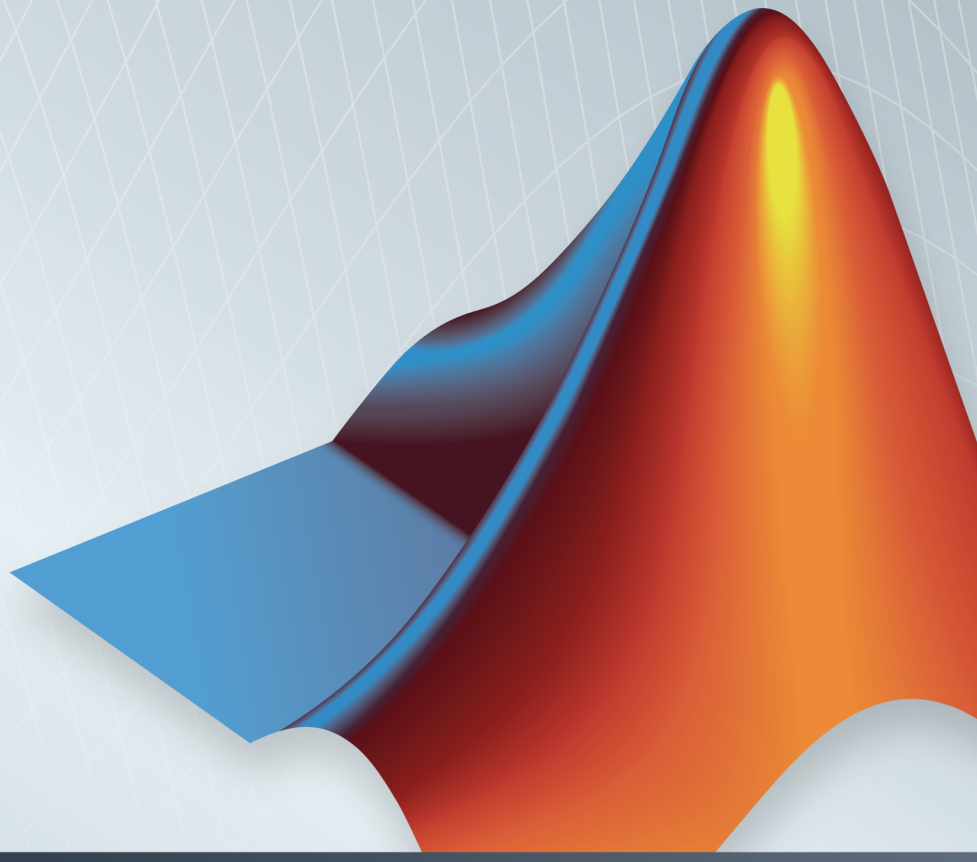
Vehicle Network Toolbox™

User's Guide

R2014**b**



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Vehicle Network Toolbox™ User's Guide

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1

Getting Started

Vehicle Network Toolbox Product Description

Communicate with in-vehicle networks and access ECUs using CAN and XCP protocols

Vehicle Network Toolbox provides connectivity to CAN devices from MATLAB® and Simulink® using industry-standard CAN database files. The toolbox provides MATLAB functions and Simulink blocks to send, receive, encode, and decode CAN and XCP messages, enabling you to exchange messages between a CAN bus and your programs and models. You also can connect to an ECU via XCP on CAN using A2L description files.

From MATLAB or Simulink, you can monitor, filter, and analyze live CAN bus data or log and record CAN messages for later analysis and replay. You also can simulate message traffic on a virtual CAN bus or connect Simulink models to a live network or ECU. Vehicle Network Toolbox supports CAN interface devices from Vector, Kvaser, and National Instruments®.

Key Features

- MATLAB functions for transmitting and receiving CAN and XCP messages
- Simulink CAN and XCP blocks for connecting a model to a CAN bus or ECU
- Vector CAN database (.dbc) file and A2L description file support
- Signal packing and unpacking functions and blocks for simplified encoding and decoding of CAN messages
- Message filtering, logging, and replay functions
- Vehicle CAN Bus Monitor app to configure devices and visualize live CAN network traffic
- Support for Vector, Kvaser, and National Instruments CAN interface devices

Product Capabilities

In this section...

Vehicle Network Toolbox Characteristics

The toolbox is a collection of functions built on the MATLAB technical computing environment.

You can use the toolbox to:

- “Connect to CAN Devices” on page 1-3
- “Use Supported CAN Devices and Drivers” on page 1-3
- “Communicate Between MATLAB and CAN Bus” on page 1-4
- “Simulate CAN Communication” on page 1-4
- “Visualize CAN Communication” on page 1-4

Connect to CAN Devices

Vehicle Network Toolbox provides host-side CAN connectivity using defined CAN devices. CAN is the predominant protocol in automotive electronics by which many distributed control systems in a vehicle function.

For example, in a common design when you press a button to lock the doors in your car, a control unit in the door reads that input and transmits lock commands to control units in the other doors. These commands exist as data in CAN messages, which the control units in the other doors receive and act on by triggering their individual locks in response.

Use Supported CAN Devices and Drivers

You can use Vehicle Network Toolbox to communicate over the CAN bus using supported Vector, Kvaser, or National Instruments devices and drivers.

See “Supported Hardware” on page 1-10 for more information.

Communicate Between MATLAB and CAN Bus

Using a set of well-defined functions, you can transfer messages between the MATLAB workspace and a CAN bus using a CAN device. You can run test applications that can log and record CAN messages for you to process and analyze. You can also replay recorded sequences of messages.

Simulate CAN Communication

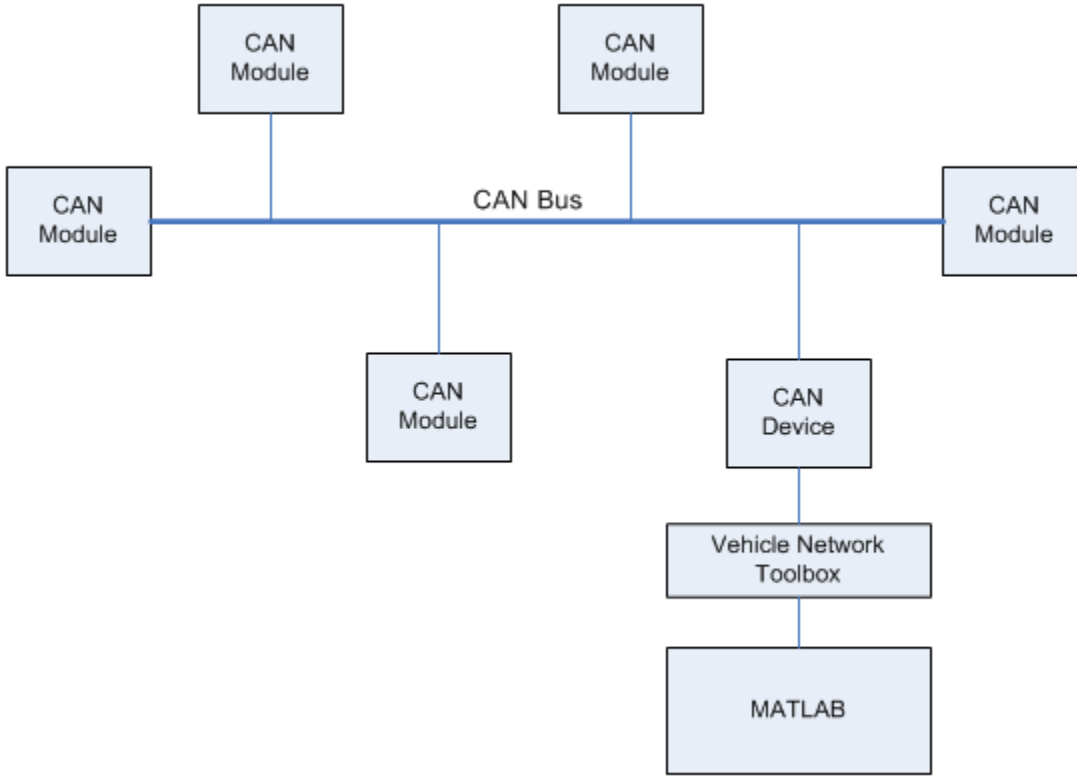
With Vehicle Network Toolbox block library and other blocks from the Simulink library, you can create sophisticated models to connect to a live network and to simulate message traffic on a CAN bus.

Visualize CAN Communication

Using Vehicle CAN Bus Monitor, a simple graphical user interface, you can monitor message traffic on a selected device and channel. You can then analyze these messages.

Interaction Between the Toolbox and Its Components

Vehicle Network Toolbox is a conduit between MATLAB and the CAN bus.



In this illustration:

- Six CAN modules are attached to a CAN bus.
- One module, which is a CAN device, is attached to the Vehicle Network Toolbox, built on the MATLAB technical computing environment.

Using Vehicle Network Toolbox from MATLAB, you can configure a channel on the CAN device to:

- Transmit messages to the CAN bus.
- Receive messages from the CAN bus.
- Trigger a callback function to run when the channel receives a message.

- Attach the database to the configured CAN channel to interpret received CAN messages.
- Use the CAN database to construct messages to transmit.
- Log and record messages and analyze them in MATLAB.
- Replay live recorded sequence of messages in MATLAB.
- Build Simulink models to connect to a CAN bus and to simulate message traffic.
- “Monitor Vehicle CAN Bus” with the CAN Tool.

Vehicle Network Toolbox is a comprehensive solution for CAN connectivity in MATLAB and Simulink. Refer to the Functions and Simulink Blocks for more information.

Expected Background

This document assumes that you are familiar with these products:

- MATLAB — To write scripts and functions, and to use functions with the command-line interface.
- Simulink — To create simple models to connect to a CAN bus or to simulate those models.
- Vector CANdb — To understand CAN databases and message and signal definitions.

Related Products

MathWorks provides several products that are relevant to the kinds of tasks you can perform with Vehicle Network Toolbox software and that extend the capabilities of MATLAB. For information about these related products, see the toolbox product page on the MathWorks Web site.

Install Required Components

In this section...

Required Components

To communicate on CAN networks from the MATLAB workspace and using Simulink models, install these components:

- Current MATLAB version
- Current Vehicle Network Toolbox software
- Hardware, drivers, and driver libraries for your devices

Note: To use the Vehicle Network Toolbox block library, install the current Simulink version.

Install Devices and Drivers

Vector Hardware Devices and Drivers

You need the latest version of the driver for your device to use with Windows® XP, Windows Vista™, or Windows 7.

The documentation from Vector provides installation instructions for hardware devices such as CANcaseXL, CANboardXL, and CANcardXL, drivers, and support libraries.

These drivers are available for download from the Vector Web site at:

`http://vector.com/vi_downloadcenter_en.html`

Drivers for 32-bit and 64-bit Windows are available in separate packages. Download and install the latest version and select the appropriate check box during installation for the hardware you want to use. Virtual channels are also installed with the hardware drivers.

XL Driver Library

Download and install the latest version of the XL Driver Library from the Vector Web site. A single package contains the driver library for 32-bit and 64-bit Windows. After installing the library:

- If you have a 32-bit system, copy the file `vxlapi.dll` from the installation folder to the *`windows root`*`\system32` folder.
- If you have a 64-bit system, copy the file `vxlapi64.dll` from the installation folder to the *`windows root`*`\system32` folder.
- If you have a 64-bit system and need to run the 32-bit version of Vehicle Network Toolbox software, copy the file `vxlapi.dll` from the installation folder to the *`windows root`*`\syswow64` folder.

Kvaser Hardware Devices and Drivers

You need the latest version of the driver for your device to use with Windows XP, Windows Vista, or Windows 7. Refer to your Kvaser device documentation for hardware installation instructions.

Drivers for your Kvaser devices are available on the Kvaser Web site at:

http://www.kvaser.com/support/downloads/.

Drivers for 32-bit and 64-bit Windows are available in the same package. Virtual channels are also installed with the hardware drivers.

National Instruments Devices and Drivers

You need the latest version of the driver for your device to use with Windows XP, Windows Vista, or Windows 7. Refer to your National Instruments device documentation for hardware installation instructions.

If you are using an NI-CAN device, install the NI-CAN programming library from the National Instruments Web site. This installs both the drivers and the driver libraries.

If you are using an NI-XNET device, install the latest NI-XNET drivers from the National Instruments Web site. This installs both the drivers and the driver libraries.

Drivers for 32-bit and 64-bit Windows are available in the same package. Virtual channels for NI-CAN devices are also installed with the hardware drivers.

Notes You can use National Instruments on a 32-bit system or on 32-bit MATLAB installed on a 64-bit system.

If you are using National Instruments CompactDAQ devices, you might need to install additional drivers. Check your device documentation for more information.

Tip To use NI-CAN and NI-XNET on the same system together, assign unique names to the device channels in NI-MAX before you create channels in the toolbox.

PEAK-System Devices and Drivers

You can use PCAN-USB, PCAN-USB PRO, PCAN-ExpressCard, PCAN-PCI, and PCAN-PCI Express devices with Vehicle Network Toolbox. You need to download the latest drivers for your device from the PEAK-System Downloads page.

If your driver installation requires the Microsoft® .NET Framework, the installer will prompt you and automatically download and install the necessary components.

Driver Library

A single package contains the driver and interface library for 32-bit and 64-bit Windows. After installing the library:

- If you have a 32-bit system, copy the file `PCANBasic.dll` from the download folder `\\Disk\PCAN-Basic API\Win32` location to the *`windows root`*`\system32` folder.
- If you have a 64-bit system, copy the file `PCANBasic.dll` from the download folder `\\Disk\PCAN-Basic API\Win64` location to the *`windows root`*`\system32` folder.
- If you have a 64-bit system and need to run the 32-bit version of Vehicle Network Toolbox software, copy the file `PCANBasic.dll` from the download folder `\\Disk\PCAN-Basic API\Win64` location to the *`windows root`*`\syswow64` folder.

Install the Toolbox

Determine if Vehicle Network Toolbox software is installed on your system by typing the following in the MATLAB Command Window:

```
ver
```

The Command Window displays information about the MATLAB version you are running, including a list of installed add-on products and their version numbers. Check the list to see if the Vehicle Network Toolbox name appears.

For information about installing the toolbox, refer to the installation documentation for your platform. If you experience installation difficulties, look for the installation and license information at the MathWorks Web site:

http://www.mathworks.com/support

Supported Hardware

Vehicle Network Toolbox supports Vector, Kvaser, National Instruments, and PEAK-System CAN devices.

Supported Vector Devices

Support for Vector CAN devices, including these product families:

- CANcaseXL
- CANcaseXLe
- CANboardXL
- CANboardXL pxi
- CANboardXL PCIe
- CANcardXL
- CANcardX

You can also use the toolbox with virtual CAN channels available with Vector hardware drivers.

Supported Kvaser Devices

Support for Kvaser CAN devices, including these product families:

- WLAN
- PCMCIA
- Leaf
- Memorator
- PCI
- USB

You can also use the toolbox with virtual CAN channels available with Kvaser hardware drivers.

For a full list of devices, see the Supported Hardware page.

Supported National Instruments Devices

You can use NI-CAN and NI-XNET devices with Vehicle Network Toolbox.

For a complete list of supported NI-CAN devices, see the Supported Hardware page.

All product families of NI-XNET devices are supported including:

- NI 9861, USB-986
- NI 9862, USB-9862
- NI PXI-8513/2, PXI-8513
- NI PXI-8512/2, PXI-8512
- NI PXI-8511/2, PXI-8511
- NI PCI-8513/2, PCI-8513
- NI PCI-8512/2, PCI-8512
- NI PCI-8511/2, PCI-8511

Supported PEAK-System Devices

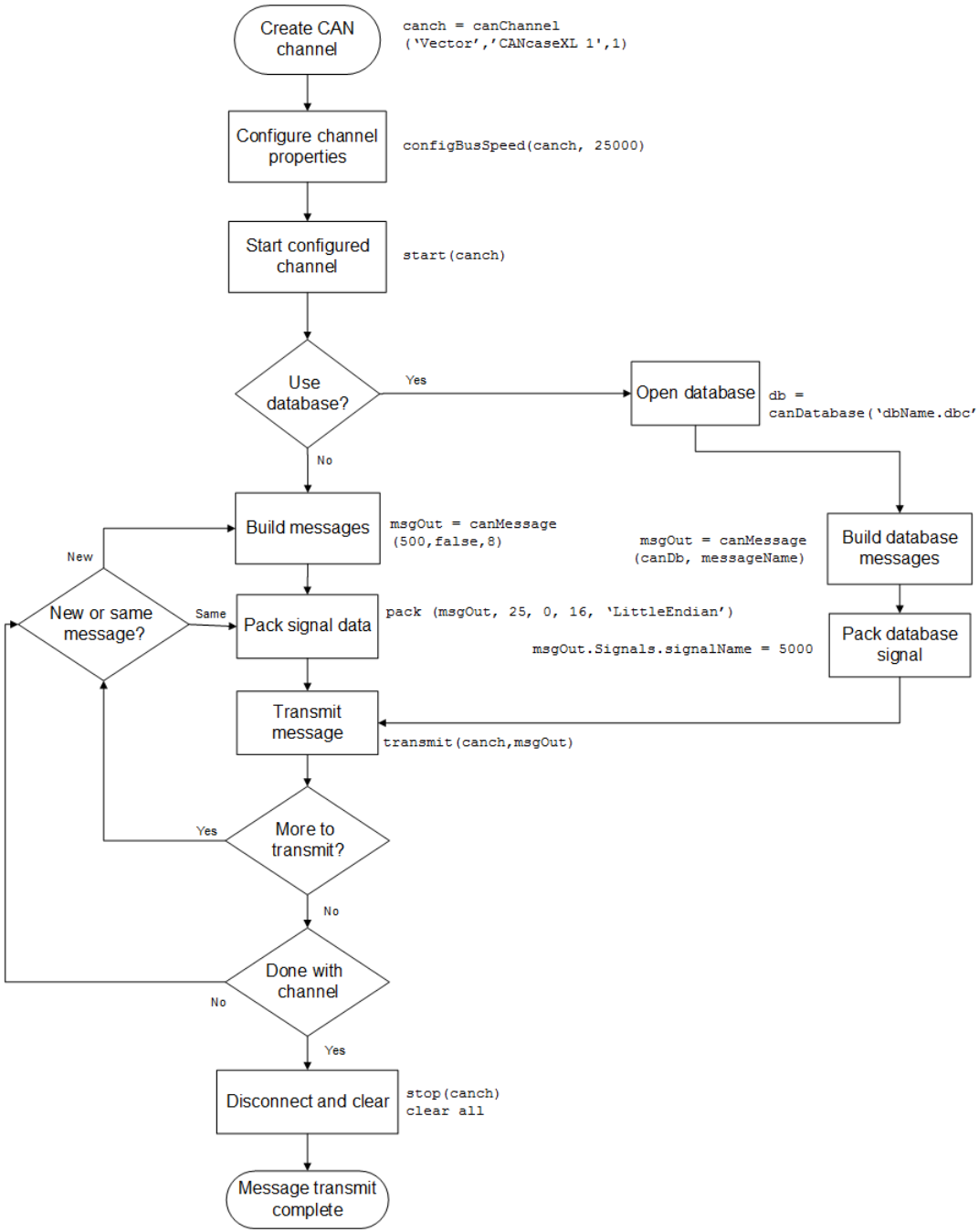
Support for PEAK-System devices, including these product families:

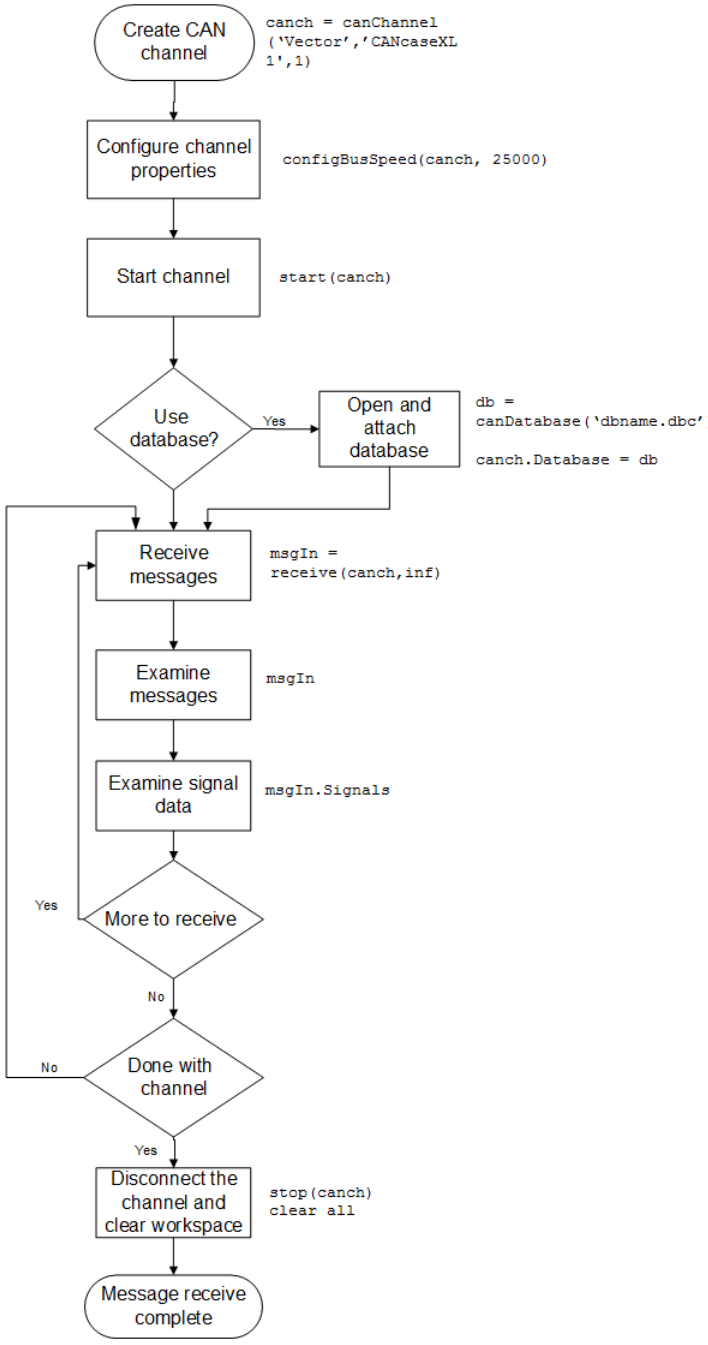
- PCAN-USB
- PCAN-USB Pro
- PCAN-USB Hub
- PCAN-PC Card

- PCAN-ExpressCard
- PCAN-PCI
- PCAN-PCI Express
- PCAN-cPCI
- PCAN-miniPCI
- PCAN-minPCIe

Vehicle Network Communication in MATLAB

Workflows in this section are sequential and will help you understand how the communication works. You can also see code snippets and map them to the examples in the next section.


Create CAN channel
canch = canChannel ('Vector','CANcaseXL 1',1)
Configure channel properties
configBusSpeed(canch, 25000)
Start configured channel
start(canch)
Use database?
Yes
Open database
db = canDatabase('dbName.dbc')
No
Build messages
msgOut = canMessage (500,false,8)
msgOut = canMessage (canDb, messageName)
Build database messages
New
New or same message?
Same
Pack signal data
pack (msgOut, 25, 0, 16, 'LittleEndian')
msgOut.Signals.signalName = 5000
Pack database signal
Transmit message
transmit(canch,msgOut)
Yes
More to transmit?
No
Done with channel
No
Yes
Disconnect and clear
stop(canch)
clear all
Message transmit complete


Create CAN channel
canch = canChannel ('Vector','CANcaseXL 1',1)
Configure channel properties
configBusSpeed(canch, 25000)
Start channel
start(canch)
Use database?
Yes
Open and attach database
db = canDatabase('dbname.dbc')
canch.Database = db
Receive messages
msgIn = receive(canch,inf)
Examine messages
msgIn
Examine signal data
msgIn.Signals
More to receive
Yes
No
Done with channel
No
Yes
Disconnect the channel and clear workspace
stop(canch)
clear all
Message receive complete

Vehicle Network Communication Examples

In this section...

Prerequisites

Examples follow a sequential workflow for configuring CAN communications. Use these examples sequentially MATLAB Command Window.

In the example, create two CAN channels using `canChannel`, and `canHWInfo` to obtain information about the devices installed on your system. Edit the properties of the first channel and create a message using `canMessage`. Transmit the message from the first channel using `transmit`, and receive it on the other using `receive` .

Before you follow this example, make sure you:

- Complete your toolbox installation before you try out the examples.
- Connect the two channels in your CAN device with a loopback connector.

The following examples use the Vector CANcaseXL hardware. You can substitute it with any other supported hardware.

Discover Installed Hardware

1 Get information about the CAN hardware devices on your system:

```
info = canHWInfo
```

MATLAB displays the following information:

```
CAN Devices Detected

Vendor | Device                       | Channel | Serial Number | Constructor
------ | ---------------------------- | ------- | ------------- | -----------------------------------
Kvaser | Virtual 1                    | 1       | 0             | canChannel('Kvaser', 'Virtual 1', 1)
Kvaser | Virtual 1                    | 2       | 0             | canChannel('Kvaser', 'Virtual 1', 2)
NI     | Virtual (CAN256)             | 1       | 0             | canChannel('NI', 'CAN256')
NI     | Virtual (CAN257)             | 2       | 0             | canChannel('NI', 'CAN257')
NI     | Series 847X Sync USB (CAN0)  | 1       | 14E1B6E       | canChannel('NI', 'CAN0')
NI     | Series 847X Sync USB (CAN1)  | 1       | 14E1B68       | canChannel('NI', 'CAN1')
Vector | CANcaseXL 1                  | 1       | 24365         | canChannel('Vector', 'CANcaseXL 1', 1)
Vector | CANcaseXL 1                  | 2       | 24365         | canChannel('Vector', 'CANcaseXL 1', 2)
Vector | Virtual 1                    | 1       | 0             | canChannel('Vector', 'Virtual 1', 1)
Vector | Virtual 1                    | 2       | 0             | canChannel('Vector', 'Virtual 1', 2)

 Use GET on the output of CANHWINFO for more information.
```

2 Save the vector device information to a variable.

```
vector = info.VendorInfo(1)
```

3 Get details about the first available CAN channel.

```
vector.ChannelInfo(1)
```

```
Package: can.vector

  Properties:
                Device: 'CANcaseXL 1'
    DeviceChannelIndex: 1
    DeviceSerialNumber: 24365
     ObjectConstructor: 'canChannel('Vector','CANcaseXL 1',1)'
```

Create a CAN Channel

Note: This example assumes that you have a loopback connection between the two channels on your CAN device.

1 Create the first CAN channel on an installed CAN device:

```
canch1 = canChannel('Vector','CANcaseXL 1',1)
```

Notes You cannot use the same variable to create multiple channels sequentially. Clear any channel in use before using the same variable to construct a new CAN Channel.

You cannot create arrays of CAN channel objects. Each object you create must exist as its own individual variable.

---

2 Press **Enter** after you create the connection. MATLAB displays a summary of the channel properties:

```
Summary of CAN Channel using 'Vector' 'CANcaseXL 1' Channel 1.

  Channel Parameters:  Bus Speed is 500000.
                       Bus Status is 'N/A'.
                       Transceiver name is 'CANpiggy 251mag (Highspeed)'.
                       Serial Number of this device is 24811.
                       Initialization access is allowed.
                       No database is attached.

              Status:  Offline - Waiting for START.
                       0 messages available to RECEIVE.
                       0 messages transmitted since last start.
                       0 messages received since last start.

      Filter History:  Standard ID Filter: Allow All | Extended ID Filter: Allow All.
```

3 Create a second CAN channel object.

```
canch2 = canChannel('Vector','CANcaseXL 1',2)
```

You used the `canChannel` function to connect to the CAN device. To identify installed devices, use the `canHWInfo` function.

Configure Properties

You can set the behavior of your CAN channel by configuring its property values. For this exercise, change the bus speed of channel 1 to 250000 using the `configBusSpeed` function.

Tip Configure property values before you start the channel.

---

1 Change the `BusSpeed` property of the channel to `250000`:

```
configBusSpeed(canch1, 250000)
```

2 To see the changed property value, type:

```
canch1.BusSpeed
```

MATLAB displays all properties on the configured channel as before, with the changed `BusSpeed` property value:

```
.
.
.
 BusSpeed = 250000
```

3 Change the bus speed of the second channel (`canch2`) by repeating steps 2 and 3.

Start the Channel

Start your CAN channels after you configure all properties.

1 Start the first channel:

```
start(canch1)
```

2 Start the second channel:

```
start(canch2)
```

3 To check that the channel is online, type the channel name in the Command Window. The **Status** section indicates that the channel is now online, as in this example:

```
>> canch1
.
.
.
              Status:  Online.
                       0 messages available to RECEIVE.
                       0 messages transmitted since last start.
                       0 messages received since last start.

      Filter History:  Standard ID Filter: Allow All | Extended ID Filter: Allow All.
```

Create a Message

After you set all the property values as desired and your channels are online, you are ready to transmit and receive messages on the CAN bus. For this exercise, transmit

a message using `canch` and receive it using `canch1`. To transmit a message, create a message object and pack the message with the required data.

1 Build a CAN message of ID 500 of standard type and a data length of 8 bytes:

```
messageout = canMessage(500, false, 8)
```

The message object is now:

```
messageout =

  can.Message handle
  Package: can

  Properties:
           ID: 500
     Extended: 0
         Name: ''
     Database: []
        Error: 0
       Remote: 0
    Timestamp: 0
         Data: [0 0 0 0 0 0 0 0]
      Signals: []

  Methods, Events, Superclasses
```

The fields in the message show:

- **can.Message (Normal Frame)** — Specifies that the message is not an error or a remote frame.
- **ID** — The ID you specified and its hexadecimal equivalent.
- **Extended** — A logical `0` (false) because you did not specify an extended ID.
- **Data** — A uint8 array of 0s specified by the data length.

Refer to the `canMessage` function to understand more about the input arguments.

You can also use a database to create a CAN message. Refer to “Message Database” for more information.

Pack a Message

After you define the message, pack it with the required data.

1. Use the `pack` function to pack your message with these input parameters:

   ```
   pack(messageout, 25, 0, 16, 'LittleEndian')
   ```

   Here you are specifying the `data` value to be 25, the start bit to be 0, the signal size to be 16, and the byte order to be little-endian format.

2. To see the packed data, type:

   ```
   messageout
   ```

   MATLAB displays your message properties with the specified data:

   ```
   messageout =

     can.Message handle
     Package: can

     Properties:
               ID: 500
        Extended: 0
            Name: ''
        Database: []
           Error: 0
          Remote: 0
       Timestamp: 0
            Data: [25 0 0 0 0 0 0 0]
         Signals: []

     Methods, Events, Superclasses
   ```

The only field that changes after you specify the data is **Data**. Refer to the `pack` function to understand more about the input arguments.

Transmit a Message

After you define the message and pack it with the required data, you are ready to transmit the message. For this example, use `canch` to transmit the message.

1. Use the `transmit` function to transmit the message, supplying the channel and the message as input arguments:

   ```
   transmit(canch1, messageout)
   ```

2. To display the channel status, type:

```
canch1
```

MATLAB displays the updated status of the channel:

```
Summary of CAN Channel using 'Vector' 'CANcaseXL 1' Channel 1.

  Channel Parameters:  Bus Speed is 250000.
                       Bus Status is 'ErrorPassive'.
                       Transceiver name is 'CANpiggy 251mag (Highspeed)'.
                       Serial Number of this device is 24811.
                       Initialization access is allowed.
                       No database is attached.

              Status:  Online.
                       1 messages available to RECEIVE.
                       1 messages transmitted since last start.
                       0 messages received since last start.

       Filter History:  Standard ID Filter: Allow All | Extended ID Filter: Allow All.
```

In the **Status** section, `messages transmitted since last start count` increments by 1 each time you transmit a message.

Refer to the `transmit` function to understand more about the input arguments.

Receive a Message

After your channel is online, use the `receive` function to receive available messages. For this example, receive the message on the second configured channel object, `canch2`.

1 To see messages available to be received on this channel, type:

```
canch2
```

The channel status displays available messages:

```
.
.
.
 Status:  Online.
          1 messages available to RECEIVE.
          0 messages transmitted since last start.
          0 messages received since last start.
```

2 To receive one message from `canch1` and store it as `messagein`, type:

```
messagein = receive(canch2, 1)
```

MATLAB returns the received message properties:

```
messagein =
```

```
  can.Message handle
  Package: can

  Properties:
           ID: 500
     Extended: 0
         Name: ''
     Database: []
        Error: 0
       Remote: 0
    Timestamp: 709.0403
         Data: [25 0 0 0 0 0 0 0]
      Signals: []

  Methods, Events, Superclasses
```

3 To check if the channel received the message, type:

```
canch2
```

MATLAB returns the channel properties, and the status indicates that the channel received one message:

```
.
.
.
Status:  Online.
         0 messages available to RECEIVE.
         0 messages transmitted since last start.
         1 messages received since last start.
```

Refer to the `receive` function to understand more about its input arguments.

Unpack a Message

After your channel receives a message, specify how to unpack the message and interpret the data in the message. Use `unpack` to specify the parameters for unpacking a message:

```
value = unpack(messagein, 0, 16, 'LittleEndian', 'int16')
```

The unpacked message returns a value based on your parameters:

```
value =
```

25

Refer to the `unpack` function to understand more about its input arguments.

Save a CAN Channel

You can save a CAN channel object to a file using the `save` function anytime during the CAN communication session.

For example, create a channel object `canch1`. To save it to the MATLAB file `mycanch.mat`, type:

```
save mycanch.mat canch1
```

Load a Saved Channel

If you have saved a CAN channel as a MATLAB file, you can load it into a session using the `load` function. For example, to reload `mycanch.mat` created above, type:

```
load mycanch.mat
```

The loaded CAN channel object reconnects to the specified hardware and reconfigures itself to the specifications when the channel was saved.

Filter Messages

You can set up filters on your channel to accept messages based on the filtering parameters you specify. Set up your filters before putting your channel online. For more information on message filtering, see these functions:

- `filterAllowAll`
- `filterBlockAll`
- `filterAllowOnly`

To specify message names you want to filter, create a CAN channel and attach a database to the channel:

```
canch1 = canChannel('Vector','CANcaseXL 1',1);
canch1.Database = canDatabase('demoVNT_CANdbFiles.dbc');
```

Set a filter for the message `EngineMsg` and display the channel:

```
filterAllowOnly(canch1, 'EngineMsg');

canch1
Summary of CAN Channel using 'Vector' 'CANcaseXL 1' Channel 1.

  Channel Parameters:  Bus Speed is 500000.
                       Bus Status is 'N/A'.
                       Transceiver name is ''.
                       Serial Number of this device is 0.
                       Initialization access is allowed.
                       'demoVNT_CANdbFiles.dbc' database is attached.

              Status:  Offline - Waiting for start.
                       0 messages available to receive.
                       0 messages transmitted since last start.
                       0 messages received since last start.

      Filter History:  Standard ID Filter: Allow Only | Extended ID Filter: Allow All
```

If you start the channel and receive messages, you should now only see the `EngineMsg` pass through the filter.

Multiplex Signals

Use multiplexing to represent multiple signals in one signal's location in a CAN message's data. A multiplexed message can have three types of signals:

Standard signal

This signal is always active. You can create one or more standard signals.

Multiplexor signal

Also called the mode signal, it is always active and its value determines which multiplexed signal is currently active in the message data. You can create only one multiplexor signal per message.

Multiplexed signal

This signal is active when its multiplex value matches the value of the multiplexor signal. You can create one or more multiplexed signals in a message.

Multiplexing works only with a CAN database with message definitions that already contain multiplex signal information. This example shows you how to access the different multiplex signals using a database constructed specifically for this purpose. This database has one message with these signals:

- `SigA`: A multiplexed signal with a multiplex value of `0`.

- `SigB`: Another multiplexed signal with a multiplex value of `1`.
- `MuxSig`: A multiplexor signal, whose value determines which of the two multiplexed signals are active in the message.

1 Create a CAN database:

```
d = canDatabase('Mux.dbc')
```

Note: This is an example database constructed for creating multiplex messages. To try this example, use your own database.

---

2 Create a CAN message:

```
m = canMessage(d, 'Msg')
```

The message displays all its properties:

```
m =

  can.Message handle
  Package: can

  Properties:
            ID: 250
      Extended: 0
          Name: 'Msg'
      Database: [1x1 can.Database]
         Error: 0
        Remote: 0
     Timestamp: 0
          Data: [0 0 0 0 0 0 0 0]
       Signals: [1x1 struct]

  Methods, Events, Superclasses
```

3 To display the signals, type:

```
m.Signals

ans =

      SigB: 0
      SigA: 0
    MuxSig: 0
```

`MuxSig` is the multiplexor signal, whose value determines which of the two multiplexed signals are active in the message. `SigA` and `SigB` are the multiplexed signals that are active in the message if their multiplex values match `MuxSig`. In the example shown, `SigA` is active because its current multiplex value of `0` matches the value of `MuxSig` (which is `0`).

4 If you want to make `SigB` active, change the value of the `MuxSig` to `1`:

```
m.Signals.MuxSig = 1
```

To display the signals, type:

```
m.Signals
```

```
ans =

      SigB: 0
      SigA: 0
    MuxSig: 1
```

`SigB` is now active because its multiplex value of `1` matches the current value of `MuxSig` (which is `1`).

5 Change the value of `MuxSig` to `2`:

```
m.Signals.MuxSig = 2
```

Here, neither of the multiplexed signals are active because the current value of `MuxSig` does not match the multiplex value of either `SigA` or `SigB`.

```
  m.Signals
```

```
 ans =

      SigB: 0
      SigA: 0
    MuxSig: 2
```

Always check the value of the multiplexor signal before using a multiplexed signal value.

```
if (m.Signals.MuxSig == 0)
% Feel free to use the value of SigA however is required.
end
```

This ensures that you are not using an invalid value because the toolbox does not prevent or protect reading or writing inactive multiplexed signals.

Note: You can access both active and inactive multiplexed signals regardless of the value of the multiplexor signal.

Refer to the `canMessage` function to learn more about creating messages.

Configure Silent Mode

The `SilentMode` property of a CAN channel specifies that the channel can only receive messages and not transmit them. Use this property to observe all message activity on the network and perform analysis without affecting the network state or behavior. See `SilentMode` for more information.

1. Change the `SilentMode` property of the first CAN channel, `canch1` to `true`:

   ```
   canch.SilentMode = true
   ```

2. To see the changed property value, type:

   ```
   canch1.SilentMode
   ```

   MATLAB displays the changed `SilentMode` property value:

   ```
   ans =

        1
   ```

Disconnect Channels and Clean Up

Disconnecting the Configured Channel

When you no longer need to communicate with your CAN bus, disconnect the CAN channel that you configured. Use the `stop` function to disconnect.

1. Stop the first channel:

```
stop(canch1)
```

2 Check the channel status:

```
canch1
```

MATLAB displays the channel status:

```
.
.
.
Status:  Offline - Waiting for START.
         1 messages available to RECEIVE.
         1 messages transmitted since last start.
         0 messages received since last start.
```

3 Stop the second channel:

```
stop(canch2)
```

4 Check the channel status:

```
canch2
```

MATLAB displays the channel status:

```
Status:  Offline - Waiting for START.
         0 messages available to RECEIVE.
         0 messages transmitted since last start.
         1 messages received since last start.
```

Clean Up the MATLAB Workspace

When you no longer need the objects you used, remove them from the MATLAB workspace. To remove channel objects and other variables from the MATLAB workspace, use the `clear` function.

1 Clear the first channel:

```
clear canch1
```

2 Clear the second channel:

```
clear canch2
```

3 Clear the CAN messages:

```
clear 'messageout'
clear 'messagein'
```

4 Clear the unpacked value:

```
clear value
```

Access the Toolbox

In this section...

Explore the Toolbox

You can access Vehicle Network Toolbox from the MATLAB Command Window directly by using any Vehicle Network Toolbox function. To see a list of all the functions available, type:

```
help vnt
```

Get Help

The toolbox functions are grouped by usage. Click a specific function for more information.

To access the online documentation for the Vehicle Network Toolbox, type:

```
doc vnt
```

To access the reference page for a specific function, type:

```
doc function_name
```

View Examples

To follow examples in this guide use the Vector CANcaseXL device, with the Vector XL Driver Library version 6.4 or later. The Examples index in the Help browser lists these examples.

2

Hardware Support Package Installation

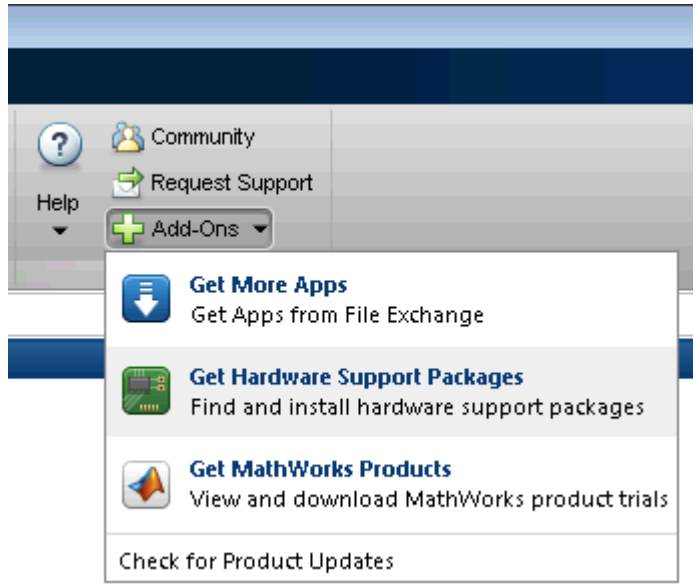
Vector CAN Device Support

Use this process to add support for Vector CAN devices to Vehicle Network Toolbox. After you download and install the Vector driver on your host computer, you can transmit and receive CAN messages with your Vector hardware using Vehicle Network Toolbox.

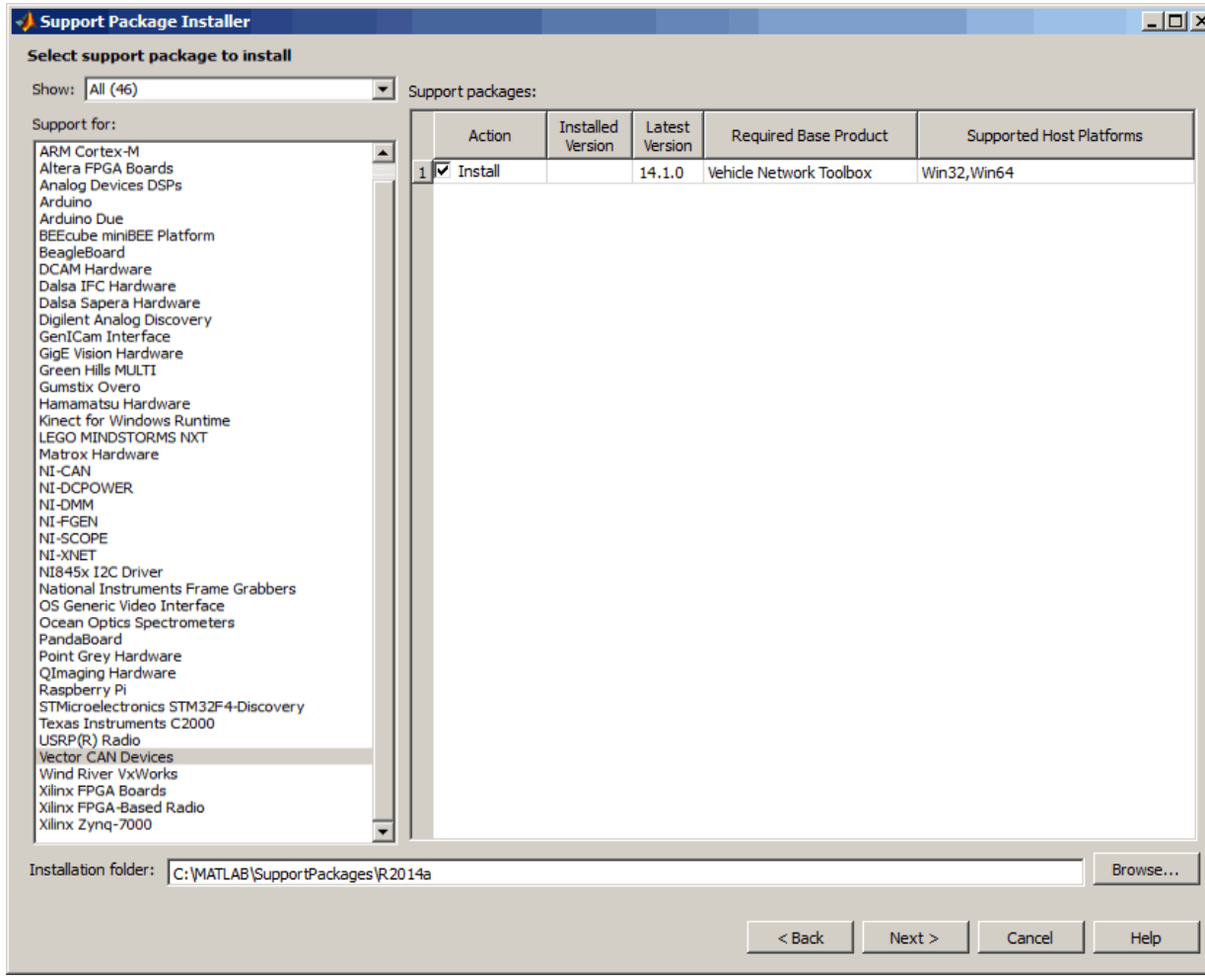
Note: You can use this support package only on a host computer running 32-bit or 64-bit Windows.

---

1. Open MATLAB.
2. Click **Add-Ons** in the MATLAB Home menu.
3. Select **Get Hardware Support Packages**.



1. The Support Package Installer opens with **Install from Internet** selected. At Support package to install, select `Vector CAN Devices`.



1 Follow the support package installer prompts. When prompted, log into your MathWorks® account.

Note: You need write privileges for the Installation folder.

At any time during this process, you can click Help for more information about downloading support packages.

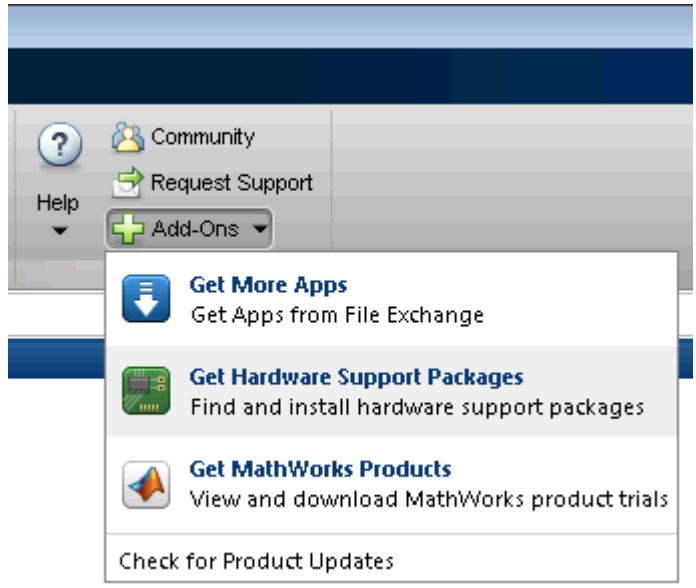
National Instruments NI-CAN Device Support

Use this process to add support for NI-CAN devices to Vehicle Network Toolbox. After you download and install the NI-CAN driver on your host computer, you can transmit and receive CAN messages on your NI-CAN hardware using Vehicle Network Toolbox.

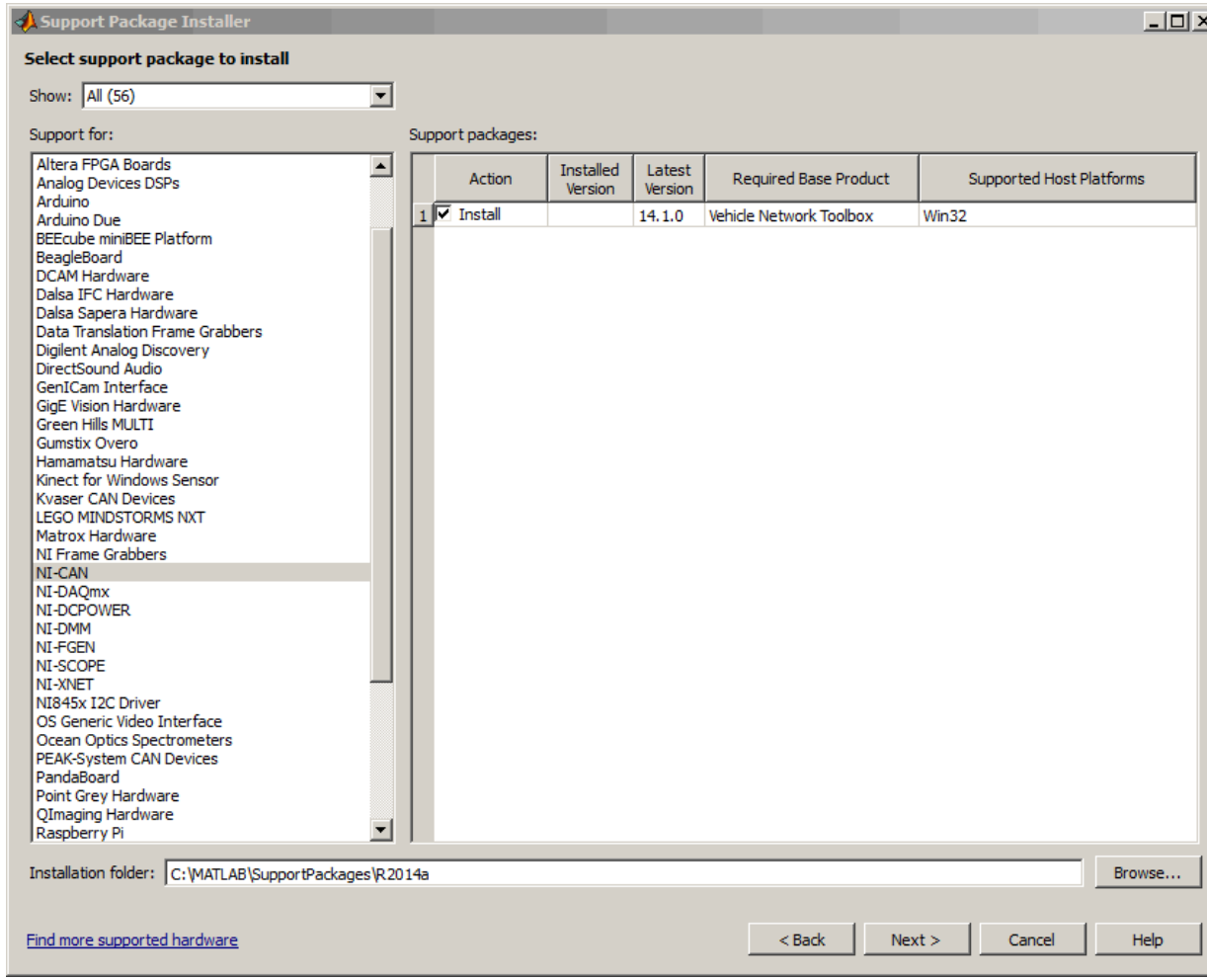
Note: You can use this support package only on a host computer running 32-bit Windows.

---

1. Open MATLAB.
2. Click **Add-Ons** in the MATLAB Home menu.
3. Select **Get Hardware Support Packages**.



1. The Support Package Installer opens with **Install from Internet** selected. At Support package to install, select `NI-CAN`.



1 Follow the support package installer prompts. When prompted, log into your MathWorks account.

Note: You need write privileges for the Installation folder.

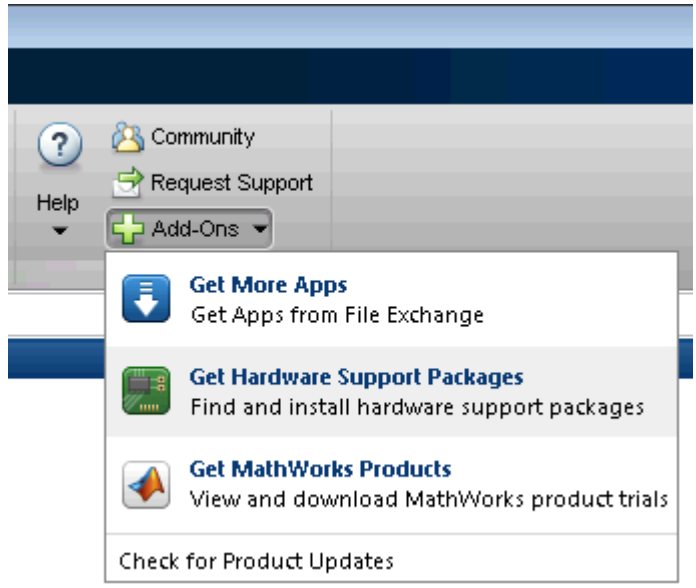
At any time during this process, you can click Help for more information about downloading support packages.

National Instruments NI-XNET Device Support

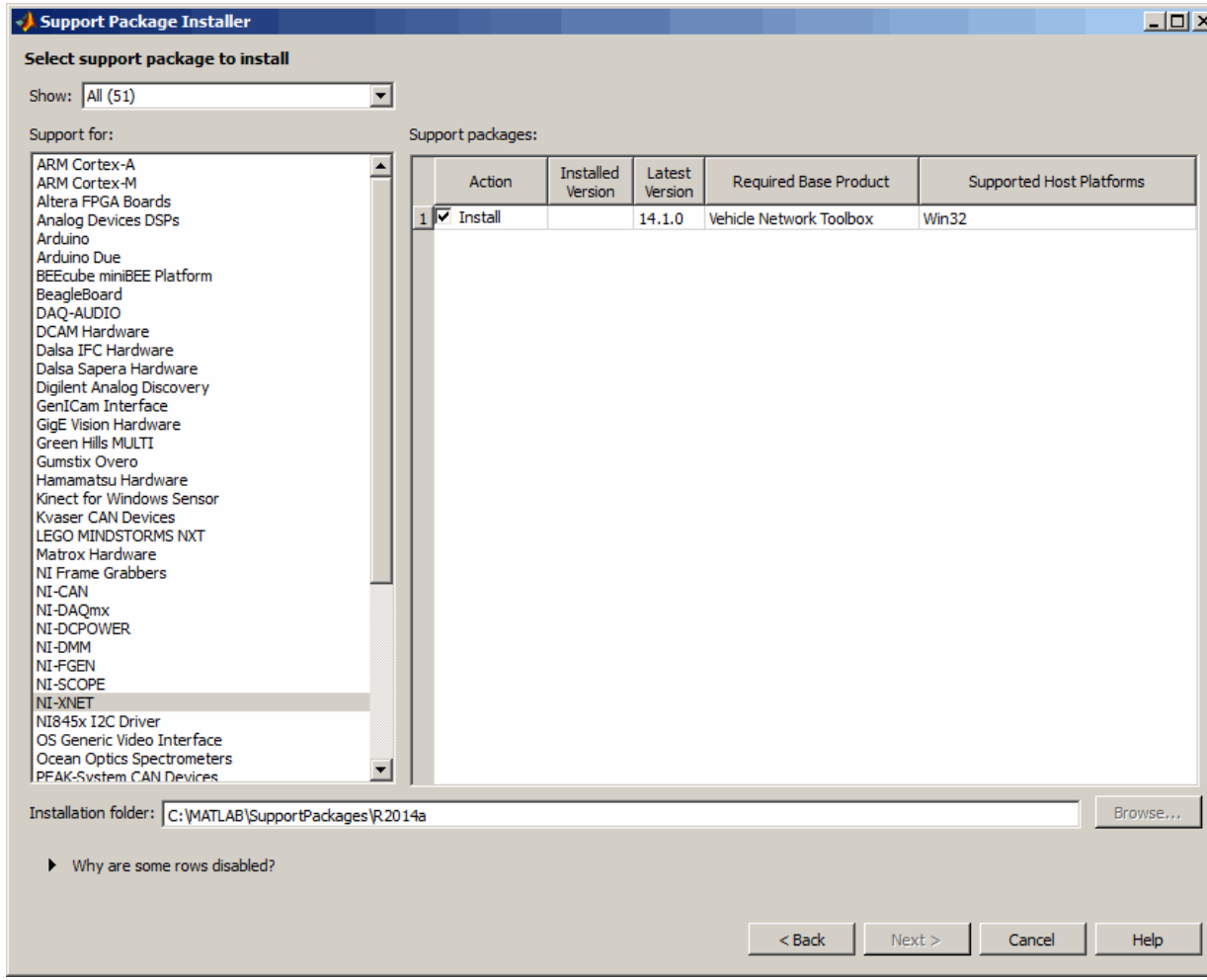
Use this process to add support for NI-XNET devices to Vehicle Network Toolbox. After you download and install the NI-XNET driver on your host computer, you can transmit and receive CAN messages on your NI-XNET hardware using Vehicle Network Toolbox.

Note: You can use this support package only on a host computer running 32-bit Windows.

1. Open MATLAB.
2. Click **Add-Ons** in the MATLAB Home menu.
3. Select **Get Hardware Support Packages**.



1. The Support Package Installer opens with **Install from Internet** selected. At Support package to install, select `NI-XNET`.



1 Follow the support package installer prompts. When prompted, log into your MathWorks account.

Note: You need write privileges for the Installation folder.

At any time during this process, you can click Help for more information about downloading support packages.

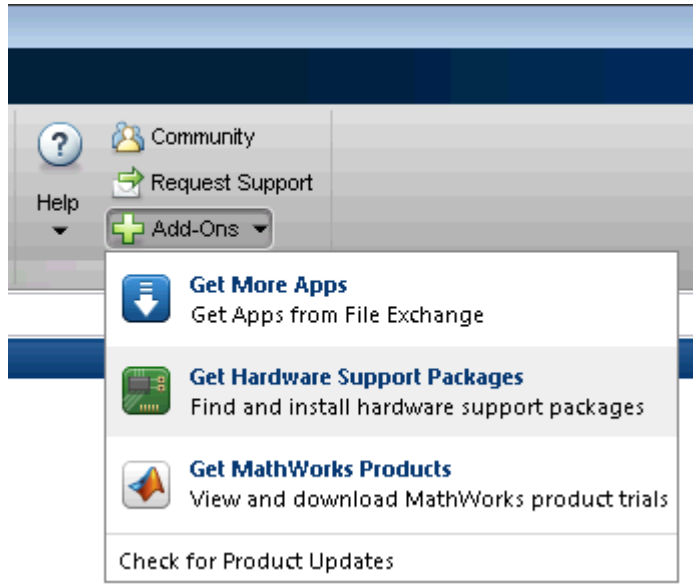
Kvaser CAN Device Support

Use this process to add support for Kvaser devices to Vehicle Network Toolbox. After you download and install the Kvaser driver on your host computer, you can transmit and receive CAN messages on your Kvaser hardware using Vehicle Network Toolbox.

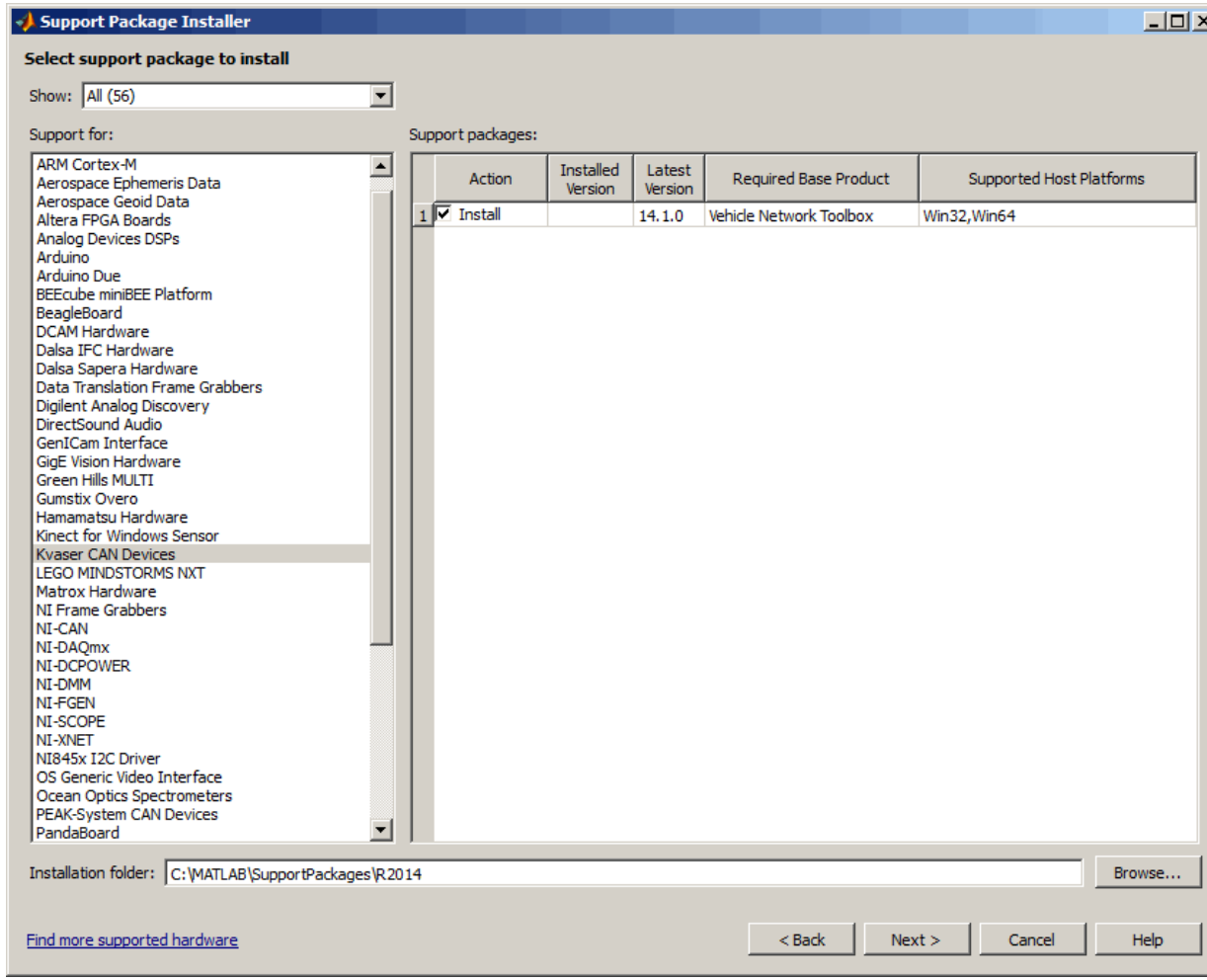
Note: You can use this support package only on a host computer running 32-bit or 64-bit Windows.

---

1. Open MATLAB.
2. Click **Add-Ons** in the MATLAB Home menu.
3. Select **Get Hardware Support Packages**.



1. The Support Package Installer opens with **Install from Internet** selected. At Support package to install, select `Kvaser CAN Devices`.



2 Follow the support package installer prompts. When prompted, log into your MathWorks account.

Note: You need write privileges for the Installation folder.

At any time during this process, you can click Help for more information about downloading support packages.

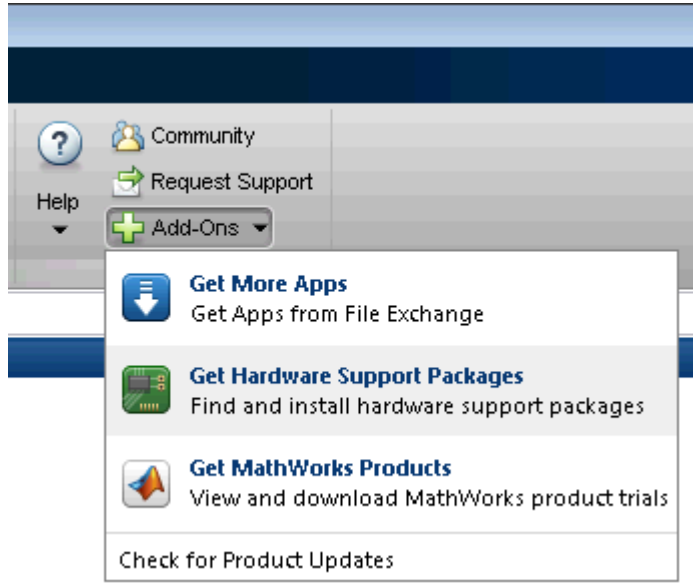
PEAK-System CAN Device Support

Use this process to add support for PEAK-System CAN devices to Vehicle Network Toolbox. After you download and install the PEAK-System driver on your host computer, you can transmit and receive CAN messages with your PEAK–System hardware using Vehicle Network Toolbox.

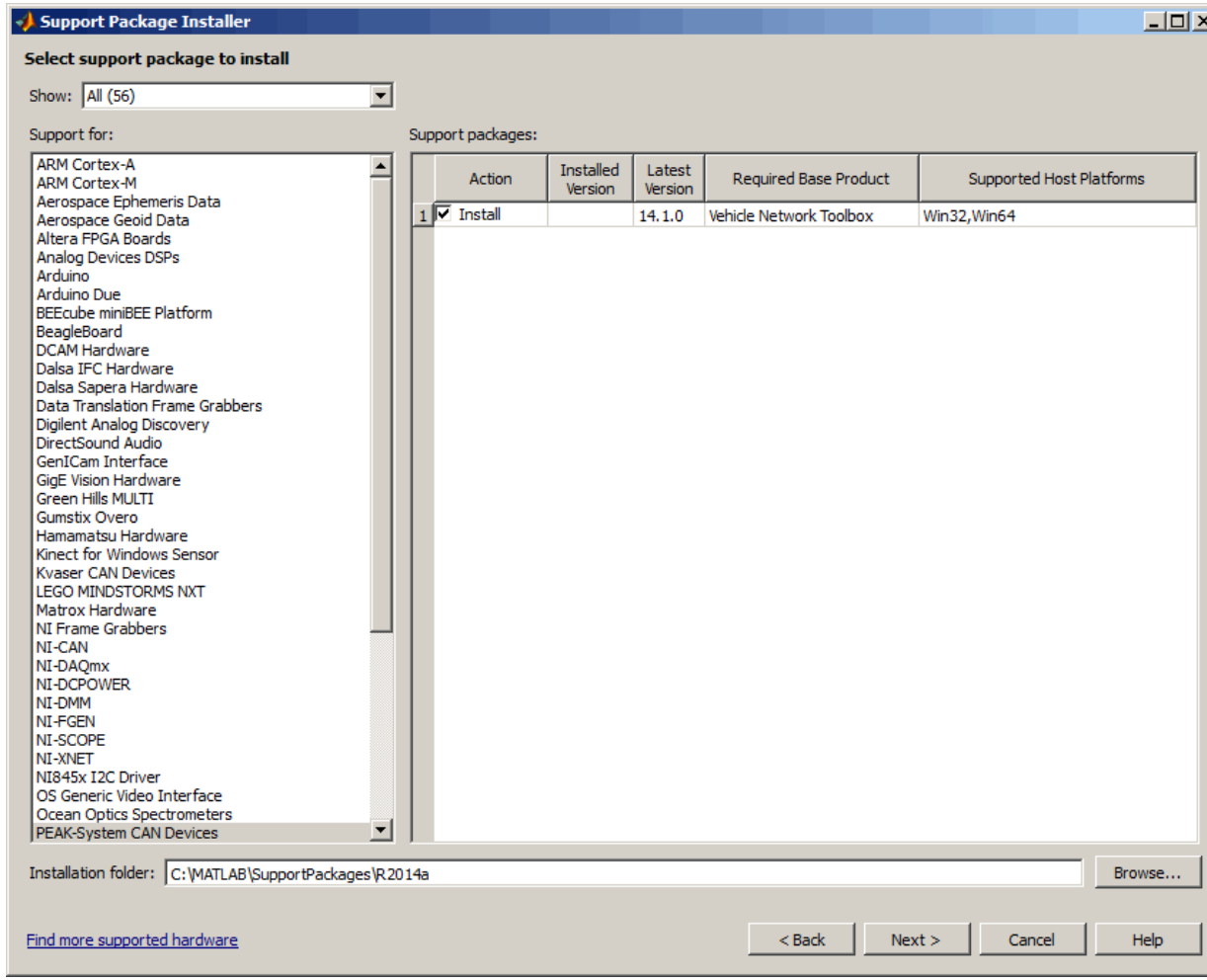
Note: You can use this support package only on a host computer running 32-bit or 64-bit Windows.

---

1. Open MATLAB.
2. Click **Add-Ons** in the MATLAB Home menu.
3. Select **Get Hardware Support Packages**.



1. The Support Package Installer opens with **Install from Internet** selected. At Support package to install, select `PEAK-System CAN Devices`.



1 Follow the support package installer prompts. When prompted, log into your MathWorks account.

Note: You need write privileges for the Installation folder.

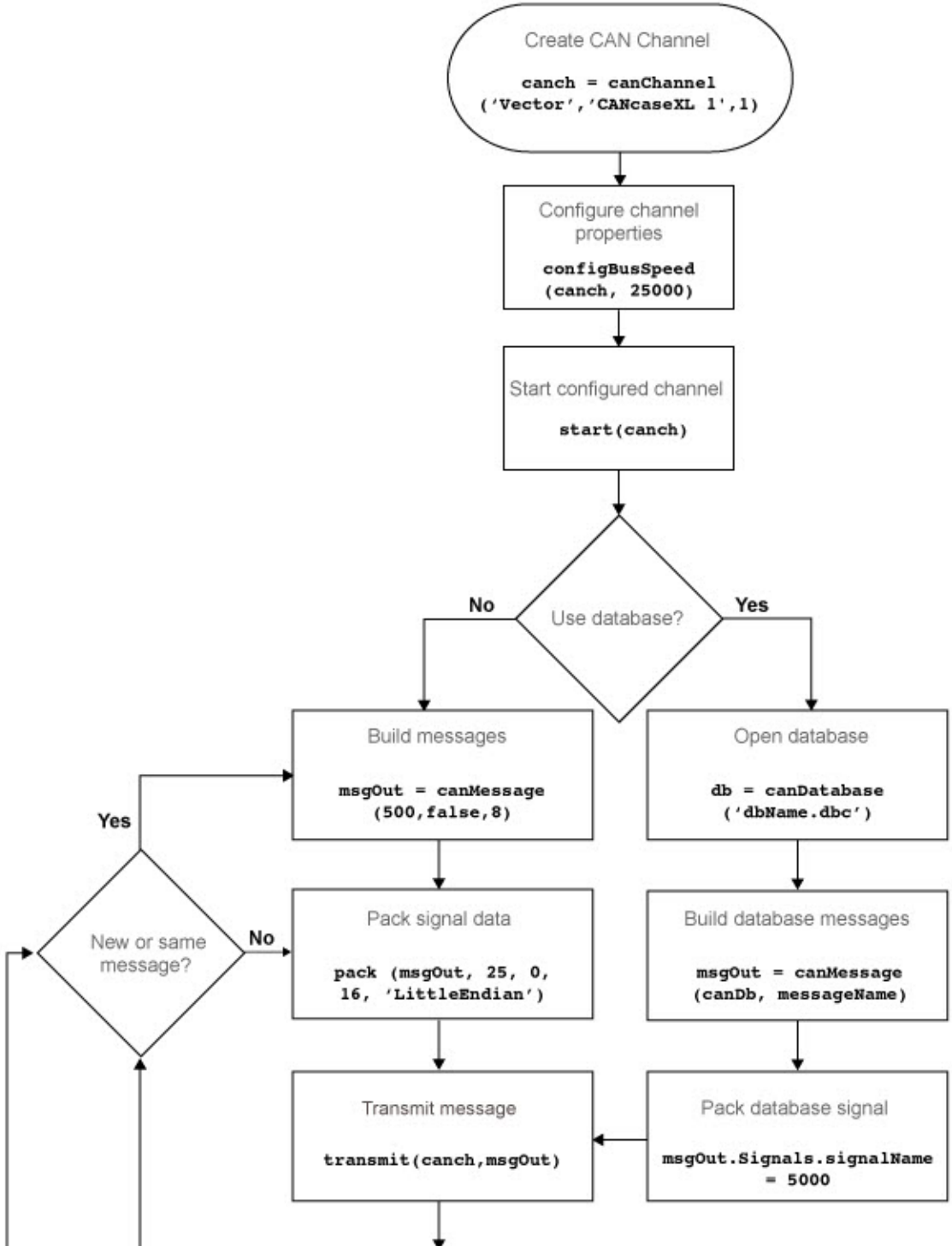
At any time during this process, you can click Help for more information about downloading support packages.

3

CAN Communication Workflows

CAN Transmit Workflow

This workflow helps you create a CAN channel and transmit messages.


Create CAN Channel
canch = canChannel ('Vector','CANcaseXL 1',1)
Configure channel properties
configBusSpeed (canch, 25000)
Start configured channel
start(canch)
Use database?
No
Yes
Build messages
msgOut = canMessage (500,false,8)
Open database
db = canDatabase ('dbName.dbc')
Yes
New or same message?
No
Pack signal data
pack (msgOut, 25, 0, 16, 'LittleEndian')
Build database messages
msgOut = canMessage (canDb, messageName)
Transmit message
transmit(canch,msgOut)
Pack database signal
msgOut.Signals.signalName = 5000

See Also

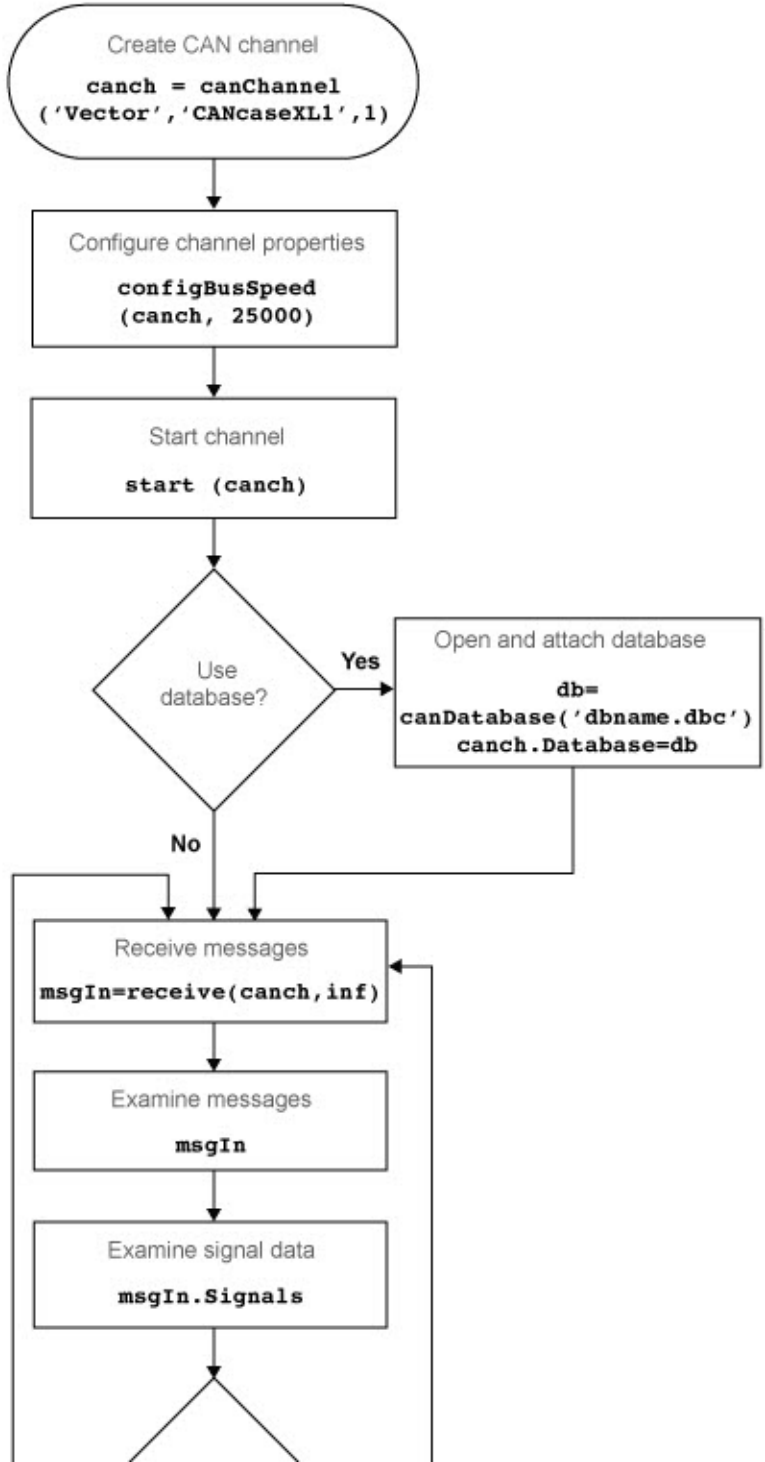
Functions
`canChannel` | `canDatabase` | `canMessage` | `canMessageImport` | `configBusSpeed` | `pack` | `start` | `stop` | `transmit` | `transmitConfiguration` | `transmitEvent` | `transmitPeriodic`

Properties
`Data` | `Database` | `Error` | `Extended` | `ID` | `Name (Message)` | `Remote` | `Signals` | `Timestamp` | `UserData`

Blocks
CAN Pack | CAN Replay | CAN Transmit

CAN Receive Workflow

Use this workflow to receive and unpack CAN messages.


Create CAN channel
canch = canChannel
('Vector','CANcaseXL1',1)
Configure channel properties
configBusSpeed
(canch, 25000)
Start channel
start (canch)
Use
database?
Yes
Open and attach database
db=
canDatabase('dbname.dbc')
canch.Database=db
No
Receive messages
msgIn=receive(canch,inf)
Examine messages
msgIn
Examine signal data
msgIn.Signals

See Also

Functions

`attachDatabase` | `canDatabase` | `configBusspeed` | `extractAll` | `extractRecent` | `extractTime` | `receive` | `stop` | `unpack`

Properties

`MessageReceivedFcn` | `MessageReceivedFcnCount` | `MessagesAvailable` | `MessagesReceived` | `MessagesTransmitted` `ReceiveErrorCount` | `TransmitErrorCount`

Blocks

CAN Log | CAN Receive | CAN Unpack

4

Using a CAN Database

Vector CAN Database Support

A CAN database contains physical message and signal definitions. Using a CAN database, you can represent message and signal information in engineering units and do need not manipulate raw data bytes. You can use a Vector CAN database with Vehicle Network Toolbox. A `.dbc` file contains definitions of CAN messages and signals.

Look up message and signal information and build messages using the information defined in the database file.

Load .dbc Files and Create Messages

In this section...

Load the CAN Database

To use a CAN database file, load the database into your MATLAB session. At the MATLAB command prompt, type:

```
db = canDatabase('filename.dbc')
```

Here *db* is a variable you chose for your database handle and *filename.dbc* is the actual file name of your CAN database. If your CAN database is not in the current working directory, type the path to the database:

```
db = canDatabase('path\filename.dbc')
```

Tip CAN database file names containing non-alphanumeric characters such as equal signs, ampersands, and so forth are incompatible with Vehicle Network Toolbox. You can use periods in your database name. Rename any CAN database files with non-alphanumeric characters before you use them.

This command returns a database object that you can use to create and interpret CAN messages using information stored in the database. Refer to the `canDatabase` function for more information.

Create a CAN Message

This example shows you how to create a message using a database constructed specifically for this example. You can access this database in the **Toolbox > VNT**

> **VNTDemos** subfolder in your MATLAB installation folder. This database has a message, `EngineMsg`. To try this example, create messages and signals using definitions in your own database.

1. Create the CAN database object:

   ```
   d = canDatabase('demoVNT_CANdbFiles.dbc')
   ```

2. Create a CAN message using the message name in the database:

   ```
   message = canMessage(d, 'EngineMsg')
   ```

Access Signals in the Constructed CAN Message

You can access the two signals defined for the message you created in the example database, `message`. You can also change the values for some signals.

1. To display signals in your message, type:

   ```
   sig = (message.Signals)
   ```

   Signals in the message are displayed as follows:

   ```
   sig =

       VehicleSpeed: 0
          EngineRPM: 250
   ```

2. Change the value of the `EngineRPM` signal:

   ```
   message.Signals.EngineRPM = 300
   ```

3. Display signal information again to see the change:

   ```
   sig

   sig =

       VehicleSpeed: 0
          EngineRPM: 300
   ```

Add a Database to a CAN Channel

To add a database to the CAN channel `canch`, type:

```
canch.Database = canDatabase('Mux.dbc')
```

For more information, see the `Database` property.

Update Database Information

When you make changes to a database file:

1. Reload the database file into your MATLAB session using the `canDatabase` function.
2. Reattach the database to messages using the `attachDatabase` function.

Create and Process Messages Using Database Definitions

This example shows you how to create, receive and process messages using information stored in CAN database files. This example uses the CAN database file, `demoVNT_CANdbFiles.dbc`.

Open the Database File

Open the database file and examine the `Messages` property to see the names of all message defined in this database.

```
db = canDatabase('demoVNT_CANdbFiles.dbc')
db.Messages
```

```
db =

  can.Database handle
  Package: can

  Properties:
        Name: 'demoVNT_CANdbFiles'
        Path: [1x75 char]
    Messages: {5x1 cell}
    UserData: []



ans =

    'DoorControlMsg'
    'EngineMsg'
```

```
    'SunroofControlMsg'
    'TransmissionMsg'
    'WindowControlMsg'
```

View Message Information

Use `messageInfo` to view message information, including the identifier, data length, and a signal list.

```
messageInfo(db, 'EngineMsg')
```

```
ans =

        Name: 'EngineMsg'
     Comment: ''
          ID: 100
    Extended: 0
      Length: 8
     Signals: {2x1 cell}
```

You can also query for information on all messages at once.

```
messageInfo(db)
```

```
ans =

5x1 struct array with fields:
    Name
    Comment
    ID
    Extended
    Length
    Signals
```

View Signal Information

Use `signalInfo` to view signal definition information, including type, byte ordering, size, and scaling values that translate raw signals to physical values.

```
signalInfo(db, 'EngineMsg', 'EngineRPM')
```

```
ans =

             Name: 'EngineRPM'
        StartBit: 0
      SignalSize: 32
       ByteOrder: 'LittleEndian'
          Signed: 0
       ValueType: 'Integer'
           Class: 'uint32'
          Factor: 0.1000
          Offset: 250
         Minimum: 250
         Maximum: 9500
           Units: 'rpm'
         Comment: ''
     Multiplexor: 0
     Multiplexed: 0
   MultiplexMode: 0
```

You can also query for information on all signals in the message at once.

```
signalInfo(db, 'EngineMsg')
```

```
ans =

2x1 struct array with fields:
    Name
    StartBit
    SignalSize
    ByteOrder
    Signed
    ValueType
    Class
    Factor
    Offset
    Minimum
    Maximum
    Units
    Comment
    Multiplexor
    Multiplexed
    MultiplexMode
```

Create a Message Using Database Definitions

Specify the name of the message when you create a new message to have the database definition applied. CAN signals in this messages are represented in engineering units in addition to the raw data bytes.

```
msgEngineInfo = canMessage(db, 'EngineMsg')
```

```
msgEngineInfo =

  can.Message handle
  Package: can

  Properties:
           ID: 100
     Extended: 0
         Name: 'EngineMsg'
     Database: [1x1 can.Database]
        Error: 0
       Remote: 0
    Timestamp: 0
         Data: [0 0 0 0 0 0 0 0]
      Signals: [1x1 struct]
     UserData: []
```

View Signal Information

Use the `Signals` property to see signal values for this message. You can directly write to and read from these signals to pack or unpack data from the message.

```
msgEngineInfo.Signals
```

```
ans =

    VehicleSpeed: 0
       EngineRPM: 250
```

Change Signal Information

Write directly to the signal to change a value and read its current value back.

```
msgEngineInfo.Signals.EngineRPM = 5500.25
msgEngineInfo.Signals
```

```
msgEngineInfo =

  can.Message handle
  Package: can

  Properties:
            ID: 100
     Extended: 0
         Name: 'EngineMsg'
     Database: [1x1 can.Database]
        Error: 0
       Remote: 0
    Timestamp: 0
         Data: [23 205 0 0 0 0 0 0]
      Signals: [1x1 struct]
     UserData: []


ans =

    VehicleSpeed: 0
       EngineRPM: 5.5003e+03
```

When you write directly to the signal, the value is translated, scaled, and packed into the message data using the database definition.

```
msgEngineInfo.Signals.VehicleSpeed = 70.81
msgEngineInfo.Signals
```

```
msgEngineInfo =

  can.Message handle
  Package: can

  Properties:
```

```
          ID: 100
    Extended: 0
        Name: 'EngineMsg'
    Database: [1x1 can.Database]
       Error: 0
      Remote: 0
   Timestamp: 0
        Data: [23 205 0 0 71 0 0 0]
     Signals: [1x1 struct]
    UserData: []


ans =

    VehicleSpeed: 71
       EngineRPM: 5.5003e+03
```

Receive Messages with Database Information

Attach a database to a CAN channel that receives messages to apply database definitions to incoming messages automatically. The database decodes only messages that are defined. All other messages are received in their raw form.

```
rxCh = canChannel('Vector', 'Virtual 1', 2);
rxCh.Database = db
```

```
rxCh =

Summary of CAN Channel using 'Vector' 'Virtual 1' Channel 2.

  Channel Parameters:  Bus Speed is 500000.
                       Bus Status is 'N/A'.
                       Transceiver name is ''.
                       Serial Number of this device is 0.
                       Initialization access is allowed.
                       'demoVNT_CANdbFiles.dbc' database is attached.

              Status:  Offline - Waiting for start.
                       0 messages available to receive.
                       0 messages transmitted since last start.
                       0 messages received since last start.
```

```
      Filter History:  Standard ID Filter: Allow All | Extended ID Filter: Allow All
```

Receive Messages

Start the channel, generate some message traffic and receive messages with physical message decoding.

```
start(rxCh);
generateMsgsDb();
rxMsg = receive(rxCh, Inf)
```

```
rxMsg =

  1x418 can.Message handle
  Package: can

  Properties:
    ID
    Extended
    Name
    Database
    Error
    Remote
    Timestamp
    Data
    Signals
    UserData
```

Stop the channel and clear it from the workspace.

```
stop(rxCh);
clear rxCh
```

Examine a Received Message

Inspect a received message to see the applied database decoding.

```
rxMsg(10)
rxMsg(10).Signals
```

```
ans =

  can.Message handle
  Package: can

  Properties:
            ID: 100
      Extended: 0
          Name: 'EngineMsg'
      Database: [1x1 can.Database]
         Error: 0
        Remote: 0
     Timestamp: 0.1746
          Data: [88 134 0 0 52 0 0 0]
       Signals: [1x1 struct]
      UserData: []



ans =

    VehicleSpeed: 52
       EngineRPM: 3.6892e+03
```

Extract Most Recent Message by Name

Use `extractRecent` and specify a message name to extract the most recent occurrence of a message.

```
msgRecentWindows = extractRecent(rxMsg, 'WindowControlMsg')
```

```
msgRecentWindows =

  can.Message handle
  Package: can

  Properties:
            ID: 600
      Extended: 0
          Name: 'WindowControlMsg'
      Database: [1x1 can.Database]
         Error: 0
        Remote: 0
```

```
    Timestamp: 5.5749
         Data: [64 62 0 0]
      Signals: [1x1 struct]
     UserData: []
```

Extract All Instances of a Specified Message by Name

Use `extractAll` and specify a message name to extract all instances of a specified message.

```
allMsgEngine = extractAll(rxMsg, 'EngineMsg')
```

```
allMsgEngine =

  1x225 can.Message handle
  Package: can

  Properties:
    ID
    Extended
    Name
    Database
    Error
    Remote
    Timestamp
    Data
    Signals
    UserData
```

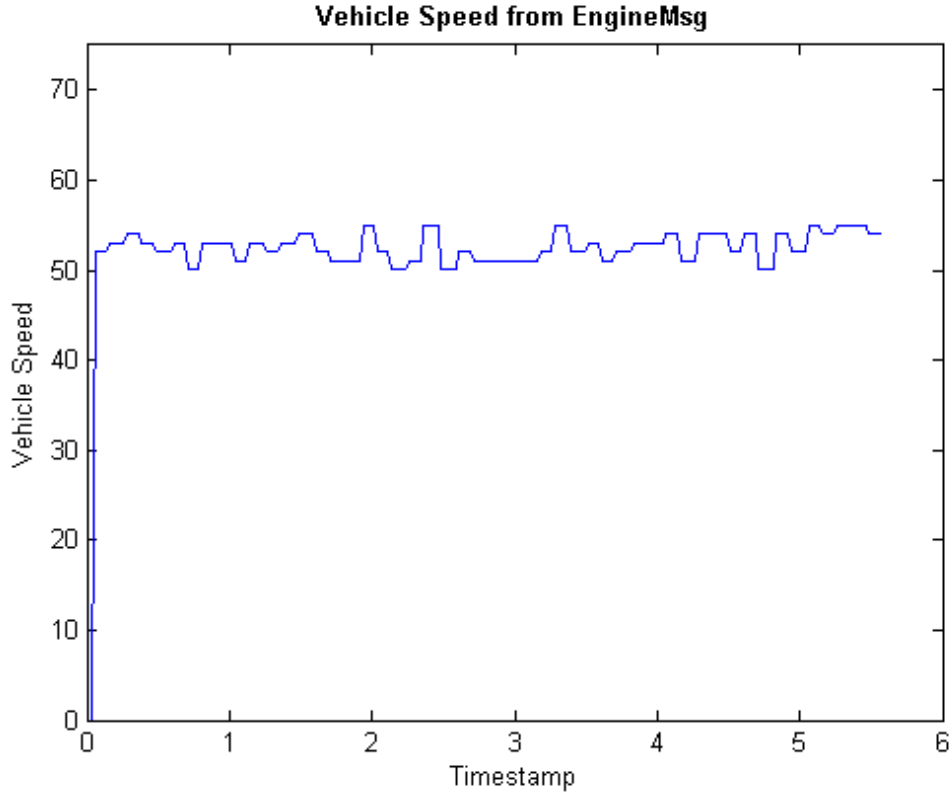
Plot Physical Signal Values

Plot the values of database decoded signals over time. Reference the message timestamps and the signal values in variables.

```
signals = [allMsgEngine.Signals]
plot([allMsgEngine.Timestamp], [signals.VehicleSpeed])
title('Vehicle Speed from EngineMsg', 'FontWeight', 'bold')
xlabel('Timestamp')
ylabel('Vehicle Speed')
axis([0 6 0 75])
```

```
signals =

1x225 struct array with fields:
    VehicleSpeed
    EngineRPM
```



Other Uses of the CAN Database

In this section...

View Message Information in a CAN Database

You can look up information on message definitions by a single message by name, or a single message by ID. You can also look up information on all message definitions in the database by typing:

```
msgInfo = messageInfo(database name)
```

This command returns the message structure of information about messages in the database. For example:

```
msgInfo =

5x1 struct array with fields:
    Name
    Comment
    ID
    Extended
    Length
    Signals
```

To get information on a single message by message name, type:

```
msgInfo = messageInfo(database name, 'message name')
```

This command returns information about the message as defined in the database. For example:

```
msgInfo = messageInfo(db, 'EngineMsg')

msgInfo =

        Name: 'EngineMsg'
     Comment: ''
```

```
        ID: 100
  Extended: 0
    Length: 8
   Signals: {2x1 cell}
```

Here the function returns information about message with name `EngineMsg` in the database `db`. You can also use the message ID to get information about a message. For example, to view the example message given here by inputting the message ID, type:

```
msgInfo = messageInfo(db, 100, false)
```

This command provides the database name, the message ID, and a Boolean value for the extended value of the ID.

To learn how to use it and work with the database, see the `messageInfo` function.

View Signal Information in a CAN Message

You can get signal definition information on a specific signal or all signals in a CAN message with database definitions attached. Provide the message name or the ID as a parameter in the command:

```
sigInfo = signalInfo(db, 'EngineMsg')
```

You can also get information about a specific signal by providing the signal name:

```
sigInfo = signalInfo(db, 'EngineMsg', 'EngineRPM')
```

To learn how to use this property and work with the database, see the `signalInfo` function.

You can also access the `Signals` property of the message to view physical signal information. When you create physical signals using database information, you can directly write to and read from these signals to pack or unpack data from the message. When you write directly to the signal name, the value is translated, scaled, and packed into the message data.

Attach a CAN Database to Existing Messages

You can attach a `.dbc` file to messages and apply the message definition defined in the database. Attaching a database allows you to view the messages in their physical form and use a signal-based interaction with the message data.

To attach a database to a message, type:

```
attachDatabase(message name, database name)
```

Note: If your message is an array, all messages in the array are associated with the database that you attach.

You can also dissociate a message from a database so that you can view the message in its raw form. To clear the attached database from a message, type:

```
attachDatabase(message name, [])
```

Note: The database gets attached even if the database does not find the specified message. Even though the database is still attached to the message, the message is displayed in its raw mode.

For more information, see the `attachDatabase` function.

5

Monitoring Vehicle CAN Bus

Vehicle CAN Bus Monitor

In this section...

About the Vehicle CAN Bus Monitor

Vehicle Network Toolbox provides a graphical user interface that monitors CAN bus traffic on selected channels. Using the CAN Bus Monitor you can:

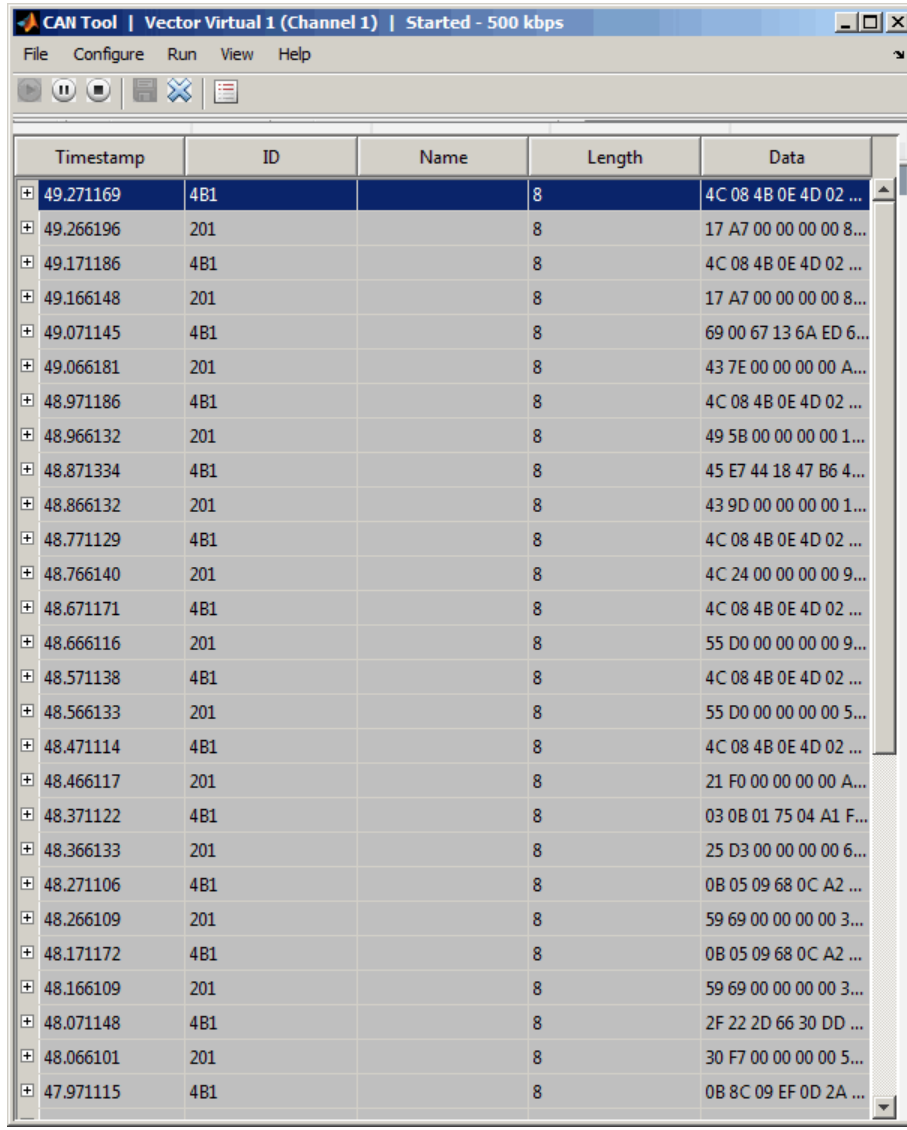
- View live CAN message data.
- Configure connection to the CAN bus.
- View unique messages.
- Attach a database to view signal information.
- Save the messages to a log file.

Opening the Vehicle CAN Bus Monitor

To open the Vehicle CAN Bus Monitor, type `canTool` in the MATLAB Command Window.

Vehicle CAN Bus Monitor Fields

The CAN bus monitor has the following menus, buttons and table.



Timestamp	ID	Name	Length	Data
49.271169	4B1		8	4C 08 4B 0E 4D 02 ...
49.266196	201		8	17 A7 00 00 00 00 8...
49.171186	4B1		8	4C 08 4B 0E 4D 02 ...
49.166148	201		8	17 A7 00 00 00 00 8...
49.071145	4B1		8	69 00 67 13 6A ED 6...
49.066181	201		8	43 7E 00 00 00 00 A...
48.971186	4B1		8	4C 08 4B 0E 4D 02 ...
48.966132	201		8	49 5B 00 00 00 00 1...
48.871334	4B1		8	45 E7 44 18 47 B6 4...
48.866132	201		8	43 9D 00 00 00 00 1...
48.771129	4B1		8	4C 08 4B 0E 4D 02 ...
48.766140	201		8	4C 24 00 00 00 00 9...
48.671171	4B1		8	4C 08 4B 0E 4D 02 ...
48.666116	201		8	55 D0 00 00 00 00 9...
48.571138	4B1		8	4C 08 4B 0E 4D 02 ...
48.566133	201		8	55 D0 00 00 00 00 5...
48.471114	4B1		8	4C 08 4B 0E 4D 02 ...
48.466117	201		8	21 F0 00 00 00 00 A...
48.371122	4B1		8	03 0B 01 75 04 A1 F...
48.366133	201		8	25 D3 00 00 00 00 6...
48.271106	4B1		8	0B 05 09 68 0C A2 ...
48.266109	201		8	59 69 00 00 00 00 3...
48.171172	4B1		8	0B 05 09 68 0C A2 ...
48.166109	201		8	59 69 00 00 00 00 3...
48.071148	4B1		8	2F 22 2D 66 30 DD ...
48.066101	201		8	30 F7 00 00 00 00 5...
47.971115	4B1		8	0B 8C 09 EF 0D 2A ...

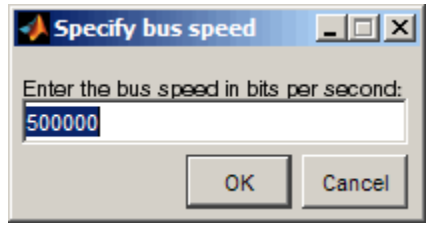
File Menu

- **Save Messages** — Saves messages to a log file.
- **Clear Messages** — Clears messages in the Vehicle CAN Bus Monitor window.

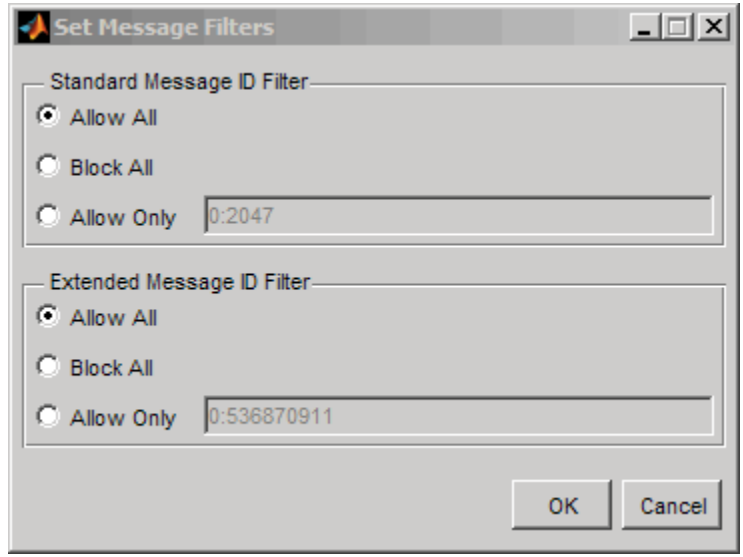
- **Exit CAN Tool** — Click to exit the CAN Tool window.

Configure Menu

- **Channel** — Displays all available CAN devices and channels on your system. Select the CAN channel to monitor.
- **Bus Speed** — Opens the Specified bus speed dialog box. To change the bus speed of the selected channel, type the new value in bits per second in the box.



- **Message Filters** — Opens the Set Message Filters dialog box. Select an option in the dialog box to configure hardware filters to block or allow messages.



  - Standard Message ID Filter
    - Allow All — Select to allow all standard ID messages.

    - Block All — Select to block all standard ID messages.
    - Allow only — Select to set up custom filtering of messages. Type the standard message IDs that you want to allow.
  - Extended Message ID Filter
    - Allow All — Select to allow all extended ID messages.
    - Block All — Select to block all extended ID messages.
    - Allow only — Select to set up custom filtering of messages. Type the extended message IDs that you want to allow.
- **Database** — Selects the database to attach to the CAN messages on the selected channel.

Run Menu

- **Start** — Click to view message activity on the selected channel.
- **Pause** — Click to pause the display of message activity on the selected channel.
- **Stop** — Click to stop the display of message activity on the selected channel.

View Menu

- **Maximum message count** — Opens the Specify maximum message count dialog box. To change the maximum number of messages displayed at a time in the Vehicle CAN Bus Monitor, type the new value in the box.

- **Number Format** — Select the number format to display message identifier data. Choose **Hexadecimal** or **Decimal**.
- **Show Unique Messages** — Select this option to display the most recent instance of each message received on the selected channel. If you select this option, the tool displays a simplified version of the message traffic. In this view, messages do not scroll up, but each message refreshes its data with each timestamp. If you do not

select this option, the tool displays all instances of all messages in the order that the selected channel receives them.

Help Menu

- **canTool Help** — Select this option to see the online help for Vehicle CAN Bus Monitor.
- **About Vehicle Network Toolbox** — Select this option to view the toolbox version and release information.

Buttons

Start 

Displays message activity on the selected channel.

Pause 

Pauses the display of message activity on the selected channel.

Stop 

Stops displaying messages on the selected channel.

Save messages 

Click this button to save the current message list on the selected channel to a file.

Clear messages 

Click this button to clear messages in the Vehicle CAN Bus Monitor window.

Show unique messages 

Select this option to display the most recent instance of each message received on the selected channel. If you select this option, the tool displays a simplified version of the message traffic. In this view, messages do not scroll up, but each message refreshes its data with each timestamp. If you do not select this option the tool displays all instances of all messages in the order that the selected channel receives them.

Docking 

Click this button to dock the Vehicle CAN Bus Monitor to the MATLAB desktop. To undock, click this button  .

Undocking 

Click this button to undock the Vehicle CAN Bus Monitor from the MATLAB desktop. To dock, click this button. 

Message Table

Timestamp

Displays the time, relative to the start time, that the device receives the message. The start time begins at 0 when you click **Start**.

ID

Displays the message ID. This field displays a number in hexadecimal format for the ID and:

- Displays numbers only for standard IDs.
- Appends an **x** for an extended ID.
- Displays an **r** for a remote frame.
- Displays **error** for messages with error frames.

To change the format to decimal, select **View** > **Number Format** > **Decimal**.

Name

Displays the name of the message, if available.

Length

Displays the length of the message in bytes.

Data

Displays the data in the message in hexadecimal format.

To change the format to decimal, select **View** > **Number Format** > **Decimal**.

If you are using a database, click the + sign to see signal information. The tool displays the signal name and the physical value of the message, as defined in the attached database.

Using the Vehicle CAN Bus Monitor

In this section...

View Messages on a Channel

1. Open the Vehicle CAN Bus Monitor and select the device and channel connected to your CAN bus by selecting **Configure** > **Channel**.
2. The Vehicle CAN Bus Monitor defaults to the bus speed set in the device driver. You can also configure a new bus speed. See Configuring the Channel Bus Speed
3. Click **Start**, or select **Run** > **Start**.
4. To pause the display, click **Pause** or select **Run** > **Pause**.
5. To stop the display, click **Stop** or select **Run** > **Stop**.

Configure the Channel Bus Speed

Configure the bus speed when your network speed differs from the default value of the channel. You require initialization access for the channel to configure the bus speed.

To configure a new bus speed:

1. Select **Configure** > **Bus Speed**.
2. Type the desired value in the Specify bus speed dialog box.
3. Click **OK**.

The value you set takes effect once you start the CAN channel. If an error occurs when applying the new bus speed, the value reverts to the default value specified in the hardware.

Filter CAN Messages in Vehicle CAN Bus Monitor

Filter CAN messages to allow or block messages displayed in the Vehicle CAN Bus Monitor.

To set up filters:

1. Select **Configure > Message Filters**.
2. To set filters on standard message IDs, select:
   a. Allow All to set the hardware filter to allow all messages with standard IDs.
   b. Block All to set the hardware filter to block all messages with standard IDs.
   c. Allow Only to set up custom filters. Type the standard IDs of the message you want to filter. You can type a range or single IDs. The default is `0:2047`.
3. To set filters on extended message IDs, select:
   a. Allow All to set the hardware filter to allow all messages extended IDs.
   b. Block All to set the hardware filter to block all messages extended IDs.
   c. Allow Only to set up custom filters. Type the extended IDs of the message you want to filter. You can type a range or single IDs. The default is `0:536870911`.

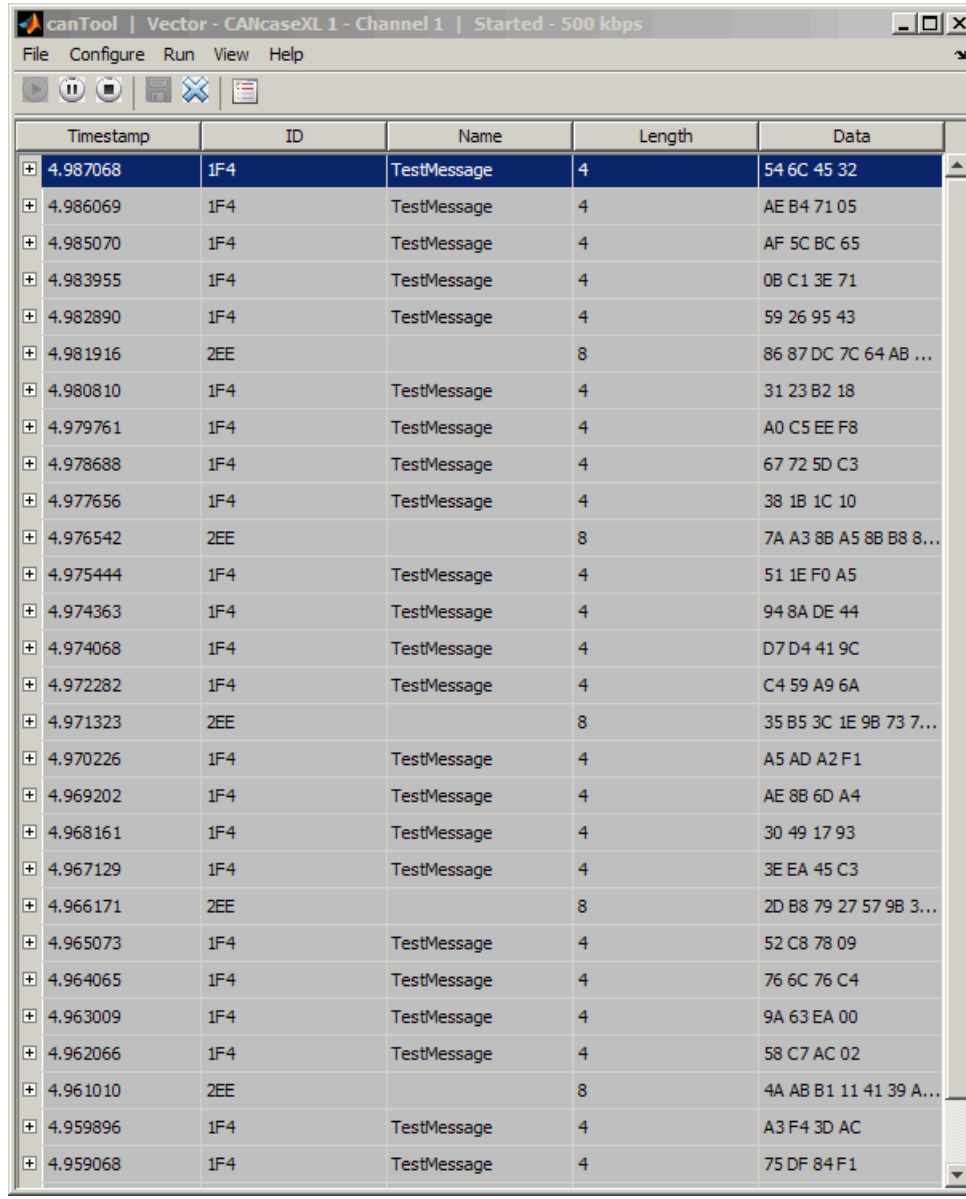
   Note: If you are using a custom filter, change the default range to the desired range. The default range allows all messages and you should select Allow All to allow all incoming messages with extended IDs.
4. Click OK.

Attach a Database

Attach a database to the Vehicle CAN Bus Monitor to see signal information of the displayed messages.

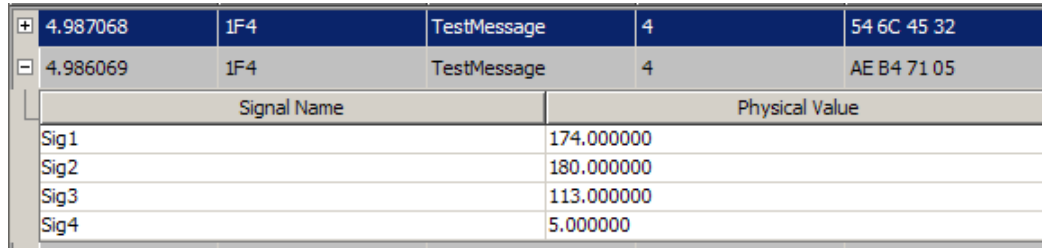
1. Select **Run > Stop** to stop the message display in the Vehicle CAN Bus Monitor.
2. Select **Configure > Database**.
3. Select the database to attach and start the message display again.

   When the tool displays the messages, it shows the message name in the Message table.



Timestamp	ID	Name	Length	Data
4.987068	1F4	TestMessage	4	54 6C 45 32
4.986069	1F4	TestMessage	4	AE B4 71 05
4.985070	1F4	TestMessage	4	AF 5C BC 65
4.983955	1F4	TestMessage	4	0B C1 3E 71
4.982890	1F4	TestMessage	4	59 26 95 43
4.981916	2EE		8	86 87 DC 7C 64 AB ...
4.980810	1F4	TestMessage	4	31 23 B2 18
4.979761	1F4	TestMessage	4	A0 C5 EE F8
4.978688	1F4	TestMessage	4	67 72 5D C3
4.977656	1F4	TestMessage	4	38 1B 1C 10
4.976542	2EE		8	7A A3 8B A5 8B B8 8...
4.975444	1F4	TestMessage	4	51 1E F0 A5
4.974363	1F4	TestMessage	4	94 8A DE 44
4.974068	1F4	TestMessage	4	D7 D4 41 9C
4.972282	1F4	TestMessage	4	C4 59 A9 6A
4.971323	2EE		8	35 B5 3C 1E 9B 73 7...
4.970226	1F4	TestMessage	4	A5 AD A2 F1
4.969202	1F4	TestMessage	4	AE 8B 6D A4
4.968161	1F4	TestMessage	4	30 49 17 93
4.967129	1F4	TestMessage	4	3E EA 45 C3
4.966171	2EE		8	2D B8 79 27 57 9B 3...
4.965073	1F4	TestMessage	4	52 C8 78 09
4.964065	1F4	TestMessage	4	76 6C 76 C4
4.963009	1F4	TestMessage	4	9A 63 EA 00
4.962066	1F4	TestMessage	4	58 C7 AC 02
4.961010	2EE		8	4A AB B1 11 41 39 A...
4.959896	1F4	TestMessage	4	A3 F4 3D AC
4.959068	1F4	TestMessage	4	75 DF 84 F1

4 Click the plus (+) sign to see the details of the message.



The tool displays the signal name as defined in the attached database and the signal's physical value.

Change the Message Count

You can change the maximum number of messages displayed to a value from 100 through 5000.

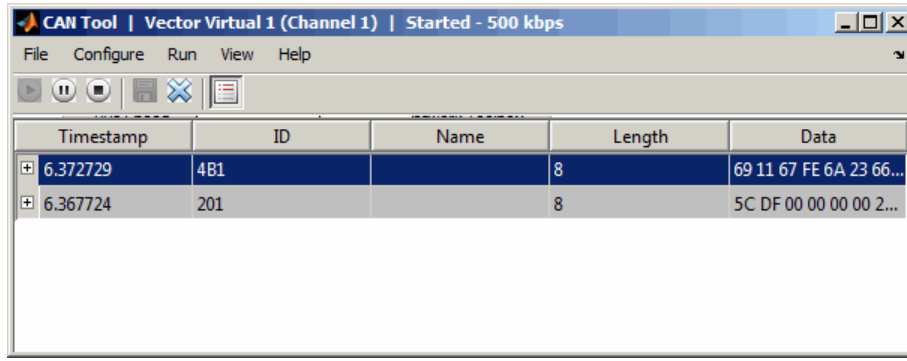
1. Select **View > Maximum Message Count**.
2. In the Specify maximum message count dialog box, type the number of messages you want displayed at one time.
3. Click **OK**.

Change the Number Format

By default the message data is displayed in hexadecimal format. To change the display to decimal format, select **View > Number Format > Decimal**.

View Unique Messages

To view the most recent instance of each unique message received on the channel, select **View > Show Unique Messages**. In this view, you do not see messages scroll up, but each message refreshes its data and timestamp with each new instance. You can also click  .



Use this feature to get a snapshot of message IDs that the selected channel receives. Use this information to analyze specific messages.

When you select **Show Unique Messages**, the tool continues to receive message actively. This simplified view allows you to focus on specific messages and analyze them.

To save messages when **Show Unique Messages** is selected, click **Pause** and then click **Save**. You cannot save just the unique message list. This operation saves the complete message log in the window.

Save the Message Log File

You can save a log file of the messages currently displayed while the tool is running. You need not stop or pause the display to save a log file.

To save a log file of the messages currently displayed in the window, select **File** > **Save Messages** or click  .

The tool saves the messages in a MATLAB file in your current working folder by default. You can change the location by browsing to a different folder in the Save dialog box.

Each time you save the message log to a file, the Vehicle CAN Bus Monitor saves them as `VNT CAN Log.mat` with sequential numbering by default. You can change the name by typing a new name in Save dialog box.

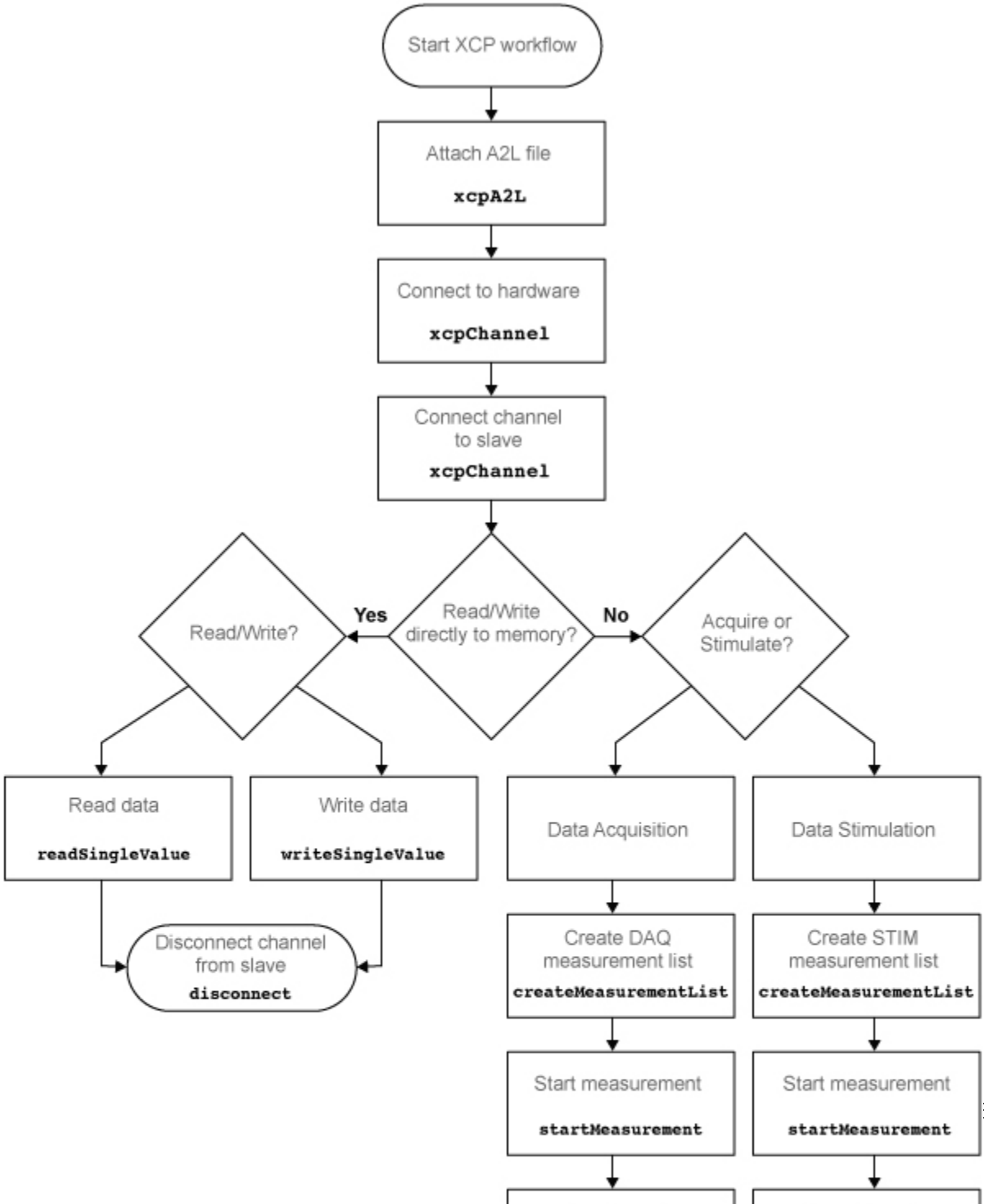
6

XCP Communication Workflows

XCP Database and Communication Workflow

This workflow helps you:

- Manage an A2L database
- Connect to an XCP device
- Create an XCP channel
- Acquire and stimulate data
- Read and write to memory


Start XCP workflow
Attach A2L file
xcpA2L
Connect to hardware
xcpChannel
Connect channel to slave
xcpChannel
Read/Write directly to memory?
Yes
No
Read/Write?
Acquire or Stimulate?
Read data
readSingleValue
Write data
writeSingleValue
Data Acquisition
Data Stimulation
Disconnect channel from slave
disconnect
Create DAQ measurement list
createMeasurementList
Create STIM measurement list
createMeasurementList
Start measurement
startMeasurement
Start measurement
startMeasurement

See Also

Functions

`connect` | `createMeasurementList` | `disconnect` | `freeMeasurementLists` | `getEventInfo` | `getMeasurementInfo` | `isConnected` | `isMeasurementRunning` | `readDAQListData` | `readSingleValue` | `startMeasurement` | `stopMeasurement` | `viewMeasurementLists` | `writeSingleValue` | `writeSTIMListData` | `xcpA2L` | `xcpChannel`

Properties

`A2LFileName` | `A2LFileName` | `DAQInfo` | `Events` | `FileName` | `FilePath` | `Measurements` | `ProtocolLayerInfo` | `SeedKeyDLL` | `SeedKeyDLL` | `SlaveName` | `SlaveName` | `SlaveName` | `TransportLayer` | `TransportLayer` | `TransportLayerCANInfo` | `TransportLayerDevice` | `TransportLayerDevice`

Blocks

XCP CAN TL Receive | XCP CAN TL Transmit | XCP CAN Transport Layer | XCP Configuration | XCP Configuration | XCP Data Acquisition | XCP Data Stimulation

7

A2L File

A2L File Support

An A2L file is a special description file that defines the implementation of an ECU that can communicate with a slave module via an XCP connection. An A2L file is a formatted text file that contains event and measurement definitions as well as other configuration information. You can use this information to connect an XCP channel to a slave module and acquire and stimulate data and perform other functions.

Inspect the Contents of an A2L File

In this section...

Access an A2L File

To use a A2L file, open the file in your MATLAB session. At the MATLAB command prompt, type:

```
a2lfile = xcpA2L('filename.a2l')
```

Here *`a2lfile`* is a variable you chose for your A2L object and *`filename.a2l`* is the actual file name of your A2L file. If your A2L file is not in the current working directory, type the path to the file:

```
a2lfile = xcpA2L('path\filename.a2l');
```

Tip A2L file names containing non-alphanumeric characters such as equal signs, ampersands, and so forth are incompatible with Vehicle Network Toolbox. You can use periods in your database name. Rename any A2L files with non-alphanumeric characters before you use them.

This command returns a A2L object that you can use with live communication to a slave module using XCP channels.

Access Event Information

This example shows how to open an A2L file and access event information.

Open an A2L file:

```
a2lfile = xcpA2L('XCPSIM.a2l');
```

Display properties of the A2L object:

```
a2lfile
```

```
A2L with properties:

                 FileName: 'XCPSIM.a2l'
                 FilePath: 'H:\Documents\work\XCPSIM.a2l'
                SlaveName: 'CPP'
        ProtocolLayerInfo: [1x1 struct]
                  DAQInfo: [1x1 struct]
    TransportLayerCANInfo: [1x1 struct]
                   Events: {'Key T'  '10 ms'  '100ms'  '1ms'  'FilterBypassDaq'  'Filte
             Measurements: {1x38 cell}
```

View all available events:

```
a2lfile.Events
```

```
ans =

    'Key T'    '10 ms'    '100ms'    '1ms'    'FilterBypassDaq'    'FilterBypassSt'
```

Get information for the `10 ms` event:

```
 getEventInfo(a2lfile,'10 ms')
```

```
ans =

                       Name: '10 ms'
                  Direction: 'DAQ_STIM'
                 MaxDAQList: 255
              ChannelNumber: 1
            ChannelTimeCycle: 10
             ChannelTimeUnit: 6
             ChannelPriority: 0
    ChannelTimeCycleInSeconds: 0.0100
```

Access Measurement Information

This example shows how to open an A2L file and access measurement information.

Open an A2L file:

```
a2lfile = xcpA2L('XCPSIM.a2l');
```

Display properties of the A2L object:

```
a2lfile
```

```
A2L with properties:

                FileName: 'XCPSIM.a2l'
                FilePath: 'H:\Documents\work\XCPSIM.a2l'
               SlaveName: 'CPP'
       ProtocolLayerInfo: [1x1 struct]
                 DAQInfo: [1x1 struct]
   TransportLayerCANInfo: [1x1 struct]
                  Events: {'Key T'  '10 ms'  '100ms'  '1ms'  'FilterBypassDaq'  'Filte
            Measurements: {1x38 cell}
```

View all available measurements:

```
a2lfile.Measurements
```

```
ans =

  Columns 1 through 8

    'BitSlice'    'BitSlice0'    'BitSlice1'    'BitSlice2'    'Counter_B4'    'Counter_B5'    'Counter_B6'    'Counter_B7

  Columns 9 through 16

    'FW1'    'KL1Output'    'PWM'    'PWMFiltered'    'PWM_Level'    'ShiftByte'    'Shifter_B0'    'Shifter_B1'

  Columns 17 through 25

    'Shifter_B2'    'Shifter_B3'    'TestStatus'    'Triangle'    'ampl'    'bit12Counter'    'byte1'    'byte2'    'byte3

  Columns 26 through 33

    'byte4'    'byteCounter'    'bytePWMFilter'    'channel3'    'dwordCounter'    'map1InputX'    'map1InputY'    'map1Ou

  Columns 34 through 38

    'period'    'sbytePWMLevel'    'v'    'vin'    'wordCounter'
```

Get information about the `BitSlice` measurement:

```
getMeasurementInfo(a2lfile,'Triangle')
```

```
ans =

                Name: 'Triangle'
      LongIdentifier: 'Triangle test signal used for PWM output PWM'
            DataType: 'SBYTE'
          Conversion: 'BitSlice.CONVERSION'
          Resolution: 0
```

```
            Accuracy: 0
          LowerLimit: -50
          UpperLimit: 50
          ECUAddress: 4951377
ECUAddressExtension: 0
           ByteOrder: 'MSB_LAST'
         SizeInBytes: 1
       SizeInNibbles: 2
          SizeInBits: 8
          MATLABType: 'int8'
```

8

Universal Measurement & Calibration Protocol (XCP)

XCP Interface

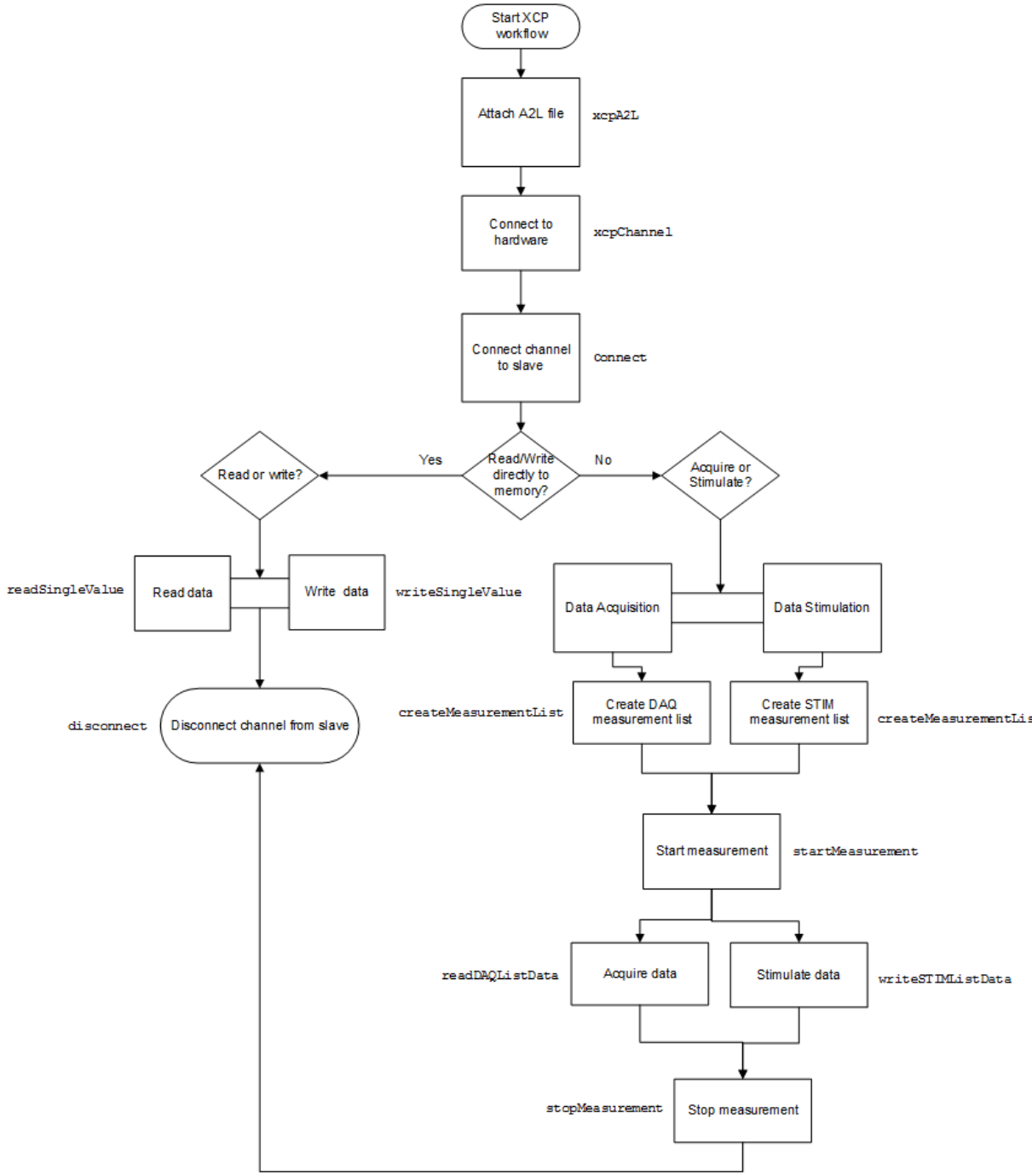
XCP is a high-level protocol that allows you to acquire, stimulate and calibrate data in electronic control units (ECU). XCP accesses ECU modules via an interface such as CAN. The XCP master communicates with one or more slave modules by sending commands. Using industry standard A2L files, you can read and write to memory or perform data acquisition and stimulation.

XCP allows you to:

- Perform Data acquisition and stimulation
- Read and write to device memory
- Dynamically configure data acquisition

XCP Hardware Connection

You can connect your XCP master to a slave module using the CAN protocol. This allows you to use events and access measurements on the slave module.


Start XCP workflow
Attach A2L file
xcpA2L
Connect to hardware
xcpChannel
Connect channel to slave
connect
Read/Write directly to memory?
Yes
No
Read or write?
Acquire or Stimulate?
readSingleValue
Read data
Write data
writeSingleValue
Data Acquisition
Data Stimulation
disconnect
Disconnect channel from slave
createMeasurementList
Create DAQ measurement list
Create STIM measurement list
createMeasurementList
Start measurement
startMeasurement
readDAQListData
Acquire data
Stimulate data
writeSTIMListData
stopMeasurement
Stop measurement

In this section...

Create XCP Channel Using CAN Device

This example shows how to create an XCP CAN channel connection and access channel properties. The example also shows how to unlock the slave using seed key security.

Access an A2L file that describe the slave module.

```
 a2lfile = xcpA2L('C:\work\XCPSIM.a2l')
```

```
a2lfile =

  A2L with properties:

                FileName: 'XCPSIM.a2l'
                FilePath: 'C:\work\XCPSIM.a2l'
               SlaveName: 'CPP'
       ProtocolLayerInfo: [1x1 struct]
                 DAQInfo: [1x1 struct]
    TransportLayerCANInfo: [1x1 struct]
                  Events: {1x6 cell}
            Measurements: {1x38 cell}
```

Create an XCP channel using Vector virtual CAN channel 1.

```
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
```

```
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
            A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
```

```
              SeedKeyDLL: []
```

Configure the Channel to Unlock the Slave

This example shows how to configure the channel to unlock the slave using a dll that contains a seed and key security algorithm when your module is locked for Stimulation operations,.

Create your XCP channel and set the channel's `SeedKeyDLL` property.

```
xcpch.SeedKeyDLL = ('C:\Work\SeedNKeyXcp.dll')
```

```
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
            A2LFileName: 'XCPSIM.a2l'
          TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
            SeedKeyDLL: 'C:\Work\SeedNKeyXcp.dll'
```

Note: Make sure the seed and key security access dll that you use matches the version of your platform. You cannot use a 32-bit dll 64-bit MATLAB or a 64-bit system.

Read a Single Value

This example shows how to access a single value by name. The value is read directly from memory.

Create an XCP channel with access to an A2L file

```
a2lfile = xcpA2L('C:\work\XCPSIM.a2l');
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the slave.

```
connect(xcpch)
```

Read a single value of the `Triangle` measurement directly from memory.

```
readSingleValue(xcpch, 'Triangle')
```

```
ans =

    50
```

Write a Single Value

This example shows how to write a single value by name. The value is written directly to memory.

Create an XCP channel linked to an A2L file.

```
a2lfile = xcpA2L('C:\work\XCPSIM.a2l');
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the slave.

```
connect(xcpch)
```

Write a single value.

```
writeSingleValue(xcpch, 'Triangle', 50)
```

Acquire Measurement Data via Dynamic DAQ Lists

This example shows how to can create a dynamic data acquisition list and assign measurements to the list. You can acquire data for measurements in this list from the slave.

Create an XCP channel linked to an A2L file and connect it to the slave.

```
a2lfile = xcpA2L('C:\work\XCPSIM.a2l');
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
connect(xcpch)
```

Create a DAQ list for the `'10 ms'` event with ,`'PWMFiltered'`and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', {'PWMFiltered','Triangle'});
```

Start measurement activity.

```
startMeasurement(xcpch)
```

Read 10 samples of data from the configured measurement list for the `'Triangle'` measurement.

```
readDAQListData(xcpch, 'Triangle', 10)
```

```
18    18    18    18    18    18    18    18    18    18
```

Stimulate Measurement Data via Dynamic STIM Lists

This example shows how to can create a dynamic data stimulation list and assign measurements to the list. You can stimulate data for specific measurements in this list.

Create an XCP channel linked to an A2L file and connect it.

```
a2lfile = xcpA2L('C:\work\XCPSIM.a2l');
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
connect(xcpch)
```

Note: If your module is locked for STIM operations, configure the channel to unlock the slave.

Create a STIM list for the `'100ms'` event with `'PWMFiltered'`and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'STIM', '100ms', {'PWMFiltered','Triangle'});
```

Start the measurement.

```
startMeasurement(xcpch)
```

Write 10 to the configured measurement list for the `'Triangle'` measurement.

```
writeSTIMListData(xcpch, 'Triangle', 10);
```

9

CAN Communications in Simulink

Vehicle Network Toolbox Simulink Blocks

This section describes how to use the Vehicle Network Toolbox CAN block library. The library contains these blocks:

- **CAN Configuration** — Configure the settings of a CAN device.
- **CAN Log**— Logs messages to file.
- **CAN Pack** — Pack signals into a CAN message.
- **CAN Receive** — Receive CAN messages from a CAN bus.
- **CAN Replay**— Replays logged messages to CAN bus or output port.
- **CAN Transmit** — Transmit CAN messages to a CAN bus.
- **CAN Unpack** — Unpack signals from a CAN message.

The Vehicle Network Toolbox block library is a tool for simulating message traffic on a CAN network, as well for using the CAN bus to send and receive messages. You can use blocks from the block library with blocks from other Simulink libraries to create sophisticated models.

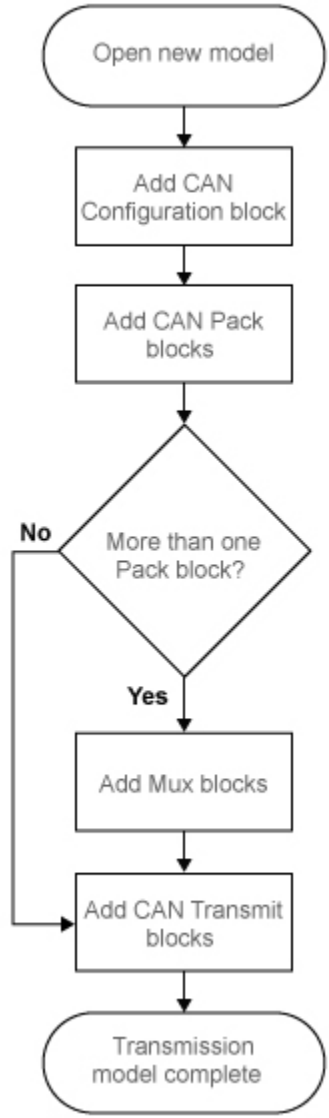
To use the Vehicle Network Toolbox block library, you require Simulink, a tool for simulating dynamic systems. Simulink is a model definition environment. Use Simulink blocks to create a block diagram that represents the computations of your system or application. Simulink is also a model simulation environment. Run the block diagram to see how your system behaves. If you are new to Simulink, read “Getting Started with Simulink” to understand its functionality better.

For more detailed information about the blocks in the Vehicle Network Toolbox block library see “CAN Communication in Simulink”.

CAN Communication in Simulink

In this section...

Message Transmission Workflow

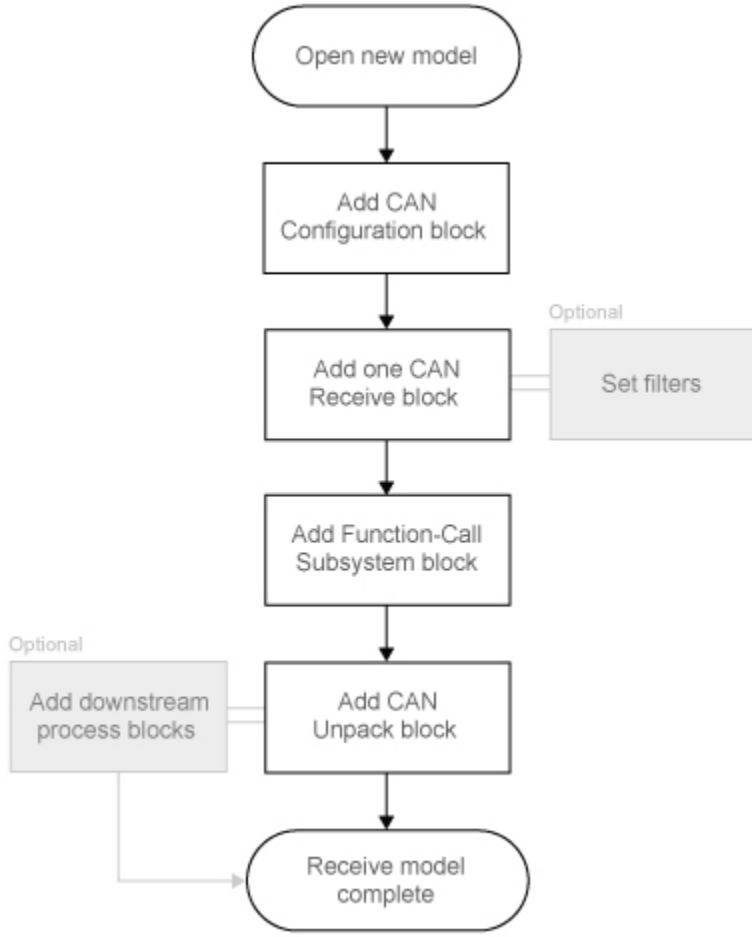


This workflow represents the most common CAN Transmit model. Adjust your model as needed. For more workflow examples, see “Build CAN Communication Simulink Models” on page 9-11 and the Vehicle Network Toolbox demos.

Using Mux Blocks

- Use a Mux block to combine every message from the source if they are transmitted at the same rate.
- Use one CAN Transmit block for each configured Mux block.

Message Reception Workflow



For workflow examples, see “Build CAN Communication Simulink Models” on page 9-11 and the Vehicle Network Toolbox demos.

Message Filtering

Set up filters to process only relevant messages. This ensures optimal simulation performance.

Do not set up filters if you need to parse all bus communications.

Function-Call Triggered Message Processing

Set up your CAN Unpack block:

- In a function-call triggered subsystem if you want to unpack every message received by your CAN Receive block.
- Without a function-call triggered subsystem if you want to unpack only the most recent message received by your CAN Receive block.
  Set up this system if your receive block is filtering for a single message.

Downstream Processing

For any downstream processing using received messages, include blocks:

- Within the function-call subsystem if your downstream process must respond to all messages received in a single timestep in this model.
- Outside the function-call subsystem if your downstream process responds only to the most recent message received in a given timestep in this model.
  In this case, the CAN Unpack block will not respond to any other messages received, irrespective of the messages ID.

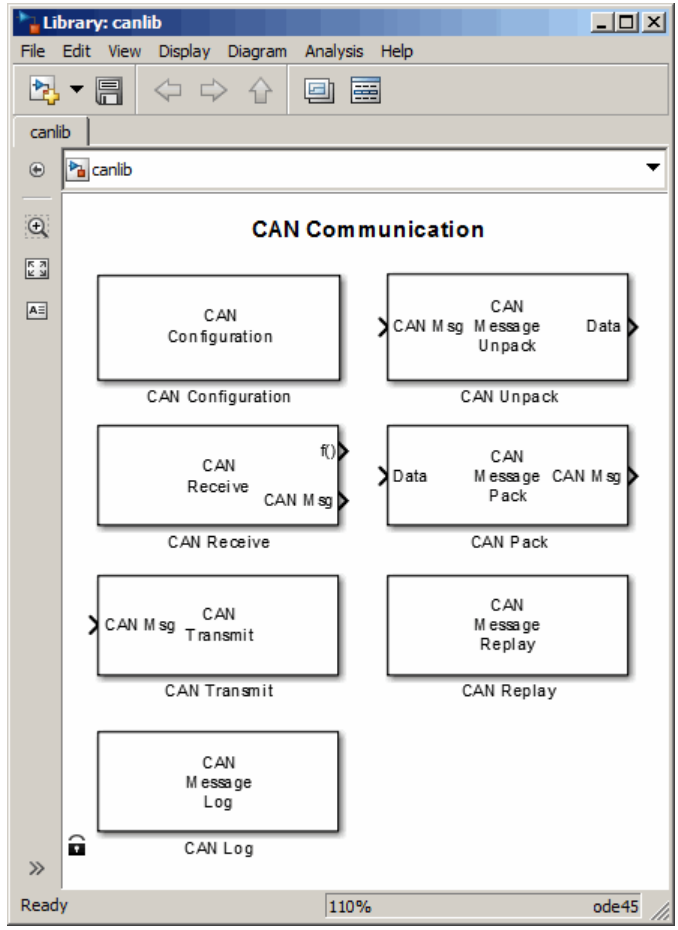
Open the Vehicle Network Toolbox Block Library

In this section...

Using the MATLAB Command Window

To open the Vehicle Network Toolbox block library, enter `canlib` in the MATLAB Command wndow.

MATLAB displays the contents of the library in a separate window.

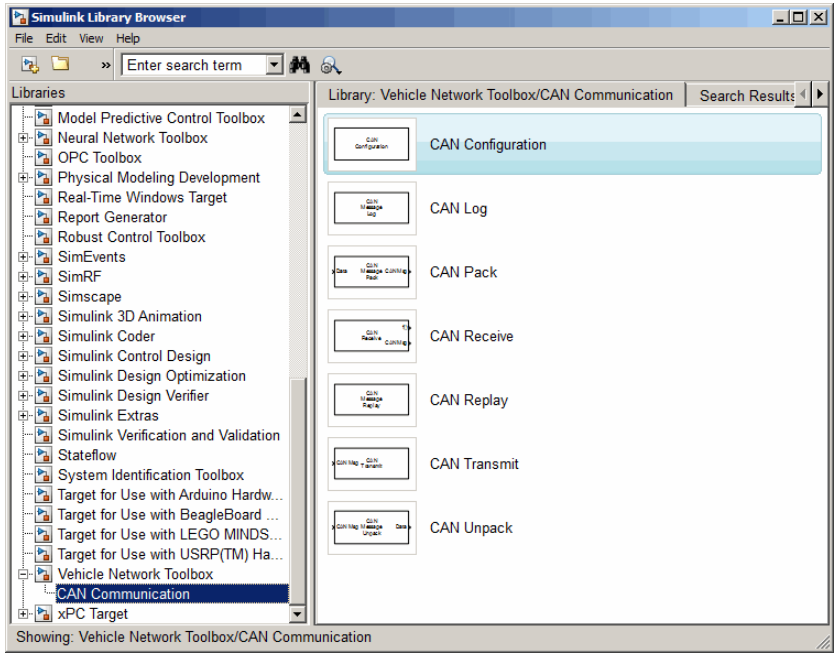


Using the Simulink Library Browser

To open the Vehicle Network Toolbox block library, start the Simulink Library Browser from MATLAB. Then select the library from the list of available block libraries displayed in the browser.

To start the Simulink Library Browser, enter `simulink` in the MATLAB Command Window.

The **Libraries** pane lists all available block libraries, with the basic Simulink library listed first, followed by other libraries listed alphabetically under it. To open the Vehicle Network Toolbox block library, click its icon and select **CAN Communication** for the CAN blocks.



Simulink loads and displays the blocks in the library.

Build CAN Communication Simulink Models

In this section...

Build a Message Transmit Model

This section provides an example that builds a simple model using Vehicle Network Toolbox blocks with other blocks in the Simulink library. This example illustrates how to send data via a CAN network.

- Use virtual CAN channels to transmit messages.
- Use the CAN Configuration block to configure your CAN channels.
- Use the Constant block to send data to the CAN Pack block.
- Use the CAN Transmit block to send the data to the virtual CAN channel.

Use this section with “Build a Message Receive Model” on page 9-15 and “Save and Run the Model” on page 9-23 to build your complete model and run the simulation.

Step 1: Open the Block Library

To open the Vehicle Network Toolbox block library, start the Simulink Library Browser by entering:

```
simulink
```

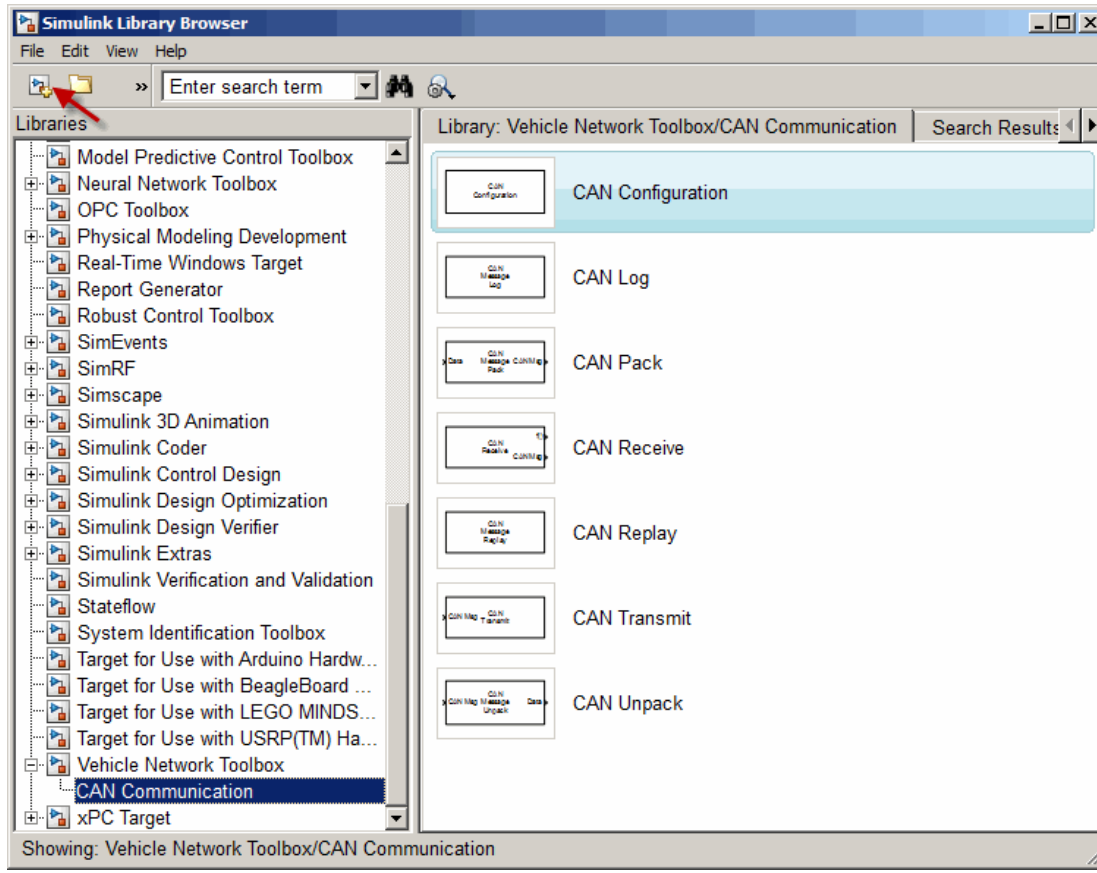
in the MATLAB Command Window. The left pane in the Simulink Library Browser lists the available block libraries. To open the Vehicle Network Toolbox block library, click its

icon. Then click **CAN Communication** to open the CAN blocks. See Using the Simulink Library Browser for more information.

Step 2: Create a New Model

To use a block, add it to an existing model or create a model.

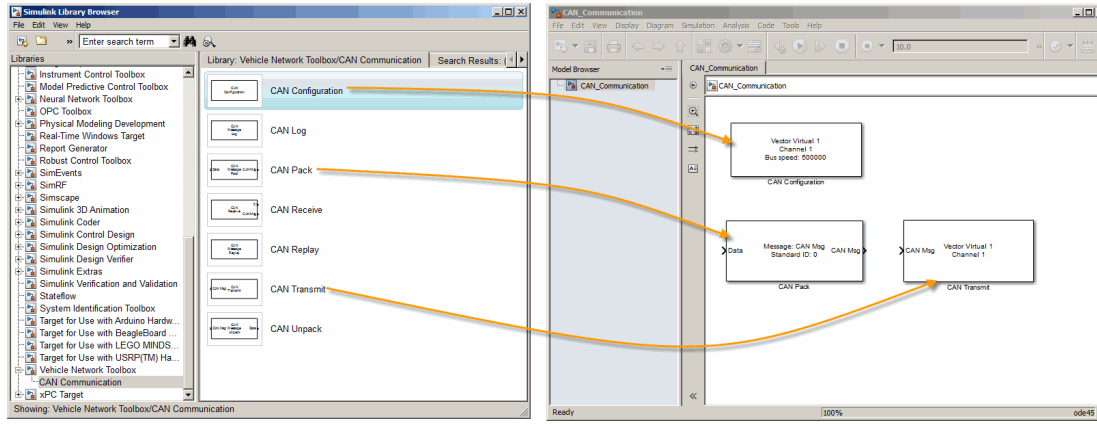
For this example, create a model by clicking the **New model** button on the toolbar.



You can also select **File** > **New** > **Model** from the Simulink Library Browser. Simulink opens an empty editor. To name the new model, use the **Save** option.

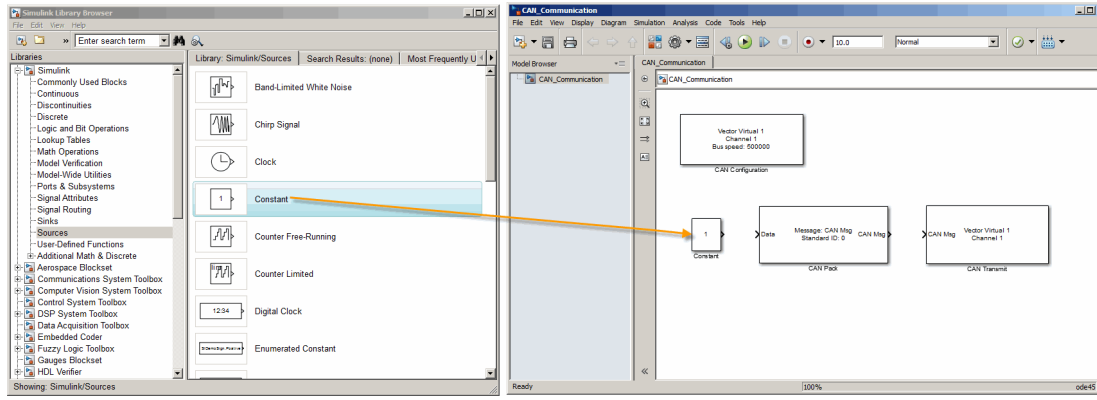
Step 3: Drag Vehicle Network Toolbox Blocks into the Model

To use the blocks in a model, click a block in the library and, holding the mouse button down, drag it into the editor. For this example, you need one instance each of the CAN Configuration, CAN Pack, and CAN Tarnsmit blocks in your model.



Step 4: Drag Other Blocks to Complete the Model

This example requires a source block that feeds data to the CAN Pack block. Add a Constant block to your model.



Step 5: Connect the Blocks

Make a connection between the Constant block and the CAN Pack block. When you move the pointer near the output port of the Constant block, the pointer becomes a cross hair. Click the Constant block output port and, holding the mouse button, drag the pointer to the input port of the CAN Pack block. Then release the button.

In the same way, make a connection between the output port of the CAN Pack block and the input port of the CAN Transmit block.

The CAN Configuration block does not connect to any other block. This block configures the CAN channel used by the CAN Transmit block to transmit the packed message.

Step 6: Specify the Block Parameter Values

You set parameters for the blocks in your model by double-clicking the block.

Configure the CAN Configuration Block

Double-click the CAN Configuration block to open its parameters dialog box. Set the:

- **Device** to `Vector Virtual 1 (Channel 1)`
- **Bus speed** to `500000`
- **Acknowledge Mode** to `Normal`

Click **OK**.

Configure the CAN Pack Block

Double-click the CAN Pack block to open its parameters dialog box. Set the:

- **Data is input as** to `raw data`
- **Name** to the default value `CAN Msg`
- **Identifier type** to the default `Standard (11-bit identifier)` type
- **Identifier** to `500`
- **Length (bytes)** to the default length of `8`

Click **OK**.

Configure the CAN Transmit Block

Double-click the CAN Transmit block to open its parameters dialog box. Set **Device** to `Vector Virtual 1 (Channel 1)`. Click **Apply**, then **OK**.

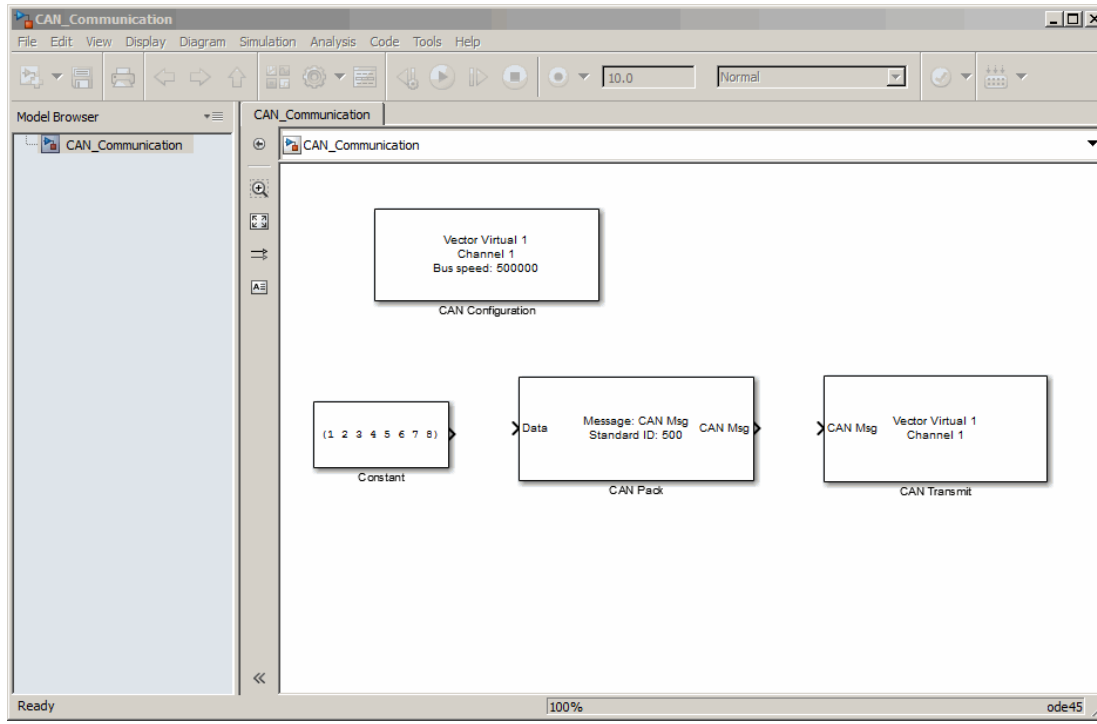
Configure the Constant Block

Double-click the Constant block to open its parameters dialog box. On the **Main** tab, set the:

- **Constant value** to `[1 2 3 4 5 6 7 8]`
- **Sample time** to `0.01` seconds

On the **Signal Attributes** tab, set the **Output data type** to `uint8`. Click **OK**.

Your model looks like this figure.



Build a Message Receive Model

This section provides an example that builds a simple model using the Vehicle Network Toolbox blocks with other blocks in the Simulink library. This example illustrates how to receive data via a CAN network.

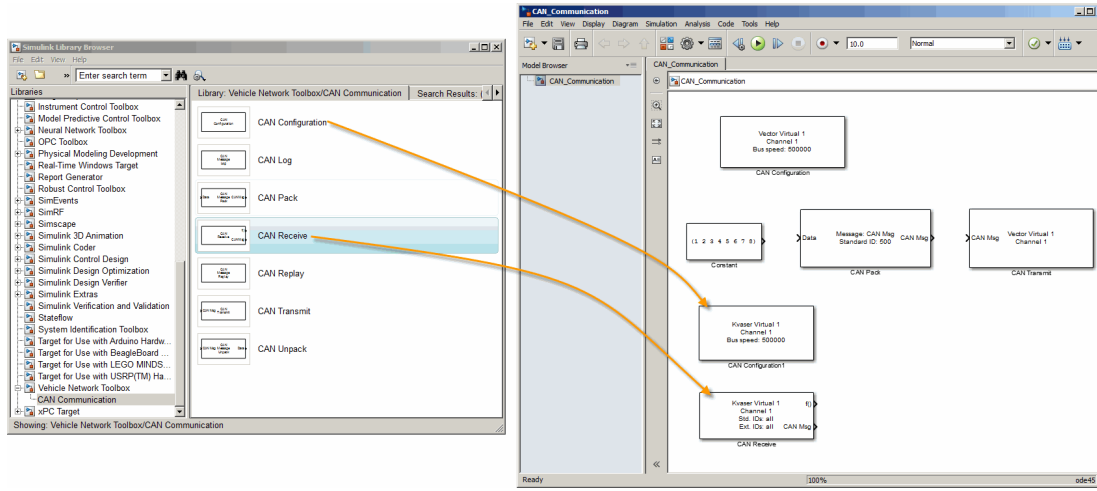
- Use a virtual CAN channel to receive messages.
- Use the CAN Configuration block to configure your virtual CAN channels.
- Use the CAN Receive block to receive the message sent by the blocks built in "Build a Message Transmit Model" on page 9-11.
- Use a Function–Call Subsystem block that contains the CAN Unpack block. This function takes the data from the CAN Receive block and uses the parameters of the CAN Unpack block to unpack your message data.
- Use a Scope block to show the transfer of data visually.

Use this section with "Build a Message Transmit Model" on page 9-11 and "Save and Run the Model" on page 9-23 to build your complete model and run the simulation.

Step 7: Drag Vehicle Network Toolbox Blocks into the Model

For this example, you need one instance each of the CAN Configuration, CAN Receive, and CAN Unpack blocks in your model. However, you add only the CAN Configuration and the CAN Receive blocks here. Add the CAN Unpack block into the Function–Call Subsystem described in "Step 8: Drag Other Blocks to Complete the Model" on page 9-17.

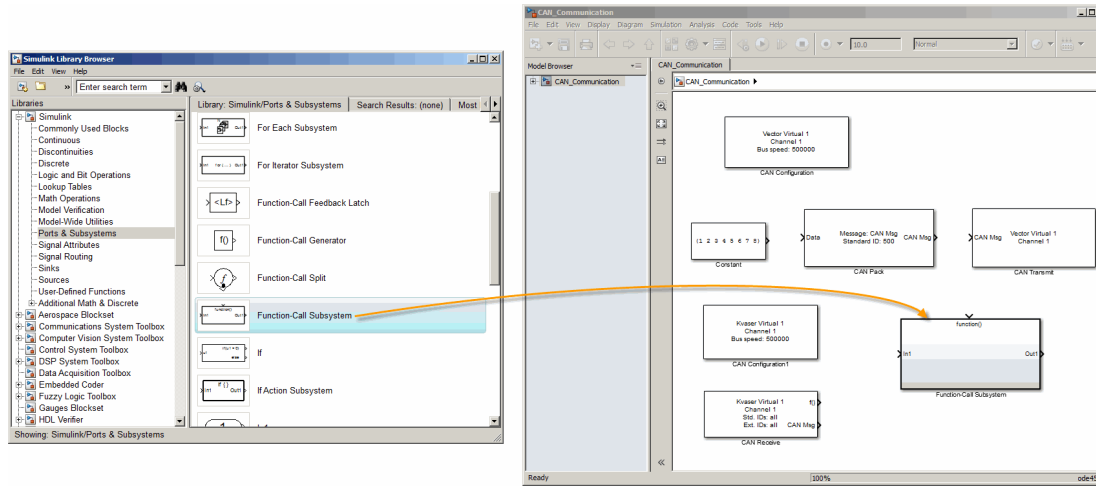
Tip Configure a separate CAN channel for the CAN Receive and CAN Transmit blocks.



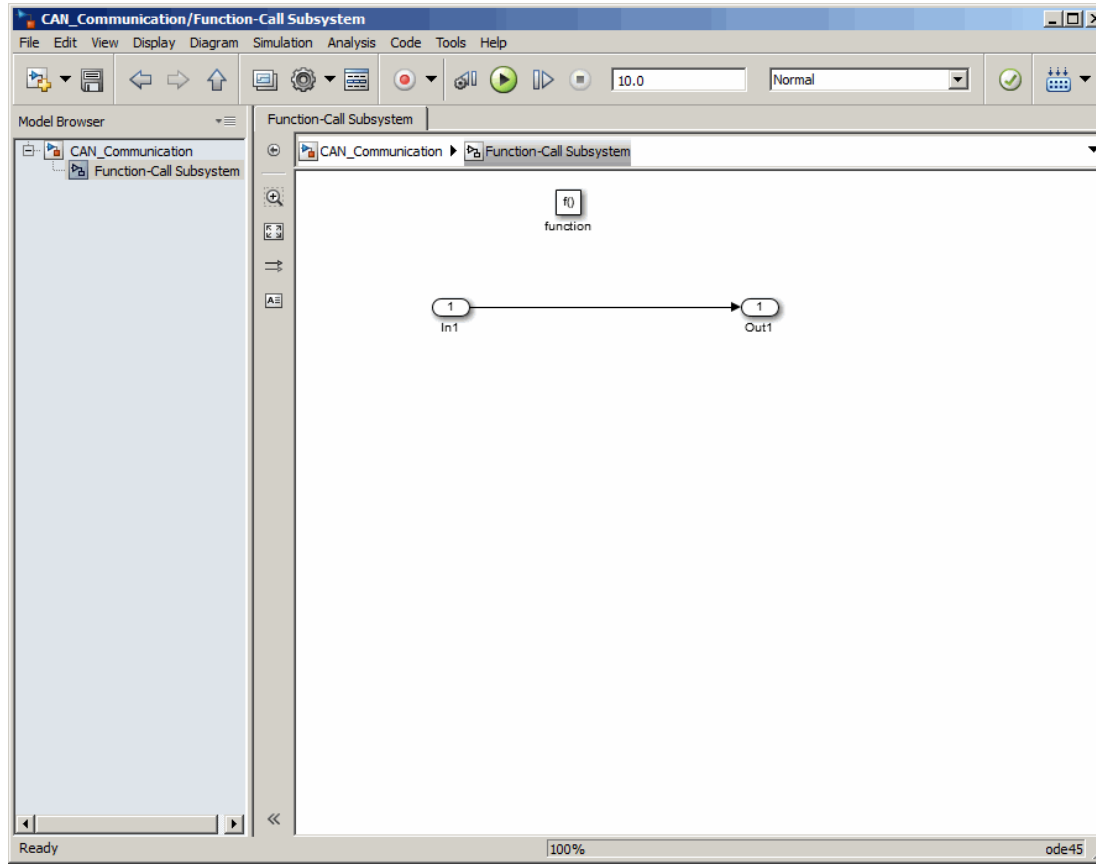
Step 8: Drag Other Blocks to Complete the Model

Use the Function–Call Subsystem block from the Simulink **Ports & Subsystems** block library to build your CAN Message pack subsystem.

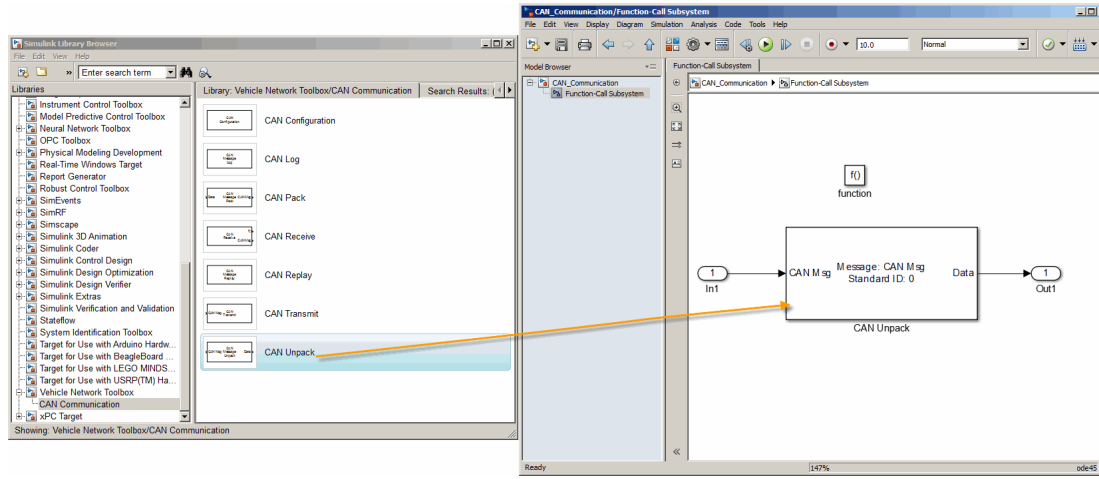
1 Drag the Function–Call Subsystem block into the model.



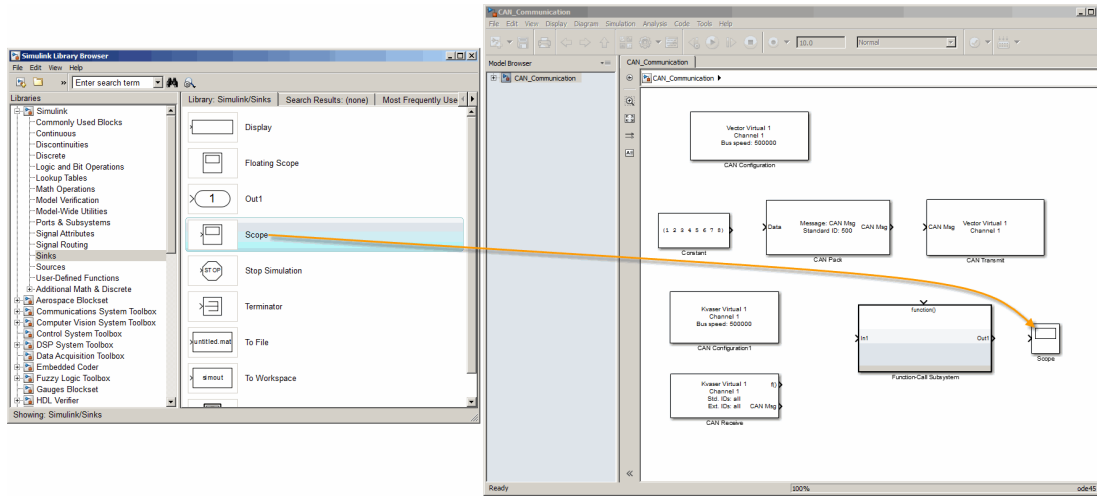
2 Double-click the Function–Call Subsystem block to open the subsystem editor.



3 Drop the CAN Unpack block from the Vehicle Network Toolbox block library in this subsystem.

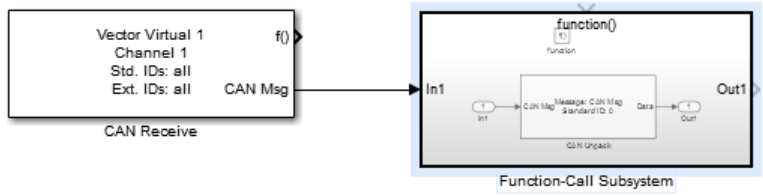


To see the results of the simulation visually, drag the Scope block from the Simulink block library into your model.



Step 9: Connect the Blocks

1 Connect the **CAN Msg** output port on the CAN Receive block to the **In1** input port on the Function–Call Subsystem block.

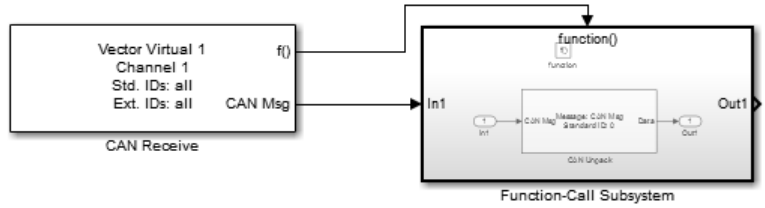


2 Open the Function–Call Subsystem block and:

- Double-click **In1** to rename it to `CAN Msg`.
- Double-click **Out1** to rename it to `data`.

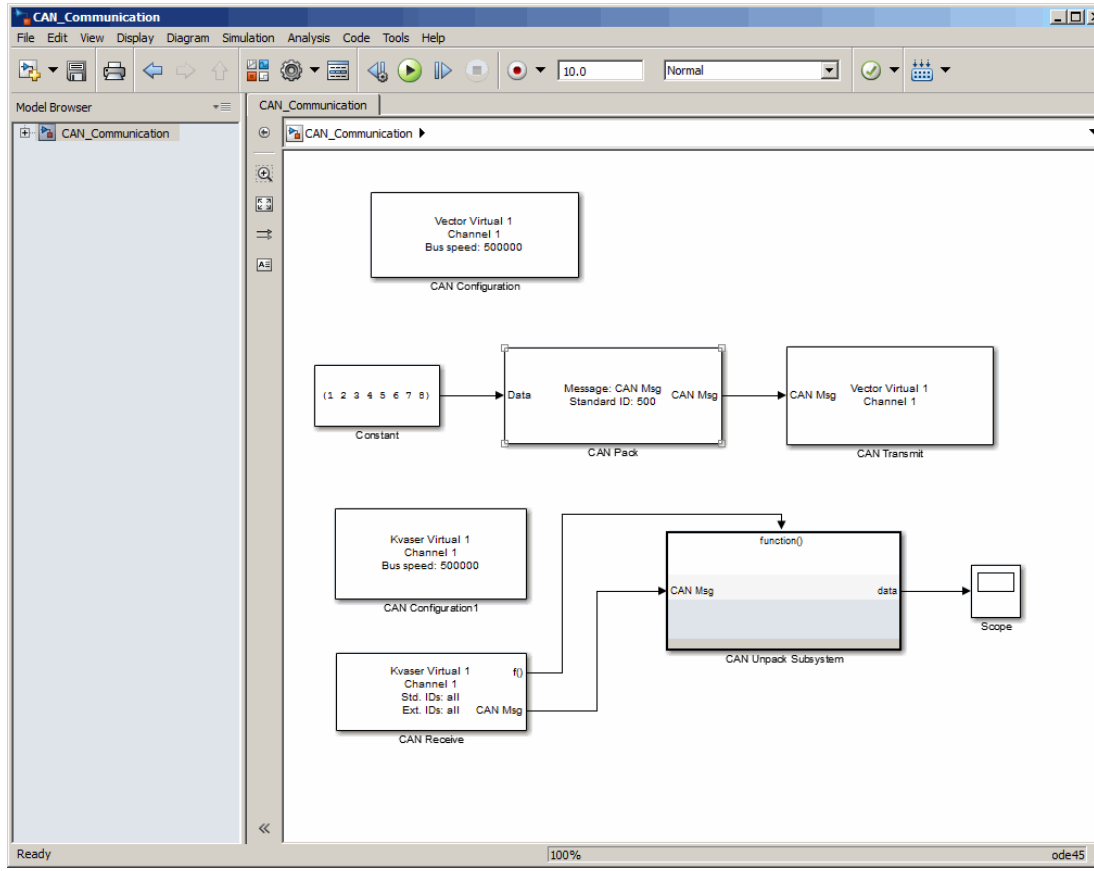
3 Rename the Function–Call Subsystem block to `CAN Unpack Subsystem`.

4 Connect the **f()** output port on the CAN Receive block to the **function()** input port on the Function–Call Subsystem block.



5 Connect the `CAN Unpack Subsystem` output port to the input port on the Scope block.

Your model looks like this figure.



The CAN Configuration block does not connect to any other block. This block configures the CAN channel used by the CAN Receive block to receive the CAN message.

Step 10: Specify the Block Parameter Values

Set parameters for the blocks in your model by double-clicking the block.

Configure the CAN Configuration1 Block

Double-click the CAN Configuration block to open its parameters dialog box. Set the:

- **Device** to `Vector Virtual 1 (Channel 2)`
- **Bus speed** to `500000`

- **Acknowledge Mode** to `Normal`

Click **OK**.

Configure the CAN Receive Block

Double-click the CAN Receive block to open its Parameters dialog box. Set the:

- **Device** to `Vector Virtual 1 (Channel 2)`
- **Sample time** to `0.01`
- **Number of messages received at each timestep** to `all`

Click **OK**.

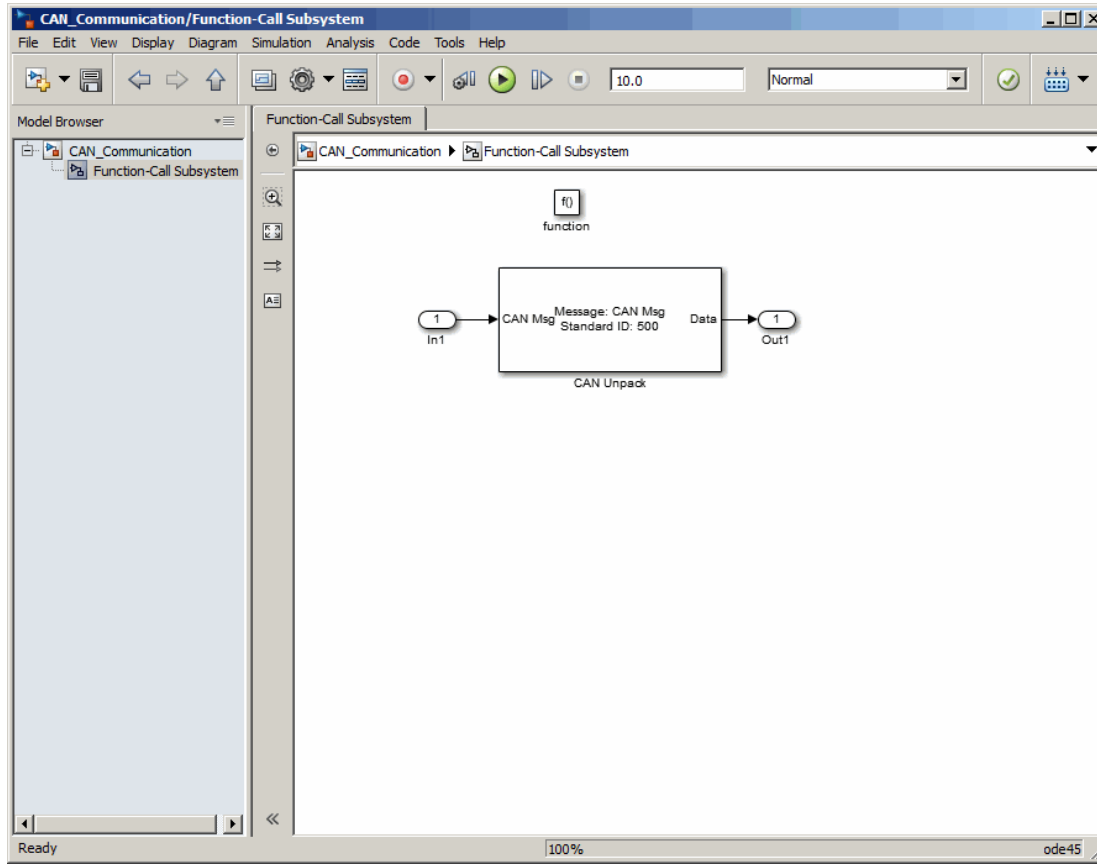
Configure the CAN Unpack Subsystem

Double-click the CAN Unpack subsystem to open the Function–Call Subsystem editor. In the model, double-click the CAN Unpack block to open its parameters dialog box. Set the:

- **Data to be output as** to `raw data`
- **Name** to the default value `CAN Msg`
- **Identifier type** to the default `Standard (11-bit identifier)` type
- **Identifier** to `500`
- **Length (bytes)** to the default length of `8`

Click **OK**.

Your subsystem looks like this figure.



Save and Run the Model

This section shows you how to save the models you built, "Build a Message Transmit Model" on page 9-11 and "Build a Message Receive Model" on page 9-15.

Step 11: Save the Model

Before you run the simulation, save your model by clicking the **Save** icon or selecting **File > Save** from the menu bar.

Step 12: Change Configuration Parameters

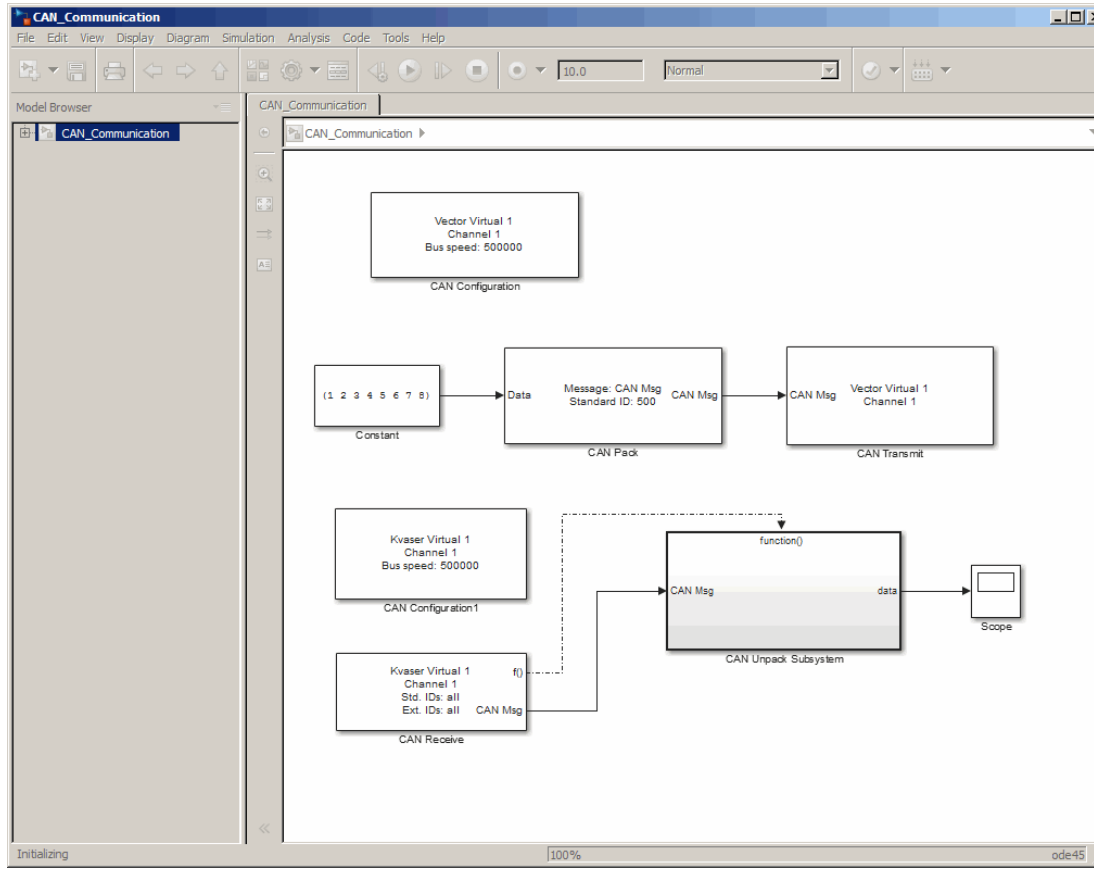
1. In your model window, select **Simulation > Model Configuration Parameters**. The Configuration Parameters dialog box opens.
2. In the Solver Options section, select:
   - **Fixed-step** from the **Type** list.
   - **Discrete (no continuous states)** from the **Solver** list.

Step 13: Run the Simulation

To run the simulation, click the **Run** button on the model window toolbar. Alternatively, you can use the **Simulation** menu in the model window and choose the **Run** option.

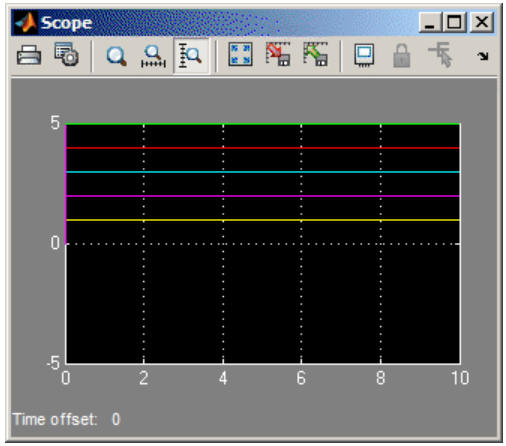
When you run the simulation, the CAN Transmit block gets the message from the CAN Pack block. It then transmits it via Virtual Channel 1. The CAN Receive block on Virtual Channel 2 receives this message and hands it to the CAN Unpack block to unpack the message.

While the simulation is running, the status bar at the bottom of the model window updates the progress of the simulation.

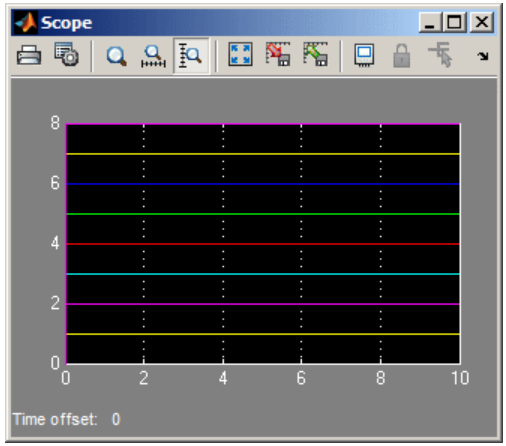


Step 14: View the Results

Double-click the Scope block to view the message transfer on a graph.



If you cannot see all the data on the graph, click the **Autoscale** toolbar button, which automatically scales both axes to display all stored simulation data.



In the graph, the horizontal axis represents the simulation time in seconds and the vertical axis represents the received data value. In the Message Transmit model, you configured blocks to pack and transmit an array of constant values, [1 2 3 4 5 6 7 8], every 0.01 second of simulation time. In the Message Receive model, these values are received and unpacked. The output in the Scope window represents the received data values.

Create Custom Blocks

You can create custom `Receive` and `Transmit` blocks to use with hardware currently not supported by the Vehicle Network Toolbox.

Vehicle Network Toolbox blocks use a custom CAN data type. To use the blocks you create with other Vehicle Network Toolbox blocks, register this custom CAN data type.

To use the custom data type defined in the Vehicle Network Toolbox, write a C++ S-function.

Note: You must use a C++ file type S-function (.cpp) to create custom blocks. Using a C-file type S-function (.c) may cause linker errors.

To register and use the custom CAN data type, in your S-function:

1. Define the `IMPORT_SCANUTIL` identifier that imports the required symbols when you compile the S-function:

   ```
   #define IMPORT_SCANUTIL
   ```

2. Include the `can_datatype.h` header located in `[MATLABROOT]\toolbox\vnt\vntblks\include\candatatype` at the top of the S-function:

   ```
   #include "can_datatype.h"
   ```

   Note: The header `can_message.h` included by `can_datatype.h` is located in `[MATLABROOT]\toolbox\shared\can\src\scanutil\`.

   ---

3. Link your S-function during build to the `scanutil.lib` located in the `[MATLABROOT]\toolbox\vnt\vntblks\lib\<ARCH>` directory. The shared library `scanutil.dll`, is located in the `[MATLABROOT]\bin\<ARCH>`

4. Call this function in `mdlInitializeSizes` to initialize the custom CAN data type:

   ```
   mdlInitialize_CAN_datatype(S);
   ```

5. Get custom data type ID using `ssGetDataTypeId`:

   ```
   dataTypeID = ssGetDataTypeId(S,SL_CAN_MESSAGE_DTYPE_NAME);
   ```

6. Do one of the following:

- To create a receive block, set output port data type to `CAN_MESSAGE`:

  ```
  ssSetOutputPortDataType(S, portID, dataTypeID );
  ```

- To create a transmit block, set the input port to `CAN_MESSAGE`:

  ```
  ssSetInputPortDataType(S, portID, dataTypeID );
  ```

For more information on S-functions, see “S-Function Basics”.

Hardware Limitations

This topic describes limitations of using hardware in the Vehicle Network Toolbox based on limitations placed by the hardware vendor:

Hardware Limitations By Vendor

Vector Hardware

You cannot have more than 64 physical or 32 virtual simultaneous connections using a Vector CAN device.

If you use more than the number of connections Vector allows, you might get an error:

- In MATLAB R2013a and later:

  ```
  Unable to query hardware information for the selected CAN channel object.
  ```

- In MATLAB R2012b:

  ```
  boost thread resource allocation error.
  ```

- In MATLAB R2012a and earlier:

  ```
  An unhandled error occurred with CAN device.
  ```

To work around this issue in Simulink:

- Use only a single Receive block for message reception in Simulink and connect all downstream Unpack blocks to it.
- Use a Mux block to combine CAN messages from Unpack blocks transmitting at the same rate into a single Transmit block.

To work around this issue in MATLAB:

- Try reusing channels you have already created for your application in MATLAB.

XCP Communications in Simulink

Vehicle Network Toolbox XCP Simulink Blocks

This section describes how to use the Vehicle Network Toolbox XCP block library. The library contains these blocks:

- **XCP CAN Transport Layer**— Transmit and Receive XCP messages over CAN bus.
- **XCP Configuration** — Configure XCP settings.
- **XCP Data Acquisition** — Acquire XCP data.
- **XCP Data Stimulation** — Stimulate XCP data.

The Vehicle Network Toolbox XCP block library is a tool for simulating XCP message traffic on a CAN network. You can use blocks from the block library with blocks from other Simulink libraries to create sophisticated models.

To use the Vehicle Network Toolbox XCP block library, you require Simulink, a tool for simulating dynamic systems. Simulink is a model definition environment. Use Simulink blocks to create a block diagram that represents the computations of your system or application. Simulink is also a model simulation environment. Run the block diagram to see how your system behaves. If you are new to Simulink, read “Getting Started with Simulink” to understand its functionality better.

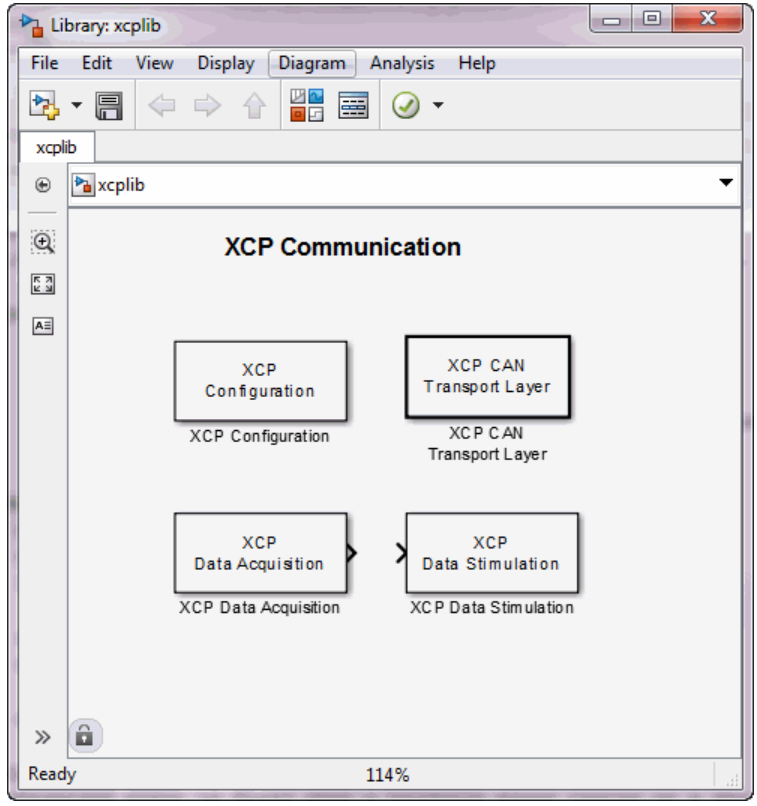
Open the Vehicle Network Toolbox XCP Block Library

In this section...

Using the MATLAB Command Window

To open the Vehicle Network Toolbox block library, enter `xcplib` in the MATLAB Command wndow.

MATLAB displays the contents of the library in a separate window.

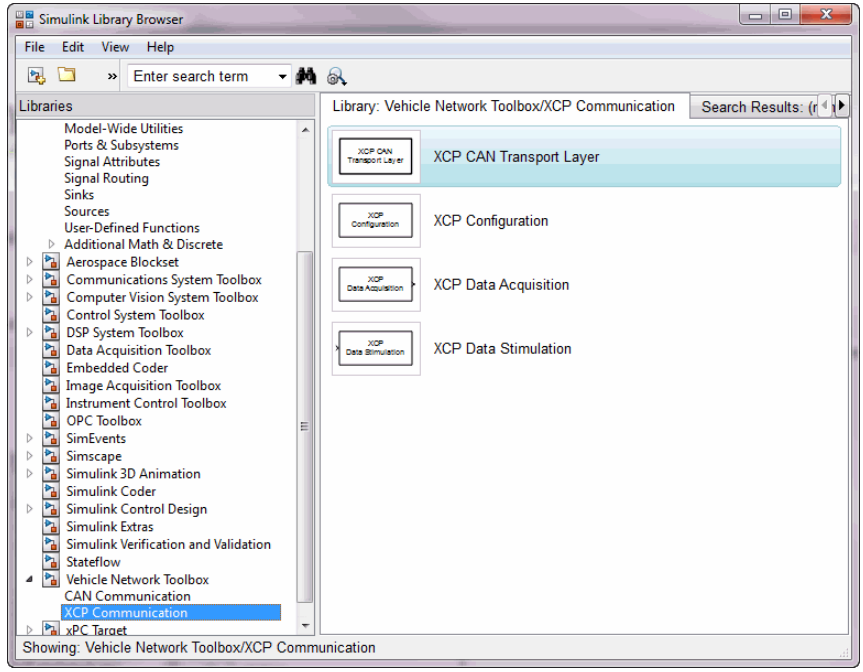


Using the Simulink Library Browser

To open the Vehicle Network Toolbox block library, start the Simulink Library Browser from MATLAB. Then select the library from the list of available block libraries displayed in the browser.

To start the Simulink Library Browser, enter `simulink` in the MATLAB Command Window.

The **Libraries** pane lists all available block libraries, with the basic Simulink library listed first, followed by other libraries listed alphabetically under it. To open the Vehicle Network Toolbox block library, click its icon and select **CAN Communication** for the CAN blocks.

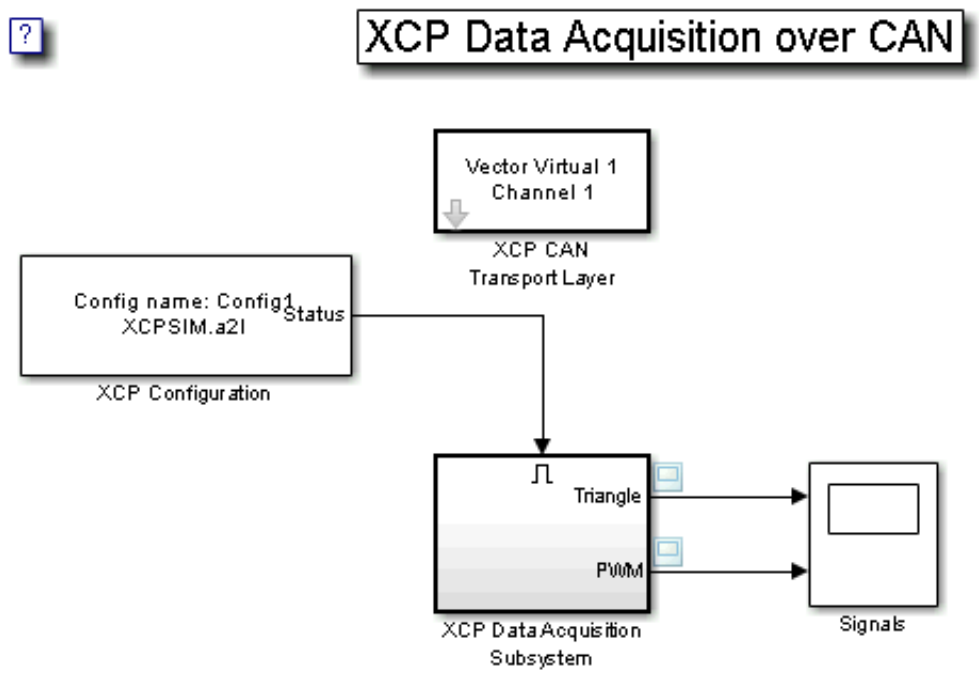


Simulink loads and displays the blocks in the library.

XCP Data Acquisition over CAN

This example shows you how to use XCP blocks to directly acquire measurement values from a slave in Simulink®. It uses an XCP slave simulator available for free download from Vector, and Vector Virtual CAN channels.

Vehicle Network Toolbox™ provides Simulink blocks for acquiring measurement values from a slave via Simulink models over Controller Area Networks (CAN). This example uses the XCP Configuration, XCP Data Acquisition, and XCP CAN Transport Layer blocks to perform data transfer over a CAN bus.



Run a Slave Simulator

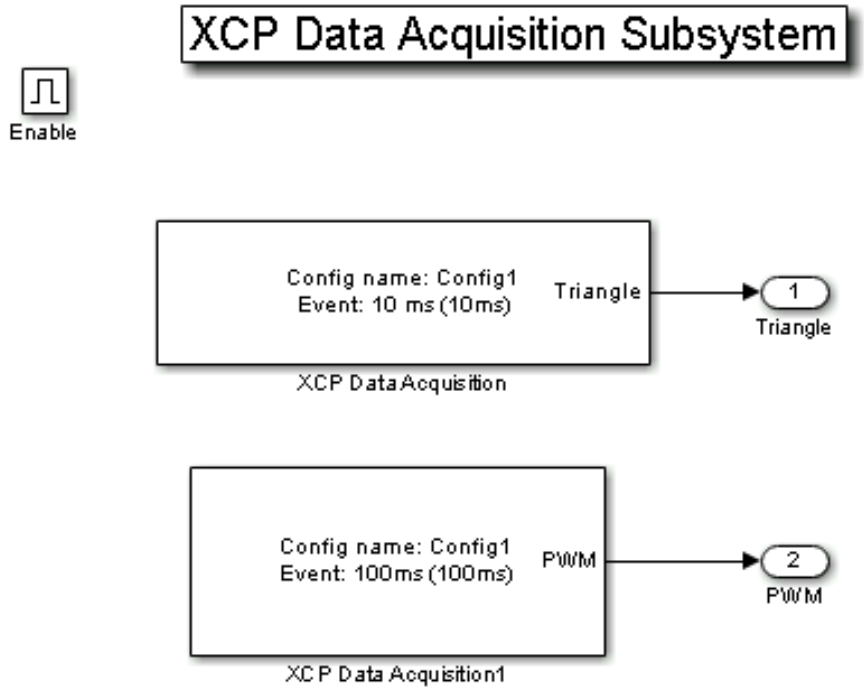
For this example, you must install a third party XCP Sample implementation from Vector. This includes a slave simulator and an A2L file. To install this free implementation:

1. Go to www.vector.com and navigate to the "DOWNLOADS" page.
2. Search for "Demos" under "Categories" and "XCP" under "Standards".
3. Download and install the available version of "XCP Sample Implementation".
4. In MATLAB, navigate to where you installed the sample package, and then go to . \Samples\XCPSim\CANape.
5. The MATLAB XCP examples will use the XCPSIM.a2l file and the XCPsim.exe slave simulator. Run XCPsim.exe.

Setting up XCP Block Parameters

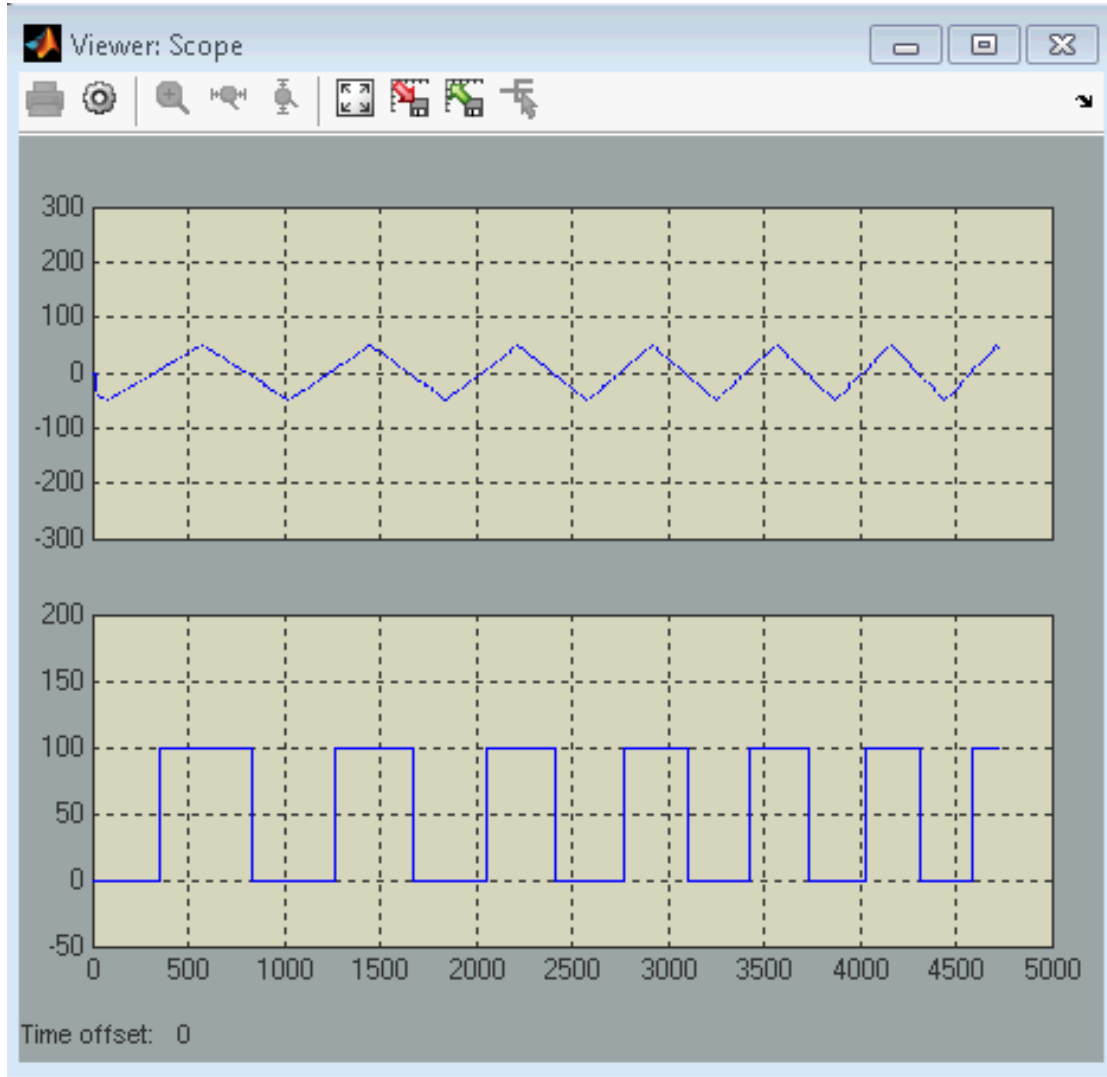
Create a model to set up XCP data acquisition for the measurements, Triangle and PWM, from the slave.

- Use an XCP Configuration block and select the A2L file, XCPSim.a2l
- Use an XCP CAN Transport Layer block and set the Device to Vector Virtual Channel 1. The transport layer is configured to transfer XCP messages over CAN via the specified virtual channel.
- Use XCP Data Acquisition blocks to receive selected measurements at specified events. For this example we have selected an XCP Data Acquisition block for each measurement of each selected event.



Visualize Measurement Values Received From Slave

Plot the results to see the measurement values for Triangle and PWM from the slave. The X-axis corresponds to the simulation timestep.


Viewer: Scope
300
200
100
0
-100
-200
-300
200
150
100
50
0
-50
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Time offset: 0

Functions — Alphabetical List

attachDatabase

Attach CAN database to messages and remove CAN database from messages

Syntax

```
attachDatabase (message, database)
attachDatabase (message, [])
```

Description

`attachDatabase (message, database)` attaches the specified database to the specified message. You can then use signal-based interaction with the message data, interpreting the message in its physical form.

`attachDatabase (message, [])` removes any attached database from the specified message. You can then interpret messages in their raw form.

Input Arguments

`message`

The name of the CAN message that you want to attach the database to or remove the database from.

`database`

Handle containing the database (`.dbc` file) that you want to attach to the message or remove from the message.

Examples

```
candb = canDatabase('C:\Database.dbc')
message = receive(canch, Inf)
attachDatabase(message, candb)
```

More About

Tips

If the specified message is an array, then the database attaches itself to each entry in the array. The database attaches itself to the message even if the message you specified does not exist in the database. The message then appears and operates like a raw message. To attach the database to the CAN channel directly, edit the Database property of the channel object.

See Also

`canDatabase` | `receive`

canChannel

Construct CAN channel connected to selected device

Syntax

```
canch = canChannel('vendor', 'device', devicechannelindex)
canch = canChannel('vendor', 'devicenumber')
```

Description

`canch = canChannel('vendor', 'device', devicechannelindex)` returns a CAN channel connected to a device from a specified vendor.

For Vector products, `device` is a combination of the device type and a device index, such as `'CANCaseXL 1'`. For example, if there are two CANcardXL devices, `device` can be `'CANcardXL 1'` or `'CANcardXL 2'`.

Use `canch = canChannel('vendor', 'devicenumber')` for National Instruments and PEAK-System devices.

For National Instruments, `vendor` is the literal string `'NI'`, and the `devicenumber` is interface number defined in the NI Measurement & Automation Explorer.

For PEAK-System devices `vendor` is the literal string `'PEAK-System'`, and the `devicenumber` is thealphanumeric device number defined for the channel.

Check the CAN Device Constructor in the `canHWInfo` display for channel construction.

Input Arguments

`vendor`

The name of the CAN device vendor. Specify the vendor name as a string.

`device`

The CAN interface that you want to connect to.

`devicechannelindex`

An alpha-numeric channel on the specified device.

`canch`

The CAN channel object the you create.

Properties

CAN Channel Properties

CAN Device Properties

Bit Timing Properties

Examples

```
canch = canChannel('Vector','CANCaseXL 1',1)
canch = canChannel('Vector','Virtual 1',2)
canch = canChannel('NI', 'CAN1')
canch = canChannel('PEAK-System', 'PCAN_USBBUS1')
```

Notes You cannot use the same variable to create multiple channels sequentially. Clear any channel in use before using the same variable to construct a new CAN channel.

You cannot create arrays of CAN channel objects. Each object you create must exist as its own individual variable.

More About

Tips

- You cannot have more than one `canChannel` configured on the same NI-CAN, NI-XNET, or PEAK-System device channel.

- Use `canHWInfo` to obtain a list of available devices.

See Also

`canHWInfo`

canDatabase

Create handle to CAN database file

Syntax

```
candb = canDatabase('dbfile.dbc')
```

Description

`candb = canDatabase('dbfile.dbc')` creates a handle to the specified database file *`dbfile.dbc`*. You can specify just a file name, a full path, or a relative path. MATLAB looks for *`dbfile.dbc`* on the MATLAB path. Vehicle Network Toolbox supports the Vector CAN database (`.dbc`) files.

Input Arguments

`dbfile.dbc`

Database file name. You can specify just the name or the full path of the database file.

Properties

Examples

```
candb = canDatabase('C:\Database.dbc')
```

See Also

`canMessage`

canHWInfo

Information on available CAN devices

Syntax

```
out = canHWInfo()
```

Description

`out = canHWInfo()` returns information about CAN devices and displays the information on a per vendor and channel basis.

Output Arguments

out

Handle that will hold the results of `canHWInfo`.

Examples

```
info = canHWInfo
```

```
ans =

CAN Devices Detected

   Vendor   |          Device           |Channel|Serial Number|               Constructor
 -----------|---------------------------|-------|-------------|-----------------------------------
 Kvaser     |Virtual 1                  |1      |0            |canChannel('Kvaser', 'Virtual 1', 1)
 Kvaser     |Virtual 1                  |2      |0            |canChannel('Kvaser', 'Virtual 1', 2)
 NI         |Virtual (CAN256)           |1      |0            |canChannel('NI', 'CAN256')
 NI         |Virtual (CAN257)           |2      |0            |canChannel('NI', 'CAN257')
 NI         |Series 847X Sync USB (CAN0)|1      |14E1B5C      |canChannel('NI', 'CAN0')
 NI         |9862 CAN/HS (CAN1)         |1      |17F509A      |canChannel('NI', 'CAN1')
 Vector     |Virtual 1                  |1      |0            |canChannel('Vector', 'Virtual 1', 1)
 Vector     |Virtual 1                  |2      |0            |canChannel('Vector', 'Virtual 1', 2)
 PEAK-System|PCAN-USB Pro (PCAN_USBBUS1)|1      |0            |canChannel('PEAK-System', 'PCAN_USBBUS1')
 PEAK-System|PCAN-USB Pro (PCAN_USBBUS2)|2      |0            |canChannel('PEAK-System', 'PCAN_USBBUS2')
```

See Also

`canChannel`

canMessage

Build CAN message based on user-specified structure

Syntax

```
message = canMessage(id, extended, datalength)
message = canMessage(database, messagename)
```

Description

`message = canMessage(id, extended, datalength)` creates and returns a CAN message object, from the raw message information.

`message = canMessage(database, messagename)` constructs a message using the message definition of the specified message, in the specified database.

Input Arguments

`id`

The ID of the message that you specify.

`extended`

Indicates whether the message ID is of standard or extended type. The Boolean value is `true` if extended or `false` if standard.

`datalength`

The length of the data of the message, in bytes. Specify from `0` through `8`.

`database`

Handle to the CAN database containing the message definition.

`messagename`

The name of the message definition in the database.

Output Arguments

`message`

The message object returned from the function.

Properties

Examples

To construct a CAN message, type:

```
message = canMessage(2500, true, 4)
```

To construct a message using CAN database message definitions, create a database object using the `canDatabase` function, and then construct your message:

```
candb = canDatabase('c:\database.dbc')
message = canMessage (candb, 'messagename')
```

See Also

`attachDatabase` | `extractAll` | `canDatabase` | `extractRecent` | `extractTime` | `pack` | `unpack`

canMessageImport

Import CAN message log file from third-party tool

Syntax

```
message = canMessageImport('file', 'vendor')
message = canMessageImport('file', 'vendor', database)
```

Description

`message = canMessageImport('file', 'vendor')` allows you to import a CAN message log file, `file`, from a third-party vendor, `vendor`, into Vehicle Network Toolbox. All the messages in the log file are imported as CAN messages, compatible with MATLAB and displayed as an array.

`message = canMessageImport('file', 'vendor', database)` allows you to apply a specify a database handle, `database`. The information in the specified database is applied to the imported CAN log messages.

Once imported, you can analyze, transmit, or replay these messages.

Input Arguments

`file`

Name of the CAN message log file to import.

`vendor`

Name of the vendor whose CAN message log file to import.

`database`

Name of the database whose information to attach to the imported log file.

Output Arguments

`message`

The message object returned by the function.

Examples

To import a log file, type:

```
message = canMessageImport('MsgLog.asc', 'Vector')
```

To specify a database name, type:

```
database = canDatabase('myDatabase.dbc')
message = canMessageImport('MsgLog.txt', 'Kvaser', database)
```

More About

Tips

- You can import message logs only in certain file formats. You can import only ASCII files from Vector and text files from Kvaser.
- `canMessageImport` assumes that the information in the imported log file is in a hexadecimal format.
- `canMessageImport` assumes that the timestamps in the imported log file are absolute values.
- To import Vector log files with symbolic message names, specify an appropriate database file in the input arguments.

See Also

`canDatabase` | `receive` | `transmit`

canSupport

Generate technical support log

Syntax

```
canSupport()
```

Description

`canSupport()` returns diagnostic information for all installed CAN devices and saves output to the text file `cansupport.txt` in the current working directory.

For online support of Vehicle Network Toolbox software, visit the toolbox page on the MathWorks Web site.

canTool

Open Vehicle CAN Bus Monitor

Syntax

```
canTool
```

Description

`canTool` starts the Vehicle CAN Bus Monitor, which displays live CAN message traffic. Use the CAN Tool to view message traffic using a selected CAN device and channel. You can also save messages to a log file via this tool.

For more information about the Bus Monitor, refer to “Monitor Vehicle CAN Bus”.

configBusSpeed

Set bit timing rate of CAN channel

Syntax

```
configBusSpeed(canch, busspeed)
configBusSpeed(canch, busspeed, sjw, tseg1, tseg2, numberofsamples)
```

Description

`configBusSpeed(canch, busspeed)` sets the speed of the CAN channel in a direct form that uses baseline bit timing calculation factors.

`configBusSpeed(canch, busspeed, sjw, tseg1, tseg2, numberofsamples)` sets the speed of the CAN channel `canch` to `busspeed` using the specified bit timing calculation factors to control the timing in an advanced form.

Input Arguments

`canch`

The CAN channel object that you want to set the bit timing rate for.

`busspeed`

The user-specified bit timing rate for the specified object.

`sjw`

The synchronization jump width. This value is the maximum value of time bit adjustments.

`tseg1`

The length of time at the start of the sample point within a bit time.

`tseg2`

The length of time at the end of the sample point within a bit time.

`numberofsamples`

The specified count of bit samples used.

Examples

To configure the bus speed using baseline bit timing calculation, type:

```
canch = canChannel('Vector','CANCaseXL 1',1)
configBusSpeed(canch,250000)
```

To specify the bit timing calculations, type:

```
canch = canChannel('Kvaser', 'USBcan Professional 1', 1)
configBusSpeed(channel, 500000, 1, 4, 3, 1)
```

More About

Tips

- Unless you have specific timing requirements for your CAN connection, use the direct form of `configBusSpeed`. Also note that you can set the bus speed only when the CAN channel is offline. The channel must also have initialization access to the CAN device.
- Synchronize all nodes on the network for CAN to work successfully. However, over time, clocks on different nodes will get out of sync, and must resynchronize. `SJW` specifies the maximum width (in time) that you can add to `tseg1` (in a slower transmitter), or subtract from `tseg2` (in a faster transmitter) to regain synchronization during the receipt of a CAN message.

See Also

`canChannel`

discard

Discard all messages from CAN channel

Syntax

```
discard(canch)
```

Description

`discard(canch)` discards messages that are available to receive on the channel, `canch`.

Input Arguments

`canch`

CAN channel that you want to discard the messages from.

Examples

Set up a CAN channel to receive messages and discard the messages received by the channel.

Discard Messages Received by a CAN Channel

Create a CAN channel to receive messages and start the channel:

```
rxCh = canChannel('Vector','CANcaseXL 1',1);
start (rxCh)
```

Discard all messages in this channel:

```
discard(rxCh);
```

See Also

`canChannel`

extractAll

Select all instances of message from message array

Syntax

```
[extracted, remainder] = extractAll(message, messagename)
[extracted, remainder] = extractAll(message, id, extended)
```

Description

`[extracted, remainder] = extractAll(message, messagename)` parses the given array `message`, and returns all instances of messages matching the specified message name.

`[extracted, remainder] = extractAll(message, id, extended)` parses the given array `message`, and returns all instances of messages matching the specified ID with the specified standard or extended type.

Input Arguments

`message`

An array of CAN message objects that you specify to parse and find the specified messages by name or ID.

`messagename`

The name of the message that you specify to extract.

`id`

The ID of the message that you specify to extract.

`extended`

Indicates whether the message ID is a standard or extended type. The Boolean value is `true` if extended and `false` if standard.

Output Arguments

`extracted`

An array of CAN message objects returned with all instances of `id` found in the `message`.

`remainder`

A CAN message object containing all messages in the original input `message` with all instances of `id` removed.

Examples

```
[msgOut, remainder] = extractAll(message, 'msg1')
[msgOut, remander] = extractAll(message,{'msg1' 'msg2' 'msg3'})
[msgOut, remainder] = extractAll(message, 3000, true)
[msgOut, remainder] = extractAll(message,[200 5000],[false true])
```

More About

Tips

You can specify `id` as a cell array of message names or a vector of identifiers. For example, if you pass `id` in as [250 5000], [false true], `extractAll` returns every instance of both CAN message `250` and message `5000` that it finds in the `message` array. If any `id` in the vector is an extended type, set `extended` to `true` and as a vector of the same length as `id`.

See Also

`extractRecent` | `extractTime`

extractRecent

Select most recent message from array of messages

Syntax

```
extracted = extractRecent(message)
extracted = extractRecent(message, messagename)
extracted = extractRecent(message, id, extended)
```

Description

`extracted = extractRecent(message)` parses the given array `message` and returns the most recent instance of each unique CAN message found in the array.

`extracted = extractRecent(message, messagename)` parses the specified array of messages and returns the most recent instance matching the specified message name.

`extracted = extractRecent(message, id, extended)` parses the given array `message` and returns the most recent instance of the message matching the specified ID with the specified standard or extended type.

Input Arguments

`message`

An array of CAN message objects that you specify to parse and find the specified messages by name or ID.

`messagename`

The name of the message that you specify to extract.

`id`

The `id` of the message that you specify to extract.

`extended`

Indicates whether the message ID is a standard or extended type. The Boolean value is `true` if extended and `false` if standard.

Output Arguments

`extracted`

An array of CAN message objects returned with the most recent instance of `id` found in the `message`.

Examples

```
msgOut = extractRecent(message)
msgOut = extractRecent(message, 'msg1')
msgOut = extractRecent(message, {'msg1' 'msg2' msg3'})
msgOut = extractRecent(message, 3000, true)
msgOut = extractRecent(message, [400, 5000], [false true])
```

More About

Tips

You can specify `id` as a vector of identifiers. For example, if you pass `id` in as [250 500], `extractRecent` returns the latest instance of both CAN message `250` and message `500` if it finds them in the `message` array. By default, all identifiers in the vector are standard CAN message identifiers unless `extended` is `true`. If any `id` in the vector is an extended type, then `extended` is `true` and is a vector of the same length as `id`.

See Also

`extractAll` | `extractTime`

extractTime

Select messages occurring within specified time range from array of messages

Syntax

```
extracted = extractTime(message, starttime, endtime, msgRange)
```

Description

`extracted = extractTime(message, starttime, endtime, msgRange)` parses the array `message` and returns all messages with a timestamp within the specified `starttime` and `endtime`, including the `starttime` and `endtime`.

Input Arguments

`message`

An array of CAN message objects.

`starttime`

The beginning of the time range in seconds that you specify. Returns messages with a timestamp greater than or equal to the specified start time.

`endtime`

The end of the time range in seconds that you specify. Parses messages with a timestamp up to the specified end time, including the specified end time.

Output Arguments

`extracted`

An array of CAN message objects returned with all messages that occur within and including `starttime` and `endtime`.

Examples

```
msgRange = extractTime(message, 5, 10.5)
msgRange = extractTime(message, 0, 60)
msgRange = extractTime(message, 150, Inf)
```

More About

Tips

Specify the time range in increasing order from `starttime` to `endtime`. If you must specify the largest available time, `endtime` also accepts `Inf` as a valid value. The earliest acceptable time you can specify for `starttime` is `0`.

See Also

`extractAll` | `extractRecent`

filterAllowAll

Allow all messages of specified identifier type

Syntax

```
filterAllowAll(canch, type)
```

Description

`filterAllowAll(canch, type)` opens the filter on the specified CAN channel to allow all messages matching the specified identifier type to pass the acceptance filter.

Input Arguments

`canch`

The CAN channel on which you want to filter messages.

`type`

The identifier type by which to filter. CAN messages are `'Standard'` and `'Extended'`.

Examples

To allow all standard and extended message typed to pass the filter, type:

```
canch = canChannel('Vector','CANCaseXL 1',1)
filterAllowAll(canch,'Standard')
filterAllowAll(canch,'Extended')
```

See Also

`filterAllowOnly` | `filterBlockAll`

filterAllowOnly

Configure message filter to allow only specified messages

Syntax

```
filterAllowOnly(canch,name)
filterAllowOnly(canch,ids,type)
```

Description

`filterAllowOnly(canch,name)` configures the filter on the channel `canch`, to pass only messages with the specified name.

`filterAllowOnly(canch,ids,type)` configures the filter on the channel `canch`, to pass only messages of the specified type with the specified identifier.

Input Arguments

`canch`

The CAN channel on which you want to filter messages.

`name`

the name of the CAN message that you want to allow. You can specify a single name as a string or a cell array of message names.

`ids`

The CAN message ID or IDs that you want to allow. You can specify:

- Single value, such as `600`
- Multiple values, such as `[600,610]`
- Range of values, such as [600:800]
- Multiple ranges, such as `[200:400, 600:800]`

`type`

The identifier type by which to filter messages. CAN messages are `'Standard'` and `'Extended'`.

Examples

To filter a database defined message with name `'EngineMsg'`, type:

```
canch = canChannel('Vector','CANCaseXL 1',1);
canch.Database = canDatabase('candatabase.dbc');
filterAllowOnly(canch,'EngineMsg')
```

To filter messages by identifier, type:

```
canch = canChannel('Vector','CANCaseXL 1',1);
filterAllowOnly(canch,[602 612],'Standard');
```

More About

Tips

- Use `Database` to attach a database to your CAN channel and filter messages using message names.
- The `id` value is stored as a decimal value. To convert a hexadecimal to a decimal value, use the `hex2dec` function.

See Also

`filterAllowAll` | `filterBlockAll` | `hex2dec`

filterBlockAll

Configure filter to block messages with specified identifier type

Syntax

```
filterBlockAll(canch,type)
```

Description

`filterBlockAll(canch,type)` configures the message filter to block all messages matching the specified identifier type.

Input Arguments

`canch`

The CAN channel on which you want to filter messages.

`type`

The identifier type by which to filter messages. CAN messages are `'Standard'` and `'Extended'`.

Examples

To block all standard message types, type:

```
canch = canChannel('Vector','CANCaseXL 1',1)
filterBlockAll(canch,'Standard')
```

See Also

`filterAllowAll` | `filterAllowOnly`

filterAcceptRange

Set range of CAN identifiers to pass acceptance filter

Note: `filterAcceptRange` has been removed. Use `filterAllowAll`, `filterAllowOnly`, or `filterBlockAll` instead.

Syntax

```
filterAcceptRange(canch, rangestart, rangeend)
```

Note: You cannot set filters on an NI device channel.

Description

`filterAcceptRange(canch, rangestart, rangeend)` sets the acceptance filter for standard identifier CAN messages. It allows messages within the given range on the CAN channel `canch` to pass. `rangestart` and `rangeend` establish the beginning and end of the acceptable range. You can use this function with Vector devices only.

Notes

- You can configure message filtering only when the CAN channel is offline.
- CAN message filters initialize to fully open.
- `filterReset` makes the acceptance filters fully open.
- `filterAcceptRange` supports only standard (11-bit) CAN identifiers.
- You must set the values from `rangestart` through `rangeend` in increasing order.
- `filterAcceptRange` and `filterBlockRange` work together by allowing and blocking ranges of CAN messages within a single filter. You can perform both operations multiple times in sequence to custom configure the filter as desired.

Input Arguments

`canch`

The CAN channel that you want to set the filter for.

`rangestart`

The first identifier of the range of message IDs that the filter accepts.

`rangeend`

The last identifier of the range of message IDs that the filter accepts.

Examples

```
canch = canChannel('Vector','CANCaseXL 1',1)
filterAcceptRange(canch,600,625)
filterAcceptRange(canch,705,710)
```

More About

Tips

When you call `filterAcceptRange` on an open or reset filter, it automatically blocks the entire standard CAN identifier range, allowing only the desired range to pass. Subsequent calls to `filterAcceptRange` open additional ranges on the filter without blocking the ranges previously allowed.

See Also

`filterBlockRange` | `filterSet` | `filterReset`

filterBlockRange

Set range of CAN identifiers to block via acceptance filter

Note: `filterBlockRange` has been removed. Use `filterAllowAll`, `filterAllowOnly`, or `filterBlockAll` instead.

Syntax

```
filterBlockRange(canch, rangestart, rangeend)
```

Note: You cannot set filters on an NI device channel.

Description

`filterBlockRange(canch, rangestart, rangeend)` blocks messages within a given range by setting an acceptance filter. You can use this function with Vector devices only.

Input Arguments

`canch`

The CAN channel that you want to set the filter for.

`rangestart`

The first identifier of the range of message IDs that the filter starts blocking at.

`rangeend`

The last identifier of the range of message IDs that the filter stops blocking at.

Examples

You can set the filter to block or accept messages within a specific range.

```
canch = canChannel('Vector','CANCaseXL 1',1)
filterBlockRange(canch, 500, 750)
filterAcceptRange(canch,600,625)
filterAcceptRange(canch,705,710)
filterBlockRange(canch,1075,1080)
```

More About

Tips

- You can configure message filtering only when the CAN channel is offline.
- CAN message filters initialize to fully open.
- `filterReset` makes the acceptance filters fully open.
- `filterBlockRange` supports only standard (11-bit) CAN identifiers.
- You must set the values from `rangestart` through `rangeend` in increasing order.
- `filterBlockRange` and `filterAcceptRange` work together by blocking and allowing ranges of CAN messages within a single filter. You can perform both operations multiple times in sequence to custom configure the filter as desired.

See Also

`filterAcceptRange` | `filterSet` | `filterReset`

filterReset

Open CAN message acceptance filters

Note: `filterReset` has been removed. Use `filterAllowAll`, `filterAllowOnly`, or `filterBlockAll` instead.

Syntax

```
filterReset(canch)
```

Note: You cannot set filters on an NI device channel.

Description

`filterReset(canch)` resets the CAN message filters on the CAN channel `canch` for both standard and extended CAN identifier types. Then all messages of all identifier types can pass.

This function does not work if the channel is online. Make sure that the channel is offline before calling `filterReset`.

Input Arguments

`canch`

The CAN channel that you want to reset the filter for.

Examples

Reset the message filters as shown:

```
canch = canChannel('Vector','CANCaseXL 1',1)
filterBlockRange(canch, 500, 750)
filterAcceptRange(canch,600,625)
filterAcceptRange(canch,705,710)
filterBlockRange(canch,1075,1080)
filterSet(canch, 500, 750, 'Standard')
filterReset(canch)
```

See Also

`filterAcceptRange` | `filterSet` | `filterBlockRange`

filterSet

Set specific CAN message acceptance filter configuration

Note: `filterSet` has been removed. Use `filterAllowAll`, `filterAllowOnly`, or `filterBlockAll` instead.

Syntax

```
filterSet(canch, code, mask, idtype)
filterSet(canch, id, idtype)
```

Note: You cannot set filters on an NI device channel.

Description

`filterSet(canch, code, mask, idtype)` sets the CAN message acceptance filter to the specified `code` and `mask`. You also must specify the CAN identifier type `idtype` on the CAN channel `canch`.

`filterSet(canch, id, idtype)` sets the CAN message acceptance filter by determining the best possible code and mask based on the ID and identifier type specified in the input argument.

Input Arguments

`canch`

The CAN channel that you want to set the filter for.

`code`

The value required for each bit position of the identifier.

`mask`

The bits in the identifier that are relevant to the filter.

`id`

Set a filter on the CAN message with the `id`, range of `ids`, multiple ranges of `ids`, or a combination of `ids`.

`idtype`

A string specifying either a standard or an extended CAN message `id` type.

Examples

```
canch = canChannel('Vector','CANCaseXL 1',1)
filterSet(canch,500,750, 'Standard')
filterSet(canch,2500,3000,'Extended')
```

To let Vehicle Network Toolbox determine the best possible code and mask option:

```
canch = canChannel('Kvaser', 'USBcan Professional 1', 1)
filterSet(canch, [500:502 1000], 'Standard')
filterSet(canch, [7500:8000 12000], 'Extended')
```

More About

Tips

- You can configure message filtering only when the CAN channel is offline.
- CAN message filters initialize to fully open.
- Use `filterReset` to make the acceptance filters fully open.
- `filterSet` supports either standard or extended CAN identifiers.

See Also

`filterAcceptRange` | `filterBlockRange` | `filterReset`

messageInfo

Information about CAN messages

Syntax

```
msgInfo = messageInfo(candb)
msgInfo = messageInfo(candb, msgName)
msgInfo = messageInfo(candb, id, extended)
```

Description

`msgInfo = messageInfo(candb)` returns information about CAN messages in the specified database `candb`.

`msgInfo = messageInfo(candb, msgName)` returns information about the specified message `'msgName'` in the specified database `candb`.

`msgInfo = messageInfo(candb, id, extended)` returns information about the message with the specified standard or extended ID in the specified database `candb`.

Input Arguments

`candb`

The database containing the CAN messages that you want information about.

`msgName`

The name of the message you want information about.

`id`

The numeric identifier of the specified message.

`extended`

Indicates whether the message ID is in standard or extended type. The Boolean value is `true` if extended and `false` if standard.

Output Arguments

`msgInfo`

Handle for the returned CAN messages in the specified database.

Examples

```
candb = canDatabase('c:\Database.dbc')
msgInfo = messageInfo(candb)
msgInfo = messageInfo(candb, 'msgName')
msgInfo = messageInfo(candb, 500, false)
```

See Also

`canDatabase` | `canMessage` | `signalInfo`

pack

Pack signal data into CAN message

Syntax

```
pack(message, value, startbit, signalsize, byteorder)
```

Description

`pack(message, value, startbit, signalsize, byteorder)` takes specified input parameters and packs them into the message.

Input Arguments

`message`

The CAN message structure that you specify for the signal to be packed in.

`value`

The value of the signal you specify to be packed in the message.

`startbit`

The signal's starting bit in the data. This is the least significant bit position in the signal data. Accepted values for `startbit` are from `0` through `63`.

`signalsize`

The length of the signal in bits. Accepted values for `signalsize` are from `1` through `64`.

`byteorder`

The signal byte order format. Accepted values are `'LittleEndian'` and `'BigEndian'`.

Examples

```
pack(message, 25, 0, 16, 'LittleEndian')
```

See Also

canMessage | extractAll | extractRecent | unpack | extractTime

receive

Receive messages from CAN bus

Syntax

```
message = receive(canch, messagesrequested)
```

Description

`message = receive(canch, messagesrequested)` returns an array of CAN message objects received on the CAN channel `canch`. The number of messages returned is less than or equal to `messagesrequested`. If fewer messages are available than `messagesrequested` specifies, the function returns the currently available messages. If no messages are available, the function returns an empty array. If `messagesrequested` is infinite, the function returns all available messages.

To understand the elements of a message, refer to `canMessage`.

Input Arguments

`canch`

The CAN channel from which to receive the message.

`messagesrequested`

The maximum count of messages to receive. The specified value must be a nonzero and positive, or `Inf`.

Output Arguments

`message`

An array of CAN message objects received from the channel.

Properties

Receive Message Properties

Error Log Properties

Examples

```
canch = canChannel('Vector','CANCaseXL 1',1)
start(canch)
message = receive(canch,5)
```

To receive all messages, type:

```
message = receive(canch,Inf)
```

See Also

`canChannel` | `canMessage` | `transmit`

replay

Retransmit messages from CAN bus

Syntax

```
replay(canch, message)
```

Description

`replay(canch, message)` retransmits the message or messages `message` on the channel `canch`, based on the relative differences of their timestamps. The replay function also replays messages from MATLAB to Simulink

To understand the elements of a message, refer to `canMessage`.

Input Arguments

`canch`

The CAN channel that you specify to transmit the messages.

`message`

An array of message objects to replay.

Examples

This example uses a loopback connection between two channels where:

- The first channel transmits messages 2 seconds apart.
- The second channel receives them.
- The `replay` function retransmits the messages with the original delay.

```
ch1 = canChannel('Vector', 'CANcaseXL 1', 1)
```

```
ch2 = canChannel('Vector', 'CANcaseXL 1', 2)
start(ch1)
start(ch2)
msgTx1 = canMessage(500, false, 8)
msgTx2 = canMessage(750, false, 8)
%The first channel transmits messages 2 seconds apart
transmit(ch1, msgTx1)
pause(2)
transmit(ch1, msgTx2)
%The second channel receives them
msgRx1 = receive(ch2, Inf)
%The replay function retransmits the messages with the original delay.
replay(ch2, msgRx1)
pause(2)
msgRx2 = receive(ch1, Inf)
```

The timestamp differentials between messages in the two receive arrays, `msgRx1` and `msgRx2`, are equal.

See Also

`canChannel` | `canMessage` | `receive` | `transmit`

signalInfo

Information about signals in CAN message

Syntax

```
SigInfo = signalInfo(candb,msgName)
SigInfo = signalInfo(candb, id, extended)
SigInfo = signalInfo(candb, id, extended, signalName)
```

Description

`SigInfo = signalInfo(candb,msgName)` returns information about the signals in the specified CAN message `msgName`, in the specified database `candb`.

`SigInfo = signalInfo(candb, id, extended)` returns information about the signals in the message with the specified standard or extended ID `id`, in the specified database `candb`.

`SigInfo = signalInfo(candb, id, extended, signalName)` returns information about the specified signal `'signalName'` in the message with the specified standard or extended ID `id`, in the specified database `candb`.

Input Arguments

`candb`

The database containing the signals that you want information about.

`msgName`

The name of the message that contains the signals that you want information about.

`id`

The numeric identifier of the specified message that contains the signals you want information about.

`extended`

Indicates whether the message ID is in standard or extended type. The Boolean value is `true` if extended and `false` if standard.

`signalName`

The name of the specific signal that you want information about.

Output Arguments

`SigInfo`

The signal information object returned from the function.

Examples

```
SigInfo = signalInfo(candb, 'Battery_Voltage')
SigInfo = signalInfo(candb, 'Battery_Voltage', 196608, true)
SigInfo = signalInfo(candb, 'Battery_Voltage', 196608, true, 'BatVlt')
```

See Also

`canDatabase` | `canMessage` | `messageInfo`

start

Set CAN channel online

Syntax

```
start(canch)
```

Description

`start(canch)` starts the CAN channel `canch` on the CAN bus to send and receive messages. The CAN channel remains online unless:

- You call `stop` on this channel.
- The channel clears from the workspace.

Examples

```
canch = canChannel('Vector','CANCaseXL 1',1)
start(canch)
```

See Also

`stop`

stop

Set CAN channel offline

Syntax

```
stop(canch)
```

Description

`stop(canch)` stops the CAN channel `canch` on the CAN bus. The CAN channel also stops running when you clear `canch` from the workspace.

Examples

```
canch = canChannel('Vector','CANCaseXL 1',1)
start(canch)
stop(canch)
```

See Also

`start`

transmit

Send CAN messages to CAN bus

Syntax

```
transmit(canch, message)
```

Description

`transmit(canch, message)` sends the array of messages onto the bus via the CAN channel.

To understand the elements of a message, refer to `canMessage`.

Input Arguments

`canch`

The CAN channel that you specify to transmit the message.

`message`

The message or an array of messages that you specify to transmit via a CAN channel.

Examples

```
message = canMessage (250, false, 8)
message.Data = ([45 213 53 1 3 213 123 43])
canch = canChannel('Vector','CANCaseXL 1', 1)
start(canch)
transmit(canch, message)
```

To transmit an array, construct `message1` and `message2` as in this example, and type:

```
transmit(canch, [message, message1 message2])
```

To transmit messages on a remote frame, type:

```
message = canMessage(250, false 8, true)
message.Data = ([45 213 53 1 3 213 123 43])
message.Remote = true
canch = canChannel('Vector','CANCaseXL 1', 1)
start(canch)
transmit(canch, message)
```

More About

Tips

The `Transmit` function ignores the `Timestamp` property and the `Error` property.

See Also

`canChannel` | `canMessage` | `receive`

transmitConfiguration

Display messages configured for automatic transmission

Syntax

```
transmitConfiguration(canch)
```

Description

`transmitConfiguration(canch)` displays information about all messages in the CAN Channel, `canch`, configured for periodic transmit or event-based transmit.

For more information on periodic transmit of messages, refer to `transmitPeriodic`.

For more information on event-based transmit of messages, refer to `transmitEvent`.

Input Arguments

`canch`

Name of the CAN channel configured for periodic transmit or event-based transmit.

Examples

Create a CAN channel and configure two messages:

```
canch = canChannel('Vector', 'Virtual 1', 1);
msg1 = canMessage(500, false, 8);
msg2 = canMessage(750, false, 8);
```

Transmit msg1 and msg2 using `transmitEvent` and `transmitPeriodic` respectively:

```
transmitEvent(canch, msg1, 'On');
transmitPeriodic(canch, msg2, 'On', 1);
```

Display messages on `canch` configured for periodic or event-based transmit:

```
transmitConfiguration(canch)
```

The function returns information about periodic configuration:

```
Periodic Messages

ID  Extended Name       Data       Rate (seconds)
--- -------- ---- ---------------- --------------
750 false         0 0 0 0 0 0 0 0  1.000000


Event Messages

ID  Extended Name       Data
--- -------- ---- ----------------
500 false         0 0 0 0 0 0 0 0
```

See Also

canChannel | canMessage | transmitEvent | transmitPeriodic

transmitEvent

Configure messages for event-based transmission

Syntax

```
transmitEvent(canch, msg, state)
```

Description

`transmitEvent(canch, msg, state)` enables an event-based transmit of the CAN message, `msg`, on the channel, `canch` when '*`state`*' is `On` and disables it when '*`state`*' is `Off`.

Input Arguments

`canch`

The name of the CAN channel on which the specified message is enabled for event-based transmit.

`msg`

The message enabled for event-based transmission on the specified CAN channel.

`state`

Specify whether event-based transmission is enabled on the specified message. Input `On` to enable event-based transmission on the specified message, and `Off` for disabling it.

Examples

Construct a CAN channel and configure a message on the channel:

```
canch = canChannel('Vector', 'CANCaseXL 1', 1);
msg = canMessage(500, false, 4);
```

Enable the message for event-based transmit, start the channel, and change some data to trigger the event-based transmit:

```
transmitEvent(ch, msg, 'On');
start(canch);
msg.Data = [1 2 3 4];
```

See Also

`canChannel` | `canMessage` | `transmitConfiguration` | `transmitPeriodic`

transmitPeriodic

Configure messages for periodic transmission

Syntax

```
transmitPeriodic(canch, msg, 'On', period)
transmitPeriodic(canch, msg, 'Off')
```

Description

`transmitPeriodic(canch, msg, 'On', period)` enables periodic transmit of the message, `msg`, on the channel, `canch`, to transmit at the specified period, `period`.

`transmitPeriodic(canch, msg, 'Off')` disables periodic transmit of the message, `msg`, on the channel, `canch`.

Input Arguments

`canch`

The name of the CAN channel on which the specified message is enabled for periodic transmit.

`msg`

The message enabled for periodic transmission on the specified CAN channel.

`'state'`

Specify whether periodic transmission is enabled on the specified message. Input `On` for enabling periodic transmission on the specified message and `Off` to disable it. If you enable periodic transmission, specify a `period` value.

`period`

Specify a period in seconds. This value is used to transmit the message in the specified period. By default this value is `0.500` seconds.

Examples

Construct a CAN channel and configure a message on the channel:

```
canch = canChannel('Vector', 'Virtual 1', 1);
msg = canMessage(500, false, 4);
```

Enable the message for periodic transmit. Set the period value to 1 sec, start the channel, and update the data in the message you want to send periodically:

```
transmitPeriodic(canch, msg, 'On', 1);
start(canch);
msg.Data = [1 2 3 4];
```

More About

Tips

You can enable and disable periodic transmit even when the channel is running. This functionality allows you to make changes to the state of the channel without stopping the channel.

See Also

`canChannel` | `canMessage` | `transmitConfiguration` | `transmitEvent`

unpack

Unpack signal data from message

Syntax

```
value = unpack(message, startbit, signalsize, byteorder, datatype)
```

Description

`value = unpack(message, startbit, signalsize, byteorder, datatype)` takes a set of input parameters to unpack the signal value from the message and returns the value as output.

Input Arguments

`message`

The CAN message structure that you specify for the signal to be unpacked from.

`startbit`

The signal's starting bit in the data. This is the least significant bit position in the signal data. Accepted values for `starbit` are from `0` through `63`.

`signalsize`

The length of the signal in bits. Accepted values for `signalsize` are from `1` through `64`.

`byteorder`

The signal binary or binblock format. Accepted values are `LittleEndian` and `BigEndian`.

`datatype`

The data type that you want to get the unpacked value in.

Output Arguments

`value`

The value of the message that you specify to be unpacked.

Examples

```
value = unpack(message, 0, 16, 'LittleEndian', 'int16')
```

See Also

`canMessage` | `extractAll` | `extractRecent` | `pack` | `extractTime`

xcpA2L

Access A2L file

Syntax

```
a2lfile = xcpA2L(filename)
```

Description

`a2lfile = xcpA2L(filename)` creates an object that accesses an A2L file. The object can parse the contents of the file and view events and measurement information.

Examples

Link to an A2L File

Create an A2L file object.

```
a2lfile = xcpA2L('XCPSIM.a2l')
```

- "Inspect the Contents of an A2L File"

Input Arguments

`filename` — A2L file name

character string

A2L file name, specified as a string. You must provide the file ending `.a2l` with the name. You can also provide a partial or full path to the file with the name.

More About

- "A2L File Support"

See Also

`getEventInfo` | `getMeasurementInfo`

getEventInfo

Get event information about specific event from A2L file

Syntax

```
info = getEventInfo(a2lFile,eventName)
```

Description

`info = getEventInfo(a2lFile,eventName)` returns information about the specified event from the specified A2L file, and stores it in the structure, `info`.

Examples

Get XCP Event Information

Create a handle to parse an A2L file and get information about the `10 ms` event.

```
a2lfile = xcpA2L('C:\XCPSIM.a2l')
info = getEventInfo(a2lfile, '10 ms')
```

```
info =

                    Name: '10 ms'
                    Direction: 'DAQ_STIM'
                  MaxDAQList: 255
               ChannelNumber: 1
             ChannelTimeCycle: 10
              ChannelTimeUnit: 6
              ChannelPriority: 0
    ChannelTimeCycleInSeconds: 0.0100
```

- “Inspect the Contents of an A2L File”

Input Arguments

`a2lFile` — Name of A2L file

character string

Name of the A2L file object, specified as a string, used in this connection. Create the A2L file handle using `xcpA2L`.

`eventName` — XCP event name

character string

XCP event name specified as a string. Event name corresponds to the XCP event defined in your A2L file. Make sure the name matches the name specified in the A2L file.

Output Arguments

`info` — XCP event information

string | numeric

XCP event information returned, as strings and numeric values, containing event details such as timing and priority.

More About

- "A2L File Support"

See Also

`getMeasurementInfo` | `xcpA2L`

getMeasurementInfo

Get information about specific measurement from A2L file

Syntax

```
info = getMeasurementInfo(a2lFile,measurementName)
```

Description

`info = getMeasurementInfo(a2lFile,measurementName)` returns information about the specified measurement from the specified A2L file, and stores it in the structure, `info`.

Examples

Get XCP Measurement Information

Create a handle to parse an A2L file and get information about the `BitSlice` measurement.

```
a2lfile = xcpA2L('C:\XCPSIM.a2l')
info = getMeasurementInfo(a2lfile, 'PWM')
```

```
info =

                  Name: 'PWM'
         LongIdentifier: 'Pulse width signal from PWM_level and Triangle'
               DataType: 'UBYTE'
             Conversion: 'HighLow'
             Resolution: 0
               Accuracy: 0
             LowerLimit: 0
             UpperLimit: 255
             ECUAddress: 4951352
    ECUAddressExtension: 0
              ByteOrder: 'MSB_LAST'
            SizeInBytes: 1
```

```
          SizeInNibbles: 2
             SizeInBits: 8
             MATLABType: 'uint8'
```

- “Inspect the Contents of an A2L File”

Input Arguments

`a2lFile` — Name of A2L file

character string

Name of the A2L file object, specified as a string, used in this connection. Create the A2L file handle using `xcpA2L`.

`measurementName` — Name of single XCP measurement

character string

Name of a single XCP measurement, specified as a string. Measurement name corresponds to the measurement name defined in your A2L file. Make sure the name matches the name specified in the A2L file

Output Arguments

`info` — XCP measurement information

string | numeric

XCP measurement information, specified as string and numeric values, containing measurement details such as memory address, units, and description.

More About

- “A2L File Support”

See Also

`getEventInfo` | `xcpA2L`

xcpChannel

Create XCP channel

Syntax

```
xcpch = xcpChannel(a2lFile,transportLayer,vendor,deviceNumber)
xcpch = xcpChannel(a2lFile,transportLayer,vendor,device,
deviceChannelIndex)
```

Description

`xcpch = xcpChannel(a2lFile,transportLayer,vendor,deviceNumber)` create a channel connected to the CAN bus via the specified transport layer, vendor and device and a defined interface number. The XCP channel accesses the slave module via the specified CAN bus and parsing the attached A2L file.

Use this syntax for National Instruments CAN devices, where `vendor` is the literal string `'NI'` and the `deviceNumber` is the interface number defined for the channel in NI Measurement & Automation Explorer.

`xcpch = xcpChannel(a2lFile,transportLayer,vendor,device,
deviceChannelIndex)` returns a handle for the created channel connected to the CAN bus via the specified transport layer, vendor and device with a channel index. The XCP channel accesses the slave module via the specified CAN bus and parsing the attached A2L file.

Examples

Create an XCP Channel using a CAN Slave Module

Create an XCP channel using a Vector CAN module's virtual channel.

Link and A2L file to your session.

```
a2l = xcpA2L('XCPSIM.a2l')
```

Create an XCP channel.

```
xcpch = xcpChannel(a2l, 'CAN', 'Vector', 'Virtual 1', 1)
```

```
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
           A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
      SeedKeyCallbackFcn: []
                KeyValue: []
```

Create an XCP Channel on a National Instruments Device

Input Arguments

`a2lFile` — Name of A2L file
character string

Name of the A2L file object, specified as a string, used in this connection. Create the A2L file handle using `xcpA2L`.

`transportLayer` — Interface used to transport XCP messages
character string

Interface used to transport XCP messages, specified as a string. Use this information to indicate the interface you are connecting to.Currently XCP works with CAN interface only.

`vendor` — Device vendor
character string

Device vendor name, specified as a string.

`deviceNumber` — Device name and interface number
character string

Device name and defined interface number for the device, specified as a string. Use this input for National Instruments CAN devices, where the devicenumber is the interface number defined for the channel in NI Measurement & Automation Explorer.

`device` — Device to connect to

character string

Device on the interface you want to connect to, specified as a string.

`deviceChannelIndex` — Index of channel on the device

numeric value

Index of channel on the device, specified as a number.

Output Arguments

`xcpch` — XCP channel that you create

XCP channel object

XCP Channel that you create, returned as an object.

See Also

`connect` | `disconnect` | `isConnected`

connect

Connect XCP channel to slave module

Syntax

```
connect(xcpch)
```

Description

`connect(xcpch)` creates an active connection between the XCP channel and the slave module, enabling active messaging between the channel and the slave.

Examples

Connect to a Slave Module

Create an XCP channel connected to a Vector CAN device on a virtual channel and connect it.

Link an A2L file to use to create an XCP channel

```
a2lfile = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the channel and see if channel is connected

```
connect (xcpch)
isConnected(xcpch)
```

```
ans =

     1
```

Input Arguments

xcpch — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`xcpA2L` | `xcpChannel`

disconnect

Disconnect from slave module

Syntax

```
disconnect(xcpch)
```

Description

`disconnect(xcpch)` disconnects the specified XCP channel from the slave module. Disconnecting the channel stops active messaging between the channel and the slave module.

Examples

Disconnect an Active XCP Connection

Create an XCP channel using a CAN module, connect the channel and disconnect it from the specified slave module.

Link an A2L file

```
a2l = xcpA2L('XCPSIM.a2l')
```

Create an XCP channel using a Vector CAN modules's virtual channel. Check to see if channel is connected.

```
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the channel and check to see if channel is connected.

```
connect(xcpch)
isConnected(xcpch)
```

```
ans =

     1
```

Disconnect the channel and check if connection is active.

```
disconnect(xcpch)
isConnected(xcpch)
```

```
ans =

     0
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`connect` | `isConnected` | `xcpA2L` | `xcpChannel`

isConnected

Return connection status

Syntax

```
isConnected(xcpch)
```

Description

`isConnected(xcpch)` returns a boolean value to indicate active connection to the slave.

Examples

Verify if XCP Channel is Connected

Create a new XCP channel and see if it is connected.

```
a2l = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
isConnected(xcpch)
```

```
ans =

     0
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`xcpChannel`

createMeasurementList

Create measurement list for XCP channel

Syntax

```
createMeasurementList(xcpch,resource,eventName,measurementName)
createMeasurementList(xcpch,resource,eventName,{measurementName,
measurementName,measurementName})
```

Description

`createMeasurementList(xcpch,resource,eventName,measurementName)` creates a data stimulation list for the XCP channel with the specified event and measurement.

`createMeasurementList(xcpch,resource,eventName,{measurementName, measurementName,measurementName})` creates a data stimulation list for the XCP channel with the specified event and list of measurements.

Examples

Create a DAQ Measurement List

Create an XCP channel connected to a Vector CAN device on a virtual channel and set up a DAQ measurement list.

```
a2lfile = xcp.A2L('XCPSIM.a2l')
xcpch = xcp.Channel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
            A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
              SeedKeyDLL: []
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data acquisition measurement list with the '10 ms' event and `'Triangle'` measurement.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', 'Triangle');
```

Create a Data Stimulation List

Create an XCP channel connected to a Vector CAN device on a virtual channel and set up a STIM measurement list.

```
a2l = xcp.A2L('XCPSIM.a2l')
xcpch = xcp.Channel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
xcpch =
  Channel with properties:

              SlaveName: 'CPP'
           A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
              SeedKeyDLL: []
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data stimulation measurement list with the '100ms' event and `'PWM'` and `'ShiftByte'` measurements.

```
createMeasurementList(xcpch, 'STIM', '100ms', {'PWM','ShiftByte'});
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

`resource` — Measurements list type

`'DAQ' | 'STIM'`

Measurement list type, specified as a literal string `'DAQ'` or `'STIM'`.

`eventName` — Name of event

character string

Name of event, specified as a string. The event is used to trigger the specified measurement list. The list of available events depends on your A2L file.

`measurementName` — Name of single XCP measurement

character string | cell array of strings

Name of a single XCP measurement specified as a string, or a set of measurements specified as a cell array of strings. Measurement name corresponds to the measurement name defined in your A2L file. Make sure the name matches the name specified in the A2L file.

See Also

`freeMeasurementLists` | `startMeasurement` | `viewMeasurementLists`

freeMeasurementLists

Remove all measurement lists from XCP channel

Syntax

```
freeMeasurementLists(xcpch)
```

Description

`freeMeasurementLists(xcpch)` removes all configured measurement lists from the specified XCP channel.

Examples

Free DAQ Lists

Create two data acquisition lists and remove them.

Create an object to parse an A2L file and connect that to an XCP channel.

```
a2lfile = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data acquisition measurement list with the `'10 ms'` event and `'PMW'` measurement.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', {'BitSlice0','PWMFiltered','Triangle'})
```

Create another measurement list with the `'100ms'` event and `'PWMFiltered'`, and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'DAQ', '100ms', {'PWMFiltered','Triangle'})
```

view details of the measurement lists.

```
viewMeasurementLists(xcpch)

DAQ List #1 using the "10 ms" event @ 0.010000 seconds and the following measurements:
   PWM

DAQ List #2 using the "100ms" event @ 0.100000 seconds and the following measurements:
   PWMFiltered
   Triangle
```

Free the measurement lists.

```
freeMeasurementLists(xcpch)
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`createMeasurementList` | `viewMeasurementLists` | `xcpA2L` | `xcpChannel`

viewMeasurementLists

View configured measurement lists on XCP channel

Syntax

```
viewMeasurementLists(xcpch)
```

Description

`viewMeasurementLists(xcpch)` shows you all configured measurement list sets for this XCP channel.

Examples

View DAQ Measurement Lists

Create an XCP channel and configure a data acquisition measurement list, then view the configured measurement list.

Create an object to parse an A2L file and connect that to an XCP channel.

```
a2lfile = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
```

```
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
           A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
      SeedKeyCallbackFcn: []
                KeyValue: []
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data acquisition measurement list with the `'10 ms'` event and `'PMW'` measurement.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', {'BitSlice0','PWMFiltered','Triangle'});
```

Create another measurement list with the `'100ms'` event and `'PWMFiltered'`and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'DAQ', '100ms', {'PWMFiltered','Triangle'});
```

view details of the measurement list.

```
viewMeasurementLists(xcpch)
```

```
DAQ List #1 using the "10 ms" event @ 0.010000 seconds and the following measurements:
   PMW

DAQ List #2 using the "100ms" event @ 0.100000 seconds and the following measurements:
   PWMFiltered
   Triangle
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`createMeasurementList` | `freeMeasurementLists`

startMeasurement

Start configured DAQ and STIM lists

Syntax

```
startMeasurement(xcpch)
```

Description

`startMeasurement(xcpch)` starts all configured data acquisition and stimulation lists on the specified XCP channel. When you start the measurement, configured DAQ lists begin acquiring data values from the slave module and STIM lists begin transmitting data values to the slave model.

Examples

Start a DAQ Measurement

Create an XCP channel connected to a Vector CAN device on a virtual channel. Set up a DAQ measurement list and start measuring data.

```
a2l = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1'1),
```

```
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
           A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
      SeedKeyCallbackFcn: []
                KeyValue: []
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data acquisition measurement list with the '10 ms' event and `'Bitslice'` measurement.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', 'BitSlice')
```

Start your measurement.

```
startMeasurement(xcpch);
```

Start a STIM Measurement

Create an XCP channel connected to a Vector CAN device on a virtual channel. Set up a DAQ measurement list and start measuring data.

```
a2l = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
           A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
    TransportLayerDevice: [1x1 struct]
      SeedKeyCallbackFcn: []
                KeyValue: []
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data stimulation measurement list with the '100ms' event and `'Bitslice0'`, `'PWMFiletered'`, and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'STIM', '100ms', {'BitSlice0','PWMFiletered','Triangle'})
```

Start your measurement.

```
startMeasurement(xcpch);
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`stopMeasurement` | `xcpChannel`

stopMeasurement

Stop configured DAQ and STIM lists

Syntax

```
stopMeasurement(xcpch)
```

Description

`stopMeasurement(xcpch)` stops all configured data acquisition and stimulation lists on the specified XCP channel. When you stop the measurement, configured DAQ lists stop acquiring data values from the slave module and STIM lists stop transmitting data values to the slave model.

Examples

Stop a DAQ Measurement

Create an XCP channel connected to a Vector CAN device on a virtual channel. Set up a DAQ measurement list and start and stop measuring data.

```
a2l = xcp2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1)
```

```
xcpch =

  Channel with properties:

              SlaveName: 'CPP'
            A2LFileName: 'XCPSIM.a2l'
         TransportLayer: 'CAN'
   TransportLayerDevice: [1x1 struct]
     SeedKeyCallbackFcn: []
               KeyValue: []
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Setup a data acquisition measurement list with the '10 ms' event and `'Bitslice'` measurement and start your measurement.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', 'BitSlice')
startMeasurement(xcpch);
```

Stop your measurement.

```
stopMeasurement(xcpch);
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`startMeasurement` | `xcpChannel`

isMeasurementRunning

Indicate if measurement is active

Syntax

```
isMeasurementRunning(xcpch)
```

Description

`isMeasurementRunning(xcpch)` returns a boolean indicating if the configured measurements are active and running.

Examples

Verify if Configured Measurement List is Active

Set up a DAQ measurement list and start it. Verify if this list is running.

Create an XCP channel with a CAN slave module.

```
a2l = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Setup a data acquisition measurement list with the '10 ms' event and `'Bitslice'` measurement and verify if measurement is running.

```
createMeasurementList(xcpch, 'DAQ', '10 ms', 'BitSlice')
isMeasurementRunning(xcpch)
```

```
ans =

     0
```

Start your measurement and verify if measurement is running.

```
startMeasurement(xcpch)
isMeasurementRunning(xcpch)
```

```
ans =

     1
```

Input Arguments

xcpch — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

See Also

`startMeasurement`

readDAQListData

Read single value of specified measurement

Syntax

```
value = readDAQListData(xcpch,measurementName)
value = readDAQListData(xcpch,measurementName,count)
```

Description

`value = readDAQListData(xcpch,measurementName)` acquires a single value for a specified measurement, and stores it in the variable, `value`. If the measurement has no data, then the function returns an empty value.

`value = readDAQListData(xcpch,measurementName,count)` acquires a single value for a specified measurement for the specified count. If the measurement has no data, then the function returns an empty value.

Examples

Acquire Data for Triangle Measurement in a DAQ List

Create an XCP channel connected to a Vector CAN device on a virtual channel. Set up a DAQ measurement list and acquire data from a `'100ms'` events `'Triangle'` measurement.

Create an object to parse an A2L file and connect that to an XCP channel.

```
a2lfile = xcp.A2L('XCPSIM.a2l')
xcpch = xcp.Channel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the channel to the slave.

```
connect(xcpch)
```

Create a measurement list with the `'100ms'` event and `'PMW'`, `'PWMFiltered'`, and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'DAQ', '100ms', {'PMW','PWMFiltered','Triangle'})
```

Start the measurement.

```
startMeasurement(xcpch)
```

Acquire data for the `'Triangle'` measurement for 5 counts.

```
value = readDAQListData(xcpch, 'Triangle', 5)
```

```
value =

   -50   -50   -50   -50   -50
```

- "Acquire Measurement Data via Dynamic DAQ Lists"

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

`measurementName` — Name of single XCP measurement

character string

Name of a single XCP measurement specified as a string. Measurement name corresponds to the XCP message name defined in your A2L file. Make sure the name matches the name specified in the A2L file.

`count` — Number of samples to read

numeric value

Number of samples to read, specified as a numeric value, for the specified measurement name. If number of samples in the measurement is less than the specified count, only the available number of samples are returned.

Output Arguments

`value` — Value from specified measurement

numeric array

Value from the specified measurement, returned as a numeric array.

See Also

`readSingleValue`

writeSTIMListData

Write to specified measurement

Syntax

```
writeSTIMListData(xcpch,measurementName,value)
```

Description

`writeSTIMListData(xcpch,measurementName,value)` writes the specified value to the specified measurement on the XCP channel.

Examples

Write Data to a Measurement in a Stimulation list

Create an XCP channel connected to a Vector CAN device on a virtual channel. Set up data stimulation list and write to a `'100ms'` event's `'Triangle'` measurement.

Create an object to parse an A2L file and connect that to an XCP channel.

```
a2lfile = xcp.A2L('XCPSIM.a2l')
xcpch = xcp.Channel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the channel to the slave.

```
connect (xcpch)
```

Create a measurement list with the `'100ms'` event and `'BitsliceO'`, `'PWMFiltered'`, and `'Triangle'` measurements.

```
createMeasurementList(xcpch, 'STIM', '100ms', {'BitSliceO','PWMFiltered','Triangle'});
```

Start the measurement.

```
startMeasurement (xcpch)
```

Write data to the `'Triangle'` measurement.

```
writeDAQListData(xcpch, 'Triangle' 10)
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

`measurementName` — Name of single XCP measurement

character string

Name of a single XCP measurement, specified as a string. Measurement name corresponds to the measurement name defined in your A2L file. Make sure the name matches the name specified in the A2L file

`value` — Value of the measurement

numeric value

Value of the selected measurement, returned as a numeric value.

See Also

`writeSingleValue`

readSingleValue

Read single sample of specified measurement from memory

Syntax

```
value = readSingleValue(xcpch,'measurementName')
```

Description

`value = readSingleValue(xcpch,'measurementName')` acquires a single value for the specified measurement through the configured XCP channel and stores it in a variable for later use. The values are read directly from memory.

Examples

Acquire a Single Value for Triangle Measurement

Read a single value from a `'100ms'` events `'Triangle'` measurement.

Create an object to parse an A2L file and connect that to an XCP channel.

```
a2lfile = xcpA2L('XCPSIM.a2l')
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
```

Connect the channel to the slave module.

```
connect(xcpch)
```

Acquire data for the `'Triangle'` measurement.

```
value = readSingleValue(xcpch, 'Triangle')
```

```
value =
```

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Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

`measurementName` — Name of single XCP measurement

character string

Name of a single XCP measurement, specified as a string. Measurement name corresponds to the measurement name defined in your A2L file. Make sure the name matches the name specified in the A2L file

Output Arguments

`value` — Value of the measurement

numeric value

Value of the selected measurement, returned as a numeric value.

See Also

`readDAQListData`

writeSingleValue

Write single sample to specified measurement

Syntax

```
writeSingleValue(xcpch,measurementName,value)
```

Description

`writeSingleValue(xcpch,measurementName,value)` writes a single value to the specified measurement through the configured XCP channel. The values are written directly to the memory on the slave module.

Examples

Write a single value

Create an XCP channel and write a single value for the `Triangle` measurement directly to memory.

Link an A2L file to your session.

```
a2l = xcpA2L('XCPSIM.a2l')
```

Create an XCP channel and connect it to the slave module

```
xcpch = xcpChannel(a2lfile, 'CAN', 'Vector', 'Virtual 1', 1);
connect(xcpch)
```

Write the value 10 to the `Triangle` measurement.

```
writeSingleValue(xcpch, 'Triangle', 10)
```

Input Arguments

`xcpch` — XCP channel

XCP channel object

XCP channel, specified as an XCP channel object created using `xcpChannel`. The XCP channel object can then communicate with the specified slave module defined by the A2L file.

`measurementName` — Name of single XCP measurement
character string

Name of a single XCP measurement, specified as a string. Measurement name corresponds to the measurement name defined in your A2L file. Make sure the name matches the name specified in the A2L file

`value` — Value of the measurement
numeric value

Value of the selected measurement, returned as a numeric value.

See Also

`writeSTIMListData`

CAN.ChannelInfo class

Package: CAN

Display device channel information

Description

`vendor.ChannelInfo(index)` displays channel information for the device vendor with the specified `index`. Obtain the vendor information using `can.VendorInfo`.

Input Arguments

`index` — Device channel index

numeric value

Device channel index specified as a numeric value.

Properties

`Device`

Name of the device.

`DeviceChannelIndex`

Index number of the specified device channel.

`DeviceSerialNumber`

Serial number of the specified device.

`ObjectConstructor`

Information on how to construct a CAN channel using this device.

Examples

Examine Kvaser Device Channel Information

Get information on installed CAN devices.

```
info = canHWInfo
```

```
info =

CAN Devices Detected

  Vendor |  Device   | Channel | Serial Number |             Constructor
  ------ | --------- | ------- | ------------- | -----------------------------------
  Kvaser | Virtual 1 | 1       | 0             | canChannel('Kvaser', 'Virtual 1', 1)
  Kvaser | Virtual 1 | 2       | 0             | canChannel('Kvaser', 'Virtual 1', 2)
  Vector | Virtual 1 | 1       | 0             | canChannel('Vector', 'Virtual 1', 1)
  Vector | Virtual 1 | 2       | 0             | canChannel('Vector', 'Virtual 1', 2)
```

Save the Kvaser device information in an object.

```
vendor = info.VendorInfo(1);
```

Get information on the first channel of the specified device.

```
vendor.ChannelInfo(1)
```

```
ans =

  ChannelInfo with properties:

               Device: 'Virtual 1'
    DeviceChannelIndex: 1
    DeviceSerialNumber: 0
     ObjectConstructor: 'canChannel('Kvaser', 'Virtual 1', 1)'
```

See Also

Functions

`can.VendorInfo` | `canHWInfo`

CAN.VendorInfo class

Package: CAN

Display available device vendor information

Syntax

```
info = canHWInfo
info.VendorInfo(index)
```

Description

`info = canHWInfo` creates an object with information of all available CAN hardware devices.

`info.VendorInfo(index)` displays available vendor information obtained from `canHWInfo` for the device with the specified `index`.

Input Arguments

`index` — Device channel index

numeric value

Device channel index specified as a numeric value.

Properties

`VendorName`

Name of the device vendor.

`VendorDriverDescription`

Description of the device driver installed for this vendor.

`VendorDriverVersion`

Version of the device driver installed for this vendor.

`ChannelInfo`

Information on the device channels available for this vendor.

Examples

Examine Kvaser Vendor Information

Get information on installed CAN devices.

```
info = canHWInfo
```

```
info =

CAN Devices Detected

  Vendor |  Device   | Channel | Serial Number |             Constructor
  ------ | --------- | ------- | ------------- | -----------------------------------
  Kvaser | Virtual 1 | 1       | 0             | canChannel('Kvaser', 'Virtual 1', 1)
  Kvaser | Virtual 1 | 2       | 0             | canChannel('Kvaser', 'Virtual 1', 2)
  Vector | Virtual 1 | 1       | 0             | canChannel('Vector', 'Virtual 1', 1)
  Vector | Virtual 1 | 2       | 0             | canChannel('Vector', 'Virtual 1', 2)

Use GET on the output of canHWInfo for more information.
```

.literotica

Parse the objects `VendorInfo` class.

```
info.VendorInfo
```

```
ans =

  1x2 heterogeneous VendorInfo (VendorInfo, VendorInfo) array with properties:

    VendorName
    VendorDriverDescription
    VendorDriverVersion
```

```
ChannelInfo
```

See Also

Functions

`can.ChannelInfo` | `canHWInfo`

Properties — Alphabetical List

BusLoad

Display load on CAN bus

Description

The `BusLoad` property displays information about the load on the CAN network for message traffic on Kvaser devices.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Float

Values

The current message traffic on a CAN network is represented as a percentage ranging from `0.00%` to `100.00%`.

See Also

Functions

`canChannel`

BusSpeed

Display speed of CAN bus

Description

The `BusSpeed` property determines the bit rate at which messages are transmitted. You can set `BusSpeed` to an acceptable bit rate using the `configBusSpeed` function.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Numerical

Values

The default value is assigned by the vendor driver. To change the bus speed of your channel, use the `configBusSpeed` function and pass the channel name and the value as input parameters.

Examples

To change the current `BusSpeed` of the CAN channel object `canch` to 250000, type:

```
configBusSpeed(canch, 250000)
```

See Also

Functions

`canChannel`, `configBusSpeed`

Properties

`NumOfSamples`, `SJW`, `TSEG1`, `TSEG2`

BusStatus

Determine status of CAN bus

Description

The `BusStatus` property displays information about the state of the CAN bus.

Characteristics

Usage	CAN channel
Read only	Always
Data type	String

Values

- N/A
- `BusOff`
- `ErrorOff`
- `ErrorActive`

See Also

Functions

`canChannel`

Data

Set CAN message data

Description

Use the `Data` property to define your message data in a CAN message.

Characteristics

Usage	CAN message
Read only	Never
Data type	Numeric

Values

The data value is a uint8 array, based on the data length you specify in the message.

Examples

To load data into a message, type:

```
message.Data = [23 43 23 43 54 34 123 1]
```

If you are using a CAN database for your message definitions, change values of the specific signals in the message directly.

You can also use the `pack` function to load data into your message.

See Also

Functions

`canMessage`, `pack`

Database

Store CAN database information

Description

The `Database` property stores information about an attached CAN database.

Characteristics

Usage	CAN channel, CAN message
Read only	For a CAN message property
Data type	Database handle

Values

This property displays the database information that your CAN channel or CAN message is attached to. This property displays an empty structure, `[ ]`, if your channel message is not attached to a database. You can edit the CAN channel property, `Database`, but cannot edit the CAN message property.

Examples

To see information about the database attached to your CAN message, type:

```
message.Database
```

To set the database information on your CAN channel to `C:\Database.dbc`, type:

```
channel.Database = canDatabase('C:\Database.dbc')
```

Tip CAN database file names containing non-alphanumeric characters such as equal signs, ampersands, and so forth are incompatible with Vehicle Network Toolbox. You

can use a period sign in your database name. Rename any CAN database files with non-alphanumeric characters before you use them.

See Also

Functions

`attachDatabase`, `canChannel`, `canDatabase`, `canMessage`

Device

Display CAN channel device type

Description

For National Instruments devices, the `Device` property displays the device number on the hardware.

For all other devices, the `Device` property displays information about the device type to which the CAN channel is connected.

Characteristics

Usage	CAN channel
Read only	Always
Data type	String

Values

Values are automatically defined when you configure the channel with the `canChannel` function.

See Also

Functions

`canChannel`, `canHWInfo`

Properties

`DeviceChannelIndex`, `DeviceSerialNumber`, `DeviceVendor`

Device(NI)

Display NI CAN channel device type

Description

For National Instruments devices, the `DeviceType` property displays information about the device type to which the CAN channel is connected.

Characteristics

Usage	CAN channel
Read only	Always
Data type	String

Values

Values are automatically defined when you configure the channel with the `canChannel` function.

See Also

Functions

`canChannel`, `canHWInfo`

Properties

`DeviceChannelIndex`, `DeviceVendor`

DeviceChannelIndex

Display CAN device channel index

Description

The `DeviceChannelIndex` property displays the channel index on which the selected CAN channel is configured.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Numeric

Values

Values are automatically defined when you configure the channel with the `canChannel` function.

See Also

Functions

`canChannel`, `canHWInfo`

Properties

`Device`, `DeviceVendor`

DeviceSerialNumber

Display CAN device serial number

Description

The `DeviceSerialNumber` property displays the serial number of the CAN device.

Characteristics

Usage	CAN channel
Read only	Always
Data type	• Numeric • Hexadecimal String (NI CAN devices only)

Values

Values are automatically defined when you configure the channel with the `canChannel` function.

See Also

Functions

`canChannel`, `canHWInfo`

Properties

`Device`, `DeviceVendor`

DeviceVendor

Display device vendor name

Description

The `DeviceVendor` property displays the name of the device vendor.

Characteristics

Usage	CAN channel
Read only	Always
Data type	String

Values

Values are automatically defined when you configure the channel with the `canChannel` function.

See Also

Functions

`canChannel`, `canHWInfo`

Properties

`Device`, `DeviceChannelIndex`, `DeviceSerialNumber`

Error

CAN message error frame

Description

The `Error` property is a read-only value that identifies the specified CAN message as an error frame. The channel sets this property to `true` when it receives a CAN message as an error frame.

Characteristics

Usage	CAN message
Read only	Always
Data type	Boolean

Values

- `false` — The message is not an error frame.
- `true` — The message is an error frame.

The `Error` property displays `false`, unless the message is an error frame.

See Also

Functions

`canMessage`

Extended

Identifier type for CAN message

Description

The `Extended` property is the identifier type for a CAN message. It can either be a standard identifier or an extended identifier.

Characteristics

Usage	CAN message
Read only	Always
Data type	Boolean

Values

- `false` — The identifier type is standard (11 bits).
- `true` — The identifier type is extended (29 bits).

Examples

To set the message identifier type to extended with the ID set to 2350 and the data length to 8 bytes, type:

```
message = canMessage(2350, true, 8)
```

You cannot edit this property after the initial configuration.

See Also

Functions

`canMessage`

Properties

ID

ID

Identifier for CAN message

Description

The `ID` property represents a numeric identifier for a CAN message.

Characteristics

Usage	CAN message
Read only	Always
Data type	Numeric

Values

The ID value must be a positive integer from:

- 0 through 2047 for a standard identifier
- 0 through 536,870,911 for an extended identifier

You can also specify a hexadecimal value using the `hex2dec` function.

Examples

To configure a message ID to a standard identifier of value 300 and a data length of 8 bytes, type:

```
message = canMessage(300, false, 8)
```

See Also

Functions

`canMessage`

Properties

`Extended`

InitializationAccess

Determine control of device channel

Description

The `InitializationAccess` property determines if the configured CAN channel object has full control of the device channel. You can change some property values of the hardware channel only if the object has full control over the hardware channel.

Note: Only the first channel created on a device is granted initialization access.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Boolean

Values

- `Yes` — Has full control of the hardware channel and can change the property values.
- `No` — Does not have full control and cannot change property values.

See Also

Functions

`canChannel`

MessageReceivedFcn

Specify function to run

Description

Configure `MessageReceivedFcn` as a callback function to run a string expression, a function handle, or a cell array when a specified number of messages are available.

The `MessageReceivedFcnCount` property defines the number of messages available before the configured `MessageReceivedFcn` runs.

Characteristics

Usage	CAN channel
Read only	Never
Data type	Callback function

Values

The default value is an empty string. You can specify the name of a callback function that you want to run when the specified number of messages are available.

Examples

```
canch.MessageReceivedFcn = @Myfunction
```

See Also

Functions

`canChannel`

Properties

`MessageReceivedFcnCount`, `MessagesAvailable`

MessageReceivedFcnCount

Specify number of messages available before function is triggered

Description

Configure `MessageReceivedFcnCount` to the number of messages that must be available before a `MessageReceivedFcn` is triggered.

Characteristics

Usage	CAN channel
Read only	While channel is online
Data type	Double

Values

The default value is `1`. You can specify a positive integer for your `MessageReceivedFcnCount`.

Examples

```
canch.MessageReceivedFcnCount = 55
```

See Also

Functions

`canChannel`

Properties

`MessageReceivedFcn`, `MessagesAvailable`

Messages

Store message names from CAN database

Description

The `Messages` property stores the names of all messages defined in the selected CAN database.

Characteristics

Usage	CAN database
Read only	Always
Data type	String

Values

The `Messages` property displays a cell array of strings. You cannot edit this property.

See Also

`canDatabase`, `messageInfo`

MessagesAvailable

Display number of messages available to be received by CAN channel

Description

The `MessagesAvailable` property displays the total number of messages available to be received by a CAN channel.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is `0` when no messages are available.

See Also

Functions

`canChannel`

Properties

`MessagesReceived`, `MessagesTransmitted`

MessagesReceived

Display number of messages received by CAN channel

Description

The `MessagesReceived` property displays the total number of messages received since the channel was last started.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is `0` when no messages have been received. This number increments based on the number of messages the channel receives.

See Also

Functions

`canChannel`, `canHWInfo`

Properties

`MessagesAvailable`, `MessagesTransmitted`

MessagesTransmitted

Display number of messages transmitted by CAN channel

Description

The `MessagesTransmitted` property displays the total number of messages transmitted since the channel was last started.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The default is `0` when no messages have been sent. This number increments based on the number of messages the channel transmits.

See Also

Functions

`canChannel`

Properties

`MessagesAvailable`, `MessagesReceived`

Name (Database)

CAN database name

Description

The `Name (Database)` property displays the name of the database.

Characteristics

Usage	CAN database
Read only	Always
Data type	String

Values

`Name` is a string value. This value is acquired from the name of the database file. You cannot edit this property.

See Also

Functions

`canDatabase`

Properties

`Extended`, `ID`

Name (Message)

CAN message name

Description

The `Name (Message)` property displays the name of the message.

Characteristics

Usage	CAN message
Read only	Always
Data type	String

Values

`Name` is a string value. This value is acquired from the name of the message you defined in the database. You cannot edit this property if you are defining raw messages.

See Also

Functions

`canMessage`

Properties

`Extended`, `ID`

NumOfSamples

Display number of samples available to channel

Description

The `NumOfSamples` property displays the total number of samples available to this channel. If you do not specify a value, the `BusSpeed` property determines the default value.

Note: This property is not available for National Instruments CAN devices. The channel displays `NaN` for the value.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is a positive integer based on the driver settings for the channel.

See Also

Functions

`canChannel`, `configBusSpeed`

Properties

`BusSpeed`, `SJW`, `TSEG1`, `TSEG2`

Path

Display CAN database directory path

Description

The `Path` property displays the path to the CAN database.

Characteristics

Usage	CAN database
Read only	Always
Data type	String

Values

The path name is a string value, pointing to the CAN database in your directory structure.

See Also

Functions

`canDatabase`

ReceiveErrorCount

Display number of received errors detected by channel

Description

The `ReceiveErrorCount` property displays the total number of errors detected by this channel during `receive` operations.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is `0` when no error messages have been received.

See Also

Functions

`canChannel`, `receive`

Properties

`TransmitErrorCount`

Remote

Specify CAN message remote frame

Description

Use the `Remote` property to specify the CAN message as a remote frame.

Characteristics

Usage	CAN message
Read only	Never
Data type	Boolean

Values

- `{false}` — The message is not a remote frame.
- `true` — The message is a remote frame.

Examples

To change the default value of `Remote` and make the message a remote frame, type:

```
message.Remote = true
```

See Also

Functions

`canMessage`

Running

Determine status of CAN channel

Description

The `Running` property displays information about the state of the CAN channel.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Boolean

Values

- `{false}` — The channel is offline.
- `true` — The channel is online.

Use the `start` function to set your channel online.

See Also

Functions

`canChannel`, `start`

SilentMode

Specify if channel is active or silent

Description

Specify whether the channel operates silently. By default `SilentMode` is false. In this mode, the channel both transmits and receives messages normally and performs other tasks on the network such as acknowledging messages and creating error frames.

To observe all message activity on the network and perform analysis without affecting the network state or behavior, change `SilentMode` to `true`. In this mode, you can only receive messages and not transmit any.

Characteristics

Usage	CAN channel
Read only	Never
Data type	Boolean

Values

- `{false}` — The channel is in normal or active mode.
- `true` — The channel is in silent mode.

Examples

To configure the channel to silent mode, type:

```
canch.SilentMode = true
```

To configure the channel to normal mode, type:

```
canch.SilentMode = false
```

See Also

Functions

`canChannel`

Signals

Display physical signals defined in CAN message

Description

The `Signals` property allows you to view and edit signal values defined for a CAN message. This property displays an empty structure if the message has no defined signals or a CAN database is not attached to the message. The input values for this property depends on the signal type.

Characteristics

Usage	CAN message
Read only	Sometimes
Data type	Structure

Examples

Display signals defined in the CAN message, `message`:

```
message.Signals

ans =

    VehicleSpeed: 0
       EngineRPM: 250
```

Change the value of a signal:

```
message.Signals.EngineRPM = 300
```

See Also

Functions

`canMessage`, `canDatabase`

SJW

Display synchronization jump width (SJW) of bit time segment

Description

In order to adjust the on-chip bus clock, the CAN controller may shorten or prolong the length of a bit by an integral number of time segments. The maximum value of these bit time adjustments are termed the synchronization jump width or SJW.

Note: This property is not available for National Instruments CAN devices. The channel displays `NaN` for the value.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Numeric

Values

The value of the SJW is determined by the specified bus speed.

See Also

Functions

`canChannel`, `configBusSpeed`

Properties

`BusSpeed`, `NumOfSamples`, `TSEG1`, `TSEG2`

Timestamp

Display message received timestamp

Description

The `Timestamp` property displays the time at which the message was received on a CAN channel. This time is based on the receiving channel's start time.

Characteristics

Usage	CAN message
Read only	Never
Data type	Double

Values

`Timestamp` displays a numeric value indicating the time the message was received, based on the start time of the CAN channel

Examples

To set the time stamp of a message to 12, type:

```
message.Timestamp = 12
```

See Also

Functions

`canChannel`, `canMessage`, `receive`, `replay`

TransceiverName

Display name of CAN transceiver

Description

The CAN transceiver translates the digital bit stream going to and coming from the CAN bus into the real electrical signals present on the bus.

Characteristics

Usage	CAN channel
Read only	Always
Data type	String

Values

Values are automatically defined when you configure the channel with the `canChannel` function.

See Also

Functions

`canChannel`

Properties

`TransceiverState`

TransceiverState

Display state or mode of CAN transceiver

Description

If your CAN transceiver allows you to control its mode, you can use the `TransceiverState` property to set the mode.

Characteristics

Usage	CAN channel
Read only	Never
Data type	Numeric

Values

The values are defined by the transceiver manufacturer. Refer to your CAN transceiver documentation for the appropriate transceiver modes. Possible modes representing the numeric value specified are:

- `high speed`
- `high voltage`
- `sleep`
- `wake up`

See Also

Functions

`canChannel`

Properties

`TransceiverName`

TransmitErrorCount

Display number of transmitted errors by channel

Description

The `TransmitErrorCount` property displays the total number of errors detected by this channel during `transmit` operations.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is `0` when no error messages have been transmitted.

See Also

Functions

`canChannel`, `transmit`

Properties

`ReceiveErrorCount`

TSEG1

Display amount that channel can lengthen sample time

Description

The `TSEG1` property displays the amount in bit time segments that the channel can lengthen the sample time to compensate for delay times in the network.

Note: This property is not available for National Instruments CAN devices. The channel displays `NaN` for the value.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is inherited when you configure the bus speed of your CAN channel.

See Also

Functions

`canChannel`, `configBusSpeed`

Properties

`BusSpeed`, `NumOfSamples`, `SJW`, `TSEG2`

TSEG2

Display amount that channel can shorten sample time

Description

The `TSEG2` property displays the amount of bit time segments the channel can shorten the sample to resynchronize.

Note: This property is not available for National Instruments CAN devices. The channel displays `NaN` for the value.

Characteristics

Usage	CAN channel
Read only	Always
Data type	Double

Values

The value is inherited when you configure the bus speed of your CAN channel.

See Also

Functions

`canChannel`, `configBusSpeed`

Properties

`BusSpeed`, `NumOfSamples`, `SJW`, `TSEG1`

UserData

Enter custom data

Description

Use the `UserData` property to enter custom data to be stored in your CAN channel, message, or database object. When you save an object with `UserData` specified, you automatically save the custom data. When you load an object with `UserData` specified, you automatically load the custom data.

Note: To avoid unexpected results when you save and load an object with `UserData`, specify your custom data in simple data types and constructs.

Characteristics

Usage	CAN channel, CAN Message, CAN Database
Read only	Never
Data type	User defined

See Also

Functions

`canChannel`, `canMessage`, `canDatabase`

Events

Display A2L events list

Description

The `Events` property displays events available in the selected A2L description file. This property contains a cell array of strings that correspond to the names of events in the A2L file. To use the A2L file events, see “Access Event Information”.

Measurements

Display A2L measurements list

Description

The `Measurements` property displays measurements available in the selected A2L description file. This property contains a cell array of strings that correspond to the names of measurements in the A2L file. To use the A2L file measurements see “Access Measurement Information”.

DAQInfo

Data acquisition information in A2L file

Description

The `DAQInfo` property displays data acquisition information in the A2L description file. This property contains a structure with values corresponding to the DAQ features in the slave.

SlaveName

Name of connected slave

Description

The `SlaveName` property displays the name of the slave node as specified in the A2L file. The name is specified as a string.

FileName

Name of referenced A2L file

Description

The `FileName` property displays the name of the referenced A2L file as a string.

FilePath

Path of A2L file

Description

The `FileName` property displays the full file path to the A2L file as a string.

ProtocolLayerInfo

Protocol layer information

Description

The `ProtocolLayerInfo` property displays a structure containing general information about the XCP protocol implementation of the slave as defined in the A2L file.

TransportLayerCANInfo

CAN transport layer information

Description

The `TransportLayerCANInfo` property displays a structure containing general information about the CAN transport layer for the XCP connection to the slave as defined in the A2L file.

A2LFileName

Name of the A2L file

Description

The `A2LFileName` property displays the name of the A2L file contains information about the slave that an XCP channel can access.

SeedKeyDLL

Name of seed and key security access dll

Description

The `SeedKeyDLL` property displays the name of the dll file that contains the seed and key security algorithm used to unlock an XCP slave module.

TransportLayer

Transport layer type

Description

The `TransportLayer` property displays the type of transport layer used in the XCP connection.

TransportLayerDevice

XCP transport layer connection

Description

The `TransportLayerDevice` property contains a structure with XCP transport layer connection details, including information about the device through which the channel communicates with the slave.

Block Reference

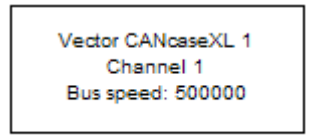
CAN Configuration
CAN Log
CAN Pack
CAN Receive
CAN Replay
CAN Transmit
CAN Unpack
XCP Configuration
XCP Data Acquisition
XCP Data Stimulation
XCP CAN Transport Layer
XCP CAN TL Receive
XCP CAN TL Transmit

CAN Configuration

Configure parameters for specified CAN device

Library

Vehicle Network Toolbox: CAN Communication



CAN Configuration

Description

The CAN Configuration block configures parameters for a CAN device that you can use to transmit and receive messages.

Specify the configuration of your CAN device before you configure other CAN blocks.

Use one CAN Configuration block to configure each device that sends and receives messages in your model. If you use a CAN Receive or a CAN Transmit block to receive and send messages on a device, your model checks to see if there is a corresponding CAN Configuration block for the specified device. If the device is not configured, you will see a prompt advising you to use a CAN Configuration block to configure the specified device.

Note: You need a license for both Vehicle Network Toolbox and Simulink software to use this block.

Other Supported Features

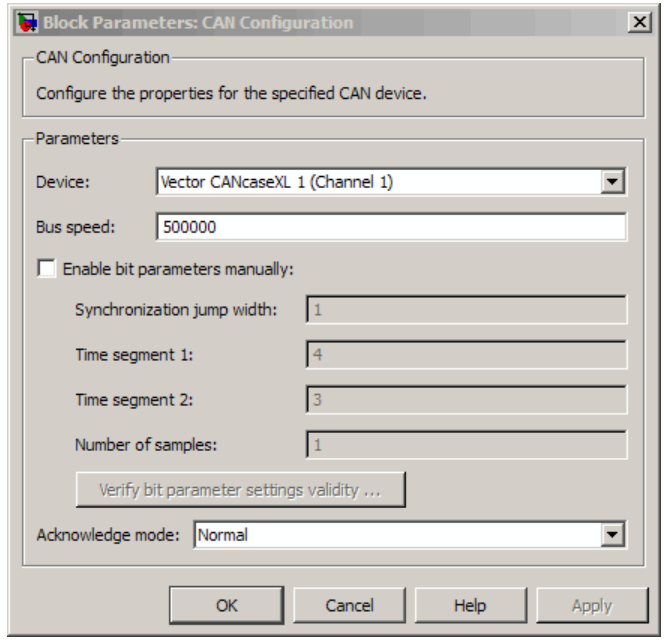
The CAN Configuration block supports the use of Simulink Accelerator™ and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The CAN Configuration block supports the use of code generation when you use it with the CAN Receive and CAN Transmit blocks.

Dialog Box

Use the Block Parameters dialog box to select your CAN device configuration.



Device

Select the CAN device and a channel on the device that you want to use from the list. Use this device to transmit and/or receive messages. The device driver determines the default bus speed.

Bus speed

Set the `bus speed` property for the selected device. The default bus speed is the default assigned by the selected device.

Enable bit parameters manually

Note: This option is disabled if you are using an NI CAN channel.

Select this check box to specify bit parameter settings manually. The bit parameter settings include:

Synchronization jump width, **Time segment 1**, **Time segment 2**, and **Number of samples**. If you do not select this option, the device automatically assigns the bit parameters depending on the bus speed setting.

Tip Use the default bit parameter settings unless you have specific timing requirements for your CAN connection.

Synchronization jump width

Specify the maximum value of the bit time adjustments. The specified value must be a positive integer. If you do not specify a value, the selected bus speed setting determine the default value. To change this value, select the **Enable bit parameters manually** check box first. Refer to the SJW property for more information.

Time segment 1

Specify the amount of bit time segments that the channel can lengthen the sample time. The specified value must be a positive integer. If you do not specify a value, the selected bus speed setting determines the default value. To change this value, select the **Enable bit parameters manually** check box first. Refer to the TSEG1 property for more information.

Time segment 2

Specify the amount of bit time segments that the channel can shorten the sample time to resynchronize. The specified value must be a positive integer. If you do not specify a value, the selected bus speed setting determines the default value. To change this value, select the **Enable bit parameters manually** check box first. Refer to the TSEG2 property for more information.

Number of samples

Specify the total number of samples available to this channel. The specified value must be a positive integer. If you do not specify a value, the selected bus speed setting determines the default value. To change this value, select the **Enable bit parameters manually** check box first. Refer to the NumOfSamples property for more information.

Verify bit parameter settings validity

If you have set the bit parameter settings manually, click this button to see if your settings are valid. The block then runs a check to see if the combination of your bus speed setting and the bit parameter value forms a valid value for the CAN device. If

the new bit parameter values do not form a valid combination, the verification fails and displays an error message.

Acknowledge mode

Specify whether the channel is in Normal or Silent mode. By default **Acknowledge mode** is Normal. In this mode, the channel both receives and transmits messages normally and performs other tasks on the network such as acknowledging messages and creating error frames. To observe all message activity on the network and perform analysis, without affecting the network state or behavior, select **Silent**. In Silent mode, you can only receive messages and not transmit.

Notes

- You cannot specify the mode if you are using NI virtual channels.
- Use Silent mode only if you want to observe and analyze your network activity.

See Also

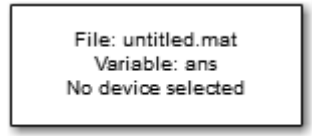
CAN Receive, CAN Transmit

CAN Log

Log received CAN messages

Library

Vehicle Network Toolbox: CAN Communication



Description

The CAN Log block logs CAN messages from the CAN network or messages sent to the blocks input port to a `.mat` file. You can load the saved messages into MATLAB for further analysis or into another Simulink model.

Note: If your model uses a National Instruments device, you cannot connect CAN Receive block and CAN Log to the same channel on the device.

You cannot connect a channel on a National Instruments device to more than one block. Configure your CAN Log block to log from the Simulink input port. Refer to the **Basic CAN Message Replay and Logging** example for more information.

The Log block appends the specified filename with the current date and time, creating unique log files for repeated logging.

If you want to use messages logged using Simulink blocks in the MATLAB Command window, use `canMessage` to convert messages to the correct format. Refer to the **Basic CAN Message Replay and Logging** example for information.

Note: You need a license for both Vehicle Network Toolbox and Simulink software to use this block.

Other Supported Features

The CAN Log block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The CAN Log block supports the use of code generation along with the packNGo function to group required source code and dependent shared libraries. For more information, see “Code Generation” on page 14-7.

Code Generation

Vehicle Network Toolbox Simulink blocks allow you to generate code, enabling models containing these blocks to run successfully in Accelerator, Rapid Accelerator, External, and Deployed modes.

Code Generation with the Simulink Coder

You can use Vehicle Network Toolbox, Simulink Coder™, and Embedded Coder®products together to generate code (on the host end) that you can use to implement your model for a practical application. For more information on code generation, see “Program Builds”.

Shared Library Dependencies

The block generates code with limited portability. The block uses precompiled shared libraries, such as DLLs, to support I/O for specific types of devices. With this block, you can use the `packNGo` function supported by the Simulink Coder, to set up and manage the build information for your models. The `packNGo` function allows you to package model code and dependent shared libraries into a zip file for deployment. You do not need MATLAB installed on the target system, but the target system needs to be supported by MATLAB.

To set up `packNGo`:

```
set_param(gcs, 'PostCodeGenCommand', 'packNGo(buildInfo)');
```

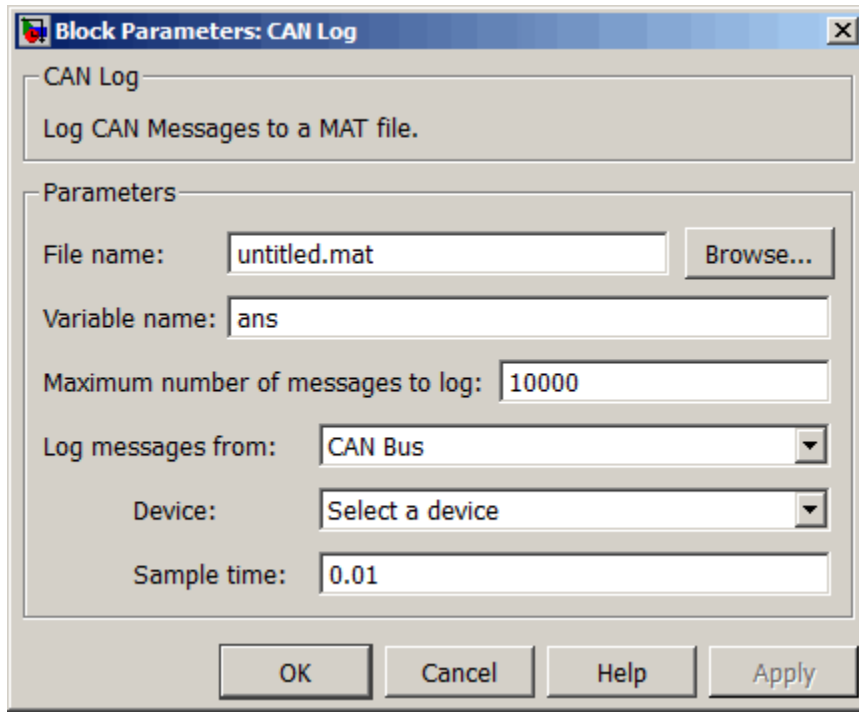
In this example, `gcs` is the current model that you wish to build. Building the model creates a zip file with the same name as model name. You can move this zip file to

another machine and the source code in the zip file can be built to create an executable which can be run independent of MATLAB and Simulink. The generated code compiles with both C and C++ compilers. For more information on `packNGo`, see "packNGo".

Dialog Box

Use the Block Parameters dialog box to configure your message logging.

Tip If you are logging from the network, you need to configure your CAN channel with a CAN Configuration block.



File name

Type the name and path of the file to log CAN messages to, or click **Browse** to browse to a file location.

The model appends the log file name with the current date and time in the `YYYY-MMM-DD_hhmmss` format. You can also open the block mask and specify a unique name to differentiate between your files for repeated logging.

Variable Name

Type the variable saved in the MAT-file that holds the CAN message information.

Maximum number of messages to log

Specify the maximum number of messages this block can log from the selected device or port. The specified value must be a positive integer. If you do not specify a value the block uses the default value of `10,000` messages. The log file saves the most recent messages up to the specified maximum number.

Log messages from

Select the source of the messages logged by the block. Possible values are `CAN Bus` or `Input port`. To log messages from the network, you must specify a device.

Device

Select the device on the CAN network that you want to log messages from. This filed is unavailable if you select `Input port` for **Log messages from** option.

Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the CAN Log block runs during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is 0.01 (in seconds).

See Also

CAN Replay

CAN Pack

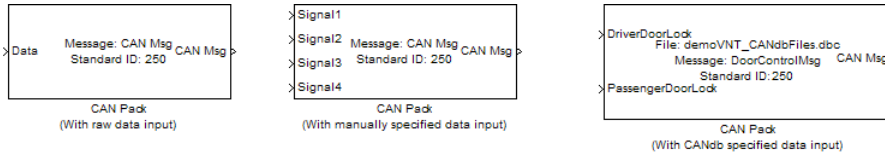
Pack individual signals into CAN message

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.

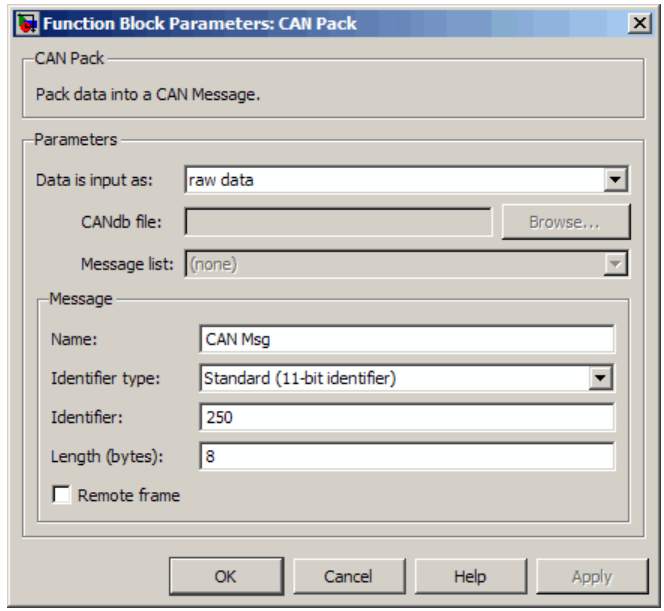
- The use of model referencing. Using this feature, your model can include other Simulink models as modular components.
- Code generation using Simulink Coder to deploy models to targets.

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.

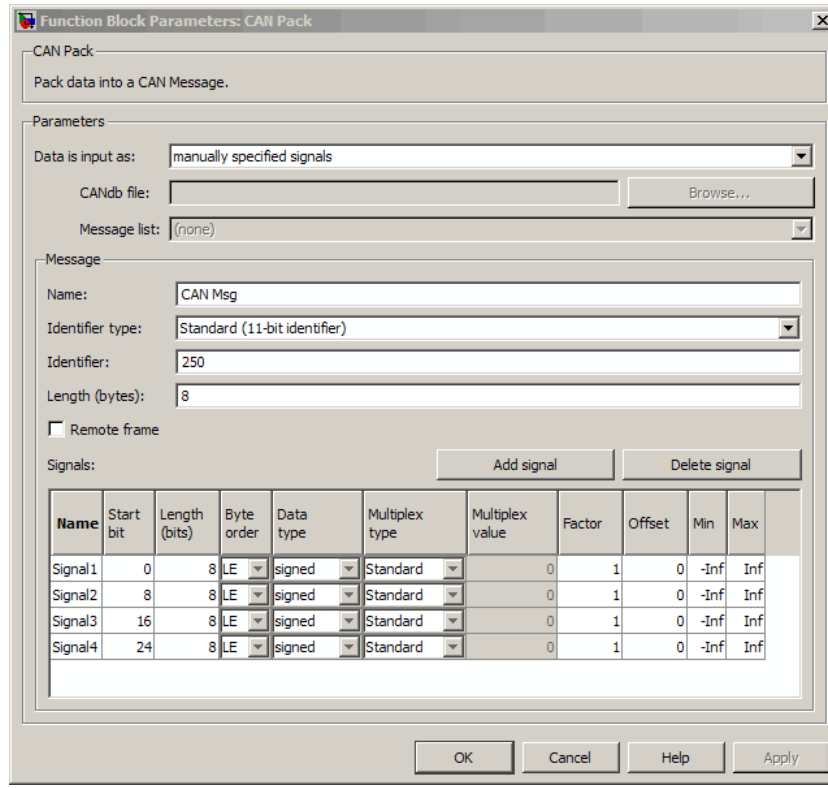


Parameters

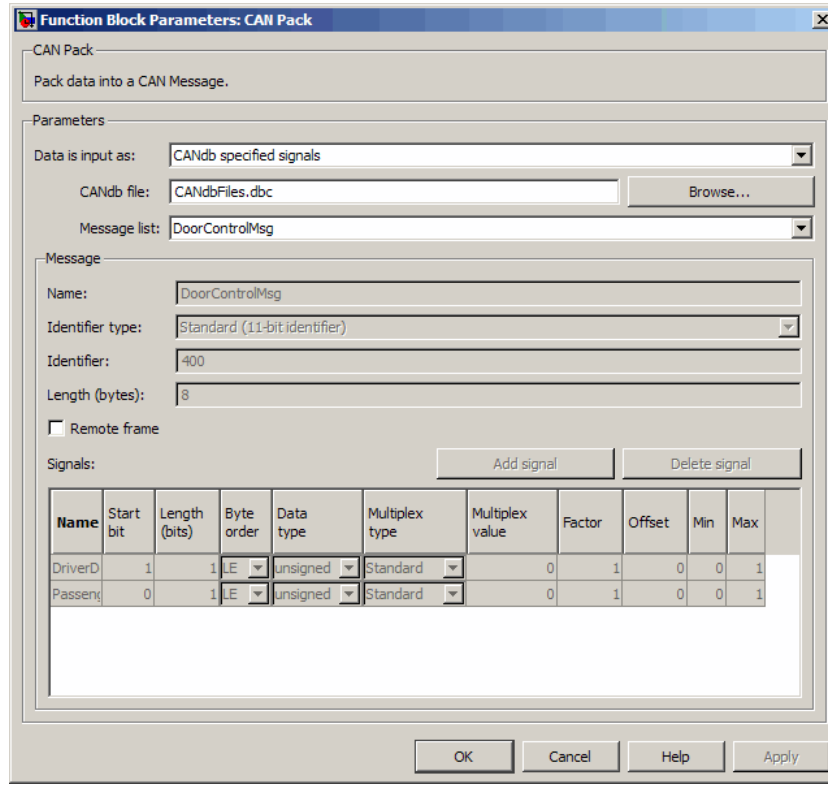
Data is input as

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.



- **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 in 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.

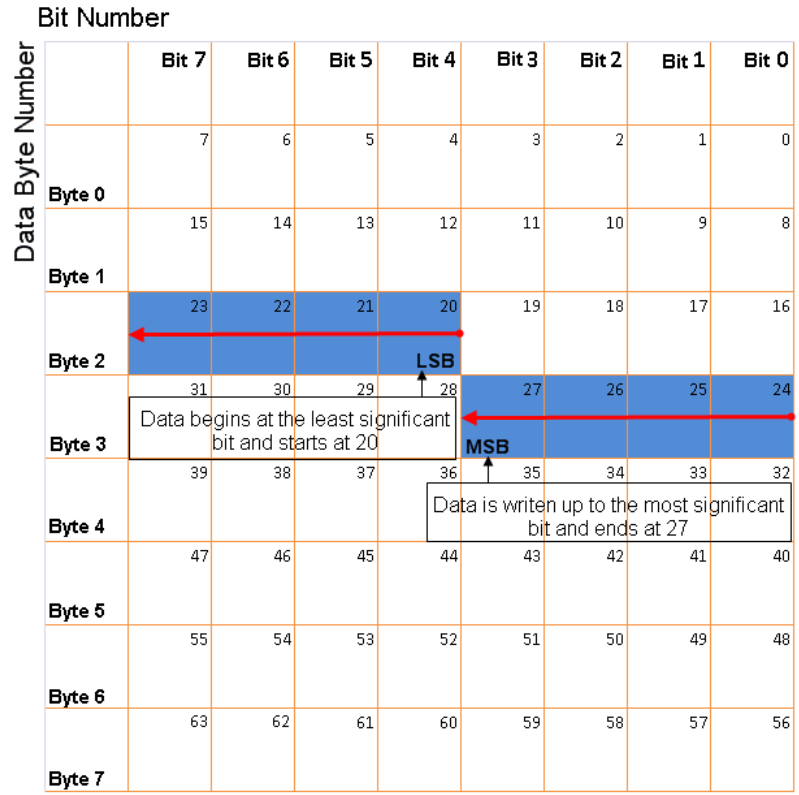
Length (bits)

Specify the number of bits the signal occupies in the message. The length must be an integer from 1 through 64.

Byte order

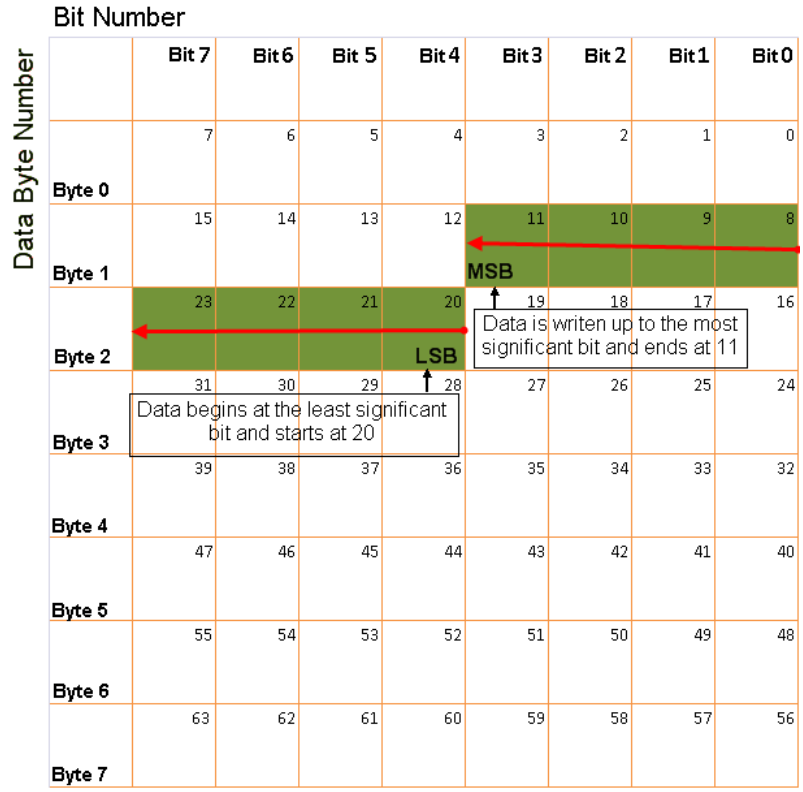
Select either of the following options:

- `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.



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.



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 14-19 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 14-19 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 14-19 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 14-19 to understand how physical values are converted to raw values packed into a message.

Conversion Formula

The conversion formula is

```
raw_value = (physical_value - Offset) / 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

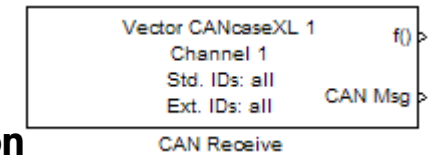
CAN Unpack

CAN Receive

Receive CAN messages from specified CAN device

Library

Vehicle Network Toolbox: CAN Communication



Description

The CAN Receive block receives messages from the CAN network and delivers them to the Simulink model. It outputs one message or all messages at each timestep, depending on the block parameters.

Note: You need a license for both Vehicle Network Toolbox and Simulink software to use this block.

The CAN Receive block has two output ports:

- The `f()` output port is a trigger to a Function-Call subsystem. If the block receives a new message, it triggers a Function-Call from this port. You can then connect to a Function-Call Subsystem to unpack and process a message.
- The `CAN Msg` output port contains a CAN message received at that particular timestep.

The CAN Receive block stores CAN messages in a first-in, first-out (FIFO) buffer. The FIFO buffer delivers the messages to your model in the queued order at every timestep.

Note: You cannot have more than one Receive block in a model using the same NI-CAN, NI-XNET, or PEAK-System device channel.

Other Supported Feature

The CAN Receive block supports the use of Simulink Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The CAN Receive block supports the use of code generation along with the packNGo function to group required source code and dependent shared libraries. For more information, see “Code Generation” on page 14-7.

Code Generation

Vehicle Network Toolbox Simulink blocks allow you to generate code, enabling models containing these blocks to run successfully in Accelerator, Rapid Accelerator, External, and Deployed modes.

Code Generation with the Simulink Coder

You can use Vehicle Network Toolbox, Simulink Coder, and Embedded Coderproducts together to generate code (on the host end) that you can use to implement your model for a practical application. For more information on code generation, see “Program Builds”.

Shared Library Dependencies

The block generates code with limited portability. The block uses precompiled shared libraries, such as DLLs, to support I/O for specific types of devices. With this block, you can use the `packNGo` function supported by the Simulink Coder, to set up and manage the build information for your models. The `packNGo` function allows you to package model code and dependent shared libraries into a zip file for deployment. You do not need MATLAB installed on the target system, but the target system needs to be supported by MATLAB.

To set up `packNGo`:

```
set_param(gcs, 'PostCodeGenCommand', 'packNGo(buildInfo)');
```

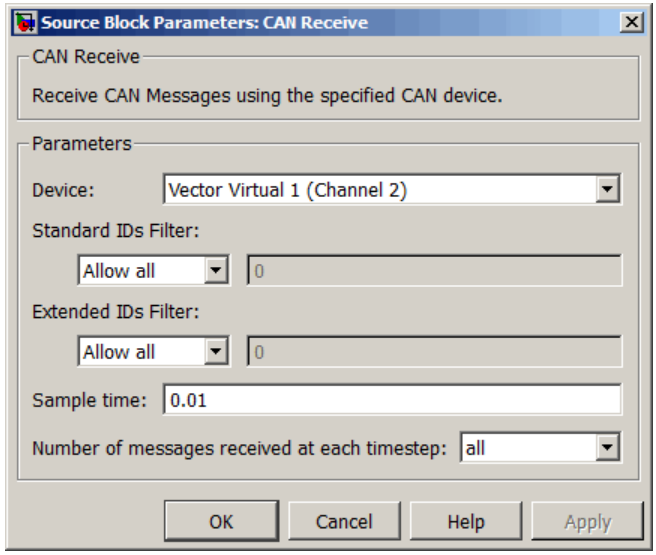
In this example, `gcs` is the current model that you wish to build. Building the model creates a zip file with the same name as model name. You can move this zip file to another machine and the source code in the zip file can be built to create an executable

which can be run independent of MATLAB and Simulink. The generated code compiles with both C and C++ compilers. For more information on `packNGo`, see “packNGo”.

Dialog Box

Use the Source Block Parameters dialog box to select your CAN Receive block parameters.

Tip Configure your CAN Configuration block before you configure the CAN Receive block parameters.



Device

Select the CAN device and a channel on the device you want to receive CAN messages from. This field lists all the devices installed on the system. It displays the vendor name, the device name, and the channel ID. The default is the first available device on your system.

Standard IDs Filter

Select the filter on this block for standard IDs. Valid choices are:

- `Allow all`: allows all standard IDs to pass the filter. This is the default filter state of the CAN Receive block
- `Allow only`: Allows only ID or range of IDs specified in the text field. You can specify a single ID or an array of IDs. You can also specify disjointed IDs or arrays separated by a comma. For example, to accept IDs from 400 through 500 and 600 through 650, enter `[[400:500] [600:650]]`. Standard IDs must be a positive integer from 0 through 2047. You can also specify a hexadecimal value using the `hex2dec` function.
- `Block all`: Blocks all standard IDs from passing the filter.

Extended IDs Filter

Select the filter on this block for extended IDs. Valid choices are:

- `Allow all`: allows all extended IDs to pass the filter. This is the default filter state of the CAN Receive block
- `Allow only`: Allows only ID or range of IDs specified in the text field. You can specify a single ID or an array of IDs. You can also specify disjointed IDs or arrays separated by a comma. For example, to accept IDs from 3000 through 3500 and 3600 through 3620, enter `[[3000:3500] [3600:3620]]`. Extended IDs must be a positive integer from 0 through 536870911. You can also specify a hexadecimal value using the `hex2dec` function.
- `Block all`: Blocks all extended IDs from passing the filter.

Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the CAN Receive block runs during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is 0.01 (in seconds).

Number of messages received at each timestep

Select how many messages the block receives at each specified timestep. The choices are `1` and `all`. By default, the block receives one message at each timestep. Then, the FIFO buffer delivers one new message to the Simulink model. If the block does not receive any message before the next timestep it outputs the last received message.

If you select `all`, the CAN Receive block delivers all available messages in the FIFO buffer to the model during a specific timestep. The block generates one function call

for every message delivered to the model for that particular timestep. The output port always contains one CAN message at a time.

See Also

CAN Configuration, CAN Unpack

CAN Replay

Replay logged CAN messages

Library

Vehicle Network Toolbox: CAN Communication

Description

The CAN Replay block replays logged messages from a `.mat` file to a CAN network or to Simulink. You need a CAN Configuration block to replay to the network.

To replay messages logged in the MATLAB Command window in your Simulink model, convert them into a compatible format using `vntslgate` and save it to a separate file. Refer to the **Basic CAN Message Replay and Logging** example for information.

Note: You need a license for both Vehicle Network Toolbox and Simulink software to use this block.

Replay Timing

When you replay logged messages, Simulink uses the original timestamps on the messages. When you replay to a network, the timestamps correlate to real time, and when you replay to the Simulink input port it correlates to simulation time. If the timestamps in the messages are all `0`, all messages are replayed as soon as the simulation starts, because simulation time and real time will be ahead of the timestamps in the replayed messages.

Other Supported Features

The CAN Replay block supports the use of Simulink Accelerator Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The CAN Replay block supports the use of code generation along with the packNGo function to group required source code and dependent shared libraries. For more information, see “Code Generation” on page 14-7.

Code Generation

Vehicle Network Toolbox Simulink blocks allow you to generate code, enabling models containing these blocks to run successfully in Accelerator, Rapid Accelerator, External, and Deployed modes.

Code Generation with the Simulink Coder

You can use Vehicle Network Toolbox, Simulink Coder, and Embedded Coderproducts together to generate code (on the host end) that you can use to implement your model for a practical application. For more information on code generation, see “Program Builds”.

Shared Library Dependencies

The block generates code with limited portability. The block uses precompiled shared libraries, such as DLLs, to support I/O for specific types of devices. With this block, you can use the `packNGo` function supported by the Simulink Coder, to set up and manage the build information for your models. The `packNGo` function allows you to package model code and dependent shared libraries into a zip file for deployment. You do not need MATLAB installed on the target system, but the target system needs to be supported by MATLAB.

To set up `packNGo`:

```
set_param(gcs, 'PostCodeGenCommand', 'packNGo(buildInfo)');
```

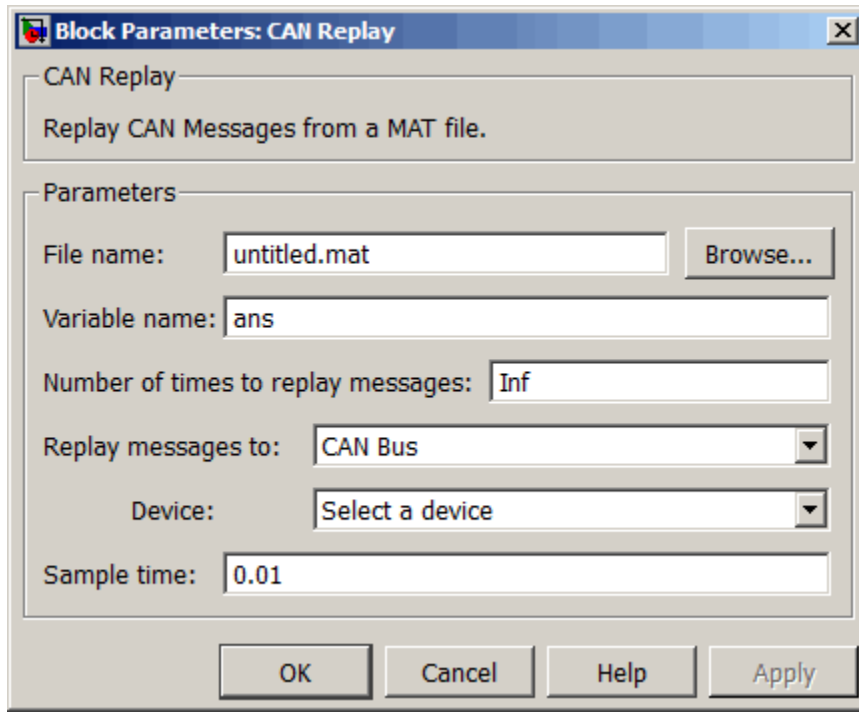
In this example, `gcs` is the current model that you wish to build. Building the model creates a zip file with the same name as model name. You can move this zip file to

another machine and the source code in the zip file can be built to create an executable which can be run independent of MATLAB and Simulink. The generated code compiles with both C and C++ compilers. For more information on `packNGo`, see "packNGo".

Dialog Box

Use the Source Block Parameters dialog box to select your message replay options.

Tip Configure your CAN Configuration block before you configure the CAN Receive block parameters.



File name

Specify the name and path of the file that contains logged CAN messages that you can replay. You can click **Browse** to browse to a file location and select the file.

Variable name

Specify the variable saved in the MAT-file that holds the CAN message information.

Number of times to replay messages

Specify the number of times you want the message replayed in your model. You can specify any positive integer, including `Inf`. Specifying `Inf` continuously replays messages until simulation stops.

Replay messages to

Specify if the model is replaying messages to the CAN network or an output port. Select a device to replay to the CAN network.

Device

Select the device on the CAN network to replay messages to. This filed is unavailable if you select `Input port` for **Replay message to** option.

Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the CAN Replay block runs during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is 0.01 (in seconds).

See Also

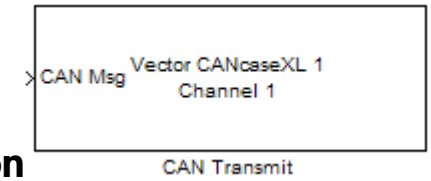
CAN Log

CAN Transmit

Transmit CAN message to selected CAN device

Library

Vehicle Network Toolbox: CAN Communication



Description

The CAN Transmit block transmits messages to the CAN network using the specified CAN device. The CAN Transmit block can transmit a single message or an array of messages during a given timestep. To transmit an array of messages, use a mux (multiplex) block from the Simulink block library.

Note: You need a license for both Vehicle Network Toolbox and Simulink software to use this block.

The CAN Transmit block has one input port. This port accepts a CAN message packed using the CAN Pack block. It has no output ports.

Note: You cannot have more than one Transmit block in a model using the same NI-XNET device channel.

Other Supported Feature

The CAN Transmit block supports the use of Simulink Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The CAN Transmit block supports the use of code generation along with the packNGo function to group required source code and dependent shared libraries. For more information, see Code Generation.

Code Generation

Vehicle Network Toolbox Simulink blocks allow you to generate code, enabling models containing these blocks to run successfully in Accelerator, Rapid Accelerator, External, and Deployed modes.

Code Generation with the Simulink Coder

You can use Vehicle Network Toolbox, Simulink Coder, and Embedded Coderproducts together to generate code (on the host end) that you can use to implement your model for a practical application. For more information on code generation, see “Program Builds”.

Shared Library Dependencies

The block generates code with limited portability. The block uses precompiled shared libraries, such as DLLs, to support I/O for specific types of devices. With this block, you can use the `packNGo` function supported by the Simulink Coder, to set up and manage the build information for your models. The `packNGo` function allows you to package model code and dependent shared libraries into a zip file for deployment. You do not need MATLAB installed on the target system, but the target system needs to be supported by MATLAB.

To set up `packNGo`:

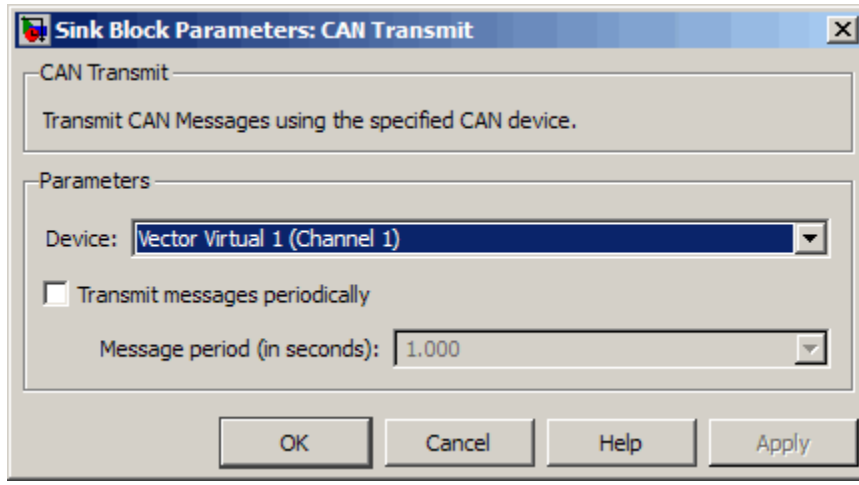
```
set_param(gcs, 'PostCodeGenCommand', 'packNGo(buildInfo)');
```

In this example, `gcs` is the current model that you wish to build. Building the model creates a zip file with the same name as model name. You can move this zip file to another machine and the source code in the zip file can be built to create an executable which can be run independent of MATLAB and Simulink. The generated code compiles with both C and C++ compilers. For more information on `packNGo`, see “packNGo”.

Dialog Box

Use the Sink Block Parameters dialog box to select your CAN Transmit block parameters.

Tip Configure your CAN Configuration block before you configure the CAN Transmit block parameters.



Device

Select the CAN device and a channel on the device to use to transmit CAN messages to the network. This list shows all the devices installed on the system. It displays the vendor name, the device name, and the channel ID. The default is the first available device on your system.

Transmit messages periodically

Select this option to enable periodic transmit of the message on the configured channel to transmit at the specified period.

Message period (in seconds)

Specify a period in seconds. This value is used to transmit the message in the specified period. By default this value is `1.000` seconds.

See Also

CAN Configuration, CAN Pack

CAN Unpack

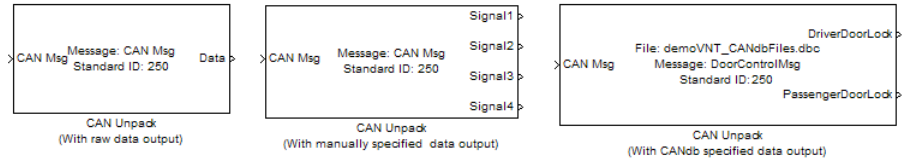
Unpack individual signals from CAN messages

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.

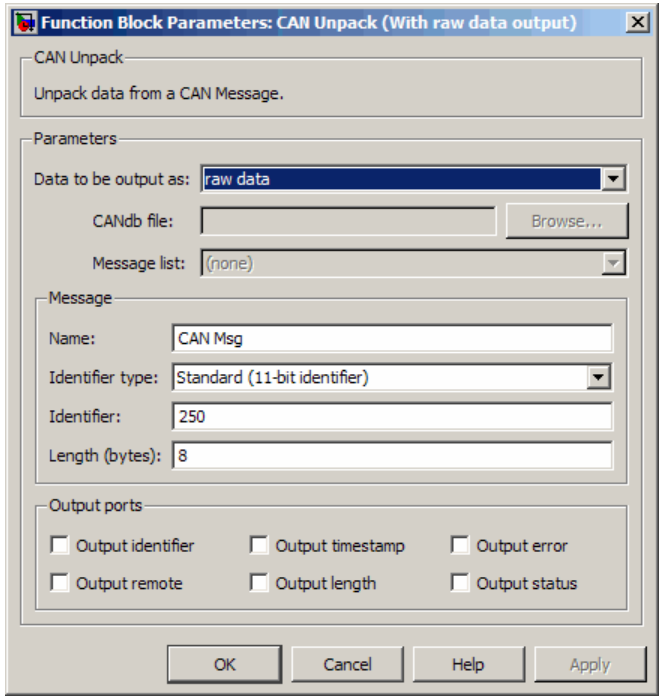
- The use of model referencing. Using this feature, your model can include other Simulink models as modular components.
- Code generation using Simulink Coder to deploy models to targets.

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.

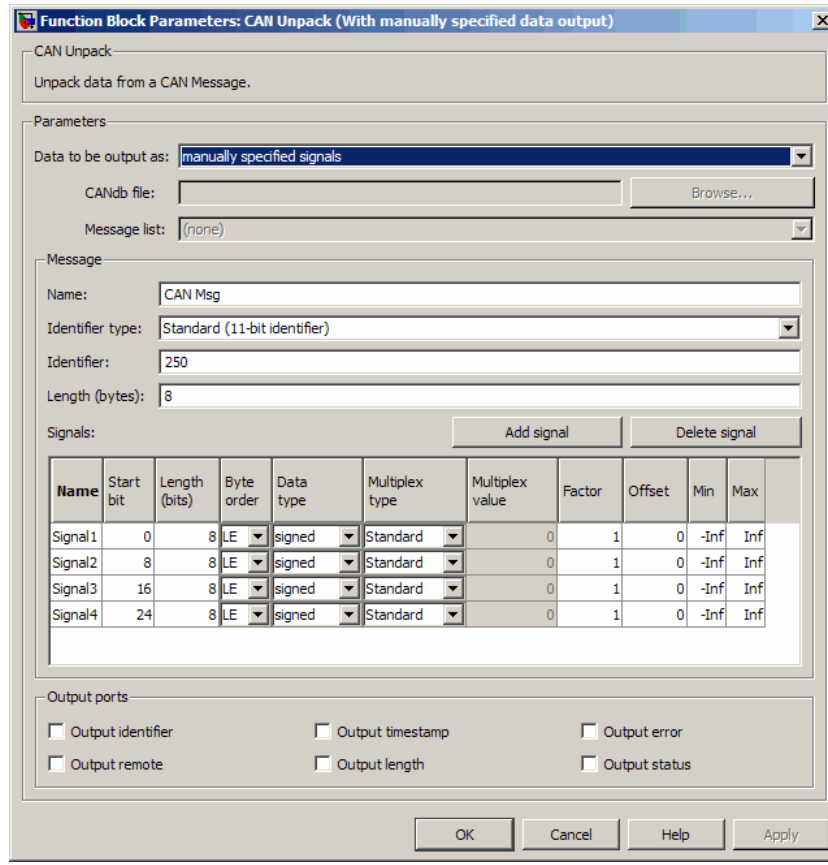


Parameters

Data to be output as

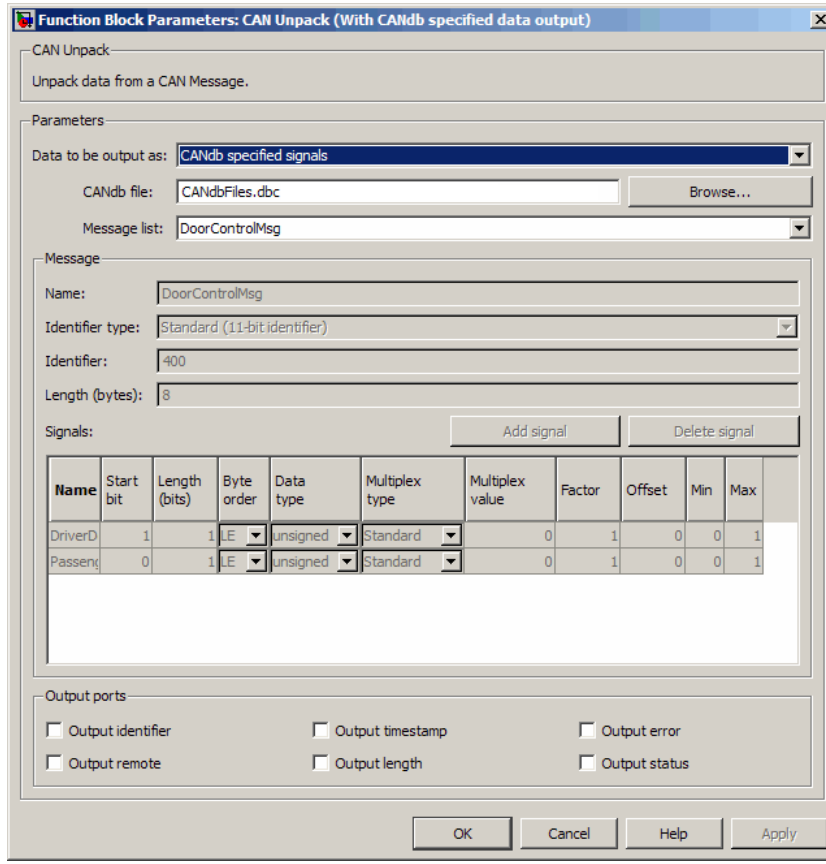
Select your data signal:

- **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.



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.



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 a 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.

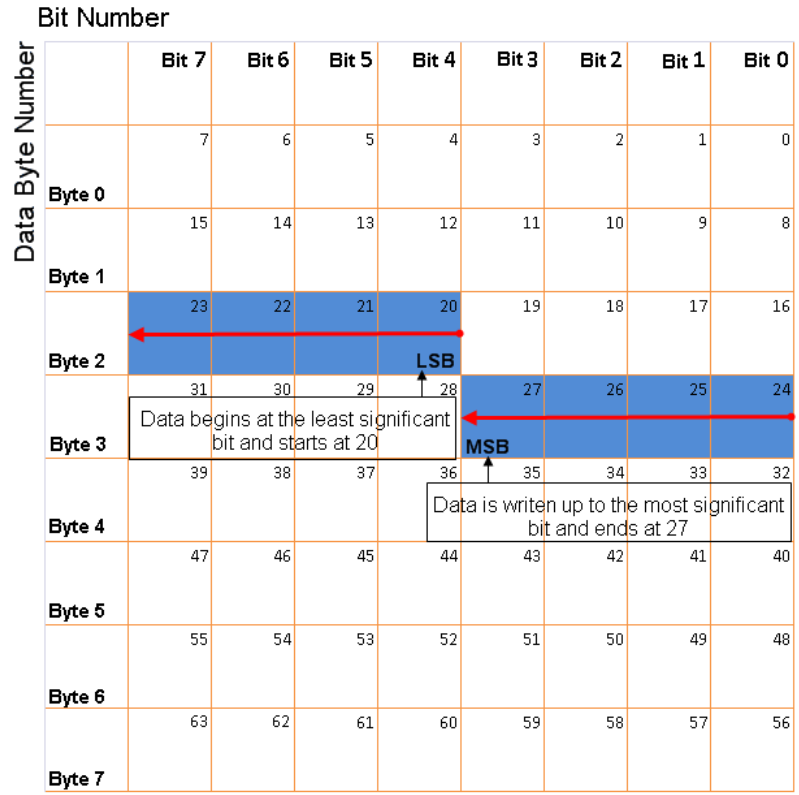
Length (bits)

Specify the number of bits the signal occupies in the message. The length must be an integer from 1 through 64.

Byte order

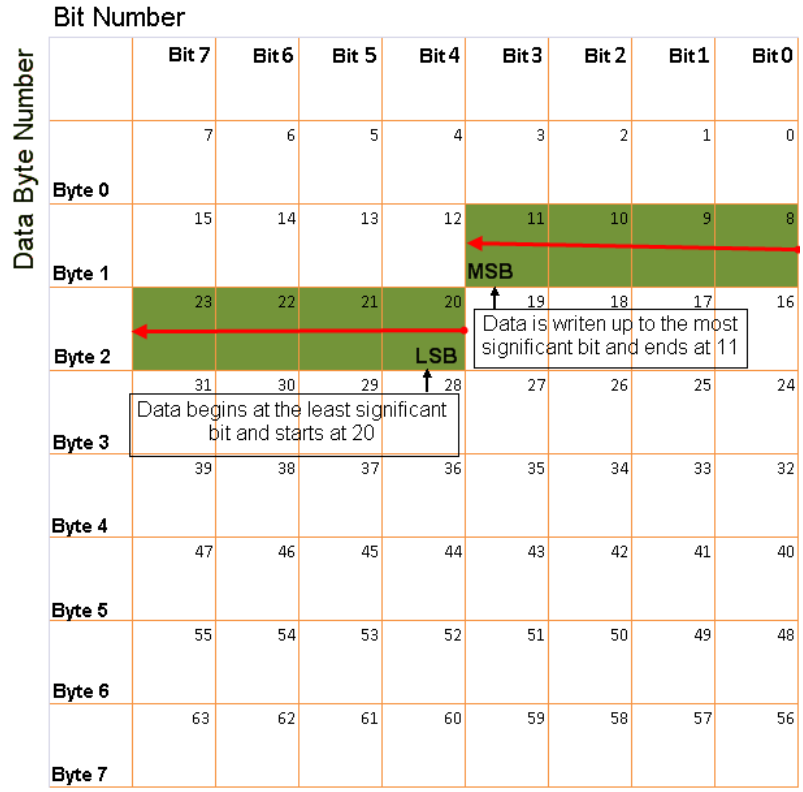
Select either of the following options:

- `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.



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.



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 14-43 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 14-43 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 14-43 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 14-43 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

```
physical_value = raw_value *   Factor + 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

XCP Configuration

Configure XCP slave connection

Library

XCP Communication

Description

The XCP Configuration block uses the parameters specified in the A2L file and the ASAP2 database to establish XCP slave connection.

Specify the A2L file to use in your XCP Configuration before you acquire or stimulate data. Use one XCP Configuration to configure one slave for data acquisition or stimulation. If you add Data Acquisition and Data Stimulation blocks, your model checks to see if there is a corresponding XCP Configuration block and will prompt you to add one.

Other Supported Features

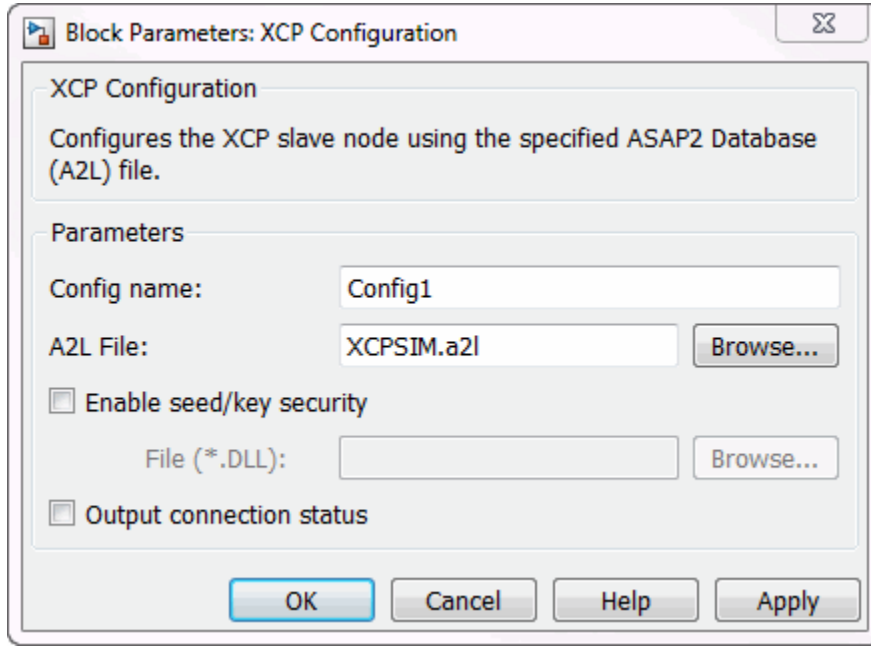
The XCP Configuration block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The XCP Configuration block also supports code generation with limited deployment capabilities. Code generation requires the Microsoft C++ compiler.

Dialog Box

Use the Block Parameters dialog box to select your XCP configuration.



Config name

Specify a unique name for your XCP session.

A2L File

Click **Browse** to select an A2L file for your XCP session.

Enable seed/key security

Select this option if your slave requires a secure key to establish connection. You need to select a file that contains the seed/key definition to enable the security.

File (*.DLL)

This field is enabled if you select **Enable seed/key security**. Click **Browse** to select the file that contains seed and key security algorithm used to unlock an XCP slave module.

Output connection status

Select this option to display the status of the connection to the slave module. Selecting this option adds a new output port.

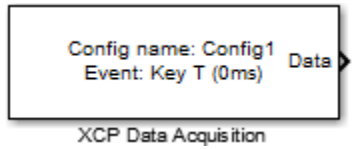
XCP Data Acquisition

Acquire selected measurements from configured slave

Library

XCP Communication

Description



The XCP Data Acquisition block acquires data from the configured slave based on the selected measurements. The block uses the XCP CAN transport layer to obtain raw data for the selected measurements at the specified simulation time step. Configure your XCP connection and use the XCP Data Acquisition block to select your event and measurements for the configured slave. The block displays the selected measurements as output ports.

Other Supported Features

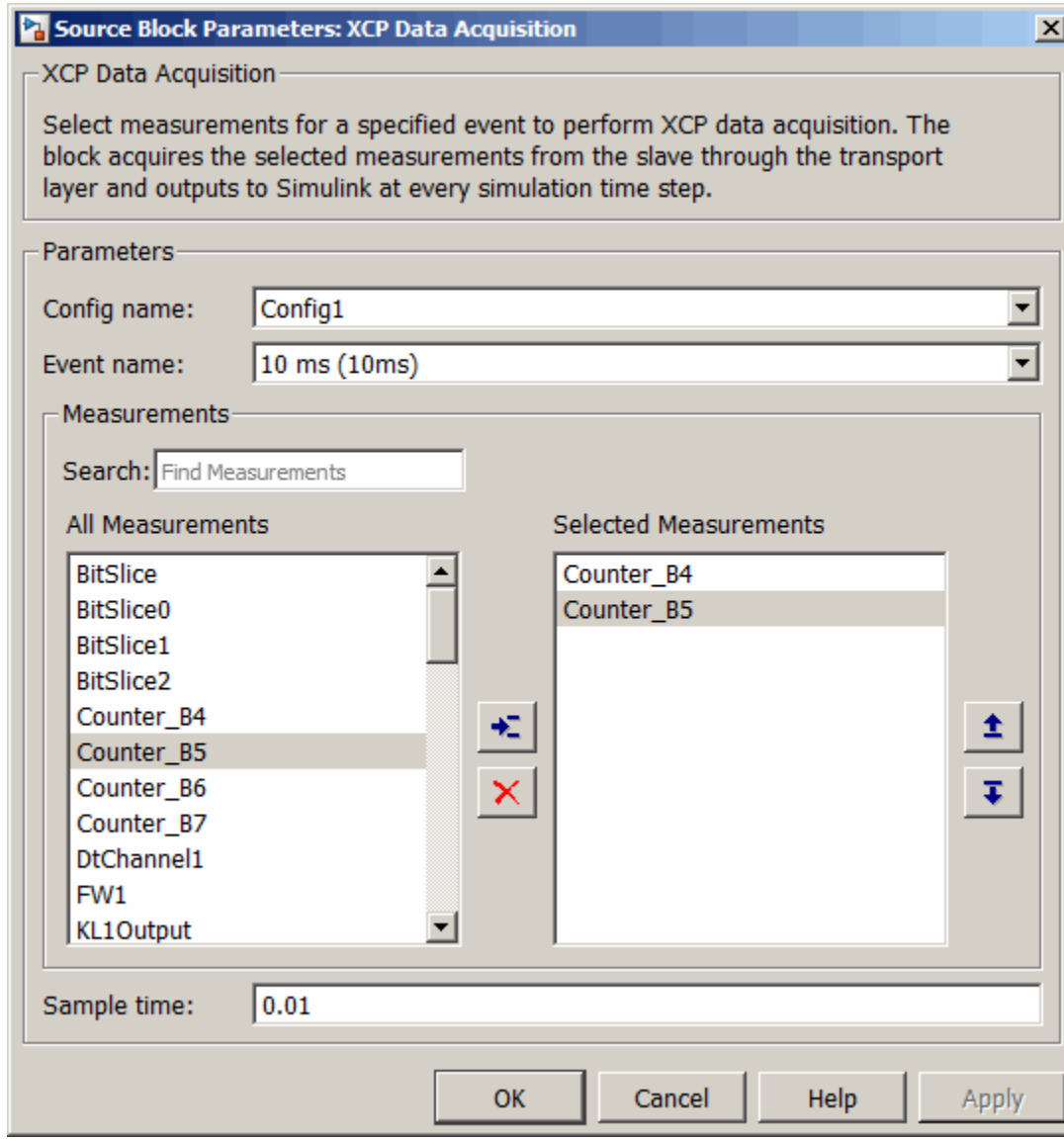
The XCP Data Acquisition block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The XCP Configuration block also supports code generation with limited deployment capabilities. Code generation requires the Microsoft C++ compiler.

Dialog Box

Use the Block Parameters dialog box to select your data acquisition parameters.


Source Block Parameters: XCP Data Acquisition
XCP Data Acquisition
Select measurements for a specified event to perform XCP data acquisition. The block acquires the selected measurements from the slave through the transport layer and outputs to Simulink at every simulation time step.
Parameters
Config name:
Config1
Event name:
10 ms (10ms)
Measurements
Search:
Find Measurements
All Measurements
Selected Measurements
BitSlice
BitSlice0
BitSlice1
BitSlice2
Counter_B4
Counter_B5
Counter_B6
Counter_B7
DtChannel1
FW1
KL1Output
Counter_B4
Counter_B5
Sample time:
0.01
OK
Cancel
Help
Apply

Parameters

Config name

Select the name of XCP configuration you want to use. The list displays all available names specified in the available XCP Configuration blocks in the model. Selecting a configuration displays events and measurements available in this configuration's A2L file.

Note: You can acquire measurements for only one event using an XCP Data Acquisition block. Use one block each for each event whose measurements you want to acquire.

Event name

Select an event from the available list of events. The XCP Configuration block uses the specified A2L file to populate the events list.

Measurements

Search

Type the name of the measurement you want to use. The All Measurements lists displays a list of all matching terms. Click the x

to clear your search.

All Measurements

This list displays all measurements available for the selected event. Select the measurement you want to use and click the add button,  to add it to the selected measurements. Hold the `Ctrl` key on your keyboard to select multiple measurements.

Selected Measurements

This list displays selected measurements. To remove a measurement from this list, select the measurement and click the remove button,  .

Toggle buttons

Use the toggle buttons  to reorder the selected measurements.

Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the XCP Data Acquisition block runs during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is 0.01 (in seconds).

See Also

XCP Configuration

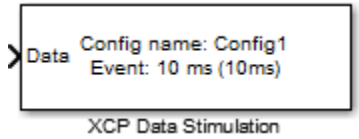
XCP Data Stimulation

Perform data stimulation on selected measurements

Library

XCP Communication

Description



The XCP Data Stimulation block sends data to the selected slave for the selected event measurements. The block uses the XCP CAN transport layer to output raw data for the selected measurements at the specified stimulation time step. Configure your XCP session and use the XCP Data Stimulation block to select your event and measurements on the configured slave. The block displays the selected measurements as input ports.

Other Supported Features

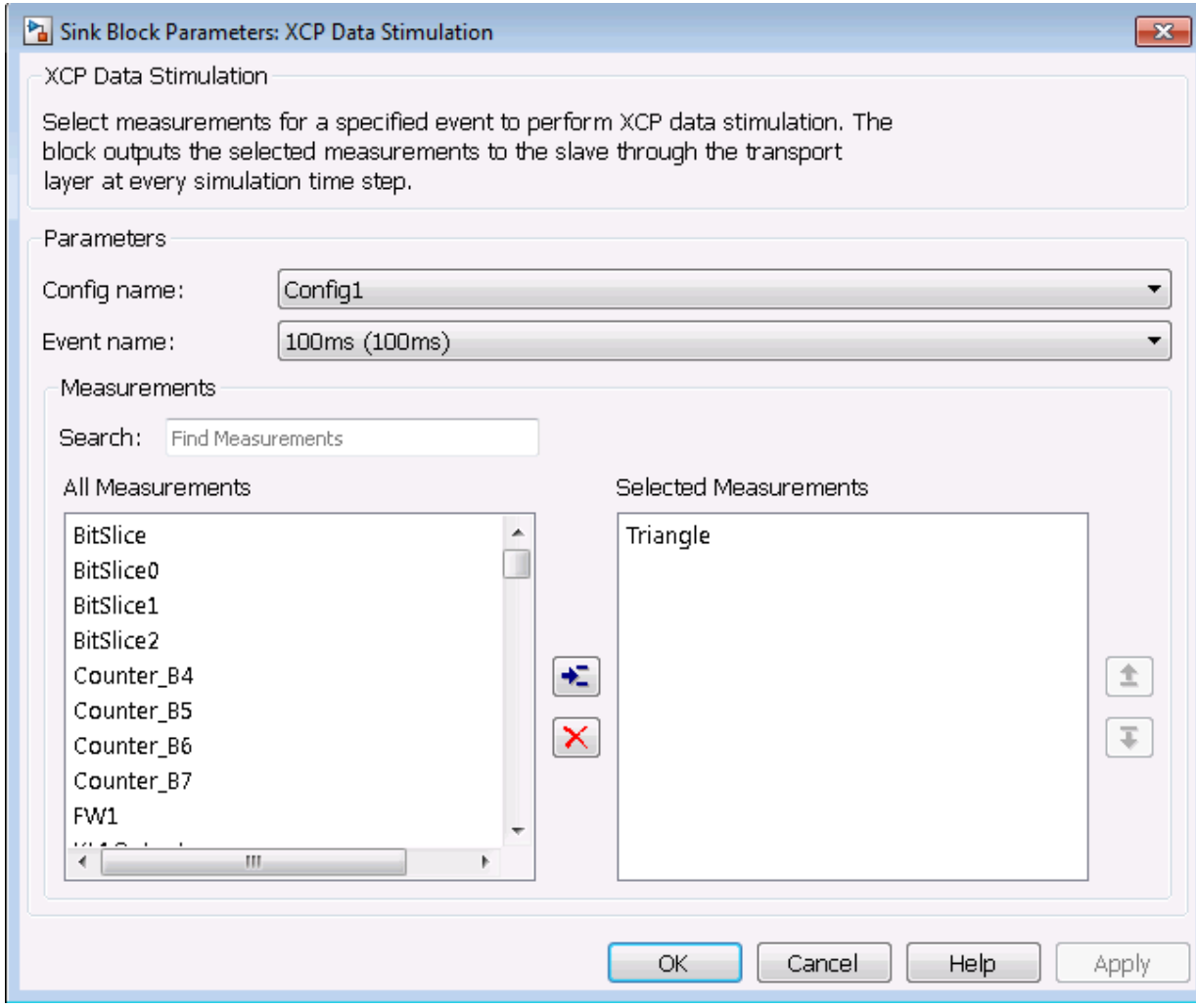
The XCP Data Stimulation block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

The XCP Configuration block also supports code generation with limited deployment capabilities. Code generation requires the Microsoft C++ compiler.

Dialog Box

Use the Block Parameters dialog box to select your data stimulation parameters.



Parameters

Config name

Select the name of XCP configuration you want to use. The list displays all available names specified in the available XCP Configuration blocks in the model. Selecting

a configuration displays events and measurements available in this configuration's A2L file.

Note: You can stimulate measurements for only one event using an XCP Data Stimulation block. Use one block each for each event whose measurements you want to stimulate.

Event name

Select an event from the available list of events. The XCP Configuration block uses the specified A2L file to populate the events list.

Measurements

Search

Type the name of the measurement you want to use. The All Measurements lists displays a list of all matching terms. Click the x

to clear your search.

All Measurements

This list displays all measurements available for the selected event. Select the measurement you want to use and click the add button,  to move it to the selected measurements. Hold the `Ctrl` key on your keyboard to select multiple measurements.

Selected Measurements

This list displays selected measurements. To remove a measurement from this list, select the measurement and click the remove button,  .

Toggle buttons

Use the toggle buttons  to reorder the selected measurements.

XCP CAN Transport Layer

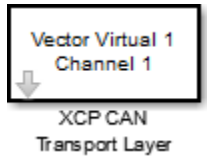
Transport XCP messages via CAN

Library

Vehicle Network Toolbox: CAN Communication

Vehicle Network Toolbox: XCP Communication

Description



The XCP CAN Transport Layer subsystem uses the specified device to transport and receive XCP messages.

Use this block with an XCP Data Acquisition block to acquire and analyze specific XCP messages. Use this block with an XCP Data Stimulation block to send specific information to modules.

Other Supported Features

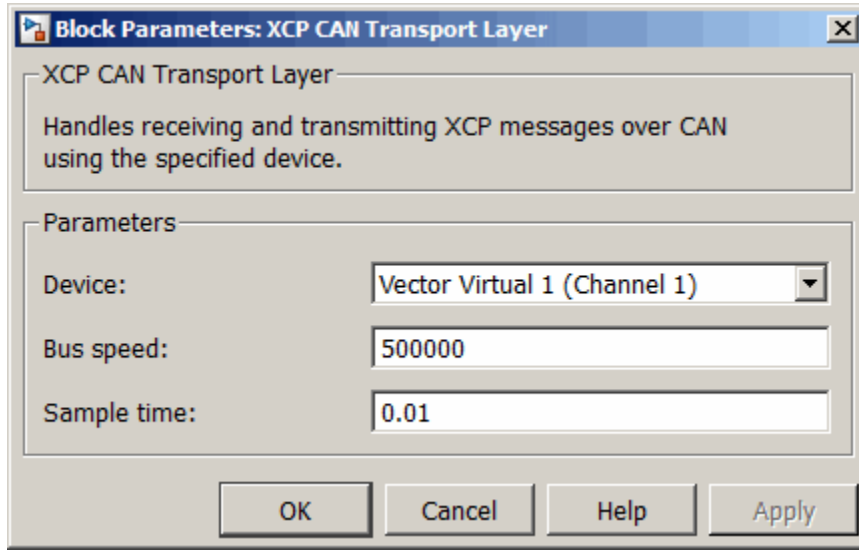
The XCP CAN Transport Layer block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

The XCP Configuration block also supports code generation with limited deployment capabilities. Code generation requires the Microsoft C++ compiler.

For more information on this feature, see the Simulink documentation.

Dialog Box

Use the Block Parameters dialog box to select your CAN Transport configuration.



Device

+

Select a CAN device from the list of devices available to your system.

Bus speed

Set the `bus speed` property for the selected device. The default bus speed is the default assigned by the selected device.

Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the XCP CAN Transport Layer subsystem and the underlying blocks run during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is 0.01 (in seconds).

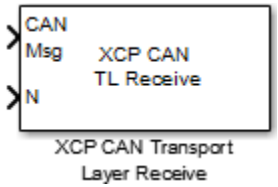
See Also

XCP Data Stimulation | XCP Configuration | XCP Data Acquisition

XCP CAN TL Receive

Receive XCP messages via CAN device

Description



The XCP CAN Transport Layer Receive block receives XCP messages from a CAN Receive block.

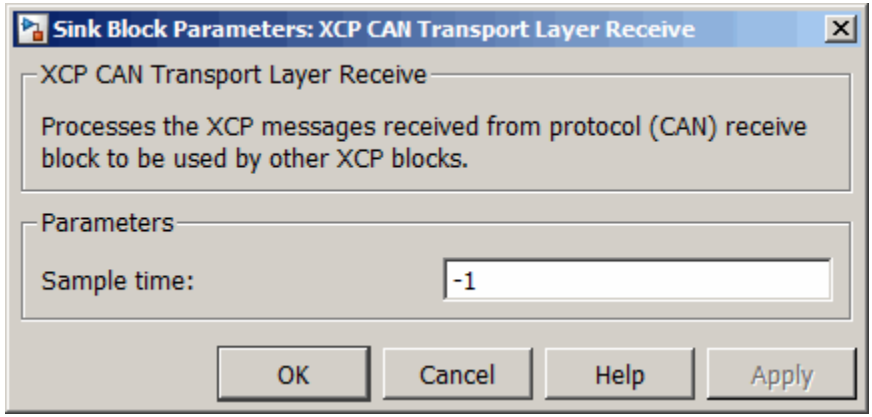
Other Supported Features

The XCP CAN TL Receive block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

Dialog Box

Use the Block Parameters dialog box to select your XCP CAN Transport Layer Receive block parameters.



Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the XCP CAN Transport Layer Receive block runs during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is –1 (in seconds).

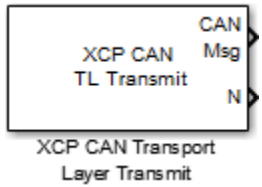
See Also

XCP CAN TL Transmit

XCP CAN TL Transmit

Transmit queued XCP Messages

Description



The XCP CAN Transport Layer Transmit block connects to a CAN Transmit block to transmit queued XCP messages.

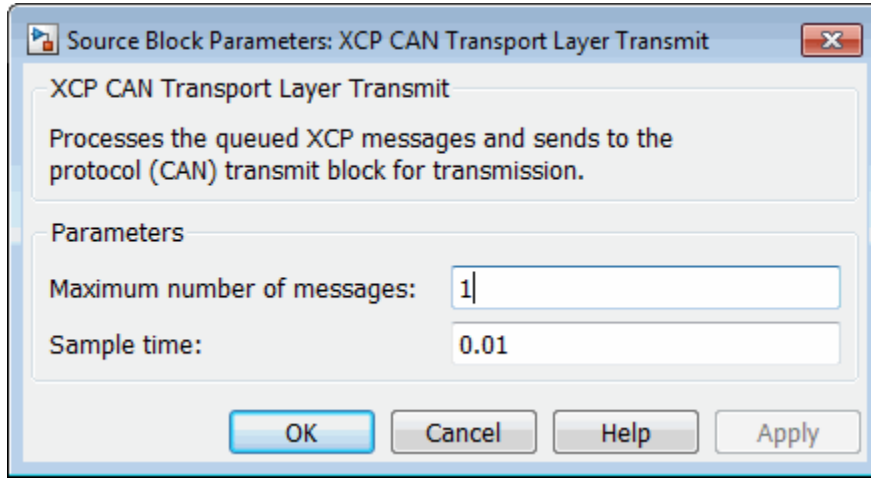
Other Supported Features

The XCP CAN TL Transmit block supports the use of Simulink Accelerator and Rapid Accelerator mode. Using this feature, you can speed up the execution of Simulink models.

For more information on this feature, see the Simulink documentation.

Dialog Box

Use the Block Parameters dialog box to select your XCP CAN Transport Layer Transmit block parameters.



Maximum number of messages

Enter the maximum number of messages the block can transmit. Value must be a positive integer.

Sample time

Specify the sampling time of the block during simulation, which is the simulation time as described by the Simulink documentation. This value defines the frequency at which the XCP CAN Transport Layer block runs during simulation. If the block is inside a triggered subsystem or to inherit sample time, you can specify –1 as your sample time. You can also specify a MATLAB variable for sample time. The default value is 0.01 (in seconds).

See Also

XCP CAN TL Receive