stopApplication  | <code>obj.stopApplication</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                  | <p>Abstract method that you must implement in a subclass.</p> <p>Called by Simulink to stop execution of the target application.</p>                                                                                                                                                                                                                                                                                                                                                                                               |
| getBuilder       | <code>builder = obj.getBuilder</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                  | Returns the <code>rtw.connectivity.Builder</code> object associated with the Launcher object.                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## How To

- “Create a Connectivity Configuration for a Target”
- `rtwdemo_custom_pil_script`

# rtw.connectivity.MakefileBuilder

---

**Purpose** Configure makefile-based build process

**Syntax** `rtw.connectivity.MakefileBuilder(componentArgs,  
targetApplicationFramework, exeExtension)`

## Description

| Constructor     | Description                           |
|-----------------|---------------------------------------|
| MakefileBuilder | Control makefile-based build process. |

| Constructor Arguments      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| componentArgs              | rtw.connectivity.ComponentArgs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| TargetApplicationFramework | rtw.pil.RtIOStream-ApplicationFramework (e.g. MyPIL.TargetFramework)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| exeExtension               | Filename extension of an executable for the target system.<br>The extension depends on the makefile and compiler that are called by the <code>MakefileBuilder</code> . These are defined by the template makefile specified by the source component (e.g., the referenced model under test).<br>For an embedded target the extension may be <code>'.elf'</code> , <code>'.abs'</code> , <code>'.sre'</code> , <code>'.hex'</code> , or others.<br>For a Windows host-based target the extension is <code>'.exe'</code> .<br>For a UNIX® host-based target the extension is empty, <code>''</code> . |

Constructor syntax:

```
rtw.connectivity.MakefileBuilder(componentArgs,
targetApplicationFramework, exeExtension)
```

MakefileBuilder controls the customizable makefile-based build process supporting the creation of custom applications (e.g. a PIL application) that interface with a Simulink component such as a referenced model (represented as a collection of binary libraries).

To build the PIL application, you must provide a template makefile that includes the target `MAKEFILEBUILDER_TGT`. You can use the standard TMF files, e.g., `ert_unix.tmf` or `ert_vc.tmf`.

## See Also

`rtw.pil.RtIOStreamApplicationFramework` |  
`rtw.connectivity.ComponentArgs`

## How To

- “Create a Connectivity Configuration for a Target”
- `rtwdemo_custom_pil_script`

# rtw.connectivity.RtIOStreamHostCommunicator

---

**Purpose** Configure host-side communications

**Syntax** `rtw.connectivity.RtIOStreamHostCommunicator(componentArgs, launcher, rtiostreamLib)`

## Description

| Constructor                             | Description                                                                                                                                            |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>RtIOStreamHostCommunicator</code> | Configure host-side communications with the target by loading and initializing a shared library that implements the <code>rtiostream</code> functions. |

| Constructor Arguments      |                                                                                                        |
|----------------------------|--------------------------------------------------------------------------------------------------------|
| <code>componentArgs</code> | A <code>rtw.connectivity.ComponentArgs</code> object.                                                  |
| <code>launcher</code>      | A <code>rtw.connectivity.Launcher</code> object.                                                       |
| <code>rtiostreamLib</code> | An <code>rtiostream</code> shared library that implements the host side of host-target communications. |

Constructor syntax:

```
rtw.connectivity.RtIOStreamHostCommunicator(componentArgs,
launcher, rtiostreamLib)
```

This class configures host-side communications with the target by loading and initializing a shared library that implements the `rtiostream` functions.

Embedded Coder provides an implementation of this shared library to support TCP/IP communications between host and target, as well as a version for serial communications. With TCP/IP or serial, you need only supply the target-side drivers.



For other communications protocols (e.g. USB), you must supply a shared library for the host-side of the communications link as well as the target-side drivers.

To create your instance of `rtw.connectivity.RtIOStreamHostCommunicator`, you have two options:

- Instantiate `rtw.connectivity.RtIOStreamHostCommunicator` directly, providing custom arguments to supply to the `rtiostream` shared library.
- Alternatively, create a subclass of `rtw.connectivity.RtIOStreamHostCommunicator`. Consider this when more complex configuration is required. For example, the subclass `rtw.connectivity.HostTCPIPCommunicator` includes additional code to determine the TCP/IP port number on which the executable application is serving, or you could use a subclass to specify a serial port number, or specify verbose or silent operation.

## Methods

|                                 |                                          |
|---------------------------------|------------------------------------------|
| <code>setTimeoutRecvSecs</code> | Sets the timeout value for reading data. |
|---------------------------------|------------------------------------------|

`hostCommunicator.setTimeoutRecvSecs(timeout)` configures data reading to time out if no new data is received for a period of greater than `timeout` seconds.

|                                  |                                                                         |
|----------------------------------|-------------------------------------------------------------------------|
| <code>setInitCommsTimeout</code> | Sets the timeout value for initial setup of the communications channel. |
|----------------------------------|-------------------------------------------------------------------------|

`hostCommunicator.setInitCommsTimeout(timeout)` For some targets you may need to set a timeout value for initial setup of the communications channel. For example, the target processor may take a few seconds before it is ready to open its side of the communications channel. If you set a nonzero timeout value then the communicator repeatedly tries to open the communications channel until the timeout value is reached.

# rtw.connectivity.RtIOStreamHostCommunicator

---

## See Also

[rtw.connectivity.ComponentArgs](#) | [rtw.connectivity.Launcher](#) | [rtiostream\\_wrapper](#)

## How To

- “Create a Connectivity Configuration for a Target”
- [rtwdemo\\_custom\\_pil\\_script](#)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                             |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get handle to model-specific C++ class interface control object                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                             |
| <b>Syntax</b>           | <code>obj = RTW.getClassInterfaceSpecification(modelName)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                             |
| <b>Description</b>      | <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> returns a handle to a model-specific C++ class interface control object.                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                             |
| <b>Input Arguments</b>  | <i>modelName</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | String specifying the name of a loaded ERT-based Simulink model.                                                                                                                            |
| <b>Output Arguments</b> | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Handle to the C++ class interface control object associated with the specified model. If the model does not have an associated C++ class interface control object, the function returns []. |
| <b>Alternatives</b>     | The <b>Configure C++ Class Interface</b> button on the <b>Interface</b> pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. Once you validate and apply your changes, you can generate code based on your C++ class interface modifications. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation. |                                                                                                                                                                                             |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li><li>• “C++ Class Interface Control”</li></ul>                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                             |

# RTW.getFunctionSpecification

---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                  |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Get handle to model-specific C prototype function control object                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                  |
| <b>Syntax</b>           | <code>obj = RTW.getFunctionSpecification(modelName)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                  |
| <b>Description</b>      | <code>obj = RTW.getFunctionSpecification(modelName)</code> returns a handle to the model-specific C function prototype control object.                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                  |
| <b>Input Arguments</b>  | <i>modelName</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | String specifying the name of a loaded ERT-based Simulink model.                                                                                                                                 |
| <b>Output Arguments</b> | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Handle to the model-specific C prototype function control object associated with the specified model. If the model does not have an associated function control object, the function returns []. |
| <b>Alternatives</b>     | The <b>Configure Model Functions</b> button on the <b>Interface</b> pane of the Simulink Configuration Parameters dialog box launches the Model Interface dialog box, which provides you flexible control over the C function prototypes that are generated for your model. Once you validate and apply your changes, you can generate code based on your C function prototype modifications. See “Configure Function Prototypes Using Graphical Interfaces” in the Embedded Coder documentation. |                                                                                                                                                                                                  |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                  |

|                     |                                                                                                                                                                                                                                         |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Superclasses</b> | ModelCPPClass                                                                                                                                                                                                                           |
| <b>Purpose</b>      | Control C++ class interfaces for models using I/O arguments style step method                                                                                                                                                           |
| <b>Description</b>  | The ModelCPPArgsClass class provides objects that describe C++ class interfaces for models using an I/O arguments style step method. Use the attachToModel method to attach a C++ class interface to a loaded ERT-based Simulink model. |
| <b>Construction</b> | RTW.ModelCPPArgsClass      Create C++ class interface object for configuring model class with I/O arguments style step method                                                                                                           |
| <b>Methods</b>      | See the methods of the base class RTW.ModelCPPClass, plus the following methods.                                                                                                                                                        |
|                     | getArgCategory      Get argument category for Simulink model port from model-specific C++ class interface                                                                                                                               |
|                     | getArgName      Get argument name for Simulink model port from model-specific C++ class interface                                                                                                                                       |
|                     | getArgPosition      Get argument position for Simulink model port from model-specific C++ class interface                                                                                                                               |
|                     | getArgQualifier      Get argument type qualifier for Simulink model port from model-specific C++ class interface                                                                                                                        |
|                     | runValidation      Validate model-specific C++ class interface against Simulink model                                                                                                                                                   |

# RTW.ModelCPPArgsClass

---

|                 |                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------|
| setArgCategory  | Set argument category for Simulink model port in model-specific C++ class interface       |
| setArgName      | Set argument name for Simulink model port in model-specific C++ class interface           |
| setArgPosition  | Set argument position for Simulink model port in model-specific C++ class interface       |
| setArgQualifier | Set argument type qualifier for Simulink model port in model-specific C++ class interface |

## Copy Semantics

Handle. To learn how this affects your use of the class, see Copying Objects in the MATLAB Programming Fundamentals documentation.

## Alternatives

The **Configure C++ Class Interface** button on the **Interface** pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. Once you validate and apply your changes, you can generate code based on your C++ class interface modifications. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

|                         |                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Create C++ class interface object for configuring model class with I/O arguments style step method                                                                                                                                                                                                                                                                                      |
| <b>Syntax</b>           | <code>obj = RTW.ModelCPPArgsClass</code>                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>      | <code>obj = RTW.ModelCPPArgsClass</code> returns a handle, <code>obj</code> , to a newly created object of class <code>RTW.ModelCPPArgsClass</code> .                                                                                                                                                                                                                                   |
| <b>Output Arguments</b> | <code>obj</code><br>Handle to a newly created C++ class interface object for configuring a model class with an I/O arguments style step method. The object has not yet been configured or attached to an ERT-based Simulink model.                                                                                                                                                      |
| <b>Alternatives</b>     | The <b>Configure C++ Class Interface</b> button on the <b>Interface</b> pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation. |
| <b>How To</b>           | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li><li>• “C++ Class Interface Control”</li></ul>                                                                                                                                                                                     |

# RTW.ModelCPPClass

---

**Purpose** Control C++ class interfaces for models

**Description** The ModelCPPClass class is the base class for the classes RTW.ModelCPPArgsClass and RTW.ModelCPPVoidClass, which provide objects that describe C++ class interfaces for models using either an I/O arguments style step method or a void-void style step method. Use the attachToModel method to attach a C++ class interface to a loaded ERT-based Simulink model.

**Construction** To access the methods of this class, use the constructor for either RTW.ModelCPPArgsClass or RTW.ModelCPPVoidClass.

|                |                   |                                                                                                  |
|----------------|-------------------|--------------------------------------------------------------------------------------------------|
| <b>Methods</b> | attachToModel     | Attach model-specific C++ class interface to loaded ERT-based Simulink model                     |
|                | getClassname      | Get class name from model-specific C++ class interface                                           |
|                | getDefaultConf    | Get default configuration information for model-specific C++ class interface from Simulink model |
|                | getNamespace      | Get name space from model-specific C++ class interface                                           |
|                | getNumArgs        | Get number of step method arguments from model-specific C++ class interface                      |
|                | getStepMethodName | Get step method name from model-specific C++ class interface                                     |
|                | setClassName      | Set class name in model-specific C++ class interface                                             |



|                   |                                                            |
|-------------------|------------------------------------------------------------|
| setNamespace      | Set name space in model-specific C++ class interface       |
| setStepMethodName | Set step method name in model-specific C++ class interface |

## Alternatives

The **Configure C++ Class Interface** button on the **Interface** pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. Once you validate and apply your changes, you can generate code based on your C++ class interface modifications. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelCPPVoidClass

---

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Superclasses</b>   | ModelCPPClass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Purpose</b>        | Control C++ class interfaces for models using void-void style step method                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>    | The ModelCPPVoidClass class provides objects that describe C++ class interfaces for models using a void-void style step method. Use the attachToModel method to attach a C++ class interface to a loaded ERT-based Simulink model.                                                                                                                                                                                                                                                                       |
| <b>Construction</b>   | RTW.ModelCPPVoidClass      Create C++ class interface object for configuring model class with void-void style step method                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Methods</b>        | See the methods of the base class RTW.ModelCPPClass, plus the following method.<br><br>runValidation      Validate model-specific C++ class interface against Simulink model                                                                                                                                                                                                                                                                                                                             |
| <b>Copy Semantics</b> | Handle. To learn how this affects your use of the class, see Copying Objects in the MATLAB Programming Fundamentals documentation.                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Alternatives</b>   | The <b>Configure C++ Class Interface</b> button on the <b>Interface</b> pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. Once you validate and apply your changes, you can generate code based on your C++ class interface modifications. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation. |
| <b>How To</b>         | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li><li>• “Configure the Step Method for a Model Class”</li></ul>                                                                                                                                                                                                                                                                                                                                              |

- “C++ Class Interface Control”

# RTW.ModelCPPVoidClass

---

**Purpose** Create C++ class interface object for configuring model class with void-void style step method

**Syntax** `obj = RTW.ModelCPPVoidClass`

**Description** `obj = RTW.ModelCPPVoidClass` returns a handle, *obj*, to a newly created object of class `RTW.ModelCPPVoidClass`.

**Output Arguments** *obj* Handle to a newly created C++ class interface object for configuring a model class with a void-void style step method. The object has not yet been configured or attached to an ERT-based Simulink model.

**Alternatives** The **Configure C++ Class Interface** button on the **Interface** pane of the Simulink Configuration Parameters dialog box launches the Configure C++ class interface dialog box, where you can flexibly control the C++ class interfaces that are generated for your model. See “Customize C++ Class Interfaces Using Graphical Interfaces” in the Embedded Coder documentation.

**How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

|                     |                                                                                                                                                                                                           |                                                                                                       |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>      | Describe signatures of functions for model                                                                                                                                                                |                                                                                                       |
| <b>Description</b>  | A <code>ModelSpecificCPrototype</code> object describes the signatures of the step and initialization functions for a model. You must use this in conjunction with the <code>attachToModel</code> method. |                                                                                                       |
| <b>Construction</b> | <code>RTW.ModelSpecificCPrototype</code>                                                                                                                                                                  | Create model-specific C prototype object                                                              |
| <b>Methods</b>      | <code>addArgConf</code>                                                                                                                                                                                   | Add argument configuration information for Simulink model port to model-specific C function prototype |
|                     | <code>attachToModel</code>                                                                                                                                                                                | Attach model-specific C function prototype to loaded ERT-based Simulink model                         |
|                     | <code>getArgCategory</code>                                                                                                                                                                               | Get argument category for Simulink model port from model-specific C function prototype                |
|                     | <code>getArgName</code>                                                                                                                                                                                   | Get argument name for Simulink model port from model-specific C function prototype                    |
|                     | <code>getArgPosition</code>                                                                                                                                                                               | Get argument position for Simulink model port from model-specific C function prototype                |
|                     | <code>getArgQualifier</code>                                                                                                                                                                              | Get argument type qualifier for Simulink model port from model-specific C function prototype          |

# RTW.ModelSpecificCPrototype

---

|                 |                                                                                                   |
|-----------------|---------------------------------------------------------------------------------------------------|
| getDefaultConf  | Get default configuration information for model-specific C function prototype from Simulink model |
| getFunctionName | Get function name from model-specific C function prototype                                        |
| getNumArgs      | Get number of function arguments from model-specific C function prototype                         |
| getPreview      | Get model-specific C function prototype code preview                                              |
| runValidation   | Validate model-specific C function prototype against Simulink model                               |
| setArgCategory  | Set argument category for Simulink model port in model-specific C function prototype              |
| setArgName      | Set argument name for Simulink model port in model-specific C function prototype                  |
| setArgPosition  | Set argument position for Simulink model port in model-specific C function prototype              |
| setArgQualifier | Set argument type qualifier for Simulink model port in model-specific C function prototype        |
| setFunctionName | Set function name in model-specific C function prototype                                          |

## Copy Semantics

Handle. To learn how this affects your use of the class, see Copying Objects in the MATLAB Programming Fundamentals documentation.

## Examples

The code below creates a function control object, `a`, and uses it to add argument configuration information to the model.

```
% Open the rtdemo_counter model and specify the System Target File
rtdemo_counter
set_param(gcs,'SystemTargetFile','ert.tlc')

%% Create a function control object
a=RTW.ModelSpecificCPrototype

%% Add argument configuration information for Input and Output ports
addArgConf(a,'Input','Pointer','inputArg','const *')
addArgConf(a,'Output','Pointer','outputArg','none')

%% Attach the function control object to the model
attachToModel(a,gcs)
```

## Alternatives

You can create a function control object using the Model Interface dialog box.

## See Also

`RTW.ModelSpecificCPrototype.addArgConf`

## How To

- “Function Prototype Control”

# RTW.ModelSpecificCPrototype

---

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Create model-specific C prototype object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Syntax</b>           | <code>obj = RTW.ModelSpecificCPrototype</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>      | <code>obj = RTW.ModelSpecificCPrototype</code> creates a handle, <code>obj</code> , to an object of class <code>RTW.ModelSpecificCPrototype</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Output Arguments</b> | <code>obj</code> Handle to model specific C prototype object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Examples</b>         | <p>Create a function control object, <code>a</code>, and use it to add argument configuration information to the model:</p> <pre>% Open the rtwdemo_counter model and specify the System Target File rtwdemo_counter set_param(gcs, 'SystemTargetFile', 'ert.tlc')  %% Create a function control object a=RTW.ModelSpecificCPrototype  %% Add argument configuration information for Input and Output ports addArgConf(a, 'Input', 'Pointer', 'inputArg', 'const *') addArgConf(a, 'Output', 'Pointer', 'outputArg', 'none')  %% Attach the function control object to the model attachToModel(a,gcs)</pre> |
| <b>Alternatives</b>     | The <b>Configure Model Functions</b> button on the <b>Interface</b> pane of the Simulink Configuration Parameters dialog box launches the Model Interface dialog box, which provides you flexible control over the C function prototypes that are generated for your model. See “Configure Function Prototypes Using Graphical Interfaces” in the Embedded Coder documentation.                                                                                                                                                                                                                             |
| <b>See Also</b>         | <code>RTW.ModelSpecificCPrototype.addArgConf</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



## How To

- “Function Prototype Control”

# rtw.pil.RtIOStreamApplicationFramework

---

**Purpose** Configure target-side communications

**Syntax** `appFrameObj = rtw.pil.RtIOStreamApplicationFramework(componentArgs)`

## Description

| Constructor                                 | Description                                                                                                                                                                                                                                          |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>RtIOStreamApplicationFramework</code> | Specify target-specific libraries and source files that are required to build the executable. These libraries and source files must include the device drivers that implement the target-side of the <code>rtiostream</code> communications channel. |

| Constructor Argument       |                                                        |
|----------------------------|--------------------------------------------------------|
| <code>componentArgs</code> | An <code>rtw.connectivity.ComponentArgs</code> object. |

`appFrameObj = rtw.pil.RtIOStreamApplicationFramework(componentArgs)` returns an object that provides access to an `RTW.BuildInfo` object containing PIL-specific files (including a PIL main). `rtw.connectivity.MakefileBuilder` combines these files with the PIL component libraries to create the PIL application.

You must make a subclass of `rtw.pil.RtIOStreamApplicationFramework`. In addition:

- Use the `addPILMain` method to specify a `main.c` file, which is required to build the PIL application.

- To the `RTW.BuildInfo` object, add data that is required for the implementation of the `rtiostream` target communications interface, using provided functions.

| Required Data                  | Function for Adding Data     |
|--------------------------------|------------------------------|
| Source file names              | <code>addSourceFiles</code>  |
| Source file paths              | <code>addSourcePaths</code>  |
| Include file names             | <code>addIncludeFiles</code> |
| Include file paths             | <code>addIncludePaths</code> |
| Libraries                      | <code>addLinkObjects</code>  |
| Preprocessor macro definitions | <code>addDefines</code>      |
| Compiler options               | <code>addCompileFlags</code> |
| Linker options                 | <code>addLinkFlags</code>    |

The following table describes `rtw.pil.RtIOStreamApplicationFramework` methods.

| Method                        | Syntax and Description                                                                                    |
|-------------------------------|-----------------------------------------------------------------------------------------------------------|
| <code>getComponentArgs</code> | <code>componentArgs = appFrameObj.getComponentArgs</code>                                                 |
|                               | Returns the <code>rtw.connectivity.ComponentArgs</code> object associated with <code>appFrameObj</code> . |
| <code>getBuildInfo</code>     | <code>buildInfo = appFrameObj.getBuildInfo</code>                                                         |
|                               | Returns the <code>RTW.BuildInfo</code> object associated with <code>appFrameObj</code> .                  |

# rtw.pil.RtIOStreamApplicationFramework

---

| Method     | Syntax and Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| addPILMain | <p><code>appFrameObj.addPILMain(<i>type</i>)</code></p> <p>To build the PIL application, a <code>main.c</code> file is required. Use this method to add one of the two provided files to the application framework. <i>type</i> is 'target' or 'host'.</p> <p>To specify a <code>main.c</code> that is adapted for on-target PIL and suitable for most PIL implementations, enter:</p> <pre>appFrameObj.addPILMain('target')</pre> <p>To specify a <code>main.c</code> that is adapted for host-based PIL, enter:</p> <pre>appFrameObj.addPILMain('host')</pre> |

## See Also

[rtw.connectivity.ComponentArgs](#) | [rtiostream\\_wrapper](#)

## How To

- “Create a Connectivity Configuration for a Target”
- “Build Information Object”
- `rtwdemo_custom_pil_script`

**Purpose** Execute CGV object

**Syntax** `result = cgvObj.run()`

**Description** `result = cgvObj.run()` executes the model once for each input data that you added to the object. `result` is a boolean value that indicates whether the run completed without execution error. `cgvObj` is a handle to a `cgv.CGV` object.

After each execution of the model, the object captures and writes the following metadata to a file in the output folder:

`ErrorDetails` — If errors occur, the error information.  
`status` — The execution status.  
`ver` — Version information for MathWorks® products.  
`hostname` — Name of computer.  
`dateTime` — Date and time of execution.  
`warnings` — If warnings occur, the warning messages.  
`username` — Name of user.  
`runtime` — The amount of time that lapsed for the execution.

## Tips

- Only call `run` once for each `cgv.CGV` object.
- The `cgv.CGV` methods that set up the object are ignored after a call to `run`. See the `cgv.CGV` for details.
- You can call `run` once without first calling `cgv.CGV.addInputData`. However, it is recommended that you first save the required data for execution to a MAT-file, including the model inputs and parameters. Then use `cgv.CGV.addInputData` to pass the MAT-file to the `CGV` object before calling `run`.
- The `cgv.CGV` object supports callback functions that you can define and add to the `cgv.CGV` object. These callback functions are called during `cgv.CGV.run()` in the following order:

# cgv.CGV.run

| Callback function | Add to object using...       | cgv.CGV.run() executes callback function...      |
|-------------------|------------------------------|--------------------------------------------------|
| HeaderReportFcn   | cgv.CGV.addHeaderReportFcn   | Before executing input data in cgv.CGV           |
| PreExecReportFcn  | cgv.CGV.addPreExecReportFcn  | Before executing each input data file in cgv.CGV |
| PreExecFcn        | cgv.CGV.addPreExecFcn        | Before executing each input data file in cgv.CGV |
| PostExecReportFcn | cgv.CGV.addPostExecReportFcn | After executing each input data file in cgv.CGV  |
| PostExecFcn       | cgv.CGV.addPostExecFcn       | After executing each input data file in cgv.CGV  |
| TrailerReportFcn  | cgv.CGV.addTrailerReportFcn  | After the input data is executed in cgv.CGV      |

## How To

- “Verify Numerical Equivalence with CGV”

# RTW.ModelCPPArgsClass.runValidation

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Validate model-specific C++ class interface against Simulink model                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                     |
| <b>Syntax</b>           | <code>[status, msg] = runValidation(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |
| <b>Description</b>      | <p><code>[status, msg] = runValidation(obj)</code> runs a validation check of the specified model-specific C++ class interface against the ERT-based Simulink model to which it is attached.</p> <p>Before calling this function, you must call either <code>attachToModel</code>, to attach a function prototype to a loaded model, or <code>RTW.getClassInterfaceSpecification</code>, to get the handle to a function prototype previously attached to a loaded model.</p>                                            |                                                                                                                                                                                                                                     |
| <b>Input Arguments</b>  | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <i>status</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Boolean value; true for a valid configuration, false otherwise.                                                                                                                                                                     |
|                         | <i>msg</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | If <i>status</i> is false, <i>msg</i> contains a string of information describing why the configuration is invalid.                                                                                                                 |
| <b>Alternatives</b>     | To validate a C++ class interface in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. Click the <b>Validate</b> button to validate your current model step function configuration. The <b>Validation</b> pane displays status and an explanation of failures. For |                                                                                                                                                                                                                                     |

# RTW.ModelCPPArgsClass.runValidation

---

more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## **How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”



# RTW.ModelCPPVoidClass.runValidation

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Validate model-specific C++ class interface against Simulink model                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                     |
| <b>Syntax</b>           | <code>[status, msg] = runValidation(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |
| <b>Description</b>      | <p><code>[status, msg] = runValidation(obj)</code> runs a validation check of the specified model-specific C++ class interface against the ERT-based Simulink model to which it is attached.</p> <p>Before calling this function, you must call either <code>attachToModel</code>, to attach a function prototype to a loaded model, or <code>RTW.getClassInterfaceSpecification</code>, to get the handle to a function prototype previously attached to a loaded model.</p>                                            |                                                                                                                                                                                                                                     |
| <b>Input Arguments</b>  | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPVoidClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <i>status</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Boolean value; true for a valid configuration, false otherwise.                                                                                                                                                                     |
|                         | <i>msg</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | If <i>status</i> is false, <i>msg</i> contains a string of information describing why the configuration is invalid.                                                                                                                 |
| <b>Alternatives</b>     | To validate a C++ class interface in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. Click the <b>Validate</b> button to validate your current model step function configuration. The <b>Validation</b> pane displays status and an explanation of failures. For |                                                                                                                                                                                                                                     |

# RTW.ModelCPPVoidClass.runValidation

---

more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## **How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.runValidation

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|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                      |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>          | Validate model-specific C function prototype against Simulink model                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                      |
| <b>Syntax</b>           | <code>[status, msg] = runValidation(obj)</code>                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                      |
| <b>Description</b>      | <p><code>[status, msg] = runValidation(obj)</code> runs a validation check of the specified model-specific C function prototype against the ERT-based Simulink model to which it is attached.</p> <p>Before calling this function, you must call either <code>attachToModel</code>, to attach a function prototype to a loaded model, or <code>RTW.getFunctionSpecification</code>, to get the handle to a function prototype previously attached to a loaded model.</p> |                                                                                                                                                                                                      |
| <b>Input Arguments</b>  | <i>obj</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
| <b>Output Arguments</b> | <i>status</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | True for a valid configuration; false otherwise.                                                                                                                                                     |
|                         | <i>msg</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                               | If <i>status</i> is false, <i>msg</i> contains a string explaining why the configuration is invalid.                                                                                                 |
| <b>Alternatives</b>     | Click the <b>Validate</b> button in the Model Interface dialog box to run a validation check of the specified model-specific C function prototype against the ERT-based Simulink model to which it is attached. See “Model Specific C Prototypes View” in the Embedded Coder documentation.                                                                                                                                                                              |                                                                                                                                                                                                      |
| <b>How To</b>           | • “Function Prototype Control”                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                      |

# set

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Set property of AUTOSAR element                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Syntax</b>          | <code>set(arProps,elementPath,property,value)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>     | <code>set(arProps,elementPath,property,value)</code> sets the specified property of the AUTOSAR element at <code>elementPath</code> to <code>value</code> . For properties that reference other elements, <code>value</code> is a path. To set XML packaging options, specify <code>elementPath</code> as <code>XmlOptions</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Input Arguments</b> | <p><b>arProps - AUTOSAR properties information for a model</b><br/>handle</p> <p>AUTOSAR properties information for a model, previously returned by <code>arProps = autosar.api.getAUTOSARProperties(model)</code>. <code>model</code> is a handle or string representing the model name.</p> <p><b>Example:</b> <code>arProps</code></p> <p><b>elementPath - Path to an AUTOSAR element</b><br/>string</p> <p>Path to an AUTOSAR element for which to set a property. To set XML packaging options, specify <code>XmlOptions</code>,</p> <p><b>Example:</b> <code>'Input'</code></p> <p><b>property - Type of property</b><br/>string</p> <p>Type of property for which to specify a value, among valid properties for the AUTOSAR element.</p> <p><b>Example:</b> <code>'IsService'</code></p> <p><b>value - Value of property</b><br/>value of property   path to composite property or property that references other properties</p> <p>Value to set for the specified property. For properties that reference other elements, specify a path.</p> |

Example: true

## Examples

### Set IsService Property for Sender-Receiver Interface

For a model, set the IsService property for sender-receiver interface Interface1 to true (1).

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
set(arProps,'Interface1','IsService',true);
isService=get(arProps,'Interface1','IsService')
```

isService =

1

### Set Runnable Symbol Name

For a model, set the symbol property for runnable Runnable1 to test\_symbol.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
compQName=get(arProps,'XmlOptions','ComponentQualified');
runnables=find(arProps,compQName,'Runnable','PathType','FullyQualified');
runnables(2)
```

ans =

```
 '/pkg/swc/ASWC/Behavior/Runnable1'
```

```
get(arProps,runnables{2},'symbol')
```

ans =

```
Runnable1
```

```
set(arProps,runnables{2},'symbol','test_symbol12')
get(arProps,runnables{2},'symbol')
```

# set

---

ans =

test\_symbol2

## See Also

get

## Related Examples

- “Configure and Map AUTOSAR Component Programmatically”
- “Configure the AUTOSAR Interface”

# RTW.ModelCPPArgsClass.setArgCategory

---

**Purpose** Set argument category for Simulink model port in model-specific C++ class interface

**Syntax** `setArgCategory(obj, portName, category)`

**Description** `setArgCategory(obj, portName, category)` sets the category — 'Value', 'Pointer', or 'Reference' — of the argument corresponding to a specified Simulink model inport or output in a specified model-specific C++ class interface.

## Input Arguments

|                 |                                                                                                                                                                                                                                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code> . |
| <i>portName</i> | String specifying the unqualified name of an inport or output in your Simulink model.                                                                                                                                               |
| <i>category</i> | String specifying the argument category — 'Value', 'Pointer', or 'Reference' — to be set for the specified Simulink model port.                                                                                                     |

---

**Note** If you change the argument category for an output from 'Pointer' to 'Value', the change causes the argument to move to the first argument position when `attachToModel` or `runValidation` is called.

---

**Alternatives** To set argument categories in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display

# RTW.ModelCPPArgsClass.setArgCategory

---

and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument categories that you can examine and modify. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”



# RTW.ModelSpecificCPrototype.setArgCategory

---

**Purpose** Set argument category for Simulink model port in model-specific C function prototype

**Syntax** `setArgCategory(obj, portName, category)`

**Description** `setArgCategory(obj, portName, category)` sets the category, 'Value' or 'Pointer', of the argument corresponding to a specified Simulink model inport or outport in a specified model-specific C function prototype.

## Input Arguments

|                 |                                                                                                                                                                                                      |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
| <i>portName</i> | String specifying the unqualified name of an inport or outport in your Simulink model.                                                                                                               |
| <i>category</i> | String specifying the argument category, 'Value' or 'Pointer', that you set for the specified Simulink model port.                                                                                   |

---

**Note** If you change the argument category for an outport from 'Pointer' to 'Value', it causes the argument to move to the first argument position when you call `RTW.ModelSpecificCPrototype.attachToModel` or `RTW.ModelSpecificCPrototype.runValidation`.

---

**Alternatives** Use the **Step function arguments** table in the Model Interface dialog box to specify argument categories. See “Model Specific C Prototypes View” in the Embedded Coder documentation.

# RTW.ModelSpecificCPrototype.setArgCategory

---

## How To

- “Function Prototype Control”

**Purpose** Set argument name for Simulink model port in model-specific C++ class interface

**Syntax** `setArgName(obj, portName, argName)`

**Description** `setArgName(obj, portName, argName)` sets the argument name that corresponds to a specified Simulink model inport or outport in a specified model-specific C++ class interface.

## Input Arguments

|                 |                                                                                                                                                                                                                                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code> . |
| <i>portName</i> | String specifying the name of an inport or outport in your Simulink model.                                                                                                                                                          |
| <i>argName</i>  | String specifying the argument name to set for the specified Simulink model port. The argument must be a valid C identifier.                                                                                                        |

**Alternatives** To set argument names in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument names that you can examine and modify. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”

# RTW.ModelCPPArgsClass.setArgName

---

- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.setArgName

---

**Purpose** Set argument name for Simulink model port in model-specific C function prototype

**Syntax** `setArgName(obj, portName, argName)`

**Description** `setArgName(obj, portName, argName)` sets the argument name corresponding to a specified Simulink model inport or outport in a specified model-specific C function prototype.

**Input Arguments**

|                 |                                                                                                                                                                                                      |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> . |
| <i>portName</i> | String specifying the name of an inport or outport in your Simulink model.                                                                                                                           |
| <i>argName</i>  | String specifying the argument name to set for the specified Simulink model port. The argument must be a valid C identifier.                                                                         |

**Alternatives** Use the **Step function arguments** table in the Model Interface dialog box to specify argument names. See “Model Specific C Prototypes View” in the Embedded Coder documentation.

**How To**

- “Function Prototype Control”

# RTW.ModelCPPArgsClass.setArgPosition

---

**Purpose** Set argument position for Simulink model port in model-specific C++ class interface

**Syntax** `setArgPosition(obj, portName, position)`

**Description** `setArgPosition(obj, portName, position)` sets the position — 1 for first, 2 for second, etc. — of the argument that corresponds to a specified Simulink model inport or outport in a specified model-specific C++ class interface. The specified argument is then moved to the specified position, and other arguments shifted by one position accordingly.

## Input Arguments

|                 |                                                                                                                                                                                                                                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>      | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(<i>modelName</i>)</code> . |
| <i>portName</i> | String specifying the name of an inport or outport in your Simulink model.                                                                                                                                                                 |
| <i>position</i> | Integer specifying the argument position — 1 for first, 2 for second, etc. — to be set for the specified Simulink model port. The value must be greater than or equal to 1 and less than or equal to the number of function arguments.     |

**Alternatives** To set argument positions in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the

Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display step method argument positions that you can examine and modify. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

## How To

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.setArgPosition

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Set argument position for Simulink model port in model-specific C function prototype                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <b>Syntax</b>          | <code>setArgPosition(obj, portName, position)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <b>Description</b>     | <code>setArgPosition(obj, portName, position)</code> sets the position — 1 for first, 2 for second, etc. — of the argument corresponding to a specified Simulink model inport or outport in a specified model-specific C function prototype. The specified argument moves to the specified position, and other arguments shift by one position accordingly.                                                                                                                                                                                                                                                                                                 |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <b>Input Arguments</b> | <table><tr><td><i>obj</i></td><td>Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code>.</td></tr><tr><td><i>portName</i></td><td>String specifying the name of an inport or outport in your Simulink model.</td></tr><tr><td><i>position</i></td><td>Integer specifying the argument position — 1 for first, 2 for second, etc. — to be set for the specified Simulink model port. The value must be greater than or equal to 1 and less than or equal to the number of function arguments.</td></tr></table> | <i>obj</i> | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> . | <i>portName</i> | String specifying the name of an inport or outport in your Simulink model. | <i>position</i> | Integer specifying the argument position — 1 for first, 2 for second, etc. — to be set for the specified Simulink model port. The value must be greater than or equal to 1 and less than or equal to the number of function arguments. |
| <i>obj</i>             | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <i>portName</i>        | String specifying the name of an inport or outport in your Simulink model.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <i>position</i>        | Integer specifying the argument position — 1 for first, 2 for second, etc. — to be set for the specified Simulink model port. The value must be greater than or equal to 1 and less than or equal to the number of function arguments.                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <b>Alternatives</b>    | Use the <b>Step function arguments</b> table in the Model Interface dialog box to specify argument position. See “Model Specific C Prototypes View” in the Embedded Coder documentation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Function Prototype Control”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                      |                 |                                                                            |                 |                                                                                                                                                                                                                                        |



# RTW.ModelCPPArgsClass.setArgQualifier

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Set argument type qualifier for Simulink model port in model-specific C++ class interface                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <b>Syntax</b>          | <code>setArgQualifier(obj, portName, qualifier)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <b>Description</b>     | <code>setArgQualifier(obj, portName, qualifier)</code> sets the type qualifier — 'none', 'const', 'const *', 'const * const', or 'const &' — of the argument that corresponds to a specified Simulink model inport or outport in a specified model-specific C++ class interface.                                                                                                                                                                                                                                                                                                                                                          |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <b>Input Arguments</b> | <table><tr><td><i>obj</i></td><td>Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code>.</td></tr><tr><td><i>portName</i></td><td>String specifying the name of an inport or outport in your Simulink model.</td></tr><tr><td><i>qualifier</i></td><td>String specifying the argument type qualifier — 'none', 'const', 'const *', 'const * const', or 'const &amp;' — to be set for the specified Simulink model port.</td></tr></table>                     | <i>obj</i> | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code> . | <i>portName</i> | String specifying the name of an inport or outport in your Simulink model. | <i>qualifier</i> | String specifying the argument type qualifier — 'none', 'const', 'const *', 'const * const', or 'const &' — to be set for the specified Simulink model port. |
| <i>obj</i>             | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <i>obj</i> = <code>RTW.ModelCPPArgsClass</code> or <i>obj</i> = <code>RTW.getClassInterfaceSpecification(modelName)</code> .                                                                                                                                                                                                                                                                                                                                                                                                       |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <i>portName</i>        | String specifying the name of an inport or outport in your Simulink model.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <i>qualifier</i>       | String specifying the argument type qualifier — 'none', 'const', 'const *', 'const * const', or 'const &' — to be set for the specified Simulink model port.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <b>Alternatives</b>    | To set argument qualifiers in the Simulink Configuration Parameters graphical user interface, go to the <b>Interface</b> pane and click the <b>Configure C++ Class Interface</b> button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the <b>Get Default Configuration</b> button to display step method argument qualifiers that you can examine and modify. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation. |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Customize C++ Class Interfaces Programmatically”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |                                                                                                                                                                                                                                     |                 |                                                                            |                  |                                                                                                                                                              |

# RTW.ModelCPPArgsClass.setArgQualifier

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- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# RTW.ModelSpecificCPrototype.setArgQualifier

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Set argument type qualifier for Simulink model port in model-specific C function prototype                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <b>Syntax</b>          | <code>setArgQualifier(obj, portName, qualifier)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <b>Description</b>     | <code>setArgQualifier(obj, portName, qualifier)</code> sets the type qualifier — 'none', 'const', 'const *', or 'const * const'— of the argument corresponding to a specified Simulink model inport or outport in a specified model-specific C function prototype.                                                                                                                                                                                                                                                                                                     |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <b>Input Arguments</b> | <table><tr><td><i>obj</i></td><td>Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code>.</td></tr><tr><td><i>portName</i></td><td>String specifying the name of an inport or outport in your Simulink model.</td></tr><tr><td><i>qualifier</i></td><td>String specifying the argument type qualifier — 'none', 'const', 'const *', or 'const * const'— to be set for the specified Simulink model port.</td></tr></table> | <i>obj</i> | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> . | <i>portName</i> | String specifying the name of an inport or outport in your Simulink model. | <i>qualifier</i> | String specifying the argument type qualifier — 'none', 'const', 'const *', or 'const * const'— to be set for the specified Simulink model port. |
| <i>obj</i>             | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> .                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <i>portName</i>        | String specifying the name of an inport or outport in your Simulink model.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <i>qualifier</i>       | String specifying the argument type qualifier — 'none', 'const', 'const *', or 'const * const'— to be set for the specified Simulink model port.                                                                                                                                                                                                                                                                                                                                                                                                                       |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <b>Alternatives</b>    | Use the <b>Step function arguments</b> table in the Model Interface dialog box to specify argument qualifiers. See “Model Specific C Prototypes View” in the Embedded Coder documentation.                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Function Prototype Control”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                                                                                                                                                                                                      |                 |                                                                            |                  |                                                                                                                                                  |

# RTW.ModelCPPClass.setClassName

---

**Purpose** Set class name in model-specific C++ class interface

**Syntax** `setClassName(obj, className)`

**Description** `setClassName(obj, className)` sets the class name in the specified model-specific C++ class interface.

**Input Arguments**

|                  |                                                                                                                                                                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>       | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.ModelCPPArgsClass</code> , <code>obj = RTW.ModelCPPVoidClass</code> , or <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <i>className</i> | String specifying a new name for the class described by the specified model-specific C++ class interface. The argument must be a valid C/C++ identifier.                                                                                                           |

**Alternatives** To set the model class name in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display the model class name, which you can examine and modify. In the void-void step method view, you can examine and modify the model class name without having to click a button. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

**How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

**Purpose** Set XML file dependencies

**Syntax** `importerObj.setDependencies(dependencies)`

**Description** `importerObj.setDependencies(dependencies)` sets the XML file dependencies associated with the `arxml.importer` object, `importerObj`.

**Input Arguments** `dependencies` Can be:

- a cell array of strings (for a list of dependencies)
- a char array (for a single dependency)
- or the empty array `[]` (for removing a dependency)

---

**Note** The atomic software components described in the XML file dependencies are ignored.

---

**How To** • “Import AUTOSAR Software Component”

# arxml.importer.setFile

---

**Purpose** Set software component XML file name

**Syntax** `importerObj.setFile(filename)`

**Description** `importerObj.setFile(filename)` sets the name of the main software component XML file associated with the `arxml.importer` object, `importerObj`.

**Input Arguments**

|                       |                                                                                        |
|-----------------------|----------------------------------------------------------------------------------------|
| <code>filename</code> | XML file name. Only atomic software components described in this file can be imported. |
|-----------------------|----------------------------------------------------------------------------------------|

**Examples** Set the name of the main software component file associated with an `arxml.importer` object.

```
>> obj = arxml.importer({'control_system_component.arxml', ...
 'control_system_interface.arxml', ...
 'control_system_datatype.arxml'});
>> obj.setFile('control_system_component2.arxml')
>> obj
```

```
obj =
```

The file "H:\wrk\control\_system\_component2.arxml" contains:

```
1 Application-Software-Component-Type:
 '/ComponentType/controlSystem'

0 Sensor-Actuator-Software-Component-Type.
0 CalPrm-Component-Type.
0 Client-Server-Interface.
>>
```

**See Also** `arxml.importer.getFile`

**How To**

- “Import AUTOSAR Software Component”

# RTW.ModelSpecificCPrototype.setFunctionName

---

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>         | Set function name in model-specific C function prototype                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <b>Syntax</b>          | <code>setFunctionName(obj, fcnName, fcnType)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <b>Description</b>     | <code>setFunctionName(obj, fcnName, fcnType)</code> sets the step or initialization function name in the specified function control object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <b>Input Arguments</b> | <table><tr><td><i>obj</i></td><td>Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code>.</td></tr><tr><td><i>fcnName</i></td><td>String specifying a new name for the function described by the function control object. The argument must be a valid C identifier.</td></tr><tr><td><i>fcnType</i></td><td>Optional. String specifying which function to name. Valid strings are 'step' and 'init'. If <i>fcnType</i> is not specified, sets the step function name.</td></tr></table> | <i>obj</i> | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> . | <i>fcnName</i> | String specifying a new name for the function described by the function control object. The argument must be a valid C identifier. | <i>fcnType</i> | Optional. String specifying which function to name. Valid strings are 'step' and 'init'. If <i>fcnType</i> is not specified, sets the step function name. |
| <i>obj</i>             | Handle to a model-specific C prototype function control object previously returned by <code>obj = RTW.ModelSpecificCPrototype</code> or <code>obj = RTW.getFunctionSpecification(modelName)</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <i>fcnName</i>         | String specifying a new name for the function described by the function control object. The argument must be a valid C identifier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <i>fcnType</i>         | Optional. String specifying which function to name. Valid strings are 'step' and 'init'. If <i>fcnType</i> is not specified, sets the step function name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <b>Alternatives</b>    | Use the <b>Initialize function name</b> and <b>Step function name</b> fields in the Model Interface dialog box to specify function names. See “Model Specific C Prototypes View” in the Embedded Coder documentation.                                                                                                                                                                                                                                                                                                                                                                                                                |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |
| <b>How To</b>          | <ul style="list-style-type: none"><li>• “Function Prototype Control”</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |                                                                                                                                                                                                      |                |                                                                                                                                    |                |                                                                                                                                                           |

# cgv.CGV.setMode

---

**Purpose** Specify mode of execution

**Syntax** `cgvObj.setMode(connectivity)`

**Description** `cgvObj.setMode(connectivity)` specifies the mode of execution for the `cgv.CGV` object, *cgvObj*. The default value for the execution mode is set to either `normal` or `sim`.

**Input Arguments** **connectivity**  
Specify mode of execution

| Value                   | Description                             |
|-------------------------|-----------------------------------------|
| sim or normal (default) | Mode of execution is normal simulation. |
| sil                     | Mode of execution is SIL.               |
| pil                     | Mode of execution is PIL.               |

**Examples** After running a `cgv.CGV` object, copy the object. Before rerunning the object, call `setMode` to change the execution mode to `sil` for an existing `cgv.CGV` object.

```
cgvModel = 'rtwdemo_cgv';
cgvObj1 = cgv.CGV(cgvModel, 'connectivity', 'sim');
cgvObj1.run();
cgvObj2 = cgvObj1.copySetup()
cgvObj2.setMode('sil');
cgvObj2.run();
```

**See Also** `cgv.CGV.run` | `cgv.CGV.copySetup`

**How To** • “Verify Numerical Equivalence with CGV”



**Purpose** Set name space for C++ function entry in code replacement table

**Syntax** `setNameSpace(hEntry, nameSpace)`

**Arguments**

*hEntry*

Handle to a code replacement function entry previously returned by one of the following:

- *hEntry* = `RTW.Tf1CFunctionEntry`
- *hEntry* = `MyCustomFunctionEntry`, where `MyCustomFunctionEntry` is a class derived from `RTW.Tf1CFunctionEntry`
- A call to the `registerCPPFunctionEntry` function

*nameSpace*

String specifying the name space in which the implementation function for the C++ function entry is defined.

**Description**

The `setNameSpace` function specifies the name space for a C++ function entry in a code replacement table. During code generation, if the function entry is matched, the software emits the name space in the generated function code (for example, `std::sin(tf1_cpp_U.In1)`).

If you created the function entry using `hEntry = RTW.Tf1CFunctionEntry` or `hEntry = MyCustomFunctionEntry` (that is, not using `registerCPPFunctionEntry`), then, before calling the `setNameSpace` function, you must enable C++ support for the function entry by calling the `enableCPP` function.

**Examples**

In the following example, the `setNameSpace` function is used to set the name space for the `sin` implementation function to `std`.

```
fcn_entry = RTW.Tf1CFunctionEntry;
fcn_entry.setTf1CFunctionEntryParameters(...
 'Key', 'sin', ...
 'Priority', 100, ...
 'ImplementationName', 'sin', ...
```

# setNameSpace

---

```
 'ImplementationHeaderFile', 'cmath');
fcn_entry.enableCPP();
fcn_entry.setNameSpace('std');
```

## See Also

[enableCPP](#) | [registerCPPFunctionEntry](#)

## How To

- “Map Math Functions to Application-Specific Implementations”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

**Purpose** Set name space in model-specific C++ class interface

**Syntax** `setNamespace(obj, nsName)`

**Description** `setNamespace(obj, nsName)` sets the name space in the specified model-specific C++ class interface.

**Input Arguments**

*obj* Handle to a model-specific C++ class interface control object, such as a handle previously returned by `obj = RTW.ModelCPPArgsClass`, `obj = RTW.ModelCPPVoidClass`, or `obj = RTW.getClassInterfaceSpecification(modelName)`.

*nsName* String specifying a name space for the class described by the specified model-specific C++ class interface. The argument must be a valid C/C++ identifier.

**Alternatives** To set the model name space in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the name space for your model class. In the **I/O arguments step method view** of this dialog box, click the **Get Default Configuration** button to display the model name space, which you can examine and modify. In the **void-void step method view**, you can examine and modify the model name space without having to click a button. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

**How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# rtw.codegenObjectives.Objective.setObjectiveName

---

**Purpose** Specify objective name

**Syntax** `setObjectiveName(obj, objName)`

**Description** `setObjectiveName(obj, objName)` specifies a name for the objective. The Configuration Set Objectives dialog box displays the name of the objective.

**Input Arguments**

|                |                                                                                                                                                                                                  |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>     | Handle to a code generation objective object previously created.                                                                                                                                 |
| <i>objName</i> | Optional string that indicates the name of the objective. If you do not specify an objective name, the Configuration Set Objectives dialog box displays the objective ID for the objective name. |

**Examples** Name the objective Reduce RAM Example:

```
setObjectiveName(obj, 'Reduce RAM Example');
```

**How To**

- “Create Custom Objectives”

**Purpose**

Specify folder

**Syntax**

```
cgvObj.setOutputDir('path')
cgvObj.setOutputDir('path', 'overwrite', 'on')
```

**Description**

`cgvObj.setOutputDir('path')` is an optional method that specifies a location where the object writes the output and metadata files for execution. `cgvObj` is a handle to a `cgv.CGV` object. `path` is the absolute or relative path to the folder. If the path does not exist, the object attempts to create the folder. If you do not call `setOutputDir`, the object uses the current working folder.

`cgvObj.setOutputDir('path', 'overwrite', 'on')` includes the property and value pair to allow read-only files in the working directory to be overwritten. The default value for 'overwrite' is 'off'.

**How To**

- “Verify Numerical Equivalence with CGV”

# cgv.CGV.setOutputFile

---

**Purpose** Specify output data file name

**Syntax** `cgvObj.setOutputFile(InputIndex,OutputFile)`

**Description** `cgvObj.setOutputFile(InputIndex,OutputFile)` is an optional method that changes the default file name for the output data. *cgvObj* is a handle to a `cgv.CGV` object. *InputIndex* is a unique numeric identifier that specifies which output data to write to the file. The *InputIndex* is associated with specific input data. *OutputFile* is the name of the file, with or without the `.mat` extension.

**How To**

- “Verify Numerical Equivalence with CGV”

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>   | Register reserved identifiers to be associated with library                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Syntax</b>    | <code>setReservedIdentifiers(<i>hTable</i>, <i>ids</i>)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Arguments</b> | <p><i>hTable</i></p> <p>Handle to a code replacement table previously returned by <i>hTable</i> = RTW.Tf1Table.</p> <p><i>ids</i></p> <p>Structure specifying reserved keywords to be registered for a library. The structure must contain the following:</p> <ul style="list-style-type: none"><li>• <b>LibraryName</b> element, a string that specifies 'ANSI_C', 'ISO_C', 'GNU', or a code replacement library name.</li><li>• <b>HeaderInfos</b> element, a structure or cell array of structures containing<ul style="list-style-type: none"><li>– <b>HeaderName</b> element, a string that specifies the header file in which the identifiers are declared</li><li>– <b>ReservedIds</b> element, a cell array of strings that specifies the names of the identifiers to be registered as reserved keywords</li></ul></li></ul> <p>For example,</p> <pre>d{1}.LibraryName = 'ANSI_C';<br/>d{1}.HeaderInfos{1}.HeaderName = 'math.h';<br/>d{1}.HeaderInfos{1}.ReservedIds = {'y0', 'y1'};</pre> |

**Description**

In a code replacement table, each function implementation name defined by a table entry will be registered as a reserved identifier. You can register additional reserved identifiers for the table on a per-header-file basis. Providing additional reserved identifiers can help prevent duplicate symbols and other identifier-related compile and link issues.

The `setReservedIdentifiers` function allows you to register up to four reserved identifier structures in a code replacement table. One set of

# setReservedIdentifiers

---

reserved identifiers can be associated with a code replacement library, while the other three (if present) must be associated with libraries named ANSI\_C, ISO\_C, or GNU.

For information about generating a list of reserved identifiers for the code replacement library that you are using to generate code, see “Simulink Coder Code Replacement Library Keywords” in the Simulink Coder documentation.

## Examples

In the following example, `setReservedIdentifiers` is used to register four reserved identifier structures, for 'ANSI\_C', 'ISO\_C', 'GNU', and 'My Custom CRL', respectively.

```
hLib = RTW.Tf1Table;

% Create and register CRL entries here

.
.
.

% Create and register reserved identifiers
d{1}.LibraryName = 'ANSI_C';
d{1}.HeaderInfos{1}.HeaderName = 'math.h';
d{1}.HeaderInfos{1}.ReservedIds = {'a', 'b'};
d{1}.HeaderInfos{2}.HeaderName = 'foo.h';
d{1}.HeaderInfos{2}.ReservedIds = {'c', 'd'};

d{2}.LibraryName = 'ISO_C';
d{2}.HeaderInfos{1}.HeaderName = 'math.h';
d{2}.HeaderInfos{1}.ReservedIds = {'a', 'b'};
d{2}.HeaderInfos{2}.HeaderName = 'foo.h';
d{2}.HeaderInfos{2}.ReservedIds = {'c', 'd'};

d{3}.LibraryName = 'GNU';
d{3}.HeaderInfos{1}.HeaderName = 'math.h';
d{3}.HeaderInfos{1}.ReservedIds = {'a', 'b'};
```



```
d{3}.HeaderInfos{2}.HeaderName = 'foo.h';
d{3}.HeaderInfos{2}.ReservedIds = {'c', 'd'};

d{4}.LibraryName = 'My Custom CRL';
d{4}.HeaderInfos{1}.HeaderName = 'my_math_lib.h';
d{4}.HeaderInfos{1}.ReservedIds = {'y1', 'u1'};
d{4}.HeaderInfos{2}.HeaderName = 'my_oper_lib.h';
d{4}.HeaderInfos{2}.ReservedIds = {'foo', 'bar'};

setReservedIdentifiers(hLib, d);
```

## How To

- “Introduction to Code Replacement Libraries”
- “Add Code Replacement Library Reserved Identifiers”

# RTW.ModelCPPClass.setStepMethodName

---

**Purpose** Set step method name in model-specific C++ class interface

**Syntax** `setStepMethodName(obj, fcnName)`

**Description** `setStepMethodName(obj, fcnName)` sets the step method name in the specified model-specific C++ class interface.

**Input Arguments**

|                |                                                                                                                                                                                                                                                                    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>obj</i>     | Handle to a model-specific C++ class interface control object, such as a handle previously returned by <code>obj = RTW.ModelCPPArgsClass</code> , <code>obj = RTW.ModelCPPVoidClass</code> , or <code>obj = RTW.getClassInterfaceSpecification(modelName)</code> . |
| <i>fcnName</i> | String specifying a new name for the step method described by the specified model-specific C++ class interface. The argument must be a valid C/C++ identifier.                                                                                                     |

**Alternatives** To set the step method name in the Simulink Configuration Parameters graphical user interface, go to the **Interface** pane and click the **Configure C++ Class Interface** button. This button launches the Configure C++ class interface dialog box, where you can display and configure the step method for your model class. In the I/O arguments step method view of this dialog box, click the **Get Default Configuration** button to display the step method name, which you can examine and modify. In the void-void step method view, you can examine and modify the step method name without having to click a button. For more information, see “Configure Step Method for Your Model Class” in the Embedded Coder documentation.

**How To**

- “Customize C++ Class Interfaces Programmatically”
- “Configure the Step Method for a Model Class”
- “C++ Class Interface Control”

# setTf1CFunctionEntryParameters

**Purpose** Set specified parameters for function entry in code replacement table

**Syntax** `setTf1CFunctionEntryParameters(hEntry, varargin)`

**Arguments** *hEntry*  
Handle to a code replacement function entry previously returned by `hEntry = RTW.Tf1CFunctionEntry` or `hEntry = MyCustomFunctionEntry`, where `MyCustomFunctionEntry` is a class derived from `RTW.Tf1CFunctionEntry`.

*varargin*  
Parameter/value pairs for the function entry. See `varargin Parameters`.

**varargin Parameters** The following function entry parameters can be specified to the `setTf1CFunctionEntryParameters` function using parameter/value argument pairs. For example,

```
setTf1CFunctionEntryParameters(..., 'Key', 'sqrt', ...);
```

**Key**  
String specifying the name of the function to be replaced. The name must match one of the functions supported for replacement:

## Math Functions

**Note** For detailed support information, see “Map Math Functions to Application-Specific Implementations”.

|       |       |       |            |
|-------|-------|-------|------------|
| abs   | acos  | acosh | asin       |
| asinh | atan  | atan2 | atanh      |
| ceil  | cos   | cosh  | exactrSqrt |
| exp   | fix   | floor | frexp      |
| hypot | ldexp | ln    | log        |

# setTfFcnFunctionEntryParameters

|          |      |         |          |
|----------|------|---------|----------|
| log10    | max  | min     | mod/fmod |
| pow      | rem  | round   | rSqrt    |
| saturate | sign | signPow | sin      |
| sincos   | sinh | sqrt    | round    |
| tan      | tanh |         |          |

## Memory Utility Functions

|        |        |        |                          |
|--------|--------|--------|--------------------------|
| memcpy | memcpy | memset | memset2zero <sup>1</sup> |
|--------|--------|--------|--------------------------|

## Nonfinite Support Utility Functions<sup>2</sup>

|                    |             |        |                    |
|--------------------|-------------|--------|--------------------|
| getInf             | getMinusInf | getNaN | isInf <sup>3</sup> |
| isNaN <sup>3</sup> |             |        |                    |

## Lookup Table Functions<sup>2</sup>

|          |          |          |                 |
|----------|----------|----------|-----------------|
| interp1D | interp4D | lookup2D | lookup5D        |
| interp2D | interp5D | lookup3D | lookupND_Direct |
| interp3D | lookup1D | lookup4D | prelookup       |

<sup>1</sup> Some target processors provide optimized memset functions for you to set memory to zero. The code replacement library API supports replacing memset to zero functions with more efficient target-specific functions.

<sup>2</sup> Code replacement is supported for Simulink code generation only.

<sup>3</sup> Replacement of isInf and isNaN is supported only for complex floating-point inputs.

## GenCallback

String specifying '' or 'RTW.copyFileToBuildDir'. The default is ''. If you specify 'RTW.copyFileToBuildDir', and if this function entry is matched and used, the function RTW.copyFileToBuildDir will be called after code generation to copy additional header, source, or object files that you have specified for this function entry to the build directory. For

more information, see “Specify Build Information for Code Replacements” in the Embedded Coder documentation.

## Priority

Positive integer specifying the function entry’s search priority, 0-100, relative to other entries of the same function name and conceptual argument list within this table. Highest priority is 0, and lowest priority is 100. The default is 100. If the table provides two implementations for a function, the implementation with the higher priority will shadow the one with the lower priority.

## ImplType

Specifies the type of entry: `FCN_IMPL_FUNC` for function or `FCN_IMPL_MACRO` for macro. The default is `FCN_IMPL_FUNC`.

## ImplementationName

String specifying the name of the implementation function, for example, `'sqrt'`, which can match or differ from the Key name. The default is `''`.

## SaturationMode

String specifying the saturation mode supported by the implementation function: `'RTW_SATURATE_ON_OVERFLOW'`, `'RTW_WRAP_ON_OVERFLOW'`, or `'RTW_SATURATE_UNSPECIFIED'`. The default is `'RTW_SATURATE_UNSPECIFIED'`.

## RoundingModes

Cell array of strings specifying one or more rounding modes supported by the implementation function: `'RTW_ROUND_FLOOR'`, `'RTW_ROUND_CEILING'`, `'RTW_ROUND_ZERO'`, `'RTW_ROUND_NEAREST'`, `'RTW_ROUND_NEAREST_ML'`, `'RTW_ROUND_SIMPLEST'`, `'RTW_ROUND_CONV'`, and `'RTW_ROUND_UNSPECIFIED'`. The default is `{'RTW_ROUND_UNSPECIFIED'}`.

## ImplementationHeaderFile

String specifying the name of the header file that declares the implementation function, for example, `'<math.h>'`. The default is `''`.

# setTflCFunctionEntryParameters

---

## ImplementationHeaderPath

String specifying the full path to the implementation header file. The string can include tokens (for example, `$myfolder$`, where `myfolder` is a variable defined as a string or cell array of strings in the MATLAB workspace). The default is `''`.

## ImplementationSourceFile

String specifying the name of the implementation source file. The default is `''`.

## ImplementationSourcePath

String specifying the full path to the implementation source file. The string can include tokens (for example, `$myfolder$`, where `myfolder` is a variable defined as a string or cell array of strings in the MATLAB workspace). The default is `''`.

---

**Note** To supply additional build information for the function entry, you can use code replacement table entry functions `addAdditionalHeaderFile`, `addAdditionalIncludePath`, `addAdditionalLinkObj`, `addAdditionalLinkObjPath`, `addAdditionalSourceFile`, and `addAdditionalSourcePath`, and code replacement table entry properties `AdditionalCompileFlags`, `AdditionalLinkFlags`, and `OtherFiles`. For more information, see “Specify Build Information for Code Replacements”.

---

## AcceptExprInput

Boolean value used to flag the code generator that the implementation function described by this entry should accept expression inputs. The default value is `true` if `ImplType` equals `FCN_IMPL_FUNCT` and `false` if `ImplType` equals `FCN_IMPL_MACRO`.

If the value is `true`, expression inputs are integrated into the generated code in a form similar to the following:

```
rtY.Out1 = mySin(rtU.In1 + rtU.In2);
```

If the value is `false`, a temporary variable is generated for the expression input, as follows:

```
real_T rtb_Sum;

rtb_Sum = rtU.In1 + rtU.In2;
rtY.Out1 = mySin(rtb_Sum);
```

## SideEffects

Boolean value used to flag the code generator that the implementation function described by this entry should not be optimized away. This parameter applies to implementation functions that return `void` but should not be optimized away, such as a `memcpy` implementation or an implementation function that accesses global memory values. For those implementation functions only, you must include this parameter and specify the value `true`. The default is `false`.

## StoreFcnReturnInLocalVar

Boolean value used to flag the code generator that the return value of the implementation function described by this entry must be stored in a local variable regardless of other expression folding settings. If the value is `false` (the default), other expression folding settings determine whether the return value is folded. Storing function returns in a local variable can increase the clarity of generated code. For example, here is an example of code generated with expression folding:

```
void sw_step(void)
{
 if (ssub(sadd(sw_U.In1, sw_U.In2), sw_U.In3) <=
 smul(ssub(sw_U.In4, sw_U.In5), sw_U.In6)) {
 sw_Y.Out1 = sw_U.In7;
 } else {
 sw_Y.Out1 = sw_U.In8;
 }
}
```

# setTfFcnFunctionEntryParameters

---

With StoreFcnReturnInLocalVar set to true, the generated code potentially is easier to understand and debug:

```
void sw_step(void)
{
 real32_T rtb_Switch;
 real32_T hoistedExpr;

 rtb_Switch = sadd(sw_U.In1, sw_U.In2);
 rtb_Switch = ssub(rtb_Switch, sw_U.In3);
 hoistedExpr = ssub(sw_U.In4, sw_U.In5);
 hoistedExpr = smul(hoistedExpr, sw_U.In6);
 if (rtb_Switch <= hoistedExpr) {
 sw_Y.Out1 = sw_U.In7;
 } else {
 sw_Y.Out1 = sw_U.In8;
 }
}
```

## EntryInfoAlgorithm

String specifying a computation or approximation method, configured for the specified math function, that must be matched in order for function replacement to occur. Code replacement libraries support function replacement based on computation or approximation method for the math functions rSqrt, sin, cos, and sincos. The valid arguments for each supported function are:

| Function | Argument           | Meaning                                     |
|----------|--------------------|---------------------------------------------|
| rSqrt    | RTW_DEFAULT        | Match the default computation method, Exact |
|          | RTW_NEWTON_RAPHSON | Match the Newton-Raphson computation method |
|          | RTW_UNSPECIFIED    | Match a computation method                  |



# setTf1CFunctionEntryParameters

| Function             | Argument        | Meaning                                      |
|----------------------|-----------------|----------------------------------------------|
| sin<br>cos<br>sincos | RTW_CORDIC      | Match the CORDIC approximation method        |
|                      | RTW_DEFAULT     | Match the default approximation method, None |
|                      | RTW_UNSPECIFIED | Match an approximation method                |

## Description

The `setTf1CFunctionEntryParameters` function sets specified parameters for a function entry in a code replacement table.

## Examples

In the following example, the `setTf1CFunctionEntryParameters` function is used to set specified parameters for a code replacement function entry for `sqrt`.

```
fcn_entry = RTW.Tf1CFunctionEntry;
fcn_entry.setTf1CFunctionEntryParameters(...
 'Key', 'sqrt', ...
 'Priority', 100, ...
 'ImplementationName', 'sqrt', ...
 'ImplementationHeaderFile', '<math.h>');
```

## How To

- “Introduction to Code Replacement Libraries”
- “Map Math Functions to Application-Specific Implementations”
- “Code Replacement Table Examples”

# setTf1COperationEntryParameters

---

**Purpose** Set specified parameters for operator entry in code replacement table

**Syntax** `setTf1COperationEntryParameters(hEntry, varargin)`

**Arguments** *hEntry*  
Handle to a code replacement table entry previously returned by one of the following class instantiations:

`hEntry = RTW.Tf1COperationEntry;` Supports operator replacement, described in “Map Scalar Operators to Application Implementations” and “Map Nonscalar Operators to Application Implementations”

`hEntry = RTW.Tf1COperationEntry-Generator;` Provides parameters for fixed-point addition and subtraction that are not available in `RTW.Tf1COperationEntry` (`SlopesMustBeTheSame` and `ZeroNetBias`), described in “Map Fixed-Point Operators to Application Implementations”

`hEntry = RTW.Tf1COperationEntry-Generator_NetSlope;` Provides net slope parameters for fixed-point multiplication and division that are not available in `RTW.Tf1COperationEntry` (`NetSlopeAdjustmentFactor` and `NetFixedExponent`), described in “Map Fixed-Point Operators to Application Implementations”

`hEntry = RTW.Tf1BlasEntry-Generator;` Supports replacement of nonscalar operators with MathWorks BLAS functions, described in “Map Nonscalar Operators to Application Implementations”

# setTf1COperationEntryParameters

---

*hEntry* = RTW.Tf1CBlasEntry-  
Generator;

Supports replacement of nonscalar operators with ANSI/ISO® C BLAS functions, described in “Map Nonscalar Operators to Application Implementations”

*hEntry* = *MyCustomOperationEntry*;  
(where *MyCustomOperationEntry*  
is a class derived from  
RTW.Tf1COperationEntry)

Supports operator replacement using custom code replacement table entries, described in “Refine Matching and Replacement Using Custom Entries”

---

**Note** If you want to specify `SlopesMustBeTheSame` or `orMustHaveZeroNetBias` for your operator entry, instantiate your table entry using `hEntry = RTW.Tf1COperationEntryGenerator` rather than `hEntry = RTW.Tf1COperationEntry`. If you want to use `NetSlopeAdjustmentFactor` and `NetFixedExponent`, instantiate your table entry using `hEntry = RTW.Tf1COperationEntryGenerator_NetSlope`.

---

*varargin*

Parameter/value pairs for the operator entry. See `varargin` Parameters.

## **varargin Parameters**

The following operator entry parameters can be specified to the `setTf1COperationEntryParameters` function using parameter/value argument pairs. For example,

```
setTf1COperationEntryParameters(..., 'Key', 'RTW_OP_ADD', ...);
```

**Key**

String specifying the operator to be replaced, among the operators supported for replacement:

# setTfIcOperationEntryParameters

| Operator                                        | Key                                                          |
|-------------------------------------------------|--------------------------------------------------------------|
| Addition (+)                                    | RTW_OP_ADD                                                   |
| Subtraction (-)                                 | RTW_OP_MINUS                                                 |
| Multiplication (*)                              | RTW_OP_MUL                                                   |
| Division (/)                                    | RTW_OP_DIV                                                   |
| Data type conversion (cast)                     | RTW_OP_CAST                                                  |
| Shift left (<<)                                 | RTW_OP_SL                                                    |
| Shift right (>>)                                | RTW_OP_SRA (arithmetic) <sup>1</sup><br>RTW_OP_SRL (logical) |
| Element-wise matrix multiplication (.*)         | RTW_OP_ELEM_MUL <sup>2</sup>                                 |
| Matrix right division (/)                       | RTW_OP_RDIV <sup>3</sup>                                     |
| Matrix left division (\)                        | RTW_OP_LDIV <sup>3</sup>                                     |
| Matrix inversion (inv)                          | RTW_OP_INV <sup>3</sup>                                      |
| Complex conjugation                             | RTW_OP_CONJUGATE                                             |
| Transposition (.')                              | RTW_OP_TRANS                                                 |
| Hermitian (complex conjugate) transposition (') | RTW_OP_HERMITIAN                                             |
| Multiplication with transposition               | RTW_OP_TRMUL                                                 |
| Multiplication with Hermitian transposition     | RTW_OP_HMMUL                                                 |

Notes:

<sup>1</sup> code replacements that provide arithmetic shift right implementations should also provide logical shift right implementations, because some arithmetic shift rights are converted to logical shift rights during code generation.

<sup>2</sup> For scalar multiplication, use RTW\_OP\_MUL.

<sup>3</sup> Matrix division and inversion are supported for Simulink code generation (not for Stateflow<sup>®</sup> or MATLAB Coder code generation).

The default is 'RTW\_OP\_ADD'.

## GenCallback

String specifying '' or 'RTW.copyFileToBuildDir'. The default is ''. If you specify 'RTW.copyFileToBuildDir', and if this operator entry is matched and used, the function RTW.copyFileToBuildDir will be called after code generation to copy additional header, source, or object files that you have specified for this operator entry to the build directory. For more information, see “Specify Build Information for Code Replacements” in the Embedded Coder documentation.

## Priority

Positive integer specifying the operator entry’s search priority, 0-100, relative to other entries of the same operator name and conceptual argument list within this table. Highest priority is 0, and lowest priority is 100. The default is 100. If the table provides two implementations for an operator, the implementation with the higher priority will shadow the one with the lower priority.

## RoundingModes

Cell array of strings specifying one or more rounding modes supported by the implementation function, among the following: 'RTW\_ROUND\_FLOOR', 'RTW\_ROUND\_CEILING', 'RTW\_ROUND\_ZERO', 'RTW\_ROUND\_NEAREST', 'RTW\_ROUND\_NEAREST\_ML', 'RTW\_ROUND\_SIMPLEST', 'RTW\_ROUND\_CONV', and 'RTW\_ROUND\_UNSPECIFIED'. The default is {'RTW\_ROUND\_UNSPECIFIED'}.

## SaturationMode

String specifying the saturation mode supported by the implementation function: 'RTW\_SATURATE\_ON\_OVERFLOW', 'RTW\_WRAP\_ON\_OVERFLOW', or 'RTW\_SATURATE\_UNSPECIFIED'. The default is 'RTW\_SATURATE\_UNSPECIFIED'.

## SlopesMustBeTheSame

Boolean flag that, when set to true, indicates that code replacement request processing must check that slopes of the arguments (input and output) are equal. The default is false.

# setTf1COperationEntryParameters

---

Use this parameter and `MustHaveZeroNetBias` for fixed-point addition and subtraction replacement. Set both parameters to `true` to disregard specific slope and bias values and map relative slope and bias values to a replacement function.

To use this parameter, you must instantiate your table entry using `hEntry = RTW.Tf1COperationEntryGenerator` rather than `hEntry = RTW.Tf1COperationEntry`.

## `MustHaveZeroNetBias`

Boolean flag that, when set to `true`, indicates that code replacement request processing must check that net bias of the arguments is zero. The default is `false`.

Use this parameter and `SlopesMustBeTheSame` for fixed-point addition and subtraction replacement. Set both parameters to `true` to disregard specific slope and bias values and map relative slope and bias values to a replacement function.

To use this parameter, you must instantiate your table entry using `hEntry = RTW.Tf1COperationEntryGenerator` rather than `hEntry = RTW.Tf1COperationEntry`.

## `NetSlopeAdjustmentFactor`

Floating-point value specifying the slope adjustment factor (F) part of the net slope,  $F2^E$ , for net slope code replacement entries. The default is `1.0`.

This parameter and `NetFixedExponent` can be used for fixed-point multiplication and division replacement. Specify both parameters to map a range of slope and bias values to a replacement function.

To use this parameter, you must instantiate your table entry using `hEntry = RTW.Tf1COperationEntryGenerator_NetSlope` rather than `hEntry = RTW.Tf1COperationEntry`.

## NetFixedExponent

Floating-point value specifying the fixed exponent (E) part of the net slope,  $F2^E$ , for net slope code replacement entries. For example, -3.0. The default is 0.

This parameter and `NetSlopeAdjustmentFactor` can be used for fixed-point multiplication and division replacement. Specify both parameters to map a range of slope and bias values to a replacement function.

To use this parameter, you must instantiate your table entry using `hEntry = RTW.Tf1COperationEntryGenerator_NetSlope` rather than `hEntry = RTW.Tf1COperationEntry`.

## ImplementationName

String specifying the name of the implementation function, for example, 's8\_add\_s8\_s8'. The default is ''.

## ImplementationHeaderFile

String specifying the name of the header file that declares the implementation function, for example, 's8\_add\_s8\_s8.h'. The default is ''.

## ImplementationHeaderPath

String specifying the full path to the implementation header file. The string can include tokens (for example, `$myfolder$`, where `myfolder` is a variable defined as a string or cell array of strings in the MATLAB workspace). The default is ''.

## ImplementationSourceFile

String specifying the name of the implementation source file, for example, 's8\_add\_s8\_s8.c'. The default is ''.

## ImplementationSourcePath

String specifying the full path to the implementation source file. The string can include tokens (for example, `$myfolder$`, where `myfolder` is a variable defined as a string or cell array of strings in the MATLAB workspace). The default is ''.

# setTflCOperationEntryParameters

---

---

**Note** To supply additional build information for the operator entry, you can use code replacement table entry functions `addAdditionalHeaderFile`, `addAdditionalIncludePath`, `addAdditionalLinkObj`, `addAdditionalLinkObjPath`, `addAdditionalSourceFile`, and `addAdditionalSourcePath`, and code replacement table entry properties `AdditionalCompileFlags`, `AdditionalLinkFlags`, and `OtherFiles`. For more information, see “Specify Build Information for Code Replacements”.

---

## AcceptExprInput

Boolean value used to flag the code generator that the implementation function described by this entry should accept expression inputs. If the value is `true` (the default), expression inputs are integrated into the generated code in a form similar to the following:

```
rtY.Out1 = u8_add_u8_u8(u8_add_u8_u8(rtU.In1, rtU.In2), rtU.In3);
```

If the value is `false`, a temporary variable is generated for the expression input, as follows:

```
uint8_T tempVar;

tempVar = u8_add_u8_u8(rtU.In1, rtU.In2);
rtY.Out1 = u8_add_u8_u8(tempVar, rtU.In3);
```

## SideEffects

Boolean value used to flag the code generator that the implementation function described by this entry should not be optimized away. This parameter applies to implementation functions that return `void` but should not be optimized away, such as an implementation function that accesses global memory values. For those implementation functions only, you must include this parameter and specify the value `true`. The default is `false`.



## StoreFcnReturnInLocalVar

Boolean value used to flag the code generator that the return value of the implementation function described by this entry must be stored in a local variable regardless of other expression folding settings. If the value is `false` (the default), other expression folding settings determine whether the return value is folded. Storing function returns in a local variable can increase the clarity of generated code. For example, here is an example of code generated with expression folding:

```
void sw_step(void)
{
 if (ssub(sadd(sw_U.In1, sw_U.In2), sw_U.In3) <=
 smul(ssub(sw_U.In4, sw_U.In5), sw_U.In6)) {
 sw_Y.Out1 = sw_U.In7;
 } else {
 sw_Y.Out1 = sw_U.In8;
 }
}
```

With `StoreFcnReturnInLocalVar` set to `true`, the generated code potentially is easier to understand and debug:

```
void sw_step(void)
{
 real32_T rtb_Switch;
 real32_T hoistedExpr;

 rtb_Switch = sadd(sw_U.In1, sw_U.In2);
 rtb_Switch = ssub(rtb_Switch, sw_U.In3);
 hoistedExpr = ssub(sw_U.In4, sw_U.In5);
 hoistedExpr = smul(hoistedExpr, sw_U.In6);
 if (rtb_Switch <= hoistedExpr) {
 sw_Y.Out1 = sw_U.In7;
 } else {
 sw_Y.Out1 = sw_U.In8;
 }
}
```

# setTf1COperationEntryParameters

---

## Description

The setTf1COperationEntryParameters function sets specified parameters for an operator entry in a code replacement table.

## Examples

In the following example, the setTf1COperationEntryParameters function is used to set parameters for a code replacement operator entry for uint8 addition.

```
op_entry = RTW.Tf1COperationEntry;
op_entry.setTf1COperationEntryParameters(...
 'Key', 'RTW_OP_ADD', ...
 'Priority', 90, ...
 'SaturationMode', 'RTW_SATURATE_UNSPECIFIED', ...
 'RoundingModes', {'RTW_ROUND_UNSPECIFIED'}, ...
 'ImplementationName', 'u8_add_u8_u8', ...
 'ImplementationHeaderFile', 'u8_add_u8_u8.h', ...
 'ImplementationSourceFile', 'u8_add_u8_u8.c');
```

In the following example, the setTf1COperationEntryParameters function is used to set parameters for a code replacement operator entry for fixed-point int16 division. The table entry specifies a net scaling between the operator inputs and output in order to map a range of slope and bias values to a replacement function.

```
op_entry = RTW.Tf1COperationEntryGenerator_NetSlope;
op_entry.setTf1COperationEntryParameters(...
 'Key', 'RTW_OP_DIV', ...
 'Priority', 90, ...
 'SaturationMode', 'RTW_WRAP_ON_OVERFLOW', ...
 'RoundingModes', {'RTW_ROUND_CEILING'}, ...
 'NetSlopeAdjustmentFactor', 1.0, ...
 'NetFixedExponent', 0.0, ...
 'ImplementationName', 's16_div_s16_s16', ...
 'ImplementationHeaderFile', 's16_div_s16_s16.h', ...
 'ImplementationSourceFile', 's16_div_s16_s16.c');
```

In the following example, the setTf1COperationEntryParameters function is used to set parameters for a code replacement operator entry for fixed-point uint16 addition. The table entry specifies equal slope

and zero net bias across operator inputs and output in order to map relative slope and bias values (rather than a specific slope and bias combination) to a replacement function.

```
op_entry = RTW.Tf1COperationEntryGenerator;
op_entry.setTf1COperationEntryParameters(...
 'Key', 'RTW_OP_ADD', ...
 'Priority', 90, ...
 'SaturationMode', 'RTW_WRAP_ON_OVERFLOW', ...
 'RoundingModes', {'RTW_ROUND_UNSPECIFIED'}, ...
 'SlopesMustBeTheSame', true, ...
 'MustHaveZeroNetBias', true, ...
 'ImplementationName', 'u16_add_SameSlopeZeroBias', ...
 'ImplementationHeaderFile', 'u16_add_SameSlopeZeroBias.h', ...
 'ImplementationSourceFile', 'u16_add_SameSlopeZeroBias.c');
```

## How To

- “Map Scalar Operators to Application Implementations”
- “Map Fixed-Point Operators to Application Implementations”
- “Code Replacement Table Examples”

# setTf1CSemaphoreEntryParameters

---

**Purpose** Set specified parameters for semaphore entry in CRL table

**Syntax** `setTf1CSemaphoreEntryParameters(hEntry, varargin)`

**Arguments**

*hEntry*  
Handle to a CRL semaphore entry previously returned by *hEntry*  
= `RTW.Tf1CSemaphoreEntry;`

*varargin*  
Parameter/value pairs for the semaphore entry. See `varargin`  
Parameters.

**varargin Parameters** The following semaphore entry parameters can be specified to the `setTf1CSemaphoreEntryParameters` function using parameter/value argument pairs. For example,

```
setTf1CSemaphoreEntryParameters(..., 'Key', 'RTW_SEM_INIT', ...);
```

Key

String specifying the semaphore or mutex operation to be replaced, among the semaphore and mutex operations supported for replacement:

| Operation         | Key               |
|-------------------|-------------------|
| Mutex Destroy     | RTW_MUTEX_DESTROY |
| Mutex Init        | RTW_MUTEX_INIT    |
| Mutex Lock        | RTW_MUTEX_LOCK    |
| Mutex Unlock      | RTW_MUTEX_UNLOCK  |
| Semaphore Destroy | RTW_SEM_DESTROY   |
| Semaphore Init    | RTW_SEM_INIT      |
| Semaphore Post    | RTW_SEM_POST      |
| Semaphore Wait    | RTW_SEM_WAIT      |

## GenCallback

String specifying '' or 'RTW.copyFileToBuildDir'. The default is ''. If you specify 'RTW.copyFileToBuildDir', and if this semaphore entry is matched and used, the function RTW.copyFileToBuildDir is called after code generation to copy additional header, source, or object files that you have specified for this semaphore entry to the build directory. For more information, see “Specify Build Information for Code Replacements” in the Embedded Coder documentation.

## Priority

Positive integer specifying the semaphore entry’s search priority, 0-100, relative to other entries of the same name and conceptual argument list within this table. Highest priority is 0, and lowest priority is 100. The default is 100. If the table provides two implementations for a semaphore operation, the implementation with the higher priority will shadow the one with the lower priority.

## ImplementationName

String specifying the name of the implementation function, for example, 'mySemCreate'.

## ImplementationHeaderFile

String specifying the name of the header file that declares the implementation function, for example, 'mySem.h'. The default is ''.

## ImplementationHeaderPath

String specifying the full path to the implementation header file. The string can include tokens (for example, \$myfolder\$, where myfolder is a variable defined as a string or cell array of strings in the MATLAB workspace). The default is ''.

## ImplementationSourceFile

String specifying the name of the implementation source file, for example, 'mySem.c'. The default is ''.

# setTf1CSemaphoreEntryParameters

---

## ImplementationSourcePath

String specifying the full path to the implementation source file. The string can include tokens (for example, `$myfolder$`, where `myfolder` is a variable defined as a string or cell array of strings in the MATLAB workspace). The default is `' '`.

---

**Note** To supply additional build information for the semaphore entry, you can use CRL table entry functions `addAdditionalHeaderFile`, `addAdditionalIncludePath`, `addAdditionalLinkObj`, `addAdditionalLinkObjPath`, `addAdditionalSourceFile`, and `addAdditionalSourcePath`, and CRL table entry properties `AdditionalCompileFlags`, `AdditionalLinkFlags`, and `OtherFiles`. For more information, see “Specify Build Information for Code Replacements”.

---

## SideEffects

Boolean value used to flag the code generator that the implementation function described by this entry should not be optimized away. This parameter applies to implementation functions that return `void` but should not be optimized away, such as an implementation function that accesses global memory values. For those implementation functions only, you must include this parameter and specify the value `true`. The default is `false`.

## Description

The `setTf1CSemaphoreEntryParameters` function sets specified parameters for a semaphore entry in a CRL table.

## Examples

In the following example, the `setTf1CSemaphoreEntryParameters` function is used to set specified parameters for a CRL table entry for a semaphore initialization replacement.

```
sem_entry = RTW.Tf1CSemaphoreEntry;
sem_entry.setTf1CSemaphoreEntryParameters(...
 'Key', ...
 'RTW_SEM_INIT', ...
```

```
'Priority', 100, ...
'ImplementationName', 'mySemCreate', ...
'ImplementationHeaderFile', 'mySem.h', ...
'ImplementationSourceFile', 'mySem.c', ...
'GenCallback', 'RTW.copyFileToBuildDir', ...
'SideEffects', true);
```

## How To

- “Map Semaphore or Mutex Operations to Application Implementations”
- “Code Replacement Table Examples”
- “Introduction to Code Replacement Libraries”

# coder.MATLABCodeTemplate.setTokenValue

---

**Purpose** Set value of token for code generation template

**Syntax** `setTokenValue(tokenName,tokenValue)`

**Description** `setTokenValue(tokenName,tokenValue)` sets the value of a token for a code generation template.

**Input Arguments**

**tokenName**  
The name of the token

**tokenValue**  
The value of the token

**Default:** empty

**Examples** Create a MATLABCodeTemplate object from a custom template. Set the value for a custom token in the template.

```
newObj = coder.MATLABCodeTemplate('myCGTFile');
% Create a MATLABCodeTemplate object from a custom template file
newObj.setTokenValue('myCustomToken', 'myValue');
% Set the value of a custom token in the file
newObj.getTokenValue('myCustomToken')
% Check value of the custom token
```

**See Also** `coder.MATLABCodeTemplate.getTokenValue` |  
`coder.MATLABCodeTemplate.getCurrentTokens` |  
`coder.MATLABCodeTemplate.emitSection`

**Related Examples**

- “Generate Custom File and Function Banners for C and C++ Code”

**Concepts**

- “Code Generation Template (CGT) Files for MATLAB”



**Purpose** Execute program loaded on processor

**Syntax**

```

IDE_Obj.run
IDE_Obj.run('runopt')
IDE_Obj.run(..., timeout)

```

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** *IDE\_Obj*.run runs the program file loaded on the referenced processor, returning immediately after the processor starts running. Program execution starts from the location of program counter (PC). Usually, the program counter is positioned at the top of the executable file. However, if you stopped a running program with `halt`, the program counter may be anywhere in the program. `run` starts the program from the program counter current location.

If *IDE\_Obj* references more than one processor, each processor calls `run` in sequence.

*IDE\_Obj*.run('runopt') includes the parameter `runopt` that defines the action of the `run` method. The options for `runopt` are listed in the following table.

| runopt string | Description                                                                                                                                                                                                           |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'run'         | Executes the run and waits to confirm that the processor is running, and then returns to MATLAB.                                                                                                                      |
| 'runtohalt'   | Executes the run but then waits until the processor halts before returning. The halt can be the result of the PC reaching a breakpoint, or by direct interaction with the IDE, or by the normal program exit process. |

| runopt string | Description                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'tohalt'      | Waits until the running program has halted. Unlike the other options, this selection does not execute a run, it simply waits for the running program to halt.                                                                                                                                                                                                                                            |
| 'main'        | This option resets the program and executes a run until the start of function 'main'.                                                                                                                                                                                                                                                                                                                    |
| 'tofunc'      | This option must be followed by an extra parameter <i>funcname</i> , the name of the function to run to:<br><br><pre>IDE_Obj.run('tofunc', funcname)</pre> <p>This executes a run from the present PC location until the start of function <i>funcname</i> is reached. If <i>funcname</i> is not along the program's normal execution path, <i>funcname</i> is not reached and the method times out.</p> |

In the 'run' and 'runtohalt' cases, a halt can be caused by a breakpoint, a direct interaction with the IDE, or by a normal program exit.

The following table shows the availability of the *runopt* options by IDE.

|             | CCS IDE | MULTI IDE | VisualDSP++ IDE |
|-------------|---------|-----------|-----------------|
| 'run'       | Yes     | Yes       | Yes             |
| 'runtohalt' | Yes     | Yes       | Yes             |
| 'tohalt'    | Yes     | Yes       |                 |
| 'main'      | Yes     | Yes       |                 |
| 'tofunc'    | Yes     | Yes       |                 |

---

*IDE\_Obj.run(...,timeout)* adds input argument *timeout*, to allow you to set the time out to a value different from the global timeout value. The *timeout* value specifies how long, in seconds, MATLAB waits for the processor to start executing the loaded program before returning.

Most often, the 'run' and 'runtohalt' options cause the processor to initiate execution, even when a timeout is reached. The timeout indicates that the confirmation was not received before the timeout period elapsed.

**See Also**

halt | load | reset

# save

---

**Purpose** Save file

**Syntax** `IDE_Obj.save(filename, filetype)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Texas Instruments Code Composer Studio v3

**Description** Use `IDE_Obj.save(filename, filetype)` to save open files in the IDE project.

The *filename* argument defines the name of the file to save. When entering the file name, include the file extension.

The optional *filetype* argument defines the type of file to save. If you omit the *filetype* argument, *filetype* defaults to 'project'. Except with VisualDSP++ IDE, 'project' is the only supported option. Therefore, you can omit the *filetype* argument in most cases.

|                | <b>CCS IDE</b> | <b>MULTI IDE</b> | <b>VisualDSP++ IDE</b> |
|----------------|----------------|------------------|------------------------|
| 'project'      | Yes            | Yes              | Yes                    |
| 'projectgroup' | No             | No               | Yes                    |

---

**Note** The open method does not support the 'text' argument.

---

## Examples

To save the project files:

```
IDE_Obj.save('all')
```

To save the myproject project:

```
IDE_Obj.save('myproject')
```

To save the active project:

```
IDE_Obj.save([])
```

For VisualDSP++ IDE, to save the projects in the project groups:

```
IDE_Obj.save('all', 'projectgroup')
```

For VisualDSP++ IDE, to save the myg.dpg project group:

```
IDE_Obj.save('myg.dpg', 'projectgroup')
```

For VisualDSP++ IDE, to save the active project in the project groups:

```
IDE_Obj.save([], 'projectgroup')
```

**See Also**

[adivdsp](#) | [close](#) | [load](#)

# setbuilddopt

---

**Purpose** Set active configuration build options

**Syntax** `IDE_Obj.setbuilddopt(tool,ostr)`  
`IDE_Obj.setbuilddopt(file,ostr)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Texas Instruments Code Composer Studio v3

**Description** Use `IDE_Obj.setbuilddopt(tool,ostr)` to set the build options for a specific build tool in the current configuration. This replaces the switch settings that are applied when you invoke the command line `tool`. For example, a build tool could be a compiler, linker or assembler. To define the `tool` argument, first use the `getbuilddopt` command to read a list of defined build tools.

If the VisualDSP++ and Code Composer Studio IDEs do not recognize the `ostr` argument, `setbuilddopt` sets the switch settings to the default values for the build tool specified by `tool`.

If the MULTI IDE does not recognize the `ostr` argument, the IDE does not load the project.

Use `IDE_Obj.setbuilddopt(file,ostr)` to configure the build options for a file you specify with the `file` argument. The source file must exist in the active project.

**See Also** `activate` | `getbuilddopt`

**Purpose** Program symbol table from IDE

**Syntax** `s = IDE_Obj.symbol`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `s = IDE_Obj.symbol` returns the symbol table for the program loaded in the processor associated with the IDE handle object, `IDE_Obj`. The `symbol` method only applies after you load a processor program file. `s` is an array of structures where each row in `s` presents the symbol name and address in the table. Therefore, `s` has two columns; one is the symbol name, and the other is the symbol address and symbol page.

For CCS IDE, this table shows a few possible elements of `s`, and their interpretation.

| <b>s Structure Field</b>     | <b>Contents of the Specified Field</b>                                    |
|------------------------------|---------------------------------------------------------------------------|
| <code>s(1).name</code>       | String reflecting the symbol entry name.                                  |
| <code>s(1).address(1)</code> | Address or value of symbol entry.                                         |
| <code>s(1).address(2)</code> | Memory page for the symbol entry. For TI C6xxx processors, the page is 0. |

For MULTI IDE, this table shows a few possible elements of `s` and their interpretation.

| <b>s Structure Field</b>  | <b>Contents of the Specified Field</b>   |
|---------------------------|------------------------------------------|
| <code>s(1).name</code>    | String reflecting the symbol entry name. |
| <code>s(1).address</code> | Address or value of symbol entry.        |
| <code>s(1).address</code> | Address or value of symbol entry in hex. |

# symbol

---

You can use field address in `s` as the address input argument to read and write.

If you use `symbol` and the symbol table does not exist, `s` returns empty and you get a warning message.

Symbol tables are a portion of a COFF object file that contains information about the symbols that are defined and used by the file. When you load a program to the processor, the symbol table resides in the IDE. While the IDE may contain more than one symbol table at a time, `symbol` accesses the symbol table belonging to the program you last loaded on the processor.

## Examples

Build and load an example program on your processor. Then use `symbol` to return the entries stored in the symbol table in the processor.

```
s = IDE_Obj.symbol;
```

`s` contains the symbols and their addresses, in a structure you can display with the following code:

```
for k=1:length(s),disp(k),disp(s(k)),end;
```

MATLAB software lists the symbols from the symbol table in a column.

## See Also

`load` | `run`



---

**Purpose** Create handle object to interact with Code Composer Studio IDE

**Syntax**

```
IDE_Obj = ticcs
IDE_Obj = ticcs('propertyname','propertyvalue',...)
```

---

**Note** The output argument name you provide for `ticcs` cannot begin with an underscore, such as `_IDE_Obj`.

---

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `IDE_Obj = ticcs` returns a `ticcs` object in `IDE_Obj` that MATLAB software uses to communicate with the default processor. If you do not use input arguments, `ticcs` constructs the object with default values for the properties. the IDE handles the communications between MATLAB software and the selected CPU. When you use the function, `ticcs` starts the IDE if it is not running. If `ticcs` opened an instance of the IDE when you issued the `ticcs` function, the IDE becomes invisible after your coder product creates the new object.

---

**Note** When `ticcs` creates the object `IDE_Obj`, it sets the working folder for the IDE to be the same as your MATLAB Current Folder. When you create files or projects in the IDE, or save files and projects, this working folder affects where you store the files and projects.

---

Each object that accesses the IDE comprises two objects—a `ticcs` object and an `rtdx` object—that include the following properties.

| Object | Property Name | Property         | Default | Description                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------|---------------|------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ticcs  | 'apiversion'  | API version      | N/A     | Defines the API version used to create the link.                                                                                                                                                                                                                                                                                                                                                                   |
|        | 'proctype'    | Processor Type   | N/A     | Specifies the kind of processor on the board.                                                                                                                                                                                                                                                                                                                                                                      |
|        | 'procname'    | Processor Name   | CPU     | Name given to the processor on the board to which this object links.                                                                                                                                                                                                                                                                                                                                               |
|        | 'status'      | Running          | No      | Status of the program currently loaded on the processor.                                                                                                                                                                                                                                                                                                                                                           |
|        | 'boardnum'    | Board Number     | 0       | Number that CCS assigns to the board. Used to identify the board.                                                                                                                                                                                                                                                                                                                                                  |
|        | 'procnum'     | Processor number | 0       | Number the CCS assigns to a processor on a board.                                                                                                                                                                                                                                                                                                                                                                  |
|        | 'timeout'     | Default timeout  | 10.0 s  | Specifies how long MATLAB software waits for a response from CCS after issuing a request. This also applies when you try to construct a ticcs object. The create process waits for this timeout period for the connection to the processor to complete. If the timeout period expires, you get an error message that the connection to the processor failed and MATLAB software could not create the ticcs object. |

| Object | Property Name | Property                | Default | Description                                                                           |
|--------|---------------|-------------------------|---------|---------------------------------------------------------------------------------------|
| rt dx  | 'timeout'     | Timeout                 | 10.0 s  | Specifies how long CCS waits for a response from the processor after requesting data. |
|        | 'numchannels' | Number of open channels | 0       | The number of open channels using this link.                                          |

`IDE_Obj = ticcs('propertyname','propertyvalue',...)` returns a handle in `IDE_Obj` that MATLAB software uses to communicate with the specified processor. CCS handles the communications between the MATLAB environment and the CPU.

MATLAB software treats input parameters to `ticcs` as property definitions. Each property definition consists of a property name/property value pair.

Two properties of the `ticcs` object are read only after you create the object:

- 'boardnum' — The identifier for the installed board selected from the active boards recognized by CCS. If you have one board, use the default property value 0 to access the board.
- 'procnum' — The identifier for the processor on the board defined by `boardnum`. On boards with more than one processor, use this value to specify the processor on the board. On boards with one processor, use the default property value 0 to specify the processor.

Given these two properties, the most common forms of the `ticcs` method are

```
IDE_Obj = ticcs('boardnum',value)
IDE_Obj = ticcs('boardnum',value,'procnum',value)
IDE_Obj = ticcs(...,'timeout',value)
```

which specify the board, and processor in the second example, as the processor.

The third example adds the `timeout` input argument and `value` to allow you to specify how long MATLAB software waits for the connection to the processor or the response to a command to return completed.

You do not need to specify the `boardnum` and `procnum` properties when you have one board with one processor installed. The default property values refer to the processor on the board.

---

**Note** Simulators are considered boards. If you defined both boards and simulators in the IDE, specify the `boardnum` and `procnum` properties to connect to specific boards or simulators. Use `ccsboardinfo` to determine the values for the `boardnum` and `procnum` properties.

---

Because these properties are read only after you create the handle, you must set these property values as input arguments when you use `ticcs`. You cannot change these values after the handle exists. After you create the handle, use the `get` function to retrieve the `boardnum` and `procnum` property values.

## Using ticcs with Multiple Processor Boards

When you create `ticcs` objects that access boards that contain more than one processor, such as the OMAP1510 platform, `ticcs` behaves a little differently.

For each of the `ticcs` syntaxes, the result of the method changes in the multiple processor case, as follows.

```
IDE_Obj = ticcs
IDE_Obj = ticcs('propertyname',propertyvalue)
IDE_Obj = ticcs('propertyname',propertyvalue,'propertyname',...
propertyvalue)
```

In the case where you do not specify a board or processor:

```
IDE_Obj = ticcs
Array of TICCS Objects:
```

```

API version : 1.2
Board name : OMAP 3.0 Platform Simulator [Texas
Instruments]
Board number : 0
Processor 0 (element 1): TMS470R2127 (MPU, Not Running)
Processor 1 (element 2): TMS320C5500 (DSP, Not Running)

```

Where you choose to identify your processor as an input argument to `ticcs`, for example, when your board contains two processors:

```

IDE_Obj = ticcs('boardnum',2)
Array of TICCS Objects:
API version : 1.2
Board name : OMAP 3.0 Platform Simulator [Texas Instruments]
Board number : 2
Processor 0 (element 1) : TMS470R2127 (MPU, Not Running)
Processor 1 (element 2) : TMS320C5500 (DSP, Not Running)

```

`IDE_Obj` returns a two element object handle with `IDE_Obj(1)` corresponding to the first processor and `IDE_Obj(2)` corresponding to the second.

You can include both the board number and the processor number in the `ticcs` syntax. For example:

```

IDE_Obj = ticcs('boardnum',2,'procnum',[0 1])
Array of TICCS Objects:
API version : 1.2
Board name : OMAP 3.0 Platform Simulator [Texas
Instruments]
Board number : 2
Processor 0 (element 1) : TMS470R2127 (MPU, Not Running)
Processor 1 (element 2) : TMS320C5500 (DSP, Not Running)

```

Enter `procnum` as either a single processor on the board (a single value in the input arguments to specify one processor) or a vector of processor numbers, as shown in the example, to select two or more processors.

## Support Coemulation and OMAP

Coemulation, defined by Texas Instruments to mean simultaneous debugging of two or more CPUs, allows you to coordinate your debugging efforts between two or more processors within one device. Efficient development with OMAP™ hardware requires coemulation support. Instead of creating one IDE\_Obj object when you issue the following command

```
IDE_Obj = ticcs
```

or your hardware that has multiple processors, the resulting IDE\_Obj object comprises a vector of IDE\_Obj objects IDE\_Obj(1), IDE\_Obj(2), and so on, each of which accesses one processor on your device, say an OMAP1510. When your processor has one processor, IDE\_Obj is a single object. With a multiprocessor board, the IDE\_Obj object returns the new vector of objects. For example, for board 2 with two processors,

```
IDE_Obj = ticcs
```

returns the following information about the board and processors:

```
IDE_Obj = ticcs('boardnum',2)
Array of TICCS Objects:
API version : 1.2
Board name : OMAP 3.0 Platform Simulator [Texas
Instruments]
Board number : 2
Processor 0 (element 1) : TMS470R2127 (MPU, Not Running)
Processor 1 (element 2) : TMS320C5500 (DSP, Not Running)
```

Checking the existing boards shows that board 2 does have two processors:

```
ccsboardinfo
```

| Board Num | Board Name | Proc Num | Processor Name | Processor Type |
|-----------|------------|----------|----------------|----------------|
|-----------|------------|----------|----------------|----------------|

```

2 OMAP 3.0 Platform Simulator [T ... 0 MPU TMS470R2x
2 OMAP 3.0 Platform Simulator [T ... 1 DSP TMS320C550
1 MGS3 Simulator [Texas Instruments] 0 CPU TMS320C5500
0 ARM925 Simulator [Texas Instru ... 0 CPU TMS470R2x

```

## Examples

On a system with three boards, where the third board has one processor and the first and second boards have two processors each, the following function:

```
IDE_Obj = ticcs('boardnum',1,'procnum',0);
```

returns an object that accesses the first processor on the second board. Similarly, the function

```
IDE_Obj = ticcs('boardnum',0,'procnum',1);
```

returns an object that refers to the second processor on the first board.

To access the processor on the third board, use

```
IDE_Obj = ticcs('boardnum',2);
```

which sets the default property value `procnum=0` to connect to the processor on the third board.

```

IDE_Obj = ticcs
TI CCS Object:
API version : 1.2
Processor type : TMS320C6711
Processor name : CPU_1
Running? : No
Board number : 1
Processor number : 0
Default timeout : 10.00 secs

RTDX channels : 0

```

Defined types : Void, Float, Double, Long, Int, Short, Char

## **See Also**

[ccsboardinfo](#) | [set](#)



**Purpose** Merge XML changes into associated mapped Simulink model

**Syntax** `importerObj.updateModel(modelName)`

**Description** `importerObj.updateModel(modelName)` updates the specified open model with changes detected in the imported AUTOSAR description represented by the `arxml.importer` object, `importerObj`. The update/merge generates a report that details the updates applied to the model, and required changes that were not made automatically. The imported description must contain the AUTOSAR software component mapped by the model.

**Input Arguments**

|                        |                                                                                                                                                    |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>modelName</code> | Name of the model to be updated with changes in the imported AUTOSAR description represented by <code>importerObj</code> . The model must be open. |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|

**Examples** Update model mySWC with AUTOSAR arxml changes described in `updatedSWC.arxml`.

```
>> open_system('mySWC')
>> obj = arxml.importer('updatedSWC.arxml');
>> obj.updateModel('mySWC');
Updating model mySWC
Saving original model as mySWC_backup
Creating HTML report mySWC_update_report.html
>>
```

**How To**

- “Merge AUTOSAR Authoring Tool Changes Into a Model”

# visible

---

**Purpose** Set whether IDE window appears while IDE runs

**Syntax** `IDE_Obj.visible(state)`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Texas Instruments Code Composer Studio v3

**Description** Use `IDE_Obj.visible(state)` to make the IDE visible on the desktop or make it run in the background.

To run the IDE in the background so it is not visible on the desktop, enter '0' for the *state* argument.

To make the IDE visible on your system desktop, enter '1' for the *state* argument.

You can use methods to interact with a IDE handle object, such as `IDE_Obj`, while the IDE is in both states, visible and not visible. You can interact with the IDE GUI while the IDE is visible.

On the Microsoft Windows platform, if you make the IDE visible and look at the Windows Task Manager:

- While the IDE is visible (*state* is 1), the IDE appears on the **Applications** page of Task Manager, and the `IDE_Obj_app.exe` process shows up on the **Processes** page as a running process.
- While the IDE is not visible (*state* is 0), the IDE disappears from the **Applications** page, but remains on the **Processes** page, with a process ID (PID), using CPU and memory resources.

**Examples** In MATLAB, use the constructor function to create a IDE handle object for your IDE. The constructor function creates a handle, such as `IDE_Obj`, and starts the IDE.

To get the visibility status of `IDE_Obj`, enter:

```
IDE_Obj.isvisible
```

```
ans =
 0
```

Now, change the visibility of the IDE to 1, and check its visibility again.

```
IDE_Obj.visible(1)
IDE_Obj.isvisible
```

```
ans =
 1
```

If you close MATLAB software while the IDE is not visible, the IDE remains running in the background. To close it, perform either of the following tasks:

- Start MATLAB software. Create a link to the IDE. Use the new link to make the IDE visible. Close the IDE.
- Open Microsoft Windows Task Manager. Click **Processes**. Find and highlight `IDE_Obj_app.exe`. Click **End Task**.

## See Also

`isvisible` | `load`

# write

---

**Purpose** Write data to processor memory block

**Syntax**

```
mem=IDE_Obj.write(address,data)
mem=write(...,datatype)
mem=IDE_Obj.write(...,memorytype)
mem=IDE_Obj.write(...,timeout)
```

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3

**Description** `mem=IDE_Obj.write(address,data)` writes *data*, a collection of values, to the memory space of the DSP processor referenced by `IDE_Obj`.

The *data* argument is a scalar, vector, or array of values to write to the memory of the processor. The block to write begins from the DSP memory location given by the input parameter *address*.

The method writes the data starting from *address* without regard to type-alignment boundaries in the DSP. Conversely, the byte ordering of the data type is automatically applied.

---

**Note** You cannot write data to processor memory while the processor is running.

---

The *address* argument is a decimal or hexadecimal representation of a memory address in the processor. The full memory address consist of two parts: the start address and the memory type. The memory type value can be explicitly defined using a numeric vector representation of the address.

Alternatively, the `IDE_Obj` object has a default memory type value which is applied if the memory type value is not explicitly incorporated

into the passed address parameter. In DSP processors with only a single memory type, by setting the `IDE_Obj` object memory type value to zero it is possible to specify the addresses using the abbreviated (implied memory type) format.

You provide the *address* argument either as a numerical value that is a decimal representation of the DSP memory address, or as a string that `write` converts to the decimal representation of the start address. (Refer to function `hex2dec` in the *MATLAB Function Reference* that `read` uses to convert the hexadecimal string to a decimal value).

The following examples show how `write` uses the *address* argument.

| <b>address Parameter Value</b> | <b>Description</b>                                                                                                                                           |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 131082                         | Decimal address specification. The memory start address is 131082 and memory type is 0. This action is the same as specifying [131082 0].                    |
| [131082 1]                     | Decimal address specification. The memory start address is 131082 and memory type is 1.                                                                      |
| '2000A'                        | Hexadecimal address specification provided as a string entry. The memory start address is 131082 (converted to the decimal equivalent) and memory type is 0. |

It is possible to specify *address* as cell array, in which case you can use a combination of numbers and strings for the start address and memory type values. For example, the following are valid addresses from cell array `myaddress`:

```
myaddress1 myaddress1{1} = 131072; myaddress1{2} =
'Program(PM) Memory';
myaddress2 myaddress2{1} = '20000'; myaddress2{2} =
'Program(PM) Memory';
myaddress3 myaddress3{1} = 131072; myaddress3{2} = 0;
```

# write

---

`mem=write(...,datatype)` where the *datatype* argument defines the interpretation of the raw values written to DSP memory. The *datatype* argument specifies the data format of the raw memory image. The data is written starting from `address` without regard to data type alignment boundaries in the DSP. The byte ordering of the data type is automatically applied. The following MATLAB data types are supported.

| <b>MATLAB Data Type</b> | <b>Description</b>                           |
|-------------------------|----------------------------------------------|
| <code>double</code>     | IEEE double-precision floating point value   |
| <code>single</code>     | IEEE single-precision floating point value   |
| <code>uint8</code>      | 8-bit unsigned binary integer value          |
| <code>uint16</code>     | 16-bit unsigned binary integer value         |
| <code>uint32</code>     | 32-bit unsigned binary integer value         |
| <code>int8</code>       | 8-bit signed two's complement integer value  |
| <code>int16</code>      | 16-bit signed two's complement integer value |
| <code>int32</code>      | 32-bit signed two's complement integer value |

`write` does not coerce data type alignment. Some combinations of `address` and `datatype` will be difficult for the processor to use.

`mem=IDE_Obj.write(...,memorytype)` adds an optional *memorytype* argument. Object `IDE_Obj` has a default memory type value 0 that `write` applies if the memory type value is not explicitly incorporated into the passed address parameter. In processors with only a single memory type, it is possible to specify the addresses using the implied

memory type format by setting the value of the `IDE_Obj` `memorytype` property to zero.

`mem=IDE_Obj.write(...,timeout)` adds the optional `timeout` argument, which is the number of seconds MATLAB waits for the write process to complete. If the `timeout` period expires before the write process returns a completion message, MATLAB throws an error and returns. Usually the process works in spite of the error message.

### Using write with VisualDSP++ IDE

Blackfin and SHARC use different memory types. Blackfin processors have one memory type. SHARC processors provide five types. The following table shows the memory types for both processor families.

| String Entry for <code>memorytype</code> | Numerical Entry for <code>memorytype</code> | Processor Support  |
|------------------------------------------|---------------------------------------------|--------------------|
| 'program(pm) memory'                     | 0                                           | Blackfin and SHARC |
| 'data(dm) memory'                        | 1                                           | SHARC              |
| 'data(dm) short word memory'             | 2                                           | SHARC              |
| 'external data(dm) byte memory'          | 3                                           | SHARC              |
| 'boot(prom) memory'                      | 4                                           | SHARC              |

## Examples

### Example with VisualDSP++ IDE

These three syntax examples show how to use `write` in some common ways. In the first example, write an array of 16-bit integers to location [131072 1].

```
IDE_Obj.write([131072 1],int16([1:100]));
```

# write

---

Now write a single-precision IEEE floating point value (32-bits) at address 2000A(Hex).

```
IDE_Obj.write('2000A',single(23.5));
```

For the third example, write a 2-D array of integers in row-major format (standard C programming format) at address 131072 (decimal).

```
mlarr = int32([1:10;101:110]);
IDE_Obj.write(131072,mlarr');
```

## See Also

[hex2dec](#) | [read](#)



**Purpose** Write messages to specified RTDX channel

---

**Note** Support for writemsg on C5000 processors will be removed in a future version.

---

**Syntax**

```
data = writemsg(rx,channelname,data)
data = writemsg(rx,channelname,data,timeout)
```

**IDEs** This function supports the following IDEs:

- Texas Instruments Code Composer Studio v3

**Description** `data = writemsg(rx,channelname,data)` writes `data` to a channel associated with `rx`. `channelname` identifies the channel queue, which you must configure for write access beforehand. The messages must be the same type for a single write operation. `writemsg` takes the elements of matrix `data` in column-major order.

In `data = writemsg(rx,channelname,data,timeout)`, the optional argument, `timeout`, limits the time `writemsg` spends transferring messages from the processor. `timeout` is the number of seconds allowed to complete the write operation. You can use `timeout` limit prolonged data transfer operations. If you omit `timeout`, `writemsg` applies the global timeout period defined for the IDE handle object `IDE_Obj`.

`writemsg` supports the following data types: `uint8`, `int16`, `int32`, `single`, and `double`.

**Examples** After you load a program to your processor, configure a link in RTDX for write access and use `writemsg` to write data to the processor. Recall that the program loaded on the processor must define `ichannel` and the channel must be configured for write access.

```
IDE_Obj=ticcs;
rx = IDE_Obj.rtdx;
open(rx,'ichannel','w'); % Could use rx.open('ichannel','w')
```

# writemsg

---

```
enable(rx, 'ichannel');
inputdata(1:25);
writemsg(rx, 'ichannel', int16(inputdata));
```

As a further illustration, the following code snippet writes the messages in matrix `indata` to the write-enabled channel specified by `ichan`. The code in this example processes only when `ichan` is defined by the program on the processor and enabled for write access.

```
indata = [1 4 7; 2 5 8; 3 6 9];
writemsg(IDE_Obj.rtdx, 'ichan', indata);
```

The matrix `indata` is written by column to `ichan`. The preceding function syntax is equivalent to

```
writemsg(IDE_Obj.rtdx, 'ichan', [1:9]);
```

## See Also

[readmat](#) | [readmsg](#) | [write](#)

**Purpose** Configure your coder product to generate makefiles

**Syntax** `xmakefilesetup`

**IDEs** This function supports the following IDEs:

- Analog Devices VisualDSP++
- Green Hills MULTI
- Texas Instruments Code Composer Studio v3
- Texas Instruments Code Composer Studio v4
- Texas Instruments Code Composer Studio v5

**Description** You can configure your coder product to generate and build your software using makefiles. This process can use the software build toolchains, such as compilers and linkers, associated with the preceding list of IDEs. However, the makefile build process does not use the graphical user interface of the IDE directly.

Enter `xmakefilesetup` at the MATLAB command line to configure how to generate makefiles.

Use this function:

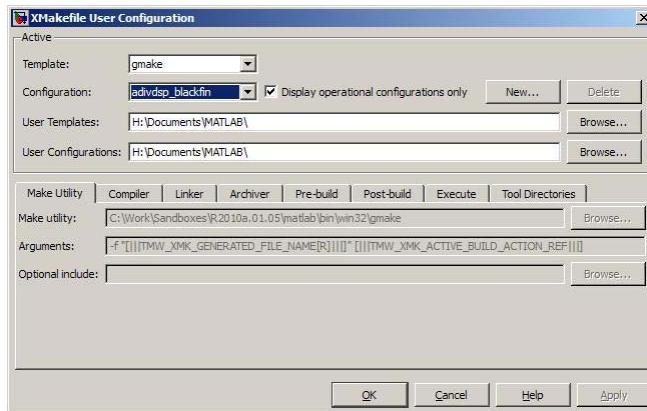
- Before you build your software using makefiles for the first time.
- If you change the software build toolchain or processor family.

For more instructions and examples, see “Makefiles for Software Build Tool Chains”.

The `xmakefile` function displays the following dialog box, which prompts you for information about your make utility and software build toolchain.

# xmakefilesetup

---



## See Also

“Build format” on page 3-120 | “Build action” on page 3-122

**Purpose** Open Support Package Installer and update firmware on third-party hardware

## Syntax

**Description** The `targetupdater` function skips over the support package installation screens and opens Support Package Installer at the “Update firmware” screen. You can use this function to update the firmware on hardware without repeating the support package installation process.

---

**Tip** Use this function when you have multiple pieces of hardware.

---

The `targetupdater` function is only available for support packages that have already been installed and that require special firmware or setup steps.

If the **Hardware** parameter does not present an option for your hardware, use the `supportPackageInstaller` function to open Support Package Installer. Support Package Installer will guide you through the process of installing a support package for your hardware and, if required, updating the firmware.

**See Also** `supportPackageInstaller` |  
`matlabshared.supportpkg.checkForUpdate` |  
`matlabshared.supportpkg.getInstalled`

# supportPackageInstaller

---

**Purpose** Find and install support for third-party hardware or software

**Syntax** supportPackageInstaller

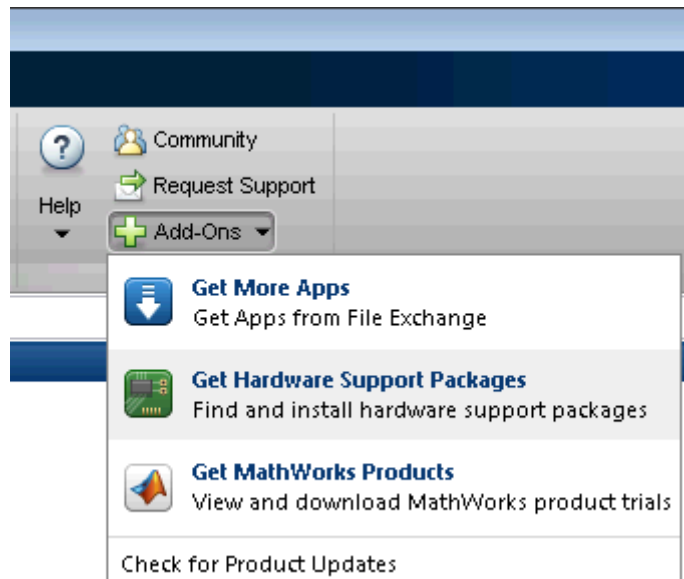
**Description** The supportPackageInstaller function opens *Support Package Installer*.

Support Package Installer can install *support packages*, which add support for specific third-party hardware or software to specific MathWorks products.

To see a list of available support packages, run Support Package Installer and advance to the second screen.

You can also start Support Package Installer in one of the following ways:

- On the MATLAB toolstrip, click **Add-Ons > Get Hardware Support Packages**.



- Double-click a support package installation file (\*.mlpkginstall).

## See Also

`targetUpdater` | `matlabshared.supportpkg.checkForUpdate` |  
`matlabshared.supportpkg.getInstalled`

# eclipseide

---

**Purpose** Create handle object to interact with Eclipse IDE

**Syntax**  
`IDE_Obj = eclipseide`  
`IDE_Obj = eclipseide('timeout', period)`

**IDEs** This function supports the following IDEs:

- Eclipse IDE

**Description** Before using `eclipseide` for the first time:

- Install the versions of Eclipse IDE and related build tools described in “Installing Third-Party Software for Eclipse™”.
- Use the `eclipseidesetup` function to configure and install a plug-in that enables your coder product to interact with Eclipse IDE.

Use `IDE_Obj = eclipseide` to create an IDE handle object, which you can use to communicate with the Eclipse IDE and processors connected to the Eclipse IDE. After creating the IDE handle object, you can use the methods for the Eclipse IDE.

When you use `eclipseide`, your coder product uses the plug-in to open a session with Eclipse. If Eclipse IDE is not already running, the `eclipseide` function starts the Eclipse IDE. The session connects via the IP port number and uses the workspace you specified previously with `eclipseidesetup`.

When you build a model, the software uses `eclipseide` to create an IDE handle object. In that case, the software gets the name of the IDE handle object from the **IDE link handle name** parameter (default value: `IDE_Obj`) in the configuration parameters for the model.

To assign a timeout period to the handle object, enter the following command:

```
IDE_Obj = eclipseide('timeout', period)
```

For *period*, enter the number of seconds that the handle object waits for processor operations (such as `load`) to complete. Operations that



exceed the timeout period generate timeout errors. The default period is 10 seconds.

## Examples

For example, to create an object handle with a 20-second timeout period, enter:

```
>> IDE_Obj = eclipseide('timeout',20)
Starting Eclipse(TM) IDE...
```

ECLIPSEIDE Object:

```
Default timeout : 20.00 secs
Eclipse folder : C:\eclipse3.4\eclipse
Eclipse workspace: C:\WINNT\Profiles\rdlugyhe\workspace
Port number : 5555
Processor site : local
```

## See Also

`eclipseidesetup`

# eclipseidesetup

---

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Configure your coder product to interact with Eclipse IDE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Syntax</b>      | <code>eclipseidesetup</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>IDEs</b>        | This function supports the following IDEs: <ul style="list-style-type: none"><li>• Eclipse IDE</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b> | <p>Before using <code>eclipseidesetup</code> for the first time, install the versions of Eclipse IDE and related build tools described in “Installing Third-Party Software for Eclipse”.</p> <p>To avoid potential build errors later on, close Eclipse IDE before you run <code>eclipseidesetup</code>. For more information, see <a href="#">Build Errors</a>.</p> <p>Use <code>eclipseidesetup</code> at the MATLAB command line to set up your coder product to interact with Eclipse IDE. This action displays a dialog box which you use to configure and add a plugin to the Eclipse IDE. For detailed instructions and examples, see “Configuring Your MathWorks Software to Work with Eclipse”.</p> <p>When to use <code>eclipseidesetup</code>:</p> <ul style="list-style-type: none"><li>• After you install or reinstall the Eclipse IDE.</li><li>• Before you use the <code>eclipseide</code> constructor function to create an IDE handle object for the first time.</li></ul> |
| <b>See Also</b>    | <code>eclipseide</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

---

|                    |                                                                                                                                                             |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b>     | Working folder used by Eclipse                                                                                                                              |
| <b>Syntax</b>      | <code>wd= IDE_Obj.pwd</code>                                                                                                                                |
| <b>IDEs</b>        | This function supports the following IDEs: <ul style="list-style-type: none"><li>• Eclipse IDE</li></ul>                                                    |
| <b>Description</b> | Use <code>wd= IDE_Obj.pwd</code> to get the working folder of the Eclipse IDE. This value is the same as the Eclipse IDE workspace folder.                  |
| <b>Examples</b>    | To get the Eclipse IDE working folder:<br><pre>IDE_Obj = eclipseide;<br/>wd = IDE_Obj.pwd<br/><br/>wd =<br/><br/>C:\WINNT\Profiles\rdlugyhe\workspace</pre> |
| <b>See Also</b>    | <code>dir</code>                                                                                                                                            |

# remoteBuild

---

## Purpose

Build Simulink-generated code on remote target running Linux

## Syntax

```
remoteBuild('modelName', 'targetrtwstartdir', 'targetipaddress',
 'username', 'passwd', 'putilsfolder')
remoteBuild(bd.buildInfo, 'targetrtwstartdir', 'targetipaddress',
 'username', 'passwd', 'putilsfolder')
```

## Description

---

**Note** Support for the `remoteBuild` method will end in a future release of the Embedded Coder products. For more information, see “Support ending for `remoteBuild` method in a future release”.

---

This function is only supported for generating code on a Windows host computers, and then performing a remote build on an embedded Linux<sup>®</sup> target.

Performing a remote build is a two-stage process. In the first stage, you generate source files and a makefile from your Simulink model without compiling and linking. In the second stage, you use `remoteBuild` to download the source files and a makefile to the remote target. There, the compiler and linker complete the build process. For more information, see “Build on BeagleBoard Hardware”.

The `remoteBuild` function supports two different syntaxes, one simple, the other a little more complex.

For the simple syntax, enter the model name as the first argument, `'modelName'`. For example:

```
remoteBuild('modelName', 'targetrtwstartdir', 'targetipaddress',
 'username', 'passwd', 'putilsfolder')
```

For the more complex syntax, use the `load` function to create an object with the build information structure of the model:

```
bd = load('path'\ 'filename'.mat')
```

Then supply that object and build information as the first argument, `bd.buildinfo`. For example:

```
remoteBuild(bd.buildInfo, 'targetrtwstartdir', 'targetipaddress',
'username', 'passwd', 'putilsfolder')
```

## Tips

- The host must be running Windows. Install ssh and scp utilities, such as plink.exe and pscp.exe, on this Windows host. These utilities are available from the PuTTY download page at <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>
- The remote target must be running Linux, with ssh and scp protocols enabled and GCC-based compiler, linker, and archiver tools installed.

## Input Arguments

### **modelName**

Specify the name of the model. For example, `sdl_test_beagle`.

### **bd**

Specify the object that contains the build information structure of the model. For example, `bd.buildInfo`.

First, use the Simulink `load` command to create this object from the `buildInfo.mat` file, located among the files you generated from your model. For example,

```
bd = load('C:\Documents\MATLAB\foo_eclipseide\buildInfo.mat')
```

### **targetrtwstartdir**

The path of the destination folder on the remote Linux target to which `remoteBuild` copies the generated source and header files. For example: `'/home/root/devel'`

If the destination folder does not exist, `remoteBuild` creates it.

### **targetipaddress**

The IP address or the host name of the remote Linux target. For example, `'10.10.10.1'`

### **username**

# remoteBuild

---

The name of the user that runs ssh commands on the remote Linux target. For example, 'root'

## **passwd**

Enter the password for username. If the username does not have a password, provide empty quotes. For example ''

## **putilsfolder**

The path of the folder on the Windows host that contains plink.exe and pscp.exe. For example, 'C:\putils'

## **Examples**

Using the one-step approach, supply the model name as the first argument:

```
remoteBuild('sdl_test_beagle', '/home/root/devel', '10.10.10.1', 'root', '', 'C:\putils')
```

Using the one-step approach, first create an object with the board specification. Then supply that object as the first argument:

```
bd = load('C:\Documents\MATLAB\foo_eclipseide\buildInfo.mat')
remoteBuild(bd.buildInfo, '/home/root/devel', '10.10.10.1', 'root', '', 'C:\putils')
```

## **References**

This stage requires using makefiles (**Build format = Makefile**), as described in “Makefiles for Software Build Tool Chains”.

## **See Also**

xmakefilesetup | load

# Blocks — Alphabetical List

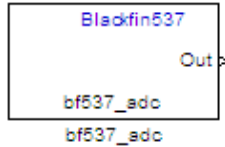
---

# Blackfin537 bf537\_adc

---

**Purpose** Configure ADC to collect data from analog jacks and output digital data

**Library** Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin®/ ADSP-BF537 EZ-KIT Lite



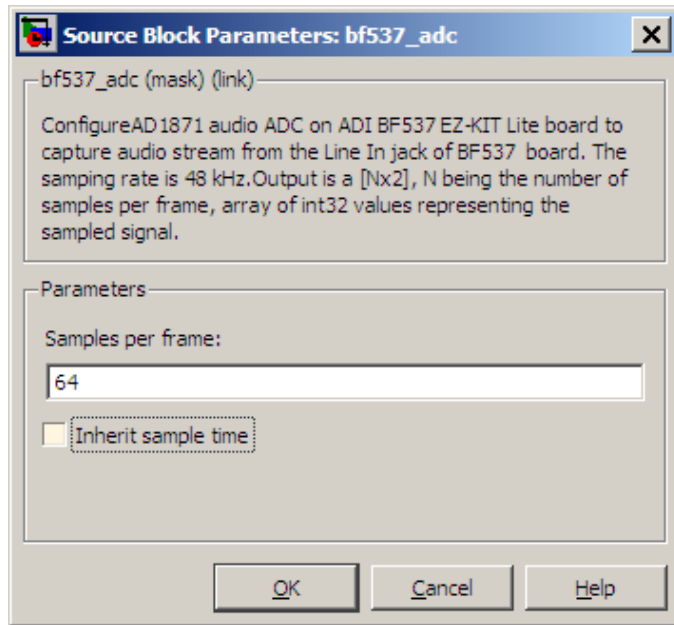
## Description

Configure AD1871 audio ADC on ADI BF537 EZ-KIT Lite board to capture audio stream from the Line In jack of BF537 board. This block uses a sampling rate of 48 kHz. It outputs the sampled signal as  $[N \times 2]$ , where N indicates number of samples per frame in an array of int32 values.

This block allocates static ADC/DAC buffers, and does not use heap memory.



## Dialog Box



### Samples per frame

Set the number of samples the ADC buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. The frame rate depends on the sample rate and frame size. The sample rate of the ADI BF537 EZ-KIT Lite board is 48 kHz. If you set **Samples per frame** to 64, the resulting frame rate is 750 frames per second ( $48000/64 = 750$ ).

### Inherit sample time

Select whether the block inherits the sample time from the model base rate or from the Simulink base rate. You can locate the Simulink base rate in the Solver options in Configuration Parameters. Selecting **Inherit sample time** directs the block to use the specified rate in model configuration. Entering -1 configures the block to accept the sample rate from the upstream Interrupt, Task, or Triggered Task blocks.

# Blackfin537 bf537\_adc

---

## **References**

*ADSP-BF537 EZ-KIT Lite® Evaluation System Manual*, Part Number 82-000865-01, available from the Analog Devices Web site.

## **See Also**

Blackfin537 bf537\_dac

**Purpose**

Convert a stream of digital data to an analog signal and send it to the output jack

**Library**

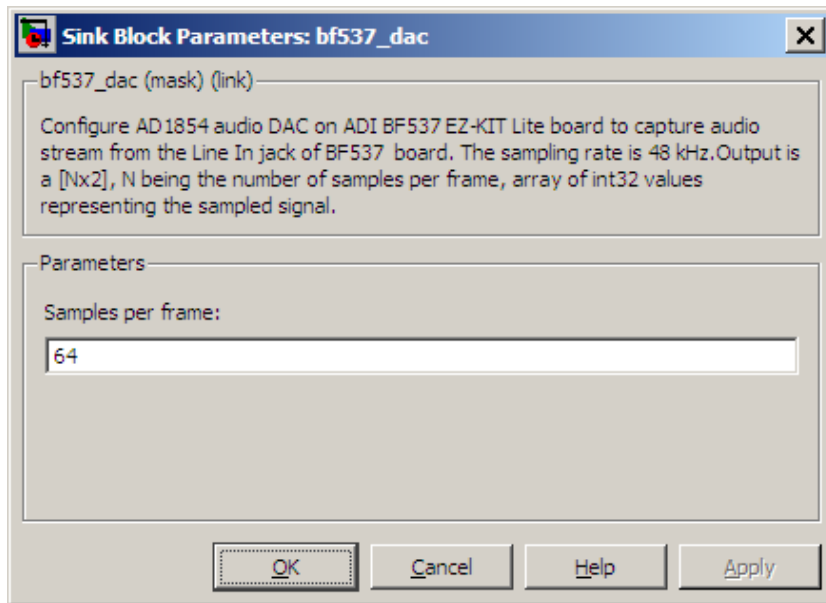
Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ ADSP-BF537 EZ-KIT Lite

**Description**

Configure AD1854 audio DAC on ADI BF537 EZ-KIT Lite board to capture audio stream from the Line In jack of BF537 board. This block uses a sampling rate of 48 kHz. It outputs the sampled signal as [Nx2], where N indicates number of samples per frame in an array of int32 values.

This block allocates static ADC/DAC buffers, and does not use heap memory.

# Blackfin537 bf537\_dac



## Dialog Box

### Samples per frame

Set the number of samples per data input frame. Match this value with the value of the block creating the data frames. This value defaults to 64 samples per frame.

## References

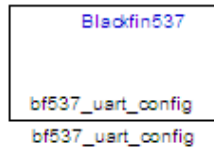
*ADSP-BF537 EZ-KIT Lite® Evaluation System Manual*, Part Number 82-000865-01, available from the Analog Devices Web site.

## See Also

Blackfin537 bf537\_adc

**Purpose** Configure UART transceiver to capture data from UART port

**Library** Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ ADSP-BF537 EZ-KIT Lite

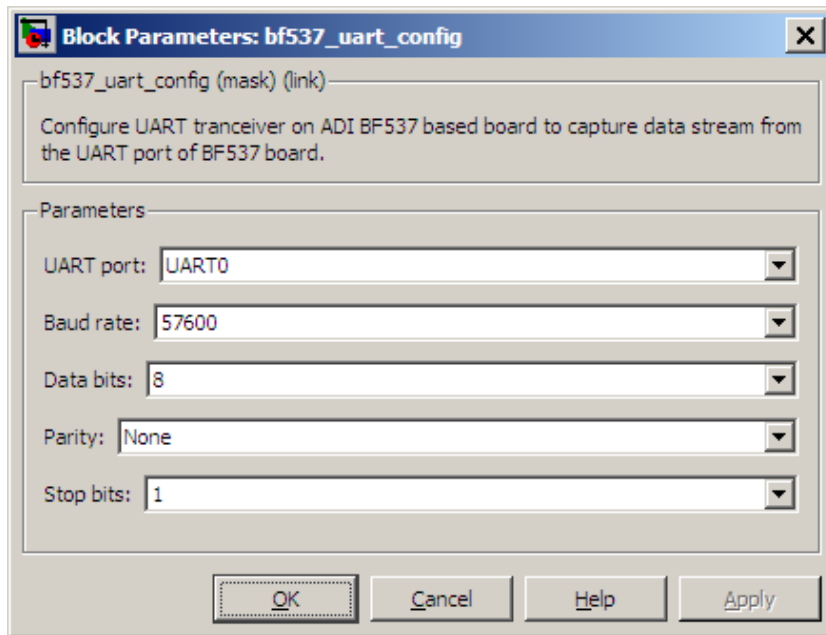


**Description**

Configure UART transceiver on ADI BF537 based board to capture data stream from the UART port of BF537 board. Your model can only contain one configuration block per UART port.

If the memory allocation for this block fails, the software generates an error that guides you to increase heap size or reduce data length. To change the heap size, use the **System heap size (MAUs)** parameter, located in the model Configuration Parameters under Code Generation > IDE Link.

# Blackfin537 bf537\_uart\_config



## Dialog Box

### UART port

Select which UART port this block configures. UART0 uses processor pins PF0 (UART0 transmit) and PF1 (UART0 receive). UART1 uses processor pins PF2 (Push button SW13) and PF3 (Push button SW12). These pins have multiple GPIO functions that depend on the configuration of the processor. For more information, see the “Programmable Flags (PFs)” section of the *ADSP-BF537 EZ-KIT Lite® Evaluation System Manual*.

### Baud rate

Configure the rate at which the UART transfers bits per second. The bits include the start bit, the data bits, the parity bit (if enabled), and the stop bits. Configure both the sending and receiving devices to the same baud rate.

## Data bits

Set the number of data bits per data frame to 5, 6, 7, or 8. The UART transmits the least significant bit sent first. Use the default value, 8 bits, unless your system requires a lower value. Configure both the sending and receiving devices to the same data bit value.

## Parity

Set type of parity checking to be none, even, or odd. When you set **Parity** to none, the UART does not perform parity checking and does not transmit a parity bit. When you set **Parity** to even, the UART sets the parity bit to 1 to obtain an even number of ones in the data word. When you set **Parity** to odd, the UART sets the parity bit to 1 to obtain an odd number of ones in the data word. Parity checking can detect errors of 1 bit only. An error in 2 bits can cause the data to have a seemingly valid parity. Configure both the sending and receiving devices to the same parity value.

## Stop bits

Set the number of bits used to indicate the end of a byte. When you set **Stop bits** to 1, the UART transmits 1 bit to signal the end of a transmission. When you set **Stop bits** to 1.5, the UART extends the length of time it transmits the 1-bit stop bit by half. Configure both the sending and receiving devices to the same stop bit value.

## References

*ADSP-BF537 EZ-KIT Lite® Evaluation System Manual*, Part Number 82-000865-01, available from the Analog Devices Web site.

## See Also

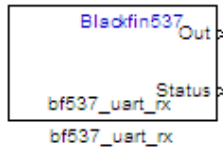
Blackfin537 bf537\_uart\_rx, Blackfin537 bf537\_uart\_tx

# Blackfin537 bf537\_uart\_rx

---

**Purpose** Receive data stream from UART port

**Library** Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ ADSP-BF537 EZ-KIT Lite

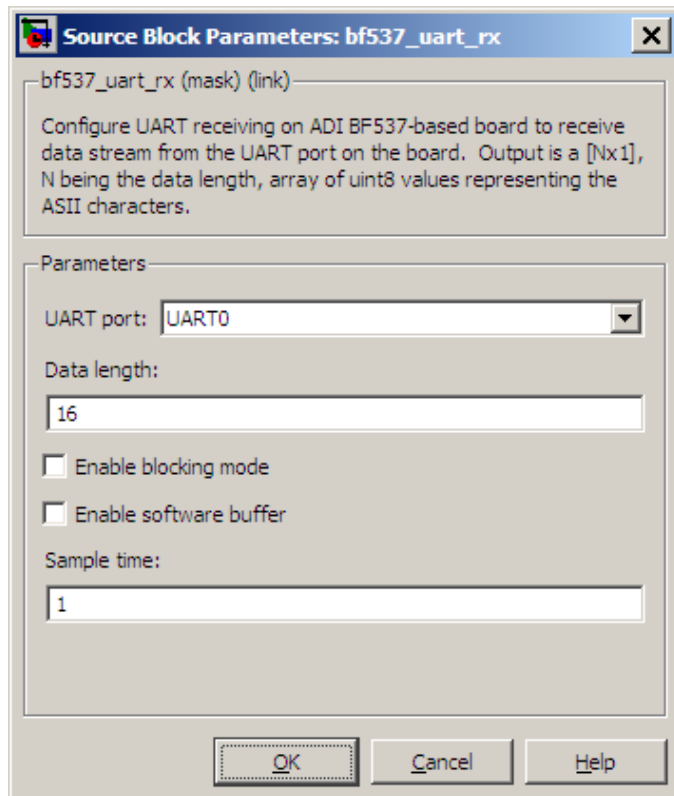


## Description

Configure UART receiving on ADI BF537-based board to receive data stream from the UART port on the board. This block outputs [Nx1], where N indicates the data length in an array of uint8 values representing the ASCII characters. Your model can only contain one receive block per UART port.

If the memory allocation for this block fails, the software generates an error that guides you to increase heap size or reduce data length. To change the heap size, use the **System heap size (MAUs)** parameter, located in the model Configuration Parameters under Code Generation > IDE Link.





## Dialog Box

### UART port

Select which UART port from which this block receives data.

### Data length

Set the data length, in bytes, of the **Out** port. This block outputs the number of bytes the **Data length** parameter specifies.

### Enable blocking mode

When you enable blocking mode, this block waits until it receives enough data before writing the data to the **Out** port.

When you disable blocking mode:

# Blackfin537 bf537\_uart\_rx

---

- If the receive buffer contains the number of bytes specified by **Data length**, the block writes the data to the **Out** port and also sends a positive number on the **Status** port. This positive number indicates valid data on the **Out** port.
- If the receive buffer does not contain the number of bytes specified by **Data length**, the block does not write the data to the **Out** port and instead sends a 0 to the **Status** port. This 0 indicates invalid data on the out port.

## **Enable software buffer**

Use a software-managed buffer, in addition to hardware FIFO, to handle incoming data.

## **Software buffer size factor**

If you enable the software buffer, set the size of **Software buffer size factor** to handle expected bursts in the incoming data.

## **Sample time**

Specify the time interval between samples. To inherit sample time from the upstream block, set this parameter to -1.

## **References**

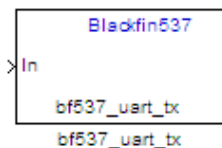
*ADSP-BF537 EZ-KIT Lite® Evaluation System Manual*, Part Number 82-000865-01, available from the Analog Devices Web site.

## **See Also**

Blackfin537 bf537\_uart\_config, Blackfin537 bf537\_uart\_tx

**Purpose** Transmit data stream from UART port

**Library** Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ ADSP-BF537 EZ-KIT Lite

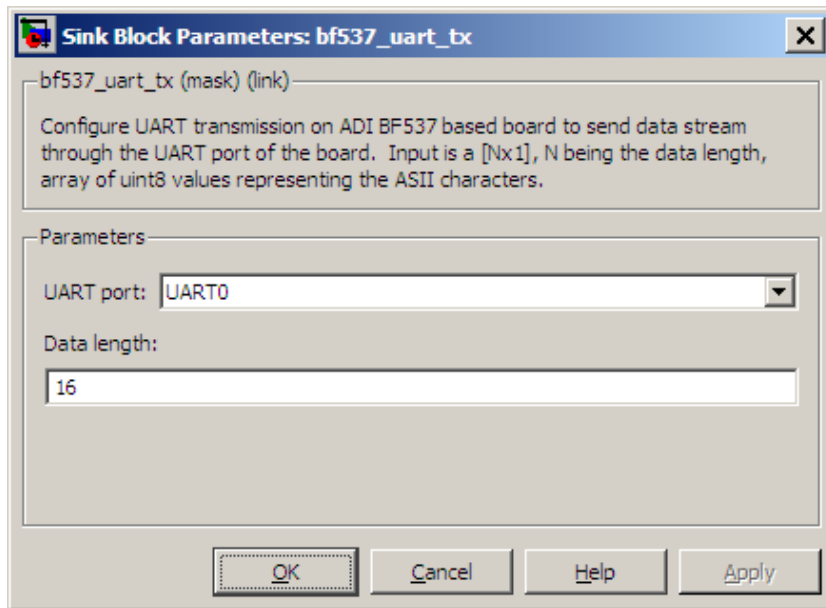


## Description

Configure UART transmission on ADI BF537 based board to send data stream through the UART port of the board. The block requires an input of [Nx1], where N indicates the data length, in an array of uint8 values representing the ASCII characters. Your model can only contain one transmit block per UART port.

If the memory allocation for this block fails, the software generates an error that guides you to increase heap size or reduce data length. To change the heap size, use the **System heap size (MAUs)** parameter, located in the model Configuration Parameters under Code Generation > IDE Link.

# Blackfin537 bf537\_uart\_tx



## Dialog Box

### UART port

Select the UART port the transmit block uses to send data.

### Data length

Set the data length, in data words, of each transmission. Match this value to the data size on the **In** port.

## References

*ADSP-BF537 EZ-KIT Lite® Evaluation System Manual*, Part Number 82-000865-01, available from the Analog Devices Web site.

## See Also

Blackfin537 bf537\_uart\_config, Blackfin537 bf537\_uart\_rx

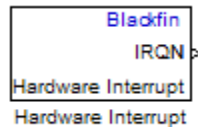
## Purpose

Generate Interrupt Service Routine

## Library

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ Scheduling

Embedded Coder Support Package for Green Hills MULTI IDE/ Analog  
Devices Blackfin/ Scheduling



## Description

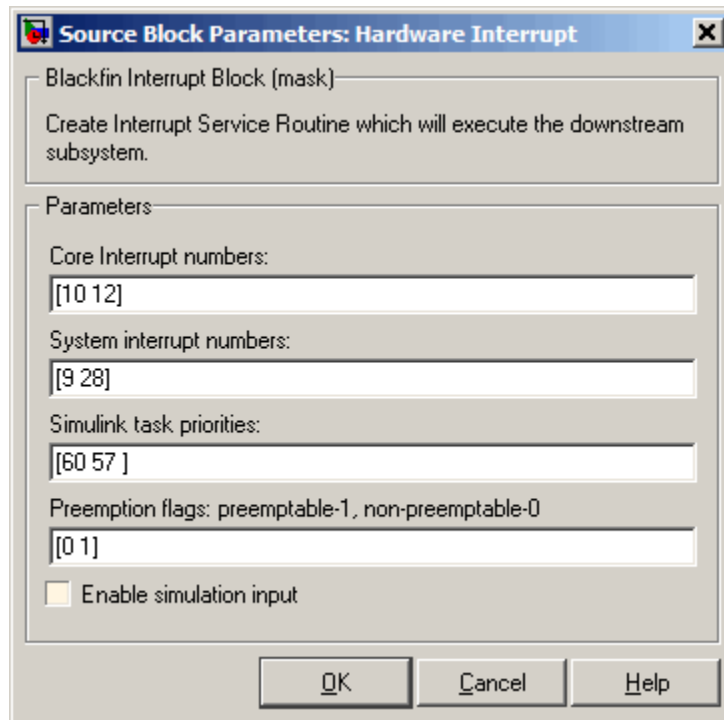
Create interrupt service routines (ISR) in the software generated by the build process. When you incorporate this block in your model, code generation results in ISRs on the processor that run the processes that are downstream from this block or an Idle Task block connected to this block. Core interrupts trigger the ISRs. System interrupts trigger the core interrupts. In the following figure, you see the mapping possibilities between system interrupts and core interrupts.

## Interrupts

Blackfin processors support the interrupt numbers shown in the following table. Some Blackfin processors do not support all of the system interrupts.

| Interrupt Description    | Valid Range in Parameter                                                     |
|--------------------------|------------------------------------------------------------------------------|
| Core interrupt numbers   | 7 to 13 and 15                                                               |
| System interrupt numbers | 0 to 63 (The upper end value depends on the processor. May be less than 63.) |

# Blackfin Hardware Interrupt



## Dialog Box

### Core interrupt numbers

Specify a vector of one or more interrupt numbers for the interrupt service routines (ISR) to install. The valid range is 7 to 13, and 15, where 7 through 13 are hardware driven, 15 is software driven. Both Green Hills MULTI and Analog Devices VisualDSP++ use core interrupt 14 to service synchronous rates. Core interrupts numbered 0 to 6 are reserved and cannot be entered in this field.

The width of the block output signal corresponds to the number of interrupt values you specify in this field. Triggering of each ISR depends on the core interrupt value, the system interrupt value, and the preemption flag you enter for each interrupt. These three

values define how the code and processor respond to interrupts during asynchronous scheduler operations.

## System interrupt numbers

System interrupt numbers identify system interrupts to map to core interrupts. Enter one or more values as a vector. The valid range depends on your processor. Some processors do not support the full range of 64 system interrupts. The software does not test for valid system interrupt values. You must verify that your values are valid for your processor. You must specify at least one system interrupt number to use asynchronous scheduling.

The block maps the first interrupt value in this field to the first core interrupt value you enter in **Core interrupt numbers**, it maps the second system interrupt value to the second core interrupt value, and so on until it has mapped all of the system interrupt values to core interrupt values. You cannot map more than one system interrupt to the same core interrupt. Therefore, you can enter one system interrupt value in this field and map it to more than one core interrupt. You cannot enter more than one value in this field and map the values to one core interrupt.

When you trigger one of the system interrupts in this field, the block triggers the ISR associated with the core interrupt that is mapped to the system interrupt.

## Simulink task priorities

Each output of the Hardware Interrupt block drives a downstream block (for example, a function call subsystem). Simulink task priority specifies the Simulink priority of the downstream blocks. Specify an array of priorities corresponding to the interrupt numbers entered in **Interrupt numbers**.

Code generation requires rate transition code (see Rate Transitions and Asynchronous Blocks). The task priority values absolute time integrity when the asynchronous task must obtain real time from its base rate or its caller. Typically, assign

# Blackfin Hardware Interrupt

---

priorities for these asynchronous tasks that are higher than the priorities assigned to periodic tasks.

## **Preemption flags: preemptable – 1, non-preemptable – 0**

Higher priority interrupts can preempt interrupts that have lower priority. To control this preemption, use the preemption flags to specify whether an interrupt can be preempted.

- Entering 1 indicates the corresponding core interrupt can be preempted.
- Entering 0 indicates the corresponding interrupt cannot be preempted.

When **Core interrupt numbers** contains more than one interrupt priority, you can assign different preemption flags to each interrupt by entering a vector of preemption flag values that correspond to the order of the interrupts in **Core interrupt numbers**. If **Core interrupt numbers** contains more than one interrupt, and you enter only one flag value in this field, that status applies to all interrupts.

For example, the default settings [0 1] indicate that the interrupt with value 10 in **Core interrupt numbers** is not preemptible and the value 12 interrupt can be preempted.

## **Enable simulation input**

When you select this option, Simulink adds an input port to the Hardware Interrupt block. This port receives input only during simulation. Connect one or more simulated interrupt sources to the simulation input.

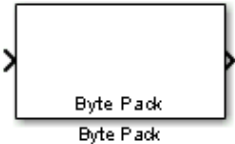


**Purpose**

Convert input signals to uint8 vector

**Library**

Embedded Coder/ Embedded Targets/ Host Communication  
Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C6000/ Target Communication  
Simulink Coder / Desktop Targets/ Host Communication



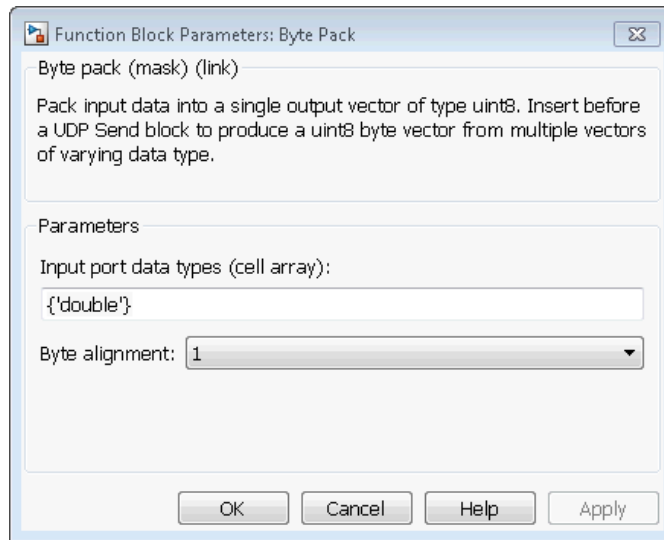
**Description**

Using the input port, the block converts data of one or more data types into a single uint8 vector for output. With the options available, you specify the input data types and the alignment of the data in the output vector. Because UDP messages are in uint8 data format, use this block before a UDP Send block to format the data for transmission using the UDP protocol.

# Byte Pack

---

## Dialog Box



### Input port data types (cell array)

Specify the data types for the different signals as part of the parameters. The block supports all Simulink data types except characters. Enter the data types as Simulink types in the cell array, such as 'double' or 'int32'. The order of the data type entries in the cell array must match the order in which the data arrives at the block input. This block determines the signal sizes automatically. The block has at least one input port and only one output port.

### Byte alignment

This option specifies how to align the data types to form the uint8 output vector. Select one of the values in bytes from the list.

Alignment can occur on 1, 2, 4, or 8-byte boundaries depending on the value you choose. The value defaults to 1. Given the alignment value, each signal data value begins on multiples of the alignment value. The alignment algorithm is that each element in the output vector begins on a byte boundary specified by the

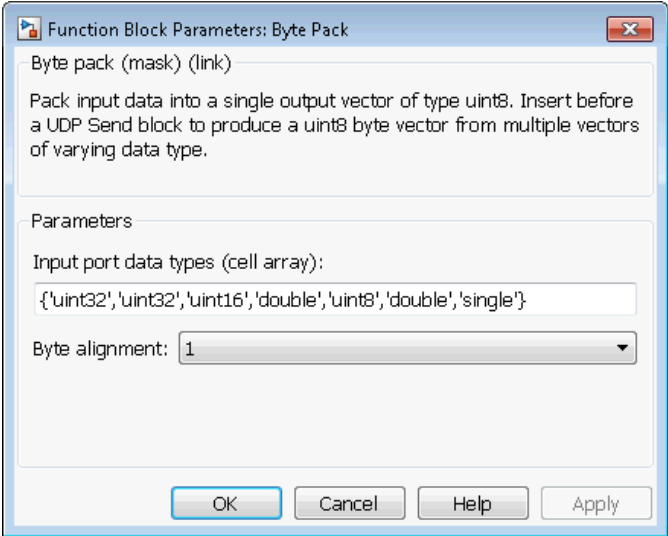
alignment value. Byte alignment sets the boundaries relative to the starting point of the vector.

Selecting 1 for **Byte alignment** provides the tightest packing, without holes between data types in the various combinations of data types and signals.

Sometimes, you can have multiple data types of varying lengths. In such cases, specifying a 2-byte alignment can produce 1-byte gaps between uint8 or int8 values and another data type. In the pack implementation, the block copies data to the output data buffer 1 byte at a time. You can specify data alignment options with data types.

## Example

Use a cell array to enter input data types in the **Input port data types** parameter. The order of the data types you enter must match the order of the data types at the block input.



In the cell array, you provide the order in which the block expects to receive data—uint32, uint32, uint16, double, uint8, double, and

# Byte Pack

---

`single`. With this information, the block automatically provides the number of block inputs.

Byte alignment equal to 2 specifies that each new value begins 2 bytes from the previous data boundary.

The example shows the following data types:

```
{'uint32','uint32','uint16','double','uint8','double','single'}
```

When the signals are scalar values (not matrices or vectors in this example), the first signal value in the vector starts at 0 bytes. Then, the second signal value starts at 2 bytes, and the third at 4 bytes. Next, the fourth signal value follows at 6 bytes, the fifth at 8 bytes, the sixth at 10 bytes, and the seventh at 12 bytes. As the example shows, the packing algorithm leaves a 1-byte gap between the `uint8` data value and the double value.

## See Also

Byte Reversal, Byte Unpack

**Purpose**

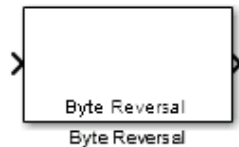
Reverse order of bytes in input word

**Library**

Embedded Coder/ Embedded Targets/ Host Communication

Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C6000/ Target Communication

Simulink Coder / Desktop Targets/ Host Communication

**Description**

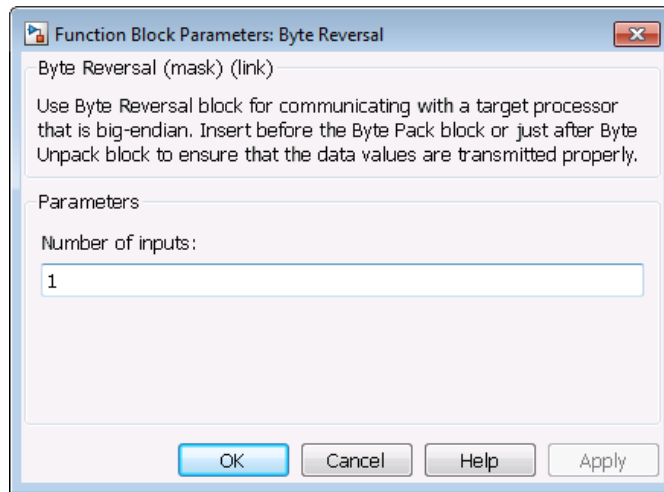
Byte reversal changes the order of the bytes in data you input to the block. Use this block when your process communicates between targets that use different endianness, such as between Intel® processors that are little endian and others that are big endian. Texas Instruments processors are little-endian by default.

To exchange data with a processor that has different endianness, place a Byte Reversal block just before the send block and immediately after the receive block.

# Byte Reversal

---

## Dialog Box



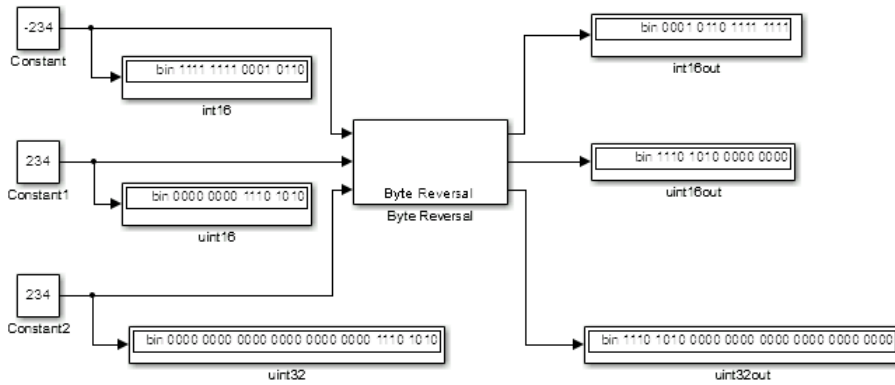
### Number of inputs

Specify the number of block inputs. The number of block inputs adjusts automatically to match value so the number of outputs equals the number of inputs.

When you use more than one input port, each input port maps to the matching output port. Data entering input port 1 leaves through output port 1, and so on.

Reversing the bytes does not change the data type. Input and output retain matching data type.

The following model shows byte reversal in use. In this figure, the input and output ports match for each path.



**See Also**      [Byte Pack](#), [Byte Unpack](#)

# Byte Unpack

---

**Purpose** Unpack UDP uint8 input vector into Simulink data type values

**Library** Embedded Coder/ Embedded Targets/ Host Communication  
Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C6000/ Target Communication  
Simulink Coder / Desktop Targets/ Host Communication

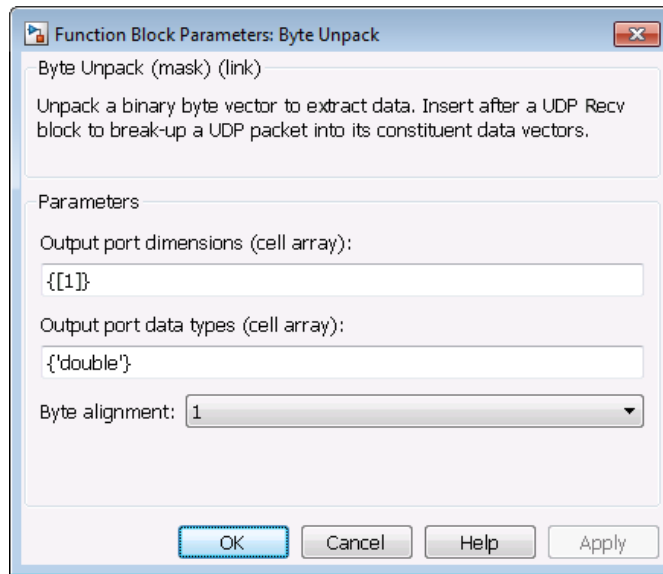


## Description

Byte Unpack is the inverse of the Byte Pack block. It takes a UDP message from a UDP receive block as a `uint8` vector, and outputs Simulink data types in various sizes depending on the input vector.

The block supports all Simulink data types.





## Dialog Box

### Output port dimensions (cell array)

Containing a cell array, each element in the array specifies the dimension that the MATLAB `size` function returns for the corresponding signal. Usually you use the same dimensions as you set for the corresponding Byte Pack block in the model. Entering one value means that the block applies that dimension to all data types.

### Output port data types (cell array)

Specify the data types for the different input signals to the Pack block. The block supports all Simulink data types—single, double, int8, uint8, int16, uint16, int32, and uint32, and Boolean. The entry here is the same as the Input port data types parameter in the Byte Pack block in the model. You can enter one data type and the block applies that type to all output ports.

# Byte Unpack

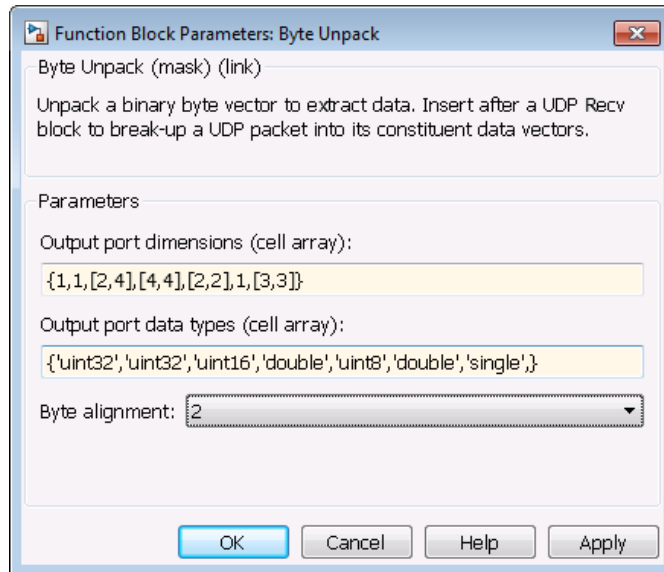
## Byte Alignment

This option specifies how to align the data types to form the input `uint8` vector. Match this setting with the corresponding Byte Pack block alignment value of 1, 2, 4, or 8 bytes.

## Example

This figure shows the Byte Unpack block that corresponds to the example in the Byte Pack example. The **Output port data types (cell array)** entry shown is the same as the **Input port data types (cell array)** entry in the Byte Pack block

```
{'uint32','uint32','uint16','double','uint8','double','single'}.
```



In addition, the **Byte alignment** setting matches as well. **Output port dimensions (cell array)** now includes scalar values and matrices to show how to enter nonscalar values. The example for the Byte Pack block assumed only scalar inputs.

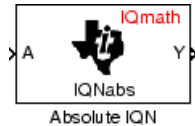
## See Also

Byte Pack, Byte Reversal

**Purpose** Absolute value

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



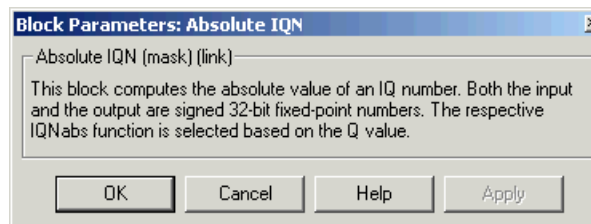
This block computes the absolute value of an IQ number input. The output is also an IQ number.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global  $Q$  setting and the MathWorks code used by this block dynamically adjusts the  $Q$  format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

# C2000 Absolute IQN

---

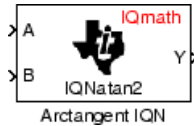
## **See Also**

c2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

**Purpose** Four-quadrant arc tangent

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



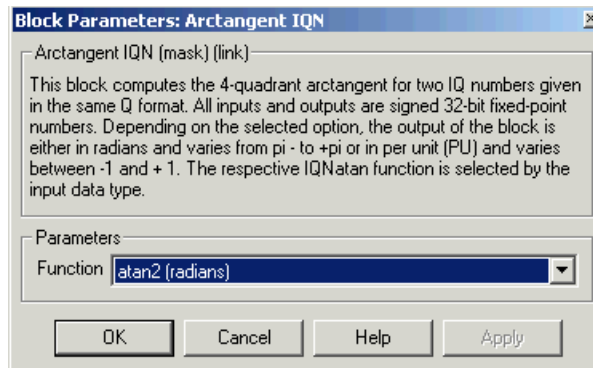
The Arctangent IQN block computes the four-quadrant arc tangent of the IQ number inputs and produces IQ number output.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global  $Q$  setting and the MathWorks code used by this block dynamically adjusts the  $Q$  format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## Function

Type of arc tangent to calculate:

# C2000 Arctangent IQN

---

- `atan2` — Compute the four-quadrant arc tangent with output in radians with values from  $-\pi$  to  $+\pi$ .
- `atan2PU` — Compute the four-quadrant arc tangent per unit. If `atan2(B,A)` is greater than or equal to 0,  $\text{atan2PU}(B,A) = \text{atan2}(B,A)/2\pi$ . Otherwise,  $\text{atan2PU}(B,A) = \text{atan2}(B,A)/2\pi+1$ . The output is in per-unit radians with values from 0 to  $2\pi$  radians.

---

**Note** The order of the inputs to the Arctangent IQN block correspond to the Texas Instruments convention, with argument 'A' at the top and 'B' at bottom.

---

## References

For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

## See Also

C2000 Absolute IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

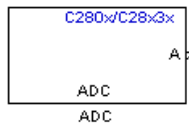
**Purpose**

Analog-to-Digital Converter (ADC)

**Library**

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

**Description**

The ADC block configures the ADC to perform analog-to-digital conversion of signals connected to the selected ADC input pins. The ADC block outputs digital values representing the analog input signal and stores the converted values in the result register of your digital signal processor. You use this block to capture and digitize analog signals from external sources such as signal generators, frequency generators, or audio devices. With the C28x3x, you can configure the ADC to use the processor's DMA module to move data directly to memory without using the CPU. This frees the CPU to perform other tasks and increases overall system capacity.

**Output**

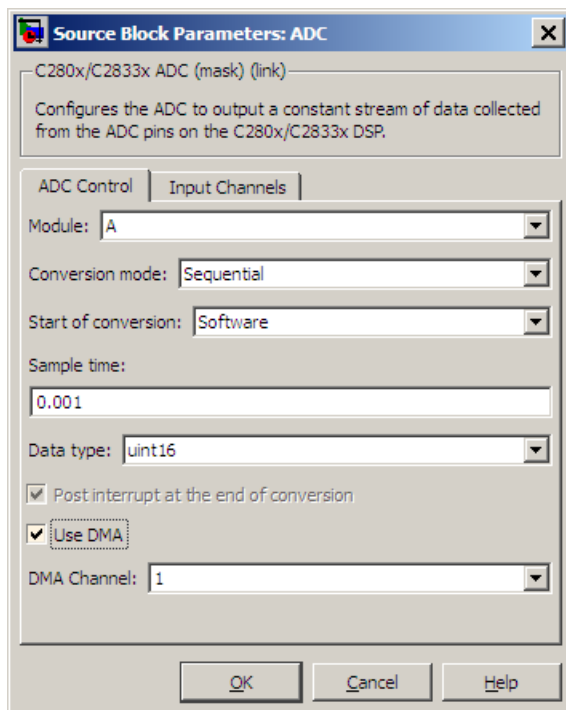
The output of the ADC is a vector of `uint16` values. The output values are in the range 0 to 4095 because the ADC is 12-bit converter.

**Modes**

The ADC block supports ADC operation in dual and cascaded modes. In dual mode, either module A or module B can be used for the ADC block, and two ADC blocks are allowed in the model. In cascaded mode, both module A and module B are used for a single ADC block.

## Dialog Box

### ADC Control Pane



### Module

Specifies which DSP module to use:

- A — Displays the ADC channels in module A (ADCINA0 through ADCINA7).
- B — Displays the ADC channels in module B (ADCINB0 through ADCINB7).
- A and B — Displays the ADC channels in both modules A and B (ADCINA0 through ADCINA7 and ADCINB0 through ADCINB7).



## Conversion mode

Type of sampling to use for the signals:

- **Sequential** — Samples the selected channels sequentially.
- **Simultaneous** — Samples the corresponding channels of modules A and B at the same time.

## Start of conversion

Type of signal that triggers conversions to begin:

- **Software** — Signal from software. Conversion values are updated at each sample time.
- **ePWMxA / ePWMxB / ePWMxA\_ePWMxB** — Start of conversion is controlled by user-defined PWM events.
- **XINT2\_ADCSOC** — Start of conversion is controlled by the XINT2\_ADCSOC external signal pin.

The choices available in **Start of conversion** depend on the **Module** setting. The following table summarizes the available choices. For each set of **Start of conversion** choices, the default is given first.

| Module Setting | Start of Conversion Choices                           |
|----------------|-------------------------------------------------------|
| A              | Software, ePWMxA, XINT2_ADCSOC                        |
| B              | ePWMxB, Software                                      |
| A and B        | Software, ePWMxA, ePWMxB, ePWMxA_ePWMxB, XINT2_ADCSOC |

## Sample time

Time in seconds between consecutive sets of samples that are converted for the selected ADC channel(s). This is the rate at which values are read from the result registers. To execute this block asynchronously, set **Sample Time** to -1, check the **Post interrupt at the end of conversion** box, and refer to

“Asynchronous Scheduling” for a discussion of block placement and other settings.

To set different sample times for different groups of ADC channels, you must add separate ADC blocks to your model and set the desired sample times for each block.

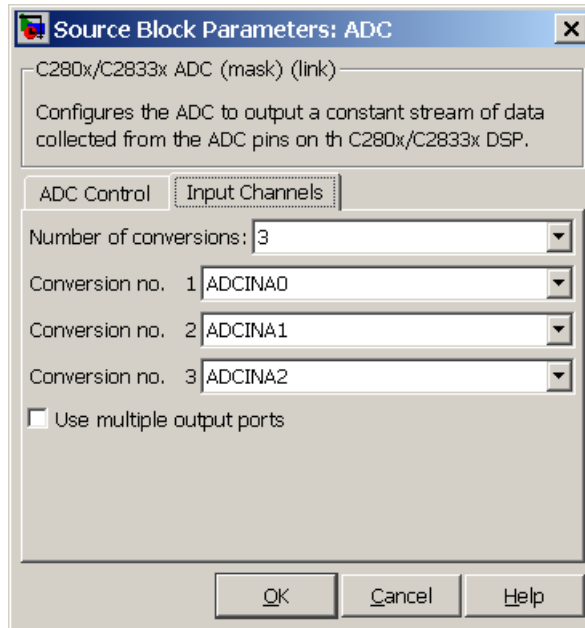
### **Data type**

Date type of the output data. Valid data types are auto, double, single, int8, uint8, int16, uint16, int32, or uint32.

### **Post interrupt at the end of conversion**

Select this check box to post an asynchronous interrupt at the end of each conversion. The interrupt is posted at the end of conversion. To execute this block asynchronously, set **Sample Time** to -1, and refer to “Asynchronous Scheduling” for a discussion of block placement and other settings.

## Input Channels Pane



### Number of conversions

Number of ADC channels to use for analog-to-digital conversions.

### Conversion no.

Specific ADC channel to associate with each conversion number.

In oversampling mode, a signal at a given ADC channel can be sampled multiple times during a single conversion sequence.

To oversample, specify the same channel for more than one conversion. Converted samples are output as a single vector.

### Use multiple output ports

If more than one ADC channel is used for conversion, you can use separate ports for each output and show the output ports on the

## C280x/C28x3x ADC

---

block. If you use more than one channel and do not use multiple output ports, the data is output in a single vector.

### **See Also**

“ADC-PWM Synchronization via ADC Interrupt”

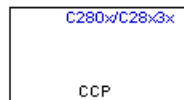
C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x ePWM

C28x Hardware Interrupt

“Configuring Acquisition Window Width for ADC Blocks”

“ADC” on page 3-271

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b> | Implement CAN Calibration Protocol (CCP) standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Library</b> | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x |



CAN Calibration Protocol

## Description

The CAN Calibration Protocol block provides an implementation of a subset of the CAN Calibration Protocol (CCP) Version 2.1. CCP is a protocol for communicating between the target processor and the host machine over CAN. In particular, a calibration tool (see “Compatibility with Calibration Packages” on page 2-45) running on the host can communicate with the target, allowing remote signal monitoring and parameter tuning.

This block processes a Command Receive Object (CRO) and outputs the resulting Data Transmission Object (DTO) and Data Acquisition (DAQ) messages.

# C28x CAN Calibration Protocol

---

For more information on CCP, refer to *ASAM Standards: ASAM MCD: MCD 1a* on the Association for Standardization of Automation and Measuring Systems (ASAM) Web site at <http://www.asam.de>.

---

**Note** With the 32-bit version of MATLAB software, you can use the CAN Calibration Protocol block to perform External mode simulations.

---

## Using the DAQ Output

---

**Note** The CCP Data Acquisition (DAQ) List mode of operation is only supported with Embedded Coder. If Embedded Coder is not available then custom storage classes `canlib.signal` are ignored during code generation: this means that the CCP DAQ Lists mode of operation cannot be used.

You can use the CCP Polling mode of operation with or without Embedded Coder.

---

The DAQ output is the output for CCP Data Acquisition (DAQ) lists that have been set up. You can use the ASAP2 file generation feature of the Real-Time (RT) target to

- Set up signals to be transmitted using CCP DAQ lists.
- Assign signals in your model to a CCP event channel automatically (see “Generate an ASAP2 File”).

Once these signals are set up, event channels then periodically fire events that trigger the transmission of DAQ data to the host. When this occurs, CAN messages with the CCP/DAQ data appear on the DAQ output, along with an associated function call trigger.

The calibration tool (see “Compatibility with Calibration Packages” on page 2-45) must use CCP commands to assign an event channel and data to the available DAQ lists, and interpret the synchronous response.

Using DAQ lists for signal monitoring has the following advantages over the polling method:

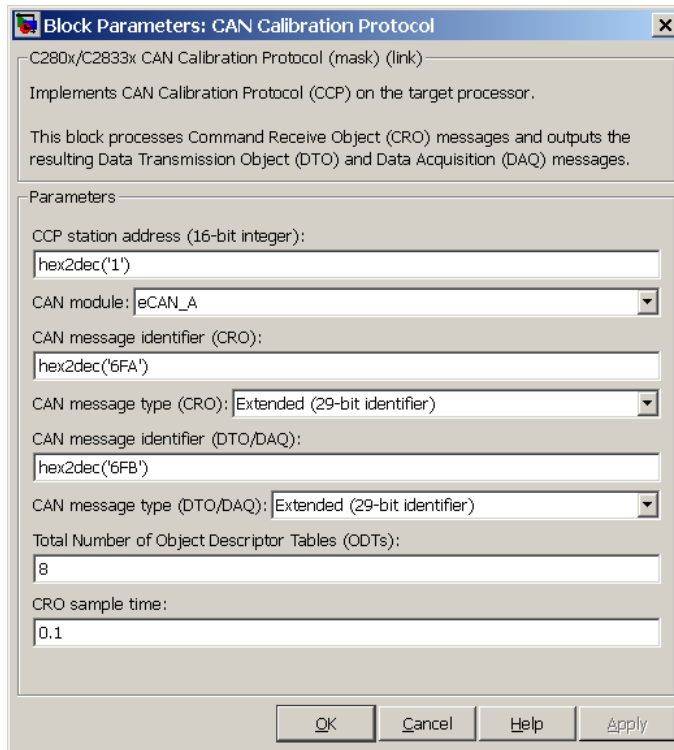
- The host does not need to poll for the data. Network traffic is halved.
- The data is transmitted at the update rate that matches the signal, reducing network traffic.
- Data is consistent. The transmission takes place after the signals have been updated, reducing interruptions while sampling the signal.

---

**Note** Embedded Coder software does not currently support event channel prescalers.

---

# C28x CAN Calibration Protocol



## Dialog Box

### CCP station address (16-bit integer)

The station address of the target. The station address is interpreted as a `uint16`. It is used to distinguish between different targets. By assigning unique station addresses to targets sharing the same CAN bus, it is possible for a single host to communicate with multiple targets.

### CAN module

If your processor has more than one module, select the module this block configures.



**CAN message identifier (CRO)**

Specify the CAN message identifier for the Command Receive Object (CRO) message you want to process.

**CAN message type (CRO)**

The incoming message type. Select either Standard(11-bit identifier) or Extended(29-bit identifier).

**CAN message identifier (DTO/DAQ)**

The message identifier is the CAN message ID used for Data Transmission Object (DTO) and Data Acquisition (DAQ) message outputs.

**CAN message type (DTO/DAQ)**

The message type to be transmitted by the DTO and DAQ outputs. Select either Standard(11-bit identifier) or Extended(29-bit identifier).

**Total Number of Object Descriptor Tables (ODTs)**

The default number of Object Descriptor Tables (ODTs) is 8. These ODTs are shared equally between all available DAQ lists. You can choose a value between 0 and 254, depending on how many signals you log simultaneously. You must make sure you allocate at least 1 ODT per DAQ list, or your build will fail. The calibration tool will give an error message if there are too few ODTs for the number of signals you specify for monitoring. Be aware that too many ODTs can make the sample time overrun. If you choose more than the maximum number of ODTs (254), the build will fail.

A single ODT uses 56 bytes of memory. Using all 254 ODTs would require over 14 KB of memory, a large proportion of the available memory on the target. To conserve memory on the target, the default number is low, allowing DAQ list signal monitoring with reduced memory overhead and processing power.

As an example, if you have five different rates in a model, and you are using three rates for DAQ, then this will create three DAQ lists and you must make sure you have at least three ODTs.

# C28x CAN Calibration Protocol

---

ODTs are shared equally among DAQ lists and, therefore, you will end up with one ODT per DAQ list. With less than three ODTs, you get zero ODTs per DAQ list and the behavior is undefined.

Taking this example further, say you have three DAQ lists with one ODT each, and start trying to monitor signals in a calibration tool. If you try to assign too many signals to a particular DAQ list (that is, signals requiring more space than seven bytes (one ODT) in this case), then the calibration tool will report this as an error.

## **CRO sample time**

The sample time for CRO messages.

## **Supported CCP Commands**

The following CCP commands are supported by the CAN Calibration Protocol block:

- CONNECT
- DISCONNECT
- DNLOAD
- DNLOAD\_6
- EXCHANGE\_ID
- GET\_CCP\_VERSION
- GET\_DAQ\_SIZE
- GET\_S\_STATUS
- SET\_DAQ\_PTR
- SET\_MTA
- SET\_S\_STATUS
- SHORT\_UP
- START\_STOP
- START\_STOP\_all

- TEST
- UPLOAD
- WRITE\_DAQ

## **Compatibility with Calibration Packages**

The above commands support:

- Synchronous signal monitoring via calibration packages that use DAQ lists
- Asynchronous signal monitoring via calibration packages that poll the target
- Asynchronous parameter tuning via CCP memory programming

This CCP implementation has been tested with Vector-Informatik CANape calibration package running in both DAQ list and polling mode.

## **See Also**

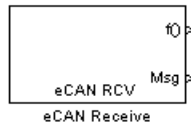
“CAN Calibration Protocol and External Mode”

# C28x eCAN Receive

---

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b> | Enhanced Control Area Network receive mailbox                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Library</b> | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x |

## Description



The C280x/C2803x/C28x3x enhanced Control Area Network (eCAN) Receive block generates source code for receiving eCAN messages through an eCAN mailbox. The eCAN modules on the DSP chip provide serial communication capability and have 32 mailboxes configurable for receive or transmit. The C280x/C2803x/C28x3x supports eCAN data frames in standard or extended format.

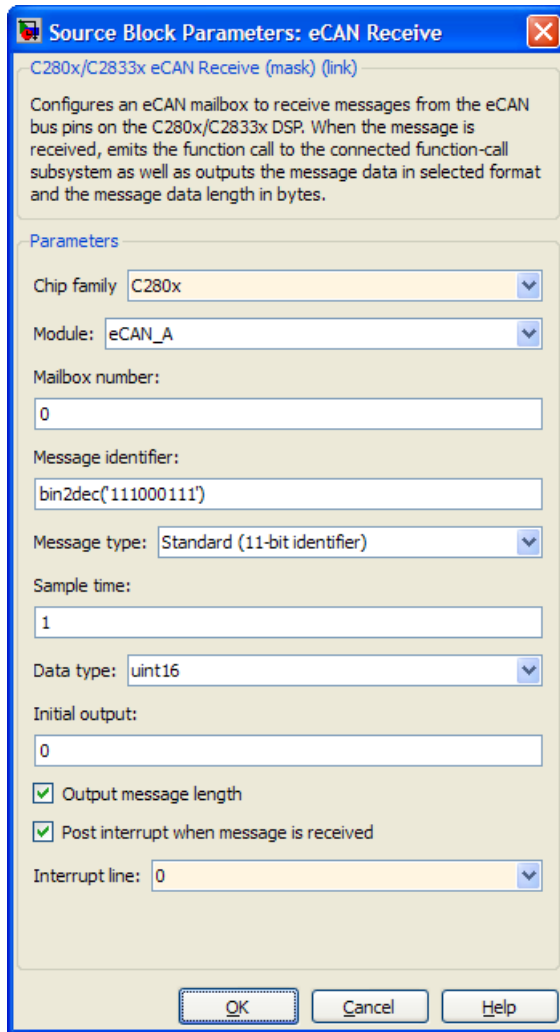
The eCAN Receive block has up to two and, optionally, three output ports.

- The first output port is the function call port, and a function call subsystem should be connected to this port. When a new message is received, this subsystem is executed.

- The second output port is the message data port. The received data is output in the form of a vector of elements of the selected data type. The length of the vector is 8 bytes. The message data port will output data. When the block is used in polling mode, if a new message is not created between the consecutive executions of the block, then the old or existing message, is repeated.
- The third output port is optional and appears only if **Output message length** is selected.

To use the eCAN Receive block with the eCAN Pack block in the canmsglib, set **Data type** to CAN\_MESSAGE\_TYPE.

# C28x eCAN Receive



## Dialog Box

### Chip family

Select the processor that has the eCAN module.

## Module

Determines which of the two eCAN modules is being configured by this instance of the eCAN Receive block. Options are eCAN\_A and eCAN\_B.

This parameter is not visible when you set **Chip family** to C2803x.

## Mailbox number

Sets the value of the mailbox number register (MBNR). For standard CAN controller (SCC) mode, enter a unique number from 0 to 15. For high-end CAN controller (HECC) mode enter a unique number from 0 to 31. In SCC mode, transmissions from the mailbox with the highest number have the highest priority. In HECC mode, the mailbox number only determines priority if the Transmit priority level (TPL) of two mailboxes is equal.

## Message identifier

Sets the value of the message identifier register (MID). The message identifier is 11 bits long for standard frame size or 29 bits long for extended frame size in decimal, binary, or hex format. For the binary and hex formats, use `bin2dec(' ')` or `hex2dec(' ')`, respectively, to convert the entry.

## Message type

Select Standard (11-bit identifier) or Extended (29-bit identifier).

## Sample time

Frequency with which the mailbox is polled to determine if a new message has been received. A new message causes a function call to be emitted from the mailbox. If you want to update the message output only when a new message arrives, then the block needs to be executed asynchronously. To execute this block asynchronously, set **Sample Time** to -1, check the **Post interrupt when message is received** box, and refer to “” for a discussion of block placement and other settings.

---

**Note** For information about setting the timing parameters of the CAN module, see “Configuring Timing Parameters for CAN Blocks”.

---

## Data type

Select one of the following options:

- `uint8` (vector length = 8 elements)
- `uint16` (vector length = 4 elements)
- `uint32` (vector length = 2 elements)
- `CAN_MESSAGE_TYPE` (Select this option to use the eCAN receive block with the CAN Unpack block.)

The length of the vector for the received message is at most 8 bytes. If the message is less than 8 bytes, the data buffer bytes are right-aligned in the output. The data are unpacked as follows using the data buffer, which is 8 bytes.

For `uint8` data, eCAN Receive reads each unit of 8 bytes in the registers, and outputs 8-bit data to 8 elements (using the lower part of the 16-bit memory):

```
Output[0] = data_buffer[0];
Output[1] = data_buffer[1];
Output[2] = data_buffer[2];
Output[3] = data_buffer[3];
Output[4] = data_buffer[4];
Output[5] = data_buffer[5];
Output[6] = data_buffer[6];
Output[7] = data_buffer[7];
```

For `uint16` data,

```
Output[0] = data_buffer[1..0];
Output[1] = data_buffer[3..2];
```



```
Output[2] = data_buffer[5..4];
Output[3] = data_buffer[7..6];
```

For uint32 data,

```
Output[0] = data_buffer[3..0];
Output[1] = data_buffer[7..4];
```

For example, if the received message has two bytes:

```
data_buffer[0] = 0x21
data_buffer[1] = 0x43
```

The uint16 output would be:

```
Output[0] = 0x4321
Output[1] = 0x0000
Output[2] = 0x0000
Output[3] = 0x0000
```

When you select `CAN_MESSAGE_TYPE`, the block outputs the following struct data (defined in `can_message.h`):

```
struct {

 /* Is Extended frame */
 uint8_T Extended;

 /* Length */
 uint8_T Length;

 /* RTR */
 uint8_T Remote;

 /* Error */
 uint8_T Error;
```

# C28x eCAN Receive

---

```
/* CAN ID */
uint32_T ID;

/*
TIMESTAMP_NOT_REQUIRED is a macro that will be defined by Target teams
PIL, xPC if they do not require the timestamp field during code
generation. By default, timestamp is defined. If the targets do not require
the timestamp field, they should define the macro TIMESTAMP_NOT_REQUIRED before
including this header file for code generation.
*/
#ifndef TIMESTAMP_NOT_REQUIRED
/* Timestamp */
double Timestamp;
#endif

/* Data field */
uint8_T Data[8];

};
```

## Initial output

Set the value the eCAN node outputs to the model before it has received data. The default value is 0.

## Output message length

Select to output the message length in bytes to the third output port. If not selected, the block has only two output ports.

## Post interrupt when message is received

Select this check box to post an asynchronous interrupt when a message is received.

## Interrupt line

Select the interrupt line the asynchronous interrupt uses. This action sets bit 2 (GIL) in the Global Interrupt Mask Register (CANGIM):

- 1 maps the global interrupts to the ECAN1INT line.

- 0 maps the global interrupts to the ECAN0INT line.

## References

For detailed information on the eCAN module, visit [ti.com](http://ti.com) and search for the documentation related to your processor. The following materials are available at the Texas Instruments Web site:

- *TMS320F2833x, 2823x Enhanced Controller Area Network (eCAN) Reference Guide*, Literature Number SPRUEU1
- *TMS320x280x/2801x Enhanced Controller Area Network (eCAN) Reference Guide*, Literature Number SPRUEU0
- *TMS320x2803x Piccolo Enhanced Controller Area Network (eCAN) Reference Guide*, Literature Number: SPRUGL7

## See Also

“CAN-Based Control of PWM Duty Cycle”

C28x eCAN Transmit

C28x Hardware Interrupt

“eCAN\_A, eCAN\_B” on page 3-276

# C28x eCAN Transmit

---

## Purpose

Enhanced Control Area Network transmit mailbox

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

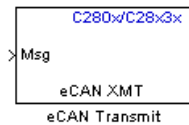
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

## Description



The C280x/C2803x/C28x3x enhanced Control Area Network (eCAN) Transmit block generates source code for transmitting eCAN messages through an eCAN mailbox. The eCAN modules on the Board chip provide serial communication capability and have 32 mailboxes configurable for receive or transmit. The C280x/C2803x/C28x3x supports eCAN data frames in standard or extended format.

---

**Note** Fixed-point inputs are not supported for this block.

---

## Data Vectors

The length of the vector for each transmitted mailbox message is 8 bytes. Input data are right-aligned in the message data buffer. Only `uint16` (vector length = 4 elements) or `uint32` (vector length = 2 elements) data are accepted. The following examples show how the different types of input data are aligned in the data buffer:

For input of type `uint32`,

```
inputdata [0] = 0x12345678
```

the data buffer is:

```
data buffer[0] = 0x78
data buffer[1] = 0x56
data buffer[2] = 0x34
data buffer[3] = 0x12
data buffer[4] = 0x00
data buffer[5] = 0x00
data buffer[6] = 0x00
data buffer[7] = 0x00
```

For input of type `uint16`,

```
inputdata [0] = 0x1234
```

the data buffer is:

```
data buffer[0] = 0x34
data buffer[1] = 0x12
data buffer[2] = 0x00
data buffer[3] = 0x00
data buffer[4] = 0x00
data buffer[5] = 0x00
data buffer[6] = 0x00
data buffer[7] = 0x00
```

For input of type `uint16[2]`, which is a two-element vector,

## C28x eCAN Transmit

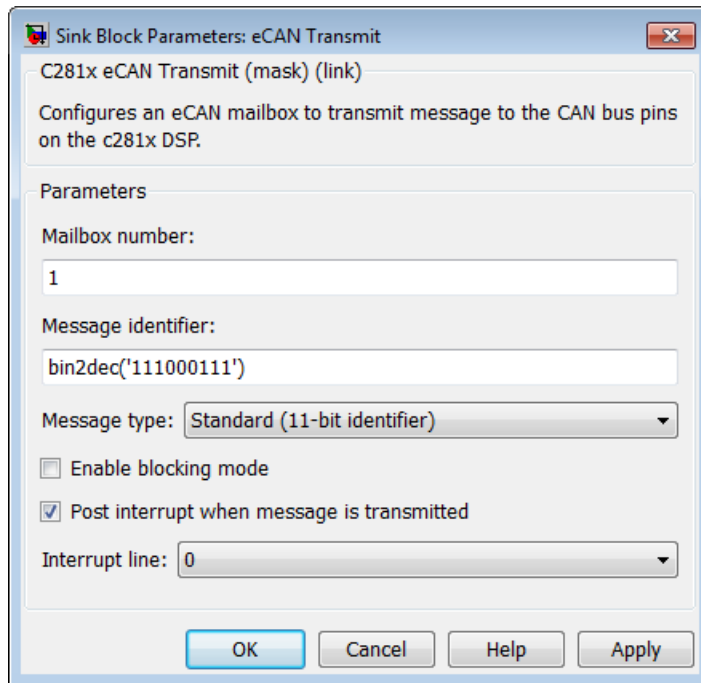
---

```
inputdata [0] = 0x1234
inputdata [1] = 0x5678
```

the data buffer is:

```
data buffer[0] = 0x34
data buffer[1] = 0x12
data buffer[2] = 0x78
data buffer[3] = 0x56
data buffer[4] = 0x00
data buffer[5] = 0x00
data buffer[6] = 0x00
data buffer[7] = 0x00
```

## Dialog Box



### Module

Determines which of the two eCAN modules is being configured by this instance of the eCAN Transmit block. Options are eCAN\_A and eCAN\_B.

### Mailbox number

Unique number from 0 to 15 for standard or from 0 to 31 for enhanced CAN mode. It refers to a mailbox area in RAM. In standard mode, the mailbox number determines priority.

### Message identifier

Identifier of length 11 bits for standard frame size or length 29 bits for extended frame size in decimal, binary, or hex. If in binary or hex, use bin2dec(' ') or hex2dec(' '), respectively, to

# C28x eCAN Transmit

---

convert the entry. The message identifier is coded into a message that is sent to the CAN bus.

---

**Note** CAN messages use the value of the Message identifier parameter in C28x CAN Transmit block for transmission even when you use the CAN Pack block to create the CAN message.

---

## Message type

Select Standard (11-bit identifier) or Extended (29-bit identifier).

## Enable blocking mode

If selected, the CAN block code waits indefinitely for a transmit (XMT) acknowledge. If not selected, the CAN block code does not wait for a transmit (XMT) acknowledge, which is useful when the hardware might fail to acknowledge transmissions.

## Post interrupt when message is transmitted

If selected, an asynchronous interrupt will be posted when data is transmitted.

## Interrupt Line

Select the interrupt line the asynchronous interrupt uses. This action sets bit 2 (GIL) in the Global Interrupt Mask Register (CANGIM):

- 1 maps the global interrupts to the ECAN1INT line.
- 0 maps the global interrupts to the ECAN0INT line.

---

**Note** For information about setting the timing parameters of the CAN module, see “Configuring Timing Parameters for CAN Blocks”.

---

## References

For detailed information on the eCAN module, see the following materials, available at the Texas Instruments Web site:



- *TMS320F2833x, 2823x Enhanced Controller Area Network (eCAN) Reference Guide*, Literature Number SPRUEU1
- *TMS320x2803x Piccolo Enhanced Controller Area Network (eCAN) Reference Guide*, Literature Number: SPRUGL7

### **See Also**

“CAN-Based Control of PWM Duty Cycle”

C28x eCAN Receive

C28x Hardware Interrupt

“eCAN\_A, eCAN\_B” on page 3-276

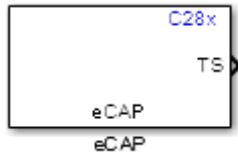
# C28x eCAP

---

**Purpose** Receive and log capture input pin transitions or configure auxiliary pulse width modulator

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

## Description



## Dialog Box

The eCAP block dialog box provides configuration parameters on four tabbed panes:

- **General**—Set the operating mode for the block (whether the block performs eCAP or APWM processes, assign the pin associated, and set the sample time)
- **eCAP**—Configure eCAP functions such as prescaler value, capture pin, and mode control

- **APWM**—Configure waveform and duty cycle values for the pulse width modulation capability
- **Interrupt**—Specify when the block posts interrupts

You can add up to six eCAP blocks to your model, one block for each capture pin. For example, you can have one block configured for eCAP mode with eCAP1 pin selected and five blocks configured for APWM mode with assigned pins eCAP2 through eCAP6. Or six blocks configured for eCAP mode with each block assigned a different eCAP pin. You cannot assign the same eCAP pin to two eCAP blocks in one model.

### Block Input and Output Ports

The eCAP block has optional input and output ports as shown in the following table.

| Port           | Description and When the Port is Enabled                                                                                                                                                                     |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input port SI  | Synchronization input for input value from software. Enabled when you select <b>Enable software forced counter synchronizing input</b> in either operating mode.                                             |
| Input port RA  | One-shot arming starts the one-shot sequence. Enabled when you set the mode control to One shot.                                                                                                             |
| Output port TS | When you enable the reset counter, this option resets the capture event counter after capturing the event time stamp. Enabled when you select <b>Enable reset counter after capture event 1 time-stamp</b> . |

## C28x eCAP

---

| <b>Port</b>    | <b>Description and When the Port is Enabled</b>                                                                             |
|----------------|-----------------------------------------------------------------------------------------------------------------------------|
| Output port CF | This port reports the status of the capture event. Enabled when you select <b>Enable capture event status flag output</b> . |
| Output port OF | Enabled when you select <b>Enable overflow status flag output</b> .                                                         |

---

**Note** The outputs of this block can be vectorized.

---

## General Pane

Source Block Parameters: eCAP

C28x eCAP (mask) (link)

Configure the settings of the C280x/C2833x/C2834x/C2802x/C2803x/C2806x DSP for eCAP (Enhanced Capture)

General eCAP APWM Interrupt

Operating mode: eCAP

eCAPx pin: eCAP1

Counter phase offset value (0 ~ 4294967295):

0

Enable counter Sync-In mode

Enable software-forced counter synchronizing input

Sync output selection: CTR=PRD

Sample time:

0.001

OK Cancel Help Apply

## Operating mode

When you select eCAP, the block captures and logs pin transitions for each capture unit to a FIFO buffer. When you select APWM, the block generates asymmetric pulse width modulation (APWM) waveforms for driving downstream systems.

## eCAPx pin

The capture unit includes the following features:

- One pin for each capture unit. For example, eCAP1, eCAP2, and so on.
- Four maskable interrupt flags, one for each capture unit.
- Ability to specify the transition detection—rising edge, falling edge, or both edges.

## Counter phase offset value (0~4294967295)

The value you enter here provides the time base for event captures, clocked by the system clock. A phase register is used to synchronize with other counters via the software or hardware forced sync (refer to **Enable counter Sync-In mode**). This is particularly useful in APWM mode when you need a phase offset between capture modules. Enter the phase offset as an integer from 0 to 42949667295 ( $2^{32}$ ) counts.

## Enable counter Sync-In mode

Select this to enable the TSCTR counter to load from the TSCTR register when the block receives either the SYNC1 signal or a software force event (refer to **Enable software-forced counter synchronizing input**).

## Enable software-forced counter synchronizing input

This option provides a convenient software method for synchronizing one or more eCAP time bases.

## Sync output selection

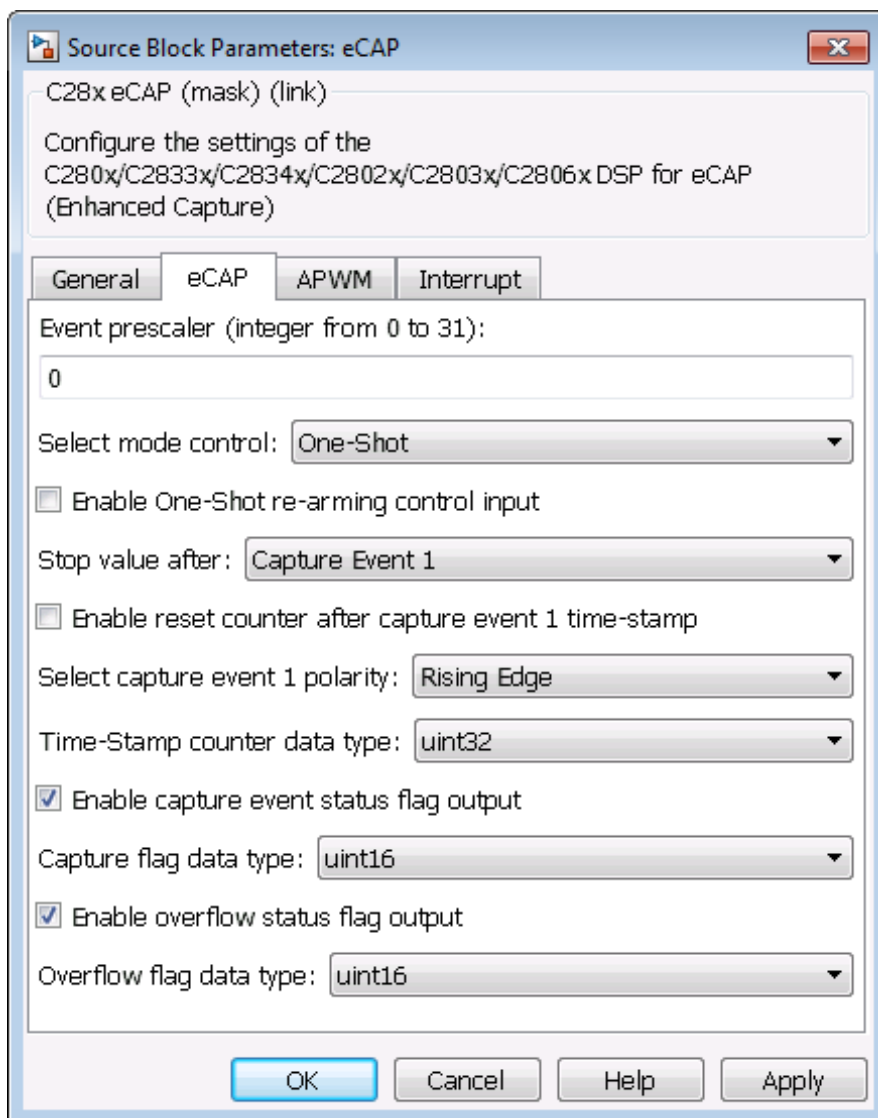
Select one of the list entries Pass through, CTR=PRD, or Disabled to synchronize with other counters.

## Sample time

Set the sample time for the block in seconds.

## eCAP Pane

To enable the configuration parameters on this pane, select eCAP from the **Operating mode** list on the **General** pane.





**Event prescaler (integer from 0 to 31)**

Multiply the input signal, called a pulse train, by this value. Entering a 0 bypasses the input prescaler, leaving the input capture signal unchanged.

**Select mode control**

**Continuous** performs continuous timestamp captures using a circular buffer to capture events 1 through 4.

**One-Shot** disables continuous mode and enables the **Enable one-shot rearming control via input port** option so you can select it.

**Enable one-shot rearming control via input port**

Select this option to arm the one-shot sequence:

- 1** Reset the Mod4 counter to zero.
- 2** Unfreeze the Mod4 counter.
- 3** Enable capture register loading.

**Stop value after**

Specifies the number of capture events after which to stop the capture.

**Enable reset counter after capture event 1 timestamp**

Enables a reset after capture event 1 and creates an **Output port TS**. When you select this option, the eCAP process resets the counters after receiving a capture event 1 timestamp.

**Select capture event 1 polarity**

Start the capture event on a **Rising edge** or **Falling edge**.

**Time-Stamp counter data type**

Select the data type of the counter. The list includes integer and unsigned 8-, 16-, and 32-bit data types, double, single, and Boolean.

## **Enable capture event status flag output**

Output the capture event status flag on the **Output port CF**. The block outputs a 0 until the event capture. After the event, the flag value is 1.

## **Overflow capture event flag data type**

Select the data type to represent the capture event flag. The list includes integer and unsigned 8-, 16-, and 32-bit data types, double, single, and Boolean.

## **Enable overflow status flag output**

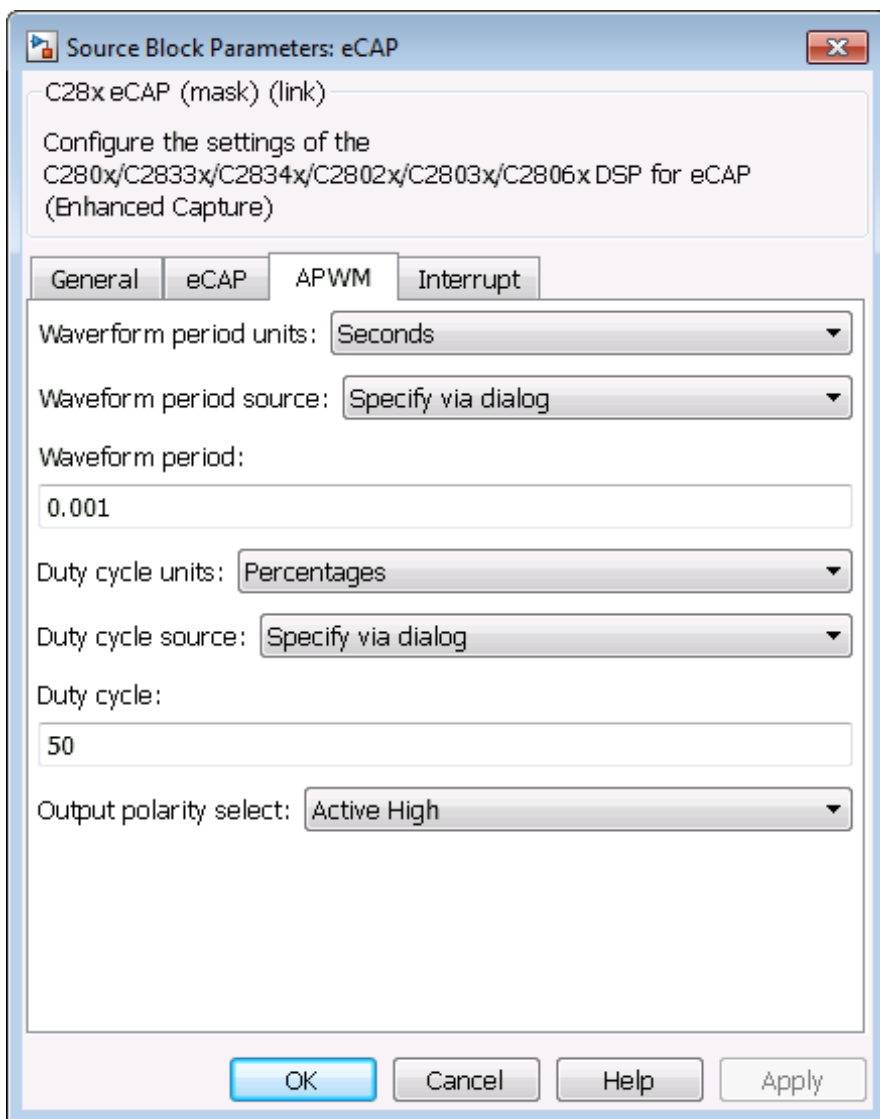
Output the status of the elements of the FIFO buffer on the **Output port OF**. After you select this option, set the data type for the flag in **Overflow flag data type**.

## **Overflow flag data type**

Select the data type to represent the status flag. The list includes integer and unsigned 8-, 16-, and 32-bit data types, double, single, and Boolean.

## **APWM Pane**

To enable the configuration parameters on this pane, select APWM from the **Operating mode** list on the **General** pane.



## **Waveform period units**

Set the units for measuring the waveform period. **Clock cycles** uses the high-speed peripheral clock cycles of the DSP chip, or **Seconds**. Changing these units changes the **Waveform period** value and the **Duty cycle** value and **Duty cycle units** selection.

## **Waveform period source**

Source from which the waveform period value is obtained. Select **Specify via dialog** to enter the value in **Waveform period** or select **Input port** to use a value from the input port.

## **Waveform period**

Period of the PWM waveform measured in clock cycles or in seconds, as specified in the **Waveform period units**.

---

**Note** The term *clock cycles* refers to the high-speed peripheral clock on the F2812 chip. This clock is 75 MHz by default because the high-speed peripheral clock prescaler is set to 2 (150 MHz/2).

---

## **Duty cycle units**

Units for the duty cycle. Select **Clock cycles** or **Percentages** from the list. Changing these units changes the **Duty cycle** value, the **Waveform period** value, and **Waveform period units** selection.

## **Duty cycle source**

Source from which the duty cycle for the specific PWM pair is obtained. Select **Specify via dialog** to enter the value in **Duty cycle** or select **Input port** to use a value from the input port.

## **Duty cycle**

Ratio of the PWM waveform pulse duration to the PWM waveform period expressed in **Duty cycle units**.

## **Output polarity select**

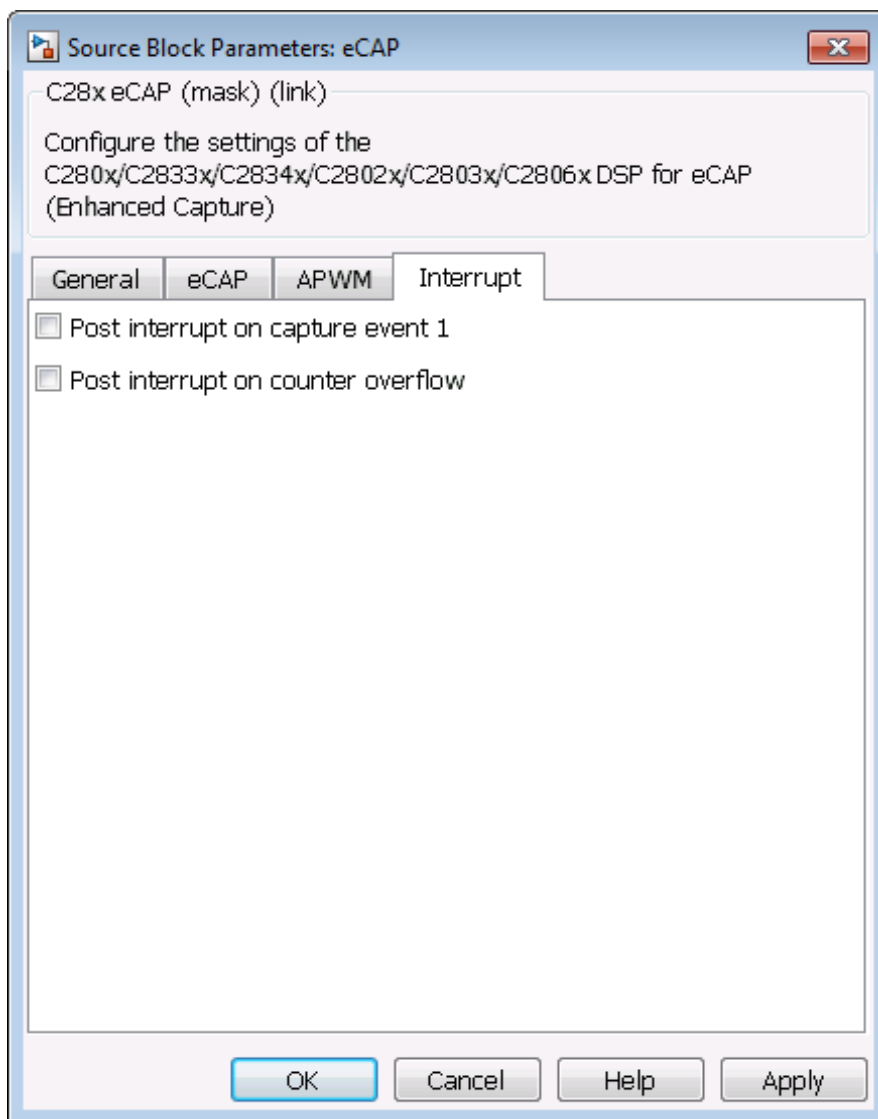
Set the active level for the output. Choose **Active High** or **Active Low** from the list. When you select **Active High**, the compare

value defines the high time. Selecting Active Low directs the compare value to define the low time.

## **Interrupt Pane**

In the following figure, you see the interrupt options when you put the block in eCAP mode by setting **Operating mode** on the **General** pane to eCAP.

## C28x eCAP



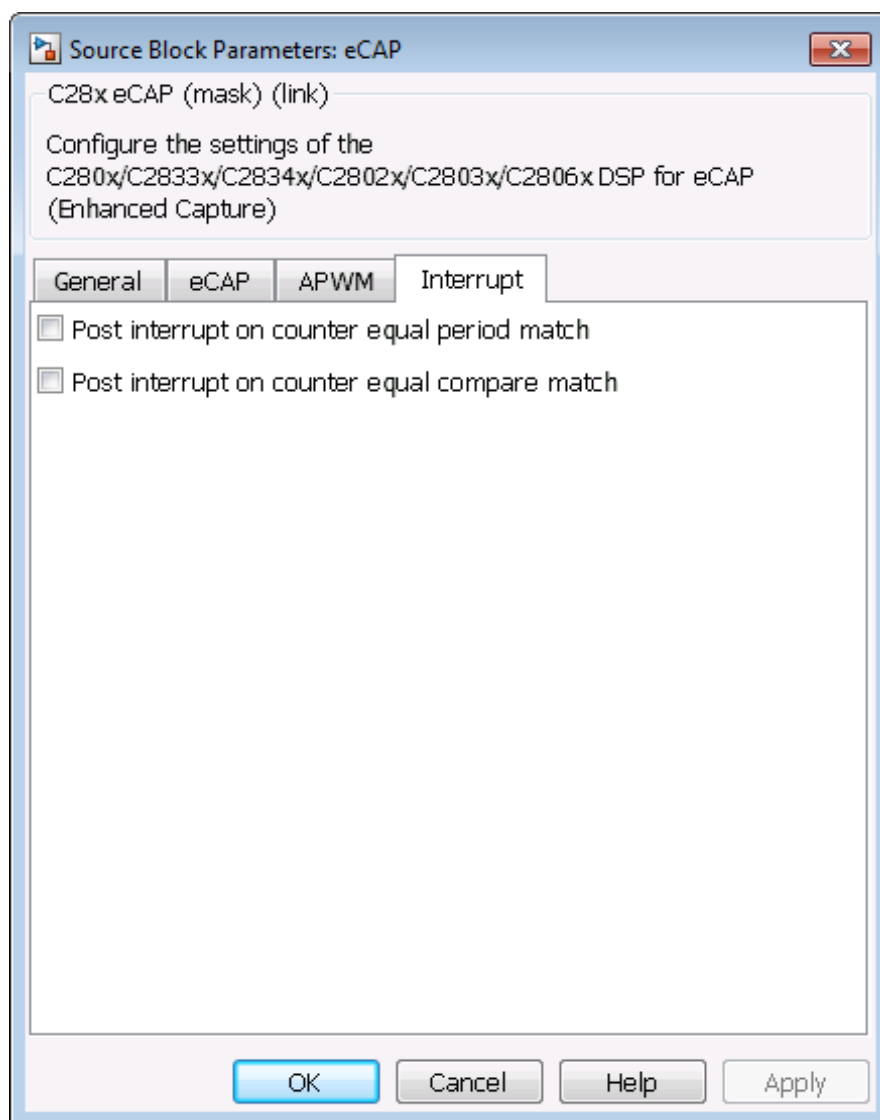
## **Post interrupt on capture event 1**

Enables capture event 1 as an interrupt source. You can use the C28x Hardware Interrupt block to react to this interrupt.

## **Post interrupt on counter overflow**

Enables counter overflow as an interrupt source.

The next figure presents the interrupt options when you put the block in APWM mode by setting **Operating mode** on the **General** pane to APWM.





**Post interrupt on counter equal period match**

Post an interrupt when the value of the counter is the same as the value of the period register (CTR=PRD).

**Post interrupt on counter equal compare match**

Post an interrupt when the value of the counter is the same as the value of the compare register (CTR=CMP).

**References**

For detailed information about interrupt processing, see *TMS320x28xx, 28xxx Enhanced Capture (eCAP) Module Reference Guide*, SPRU807B, available at the Texas Instruments Web site.

**See Also**

“eCAP” on page 3-279

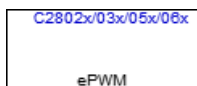
# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x ePWM

---

**Purpose** Configure Event Manager to generate Enhanced Pulse Width Modulator (ePWM) waveforms

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

## Description



Configures the Event Manager of the C280x/C2802x/C2803x/C28x3x DSP to generate ePWM waveforms. These DSPs contain multiple ePWM modules. Each module has two outputs, ePWMA and ePWMB. You can use the ePWM block to configure up to six ePWM modules.

When you enable the High-Resolution Pulse Width Modulator (HRPWM), the ePWM block uses the Scale Factor Optimizing Software Version 5 library (SFO\_TI\_Build\_V5.lib). SFO\_TI\_Build\_V5.lib can “dynamically determine the number of MEP steps per SYSCLKOUT period.” For more information, consult *TMS320x28xx, 28xxx High-Resolution Pulse Width Modulator (HRPWM) Reference Guide*, Literature Number SPRU924, available at the Texas Instruments Web site.

## Dialog Box

## General Pane

Block Parameters: ePWM

C2802x/03x/05x/06x ePWM (mask) (link)

Configures the Event Manager of the C2802x/C2803x/C2805x/C2806x DSP to generate ePWM waveforms.  
The number of available ePWM modules (ePWM1-ePWM8) vary between C2000 processors.

General ePWMA ePWMB Deadband unit Event Trigger PWM chopper control Trip Zone unit Digital Compare

Module: ePWM1

Timer period units: Clock cycles

Specify timer period via: Input port

Timer initial period: 64000

Reload for time base period register (PRLD): Counter equals to zero

Counting mode: Up-Down

Synchronization action: Set counter to phase value specified via input port

Counting direction after phase synchronization: Count down after sync

Specify software synchronization via input port (SWFSYNC)

Enable digital compare A event1 synchronization (DCAEVT1)

Enable digital compare B event1 synchronization (DCBEVT1)

Synchronization output (SYNCO): Counter equals to zero (CTR=Zero)

Time base clock (TBCLK) prescaler divider: 1

High speed time base clock (HSPCLKDIV) prescaler divider: 1

Enable swap module A and B (HRPWM not available in F2805x processors)

Enable high resolution PWM (HRPWM -Period)

Enable high resolution PWM (HRPWM -CMP)

High resolution PWM (HRPWM) loading mode: Counter equals to zero (CTR=ZERO)

High resolution PWM (HRPWM) control mode: Duty control mode

High resolution PWM (HRPWM) edge control mode: Both edge

Use scale factor optimizer (SFO) software

Enable auto convert

OK Cancel Help Apply

### Allow use of 16 HRPWMs (for C28044) instead of 6 PWMs

Enable all 16 High-Resolution PWM modules (HRPWM) on the C28044 digital signal controller when the PWM resolution is too low.

For example, the Spectrum Digital eZdsp™ F28044 board has a system clock of 100 MHz (200-kHz switching). At these frequencies, conventional PWM resolution is too low—approximately 9 bits or 10 bits. By comparison, the HRPWM resolution for the same board is 14.8 bits.

All the C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x ePWM blocks in your model become HRPWM blocks. Thus, when you enable this parameter:

- Use the HRPWM parameters under the ePWMA tab to make additional configuration changes.
- Most of the configuration parameters under the ePWMB tab are unavailable.
- Your model can contain up to 16 C280x/C2803x/C28x3x ePWM blocks, provided you configure each one for a separate module. (For example, **Module** is ePWM1, ePWM2, and so on.)

For processors other than the C28044, deselect (disable) **Allow use of 16 HRPWMs (for C28044) instead of 6 PWMs**. To enable HRPWM for other processors, first determine how many HRPWM modules are available. Consult the Texas Instruments documentation for your processor, and then use the HRPWM parameters under the ePWMA tab to enable and configure HRPWM.

For additional information about the C28044 and HRPWM, consult the “References” on page 2-112 section.

## Module

Specify which target ePWM module to use.

## Timer period units

Specify the units of the **Timer period** or **Timer initial period** as **Clock cycles** (the default) or **Seconds**. When **Timer period units** is **Seconds**, the software down-converts the **Timer period** or **Timer initial period**, a double for the period register to a

uint16. For best results, select **Clock cycles**. Doing so reduces calculations and rounding errors.

---

**Note** If you set **Timer period units** to **Seconds**, enable support for floating-point numbers. In the model window, select **Simulation > Model Configuration Parameters**. In the Configuration Parameters dialog box, select **Code Generation > Interface**. Under **Software Environment**, enable **floating-point numbers**.

---

### Specify timer period via

Configure the source of the timer period value. Selecting **Specify via dialog** changes the following parameter to **Timer period**. Selecting **Input port** changes the following parameter to **Timer initial period** and creates a timer period input port, **T**, on the block.

### Timer period

Set the period of the PWM waveform in clock cycles or in seconds, as determined by the **Timer period units** parameter. When you enable HRMWM, you can enter a high-precision floating point value. The Time-Base Period High Resolution Register (TBPRDHR) stores the high-resolution portion of the timer period value.

---

**Note** The term *clock cycles* refers to the Time-base Clock on the DSP. See the **TB clock prescaler divider** topic for an explanation of Time-base Clock speed calculations.

---

### Timer initial period

The period of the waveform from the time the PWM peripheral starts operation until the ePWM input port, **T**, receives a new

value for the period. Use **Timer period units** to measure the period in clock cycles or in seconds.

---

**Note** The term *clock cycles* refers to the Time-base Clock on the DSP. See the **TB clock prescaler divider** topic for an explanation of Time-base Clock speed calculations.

---

### Reload for time base period register (PRDL)

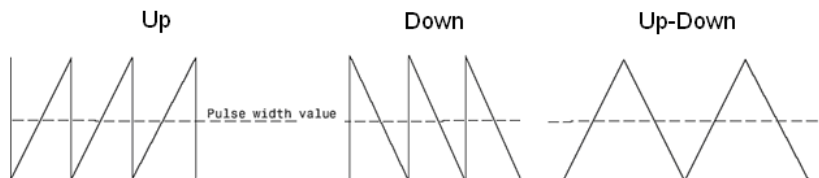
The time at which the counter period is reset.

- Counter equals to zero The counter period refreshes when the value of the counter is 0.
- Immediate without using shadow The counter period refreshes immediately.

### Counting mode

Specify the counting mode in which to operate. This PWM module can operate in three distinct counting modes: Up, Down, and Up-Down. The Down option is not compatible with HRPWM. To avoid an error when you build the model, do not set the **Counting mode** parameter to Down and select the **Enable HRPWM (Period)** parameter checkbox.

The following illustration shows the waveforms that correspond to these three modes:



## Synchronization action

Specify the source of a phase offset to apply to the Time-base synchronization input signal, EPWMxSYNCI from the **SYNC** input port. Selecting Set counter to phase value specified via dialog creates the **Phase offset value** parameter. Selecting Set counter to phase value specified via input port creates a phase input port, **PHS**, on the block. Selecting Disable, the default value prevents the application of phase offsets to the TB module.

## Counting direction after phase synchronization

This parameter appears when **Counting mode** is Up-Down and **Synchronization action** is Set counter to phase value specified via dialog or Input port. Configure the timer to count up from zero, or down to zero, following synchronization. This parameter corresponds to the PHSDIR field of the Time-base Control Register (TBCTL).

## Phase offset value (TBPHS)

This field appears when you select Set counter to phase value specified via dialog in **Synchronization action**.

Configure the phase offset (delay) between the following events:

- The arrival of the Time-base synchronization input signal (EPWMxSYNCI) on the **SYNC** input port
- The moment the Time-base (TB) submodule synchronizes the ePWM module.

---

**Note** Enter the **Phase offset value (TBPHS)** in TBCLK cycles, from 0 to 65535. Do not use fractional seconds.

---

This parameter corresponds to the Time-Base Phase Register (TBPHS).

## **Specify software synchronization via input port (SWFSYNC)**

Create an input port, **SYNC**, for a Time-base synchronization input signal, **EPWMxSYNCl**. You can use this option to achieve precise synchronization across multiple ePWM modules by daisy-chaining multiple Time-base (TB) submodules.

## **Enable digital compare A event1 synchronization (DCAEVT1)**

This parameter only appears in the C2802x and C2803x ePWM blocks.

Synchronize the ePWM time base to a DCAEVT1 digital compare event. Use this feature to synchronize this PWM module to the time base of another PWM module. Fine-tune the synchronization between the two modules using the **Phase offset value**. This option is not compatible with HRPWM. Enabling HRPWM disables this option.

## **Enable digital compare B event1 synchronization (DCBEVT1)**

This parameter only appears in the C2802x and C2803x ePWM blocks.

Synchronize the ePWM time base to a DCBEVT1 digital compare event. Use this feature to synchronize this PWM module to the time base of another PWM module. Fine-tune the synchronization between the two modules using the **Phase offset value**. This option is not compatible with HRPWM. Enabling HRPWM disables this option.

## **Synchronization output (SYNCO)**

This parameter corresponds to the SYNCSEL field in the Time-Base Control Register (TBCTL).

Use this parameter to specify the event that generates a Time-base synchronization output signal, **EPWMxSYNCO**, from the Time-base (TB) submodule.

The available choices are:



- Pass through (EPWMxSYNCR or SWFSYNCR) — a Synchronization input pulse or Software forced synchronization pulse, respectively. You can use this option to achieve precise synchronization across multiple ePWM modules by daisy chaining multiple Time-base (TB) submodules.
- Counter equals to zero (CTR=Zero) — Time-base counter equal to zero (TBCTR = 0x0000)
- Counter equals to compare B (CTR=CMPB) — Time-base counter equal to counter-compare B (TBCTR = CMPB)
- Disable — Disable the EPWMxSYNCO output (the default)

### **Time base clock (TBCLK) prescaler divider**

Use the **Time base clock (TBCLK) prescaler divider** (CLKDIV) and the **High speed time base clock (HSPCLKDIV) prescaler divider** (HSPCLKDIV) to configure the Time-base clock speed (TBCLK) for the ePWM module. Calculate TBCLK using the following equation:

$$\text{TBCLK} = \text{SYSCLKOUT}/(\text{HSPCLKDIV} * \text{CLKDIV})$$

For example, the default values of both CLKDIV and HSPCLKDIV are 1, and the default frequency of SYSCLKOUT is 100 MHz, so:

$$\text{TBCLK} = 100 \text{ MHz} = 100 \text{ MHz}/(1 * 1)$$

The choices for the **Time base clock (TBCLK) prescaler divider** are: 1, 2, 4, 8, 16, 32, 64, and 128.

The **Time block clock (TBCLK) prescaler divider** parameter corresponds to the CLKDIV field of the Time-base Control Register (TBCTL).

---

**Note** The frequency of SYSCLKOUT depends on the oscillator frequency and the configuration of PLL-based clock module. Changing the values of the PLL Control Register (PLLCR) affects the timing of all ePWM modules.

For more information, consult the “PLL-Based Clock Module” section of the data manual for your specific target (see “References” on page 2-112).

---

### **High speed time base clock (HSPCLKDIV) prescaler divider**

See the **Time base clock (TBCLK) prescaler divider** topic for an explanation of the role of this value in setting the speed of the Time-base Clock. Choices are to divide by 1, 2, 4, 6, 8, 10, 12, and 14. Selecting **Enable high resolution PWM (HRPWM-Period)** forces this option to 1.

This parameter corresponds to the HSPCLKDIV field of the Time-base Control Register (TBCTL).

### **Enable swap module A and B**

This parameter only appears in the C2802x and C2803x ePWM blocks.

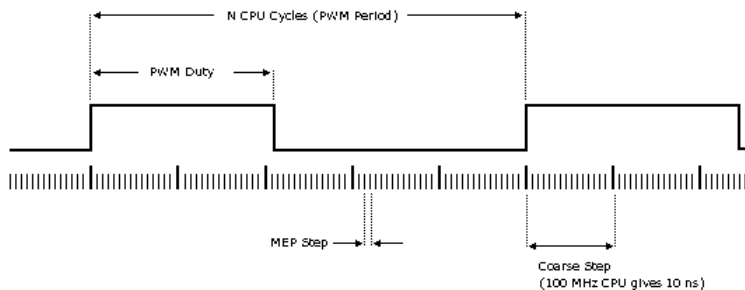
Swap the ePWMA and ePWMB outputs. This option outputs the ePWMA signals on the ePWMB outputs and the ePWMB signals on the ePWMA outputs.

### **Enable high resolution PWM (HRPWM - Period)**

This parameter only appears in the C2802x and C2803x ePWM blocks.

When the effective resolution for conventionally generated PWM is insufficient, consider using High Resolution PWM (HRPWM). The resolution of PWM is normally dependent upon the PWM frequency and the underlying system clock frequency. To address this limitation, HRPWM uses **Micro Edge Positioner (MEP)**™

technology to position edges more finely by dividing each coarse system clock. The accuracy of the subdivision is on the order of 150ps. The following figure shows the relationship between one system clock and edge position in terms of **MEP** steps:



MEP scale factor = Number of MEP steps in one coarse step

Enable HRPWM mode and control it via the Extension Register for HRPWM Period (TBPRDHR) register. When you enable this parameter, you can enter an 8-bit floating point value in for the **Timer period** parameter. This parameter enables the **Enable high resolution PWM (HRPWM - CMP)** option, and displays the **HRPWM loading mode**, **HRPWM control mode**, and **HRPWM edge control mode** options. Also configure **HRPWM control mode**.

Selecting **Enable HRPWM (Period)** forces **TB clock prescaler divider** and **High Speed TB clock prescaler divider** to 1. These settings match the HRPWM time base clock with the SYSCLKOUT frequency.

The **Down** option in the **Counting mode** parameter is not compatible with HRPWM. To avoid an error when you build the model, do not set the **Counting mode** parameter to **Down** and select the **Enable HRPWM (Period)** parameter checkbox.

## **Enable high resolution PWM (HRPWM - CMP)**

This parameter only appears in the C2802x and C2803x ePWM blocks.

Enable HRPWM mode and control it via the Extension Register for HRPWM Duty (CMPAHR) register. Also configure **HRPWM control mode**.

## **High resolution PWM (HRPWM) loading mode**

This parameter appears only when the **Enable high resolution PWM (HRPWM - Period)** is selected. Determine when to transfer the value of the CMPAHR shadow to the active register:

- Counter equals to zero (CTR=ZERO) Transfer the value when the time base counter equals zero (TBCTR = 0x0000).
- Counter equals to period (CTR=PRD) Transfer the value when the time base counter equals the period (TBCTR = TBPRD).
- Counter equals to either zero or period (CTR=ZERO or CTR=PRD) Transfer the value when either case is true.

This option configures the HRLOAD “Shadow Mode Bit” in the HRPWM Configuration Register (HRCNFG).

## **High resolution PWM (HRPWM) control mode**

This parameter appears only when the **Enable high resolution PWM (HRPWM - CMP)** is selected. Select which register controls the Micro Edge Positioner (MEP) step size. The **High resolution PWM (HRPWM) Control mode** option configures the CTLMODE “Control Mode Bits”.

- Duty control mode uses the Extension Register for HRPWM Duty (CMPAHR) or the Extension Register for HRPWM Period (TBPRDHR) to control the MEP edge position.
- Select Phase control mode to use the Time Base Period High-Resolution Register (TBPRDHR) to control the MEP edge position.

The **High resolution PWM (HRPWM) control mode** option configures the CTLMODE “Control Mode Bits” in the HRPWM Configuration Register (HRCNFG).

### **High resolution PWM (HRPWM) edge control mode**

Swap the ePWMA and ePWMB outputs. This parameter sets the SWAPAB field in the HRPWM Configuration Register (HRCNFG).

### **Use scale factor optimizer (SFO) software**

This parameter is enabled only if the **Enable high resolution PWM (HRPWM - CMP)** is selected. Enable scale factor optimizing (SFO) software with HRPWM. This software dynamically determines the scaling factor for the Micro Edge Positioner (MEP) step size. The step size varies depending on operating conditions such as temperature and voltage. The SFO software reduces variability due to these conditions. For more information, see the “Scale Factor Optimizing Software (SFO)” section of the *TMS320x2802x, 2803x Piccolo High Resolution Pulse Width Modulator (HRPWM) Reference Guide*, Literature Number: SPRUGE8.

### **Enable auto convert**

This parameter only appears if the **Enable high resolution PWM (HRPWM - CMP)** is selected for the C2802x, C2803x, and C2806x ePWM blocks.

Apply the scaling factor calculated by the SFO software to the controlling period or duty cycle. (Use the **HRPWM control mode** to select controlling period or duty cycle.) This parameter sets the AUTOCONV field in the HRPWM Configuration Register (HRCNFG).

### **ePWMA and ePWMB panes**

Each ePWM module has two outputs, ePWMA and ePWMB. The **ePWMA output** pane and **ePWMB output** pane include the same settings, although the default values vary in some cases, as noted.

# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x ePWM

Block Parameters: ePWM

C2802x/03x/05x/06x ePWM (mask) (link)

Configures the Event Manager of the C2802x/C2803x/C2805x/C2806x DSP to generate ePWM waveforms.  
The number of available ePWM modules (ePWM1-ePWM8) vary between C2000 processors.

General | ePWMA | ePWMB | Deadband unit | Event Trigger | PWM chopper control | Trip Zone unit | Digital Compare

Enable ePWM1A

CMPA units: Clock cycles

Specify CMPA via: Specify via dialog

CMPA value: 32000

Reload for compare A Register (SHDWAMODE): Counter equals to zero

Action when counter=ZERO: Do nothing

Action when counter=PRD: Clear

Action when counter=CMPA on up-count (CAU): Set

Action when counter=CMPA on down-count (CAD): Do nothing

Action when counter=CMPB on up-count (CBU): Do nothing

Action when counter=CMPB on down-count (CBD): Do nothing

Compare value reload condition: Load on counter equals to zero (CTR=Zero)

Add continuous software force input port

Continuous software force logic: Forcing disable

Reload condition for software force: Zero

OK Cancel Help Apply

# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c283x ePWM

Block Parameters: ePWM

C2802x/03x/05x/06x ePWM (mask)

Configures the Event Manager of the C2802x/C2803x/C2805x/C2806x DSP to generate ePWM waveforms.  
The number of available ePWM modules (ePWM1-ePWM8) vary between C2000 processors.

General ePWMA ePWMB Deadband unit Event Trigger PWM chopper control Trip Zone unit Digital Compare

Enable ePWM1B

CMPB units: Clock cycles

Specify CMPB via: Specify via dialog

CMPB value: 32000

Reload for compare B Register (SHDWBMODE): Counter equals to zero

Action when counter=ZERO: Do nothing

Action when counter=period (PRD): Set

Action when counter=CMPA on up-count (CAU): Do nothing

Action when counter=CMPA on down-count (CAD): Do nothing

Action when counter=CMPB on up-count (CBU): Clear

Action when counter=CMPB on down-count (CBD): Do nothing

Compare value reload condition: Load on counter equals to zero (CTR=Zero)

Add continuous software force input port

Continuous software force logic: Forcing disable

Reload condition for software force: Zero

Inverted version of ePWMxA

OK Cancel Help Apply

## Enable ePWMxA

## Enable ePWMxB

Enables the ePWMA and/or ePWMB output signals for the ePWM module identified on the **General** pane. By default, **Enable ePWMxA** is enabled, and **Enable ePWMxB** is disabled.

---

**Note** To **Enable ePWMxA** or **Enable ePWMxB**, also enable support for floating-point numbers: In the model window, select **Code > C/C++ Code > Code Generation Options**. In the Configuration Parameters dialog box, select **Code Generation > Interface**. Under **Software Environment**, enable **floating-point numbers**.

---

## CMPA units

## CMPB units

Specify the units used by the compare register: Percentages (the default) or **Clock cycles**.

---

## Notes

- The term *clock cycles* refers to the Time-base Clock on the DSP. See the **TB clock prescaler divider** topic for an explanation of Time-base Clock speed calculations.
  - Percentages use additional computation time in generated code and can decrease results.
  - If you set **CMPA units** or **CMPB units** to Percentages, also enable support for floating-point numbers: In the model window, select **Simulation > Model Configuration Parameters**. In the Configuration Parameters dialog box, select **Code Generation > Interface**. Under **Software Environment**, enable **floating-point numbers**.
-



## **Specify CMPA via**

## **Specify CMPB via**

Specify the source of the pulse width. If you select **Specify via dialog** (the default), enter a value in the **CMPA value** or **CMPB value** field. If you select **Input port**, set the value using an input port, **WA** or **WB**, on the block. If you select **Input port** also set **CMPA initial value** or **CMPB initial value**.

## **CMPA value**

## **CMPB value**

This field appears when you choose **Specify via dialog** in **CMPA source** or **CMPB source**. Enter a value that specifies the pulse width, in the units specified in **CMPA units** or **CMPB units**.

## **CMPA initial value**

## **CMPB initial value**

This field appears when you set **CMPA source** or **CMPB source** to **Input port**. Enter the initial pulse width of CMPA or CMPB the PWM peripheral uses when it starts operation. Subsequent inputs to the **WA** or **WB** ports change the CMPA or CMPB pulse width.

## **Reload for compare A Register (SHDWAMODE)**

## **Reload for compare B Register (SHDWBMODE)**

The time at which the counter period is reset.

- Select **Counter equals to zero** the counter period refreshes when the value of the counter is 0.
- Select **Immediate without using shadow** the counter period refreshes immediately.

**Action when counter=ZERO**

**Action when counter=period (PRD)**

**Action when counter=CMPA on up-count (CAU)**

**Action when counter=CMPA on down-count (CAD)**

**Action when counter=CMPB on up-count (CBU)**

**Action when counter=CMPB on down-count (CBD)**

These settings, along with the other remaining settings in the **ePWMA output** and **ePWMB output** panes, determine the behavior of the Action Qualifier (AQ) submodule. The AQ module determines which events are converted into various action types, producing the required switched waveforms of the ePWMxA and ePWMxB output signals.

For each of these four fields, the available choices are Do nothing, Clear, Set, and Toggle.

The default values for these fields vary between the **ePWMA output** and **ePWMB output** panes.

The following table shows the defaults for each of these panes when you set **Counting mode** to Up or Up-Down:

| <b>Action when counter =...</b> | <b>ePWMA output pane</b> | <b>ePWMB output pane</b> |
|---------------------------------|--------------------------|--------------------------|
| ZERO                            | Do nothing               | Do nothing               |
| PRD                             | Clear                    | Set                      |
| CMPA on up-count (CAU)          | Set                      | Do nothing               |
| CMPA on down-count (CAD)        | Do nothing               | Do nothing               |
| CMPB on up-count (CBU)          | Do nothing               | Clear                    |
| CMPB on down-count (CBD)        | Do nothing               | Do nothing               |

The following table shows the defaults for each of these panes when you set **Counting mode** to Down:

| Action when counter =... | ePWMA output pane | ePWMB output pane |
|--------------------------|-------------------|-------------------|
| ZERO                     | Do nothing        | Do nothing        |
| period (PRD)             | Clear             | Set               |
| CMPA on down-count (CAD) | Do nothing        | Do nothing        |
| CMPB on down-count (CBD) | Do nothing        | Do nothing        |

For a detailed discussion of the AQ submodule, consult the *TMS320x280x Enhanced Pulse Width Modulator (ePWM) Module Reference Guide* (SPRU791), available on the Texas Instruments Web site.

### Compare value reload condition

#### Add continuous software force input port

#### Continuous software force logic

#### Reload condition for software force

These four settings determine how the action-qualifier (AQ) submodule handles the S/W force event, an asynchronous event initiated by software (CPU) via control register bits.

**Compare value reload condition** determines if and when to reload the Action-qualifier S/W Force Register from a shadow register. Choices are Load on counter equals to zero (CTR=Zero) (the default), Load on counter equals to period (CTR=PRD), Load on either, and Freeze.

**Add continuous software force input port** creates an input port, **SFA**, which you can use to control the software force logic. Send one of the following values to **SFA** as an unsigned integer data type:

- 0 = Forcing disable: Do nothing. The default option.

- 1 = Forcing low: Clear low
- 2 = Forcing high: Set high

If you did not create the **SFA** input port, you can use **Continuous software force logic** to select which type of software force logic to apply. The choices are:

- Forcing disable: Do nothing. The default.
- Forcing low: Clear low
- Forcing high: Set high

**Reload condition for software force** — Choices are Zero (the default), Period, Either period or zero, and Immediate.

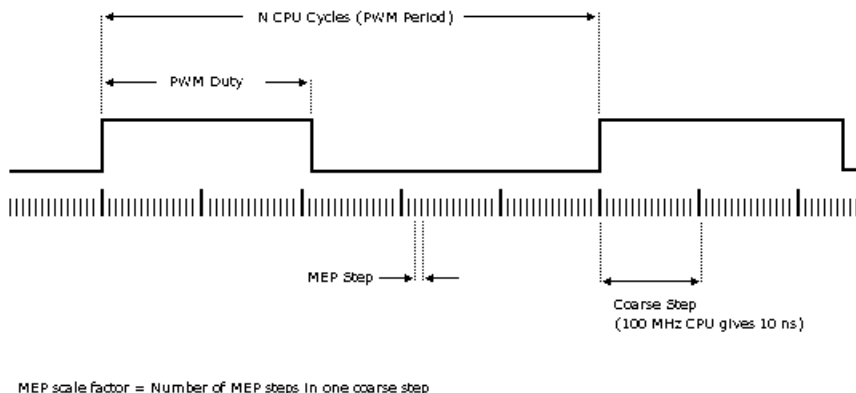
### **Inverted version of ePWMxA**

Only the ePWMB pane on the C2802x and C2803x blocks displays this option. Invert the ePWMxA signal and output it on the ePWMxB outputs. This parameter sets the SELOUTB field in the HRPWM Configuration Register (HRCNFG).

### **Enable high resolution PWM (HRPWM)**

This parameter appears at this position in the C280x and C2833x ePWM blocks.

Select to enable High Resolution PWM settings. When the effective resolution for conventionally generated PWM is insufficient, consider High Resolution PWM (HRPWM). The resolution of PWM is normally dependent upon the PWM frequency and the underlying system clock frequency. To address this limitation, HRPWM uses **Micro Edge Positioner (MEP)** technology to position edges more finely by dividing each coarse system clock. The accuracy of the subdivision is on the order of 150ps. The following figure shows the relationship between one system clock and edge position in terms of **MEP** steps:



## High resolution PWM (HRPWM) loading mode

This parameter appears at this position in the C280x and C2833x ePWM blocks.

Determine when to transfer the value of the CMPAHR shadow to the active register:

- Counter equals to zero (CTR=ZERO): Transfer the value when the time base counter equals zero (TBCTR = 0x0000).
- Counter equals to period (CTR=PRD): Transfer the value when the time base counter equals the period (TBCTR = TBPRD).
- CTR=Zero or CTR=PRD Transfer the value when either case is true.

## High resolution PWM (HRPWM) control mode

This parameter appears at this position in the C280x and C2833x ePWM blocks.

Select which register controls the Micro Edge Positioner (MEP) step size. The **High resolution PWM (HRPWM) control mode** option configures the CTLMODE "Control Mode Bits".

- Duty control mode uses the Extension Register for HRPWM Duty (CMPAHR) or the Extension Register for HRPWM Period (TBPRDHR) to control the MEP edge position.
- Select Phase control mode to use the Time Base Period High-Resolution Register (TBPRDHR) to control the MEP edge position.

The **High resolution PWM (HRPWM) control mode** option configures the CTLMODE “Control Mode Bits” in the HRPWM Configuration Register (HRCNFG).

### **High resolution (HRPWM) edge control mode**

This parameter appears at this position in the C280x and C2833x ePWM blocks.

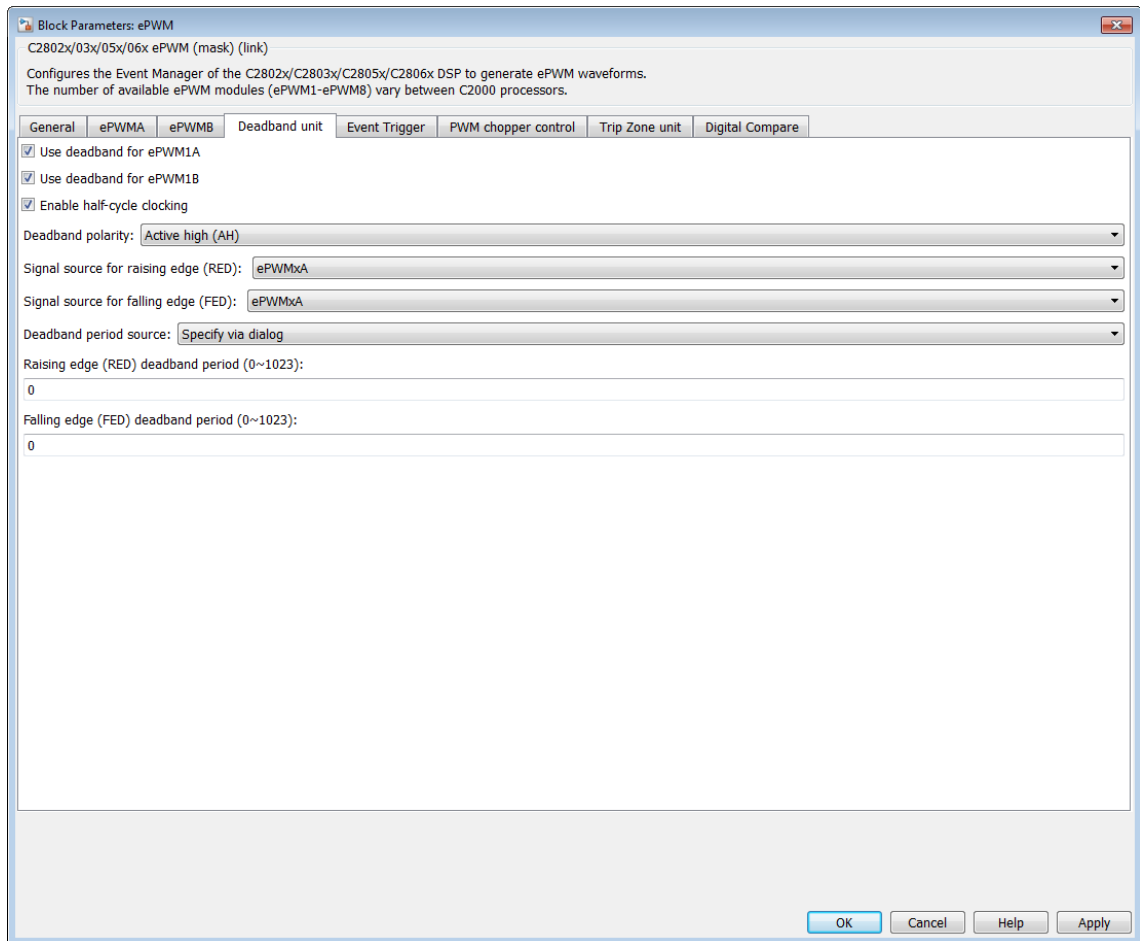
Swap the ePWMA and ePWMB outputs. This parameter sets the SWAPAB field in the HRPWM Configuration Register (HRCNFG).

### **Use scale factor optimizer (SFO) software**

Enable scale factor optimizing (SFO) software with HRPWM. This software dynamically determines the scaling factor for the Micro Edge Positioner (MEP) step size. The step size varies depending on operating conditions such as temperature and voltage. The SFO software reduces variability due to these conditions. For more information, see the “Scale Factor Optimizing Software (SFO)” section of the *TMS320x2802x, 2803x Piccolo High Resolution Pulse Width Modulator (HRPWM) Reference Guide*, Literature Number: SPRUGE8.

### **Deadband Unit Pane**

The **Deadband unit** pane lets you specify parameters for the Dead-Band Generator (DB) submodule.



## Use deadband for ePWMxA

## Use deadband for ePWMxB

Enables a deadband area of without signal overlap between pairs of ePWM output signals. This check box is cleared by default.

## **Enable half-cycle clocking**

This parameter only appears in the C2802x and C2803x ePWM blocks.

To double the deadband resolution, enable half-cycle clocking. This option clocks the deadband counters at  $TBCLK*2$ . When you disable this option, the deadband counters use full-cycle clocking ( $TBCLK*1$ ).

## **Deadband polarity**

Configure the deadband polarity as Active high (AH) (the default option), Active low (AL), Active high complementary (AHC) or Active low complementary (ALC)

## **Signal source for rising edge (RED)**

This field appears only when you select **Use deadband for ePWMxA** in the **ePWMA output** pane. Enter a value from 0 to 1023 to specify a rising edge delay.

## **Signal source for falling edge (FED)**

This field appears only when you select **Use deadband for ePWMxB** in the **ePWMB output** pane. Enter a value from 0 to 1023 to specify a falling edge delay.

## **Deadband period source**

Specify the source of the control logic. Choose **Specify via dialog** (the default) to enter explicit values, or **Input port** to use a value from the input port.

## **Rising edge (RED) deadband period (0~1023)**

This field appears when you select the check box **Use deadband for ePWMxA**. The value you enter in the field specifies the deadband delay in time-base clock (TBCLK) cycles.

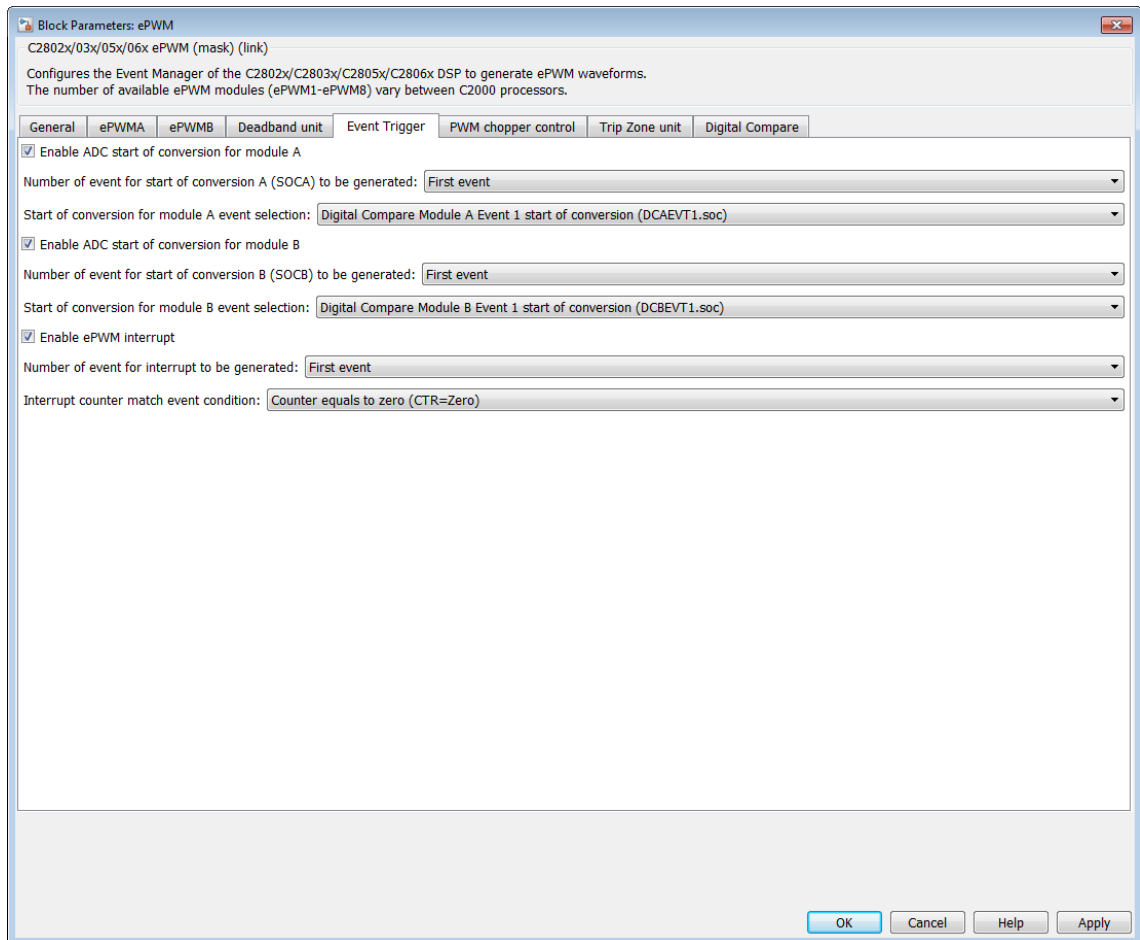
## **Falling edge (FED) deadband period (0~1023)**

This field appears when you select the check box **Use deadband for ePWMxB**. The value you enter in the field specifies the deadband delay in time-base clock (TBCLK) cycles.



## Event Trigger Pane

Configure ADC Start of Conversion (SOC) by one or both of the ePWMA and ePWMB outputs.



## **Enable ADC start of conversion for module A**

When you select this option, ePWM starts the Analog-to-Digital Conversion (ADC) for module A. By default, the software clears (disables) this option.

## **Number of event for start of conversion for Module A (SOCA) to be generated**

When you select **Enable ADC start of conversion for module A**, this field specifies the number of the event that triggers ADC Start of Conversion for Module A (SOCA): **First** event triggers ADC start of conversion with every event (the default). **Second** event triggers ADC start of conversion with every second event. **Third** event triggers ADC start of conversion with every third event.

## **Start of conversion for module A event selection**

When you select **Enable ADC start of conversion for module A**, this field specifies the counter match condition that triggers an ADC start of conversion event. The choices are:

Digital Compare Module A Event 1 start of conversion (DCAEVT1.soc) and Digital Compare Module B Event 1 start of conversion (DCBEVT1.soc)

(For C2802x and C2803x only) When the ePWM asserts a DCAEVT1 or DCBEVT1 digital compare event. Use this feature to synchronize this PWM module to the time base of another PWM module. Fine-tune the synchronization between the two modules using the **Phase offset value**.

Counter equals to zero (CTR=Zero)

When the ePWM counter reaches zero (the default).

Counter equals to period (CTR=PRD)

When the ePWM counter reaches the period value.

Counter equals to zero or period (CTR=Zero or CTR=PRD)

When the time base counter equals zero (TBCTR = 0x0000) or when the time base counter equals the period (TBCTR = TBPRD).

Counter is incrementing and equals to the compare A register (CTRU=CMPA)

When the ePWM counter reaches the compare A value on the way up.

Counter is decrementing and equals to the compare A register (CTRD=CMPA)

When the ePWM counter reaches the compare A value on the way down.

Counter is incrementing and equals to the compare B register (CTRU=CMPB)

When the ePWM counter reaches the compare B value on the way up.

Counter is decrementing and equals to the compare B register (CTRD=CMPB)

When the ePWM counter reaches the compare B value on the way down.

### **Enable ADC start of conversion for module B**

When you select this option, ePWM starts the Analog-to-Digital Conversion (ADC) for module B. By default, the software clears (disables) this option.

### **Number of event for start of conversion for Module B (SOCB) to be generated**

When you select **Enable ADC start module B**, this field specifies the number of the event that triggers ADC start of conversion: **First** event triggers ADC start of conversion with every event (the default), **Second** event triggers ADC start of conversion with every second event, and **Third** event triggers ADC start of conversion with every third event.

### **Start of conversion for module B event selection**

When you select **Enable ADC start of conversion for module B**, this field specifies the counter match condition that triggers an ADC start of conversion event. The choices are the same as for **Module A counter match event condition**.

## **Enable ePWM interrupt**

Select this option to generate interrupts based on different events defined by **Number of event for interrupt to be generated** and **Interrupt counter match event condition**. By default, the software clears (disables) this option.

## **Number of event for interrupt to be generated**

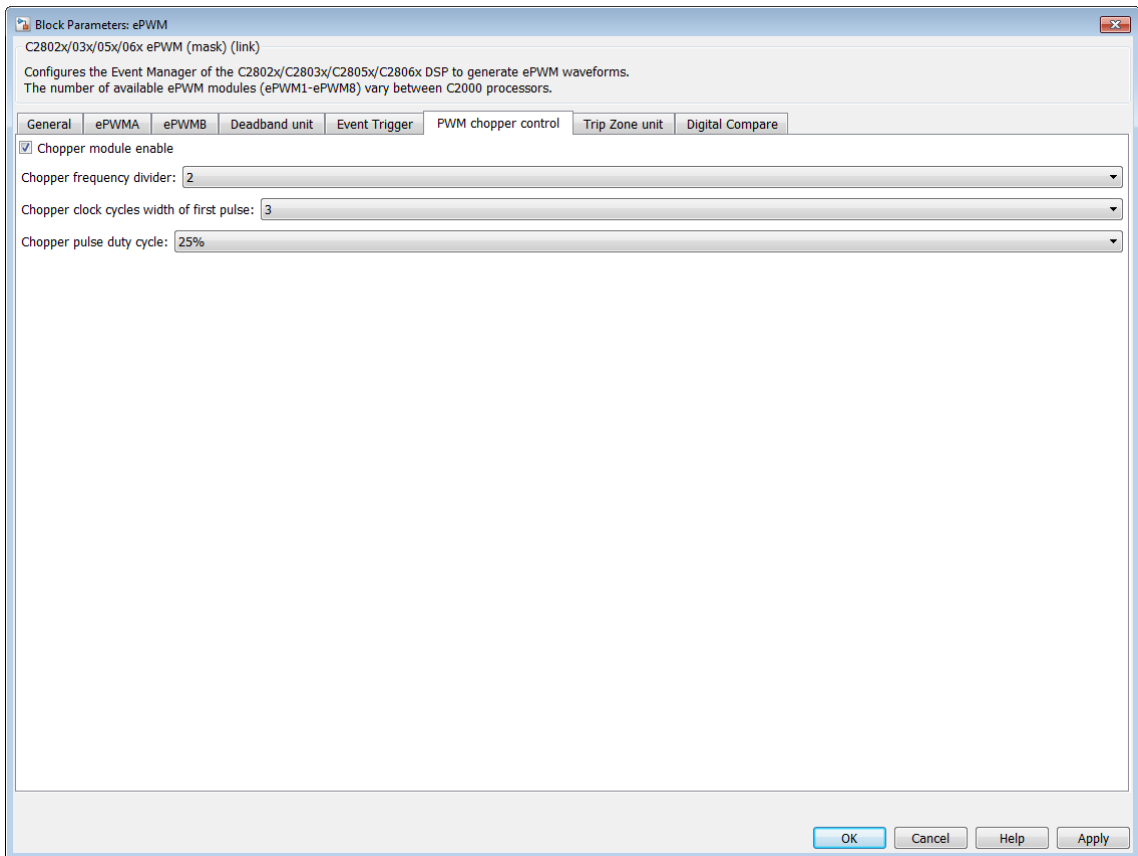
When you select **Enable ePWM interrupt**, this field specifies the number of the event that triggers the ePWM interrupt: **First** event triggers ePWM interrupt with every event (the default), **Second** event triggers ePWM interrupt with every second event, and **Third** event triggers ePWM interrupt with every third event.

## **Interrupt counter match event condition**

When you select **Enable ePWM interrupt**, this field specifies the counter match condition that triggers ePWM interrupt. The choices are the same as for **Module A counter match event condition**.

## **PWM Chopper Control Pane**

The **PWM chopper control** pane lets you specify parameters for the PWM-Chopper (PC) submodule. The PC submodule uses a high-frequency carrier signal to modulate the PWM waveform generated by the AQ and DB modules.



### **Chopper module enable**

Select to enable the chopper module. Use of the chopper module is optional, so this check box is cleared by default.

### **Chopper frequency divider**

Set the prescaler value that determines the frequency of the chopper clock. The system clock speed is divided by this value to determine the chopper clock frequency. Choose an integer value from 1 to 8.

## **Chopper clock cycles width of first pulse**

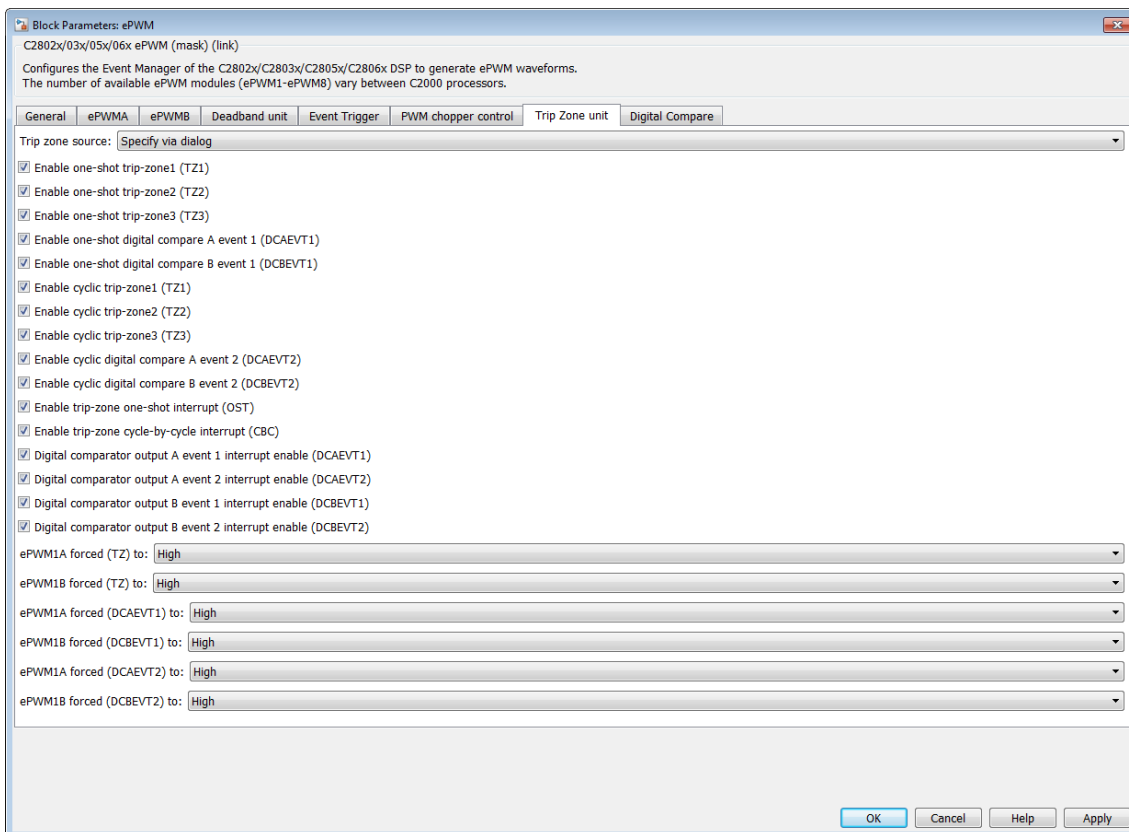
Choose an integer value from 1 to 16 to set the width of the first pulse. This feature provides a high-energy first pulse for a hard and fast power switch turn on.

## **Chopper pulse duty cycle**

The duty cycles of the second and subsequent pulses are also programmable. Choices are 12.5%, 25%, 37.5%, 50%, 62.5%, 75%, and 87.5%.

## **Trip Zone Unit Pane**

The **Trip Zone unit** pane lets you specify parameters for the Trip-zone (TZ) submodule. Each ePWM module receives six TZ signals (TZ1 to TZ6) from the GPIO MUX. These signals indicate external fault or trip conditions. Use the settings in this pane to program the EPWM outputs to respond when faults occur.



## Trip zone source

Specify the source of the control logic to enable or disable the TZ Interrupts (**One shot TZ1-TZ6 and Cyclic TZ1-TZ6**). Select **Specify via dialog** (the default) to enable specific Trip-zone signals in the block dialog. Choose **Input port** to enable specific Trip-zone signals using a block input port, **TZSEL**.

If you select **Input port**, use the following bit operation to determine the value of the 16-bit integer to send to the **TZSEL** input port:

$$\text{TZSEL INPUT VALUE} = (\text{OSHT6} * 2^{13} + \text{OSHT5} * 2^{12} + \text{OSHT4} * 2^{11} + \text{OSHT3} * 2^{10} + \text{OSHT2} * 2^9 + \text{OSHT1} * 2^8 + \text{CBC6} * 2^5 + \text{CBC5} * 2^4 + \text{CBC4} * 2^3 + \text{CBC3} * 2^2 + \text{CBC2} * 2^1 + \text{CBC1} * 2^0)$$

The software uses the higher 8 bits for the **One shot TZ1-TZ6** and the lower 8 bits for **Cyclic TZ1-TZ6**. You can set up a group of TZ sources (1~6), use a bit operation to combine them into an integer, and then feed the integer to TZSEL.

For example, to enable One Shot TZ6 (OSHT6) and One Shot TZ5 (OSHT5) as trip zone sources, set OSHT6 and OSHT5 to “1” and leave the remaining values as “0”.

$$\text{TZSEL INPUT VALUE} = (1 * 2^{13} + 1 * 2^{12} + 0 * 2^{11} \dots)$$

$$\text{TZSEL INPUT VALUE} = (8192 + 4096 + 0 \dots)$$

$$\text{TZSEL INPUT VALUE} = 12288$$

When the block receives this value, it applies it to the TZSEL register as a binary value: 11000000000000.

For more information, see the “Trip-Zone Submodule Control and Status Registers” section of the *TMS320x28xx, 28xxx Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*, Literature Number: SPRU791 on [www.ti.com](http://www.ti.com)

**Enable One-Shot Trip zone1 (TZ1)**

**Enable One-Shot Trip zone2 (TZ2)**

**Enable One-Shot Trip zone3 (TZ3)**

**Enable One-Shot Trip zone4 (TZ4)**

**Enable One-Shot Trip zone5 (TZ5)**

**Enable One-Shot Trip zone6 (TZ6)**

Select these check boxes to enable the corresponding Trip-zone signal in One-Shot Mode. In this mode, when the trip event is active, the software performs the corresponding action on the



EPWMxA/B output immediately and latches the condition. You can unlatch the condition using software control.

**Enable one-shot digital compare A event 1 (DCAEVT1)**

**Enable one-shot digital compare B event 1 (DCBEVT1)**

Select these check boxes to enable the corresponding event signal as a OST trip source for event 1. In this mode, if the digital compare A or digital compare B event 1 is active, the software performs the corresponding action on the EPWM1A/B output immediately and latches the condition. You can unlatch the condition using the software control.

**Enable Cyclic Trip zone1 (TZ1)**

**Enable Cyclic Trip zone2 (TZ2)**

**Enable Cyclic Trip zone3 (TZ3)**

**Enable Cyclic Trip zone4 (TZ4)**

**Enable Cyclic Trip zone5 (TZ5)**

**Enable Cyclic Trip zone6 (TZ6)**

Select these check boxes to enable the corresponding Trip-zone signal in Cycle-by-Cycle Mode. In this mode, when the trip event is active, the software performs the corresponding action on the EPWMxA/B output immediately and latches the condition. In Cycle-by-Cycle Mode, the software automatically clears condition when the PWM Counter reaches zero. Therefore, in Cycle-by-Cycle Mode, every PWM cycle resets or clears the trip event.

**Enable cyclic digital compare A event 2 (DCAEVT2)**

**Enable cyclic digital compare B event 2 (DCBEVT2)**

Select these check boxes to enable the corresponding event signal as a cyclic trip source for event 2. In this mode, if the digital compare A or digital compare B event 2 is active, the software performs the corresponding action on the EPWM2A/B output immediately and latches the condition. You can unlatch the condition using the software control.

**Enable Trip-zone One-Shot interrupt (OST)**

Generate an interrupt when the one shot (OST) triggering event occurs.

## **Enable Trip-zone Cycle-by-Cycle interrupt (CBC)**

Generate an interrupt when the cyclic or cycle-by-cycle (CBC) triggering event occurs.

## **Digital comparator output A event x interrupt enable (DCAEVTx)**

## **Digital comparator output B event x interrupt enable (DCBEVTx)**

Generate an interrupt when Digital Comparator Output A or Digital Comparator Output B for event 1 or 2 occurs.

## **ePWMxA forced (TZ) to ePWMxB forced (TZ) to ePWMxA forced (DCAEVTx) to ePWMxB forced (DCBEVTx) to**

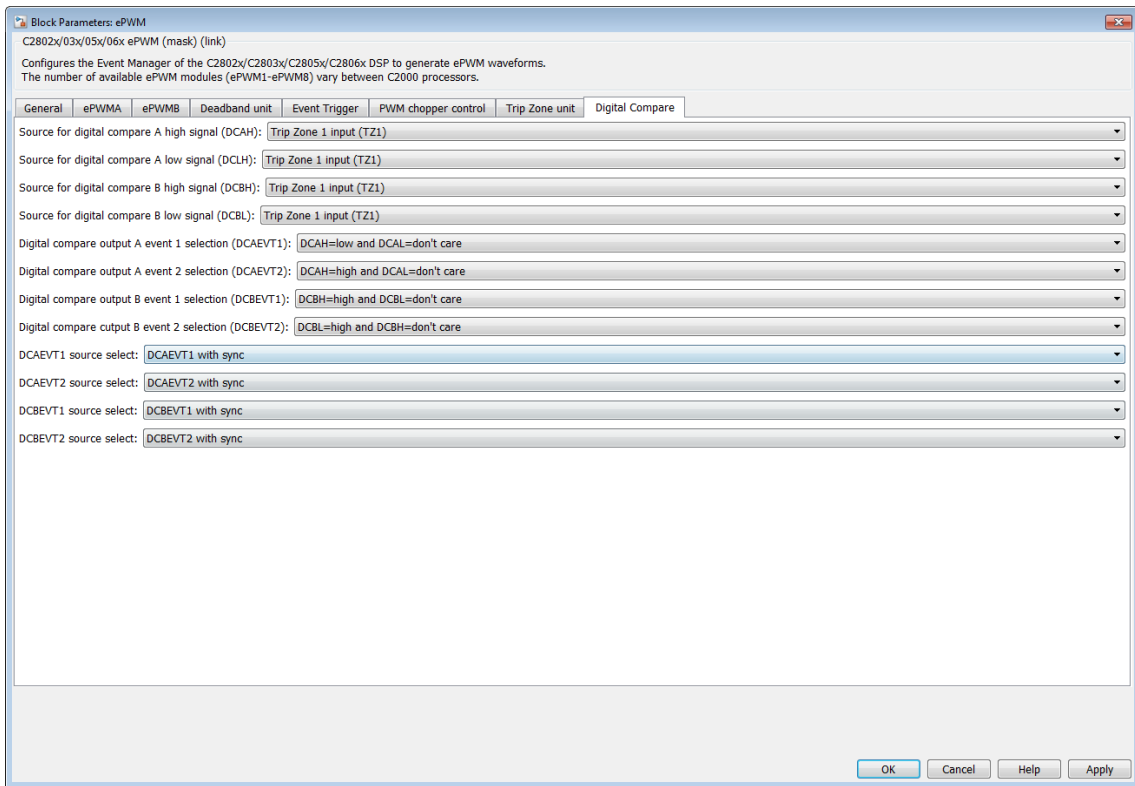
Upon a fault condition, the software overrides and forces the ePWMxA and/or ePWMxB (TZ or DCAEVTx) output to one of the following states: No action (the default), High, Low, or Hi-Z (High Impedance).

## **Digital Compare**

Use the **Digital Compare** pane to configure the Digital Compare (DC) submodule.

Each digital compare (DC) submodule receives three TZ signals (TZ1 to TZ3) from the GPIO MUX, and three COMP signals from the COMP. These signals indicate fault or trip conditions that are external to the PWM submodule. Use the settings in this pane to output specific DC events in response to those external signals. These DC events feed directly into the Time-base, Trip-zone, and Event-trigger submodules.

For more information, see the “Digital Compare (DC) Submodule” section of the *TMS320x2802x, 2803x Piccolo Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*, Literature Number: SPRUGE9.



### Source for digital compare A high signal (DCAH), Source for digital compare B high signal (DCBH)

If the TZ or COMP event you select occurs, assert a high signal. Qualify this signal using the **DCAEVT# source select**, **DCBEVT# source select** options.

### Source for digital compare A low signal (DCAL), Source for digital compare B low signal (DCBL)

If the TZ or COMP event you select occurs, assert a low signal. Qualify this signal using the **DCAEVT# source select**, **DCBEVT# source select** options.

## Digital compare output A event # selection (DCAEVT#), Digital Compare output B event # selection (DCBEVT#)

Qualify the signals that generate DC events, such as DCAEVT# or DCBEVT#. Select the states of **Source for digital compare A high signal DCAH**, **Source for digital compare B high signal DCBH**, **Source for digital compare A low signal (DCAL)**, and **Source for digital compare B low signal (DCBL)** that generate the event. To disable this feature, choose the Event disabled option.

## DCAEVT# source select, DCBEVT# source select

This parameter controls two separate aspects of triggering DC events:

- Triggering filtered or unfiltered DC event. (Configures DCACTL[EVT1SRCSEL] or DCACTL[EVT2SRCSEL].)
- Trigger the DC event synchronously or asynchronously. (Configures DCACTL[EVT1FRCSYNCSEL] or DCACTL[EVT2FRCSYNCSEL].)

## Filtering

- Options that begin with DCAEVT# with sync or DCAEVT# with async do not apply filtering to DC events. Qualified signals trigger DC events.
- Options that begin with DCEVTFILT sync apply filtering to DC events. Qualified signals pass through filtering circuits before triggering DC events. This filtering is not configurable in the ePWM block. For more information, refer to the “Event Filtering” section of the *TMS320x2802x, 2803x Piccolo Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*, Literature Number: SPRUGE9.

## Synchronizing

- Options that end with async trigger DC events asynchronously. When the qualified or filtered signals exist, the DC submodule triggers the DC event immediately.

- Options that end with sync trigger DC events synchronously. Once the qualified or filtered signals exist, the DC submodule triggers the DC event in sync with the TBCLK signal.

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**Note** The following fields appear when you select DCEVTFILT with sync or DCEVTFILT with async for the **DCAEVTX source select** or **DCBEVTX source select**.

For more details about the following parameters, refer to the sections: *TMS320x2806x Piccolo processor: 3.2.9.3.2 (Event Filtering) and Table 56 of Technical Reference Manual (SPRUH18C)*. *TMS320x2802x/03x Piccolo processors : 2.9.3.2 (Event Filtering) and Table 56 of Enhanced Pulse Width Modulator (ePWM) Module Reference Guide (SPRUGE9E) for TMS320x2802x and TMS320x2803x Piccolo processors*.

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### **Pulse select**

The blanking window which filters out event occurrences on the signal while active, is aligned to either a CTR = PRD pulse or a CTR = 0 pulse.

### **Blanking window inverted**

The option that allows you to Enable or Disable the Inverted Blanking window.

### **Blanking window offset**

The number of TBCLK cycles required from the blanking window reference to the point when the blanking window is applied.

### **Blanking window width**

The duration of the blanking window in terms of TBCLK.

### **Filter source select**

The option that allows you to select a source for Filtering.

The available options are:

- Filtered version of DCAEVT1 (DCAEVT1FILT)
- Filtered version of DCAEVT2 (DCAEVT2FILT)
- Filtered version of DCBEVT1 (DCBEVT1FILT)
- Filtered version of DCBEVT2 (DCBEVT2FILT)

### **Enable counter capture**

The option that allows you to Enable or Disable the time-base counter capture.

## **References**

For more information, consult the following references, available at the Texas Instruments Web site:

- *TMS320x28xx, 28xxx Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*, literature number SPRU791
- *TMS320x280x, 2801x, 2804x High Resolution Pulse Width Modulator Reference Guide*, literature number SPRU924E
- *TMS320x2802x, 2803x Piccolo Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*, literature number SPRUGE9
- *TMS320x2802x, 2803x Piccolo High Resolution Pulse Width Modulator (HRPWM) Reference Guide*, literature number SPRUGE8
- *Using the ePWM Module for 0% - 100% Duty Cycle Control Application Report*, literature number SPRU791
- *Configuring Source of Multiple ePWM Trip-Zone Events*, literature number SPRAAR4
- *TMS320F2809, TMS320F2808, TMS320F2806 TMS320F2802, TMS320F2801 TMS320C2802, TMS320C2801, and TMS320F2801x DSPs Data Manual*, literature number SPRS230
- *TMS320F28044 Digital Signal Processor Data Manual*, literature number SPRS357

- *TMS320F28335/28334/28332 TMS320F28235/28234/28232 Digital Signal Controllers (DSCs) Data Manual*, literature number SPRS439

## See Also

“CAN-Based Control of PWM Duty Cycle”

“SPI-Based Control of PWM Duty Cycle”

“ADC-PWM Synchronization via ADC Interrupt”

C280x/C28x3x ADC

“ePWM” on page 3-280

# C28x eQEP

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## Purpose

Quadrature encoder pulse circuit

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

## Description

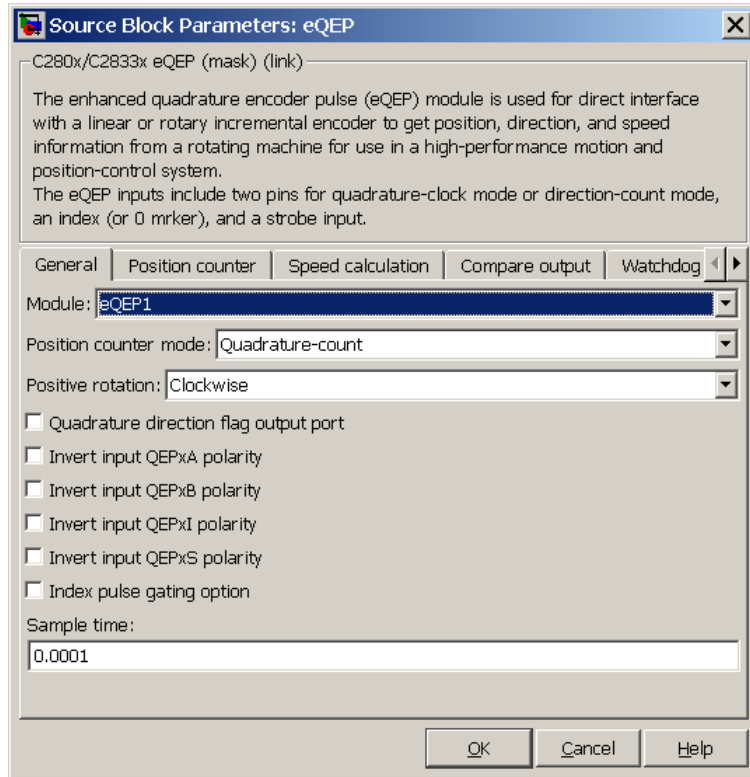


The enhanced quadrature encoder pulse (eQEP) module is used for direct interface with a linear or rotary incremental encoder to get position, direction, and speed information from a rotating machine for use in motion and position-control systems.



## Dialog Box

### General Pane



### Module

If more than one eQEP module is available on your processor, select the module this block configures.

### Position counter mode

The input signals QEPxA and QEPxB are processed by the Quadrature Decoder Unit (QDU) to produce clock (QCLK) and direction (QDIR) signals. Choose the position counter mode that matches the way the input to the eQEP module is encoded.

Choices are Quadrature-count (the default), Direction-count, Up-count, and Down-count.

### **Positive rotation**

This field appears only when you choose Quadrature-count in **Position counter mode**. Choose the direction that represents positive rotation: Clockwise (the default) or Counterclockwise.

### **External clock rate**

This field appears only when you choose Direction-count, Up-count, or Down-count in **Position counter mode**. In these cases, you can program clock generation to the position counter to occur on both rising and falling edges of the QEPA input or on the rising edge only. Choosing the former increases the measurement resolution by a factor of 2. Choices are **2x resolution: Count the rising/falling edge** (the default) or **1x resolution: Count the rising edge only**.

### **Quadrature direction flag output port**

This check box appears only when you choose Quadrature-count in **Position counter mode**. Select this check box if you want to create a port on the block that gives access to the direction flag of the quadrature module.

### **Invert input QEPxA polarity**

### **Invert input QEPxB polarity**

### **Invert input QEPxI polarity**

### **Invert input QEPxS polarity**

Select these check boxes to invert the polarity of the respective eQEP input signal.

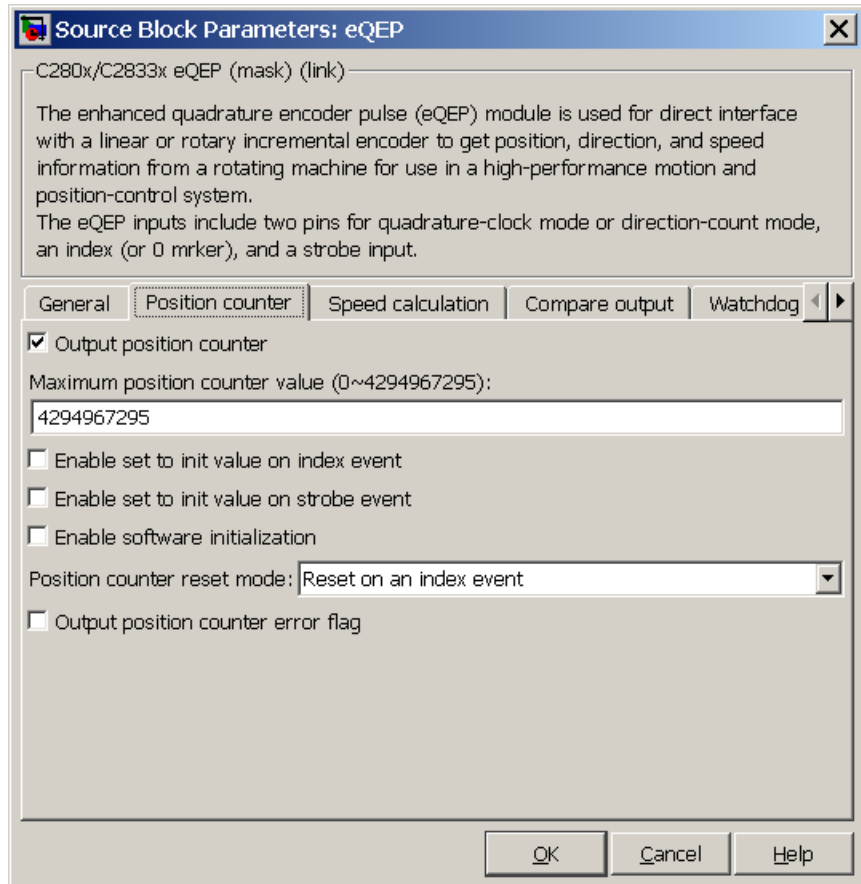
### **Index pulse gating option**

Select this check box to enable gating of the index pulse.

### **Sample time**

Enter the sample time in seconds.

## Position Counter Pane



### Output position counter

This check box is selected by default. Leave it selected to output the position counter signal PCSOUT from the position counter and control unit (PCCU).

## **Maximum position counter value**

Enter a maximum value for the position counter. Enter a value from 0 to 4294967295. The value defaults to the maximum allowed value of 4294967295.

## **Enable set to init value on index event**

Select to set the position counter to its initialization value on an index event. This check box is cleared by default.

## **Set to init value on index event**

This field appears only when **Enable set to init value on index event** is selected. Choose to set the position counter to its initialization value on the **Rising edge** (the default) or the **Falling edge** of the index input.

## **Enable set to init value on strobe event**

Select to set the position counter to its initialization value on a strobe event. This check box is cleared by default.

## **Set to init value on strobe event**

This field appears only when **Enable set to init value on strobe event** is selected. **Rising edge**, the default option, sets the position counter to its initialization value on the rising edge of the strobe input. In the forward direction, **Depending on direction** sets the position counter to its initialization value on the rising edge of the strobe input. In the reverse direction, **Depending on direction** sets the position counter to its initialization value on the falling edge of the strobe input.

## **Enable software initialization**

Select to allow the position counter to be set to its initialization value via software. This check box is cleared by default.

## **Software initialization source**

This field appears only when **Enable software initialization** is selected. Choose **Set to init value at start up** (the default) or **Input port** to receive the control logic through the input port.

**Initialization value**

This field appears only when **Enable set to init value on index event**, **Enable set to init value on strobe event**, or **Enable software initialization** check box is selected. Enter the initialization value for the position counter. Enter a value from 0 to 4294967295. The value defaults to 2147483648.

**Position counter reset mode**

Choose a position counter reset mode, depending on the nature of the system the eQEP module is working with: Reset on an index event (the default), Reset on the maximum position, Reset on the first index event, or Reset on a time unit event.

**Output position counter error flag**

This check box appears only when **Position counter reset mode** is set to Reset on an index event. Select this check box to output the position counter error flag on error.

**Output latch position counter on index event**

This check box appears only when **Position counter reset mode** is set to Reset on the maximum position or Reset on the first index event. The eQEP index input can be configured to latch the position counter (QPOSCNT) into QPOSILAT on occurrence of a definite event on this pin. Select this check box to latch the position counter on each index event.

**Index event latch of position counter**

This field appears only when the **Output latch position counter on index event** check box is selected. Choose one of the following events to configure the eQEP position counter to latch on that event: Rising edge, Falling edge, or Software index marker via input port.

**Output latch position counter on strobe event**

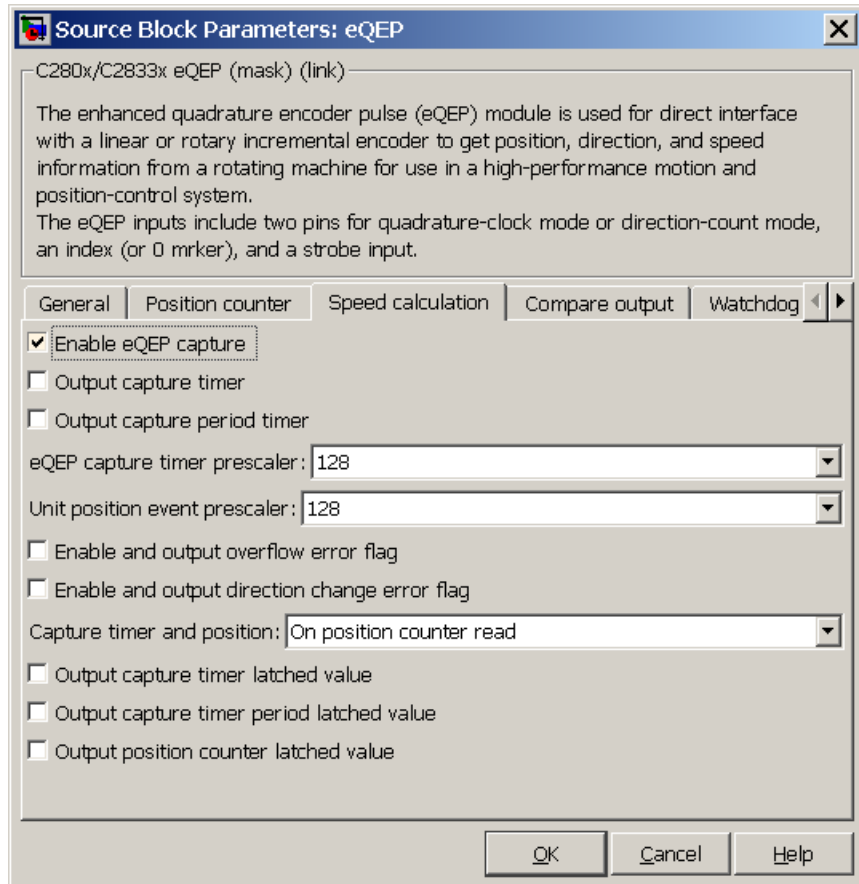
This check box appears only when **Position counter reset mode** is set to Reset on the maximum position or Reset on the first index event. The eQEP strobe input can be configured to latch the position counter (QPOSCNT) into QPOSSLAT on

occurrence of a definite event on this pin. Select this check box to latch the position counter on each strobe event.

**Strobe event of latched position counter**

This field appears only when the **Output latch position counter on strobe event** check box is selected. Choose **Rising edge** to latch on the rising edge of the strobe event input, or **Depending on direction** to latch on the rising edge in the forward direction and the falling edge in the reverse direction.

## Speed Calculation Pane



### Enable QEP capture

The eQEP peripheral includes an integrated edge capture unit to measure the elapsed time between the unit position events. Check this check box to enable the edge capture unit. This check box is cleared by default.

## **Output capture timer**

Select this check box to output the capture timer into the capture period register. This check box is cleared by default.

## **Output capture period timer**

Select this check box to output the capture period into the capture period register. This check box is cleared by default.

## **eQEP capture timer prescaler**

The eQEP capture timer runs from prescaled SYSCLKOUT. The capture timer period is the value of SYSCLKOUT divided by the value you choose in this field. Choices are 1, 2, 4, 8, 16, 32, 64, and 128 (the default).

## **Unit position event prescaler**

The timing of the unit position event is determined by prescaling the quadrature-clock (QCLK). QCLK is divided by the value you choose in this popup. Choices are 4, 8, 16, 32, 64, 128, 256, 512, 1024, and 2048 (the default).

## **Enable and output overflow error flag**

Select this check box to enable and output the eQEP overflow error flag in the event of capture timer overflow between unit position events.

## **Enable and output direction change error flag**

Select this check box to enable and output the direction change error flag.

## **Capture timer and position**

Choose the event that triggers the latching of the capture timer and capture period register: On position counter read (the default) or On unit time-out event.

## **Unit timer period**

This field appears only when you choose On unit time-out event in **Capture timer and position**. Enter a value for the unit timer period from 0 to 4294967295. The value defaults to 100000000.



**Output capture timer latched value**

Select this check box to output the capture timer latched value from the QCTMRLAT register.

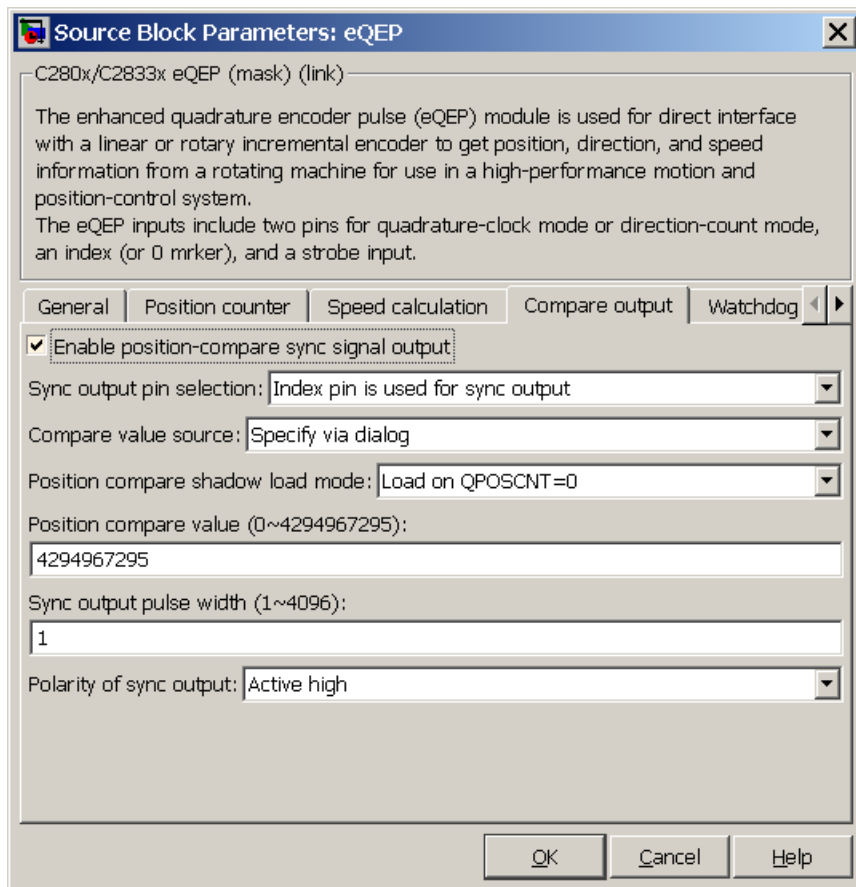
**Output capture timer period latched value**

Select this check box to output the capture timer period latched value from the QCPRDLAT register.

**Output position counter latched value**

Select this check box to output the position counter latched value from the QPOSLAT register.

## Compare Output Pane



### Enable position-compare sync signal output

The eQEP peripheral includes a position-compare unit that is used to generate the position-compare sync signal on compare match between the position counter register (QPOSCNT) and the position-compare register (QPOSCMP). Select this check box to

enable the position-compare sync signal output. This check box is cleared by default.

**Sync output pin selection**

Choose which pin is used for the sync signal output. Choices are Index pin is used for sync output (the default) and Strobe pin is used for sync output.

**Compare value source**

Choose the source of the value to use in the position comparison. Choose Specify via dialog (the default) to specify a fixed value or Input port to read the value from the input port.

**Position compare shadow load mode**

This field lets you enable or disable shadow mode for use in generating the position-compare sync signal (shadow mode is enabled by default). When shadow mode is enabled, you can also choose an event to trigger the loading of the shadow register value into the active register.

Choose Disable shadow mode to disable shadow mode. Choose Load on QPOSCNT=0 (the default) to load on the position-counter zero event. Choose Load on QPOSCNT=QPOSCMP to load on compare match.

**Position compare value**

This field appears only when you choose Specify via dialog in **Compare value source**. Enter a value from 0 to 4294967295. The value defaults to 4294967295. This value is loaded into the position-compare register (QPOSCMP).

**Sync output pulse width**

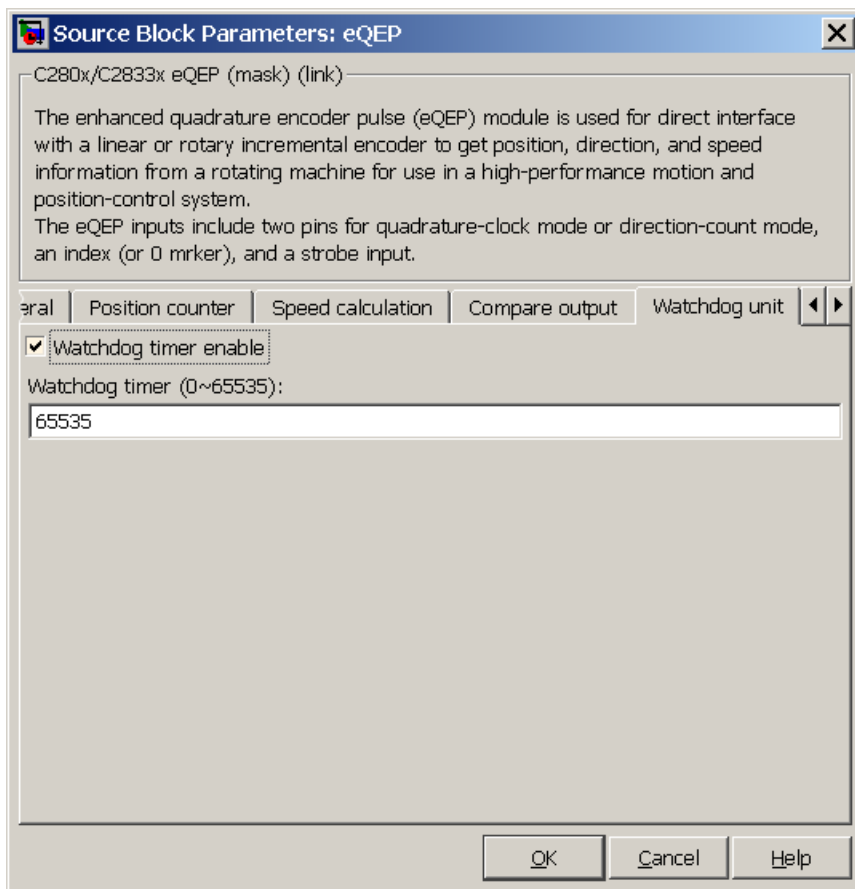
The pulse stretcher logic in the position-compare unit generates a programmable position-compare sync pulse output on the position-compare match.

Enter a value from 1 to 4096 to determine the pulse width of the position-compare sync output signal. The value defaults to 1.

## Polarity of sync output

Choose a value to determine the polarity of the sync output signal:  
Active high (the default) or Active low.

## Watchdog Unit Pane



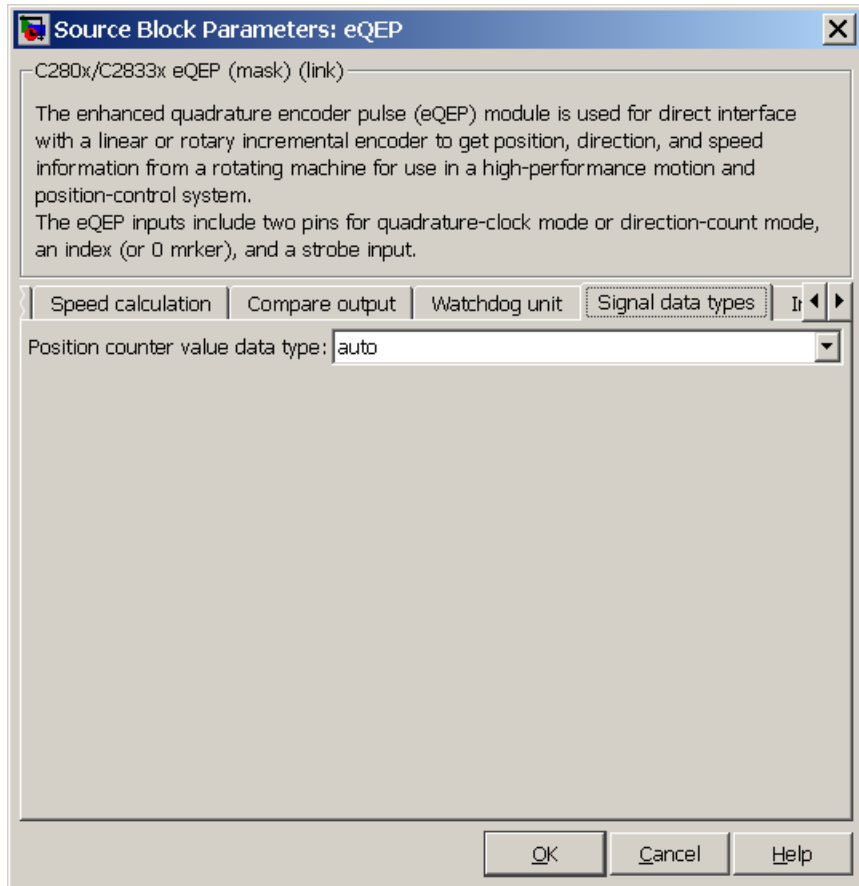
**Enable watchdog time out flag via output port**

The eQEP peripheral contains a watchdog timer that monitors the quadrature-clock to indicate that the motion-control system is operating. Select this check box to enable the watchdog time out flag.

**Watchdog timer**

Enter the time-out value for the watchdog timer. Enter a value from 0 to 65535 (the default).

## Signal Data Types Pane



The image above shows the default condition of the **Signal data types** pane. Choosing a number of options in other panes of the eQEP dialog box causes a corresponding popup to appear in the **Signal data types** pane.

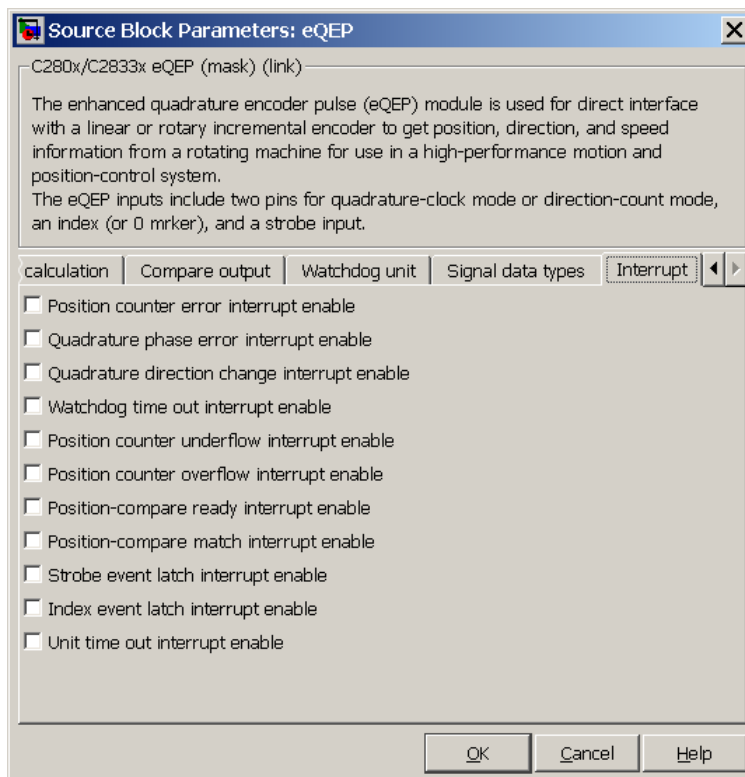
The following table summarizes the options for which you can set the data type in the **Signal data types** pane:

| Pane              | Option                                        |
|-------------------|-----------------------------------------------|
| General           | Quadrature direction flag output port         |
| Position counter  | Output position counter (selected by default) |
|                   | Output position counter error flag            |
|                   | Output latch position counter on index event  |
|                   | Output latch position counter on strobe event |
| Speed calculation | Output capture timer                          |
|                   | Output capture period timer                   |
|                   | Enable and output overflow error flag         |
|                   | Enable and output direction change error flag |
|                   | Output capture timer latched value            |
|                   | Output capture timer period latched value     |
|                   | Output position counter latched value         |
| Watchdog unit     | Enable watchdog time out flag via output port |

The fields that appear on the **Signal data types** pane are named similarly to these options. For example, **Position counter value data type** on the **Signal data types** pane corresponds to the **Output position counter** option on the **Position counter** pane.

For all data type fields, valid data types are auto, double, single, int8, uint8, int16, uint16, int32, uint32, and boolean.

## Interrupt Pane



The image above shows the default condition of the **Interrupt** pane. Interrupts corresponding to specific events are enabled or disabled based on the settings in this pane.

### Position counter error interrupt enable

Check this box to enable position counter error interrupts. This checkbox is cleared by default.



**Quadrature phase error interrupt enable**

Check this box to enable quadrature phase error interrupts. This checkbox is cleared by default.

**Quadrature direction change interrupt enable**

Check this box to enable quadrature direction change interrupts for changes in the counting direction. This checkbox is cleared by default.

**Watchdog timeout interrupt enable**

The eQEP Peripheral contains a watchdog timer that monitors the quadrature clock. Check this box to enable watchdog timeout interrupts. This checkbox is cleared by default.

**Position counter underflow interrupt enable**

Check this box to enable position counter underflow interrupts. This checkbox is cleared by default.

**Position counter overflow interrupt enable**

Check this box to enable position counter overflow interrupts. This checkbox is cleared by default.

**Position-compare ready interrupt enable**

Check this box to enable position-compare ready interrupts. This checkbox is cleared by default.

**Position-compare match interrupt enable**

Check this box to enable position-compare match interrupts. This checkbox is cleared by default.

**Strobe event latch interrupt enable**

Check this box to enable strobe event latch interrupts. This checkbox is cleared by default.

**Index event latch interrupt enable**

Check this box to enable index event latch interrupts. This checkbox is cleared by default.

**Unit timeout interrupt enable**

Check this box to enable unit timeout interrupts. This checkbox is cleared by default.

## References

For more information on the QEP module, consult the following documents, available at the Texas Instruments Web site:

- *TMS320x280x, 2801x, 2804x Enhanced Quadrature Encoder Pulse (eQEP) Module Reference Guide*, Literature Number SPRU790
- *Using the Enhanced Quadrature Encoder Pulse (eQEP) Module in TMS320x280x, 28xxx as a Dedicated Capture Application Report*, Literature Number SPRAAH1

## See Also

“eQEP” on page 3-295

# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2833x GPIO Digital Input

## Purpose

Configure general-purpose input pins

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

## Description



This block configures the general-purpose I/O (GPIO) MUX registers that control the operation of GPIO shared pins for digital input. Each I/O port has one MUX register that selects peripheral operation or digital I/O operation (the default). When a pin is configured for digital input, it becomes unavailable for digital output or peripheral operation. You can configure the **Input qualification type** for individual digital input pins. To do so, use the **Peripheral** tab of Coder Target -> Target Hardware Resources for your processor type.

Each processor has a different number of available GPIO pins:

- F280x, C2801x, F2802x, and F28044 has 35 GPIO pins

# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Input

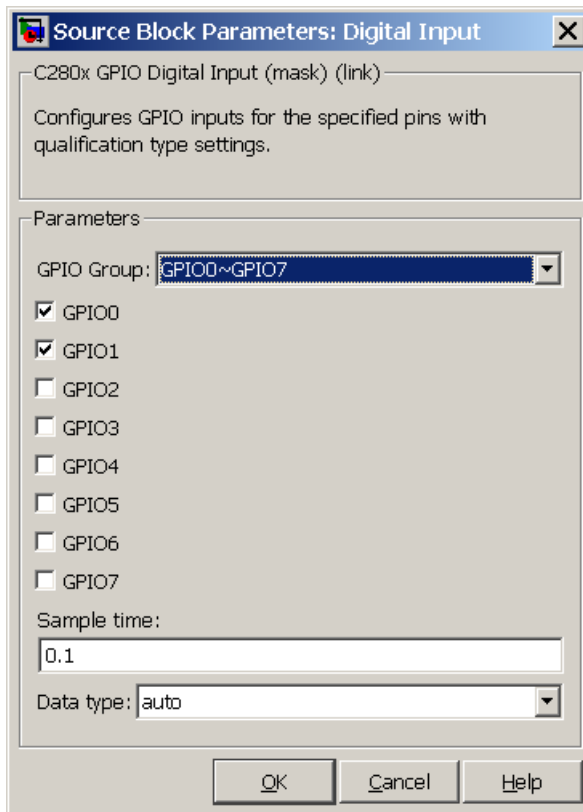
---

- F2802x has 22 GPIO pins, even though **GPIO group** lists 35
- F2803x has 45 GPIO pins
- F2806x has 59 GPIO pins
- F28x3x and F28x4x has 64 GPIO pins

---

**Note** To avoid losing new settings, click **Apply** before changing the **GPIO Group** parameter.

---



## Dialog Box

The dialog boxes for the C2802x and C28x3x processors are similar to that of the C280x, shown in the preceding figure.

### GPIO Group

Select the group of GPIO pins you want to view or configure. For a table of GPIO pins and peripherals, refer to the Texas Instruments documentation for your specific target.

### Sample time

Specify the time interval between output samples. To inherit sample time from the upstream block, set this parameter to -1.

# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Input

---

For more information, refer to the section on “Specify Sample Time” in the Simulink documentation.

## **Data type**

Specify the data type of the input. The input is read as 16-bit integer, and then cast to the selected data type. Valid data types are auto, double, single, int8, uint8, int16, uint16, int32, uint32 or boolean.

## **See Also**

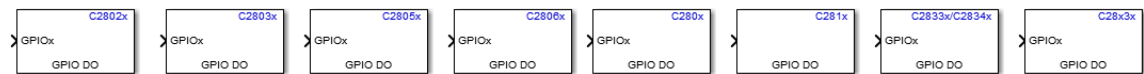
C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Output

“GPIO” on page 3-299

# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Output

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b> | Configure general-purpose input/output pins as digital outputs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Library</b> | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x |

## Description



Configure individual general-purpose input/output (GPIO) pins to operate as digital outputs. When a pin is configured for digital output, it cannot operate as a digital input or connect to peripheral I/O signals. When you select a pin for digital output, the user interface presents a **Toggle** option that inverts the output signal on the pin.

Each processor has a different number of available GPIO pins:

- C280x has 35 GPIO pins
- C2802x has 22 GPIO pins, even though **GPIO group** lists 35
- C2803x has 45 GPIO pins

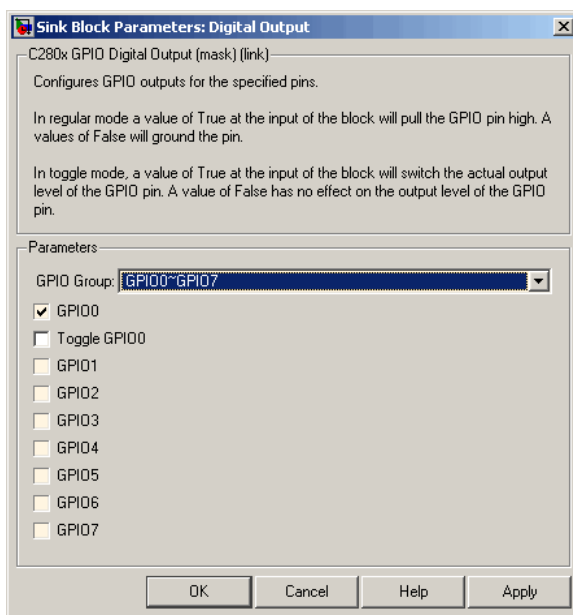
# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Output

- C28x3x has 64 GPIO pins

---

**Note** To avoid losing new settings, click **Apply** before changing the **GPIO Group** parameter.

---



## Dialog Box

The dialog boxes for the C2802x and C28x3x processors are similar to that of the C280x, shown in the preceding figure.

### GPIO Group

Select the group of GPIO pins you want to view or configure.

### GPIO pins for output

To configure a GPIO pin for digital output, select the checkbox next to it. Refer to the block for a table of all available peripherals for each pin.



# C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c283x GPIO Digital Output

---

A value of `True` at the input of the block drives the selected GPIO pin high. A value of `False` at the input of the block grounds the selected GPIO pin.

## **Toggle GPIO[bit#]**

For each pin selected for output, you can elect to toggle the signal of that pin. In **Toggle** mode, a value of `True` at the input of the block switches the GPIO pin output level. Thus, if the GPIO pin was driven high, in **Toggle** mode, with the value of `True` at the input, the pin output level is driven low. If the GPIO pin was driven low, in **Toggle** mode, with the value of `True` at the input of the block, the same pin output level is driven high. If the input of the block is `False`, the GPIO pin output level is unaffected.

---

**Note** The outputs of this block can be vectorized.

---

## **See Also**

C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Input

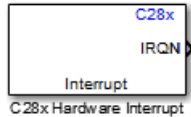
“GPIO” on page 3-299

# C28x Hardware Interrupt

---

**Purpose** Interrupt Service Routine to handle hardware interrupt on C28x processors

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Scheduling



## Description

Execution scheduling models based on timer interrupts do not meet the requirements of some real-time applications to respond to external events. The C28x Hardware Interrupt block addresses this problem by allowing asynchronous processing of interrupts triggered by events managed by other blocks in the C280x/C28x3x DSP Chip Support Library.

The following C28x blocks can generate an interrupt for asynchronous processing:

- ADC
- eCAN Receive
- SCI Receive
- SCI Transmit
- SPI Receive
- SPI Transmit

Only one Hardware Interrupt block can be used in a model. To handle multiple interrupts, place a Demux block at the output of the Hardware Interrupt block to direct function calls to the function-call subsystems.

### Vectorized Output

The output of this block is a function call. The size of the function call line equals the number of interrupts the block is set to handle. Each

interrupt is represented by four parameters shown on the dialog box of the block. These parameters are a set of four vectors of equal length. Each interrupt is represented by one element from each parameter (four elements total), one from the same position in each of these vectors.

Each interrupt is described by:

- CPU interrupt numbers
- PIE interrupt numbers
- Task priorities
- Preemption flags

So one interrupt is described by a CPU interrupt number, a PIE interrupt number, a task priority, and a preemption flag.

The CPU and PIE interrupt numbers together uniquely specify a single interrupt for a single peripheral or peripheral module.

The following table shows a super set of Peripheral Interrupts Expansion (PIE) matrices for c28x (except c281x) processors. Some peripheral interrupts may not be available on a particular device; refer to the corresponding literature listed below for an exact PIE representation of your processor. In the table, the row headers 1-12 represent the CPU values and the column headers 1-8 represent the PIE values.

The PIE tables for c28x processors except c281x are as follows. The first table has PIE values 5 through 8 and the second table 1 through 4.

| <b>PIE •</b> | <b>8</b>            | <b>7</b>        | <b>6</b>     | <b>5</b>    |
|--------------|---------------------|-----------------|--------------|-------------|
| <b>CPU •</b> |                     |                 |              |             |
| 1            | WAKEINT<br>(LPM/WD) | TINT0 (TIMER 0) | ADCINT (ADC) | XINT2       |
| 2            | EPWM8_TZINT         | EPWM7_TZINT     | EPWM6_TZINT  | EPWM5_TZINT |
| 3            | EPWM8_INT           | EPWM7_INT       | EPWM6_INT    | EPWM5_INT   |

# C28x Hardware Interrupt

| PIE • | 8                         | 7                         | 6                                          | 5                                          |
|-------|---------------------------|---------------------------|--------------------------------------------|--------------------------------------------|
| CPU • |                           |                           |                                            |                                            |
| 4     | HRCAP2_INT                | HRCAP1_INT                | ECAP6_INT                                  | ECAP5_INT                                  |
| 5     | Reserved                  | Reserved                  | Reserved                                   | HRCAP4_INT                                 |
| 6     | SPITXINTD<br>(SPI-D)      | SPIRXINTD<br>(SPI-D)      | SPITXINTC<br>(SPI-C) / MXINTA<br>(McBSP-A) | SPIRXINTC<br>(SPI-C) / MRINTA<br>(McBSP-A) |
| 7     | Reserved                  | Reserved                  | DINTCH6<br>(DMA6)                          | DINTCH5 (DMA5)                             |
| 8     | Reserved                  | Reserved                  | SCITXINTC<br>(SCI-C)                       | SCIRXINTC<br>(SCI-C)                       |
| 9     | ECAN1INTB<br>(CAN-B)      | ECAN0INTB<br>(CAN-B)      | ECAN1INTA<br>(CAN-A)                       | ECAN0INTA<br>(CAN-A)                       |
| 10    | ADCINT8 /<br>EPWM16_TZINT | ADCINT7 /<br>EPWM15_TZINT | ADCINT6 /<br>EPWM14_TZINT                  | ADCINT5 /<br>EPWM13_TZINT                  |
| 11    | CLA1_INT8 /<br>EPWM16_INT | CLA1_INT7 /<br>EPWM15_INT | CLA1_INT6 /<br>EPWM14_INT                  | CLA1_INT5 /<br>EPWM13_INT                  |
| 12    | LUF                       | LVF                       | Reserved                                   | XINT7                                      |

| PIE • | 4           | 3           | 2             | 1             |
|-------|-------------|-------------|---------------|---------------|
| CPU • |             |             |               |               |
| 1     | XINT1       | Reserved    | SEQ2INT (ADC) | SEQ1INT (ADC) |
| 2     | EPWM4_TZINT | EPWM3_TZINT | EPWM2_TZINT   | EPWM1_TZINT   |
| 3     | EPWM4_INT   | EPWM3_INT   | EPWM2_INT     | EPWM1_INT     |
| 4     | ECAP4_INT   | ECAP3_INT   | ECAP2_INT     | ECAP1_INT     |
| 5     | HRCAP3_INT  | Reserved    | EQEP2_INT     | EQEP1_INT     |

## C28x Hardware Interrupt

| PIE • | 4                                          | 3                                          | 2                         | 1                         |
|-------|--------------------------------------------|--------------------------------------------|---------------------------|---------------------------|
| CPU • |                                            |                                            |                           |                           |
| 6     | SPITXINTB<br>(SPI-B) / MXINTB<br>(McBSP-B) | SPIRXINTB<br>(SPI-B) / MRINTB<br>(McBSP-B) | SPITXINTA<br>(SPI-A)      | SPIRXINTA<br>(SPI-A)      |
| 7     | DINTCH4<br>(DMA4)                          | DINTCH3<br>(DMA3)                          | DINTCH2 (DMA2)            | DINTCH1<br>(DMA1)         |
| 8     | Reserved                                   | Reserved                                   | I2CINT2A                  | I2CINT1A                  |
| 9     | SCITXINTB<br>(SCI-B) /<br>LINA_INT1        | SCIRXINTB<br>(SCI-B) /<br>LINA_INT0        | SCITXINTA<br>(SCI-A)      | SCIRXINTA<br>(SCI-A)      |
| 10    | ADCINT4 /<br>EPWM12_TZINT                  | ADCINT3 /<br>EPWM11_TZINT                  | ADCINT2 /<br>EPWM10_TZINT | ADCINT1 /<br>EPWM9_TZINT  |
| 11    | CLA1_INT4 /<br>EPWM12_INT                  | CLA1_INT3 /<br>EPWM11_INT                  | CLA1_INT2 /<br>EPWM10_INT | CLA1_INT1 /<br>EPWM9_INT7 |
| 12    | XINT6                                      | XINT5                                      | XINT4                     | XINT3                     |

The PIE tables for c281x processor are as follows. The first table has PIE values 5 through 8 and the second table 1 through 4.

| PIE • | 8                   | 7               | 6              | 5              |
|-------|---------------------|-----------------|----------------|----------------|
| CPU • |                     |                 |                |                |
| 1     | WAKEINT<br>(LPM/WD) | TINT0 (TIMER 0) | ADCINT (ADC)   | XINT2          |
| 2     | Reserved            | T1OFINT (EV-A)  | T1UFINT (EV-A) | T1CINT (EV-A)  |
| 3     | Reserved            | CAPINT3 (EV-A)  | CAPINT2 (EV-A) | CAPINT1 (EV-A) |
| 4     | Reserved            | T3OFINT (EV-B)  | T3UFINT (EV-B) | T3CINT (EV-B)  |
| 5     | Reserved            | CAPINT6 (EV-B)  | CAPINT5 (EV-B) | CAPINT4 (EV-B) |
| 6     | Reserved            | Reserved        | MXINT (McBSP)  | MRINT (McBSP)  |

# C28x Hardware Interrupt

| <b>PIE •</b> | <b>8</b> | <b>7</b> | <b>6</b>       | <b>5</b>       |
|--------------|----------|----------|----------------|----------------|
| <b>CPU •</b> |          |          |                |                |
| 7            | Reserved | Reserved | Reserved       | Reserved       |
| 8            | Reserved | Reserved | Reserved       | Reserved       |
| 9            | Reserved | Reserved | ECAN1INT (CAN) | ECAN0INT (CAN) |
| 10           | Reserved | Reserved | Reserved       | Reserved       |
| 11           | Reserved | Reserved | Reserved       | Reserved       |
| 12           | Reserved | Reserved | Reserved       | Reserved       |

| <b>PIE •</b> | <b>4</b>          | <b>3</b>          | <b>2</b>          | <b>1</b>          |
|--------------|-------------------|-------------------|-------------------|-------------------|
| <b>CPU •</b> |                   |                   |                   |                   |
| 1            | XINT1             | Reserved          | PDPINTB (EV-B)    | PDPINTA (EV-A)    |
| 2            | T1PINT (EV-A)     | CMP3INT (EV-A)    | CMP2INT (EV-A)    | CMP1INT (EV-A)    |
| 3            | T2OFINT (EV-A)    | T2UFINT (EV-A)    | T2CINT (EV-A)     | T2PINT (EV-A)     |
| 4            | T3PINT (EV-B)     | CMP6INT (EV-B)    | CMP5INT (EV-B)    | CMP4INT (EV-B)    |
| 5            | T4OFINT (EV-B)    | T4UFINT (EV-B)    | T4CINT (EV-B)     | T4PINT (EV-B)     |
| 6            | Reserved          | Reserved          | SPITXINTA (SPI)   | SPIRXINTA (SPI)   |
| 7            | Reserved          | Reserved          | Reserved          | Reserved          |
| 8            | Reserved          | Reserved          | Reserved          | Reserved          |
| 9            | SCITXINTB (SCI-B) | SCIRXINTB (SCI-B) | SCITXINTA (SCI-A) | SCIRXINTA (SCI-A) |
| 10           | Reserved          | Reserved          | Reserved          | Reserved          |
| 11           | Reserved          | Reserved          | Reserved          | Reserved          |
| 12           | Reserved          | Reserved          | Reserved          | Reserved          |

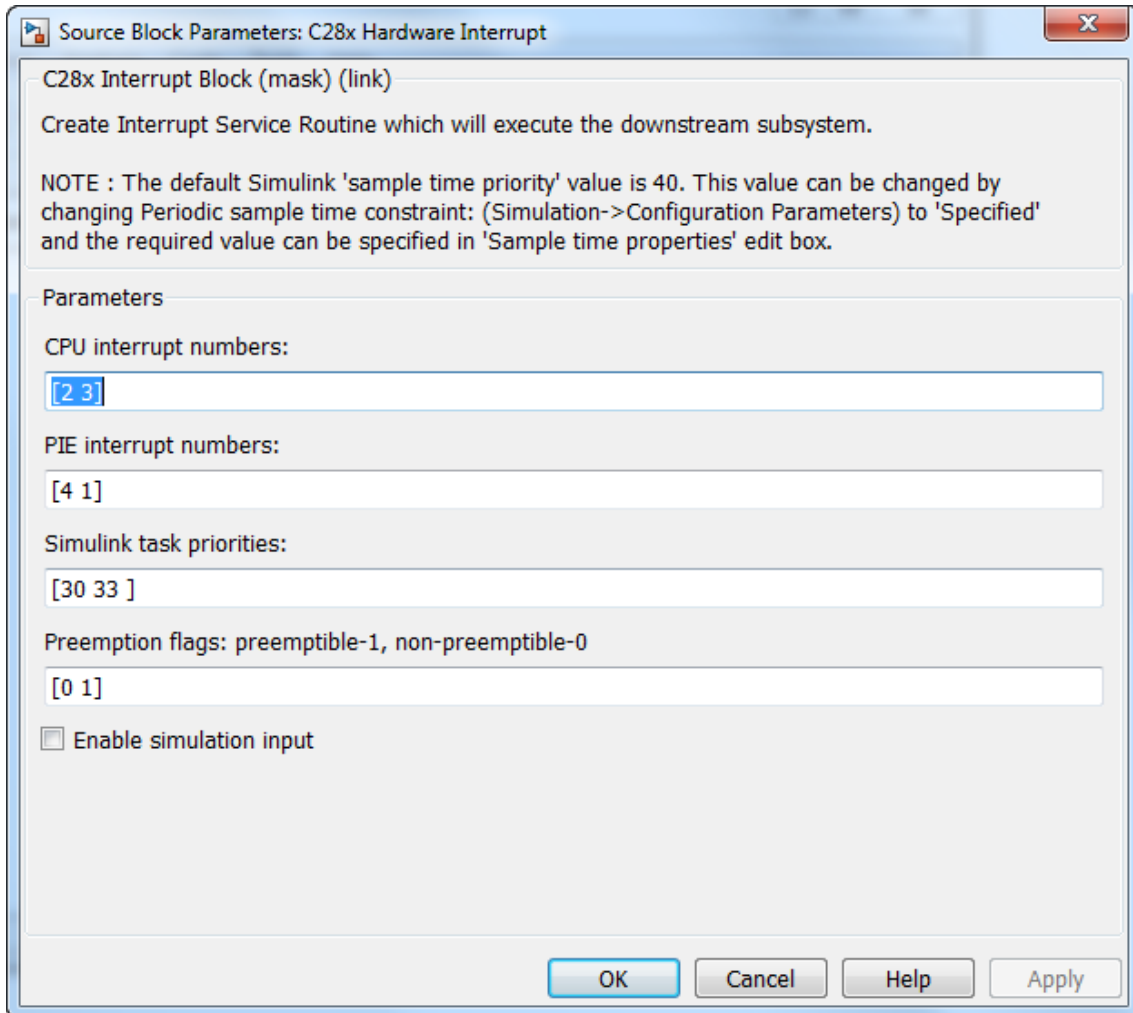
| <b>Processor</b> | <b>Literature Number at ti.com</b> |
|------------------|------------------------------------|
| 280x and 28044   | SPRU712                            |
| C2833x           | SPRUFB0                            |
| C2834x           | SPRUFN1                            |
| C2802x           | SPRUFN3                            |
| C2803x           | SPRUGL8                            |
| C2806x           | SPRUH18                            |

The task priority indicates the relative importance tasks associated with the asynchronous interrupts. If an interrupt triggers a higher-priority task while a lower-priority task is running, the execution of the lower-priority task will be suspended while the higher-priority task is executed. The lowest value represents the highest priority. The default priority value of the base rate task is 40, so the priority value for each asynchronously triggered task must be less than 40 for these tasks to suspend the base rate task.

The preemption flag determines whether a given interrupt is pre-emptable. Preemption overrides prioritization, such that a preemptable task of higher priority can be preempted by a non-preemptable task of lower priority.

# C28x Hardware Interrupt

## Dialog Box





## **CPU interrupt numbers**

Enter a vector of CPU interrupt numbers for the interrupts you want to process asynchronously.

## **PIE interrupt numbers**

Enter a vector of PIE interrupt numbers for the interrupts you want to process asynchronously.

## **Simulink task priorities**

Enter a vector of task priorities for the interrupts you want to process asynchronously.

See the discussion of this block's "Vectorized Output" on page 2-140 for an explanation of task priorities.

## **Preemption flags**

Enter a vector of preemption flags for the interrupts you want to process asynchronously.

See the discussion of this block's "Vectorized Output" on page 2-140 for an explanation of preemption flags.

## **Enable simulation input**

Select this check box if you want to be able to test asynchronous interrupt processing in the context of your Simulink software model.

---

**Note** Select this check box to enable you to test asynchronous interrupt processing behavior in Simulink software.

---

## **References**

Detailed information about interrupt processing is in *TMS320x280x DSP System Control and Interrupts Reference Guide*, Literature Number SPRU712B, available at the Texas Instruments Web site.

## **See Also**

The following links refer to topics that require the Embedded Coder software.

# C28x Hardware Interrupt

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“Asynchronous Scheduling”

C28x Software Interrupt Trigger, Idle Task

**Purpose** Configure inter-integrated circuit (I2C) module to receive data from I2C bus

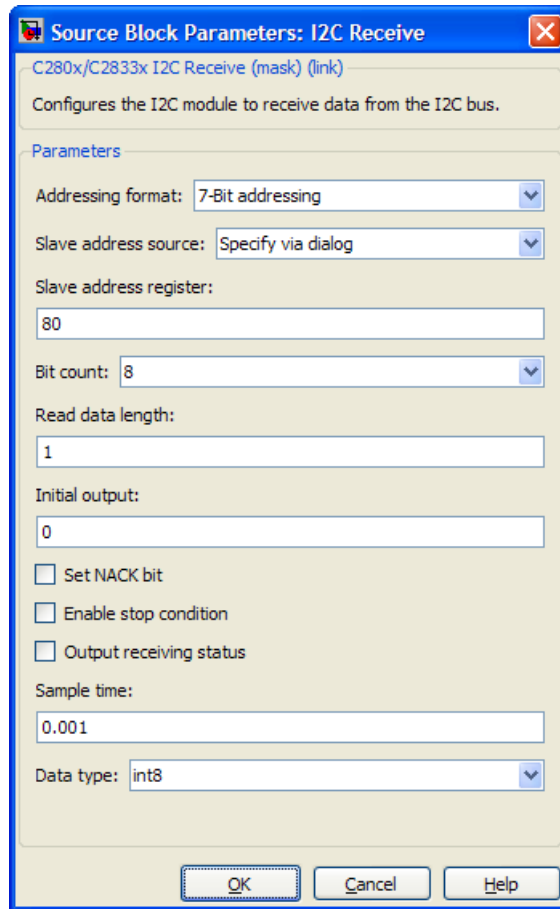
**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

**Description**



Configure the I2C module to receive data from the two-wire I2C serial bus.

# C28x I2C Receive



## Dialog Box

### Addressing format

The I2C receive block supports the **7–Bit addressing**, **10–Bit addressing**, and **Free data format**. The default setting is **7–Bit addressing**.

### Slave address source

Select the method for setting the slave address register of the I2C slave. Selecting **Specify via dialog** displays **Slave address**

**register** parameter. Selecting **Input port** enables definition of the address register via the input port. The default setting is **Specify via dialog**.

### **Slave address register**

When you select **Specify via dialog**, enter a value for the **Slave address register**. The default value is **80**. This field takes a decimal value.

### **Bit Count**

Set the bit count to 1 through 8. The default setting is **8**.

### **Read data length**

Set the length of the read data. The default value is **1**.

### **Initial output**

Set the value the I2C node outputs to the model before it has received data.

The default value is **0**.

### **NACK bit generation**

Select this parameter to generate a no-acknowledge bit (NACK) during the I2C acknowledge cycle and ignore new bits from the transmitting I2C node. The default setting is disabled (not selected).

### **Enable stop condition**

Enable the I2C Receive Block in master mode to send a STOP message to the I2C Transmit block while it is in slave mode. The default setting is disabled (not selected).

### **Output receiving status**

Selecting this parameter creates a status output that indicates when the I2C receive block is receiving a message. The default setting is disabled (not selected).

### **Sample time**

Set the sample time for the block's input sampling. To execute this block asynchronously, set **Sample Time** to **-1**, and refer

# C28x I2C Receive

---

to Asynchronous Interrupt Processing for a discussion of block placement and other settings. The default value is **0.001**.

## Data type

Type of data in the data vector. The length of the vector for the received message is at most 8 bytes. If the message is less than 8 bytes, the data buffer bytes are right-aligned in the output. You can set this parameter to `int8`, `uint8`, `int16`, `uint16`, `int32`, or `uint32`. The default setting is **int8**.

## References

For detailed information on the I2C module, see:

- The *TMS320x28xx, 28xxx Inter-Integrated Circuit (I2C) Module Reference Guide*, Literature Number SPRU721, available at the Texas Instruments Web site, [www.ti.com](http://www.ti.com).
- The *Philips Semiconductors Inter-IC bus (I2C-bus) specification* is available on the Philips Semiconductors Web site at [http://www.nxp.com/documents/other/UM10204\\_v5.pdf](http://www.nxp.com/documents/other/UM10204_v5.pdf).

## See Also

“Using the I2C Bus to Access a Connected EEPROM”

C28x I2C Transmit

“I2C” on page 3-282

## Purpose

Configure inter-integrated circuit (I2C) module to transmit data to I2C bus

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

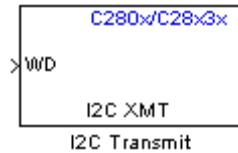
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x



## Description

Configure the I2C module to transmit data to the two-wire I2C serial bus.

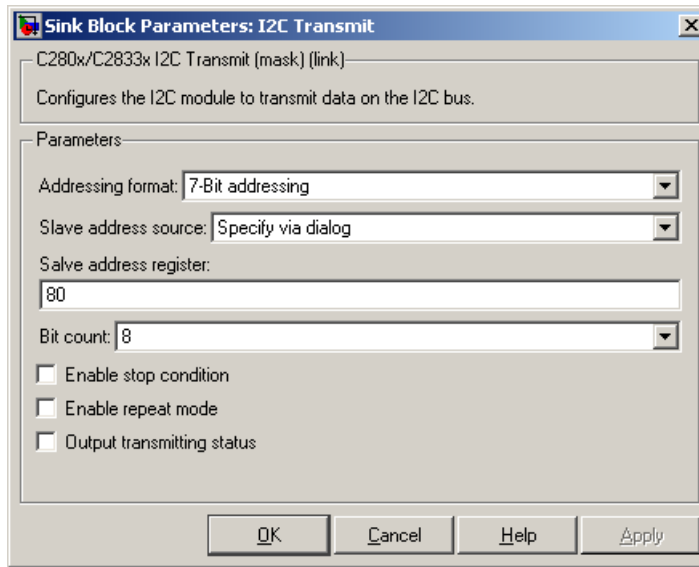
---

**Note** You can use this block to configure the I2C settings under the Peripherals tab of the Coder Target > Target Hardware Resources for the F2808 eZdsp, and F28335 eZdsp boards.

---

# C28x I2C Transmit

## Dialog Box



### Addressing format

The I2C transmit block supports the **7–Bit addressing**, **10–Bit addressing**, and **Free data format**. The default setting is **7–Bit addressing**.

### Slave address source

Select the method for setting the slave address register of the I2C slave. Selecting **Specify via dialog** displays **Slave address register** parameter. Selecting **Input port** enables definition of the address register via the input port. The default setting is **Specify via dialog**.

### Slave address register

When you select **Specify via dialog**, enter a value for the **Slave address register**. The default value is **80**.

### Bit Count

Set the bit count to 1 through 8. The default setting is **8**.



## **Enable stop condition**

Selecting this parameter enables the transmitter to accept a STOP condition from the C28x I2C Receive block. The default setting is disabled (not selected).

## **Enable repeat mode**

When you enable repeat mode, the I2C module retransmits the same data until it detects a stop or start condition. If you use this mode, also consider selecting **Enable stop condition**.

If you disable repeat mode, the I2C module operates in standard mode, sending a specific number of data values once.

The default setting is disabled (not selected).

## **Output transmitting status**

Selecting this parameter creates a status output that indicates when the I2C transmit block is transmitting a message. The default setting is disabled (not selected).

## **References**

For detailed information on the I2C module, see:

- The *TMS320x28xx, 28xxx Inter-Integrated Circuit (I2C) Module Reference Guide*, Literature Number SPRU721, available at the Texas Instruments Web site, [www.ti.com](http://www.ti.com).
- The *Philips Semiconductors Inter-IC bus (I2C-bus) specification version 2.1* is available on the Philips Semiconductors Web site.

## **See Also**

“Using the I2C Bus to Access a Connected EEPROM”

C28x I2C Receive

“I2C” on page 3-282

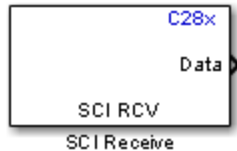
# C28x SCI Receive

---

**Purpose** Receive data on target via serial communications interface (SCI) from host

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

## Description



The SCI Receive block supports asynchronous serial digital communications between the target and other asynchronous peripherals. This block receives scalar or vector data using the specified SCI hardware module.

---

**Note** A model can only contain one SCI Receive block per module. There are a maximum of 3 SCI modules on the c28x processor, A, B, and C, which can be configured through **Code Generation-> Coder Target-> Target Hardware Resources-> Peripherals**. Verify that these settings meet the requirements of your application.

---

# C28x SCI Receive

## Dialog Box

Source Block Parameters: SCI Receive

C28x SCI Receive (mask) (link)

Configures Serial Communication Interface (SCI) of the C2000 MCUs to receive data from SCIRXD pin. This enables asynchronous serial digital communications between the MCU and other connected peripherals.

Parameters

SCI module: A

Additional package header: 'S'

Additional package terminator: 'E'

Data type: uint8

Data length: 1

Initial output: 0

Action taken when connection times out: Output the last received value

Sample time: 0.1

Output receiving status

Enable receive FIFO interrupt

Receive FIFO interrupt level (maximum 4 for Piccolo devices): 1

OK Cancel Help Apply

## SCI module

SCI module to be used for communications.

## Additional package header

This field specifies the data located at the front of the received data package, which is not part of the data being received, and generally indicates start of data. The additional package header must be an ASCII value. You can use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not received nor are they included in the total byte count. To specify a null value (no package header), enter two single quotes alone.

---

**Note** Match additional package headers or terminators with those specified in the host SCI Transmit block.

---

## Additional package terminator

This field specifies the data located at the end of the received data package, which is not part of the data being received, and generally indicates end of data. The additional package terminator must be an ASCII value. Use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not received nor are they included in the total byte count. To specify a null value (no package terminator), enter two single quotes alone.

## Data type

Data type of the output data. Available options are `single`, `int8`, `uint8`, `int16`, `uint16`, `int32`, or `uint32`.

## Data length

How many of **Data type** the block will receive (not bytes). Anything more than 1 is a vector. The data length is inherited from the input (the data length originally input to the host-side SCI Transmit block).

## Initial output

Default value from the SCI Receive block. This value is used, for example, if a connection time-out occurs and the **Action taken when connection timeout** field is set to “Output the last received value”, but nothing yet has been received.

## Action taken when connection times out

Specify what to output if a connection time-out occurs. If **Output the last received value** is selected, the block outputs the last received value. If a value has not been received, the block outputs the **Initial output** value.

If you select **Output custom value**, use the **Output value when connection times out** field to set the custom value.

## Sample time

Sample time,  $T_s$ , for the block’s input sampling. To execute this block asynchronously, set **Sample Time** to -1, and refer to “Asynchronous Scheduling” for a discussion of block placement and other settings.

## Output receiving status

Selecting this checkbox creates a **Status** block output that provides the status of the transaction.

The error status may be one of the following values:

- 0: No errors
- 1: A time-out occurred while the block was waiting to receive data
- 2: There is an error in the received data (checksum error)
- 3: SCI parity error flag — Occurs when a character is received with a mismatch
- 4: SCI framing error flag — Occurs when an expected stop bit is not found

## **Enable receive FIFO interrupt**

If this option is selected, an interrupt is posted when FIFO is full, allowing the subsystem to take some sort of action (for example, read data as soon as it is received). If this option is cleared, the block stays in polling mode. If the block is in polling mode and not blocking, it checks the FIFO for data. If data is present, the block reads and outputs the data. If data is not present, the block continues. If the block is in polling mode and blocking, it waits until data is available to read (after data length is reached).

## **Receive FIFO interrupt level (maximum 4 for Piccolo devices)**

This parameter is enabled when the **Enable receive FIFO interrupt** option is selected. Select an interrupt level from 0 to 16. The default level is 0.

## **References**

For detailed information on the SCI module, see *TMS320x281x, 280x DSP Serial Communication Interface (SCI) Reference Guide*, Literature Number SPRU051B, available at the Texas Instruments Web site.

## **See Also**

“HIL Verification of IIR Filter via SCI”

C28x SCI Transmit, C28x Hardware Interrupt

“SCI\_A, SCI\_B, SCI\_C” on page 3-289

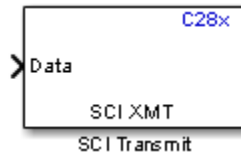
# C28x SCI Transmit

---

**Purpose** Transmit data from target via serial communications interface (SCI) to host

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x  
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

## Description



The SCI Transmit block transmits scalar or vector data using the specified SCI hardware module. The sampling rate and data type are inherited from the input port. The data type of the input port must be one of the following: single, int8, uint8, int16, uint16, int32, uint32. If the data type is not specified, the default data type is uint8.



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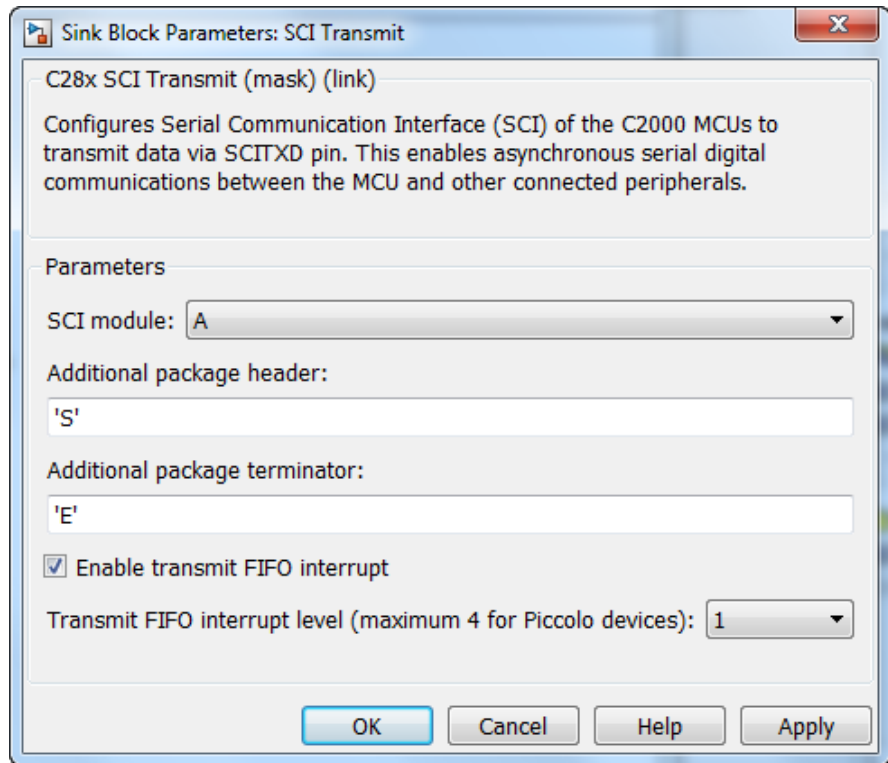
**Note** A model can only contain one SCI Transmit block per module. There are a maximum of 3 SCI modules on the c28x processor, A, B and C, which can be configured through **Code Generation-> Coder Target-> Target Hardware Resources -> Peripherals**.

Verify that these settings meet the requirements of your application.

Fixed-point inputs are not supported for this block but you can use a Data Type Conversion block with "Stored Integer" to pass the native data type of your fixed-point format.

---

# C28x SCI Transmit



## Dialog Box

### SCI module

SCI module to be used for communications.

### Additional package header

This field specifies the data located at the front of the sent data package, which is not part of the data being transmitted, and generally indicates start of data. The additional package header must be an ASCII value. Use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not sent nor are they included in the total byte count. To specify a null value (no package header), enter two single quotes alone.

---

**Note** Match additional package headers or terminators with those specified in the host SCI Receive block.

---

### **Additional package terminator**

This field specifies the data located at the end of the sent data package, which is not part of the data being transmitted, and generally indicates end of data. The additional package terminator must be an ASCII value. Use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not sent nor are they included in the total byte count. To specify a null value (no package terminator), enter two single quotes alone.

### **Enable transmit FIFO interrupt**

If checked, an interrupt is posted when FIFO is full, allowing the subsystem to take some sort of action.

### **Transmit FIFO interrupt level (maximum 4 for Piccolo devices)**

This parameter is enabled when the **Enable transmit FIFO interrupt** option is selected. Select an interrupt level from 0 to 16. The default level is 0.

## **References**

For detailed information on the SCI module, see *TMS320x281x, 280x DSP Serial Communication Interface (SCI) Reference Guide*, Literature Number SPRU051B, available at the Texas Instruments Web site.

## **See Also**

“HIL Verification of IIR Filter via SCI”

C28x SCI Receive

C28x Hardware Interrupt

“SCI\_A, SCI\_B, SCI\_C” on page 3-289

# C28x Software Interrupt Trigger

---

## Purpose

Generate software triggered nonmaskable interrupt

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

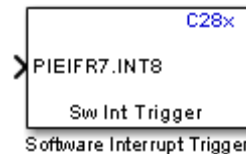
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

## Description



When you add this block to a model, the block polls the input port for the input value. When the input value is greater than the value in **Trigger software interrupt when input value is greater than**, the block posts the interrupt to a Hardware Interrupt block in the model.

To use this block, add a Hardware Interrupt block to your model to process the software triggered interrupt from this block into an interrupt service routine on the processor. Set the interrupt number

in the Hardware Interrupt block to the value you set here in **CPU interrupt number**.

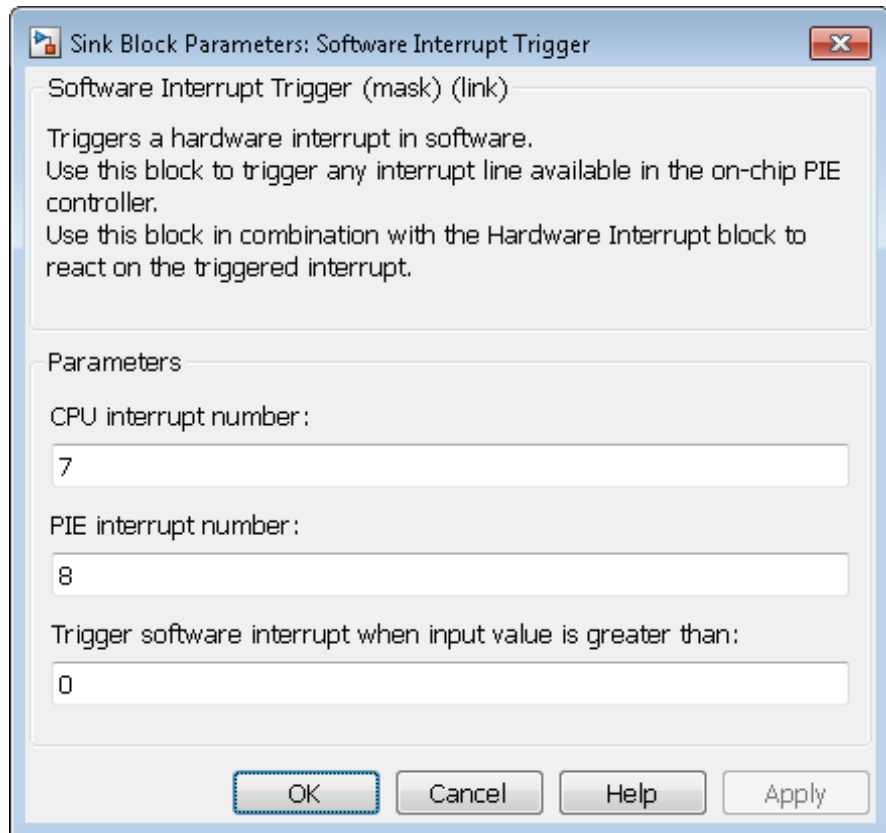
The CPU and PIE interrupt numbers together specify a single interrupt for a single peripheral or peripheral module. The following table maps CPU and PIE interrupt numbers to these peripheral interrupts. The row numbers are CPU values and the column numbers are the PIE values.

---

**Note** Fixed-point inputs are not supported for this block.

---

# C28x Software Interrupt Trigger



## Dialog Box

### **CPU interrupt number**

Specify the interrupt to which the block responds. Interrupt numbers are integers ranging from 1 to 12.

### **PIE interrupt number**

Enter an integer value from 1 to 8 to set the Peripheral Interrupt Expansion (PIE) interrupt number.

# C28x Software Interrupt Trigger

---

**Trigger software interrupt when input value is greater than:**

Sets the value above which the block posts an interrupt. Enter the value for the level that indicates that the interrupt is asserted by a requesting routine.

**References**

For detailed information about interrupt processing, see *TMS320x280x DSP System Control and Interrupts Reference Guide*, SPRU712B, available at the Texas Instruments Web site.

**See Also**

C28x Hardware Interrupt

# C28x SPI Receive

---

## Purpose

Receive data via serial peripheral interface (SPI) on target

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

## Description



The SPI Receive block supports synchronous, serial peripheral input/output port communications between the Board controller and external peripherals or other controllers. The block can run in either slave or master mode.

In master mode, the SPISIMO pin transmits data and the SPISOMI pin receives data. When master mode is selected, the SPI initiates the data transfer by sending a serial clock signal (SPICLK), which is used for the entire serial communications link. Data transfers are synchronized to



this SPICLK, which enables both master and slave to send and receive data simultaneously. The maximum for the clock is one quarter of the DSP controller's clock frequency.

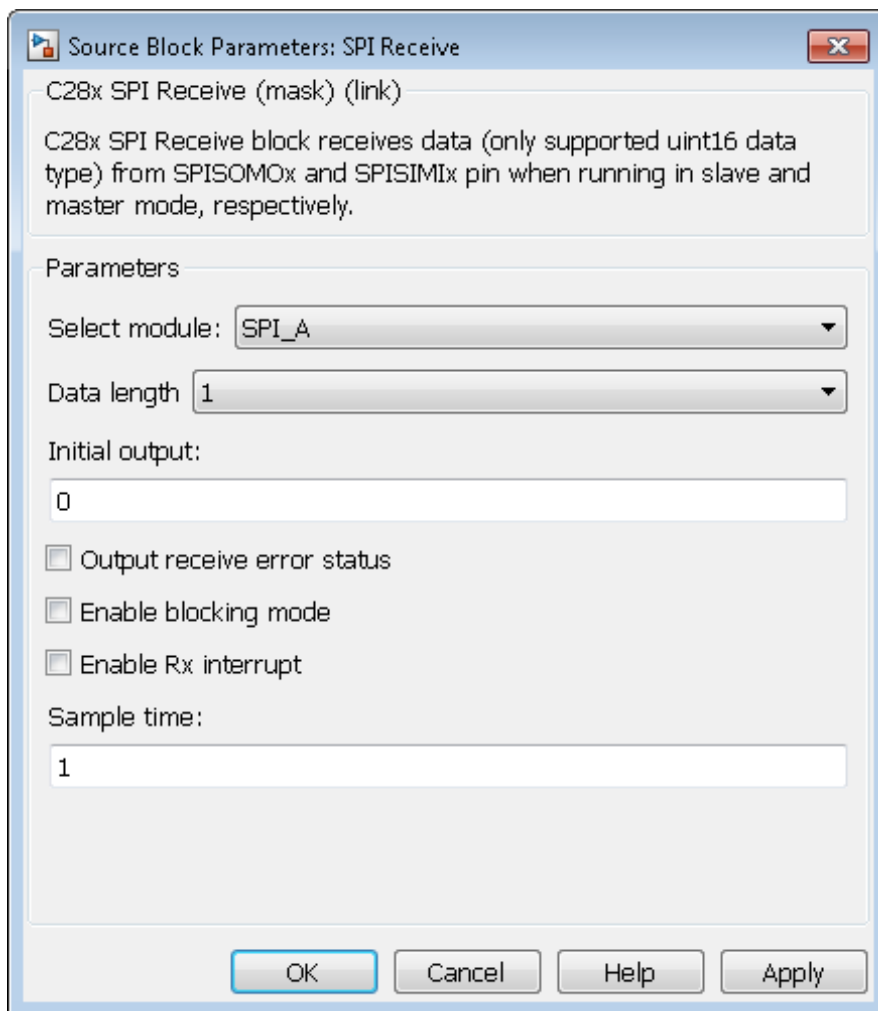
A model can only contain one SPI Receive block per module. There are two modules, A and B, which can be configured through Coder Target -> Target Hardware Resources.

---

**Note** Many SPI-specific settings are in the **Board** section of Coder Target -> Target Hardware Resources. Verify that these settings meet the requirements of your application.

---

## C28x SPI Receive



### Dialog Box

#### Select module

Select the SPI module to be used for communications. Each processor has a different number of modules.

**Data length**

Specify how many uint16s are expected to be received. Select 1 through 16.

**Initial output**

Set the value the SPI node outputs to the model before it has received data.

The default value is 0.

**Enable blocking mode**

If this option is selected, system waits until data is received before continuing processing.

**Output receive error status**

Selecting this checkbox creates a **Status** block output that provides the status of the transaction.

Error status may be one of the following values:

- 0: No errors
- 1: Data loss occurred, (Overrun: when FIFO disabled, Overflow when FIFO enabled)
- 2: Data not ready, a time out occurred while the block was waiting to receive data

**Post interrupt when data is received**

Check this check box to post an asynchronous interrupt when data is received.

**Sample time**

Sample time,  $T_s$ , for the block's input sampling. To execute this block asynchronously, set **Sample Time** to -1, check the **Post interrupt when message is received** box, and refer to "" for a discussion of block placement and other settings.

**See Also**

“SPI-Based Control of PWM Duty Cycle”

C28x SPI Transmit

## C28x SPI Receive

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C28x Hardware Interrupt

“SPI\_A, SPI\_B, SPI\_C, SPI\_D” on page 3-292

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Purpose</b> | Transmit data via serial peripheral interface (SPI) to host                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Library</b> | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x<br>Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x |

## Description



The SPI Transmit supports synchronous, serial peripheral input/output port communications between the Board controller and external peripherals or other controllers. The block can run in either slave or master mode. In master mode, the SPISIMO pin transmits data and the SPISOMI pin receives data. When master mode is selected, the SPI initiates the data transfer by sending a serial clock signal (SPICLK), which is used for the entire serial communications link. Data transfers are synchronized to this SPICLK, which enables both master and slave

## C28x SPI Transmit

---

to send and receive data simultaneously. The maximum for the clock is one quarter of the Board controller's clock frequency.

The sampling rate is inherited from the input port. The supported data type is `uint16`.

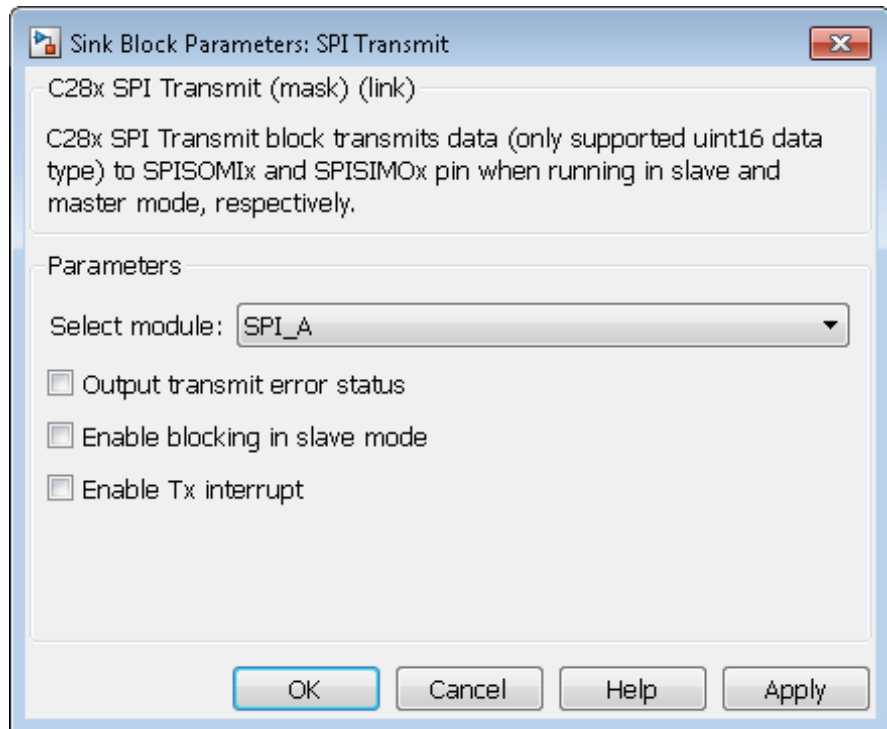
---

**Note** A model can only contain one SPI Transmit block per module. There are two modules, A and B, which can be configured through Coder Target -> Target Hardware Resources.

Many SPI-specific settings are in the **Board** section of Coder Target -> Target Hardware Resources. Verify that these settings meet the requirements of your application.

---

## Dialog Box



### Select module

Select the SPI module to be used for communications. Each processor has a different number of modules.

### Output transmit error status

Selecting this check box creates a **Status** block output that provides the status of the transaction.

Error status may be one of the following values:

- 0: No errors
- 1: A time-out occurred while the block was transmitting data

## C28x SPI Transmit

---

- 2: There is an error in the transmitted data (for example, header or terminator don't match, length of data expected is too big or too small)

### **Enable blocking mode**

If this option is selected, system waits until data is sent before continuing processing.

### **Post interrupt when data is transmitted**

Check this check box to post an asynchronous interrupt when data is transmitted.

### **See Also**

“SPI-Based Control of PWM Duty Cycle”

C28x SPI Receive

C28x Hardware Interrupt

“SPI\_A, SPI\_B, SPI\_C, SPI\_D” on page 3-292



**Purpose**

Compare two input voltages on comparator pins

**Library**

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

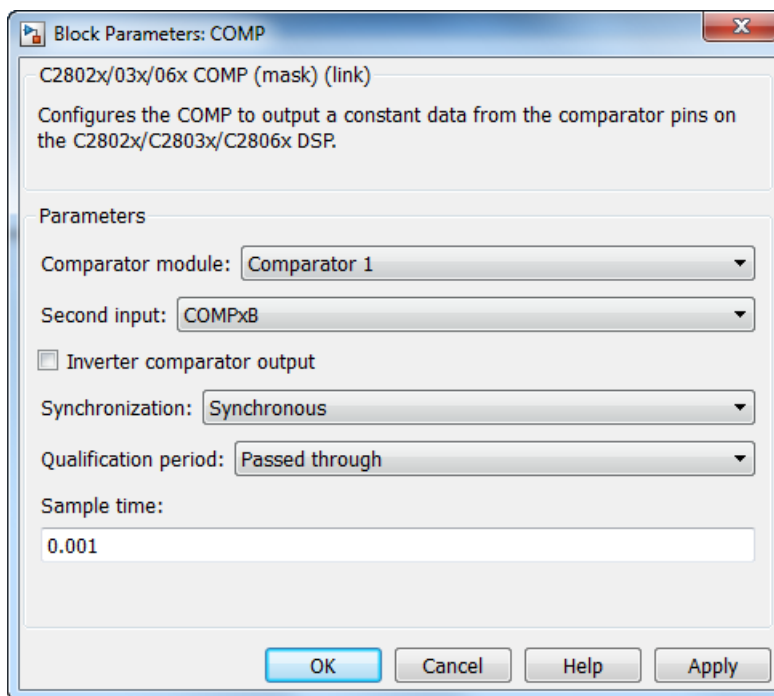
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

**Description**

Configures the COMP to output a constant data from the comparator pins on the DSP.

# C2802x/C2803x/C2806x COMP



## Dialog Box

### Comparator module

Select the comparator module to which the block configures. Use only one block per module.

### Second input

Select COMPxB to compare the voltage of **Input Pin A** with **Input Pin B**

Select Internal DAC to compare the voltage of **Input Pin A** with the output of a DAC reference located in the comparator. For more information, see the “DAC Reference” section of the *TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator*.

The comparator source outputs 1, if **Input Pin A** has a value greater than **Input Pin B** or the 10-bit DAC reference. Otherwise, it outputs 0.

### **Inverter comparator output**

Select this check box to apply a logical NOT to the output of the comparator source. For example, when the comparator source outputs 1, the inverter circuit changes it to 0.

### **Synchronization**

Select **Asynchronous** to pass the asynchronous version of the comparator output. Select **Synchronous** to pass the synchronous version of the comparator output. Selecting **Synchronous** enables the **Qualification period** option.

### **Qualification period**

Qualify changes in the comparator output before passing them along. The **Passed through** setting passes changes in the comparator value along without qualifying them. The **consecutive clocks** settings pass changes in the comparator value along after receiving the specified number of consecutive samples with the same value. Use this setting to prevent intermittent and spurious changes in the comparator output.

### **Sample time**

Specify the time interval between samples. To inherit sample time from the upstream block, set this parameter to -1.

## **References**

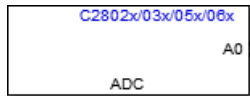
*TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator*, Literature Number: SPRUGE5, from the Texas Instruments Web site.

# C2802x/C2803x/C2805x/C2806x ADC

---

|                |                                                                               |
|----------------|-------------------------------------------------------------------------------|
| <b>Purpose</b> | Configure ADC to sample analog pins and output digital data                   |
| <b>Library</b> | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x |
|                | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x |
|                | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x |
|                | Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x |

## Description



Configures the ADC to output a constant stream of data collected from the ADC pins on the DSP.

An ADC block allows for reading one ADC channel. Use multiple ADC blocks to read multiple ADC channels.

## Examples

### Synchronize ADC with PWM

Use a hardware interrupt to synchronize changes to the PWM duty cycle with ADC conversion.

This example demonstrates the use of the ADC block and PWM blocks. The generated DSP code produces the pulse waveform whose duty cycle is changing as the voltage applied to ADC input changes. The waveform period is kept constant. The example also shows the use of the Hardware Interrupt block to synchronize the update of the PWM duty cycle with the ADC conversion.

This model uses the ADC block to sample an analog voltage and the PWM block to generate a pulse waveform. The analog voltage controls the duty cycle of the PWM waveform. Duty cycle changes can be observed on the oscilloscope. "Hardware Interrupt" installs an Interrupt

Service Routine (ISR) for ADC interrupt and schedules the execution of the connected subsystem (ADC-PWM Subsystem) when ADC interrupt (ADCINT) is received.

"ADC-PWM Subsystem" consists of an ADC driving the duty cycle input port of the PWM. PWM is configured to trigger ADC start of conversion (SOC).

Required Hardware:

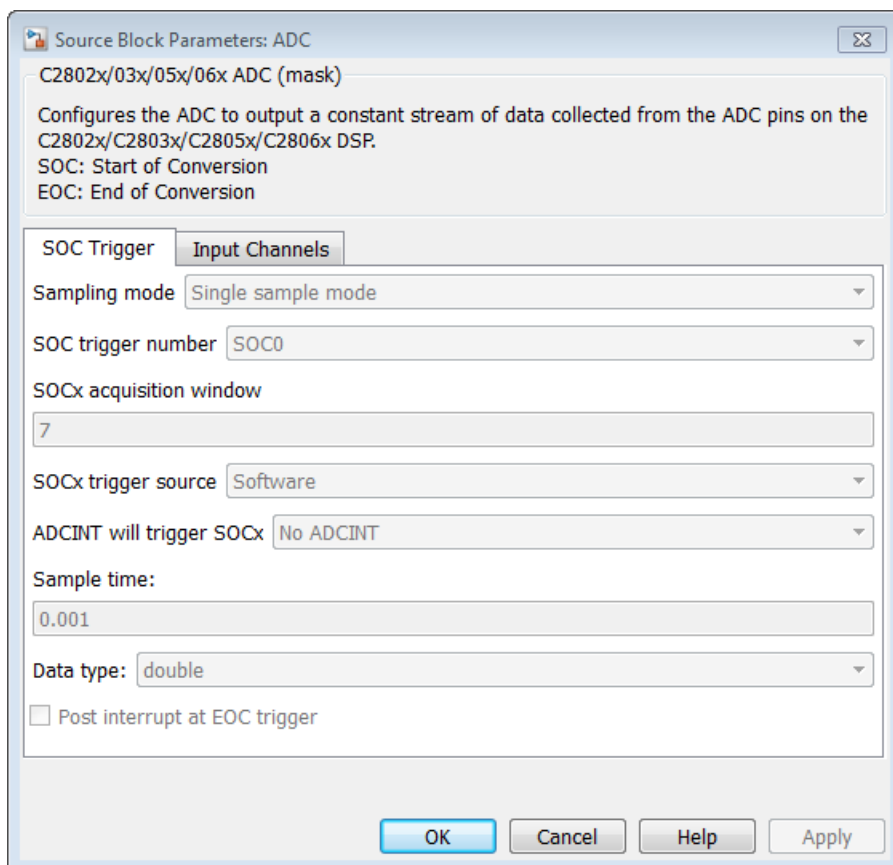
- Spectrum Digital F2812/F2808/F28335 eZdsp boards or F28027 controlSTICK
- Oscilloscope and probes
- Function generator

Hardware Connections: Connect the function generator output to the ADC input ADCINA0 on the board. Connect the output of the PWM1 to the analog input of the oscilloscope.

To run the example on on the DSP Board:

- 1** Open the model.
- 2** Click "Incremental build" to generate, build, load and run the DSP code.
- 3** Observe the change of the PWM waveform on the oscilloscope.

# C2802x/C2803x/C2805x/C2806x ADC



## Dialog Box

### Sampling mode

Select **Single sample mode** to sample two signals sequentially. Select **Simultaneous sample mode** to sample the two signals with a minimal delay between the samples.

### SOC trigger number

Identify the start-of-conversion trigger by number. In single sampling mode, you can select an individual trigger. In simultaneous sampling mode, you can select triggers in pairs.

## **SOCx acquisition window**

Define the length of the acquisition period, the acquisition window, in sample cycles. The minimal value for this parameter is 7 cycles. For more information, see the “ADC Acquisition (Sample and Hold) Window” section of the *TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator Reference Guide*.

## **SOCx trigger source**

Select the source that triggers the start of conversion. The following types of inputs are available:

- Software
- CPU Timers 0/1/2 interrupts
- XINT2 SOC
- ePWM1-7 SOCA and SOCB

If you set **SOCx trigger source** to XINT2\_XINT2SOC, use the **XINT2SOC external pin** parameter in the Coder Target -> Target Hardware Resources to define the external GPIO pin that triggers the start of conversion. **XINT2SOC external pin** is located under the Coder Target -> Target Hardware Resources of the Peripherals tab, on the ADC pane.

## **ADCINT will trigger SOCx**

At the end of conversion, use the ADCINT1 or ADCINT2 interrupt to trigger a start of conversion (SOC). This loop creates a continuous sequence of conversions. The default selection, No ADCINT disables this parameter.

## **Sample time**

Specify the time interval between samples. To inherit sample time from the upstream block, set this parameter to -1.

## **Data type**

Select the data type of the digital output data. You can choose from the options double, single, int8, uint8, int16, uint16, int32, and uint32.

## **Post interrupt at EOC trigger**

Post interrupts when the ADC triggers EOC pulses. When you select this option, the dialog box displays the **Interrupt selection** and **ADCINT# continuous mode** options. For more information, see the “EOC and Interrupt Operation” section of the *TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator Reference Guide*.

## **Interrupt selection**

Select which interrupt the ADC posts after triggering an EOC pulse.

## **ADCINT1 continuous mode**

## **ADCINT2 continuous mode**

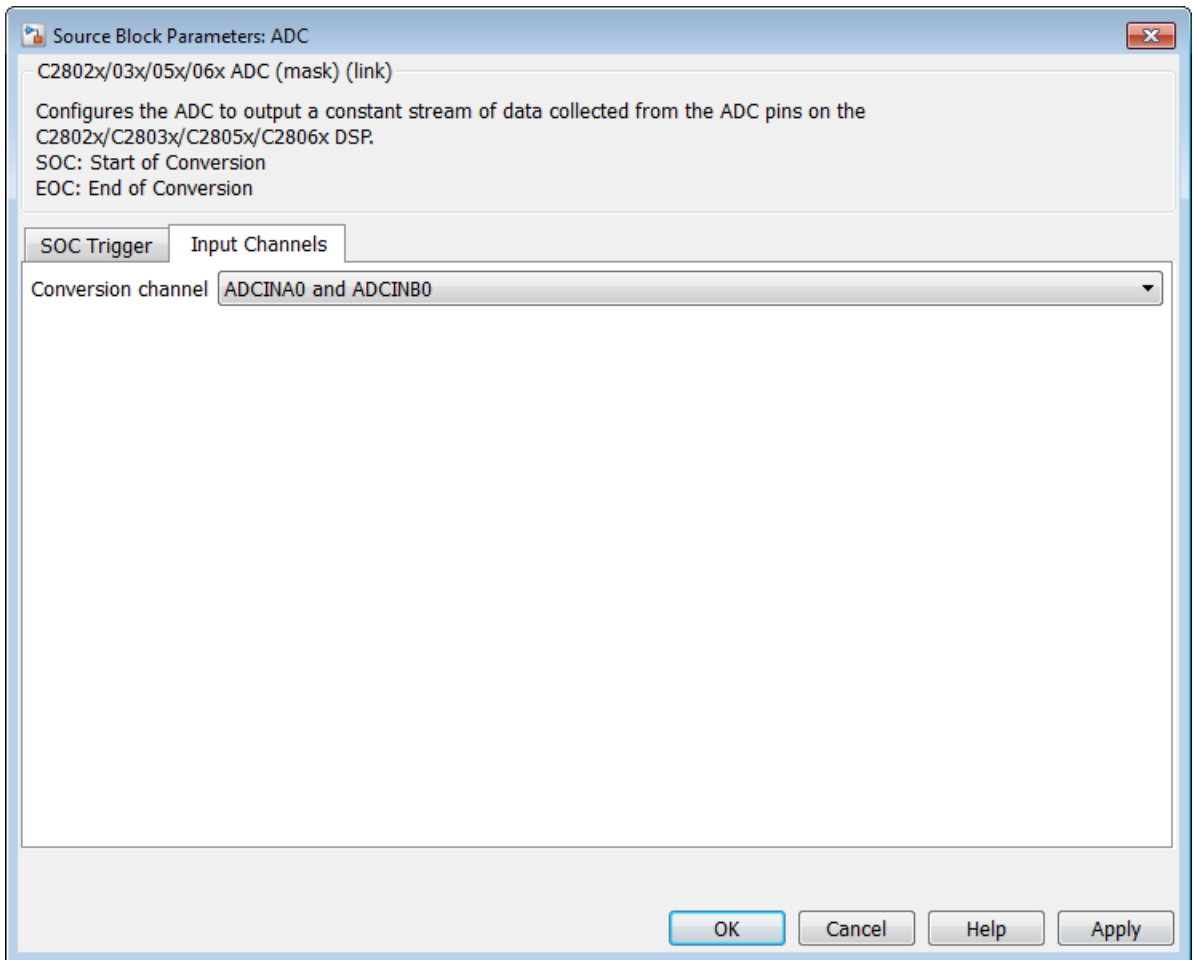
When the ADC generates an end of conversion (EOC) signal, generate an ADCINT# interrupt whether the previous interrupt flag has been acknowledged or not.

## **Input Channels — Conversion channel**

Select the input channel to which this ADC conversion applies.



# C2802x/C2803x/C2805x/C2806x ADC



## References

*TMS320x2802x, 2803x Piccolo Analog-to-Digital Converter (ADC) and Comparator*, Literature Number: SPRUGE5, from the Texas Instruments Web site.

## See Also

“ADC-PWM Synchronization via ADC Interrupt”

# C2802x/C2803x/C2805x/C2806x ADC

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C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x ePWM

C28x Hardware Interrupt

“Configuring Acquisition Window Width for ADC Blocks”

“ADC” on page 3-271

# C2802x/C2803x/C2806x AnalogIO Input

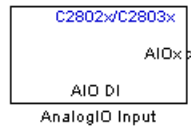
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**Purpose** Configure pin, sample time, and data type for analog input

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

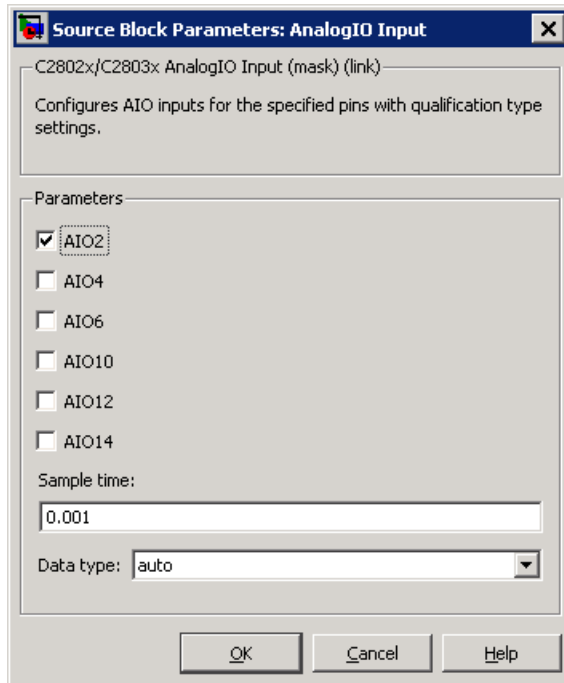
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x



## Description

Use this block to sample the Analog IO input pins on the C2802x processor for a positive voltage and output the results.

# C2802x/C2803x/C2806x AnalogIO Input



## Dialog Box

### Parameters (Input pins)

Select the input pins to sample.

### Sample time

Specify the time interval between samples. To inherit sample time from the upstream block, set this parameter to -1.

### Data type

Select the data type of the digital output data. If you select auto, the block automatically selects the data type for your model. You can also manually select a data type. You can choose from the options double, single, int8, uint8, int16, uint16, int32, and uint32.

## See Also

C2802x/C2803x/C2806x AnalogIO Output

# C2802x/C2803x/C2806x AnalogIO Output

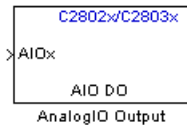
**Purpose** Configure Analog IO to output analog signals on specific pins

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

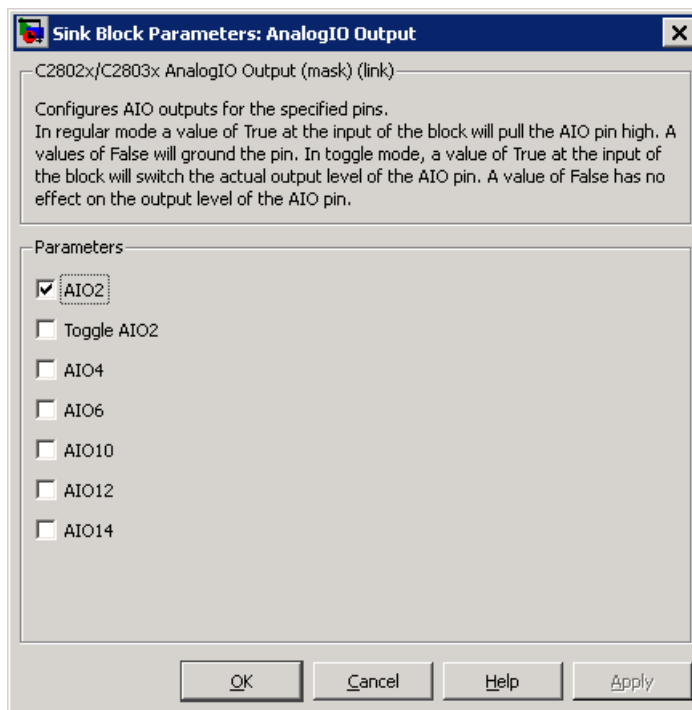
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

## Description



Configures the Analog IO output pins for the specified pins. In regular mode, a value of True at the input of the block pulls the Analog IO pin high. A value of False grounds the pin. In toggle mode, a value of True at the input of the block switches the actual output level of the Analog IO pin. A value of False does not alter the output level of the Analog IO pin.

# C2802x/C2803x/C2806x AnalogIO Output



## Dialog Box

### Parameters (Output Pins)

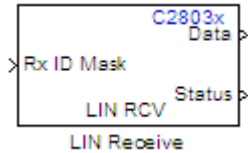
Select the analog output pins that express the value of the digital input on **AIOx**. Selecting **Toggle** inverts the output voltage levels of the pins.

## See Also

C2802x/C2803x/C2806x AnalogIO Input

**Purpose** Receive data via local interconnect network (LIN) module on target

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x



## Description

The Local Interconnect Network (LIN) bus implements a serial communications protocol for distributed automotive and industrial applications. In particular, LIN serves low cost applications that do not require the bandwidth or robustness provided by the CAN protocol. For more information about LIN, see <http://www.lin-subbus.org/>.

The LIN Receive block configures the target to receive scalar or vector data from the LINRX or LINTX pins.

Each C2803x target has one LIN module. Your model can only contain one LIN Transmit and one LIN Receive block per module.

The C2803x LIN Transmit block takes three inputs:

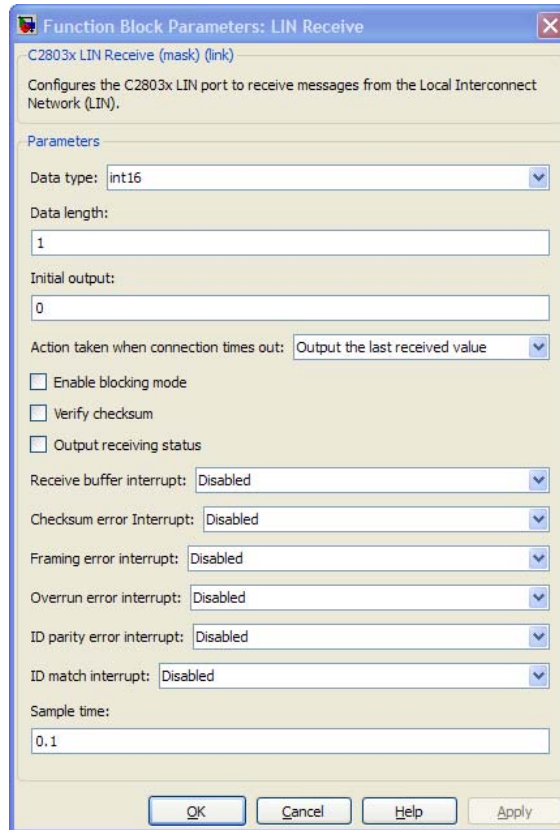
- **ID**: Set the value of the LIN ID for the LIN transmit node.
- **Tx ID Mask**: Set the value of the LIN ID mask for the LIN transmit node.
- **Data**: Connect this input to the data source.

For more information and examples, see:

- “Configuring LIN Communications”
- LIN-Based Control of PWM Duty Cycle (example)

# C2803x LIN Receive

**Note** Many LIN-specific settings are located under **Peripherals > LIN** in Coder Target -> Target Hardware Resources for your model. Verify that these settings meet the requirements of your application.



## Dialog Box

### Data type

Select the data type the LIN block outputs to the model. Available options are single, int8, uint8, int16, uint16, int32, or uint32.



To interpret the data, the data type and data length must match those of the data input to transmitting LIN node.

The default value is int16.

## Data length

Set the length of the data the LIN block outputs to the model. This value is measured in multiples of the **Data type**. For example, if **Data type** is int16 and **Data length** is int16, the LIN block outputs the data to the model in lengths of

1 x int16

If you set the **Data length** to a value greater than 1, the block outputs the data as vectors.

To interpret the data, the data type and data length must match those of the data input to transmitting LIN node.

The default value is 1.

---

**Note** In a loopback configuration, the maximum data length cannot exceed 8 bytes. If the sum of the incoming and the outgoing data exceeds the hardware buffer length of the LIN module, the module discards incoming bytes of data.

---

## Initial output

Set the initial value the DATA port outputs to the model before the LIN node has received data.

The default value is 0.

## Action taken when connection times out

Specify what the LIN block outputs on the DATA port in response to a connection time-out. The choices are:

- Output the last received value — the DATA port outputs the last data value the LIN node received.
- Output custom value — the DATA port outputs the value defined by **Output value when connection times out**.

The default value is Output the last received value.

If the LIN node has not received data, and you set this parameter to Output the last received value, the DATA port outputs the **Initial output** value.

### **Output value when connection times out**

Specify the custom value the DATA port outputs when **Action taken when connection times out** is set to Output custom value and a connection timeout occurs.

### **Enable blocking mode**

If you enable (select) this checkbox, the target application stops and waits for the LIN node to receive data before continuing. If you disable this option, the application continues running and does not wait for data to arrive.

The default value is disabled (deselected).

### **Verify checksum**

If you enable (select) this option, the LIN node verifies the checksum it receives.

The default value is disabled (deselected).

### **Output receiving status**

Enabling (selecting) this checkbox adds a **status** output to the LIN Receive block, as shown in the following figure.

The **status** output reports the following values for each message the LIN node receives:

- 0: No error.

- -1: A time-out occurred while the block was waiting to receive data.
- -2: Unable to receive.
- Other status values represent the highest 8 bits of the SCI Flags Register. Convert these values from decimal to binary. Then determine the meaning of these values by referring to “Table 14. SCI Flags Register (SCIFLR) Field Descriptions” in *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2, available at the Texas Instruments Web site.

### **Receive buffer interrupt**

If you enable this option, the SCI node generates an interrupt after it receives a complete frame. The default value is Disabled.

### **Checksum error interrupt**

If you enable this option, the LIN block generates an interrupt when the incoming message contains an invalid checksum.

The default value is Disabled.

The TXRX Error Detector Checksum Calculator verifies checksums for incoming messages. With the classic LIN implementation, the checksum only covers the data fields. For LIN 2.0-compliant messages, the checksum includes both the ID field and the data fields. If you enable this option, the Checksum Calculator generates interrupts when it detects checksum errors, such as those caused by LIN message collisions.

### **Framing error interrupt**

If you enable this option, the LIN module generates interrupts when framing errors occur.

The default value is Disabled.

### **Overrun error interrupt**

If you enable this option, the LIN module generates interrupt when overrun errors occur.

# C2803x LIN Receive

---

The default value is Disabled.

## **ID parity error interrupt**

If you enable this option, the LIN module generates an ID-Parity interrupt when it receives an invalid ID.

The default value is Disabled.

If you enable this option, also enable **Parity mode** in Coder Target -> Target Hardware Resources.

## **ID match interrupt**

If you enable this option, the LIN module generates an interrupt when the LIN node validates the ID in messages it receives.

The default value is Disabled.

## **Sample time**

Set the block's input sample time,  $T_s$ .

The default value is 0.1 seconds.

## **References**

For detailed information on the LIN module, see *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2, available at the Texas Instruments Web site.

## **See Also**

C2803x LIN Transmit (block reference)

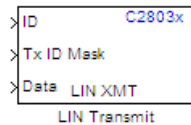
“LIN” on page 3-315

“Configuring LIN Communications”

LIN-Based Control of PWM Duty Cycle (example)

**Purpose** Transmit data from target via serial communications interface (SCI) to host

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x



## Description

The Local Interconnect Network (LIN) bus implements a serial communications protocol for distributed automotive and industrial applications. In particular, LIN serves low cost applications that do not require the bandwidth or robustness provided by the CAN protocol. For more information about LIN, see <http://www.lin-subbus.org/>.

The C2803x LIN Transmit block takes three inputs:

- **ID:** Set the value of the LIN ID for the LIN transmit node.
- **Tx ID Mask:** Set the value of the LIN ID mask for the LIN transmit node.
- **Data:** Connect this input to the data source.

For more information and examples, see:

- “Configuring LIN Communications”
- LIN-Based Control of PWM Duty Cycle (example)

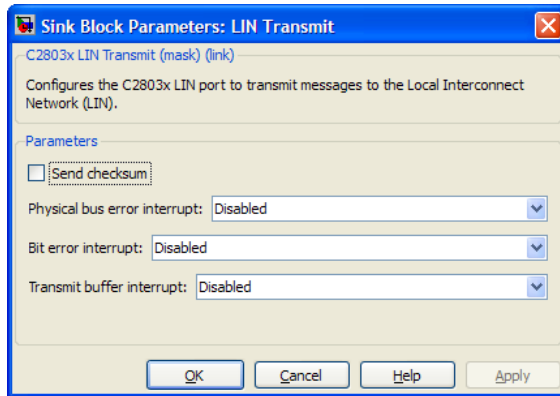
---

**Note** Many LIN-specific settings are located under **Peripherals > LIN** in Coder Target -> Target Hardware Resources for your model. Verify that these settings meet the requirements of your application.

---

# C2803x LIN Transmit

## Dialog Box



### Send checksum

Select this checkbox to include a checksum in the last data field of the checkbyte. LIN 2.0 implementations require this checksum.

The default value is unchecked (disabled).

### Physical bus error interrupt

The LIN master node detects when the physical bus cannot convey a valid message. For example, if the bus had a short circuit to ground or to  $V_{BAT}$ . This raises a physical bus error flag in all of the LIN nodes on the network. If you enable **Physical bus error interrupt**, the LIN transmit node generates an interrupt in response to a physical bus error flag.

### Bit error interrupt

If you enable this option, the LIN node compares the data it transmits and the data on the LIN bus.

The default value is Disabled.

The TXRX Error Detector Bit Monitor compares data bits on the LIN transmit (LINTX) and receive (LINRX) pins. If the data do not match, the Bit Monitor raises a bit-error flag. When you

enable this option, the bit-error flag also produces a bit-error interrupt.

### **Transmit buffer interrupt**

If you enable this option, the LIN node generates an interrupt while it is generating a checksum and setting the Transmitter buffer register ready flag.

The default value is Disabled.

## **References**

For detailed information on the SCI module, see *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2, available at the Texas Instruments Web site.

## **See Also**

C2803x LIN Receive (block reference)

“LIN” on page 3-315

“Configuring LIN Communications”

LIN-Based Control of PWM Duty Cycle (example)

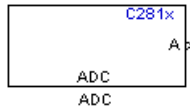
# C281x ADC

---

**Purpose** Analog-to-digital converter (ADC)

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

**Description**



The C281x ADC block configures the C281x ADC to perform analog-to-digital conversion of signals connected to the selected ADC input pins. The ADC block outputs digital values representing the analog input signal and stores the converted values in the result register of your digital signal processor. You use this block to capture and digitize analog signals from external sources such as signal generators, frequency generators, or audio devices.

### Triggering

The C281x ADC trigger mode depends on the internal setting of the source start-of-conversion (SOC) signal. In unsynchronized mode the ADC is usually triggered by software at the sample time intervals specified in the ADC block. For more information on configuring the specific parameters for this mode, see “Configuring Acquisition Window Width for ADC Blocks”.

In synchronized mode, the Event (EV) Manager associated with the same module as the ADC triggers the ADC. In this case, the ADC is synchronized with the pulse width modulator (PWM) waveforms generated by the same EV unit via the **ADC Start Event** signal setting. The **ADC Start Event** is set in the C281x PWM block. See that block for information on the settings.

---

**Note** The ADC cannot be synchronized with the PWM if the ADC is in cascaded mode (see below).

---



## Output

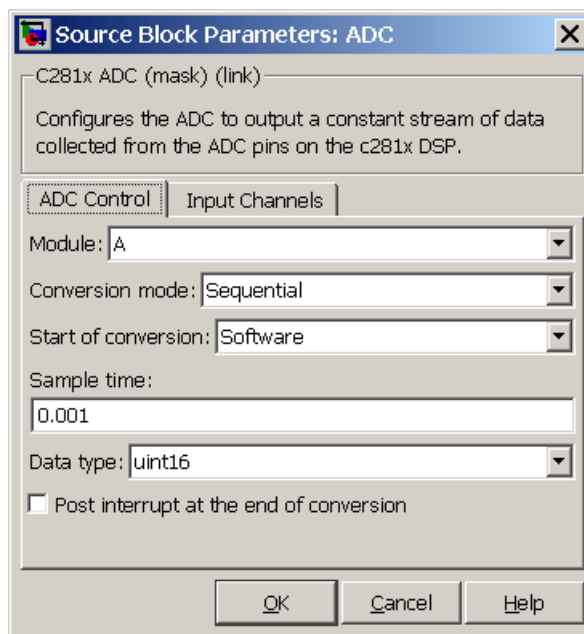
The output of the C281x ADC is a vector of uint16 values. The output values are in the range 0 to 4095 because the C281x ADC is 12-bit converter.

## Modes

The C281x ADC block supports ADC operation in dual and cascaded modes. In dual mode, either module A or module B can be used for the ADC block, and two ADC blocks are allowed in the model. In cascaded mode, both module A and module B are used for a single ADC block.

## Dialog Box

### ADC Control Pane



### Module

Specify which DSP module to use:

- **A** — Displays the ADC channels in module A (ADCINA0 through ADCINA7).
- **B** — Displays the ADC channels in module B (ADCINB0 through ADCINB7).
- **A and B** — Displays the ADC channels in both modules A and B (ADCINA0 through ADCINA7 and ADCINB0 through ADCINB7)

Then, use the check boxes to select the desired ADC channels.

### **Conversion mode**

Type of sampling to use for the signals:

- **Sequential** — Samples the selected channels sequentially
- **Simultaneous** — Samples the corresponding channels of modules A and B at the same time

### **Start of conversion**

Specify the type of signal that triggers the conversion:

- **Software** — Signal from software
- **EVA** — Signal from Event Manager A (only for Module A)
- **EVB** — Signal from Event Manager B (only for Module B)
- **External** — Signal from external hardware

### **Sample time**

Time in seconds between consecutive sets of samples that are converted for the selected ADC channel(s). This is the rate at which values are read from the result registers. See “Scheduling and Timing” for more information on timing. To execute this block asynchronously, set **Sample Time** to -1, check the **Post interrupt at the end of conversion** box, and refer to “” for a discussion of block placement and other settings.

To set different sample times for different groups of ADC channels, you must add separate C281x ADC blocks to your model and set the desired sample times for each block.

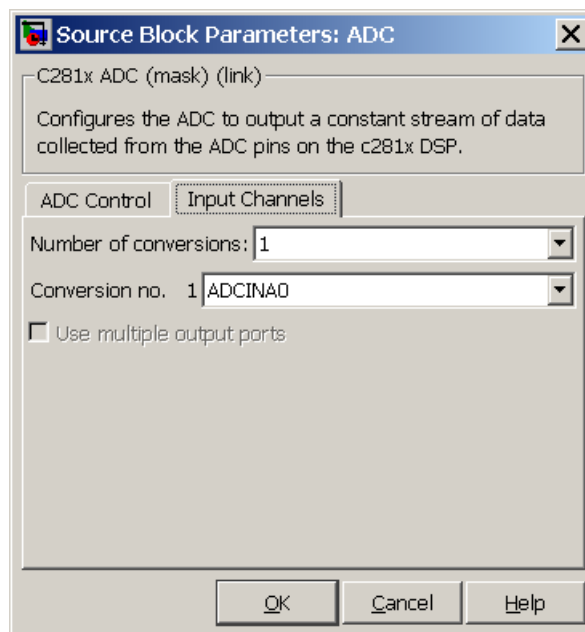
### Data type

Date type of the output data. Valid data types are auto, double, single, int8, uint8, int16, uint16, int32, or uint32.

### Post interrupt at the end of conversion

Check this check box to post an asynchronous interrupt at the end of each conversion. The interrupt is posted at the end of conversion.

### Input Channels Pane



### Number of conversions

Number of ADC channels to use for analog-to-digital conversions.

**Conversion no.**

Specific ADC channel to associate with each conversion number.

In oversampling mode, a signal at a given ADC channel can be sampled multiple times during a single conversion sequence. To oversample, specify the same channel for more than one conversion. Converted samples are output as a single vector.

**Use multiple output ports**

If more than one ADC channel is used for conversion, you can use separate ports for each output and show the output ports on the block. If you use more than one channel and do not use multiple output ports, the data is output in a single vector.

**See Also**

“ADC-PWM Synchronization via ADC Interrupt”

C281x PWM

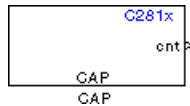
C28x Hardware Interrupt

“ADC” on page 3-271

**Purpose** Receive and log capture input pin transitions

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

**Description**



The C281x CAP module provides input capture functionality for systems where precise timing of external events is important. The C281x CAP block sets parameters for the capture units (CAPs) of the Event Manager (EV) module. The capture units log transitions detected on the capture unit pins by recording the times of the input signal transitions into a two-level deep FIFO stack. You can set the capture unit pins to detect rising edge, falling edge, either type of transition, or no transition. The cnt output of the block gives the captured value of the EV running timer.

The C281x chip has six capture units — three associated with each EV module. Capture units 1, 2, and 3 are associated with EVA and capture units 4, 5, and 6 are associated with EVB. Each capture unit is associated with a capture input pin.

Each group of EV module capture units can use one of two general-purpose (GP) timers on the target board. EVA capture units can use GP timer 1 or 2. EVB capture units can use GP timer 3 or 4. When a transition occurs, the module stores the value of the selected timer in the two-level deep FIFO stack.

The C281x CAP module shares GP Timers with other C281 blocks. For more information and guidance on sharing timers, see “Sharing General Purpose Timers between C281x Peripherals”.

**Note** You can have up to two C281x CAP blocks in a model—one block for each EV module.

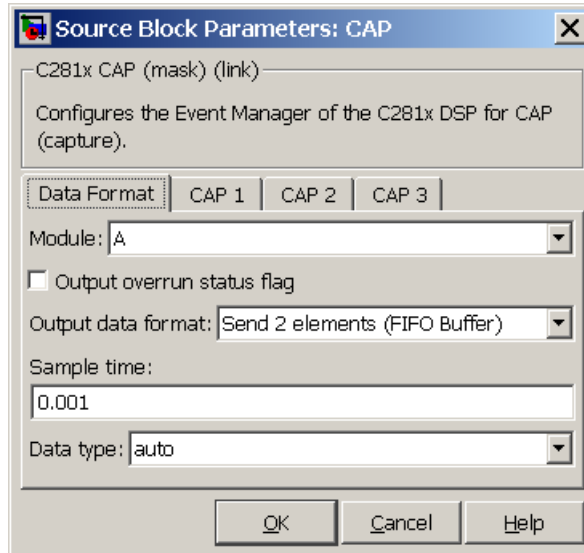
## Outputs

This block has up to two outputs: a `cnt` (count) output and an optional, FIFO status `flag` output. The `cnt` output holds the value of the EV timer captured during the detected transitions. The `cnt` output gives the captured values of the running counter based on the value set in **Output data format** parameter. The status flag outputs are:

- 0 — The FIFO is empty. Either no captures have occurred or the previously stored captures have been read from the stack. (The binary version of this flag is 00.)
- 1 — The FIFO has one entry in the top register of the stack. (The binary version of this flag is 01.)
- 2 — The FIFO has two entries in the stack registers. (The binary version of this flag is 10.)
- 3 — The FIFO has two entries in the stack registers and one or more captured values have been lost. This occurs because another capture occurred before the FIFO stack was read. This means that the FIFO stack is read when you execute the block as specified by your scheduling scheme synchronously, if a sample time is used or asynchronously, if triggered by an interrupt or an idle task. The new value is placed in the bottom register. The bottom register value is pushed to the top of the stack and the top value is pushed out of the stack. (The binary version of this flag is 11.)

## Dialog Box

### Data Format Pane



#### Module

Select the Event Manager (EV) module to use:

- A — Use CAPs 1, 2, and 3.
- B — Use CAPs 4, 5, and 6.

#### Output overrun status flag

Select to output the status of the elements in the FIFO. The data type of the status flag is uint16.

#### Output data format

The type of data to output:

- Send 2 elements (FIFO Buffer) — Sends the latest two values. The output is updated when there are two elements in the FIFO, which is indicated by bit 13 or 11 or 9 being sent (CAP x FIFO). If the CAP is polled when fewer than two

elements are captures, old values are repeated. The CAP registers are read as follows:

- 1** The CAP x FIFO status bits are read and the value is stored in the status flag.
  - 2** The top value of the FIFO is read and stored in the output at index 0.
  - 3** The new top value of the FIFO (the previously stored bottom stack value) is read and stored in the output at index 1.
- **Send 1 element (oldest)** — Sends the older of the two most recent values. The output is updated when there is at least one element in the FIFO, which is indicated by the bits 13:12, or 11:10, or 9:8 being sent. The CAP registers are read as follows:
    - 4** The CAP x FIFO status bits are read and the value is stored in the status flag.
    - 5** The top value of the FIFO is read and stored in the output.
  - **Send 1 element (latest)** — Sends the most recent value. The output is updated when there is at least one element in the FIFO, which is indicated by the bits 13:12, or 11:10, or 9:8 being sent. The CAP registers are read as follows:
    - 6** The CAP x FIFO status bits are read and the value is stored in the status flag.
    - 7** If the FIFO buffer contains two entries, the bottom value is read and stored in the output. If the FIFO buffer contains one entry, the top value is read and stored in the output.

### **Sample time**

Time between outputs from the FIFO. If new data is not available, the previous data is sent.

### **Data type**

Data type of the output data. Available options are `auto`, `double`, `single`, `int8`, `uint8`, `int16`, `uint16`, `int32`, `uint32`, and `boolean`. The `auto` option uses the data type of a connected block that



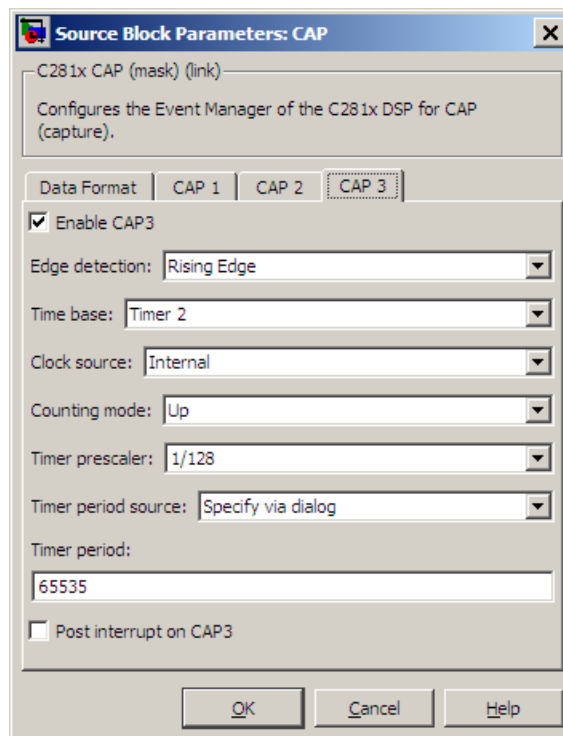
outputs data to this block. If this block does not receive an input, auto sets the data type to double.

---

**Note** The output of the C281x CAP block can be vectorized.

---

## CAP Panes



The CAP panes set parameters for individual CAPs. The particular CAP affected by a CAP pane depends on the EV module you selected:

- **CAP1** controls CAP 1 or CAP 4, for EV module A or B, respectively.

- **CAP2** controls CAP 2 or CAP 5, for EV module A or B, respectively.
- **CAP3** controls CAP 3 or CAP 6, for EV module A or B, respectively.

## **Enable CAP**

Select to use the specified capture unit pin.

## **Edge Detection**

Type of transition detection to use for this CAP. Available types are Rising Edge, Falling Edge, Both Edges, and No transition.

## **Time Base**

Select which target board GP timer the CAP uses as a time base. CAPs 1, 2, and 3 can use Timer 1 or Timer 2. CAPs 4, 5, and 6 can use Timer 3 or Timer 4.

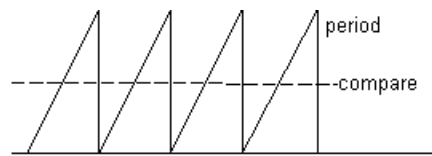
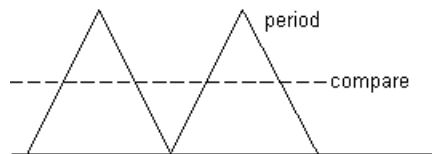
## **Clock source**

This option is available only for the CAP 3 pane. You can select Internal to use the internal time base. Also configure the **Counting mode**, **Timer prescaler**, and **Timer period source** for the internal time base.

Select QEP circuit to generate the input clock from the quadrature encoder pulse (QEP) submodule.

## **Counting mode**

Select Up to generate an asymmetrical waveform output, or Up-down to generate a symmetrical waveform output, as shown in the following illustration.

**Mode: Up/Asymmetric****Resulting waveform****Mode: Up-down/Symmetric****Resulting waveform**

The Counting mode is for the internal timer settings.

When you specify the **Counting mode** as Up (asymmetric) the waveform:

- Starts low
- Goes high when the rising period counter value matches the **Compare value**
- Goes low at the end of the period

When you specify the **Counting mode** as Up-down (symmetric) the waveform:

- Starts low

- Goes high when the increasing period counter value matches the **Compare value**
- Goes low when the decreasing period counter value matches the **Compare value**

**Counting mode** becomes unavailable when you set **Clock source** to QEP circuit.

### Timer Prescaler

Clock divider factor by which to prescale the selected GP timer to produce the desired timer counting rate. Available options are none, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, and 1/128. The following table shows the rates that result from selecting each option.

| Scaling | Resulting Rate ( $\mu$ s) |
|---------|---------------------------|
| none    | 0.01334                   |
| 1/2     | 0.02668                   |
| 1/4     | 0.05336                   |
| 1/8     | 0.10672                   |
| 1/16    | 0.21344                   |
| 1/32    | 0.42688                   |
| 1/64    | 0.85376                   |
| 1/128   | 1.70752                   |

---

**Note** These rates assume a 75 MHz input clock.

---

### Timer period source

Select **Specify via dialog** to enable the **Timer period** parameter. Select **Input port** to create a block input, **T1**, that accepts the timer period value.

## Timer period

Set the length of the timer period in clock cycles. Enter a value from 0 to 65535. The value defaults to 65535.

If you know the length of a clock cycle, you can easily calculate how many clock cycles to set for the timer period. The following calculation determines the length of one clock cycle:

$$\text{Sysclk}(150\text{MHz}) \rightarrow \text{HISPCLK}(1/2) \rightarrow \text{InputClockPr escaler}(1/128)$$

In this calculation, you divide the System clock frequency of 150 MHz by the high-speed clock prescaler of 2. Then, you divide the resulting value by the timer control input clock prescaler, 128. The resulting frequency is 0.586 MHz. Thus, one clock cycle is 1/.586 MHz, which is 1.706  $\mu\text{s}$ .

## Post interrupt on CAP

Check this check box to post an asynchronous interrupt on CAP.

## See Also

C28x Hardware Interrupt

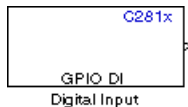
# C281x GPIO Digital Input

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**Purpose** General-purpose I/O pins for digital input

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

**Description**

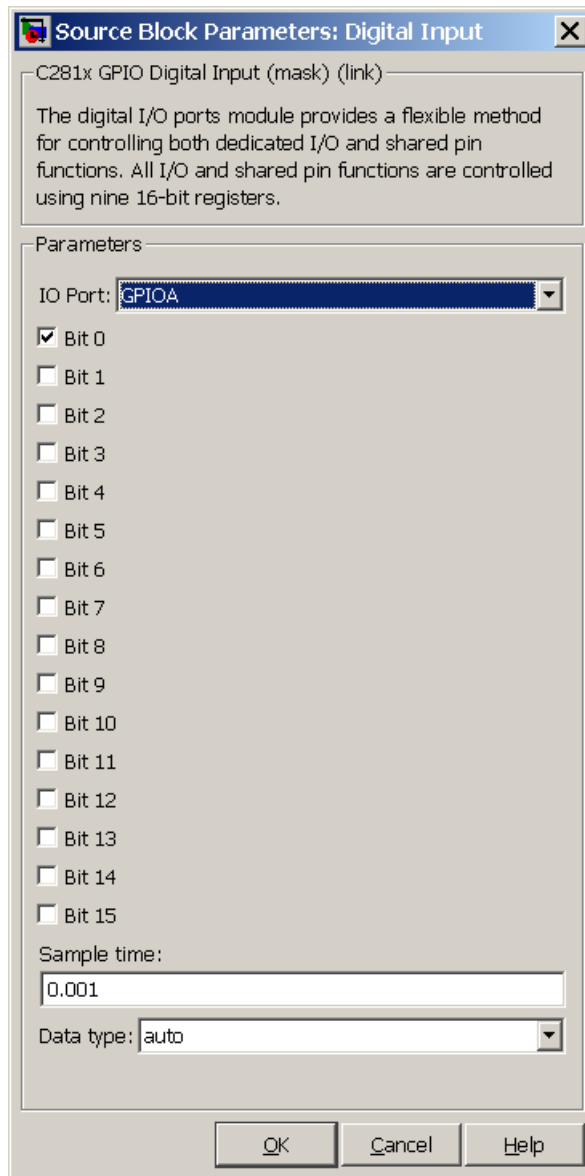


This block configures the general-purpose I/O (GPIO) registers that control the GPIO shared pins for digital input. Each I/O port has one MUX register, which is used to select peripheral operation or digital I/O operation.

---

**Note** To avoid losing new settings, click **Apply** before changing the **IO Port** parameter.

---



## Dialog Box

### IO Port

Select the input/output port to use: GPIOA, GPIOB, GPIOD, GPIOE, GPIOF, or GPIOG and select the I/O Port bits to enable for digital input. (There is no GPIOC port on the C281x.) If you

# C281x GPIO Digital Input

---

select multiple bits, vector input is expected. Cleared bits are available for peripheral functionality. Multiple GPIO DI blocks cannot share the same I/O port.

---

**Note** The input function of the digital I/O and the input path to the related peripheral are enabled on the board. If you configure a pin as digital I/O, the corresponding peripheral function cannot be used.

---

The following tables show the shared pins.

## GPIO A MUX

| Bit | Peripheral Name<br>(Bit = 1) | GPIO Name<br>(Bit = 0) |
|-----|------------------------------|------------------------|
| 0   | PWM1                         | GPIOA0                 |
| 1   | PWM2                         | GPIOA1                 |
| 2   | PWM3                         | GPIOA2                 |
| 3   | PWM4                         | GPIOA3                 |
| 4   | PWM5                         | GPIOA4                 |
| 5   | PWM6                         | GPIOA5                 |
| 8   | QEP1/CAP1                    | GPIOA8                 |
| 9   | QEP2/CAP2                    | GPIOA9                 |
| 10  | CAP3                         | GPIOA10                |



## GPIO B MUX

| Bit | Peripheral Name<br>(Bit = 1) | GPIO Name<br>(Bit = 0) |
|-----|------------------------------|------------------------|
| 0   | PWM7                         | GPIOB0                 |
| 1   | PWM8                         | GPIOB1                 |
| 2   | PWM9                         | GPIOB2                 |
| 3   | PWM10                        | GPIOB3                 |
| 4   | PWM11                        | GPIOB4                 |
| 5   | PWM12                        | GPIOB5                 |
| 8   | QEP3/CAP4                    | GPIOB8                 |
| 9   | QEP4/CAP5                    | GPIOB9                 |
| 10  | CAP6                         | GPIOB10                |

### Sample time

Time interval, in seconds, between consecutive input from the pins.

### Data type

Data type of the data to obtain from the GPIO pins. The data is read as 16-bit integer data and then cast to the selected data type. Valid data types are auto, double, single, int8, uint8, int16, uint16, int32, uint32 or boolean.

---

**Note** The width of the vectorized data output by this block is determined by the number of bits selected in the **Block Parameters** dialog box.

---

## See Also

C281x GPIO Digital Output

“GPIO” on page 3-299

# C281x GPIO Digital Output

---

**Purpose** General-purpose I/O pins for digital output

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

**Description**



This block configures the general-purpose I/O (GPIO) registers that control the GPIO shared pins for digital output. Each I/O port has one MUX register, which is used to select peripheral operation or digital I/O operation.

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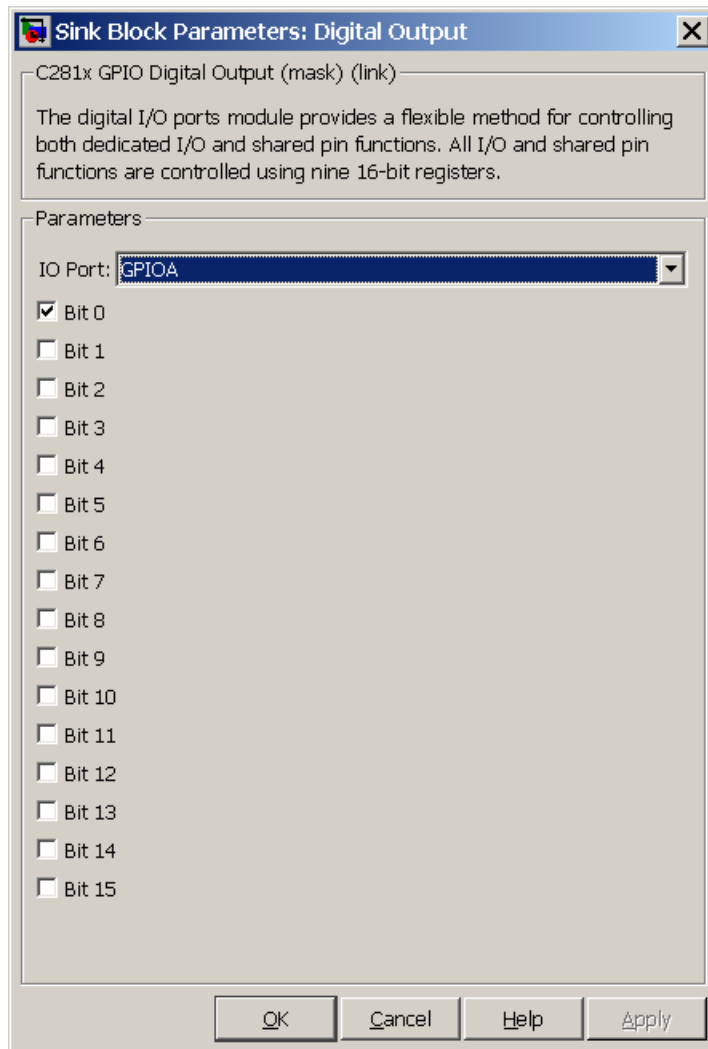
**Note** Fixed-point inputs are not supported for this block.

---

---

**Note** To avoid losing new settings, click **Apply** before changing the **IO Port** parameter.

---



## Dialog Box

### IO Port

Select the input/output port to use: GPIOA, GPIOB, GPIOPD, GPIOPE, GPIOPF, or GPIOPG and select the I/O Port bits to enable

# C281x GPIO Digital Output

---

for digital input. (There is no GPIOPC port on the C281x.) If you select multiple bits, vector input is expected. Cleared bits are available for peripheral functionality. Multiple GPIO DO blocks cannot share the same I/O port.

---

**Note** The input function of the digital I/O and the input path to the related peripheral are enabled on the board. If you configure a pin as digital I/O, the corresponding peripheral function cannot be used.

---

The following tables show the shared pins.

## GPIO A MUX

| Bit | Peripheral Name<br>(Bit = 1) | GPIO Name<br>(Bit = 0) |
|-----|------------------------------|------------------------|
| 0   | PWM1                         | GPIOA0                 |
| 1   | PWM2                         | GPIOA1                 |
| 2   | PWM3                         | GPIOA2                 |
| 3   | PWM4                         | GPIOA3                 |
| 4   | PWM5                         | GPIOA4                 |
| 5   | PWM6                         | GPIOA5                 |
| 8   | QEP1/CAP1                    | GPIOA8                 |
| 9   | QEP2/CAP2                    | GPIOA9                 |
| 10  | CAP3                         | GPIOA10                |

## GPIO B MUX

| Bit | Peripheral Name<br>(Bit = 1) | GPIO Name<br>(Bit = 0) |
|-----|------------------------------|------------------------|
| 0   | PWM7                         | GPIOB0                 |
| 1   | PWM8                         | GPIOB1                 |
| 2   | PWM9                         | GPIOB2                 |
| 3   | PWM10                        | GPIOB3                 |
| 4   | PWM11                        | GPIOB4                 |
| 5   | PWM12                        | GPIOB5                 |
| 8   | QEP3/CAP4                    | GPIOB8                 |
| 9   | QEP4/CAP5                    | GPIOB9                 |
| 10  | CAP6                         | GPIOB10                |

### See Also

C281x GPIO Digital Input

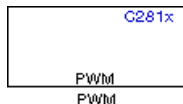
“GPIO” on page 3-299

# C281x PWM

---

**Purpose** Pulse width modulators (PWMs)

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x



**Description**

F2812 DSPs include a suite of pulse width modulators (PWMs) used to generate various signals. This block provides options to set the A or B module Event Managers to generate the waveforms you require. The twelve PWMs are configured in six pairs, with three pairs in each module.

The C281x PWM module shares GP Timers with other C281 blocks. For more information and guidance on sharing timers, see “Sharing General Purpose Timers between C281x Peripherals”.

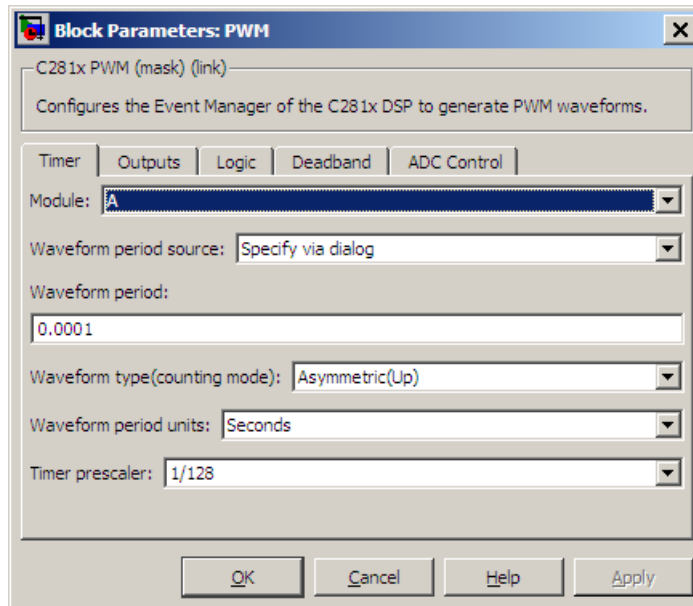
---

**Note** All inputs to the C281x PWM block must be scalar values.

---

## Dialog Box

### Timer Pane



### Module

Specify which target PWM pairs to use:

- **A** — Displays the PWMs in module A (PWM1/PWM2, PWM3/PWM4, and PWM5/PWM6).
- **B** — Displays the PWMs in module B (PWM7/PWM8, PWM9/PWM10, and PWM11/PWM12).

---

**Note** PWMs in module A use Event Manager A, Timer 1, and PWMs in module B use Event Manager B, Timer 3.

---

## Waveform period source

Source from which the waveform period value is obtained. Select **Specify via dialog** to enter the value in **Waveform period** or select **Input port** to use a value from the input port.

---

**Note** All inputs to the C281x PWM block must be scalar values.

---

## Waveform period

Period of the PWM waveform measured in clock cycles or in seconds, as specified in the **Waveform period units**.

---

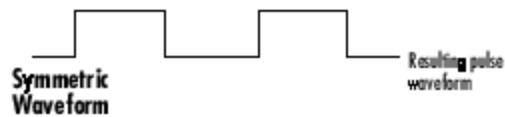
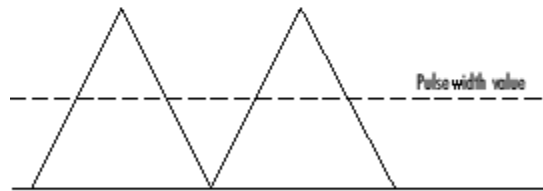
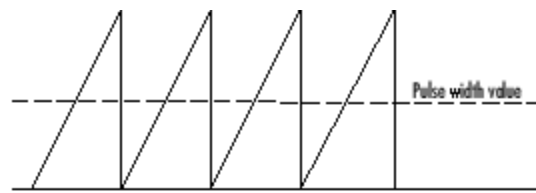
**Note** The term *clock cycles* refers to the high-speed peripheral clock on the F2812 chip. This clock is 75 MHz by default because the high-speed peripheral clock prescaler is set to 2 (150 MHz/2).

---

## Waveform type (counting mode)

Type of waveform to be generated by the PWM pair. The F2812 PWMs can generate two types of waveforms: **Asymmetric (Up)** and **Symmetric (Up-down)**. The following illustration shows the difference between the two types of waveforms.





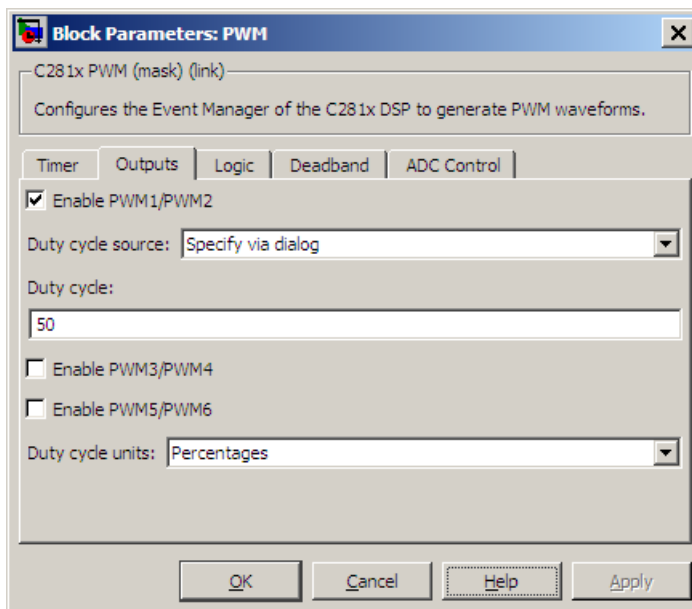
## Waveform period units

Units in which to measure the waveform period. Options are **Clock cycles**, which refer to the high-speed peripheral clock on the F2812 chip (75 MHz), or **Seconds**. Changing these units changes the **Waveform period** value and the **Duty cycle** value and **Duty cycle units** selection.

## Timer prescaler

Divide the clock input to produce the desired timer counting rate.

## Outputs Pane



### Enable PWM#/PWM#

Check to activate the PWM pair. PWM1/PWM2 are activated via the Output 1 pane, PWM3/PWM4 are on Output 2, and PWM5/PWM6 are on Output 3.

### Duty cycle source

Select **Specify via dialog** to use the dialog box to enter a **Duty cycle** value for the pair of PWM outputs. Select **Input port** to use the input port, **W#**, to enter a **Duty cycle** value for the pair of PWM outputs.

The input port **W1** corresponds to PWM1/PWM2. **W2** corresponds to PWM3/PWM4. **W3** corresponds to PWM5/6.

---

**Note** All inputs to the C281x PWM block must be scalar values.

---

## **Duty cycle**

Set the ratio of the PWM waveform pulse duration to the PWM **Waveform period**.

## **Duty cycle units**

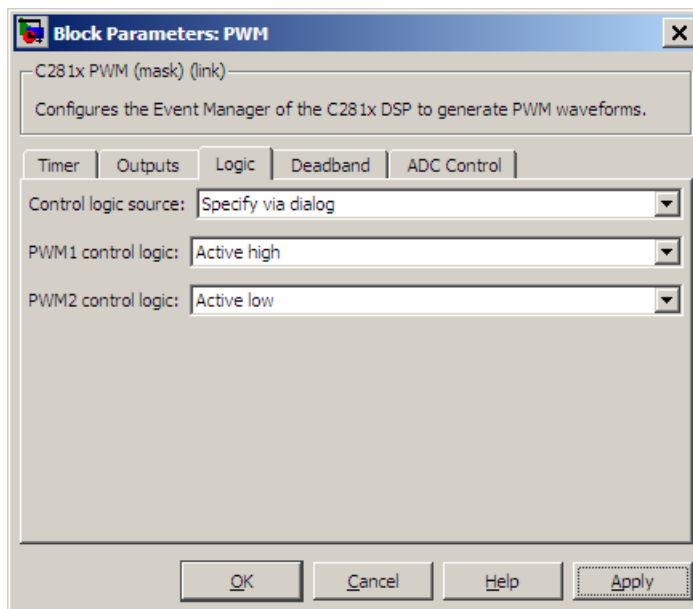
Units for the duty cycle. Valid choices are **Clock cycles** and **Percentages**. Changing these units changes the **Duty cycle** value, and the **Waveform period** value and **Waveform period units** selection.

---

**Note** Using percentages can cause some additional computation time in generated code. This may or may not be noticeable in your application.

---

## Logic Pane



### Control logic source

Configure the control logic for all PWMs enabled on the Outputs tab. Valid settings are `Specify via dialog` (default setting) or `Input port`.

`Specify via Dialog` enables **PWM control logic** settings for each PWM output:

- `Forced high` causes the pulse value to be high.  
`Active high` causes the pulse value to go from low to high.  
`Active low` causes the pulse value to go from high to low.  
`Forced low` causes the pulse value to be low.

Input port adds an input port to the PWM block for setting the C2000 ACTRx register. Each PWM uses 2 bits to set the following options:

- 00 Forced Low
- 01 Active Low
- 10 Active High
- 11 Forced High

Bits 11–0 of the 16–bit Compare Action Control Registers for module A control PWM1-6

Bits 11–0 of the 16–bit Compare Action Control Registers for module B control PWM1-6

For example: If a decimal value of 3222 is read at the input port while using PWM module A, the following PWM settings will be honored:

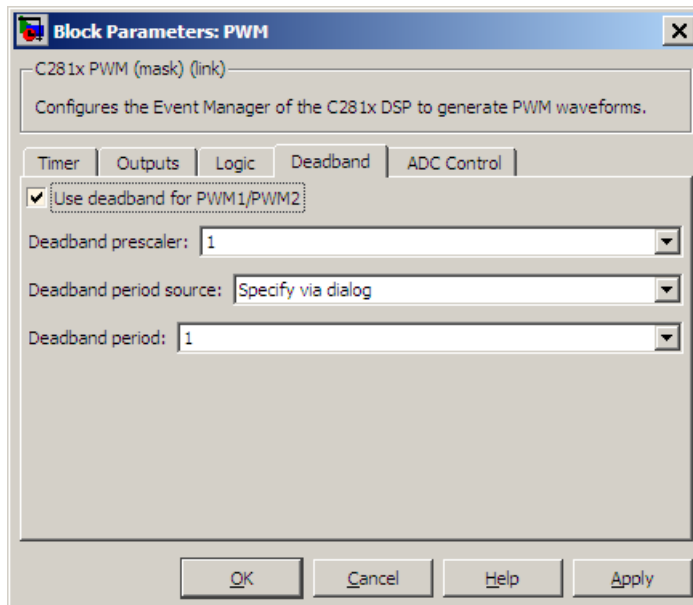
$$3222 = 0C96h = 110010010110b$$

So that:

- PW1: Active High
- PW2: Active Low
- PW3: Active Low
- PW4: Active High
- PW5: Forced Low
- PW6: Forced High

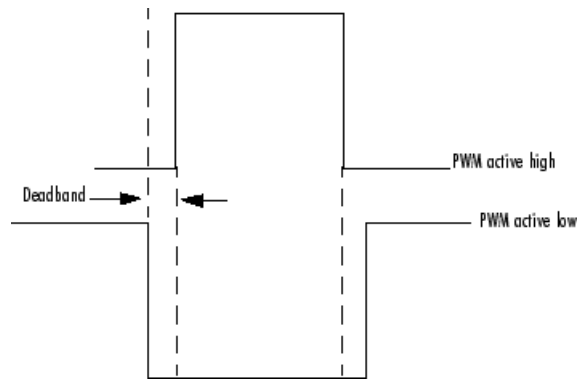
For more information, see the section on Compare Action Control Registers (ACTRA and ACTRB) in the Texas Instruments™ document “TMS320x281x DSP Event Manager (EV) Reference Guide”, literature number SPRU065.

## Deadband Pane



### Use deadband for PWM#/PWM#

Enables a deadband area without signal overlap at the beginning of particular PWM pair signals. The following figure shows the deadband area.



### Deadband prescaler

Number of clock cycles, which, when multiplied by the Deadband period, determines the size of the deadband. Selectable values are 1, 2, 4, 8, 16, and 32.

### Deadband period source

Source from which the deadband period is obtained. Select **Specify via dialog** to enter the values in the **Deadband period** field or select **Input port** to use a value, in clock cycles, from the input port.

---

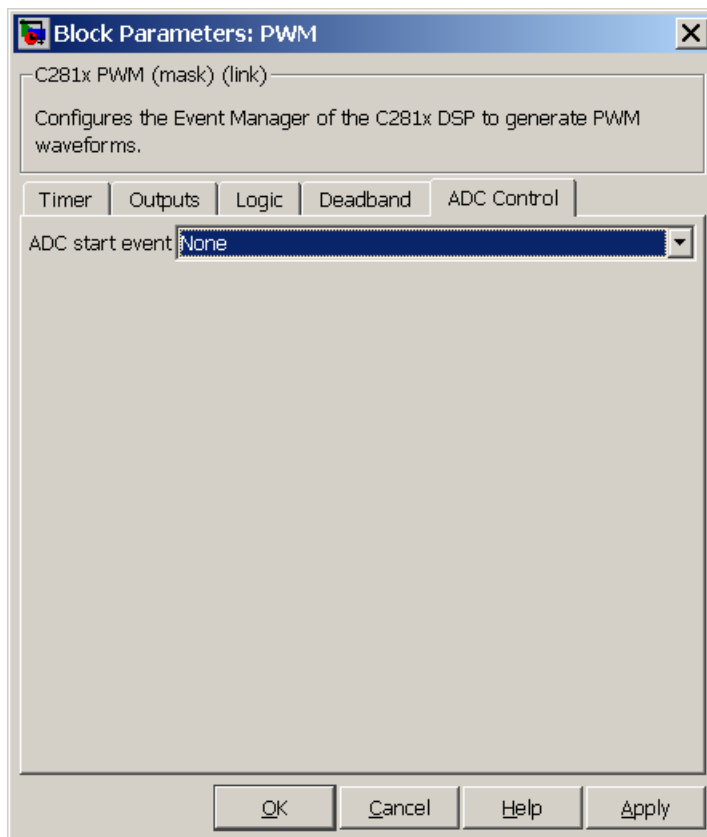
**Note** All inputs to the C281x PWM block must be scalar values.

---

### Deadband period

Value that, when multiplied by the Deadband prescaler, determines the size of the deadband. Selectable values are from 1 to 15.

## ADC Control Pane



### ADC start event

Controls whether this PWM and ADC associated with the same EV module are synchronized. Select **None** to disable synchronization or select an event to generate the source start-of-conversion (SOC) signal for the associated ADC.

- **None** — The ADC and PWM are not synchronized. The EV does not generate an SOC signal and the ADC is triggered by



software (that is, the A/D conversion occurs when the ADC block is executed in the software).

- **Underflow interrupt** — The EV generates an SOC signal for the ADC associated with the same EV module when the board's general-purpose (GP) timer counter reaches a hexadecimal value of FFFF.
- **Period interrupt** — The EV generates an SOC signal for the ADC associated with the same EV module when the value in GP timer matches the value in the period register. The value set in **Waveform period** above determines the value in the register.

---

**Note** If you select **Period interrupt** and specify a sampling time less than the specified **(Waveform period)/(Event timer clock speed)**, zero-order hold interpolation will occur. (For example, if you enter 64000 as the waveform period, the period for the timer is  $64000/75 \text{ MHz} = 8.5333\text{e-}004$ . If you enter a **Sample time** in the C281x ADC dialog box that is less than this result, it will cause zero-order hold interpolation.)

---

- **Compare interrupt** — The EV generates an SOC signal for the ADC associated with the same EV module when the value in the GP timer matches the value in the compare register. The value set in **Duty cycle** above determines the value in the register.

## See Also

“CAN-Based Control of PWM Duty Cycle”

“SPI-Based Control of PWM Duty Cycle”

“ADC-PWM Synchronization via ADC Interrupt”

C281x ADC

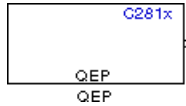
# C281x QEP

---

**Purpose** Quadrature encoder pulse circuit

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

**Description**

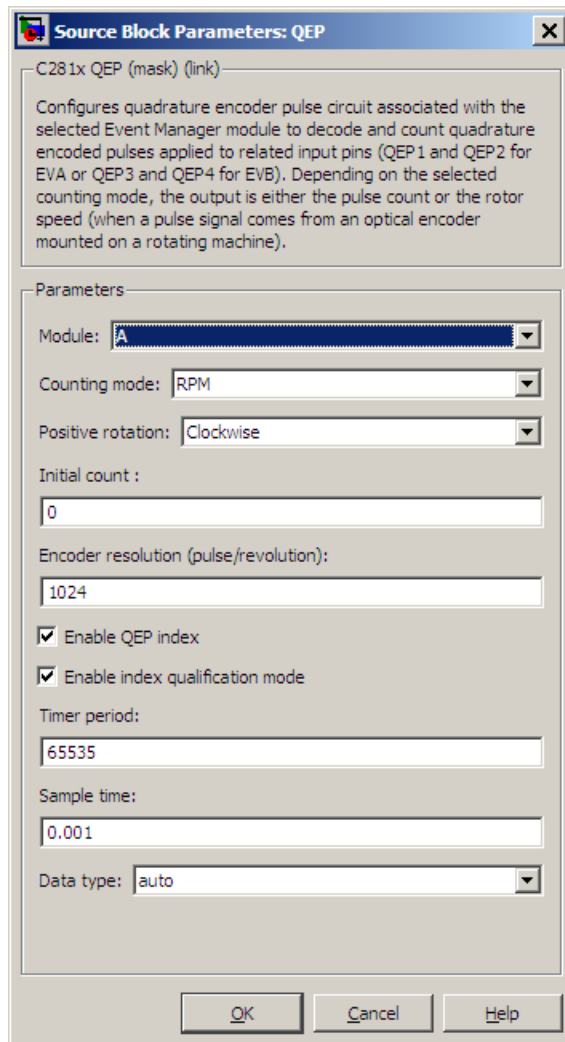


Each F2812 Event Manager has three capture units, which can log transitions on its capture unit pins. Event Manager A (EVA) uses capture units 1, 2, and 3. Event Manager B (EVB) uses capture units 4, 5, and 6.

The quadrature encoder pulse (QEP) circuit decodes and counts quadrature encoded input pulses on these capture unit pins. QEP pulses are two sequences of pulses with varying frequency and a fixed phase shift of 90 degrees (or one-quarter of a period). The circuit counts both edges of the QEP pulses, so the frequency of the QEP clock is four times the input sequence frequency.

The QEP, in combination with an optical encoder, is useful for obtaining speed and position information from a rotating machine. Logic in the QEP circuit determines the direction of rotation by which sequence is leading. For module A, if the QEP1 sequence leads, the general-purpose (GP) Timer counts up and if the QEP2 sequence leads, the timer counts down. The pulse count and frequency determine the angular position and speed.

The C281x QEP module shares GP Timers with other C281 blocks. For more information and guidance on sharing timers, see “Sharing General Purpose Timers between C281x Peripherals”.



## Dialog Box

### Module

Specify which QEP pins to use:

- A — Uses QEP1 and QEP2 pins.

- B — Uses QEP3 and QEP4 pins.

## Counting mode

Specify how to count the QEP pulses:

- Counter — Count the pulses based on GP Timer 2 (or GP Timer 4 for EVB).
- RPM — Count the rotations per minute.

## Positive rotation

Defines whether to use `Clockwise` or `Counterclockwise` as the direction to use as positive rotation. This field appears only if you select RPM.

## Initial count

Initial value for the counter. The value defaults to 0.

## Encoder resolution (pulse/revolution)

Number of QEP pulses per revolution. This field appears only if you select RPM.

## Enable QEP index

Reset the QEP counter to zero when the QEP index input on CAP3\_QEPI1 transitions from low to high.

## Enable index qualification mode

Qualify the QEP index input on CAP3\_QEPI1. Check that the levels on CAP1\_QEP1 and CAP2\_QEP2 are high before asserting the index signal as valid.

## Timer period

Set the length of the timer period in clock cycles. Enter a value from 0 to 65535. The value defaults to 65535.

If you know the length of a clock cycle, you can easily calculate how many clock cycles to set for the timer period. The following calculation determines the length of one clock cycle:

$$\text{Sysclk}(150\text{MHz}) \rightarrow \text{HISPCLK}(1/2) \rightarrow \text{InputClockPr escaler}(1/128)$$

In this calculation, you divide the System clock frequency of 150 MHz by the high-speed clock prescaler of 2. Then, you divide the resulting value by the timer control input clock prescaler, 128. The resulting frequency is 0.586 MHz. Thus, one clock cycle is 1/.586 MHz, which is 1.706  $\mu$ s.

**Sample time**

Time interval, in seconds, between consecutive reads from the QEP pins.

**Data type**

Data type of the QEP pin data. The circuit reads the data as 16-bit data and then casts it to the selected data type. Valid data types are `auto`, `double`, `single`, `int8`, `uint8`, `int16`, `uint16`, `int32`, `uint32` or `boolean`.

**References**

For more information on the QEP module, consult the following documents, available at the Texas Instruments Web site:

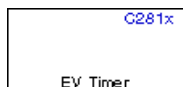
- *TMS320x280x, 2801x, 2804x Enhanced Quadrature Encoder Pulse (eQEP) Module Reference Guide*, Literature Number SPRU790
- *Using the Enhanced Quadrature Encoder Pulse (eQEP) Module in TMS320x280x, 28xxx as a Dedicated Capture Application Report*, Literature Number SPRAAH1

# C281x Timer

---

**Purpose** Configure general-purpose timer in Event Manager module

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

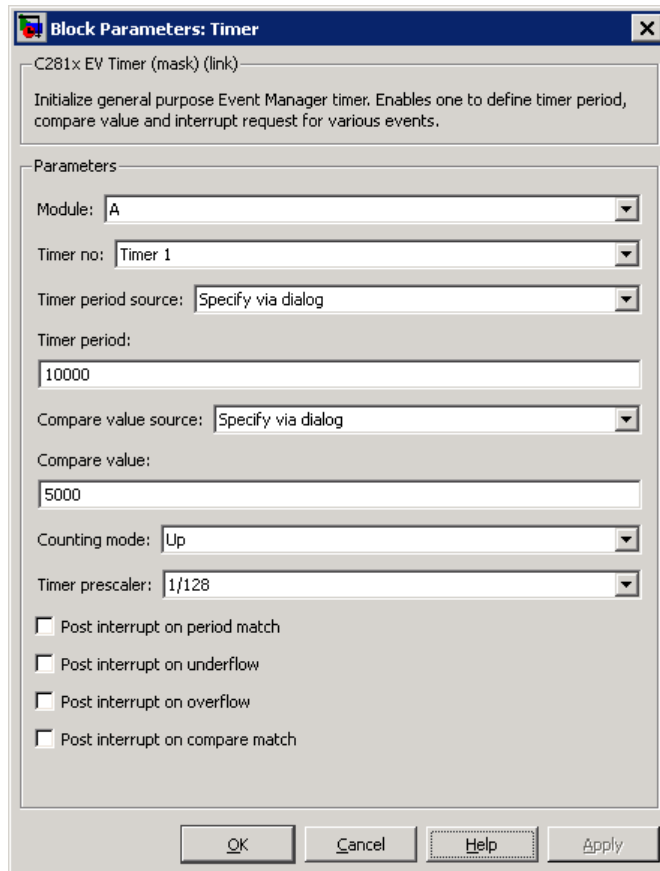


## Description

The C281x contains two event-manager (EV) modules. Each module contains two general-purpose (GP) timers. You can use these timers as independent time bases for various applications.

Use the C281x Timer block to set the periodicity of one GP timer and the conditions under which it posts interrupts. Each model can contain up to four C281x Timer blocks.

The C281x Timer module configures GP Timers that other C281 blocks share. For more information and guidance on sharing timers, see “Sharing General Purpose Timers between C281x Peripherals”.



## Dialog Box

### Module

#### Timer no

Select which of four possible timers to configure. Setting **Module** to A lets you select **Timer 1** or **Timer 2** in **Timer no**. Setting **Module** to B lets you select **Timer 3** or **Timer 4** in **Timer no**.

#### Clock source

When **Timer no** has a value of **Timer 2** or **Timer 4**, use this parameter to select the clock source for the event timer. You

can choose either Internal or QEP circuit. When you select Internal, you can configure other options such as **Timer period source**, **Counting mode**, and **Timer prescaler**.

## Timer period source

Select the source of the event timer period. Use Specify via dialog to set the period using **Timer period**. Select Input port to create an input, **T**, that accepts the value of the timer period in clock cycles, from 0 to 65535. **Timer period source** becomes unavailable when **Clock source** is set to QEP circuit.

## Timer period

Set the length of the timer period in clock cycles. Enter a value from 0 to 65535. The value defaults to 10000.

If you know the length of a clock cycle, you can easily calculate how many clock cycles to set for the timer period. The following calculation determines the length of one clock cycle:

$$\text{Sysclk}(150\text{MHz}) \rightarrow \text{HISPCLK}(1/2) \rightarrow \text{InputClockPr escaler}(1/128)$$

In this calculation, you divide the System clock frequency of 150 MHz by the high-speed clock prescaler of 2. Then, you divide the resulting value by the timer control input clock prescaler, 128. The resulting frequency is 0.586 MHz. Thus, one clock cycle is 1/.586 MHz, which is 1.706  $\mu\text{s}$ .

## Compare value source

Select the source of the compare value. Use Specify via dialog to set the period using the **Compare value** parameter. Select Input port to create a block input, **W**, that accepts the value of the compare value, from 0 to 65535.

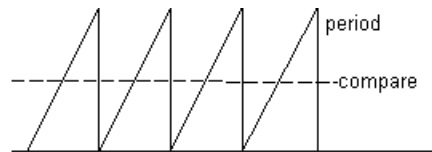
## Compare value

Enter a constant value for comparison to the running timer value for generating interrupts. Enter a value from 0 to 65535. The value defaults to 5000. The timer only generates interrupts if you enable **Post interrupt on compare match**.



## Counting mode

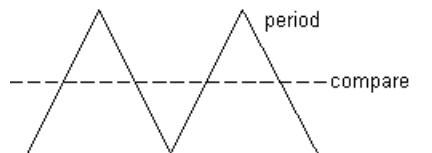
Select **Up** to generate an asymmetrical waveform output, or **Up-down** to generate a symmetrical waveform output, as shown in the following illustration.



**Mode: Up/Asymmetric**



**Resulting waveform**



**Mode: Up-down/Symmetric**



**Resulting waveform**

When you specify the **Counting mode** as **Up** (asymmetric) the waveform:

- Starts low
- Goes high when the rising period counter value matches the **Compare value**
- Goes low at the end of the period

# C281x Timer

---

When you specify the **Counting mode** as Up-down (symmetric) the waveform:

- Starts low
- Goes high when the increasing period counter value matches the **Compare value**
- Goes low when the decreasing period counter value matches the **Compare value**

**Counting mode** becomes unavailable when **Clock source** is set to QEP circuit.

## Timer prescaler

Divide the clock input to produce the desired timer counting rate.

**Timer prescaler** becomes unavailable when **Clock source** is set to QEP circuit.

## Post interrupt on period match

Generate an interrupt when the value of the timer reaches its maximum value as specified in **Timer period**.

## Post interrupt on underflow

Generate an interrupt when the value of the timer cycles back to 0.

## Post interrupt on overflow

Generate an interrupt when the value of the timer reaches its maximum, 65535. Also set **Timer period** to 65535 for this parameter to work.

## Post interrupt on compare match

Generate an interrupt when the value of the timer equals **Compare value**.

## References

*TMS320x281x DSP Event Manager (EV) Reference Guide*, Literature Number: SPRU065, available from the Texas Instruments Web site.

## See Also

C28x Hardware Interrupt, Idle Task

## Purpose

Configure counter reset source of DSP Watchdog module

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2802x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2803x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2805x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2806x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C280x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C281x

Embedded Coder Support Package for Texas Instruments C2000 Processors/ C28x3x

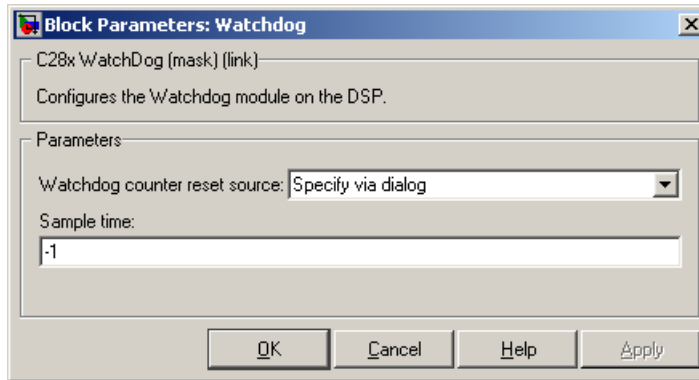
Embedded Coder Support Package for Texas Instruments C2000 Processors/ C2834x



## Description

This block configures the counter reset source of the Watchdog module on the DSP.

# C28x Watchdog



## Dialog Box

### Watchdog counter reset source

- **Input** — Create an input port on the watchdog block. The input signal resets the counter.
- **Specify via dialog** — Use the value of **Sample time** to reset the watchdog timer.

### Sample time

The interval at which the DSP resets the watchdog timer. When you set this value to -1, the model inherits the sample time value of the model. To execute this block asynchronously, set **Sample Time** to -1, and refer to “” for a discussion of block placement and other settings.

## See Also

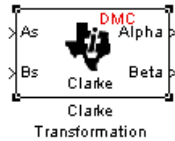
“Watchdog” on page 3-297

## Purpose

Convert balanced three-phase quantities to balanced two-phase quadrature quantities

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



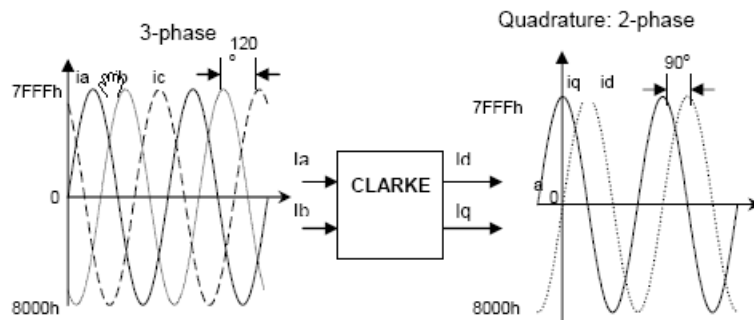
## Description

This block converts balanced three-phase quantities into balanced two-phase quadrature quantities. The transformation implements these equations

$$I_d = I_a$$

$$I_q = (2I_b + I_a) / \sqrt{3}$$

and is illustrated in the following figure.

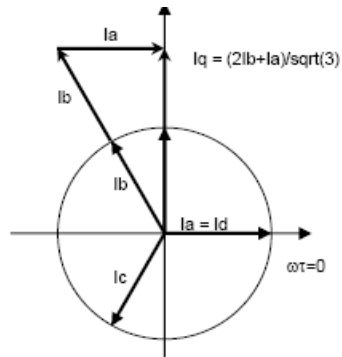


The inputs to this block are the phase a (As) and phase b (Bs) components of the balanced three-phase quantities and the outputs are the direct axis (Alpha) component and the quadrature axis (Beta) of the transformed signal.

# C2000 Clarke Transformation

The instantaneous outputs are defined by the following equations and are shown in the following figure:

$$\begin{aligned}
 ia &= I * \sin(\omega t) \\
 ib &= I * \sin(\omega t + 2\pi/3) \\
 ic &= I * \sin(\omega t - 2\pi/3) \\
 id &= I * \sin(\omega t) \\
 iq &= I * \sin(\omega t + \pi/2)
 \end{aligned}$$



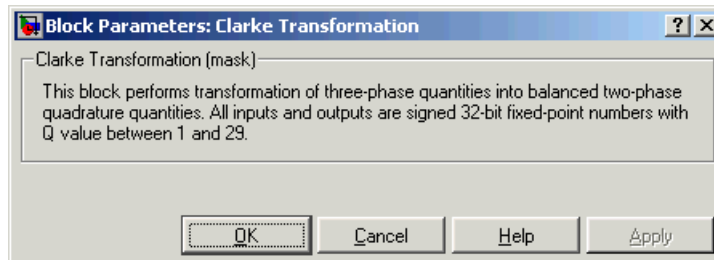
The variables used in the preceding equations and figures correspond to the variables on the block as shown in the following table:

|         | <b>Equation Variables</b> | <b>Block Variables</b> |
|---------|---------------------------|------------------------|
| Inputs  | ia                        | As                     |
|         | ib                        | Bs                     |
| Outputs | id                        | Alpha                  |
|         | iq                        | Beta                   |

---

## Note

- To generate optimized code from this block, enable the TI C28x or TI C28x (ISO) CRL. See “About Code Replacement and Optimization”.
  - The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.
- 



## Dialog Box

## References

For detailed information on the DMC library, see *C/F 28xx Digital Motor Control Library*, Literature Number SPRC080, available at the Texas Instruments Web site.

## See Also

C2000 Inverse Park Transformation, C2000 Park Transformation, C2000 PID Controller, C2000 Space Vector Generator, C2000 Speed Measurement

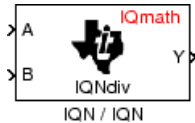
# C2000 Division IQN

---

**Purpose** Divide IQ numbers

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



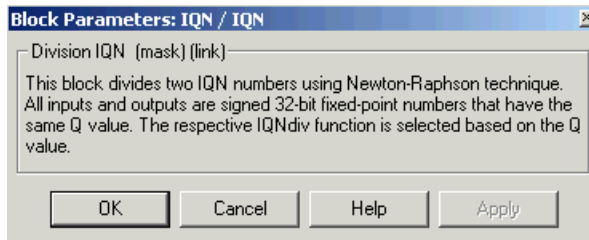
This block divides two numbers that use the same Q format, using the Newton-Raphson technique. The resulting quotient uses the same Q format at the inputs.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).



### **See Also**

C2000 Absolute IQN, c2000 Arctangent IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

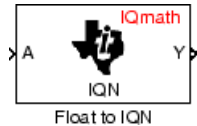
# C2000 Float to IQN

---

**Purpose** Convert floating-point number to IQ number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC

## Description



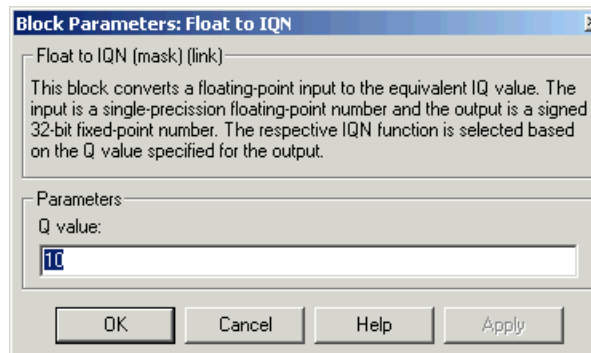
This block converts a floating-point number to an IQ number. The Q value of the output is specified in the dialog.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



### Q value

Q value from 1 to 30 that specifies the precision of the output

## References

For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

## See Also

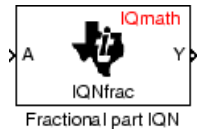
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

# C2000 Fractional part IQN

---

**Purpose** Fractional part of IQ number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath



## Description

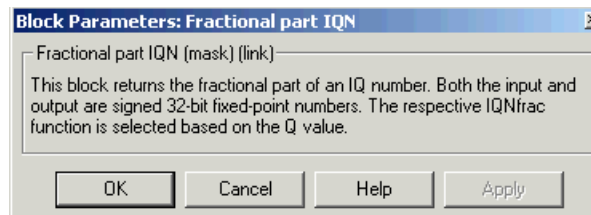
This block returns the fractional portion of an IQ number. The returned value is an IQ number in the same IQ format.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

### **See Also**

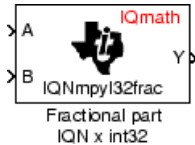
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

# C2000 Fractional part IQN x int32

---

**Purpose** Fractional part of result of multiplying IQ number and long integer

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath



## Description

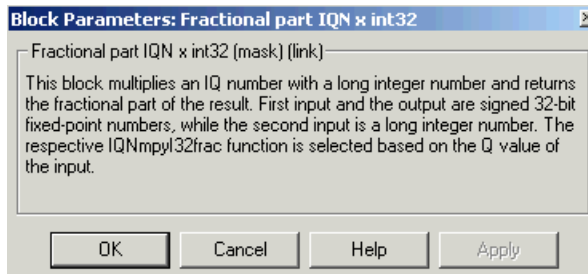
This block multiplies an IQ input and a long integer input and returns the fractional portion of the resulting IQ number.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

### **See Also**

C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

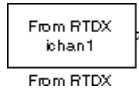
# C2000 From RTDX

---

**Purpose** Add RTDX communication channel for target to receive data from host

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ RTDX Instrumentation

**Description**



---

**Note** This block will be removed from the Embedded Coder product in an upcoming release.

---

---

**Note** To use RTDX for C28x host/target communications, download and install TI DSP/BIOS™. The DSP/BIOS installation includes files required for RTDX communications. For more information, see *DSP/BIOS, RTDX and Host-Target Communications*, Literature Number SPRA895, available at the Texas Instruments Web site.

---

When you generate code from Simulink in Simulink Coder software with a From RTDX block in your model, code generation inserts the C commands to create an RTDX input channel on the target. Input channels transfer data from the host to the target.

The generated code contains this command:

```
RTDX_enableInput(&channelname)
```

where channelname is the name you enter in **Channel name**.



---

**Note** From RTDX blocks work only in code generation and when your model runs on your target. In simulations, this block does not perform operations, except generating an output matching your specified initial conditions.

---

To use RTDX blocks in your model, you must do the following:

- 1 Add one or more To RTDX or From RTDX blocks to your model.
- 2 Download and run your model on your target.
- 3 Enable the RTDX channels from MATLAB or use **Enable RTDX channel on start-up** on the block dialog.
- 4 Use the `readmsg` and `writemsg` functions on the MATLAB command line to send and retrieve data from the target over RTDX.

For more information about using RTDX in your model, see the following examples:

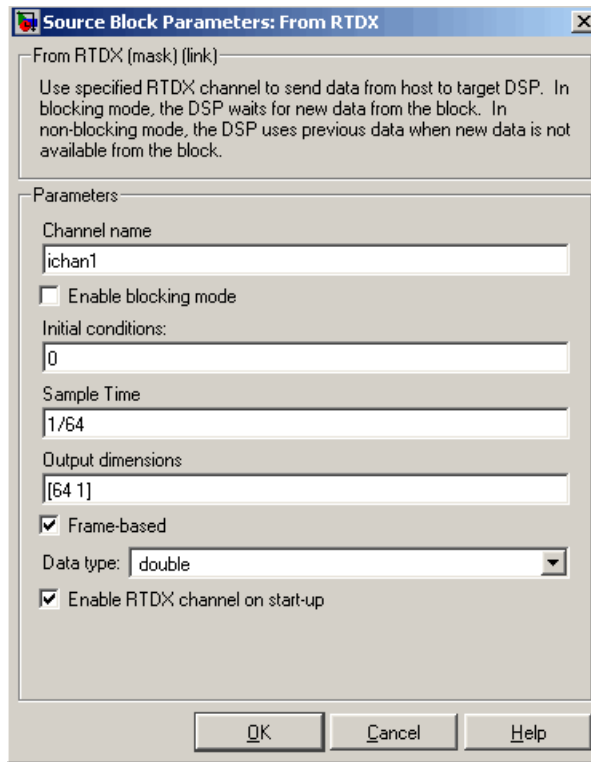
- Real-Time Data Exchange (RTDX™) Tutorial
- Comparing Simulation and Target Implementation with RTDX
- Real-Time Data Exchange via RTDX
- DC Motor Speed Control via RTDX™

---

**Note** To use RTDX with the XDS100 USB JTAG Emulator and the C28027 chip, add the following line to the linker command file:

```
_RTDX_interrupt_mask = -0x00000008;
```

---



## Dialog Box

### Channel name

Name of the input channel to be created by the generated code. The channel name must meet C syntax requirements for length and character content.

### Enable blocking mode

Blocking mode instructs the target processor to pause processing until new data is available from the From RTDX block. If you enable blocking and new data is not available when the processor needs it, your process stops. In nonblocking mode, the processor uses old data from the block when new data is not available.

Nonblocking operation is the default and is recommended for most operations.

## **Initial conditions**

Data the processor reads from RTDX for the first read. If blocking mode is not enabled, you must have an entry for this option. Leaving the option blank causes an error in Simulink Coder software. Valid values are 0, null ([ ]), or a scalar. The default value is 0.

0 or null ([ ]) outputs a zero to the processor. A scalar generates one output sample with the value of the scalar. If **Output dimensions** specifies an array, every element in the array has the same scalar or zero value. A null array ([ ]) outputs a zero for every sample.

## **Sample time**

Time between samples of the signal. The value defaults to 1 second. This produces a sample rate of one sample per second ( $1/\text{Sample time}$ ).

## **Output dimensions**

Dimensions of a matrix for the output signal from the block. The first value is the number of rows and the second is the number of columns. For example, the default setting [ 1 64 ] represents a 1-by-64 matrix of output values. Enter a 1-by-2 vector for the dimensions.

## **Frame-based**

Sets a flag at the block output that directs downstream blocks to use frame-based processing on the data from this block. In frame-based processing, the samples in a frame are processed simultaneously. In sample-based processing, samples are processed one at a time. Frame-based processing can increase the speed of your application running on your target. Throughput remains the same in samples per second processed. Frame-based operation is the default.

## Data type

Type of data coming from the block. Select one of the following types:

- **Double** — Double-precision floating-point values. This is the default. Values range from -1 to 1.
- **Single** — Single-precision floating-point values ranging from -1 to 1.
- **Uint8** — 8-bit unsigned integers. Output values range from 0 to 255.
- **Int16** — 16-bit signed integers. With the sign, the values range from -32768 to 32767.
- **Int32** — 32-bit signed integers. Values range from  $-2^{31}$  to  $(2^{31}-1)$ .

## Enable RTDX channel on start-up

Enables the RTDX channel when you start the channel from MATLAB. With this selected, you do not need to use the `enable` function to prepare your RTDX channels. This option applies only to the channel you specify in **Channel name**. You do have to open the channel.

## See Also

“Real-Time Data Exchange via RTDX™”

`ticcs`, `readmsg`, `C2000 To RTDX`, `writemsg`.

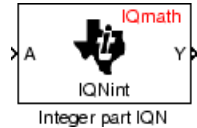
## References

*RTDX 2.0 User's Guide*, Literature Number: SPRUFC7, available from the Texas Instruments Web site.

*How to Write an RTDX Host Application Using MATLAB*, Literature Number: SPRA386, available from the Texas Instruments Web site.

**Purpose** Integer part of IQ number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath



## Description

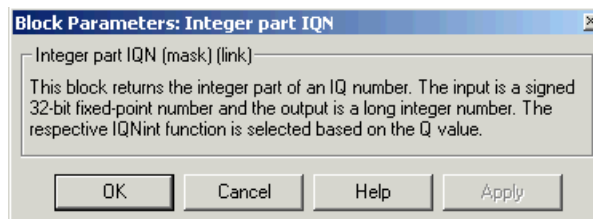
This block returns the integer portion of an IQ number. The returned value is a long integer.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

# C2000 Integer part IQN

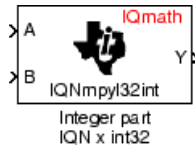
---

## **See Also**

C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

**Purpose** Integer part of result of multiplying IQ number and long integer

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath



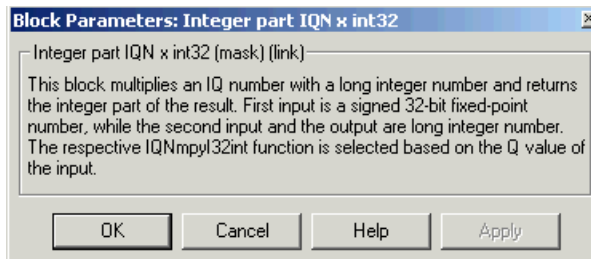
## Description

This block multiplies an IQ input and a long integer input and returns the integer portion of the resulting IQ number as a long integer.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---



## Dialog Box

## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

## C2000 Integer part IQN x int32

---

### **See Also**

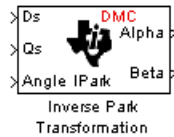
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN



# C2000 Inverse Park Transformation

**Purpose** Convert rotating reference frame vectors to two-phase stationary reference frame

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



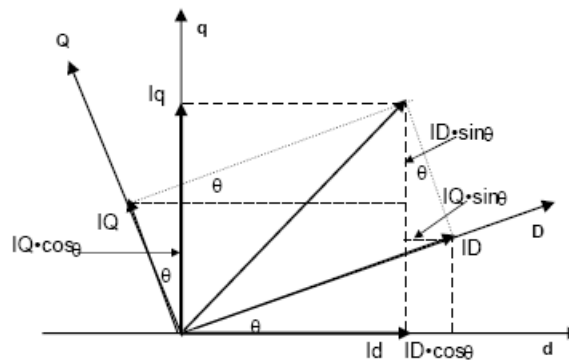
## Description

This block converts vectors in an orthogonal rotating reference frame to a two-phase orthogonal stationary reference frame. The transformation implements these equations:

$$I_d = I_D \cdot \cos \theta - I_Q \cdot \sin \theta$$

$$I_q = I_D \cdot \sin \theta + I_Q \cdot \cos \theta$$

and is illustrated in the following figure.



The inputs to this block are the direct axis (Ds) and quadrature axis (Qs) components of the transformed signal in the rotating frame and the phase angle (Angle) between the stationary and rotating frames.

# C2000 Inverse Park Transformation

---

The outputs are the direct axis (Alpha) and the quadrature axis (Beta) components of the transformed signal.

The variables used in the preceding figure and equations correspond to the block variables as shown in the following table:

|         | <b>Equation Variables</b> | <b>Block Variables</b> |
|---------|---------------------------|------------------------|
| Inputs  | ID                        | Ds                     |
|         | IQ                        | Qs                     |
|         | $\theta$                  | Angle                  |
| Outputs | id                        | Alpha                  |
|         | iq                        | Beta                   |

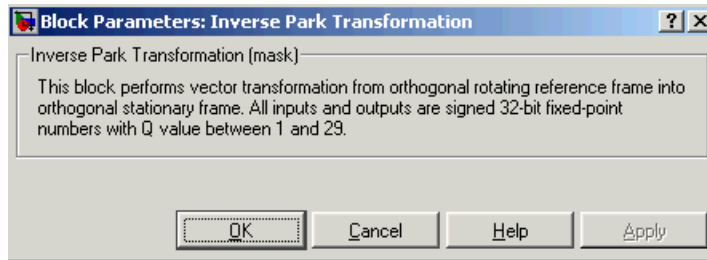
---

## Note

- To generate optimized code from this block, enable the TI C28x or TI C28x (ISO) Code Replacement Library. See “About Code Replacement and Optimization”.
  - The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.
-

# C2000 Inverse Park Transformation

---



## Dialog Box

## References

For detailed information on the DMC library, see *C/F 28xx Digital Motor Control Library*, Literature Number SPRC080, available at the Texas Instruments Web site.

## See Also

C2000 Clarke Transformation, C2000 Park Transformation, C2000 PID Controller, C2000 Space Vector Generator, C2000 Speed Measurement

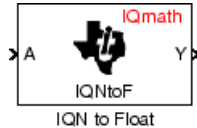
# C2000 IQN to Float

---

**Purpose** Convert IQ number to floating-point number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



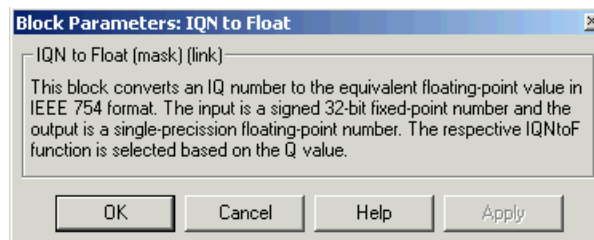
This block converts an IQ input to an equivalent floating-point number. The output is a single floating-point number.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

### **See Also**

C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

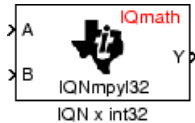
# C2000 IQN x int32

---

**Purpose** Multiply IQ number with long integer

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



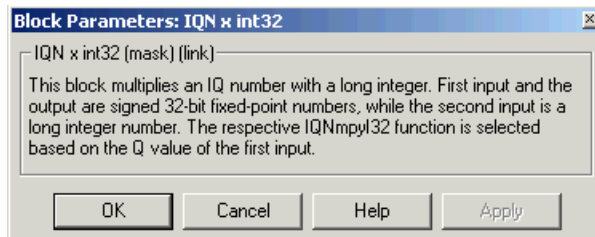
This block multiplies an IQ input and a long integer input and produces an IQ output of the same Q value as the IQ input.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user’s guide is included in the zip file download that also contains the IQmath library (registration required).

### **See Also**

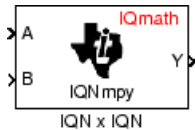
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

# C2000 IQN x IQN

**Purpose** Multiply IQ numbers with same Q format

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



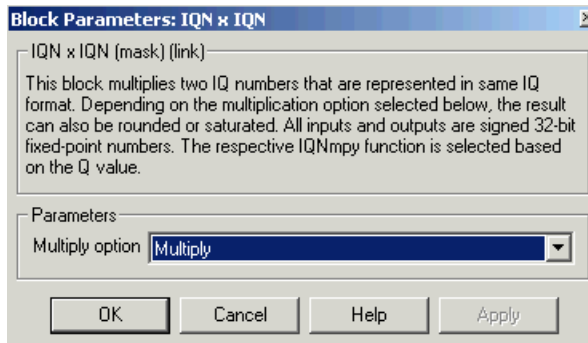
This block multiplies two IQ numbers. Optionally, it can also round and saturate the result.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



### Multiply option

Type of multiplication to perform:

- Multiply — Multiply the numbers.



- **Multiply with Rounding** — Multiply the numbers and round the result.
- **Multiply with Rounding and Saturation** — Multiply the numbers and round and saturate the result to the maximum value.

## References

For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

## See Also

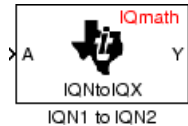
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

# C2000 IQN1 to IQN2

**Purpose** Convert IQ number to different Q format

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



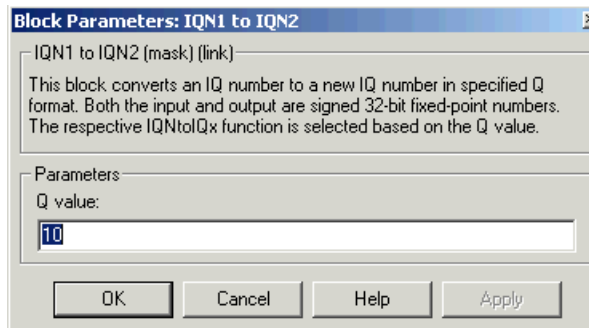
This block converts an IQ number in a particular Q format to a different Q format.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



### Q value

Q value from 1 to 30 that specifies the precision of the output

## References

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature

Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

### **See Also**

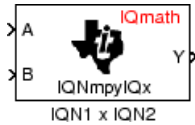
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

# C2000 IQN1 x IQN2

**Purpose** Multiply IQ numbers with different Q formats

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



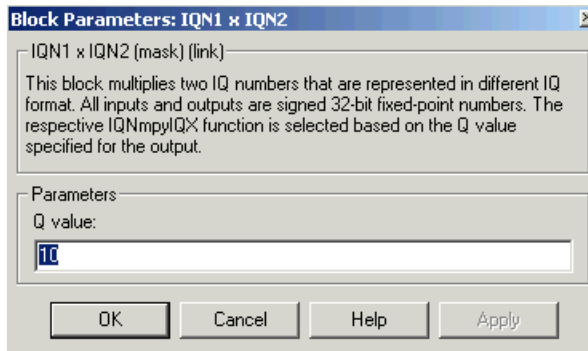
This block multiplies two IQ numbers when the numbers are represented in different Q formats. The format of the result is specified in the dialog box.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



### Q value

Q value from 1 to 30 that specifies the precision of the output

## References

For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

## See Also

C2000 Absolute IQN, C2000 Arc tangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

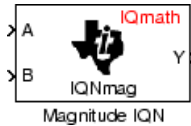
# C2000 Magnitude IQN

---

**Purpose** Magnitude of two orthogonal IQ numbers

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

**Description**



This block calculates the magnitude of two IQ numbers using

$$\sqrt{a^2 + b^2}$$

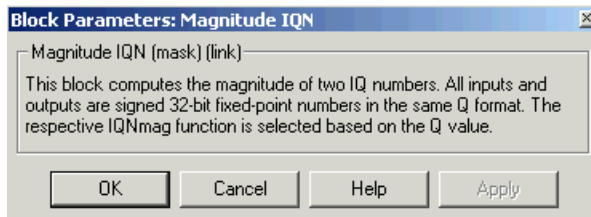
The output is an IQ number in the same Q format as the input.

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**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

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**Dialog Box**



**References**

For detailed information on the IQmath library, see the user’s guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The

user's guide is included in the zip file download that also contains the IQmath library (registration required).

### **See Also**

C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Saturate IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

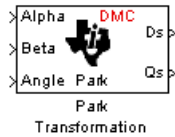
# C2000 Park Transformation

## Purpose

Convert two-phase stationary system vectors to rotating system vectors

## Library

Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



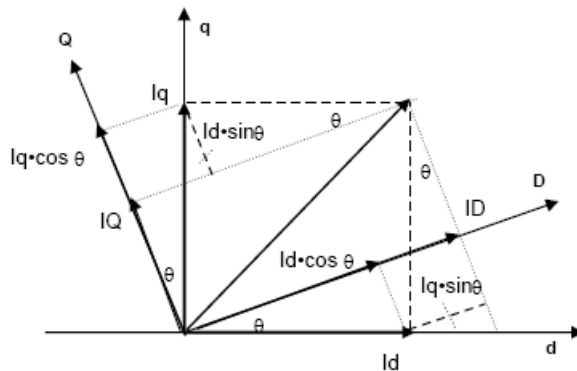
## Description

This block converts vectors in balanced two-phase orthogonal stationary systems into an orthogonal rotating reference frame. The transformation implements these equations

$$ID = Id * \cos \theta + Iq * \sin \theta$$

$$IQ = -Id * \sin \theta + Iq * \cos \theta$$

and is illustrated in the following figure.



The variables used in the preceding figure and equations correspond to the block variables as shown in the following table:



|         | Equation Variables | Block Variables |
|---------|--------------------|-----------------|
| Inputs  | id                 | Alpha           |
|         | iq                 | Beta            |
|         | $\theta$           | Angle           |
| Outputs | ID                 | Ds              |
|         | IQ                 | Qs              |

The inputs to this block are the direct axis (Alpha) and the quadrature axis (Beta) components of the transformed signal and the phase angle (Angle) between the stationary and rotating frames.

The outputs are the direct axis (Ds) and quadrature axis (Qs) components of the transformed signal in the rotating frame.

The instantaneous inputs are defined by the following equations:

$$id = I * \sin(\omega t)$$

$$iq = I * \sin(\omega t + \pi/2)$$

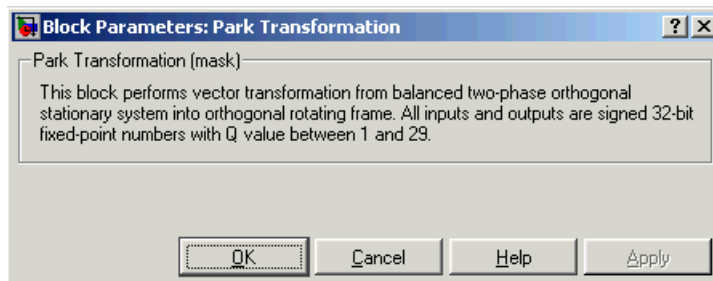
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## Note

- To generate optimized code from this block, enable the TI C28x or TI C28x (ISO) Code Replacement Library. See “About Code Replacement and Optimization”.
  - The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.
-

# C2000 Park Transformation

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## Dialog Box

## References

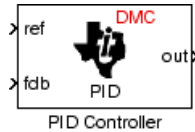
For detailed information on the DMC library, see *C/F 28xx Digital Motor Control Library*, Literature Number SPRC080, available at the Texas Instruments Web site.

## See Also

C2000 Clarke Transformation, C2000 Inverse Park Transformation, C2000 PID Controller, C2000 Space Vector Generator, C2000 Speed Measurement

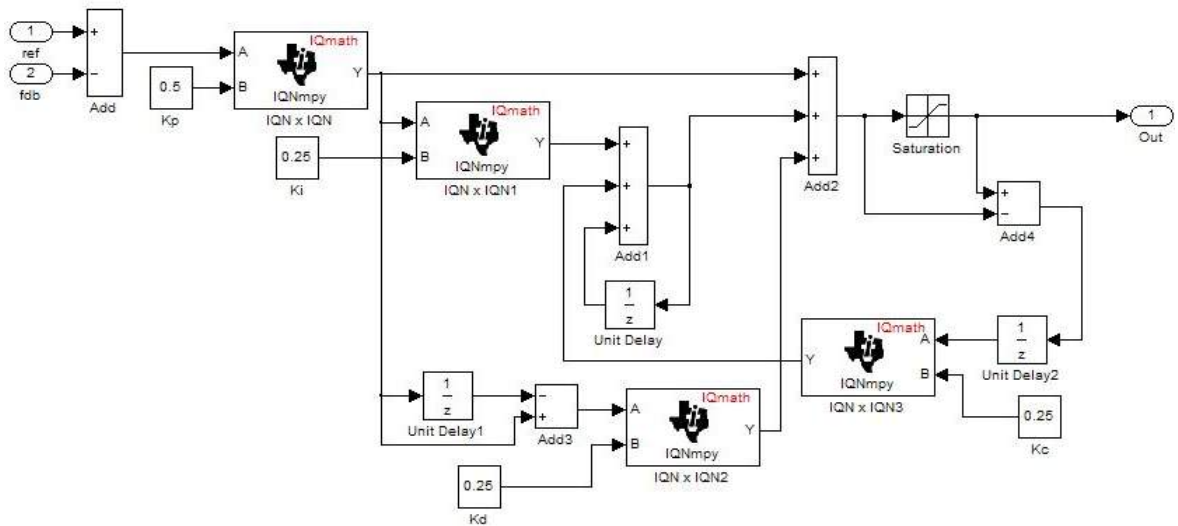
**Purpose** Digital PID controller

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



## Description

This block implements a 32-bit digital PID controller with antiwindup correction. The inputs are a reference input (ref) and a feedback input (fdb) and the output (out) is the saturated PID output. The following diagram shows a PID controller with antiwindup.



The differential equation describing the PID controller before saturation that is implemented in this block is

$$u_{presat}(t) = u_p(t) + u_i(t) + u_d(t)$$

# C2000 PID Controller

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where  $u_{presat}$  is the PID output before saturation,  $u_p$  is the proportional term,  $u_i$  is the integral term with saturation correction, and  $u_d$  is the derivative term.

The proportional term is

$$u_p(t) = K_p e(t)$$

where  $K_p$  is the proportional gain of the PID controller and  $e(t)$  is the error between the reference and feedback inputs.

The integral term with saturation correction is

$$u_i(t) = \int_0^t \left\{ \frac{K_p}{T_i} e(\tau) + K_c (u(\tau) - u_{presat}(\tau)) \right\} d\tau$$

where  $K_c$  is the integral correction gain of the PID controller.

The derivative term is

$$u_d(t) = K_p T_d \frac{de(t)}{dt}$$

where  $T_d$  is the derivative time of the PID controller. In discrete terms, the derivative gain is defined as  $K_d = T_d/T$ , and the integral gain is defined as  $K_i = T/T_i$ , where  $T$  is the sampling period and  $T_i$  is the integral time of the PID controller.

Using backward approximation, the preceding differential equations can be transformed into the following discrete equations.

$$u_p[n] = K_p e[n]$$

$$u_i[n] = u_i[n-1] + K_i K_p e[n] + K_c (u[n-1] - u_{presat}[n-1])$$

$$u_d[n] = K_d K_p (e[n] - e[n-1])$$

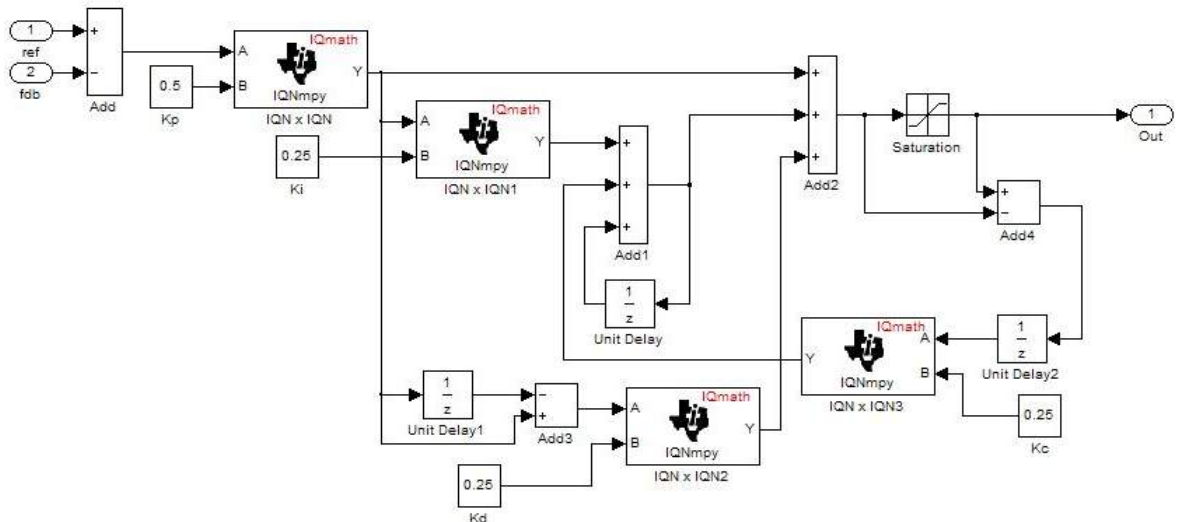
$$u_{presat}[n] = u_p[n] + u_i[n] + u_d[n]$$

$$u[n] = \text{SAT}(u_{presat}[n])$$

## Note

- To generate optimized code from this block, enable the TI C28x or TI C28x (ISO) Code Replacement Library. See “About Code Replacement and Optimization”.
- The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

This block implements a 32-bit digital PID controller with antiwindup correction. The inputs are a reference input (ref) and a feedback input (fdb) and the output (out) is the saturated PID output. The following diagram shows a PID controller with antiwindup.



## C2000 PID Controller

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The differential equation describing the PID controller before saturation that is implemented in this block is

$$u_{presat}(t) = u_p(t) + u_i(t) + u_d(t)$$

where  $u_{presat}$  is the PID output before saturation,  $u_p$  is the proportional term,  $u_i$  is the integral term with saturation correction, and  $u_d$  is the derivative term.

The proportional term is

$$u_p(t) = K_p e(t)$$

where  $K_p$  is the proportional gain of the PID controller and  $e(t)$  is the error between the reference and feedback inputs

$$u_i(t) = \int_0^t \left\{ \frac{K_p}{T_i} e(\tau) + K_c (u(\tau) - u_{presat}(\tau)) \right\} d\tau$$

where  $K_c$  is the integral correction gain of the PID controller.

The derivative term is

$$u_d(t) = K_p T_d \frac{de(t)}{dt}$$

where  $T_d$  is the derivative time of the PID controller. In discrete terms, the derivative gain is defined as  $K_d = T_d/T$ , and the integral gain is defined as  $K_i = T/T_i$ , where  $T$  is the sampling period and  $T_i$  is the integral time of the PID controller.

Using backward approximation, the preceding differential equations can be transformed into the following discrete equations.

$$u_p[n] = K_p e[n]$$

$$u_i[n] = u_i[n-1] + K_i K_p e[n] + K_c (u[n-1] - u_{presat}[n-1])$$

$$u_d[n] = K_d K_p (e[n] - e[n-1])$$

$$u_{presat}[n] = u_p[n] + u_i[n] + u_d[n]$$

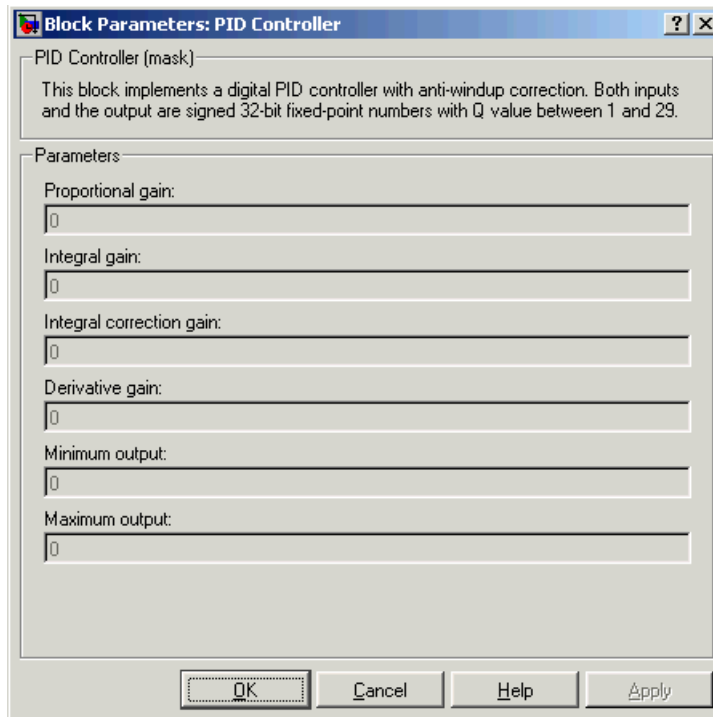
$$u[n] = SAT(u_{presat}[n])$$

---

## Note

- To generate optimized code from this block, enable the TI C28x or TI C28x (ISO) Code Replacement Library. See “About Code Replacement and Optimization”.
  - The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.
-

# C2000 PID Controller



## Dialog Box

### Proportional gain

Amount of proportional gain ( $K_p$ ) to apply to the PID

### Integral gain

Amount of gain ( $K_i$ ) to apply to the integration equation

### Integral correction gain

Amount of correction gain ( $K_c$ ) to apply to the integration equation

### Derivative gain

Amount of gain ( $K_d$ ) to apply to the derivative equation.

### Minimum output

Minimum allowable value of the PID output



**Maximum output**

Maximum allowable value of the PID output

**References**

For detailed information on the DMC library, see *C/F 28xx Digital Motor Control Library*, Literature Number SPRC080, available at the Texas Instruments Web site.

**See Also**

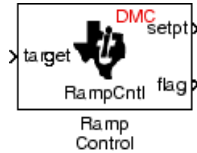
C2000 Clarke Transformation, C2000 Inverse Park Transformation, C2000 Park Transformation, C2000 Space Vector Generator, C2000 Speed Measurement

# C2000 Ramp Control

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**Purpose** Create ramp-up and ramp-down function

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



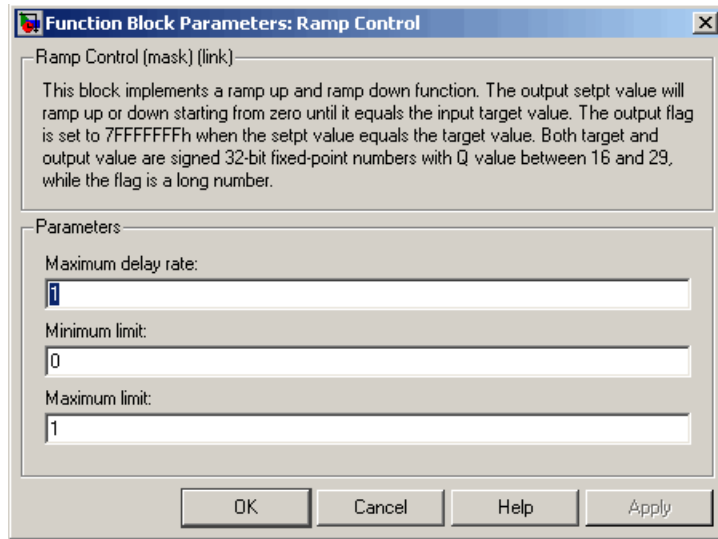
## Description

This block implements a ramp-up and ramp-down function. The input is a `target` value and the outputs are the set point value (`setpt`) and a `flag`. The `flag` output is set to `7FFFFFFFh` when the output `setpt` value reaches the input `target` value. The `target` and `setpt` values are signed 32-bit fixed-point numbers with  $Q$  values between 16 and 29. The `flag` is a long number.

The `target` value is compared with the `setpt` value. If they are not equal, the output `setpt` is adjusted up or down by a fixed step size (0.0000305).

If the fixed step size is relatively large compared to the `target` value, the output may oscillate around the `target` value.

## Dialog Box



### Maximum delay rate

Value that is multiplied by the sampling loop time period to determine the time delay for each ramp step. Valid values are integers greater than 0.

### Minimum limit

Minimum allowable ramp value. If the input falls below this value, it will be saturated to this minimum. The smallest value you can enter is the minimum value that can be represented in fixed-point data format by the input and output blocks to which this Ramp Control block is connected in your model. If you enter a value below this minimum, an error occurs at the start of code generation or simulation. For example, if your input is in Q29 format, its minimum value is -4.

### Maximum limit

Maximum allowable ramp value. If the input goes above this value, it will be reduced to this maximum. The largest value you can enter is the maximum value that can be represented in fixed-point data format by the input and output blocks to which

# C2000 Ramp Control

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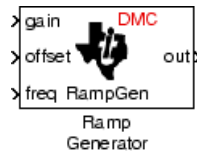
this Ramp Control block is connected in your model. If you enter a value above this maximum, an error occurs at the start of code generation or simulation. For example, if your input is in Q29 format, its maximum value is 3.9999....

## **See Also**

C2000 Ramp Generator

**Purpose** Generate ramp output

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



## Description

This block generates ramp output (*out*) from the slope of the ramp signal (*gain*), DC offset in the ramp signal (*offset*), and frequency of the ramp signal (*freq*) inputs. All of the inputs and output are 32-bit fixed-point numbers with *Q* values between 1 and 29.

## Algorithm

The block's output (*out*) at the sampling instant *k* is governed by the following algorithm:

$$\text{out}(k) = \text{angle}(k) * \text{gain}(k) + \text{offset}(k)$$

For  $\text{out}(k) > 1$ ,  $\text{out}(k) = \text{out}(k) - 1$ . For  $\text{out}(k) < -1$ ,  $\text{out}(k) = \text{out}(k) + 1$ .

Angle(*k*) is defined as follows:

$$\text{angle}(k) = \text{angle}(k-1) + \text{freq}(k) * \text{Maximum step angle}$$

$$\text{for } \text{angle}(k) > 1, \text{angle}(k) = \text{angle}(k) - 1$$

$$\text{for } \text{angle}(k) < -1, \text{angle}(k) = \text{angle}(k) + 1$$

The frequency of the ramp output is controlled by a precision frequency generation algorithm that relies on the modulo nature of the finite length variables. The frequency of the output ramp signal is equal to

$$f = (\text{Maximum step angle} * \text{sampling rate}) / 2^m$$

where *m* represents the fractional length of the data type of the inputs.

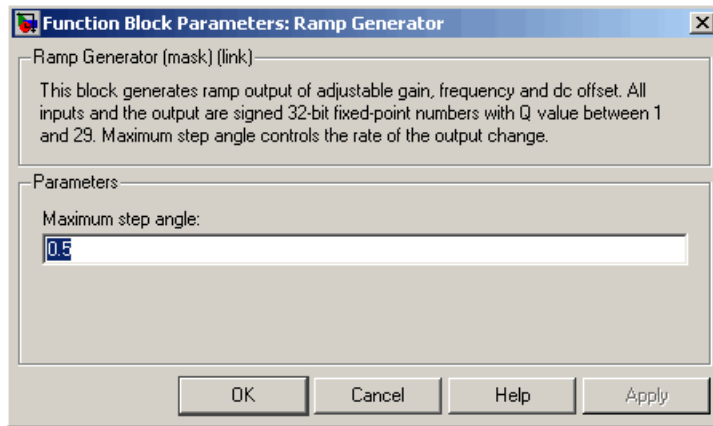
# C2000 Ramp Generator

All math operations are carried out in fixed-point arithmetic, where the fixed-point fractional length is determined by the block's inputs.

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**Note** To generate optimized code from this block, enable the TI C28x or TI C28x (IS0) Code Replacement Library. See “About Code Replacement and Optimization”.

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## Dialog Box

### Maximum step angle

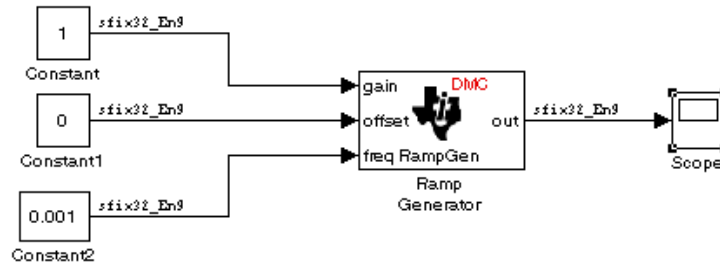
The maximum step size, which determines the rate of change of the output (i.e., the minimum period of the ramp signal).

When you enter double-precision floating-point values for parameters in the IQ Math blocks, the software converts them to single-precision values that are compatible with the behavior on c28x processor.

## Examples

The following model demonstrates the Ramp Generator block. The Constant and Scope blocks are available in Simulink Commonly Used Blocks.

# C2000 Ramp Generator

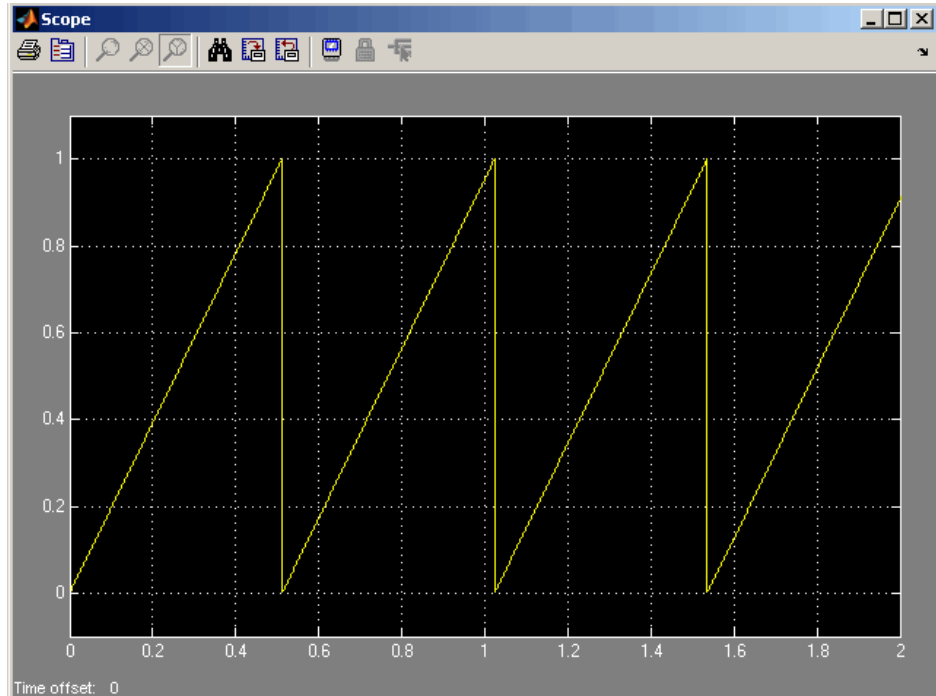


In your model, select **Simulation > Model Configuration Parameters**. On the **Solver** pane, set **Type** to Fixed-step and **Solver** to Discrete (no continuous states). Set the parameter values for the blocks as shown in the following table.

| Block                | Connects to                               | Parameter                                                                | Value                                         |
|----------------------|-------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------|
| Constant             | Ramp Generator - gain                     | Constant value<br>Sample time<br>Output data type<br>Output scalig value | 1<br>0.001<br>sfixed(32)<br>2 <sup>-9</sup>   |
| Constant             | Ramp Generator - offset                   | Constant value<br>Sample time<br>Output data type<br>Output scalig value | 0<br>inf<br>sfixed(32)<br>2 <sup>-9</sup>     |
| Constant             | Ramp Generator - freq                     | Constant value<br>Sample time<br>Output data type<br>Output scalig value | 0.001<br>inf<br>sfixed(32)<br>2 <sup>-9</sup> |
| C2000 Ramp Generator | Scope and Floating Scope (Simulink block) | Maximum step angle                                                       | 1                                             |

# C2000 Ramp Generator

When you run the model, the Scope block generates the following output (drag a zoom box around a portion of the output to change the display).



With fixed point calculations in IQMath, for a given frequency input on the block, **f\_input**, the equation is:

$$f = (\text{Maximum step angle} * f_{\text{input}} * \text{sampling rate}) / 2^m$$

For example, if  $f_{\text{input}} = 0.001$ , the real value, 1, counts as fixed point with a fractional length of 9:

$$f = (1 * 1 * (1/0.001)) / 2^9 = 1.9531 \text{ Hz}$$

Where 0.001 is the block sample time.



If we use normal math, and  $f_{\text{input}}$  is a non-fixed point real value, then:

$$f = (\text{Maximum step angle} * f_{\text{input}} * \text{sampling rate}) / 1$$

For example, if we are using floating point calculation:

$$f = (1 * 0.001 * (1/0.001)) / 1 = 1 \text{ Hz}$$

When using fixed point with fractional length 9, the expected period becomes:

$$T = 1/f = 1/1.9531 \text{ Hz} = 0.5120 \text{ s}$$

This result is what the above Scope output shows.

---

**Note** If you use different fractional lengths for the fixed point calculations, the output frequency varies depending on the precision.

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## See Also

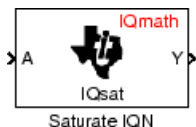
C2000 Ramp Control

# C2000 Saturate IQN

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**Purpose** Saturate IQ number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath



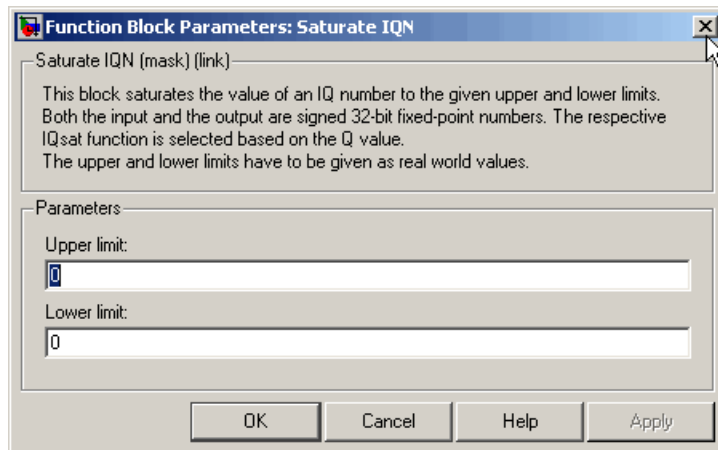
## Description

This block saturates an input IQ number to the specified upper and lower limits. The returned value is an IQ number of the same Q value as the input.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---



## Dialog Box

### Upper Limit

Maximum real-world value to which to saturate

### Lower Limit

Minimum real-world value to which to saturate

## References

For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

## See Also

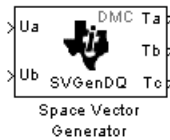
C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Square Root IQN, C2000 Trig Fcn IQN

# C2000 Space Vector Generator

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**Purpose** Duty ratios for stator reference voltage

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC



## Description

This block calculates duty ratios that generate a given stator reference voltage using space vector PWM technique. Space vector pulse width modulation is a switching sequence of the upper three power devices of a three-phase voltage source inverter and is used in applications such as AC induction and permanent magnet synchronous motor drives. The switching scheme results in three pseudosinusoidal currents in the stator phases. This technique approximates a given stator reference voltage vector by combining the switching pattern corresponding to the basic space vectors.

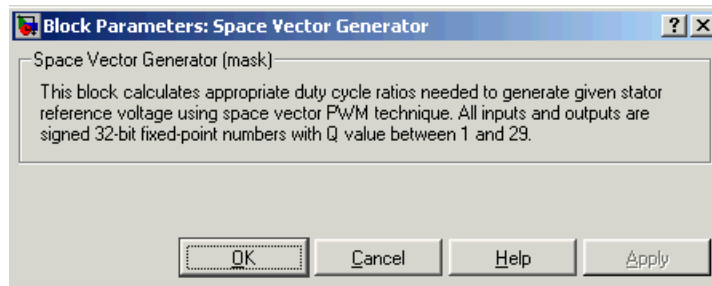
The inputs to this block are

- Alpha component — the reference stator voltage vector on the direct axis stationary reference frame ( $U_a$ )
- Beta component — the reference stator voltage vector on the direct axis quadrature reference frame ( $U_b$ )

The alpha and beta components are transformed via the inverse Clarke equation and projected into reference phase voltages. These voltages are represented in the outputs as the duty ratios of the PWM1 ( $T_a$ ), PWM3 ( $T_b$ ), and PWM5 ( $T_c$ ).

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

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## Dialog Box

## References

For detailed information on the DMC library, see *C/F 28xx Digital Motor Control Library*, Literature Number SPRC080, available at the Texas Instruments Web site.

## See Also

C2000 Clarke Transformation, C2000 Inverse Park Transformation, C2000 Park Transformation, C2000 PID Controller, C2000 Speed Measurement

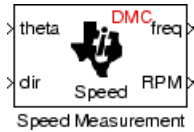
# C2000 Speed Measurement

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**Purpose** Calculate motor speed

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x DMC

**Description**



This block calculates the motor speed based on the rotor position when the direction information is available. The inputs are the electrical angle (`theta`) and the direction of rotation (`dir`) from the encoder. The outputs are the speed normalized from 0 to 1 in the Q format (`freq`) and the speed in revolutions per minute (`rpm`).

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**Note**

- To generate optimized code from this block, enable the TI C28x or TI C28x (ISO) Code Replacement Library. See “About Code Replacement and Optimization”.
- This block does not call the corresponding Texas Instruments library function during code generation. Instead, the MathWorks code uses the TI functions global Q setting to adjust dynamically the Q format based on the block input. See “Using the IQmath Library” for more information.

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**Understanding the Theta Input to the Block**

To indicate the rotational position of your motor, the block expects a 32-bit, fixed-point value that varies from 0 to 1.

Block input `theta` is defined by the following relations:

- A `theta` input signal equal to 0 indicates 0 degrees of rotation.

- A theta input signal equal to 1 indicates 360 degrees of rotation (one full rotation).

When the motor spins at a constant speed, theta (in counts) from your position sensor (encoder) should increase linearly from 0 to 1 and then abruptly return to 0, like a saw-shaped signal. Adjust the theta signal output from your encoder to get the input signal range for the Speed Measurement block. Then, convert your encoder signal to 32-bit fixed-point Q format that meets your resolution needs.

For example, if you are using a position sensor that generates 8000 counts for one full revolution of the motor, (0.0450 degrees per count), you need to reset your counter to 0 after your counter reaches 8000. Each time you read your encoder position, you need to convert the position to a 32-bit, fixed-point Q format value knowing that 8000 is represented as a 1.0. In this example your format could be Q31.

## The Base Speed Parameter

*Base speed* is the maximum motor rotation rate to measure. This value is probably not the maximum speed the motor can achieve.

The Speed Measurement block calculates motor speed from two successive *theta* readings of the motor position,  $\theta_{new}$  and  $\theta_{old}$  (the base speed of the motor; and the time between readings). The maximum speed the block can calculate occurs when the difference between two successive samples [ $\text{abs}(\theta_{new} - \theta_{old})$ ] is 1.0—one full motor revolution occurs between theta samples.

Therefore, the value you provide for the Base speed (in revolutions per minute) parameter is the speed, in revolutions per minute, at which your motor position signal reports one full revolution during one sample time. While the motor may spin faster than the base speed, the block cannot calculate the rotation rate in that case. If the motor completes more than one revolution in one sample time, the calculated speed may be wrong. The block does not know that between samples  $\theta_{new}$  and  $\theta_{old}$ , *theta* wrapped from 1 back to 0 and started counting up again.

The time difference between the two theta readings is the sample time. The Speed Measurement block inherits the sample time from the

# C2000 Speed Measurement

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upstream block in your model. You set the sample time in the upstream block and then the Speed Measurement block uses that sample time to calculate the rotation rate of the motor.

## The Sample Time Calculation

Motor speed measurements depend on the sample time you set in the model. Your sample time must be short enough to measure the full speed of the motor.

Two parameters drive your sample time—motor base speed and encoder counts per revolution. To be able to measure the maximum rotation rate, you must take at least one sample for each revolution. For a motor with base speed equal to 1000 rpm, which is 16.67 rps, you need to sample at  $1/16.67$  s, which is 0.06 s/sample. This sample rate of 16.67 samples per second is the maximum sample time (lowest sample rate) so that you can measure the full speed of the motor.

Using the same sample rate assumption, the minimum speed the block can measure depends on the encoder counts per revolution. At the minimum measurable motor speed, the encoder generates one count per sample period—16.67 counts per second. For an encoder that generates 8000 counts per revolution, this results in being able to measure a speed of  $[(16.67 \text{ counts/s}) * (0.045 \text{ degrees/count})] = 0.752 \text{ degrees per second}$ , or about 45 degrees per minute—one-eighth RPM.

## The Differentiator Constant

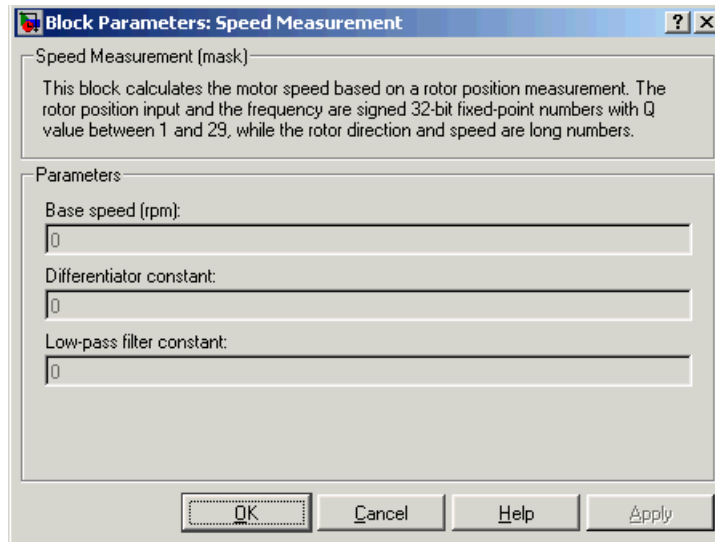
The differentiator constant is a scalar value applied to the block output. For example, setting it to 1 does not alter the output. Setting the constant to  $1/4$  multiplies the frequency and revolutions per minute outputs by 0.25. This setting can be useful when your motor has multiple pole pairs, and one electrical revolution is not equal to one mechanical revolution. The constant lets you account for the difference between electrical and mechanical rotation rates.

## The Low-Pass Filter Constant

This block includes filtering capability if your position signal is noisy. Setting the filter constant to 0 disables the filter. Setting the filter constant to 1 filters out the entire signal and results in a block output



equal to 0. Use a simulation to determine the best filter constant for your system. Your goal is to filter enough to remove the noise on your signal but not so much that the speed measurements cannot react to abrupt speed changes.



## Dialog Box

### Base speed

Maximum speed of the motor to measure in revolutions per minute.

### Differentiator constant

Constant used in the differentiator equation that describes the rotor position.

### Low-pass filter constant

Constant to apply to the lowpass filter. This constant is  $1/(1+T*(2\pi f_c))$ , where  $T$  is the sampling period and  $f_c$  is the cutoff frequency. The  $1/(2\pi f_c)$  term is the lowpass filter time constant. This block uses a lowpass filter to reduce noise generated by the differentiator.

# C2000 Speed Measurement

---

## Example

The following example demonstrates how you configure the Speed Measurement block.

### Configuring the Speed Measurement Block to Measure Motor Speed

Use the following process to set up the Speed Measurement block parameters.

- 1 Add the block to your model.
- 2 Open the block dialog box to view the block parameters.
- 3 Set the value for **Base Speed** to the maximum speed to measure, in revolutions per minute.
- 4 Enter values for **Differentiator** and **Low-Pass Filter Constant**.
- 5 Click **OK** to close the dialog box.

### Setting the Sample Time to Measure Motor Speed

Use the following process to set the sample time for measuring the motor speed.

- 1 Open the block dialog box for the block before the Speed Measurement block in your model (the upstream or driving block).
- 2 Set the sample time parameter in the upstream block according to the sample time guidelines described in The Sample Time Calculation.
- 3 Click **OK** to close the dialog box.

## References

For detailed information on the DMC library, see *C/F 28xx Digital Motor Control Library*, SPRC080, available at the Texas Instruments Web site.

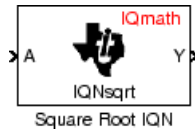
## See Also

C2000 Clarke Transformation, C2000 Inverse Park Transformation, C2000 Park Transformation, C2000 PID Controller, C2000 Space Vector Generator

**Purpose** Square root or inverse square root of IQ number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath

## Description



This block calculates the square root or inverse square root of an IQ number and returns an IQ number of the same Q format. The block uses table lookup and a Newton-Raphson approximation.

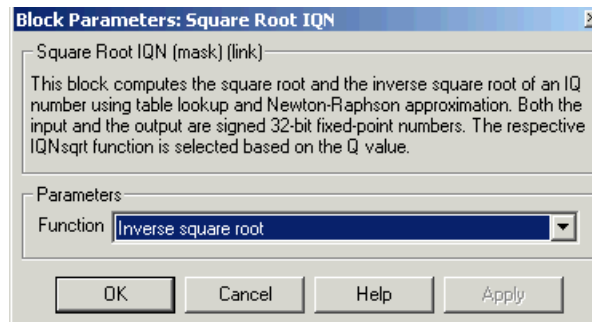
Negative inputs to this block return a value of zero.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## Function

Whether to calculate the square root or inverse square root

# C2000 Square Root IQN

---

- Square root (`_sqrt`) — Compute the square root.
- Inverse square root (`_isqrt`) — Compute the inverse square root.

## References

For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

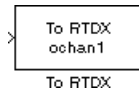
## See Also

C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, Fractional part IQN x int32, C2000 Integer part IQN, Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Trig Fcn IQN

**Purpose** Add RTDX communication channel to send data from target to host

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ RTDX Instrumentation

**Description**



---

**Note** This block will be removed from the Embedded Coder product in an upcoming release.

---

---

**Note** To use RTDX for C28x host/target communications, download and install TI DSP/BIOS. The DSP/BIOS installation includes files required for RTDX communications. For more information, see *DSP/BIOS, RTDX and Host-Target Communications*, Literature Number SPRA895, available at the Texas Instruments Web site.

---

When you generate code from Simulink in Simulink Coder software with a To RTDX block in your model, code generation inserts the C commands to create an RTDX output channel on the target DSP. The output channels transfer data from the target DSP to the host.

The generated code contains this command:

```
RTDX_enableOutput(&channelName)
```

where `channelName` is the name you enter in the **channelName** field in the To RTDX dialog box.

---

**Note** To RTDX blocks work only in code generation and when your model runs on your target. In simulations, this block does not perform operations.

---

To use RTDX blocks in your model, you must do the following:

- 1 Add one or more To RTDX or From RTDX blocks to your model.
- 2 Download and run your model on your target.
- 3 Enable the RTDX channels from MATLAB or use **Enable RTDX channel on start-up** on the block dialog.
- 4 Use the `readmsg` and `writemsg` functions on the MATLAB command line to send and retrieve data from the target over RTDX.

For more information about using RTDX in your model, see the following examples:

- Real-Time Data Exchange (RTDX™) Tutorial
- Comparing Simulation and Target Implementation with RTDX
- Real-Time Data Exchange via RTDX
- DC Motor Speed Control via RTDX™

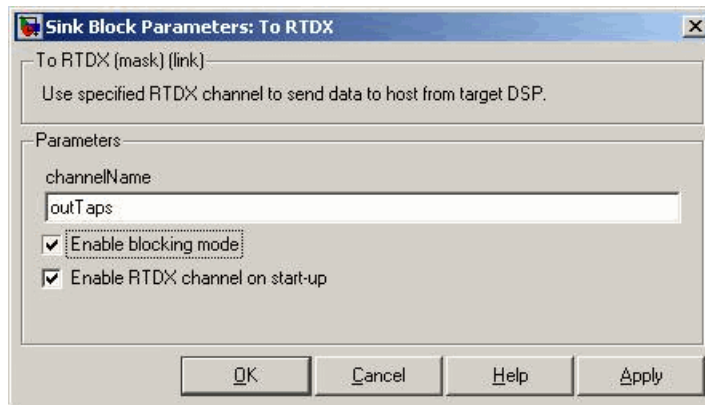
---

**Note** To use RTDX with the XDS100 USB JTAG Emulator and the C28027 chip, add the following line to the linker command file:

```
_RTDX_interrupt_mask = -0x00000008;
```

---

## Dialog Box



### Channel name

Name of the output channel to be created by the generated code. The channel name must meet C syntax requirements for length and character content.

### Enable blocking mode

Enables blocking mode (selected by default). In blocking mode, writing a message is suspended while the RTDX channel is busy, that is, when data is being written in either direction. The code waits at the RTDX\_write call site while the channel is busy. An interrupt of the higher priority will temporarily divert the program execution from this site, but it will eventually come back and wait until the channel stops writing.

When blocking mode is not enabled (when the check box is cleared), writing a message is abandoned if the RTDX channel is busy, and the code proceeds with the current iteration.

### Enable RTDX channel on start-up

Enables the RTDX channel when you start the channel from MATLAB. With this selected, you do not need to use the `enable` function to prepare your RTDX channels. This option applies only to the channel you specify in **Channel name**. You do have to open the channel.

# C2000 To RTDX

---

## **See Also**

“Real-Time Data Exchange via RTDX™”  
C2000 From RTDX

## **References**

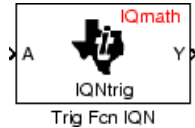
*RTDX 2.0 User's Guide*, Literature Number: SPRUFC7, available from the Texas Instruments Web site.

*How to Write an RTDX Host Application Using MATLAB*, Literature Number: SPRA386, available from the Texas Instruments Web site.



**Purpose** Sine, cosine, or arc tangent of IQ number

**Library** Embedded Coder Support Package for Texas Instruments C2000 Processors/ Optimization/ C28x IQmath



## Description

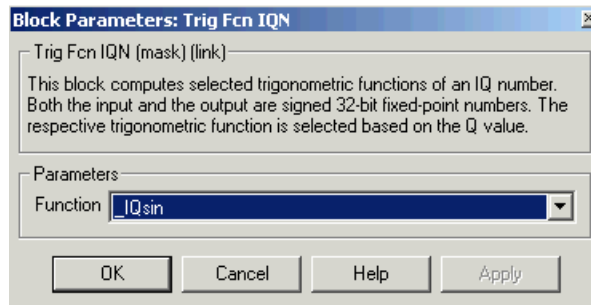
This block calculates basic trigonometric functions and returns the result as an IQ number. Valid Q values for `_IQsinPU` and `_IQcosPU` are 1 to 30. For all others, valid Q values are from 1 to 29.

---

**Note** The implementation of this block does not call the corresponding Texas Instruments library function during code generation. The TI function uses a global Q setting and the MathWorks code used by this block dynamically adjusts the Q format based on the block input. See “Using the IQmath Library” for more information.

---

## Dialog Box



## Function

Type of trigonometric function to calculate:

- `_IQsin` — Compute the sine ( $\sin(A)$ ), where A is in radians.

# C2000 Trig Fcn IQN

---

- `_IQsinPU` — Compute the sine per unit ( $\sin(2\pi A)$ ), where A is in per-unit radians.
- `_IQcos` — Compute the cosine ( $\cos(A)$ ), where A is in radians.
- `_IQcosPU` — Compute the cosine per unit ( $\cos(2\pi A)$ ), where A is in per-unit radians.

## References

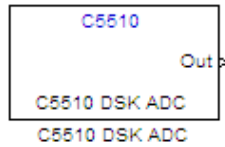
For detailed information on the IQmath library, see the user's guide for the *C28x IQmath Library - A Virtual Floating Point Engine*, Literature Number SPRC087, available at the Texas Instruments Web site. The user's guide is included in the zip file download that also contains the IQmath library (registration required).

## See Also

C2000 Absolute IQN, C2000 Arctangent IQN, C2000 Division IQN, C2000 Float to IQN, C2000 Fractional part IQN, C2000 Fractional part IQN x int32, C2000 Integer part IQN, C2000 Integer part IQN x int32, C2000 IQN to Float, C2000 IQN x int32, C2000 IQN x IQN, C2000 IQN1 to IQN2, C2000 IQN1 x IQN2, C2000 Magnitude IQN, C2000 Saturate IQN, C2000 Square Root IQN

**Purpose** Configure AIC23 and peripherals to collect data from analog jacks and output digital data

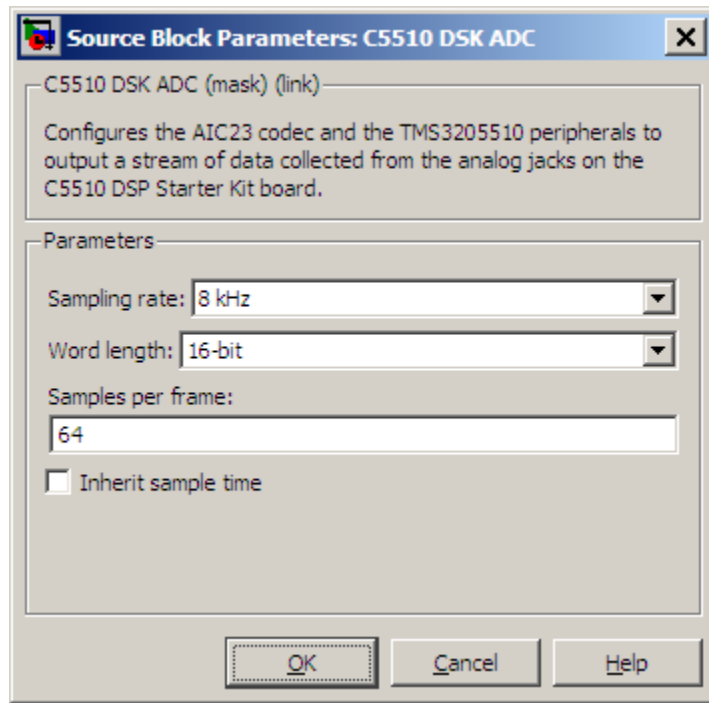
**Library** Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C5000/ C5510 DSK



**Description**

Configures the AIC23 codec and the TMS320C5510 peripherals to output a stream of digital data. The block collects this data from the analog jacks on the C5510 DSP Starter Kit board.

# C5510 DSK ADC



## Dialog Box

### Sampling rate

Set the rate at which the analog-to-digital converter samples the analog input. A higher rate increases the resolution of the data the ADC outputs.

### Word length

Set the number of data bits the ADC creates for each sample. Increasing the word length increases the accuracy of the data in each sample. If your model also contains a DAC block, set the word length in the DAC block to match that of the ADC block.

### Samples per frame

Set the number of samples the ADC buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. The

frame rate depends on the sample rate and frame size. Thus, if you set **Sampling Rate** to 8 kHz, and **Samples per frame** to 32, the resulting frame rate is 250 frames per second ( $8000/32 = 250$ ).

### **Inherit sample time**

Select whether the block inherits the sample time from the model base rate or from the Simulink base rate. You can locate the Simulink base rate in the Solver options in Configuration Parameters. Selecting Inherit sample time directs the block to use the specified rate in model configuration. Entering -1 configures the block to accept the sample rate from the upstream HWI, Task, or Triggered Task blocks.

### **See Also**

C5510 DSK DAC

# C5510 DSK DAC

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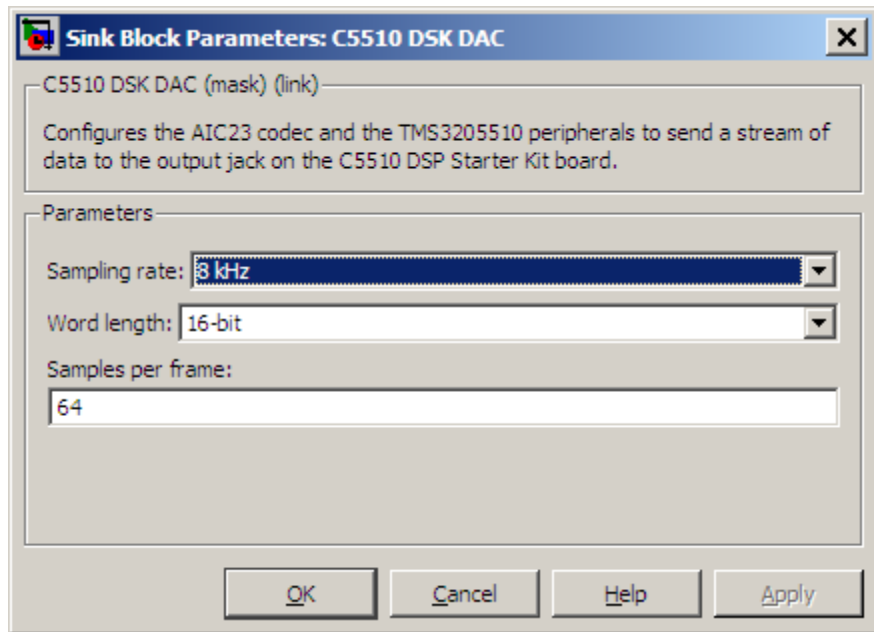
**Purpose** Configure AIC23 codec and peripherals to send data stream to output jack

**Library** Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments C5000/ C5510 DSK



**Description** Configures the AIC23 codec and the TMS3205510 peripherals to send a stream of data to the output jack on the C5510 DSP Starter Kit board.

## Dialog Box



### Sampling Rate

Set the rate at which the digital-to-analog converter receives each data sample. If your model contains an ADC block, set this value to match the sampling rate of the ADC block.

### Word length

Set the number of bits in each data input sample the DAC. If your model also contains an ADC block, set the word length in the DAC block to match that of the ADC block. If you enter the incorrect value for this parameter, the DAC cannot generate an analog output that corresponds to the data it receives.

### Samples per frame

Set the number of samples per data input frame. Match this value with the value of the block creating the data frames. This value defaults to 64 samples per frame.

# C5510 DSK DAC

---

## **See Also**

C5510 DSK ADC

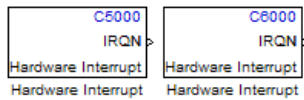


# C5000/C6000 Hardware Interrupt

**Purpose** Interrupt Service Routine to handle hardware interrupt on C5000 and C6000 processors

**Library** Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments C5000/ Scheduling

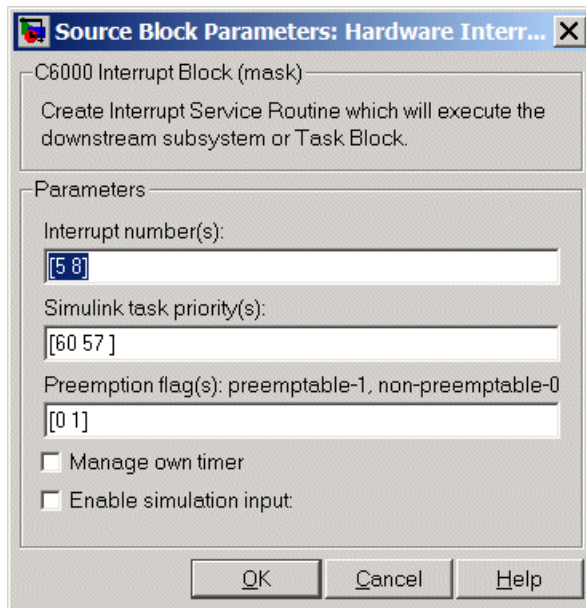
Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments C6000/ Scheduling



## Description

Create interrupt service routines (ISR) in the software generated by the build process. When you incorporate this block in your model, code generation results in ISRs on the processor that run the processes that are downstream from the this block or a Task block connected to this block.

# C5000/C6000 Hardware Interrupt



## Dialog Box

### Interrupt numbers

Specify an array of interrupt numbers for the interrupts to install. The following table provides the valid range for C5xxx and C6xxx processors:

| Processor Family | Valid Interrupt Numbers |
|------------------|-------------------------|
| C5xxx            | 2, 3, 5-21, 23          |
| C6xxx            | 4-15                    |

The width of the block output signal corresponds to the number of interrupt numbers specified here. Combined with the **Simulink task priorities** that you enter and the **preemption flag** you enter for each interrupt, these three values define how the code and processor handle interrupts during asynchronous scheduler operations.

## Simulink task priorities

Each output of the Hardware Interrupt block drives a downstream block (for example, a function call subsystem). Simulink software task priority specifies the Simulink priority of the downstream blocks. Specify an array of priorities corresponding to the interrupt numbers entered in **Interrupt numbers**.

Simulink task priority values are required to generate rate transition code (refer to Rate Transitions and Asynchronous Blocks). The task priority values are also required for absolute time integrity when the asynchronous task needs to obtain real time from its base rate or its caller. Typically, you assign priorities for these asynchronous tasks that are higher than the priorities assigned to periodic tasks.

## Preemption flags preemptable – 1, non-preemptable – 0

Higher priority interrupts can preempt interrupts that have lower priority. To allow you to control preemption, use the preemption flags to specify whether an interrupt can be preempted.

Entering 1 indicates that the interrupt can be preempted. Entering 0 indicates the interrupt cannot be preempted. When **Interrupt numbers** contains more than one interrupt priority, you can assign different preemption flags to each interrupt by entering a vector of flag values, corresponding to the order of the interrupts in **Interrupt numbers**. If **Interrupt numbers** contains more than one interrupt, and you enter only one flag value in this field, that status applies to all interrupts.

In the default settings [0 1], the interrupt with priority 5 in **Interrupt numbers** is not preemptible and the priority 8 interrupt can be preempted.

## Enable simulation input

When you select this option, Simulink software adds an input port to the Hardware Interrupt block. This port is used in simulation only. Connect one or more simulated interrupt sources to the simulation input.

# C6000 Block Processing

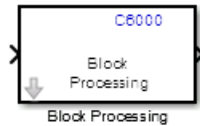
---

## Purpose

Repeat user-specified operation on submatrices of input matrix, using internal memory of DSP for increased efficiency

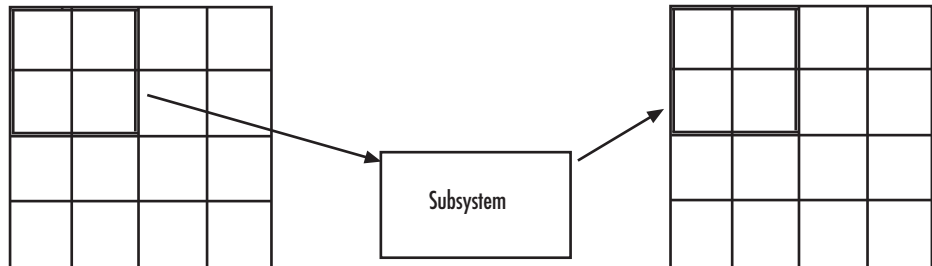
## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling



## Description

Using Direct Memory Access (DMA) on the processor, the Block Processing block extracts submatrices of a user-specified size from each input matrix. It sends each submatrix to a subsystem for processing, and then reassembles each subsystem output into the output matrix, as shown in the following figure. While processing images as matrices, this submatrix capability can greatly improve the throughput.



---

**Note** Because you modify the Block Processing block subsystem, the link between this block and the block library is broken when you click-and-drag a Block Processing block into your model. Thus, this block is not automatically updated if you upgrade to a newer version of the Embedded Coder. To delete blocks from this subsystem without triggering a warning, right-click on the block and select **Mask > Look Under Mask**. If you search for library blocks in a model, this block is not part of the results.

---

The blocks inside the subsystem dictate the following block configuration information:

- Frame status of the input and output signals
- Whether the block supports single channel or multichannel signals
- Which data types this block supports

Use the **Number of inputs** and **Number of outputs** parameters to specify the number of input and output ports on the Block Processing block.

Use the **Block size** parameter to specify the size of each submatrix in cell array format. Each vector in the cell array corresponds to one input; the block uses the vectors in the order you enter them. If you have one input port, enter one vector. If you have more than one input port, you can enter one vector that is used for all inputs or you can specify a different vector for each input. For example, to specify each submatrix as a 2-by-3 array, enter `{[2 3]}`. The output matrix size depends on the size of the submatrix at the output of the subsystem and the number of submatrices at the input. For example, if the output submatrix size is 32x16 and the input submatrix sizes are 8x16, the total output matrix size will be 256x256. If the block size specified does not subdivide an input matrix evenly, i.e. there are leftover matrix elements which are not covered by the subdivision, those uncovered elements will be ignored.

# C6000 Block Processing

---

Use the **Overlap** parameter to specify the overlap of each submatrix in cell array format. Each vector in the cell array corresponds to the overlap of one input; the block uses the vectors in the order they are specified. If you enter one vector, each overlap is the same size. For example, to specify that each 3-by-3 submatrix overlap by 1 row and 2 columns, enter `{[1 2]}`.

The **Traverse order** parameter determines how the block extracts submatrices from the input matrix. If you select **Row-wise**, the block extracts submatrices by moving across the rows. If you select **Column-wise**, the block extracts submatrices by moving down the columns.

Click **Open Subsystem** to open the block subsystem. Click-and-drag blocks into this subsystem to define the processing operations the block performs on the submatrices. The input to this subsystem are the submatrices defined by the **Block size** parameter.

---

**Note** When you place an Assignment block inside a Block Processing block subsystem, the Assignment block behaves as though it is inside a For Iterator block. For a description of this behavior, refer to “Iterated Assignment” on the Assignment block reference page. To produce the normal behavior of the Assignment block, use an Overwrite Values block inside the Block Processing block subsystem.

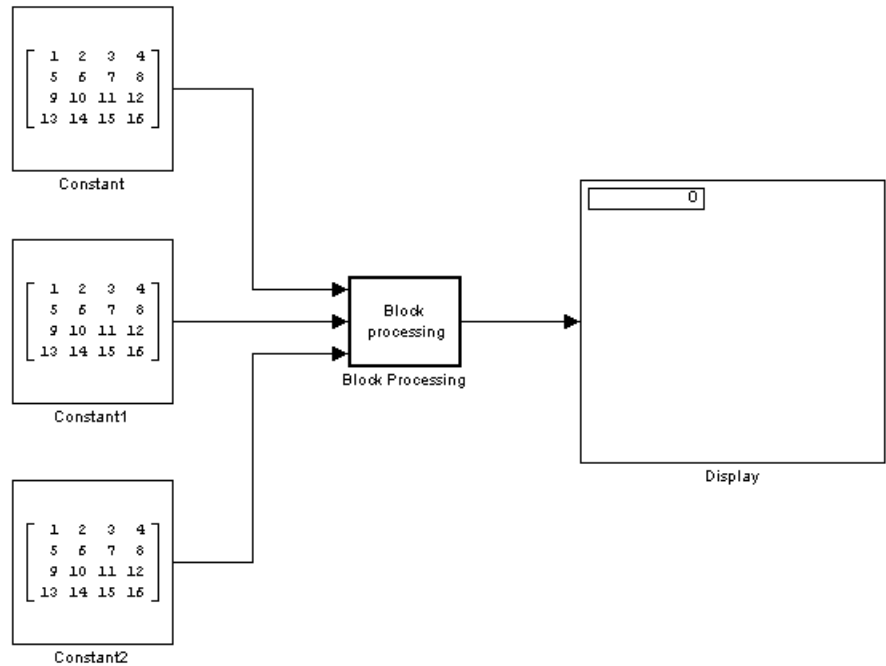
---

## Example

This section provides an example that applies the block processing block to multiply and add submatrices.

### Multiple Inputs

In this example, you multiply each element of three input matrices by two and add the results using the Block Processing block. Suppose you have the following model:



1 Use the Block Processing block to perform the multiplication and addition on submatrices of the three input matrices. Set the following parameters as given:

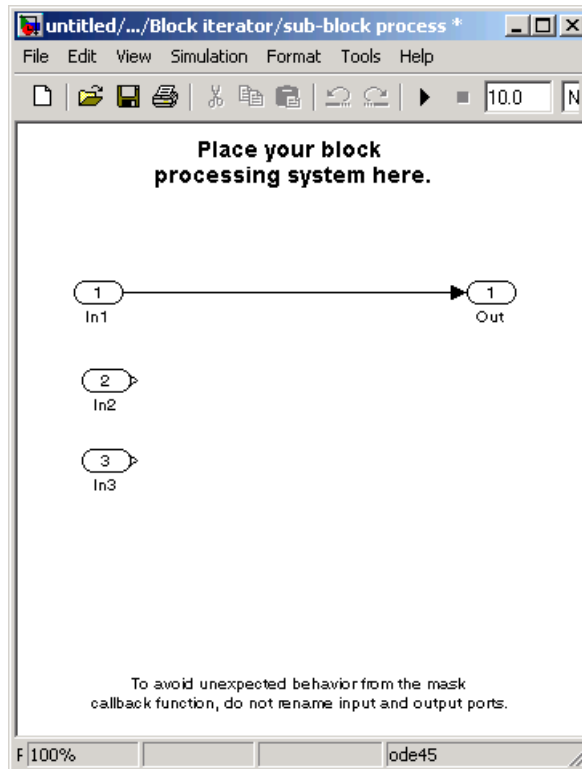
- **Number of inputs** = 3
- **Number of outputs** = 1
- **Block size** =  $\{[2 \ 2]\}$

For each iteration, the block sends a 2-by-2 submatrix from each input matrix to the Block Processing block subsystem to be processed. The block calculates its total number of iterations using the dimensions of the matrix connected to the top input port. In this case, the first input is a 4-by-4 matrix. The block can extract four 2-by-2 submatrices from this input matrix, so the block iterates four times.

# C6000 Block Processing

- 2 In the open Block Processing block, click the **Open Subsystem** button located near the bottom of the block mask.

This action opens the block subsystem.

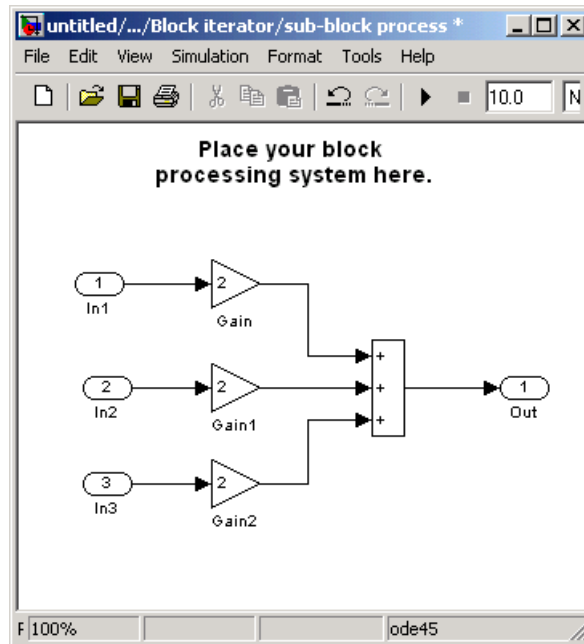


- 3 Click and drag the blocks shown in the following table into the subsystem.

| Block | Library                    | Quantity |
|-------|----------------------------|----------|
| Gain  | Simulink / Math Operations | 3        |
| Sum   | Simulink / Math Operations | 1        |

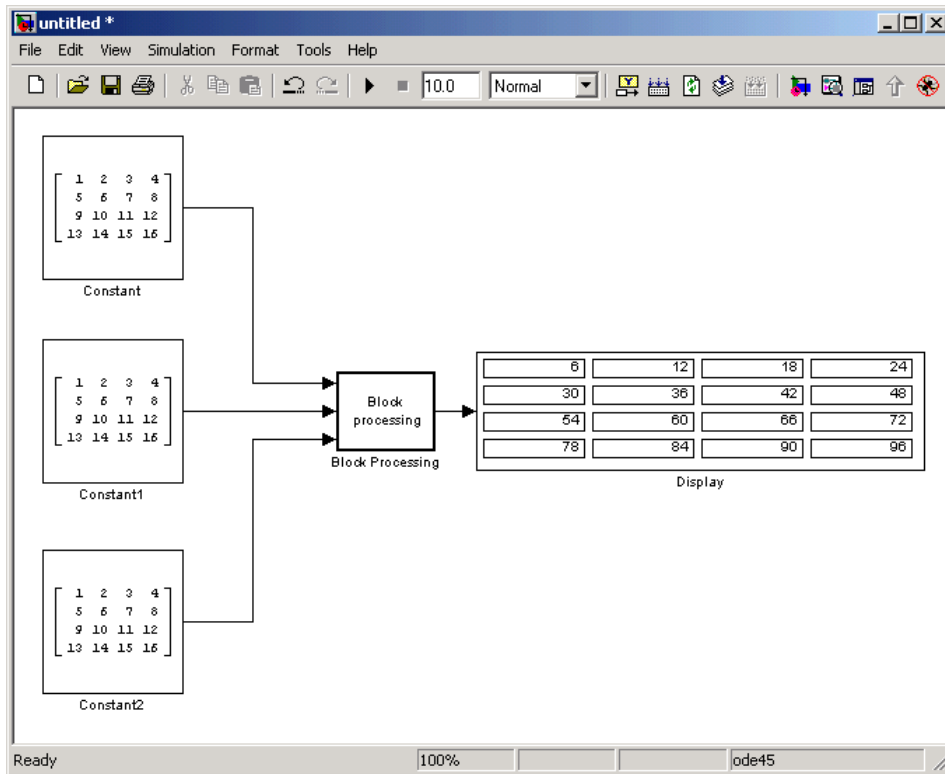


- 4 Use the Gain blocks to multiply the elements of each submatrix by two. Set the **Gain** parameter to 2.
- 5 Use the Sum block to add the values. Set the **Icon shape** parameter to rectangular and the **List of signs** parameter to +++.
- 6 Connect the blocks as shown in the following figure.



- 7 Close the subsystem and click **OK**.
- 8 Run the model.

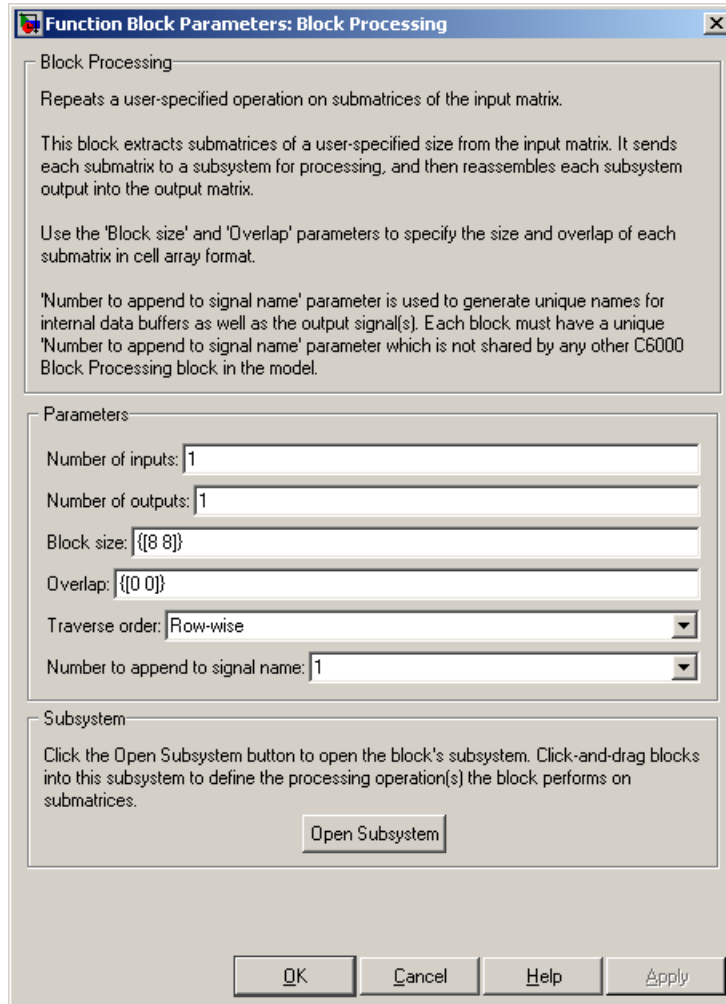
# C6000 Block Processing



The Block Processing block operates on the submatrices, assembles the results into an output matrix, and then uses the Display block to present the output matrix.

## Dialog Box

The Block Processing dialog box appears as shown in the following figure.



# C6000 Block Processing

---

## **Number of inputs**

Enter the number of block inputs on the Block Processing block.

## **Number of outputs**

Enter the number of output ports on the Block Processing block.

## **Block size**

Specify the size of each submatrix in cell array format. Each vector in the cell array corresponds to one input.

## **Overlap**

Specify the overlap of each submatrix in cell array format. Each vector in the cell array corresponds to the overlap of one input.

## **Traverse order**

Determines how the block extracts submatrices from the input matrix. If you select **Row-wise**, the block extracts submatrices by moving across the rows. If you select **Column-wise**, the block extracts submatrices by moving down the columns.

## **Open Subsystem**

Click this button to open the block's subsystem. Click and drag blocks into this subsystem to define the processing the block performs on the submatrices.

## **See Also**

Memory Allocate, Memory Copy, C6000 EDMA

## Purpose

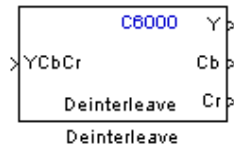
Separate interleaved YCbCr 4:2:2 data into Y, Cb, and Cr components

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Avnet S3ADSP DM6437

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

## Description



This block separates interleaved YCbCr 4:2:2 data into its luma component (Y), blue-difference chroma component (Cb), and red-difference chroma component (Cr).

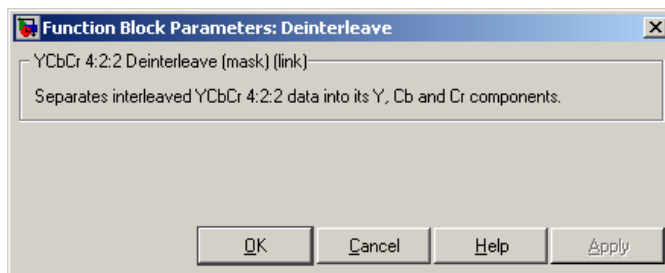
The input, YCbCr, is a  $(2*M)*N$  array of 8-bit unsigned values representing an interleaved YCbCr 4:2:2 image where the size of the luma plane, Y, is  $M*N$ . Input data is assumed to be in row-major format, and the data stored in each row of the input is assumed to be interleaved in the following order:

$Cb(1), Y(1), Cr(1), Y(2), \dots, Cb(M), Y(M), Cr(M), Y(M)$

The deinterleaved outputs are the planar format luma component, Y, and the chroma components, Cb and Cr, of the YCbCr 4:2:2 input. If the input image is a  $(2*M)$  by  $N$  matrix, then the output dimensions for the Y port is  $(M*N)$  and the dimensions for the Cb and Cr ports are  $(M/2)$  by  $N$ .

# C6000 Deinterleave

---



## Dialog Box

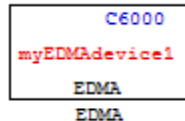
This block does not have settable options.

## See Also

C6000 Interleave

**Purpose** Configure EDMA Controller on C6000 processor

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling



**Description**

Use this block to configure the Enhanced Direct Memory Access (EDMA) Controller on C6000 processors. The controller manages data transfers between the device peripherals on the C6000 processors and the level two (L2) cache/memory controller. Data transfers handled by the controller include:

- Host accesses to cache
- Accessing noncacheable memory
- Servicing cache
- Transferring data by user programs

EDMA controller handles transfers without involving the processor and can process transfers between addressable memory spaces, including internal and external memory.

For details about the EDMA controller, refer to *TMS320C6000 DSP Enhanced Direct Memory Access (EDMA) Controller Reference Guide*, SPRU234, from the Texas Instruments Web site.

---

**Note** The C6000 EDMA block does not support C64x<sup>+</sup> processors, such as the C6455 or TCI6482.

---

EDMA blocks provide two operating modes—open an EDMA channel and allocate a table in EDMA parameter RAM (PaRAM).

The open channel mode opens an EDMA channel for the controller. When you open a channel, EDMA sets the transfer parameters for the channel and writes those to a table as PaRAM entries.

In allocate table mode, the block sets the EDMA transfer parameters and places them in a table in EDMA PaRAM without opening a channel. With this mode, you can use EDMA channels and transfers to develop complex memory structures like sorting, or circular buffers. The allocate table operating mode lets you link multiple EDMA blocks on one EDMA channel. One EDMA block opens an EDMA channel and succeeding blocks link to the open channel and originating EDMA block by the device handle setting.

Use the following procedure to link EDMA blocks in a model:

- 1** Add an EDMA block to your model, open the block dialog box, and set **Setup type** to **Open channel**.
- 2** Assign an EDMA channel to use in **EDMA channel (-1 for auto-allocate)** by entering a channel number or entering -1 to let the block choose the channel.
- 3** In **Device handle**, provide a name for this EDMA block. The name you enter becomes the block identifier for other blocks to link to this block. Use a valid C variable string.
- 4** Close the block dialog box.
- 5** Add a second EDMA block to your model, and open the block dialog box to set the block parameters.
- 6** Select **Allocate table** from the **Setup type** list.
- 7** Select the **Link to event** check box.
- 8** Enter the device handle from the earlier block to link to in **Linked event handle** in this block. The two blocks are linked together through the device handle and they use the same channel.



**9** Close the block dialog box.

**10** To link more EDMA blocks to this channel, repeat steps 5 through 9 for each new block, entering the same device handle.

For a demonstration of using and linking EDMA blocks, refer to the example Custom Device Driver via Legacy Code Integration example.

# C6000 EDMA

**Block Parameters: EDMA**

c6000 EDMA (mask)

Configures EDMA peripheral on TI TMS320C6000 DSP chips. Depending on the setup type, it first opens an EDMA channel or allocates PRAM tables used for the reload/link parameters. Then, it sets up the EDMA channel using the EDMA parameter arguments which are written to the EDMA PRAM entries.

Parameters

Setup type: Open channel

EDMA channel (-1 for auto-allocate): -1

Device handle: myEDMAdevice1

Element count: 64

Element size: 32-bit word

Transfer source: 0x00000000

Transfer source address update: None

Transfer destination: 0x00000000

Transfer destination address update: None

Link to event

Linked event handle: 0

Raise interrupt

Transfer complete code (-1 for auto-allocate): -1

OK Cancel Help Apply

## Dialog

## Box

The preceding dialog box shown presents all of the parameters available. In some cases, parameters are available only when you select other parameters. The following list of block parameters describes all of the available parameters for the block and when one parameter enables another.

### Setup type

Choose either `Open channel` or `Allocate table` from the list. If this is the only EDMA block in your model, choose `Open channel`. If your model includes multiple EDMA blocks, choose `Open channel` when each block should use a different channel. Select `Allocate table` for a block that you plan to link to another EDMA block.

### EDMA channel (-1 for auto-allocate)

Enter an integer from 0 to 63 to specify the EDMA channel to use. If you enter -1, the block assigns the channel automatically from the available channels.

### Device handle

Provide a name for this block. The name you enter must be a valid C variable. The EDMA controller uses the name as the identifier for this block and open channel. Other EDMA blocks in your model can link to this block and channel by using the device handle you enter.

### Element count

Specifies the number of elements in a frame. The value 65355 is the maximum number of elements allowed in one frame. The value defaults to 64 elements.

### Element size

EDMA supports 32-bit words, 16-bit half words, and 8-bit bytes. Select one of the list entries according to your needs.

### Transfer source

Enter the address of the elements to transfer. Specify the address as a hexadecimal value as shown by the default address 0x.00000000

## Transfer source address update

Select whether to enable transfer source update on the EDMA controller. When you select an option from the list, the controller updates the transfer source address according to your choice. Choose one of the list entries shown in the following table.

| Option    | Transfer Source Address                                                                                    | Condition Indicated                                                                                                             |
|-----------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| None      | Does not change address after submitting the transfer request.                                             | Indicates that all of the elements to transfer are located at the same address in memory.                                       |
| Increment | Increases the transfer address by the value in <b>Element count</b> after submitting the transfer request. | Indicates that the elements are contiguous, with each subsequent element located at a higher address than the previous element. |
| Decrement | Decreases the transfer address by the value in <b>Element count</b> after submitting the transfer request. | Indicates that the elements are contiguous, with each subsequent element located at a lower address than the previous element.  |

## Transfer destination

Enter the destination memory address for the data transfer. Specify the address as a hexadecimal value as shown by the default address 0x.00000000

## Transfer destination address update

Select whether to enable transfer destination update on the EDMA controller. When you select an option from the list, the controller updates the transfer destination address according to your choice. Choose one of the list entries shown in the following table.

| Option    | Transfer Destination Address                                                                               | Condition Indicated                                                                                                             |
|-----------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| None      | Does not change address after submitting the transfer request.                                             | Indicates that all of the elements to transfer are located at the same address in memory.                                       |
| Increment | Increases the transfer address by the value in <b>Element count</b> after submitting the transfer request. | Indicates that the elements are contiguous, with each subsequent element located at a higher address than the previous element. |
| Decrement | Decreases the transfer address by the value in <b>Element count</b> after                                  | Indicates that the elements are                                                                                                 |

| Option | Transfer Destination Address     | Condition Indicated                                                                            |
|--------|----------------------------------|------------------------------------------------------------------------------------------------|
|        | submitting the transfer request. | contiguous, with each subsequent element located at a lower address than the previous element. |

### Link to event

You can link EDMA transfers together to create more complicated memory applications such as buffers and sorting routines. When you select **Link to event** to enable linking, the EDMA controller link feature reloads the current transfer parameters from PaRAM when the previous transfer is complete.

### Linked event handle

To link to another EDMA block to create more complex memory applications, enter the device handle from the EDMA block to link to in **Linked event handle**. This entry is an alphanumeric string and the EDMA controller interprets your entry as a string.

### Raise interrupt

Select this check box to direct the EDMA controller to raise an interrupt when the transfer request completes. When you select this parameter, you enable the Transfer complete code (-1 for auto-allocate) option. Clearing Raise interrupt stops the controller from raising the interrupt on TR completion.

### Transfer complete code (-1 for auto-allocate)

The transfer code Indicates when the controller has submitted a required number of transfer requests (TR). Provide an integer from 0 and 62. On C67x processors, the code must be from 0 to 15. The default value of -1 lets the controller assign the transfer code for this channel.

When you enable this option, the EDMA controller submits the transfer request with a request that the controller signal completion of the transfer with this code. When the transfer is completed, the transfer controller returns the specified code to the EDMA controller.

After the EDMA controller receives the transfer complete code in response to the TR, the controller uses the code to trigger another TR or to raise an interrupt to the processor when you select **Raise interrupt**.

## References

For details about the EDMA controller, refer to *TMS320C6000 DSP Enhanced Direct Memory Access (EDMA) Controller Reference Guide*, SPRU234, available from the Texas Instruments Web site.

For an introduction to the EDMA controller, refer to *TMS320C6000 Peripherals Reference Guide*, SPRU190, which provides an overview of the controller, available from the Texas Instruments Web site.

## See Also

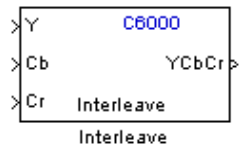
Memory Allocate, Memory Copy

# C6000 Interleave

**Purpose** Convert planar YCbCr 4:2:2 data to interleaved YCbCr 4:2:2 data

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Avnet S3ADSP DM6437



## Description

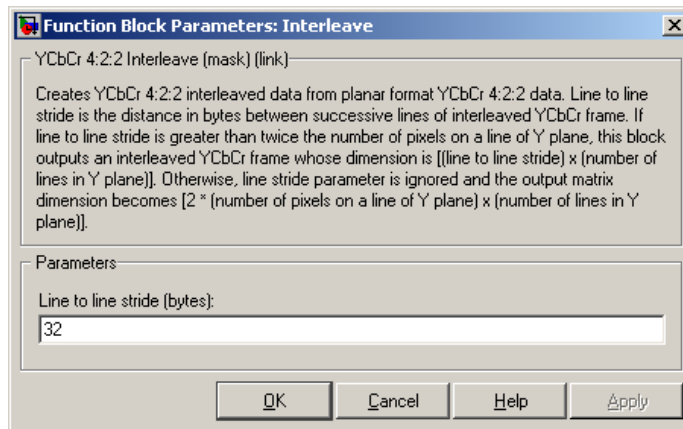
This block takes planar YCbCr 4:2:2 data on three separate inputs and converts them to a single interleaved YCbCr 4:2:2 data output.

The input is a planar, color separated, YCbCr 4:2:2 image represented as a 2-D matrix of 8-bit unsigned integers. There are three block inputs, one each for the luma component (Y), blue-difference chroma component (Cb), and red-difference chroma component (Cr). If the input to the Y port has dimensions  $M*N$ , the input to the Cb and Cr ports must be  $(M/2)$  by  $N$ .

The output is an interleaved YCbCr 4:2:2 image represented as a 2-D matrix of 8-bit unsigned integers. If the dimension of the Y port is  $M*N$  and dimensions of the Cb and Cr ports are  $M/2$  by  $N$ , the image dimensions of the YCbCr output dimensions are  $2*M*N$  under normal conditions. If you specify a line-to-line stride greater than  $2*M$  in the block's mask, the output dimensions become  $(\text{line-to-line stride})*N$ .



## Dialog Box



### Line to line stride (bytes)

Use the line-to-line stride parameter to satisfy the input requirements of the DM6437EVM Video Display block. Because of hardware requirements, each line of the input to the DM6437EVM Video Display block must have a size that is multiple of 32 bytes. For example, if the image you want to display is 180 by 120, use a line-to-line stride of 384 to satisfy the hardware requirements. Under normal conditions, the output of the Interleave block would have size 360x120 which would not be accepted by the DM6437EVM Video Display block. By using a line stride of 384, the block outputs a 384 by 120 matrix—of which only the 360x120 portion contains valid data—that is readily accepted by the DM6437EVM Video Display block.

Line-to-line stride is the distance in bytes between successive lines of an interleaved YCbCr frame. If line-to-line stride is greater than twice the number of pixels on a line of Y plane, this block outputs an interleaved YCbCr frame whose dimensions are the line-to-line stride times the number of lines in Y plane. Otherwise, line stride parameter is ignored, and the output matrix dimension becomes  $2 * (\text{number of pixels on a line of Y plane}) * (\text{the number of lines in Y plane})$ .

# C6000 Interleave

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## **See Also**

C6000 Deinterleave

**Purpose** Configure Internet Protocol on C6000 targets with Ethernet ports

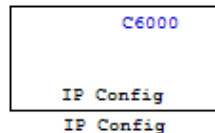
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Avnet S3ADSP DM6437

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6747 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM648 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Target Communication



## Description

Adding this block to your model provides options to configure the IP parameters for your C6000 board. Setting the options for the block sets the address and name for your board and specifies your target and Ethernet daughtercard.

To use this block with the C6416, C6713, or C6713 DSK targets, you must meet the following requirements:

- Install the D.signT DSK-91C111 Ethernet adapter daughter card.
- Install the Texas Instruments TMS320C6000 TCP/IP stack software.

The block uses dynamic addressing, getting the address from the local server or static addressing. If you have a dynamic host configuration protocol (DHCP) server available, you can allow the server to provide an IP address for your board. Dynamic IP addresses can be useful but unreliable — they can change.

## C6000 IP Config

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To use static addressing, create a static IP address by clearing **Use DHCP to allocate an IP address for DM642 EVM (requires DHCP server)**. to enable the manual IP address configuration parameters.

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**Note** When you use the UDP Send and Receive blocks in a model, you must also include this block to set up the IP drivers for the Ethernet parameters for the target networking capability.

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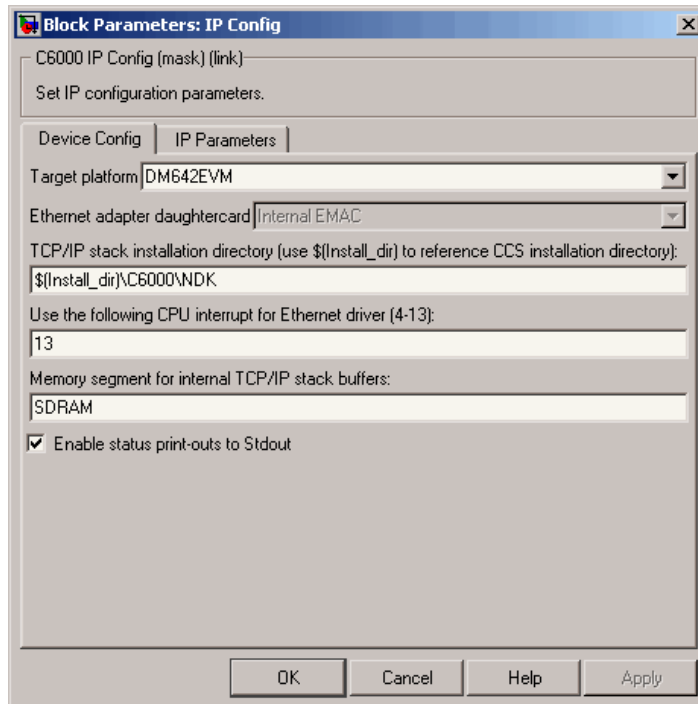
Whether you choose to use dynamic addressing, you must set the Host name, and select and set the **Use the following CPU interrupt for Ethernet driver (4-13)** options.

When you build and run your model, this block does not alter the results. It outputs zeros. When you generate code from your model, this block adds the code that configures IP on your board.

## Dialog Box

The block dialog box provides options on two tabs — **Device Config** and **IP Parameters**.

### Device Tab Options



### Target platform

Specify your C6000 target by selecting the target board from the list. Changing the target platform changes the entry on the **Ethernet adapter daughtercard** list.

### Ethernet adapter daughtercard

After you select your target platform, this option lets you select whatever daughtercard is available to implement Ethernet communications on the target.

## **TCP/IP stack installation folder**

To use the UDP and TCP blocks for the board, you must install the TMS320C6000 TCP/IP Stack from Texas Instruments. Specify the folder where the TMS320C6000 TCP/IP Stack from Texas Instruments is installed.

## **Use the following CPU interrupt for Ethernet driver (4-13)**

The Ethernet driver on the DM642 can respond to a CPU interrupt from 4 to 13. Enter one valid CPU interrupt for the driver to react to. CPU interrupt 13 is the default interrupt.

## **Memory segment for internal TCP/IP stack buffers**

Shows you the segment in memory where the TCP/IP stack buffers reside. For the supported boards, the default setting and location is SDRAM. You can change the location by entering the name of the memory segment to use. TCP/IP stack buffers occupy approximately 130 kB of memory. In most cases you should locate the TCP/IP stack buffers in external memory. Be sure that the segment you specify here agrees with the memory segment allocation in the Target Hardware Resources tab.

## **Enable status print-outs to Stdout**

Select this option to direct the block to send IP status information to the standard output device.

## IP Parameters Options

**Block Parameters: IP Config**

C6000 IP Config (mask)  
Set IP configuration parameters.

Device Config | **IP Parameters**

Use DHCP to allocate an IP address (requires a DHCP server):  
Use the following IP address:  
100.100.100.2  
Subnet mask:  
255.255.255.0  
Gateway IP:  
100.100.100.1  
Domain name server IP:  
0.0.0.0  
Domain name (less than 64 characters):  
mathworks.net  
Host name (less than 64 characters):  
dm642evm

OK Cancel Help Apply

### Use DHCP to allocate an IP address (requires a DHCP server)

Selecting this parameter configures the board to get an IP address from the local DHCP server on the network. If you select this option and you do not have a DHCP server, the generated code does not run as expected. Clearing this option enables all of the IP configuration options for the block to let you define your IP address manually.

# C6000 IP Config

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## **Use the following IP address**

Specify an IP address. This value is the address that others use to communicate with the evaluation module over IP. Use the full xxx.xxx.xxx.xxx format.

## **Subnet mask**

Define the subnet mask address, entering the full subnet mask in the format xxx.xxx.xxx.xxx. Subnet masks define how many bits of the IP address are used to identify the network.

By using 1s in all the address bits that identify the network, the subnet mask shows you which bits define the network and which are internal to the network. In the figure, the subnet mask 255.255.255.0 indicates that the first three octets in the address define the network.

## **Gateway IP**

Enter one address for the gateway server or router that maintains a more complete listing of the surrounding networks. Messages that are destined for machines outside the local network are sent to the gateway address for address resolution.

## **Domain name server IP**

Enter the address of the server for the domain in which the target is a member.

## **Domain name**

Enter the name for the domain. Without the domain name, the target cannot communicate on the network within the domain.

## **Host name (less than 64 characters)**

Enter the name of the host. Usually this value is the NetBIOS name for the machine if it exists.

## **See Also**

C6000 TCP/IP Receive, C6000 TCP/IP Send,

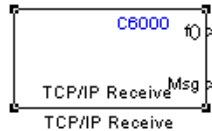


## Purpose

Receive message from remote IP interface

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Target Communication



## Description

Adding this block to your Simulink model results in generated code that configures TCP/IP on your target to receive messages.

To use this block with the C6416, C6713, or C6713 DSK targets, you must meet the following requirements.

- Install the D.signT DSK-91C111 Ethernet adapter daughter card.
- Install the Texas Instruments TMS320C6000 TCP/IP stack software.

The block receives the message from the specified IP address on a host machine and passes it out the Msg port to a downstream block. The size of the message is unrestricted.

A second block output is a function call port that issues a function call whenever a new message is available on the receive buffer.

In simulations, this block outputs a stream of data (default type `uint8_T`) from the Msg port with the first bytes set to `0xFF` and the rest set to `0x00`. When the function call port exists, it generates a function call for every sample time hit.

Models that contain this block generate code for the parameters that configure TCP/IP on the target, including the ports, buffers, and message sizes.

# C6000 TCP/IP Receive

## Dialog Box

## Main Pane

Source Block Parameters: TCP/IP Receive

C6000 TCP/IP Receive (mask) (link)

Configure TCP/IP stack to receive TCP/IP messages from a remote interface identified by a remote IP address and a remote IP port parameter pair. Local port parameter is used to specify the listening port on the target for incoming connections.

Main | Data types

Connection type: Server

Remote IP address and IP port to receive from (format IP address:IP port):  
100.100.100.2:0

Local IP port:  
49000

TCP/IP receive buffer size:  
8192

Enable blocking mode

Sample time:  
0.01

OK Cancel Help

## Connection type

**Connection type** specifies the connection initiation method used for the block. This is a read-only parameter — you cannot change it.

A **Server** connection creates a listening socket at the IP address and port in **Local IP port**. The TCP/IP layer uses this socket to accept incoming connection requests. External TCP/IP interfaces that send TCP/IP data to this block must actively seek the connection to establish communications (the *client* model).

## **Remote address and IP port to receive from (format IP Address:IP port)**

Identifies the remote TCP/IP interface, by IP address and IP port, from which the block expects to receive messages. The input format uses the IP address and IP port identifier, separated by a colon. IP port value ranges from 0 to 65535. Entering a 0 for the IP port when the **Connection type** is **Client** specifies that the TCP/IP stack automatically assigns a port to use to seek connections.

## **Local IP port**

This option identifies the IP port to use when **Connection type** is **Server** and when it is **Client**.

When you choose **Server**, **Local IP port** specifies the well-known port of the target TCP/IP server. Your IP port value must lie between 1 and 65535.

When you specify **Client** for the connection type, **Local IP port** specifies the TCP/IP address for the client socket. The IP port value can range from 0 to 65535, where 0 specifies that the TCP/IP stack assigns an ephemeral port automatically to seek connections.

## **TCP/IP receive buffer size**

Specifies the size of the buffer used for queuing incoming TCP/IP messages. Typically, larger TCP/IP receive buffers provide a cushion for packet drops and can improve efficiency. The compiler allocates the TCP/IP receive buffer on the heap.

all TCP/IP blocks that specify a common local IP port must share a common TCP/IP receive buffer, because the size of the TCP/IP buffer is set only for the listening socket. all active connecting sockets inherit their buffer size value from the listening socket.

## **Enable blocking mode**

Select this option to put the calling TCP/IP task into blocking mode so that the block receives messages completely before

## C6000 TCP/IP Receive

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outputting the messages in the buffer to downstream blocks. Blocks connected to the receive block do not execute until the receive process completes. In blocking mode, program execution for receiving data stops until data in the message buffer is received.

Clearing this option puts the block in non blocking mode. The block checks the number of bytes in the TCP/IP receive buffer and returns output data only when the receive buffer contains more data than requested.

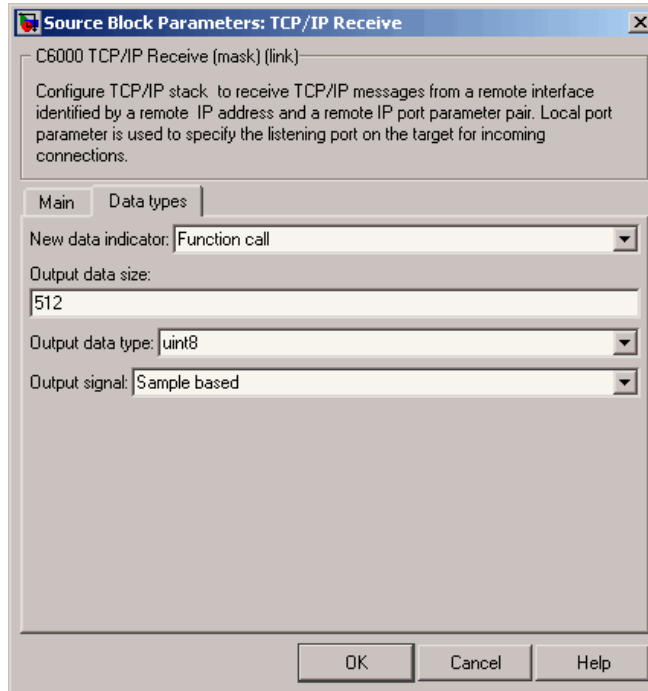
The block receives or outputs data continuously. Processes do not wait for data. Disabling blocking activates the **Sample time** parameter and adds an additional function call port to the block that indicates when the data port contains new, valid data.

Selecting blocking mode activates the **Timeout** parameter.

### **Sample Time**

Use this option to specify when the block polls for new messages. This parameter value should be positive. Setting this to a specific value, often large, can reduce the chances of TCP/IP messages getting dropped. The default sample time is 0.01 seconds.

## Data Types Pane



### New Data Indicator

Use this option to specify how new data is indicated, either by a function call or a Boolean status.

### Output Data Size

Use this option to specify the size of the output data, the units depend on the output data type.

### Output Data Type

Use this option to specify the type of the output data. The value selected can be a built-in Simulink data type.

## C6000 TCP/IP Receive

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### **Output Signal**

Use this option to specify whether the output signal is to be frame-based or sample-based.

### **See Also**

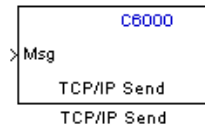
C6000 TCP/IP Send, C6000 UDP Receive, C6000 UDP Send

## Purpose

Send message to remote IP interface

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Target Communication



## Description

Adding this block to your Simulink model results in generated code that configures TCP/IP on your target to send messages.

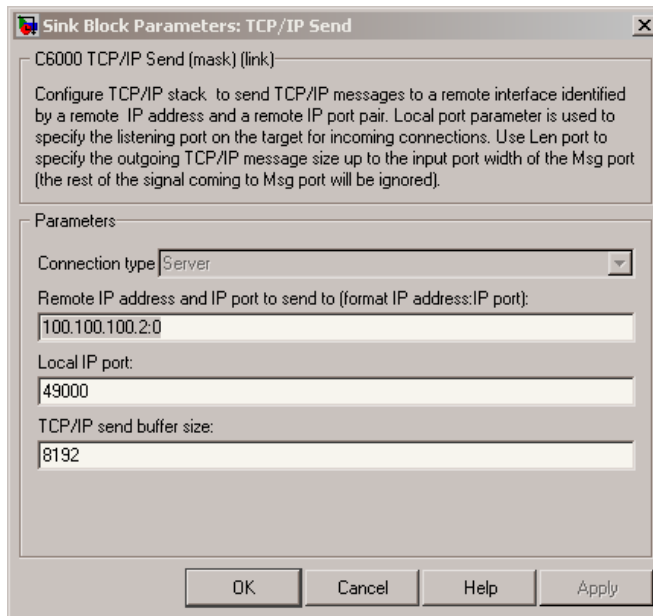
To use this block with the C6416, C6713, or C6713 DSK targets, you must meet the following requirements.

- Install the D.signT DSK-91C111 Ethernet adapter daughter card.
- Install the Texas Instruments TMS320C6000 TCP/IP stack software.

The block sends the message to the specified IP address on a host machine. The data type of the message is unrestricted, as long as it is a built-in Simulink data type. The size of the data to be transmitted is also unrestricted.

Models that contain this block generate code for the parameters that configure TCP/IP on the target, including the ports, buffers, and message sizes.

# C6000 TCP/IP Send



## Dialog Box

### Connection type

**Connection type** specifies the connection initiation method used for the block. This is a read-only parameter — you cannot change it.

A **Server** connection creates a listening socket at the IP address and port in **Local IP port**. The TCP/IP layer uses this socket to accept incoming connection requests. For an external TCP/IP interface to receive TCP/IP data from this block, it must actively seek the connection to establish communications (the *client* model).

**IP Address:IP port**). External interfaces that want to exchange data with this block must be listening at the specified remote IP address and port.



## **Remote IP address and IP port to send to (format IP address:IP port)**

Identifies the remote TCP/IP interface, by IP address and IP port, to which the block expects to send messages. The input format uses the IP address and IP port identifier, separated by a colon. IP port value ranges from 0 to 65535. Entering a 0 for the IP port when the **Connection type** is **Client** specifies that the TCP/IP stack automatically assigns a port to use to seek connections.

## **Local IP port**

This option identifies the IP port used when **Connection type** is **Server**.

When the connection type is **Server**, **Local IP port** specifies the well-known port of the target TCP/IP server. The IP port value must lie between 1 and 65535.

## **TCP/IP send buffer size**

Specifies the size of the buffer used for queuing outgoing TCP/IP messages. Typically, larger TCP/IP receive buffers provide a cushion for packet drops and can improve efficiency. The compiler allocates the TCP/IP send buffer on the heap.

all TCP/IP blocks that specify a common local IP port must share a common TCP/IP send buffer, because the size of the TCP/IP buffer is set only for the listening socket. all active connecting sockets inherit their buffer size value from the listening socket.

## **See Also**

C6000 TCP/IP Receive, UDP Send, UDP Receive

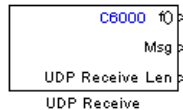
# C6000 UDP Receive

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**Purpose** Receive uint8 vector as UDP message

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Target Communication

## Description



This block configures the Ethernet driver on the target to receive UDP messages. A UDP message comes into this block from the transport layer, usually TCP/IP. The block passes the message to the next downstream block out the Msg port. One block output (Msg) is the data vector from the message. A second output is a flag that indicates when a new UDP message is available. A third output specifies the length of the message for variable length messages.

To use this block with the C6416, or C6713 DSK targets, you must meet the following requirements.

- Install the D.signT DSK-91C111 Ethernet adapter daughter card.
- Install the Texas Instruments TMS320C6000 TCP/IP stack software.

This block reads a single UDP packet every sample hit. It does not attempt to receive multiple UDP packets to fill the output vector. If the UDP packet size is greater than the output port width parameter, UDP messages at the Msg port are truncated. The part for the UDP packet that does not fit into the Msg port is discarded as a result. The missing message content cannot be retrieved. Conversely, if the UDP packet size is smaller than the Msg port width specified, the portion of the output vector that does not fit into the specified size is invalid data.

In non blocking mode, the data in the Msg port is not valid unless the block issues a function call.

C6000 UDP Receive blocks operate only to generate code for the target Ethernet driver. They do not perform a function in simulation and their simulation outputs are zeros.

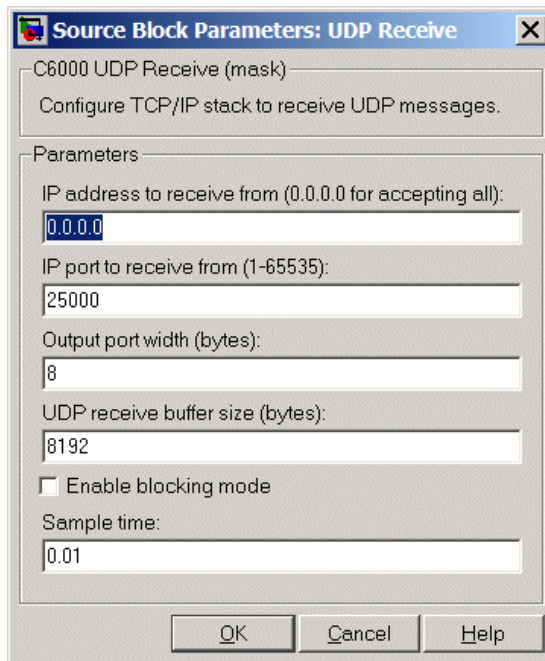
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**Note** To use the C6000 UDP Send and C6000 UDP Receive blocks, you must include the C6000 IP Config block to configure the Ethernet parameters for the target network. This block sets up the IP drivers for use and must be in the model for network-related processing.

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Additional options let you decide whether the UDP messages work in blocking mode and set the sampling time for polling for new messages.

# C6000 UDP Receive



## Dialog Box

### IP address to receive from (0.0.0.0 to accept all)

Specifies the IP address from which the block accepts messages. Setting the address 0.0.0.0 configures the block to accept messages from all IP addresses. Setting a specific address, not 0.0.0.0, directs the block to accept messages from the specified address only.

Selecting Enable blocking mode, disables the **IP address to receive from** parameter. As a result, the block accepts messages from any IP address. You must clear **Enable blocking mode** to set this parameter to a specific IP address. The block must be in non blocking mode to specify the address to receive messages from via UDP.

**IP port to receive from**

Specify the port on this machine from which the block accepts messages. The other end of the communication, usually a UDP Send block, sends messages to this port. The value defaults to 25000, but the values can range from 1 to 65535.

**Output port width (bytes)**

Specifies the width of messages that the block accepts. When you design the transmit end of the UDP communication channel, you decide the message width. Set this parameter to a value equal or greater than the size of messages you expect to receive.

**UDP receive buffer size (bytes)**

Specify the size of the buffer in which UDP messages are stored when received. 8192 bytes is the default size. You need a buffer large enough to store UDP messages that come in while your process reads a message from the buffer or performs other tasks. Specifying the buffer size prevents the receive buffer from overflowing.

**Enable blocking mode**

Select this option to put the UDP receive process in blocking mode meaning the block outputs received messages before accepting input new messages. In blocking mode, program execution for receiving data stops until data in the buffer is sent. In non blocking mode, the block can receive or send data continuously. Processes do not wait for data.

**Sample time (seconds)**

Use this option to specify when the block polls for new messages. The value entered here should be greater than zero. Setting this to a specific value, often large, can reduce the chances of UDP messages getting dropped. The default sample time is 0.01 seconds.

**See Also**

C6000 TCP/IP Receive, C6000 TCP/IP Send, C6000 UDP Send

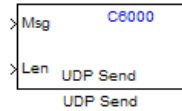
# C6000 UDP Send

---

**Purpose** Send UDP message to host

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Target Communication

**Description**



The UDP send block configures the target's on-board Ethernet driver to receive a `uint8` vector that it sends as a UDP message to the host. Models can contain only one C6000 UDP Send block.

To use this block with the C6416, C6713, or C6713 DSK targets, you must meet the following requirements.

- Install the D.signT DSK-91C111 Ethernet adapter daughter card.
- Install the Texas Instruments TMS320C6000 TCP/IP stack software.

Msg input format must be a `uint8` vector with UDP format. To use variable length messages, supply the message length for each message as input to the Len port. Message length can be an integer value in bytes up to the input width of signal at the Msg port.

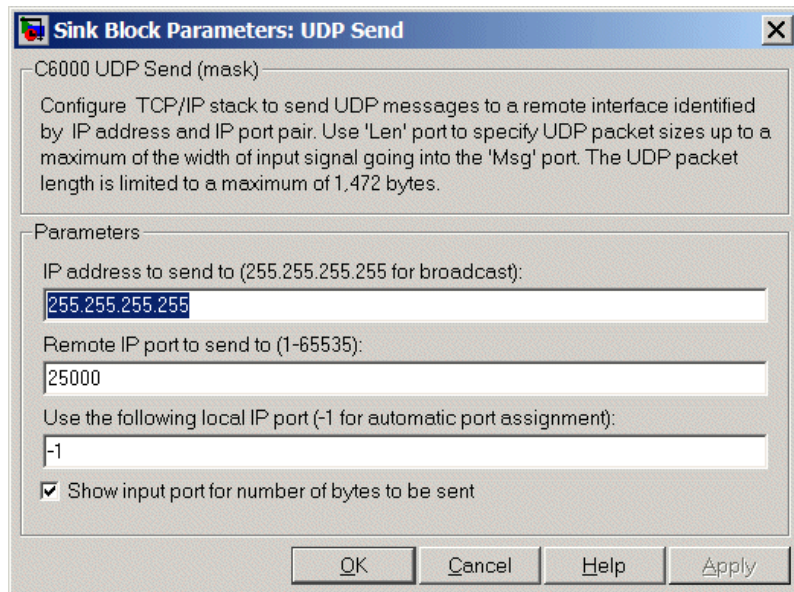
C6000 UDP Send blocks operate only to generate code for the target Ethernet driver. They do not perform a function during simulation and they output zero.

---

**Note** To use the UDP Send and Receive blocks, for network processing, you must include the C6000 IP Config block to set up the IP drivers for the target Ethernet network.

---

## Dialog Box



### IP address to send to (255.255.255.255 for broadcast)

Specify the IP address to which the block sends the message. If you enter the address 255.255.255.255, the block broadcasts message to a listening IP address. If you enter a specific IP address, you limit the block to sending the message to the specified address.

### Remote IP port to send to (1–65535)

Specify the port on the host to which the block sends the message. Port numbers range from 1 to 65535.

---

**Note** This port designation must match the port number where you configure the host to receive UDP messages.

---

# C6000 UDP Send

---

## **Use the following local IP port (-1 for automatic port assignment)**

Specify the local IP port the block sends the message from. If you accept the default value of -1, the network automatically selects the local IP port for sending the message.

If the address you are sending to expects the message to come from a specific port, enter that port address in this parameter. If you entered a port number in the UDP Receive block option **Remote IP port to receive from**, enter that port identifier in this parameter also.

## **Show input port for the number of bytes to be sent**

Adds a block input port that lets you specify the number of bytes to send for each UDP message. The maximum allowed value is 1472 bytes. Use the input to dynamically change the length of each message.

## **See Also**

C6000 TCP/IP Receive, C6000 TCP/IP Send, C6000 UDP Receive



## Purpose

Autocorrelate input vector or frame-based matrix

## Library

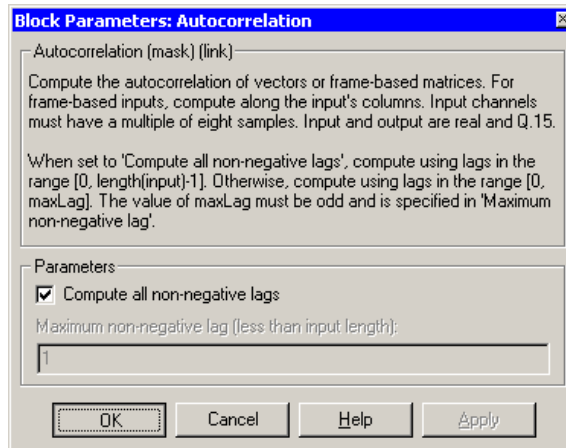
Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The Autocorrelation block computes the autocorrelation of an input vector or frame-based matrix. For frame-based inputs, the autocorrelation is computed along each of the input's columns. The number of samples in the input channels must be an integer multiple of eight. Input and output signals are real and Q.15.

Autocorrelation blocks support discrete sample times and little-endian code generation only.



## Dialog Box

### Compute all non-negative lags

When you select this parameter, the autocorrelation is performed using all nonnegative lags, where the number of lags is one less

# C62x Autocorrelation

---

than the length of the input. The lags produced are therefore in the range  $[0, \text{length}(\text{input})-1]$ . When this parameter is not selected, you specify the lags used in **Maximum non-negative lag (less than input length)**.

## **Maximum non-negative lag (less than input length)**

Specify the maximum lag (maxLag) the block should use in performing the autocorrelation. The lags used are in the range  $[0, \text{maxLag}]$ . The maximum lag must be odd. Enable this parameter by clearing the **Compute all non-negative lags** parameter.

## **Algorithm**

In simulation, the Autocorrelation block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_autocor`. During code generation, this block calls the `DSP_autocor` routine to produce optimized code.

## Purpose

Bit-reverse elements of each complex input signal channel

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

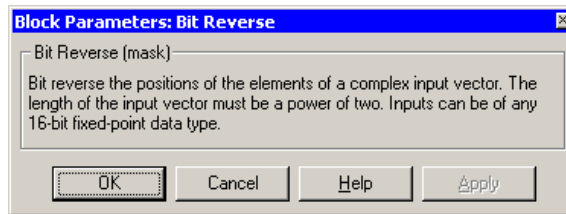
## Description



The Bit Reverse block bit-reverses the elements of each channel of a complex input signal, X. The Bit Reverse block is primarily used to provide ordered inputs and outputs to or from blocks that perform FFTs. Inputs to this block must be 16-bit fixed-point data types.

The Bit Reverse block supports discrete sample times and little-endian code generation only.

## Dialog Box



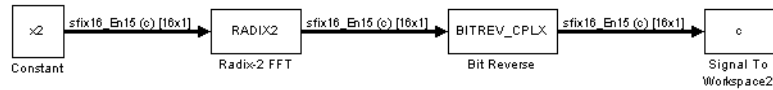
## Algorithm

In simulation, the Bit Reverse block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_bitrev_cplx`. During code generation, this block calls the `DSP_bitrev_cplx` routine to produce optimized code.

## Examples

The Bit Reverse block reorders the output of the C62xRadix-2 FFT in the model below to natural order.

# C62x Bit Reverse



The following code calculates the same FFT in the workspace. The output from this calculation, `y2`, is displayed side-by-side with the output from the model, `c`. The outputs match, showing that the Bit Reverse block reorders the Radix-2 FFT output to natural order:

```
k = 4;
n = 2^k;
xr = zeros(n, 1);
xr(2) = 0.5;
xi = zeros(n, 1);
x2 = complex(xr, xi);
y2 = fft(x2);
```

```
[y2, c]
0.5000 0.5000
0.4619 - 0.1913i 0.4619 - 0.1913i
0.3536 - 0.3536i 0.3535 - 0.3535i
0.1913 - 0.4619i 0.1913 - 0.4619i
0 - 0.5000i 0 - 0.5000i
-0.1913 - 0.4619i -0.1913 - 0.4619i
-0.3536 - 0.3536i -0.3535 - 0.3535i
-0.4619 - 0.1913i -0.4619 - 0.1913i
-0.5000 -0.5000
-0.4619 + 0.1913i -0.4619 + 0.1913i
-0.3536 + 0.3536i -0.3535 + 0.3535i
-0.1913 + 0.4619i -0.1913 + 0.4619i
0 + 0.5000i 0 + 0.5000i
0.1913 + 0.4619i 0.1913 + 0.4619i
0.3536 + 0.3536i 0.3535 + 0.3535i
0.4619 + 0.1913i 0.4619 + 0.1913i
```

## See Also

C62xRadix-2 FFT, C62xRadix-2 IFFT

## Purpose

Minimum number of extra sign bits in each input channel

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

## Description

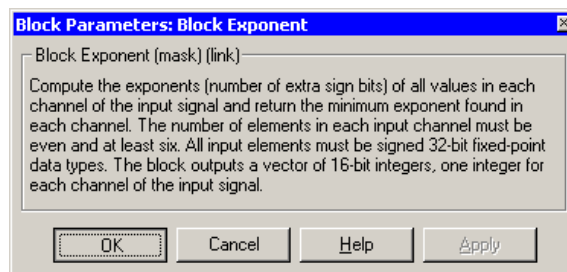


The Block Exponent block first computes the number of extra sign bits of all values in each channel of an input signal, and then returns the minimum number of sign bits found in each channel. The number of elements in each input channel must be even and at least six. All input elements must be 32-bit signed fixed-point data types. The output is a vector of 16-bit integers — one integer for each channel of the input signal.

This block is useful for determining whether every sample in a channel is using extra sign bits. If so, you can scale your signal by the minimum number of extra sign bits to eliminate the common extra bits. This increases the representable precision and decreases the representable range of the signal.

The Block Exponent block supports both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



# C62x Block Exponent

---

## **Algorithm**

In simulation, the Block Exponent block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_bexp`. During code generation, this block calls the `DSP_bexp` routine given to produce optimized code.

**Purpose**

Filter complex input signal using complex FIR filter

**Library**

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

**Description**

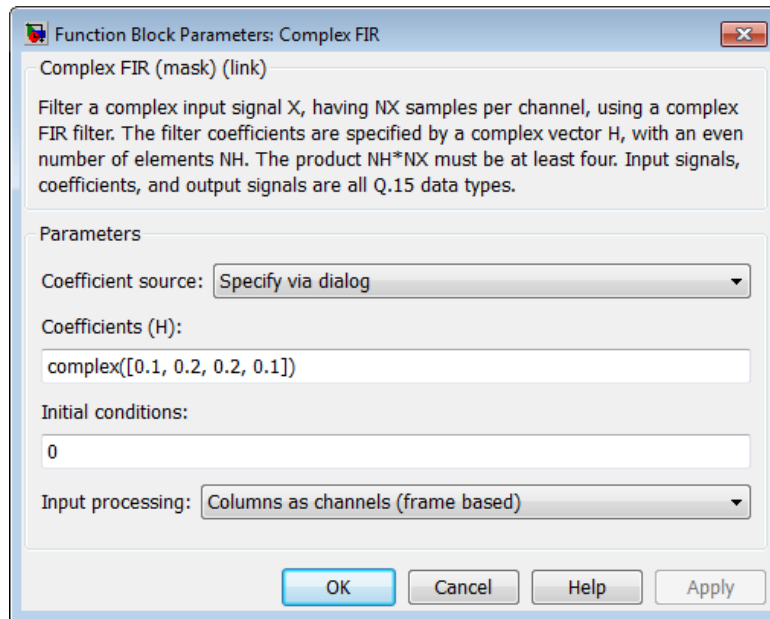
The Complex FIR block filters a complex input signal  $X$  using a complex FIR filter. This filter is implemented using a direct form structure.

The number of FIR filter coefficients, which are given as elements of the input vector  $H$ , must be even. The product of the number of elements of  $X$  and the number of elements of  $H$  must be at least four. Inputs, coefficients, and outputs are all  $Q.15$  data types.

The Complex FIR block supports discrete sample times and little-endian code generation only.

# C62x Complex FIR

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- Specify via dialog — Enter the coefficients in the **Coefficients (H)** parameter in the dialog
- Input port — Accept the coefficients from port H. This port must have the same rate as the input data port X.

### Coefficients (H)

Designate the filter coefficients in vector format. There must be an even number of coefficients. This parameter is only visible when Specify via dialog is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, you need only enter a scalar.



- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.
- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

You may enter real-valued initial conditions. Zero-valued imaginary parts will be assumed.

## Input Processing

Process input signal as frames or samples

- **Columns as channels (frame based)** — Process the input signal as frames. Each frame contains a group of sequential data samples. To perform frame-based processing, you must have a DSP System Toolbox™ license.
- **Elements as channels (sample based)** — Process the input signal as individual data samples.
- **Inherited (this choice will be removed see release notes)** — Use the frame status attribute of the input signal to determine whether to process the input as frames or samples.

When you load an existing model in R2011a, the software sets this parameter to **Inherited (this choice will be removed - see release notes)**. Selecting this option allows you to continue working with your model until you upgrade. Upgrade your model using the `slupdate` function as soon as possible.

---

**Note** For more information about this option, see “Changes to Frame-Based Processing”

---

## C62x Complex FIR

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### **Algorithm**

In simulation, the Complex FIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fir_cplx`. During code generation, this block calls the `DSP_fir_cplx` routine to produce optimized code.

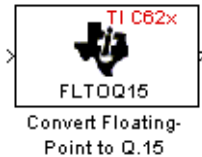
### **See Also**

C62xGeneral Real FIR, C62xRadix-4 Real FIR, C62xRadix-8 Real FIR, C62xSymmetric Real FIR

# C62x Convert Floating-Point to Q.15

**Purpose** Convert single-precision floating-point input signal to Q.15 fixed-point

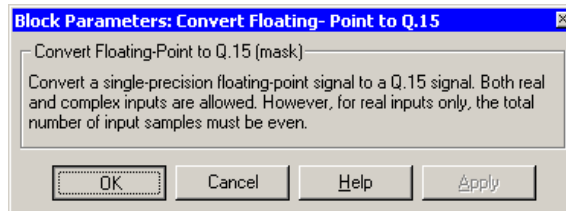
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The Convert Floating-Point to Q.15 block converts a single-precision floating-point input signal to a Q.15 output signal. Input can be real or complex. For real inputs, the number of input samples must be even.

The Convert Floating-Point to Q.15 block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Convert Floating-Point to Q.15 block is equivalent to the TMS320C62x DSP Library assembly code function DSP\_f1toq15. During code generation, this block calls the DSP\_f1toq15 routine to produce optimized code.

## See Also

C62xConvert Q.15 to Floating Point

# C62x Convert Q.15 to Floating-Point

**Purpose** Convert Q.15 fixed-point signal to single-precision floating-point

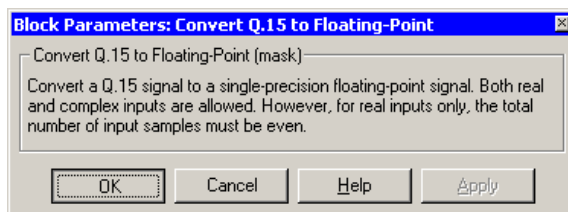
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The Convert Q.15 to Floating-Point block converts a Q.15 input signal to a single-precision floating-point output signal. Input can be real or complex. For real inputs, the number of input samples must be even.

The Convert Q.15 to Floating-Point block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Convert Q.15 to Floating-Point block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_q15tof1`. During code generation, this block calls the `DSP_q15tof1` routine to produce optimized code.

**See Also** C62xConvert Floating-Point to Q.15

**Purpose** Decimation-in-frequency forward FFT of complex input vector

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The FFT block computes the decimation-in-frequency forward FFT, with scaling between stages, of each channel of a complex input signal. The input length of each channel must be both a power of two and in the range 8 to 16,384, inclusive. The input must also be in natural (linear) order. The block outputs a complex signal in natural order. Inputs and outputs are signed 16-bit fixed-point data types.

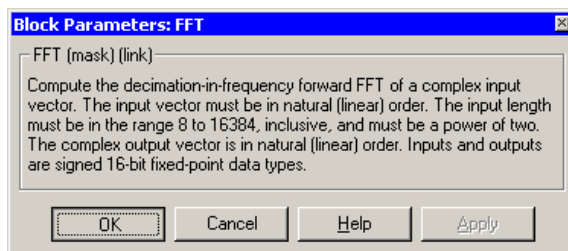
The `fft16x16r` routine used by this block employs butterfly stages to perform the FFT. The number of butterfly stages used,  $S$ , depends on the input length  $L = 2^k$ . If  $k$  is even, then  $S = k/2$ . If  $k$  is odd, then  $S = (k+1)/2$ .

If  $k$  is even, then  $L$  is a power of two as well as a power of four, and this block performs all  $S$  stages with radix-4 butterflies to compute the output. If  $k$  is odd, then  $L$  is a power of two but not a power of four. In that case this block performs the first  $(S-1)$  stages with radix-4 butterflies, followed by a final stage using radix-2 butterflies.

To minimize noise, the FFT block also implements a divide-by-two scaling on the output of each stage except for the last. Therefore, for the gain of the block to match that of the theoretical FFT, the FFT block offsets the location of the binary point of the output data type by  $(S-1)$  bits to the right relative to the location of the binary point of the input data type. That is, the number of fractional bits of the output data type equals the number of fractional bits of the input data type minus  $(S-1)$ .

$$\text{OutputFractionalBits} = \text{InputFractionalBits} - (S-1)$$

The FFT block supports both continuous and discrete sample times. This block supports little-endian code generation.



## Dialog Box

## Algorithm

In simulation, the FFT block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fft16x16r`. During code generation, this block calls the `DSP_fft16x16r` routine to produce optimized code.

## See Also

C62xRadix-2 FFT, C62xRadix-2 IFFT

**Purpose** Filter real input signal using real FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



**Description**

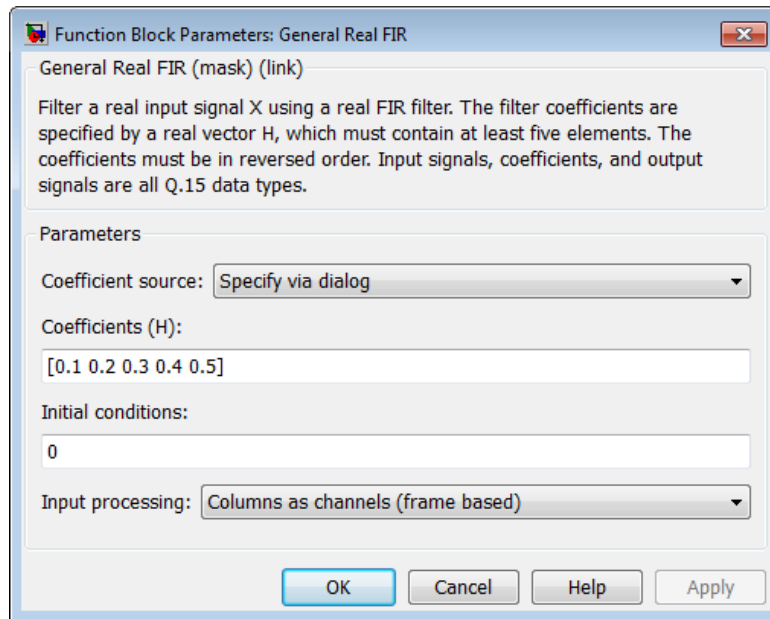
The General Real FIR block filters a real input signal  $X$  using a real FIR filter. This filter is implemented using a direct form structure.

The filter coefficients are specified by a real vector  $H$ , which must contain at least five elements. The coefficients must be in reversed order. all inputs, coefficients, and outputs are  $Q.15$  signals.

The General Real FIR block supports discrete sample times and supports little-endian code generation only.

# C62x General Real FIR

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients (H)** parameter in the dialog
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X

### Coefficients (H)

Designate the filter coefficients in vector format. This parameter is only visible when **Specify via dialog** is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, you need only enter a scalar.



- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.
- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

The initial conditions must be real.

## Input Processing

Process input signal as frames or samples

- **Columns as channels (frame based)** — Process the input signal as frames. Each frame contains a group of sequential data samples. To perform frame-based processing, you must have a DSP System Toolbox license.
- **Elements as channels (sample based)** — Process the input signal as individual data samples.
- **Inherited (this choice will be removed see release notes)** — Use the frame status attribute of the input signal to determine whether to process the input as frames or samples.

When you load an existing model in R2011a, the software sets this parameter to **Inherited (this choice will be removed - see release notes)**. Selecting this option allows you to continue working with your model until you upgrade. Upgrade your model using the `slupdate` function as soon as possible.

---

**Note** For more information about this option, see “Changes to Frame-Based Processing”

---

## Algorithm

In simulation, the General Real FIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fir_gen`.

## C62x General Real FIR

---

During code generation, this block calls the `DSP_fir_gen` routine to produce optimized code.

### **See Also**

C62xComplex FIR, C62xRadix-4 Real FIR, C62xRadix-8 Real FIR, C62xSymmetric Real FIR

**Purpose** LMS adaptive FIR filtering

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The LMS Adaptive FIR block performs least-mean-square (LMS) adaptive filtering. This filter is implemented using a direct form structure.

---

**Note** To implement a complete LMS algorithm, use this block in combination with the 5 other blocks shown in the “Examples” on page 2-392 section.

---

---

**Note** This block performs fixed-point computations using `fixdt(1,16,15)` and `fixdt(1,32,30)` data types. Because of this limitation, you may not be able to address numeric overflow and underflow problems with this block. As a result, this block is useful in a limited set of applications.

---

The following constraints apply to the inputs and outputs of this block:

- The scalar input  $X$  must be a Q.15 data type.
- The scalar input  $B$  must be a Q.15 data type.
- The scalar output  $R$  is a Q1.30 data type.
- The output  $\bar{H}$  has length equal to the number of filter taps and is a Q.15 data type. The number of filter taps must be a positive, even integer.

## C62x LMS Adaptive FIR

---

This block performs LMS adaptive filtering according to the equations

$$e(n+1) = d(n+1) - [\bar{H}(n) \cdot \bar{X}(n+1)]$$

and

$$\bar{H}(n+1) = \bar{H}(n) + [\mu e(n+1) \cdot \bar{X}(n+1)],$$

where

- $n$  designates the time step.
- $\bar{X}$  is a vector composed of the current and last  $nH-1$  scalar inputs.
- $d$  is the desired signal. The output  $R$  converges to  $d$  as the filter converges.
- $\bar{H}$  is a vector composed of the current set of filter taps.
- $e$  is the error, or  $d - [\bar{H}(n) \cdot \bar{X}(n+1)]$ .
- $\mu$  is the step size.

For this block, the input  $B$  and the output  $R$  are defined by

$$B = \mu e(n+1)$$

and

$$R = \bar{H}(n) \cdot \bar{X}(n+1),$$

which combined with the first two equations, result in the following equations that this block follows:

$$e(n+1) = d(n+1) - R$$

$$\bar{H}(n+1) = \bar{H}(n) + [B \cdot \bar{X}(n+1)].$$

$d$  and  $B$  must be produced externally to the LMS Adaptive FIR block. Refer to Examples below for a sample model that does this.

The LMS Adaptive FIR block supports discrete sample times and supports little-endian code generation only.

The rounding mode used is *floor*, and the saturation mode is *wrap*. all intermediate products have **s32Q30** data type. The update equation is as follows:

$$H_i = H_i + s16Q15(s32Q30(B) \times s32Q30(X_i))$$
$$R = \sum_N (X_i \times H_i),$$

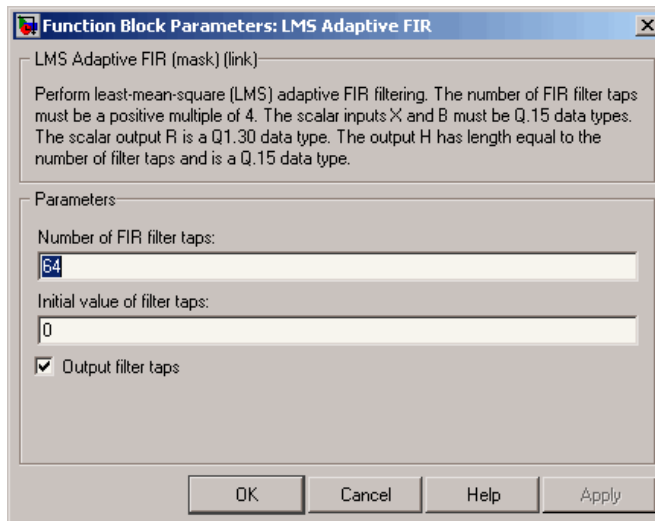
where  $N$  is the number of filter taps.

---

**Note** This block does not implement a leaky LMS algorithm. Therefore, do not compare it with the leakage factor of the LMS block of the DSP System Toolbox software.

---

# C62x LMS Adaptive FIR



## Dialog Box

### Number of FIR filter taps

Designate the number of filter taps. The number of taps must be a positive, even integer.

### Initial value of filter taps

Enter the initial value of the filter taps.

### Output filter coefficients H?

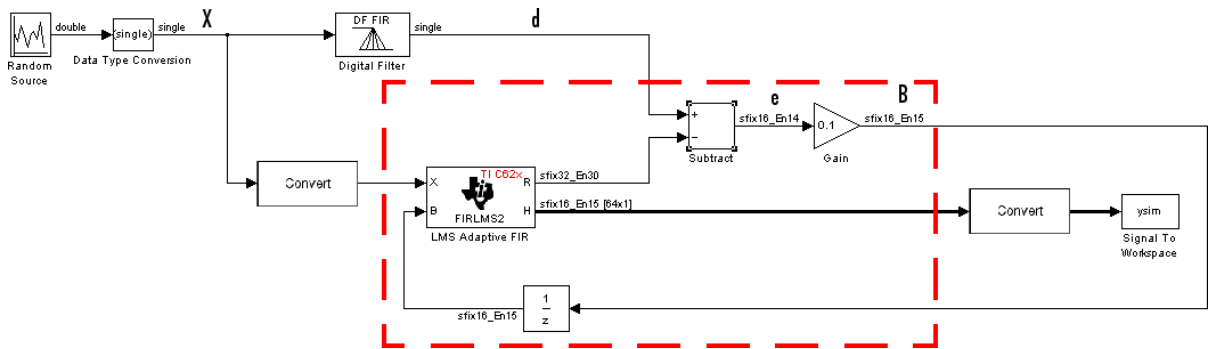
If you select this option, the filter taps are produced as output H. If not selected, H is suppressed.

## Algorithm

In simulation, the LMS Adaptive FIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fir1ms2`. During code generation, this block calls the `DSP_fir1ms2` routine to produce optimized code.

## Examples

The following model uses the LMS Adaptive FIR block.



The portion of the model enclosed by the dashed line produces the signal  $B$  and feeds it back into the LMS Adaptive FIR block. The inputs to this region are  $\bar{X}$  and the desired signal  $d$ , and the output of this region is the vector of filter taps  $\bar{H}$ . Thus this region of the model acts as a canonical LMS adaptive filter. For example, compare this region to the `adaptfilt.lms` function in DSP System Toolbox software. `adaptfilt.lms` performs canonical LMS adaptive filtering and has the same inputs and output as the outlined section of this model.

To use the LMS Adaptive FIR block you must create the input  $B$  in some way similar to the one shown here. You must also provide the signals  $\bar{X}$  and  $d$ . This model simulates the desired signal  $d$  by feeding  $\bar{X}$  into a digital filter block. You can simulate your desired signal in a similar way, or you may bring  $d$  in from the workspace with a From Workspace or codec block.

# C62x Matrix Multiply

**Purpose** Matrix multiply two input signals

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The Matrix Multiply block multiplies two input matrices A and B. Inputs and outputs are real, 16-bit, signed fixed-point data types. This block wraps overflows when they occur.

The product of the two 16-bit inputs results in a 32-bit accumulator value. The Matrix Multiply block, however, only outputs 16 bits. You can choose to output the highest or second-highest 16 bits of the accumulator value.

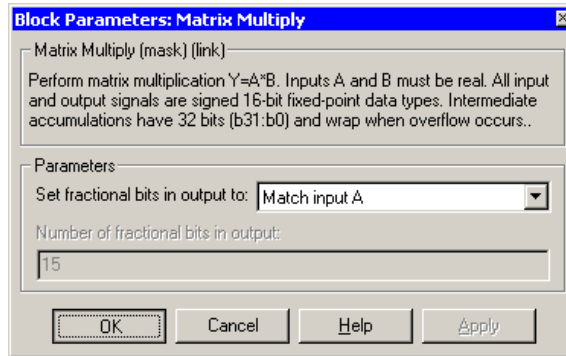
Alternatively, you can choose to output 16 bits according to how many fractional bits you want in the output. The number of fractional bits in the accumulator value is the sum of the fractional bits of the two inputs.

|                        | <b>Input A</b> | <b>Input B</b> | <b>Accumulator Value</b> |
|------------------------|----------------|----------------|--------------------------|
| <b>Total Bits</b>      | 16             | 16             | 32                       |
| <b>Fractional Bits</b> | $R$            | $S$            | $R + S$                  |

Therefore  $R+S$  is the location of the binary point in the accumulator value. You can select 16 bits in relation to this fixed position of the accumulator binary point to give the desired number of fractional bits in the output (see Examples below). You can either require the output to have the same number of fractional bits as one of the two inputs, or you can specify the number of output fractional bits in the **Number of fractional bits in output** parameter.



The Matrix Multiply block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

### Set fractional bits in output to

Only 16 bits of the 32 accumulator bits are output from the block. Choose which 16 bits to output from the list:

- **Match input A** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in input A (or *R* in the discussion above).
- **Match input B** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in input B (or *S* in the discussion above).
- **Match high bits of acc. (b31:b16)** — Output the highest 16 bits of the accumulator value.
- **Match high bits of prod. (b30:b15)** — Output the second-highest 16 bits of the accumulator value.
- **User-defined** — Output the 16 bits of the accumulator value that cause the number of fractional bits of the output to match the value specified in the **Number of fractional bits in output** parameter.

# C62x Matrix Multiply

---

## Number of fractional bits in output

Specify the number of bits to the right of the binary point in the output. This parameter is enabled only when you select User-defined for **Set fractional bits in output to**.

## Algorithm

In simulation, the Matrix Multiply block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_mat_mul`. During code generation, this block calls the `DSP_mat_mul` routine to produce optimized code.

## Examples

### Example 1

Suppose A and B are both Q.15. The data type of the resulting accumulator value is therefore the 32-bit data type Q1.30 ( $R + S = 30$ ). In the accumulator, bits 31:30 are the sign and integer bits, and bits 29:0 are the fractional bits. The following table shows the resulting data type and accumulator bits used for the output signal for different settings of the **Set fractional bits in output to** parameter.

| <b>Set fractional bits in output to</b> | <b>Data Type</b> | <b>Accumulator Bits</b> |
|-----------------------------------------|------------------|-------------------------|
| Match input A                           | Q.15             | b30:b15                 |
| Match input B                           | Q.15             | b30:b15                 |
| Match high bits of acc.                 | Q1.14            | b31:b16                 |
| Match high bits of prod.                | Q.15             | b30:b15                 |

### Example 2

Suppose A is Q12.3 and B is Q10.5. The data type of the resulting accumulator value is therefore Q23.8 ( $R + S = 8$ ). In the accumulator, bits 31:8 are the sign and integer bits, and bits 7:0 are the fractional bits. The following table shows the resulting data type and accumulator bits used for the output signal for different settings of the **Set fractional bits in output to** parameter.

| Set fractional bits in output to | Data Type | Accumulator Bits |
|----------------------------------|-----------|------------------|
| Match input A                    | Q12.3     | b20:b5           |
| Match input B                    | Q10.5     | b18:b3           |
| Match high bits of acc.          | Q23.-8    | b31:b16          |
| Match high bits of prod.         | Q22.-7    | b30:b15          |

## See Also

C62xVector Multiply

# C62x Matrix Transpose

---

**Purpose** Matrix transpose input signal

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

## Description



The Matrix Transpose block transposes an input matrix or vector. A 1-D input is treated as a column vector and is transposed to a row vector. Input and output signals are real, 16-bit, signed fixed-point data types.

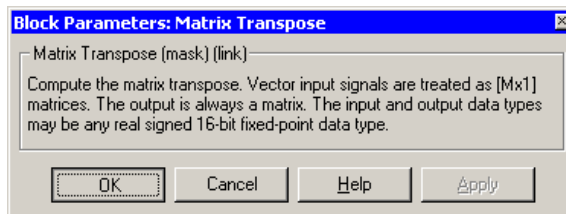
The Matrix Transpose block supports both continuous and discrete sample times. This block supports little-endian code generation only.

---

**Note** If you use Code Replacement Library (CRL) technology with this block, the TI compiler generates processor and compiler-specific instructions that improve the generated code. For more information, consult “Introduction to Code Replacement Libraries”.

---

## Dialog Box



## Algorithm

In simulation, the Matrix Transpose block is equivalent to the TMS320C62x DSP Library assembly code function DSP\_mat\_trans. During code generation, this block calls the DSP\_mat\_trans routine to produce optimized code.

**Purpose** Radix-2 decimation-in-frequency forward FFT of complex input vector

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

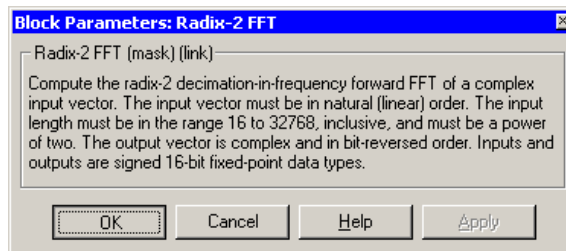


## Description

The Radix-2 FFT block computes the radix-2 decimation-in-frequency forward FFT of each channel of a complex input signal. The input length of each channel must be both a power of two and in the range 16 to 32,768, inclusive. The input must also be in natural (linear) order. The output of this block is a complex signal in bit-reversed order. Inputs and outputs are signed 16-bit fixed-point data types, and the output data type matches the input data type.

You can use the C62x Bit Reverse block to reorder the output of the Radix-2 FFT block to natural order.

The Radix-2 FFT block supports both continuous and discrete sample times. This block supports little-endian code generation.



## Dialog Box

## Algorithm

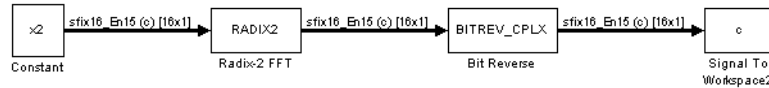
In simulation, the Radix-2 FFT block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_radix2`. During

# C62x Radix-2 FFT

code generation, this block calls the DSP\_radix2 routine to produce optimized code.

## Examples

The output of the Radix-2 FFT block is bit-reversed. This example shows you how to use the C62x Bit Reverse block to reorder the output of the Radix-2 FFT block to natural order.



The following code calculates the same FFT as the above model in the workspace. The output from this calculation, `y2`, is then displayed side-by-side with the output from the model, `c`. The outputs match, showing that the Bit Reverse block does reorder the Radix-2 FFT block output to natural order:

```
k = 4;
n = 2^k;
xr = zeros(n, 1);
xr(2) = 0.5;
xi = zeros(n, 1);
x2 = complex(xr, xi);
y2 = fft(x2);
```

```
[y2, c]
0.5000 0.5000
0.4619 - 0.1913i 0.4619 - 0.1913i
0.3536 - 0.3536i 0.3535 - 0.3535i
0.1913 - 0.4619i 0.1913 - 0.4619i
0 - 0.5000i 0 - 0.5000i
-0.1913 - 0.4619i -0.1913 - 0.4619i
-0.3536 - 0.3536i -0.3535 - 0.3535i
-0.4619 - 0.1913i -0.4619 - 0.1913i
-0.5000 -0.5000
-0.4619 + 0.1913i -0.4619 + 0.1913i
-0.3536 + 0.3536i -0.3535 + 0.3535i
```

|                   |                   |
|-------------------|-------------------|
| -0.1913 + 0.4619i | -0.1913 + 0.4619i |
| 0 + 0.5000i       | 0 + 0.5000i       |
| 0.1913 + 0.4619i  | 0.1913 + 0.4619i  |
| 0.3536 + 0.3536i  | 0.3535 + 0.3535i  |
| 0.4619 + 0.1913i  | 0.4619 + 0.1913i  |

### See Also

C62x Bit Reverse, C62x FFT, C62x Radix-2 IFFT

# C62x Radix-2 IFFT

---

**Purpose** Radix-2 inverse FFT of complex input vector

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



## Description

The Radix-2 IFFT block computes the radix-2 inverse FFT of each channel of a complex input signal. This block uses a decimation-in-frequency forward FFT algorithm with butterfly weights modified to compute an inverse FFT. The input length of each channel must be both a power of two and in the range 16 to 32,768, inclusive. The input must also be in natural (linear) order. The output of this block is a complex signal in bit-reversed order. Inputs and outputs are signed 16-bit fixed-point data types.

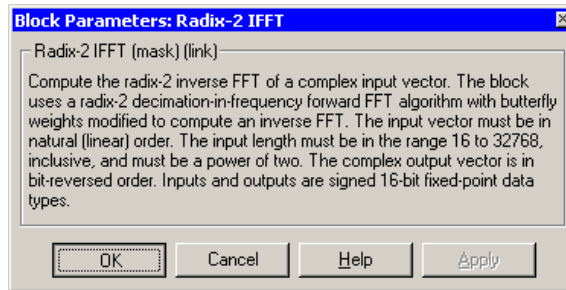
The `radix2` routine used by this block employs a radix-2 FFT of length  $L=2^k$ . So that the gain of the block matches that of the theoretical IFFT, the Radix-2 IFFT block offsets the location of the binary point of the output data type by  $k$  bits to the left relative to the location of the binary point of the input data type. That is, the number of fractional bits of the output data type equals the number of fractional bits of the input data type plus  $k$ .

$$\text{OutputFractionalBits} = \text{InputFractionalBits} + (k)$$

You can use the C62x Bit Reverse block to reorder the output of the Radix-2 IFFT block to natural order.

The Radix-2 IFFT block supports both continuous and discrete sample times. This block supports little-endian code generation.





## Dialog Box

## Algorithm

In simulation, the Radix-2 IFFT block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_radix2`. During code generation, this block calls the `DSP_radix2` routine to produce optimized code.

## See Also

C62x Bit Reverse, C62x FFT, C62x Radix-2 FFT

# C62x Radix-4 Real FIR

---

**Purpose** Filter real input signal using real FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



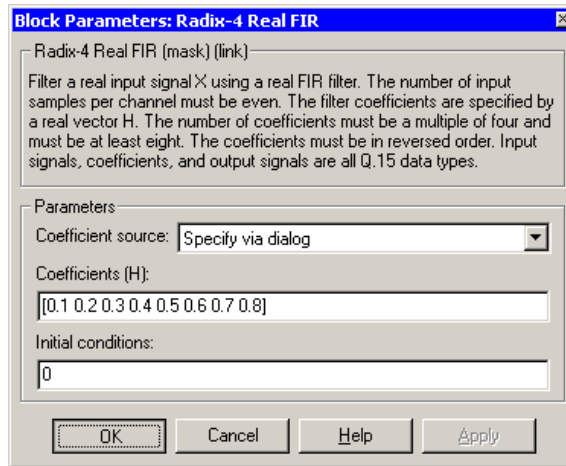
## Description

The Radix-4 Real FIR block filters a real input signal  $X$  using a real FIR filter. This filter is implemented using a direct form structure.

The number of input samples per channel must be even. The filter coefficients are specified by a real vector,  $H$ . The number of filter coefficients must be a multiple of four and must be at least eight. The coefficients must also be in reversed order. all inputs, coefficients, and outputs are Q.15 signals.

The Radix-4 Real FIR block supports discrete sample times and supports little-endian code generation only.

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients** parameter in the dialog
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X

### Coefficients (H)

Designate the filter coefficients in vector format. This parameter is only visible when **Specify via dialog** is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.

## C62x Radix-4 Real FIR

---

- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

Initial conditions must be real.

### **Algorithm**

In simulation, the Radix-4 Real FIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fir_r4`. During code generation, this block calls the `DSP_fir_r4` routine to produce optimized code.

### **See Also**

C62xComplex FIR, C62xGeneral Real FIR, C62xRadix-8 Real FIR, C62xSymmetric Real FIR

**Purpose**

Filter real input signal using real FIR filter

**Library**

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

**Description**

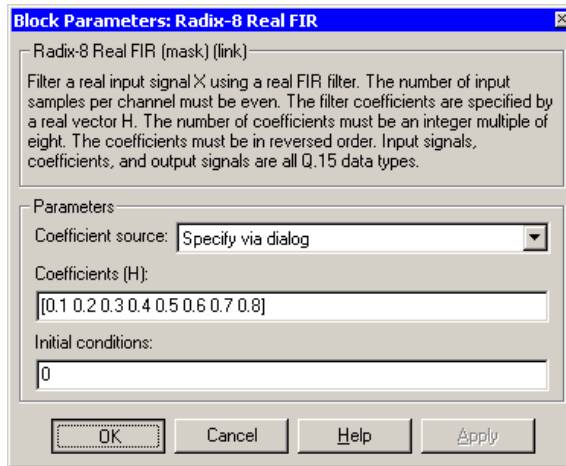
The Radix-8 Real FIR block filters a real input signal  $X$  using a real FIR filter. This filter is implemented using a direct form structure.

The number of input samples per channel must be even. The filter coefficients are specified by a real vector,  $H$ . The number of coefficients must be an integer multiple of eight. The coefficients must be in reversed order. all inputs, coefficients, and outputs are Q.15 signals.

The Radix-8 Real FIR block supports discrete sample times and little-endian code generation only.

# C62x Radix-8 Real FIR

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients** parameter in the dialog
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X

### Coefficients (H)

Designate the filter coefficients in vector format. This parameter is only visible when **Specify via dialog** is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.

- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

Initial conditions must be real.

## **Algorithm**

In simulation, the Radix-8 Real FIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fir_r8`. During code generation, this block calls the `DSP_fir_r8` routine to produce optimized code.

## **See Also**

C62xComplex FIR, C62xGeneral Real FIR, C62xRadix-4 Real FIR, C62xSymmetric Real FIR

# C62x Real Forward Lattice All-Pole IIR

---

**Purpose** Filter real input signal using lattice filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



Real Forward Lattice  
All-Pole IIR

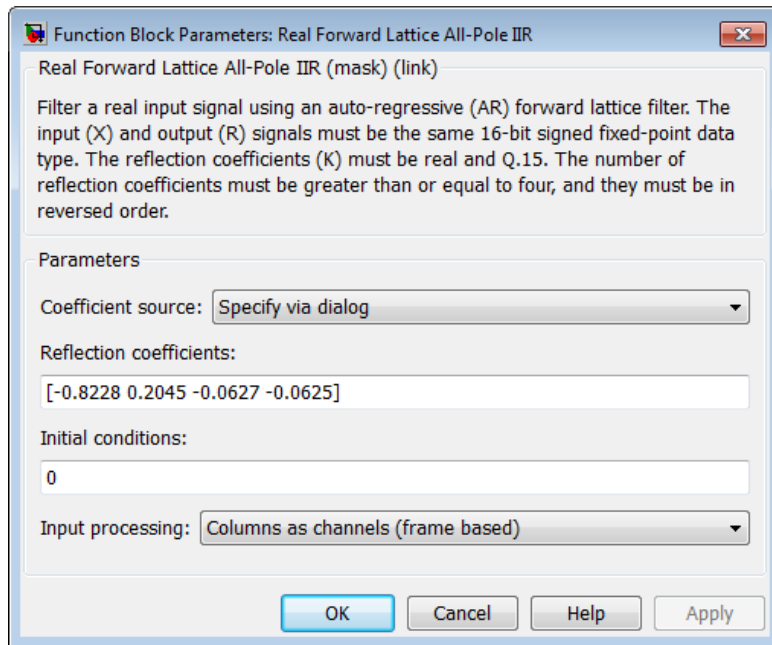
## Description

The Real Forward Lattice all-Pole IIR block filters a real input signal using an autoregressive forward lattice filter. The input and output signals must be the same 16-bit signed fixed-point data type. The reflection coefficients must be real and Q.15. The number of reflection coefficients must be greater than or equal to four, and they must be in reversed order. Use an even number of reflection coefficients to maximize the speed of your generated code.

The Real Forward Lattice all-Pole IIR block supports discrete sample times and supports little-endian code generation only.



## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- Specify via dialog — Enter the coefficients in the **Reflection coefficients** parameter in the dialog
- Input port — Accept the coefficients from port K

### Reflection coefficients

Designate the reflection coefficients of the filter in vector format. The number of coefficients must be greater than or equal to four, and they must be in reverse order. Using an even number of reflection coefficients maximizes the speed of your generated code. This parameter is visible when you select **Specify via dialog** for the **Coefficient source** parameter. This parameter is tunable in simulation.

## Initial conditions

If your block initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length (number of elements) of this vector must be the same as the number of reflection coefficients in your filter.
- Different across channels, enter a matrix containing all initial conditions. The number of rows (initial conditions for one channel) of this matrix must be the same as the number of reflection coefficients, and the number of columns of this matrix must be equal to the number of channels.

## Input Processing

Process input signal as frames or samples

- **Columns as channels (frame based)** — Process the input signal as frames. Each frame contains a group of sequential data samples. To perform frame-based processing, you must have a DSP System Toolbox license.
- **Elements as channels (sample based)** — Process the input signal as individual data samples.
- **Inherited (this choice will be removed - see release notes)** — Use the frame status attribute of the input signal to determine whether to process the input as frames or samples.

When you load an existing model in R2011a, the software sets this parameter to **Inherited (this choice will be removed - see release notes)**. Selecting this option allows you to continue working with your model until you upgrade. Upgrade your model using the `slupdate` function as soon as possible.

---

**Note** For more information about this option, see “Changes to Frame-Based Processing”

---

**Algorithm**

In simulation, the Real Forward Lattice all-Pole IIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_iirlat`. During code generation, this block calls the `DSP_iirlat` routine to produce optimized code.

**See Also**

C62xReal IIR

# C62x Real IIR

---

**Purpose** Filter real input signal using IIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

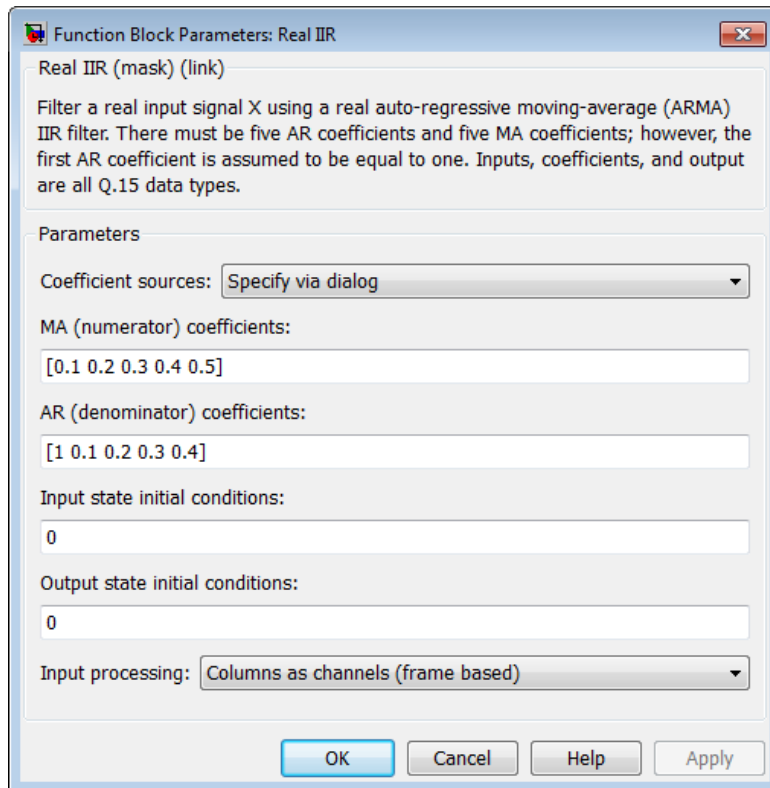
**Description**



The Real IIR block filters a real input signal  $X$  using a real autoregressive moving-average (ARMA) IIR Filter. This filter is implemented using a direct form I structure.

There must be five AR coefficients and five MA coefficients. The first AR coefficient is assumed to be one. Inputs, coefficients, and output are Q.15 data types.

The Real IIR block supports discrete sample times and supports little-endian code generation only.



## Dialog Box

### Coefficient sources

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **MA (numerator) coefficients** and **AR (denominator) coefficients** parameters in the dialog
- **Input ports** — Accept the coefficients from block input ports MA and AR

### MA (numerator) coefficients

Designate the moving-average coefficients of the filter in vector format. There must be five MA coefficients. This parameter is only

visible when `Specify via dialog` is selected for the **Coefficient sources** parameter. This parameter is tunable in simulation.

## **AR (denominator) coefficients**

Designate the autoregressive coefficients of the filter in vector format. There must be five AR coefficients, however the first AR coefficient is assumed to be equal to one. This parameter is only visible when `Specify via dialog` is selected for the **Coefficient sources** parameter. This parameter is tunable in simulation.

## **Input state initial conditions**

If the input state initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the input state initial conditions for one channel. The length of this vector must be four.
- Different across channels, enter a matrix containing all input state initial conditions. This matrix must have four rows.

## **Output state initial conditions**

If the output state initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the output state initial conditions for one channel. The length of this vector must be four.
- Different across channels, enter a matrix containing all output state initial conditions. This matrix must have four rows.

## **Input Processing**

Process input signal as frames or samples

- **Columns as channels (frame based)** — Process the input signal as frames. Each frame contains a group of sequential data samples. To perform frame-based processing, you must have a DSP System Toolbox license.

- Elements as channels (sample based) — Process the input signal as individual data samples.
- Inherited (this choice will be removed see release notes) — Use the frame status attribute of the input signal to determine whether to process the input as frames or samples.

When you load an existing model in R2011a, the software sets this parameter to Inherited (this choice will be removed - see release notes). Selecting this option allows you to continue working with your model until you upgrade. Upgrade your model using the `slupdate` function as soon as possible.

---

**Note** For more information about this option, see “Changes to Frame-Based Processing”

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## Algorithm

In simulation, the Real IIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_iir`. During code generation, this block calls the `DSP_iir` routine to produce optimized code.

## See Also

C62xReal Forward Lattice all-Pole IIR

# C62x Reciprocal

**Purpose** Fraction and exponent portions of reciprocal of real input signal

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

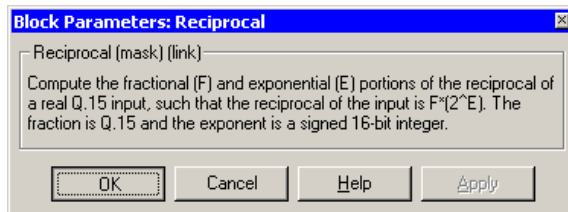
## Description



The Reciprocal block computes the fractional (F) and exponential (E) portions of the reciprocal of a real Q.15 input, such that the reciprocal of the input is  $F \cdot 2^E$ . The fraction is Q.15 and the exponent is a 16-bit signed integer.

The Reciprocal block supports both continuous and discrete sample times. This block also supports little-endian code generation only.

## Dialog Box



## Algorithm

In simulation, the Reciprocal block is equivalent to the TMS320C62x DSP Library assembly code function DSP\_recip16. During code generation, this block calls the DSP\_recip16 routine to produce optimized code.



**Purpose** Filter real input signal using FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



**Description** Symmetric Real FIR

The Symmetric Real FIR block filters a real input signal using a symmetric real FIR filter. This filter is implemented using a direct form structure.

The number of input samples per channel must be even. The filter coefficients are specified by a real vector  $H$ , which must be symmetric about its middle element. The number of coefficients must be of the form  $16k + 1$ , where  $k$  is a positive integer. This block wraps overflows that occur. The input, coefficients, and output are 16-bit signed fixed-point data types.

Intermediate multiplies and accumulates performed by this filter result in a 32-bit accumulator value. However, the Symmetric Real FIR block only outputs 16 bits. You can choose to output 16 bits of the accumulator value in one of the following ways.

|                            |                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Match input $x$            | Output 16 bits of the accumulator value such that the output has the same number of fractional bits as the input        |
| Match coefficients $h$     | Output 16 bits of the accumulator value such that the output has the same number of fractional bits as the coefficients |
| Match high 16 bits of acc. | Output bits 31 - 16 of the accumulator value                                                                            |

# C62x Symmetric Real FIR

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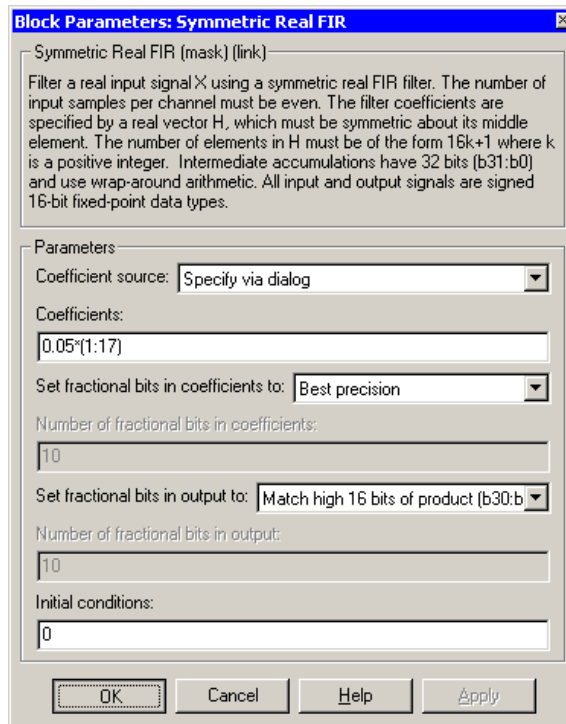
Match high 16 bits of  
prod.

User-defined

Output bits 30 - 15 of the accumulator  
value

Output 16 bits of the accumulator  
value such that the output has the  
number of fractional bits specified in  
the **Number of fractional bits in  
output** parameter

The Symmetric Real FIR block supports discrete sample times and  
only little-endian code generation.



## Dialog Box

### Coefficient source

Specify the source of the filter coefficients:

- Specify via dialog — Enter the coefficients in the **Coefficients** parameter in the dialog
- Input port — Accept the coefficients from port H

### Coefficients

Enter the coefficients in vector format. This parameter is visible only when Specify via dialog is specified for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Set fractional bits in coefficients to

Specify the number of fractional bits in the filter coefficients:

# C62x Symmetric Real FIR

---

- **Match input X** — Sets the coefficients to have the same number of fractional bits as the input
- **Best precision** — Sets the number of fractional bits of the coefficients such that the coefficients are represented to the best precision possible
- **User-defined** — Sets the number of fractional bits in the coefficients with the **Number of fractional bits in coefficients** parameter

This parameter is visible only when **Specify via dialog** is specified for the **Coefficient source** parameter.

## **Number of fractional bits in coefficients**

Specify the number of bits to the right of the binary point in the filter coefficients. This parameter is visible only when **Specify via dialog** is specified for the **Coefficient source** parameter, and is only enabled if **User-defined** is specified for the **Set fractional bits in coefficients to** parameter.

## **Set fractional bits in output to**

Only 16 bits of the 32 accumulator bits are output from the block. Select which 16 bits to output:

- **Match input X** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in input X
- **Match coefficients H** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in coefficients H
- **Match high bits of acc. (b31:b16)** — Output the highest 16 bits of the accumulator value
- **Match high bits of prod. (b30:b15)** — Output the second-highest 16 bits of the accumulator value

- **User-defined** — Output the 16 bits of the accumulator value that cause the number of fractional bits of the output to match the value specified in the **Number of fractional bits in output** parameter

See Matrix Multiply “Examples” on page 2-396 for demonstrations of these selections.

### **Number of fractional bits in output**

Specify the number of bits to the right of the binary point in the output. This parameter is only enabled if **User-defined** is selected for the **Set fractional bits in output to** parameter.

### **Initial conditions**

If the initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.
- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

## **Algorithm**

In simulation, the Symmetric Real FIR block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_fir_sym`. During code generation, this block calls the `DSP_fir_sym` routine to produce optimized code.

## **See Also**

C62xComplex FIR, C62xGeneral Real FIR, C62xRadix-4 Real FIR, C62xRadix-8 Real FIR

# C62x Vector Dot Product

**Purpose** Vector dot product of real input signals

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

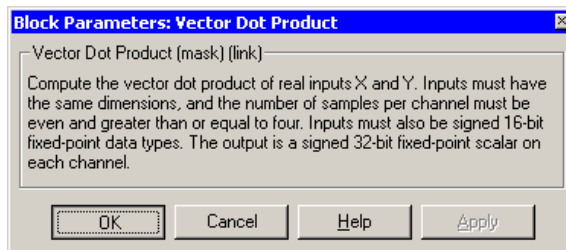
## Description



The Vector Dot Product block computes the vector dot product of two real input vectors, X and Y. The input vectors must have the same dimensions and must be signed 16-bit fixed-point data types. The number of samples per channel of the inputs must be even and greater than or equal to four. The output is a signed 32-bit fixed-point scalar on each channel, and the number of fractional bits of the output is equal to the sum of the number of fractional bits of the inputs.

The Vector Dot Product block supports both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



## Algorithm

In simulation, the Vector Dot Product block is equivalent to the TMS320C62x DSP Library assembly code function DSP\_dotprod. During code generation, this block calls the DSP\_dotprod routine to produce optimized code.

**Purpose** Zero-based index of maximum value element in each input signal channel

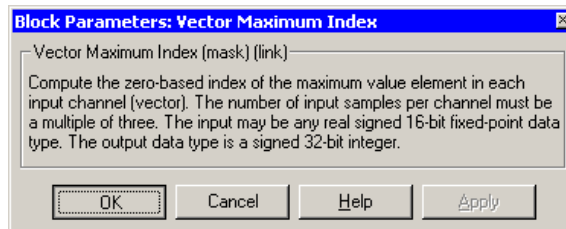
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



**Description** Vector Maximum Index

The Vector Maximum Index block computes the zero-based index of the maximum value element in each channel (vector) of the input signal. The input takes a real, 16-bit, signed fixed-point data type. The number of samples per input channel must be an integer multiple of three. The output data type is a 32-bit signed integer.

The Vector Maximum Index block supports both continuous and discrete sample times. This block supports little-endian code generation only.



**Dialog Box**

**Algorithm**

In simulation, the Vector Maximum Index block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_maxidx`. During code generation, this block calls the `DSP_maxidx` routine to produce optimized code.

# C62x Vector Maximum Value

**Purpose** Maximum value for each input signal channel

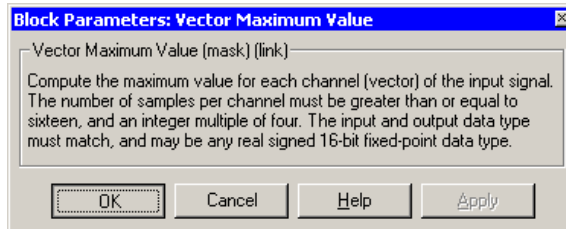
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



**Description** Vector Maximum Value

The Vector Maximum Value block returns the maximum value in each channel (vector) of the input signal. The input takes a real, 16-bit, signed fixed-point data type. The number of samples on each input channel must be an integer multiple of four and must be at least 16. The output data type matches the input data type.

The Vector Maximum Value block supports both continuous and discrete sample times. This block supports little-endian code generation only.



**Dialog Box**

**Algorithm** In simulation, the Vector Maximum Value block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_maxval`. During code generation, this block calls the `DSP_maxval` routine to produce optimized code.

**See Also** C62xVector Minimum Value



**Purpose** Minimum value for each input signal channel

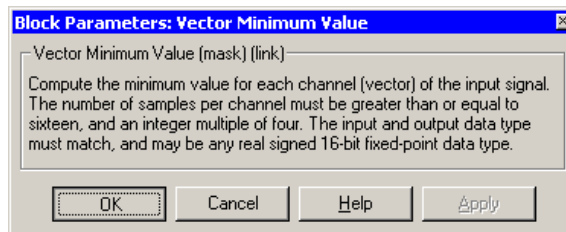
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library



**Description** Vector Minimum Value

The Vector Minimum Value block returns the minimum value in each channel of the input signal. The input may be a real, 16-bit, signed fixed-point data type. The number of samples on each input channel must be an integer multiple of four and must be at least 16. The output data type matches the input data type.

The Vector Minimum Value block supports both continuous and discrete sample times. This block supports little-endian code generation only.



**Dialog Box**

**Algorithm** In simulation, the Vector Minimum Value block is equivalent to the TMS320C62x DSP Library assembly code function DSP\_minval. During code generation, this block calls the DSP\_minval routine to produce optimized code.

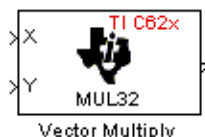
**See Also** C62xVector Maximum Value

# C62x Vector Multiply

**Purpose** Element-wise multiplication on inputs

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

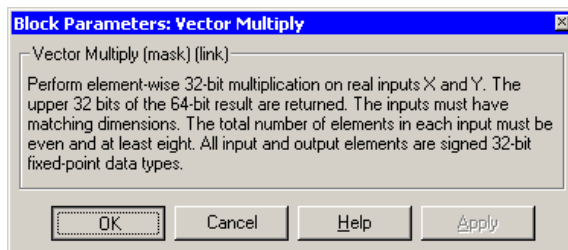
## Description



The Vector Multiply block performs element-wise 32-bit multiplication of two inputs X and Y. The total number of elements in each input must be even and at least eight, and the inputs must have matching dimensions. The upper 32 bits of the 64-bit accumulator result are returned. All input and output elements are 32-bit signed fixed-point data types.

The Vector Multiply block supports both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



## Algorithm

In simulation, the Vector Multiply block is equivalent to the TMS320C62x DSP Library assembly code function DSP\_mu132. During code generation, this block calls the DSP\_mu132 routine to produce optimized code.

**See Also** C62xMatrix Multiply

**Purpose** Negate each input signal element

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

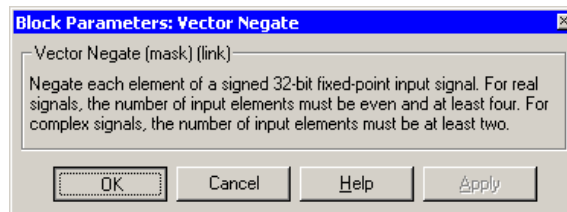
## Description



The Vector Negate block negates each element of a 32-bit signed fixed-point input signal. For real signals, the number of input elements must be even and at least four. For complex signals, the number of input elements must be at least two. The output is the same data type as the input.

The Vector Negate block supports both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



## Algorithm

In simulation, the Vector Negate block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_neg32`. During code generation, this block calls the `DSP_neg32` routine to produce optimized code.

# C62x Vector Sum of Squares

**Purpose** Sum of squares over each real input channel

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

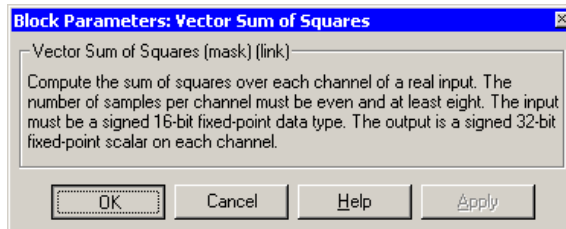


## Description

Vector Sum of Squares

The Vector Sum of Squares block computes the sum of squares over each channel of a real input. The number of samples per input channel must be even and at least eight, and the input must be a 16-bit signed fixed-point data type. The output is a 32-bit signed fixed-point scalar on each channel. The number of fractional bits of the output is twice the number of fractional bits of the input.

The Vector Sum of Squares block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Vector Sum of Squares block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_vecsumsq`. During code generation, this block calls the `DSP_vecsumsq` routine to produce optimized code.

**Purpose** Weighted sum of input vectors

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C62x DSP Library

## Description

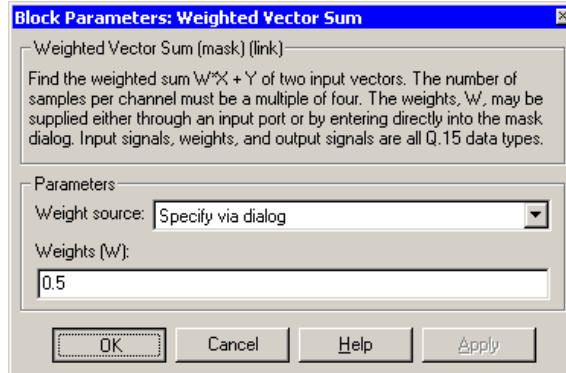


Weighted Vector Sum

The Weighted Vector Sum block computes the weighted sum of two inputs, X and Y, according to  $(W*X)+Y$ . Inputs may be vectors or frame-based matrices. The number of samples per channel must be a multiple of four. Inputs, weights, and output are Q.15 data types, and weights must be in the range  $-1 < W < 1$ .

The Weighted Vector Sum block supports both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



### Weight source

Specify the source of the weights:

- **Specify via dialog** — Enter the weights in the **Weights (W)** parameter in the dialog

# C62x Weighted Vector Sum

---

- Input port — Accept the weights from port W

## Weights (W)

This parameter is visible only when **Specify via dialog** is specified for the **Weight source** parameter. This parameter is tunable in simulation. When the weights are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be a multiple of four.
- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be a multiple of four, and the number of columns of this matrix must be equal to the number of channels.

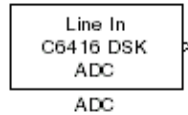
Weights must be in the range  $-1 < W < 1$ .

## Algorithm

In simulation, the Weighted Vector Sum block is equivalent to the TMS320C62x DSP Library assembly code function `DSP_w_vec`. During code generation, this block calls the `DSP_w_vec` routine to produce optimized code.

**Purpose** Digitized output from codec to processor

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6416 DSK



## Description

Use the C6416 DSK ADC (analog-to-digital converter) block to capture and digitize analog signals from the analog input jacks on the board. Placing an C6416 DSK ADC block in your Simulink block diagram lets you use the AIC23 coder-decoder module (codec) on the C6416 DSK to convert an analog input signal to a digital signal for the digital signal processor.

Most of the configuration options in the block alter the codec. However, the **Output data type**, **Samples per frame**, and **Scaling** options relate to the model you are using in Simulink software, the signal processor on the board, or direct memory access (DMA) on the board. In the following table, you find each option listed with the C6416 DSK hardware affected.

| Option            | Affected Hardware                    |
|-------------------|--------------------------------------|
| ADC Source        | Codec                                |
| Mic               | Codec                                |
| Output data type  | TMS320C6416 digital signal processor |
| Samples per frame | Direct memory access module          |
| Sample Rate       | Codec                                |
| Scaling           | TMS320C6416 digital signal processor |
| Word Length       | Codec                                |

You can select one of two input sources from the **ADC source** list:

- **Line In** — the codec accepts input from the line in connector (LINE IN) on the board's mounting bracket.
- **Mic** — the codec accepts input from the microphone connector (MIC IN) on the board mounting bracket.

Use the **Stereo** check box to indicate whether the audio input is monaural or stereo. Clear the check box to choose monaural audio input. Select the check box to enable stereo audio input. Monaural (mono) input is left channel only, but the output sends left channel content to both the left and right output channels; stereo uses the left and right channels on input and output.

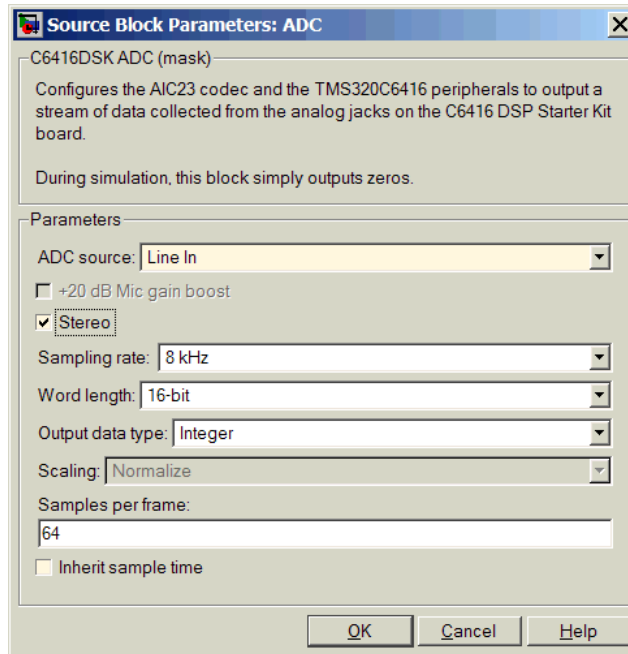
The block uses frame-based processing of inputs, buffering the input data into frames at the specified samples per frame rate. In Simulink software, the block puts monaural data into an N-element column vector. Stereo data input forms an N-by-2 matrix with N data values and two stereo channels (left and right).

When the samples per frame setting is more than one, each frame of data is either the N-element vector (monaural input) or N-by-2 matrix (stereo input). For monaural input, the elements in each frame form the column vector of input audio data. In the stereo format, the frame is the matrix of audio data represented by the matrix rows and columns — the rows are the audio data samples and the columns are the left and right audio channels.

When you select Mic for **ADC source**, you can select the **+20 dB Mic gain boost** check box to add 20 dB to the microphone input signal before the codec digitizes the signal.



## Dialog Box



### ADC source

The input source to the codec. **Line In** is the default. Selecting **Mic** enables the **+20 dB Mic gain boost** option.

### +20 dB Mic gain boost

Boosts the input signal by +20dB when **ADC source** is **Mic**. Gain is applied before analog-to-digital conversion.

### Stereo

Indicates whether the input audio data is in monaural or stereo format. Select the check box to enable stereo input. Clear the check box when you input monaural data. By default, stereo is enabled. Monaural data comes from the right channel.

### Sample rate

Sets the sample rate for the data output by the codec. Options are 8, 32, 44.1, 48, and 96kHz, with a default of 8kHz.

## Word length

Sets the resolution with which the ADC samples the analog input. Increasing the word length increases the accuracy of the data in each sample. If your model also contains a DAC block, set its word length match that of the ADC block.

## Output data type

Selects the word length and shape of the data from the codec. By default, `double` is selected. Options are `Double`, `Single`, and `Integer`. To process single and double data types, the block uses emulated floating-point instructions on the C6416 processor.

## Scaling

Selects whether the codec data is unmodified, or normalized to the output range to  $\pm 1.0$ , based on the codec data format. Select either `Normalize` or `Integer` from the list. `Normalize` is the default setting.

## Samples per frame

Creates frame-based outputs from sample-based inputs. This parameter specifies the number of samples of the signal the block buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. Notice that the frame rate depends on the sample rate and frame size. For example, if your input is 8000 samples per second, and you select 32 samples per frame, the frame rate is 250 frames per second. The throughput remains the same at 8000 samples per second.

## Inherit sample time

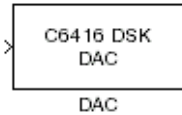
Selects whether the block inherits the sample time from the model base rate or Simulink base rate as determined in the Solver options in Configuration Parameters. Selecting **Inherit sample time** directs the block to use the specified rate in model configuration. Entering `-1` configures the block to accept the sample rate from the upstream HWI, Task, or Triggered Task blocks.

## See Also

C6416 DSK DAC

**Purpose** Use codec to convert digital input to analog output

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6416 DSK



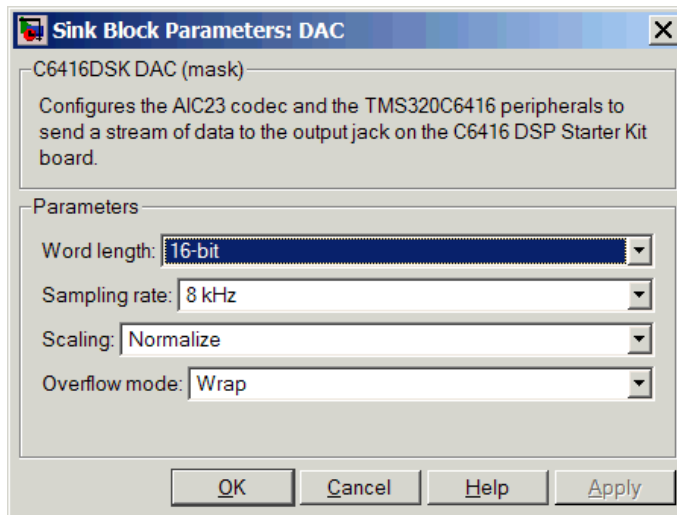
**Description**

Adding the C6416 DSK DAC (digital-to-analog converter) block to your Simulink model lets you output an analog signal to the LINE OUT connection on the C6416 DSK board. When you add the C6416 DSK DAC block, the digital signal received by the codec is converted to an analog signal and sent to the output jack.

Only the **Word length** option in the block affects the codec. The other options relate to the model you are using in Simulink software and the signal processor on the board. Refer to the following table for information.

| Option        | Affected Hardware                    |
|---------------|--------------------------------------|
| Overflow mode | TMS320C6416 Digital Signal Processor |
| Scaling       | TMS320C6416 Digital Signal Processor |
| Word length   | Codec                                |

## Dialog Box



### Word length

Sets the DAC to interpret the input data word length. Without this setting, the DAC cannot convert the digital data to analog as expected. The value defaults to 16 bits, with options of 20, 24, and 32 bits. The word length you set here should match the ADC setting.

### Sampling rate

Sets the sampling rate for the block output to the output ports on the target. Select from the list of available rates.

### Scaling

Selects whether the input to the codec represents unmodified data, or data that has been normalized to the range  $\pm 1.0$ . Match the setting for the C6416 DSK ADC block.

### Overflow mode

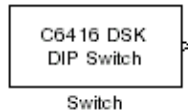
Determines how the codec responds to data that is outside the range specified by the **Scaling** parameter. You can choose *Wrap* or *Saturate* to handle the result of an overflow in an operation. If efficient operation matters, *Wrap* is the more efficient mode.

**See Also**      C6416 DSK ADC

# C6416 DSK DIP Switch

**Purpose** Simulate or read DIP switches

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6416 DSK



## Description

Added to your model, this block behaves differently in simulation than in code generation and targeting.

**In Simulation** — the options **Switch 0**, **Switch 1**, **Switch 2**, and **Switch 3** generate output to simulate the settings of the user-defined dual inline pin (DIP) switches on your C6416 DSK. Each option turns the associated DIP switch on when you select it. The switches are independent of one another.

By defining the switches to represent actions on your target, DIP switches let you modify the operation of your process by reconfiguring the switch settings.

Use the **Data type** to specify whether the DIP switch options output an integer or a logical string of bits to represent the status of the switches. The table that follows presents all the option setting combinations with the result of your **Data type** selection.

### Option Settings to Simulate the User DIP Switches on the C6416 DSK

| Switch 0 (LSB) | Switch 1 | Switch 2 | Switch 3 (MSB) | Boolean Output | Integer Output |
|----------------|----------|----------|----------------|----------------|----------------|
| Cleared        | Cleared  | Cleared  | Cleared        | 0000           | 0              |
| Selected       | Cleared  | Cleared  | Cleared        | 0001           | 1              |
| Cleared        | Selected | Cleared  | Cleared        | 0010           | 2              |
| Selected       | Selected | Cleared  | Cleared        | 0011           | 3              |

## Option Settings to Simulate the User DIP Switches on the C6416 DSK (Continued)

| Switch 0 (LSB) | Switch 1 | Switch 2 | Switch 3 (MSB) | Boolean Output | Integer Output |
|----------------|----------|----------|----------------|----------------|----------------|
| Cleared        | Cleared  | Selected | Cleared        | 0100           | 4              |
| Selected       | Cleared  | Selected | Cleared        | 0101           | 5              |
| Cleared        | Selected | Selected | Cleared        | 0110           | 6              |
| Selected       | Selected | Selected | Cleared        | 0111           | 7              |
| Cleared        | Cleared  | Cleared  | Selected       | 1000           | 8              |
| Selected       | Cleared  | Cleared  | Selected       | 1001           | 9              |
| Cleared        | Selected | Cleared  | Selected       | 1010           | 10             |
| Selected       | Selected | Cleared  | Selected       | 1011           | 11             |
| Cleared        | Cleared  | Selected | Selected       | 1100           | 12             |
| Selected       | Cleared  | Selected | Selected       | 1101           | 13             |
| Cleared        | Selected | Selected | Selected       | 1110           | 14             |
| Selected       | Selected | Selected | Selected       | 1111           | 15             |

Selecting the **Integer** data type results in the switch settings generating integers in the range from 0 to 15 (uint8), corresponding to converting the string of individual switch settings to a decimal value. In the **Boolean** data type, the output string presents the separate switch setting for each switch, with the **Switch 0** status represented by the least significant bit (LSB) and the status of **Switch 3** represented by the most significant bit (MSB).

**In Code generation and targeting** — the code generated by the block reads the physical switch settings of the user switches on the board and reports them as shown in the table above. Your process uses the result in the same way whether in simulation or in code generation. In code generation and when running your application, the block code ignores the settings for **Switch 0**, **Switch 1**, **Switch 2** and **Switch 3** in favor

# C6416 DSK DIP Switch

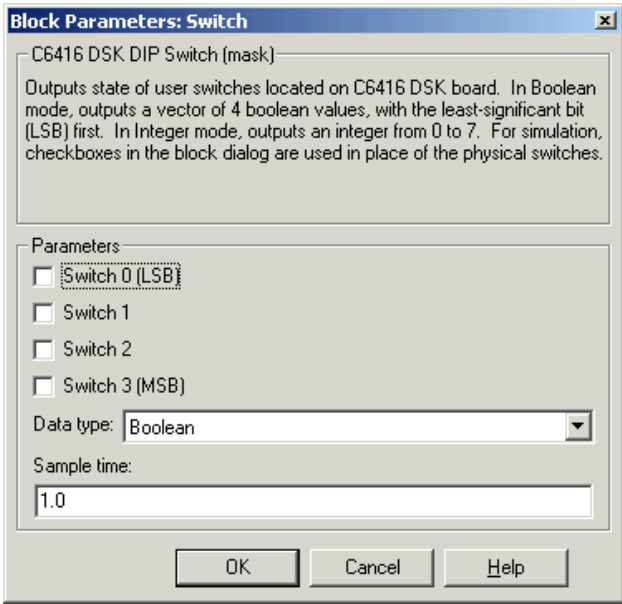
---

of reading the hardware switch settings. When the block reads the DIP switches, it reports the results as either a Boolean string or an integer value as the following table shows.

## Output Values From The User DIP Switches on the C6416 DSK

| Switch 0 (LSB) | Switch 1 | Switch 2 | Switch 3 (MSB) | Boolean Output | Integer Output |
|----------------|----------|----------|----------------|----------------|----------------|
| Off            | Off      | Off      | Off            | 0000           | 0              |
| On             | Off      | Off      | Off            | 0001           | 1              |
| Off            | On       | Off      | Off            | 0010           | 2              |
| On             | On       | Off      | Off            | 0011           | 3              |
| Off            | Off      | On       | Off            | 0100           | 4              |
| On             | Off      | On       | Off            | 0101           | 5              |
| Off            | On       | On       | Off            | 0110           | 6              |
| On             | On       | On       | Off            | 0111           | 7              |
| Off            | Off      | Off      | On             | 1000           | 8              |
| On             | Off      | Off      | On             | 1001           | 9              |
| Off            | On       | Off      | On             | 1010           | 10             |
| On             | On       | Off      | On             | 1011           | 11             |
| Off            | Off      | On       | On             | 1100           | 12             |
| On             | Off      | On       | On             | 1101           | 13             |
| Off            | On       | On       | On             | 1110           | 14             |
| On             | On       | On       | On             | 1111           | 15             |





## Dialog Box

### Switch 0

Simulate the status of the user-defined DIP switch on the board.

### Switch 1

Simulate the status of the user-defined DIP switch on the board.

### Switch 2

Simulate the status of the user-defined DIP switch on the board.

### Switch 3

Simulate the status of the user-defined DIP switch on the board.

### Data type

Determines how the block reports the status of the user-defined DIP switches. **Boolean** is the default, indicating that the output is a vector of four logical values.

Each vector element represents the status of one DIP switch; the first is **Switch 0** and the fourth is **Switch 3**. The data type

## C6416 DSK DIP Switch

---

Integer converts the logical string to an equivalent unsigned 8-bit (uint8) value. For example, when the logical string generated by the switches is 0101, the conversion yields 5 — the MSB is 0 and the LSB is 1.

### **Sample time**

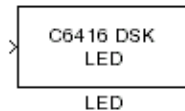
Specifies the time between samples of the signal. This value defaults to 1 second between samples, for a sample rate of one sample per second (1/**Sample time**).

## Purpose

Control LEDs

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6416 DSK



## Description

Adding the C6416 DSK LED block to your Simulink block diagram lets you trigger the user light emitting diodes (LED) on the C6416 DSK. To use the block, send a nonzero real scalar to the block. The C6416 DSK LED block controls all four User LEDs located on the C6416 DSK.

When you add this block to a model, and send an integer to the block input, the block sets the LED state based on the input value it receives:

- When the block receives an input value equal to 0, the specified LEDs are turned off (disabled), 0000
- When the block receives a nonzero input value, the specified LEDs are turned on (enabled), 0001 to 1111

To activate the block, send it an integer in the range 0 to 15. Vectors do not work to activate LEDs; nor do complex numbers as scalars or vectors.

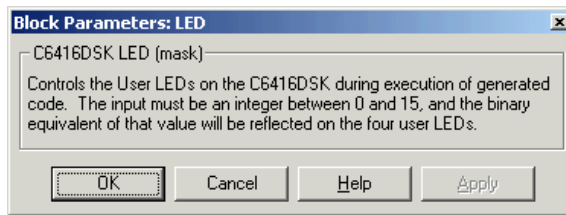
For example, sending the value 6 turns on the diodes to show 0110 (off/on/on/off). 13 turns on the diodes to show 1101.

all LEDs maintain their state until the C6416 DSK LED block receives an input value that changes the state. Enabled LEDs stay on until the block receives an input value that turns the LEDs off; disabled LEDs stay off until turned on. Resetting the C6416 DSK turns off all User LEDs. When you start an application, the LEDs are turned off by default.

# C6416 DSK LED

---

## Dialog Box



This dialog does not have user-selectable options.

**Purpose** Reset to initial conditions

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6416 DSK



**Description**

Reset

Double-clicking this block in a Simulink model window resets the C6416 DSK that is running the executable code built from the model. When you double-click the C6416 DSK Reset block, the block runs the software reset function provided by CCS IDE that resets the processor on your C6416 DSK. Applications running on the board stop and the signal processor returns to the initial conditions you defined.

Before you build and download your model, add the block to the model as a stand-alone block. You do not need to connect the block to a block in the model. When you double-click this block in the block library, it resets your C6416 DSK. In other words, when you double-click a C6416 DSK Reset block, you reset your C6416 DSK.

**Dialog Box**

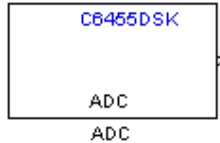
This block does not have settable options and does not provide a user interface dialog.

# C6455 DSK/EVM ADC

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**Purpose** Configure AIC23 audio codec to capture audio stream from LINE-IN or MIC

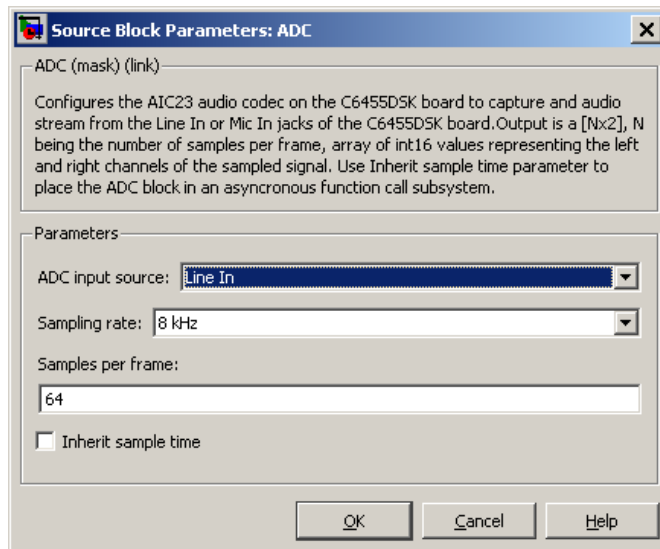
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM



## Description

This block uses the AIC23 audio codec on the C6455 DSK/EVM board to capture an analog audio stream from the **Line In** or **Mic** jacks and generate a digital frame-based output. Output is a [Nx2] array of int16 values representing the left and right channels of the sampled signal, where N is the number of samples per frame. Use the **Inherit sample time** parameter to place the ADC block in an asynchronous function call subsystem.

## Dialog Box



### ADC input source

Select **Line In** or **Mic In** as the input source.

### Sampling Rate

Set the sampling rate of the analog-to-digital converter.

Increasing the frequency increases the accuracy of the sampling data over time.

### Samples per frame

Set the number of samples the block buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. The frame rate depends on the sample rate and frame size. For example, if **Sampling Rate** is 8 kHz, and **Samples per frame** is 32, the frame rate is 250 frames per second ( $8000/32 = 250$ ).

### Inherit sample time

Select whether the block inherits the sample time from the model base rate or Simulink base rate as determined in the Solver options in Configuration Parameters. Selecting Inherit

## C6455 DSK/EVM ADC

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sample time directs the block to use the specified rate in model configuration. Entering -1 configures the block to accept the sample rate from the upstream HWI, Task, or Triggered Task blocks.

### **See Also**

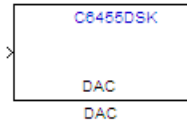
DM6437 EVM DAC



**Purpose** Configure AIC23 codec to convert digital signal to audio output on LINE OUT and HP OUT

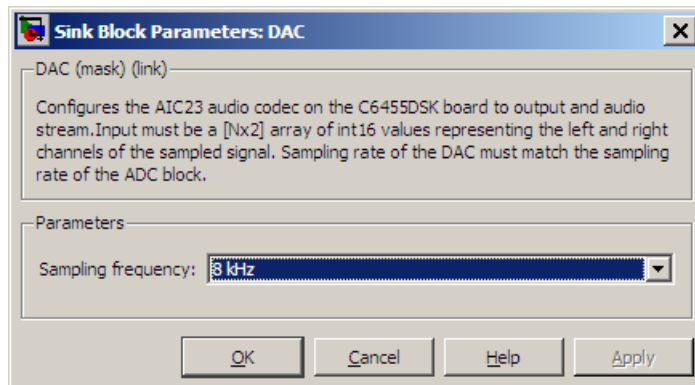
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM

## Description



Configure the AIC23 stereo codec on the C6455 EVM board to convert a digital signal to an analog audio stream on the LINE OUT and HP OUT output jacks. The digital signal input must be an [Nx2] array of int16 values. Column 1 of the array is the left channel and column 2 is the right channel of the sampled signal. The sampling rate of the DAC output must match the sampling rate of the digital signal from the ADC.

## Dialog Box



### Sampling Frequency

Set the sampling rate of the digital-to-analog converter. The rate defaults to 8 kHz. Options range up to 96 kHz.

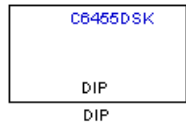
**See Also** C6455 DSK/EVM ADC

# C6455 DSK/EVM DIP

**Purpose** Output state of user-selected DIP switch as Boolean

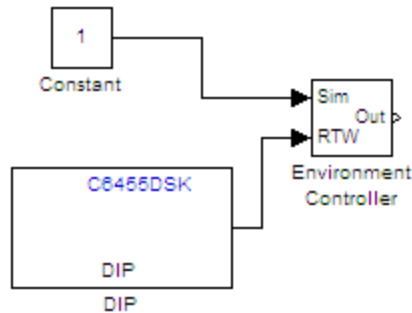
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM

## Description

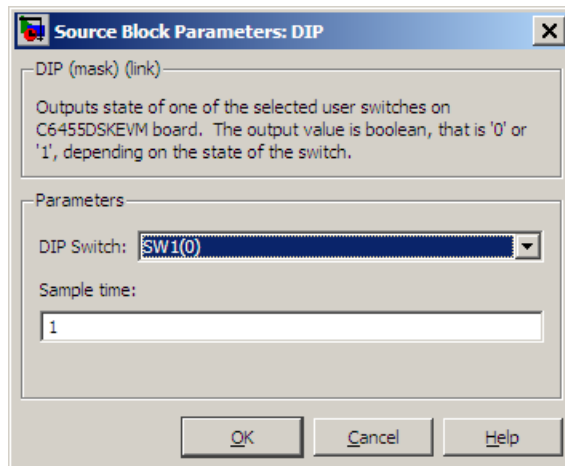


Outputs a Boolean that gives the state of a user-selected DIP switch from the SW1 bank of switches on the C6455 DSK/EVM board. Boolean 0 means the switch is open, and Boolean 1 means it is closed. Use multiple blocks to output the state of multiple DIP switches.

For simulations, you may want to use the C6455 DSK/EVM DIP block with a Constant block and an Environment Controller block, both from the Simulink block libraries.



## Dialog Box



### DIP Switch

Select the switch, 0 through 3, from the SW1 bank of switches.

### Sample Time

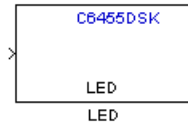
Specifies the time between samples of the signal in seconds. This value defaults to 1 second between samples.

# C6455 DSK/EVM LED

**Purpose** Apply Boolean input to user-selected LED

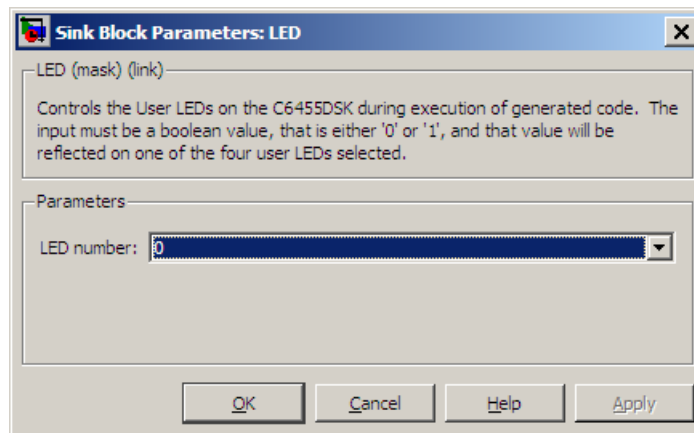
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM

## Description



This block controls an individual LED among the User LEDs on the C6455 DSK/EVM during execution of generated code. The block input accepts Boolean values, 0 (off) or 1 (on). Use multiple blocks to control multiple LEDs.

## Dialog Box



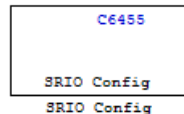
**LED number** Specify the number of the User LED that the Boolean input controls.

## Purpose

Configure generated code for serial RapidI/O peripheral

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM



## Description

The C6455 processor supports the serial RapidI/O (SRIO) peripheral from Texas Instruments for high-speed packet-switched chip-to-chip and board-to-board communications. This block provides the parameters you use to configure the SRIO peripheral on your hardware to communicate between different processors.

The dialog box parameters that you set provide values to initialize the registers on the processor relevant to SRIO processing.

Because SRIO handles communications between two platforms, it requires two models or sets of code—one running on the local device and one running on the remote device. Both models must include the SRIO Config block to configure their SRIO communications capability, and the blocks must have the device IDs to refer to one another.

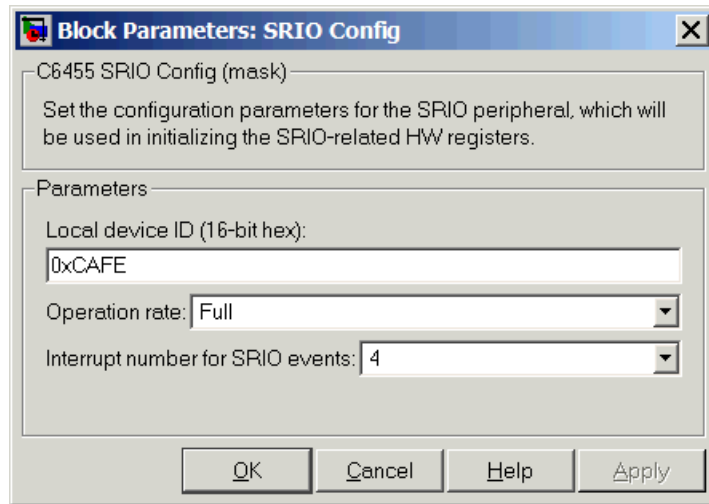
SRIO blocks implement both direct I/O and doorbell interrupt forms of SRIO communications. Direct I/O provides data transfer directly between two processors. With direct I/O you have burst-write and burst-read access with the remote device. The block configures the SRIO peripheral as a 4x SRIO, meaning that all four links of SRIO are bundled together for the fastest link. Direct I/O uses the Load/Store Unit (LSU) and Direct Memory Access (DMA) Engine to control and monitor the data transfer.

Doorbell interrupt enables the local device to initiate CPU interrupts on the remote device if burst-write access is enabled. Such interrupts signal that data is ready to transfer. Both devices, local (source) and remote (destination) include doorbell message queues. The destination

# C6455 SRIO Config

device reads its queue to determine the interrupt source and to process the doorbell INFO field.

To see the SRIO blocks in use, refer to the Interprocessor Communications via Serial Rapid I/O (SRIO) example, located in the online help system examples for Embedded Coder software.



## Dialog Box

### Local device ID (16-bit hex)

Enter the ID of the local device to configure the device ID field in the generated code. Use a 16-bit hexadecimal format. When you configure SRIO Transmit and SRIO Receive blocks in models, the local device ID in this field must match the remote device ID for the Transmit and Receive block in each model.

In the generated code, you see the input device ID as a constant mapped to the following program code entry.

```
#define SRIO_LARGE_DEV_ID 0xCAFE
```

## Operation rate

Set the operating frequency of the SRIO serializer/deserializer (SERDES). Two variables determine the primary operating frequency of the SERDES, the reference clock frequency and PLL multiplication factor. Select `Full`, `Half`, or `Quarter` from the list.

- `Full` takes two data samples for each PLL output clock cycle.
- `Half` takes one data sample for each PLL output clock cycle.
- `Quarter` takes one data sample and a delay for two PLL output cycles

This value defaults to `Full`.

## Interrupt number for SRIO events

Assigns an interrupt number to initiate for SRIO events. After you select a value from the list, you see a constant similar to the following defined in the generated code

```
#define SRIO_INTR_NUMBER 4
```

## References

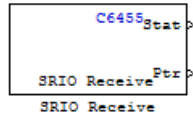
For more information about SRIO, refer to *TMS320TCI648x Serial RapidIO User's Guide*, Literature Number: SPRUE13. Texas Instruments Incorporated.

# C6455 SRIO Receive

**Purpose** Configure generated code to receive serial RapidI/O packets

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM

## Description



SRIO receive blocks add the ability to receive SRIO packets to the processor that is running the embedded code. Each receive block has two output ports—theStat port that is permanent and the optional Ptr port, that report the status of the block and output a pointer to data.

Writing data between DSPs is more efficient than reading because SRIO write can handle up to 4kB per write request without stalling the processor while SRIO read only handles up to 256 bytes per read request. Thus, the elapsed time for transferring data by reading from the remote device can be much longer than that required for writing from the remote device. Use the doorbell interrupt options to signal remote devices and to coordinate the data transfer between processors.

The Stat port reports SRIO operating status as shown in the following table.

| Value at Stat Port | Description                                                      |
|--------------------|------------------------------------------------------------------|
| 1                  | SRIO request is done (complete)                                  |
| 0                  | SRIO request is pending                                          |
| -1                 | SRIO request failed                                              |
| -2                 | SRIO request was not sent because the SRIO request queue is full |



To see the SRIO blocks in use, refer to the Interprocessor Communications via Serial Rapid I/O (SRIO) example in the online help system examples for Embedded Coder software.

### **Dialog Box**

The block dialog box provides parameters on two panes:

- **Main** pane includes parameters that configure the data transfer operation, the doorbell interrupt ID, and various address settings for the remote device and host.
- “Data Types Pane” on page 2-359 parameters configure the data type and size that the block reads.

# C6455 SRIO Receive

## Main Pane

The screenshot shows a dialog box titled "Source Block Parameters: SRIO Receive". It contains the following fields and options:

- Header: C6455 SRIO Receive (mask)
- Instruction: Configure the SRIO peripheral to accept doorbell interrupt and/or read data from remote device.
- Tabs: Main (selected), Data Properties
- Remote device ID (16-bit hex): 0xCAFE
- Accept doorbell interrupt from remote device
- Doorbell interrupt ID: 0
- Read from remote device
- Remote address (32-bit hex aligned to an 8-byte boundary): 0x00900000
- Show output port for local address pointer
- Local address (32-bit hex aligned to an 8-byte boundary): 0x00900500
- Enable blocking mode
- Sample time: 0.01
- Timeout value: inf
- Buttons: OK, Cancel, Help

### Remote device ID (16-bit hex)

Enter the ID of the remote device in 16-bit hexadecimal format to configure the remote ID field in the generated code. When you configure SRIO Receive blocks for this communication link, the remote device ID in this field must match the local device ID for the SRIO Config block in the transmitting model.

## **Accept doorbell interrupt from remote device**

Enables the doorbell interrupt operation for the block. The block waits until it receives a doorbell interrupt before it reads from the remote device. Selecting this option enables the **Doorbell interrupt ID** parameter so you can set the interrupt ID.

## **Doorbell interrupt ID**

Sets the interrupt ID for the doorbell to determine which SRIO Receive block should be awakened based on the incoming interrupt value. Select a value from the list. If your model contains more than one SRIO receive block, each receive block must use a different ID. IDs range from 0 to 15 with a default value of 0. SRIO Receive and SRIO Transmit blocks are paired together by this ID. Create an SRIO Transmit block with this ID to send the doorbell interrupt.

## **Read from remote device**

Selecting this option tells the block to perform a burst read from the remote device at the address in **Remote address**. If you clear this option, you must select **Accept doorbell interrupt from remote device**.

## **Remote address (32-bit hex aligned to an 8-byte boundary)**

This address specifies where the data is being read from the remote device. The address you enter here should match the local address of the corresponding SRIO Transmit block.

This address should align to an 8-byte boundary in memory.

## **Show output port for local address pointer**

When you select this parameter, the output port **Ptr** returns the pointer that you specify in **Local address (32-bit hex aligned to an 8 byte boundary)**. Clearing this option removes the **Ptr** port from the block.

## **Local address (32-bit hex aligned to an 8 byte boundary)**

This address specifies the destination for the data to transfer. This address should match the remote address of the corresponding

SRIO Transmit block. You will need it if the SRIO Transmit block performs burst-write operations.

## **Enable blocking mode**

SRIO receive blocks can operate in either blocking or nonblocking modes.

- Selecting this option puts the block in blocking mode and the block waits for a doorbell interrupt to come or timeout to occur before passing program control to downstream blocks or performing read operations.
  - Clearing **Enable blocking mode** directs the block to poll the doorbell interrupt status register to determine whether the SRIO Transmit block sent a doorbell packet.
  - Sending the packet indicates that the transmitting block completed a data transfer to this block.
- Clearing this option to put the block in nonblocking mode enables the **Sample time** option. In nonblocking mode, Simulink software uses the sample time to determine the polling period the block uses for polling the interrupt status register.

**Enable blocking mode** is not available when you clear **Enable doorbell**. Clearing **Accept doorbell interrupt from remote device** also disables this option because blocking mode refers to the doorbell interrupt process.

## **Sample time**

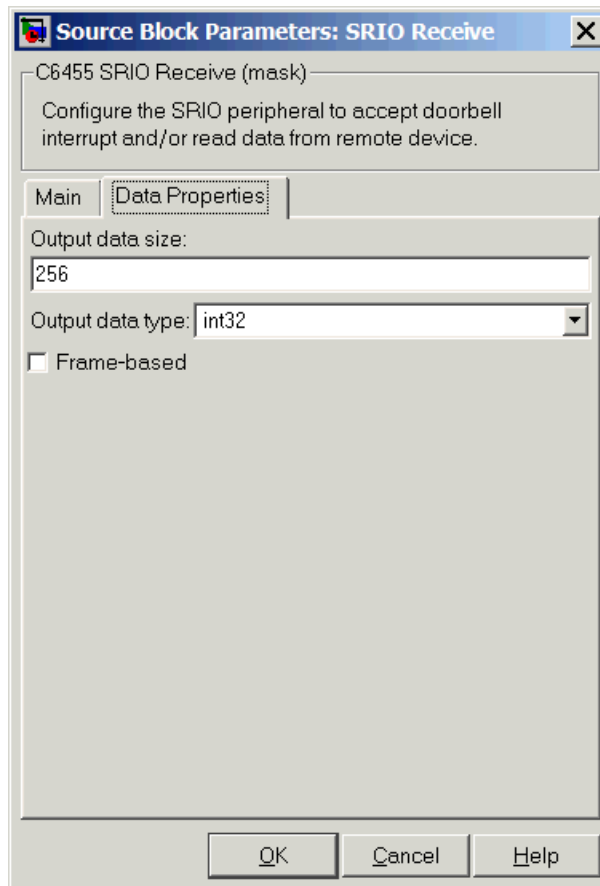
Determines the polling period, in seconds, for the block in nonblocking mode. Enter the time period to wait between polls. To enable this option, clear **Enable blocking mode** and select **Accept doorbell interrupt from remote device**.

## **Timeout value**

In blocking mode, this value determines how long the block waits for a doorbell interrupt before it sets the **Stat** output port to Timeout status. Enter a time in seconds (The value defaults

to inf to block until the block receives a doorbell interrupt). The default time-out value is 1 second. Clearing either **Enable blocking mode** or **Accept doorbell interrupt from remote device** disables this option.

## Data Properties Pane



### Output data size

Use this to specify the amount of data in bytes to transfer. Enter either a scalar to define a vector of elements or a two-element array. For example, enter 256 to specify a vector of 256 elements. To specify a two-dimensional array of 512 elements, enter [256 2]. The block uses this value to determine the size of the `Ptr` port. If you select the **Frame-based** option, you must enter the vector, or scalar value, as an array. Thus the 256-element vector example entry becomes [256 1].

### Output data type

Specify the data type used for the output. With this information, the block calculates the size of the data transfer in bytes using this value and the **Output data size** value.

### Frame-based

When you select this option, the block treats the data as frame-based rather than sample-based. If you select **Frame-based**, you must enter your output data size as a two-element array. For example, to specify a vector that contains 256 elements, enter [256 1].

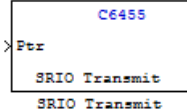
## References

For more information about SRIO, refer to *TMS320TCI648x Serial RapidIO User's Guide*, Literature Number: SPRUE13. Texas Instruments Incorporated.

**Purpose** Configure generated code to transmit serial RapidI/O packets

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6455 EVM

**Description**



SRIO transmit blocks add the ability to transmit SRIO packets to another processor. Each transmit block has an input Ptr port, and an optional Stat output port controlled by the **Show output port for status** option.

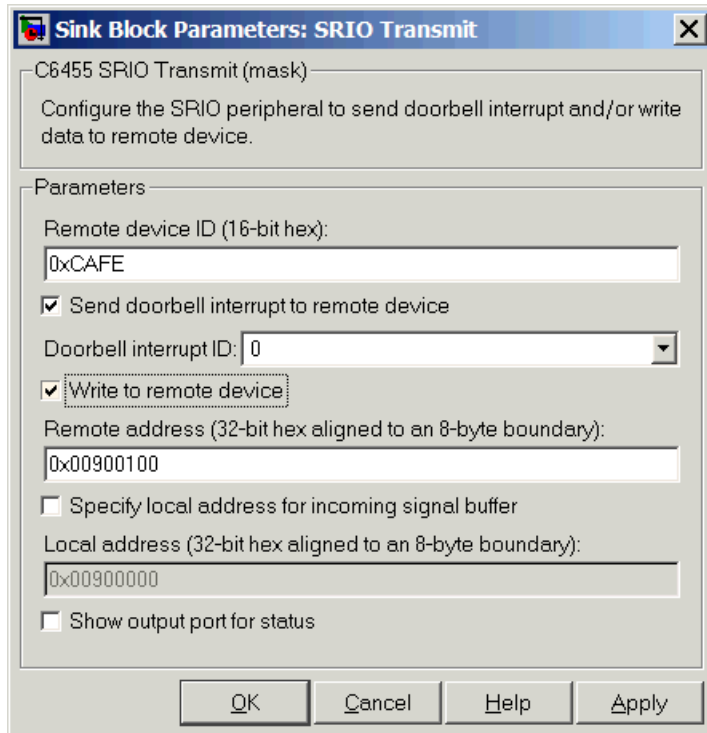
Writing data between DSPs is more efficient than reading because SRIO write can handle up to 4kB per write request without stalling the processor while SRIO read only handles up to 256 bytes per read request. Thus, the time used to transfer data by reading from the remote device can be much longer than that required for writing from the remote device. SRIO read may require multiple requests. Use the doorbell interrupt options signal remote devices and to coordinate the data transfer between the processors.

The Stat port reports SRIO operating status as shown in the following table.

| Value at Stat Port | Description                                                      |
|--------------------|------------------------------------------------------------------|
| 1                  | SRIO request is done (complete)                                  |
| 0                  | SRIO request is pending                                          |
| -1                 | SRIO request failed                                              |
| -2                 | SRIO request was not sent because the SRIO request queue is full |

# C6455 SRIO Transmit

To see the SRIO blocks in use, refer to the Interprocessor Communications via Serial Rapid I/O (SRIO) example in the online help system examples for Embedded Coder software.



## Dialog Box

### Remote device ID (16-bit hex)

Enter the ID of the remote device in 16-bit hexadecimal format to configure the remote ID field in the generated code. When you configure SRIO Transmit blocks for this communication link, the remote device ID in this field must match the local device ID for the SRIO Config block on the receiving end of the transmission.



## **Send doorbell interrupt to remote device**

Enables the doorbell interrupt operation for the bloc, which sends a doorbell interrupt after writing data to the remote device.

Selecting this option enables **Doorbell interrupt ID**.

## **Doorbell interrupt ID**

Sets the interrupt ID for the doorbell to set the doorbell INFO field of the SRIO packet. Select a value from the list. If your model contains more than one SRIO transmit block, each transmit block must use a different ID. IDs range from 0 to 15 with a default value of 0. SRIO Receive and SRIO Transmit blocks are paired together by this ID. Create an SRIO Receive block with this ID to receive the doorbell interrupt. The block uses this value to set the doorbell INFO field in an SRIO packet.

## **Write to remote device**

Selecting this option tells the block to perform a burst write using Direct IO to the device at the address in **Remote device ID**. If you clear this option, you must select **Send doorbell interrupt to remote device**. Selecting this option enables the **Remote address (32-bit hex aligned to an 8-byte boundary)** option.

## **Remote address (32-bit hex aligned to an 8-byte boundary)**

Enter the address to write the output data to at the remote device.

Clearing **Write to remote device** disables this option. It becomes and do not care field.

For efficient data transfers, enter an address that aligns to an 8-byte boundary in memory.

## **Specify local address for incoming signal buffer**

Select this option to enable you to specify the local address for the input data to this block. Select his option if you are pairing this block with an SRIO Receive block that performs burst-read operation. The SRIO Receive block needs to know the specific address to read the data from. When you select this option, you enable **Local address (32-bit hex aligned to an 8 byte boundary)** where you enter the local address.

# C6455 SRIO Transmit

---

## **Local address (32-bit hex aligned to an 8 byte boundary)**

This address specifies the location of the incoming data. For burst write operations, this value is a local address that SRIO uses to form the direct I/O packets.

For efficient data transfers, enter an address that aligns to an 8-byte boundary in memory.

## **Show output port for status**

When you select this parameter, the output port Stat appears on the block. Stat returns the status of the write transmit operation.

## **References**

For more information about SRIO, refer to *TMS320TCI648x Serial RapidIO User's Guide*, Literature Number: SPRUE13. Texas Instruments Incorporated.

**Purpose**

Autocorrelate input vector or frame-based matrix

**Library**

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

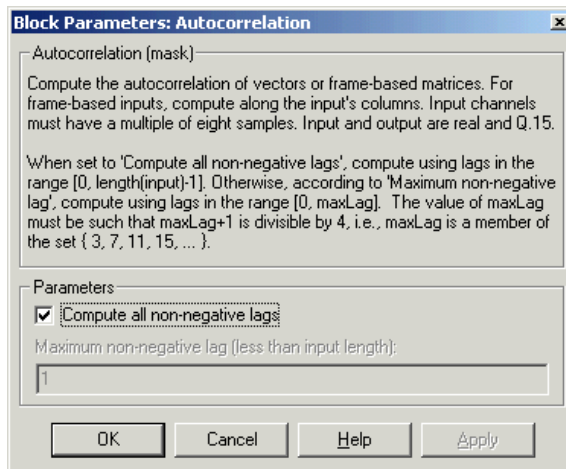
**Description**

The C64x Autocorrelation block computes the autocorrelation of an input vector or frame-based matrix. For frame-based inputs, the autocorrelation is computed along each of the input's columns. The number of samples in the input channels must be an integer multiple of eight. Input and output signals are real and Q.15.

Autocorrelation blocks support discrete sample times and little-endian code generation only.

# C64x Autocorrelation

## Dialog Box



### Compute all non-negative lags

When you select this parameter, the autocorrelation is performed using all nonnegative lags, where the number of lags is one less than the length of the input. The lags produced are therefore in the range  $[0, \text{length}(\text{input})-1]$ . When this parameter is not selected, you specify the lags used in **Maximum non-negative lag (less than input length)**.

### Maximum non-negative lag (less than input length)

Specify the maximum lag ( $\text{maxLag}$ ) the block should use in performing the autocorrelation. The lags used are in the range  $[0, \text{maxLag}]$ . The maximum lag must be odd, and  $(\text{maxLag}+1)$  must be divisible by 4, such as  $\text{maxLag}$  equal to 3, 7, or 19. This parameter is enabled when you clear the **Compute all non-negative lags** parameter.

## Algorithm

In simulation, the Autocorrelation block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_autocor`. During code generation, this block calls the `DSP_autocor` routine to produce optimized code.

## Purpose

Bit-reverse elements of each complex input signal channel

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

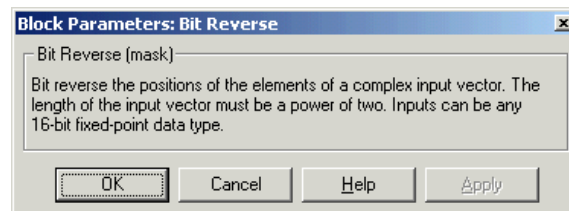
## Description



The C64x Bit Reverse block bit-reverses the elements of each channel of a complex input signal  $X$ . The Bit Reverse block is used primarily to provide ordered inputs and outputs to or from blocks that perform FFTs. Inputs to this block must be 16-bit fixed-point data types. Input vector lengths must be a power of two. Because you use this block with FFT blocks the input vector length must be a power of two.

The Bit Reverse block supports discrete sample times and little-endian code generation only.

## Dialog Box



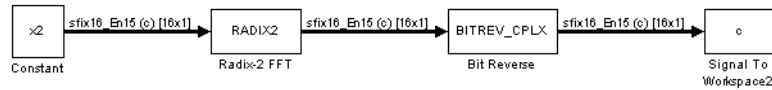
## Algorithm

In simulation, the Bit Reverse block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_bitrev_cplx`. During code generation, this block calls the `DSP_bitrev_cplx` routine to produce optimized code.

## Examples

The Bit Reverse block reorders the output of the C64x Radix-2 FFT in the model below to natural order.

# C64x Bit Reverse



The following code calculates the same FFT in the workspace. The output from this calculation, `y2`, is displayed side-by-side with the output from the model, `c`. The outputs match, showing that the Bit Reverse block reorders the Radix-2 FFT output to natural order:

```
k = 4;
n = 2^k;
xr = zeros(n, 1);
xr(2) = 0.5;
xi = zeros(n, 1);
x2 = complex(xr, xi);
y2 = fft(x2);
```

```
[y2, c]
0.5000 0.5000
0.4619 - 0.1913i 0.4619 - 0.1913i
0.3536 - 0.3536i 0.3535 - 0.3535i
0.1913 - 0.4619i 0.1913 - 0.4619i
0 - 0.5000i 0 - 0.5000i
-0.1913 - 0.4619i -0.1913 - 0.4619i
-0.3536 - 0.3536i -0.3535 - 0.3535i
-0.4619 - 0.1913i -0.4619 - 0.1913i
-0.5000 -0.5000
-0.4619 + 0.1913i -0.4619 + 0.1913i
-0.3536 + 0.3536i -0.3535 + 0.3535i
-0.1913 + 0.4619i -0.1913 + 0.4619i
0 + 0.5000i 0 + 0.5000i
0.1913 + 0.4619i 0.1913 + 0.4619i
0.3536 + 0.3536i 0.3535 + 0.3535i
0.4619 + 0.1913i 0.4619 + 0.1913i
```

## See Also

C64x Radix-2 FFT, C64x Radix-2 IFFT

## Purpose

Minimum number of extra sign bits in each input channel

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



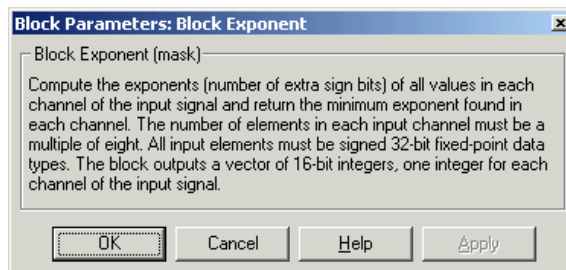
## Description

The C64x Block Exponent block first computes the number of extra sign bits of all values in each channel of an input signal, and then returns the minimum number of sign bits found in each channel. The number of elements in each input channel must be a multiple of eight. Input elements must be 32-bit signed fixed-point data types. The output is a vector of 16-bit integers — one integer for each channel of the input signal.

This block is useful for determining whether every sample in a channel is using extra sign bits. If so, you can scale your signal by the minimum number of extra sign bits to eliminate the common extra bits. This increases the representable precision and decreases the representable range of the signal.

Block Exponent blocks support both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



# C64x Block Exponent

---

## **Algorithm**

In simulation, the Block Exponent block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_bexp`. During code generation, this block calls the `DSP_bexp` routine given to produce optimized code.



**Purpose**

Filter complex input signal using complex FIR filter

**Library**

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

**Description**

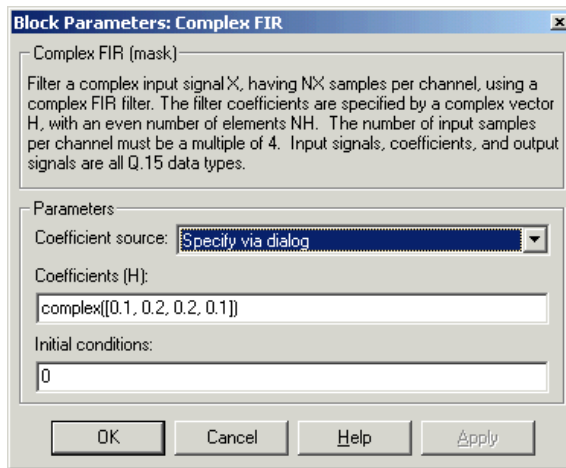
The C64x Complex FIR block filters a complex input signal  $X$  using a complex FIR filter. This filter is implemented using a direct form structure. Each input channel must contain an integer multiple of four samples, with four samples as the minimum required.

The number of FIR filter coefficients, which are given as elements of the input vector  $H$ , must be even. The product of the number of elements of  $X$  and the number of elements of  $H$  must be at least four. Inputs, coefficients, and outputs are all Q.15 data types. For each channel, the number of input elements must be a multiple of four.

The Complex FIR block supports discrete sample times and little-endian code generation only.

# C64x Complex FIR

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients (H)** parameter in the dialog box
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X. Choosing this option adds an input port to the block.

### Coefficients (H)

Designate the filter coefficients in vector format. There must be an even number of coefficients. This parameter is visible only when **Specify via dialog** is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

Lets you provide initial conditions for the filter. If your initial conditions for the channels are

- all the same, enter a scalar that applies to all channels.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. These

conditions then apply to all channels. The length of this vector must be one less than the number of coefficients.

- Different across channels, enter a matrix containing all initial conditions for every individual channel. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

You may enter real-valued initial conditions. Zero-valued imaginary parts will be assumed.

## Algorithm

In simulation, the Complex FIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fir_cplx`. During code generation, this block calls the `DSP_fir_cplx` routine to produce optimized code.

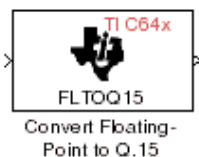
## See Also

C64x General Real FIR, C64x Radix-4 Real FIR, C64x Radix-8 Real FIR, C64x Symmetric Real FIR

# C64x Convert Floating-Point to Q.15

**Purpose** Convert floating-point signal to Q.15 fixed-point

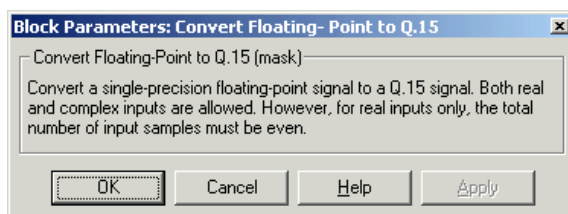
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Convert Floating-Point to Q.15 block converts a single-precision floating-point input signal to a Q.15 output signal. Input can be real or complex. For real inputs, the number of input samples must be even.

The Convert Floating-Point to Q.15 block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

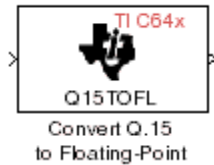
In simulation, the Convert Floating-Point to Q.15 block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_f1toq15`. During code generation, this block calls the `DSP_f1toq15` routine to produce optimized code.

**See Also** C64x Convert Q.15 to Floating Point

# C64x Convert Q.15 to Floating-Point

**Purpose** Convert Q.15 fixed-point signal to single-precision floating-point

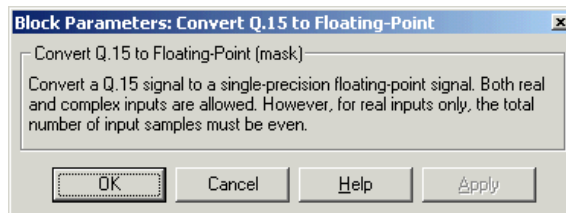
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Convert Q.15 to Floating-Point block converts a Q.15 input signal to a single-precision floating-point output signal. Input can be real or complex. For real inputs, the number of input samples must be even.

The Convert Q.15 to Floating-Point block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Convert Q.15 to Floating-Point block is equivalent to the TMS320C64x DSP Library assembly code function DSP\_q15tof1. During code generation, this block calls the DSP\_q15tof1 routine to produce optimized code.

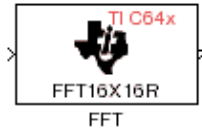
**See Also** C64x Convert Floating-Point to Q.15

# C64x FFT

---

**Purpose** Decimation-in-frequency forward FFT of complex input vector

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x FFT block computes the decimation-in-frequency forward FFT, with scaling between stages, of each channel of a complex input signal. The input length of each channel must be both a power of two and in the range 8 to 16,384, inclusive. The input must also be in natural (linear) order. The output of this block is a complex signal in natural order. Inputs and outputs are all signed 16-bit fixed-point data types.

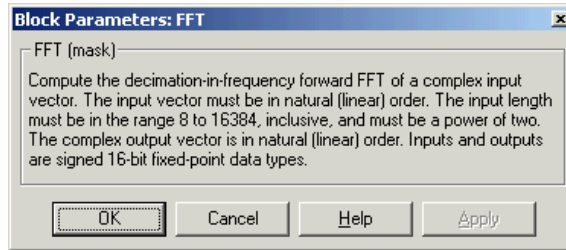
The `fft16x16r` routine used by this block employs butterfly stages to perform the FFT. The number of butterfly stages used,  $S$ , depends on the input length  $L = 2^k$ . If  $k$  is even, then  $S = k/2$ . If  $k$  is odd, then  $S = (k+1)/2$ .

If  $k$  is even, then  $L$  is a power of two as well as a power of four, and this block performs all  $S$  stages with radix-4 butterflies to compute the output. If  $k$  is odd, then  $L$  is a power of two but not a power of four. In that case this block performs the first  $(S-1)$  stages with radix-4 butterflies, followed by a final stage using radix-2 butterflies.

To minimize noise, the FFT block also implements a divide-by-two scaling on the output of each stage except for the last. So that the gain of the block matches that of the theoretical FFT, the FFT block offsets the location of the binary point of the output data type by  $(S-1)$  bits to the right relative to the location of the binary point of the input data type. That is, the number of fractional bits of the output data type equals the number of fractional bits of the input data type minus  $(S-1)$ .

$$\text{OutputFractionalBits} = \text{InputFractionalBits} - (S-1)$$

The FFT block supports both continuous and discrete sample times. This block supports little-endian code generation.



## Dialog Box

## Algorithm

In simulation, the FFT block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fft16x16r`. During code generation, this block calls the `DSP_fft16x16r` routine to produce optimized code.

## See Also

C64x Radix-2 FFT, C64x Radix-2 IFFT

# C64x General Real FIR

---

**Purpose** Filter real input signal using real FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x General Real FIR block filters a frame-based real input signal  $X$  using a real FIR filter. This filter is implemented using a direct form structure. Signal  $X$  must contain at least four samples per channel and the number of samples must be an integer multiple of four.

If the input it is a sample-based signal, the model throws the following error:

```
%%BEGIN ERROR%%
Error reported by S-function 'stic6x_fir_real' in 'model/General Real FIR1':
Number of output samples must be divisible by 4.
%%END ERROR%%
```

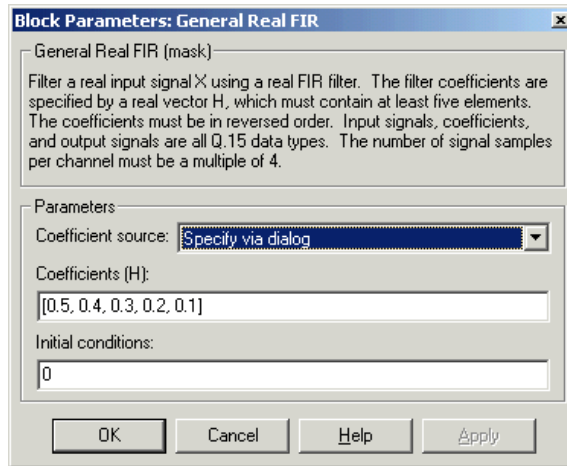
To resolve this error, convert the signal to a frame-based signal.

The filter coefficients are specified by a real vector  $H$ , which must contain at least five elements. The coefficients must be in reversed order. all inputs, coefficients, and outputs are  $Q.15$  signals.

The General Real FIR block supports discrete sample times and supports little-endian code generation only.



## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients (H)** parameter in the dialog box
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X

### Coefficients (H)

Designate the filter coefficients in vector format. This parameter is only visible when **Specify via dialog** is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel.

# C64x General Real FIR

---

The length of this vector must be one less than the number of coefficients.

- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

The initial conditions must be real.

## **Algorithm**

In simulation, the General Real FIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fir_gen`. During code generation, this block calls the `DSP_fir_gen` routine to produce optimized code.

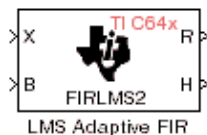
## **See Also**

C64x Complex FIR, C64x Radix-4 Real FIR, C64x Radix-8 Real FIR, C64x Symmetric Real FIR

**Purpose** LMS adaptive FIR filtering

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

## Description



The C64x LMS Adaptive FIR block performs least-mean-square (LMS) adaptive filtering. This filter is implemented using a direct form structure.

---

**Note** To implement a complete LMS algorithm, use this block in combination with the 5 other blocks shown in the “Examples” on page 2-488 section.

---

---

**Note** This block performs fixed-point computations using `fixdt(1,16,15)` and `fixdt(1,32,30)` data types. Because of this limitation, you may not be able to address numeric overflow and underflow problems with this block. As a result, this block is useful in a limited set of applications.

---

The following constraints apply to the inputs and outputs of this block:

- The scalar input,  $X$  must be a Q.15 data type.
- The scalar input  $B$  must be a Q.15 data type.
- The scalar output  $R$  is a Q1.30 data type.
- The output  $\bar{H}$  has length equal to the number of filter taps and is a Q.15 data type. The number of filter taps must be a positive integer that is a multiple of four.

## C64x LMS Adaptive FIR

---

This block performs LMS adaptive filtering according to the equations

$$e(n+1) = d(n+1) - [\bar{H}(n) \cdot \bar{X}(n+1)]$$

and

$$\bar{H}(n+1) = \bar{H}(n) + [\mu e(n+1) \cdot \bar{X}(n+1)],$$

where

- $n$  designates the time step.
- $\bar{X}$  is a vector composed of the current and last  $nH-1$  scalar inputs.
- $d$  is the desired signal. The output  $R$  converges to  $d$  as the filter converges.
- $\bar{H}$  is a vector composed of the current set of filter taps.
- $e$  is the error, or  $d - [\bar{H}(n) \cdot \bar{X}(n+1)]$ .
- $\mu$  is the step size.

For this block, the input  $B$  and the output  $R$  are defined by

$$B = \mu e(n+1)$$

and

$$R = \bar{H}(n) \cdot \bar{X}(n+1),$$

which combined with the first two equations, result in the following equations that this block follows:

$$e(n+1) = d(n+1) - R$$

$$\bar{H}(n+1) = \bar{H}(n) + [B \cdot \bar{X}(n+1)].$$

$d$  and  $B$  must be produced externally to the LMS Adaptive FIR block. See “Examples” on page 2-488 below for a sample model where this is done.

The LMS Adaptive FIR block supports discrete sample times and supports little-endian code generation only.

The rounding mode used is *floor*, and the saturation mode is *wrap*. all intermediate products have **s32Q30** data type. The update equation is as follows:

$$H_i = H_i + s16Q15(s32Q30(B) \times s32Q30(X_i))$$
$$R = \sum_N (X_i \times H_i),$$

where  $N$  is the number of filter taps.

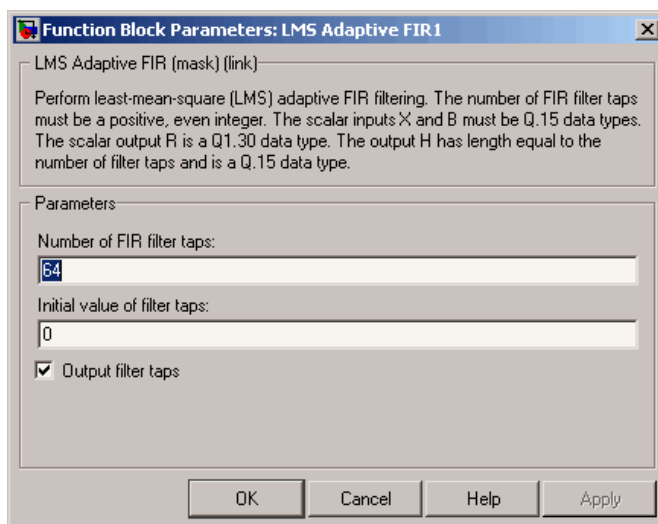
---

**Note** This block does not implement a leaky LMS algorithm. Therefore, do not compare it with the leakage factor of the LMS block of the DSP System Toolbox software.

---

# C64x LMS Adaptive FIR

---



## Dialog Box

### Number of FIR filter taps

Designate the number of filter taps. The number of taps must be a positive integer that is also a multiple of four.

### Initial value of filter taps

Enter the initial value of the filter taps.

### Output filter coefficients H?

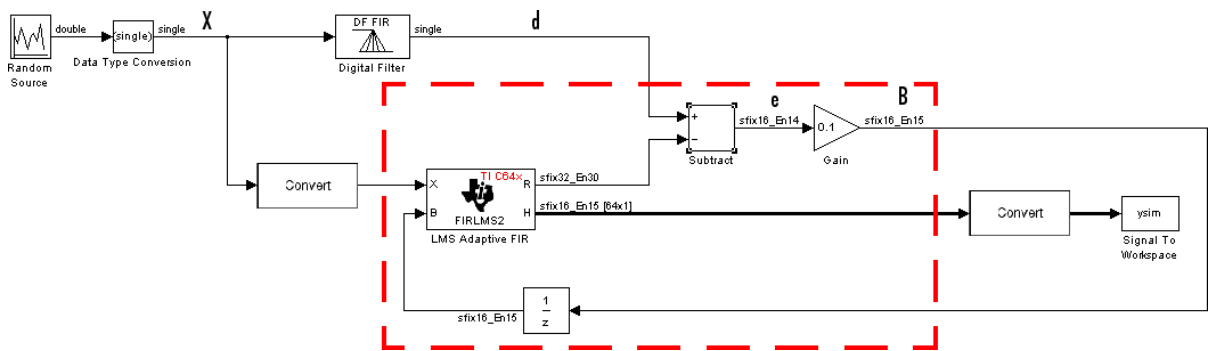
If you select this option, the filter taps are produced as output H. If you do not select this option, H is suppressed.

## Algorithm

In simulation, the LMS Adaptive FIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fir1ms2`. During code generation, this block calls the `DSP_fir1ms2` routine to produce optimized code.

## Examples

The following model uses the LMS Adaptive FIR block.



The portion of the model enclosed by the dashed line produces the signal  $B$  and feeds it back into the LMS Adaptive FIR block. The inputs to this region are  $\bar{X}$  and the desired signal  $d$ , and the output of this region is the vector of filter taps  $\bar{H}$ . Thus this region of the model acts as a canonical LMS adaptive filter. For example, compare this region to the `adaptfilt.lms` function in DSP System Toolbox software. `adaptfilt.lms` performs canonical LMS adaptive filtering and has the same inputs and output as the outlined section of this model.

To use the LMS Adaptive FIR block you must create the input  $B$  in some way similar to the one shown here. You must also provide the signals  $\bar{X}$  and  $d$ . This model simulates the desired signal  $d$  by feeding  $\bar{X}$  into a digital filter block. You can simulate your desired signal in a similar way, or you may bring  $d$  in from the workspace with a From Workspace or codec block.

# C64x Matrix Multiply

**Purpose** Matrix multiply two input signals

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C64x DSP Library



## Description

The C64x Matrix Multiply block multiplies two input matrices A and B. Inputs and outputs are real, 16-bit, signed fixed-point data types. This block wraps overflows when they occur.

The product of the two 16-bit inputs results in a 32-bit accumulator value. The Matrix Multiply block, however, only outputs 16 bits. You can choose to output the highest or second-highest 16 bits of the accumulator value.

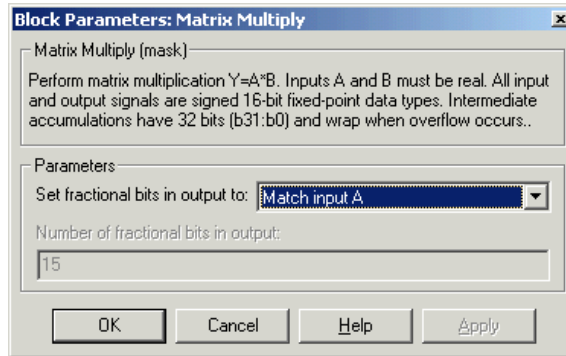
Alternatively, you can choose to output 16 bits according to how many fractional bits you want in the output. The number of fractional bits in the accumulator value is the sum of the fractional bits of the two inputs.

|                        | <b>Input A</b> | <b>Input B</b> | <b>Accumulator Value</b> |
|------------------------|----------------|----------------|--------------------------|
| <b>Total Bits</b>      | 16             | 16             | 32                       |
| <b>Fractional Bits</b> | $R$            | $S$            | $R + S$                  |

Therefore  $R+S$  is the location of the binary point in the accumulator value. You can select 16 bits in relation to this fixed position of the accumulator binary point to give the desired number of fractional bits in the output (see “Examples” on page 2-492 below). You can either require the output to have the same number of fractional bits as one of the two inputs, or you can specify the number of output fractional bits in the **Number of fractional bits in output** parameter.



The Matrix Multiply block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

### Set fractional bits in output to

Only 16 bits of the 32 accumulator bits are output from the block. Choose which 16 bits to output from the list:

- **Match input A** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in input A (or *R* in the discussion above).
- **Match input B** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in input B (or *S* in the discussion above).
- **Match high bits of acc. (b31:b16)** — Output the highest 16 bits of the accumulator value.
- **Match high bits of prod. (b30:b15)** — Output the second-highest 16 bits of the accumulator value.
- **User-defined** — Output the 16 bits of the accumulator value that cause the number of fractional bits of the output to match the value specified in the **Number of fractional bits in output** parameter.

# C64x Matrix Multiply

---

## Number of fractional bits in output

Specify the number of bits to the right of the binary point in the output. This parameter is enabled only when you select User-defined for **Set fractional bits in output to**.

## Algorithm

In simulation, the Matrix Multiply block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_mat_mul`. During code generation, this block calls the `DSP_mat_mul` routine to produce optimized code.

## Examples

### Example 1

Suppose A and B are both Q.15. The data type of the resulting accumulator value is therefore the 32-bit data type Q1.30 ( $R + S = 30$ ). In the accumulator, bits 31:30 are the sign and integer bits, and bits 29:0 are the fractional bits. The following table shows the resulting data type and accumulator bits used for the output signal for different settings of the **Set fractional bits in output to** parameter.

| <b>Set fractional bits in output to</b> | <b>Data Type</b> | <b>Accumulator Bits</b> |
|-----------------------------------------|------------------|-------------------------|
| Match input A                           | Q.15             | b30:b15                 |
| Match input B                           | Q.15             | b30:b15                 |
| Match high bits of acc.                 | Q1.14            | b31:b16                 |
| Match high bits of prod.                | Q.15             | b30:b15                 |

### Example 2

Suppose A is Q12.3 and B is Q10.5. The data type of the resulting accumulator value is therefore Q23.8 ( $R + S = 8$ ). In the accumulator, bits 31:8 are the sign and integer bits, and bits 7:0 are the fractional bits. The following table shows the resulting data type and accumulator bits used for the output signal for different settings of the **Set fractional bits in output to** parameter.

| Set fractional bits in output to | Data Type | Accumulator Bits |
|----------------------------------|-----------|------------------|
| Match input A                    | Q12.3     | b20:b5           |
| Match input B                    | Q10.5     | b18:b3           |
| Match high bits of acc.          | Q23.-8    | b31:b16          |
| Match high bits of prod.         | Q22.-7    | b30:b15          |

## See Also

C64x Vector Multiply

# C64x Matrix Transpose

---

**Purpose** Matrix transpose input signal

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Matrix Transpose block transposes an input matrix or vector. A 1-D input is treated as a column vector and transposed to a row vector. Input and output signals are real, 16-bit, signed fixed-point data type. Both the number of rows and the number of columns must be multiples of four.

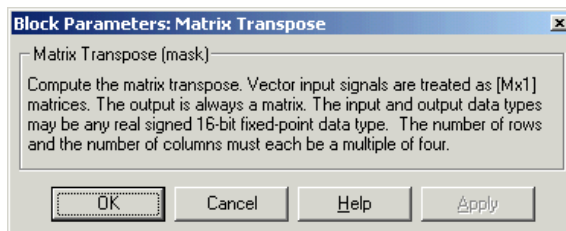
The Matrix Transpose block supports both continuous and discrete sample times. This block supports little-endian code generation only.

---

**Note** If you use Code Replacement Library (CRL) technology with this block, the TI compiler generates processor and compiler-specific instructions that improve the generated code. For more information, consult “Introduction to Code Replacement Libraries”.

---

## Dialog Box



## Algorithm

In simulation, the Matrix Transpose block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_mat_trans`. During code generation, this block calls the `DSP_mat_trans` routine to produce optimized code.

# C64x Radix-2 FFT

**Purpose** Radix-2 decimation-in-frequency forward FFT of complex input vector

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

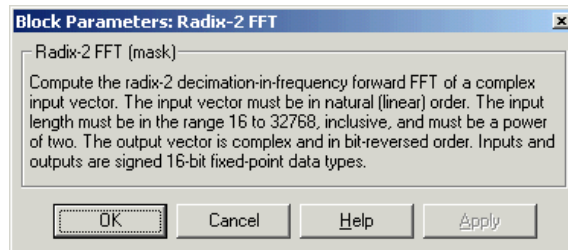


## Description

The C64x Radix-2 FFT block computes the radix-2 decimation-in-frequency forward FFT of each channel of a complex input signal. The input length of each channel must be both a power of two and in the range 16 to 32,768, inclusive. The input must also be in natural (linear) order. The output of this block is a complex signal in bit-reversed order. Inputs and outputs are signed 16-bit fixed-point data types, and the output data type matches the input data type.

You can use the C64x Bit Reverse block to reorder the output of the Radix-2 FFT block to natural order.

The Radix-2 FFT block supports both continuous and discrete sample times. This block supports little-endian code generation.



## Dialog Box

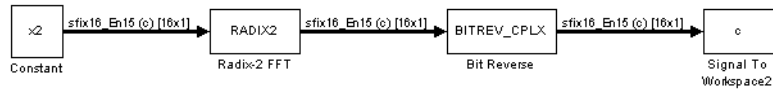
## Algorithm

In simulation, the Radix-2 FFT block is equivalent to the TMS320C64x DSP Library assembly code function DSP\_radix2. During

code generation, this block calls the DSP\_radix2 routine to produce optimized code.

## Examples

The output of the Radix-2 FFT block is bit-reversed. This example shows you how to use the C64x Bit Reverse block to reorder the output of the Radix-2 FFT block to natural order.



The following code calculates the same FFT as the above model in the workspace. The output from this calculation, y2, is then displayed side-by-side with the output from the model, c. The outputs match, showing that the Bit Reverse block does reorder the Radix-2 FFT block output to natural order:

```

k = 4;
n = 2^k;
xr = zeros(n, 1);
xr(2) = 0.5;
xi = zeros(n, 1);
x2 = complex(xr, xi);
y2 = fft(x2);

```

```

[y2, c]
 0.5000 0.5000
 0.4619 - 0.1913i 0.4619 - 0.1913i
 0.3536 - 0.3536i 0.3535 - 0.3535i
 0.1913 - 0.4619i 0.1913 - 0.4619i
 0 - 0.5000i 0 - 0.5000i
 -0.1913 - 0.4619i -0.1913 - 0.4619i
 -0.3536 - 0.3536i -0.3535 - 0.3535i
 -0.4619 - 0.1913i -0.4619 - 0.1913i
 -0.5000 -0.5000
 -0.4619 + 0.1913i -0.4619 + 0.1913i
 -0.3536 + 0.3536i -0.3535 + 0.3535i

```

## C64x Radix-2 FFT

---

|                   |                   |
|-------------------|-------------------|
| -0.1913 + 0.4619i | -0.1913 + 0.4619i |
| 0 + 0.5000i       | 0 + 0.5000i       |
| 0.1913 + 0.4619i  | 0.1913 + 0.4619i  |
| 0.3536 + 0.3536i  | 0.3535 + 0.3535i  |
| 0.4619 + 0.1913i  | 0.4619 + 0.1913i  |

### See Also

C64x Bit Reverse, C64x FFT, C64x Radix-2 IFFT



**Purpose** Radix-2 inverse FFT of complex input vector

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Radix-2 IFFT block computes the radix-2 inverse FFT of each channel of a complex input signal. This block uses a decimation-in-frequency forward FFT algorithm with butterfly weights modified to compute an inverse FFT. The input length of each channel must be both a power of two and in the range 16 to 32,768, inclusive. The input must also be in natural (linear) order. The output of this block is a complex signal in bit-reversed order. Inputs and outputs are signed 16-bit fixed-point data types.

The `radix2` routine used by this block employs a radix-2 FFT of length  $L=2^k$ . So that the gain of the block matches that of the theoretical IFFT, the Radix-2 IFFT block offsets the location of the binary point of the output data type by  $k$  bits to the left relative to the location of the binary point of the input data type. That is, the number of fractional bits of the output data type equals the number of fractional bits of the input data type plus  $k$ .

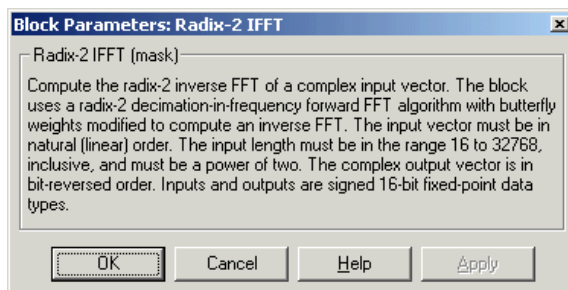
$$\text{OutputFractionalBits} = \text{InputFractionalBits} + (k)$$

You can use the C64x Bit Reverse block to reorder the output of the Radix-2 IFFT block to natural order.

The Radix-2 IFFT block supports both continuous and discrete sample times. This block supports little-endian code generation.

# C64x Radix-2 IFFT

---



## Dialog Box

## Algorithm

In simulation, the Radix-2 IFFT block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_radix2`. During code generation, this block calls the `DSP_radix2` routine to produce optimized code.

## See Also

C64x Bit Reverse, C64x FFT, C64x Radix-2 FFT

**Purpose** Filter real input signal using real FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

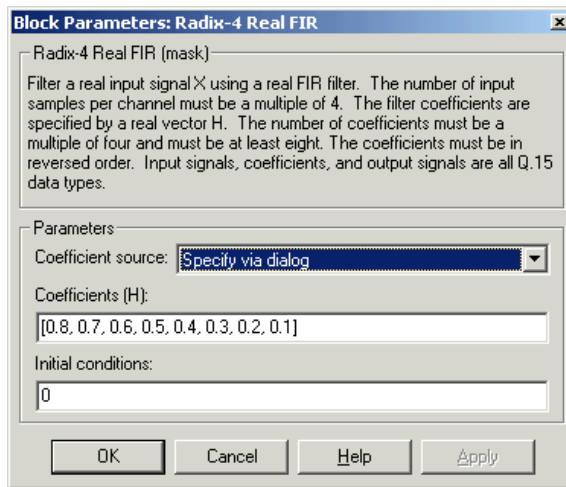
The C64x Radix-4 Real FIR block filters a real input signal  $X$  using a real FIR filter. This filter is implemented using a direct form structure.

The number of input samples per channel must be a multiple of four. The filter coefficients are specified by a real vector,  $H$ . The number of filter coefficients must be a multiple of four and must be at least eight. The coefficients must also be in reversed order  $\{b(n), b(n-1), \dots, b(0)\}$ . all inputs, coefficients, and outputs are  $Q.15$  signals.

The Radix-4 Real FIR block supports discrete sample times and supports little-endian code generation only.

# C64x Radix-4 Real FIR

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients** parameter in the dialog box
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X

### Coefficients (H)

Designate the filter coefficients in vector format. This parameter is only visible when **Specify via dialog** is selected for the **Coefficient source** parameter. Enter the  $n$  coefficients in reversed order —  $b(n), b(n-1), \dots, b(0)$ . This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel.

The length of this vector must be one less than the number of coefficients.

- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

Initial conditions must be real.

## **Algorithm**

In simulation, the Radix-4 Real FIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fir_r4`. During code generation, this block calls the `DSP_fir_r4` routine to produce optimized code.

## **See Also**

C64x Complex FIR, C64x General Real FIR, C64x Radix-8 Real FIR, C64x Symmetric Real FIR

# C64x Radix-8 Real FIR

---

**Purpose** Filter real input signal using real FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



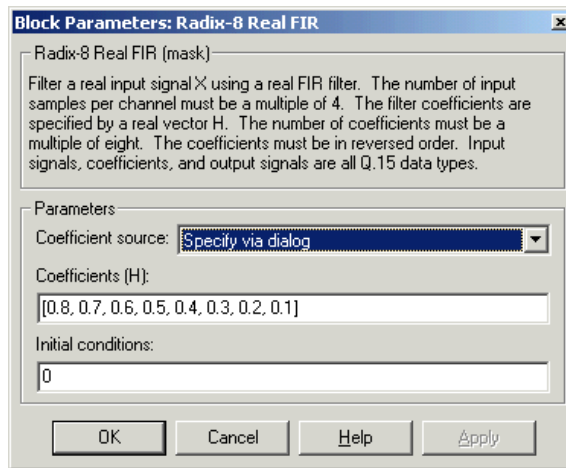
## Description

The C64x Radix-8 Real FIR block filters a real input signal  $X$  using a real FIR filter. This filter is implemented using a direct form structure.

The number of input samples per channel must be a multiple of four. The filter coefficients are specified by a real vector,  $H$ . The number of coefficients must be an integer multiple of eight. The coefficients must be in reversed order —  $\{b(n), b(n-1), \dots, b(0)\}$ . all inputs, coefficients, and outputs are Q.15 signals.

The Radix-8 Real FIR block supports discrete sample times and little-endian code generation only.

## Dialog Box



### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients** parameter in the dialog box
- **Input port** — Accept the coefficients from port H. This port must have the same rate as the input data port X

### Coefficients (H)

Designate the filter coefficients in vector format, entering them in reversed order —  $b(n), b(n-1), \dots, b(0)$ . This parameter is visible when **Specify via dialog** is selected for the **Coefficient source** parameter. This parameter is tunable in simulation.

### Initial conditions

If the initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.

# C64x Radix-8 Real FIR

---

- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

Initial conditions must be real.

## **Algorithm**

In simulation, the Radix-8 Real FIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fir_r8`. During code generation, this block calls the `DSP_fir_r8` routine to produce optimized code.

## **See Also**

C64x Complex FIR, C64x General Real FIR, C64x Radix-4 Real FIR, C64x Symmetric Real FIR



# C64x Real Forward Lattice All-Pole IIR

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## Purpose

Filter real input signal using lattice IIR filter

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

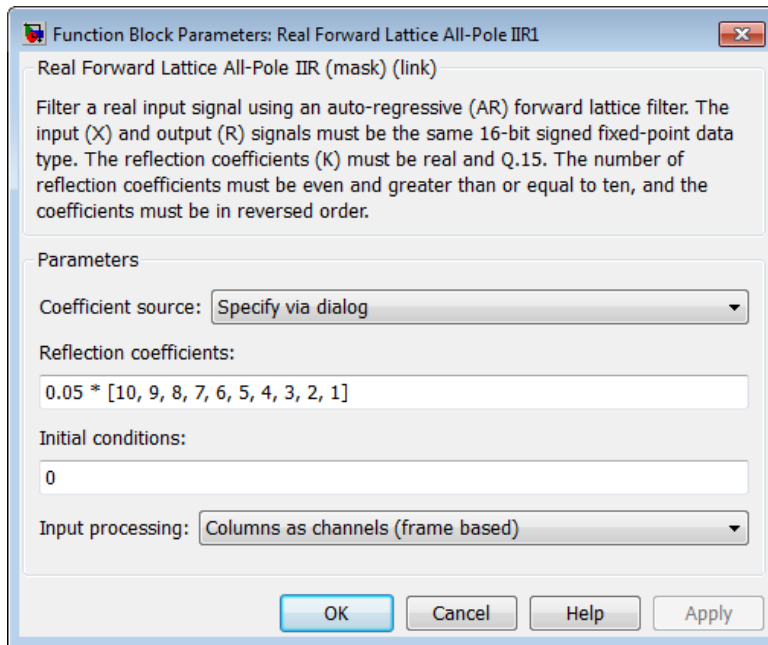


## Description

The C64x Real Forward Lattice all-Pole IIR block filters a real input signal using an autoregressive forward lattice filter. The input and output signals must be the same 16-bit signed fixed-point data type. The reflection coefficients must be real and Q.15. The number of reflection coefficients must be greater than or equal to ten; they must be even; and they must be in reversed order —  $k(n), k(n-1), \dots, k(0)$ . Using an even number of reflection coefficients maximizes the speed of your generated code.

The Real Forward Lattice all-Pole IIR block supports discrete sample times and supports little-endian code generation only.

# C64x Real Forward Lattice All-Pole IIR



## Dialog Box

### Coefficient source

Specify the source of the filter coefficients:

- Specify via dialog — Enter the coefficients in the **Reflection coefficients** parameter in the dialog box
- Input port — Accept the coefficients from port K

### Reflection coefficients

Designate the reflection coefficients of the filter in vector format. The number of coefficients must be greater than or equal to ten and be even. Enter the coefficients in reverse order from  $k(n)$  to  $k(0)$ . Using an even number of reflection coefficients maximizes the speed of your generated code. This parameter is visible when you select Specify via dialog for the **Coefficient source** parameter. This parameter is tunable in simulation.

## Initial conditions

If your block initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length (number of elements) of this vector must be the same as the number of reflection coefficients in your filter.
- Different across channels, enter a matrix containing all initial conditions. The number of rows (initial conditions for one channel) of this matrix must be the same as the number of reflection coefficients, and the number of columns of this matrix must be equal to the number of channels.

## Input Processing

Process input signal as frames or samples

- **Columns as channels (frame based)** — Process the input signal as frames. Each frame contains a group of sequential data samples. To perform frame-based processing, you must have a DSP System Toolbox license.
- **Elements as channels (sample based)** — Process the input signal as individual data samples.
- **Inherited (this choice will be removed - see release notes)** — Use the frame status attribute of the input signal to determine whether to process the input as frames or samples.

When you load an existing model in R2011a, the software sets this parameter to **Inherited (this choice will be removed - see release notes)**. Selecting this option allows you to continue working with your model until you upgrade. Upgrade your model using the `slupdate` function as soon as possible.

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**Note** For more information about this option, see “Changes to Frame-Based Processing”

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# C64x Real Forward Lattice All-Pole IIR

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## **Algorithm**

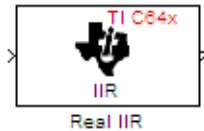
In simulation, the Real Forward Lattice all-Pole IIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_iirlat`. During code generation, this block calls the `DSP_iirlat` routine to produce optimized code.

## **See Also**

C64x Real IIR

**Purpose** Filter real input signal using IIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

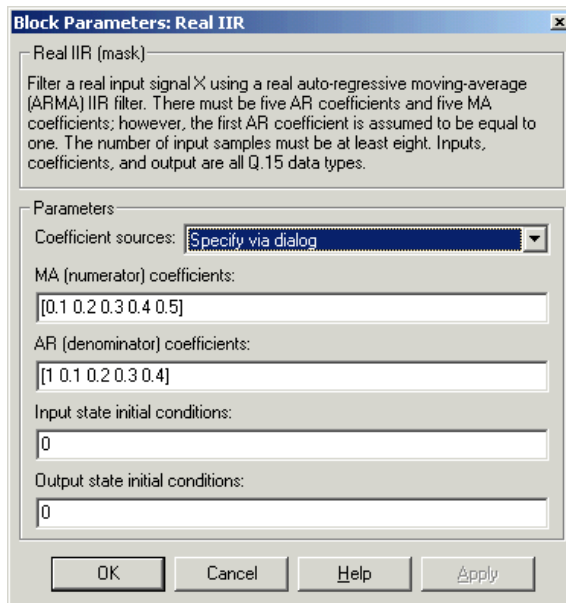


## Description

The C64x Real IIR block filters a real input signal  $X$  using a real autoregressive moving-average (ARMA) IIR Filter. This filter is implemented using a direct form I structure. You must use at least eight input samples.

There must be five AR coefficients and five MA coefficients. The first AR coefficient is assumed to be one. Inputs, coefficients, and output are Q.15 data types.

The Real IIR block supports discrete sample times and supports little-endian code generation only.



## Dialog Box

### Coefficient sources

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **MA (numerator) coefficients** and **AR (denominator) coefficients** parameters in the dialog box
- **Input ports** — Accept the coefficients from block input ports MA and AR

### MA (numerator) coefficients

Designate the moving-average coefficients of the filter in vector format. There must be five MA coefficients. This parameter is only visible when **Specify via dialog** is selected for the **Coefficient sources** parameter. This parameter is tunable in simulation.

### AR (denominator) coefficients

Designate the autoregressive coefficients of the filter in vector format. There must be five AR coefficients, however the first AR

coefficient is assumed to be equal to one. This parameter is only visible when `Specify via dialog` is selected for the **Coefficient sources** parameter. This parameter is tunable in simulation.

## Input state initial conditions

If the input state initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the input state initial conditions for one channel. The length of this vector must be four.
- Different across channels, enter a matrix containing all input state initial conditions. This matrix must have four rows.

## Output state initial conditions

If the output state initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the output state initial conditions for one channel. The length of this vector must be four.
- Different across channels, enter a matrix containing all output state initial conditions. This matrix must have four rows.

## Algorithm

In simulation, the Real IIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_iir`. During code generation, this block calls the `DSP_iir` routine to produce optimized code.

## See Also

C64x Real Forward Lattice all-Pole IIR

# C64x Reciprocal

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**Purpose** Fraction and exponent of reciprocal of real input signal

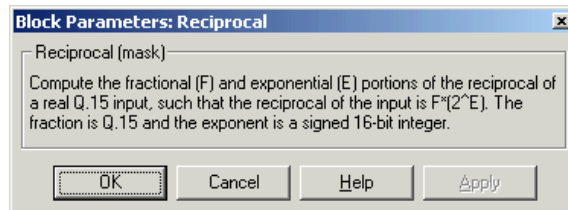
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Reciprocal block computes the fractional (F) and exponential (E) portions of the reciprocal of a real Q.15 input, such that the reciprocal of the input is  $F \cdot (2^E)$ . The fraction is Q.15 and the exponent is a 16-bit signed integer.

The Reciprocal block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Reciprocal block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_recip16`. During code generation, this block calls the `DSP_recip16` routine to produce optimized code.



**Purpose** Filter real input signal using FIR filter

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Symmetric Real FIR block filters a real input signal using a symmetric real FIR filter. This filter is implemented using a direct form structure.

The number of input samples per channel must be even. The filter coefficients are specified by a real vector  $H$ , which must be symmetric about its middle element. Thus you must use an odd number of coefficients. The number of coefficients must be of the form  $16k + 1$ , where  $k$  is a positive integer. This block wraps overflows that occur. The input, coefficients, and output are 16-bit signed fixed-point data types.

Intermediate multiplies and accumulates performed by this filter result in 32-bit accumulator values. However, the Symmetric Real FIR block only outputs 16 bits. You can choose to output 16 bits of the accumulator value in one of the following ways.

|                            |                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Match input $x$            | Output 16 bits of the accumulator value such that the output has the same number of fractional bits as the input        |
| Match coefficients $h$     | Output 16 bits of the accumulator value such that the output has the same number of fractional bits as the coefficients |
| Match high 16 bits of acc. | Output bits 31 - 16 of the accumulator value                                                                            |

# C64x Symmetric Real FIR

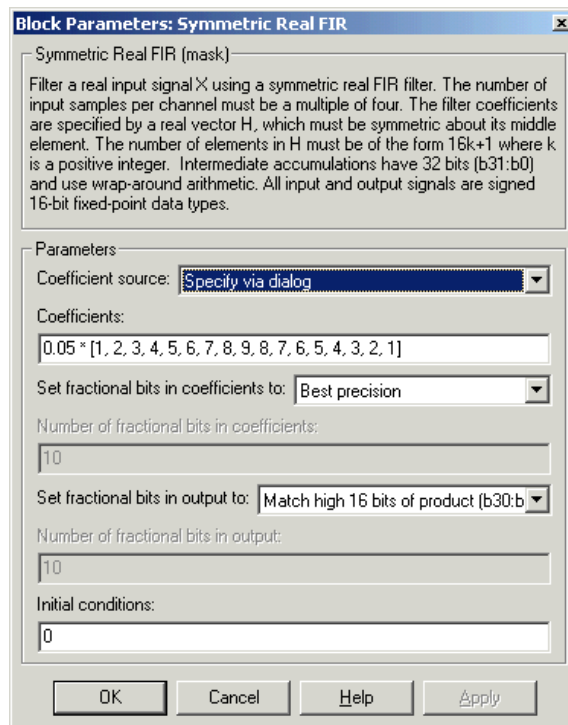
Match high 16 bits of prod.

Output bits 30 - 15 of the accumulator value

User-defined

Output 16 bits of the accumulator value such that the output has the number of fractional bits specified in the **Number of fractional bits in output** parameter

The Symmetric Real FIR block supports discrete sample times and only little-endian code generation.



## Dialog Box

### Coefficient source

Specify the source of the filter coefficients:

- **Specify via dialog** — Enter the coefficients in the **Coefficients** parameter in the dialog box
- **Input port** — Accept the coefficients from port H

## **Coefficients**

Enter the coefficients in vector format. Coefficients must be symmetric about the middle element of the vector, so the number of coefficients must be odd. This parameter is visible when **Specify via dialog** is specified for the **Coefficient source** parameter. This parameter is tunable in simulation.

## **Set fractional bits in coefficients to**

Specify the number of fractional bits in the filter coefficients:

- **Match input X** — Sets the coefficients to have the same number of fractional bits as the input
- **Best precision** — Sets the number of fractional bits of the coefficients such that the coefficients are represented to the best precision possible
- **User-defined** — Sets the number of fractional bits in the coefficients with the **Number of fractional bits in coefficients** parameter

This parameter is visible only when **Specify via dialog** is specified for the **Coefficient source** parameter.

## **Number of fractional bits in coefficients**

Specify the number of bits to the right of the binary point in the filter coefficients. This parameter is visible only when **Specify via dialog** is specified for the **Coefficient source** parameter, and is only enabled if **User-defined** is specified for the **Set fractional bits in coefficients to** parameter.

## **Set fractional bits in output to**

Only 16 bits of the 32 accumulator bits are output from the block. Select which 16 bits to output:

# C64x Symmetric Real FIR

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- **Match input X** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in input X
- **Match coefficients H** — Output the 16 bits of the accumulator value that cause the number of fractional bits in the output to match the number of fractional bits in coefficients H
- **Match high bits of acc. (b31:b16)** — Output the highest 16 bits of the accumulator value
- **Match high bits of prod. (b30:b15)** — Output the second-highest 16 bits of the accumulator value
- **User-defined** — Output the 16 bits of the accumulator value that cause the number of fractional bits of the output to match the value specified in the **Number of fractional bits in output** parameter

See Matrix Multiply “Examples” on page 2-492 for demonstrations of these selections.

## **Number of fractional bits in output**

Specify the number of bits to the right of the binary point in the output. This parameter is only enabled if **User-defined** is selected for the **Set fractional bits in output to** parameter.

## **Initial conditions**

If the initial conditions are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be one less than the number of coefficients.
- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be one less

than the number of coefficients, and the number of columns of this matrix must be equal to the number of channels.

## Algorithm

In simulation, the Symmetric Real FIR block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_fir_sym`. During code generation, this block calls the `DSP_fir_sym` routine to produce optimized code.

## See Also

C64x Complex FIR, C64x General Real FIR, C64x Radix-4 Real FIR, C64x Radix-8 Real FIR

# C64x Vector Dot Product

**Purpose** Vector dot product of real input signals

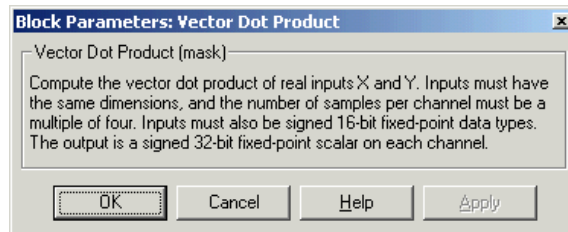
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Vector Dot Product block computes the vector dot product of two real input vectors, X and Y. The input vectors must have the same dimensions and must be signed 16-bit fixed-point data types. The number of samples per channel of the inputs must be a multiple of four. The output is a signed 32-bit fixed-point scalar on each channel, and the number of fractional bits of the output is equal to the sum of the number of fractional bits of the inputs.

The Vector Dot Product block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Vector Dot Product block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_dotprod`. During code generation, this block calls the `DSP_dotprod` routine to produce optimized code.

**Purpose** Zero-based index of maximum value element in each input signal channel

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

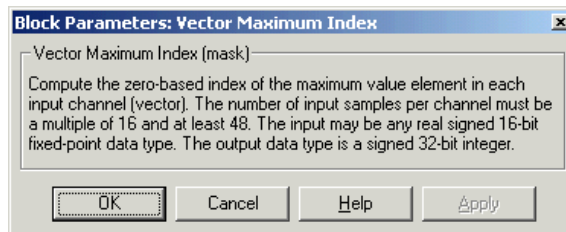


Vector Maximum Index

## Description

The C64x Vector Maximum Index block computes the zero-based index of the maximum value element in each channel (vector) of the input signal. The input may be real, 16-bit, signed fixed-point data type. The number of samples per input channel must be an integer multiple of 16 and at least 48. The output data type is 32-bit signed integer.

The Vector Maximum Index block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Vector Maximum Index block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_maxidx`. During code generation, this block calls the `DSP_maxidx` routine to produce optimized code.

# C64x Vector Maximum Value

**Purpose** Maximum value for each input signal channel

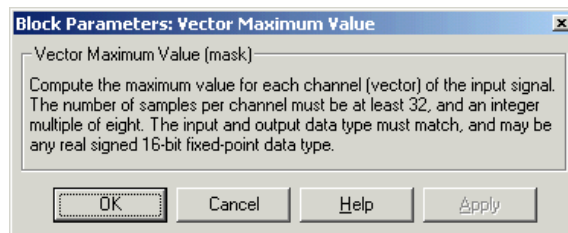
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Vector Maximum Value block returns the maximum value in each channel (vector) of the input signal. The input can be real, 16-bit, signed fixed-point data type. The number of samples on each input channel must be an integer multiple of 8 and must be at least 32. The output data type matches the input data type.

The Vector Maximum Value block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Vector Maximum Value block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_maxval`. During code generation, this block calls the `DSP_maxval` routine to produce optimized code.

**See Also** C64x Vector Minimum Value



**Purpose** Minimum value for each input signal channel

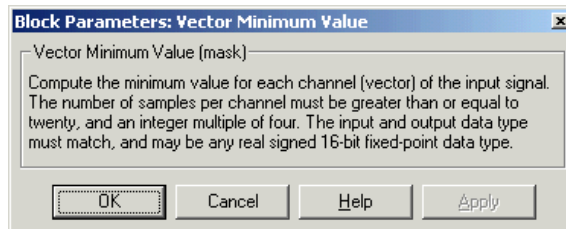
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



**Description** Vector Minimum Value

The C64x Vector Minimum Value block returns the minimum value in each channel of the input signal. The input may be a real, 16-bit, signed fixed-point data type. The number of samples on each input channel must be an integer multiple of 4 and must be at least 20. The output data type matches the input data type.

The Vector Minimum Value block supports both continuous and discrete sample times. This block supports little-endian code generation only.



**Dialog Box**

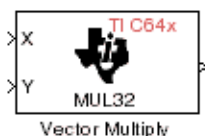
**Algorithm** In simulation, the Vector Minimum Value block is equivalent to the TMS320C64x DSP Library assembly code function DSP\_minval. During code generation, this block calls the DSP\_minval routine to produce optimized code.

**See Also** C64x Vector Maximum Value

# C64x Vector Multiply

**Purpose** Element-wise multiplication on inputs

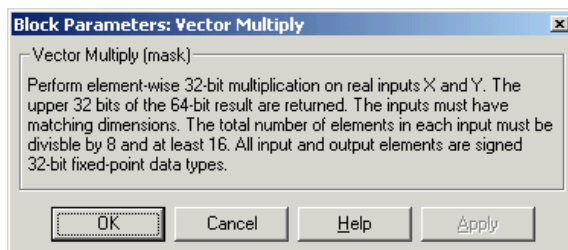
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Vector Multiply block performs element-wise 32-bit multiplication of two inputs X and Y. The total number of elements in each input must be a multiple of 8 and at least 16, and the inputs must have matching dimensions. The upper 32 bits of the 64-bit accumulator result are returned. All input and output elements are 32-bit signed fixed-point data types.

The Vector Multiply block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Vector Multiply block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_mu132`. During code generation, this block calls the `DSP_mu132` routine to produce optimized code.

**See Also** C64x Matrix Multiply

**Purpose** Negate each input signal element

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

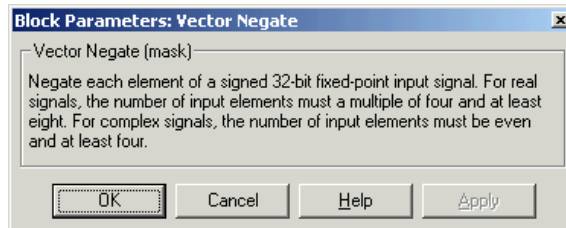


## Description

Vector Negate

The C64x Vector Negate block negates each element of a 32-bit signed fixed-point input signal. For real signals, the number of input elements must be a multiple of four, and at least eight. For complex signals, the number of input elements must be at least two. The output is the same data type as the input.

The Vector Negate block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

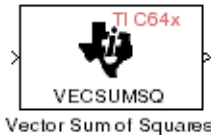
In simulation, the Vector Negate block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_neg32`. During code generation, this block calls the `DSP_neg32` routine to produce optimized code.

# C64x Vector Sum of Squares

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**Purpose** Sum of squares over each real input channel

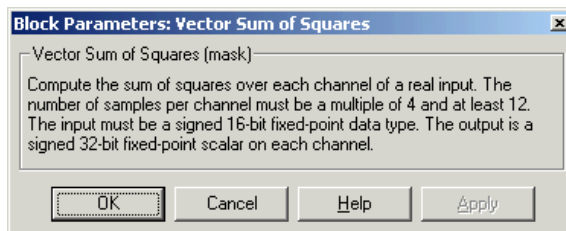
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library



## Description

The C64x Vector Sum of Squares block computes the sum of squares over each channel of a real input. The number of samples per input channel must be divisible by 4; equal to or greater than 8; and the input must be a 16-bit signed fixed-point data type. The output is a 32-bit signed fixed-point scalar on each channel. The number of fractional bits of the output is twice the number of fractional bits of the input.

The Vector Sum of Squares block supports both continuous and discrete sample times. This block supports little-endian code generation only.



## Dialog Box

## Algorithm

In simulation, the Vector Sum of Squares block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_vecsumsq`. During code generation, this block calls the `DSP_vecsumsq` routine to produce optimized code.

**Purpose** Weighted sum of input vectors

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Optimization/ C64x DSP Library

## Description

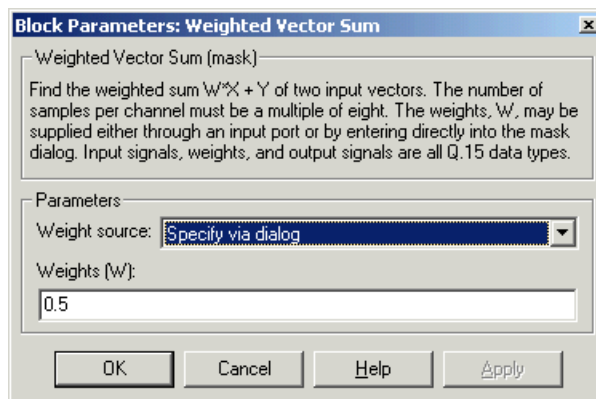


Weighted Vector Sum

The C64x Weighted Vector Sum block computes the weighted sum of two inputs, X and Y, according to  $(W*X)+Y$ . Inputs may be vectors or frame-based matrices. The number of samples per channel must be a multiple of eight. Inputs, weights, and output are Q.15 data types, and weights must be in the range  $-1 < W < 1$ .

The Weighted Vector Sum block supports both continuous and discrete sample times. This block supports little-endian code generation only.

## Dialog Box



### Weight source

Specify the source of the weights:

- **Specify via dialog** — Enter the weights in the **Weights (W)** parameter in the dialog box

# C64x Weighted Vector Sum

---

- Input port — Accept the weights from port W

## Weights (W)

This parameter is visible only when **Specify via dialog** is specified for the **Weight source** parameter. This parameter is tunable in simulation. When the weights are

- all the same, you need only enter a scalar.
- Different within channels but the same across channels, enter a vector containing the initial conditions for one channel. The length of this vector must be a multiple of four.
- Different across channels, enter a matrix containing all initial conditions. The number of rows of this matrix must be a multiple of four, and the number of columns of this matrix must be equal to the number of channels.

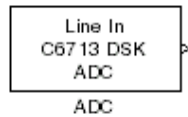
Weights must be in the range  $-1 < W < 1$ .

## Algorithm

In simulation, the Weighted Vector Sum block is equivalent to the TMS320C64x DSP Library assembly code function `DSP_w_vec`. During code generation, this block calls the `DSP_w_vec` routine to produce optimized code.

**Purpose** Digitized signal output from codec to processor

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6713 DSK



**Description**

Use the C6713 DSK ADC (analog-to-digital converter) block to capture and digitize analog signals from external sources, such as signal generators, frequency generators or audio devices. Placing an C6713 DSK ADC block in your Simulink block diagram lets you use the audio coder-decoder module (codec) on the C6713 DSK to convert an analog input signal to a digital signal for the digital signal processor.

Due to a hardware limitation, there can be only one C6713 DSK ADC block per model. Using two blocks will generate an error message.

Most of the configuration options in the block alter the codec. However, the **Output data type**, **Samples per frame** and **Scaling** options are related to the model you are using in Simulink software, the signal processor on the board, or direct memory access (DMA) on the board. In the following table, you find each option listed with the C6713 DSK hardware affected.

| Option            | Affected Hardware                    |
|-------------------|--------------------------------------|
| ADC source        | Codec                                |
| Mic               | Codec                                |
| Output data type  | TMS320C6713 digital signal processor |
| Samples per frame | Direct memory access functions       |

## C6713 DSK ADC

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| Option           | Affected Hardware                    |
|------------------|--------------------------------------|
| Scaling          | TMS320C6713 digital signal processor |
| Source gain (dB) | Codec                                |

You can select one of three input sources from the **ADC source** list:

- **Line In** — the codec accepts input from the line in connector (**LINE IN**) on the board's mounting bracket.
- **Mic** — the codec accepts input from the microphone connector (**MIC IN**) on the board mounting bracket.

Use the **Stereo** check box to indicate whether the audio input is monaural or stereo. Clear the check box to choose monaural audio input. Select the check box to enable stereo audio input. Monaural (mono) input is left channel only, but the output sends left channel content to both the left and right output channels; stereo uses the left and right channels on input and output.

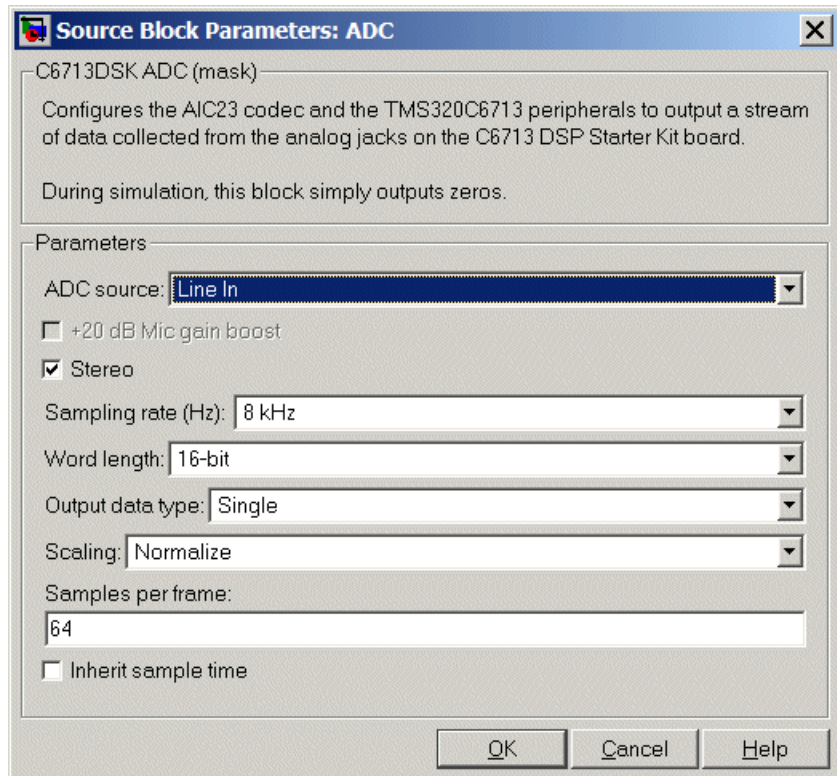
The block uses frame-based processing of inputs, buffering the input data into frames at the specified samples per frame rate. In Simulink software, the block puts monaural data into an N-element column vector. Stereo data input forms an N-by-2 matrix with N data values and two stereo channels (left and right).

When the samples per frame setting is more than one, each frame of data is either the N-element vector (monaural input) or N-by-2 matrix (stereo input). For monaural input, the elements in each frame form the column vector of input audio data. In the stereo format, the frame is the matrix of audio data represented by the matrix rows and columns — the rows are the audio data samples and the columns are the left and right audio channels.

When you select **Mic** for **ADC source**, you can select the **+20 dB Mic gain boost** check box to add 20 dB to the microphone input signal before the codec digitizes the signal.



**Source gain (dB)** lets you add gain to the input signal before the A/D conversion. Select the gain from the list.



## Dialog Box

### ADC source

The input source to the codec. **Line In** is the default setting. Selecting **Mic** enables the **+20 dB Mic gain boost** option.

### +20 dB Mic gain boost

Boosts the input signal by +20dB when **ADC source** is **Mic**. Gain is applied before analog-to-digital conversion.

## **Stereo**

Indicates whether the input audio data is in monaural or stereo format. Select the check box to enable stereo input. Clear the check box when you input monaural data. By default, stereo operation is enabled.

## **Sampling Rate**

Set the sampling rate of the analog-to-digital converter. Increasing the frequency increases the accuracy of the sampling data over time.

## **Word length**

Sets the resolution with which the ADC samples the analog input. Increasing the word length increases the accuracy of the data in each sample. If your model also contains a DAC block, set its word length match that of the ADC block.

## **Output data type**

Selects the word length and shape of the data from the codec. By default, double is selected. Options are Double, Single, and Integer.

## **Scaling**

Selects whether the codec data is unmodified, or normalized to the output range to  $\pm 1.0$ , based on the codec data format. Select either Normalize or Integer Value. Normalize is the default setting.

## **Samples per frame**

Creates frame-based outputs from sample-based inputs. This parameter specifies the number of samples of the signal the block buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. Notice that the frame rate depends on the sample rate and frame size. For example, if your input is 8kHz samples per second, and you select 64 samples per frame, the frame rate is 125 frames every second. The throughput remains the same at 64 samples per second.

## **Inherit sample time**

Select whether the block inherits the sample time from the model base rate or from the Simulink base rate. You can locate the Simulink base rate in the Solver options in Configuration Parameters. Selecting Inherit sample time directs the block to use the specified rate in model configuration.

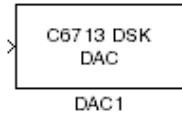
## **See Also**

C6713 DSK DAC

# C6713 DSK DAC

**Purpose** Configure codec to convert digital input to analog output

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6713 DSK



## Description

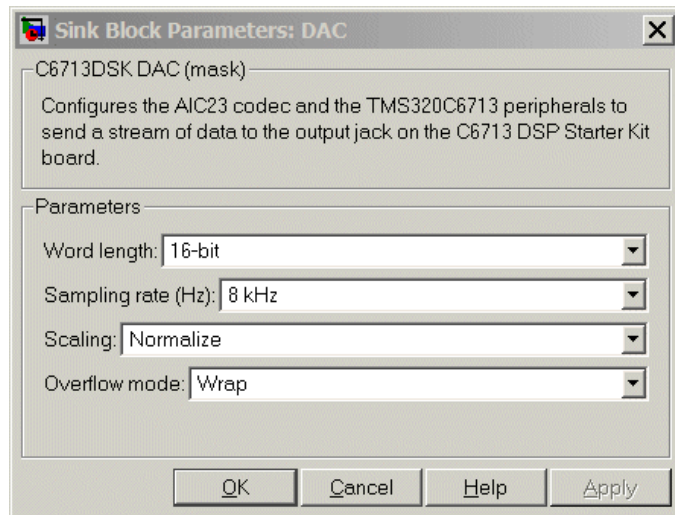
Adding the C6713 DSK DAC (digital-to-analog converter) block to your Simulink model lets you connect an analog signal to the analog output jack on the C6713 DSK. When you add the C6713 DSK DAC block, the digital signal received by the codec is converted to an analog signal and sent to the output jack.

The input on the C6713DSK DAC block takes  $[N \times 1]$  and  $[N \times 2]$  signals. The AIC23 audio codec on the C6713DSK board outputs stereo samples, even though it accepts both mono  $[N \times 1]$  and stereo  $[N \times 2]$  signals. If the input is a mono signal with dimension  $[N \times 1]$ , the block outputs the same signal on both the left and right channels. If the input is a stereo signal with dimension  $[N \times 2]$ , each of the  $N$  samples are output separately through the left and right channels.

Only the **Word length** option in the block affects the codec. The other options relate to the model you are using in Simulink software and the signal processor on the board. Refer to the following table for information.

| Option        | Affected Hardware                    |
|---------------|--------------------------------------|
| Overflow mode | TMS320C6713 Digital Signal Processor |
| Scaling       | TMS320C6713 Digital Signal Processor |
| Word length   | Codec                                |

## Dialog Box



### Word length

Sets the DAC to interpret the input data word length. Without this setting, the DAC cannot convert the digital data to analog as expected. The value defaults to 16 bits, with options of 20, 24, and 32 bits. Select the word length to match the ADC setting.

### Scaling

Selects whether the input to the codec represents unmodified data, or data that has been normalized to the range  $\pm 1.0$ . Match the setting of the C6713 DSK ADC block.

### Overflow mode

Determines how the codec responds to data that is outside the range specified by the **Scaling** parameter. You can choose **Wrap** or **Saturate** options to apply to the result of an overflow in an operation. **Saturation** is the less efficient operating mode if efficiency is important to your development.

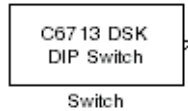
## See Also

C6713 DSK ADC

# C6713 DSK DIP Switch

**Purpose** Simulate or read DIP switches

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6713 DSK



## Description

Added to your model, this block behaves differently in simulation than in code generation and targeting.

**In Simulation** — the options **Switch 0**, **Switch 1**, **Switch 2**, and **Switch 3** generate output to simulate the settings of the user-defined dual inline pin (DIP) switches on your C6713 DSK. Each option turns the associated DIP switch on when you select it. The switches are independent of one another.

By defining the switches to represent actions on your target, DIP switches let you modify the operation of your process by reconfiguring the switch settings.

Use the **Data type** to specify whether the DIP switch options output an integer or a logical string of bits to represent the status of the switches. The table that follows presents all the option setting combinations with the result of your **Data type** selection.

### Option Settings to Simulate the User DIP Switches on the C6713 DSK

| Switch 0 (LSB) | Switch 1 | Switch 2 | Switch 3 (MSB) | Boolean Output | Integer Output |
|----------------|----------|----------|----------------|----------------|----------------|
| Cleared        | Cleared  | Cleared  | Cleared        | 0000           | 0              |
| Selected       | Cleared  | Cleared  | Cleared        | 0001           | 1              |
| Cleared        | Selected | Cleared  | Cleared        | 0010           | 2              |

## Option Settings to Simulate the User DIP Switches on the C6713 DSK (Continued)

| Switch 0 (LSB) | Switch 1 | Switch 2 | Switch 3 (MSB) | Boolean Output | Integer Output |
|----------------|----------|----------|----------------|----------------|----------------|
| Selected       | Selected | Cleared  | Cleared        | 0011           | 3              |
| Cleared        | Cleared  | Selected | Cleared        | 0100           | 4              |
| Selected       | Cleared  | Selected | Cleared        | 0101           | 5              |
| Cleared        | Selected | Selected | Cleared        | 0110           | 6              |
| Selected       | Selected | Selected | Cleared        | 0111           | 7              |
| Cleared        | Cleared  | Cleared  | Selected       | 1000           | 8              |
| Selected       | Cleared  | Cleared  | Selected       | 1001           | 9              |
| Cleared        | Selected | Cleared  | Selected       | 1010           | 10             |
| Selected       | Selected | Cleared  | Selected       | 1011           | 11             |
| Cleared        | Cleared  | Selected | Selected       | 1100           | 12             |
| Selected       | Cleared  | Selected | Selected       | 1101           | 13             |
| Cleared        | Selected | Selected | Selected       | 1110           | 14             |
| Selected       | Selected | Selected | Selected       | 1111           | 15             |

Selecting the **Integer** data type results in the switch settings generating integers in the range from 0 to 15 (uint8), corresponding to converting the string of individual switch settings to a decimal value. In the **Boolean** data type, the output string presents the separate switch setting for each switch, with the **Switch 0** status represented by the least significant bit (LSB) and the status of **Switch 3** represented by the most significant bit (MSB).

**In Code generation and targeting** — the code generated by the block reads the physical switch settings of the user switches on the board and reports them as shown above. Your process uses the result in the same way whether in simulation or in code generation. In code generation

# C6713 DSK DIP Switch

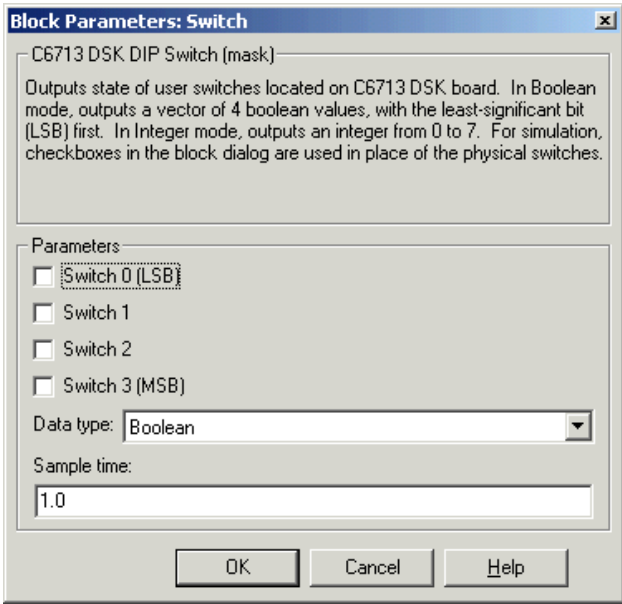
---

and when running your application, the block code ignores the settings for **Switch 0**, **Switch 1**, **Switch 2** and **Switch 3** in favor of reading the hardware switch settings. When the block reads the DIP switches, it reports the results as either a Boolean string or an integer value as the table below shows.

## Output Values From The User DIP Switches on the C6713 DSK

| Switch 0 (LSB) | Switch 1 | Switch 2 | Switch 3 (MSB) | Boolean Output | Integer Output |
|----------------|----------|----------|----------------|----------------|----------------|
| Off            | Off      | Off      | Off            | 0000           | 0              |
| On             | Off      | Off      | Off            | 0001           | 1              |
| Off            | On       | Off      | Off            | 0010           | 2              |
| On             | On       | Off      | Off            | 0011           | 3              |
| Off            | Off      | On       | Off            | 0100           | 4              |
| On             | Off      | On       | Off            | 0101           | 5              |
| Off            | On       | On       | Off            | 0110           | 6              |
| On             | On       | On       | Off            | 0111           | 7              |
| Off            | Off      | Off      | On             | 1000           | 8              |
| On             | Off      | Off      | On             | 1001           | 9              |
| Off            | On       | Off      | On             | 1010           | 10             |
| On             | On       | Off      | On             | 1011           | 11             |
| Off            | Off      | On       | On             | 1100           | 12             |
| On             | Off      | On       | On             | 1101           | 13             |
| Off            | On       | On       | On             | 1110           | 14             |
| On             | On       | On       | On             | 1111           | 15             |





## Dialog Box

### Switch 0

Simulate the status of the user-defined DIP switch on the board.

### Switch 1

Simulate the status of the user-defined DIP switch on the board.

### Switch 2

Simulate the status of the user-defined DIP switch on the board.

### Switch 3

Simulate the status of the user-defined DIP switch on the board.

### Data type

Determines how the block reports the status of the user-defined DIP switches. **Boolean** is the default, indicating that the output is a vector of four logical values, either 0 or 1.

Each vector element represents the status of one DIP switch; the first switch is switch **Switch 0** and the fourth is switch **Switch 3**.

## C6713 DSK DIP Switch

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The data type `Integer` converts the logical string to an equivalent unsigned 8-bit (`uint8`) value. For example, when the logical string generated by the switches is 0101, the conversion yields 5 — the LSB is 1 and the MSB is 0.

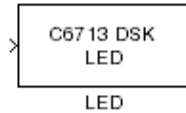
### **Sample time**

Specifies the time between samples of the signal. This value defaults to 1 second between samples, for a sample rate of one sample per second ( $1/\mathbf{Sample\ time}$ ).

**Purpose** Control LEDs

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6713 DSK

**Description**



Adding the C6713 DSK LED block to your Simulink block diagram lets you trigger all four of the user light emitting diodes (LED) on the C6713 DSK. To use the block, send a nonzero real scalar to the block. The C6713 DSK LED block controls all four User LEDs located on the C6713 DSK.

When you add this block to a model, and send a real scalar to the block input, the block sets the LED state based on the input value it receives:

- When the block receives an input value equal to 0, the specified LEDs are turned off (disabled), 0000
- When the block receives a nonzero input value, the specified LEDs are turned on (enabled), 0001 to 1111

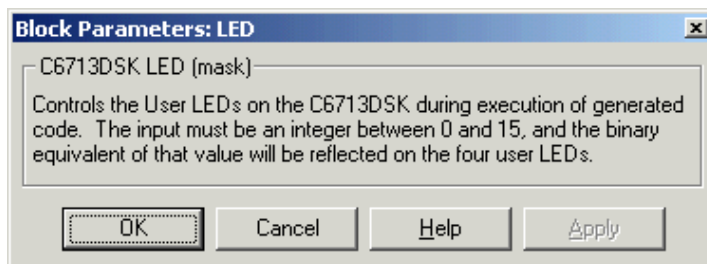
To activate the block, send it an integer in the range 0 to 15. Vectors do not work to activate LEDs; nor do complex numbers as scalars or vectors.

all LEDs maintain their state until they receive an input value that changes the state. Enabled LEDs stay on until the block receives an input value that turns the LEDs off; disabled LEDs stays off until turned on. Resetting the C6713 DSK turns off all User LEDs. By default, the LEDs are turned off when you start an application.

## C6713 DSK LED

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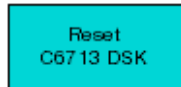
### Dialog Box



This dialog box does not have user-selectable options.

**Purpose** Reset to initial conditions

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6713 DSK



**Description**

Reset

Double-clicking this block in a Simulink model window resets the C6713 DSK that is running the executable code built from the model. When you double-click the Reset block, the block runs the software reset function provided by CCS IDE that resets the processor on your C6713 DSK. Applications running on the board stop and the signal processor returns to the initial conditions you defined.

Before you build and download your model, add the block to the model as a stand-alone block. You do not need to connect the block to a block in the model. When you double-click this block in the block library it resets your C6713 DSK. In other words, anytime you double-click a C6713 DSK Reset block you reset your C6713 DSK.

**Dialog Box**

This block does not have settable options and does not provide a user interface dialog box.

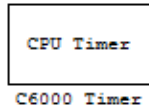
# C6000 CPU Timer

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**Purpose** Select timer and configure periodic interrupt

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

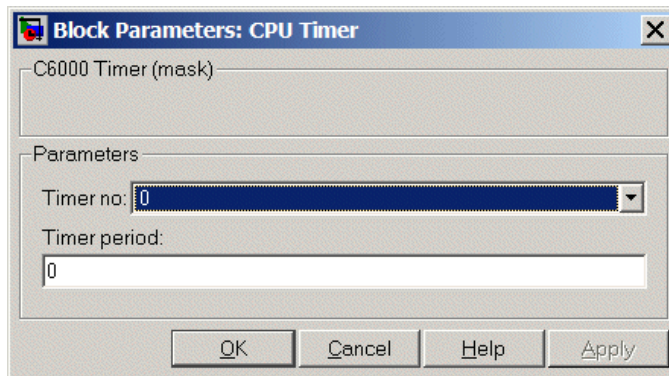
## Description



Configures the CPU timer period on your board. The timer raises periodic interrupts when the timer counter reaches the timer period. While the block provides two timers, 0 and 1, some CPU's have more or fewer than two timers. For example, the DM642 provides three timers. If you set **Timer no** to 1, verify that your CPU has two or more timers.

The C6000 CPU Timer block does not support C64x processors.

## Dialog Box



### Timer no.

Select the timer to use from the list. Verify that the target offers a timer with the timer number you choose. Timer 0 is selected by default.

### Timer period

Set the timer interrupt period in terms of CPU clock cycles.

Enter the timer period in clock cycles, either as an integer, fraction, decimal, or a variable in your workspace. 0 is the default value.

For example, to generate a periodic timer interrupt every second when the CPU clock operates at 720MHz, set **Timer period** to 720e6 clock cycles.

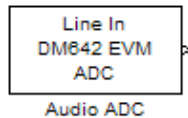
### **See Also**

C5000/C6000 Hardware Interrupt, Idle Task

# DM642 EVM Audio ADC

**Purpose** Audio codec and peripherals

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM



## Description

Use the DM642 EVM ADC (analog-to-digital converter) block to capture and digitize analog audio signals from external sources, such as signal generators, frequency generators, or audio devices. Placing a DM642 EVM ADC block in your Simulink block diagram lets you use the audio coder-decoder module (codec) on the DM642 EVM to convert an analog input signal to a digital signal for the digital signal processor.

ADC blocks output `int16` data independent of the data type you provide as input to the block.

Most of the configuration options in the block alter the codec. However, the **Samples per frame** and **Scaling** options are related to the model you are using in Simulink software, the signal processor on the board, or direct memory access (DMA) on the board. In the following table, you find each option listed with the DM642 EVM hardware affected.

| Option            | Affected Hardware              |
|-------------------|--------------------------------|
| ADC Source        | Codec                          |
| Mic               | Codec                          |
| Sample rate (Hz)  | Codec                          |
| Samples per frame | Direct memory access functions |
| Stereo            | Codec                          |

You can select one of two input sources from the **ADC source** list:

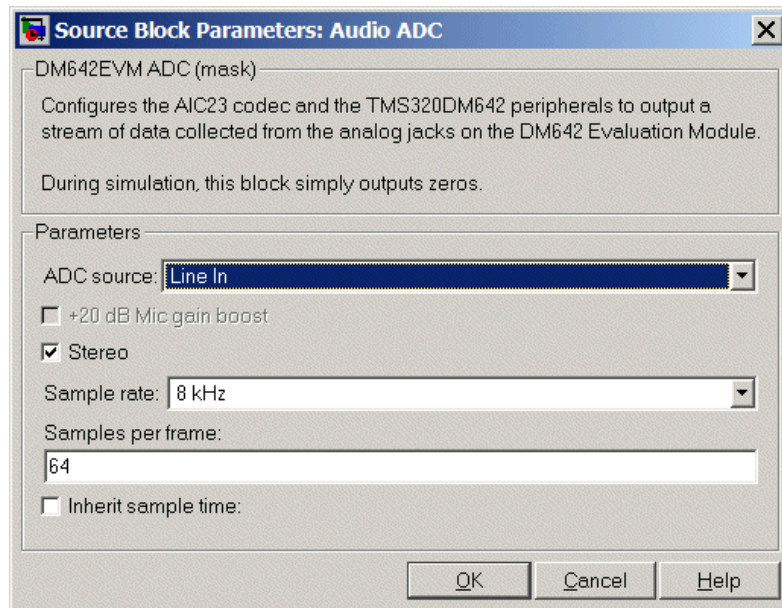


- **Line In** — the codec accepts input from the line in connector (LINE IN) on the board's mounting bracket.
- **Mic in** — the codec accepts input from the microphone connector (MIC IN) on the board mounting bracket.

Use the **Stereo** check box to indicate whether the audio input is monaural or stereo. Clear the check box to choose monaural audio input. Select the check box to enable stereo audio input. Monaural (mono) input is left channel only, but the output sends left channel content to both the left and right output channels; stereo uses the left and right channels.

You must set the sample rate for the block. From **Sample rate (Hz)**, select the sample rate for your model. **Sample rate (Hz)** specifies the number of times each second that the codec samples the input signal. Sample rates range from 8 kHz to 96 kHz, in preset rates. You must select from the list; you cannot enter a sample rate that is not on the list.

# DM642 EVM Audio ADC



## Dialog Box

### ADC source

The input source to the codec. **Line In** is the default.

### +20 dB Mic gain boost

Boosts the input signal by +20dB when **ADC source** is **Mic**. Gain is applied before analog-to-digital conversion.

### Stereo

The number of channels input to the A/D converter. Clearing this option selects the left channel; selecting this option selects both left and right input channels. To configure the DM642 EVM board for monaural operation, clear the **Stereo** check box. When you first open the dialog box, **Stereo** is selected. This value defaults to stereo operation.

## **Sample rate (Hz)**

Sampling rate of the A/D converter. Available sample rates are set by the codec. Default rate is 8 kHz. Options range up to 96 kHz. Select the sample rate from the list.

## **Samples per frame**

Creates frame-based outputs from sample-based inputs. This parameter specifies the number of samples of the signal buffered internally by the block before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. Notice that the frame rate depends on the sample rate and frame size. For example, if your input is 32 samples per second, and you select 64 samples per frame, the frame rate is one frame every two seconds. The throughput remains the same at 32 samples per second.

## **Inherit sample time**

Selects whether the block inherits the sample time from the model base rate or Simulink base rate as determined in the Solver options in Configuration Parameters. Selecting **Inherit sample time** directs the block to use the specified rate in model configuration. You must select this option to use the block in a function subsystem with the asynchronous scheduler.

## **See Also**

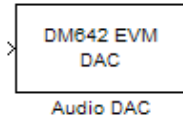
DM642 EVM Audio DAC

# DM642 EVM Audio DAC

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**Purpose** Configure codec to convert digital audio input to analog audio output

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM



## Description

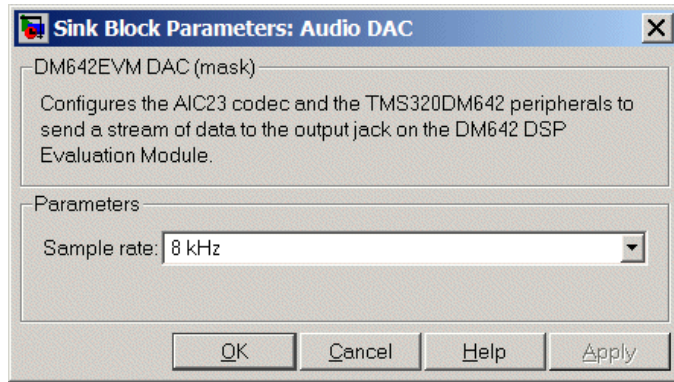
Adding the DM642 EVM DAC (digital-to-analog converter) block to your Simulink model lets you output an analog signal to the LINE OUT connection on the DM642 EVM mounting bracket. When you add the DM642 EVM DAC block, the digital signal received by the codec is converted to an analog signal (digital-to-analog conversion) and sent to the output audio jack.

The DAC data word length is 16 bits. The block converts all input data to `int16` before it writes the data out to the DAC output buffer.

With an integer data word length of 16 bits, a data value above  $2^{15}-1$  or below  $-2^{15}$  wraps back into the representable range of values between  $-2^{15}$  to  $2^{15}-1$ . Wrapping uses modulo arithmetic to cast an overflow back into the representable range of the data type. Saturate arithmetic is not available. For example,

While converting the digital signal to an analog signal, the codec rounds floating point data to the nearest integer, thus rounding 0.51 up to 1.0 or 4.49 down to 4.0.

Setting the sample rate configures the codec sampling rate for the analog output data stream. The rates range from 8000 Hz, similar to plain old telephone service quality, to 48 kHz (CD quality audio) to 96 kHz.



## Dialog Box

### Sample rate (Hz)

Sampling rate of the D/A converter. Available output sample rates are set by the codec. Default rate is 8000 Hz (8 kHz) and the maximum rate is 96000 Hz (96 kHz). Choose the rate from the list.

## See Also

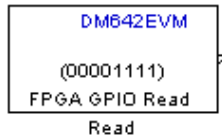
DM642 EVM Audio ADC

# DM642 EVM FPGA GPIO Read

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**Purpose** User GPIO registers to read from selected pins

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM

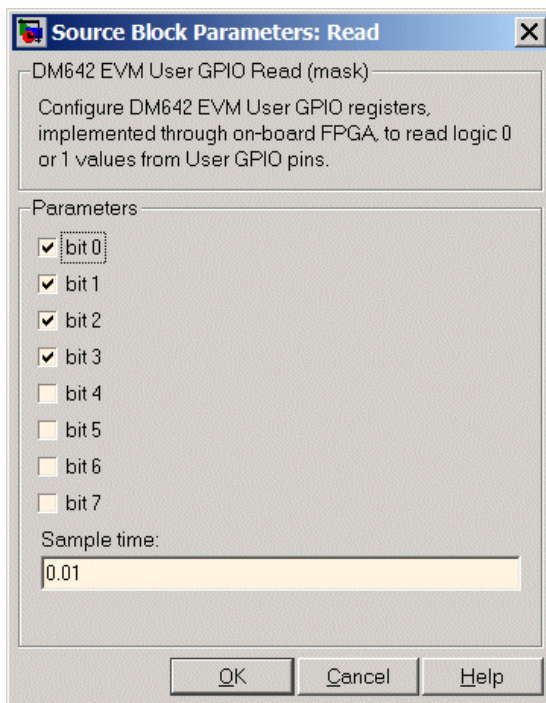


## Description

Added to your model, this block reads logical values from the GPIO registers you select in the dialog box and sends the data out to downstream blocks as an unsigned 8-bit word.

The DM642 EVM offers eight general purpose I/O registers that you can read from and write to for your needs. Each I/O pin represents either a logical 0 or 1 depending on the signal at the pin.

An important note — you cannot read and write to the same I/O registers with the FPGA GPIO Read and FPGA GPIO Write blocks. If you read register 1 with the read block you cannot write to register 1 with the write block. This applies to all eight registers.



## Dialog Box

### bit 0 to bit 7

Each bit represents the logical value at one GPIO register. **Bit 0** is register 0, **bit 7** is register 7. Select the bits that represent the registers to read. The read and write functions cannot share the same registers. If you select a register to read, you cannot write to that register.

### Sample time

Time in seconds between consecutive inputs to the registers. Enter a real positive value or a variable name from your workspace.

## See Also

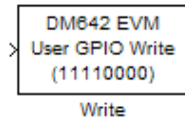
DM642 EVM FPGA GPIO Write

# DM642 EVM FPGA GPIO Write

---

**Purpose** Write to GPIO registers

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM



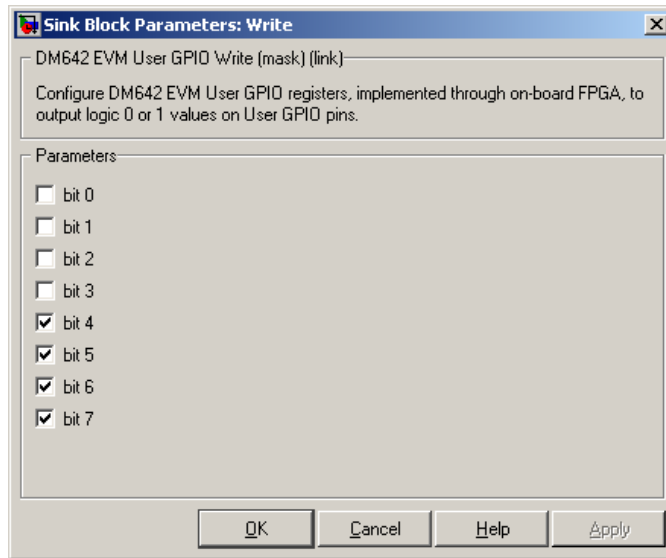
## Description

Added to your model, this block writes logical values to the GPIO registers you select in the dialog box, reading the data from an upstream block as an unsigned 8-bit word.

The DM642 EVM offers eight general purpose I/O registers that you can read from and write to for your needs. Each I/O pin represents either a logical 0 or 1 depending on the signal at the pin.

An important note — you cannot read and write to the same I/O registers with the FPGA GPIO Read and FPGA GPIO Write blocks. If you write register 1 with the write block you cannot read from register 1 with the read block. This applies to all eight registers.





## Dialog Box

### bit 0 to bit 7

Each bit represents the logical value at one GPIO register. **Bit 0** is register 0, **bit 7** is register 7. Select the bits that represent the registers to write. The read and write functions cannot share the same registers. When you select a register to write to, you cannot read that register.

## See Also

DM642 EVM FPGA GPIO Read

# DM642 EVM Video ADC

---

## Purpose

Video decoders to capture analog video

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM

## Description



Adding this block to a model enables code generated from your model to perform the following tasks:

- 1 Capture analog video data from the video block inputs on the DM642 EVM.
- 2 Convert the input to a format and mode you define in the block.
- 3 Output the converted digital video for further downstream processing.

Adding two of these blocks to a model lets you capture two separate video data streams and prepare them for display simultaneously, such as in picture-in-picture mode.

The block captures and buffers one frame (two fields for NTSC standard) of analog input video from the block inputs, converts the buffered video to the specified format, and then outputs the converted video frame as 8-bit unsigned integer data for further processing.

Input to the DM642 EVM must be analog National Television Standards Committee (NTSC) or Phase Alternating Line (PAL) video format. The block captures and processes data in frames, not fields.

To configure the format for the output video, the block offers output format options that control how the block handles color data. The block also offers a sample time option to let you set the frame rate for video output from the block.

---

**Note** This block does not provide output video for display. Use the DM642 EVM Video DAC to generate video data to output to the board video output connectors. The DM642EVM board provides both composite and S-video connectors for output. However, these are driven simultaneously, so you do not need to specify which one is to be used.

---

When you add this block to a Simulink model, it does not alter the simulation — it outputs a string of zeros. Generating code from a model that includes this block produces the code used for capturing data on your evaluation module by adding

- Video device configuration code for the chosen mode
- Code used to copy the run time buffer

To use video in a Simulink model, use one of the available video source blocks to introduce video data to your model.

Options for the block let you configure the digital video format and video mode for the data output by the block.

NTSC TV systems use interlaced scanning to create TV frames from fields. The even and odd TV lines are separated into even and odd fields that combine to make a complete TV frame image. For output, the block provides complete frames, consisting of two fields, which are available at an instant. When the sample time you specify for the block is different from the NTSC frame rate of 30Hz, you may encounter visible anomalies in the video stream from the block.

## **Memory Use**

This block allocates video capture buffers on the system heap, using a TI driver that allocates three frame buffers on the heap for continuous video capture. To use the block you must create a heap in external memory on the target with the label EXTERNALHEAP. If you do not create the heap, either using the default values in the Target Hardware

Resources tab or setting your own values. Embedded Coder software returns an error.

Use **Create heap** and **Heap size** and set the heap size in the Target Hardware Resources tab to configure the heap. Select **Define label** and name the heap EXTERNALHEAP in **Heap label**.

The default settings for the Target Hardware Resources tab create a heap with enough memory to handle the worst case memory allocation needs automatically. If you configure the heap without enough memory, you get a run-time error because the system cannot initialize the video driver.

## **Notes About Converting NTSC Video Input From YCbCr to RGB24**

When you choose to convert your NTSC YCbCr-defined video input to RGB24 (8:8:8 RGB) for output from the block, the block performs an intermediate conversion step that follows a standard process for conversion (as described by Graphical Device Interface (GDI) color space conversions documentation from the International Color Consortium (ICC)).

First, the block converts the luma component (Y), blue-difference chroma component (Cb), and red-difference chroma component (Cr) of the input signal to 5:6:5 RGB format where the red and blue channels of the source use a 5-bit representation and the green channel uses 6 bits.

Now the block converts your 5:6:5 RGB to 8:8:8 RGB using the following conventions:

- 1** For the red and blue 5-bit channels, it copies the three most significant bits (MSB) from the 5-bit source word and append them to the lower order end of the target word.
- 2** For the green 6-bit channel, it copies the two MSBs from the green source word and append them to the lower order end of the target green word.

The results is to output three RGB channels — red, green, and blue — each with 8-bit words.

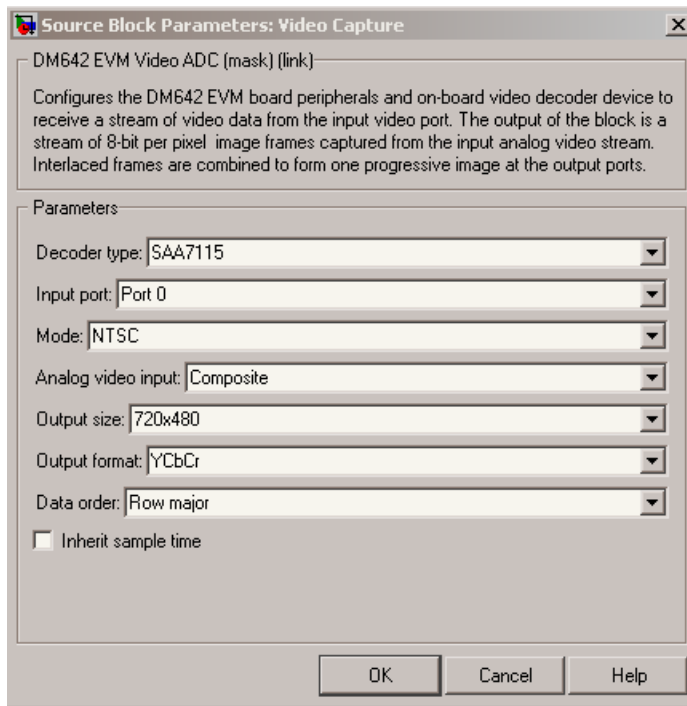
For example, to convert hexadecimal values by this algorithm, 5:5:5 RGB data of (0x19, 0x33, 0x1A) becomes (0xCE, 0xCF, 0xD6) of 8:8:8 RGB output.

To do the conversion in the binary case for 5:5:5 RGB data:

- 1** blue data 1 1101 converts to 11101111
- 2** for the green channel, conversion takes 11 0011 to 1100 1111
- 3** red data 1 0101 becomes 1010 1101 (same algorithm as blue data)

To maximize the speed of the RGB conversion, the Video ADC block provides color space conversion using a routine written in assembly language and optimized for the DM64x processor core. Using the optimized color space conversion code replaces the Color Space Conversion block available from the Computer Vision System Toolbox™ (VIP blockset). While you can use a compatible VIP blockset block with the DM642, this particular color space conversion operation is handled better by the conversion code included in the ADC block.

# DM642 EVM Video ADC



## Dialog Box

### Decoder type

Configures the block options to support either the TVP5146 Decoder on the DM642 EVM or the SAA7115 Decoder, depending on the model of your board. Choose one option from the list — TVP5146 or SAA7115. When you select SAA7115 for the type of decoder, the dialog box adds a new option — **Output Mode**. Generally, older DM642 EVM boards use the SAA7115 decoder. Newer boards use the default setting TVP5146 decoder.

### Input port

Directs the block to capture video from either the 0 or 1 video input port on the DM642 EVM. The block does not support port 2 for video input. Input port 0 provides both composite video (via connector J15) and S-video (connector J16) inputs.

## Mode

Select the video format to capture from the list. The block supports NTSC and PAL video formats.

## Analog Video Input

Select composite video or S-video. The video decoder connected to port 0 has both composite and S-video inputs. These are available via connector J15 and J16, respectively. Port 1 has two composite video connectors, but does not provide S-video.

## Output size

Reports the size of the video images to output. **Output size** is a read-only parameter set to 720 x 576 resolution elements when you select PAL mode and the TVP5146 decoder in **Decoder type**. When you select NTSC mode with the TVP5146 decoder, **Output size** reports the read-only value 720 x 480.

If you select the SAA7115 decoder, **Output size** lists the available video sizes to output for further processing, depending on the **Mode** setting. The following tables show the sizes to pick from depending on whether you pick NTSC or PAL for **Mode**. The block scales the input video to the selected size for output.

| Video Output Size Options For NTSC Mode | Description                                                                                                       |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 128 x 96                                | Output NTSC video with dimensions 128 pixels by 96 pixels. Scales the output to 1/4 the resolution of QCIF video. |
| 176 x 144                               | Output NTSC video with dimensions 176 pixels by 144 pixels. Scales the output to 1/4 the resolution of CIF video. |

# DM642 EVM Video ADC

| <b>Video Output Size Options For NTSC Mode</b> | <b>Description</b>                                                                                                                                           |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 320 x 240                                      | Output NTSC video with dimensions 320 pixels by 240 pixels. Scales the output to standard interchange format NTSC. Derived from CCIR 601 video (most often). |
| 720 x 480                                      | Output NTSC video with dimensions 720 pixels by 480 pixels. Scales the output to higher definition TV mode.                                                  |

| <b>Video Output Size Options For PAL Mode</b> | <b>Description</b>                                     |
|-----------------------------------------------|--------------------------------------------------------|
| 128 x 96                                      | Output video with dimensions 128 pixels by 96 pixels   |
| 176 x 144                                     | Output video with dimensions 176 pixels by 144 pixels. |
| 320 x 240                                     | Output video with dimensions 320 pixels by 240 pixels  |
| 720 x 576                                     | Output video with dimensions 720 pixels by 576 pixels  |

## **Output format**

Determines how the block represents color data in the output. Choose one of the following color representations according to what your model and algorithm require.



| Digital Output Format | Description                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RGB24                 | Output uses 8 bits each of red, green, and blue colors to represent the color of each pixel in the image. RGB color space is device-dependent.                                                                                                                                                                                                                   |
| YCbCr                 | Output from the block includes three channels to represent the color image data per pixel: <ul style="list-style-type: none"><li>• Y — the luma component (essentially a black/white signal)</li><li>• Cb — the blue-difference chroma component</li><li>• Cr — the red-difference chroma component</li></ul> This is the digital standard color space DVDs use. |
| Y                     | Black/White video. Does not contain color/chromaticity values.                                                                                                                                                                                                                                                                                                   |

## Data order

With data order, you control the way the video decoder stores and outputs video data fields and frames of images. Choose one of these options from the list.

- **Row major** — store video data in row major order. This is the default setting and matches most video data.
- **Column major** — store video data in column major order. The Simulink and MATLAB software use this format to store images and matrices.

# DM642 EVM Video ADC

---

DM642 EVM Video ADC blocks store the image data in row major format because most video capture devices use a scanning order of left-to-right and top-to-bottom, favoring the rows.

MATLAB and Simulink software use column major ordering to store image and matrix data. Therefore, some of the Simulink blocks may not work as expected with the DM642 EVM Video ADC blocks.

To address this problem, the Video ADC blocks include an option **Data order** to let you select either row major or the column major storage formats. By default, this block uses row major data format.

When you select **Column major**, the block performs an explicit transposition on the image data to map the data format from row major to column major order. To minimize the processor time spent on the transposition, the block uses optimized assembly routines to transpose the image data.

## **Inherit sample time**

Selecting **Inherit sample time** sets the sample time to  $-1$ . To use this block in a function call subsystem, you must select this option. **Inherit sample time** is cleared by default and the block uses the model sample time.

Specifying sample-time inheritance for a this block, a source block, can cause Simulink software to assign an inappropriate sample time to the block. You should avoid selecting **Inherit sample time** unless you are required to do so because you placed the block in a function call subsystem. When you select **Inherit sample time**, Simulink software displays a warning message when you update or simulate the model.

## **See Also**

DM642 EVM Video DAC

**Purpose** Video encoder to display video

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM



## Description

In the project generated from a model, this block provides the code to gather video from another block in the model, and direct the video stream to the video output port on the board.

You should input unsigned 8-bit integers to the block in the specified mode.

Adding this block to a model enables code generated from your model to perform the following tasks:

- 1 Capture digital video data from the application on your DM642 EVM.
- 2 Buffer the captured video into frames for NTSC display — two fields per frame and 30 frames per second, or SVGA display — RGB24 color with noninterlaced frames.
- 3 Convert to analog video.
- 4 Output the converted analog video to the EVM Video Out ports.

Unlike the DM642 EVM Video ADC block, this DAC block does not convert the video between formats. Nor does this block inherit settings from the DM642 EVM Video ADC block, as some of the other C6000 DAC blocks do.

The **Mode** option specifies both the video format the block accepts and the format the block outputs to the video output ports on the EVM.

To be able to be displayed, images that you send to the block should be equal to or smaller than the target display size. If the input images are smaller than the target display size, the block pads the image by adding zeros to the image.

When you add this block to your Simulink model, it does not alter your simulation — it outputs a string of zeros. In code generation, the block creates the device code used to buffer, convert, and send video to the output port on the EVM.

---

**Note** The DM642EVM board provides both composite and S-video connectors for output. However, these are driven simultaneously, so you do not need to specify which one is to be used.

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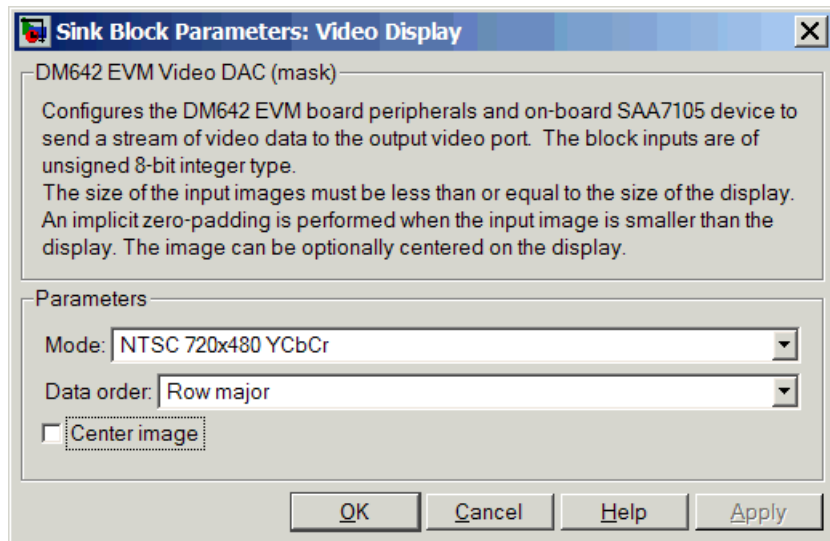
## Memory Use

This block allocates video capture buffers on the system heap, using a TI driver that allocates three frame buffers on the heap for continuous video capture. To use the block you must create a heap in external memory on the target with the label EXTERNALHEAP. If you do not create the heap, either using the default values in the Target Hardware Resources tab or setting your own values. Embedded Coder software returns an error.

Use **Create heap** and **Heap size** and set the heap size in the Target Hardware Resources tab to configure the heap. Select **Define label** and name the heap EXTERNALHEAP in **Heap label**.

The default settings for the Target Hardware Resources tab create a heap with enough memory to handle the worst case memory allocation needs automatically. If you configure the heap without enough memory, you get a run-time error because the system cannot initialize the video driver.

## Dialog Box



### Mode

Specifies the video format for the block. The block then sends video in this format to the video output port on the EVM. The **Mode** parameter offers the following options:

| Analog Output Mode | Description                                                                                                         |
|--------------------|---------------------------------------------------------------------------------------------------------------------|
| NTSC 720x480 YCbCr | Analog output of video data in 720-by-480 pixels format with full color.                                            |
| NTSC 640x480 Y     | Analog video output in 640-by-480 pixels format with black and white only (luminance). Does not contain color data. |
| SVGA 800x600 RGB24 | Full super VGA format 800-by-600 pixels with three color channels: 8-bit red, 8-bit green, and 8-bit blue data.     |

# DM642 EVM Video DAC

---

| Analog Output Mode | Description                                                                                                                     |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------|
| PAL 720x570 YCbCr  | Analog output of video data in 720-by-570 pixels PAL format with full color.                                                    |
| PAL 720 x 570 Y    | Analog output of video data in 720-by-570 pixels PAL format with black and white only (luminance). Does not contain color data. |

## Data order

With data order, you control the way the video decoder stores and outputs video data fields and frames of images. Choose one of these options from the list.

- **Row major** — store video data in row major order. This is the default setting and matches most video data.
- **Column major** — store video data in column major order. Simulink and MATLAB software use this format to store images and matrices.

DM642 EVM Video DAC blocks store the image data in row major format because most video display devices use a scanning order of left-to-right and top-to-bottom, favoring the rows.

MATLAB and Simulink software use column major ordering to store image and matrix data. Therefore, some of the Simulink blocks may not work as expected with the DM642 EVM Video DAC blocks.

To address this problem, the Video DAC blocks include an option **Data order** to let you select either row major or the column major storage formats. By default, these blocks use row major data format.

When the column major data ordering option is selected, the block performs an explicit transposition on the image data to map the data format from row major to column major order.

To minimize the processor time spent on the transposition, the block uses optimized assembly routines to accomplish the image transposition.

## **Center Image**

Directs the block to center the output image on the display. Centering the image requires some computation by the processor so there are small time and CPU cycles penalties for choosing this option. For that reason, **Center image** is cleared by default.

Another note of interest — some cameras pad their video output with zeros so that the display does not cut off the image on one side, usually the left. Images that include such padding may appear to be off-center on the display. In fact, while the displayed image may not appear centered, the electronic image (the data that compose the displayed image plus the padding which you cannot see) is centered in the display area.

## **See Also**

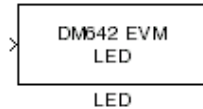
DM642 EVM Video ADC

# DM642 EVM LED

**Purpose** Control LEDs

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM

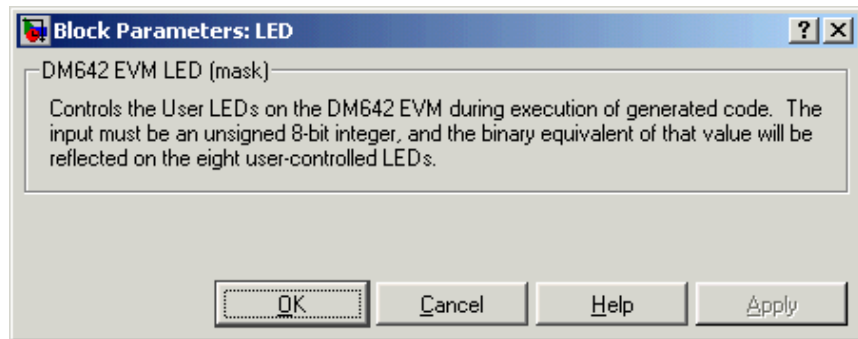
## Description



Controls the User LEDs on the DM642 EVM while the processor executes your generated code. To trigger the LEDs, input an unsigned 8-bit integer to the block. In response, the eight user-controlled LEDs reflect the binary equivalent of that input value — turning off an LED is 0 and turning on an LED is 1.

During operation, the LED block inherits the sample time from the upstream block in the model. Therefore, each time the model operation encounters the LED block, the block writes the desired output value to the LEDs.

## Dialog Box



You see the block does not provide user options. Adding the block to your model adds the ability to control the LEDs.

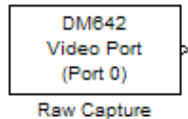


## Purpose

Video port to receive video data from video input port

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM



## Description

Adding this block to your model lets you define the format of raw video captured by the video port on the DM642 EVM. The block outputs video as a stream of image frames built from the defined input.

You can select the video port the block reads from, set the size of the input data in bits per pixel, and define the frame sizes in pixels and lines.

When your process captures standard video input, like NTSC format video, use the DM642 EVM Video ADC block instead of this one.

By default, the block settings define NTSC format input video to capture — 640 pixels wide by 480 lines tall using 8 bits per pixel.

The block does not check your inputs to determine whether they form valid frames. You must be sure the values you assign work for your application.

The block does not support video capture from port 2 on the EVM.

Blanking intervals, both horizontal and vertical, represent the time used for the scan to return to the starting point of the next line (the horizontal blanking period) or field or frame (the vertical blanking period).

## Memory Use

This block allocates video capture buffers on the system heap, using a TI driver that allocates three frame buffers on the heap for continuous video capture. To use the block you must create a heap in external memory on the target with the label EXTERNALHEAP. If you do not

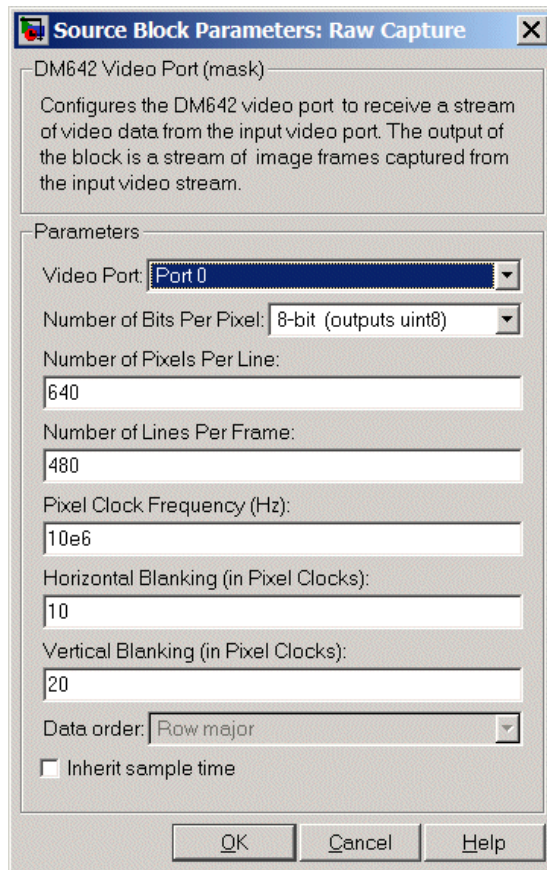
## DM642 EVM Video Port

---

create the heap, either using the default values in the Target Hardware Resources tab or setting your own values. Embedded Coder software returns an error.

Use **Create heap** and **Heap size** and set the heap size in the Target Hardware Resources tab to configure the heap. Select **Define label** and name the heap EXTERNALHEAP in **Heap label**.

The default settings for the Target Hardware Resources tab create a heap with enough memory to handle the worst case memory allocation needs automatically. If you configure the heap without enough memory, you get a run-time error because the system cannot initialize the video driver.



## Dialog Box

### Video Port

Select the video port to be the source of the raw video data stream. Either 0 or 1 appear on the list and 0 is the default port.

### Number of bits per pixel

Select the number of bits used to represent a pixel in the input video stream. List entries tell you the input pixel representation and the data type of the output pixels for each input size. You cannot enter values here. Select from the list.

**Number of pixels per line**

Configure the width of each video frame in pixels. Enter the pixel count as an integer greater than zero.

**Number of lines per frame**

Configure the height of a single frame of video in lines. Enter the number of lines as an integer greater than zero. Combined with the **Number of bits per pixel**, this specifies the video frame format.

**Pixel clock frequency**

Specify the rate at which picture elements (pixels) arrive at the block input. Usually you enter this in Hz using scientific notation as shown by the default value. You can enter the value in decimal notation as well.

**Horizontal blanking (in pixel clocks)**

The blanking signal that occurs at the end of each video scanning line. Enter the value as an integer number of pixels. One video line comprises the number of pixels in the line plus the horizontal blanking pixels.

**Vertical blanking (in pixel clocks)**

The blanking signal that occurs at the end of each video field or frame. Enter this value as an integer number of lines (pixels). One frame includes the number of lines in the height of the frame plus the additional blanking lines.

**Data order**

With this option you tell the encoder whether to output video in row major or column major order. Most video capture and display systems use row major ordering. MATLAB and Simulink software use column major order. As a result, some Simulink blocks and MATLAB operations may not produce the output you expect unless you change the ordering for video from the default row major setting to column major.

**Inherit sample time**

Selects whether the block inherits the sample time from the model base rate or Simulink base rate as determined in the

Solver options in Configuration Parameters. Selecting **Inherit sample time** directs the block to use the specified rate in model configuration. Entering -1 configures the block to accept the sample rate from the upstream HWI, Task, or Triggered Task blocks.

### **See Also**

DM642 EVM Video ADC, DM642 EVM Video DAC

# DM642 EVM Reset

---

**Purpose** Reset to initial conditions

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM642 EVM



**Description**

Reset

Double-clicking this block in a Simulink model window resets the DM642 EVM that is running the executable code built from the model. When you double-click the Reset block, the block runs the software reset function provided by CCS IDE that resets the processor on your DM642 EVM. Applications running on the board stop and the signal processor returns to the initial conditions you defined.

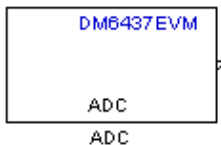
Before you build and download your model, add the block to the model as a stand-alone block. You do not need to connect the block to a block in the model. When you double-click this block in the block library it resets your DM642 EVM. In other words, anytime you double-click a DM642 EVM Reset block you reset your DM642 EVM.

**Dialog Box**

This block does not have settable options and does not provide a user interface dialog box.

**Purpose** Configure AIC33 audio codec to capture audio stream from LINE-IN or MIC

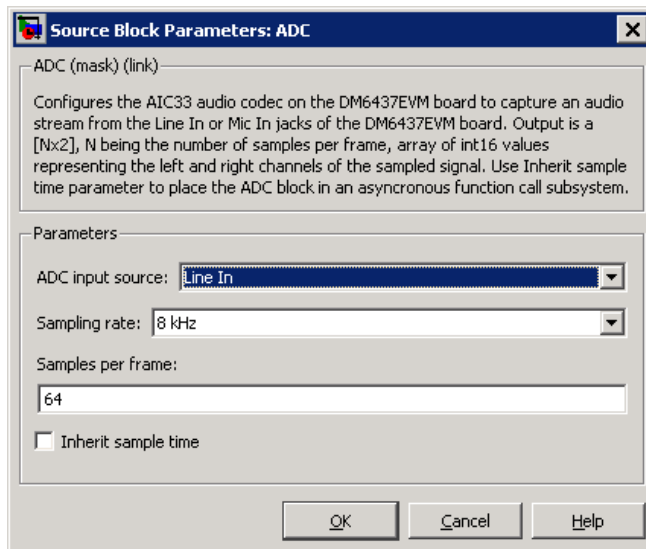
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM



**Description**

This block uses the AIC33 audio codec on the DM6437 EVM board to capture an analog audio stream from the **Line In** or **Mic** jacks and generate a digital frame-based output. Output is a [Nx2] array of int16 values representing the left and right channels of the sampled signal, where N is the number of samples per frame. Use the **Inherit sample time** parameter to place the ADC block in an asynchronous function call subsystem.

## Dialog Box



### ADC input source

Select **Line In** or **Mic In** as the input source.

### Sampling Rate

Set the sampling rate of the analog-to-digital converter, from 8 kHz (the default) to 96 kHz.

### Samples per frame

Set the number of samples the block buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to **64** samples per frame. The frame rate depends on the sample rate and frame size. For example, if **Sampling Rate** is 8 kHz, and **Samples per frame** is 32, the frame rate is 250 frames per second ( $8000/32 = 250$ ).

### Inherit sample time

Select whether the block inherits the sample time from the model base rate or Simulink base rate as determined in the Solver options in Configuration Parameters. Selecting **Inherit sample time** directs the block to use the specified rate in model



configuration. Entering -1 configures the block to accept the sample rate from the upstream HWI, Task, or Triggered Task blocks.

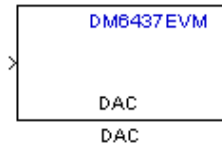
**See Also**      DM6437 EVM DAC

# DM6437 EVM DAC

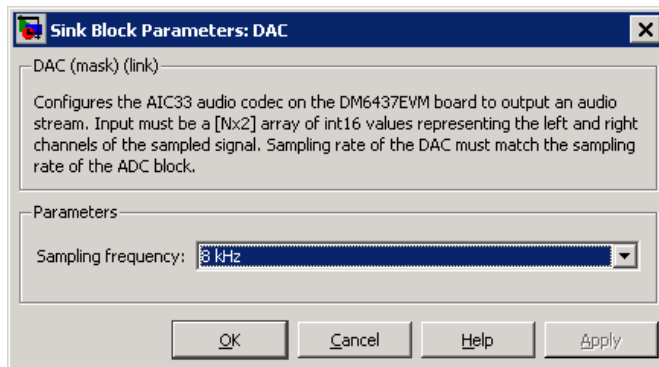
**Purpose** Configure AIC33 codec to convert digital signal to audio output on LINE OUT and HP OUT

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

## Description



Configure the AIC33 stereo codec on the DM6437 EVM board to convert a digital signal to an analog audio stream on the LINE OUT and HP OUT output jacks. The digital signal input must be an [Nx2] array of int16 values. Column 1 of the array is the left channel and column 2 is the right channel of the sampled signal. The sampling rate of the DAC output must match the sampling rate of the digital signal from the ADC.



## Dialog Box

### Sampling frequency

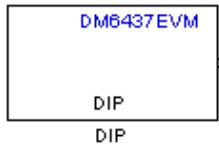
Select the sampling rate of the digital signal input. This value must match the **Sampling rate** of the ADC block in your model.

**See Also** DM6437 EVM ADC

**Purpose** Output state of user-selected DIP switch as Boolean

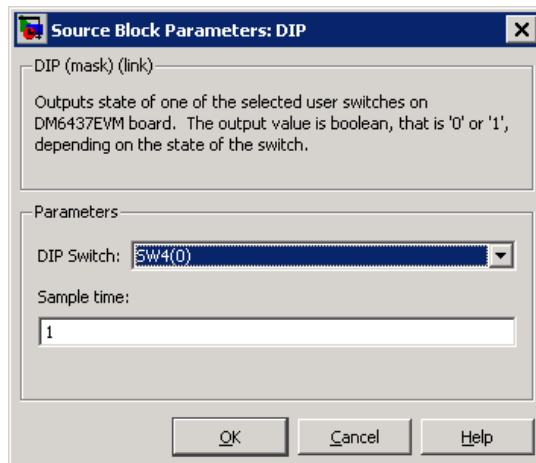
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

## Description



Outputs the state of a user-selected DIP switch or jumper on the DM6437 EVM board. The output is a Boolean value, 0 (open) or 1 (closed). Use multiple blocks to output the state of multiple DIP switches.

## Dialog Box



### DIP Switch

Select the switch or jumper to sample: SW4(0),SW4(1), SW4(2), SW4(3), JP1, SW7.

SW4 is a read-only user switch. JP1 is for NTSC/PAL selection. SW7 is a slide switch.

# DM6437 EVM DIP

---

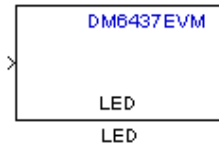
## **Sample time**

The interval between samples, in seconds. This value defaults to 1 second between samples.

**Purpose** Apply Boolean input to user-selected LED

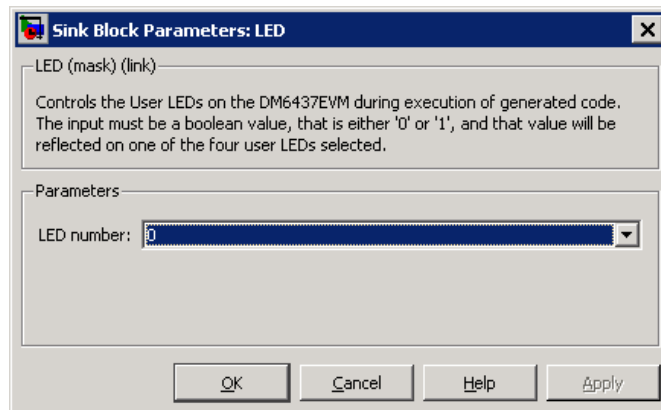
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

**Description**



This block controls an individual LED among the User LEDs on the DM6437 EVM during execution of generated code. The block input accepts Boolean values, 0 (off) or 1 (on). Use multiple blocks to control multiple LEDs.

**Dialog Box**



**LED number**

Specify the number of the User LED that the Boolean input controls.

# DM6437 EVM Video Capture

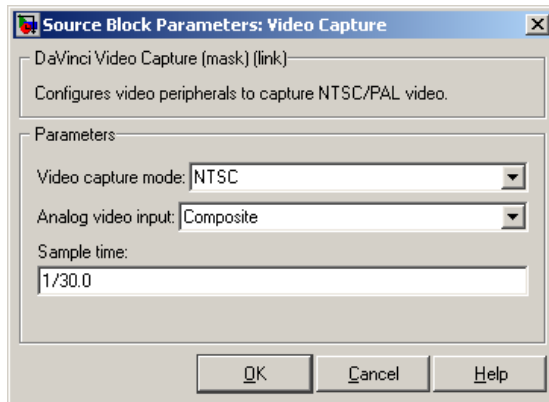
**Purpose** Configure video peripherals to capture NTSC/PAL video

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM



## Description

Configure the video peripherals to capture an NTSC/PAL video input and make it available as a stream of YCbCr 4:2:2 interleaved data.



## Dialog Box

### Video capture mode

Set the video format to match that of the input, **NTSC** or **PAL**.

### Analog video input

Set the input type to match that of the input, **Composite** or **S-video**.

### Sample time

Set a sample time rate that matches the frame rate of the input signal, typically 1/30 for NTSC and 1/25 for PAL. A mismatch

between these two rates may cause discontinuities in the video output signal.

**See Also**

DM643x Draw Rectangles, DM643x OSD, DM643x Video Display

# DM643x CAN Receive

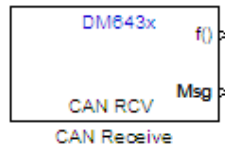
---

**Purpose** Receive messages from CAN serial communications bus on DM643x

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

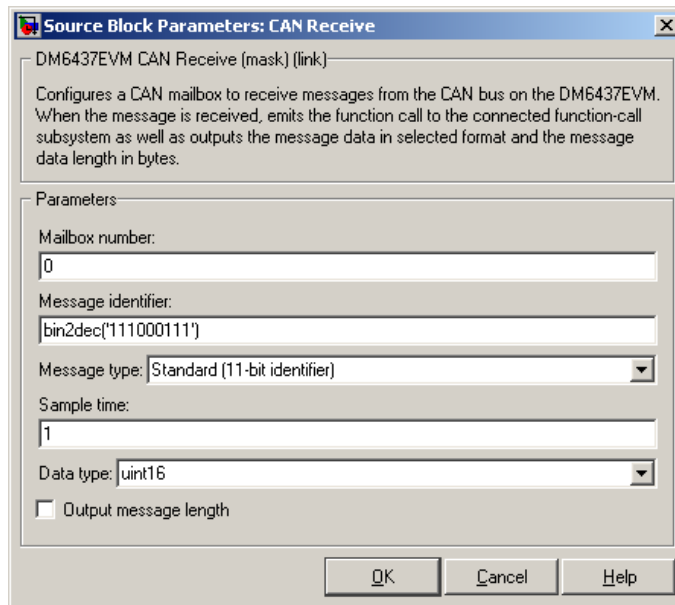
## Description



The CAN Receive block listens to broadcast messages on the DM643x CAN protocol bus. It saves messages with the user-specified **Message Identifier** to its message buffer. The CAN Receive block polls the message buffer at a rate determined by **Sample time**. When it detects a message in the message buffer, the block triggers the function-call output (f0) and makes the CAN message data available at the message output (Msg).



## Dialog Box



### Mailbox number

Enter a unique number from 0 to 15 for standard or from 0 to 31 for enhanced CAN mode. This field refers to a mailbox area in RAM. In standard mode, the mailbox number determines priority.

### Message identifier

Identifies the length of the message—11 bits for standard frame size or 29 bits for extended frame size in decimal, binary, or hex formats. If the format is binary or hex, use `bin2dec('')` or `hex2dec('')`, respectively, to convert the entry. The message identifier is associated with a receive mailbox. This mailbox only accepts messages that match the mailbox message identifier.

### Message type

Select Standard (11-bit identifier) or Extended (29-bit identifier).

# DM643x CAN Receive

---

## Sample time

Frequency with which the mailbox is polled to determine if a new message has been received. A new message causes a function call to be emitted from the mailbox. To update the message output only when a new message arrives, the block must be executed asynchronously. To execute this block asynchronously, set **Sample Time** to -1. Refer to “Asynchronous Scheduling” for a discussion of block placement and other settings.

For information about setting the timing parameters of the CAN module “Configuring Timing Parameters for CAN Blocks”.

## Data type

Type of data in the data vector. The length of the vector for the received message is, at most, 8 bytes. If the message is less than 8 bytes, the data buffer bytes are right-aligned in the output. Only `uint16` (vector length = 4 elements) or `uint32` (vector length = 8 elements) data are allowed. This block uses an 8-byte data buffer to unpack the data, as follows:

For `uint16` data,

```
Output[0] = data_buffer[1..0];
Output[1] = data_buffer[3..2];
Output[2] = data_buffer[5..4];
Output[3] = data_buffer[7..6];
```

For `uint32` data,

```
Output[0] = data_buffer[3..0];
Output[1] = data_buffer[7..4];
```

For example, if the received message has two bytes,

```
data_buffer[0] = 0x21
data_buffer[1] = 0x43
```

the `uint16` output would be:

```
Output[0] = 0x4321
Output[1] = 0x0000
Output[2] = 0x0000
Output[3] = 0x0000
```

### **Output message length**

Select this option to output the message length, in bytes, to the third output port. If you do not select this option, the block has only two output ports.

### **References**

For detailed information on the CAN module, see *TMS320DM643x DMP High-End CAN Controller User's Guide (Rev. A)*, Literature Number SPRU981, available at the Texas Instruments Web site.

### **See Also**

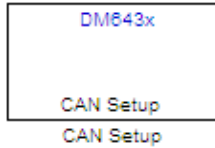
“Configuring Timing Parameters for CAN Blocks”, DM643x CAN Setup, DM643x CAN Transmit

# DM643x CAN Setup

---

**Purpose** Configure CAN serial communications bus parameters on DM643x

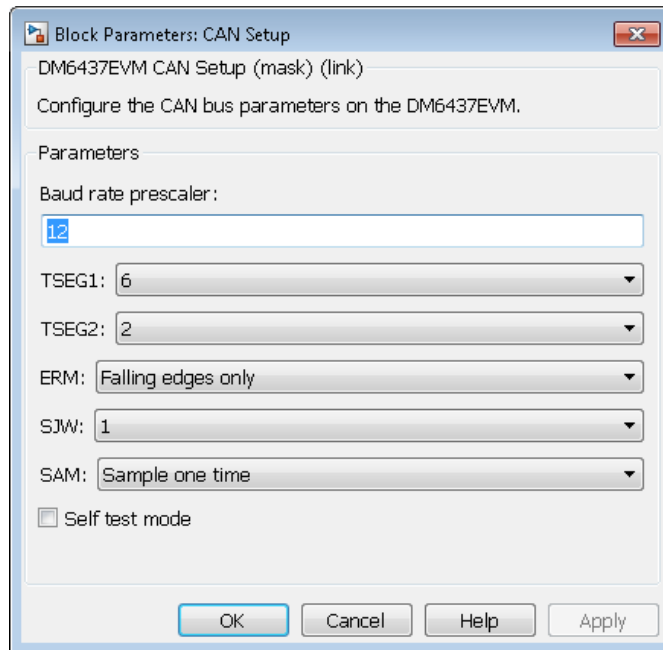
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM  
Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling



**Description**

This block configures the CAN serial communications bus parameters on the DM6437EVM. The “Configuring Timing Parameters for CAN Blocks” topic provides instructions and examples for configuring this block.

## Dialog Box



### Baud rate prescaler

Value by which to scale the bit rate. Valid values are 0 to 255.

### TSEG1

(Time SEGment 1) Sets the value of time segment 1, which, with **TSEG2** and **Baud rate prescaler**, determines the length of a bit on the CAN bus. Valid values for **TSEG1** are 2 through 16.

### TSEG2

(Time SEGment 2) Sets the value of time segment 2, which, with **TSEG1** and **Baud rate prescaler**, determines the length of a bit on the CAN bus. Valid values for **TSEG2** are 2 through 8.

### ERM

(Edge Resynchronization Mode) Sets the message resynchronization triggering. Options are **Falling edges only** and **Both falling and rising edges**.

# DM643x CAN Setup

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## **SJW**

(Synchronization Jump Width) For CAN to work, all nodes on the network must be synchronized. However, as time passes, clocks on different nodes drift out of sync, and must resynchronize.

**SJW** specifies the maximum width (in time quanta) that can be added to **TSEG1** (in the case of a slower transmitter), or subtracted from **TSEG2** (in the case of a faster transmitter) to regain synchronization during the receipt of a CAN message. Valid values for **SJW** are 1 to 4.

## **SAM**

(SAMple point setting) Number of samples used by the CAN module to determine the CAN bus level. Selecting **Sample one** time samples once at the sampling point. Selecting **Sample three** times samples once at the sampling point and twice before at a distance of TQ/2 (Time Quanta/2). A majority decision is derived from the three points.

## **Self test mode**

Puts the CAN module into loop back mode, that sends a dummy acknowledge message without requiring an acknowledge bit.

## **References**

For detailed information on the CAN module, see *TMS320DM643x DMP High-End CAN Controller User's Guide (Rev. A)*, Literature Number SPRU981, available at the Texas Instruments Web site.

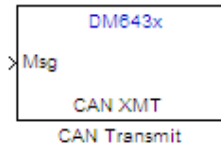
## **See Also**

“Configuring Timing Parameters for CAN Blocks”, DM643x CAN Transmit, DM643x CAN Receive

**Purpose** Configure CAN mailbox to transmit messages on CAN serial communications bus on DM643x

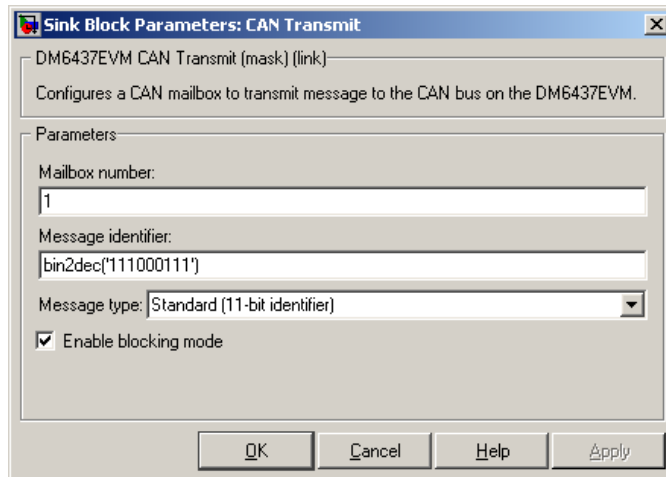
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling



## Description

The CAN Transmit block receives messages through the message input (Msg) and broadcasts them to the CAN serial communication bus on the DM643x.



## Dialog Box

### Mailbox number

Sets the value of the mailbox number register (MBNR). For standard CAN controller (SCC) mode, enter a unique number

# DM643x CAN Transmit

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from 0 to 15. For high-end CAN controller (HECC) mode enter a unique number from 0 to 31 . In SCC mode, transmissions from the mailbox with the highest number have the highest priority. In HECC mode, the mailbox number only determines priority if the Transmit priority level (TPL) of two mailboxes is equal.

## Message identifier

Sets the value of the message identifier register (MID). The message identifier is 11 bits long for standard frame size or 29 bits long for extended frame size in decimal, binary, or hex format. For the binary and hex formats, use `bin2dec(' ')` or `hex2dec(' ')`, respectively, to convert the entry.

## Message type

Select Standard (11-bit identifier) or Extended (29-bit identifier).

## Enable blocking mode

If you enable blocking mode, the CAN block code blocks further transmissions indefinitely until it receives a transmit acknowledge (TA bit in the CANTA register = 1). If you disable blocking mode, the CAN block code continues transmitting without receiving transmit acknowledgements. This is useful when the hardware might fail to acknowledge transmissions.

## References

For detailed information on the CAN module, see *TMS320DM643x DMP High-End CAN Controller User's Guide (Rev. A)*, Literature Number SPRU981, available at the Texas Instruments Web site.

## See Also

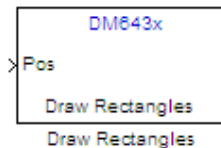
“Configuring Timing Parameters for CAN Blocks”, DM643x CAN Setup, DM643x CAN Receive



**Purpose** Configure Video Processing Back End to draw rectangles using On Screen Display (OSD) module

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

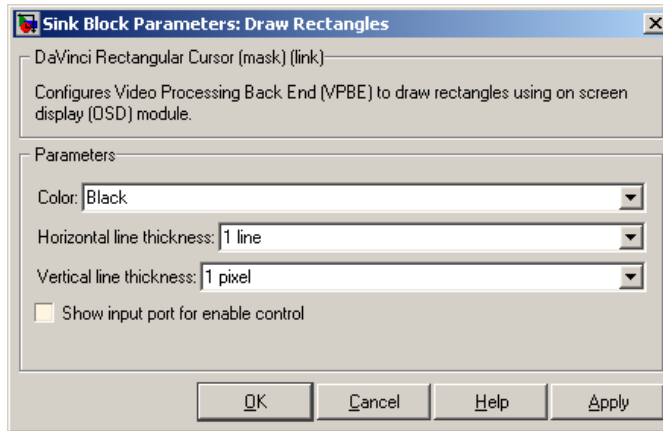


## Description

This block configures the Video Processing Back End (VPBE) to draw and position rectangles using the On Screen Display (OSD) module. The position input (**Pos**) is a 1x4 vector, designates the location of the upper-left corner of the rectangle. The position coordinates (0,0) originate in the upper-left corner of the video display.

# DM643x Draw Rectangles

## Dialog Box



### Color

Select the rectangle color. For **Specify via dialog**, enter an integer between 0–255. This integer specifies a corresponding RGB color in the DM643x ROM0 color lookup table (DM643x ROM0 CLUT). If you select **Specify via input port**, the block displays an additional input port, Color. Like **Specify via dialog**, the Color input takes an integer between 0–255 that fetches a color from the DM643x ROM0 CLUT. Changing the input value to the Color input port can change the color of the rectangle while the model is running.

# DM643x Draw Rectangles

DM643x ROM0 color lookup table

|    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|    | 16 | 32 | 48 | 64 | 80 | 96  | 112 | 128 | 144 | 160 | 176 | 192 | 208 | 224 | 240 |
| 1  | 17 | 33 | 49 | 65 | 81 | 97  | 113 | 129 | 145 | 161 | 177 | 193 | 209 | 225 | 241 |
| 2  | 18 | 34 | 50 | 66 | 82 | 98  | 114 | 130 | 146 | 162 | 178 | 194 | 210 | 226 | 242 |
| 3  | 19 | 35 | 51 | 67 | 83 | 99  | 115 | 131 | 147 | 163 | 179 | 195 | 211 | 227 | 243 |
| 4  | 20 | 36 | 52 | 68 | 84 | 100 | 116 | 132 | 148 | 164 | 180 | 196 | 212 | 228 | 244 |
| 5  | 21 | 37 | 53 | 69 | 85 | 101 | 117 | 133 | 149 | 165 | 181 | 197 | 213 | 229 |     |
| 6  | 22 | 38 | 54 | 70 | 86 | 102 | 118 | 134 | 150 | 166 | 182 | 198 | 214 | 230 | 246 |
| 7  | 23 | 39 | 55 | 71 | 87 | 103 | 119 | 135 | 151 | 167 | 183 | 199 | 215 | 231 | 247 |
| 8  | 24 | 40 | 56 | 72 | 88 | 104 | 120 | 136 | 152 | 168 | 184 | 200 | 216 | 232 | 248 |
| 9  | 25 | 41 | 57 | 73 | 89 | 105 | 121 | 137 | 153 | 169 | 185 | 201 | 217 | 233 | 249 |
| 10 | 26 | 42 | 58 | 74 | 90 | 106 | 122 | 138 | 154 | 170 | 186 | 202 | 218 | 234 | 250 |
|    | 27 | 43 | 59 | 75 | 91 | 107 | 123 | 139 | 155 | 171 | 187 | 203 | 219 | 235 | 251 |
|    | 28 | 44 | 60 | 76 | 92 | 108 | 124 | 140 | 156 | 172 | 188 | 204 | 220 | 236 | 252 |
|    | 29 | 45 | 61 | 77 | 93 | 109 | 125 | 141 | 157 | 173 | 189 | 205 | 221 | 237 | 253 |
|    | 30 | 46 | 62 | 78 | 94 | 110 | 126 | 142 | 158 | 174 | 190 | 206 | 222 | 238 | 254 |
|    | 31 | 47 | 63 | 79 | 95 | 111 | 127 | 143 | 159 | 175 | 191 | 207 | 223 | 239 | 255 |

For more information about the DM643x ROM0 CLUT, enter the following text at the MATLAB command prompt:

```
help 'dm643x_clut'
```

### **Horizontal line thickness**

Select the cursor height in lines.

### **Vertical line thickness**

Select the cursor width in pixels.

### **Show input port for enable control**

Create an input port (**En**) that can be used to enable or disable the position input.

## **See Also**

DM643x OSD, DM643x Video Capture, DM643x Video Display

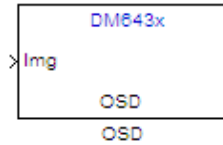
# DM643x OSD

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**Purpose** Overlay graphics and text on video

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM  
Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

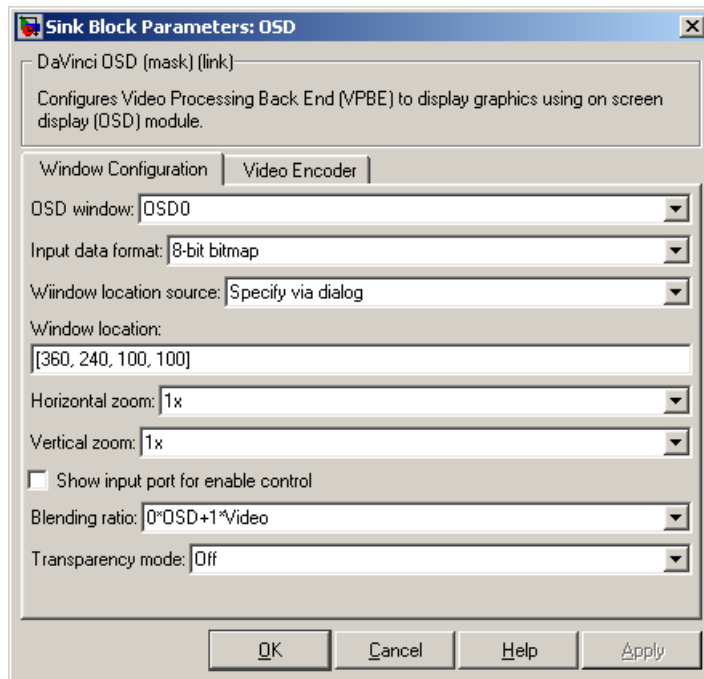
**Description**



Use the On Screen Display (OSD) capabilities of the Video Processing Back End (VPBE) to overlay graphics and text on video.

## Dialog Box

### Window Configuration Pane



#### OSD window

Display graphics using OSD window 0 or 1.

#### Window Mode

If you set **OSD Window** to **OSD1**, the **Window Mode** parameter appears. Selecting **Display** configures OSD1 to display graphics. Selecting **Attribute** configures OSD1 to serve as an “alpha” input for controlling the transparency of OSD0. The positions of the two OSD windows must match for this to work.

#### Input data format

Set the format of the input data to 1-, 2-, 4-, 8-bit bitmap, or RGB565 which provides 16-bit color depth (64k colors).

Due to bandwidth constraints, RGB565 can only be used with one OSD window at a time. If you are using OSD1 to control transparency (i.e., OSD1 **Window Mode** is **Attribute**), get the best color depth by setting OSD1 **Input data format** to one of the bitmap settings and OSD0 **Input data format** to **RGB565**.

## Window location source

Select the method for setting the location of the graphics display window. **Specify via dialog** creates the **Window location** field. **Specify via input port** creates an position input (**Pos**) on the OSD block which accepts the location of the window as data.

## Window location

This parameter appears when you set **Window location source** to **Specify via dialog**. Set the pixel width, height, and base coordinates. For example, the default values, [360, 240, 100, 100] set the width to 360 pixels, the height to 240 pixels, the base coordinates for x to 100 pixels, and the base coordinates for y to 100 pixels.

---

**Note** [0, 0], the origin of the coordinate system, is the located in the upper-left corner of the Video0 window.

---

## Horizontal zoom

Set the horizontal magnification of the graphics display window. Selecting **Specify via input port** creates a zoom input (**Zoom**) on the OSD block.

## Vertical zoom

Set the vertical magnification of the graphics display window. Selecting **Specify via input port** creates a zoom input (**Zoom**) on the OSD block.

## Show input port for enable control

Create an input port (**En**) to enable or disable the OSD graphics display window. This parameter is not available when **Window Mode** is **Attribute**.

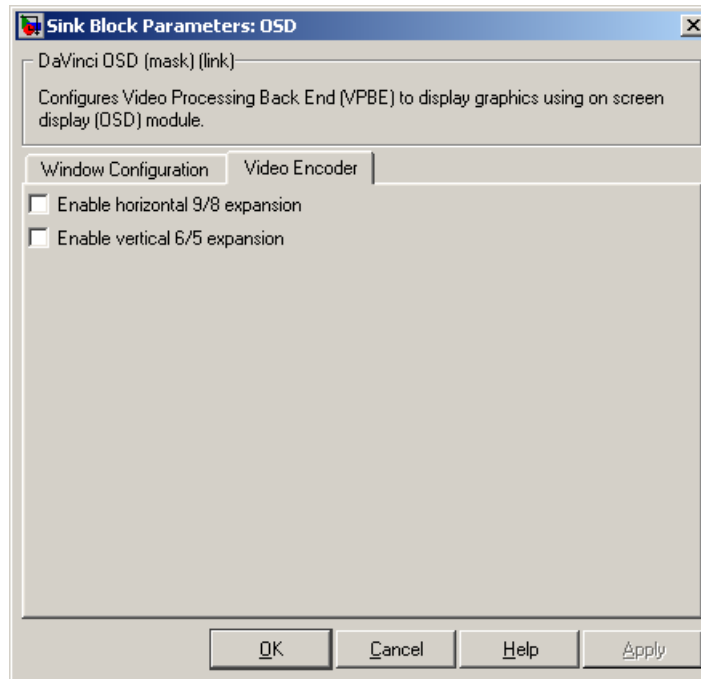
## **Blending ratio**

Control the degree of blending between the OSD graphics display window and the Video display window in the background. This can be used to superimpose a semitransparent OSD graphic on a video background or to create fade-in and fade-out effects. The settings range from full OSD to full video in steps of 1/8. An additional setting, **Specify via input port**, creates an input port (**Blend**) for changing the ratio dynamically.

## **Transparency mode**

Turn the transparency mode of the graphics display window **On** or **Off**, or select **Specify via input port** to create an input (**Trans**) on the OSD block. With transparency enabled, OSD pixels that match the color of the Video background color are rendered transparent. This is used for typical “bluescreen” type effects.

## Video Encoder Pane



### Enable horizontal 9/8 expansion

Expands the image horizontally and is typically used to compensate for spatially compressed NTSC and PAL video signals. For example, you can use this setting to adjust a 720 x 480 pixel NTSC analog video input that is displayed as a 640 x 480 pixel image.

### Enable vertical 6/5 expansion

Expands the image vertically and is typically used to compensate for spatially compressed PAL video signals. For example, you can use this setting in combination with the **Enable horizontal 9/8 expansion** setting to adjust a 720 x 576 pixel PAL analog video input that is displayed as a 640 x 480 pixel image.



**See Also**

DM643x Draw Rectangles, DM643x Video Capture, DM6437 EVM  
Video Capture, DM643x Video Display

# DM643x PWM

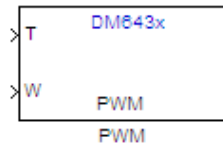
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**Purpose** Configure DM643x DSP Event Manager to generate PWM waveforms

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

## Description



This block configures one of the three PWM modules on the DM6437; each module has one output. The PWM module's clock cycles depend on the DM6437's 27 MHz input clock, and are not affected by the DM6437's PLL module. Upon startup, the PWM module uses the **Initial waveform period** and **Initial duty-cycle** values. Inputs to the waveform period port, **T**, and the duty-cycle port, **W**, can change those values while the application is running.

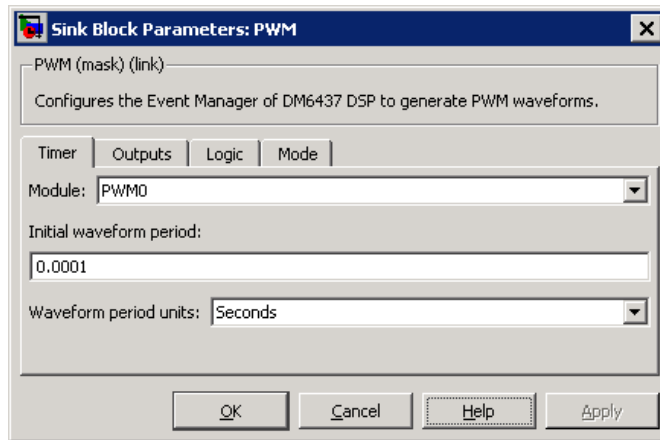
## Dialog Box

The PWM block dialog box comprises four tabs:

- **Timer** — Select the PWM module, and configure the initial waveform.
- **Outputs** — Configure the initial duty cycle.
- **Logic** — Configure the control logic.
- **Mode** — Configure one-shot or continuous operation.

The following sections describe the contents of each tab in the dialog box.

## Timer



### Module

Select the PWM module for this block. All the parameter settings in this block configure the registers of the PWM module selected.

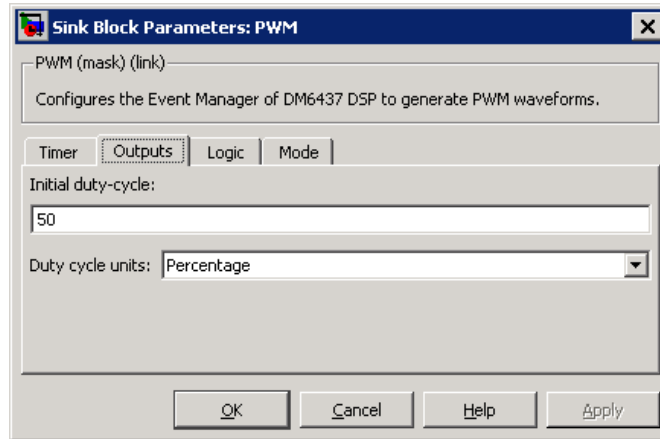
### Initial waveform period

Set the initial period of the PWM waveform. The waveform period applied at the input port, **T**, changes this value. The range of acceptable values is 0.000000296 to 79.536431370 seconds or 8 to  $2^{31}-1$  clock cycles. These ranges depend on the 27 MHz clock frequency and the width of the 32-bit register.

### Waveform period units

Set the unit of measure of the waveform period to **Seconds** or **Clock cycles**. This setting applies to both the **Initial waveform period** and the waveform period input, **T**. Clock cycles depend on the DM6437's 27 MHz input clock.

## Outputs



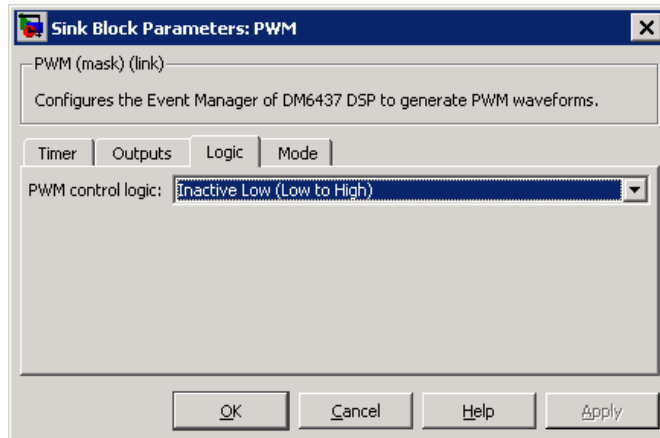
### Initial duty-cycle

Set the initial duty-cycle of the PWM. The duty-cycle applied at the input port, **W**, changes this value. The range of acceptable values is 0 to 100 percent or 8 to  $2^{31}-1$  clock cycles. These ranges depend on the 27 MHz clock frequency and the width of the 32-bit register.

### Duty-cycle units

Set the unit of measure of the duty-cycle to percentage or clock cycles. This setting applies to both the **Initial duty-cycle** and the duty-cycle input, **W**. Clock cycles depend on the DM6437's 27 MHz input clock.

## Logic

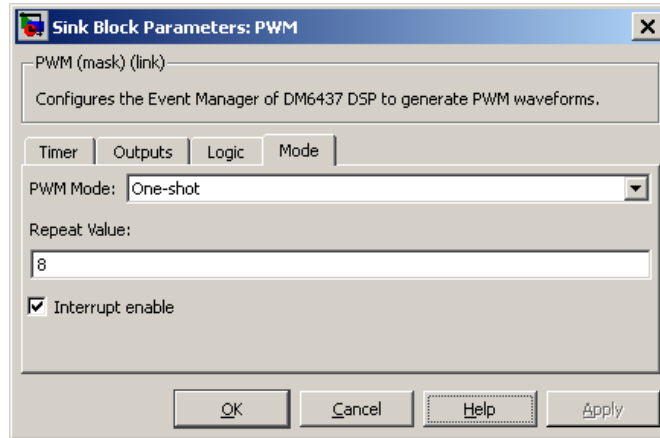


### PWM control logic

Control the state of the PWM output while it is inactive and the polarity of the PWM waveform when it is active:

- **Inactive Low (Low to High):** When the PWM output is inactive, the output remains low. When it is active, the first phase is low, and the second phase is high.
- **Inactive Low (High to Low):** When the PWM output is inactive, the output remains low. When it is active, the first phase is high, and the second phase is low.
- **Inactive High (Low to High):** When the PWM output is inactive, the output remains high. When it is active, the first phase is low, and the second phase is high.
- **Inactive High (High to Low):** When the PWM output is inactive, the output remains high. When it is active, the first phase is high, and the second phase is low.

## Mode



### PWM Mode

Set the mode to one-shot or continuous. One-shot repeats the waveform for the number of periods given by repeat value and then, if interrupts are enabled, generates an interrupt at the end of operation. Continuous repeats the waveform infinitely and generates an interrupt, if enabled, every period.

### Repeat Value

Set the repeat value if **PWM Mode** is set to **One-shot**. The PWM module outputs the waveform the specified number of times +1.

### Interrupt enable

Enable the PWM module to generate an interrupt.

In one-shot mode, the PWM module generates an interrupt when number of periods given by **Repeat value** have been completed.

In continuous mode, the PWM module generates an interrupt during each period signaling that it is okay to set values for the subsequent waveform period and duty cycle.

## References

For detailed information on the PWM module, see *TMS320DM643x DMP Pulse-Width Modulator (PWM) Peripheral User's Guide*, Literature Number SPRU995, available at the Texas Instruments Web site.

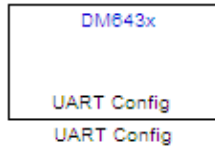
# DM643x UART Config

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**Purpose** Configure DM643x UART for serial communication

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM



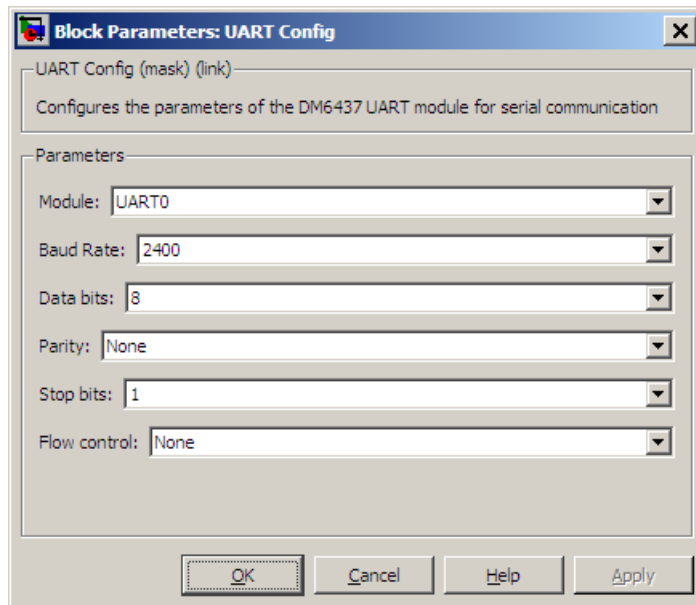
**Description**

Configure the serial communication parameters that are common to the transmit and receive elements of the DM643x UART module. If your model contains a DM643x UART Transmit block or a DM643x UART Receive block, it must also contain a DM643x UART Config block.

The UART module converts data between parallel and serial formats depending on whether it is transmitting or receiving data from external peripheral devices. Except for the **Module** parameter, configure all of the parameters in this block so they match the serial communication settings of the external peripheral devices.



## Dialog Box



### Module

Select the UART module this block configures, UART0 or UART1. Your model can only contain one DM643x UART Config block per module.

### Baud rate

Set the rate of signal modulations per second. Choose from 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

### Data bits

Set the number of data bits in the character frame, from 5, 6, 7, or 8.

### Parity

Enable and configure parity error detection.

In parity error detection, the transmitter reserves a parity bit at the end of the character frame, adds the number of 1's in the data

# DM643x UART Config

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bits, and assigns a value to the parity bit. The receiver compares the number of 1's in the data bits with the value of the parity bit. If the two values don't match, the receiver signals the transmitter that an error has occurred.

- **None** disables parity error detection. The character frame does not include a parity bit.
- **Odd** enables parity error detection and reserves a parity bit at the end of the character frame. If the data bits contain an odd number of 1's, the method assigns a value of 0 to the parity bit.
- **Even** enables parity error detection and reserves a parity bit to the end of the character frame. If the data bits contain an even number of 1's, the method assigns a value of 0 to the parity bit.

## Stop bits

Select 1 or 2.

## Flow control

Select None or Hardware.

## References

For detailed information on the UART module, see *TMS320DM643x DMP Universal Asynchronous Receiver/Transmitter (UART) User's Guide*, Literature Number: SPRU997, available at the Texas Instruments Web site.

## See Also

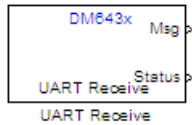
DM643x UART Receive, DM643x UART Transmit

**Purpose** Configure receiver element of DM643x UART module for serial communication

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

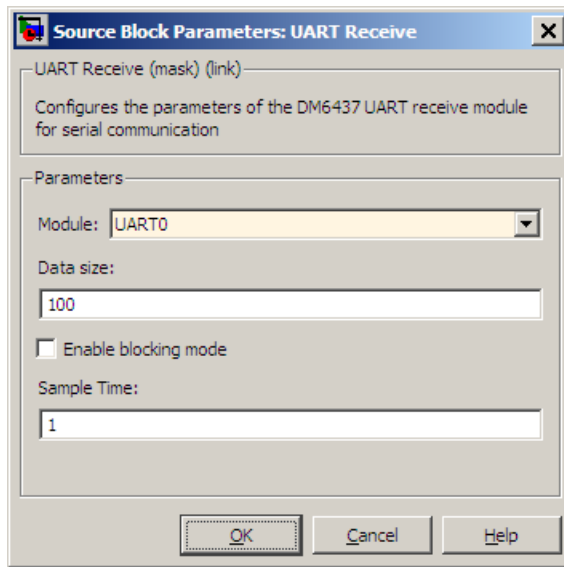
**Description**



Configure the serial communication parameters of the receiver element of the DM643x UART module. The receiver element converts data from external peripheral devices from serial to parallel format and passes it to the CPU. If your model contains a DM643x UART Receive block, it must also contain a DM643x UART Config block.

# DM643x UART Receive

## Dialog Box



### Module

Select the UART module this block configures, **UART0** or **UART1**. Your model can only contain one DM643x UART Receive block per module. This parameter must also match the **Module** parameter in the DM643x UART Config block.

### Data size

Set the data size, in bytes, of each transmission. Blocking mode uses this parameter to determine whether to generate an error.

### Enable blocking mode

Enable this parameter to generate an error if the size of the last data transmission does not match the value of the **Data size** parameter. The DM643x UART Receive block sends the error message as a negative value on its **Status** output. If you disable **Enable blocking mode**, the block sends the number of bytes it received as a positive value on its **Status** output.

## Sample time

Set the sample time for the block's input sampling. To execute this block asynchronously, set **Sample Time** to -1, and refer to "Asynchronous Scheduling" for a discussion of block placement and other settings.

## References

For detailed information on the UART module, see *TMS320DM643x DMP Universal Asynchronous Receiver/Transmitter (UART) User's Guide*, Literature Number: SPRU997, available at the Texas Instruments Web site.

## See Also

DM643x UART Config, DM643x UART Transmit

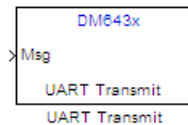
# DM643x UART Transmit

**Purpose** Configure transmitter element of DM643x UART module for serial communication

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

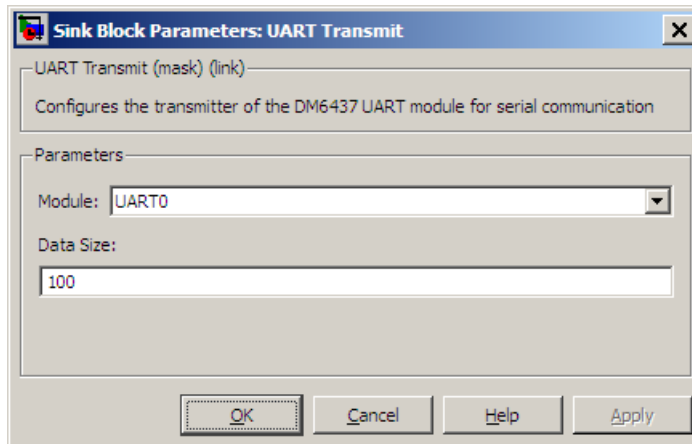
Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM

## Description



Configure the serial communication parameters of the transmitter element of the DM643x UART module. If your model contains a DM643x UART Receive block, it must also contain a DM643x UART Config block. The transmitter element converts parallel data from the CPU to a serial data format for output to external peripheral devices.

## Dialog Box



## Module

Select the UART module this block configures, UART0 or UART1. Your model can only contain one DM643x UART Transmit

block per module. This parameter must also match the Module parameter in the DM643x UART Config block.

**Data size**

Set the number of bytes to send per transmission.

**References**

For detailed information on the UART module, see *TMS320DM643x DMP Universal Asynchronous Receiver/Transmitter (UART) User's Guide*, Literature Number: SPRU997, available at the Texas Instruments Web site.

**See Also**

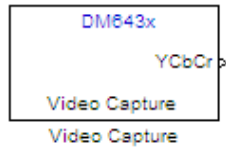
DM643x UART Config, DM643x UART Receive

# DM643x Video Capture

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**Purpose** Configure Video Processing Front End (VPFE) to capture REC656 or generic YCbCr 4:2:2 video

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

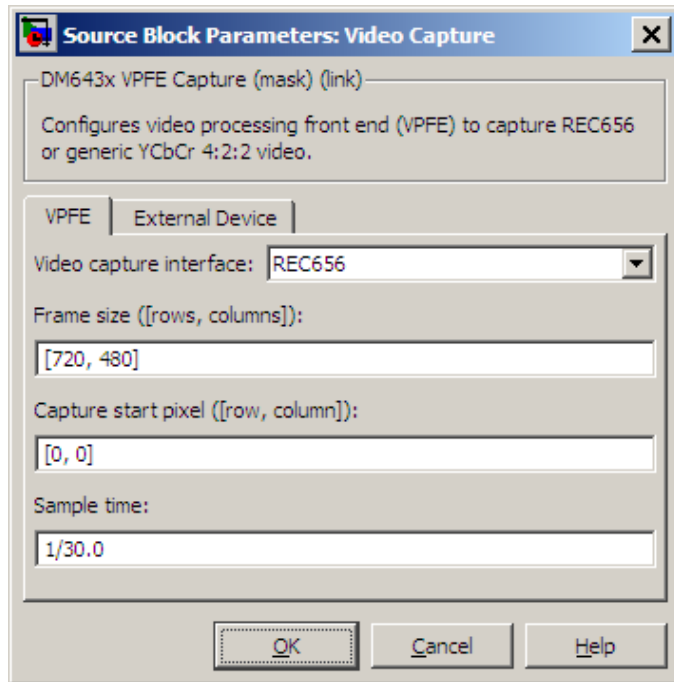


**Description** Configure the video processing front end (VPFE) to capture NTSC or PAL video.



## Dialog Box

### VPFE



### Video capture interface

Configure this parameter to match the format of the input signal using either the **REC656** or **Generic YCbCr-4:2:2** option. The **REC656** format is also known to as ITU-R BT.656 or CCIR-656 and comprises an 8-bit YCbCr 422 input signal. **Generic YCbCr-4:2:2** comprises an 8-bit signal with discrete horizontal (H) and vertical (VSYNC) signals, such as a computer monitor signal.

### Data input mode

When **Video capture interface** is set to **Generic YCbCr-4:2:2**, set this parameter depending on the number of pins used by the physical interface. If the physical interfaces uses pins 0–8, select

# DM643x Video Capture

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**8-bit.** If the physical interface uses pins 0–15, use **16-bit**. When you select **16-bit**, the lower 8 pins capture Y and the upper 8 pins capture the C (chroma) components.

For more information, refer to *Table 1. Interface Signals for Video Processing Front End* in the *TMS320DM643x DMP Video Processing Front End (VPFE) User's Guide*, Literature Number: SPRU977, available on the Texas Instruments Web site.

## Scan mode

If you set **Video capture interface** to **Generic YCbCr-4:2:2**, set **Scan mode** to match the scan mode of the input signal, **Interlaced** or **Progressive**. Regardless of the setting, the block outputs an interleaved YCbCr 422 signal, which you can deinterleave using the C6000 Deinterleave block.

---

**Note** If you set **Scan mode** to **Interlaced**, verify that the Field ID signal is connected to the input pin for this video capture driver to work as expected.

---

## Frame size

Define the size of the capture frame. You can use this parameter to capture the entire input frame or to capture just a portion of it. The minimum value must be greater than zero. The maximum value is the size of the input frame. Enter the row and column dimensions of the capture frame in pixels. For example, entering [740, 480] sets the row width to 740 pixels, and the column height to 480 pixels.

## Capture start pixel

Set the location of the capture frame relative to the display frame, using the upper-left corners of both frames (e.g., [0, 0]) as the point of reference. You can position the start pixel anywhere in the input frame. Enter the row and column dimensions of the Capture start pixel in pixels. For example, entering [10, 20]

positions the upper-left corner of the capture frame at row 10, column 20 from the upper-left corner of the display frame.

The combination of the **Frame size** and **Capture start pixel** parameters may place the capture frame outside the display frame. If so, the portions of the capture frame that lie outside the display frame capture null video data (black screen) without generating an error.

### **Sample time**

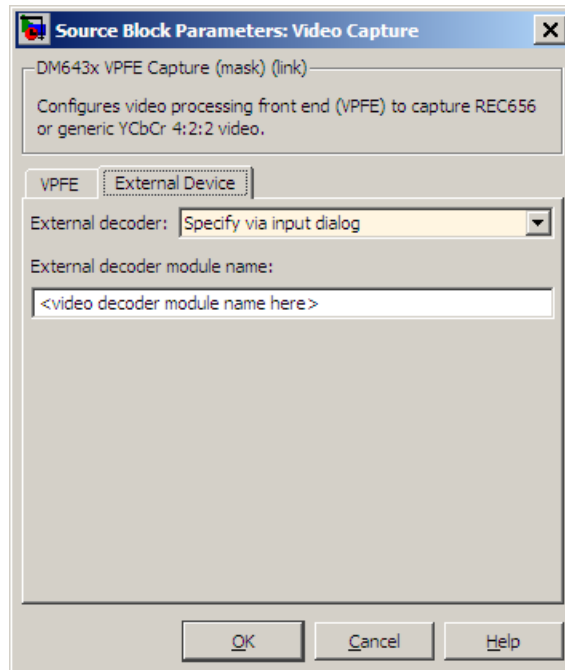
Set the sampling rate of the video capture frame. Enter **Sample time** as a fraction of 1 over the sample rate per second. For example, to obtain a sample rate of 30 frames per second, enter  $1/30.0$ . NTSC has a typical frame rate of  $1/30$ , while PAL usually requires  $1/25$ .

You can set this parameter to match the frame rate of the input signal, or you can use it to downsample the input signal. For example, sampling a  $1/30$  input at  $1/15$  halves the data throughput of the signal.

Setting the sample time to a different value from the input signal refresh rate may cause discontinuities in the video image. Avoid exceeding the sample rate of the input signal.

# DM643x Video Capture

## External Device



The **External Device** tab enables you to connect a video device with an external video decoder to the VPFE. When you specify the external coder, you create hookpoints in the VPFE driver initialization code for opening the external video decoder, starting the data output, and closing the external video decoder. The external decoder plugs into the following function pointers:

- EVD\_Handle (\*Open)()
- Int (\*Close)(Ptr handle)
- Int (\*Control)(Ptr handle, Uint32 Cmd, Ptr CmdArg)

For example, if you were to enter “PSP\_VPFE\_TVP5146” for **External decoder module name**, you would declare the following functions as shown:

```
// External device open function
EVD_Handle PSP_VPFE_TVP5146_Open(void);
// External device close function
Int PSP_VPFE_TVP5146_Close(EVD_Handle handle);
// External device control function
Int PSP_VPFE_TVP5146_Control(EVD_Handle handle, Uint32 Cmd, Ptr CmdArg);
```

The VPFE driver also assumes that a user structure named `TVP5146_ConfigParams` and a variable called `PSP_VPFE_TVP5146_params` exists to pass to the `PSP_VPFE_TVP5146_Control` function. In other words, there must be a declaration like the following:

```
typedef struct _PSP_VPFE_TVP5146_ConfigParams
{
 int dummy; // User defined fields
} PSP_VPFE_TVP5146_ConfigParams;
TVP5146_ConfigParams PSP_VPFE_TVP5146_params;
```

You must use the custom code interface to add the header file that declares function prototypes and the source files that contain the implementation of the `_Open`, `*_Close` and `*_Control` functions to the generated project.

## External decoder

If your target is connected to a video device that outputs a RAW video signal and relies on the DM643x VPFE's built-in decoder, select **None**. If your target is connected to a video device with a decoder that outputs REC656 or generic YCbCr-4:2:2, select **Specify via input dialog**.

# DM643x Video Capture

---

## **External decoder module name**

If you set the **External decoder** to Specify via input dialog, then enter a name for the external video decoder module name in this field.

## **See Also**

DM643x Draw Rectangles, DM643x OSD, DM643x Video Display

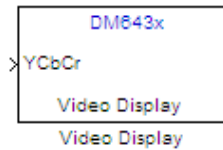
## **References**

*TMS320DM643x DMP Video Processing Front End (VPFE) User's Guide*, Literature Number: SPRU977, available from the Texas Instruments Web site.

**Purpose** Configure Video Processing Back End to display NTSC/PAL video

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM6437 EVM  
Embedded Coder Support Package for Texas Instruments C6000 Processors/ Scheduling

## Description



This block configures the Video Processing Back End (VPBE) to display NTSC/PAL video.

## Dialog Box

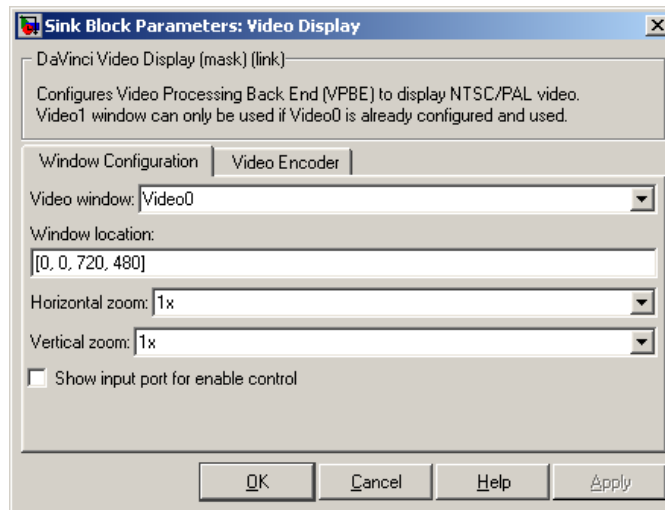
The block dialog box comprises multiple tabs:

- **Window Configuration** — Configure the video window, position, zoom, and whether to display the input port.
- **Video Encoder** — Configure the video display mode, analog video output, and horizontal or vertical expansion.

The dialog box images show all of the available parameters enabled. Some of the parameters shown do not appear until you select one or more other parameters.

# DM643x Video Display

## Window Configuration



### Video window

Create a video display window, **Video0** or **Video1**.

You must create a **Video0** display window before you can use the following video elements:

- a Video1 video display window from the DM643x Video Display block
- an on-screen display from the DM643x OSD block
- a video rectangle from the DM643x Draw Rectangles block

### Window location source

Select the method for setting the location of the graphics display window. **Specify via dialog** creates the **Window location** field. **Specify via input port** creates an position input (Pos) on the OSD block which accepts the location of the window as data.



## Window location

This parameter appears when you set **Window location source** to **Specify via dialog**. Set the pixel width, height, and base coordinates. For example, the default values, [360, 240, 100, 100] set the width to 360 pixels, the height to 240 pixels, the base coordinates for x to 100 pixels, and the base coordinates for y to 100 pixels.

---

**Note** [0, 0], the origin of the coordinate system, is the located in the upper-left corner of the Video0 window.

---

## Horizontal zoom

Set the horizontal magnification of the graphics display window. Selecting **Specify via input port** creates a zoom input (**Zoom**) on the video display block.

## Vertical zoom

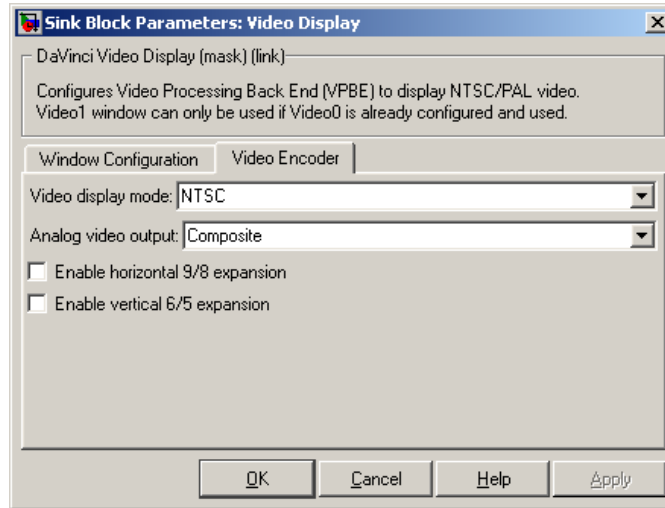
Set the vertical magnification of the graphics display window. Selecting **Specify via input port** creates a zoom input (**Zoom**) on the video display block.

## Show input port for enable control

Create an input port (**En**) to enable or disable the video display window.

# DM643x Video Display

## Video Encoder Pane



### Video output mode

Set the output mode to **Analog** or **Digital**. This parameter is only available in the block that comes from the Avnet S3 ADSP DM6437 library.

### Video display mode

Set the video format to **NTSC**, **PAL**, **HD 480p60**, or **HD 576p50**.

### Analog video output

Set the output type to **Composite**, **S-video**, or **Component**.

### Enable horizontal 9/8 expansion

Expands the image horizontally. Typically used to compensate for spatially compressed NTSC and PAL video signals. For example, use this setting to adjust a 720 x 480 pixel NTSC analog video input that is displayed as a 640 x 480 pixel image.

### Enable vertical 6/5 expansion

Expands the image vertically. Typically used to compensate for spatially compressed PAL video signals. For example, use

this setting in combination with the **Enable horizontal 9/8 expansion** setting to adjust a 720 x 576 pixel PAL analog video input that is displayed as a 640 x 480 pixel image.

### **See Also**

DM643x Draw Rectangles, DM643x OSD, DM6437 EVM Video Capture, DM643x Video Capture

# DM648 EVM Video Capture

---

## Purpose

Configure DSP peripherals to capture NTSC/PAL or HD video

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM648 EVM

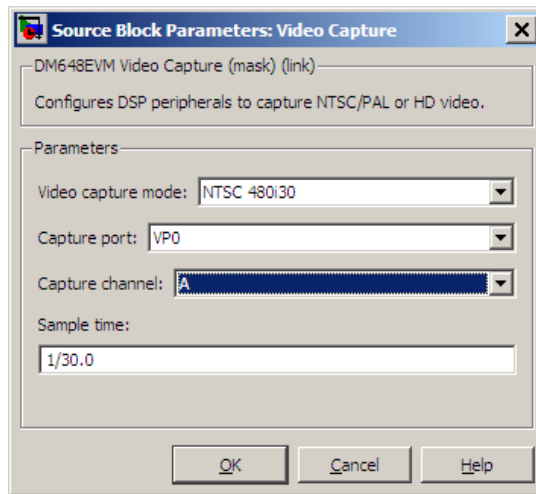


## Description

This block configures the Video Processing Back End (VPBE) to capture NTSC, PAL, or HD video.

To capture multiple video data streams for applications such as multipicture displays, use multiple **Video capture** blocks. For NTSC and PAL, you can capture eight video streams by combining four **Capture ports** with two **Capture channels**. For HD, you can capture two video streams using two **Capture ports**.

## Dialog



### Video capture mode

Set the video format to **NTSC**, **PAL**, or **HD**. Each menu item gives the encoding type, the vertical lines of resolution, whether the scanning type is interlaced (i) or progressive (p), and the frame rate of the input. For example, the “NTSC 480i30” indicates NTSC encoding, 480 lines of vertical resolution, interlaced, and 30 frames per second.

### Capture port

Select the video input port. When you configure Video capture mode for an NTSC or PAL input, four capture ports become available. When you configure Video capture mode for an HD input, two capture ports become available. VP1 is not available in the list of capture ports because it is reserved for video display.

### Capture channel

Two capture channels, A and B, are available for NTSC or PAL. **Capture channel** is not available when **Video capture mode** is configured for an HD input.

# DM648 EVM Video Capture

---

## **Sample time**

Set the interval between samples in fractions of a second. This value defaults to 1/30.0, or one-thirtieth of a second. If the sample time does not match the frame rate of the video input, some irregularities may occur.

## **See Also**

DM648 EVM Video Display

## Purpose

Configure DSP peripherals to display NTSC, PAL, HD, or VESA video

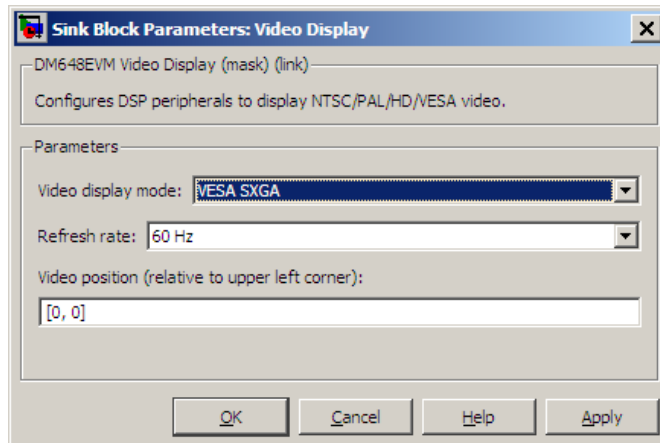
## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DM648 EVM



## Description

This block configures the Video Processing Back End (VPBE) to display NTSC/PAL/HD/VESA video. When sending the video output to a computer display, verify that the combination of the resolution of the **VESA in Video display mode** and the frequency in **Refresh rate** are valid settings for the monitor. Using unsupported combinations may permanently damage the computer display connected to a video output.



## Dialog Box

### Video display mode

Set the video display mode to **NTSC**, **PAL**, **HD**, or **VESA**. The **NTSC**, **PAL**, and **HD** menu items give the encoding type, the vertical lines of resolution, whether the scanning type is interlaced

# DM648 EVM Video Display

---

(i) or progressive (p), and the frame rate of the input. For example, the “NTSC 480i30” indicates NTSC encoding, 480 lines of vertical resolution, interlaced, and 30 frames per second. The **VESA** modes correspond to a range of standard computer display modes.

## **Refresh rate**

When **Video display mode** is one of the VESA modes, set the refresh rate of the video output.

## **Video position**

Position the upper-left corner of the video output in the video display by entering coordinates. The default coordinates, [0,0], correspond to the upper-left corner of the video display. Increasing the horizontal and vertical coordinates moves the video output to the right and down.

## **See Also**

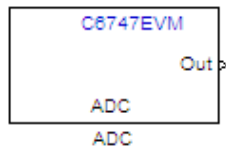
DM643x Draw Rectangles, DM643x OSD, DM6437 EVM Video Capture, DM643x Video Capture



**Purpose** Capture audio stream from LINE IN jack

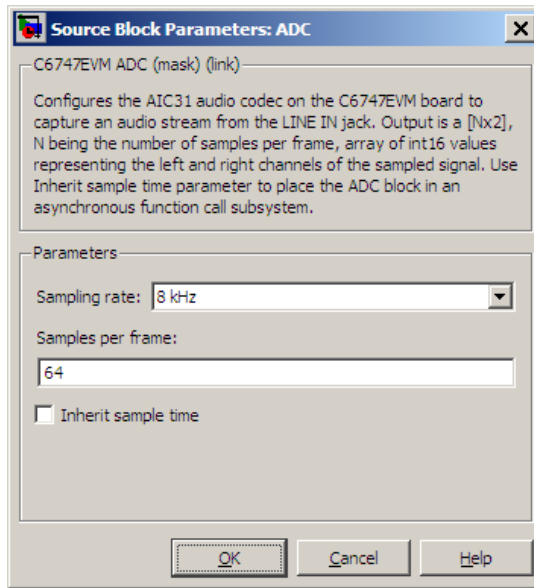
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6747 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6748 EVM



**Description**

Configures the AIC31 audio codec on the C6747EVM/C6748EVM board to capture an audio stream from the LINE IN jack. Output is a [Nx2], N being the number of samples per frame, array of int16 values representing the left and right channels of the sampled signal. Use Inherit sample time parameter to place the ADC block in an asynchronous function call subsystem.



## Dialog Box

### Sampling rate

Set the rate at which the analog-to-digital converter samples the analog input. A higher rate increases the resolution of the data the ADC outputs.

### Samples per frame

Set the number of samples the ADC buffers internally before it sends the digitized signals, as a frame vector, to the next block in the model. This value defaults to 64 samples per frame. The frame rate depends on the sample rate and frame size. Thus, if you set Sampling Rate to 8 kHz, and Samples per frame to 64, the resulting frame rate is 125 frames per second ( $8000/64 = 125$ ).

### Inherit sample time

Select whether the block inherits the sample time from the model base rate or from the Simulink base rate. You can locate the Simulink base rate in the Solver options in Configuration

Parameters. Selecting Inherit sample time directs the block to use the specified rate in model configuration.

**See Also**      C6747 EVM/C6748 EVM DAC

# C6747 EVM/C6748 EVM DAC

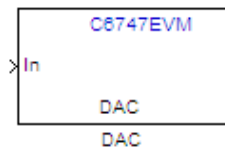
---

**Purpose** Output audio on LINE OUT / HP OUT jacks

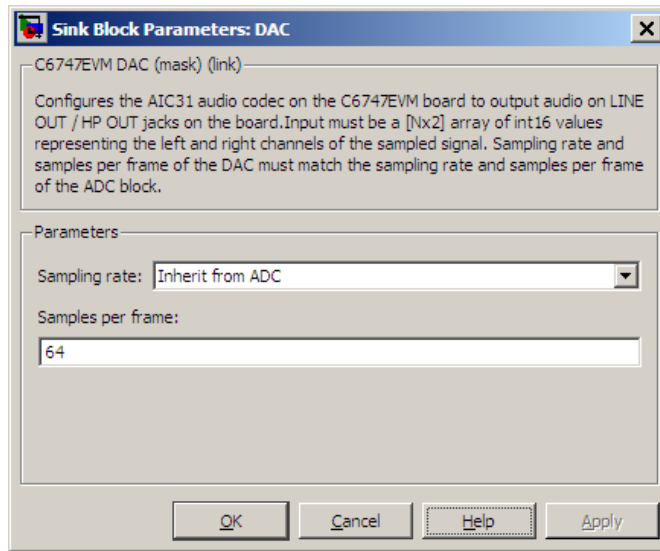
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6747 EVM

Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6748 EVM

**Description**



Configures the AIC31 audio codec on the C6747EVM/C6748EVM board to output audio on LINE OUT / HP OUT jacks on the board. Input must be a [Nx2] array of int16 values representing the left and right channels of the sampled signal. Sampling rate and samples per frame of the DAC must match the sampling rate and samples per frame of the ADC block.



## Dialog Box

### Sampling rate

Set the rate at which the digital-to-analog converter receives each data sample. If your model contains an ADC block, select *Inherit from ADC*.

### Samples per frame

Set the number of samples per data input frame. Match this value with the value of the block creating the data frames. This value defaults to 64 samples per frame.

## See Also

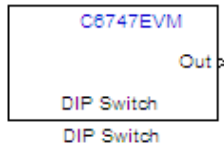
DM643x Draw Rectangles, DM643x OSD, DM6437 EVM Video Capture, DM643x Video Capture

# C6747 EVM DIP Switch

**Purpose** Output DIP switch status

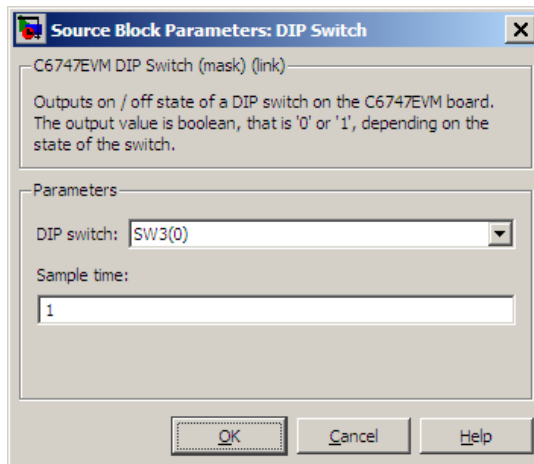
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6747 EVM

## Description



Outputs on / off state of a DIP switch on the C6747EVM board. The output value is boolean, that is '0' or '1', depending on the state of the switch.

## Dialog Box



### DIP Switch

Select the switch, 0 through 3, from the SW3 bank of switches.

### Sample time

Specify the time between samples of the signal in seconds. This value defaults to 1 second between samples.

**See Also**

DM643x Draw Rectangles, DM643x OSD, DM6437 EVM Video Capture,  
DM643x Video Capture

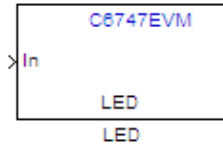
# C6747 EVM LED

---

**Purpose** Control four on-board LEDs

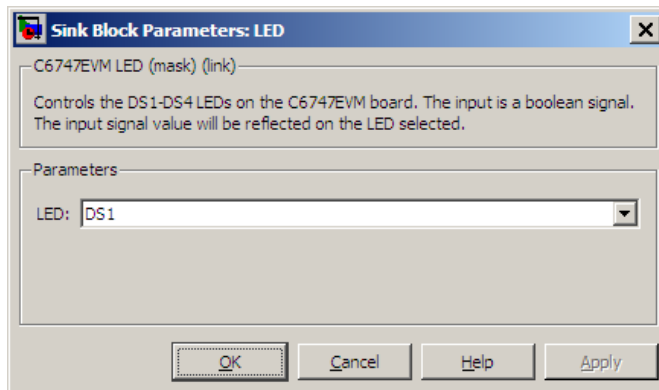
**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ C6747 EVM

## Description



Controls the DS1-DS4 LEDs on the C6747EVM board. The input is a boolean signal. The input signal value will be reflected on the LED selected.

## Dialog Box



## LED

Specify the number of the User LED that the Boolean input controls.

## See Also

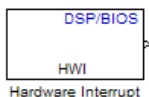
DM643x Draw Rectangles, DM643x OSD, DM6437 EVM Video Capture, DM643x Video Capture



**Purpose** Generate Interrupt Service Routine

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DSP/BIOS

**Description**



Creates an Interrupt Service Routine (ISR) that executes the task block or subsystem that is downstream from the block. ISRs are functions that the CPU executes in response to an external event.

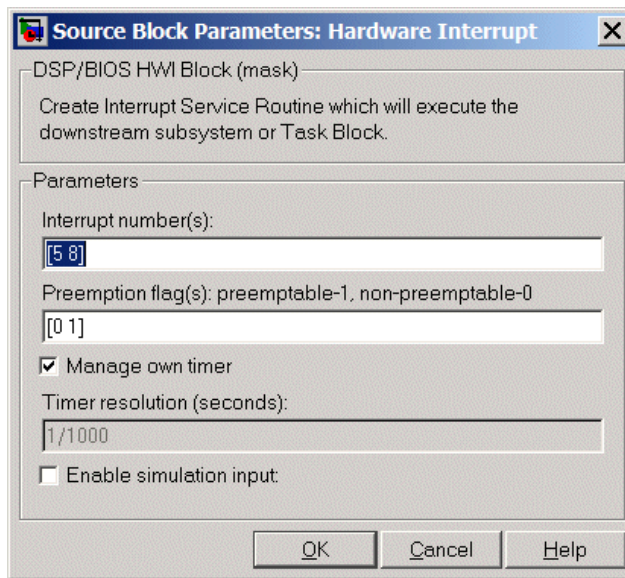
Interrupt numbers for C6000 family processors range from 0 to 15, with 0 reserved for the reset ISR. The following table presents the set of interrupt numbers for the C6713 processor. For more detailed and specific information about interrupts, refer to Texas Instruments technical documentation for your target processor.

| Interrupt Number | Default Event | Module    |
|------------------|---------------|-----------|
| 0                | Reset         |           |
| 1                | NMI           |           |
| 2                | Reserved      |           |
| 3                | Reserved      |           |
| 4                | GPINT4        | GPIO      |
| 5                | GPINT5        | GPIO      |
| 6                | GPINT6        | GPIO      |
| 7                | GPINT7        | GPIO      |
| 8                | EDMAINT       | EDMA      |
| 9                | EMUDDTDM      | Emulation |
| 10               | SDINT         | EMIF      |

# DSP/BIOS Hardware Interrupt

| Interrupt Number | Default Event | Module    |
|------------------|---------------|-----------|
| 11               | EMURTDXR      | Emulation |
| 12               | EMURTDXTX     | Emulation |
| 13               | DSPINT        | HPI       |
| 14               | TINT0         | Timer 0   |
| 15               | TINT1         | Timer 1   |

In models, you usually follow this block with either a DSP/BIOS Task or DSP/BIOS Triggered Task block.



## Dialog Box

### Interrupt number(s)

Enter one or more integer values as a vector that represent interrupts. Interrupts have a value from 0, the highest priority to

15, lowest priority. As shown, enter the values enclosed in square brackets. For example, entering

[3 5 15]

results in three interrupt routines. [5 8] is the default entry, specifying two interrupts.

## **Preemption flag(s)**

Higher priority interrupts can preempt interrupts that have lower priority. To allow you to control preemption, use the preemption flags to specify whether an interrupt can be preempted.

Entering 1 indicates that the interrupt can be preempted. Entering 0 indicates the interrupt cannot be preempted. When **Interrupt numbers** contains more than one interrupt priority, you can assign different preemption flags to each interrupt by entering a vector of flag values, corresponding to the order of the interrupts in **Interrupt numbers**. If **Interrupt numbers** contains more than one interrupt, and you enter only one flag value here, that status applies to all interrupts.

In the default settings [0 1], the interrupt with priority 5 in **Interrupt numbers** is not preemptible and the priority 8 interrupt can be preempted.

## **Manage own timer**

The ISR generated by the this block can manage its own time by reading time from the clock on the board. Selecting this option directs the ISR to maintain the time itself. When you select **Manage own timer**, you enable the **Timer resolution** option that reports the timer resolution the ISR uses.

## **Timer resolution (seconds)**

When you direct the block to manage its own time, this option (available only when you select **Manage own timer**) reports the resolution of the clock. **Timer resolution** is a read-only parameter. You cannot change the value.

# DSP/BIOS Hardware Interrupt

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## **Enable simulation input**

Selecting this option adds an input port to the block for simulating inputs in Simulink software. Connect interrupt simulation sources to the input. This option affects simulation only. It does not alter generated code.

## **See Also**

DSP/BIOS Task, DSP/BIOS Triggered Task

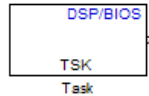
## Purpose

Create task that runs as separate DSP/BIOS thread

## Library

Embedded Coder Support Package for Texas Instruments C6000 Processors/ DSP/BIOS

## Description

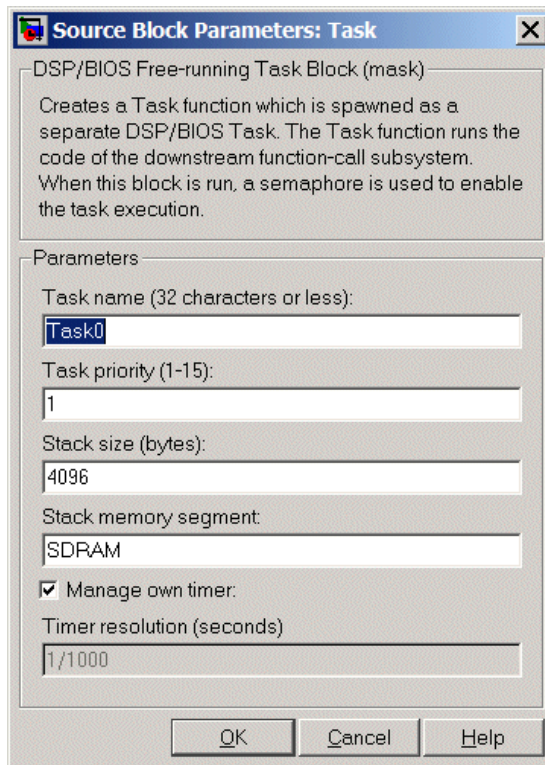


Creates a free-running task that runs in response to an ISR and as a separate DSP/BIOS thread. The spawned task runs the downstream function call subsystem in the model.

When the process runs this task, it uses a semaphore structure to enable the task and restrict access by it to other resources.

In order to use this block, set the **System target file** parameter to `idelink_ert.tlc` or `idelink_ert.tlc`. The **System target file** parameter is located on the Code Generation pane of the Model Configuration Parameters dialog, which you can view by selecting your model and pressing **Ctrl+E**.

# DSP/BIOS Task



## Dialog Box

### **Task name (32 characters or less)**

Creates a name for the task. Enter a string of up to 32 characters, including numbers and letters. You cannot use the standard C reserved characters, such as / and : in the name.

### **Task priority (1-15)**

Sets the priority for the task, where 1 is the lowest priority and 15 the highest. Higher priority tasks can preempt tasks that have lower priority.

### **Stack size (bytes)**

Specify the size of the stack the task uses. The value defaults to 4096 bytes. Each DSP/BIOS task has a separate stack. This

parameter is not related to **System stack size (MAUs)** in the model Configuration Parameters.

### **Stack memory segment**

Specify where the stack resides in memory.

### **Manage own timer**

This block can manage its own time by reading time from the clock on the board. Selecting this option directs the task/block to maintain the time itself. When you select **Manage own timer**, you enable the **Timer resolution** option that reports the timer resolution the task uses.

### **Timer resolution (seconds)**

When you direct the block to manage its own time, this option (available only when you select **Manage own timer**) reports the resolution of the clock. **Timer resolution** is a read-only parameter. You cannot change the value.

## **See Also**

DSP/BIOS Hardware Interrupt, DSP/BIOS Triggered Task

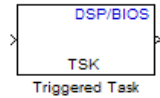
# DSP/BIOS Triggered Task

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**Purpose** Create asynchronously triggered task

**Library** Embedded Coder Support Package for Texas Instruments C6000 Processors/ DSP/BIOS

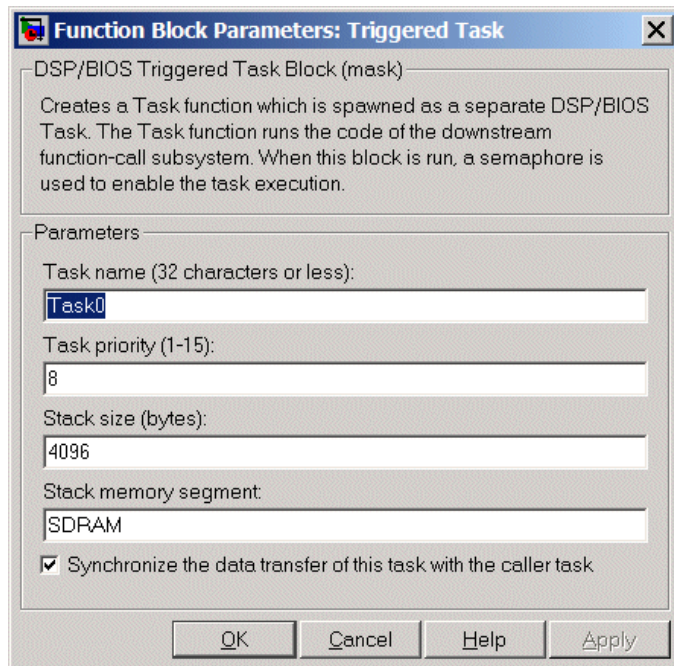
**Description**



Creates a task that runs asynchronously in response to an ISR and as a separate DSP/BIOS thread. The spawned task runs the downstream function call subsystem in the model.

When the process runs this task, it uses a semaphore structure to enable the task and restrict access by it to other resources.





## Dialog Box

### Task name (32 characters or less)

Creates a name for the task. Enter a string of up to 32 characters, including numbers and letters. You cannot use the standard C reserved characters, such as / or : in the name.

### Task priority (1-15)

Sets the priority for the task, where 1 is the lowest priority and 15 the highest. Higher priority tasks can preempt tasks that have lower priority, unless the preemptible flag (**Preemption flag** option on the C5000/C6000 Hardware Interrupt block) prevents preempting the task.

### Stack size (bytes)

Specify the size of the stack the task uses. The value defaults to 4096 bytes. Take care to set this value to a value that is large

# DSP/BIOS Triggered Task

---

enough. If the task uses more than the allotted space it can write into other memory areas with unintended results.

Each DSP/BIOS task has a separate stack. This parameter is not related to **System stack size (MAUs)** in the model Configuration Parameters.

## **Stack memory segment**

Specify where the stack resides in memory by specifying the memory segment. Additional information about DSP/BIOS memory segments also appears in the Target Hardware Resources tab.

## **Synchronize data transfer of this task with caller task**

Specify whether this task should synchronize data transfer with the calling task. Select this option to enable synchronization. Clearing this option enables the **Timer resolution** option.

## **Timer resolution**

When you direct the block not to synchronize data with the calling task (by clearing **Synchronize data transfer of this task with caller task**), **Timer resolution** reports the resolution of the timer. **Timer resolution** is a read-only parameter. You cannot change the value.

## **See Also**

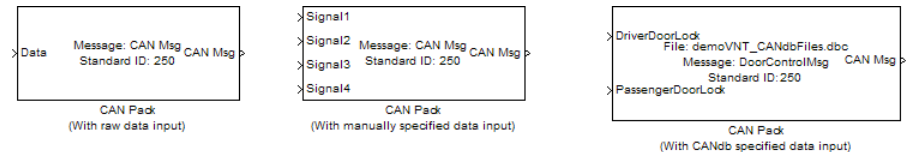
DSP/BIOS Hardware Interrupt, DSP/BIOS Task

**Purpose** Pack individual signals into CAN message

**Library** CAN Communication

Embedded Coder/ Embedded Targets/ Host Communication

## Description



The CAN Pack block loads signal data into a message at specified intervals during the simulation.

---

**Note** To use this block, you also need a license for Simulink software.

---

CAN Pack block has one input port by default. The number of block inputs is dynamic and depends on the number of signals you specify for the block. For example, if your block has four signals, it has four block inputs.

This block has one output port, CAN Msg. The CAN Pack block takes the specified input parameters and packs the signals into a message.

## Other Supported Features

The CAN Pack block supports:

- The use of Simulink Accelerator™ Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.
- The use of model referencing. Using this feature, your model can include other Simulink models as modular components.
- Code generation using Simulink Coder to deploy models to targets.

# CAN Pack

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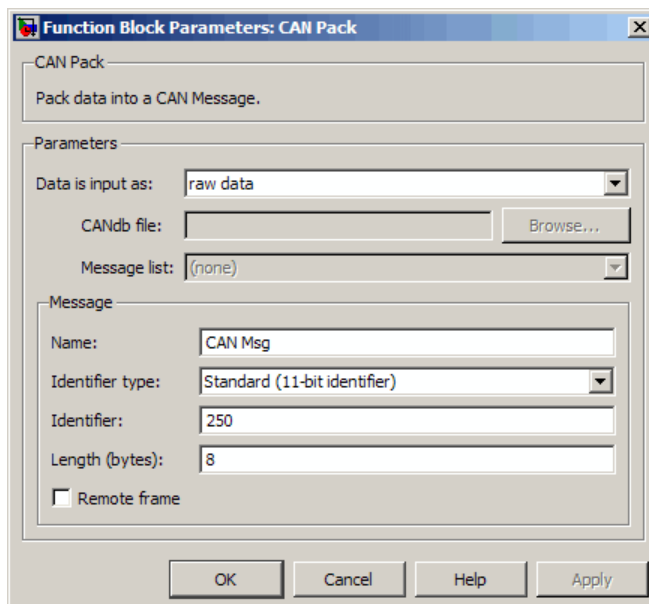
**Note** Code generation is not supported if your signal information consists of signed or unsigned integers greater than 32-bits long.

---

For more information on these features, see the Simulink documentation.

## Dialog Box

Use the Function Block Parameters dialog box to select your CAN Pack block parameters.



## Parameters

### Data is input as

Select your data signal:

- **raw data:** Input data as a uint8 vector array. If you select this option, you only specify the message fields. all other signal

parameter fields are unavailable. This option opens only one input port on your block.

- **manually specified signals:** Allows you to specify data signal definitions. If you select this option, use the **Signals** table to create your signals. The number of block inputs depends on the number of signals you specify.

Function Block Parameters: CAN Pack

CAN Pack:  
Pack data into a CAN Message.

Parameters:  
Data is input as: manually specified signals  
CANdb file:  Browse...  
Message list: (none)

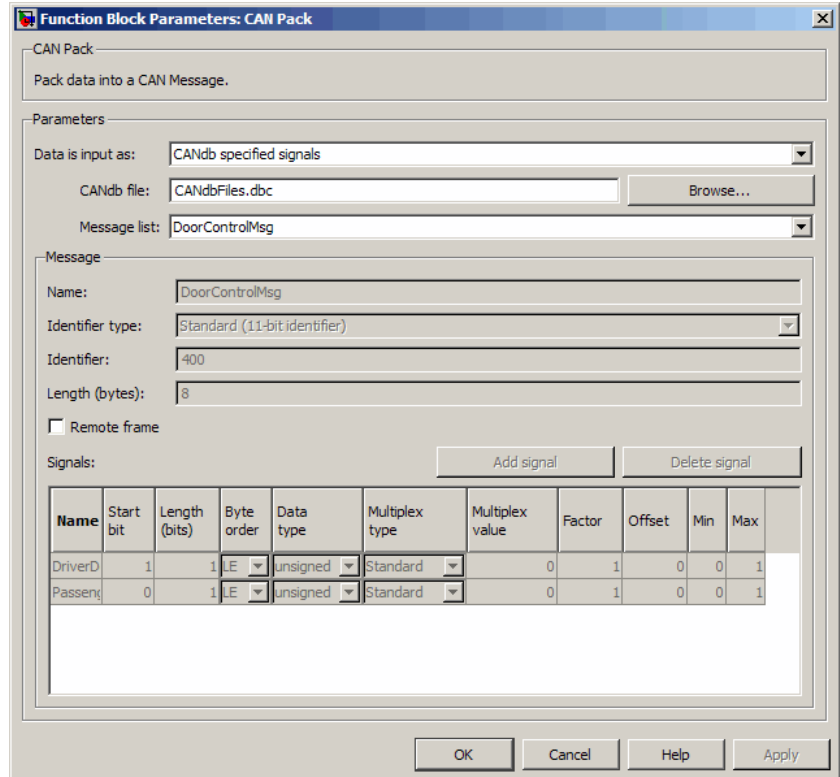
Message:  
Name: CAN Msg  
Identifier type: Standard (11-bit identifier)  
Identifier: 250  
Length (bytes): 8  
 Remote frame

Signals:

| Name    | Start bit | Length (bits) | Byte order | Data type | Multiplex type | Multiplex value | Factor | Offset | Min  | Max |
|---------|-----------|---------------|------------|-----------|----------------|-----------------|--------|--------|------|-----|
| Signal1 | 0         | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |
| Signal2 | 8         | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |
| Signal3 | 16        | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |
| Signal4 | 24        | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |

- **CANdb specified signals:** Allows you to specify a CAN database file that contains message and signal definitions. If you select this option, select a CANdb file. The number of

block inputs depends on the number of signals specified in the CANdb file for the selected message.



## CANdb file

This option is available if you specify that your data is input via a CANdb file in the **Data is input as** list. Click **Browse** to find the CANdb file on your system. The message list specified in the CANdb file populates the **Message** section of the dialog box. The CANdb file also populates the **Signals** table for the selected message.

---

**Note** File names that contain non-alphanumeric characters such as equal signs, ampersands, and so forth are not valid CAN database file names. You can use periods in your database name. Rename CAN database files with non-alphanumeric characters before you use them.

---

## Message list

This option is available if you specify that your data is input via a CANdb file in the **Data is input as** field and you select a CANdb file in the **CANdb file** field. Select the message to display signal details in the **Signals** table.

## Message

### Name

Specify a name for your CAN message. The default is **CAN Msg**. This option is available if you choose to input raw data or manually specify signals. This option is unavailable if you choose to use signals from a CANdb file.

### Identifier type

Specify whether your CAN message identifier is a **Standard** or an **Extended** type. The default is **Standard**. A standard identifier is an 11-bit identifier and an extended identifier is a 29-bit identifier. This option is available if you choose to input raw data or manually specify signals. For CANdb specified signals, the **Identifier type** inherits the type from the database.

### Identifier

Specify your CAN message ID. This number must be a positive integer from 0 through 2047 for a standard identifier and from 0 through 536870911 for an extended identifier. You can also specify hexadecimal values using the **hex2dec** function. This option is available if you choose to input raw data or manually specify signals.

**Length (bytes)**

Specify the length of your CAN message from 0 to 8 bytes. If you are using **CANdb specified signals** for your data input, the CANdb file defines the length of your message. If not, this field defaults to 8. This option is available if you choose to input raw data or manually specify signals.

**Remote frame**

Specify the CAN message as a remote frame.

**Signals Table**

This table appears if you choose to specify signals manually or define signals using a CANdb file.

If you are using a CANdb file, the data in the file populates this table automatically and you cannot edit the fields. To edit signal information, switch to manually specified signals.

If you have selected to specify signals manually, create your signals manually in this table. Each signal you create has the following values:

**Name**

Specify a descriptive name for your signal. The Simulink block in your model displays this name. The default is **Signal [row number]**.

**Start bit**

Specify the start bit of the data. The start bit is the least significant bit counted from the start of the message data. The start bit must be an integer from 0 through 63.

**Length (bits)**

Specify the number of bits the signal occupies in the message. The length must be an integer from 1 through 64.

**Byte order**

Select either of the following options:

- **LE:** Where the byte order is in little-endian format (Intel). In this format you count bits from the start, which is the least



significant bit, to the most significant bit, which has the highest bit index. For example, if you pack one byte of data in little-endian format, with the start bit at 20, the data bit table resembles this figure.

| Bit Number       |        | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|------------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| Data Byte Number | Byte 0 | 7     | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
|                  | Byte 1 | 15    | 14    | 13    | 12    | 11    | 10    | 9     | 8     |
|                  | Byte 2 | 23    | 22    | 21    | 20    | 19    | 18    | 17    | 16    |
|                  | Byte 3 | 31    | 30    | 29    | 28    | 27    | 26    | 25    | 24    |
|                  | Byte 4 | 39    | 38    | 37    | 36    | 35    | 34    | 33    | 32    |
|                  | Byte 5 | 47    | 46    | 45    | 44    | 43    | 42    | 41    | 40    |
|                  | Byte 6 | 55    | 54    | 53    | 52    | 51    | 50    | 49    | 48    |
|                  | Byte 7 | 63    | 62    | 61    | 60    | 59    | 58    | 57    | 56    |

### Little-Endian Byte Order Counted from the Least Significant Bit to the Highest Address

- BE: Where byte order is in big-endian format (Motorola®). In this format you count bits from the start, which is the least significant bit, to the most significant bit. For example, if you

pack one byte of data in big-endian format, with the start bit at 20, the data bit table resembles this figure.

| Bit Number       |        | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|------------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| Data Byte Number | Byte 0 | 7     | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
|                  | Byte 1 | 15    | 14    | 13    | 12    | 11    | 10    | 9     | 8     |
|                  | Byte 2 | 23    | 22    | 21    | 20    | 19    | 18    | 17    | 16    |
|                  | Byte 3 | 31    | 30    | 29    | 28    | 27    | 26    | 25    | 24    |
|                  | Byte 4 | 39    | 38    | 37    | 36    | 35    | 34    | 33    | 32    |
|                  | Byte 5 | 47    | 46    | 45    | 44    | 43    | 42    | 41    | 40    |
|                  | Byte 6 | 55    | 54    | 53    | 52    | 51    | 50    | 49    | 48    |
|                  | Byte 7 | 63    | 62    | 61    | 60    | 59    | 58    | 57    | 56    |

### Big-Endian Byte Order Counted from the Least Significant Bit to the Lowest Address

#### Data type

Specify how the signal interprets the data in the allocated bits.  
Choose from:

- signed (default)
- unsigned

- single
- double

### Multiplex type

Specify how the block packs the signals into the CAN message at each timestep:

- **Standard:** The signal is packed at each timestep.
- **Multiplexor:** The Multiplexor signal, or the mode signal is packed. You can specify only one Multiplexor signal per message.
- **Multiplexed:** The signal is packed if the value of the Multiplexor signal (mode signal) at run time matches the configured **Multiplex value** of this signal.

For example, a message has four signals with the following types and values.

| Signal Name | Multiplex Type | Multiplex Value |
|-------------|----------------|-----------------|
| Signal-A    | Standard       | N/A             |
| Signal-B    | Multiplexed    | 1               |
| Signal-C    | Multiplexed    | 0               |
| Signal-D    | Multiplexor    | N/A             |

In this example:

- The block packs Signal-A (Standard signal) and Signal-D (Multiplexor signal) in every timestep.
- If the value of Signal-D is 1 at a particular timestep, then the block packs Signal-B along with Signal-A and Signal-D in that timestep.
- If the value of Signal-D is 0 at a particular timestep, then the block packs Signal-C along with Signal-A and Signal-D in that timestep.

- If the value of Signal-D is not 1 or 0, the block does not pack either of the Multiplexed signals in that timestep.

## **Multiplex value**

This option is available only if you have selected the **Multiplex type** to be Multiplexed. The value you provide here must match the Multiplexor signal value at run time for the block to pack the Multiplexed signal. The **Multiplex value** must be a positive integer or zero.

## **Factor**

Specify the **Factor** value to apply to convert the physical value (signal value) to the raw value packed in the message. See “Conversion Formula” on page 2-662 to understand how physical values are converted to raw values packed into a message.

## **Offset**

Specify the **Offset** value to apply to convert the physical value (signal value) to the raw value packed in the message. See “Conversion Formula” on page 2-662 to understand how physical values are converted to raw values packed into a message.

## **Min**

Specify the minimum physical value of the signal. The default value is `-inf` (negative infinity). You can specify a number for the minimum value. See “Conversion Formula” on page 2-662 to understand how physical values are converted to raw values packed into a message.

## **Max**

Specify the maximum physical value of the signal. The default value is `inf`. You can specify a number for the maximum value. See “Conversion Formula” on page 2-662 to understand how physical values are converted to raw values packed into a message.

## **Conversion Formula**

The conversion formula is

$$\text{raw\_value} = (\text{physical\_value} - \text{Offset}) / \text{Factor}$$

where `physical_value` is the value of the signal after it is saturated using the specified **Min** and **Max** values. `raw_value` is the packed signal value.

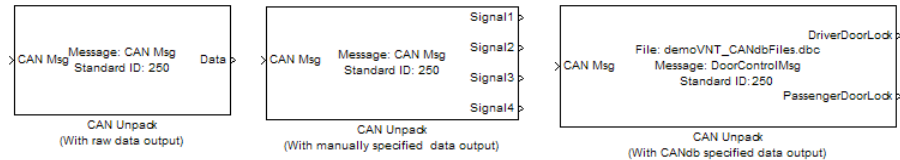
### **See Also**

CAN Unpack

# CAN Unpack

**Purpose** Unpack individual signals from CAN messages

**Library** CAN Communication  
Embedded Coder/ Embedded Targets/ Host Communication



## Description

The CAN Unpack block unpacks a CAN message into signal data using the specified output parameters at every timestep. Data is output as individual signals.

---

**Note** To use this block, you also need a license for Simulink software.

---

The CAN Unpack block has one output port by default. The number of output ports is dynamic and depends on the number of signals you specify for the block to output. For example, if your block has four signals, it has four output ports.

## Other Supported Features

The CAN Unpack block supports:

- The use of Simulink Accelerator Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.
- The use of model referencing. Using this feature, your model can include other Simulink models as modular components.
- Code generation using Simulink Coder to deploy models to targets.

---

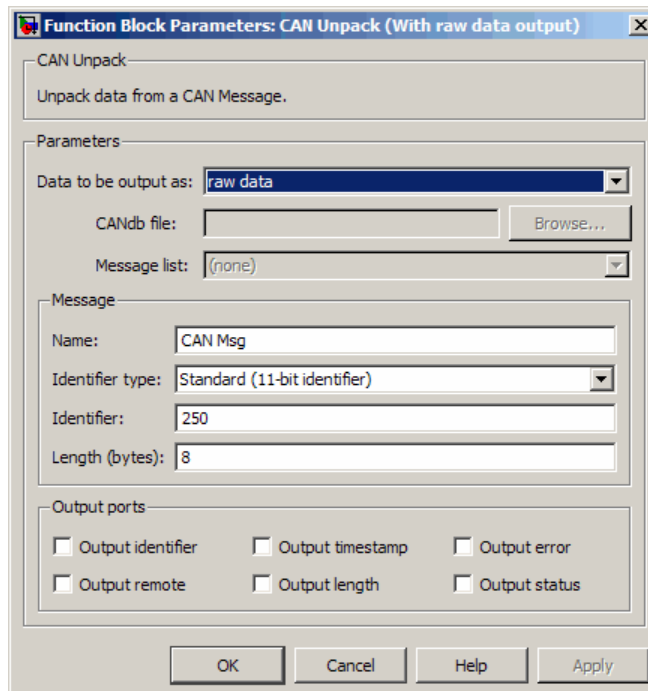
**Note** Code generation is not supported if your signal information consists of signed or unsigned integers greater than 32-bits long.

---

For more information on these features, see the Simulink documentation.

## Dialog Box

Use the Function Block Parameters dialog box to select your CAN message unpacking parameters.



### Parameters

#### Data to be output as

Select your data signal:

# CAN Unpack

- **raw data:** Output data as a uint8 vector array. If you select this option, you only specify the message fields. The other signal parameter fields are unavailable. This option opens only one output port on your block.
- **manually specified signals:** Allows you to specify data signals. If you select this option, use the Signals table to create your signals message manually.

Function Block Parameters: CAN Unpack (With manually specified data output)

CAN Unpack  
Unpack data from a CAN Message.

Parameters

Data to be output as: manually specified signals

CANdb file:  Browse...

Message list: (none)

Message

Name: CAN Msg

Identifier type: Standard (11-bit identifier)

Identifier: 250

Length (bytes): 8

Signals:

| Name    | Start bit | Length (bits) | Byte order | Data type | Multiplex type | Multiplex value | Factor | Offset | Min  | Max |
|---------|-----------|---------------|------------|-----------|----------------|-----------------|--------|--------|------|-----|
| Signal1 | 0         | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |
| Signal2 | 8         | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |
| Signal3 | 16        | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |
| Signal4 | 24        | 8             | LE         | signed    | Standard       | 0               | 1      | 0      | -Inf | Inf |

Output ports

Output identifier  Output timestamp  Output error

Output remote  Output length  Output status



The number of output ports on your block depends on the number of signals you specify. For example, if you specify four signals, your block has four output ports.

- **CANdb specified signals:** Allows you to specify a CAN database file that contains data signals. If you select this option, select a CANdb file.

Function Block Parameters: CAN Unpack (With CANdb specified data output)

CAN Unpack  
Unpack data from a CAN Message.

Parameters

Data to be output as: CANdb specified signals

CANdb file: CANdbFiles.dbc Browse...

Message list: DoorControlMsg

Message

Name: DoorControlMsg

Identifier type: Standard (11-bit identifier)

Identifier: 400

Length (bytes): 8

Signals: Add signal Delete signal

| Name    | Start bit | Length (bits) | Byte order | Data type | Multiplex type | Multiplex value | Factor | Offset | Min | Max |
|---------|-----------|---------------|------------|-----------|----------------|-----------------|--------|--------|-----|-----|
| DriverD | 1         | 1             | LE         | unsigned  | Standard       | 0               | 1      | 0      | 0   | 1   |
| PassenD | 0         | 1             | LE         | unsigned  | Standard       | 0               | 1      | 0      | 0   | 1   |

Output ports

Output identifier  Output timestamp  Output error  
 Output remote  Output length  Output status

OK Cancel Help Apply

The number of output ports on your block depends on the number of signals specified in the CANdb file. For example, if

the selected message in the CANdb file has four signals, your block has four output ports.

## CANdb file

This option is available if you specify that your data is input via a CANdb file in the **Data to be output as** list. Click **Browse** to find the CANdb file on your system. The messages and signal definitions specified in the CANdb file populate the **Message** section of the dialog box. The signals specified in the CANdb file populate **Signals** table.

---

**Note** File names that contain non-alphanumeric characters such as equal signs, ampersands, and so forth are not valid CAN database file names. You can use periods in your database name. Rename CAN database files with non-alphanumeric characters before you use them.

---

## Message list

This option is available if you specify that your data is to be output as a CANdb file in the **Data to be output as** list and you select a CANdb file in the **CANdb file** field. You can select the message that you want to view. The **Signals** table then displays the details of the selected message.

## Message

### Name

Specify a name for your CAN message. The default is CAN Msg. This option is available if you choose to output raw data or manually specify signals.

### Identifier type

Specify whether your CAN message identifier is a **Standard** or an **Extended** type. The default is **Standard**. A standard identifier is an 11-bit identifier and an extended identifier is a 29-bit identifier. This option is available if you choose to output raw

data or manually specify signals. For CANdb-specified signals, the **Identifier type** inherits the type from the database.

## Identifier

Specify your CAN message ID. This number must be an integer from 0 through 2047 for a standard identifier and from 0 through 536870911 for an extended identifier. If you specify 1, the block unpacks the messages that match the length specified for the message. You can also specify hexadecimal values using the `hex2dec` function. This option is available if you choose to output raw data or manually specify signals.

## Length (bytes)

Specify the length of your CAN message from 0 to 8 bytes. If you are using `CANdb specified signals` for your output data, the CANdb file defines the length of your message. If not, this field defaults to 8. This option is available if you choose to output raw data or manually specify signals.

## Signals Table

This table appears if you choose to specify signals manually or define signals using a CANdb file.

If you are using a CANdb file, the data in the file populates this table automatically and you cannot edit the fields. To edit signal information, switch to manually specified signals.

If you have selected to specify signals manually, create your signals manually in this table. Each signal you create has the following values:

### Name

Specify a descriptive name for your signal. The Simulink block in your model displays this name. The default is `Signal [row number]`.

### Start bit

Specify the start bit of the data. The start bit is the least significant bit counted from the start of the message. The start bit must be an integer from 0 through 63.

# CAN Unpack

---

## **Length (bits)**

Specify the number of bits the signal occupies in the message. The length must be an integer from 1 through 64.

## **Byte order**

Select either of the following options:

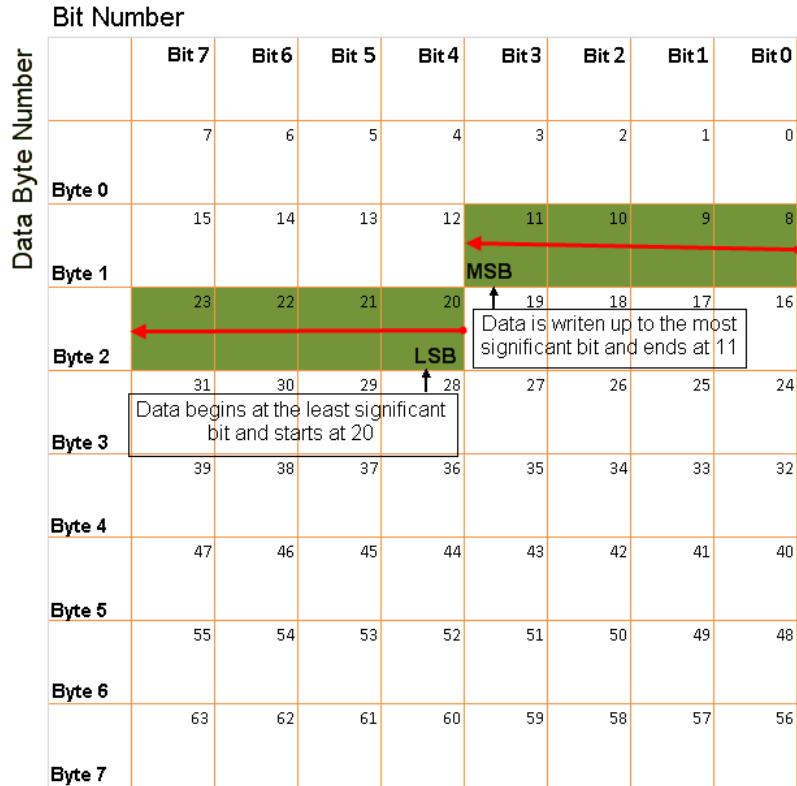
- **LE:** Where the byte order is in little-endian format (Intel). In this format you count bits from the start, which is the least significant bit, to the most significant bit, which has the highest bit index. For example, if you pack one byte of data in little-endian format, with the start bit at 20, the data bit table resembles this figure.

|                  |        | Bit Number |       |       |       |       |       |       |       |
|------------------|--------|------------|-------|-------|-------|-------|-------|-------|-------|
|                  |        | Bit 7      | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| Data Byte Number | Byte 0 | 7          | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
|                  | Byte 1 | 15         | 14    | 13    | 12    | 11    | 10    | 9     | 8     |
|                  | Byte 2 | 23         | 22    | 21    | 20    | 19    | 18    | 17    | 16    |
|                  | Byte 3 | 31         | 30    | 29    | 28    | 27    | 26    | 25    | 24    |
|                  | Byte 4 | 39         | 38    | 37    | 36    | 35    | 34    | 33    | 32    |
|                  | Byte 5 | 47         | 46    | 45    | 44    | 43    | 42    | 41    | 40    |
|                  | Byte 6 | 55         | 54    | 53    | 52    | 51    | 50    | 49    | 48    |
|                  | Byte 7 | 63         | 62    | 61    | 60    | 59    | 58    | 57    | 56    |

### Little-Endian Byte Order Counted from the Least Significant Bit to the Highest Address

- BE: Where the byte order is in big-endian format (Motorola). In this format you count bits from the start, which is the least significant bit, to the most significant bit. For example, if you pack one byte of data in big-endian format, with the start bit at 20, the data bit table resembles this figure.

# CAN Unpack



## Big-Endian Byte Order Counted from the Least Significant Bit to the Lowest Address

### Data type

Specify how the signal interprets the data in the allocated bits.

Choose from:

- signed (default)
- unsigned
- single
- double

## Multiplex type

Specify how the block unpacks the signals from the CAN message at each timestep:

- **Standard:** The signal is unpacked at each timestep.
- **Multiplexor:** The Multiplexor signal, or the mode signal is unpacked. You can specify only one Multiplexor signal per message.
- **Multiplexed:** The signal is unpacked if the value of the Multiplexor signal (mode signal) at run time matches the configured **Multiplex value** of this signal.

For example, a message has four signals with the following values.

| Signal Name | Multiplex Type | Multiplex Value |
|-------------|----------------|-----------------|
| Signal-A    | Standard       | N/A             |
| Signal-B    | Multiplexed    | 1               |
| Signal-C    | Multiplexed    | 0               |
| Signal-D    | Multiplexor    | N/A             |

In this example:

- The block unpacks Signal-A (Standard signal) and Signal-D (Multiplexor signal) in every timestep.
- If the value of Signal-D is 1 at a particular timestep, then the block unpacks Signal-B along with Signal-A and Signal-D in that timestep.
- If the value of Signal-D is 0 at a particular timestep, then the block unpacks Signal-C along with Signal-A and Signal-D in that timestep.
- If the value of Signal-D is not 1 or 0, the block does not unpack either of the Multiplexed signals in that timestep.

## **Multiplex value**

This option is available only if you have selected the **Multiplex type** to be Multiplexed. The value you provide here must match the Multiplexor signal value at run time for the block to unpack the Multiplexed signal. The **Multiplex value** must be a positive integer or zero.

## **Factor**

Specify the **Factor** value applied to convert the unpacked raw value to the physical value (signal value). See “Conversion Formula” on page 2-675 to understand how unpacked raw values are converted to physical values.

## **Offset**

Specify the **Offset** value applied to convert the physical value (signal value) to the unpacked raw value. See “Conversion Formula” on page 2-675 to understand how unpacked raw values are converted to physical values.

## **Min**

Specify the minimum raw value of the signal. The default value is `-inf` (negative infinity). You can specify a number for the minimum value. See “Conversion Formula” on page 2-675 to understand how unpacked raw values are converted to physical values.

## **Max**

Specify the maximum raw value of the signal. The default value is `inf`. You can specify a number for the maximum value. See “Conversion Formula” on page 2-675 to understand how unpacked raw values are converted to physical values.

## **Output Ports**

Selecting an **Output ports** option adds an output port to your block.

## **Output identifier**

Select this option to output a CAN message identifier. The data type of this port is **uint32**.



## **Output remote**

Select this option to output the message remote frame status.

This option adds a new output port to the block. The data type of this port is **uint8**.

## **Output timestamp**

Select this option to output the message time stamp. This option adds a new output port to the block. The data type of this port is **double**.

## **Output length**

Select this option to output the length of the message in bytes.

This option adds a new output port to the block. The data type of this port is **uint8**.

## **Output error**

Select this option to output the message error status. This option adds a new output port to the block. The data type of this port is **uint8**.

## **Output status**

Select this option to output the message received status. The status is 1 if the block receives new message and 0 if it does not.

This option adds a new output port to the block. The data type of this port is **uint8**.

If you do not select an **Output ports** option, the number of output ports on your block depends on the number of signals you specify.

## **Conversion Formula**

The conversion formula is

$$\text{physical\_value} = \text{raw\_value} * \text{Factor} + \text{Offset}$$

where **raw\_value** is the unpacked signal value. **physical\_value** is the scaled signal value which is saturated using the specified **Min** and **Max** values.

## **See Also**

CAN Pack

# Custom MATLAB file

---

**Purpose** Automatically update active configuration parameters of parent model using file containing custom MATLAB code

**Library** Configuration Wizards



## Description

When you add a Custom MATLAB file block to your Simulink model and double-click it, a custom MATLAB script executes and automatically configures model parameters that are relevant to code generation. You can also set a block option to invoke the build process after configuring the model.

After double-clicking the block, you can verify that the model parameter values have changed by opening the Configuration Parameters dialog box and examining the settings.

MathWorks provides an example MATLAB script, `matlabroot/toolbox/rtw/rtw/rtwsampleconfig.m`, that you can use with the Custom MATLAB file block and adapt to your model requirements. The block and the script provide a starting point for customization. For more information, see “Create a Custom Configuration Wizard Block” in the Embedded Coder documentation.

---

**Note** You can include more than one Configuration Wizard block in your model. This provides a quick way to switch between configurations.

---

**Parameters** **Configure the model for**  
Value selected from

- ERT (optimized for fixed-point)
- ERT (optimized for floating-point)
- GRT (optimized for fixed/floating-point)

- GRT (debug for fixed/floating-point)
- Custom

For this block, Custom is selected by default.

### **Configuration function**

Name of the predefined or custom MATLAB script to be used to update the active configuration parameters of the parent Simulink model. The default value is `rtwsampleconfig`, which refers to the example script `rtwsampleconfig.m`.

### **Invoke build process after configuration**

If selected, the script initiates the code generation and build process after updating the model's configuration parameters. If not selected (the default), the build process is not initiated.

### **See Also**

ERT (optimized for fixed-point), ERT (optimized for floating-point), GRT (debug for fixed/floating-point), GRT (optimized for fixed/floating-point) “Wizard” in the Embedded Coder documentation

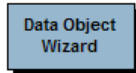
# Data Object Wizard

---

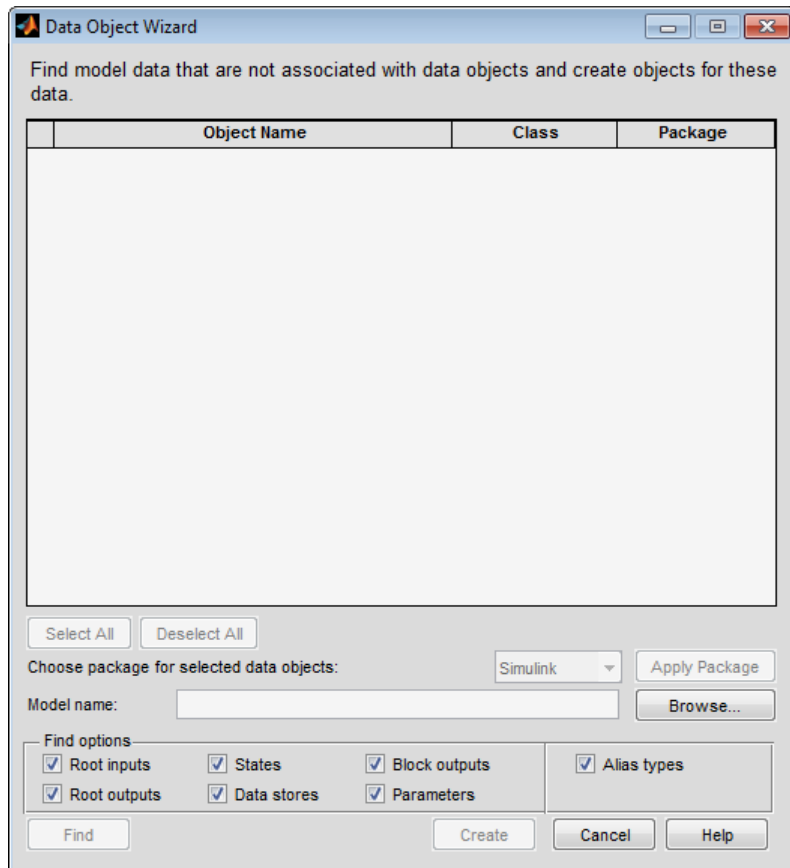
**Purpose** Simulink data object wizard for creating potential Simulink data objects

**Library** Module Packaging

**Description**



When you add a Data Object Wizard block to your Simulink model and double-click it, the Data Object Wizard is launched:



The Data Object Wizard allows you to determine quickly which model data is not associated with Simulink data objects and to create and associate data objects with the data.

You can also launch the Data Object Wizard by entering `dataobjectwizard` at the MATLAB command line or by selecting **Code > Data Objects > Data Object Wizard** in your model.

# Data Object Wizard

---

**Example**

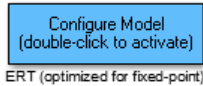
For an example of a model that incorporates the Data Object Wizard block, see `rtwdemo_mpf`.

**See Also**

“Create Data Objects with Data Object Wizard”

**Purpose** Automatically update active configuration parameters of parent model for ERT fixed-point code generation

**Library** Configuration Wizards



## Description

When you add an ERT (optimized for fixed-point) block to your Simulink model and double-click it, a predefined MATLAB script executes and automatically configures the model parameters optimally for fixed-point code generation with the ERT target. You can also set a block option to invoke the build process after configuring the model.

After double-clicking the block, you can verify that the model parameter values have changed by opening the Configuration Parameters dialog box and examining the settings.

---

**Note** You can include more than one Configuration Wizard block in your model. This provides a quick way to switch between configurations.

---

## Parameters

**Configure the model for**  
Value selected from

- ERT (optimized for fixed-point)
- ERT (optimized for floating-point)
- GRT (optimized for fixed/floating-point)
- GRT (debug for fixed/floating-point)
- Custom

For this block, ERT (optimized for fixed-point) is selected by default.

## ERT (optimized for fixed-point)

---

### **Configuration function**

Grayed out unless **Configure the model for** is set to Custom.  
This parameter is used with the Custom MATLAB file block.

### **Invoke build process after configuration**

If selected, the script initiates the code generation and build process after updating the model's configuration parameters. If not selected (the default), the build process is not initiated.

### **See Also**

Custom MATLAB file, ERT (optimized for floating-point), GRT (debug for fixed/floating-point), GRT (optimized for fixed/floating-point)

“Wizard” in the Embedded Coder documentation

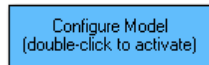


# ERT (optimized for floating-point)

---

**Purpose** Automatically update active configuration parameters of parent model for ERT floating-point code generation

**Library** Configuration Wizards



**Description**

ERT (optimized for floating-point)

When you add an ERT (optimized for floating-point) block to your Simulink model and double-click it, a predefined MATLAB script executes and automatically configures the model parameters optimally for floating-point code generation with the ERT target. You can also set a block option to invoke the build process after configuring the model.

After double-clicking the block, you can verify that the model parameter values have changed by opening the Configuration Parameters dialog box and examining the settings.

---

**Note** You can include more than one Configuration Wizard block in your model. This provides a quick way to switch between configurations.

---

**Parameters**

**Configure the model for**

Value selected from

- ERT (optimized for fixed-point)
- ERT (optimized for floating-point)
- GRT (optimized for fixed/floating-point)
- GRT (debug for fixed/floating-point)
- Custom

For this block, ERT (optimized for floating-point) is selected by default.

## ERT (optimized for floating-point)

---

### **Configuration function**

Grayed out unless **Configure the model for** is set to Custom.  
This parameter is used with the Custom MATLAB file block.

### **Invoke build process after configuration**

If selected, the script initiates the code generation and build process after updating the model's configuration parameters. If not selected (the default), the build process is not initiated.

### **See Also**

Custom MATLAB file, ERT (optimized for fixed-point), GRT (debug for fixed/floating-point), GRT (optimized for fixed/floating-point)

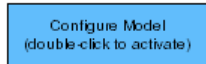
“Wizard” in the Embedded Coder documentation

# GRT (debug for fixed/floating-point)

---

**Purpose** Automatically update active configuration parameters of parent model for GRT fixed- or floating-point code generation with debugging enabled

**Library** Configuration Wizards



**Description** GRT (debug for fixed/floating-point)

When you add a GRT (debug for fixed/floating-point) block to your Simulink model and double-click it, a predefined MATLAB script executes and automatically configures the model parameters optimally for fixed/floating-point code generation, with TLC debugging options enabled, with the GRT target. You can also set a block option to invoke the build process after configuring the model.

After double-clicking the block, you can verify that the model parameter values have changed by opening the Configuration Parameters dialog box and examining the settings.

---

**Note** You can include more than one Configuration Wizard block in your model. This provides a quick way to switch between configurations.

---

## Parameters

### Configure the model for

Value selected from

- ERT (optimized for fixed-point)
- ERT (optimized for floating-point)
- GRT (optimized for fixed/floating-point)
- GRT (debug for fixed/floating-point)
- Custom

For this block, GRT (debug for fixed/floating-point) is selected by default.

# GRT (debug for fixed/floating-point)

---

## **Configuration function**

Grayed out unless **Configure the model for** is set to Custom.  
This parameter is used with the Custom MATLAB file block.

## **Invoke build process after configuration**

If selected, the script initiates the code generation and build process after updating the model's configuration parameters. If not selected (the default), the build process is not initiated.

## **See Also**

Custom MATLAB file, ERT (optimized for fixed-point), ERT (optimized for floating-point), GRT (optimized for fixed/floating-point)

“Wizard” in the Embedded Coder documentation

# GRT (optimized for fixed/floating-point)

---

**Purpose** Automatically update active configuration parameters of parent model for GRT fixed- or floating-point code generation

**Library** Configuration Wizards



**Description** GRT (optimized for fixed/floating-point)

When you add a GRT (optimized for fixed/floating-point) block to your Simulink model and double-click it, a predefined MATLAB script executes and automatically configures the model parameters optimally for fixed/floating-point code generation with the GRT target. You can also set a block option to invoke the build process after configuring the model.

After double-clicking the block, you can verify that the model parameter values have changed by opening the Configuration Parameters dialog box and examining the settings.

---

**Note** You can include more than one Configuration Wizard block in your model. This provides a quick way to switch between configurations.

---

**Parameters** **Configure the model for**  
Value selected from

- ERT (optimized for fixed-point)
- ERT (optimized for floating-point)
- GRT (optimized for fixed/floating-point)
- GRT (debug for fixed/floating-point)
- Custom

For this block, GRT (optimized for fixed/floating-point) is selected by default.

# GRT (optimized for fixed/floating-point)

---

## **Configuration function**

Grayed out unless **Configure the model for** is set to Custom.  
This parameter is used with the Custom MATLAB file block.

## **Invoke build process after configuration**

If selected, the script initiates the code generation and build process after updating the model's configuration parameters. If not selected (the default), the build process is not initiated.

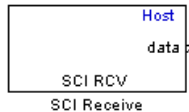
## **See Also**

Custom MATLAB file, ERT (optimized for fixed-point), ERT (optimized for floating-point), GRT (debug for fixed/floating-point)

“Wizard” in the Embedded Coder documentation

**Purpose** Configure host-side serial communications interface to receive data from serial port

**Library** Embedded Coder/ Embedded Targets/ Host Communication



## Description

Specify the configuration of data being received from the target by this block.

The data package being received is limited to 16 bytes of ASCII characters, including package headers and terminators. Calculate the size of a package by including the package header, or terminator, or both, and the data size.

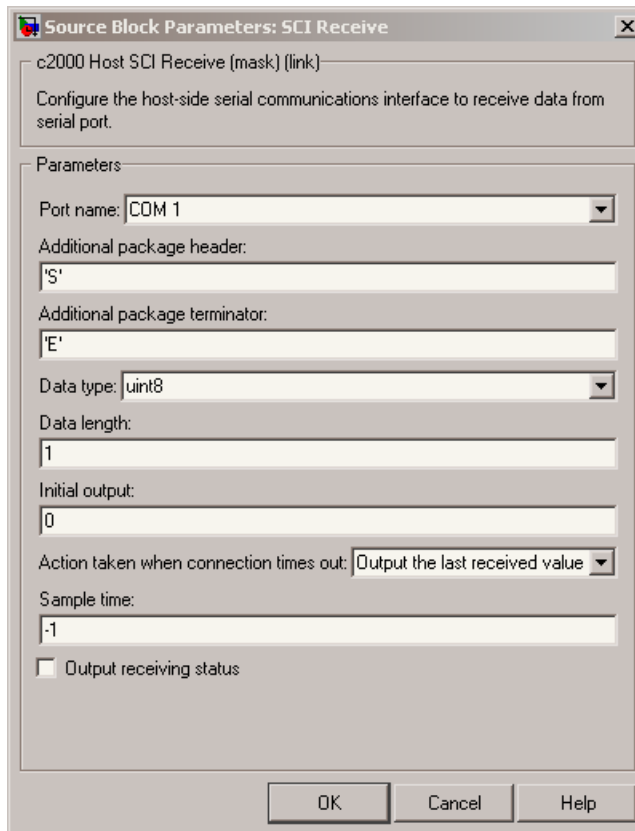
Acceptable data types are `single`, `int8`, `uint8`, `int16`, `uint16`, `int32`, or `uint32`. The number of bytes in each data type is listed in the following table:

| Data Type                                  | Byte Count |
|--------------------------------------------|------------|
| <code>single</code>                        | 4 bytes    |
| <code>int8</code> and <code>uint8</code>   | 1 byte     |
| <code>int16</code> and <code>uint16</code> | 2 bytes    |
| <code>int32</code> and <code>uint32</code> | 4 bytes    |

For example, if your data package has package header 'S' (1 byte) and package terminator 'E' (1 byte), that leaves 14 bytes for the actual data. If your data is of type `int8`, there is room in the data package for 14 `int8`s. If your data is of type `uint16`, there is room in the data package for 7 `uint16`s. If your data is of type `int32`, there is room in the data package for only 3 `int32`s, with 2 bytes left over. Even though you could fit two `int8`s or one `uint16` in the remaining space, you may not, because you cannot mix data types in the same package.

# Host SCI Receive

The number of data types that can fit into a data package determine the data length (see **Data length** in the Dialog Box description). In the example just given, the 14 for data type `int8` and the 7 for data type `uint16` are the data lengths for each data package, respectively. When the data length exceeds 16 bytes, unexpected behavior, including run time errors, may result.



## Dialog Box

### Port name

You may configure up to four COM ports (COM1 through COM4) for up to four host-side SCI Receive blocks.



## Additional package header

This field specifies the data located at the front of the received data package, which is not part of the data being received, and generally indicates start of data. The additional package header must be an ASCII value. You can use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not received nor are they included in the total byte count.

---

**Note** Match additional package headers or terminators with those specified in the target SCI transmit block.

---

## Additional package terminator

This field specifies the data located at the end of the received data package, which is not part of the data being received, and generally indicates end of data. The additional package terminator must be an ASCII value. You can use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not received nor are they included in the total byte count.

## Data type

Choice of single, int8, uint8, int16, uint16, int32, or uint32.

The input port of the SCI Transmit block accepts only one of these values. Which value it accepts is inherited from the data type from the input (the data length is also inherited from the input). Data must consist of only one data type; you cannot mix types.

## Data length

How many of **Data type** the block receives (not bytes). Anything more than 1 is a vector. The data length is inherited from the input (the data length input to the SCI Transmit block).

# Host SCI Receive

---

## Initial output

Default value from the SCI Receive block. This value is used, for example, if a connection time-out occurs and the **Action taken when connection timeout** field is set to “Output the last received value”, but nothing yet has been received.

## Action Taken when connection times out

Specify what to output if a connection time-out occurs. If “Output the last received value” is selected, the block outputs the last received value. If a value has not been received, the block outputs the **Initial output**.

If you select **Output custom value**, use the **Output value when connection times out** field to set the custom value.

## Sample time

Determines how often the SCI Receive block is called (in seconds). When you set this value to -1, the model inherits the sample time value of the model. To execute this block asynchronously, set **Sample Time** to -1, and refer to “” for a discussion of block placement and other settings.

## Output receiving status

Selecting this checkbox creates a **Status** block output that provides the status of the transaction.

The error status may be one of the following values:

- 0: No errors
- 1: A time-out occurred while the block was waiting to receive data
- 2: There is an error in the received data (checksum error)
- 3: SCI parity error flag — Occurs when a character is received with a mismatch
- 4: SCI framing error flag — Occurs when an expected stop bit is not found

**See Also**      “SCI\_A, SCI\_B, SCI\_C” on page 3-289

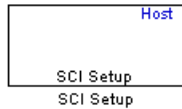
# Host SCI Setup

---

**Purpose** Configure COM ports for host-side SCI Transmit and Receive blocks

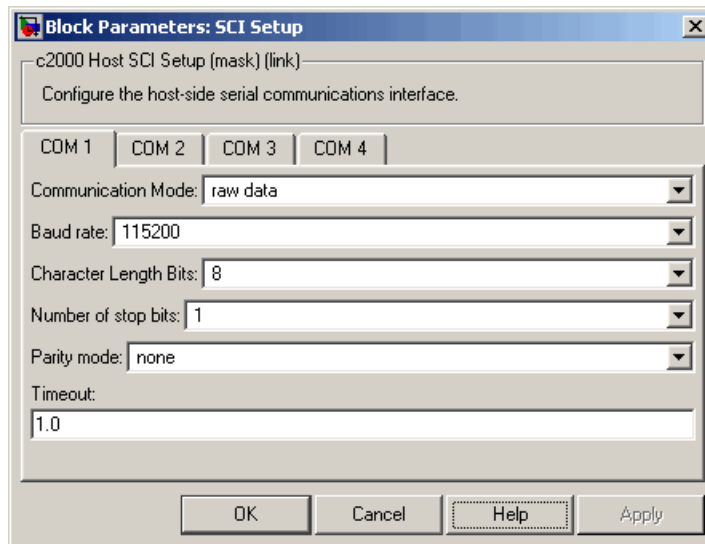
**Library** Embedded Coder/ Embedded Targets/ Host Communication

**Description**



Standardize COM port settings for use by the host-side SCI Transmit and Receive blocks. Setting COM port configurations globally with the SCI Setup block avoids conflicts (e.g., the host-side SCI Transmit block cannot use COM1 with settings different than those the COM1 used by the host-side SCI Receive block) and requires that you set configurations only once for each COM port. The SCI Setup block is a stand alone block.

## Dialog Box



### Communication Mode

Raw data or protocol. Raw data is unformatted and sent whenever the transmitting side is ready to send, whether the receiving side is ready or not. Without a wait state, deadlocks do not occur. Data transmission is asynchronous. With this mode, it is possible the receiving side could miss data, but if the data is noncritical, using raw data mode can avoid blocking processes.

If you specify protocol mode, some handshaking between host and target occurs. The transmitting side sends \$SND indicating that it is ready to transmit. The receiving side sends back \$RDY indicating that it is ready to receive. The transmitting side then sends data and, when the transmission is completed, it sends a checksum.

Advantages to using protocol mode include

- Data is received as expected (checksum)
- Data is received by target

# Host SCI Setup

---

- Time consistency; each side waits for its turn to send or receive

---

**Note** Deadlocks can occur if one SCI Transmit block is trying to communicate with more than one SCI Receive block on different COM ports when both are blocking (using protocol mode). Deadlocks cannot occur on the same COM port.

---

## **Baud rate**

Choose from 110, 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

## **Number of stop bits**

Select 1 or 2.

## **Parity mode**

Select none, odd, or even.

## **Timeout**

Enter values greater than or equal to 0, in seconds. When the COM port involved is using protocol mode, this value indicates how long the transmitting side waits for an acknowledgement from the receiving side or how long the receiving side waits for data. The system displays a warning message if the time-out is exceeded, every  $n$  number of seconds,  $n$  being the value in **Timeout**.

---

**Note** Simulink suspends processing for the length of the time-out. During that time you cannot perform actions in Simulink. If the time-out is set for a long period of time, it may appear that Simulink has frozen.

---

## **See Also**

“SCI\_A, SCI\_B, SCI\_C” on page 3-289

**Purpose** Configure host-side serial communications interface to transmit data to serial port

**Library** Embedded Coder/ Embedded Targets/ Host Communication

## Description



Specify the configuration of data being transmitted to the target from this block.

The data package being sent is limited to 16 bytes of ASCII characters, including package headers and terminators. Calculate the size of a package by figuring in package header, or terminator, or both, and the data size.

Acceptable data types are `single`, `int8`, `uint8`, `int16`, `uint16`, `int32`, or `uint32`. The byte size of each data type is as follows:

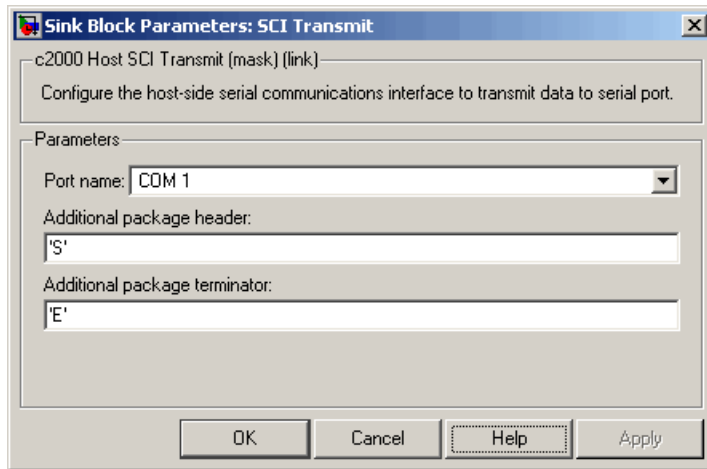
| Data Type                                | Byte Count |
|------------------------------------------|------------|
| <code>single</code>                      | 4 bytes    |
| <code>int8</code> & <code>uint8</code>   | 1 byte     |
| <code>int16</code> & <code>uint16</code> | 2 bytes    |
| <code>int32</code> & <code>uint32</code> | 4 bytes    |

For example, if your data package has package header “S” (1 byte) and package terminator “E” (1 byte), that leaves 14 bytes for the actual data. If your data is of type `int8`, there is room in the data package for 14 `int8`s. If your data is of type `uint16`, there is room in the data package for only 7 `uint16`s. If your data is of type `int32`, there is room in the data package for only 3 `int32`s, with 2 bytes left over. Even though you could fit two `int8`s or one `uint16` in the remaining space, you may not, because you cannot mix data types in the same package.

# Host SCI Transmit

---

The number of data types that can fit into a data package determine the data length (see **Data length** in the Dialog Box description). In the example just given, the 14 for data type int8 and the 7 for data type uint16 are the data lengths for each data package, respectively. When the data length exceeds 16 bytes, unexpected behavior, including run time errors, may result.



## Dialog Box

### Port name

You may configure up to four COM ports (COM1 through COM4) for up to four host-side SCI Transmit blocks.

### Additional package header

This field specifies the data located at the front of the transmitted data package, which is not part of the data being transmitted, and generally indicates start of data. The additional package header must be an ASCII value. You can use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not sent nor are they included in the total byte count.



---

**Note** Match additional package headers or terminators with those specified in the target SCI receive block.

---

### **Additional package terminator**

This field specifies the data located at the end of the transmitted data package, which is not part of the data being sent, and generally indicates end of data. The additional package terminator must be an ASCII value. You can use a string or number (0–255). You must put single quotes around strings entered in this field, but the quotes are not transmitted nor are they included in the total byte count.

### **See Also**

“SCI\_A, SCI\_B, SCI\_C” on page 3-289

# Idle Task

---

## Purpose

Create free-running task

## Library

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ Scheduling

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
SHARC®/ Scheduling

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
TigerSHARC®/ Scheduling

Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C2000/ Scheduling

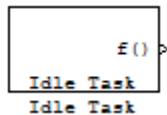
Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C5000/ Scheduling

Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C6000/ Scheduling

Embedded Coder Support Package for Green Hills MULTI IDE/ Analog  
Devices Blackfin/ Scheduling

Embedded Coder Support Package for Green Hills MULTI IDE/  
Freescale MPC55xx MPC74xx/ Scheduling

## Description



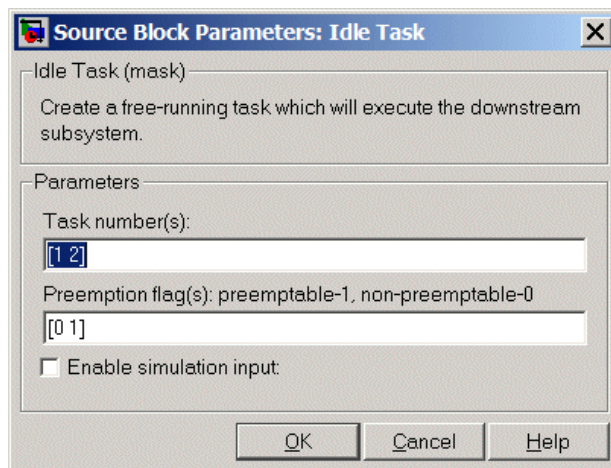
The Idle Task block, and the subsystem connected to it, specify one or more functions to execute as background tasks. The tasks executed through the Idle Task block are of the lowest priority, lower than that of the base rate task.

This block is not supported on targets running an operating system or RTOS.

## Vectorized Output

The block output comprises a set of vectors—the task numbers vector and the preemption flag or flags vector. A preemption-flag vector must be the same length as the number of tasks vector unless the preemption flag vector has only one element. The value of the preemption flag determines whether a given interrupt (and task) is preemptible. Preemption overrides prioritization. A lower-priority nonpreemptible task can preempt a higher-priority preemptible task.

When the preemption flag vector has one element, that element value applies to the functions in the downstream subsystem as defined by the task numbers in the task number vector. If the preemption flag vector has the same number of elements as the task number vector, each task defined in the task number vector has a preemption status defined by the value of the corresponding element in the preemption flag vector.



## Dialog Box

### Task numbers

Identifies the created tasks by number. Enter as many tasks as you need by entering a vector of integers. The default values are [1,2] to indicate that the downstream subsystem has two functions.

# Idle Task

---

The values you enter determine the execution order of the functions in the downstream subsystem, while the number of values you enter corresponds to the number of functions in the downstream subsystem.

Enter a vector containing the same number of elements as the number of functions in the downstream subsystem. This vector can contain up to 16 elements, and the values must be from 0 to 15 inclusive.

The value of the first element in the vector determines the order in which the first function in the subsystem is executed, the value of the second element determines the order in which the second function in the subsystem is executed, and so on.

For example, entering [2,3,1] in this field indicates that there are three functions to be executed, and that the third function is executed first, the first function is executed second, and the second function is executed third. After the functions are executed, the Idle Task block cycles back and repeats the execution of the functions in the same order.

## Preemption flags

Higher-priority interrupts can preempt interrupts that have lower priority. To allow you to control preemption, use the preemption flags to specify whether an interrupt can be preempted.

Entering 1 indicates that the interrupt can be preempted. Entering 0 indicates the interrupt cannot be preempted. When **Task numbers** contains more than one task, you can assign different preemption flags to each task by entering a vector of flag values, corresponding to the order of the tasks in **Task numbers**. If **Task numbers** contains more than one task, and you enter only one flag value here, that status applies to the tasks.

In the default settings [0 1], the task with priority 1 in **Task numbers** is not preemptible, and the priority 2 task can be preempted.

### **Enable simulation input**

When you select this option, Simulink software adds an input port to the Idle Task block. This port is used in simulation only. Connect one or more simulated interrupt sources to the simulation input.

---

**Note** Select this check box to test asynchronous interrupt processing behavior in Simulink software.

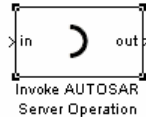
---

# Invoke AUTOSAR Server Operation

---

**Purpose** Configure AUTOSAR client port to access Basic Software or application software components

**Library** Embedded Coder/ AUTOSAR



## Description

Use this block to configure an AUTOSAR client port for your Simulink model, which provides access to Basic Software or application software components:

- 1 Copy or drag this block from the AUTOSAR library into your model.
- 2 Double-click the block to open the Invoke AUTOSAR Server Operation dialog box.
- 3 Specify the parameters and click **OK**. This action updates the number of inports and outports to match the operation prototype.
- 4 Connect this block to other blocks in your model as required.
- 5 Save and build the model to generate AUTOSAR-compliant code and XML files.

---

**Note** If you run a SIL simulation with a model that contains an Invoke AUTOSAR Server block, the software sets the return arguments from the block to ground values.

---

Simulink does not support pointer data types. If you want to pass a NULL pointer as an input argument to your operation:

# Invoke AUTOSAR Server Operation

---

- 1 Specify the data type of the argument as `uint8`.
- 2 Connect a constant signal with data type `uint8` and value 0 to the corresponding input port of the block.
- 3 Check that your client-server interface XML file specifies the argument as an array with data type `uint8`.

## Parameters

### Client port name

Must be a valid AUTOSAR short-name identifier.

### Operation prototype

Controls the type and number of inports and outports of the block, and must be of the form:

```
operation(prt1 datatype1 arg1, prt2 datatype2 arg2, ...
prtN datatypeN argN, ...)
```

- *operation* — Name of the operation
- *prtN*. Either IN or OUT, which indicates whether data passes into or out of the function.
- *datatypeN* — A string indicating data type, which can be an AUTOSAR basic data type or record, Simulink data type, or array.
- *argN* — Name of the argument

### Interface path

The reference path for the client-server interface XML file that you provide.

### Server type

You select the value from:

- `Application software` — For communication with an application software component.
- `Basic software` — For communication with AUTOSAR Basic Software.

# Invoke AUTOSAR Server Operation

---

For this block, Application software is the default.

## **Show error status**

If you select this, client port receives error status of client-server communication.

## **Sample time (-1 for inherited)**

To inherit the sample time, set this parameter to -1.

## **See Also**

Mode Switch for Invoke AUTOSAR Server Operation

“Configure AUTOSAR Client-Server Communication” and  
rtwdemo\_autosar\_PIM\_script in the Embedded Coder documentation



**Purpose**

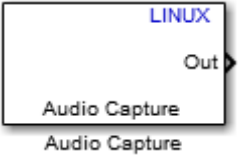
Capture ALSA audio from sound card and output data

**Library**

Embedded Coder/ Embedded Targets/ Operating Systems/ Embedded Linux

Simulink Coder / Desktop Targets/ Operating Systems/ Linux

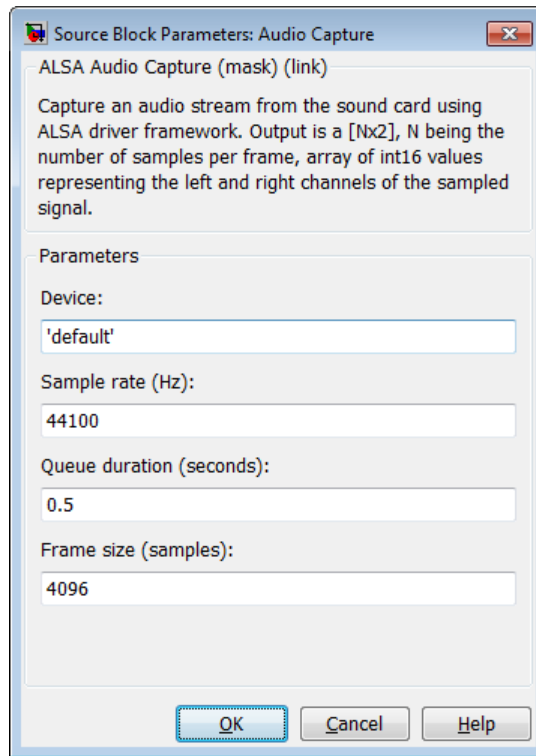
**Description**



This block uses the ALSA driver framework to capture an audio stream from a sound card. It outputs the left and right channels of the signal as an [Nx2] frame of int16 values. N is the number of samples per frame.

# Linux Audio Capture

---



## Dialog

### Device

Use the default ALSA device, or enter the name of a specific audio output device.

Entering 'default' selects the ALSA device specified by an ALSA configuration file on your target Linux system.

One of the following ALSA configuration files defines the default device:

- `/etc/asound.conf`, which defines system-wide options for all users

- `~/.asoundrc`, which overrides `/etc/asound.conf` for the current user

The entry that specifies the default device looks similar to this example:

```
pcm.!default {
 type hw
 card 0
 device 2
}
```

To enter the name of an alternate audio input device, review the `/proc/asound/cards` file on your target Linux system. For example, if `/proc/asound/cards` contained the following entries, you could set the value of **Device** to `'AudioPCI'` :

```
$ cat /proc/asound/cards

0 [Dummy]: Dummy - Dummy
 Dummy 1

1 [VirMIDI]: VirMIDI - VirMIDI
 Virtual MIDI Card 1

2 [AudioPCI]: ENS1371 - Ensoniq AudioPCI
 Ensoniq AudioPCI ENS1371 at 0xe400, irq 11
```

The default value for **Device** is `'default'`.

## Sample rate (Hz)

Enter a value that matches the sample rate of the ALSA audio output.

By default, the sample rate of the ALSA output equals the output of the audio capture device. In this case, enter the sample rate of the audio capture device.

# Linux Audio Capture

---

The `/etc/asound.conf` and `~/.asoundrc` files can configure ALSA to downsample the signal from the audio capture device. In this case, enter the downsample rate specified by the configuration files. For example, if one of the configuration files contained the following entry, you would set the value of **Sample rate (Hz)** to 16000 :

```
pcm_slave.sl3 {
 pcm ens1371
 format S16_LE
 channels 1
 rate 16000
}
pcm.complex_convert {
 type plug
 slave sl3
}
```

The default value for **Sample rate (Hz)** is 44100 Hz (44.1 kHz). The maximum rate equals the sampling rate of the audio capture device.

## **Queue duration (seconds)**

Set the duration of the queue in seconds. This queue provides a software-based frame buffer between the ALSA output and the Linux Audio Capture block. The queue prevents dropped data caused by temporary mismatches in the rate of data arriving and leaving the queue. Higher values can handle more significant mismatches, but such values also increase signal latency and memory usage.

The default value for **Queue duration (seconds)** is 0.5 seconds.

## **Frame size (samples)**

Set the number of samples per frame in the output this block sends to your model. The default value for this parameter is 4096 samples.

**References**      <http://www.alsa-project.org>

**See Also**        <http://www.alsa-project.org>  
Linux Audio Playback  
Linux Task

# Linux Audio Playback

---

## Purpose

Send audio data stream to ALSA audio device output

## Library

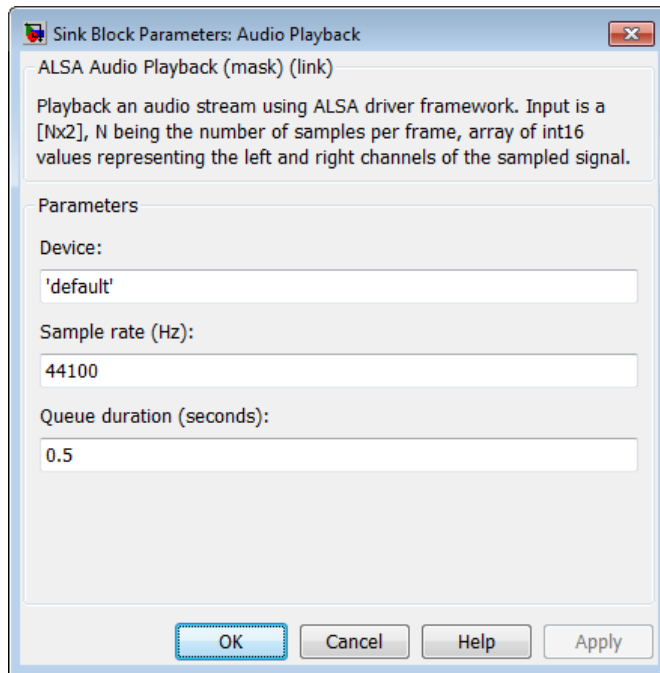
Embedded Coder/ Embedded Targets/ Operating Systems/ Embedded Linux (linuxlib)

Simulink Coder / Desktop Targets/ Operating Systems/ Linux



## Description

This block takes a stream of audio data and sends it to the output jack of an ALSA audio device. The block input, **In**, takes the left and right channels of data as an [Nx2] frame of int16 values. N is the number of samples per frame.



## Dialog

### Device

Use the default ALSA device, or enter the name of a specific audio device.

Entering 'default' selects the ALSA device specified by an ALSA configuration file on your target Linux system.

One of the following ALSA configuration files defines the default device:

- `/etc/asound.conf`, which defines system-wide options for all users
- `~/.asoundrc`, which overrides `/etc/asound.conf` for the current user

# Linux Audio Playback

---

The entry that specifies the default device looks like this hypothetical example:

```
pcm.!default {
 type hw
 card 0
 device 2
}
```

To enter the name of an alternate audio device, consult the `/proc/asound/cards` file on your target Linux system. For example, if `/proc/asound/cards` contained the following hypothetical entries, you could set the value of **Device** to `'AudioPCI'`:

```
$ cat /proc/asound/cards

0 [Dummy]: Dummy - Dummy
 Dummy 1

1 [VirMIDI]: VirMIDI - VirMIDI
 Virtual MIDI Card 1

2 [AudioPCI]: ENS1371 - Ensoniq AudioPCI
 Ensoniq AudioPCI ENS1371 at 0xe400, irq 11
```

The default value for **Device** is `'default'`.

## Sample rate (Hz)

Enter a value that matches the sample rate of the ALSA audio output.

By default, the sample rate of the ALSA output is the same as the output of the audio capture device. In this case, enter the sample rate of the audio capture device.

The `/etc/asound.conf` and `~/.asoundrc` files can configure ALSA to downsample the signal from the audio capture device. In



this case, enter the downsample rate specified by the configuration files. For example, if one of the configuration files contained the following hypothetical entry, you would set the value of **Sample rate (Hz)** to 16000 :

```
pcm_slave.sl3 {
 pcm ens1371
 format S16_LE
 channels 1
 rate 16000
}
pcm.complex_convert {
 type plug
 slave sl3
}
```

The default value for **Sample rate (Hz)** is 44100 Hz (44.1 kHz). The maximum rate is the sampling rate of the audio capture device.

### **Queue duration (seconds)**

Set the duration of the queue in seconds. This queue provides a software-based frame buffer between the ALSA audio device and this block. The queue prevents dropped data caused by temporary mismatches in the rate of data arriving and leaving the queue. Higher values can handle more significant mismatches, but increase signal latency and memory usage.

The default value for **Queue duration (seconds)** is 0.5 seconds.

### **See Also**

<http://www.alsa-project.org>

Linux Audio Capture

Linux Task

# Linux Task

## Purpose

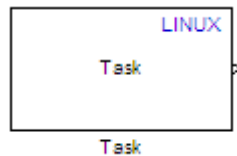
Spawn task function as separate Linux thread

## Library

Embedded Coder/ Embedded Targets/ Operating Systems/ Embedded Linux

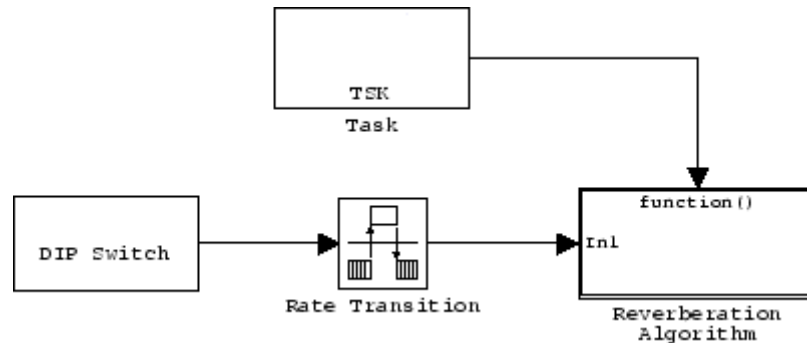
Embedded Coder Support Package for Xilinx® Zynq®-7000 Platform

Simulink Coder / Desktop Targets/ Operating Systems/ Linux



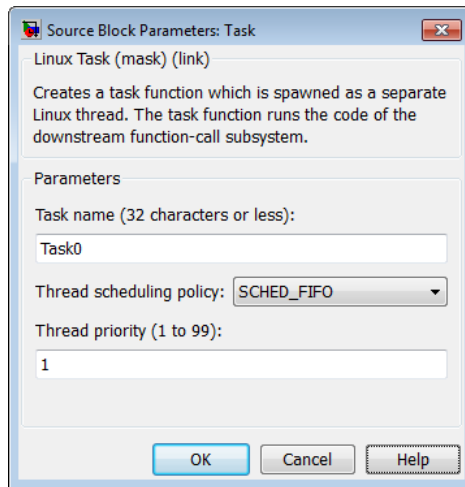
## Description

Use this block to create a task function that spawns as a separate Linux thread. The task function runs the code of the downstream function-call subsystem. For example:



In order to use this block, set the **System target file** parameter to `idmlink_ert.tlc` or `idmlink_ert.tlc`. The **System target file** parameter is located on the Code Generation pane of the Model Configuration Parameters dialog, which you can view by selecting your model and pressing **Ctrl+E**.

## Dialog



### Task name

Assign a name to this task. You can enter up to 32 letters and numbers. Do not use standard C reserved characters, such as the / and : characters.

### Thread scheduling policy

Select the scheduling policy that applies to this thread. You can choose from the following options:

- `SCHED_FIFO` enables a First In, First Out scheduling algorithm that executes real-time processes without time slicing. With FIFO scheduling, a higher-priority process preempts a lower-priority process. The lower-priority process remains at the top of the list for its priority and resumes execution when the scheduler blocks all higher-priority processes.

For example, in the following image, task2 preempts task1. Then task3 preempts task2. When task3 completes, task2 resumes. When task2 completes, task1 resumes.



## Linux Audio Playback

# Memory Allocate

---

## Purpose

Allocate memory section

## Library

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
SHARC/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
TigerSHARC/ Memory Operations

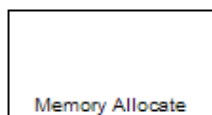
Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C2000/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C5000/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C6000/ Memory Operations

Embedded Coder Support Package for Green Hills MULTI IDE/ Analog  
Devices Blackfin/ Memory Operations

Embedded Coder Support Package for Green Hills MULTI IDE/  
Freescale MPC55xx MPC74xx/ Memory Operations



## Description

On C2xxx, C5xxx, or C6xxx processors, this block directs the TI compiler to allocate memory for a new variable you specify. Parameters in the block dialog box let you specify the variable name, the alignment of the variable in memory, the data type of the variable, and other features that fully define the memory required.

The block does not verify whether the entries for your variable are valid, such as checking the variable name, data type, or section. You

must check that all variable names are valid, that they use valid data types, and that all section names you specify are valid as well.

The block does not have input or output ports. It only allocates a memory location. You do not connect it to other blocks in your model.

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**Note** When using this block with Green Hills MULTI IDE and Blackfin processors, set the `-no_discard_zero_initializers` option.

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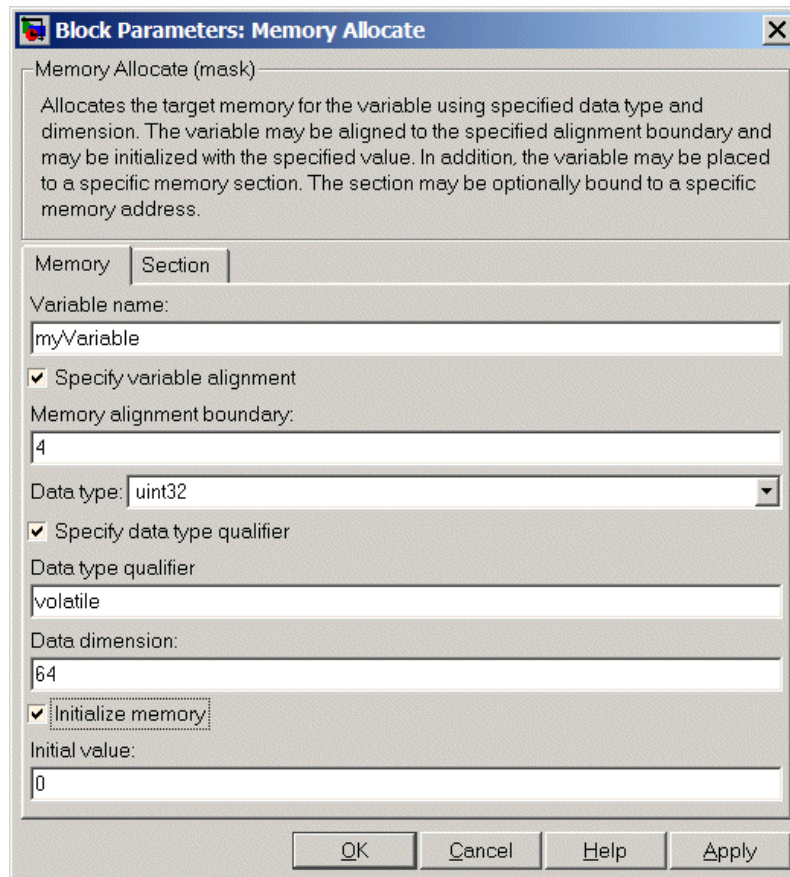
## Dialog Box

The block dialog box comprises multiple tabs:

- **Memory** — Allocate the memory for storing variables. Specify the data type and size.
- **Section** — Specify the memory section in which to allocate the variable.

The dialog box images show all of the available parameters enabled. Some of the parameters shown do not appear until you select one or more other parameters.

# Memory Allocate



The following sections describe the contents of each pane in the dialog box.



## Memory Parameters

**Block Parameters: Memory Allocate**

Memory Allocate (mask)

Allocates the target memory for the variable using specified data type and dimension. The variable may be aligned to the specified alignment boundary and may be initialized with the specified value. In addition, the variable may be placed to a specific memory section. The section may be optionally bound to a specific memory address.

Memory | Section

Variable name:  
myVariable

Specify variable alignment

Memory alignment boundary:  
4

Data type: uint32

Specify data type qualifier

Data type qualifier  
volatile

Data dimension:  
64

Initialize memory

Initial value:  
0

OK Cancel Help Apply

You find the following memory parameters on this tab.

### Variable name

Specify the name of the variable to allocate. The variable is allocated in the generated code.

# Memory Allocate

---

## **Specify variable alignment**

Select this option to direct the compiler to align the variable in **Variable name** to an alignment boundary. When you select this option, the **Memory alignment boundary** parameter appears so you can specify the alignment. Use this parameter and **Memory alignment boundary** when your processor requires this feature.

## **Memory alignment boundary**

After you select **Specify variable alignment**, this option enables you to specify the alignment boundary in bytes. If your variable contains more than one value, such as a vector or an array, the elements are aligned according to rules applied by the compiler.

## **Data type**

Defines the data type for the variable. Select from the list of types available.

## **Specify data type qualifier**

Selecting this enables **Data type qualifier** so you can specify the qualifier to apply to your variable.

## **Data type qualifier**

After you select **Specify data type qualifier**, you enter the desired qualifier here. `volatile` is the default qualifier. Enter the qualifier you need as text. Common qualifiers are `static` and `register`. The block does not check for valid qualifiers.

## **Data dimension**

Specifies the number of elements of the type you specify in **Data type**. Enter an integer here for the number of elements.

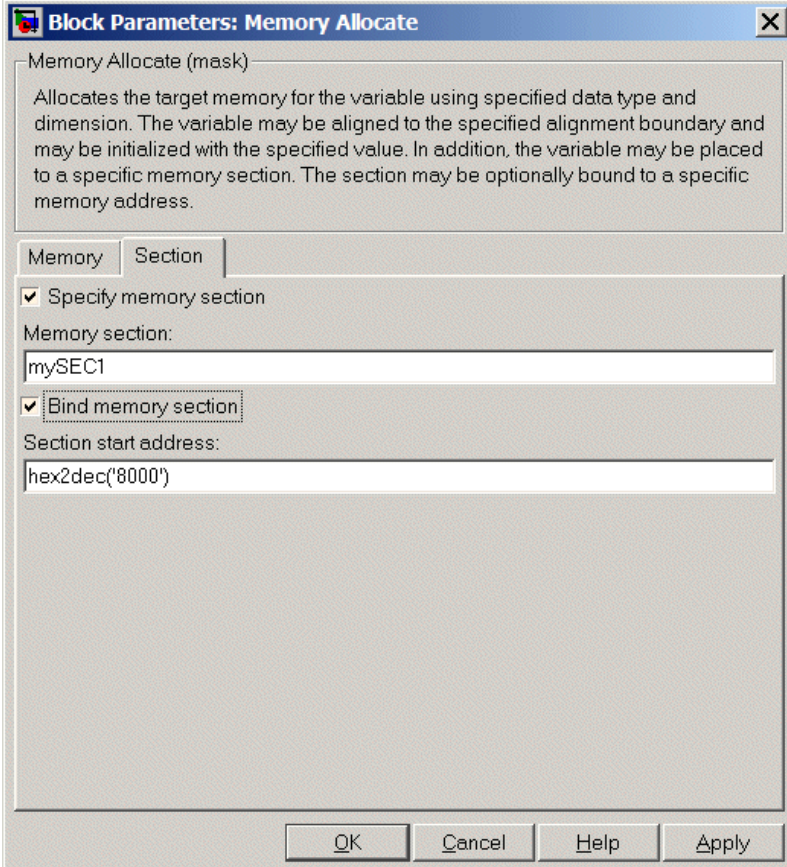
## **Initialize memory**

Directs the block to initialize the memory location to a fixed value before processing.

## **Initial value**

Specifies the initialization value for the variable. At run time, the block sets the memory location to this value.

## Section Parameters



**Block Parameters: Memory Allocate**

Memory Allocate (mask)

Allocates the target memory for the variable using specified data type and dimension. The variable may be aligned to the specified alignment boundary and may be initialized with the specified value. In addition, the variable may be placed to a specific memory section. The section may be optionally bound to a specific memory address.

Memory | **Section**

Specify memory section

Memory section:  
mySEC1

Bind memory section

Section start address:  
hex2dec('8000')

OK Cancel Help Apply

Parameters on this pane specify the section in memory to store the variable.

### Specify memory section

Selecting this parameter enables you to specify the memory section to allocate space for the variable. Enter either one of the

# Memory Allocate

---

standard memory sections or a custom section that you declare elsewhere in your code.

## Memory section

Identify a specific memory section to allocate the variable in **Variable name**. Verify that the section has enough space to store your variable. After you specify a memory section by selecting **Specify memory section** and entering the section name in **Memory section**, use **Bind memory section** to bind the memory section to a location.

## Bind memory section

After you specify a memory section by selecting **Specify memory section** and entering the section name in **Memory section**, use this parameter to bind the memory section to the location in memory specified in **Section start address**. When you select this, you enable the **Section start address** parameter.

The new memory section specified in **Memory section** is defined when you check this parameter.

---

**Note** Do not use **Bind memory section** for existing memory sections.

---

## Section start address

Specify the address to which to bind the memory section. Enter the address in decimal form or in hexadecimal with a conversion to decimal as shown by the default value `hex2dec('8000')`. The block does not verify the address—verify that the address exists and can contain the memory section you entered in **Memory section**.

## See Also

Memory Copy

## Purpose

Copy to and from memory section

## Library

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
Blackfin/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
SHARC/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
TigerSHARC/ Memory Operations

Embedded Coder Support Package for STMicroelectronics®  
STM32F4–Discovery Board/ Memory Operations

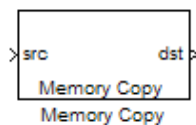
Embedded Coder Support Package for Texas Instruments C2000  
Processors/ Memory Operations

Embedded Coder/ Embedded Targets/ Processors/ Texas Instruments  
C5000/ Memory Operations

Embedded Coder Support Package for Texas Instruments C6000  
Processors/ Memory Operations

Embedded Coder Support Package for Green Hills MULTI IDE/ Analog  
Devices Blackfin/ Memory Operations

Embedded Coder Support Package for Green Hills MULTI IDE/  
Freescale MPC55xx MPC74xx/ Memory Operations



## Description

In generated code, this block copies variables or data from and to processor memory as configured by the block parameters. Your model can contain as many of these blocks as you require to manipulate memory on your processor.

Each block works with one variable, address, or set of addresses provided to the block. Parameters for the block let you specify both

# Memory Copy

---

the source and destination for the memory copy, as well as options for initializing the memory locations.

Using parameters provided by the block, you can change options like the memory stride and offset at run time. In addition, by selecting various parameters in the block, you can write to memory at program initialization, at program termination, and at every sample time. The initialization process occurs once, rather than occurring for every read and write operation.

With the custom source code options, the block enables you to add custom ANSI C source code before and after each memory read and write (copy) operation. You can use the custom code capability to lock and unlock registers before and after accessing them. For example, some processors have registers that you may need to unlock and lock with `EALLOW` and `EDIS` macros before and after your program accesses them.

If your processor or board supports quick direct memory access (QDMA) the block provides a parameter to check that implements the QDMA copy operation, and enables you to specify a function call that can indicate that the QDMA copy is finished. Only the C621x, C64xx, and C671x processor families support QDMA copy.

---

**Note** Replace Read from Memory and Write To Memory blocks, which were removed in a previous release, with the Memory Copy block.

---

## Block Operations

This block performs operations at three periods during program execution—initialization, real-time operations, and termination. With the options for setting memory initialization and termination, you control when and how the block initializes memory, copies to and from memory, and terminates memory operations. The parameters enable you to turn on and off memory operations in the three periods independently.

Used in combination with the Memory Allocate block, this block supports building custom device drivers, such as PCI bus drivers or codec-style drivers, by letting you manipulate and allocate memory. This block does not require the Memory Allocate block to be in the model.

In a simulation, this block does not perform an operation. The block output is not defined.

## Copy Memory

When you employ this block to copy an individual data element from the source to the destination, the block copies the element from the source in the source data type, and then casts the data element to the destination data type as provided in the block parameters.

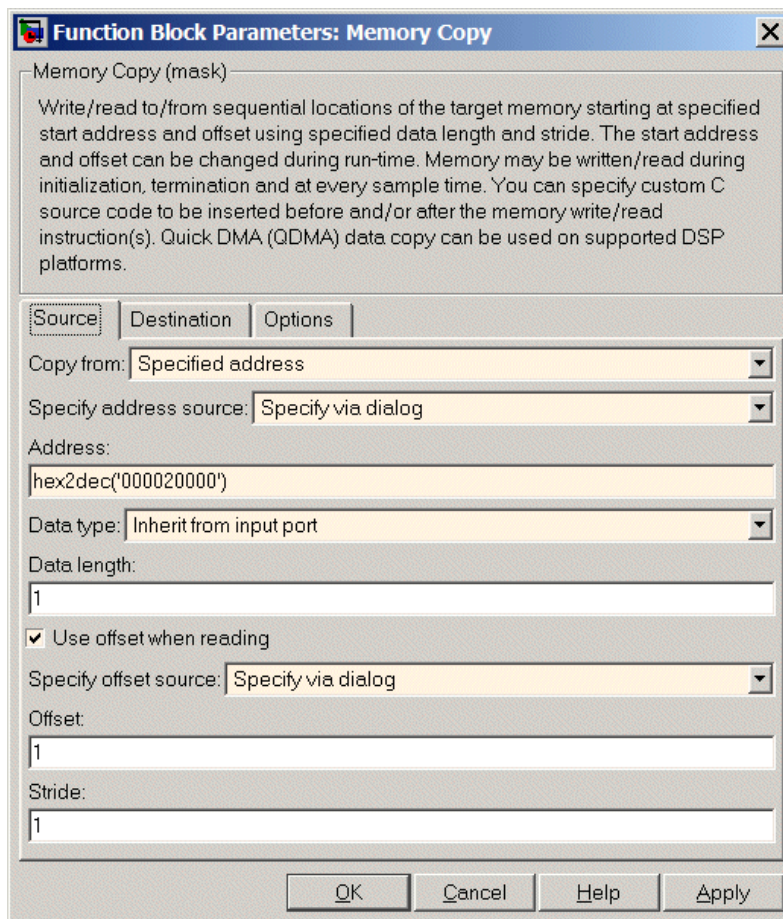
## Dialog Box

The block dialog box contains multiple tabs:

- **Source** — Identifies the sequential memory location to copy from. Specify the data type, size, and other attributes of the source variable.
- **Destination** — Specify the memory location to copy the source to. Here you also specify the attributes of the destination.
- **Options** — Select various parameters to control the copy process.

The dialog box images show many of the available parameters enabled. Some parameters shown do not appear until you select one or more other parameters. Some parameters are not shown in the figures, but the text describes them and how to make them available.

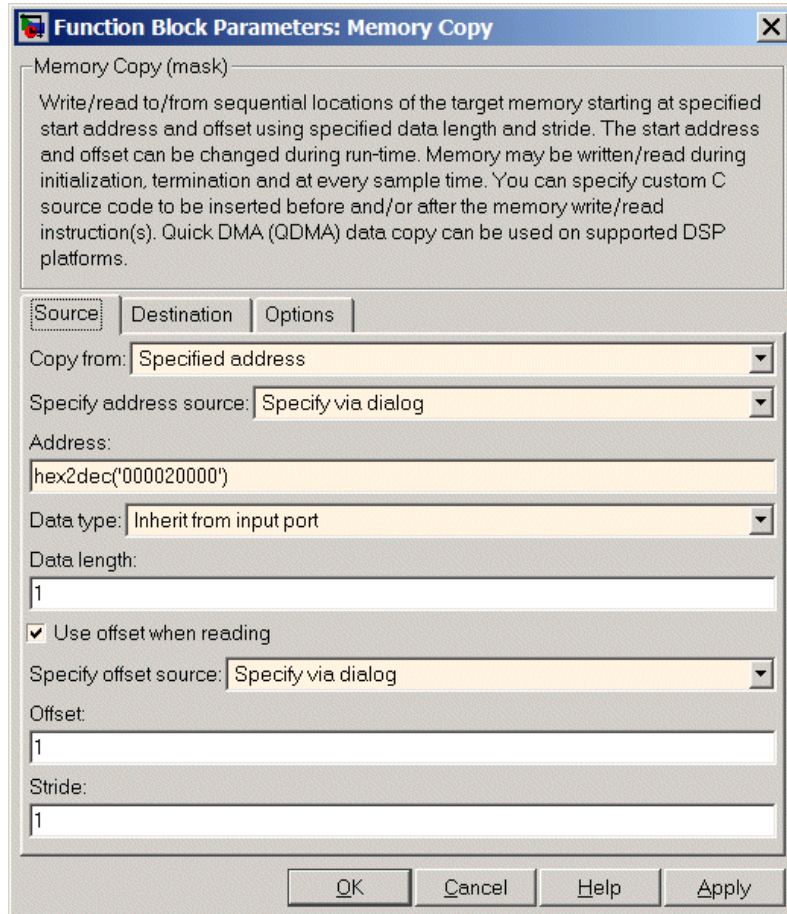
# Memory Copy



Sections that follow describe the parameters on each tab in the dialog box.



## Source Parameters



The image shows a dialog box titled "Function Block Parameters: Memory Copy". It contains a text area with a description of the Memory Copy block, followed by several input fields and a checkbox. The fields are: "Copy from:" (dropdown menu with "Specified address" selected), "Specify address source:" (dropdown menu with "Specify via dialog" selected), "Address:" (text field with "hex2dec('000020000')"), "Data type:" (dropdown menu with "Inherit from input port" selected), "Data length:" (text field with "1"), "Use offset when reading" (checkbox checked), "Specify offset source:" (dropdown menu with "Specify via dialog" selected), "Offset:" (text field with "1"), and "Stride:" (text field with "1"). At the bottom are buttons for "OK", "Cancel", "Help", and "Apply".

Memory Copy (mask)

Write/read to/from sequential locations of the target memory starting at specified start address and offset using specified data length and stride. The start address and offset can be changed during run-time. Memory may be written/read during initialization, termination and at every sample time. You can specify custom C source code to be inserted before and/or after the memory write/read instruction(s). Quick DMA (QDMA) data copy can be used on supported DSP platforms.

Source | Destination | Options

Copy from: Specified address

Specify address source: Specify via dialog

Address:  
hex2dec('000020000')

Data type: Inherit from input port

Data length:  
1

Use offset when reading

Specify offset source: Specify via dialog

Offset:  
1

Stride:  
1

OK Cancel Help Apply

### Copy from

Select the source of the data to copy. Choose one of the entries on the list:

- **Input port** — This source reads the data from the block input port.

# Memory Copy

---

- **Specified address** — This source reads the data at the specified location in **Specify address source** and **Address**.
- **Specified source code symbol** — This source tells the block to read the symbol (variable) you enter in **Source code symbol**. When you select this copy from option, you enable the **Source code symbol** parameter.

---

**Note** If you do not select **Input port** for **Copy from**, change **Data type** from the default **Inherit from source** to one of the data types on the **Data type** list. If you do not make the change, you receive an error message that the data type cannot be inherited because the input port does not exist.

---

Depending on the choice you make for **Copy from**, you see other parameters that let you configure the source of the data to copy.

## **Specify address source**

This parameter directs the block to get the address for the variable either from an entry in **Address** or from the input port to the block. Select either **Specify via dialog** or **Input port** from the list. Selecting **Specify via dialog** activates the **Address** parameter for you to enter the address for the variable.

When you select **Input port**, the port label on the block changes to **&src**, indicating that the block expects the address to come from the input port. Being able to change the address dynamically lets you use the block to copy different variables by providing the variable address from an upstream block in your model.

## **Source code symbol**

Specify the symbol (variable) in the source code symbol table to copy. The symbol table for your program must include this symbol. The block does not verify that the symbol exists and uses valid syntax. Enter a string to specify the symbol exactly as you use it in your code.

## Address

When you select **Specify via dialog** for the address source, you enter the variable address here. Addresses should be in decimal form. Enter either the decimal address or the address as a hexadecimal string with single quotations marks and use `hex2dec` to convert the address to the expected format. The following example converts `0x1000` to decimal form.

```
4096 = hex2dec('1000');
```

For this example, you could enter either `4096` or `hex2dec('1000')` as the address.

## Data type

Use this parameter to specify the type of data that your source uses. The list includes the supported data types, such as `int8`, `uint32`, and `Boolean`, and the option `Inherit from source` for inheriting the data type from the block input port.

## Data length

Specifies the number of elements to copy from the source location. Each element has the data type specified in **Data type**.

## Use offset when reading

When you are reading the input, use this parameter to specify an offset for the input read. The offset value is in elements with the assigned data type. The **Specify offset source** parameter becomes available when you check this option.

## Specify offset source

The block provides two sources for the offset — `Input port` and `Specify via dialog`. Selecting `Input port` configures the block input to read the offset value by adding an input port labeled `src ofs`. This port enables your program to change the offset dynamically during execution by providing the offset value as an input to the block. If you select `Specify via dialog`, you enable the **Offset** parameter in this dialog box so you can enter the offset to use when reading the input data.

# Memory Copy

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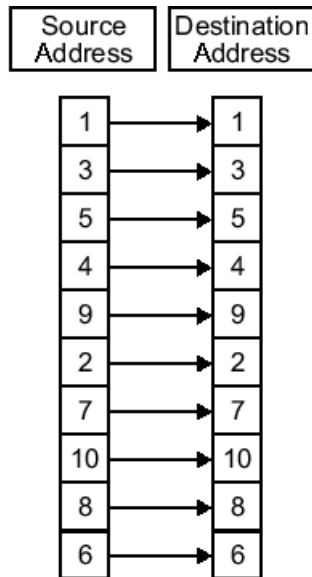
## Offset

**Offset** tells the block whether to copy the first element of the data at the input address or value, or skip one or more values before starting to copy the input to the destination. **Offset** defines how many values to skip before copying the first value to the destination. Offset equal to one is the default value and **Offset** accepts only positive integers of one or greater.

## Stride

Stride lets you specify the spacing for reading the input. By default, the stride value is one, meaning the generated code reads the input data sequentially. When you add a stride value that is not equal to one, the block reads the input data elements not sequentially, but by skipping spaces in the source address equal to the stride. **Stride** must be a positive integer.

The next two figures help explain the stride concept. In the first figure you see data copied without a stride. Following that figure, the second figure shows a stride value of two applied to reading the input when the block is copying the input to an output location. You can specify a stride value for the output with parameter **Stride** on the **Destination** pane. Compare stride with offset to see the differences.

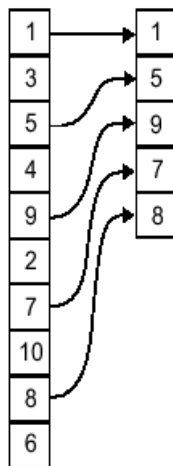


Input Stride = 1  
Output Stride = 1  
Number of Elements Copied = 10

# Memory Copy

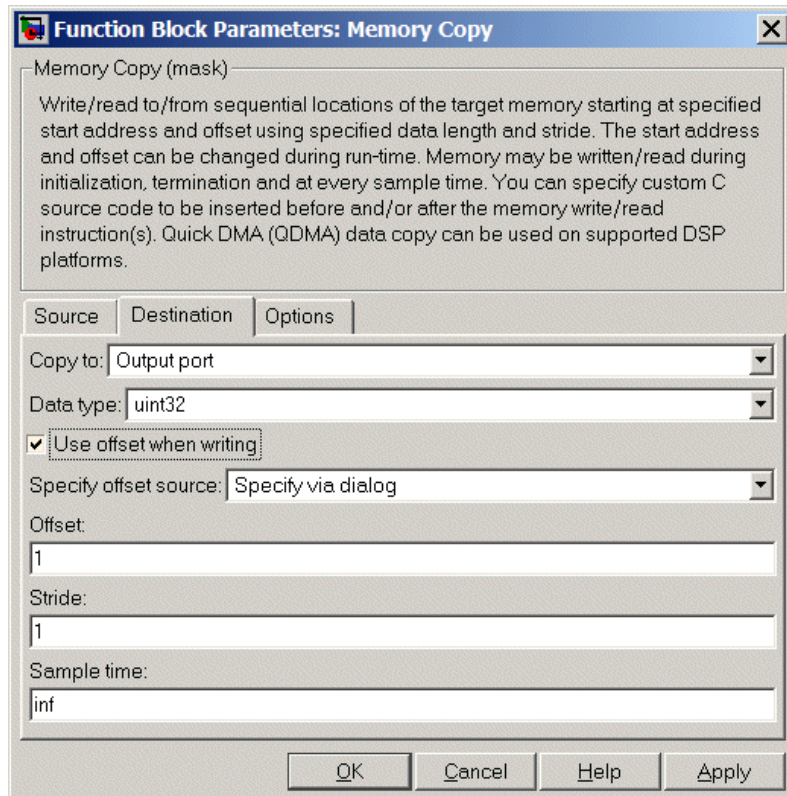
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| Source Address | Destination Address |
|----------------|---------------------|
|----------------|---------------------|



Input Stride = 2  
Output Stride = 1  
Number of Elements Copied = 5

## Destination Parameters



### Copy to

Select the destination for the data. Choose one of the entries on the list:

- **Output port** — Copies the data to the block output port. From the output port the block passes data to downstream blocks in the code.
- **Specified address** — Copies the data to the specified location in **Specify address source** and **Address**.

- **Specified source code symbol** — Tells the block to copy the variable or symbol (variable) to the symbol you enter in **Source code symbol**. When you select this copy to option, you enable the **Source code symbol** parameter.

Depending on the choice you make for **Copy from**, you see other parameters that let you configure the source of the data to copy.

## **Specify address source**

This parameter directs the block to get the address for the variable either from an entry in **Address** or from the input port to the block. Select either **Specify via dialog** or **Input port** from the list. Selecting **Specify via dialog** activates the **Address** parameter for you to enter the address for the variable.

When you select **Input port**, the port label on the block changes to **&dst**, indicating that the block expects the destination address to come from the input port. Being able to change the address dynamically lets you use the block to copy different variables by providing the variable address from an upstream block in your model.

## **Source code symbol**

Specify the symbol (variable) in the source code symbol table to copy. The symbol table for your program must include this symbol. The block does not verify that the symbol exists and uses valid syntax.

## **Address**

When you select **Specify via dialog** for the address source, you enter the variable address here. Addresses should be in decimal form. Enter either the decimal address or the address as a hexadecimal string with single quotations marks and use `hex2dec` to convert the address to the expected format. This example converts `0x2000` to decimal form.

```
8192 = hex2dec('2000');
```



For this example, you could enter either 8192 or `hex2dec('2000')` as the address.

## Data type

Use this parameter to specify the type of data that your variable uses. The list includes the supported data types, such as `int8`, `uint32`, and `Boolean`, and the option `inherit from source` for inheriting the data type for the variable from the block input port.

## Specify offset source

The block provides two sources for the offset—`Input port` and `Specify via dialog`. Selecting `Input port` configures the block input to read the offset value by adding an input port labeled `src ofs`. This port enables your program to change the offset dynamically during execution by providing the offset value as an input to the block. If you select `Specify via dialog`, you enable the **Offset** parameter in this dialog box so you can enter the offset to use when writing the output data.

## Offset

**Offset** tells the block whether to write the first element of the data to be copied to the first destination address location, or skip one or more locations at the destination before writing the output. **Offset** defines how many values to skip in the destination before writing the first value to the destination. One is the default offset value and **Offset** accepts only positive integers of one or greater.

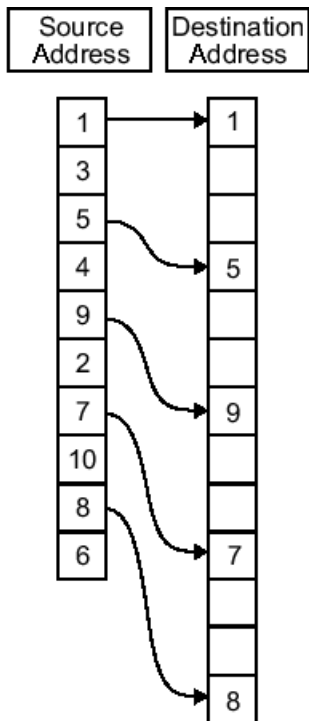
## Stride

Stride lets you specify the spacing for copying the input to the destination. By default, the stride value is one, meaning the generated code writes the input data sequentially to the destination in consecutive locations. When you add a stride value not equal to one, the output data is stored not sequentially, but by skipping addresses equal to the stride. **Stride** must be a positive integer.

This figure shows a stride value of three applied to writing the input to an output location. You can specify a stride value for the input with parameter **Stride** on the **Source** pane. As shown in

# Memory Copy

the figure, you can use both an input stride and output stride at the same time to enable you to manipulate your memory more fully.



Input Stride = 2  
Output Stride = 3  
Number of Elements Copied = 5

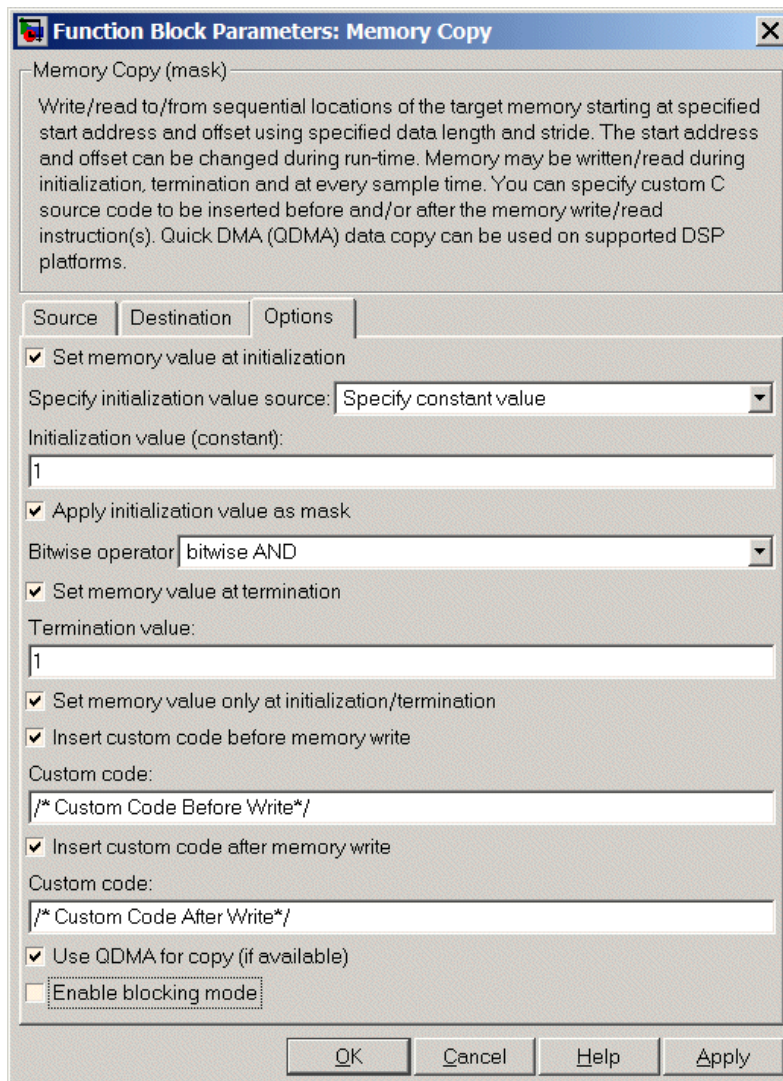
## Sample time

**Sample time** sets the rate at which the memory copy operation occurs, in seconds. The default value Inf tells the block to use a constant sample time. You can set **Sample time** to -1 to direct the block to inherit the sample time from the input, or from the

Simulink software model when there are no block inputs. Enter the sample time in seconds as you need.

# Memory Copy

## Options Parameters



**Function Block Parameters: Memory Copy**

Memory Copy (mask)

Write/read to/from sequential locations of the target memory starting at specified start address and offset using specified data length and stride. The start address and offset can be changed during run-time. Memory may be written/read during initialization, termination and at every sample time. You can specify custom C source code to be inserted before and/or after the memory write/read instruction(s). Quick DMA (QDMA) data copy can be used on supported DSP platforms.

Source | Destination | Options

- Set memory value at initialization  
Specify initialization value source: Specify constant value  
Initialization value (constant): 1
- Apply initialization value as mask  
Bitwise operator: bitwise AND
- Set memory value at termination  
Termination value: 1
- Set memory value only at initialization/termination
- Insert custom code before memory write  
Custom code: /\* Custom Code Before Write\*/
- Insert custom code after memory write  
Custom code: /\* Custom Code After Write\*/
- Use QDMA for copy (if available)
- Enable blocking mode

OK Cancel Help Apply

## **Set memory value at initialization**

When you check this option, you direct the block to initialize the memory location to a specific value when you initialize your program at run time. After you select this option, use the **Set memory value at termination** and **Specify initialization value source** parameters to set your desired value. Alternately, you can tell the block to get the initial value from the block input.

## **Specify initialization value source**

After you check **Set memory value at initialization**, use this parameter to select the source of the initial value. Choose either

- **Specify constant value** — Sets a single value to use when your program initializes memory.
- **Specify source code symbol** — Specifies a variable (a symbol) to use for the initial value. Enter the symbol as a string.

## **Initialization value (constant)**

If you check **Set memory value at initialization** and choose **Specify constant value** for **Specify initialization value source**, enter the constant value to use in this field.

## **Initialization value (source code symbol)**

If you check **Set memory value at initialization** and choose **Specify source code symbol** for **Specify initialization value source**, enter the symbol to use in this field. Use a valid symbol from the symbol table for the program. When you enter the symbol, the block does not verify whether the symbol is a valid one. If it is not valid you get an error when you try to compile, link, and run your generated code.

## **Apply initialization value as mask**

You can use the initialization value as a mask to manipulate register contents at the bit level. Your initialization value is treated as a string of bits for the mask.

Checking this parameter enables the **Bitwise operator** parameter for you to define how to apply the mask value.

# Memory Copy

---

To use your initialization value as a mask, the output from the copy has to be a specific address. It cannot be an output port, but it can be a symbol.

## Bitwise operator

To use the initialization value as a mask, select one of the entries on the following table from the **Bitwise operator** list to describe how to apply the value as a mask to the memory value.

| Bitwise Operator List Entry | Description                                                                                                                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| bitwise AND                 | Apply the mask value as a bitwise AND to the value in the register.                                                                                                                                                                                                     |
| bitwise OR                  | Apply the mask value as a bitwise OR to the value in the register.                                                                                                                                                                                                      |
| bitwise exclusive OR        | Apply the mask value as a bitwise exclusive OR to the value in the register.                                                                                                                                                                                            |
| left shift                  | Shift the bits in the register left by the number of bits represented by the initialization value. For example, if your initialization value is 3, the block shifts the register value to the left 3 bits. In this case, the value must be a positive integer.          |
| right shift                 | Shift the bits in the register to the right by the number of bits represented by the initialization value. For example, if your initialization value is 6, the block shifts the register value to the right 6 bits. In this case, the value must be a positive integer. |

Applying a mask to the copy process lets you select individual bits in the result, for example, to read the value of the fifth bit by applying the mask.

## **Set memory value at termination**

Along with initializing memory when the program starts to access this memory location, this parameter directs the program to set memory to a specific value when the program terminates.

## **Set memory value only at initialization/termination**

This block performs operations at three periods during program execution—initialization, real-time operations, and termination. When you check this option, the block only does the memory initialization and termination processes. It does not perform copies during real-time operations.

## **Insert custom code before memory write**

Select this parameter to add custom ANSI C code before the program writes to the specified memory location. When you select this option, you enable the **Custom code** parameter where you enter your ANSI C code.

## **Custom code**

Enter the custom ANSI C code to insert into the generated code just before the memory write operation. Code you enter in this field appears in the generated code exactly as you enter it.

## **Insert custom code after memory write**

Select this parameter to add custom ANSI C code immediately after the program writes to the specified memory location. When you select this option, you enable the **Custom code** parameter where you enter your ANSI C code.

## **Custom code**

Enter the custom ANSI C code to insert into the generated code just after the memory write operation. Code you enter in this field appears in the generated code exactly as you enter it.

## **Use QDMA for copy (if available)**

For processors that support quick direct memory access (QDMA), select this parameter to enable the QDMA operation and to access the blocking mode parameter.

# Memory Copy

---

If you select this parameter, your source and destination data types must be the same or the copy operation returns an error. Also, the input and output stride values must be one.

## **Enable blocking mode**

If you select the **Use QDMA for copy** parameter, select this option to make the memory copy operations blocking processes. With blocking enabled, other processing in the program waits while the memory copy operation finishes.

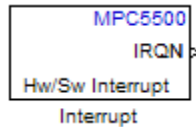
## **See Also**

Memory Allocate



**Purpose** Generate Interrupt Service Routine

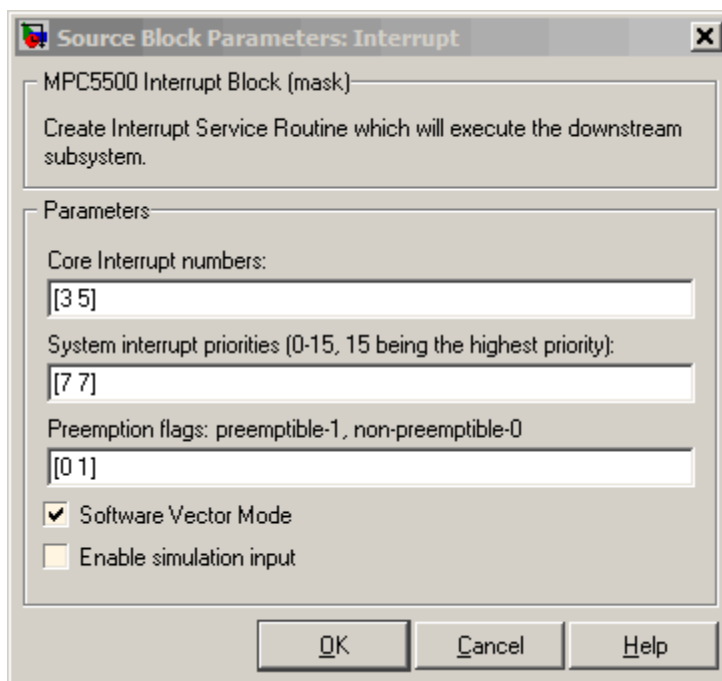
**Library** Embedded Coder Support Package for Green Hills MULTI IDE/  
Freescale MPC55xx MPC74xx/ Scheduling



**Description**

Create interrupt service routines (ISR) in the software generated by the build process. When you incorporate this block in your model, code generation results in ISRs on the processor that either run the processes that are downstream from this block or trigger an Idle Task block connected to this block. Core interrupts trigger the ISRs. System interrupts trigger the core interrupts.

# MPC5500 Interrupt



## Dialog Box

### Core interrupt numbers

Specify a vector of interrupt numbers for the interrupts to install. The block services these interrupts. When your model or code raises one of these interrupts, either through hardware or software, this block reacts to the interrupt and runs the associated downstream block or function. The valid range or interrupts depends on the processor. For example, MPC5553 processors support 212 interrupts. MPC5554 processors support 308 interrupts. Each interrupt in the row vector must be unique. Interrupts that you do not specify in this parameter cause system failures if your project raises them.

The width of the block output signal corresponds to the number of interrupt numbers specified in this field. The values in this

field and the preemption flag entries in **Preemption flags: preemptible-1, non-preemptible-0** define how the code and processor handle interrupts during asynchronous scheduler operations.

## **System interrupt priorities (0–15, 15 being the highest priority)**

Each output of the HW/SW Interrupt block drives a downstream block (for example, a function call subsystem). Simulink task priority specifies the Simulink priority of the downstream blocks. Specify an array of priorities corresponding to the interrupt numbers entered in **Core interrupt numbers**. In the default settings shown in the figure, interrupts 3 and 5 have the same priority value—7.

Code generation requires rate transition code (see Rate Transitions and Asynchronous Blocks). The task priority values make certain there is absolute time integrity when the asynchronous task must obtain real time from its base rate or its caller. Typically, assign priorities for these asynchronous tasks that are higher than the priorities assigned to periodic tasks.

If multiple interrupts share the same priority and are asserted simultaneously, the block selects the lowest numbered interrupt first.

## **Preemption flags: preemptible – 1, non-preemptible – 0**

Higher-priority interrupts can preempt interrupts that have lower priority. To allow you to control preemption, use the preemption flags to specify whether an interrupt can be preempted.

- Entering 1 indicates that the interrupt can be preempted.
- Entering 0 indicates the interrupt cannot be preempted.

You cannot set a task that has priority higher than the base rate to be preemptable.

When **Interrupt numbers** contains more than one interrupt value, you can assign different preemption flags to each interrupt

# MPC5500 Interrupt

---

by entering a vector of flag values to correspond to the order of the interrupts in **Interrupt numbers**. If **Interrupt numbers** contains more than one interrupt, and you enter only one flag value in this field, that status applies to the interrupts.

In the default settings [0 1], the interrupt with priority 5 in **Interrupt numbers** is not preemptible and the priority 8 interrupt can be preempted.

## **Software vector mode**

Select this option to put the block and processor in software vector mode. Enabling this option creates a common interrupt handler. Clearing this option puts the processor in hardware vector mode. Refer to the MULTI documentation for more information about the modes.

## **Enable simulation input**

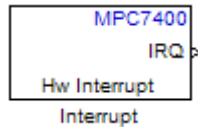
When you select this option, Simulink adds an input port to the HW/SW Interrupt block. This port is used in simulation only. Connect one or more simulated interrupt sources to the simulation input.

**Purpose**

Generate Interrupt Service Routine

**Library**

Embedded Coder Support Package for Green Hills MULTI IDE/  
Freescale MPC55xx MPC74xx/ Scheduling

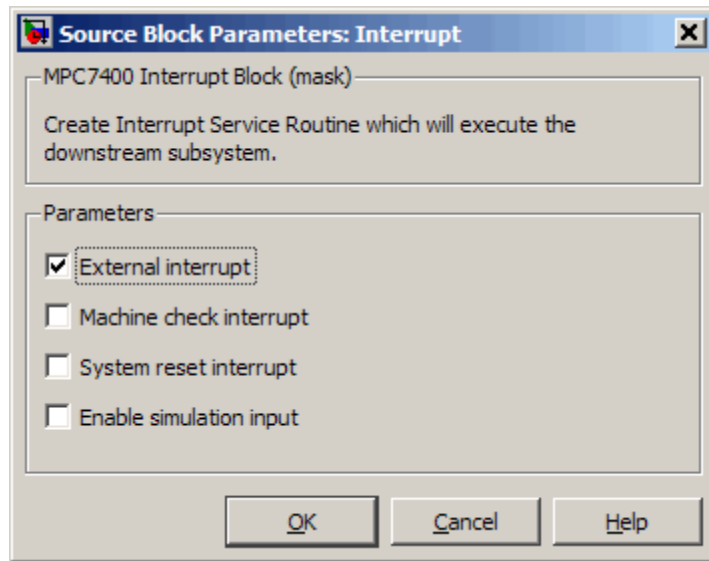
**Description**

The block creates ISRs for three processor interrupts—External, Machine check and System reset. When you incorporate this block in your model, code generation results in ISRs on the processor that run the blocks downstream from this block. For more information about these interrupts, refer to your MPC7400 documentation.

When you enable more than one interrupt on the block dialog box, the block multiplexes the ISR outputs onto the output port on the block. To resolve the different ISRs, connect the output port IRQ to a Demux block. Connect the demultiplexed outputs to downstream blocks or subsystems. Refer to Examples to see the multiple interrupt configuration in a model.

# MPC7400 Hardware Interrupt

## Dialog Box



### External interrupt

Interrupt generated by an external system that asserts the intr pin of the 7400 microprocessor.

### Machine check interrupt

Enable the asynchronous, nonmaskable machine check exception provided by the processor. The exception responds to the conditions described in the MPC7400 documentation.

### System reset interrupt

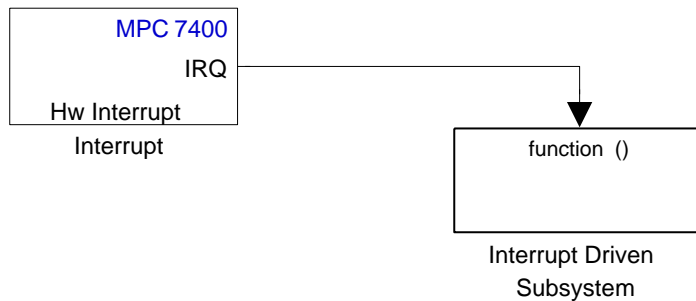
Enable the asynchronous, nonmaskable System interrupt exception provided by the processor. The exception responds to the conditions described in the MPC7400 documentation.

### Enable simulation input

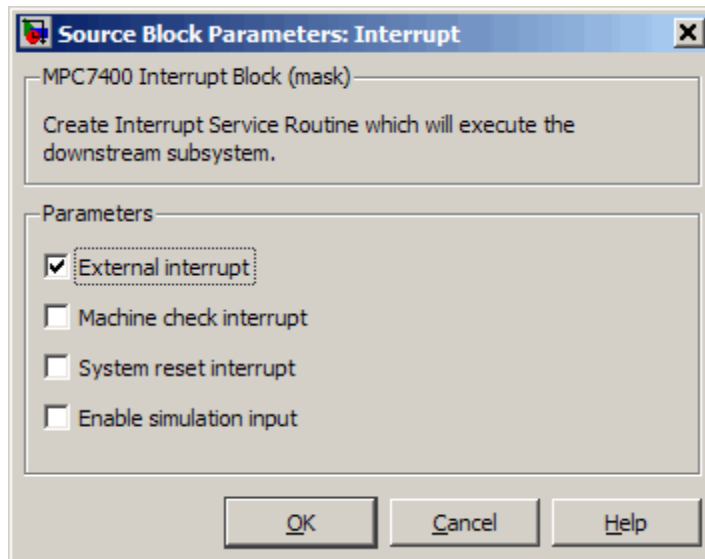
Select this option to have Simulink add an input port to the HW Interrupt block. This port receives input only during simulation. Connect one or more simulated interrupt sources to the input to drive the model interrupt processing.

## Example

The following model shows the HW Interrupt block triggering a subsystem. The interrupt block is configured to respond to external interrupts.



Here is the block mask.



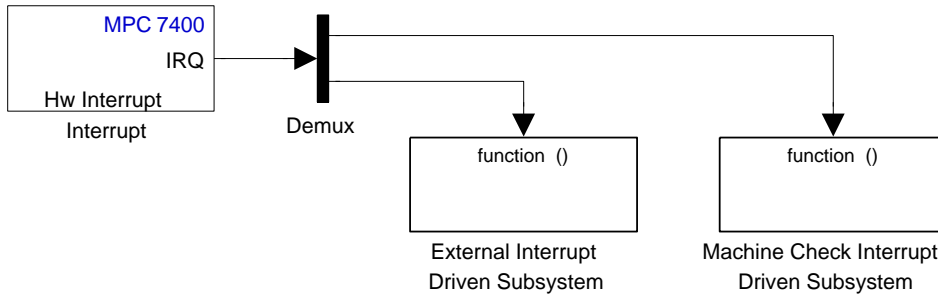
When your peripherals assert the external interrupt pin on the processor, the code generated by the HW Interrupt block during the

# MPC7400 Hardware Interrupt

---

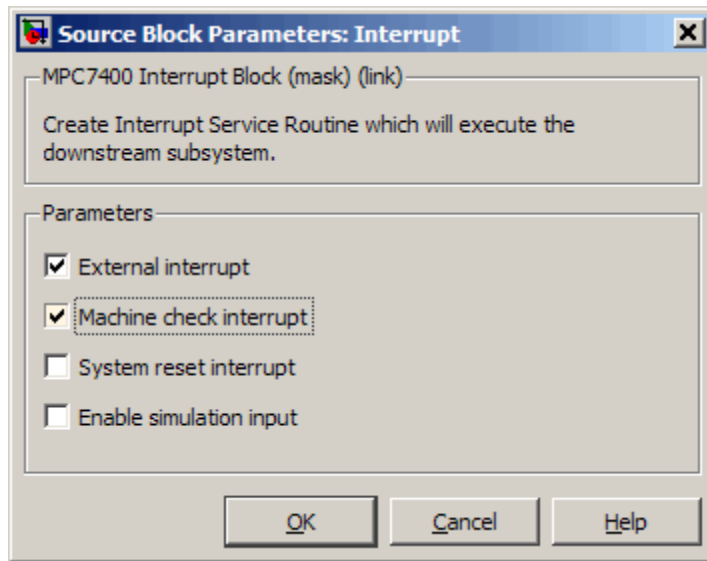
project build process accepts the interrupt and triggers the attached subsystem through an ISR.

When you select more than one interrupt, connect the output of the block to a Demux block to separate the ISRs, as shown in the following model:



Here is the block mask showing the external and Machine check interrupts selected.





To test your interrupt configuration in simulation, select **Enable simulation input** on the block dialog box and then input a signal to the block to simulate the external interrupt.

## See Also

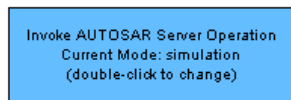
Idle Task, Memory Allocate, Memory Copy

# Mode Switch for Invoke AUTOSAR Server Operation

---

**Purpose** Toggle AUTOSAR client-server operation subsystem blocks between simulation and code generation mode

**Library** Embedded Coder/ AUTOSAR



Mode Switch for  
Invoke AUTOSAR  
Server Operation

## Description

You can add this switch block to your Simulink model that contains client-server subsystem blocks. Double-click the switch block to toggle client-server blocks between simulation and code-generation mode.

**Parameters** **Configure the model for**  
Value selected from

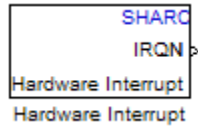
- code generation
- simulation

For this block, code generation is selected by default.

**See Also** Invoke AUTOSAR Server Operation

“Configure AUTOSAR Client-Server Communication” in the Embedded Coder documentation

**Purpose** Generate Interrupt Service Routine



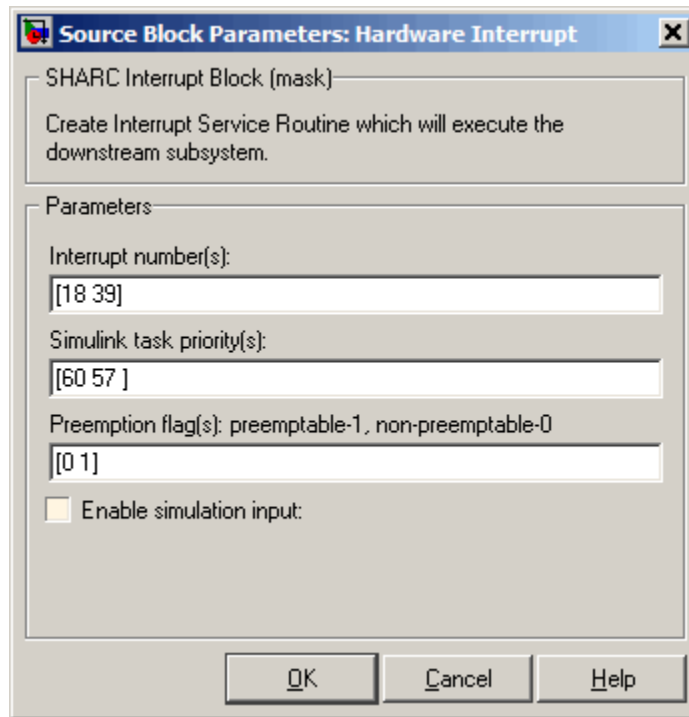
**Library**

Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
SHARC/ Scheduling

**Description**

Create interrupt service routines (ISR) in the software generated by the build process. When you incorporate this block in your model, code generation results in ISRs on the processor that either run the processes that are downstream from this block or trigger an Idle Task block connected to this block.

# SHARC Hardware Interrupt



## Dialog Box

### Interrupt numbers

Specify an array of interrupt numbers for the interrupts to install. The valid ranges are 8-36 and 38-40.

The width of the block output signal corresponds to the number of interrupt numbers specified in this field. The values in this field and the preemption flag entries in **Preemption flags: preemptable-1, non-preemptable-0** define how the code and processor handle interrupts during asynchronous scheduler operations.

### Simulink task priorities

Each output of the Hardware Interrupt block drives a downstream block (for example, a function call subsystem). Simulink model

task priority specifies the priority of the downstream blocks. Specify an array of priorities corresponding to the interrupt numbers entered in **Interrupt numbers**.

Code generation requires rate transition code (refer to Rate Transitions and Asynchronous Blocks in the Simulink Coder documentation). The task priority values facilitate absolute time integrity when the asynchronous task must obtain real time from its base rate or its caller. Typically, assign priorities for these asynchronous tasks that are higher than the priorities assigned to periodic tasks.

### **Preemption flags preemptible – 1, non-preemptible – 0**

Higher-priority interrupts can preempt interrupts that have lower priority. To allow you to control preemption, use the preemption flags to specify whether an interrupt can be preempted.

- Entering 1 indicates that the interrupt can be preempted.
- Entering 0 indicates the interrupt cannot be preempted.

When **Interrupt numbers** contains more than one interrupt value, you can assign different preemption flags to each interrupt by entering a vector of flag values to correspond to the order of the interrupts in **Interrupt numbers**. If **Interrupt numbers** contains more than one interrupt, and you enter only one flag value in this field, that status applies to all interrupts.

In the default settings [0 1], the interrupt with priority 18 in **Interrupt numbers** is not preemptible and the priority 39 interrupt can be preempted.

### **Enable simulation input**

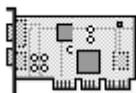
When you select this option, Simulink software adds an input port to the Hardware Interrupt block. This port is used in simulation only. Connect one or more simulated interrupt sources to the simulation input.

# Target Preferences (Removed)

---

**Purpose** Configure model for specific IDE, tool chain, board, and processor

**Library** Simulink Coder / Desktop Targets  
Embedded Coder/ Embedded Targets



Target Preferences

## Description

The Target Preferences block has been removed from the Simulink block libraries. The contents of the Target Preferences block have been moved to the Target Hardware Resources tab, located in the Configuration Parameters dialog. For more information, see:

- “Hardware configuration relocation from Target Preferences block to Configuration Parameters dialog box”
- “Configure Target Hardware Resources”
- “Code Generation: Coder Target Pane” on page 3-115

# TigerSHARC Hardware Interrupt

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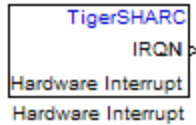
## Purpose

Generate Interrupt Service Routine

## Library

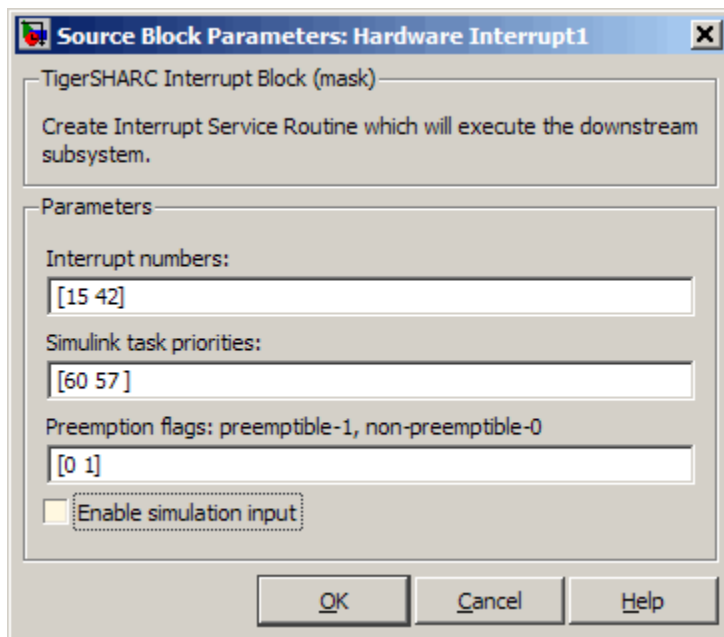
Embedded Coder/ Embedded Targets/ Processors/ Analog Devices  
TigerSHARC/ Scheduling

## Description



Create interrupt service routines (ISR) in the software generated by the build process. When you incorporate this block in your model, code generation results in ISRs on the processor that run the processes that are downstream from the this block or an Idle Task block connected to this block.

# TigerSHARC Hardware Interrupt



## Dialog Box

### Interrupt numbers

Specify an array of interrupt numbers for the interrupts to install. The valid interrupts are 2, 3, 6-9, 14-17, 22-25, 29-32, 37, 38, 41-44, 52.

The width of the block output signal corresponds to the number of interrupt numbers specified in this field. Combined with the **Simulink task priorities** that you enter and the preemption flag you enter for each interrupt, these three values define how the code and processor handle interrupts during asynchronous scheduler operations.

### Simulink task priorities

Each output of the Hardware Interrupt block drives a downstream block (for example, a function call subsystem). Simulink model task priority specifies the priority of the downstream blocks.



Specify an array of priorities corresponding to the interrupt numbers entered in **Interrupt numbers**.

Simulink model task priority values are required to generate rate transition code (refer to Rate Transitions and Asynchronous Blocks in the Simulink Coder documentation). The task priority values are also required for absolute time integrity when the asynchronous task needs to obtain real time from its base rate or its caller. Typically, you assign priorities for these asynchronous tasks that are higher than the priorities assigned to periodic tasks.

### **Preemption flags preemptible – 1, non-preemptible – 0**

Higher priority interrupts can preempt interrupts that have lower priority. To allow you to control preemption, use the preemption flags to specify whether an interrupt can be preempted.

Entering 1 indicates that the interrupt can be preempted. Entering 0 indicates the interrupt cannot be preempted. When **Interrupt numbers** contains more than one interrupt priority, you can assign different preemption flags to each interrupt by entering a vector of flag values, corresponding to the order of the interrupts in **Interrupt numbers**. If **Interrupt numbers** contains more than one interrupt, and you enter only one flag value in this field, that status applies to all interrupts.

In the default settings [0 1], the interrupt with priority 15 in **Interrupt numbers** is not preemptible and the priority 42 interrupt can be preempted.

### **Enable simulation input**

When you select this option, Simulink software adds an input port to the Hardware Interrupt block. This port is used in simulation only. Connect one or more simulated interrupt sources to the simulation input.

# UDP Receive

---

## Purpose

Receive UDP packet

## Library

Embedded Coder/ Embedded Targets/ Host Communication

Embedded Coder/ Embedded Targets/ Operating Systems/ Embedded Linux

Embedded Coder Support Package for Wind River® VxWorks® RTOS

Embedded Coder Support Package for Xilinx Zynq-7000 Platform

Simulink Coder / Desktop Targets/ Host Communication

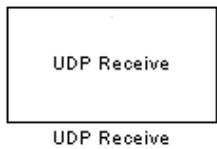
Windows (windowslib)

---

**Note** If your target system uses Linux or Windows, get the UDP block from `linuxlib` or `windowslib`.

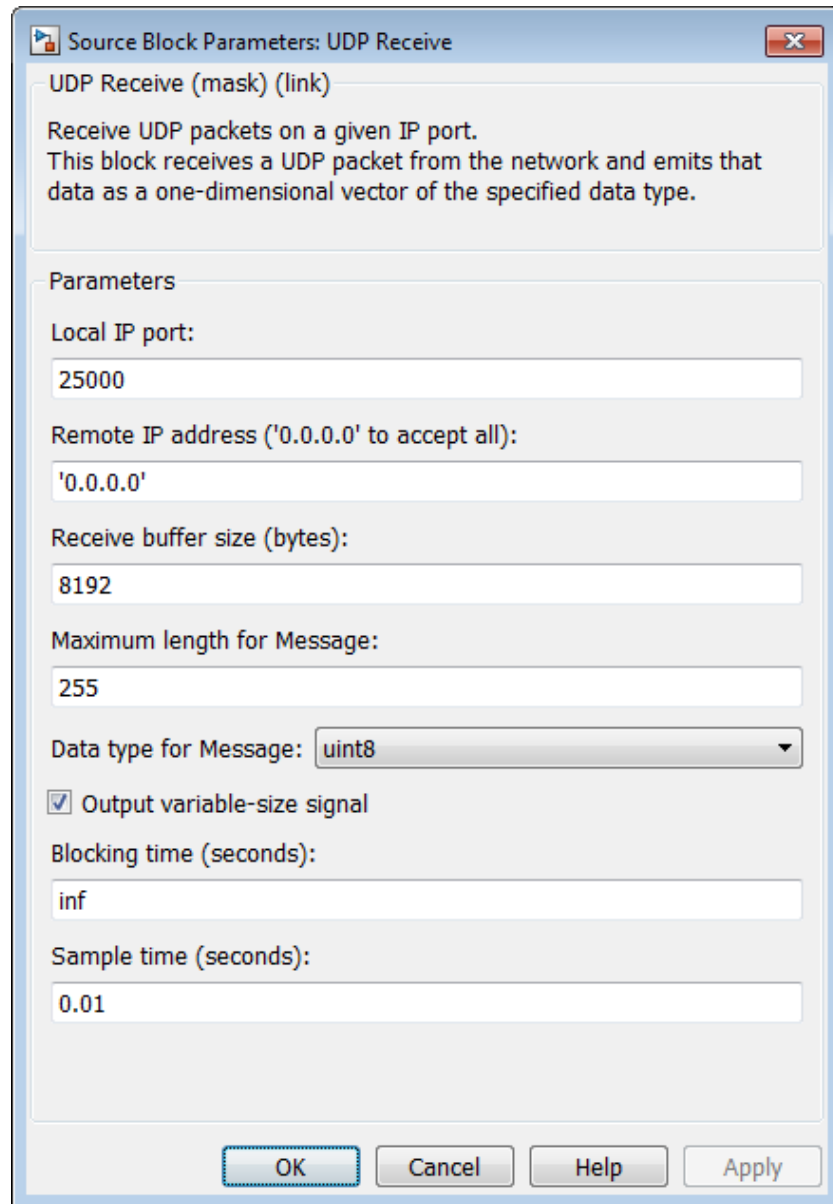
---

## Description



The UDP Receive block receives UDP packets from an IP network port and saves them to its buffer. With each sample, the block output, emits the contents of a single UDP packet as a data vector.

The generated code for this block relies on prebuilt .dll files. You can run this code outside the MATLAB environment, or redeploy it, but be sure to account for these extra .dll files when doing so. The `packNGo` function creates a single zip file containing all of the pieces required to run or rebuild this code. See `packNGo` for more information.



## Dialog

### Local IP port

Specify the IP port number upon which to receive UDP packets. This value defaults to 25000. The value can range 1–65535.

# UDP Receive

---

---

**Note** On Linux, to set the IP port number below 1024, run MATLAB with root privileges. For example, at the Linux command line, enter:

```
sudo matlab
```

---

## **Remote IP address ('0.0.0.0' to accept all)**

Specify the IP address from which to accept packets. Entering a specific IP address blocks UDP packets from other addresses. To accept packets from any IP address, enter '0.0.0.0'. This value defaults to '0.0.0.0'.

## **Receive buffer size (bytes)**

Make the receive buffer large enough to avoid data loss caused by buffer overflows. This value defaults to 8192.

## **Maximum length for Message**

Specify the maximum length, in vector elements, of the data output vector. Set this parameter to a value equal or greater than the data size of a UDP packet. The system truncates data that exceeds this length. This value defaults to 255.

If you disable **Output variable-size signal**, the block outputs a fixed-length output the same length as the **Maximum length for Message**.

## **Data type for Message**

Set the data type of the vector elements in the Message output. Match the data type with the data input used to create the UDP packets. This option defaults to `uint8`.

## **Output variable-size signal**

If your model supports signals of varying length, enable the **Output variable-size signal** parameter. This checkbox defaults to selected (enabled). In that case:

- The output vector varies in length, depending on the amount of data in the UDP packet.
- The block emits the data vector from a single unlabeled output.

If your model does not support signals of varying length, disable the **Output variable-size signal** parameter. In that case:

- The block emits a fixed-length output the same length as the **Maximum length for Message**.
- If the UDP packet contains less data than the fixed-length output, the difference contains invalid data.
- The block emits the data vector from the **Message** output.
- The block emits the length of the valid data from the **Length** output.
- The block dialog box displays the **Data type for Length** parameter.

In both cases, the block truncates data that exceeds the **Maximum length for Message**.

### **Data type for Length**

Set the data type of the Length output. This option defaults to double.

### **Blocking time (seconds)**

For each sample, wait this length of time for a UDP packet before returning control to the scheduler. This value defaults to `inf`, which indicates to wait indefinitely.

---

**Note** This parameter appears only in the Embedded Coder UDP Receive block.

---

### **Sample time (seconds)**

Specify how often the scheduler runs this block. Enter a value greater than zero. In real-time operation, setting this option to a

# UDP Receive

---

large value reduces the likelihood of dropped UDP messages. This value defaults to a sample time of 0.01 s.

## **Output port width**

Specify the width of packets the block accepts. When you design the transmit end of the UDP communication channel, you decide the packet width. Set this option to a value as large or larger than a packet you expect to receive.

---

**Note** This parameter appears only in a deprecated version of the UDP Receive block. Replace the deprecated UDP Receive block with a current UDP Receive block.

---

## **UDP receive buffer size (bytes)**

Specify the size of the buffer to which the system stores UDP packets. The default size is 8192 bytes. Make the buffer large enough to store UDP packets that come in while your process reads a packet from the buffer or performs other tasks. Specifying the buffer size prevents the receive buffer from overflowing.

---

**Note** This parameter appears only in a deprecated version of the UDP Receive block. Replace the deprecated UDP Receive block with a current UDP Receive block.

---

## **See Also**

Byte Pack, Byte Reversal, Byte Unpack, UDP Send

## Purpose

Send UDP message

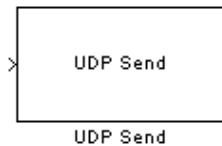
## Library

Embedded Coder/ Embedded Targets/ Host Communication  
Embedded Coder/ Embedded Targets/ Operating Systems/ Embedded Linux  
Embedded Coder Support Package for Wind River VxWorks RTOS  
Embedded Coder Support Package for Xilinx Zynq-7000 Platform  
Simulink Coder / Desktop Targets/ Host Communication  
Windows (windowlib)

---

**Note** If your target system uses Linux or Windows, get the UDP block from `linuxlib` or `windowlib`.

---



## Description

The UDP Send block transmits an input vector as a UDP message over an IP network port.

---

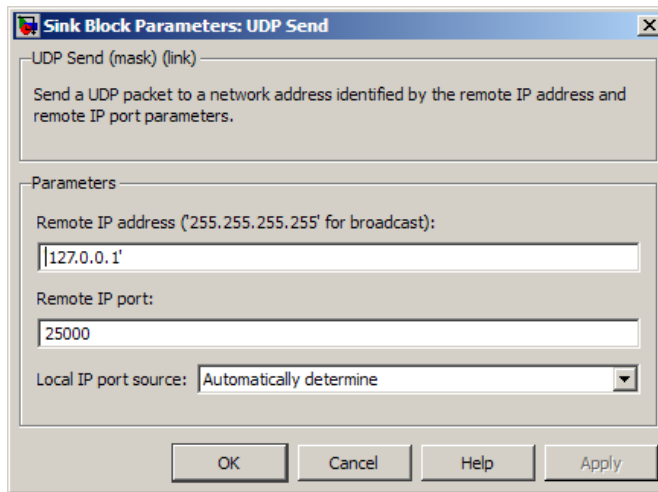
**Note** Some Simulink blocks and `.exe` files built from models that contain those blocks require shared libraries, such as `.dll` files on Windows. The UDP Send block requires `networkdevice.dll`. To meet this requirement, open the `packNGo` topic, and follow the example to package the code files for your model. The resulting compressed folder contains the `.dll` files that the model requires, including `networkdevice.dll`. To run this type of `.exe` file outside a MATLAB environment, place the required `.dll` files in the same folder as the `.exe` file, or place them in a folder on the Windows system path.

---

# UDP Send

---

## Dialog Box



### IP address ('255.255.255.255' for broadcast)

Specify the IP address or hostname to which the block sends the message. To broadcast the UDP message, retain the default value, '255.255.255.255'.

### Remote IP port

Specify the port to which the block sends the message. The value defaults to 25000, but the values range from 1–65535.

---

**Note** On Linux, to set the IP port number below 1024, run MATLAB with root privileges. For example, at the Linux command line, enter:

```
sudo matlab
```

---



**Local IP port source**

To let the system automatically assign the port number, select `Assign automatically`. To specify the IP port number using the **Local IP port** parameter, select `Specify`.

**Local IP port**

Specify the IP port number from which the block sends the message.

If the receiving address expects messages from a particular port number, enter that number here.

**Sample time**

Sample time tells the block how long to wait before polling for new messages.

---

**Note** This parameter only appears in a deprecated version of the UDP Send block. Replace the deprecated UDP Send block with a current UDP Send block.

---

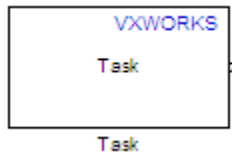
**See Also**

Byte Pack, Byte Reversal, Byte Unpack, UDP Receive

# VxWorks Task

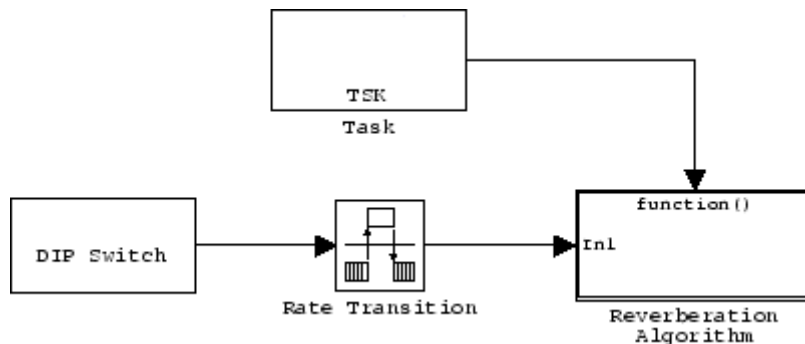
**Purpose** Spawn task function as separate VxWorks thread

**Library** Embedded Coder Support Package for Wind River VxWorks RTOS



## Description

Use this block to create a task function that spawns as a separate VxWorks thread. The task function runs the code of the downstream function-call subsystem. For example:



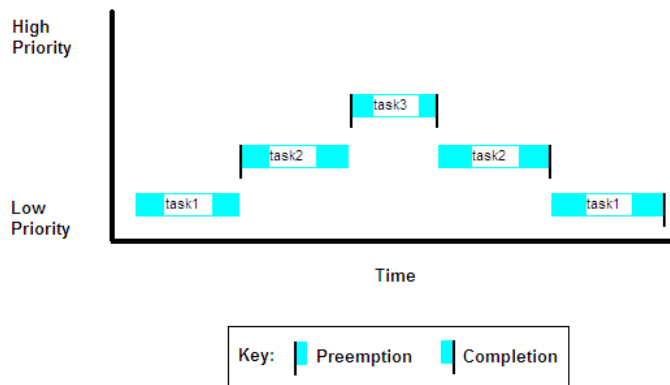
In order to use this block, set the **System target file** parameter to `idelink_ert.tlc` or `idelink_ert.tlc`. The **System target file** parameter is located on the Code Generation pane of the Model Configuration Parameters dialog, which you can view by selecting your model and pressing **Ctrl+E**.

The VxWorks Task block uses a First In, First Out (FIFO) scheduling algorithm, which executes real-time processes without time slicing. With FIFO scheduling, a higher-priority process preempts a lower-priority process. While the higher-priority process runs, the lower-priority process remains at the top of the list for its priority. When

the scheduler blocks the higher-priority processes, the lower-priority process resumes.

For example, in the following image, task2 preempts task1. Then, task3 preempts task2. When task3 completes, task2 resumes. When task2 completes, task1 resumes.

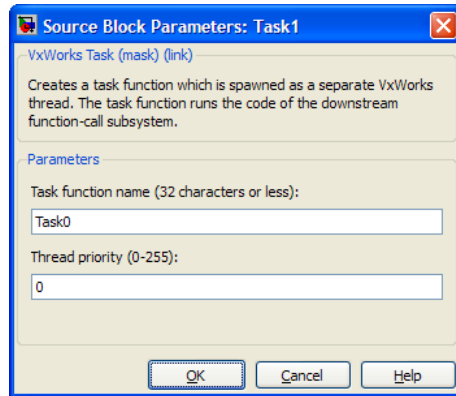
## FIFO Scheduling



# VxWorks Task

---

## Dialog



### Task name

Assign a name to this task. You can enter up to 32 letters and numbers. Do not use standard C reserved characters, such as the / and : characters.

### Thread priority (0 to 255)

Set the priority for the thread, from 0 to 255 (low-to-high). Higher-priority tasks can preempt lower-priority tasks.

# Analog to Digital Converter

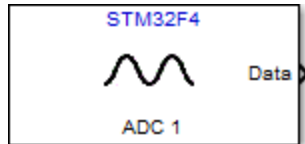
---

**Purpose**

Convert analog signal on ADC input pin to digital signal

**Library**

Embedded Coder Support Package for STMicroelectronics STM32F4 Discovery™ Board

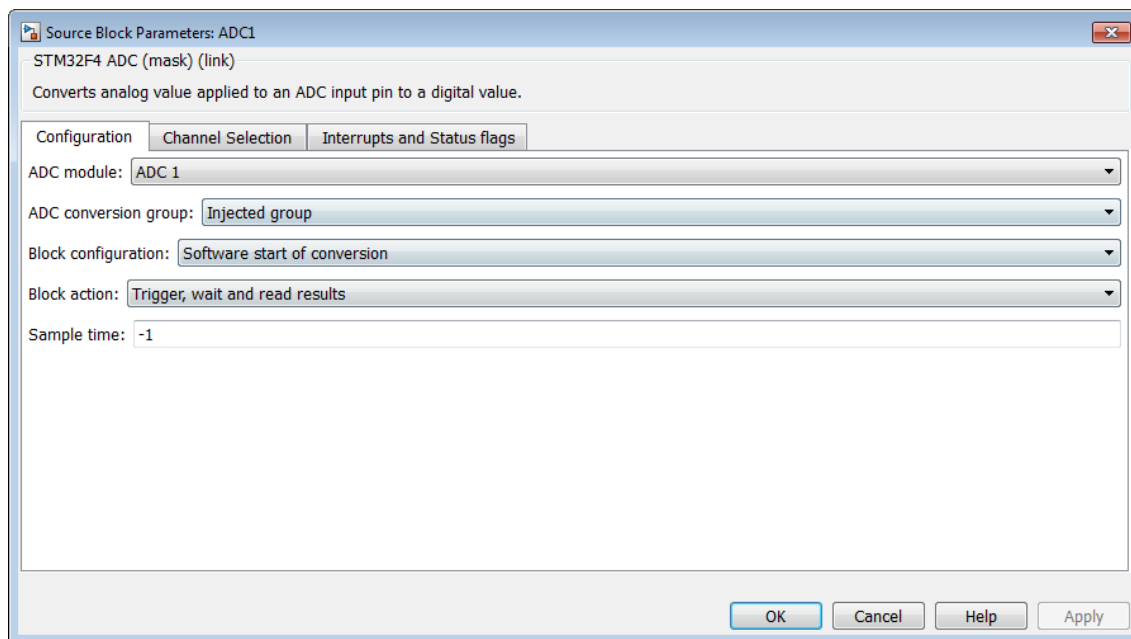
**Description**

You can use Support Package for STMicroelectronics STM32F4 Discovery Board Analog to Digital Converter block in your applications to simplify measurements and obtain efficient results. The Support Package for STMicroelectronics STM32F4 Discovery Board comes with three ADCs. You can also run these in independent mode, dual mode, or triple mode.

# Analog to Digital Converter

## Dialog Box

## Configuration



### ADC module

The module that you select for conversion.

### ADC conversion group

The option that you select for conversion. The options available are:

- **Injected group** — Select this option when you want the conversion to trigger by an external event or by software. The Injected group has higher priority over the Regular group.
- **Regular group** — Select this option when you do not want the conversion to trigger by an external event.

**Block configuration**

The option that you select to indicate when the block configuration must be on. The options in this parameter change based on the value you select in **ADC conversion group**.

**Block action**

The option that you select to start conversion.

**Enable continuous conversion**

The option you can select to enable continuous conversion. This option is available only when you select Regular group for **ADC conversion group**.

**Enable EOC signal at the end of each channel conversion**

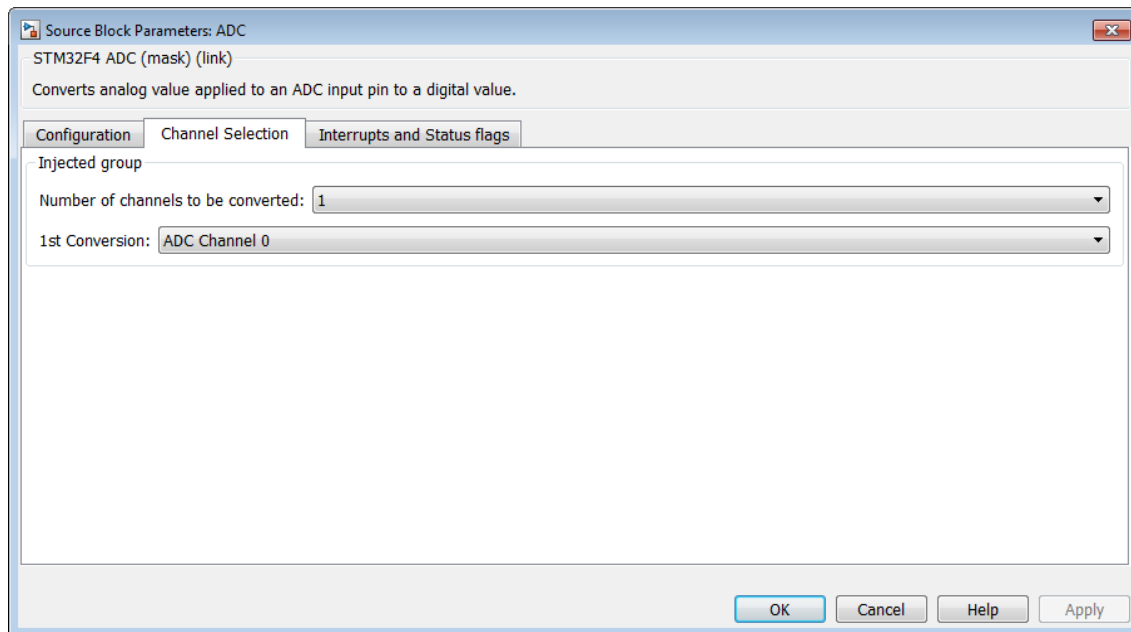
The option that you select to indicate the end of conversion after each channel conversion. This option is available only when you select Regular group for **ADC conversion group**.

**Sample time**

The sample time that you select for conversion.

# Analog to Digital Converter

## Channel Selection



### Number of channels to be converted

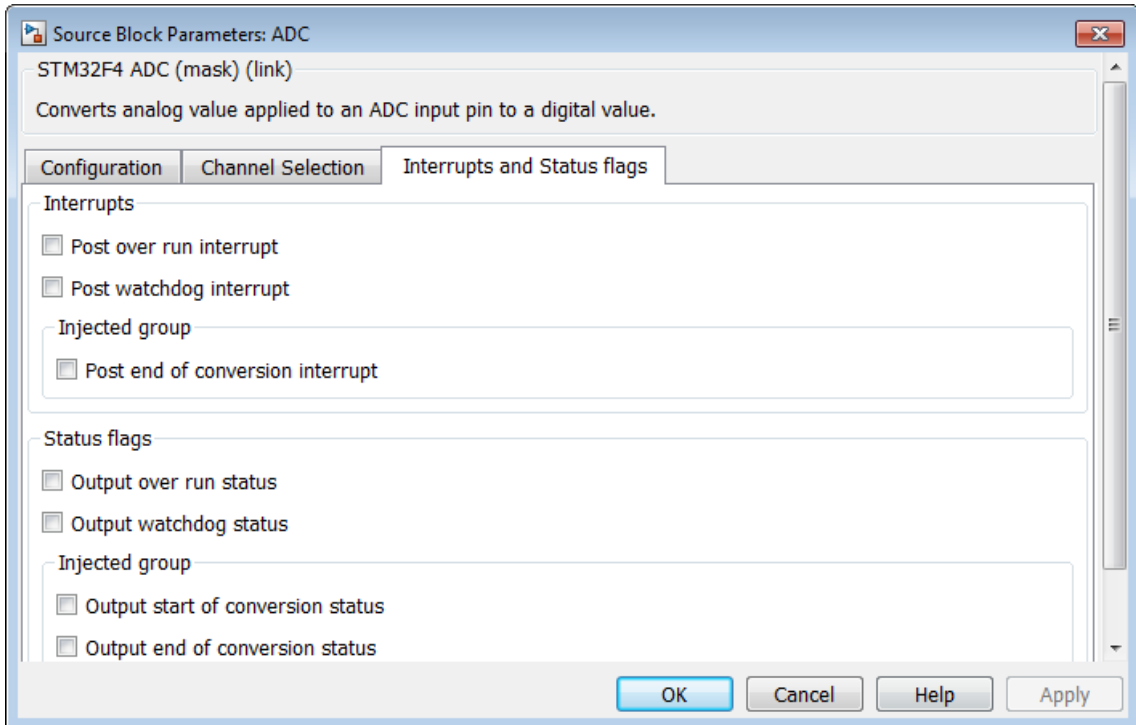
The number of channels that you can select for conversion. The number of channels change based the value you select for **ADC conversion group** on the **Configuration** tab.

### 1st Conversion

The channel number that you select for the first conversion.



## Interrupts and Status Flags



### **Post over run interrupt**

The option you select to indicate that the overrun interrupt must be posted.

### **Post watchdog interrupt**

The option to indicate that the post watchdog interrupt must be posted.

### **Post end of conversion interrupt**

The option to indicate that the end of conversion interrupt for injected group should be output.

# Analog to Digital Converter

---

## **Output over run status**

Select the check box to indicate that the overrun status must be notified.

## **Output watchdog status**

Select the check box to indicate that the watchdog status must be notified.

## **Output start of conversion status**

Select the check box to indicate that the start of conversion status for injected group must be notified.

## **Output end of conversion status**

Select the check box to indicate that the end of conversion status for injected group must be notified.

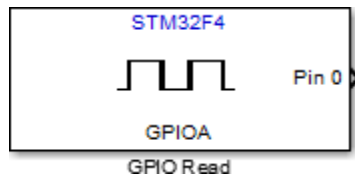
## **See Also**

[GPIO Read](#) | [GPIO Write](#)

**Purpose** Read selected GPIO pin status

**Library** Embedded Coder Support Package for STMicroelectronics STM32F4 Discovery Board

**Description**



You can configure a GPIO pin as input, read and output the status of the pin.

There are nine General purpose I/O (GPIO) peripherals that you can configure with each peripheral having up to 16 I/O pins to configure.

You can configure each I/O pin of a GPIO for different functionalities as follows:

- Input floating
- Input pull-up
- Input pull-down
- Analog
- Output open-drain with pull-up or pull-down capability
- Output push-pull with pull-up or pull-down capability
- Alternate function push-pull with pull-up or pull-down capability
- Alternate function open-drain with pull-up or pull-down capability

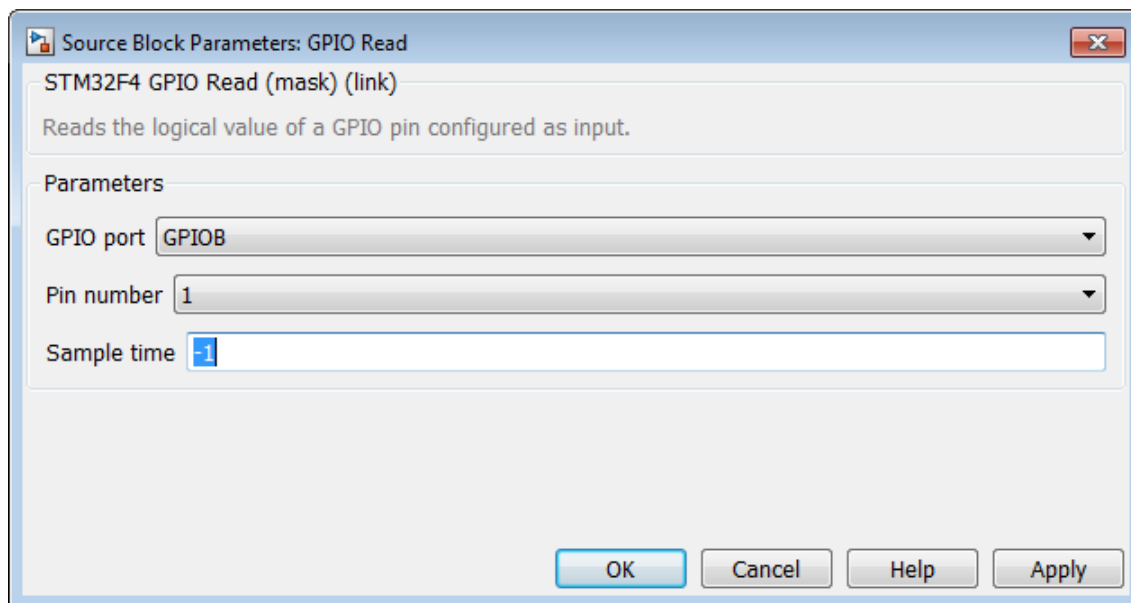
You specify these functionalities with settings parameters using:

- Centralized configuration from **Configuration Parameters > Coder Target** option.
- Decentralized configuration:

# GPIO Read

peripherals of **Configuration Parameters > Coder Target** level.  
blocks of your model for GPIO characters, input, output, alternate function, and analog.

## Dialog Box



### GPIO port

The GPIO port that you configure from the range GPIOA to GPIOI for digital input.

### Pin number

The specific pin that you can configure on the selected GPIO port for reading digital input.

### Sample time

The sample time used for reading the digital input.

### **See Also**

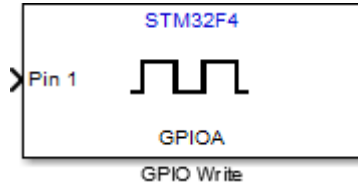
[GPIO Write](#) | [Analog to Digital Converter](#)

# GPIO Write

---

**Purpose** Change the selected GPIO pin status

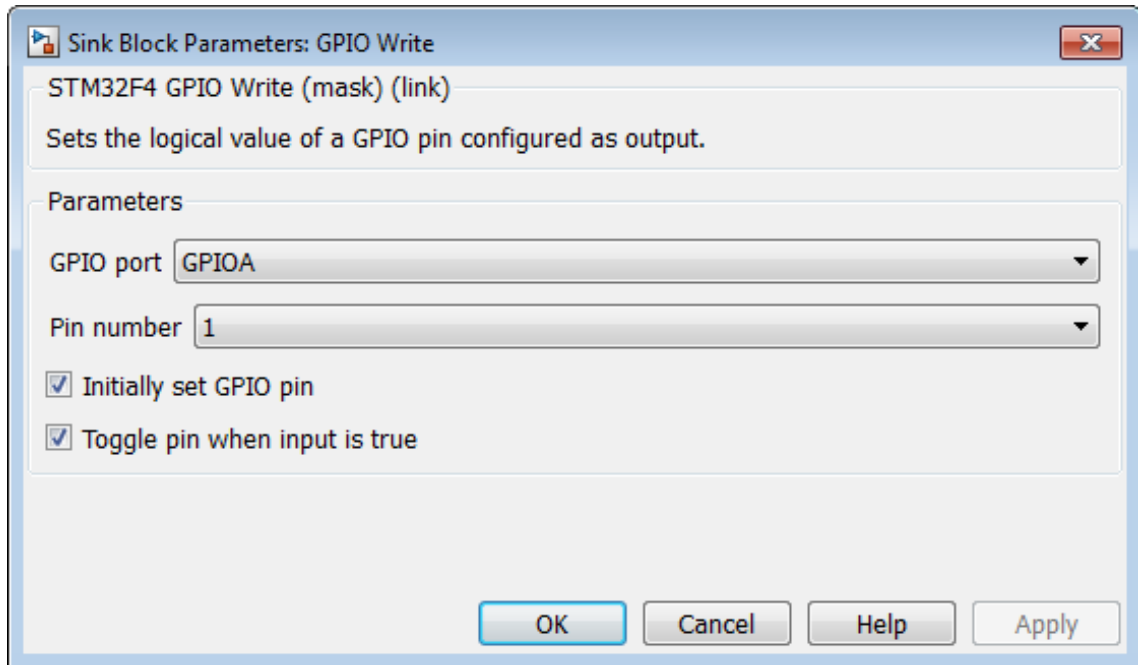
**Library** Embedded Coder Support Package for STMicroelectronics STM32F4 Discovery Board



**Description**

You can configure the pin selected as output and write the pin value to the selected pin.

## Dialog Box



### GPIO port

The GPIO port that you can select from the range GPIOA to GPIOI for digital output.

### Pin number

The pin number that you can configure on the selected GPIO port for digital output from the range 1 to 15.

### Initially set GPIO pin

The option that you select to set the GPIO pin initially.

# GPIO Write

---

## **Toggle pin when input is true**

The option that you select to toggle pin status when the input value is 'true'.

## **See Also**

[GPIO Read](#) | [Analog to Digital Converter](#)



## Purpose

Send processed audio samples to audio devices

## Library

Embedded Coder Support Package for STMicroelectronics STM32F4 Discovery Board



## Description

This block writes the processed audio data to the audio device connected to the STM32F4 processor on the STM32F4 Discovery Board. You can send audio samples at different rates such as 16kHz, 32kHz etc. with different frame sizes.

You can play mono ( $[1 \times N]$  or  $[N \times 1]$ ) or stereo  $[N \times 2]$  audio frames on this block.

In the Configuration Parameters dialog, under Coder Target, select `Audio out` block DMA interrupt as the **Scheduler Interrupt Source**. This ensures that the rest of the processing algorithm is synchronized with the Audio out block interrupt.

When you select this option, make sure to schedule the Audio out block at base rate.

---

**Note** You cannot play  $[1 \times 1]$  audio samples on this block as the frame requires at least two samples.

---

## Send Processed Audio Samples Using Double Buffering

The Audio out block uses a double buffering mechanism to send data to the audio device.

With double buffering, one buffer is used by the DMA to transfer audio frame from the processor to the audio device while the other buffer is used to receive the processed audio frame from your audio algorithm.

## Audio out

---

Doing so helps to prevent overwriting the buffer while sending the data to the audio device.

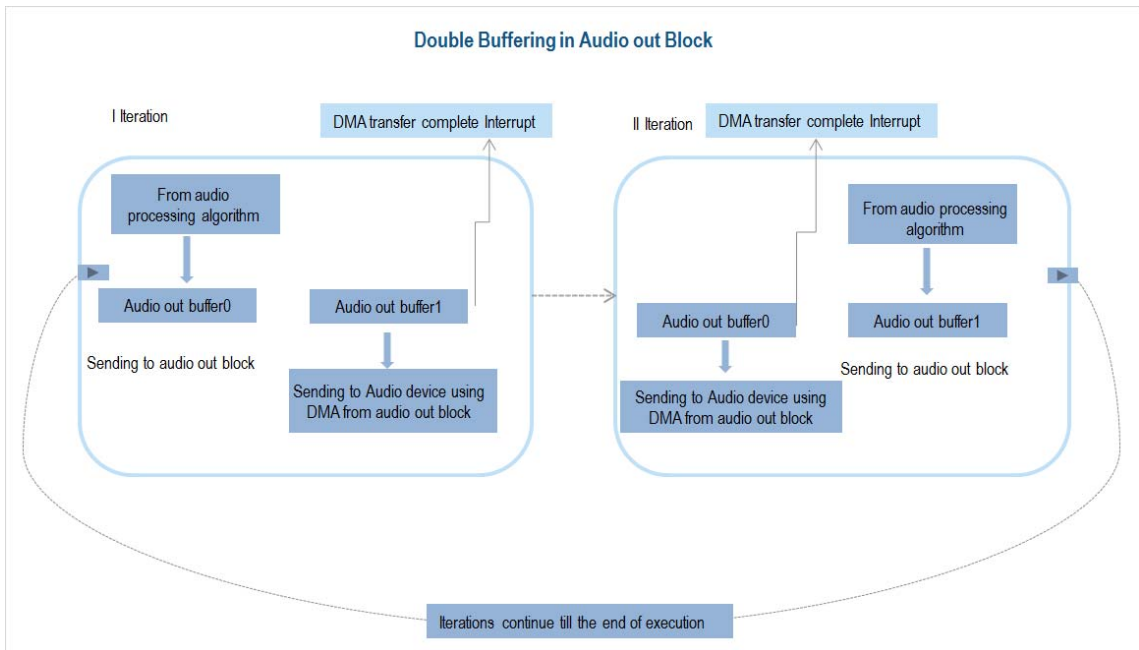
When you send an audio frame of length `N` samples, the block creates two buffers of length `N` samples.

The following describes the double buffering mechanism in the Audio out block.

- In the first iteration, when the processed audio signal is sent to the audio device from 'Audio out buffer1', the 'Audio out buffer0' is filled with audio signal from the audio processing algorithm.

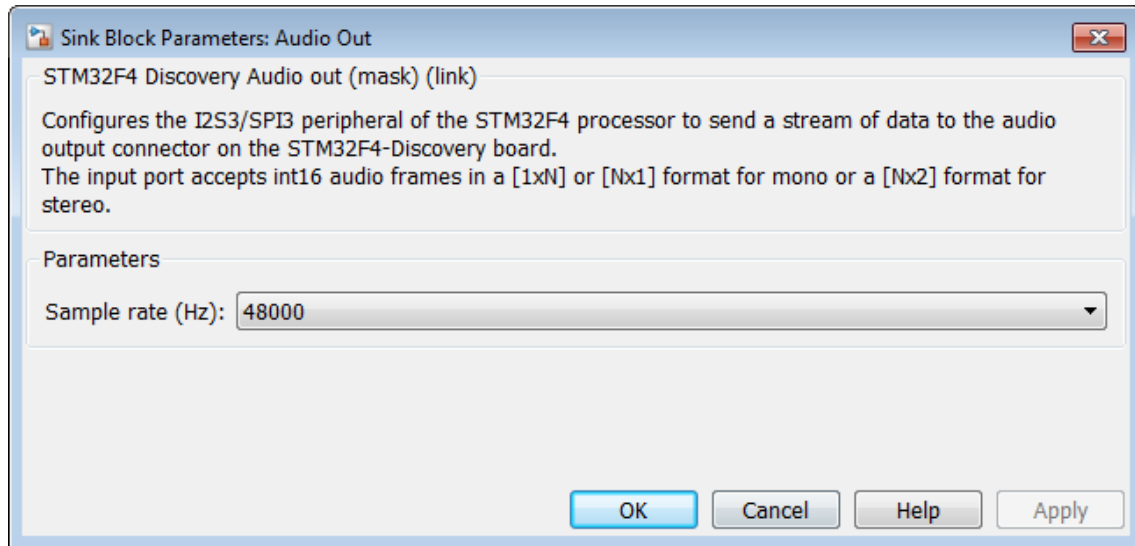
In the first iteration, the 'Audio out buffer1' does not contain the audio samples. Therefore, the audio samples from the Audio out block are delayed by one audio frame. If your model has Mic in and the Audio out blocks, then there is a time delay of two audio frames as the Mic in block also uses the same double buffering technique.

- After the DMA completes sending out the processed data from 'Audio out buffer1', an interrupt is generated.
- In the second iteration, when the processed audio signal is sent out to the audio device from Audio out buffer0, the 'Audio out buffer1' is filled with the audio data from the audio processing algorithm.



# Audio out

## Dialog Box



### Sample rate (Hz)

The sample rate at which the processed audio samples are sent out to the audio device.

**See Also** Mic in

**Purpose** Read audio sample from MEMS microphone available on the Support Package for STMicroelectronics STM32F4 Discovery Board

**Library** Embedded Coder Support Package for STMicroelectronics STM32F4 Discovery Board



## Description

This block reads the audio sample data collected from the MEMS microphone (MP45DT02, ST MEMS audio sensor, omnidirectional digital microphone), available on STM32F4-Discovery board. The MEMS microphone produces a Pulse Density Modulated (PDM) signal.

The block outputs 1ms of int16 Pulse Code Modulated (PCM) audio frame data with your sample rate selection on the block. You can select different sample rates such as 16kHz, 32kHz etc.

In the Configuration Parameters dialog, under Coder Target, select `Mic in` block DMA interrupt as the **Scheduler Interrupt Source**. This ensures that the rest of the processing algorithm is synchronized with the Mic in block interrupt.

When you select this option, make sure to schedule the Mic in block at base rate. In this case, the base rate of your model is the product of audio frame input size and the selected sample rate (Sample time) of the Mic in block.

### PDM Processing

Pulse Density Modulation, 'PDM' is a modulation that uses the density of a pulse to represent a signal. The relative density of the pulses in PDM corresponds to the analog signal amplitude. In PDM bit stream, '1' corresponds to a pulse of positive polarity and '0' corresponds to a pulse of negative polarity. PDM uses a single bit to convey the audio.

Some of the advantages of PDM processing are:

- Simple in concept and execution
- Low cost audio transmission in digital form
- Efficient systems with good design
- Low noise and less interfering signals

## **Read Audio Data using Double Buffering**

The Mic in block uses a double buffering to read the audio data from the MEMS microphone.

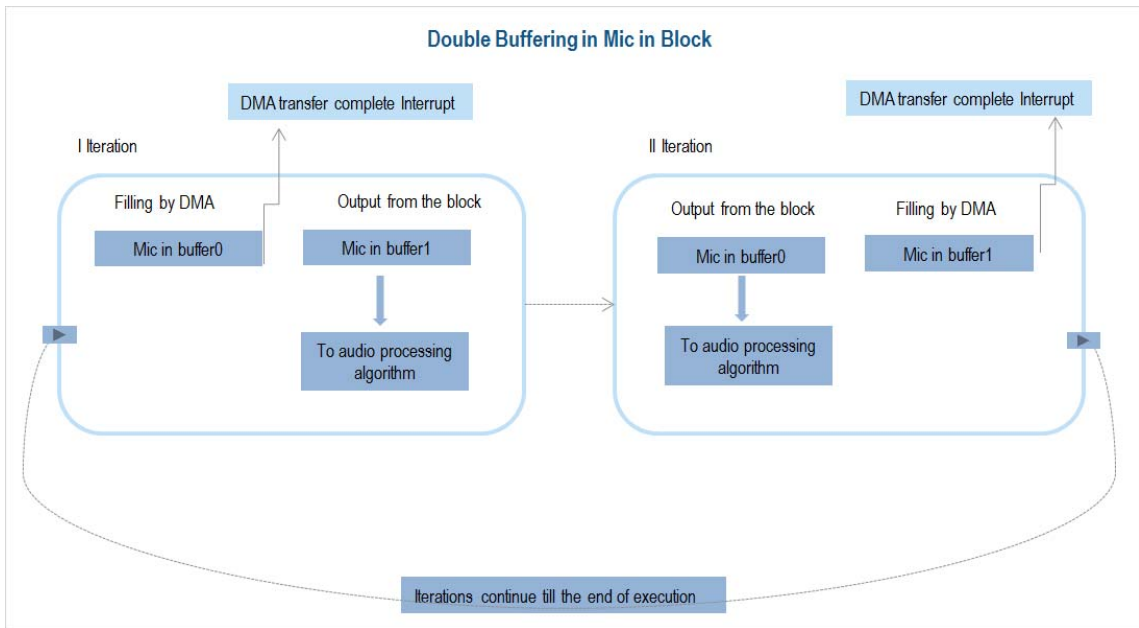
With double buffering, one buffer is used by the DMA to read audio PDM signal from the MEMS microphone while the other buffer is used to send audio frames to the audio processing algorithm. This helps to prevent overwriting of the buffer while being used by the audio algorithm.

The following describes the double buffering mechanism in the Mic in block.

- In the first iteration, when the 'Mic in buffer1' sends the data for audio processing, the DMA fills 'Mic in buffer0'.

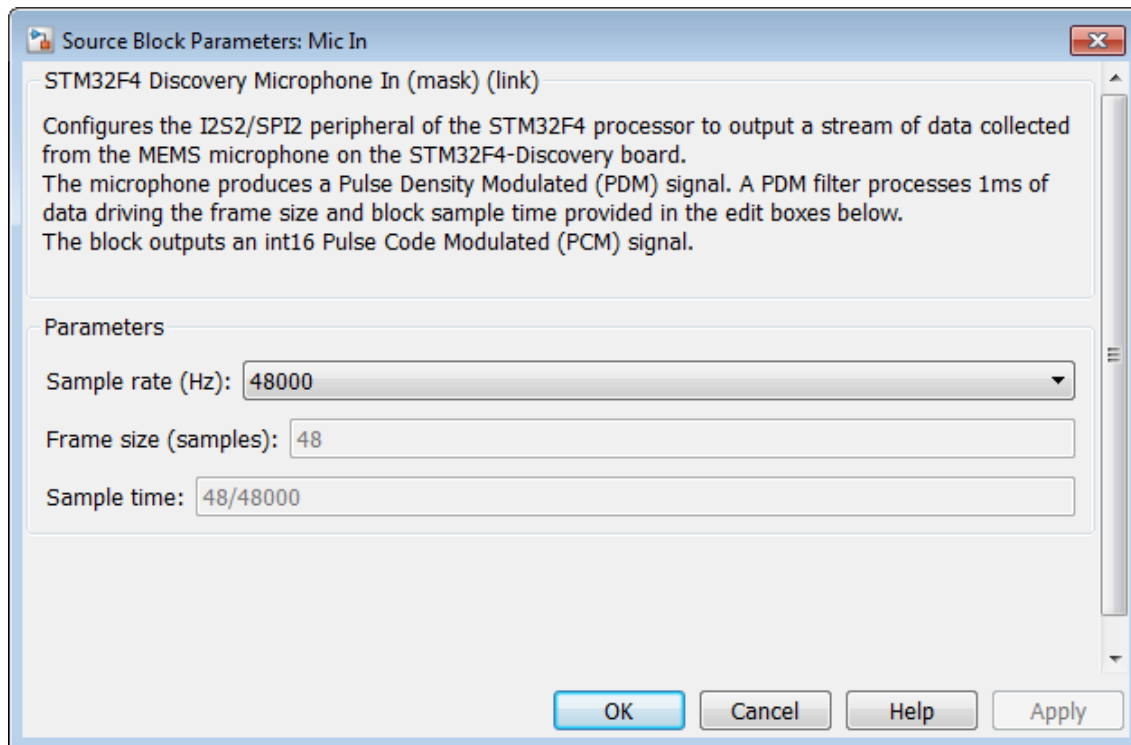
In the first iteration, the 'Mic in buffer1' does not contain the audio samples. Therefore, the audio samples from the Mic in block is delayed by one audio frame.

- After the DMA completes filling Mic in buffer0, an interrupt is triggered.
- In the second iteration, when the 'Mic in buffer0' sends the data for audio processing and the DMA fills 'Mic in buffer1'.



# Mic in

## Dialog Box



### Sample rate (Hz)

Sampling frequency of the audio signal read from the MEMS microphone.

### Frame size (samples)

The audio signal frame size based on the sample rate that you select.



## Sample time

The block sample time calculated based on the sample rate that you select.

---

**Note** As the Mic in block always outputs 1ms of int16 PCM audio frame data, the values in **Frame Size** and **Sample Time** are calculated based on the **Sample Rate** that you select. The values in these parameters are for display purposes only. You cannot edit these values.

---

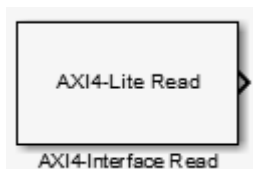
**See Also** [Audio out](#)

# AXI4-Interface Read

---

**Purpose** Read data from IP core on Xilinx Zynq platform

**Library** Embedded Coder Support Package for Xilinx Zynq-7000 Platform (axiinterfacelib)



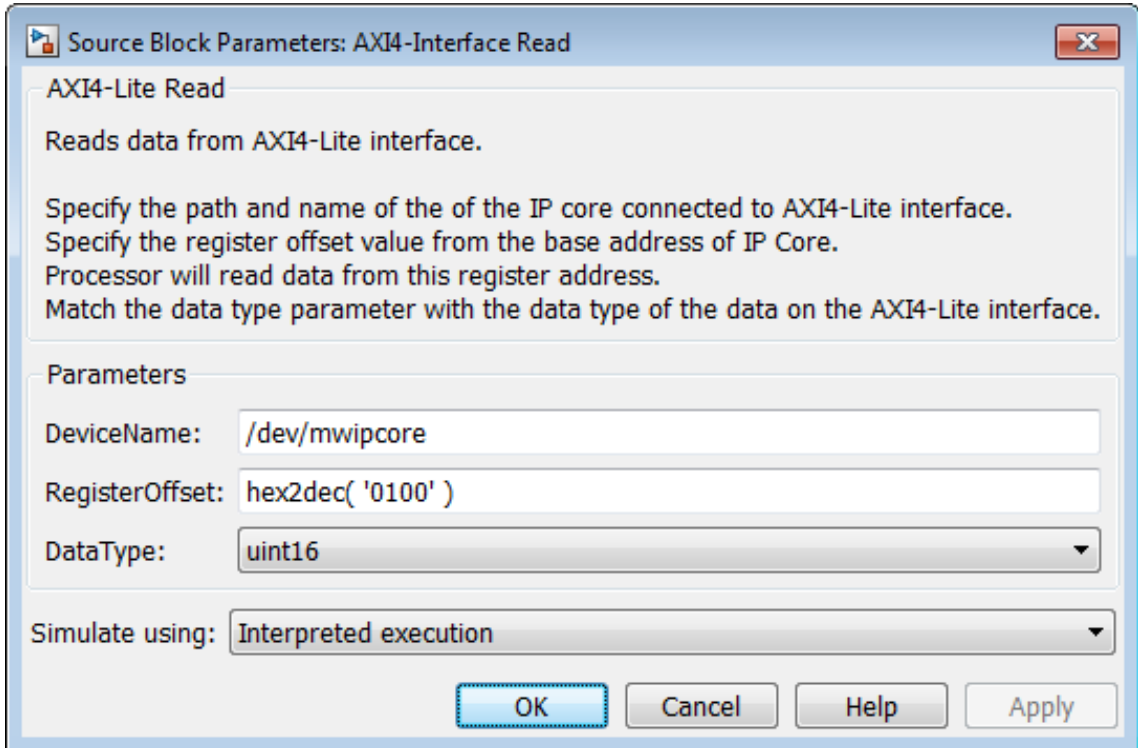
## Description

Use the AXI4-Lite interface to read data from a register on the Intellectual Property (IP) core of the Xilinx Zynq platform.

This block polls the register on the IP core for data. The polling frequency is determined by the base-rate of the subsystem that contains this block.

To open the block library that contains this block, enter `axiinterfacelib` in the MATLAB Command Window.

## Dialog Box



### DeviceName

Specify the path and name of the of the IP core device.

---

**Note** If you are using HDL Coder™ to generate the IP core, the IP core is mapped to /dev/mwipcore.

---

# AXI4-Interface Read

---

## RegisterOffset

Specify the offset from the base address of the IP core to the register. The block reads data from this register.

Use the `hex2dec` function when you specify the offset address using a hexadecimal number string.

---

**Note** If you are using HDL Coder to generate the IP core, you can get the value of the offset address from the “Register Address Mapping” portion of the Custom IP Core Report. For more information, see “Register Address Mapping”.

---

## Data Type

Specify the output data type to receive from the block.

## Simulate using

- **Interpreted execution** — Simulates this block using MATLAB interpreter. This option shortens startup times, but typically has slower simulation speeds than Code Generation. This is the default option.
- **Code generation** — Creates a MEX-file for this block the first time you run a simulation. Creating the MEX-file requires additional startup time. Subsequent simulations reuse the MEX-file. The MEX-file provides faster simulation speeds than Interpreted execution.

This parameter only applies to simulations. It does not alter the process of building a model to create and run a binary executable on the Zynq platform.

## See Also

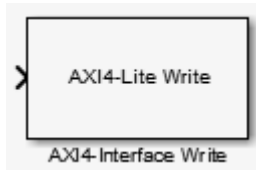
AXI4-Interface Write | “Custom IP Core Report” | Getting Started with HW/SW Co-design Workflow for Xilinx Zynq Platform

## External Web Sites

- <http://www.xilinx.com/ipcenter/axi4.htm>

**Purpose** Write data to IP core on Xilinx Zynq platform

**Library** Embedded Coder Support Package for Xilinx Zynq-7000 Platform (axiinterfacelib)



**Description**

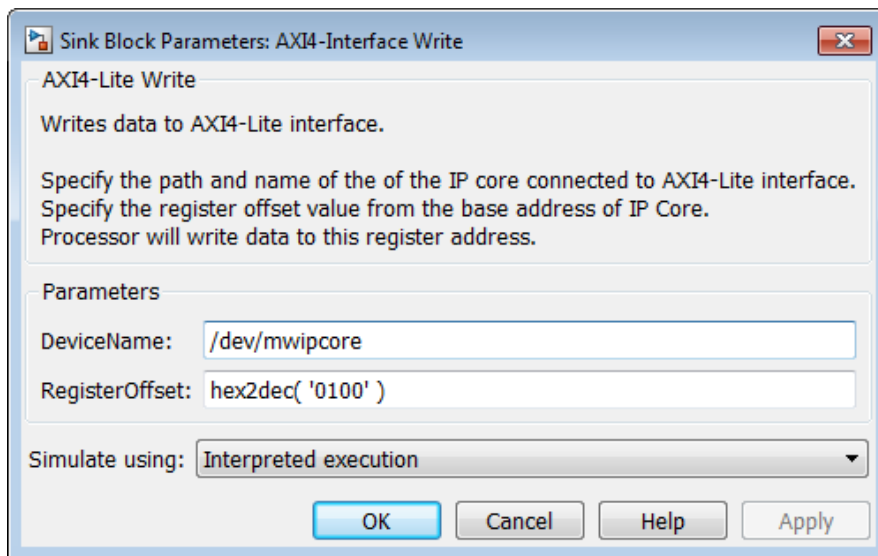
Use the AXI4-Lite interface to write data to a register on the Intellectual Property (IP) core of the Xilinx Zynq platform.

The sample rate of the block input controls how often this block writes data to the register.

To open the block library that contains this block, enter `axiinterfacelib` in the MATLAB Command Window.

# AXI4-Interface Write

## Dialog Box



### DeviceName

Specify the path and name of the of the IP core device.

---

**Note** If you are using HDL Coder to generate the IP core, the IP core is mapped to /dev/mwipcore.

---

### RegisterOffset

Specify the offset from the base address of the IP core to the register. The block writes data to this register.

Use the hex2dec function when you specify the offset address using a hexadecimal number string.

---

**Note** If you are using HDL Coder to generate the IP core, you can get the value of the offset address from the “Register Address Mapping” portion of the Custom IP Core Report. For more information, see “Register Address Mapping”.

---

## Simulate using

- **Interpreted execution** — Simulates this block using MATLAB interpreter. This option shortens startup times, but typically has slower simulation speeds than Code Generation. This is the default option.
- **Code generation** — Creates a MEX-file for this block the first time you run a simulation. Creating the MEX-file requires additional startup time. Subsequent simulations reuse the MEX-file. The MEX-file provides faster simulation speeds than Interpreted execution.

This parameter only applies to simulations. It does not alter the process of building a model to create and run a binary executable on the Zynq platform.

## See Also

AXI4-Interface Read | “Custom IP Core Report” | Getting Started with HW/SW Co-design Workflow for Xilinx Zynq Platform

## External Web Sites

- <http://www.xilinx.com/ipcenter/axi4.htm>

# **AXI4-Interface Write**

---

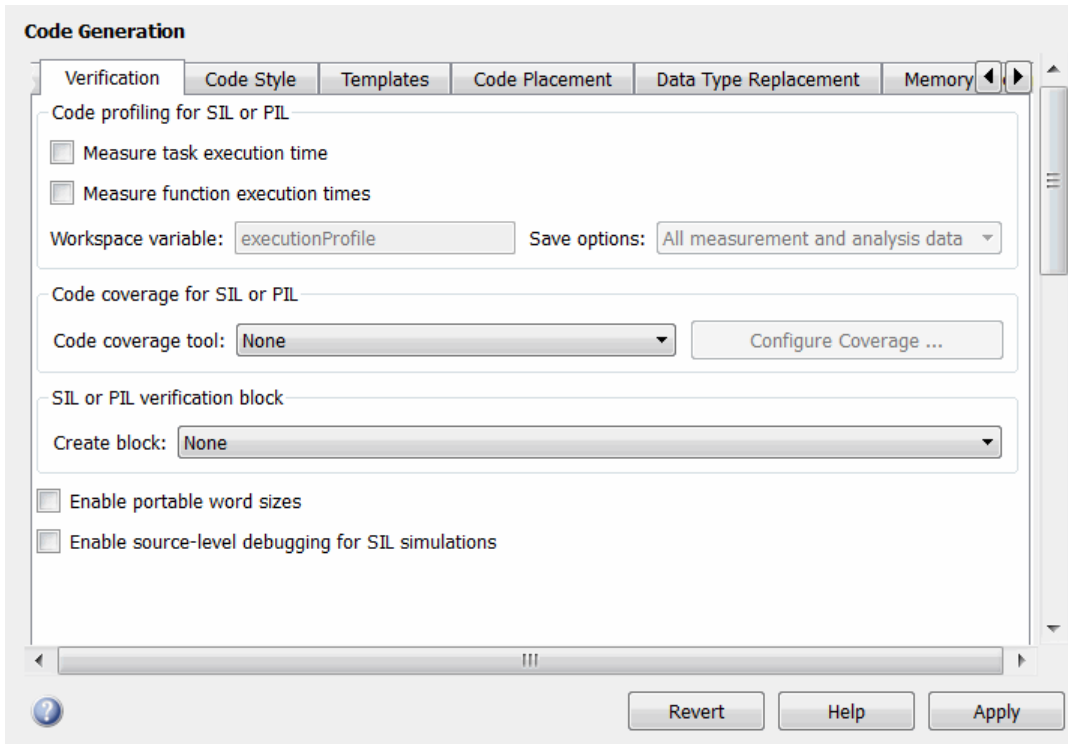


# Configuration Parameters

---

- “Code Generation Pane: Verification” on page 3-2
- “Code Generation Pane: Code Style” on page 3-20
- “Code Generation Pane: Templates” on page 3-35
- “Code Generation Pane: Code Placement” on page 3-46
- “Code Generation Pane: Data Type Replacement” on page 3-63
- “Code Generation Pane: Memory Sections” on page 3-92
- “Code Generation Pane: AUTOSAR Code Generation Options” on page 3-109
- “Code Generation: Coder Target Pane” on page 3-115
- “Code Generation: Target Hardware Resources Pane” on page 3-152
- “Coder Target Pane: ARM® Cortex®-A9 (QEMU)” on page 3-231
- “Coder Target Pane: ARM® Cortex®-M3 (QEMU)” on page 3-238
- “Coder Target Pane: Support Package for STMicroelectronics STM32F4 Discovery Hardware” on page 3-242
- “Coder Target Pane: Texas Instruments C2000 Processors” on page 3-258
- “Coder Target Pane: Xilinx Zynq ZC702/ZC706 Evaluation Kits, ZedBoard” on page 3-325
- “Parameter Reference” on page 3-330

## Code Generation Pane: Verification



### In this section...

“Code Generation: Verification Tab Overview” on page 3-4

“Measure task execution time” on page 3-5

“Measure function execution times” on page 3-7

“Workspace variable” on page 3-9

“Save options” on page 3-11

“Code coverage tool” on page 3-13

“Create block” on page 3-15

**In this section...**

“Enable portable word sizes” on page 3-17

“Enable source-level debugging for SIL” on page 3-19

### **Code Generation: Verification Tab Overview**

Create SIL block and configure word size portability, code coverage for SIL testing, and code execution profiling

#### **Configuration**

This tab appears only if you specify an ERT-based system target file.

#### **See Also**

“About SIL and PIL Simulations”

## Measure task execution time

Specify whether to collect execution time profiles for tasks in generated code

### Settings

**Default:** off



On

Collect measurements of execution times. Data obtained from instrumentation probes added to SIL or PIL test harness.



Off

Do not collect measurements of execution times

### Dependencies

When you use this parameter, you must also specify a workspace variable. The software uses this variable to collect execution time measurements.

### Command-Line Information

**Parameter:** CodeExecutionProfiling

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

### Recommended Settings

| Application       | Setting |
|-------------------|---------|
| Debugging         | On      |
| Traceability      | On      |
| Efficiency        | Off     |
| Safety precaution | Off     |

### **See Also**

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”

## Measure function execution times

Specify whether to collect execution times for functions inside generated code

### Settings

**Default:** off



On

Collect execution times for functions. Data obtained from instrumentation probes placed inside code generated from atomic subsystems and model reference hierarchies.



Off

Do not collect execution times for functions inside generated code

### Dependencies

To use this parameter, you must also select the **Measure task execution time** check box and specify a workspace variable.

### Command-Line Information

**Parameter:** CodeProfilingInstrumentation

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

### Recommended Settings

| Application       | Setting |
|-------------------|---------|
| Debugging         | On      |
| Traceability      | On      |
| Efficiency        | Off     |
| Safety precaution | Off     |

### **See Also**

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”



## Workspace variable

Specify workspace variable that collects measurements and allows viewing and analysis of execution profiles

### Settings

**Default:** executionProfile

When you run simulation, software generates specified workspace variable as an `coder.profile.ExecutionTime` object. To view and analyze execution profiles, use methods from the `coder.profile.ExecutionTime` and `coder.profile.ExecutionTimeSection` classes.

### Dependency

You can only specify this parameter if you select the **Measure task execution time** check box. Otherwise the field appears dimmed.

### Command-Line Information

**Parameter:** CodeExecutionProfileVariable

**Type:** string

**Value:** valid MATLAB variable name

**Default:** none

### Recommended Settings

| Application       | Setting                    |
|-------------------|----------------------------|
| Debugging         | No impact                  |
| Traceability      | Valid MATLAB variable name |
| Efficiency        | No impact                  |
| Safety precaution | No impact                  |

### See Also

- “Configure Code Execution Profiling for SIL and PIL”

- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”

## Save options

Specify whether to save code profiling measurement and analysis data to base workspace

## Settings

**Default:** Summary data only

### Summary data only

Save only code profiling summary data to a `coder.profile.ExecutionTime` in the base workspace. Use this option to limit the amount of data that the software saves to base workspace. For example, if you are concerned that your computer may not have enough memory to store the time measurements for a long simulation. The software calculates metrics for the code execution report as the simulation proceeds, without saving raw data to memory. To view these metrics, use the `coder.profile.ExecutionTime` report method.

### All measurement and analysis data

Save the code profiling measurement and analysis data to a `coder.profile.ExecutionTime` object in the base workspace. In addition to viewing the code execution report, this option allows you to analyze data using `coder.profile.ExecutionTime` and `coder.profile.ExecutionTimeSection` methods.

## Dependency

You can only specify this parameter if you select the **Measure task execution time** check box. Otherwise the field appears dimmed.

## Command-Line Information

**Parameter:** CodeProfilingSaveOptions

**Type:** string

**Value:** 'SummaryOnly' | 'AllData'

**Default:** 'SummaryOnly'

#### Recommended Settings

| Application       | Setting                           |
|-------------------|-----------------------------------|
| Debugging         | All measurement and analysis data |
| Traceability      | All measurement and analysis data |
| Efficiency        | Summary data only                 |
| Safety precaution | No impact                         |

#### See Also

- “Configure Code Execution Profiling for SIL and PIL”
- “View and Compare Code Execution Times”
- “Analyze Code Execution Data”

## Code coverage tool

Specify a code coverage tool

### Settings

**Default:** None

None

No code coverage tool specified

BullseyeCoverage

Specifies the BullseyeCoverage™ tool from Bullseye Testing Technology™

LDRA Testbed

Specifies the LDRA Testbed® tool from LDRA Software Technology

### Dependencies

You cannot specify this parameter if **Create block** is either SIL or PIL.

If you do not specify a tool, **Configure Coverage** appears dimmed. If you specify a tool, click **Configure Coverage** to open the Code Coverage Settings dialog box.

### Command-Line Information

**Parameter:** CoverageTool

**Type:** string

**Value:** 'None' | 'BullseyeCoverage' | 'LDRA Testbed'

**Default:** 'None'

---

**Tip** To access the CoverageTool parameter, type:

```
covSettings = get_param(gcs, 'CodeCoverageSettings');
covSettings.CoverageTool
```

---

#### Recommended Settings

| Application       | Setting                          |
|-------------------|----------------------------------|
| Debugging         | BullseyeCoverage or LDRA Testbed |
| Traceability      | BullseyeCoverage or LDRA Testbed |
| Efficiency        | None (code coverage off)         |
| Safety precaution | None (code coverage off)         |

#### See Also

- “Configure SIL and PIL Code Coverage”
- “Configure Code Coverage Programmatically”

## Create block

Generate a SIL or PIL block

### Settings

**Default:** None

None

SIL or PIL block not generated.

SIL

Generate a SIL block that represents a top-model or subsystem.

If you select this option, the software creates and opens an untitled model with a SIL block. The SIL block contains an S-function wrapper, through which the software runs compiled object code on the host computer. With this block, you can verify the behavior of source code generated from top-model or subsystem components.

PIL

Generate a PIL block that represents a top-model or subsystem.

If you select this option, the software creates and opens an untitled model with a PIL block. The PIL block contains an S-function, through which the software runs cross-compiled object code on a target processor or instruction set simulator. With this block, you can verify the behavior of object code generated from top-model or subsystem components.

To control the way code compiles and executes in the target environment, use Target Connectivity API.

### Command-Line Information

**Parameter:** CreateSILPILBlock

**Type:** string

**Value:** 'None' | 'SIL' | 'PIL'

**Default:** 'None'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | On        |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- “Use a SIL or PIL Block”
- Techniques for Exporting Function-Call Subsystems
- Validating ERT Production Code on the MATLAB Host Computer Using Portable Word Sizes
- “About SIL and PIL Simulations”



## Enable portable word sizes

Allow portability across host and target processors that support different word sizes.

You can enable portable word sizes to support SIL testing of your generated code. For a SIL simulation, select **SIL** in the **Create block** field, or use top-model or Model block SIL simulation mode.

### Settings

**Default:** off



On

Generate conditional processing macros to support compilation of generated code on a processor that supports a different word size than the target processor on which production code is intended to run. This option allows you to use the same generated code for software-in-the-loop (SIL) testing on the host platform and production deployment on the target platform. For example, you can perform SIL testing on a 32-bit host and deploy the code on a 16-bit target.



Off

Does not generate portable code.

### Dependencies

- When you use this option, you should select **Test hardware is the same as production hardware** on the **Hardware Implementation** pane.
- The **MAT-file logging** option on the **Code Generation > Interface** pane cannot be used with this option.

### Command-Line Information

**Parameter:** PortableWordSizes

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | On        |
| Traceability      | On        |
| Efficiency        | Off       |
| Safety precaution | No impact |

### See Also

- Validating ERT Production Code on the MATLAB Host Computer Using Portable Word Sizes
- Tips for Optimizing the Generated Code
- “Configure Hardware Implementation Settings for SIL”

## Enable source-level debugging for SIL

Allow debugging of generated code during a SIL simulation

### Settings

Default: off



On

Source-level debugging is enabled.



Off

Source-level debugging is disabled.

### Command-Line Information

Parameter: SILDebugging

Type: string

Value: 'on' | 'off'

Default: 'off'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | On        |
| Traceability      | On        |
| Efficiency        | Off       |
| Safety precaution | No impact |

### See Also

“Debugging During SIL Simulations”

## Code Generation Pane: Code Style

**Code Generation**

Debug Interface Verification **Code Style** Templates Code Placement Data Type Replacement Memory Se

Code style

Parentheses level: Nominal (Optimize for readability)

Preserve operand order in expression

Preserve condition expression in if statement

Convert if-elseif-else patterns to switch-case statements

Preserve extern keyword in function declarations

Suppress generation of default cases for Stateflow switch statements if unreachable

Code indentation

Indent style: K&R Indent size: 2

### In this section...

“Code Generation: Code Style Tab Overview” on page 3-21

“Parentheses level” on page 3-22

“Preserve operand order in expression” on page 3-24

“Preserve condition expression in if statement” on page 3-25

“Convert if-elseif-else patterns to switch-case statements” on page 3-27

“Preserve extern keyword in function declarations” on page 3-29

“Suppress generation of default cases for Stateflow switch statements if unreachable” on page 3-31

“Indent style” on page 3-32

“Indent size” on page 3-34

## **Code Generation: Code Style Tab Overview**

Control optimizations for readability in generated code.

### **Configuration**

This tab appears only if you specify an ERT based system target file.

### **See Also**

- “Control Code Style”
- “Code Generation Pane: Code Style” on page 3-20

### Parentheses level

Specify parenthesization style for generated code.

#### Settings

**Default:** Nominal (Optimize for readability)

#### Minimum (Rely on C/C++ operators for precedence)

Inserts parentheses only where required by ANSI<sup>1</sup> C or C++, or to override default precedence. For example:

```
Out = In2 - In1 > 1.0 && In2 > 2.0;
```

#### Nominal (Optimize for readability)

Inserts parentheses in a way that compromises between readability and visual complexity. For example:

```
Out = ((In2 - In1 > 1.0) && (In2 > 2.0));
```

#### Maximum (Specify precedence with parentheses)

Includes parentheses to specify meaning without relying on operator precedence. Code generated with this setting conforms to MISRA<sup>®2</sup> requirements. For example:

```
Out = (((In2 - In1) > 1.0) && (In2 > 2.0));
```

### Command-Line Information

**Parameter:** ParenthesesLevel

**Type:** string

**Value:** 'Minimum' | 'Nominal' | 'Maximum'

**Default:** 'Nominal'

- 
1. ANSI<sup>®</sup> is a registered trademark of the American National Standards Institute, Inc.
  2. MISRA<sup>®</sup> is a registered trademarks of MIRA Ltd, held on behalf of the MISRA<sup>®</sup> Consortium.

## Recommended Settings

| Application       | Setting                                          |
|-------------------|--------------------------------------------------|
| Debugging         | Nominal (Optimized for readability)              |
| Traceability      | Nominal (Optimized for readability)              |
| Efficiency        | Minimum (Rely on C/C++ operators for precedence) |
| Safety precaution | Maximum (Specify precedence with parentheses)    |

## See Also

Controlling Parenthesization

## Preserve operand order in expression

Specify whether to preserve order of operands in expressions.

### Settings

**Default:** off



On

Preserves the expression order specified in the model. Select this option to increase readability of the code or for code traceability purposes.

$A*(B+C)$



Off

Optimizes efficiency of code for nonoptimized compilers by reordering commutable operands to make expressions left-recursive. For example:

$(B+C)*A$

### Command-Line Information

**Parameter:** PreserveExpressionOrder

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

### Recommended Settings

| Application       | Setting |
|-------------------|---------|
| Debugging         | On      |
| Traceability      | On      |
| Efficiency        | Off     |
| Safety precaution | On      |



## Preserve condition expression in if statement

Specify whether to preserve empty primary condition expressions in if statements.

### Settings

**Default:** off



On

Preserves empty primary condition expressions in if statements, such as the following, to increase the readability of the code or for code traceability purposes.

```
if expression1
else
 statements2;
end
```



Off

Optimizes empty primary condition expressions in if statements by negating them. For example, consider the following if statement:

```
if expression1
else
 statements2;
end
```

By default, the code generator negates this statement as follows:

```
if ~expression1
 statements2;
end
```

### Command-Line Information

**Parameter:** PreserveIfCondition

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

#### Recommended Settings

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Debugging          | On             |
| Traceability       | On             |
| Efficiency         | Off            |
| Safety precaution  | On             |

## Convert if-elseif-else patterns to switch-case statements

Specify whether to generate code for if-elseif-else decision logic as switch-case statements.

This readability optimization works on a per-model basis and applies only to:

- Flow charts in Stateflow charts
- MATLAB functions in Stateflow charts
- MATLAB Function blocks in that model

### Settings

**Default:** off



On

Generate code for if-elseif-else decision logic as switch-case statements.

For example, assume that you have the following logic pattern:

```
if (x == 1) {
 y = 1;
} else if (x == 2) {
 y = 2;
} else if (x == 3) {
 y = 3;
} else {
 y = 4;
}
```

Selecting this check box converts the if-elseif-else pattern to the following switch-case statements:

```
switch (x) {
 case 1:
 y = 1; break;
 case 2:
 y = 2; break;
```

```
 case 3:
 y = 3; break;
 default:
 y = 4; break;
 }
```



Off

Preserve if-elseif-else decision logic in generated code.

### Command-Line Information

**Parameter:** ConvertIfToSwitch

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

### Recommended Settings

| Application       | Setting                              |
|-------------------|--------------------------------------|
| Debugging         | No impact                            |
| Traceability      | Off                                  |
| Efficiency        | On (execution, ROM), No impact (RAM) |
| Safety precaution | No impact                            |

### See Also

- “Enhance Readability of Code for Flow Charts”
- “Enhance Code Readability for MATLAB Function Blocks”
- “Control Code Style”

## Preserve extern keyword in function declarations

Specify whether to include the extern keyword in function declarations in the generated code.

---

**Note** The extern keyword is optional for functions with external linkage. It is considered good programming practice to include the extern keyword in function declarations for code readability.

---

### Settings

**Default:** on



On

Include the extern keyword in function declarations in the generated code. For example, the generated code for themodel rtwdemo\_hyperlinks contains the following function declarations in rtwdemo\_hyperlinks.h:

```
/* Model entry point functions */
extern void rtwdemo_hyperlinks_initialize(void);
extern void rtwdemo_hyperlinks_step(void);
```

The extern keyword explicitly indicates that the function has external linkage. The function definitions in this example are in the generated file rtwdemo\_hyperlinks.c.



Off

Remove the extern keyword from function declarations in the generated code.

### Command-Line Information

**Parameter:** PreserveExternInFcnDecls

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'on'

#### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

#### See Also

For more information on code style options, see “Code Generation Pane: Code Style” on page 3-20.

## Suppress generation of default cases for Stateflow switch statements if unreachable

Specify whether to generate default cases for switch-case statements in the code for Stateflow charts. This optimization works on a per-model basis. It applies to the code generated for a state that has multiple substates. For a list of the state functions in the generated code, see “Inline State Functions in Generated Code” in the Stateflow documentation.

### Settings

**Default:** off



On

Do not generate the default case when it is unreachable. This setting enables better code coverage because every branch in the generated code is falsifiable.



Off

Generate a default case whether or not it is reachable. This setting supports MISRA C<sup>®</sup> compliance and provides a backup in case of RAM corruption.

For example, when the state has a nontrivial entry function, the following default case appears in the generated code for the during function:

```
default:
 entry_internal();
 break;
```

In this case, the code marks the corresponding substate as active.

### Command-Line Information

**Parameter:** SuppressUnreachableDefaultCases

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

## Recommended Settings

| Application       | Setting                              |
|-------------------|--------------------------------------|
| Debugging         | No impact                            |
| Traceability      | On                                   |
| Efficiency        | On (execution, ROM), No impact (RAM) |
| Safety precaution | Off                                  |

## See Also

For more information on code style options, see “Code Generation Pane: Code Style” on page 3-20.

## Indent style

Specify style for the placement of braces in generated code.

## Settings

**Default:** K&R

### K&R

For blocks within a function, an opening brace is on the same line as its control statement. For example:

```
void rt_OneStep(void)
{
 static boolean_T OverrunFlag = 0;
 if (OverrunFlag) {
 rtmSetErrorStatus(rtwdemo_counter_M, "Overrun");
 return;
 }

 OverrunFlag = TRUE;
 rtwdemo_counter_step();
 OverrunFlag = FALSE;
}
```



**Allman**

For blocks within a function, an opening brace is on its own line at the same level of indentation as its control statement. For example:

```
void rt_OneStep(void)
{
 static boolean_T OverrunFlag = 0;
 if (OverrunFlag)
 {
 rtmSetErrorStatus(rtwdemo_counter_M, "Overrun");
 return;
 }

 OverrunFlag = TRUE;
 rtwdemo_counter_step();
 OverrunFlag = FALSE;
}
```

**Command-Line Information**

**Parameter:** IndentStyle

**Type:** string

**Value:** 'K&R' | 'Allman'

**Default:** 'K&R'

**Recommended Settings**

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

**See Also**

For more information on code indentation options, see “Code Indentation”.

### Indent size

Specify indent size for generated code.

#### Settings

**Default:** 2

Specify an integer value that indicates the number of characters per indent level. Possible values range from 2–8 characters.

#### Command-Line Information

**Parameter:** IndentSize

**Type:** integer

**Value:** integer from 2–8

**Default:** 2

#### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

#### See Also

For more information on code indentation options, see “Code Indentation”.

## Code Generation Pane: Templates

**Code Generation**

SIL and PIL Verification | Code Style | **Templates** | Code Placement | Data Type Replacement | Memory Sections

Code templates

Source file (\*.c) template:  Browse... Edit...

Header file (\*.h) template:  Browse... Edit...

Data templates

Source file (\*.c) template:  Browse... Edit...

Header file (\*.h) template:  Browse... Edit...

Custom templates

File customization template:  Browse... Edit...

Generate an example main program

Target operating system:

### In this section...

“Code Generation: Templates Tab Overview” on page 3-36

“Code templates: Source file (\*.c) template” on page 3-37

“Code templates: Header file (\*.h) template” on page 3-38

“Data templates: Source file (\*.c) template” on page 3-39

“Data templates: Header file (\*.h) template” on page 3-40

“File customization template” on page 3-41

“Generate an example main program” on page 3-42

“Target operating system” on page 3-44

### **Code Generation: Templates Tab Overview**

Customize the organization of your generated code.

#### **Configuration**

This tab appears only if you specify an ERT based system target file.

#### **See Also**

“Code Generation Pane: Templates” on page 3-35

## Code templates: Source file (\*.c) template

Specify the code generation template (CGT) file to use when generating a source code file.

### Settings

**Default:** ert\_code\_template.cgt

You can use a CGT file to define the top-level organization and formatting of generated source code files (.c or .cpp).

---

**Note** The CGT file must be located on the MATLAB path.

---

### Command-Line Information

**Parameter:** ERTSrcFileBannerTemplate

**Type:** string

**Value:** valid CGT file

**Default:** 'ert\_code\_template.cgt'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- Selecting and Defining Templates
- Custom File Processing

## Code templates: Header file (\*.h) template

Specify the code generation template (CGT) file to use when generating a code header file.

### Settings

**Default:** ert\_code\_template.cgt

You can use a CGT file to define the top-level organization and formatting of generated header files (.h).

---

**Note** The CGT file must be located on the MATLAB path.

---

### Command-Line Information

**Parameter:** ERTHdrFileBannerTemplate

**Type:** string

**Value:** valid CGT file

**Default:** 'ert\_code\_template.cgt'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- Selecting and Defining Templates
- Custom File Processing

## Data templates: Source file (\*.c) template

Specify the code generation template (CGT) file to use when generating a data source file.

### Settings

**Default:** ert\_code\_template.cgt

You can use a CGT file to define the top-level organization and formatting of generated data source files (.c or .cpp) that contain definitions of variables of global scope.

---

**Note** The CGT file must be located on the MATLAB path.

---

### Command-Line Information

**Parameter:** ERTDataSrcFileTemplate  
**Type:** string  
**Value:** valid CGT file  
**Default:** 'ert\_code\_template.cgt'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- Selecting and Defining Templates
- Custom File Processing

## Data templates: Header file (\*.h) template

Specify the code generation template (CGT) file to use when generating a data header file.

### Settings

**Default:** ert\_code\_template.cgt

You can use a CGT file to define the top-level organization and formatting of generated data header files (.h) that contain declarations of variables of global scope.

---

**Note** The CGT file must be located on the MATLAB path.

---

### Command-Line Information

**Parameter:** ERTDataHdrFileTemplate

**Type:** string

**Value:** valid CGT file

**Default:** 'ert\_code\_template.cgt'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- Selecting and Defining Templates
- Custom File Processing



## File customization template

Specify the custom file processing (CFP) template file to use when generating code.

### Settings

**Default:** 'example\_file\_process.tlc'

You can use a CFP template file to customize generated code. A CFP template file is a TLC file that organizes types of code (for example, includes, typedefs, and functions) into sections. The primary purpose of a CFP template is to assemble code to be generated into buffers, and to call a code template API to emit the buffered code into specified sections of generated source and header files. The CFP template file must be located on the MATLAB path.

### Command-Line Information

**Parameter:** ERTCustomFileTemplate

**Type:** string

**Value:** valid TLC file

**Default:** 'example\_file\_process.tlc'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- Selecting and Defining Templates
- Custom File Processing

### Generate an example main program

Control whether to generate an example main program for a model.

#### Settings

Default: on



On

Generates an example main program, `ert_main.c` (or `.cpp`). The file includes:

- The `main()` function for the generated program
- Task scheduling code that determines how and when block computations execute on each time step of the model

The operation of the main program and the scheduling algorithm employed depend primarily on whether your model is single-rate or multirate, and also on your model's solver mode (`SingleTasking` or `MultiTasking`).



Off

Does not generate an example main program.

---

**Note** The software provides static versions of the main file, `matlabroot/rtw/c/src/common/rt_main.c` and `matlabroot/rtw/c/src/common/rt_cppclass_main.cpp`, as a basis for custom modifications. You can use either static main file as a template for developing embedded applications.

---

#### Tips

- After you generate and customize the main program, disable this option to prevent regenerating the main module and overwriting your customized version.
- You can use a custom file processing (CFP) template file to override normal main program generation, and generate a main program module customized for your target environment.

- If you disable this option, the coder generates slightly different rate grouping code to maintain compatibility with an older static main module.

## Dependencies

- This parameter enables **Target operating system**.
- You must enable this parameter and select VxWorksExample for **Target operating system** if you use VxWorks<sup>3</sup> library blocks.

## Command-Line Information

**Parameter:** GenerateSampleERTMain

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'on'

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

- “Generate a Standalone Program”
- Static Main Program Module
- Custom File Processing

3. VxWorks® is a registered trademark of Wind River® Systems, Inc.

### Target operating system

Specify a target operating system to use when generating model-specific example main program module.

#### Settings

**Default:** BareBoardExample

##### BareBoardExample

Generates a bareboard main program designed to run under control of a real-time clock, without a real-time operating system.

##### VxWorksExample

Generates a fully commented example showing how to deploy the code under the VxWorks real-time operating system.

##### NativeThreadsExample

Generates a fully commented example showing how to deploy the threaded code under the host operating system. This option requires you to configure your model for concurrent execution.

#### Dependencies

- This parameter is enabled by **Generate an example main program**.
- This parameter must be the same for top-level and referenced models.

#### Command-Line Information

**Parameter:** TargetOS

**Type:** string

**Value:** 'BareBoardExample' | 'VxWorksExample' |  
'NativeThreadsExample'

**Default:** 'BareBoardExample'

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

- “Generate a Standalone Program”
- Static Main Program Module
- Custom File Processing

## Code Generation Pane: Code Placement

**Code Generation**

SIL and PIL Verification | Code Style | Templates | **Code Placement** | Data Type Replacement | Memory Sections

Global data placement (custom storage classes only)

Data definition: Auto

Data declaration: Auto

#include file delimiter: Auto

Use owner from data object for data definition placement

Global data placement (MPT data objects only)

Signal display level: 10 | Parameter tune level: 10

Code Packaging

File packaging format: Modular

### In this section...

- “Code Generation: Code Placement Tab Overview” on page 3-47
- “Data definition” on page 3-48
- “Data definition filename” on page 3-50
- “Data declaration” on page 3-52
- “Data declaration filename” on page 3-54
- “Use owner from data object for data definition placement” on page 3-56
- “#include file delimiter” on page 3-56
- “Signal display level” on page 3-57
- “Parameter tune level” on page 3-59
- “File packaging format” on page 3-61

## **Code Generation: Code Placement Tab Overview**

Specify the data placement in the generated code.

### **Configuration**

This tab appears only if you specify an ERT based system target file.

### **See Also**

“Code Generation Pane: Code Placement” on page 3-46

### Data definition

Specify where to place definitions of global variables.

#### Settings

**Default:** Auto

Auto

Lets the code generator determine where the definitions should be located.

Data defined in source file

Places definitions in `.c` source files where functions are located. The code generator places the definitions in one or more function `.c` files, depending on the number of function source files and the file partitioning previously selected in the Simulink model.

Data defined in a single separate source file

Places definitions in the source file specified in the **Data definition filename** field. The code generator organizes and formats the definitions based on the data source template specified by the **Source file (\*.c) template** parameter in the data section of the **Templates** pane.

### Dependencies

- This parameter applies to data with custom storage classes only.
- This parameter enables **Data definition filename**.

### Command-Line Information

**Parameter:** GlobalDataDefinition

**Type:** string

**Value:** 'Auto' | 'InSourceFile' | 'InSeparateSourceFile'

**Default:** 'Auto'



## Recommended Settings

| Application       | Setting       |
|-------------------|---------------|
| Debugging         | No impact     |
| Traceability      | A valid value |
| Efficiency        | No impact     |
| Safety precaution | No impact     |

## See Also

“Data Definition and Declaration Management”

## Data definition filename

Specify the name of the file that is to contain data definitions.

### Settings

**Default:** `global.c` or `global.cpp`

The code generator organizes and formats the data definitions in the specified file based on the data source template specified by the **Source file (\*.c) template** parameter in the data section of the **Code Generation** pane: **Templates** tab.

If you specify C++ as the target language, omit the `.cpp` extension. The code generator generates a file that has the extension `.cpp`.

### Limitation

The code generator does not check for unique filenames. Specify filenames that do not collide with default filenames from code generation.

### Dependency

This parameter is enabled by **Data definition**.

### Command-Line Information

**Parameter:** `DataDefinitionFile`

**Type:** `string`

**Value:** a valid file

**Default:** `'global.c'`

### Recommended Settings

| Application  | Setting      |
|--------------|--------------|
| Debugging    | No impact    |
| Traceability | A valid file |

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

### **See Also**

- [Selecting and Defining Templates](#)
- [Custom File Processing](#)

### Data declaration

Specify where extern, typedef, and #define statements are to be declared.

#### Settings

**Default:** Auto

Auto

Lets the code generator determine where the declarations should be located.

Data declared in source file

Places declarations in .c source files where functions are located. The data header template file is not used. The code generator places the declarations in one or more function .c files, depending on the number of function source files and the file partitioning previously selected in the Simulink model.

Data defined in a single separate source file

Places declarations in the data header file specified in the **Data declaration filename** field. The code generator organizes and formats the declarations based on the data header template specified by the **header file (\*.h) template** parameter in the data section of the **Code Generation** pane: **Templates** tab.

#### Dependencies

- This parameter applies to data with custom storage classes only.
- This parameter enables **Data declaration filename**.

#### Command-Line Information

**Parameter:** GlobalDataReference

**Type:** string

**Value:** 'Auto' | 'InSourceFile' | 'InSeparateHeaderFile'

**Default:** 'Auto'

## Recommended Settings

| Application       | Setting       |
|-------------------|---------------|
| Debugging         | No impact     |
| Traceability      | A valid value |
| Efficiency        | No impact     |
| Safety precaution | No impact     |

## See Also

“Data Definition and Declaration Management”

### Data declaration filename

Specify the name of the file that is to contain data declarations.

#### Settings

**Default:** `global.h`

The code generator organizes and formats the data declarations in the specified file based on the data header template specified by the **Header file (\*.h) template** parameter in the data section of the **Code Generation** pane: **Templates** tab.

#### Limitation

The code generator does not check for unique filenames. Specify filenames that do not collide with default filenames from code generation.

#### Dependency

This parameter is enabled by **Data declaration**.

#### Command-Line Information

**Parameter:** `DataReferenceFile`

**Type:** `string`

**Value:** a valid file

**Default:** `'global.h'`

#### Recommended Settings

| Application       | Setting      |
|-------------------|--------------|
| Debugging         | No impact    |
| Traceability      | A valid file |
| Efficiency        | No impact    |
| Safety precaution | No impact    |

## **See Also**

- [Selecting and Defining Templates](#)
- [Custom File Processing](#)

## Use owner from data object for data definition placement

Specify whether the model uses or ignores the ownership setting of a data object for data definition in code generation.

### Settings

**Default:** on

On  
Uses the ownership setting of the data object for data definition. This value corresponds to the `SameAsModel` value of the `ModuleNamingRule` parameter.

Off  
Ignores the ownership setting of the data object for data definition. This value corresponds to the `Unspecified` value of the `ModuleNamingRule` parameter.

### Command-Line Information

**Parameter:** `EnableDataOwnership`

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'on'

### Recommended Settings

| Application       | Setting       |
|-------------------|---------------|
| Debugging         | No impact     |
| Traceability      | A valid value |
| Efficiency        | No impact     |
| Safety precaution | No impact     |

### #include file delimiter

Specify the type of `#include` file delimiter to use in generated code.



## Settings

**Default:** Auto

Auto

Lets the code generator choose the `#include` file delimiter

`#include header.h`

Uses double quote (" ") characters to delimit file names in `#include` statements.

`#include <header.h>`

Uses angle brackets (< >) to delimit file names in `#include` statements.

## Dependency

The delimiter format that you use when specifying parameter and signal object property values overrides what you set for this parameter.

## Command-Line Information

**Parameter:** IncludeFileDelimiter

**Type:** string

**Value:** 'Auto' | 'UseQuote' | 'UseBracket'

**Default:** 'Auto'

## Recommended Settings

| Application       | Setting       |
|-------------------|---------------|
| Debugging         | No impact     |
| Traceability      | A valid value |
| Efficiency        | No impact     |
| Safety precaution | No impact     |

## Signal display level

Specify the persistence level for MPT signal data objects.

### Settings

**Default:** 10

Specify an integer value indicating the persistence level for MPT signal data objects. This value indicates the level at which to declare signal data objects as global data in the generated code. The persistence level allows you to make intermediate variables global during initial development so you can remove them during later stages of development to gain efficiency.

This parameter is related to the **Persistence level** value that you can specify for a specific MPT signal data object in the Model Explorer signal properties dialog.

### Dependency

This parameter must be the same for top-level and referenced models.

### Command-Line Information

**Parameter:** SignalDisplayLevel

**Type:** integer

**Value:** a valid integer

**Default:** 10

### Recommended Settings

| Application       | Setting         |
|-------------------|-----------------|
| Debugging         | No impact       |
| Traceability      | A valid integer |
| Efficiency        | No impact       |
| Safety precaution | No impact       |

### See Also

Selecting Persistence Level for Signals and Parameters

## Parameter tune level

Specify the persistence level for MPT parameter data objects.

### Settings

**Default:** 10

Specify an integer value indicating the persistence level for MPT parameter data objects. This value indicates the level at which to declare parameter data objects as tunable global data in the generated code. The persistence level allows you to make intermediate variables global and tunable during initial development so you can remove them during later stages of development to gain efficiency.

This parameter is related to the **Persistence level** value you that can specify for a specific MPT parameter data object in the Model Explorer parameter properties dialog.

### Dependency

This parameter must be the same for top-level and referenced models.

### Command-Line Information

**Parameter:** ParamTuneLevel

**Type:** integer

**Value:** a valid integer

**Default:** 10

### Recommended Settings

| Application       | Setting         |
|-------------------|-----------------|
| Debugging         | No impact       |
| Traceability      | A valid integer |
| Efficiency        | No impact       |
| Safety precaution | No impact       |

**See Also**

Selecting Persistence Level for Signals and Parameters

## File packaging format

Specify whether code generation modularizes the code components into many files or compacts the generated code into a few files. You can specify a different file packaging format for each referenced model.

### Settings

**Default:** Modular

#### Modular

- Outputs *model\_data.c*, *model\_private.h*, and *model\_types.h*, in addition to generating *model.c* and *model.h*. For the contents of these files, see the table in “Generated Code Modules”.
- Supports generating separate source files for subsystems. For more information on generating code for subsystems, see “Code Generation of Subsystems”.
- If you specify **Shared code placement** as Auto on the **Code Generation > Interface** pane of the Configuration Parameter dialog box, some utility files are in the build directory. If you specify **Shared code placement** as Shared location, separate files are generated for utility code in a shared location. For more information, see “Controlling Shared Utility Code Placement”.

#### Compact (with separate data file)

- Conditionally outputs *model\_data.c*, in addition to generating *model.c* and *model.h*.
- If you specify **Shared code placement** as Auto on the **Code Generation > Interface** pane of the Configuration Parameter dialog box, utility algorithms are defined in *model.c*. If you specify **Shared code placement** as Shared location, separate files are generated for utility code in a shared location. For more information, see “Controlling Shared Utility Code Placement”.
- Does not support separate source files for subsystems.
- Does not support models with noninlined S-functions.

#### Compact

- The contents of *model\_data.c* are in *model.c*.

- The contents of *model\_private.h* and *model\_types.h* are in *model.h* or *model.c*.
- If you specify **Shared code placement** as Auto on the **Code Generation > Interface** pane of the Configuration Parameter dialog box, utility algorithms are defined in *model.c*. If you specify **Shared code placement** as Shared location, separate files are generated for utility code in a shared location. For more information, see “Controlling Shared Utility Code Placement”.
- Does not support separate source files for subsystems.
- Does not support models with noninlined S-functions.

### Command-Line Information

**Parameter:** ERTFilePackagingFormat

**Type:** string

**Value:** 'Modular' | 'CompactWithDataFile' | 'Compact'

**Default:** 'Modular'

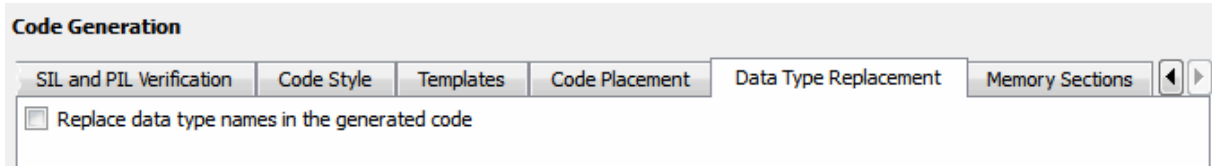
### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

- “Customize Generated Code Modules”
- “Generate Code Modules”
- “Customize Post-Code-Generation Build Processing”

## Code Generation Pane: Data Type Replacement



### In this section...

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“Replace data type names in the generated code” on page 3-65

“Replacement Name: double” on page 3-68

“Replacement Name: single” on page 3-70

“Replacement Name: int32” on page 3-72

“Replacement Name: int16” on page 3-74

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“Replacement Name: uint8” on page 3-82

“Replacement Name: boolean” on page 3-84

“Replacement Name: int” on page 3-86

“Replacement Name: uint” on page 3-88

“Replacement Name: char” on page 3-90

### Code Generation: Data Type Replacement Tab Overview

Replace built-in data type names with user-defined replacement data type names in the generated code for your model.

#### Configuration

This tab appears only if you specify an ERT based System target file.

If your application requires you to replace built-in data type names with user-defined replacement data type names in the generated code:

- 1 Select **Replace data type names in the generated code**.
- 2 Selectively specify replacement data type names to use for built-in Simulink data types in the **Replacement Name** fields.

#### See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”



## Replace data type names in the generated code

Specify whether to replace built-in data type names with user-defined data type names in generated code.

### Settings

**Default:** off



On

Displays the **Data type names** table. The table provides a way for you to replace the names of built-in data types used in generated code. This mechanism can be particularly useful for generating code that adheres to application or site data type naming standards.

You can choose to specify new data type names for some or all Simulink built-in data types listed in the table. For each replacement data type name that you specify:

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- For `double`, `single`, `int32`, `int16`, `int8`, `uint32`, `uint16`, and `uint8`, the `BaseType` of the replacement data type must match the built-in data type.
- For `boolean`, the `BaseType` of the replacement data type must be either an 8-bit integer or an integer of the size displayed for **Number of bits: int** on the **Hardware Implementation** pane of the Configuration Parameters dialog box.
- For `int`, `uint`, and `char`, the size of the replacement data type must match the size displayed for **Number of bits: int** or **Number of bits: char** on the **Hardware Implementation** pane of the Configuration Parameters dialog box.

An error occurs, if

- A replacement data type specification is inconsistent.

- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.



Off

Uses Simulink Coder names for built-in Simulink data types in generated code.

### Dependencies

This parameter enables:

**double Replacement Name**  
**single Replacement Name**  
**int32 Replacement Name**  
**int16 Replacement Name**  
**int8 Replacement Name**  
**uint32 Replacement Name**  
**uint16 Replacement Name**  
**uint8 Replacement Name**  
**boolean Replacement Name**  
**int Replacement Name**  
**uint Replacement Name**  
**char Replacement Name**

### Command-Line Information

**Parameter:** `EnableUserReplacementTypes`

**Type:** `string`

**Value:** `'on' | 'off'`

**Default:** `'off'`

### Recommended Settings

| Application  | Setting   |
|--------------|-----------|
| Debugging    | No impact |
| Traceability | On        |

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

### **See Also**

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: double

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.double`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''

## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: single

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.single`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''

## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: int32

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.int32`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''



## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: int16

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types .

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.int16`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''

## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: `int8`

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** `''`

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.int8`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** `''`

## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: uint32

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.uint32`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''

## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: uint16

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.uint16`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''



## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: uint8

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The `BaseType` of the replacement data type must match the built-in data type.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.uint8`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and `BaseType` of the replacement data type must match the built-in data type

**Default:** ''

## Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ' '            |

## See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: boolean

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be either an 8-bit integer or an integer of the size displayed for **Number of bits: int** on the **Hardware Implementation** pane of the Configuration Parameters dialog box.

---

**Note** For ERT S-functions, the replacement data type can only be an 8-bit integer, `int8` or `uint8`.

---

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.boolean`

**Type:** string

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be either an 8-bit integer or

an integer of the size displayed for **Number of bits: int** on the **Hardware Implementation** pane of the Configuration Parameters dialog box  
**Default:** ''

### Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ''             |

### See Also

- “Replace boolean with an Integer Data Type”
- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: int

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The size of the replacement data type must match the size displayed on the **Hardware Implementation** pane of the Configuration Parameters dialog box.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.int`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and the size of the replacement data type must match the size displayed on the **Hardware Implementation** pane of the Configuration Parameters dialog box

**Default:** ''

### **Recommended Settings**

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Debugging          | No impact      |
| Traceability       | A valid value  |
| Efficiency         | No impact      |
| Safety precaution  | ''             |

### **See Also**

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: uint

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The size of the replacement data type must match the size displayed on the **Hardware Implementation** pane of the Configuration Parameters dialog box.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.uint`

**Type:** `string`

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and the size of the replacement data type must match the size displayed on the **Hardware Implementation** pane of the Configuration Parameters dialog box



**Default:** ''

### Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ''             |

### See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

### Replacement Name: char

Specify names to use for built-in Simulink data types in generated code.

#### Settings

**Default:** ''

Specify strings that the code generator is to use as names for built-in Simulink data types.

- The name must match the name of a `Simulink.AliasType` object that exists in the base workspace.
- The `BaseType` property of the associated `Simulink.AliasType` object must be consistent with the built-in data type it replaces.
- The size of the replacement data type must match the size displayed for on the **Hardware Implementation** pane of the Configuration Parameters dialog box.

An error occurs, if

- A replacement data type specification is inconsistent.
- The `Simulink.AliasType` object has the **Data scope** parameter set to `Exported`.

#### Dependency

This parameter is enabled by **Replace data type names in the generated code**.

#### Command-Line Information

**Parameter:** `ReplacementTypes`, `replacementName.char`

**Type:** string

**Value:** name of a `Simulink.AliasType` object that exists in the base workspace; `BaseType` property of object must be consistent with the built-in data type it replaces and the size of the replacement data type must match the size displayed on the **Hardware Implementation** pane of the Configuration Parameters dialog box

**Default:** ''

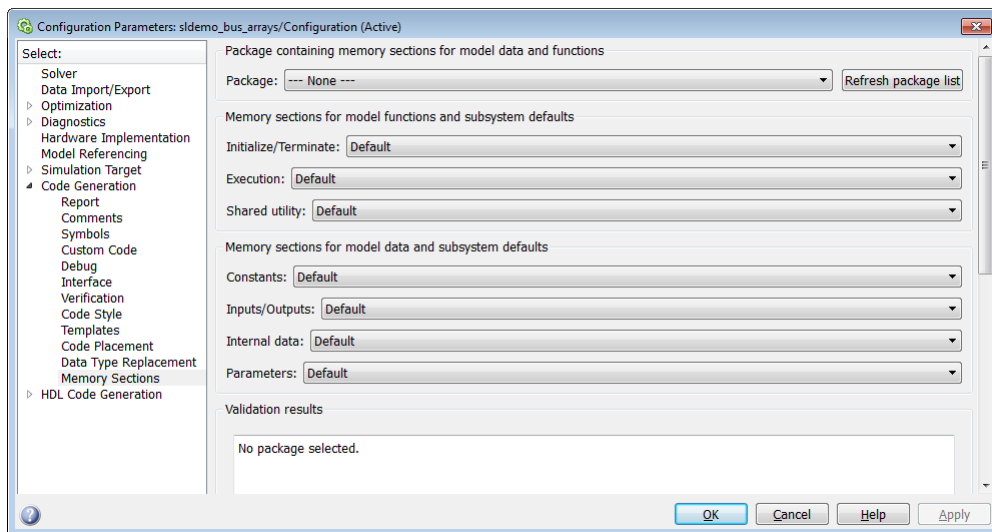
### Recommended Settings

| Application       | Setting        |
|-------------------|----------------|
| Debugging         | No impact      |
| Traceability      | A valid string |
| Efficiency        | No impact      |
| Safety precaution | ''             |

### See Also

- “Data Type Replacement”
- “Data Type Replacement Limitations”

## Code Generation Pane: Memory Sections



### In this section...

“Code Generation: Memory Sections Tab Overview” on page 3-93

“Package” on page 3-94

“Refresh package list” on page 3-96

“Initialize/Terminate” on page 3-97

“Execution” on page 3-98

“Shared utility” on page 3-99

“Constants” on page 3-100

“Inputs/Outputs” on page 3-102

“Internal data” on page 3-104

“Parameters” on page 3-106

“Validation results” on page 3-108

## **Code Generation: Memory Sections Tab Overview**

Insert comments and pragmas into the generated code for data and functions.

### **Configuration**

This tab appears only if you specify an ERT based system target file.

### **See Also**

- “Memory Sections”
- “Code Generation Pane: Memory Sections” on page 3-92

## Package

Specify a package that contains memory sections you want to apply to model-level functions and internal data.

## Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** ---None---

---None---

Suppresses memory sections.

Simulink

Applies the built-in Simulink package.

mpt

Applies the built-in mpt package.

## Tip

If you have defined packages of your own, click **Refresh package list**. This action adds user-defined packages on your search path to the package list.

## Command-Line Information

**Parameter:** MemSecPackage

**Type:** string

**Value:** '--- None ---' | 'Simulink' | 'mpt'

**Default:** '--- None ---'

## Recommended Settings

| Application  | Setting   |
|--------------|-----------|
| Debugging    | No impact |
| Traceability | No impact |

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

**See Also**

“Memory Sections”

### **Refresh package list**

Add user-defined packages that are on the search path to list of packages displayed by **Packages**.

#### **Tip**

If you have defined packages of your own, click **Refresh package list**. This action adds user-defined packages on your search path to the package list.

#### **See Also**

“Memory Sections”



## Initialize/Terminate

Specify whether to apply a memory section to Initialize/Start and Terminate functions.

### Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppresses the use of a memory section for Initialize, Start, and Terminate functions.

*memory-section-name*

Applies a memory section to Initialize, Start, and Terminate functions.

### Command-Line Information

**Parameter:** MemSecFuncInitTerm

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

“Memory Sections”

## Execution

Specify whether to apply a memory section to execution functions.

## Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppresses the use of a memory section for Step, Run-time initialization, Derivative, Enable, and Disable functions.

*memory-section-name*

Applies a memory section to Step, Run-time initialization, Derivative, Enable, and Disable functions.

## Command-Line Information

**Parameter:** MemSecFuncExecute

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

“Memory Sections”

## Shared utility

Specify whether to apply memory sections to shared utility functions.

### Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppresses the use of memory sections for shared utility functions.

*memory-section-name*

Applies a memory section to shared utility functions, such as fixed-point functions, lookup table functions, and binary search functions.

### Command-Line Information

**Parameter:** MemSecFuncSharedUtil

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

“Memory Sections”

## Constants

Specify whether to apply a memory section to constants.

## Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppresses the use of a memory section for constants.

*memory-section-name*

Applies a memory section to constants.

This parameter applies to:

| Data Definition | Data Purpose        |
|-----------------|---------------------|
| <i>model_CP</i> | Constant parameters |
| <i>model_CB</i> | Constant block I/O  |
| <i>model_Z</i>  | Zero representation |

## Command-Line Information

**Parameter:** MemSecDataConstants

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'

## Recommended Settings

| Application  | Setting   |
|--------------|-----------|
| Debugging    | No impact |
| Traceability | No impact |

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

**See Also**

“Memory Sections”

## Inputs/Outputs

Specify whether to apply a memory section to root input and output.

### Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppresses the use of a memory section for root-level input and output.

*memory-section-name*

Applies a memory section for root-level input and output.

This parameter applies to:

| Data Definition | Data Purpose      |
|-----------------|-------------------|
| <i>model_U</i>  | Root-level input  |
| <i>model_Y</i>  | Root-level output |

## Command-Line Information

**Parameter:** MemSecDataIO

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'

## Recommended Settings

| Application  | Setting   |
|--------------|-----------|
| Debugging    | No impact |
| Traceability | No impact |

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

**See Also**

“Memory Sections”

## Internal data

Specify whether to apply a memory section to internal data.

### Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppresses the use of a memory section for internal data.

*memory-section-name*

Applies a memory section for internal data.

This parameter applies to:

| Data Definition   | Data Purpose   |
|-------------------|----------------|
| <i>model_B</i>    | Block I/O      |
| <i>model_D</i>    | DWork vectors  |
| <i>model_M</i>    | Run-time model |
| <i>model_Zero</i> | Zero-crossings |

### Command-Line Information

**Parameter:** MemSecDataInternal

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'



**Recommended Settings**

| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Debugging          | No impact      |
| Traceability       | No impact      |
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

**See Also**

“Memory Sections”

## Parameters

Specify whether to apply a memory section to parameters.

### Settings

Memory section specifications for model-level functions and internal data apply to the top level of the model and to subsystems except atomic subsystems that contain overriding memory section specifications.

**Default:** Default

Default

Suppress the use of a memory section for parameters.

*memory-section-name*

Apply memory section for parameters.

This parameter applies to:

| Data Definition | Data Purpose |
|-----------------|--------------|
| <i>model_P</i>  | Parameters   |

### Command-Line Information

**Parameter:** MemSecDataParameters

**Type:** string

**Value:** 'Default' | 'MemConst' | 'MemVolatile' | 'MemConstVolatile'

**Default:** 'Default'

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

**See Also**

Memory Sections

### Validation results

Display the results of memory section validation.

### Settings

The code generation software checks and reports whether the currently chosen package is on the MATLAB path and that the selected memory sections exist inside the package.

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## Code Generation Pane: AUTOSAR Code Generation Options

Generate XML file for schema version

Maximum SHORT-NAME length:

Use AUTOSAR compiler abstraction macros

Support root-level matrix I/O using one-dimensional arrays

### In this section...

“Code Generation: AUTOSAR Code Generation Options Tab Overview” on page 3-110

“Generate XML file from schema version” on page 3-111

“Maximum SHORT-NAME length” on page 3-112

“Use AUTOSAR compiler abstraction macros” on page 3-113

“Support root-level matrix I/O using one-dimensional arrays” on page 3-114

### **Code Generation: AUTOSAR Code Generation Options Tab Overview**

Parameters for controlling AUTOSAR code generation options.

#### **Configuration**

This pane appears only if you specify the `autosar.tlc` system target file.

#### **Tip**

From the Simulink **Code** menu, select **C/C++ Code > Configure Model as AUTOSAR Component** to open a dialog box where you can configure other AUTOSAR options.

#### **See Also**

- “AUTOSAR Code Generation”
- “Code Generation Pane: AUTOSAR Code Generation Options” on page 3-109

## Generate XML file from schema version

Select the AUTOSAR schema version to use when generating XML files.

### Settings

**Default:** 4.0

- 4.0      Use schema version 4.0 (4.0.3)
- 3.2      Use schema version 3.2 (3.2.1)
- 3.1      Use schema version 3.1 (3.1.4)
- 3.0      Use schema version 3.0 (3.0.2)
- 2.1      Use schema version 2.1 (XSD rev 0017)

### Tip

From the Simulink **Code** menu, select **C/C++ Code > Configure Model as AUTOSAR Component** to open a dialog box where you can configure other AUTOSAR options.

### Command-Line Information

**Parameter:** AutosarSchemaVersion

**Type:** string

**Value:** '4.0' | '3.2' | '3.1' | '3.0' | '2.1'

**Default:** '4.0'

### See Also

“AUTOSAR Code Generation”

### Maximum SHORT-NAME length

Specify maximum length for SHORT-NAME XML elements

#### Settings

**Default:** 32

The AUTOSAR standard specifies that the length of SHORT-NAME XML elements cannot be greater than 32 characters. This option allows you to specify a maximum length of up to 128 characters.

#### Command-Line Information

**Parameter:** AutosarMaxShortNameLength

**Type:** integer

**Value:** an integer less or equal to 128

**Default:** 32

#### See Also

“Specify Maximum SHORT-NAME Length”



## Use AUTOSAR compiler abstraction macros

Specify use of AUTOSAR macros to abstract compiler directives

### Settings

Default: Off



On

Software generates code with C macros that are abstracted compiler directives (near/far memory calls)



Off

Software generates code that does *not* contain AUTOSAR compiler abstraction macros.

### Command-Line Information

**Parameter:** AutosarCompilerAbstraction

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

### See Also

“Configure AUTOSAR Compiler Abstraction Macros”

### Support root-level matrix I/O using one-dimensional arrays

Allow root-level matrix I/O

#### Settings

Default: Off



On

Software supports matrix I/O at the root-level by generating code that implements matrices as one-dimensional arrays.



Off

Software does not allow matrix I/O at the root-level. If you try to build a model that has matrix I/O at the root-level, the software produces an error.

#### Command-Line Information

**Parameter:** AutosarMatrixIOAsArray

**Type:** string

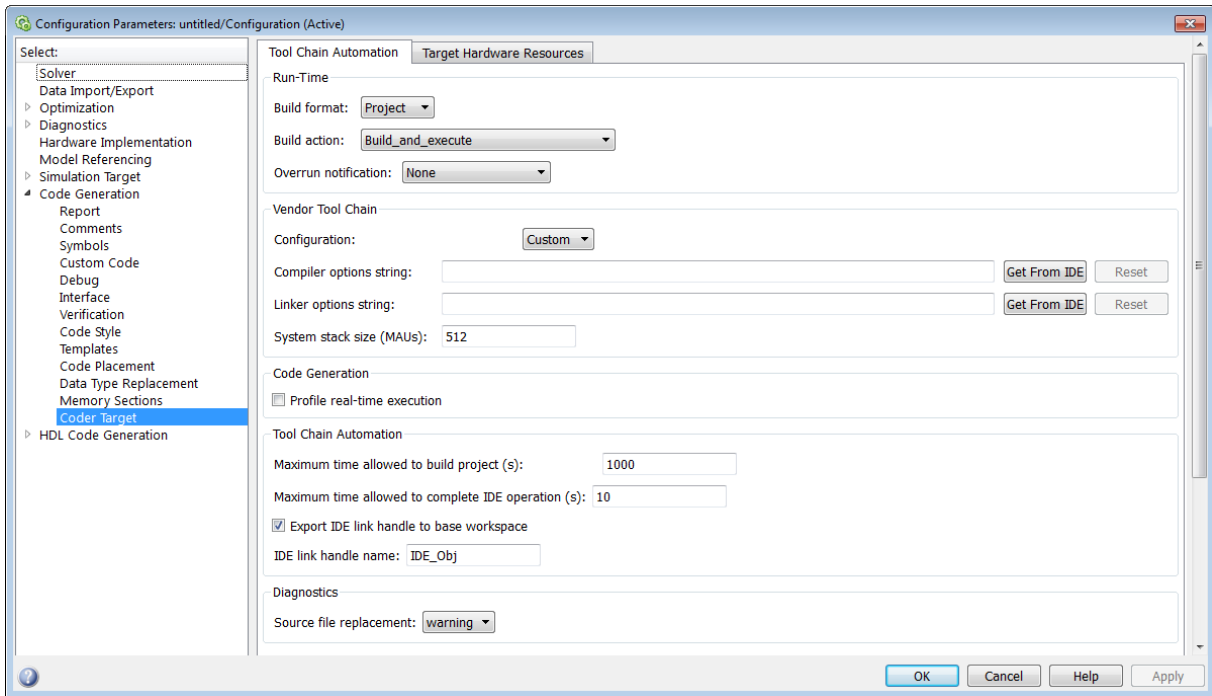
**Value:** 'on' | 'off'

**Default:** 'off'

#### See Also

“Root-Level Matrix I/O”

## Code Generation: Coder Target Pane



### In this section...

“Code Generation: Coder Target Pane Overview (previously “IDE Link Tab Overview”)” on page 3-117

“Coder Target: Tool Chain Automation Tab Overview” on page 3-118

“Build format” on page 3-120

“Build action” on page 3-122

“Overrun notification” on page 3-125

“Function name” on page 3-127

“Configuration” on page 3-128

“Compiler options string” on page 3-130

**In this section...**

“Linker options string” on page 3-132

“System stack size (MAUs)” on page 3-134

“System heap size (MAUs)” on page 3-136

“Profile real-time execution” on page 3-138

“Profile by” on page 3-140

“Number of profiling samples to collect” on page 3-142

“Maximum time allowed to build project (s)” on page 3-144

“Maximum time allowed to complete IDE operation (s)” on page 3-146

“Export IDE link handle to base workspace” on page 3-147

“IDE link handle name” on page 3-149

“Source file replacement” on page 3-150

## **Code Generation: Coder Target Pane Overview (previously “IDE Link Tab Overview”)**

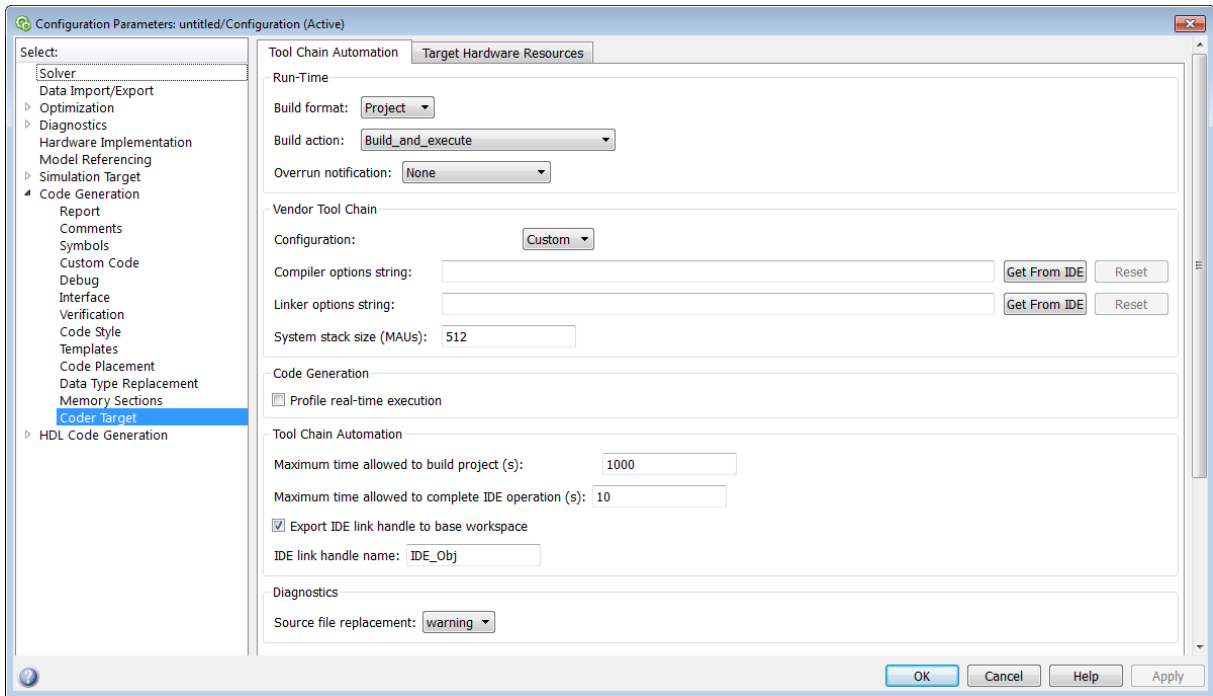
Configure the parameters for:

- Tool Chain Automation — How the coder software interacts with third-party software build toolchains.
- Target Hardware Resources — The IDE toolchain and properties of the physical hardware, such as board, operating system, memory, and peripherals.

### **See Also**

- Coder Target: Tool Chain Automation Tab Overview
- Coder Target: Target Hardware Resources Tab Overview

## Coder Target: Tool Chain Automation Tab Overview



The Tool Chain Automation Tab is only visible under the Coder Target pane.

The following table lists the parameters on the Tool Chain Automation Tab.

- “Build format” on page 3-120
- “Build action” on page 3-122
- “Overrun notification” on page 3-125
- “Function name” on page 3-127
- “Configuration” on page 3-128
- “Compiler options string” on page 3-130
- “Linker options string” on page 3-132
- “System stack size (MAUs)” on page 3-134

- “System heap size (MAUs)” on page 3-136
- “Profile real-time execution” on page 3-138
- “Profile by” on page 3-140
- “Number of profiling samples to collect” on page 3-142
- “Maximum time allowed to build project (s)” on page 3-144
- “Maximum time allowed to complete IDE operation (s)” on page 3-146
- “Export IDE link handle to base workspace” on page 3-147
- “IDE link handle name” on page 3-149
- “Source file replacement” on page 3-150

### Build format

Defines how Simulink Coder software responds when you press Ctrl+B to build your model.

### Settings

**Default:** Project

**Project**

Builds your model as an IDE project.

**Makefile**

Creates a makefile and uses it to build your model.

### Dependencies

Selecting Makefile removes the following parameters:

- **Code Generation**
  - **Profile real-time execution**
  - **Profile by**
  - **Number of profiling samples to collect**
- **Link Automation**
  - **Maximum time allowed to build project (s)**
  - **Maximum time allowed to complete IDE operation (s)**
  - **Export IDE link handle to base workspace**
  - **IDE link handle name**

### Command-Line Information

**Parameter:** buildFormat

**Type:** string

**Value:** Project | Makefile

**Default:** Build\_and\_execute



## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | Project   |
| Traceability      | Project   |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### Build action

Defines how Simulink Coder software responds when you press Ctrl+B to build your model.

### Settings

**Default:** `Build_and_execute`

If you set **Build format** to `Project`, select one of the following options:

#### `Build_and_execute`

Builds your model, generates code from the model, and then compiles and links the code. After the software links your compiled code, the build process downloads and runs the executable on the processor.

#### `Create_project`

Directs Simulink Coder software to create a new project in the IDE. The command line equivalent for this setting is `Create`.

#### `Archive_library`

Invokes the IDE Archiver to build and compile your project, but It does not run the linker to create an executable project. Instead, the result is a library project.

#### `Build`

Builds a project from your model. Compiles and links the code. Does not download and run the executable on the processor.

#### `Create_processor_in_the_loop_project`

Directs the Simulink Coder code generation process to create PIL algorithm object code as part of the project build.

If you set **Build format** to `Makefile`, select one of the following options:

#### `Create_makefile`

Creates a makefile. For example, “.mk”. The command line equivalent for this setting is `Create`.

#### `Archive_library`

Creates a makefile and an archive library. For example, “.a” or “.lib”.

#### `Build`

Creates a makefile and an executable. For example, “.exe”.

### Build\_and\_execute

Creates a makefile and an executable. Then it evaluates the execute instruction under the **Execute** tab in the current XMakefile configuration.

## Dependencies

Selecting Archive\_library removes the following parameters:

- **Overrun notification**
- **Function name**
- **Profile real-time execution**
- **Number of profiling samples to collect**
- **Linker options string**
- **Get from IDE**
- **Reset**
- **Export IDE link handle to base workspace**

Selecting Create\_processor\_in\_the\_loop\_project removes the following parameters:

- **Overrun notification**
- **Function name**
- **Profile real-time execution**
- **Number of profiling samples to collect**
- **Linker options string**
- **Get from IDE**
- **Reset**
- **Export IDE link handle to base workspace** with the option set to export the handle

## Command-Line Information

**Parameter:** buildAction

**Type:** string

**Value:** Build | Build\_and\_execute | Create | Archive\_library | Create\_processor\_in\_the\_loop\_project

**Default:** Build\_and\_execute

## Recommended Settings

| Application       | Setting           |
|-------------------|-------------------|
| Debugging         | Build_and_execute |
| Traceability      | Archive_library   |
| Efficiency        | No impact         |
| Safety precaution | No impact         |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

For more information about PIL and its uses, refer to the “Verifying Generated Code via Processor-in-the-Loop” topic.

## Overrun notification

Specifies how your program responds to overrun conditions during execution.

### Settings

**Default:** None

None

Your program does not notify you when it encounters an overrun condition.

Print\_message

Your program prints a message to standard output when it encounters an overrun condition.

Call\_custom\_function

When your program encounters an overrun condition, it executes a function that you specify in **Function name**.

### Tips

- The definition of the standard output depends on your configuration.

### Dependencies

Selecting Call\_custom\_function enables the **Function name** parameter.

Setting this parameter to Call\_custom\_function enables the **Function name** parameter.

### Command-Line Information

**Parameter:** overrunNotificationMethod

**Type:** string

**Value:** None | Print\_message | Call\_custom\_function

**Default:** None

#### Recommended Settings

| Application       | Setting                               |
|-------------------|---------------------------------------|
| Debugging         | Print_message or Call_custom_function |
| Traceability      | Print_message                         |
| Efficiency        | None                                  |
| Safety precaution | No impact                             |

#### See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

## Function name

Specifies the name of a custom function your code runs when it encounters an overrun condition during execution.

## Settings

No Default

## Dependencies

This parameter is enabled by setting **Overrun notification** to `Call_custom_function`.

## Command-Line Information

**Parameter:** `overrunNotificationFcn`

**Type:** string

**Value:** no default

**Default:** no default

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | String    |
| Traceability      | String    |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### Configuration

Sets the Configuration for building your project from the model.

### Settings

**Default:** Custom

#### Custom

Lets the user apply a specialized combination of build and optimization settings.

Custom applies the same settings as the Release project configuration in IDE, except:

- The compiler options do not use optimizations.
- The memory configuration specifies a memory model that uses Far Aggregate for data and Far for functions.

#### Debug

Applies the Debug Configuration defined by the IDE to the generated project and code.

#### Release

Applies the Release project configuration defined by the IDE to the generated project and code.

### Dependencies

- Selecting Custom disables the reset options for **Compiler options string** and **Linker options string**.
- Selecting Release sets the **Compiler options string** to the settings defined by the IDE.
- Selecting Debug sets the **Compiler options string** to the settings defined by the IDE.

### Command-Line Information

**Parameter:** projectOptions



**Type:** string  
**Value:** Custom | Debug | Release  
**Default:** Custom

### Recommended Settings

| Application       | Setting                |
|-------------------|------------------------|
| Debugging         | Custom or Debug        |
| Traceability      | Custom, Debug, Release |
| Efficiency        | Release                |
| Safety precaution | No impact              |

### See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### Compiler options string

To determine the degree of optimization provided by the optimizing compiler, enter the optimization level to apply to files in your project. For details about the compiler options, refer to your IDE documentation. When you create new projects, the coder product does not set optimization flags.

With Texas Instruments Code Composer Studio v3.3 and Analog Devices VisualDSP++, the user interface displays **Get From IDE** and **Reset** buttons next to this parameter. If you have an active project open in the IDE, you can click **Get From IDE** to import the compiler option setting from the current project in the IDE. To reset the compiler option to the default value, click **Reset**.

### Settings

**Default:** No default

### Tips

- Use spaces between options.
- Verify that the options are valid. The software does not validate the option string.
- Setting **Configuration** to **Custom** applies the **Custom** compiler options defined by coder software. **Custom** does not use optimizations.
- Setting **Configuration** to **Debug** applies the debug settings defined by the IDE.
- Setting **Configuration** to **Release** applies the release settings defined by the IDE.

### Command-Line Information

**Parameter:** compilerOptionsStr

**Type:** string

**Value:** Custom | Debug | Release

**Default:** Custom

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | Custom    |
| Traceability      | Custom    |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### Linker options string

To specify the options provided by the linker during link time, you enter the linker options as a string. For details about the linker options, refer to your IDE documentation. When you create new projects, the coder product does not set linker options.

With Texas Instruments Code Composer Studio v3.3 and Analog Devices VisualDSP++, the user interface displays **Get From IDE** and **Reset** buttons next to this parameter. If you have an active project open in the IDE, you can click **Get From IDE** to import the linker options string from the current project in the IDE. To reset the linker options to the default value of no options, click **Reset**.

### Settings

**Default:** No default

### Tips

- Use spaces between options.
- Verify that the options are valid. The software does not validate the options string.

### Dependencies

Setting **Build action** to `Archive_library` removes this parameter.

### Command-Line Information

**Parameter:** linkerOptionsStr

**Type:** string

**Value:** valid linker option

**Default:** none

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### System stack size (MAUs)

Enter the amount of memory that is available for allocating stack data. Block output buffers are placed on the stack until the stack memory is fully allocated. After that, the output buffers go in global memory.

This parameter is used in targets to allocate the stack size for the generated application. For example, with embedded processors that are not running an operating system, this parameter determines the total stack space that can be used for the application. For operating systems such as Linux or VxWorks, this value specifies the stack space allocated per thread.

This parameter also affects the “Maximum stack size (bytes)” parameter, located in the Optimization > Signals and Parameters pane.

#### Settings

**Default:** 8192

**Minimum:** 0

**Maximum:** Available memory

- Enter the stack size in minimum addressable units (MAUs). An MAU is typically 1 byte, but its size can vary by target processor.
- The software does not verify the value you entered is valid.

#### Dependencies

Setting **Build action** to `Archive_library` removes this parameter.

When you set the **System target file** parameter on the **Code Generation** pane to `idelink_ert.tlc` or `idelink_grt.tlc`, the software sets the **Maximum stack size** parameter on the **Optimization > Signals and Parameters** pane to `Inherit from target` and makes it non-editable. In that case, the **Maximum stack size** parameter compares the value of  $(\text{System stack size}/2)$  with 200,000 bytes and uses the smaller of the two values.

## Command-Line Information

**Parameter:** `systemStackSize`

**Type:** `int`

**Default:** 8192

## Recommended Settings

| Application       | Setting          |
|-------------------|------------------|
| Debugging         | <code>int</code> |
| Traceability      | <code>int</code> |
| Efficiency        | <code>int</code> |
| Safety precaution | No impact        |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### System heap size (MAUs)

Set the default heap size that the target processor reserves for dynamic memory allocation.

The target processor uses this heap for functions like `printf()` and system services code.

The following IDEs use this parameter:

- Analog Devices VisualDSP++
- Green Hills MULTI
- IAR Embedded Workbench
- Wind River Diab/GCC (makefile generation only)

### Settings

**Default:** 8192

**Minimum:** 0

**Maximum:** Available memory

- Enter the heap size in minimum addressable units (MAUs). An MAU is typically 1 byte, but its size can vary by target processor.
- The software does not verify that your size is valid. Be sure that you enter an acceptable value.

### Dependencies

Setting **Build action** to `Archive_library` removes this parameter.

### Command-Line Information

**Parameter:** `systemHeapSize`

**Type:** `int`

**Default:** 8192



## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | int       |
| Traceability      | int       |
| Efficiency        | int       |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### Profile real-time execution

Enables real-time execution profiling in the generated code by adding instrumentation for task functions or atomic subsystems.

#### Settings

**Default:** Off



On

Adds instrumentation to the generated code to support execution profiling and generate the profiling report.



Off

Does not instrument the generated code to produce the profile report.

#### Dependencies

This parameter adds **Number of profiling samples to collect** and **Profile by**.

Selecting this parameter enables **Export IDE link handle to base workspace** and makes it non-editable, since the coder software must create a handle.

Setting **Build action** to `Archive_library` or `Create_processor_in_the_loop` project removes this parameter.

#### Command-Line Information

**Parameter:** ProfileGenCode

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'off'

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | On        |
| Traceability      | On        |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

For more information about using profiling, refer to the “profile” and “Profiling Code Execution in Real-Time” topics..

### Profile by

Defines which execution profiling technique to use.

### Settings

**Default:** Task

Task

Profiles model execution by the tasks in the model.

Atomic subsystem

Profiles model execution by the atomic subsystems in the model.

### Dependencies

Selecting **Real-time execution profiling** enables this parameter.

### Command-Line Information

**Parameter:** profileBy

**Type:** string

**Value:** Task | Atomic subsystem

**Default:** Task

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

### See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

For more information about PIL and its uses, refer to the “Verifying Generated Code via Processor-in-the-Loop” topic.

For more information about using profiling, refer to the “profile” and “Profiling Code Execution in Real-Time” topics.

### Number of profiling samples to collect

Specify the size of the buffer that holds the profiling samples. Enter a value that is 2 times the number of profiling samples.

Each task or subsystem execution instance represents one profiling sample. Each sample requires two memory locations, one for the start time and one for the end time. Consequently, the size of the buffer is twice the number of samples.

Sample collection begins with the start of code execution and ends when the buffer is full.

The profiling data is held in a statically sited buffer on the target processor.

#### Settings

**Default:** 100

**Minimum:** 2

**Maximum:** Buffer capacity

#### Tips

- Data collection stops when the buffer is full, but the application and processor continue running.
- Real-time task execution profiling works with hardware only. Simulators do not support the profiling feature.

#### Dependencies

This parameter is enabled by **Profile real-time execution**.

#### Command-Line Information

**Parameter:** ProfileNumSamples

**Type:** int

**Value:** Positive integer

**Default:** 100

## Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | 100       |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

## Maximum time allowed to build project (s)

Specifies how long, in seconds, the software waits for the project build process to return a completion message.

### Settings

**Default:** 1000

**Minimum:** 1

**Maximum:** No limit

### Tips

- The build process continues even if MATLAB does not receive the completion message in the allotted time.
- This timeout value does not depend on the global timeout value in a `IDE_Obj` object or the **Maximum time allowed to complete IDE operation** timeout value.

### Dependency

This parameter is disabled when you set **Build action** to `Create_project`.

### Command-Line Information

**Parameter:** `ideObjBuildTimeout`

**Type:** `int`

**Value:** Integer greater than 0

**Default:** 100

### Recommended Settings

| Application  | Setting   |
|--------------|-----------|
| Debugging    | No impact |
| Traceability | No impact |



| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

**See Also**

For more information, refer to the “Code Generation Pane: Coder Target” topic.

## Maximum time allowed to complete IDE operation (s)

specifies how long, in seconds, the software waits for IDE functions, such as read or write, to return completion messages.

### Settings

**Default:** 10

**Minimum:** 1

**Maximum:** No limit

### Tips

- The IDE operation continues even if MATLAB does not receive the message in the allotted time.
- This timeout value does not depend on the global timeout value in a `IDE_Obj` object or the **Maximum time allowed to build project (s)** timeout value

### Command-Line Information

**Parameter:** 'ideObjTimeout'

**Type:** int

**Value:**

**Default:** 10

### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | No impact |
| Traceability      | No impact |
| Efficiency        | No impact |
| Safety precaution | No impact |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

## Export IDE link handle to base workspace

Directs the software to export the IDE\_Obj object to your MATLAB workspace.

### Settings

**Default:** On



On

Directs the build process to export the IDE\_Obj object created to your MATLAB workspace. The new object appears in the workspace browser. Selecting this option enables the **IDE link handle name** option.



Off

prevents the build process from exporting the IDE\_Obj object to your MATLAB software workspace.

### Dependency

Selecting **Profile real-time execution** enables **Export IDE link handle to base workspace** and makes it non-editable, since the coder software must create a handle.

Selecting **Export IDE link handle to base workspace** enables **IDE link handle name**.

### Command-Line Information

**Parameter:** exportIDEObj

**Type:** string

**Value:** 'on' | 'off'

**Default:** 'on'

#### Recommended Settings

| Application       | Setting   |
|-------------------|-----------|
| Debugging         | On        |
| Traceability      | On        |
| Efficiency        | No impact |
| Safety precaution | No impact |

#### See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

## IDE link handle name

specifies the name of the IDE\_Obj object that the build process creates.

### Settings

**Default:** IDE\_Obj

- Enter a valid C variable name, without spaces.
- The name you use here appears in the MATLAB workspace browser to identify the IDE\_Obj object.
- The handle name is case sensitive.

### Dependency

This parameter is enabled by **Export IDE link handle to base workspace**.

### Command-Line Information

**Parameter:** ideObjName

**Type:** string

**Value:**

**Default:** IDE\_Obj

### Recommended Settings

| Application       | Setting                                               |
|-------------------|-------------------------------------------------------|
| Debugging         | Enter a valid C program variable name, without spaces |
| Traceability      | No impact                                             |
| Efficiency        | No impact                                             |
| Safety precaution | No impact                                             |

### See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

### Source file replacement

Selects the diagnostic action to take if the coder software detects conflicts that you are replacing source code with custom code.

#### Settings

**Default:** warn

none

Does not generate warnings or errors when it finds conflicts.

warning

Displays a warning.

error

Terminates the build process and displays an error message that identifies which file has the problem and suggests how to resolve it.

#### Tips

- The build operation continues if you select warning and the software detects custom code replacement. You see warning messages as the build progresses.
- Select error the first time you build your project after you specify custom code to use. The error messages can help you diagnose problems with your custom code replacement files.
- Select none when you do not want to see multiple messages during your build.
- The messages apply to Simulink Coder **Custom Code** replacement options as well.

#### Command-Line Information

**Parameter:** DiagnosticActions

**Type:** string

**Value:** none | warning | error

**Default:** warning

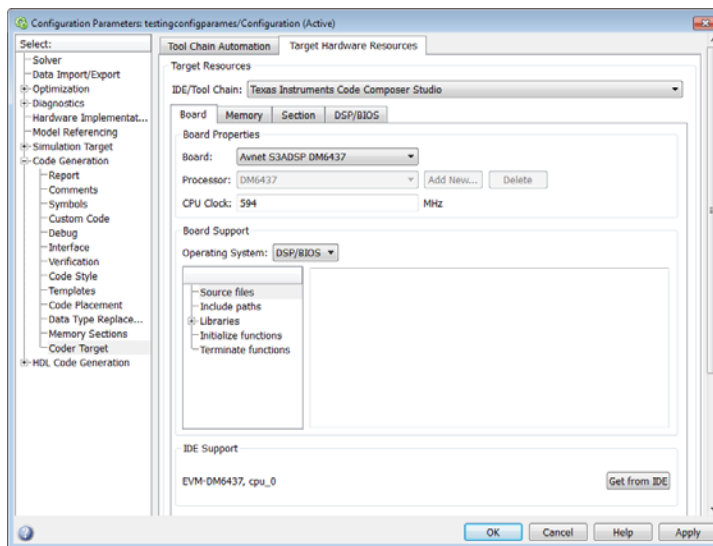
## Recommended Settings

| Application       | Setting |
|-------------------|---------|
| Debugging         | error   |
| Traceability      | error   |
| Efficiency        | warning |
| Safety precaution | error   |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

## Code Generation: Target Hardware Resources Pane



### In this section...

“Coder Target Pane: TI C2000 Processors Overview” on page 3-260

“Coder Target: Target Hardware Resources Tab Overview” on page 3-155

“IDE/Tool Chain” on page 3-156

“Target Hardware Resources: Board Tab” on page 3-158

“Target Hardware Resources: Memory Tab” on page 3-162

“Target Hardware Resources: Section Tab” on page 3-165

“Target Hardware Resources: DSP/BIOS Tab” on page 3-169

“Target Hardware Resources: Peripherals Tab” on page 3-172

“Clocking” on page 3-267

“ADC” on page 3-271

“COMP” on page 3-275

“eCAN\_A, eCAN\_B” on page 3-276



**In this section...**

“eCAP” on page 3-279

“ePWM” on page 3-280

“I2C” on page 3-282

“SCI\_A, SCI\_B, SCI\_C” on page 3-289

“SPI\_A, SPI\_B, SPI\_C, SPI\_D” on page 3-292

“eQEP” on page 3-295

“Watchdog” on page 3-297

“GPIO” on page 3-299

“Flash\_loader” on page 3-303

“DMA\_ch[#]” on page 3-305

“LIN” on page 3-315

“Add Processor Dialog Box” on page 3-228

“Target Hardware Resources Tab: Linux, VxWorks, or Windows” on page 3-230

### **Code Generation: Coder Target Pane Overview (Target Hardware Resources)**

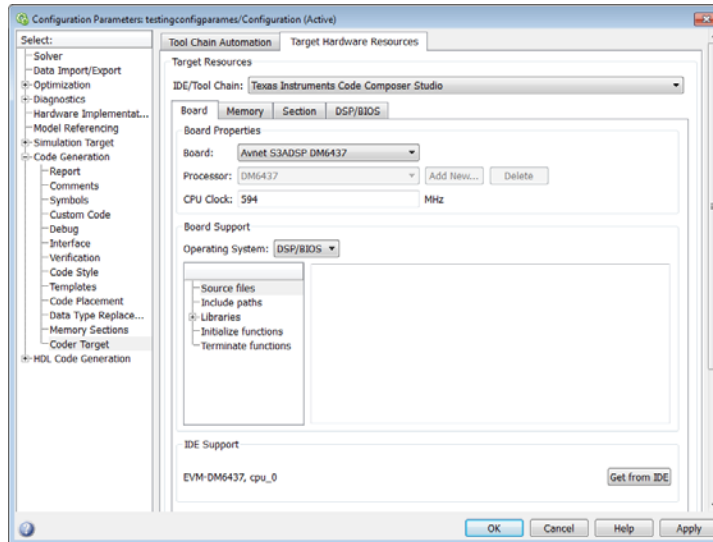
Configure the parameters for:

- Tool Chain Automation — How the coder software interacts with third-party software build toolchains.
- Target Hardware Resources — The IDE toolchain and properties of the physical hardware, such as board, operating system, memory, and peripherals.

#### **See Also**

- Coder Target: Tool Chain Automation Tab Overview
- Coder Target: Target Hardware Resources Tab Overview

## Coder Target: Target Hardware Resources Tab Overview



The Target Hardware Resources tab is only visible under the Coder Target pane.

The following table lists the parameters and tabs on the Target Hardware Resources tab.

- “IDE/Tool Chain” on page 3-156
- “Target Hardware Resources: Board Tab” on page 3-158
- “Target Hardware Resources: Memory Tab” on page 3-162
- “Target Hardware Resources: Section Tab” on page 3-165
- “Target Hardware Resources: Peripherals Tab” on page 3-172

### IDE/Tool Chain

Select the IDE or software build tool chain you are using from the list of options. This action applies parameter values for a specific IDE or tool chain.

Located on the Target Hardware Resources tab.

### Settings

#### Analog Devices VisualDSP++

This option is available after you install the Embedded Coder Support Package for Analog Devices DSPs. See “Add Support for Hardware and Software”.

Sets the Target Hardware Resources parameters for Analog Devices VisualDSP++ IDE.

#### Eclipse

Sets the Target Hardware Resources parameters for Eclipse IDE.

#### IAR Embedded Workbench

Sets the Target Hardware Resources parameters for IAR Embedded Workbench IDE.

#### Texas Instruments Code Composer Studio

Sets the Target Hardware Resources parameters for Texas Instruments Code Composer Studio v3.3 IDE.

#### Texas Instruments Code Composer Studio v4 (makefile generation only)

Sets the Target Hardware Resources parameters for Texas Instruments Code Composer Studio v4 IDE.

#### Texas Instruments Code Composer Studio v5 (makefile generation only)

Sets the Target Hardware Resources parameters for Texas Instruments Code Composer Studio v5 IDE.

#### Wind River Diab/GCC (makefile generation only)

Sets the Target Hardware Resources parameters for Wind River Diab/GCC tool chain.

**Green Hills MULTI**

This option is available after you install the Embedded Coder Support Package for Green Hills MULTI. See “Add Support for Hardware and Software”.

Sets the Target Hardware Resources parameters for Green Hills MULTI IDE.

**Xilinx ISE Design Suite**

This option is available after you install the Embedded Coder Support Package for Xilinx Zynq-7000 Platform. See “Add Support for Hardware and Software”.

Sets the Target Hardware Resources parameters for Xilinx ISE Design Suite.

**Get more...**

Launches the Support Package Installer. See “Add Support for Hardware and Software”.

**See Also**

“Add Support for Hardware and Software”

### Target Hardware Resources: Board Tab

The following options appear on the **Board** pane, which has separate panels for **Board Properties**, **Board Support**, and **IDE Support** labels.

#### Board

Select your target board from the list of options. Selecting a specific board sets the value for the **Processor** parameter. If you select a custom board, also set the **Processor** parameter.

#### Processor

The Board and Processor settings apply default values to many of the parameters, such as those under the **Memory** and **Section** tabs.

If the coder product supports an operating system for the processor, it enables the **Operating system** option.

If you are using the Eclipse IDE and set **Processor** to **Generic/Custom**, open the model Configuration Parameters and use the **Hardware Implementation** pane to define the custom hardware. With this approach, hardware support depends on the Simulink Coder product, not on the coder product. For more information, see “Hardware Implementation Pane”.

---

**Note** Selecting or reselecting a processor resets the solver and some processor-specific parameters to their default values.

---

#### Add New

Clicking **Add new** opens a new dialog box where you specify configuration information for a processor that is not on the Processor list.

For details about the New Processor dialog box, refer to “Add Processor Dialog Box” on page 3-228.

#### Delete

Clicking **Delete**, removes a processor that you added to the **Processor** list. You cannot delete the standard processors.

### CPU Clock

Enter the actual clock rate the board uses. This action does not change the rate on the board. Rather, the code generation process requires this information to produce code that runs on the hardware. Setting this value incorrectly causes timing and profiling errors when you run the code on the hardware.

The timer uses the value of **CPU clock** to calculate the time for each interrupt. For example, a model with a sine wave generator block running at 1 kHz uses timer interrupts to generate sine wave samples at the specified rate. For example, using 100 MHz, the timer calculates the sine generator interrupt period as follows:

- Sine block rate = 1 kHz, or 0.001 s/sample
- CPU clock rate = 100 MHz, or 0.000000001 s/sample

To create sine block interrupts at 0.001 s/sample requires:

$100,000,000/1000 = 1$  Sine block interrupt per 100,000 clock ticks

### Board Support

Select the following parameters and edit their values in the text box on the right:

- **Source files** — Enter the full paths to source code files.
- **Include paths** — Add paths to include files.
- **Libraries** — Identify specific libraries for the processor. Required libraries appear on the list by default. To add more libraries, entering the full path to the library with the library file in the text area.
- **Initialize functions** — If your project requires an initialize function, enter it in this field. By default, this parameter is empty.
- **Terminate functions** — Enter a function to run when a program terminates. The default setting is not to include a specific termination function.

---

**Note** Invalid or incorrect entries in these fields can cause errors during code generation. When you enter a file path, library, or function, the block does not verify that the path or function exists or is valid.

---

When entering a path to a file, library, or other custom code, use the following string in the path to refer to the IDE installation folder.

```
$(Install_dir)
```

Enter new paths or files (custom code items) one entry per line. Include the full path to the file for libraries and source code. **Support** options do not support functions that use return arguments or values. These parameters accept only functions of type `void fname void` as valid as entries.

You can also set up environment variables to use as folder path tokens. For example, if you set up an environment called `USER_VAR`, you can use it as a token when you define a path in Coder Target > Target Hardware Resources. For example: `$(USER_VAR)\myinstal\foo.c`.

### Operating System

Select an operating system or RTOS for your target. If your target platform supports an operating system, the software enables the **Operating system** parameter. Otherwise, the software disables this option.

### Get from IDE

This button only appears when you are using Texas Instruments Code Composer Studio 3.3 IDE or Analog Devices VisualDSP++ IDE:

- With Texas Instruments Code Composer Studio 3.3 IDE, the **Get from IDE** button imports the current **Board Name** and **Processor Name** from the IDE.
- With Analog Devices VisualDSP++ IDE, the **Get from IDE** button imports the current **Session Name** and **Processor Name** from the IDE.

Use the **Get from IDE** button to update the Coder Target > Target Hardware Resources, the IDE, and the hardware board so they refer to



the same processor. Otherwise, during code generation, the software generates a warning similar to the following message:

```
Target Hardware Resources tab specifies that the board named
'<boardname1>' will be used to run generated code.
However, since only board named '<boardname2>' is found
in your system, that board will be used.
```

### **Board Name**

**Board Name** appears after you click **Get from IDE**. Select the board you are using. Match **Board Name** with the **Board** option near the top of the **Board** pane.

### **Processor Name**

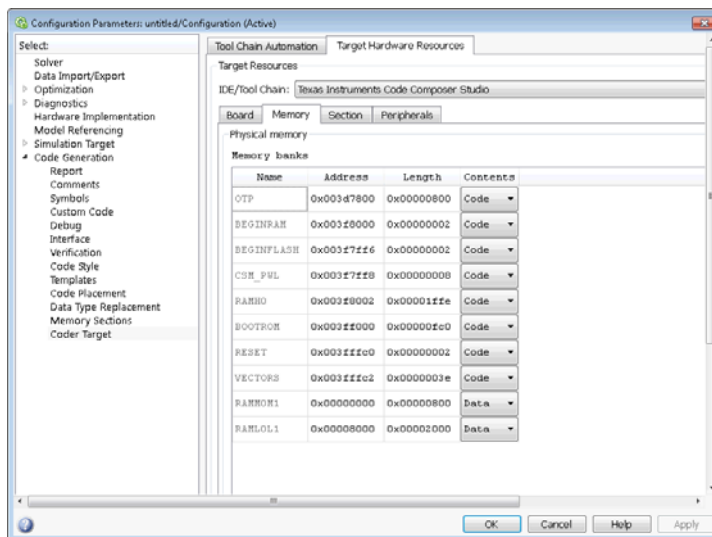
**Processor Name** appears after you click **Get from IDE**. If the board you selected in **Board Name** has multiple processors, select the processor you are using. Match **Processor Name** with the **Processor** option near the top of the **Board** pane.

---

**Note** Click **Apply** to update the board and processor description under **IDE Support**.

---

## Target Hardware Resources: Memory Tab



After selecting a board, specify the layout of the physical memory on your processor and board to determine how to use it for your program.

The **Memory** pane contains memory options for:

- **Physical Memory** — Specifies the processor and board memory map
- **Cache Configuration** — Select a cache configuration where available, such as L2 cache, and select one of the corresponding configuration options, such as 32 kb.

For more information about memory segments and memory allocation, consult the reference documentation for the IDE or processor.

The **Physical Memory** table shows the memory segments or *memory banks* available on the board and processor. By default, Target Hardware Resources tab show the memory segments found on the selected processor. In addition, the **Memory** pane on Target Hardware Resources tab shows the memory segments available on the board, but external to the processor. Target Hardware Resources tab set default starting addresses, lengths, and

contents of the default memory segments. The default memory segments for each processor and board differ.

Click **Add** to add physical memory segments to the **Memory banks** table.

After you add the segment, you can configure the starting address, length, and contents for the new segment.

### **Name**

To change the memory segment name, click the name, and then type the new name. Names are case sensitive. `NewSegment` is not the same as `newsegment` or `newSegment`.

---

**Note** You cannot rename default processor memory segments (name in gray text).

---

### **Address**

**Address** reports the starting address for the memory segment showing in **Name**. Address entries appear in hexadecimal format and are limited only by the board or processor memory.

### **Length**

From the starting address, **Length** sets the length of the memory allocated to the segment in **Name**. As in all memory entries, specify the length in hexadecimal format, in minimum addressable data units (MADUs).

For the C6000 processor family, the MADU requires inputs of 8 bytes, one word.

### **Contents**

Configure the segment to store **Code**, **Data**, or **Code & Data**. Changing processors changes the options for each segment.

You can add and use as many segments of each type as you need, within the limits of the memory on your processor. Every processor must have a segment that holds code, and a segment that holds data.

### Add

Click **Add** to add a new memory segment to the processor memory map. When you click **Add**, a new segment name appears, for example NEWMEM1, in **Name** and on the **Memory banks** table. In **Name**, change the temporary name NEWMEM1 by entering the new segment name. Entering the new name, or clicking **Apply**, updates the temporary name on the table to the name you enter.

### Remove

This option lets you remove a memory segment from the memory map. Select the segment to remove on the **Memory banks** table, and click **Remove** to delete the segment.

### Cache (Configuration)

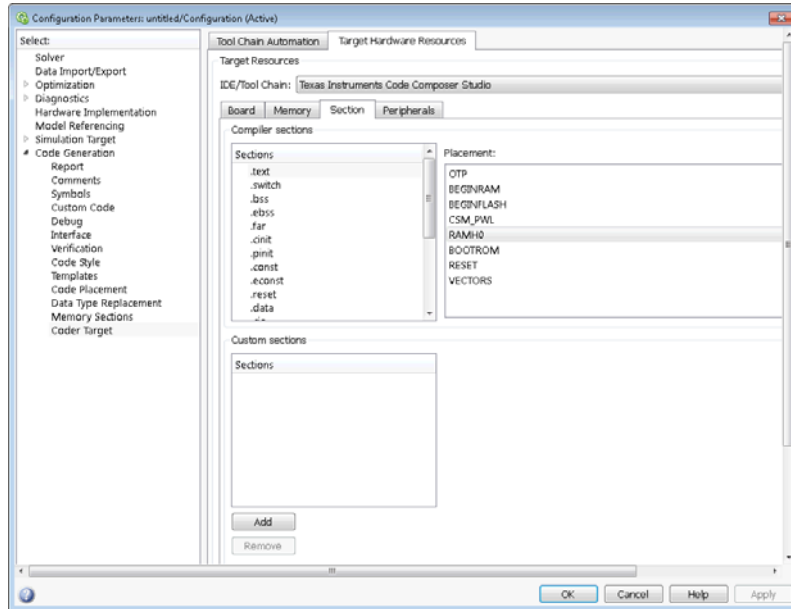
When the **Processor** on the Board pane supports a cache memory structure, the dialog box displays a table of **Cache** parameters. You can use this table to configure the cache as SRAM and partial cache. Both the data memory and the program share this second-level memory.

If your processor supports the two-level memory scheme, this option enables the L2 cache on the processor.

Some processors support code base memory organization. For example, you can configure part of internal memory as code.

Cache level lets you select one of the available cache levels to configure by selecting one of its configurations. For example, you can select L2 cache level, and choose one of its configurations, such as 32 kb.

## Target Hardware Resources: Section Tab



Options on this pane specify where program sections appear in memory. Program sections differ from memory segments—sections comprise portions of the executable code stored in contiguous memory locations. Commonly used sections include `.text`, `.bss`, `.data`, and `.stack`. Some sections relate to the compiler, and some can be custom sections.

For more information about program sections and objects, refer to the online help for your IDE.

Within the Section pane, you configure the allocation of sections for **Compiler** and **Custom** needs.

This table provides brief definitions of the kinds of sections in the **Compiler sections** and **Custom sections** lists in the pane. all sections do not appear on all lists.

| <b>String</b>          | <b>Section List</b> | <b>Description of the Section Contents</b>                                                 |
|------------------------|---------------------|--------------------------------------------------------------------------------------------|
| <code>.bss</code>      | Compiler            | Static and global C variables in the code                                                  |
| <code>.cinit</code>    | Compiler            | Tables for initializing global and static variables and constants                          |
| <code>.cio</code>      | Compiler            | Standard I/O buffer for C programs                                                         |
| <code>.const</code>    | Compiler            | Data defined with the C qualifier and string constants                                     |
| <code>.data</code>     | Compiler            | Program data for execution                                                                 |
| <code>.far</code>      | Compiler            | Variables, both static and global, defined as far variables                                |
| <code>.pinit</code>    | Compiler            | Load allocation of the table of global object constructors section                         |
| <code>.stack</code>    | Compiler            | The global stack                                                                           |
| <code>.switch</code>   | Compiler            | Jump tables for switch statements in the executable code                                   |
| <code>.systemem</code> | Compiler            | Dynamically allocated object in the code containing the heap                               |
| <code>.text</code>     | Compiler            | Load allocation for the literal strings, executable code, and compiler generated constants |

You can learn more about memory sections and objects in the online help for your IDE.

#### **Default Sections**

When you highlight a section on the list, **Description** show a brief description of the section. Also, **Placement** shows you the memory allocation of the section.

#### **Description**

Provides a brief explanation of the contents of the selected entry on the **Compiler sections** list.

### Placement

Shows the allocation of the selected **Compiler sections** entry in memory. You change the memory allocation by selecting a different location from the **Placement** list. The list contains the memory segments as defined in the physical memory map on the **Memory** pane. Select one of the listed memory segments to allocate the highlighted compiler section to the segment.

To see a description of the placement item, hover your mouse pointer over the item for a few moments.

### Custom Sections

If your program uses code or data sections that are not in the **Compiler sections**, add the new sections to **Custom sections**.

### Sections

This window lists data sections that are not in the **Compiler sections**.

### Placement

With your new section added to the **Name** list, select the memory segment to which to add your new section. Within the restrictions imposed by the hardware and compiler, you can select a segment that appears on the list.

### Add

Clicking **Add** lets you configure a new entry to the list of custom sections. When you click **Add**, the block provides a new temporary name in **Name**. Enter the new section name to add the section to the **Custom sections** list. After typing the new name, click **Apply** to add the new section to the list. You can also click **OK** to add the section to the list and close the dialog box.

### Name

Enter the name of the new section here. To add a new section, click **Add**. Then, replace the temporary name with the name to use. Although the temporary name includes a period at the beginning you do not need to include the period in your new name. Names are case sensitive. NewSection is not the same as newsection, or newSection.

### Contents

Identify whether the contents of the new section are Code, Data, or Any.

### **Remove**

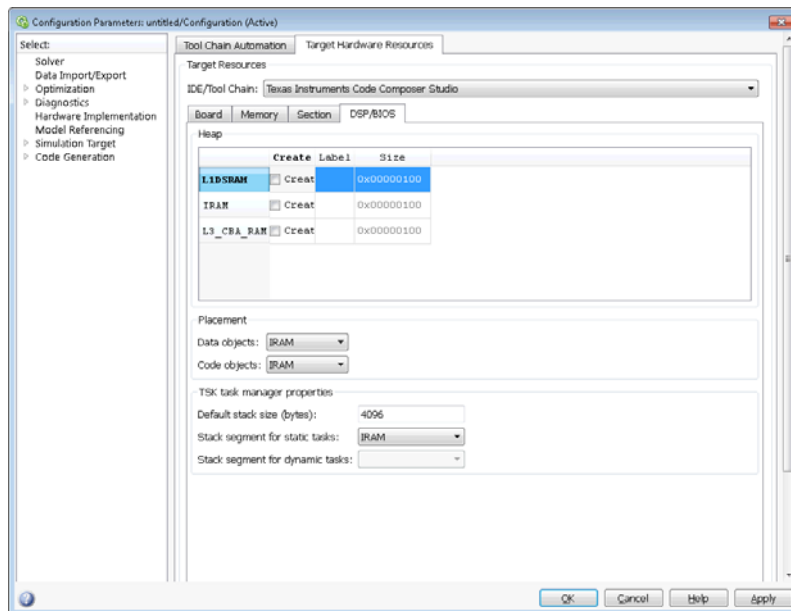
To remove a section from the **Custom sections** list, select the section and click **Remove**.



## Target Hardware Resources: DSP/BIOS Tab

The DSP/BIOS pane is available if the two following conditions are true:

- You are using Texas Instruments CCS IDE.
- You set the Target Hardware Resources tab **Processor** option to a C6000 processor that supports DSP/BIOS.



Selecting DSP/BIOS for **Operating system** on the Board pane enables this pane.

Use the **Heap**, **Placement**, and **TSK task manager properties** sections of this pane to configure various modules of DSP/BIOS.

For more information about tasks, refer to the Code Composer Studio online help.

---

**Note** To enable the **Heap** option, select DSP/BIOS for **Operating system** on the **Board** pane.

---

### Heap

The heap section contains the **Create**, **Label**, and **Size** options to manage the heap.

### Create

If your processor supports using a heap, selecting this option enables creating the heap. Define the heap using the **Label** and **Size** options. **Create** becomes unavailable for processors that do not provide a heap or do not allow you to configure the heap.

The location of the heap in the memory segment is not under your control. The only way to control the location of the heap in a segment is to make the segment and the heap the same size. Otherwise, the compiler determines the location of the heap in the segment.

### Size

After you select **Create**, this option lets you specify the size of the heap in words. Enter the number of words in decimal format. When you enter the heap size in decimal words, the system converts the decimal value to hexadecimal format. You can enter the value directly in hexadecimal format as well. Processors can support different maximum heap sizes.

### Label

Selecting **Create** enables this option. Enter your label for the heap in the **Heap** option.

---

**Note** When you enter a label, the block does not verify that the label is valid. An invalid label in this field can cause errors during code generation.

---

### Placement

Use the **Data object** and **Code object** options in **Placement** to configure the memory allocation of the selected **Heap** list entry.

**Data object**

Specify where to place new data objects in memory.

**Code object**

Specify where to place new code objects in memory.

**TSK task manager properties**

Use the **Default stack size (bytes)**, **Stack segment for static tasks**, and **Stack segment for dynamic tasks** options in **TSK task manager properties** to configure the task manager properties.

**Default stack size (bytes)**

DSP/BIOS uses a stack to save and restore variables and CPU context during thread preemption for task threads. This option sets the size of the DSP/BIOS stack in bytes allocated for each task. The software sets the default value to 4096 bytes. The maximum value is determined by the processor. Set the stack size so that tasks do not use more memory than you allocate. Exceeding the stack memory size can cause the task to write into other memory or data areas, causing unpredictable behavior.

**Stack segment for static tasks**

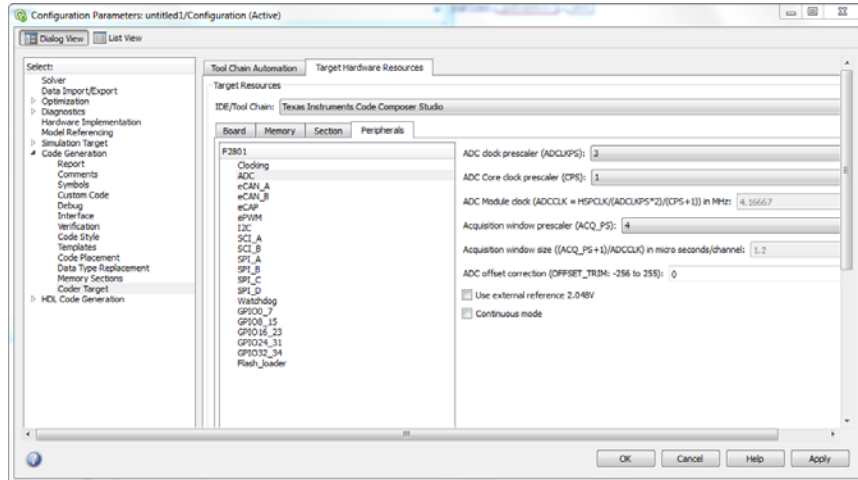
Use this option to specify where to allocate the stack for static tasks. Tasks that your program uses often are good candidates for static tasks. Infrequently used tasks usually work best as dynamic tasks.

The list offers IDRAM for locating the stack in memory. The Memory pane provides more options for the physical memory on the processor.

**Stack segment for dynamic tasks**

Like static tasks, dynamic tasks use a stack as well. Setting this option specifies where to locate the stack for dynamic tasks. In this case, `MEM_NULL` is the only valid stack location in memory. Allocate system heap storage to use this option. Specify the system heap configuration on the “Target Hardware Resources: Memory Tab” on page 3-162.

## Target Hardware Resources: Peripherals Tab



The Peripherals pane is only visible under the Target Hardware Resources tab, when **Board** and **Processor** parameters are configured for a C2000 processors.

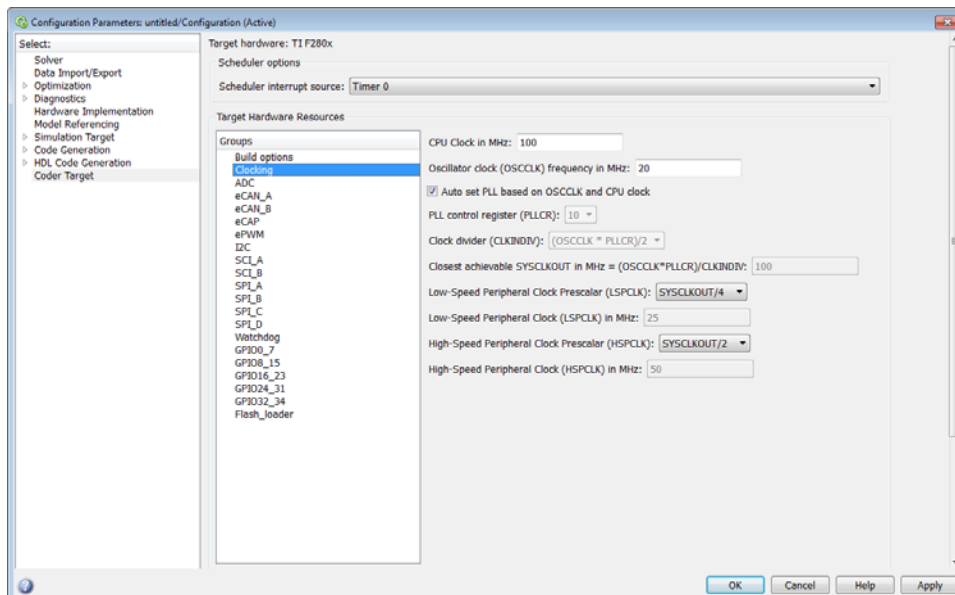
To set the attributes for a peripheral, select the peripheral from the **Peripherals** list and then set the attribute options on the right side.

The following table describes all the peripherals provided on the **Peripherals** list. Some peripherals are not available on some C2000 processors.

| Peripheral Name         | Description                                                                          |
|-------------------------|--------------------------------------------------------------------------------------|
| “Clcking” on page 3-267 | Clocking parameters to adjust clock settings and match custom oscillator frequencies |
| “ADC” on page 3-271     | Analog-to-Digital Converter (ADC) parameters                                         |
| “COMP” on page 3-275    | Parameters to assign COMP pins to GPIO pins.                                         |

| <b>Peripheral Name</b>                                 | <b>Description</b>                                                                          |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------|
| “eCAN_A,<br>eCAN_B” on<br>page 3-276                   | Enhanced Controller Area Network (eCAN) parameters for modules A or B                       |
| “eCAP” on<br>page 3-279                                | Enhanced Capture (eCAP) parameters for pin mapping to GPIO                                  |
| “ePWM” on<br>page 3-280                                | Enhanced Pulse Width Modulation (ePWM) parameters for pin mapping to GPIO                   |
| “I2C” on page<br>3-282                                 | Inter-Integrated Circuit (I2C) parameters for communications                                |
| “SCI_A,<br>SCI_B,<br>SCI_C” on<br>page 3-289           | Serial Communications Interface (SCI) parameters for communications with modules A, B, or C |
| “SPI_A,<br>SPI_B,<br>SPI_C,<br>SPI_D” on<br>page 3-292 | Serial Peripheral Interface (SPI) parameters for communications with module A, B, C, or D   |
| “eQEP” on<br>page 3-295                                | Enhanced Quadrature Encoder Pulse (eQEP) parameters for pin mapping to GPIO                 |
| “Watchdog”<br>on page 3-297                            | Watchdog enable/disable and timing                                                          |
| “GPIO” on<br>page 3-299                                | General Purpose Input Output (GPIO) parameters for input qualification types                |
| “Flash_loader”<br>on page 3-303                        | Flash memory loader/programmer                                                              |
| “DMA_ch[#]”<br>on page 3-305                           | Direct Memory Access (DMA) parameters for channels 1 to N                                   |
| “LIN” on page<br>3-315                                 | Local Interconnect Network (LIN) parameters for communications                              |

## Clocking



Use the clocking options to help you achieve the CPU Clock rate specified on the board. The default clocking values run the CPU clock (CLKIN) at its maximum frequency. The parameters use the external oscillator frequency on the board (OSCCLK) that is recommended by the processor vendor.

You can get feedback on the closest achievable SYSCLKOUT value with the specified Oscillator clock frequency by selecting the **Auto set PLL based on OSCCLK and CPU clock** check box. Alternatively, you can manually specify the PLL value for the SYSCLKOUT value calculation.

Change the clocking values if:

- You want to change the CPU frequency.
- The external oscillator frequency differs from the value recommended by the manufacturer.

To determine the CPU frequency (CLKIN), use the following equation:

$$\text{CLKIN} = (\text{OSCCLK} * \text{PLLCCR}) / (\text{DIVSEL or CLKINDIV})$$

- **CLKIN** is the frequency at which the CPU operates, also known as the CPU clock.
- **OSCCLK** is the frequency of the oscillator.
- **PLLCCR** is the PLL Control Register value.
- **CLKINDIV** is the Clock in Divider.
- **DIVSEL** is the Divider Select.

The availability of the **DIVSEL** or **CLKINDIV** parameters changes depending on the processor that you select. If neither parameter is available, use the following equation:

$$\text{CLKIN} = (\text{OSCCLK} * \text{PLLCCR}) / 2$$

In the **CPU clock** parameter of the Coder Target > Target Hardware Resources tab, enter the resulting CPU clock frequency (**CLKIN**).

For more information, see the “PLL-Based Clock Module” section in the Texas Instruments *Reference Guide* for your processor.

#### **Use internal oscillator**

Use the internal zero pin oscillator on the CPU. This parameter is enabled by default.

#### **Oscillator clock (OSCCLK) frequency in MHz**

The oscillator frequency that is used in the processor.

#### **Auto set PLL based on OSCCLK and CPU clock**

The option that helps you set the PLL control register value automatically. When you select this check box, the values in the **PLLCCR**, **DIVSEL**, and the Closest achievable **SYSCLKOUT** in MHz parameters are automatically calculated based on the **CPU Clock** value entered on the Board.

#### **PLL control register (PLLCCR)**

If you select the **Auto set PLL based on OSCCLK and CPU clock** check box, the auto calculated control register value achieves the

specified CPU Clock value, based on the Oscillator clock frequency. Otherwise, you can select a value for PLL control register.

#### **Clock divider (DIVSEL)**

If you select the **Auto set PLL based on OSCCLK and CPU clock** check box, the auto calculated clock divider value achieves the specified CPU Clock value based on the Oscillator clock frequency. Otherwise, you can select a value for Clock divider (DIVSEL).

#### **Closest achievable SYSCLKOUT in MHz =**

$$\text{Closest achievable SYSCLKOUT in MHz} = \frac{\text{OSCCLK} * \text{PLLCR}}{\text{DIVSEL} * \text{CLKINDIV}}$$

The auto calculated feedback value that matches most closely to the desired CPU Clock value on the board, based on the values of OSCCLK, PLLCR, and the DIVSEL.

#### **Low-Speed Peripheral Clock Prescaler (LSPCLK)**

The value by which to scale the LSPCLK. This value is based on the SYSCLKOUT.

#### **Low-Speed Peripheral Clock (LSPCLK) in MHz**

This value is calculated based on LSPCLK Prescaler. Example: SPI uses a LSPCLK.

#### **High-Speed Peripheral Clock Prescaler (HSPCLK)**

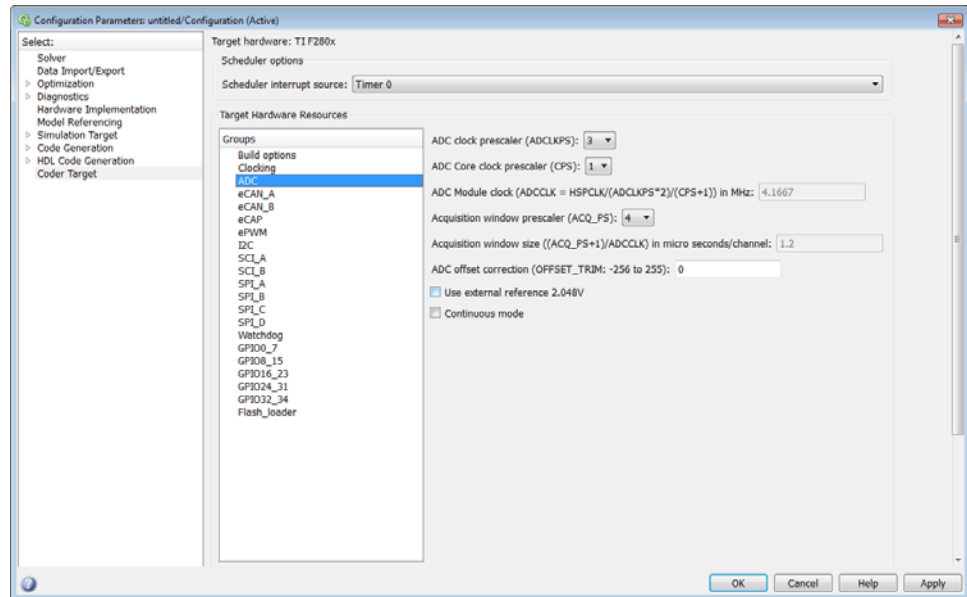
The value by which to scale the HSPCLK. This value is based on the SYSCLKOUT.

#### **High-Speed Peripheral Clock (HSPCLK) in MHz**

This value is calculated based on HSPCLK Prescaler. Example: ADC uses a HSPCLK.



## ADC



The high-speed peripheral clock (HSPCLK) controls the internal timing of the ADC module. The ADC derives the operating clock speed from the HSPCLK speed in several prescaler stages. For more information about configuring these scalars, refer to “Configuring ADC Parameters for Acquisition Window Width”.

You can set the following parameters for the ADC clock prescaler:

### ADC clock prescaler (ADCCLK)

The option to select the ADCCLK divider for processors c2802x, c2803x, c2806x.

### ADC clock frequency in MHz

The clock frequency for ADC. This is a read-only field and the value in this field is based on the value you select in **ADC clock prescaler (ADCCLK)**.

### ADC overlap of sample and conversion (ADCNONOVERLAP)

The option to enable or disable overlap of sample and conversion.

**ADC clock prescaler (ADCLKPS)**

The HSPCLK speed is divided by this 4-bit value as the first step in deriving the core clock speed of the ADC. The default value is 3.

**ADC Core clock prescaler (CPS)**

After dividing the HSPCLK speed by the **ADC clock prescaler (ADCLKPS)** value, setting the **ADC clock prescaler (ADCLKPS)** parameter to 1, the default value, divides the result by 2.

**ADC Module clock (ADCCLK = HSPCLK/ADCLKPS\*2)/(CPS+1) in MHz**

The clock to the ADC module and indicates the ADC operating clock speed.

**Acquisition window prescaler (ACQ\_PS)**

This value does not directly alter the core clock speed of the ADC. It serves to determine the width of the sampling or acquisition period. The higher the value, the wider is the sampling period. The default value is 4.

**Acquisition window size ((ACQ\_PS+1)/ADCCLK) in micro seconds/channel**

Acquisition window size determines for what time duration the sampling switch is closed. The width of SOC pulse is ADCTRL1[11:8] + 1 times the ADCLK period.

**Use external reference 2.048VExternal reference**

By default, an internally generated band gap voltage reference supplies the ADC logic. However, depending on application requirements, you can enable the external reference so the ADC logic uses an external voltage reference instead. Select the check box to use a 2.048V external voltage reference.

**Use external reference**

By default, an internally generated band gap voltage reference supplies the ADC logic. However, depending on application requirements, you can enable the external reference so the ADC logic uses an external voltage reference instead. Select the check box to use an external voltage reference.

**Continuous mode**

When the ADC generates an end of conversion (EOC) signal, generate an ADCINT# interrupt whether the previous interrupt flag has been acknowledged or not.

**ADC offset correction (OFFSET\_TRIM: -256 to 255)**

The 280x ADC supports offset correction via a 9-bit value that it adds or subtracts before the results are available in the ADC result registers. Timing for results is not affected. The default value is 0.

**VREFHI****VREFLO**

(For Piccolo processors) When you disable the **Use external reference 2.048V** or **External reference** option, the ADC logic uses a fixed 0-volt to 3.3-volt input range and the software disables **VREFHI** and **VREFLO**. To interpret the ADC input as a ratiometric signal, select the **External reference** option. Then set values for the high voltage reference (**VREFHI**) and the low voltage reference (**VREFLO**). **VREFHI** uses the external ADCINA0 pin, and **VREFLO** uses the internal GND.

**INT pulse control**

(For Piccolo processors) Use this option to configure when the ADC sets ADCINTFLG .ADCINTx relative to the SOC and EOC Pulses. Select **Late interrupt pulse** or **Early interrupt pulse**.

**SOC high priority**

(For Piccolo processors) Use this option to enable and configure **SOC high priority mode**. In all in round robin mode, the default selection, the ADC services each SOC interrupt in a numerical sequence.

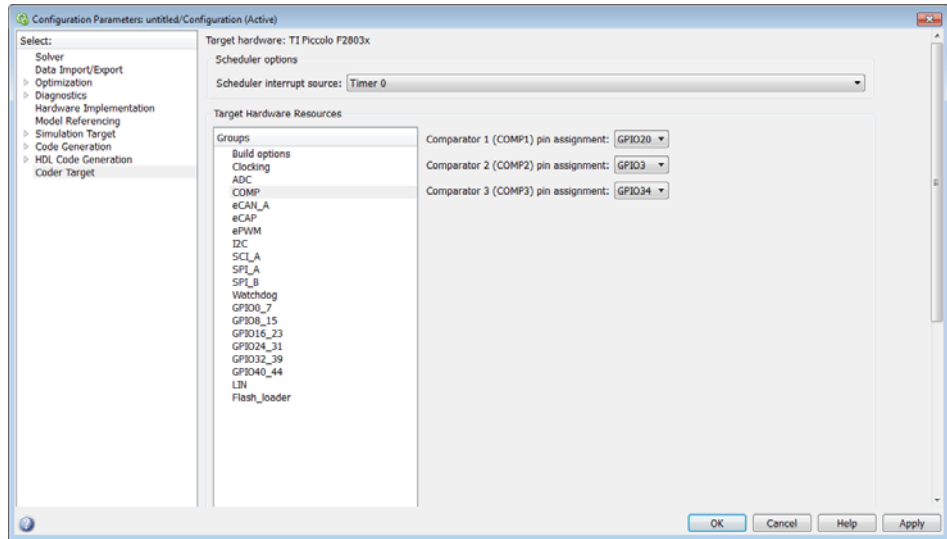
Choose one of the high priority selections to assign high priority to one or more of the SOCs. In this mode, the ADC operates in round robin mode until it receives a high priority SOC interrupt. The ADC finishes servicing the current SOC, services the high priority SOCs, and then returns to the next SOC in the round robin sequence.

For example, the ADC is servicing SOC8 when it receives a high priority interrupt on SOC1. The ADC completes servicing SOC8, services SOC1, and then services SOC9.

### **XINT2SOC external pin**

(For Piccolo processors) Select the pin to which the ADC sends the XINT2SOC pulse.

## COMP



Assigns COMP pins to GPIO pins.

### Comparator 1 (COMP1) pin assignment

Select an option from the list — None,GPIO1, GPIO20, GPIO42.

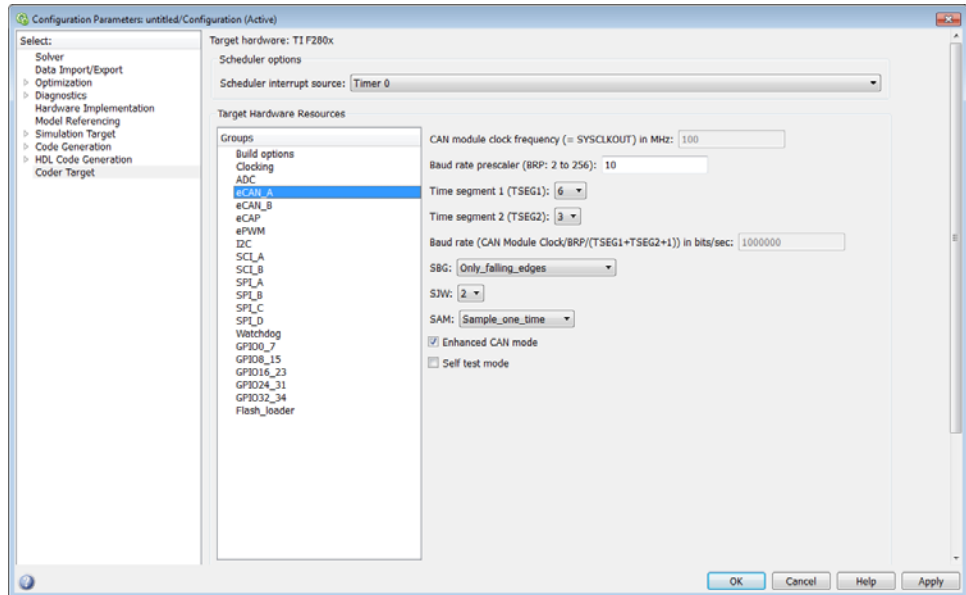
### Comparator 2 (COMP2) pin assignment

Select an option from the list — None,GPIO3, GPIO21, GPIO34, GPIO43.

### Comparator 3 (COMP3) pin assignment

Select an option from the list — None,GPIO34.

## eCAN\_A, eCAN\_B



For more help on setting the timing parameters for the eCAN modules, refer to [Configuring Timing Parameters for CAN Blocks](#). You can set the following parameters for the eCAN module:

### **CAN module clock frequency (= SYSCLKOUT) in MHz:**

The clock to the enhanced CAN module. The CAN module clock frequency is equal SYSCLKOUT for processors such as c280x, c281x, c28044.

### **CAN module clock frequency (=SYSCLKOUT/2) in MHz**

The clock to the enhanced CAN module. The CAN module clock frequency is equal to SYSCLKOUT/2 for processors such as piccolo, c2834x, c28x3x.

### **Baud rate prescaler (BRP: 2 to 256):**

Value by which to scale the bit rate. Valid values are from 2 to 256.

**Time segment 1 (TSEG1):**

Sets the value of time segment 1, which, with **TSEG2** and **Baud rate prescaler**, determines the length of a bit on the eCAN bus. Valid values for **TSEG1** are from 1 through 16.

**Time segment 2 (TSEG2):**

Sets the value of time segment 2, which, with **TSEG1** and **Baud rate prescaler**, determines the length of a bit on the eCAN bus. Valid values for **TSEG2** are from 1 through 8.

**Baud rate (CAN Module Clock/BRP/(TSEG1 + TSEG2 +1)) in bits/sec:**

CAN module communication speed represented in bits/sec.

**SBG**

Sets the message resynchronization triggering. Options are `Only_falling_edges` and `Both_falling_and_rising_edges`.

**SJW**

Sets the synchronization jump width, which determines how many units of TQ a bit can be shortened or lengthened when resynchronizing.

**SAM**

Number of samples used by the CAN module to determine the CAN bus level. Selecting `Sample_one_time` samples once at the sampling point. Selecting `Sample_three_times` samples once at the sampling point and twice before at a distance of TQ/2. The CAN module makes a majority decision from the three points.

**Enhanced CAN Mode**

To enable time-stamping and to use **Mailbox Numbers** 16 through 31 in the C2000 eCAN blocks, enable this parameter. Texas Instruments documentation refers to this “HECC mode”.

**Self test mode**

If you set this parameter to `True`, the eCAN module goes to loopback mode. Loopback mode sends a “dummy” acknowledge message back without needing an acknowledge bit. The default is `False`.

**Pin assignment (Tx)**

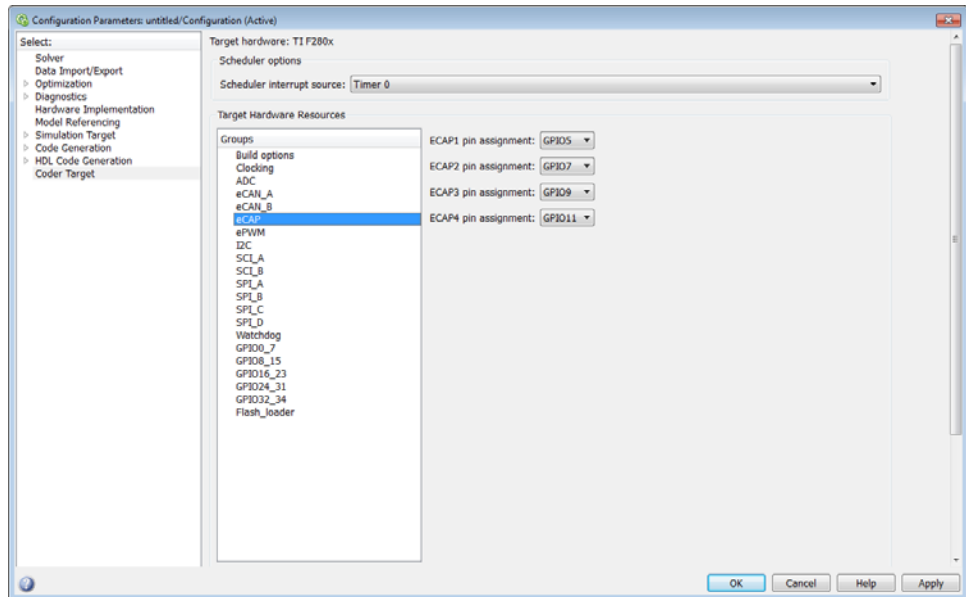
Assigns the CAN transmit pin to use with the eCAN\_B module. Possible values are `GPI08`, `GPI012`, `GPI016`, and `GPI020`.

### **Pin assignment (Rx)**

Assigns the CAN receive pin to use with the eCAN\_B module. Possible values are GPI010, GPI013, GPI017, and GPI021.



## eCAP



Assigns eCAP pins to GPIO pins.

### ECAP1 pin assignment

Select an option from the list—None, GPIO5, or GPIO24.

### ECAP2 pin assignment

Select an option from the list—None, GPIO7, or GPIO25.

### ECAP3 pin assignment

Select an option from the list—None, GPIO9, or GPIO26.

### ECAP4 pin assignment

Select an option from the list—None, GPIO11, or GPIO27.

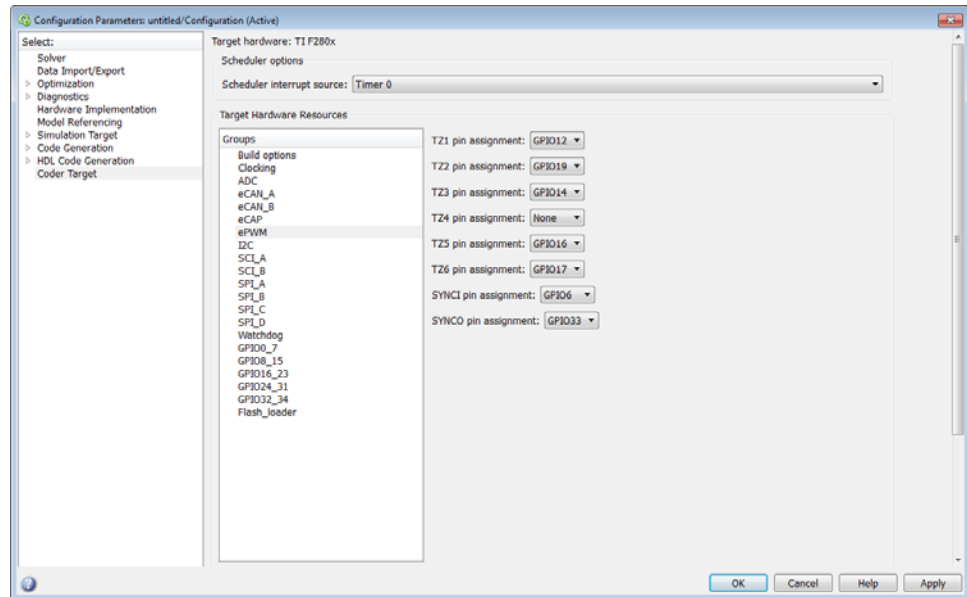
### ECAP5 pin assignment

Select an option from the list—None, GPIO3, or GPIO48.

### ECAP6 pin assignment

Select an option from the list—None, GPIO1, or GPIO49.

## ePWM



Assigns ePWM signals to GPIO pins.

### TZ1 pin assignment

Assigns the trip-zone input 1 (TZ1) to a GPIO pin. Choices are None (the default), GPIO12, and GPIO15.

### TZ2 pin assignment

Assigns the trip-zone input 2 (TZ2) to a GPIO pin. Choices are None (the default), GPIO16, and GPIO28.

### TZ3 pin assignment

Assigns the trip-zone input 3 (TZ3) to a GPIO pin. Choices are None (the default), GPIO17, and GPIO29.

### TZ4 pin assignment

Assigns the trip-zone input 4 (TZ4) to a GPIO pin. Choices are None (the default), GPIO17, and GPIO28.

### TZ5 pin assignment

Assigns the trip-zone input 5 (TZ5) to a GPIO pin. Choices are None (the default), GPIO16, and GPIO28.

**TZ6 pin assignment**

Assigns the trip-zone input 6 (TZ6) to a GPIO pin. Choices are None (the default), GPI017, and GPI029.

**SYNCI pin assignment**

Assigns the ePWM external sync pulse input (SYNCI) to a GPIO pin. Choices are None (the default), GPI06, and GPI032.

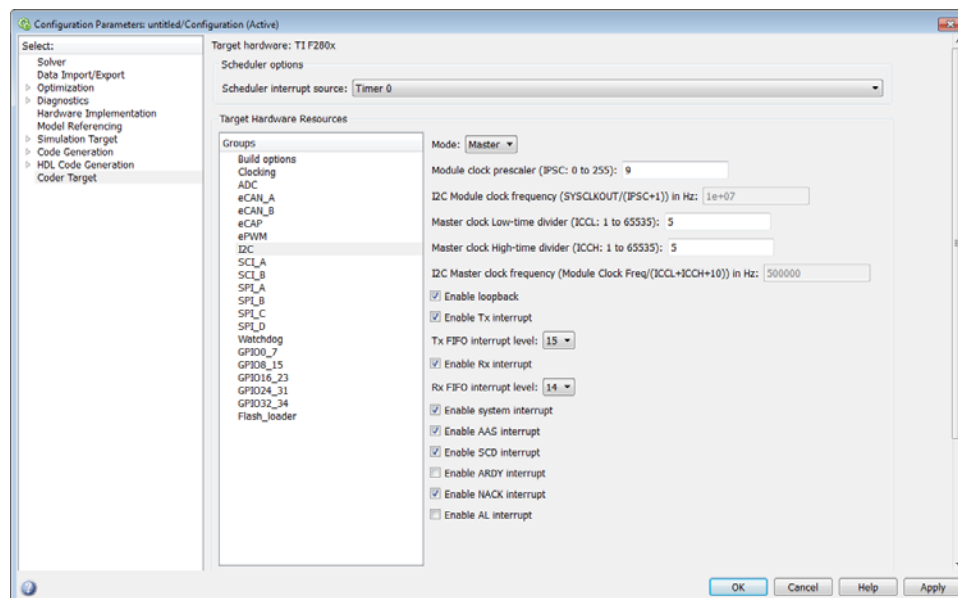
**SYNCO pin assignment**

Assigns the ePWM external sync pulse output (SYNCO) to a GPIO pin. Choices are None (the default), GPI06, and GPI033.

**PWM # A, PWM # B, PWM # C pin assignment**

The PWM # A, PWM # B, PWM # C pin assignment.

## I2C



Report or set Inter-Integrated Circuit parameters. For more information, consult the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721A, available on the Texas Instruments Web site.

**Mode**

Configure the I2C module as **Master** or **Slave**.

If a module is an I2C master, it:

Initiates communication with slave nodes by sending the slave address and requesting data transfer to or from the slave.

Outputs the **Master clock frequency** on the serial clock line (SCL) line.

If a module is an I2C slave, it:

- Synchronizes itself with the serial clock line (SCL) line.
- Responds to communication requests from the master.

When **Mode** is **Slave**, you can configure the **Addressing format**, **Address register**, and **Bit count** parameters.

The **Mode** parameter corresponds to bit 10 (MST) of the I2C Mode Register (I2CMDR).

#### **Addressing format**

If **Mode** is **Slave**, determine the addressing format of the I2C master, and set the I2C module to the same mode:

- 7-Bit Addressing, the normal address mode.
- 10-Bit Addressing, the expanded address mode.
- Free Data Format, a mode that does not use addresses. (If you **Enable loopback**, the Free data format is not supported.)

The **Addressing format** parameter corresponds to bit 3 (FDF) and bit 8 (XA) of the I2C Mode Register (I2CMDR).

#### **Own address register**

If **Mode** is **Slave**, enter the 7-bit (0–127) or 10-bit (0–1023) address this I2C module uses while it is a slave.

This parameter corresponds to bits 9–0 (OAR) of the I2C Own Address Register (I2COAR).

#### **Bit count**

If **Mode** is **Slave**, set the number of bits in each *data byte* the I2C module transmits and receives. This value must match that of the I2C master.

This parameter corresponds to bits 2–0 (BC) of the I2C Mode Register (I2CMDR).

#### **Module clock prescaler (IPSC: 0 to 255):**

If **Mode** is **Master**, configure the module clock frequency by entering a value 0–255.

*Module clock frequency = I2C input clock frequency / (Module clock prescaler + 1)*

The I2C specifications require a module clock frequency between 7 MHz and 12 MHz.

The *I2C input clock frequency* depends on the DSP input clock frequency and the value of the PLL Control Register divider (PLLCR). For more information on setting the PLLCR, consult the documentation for your specific Digital Signal Controller.

This **Module clock prescaler (IPSC: 0 to 255)**: corresponds to bits 7–0 (IPSC) of the I2C Prescaler Register (I2CPSC).

**I2C Module clock frequency (SYSCLKOUT / (IPSC+1)) in Hz:**

This field displays the frequency the I2C module uses internally. To set this value, change the **Module clock prescaler**.

For more information about this value, consult the “Formula for the Master Clock Period” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721, on the Texas Instruments Web site.

**I2C Master clock frequency (Module Clock Freq/(ICCL+ICCH+10)) in Hz:**

This field displays the master clock frequency.

For more information about this value, consult the “Clock Generation” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721, available on the Texas Instruments Web site.

**Master clock Low-time divider (ICCL: 1 to 65535):**

When **Mode** is Master, this divider determines the duration of the low state of the SCL line on the I2C-bus.

The low-time duration of the master clock = Tmod x (ICCL + d).

For more information, consult the “Formula for the Master Clock Period” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721A, available on the Texas Instruments Web site.

This parameter corresponds to bits 15–0 (ICCL) of the Clock Low-Time Divider Register (I2CCLKL).

**Master clock High-time divider (ICCH: 1 to 65535):**

When **Mode** is **Master**, this divider determines the duration of the high state on the serial clock pin (SCL) of the I2C-bus.

The high-time duration of the master clock =  $T_{\text{mod}} \times (\text{ICCL} + d)$ .

For more information about this value, consult the “Formula for the Master Clock Period” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721A, available on the Texas Instruments Web site.

This parameter corresponds to bits 15–0 (ICCH) of the Clock High-Time Divider Register (I2CCLKH).

**Enable loopback**

When **Mode** is **Master**, enable or disable digital loopback mode. In digital loopback mode, I2CDXR transmits data over an internal path to I2CDRR, which receives the data after a configurable delay.

The delay, measured in DSP cycles, equals  $(\text{I2C input clock frequency} / \text{module clock frequency}) \times 8$ .

While **Enable loopback** is enabled, free data format addressing is not supported.

This parameter corresponds to bit 6 (DLB) of the I2C Mode Register (I2CMODR).

**Enable Tx interrupt**

This parameter corresponds to bit 5 (TXFFIENA) of the I2C Transmit FIFO Register (I2CFFTX).

**Tx FIFO interrupt level**

This parameter corresponds to bits 4–0 (TXFFIL4-0) of the I2C Transmit FIFO Register (I2CFFTX).

**Enable Rx interrupt**

This parameter corresponds to bit 5 (RXFFIENA) of the I2C Receive FIFO Register (I2CFFRX).

### **Rx FIFO interrupt level**

This parameter corresponds to bit 4–0 (RXFFIL4-0) of the I2C Receive FIFO Register (I2CFFRX).

### **Enable system interrupt**

Select this parameter to display and individually configure the following five Basic I2C Interrupt Request parameters in the Interrupt Enable Register (I2CIER):

- Enable AAS interrupt
- Enable SCD interrupt
- Enable ARDY interrupt
- Enable NACK interrupt
- Enable AL interrupt

### **Enable AAS interrupt**

Enable the addressed-as-slave interrupt.

When enabled, the I2C module generates an interrupt (AAS bit = 1) upon receiving one of the following:

- Its **Own address register**
- A general call (all zeros)
- A data byte is in free data format

When enabled, the I2C module clears the interrupt (AAS = 0) upon receiving one of the following:

- Multiple START conditions (7-bit addressing mode only)
- A slave address that is different from **Own address register** (10-bit addressing mode only)
- A NACK or a STOP condition

This parameter corresponds to bit 6 (AAS) of the Interrupt Enable Register (I2CIER).

### **Enable SCD interrupt**

Enable stop condition detected interrupt.



When enabled, the I2C module generates an interrupt (SCD bit = 1) when the CPU detects a stop condition on the I2C bus.

When enabled, the I2C module clears the interrupt (SCD = 0) upon one of the following events:

- The CPU reads the I2CISRC while it indicates a stop condition
- A reset of the I2C module
- Someone manually clears the interrupt

This parameter corresponds to bit 5 (SCD) of the Interrupt Enable Register (I2CIER).

#### **Enable ARDY interrupt**

Enable register-access-ready interrupt enable bit.

When enabled, the I2C module generates an interrupt (ARDY bit = 1) when the previous address, data, and command values in the I2C module registers have been used and new values can be written to the I2C module registers.

This parameter corresponds to bit 2 (ARDY) of the Interrupt Enable Register (I2CIER).

#### **Enable NACK interrupt**

Enable no acknowledgment interrupt enable bit.

When enabled, the I2C module generates an interrupt (NACK bit = 1) when the module is a transmitter in master or slave mode and it receives a NACK condition.

This parameter corresponds to bit 1 (NACK) of the Interrupt Enable Register (I2CIER).

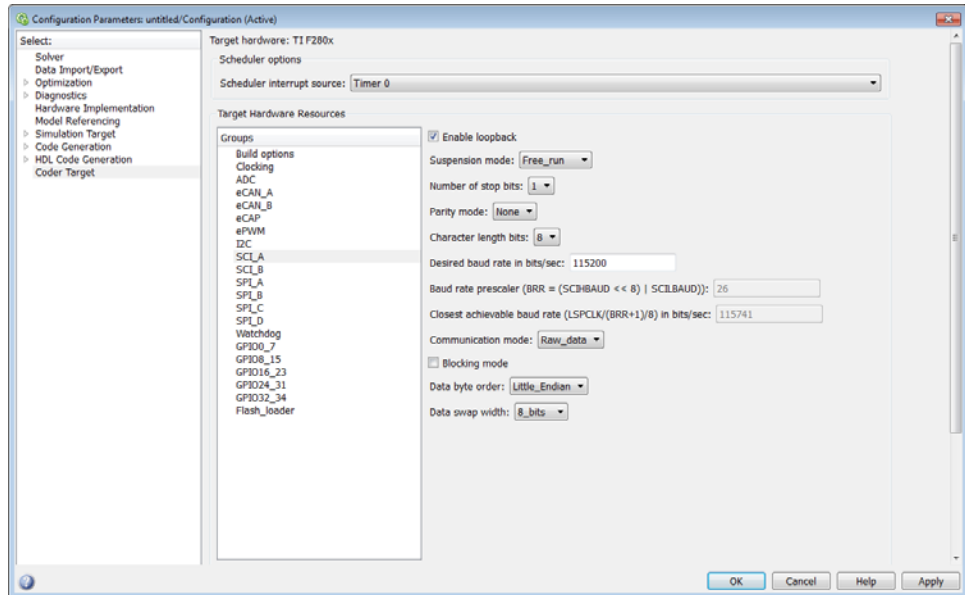
#### **Enable AL interrupt**

Enable arbitration-lost interrupt.

When enabled, the I2C module generates an interrupt (AL bit = 1) when the I2C module is operating as a master transmitter and loses an arbitration contest with another master transmitter.

This parameter corresponds to bit 0 (AL) of the Interrupt Enable Register (I2CIER).

## SCI\_A, SCI\_B, SCI\_C



The serial communications interface parameters you can set for module A. These parameters are:

### Enable loopback

Select this parameter to enable the loopback function for self-test and diagnostic purposes only. When this function is enabled, a C28x DSP Tx pin is internally connected to its Rx pin and can transmit data from its output port to its input port to check the integrity of the transmission.

### Baud rate

Baud rate for transmitting and receiving data. Select from 115200 (the default), 57600, 38400, 19200, 9600, 4800, 2400, 1200, 300, and 110.

### Suspension mode

Type of suspension to use when debugging your program with Code Composer Studio. When your program encounters a breakpoint, the suspension mode determines whether to perform the program instruction. Available options are Hard\_abort, Soft\_abort, and Free\_run. Hard\_abort stops the program immediately. Soft\_abort

stops when the current receive/transmit sequence is complete. `Free_run` continues running regardless of the breakpoint.

**Number of stop bits**

Select whether to use 1 or 2 stop bits.

**Parity mode**

Type of parity to use. Available selections are None, Odd parity, or Even parity. None disables parity. Odd sets the parity bit to one if you have an odd number of ones in your bytes, such as 00110010. Even sets the parity bit to one if you have an even number of ones in your bytes, such as 00110011.

**Character length bits**

Length in bits of each transmitted or received character, set to 8 bits.

**Desired baud rate in bits/sec**

The desired baud rate specified by the user.

**Baud rate prescaler (BRR = (SCIHBAUD << 8) | SCILBAUD))**

The baud rate prescaler.

**Closest achievable baud rate (LSPCLK/(BRR+1)/8) in bits/sec**

The closest achievable baud rate calculated based on LSPCLK and BRR.

**Communication mode**

Select `Raw_data` or `Protocol` mode. Raw data is unformatted and sent whenever the transmitting side is ready to send, whether the receiving side is ready or not. Without a wait state, deadlock conditions do not occur. Data transmission is asynchronous. With this mode, it is possible the receiving side could miss data, but if the data is noncritical, using raw data mode can avoid blocking processes.

When you select protocol mode, some handshaking between host and processor occurs. The transmitting side sends `$SND` to indicate it is ready to transmit. The receiving side sends back `$RDY` to indicate it is ready to receive. The transmitting side then sends data and, when the transmission is completed, it sends a checksum.

Advantages to using protocol mode include:

- Avoids deadlock
- Determines whether data is received without errors (checksum)

- Determines whether data is received by processor
- Determines time consistency; each side waits for its turn to send or receive

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**Note** Deadlocks can occur if one SCI Transmit block tries to communicate with more than one SCI Receive block on different COM ports when both are blocking (using protocol mode). Deadlocks cannot occur on the same COM port.

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### **Blocking mode**

If this option is set to True, system waits until data is available to read (when data length is reached). If this option is set to False, system checks FIFO periodically (in polling mode) for data to read. If data is present, the block reads and outputs the contents. When data is not present, the block outputs the last value and continues.

### **Data byte order**

Select `Little Endian` or `Big Endian`, to match the endianness of the data being moved.

### **Data swap width**

Select `8_bits` or `16_bits`, to match the width of the data being moved by the data swap operation. When you set **Data byte order** to `Big Endian`, the only available option for **Data swap width** is `8_bits`.

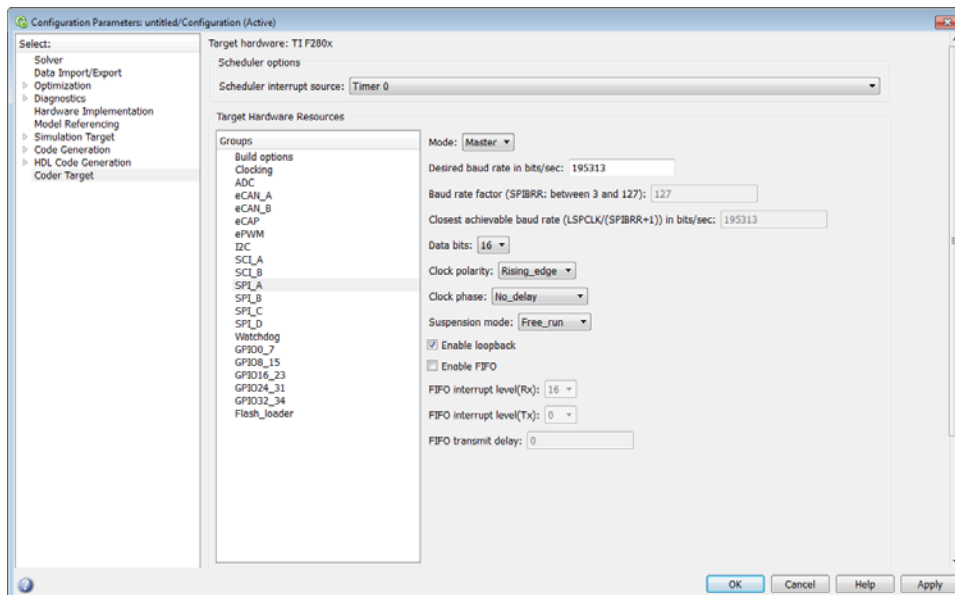
### **Pin assignment (Tx)**

Assigns the SCI transmit pin to use with the SCI module.

### **Pin assignment (Rx)**

Assigns the SCI receive pin to use with the SCI module.

## SPI\_A, SPI\_B, SPI\_C, SPI\_D



The serial peripheral interface parameters you can set for the A module. These parameters are:

### Mode

Set to Master or Slave.

### Desired baud rate in bits/sec

The desired baud rate specified by the user.

### Baud rate factor (SPIBRR: between 3 and 127)

To set the **Baud rate factor**, search for “Baud Rate Determination” and “SPI Baud Rate Register (SPIBRR) Bit Descriptions” in *TMS320x28xx, 28xxx DSP Serial Peripheral Interface (SPI) Reference Guide*, Literature Number: SPRU059, available on the Texas Instruments Web Site.

### Closest achievable baud rate (LSPCLK/(SPIBRR+1)) in bits/sec

The closest achievable baud rate calculated based on LSPCLK and SPIBRR.

**Data bits**

Length in bits from 1 to 16 of each transmitted or received character. For example, if you select 8, the maximum data that can be transmitted using SPI is  $2^{8-1}$ . If you send data greater than this value, the buffer overflows.

**Clock polarity**

Select `Rising_edge` or `Falling_edge`.

**Clock phase**

Select `No_delay` or `Delay_half_cycle`.

**Suspension mode**

Type of suspension to use when debugging your program with Code Composer Studio. When your program encounters a breakpoint, the selected suspension mode determines whether to perform the program instruction. Available options are `Hard_abort`, `Soft_abort`, and `Free_run`. `Hard_abort` stops the program immediately. `Soft_abort` stops when the current receive or transmit sequence is complete. `Free_run` continues running regardless of the breakpoint.

**Enable loopback**

Select this option to enable the loopback function for self-test and diagnostic purposes only. When this function is enabled, the Tx pin on a C28x DSP is internally connected to its Rx pin and can transmit data from its output port to its input port to check the integrity of the transmission.

**Enable 3-wire mode**

Enable SPI communication over three pins instead of the normal four pins.

**Enable FIFO**

Set true or false.

**FIFO interrupt level (Rx)**

Set level for receive FIFO interrupt. Select 0 through 16.

**FIFO interrupt level (Tx)**

Set level for transmit FIFO interrupt. Select 0 through 16.

**FIFO transmit delay**

Enter FIFO transmit delay (in processor clock cycles) to pause between data transmissions. Enter an integer.

**CLK pin assignment**

Assigns the SPI something (CLK) to a GPIO pin. Choices are None (default), GPI014, or GPI026.

**SOMI pin assignment**

Assigns the SPI something (SOMI) to a GPIO pin. Choices are None (default), GPI013, or GPI025.

**STE pin assignment**

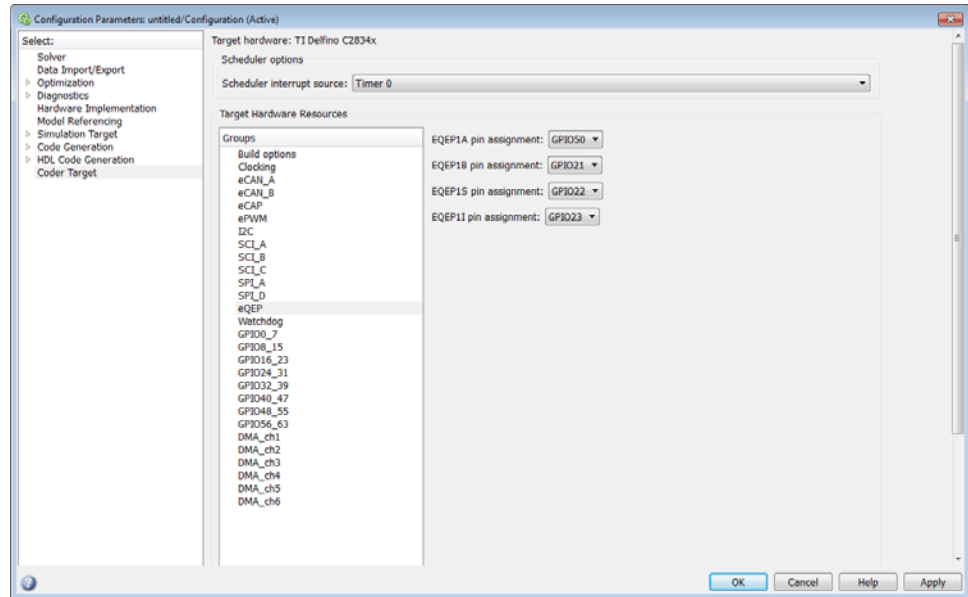
Assigns the SPI something (STE) to a GPIO pin. Choices are None (default), GPI015, or GPI027.

**SIMO pin assignment**

Assigns the SPI something (SIMO) to a GPIO pin. Choices are None (default), GPI012, or GPI024.



## eQEP



Assigns eQEP pins to GPIO pins.

### **EQEP1A pin assignment**

Select an option from the list—GPIO20 or GPIO50.

### **EQEP1B pin assignment**

Select an option from the list—GPIO21 or GPIO51.

### **EQEP1S pin assignment**

Select an option from the list—GPIO22 or GPIO52.

### **EQEP1I pin assignment**

Select an option from the list—GPIO23 or GPIO53.

### **EQEP2A pin assignment**

Select an option from the list—GPIO24 or GPIO54.

### **EQEP2B pin assignment**

Select an option from the list—GPIO25 or GPIO55.

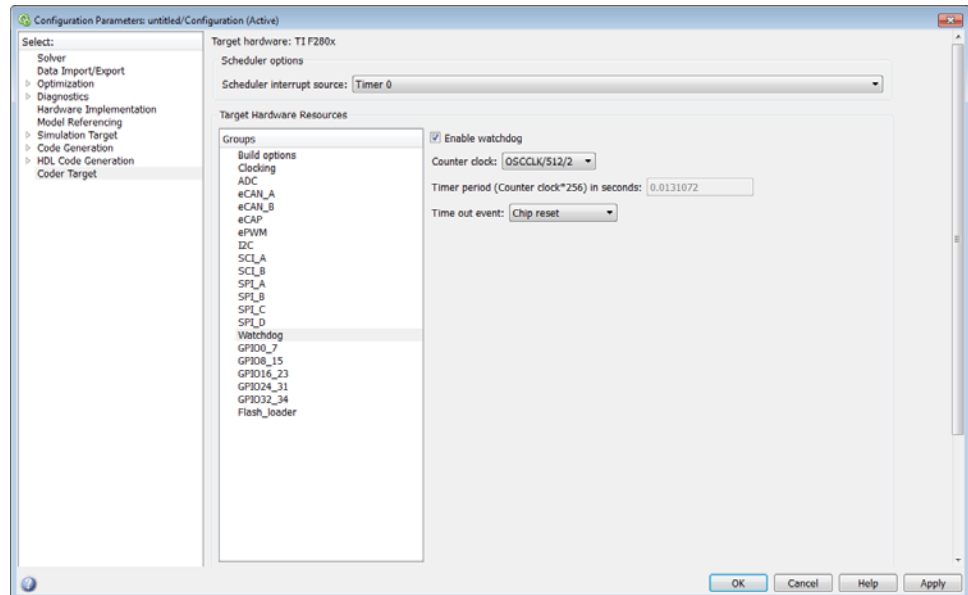
### **EQEP2S pin assignment**

Select an option from the list—GPIO27 or GPIO31. or GPIO57

**EQEP2I pin assignment**

Select an option from the list—GPIO26 or GPIO30. or GPIO56

## Watchdog



When enabled, if the software fails to reset the watchdog counter within a specified interval, the watchdog resets the processor or generates an interrupt. This feature enables the processor to recover from some fault conditions.

For more information, locate the *Data Manual* or *System Control and Interrupts Reference Guide* for your processor on the Texas Instruments Web site.

### Enable watchdog

Enable the watchdog timer module.

This parameter corresponds to bit 6 (WDDIS) of the Watchdog Control Register (WDCR) and bit 0 (WDOVERRIDE) of the System Control and Status Register (SCSR).

### Counter clock

Set the watchdog timer period relative to OSCCLK/512.

This parameter corresponds to bits 2–0 (WDPS) of the Watchdog Control Register (WDCR).

### **Timer period (Counter clock\*256) in seconds**

This field displays the timer period in seconds. This value automatically updates when you change the **Counter clock** parameter.

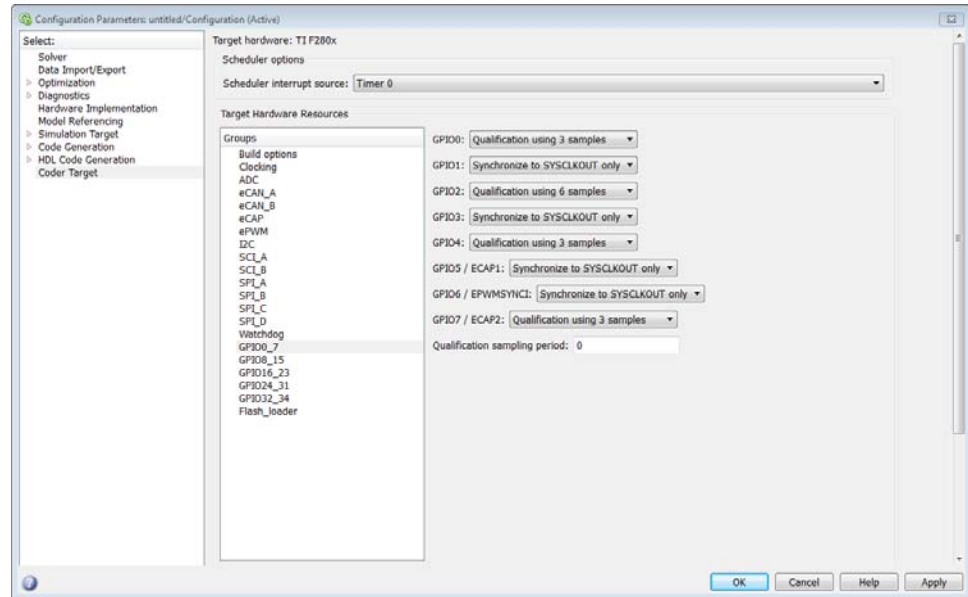
### **Time out event**

Configure the watchdog to reset the processor or generate an interrupt when the software fails to reset the watchdog counter:

- Select **Chip reset** to generate a signal that resets the processor (WDRST signal) and disable the watchdog interrupt signal (WDINT signal).
- Select **Raise WD Interrupt** to generate a watchdog interrupt signal (WDINT signal) and disable the reset processor signal (WDRST signal). This signal can be used to wake the device from an IDLE or STANDBY low-power mode.

This parameter corresponds to bit 1 (WDENINT) of the System Control and Status Register (SCSR).

## GPIO



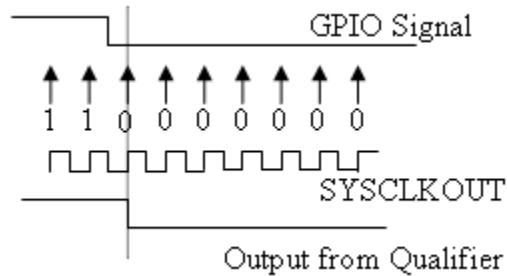
**GPIO** Use the GPIO pins for digital input or output by connecting to one of the three peripheral I/O ports.

The range of GPIO pins for different processors is given below:

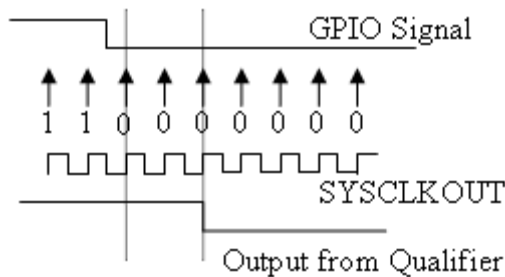
| Processors                    | GPIO Pin Values                                                                     |
|-------------------------------|-------------------------------------------------------------------------------------|
| C281x                         | GPIOA, GPIOB, GPIOD, GPIOE, GPIOF, and GPIOG                                        |
| F2803x                        | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–39, GPIO40–44                       |
| F2806x                        | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–39, GPIO40–44, GPIO50–55, GPIO56–58 |
| F2823x, F2833x, and C2834x    | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–39, GPIO40–47, GPIO48–55, GPIO56–63 |
| C2801x, F2802x, F28044, F280x | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–34                                  |

Each pin selected for input offers four signal qualification types:

- Sync to SYSCLKOUT only — This setting is the default for all pins at reset. Using this qualification type, the input signal is synchronized to the system clock SYSCLKOUT. The following figure shows the input signal measured on each tick of the system clock, and the resulting output from the qualifier.

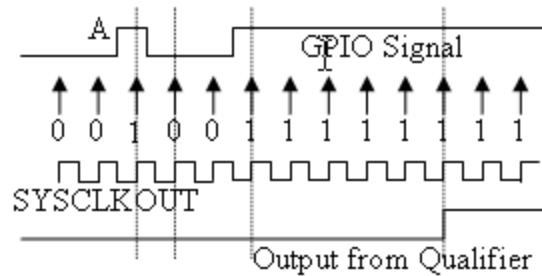


- Qualification using 3 samples — This setting requires three consecutive cycles of the same value for the output value to change. The following figure shows that, in the third cycle, the GPIO value changes to 0, but the qualifier output is still 1 because it waits for three consecutive cycles of the same GPIO value. The next three cycles all have a value of 0, and the output from the qualifier changes to 0 immediately after the third consecutive value is received.



- Qualification using 6 samples — This setting requires six consecutive cycles of the same GPIO input value for the output from the qualifier to change. In the following figure, the glitch A does not alter the output signal. When the glitch occurs, the counting begins, but the next measurement is

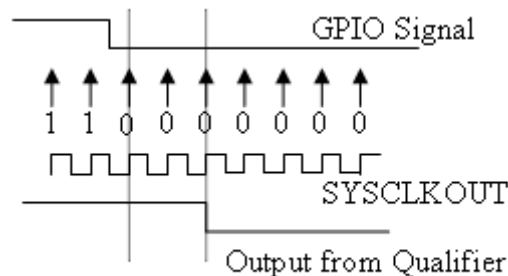
low again, so the count is ignored. The output signal does not change until six consecutive samples of the high signal are measured.



### Qualification sampling period prescaler

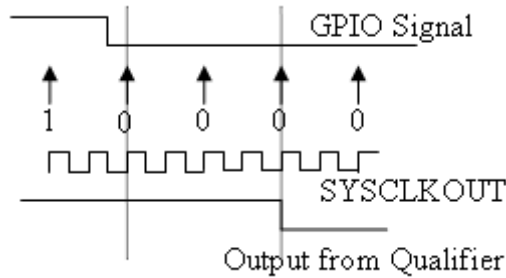
Visible only when a setting for **Qualification type for GPIO [pin#]** is selected. The qualification sampling period prescaler, with possible values of 0 to 255, calculates the frequency of the qualification samples or the number of system clock ticks per sample. The formula for calculating the qualification sampling frequency is  $\text{SYSCLKOUT}/(2 * \text{Prescaler})$ , except for zero. When **Qualification sampling period prescaler=0**, a sample is taken every SYSCLKOUT clock tick. For example, a prescale setting of 0 means that a sample is taken on each SYSCLKOUT tick.

The following figure shows the SYSCLKOUT ticks, a sample taken every clock tick, and the **Qualification type** set to Qualification using 3 samples. In this case, the **Qualification sampling period prescaler=0**:

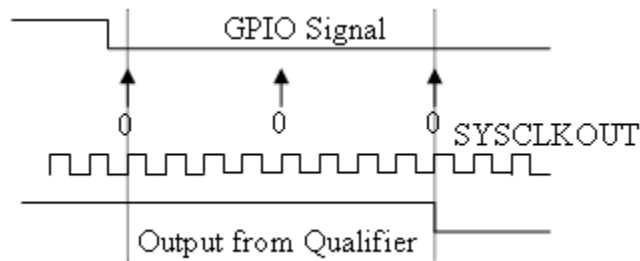


In the next figure **Qualification sampling period prescaler=1**. A sample is taken every two clock ticks, and the **Qualification type** is set to

Qualification using 3 samples. The output signal changes much later than if **Qualification sampling period prescaler=0**.



In the following figure, **Qualification sampling period prescaler=2**. Thus, a sample is taken every four clock ticks, and the **Qualification type** is set to Qualification using 3 samples.



- Asynchronous

Using this qualification type, the signal is synchronized to an asynchronous event initiated by software (CPU) via control register bits.

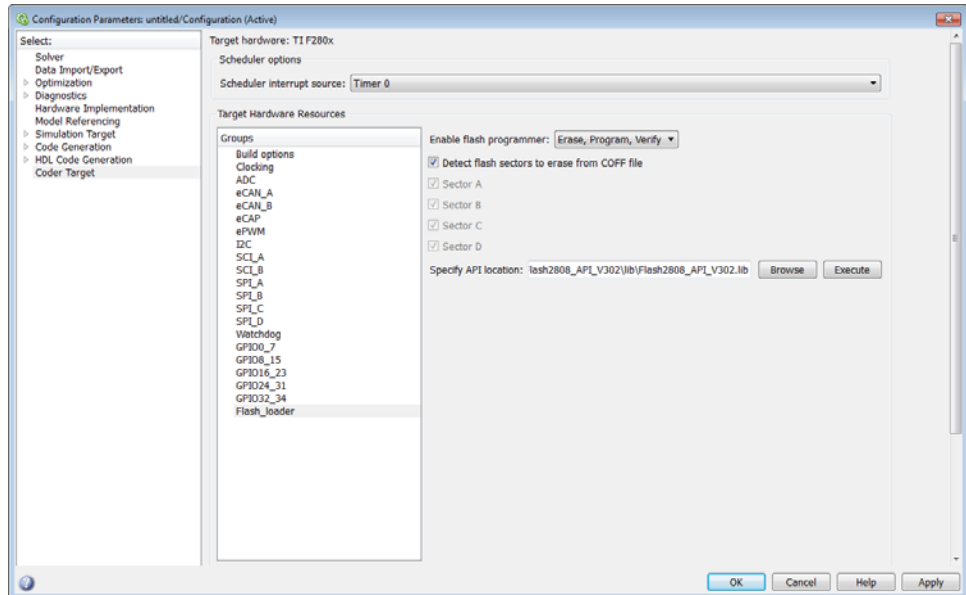
#### Qualification sampling period

Enter the qualification sampling period.

**GPIOA, GPIOB, GPIOD, GPIOE input qualification sampling period**



## Flash\_loader



You can use `Flash_loader` to:

- Automatically program generated code to flash memory on the target when you build the code.
- Manually erase, program, or verify specific flash memory sectors.

To use this feature, download and install the TI Flash API plugin from the TI Web site.

For more information, consult the “Programming Flash Memory” topic or the `*_API_Readme.pdf` file included in the *TI Flash API* downloadable zip file.

### Enable Flash Programmer

Enable the flash programmer by selecting a task for it to perform when you click **Execute** or build the software.

To program the flash memory when you build the software, select **Erase, Program, Verify**.

### **Detect Flash sectors to erase from COFF file**

When enabled, the flash programmer erases all of the flash sectors defined by the COFF file.

### **Sector A, Sector B, Sector C...**

When **Detect Flash sectors to erase from COFF file** is disabled, you can select the specific sector to erase.

### **Specify API location**

Specify the folder path of the TI flash API executable you downloaded and installed on your computer.

Use **Browse** to locate the file or enter the path in the text box.

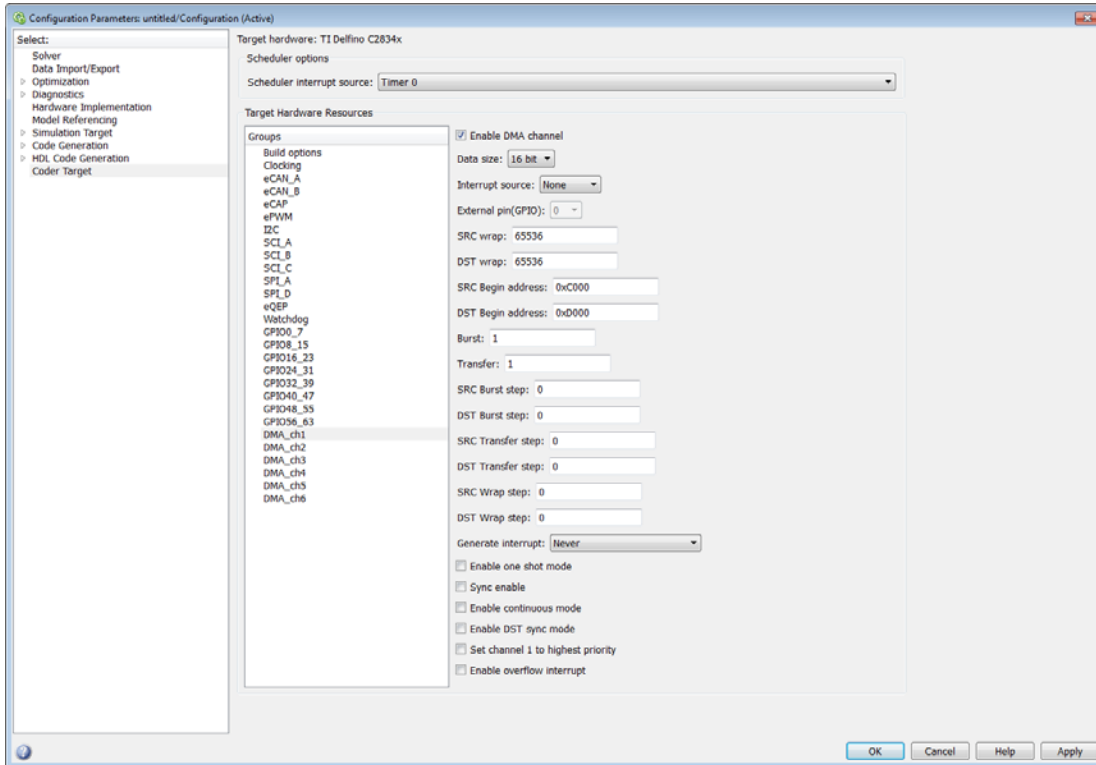
For example,

```
C:\TI\controlSUITE\libs\utilities\flash_api\2806x\v100\lib\2806x_BootR
```

### **Execute**

Click this button to initiate the task selected in **Enable Flash Programmer**.

## DMA\_ch[#]



The Direct Memory Access module transfers data directly between peripherals and memory using a dedicated bus, increasing overall system performance.

You can individually enable and configure each DMA channel.

The DMA module services are event driven. Using the **Interrupt source** and **External pin (GPIO)** parameters, you can configure a wide range of peripheral interrupt event triggers.

To avoid error messages, open the Coder Target > Target Hardware Resources, select the **Peripherals** tab, and *disable* the same DMA channel number.

For more information, consult the *TMS320x2833x, 2823x Direct Memory Access (DMA) Module Reference Guide*, Literature Number: SPRUFB8A,

Also consult the *Increasing Data Throughput using the TMS320F2833x DSC DMA* training presentation (requires login), both available from the TI Web site.

### **Enable DMA channel**

Enable this parameter to edit the configuration of a specific DMA channel.

This parameter does not have a corresponding bit or register.

### **Data size**

Select the size of the data bit transfer: 16 bit or 32 bit.

The DMA read/write data buses are 32 bits wide. 32-bit transfers have twice the data throughput of a 16-bit transfer.

When providing DMA service to McBSP, set **Data size** to 16 bit.

The following parameters are based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of the following parameters:

- Size: Burst
- Source: Burst step
- Source: Transfer step
- Source: Wrap step
- Destination: Burst step
- Destination: Transfer step
- Destination: Wrap step

**Data size** corresponds to bit 14 (DATASIZE) in the Mode Register (MODE).

### **Interrupt source**

Select the peripheral interrupt that triggers a DMA burst for the specified channel.

Select SEQ1INT or SEQ2INT to configure the ADC interrupt as interrupt source.

Select XINT1, XINT2, or XINT13 to configure GPIO pin 0 to 31 as an external interrupt source. Select XINT3 to XINT7 to configure GPIO pin 32 to 63 as an external interrupt source.

For more information about configuring XINT, consult the following references:

- *TMS320x2833x, 2823x External Interface (XINTF) User's Guide*, Literature Number: SPRU949, available on the TI Web site.
- *TMS320x2833x System Control and Interrupts*, Literature Number: SPRUFB0, available on the TI Web site.
- The C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Input and C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Output block reference sections.

Drop-down menu items from TINT0 to MREVTB may require manual configuration.

Select ePWM1SOCA through ePWM6SOCA to configure the ePWM interrupt as an interrupt source. Note that not all revisions of the TMS320F2833x silicon provide ePWM interrupts as sources for DMA transfers. For more information about silicon revisions consult the following reference:

*TMS320x2833x, 2823x Silicon Errata*, Literature Number: SPRZ272, available on the TI Web site.

The **Interrupt source** parameter corresponds to bit 4-0 (PERINTSEL) in the Mode Register (MODE).

### External pin(GPIO)

When you set **Interrupt source** is set to an external interface (XINT[#]), specify the GPIO pin number from which the interrupt originates.

This parameter corresponds to the GPIO XINTn, XNMI Interrupt Select (GPIOXINTnSEL, GPIOXNMISEL) Registers.

For more information, consult the *TMS320x2833x System Control and Interrupts Reference Guide*, Literature Number SPRUFB0, available from the TI Web site.

### **SRC wrap**

Specify the number of bursts before returning the current source address pointer to the **Source Begin Address** value. To disable wrapping, enter a value for **SRC wrap** that is greater than the **Transfer** value.

This parameter corresponds to bits 15-0 (SRC\_WRAP\_SIZE) in the Source Wrap Size Register (SRC\_WRAP\_SIZE).

### **DST wrap**

Specify the number of bursts before returning the current destination address pointer to the **Destination Begin Address** value. To disable wrapping, enter a value for **DST wrap** that is greater than the **Transfer** value.

This parameter corresponds to bits 15-0 (DST\_WRAP\_SIZE) in the Destination Wrap Size Register (DST\_WRAP\_SIZE).

### **SRC Begin address**

Set the starting address for the current source address pointer. The DMA module points to this address at the beginning of a transfer and returns to it as specified by the **SRC wrap** parameter.

This parameter corresponds to bits 21-0 (BEGADDR) in the Active Source Begin Register (SRC\_BEG\_ADDR).

### **DST Begin address**

Set the starting address for the current destination address pointer. The DMA module points to this address at the beginning of a transfer and returns to it as specified by the **DST wrap** parameter.

This parameter corresponds to bits 21-0 (BEGADDR) in the Active Destination Begin Register (DST\_BEG\_ADDR).

## Burst

Specify the number of 16-bit words in a burst, from 1 to 32. The DMA module must complete a burst before it can service the next channel.

Set the **Burst** value for the peripheral the DMA module is servicing. For the ADC, the value equals the number of ADC registers used, up to 16. For multichannel buffered serial ports (McBSP), which lack FIFOs, the value is 1.

For RAM, the value can range from 1 to 32.

This parameter corresponds to bits 4-0 (BURSTSIZE) in the Burst Size Register (BURST\_SIZE).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

## Transfer

Specify the number of bursts in a transfer, from 1 to 65536.

This parameter corresponds to bits 15-0 (TRANSFERSIZE) in the Transfer Size Register (TRANSFER\_SIZE).

## SRC Burst step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next burst. Enter a value from -4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Burst step** to 0. For example, because McBSP does not use FIFO, configure DMA to maintain the sequence of the McBSP data by moving each word of the data individually.

Accordingly, when you use DMA to transmit or receive McBSP data, set **Burst size** to 1 word and **Burst step** to 0.

This parameter corresponds to bits 15-0 (SRCBURSTSTEP) in the Source Burst Step Size Register (SRC\_BURST\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### DST Burst step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next burst. Enter a value from –4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Burst step** to 0. For example, because McBSP does not use FIFO, configure DMA to maintain the sequence of the McBSP data by moving each word of the data individually. Accordingly, when you use DMA to transmit or receive McBSP data, set **Burst size** to 1 word and **Burst step** to 0.

This parameter corresponds to bits 15-0 (DSTBURSTSTEP) in the Destination Burst Step Size Register (DST\_BURST\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### SRC Transfer step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next transfer. Enter a value from –4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Transfer step** to 0.

This parameter corresponds to bits 15-0 (SRCTRANSFERSTEP) Source Transfer Step Size Register (SRC\_TRANSFER\_STEP).

If DMA is configured to perform memory wrapping (if **SRC wrap** is enabled) the corresponding source **Transfer step** does not alter the results.



---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### DST Transfer step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next transfer. Enter a value from -4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Transfer step** to 0.

This parameter corresponds to bits 15-0 (DSTTRANSFERSTEP) Destination Transfer Step Size Register (DST\_TRANSFER\_STEP).

If DMA is configured to perform memory wrapping (if **DST wrap** is enabled) the corresponding destination **Transfer step** does not alter the results.

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### SRC Wrap step

Set the number of 16-bit words by which to increment or decrement the SRC\_BEG\_ADDR address pointer when a wrap event occurs. Enter a value from -4096 (decrement) to 4095 (increment).

This parameter corresponds to bits 15-0 (WRAPSTEP) in the Source Wrap Step Size Registers (SRC\_WRAP\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

#### **DST Wrap step**

Set the number of 16-bit words by which to increment or decrement the DST\_BEG\_ADDR address pointer when a wrap event occurs. Enter a value from -4096 (decrement) to 4095 (increment).

This parameter corresponds to bits 15-0 (WRAPSTEP) in the Destination Wrap Step Size Registers (DST\_WRAP\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

#### **Generate interrupt**

Enable this parameter to have the DMA channel send an interrupt to the CPU via the PIE at the beginning or end of a data transfer.

This parameter corresponds to bit 15 (CHINTE) and bit 9 (CHINTMODE) in the Mode Register (MODE).

#### **Enable one shot mode**

Enable this parameter to have the DMA channel complete an entire *transfer* in response to an interrupt event trigger.

This option allows a single DMA channel and peripheral to dominate resources, and may streamline processing, but it also creates the potential for resource conflicts and delays.

Disable this parameter to have DMA complete one *burst* per channel per interrupt.

#### **Sync enable**

When **Interrupt source** is set to SEQ1INT, enable this parameter to reset the DMA wrap counter when it receives the ADCSYNC signal from SEQ1INT. This way, the wrap counter and the ADC channels remain synchronized with each other.

If **Interrupt source** is not set to SEQ1INT, **Sync enable** does not alter the results.

This parameter corresponds to bit 12 (SYNCE) of the Mode Register (MODE).

**Enable continuous mode**

Select this parameter to leave the DMA channel enabled upon completing a transfer. The channel will wait for the next interrupt event trigger.

Clear this parameter to disable the DMA channel upon completing a transfer. The DMA module disables the DMA channel by clearing the RUNSTS bit in the CONTROL register when it completes the transfer. To use the channel again, first reset the RUN bit in the CONTROL register.

**Enable DST sync mode**

When **Sync enable** is enabled, enabling this parameter resets the destination wrap counter (DST\_WRAP\_COUNT) when the DMA module receives the SEQ1INT interrupt/ADCSYNC signal.

Disabling this parameter resets the source wrap counter (SCR\_WRAP\_COUNT) when the DMA module receives the SEQ1INT interrupt/ADCSYNC signal.

This parameter is associated with bit 13 (SYNCSEL) in the Mode Register (MODE).

**Set channel 1 to highest priority**

This parameter is only available for DMA\_ch1.

Enable this setting when DMA channel 1 is configured to handle high-bandwidth data, such as ADC data, and the other DMA channels are configured to handle lower-priority data.

When enabled, the DMA module services each enabled channel sequentially until it receives a trigger from channel 1.

Upon receiving the trigger, DMA interrupts its service to the current channel at the end of the current word, services the channel 1 burst that generated the trigger, and then continues servicing the current channel at the beginning of the next word.

Disable this channel to give each DMA channel equal priority, or if DMA channel 1 is the only enabled channel.

When disabled, the DMA module services each enabled channel sequentially.

This parameter corresponds to bit 0 (CH1PRIORITY) in the Priority Control Register 1 (PRIORITYCTRL1).

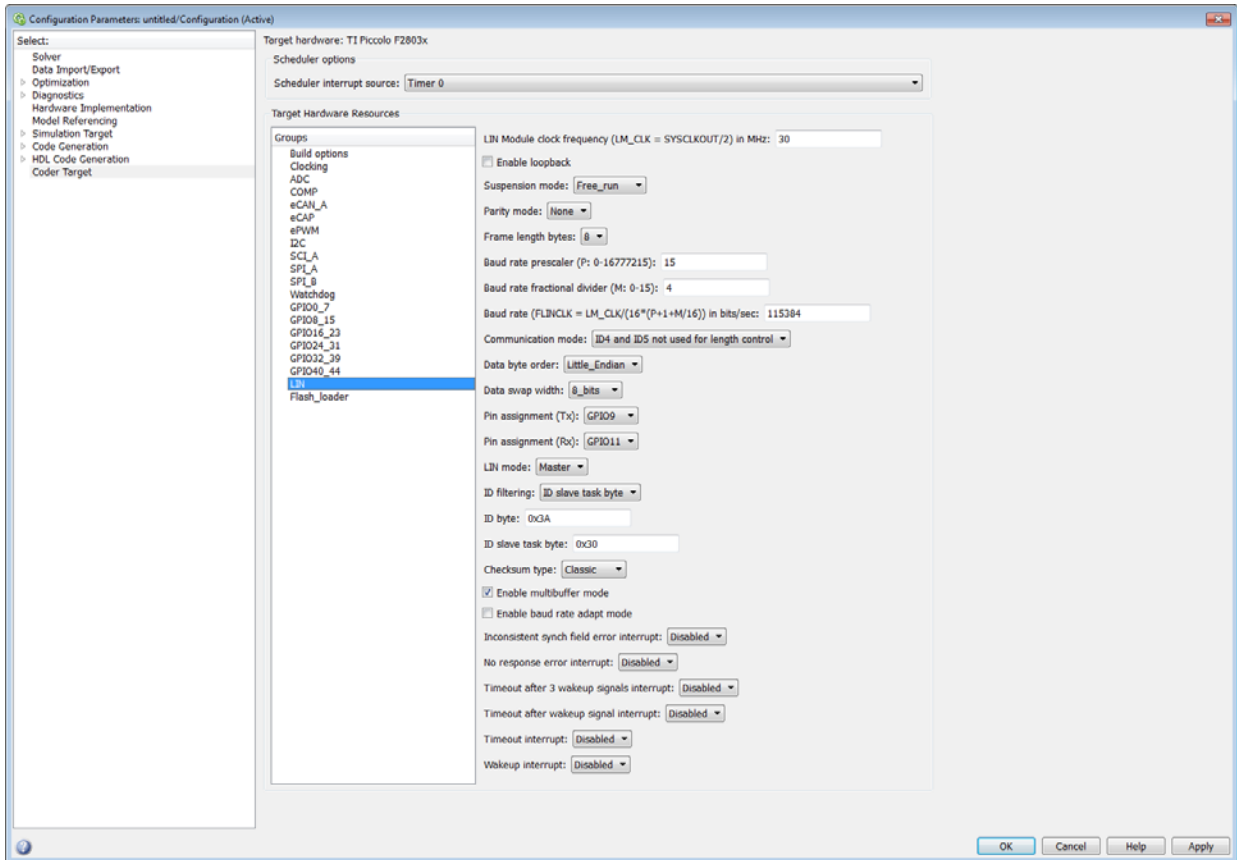
### **Enable overflow interrupt**

Enable this parameter to have the DMA channel send an interrupt to the CPU via PIE if the DMA module receives a peripheral interrupt while a previous interrupt from the same peripheral is waiting to be serviced.

This parameter is typically used for debugging during the development phase of a project.

The **Enable overflow interrupt** parameter corresponds to bit 7 (OVRINTE) of the Mode Register (MODE), and involves the Overflow Flag Bit (OVRFLG) and Peripheral Interrupt Trigger Flag Bit (PERINTFLG).

## LIN



For detailed information on the LIN module, see *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2, available at the Texas Instruments Web site.

The following options configure all LIN Transmit and LIN Receive blocks within a model.

**LIN Module clock frequency (LM\_CLK = SYSCLKOUT/2) in MHz**  
Displays the frequency of the LIN module clock in MHz.

### Enable loopback

To enable LIN loopback testing, select this option. While this option is enabled, the LIN module does the following:

- Internally redirects the LINTX output to the LINRX input.
- Puts the external LINTX pin into high state.
- Puts the external LINRX pin into a high impedance state.

The default is disabled (unchecked).

### Suspension mode

Use this option to configure how the LIN state machine behaves while you debug the program on an emulator. If you select `Hard_abort`, entering LIN debug mode halts the transmissions and counters.

The transmissions and counters resume when you exit LIN debug mode. If you select `Free_run`, entering LIN debug mode allows the current transmit and receive functions to complete.

The default is `Free_run`.

### Parity mode

Use this option to configure parity checking:

- To disable parity checking, select `None`.
- To enable odd parity checking, select `Odd`.
- To enable even parity checking, select `Even`.

The default is `None`.

In order for **ID parity error interrupt** in the LIN Receive block to generate interrupts, also enable **Parity mode**.

### Frame length bytes

Set the number of data bytes in the response field, from 1 to 8 bytes.

The default is 8 bytes.

### Baud rate prescaler (P: 0-16777215)

To set the LIN baud rate manually, enter a prescaler value, from 0 to 16777215. Click **Apply** to update the **Baud rate** display.

The default is 15.

For more information, consult the “Baud Rate” topic in the TI document, *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2.

#### **Baud rate fractional divider (M: 0–15)**

To set the LIN baud rate manually, enter a fractional divider value, from 0 to 15. Click **Apply** to update the **Baud rate** display.

The default is 4.

For more information, consult the “Baud Rate” topic in the TI document, *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2.

#### **Baud rate (FLINCLK = LM\_CLK/(16\*(P+1+M/16)) in bits/sec**

This field displays the baud rate. For more information, see “Setting the LIN baud rate”.

#### **Communication mode**

Enable or disable the LIN module from using the ID-field bits ID4 and ID5 for length control.

The default is ID4 and ID5 not used for length control

#### **Data byte order**

Set the “endianness” of the LIN message data bytes to `Little_Endian` or `Big_Endian`.

The default is `Little_Endian`.

#### **Data swap width**

Select `8_bits` or `16_bits`. If you set **Data byte order** to `Big_Endian`, the only available option for **Data swap width** is `8_bits`.

#### **Pin assignment (Tx)**

Map the LINTX output to a specific GPIO pin.

The default is GPI09.

#### **Pin assignment (Rx)**

Map the LINRX input to a specific GPIO pin.

The default is GPI011.

### **LIN mode**

Put the LIN module in Master or Slave mode. The default is Slave.

In master mode, the LIN node can transmit queries and commands to slaves. In slave mode, the LIN module responds to queries or commands from a master node.

This option corresponds to the CLK\_MASTER field in the SCI Global Control Register (SCIGCR1).

### **ID filtering**

Select which type of mask filtering comparison the LIN module performs, ID byte or ID slave task byte.

If you select ID byte, the module uses the RECID and ID-BYTE fields in the LINID register to detect a match. If you select this option and enter 0xFF for LINMASK, the LIN module does not report matches.

If you select ID slave task, the module uses the RECID and ID-SlaveTask byte to detect a match. If you select this option and enter 0xFF for LINMASK, the LIN module reports matches.

The default is ID slave task byte.

### **ID byte**

If you set **ID filtering** to ID byte, use this option to set the ID BYTE, also known as the “LIN mode message ID”.

In master mode, the CPU writes this value to initiate a header transmission. In slave mode, the LIN module uses this value to perform message filtering.

The default is 0x3A.

### **ID slave task byte**

If you set **ID filtering** to ID slave task byte, use this option to set the ID-SlaveTask BYTE. The LIN node compares this byte with the Received ID and determines whether to send a transmit or receive response.



The default is 0x30.

### **Checksum type**

Use this option to select the type of checksum. If you select **Classic**, the LIN node generates the checksum field from the data fields in the response.

If you select **Enhance**, the LIN node generates the checksum field from both the ID field in the header and data fields in the response. LIN 1.3 supports classic checksums only. LIN 2.0 supports both classic and enhanced checksums.

The default is **Classic**.

### **Enable multibuffer mode**

When you enable (select) this checkbox, the LIN node uses transmit and receive buffers instead of just one register. This setting affects various other LIN registers, such as: checksums, framing errors, transmitter empty flags, receiver ready flags, transmitter ready flags.

The default is enabled (checked).

### **Enable baud rate adapt mode**

The dialog box displays this option when you set **LIN mode** to **Slave**.

If you enable this option, the slave node automatically adjusts its baud rate to match that of the master node. For this feature to work, first set the **Baud rate prescaler** and **Baud rate fractional divider**.

If you disable this option, the LIN module sets a static baud rate based on the **Baud rate prescaler** and **Baud rate fractional divider**.

The default is disabled (unchecked).

### **Inconsistent synch field error interrupt**

The dialog box displays this option when you set **LIN mode** to **Slave**.

If you enable this option, the slave node generates interrupts when it detects irregularities in the synch field. This option is only relevant if you enable **Enable adapt mode**.

The default is **Disabled**.

### **No response error interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

If you enable this option, the LIN module generates an interrupt if it does not receive a complete response from the master node within a timeout period.

The default is Disabled.

### **Timeout after 3 wakeup signals interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When enabled, the slave node generates an interrupt when it sends three wakeup signals to the master node and does not receive a header in response. (The slave waits 1.5 seconds before sending another series of wakeup signals.)

This interrupt typically indicates the master node is having a problem recovering from low-power or sleep mode.

The default is Disabled.

### **Timeout after wakeup signal interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When enabled, the slave node generates an interrupt when it sends a wakeup signal to the master node and does not receive a header in response. (The slave waits 150 milliseconds before sending another series of wakeup signals.)

This interrupt typically indicates the master node is delayed recovering from low-power or sleep mode.

The default is Disabled.

### **Timeout interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When enabled, the slave node generates an interrupt after 4 seconds of inactivity on the LIN bus.

The default is Disabled.

### **Wakeup interrupt**

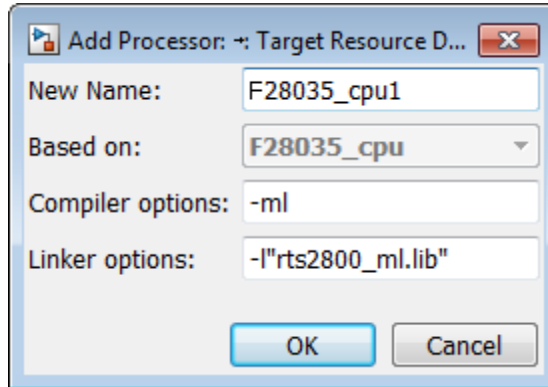
The dialog box displays this option when you set **LIN mode** to Slave.

When you enable this option:

- In low-power mode, a LIN slave node generates a wakeup interrupt when it detects the falling edge of a wake-up pulse or a low level on the LINRX pin.
- A LIN slave node that is “awake” generates a wakeup interrupt if it receives a request to enter low-power mode while it is receiving.
- A LIN slave node that is “awake” does not generate a wakeup interrupt if it receives a wakeup pulse.

The default is Disabled.

## Add Processor Dialog Box



To add a new processor to the drop down list for the **Processors** option, click the **Add new** button on the **Board** pane. The software opens the **Add Processor** dialog box.

---

**Note** You can use this feature to create duplicates of existing processors with minor changes to the compiler and linker options. Avoid using this feature to create profiles for processors that are not already supported.

---

### New Name

Provide a name to identify your new processor. Use a valid C string. The name you enter in this field appears on the list of processors after you add the new processor.

If you do not provide an entry for each parameter, the coder product returns an error message without creating a processor entry.

### Based On

When you add a processor, the dialog box uses the settings from the currently selected processor as the basis for the new one. This parameter displays the currently selected processor.

### Compiler options

Identifies the processor family of the new processor to the compiler. The string depends on the processor family or class.

For example, to set the compiler switch for a new C5509 processor, enter `-m1`. The following table shows the compiler switch string for supported processor families.

| <b>Processor Family</b>     | <b>Compiler Switch String</b> |
|-----------------------------|-------------------------------|
| C62xx                       |                               |
| C64xx                       |                               |
| C67xx                       |                               |
| DM64x and DM64xx            |                               |
| C55xx                       | -m1                           |
| C28xx, F28xx, R28xx, F28xxx | -m1                           |

### **Linker options**

You can use this parameter to specify linker command options. The IDE uses these options to modify how it links project files when you build a project. To get information about specific linker options you can enter here, consult the documentation for your IDE.

### Target Hardware Resources Tab: Linux, VxWorks, or Windows

This tab appears when both of the following conditions are true:

- The **IDE/Tool Chain** parameter is set to a toolchain that builds generated code to run on Windows, Linux, or VxWorks (requires an Embedded Coder license).
- The **Operating System** parameter on the Board tab is set to Windows, Linux, or VxWorks

#### Scheduling Mode

When you select `free-running`, the model generates multi-threaded free-running code. Each rate in the model maps to a separate thread in the generated code. Multi-threaded code can potentially run faster than single threaded code.

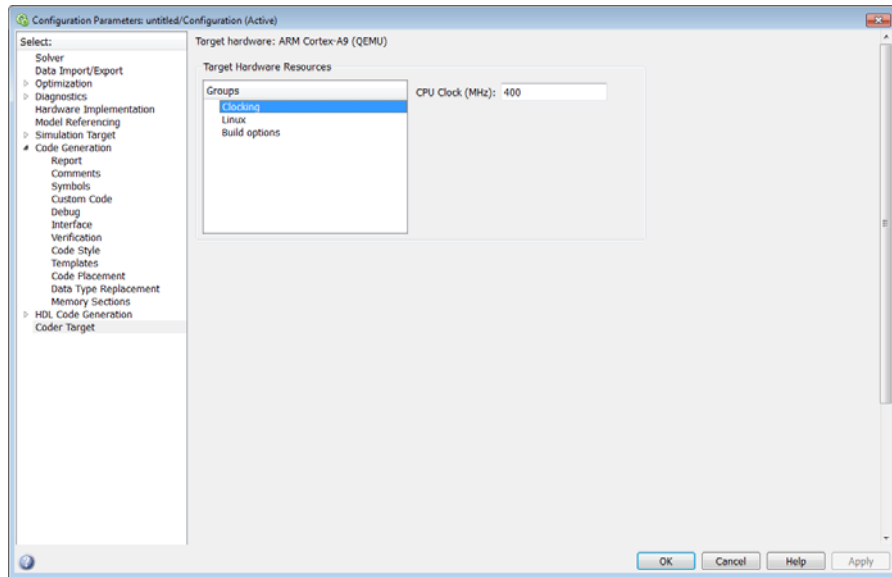
When you select `real-time`, the model generates multi-threaded real-time code: Each rate in the Simulink model runs at the rate specified in the model. For example, a 1-second rate runs at exactly 1-second intervals. The timing is provided by using a real-time clock.

#### Base rate task priority

The base rate in the model maps to a thread and runs as fast as possible. You can use the value of the base rate priority to set a static priority for the base rate task. By default, this rate is 40.

This parameter is not available for Windows.

## Coder Target Pane: ARM Cortex-A9 (QEMU)



### In this section...

“Coder Target Pane Overview” on page 3-232

“Coder Target” on page 3-233

“Clocking” on page 3-234

“Linux” on page 3-235

“Build Options” on page 3-236

### **Coder Target Pane Overview**

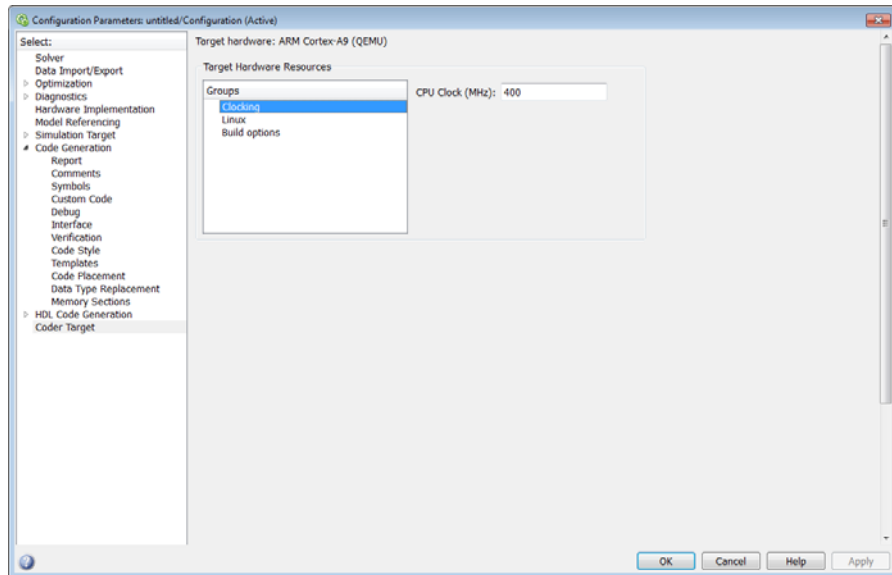
Configure the parameters for properties of the physical hardware, such as peripherals.

#### **See Also**

Coder Target: Target Hardware Resources Tab Overview



## Coder Target



The Coder Target pane is visible when the following parameters are on the Code Generation pane are both set as follows:

- **System target file** is `ert.tlc`
- **Target hardware** is ARM Cortex-A9 (QEMU)

Changing the **Target hardware** parameter changes the number and type of parameters that are available on the Coder Target pane.

### **Clocking**

#### **CPU Clock (MHz)**

Specify the CPU clock frequency of a real ARM<sup>®</sup> Cortex<sup>®</sup>-A9 processor in MHz. The QEMU uses this value to emulate an ARM Cortex-A9 processor.

## **Linux**

### **Base Rate Task Priority**

The base rate in the model maps to a thread and runs as fast as possible. You can use the value of the base rate priority to set a static priority for the base rate task. By default, this rate is 40.

## Build Options

### Build action

Defines how Simulink Coder software responds when you press Ctrl+B to build your model.

### Settings

**Default:** Build, load and run

Build, load and run

With this option, pressing Ctrl+B or clicking Build Model:

- 1 Generates code from the model.
- 2 Compiles and links the code into an executable with libraries.
- 3 Loads the executable and libraries into the QEMU emulator.
- 4 Runs the executable in the QEMU emulator.

Build

With this option, pressing Ctrl+B or clicking Build Model:

- 1 Generates code from the model.
- 2 Compiles and links the code into an executable with libraries.

This option does not load and run the executable in the QEMU emulator.

## Command-Line Information

**Parameter:** buildAction

**Type:** string

**Value:** Build | Build\_load\_and\_run |

**Default:** Build\_load\_and\_run

## Recommended Settings

| Application  | Setting            |
|--------------|--------------------|
| Debugging    | Build_load_and_run |
| Traceability | No impact          |

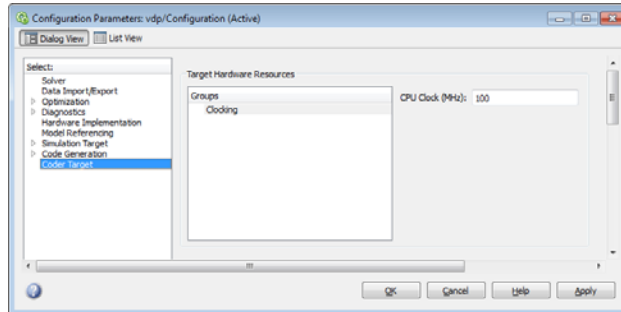
| <b>Application</b> | <b>Setting</b> |
|--------------------|----------------|
| Efficiency         | No impact      |
| Safety precaution  | No impact      |

**See Also**

For more information, refer to the “Code Generation Pane: Coder Target” topic.

For more information about PIL and its uses, refer to the “Verifying Generated Code via Processor-in-the-Loop” topic.

## Coder Target Pane: ARM Cortex-M3 (QEMU)



### In this section...

“Coder Target Pane Overview” on page 3-239

“Coder Target” on page 3-240

“Clocking” on page 3-241

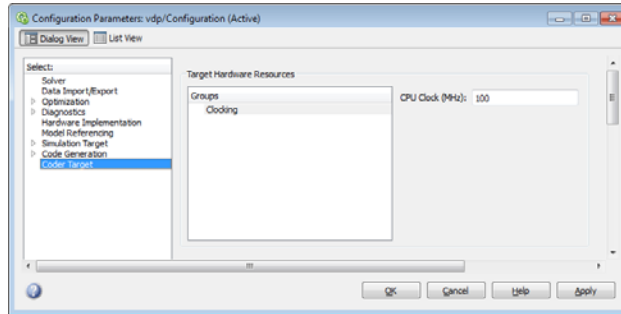
## **Coder Target Pane Overview**

Configure the parameters for properties of the physical hardware, such as peripherals.

### **See Also**

Coder Target: Target Hardware Resources Tab Overview

### Coder Target



The Coder Target pane is visible when the following parameters are on the Code Generation pane are both set as follows:

- **System target file** is `ert.tlc`
- **Target hardware** is ARM Cortex-M3 (QEMU)

Changing the **Target hardware** parameter changes the number and type of parameters that are available on the Coder Target pane.



## **Clocking**

### **CPU Clock (MHz)**

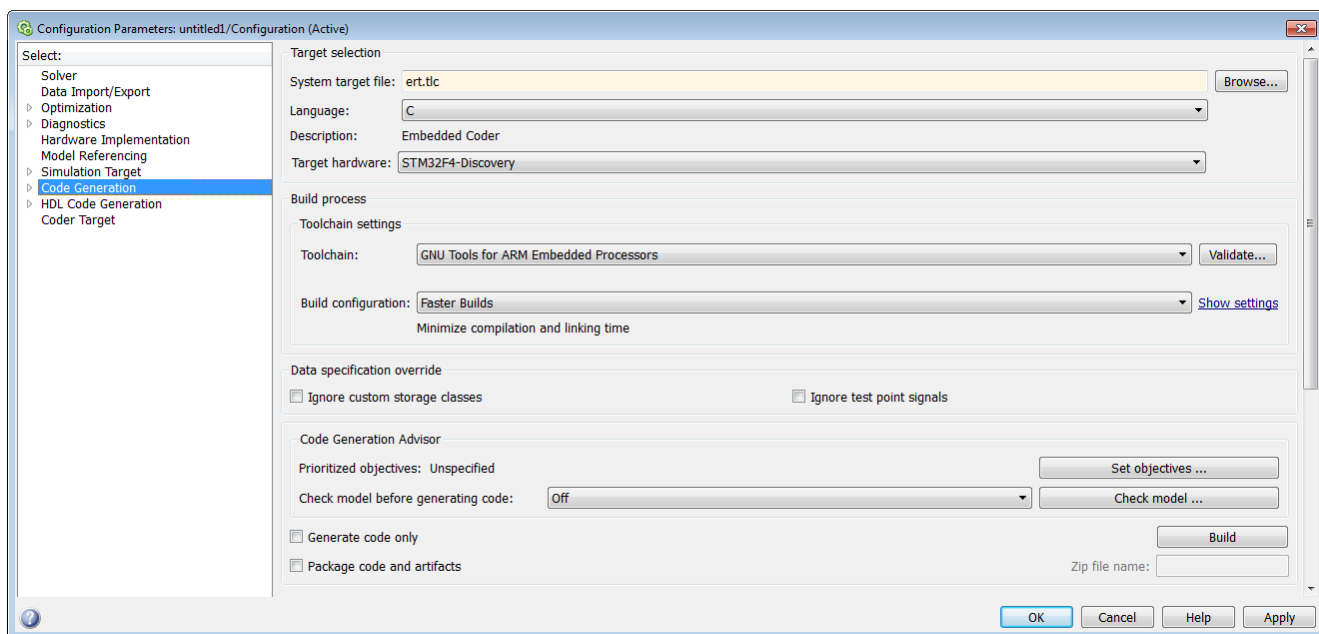
Specify the CPU clock frequency of a real ARM Cortex-M3 processor in MHz. The QEMU uses this value to emulate an ARM Cortex-M3 processor.

## Coder Target Pane: Support Package for STMicroelectronics STM32F4 Discovery Hardware

The Coder Target pane is visible when you set both of the following parameters on the Code Generation pane as follows:

- **System target file** is `ert.tlc`
- **Target hardware** is STM32F4 Discovery hardware (not None)

Changing the **Target hardware** parameter changes the number and type of parameters that are available on the Coder Target pane.



### In this section...

“Coder Target Pane: STM32F4–Discovery Overview” on page 3-244

“Support Package for STMicroelectronics STM32F4 Discovery Hardware Settings” on page 3-245

“Scheduler options” on page 3-246

**In this section...**

“Clocking” on page 3-248

“PIL” on page 3-249

“ADC Common” on page 3-250

“ADC 1, ADC 2, ADC 3” on page 3-252

“GPIO A, GPIO B, GPIO C, GPIO D, GPIO E, GPIO F, GPIO G, GPIO H, GPIO I” on page 3-254

“Coder Target Pane” on page 3-255

“System target file” on page 3-256

“Target hardware” on page 3-257

“Toolchain” on page 3-257

### **Coder Target Pane: STM32F4–Discovery Overview**

Configure the parameters for properties of the physical hardware, such as peripherals.

#### **See Also**

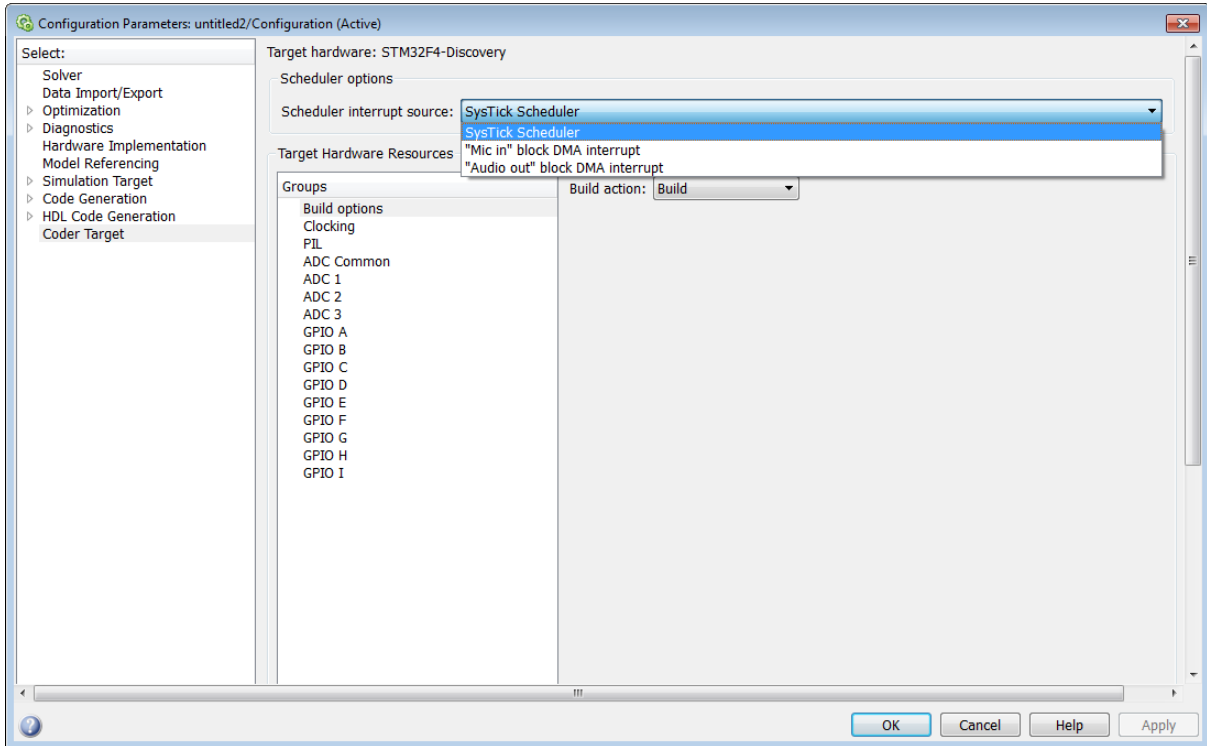
- “Coder Target Pane” on page 3-255
- “Coder Target Pane: Support Package for STMicroelectronics STM32F4 Discovery Hardware” on page 3-242

## Support Package for STMicroelectronics STM32F4 Discovery Hardware Settings

The following table provides links to topics for Support Package for STMicroelectronics STM32F4 Discovery hardware processors.

| Peripheral Name                                                                        | Description                                                                                                          |
|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| “Scheduler options” on page 3-246                                                      | The scheduler parameter to select the scheduler interrupt source                                                     |
| “Clocking” on page 3-248                                                               | The clocking parameters to view the CPU clock rate                                                                   |
| “PIL” on page 3-249                                                                    | The Processor—in—the—Loop (PIL) parameters to configure PIL communication parameters, such as interface and COM port |
| “ADC Common” on page 3-250                                                             | The Analog to Digital Converter (ADC) parameters to set the common ADC peripheral parameters                         |
| “ADC 1, ADC 2, ADC 3” on page 3-252                                                    | The parameters to configure different channels on the three ADCs, ADC1, ADC2, and ADC3                               |
| “GPIO A, GPIO B, GPIO C, GPIO D, GPIO E, GPIO F, GPIO G, GPIO H, GPIO I” on page 3-254 | The GPIO parameters to configure different GPIO pins                                                                 |

## Scheduler options



The source of the scheduler interrupt. The different scheduler options available are as follows:

### Scheduler interrupt source

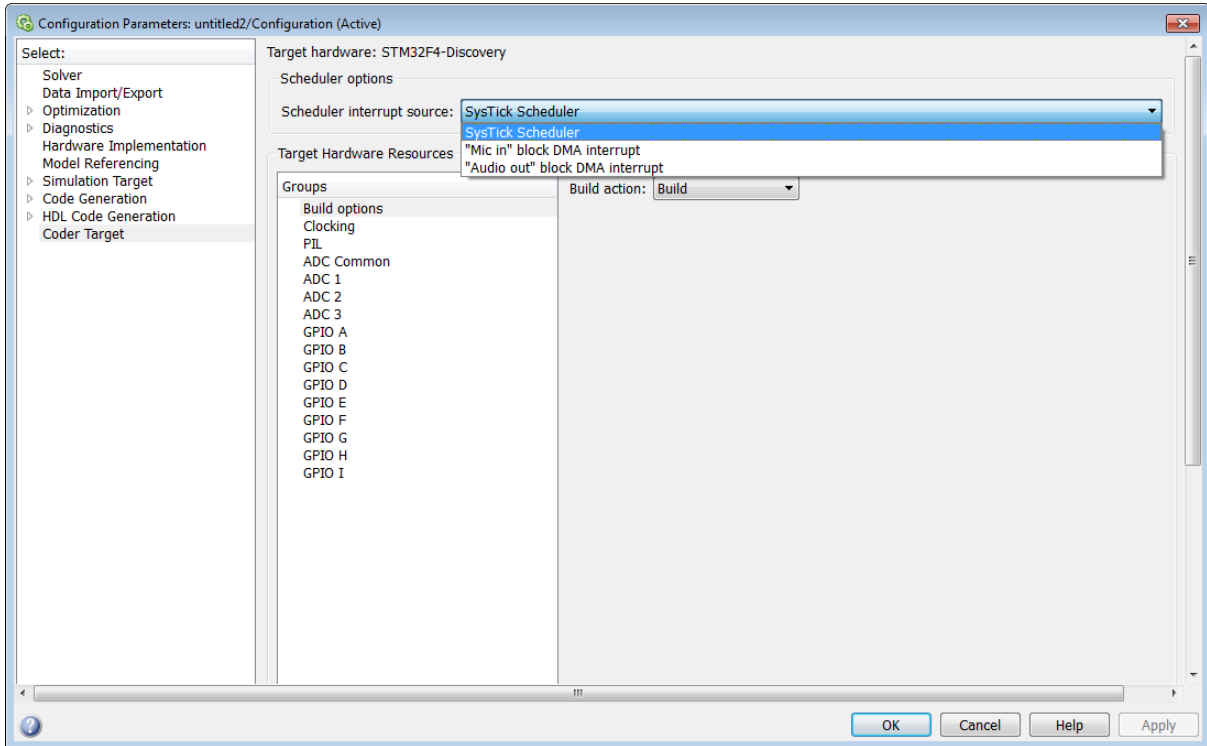
- **SysTick Scheduler** – The SysTick timer interrupt schedules the model at the base rate. This timer is available in the ARM Cortex-M3 and the ARM Cortex-M4 based processors. When you select STM32F4-Discovery as the target hardware, this option is the default Scheduler option.
- **Mic in block DMA interrupt** – The model is scheduled based on the DMA interrupt rate of the Mic in block. The Mic in block generates a DMA (DMA1- Channel0-Stream3) interrupt every 1 ms. The base rate of the model is set to 1ms, regardless of any other faster

base rate of the model. Make sure that the model does not contain blocks with sample rates higher than the Mic in block.

- **Audio out block DMA interrupt** – The model is scheduled based on the DMA interrupt rate of the Audio out block. The DMA interrupt rate depends on the frame size that is input to the Audio out block in the model. Make sure that the model does not contain blocks with sample rates higher than the Audio out block.

For example, if you select an audio sample frequency of 48000 Hz and you input data of 96 audio samples/frame to the right and the left channels of the Audio out block, the **Audio out block DMA interrupt** occurs every  $96/48000 = 0.002$  secs (2 ms). You must schedule the model base rate at 2 ms.

## Clocking



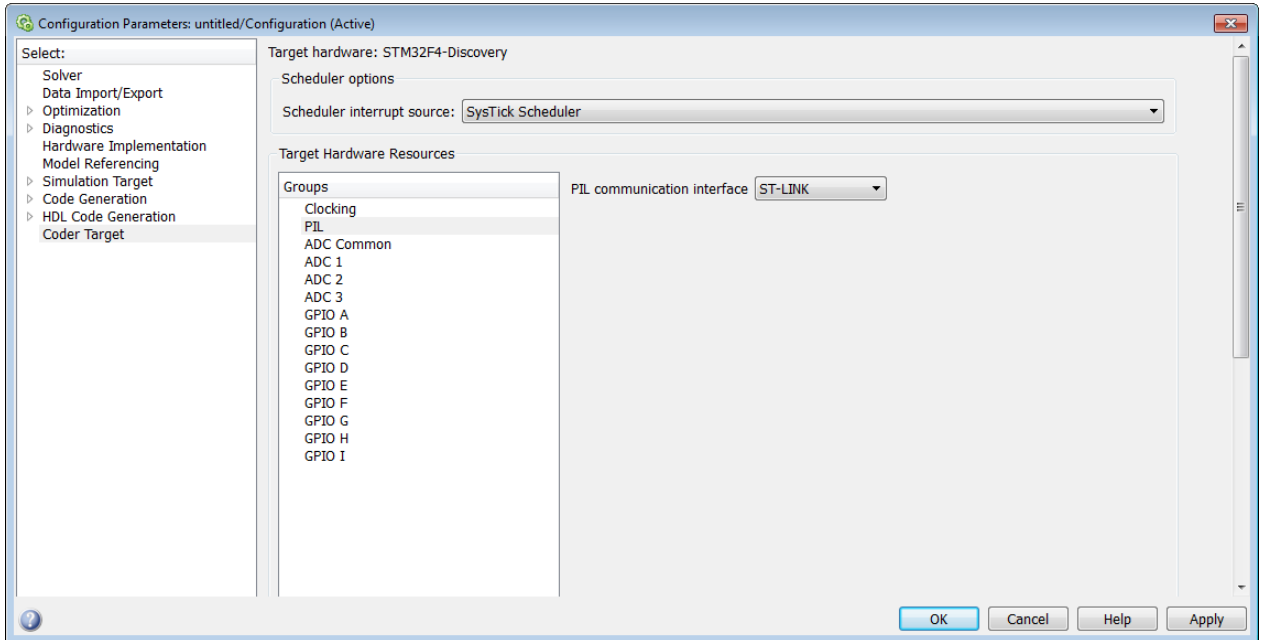
Use the clocking option to achieve the CPU Clock rate specified.

### **CPU Clock (MHz)**

The CPU clock rate.



## PIL



Use the PIL options to set PIL (Processor-in-the-Loop) communications parameters.

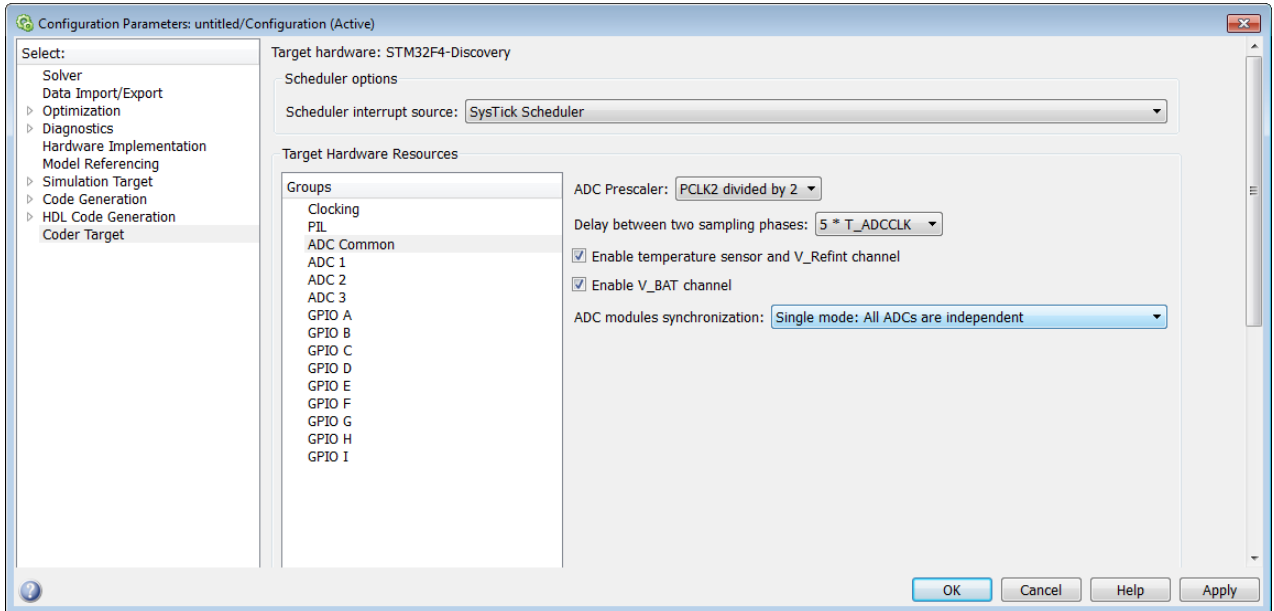
### **PIL communication interface**

The interface used for PIL communication.

### **COM port**

The COM port used PIL communication.

## ADC Common



Use the ADC Common options to set the common ADC parameters.

### ADC Prescaler

The option to select the PCLK divider.

### Delay between two sampling phases

The option to select the time delay between two sampling phases.

### Enable temperature sensor and V\_Refint channel

The option to enable the temperature sensor and the V\_Refint channel.

### Enable V\_BAT channel

The option to enable the V\_BAT channel.

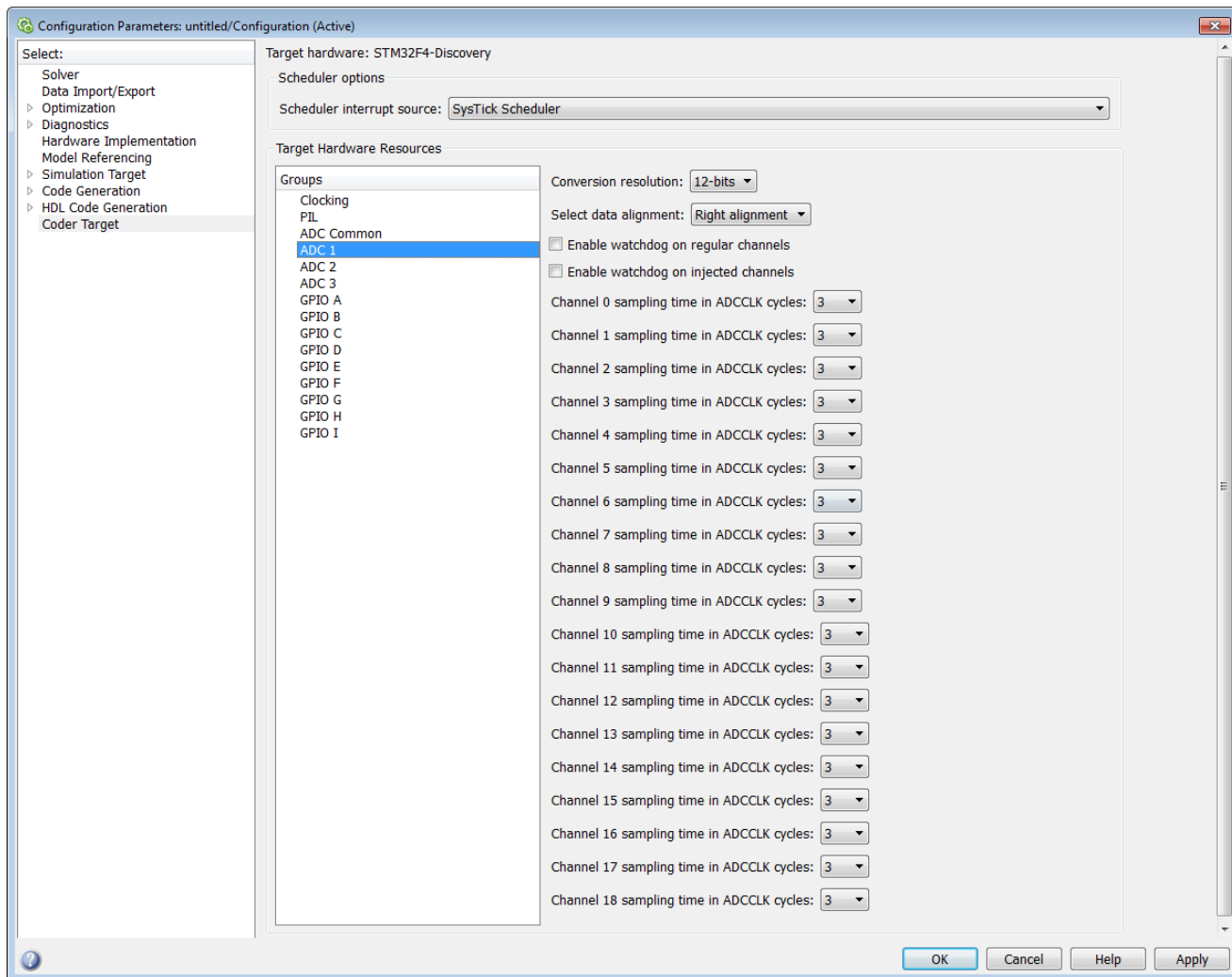
### ADC modules synchronization

The option that you select for ADC module synchronization. The different options you available are:

- **Single mode:** All ADCs are independent — Select this option when the three ADCs must perform the conversion independently.

- **Dual mode:** ADC1 and ADC2 combined, ADC3 independent — Select this option when you want to combine ADC1 and ADC2 and ADC3 to perform conversion independently.
- **Triple mode:** ADC1, ADC2, and ADC3 combined — Select this option when you want to combine ADC1, ADC2, and ADC3 together for conversion.

## ADC 1, ADC 2, ADC 3



Use the three ADC1, ADC2, and ADC3 parameters to configure the sample time in ADDCLK cycles for different channels.

### Conversion resolution

The resolution that you select for conversion.

**Convert number of channels in discontinuous mode**

The number of channels to convert in discontinuous mode.

**Select data alignment**

The option that you select for the alignment of data after conversion.  
The data can be right or left aligned.

**Enable watchdog on regular channels**

The option you select to enable the watchdog on regular channels.

**Enable watchdog on injected channels**

The option you select to enable the watchdog on injected channels.

**Enable discontinuous conversion on injected group**

The option that you select to enable the discontinuous conversion on injected group.

**Enable discontinuous conversion on regular group**

The option that you select to enable discontinuous conversion on regular group.

**DMA mode for multi ADC mode**

The option that you select for DMA mode in multi ADC mode.

**Enable DMA selection for multi ADC mode**

The option that you select to enable DMA selection for multi ADC mode.

**Multi ADC mode selection**

The option that you select for multi ADC mode.

**Watchdog on channel**

The option to select channel for watchdog.

**Watchdog lower threshold**

The lower threshold of the watchdog.

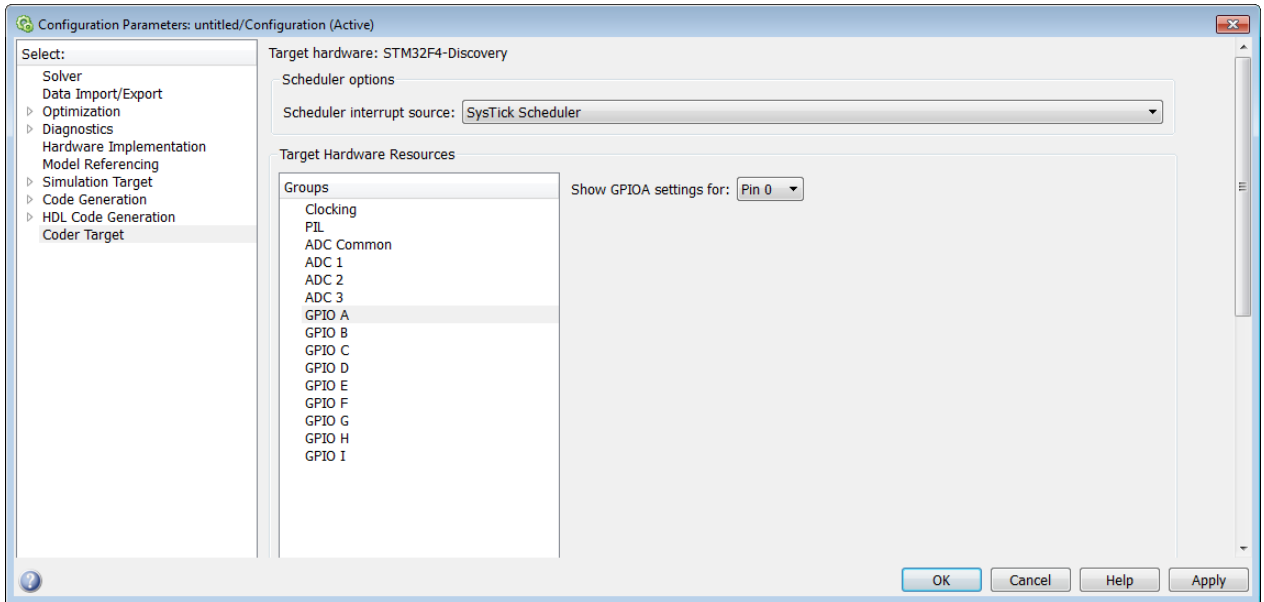
**Watchdog higher threshold**

The higher threshold of the watchdog.

**Channel # sampling time in ADCCLK cycles**

The sampling time that you select in ADCCLK cycles for channel numbers from 1 to 18.

## **GPIO A, GPIO B, GPIO C, GPIO D, GPIO E, GPIO F, GPIO G, GPIO H, GPIO I**



Use the GPIO A-I parameters to configure the pins for input/output.

### **Show GPIO# settings for**

The pin number that you select to show the GPIO settings.

### **Select output type for Pin #**

The output type that you select for pins 1 to 15.

### **Select output speed for Pin #**

The output speed that you select for pins 1 to 15.

### **Select pull mode for Pin #**

The pull mode that you select for pins from 1 to 15.

## Coder Target Pane

The Coder Target pane is visible when you set the following parameters on the Code Generation pane as follows:

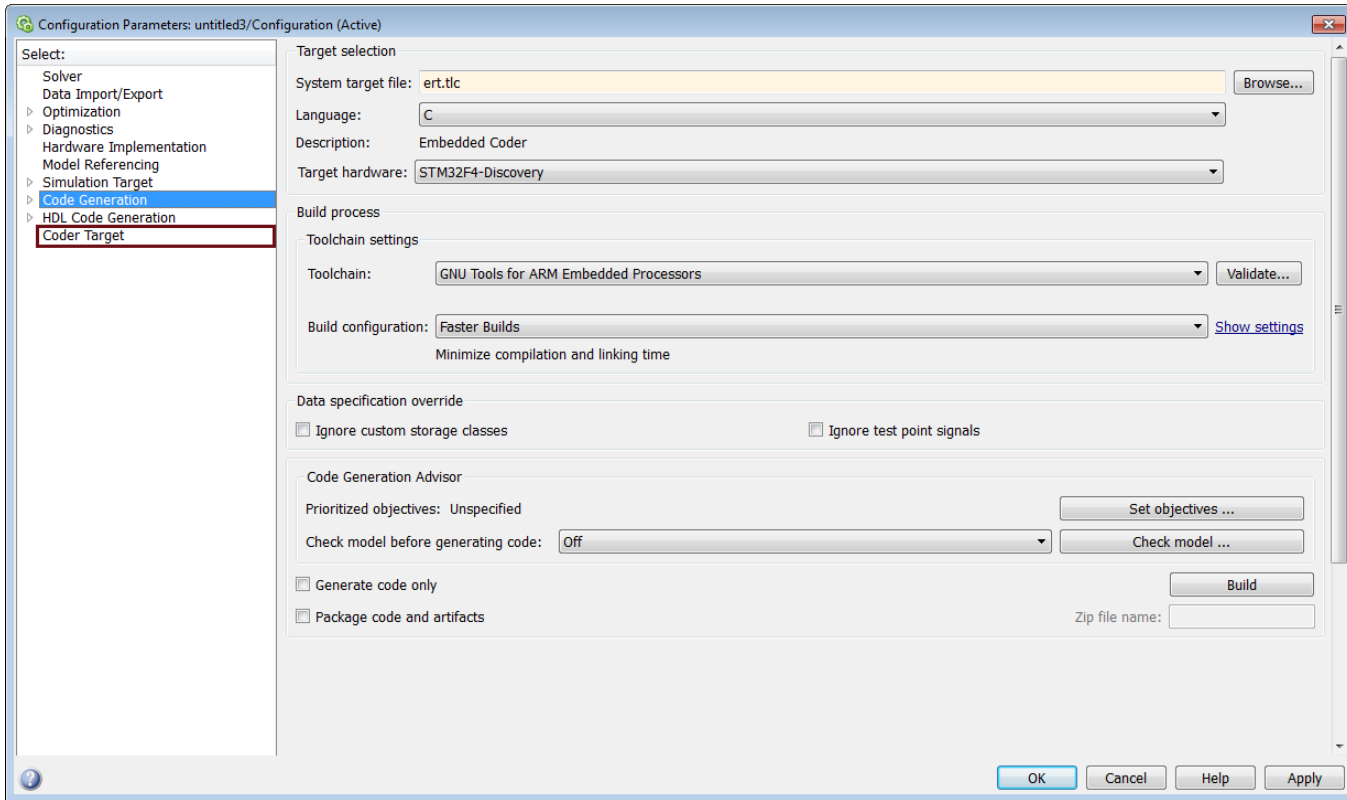
**System target file** to `ert.tlc`.

**Target hardware** to a specific type of hardware (not None).

If you are a new user, the `ert.tlc` system target file is the preferred option over the `idmlink_ert.tlc`. This option provides a uniform model configuration workflow across the phases of development such as simulation, target prototyping and production code generation.

The features that the `ert.tlc` workflow supports include:

- Production code generation workflow.
- Auto-download and run (when supported with the respective vendor tools).



### System target file

Specify the system target file.

### Settings

**Default:** `grt.tlc`

Use the System Target File Browser. Click the **Browse** button, which lets you select a preset target configuration consisting of a system target file, template makefile, and make command. For uniform model configuration workflow, select `ert.tlc`.



## Target hardware

Select the target hardware for which to generate code.

The **Coder Target** pane is visible with corresponding peripherals, when you select a target hardware. Changing the **Target hardware** parameter changes the peripherals visible on the **Coder Target** pane.

## Toolchain

Based on the target hardware you select, the corresponding tool chain is automatically selected. You can select a different value from the **Toolchain** list.

---

**Note** The above parameters settings are specific to **Coder Target** pane. For the other parameter settings on the screen, see “Code Generation Pane: General”.

---

## Coder Target Pane: Texas Instruments C2000 Processors

You will see the **Coder Target** pane is visible when the following parameters are on the Code Generation pane are both set as follows:

- **System target file** is `ert.tlc`
- **Target hardware** is one of the TI hardware (not None)

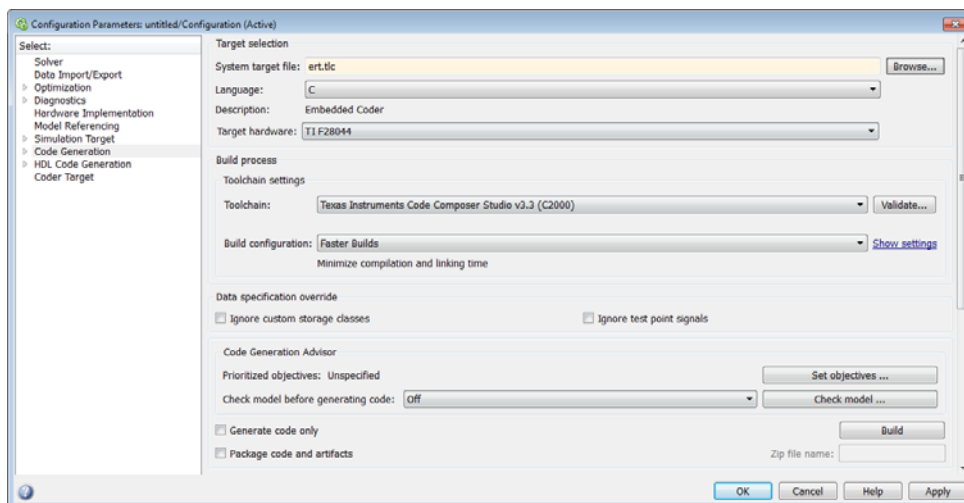
Changing the **Target hardware** parameter changes the number and type of parameters that are available on the **Coder Target** pane.

If you are already using an older version of the software, you can upgrade from the existing models of `idelink_ert.tlc` or `idelink_grt.tlc` to `ert.tlc`, using the Upgrade Advisor.

---

**Note** To setup the Code Composer Studio, see “Setting Up Code Composer Studio (ert.tlc System Target File)”.

---



**In this section...**

“Coder Target Pane: TI C2000 Processors Overview” on page 3-260

“Texas Instruments C2000 Settings” on page 3-261

“Scheduler options” on page 3-263

“Build options” on page 3-265

“Clocking” on page 3-267

“ADC” on page 3-271

“COMP” on page 3-275

“eCAN\_A, eCAN\_B” on page 3-276

“eCAP” on page 3-279

“ePWM” on page 3-280

“I2C” on page 3-282

“SCI\_A, SCI\_B, SCI\_C” on page 3-289

“SPI\_A, SPI\_B, SPI\_C, SPI\_D” on page 3-292

“eQEP” on page 3-295

“Watchdog” on page 3-297

“GPIO” on page 3-299

“Flash\_loader” on page 3-303

“DMA\_ch[#]” on page 3-305

“LIN” on page 3-315

“Coder Target Pane” on page 3-322

“System target file” on page 3-323

“Target hardware” on page 3-323

“Toolchain” on page 3-324

### **Coder Target Pane: TI C2000 Processors Overview**

Configure the parameters for properties of the physical hardware, such as peripherals for Texas Instruments C2000.

#### **See Also**

- “Coder Target Pane” on page 3-322
- “Coder Target Pane: Texas Instruments C2000 Processors” on page 3-258

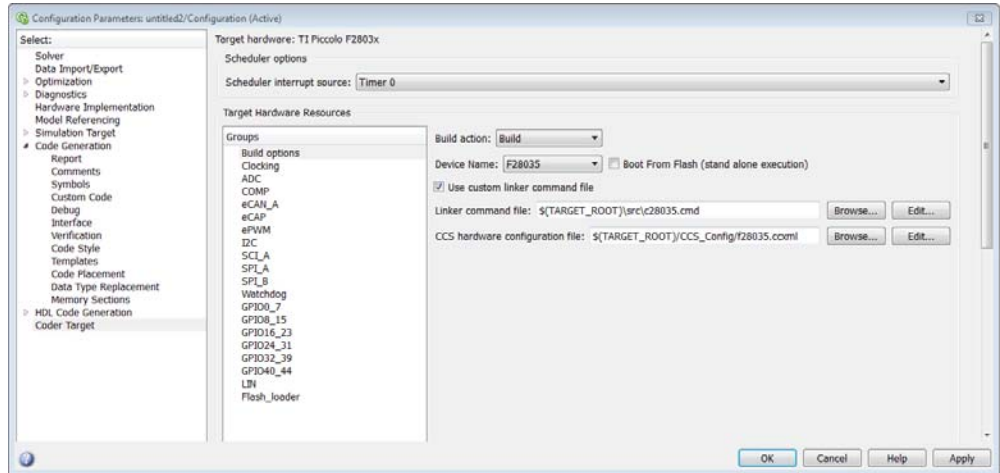
## Texas Instruments C2000 Settings

The following table provides links to topics for Texas Instruments C2000 processors.

| Peripheral Name                            | Description                                                                                 |
|--------------------------------------------|---------------------------------------------------------------------------------------------|
| “Build options” on page 3-265              | Build parameters for the build process                                                      |
| “Clocking” on page 3-267                   | Clocking parameters to adjust clock settings and match custom oscillator frequencies        |
| “ADC” on page 3-271                        | Analog-to-Digital Converter (ADC) parameters                                                |
| “COMP” on page 3-275                       | Parameters to assign COMP pins to GPIO pins                                                 |
| “eCAN_A, eCAN_B” on page 3-276             | Enhanced Controller Area Network (eCAN) parameters for modules A or B                       |
| “eCAP” on page 3-279                       | Enhanced Capture (eCAP) parameters for pin mapping to GPIO                                  |
| “ePWM” on page 3-280                       | Enhanced Pulse Width Modulation (ePWM) parameters for pin mapping to GPIO                   |
| “I2C” on page 3-282                        | Inter-Integrated Circuit (I2C) parameters for communications                                |
| “SCI_A, SCI_B, SCI_C” on page 3-289        | Serial Communications Interface (SCI) parameters for communications with modules A, B, or C |
| “SPI_A, SPI_B, SPI_C, SPI_D” on page 3-292 | Serial Peripheral Interface (SPI) parameters for communications with module A, B, C, or D   |

| <b>Peripheral Name</b>       | <b>Description</b>                                                           |
|------------------------------|------------------------------------------------------------------------------|
| “eQEP” on page 3-295         | Enhanced Quadrature Encoder Pulse (eQEP) parameters for pin mapping to GPIO  |
| “Watchdog” on page 3-297     | Watchdog enable/disable and timing                                           |
| “GPIO” on page 3-299         | General Purpose Input Output (GPIO) parameters for input qualification types |
| “Flash_loader” on page 3-303 | Flash memory loader/programmer                                               |
| “DMA_ch[#]” on page 3-305    | Direct Memory Access (DMA) parameters for channels 1 to N                    |
| “LIN” on page 3-315          | Local Interconnect Network (LIN) parameters for communications               |

## Scheduler options



### Scheduler interrupt source

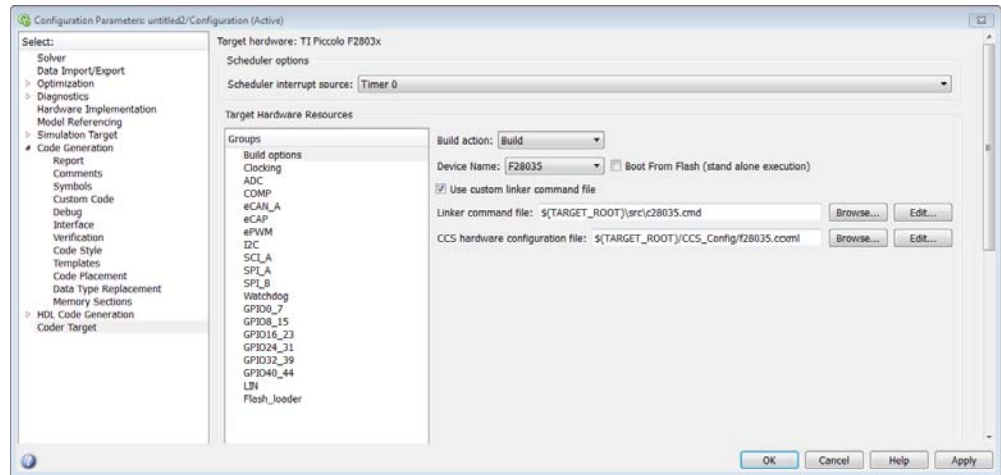
The source of the scheduler interrupt. The different scheduler options available are:

- **Timer 0** - The default option to schedule all synchronous rates present in your model with CPU Timer 0. When you select this option, the CPU Timer 0 is set to honor the base rate of the model.
- **ADCINT1** - The option to schedule all synchronous rates present in your model with ADC interrupt 1 (ADCINT1). When you select this option, make sure that ADCINT1 triggers periodically at base rate used in the model.
- **ADCINT2** - The option to schedule all synchronous rates present in your model with ADC interrupt 2 (ADCINT2). When you select this option, make sure that ADCINT2 triggers periodically at base rate used in the model.

**Warning** Replacing the default scheduler interrupt source Timer 0 with ADCINT1 or ADCINT2 is an advanced maneuver. It is your responsibility to ensure that you configure ADCINT1 or ADCINT2 to trigger periodically at the specified base rate. If the ADCINT1 or ADCINT2 does not trigger periodically or triggers at a different rate than the base rate, the model execution on the target is unpredictable.



## Build options



Use the build options to specify how the build process should take place.

### Build action

The option to specify if you want only 'build' or 'build, load, and run' action during the build process. The build, load and run option is supported only for TI Code Composer Studio v4/5 (C2000) tool chain.

If you select build, load and run option, you must provide the required CCS hardware configuration file.

### Device Name

The option to select a particular device from the selected processor family in the Target hardware parameter on the Code Generation pane.

### Boot From Flash (stand alone execution)

The option to specify if the application has to load to the flash. If you do not select this option, the application loads to the RAM.

### Use custom linker command file

The option to indicate that the custom linker command file must be used during the build action. Select this option, if you have your own custom linker file, which you can specify in Linker command file parameter. If you do not select this option, based on the device you have selected, a default custom linker command file will be used.

### Linker command file

The path to memory description file that is required during linking. For each family of TI processor selected under ‘Target Hardware’, one linker command file will be selected automatically.

For different variant of processor, you can select from the ‘src’ folder inside the Support Package installation path. You can also create custom linker command file and select the file path using **Browse**.

### CCS hardware configuration file

The Code Composer Studio file required for downloading the application on the hardware. Select one of the .ccxml files from the folder ‘CCS\_Config’ folder under Support Package installation folder.

Instead, you can also create your own .ccxml file as explained in the section: . Select the file you created using **Browse**.

The .ccxml files provided with the support package are as follows:

- f28027.ccxml— TI F28027 with Texas Instruments XDS100v1 USB Emulator
- f28035.ccxml— TI F28035 with Texas Instruments XDS100v1 USB Emulator
- f28069.ccxml— TI F28069 with Texas Instruments XDS100v1 USB Emulator
- f2808.ccxml—TI F2808 with Texas Instruments XDS100v1 USB Emulator
- f2808\_eZdsp.ccxml—F2808 Spectrum Digital DSK-EVM-eZdsp onboard USB Emulator
- f28044.ccxml—TI F28044 with Texas Instruments XDS100v1 USB Emulator
- f28335.ccxml—TI F28335 with Texas Instruments XDS100v1 USB Emulator
- f28335\_eZdsp.ccxml—F28335 Spectrum Digital DSK-EVM-eZdsp onboard USB Emulator
- f2812\_BH2000.ccxml—Blackhawk USB2000 Controller for F2812 eZDSP

- f28x\_generic.ccxml— Generic Texas Instruments XDS100v1 USB Emulator
- f28x\_ezdsp\_generic.ccxml—Generic Spectrum Digital eZdsp onboard USB Emulator
- f28055.ccxml— TI F28055 with Texas Instruments XDS100v1 USB Emulator

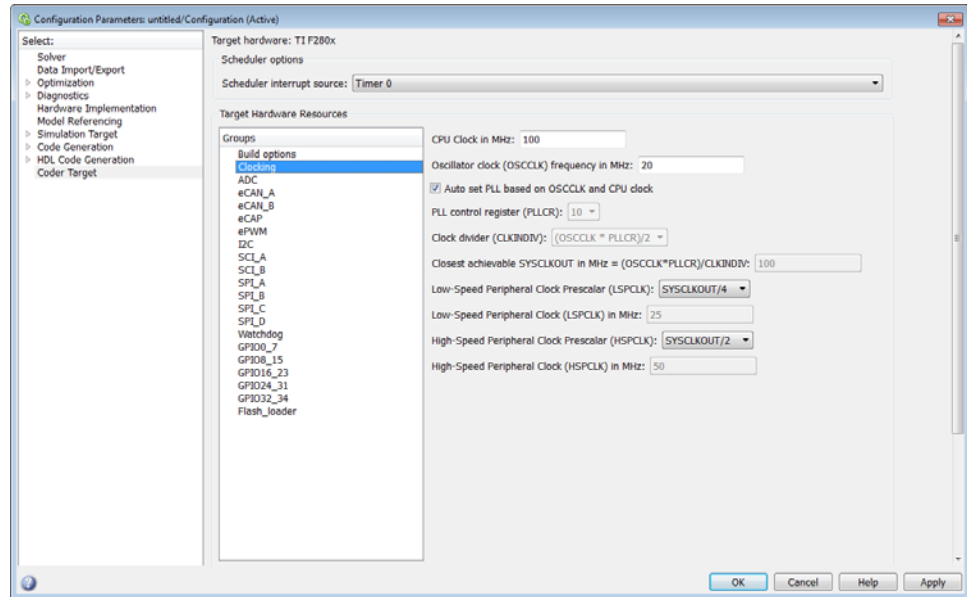
### Enable DMA to access ePWM Registers instead of CLA

The option that you can select to enable the DMA to access ePWM registers instead of CLA. This option is available only for F2806x processors.

### Remap ePWMs for DMA access (Requires silicon revision A and above)

The option that you can select to remap ePWMs registers for DMA access. This option is available only for F2833x processors.

## Clocking



Use the clocking options to help you achieve the CPU Clock rate specified on the board. The default clocking values run the CPU clock (CLKIN) at its maximum frequency. The parameters use the external oscillator frequency on the board (OSCCLK) that is recommended by the processor vendor.

You can get feedback on the closest achievable SYSCLKOUT value with the specified Oscillator clock frequency by selecting the **Auto set PLL based on OSCCLK and CPU clock** check box. Alternatively, you can manually specify the PLL value for the SYSCLKOUT value calculation.

Change the clocking values if:

- You want to change the CPU frequency.
- The external oscillator frequency differs from the value recommended by the manufacturer.

To determine the CPU frequency (CLKIN), use the following equation:

$$\text{CLKIN} = (\text{OSCCLK} * \text{PLLCR}) / (\text{DIVSEL or CLKINDIV})$$

- CLKIN is the frequency at which the CPU operates, also known as the CPU clock.
- OSCCLK is the frequency of the oscillator.
- PLLCR is the PLL Control Register value.
- CLKINDIV is the Clock in Divider.
- DIVSEL is the Divider Select.

The availability of the DIVSEL or CLKINDIV parameters changes depending on the processor that you select. If neither parameter is available, use the following equation:

$$\text{CLKIN} = (\text{OSCCLK} * \text{PLLCR}) / 2$$

In the **CPU clock** parameter of the Coder Target > Target Hardware Resources tab, enter the resulting CPU clock frequency (CLKIN).

For more information, see the “PLL-Based Clock Module” section in the Texas Instruments *Reference Guide* for your processor.

#### **Use internal oscillator**

Use the internal zero pin oscillator on the CPU. This parameter is enabled by default.

#### **Oscillator clock (OSCCLK) frequency in MHz**

The oscillator frequency that is used in the processor.

#### **Auto set PLL based on OSCCLK and CPU clock**

The option that helps you set the PLL control register value automatically. When you select this check box, the values in the PLLCR, DIVSEL, and the Closest achievable SYSCLKOUT in MHz parameters are automatically calculated based on the **CPU Clock** value entered on the Board.

#### **PLL control register (PLLCR)**

If you select the **Auto set PLL based on OSCCLK and CPU clock** check box, the auto calculated control register value achieves the specified CPU Clock value, based on the Oscillator clock frequency. Otherwise, you can select a value for PLL control register.

#### **Clock divider (DIVSEL)**

If you select the **Auto set PLL based on OSCCLK and CPU clock** check box, the auto calculated clock divider value achieves the specified CPU Clock value based on the Oscillator clock frequency. Otherwise, you can select a value for Clock divider (DIVSEL).

#### **Closest achievable SYSCLKOUT in MHz =**

$$\frac{(\text{OSCCLK} * \text{PLLCR})}{\text{DIVSEL}}$$

#### **Closest achievable SYSCLKOUT in MHz =**

$$\frac{(\text{OSCCLK} * \text{PLLCR})}{\text{CLKINDIV}}$$

The auto calculated feedback value that matches most closely to the desired CPU Clock value on the board, based on the values of OSCCLK, PLLCR, and the DIVSEL.

#### **Low-Speed Peripheral Clock Prescaler (LSPCLK)**

The value by which to scale the LSPCLK. This value is based on the SYSCLKOUT.

#### **Low-Speed Peripheral Clock (LSPCLK) in MHz**

This value is calculated based on LSPCLK Prescaler. Example: SPI uses a LSPCLK.

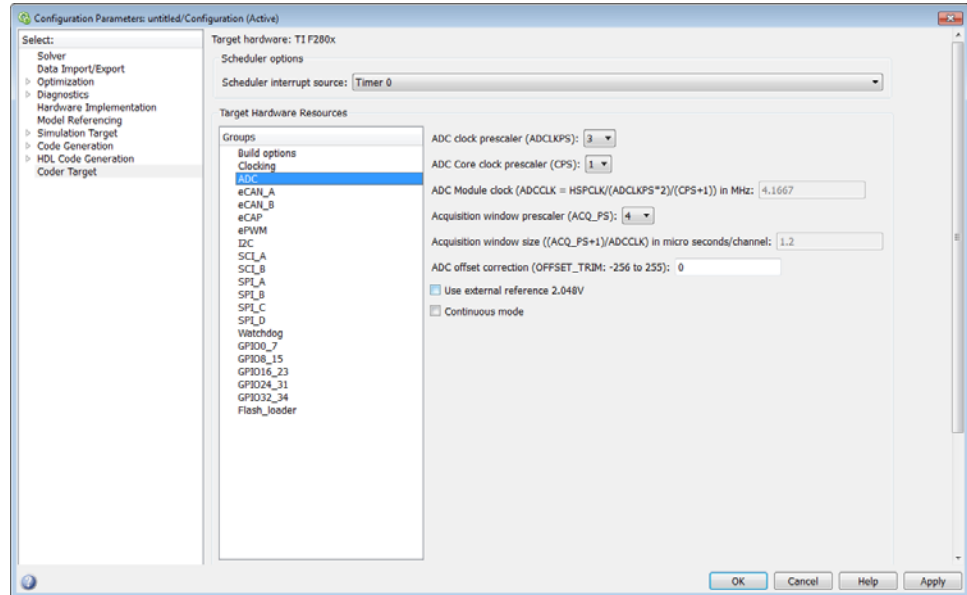
### **High-Speed Peripheral Clock Prescaler (HSPCLK)**

The value by which to scale the HSPCLK. This value is based on the SYSCLKOUT.

### **High-Speed Peripheral Clock (HSPCLK) in MHZ**

This value is calculated based on HSPCLK Prescaler. Example: ADC uses a HSPCLK.

## ADC



The high-speed peripheral clock (HSPCLK) controls the internal timing of the ADC module. The ADC derives the operating clock speed from the HSPCLK speed in several prescaler stages. For more information about configuring these scalars, refer to “Configuring ADC Parameters for Acquisition Window Width”.

You can set the following parameters for the ADC clock prescaler:

### ADC clock prescaler (ADCCLK)

The option to select the ADCCLK divider for processors c2802x, c2803x, c2806x.

### ADC clock frequency in MHz

The clock frequency for ADC. This is a read-only field and the value in this field is based on the value you select in **ADC clock prescaler (ADCCLK)**.

### ADC overlap of sample and conversion (ADCNONOVERLAP)

The option to enable or disable overlap of sample and conversion.

**ADC clock prescaler (ADCLKPS)**

The HSPCLK speed is divided by this 4-bit value as the first step in deriving the core clock speed of the ADC. The default value is 3.

**ADC Core clock prescaler (CPS)**

After dividing the HSPCLK speed by the **ADC clock prescaler (ADCLKPS)** value, setting the **ADC clock prescaler (ADCLKPS)** parameter to 1, the default value, divides the result by 2.

**ADC Module clock (ADCCLK = HSPCLK/ADCLKPS\*2)/(CPS+1) in MHz**

The clock to the ADC module and indicates the ADC operating clock speed.

**Acquisition window prescaler (ACQ\_PS)**

This value does not directly alter the core clock speed of the ADC. It serves to determine the width of the sampling or acquisition period. The higher the value, the wider is the sampling period. The default value is 4.

**Acquisition window size ((ACQ\_PS+1)/ADCCLK) in micro seconds/channel**

Acquisition window size determines for what time duration the sampling switch is closed. The width of SOC pulse is ADCTRL1[11:8] + 1 times the ADCLK period.

**Use external reference 2.048VExternal reference**

By default, an internally generated band gap voltage reference supplies the ADC logic. However, depending on application requirements, you can enable the external reference so the ADC logic uses an external voltage reference instead. Select the check box to use a 2.048V external voltage reference.

**Use external reference**

By default, an internally generated band gap voltage reference supplies the ADC logic. However, depending on application requirements, you can enable the external reference so the ADC logic uses an external voltage reference instead. Select the check box to use an external voltage reference.



**Continuous mode**

When the ADC generates an end of conversion (EOC) signal, generate an ADCINT# interrupt whether the previous interrupt flag has been acknowledged or not.

**ADC offset correction (OFFSET\_TRIM: -256 to 255)**

The 280x ADC supports offset correction via a 9-bit value that it adds or subtracts before the results are available in the ADC result registers. Timing for results is not affected. The default value is 0.

**VREFHI****VREFLO**

(For Piccolo processors) When you disable the **Use external reference 2.048V** or **External reference** option, the ADC logic uses a fixed 0-volt to 3.3-volt input range and the software disables **VREFHI** and **VREFLO**. To interpret the ADC input as a ratiometric signal, select the **External reference** option. Then set values for the high voltage reference (**VREFHI**) and the low voltage reference (**VREFLO**). **VREFHI** uses the external ADCINA0 pin, and **VREFLO** uses the internal GND.

**INT pulse control**

(For Piccolo processors) Use this option to configure when the ADC sets ADCINTFLG .ADCINTx relative to the SOC and EOC Pulses. Select **Late interrupt pulse** or **Early interrupt pulse**.

**SOC high priority**

(For Piccolo processors) Use this option to enable and configure **SOC high priority mode**. In all in round robin mode, the default selection, the ADC services each SOC interrupt in a numerical sequence.

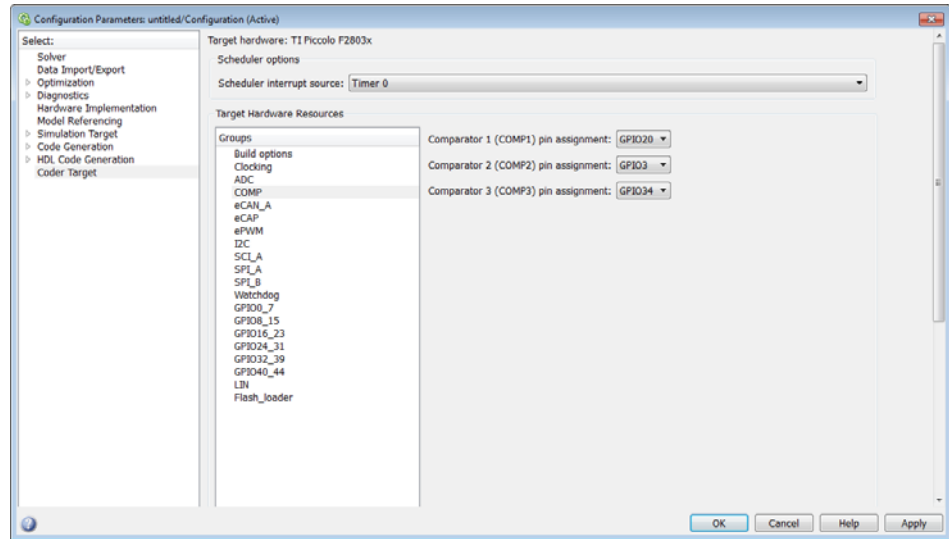
Choose one of the high priority selections to assign high priority to one or more of the SOCs. In this mode, the ADC operates in round robin mode until it receives a high priority SOC interrupt. The ADC finishes servicing the current SOC, services the high priority SOCs, and then returns to the next SOC in the round robin sequence.

For example, the ADC is servicing SOC8 when it receives a high priority interrupt on SOC1. The ADC completes servicing SOC8, services SOC1, and then services SOC9.

### **XINT2SOC external pin**

(For Piccolo processors) Select the pin to which the ADC sends the XINT2SOC pulse.

## COMP



Assigns COMP pins to GPIO pins.

### Comparator 1 (COMP1) pin assignment

Select an option from the list — None,GPIO1, GPIO20, GPIO42.

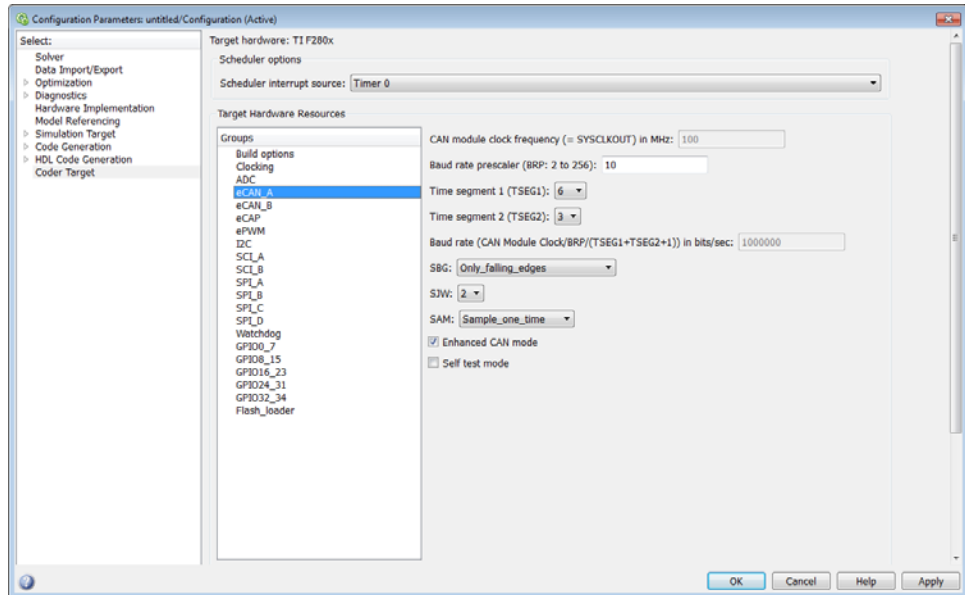
### Comparator 2 (COMP2) pin assignment

Select an option from the list — None,GPIO3, GPIO21, GPIO34, GPIO43.

### Comparator 3 (COMP3) pin assignment

Select an option from the list — None,GPIO34.

## eCAN\_A, eCAN\_B



For more help on setting the timing parameters for the eCAN modules, refer to [Configuring Timing Parameters for CAN Blocks](#). You can set the following parameters for the eCAN module:

#### **CAN module clock frequency (= SYSCLKOUT) in MHz:**

The clock to the enhanced CAN module. The CAN module clock frequency is equal SYSCLKOUT for processors such as c280x, c281x, c28044.

#### **CAN module clock frequency (=SYSCLKOUT/2) in MHz**

The clock to the enhanced CAN module. The CAN module clock frequency is equal to SYSCLKOUT/2 for processors such as piccolo, c2834x, c28x3x.

#### **Baud rate prescaler (BRP: 2 to 256):**

Value by which to scale the bit rate. Valid values are from 2 to 256.

**Time segment 1 (TSEG1):**

Sets the value of time segment 1, which, with **TSEG2** and **Baud rate prescaler**, determines the length of a bit on the eCAN bus. Valid values for **TSEG1** are from 1 through 16.

**Time segment 2 (TSEG2):**

Sets the value of time segment 2, which, with **TSEG1** and **Baud rate prescaler**, determines the length of a bit on the eCAN bus. Valid values for **TSEG2** are from 1 through 8.

**Baud rate (CAN Module Clock/BRP/(TSEG1 + TSEG2 + 1)) in bits/sec:**

CAN module communication speed represented in bits/sec.

**SBG**

Sets the message resynchronization triggering. Options are `Only_falling_edges` and `Both_falling_and_rising_edges`.

**SJW**

Sets the synchronization jump width, which determines how many units of TQ a bit can be shortened or lengthened when resynchronizing.

**SAM**

Number of samples used by the CAN module to determine the CAN bus level. Selecting `Sample_one_time` samples once at the sampling point. Selecting `Sample_three_times` samples once at the sampling point and twice before at a distance of TQ/2. The CAN module makes a majority decision from the three points.

**Enhanced CAN Mode**

To enable time-stamping and to use **Mailbox Numbers** 16 through 31 in the C2000 eCAN blocks, enable this parameter. Texas Instruments documentation refers to this “HECC mode”.

**Self test mode**

If you set this parameter to `True`, the eCAN module goes to loopback mode. Loopback mode sends a “dummy” acknowledge message back without needing an acknowledge bit. The default is `False`.

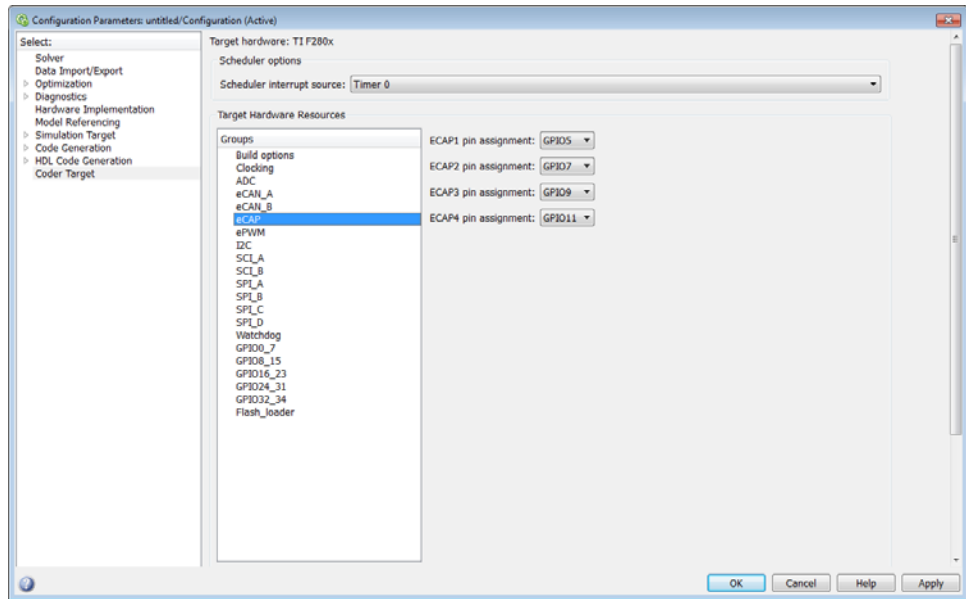
**Pin assignment (Tx)**

Assigns the CAN transmit pin to use with the eCAN\_B module. Possible values are `GPI08`, `GPI012`, `GPI016`, and `GPI020`.

### **Pin assignment (Rx)**

Assigns the CAN receive pin to use with the eCAN\_B module. Possible values are GPI010, GPI013, GPI017, and GPI021.

## eCAP



Assigns eCAP pins to GPIO pins.

### **ECAP1 pin assignment**

Select an option from the list—None, GPIO5, or GPIO24.

### **ECAP2 pin assignment**

Select an option from the list—None, GPIO7, or GPIO25.

### **ECAP3 pin assignment**

Select an option from the list—None, GPIO9, or GPIO26.

### **ECAP4 pin assignment**

Select an option from the list—None, GPIO11, or GPIO27.

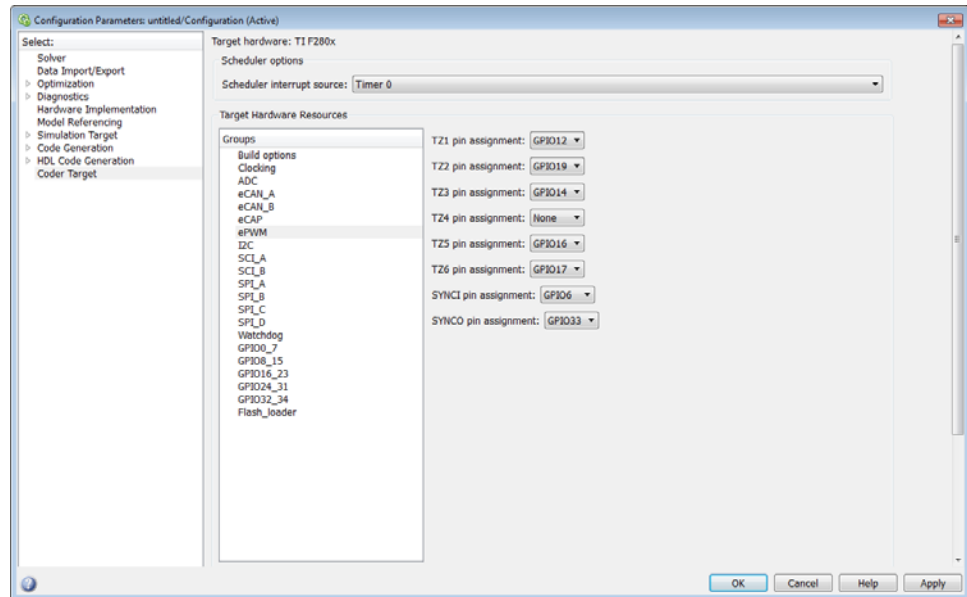
### **ECAP5 pin assignment**

Select an option from the list—None, GPIO3, or GPIO48.

### **ECAP6 pin assignment**

Select an option from the list—None, GPIO1, or GPIO49.

## ePWM



Assigns ePWM signals to GPIO pins.

### **TZ1 pin assignment**

Assigns the trip-zone input 1 (TZ1) to a GPIO pin. Choices are None (the default), GPIO12, and GPIO15.

### **TZ2 pin assignment**

Assigns the trip-zone input 2 (TZ2) to a GPIO pin. Choices are None (the default), GPIO16, and GPIO28.

### **TZ3 pin assignment**

Assigns the trip-zone input 3 (TZ3) to a GPIO pin. Choices are None (the default), GPIO17, and GPIO29.

### **TZ4 pin assignment**

Assigns the trip-zone input 4 (TZ4) to a GPIO pin. Choices are None (the default), GPIO17, and GPIO28.

### **TZ5 pin assignment**

Assigns the trip-zone input 5 (TZ5) to a GPIO pin. Choices are None (the default), GPIO16, and GPIO28.



**TZ6 pin assignment**

Assigns the trip-zone input 6 (TZ6) to a GPIO pin. Choices are None (the default), GPIO17, and GPIO29.

**SYNCI pin assignment**

Assigns the ePWM external sync pulse input (SYNCI) to a GPIO pin. Choices are None (the default), GPIO6, and GPIO32.

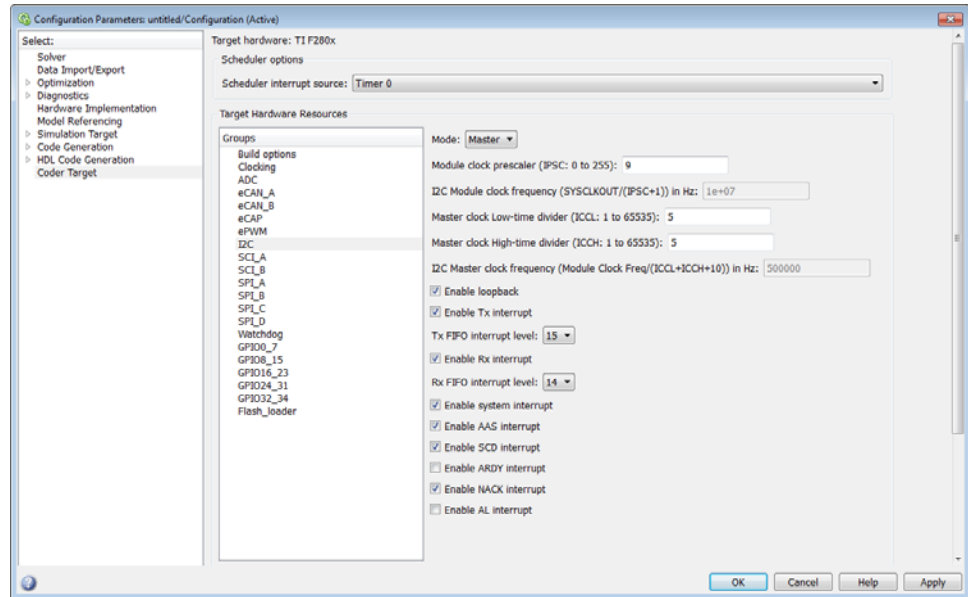
**SYNCO pin assignment**

Assigns the ePWM external sync pulse output (SYNCO) to a GPIO pin. Choices are None (the default), GPIO6, and GPIO33.

**PWM # A, PWM # B, PWM # C pin assignment**

The PWM # A, PWM # B, PWM # C pin assignment.

## I2C



Report or set Inter-Integrated Circuit parameters. For more information, consult the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721A, available on the Texas Instruments Web site.

### Mode

Configure the I2C module as **Master** or **Slave**.

If a module is an I2C master, it:

Initiates communication with slave nodes by sending the slave address and requesting data transfer to or from the slave.

Outputs the **Master clock frequency** on the serial clock line (SCL) line.

If a module is an I2C slave, it:

- Synchronizes itself with the serial clock line (SCL) line.
- Responds to communication requests from the master.

When **Mode** is **Slave**, you can configure the **Addressing format**, **Address register**, and **Bit count** parameters.

The **Mode** parameter corresponds to bit 10 (MST) of the I2C Mode Register (I2CMDR).

#### **Addressing format**

If **Mode** is **Slave**, determine the addressing format of the I2C master, and set the I2C module to the same mode:

- 7-Bit Addressing, the normal address mode.
- 10-Bit Addressing, the expanded address mode.
- Free Data Format, a mode that does not use addresses. (If you **Enable loopback**, the Free data format is not supported.)

The **Addressing format** parameter corresponds to bit 3 (FDF) and bit 8 (XA) of the I2C Mode Register (I2CMDR).

#### **Own address register**

If **Mode** is **Slave**, enter the 7-bit (0–127) or 10-bit (0–1023) address this I2C module uses while it is a slave.

This parameter corresponds to bits 9–0 (OAR) of the I2C Own Address Register (I2COAR).

#### **Bit count**

If **Mode** is **Slave**, set the number of bits in each *data byte* the I2C module transmits and receives. This value must match that of the I2C master.

This parameter corresponds to bits 2–0 (BC) of the I2C Mode Register (I2CMDR).

#### **Module clock prescaler (IPSC: 0 to 255):**

If **Mode** is **Master**, configure the module clock frequency by entering a value 0–255.

*Module clock frequency = I2C input clock frequency / (Module clock prescaler + 1)*

The I2C specifications require a module clock frequency between 7 MHz and 12 MHz.

The *I2C input clock frequency* depends on the DSP input clock frequency and the value of the PLL Control Register divider (PLLCR). For more information on setting the PLLCR, consult the documentation for your specific Digital Signal Controller.

This **Module clock prescaler (IPSC: 0 to 255)**: corresponds to bits 7–0 (IPSC) of the I2C Prescaler Register (I2CPSC).

**I2C Module clock frequency (SYSCLKOUT / (IPSC+1)) in Hz:**

This field displays the frequency the I2C module uses internally. To set this value, change the **Module clock prescaler**.

For more information about this value, consult the “Formula for the Master Clock Period” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721, on the Texas Instruments Web site.

**I2C Master clock frequency (Module Clock Freq/(ICCL+ICCH+10)) in Hz:**

This field displays the master clock frequency.

For more information about this value, consult the “Clock Generation” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721, available on the Texas Instruments Web site.

**Master clock Low-time divider (ICCL: 1 to 65535):**

When **Mode** is Master, this divider determines the duration of the low state of the SCL line on the I2C-bus.

The low-time duration of the master clock =  $T_{mod} \times (ICCL + d)$ .

For more information, consult the “Formula for the Master Clock Period” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721A, available on the Texas Instruments Web site.

This parameter corresponds to bits 15–0 (ICCL) of the Clock Low-Time Divider Register (I2CCLKL).

**Master clock High-time divider (ICCH: 1 to 65535):**

When **Mode** is Master, this divider determines the duration of the high state on the serial clock pin (SCL) of the I2C-bus.

The high-time duration of the master clock =  $T_{\text{mod}} \times (\text{ICCL} + d)$ .

For more information about this value, consult the “Formula for the Master Clock Period” section in the *TMS320x280x Inter-Integrated Circuit Module Reference Guide*, Literature Number: SPRU721A, available on the Texas Instruments Web site.

This parameter corresponds to bits 15–0 (ICCH) of the Clock High-Time Divider Register (I2CCLKH).

**Enable loopback**

When **Mode** is Master, enable or disable digital loopback mode. In digital loopback mode, I2CDXR transmits data over an internal path to I2CDRR, which receives the data after a configurable delay.

The delay, measured in DSP cycles, equals  $(\text{I2C input clock frequency} / \text{module clock frequency}) \times 8$ .

While **Enable loopback** is enabled, free data format addressing is not supported.

This parameter corresponds to bit 6 (DLB) of the I2C Mode Register (I2CMODR).

**Enable Tx interrupt**

This parameter corresponds to bit 5 (TXFFIENA) of the I2C Transmit FIFO Register (I2CFFTX).

**Tx FIFO interrupt level**

This parameter corresponds to bits 4–0 (TXFFIL4-0) of the I2C Transmit FIFO Register (I2CFFTX).

**Enable Rx interrupt**

This parameter corresponds to bit 5 (RXFFIENA) of the I2C Receive FIFO Register (I2CFFRX).

#### **Rx FIFO interrupt level**

This parameter corresponds to bit 4–0 (RXFFIL4-0) of the I2C Receive FIFO Register (I2CFFRX).

#### **Enable system interrupt**

Select this parameter to display and individually configure the following five Basic I2C Interrupt Request parameters in the Interrupt Enable Register (I2CIER):

- Enable AAS interrupt
- Enable SCD interrupt
- Enable ARDY interrupt
- Enable NACK interrupt
- Enable AL interrupt

#### **Enable AAS interrupt**

Enable the addressed-as-slave interrupt.

When enabled, the I2C module generates an interrupt (AAS bit = 1) upon receiving one of the following:

- Its **Own address register**
- A general call (all zeros)
- A data byte is in free data format

When enabled, the I2C module clears the interrupt (AAS = 0) upon receiving one of the following:

- Multiple START conditions (7-bit addressing mode only)
- A slave address that is different from **Own address register** (10-bit addressing mode only)
- A NACK or a STOP condition

This parameter corresponds to bit 6 (AAS) of the Interrupt Enable Register (I2CIER).

#### **Enable SCD interrupt**

Enable stop condition detected interrupt.

When enabled, the I2C module generates an interrupt (SCD bit = 1) when the CPU detects a stop condition on the I2C bus.

When enabled, the I2C module clears the interrupt (SCD = 0) upon one of the following events:

- The CPU reads the I2CISRC while it indicates a stop condition
- A reset of the I2C module
- Someone manually clears the interrupt

This parameter corresponds to bit 5 (SCD) of the Interrupt Enable Register (I2CIER).

#### **Enable ARDY interrupt**

Enable register-access-ready interrupt enable bit.

When enabled, the I2C module generates an interrupt (ARDY bit = 1) when the previous address, data, and command values in the I2C module registers have been used and new values can be written to the I2C module registers.

This parameter corresponds to bit 2 (ARDY) of the Interrupt Enable Register (I2CIER).

#### **Enable NACK interrupt**

Enable no acknowledgment interrupt enable bit.

When enabled, the I2C module generates an interrupt (NACK bit = 1) when the module is a transmitter in master or slave mode and it receives a NACK condition.

This parameter corresponds to bit 1 (NACK) of the Interrupt Enable Register (I2CIER).

#### **Enable AL interrupt**

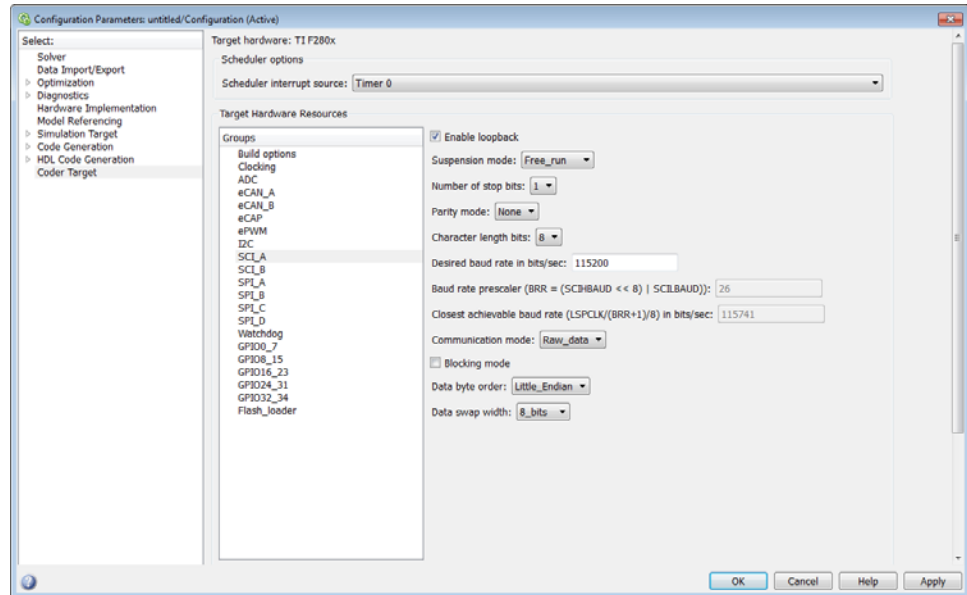
Enable arbitration-lost interrupt.

When enabled, the I2C module generates an interrupt (AL bit = 1) when the I2C module is operating as a master transmitter and loses an arbitration contest with another master transmitter.

This parameter corresponds to bit 0 (AL) of the Interrupt Enable Register (I2CIER).



## SCI\_A, SCI\_B, SCI\_C



The serial communications interface parameters you can set for module A. These parameters are:

### Enable loopback

Select this parameter to enable the loopback function for self-test and diagnostic purposes only. When this function is enabled, a C28x DSP Tx pin is internally connected to its Rx pin and can transmit data from its output port to its input port to check the integrity of the transmission.

### Baud rate

Baud rate for transmitting and receiving data. Select from 115200 (the default), 57600, 38400, 19200, 9600, 4800, 2400, 1200, 300, and 110.

### Suspension mode

Type of suspension to use when debugging your program with Code Composer Studio. When your program encounters a breakpoint, the suspension mode determines whether to perform the program instruction. Available options are Hard\_abort, Soft\_abort, and Free\_run. Hard\_abort stops the program immediately. Soft\_abort

stops when the current receive/transmit sequence is complete. `Free_run` continues running regardless of the breakpoint.

**Number of stop bits**

Select whether to use 1 or 2 stop bits.

**Parity mode**

Type of parity to use. Available selections are None, Odd parity, or Even parity. None disables parity. Odd sets the parity bit to one if you have an odd number of ones in your bytes, such as 00110010. Even sets the parity bit to one if you have an even number of ones in your bytes, such as 00110011.

**Character length bits**

Length in bits of each transmitted or received character, set to 8 bits.

**Desired baud rate in bits/sec**

The desired baud rate specified by the user.

**Baud rate prescaler (BRR = (SCIHBAUD << 8) | SCILBAUD))**

The baud rate prescaler.

**Closest achievable baud rate (LSPCLK/(BRR+1)/8) in bits/sec**

The closest achievable baud rate calculated based on LSPCLK and BRR.

**Communication mode**

Select `Raw_data` or `Protocol` mode. Raw data is unformatted and sent whenever the transmitting side is ready to send, whether the receiving side is ready or not. Without a wait state, deadlock conditions do not occur. Data transmission is asynchronous. With this mode, it is possible the receiving side could miss data, but if the data is noncritical, using raw data mode can avoid blocking processes.

When you select protocol mode, some handshaking between host and processor occurs. The transmitting side sends `$SND` to indicate it is ready to transmit. The receiving side sends back `$RDY` to indicate it is ready to receive. The transmitting side then sends data and, when the transmission is completed, it sends a checksum.

Advantages to using protocol mode include:

- Avoids deadlock
- Determines whether data is received without errors (checksum)

- Determines whether data is received by processor
- Determines time consistency; each side waits for its turn to send or receive

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**Note** Deadlocks can occur if one SCI Transmit block tries to communicate with more than one SCI Receive block on different COM ports when both are blocking (using protocol mode). Deadlocks cannot occur on the same COM port.

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### **Blocking mode**

If this option is set to True, system waits until data is available to read (when data length is reached). If this option is set to False, system checks FIFO periodically (in polling mode) for data to read. If data is present, the block reads and outputs the contents. When data is not present, the block outputs the last value and continues.

### **Data byte order**

Select `Little Endian` or `Big Endian`, to match the endianness of the data being moved.

### **Data swap width**

Select `8_bits` or `16_bits`, to match the width of the data being moved by the data swap operation. When you set **Data byte order** to `Big Endian`, the only available option for **Data swap width** is `8_bits`.

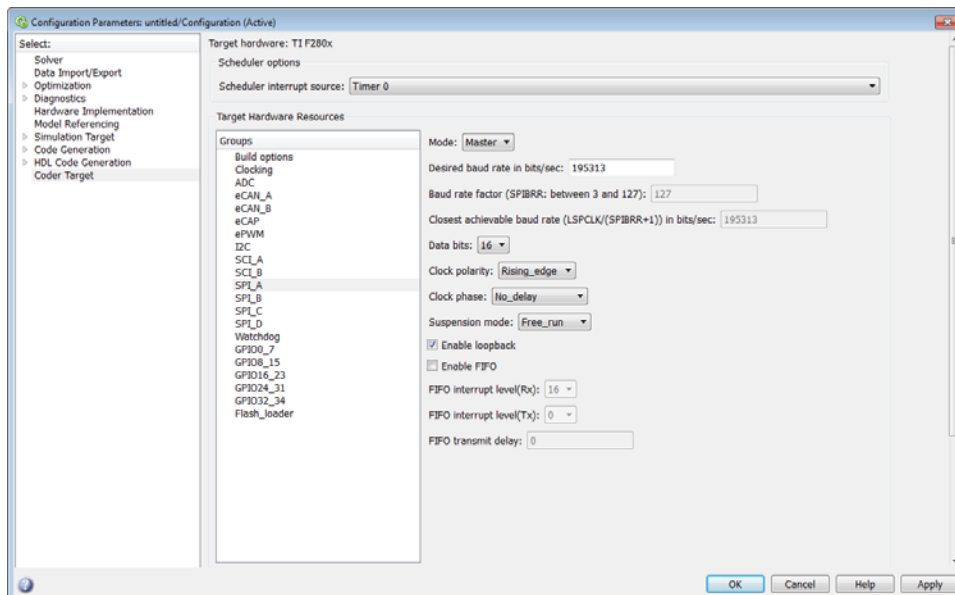
### **Pin assignment (Tx)**

Assigns the SCI transmit pin to use with the SCI module.

### **Pin assignment (Rx)**

Assigns the SCI receive pin to use with the SCI module.

## SPI\_A, SPI\_B, SPI\_C, SPI\_D



The serial peripheral interface parameters you can set for the A module. These parameters are:

### Mode

Set to Master or Slave.

### Desired baud rate in bits/sec

The desired baud rate specified by the user.

### Baud rate factor (SPIBRR: between 3 and 127)

To set the **Baud rate factor**, search for “Baud Rate Determination” and “SPI Baud Rate Register (SPIBRR) Bit Descriptions” in *TMS320x28xx, 28xxx DSP Serial Peripheral Interface (SPI) Reference Guide*, Literature Number: SPRU059, available on the Texas Instruments Web Site.

### Closest achievable baud rate (LSPCLK/(SPIBRR+1)) in bits/sec

The closest achievable baud rate calculated based on LSPCLK and SPIBRR.

**Data bits**

Length in bits from 1 to 16 of each transmitted or received character. For example, if you select 8, the maximum data that can be transmitted using SPI is  $2^{8-1}$ . If you send data greater than this value, the buffer overflows.

**Clock polarity**

Select `Rising_edge` or `Falling_edge`.

**Clock phase**

Select `No_delay` or `Delay_half_cycle`.

**Suspension mode**

Type of suspension to use when debugging your program with Code Composer Studio. When your program encounters a breakpoint, the selected suspension mode determines whether to perform the program instruction. Available options are `Hard_abort`, `Soft_abort`, and `Free_run`. `Hard_abort` stops the program immediately. `Soft_abort` stops when the current receive or transmit sequence is complete. `Free_run` continues running regardless of the breakpoint.

**Enable loopback**

Select this option to enable the loopback function for self-test and diagnostic purposes only. When this function is enabled, the Tx pin on a C28x DSP is internally connected to its Rx pin and can transmit data from its output port to its input port to check the integrity of the transmission.

**Enable 3-wire mode**

Enable SPI communication over three pins instead of the normal four pins.

**Enable FIFO**

Set true or false.

**FIFO interrupt level (Rx)**

Set level for receive FIFO interrupt. Select 0 through 16.

**FIFO interrupt level (Tx)**

Set level for transmit FIFO interrupt. Select 0 through 16.

**FIFO transmit delay**

Enter FIFO transmit delay (in processor clock cycles) to pause between data transmissions. Enter an integer.

**CLK pin assignment**

Assigns the SPI something (CLK) to a GPIO pin. Choices are None (default), GPI014, or GPI026.

**SOMI pin assignment**

Assigns the SPI something (SOMI) to a GPIO pin. Choices are None (default), GPI013, or GPI025.

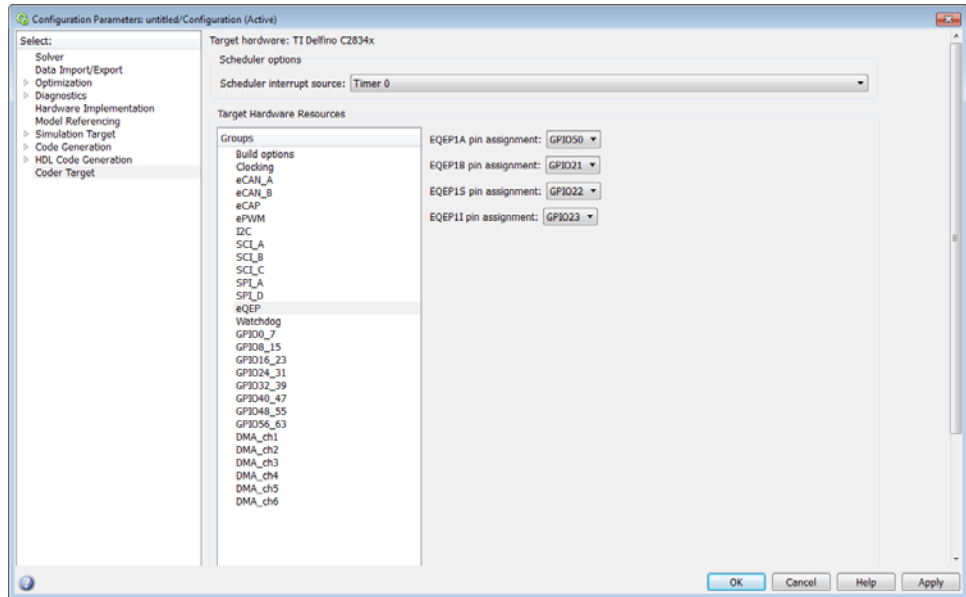
**STE pin assignment**

Assigns the SPI something (STE) to a GPIO pin. Choices are None (default), GPI015, or GPI027.

**SIMO pin assignment**

Assigns the SPI something (SIMO) to a GPIO pin. Choices are None (default), GPI012, or GPI024.

## eQEP



Assigns eQEP pins to GPIO pins.

### **EQEP1A pin assignment**

Select an option from the list—GPIO20 or GPIO50.

### **EQEP1B pin assignment**

Select an option from the list—GPIO21 or GPIO51.

### **EQEP1S pin assignment**

Select an option from the list—GPIO22 or GPIO52.

### **EQEP1I pin assignment**

Select an option from the list—GPIO23 or GPIO53.

### **EQEP2A pin assignment**

Select an option from the list—GPIO24 or GPIO54.

### **EQEP2B pin assignment**

Select an option from the list—GPIO25 or GPIO55.

### **EQEP2S pin assignment**

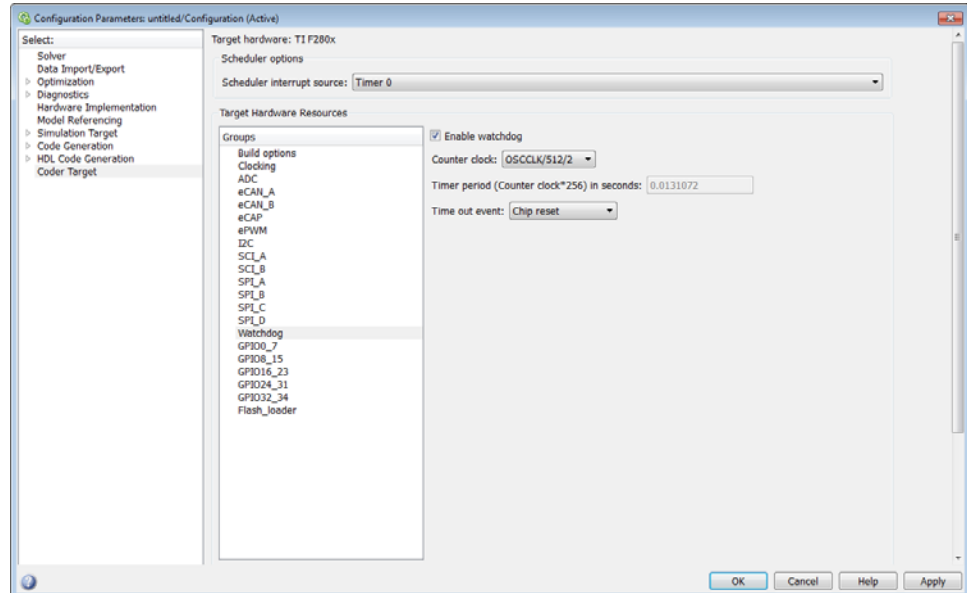
Select an option from the list—GPIO27 or GPIO31. or GPIO57

**EQEP2I pin assignment**

Select an option from the list—GPIO26 or GPIO30. or GPIO56



## Watchdog



When enabled, if the software fails to reset the watchdog counter within a specified interval, the watchdog resets the processor or generates an interrupt. This feature enables the processor to recover from some fault conditions.

For more information, locate the *Data Manual* or *System Control and Interrupts Reference Guide* for your processor on the Texas Instruments Web site.

### Enable watchdog

Enable the watchdog timer module.

This parameter corresponds to bit 6 (WDDIS) of the Watchdog Control Register (WDCR) and bit 0 (WDOVERRIDE) of the System Control and Status Register (SCSR).

### Counter clock

Set the watchdog timer period relative to OSCCLK/512.

This parameter corresponds to bits 2–0 (WDPS) of the Watchdog Control Register (WDCR).

### **Timer period (Counter clock\*256) in seconds**

This field displays the timer period in seconds. This value automatically updates when you change the **Counter clock** parameter.

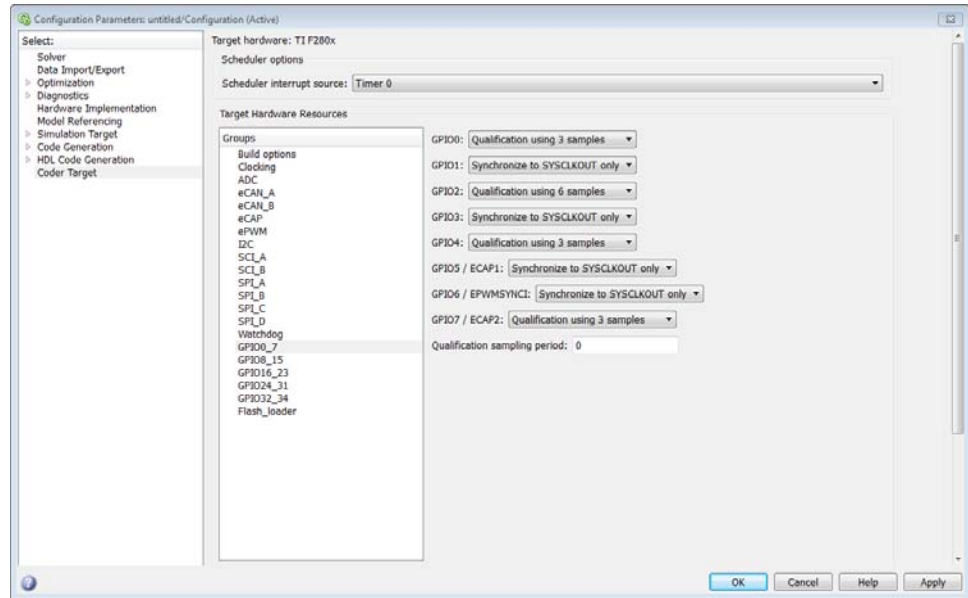
### **Time out event**

Configure the watchdog to reset the processor or generate an interrupt when the software fails to reset the watchdog counter:

- Select **Chip reset** to generate a signal that resets the processor (WDRST signal) and disable the watchdog interrupt signal (WDINT signal).
- Select **Raise WD Interrupt** to generate a watchdog interrupt signal (WDINT signal) and disable the reset processor signal (WDRST signal). This signal can be used to wake the device from an IDLE or STANDBY low-power mode.

This parameter corresponds to bit 1 (WDENINT) of the System Control and Status Register (SCSR).

## GPIO



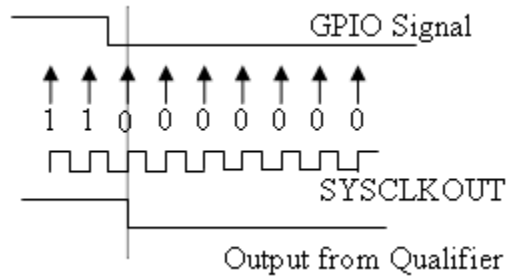
**GPIO** Use the GPIO pins for digital input or output by connecting to one of the three peripheral I/O ports.

The range of GPIO pins for different processors is given below:

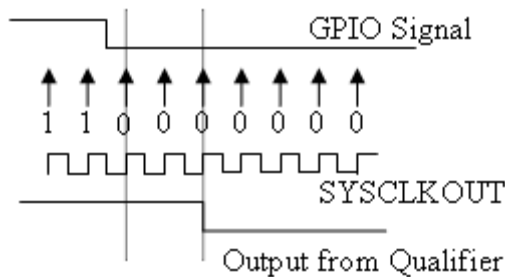
| Processors                    | GPIO Pin Values                                                                     |
|-------------------------------|-------------------------------------------------------------------------------------|
| C281x                         | GPIOA, GPIOB, GPIOD, GPIOE, GPIOF, and GPIOG                                        |
| F2803x                        | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–39, GPIO40–44                       |
| F2806x                        | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–39, GPIO40–44, GPIO50–55, GPIO56–58 |
| F2823x, F2833x, and C2834x    | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–39, GPIO40–47, GPIO48–55, GPIO56–63 |
| C2801x, F2802x, F28044, F280x | GPIO0–7, GPIO8–15, GPIO16–23, GPIO24–31, GPIO32–34                                  |

Each pin selected for input offers four signal qualification types:

- Sync to SYSCLKOUT only — This setting is the default for all pins at reset. Using this qualification type, the input signal is synchronized to the system clock SYSCLKOUT. The following figure shows the input signal measured on each tick of the system clock, and the resulting output from the qualifier.

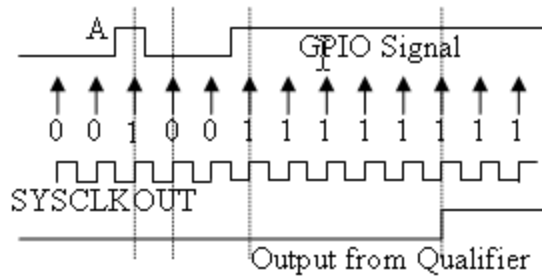


- Qualification using 3 samples — This setting requires three consecutive cycles of the same value for the output value to change. The following figure shows that, in the third cycle, the GPIO value changes to 0, but the qualifier output is still 1 because it waits for three consecutive cycles of the same GPIO value. The next three cycles all have a value of 0, and the output from the qualifier changes to 0 immediately after the third consecutive value is received.



- Qualification using 6 samples — This setting requires six consecutive cycles of the same GPIO input value for the output from the qualifier to change. In the following figure, the glitch A does not alter the output signal. When the glitch occurs, the counting begins, but the next measurement is

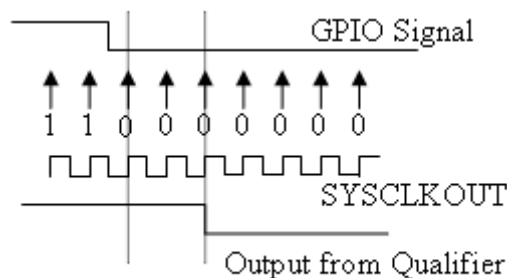
low again, so the count is ignored. The output signal does not change until six consecutive samples of the high signal are measured.



### Qualification sampling period prescaler

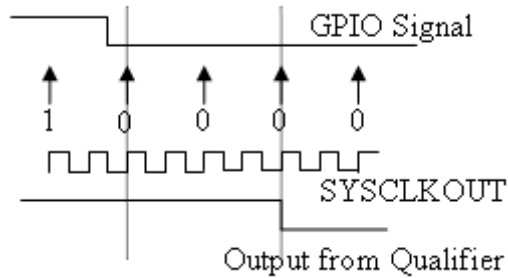
Visible only when a setting for **Qualification type for GPIO [pin#]** is selected. The qualification sampling period prescaler, with possible values of 0 to 255, calculates the frequency of the qualification samples or the number of system clock ticks per sample. The formula for calculating the qualification sampling frequency is  $\text{SYSCLKOUT}/(2 * \text{Prescaler})$ , except for zero. When **Qualification sampling period prescaler=0**, a sample is taken every SYSCLKOUT clock tick. For example, a prescale setting of 0 means that a sample is taken on each SYSCLKOUT tick.

The following figure shows the SYSCLKOUT ticks, a sample taken every clock tick, and the **Qualification type** set to Qualification using 3 samples. In this case, the **Qualification sampling period prescaler=0**:

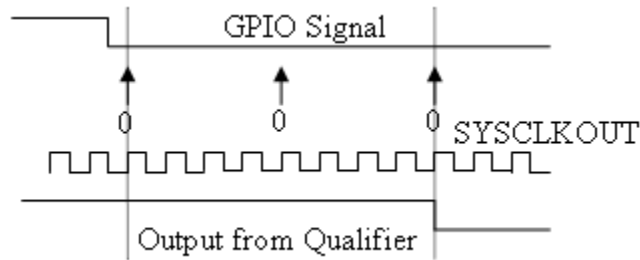


In the next figure **Qualification sampling period prescaler=1**. A sample is taken every two clock ticks, and the **Qualification type** is set to

Qualification using 3 samples. The output signal changes much later than if **Qualification sampling period prescaler=0**.



In the following figure, **Qualification sampling period prescaler=2**. Thus, a sample is taken every four clock ticks, and the **Qualification type** is set to Qualification using 3 samples.



- Asynchronous

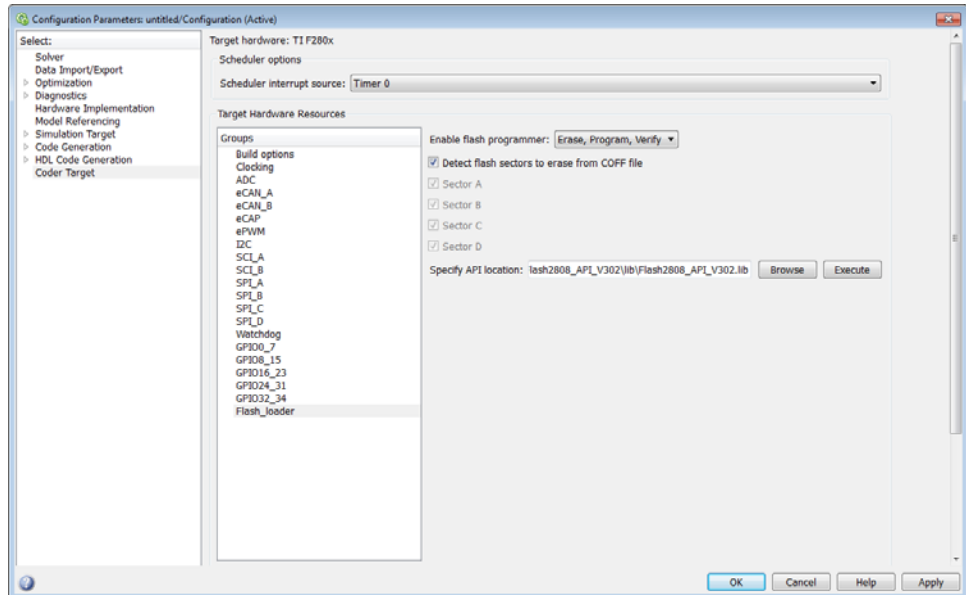
Using this qualification type, the signal is synchronized to an asynchronous event initiated by software (CPU) via control register bits.

#### Qualification sampling period

Enter the qualification sampling period.

**GPIOA, GPIOB, GPIOD, GPIOE input qualification sampling period**

## Flash\_loader



You can use `Flash_loader` to:

- Automatically program generated code to flash memory on the target when you build the code.
- Manually erase, program, or verify specific flash memory sectors.

To use this feature, download and install the TI Flash API plugin from the TI Web site.

For more information, consult the “Programming Flash Memory” topic or the `*_API_Readme.pdf` file included in the *TI Flash API* downloadable zip file.

### Enable Flash Programmer

Enable the flash programmer by selecting a task for it to perform when you click **Execute** or build the software.

To program the flash memory when you build the software, select **Erase, Program, Verify**.

### **Detect Flash sectors to erase from COFF file**

When enabled, the flash programmer erases all of the flash sectors defined by the COFF file.

### **Sector A, Sector B, Sector C...**

When **Detect Flash sectors to erase from COFF file** is disabled, you can select the specific sector to erase.

### **Specify API location**

Specify the folder path of the TI flash API executable you downloaded and installed on your computer.

Use **Browse** to locate the file or enter the path in the text box.

For example,

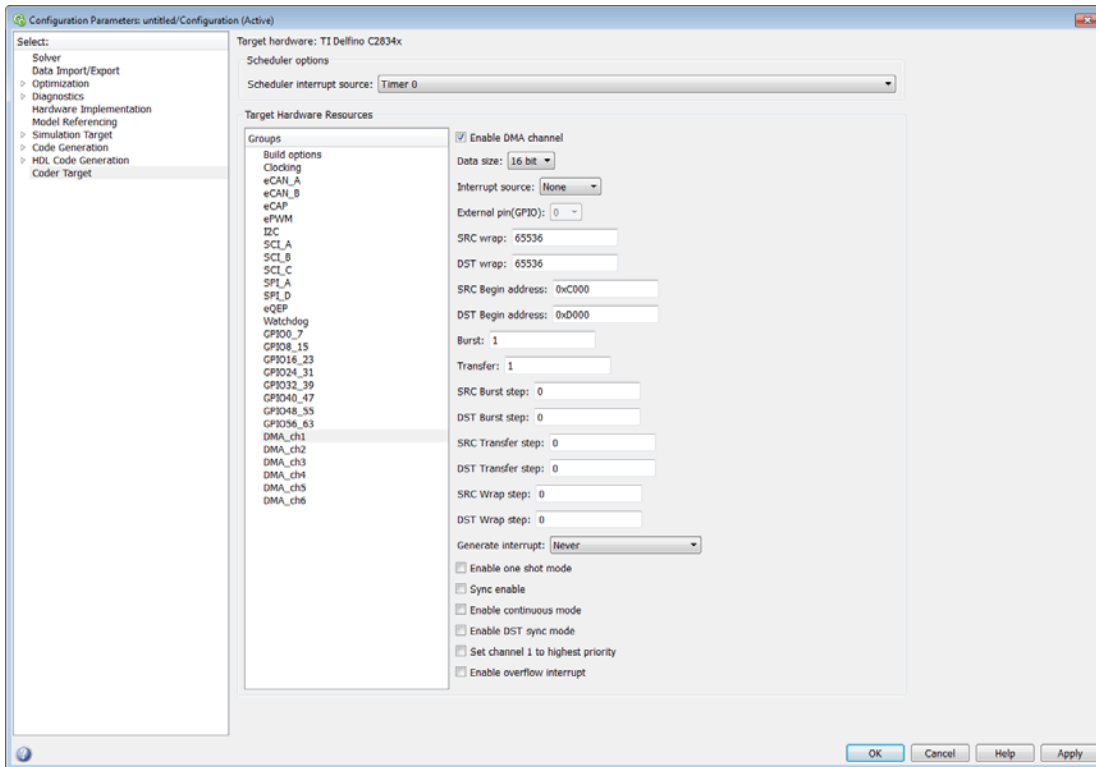
```
C:\TI\controlSUITE\libs\utilities\flash_api\2806x\v100\lib\2806x_BootR
```

### **Execute**

Click this button to initiate the task selected in **Enable Flash Programmer**.



## DMA\_ch[#]



The Direct Memory Access module transfers data directly between peripherals and memory using a dedicated bus, increasing overall system performance.

You can individually enable and configure each DMA channel.

The DMA module services are event driven. Using the **Interrupt source** and **External pin (GPIO)** parameters, you can configure a wide range of peripheral interrupt event triggers.

To avoid error messages, open the Coder Target > Target Hardware Resources, select the **Peripherals** tab, and *disable* the same DMA channel number.

For more information, consult the *TMS320x2833x, 2823x Direct Memory Access (DMA) Module Reference Guide*, Literature Number: SPRUFB8A,

Also consult the *Increasing Data Throughput using the TMS320F2833x DSC DMA* training presentation (requires login), both available from the TI Web site.

### **Enable DMA channel**

Enable this parameter to edit the configuration of a specific DMA channel.

This parameter does not have a corresponding bit or register.

### **Data size**

Select the size of the data bit transfer: 16 bit or 32 bit.

The DMA read/write data buses are 32 bits wide. 32-bit transfers have twice the data throughput of a 16-bit transfer.

When providing DMA service to McBSP, set **Data size** to 16 bit.

The following parameters are based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of the following parameters:

- Size: Burst
- Source: Burst step
- Source: Transfer step
- Source: Wrap step
- Destination: Burst step
- Destination: Transfer step
- Destination: Wrap step

**Data size** corresponds to bit 14 (DATASIZE) in the Mode Register (MODE).

### **Interrupt source**

Select the peripheral interrupt that triggers a DMA burst for the specified channel.

Select SEQ1INT or SEQ2INT to configure the ADC interrupt as interrupt source.

Select XINT1, XINT2, or XINT13 to configure GPIO pin 0 to 31 as an external interrupt source. Select XINT3 to XINT7 to configure GPIO pin 32 to 63 as an external interrupt source.

For more information about configuring XINT, consult the following references:

- *TMS320x2833x, 2823x External Interface (XINTF) User's Guide*, Literature Number: SPRU949, available on the TI Web site.
- *TMS320x2833x System Control and Interrupts*, Literature Number: SPRUFB0, available on the TI Web site.
- The C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Input and C280x/C2802x/C2803x/C2805x/C2806x/C28x3x/c2834x GPIO Digital Output block reference sections.

Drop-down menu items from TINT0 to MREVTB may require manual configuration.

Select ePWM1SOCA through ePWM6SOCA to configure the ePWM interrupt as an interrupt source. Note that not all revisions of the TMS320F2833x silicon provide ePWM interrupts as sources for DMA transfers. For more information about silicon revisions consult the following reference:

*TMS320x2833x, 2823x Silicon Errata*, Literature Number: SPRZ272, available on the TI Web site.

The **Interrupt source** parameter corresponds to bit 4-0 (PERINTSEL) in the Mode Register (MODE).

### External pin(GPIO)

When you set **Interrupt source** is set to an external interface (XINT[#]), specify the GPIO pin number from which the interrupt originates.

This parameter corresponds to the GPIO XINTn, XNMI Interrupt Select (GPIOXINTnSEL, GPIOXNMISEL) Registers.

For more information, consult the *TMS320x2833x System Control and Interrupts Reference Guide*, Literature Number SPRUFB0, available from the TI Web site.

### **SRC wrap**

Specify the number of bursts before returning the current source address pointer to the **Source Begin Address** value. To disable wrapping, enter a value for **SRC wrap** that is greater than the **Transfer** value.

This parameter corresponds to bits 15-0 (SRC\_WRAP\_SIZE) in the Source Wrap Size Register (SRC\_WRAP\_SIZE).

### **DST wrap**

Specify the number of bursts before returning the current destination address pointer to the **Destination Begin Address** value. To disable wrapping, enter a value for **DST wrap** that is greater than the **Transfer** value.

This parameter corresponds to bits 15-0 (DST\_WRAP\_SIZE) in the Destination Wrap Size Register (DST\_WRAP\_SIZE).

### **SRC Begin address**

Set the starting address for the current source address pointer. The DMA module points to this address at the beginning of a transfer and returns to it as specified by the **SRC wrap** parameter.

This parameter corresponds to bits 21-0 (BEGADDR) in the Active Source Begin Register (SRC\_BEG\_ADDR).

### **DST Begin address**

Set the starting address for the current destination address pointer. The DMA module points to this address at the beginning of a transfer and returns to it as specified by the **DST wrap** parameter.

This parameter corresponds to bits 21-0 (BEGADDR) in the Active Destination Begin Register (DST\_BEG\_ADDR).

## Burst

Specify the number of 16-bit words in a burst, from 1 to 32. The DMA module must complete a burst before it can service the next channel.

Set the **Burst** value for the peripheral the DMA module is servicing. For the ADC, the value equals the number of ADC registers used, up to 16. For multichannel buffered serial ports (McBSP), which lack FIFOs, the value is 1.

For RAM, the value can range from 1 to 32.

This parameter corresponds to bits 4-0 (BURSTSIZE) in the Burst Size Register (BURST\_SIZE).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

## Transfer

Specify the number of bursts in a transfer, from 1 to 65536.

This parameter corresponds to bits 15-0 (TRANSFERSIZE) in the Transfer Size Register (TRANSFER\_SIZE).

## SRC Burst step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next burst. Enter a value from -4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Burst step** to 0. For example, because McBSP does not use FIFO, configure DMA to maintain the sequence of the McBSP data by moving each word of the data individually.

Accordingly, when you use DMA to transmit or receive McBSP data, set **Burst size** to 1 word and **Burst step** to 0.

This parameter corresponds to bits 15-0 (SRCBURSTSTEP) in the Source Burst Step Size Register (SRC\_BURST\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### DST Burst step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next burst. Enter a value from –4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Burst step** to 0. For example, because McBSP does not use FIFO, configure DMA to maintain the sequence of the McBSP data by moving each word of the data individually. Accordingly, when you use DMA to transmit or receive McBSP data, set **Burst size** to 1 word and **Burst step** to 0.

This parameter corresponds to bits 15-0 (DSTBURSTSTEP) in the Destination Burst Step Size Register (DST\_BURST\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### SRC Transfer step

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next transfer. Enter a value from –4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Transfer step** to 0.

This parameter corresponds to bits 15-0 (SRCTRANSFERSTEP) Source Transfer Step Size Register (SRC\_TRANSFER\_STEP).

If DMA is configured to perform memory wrapping (if **SRC wrap** is enabled) the corresponding source **Transfer step** does not alter the results.

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### **DST Transfer step**

Set the number of 16-bit words by which to increment or decrement the current address pointer before the next transfer. Enter a value from -4096 (decrement) to 4095 (increment).

To disable incrementing or decrementing the address pointer, set **Transfer step** to 0.

This parameter corresponds to bits 15-0 (DSTTRANSFERSTEP) Destination Transfer Step Size Register (DST\_TRANSFER\_STEP).

If DMA is configured to perform memory wrapping (if **DST wrap** is enabled) the corresponding destination **Transfer step** does not alter the results.

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

### **SRC Wrap step**

Set the number of 16-bit words by which to increment or decrement the SRC\_BEG\_ADDR address pointer when a wrap event occurs. Enter a value from -4096 (decrement) to 4095 (increment).

This parameter corresponds to bits 15-0 (WRAPSTEP) in the Source Wrap Step Size Registers (SRC\_WRAP\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

#### **DST Wrap step**

Set the number of 16-bit words by which to increment or decrement the DST\_BEG\_ADDR address pointer when a wrap event occurs. Enter a value from -4096 (decrement) to 4095 (increment).

This parameter corresponds to bits 15-0 (WRAPSTEP) in the Destination Wrap Step Size Registers (DST\_WRAP\_STEP).

---

**Note** This parameter is based on a 16-bit word size. If you set **Data size** to 32 bit, double the value of this parameter.

---

#### **Generate interrupt**

Enable this parameter to have the DMA channel send an interrupt to the CPU via the PIE at the beginning or end of a data transfer.

This parameter corresponds to bit 15 (CHINTE) and bit 9 (CHINTMODE) in the Mode Register (MODE).

#### **Enable one shot mode**

Enable this parameter to have the DMA channel complete an entire *transfer* in response to an interrupt event trigger.

This option allows a single DMA channel and peripheral to dominate resources, and may streamline processing, but it also creates the potential for resource conflicts and delays.

Disable this parameter to have DMA complete one *burst* per channel per interrupt.

#### **Sync enable**

When **Interrupt source** is set to SEQ1INT, enable this parameter to reset the DMA wrap counter when it receives the ADCSYNC signal from SEQ1INT. This way, the wrap counter and the ADC channels remain synchronized with each other.

If **Interrupt source** is not set to SEQ1INT, **Sync enable** does not alter the results.



This parameter corresponds to bit 12 (SYNCE) of the Mode Register (MODE).

**Enable continuous mode**

Select this parameter to leave the DMA channel enabled upon completing a transfer. The channel will wait for the next interrupt event trigger.

Clear this parameter to disable the DMA channel upon completing a transfer. The DMA module disables the DMA channel by clearing the RUNSTS bit in the CONTROL register when it completes the transfer. To use the channel again, first reset the RUN bit in the CONTROL register.

**Enable DST sync mode**

When **Sync enable** is enabled, enabling this parameter resets the destination wrap counter (DST\_WRAP\_COUNT) when the DMA module receives the SEQ1INT interrupt/ADCSYNC signal.

Disabling this parameter resets the source wrap counter (SCR\_WRAP\_COUNT) when the DMA module receives the SEQ1INT interrupt/ADCSYNC signal.

This parameter is associated with bit 13 (SYNCSEL) in the Mode Register (MODE).

**Set channel 1 to highest priority**

This parameter is only available for DMA\_ch1.

Enable this setting when DMA channel 1 is configured to handle high-bandwidth data, such as ADC data, and the other DMA channels are configured to handle lower-priority data.

When enabled, the DMA module services each enabled channel sequentially until it receives a trigger from channel 1.

Upon receiving the trigger, DMA interrupts its service to the current channel at the end of the current word, services the channel 1 burst that generated the trigger, and then continues servicing the current channel at the beginning of the next word.

Disable this channel to give each DMA channel equal priority, or if DMA channel 1 is the only enabled channel.

When disabled, the DMA module services each enabled channel sequentially.

This parameter corresponds to bit 0 (CH1PRIORITY) in the Priority Control Register 1 (PRIORITYCTRL1).

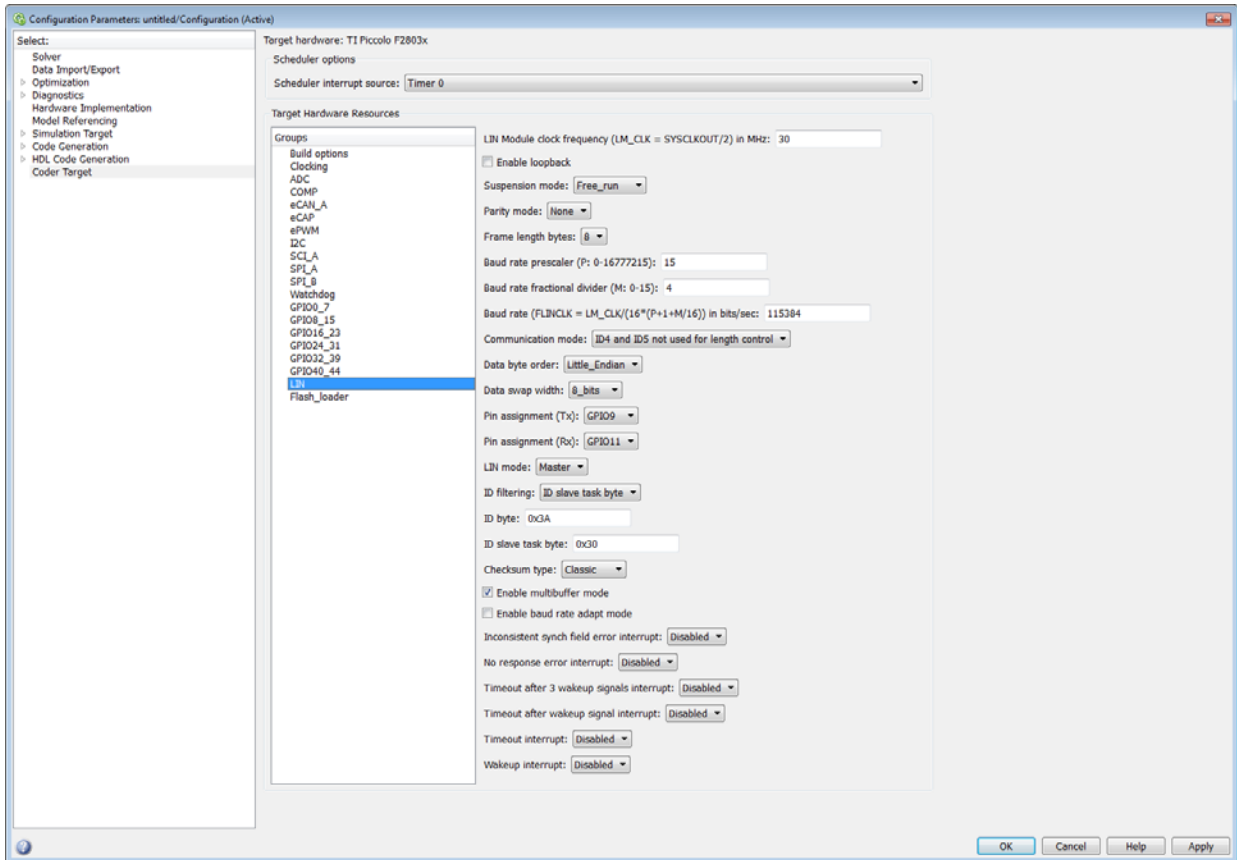
### **Enable overflow interrupt**

Enable this parameter to have the DMA channel send an interrupt to the CPU via PIE if the DMA module receives a peripheral interrupt while a previous interrupt from the same peripheral is waiting to be serviced.

This parameter is typically used for debugging during the development phase of a project.

The **Enable overflow interrupt** parameter corresponds to bit 7 (OVRINTE) of the Mode Register (MODE), and involves the Overflow Flag Bit (OVRFLG) and Peripheral Interrupt Trigger Flag Bit (PERINTFLG).

# LIN



For detailed information on the LIN module, see *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2, available at the Texas Instruments Web site.

The following options configure all LIN Transmit and LIN Receive blocks within a model.

**LIN Module clock frequency (LM\_CLK = SYSCLKOUT/2) in MHz**  
Displays the frequency of the LIN module clock in MHz.

### Enable loopback

To enable LIN loopback testing, select this option. While this option is enabled, the LIN module does the following:

- Internally redirects the LINTX output to the LINRX input.
- Puts the external LINTX pin into high state.
- Puts the external LINRX pin into a high impedance state.

The default is disabled (unchecked).

### Suspension mode

Use this option to configure how the LIN state machine behaves while you debug the program on an emulator. If you select `Hard_abort`, entering LIN debug mode halts the transmissions and counters.

The transmissions and counters resume when you exit LIN debug mode. If you select `Free_run`, entering LIN debug mode allows the current transmit and receive functions to complete.

The default is `Free_run`.

### Parity mode

Use this option to configure parity checking:

- To disable parity checking, select `None`.
- To enable odd parity checking, select `Odd`.
- To enable even parity checking, select `Even`.

The default is `None`.

In order for **ID parity error interrupt** in the LIN Receive block to generate interrupts, also enable **Parity mode**.

### Frame length bytes

Set the number of data bytes in the response field, from 1 to 8 bytes.

The default is 8 bytes.

### Baud rate prescaler (P: 0-16777215)

To set the LIN baud rate manually, enter a prescaler value, from 0 to 16777215. Click **Apply** to update the **Baud rate** display.

The default is 15.

For more information, consult the “Baud Rate” topic in the TI document, *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2.

**Baud rate fractional divider (M: 0–15)**

To set the LIN baud rate manually, enter a fractional divider value, from 0 to 15. Click **Apply** to update the **Baud rate** display.

The default is 4.

For more information, consult the “Baud Rate” topic in the TI document, *TMS320F2803x Piccolo Local Interconnect Network (LIN) Module*, Literature Number SPRUGE2.

**Baud rate (FLINCLK = LM\_CLK/(16\*(P+1+M/16)) in bits/sec**

This field displays the baud rate. For more information, see “Setting the LIN baud rate”.

**Communication mode**

Enable or disable the LIN module from using the ID-field bits ID4 and ID5 for length control.

The default is ID4 and ID5 not used for length control

**Data byte order**

Set the “endianness” of the LIN message data bytes to `Little_Endian` or `Big_Endian`.

The default is `Little_Endian`.

**Data swap width**

Select `8_bits` or `16_bits`. If you set **Data byte order** to `Big_Endian`, the only available option for **Data swap width** is `8_bits`.

**Pin assignment (Tx)**

Map the LINTX output to a specific GPIO pin.

The default is GPIO9.

**Pin assignment (Rx)**

Map the LINRX input to a specific GPIO pin.

The default is GPI011.

### **LIN mode**

Put the LIN module in Master or Slave mode. The default is Slave.

In master mode, the LIN node can transmit queries and commands to slaves. In slave mode, the LIN module responds to queries or commands from a master node.

This option corresponds to the CLK\_MASTER field in the SCI Global Control Register (SCIGCR1).

### **ID filtering**

Select which type of mask filtering comparison the LIN module performs, ID byte or ID slave task byte.

If you select ID byte, the module uses the RECID and ID-BYTE fields in the LINID register to detect a match. If you select this option and enter 0xFF for LINMASK, the LIN module does not report matches.

If you select ID slave task, the module uses the RECID and ID-SlaveTask byte to detect a match. If you select this option and enter 0xFF for LINMASK, the LIN module reports matches.

The default is ID slave task byte.

### **ID byte**

If you set **ID filtering** to ID byte, use this option to set the ID BYTE, also known as the “LIN mode message ID”.

In master mode, the CPU writes this value to initiate a header transmission. In slave mode, the LIN module uses this value to perform message filtering.

The default is 0x3A.

### **ID slave task byte**

If you set **ID filtering** to ID slave task byte, use this option to set the ID-SlaveTask BYTE. The LIN node compares this byte with the Received ID and determines whether to send a transmit or receive response.

The default is 0x30.

### **Checksum type**

Use this option to select the type of checksum. If you select **Classic**, the LIN node generates the checksum field from the data fields in the response.

If you select **Enhance**, the LIN node generates the checksum field from both the ID field in the header and data fields in the response. LIN 1.3 supports classic checksums only. LIN 2.0 supports both classic and enhanced checksums.

The default is **Classic**.

### **Enable multibuffer mode**

When you enable (select) this checkbox, the LIN node uses transmit and receive buffers instead of just one register. This setting affects various other LIN registers, such as: checksums, framing errors, transmitter empty flags, receiver ready flags, transmitter ready flags.

The default is enabled (checked).

### **Enable baud rate adapt mode**

The dialog box displays this option when you set **LIN mode** to **Slave**.

If you enable this option, the slave node automatically adjusts its baud rate to match that of the master node. For this feature to work, first set the **Baud rate prescaler** and **Baud rate fractional divider**.

If you disable this option, the LIN module sets a static baud rate based on the **Baud rate prescaler** and **Baud rate fractional divider**.

The default is disabled (unchecked).

### **Inconsistent synch field error interrupt**

The dialog box displays this option when you set **LIN mode** to **Slave**.

If you enable this option, the slave node generates interrupts when it detects irregularities in the synch field. This option is only relevant if you enable **Enable adapt mode**.

The default is **Disabled**.

### **No response error interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

If you enable this option, the LIN module generates an interrupt if it does not receive a complete response from the master node within a timeout period.

The default is Disabled.

### **Timeout after 3 wakeup signals interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When enabled, the slave node generates an interrupt when it sends three wakeup signals to the master node and does not receive a header in response. (The slave waits 1.5 seconds before sending another series of wakeup signals.)

This interrupt typically indicates the master node is having a problem recovering from low-power or sleep mode.

The default is Disabled.

### **Timeout after wakeup signal interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When enabled, the slave node generates an interrupt when it sends a wakeup signal to the master node and does not receive a header in response. (The slave waits 150 milliseconds before sending another series of wakeup signals.)

This interrupt typically indicates the master node is delayed recovering from low-power or sleep mode.

The default is Disabled.

### **Timeout interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When enabled, the slave node generates an interrupt after 4 seconds of inactivity on the LIN bus.



The default is Disabled.

### **Wakeup interrupt**

The dialog box displays this option when you set **LIN mode** to Slave.

When you enable this option:

- In low-power mode, a LIN slave node generates a wakeup interrupt when it detects the falling edge of a wake-up pulse or a low level on the LINRX pin.
- A LIN slave node that is “awake” generates a wakeup interrupt if it receives a request to enter low-power mode while it is receiving.
- A LIN slave node that is “awake” does not generate a wakeup interrupt if it receives a wakeup pulse.

The default is Disabled.

### Coder Target Pane

The Coder Target pane is visible when you set the following parameters on the Code Generation pane as follows:

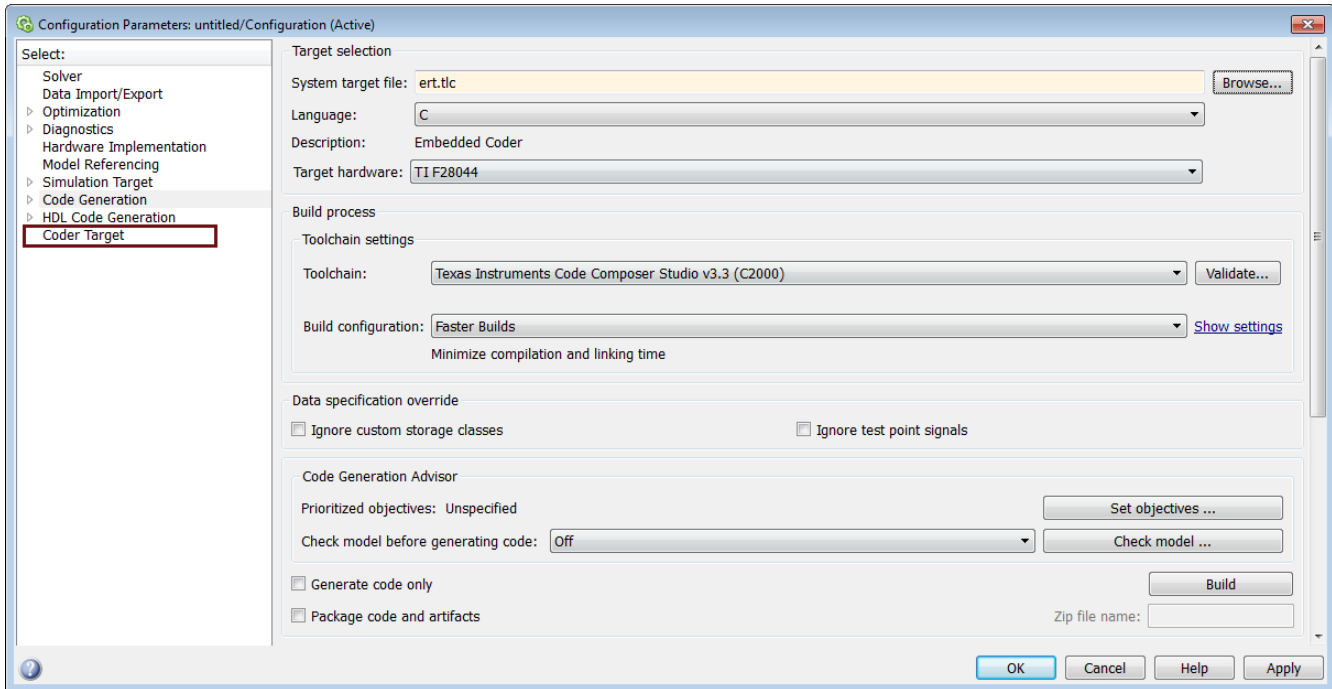
**System target file** to `ert.tlc`.

**Target hardware** to a specific type of hardware (not None).

If you are a new user, the `ert.tlc` system target file is the preferred option over the `idmlink_ert.tlc`. This option provides a uniform model configuration workflow across the phases of development such as simulation, target prototyping and production code generation.

The features that the `ert.tlc` workflow supports include:

- Production code generation workflow.
- Auto-download and run (when supported with the respective vendor tools).



## System target file

Specify the system target file.

## Settings

**Default:** grt.tlc

Use the System Target File Browser. Click the **Browse** button, which lets you select a preset target configuration consisting of a system target file, template makefile, and make command. For uniform model configuration workflow, select `ert.tlc`.

## Target hardware

Select the target hardware for which to generate code.

The **Coder Target** pane is visible with corresponding peripherals, when you select a target hardware. Changing the **Target hardware** parameter changes the peripherals visible on the **Coder Target** pane.

### **Toolchain**

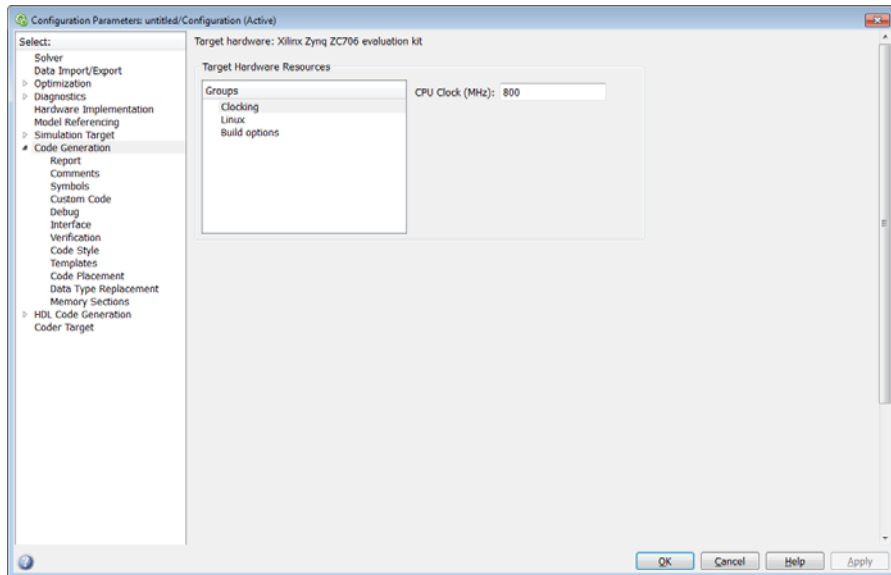
Based on the target hardware you select, the corresponding tool chain is automatically selected. You can select a different value from the **Toolchain** list.

---

**Note** The above parameters settings are specific to **Coder Target** pane. For the other parameter settings on the screen, see “Code Generation Pane: General”.

---

## Coder Target Pane: Xilinx Zynq ZC702/ZC706 Evaluation Kits, ZedBoard



### In this section...

“Coder Target Pane Overview” on page 3-326

“Coder Target” on page 3-327

“Cloning” on page 3-328

“Linux” on page 3-328

“Build Options” on page 3-328

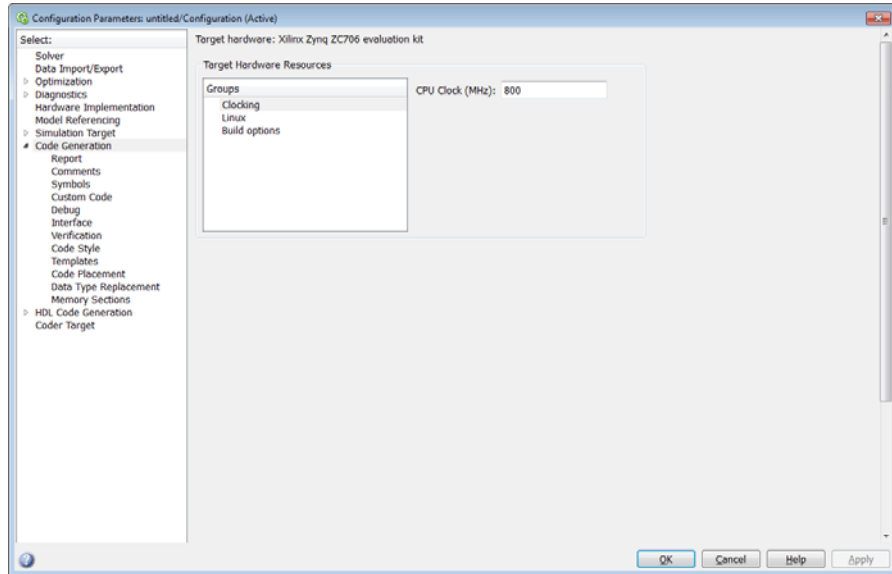
### **Coder Target Pane Overview**

Configure the parameters for properties of the physical hardware, such as peripherals.

#### **See Also**

“Support Package for Xilinx Zynq-7000 Platform”

## Coder Target



This Coder Target pane is visible when the following parameters are on the Code Generation pane are both set as follows:

- **System target file** is `ert.tlc`
- **Target hardware** is Xilinx Zynq ZC702 evaluation kit

### Clocking

#### CPU Clock (MHz)

Specify the CPU clock frequency of the real ARM Cortex processor on the target hardware.

### Linux

#### Base Rate Task Priority

This parameter sets the static priority of the base rate task. By default, the priority is 40.

### Build Options

#### Build action

Defines how Simulink Coder software responds when you press Ctrl+B to build your model.

### Settings

**Default:** Build, load and run

Build, load and run

With this option, pressing Ctrl+B or clicking Build Model:

- 1 Generates code from the model.
- 2 Compiles and links the code into an executable with libraries.
- 3 Loads the executable and libraries into the QEMU emulator.
- 4 Runs the executable in the QEMU emulator.

Build

With this option, pressing Ctrl+B or clicking Build Model:

- 1 Generates code from the model.
- 2 Compiles and links the code into an executable with libraries.

This option does not load and run the executable in the QEMU emulator.



## Command-Line Information

**Parameter:** buildAction

**Type:** string

**Value:** Build | Build\_load\_and\_run |

**Default:** Build\_load\_and\_run

## Recommended Settings

| Application       | Setting            |
|-------------------|--------------------|
| Debugging         | Build_load_and_run |
| Traceability      | No impact          |
| Efficiency        | No impact          |
| Safety precaution | No impact          |

## See Also

For more information, refer to the “Code Generation Pane: Coder Target” topic.

For more information about PIL and its uses, refer to the “Verifying Generated Code via Processor-in-the-Loop” topic.

## Parameter Reference

|                                                            |
|------------------------------------------------------------|
| <b>In this section...</b>                                  |
| “Recommended Settings Summary” on page 3-330               |
| “Parameter Command-Line Information Summary” on page 3-345 |

### Recommended Settings Summary

The following table summarizes the impact of each Embedded Coder configuration parameter on debugging, traceability, efficiency, and safety considerations, and indicates the factory default configuration settings for the ERT target. The Simulink Coder configuration parameters are documented in “Recommended Settings Summary”. For additional details, click the links in the Configuration Parameter column.

#### Mapping of Application Requirements to the Optimization Pane : General tab

| <b>Configuration Parameter</b>                                 | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b>                                                | <b>Safety Precaution</b> | <b>Factory Default</b> |
|----------------------------------------------------------------|------------------|---------------------|------------------------------------------------------------------|--------------------------|------------------------|
| <b>Application lifespan (days)</b>                             | No impact        | No impact           | Optimal finite value                                             | inf                      | 1(ERT targets)         |
| <b>Optimize using the specified minimum and maximum values</b> | Off              | Off                 | On                                                               | Off                      | Off                    |
| <b>Remove root level I/O zero initialization</b>               | No impact        | No impact           | On (GUI) off (command line)<br>(execution, ROM), No impact (RAM) | Off                      | Off                    |

### Mapping of Application Requirements to the Optimization Pane : General tab (Continued)

| <b>Configuration Parameter</b>                                          | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b>                                                | <b>Safety Precaution</b> | <b>Factory Default</b> |
|-------------------------------------------------------------------------|------------------|---------------------|------------------------------------------------------------------|--------------------------|------------------------|
| <b>Remove internal data zero initialization</b>                         | No impact        | No impact           | On (GUI) off (command line)<br>(execution, ROM), No impact (RAM) | Off                      | Off                    |
| <b>Optimize initialization code for model reference</b>                 | No impact        | No impact           | On (execution, ROM), No impact (RAM)                             | No impact                | On                     |
| <b>Remove code that protects against division arithmetic exceptions</b> | No impact        | No impact           | On                                                               | Off                      | Off                    |

**Mapping of Application Requirements to the Optimization Pane: Signals and Parameters tab**

| <b>Configuration Parameter</b>            | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b>                                                                                                        | <b>Safety Precaution</b> | <b>Factory Default</b> |
|-------------------------------------------|------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------|
| <b>Simplify array indexing</b>            | No impact        | No impact           | No impact                                                                                                                | No impact                | Off                    |
| <b>Pack Boolean data into bitfields</b>   | No impact        | No Impact           | Off (execution, ROM), On (RAM)                                                                                           | No impact                | Off                    |
| <b>Bitfield declarator type specifier</b> | No impact        | No impact           | Target dependent                                                                                                         | No impact                | uint_T                 |
| <b>Pass reusable subsystem outputs as</b> | No impact        | No impact           | No impact (execution), Structure reference (ROM), Individual arguments (RAM)                                             | No impact                | Structure reference    |
| “Optimize global data access”             | No impact        | No impact           | None (execution, ROM, RAM), Use global to hold temporary results (ROM, RAM, execution) Minimize global data access (ROM, | No impact                | None                   |

### Mapping of Application Requirements to the Optimization Pane: Signals and Parameters tab (Continued)

| Configuration Parameter | Debugging | Traceability | Efficiency       | Safety Precaution | Factory Default |
|-------------------------|-----------|--------------|------------------|-------------------|-----------------|
|                         |           |              | RAM, execution)  |                   |                 |
| Parameter structure     | No impact | Hierarchical | Non-Hierarchical | No impact         | Hierarchical    |

### Mapping of Application Requirements to the Code Generation Pane

| Configuration Parameter       | Debugging | Traceability | Efficiency | Safety Precaution | Factory Default |
|-------------------------------|-----------|--------------|------------|-------------------|-----------------|
| Ignore custom storage classes | No impact | No impact    | No impact  | No impact         | Off             |
| Ignore test point signals     | Off       | No impact    | On         | No impact         | Off             |

### Mapping of Application Requirements to the Code Generation Pane: Report Tab

| Configuration Parameter     | Debugging | Traceability | Efficiency | Safety Precaution | Factory Default |
|-----------------------------|-----------|--------------|------------|-------------------|-----------------|
| Code-to-model               | On        | On           | No impact  | On                | Off             |
| Model-to-code               | On        | On           | No impact  | On                | Off             |
| Generate model Web view     | No impact | No impact    | No impact  | No impact         | Off             |
| Eliminated / virtual blocks | On        | On           | No impact  | On                | Off             |
| Traceable Simulink blocks   | On        | On           | No impact  | On                | Off             |

**Mapping of Application Requirements to the Code Generation Pane: Report Tab (Continued)**

| <b>Configuration Parameter</b>                     | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|----------------------------------------------------|------------------|---------------------|-------------------|--------------------------|------------------------|
| Traceable Stateflow objects                        | On               | On                  | No impact         | On                       | Off                    |
| Traceable MATLAB functions                         | On               | On                  | No impact         | On                       | Off                    |
| Static code metrics                                | No impact        | No impact           | No impact         | No impact                | Off                    |
| Summarize which blocks triggered code replacements | No impact        | No impact           | No impact         | No impact                | Off                    |

**Mapping of Application Requirements to the Code Generation Pane: Comments Tab**

| <b>Configuration Parameter</b>     | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|------------------------------------|------------------|---------------------|-------------------|--------------------------|------------------------|
| Simulink block descriptions        | On               | On                  | No impact         | No impact                | Off                    |
| Simulink data object descriptions  | On               | On                  | No impact         | No impact                | Off                    |
| Custom comments (MPT objects only) | On               | On                  | No impact         | No impact                | Off                    |

### Mapping of Application Requirements to the Code Generation Pane: Comments Tab (Continued)

| Configuration Parameter        | Debugging       | Traceability    | Efficiency | Safety Precaution | Factory Default |
|--------------------------------|-----------------|-----------------|------------|-------------------|-----------------|
| Custom comments function       | Valid file name | Valid file name | No impact  | No impact         | ' '             |
| Stateflow object descriptions  | On              | On              | No impact  | No impact         | Off             |
| Requirements in block comments | On              | On              | No impact  | On                | Off             |

### Mapping of Application Requirements to the Code Generation Pane: Symbols Tab

| Configuration Parameter    | Debugging | Traceability                | Efficiency | Safety Precaution        | Factory Default          |
|----------------------------|-----------|-----------------------------|------------|--------------------------|--------------------------|
| Global variables           | No impact | Valid combination of tokens | No impact  | \$R\$N\$M                | \$R\$N\$M                |
| Global types               | No impact | Valid combination of tokens | No impact  | \$N\$R\$M_T              | &N\$R\$M_T               |
| Field name of global types | No impact | Valid combination of tokens | No impact  | \$N\$M                   | \$N\$M                   |
| Subsystem methods          | No impact | Valid combination of tokens | No impact  | \$R\$N\$M\$F             | \$R\$N\$M\$F             |
| Subsystem method arguments | No impact | Valid combination of tokens | No impact  | rtu_\$N\$M or rty_\$N\$M | rtu_\$N\$M or rty_\$N\$M |

**Mapping of Application Requirements to the Code Generation Pane: Symbols Tab (Continued)**

| <b>Configuration Parameter</b>               | <b>Debugging</b> | <b>Traceability</b>         | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|----------------------------------------------|------------------|-----------------------------|-------------------|--------------------------|------------------------|
| <b>Local temporary variables</b>             | No impact        | Valid combination of tokens | No impact         | \$N\$M                   | \$N\$M                 |
| <b>Local block output variables</b>          | No impact        | Valid combination of tokens | No impact         | rtb_\$N\$M               | rtb_\$N\$M             |
| <b>Constant macros</b>                       | No impact        | Valid combination of tokens | No impact         | \$R\$N\$M                | \$R\$N\$M              |
| <b>Shared utilities</b>                      | No impact        | Valid combination of tokens | No impact         | \$N\$C                   | \$N\$C                 |
| <b>Minimum mangle length</b>                 | No impact        | 1                           | No impact         | No impact                | 1                      |
| <b>System-generated identifiers</b>          | No impact        | No impact                   | No impact         | No impact                | Shortened              |
| <b>Generate scalar inlined parameters as</b> | No impact        | Macros                      | Literals          | No impact                | Literals               |
| <b>#define naming</b>                        | No impact        | Force uppercase             | No impact         | No impact                | None                   |
| <b>Parameter naming</b>                      | No impact        | Force uppercase             | No impact         | No impact                | None                   |
| <b>Signal naming</b>                         | No impact        | Force uppercase             | No impact         | No impact                | None                   |
| <b>MATLAB function</b>                       | No impact        | No impact                   | No impact         | No impact                | ' '                    |



**Mapping of Application Requirements to the Code Generation Pane: Interface Tab**

| <b>Configuration Parameter</b>         | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b>                               | <b>Safety Precaution</b> | <b>Factory Default</b>         |
|----------------------------------------|------------------|---------------------|-------------------------------------------------|--------------------------|--------------------------------|
| <b>Support: floating-point numbers</b> | No impact        | No impact           | Off (GUI), 'on' (command-line) for integer only | No impact                | On (GUI), 'off' (command-line) |
| <b>Support complex numbers</b>         | No impact        | No impact           | Off for real only                               | No impact                | On                             |
| <b>Support absolute time</b>           | No impact        | No impact           | Off                                             | Off                      | On                             |
| <b>Support continuous time</b>         | No impact        | No impact           | Off (execution, ROM), No impact (RAM)           | Off                      | Off                            |
| <b>Support non-inlined S-functions</b> | No impact        | No impact           | Off                                             | Off                      | Off                            |
| <b>Support variable-size signals</b>   | No impact        | No impact           | Off                                             | Off                      | Off                            |
| <b>Multiword type definitions</b>      | No impact        | No impact           | No impact                                       | Use default              | System defined                 |
| <b>Maximum word length</b>             | No impact        | No impact           | No impact                                       | Use default              | 256                            |
| <b>Pass root-level I/O as</b>          | No impact        | No impact           | No impact                                       | No impact                | Individual arguments           |

**Mapping of Application Requirements to the Code Generation Pane: Interface Tab (Continued)**

| <b>Configuration Parameter</b>                                 | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b>                     | <b>Safety Precaution</b> | <b>Factory Default</b> |
|----------------------------------------------------------------|------------------|---------------------|---------------------------------------|--------------------------|------------------------|
| <b>Generate function to allocate model data</b>                | No impact        | No impact           | No impact                             | Off                      | Off                    |
| <b>Single output/update function</b>                           | On               | On                  | On                                    | On                       | On                     |
| <b>Terminate function required</b>                             | No impact        | No impact           | Off (execution, ROM), No impact (RAM) | Off                      | On                     |
| <b>Generate preprocessor conditionals</b>                      | No impact        | No impact           | No impact                             | No impact                | Use local settings     |
| <b>Suppress error status in real-time model data structure</b> | Off              | No impact           | On                                    | On                       | Off                    |
| <b>Combine signal/state structures</b>                         | Off              | No impact           | No impact                             | On                       | No impact              |
| <b>Block parameter visibility</b>                              | No impact        | No impact           | No impact                             | protected                | private                |
| <b>Internal data visibility</b>                                | No impact        | No impact           | No impact                             | protected                | private                |

### Mapping of Application Requirements to the Code Generation Pane: Interface Tab (Continued)

| Configuration Parameter                                   | Debugging      | Traceability   | Efficiency     | Safety Precaution | Factory Default |
|-----------------------------------------------------------|----------------|----------------|----------------|-------------------|-----------------|
| Block parameter access                                    | Inlined method | Inlined method | Inlined method | None              | None            |
| Internal data access                                      | Inlined method | Inlined method | Inlined method | None              | None            |
| External I/O access                                       | Inlined method | Inlined method | Inlined method | None              | None            |
| Generate destructor                                       | No impact      | No impact      | No impact      | Off               | On              |
| Use operator new for referenced model object registration | No impact      | No impact      | On             | Off               | Off             |

### Mapping of Application Requirements to the Code Generation Pane: Verification Tab

| Configuration Parameter                   | Debugging                        | Traceability                     | Efficiency               | Safety Precaution        | Factory Default          |
|-------------------------------------------|----------------------------------|----------------------------------|--------------------------|--------------------------|--------------------------|
| “Code coverage tool” on page 3-13         | BullseyeCoverage or LDRA Testbed | BullseyeCoverage or LDRA Testbed | None (code coverage off) | None (code coverage off) | None (code coverage off) |
| “Create block” on page 3-15               | On                               | No impact                        | No impact                | No impact                | Off                      |
| “Enable portable word sizes” on page 3-17 | On                               | On                               | Off                      | No impact                | Off                      |

**Mapping of Application Requirements to the Code Generation Pane: Verification Tab (Continued)**

| <b>Configuration Parameter</b>                       | <b>Debugging</b>                  | <b>Traceability</b>               | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|------------------------------------------------------|-----------------------------------|-----------------------------------|-------------------|--------------------------|------------------------|
| “Enable source-level debugging for SIL” on page 3-19 | On                                | On                                | Off               | No impact                | Off                    |
| “Measure task execution time” on page 3-5            | On                                | On                                | Off               | No impact                | Off                    |
| “Measure function execution times” on page 3-7       | On                                | On                                | Off               | No impact                | Off                    |
| “Save options” on page 3-11                          | All measurement and analysis data | All measurement and analysis data | Summary data only | No impact                | Summary data only      |
| “Workspace variable” on page 3-9                     | No impact                         | Valid MATLAB variable name        | No impact         | No impact                | Off                    |

**Mapping of Application Requirements to the Code Generation Pane: Code Style Tab**

| <b>Configuration Parameter</b>                                                             | <b>Debugging</b>                      | <b>Traceability</b>                   | <b>Efficiency</b>                                   | <b>Safety Precaution</b>                         | <b>Factory Default</b>                |
|--------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------|-----------------------------------------------------|--------------------------------------------------|---------------------------------------|
| <b>Parentheses level</b>                                                                   | Nominal<br>(Optimize for readability) | Nominal<br>(Optimize for readability) | Minimum<br>(Rely on C/C++ operators for precedence) | Maximum<br>(Specify precedence with parentheses) | Nominal<br>(Optimize for readability) |
| <b>Preserve operand order in expression</b>                                                | On                                    | On                                    | Off                                                 | On                                               | Off                                   |
| <b>Preserve condition expression in if statement</b>                                       | On                                    | On                                    | Off                                                 | On                                               | Off                                   |
| <b>Convert if-elseif-else patterns to switch-case statements</b>                           | No impact                             | Off                                   | On<br>(execution, ROM), No impact<br>(RAM)          | No impact                                        | Off                                   |
| <b>Preserve extern keyword in function declarations</b>                                    | No impact                             | No impact                             | No impact                                           | No impact                                        | On                                    |
| <b>Suppress generation of default cases for Stateflow switch statements if unreachable</b> | No impact                             | On                                    | On<br>(execution, ROM), No impact<br>(RAM)          | Off                                              | Off                                   |

**Mapping of Application Requirements to the Code Generation Pane: Code Style Tab (Continued)**

| <b>Configuration Parameter</b> | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|--------------------------------|------------------|---------------------|-------------------|--------------------------|------------------------|
| Indent style                   | K&R              | K&R                 | K&R               | K&R                      | K&R                    |
| Indent size                    | 2                | 2                   | 2                 | 2                        | 2                      |

**Mapping of Application Requirements to the Code Generation Pane: Templates Tab**

| <b>Configuration Parameter</b>                    | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b>    |
|---------------------------------------------------|------------------|---------------------|-------------------|--------------------------|---------------------------|
| <b>Code templates: Source file (*.c) template</b> | No impact        | No impact           | No impact         | No impact                | ert_code_-template.cgt    |
| <b>Code templates: Header file (*.h) template</b> | No impact        | No impact           | No impact         | No impact                | ert_code_-template.cgt    |
| <b>Data templates: Source file (*.c) template</b> | No impact        | No impact           | No impact         | No impact                | ert_code_-template.cgt    |
| <b>Data templates: Header file (*.h) template</b> | No impact        | No impact           | No impact         | No impact                | ert_code_-template.cgt    |
| <b>File customization template</b>                | No impact        | No impact           | No impact         | No impact                | example_file_-process.tlc |

### Mapping of Application Requirements to the Code Generation Pane: Templates Tab (Continued)

| Configuration Parameter          | Debugging | Traceability | Efficiency | Safety Precaution | Factory Default   |
|----------------------------------|-----------|--------------|------------|-------------------|-------------------|
| Generate an example main program | No impact | No impact    | No impact  | No impact         | On                |
| Target operating system          | No impact | No impact    | No impact  | No impact         | BareBoard-Example |

### Mapping of Application Requirements to the Code Generation Pane: Code Placement Tab

| Configuration Parameter   | Debugging | Traceability  | Efficiency | Safety Precaution | Factory Default |
|---------------------------|-----------|---------------|------------|-------------------|-----------------|
| Data definition           | No impact | Valid value   | No impact  | No impact         | Auto            |
| Data definition filename  | No impact | Valid value   | No impact  | No impact         | global.c        |
| Data declaration          | No impact | Valid value   | No impact  | No impact         | Auto            |
| Data declaration filename | No impact | Valid value   | No impact  | No impact         | global.h        |
| #include file delimiter   | No impact | Valid value   | No impact  | No impact         | off             |
| #include file delimiter   | No impact | Valid value   | No impact  | No impact         | Auto            |
| Signal display level      | No impact | Valid integer | No impact  | No impact         | 10              |

**Mapping of Application Requirements to the Code Generation Pane: Code Placement Tab (Continued)**

| <b>Configuration Parameter</b> | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|--------------------------------|------------------|---------------------|-------------------|--------------------------|------------------------|
| Parameter tune level           | No impact        | Valid integer       | No impact         | No impact                | 10                     |
| File packaging format          | No impact        | No impact           | No impact         | No impact                | Modular                |

**Mapping of Application Requirements to the Code Generation Pane: Data Type Replacement Tab**

| <b>Configuration Parameter</b>                | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|-----------------------------------------------|------------------|---------------------|-------------------|--------------------------|------------------------|
| Replace data type names in the generated code | No impact        | On                  | No impact         | No impact                | Off                    |
| Replacement Name                              | No impact        | Valid string        | No impact         | ' '                      | ' '                    |

**Mapping of Application Requirements to the Code Generation Pane: Memory Sections Tab**

| <b>Configuration Parameter</b> | <b>Debugging</b> | <b>Traceability</b> | <b>Efficiency</b> | <b>Safety Precaution</b> | <b>Factory Default</b> |
|--------------------------------|------------------|---------------------|-------------------|--------------------------|------------------------|
| Package                        | No impact        | No impact           | No impact         | No impact                | ---None---             |
| Initialize/- Terminate         | No impact        | No impact           | No impact         | No impact                | Default                |
| Execution                      | No impact        | No impact           | No impact         | No impact                | Default                |
| Shared utility                 | No impact        | No impact           | No impact         | No impact                | Default                |
| Constants                      | No impact        | No impact           | No impact         | No impact                | Default                |



## Mapping of Application Requirements to the Code Generation Pane: Memory Sections Tab (Continued)

| Configuration Parameter | Debugging | Traceability | Efficiency | Safety Precaution | Factory Default      |
|-------------------------|-----------|--------------|------------|-------------------|----------------------|
| Inputs/Outputs          | No impact | No impact    | No impact  | No impact         | Default              |
| Internal data           | No impact | No impact    | No impact  | No impact         | Default              |
| Parameters              | No impact | No impact    | No impact  | No impact         | Default              |
| Validation results      | No impact | No impact    | No impact  | No impact         | No package selected. |

### Parameter Command-Line Information Summary

The following tables list Embedded Coder parameters that you can use to tune model and target configurations. The table provides brief descriptions, valid values (bold type highlights defaults), and a mapping to Configuration Parameter dialog box equivalents.

Use the `get_param` and `set_param` commands to retrieve and set the values of the parameters on the MATLAB command line or programmatically in scripts. The Configuration Wizard also provides buttons and scripts for customizing code generation.

---

**Note** Parameters that are specific to the ERT target or targets based on the ERT target, Stateflow, or the Fixed-Point Designer product are marked with (ERT), (Stateflow), and (Fixed-Point Designer), respectively. To set the values of parameters marked with (ERT), you must specify an ERT or ERT-based target for your configuration set. Also, note that the default setting for a parameter might vary for different targets. Parameters marked with (ERT) are listed with ERT target defaults.

---

**Command-Line Information: Optimization Pane: General tab**

| <b>Parameter and Values</b>                                                | <b>Configuration Parameters Dialog Box Equivalent</b>                   | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NoFixptDivByZeroProtection (ERT) (Fixed-Point Designer)<br><b>off</b> , on | <b>Remove code that protects against division arithmetic exceptions</b> | Suppress generation of code that guards against division by zero for fixed-point data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| OptimizeModelRefInitCode (ERT)<br><b>off</b> , on                          | <b>Optimize initialization code for model reference</b>                 | <p>Suppresses generation of initialization code for blocks that have states unless the blocks are in a system that can reset its states, such as an enabled subsystem. This results in more efficient code.</p> <p>The following restrictions apply to using the <b>Optimize initialization code for model reference</b> parameter. However, these restrictions do not apply to a Model block that references a function-call model.</p> <ul style="list-style-type: none"> <li>• In a subsystem that resets states, do not include a Model block that references a model that has this parameter set to on. For example, in an enabled subsystem with the <b>States when enabling</b> block parameter set to reset, do not include</li> </ul> |

**Command-Line Information: Optimization Pane: General tab (Continued)**

| Parameter and Values                                        | Configuration Parameters Dialog Box Equivalent                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                             |                                                                | <p>a Model block that references a model that has the <b>Optimize initialization code for model reference</b> parameter set to on.</p> <ul style="list-style-type: none"> <li>If you set the <b>Optimize initialization code for model reference</b> parameter to off in a model that includes a Model block, do not set the <b>Optimize initialization code for model reference</b> parameter for the Model block to on.</li> </ul> |
| UseSpecifiedMinMax (ERT)<br><i>string</i> - <b>off</b> , on | <b>Optimize using the specified minimum and maximum values</b> | Use the specified minimum and maximum values, such as block Output minimum and                                                                                                                                                                                                                                                                                                                                                       |
| ZeroExternalMemoryAtStartup (ERT)<br>off, <b>on</b>         | <b>Remove root level I/O zero initialization</b>               | Suppress code that initializes root-level I/O data structures to zero.                                                                                                                                                                                                                                                                                                                                                               |
| ZeroInternalMemoryAtStartup (ERT)<br>off, <b>on</b>         | <b>Remove internal data zero initialization</b>                | Suppress code that initializes global data structures (for example, block I/O data structures) to zero.                                                                                                                                                                                                                                                                                                                              |

**Command-Line Information: Optimization Pane: Signals and Parameters tab**

| <b>Parameter and Values</b>                                                                                 | <b>Configuration Parameters Dialog Box Equivalent</b> | <b>Description</b>                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InlinedParameterPlacement (ERT)<br><b>Hierarchical,</b><br>NonHierarchical                                  | <b>Parameter structure</b>                            | Specify how generated code stores global (tunable) parameters. Specify NonHierarchical to trade off modularity for efficiency.                                     |
| BooleansAsBitfields (ERT)<br><b>off, on</b>                                                                 | <b>Pack Boolean data into bitfields</b>               | Specify how generated code stores Boolean signals. If selected, Boolean signals are stored into one-bit bitfields in global block I/O structures or DWork vectors. |
| BitfieldContainerType (ERT)<br><b>uint_T, uchar_T</b>                                                       | <b>Bitfield declarator type specifier</b>             | Specify the bitfield type when using the optimization to pack boolean data into bitfields.                                                                         |
| GlobalVariableUsage (ERT)<br><b>None,</b> Use global to hold temporary results, Minimize global data access | <b>Optimize global data access</b>                    | Specify global data usage optimization.                                                                                                                            |
| StrengthReduction (ERT)<br><b>off, on</b>                                                                   | <b>Simplify array indexing</b>                        | Suppress generation of code that replaces multiply operations when accessing arrays in a loop.                                                                     |
| PassReuseOutputArgsAs (ERT)<br><b>Structure reference,</b><br>Individual arguments                          | <b>Pass reusable subsystem output as</b>              | Specify how a reusable subsystem passes outputs. Specify Individual arguments for efficiency.                                                                      |

**Command-Line Information: Optimization Pane: Stateflow tab**

| Parameter and Values                        | Configuration Parameters Dialog Box Equivalent | Description                                   |
|---------------------------------------------|------------------------------------------------|-----------------------------------------------|
| DataBitsets (Stateflow)<br><b>off</b> , on  | Use bitsets for storing Boolean data           | Use bit sets for storing Boolean data.        |
| StateBitsets (Stateflow)<br><b>off</b> , on | Use bitsets for storing state configuration    | Use bit sets for storing state configuration. |

**Command-Line Information: Code Generation Pane: General Tab**

| Parameter and Values                                                | Configuration Parameters Dialog Box Equivalent            | Description                                           |
|---------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------|
| IgnoreCustomStorageClasses (ERT)<br><i>string</i> - <b>off</b> , on | Code Generation > General > Ignore custom storage classes | Treat custom storage classes as 'Auto'.               |
| IgnoreTestpoints (ERT)<br><i>string</i> - <b>off</b> , on           | Code Generation > General > Ignore test point signals     | Specify allocation of memory buffers for test points. |

**Command-Line Information: Code Generation Pane: Report Tab**

| Parameter and Values                                              | Configuration Parameters Dialog Box Equivalent     | Description                                                                                                               |
|-------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| GenerateTraceInfo (ERT)<br><i>string</i> - <b>off</b> , on        | Code Generation > Report > Model-to-code           | Includes model-to-code traceability support in the generated HTML report.                                                 |
| IncludeHyperlinkInReport (ERT)<br><i>string</i> - <b>off</b> , on | Code Generation > Report > Code-to-model           | Link code segments to the corresponding object in the model. This option increases code generation time for large models. |
| GenerateWebview (ERT)<br><i>string</i> - <b>off</b> , on          | Code Generation > Report > Generate model Web view | Include the model Web view in the code generation report.                                                                 |

**Command-Line Information: Code Generation Pane: Report Tab (Continued)**

| <b>Parameter and Values</b>                                            | <b>Configuration Parameters Dialog Box Equivalent</b>                                      | <b>Description</b>                                                                                                                |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| GenerateTraceReport (ERT)<br><i>string</i> - <b>off</b> , on           | <b>Code Generation &gt; Report &gt; Eliminated / virtual blocks</b>                        | Include summary of eliminated and virtual blocks in Code Generation report.                                                       |
| GenerateTraceReportSl (ERT)<br><i>string</i> - <b>off</b> , on         | <b>Code Generation &gt; Report &gt; Traceable Simulink blocks</b>                          | Include summary of Simulink blocks in Code Generation report.                                                                     |
| GenerateTraceReportSf (ERT)<br><i>string</i> - <b>off</b> , on         | <b>Code Generation &gt; Report &gt; Traceable Stateflow objects</b>                        | Include summary of Stateflow objects in Code Generation report.                                                                   |
| GenerateTraceReportEm1 (ERT)<br><i>string</i> - <b>off</b> , on        | <b>Code Generation &gt; Report &gt; Traceable MATLAB functions</b>                         | Include summary of MATLAB functions in Code Generation report.                                                                    |
| GenerateCodeMetricsReport (ERT)<br><i>string</i> - <b>off</b> , on     | <b>Code Generation &gt; Report &gt; Static code metrics</b>                                | Include static code metrics report in the code generation report.                                                                 |
| GenerateCodeReplacementReport (ERT)<br><i>string</i> - <b>off</b> , on | <b>Code Generation &gt; Report &gt; Summarize which blocks triggered code replacements</b> | Include code replacement report summarizing replacement functions used and their associated blocks in the code generation report. |

**Command-Line Information: Code Generation Pane: Comments Tab**

| <b>Parameter and Values</b>                                   | <b>Configuration Parameters Dialog Box Equivalent</b>                        | <b>Description</b>                                                                                                             |
|---------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| CustomCommentsFcn (ERT)<br><i>string</i> - ''                 | <b>Code Generation &gt; Comments &gt; Custom comments function</b>           | Specify the filename of the MATLAB or TLC function that adds the custom comment.                                               |
| EnableCustomComments (ERT)<br><i>string</i> - <b>off</b> , on | <b>Code Generation &gt; Comments &gt; Custom comments (MPT objects only)</b> | Add a comment above a signal's or parameter's identifier in the generated file.                                                |
| InsertBlockDesc (ERT)<br><i>string</i> - <b>off</b> , on      | <b>Code Generation &gt; Comments &gt; Simulink block descriptions</b>        | Insert the contents of the <b>Description</b> field from the Block Parameters dialog box into the generated code as a comment. |
| ReqsInCode (ERT)<br><i>string</i> - <b>off</b> , on           | <b>Code Generation &gt; Comments &gt; Requirements in block comments</b>     | Include specified requirements in the generated code as a comment.                                                             |
| SFDataObjDesc (ERT)<br><i>string</i> - <b>off</b> , on        | <b>Code Generation &gt; Comments &gt; Stateflow object descriptions</b>      | Insert Stateflow object descriptions into the generated code as a comment.                                                     |
| SimulinkDataObjDesc (ERT)<br><i>string</i> - <b>off</b> , on  | <b>Code Generation &gt; Comments &gt; Simulink data object descriptions</b>  | Insert Simulink data object descriptions into the generated code as comments.                                                  |

**Command-Line Information: Code Generation Pane: Symbols Tab**

| <b>Parameter and Values</b>                                                                | <b>Configuration Parameters Dialog Box Equivalent</b>                 | <b>Description</b>                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CustomSymbolStrBlkIO (ERT)<br><i>string</i> - <b>rtb_</b> $\$N\$M$                         | <b>Code Generation &gt; Symbols &gt; Local block output variables</b> | Specify a symbol format rule for local block output variables. The rule can contain valid C identifier characters and the following macros:<br>$\$M$ - Mangle<br>$\$N$ - Name of object<br>$\$A$ - Data type acronym                                                        |
| CustomSymbolStrFcn (ERT)<br><i>string</i> - <b>\\$R</b> $\$N\$M\$F$                        | <b>Code Generation &gt; Symbols &gt; Subsystem methods</b>            | Specify a symbol format rule for subsystem methods. The rule can contain valid C identifier characters and the following macros:<br>$\$M$ - Mangle<br>$\$R$ - Root model name<br>$\$N$ - Name of object<br>$\$H$ - System hierarchy number<br>$\$F$ - Subsystem method name |
| CustomSymbolStrFcnArg(ERT)<br><i>string</i> - <b>rtu_</b> $\$N\$M$ or <b>rty_</b> $\$N\$M$ | <b>Code Generation &gt; Symbols &gt; Subsystem method arguments</b>   | Specify a symbol format rule for subsystem method arguments. The rule can contain valid C identifier characters and the following macros:<br>$\$I$ — $u$ if the argument is an input or $y$ if the argument is an output<br>$\$M$ - Mangle<br>$\$N$ - Name of object        |



**Command-Line Information: Code Generation Pane: Symbols Tab (Continued)**

| <b>Parameter and Values</b>                                        | <b>Configuration Parameters Dialog Box Equivalent</b>               | <b>Description</b>                                                                                                                                                                                                                            |
|--------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CustomSymbolStrField (ERT)<br><i>string</i> - <b>\$N\$M</b>        | <b>Code Generation &gt; Symbols &gt; Field name of global types</b> | Specify a symbol format rule for field name of global types. The rule can contain valid C identifier characters and the following macros:<br>\$M - Mangle<br>\$N - Name of object<br>\$H - System hierarchy number<br>\$A - Data type acronym |
| CustomSymbolStrGlobalVar (ERT)<br><i>string</i> - <b>\$R\$N\$M</b> | <b>Code Generation &gt; Symbols &gt; Global variables</b>           | Specify a symbol format rule for global variables. The rule can contain valid C identifier characters and the following macros:<br>\$M - Mangle<br>\$R - Root model name<br>\$N - Name of object                                              |
| CustomSymbolStrMacro (ERT)<br><i>string</i> - <b>\$R\$N\$M</b>     | <b>Code Generation &gt; Symbols &gt; Constant macros</b>            | Specify a symbol format rule for constant macros. The rule can contain valid C identifier characters and the following macros:<br>\$M - Mangle<br>\$R - Root model name<br>\$N - Name of object                                               |

**Command-Line Information: Code Generation Pane: Symbols Tab (Continued)**

| <b>Parameter and Values</b>                                   | <b>Configuration Parameters Dialog Box Equivalent</b>                          | <b>Description</b>                                                                                                                                                                                                                   |
|---------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CustomSymbolStrTmpVar (ERT)<br><i>string</i> - <b>\$N\$M</b>  | <b>Code Generation &gt; Symbols &gt; Local temporary variables</b>             | Specify a symbol format rule for local temporary variables. The rule can contain valid C identifier characters and the following macros:<br>\$M - Mangle<br>\$R - Root model name<br>\$N - Name of object<br>\$A - Data type acronym |
| CustomSymbolStrType (ERT)<br><i>string</i> - <b>\$N\$R\$M</b> | <b>Code Generation &gt; Symbols &gt; Global types</b>                          | Specify a symbol format rule for global types. The rule can contain valid C identifier characters and the following macros:<br>\$M - Mangle<br>\$R - Root model name<br>\$N - Name of object                                         |
| CustomSymbolStrUtil (ERT)<br><i>string</i> - <b>\$N\$C</b>    | <b>Code Generation &gt; Symbols &gt; Shared utilities</b>                      | Specify a symbol format rule for shared utilities. The rule can contain valid C identifier characters and the following macros:<br>\$N - Name of object<br>\$C - Checksum                                                            |
| DefineNamingFcn (ERT)<br><i>string</i> - ''                   | <b>Code Generation &gt; Symbols &gt; #define naming &gt; Custom M-function</b> | Specify a custom MATLAB function to control the naming of symbols with #define statements. You can set this parameter only if DefineNamingRule is set to Custom.                                                                     |

**Command-Line Information: Code Generation Pane: Symbols Tab (Continued)**

| <b>Parameter and Values</b>                                                   | <b>Configuration Parameters Dialog Box Equivalent</b>                                   | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DefineNamingRule (ERT)<br>string - <b>None</b> , UpperCase, LowerCase, Custom | <b>Code Generation &gt; Symbols &gt; #define naming</b>                                 | Specify the rule that changes the spelling of #define names.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| IncDataTypeInIds (ERT)<br><b>off</b> , on                                     | <b>Code Generation &gt; Symbol &gt; Include data type acronym in identifiers</b>        | Include acronyms that express data types in signal and work vector identifiers. For example, 'rtB.i32_signame' identifies a 32-bit integer block output signal named 'signame'.                                                                                                                                                                                                                                                                                                            |
| IncHierarchyInIds (ERT)<br><b>off</b> , on                                    | <b>Code Generation &gt; Symbols &gt; Include system hierarchy number in identifiers</b> | Include the system hierarchy number in variable identifiers. For example, 's3_' is the system hierarchy number in rtB.s3_signame for a block output signal named 'signame'. Including the system hierarchy number in identifiers improves the traceability of generated code. To locate the subsystem in which the identifier resides, type <code>hilite_system('&lt;S3&gt;')</code> at the MATLAB prompt. The argument specified with <code>hilite_system</code> requires an uppercase S. |

**Command-Line Information: Code Generation Pane: Symbols Tab (Continued)**

| <b>Parameter and Values</b>                                                  | <b>Configuration Parameters Dialog Box Equivalent</b>                          | <b>Description</b>                                                                                                                                                                                                              |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InlinedPrmAccess (ERT)<br>string - <b>Literals</b> , Macros                  | <b>Code Generation &gt; Symbols &gt; Generate scalar inlined parameters as</b> | Specify whether inlined parameters are coded as numeric constants or macros. Specify <b>Macros</b> for more efficient code.                                                                                                     |
| MangleLength (ERT)<br>int - <b>1</b>                                         | <b>Code Generation &gt; Symbols &gt; Minimum mangle length</b>                 | Specify the minimum number of characters to be used for name mangling strings generated and applied to symbols to avoid name collisions. A larger value reduces the chance of identifier disturbance when you modify the model. |
| InternalIdentifier (ERT)<br>string - <b>Shortened</b> , Classic              | <b>Code Generation &gt; Symbols &gt; System-generated identifiers</b>          | Specify whether the code generator uses shorter, more consistent names for system-generated identifiers.                                                                                                                        |
| ParamNamingRule (ERT)<br>string - <b>None</b> , UpperCase, LowerCase, Custom | <b>Code Generation &gt; Symbols &gt; Parameter naming</b>                      | Select a rule that changes spelling of parameter names.                                                                                                                                                                         |

**Command-Line Information: Code Generation Pane: Symbols Tab (Continued)**

| <b>Parameter and Values</b>                                                   | <b>Configuration Parameters Dialog Box Equivalent</b>                            | <b>Description</b>                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PrefixModelToSubsysFcnNames (ERT)<br>off, <b>on</b>                           | <b>Code Generation &gt; Symbols &gt; Prefix model name to global identifiers</b> | Add the model name as a prefix to subsystem function names for code formats. Also consider adding the model name as a prefix to top-level functions and data structures. This prevents compiler errors due to name clashes when combining multiple models. |
| SignalNamingRule (ERT)<br>string - <b>None</b> , UpperCase, LowerCase, Custom | <b>Code Generation &gt; Symbols &gt; Signal naming</b>                           | Specify a rule the code generator is to use that changes spelling of signal names.                                                                                                                                                                         |

**Command-Line Information: Code Generation Pane: Interface Tab**

| <b>Parameter and Values</b>                              | <b>Configuration Parameters Dialog Box Equivalent</b>                    | <b>Description</b>                                                                                                                                                                                                      |
|----------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CombineOutputUpdateFcns (ERT)<br>string - off, <b>on</b> | <b>Code Generation &gt; Interface &gt; Single output/update function</b> | Generate a model's output and update routines into a single-step function.                                                                                                                                              |
| ERTMultiwordLength (ERT)<br>int - <b>256</b>             | <b>Code Generation &gt; Interface &gt; Maximum word length</b>           | Specify a maximum word length, in bits, for which the code generation process will generate system-defined multiword types into the file <code>rtwtypes.h</code> . Specifying 0 provides you complete control over type |

**Command-Line Information: Code Generation Pane: Interface Tab (Continued)**

| Parameter and Values                                                                                                                                | Configuration Parameters Dialog Box Equivalent                                      | Description                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                     |                                                                                     | definitions for multiword data types in generated code.                                                                                                               |
| ERTMultiwordTypeDef (ERT)<br>string - <b>System defined</b> , User defined                                                                          | <b>Code Generation &gt; Interface &gt; Multiword type definitions</b>               | Use system-defined or user-defined type definitions for multiword data types in generated code.                                                                       |
| GenerateAllocFcn (ERT)<br>string - <b>off</b> , on                                                                                                  | <b>Code Generation &gt; Interface &gt; Generate function to allocate model data</b> | Generate a function to dynamically allocate memory (using malloc) for model data structures.                                                                          |
| GenerateDestructor (ERT)<br>string - off, <b>on</b>                                                                                                 | <b>Code Generation &gt; Interface &gt; Generate destructor</b>                      | Generate a destructor for the C++ model class.                                                                                                                        |
| GenerateExternalIOAccess-<br>Methods (ERT)<br>string - <b>None</b> , Method, Inlined method, Structure-based method, Inlined structure-based method | <b>Code Generation &gt; Interface &gt; External I/O access</b>                      | Generate access methods for root-level I/O signals for the C++ model class.                                                                                           |
| GenerateInternalMember-<br>AccessMethods (ERT)<br>string - <b>None</b> , Method, Inlined method                                                     | <b>Code Generation &gt; Interface &gt; Internal data access</b>                     | Generate access methods for internal data structures such as Block I/O, DWork vectors, Run-time model, Zero-crossings, and continuous states for the C++ model class. |

**Command-Line Information: Code Generation Pane: Interface Tab (Continued)**

| <b>Parameter and Values</b>                                                                                    | <b>Configuration Parameters Dialog Box Equivalent</b>                                              | <b>Description</b>                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GenerateParameterAccess-<br>Methods (ERT)<br>string - <b>None</b> , Method, Inlined<br>method                  | <b>Code Generation</b><br>> <b>Interface</b> > <b>Block</b><br><b>parameter access</b>             | Generate access methods<br>for block parameters for<br>the C++ model class.                                                                                                                                             |
| GeneratePreprocessor-<br>Conditionals (ERT)<br>string - <b>Use local settings</b> ,<br>Enable all, Disable all | <b>Code Generation</b><br>> <b>Interface</b> > <b>Generate</b><br><b>preprocessor conditionals</b> | Generate preprocessor<br>conditionals locally<br>for each Model block<br>containing variants or<br>globally for all Model<br>blocks in a model.                                                                         |
| IncludeMdlTerminateFcn<br>(ERT)<br>string - off, <b>on</b>                                                     | <b>Code</b><br><b>Generation</b> > <b>Interface</b> ><br><b>Terminate function required</b>        | Generate a terminate<br>function for the model.                                                                                                                                                                         |
| InternalMemberVisibility<br>(ERT)<br>string - public, <b>private</b> ,<br>protected                            | <b>Code Generation</b><br>> <b>Interface</b> > <b>Internal data</b><br><b>visibility</b>           | Generate internal<br>data structures such<br>as Block I/O, DWork<br>vectors, Run-time model,<br>Zero-crossings, and<br>continuous states as<br>public, private, or<br>protected data members<br>of the C++ model class. |
| ParameterMemberVisibility<br>(ERT)<br>string - public, <b>private</b> ,<br>protected                           | <b>Code Generation</b><br>> <b>Interface</b> > <b>Block</b><br><b>parameter visibility</b>         | Generate the block<br>parameter structure<br>as a public, private, or<br>protected data member<br>of the C++ model class.                                                                                               |
| PurelyIntegerCode (ERT)<br>string - <b>off</b> , on                                                            | <b>Code</b><br><b>Generation</b> > <b>Interface</b> ><br><b>floating-point numbers</b>             | Support floating-point<br>data types in the<br>generated code. This<br>option is forced on when<br>SupportNonInlinedSFcns<br>is on.                                                                                     |

**Command-Line Information: Code Generation Pane: Interface Tab (Continued)**

| <b>Parameter and Values</b>                                                                                    | <b>Configuration Parameters Dialog Box Equivalent</b>                                              | <b>Description</b>                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RootIOFormat (ERT)<br>string - <b>Individual arguments</b> , Structure reference, Part of model data structure | <b>Code Generation &gt; Interface &gt; Pass root-level I/O as</b>                                  | Specify how the generated code passes root-level I/O data into a reusable function.                                                                           |
| SupportAbsoluteTime (ERT)<br>string - <b>off</b> , on                                                          | <b>Code Generation &gt; Interface &gt; absolute time</b>                                           | Support absolute time in the generated code. Blocks such as the Discrete Integrator might require absolute time.                                              |
| SupportComplex (ERT)<br>string - <b>off</b> , on                                                               | <b>Code Generation &gt; Interface &gt; complex numbers</b>                                         | Support complex data types in the generated code.                                                                                                             |
| SupportContinuousTime (ERT)<br>string - <b>off</b> , <b>on</b>                                                 | <b>Code Generation &gt; Interface &gt; continuous time</b>                                         | Support continuous time in the generated code. This allows blocks to be configured with a continuous sample time. Not available if SuppressErrorStatus is on. |
| SupportVariableSizeSignals (ERT)<br>string - <b>off</b> , on                                                   | <b>Code Generation &gt; Interface &gt; variable-size signals</b>                                   | Generate code for models that use variable-size signals.                                                                                                      |
| SuppressErrorStatus (ERT)<br>string - <b>off</b> , on                                                          | <b>Code Generation &gt; Interface &gt; Suppress error status in real-time model data structure</b> | Remove the error status field of the real-time model data structure to preserve memory. When selected, SupportContinuousTime is cleared.                      |



**Command-Line Information: Code Generation Pane: Interface Tab (Continued)**

| <b>Parameter and Values</b>                                              | <b>Configuration Parameters Dialog Box Equivalent</b>                                                | <b>Description</b>                                                                                                                                                                                                     |
|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CombineSignalStateStructs (ERT)<br>string - <b>off</b> , on              | <b>Code Generation &gt; Interface &gt; Combine signal/state structures</b>                           | Combine a model block's signals (global block I/O structure) and discrete states (DWork vector) into a single data structure in the generated code.                                                                    |
| UseOperatorNewForModelRef-Registration (ERT)<br>string - <b>off</b> , on | <b>Code Generation &gt; Interface &gt; Use operator new for referenced model object registration</b> | For a model containing Model blocks, specify whether generated code should use the operator new, during model object registration, to instantiate objects for referenced models configured with a C++ class interface. |

**Command-Line Information: Code Generation Pane: Verification Tab**

| <b>Parameter and Values</b>                                                 | <b>Configuration Parameters Dialog Box Equivalent</b>            | <b>Description</b>           |
|-----------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------|
| CoverageTool (ERT)<br>string - <b>None</b> , BullseyeCoverage, LDRA Testbed | <b>Code Generation &gt; Verification &gt; Code coverage tool</b> | Specify a code coverage tool |

**Command-Line Information: Code Generation Pane: Verification Tab (Continued)**

| Parameter and Values                                                                                                                                    | Configuration Parameters Dialog Box Equivalent                                            | Description                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Tip</b> To access the CoverageTool parameter, type:</p> <pre>covSettings = get_param(gcs, 'CodeCoverageSettings'); covSettings.CoverageTool</pre> |                                                                                           |                                                                                                                                            |
| <p>CodeExecutionProfileVariable (ERT)<br/>string - <b>executionProfile</b></p>                                                                          | <p><b>Code Generation &gt; Verification &gt; Workspace variable</b></p>                   | <p>Specify workspace <b>workspace</b> that collects measurements and allows viewing and analysis of execution profiles.</p>                |
| <p>CodeExecutionProfiling (ERT)<br/>string - <b>off</b>, on</p>                                                                                         | <p><b>Code Generation &gt; Verification &gt; Measurement task execution time</b></p>      | <p>Specify whether to collect <b>measurement</b> time profiles for tasks in generated code.</p>                                            |
| <p>CodeProfilingInstrumentation (ERT)<br/>string - <b>off</b>, on</p>                                                                                   | <p><b>Code Generation &gt; Verification &gt; Measurement function execution times</b></p> | <p>Specify whether to collect <b>measurement</b> time profiles for functions in code generated from the model.</p>                         |
| <p>CodeProfilingSaveOptions (ERT)<br/>string - <b>SummaryOnly</b>, AllData</p>                                                                          | <p><b>Code Generation &gt; Verification &gt; Save options</b></p>                         | <p>Specify whether to <b>save</b> code profiling measurement and analysis data to base workspace.</p>                                      |
| <p>CreateSILPILBlock (ERT)<br/>string - <b>None</b>, SIL, PIL</p>                                                                                       | <p><b>Code Generation &gt; Verification &gt; Create block</b></p>                         | <p>Create SIL or PIL block <b>create</b> allow verification of source or object code generated from subsystem or top-model components.</p> |

**Command-Line Information: Code Generation Pane: Verification Tab (Continued)**

| <b>Parameter and Values</b>                         | <b>Configuration Parameters Dialog Box Equivalent</b>                                           | <b>Description</b>                                                                                                                                                                                                                                               |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PortableWordSizes (ERT)<br>string - <b>off</b> , on | <b>Code Generation &gt; Verification &gt; Enable portable word sizes</b>                        | Specify that model code should be generated with conditional processing macros that allow the same generated source code files to be used both for software-in-the-loop (SIL) testing on the host platform and for production deployment on the target platform. |
| SILDebugging (ERT)<br>string - <b>off</b> , on      | <b>Code Generation &gt; Verification &gt; Enable source-level debugging for SIL simulations</b> | Enable use of Microsoft Visual Studio® debugger during SIL simulation.                                                                                                                                                                                           |

**Command-Line Information: Code Generation Pane: Code Style Tab**

| <b>Parameter and Values</b>                                          | <b>Configuration Parameters Dialog Box Equivalent</b>                                                 | <b>Description</b>                                                                                 |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| ConvertIfToSwitch (ERT)<br>string - <b>off</b> , on                  | <b>Code Generation &gt; Code Style &gt; Convert if-elseif-else patterns to switch-case statements</b> | Control whether if-elseif-else decision logic appears in generated code as switch-case statements. |
| ParenthesesLevel (ERT)<br>string - Minimum, <b>Nominal</b> , Maximum | <b>Code Generation &gt; Code Style &gt; Parentheses Level</b>                                         | Control existence of optional parentheses in generated code.                                       |
| PreserveExpressionOrder (ERT)<br>string - <b>off</b> , on            | <b>Code Generation &gt; Code Style &gt; Preserve operand order in expression</b>                      | Control reordering of commutable expressions.                                                      |

**Command-Line Information: Code Generation Pane: Code Style Tab (Continued)**

| <b>Parameter and Values</b>                                        | <b>Configuration Parameters Dialog Box Equivalent</b>                                                                           | <b>Description</b>                                                                                           |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| PreserveExternInFcnDecls (ERT)<br>string - off, <b>on</b>          | <b>Code Generation &gt; Code Style &gt; Preserve extern keyword in function declarations</b>                                    | Control whether extern keyword appears in function declarations with external linkage in the generated code. |
| PreserveIfCondition (ERT)<br>string - <b>off</b> , on              | <b>Code Generation &gt; Code Style &gt; Preserve condition expression in if statement</b>                                       | Control preservation of if statement conditions.                                                             |
| SuppressUnreachableDefault-Cases (ERT)<br>string - <b>off</b> , on | <b>Code Generation &gt; Code Style &gt; Suppress generation of default cases for Stateflow switch statements if unreachable</b> | Control whether to generate default cases for switch-case statements in the code for Stateflow charts.       |
| IndentStyle (ERT)<br>string - <b>K&amp;R</b> , Allman              | <b>Code Generation &gt; Code Style &gt; Indent Style</b>                                                                        | ROUGH DRAFT Control the placement of braces.                                                                 |
| IndentSize (ERT)<br>int - <b>2</b>                                 | <b>Code Generation &gt; Code Style &gt; Indent Size</b>                                                                         | ROUGH DRAFT Control the number of characters per indent level. Range can be 2–8.                             |

**Command-Line Information: Code Generation Pane: Templates Tab**

| <b>Parameter and Values</b>                                                                            | <b>Configuration Parameters Dialog Box Equivalent</b>                          | <b>Description</b>                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ERTCustomFileTemplate (ERT)<br><i>string</i> -<br><b>example_file_process.tlc</b>                      | <b>Code Generation &gt; Templates &gt; File customization template</b>         | Specify a TLC callback script for customizing the generated code.                                                                                                                              |
| ERTDataHdrFileTemplate (ERT)<br><i>string</i> -<br><b>ert_code_template.cgt</b>                        | <b>Code Generation &gt; Templates &gt; Header file (*.h) template</b>          | Specify a template that organizes the generated data .h header files.                                                                                                                          |
| ERTDataSrcFileTemplate (ERT)<br><i>string</i> -<br><b>ert_code_template.cgt</b>                        | <b>Code Generation &gt; Templates &gt; Source file (*.c or *.cpp) template</b> | Specify a template that organizes the generated data .c source files.                                                                                                                          |
| ERTHdrFileBannerTemplate (ERT)<br><i>string</i> -<br><b>ert_code_template.cgt</b>                      | <b>Code Generation &gt; Templates &gt; Header file (*.h) template</b>          | Specify a template that organizes the generated code .h header files.                                                                                                                          |
| ERTSrcFileBannerTemplate (ERT)<br><i>string</i> -<br><b>ert_code_template.cgt</b>                      | <b>Code Generation &gt; Templates &gt; Source file (*.c or *.cpp) template</b> | Specify a template that organizes the generated code .c or .cpp source files.                                                                                                                  |
| GenerateSampleERTMain (ERT)<br><i>string</i> - <b>off</b> , on                                         | <b>Code Generation &gt; Templates &gt; Generate an example main program</b>    | Generate an example main program that demonstrates how to deploy the generated code. The program is written to the file <code>ert_main.c</code> or <code>ert_main.cpp</code> .                 |
| TargetOS (ERT)<br><i>string</i> - <b>BareBoardExample</b> ,<br>VxWorksExample,<br>NativeThreadsExample | <b>Code Generation &gt; Templates &gt; Target operating system</b>             | Specify the target operating system for the example main <code>ert_main.c</code> or <code>ert_main.cpp</code> . <b>BareBoardExample</b> is a generic example that does not assume an operating |

**Command-Line Information: Code Generation Pane: Templates Tab (Continued)**

| Parameter and Values | Configuration Parameters Dialog Box Equivalent | Description                                                                                                                                                                      |
|----------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                                                | system. VxWorksExample is tailored to the VxWorks <sup>4</sup> real-time operating system. NativeThreadsExample works with threaded code under the native host operating system. |

**Command-Line Information: Code Generation Pane: Code Placement Tab**

| Parameter and Values                                                                           | Configuration Parameters Dialog Box Equivalent                            | Description                                                                                              |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| DataDefinitionFile (ERT)<br><i>string</i> - <b>global.c</b>                                    | <b>Code Generation &gt; Code Placement &gt; Data definition filename</b>  | Specify the name of a single separate .c or .cpp file that contains global data definitions.             |
| DataReferenceFile (ERT)<br><i>string</i> - <b>global.h</b>                                     | <b>Code Generation &gt; Code Placement &gt; Data declaration filename</b> | Specify the name of a single separate .c or .cpp file that contains global data references.              |
| GlobalDataDefinition (ERT)<br><i>string</i> - <b>Auto</b> , InSourceFile, InSeparateSourceFile | <b>Code Generation &gt; Code Placement &gt; Data definition</b>           | Select the .c or .cpp file where variables of global scope are defined.                                  |
| GlobalDataReference (ERT)<br><i>string</i> - <b>Auto</b> , InSourceFile, InSeparateHeaderFile  | <b>Code Generation &gt; Data Placement &gt; Data declaration</b>          | Select the .h file where variables of global scope are declared (for example, extern real_T globalvar;). |

4. VxWorks<sup>®</sup> is a registered trademark of Wind River<sup>®</sup> Systems, Inc.

**Command-Line Information: Code Generation Pane: Code Placement Tab (Continued)**

| <b>Parameter and Values</b>                                                                         | <b>Configuration Parameters Dialog Box Equivalent</b>                                                    | <b>Description</b>                                                                                                     |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| IncludeFileDelimiter (ERT)<br>string - <b>Auto</b> , UseQuote,<br>UseBracket                        | <b>Code Generation &gt; Code Placement &gt; #include file delimiter</b>                                  | Specify the delimiter to be used for data objects that do not have a delimiter specified in the IncludeFile property.  |
| EnableDataOwnership<br>string - <b>off</b> , on                                                     | <b>Code Generation &gt; Code Placement &gt; Use owner from data object for data definition placement</b> | Specify whether the model uses the ownership setting of a data object for data definition in code generation.          |
| ModuleNamingRule (ERT)<br>string - <b>Unspecified</b> , SameAsModel                                 | <b>Code Generation &gt; Code Placement &gt; Use owner from data object for data definition placement</b> | Specify whether the model uses the ownership setting of a data object for data definition in code generation.          |
| ParamTuneLevel (ERT)<br>int - <b>10</b>                                                             | <b>Code Generation &gt; Code Placement &gt; Parameter tune level</b>                                     | Specify whether the code generator is to declare a parameter data object as tunable global data in the generated code. |
| SignalDisplayLevel (ERT)<br>int - <b>10</b>                                                         | <b>Code Generation &gt; Code Placement &gt; Signal display level</b>                                     | Specify whether the code generator is to declare a signal data object as global data in the generated code.            |
| ERTFilePackagingFormat (ERT)<br>string - <b>Modular</b> , Compact with separate data files, Compact | <b>Code Generation &gt; Code Placement &gt; File Packaging Format</b>                                    | Specify how the code generator organizes the code into files.                                                          |

**Command-Line Information: Code Generation Pane: Data Type Replacement Tab**

| <b>Parameter and Values</b>                                  | <b>Configuration Parameters Dialog Box Equivalent</b>                  | <b>Description</b>                                                                                       |
|--------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| EnableUserReplacementTypes (ERT)<br>string - <b>off</b> , on | <b>Code Generation &gt; Data Type Replacement</b>                      | Specify whether to replace built-in data type names with user-defined data type names in generated code. |
| ReplacementTypes (ERT)<br>string - ''                        | <b>Code Generation &gt; Data Type Replacement &gt; Data type names</b> | Specify names to use for built-in data types in generated code.                                          |

**Command-Line Information: Code Generation Pane: Memory Sections Tab**

| <b>Parameter and Values</b>                                                                         | <b>Configuration Parameters Dialog Box Equivalent</b>                 | <b>Description</b>                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MemSecPackage (ERT)<br>string - --- <b>None</b> ---,<br>Simulink, mpt                               | <b>Code Generation &gt; Memory Sections &gt; Package</b>              | Specify the package that contains the memory sections that you want to apply.                                                                                                                                                      |
| MemSecFuncInitTerm (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile | <b>Code Generation &gt; Memory Sections &gt; Initialize/Terminate</b> | Apply memory sections to: <ul style="list-style-type: none"> <li>• Initialize/Start functions</li> <li>• Terminate functions</li> </ul>                                                                                            |
| MemSecFuncExecute (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile  | <b>Code Generation &gt; Memory Sections &gt; Execution</b>            | Apply memory sections to: <ul style="list-style-type: none"> <li>• Step functions</li> <li>• Run-time initialization functions</li> <li>• Derivative functions</li> <li>• Enable functions</li> <li>• Disable functions</li> </ul> |



**Command-Line Information: Code Generation Pane: Memory Sections Tab (Continued)**

| <b>Parameter and Values</b>                                                                           | <b>Configuration Parameters Dialog Box Equivalent</b>           | <b>Description</b>                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MemSecFuncSharedUtil (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile | <b>Code Generation &gt; Memory Sections &gt; Shared utility</b> | Apply memory sections to shared utility functions.                                                                                                                   |
| MemSecDataConstants (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile  | <b>Code Generation &gt; Memory Sections &gt; Constants</b>      | Apply memory sections to: <ul style="list-style-type: none"> <li>• Constant parameters</li> <li>• Constant block I/O</li> <li>• Zero representation</li> </ul>       |
| MemSecDataIO (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile         | <b>Code Generation &gt; Memory Sections &gt; Inputs/Outputs</b> | Apply memory sections to: <ul style="list-style-type: none"> <li>• Root inputs</li> <li>• Root outputs</li> </ul>                                                    |
| MemSecDataInternal (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile   | <b>Code Generation &gt; Memory Sections &gt; Internal data</b>  | Apply memory sections to: <ul style="list-style-type: none"> <li>• Block I/O</li> <li>• DWork vectors</li> <li>• Run-time model</li> <li>• Zero-crossings</li> </ul> |
| MemSecDataParameters (ERT)<br>string - <b>Default</b> ,<br>MemConst, MemVolatile,<br>MemConstVolatile | <b>Code Generation &gt; Memory Sections &gt; Parameters</b>     | Apply memory sections to: <ul style="list-style-type: none"> <li>• Parameters</li> </ul>                                                                             |

**Command-Line Information: Not in GUI**

| Parameter and Values                                                                      | Configuration Parameters Dialog Box Equivalent | Description                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>CommentStyle (ERT)<br/>string - <b>Auto</b>, Multi-line,<br/>Single-line</p>           | <p>Not available</p>                           | <p>Specify the comment style for generated C or C++ code:</p> <ul style="list-style-type: none"> <li>• Auto (multi-line for C, single-line for C++)</li> <li>• Multi-line (/*...*/)</li> <li>• Single-line (//...)</li> </ul>                                                                                                                          |
| <p>CPPClassGenCompliant (ERT)<br/>string - off, <b>on</b></p>                             | <p>Not available</p>                           | <p>Set in <code>SelectCallback</code> for a target to indicate whether the target supports the ability to generate and configure C++ class interfaces to model code. Default is off for custom and non-ERT targets and on for ERT (<code>ert.tlc</code>) targets. (For more information, see “Support C++ Class Interface Control”.)</p>               |
| <p>ModelStepFunctionPrototype-<br/>ControlCompliant (ERT)<br/>string - off, <b>on</b></p> | <p>Not available</p>                           | <p>Set in <code>SelectCallback</code> for a target to indicate whether the target supports the ability to control the function prototypes of initialize and step functions that are generated for a Simulink model. Default is off for non-ERT targets and on for ERT targets. (For more information, see “Support C Function Prototype Control”.)</p> |

# Model Advisor Checks

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## Embedded Coder Checks

**In this section...**

“Embedded Coder Checks Overview” on page 4-3

“Check for blocks not recommended for C/C++ production code deployment” on page 4-4

“Identify lookup table blocks that generate expensive out-of-range checking code” on page 4-5

“Check output types of logic blocks” on page 4-7

“Check the hardware implementation” on page 4-9

“Identify questionable software environment specifications” on page 4-11

“Identify questionable code instrumentation (data I/O)” on page 4-13

“Check for blocks not recommended for MISRA-C:2004 compliance” on page 4-14

“Check configuration parameters for MISRA-C:2004 compliance” on page 4-15

“Identify questionable subsystem settings” on page 4-17

“Identify blocks that generate expensive fixed-point and saturation code” on page 4-17

“Identify questionable fixed-point operations” on page 4-22

“Identify blocks that generate expensive rounding code” on page 4-24

## **Embedded Coder Checks Overview**

Use Embedded Coder Model Advisor checks to configure your model for code generation.

### **See Also**

- “Consult the Model Advisor”
- “Simulink Checks”
- “Simulink Coder Checks”

## Check for blocks not recommended for C/C++ production code deployment

Identify blocks not supported by code generation or not recommended for C/C++ production code deployment.

### Description

This check partially identifies model constructs that are not recommended for C/C++ production code generation as identified in the Simulink Block Support tables for Simulink Coder and Embedded Coder. If you are using blocks with support notes for code generation, review the information and follow the given advice.

Available with Simulink Verification and Validation™ and Embedded Coder.

### Results and Recommended Actions

| Condition                                                                                      | Recommended Action                                                                                                             |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| The model or subsystem contains blocks that should not be used for production code deployment. | Consider replacing the blocks listed in the results. Click an element from the list of questionable items to locate condition. |

### Capabilities and Limitations

You can run this check on your library models.

### See Also

“Supported Products and Block Usage”

## Identify lookup table blocks that generate expensive out-of-range checking code

Identify lookup table blocks that generate code to protect against out-of-range inputs for breakpoint or index values.

### Description

This check verifies that the following blocks do not generate code to protect against inputs that fall outside the range of valid breakpoint values:

- 1-D Lookup Table
- 2-D Lookup Table
- n-D Lookup Table
- Prelookup

This check also verifies that Interpolation Using Prelookup blocks do not generate code to protect against inputs that fall outside the range of valid index values.

Following the recommended actions increases both execution and ROM efficiency of the generated code.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                    | Recommended Action                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The lookup table block generates out-of-range checking code. | <p>Change the setting on the block dialog box so that out-of-range checking code is not generated.</p> <ul style="list-style-type: none"> <li>• For the 1-D Lookup Table, 2-D Lookup Table, n-D Lookup Table, and Prelookup blocks, select the check box for <b>Remove protection</b></li> </ul> |

| Condition | Recommended Action                                                                                                                                                                                                                                         |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <p><b>against out-of-range input in generated code.</b></p> <ul style="list-style-type: none"><li>• For the Interpolation Using Prelookup block, select the check box for <b>Remove protection against out-of-range index in generated code.</b></li></ul> |

### Capabilities and Limitations

You can run this check on your library models.

### Action Results

Clicking **Modify** prevents lookup table blocks from generating out-of-range checking code, which makes the generated code more efficient.

### See Also

- n-D Lookup Table block in the Simulink documentation
- Prelookup block in the Simulink documentation
- Interpolation Using Prelookup block in the Simulink documentation
- “Optimize Generated Code for Lookup Table Blocks” in the Simulink documentation



## Check output types of logic blocks

Identify logic blocks that do not use boolean for the output data type.

### Description

This check verifies that the output data type of the following blocks is boolean:

- Compare To Constant
- Compare To Zero
- Detect Change
- Detect Decrease
- Detect Fall Negative
- Detect Fall Nonpositive
- Detect Increase
- Detect Rise Nonnegative
- Detect Rise Positive
- Interval Test
- Interval Test Dynamic
- Logical Operator
- Relational Operator

Using output data type boolean increases execution efficiency of the generated code.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                             | Recommended Action                                               |
|-------------------------------------------------------|------------------------------------------------------------------|
| The output data type of a logic block is not boolean. | In the block dialog box, set <b>Output data type</b> to boolean. |

### **Capabilities and Limitations**

You can run this check on your library models.

### **Action Results**

Clicking **Modify** forces logic blocks to use `boolean` as the output data type. If a logic block uses `uint8` for the output type, clicking **Modify** changes the output type to `boolean`.

## Check the hardware implementation

Identify inconsistent or underspecified hardware implementation settings

### Description

The Simulink and Simulink Coder software require two sets of target specifications. The first set describes the final intended production target. The second set describes the currently selected target. If the configurations do not match, the code generator creates extra code to emulate the behavior of the production target. Inconsistencies or underspecification of hardware attributes can lead to inefficient or incorrect code generation for the target hardware.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                                                               | Recommended Action                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Device type</b> is set to Unspecified (assume 32-bit Generic).                                       | In the Configuration Parameters dialog box, on the <b>Hardware Implementation</b> pane, set <b>Device type</b> to the target hardware.                                                                                                                |
| Hardware implementation parameters are not set to recommended values.                                   | In the Configuration Parameters dialog box, on the <b>Hardware Implementation</b> pane, specify the following parameters: <ul style="list-style-type: none"> <li>• <b>Byte ordering</b></li> <li>• <b>Signed integer division rounding</b></li> </ul> |
| Hardware implementation <b>Production hardware</b> settings do not match <b>Test hardware</b> settings. | In the Configuration Parameters dialog box, on the <b>Hardware Implementation</b> pane, consider selecting the <b>Test hardware is the same as production hardware</b> check box, or modify the settings to match.                                    |

**See Also**

Making GRT-Based Targets ERT-Compatible

## Identify questionable software environment specifications

Identify questionable software environment settings.

### Description

- Support for some software environment settings can lead to inefficient code generation and nonoptimal results.
- Industry standards for C, such as ISO and MISRA, require identifiers to be unique within the first 31 characters.
- Stateflow charts with weak Simulink I/O data types lead to inefficient code.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                                                                                                       | Recommended Action                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The maximum identifier length does not conform with industry standards for C.                                                                   | In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Symbols</b> pane, set the <b>Maximum identifier length</b> parameter to 31 characters.                                                                                                                                                   |
| In the Configuration Parameters dialog box, the parameters on the <b>Code Generation &gt; Interface</b> pane are not set to recommended values. | In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Interface</b> pane, clear the following parameters: <ul style="list-style-type: none"> <li>• <b>Support: continuous time</b></li> <li>• <b>Support: non-finite numbers</b></li> <li>• <b>Support: non-inlined S-functions</b></li> </ul> |

| <b>Condition</b>                                                                                                                                                                              | <b>Recommended Action</b>                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>In the Configuration Parameters dialog box, the parameters on the <b>Code Generation &gt; Symbols</b> pane are not set to recommended values.</p>                                          | <p>In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Symbols</b> pane, set the <b>Generate scalar inlined parameters as</b> parameter to <b>Literals</b>.</p>                     |
| <p>In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Interface</b> pane, <b>Support: variable-size signals</b> is selected. This might lead to inefficient code.</p> | <p>If you do not intend to support variable-sized signals, clear the <b>Code Generation &gt; Interface &gt; “Support: variable-size signals”</b> check box in the Configuration Parameters dialog box.</p> |
| <p>The model contains Stateflow charts with weak Simulink I/O data type specifications.</p>                                                                                                   | <p>Select the Stateflow chart property <b>Use Strong Data Typing with Simulink I/O</b>. You might need to adjust the data types in your model after selecting the property.</p>                            |

**Limitations**

A Stateflow license is required when using Stateflow charts.

**See Also**

“Strong Data Typing with Simulink I/O”

## Identify questionable code instrumentation (data I/O)

Identify questionable code instrumentation.

### Description

- Instrumentation of the generated code can cause nonoptimal results.
- Test points require global memory and are not optimal for production code generation.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                                                                                                                                                                                              | Recommended Action                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interface parameters are not set to recommended values.                                                                                                                                                                                | In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Interface</b> pane, set the parameters to the recommended values.                                                                                                                                                                                                                                                                            |
| Blocks generate assertion code.                                                                                                                                                                                                        | In the Configuration Parameters dialog box, on the <b>Diagnostics &gt; Data Validity</b> pane, set the <b>Model Verification block enabling</b> parameter to <b>Disable All</b> on a block-by-block basis or globally.                                                                                                                                                                                                  |
| Block output signals have one or more test points and, if you have an Embedded Coder license, the <b>Ignore test point signals</b> check box is cleared in the <b>Code Generation</b> pane of the Configuration Parameters dialog box. | Remove test points from the specified block output signals. For each signal, in the Signal Properties dialog box, clear the <b>Test point</b> check box.<br><br>Alternatively, if the model is using an ERT-based system target file, select the <b>Ignore test point signals</b> check box on the <b>Code Generation</b> pane in the Configuration Parameters dialog box to ignore test points during code generation. |

## Check for blocks not recommended for MISRA-C:2004 compliance

Identify blocks that are not supported or recommended for MISRA-C:2004 compliant code generation.

### Description

Following the recommendations of this check increases the likelihood of generating MISRA-C:2004 compliant code for embedded applications.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                                                                                                                                                                                | Recommended Action                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Blocks that are not supported or recommended for MISRA-C:2004 compliant code generation were found in the model or subsystem. For a list of blocks, see “hisl_0020: Blocks not recommended for MISRA-C:2004 compliance”. | Consider replacing the specified blocks. |

### Capabilities and Limitations

You can run this check on your library models.

### See Also

- “hisl\_0020: Blocks not recommended for MISRA-C:2004 compliance”
- “MISRA C Guidelines” in the Embedded Coder documentation.
- “MISRA-C:2004 Compliance Considerations”



## Check configuration parameters for MISRA-C:2004 compliance

Identify configuration parameters that might impact MISRA-C:2004 compliant code generation.

### Description

Following the recommendations of this check increases the likelihood of generating MISRA-C:2004 compliant code for embedded applications.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                                               | Recommended Action                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Model Verification block enabling</b> is set to Use local settings or Enable All.    | In the Configuration Parameters dialog box, on the <b>Diagnostics &gt; Data Validity</b> pane, set <b>Model Verification block enabling</b> to Disable All.                                                                                                                                                                                           |
| <b>System target file</b> is set to a GRT-based target.                                 | In the Configuration Parameters dialog box, on the <b>Code Generation &gt; General</b> pane, set <b>System target file</b> to an ERT-based target.                                                                                                                                                                                                    |
| <b>Code Generation &gt; Interface</b> parameters are not set to the recommended values. | In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Interface</b> pane: <ul style="list-style-type: none"> <li>• Clear <b>Support: non-finite numbers</b></li> <li>• Clear <b>Support: continuous time</b> (ERT-based target only)</li> <li>• Clear <b>Support: non-inlined S-functions</b> (ERT-based target only)</li> </ul> |

| Condition                                                                                    | Recommended Action                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                              | <ul style="list-style-type: none"> <li>• Clear <b>MAT-file logging</b></li> <li>• Set <b>Standard math library</b> to C89/C90 (ANSI)</li> <li>• Set <b>Code replacement library</b> to None</li> </ul> |
| <p><b>Parenthesis level</b> is not set to Maximum (Specify precedence with parentheses).</p> | <p>In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Code Style</b> pane, set <b>Parenthesis level</b> to Maximum (Specify precedence with parentheses).</p>                  |
| <p><b>Maximum identifier length</b> is not set to 31.</p>                                    | <p>In the Configuration Parameters dialog box, on the <b>Code Generation &gt; Symbols</b> pane, set <b>Maximum identifier length</b> to 31.</p>                                                        |

### Action Results

Clicking **Modify All** changes the parameter values to the recommended values.

### Limitations

This check does not review referenced models.

### See Also

- “hisl\_0060: Configuration parameters that improve MISRA-C:2004 compliance”
- “MISRA C Guidelines” in the Embedded Coder documentation.
- “MISRA-C:2004 Compliance Considerations”

## Identify questionable subsystem settings

Identify questionable subsystem block settings.

### Description

Subsystem blocks implemented as void/void functions in the generated code use global memory to store the subsystem I/O.

Available with Embedded Coder.

### Results and Recommended Actions

| Condition                                                                                                         | Recommended Action                                                             |
|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Subsystem blocks have the <b>Subsystem Parameters &gt; Function packaging</b> option set to Nonreusable function. | Set the <b>Subsystem Parameters &gt; Function packaging</b> parameter to Auto. |

### See Also

Subsystem block

## Identify blocks that generate expensive fixed-point and saturation code

Identify fixed-point operations that can lead to nonoptimal results.

### Description

Certain block settings can lead to expensive fixed-point and saturation code.

## Results and Recommended Actions

| Conditions                                                                                                                                                                                       | Recommended Action                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blocks generate expensive saturation code.                                                                                                                                                       | Check whether your application requires setting <b>Function Block Parameters &gt; Signal Attributes &gt; Saturate on integer overflow</b> . Otherwise, clear the <b>Saturate on integer overflow</b> parameter for the most efficient implementation of the block in the generated code.                                                                                                                                                                    |
| Product blocks are multiplying signals with mismatched slope adjustment factors. The net slope correction uses multiplication followed by shifts, which is inefficient for some target hardware. | Select <b>Use integer division to handle net slopes that are reciprocals of integers</b> if the net slope is the reciprocal of an integer and division is more efficient than multiplication and shifts on the target hardware.<br><br><hr/> <b>Note</b> This optimization takes place only if certain simplicity and accuracy conditions are met. For more information, see “Handle Net Slope Correction” in the Fixed-Point Designer documentation. <hr/> |
| Product blocks are configured with a divide operation for the first input and a multiply operation for the second input.                                                                         | Reverse the inputs so the multiply operation occurs first and the division operation occurs second.                                                                                                                                                                                                                                                                                                                                                         |
| Product blocks are configured to do multiple division operations.                                                                                                                                | Multiply all the denominator terms together, and then do a single division using cascading Product blocks.                                                                                                                                                                                                                                                                                                                                                  |

| Conditions                                                                                                                         | Recommended Action                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product blocks are configured to do many multiplication or division operations.                                                    | Split the operations across several blocks, with each block performing one multiplication or one division operation.                                                                                                                                                                                                                                                                                         |
| Protection code generated as part of the division operation is redundant.                                                          | Verify that your model cannot cause exceptions in division operations and then remove redundant protection code by setting the <b>Optimization &gt; Remove code that protects against division arithmetic exceptions</b> parameter in the Configuration Parameters dialog box.                                                                                                                               |
| The data type range of the inputs of Sum blocks exceeds the data type range of the output, which can cause overflow or saturation. | <p>Change the output and accumulator data types so the range equals or exceeds all input ranges.</p> <p>For example, if the model has two inputs</p> <ul style="list-style-type: none"> <li>• int8 (–128 to 127)</li> <li>• uint8 (0 to 255)</li> </ul> <p>The data type range of the output and accumulator must equal or exceed –128 to 255. A int16 (–32768 to 32767) data type meets this condition.</p> |
| A Sum block has an input with a slope adjustment factor that does not equal the slope adjustment factor of the output.             | Change the data types so the inputs, outputs, and accumulator have the same slope adjustment factor.                                                                                                                                                                                                                                                                                                         |
| The net sum of the Sum block input biases does not equal the bias of the output.                                                   | Change the bias of the output scaling, making the net bias adjustment zero.                                                                                                                                                                                                                                                                                                                                  |

| Conditions                                                                                                                                                                                                                                                                                                                                                                      | Recommended Action                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The input and output of the MinMax block have different data types.</p>                                                                                                                                                                                                                                                                                                      | <p>Change the data type of the input or output.</p>                                                                                                                 |
| <p>The input of the MinMax block has a different slope adjustment factor than the output.</p>                                                                                                                                                                                                                                                                                   | <p>Change the scaling of the input or the output.</p>                                                                                                               |
| <p>The initial condition of the Discrete-Time Integrator block is used to initialize both the state and the output.</p>                                                                                                                                                                                                                                                         | <p>Set the <b>Function Block Parameters &gt; Use initial condition as initial and reset value for</b> parameter to <code>State only</code> (most efficient).</p>    |
| <p>Parameter overflow occurred for the Compare to Zero block. This block uses the input data type to represent zero. The input data type cannot represent zero exactly, so the input value was compared to the closest representable value of zero.</p>                                                                                                                         | <p>Select an input data type that can represent zero.</p>                                                                                                           |
| <p>Parameter overflow occurred for the following Compare to Constant block. This block uses the input data type to represent its <b>Constant value</b> parameter. The <b>Constant value</b> parameter is outside the range that the input data type can represent. The input signal was compared to the closest representable value of the <b>Constant value</b> parameter.</p> | <p>Choose an input data type that can represent the <b>Constant value</b> parameter or change the <b>Constant value</b> parameter to match the input data type.</p> |

### Capabilities and Limitations

A Fixed-Point Designer license is required to generate fixed-point code.

### See Also

- “Identify Blocks that Generate Expensive Fixed-Point and Saturation Code”



## Identify questionable fixed-point operations

Identify fixed-point operations that can lead to nonoptimal results.

### Description

Less efficient code can result from blocks that generate cumbersome multiplication and division operations, expensive conversion code, inefficiencies in lookup table blocks, and expensive comparison code.

### Results and Recommended Actions

| Conditions                                                                                                            | Recommended Action                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integer division generated code is large.                                                                             | In the Configuration Parameters dialog box, on the <b>Hardware Implementation</b> pane, set the <b>Signed integer division rounds to</b> parameter to the recommended value. |
| Lookup Table vector of input values is not evenly spaced.                                                             | If breakpoint data is nontunable, adjust the data to have even, power of 2 spacing. See <code>fixpt_look1_func_approx</code> .                                               |
| Lookup Table vector of input values is not evenly spaced when quantized, but it is very close to being evenly spaced. | If breakpoint data is nontunable, adjust the data to have even, power of 2 spacing. See <code>fixpt_evenspace_cleanup</code> .                                               |
| Lookup Table vector of input values is evenly spaced, but the spacing is not a power of 2.                            | If breakpoint data is nontunable, adjust the data to have even, power of 2 spacing. See <code>fixpt_look1_func_approx</code> .                                               |



| Conditions                                                                                                                                                   | Recommended Action                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>For a Prelookup or n-D Lookup Table block, <b>Index search method</b> is Evenly spaced points. Breakpoint data does not have power of 2 spacing.</p>      | <p>If breakpoint data is nontunable, adjust the data to have even, power of 2 spacing. Otherwise, in the block parameter dialog box, specify a different <b>Index search method</b> to avoid the computation-intensive division operation.</p> |
| <p>n-D Lookup Table breakpoint data is not evenly spaced and <b>Index search method</b> is not Evenly spaced points.</p>                                     | <p>If breakpoint data is nontunable, adjust the data to have even, power of 2 spacing and then set <b>Index search method</b> to Evenly spaced points.</p>                                                                                     |
| <p>n-D Lookup Table breakpoint data is evenly spaced and <b>Index search method</b> is Evenly spaced points. But the spacing is not a power of 2.</p>        | <p>If breakpoint data is nontunable, adjust the data to have even, power of 2 spacing. See <code>fixpt_look1_func_approx</code>.</p>                                                                                                           |
| <p>n-D Lookup Table breakpoint data is evenly spaced, but the spacing is not a power of 2. Also, <b>Index search method</b> is not Evenly spaced points.</p> | <p>Set <b>Index search method</b> to Evenly spaced points. Also, if the data is nontunable, consider an even, power of 2 spacing.</p>                                                                                                          |
| <p>n-D Lookup Table breakpoint data is evenly spaced, and the spacing is a power of 2. But the <b>Index search method</b> is not Evenly spaced points.</p>   | <p>Set <b>Index search method</b> to Evenly spaced points.</p>                                                                                                                                                                                 |
| <p>Blocks require cumbersome multiplication.</p>                                                                                                             | <p>Restrict multiplication operations:</p> <ul style="list-style-type: none"> <li>• So the product integer size is not larger than the target integer size.</li> <li>• To the recommended size.</li> </ul>                                     |
| <p>Product blocks are multiplying signals with mismatched slope adjustment factors.</p>                                                                      | <p>Change the scaling of the output so that its slope adjustment factor is the product of the input slope adjustment factors.</p>                                                                                                              |

| Conditions                                                                                                                          | Recommended Action                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blocks multiply signals with nonzero bias.                                                                                          | Insert a Data Type Conversion block before and after the block containing the multiplication operation.                                                                                                                                                             |
| The inputs of the Relational Operator block have different data types.                                                              | <ul style="list-style-type: none"> <li>• Change the data type and scaling of the invariant input to match other inputs.</li> <li>• Insert Data Type Conversion blocks before the Relational Operator block to convert both inputs to a common data type.</li> </ul> |
| The inputs of the Relational Operator block have different slope adjustment factors.                                                | Change the scaling of either input.                                                                                                                                                                                                                                 |
| The output of the Relational Operator block is constant. This might result in dead code which will be eliminated by Simulink Coder. | Review your model design and either remove the Relational Operator block or replace it with the constant.                                                                                                                                                           |

### Capabilities and Limitations

A Fixed-Point Designer license is required to generate fixed-point code.

### See Also

- 1-D Lookup Table
- n-D Lookup Table
- Prelookup
- “Identify Questionable Fixed-Point Operations”

### Identify blocks that generate expensive rounding code

Check for blocks that generate expensive rounding code.

## Description

Generated rounding code is inefficient because of **Integer rounding mode** parameter setting.

Available with Embedded Coder.

## Results and Recommended Actions

| Condition                      | Recommended Action                                                                                      |
|--------------------------------|---------------------------------------------------------------------------------------------------------|
| Generated code is inefficient. | Set the <b>Function Block Parameters &gt; Integer rounding mode</b> parameter to the recommended value. |

## See Also

- “Identify Blocks that Generate Expensive Rounding Code”