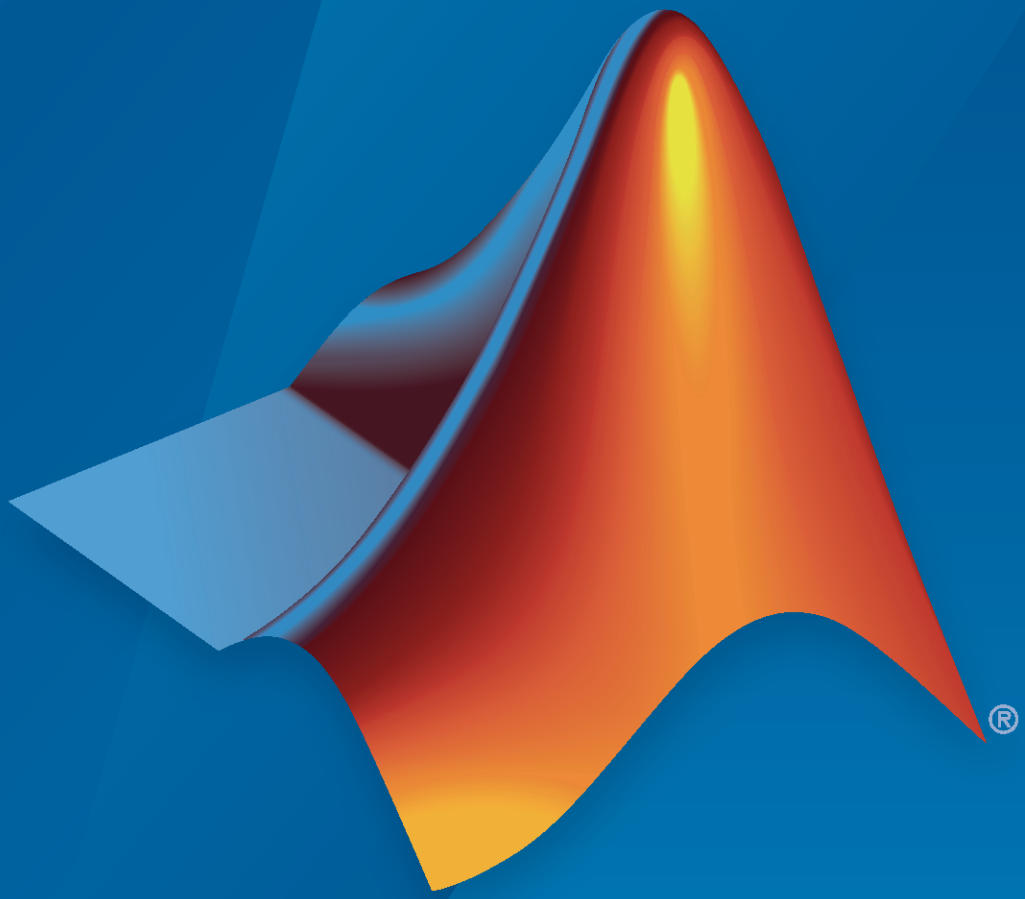
Simulink®

MathWorks® Advisory Board Control Algorithm Modeling Guidelines



MATLAB® & SIMULINK®

R2022a

MathWorks®

How to Contact MathWorks

Latest news: `www.mathworks.com`

Sales and services: `www.mathworks.com/sales_and_services`

User community: `www.mathworks.com/matlabcentral`

Technical support: `www.mathworks.com/support/contact_us`

Phone: 508-647-7000

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

MathWorks® Advisory Board Modeling Guidelines

© COPYRIGHT 2007–2022 by The MathWorks, Inc.

The software described in this document is furnished under a license agreement. The software may be used or copied only under the terms of the license agreement. No part of this manual may be photocopied or reproduced in any form without prior written consent from The MathWorks, Inc.

FEDERAL ACQUISITION: This provision applies to all acquisitions of the Program and Documentation by, for, or through the federal government of the United States. By accepting delivery of the Program or Documentation, the government hereby agrees that this software or documentation qualifies as commercial computer software or commercial computer software documentation as such terms are used or defined in FAR 12.212, DFARS Part 227.72, and DFARS 252.227-7014. Accordingly, the terms and conditions of this Agreement and only those rights specified in this Agreement, shall pertain to and govern the use, modification, reproduction, release, performance, display, and disclosure of the Program and Documentation by the federal government (or other entity acquiring for or through the federal government) and shall supersede any conflicting contractual terms or conditions. If this License fails to meet the government's needs or is inconsistent in any respect with federal procurement law, the government agrees to return the Program and Documentation, unused, to The MathWorks, Inc.

Trademarks

MATLAB and Simulink are registered trademarks of The MathWorks, Inc. See `www.mathworks.com/trademarks` for a list of additional trademarks. Other product or brand names may be trademarks or registered trademarks of their respective holders.

Patents

MathWorks products are protected by one or more U.S. patents. Please see `www.mathworks.com/patents` for more information.

Revision History

March 2009	Online only	New for Version 2.0 (Release 2009a)
September 2009	Online only	Revised for Version 2.1 (Release 2009b)
March 2010	Online only	Rereleased for Version 2.1 (Release 2010a)
September 2010	Online only	Rereleased for Version 2.1 (Release 2010b)
April 2011	Online only	Rereleased for Version 2.1 (Release 2011a)
September 2011	Online only	Rereleased for Version 2.1 (Release 2011b)
March 2012	Online only	Rereleased for Version 2.2 (Release 2012a)
September 2012	Online only	Rereleased for Version 2.2 (Release 2012b)
March 2013	Online only	Revised for Version 3.0 (Release 2013a)
September 2013	Online only	Rereleased for Version 3.0 (Release 2013b)
March 2014	Online only	Revised for Version 3.1 (Release 2014a)
October 2014	Online only	Rereleased for Version 3.1 (Release 2014b)
March 2015	Online only	Rereleased for Version 3.1 (Release 2015a)
September 2015	Online only	Rereleased for Version 3.1 (Release 2015b)
March 2016	Online only	Rereleased for Version 3.1 (Release 2016a)
September 2016	Online only	Rereleased for Version 3.1 (Release 2016b)
March 2017	Online only	Rereleased for Version 3.1 (Release 2017a)
September 2017	Online only	Rereleased for Version 3.1 (Release 2017b)
March 2018	Online only	Rereleased for Version 3.1 (Release 2018a)
September 2018	Online only	Rereleased for Version 3.1 (Release 2018b)
March 2019	Online only	Rereleased for Version 3.1 (Release 2019a)
September 2019	Online only	Rereleased for Version 3.2 (Release 2019b)
March 2020	Online only	MAAB guidelines revised and reintroduced as the MathWorks Advisory Board (MAB) Modeling Guidelines, Version 5.0 (Release 2020a)
September 2020	Online only	Rereleased for Version 5.0 (Release 2020b)
March 2021	Online only	Rereleased for Version 5.0 (Release 2021a)
September 2021	Online only	Rereleased for Version 5.0 (Release 2021b)
March 2022	Online only	Revised for Version 5.0 (Release 2022a)

Contents

1 Introduction

Purpose of the Guidelines and Template **1-2**

Model Advisor Checks for MAB Guidelines **1-6**
Modeling Guidelines and Model Advisor Checks for MAB and JMAAB **1-6**

2 Naming Conventions

General Conventions **2-2**

Content Conventions **2-11**

3 Simulink

Configuration Parameters **3-2**

Diagram Appearance **3-11**

Signal **3-63**

Conditional Subsystem Relations **3-98**

Operation Blocks **3-120**

Other Blocks **3-170**

4 Stateflow

Stateflow Blocks / Data / Events **4-2**

Stateflow Diagram **4-27**

Conditional Transition / Action **4-80**

Label Description **4-141**

Miscellaneous **4-167**

5 MATLAB

MATLAB Appearance **5-2**

MATLAB Data and Operations **5-6**

MATLAB Usage **5-13**

6 Considerations

Considerations for Determining Guideline Operation Rules **6-2**
Process Definition and Development Environment **6-2**
MATLAB and Simulink Versions **6-2**
MATLAB and Simulink Settings **6-2**
Usable Blocks **6-3**
Using Optimization and Configuration Parameters **6-3**

Considerations for Applying Guidelines to a Project **6-5**
Using the Model Analysis Process When Applying Guidelines **6-5**
Adoption of the Guideline Rule and Process Settings **6-5**
Setting the Guideline Rule Application Field and the Clarifying the Exclusion Condition **6-5**
Parameter Recommendations in the Guidelines **6-6**
Verifying Adherence to the Guidelines **6-6**
Modifying Adherence to the Guidelines **6-6**

A Using Simulink and Stateflow

Understanding Model Architecture **A-2**
Hierarchical Structure of a Controller Model **A-2**
Relationship between Simulink Models and Embedded Implementation . . **A-9**

Using Simulink and Stateflow in Modeling **A-16**
Simulink Functionality **A-17**
Stateflow Functionality **A-24**
Initialization **A-31**

B

Usage Patterns **B-2**
Simulink Patterns for If, elseif, else Constructs **B-2**
Simulink Patterns for case Constructs **B-2**
Simulink Patterns for Logical Constructs **B-3**
Simulink Patterns for Vector Signals **B-4**
Using Switch and If, Elseif, Else Action Subsystems **B-6**
Use of If, Elseif, Else Action Subsystem to Replace Multiple Switches **B-8**
Usage Rules for Action Subsystems Using Conditional Control Flow **B-13**
Test for Information From Errors **B-17**
Flow Chart Patterns for Conditions **B-18**
Flow Chart Patterns for Condition Actions **B-19**
Flow Chart Patterns for If, Elseif, Else Constructs **B-20**
Flow Chart Patterns for Case Constructs **B-21**
Flow Chart Patterns for Loop Constructs **B-23**
State Machine Patterns for Conditions **B-24**
State Machine Patterns for Transition Actions **B-24**
jc_0321Limiting State Layering **B-25**
Number of States per Stateflow Container **B-26**
Function Call from Stateflow **B-26**
Function Types Available in Stateflow **B-27**

C

Introduction

- “Purpose of the Guidelines and Template” on page 1-2
- “Model Advisor Checks for MAB Guidelines” on page 1-6

Purpose of the Guidelines and Template

MathWorks Advisory Board (MAB) guidelines stipulate important basic rules for modeling in Simulink and Stateflow. The overall purpose of these modeling guidelines is to allow for a simple, common understanding by modelers and consumers of control system models.

The main objectives of these guidelines are:

- Readability
  - Improve graphical understandability
  - Improve readability of functional analysis
  - Prevent connection mistakes
  - Comments, etc.
- Simulation and verification
  - Mechanism to enable simulation
  - Testability
- Code Generation
  - Improve the efficiency of code generation (ROM, RAM efficiency)
  - Ensure the robustness of generated code

Note Model runtime errors and recommendations that cannot be implemented are outside of the scope of these rules.

Guidelines are documented by using a standard template. Use of this template is recommended when creating original guidelines.

Note This template specifies the minimum requirements that are needed to understand a guideline. New items can be added to the template as long as they do not duplicate existing information.

Section Heading	Format	Section Description
Rule ID: Title	*XX_nnnn*: Title of the guideline (unique, short)	A rule ID, which is used to identify the guideline, consists of two lower case letters and a four-digit number. The letter and number combination is separated by an underscore. For example, **xx_nnnn.**A rule ID is permanent and will not change. **Note** The two-letters in the rule ID identify the guideline author.

Section Heading	Format	Section Description
Sub ID Recommendations	NA-MAAB: x, y, z JMAAB: x, y, z	Specifies guideline sub IDs that are recommended for use by the NA-MAAB (North American MathWorks Automotive Advisory Board) and JMAAB (Japan MathWorks Automotive Advisory Board) modeling standards organizations. Each organization is a region-specific consortium of automotive OEMs and suppliers; NA-MAAB represents North America and Europe. JMAAB represents Japan.
MATLAB Versions	All RX, RY, RZ RX and earlier RX and later RX through RY	MAB guidelines support all versions of MATLAB and Simulink products. When a rule applies only to a specific version(s), the version is identified in the MATLAB Version field by using one of these formats: • All — All versions of MATLAB • RX, RY, RZ — A specific version of MATLAB • RX and earlier — Versions of MATLAB until version RX • RX and later — Versions of MATLAB from version RX to the current version • RX through RY — Versions of MATLAB between RX and RY

Section Heading	Format	Section Description
Rule > Sub ID	Specifies the condition(s) of the rule by using Sub IDs. There can be multiple sub IDs per rule ID. The subsections for a Sub ID include: • **Custom Parameter** • (Optional) **Exclusion** • (Optional) **Example**	Specifies the condition(s) of the rule. Sub IDs are designated as either: • Selectable — Consist of one lower-case letter (alphabetical order). The choice of whether to adopt a selectable sub ID is left to the user. • Mutually Exclusive — Consist of one lower case letter (alphabetical order) and a single-digit number. When choosing to accept or reject a mutually exclusive sub ID, only one option can be selected. For example, Sub IDs for guideline xy_0000 are: • xy_0000a — Represents a selectable (user's choice) option • xy_0000b1 xy_0000b2 — Mutually Exclusive (if using, choose from xy_0000b1 or xy_0000b2) For rules that include custom parameters, the chosen value is specific for the project with regard to the item being described. Example of objects and values are provided in the description field. However, a project's processes, condition of the control target, and skill levels of the engineers should be comprehensively evaluated when specifying a custom parameter.

Section Heading	Format	Section Description
Rationale	Motivation for the Sub IDs	Provides reasoning for the use of the guideline with regard to readability, verification efficiency, efficiency of code after code generation, etc.
Verification	Verification methods	Method(s) that verify compliance of the model with guideline conditions, such as: • Model Advisor check • Manual verification method
Last Change	R<year>	MATLAB revision in which the content of the guideline was last updated. For example, R2020a.
See Also	References	Additional information that can be helpful to better understand the guideline.

Model Advisor Checks for MAB Guidelines

For information on using the Model Advisor, see “Run Model Advisor Checks”.

Modeling Guidelines and Model Advisor Checks for MAB and JMAAB

This table identifies MathWorks Advisor Board (MAB) guidelines, the corresponding Japan MathWorks Automotive Advisor Board (JMAAB) guidelines, and Model Advisor check that you can use to verify compliance with these guidelines. Additional information in the tables includes:

- **MAB Modeling Guideline** — Links to the MathWorks Advisory Board (MAB) guideline.
- **Corresponding JMAAB Modeling Guideline** — Identifies the JMAAB modelling guideline that corresponds to the MAB guideline. To review the guideline, see *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- **Model Advisor Check** — Provides links to the Model Advisor check that is used to verify compliance to the modeling guideline.

  When applicable, this column clarifies why a guideline does not have a corresponding check:

  - *No check* — Indicates that the guideline can be checked by using a Model Advisor check, however, the check does not currently exist.
  - *Not checkable* — Indicates that it is not possible to verify compliance to this guideline by using a Model Advisor check.

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
ar_0001: Usable characters for file names	ar_0001	“Check file names” (Simulink Check)
ar_0002: Usable characters for folder names	ar_0002	“Check folder names” (Simulink Check)
jc_0241: Length restriction for model file names	jc_0241	“Check length of model file name” (Simulink Check)
jc_0242: Length restriction for folder names	jc_0242	“Check length of folder name at every level of model path” (Simulink Check)
jc_0201: Usable characters for subsystem names	jc_0201	“Check Subsystem names” (Simulink Check)
jc_0231: Usable characters for block names	jc_0231	“Check character usage in block names” (Simulink Check)
jc_0211: Usable characters for Inport blocks and Outport block	jc_0211	“Check port block names” (Simulink Check)
jc_0243: Length restriction for subsystem names	jc_0243	“Check length of subsystem names” (Simulink Check)
jc_0247: Length restriction for block names	jc_0247	“Check length of block names” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
jc_0244: Length restriction for Inport and Outport names	jc_0244	“Check length of Inport and Outport names” (Simulink Check)
jc_0222: Usable characters for signal and bus names	jc_0222	“Check usable characters for signal names and bus names” (Simulink Check)
jc_0232: Usable characters for parameter names	jc_0232	“Check usable characters for parameter names” (Simulink Check)
jc_0245: Length restriction for signal and bus names	jc_0245	“Check length of signal and bus names” (Simulink Check)
jc_0246: Length restriction for parameter name	jc_0246	“Check length of parameter names” (Simulink Check)
jc_0795: Usable characters for Stateflow data names	jc_0795	“Check usable characters for Stateflow data names” (Simulink Check)
jc_0796: Length restriction for Stateflow data names	jc_0796	“Check length of Stateflow data name” (Simulink Check)
jc_0791: Duplicate data name definitions	jc_0791	“Check duplication of Simulink data names” (Simulink Check)
jc_0792: Unused Data	jc_0792	“Check unused data in Simulink Model” (Simulink Check)
jc_0700: Unused data in Stateflow block	jc_0700	“Check for unused data in Stateflow Charts” (Simulink Check)
na_0019: Restricted variable names	No corresponding JMAAB guideline	“Check usage of restricted variable names” (Simulink Check)
jc_0011: Optimization parameters for Boolean data types	jc_0011	“Check Implement logic signals as Boolean data (vs. double)” (Simulink Check)
jc_0642: Integer rounding mode setting	jc_0642	“Check Signed Integer Division Rounding mode” (Simulink Check)
jc_0806: Detecting incorrect calculation results	jc_0806	“Check diagnostic settings for incorrect calculation results” (Simulink Check)
jc_0021: Model diagnostic settings	No corresponding JMAAB guideline	“Check model diagnostic parameters” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
na_0004: Simulink model appearance settings	na_0004	“Check for Simulink diagrams using nonstandard display attributes” (Simulink Check)
db_0043: Model font and font size	db_0043	“Check Model font settings” (Simulink Check)
jm_0002: Block resizing	jm_0002	*No check*
db_0142: Position of block names	db_0142	“Check whether block names appear below blocks” (Simulink Check)
jc_0061: Display of block names	jc_0061	“Check the display attributes of block names” (Simulink Check)
db_0140: Display of block parameters	db_0140	“Check for nondefault block attributes” (Simulink Check)
jc_0603: Model description	jc_0603	“Check Model Description” (Simulink Check)
jc_0604: Using block shadow	jc_0604	“Check if blocks are shaded in the model” (Simulink Check)
db_0081: Unconnected signals and blocks	db_0081	“Check for unconnected signal lines and blocks” (Simulink Check)
db_0032: Signal line connections	db_0032	“Check signal line connections” (Simulink Check)
db_0141: Signal flow in Simulink models	db_0141	“Check signal flow in model Check position of signal labels” (Simulink Check)
jc_0110: Direction of block	jc_0110	“Check block orientation” (Simulink Check)
jc_0171: Clarification of connections between structural subsystems	jc_0171	“Check connections between structural subsystems” (Simulink Check)
jc_0602: Consistency in model element names	jc_0602	“Check for consistency in model element names” (Simulink Check)
jc_0281: Trigger signal names	jc_0281	“Check trigger signal names” (Simulink Check)
db_0143: Usable block types in model hierarchy	db_0143	“Check for mixing basic blocks and subsystems” (Simulink Check)
db_0144: Use of subsystems	db_0144	*Not checkable*

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
jc_0653: Delay block layout in feedback loops	jc_0653	“Check for avoiding algebraic loops between subsystems” (Simulink Check)
hd_0001: Prohibited Simulink sinks	No corresponding JMAAB guideline	“Check for prohibited sink blocks” (Simulink Check)
na_0010: Usage of vector and bus signals	na_0010	“Check usage of vector and bus signals” (Simulink Check)
jc_0008: Definition of signal names	jc_0008	“Check signal line labels” (Simulink Check)
jc_0009: Signal name propagation	jc_0009	“Check for propagated signal labels” (Simulink Check)
db_0097: Position of labels for signals and buses	db_0097	“Check signal flow in model Check position of signal labels” (Simulink Check)
na_0008: Display of labels on signals	No corresponding JMAAB guideline	“Check signal line labels” (Simulink Check)
na_0009: Entry versus propagation of signal labels	No corresponding JMAAB guideline	“Check for propagated signal labels” (Simulink Check)
db_0110: Block parameters	db_0110	“Check usage of tunable parameters in blocks” (Simulink Check)
db_0112: Usage of index	db_0112	“Check Indexing Mode” (Simulink Check)
jc_0645: Parameter definition for calibration	jc_0645	“Check if tunable block parameters are defined as named constants” (Simulink Check)
jc_0641: Sample time setting	jc_0641	“Check for sample time setting” (Simulink Check)
jc_0643: Fixed-point setting	jc_0643	“Check usage of fixed-point data type with non-zero bias” (Simulink Check)
jc_0644: Type setting	jc_0644	“Check type setting by data objects” (Simulink Check)
db_0146: Block layout in conditional subsystems	db_0146	“Check position of conditional blocks and iterator blocks” (Simulink Check)
jc_0640: Initial value settings for Outport blocks in conditional subsystems	jc_0640	“Check undefined initial output for conditional subsystems” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
jc_0659: Usage restrictions of signal lines input to Merge blocks	jc_0659	“Check usage of Merge block” (Simulink Check)
na_0003: Usage of If blocks	na_0003	“Check logical expressions in If blocks” (Simulink Check)
jc_0656: Usage of Conditional Control blocks	jc_0656	“Check default/else case in Switch Case blocks and If blocks” (Simulink Check)
jc_0657: Retention of output value based on conditional control flow blocks and Merge blocks	jc_0657	*Not checkable*
na_0002: Appropriate usage of basic logical and numerical operations	na_0002	“Check fundamental logical and numerical operations” (Simulink Check)
jc_0121: Usage of add and subtraction blocks	jc_0121	“Check usage of Sum blocks” (Simulink Check)
jc_0610: Operator order for multiplication and division block	jc_0610	“Check operator order of Product blocks” (Simulink Check)
jc_0611: Input sign for multiplication and division blocks	jc_0611	“Check signs of input signals in product blocks” (Simulink Check)
jc_0794: Division in Simulink	jc_0794	“Check for division by zero in Simulink” (Simulink Check)
jc_0805: Numerical operation block inputs	jc_0805	*No check*
jc_0622: Usage of Fcn blocks	jc_0622	“Check for parentheses in Fcn block expressions” (Simulink Check)
jc_0621: Usage of Logical Operator blocks	jc_0621	“Check icon shape of Logical Operator blocks” (Simulink Check)
jc_0131: Usage of Relational Operator blocks	jc_0131	“Check usage of Relational Operator blocks” (Simulink Check)
jc_0800: Comparing floating-point types in Simulink	jc_0800	“Comparing floating point types in Simulink” (Simulink Check)
jc_0626: Usage of Lookup Table blocks	jc_0626	“Check usage of Lookup Tables” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
jc_0623: Usage of continuous-time Delay blocks and discrete-time Delay blocks	jc_0623	“Check usage of Memory and Unit Delay blocks” (Simulink Check)
jc_0624: Usage of Tapped Delay blocks/Delay blocks	jc_0624	“Check for cascaded Unit Delay blocks” (Simulink Check)
jc_0627: Usage of Discrete-Time Integrator blocks	jc_0627	“Check usage of Discrete-Time Integrator block” (Simulink Check)
jc_0628: Usage of Saturation blocks	jc_0628	“Check usage of the Saturation blocks” (Simulink Check)
jc_0651: Implementing a type conversion	jc_0651	“Check output data type of operation blocks” (Simulink Check)
db_0042: Usage of Inport and Outport blocks	db_0042	“Check position of Inport and Outport blocks” (Simulink Check)
jc_0081: Inport and Outport block icon display	jc_0081	“Check display for port blocks” (Simulink Check)
na_0011: Scope of Goto and From blocks	na_0011	“Check scope of From and Goto blocks” (Simulink Check)
jc_0161: Definition of Data Store Memory blocks	jc_0161	“Check for usage of Data Store Memory blocks” (Simulink Check)
jc_0141: Usage of the Switch blocks	jc_0141	“Check usage of Switch blocks” (Simulink Check)
jc_0650: Block input/output data type with switching function	jc_0650	“Check input and output datatype for Switch blocks” (Simulink Check)
jc_0630: Usage of Multiport Switch blocks	jc_0630	“Check settings for data ports in Multiport Switch blocks” (Simulink Check)
na_0020: Number of inputs to variant subsystems	na_0020	“Check for missing ports in Variant Subsystems” (Simulink Check)
na_0036: Default variant	na_0036	“Check use of default variants” (Simulink Check)
na_0037: Use of single variable for variant condition	na_0037	“Check use of single variable variant conditionals” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
db_0123: Stateflow port names	No corresponding JMAAB guideline	“Check for names of Stateflow ports and associated signals” (Simulink Check)
db_0125: Stateflow local data	db_0125	“Check definition of Stateflow data” (Simulink Check)
db_0126: Defining Stateflow events	db_0126	“Check definition of Stateflow events” (Simulink Check)
jc_0701: Usable number for first index	jc_0701	“Check usable number for first index” (Simulink Check)
jc_0712: Execution timing for default transition path	jc_0712	“Check execution timing for default transition path” (Simulink Check)
jc_0722: Local data definition in parallel states	jc_0722	“Check scope of data in parallel states” (Simulink Check)
jc_0797: Unconnected transitions / states / connective junctions	jc_0797	“Check for unconnected objects in Stateflow Charts” (Simulink Check)
db_0137: States in state machines	db_0137	“Check for state in state machines” (Simulink Check)
jc_0721: Usage of parallel states	jc_0721	“Check usage of parallel states” (Simulink Check)
db_0129: Stateflow transition appearance	db_0129	“Check for Stateflow transition appearance” (Simulink Check)
jc_0531: Default transition	jc_0531	“Check default transition placement in Stateflow charts” (Simulink Check)
jc_0723: Prohibited direct transition from external state to child state	jc_0723	“Check usage of transitions to external states” (Simulink Check)
jc_0751: Backtracking prevention in state transition	jc_0751	“Check for unexpected backtracking in state transitions” (Simulink Check)
jc_0760: Starting point of internal transition	jc_0760	“Check starting point of internal transition in Stateflow” (Simulink Check)
jc_0763: Usage of multiple internal transitions	jc_0763	“Check usage of internal transitions in Stateflow states” (Simulink Check)
jc_0762: Prohibition of state action and flow chart combination	jc_0762	“Check prohibited combination of state action and flow chart” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
db_0132: Transitions in flow charts	db_0132	“Check transitions in Stateflow Flow charts” (Simulink Check)
jc_0773: Unconditional transition of a flow chart	jc_0773	“Check usage of unconditional transitions in flow charts” (Simulink Check)
jc_0775: Terminating junctions in flow charts	jc_0775	“Check terminal junctions in Stateflow” (Simulink Check)
jc_0738: Usage of Stateflow comments	jc_0738	“Check usage of Stateflow comments” (Simulink Check)
jc_0790: Action language of Chart block	jc_0790	“Check Stateflow chart action language” (Simulink Check)
jc_0702: Use of named Stateflow parameters and constants	jc_0702	“Check usage of numeric literals in Stateflow” (Simulink Check)
jm_0011: Pointers in Stateflow	jm_0011	“Check for pointers in Stateflow charts” (Simulink Check)
jc_0491: Reuse of Stateflow data	jc_0491	*Not checkable*
jm_0012: Usage restrictions of events and broadcasting events	jm_0012	“Check for usage of events and broadcasting events in Stateflow charts” (Simulink Check)
jc_0733: Order of state action types	jc_0733	“Check order of state action types” (Simulink Check)
jc_0734: Number of state action types	jc_0734	“Check repetition of Action types” (Simulink Check)
jc_0740: Limitation on use of exit state action	jc_0740	“Check if state action type 'exit' is used in the model” (Simulink Check)
jc_0741: Timing to update data used in state chart transition conditions	jc_0741	“Check updates to variables used in state transition conditions” (Simulink Check)
jc_0772: Execution order and transition conditions of transition lines	jc_0772	“Check usage of transition conditions in Stateflow transitions” (Simulink Check)
jc_0753: Condition actions and transition actions in Stateflow	jc_0753	“Check condition actions and transition actions in Stateflow” (Simulink Check)
jc_0711: Division in Stateflow	jc_0711	*Not checkable*
db_0127: Limitation on MATLAB commands in Stateflow blocks	db_0127	“Check for MATLAB expressions in Stateflow charts” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
jc_0481: Use of hard equality comparisons for floating point numbers in Stateflow	jc_0481	“Check usage of floating-point expressions in Stateflow charts” (Simulink Check)
na_0001: Standard usage of Stateflow operators	na_0001	“Check Stateflow operators” (Simulink Check)
jc_0655: Prohibition of logical value comparison in Stateflow	jc_0655	“Check prohibited comparison operation of logical type signals” (Simulink Check)
jc_0451: Use of unary minus on unsigned integers	jc_0451	“Check usage of unary minus operations in Stateflow charts” (Simulink Check)
jc_0802: Prohibited use of implicit type casting in Stateflow	jc_0802	“Check for implicit type casting in Stateflow” (Simulink Check)
jc_0803: Passing values to library functions	jc_0803	*Not checkable*
jc_0732: Distinction between state names, data names, and event names	jc_0732	“Check uniqueness of Stateflow State and Data names” (Simulink Check)
jc_0730: Unique state name in Stateflow blocks	jc_0730	“Check uniqueness of State names” (Simulink Check)
jc_0731: State name format	jc_0731	“Check usage of State names” (Simulink Check)
jc_0501: Format of entries in a State block	jc_0501	“Check entry formatting in State blocks in Stateflow charts” (Simulink Check)
jc_0736: Uniform indentations in Stateflow blocks	jc_0736	“Check indentation of code in Stateflow states” (Simulink Check)
jc_0739: Describing text inside states	jc_0739	“Check for usage of text inside states” (Simulink Check)
jc_0770: Position of transition label	jc_0770	“Check placement of Label String in Transitions” (Simulink Check)
jc_0771: Comment position in transition labels	jc_0771	“Check position of comments in transition labels” (Simulink Check)
jc_0752: Condition action in transition label	jc_0752	“Check usage of parentheses in Stateflow transitions” (Simulink Check)

MAB Modeling Guideline (Version 5.0)	Corresponding JMAAB Modeling Guideline (Version 5.1)	Model Advisor Check
jc_0774: Comments for through transition	jc_0774	“Check for comments in unconditional transitions” (Simulink Check)
jc_0511: Return values from a graphical function	jc_0511	“Check return value assignments in Stateflow graphical functions” (Simulink Check)
jc_0804: Prohibited use of recursive calls with graphical functions	jc_0804	“Check usage of graphical functions in Stateflow” (Simulink Check)
na_0042: Usage of Simulink functions	na_0042	“Check usage of Simulink function in Stateflow” (Simulink Check)
na_0039: Limitation on Simulink functions in Chart blocks	na_0039	“Check use of Simulink in Stateflow charts” (Simulink Check)
na_0018: Number of nested if/ else and case statement	No corresponding JMAAB guideline	“Check nested conditions in MATLAB Functions” (Simulink Check)
na_0025: MATLAB Function header	No corresponding JMAAB guideline	*No check*
na_0024: Shared data in MATLAB functions	na_0024	“Check MATLAB code for global variables” (Simulink Check)
na_0031: Definition of default enumerated value	na_0031	“Check usage of enumerated values” (Simulink Check)
na_0034: MATLAB Function block input/output settings	na_0034	“Check input and output settings of MATLAB Functions” (Simulink Check)
na_0016: Source lines of MATLAB Functions	No corresponding JMAAB guideline	“Check lines of code in MATLAB Functions” (Simulink Check)
na_0017: Number of called function levels	No corresponding JMAAB guideline	“Check the number of function calls in MATLAB Function blocks” (Simulink Check)
na_0021: Strings in MATLAB functions	na_0021	“Check usage of character vector inside MATLAB Function block” (Simulink Check)
na_0022: Recommended patterns for Switch/Case statements	No corresponding JMAAB guideline	“Check usage of recommended patterns for Switch/Case statements” (Simulink Check)
jc_0801: Prohibited use of the /* and */ comment symbols	jc_0801	“Check for use of C-style comment symbols” (Simulink Check)

See Also

- “Run Model Advisor Checks and Review Results”

Naming Conventions

- “General Conventions” on page 2-2
- “Content Conventions” on page 2-11

General Conventions

ar_0001: Usable characters for file names

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f, g
- JMAAB — a, b, c, d, e, f, g

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used in file names:

- Single-byte alphanumeric characters (a-z, A-Z, 0-9)
- Single-byte underscore (_)

Line breaks, single-byte spaces, double-byte characters, and control characters shall not be used. File types that are checked for model and MATLAB files shall be set in the project settings.

Custom Parameter

File (extension)

Example — Incorrect

`MAB Model.slx` — Single-byte spaces are used

`JMAAB 設定.m` or `NA-MAABModel.p` — Double-byte characters are used.

`JMAAB(Model).mdl` — Symbol characters are used.

Sub ID b

The file name shall not use numbers at the beginning.

Custom Parameter

File (extension)

Example — Incorrect

```
001_JMAABModel.slx
```

Sub ID c

The file name shall not use underscores at the beginning.

Custom Parameter

File (extension)

Example — Incorrect

`_JMAABModel.slx`

Sub ID d

The file name shall not use an underscore at the end.

Custom Parameter

File (extension)

Example — Incorrect

`MABModel_.slx`

Sub ID e

The file name shall not use consecutive underscores.

Custom Parameter

File (extension)

Example — Incorrect

`JMAAB__Model.slx`

Sub ID f

The file name shall not consist solely of a single reserved MATLAB word.

Custom Parameter

File (extension)

Example — Incorrect

`ans.slx`, `double.slx`

Sub ID g

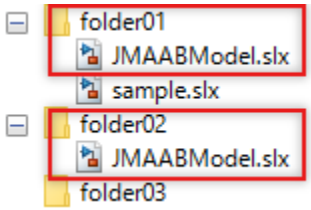
File names on the MATLAB path shall not be identical.

Custom Parameter

File (extension)

Example — Incorrect

Files with the same name are saved to the folder that goes through the MATLAB path.



Rationale

Sub IDs a, b, c, f:

- Readability is impaired.
- Deviation from the rule can cause unexpected issues.

Sub IDs d, e

- Readability is impaired.

Sub ID g:

- If there are multiple files with the same name, the one higher on the path is loaded. As a result, unnecessary files might be included.
- Readability is impaired.
- Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check file names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline ar_0001, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reserved Keywords” (Embedded Coder)
- “Reserved Identifiers and Code Replacement” (Embedded Coder)

Introduced in R2020a

ar_0002: Usable characters for folder names

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f
- JMAAB — a, b, c, d, e, f

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used in folder names:

- Single-byte alphanumeric characters (`a-z`, `A-Z`, `0-9`)
- Single-byte underscore (_)

Line breaks, single-byte spaces, double-byte characters, and control characters shall not be used.

Custom Parameter

Not Applicable

Example — Incorrect

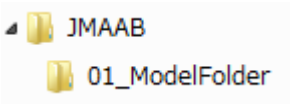
Sub ID b

The folder name shall not use numbers at the beginning.

Custom Parameter

Not Applicable

Example — Incorrect



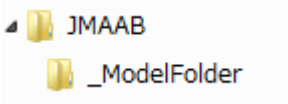
Sub ID c

The folder name shall not use underscores at the beginning.

Custom Parameter

Not Applicable

Example — Incorrect



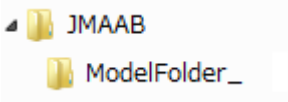
Sub ID d

The folder name shall not use underscores at the end.

Custom Parameter

Not Applicable

Example — Incorrect



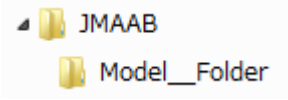
Sub ID e

The folder name shall not use consecutive underscores.

Custom Parameter

Not Applicable

Example — Incorrect



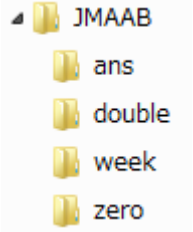
Sub ID f

The folder name shall not consist solely of a single reserved MATLAB word.

Custom Parameter

Not Applicable

Example — Incorrect



Rationale

Sub IDs a, b, c, d, e, f:

- Readability is impaired.
- Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check folder names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline ar_0002, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reserved Keywords” (Embedded Coder)
- “Reserved Identifiers and Code Replacement” (Embedded Coder)

Introduced in R2020a

jc_0241: Length restriction for model file names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Model file name length shall be a maximum of 63 characters (not including dots and extension).

Custom Parameter

Maximum model file name length

Rationale

Sub ID a:

- Possible that a long file name cannot be referred to in the model reference.

Verification

Model Advisor check: “Check length of model file name” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0241, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0242: Length restriction for folder names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Folder name length shall be a maximum of 63 characters.

Custom Parameter

Maximum folder name

Rationale

Sub ID a:

- Possible that the full path name cannot be display in the user interface.

Verification

Model Advisor check: “Check length of folder name at every level of model path” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0242, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

Content Conventions

jc_0201: Usable characters for subsystem names

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f
- JMAAB — a, b, c, d, e, f

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used in structural subsystem names:

- Single-byte alphanumeric characters (`a-z`, `A-Z`, `0-9`)
- Single-byte underscore (_)

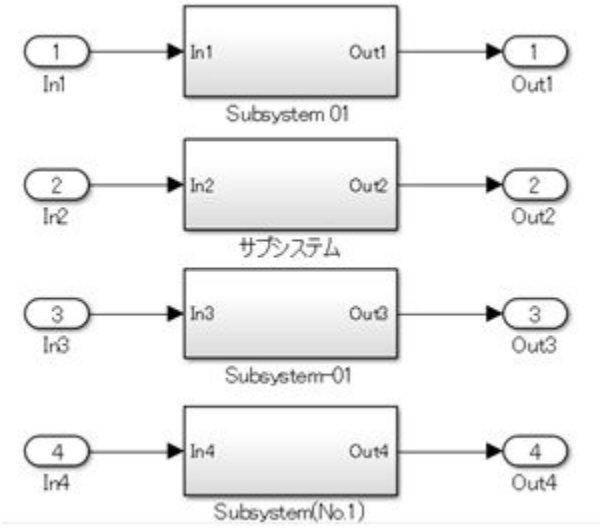
Line breaks, single-byte spaces, double-byte characters, and control characters shall not be used.

Custom Parameter

Not Applicable

Example — Incorrect

Single-byte spaces, double-byte, and symbol characters are used.



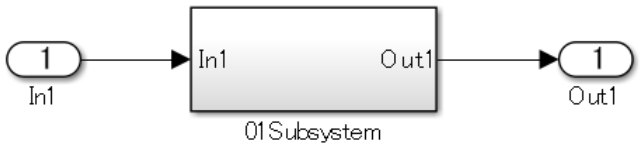
Sub ID b

A structural subsystem name shall not use numbers at the beginning.

Custom Parameter

Not Applicable

Example — Incorrect



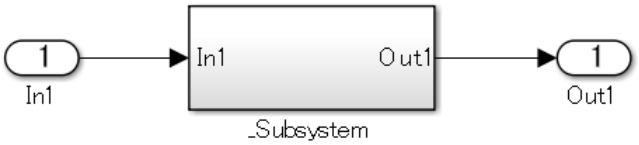
Sub ID c

A structural subsystem name shall not use an underscore at the beginning.

Custom Parameter

Not Applicable

Example — Incorrect



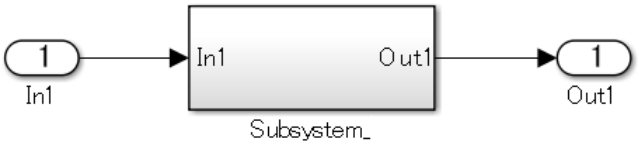
Sub ID d

A structural subsystem name shall not use an underscore at the end.

Custom Parameter

Not Applicable

Example — Incorrect



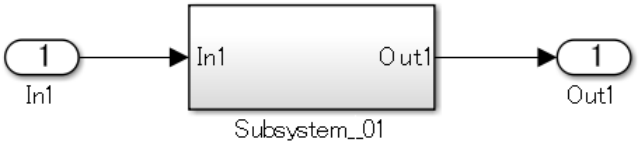
Sub ID e

A structural subsystem name shall not use consecutive underscores.

Custom Parameter

Not Applicable

Example — Incorrect



Sub ID f

A structural subsystem shall not consist solely of a single reserved MATLAB word.

Custom Parameter

Not Applicable

Example — Incorrect

Rationale

Sub IDs a, b, f:

- Cannot generate code using the configured structural subsystem name.

Sub IDs c, d, e:

- May not be able to generate code using the configured structural subsystem name.

Verification

Model Advisor check: “Check Subsystem names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0201, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Types of Subsystems”

Introduced in R2020a

jc_0231: Usable characters for block names

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f
- JMAAB — a, b, c, d, e, f

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used for basic block names:

- Single-byte alphanumeric characters (`a-z`, `A-Z`, `0-9`)
- Single-byte underscore (_)

Line breaks and single-byte spaces shall not be permitted when adding a new block name. However, they shall be permitted when used initially as a block name that is saved in the Simulink library.

Double-byte characters and control characters shall not be used.

Exception

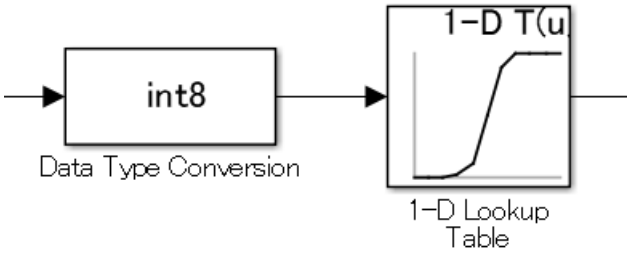
Inport and Outport blocks

Custom Parameter

Not Applicable

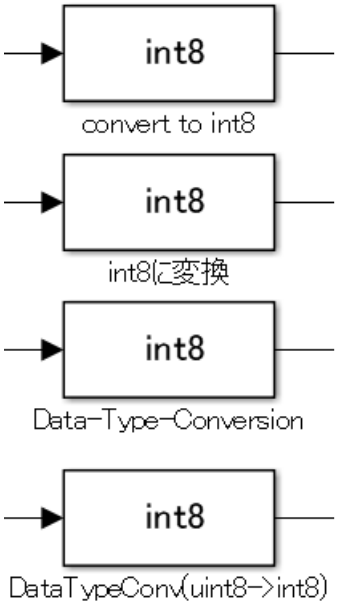
Example — Correct

Block names are registered in the Simulink library.



Example — Incorrect

Single-byte spaces, double-byte characters, and symbol characters are used.



Sub ID b

Basic block names shall not use numbers at the beginning.

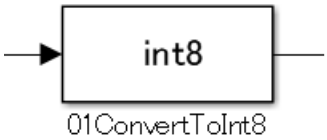
Exception

Inport and Outport blocks

Custom Parameter

Not Applicable

Example — Incorrect



Sub ID c

Basic block names shall not use underscores at the beginning.

Exception

Inport and Outport blocks

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID d

Basic block names shall not use underscores at the end.

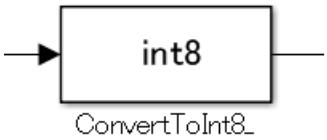
Exception

Inport and Outport blocks

Custom Parameter

Not Applicable

Example — Incorrect



Sub ID e

Basic block names shall not use consecutive underscores.

Exception

Inport and Outport blocks

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID f

Basic block names shall not consist solely of a single reserved MATLAB word.

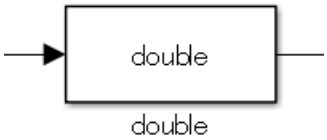
Exception

Inport and Outport blocks

Custom Parameter

Not Applicable

Example — Incorrect



Rationale

Sub IDs a, b:

- Deviation from the rule can make it difficult to maintain the integrity of the model and code.

Sub IDs c, e:

- Readability is impaired.

Sub IDs d:

- Readability is impaired.
- Underscores can be used to separate words. However, they are typically used as word breaks and can cause misunderstanding in the description.

Sub IDs f:

- Readability is impaired.
- Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check character usage in block names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0231, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reserved Keywords” (Embedded Coder)
- “Reserved Identifiers and Code Replacement” (Embedded Coder)

Introduced in R2020a

jc_0211: Usable characters for Inport blocks and Outport block

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f
- JMAAB — a, b, c, d, e, f

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used in Inport and Outport block names:

- Single-byte alphanumeric characters (`a-z`, `A-Z`, `0-9`)
- Single-byte underscore (_)

Line breaks, single-byte spaces, double-byte characters, and control characters shall not be used.

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID b

[Inport] and [Outport] block names shall not use numbers at the beginning.

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID c

[Inport] and [Outport] block names shall not use underscores at the beginning.

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID d

[Inport] and [Outport] block names shall not use underscores at the end.

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID e

[Inport] and [Outport] block names shall not use consecutive underscores.

Custom Parameter

Not Applicable

Example — Incorrect

Sub ID f

[Inport] and [Outport] block names shall not consist solely of a single reserved MATLAB word.

Custom Parameter

Not Applicable

Example — Incorrect

Rationale

Sub IDs a, b:

- Deviation from the rule can make it difficult to maintain the integrity of the model and code.

Sub IDs c, e:

- Readability is impaired.

Sub IDs d:

- Readability is impaired.
- Underscores can be used to separate words. However, they are typically used as word breaks and can cause misunderstanding in the description.

Sub IDs f:

- Readability is impaired.
- Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check port block names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0211, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reserved Keywords” (Embedded Coder)
- “Reserved Identifiers and Code Replacement” (Embedded Coder)

Introduced in R2020a

jc_0243: Length restriction for subsystem names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Structural subsystem name length shall be a maximum of 63 characters.

Custom Parameter

Maximum subsystem name length

Rationale

Sub ID a:

- Code generation may not be possible.

Verification

Model Advisor check: “Check length of subsystem names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0243, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Model Configuration Parameters”
- “Types of Subsystems”

Introduced in R2020a

jc_0247: Length restriction for block names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Basic block name length shall be a maximum of 63 characters.

Exception

Inport and Outport blocks

Custom Parameter

Maximum block name length

Rationale

Sub ID a:

- Code generation may not be possible.

Verification

Model Advisor check: “Check length of block names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0247, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0244: Length restriction for Inport and Outport names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Inport and Outport block name length shall be a maximum of 63 characters.

Custom Parameter

Maximum Inport block name length

Maximum Outport block name length

Rationale

Sub ID a:

- Code generation may not be possible.

Verification

Model Advisor check: “Check length of Inport and Outport names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0244, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0222: Usable characters for signal and bus names

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f
- JMAAB — a, b, c, d, e, f

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used in signal and bus names:

- Single-byte alphanumeric characters (`a-z`, `A-Z`, `0-9`)
- Single-byte underscore (_)

Line breaks, single-byte spaces, double-byte characters, and control characters shall not be used.

Custom Parameter

Not Applicable

Sub ID b

Signal and bus names shall not use numbers at the beginning.

Custom Parameter

Not Applicable

Sub ID c

The signal or bus name shall not use underscores at the beginning.

Custom Parameter

Not Applicable

Sub ID d

Signal and bus names shall not use underscores at the end.

Custom Parameter

Not Applicable

Sub ID e

Signal and bus names shall not use consecutive underscores.

Custom Parameter

Not Applicable

Sub ID f

Signal and bus names shall not consist solely of a single reserved MATLAB word.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b:

- Deviation from the rule can make it difficult to maintain the integrity of the model and code.

Sub IDs c, e:

- Readability is impaired.

Sub IDs d:

- Readability is impaired.
- Underscores can be used to separate words. However, they are typically used as word breaks and can cause misunderstanding in the description.

Sub IDs f:

- Readability is impaired.
- Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check usable characters for signal names and bus names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0222, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reserved Keywords” (Embedded Coder)
- “Reserved Identifiers and Code Replacement” (Embedded Coder)
- “Signal Basics”

- “Explore Simulink Bus Capabilities”

Introduced in R2020a

jc_0232: Usable characters for parameter names

Sub ID Recommendations

- NA-MAAB — d, e
- JMAAB — a, b, c, d, e, f

MATLAB Versions

All

Rule

Sub ID a

Only these character types shall be used in parameter names:

- Single-byte alphanumeric characters (`a-z`, `A-Z`, `0-9`)
- Single-byte underscore (_)

Line break, single-byte space, double-byte characters, and control characters shall not be used.

Custom Parameter

Not Applicable

Sub ID b

The parameter name shall not use numbers at the beginning.

Custom Parameter

Not Applicable

Sub ID c

The parameter name shall not use underscores at the beginning.

Custom Parameter

Not Applicable

Sub ID d

The parameter name shall not use underscores at the end.

Custom Parameter

Not Applicable

Sub ID e

The parameter name shall not use consecutive underscores.

Custom Parameter

Not Applicable

Sub ID f

The parameter name shall not consist solely of a single reserved MATLAB word.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b:

- Deviation from the rule can make it difficult to maintain the integrity of the model and code.

Sub IDs c, e:

- Readability is impaired.

Sub ID d:

- Readability is impaired.
- Underscores can be used to separate words. However, they are typically used as word breaks and can cause misunderstanding in the description.

Sub ID f:

- Readability is impaired. Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check usable characters for parameter names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0232, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reserved Keywords” (Embedded Coder)
- “Reserved Identifiers and Code Replacement” (Embedded Coder)

Introduced in R2020a

jc_0245: Length restriction for signal and bus names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Signal and bus name length shall be a maximum of 63 characters.

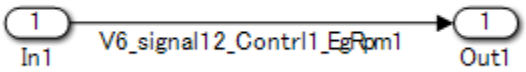
Custom Parameter

Maximum signal name length

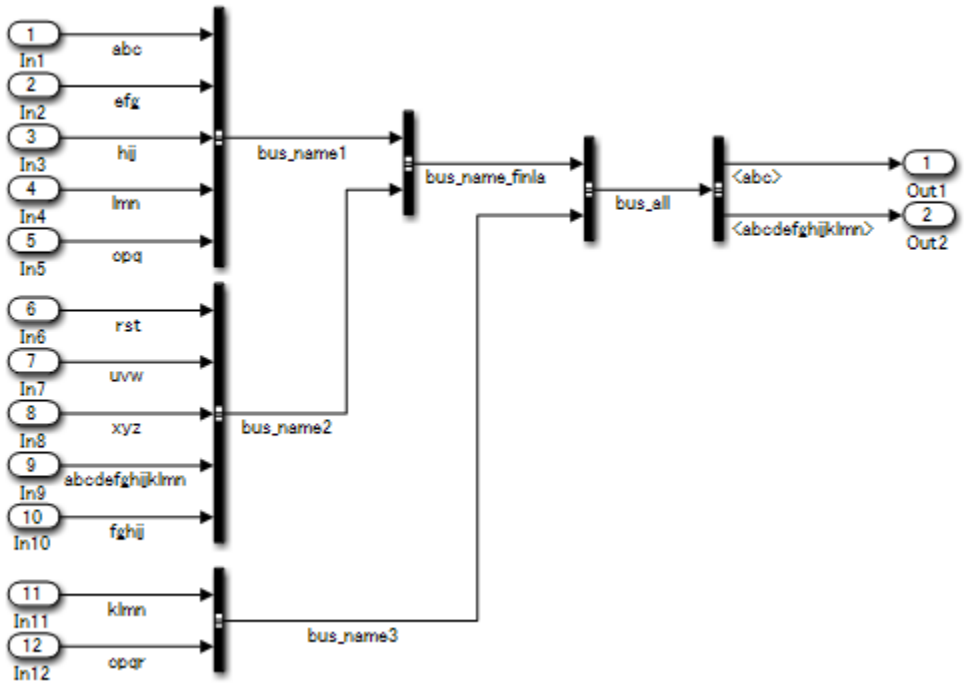
Maximum bus name length

Example — Correct

Signal name length is less than 63 characters.



The length of the hierarchical signal name (full path) `bus_all.bus_name_finla.bus_name2.abcdefghijklmn` is less than or equal to 63 characters.



Rationale

Sub ID a:

- Code generation may not be possible.

Verification

Model Advisor check: “Check length of signal and bus names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0245, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Model Configuration Parameters”
- “Signal Basics”
- “Explore Simulink Bus Capabilities”

Introduced in R2020a

jc_0246: Length restriction for parameter name

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Parameter name length shall be a maximum of 63 characters.

Custom Parameter

Maximum parameter name length

Rationale

Sub ID a:

- Code generation may not be possible.

Verification

Model Advisor check: “Check length of parameter names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0246, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0795: Usable characters for Stateflow data names

Sub ID Recommendations

- NA-MAAB — a, b, c, d
- JMAAB — a, b, c, d

MATLAB Versions

All

Rule

Sub ID a

Stateflow data {name} shall not use underscores at the beginning.

Custom Parameter

Not Applicable

Sub ID b

Stateflow data {name} shall not use underscores at the end.

Custom Parameter

Not Applicable

Sub ID c

Stateflow data {name} shall not use consecutive underscores.

Custom Parameter

Not Applicable

Sub ID d

Stateflow data {name} shall not consist solely of a single reserved MATLAB word.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b, c, d:

- Readability is impaired.
- Deviation from the rule may result in unintended code behavior.

Verification

Model Advisor check: “Check usable characters for Stateflow data names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0795, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Add Stateflow Data” (Stateflow)
- “Set Data Properties” (Stateflow)

Introduced in R2020a

jc_0796: Length restriction for Stateflow data names

Sub ID Recommendations

- NA-MAAB — a, b, c, d
- JMAAB — a, b, c, d

MATLAB Versions

All

Rule

Sub ID a

Stateflow data {name} shall be a maximum of 63 characters.

Custom Parameter

Stateflow data name character limit

Rationale

Sub ID a:

- Readability is impaired.
- Deviation from the rule can result in unintended code behavior

Verification

Model Advisor check: “Check length of Stateflow data name” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0796, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Add Stateflow Data” (Stateflow)
- “Set Data Properties” (Stateflow)

Introduced in R2020a

jc_0791: Duplicate data name definitions

Sub ID Recommendations

- NA-MAAB — a, b, c
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

Data name definitions shall not be duplicated in the base workspace and model workspace.

Custom Parameter

Not Applicable

Sub ID b

Data names shall not be duplicated in the base workspace and data dictionary (sldd).

Custom Parameter

Types of data dictionary

Sub ID c

Data name definitions shall not be duplicated in the model workspace and data dictionary (sldd).

Custom Parameter

Types of data dictionary

Rationale

Sub IDs a, b, c:

- Duplicated data name can cause unintended model behavior.

Verification

Model Advisor check: “Check duplication of Simulink data names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0791, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Set Data Properties” (Stateflow)
- “Add Stateflow Data” (Stateflow)
- “Model Workspaces and Data Dictionaries”

Introduced in R2020a

jc_0792: Unused Data

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

The data dictionary (`sldd`) shall define only the data that is used in the Simulink or Stateflow Coder™ model.

Custom Parameter

Types of data dictionary

Sub ID b

The model workspace shall define only the data that is used in the Simulink or Stateflow model.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b:

- Unused data can affect maintainability and operability.

Verification

Model Advisor check: “Check unused data in Simulink Model” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0792, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

- “Model Workspaces and Data Dictionaries”

Introduced in R2020a

jc_0700: Unused data in Stateflow block

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

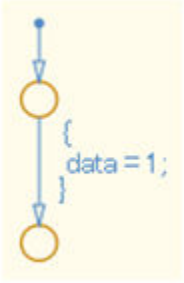
Sub ID a

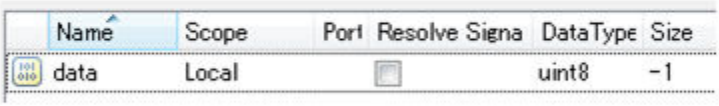
Configuration parameter **Unused data, events, messages, and functions** shall be set to `Warning` or `Error` to prevent unused Stateflow data, events, and messages in the Stateflow block.

Custom Parameter

Not Applicable

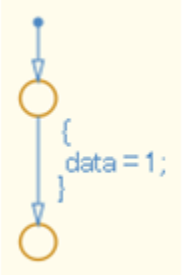
Example — Correct

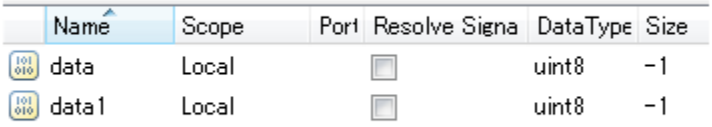




Example — Incorrect

Unused data is defined.





Rationale

Sub ID a:

- Unused data and events in the Stateflow block can affect maintainability and reusability.
- Affects code as a declarative statement concerning unused data is inserted into the generated code.

Verification

Model Advisor check: “Check for unused data in Stateflow Charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0700, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Data, Events, and Messages” (Stateflow)
- “View Differences Between Stateflow Messages, Events, and Data” (Stateflow)
- “Manage Symbols in the Stateflow Editor” (Stateflow)

Introduced in R2020a

na_0019: Restricted variable names

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

Reserved C variable names shall not be used as variable names in MATLAB code. For example, avoid using `const`, `TRUE`, `FALSE`, `infinity`, `nil`, `double`, `single`, or `enum` in MATLAB code.

Custom Parameter

Not Applicable

Sub ID b

Variable names that conflict with MATLAB functions, such as `conv`, shall not be used.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b:

- Improves readability of the code
- Code generation may not be possible.

Verification

Model Advisor check: “Check usage of restricted variable names” (Simulink Check)

Last Changed

R2020a

See Also

- “Reserved Keywords” (Embedded Coder)

- “Reserved Identifiers and Code Replacement” (Embedded Coder)
- “Program a MATLAB Function in a Chart” (Stateflow)
- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”

Introduced in R2020a

Simulink

- “Configuration Parameters” on page 3-2
- “Diagram Appearance” on page 3-11
- “Signal” on page 3-63
- “Conditional Subsystem Relations” on page 3-98
- “Operation Blocks” on page 3-120
- “Other Blocks” on page 3-170

Configuration Parameters

jc_0011: Optimization parameters for Boolean data types

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Configuration parameter **Implement logic signals as Boolean data (vs. double)** shall be selected so that optimization parameters are activated for logic signals.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Using Boolean data can reduce RAM capacity when using C code.

Verification

Model Advisor check: “Check Implement logic signals as Boolean data (vs. double)” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0011, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”

Introduced in R2020a

jc_0642: Integer rounding mode setting

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

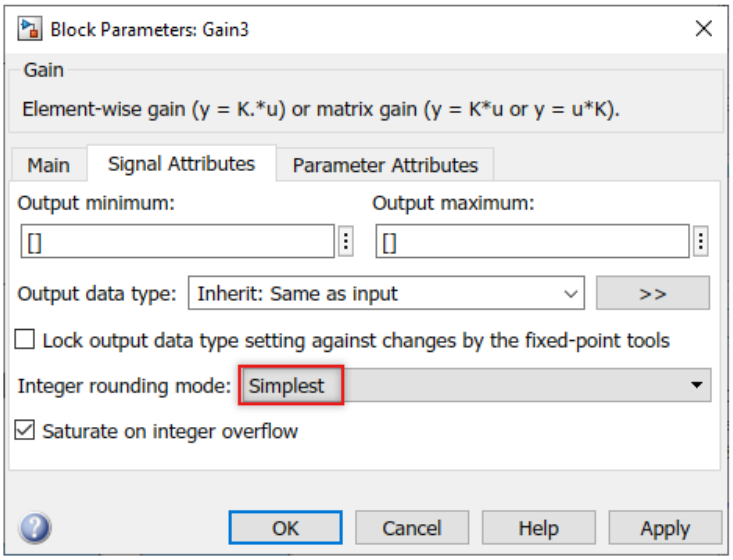
When block parameter **Integer rounding mode** is set to `Simplest`, configuration parameter **Production hardware signed integer division rounds to** shall be set to `Floor` or `Zero`.

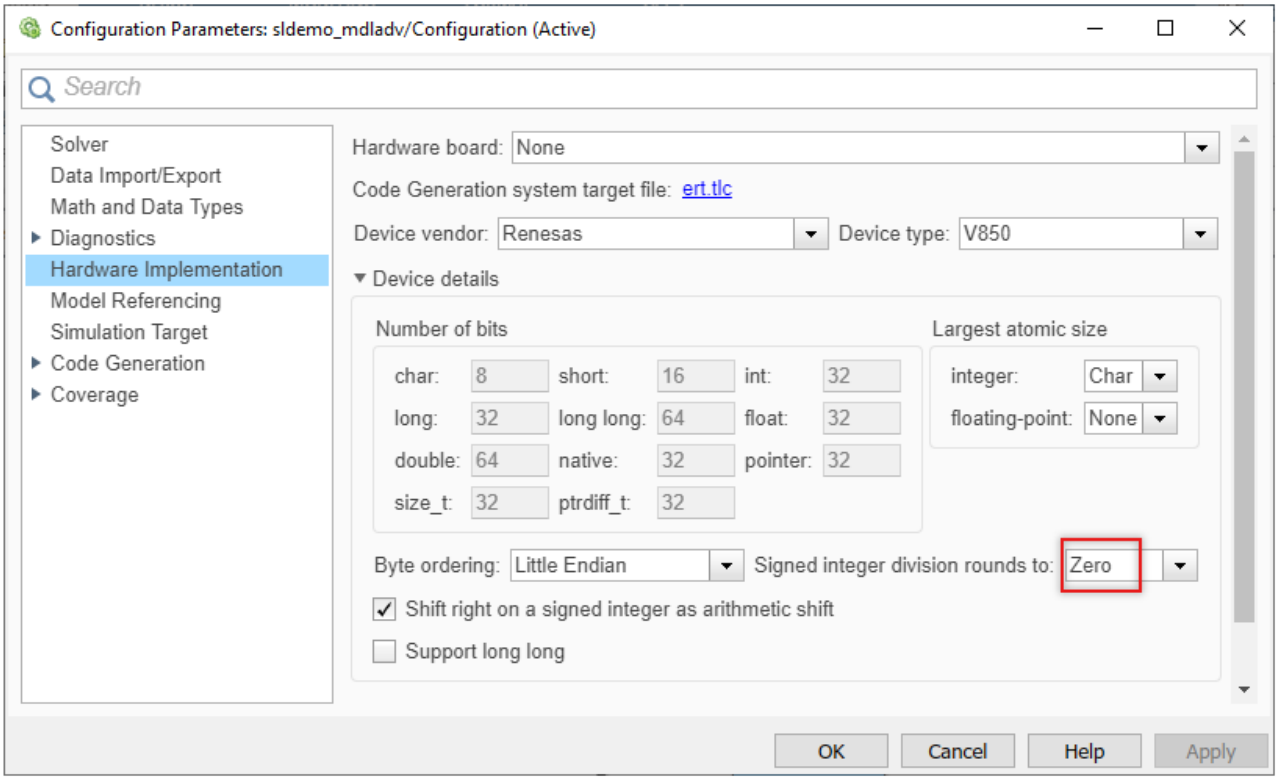
Custom Parameter

Not Applicable

Example — Correct

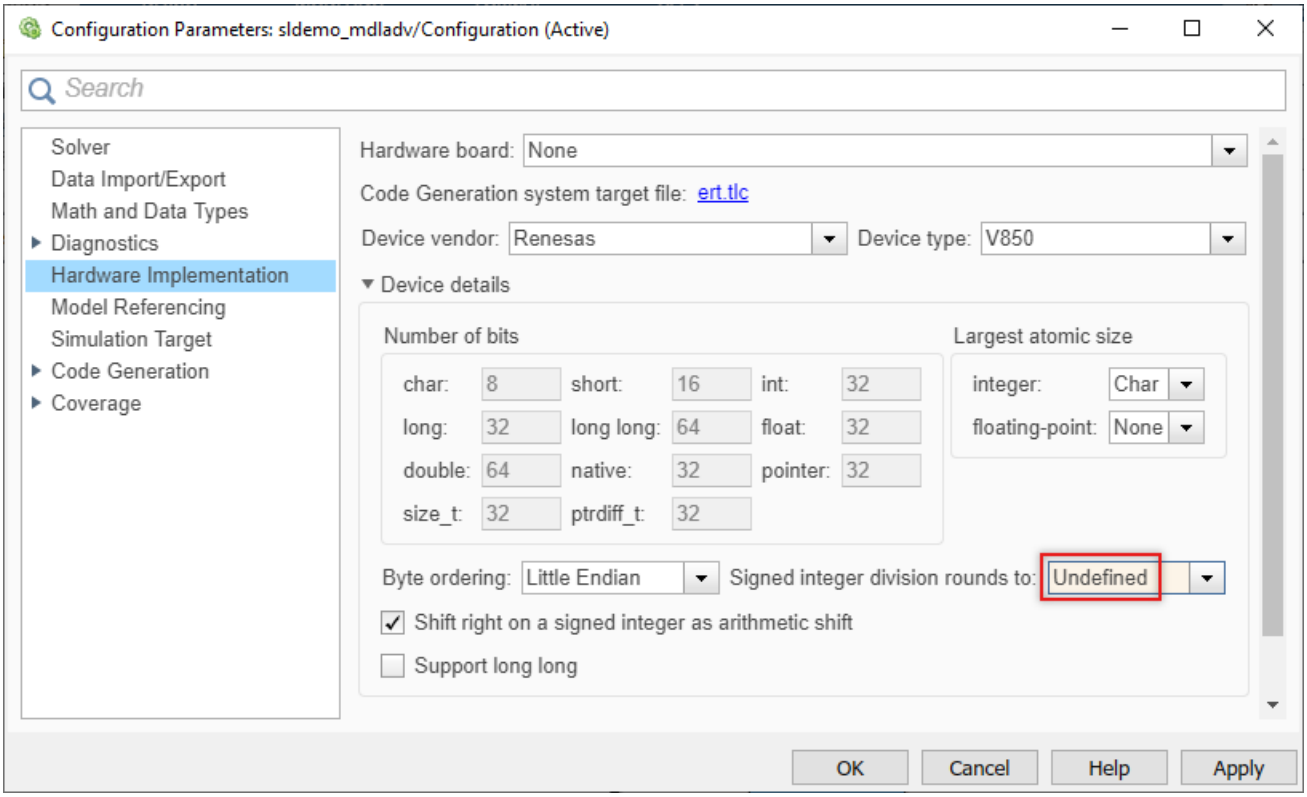
Block parameter **Integer rounding mode** is set to `Simplest` and configuration parameter **Production hardware signed integer division rounds to** is set to `Zero`.





Example — Incorrect

Configuration parameter **Production hardware signed integer division rounds to** is set to `Undefined` when block parameter **Integer rounding mode** is set to `Simplest`.



Rationale

Sub ID a:

- Prevents unintended rounding of divided signed integers.

Verification

Model Advisor check: “Check Signed Integer Division Rounding mode” (Simulink Check)

Last Changed

R2020a

See Also

- Sub ID a, see MISRA AC SLSF 008B
- JMAAB guideline jc_0642, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signed integer division rounds to”

Introduced in R2020a

jc_0806: Detecting incorrect calculation results

Sub ID Recommendations

- NA-MAAB — a, b, c
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

Configuration parameter **Division by singular matrix** shall be set to `Error`.

Custom Parameter

Not Applicable

Sub ID b

Configuration parameter **Inf or NaN block output** shall be set to `Error`.

Custom Parameter

Not Applicable

Sub ID c

(R2014b and later) These configuration parameters shall be set to `Error`:

- **Wrap on overflow**
- **Saturate on overflow**

(R2010b to R2014a) Configuration parameter **Detect overflow** shall be set to `Error`.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b, c:

- Allows detection of operations with invalid values.

Verification

Model Advisor check: “Check diagnostic settings for incorrect calculation results” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0806, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0021: Model diagnostic settings

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

These configuration parameters shall be set to `warning` or `error`:

- “Algebraic loop”
- “Minimize algebraic loop”
- “Multitask data transfer”
- “Inf or NaN block output”
- “Duplicate data store names”
- “Unconnected block input ports”
- “Unconnected block output ports”
- “Unconnected line”
- “Unspecified bus object at root Outport block”
- “Element name mismatch”
- (R2017a and earlier) Mux blocks used to create bus signals
- (R2012a and earlier) Invalid function-call connection

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Improves model workflow.
- Code generation may not be possible

Verification

Model Advisor check “Check model diagnostic parameters” (Simulink Check)

Last Changed

R2020a

Introduced in R2020a

Diagram Appearance

na_0004: Simulink model appearance settings

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Simulink model appearance settings shall conform with the project settings.

Custom Parameter

Display option

Example — View Options

On the Simulink toolstrip, these parameters are available in the **Modeling** tab, under **Environment**.

Parameter	Setting
Model Browser	Deselect **Model Browser**.
Status Bar	Select **Status Bar**.
Toolstrip	Select **Toolstrip**.
Zoom	Select **Zoom (Normal View 100%)**.

Example — Block Display Options

On the Simulink toolstrip, these parameters are available in the **Debug** tab, under **Information Overlays**.

Parameter	Setting
Library Links	Select **Hide All Links**.
Linearization Indicators	Select **Linearization Indicators**.
Ref. Model I/O Mismatch	Deselect **Ref. Model I/O Mismatch**.
Ref. Model Version	Deselect **Ref. Model Version**.
Sample Time Colors	Deselect **Colors**.
Execution Order	Deselect **Execution Order**.

Example — Block Color Options

On the Simulink toolstrip, these parameters are available in the **Format** tab.

Parameter	Setting
Background color	Select **white** option from the **Background** list.
Foreground color	Select **black** option from the **Foreground** list.

Example — Storage Class Indicators

To access the parameter below, On the Simulink toolstrip, open Simulink Coder from Apps, select **C Code** tab and choose **Code Interface**.

Parameter	Setting
Storage Class Indicator	Deselect **Storage Class Indicator**.

Example — Signal Display Options

On the Simulink toolstrip, these parameters are available in the **Debug** tab, under **Information Overlays**.

Parameter	Setting
Base Data Types	Deselect **Base Data Types**.
Alias Data Types	Deselect **Alias Data Types**.
Signal Dimensions	Deselect **Signal Dimensions**.
Testpoint	Select **Test Point**.
Logging and Viewer indicators	Select **Logging & Viewers**.
Nonscalar Signals	Select **Nonscalar Signals**.

Rationale

Sub ID a:

- Standard model appearance improves readability.

Verification

Model Advisor check: “Check for Simulink diagrams using nonstandard display attributes” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline: na_0004, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- MISRA AC SLSF 023A
- “Mapping from Simulink Editor to the Simulink Toolstrip”

Introduced in R2020a

db_0043: Model font and font size

Sub ID Recommendations

- NA-MAAB — a, b, c, d
- JMAAB — a, b, c, d

MATLAB Versions

All

Rule

Sub ID a

Block name *font* and *font style* shall conform with the project settings.

Signal name *font* and *font style* shall conform with the project settings.

Custom Parameter

Font

Font style

Sub ID b

Block name *font size* shall conform with the project settings.

Signal name *font size* shall conform with the project settings

Custom Parameter

Font size

Sub ID c

State labels and box name *font* and *font style* shall conform with the project settings.

Transition labels and comment *font* and *font style* shall conform with the project settings.

Custom Parameter

Font

Font style

Sub ID d

State labels and box name *font size* shall conform with the project settings.

Transition labels and comment *font size* shall conform with the project settings.

Custom Parameter

Font size

Rationale

Sub IDs a, c:

- Standard fonts improve readability.

Sub IDs b, d:

- Standard font size improves readability.

Verification

Model Advisor check: “Check Model font settings” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0043, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jm_0002: Block resizing

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

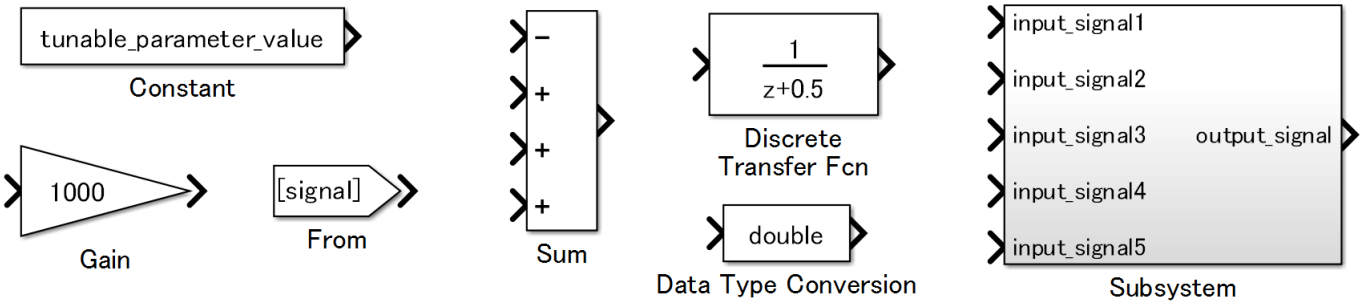
Blocks shall be sized so that the block icon is visible and recognizable.

Custom Parameter

Not Applicable

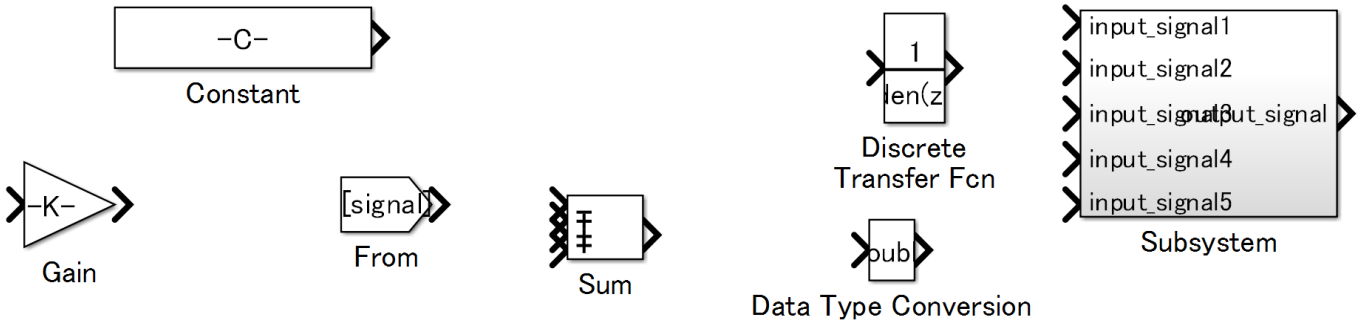
Example — Correct

The block icon is visible and recognizable.



Example — Incorrect

The block is too small so the icon is neither visible nor recognizable.



Rationale

Sub ID a:

- When a block is too small, the text and symbol displayed by the icon can be difficult to see, which impairs readability.

Verification

Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jm_0002, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Format a Model”

Introduced in R2020a

db_0142: Position of block names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

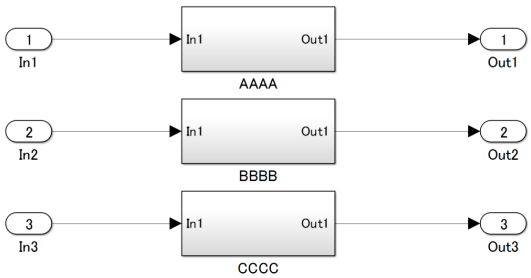
Sub ID a

The block name shall be positioned below the block.

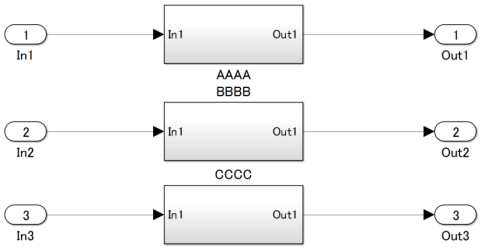
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Consistent placement of the block name improves model readability because it is easier to determine which name corresponds to the block.

Verification

Model Advisor check: “Check whether block names appear below blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0142, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0061: Display of block names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Block names shall be hidden for blocks that meet the following criteria:

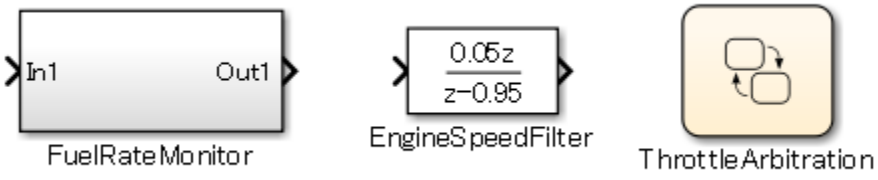
- Block type is evident from its visual appearance
- Uses the default block name (including instances where only a number has been added at the end)

For blocks that do not meet the criteria, their name shall be displayed.

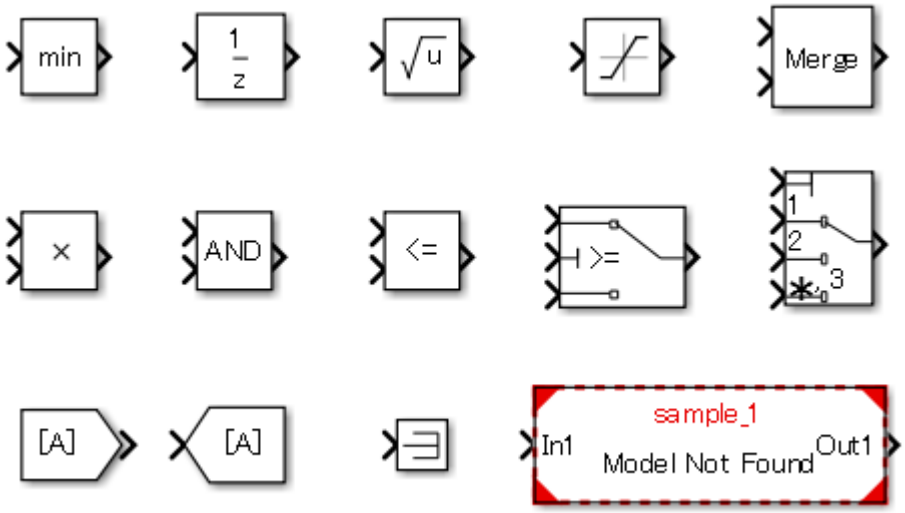
Custom Parameter

Blocks with a clear type due their appearance

Example — Displayed block names



Example — Hidden block names



Rationale

Sub ID a:

- Improves model readability.

Verification

Model Advisor check: “Check the display attributes of block names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0061, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- MISRA AC SLSF 026A

Introduced in R2020a

db_0140: Display of block parameters

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

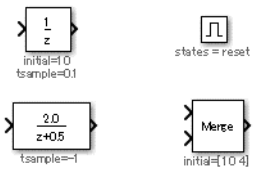
Sub ID a

Block annotation shall display block parameters that are defined by the project.

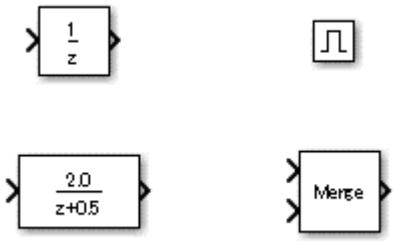
Custom Parameter

Block parameters

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Readability improves when block parameters are displayed.

Verification

Model Advisor check: “Check for nondefault block attributes” (Simulink Check)

Last Changed

R2020a

See Also

- MISRA AC SLSF 026E
- JMAAB guideline db_0140, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Set Block Annotation Properties”

Introduced in R2020a

jc_0603: Model description

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

The model layer shall include a description of the layer.

Layers that require a description are defined (by function and layer type) in the project.

Custom Parameter

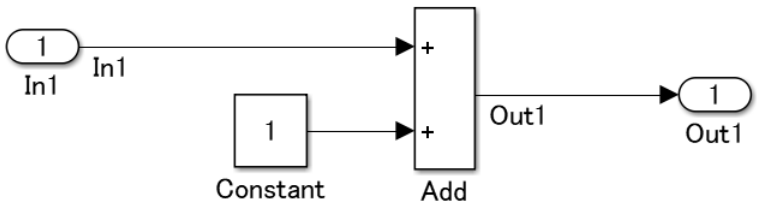
Description object (block type, etc.)

Layer being described

Example — Correct

Model layer includes description [Requirement].

【Requirement】
Performs an increment process on the input signal In1



Sub ID b

The format of the layer description shall be consistent in the model.

Custom Parameter

Model description format

Rationale

Sub ID a:

- When a description is not included, the readability of the control specifications is reduced. Usability, maintainability, and portability also decreases.

Sub ID b:

- Readability is impaired when the description format is not consistent.

Verification

Model Advisor check: “Check Model Description” (Simulink Check)

Last Changed

R2020a

See Also

- Sub ID a and b, see MISRA AC SLSF 022
- JMAAB guideline jc_0603, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0604: Using block shadow

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

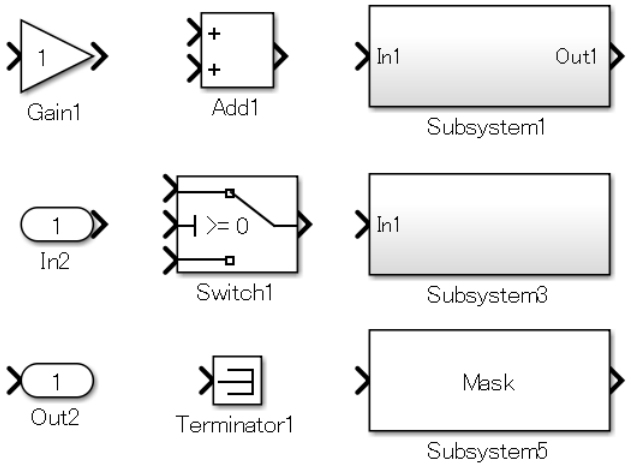
Sub ID a

Block format property **Shadow** (`DropShadow`) shall not be selected.

Custom Parameter

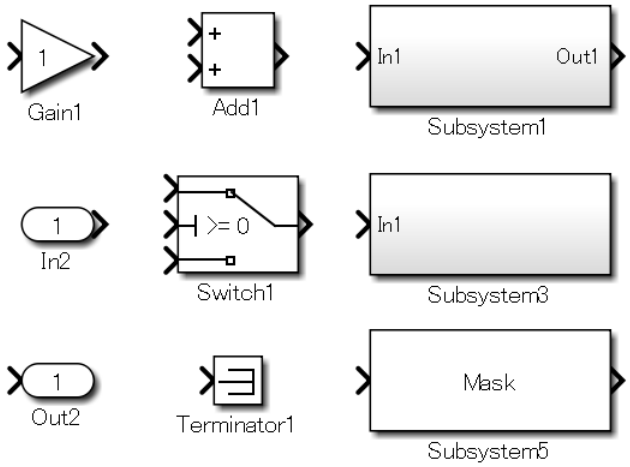
Not Applicable

Example — Correct



Example — Incorrect

Blocks have a drop shadow.



Rationale

Sub ID a:

- Difficult to determine if a port exists because it is hidden by the shading, which impairs readability.

Verification

Model Advisor check: “Check if blocks are shaded in the model” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0604, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Common Block Properties”
- “Set Block Parameter Values”

Introduced in R2020a

db_0081: Unconnected signals and blocks

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

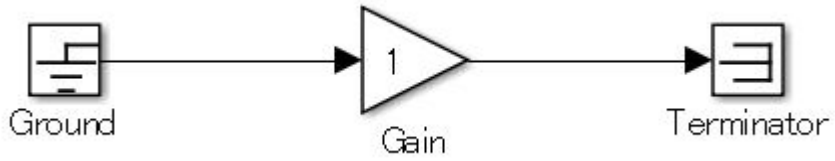
Sub ID a

The model shall not have signal lines that are not connected.

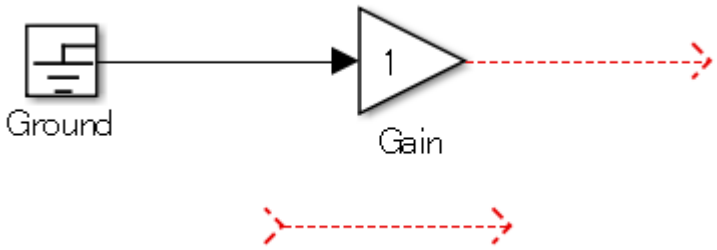
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



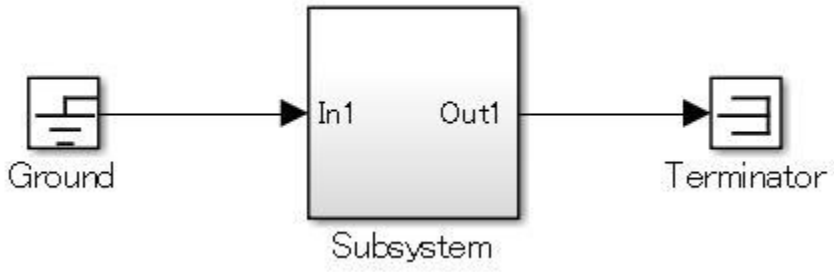
Sub ID b

The model shall not have subsystems or basic blocks that are not connected.

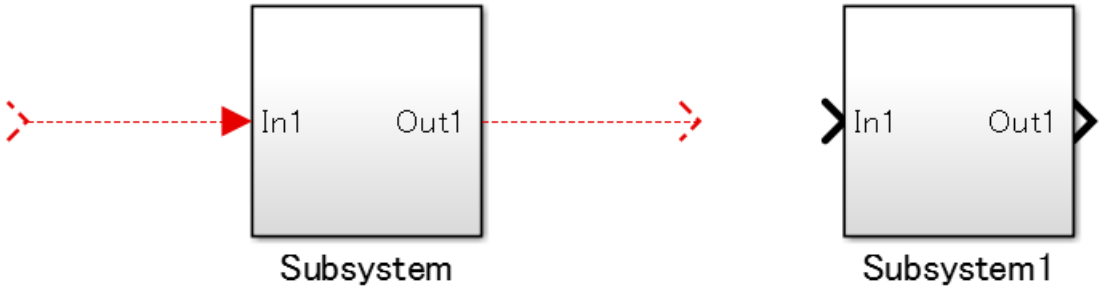
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub IDs a, b:

- Unconnected lines can have adverse effects, such as simulation errors or failure to generate code.

Verification

Model Advisor check: “Check for unconnected signal lines and blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0081, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Types of Subsystems”

Introduced in R2020a

db_0032: Signal line connections

Sub ID Recommendations

- NA-MAAB — a1/a2, b, c, e
- JMAAB — a1/a2, b, c, d, e

MATLAB Versions

All

Rule

Sub ID a1

Vertical and horizontal signal lines shall not cross over one another.

Custom Parameter

Not Applicable

Sub ID a2

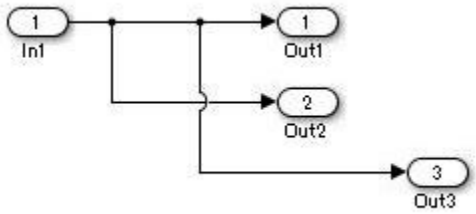
(R2014a and later) When vertical and horizontal signal lines must cross, Simulink editor preference **Line crossing style** shall be set to `Line hop`.

Custom Parameter

Not Applicable

Example — Correct

The vertical line hops over the horizontal line.



Sub ID b

Signal lines shall not overlap with other signal lines.

Custom Parameter

Not Applicable

Sub ID c

Signal lines shall not cross over blocks.

Custom Parameter

Not Applicable

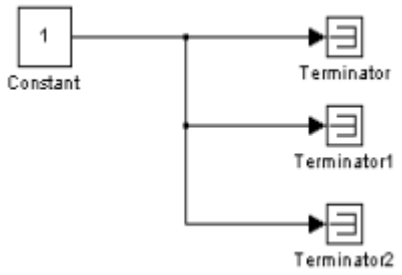
Sub ID d

Signal lines shall not split into more than two sub lines at a single branching point.

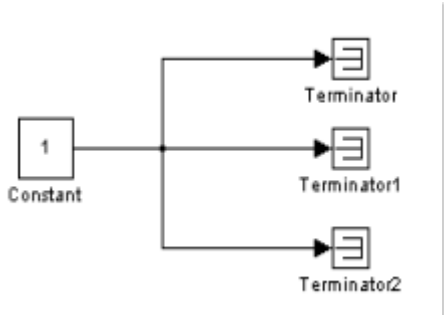
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID e

Signal lines shall be resized vertically or horizontally as required for the model layout.

Custom Parameter

Not Applicable

Rationale

Sub IDs a1, c:

- Difficult to understand the relationships between blocks when signal lines cross.

Sub ID a2:

- In R2014a and later, the difference between crossing and branching is clarified.

Sub ID b:

- Difficult to understand the relationships between blocks when signal lines overlap.

Sub ID d:

- Difficult to understand the relationships between blocks.

Sub ID e:

- Consistent application of signal lines improves readability.

Verification

Model Advisor check: “Check signal line connections” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0032, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”

Introduced in R2020a

db_0141: Signal flow in Simulink models

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

Signals shall flow from left to right.

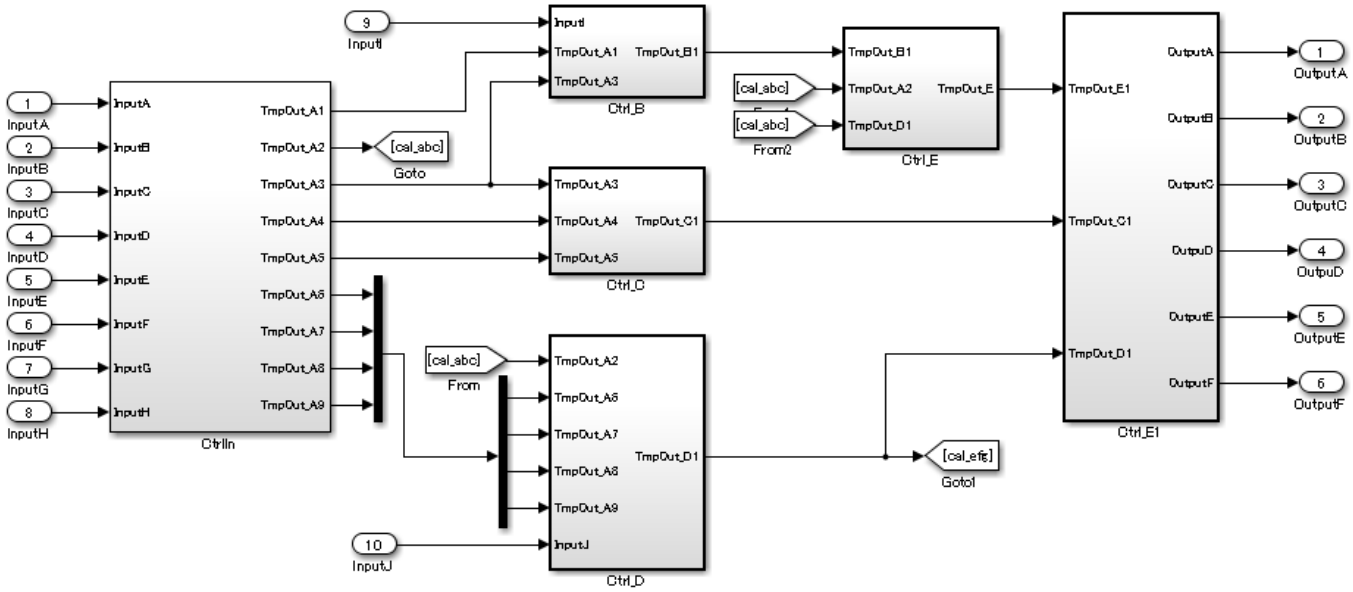
Exception

Feedback loops can flow from right to left.

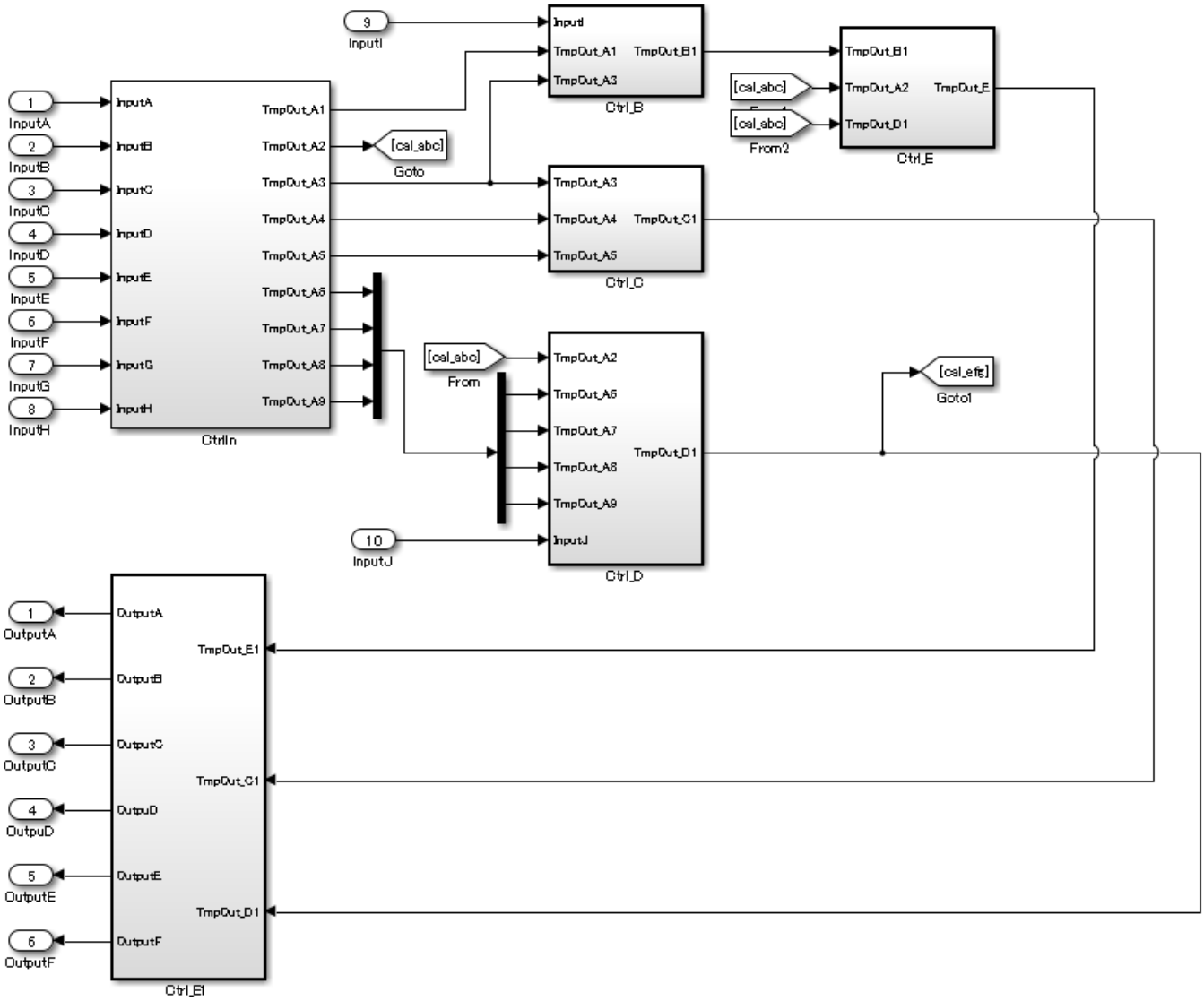
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



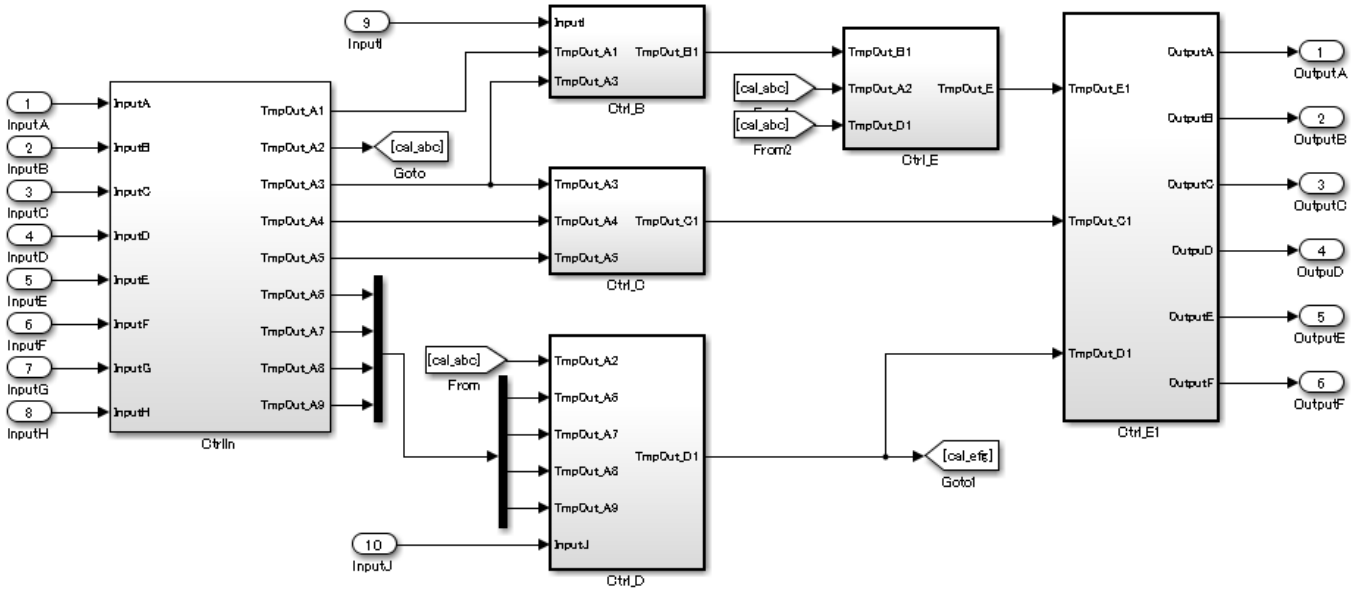
Sub ID b

Parallel blocks or subsystems shall be arranged from top to bottom.

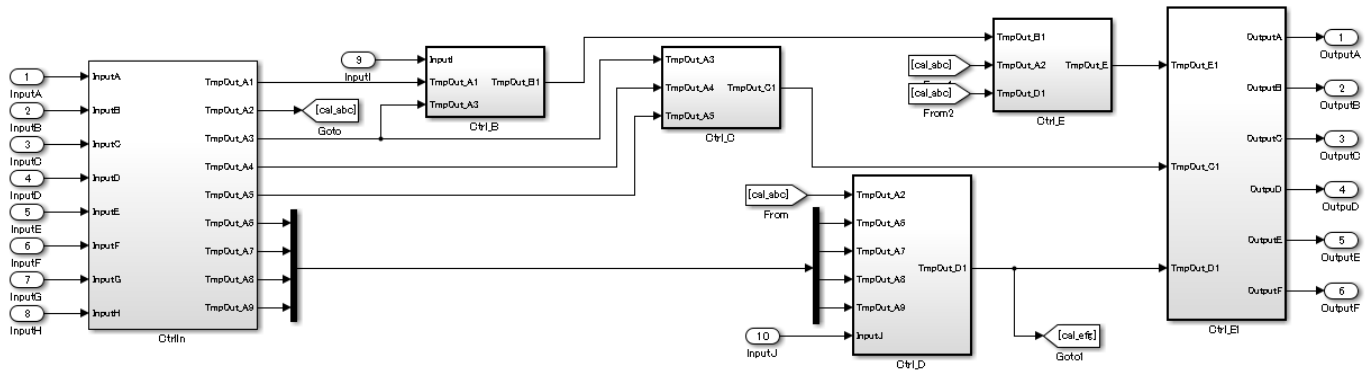
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



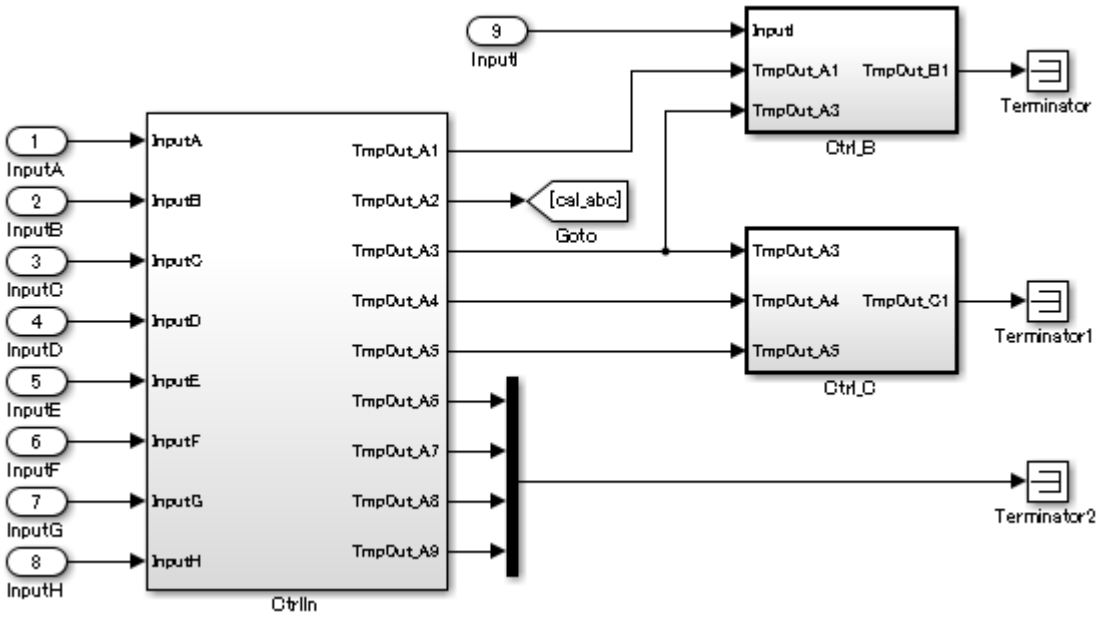
Sub ID c

Signal lines shall not bend multiple times unnecessarily.

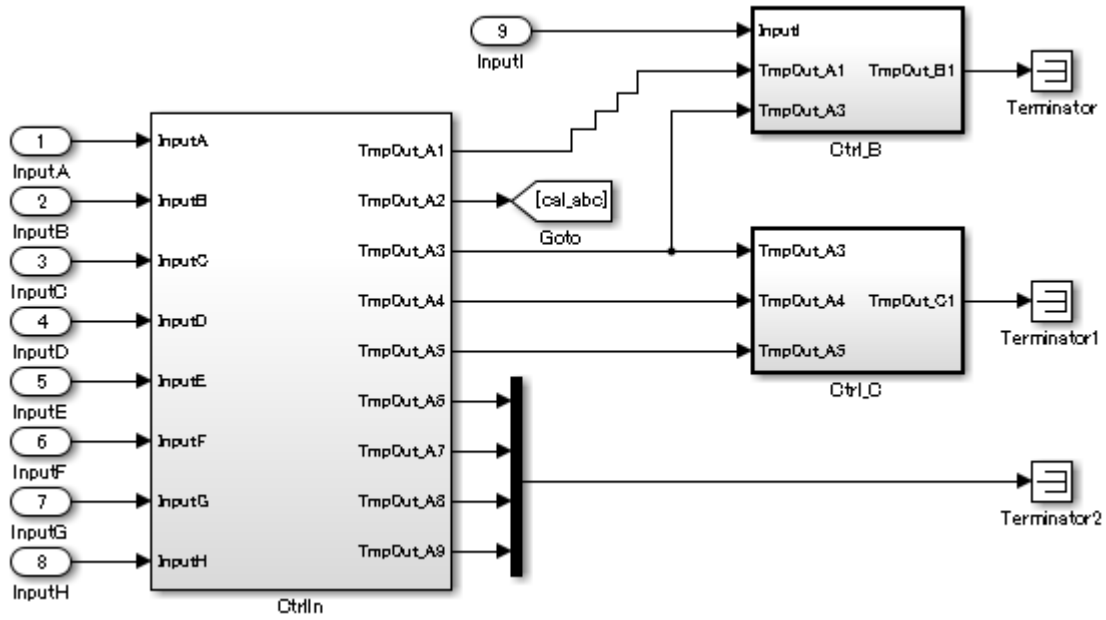
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub IDs a, b, c:

- Deviation from the rules can impair readability.

Verification

Model Advisor check: “Check signal flow in model Check position of signal labels” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0141, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Types of Subsystems”

Introduced in R2020a

jc_0110: Direction of block

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Blocks shall be arranged so the output is to the right.

Exception

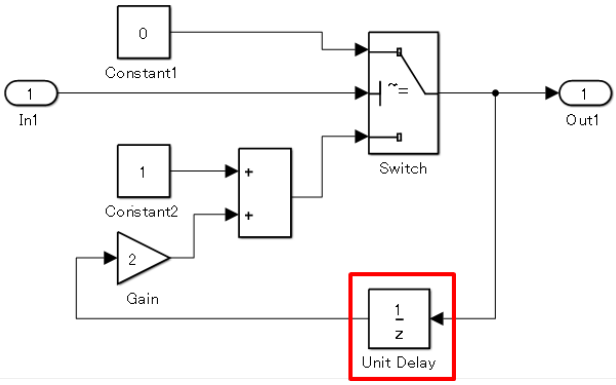
When a Delay is used in a feedback loop, the output can be to the left.

Custom Parameter

Not Applicable

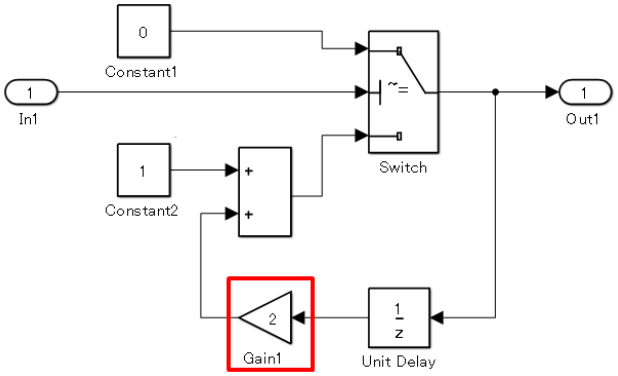
Example — Correct

The model is arranged so that the output is to the right. The output of the Delay block is to the left.



Example — Incorrect

The block is arranged so the output is to the left.



Rationale

Sub ID a:

- Signal flow can be difficult to understand if the direction of the signals is not consistent.

Verification

Model Advisor check: “Check block orientation” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0110, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0171: Clarification of connections between structural subsystems

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

A minimum of one signal line shall connect two structural subsystems.

When a two-way signal connection exists between two structural subsystems (A and B), each direction shall be connected to at least one signal line.

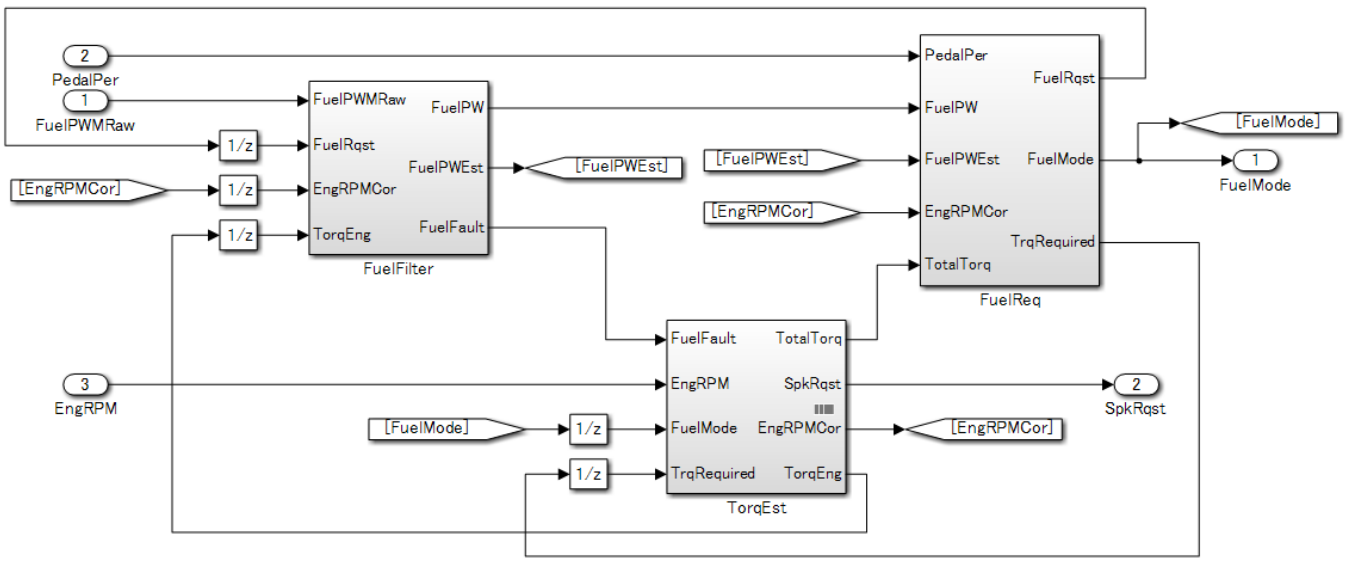
Exception

Using Goto and From blocks to create buses or connect signals to a Merge block.

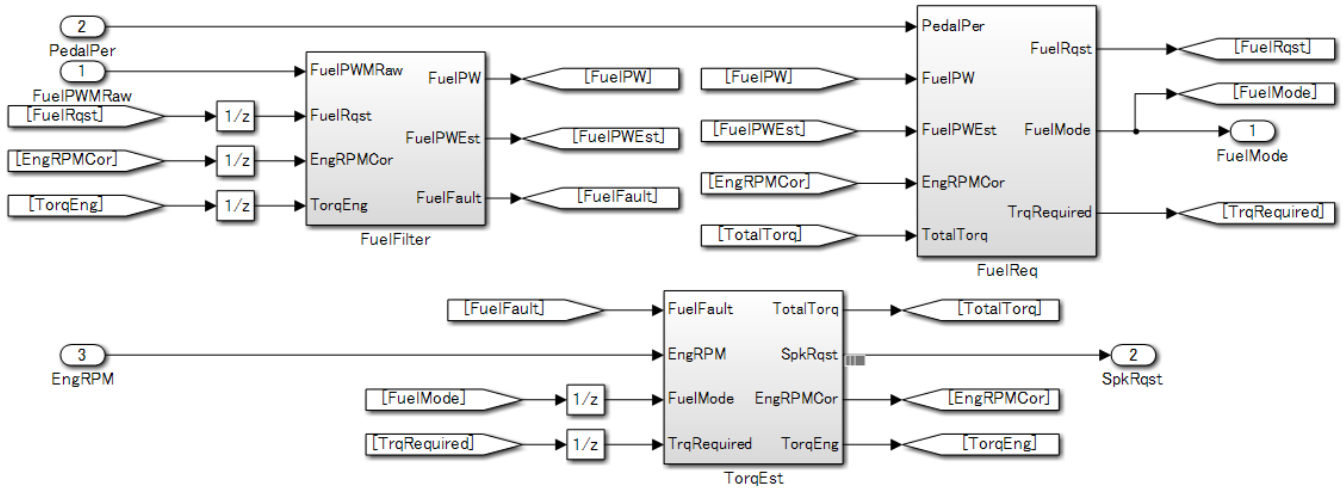
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



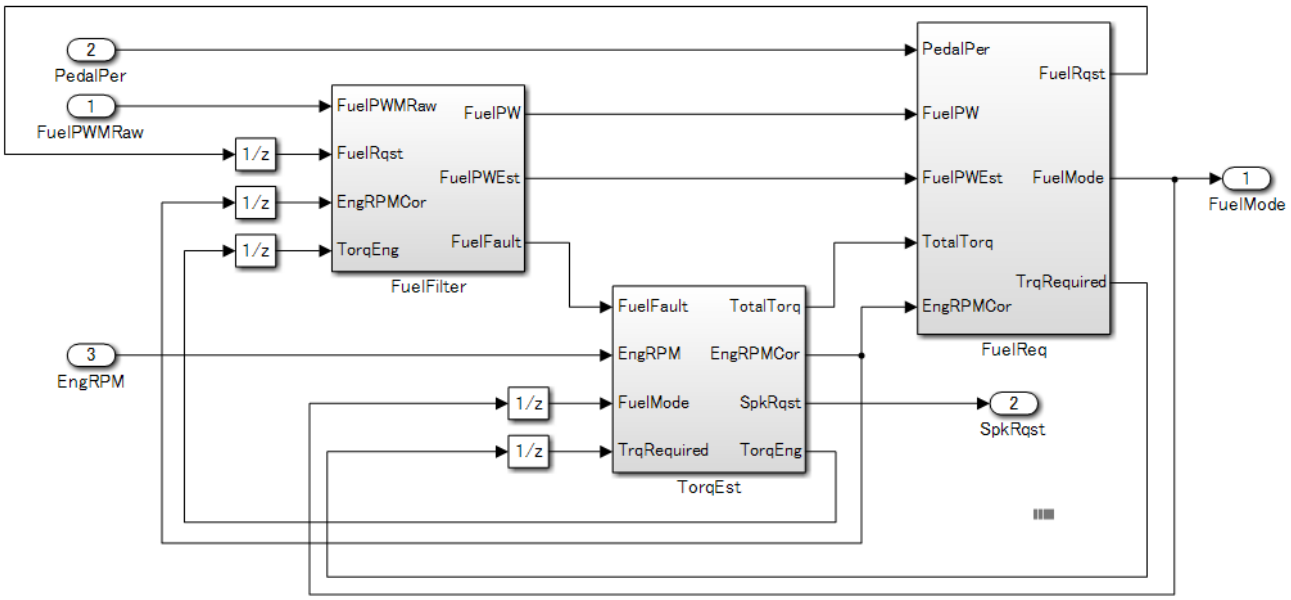
Sub ID b

Signals that are not used within a structural subsystem shall be input to a structural subsystem. These signals shall not be output to other structural subsystems or basic blocks.

Custom Parameter

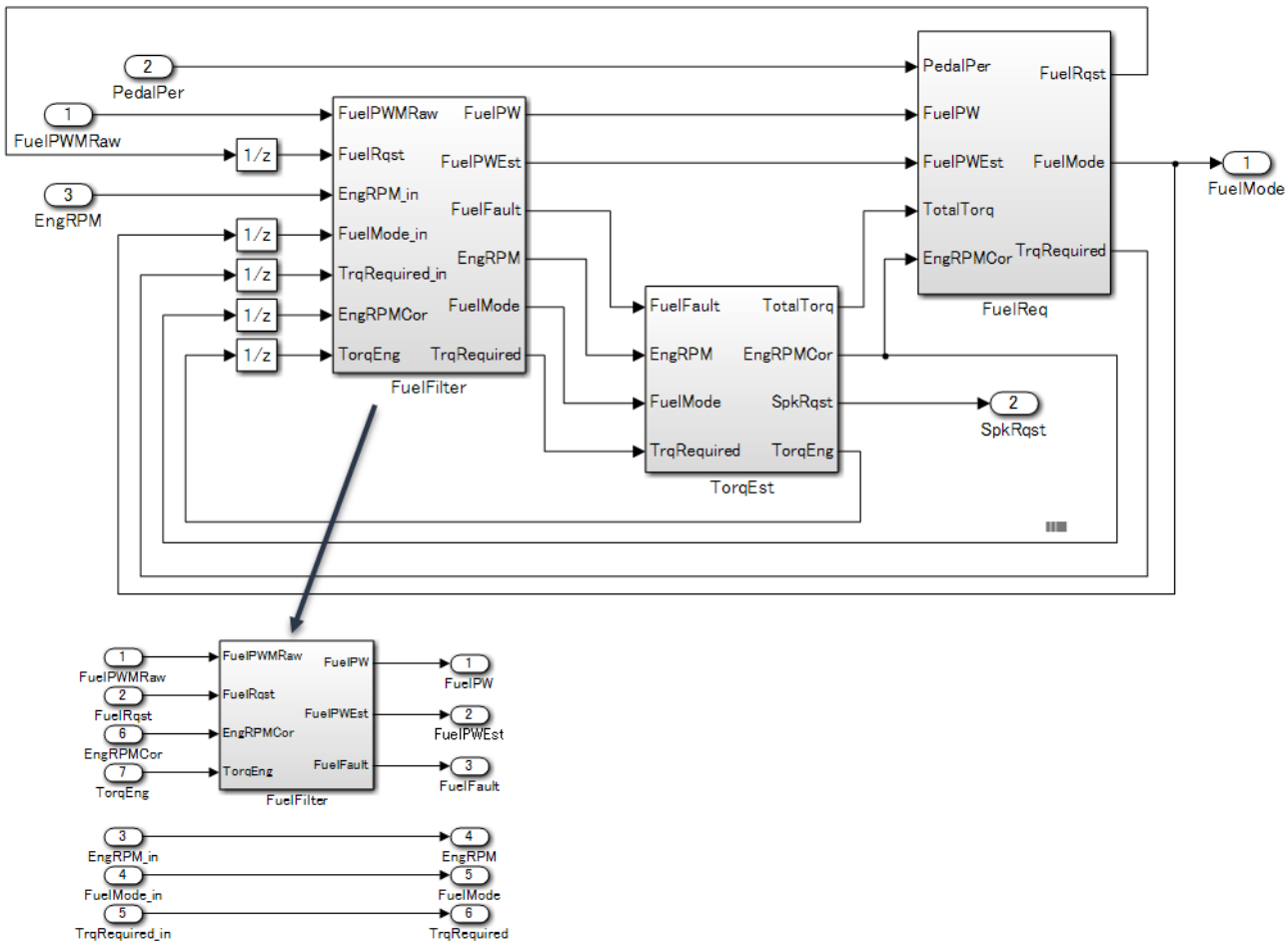
Not Applicable

Example — Correct



Example — Incorrect

Signals that are not used in the subsystem are connected to avoid crossing of signal lines.



Rationale

Sub ID a:

- Clarifies structural subsystem connections and execution order.

Sub ID b:

- Eliminating unnecessary connections clarifies the relationship between connections.
- Deviation from the rule can cause to confusion due to unused input/output signals.

Verification

Model Advisor check: “Check connections between structural subsystems” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0171, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Types of Subsystems”

Introduced in R2020a

jc_0602: Consistency in model element names

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

These names shall match when they are directly connected by using signal lines.

- Inport block name
- Outport block name
- Structural subsystem input port label name
- Structural subsystem output port label name
- From block tag name
- Goto block tag name
- Signal line signal name

Exceptions

A signal line that connects to one of the following subsystem types can have a name that differs from that of the subsystem port label:

- Subsystems linked to a library
- Reusable subsystems

When a combination of Inport, Outport, and other blocks have the same name, use a suffix or prefix for the Inport and Outport blocks. Any prefix or suffix can be used for ports, but they must be consistent. For example, the Inport block uses “in” and Outport block uses “out”.

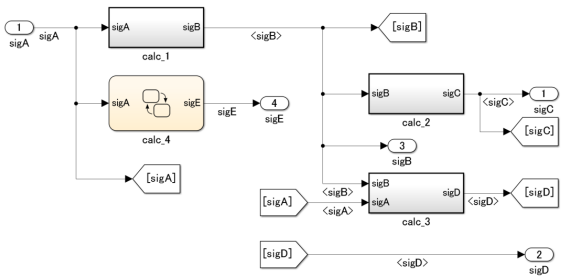
Note Inport and Outport blocks must have different names and signal names.

Custom Parameter

Not Applicable

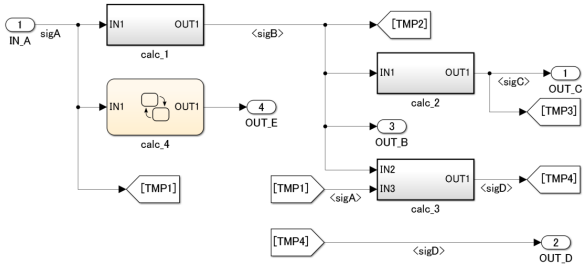
Example — Correct

Names of model elements that connect directly to signal lines are consistent.



Example — Incorrect

Inconsistent names for model elements that connect directly to signal lines.



Rationale

Sub ID a:

- Prevent misconnected signal lines.
- Readability is impaired.
- Deviation from the rule can make it difficult to maintain the integrity of the model and code.

Verification

Model Advisor check: “Check for consistency in model element names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0602, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Manage Signal Lines”
- “Types of Subsystems”

Introduced in R2020a

jc_0281: Trigger signal names

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a1/a2/a3/a4, b1/b2/b3/b4

MATLAB Versions

All

Rule

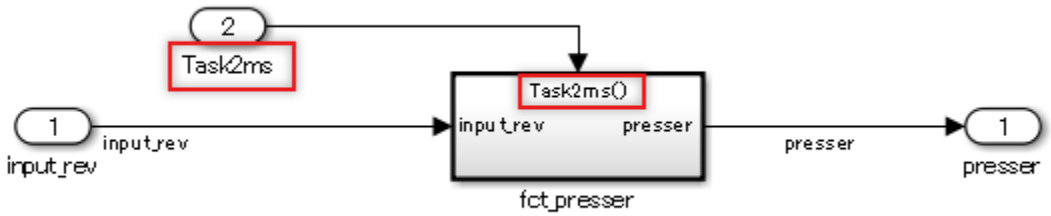
Sub ID a1

The name of the conditional input block at the destination shall include the name of the block at the origin of the trigger signal

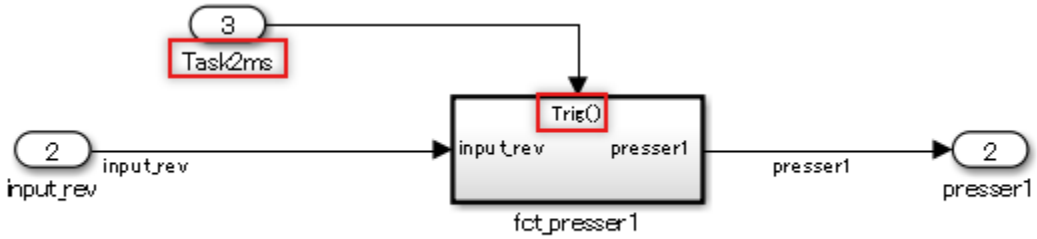
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



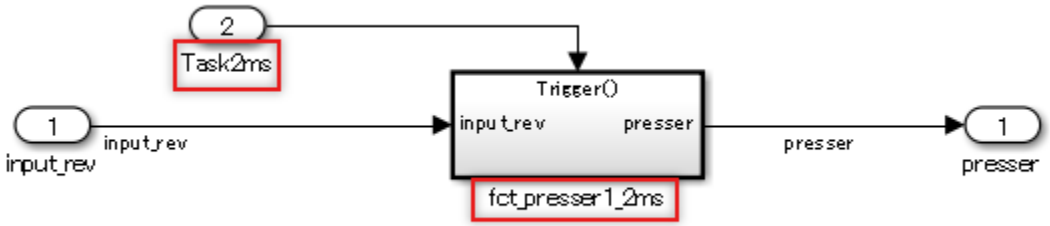
Sub ID a2

The name of the conditional subsystem at the destination shall include the name of the block at the origin of the trigger signal.

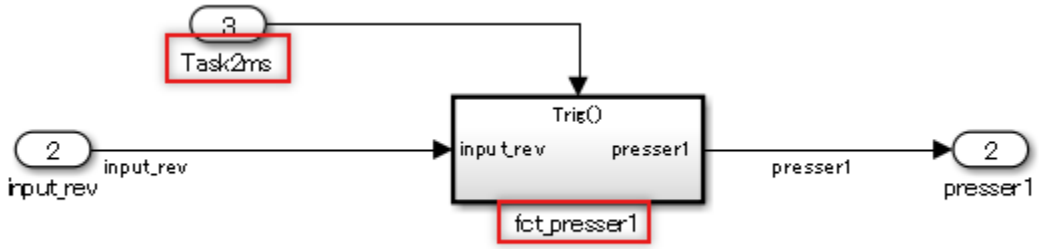
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



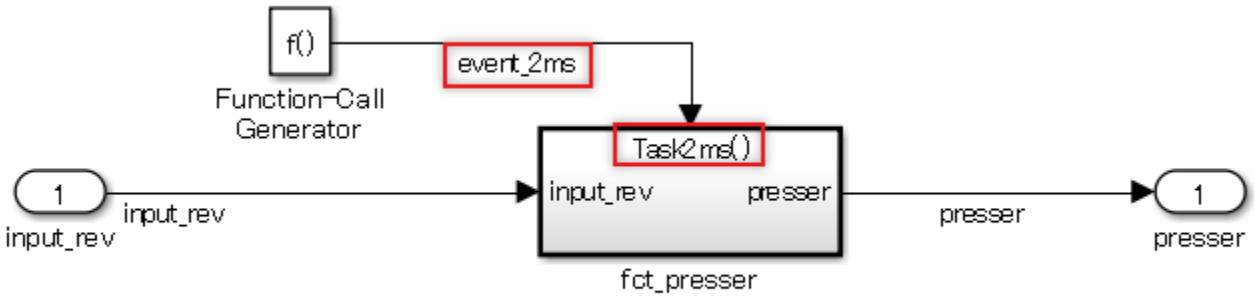
Sub ID a3

The name of the conditional input block at the destination shall include the name of the trigger signal.

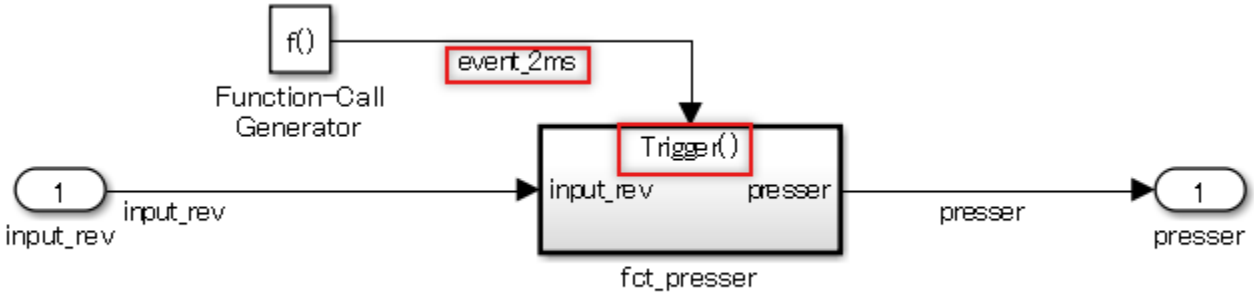
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



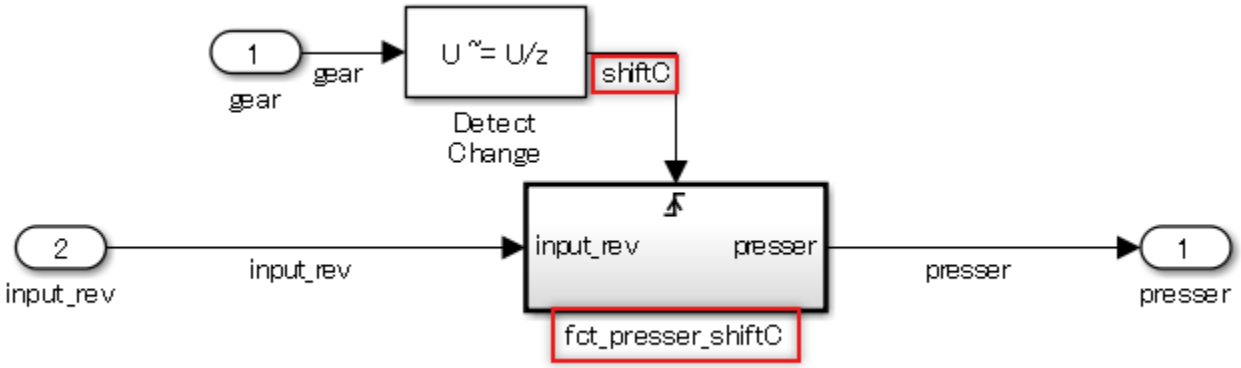
Sub ID a4

The name of the conditional subsystem at the destination shall include the name of the trigger signal.

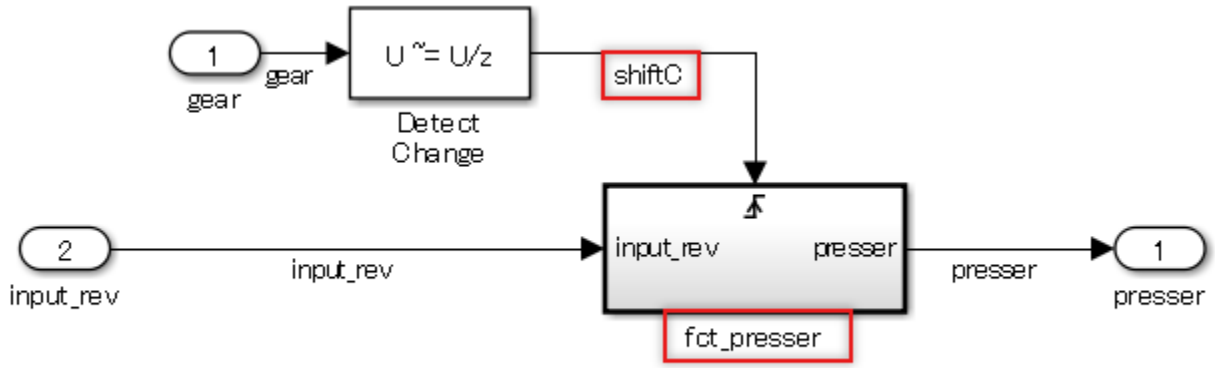
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



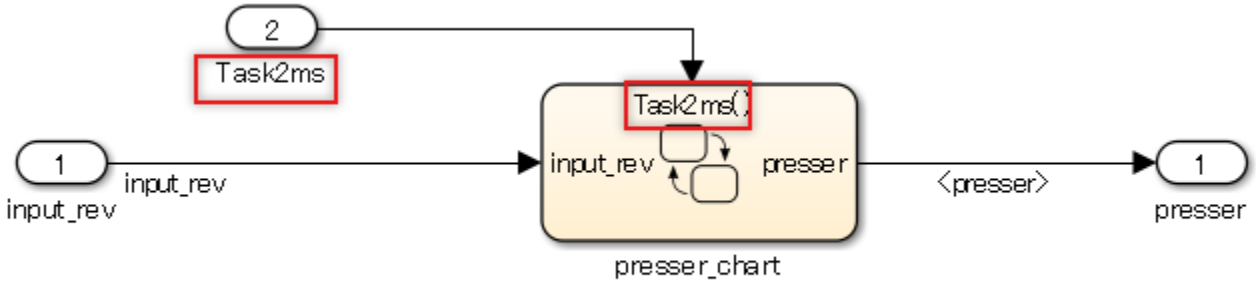
Sub ID b1

The name of the Stateflow block event at the destination shall include the name of the block at the origin of the trigger signal.

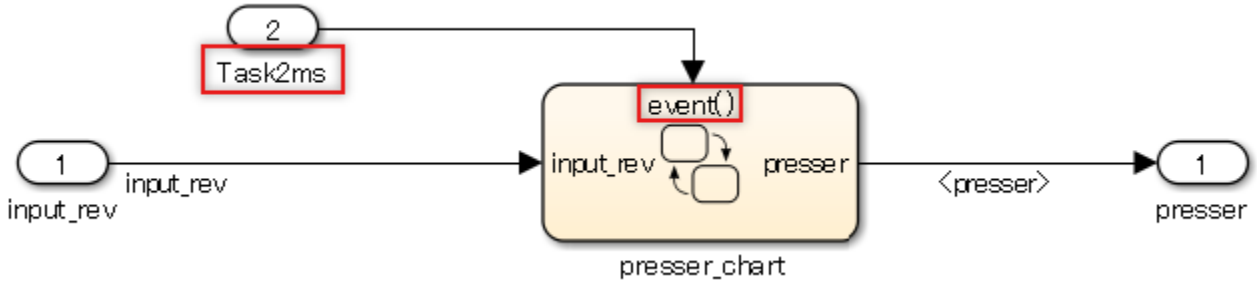
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



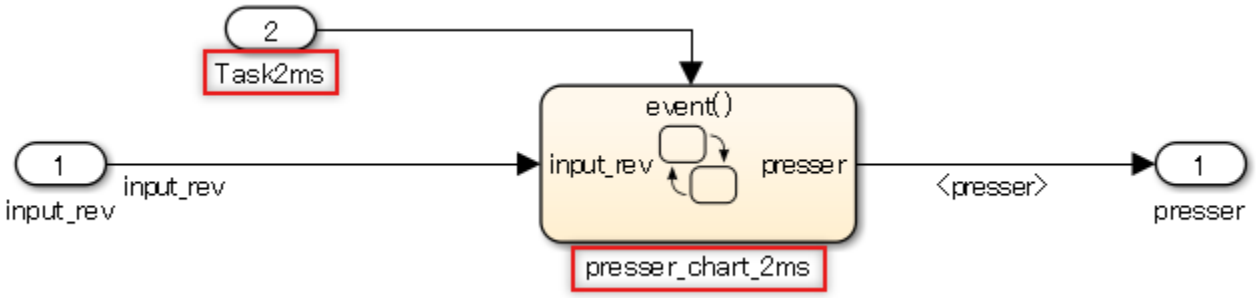
Sub ID b2

The name of Stateflow Chart at the destination shall include the name of the block at the origin of the trigger signal.

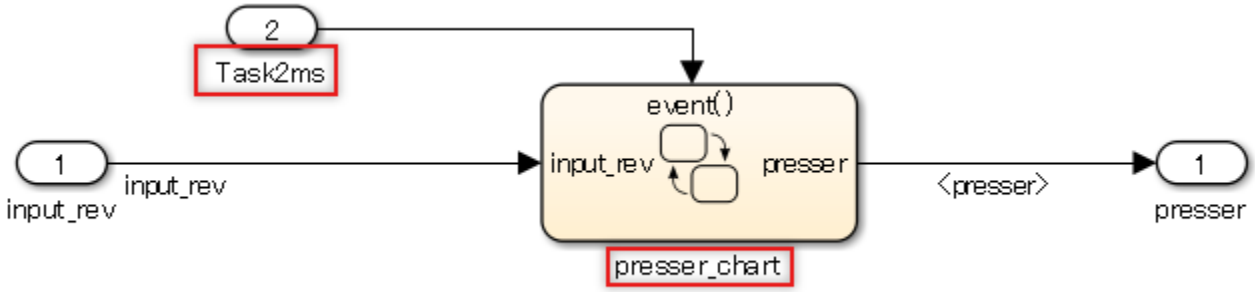
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



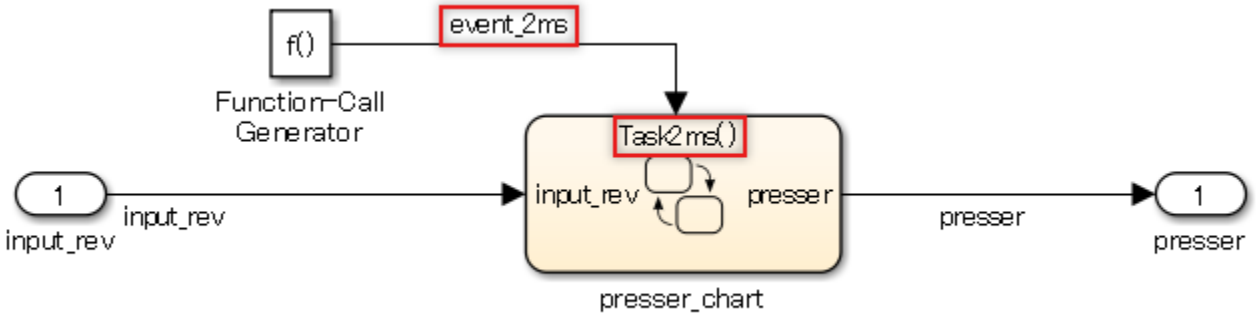
Sub ID b3

The name of the Stateflow block event at the destination shall include the name of the trigger signal.

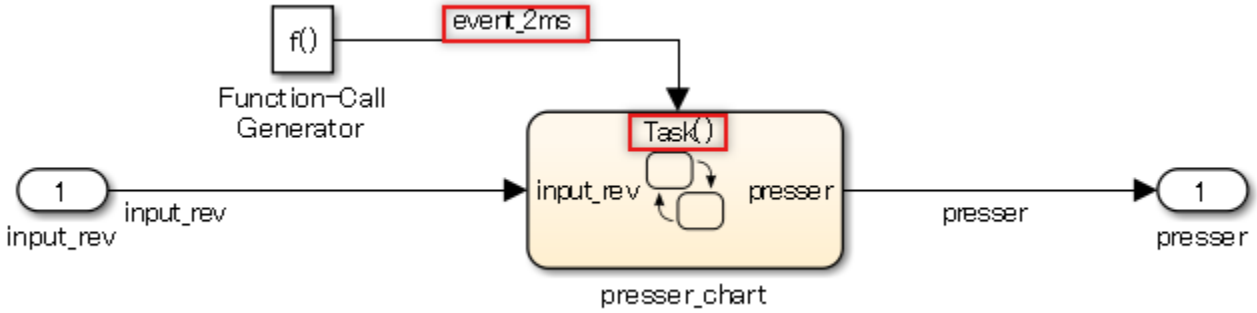
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



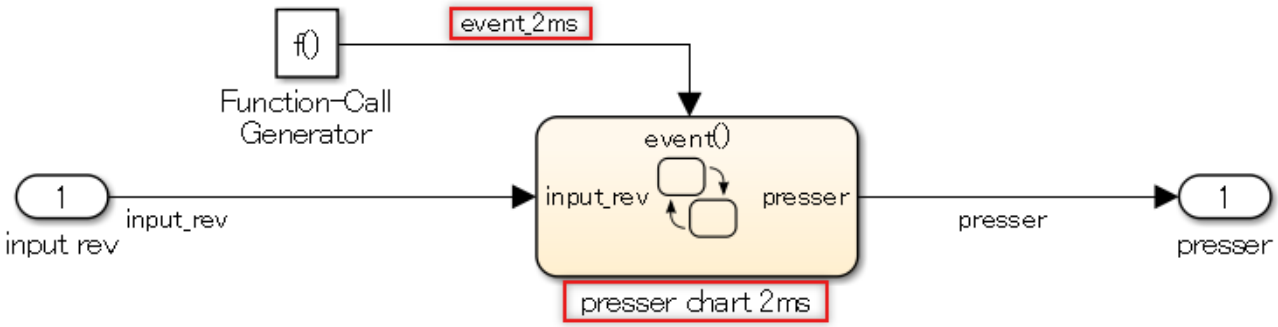
Sub ID b4

The name of the trigger signal and the Stateflow Chart name at the destination must include the same name. The name of the Chart block at the destination shall include the name of the trigger signal.

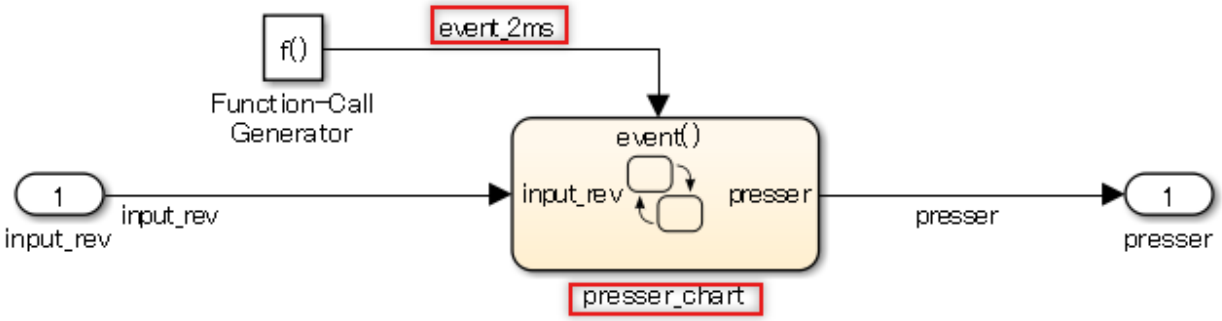
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a1, a2, a3, a4, b1, b2, b3, b4:

- Reduces connection mistakes.
- Increases understanding of the relationship between the origin of the trigger signal and the destination.

Verification

Model Advisor check: “Check trigger signal names” (Simulink Check)

Last Changed

R2020a

See Also

- Sub ID a1, a2, a3, a4, see MISRA AC SLSF 026C
- JMAAB guideline jc_0281, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Use Events to Execute Charts” (Stateflow)
- “Types of Subsystems”

Introduced in R2020a

db_0143: Usable block types in model hierarchy

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Model levels shall use only the block types that are defined for the layer type. Clearly defined layer types restrict the number of blocks that can be used.

Block restrictions:

- (R2011a and earlier) Enable block cannot be used at the root level of the model.
- Action ports are not permitted at the root level of a model.

Layer restrictions:

- Data flow layers that are used for basic blocks only.
- Other than data flow layers, layers can include blocks that are used for structural subsystems and all other layers.

Blocks that can be used for all layers include:

- Inport
- Outport
- Mux
- Demux
- Bus Selector
- Bus Creator
- Selector
- Ground
- Terminator
- From
- Goto
- Merge
- Unit Delay

- Rate Transition
- Data Type Conversion
- Data Store Memory
- If
- Switch Case
- Function-Call Generator
- Function-Call Split
- Inport Shadow

Custom Parameter

Layer type

Block type

Rationale

Sub ID a:

- Readability is impaired when subsystems and basic blocks are used in the same layer.

Verification

Model Advisor check: “Check for mixing basic blocks and subsystems” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0143, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

db_0144: Use of subsystems

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

Blocks in a Simulink diagram shall be grouped together into subsystems based on functional decomposition of the algorithm, or portion thereof, represented in the diagram. Blocks can also be grouped together based on behavioral variants or timing.

Avoid grouping blocks into subsystems primarily for the purpose of saving space in the diagram. Each subsystem in the diagram should represent a unit of functionality that is required to accomplish the purpose of the model or submodel.

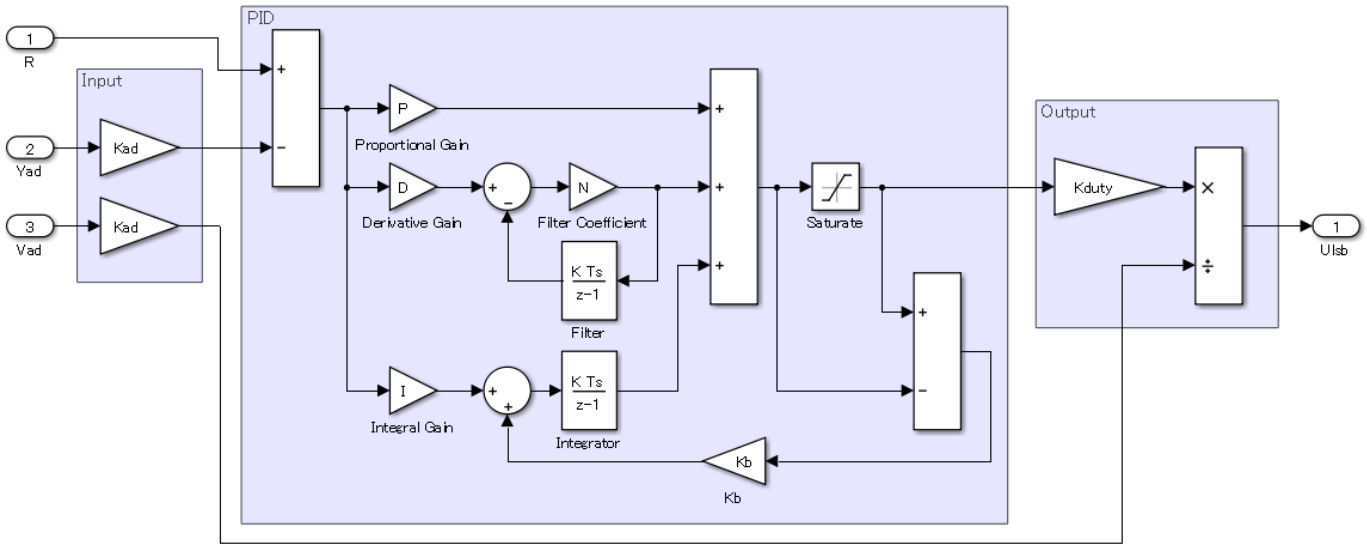
When implementing a subsystem to alleviate readability issues, use a virtual subsystem.

Custom Parameter

Not Applicable

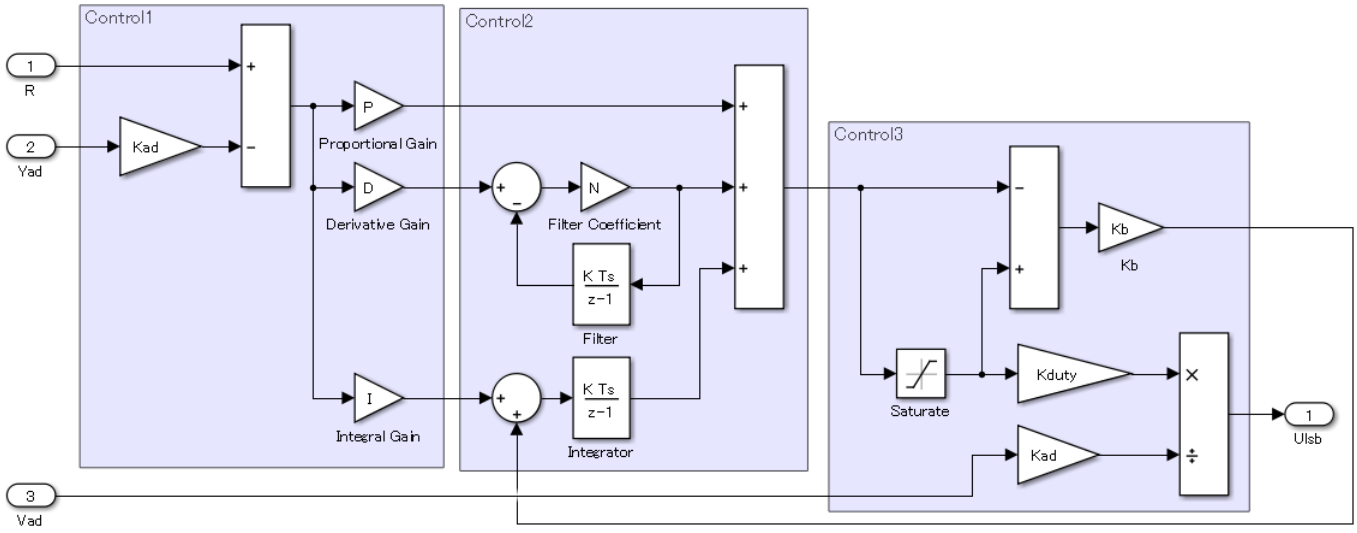
Example — Correct

Subsystems are divided by functional unit.



Example — Incorrect

Subsystems are not divided by functional unit.



Sub ID b

A virtual subsystem shall be used when processing order and code generation does not need to be taken into consideration.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Avoid grouping blocks into subsystems primarily for the purpose of saving space in the diagram.
- It can be difficult to reuse the subsystem.

Sub ID b:

- As atomic subsystems are considered a single process that influences processing order and code optimization, they can be misinterpreted when used other than as intended.

Verification

Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline db_0144, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Types of Subsystems”
- Subsystem

Introduced in R2020a

jc_0653: Delay block layout in feedback loops

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

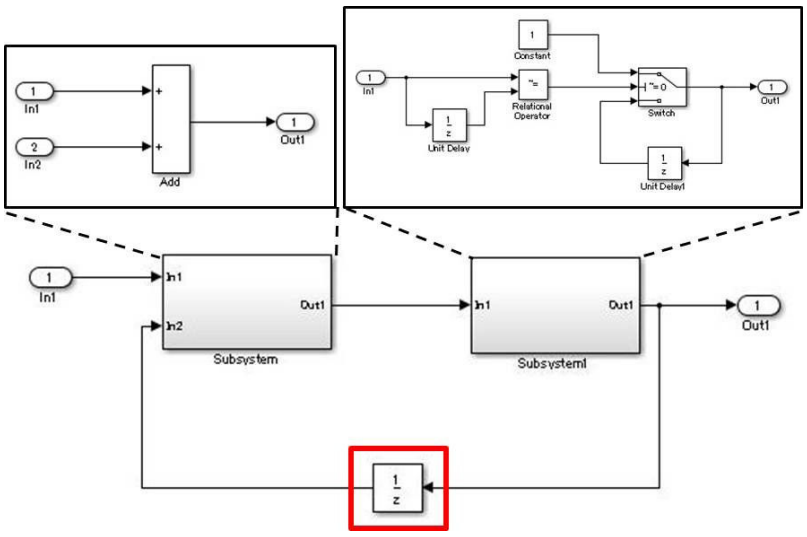
Delay block in feedback loops across subsystems shall reside in the hierarchy that describes the feedback loop.

Custom Parameter

Not Applicable

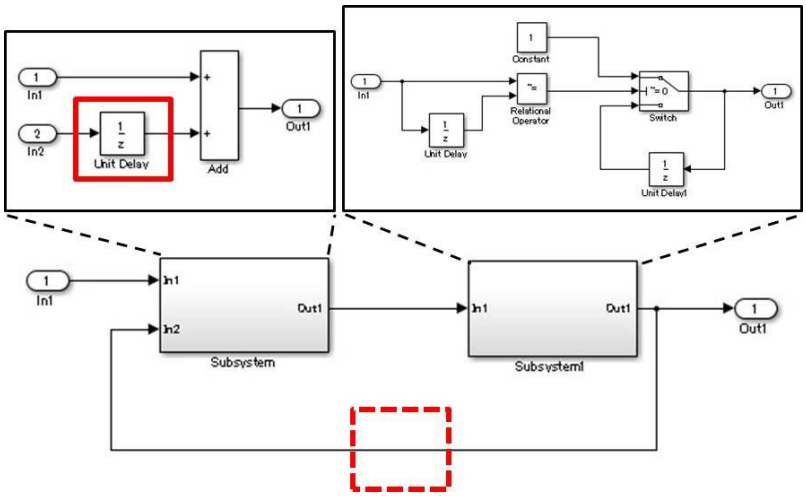
Example — Correct

Delay block resides in the hierarchy that describes the feedback loop.



Example — Incorrect

Delay block resides in a subsystem that is nested within the hierarchy which describes the feedback loop.



Rationale

Sub ID a:

- Prevents double placement of the Delay block.
- Clarifying the extent of diversion improves reusability.
- Improves testability; it is difficult to test a subsystem that contains a Delay block on its own because past values cannot be entered directly.

Verification

Model Advisor check: “Check for avoiding algebraic loops between subsystems” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0653, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

hd_0001: Prohibited Simulink sinks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

Control algorithm models shall be designed from discrete blocks.

Scope and Display blocks can be used in the model diagram.

These sink blocks shall not be used:

- To File
- To Workspace
- Stop Simulation

Consider using signal logging and the Viewers and Generators Manager for data logging and viewing requirements. (R2019b and later) To log and manage the signal, click the **Simulation** tab and, under the **Prepare** gallery, select the appropriate tool.

Custom Parameter

Not Applicable

Rationale

Sub ID a

- Improves readability and model simulation.
- Code generation may not be possible.

Verification

Model Advisor check: “Check for prohibited sink blocks” (Simulink Check)

Last Changed

R2020a

See Also

- “Viewers and Generators Manager”

Introduced in R2020a

Signal

na_0010: Usage of vector and bus signals

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b, c, d

MATLAB Versions

All

Rule

Sub ID a

Mux and Demux blocks shall be used when generating and decomposing vectors.

Custom Parameter

Not Applicable

Sub ID b

Mux block inputs shall be scalars and vectors.

Custom Parameter

Not Applicable

Sub ID c

Bus Creator and Bus Selector blocks shall be used when generating and decomposing buses.

Custom Parameter

Not Applicable

Sub ID d

Buses shall connect to blocks that support buses.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b, c, d:

- Prevents issues that are caused by combining vector and bus signals.

Verification

Model Advisor check: “Check usage of vector and bus signals” (Simulink Check)

Last Changed

R2021a

See Also

- JMAAB guideline na_0010, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Signal Types”
- “Data Types for Buses”
- “Bus-Capable Blocks”

Introduced in R2020a

jc_0008: Definition of signal names

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Signal names shall be defined for signal lines that output from important blocks. The signal name shall be provided once, at the origin of the signal line.

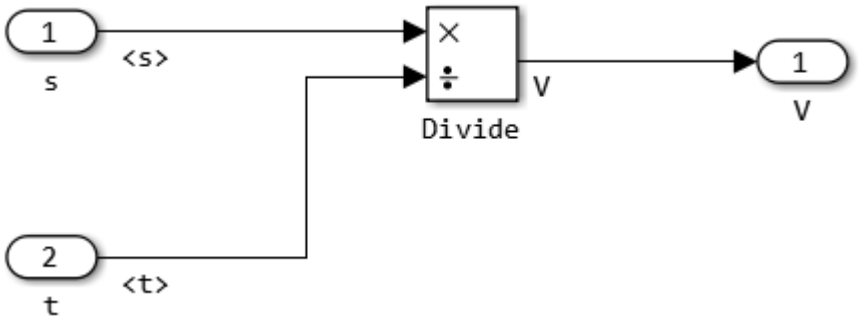
A label shall be used to display defined signal names.

Note An important block is defined by the system input and output of meaningful results, not by its type.

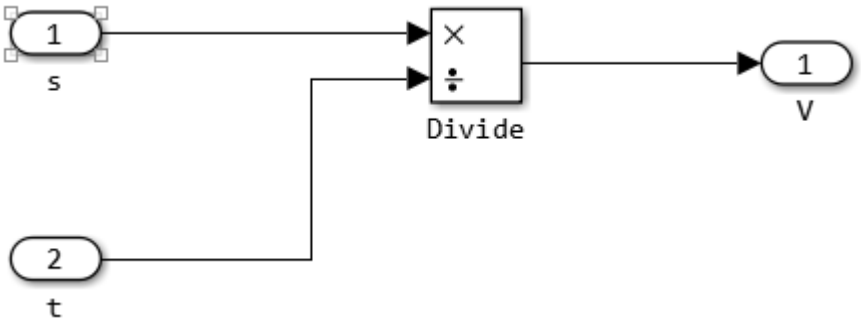
Custom Parameter

Definition of an important block

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Defining the signal name and displaying the label for the output of meaningful results from important blocks improves the readability of the model.

Verification

Model Advisor check: “Check signal line labels” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0008, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Types of Subsystems”

Introduced in R2020a

jc_0009: Signal name propagation

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

When defining the signal name for a signal that extends across a hierarchy, signal property **Show propagated signals** shall be selected so that propagated signal names are displayed.

However, when one of the following conditions is met, do not select **Show propagated signals**:

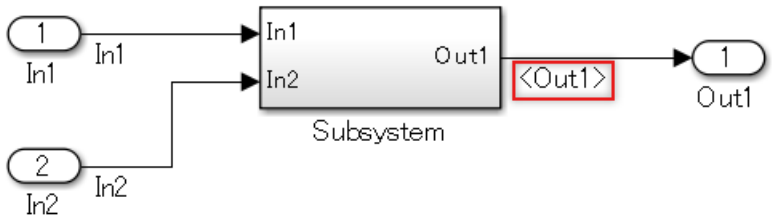
- In a subsystem with a library
- In subsystems where reusable functions are set
- A signal name is not set at the outport signal of the Bus Creator block

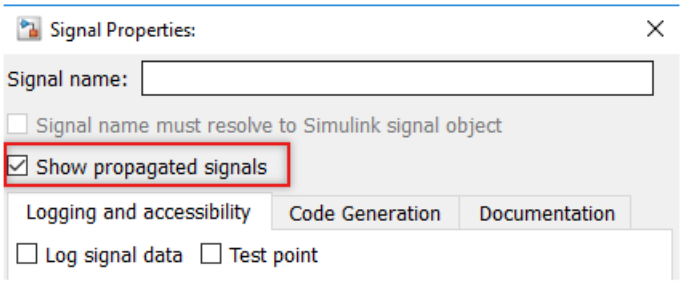
Custom Parameter

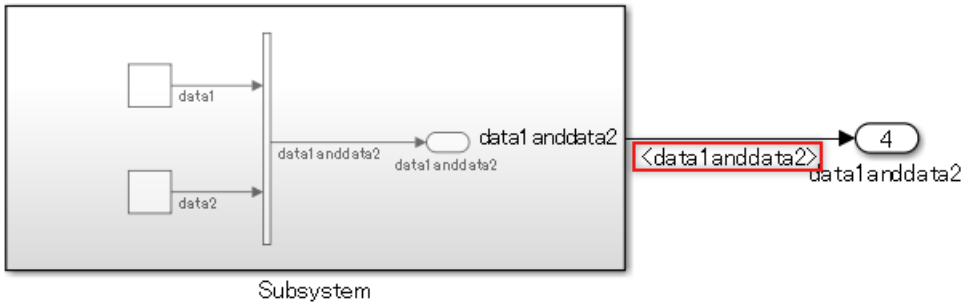
Not Applicable

Example — Correct

Propagated signal names are displayed.

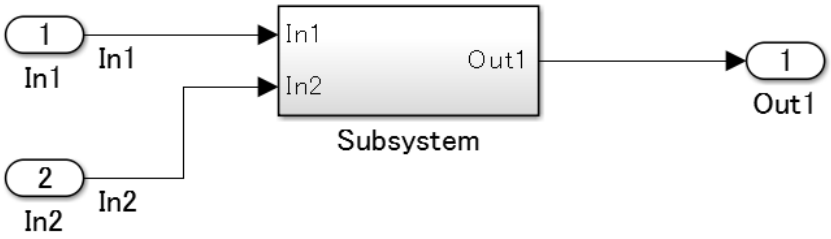


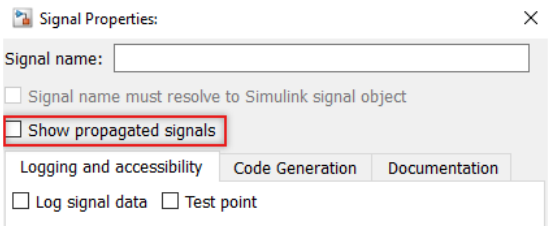




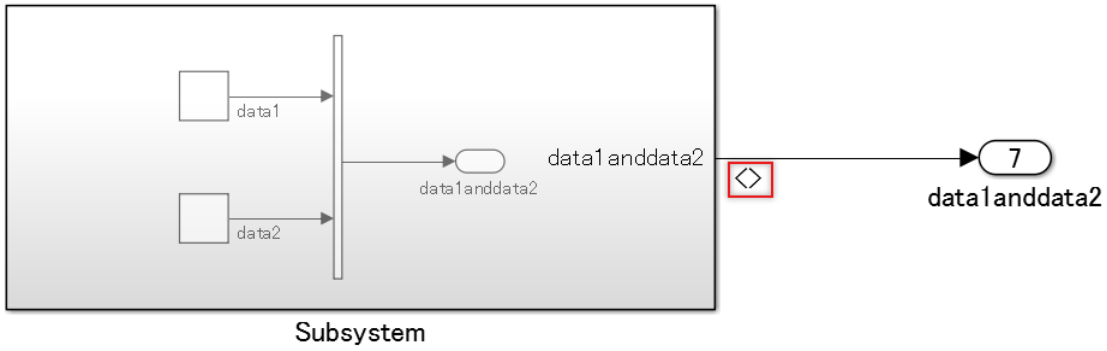
Example — Incorrect

Show propagated signals is not selected, therefore signal names are not displayed.

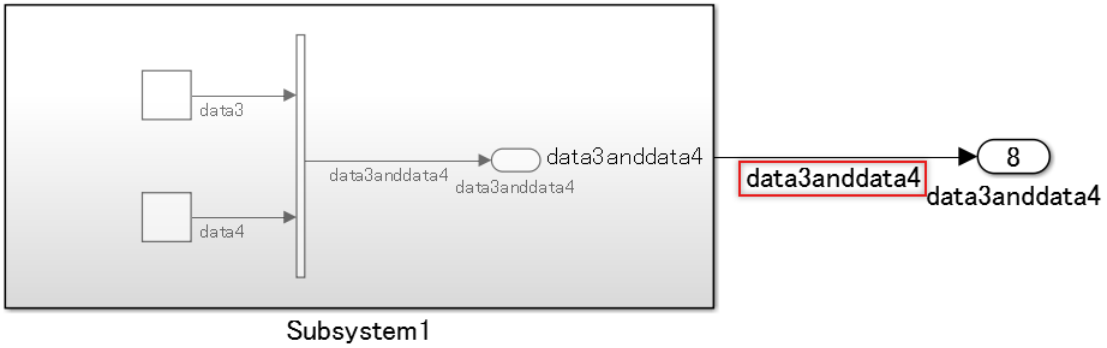




Signals that connect to Bus Creator and Outport blocks do not have names, but **Show propagated signals** is selected for signals that connect to Subsystem and Outport blocks.



Signals that connect to Bus Creator and Outport blocks have names, but signals that connect to Subsystem and Outport blocks also have names.



Sub ID b

Signal property **Show propagated signals** shall be selected for these blocks so that propagated signal names of the signal output are displayed:

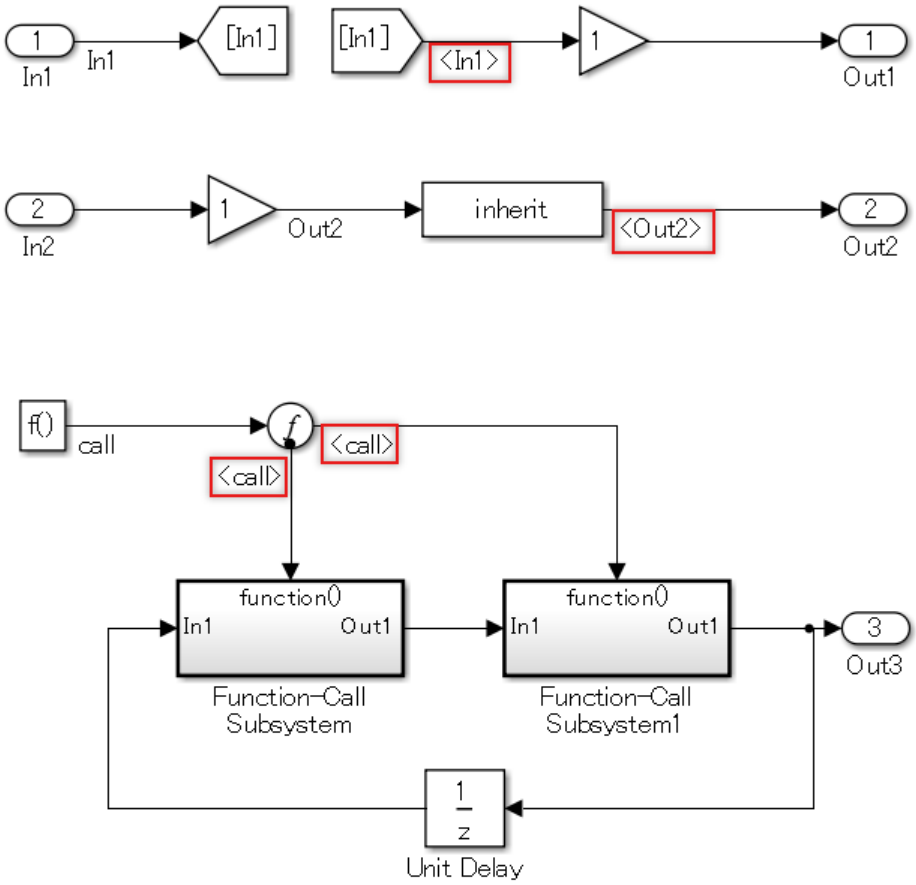
- From
- Signal Specification
- Function-Call Split[

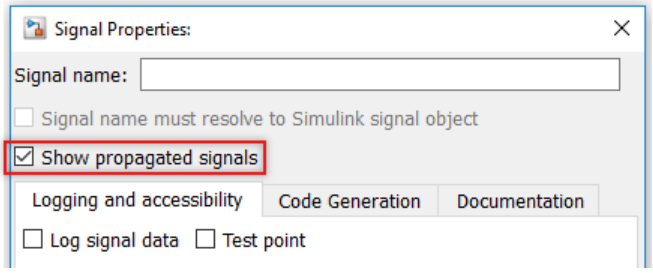
Custom Parameter

Not Applicable

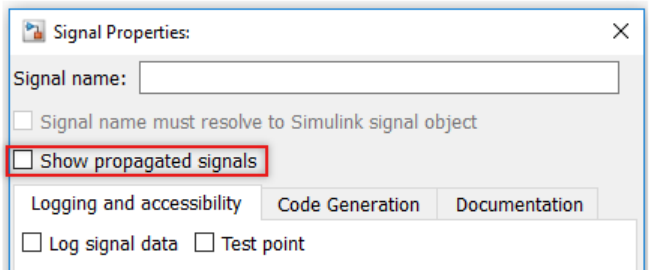
Example — Correct

Propagated signal names are displayed.

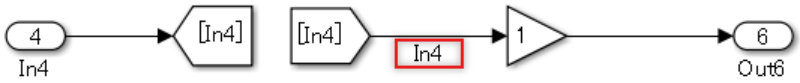


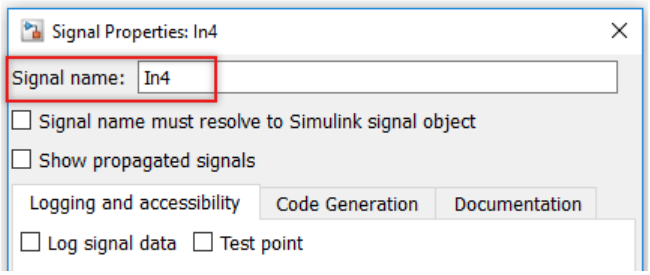


Signals that connect to Inport and Goto blocks do not have names, therefore **Show propagated signals** does not need to be selected.



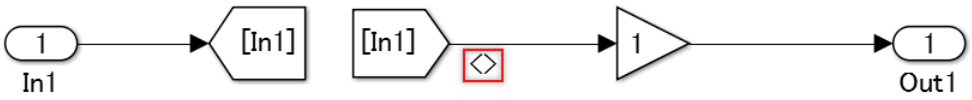
Signals that connect to Inport and Goto blocks do not have names, therefore signals that connect to From and Gain blocks can be left unnamed.



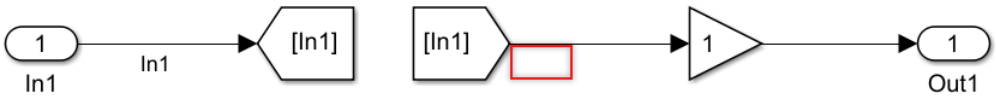


Example — Incorrect

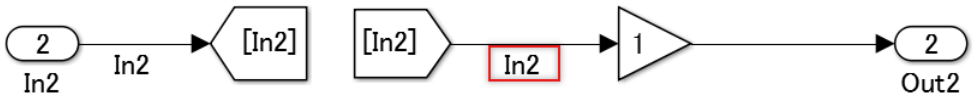
Signals that connect to Inport and Goto blocks do not have names, but **Show propagated signals** is selected for signals that connect to From and Gain blocks.



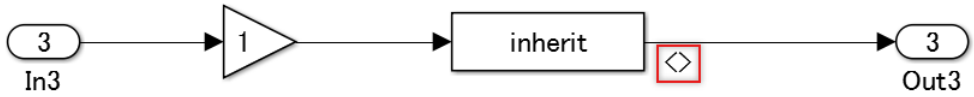
Regardless of whether signals are propagated, **Show propagated signals** is not selected



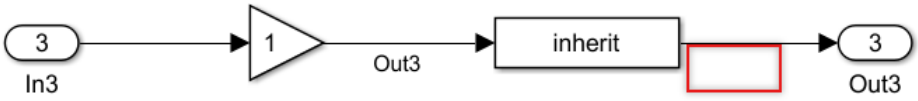
Signals that connect to Inport and Goto blocks have names, but signals that connect to From and Gain blocks are named.



Signals that connect to Gain and Signal Specification blocks do not have names, but **Show propagated signals** is selected for signals that connect to Signal Specification and Outport blocks.

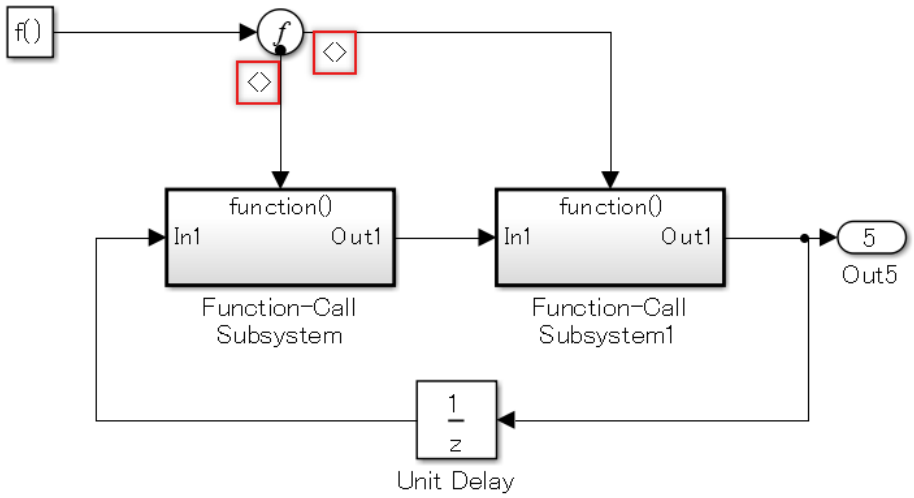


Regardless of whether signals are propagated, **Show propagated signals** is not selected.

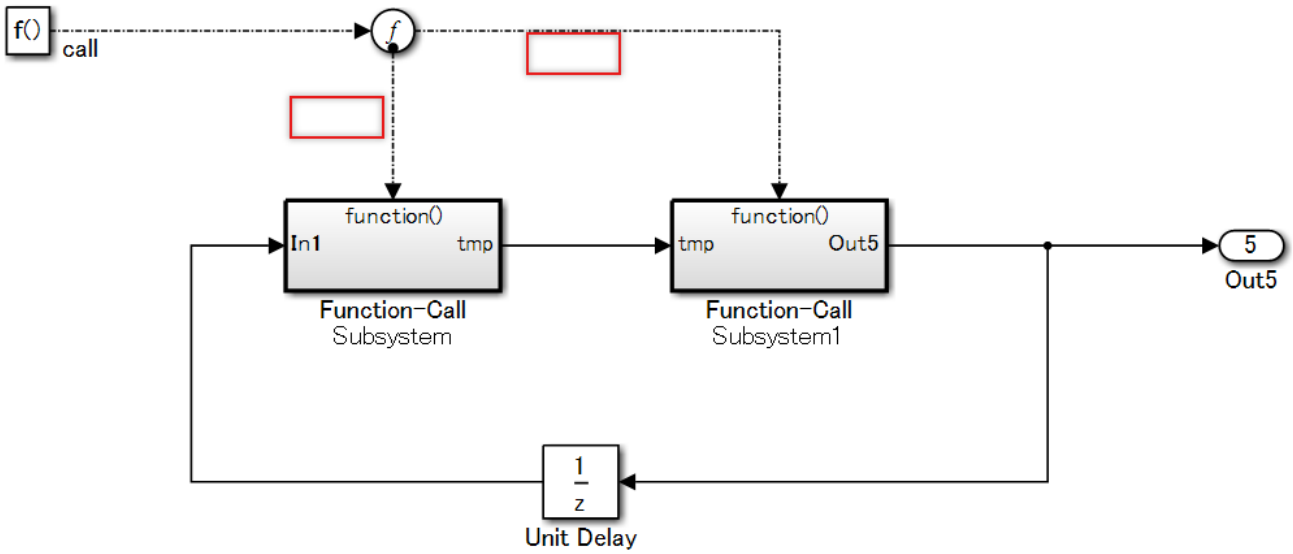


Signals that connect to Gain and Signal Specification blocks have names, but signals that connect to Signal Specification and Outport blocks also have names.

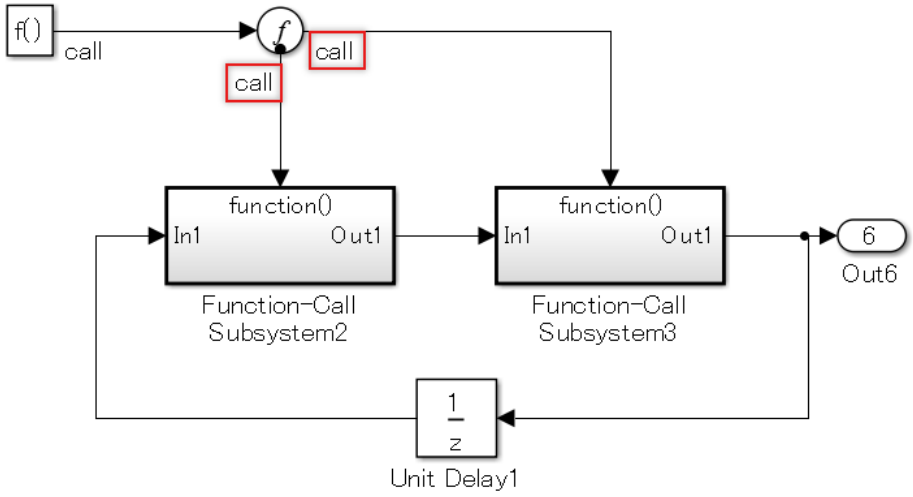
Signals that connect to Function-Call Generator and Function-Call Split blocks do not have names, but **Show propagated signals** is selected for signals that connect to Function-Call Split and Function-Call Subsystem blocks.



Regardless of whether signals are propagated, **Show propagated signals** is not selected.



Signals that connect to Function-Call Generator and Function-Call Split blocks have names and signals that connect to Function-Call Split and Function-Call Subsystem blocks are also named.



Rationale

Sub IDs a, b:

- Prevents signal line connection mistakes.
- Prevents signal line name mistakes.

Verification

Model Advisor check: “Check for propagated signal labels” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0009, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”
- “Types of Subsystems”

Introduced in R2020a

db_0097: Position of labels for signals and buses

Sub ID Recommendations

- NA-MAAB — a, b, c
- JMAAB — a, b,c

MATLAB Versions

All

Rule

Sub ID a

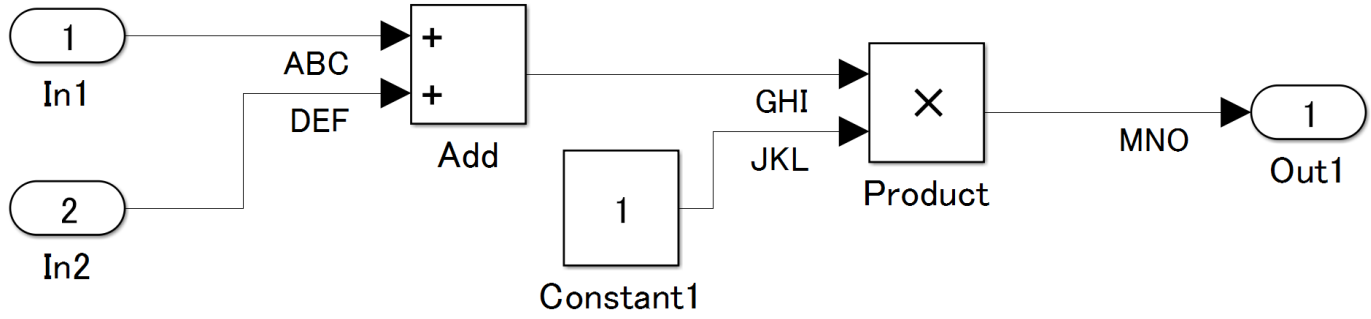
Signal line labels and bus labels shall not overlap other labels, signal lines, or blocks.

Custom Parameter

Not Applicable

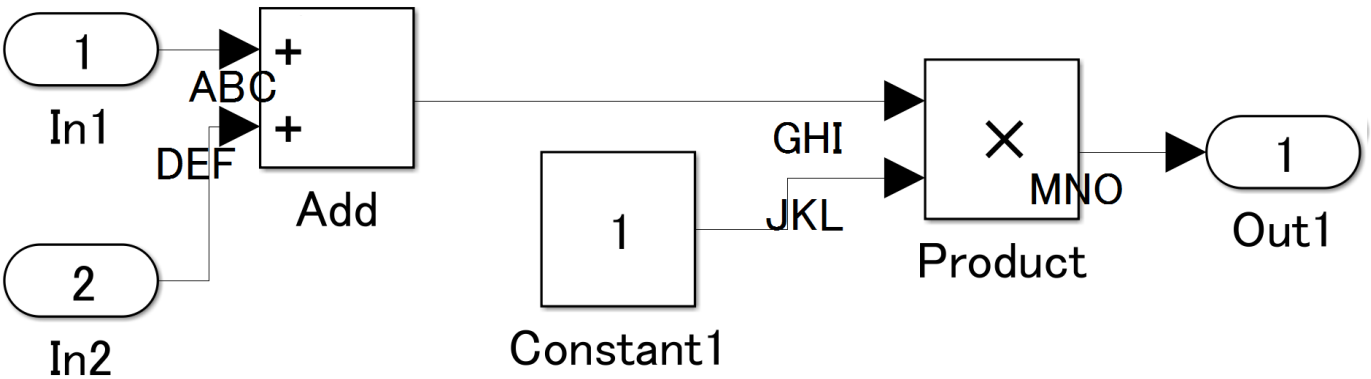
Example — Correct

Signal line labels and bus labels do not overlap other labels, signal lines, or blocks.



Example — Incorrect

Signal line labels and bus labels overlap other labels, signal lines, or blocks.



Sub ID b

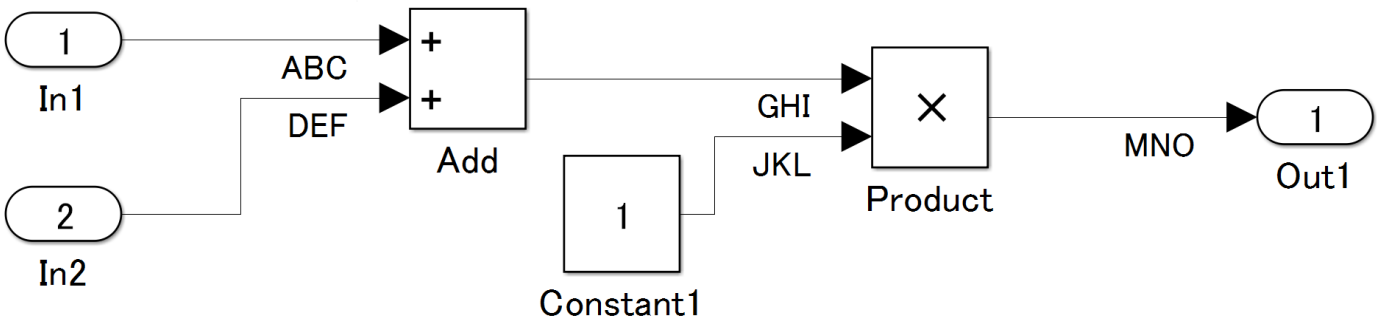
Signal line labels and bus labels shall be positioned below signal lines.

Custom Parameter

Not Applicable

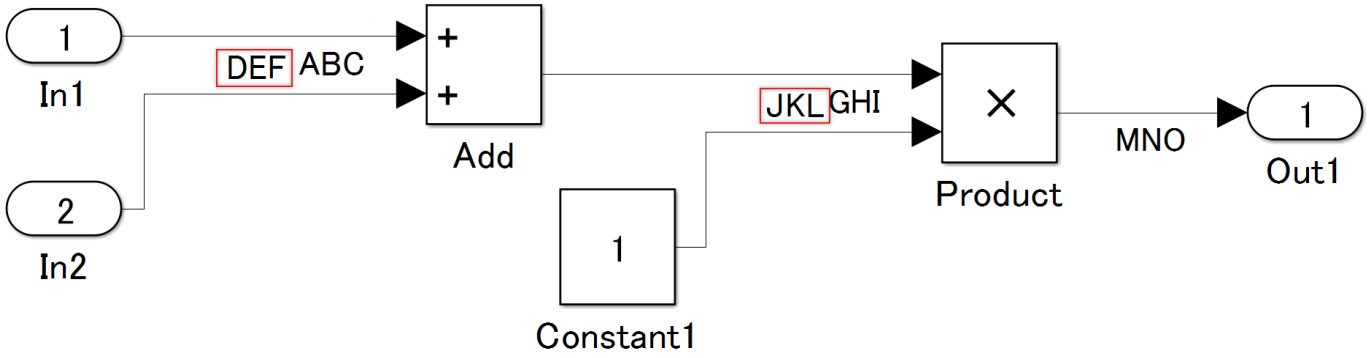
Example — Correct

Signal line labels and bus labels are below signal lines.



Example — Incorrect

Signal line labels and bus labels are above the signal line.



Sub ID c

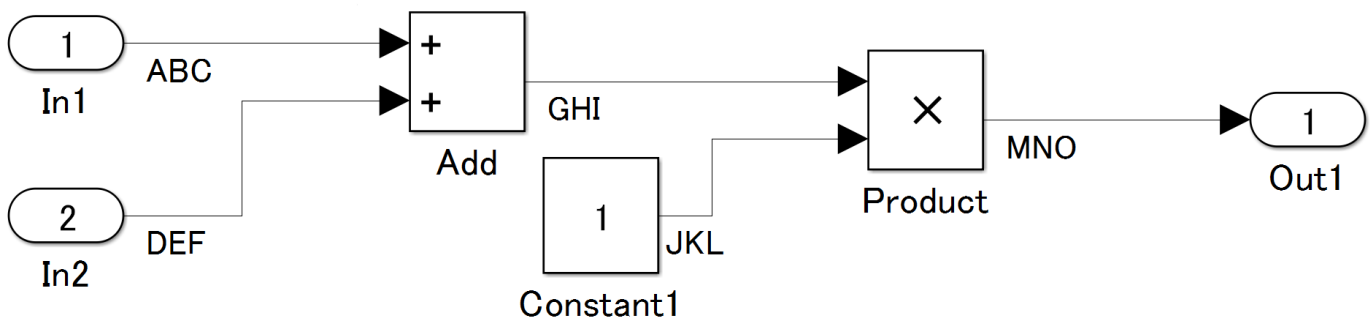
Signal line labels and bus labels shall be positioned at the origin of the connection.

Custom Parameter

Not Applicable

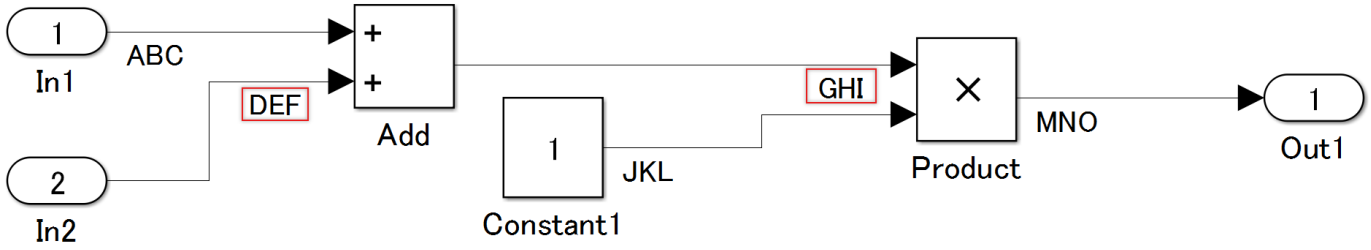
Example — Correct

Signal line labels and bus labels are positioned at the origin of the signal line connection.



Example — Incorrect

Signal line labels and bus labels are positioned at the destination of the signal line connection.



Rationale

Sub ID a:

- Adherence to this rule prevents confusion with corresponding names, signal lines, and buses, which improves readability of the model.

Sub ID b, c:

- Consistent label position prevents confusion with corresponding labels, signal lines, and buses, which improves the readability of the model.

Verification

Model Advisor check: “Check signal flow in model Check position of signal labels” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0097, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”

- “Signal Lines”
- “Explore Simulink Bus Capabilities”

Introduced in R2020a

na_0008: Display of labels on signals

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

A label shall be displayed on the signal line originating from these blocks:

- Inport
- From (see exception)
- Subsystem or Stateflow Chart (see exception)
- Bus Selector (the tool forces this to happen)
- Demux
- Selector
- Data Store Read (see exception)
- Constant (see exception)

Exception

When the signal label is visible in the originating block icon display, the signal does not need not to have the label displayed *unless* the signal label is needed elsewhere due to a destination-based rule.

Custom Parameter

Not Applicable

Sub ID b

A label shall be displayed on a signal line that connects (either directly or by way of a basic block that performs a non-transformative operation) to these destination blocks:

- Outport
- Goto
- Data Store Write
- Bus Creator
- Mux
- Subsystem

- Stateflow Chart

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Improves readability, model simulation, and workflow.
- Code generation may not be possible.

Sub ID b:

- Improves readability, model simulation, and workflow.

Verification

Model Advisor check: “Check signal line labels” (Simulink Check)

Last Changed

R2020a

See Also

- “Signal Basics”
- “Manage Signal Lines”
- “Types of Subsystems”

Introduced in R2020a

na_0009: Entry versus propagation of signal labels

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

When a label is displayed for a signal, the following rules define whether that label is created there (entered directly on the signal) or propagated from its true source (inherited from elsewhere in the model by using the < character).

Signal labels shall be entered for signals that originate from:

- The Inport block at the root (top) level of a model
- Basic blocks that perform a transformative operation (For the purpose of interpreting this rule only, the Bus Creator, Mux, and Selector blocks also perform transformative operations.)

Signal labels shall be propagated for signals that originate from:

- Inport block in a nested subsystem
- Basic blocks that perform a non-transformative operation
- Subsystem block or Stateflow Chart block.

Exceptions

When the nested subsystem is a library subsystem, a label can be entered on the signal coming from the Inport block to accommodate reuse of the library block.

When the connection originates from the output of a library subsystem block, a new label can be entered on the signal to accommodate readability.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- The result of executing a MATLAB command is reflected in the code, which makes consistency between the model and code difficult to maintain.

Verification

Model Advisor check: “Check for propagated signal labels” (Simulink Check)

Last Changed

R2020a

See Also

- “Signal Basics”
- “Manage Signal Lines”
- “Signal Label Propagation”
- “Types of Subsystems”

Introduced in R2020a

db_0110: Block parameters

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Block parameters shall not be used to describe:

- Operation expressions
- Data type conversion
- Selection of rows or columns
- MATLAB commands

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Operation expressions, data type conversion, or row or column selection become a magic number in generated code, which makes consistency between the model and code difficult to maintain. Adjusting parameters also becomes difficult.
- Describing the calculation formula within the block decreases readability.
- The result of executing a MATLAB command is reflected in the code, which makes consistency between the model and code difficult to maintain.

Verification

Model Advisor check: “Check usage of tunable parameters in blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0110, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

db_0112: Usage of index

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

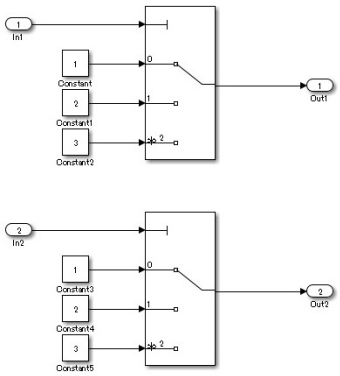
A vector signal shall use a one-based index mode.

Custom Parameter

Not Applicable

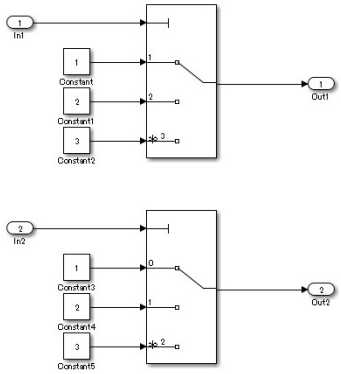
Example — Correct

A uniform zero-based index mode is used.



Example — Incorrect

A uniform index mode is not used.



Sub ID a2

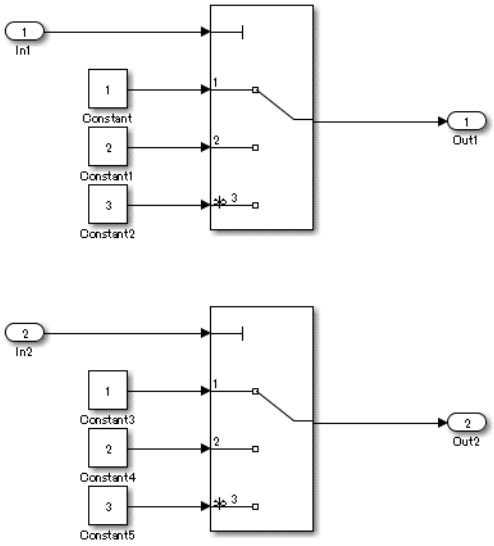
A vector signal shall use a one-based index mode.

Custom Parameter

Not Applicable

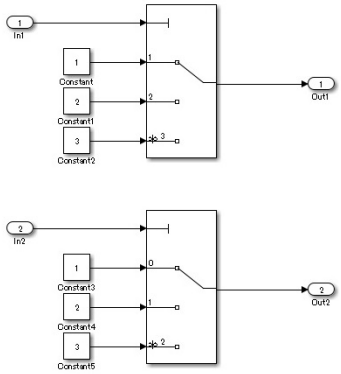
Example — Correct

A uniform one-based index mode is used.



Example — Incorrect

A uniform index mode is not used (same as the incorrect example for sub ID a1).



Rationale

Sub IDs a1, a2

- Logic is easier to understand when using a uniform index mode.

Verification

Model Advisor check: “Check Indexing Mode” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0112, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- Index Vector

Introduced in R2020a

jc_0645: Parameter definition for calibration

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

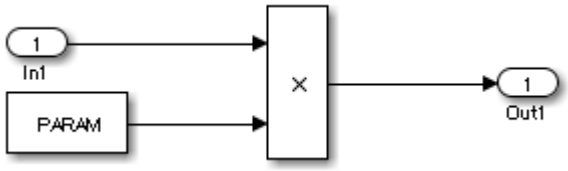
Block parameters that are targets of calibration shall be defined as named constants. Examples of parameters that are outside of the calibration target include:

- Initial value parameter 0
- Increment, decrement 1
- Arithmetic expressions

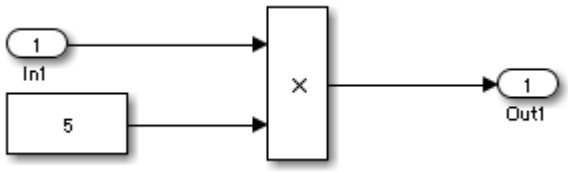
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- A literal constant in the model will propagate as a literal constant in the generated code, making calibration impossible.

Verification

Model Advisor check: “Check if tunable block parameters are defined as named constants” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0645, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Set Block Parameter Values”

Introduced in R2020a

jc_0641: Sample time setting

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Block parameter **Sample time** shall be set to `-1` (inherited).

Exceptions

- Inport block
- Outport block
- Atomic subsystem
- Blocks with state variables, such as Unit Delay and Memory
- Signal conversion blocks, such as Data Type Conversion and Rate Transition
- Blocks that do not have external inputs, such as Constant
- Stateflow charts

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Discrepancies can occur in the processing of the model because of different simulation times.
- Maintainability of the model deteriorates when a specific sample time is set for each block individually.

Verification

Model Advisor check: “Check for sample time setting” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0641, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “What Is Sample Time?”
- “Types of Subsystems”
- “Construct and Run a Stateflow Chart” (Stateflow)

Introduced in R2020a

jc_0643: Fixed-point setting

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

When block parameter **Data type** is a set to `fixdt` (fixed-point) and **Scaling** is set to `Slope and bias`, parameter **Bias** shall be set to `0`.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- When the bias in a model is not uniform:
  - Behavior of the model is impossible to determine by its appearance.
  - Unintended overflows and underflows occur.
  - Results in wasteful operation and deterioration of code efficiency/computing load.

Verification

Model Advisor check: “Check usage of fixed-point data type with non-zero bias” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0643, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Specify Fixed-Point Data Types”
- “Specify Data Types Using Data Type Assistant”

- “Scaling, Precision, and Range”

Introduced in R2020a

jc_0644: Type setting

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

The data type shall not be set by using a block or Stateflow data dictionary when the data type is set by a data object.

Exceptions

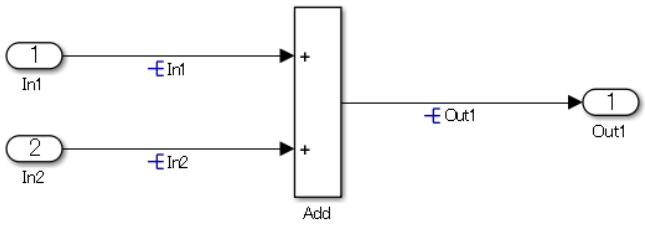
- Inside a reusable function
- Data Type Conversion block
- Data types set by using `fixdt`
- `Boolean` or `double` types

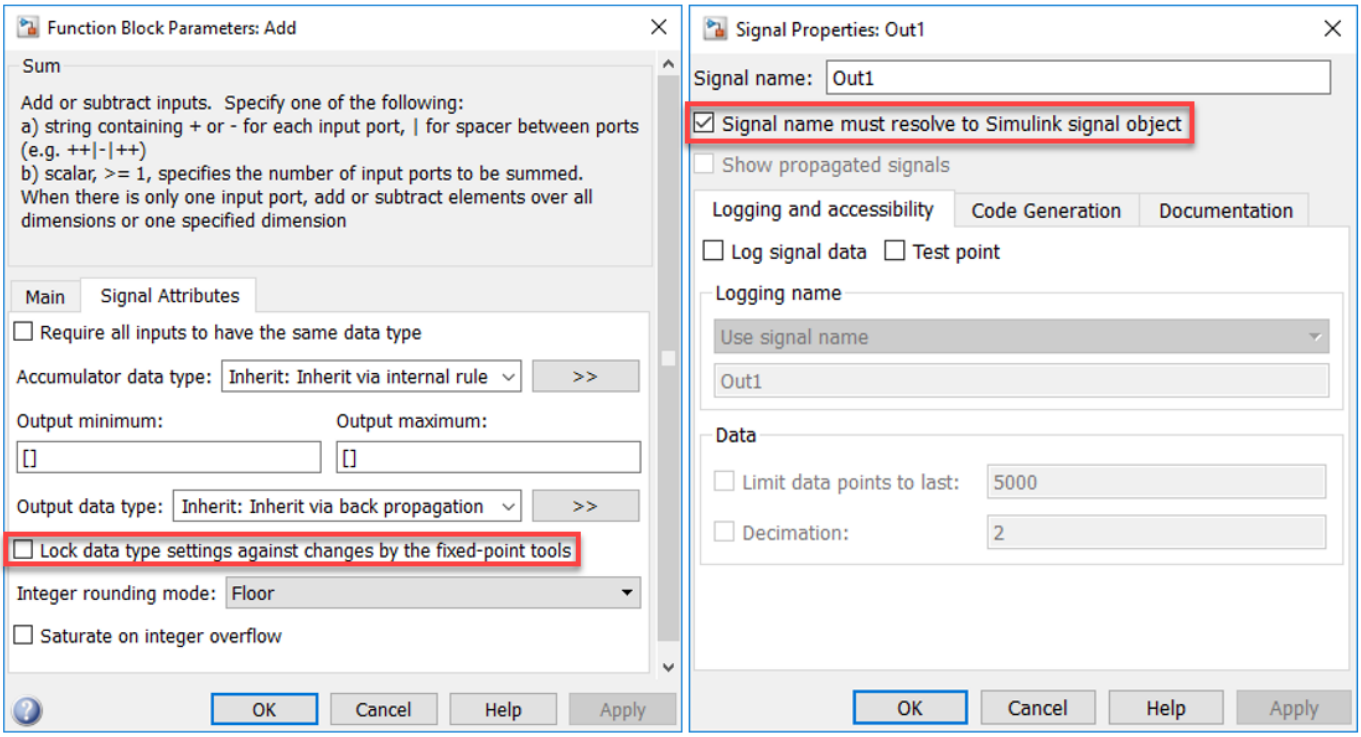
Custom Parameter

Not Applicable

Example — Correct

Type is set the data object.





Rationale

Sub ID a:

- When the data type is set in a block and it differs from the type setting in the data object, it can be difficult to determine which setting is correct. This can impair readability.
- When the type is set in the block, maintainability is affected when the signal line type changes.
- Exceptions:
  - When block structures are identical, differences between input/output data type can result in different C source code that is not reusable. For reusable functions, data types of input/output blocks should be specified at the subsystem level.
  - The Data Type Conversion block is used to explicitly set the data type.
  - When the data type is `fixdt` (fixed-point), data type must be set individually because each block can have different data points. In this scenario, it is impossible to use only the data object to set the data type.

- Some block types must be set to `Boolean`.

  `Double` type is generally used in plant models and for Rapid Control Prototyping (RCP), therefore it is not within scope of this rule. Embedded software uses double type in specific situations. Use caution when configuring the settings on these blocks to minimize the use of `double` type.

Verification

Model Advisor check: “Check type setting by data objects” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0644, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “About Data Types in Simulink”
- “Simulink Functions Overview”

Introduced in R2020a

Conditional Subsystem Relations

db_0146: Block layout in conditional subsystems

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

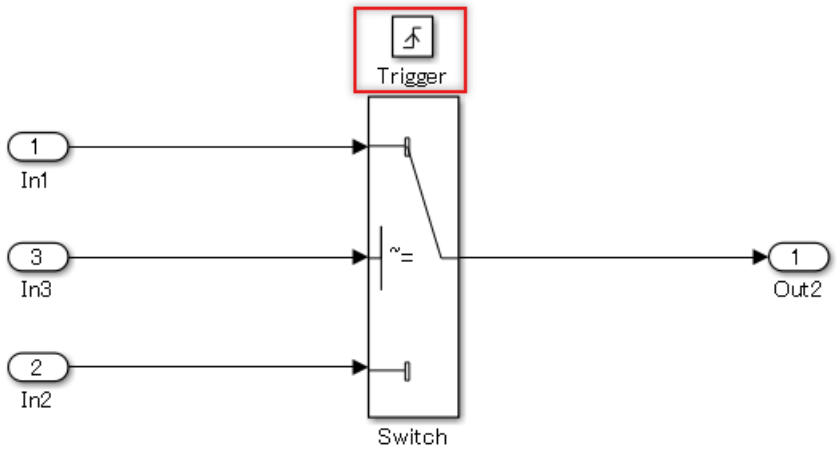
Sub ID a

Conditional input blocks shall be positioned at the top of the subsystem.

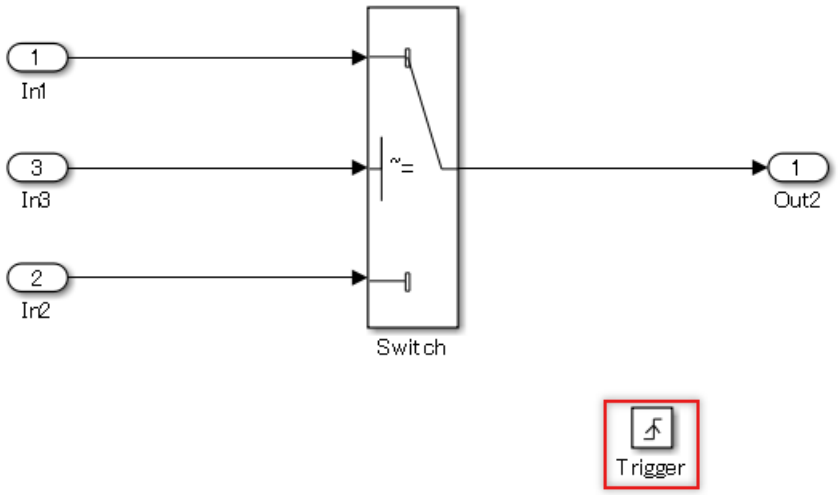
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID b

The position of these blocks shall be defined by the project:

- For Each
- For Iterator
- While Iterator

Custom Parameter

Location layout

Rationale

Sub IDs a, b:

- Unifying the internal and external layout of the conditional subsystem improves readability of the model.

Verification

Model Advisor check: “Check position of conditional blocks and iterator blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0146, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

- “Conditionally Executed Subsystems Overview”
- “Types of Subsystems”

Introduced in R2020a

jc_0640: Initial value settings for Outport blocks in conditional subsystems

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

The initial condition shall be defined on an Outport block when both of these conditions are met for a conditional subsystem:

- Includes a block with initial conditions (i.e. Constant and Delay blocks)
- Connects to Outport block

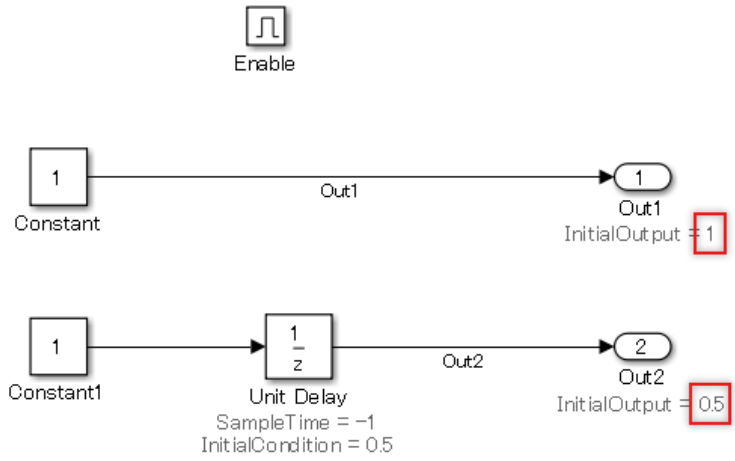
When the output signal from a conditional subsystem is connected to a Merge block, the initial condition shall be defined on the Merge block.

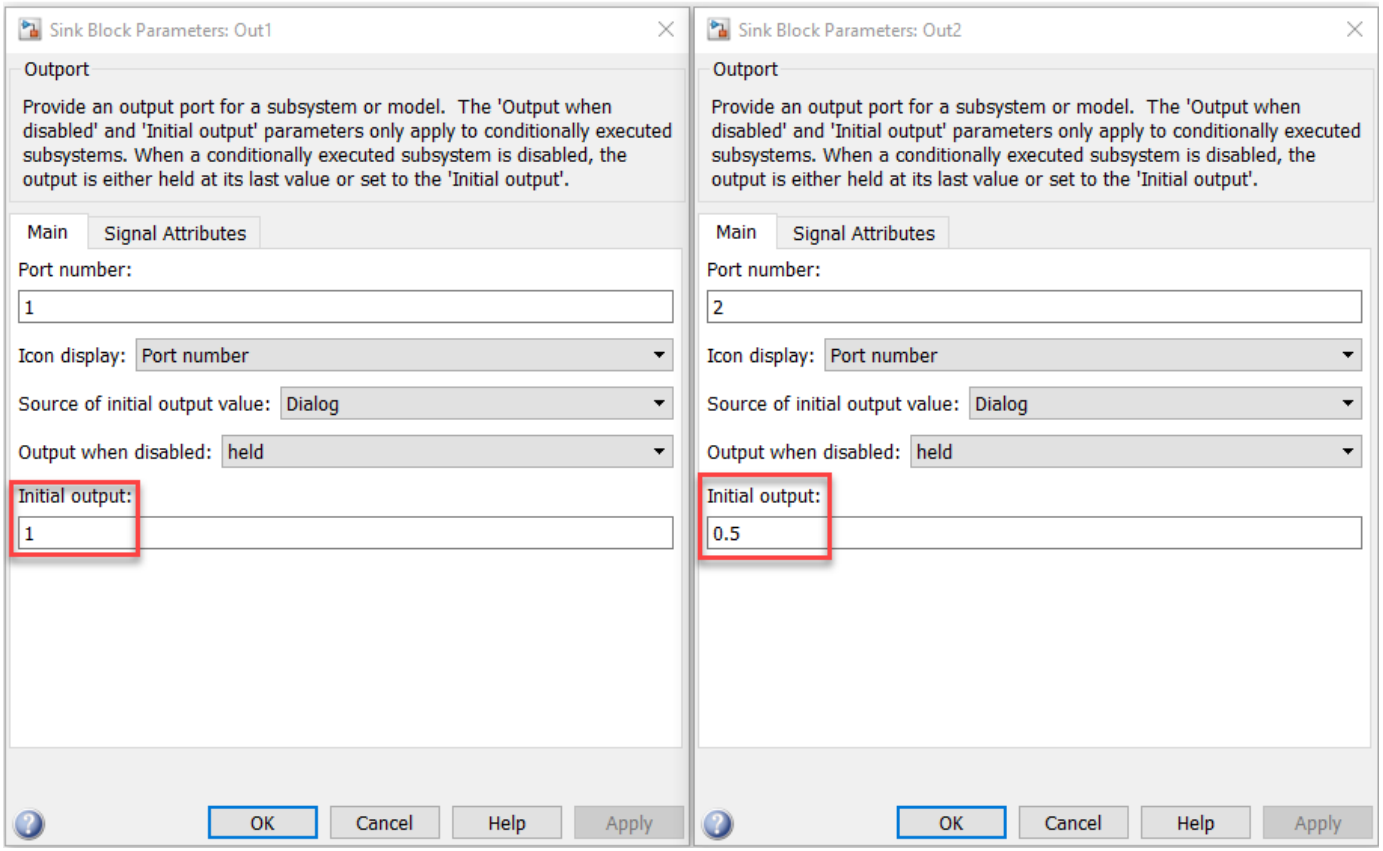
Custom Parameter

Not Applicable

Example — Correct

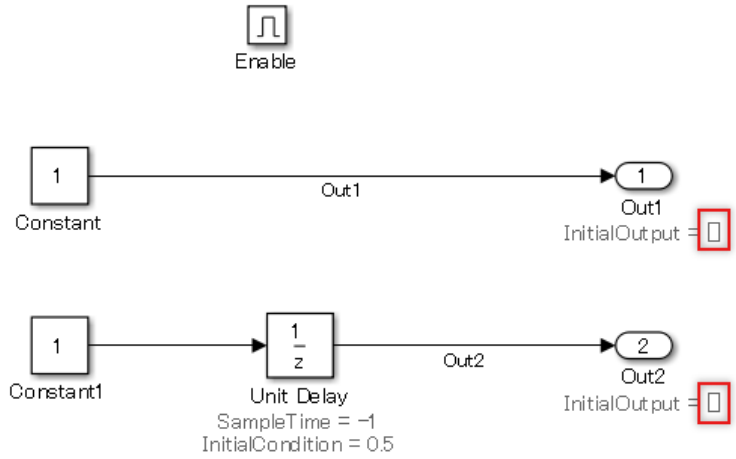
The initial condition is defined.

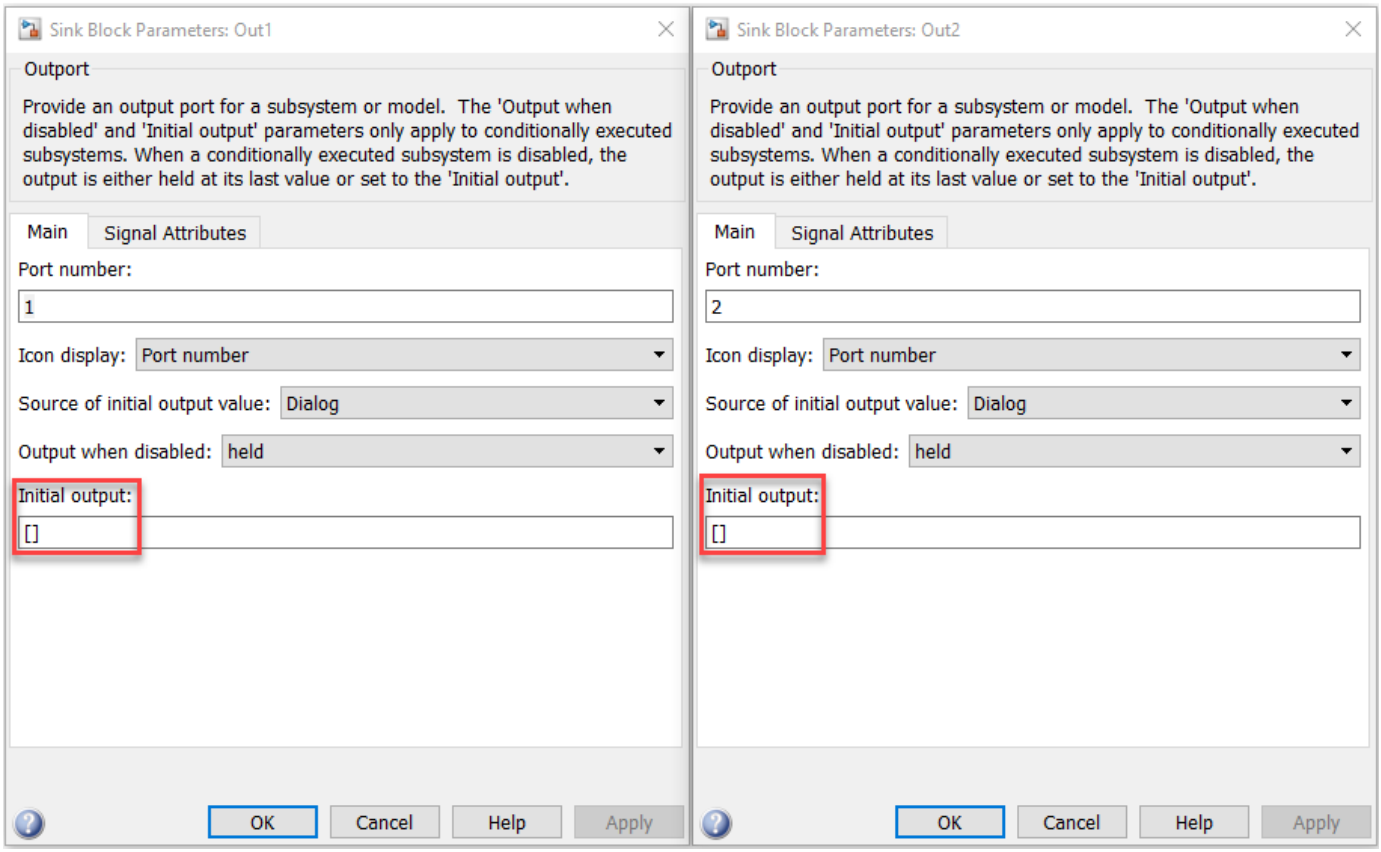




Example — Incorrect

The initial condition is not defined.





Rationale

Sub ID a:

- The model may not behave as intended when the initial condition is unclear.

Verification

Model Advisor check: “Check undefined initial output for conditional subsystems” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0640, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Types of Subsystems”
- “Conditionally Executed Subsystems and Models”

Introduced in R2020a

jc_0659: Usage restrictions of signal lines input to Merge blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

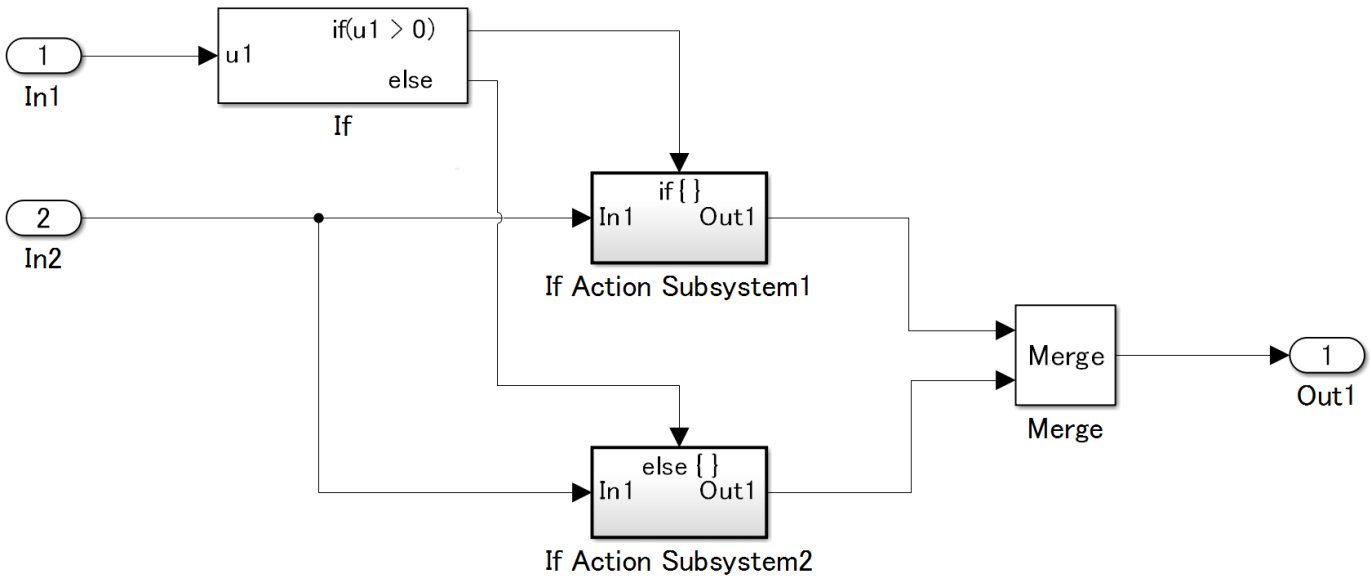
Sub ID a

Only conditional subsystem output signals shall input to Merge blocks.

Custom Parameter

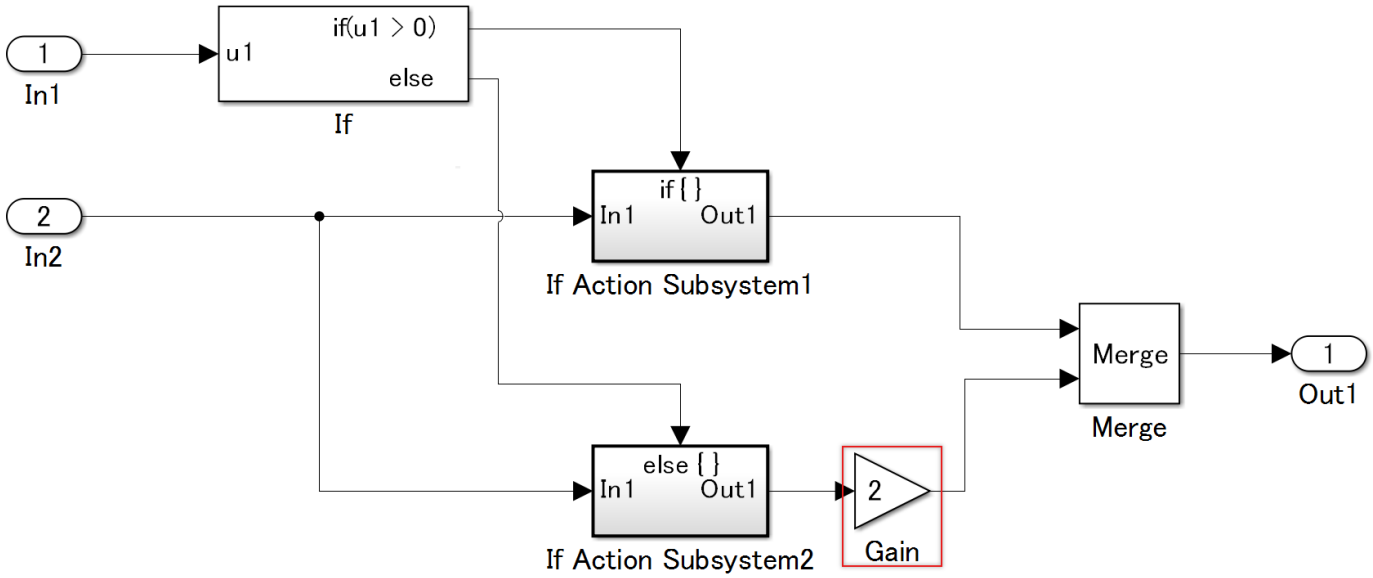
Not Applicable

Example — Correct



Example — Incorrect

A Gain block output signal is input to Merge.



Rationale

Sub ID a:

- Prevents the simulation from proceeding as intended.

Verification

Model Advisor check: “Check usage of Merge block” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0659, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Types of Subsystems”
- “Conditionally Executed Subsystems Overview”

Introduced in R2020a

na_0003: Usage of If blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

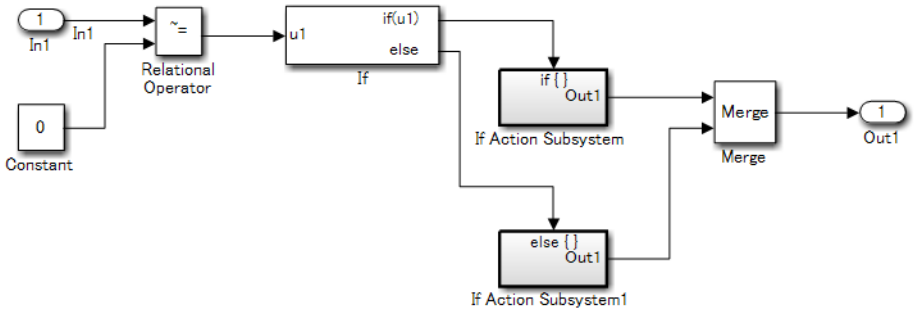
For the If block, the `if` expression and `elseif` expression shall be used only to define input signals.

Custom Parameter

Not Applicable

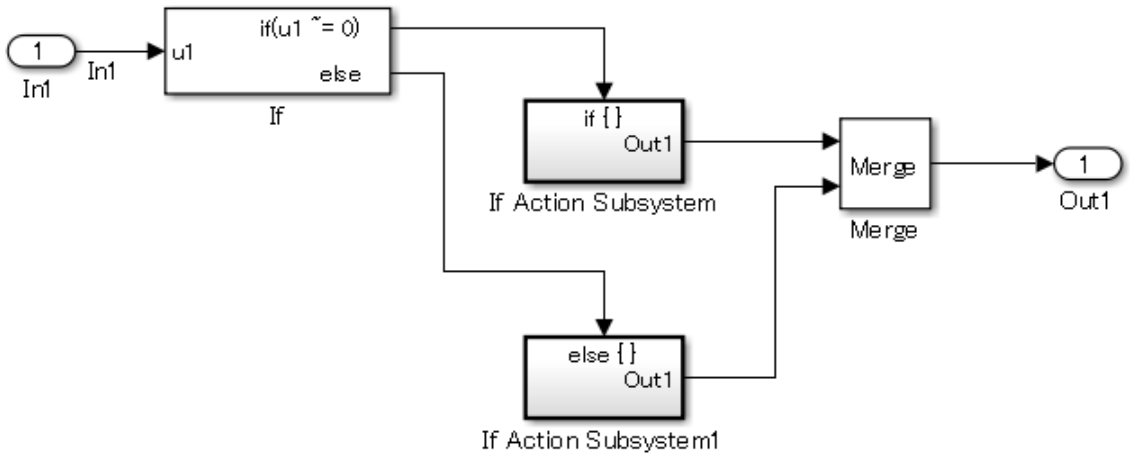
Example — Correct

The `if` expression only defines the input variables.



Example — Incorrect

The `if` expression defines a comparison operation.



Rationale

Sub ID a:

- Visual comprehension of control conditions is easier when logical operations are described outside of the If block.
- Describing logical operations outside of the If block allows verification to focus on the logical operation.

Verification

Model Advisor check: “Check logical expressions in If blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0003, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Loops and Conditional Statements”

Introduced in R2020a

jc_0656: Usage of Conditional Control blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

To make all actions in the conditions explicit, these block parameters shall be set as follows :

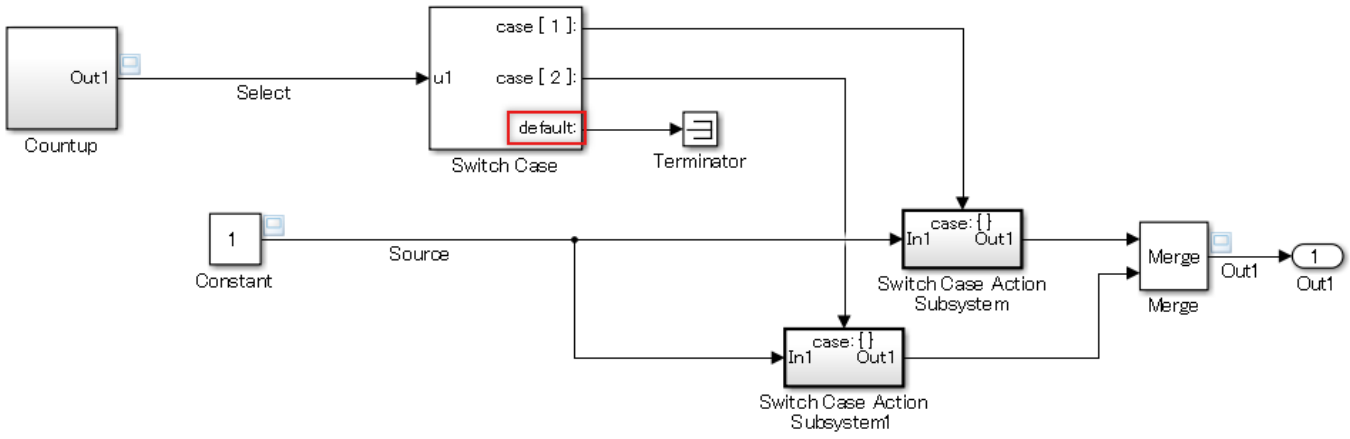
- For If blocks, select **Show else condition**
- For Switch Case blocks, select **Show default case**

Custom Parameter

Not Applicable

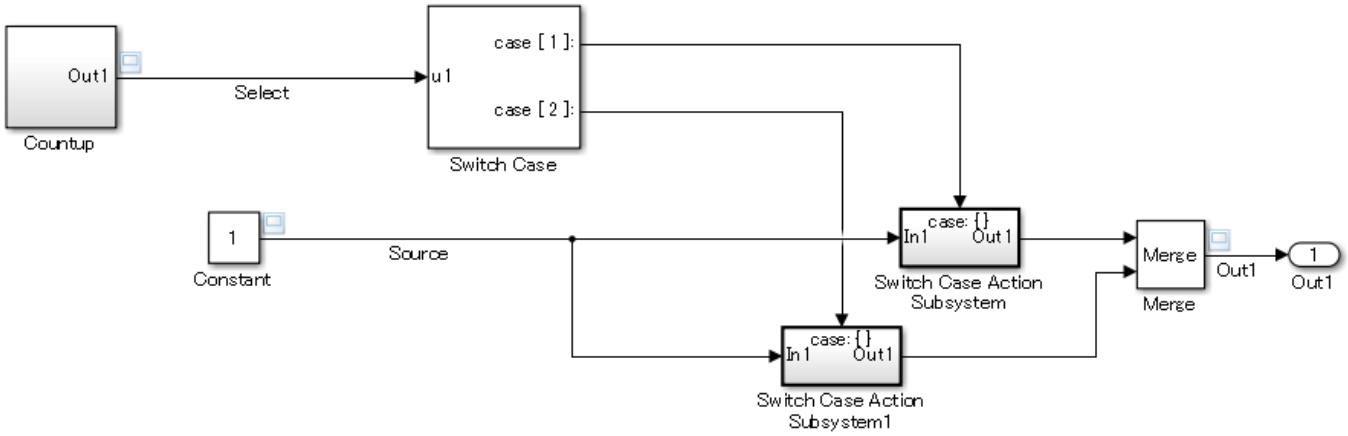
Example — Correct

Using default behavior in the Switch Case block.



Example — Incorrect

Not using default behavior in the Switch Case block.



Rationale

Sub ID a:

- Determining whether there is pointless processing or if something is missing from the design (such as a missing description) is easier when the processing of exceptions (`else`, `default`) is explicitly set in the model.

Verification

Model Advisor check: “Check default/else case in Switch Case blocks and If blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0656, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Conditionally Executed Subsystems Overview”
- “Set Block Parameters”
- “Select Subsystem Execution”

Introduced in R2020a

jc_0657: Retention of output value based on conditional control flow blocks and Merge blocks

Sub ID Recommendations

- NA-MAAB — a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

Unused action ports shall connect to Terminator block when these conditions are met:

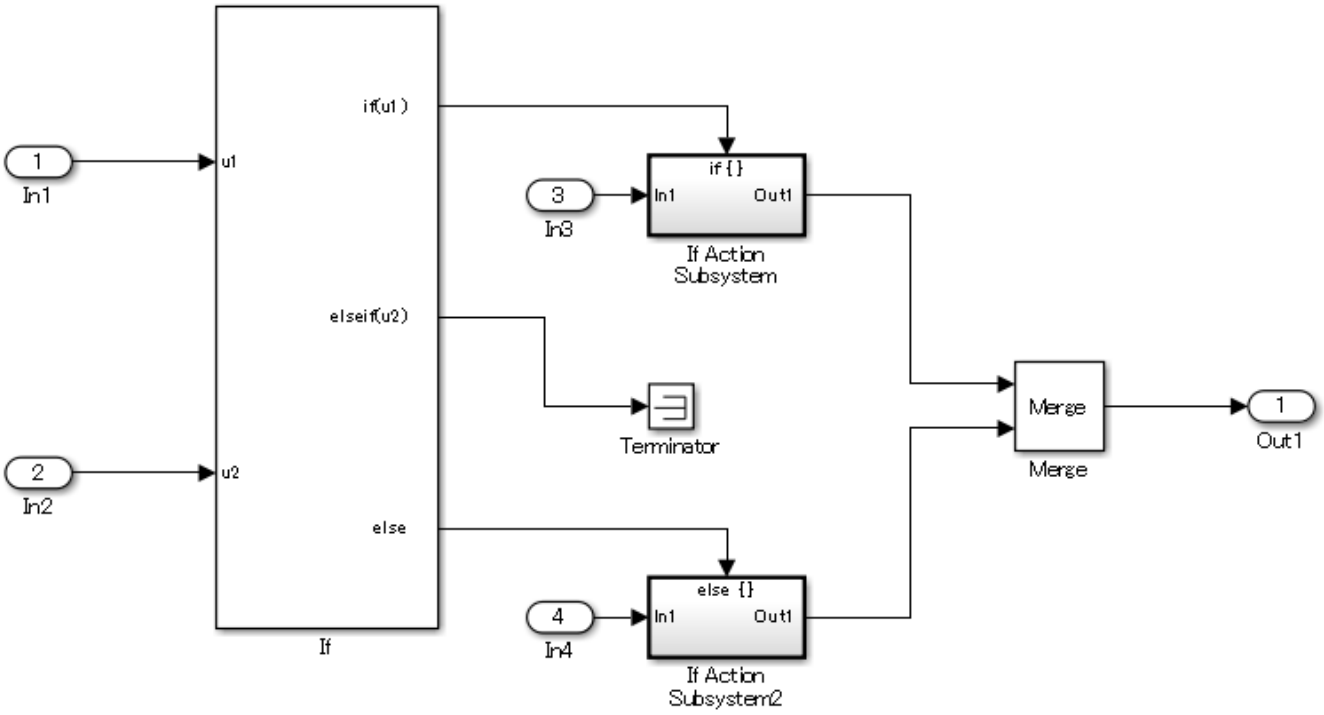
- Past value is retained
- Merge block and a conditional flow block, such as an If or Switch Case block, are used to switch functions.

Custom Parameter

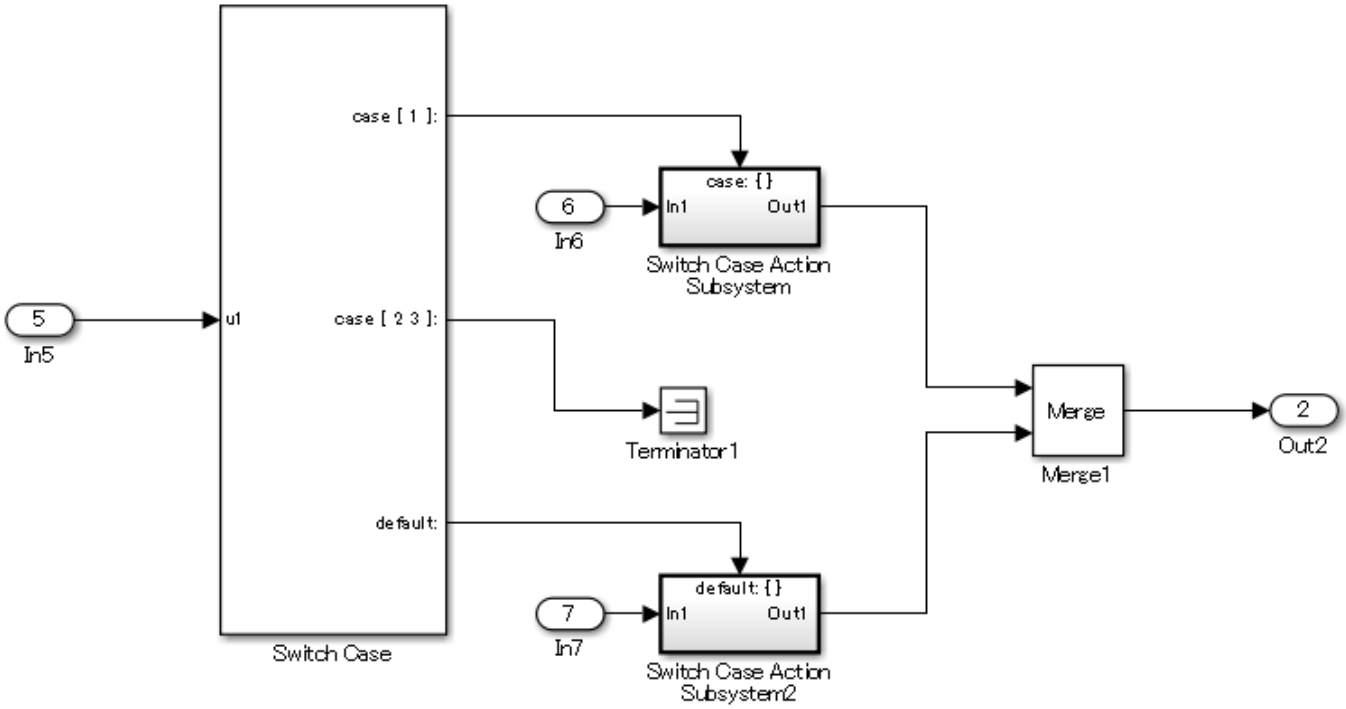
Not Applicable

Example — Correct

If block example

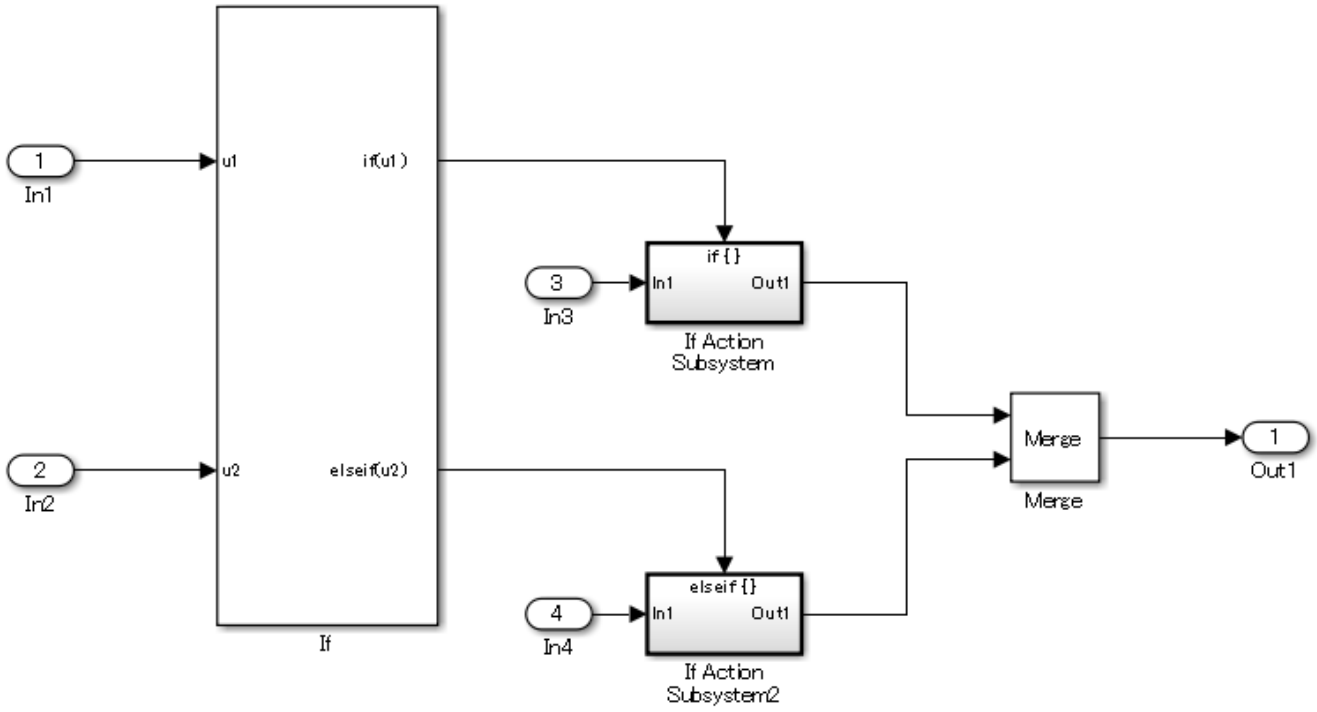


Switch Case block example

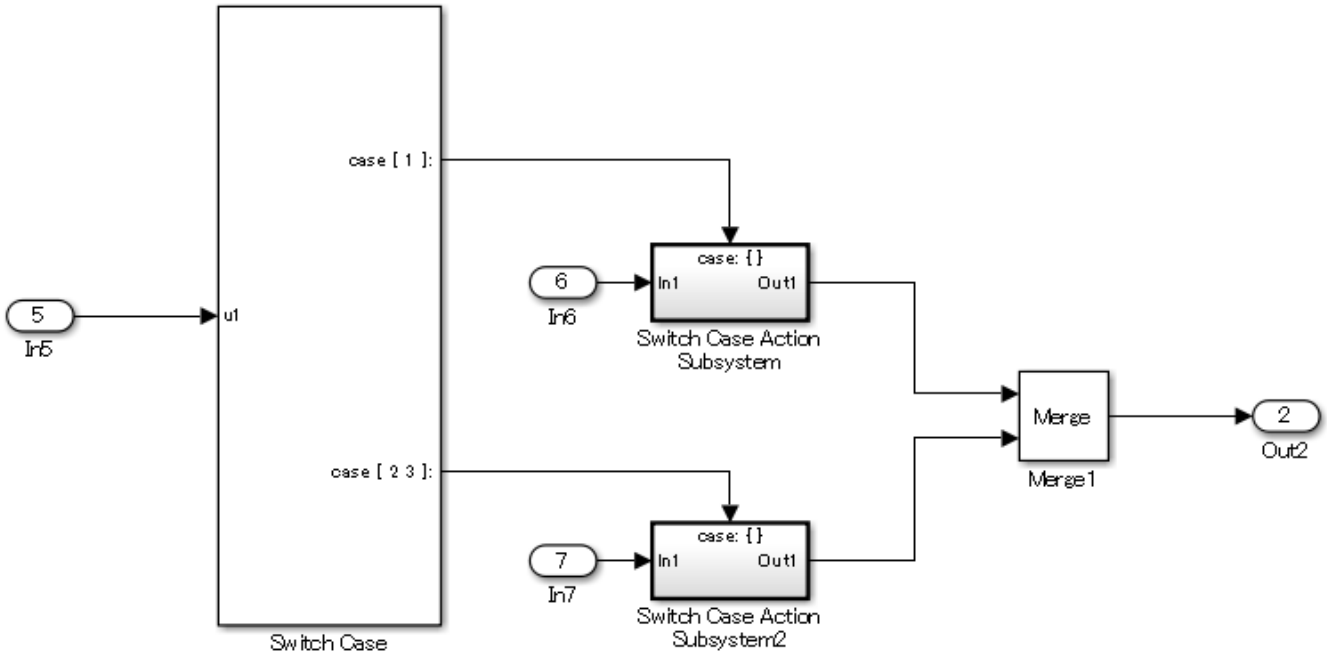


Example — Incorrect

If block example



Switch Case block example



Sub ID a2

A feedback loop using a Delay block shall be implemented when these conditions are met:

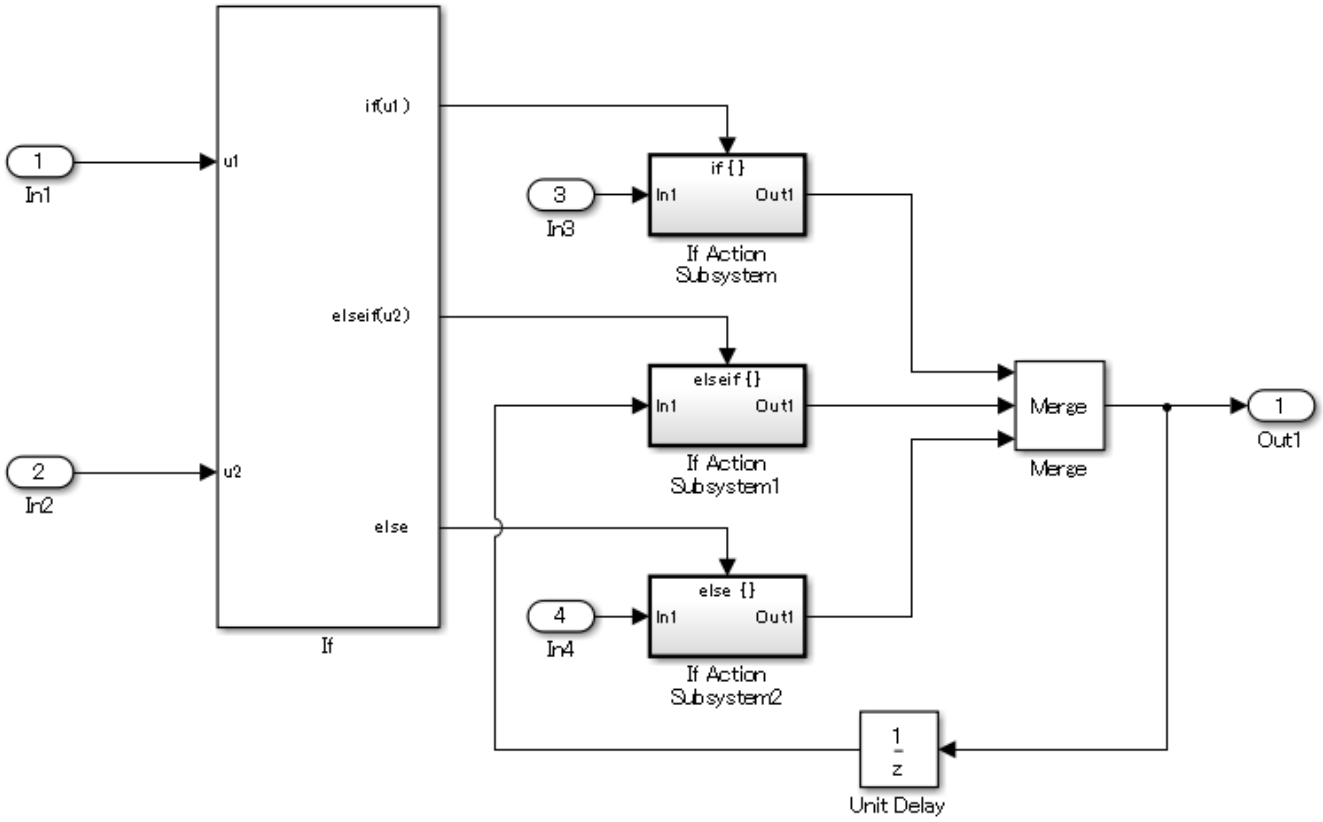
- Past value is retained
- Merge block and a conditional flow block, such as an If or Switch Case block, are used to switch functions.

Custom Parameter

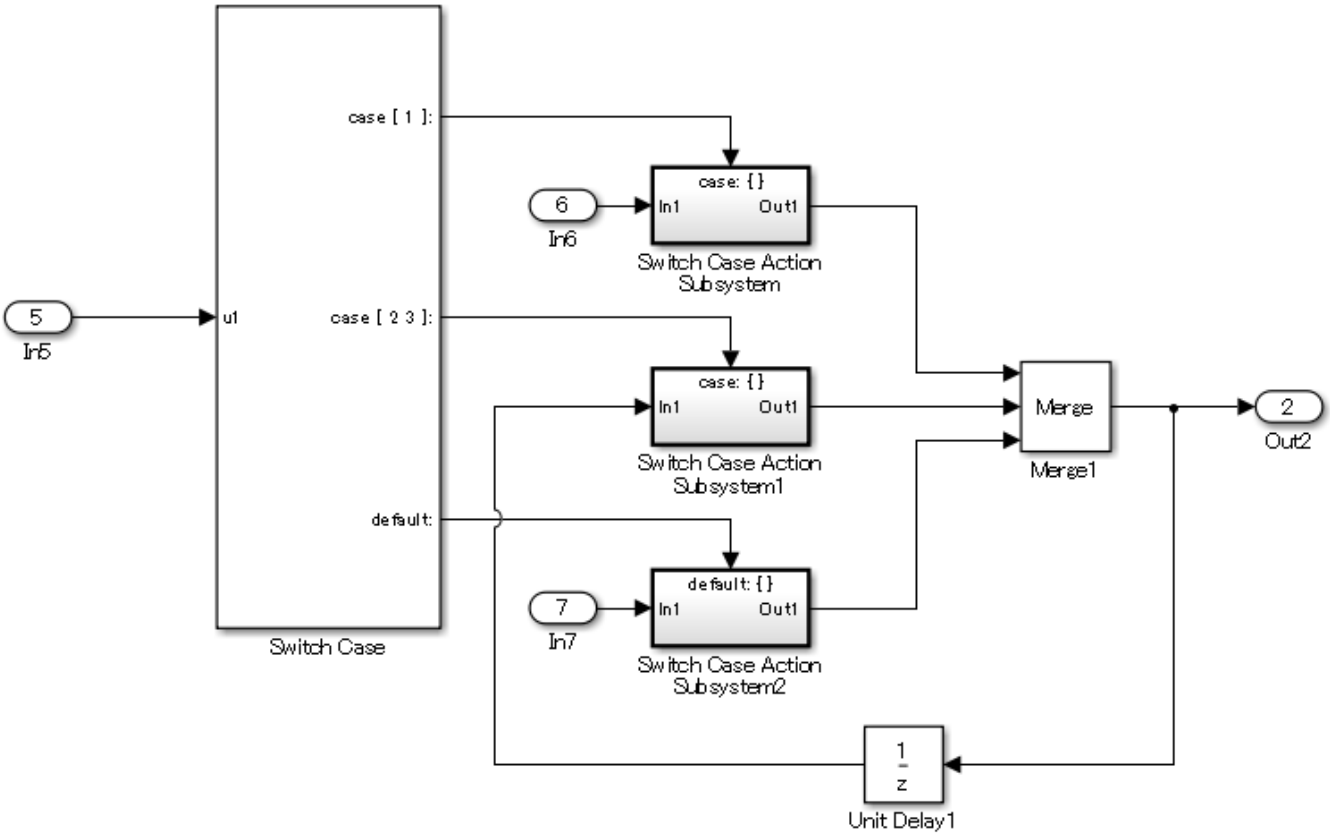
Not Applicable

Example — Correct

If block example

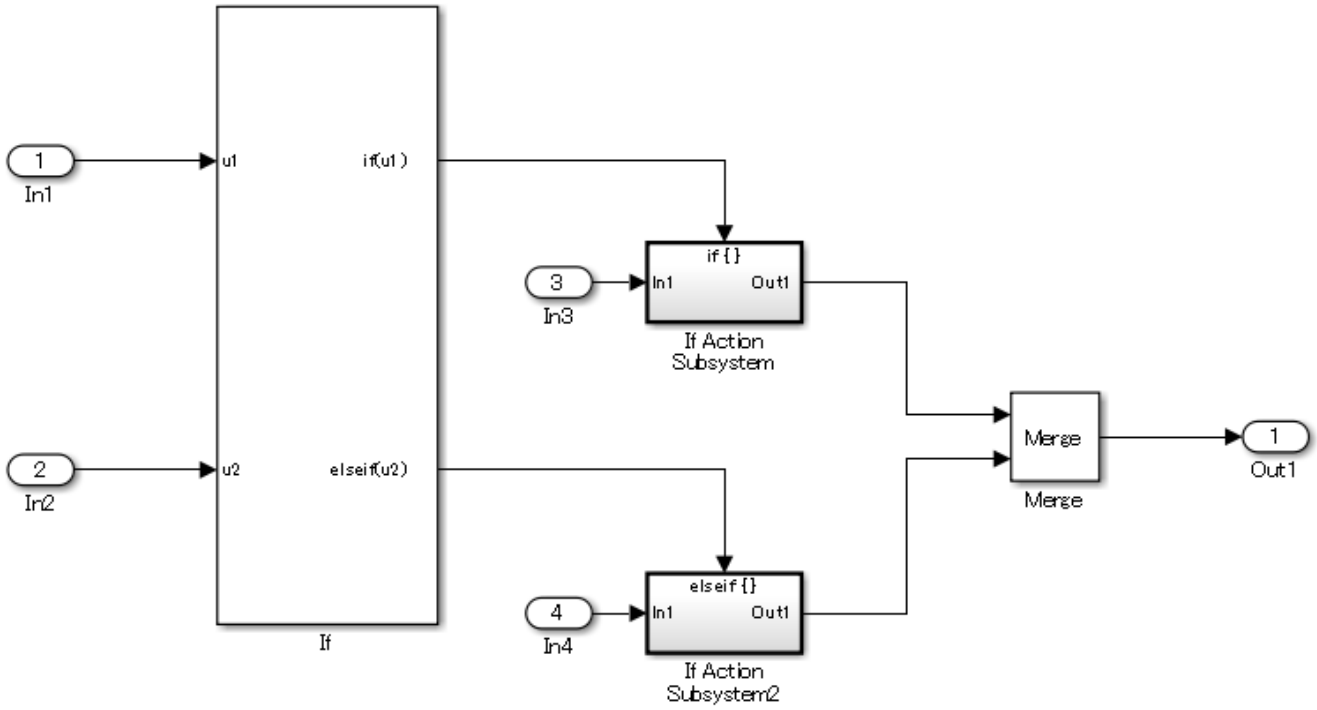


Switch Case block example

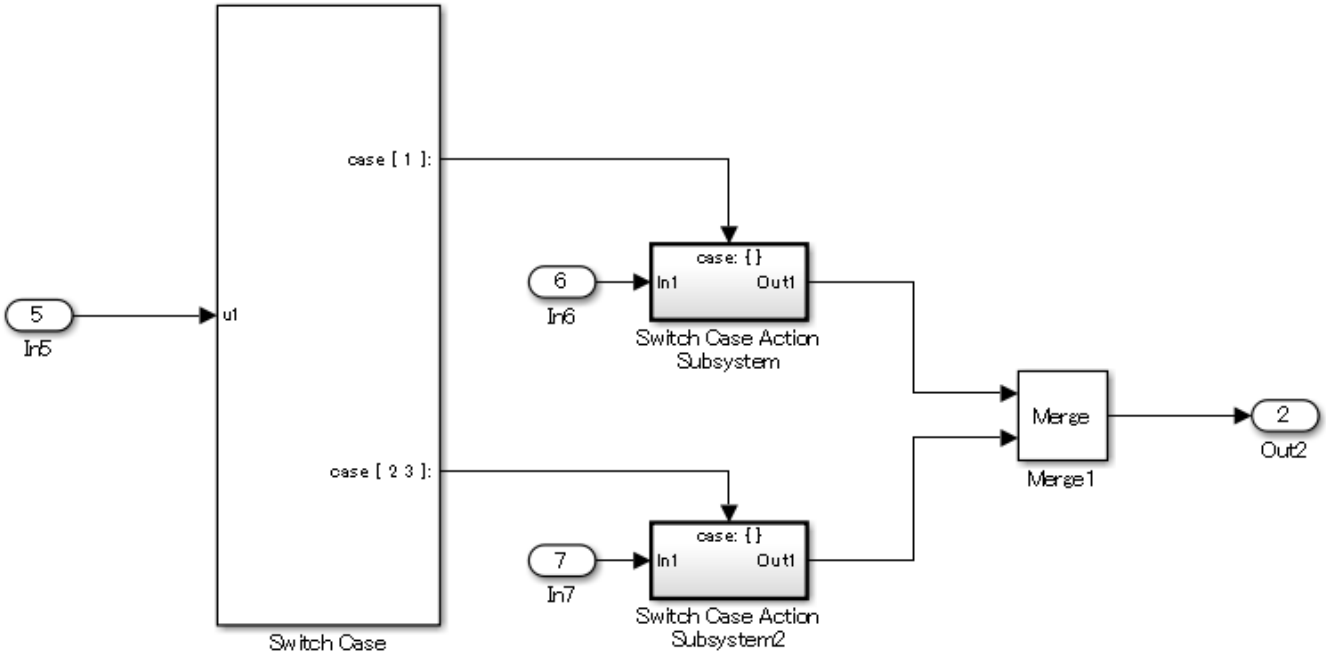


Example — Incorrect

If block example



Switch Case block example



Rationale

Sub ID a1:

- Improves code efficiency.
- Connections to Terminator block can be used when past values are held other than by the default (`else`).

Sub ID a2:

- Retaining past values is explicit.

Verification

Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jc_0657, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

Operation Blocks

na_0002: Appropriate usage of basic logical and numerical operations

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

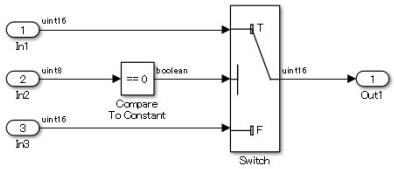
Logical signals shall not connect to blocks that operate on numerical signals.

Custom Parameter

Blocks receiving numerical signals

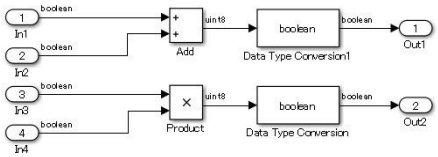
Example — Correct

Numerical values are compared to determine if they are equal.

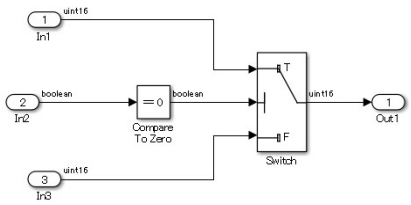


Example — Incorrect

A logical output is connected directly to the input of blocks that process numerical inputs.



A logical signal is compared with a numerical value.



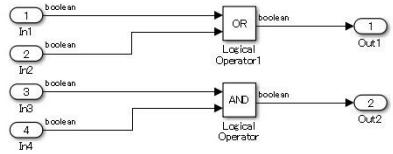
Sub ID b

Numerical signals shall not connect to blocks that operate on logical signals.

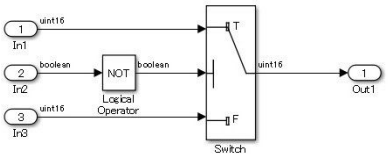
Custom Parameter

Blocks receiving logical signals

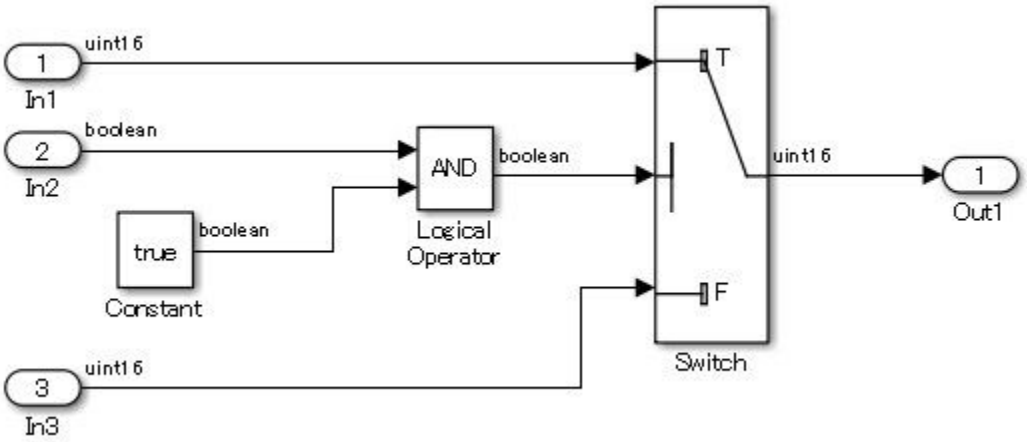
Example — Correct



Logical signal is inverted by using a logical operation.



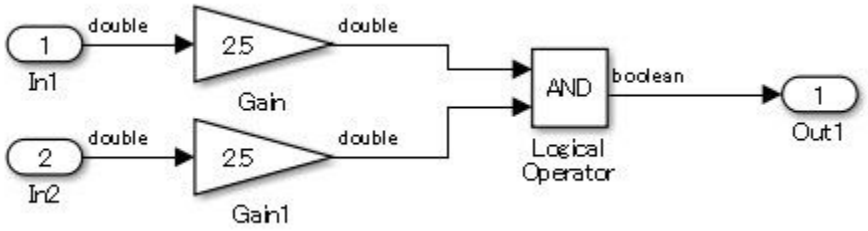
Logical signal is evaluated by using a logical operation.



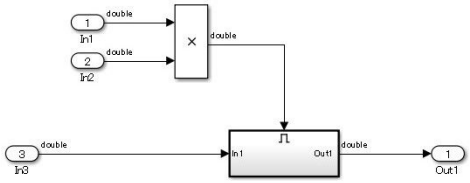
Example — Incorrect

Logical signal is inverted by using a logical operation.

A block that is used to perform logical operations is being used to perform numerical operations. A numerical output is connected to the input of blocks that process logical inputs.



A block that is used to perform numerical operations is being used to perform logical operations. Inputs other than logical values can be provided to the block. However, the Enable port block can receive only logical signals that have `On/Off`. The Product block performs logical operations when it connects the numerical operations result to a block that receives the logical value Enable port.



Rationale

Sub IDs a, b:

- When numerical and logical values are treated the same, the original intention becomes unclear and the next operation in the model can be incorrectly interpreted, further compounding the error.

Verification

Model Advisor check: “Check fundamental logical and numerical operations” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0002, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Basics”

Introduced in R2020a

jc_0121: Usage of add and subtraction blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

The icon shape of the add and subtraction Sum block shall be `rectangular`.

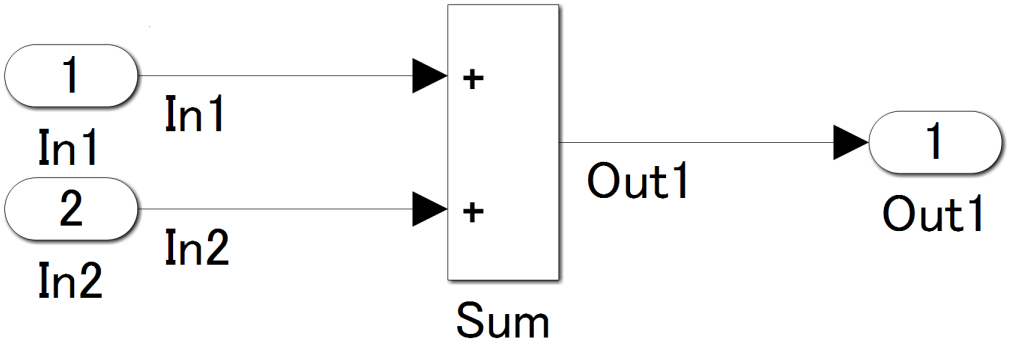
When used in a feedback loop, the *icon shape* can be `round`.

Custom Parameter

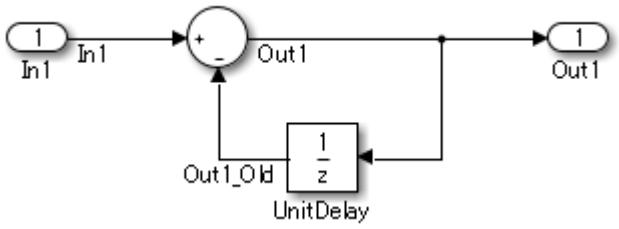
Not Applicable

Example — Correct

The icon shape of the add and subtraction Sum block shall be `rectangular`.

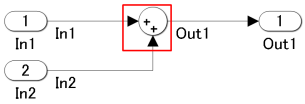


The second input to the add and subtraction Sum block is a feedback loop, so the *icon shape* is `round`.



Example — Incorrect

This is not a feedback loop, but the *icon shape* of the add and subtractionSum block is `round`.



Sub ID b

The + mark shall be used for the first input to the add and subtraction Sum block.

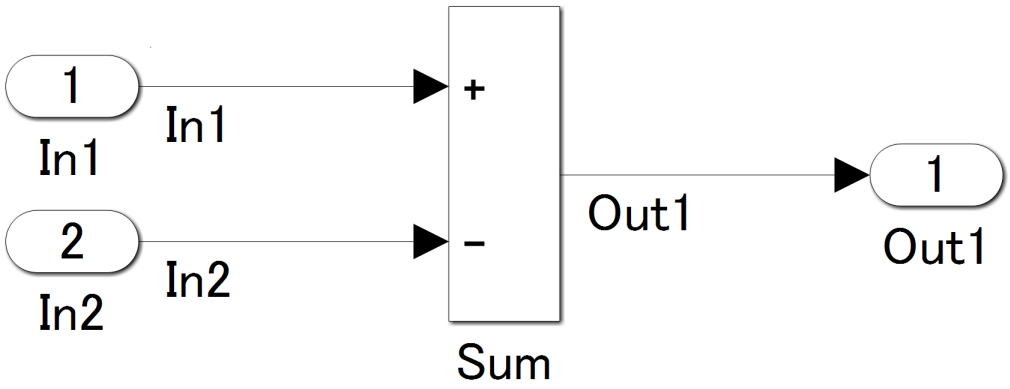
For a feedback loop, the first input can be set by using the `-` mark.

Custom Parameter

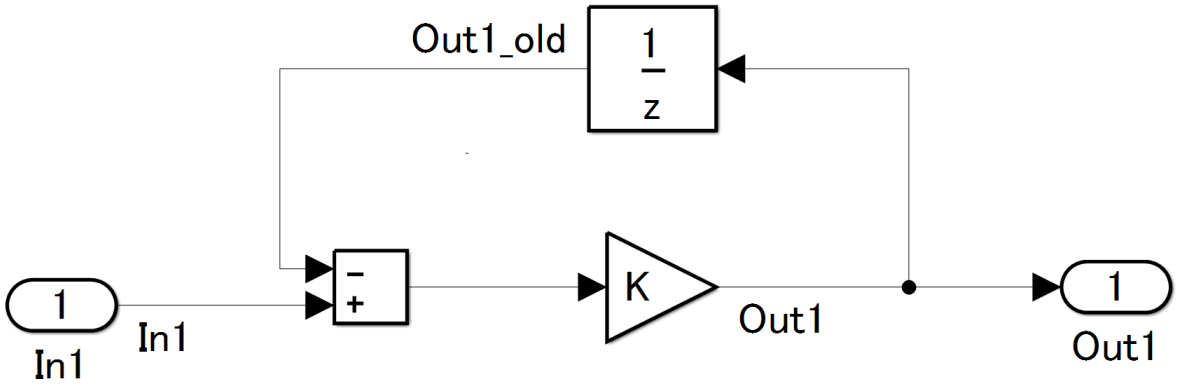
Not Applicable

Example — Correct

The + mark is used for the first input to the add and subtraction Sum block.

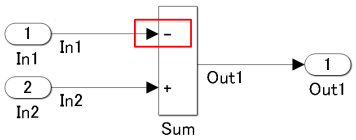


The second input to the add and subtraction Sum block is a feedback loop, so the `-` mark is used



Example — Incorrect

The sign for the first input to the add and subtraction Sum block is the - mark.



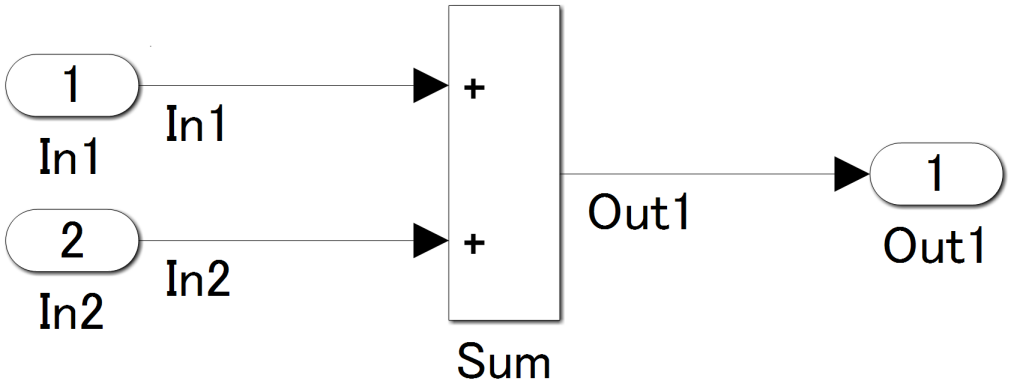
Sub ID c

The add and subtraction Sum block shall not have more than two inputs.

Custom Parameter

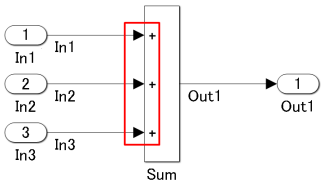
Not Applicable

Example — Correct



Example — Incorrect

The add and subtraction Sum block has three inputs.



Rationale

Sub ID a:

- Adherence to the guideline improves readability of the model.

Sub ID b:

- Readability of the control specification improves when the sign for the first input is consistent.

Sub ID c:

- The order of operations is clearly defined.

Verification

Model Advisor check: “Check usage of Sum blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0121, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0610: Operator order for multiplication and division block

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b

MATLAB Versions

All

Rule

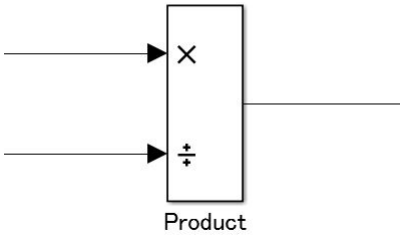
Sub ID a

The * mark shall be used for the first input to a multiplication and division Product block.

Custom Parameter

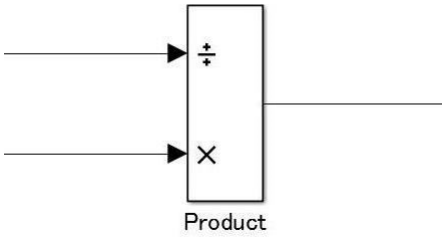
Not Applicable

Example — Correct



Example — Incorrect

The / mark is used for the first input.



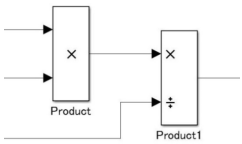
Sub ID b

The multiplication and division Product block shall not have more than two inputs.

Custom Parameter

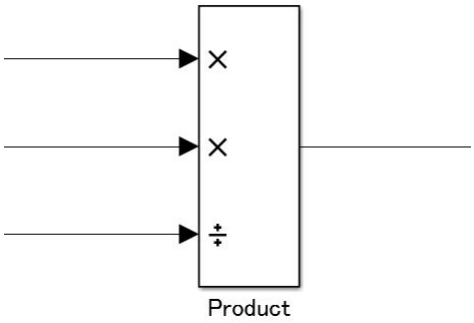
Not Applicable

Example — Correct



Example — Incorrect

The block has three inputs.



Rationale

Sub ID a:

- When checking the block, the input order of the expression and block is reversed, which impairs readability.
- For floating point numbers, the code is generated according to the operation order in the block -- `((1÷1st input)) × 2nd input`. However, if division is performed later, then the number of operations can be reduced.

Sub ID b:

- The order of operations is clearly defined.

Verification

Model Advisor check: “Check operator order of Product blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0610, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Multiply and Divide Inputs Using the Product Block”

Introduced in R2020a

jc_0611: Input sign for multiplication and division blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

When using fixed-point values as the input to the multiplication and division Product block, the sign of the data type shall be the same for all input signals.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- A utility function is created for each least significant bit (LSB) when fixed-point code is generated. Unification of data type signs can reduce the number of utility functions.

Verification

Model Advisor check: “Check signs of input signals in product blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0611, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Multiply and Divide Inputs Using the Product Block”

Introduced in R2020a

jc_0794: Division in Simulink

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

When using division, implementation of the algorithm shall avoid division by zero.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Deviation from the rule can cause unintended operation and code generation results.

Model Advisor Check

“Check for division by zero in Simulink” (Simulink Check)

Last Changed

R2021a

See Also

- JMAAB guideline jc_0794, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- Multiply “Multiply and Divide Inputs Using the Product Block”

Introduced in R2020a

jc_0805: Numerical operation block inputs

Sub ID Recommendations

- NA-MAAB — a1/a2, b, c1/c2, d, e, f1/f2, g, h, i, j
- JMAAB — a1/a2, b, c1/c2, d, e, f1/f2, g, h, i, j

MATLAB Versions

All

Rule

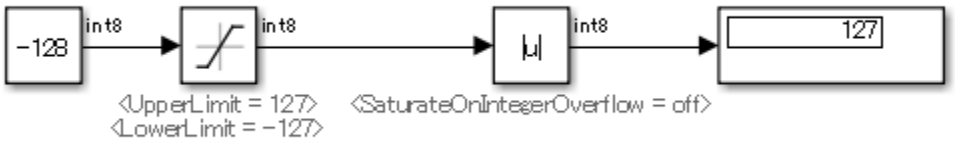
Sub ID a1

When using and Abs block with signed integer types, the input shall not be the most negative value.

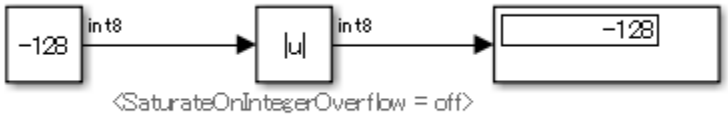
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



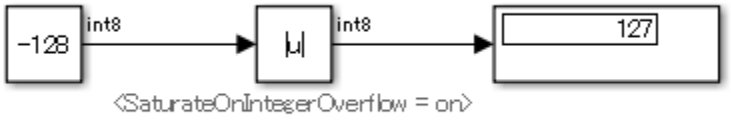
Sub ID a2

Abs block parameter **Saturation on Integer Overflow** shall be selected.

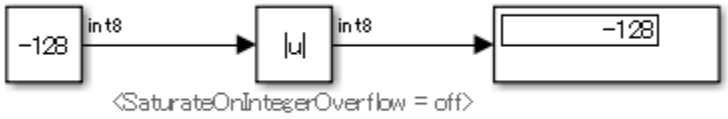
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



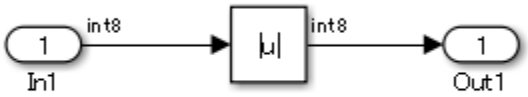
Sub ID b

Input to the Abs block shall not be unsigned integer types or fixed-point types.

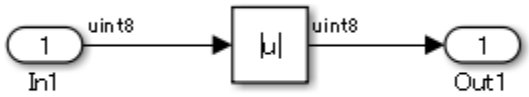
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID c1

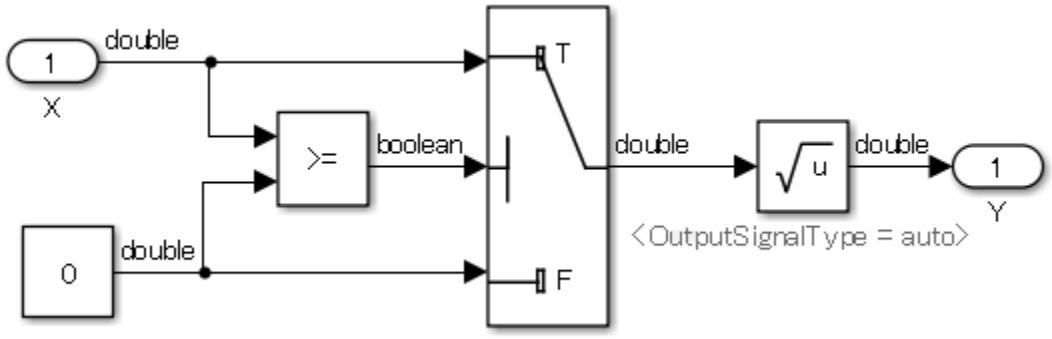
Input to the Sqrt block shall not be a negative value.

Custom Parameter

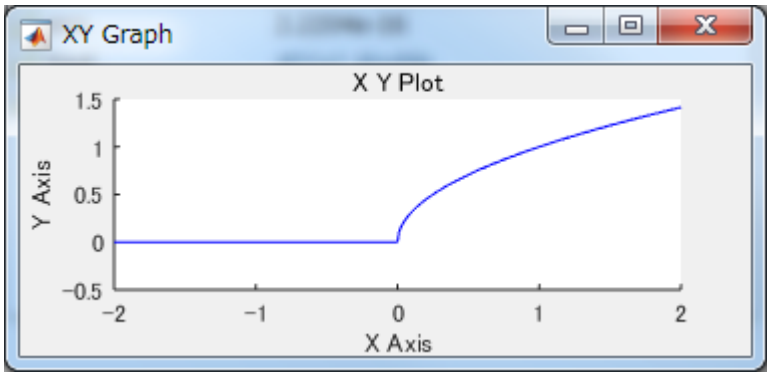
Not Applicable

Example — Correct

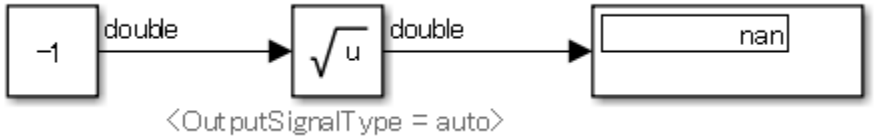
Negative number is saturated with 0.



Simulation result



Example — Incorrect



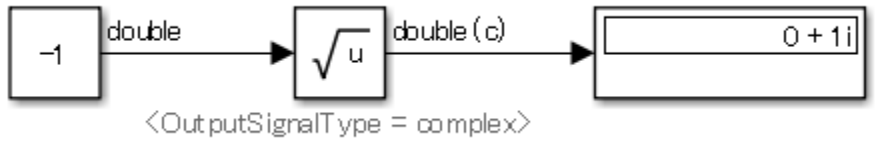
Sub ID c2

Sqrt block parameter **Output Signal Type** shall be set to `complex`.

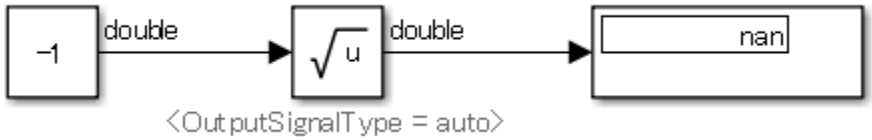
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID d

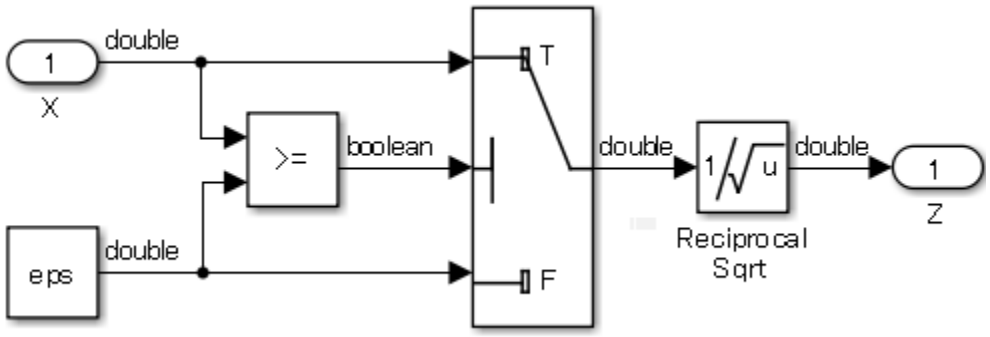
Input to the Reciprocal Sqrt block shall not be less than zero.

Custom Parameter

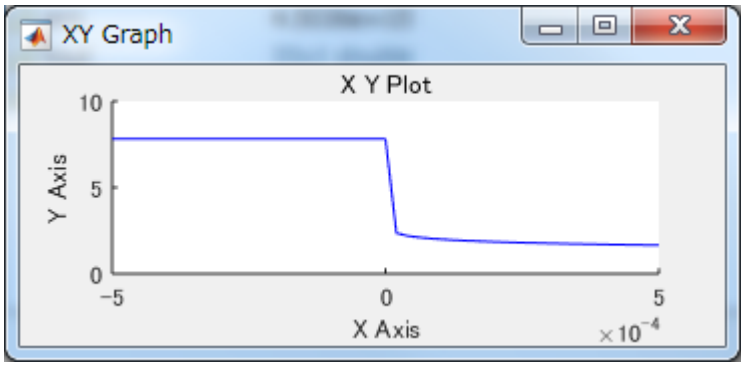
Not Applicable

Example — Correct

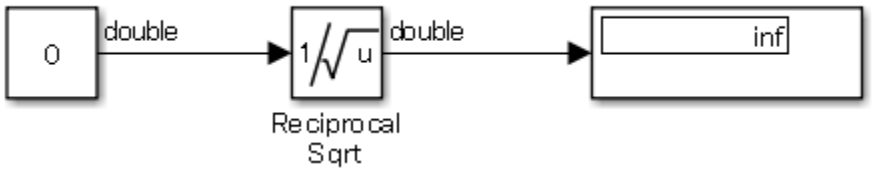
Less than eps saturated with eps.



Simulation result: Plot as Y=log10(Z)



Example — Incorrect



Sub ID e

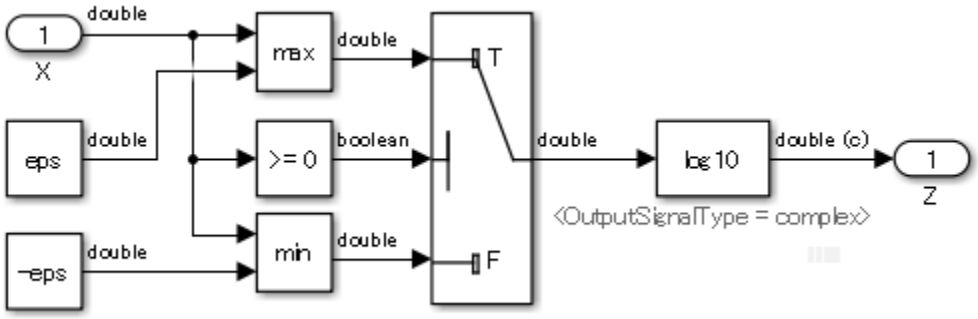
When Math Function block parameter **Function** is set to `log` or `log10`, the input to the block shall not be zero.

Custom Parameter

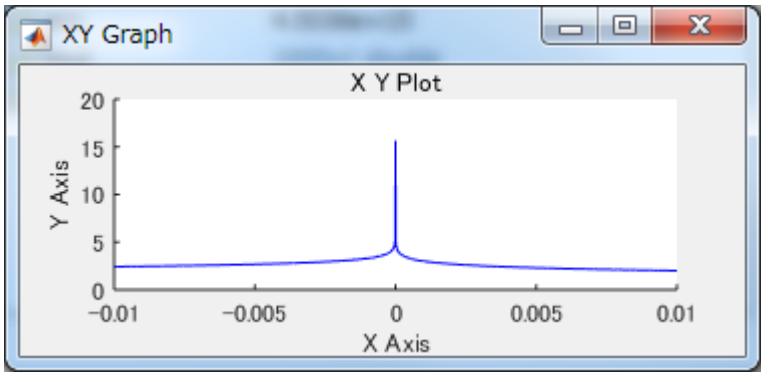
Not Applicable

Example — Correct

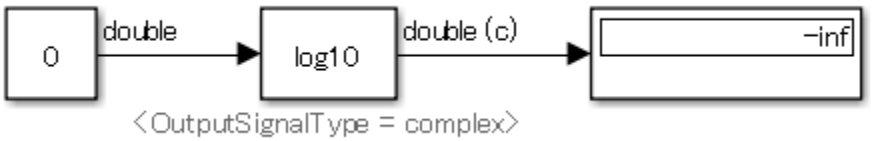
Replace within ±eps with ±eps



Simulation result: Plot as Y = |Z|



Example — Incorrect



Sub ID f1

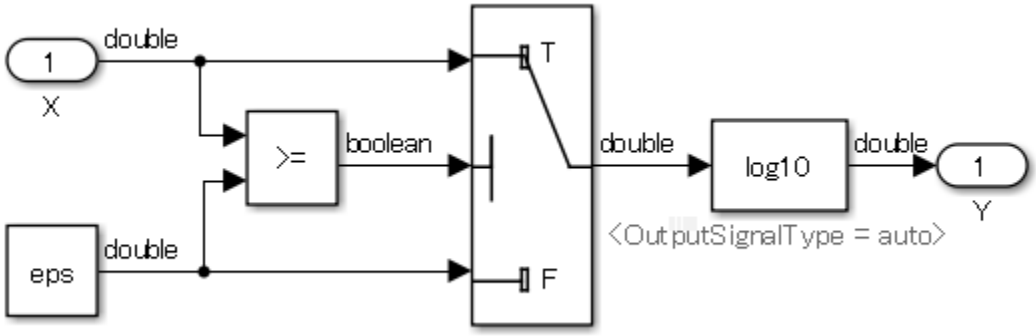
When Math Function block parameter **Function** is set to `log` or `log10`, the input to the block shall not be a negative number.

Custom Parameter

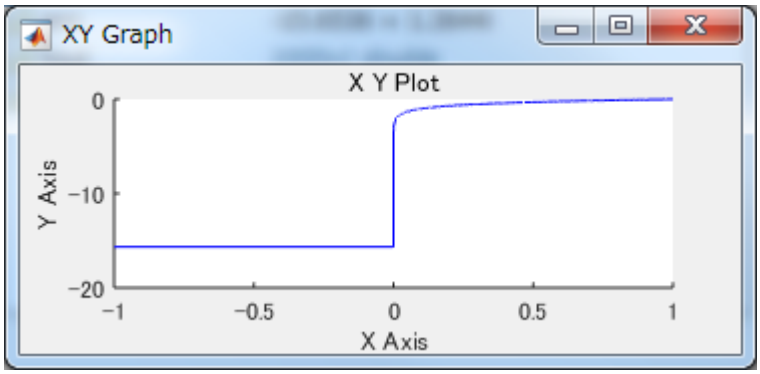
Not Applicable

Example — Correct

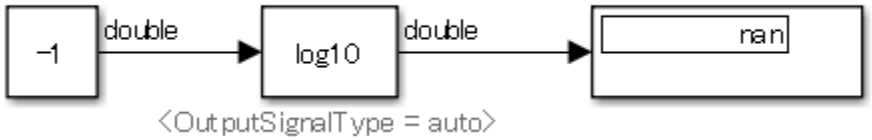
When the input is less than eps, the value is saturated to eps. Less than eps saturated with eps.



Simulation result



Example — Incorrect



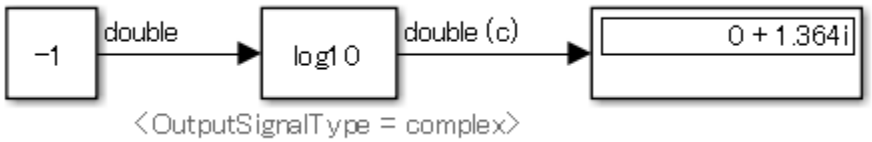
Sub ID f2

When Math Function block parameter **Function** is set to `log` or `log10`, block parameter **Output Signal Type** shall be set to `complex`.

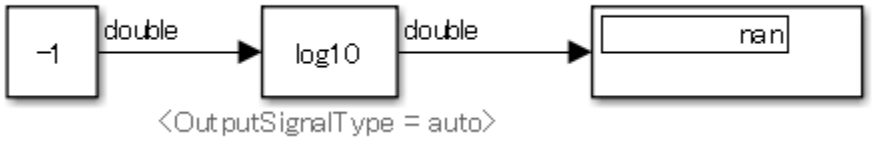
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



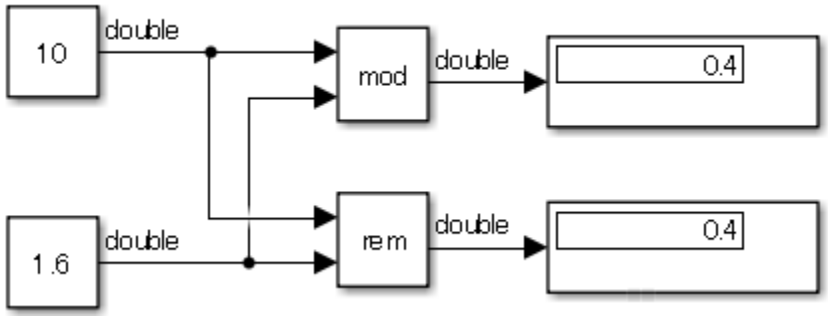
Sub ID g

When Math Function block parameter **Function** is set to `mod` or `rem`, the second argument input shall not be zero.

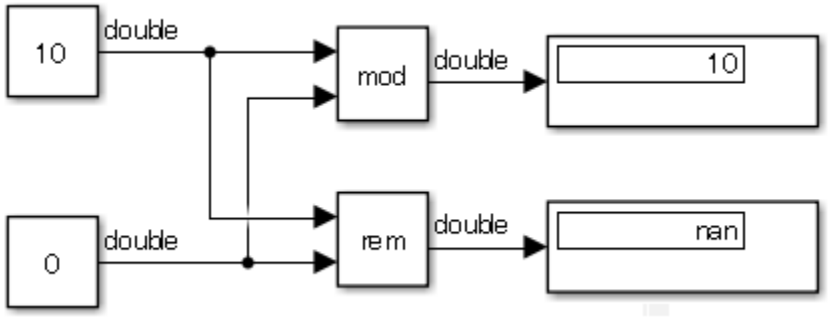
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID h

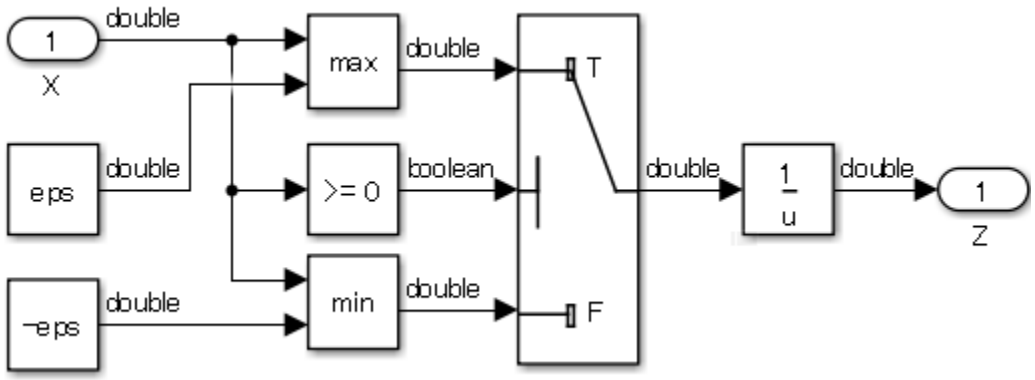
When Math Function block parameter **Function** is set to `reciprocal`, the input to the block shall not be zero.

Custom Parameter

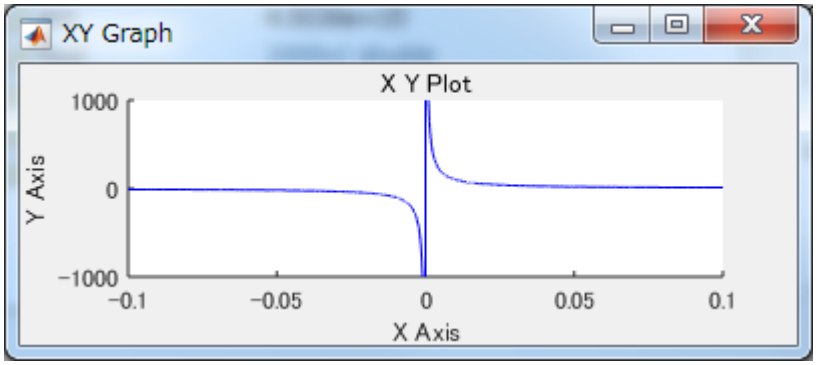
Not Applicable

Example — Correct

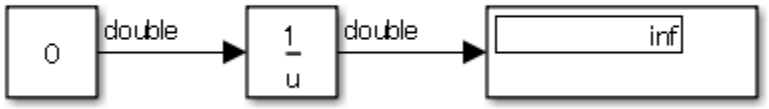
Replace within ±eps with ±eps



Simulation result: Simulation results is not inf, but since it is close to zero, the change in the output value is significant.



Example — Incorrect



Sub ID i

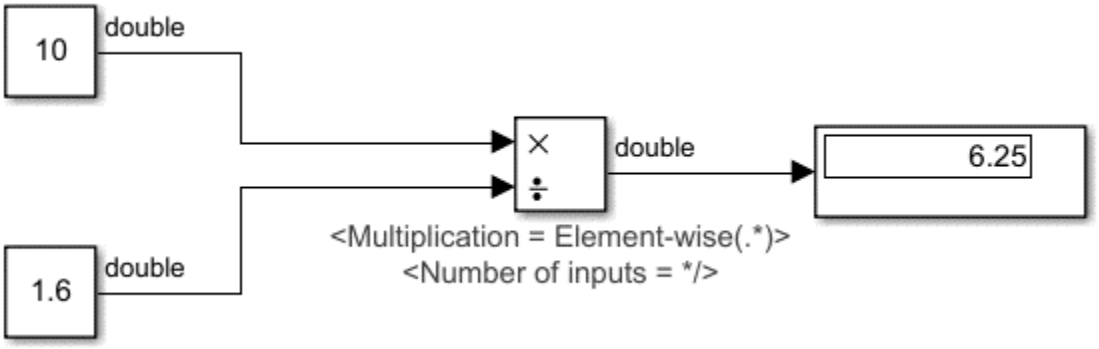
When Product block parameter **Multiplication** is set to `Element-wise(.*)`, the divisor input shall not be zero.

Note To specify a divisor input, set Product block parameter **Number of inputs** to `*/`.

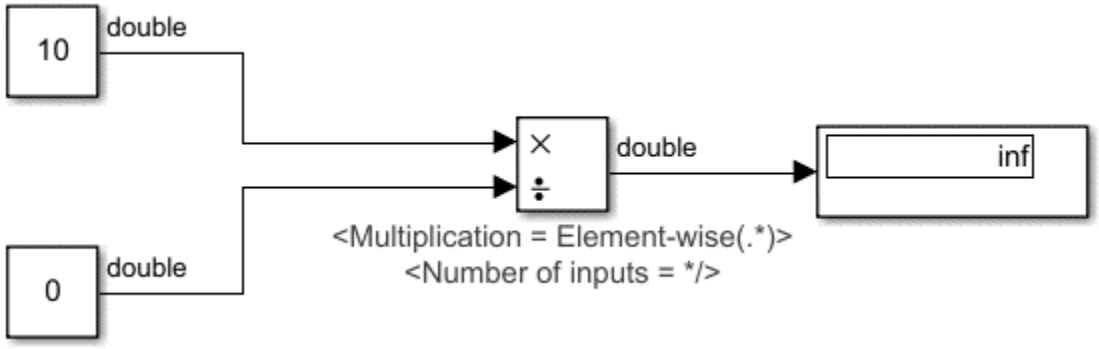
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID j

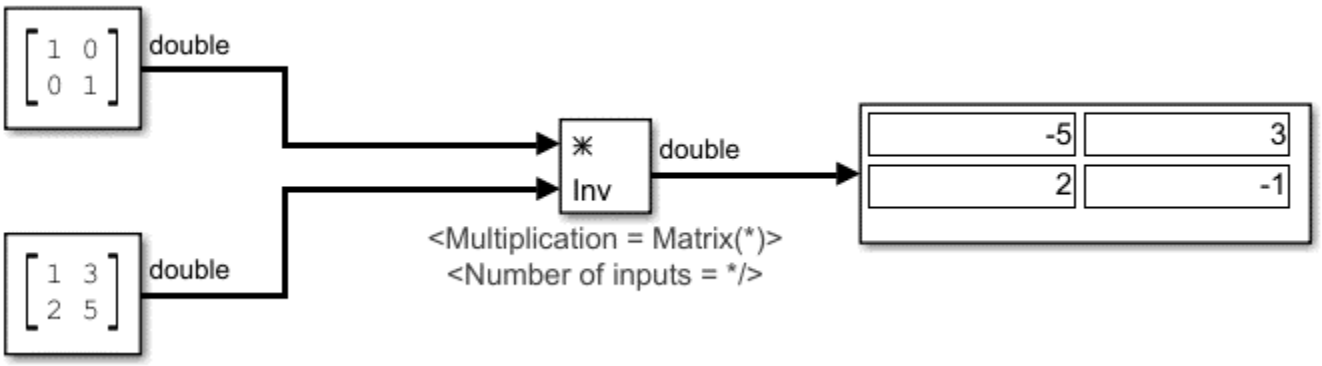
When Product block parameter **Multiplication** is set to `Matrix(*)`, the divisor input shall not be set to a singular matrix.

Note To specify a divisor input, set Product block parameter **Number of inputs** to `*/`.

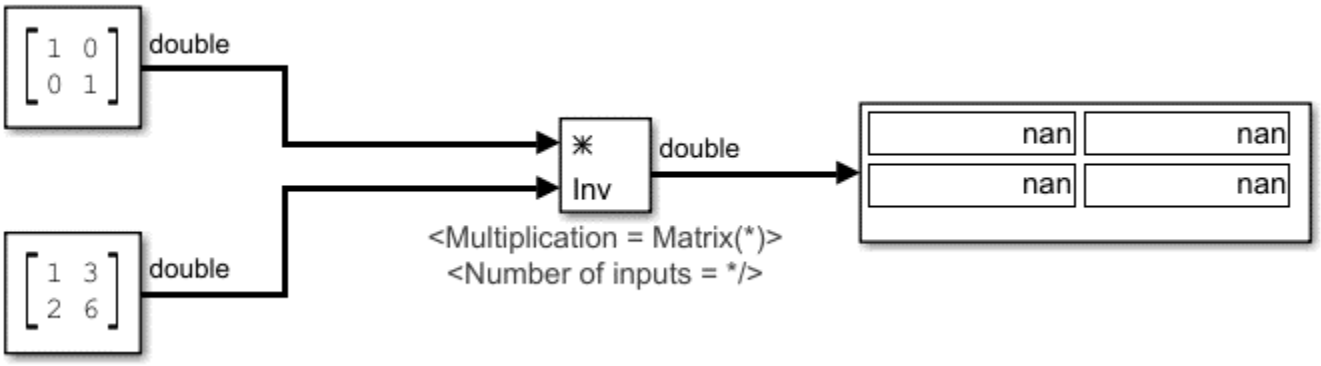
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub IDs a1, c1, d, e, f1, g, h, i, j:

- The result of entering an invalid value is implementation dependent. Deviation from the rules can result in unintended behavior.

Sub ID a2:

- Correct settings prevent unintended behavior that can result from using invalid values.

Sub ID b:

- The block can become optimized out of the generated code, resulting in a block that you cannot trace to the generated code.

Sub IDs c2, f2:

- Correct settings prevent unintended behavior that can result from using negative values.

Verification

Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jc_0805, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Specify Block Properties”
- “Control Data Types of Signals”

Introduced in R2020a

jc_0622: Usage of Fcn blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

When a Fcn block has operators with different priorities, parentheses shall be used to specify the priority order.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- When operators have different priorities and the computation order is not clearly specified by using parentheses, readability is impaired and can be misinterpreted. This can result in unintended behavior.

Verification

Model Advisor check: “Check for parentheses in Fcn block expressions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0622, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Algebraic Loop Concepts”

Introduced in R2020a

jc_0621: Usage of Logical Operator blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

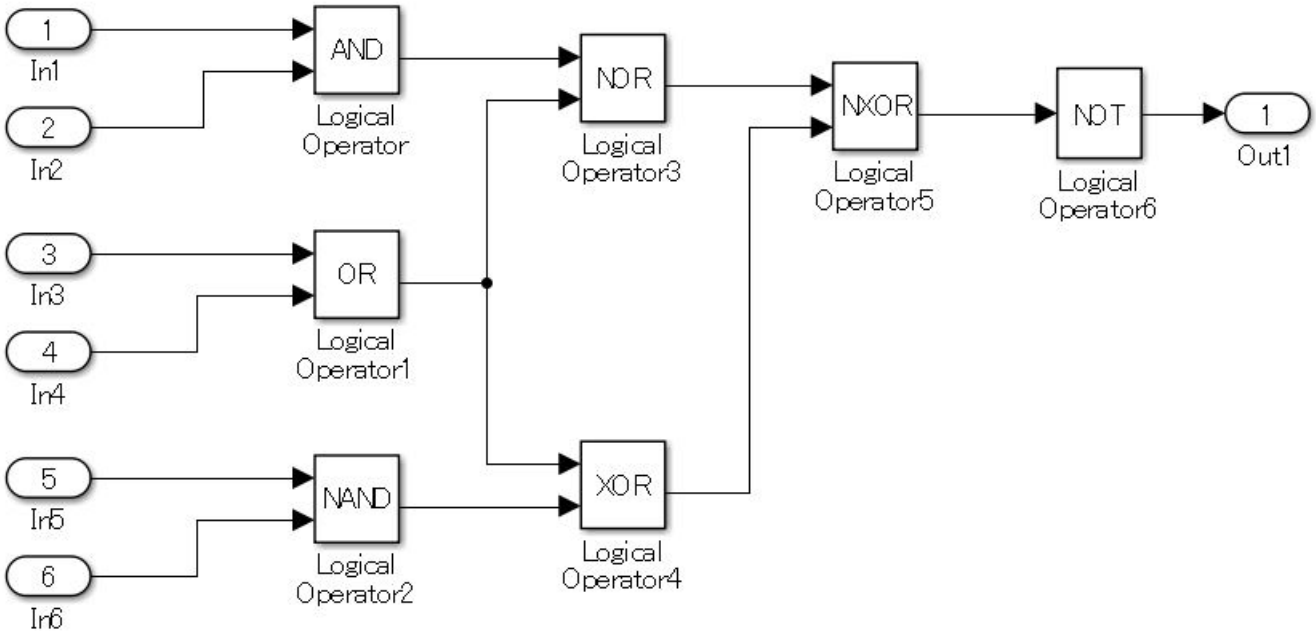
Sub ID a

The **icon shape** for the Logical Operator block shall be set to `rectangular`.

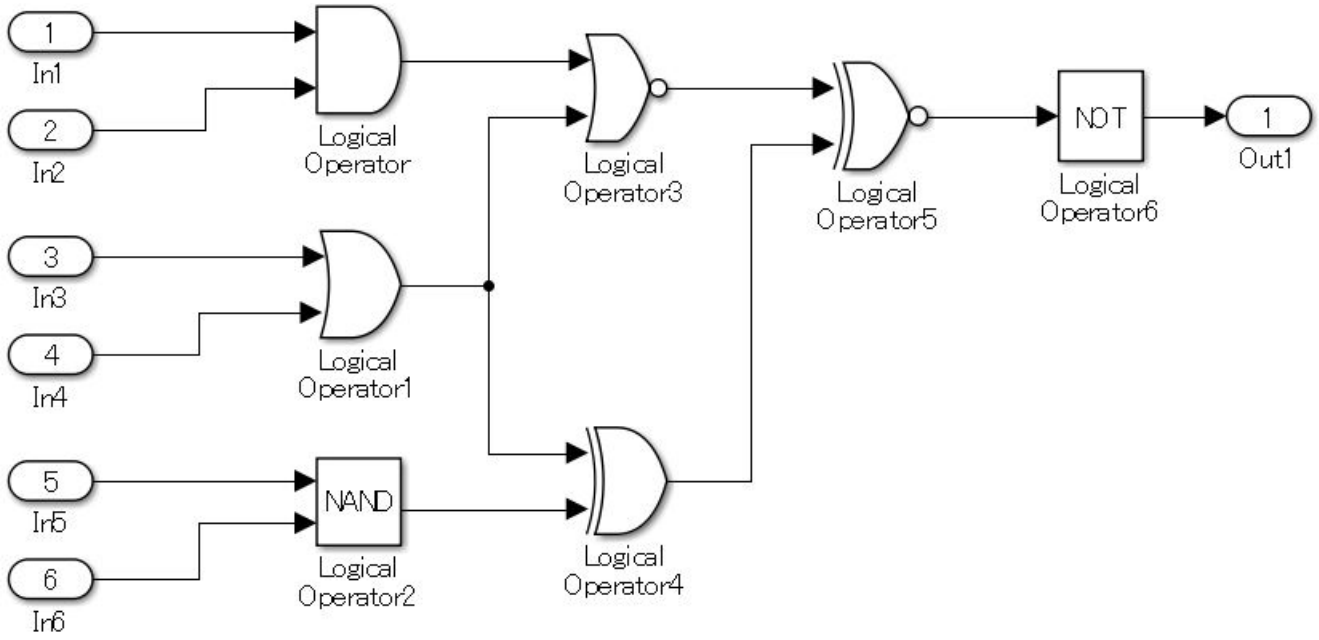
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- When describing the same function, using a consistent expression improves readability. Since "characteristics" shapes are similar, the risk of misinterpretation is greater than with `rectangular` shapes.

Verification

Model Advisor check: “Check icon shape of Logical Operator blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0621, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0131: Usage of Relational Operator blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

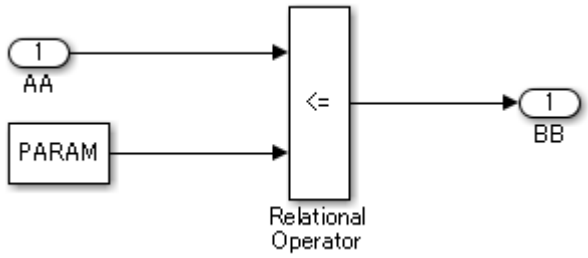
Sub ID a

When using a Relational Operator block for comparison of signals and constants, the second (bottom) input shall be used as the constant input.

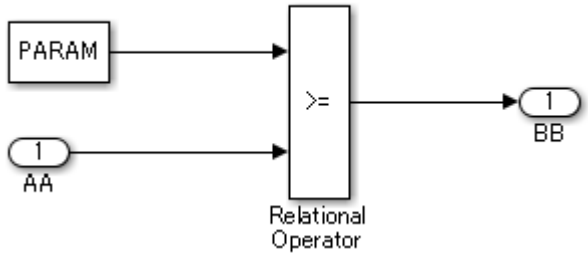
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Using constant values and the same comparison method reduces misinterpretation of the model.

Verification

Model Advisor check: “Check usage of Relational Operator blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0131, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Relational and Logical Operators” (Embedded Coder)

Introduced in R2020a

jc_0800: Comparing floating-point types in Simulink

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

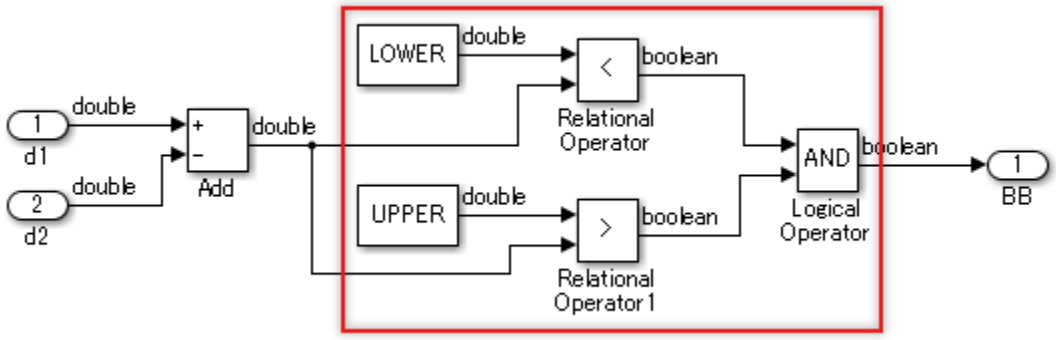
Sub ID a

Equivalence comparison operators (==, ~=) shall not be used on floating-point data types.

Custom Parameter

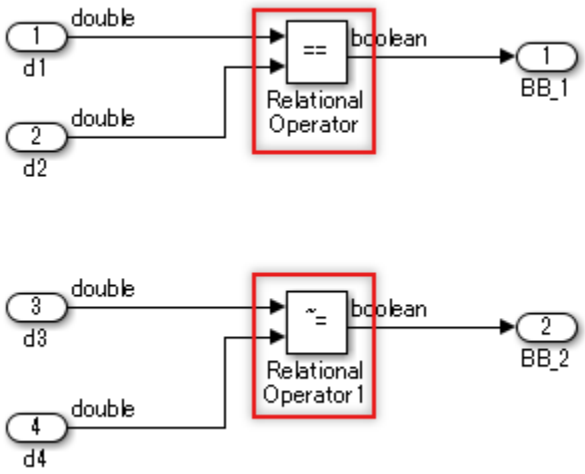
Not Applicable

Example — Correct



Example — Incorrect

Uses equivalence comparison operators == and ~= on the floating-point data type.



Rationale

Sub ID a:

- Due to the characteristics of the floating-point, since the error is included in the value, the result of the equivalence comparison operation may be false when it was expected to be true.

Verification

Model Advisor check: “Comparing floating point types in Simulink” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0800, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Validate a Floating-Point Embedded Model”

Introduced in R2020a

jc_0626: Usage of Lookup Table blocks

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

The Lookup Table Dynamic block parameter **Lookup Method** shall be set to `Interpolation — Use End Values`.

Custom Parameter

Not Applicable

Sub ID b

These n-D Lookup Table block parameters shall be set as follows:

- Set **Interpolation Method** to `Linear point-slope` or `Linear Lagrange`.
- Set **Extrapolation Method** to `Clip`.
- Select **Use last table value for inputs at or above last breakpoint**.

Custom Parameter

Not Applicable

Rationale

Sub IDs a, b:

- When an unexpected value is entered for the Lookup Table block, the output is determined by using the extrapolation method and can become an impossible value or cause the Lookup Table output to overflow.

Verification

Model Advisor check: “Check usage of Lookup Tables” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0626, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Methods for Approximating Function Values”

Introduced in R2020a

jc_0623: Usage of continuous-time Delay blocks and discrete-time Delay blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Unit Delay or Delay blocks shall be used in a discrete model or subsystem.

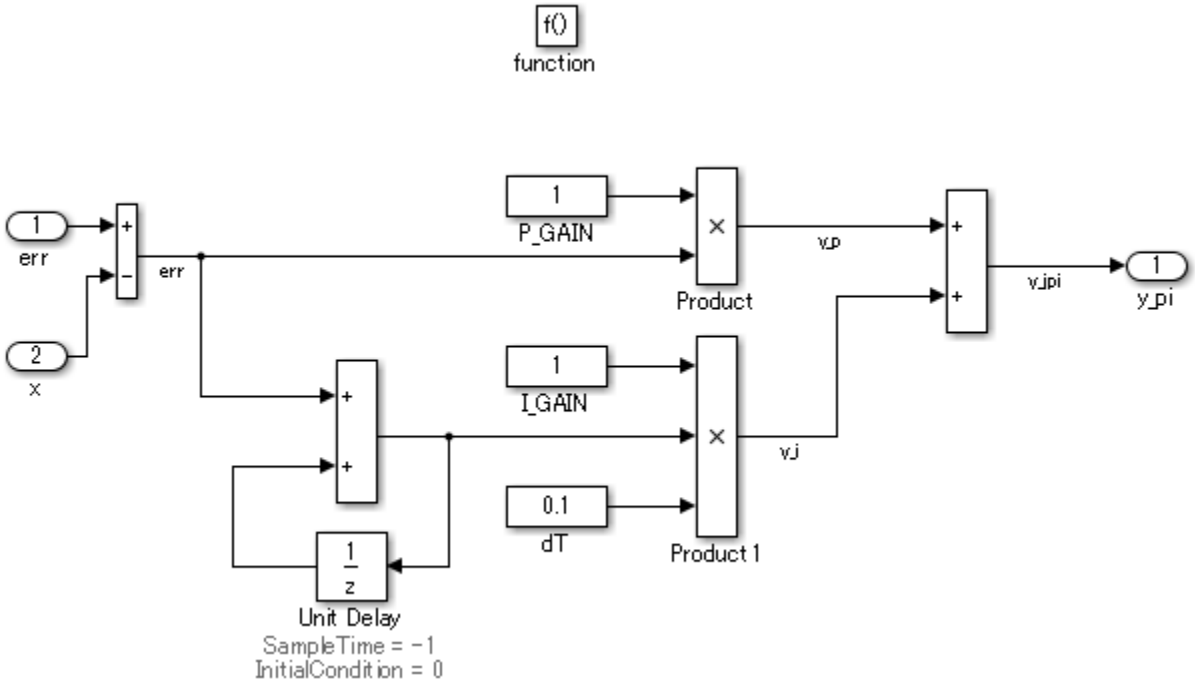
A Memory block shall be used in a continuous type model or subsystem.

Custom Parameter

Not Applicable

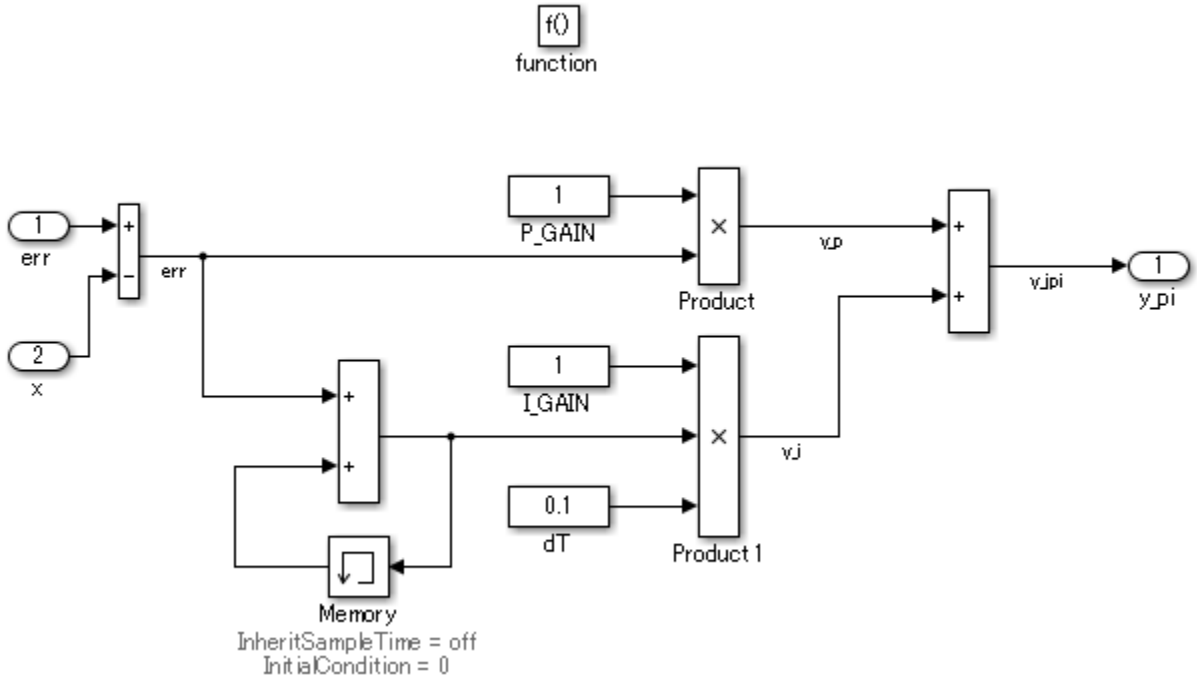
Example — Correct

A Unit Delay block is used in the discrete type model.



Example — Incorrect

A Memory block is used in the discrete type model.



Rationale

Sub ID a:

- Adherence to the rule improves readability of the model.

Verification

Model Advisor check: “Check usage of Memory and Unit Delay blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0623, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Types of Subsystems”
- “Model a Continuous System”
- “Convert Signals Between Continuous Time and Discrete Time”
- “Discrete and Continuous Resettable Subsystems”

Introduced in R2020a

jc_0624: Usage of Tapped Delay blocks/Delay blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b

MATLAB Versions

All

Rule

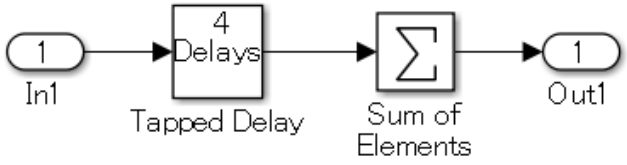
Sub ID a

When holding previous past values, Tapped Delay block shall be used to create a vector signal from all held values.

Custom Parameter

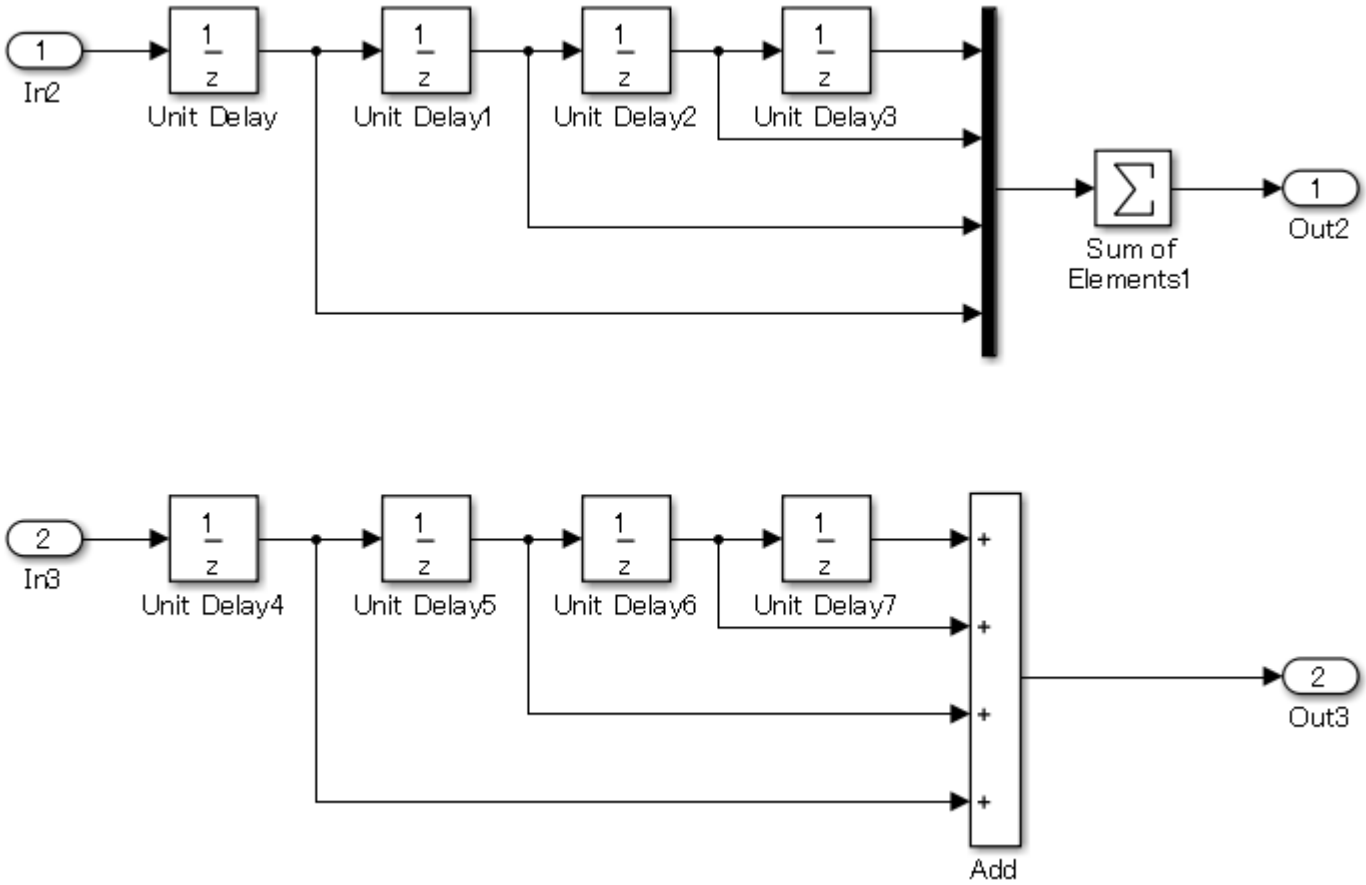
Not Applicable

Example — Correct



Example — Incorrect

The Tapped Delay block is not used.



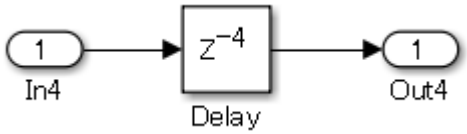
Sub ID b

When holding past values, Delay block shall be used to obtain the oldest value only

Custom Parameter

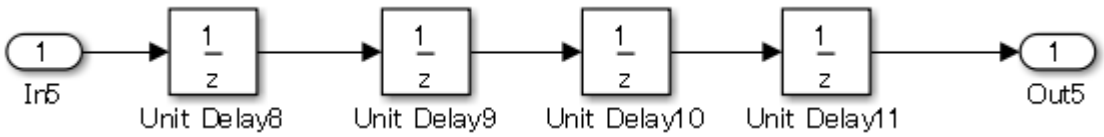
Not Applicable

Example — Correct



Example — Incorrect

The Delay block is not used.



Rationale

Sub ID a:

- Tapped Delay is set with arrays that hold past values, which improves code readability to assist code efficiency.

Sub ID b:

- Improves model readability and code efficiency.

Verification

Model Advisor check: “Check for cascaded Unit Delay blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0624, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Signal Lines”

Introduced in R2020a

jc_0627: Usage of Discrete-Time Integrator blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a, b

MATLAB Versions

All

Rule

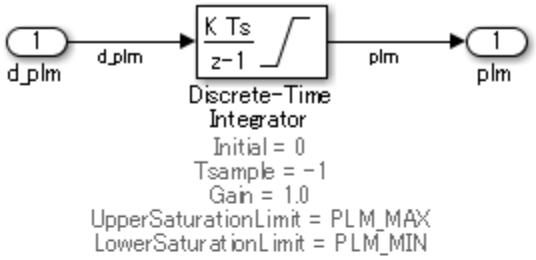
Sub ID a

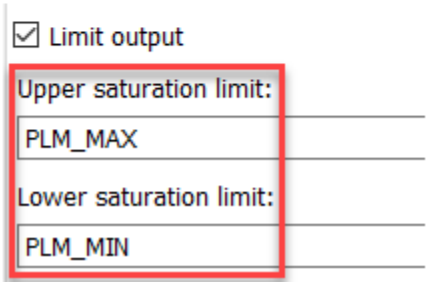
Discrete-Time Integrator block parameters **Upper saturation limit** and **Lower saturation limit** shall be defined.

Custom Parameter

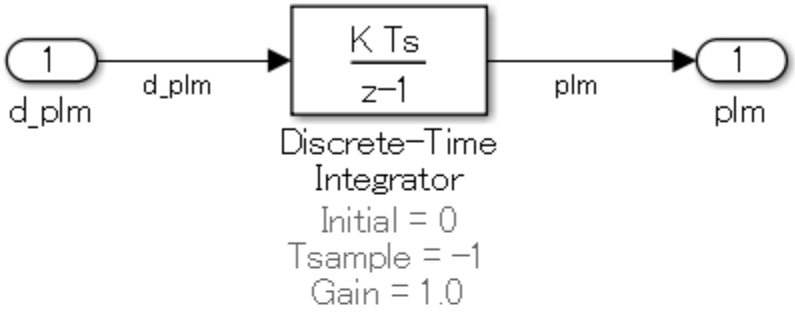
Not Applicable

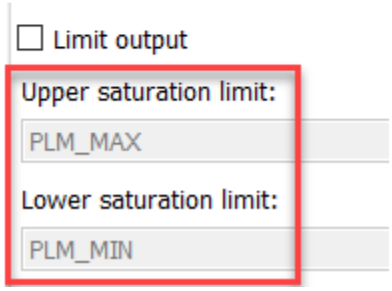
Example — Correct





Example — Incorrect





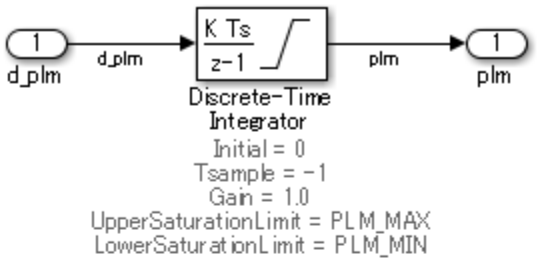
Sub ID b

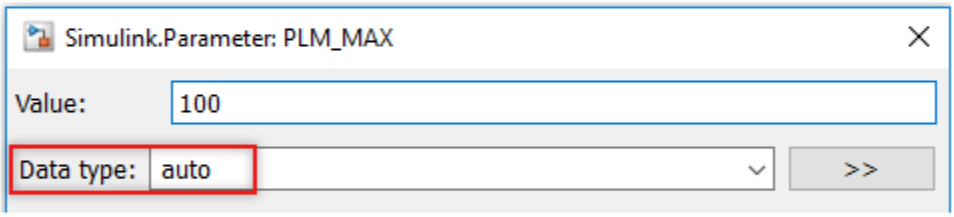
When Discrete-Time Integrator block parameters **Upper saturation limit** and **Lower saturation limit** are defined as `Simulink.Parameter`, parameter **Data type** shall be set to `auto`.

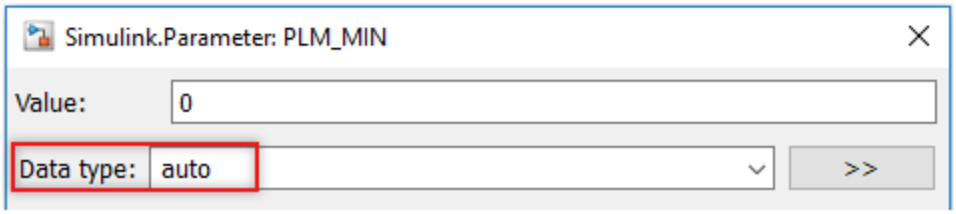
Custom Parameter

Not Applicable

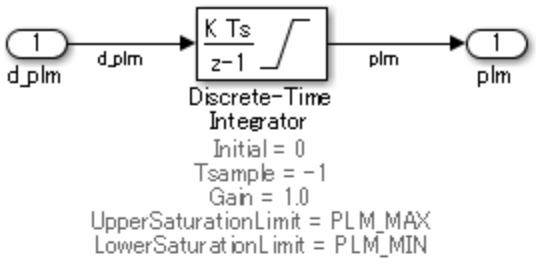
Example — Correct

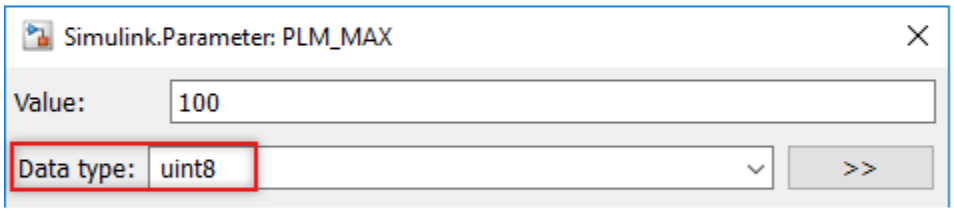


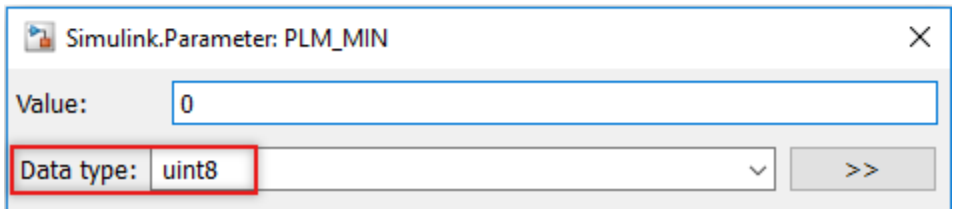




Example — Incorrect







Rationale

Sub ID a:

- Avoids block output overflow and prevents other computation blocks that use the output of this block from producing unexpected results.

Sub ID b:

- Simulation errors occur when **Data type** is set to a value other than `auto`, `single`, or `double`.

Verification

Model Advisor check: “Check usage of Discrete-Time Integrator block” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0627, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

- `Simulink.Parameter`
- “Simulink.Parameter Property Dialog Box”

Introduced in R2020a

jc_0628: Usage of Saturation blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Saturation and Saturation Dynamic blocks shall be used to limit physical quantity.

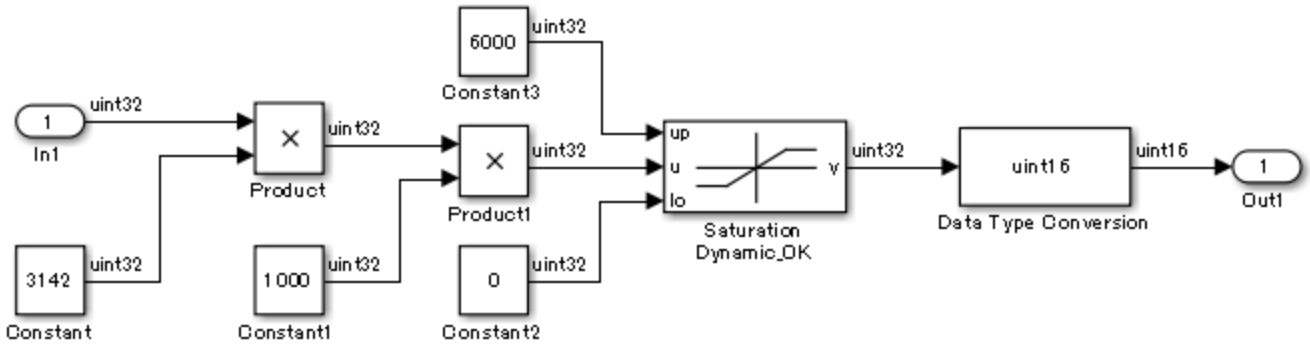
Type conversion shall not be used. Block parameters **Upper limit** and **Lower limit** shall not be set.

Custom Parameter

Not Applicable

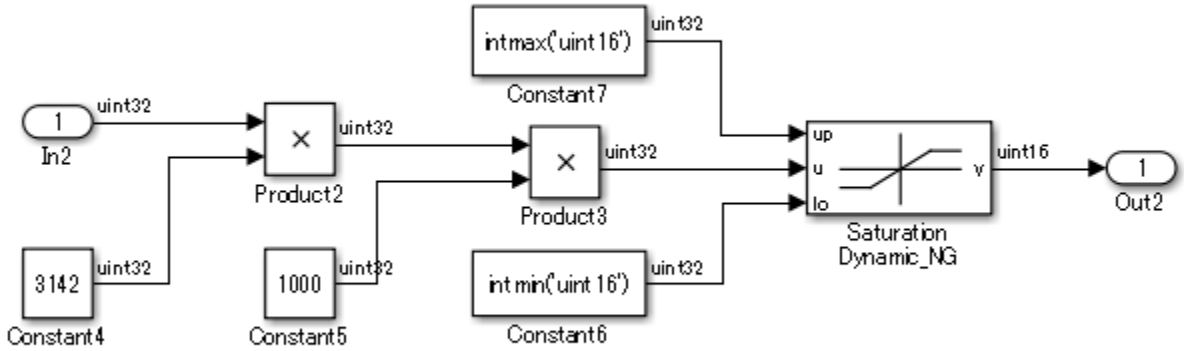
Example — Correct

The Saturation Dynamic block is limiting physical quality.



Example — Incorrect

The Saturation Dynamic block is not being used to limit physical quantity. Type conversion is being used. The upper and lower limits for the data type maximum and minimum values are set.



Rationale

Sub ID a:

- Consistent use of Saturation blocks improve maintainability of the model.

Verification

Model Advisor check: “Check usage of the Saturation blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0628, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0651: Implementing a type conversion

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

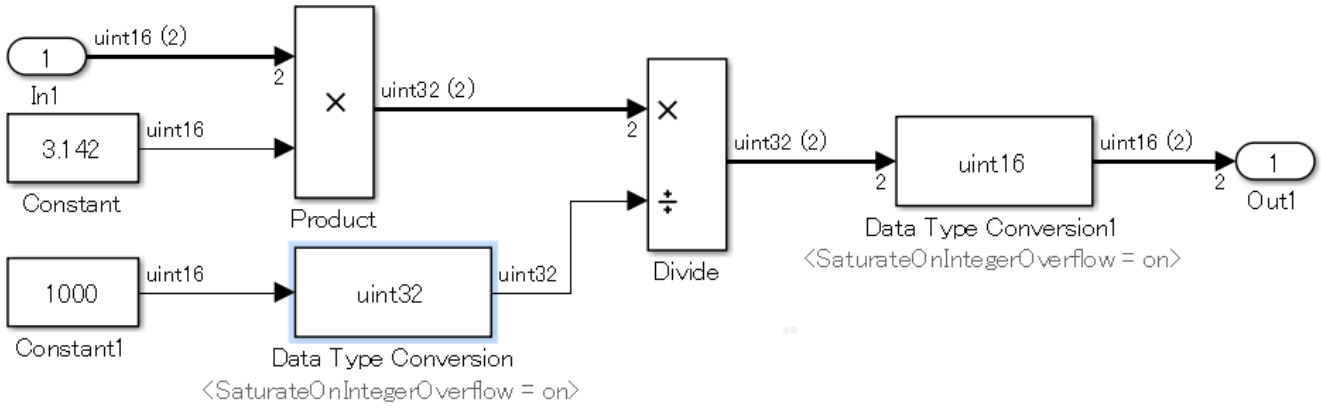
Data Type Conversion block shall be used when changing the data type of the block output signal.

Custom Parameter

Not Applicable

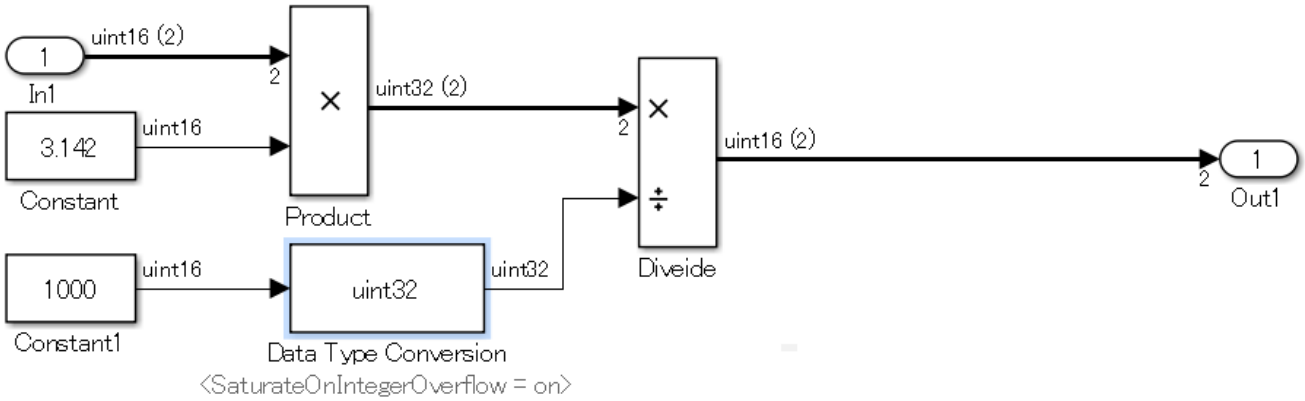
Example — Correct

Data Type Conversion block is used to convert the data type of the Divide block output signal.



Example — Incorrect

Data Type Conversion block is not used to convert the data type of the [Divide] output signal.



Rationale

Sub ID a:

- Determining whether there is pointless processing or if something is missing from the design (such as a missing description) is easier when the processing of exceptions (else, default) is explicitly set in the model.

Verification

Model Advisor check: “Check output data type of operation blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0651, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

Other Blocks

db_0042: Usage of Inport and Outport blocks

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

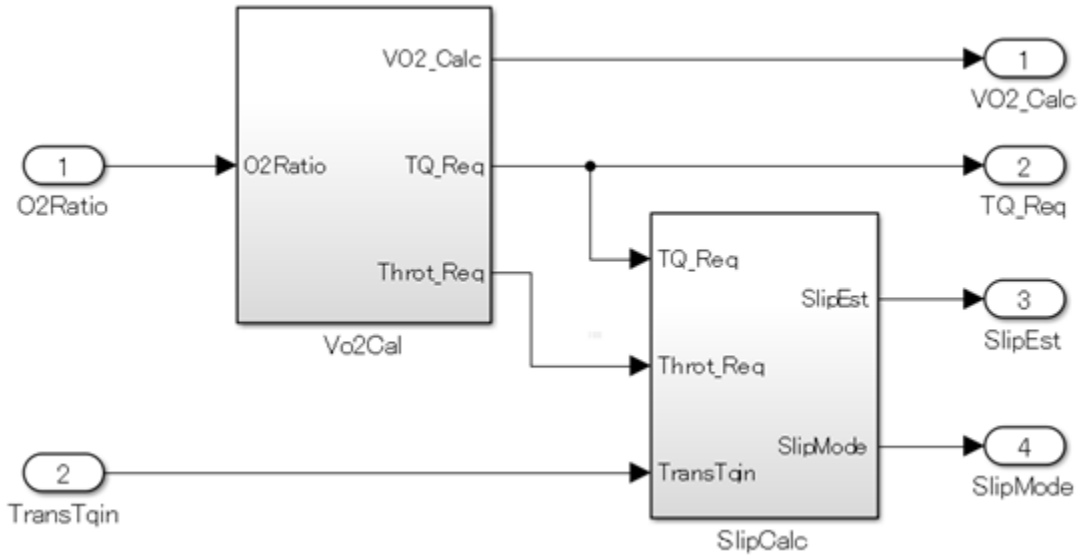
The Inport block shall be positioned on the left side of the diagram, but can be moved to prevent the crossing of signals.

Custom Parameter

Not Applicable

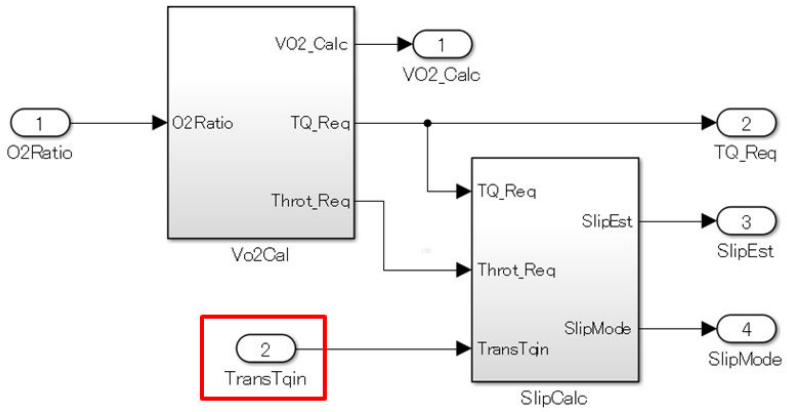
Example — Correct

Inport block is positioned on the left side of the diagram.



Example — Incorrect

Inport block is not positioned on the left side of the diagram.



Sub ID b

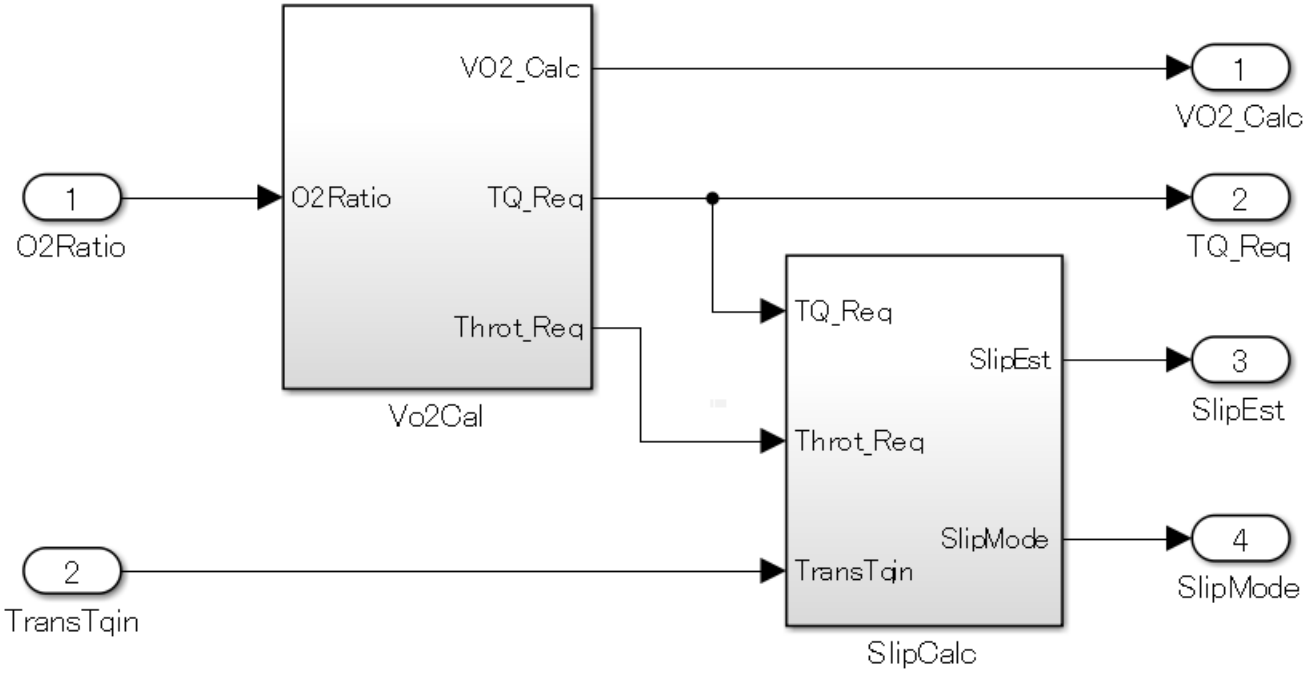
The Outport block shall be positioned on the right side of the diagram, but can be moved to prevent the crossing of signals.

Custom Parameter

Not Applicable

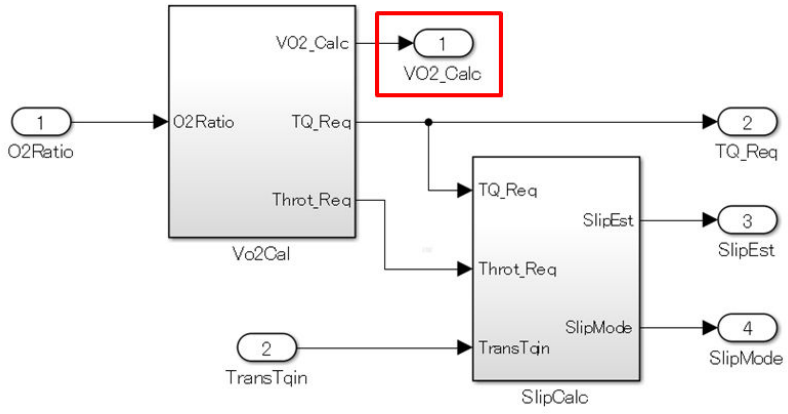
Example — Correct

Outport block is positioned on the right side of the diagram.



Example — Incorrect

Outport block is not positioned on the right side of the diagram.



Sub ID c

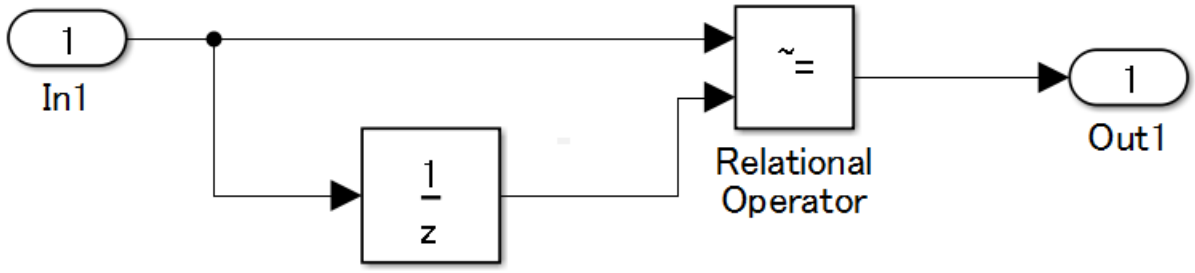
Duplicate Inport blocks shall be prohibited.

Custom Parameter

Not Applicable

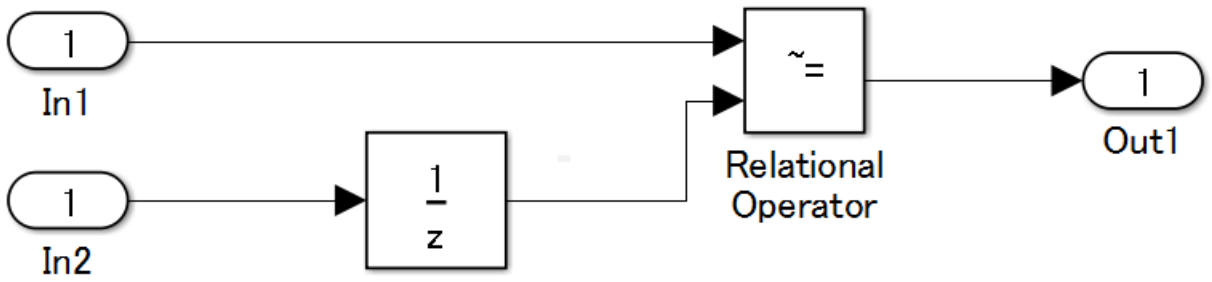
Example — Correct

One Inport block is used.



Example — Incorrect

Inport blocks is duplicated.



Rationale

Sub IDs a, b, c:

- Defined operation rules improve readability.

Verification

Model Advisor check: “Check position of Inport and Outport blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0042, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0081: Inport and Outport block icon display

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

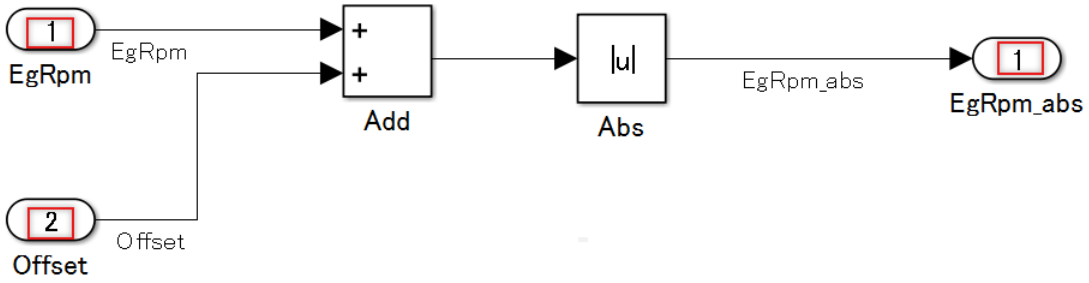
Sub ID a

For Inport and Outport blocks, parameter **Icon Display** shall be set to `Port number`.

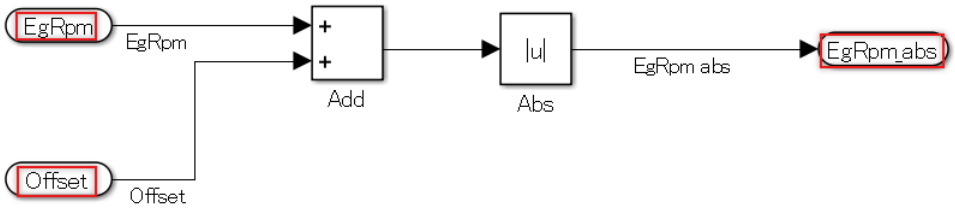
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Improves readability by displaying the port number of Inport and Outport blocks.
- Allows for easy identification of port numbers that are within a subsystem.
- Prevents misconnections to hierarchized subsystems by displaying the block names and making the names of signal lines to the Inport and Outport blocks the same as the block names.

Verification

Model Advisor check: “Check display for port blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0081, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Set Block Parameter Values”
- “Signal Basics”
- “Explore Simulink Bus Capabilities”

Introduced in R2020a

na_0011: Scope of Goto and From blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Goto block parameter **tag visibility** shall be set to `Local`.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- When hierarchies of the Goto block and corresponding From block are different, the connection relationships can be difficult to understand.
- Simulation errors can occur when hierarchies of the Goto block and corresponding From block are different and a virtual subsystem changes to an Atomic subsystem.

Verification

Model Advisor check: “Check scope of From and Goto blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0011, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Block-Specific Parameters”
- “Types of Subsystems”
- “Simulink Subsystem Semantics”

Introduced in R2020a

jc_0161: Definition of Data Store Memory blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

The smallest scope level shall be used to define the Data Store Memory block.

Custom Parameter

Not Applicable

Sub ID b

Only data required for execution and code generation shall be defined in the Data Store Memory block.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Readability improves when usage is limited.

Sub ID b:

- Unused data can affect maintenance and operability.

Verification

Model Advisor check: “Check for usage of Data Store Memory blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0161, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Data Store Basics”

Introduced in R2020a

jc_0141: Usage of the Switch blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

The second Switch block input condition shall be a logical type. Switchblock parameter **Criteria for passing first input** shall be set to `u2~=0`.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- It is easier to understand specifications when the configuration is applied by using Simulink blocks rather than by writing operation expressions in blocks.

Verification

Model Advisor check: “Check usage of Switch blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0141, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0650: Block input/output data type with switching function

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

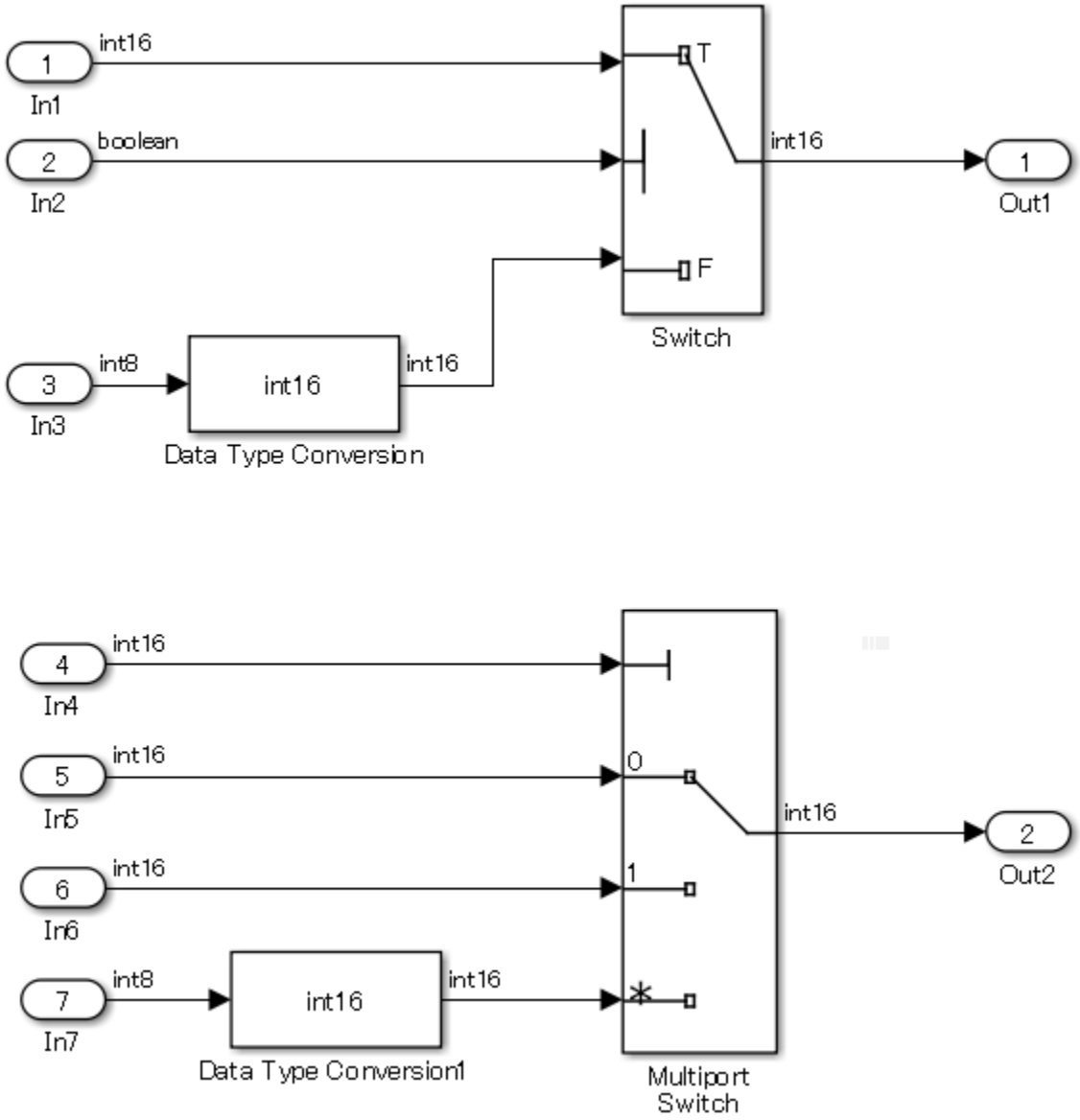
For blocks with switching functions (Switch, Multiport Switch, and Index Vector), the same data type shall be used for data ports and output ports.

Custom Parameter

Not Applicable

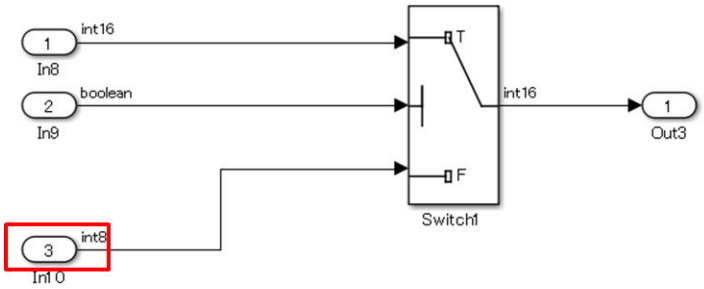
Example — Correct

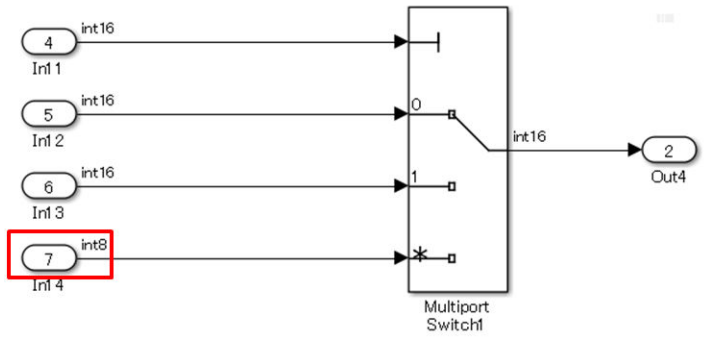
The data type for the data port and output port is the same.



Example — Incorrect

The data port and output port have different data types.





Rationale

Sub ID a:

- Prevents implicit data conversion.

Verification

Model Advisor check: “Check input and output datatype for Switch blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0650, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0630: Usage of Multiport Switch blocks

Sub ID Recommendations

- NA-MAAB — a, c
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

Multiport Switch block parameter **Number of data ports** shall be two or more.

Custom Parameter

Not Applicable

Sub ID b

The input to the Multiport Switch control port shall be an unsigned integer.

Custom Parameter

Not Applicable

Sub ID c

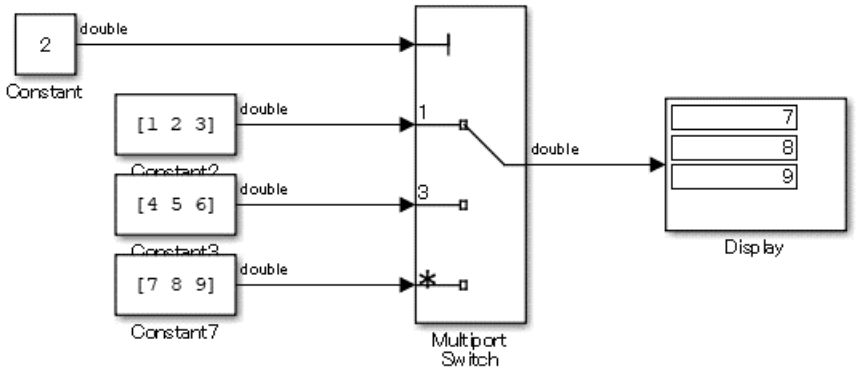
When Multiport Switch block parameter **Data port order** is set to `Specify indices`, these block parameters shall be set as follows:

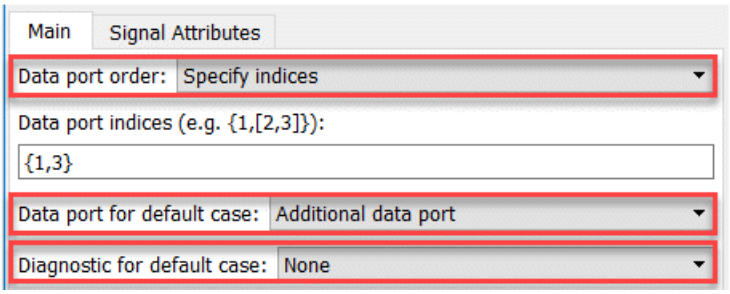
- Set **Data port for default case** to `Additional data port`.
- Set **Diagnostic for default case** to `None`.

Custom Parameter

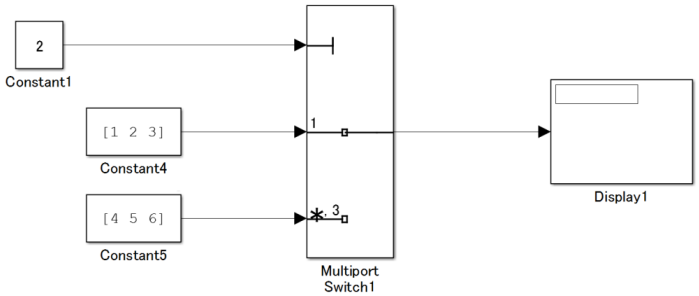
Not Applicable

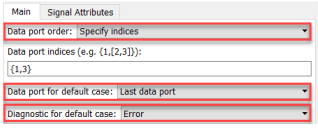
Example — Correct





Example — Incorrect





Rationale

Sub ID a:

- Unintended output can occur when there is only one data port because the block changes to extract scalars from vectors.

Sub ID b:

- The control port is an input range that expects an integer value of zero or greater. When a signed or non-integer signal is connected to the control port, it can appear as a misconnection.

- There is a possibility of data ports being unintentionally selected when negative or non-integer values are input.

Sub ID c:

- When block parameter **Data port order** is set to `Specify indices`, a value that inputs to the Multiport Switch block, other than the index specified for the control port, is treated the same as the last value of the specified index. As a result, an unintended data port can be selected.

Verification

Model Advisor check: “Check settings for data ports in Multiport Switch blocks” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0630, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

na_0020: Number of inputs to variant subsystems

Sub ID Recommendations

- NA-MAAB — b
- JMAAB — a, b

MATLAB Versions

All

Rule

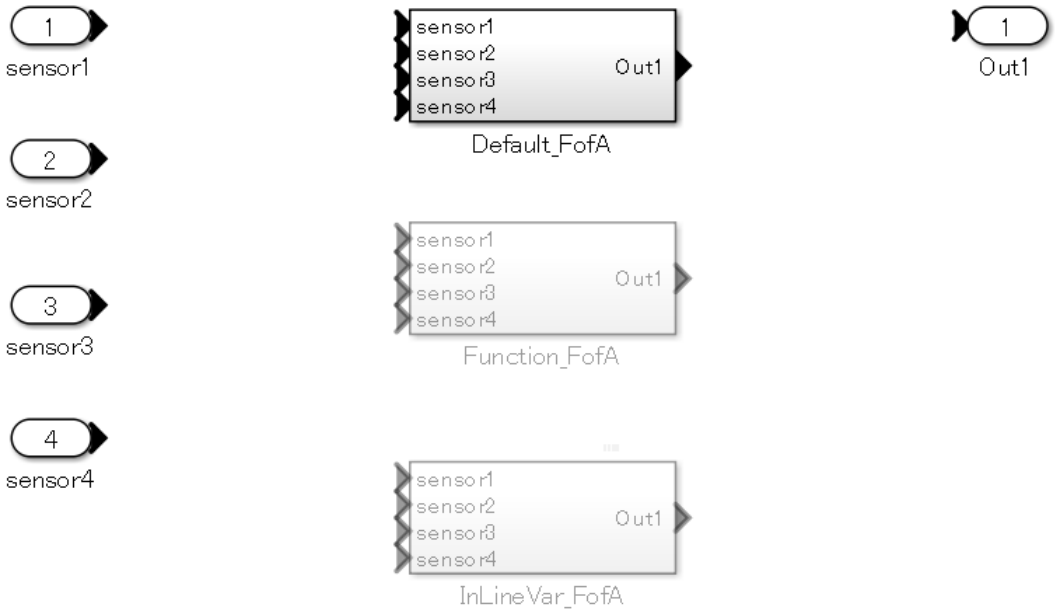
Sub ID a

The number of inputs/outputs for a Variant Subsystem block and its child subsystem or model reference shall be the same.

Custom Parameter

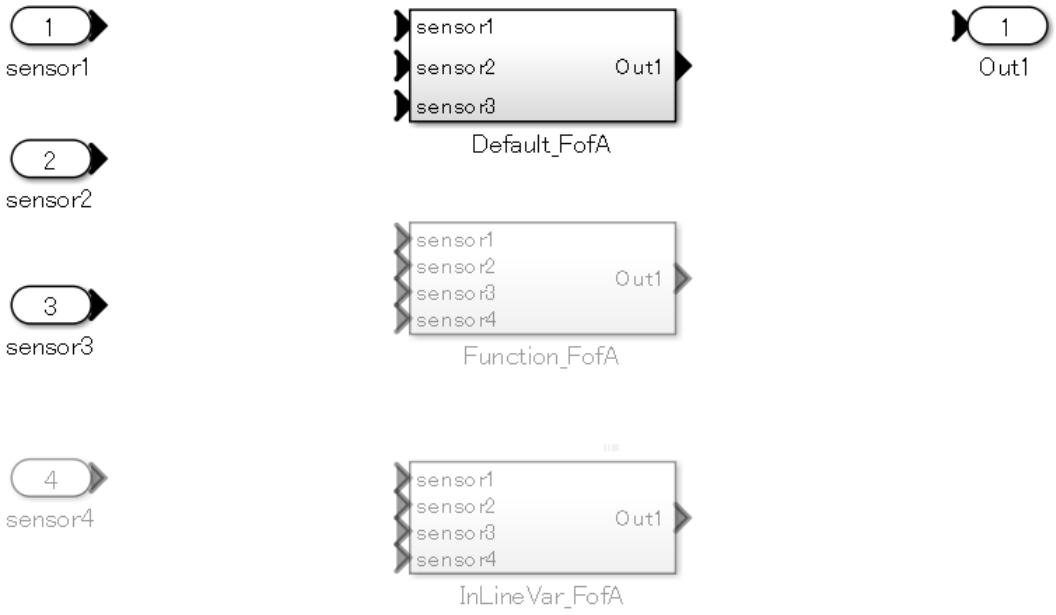
Not Applicable

Example — Correct



Example — Incorrect

The number of inputs to the child subsystem is different.



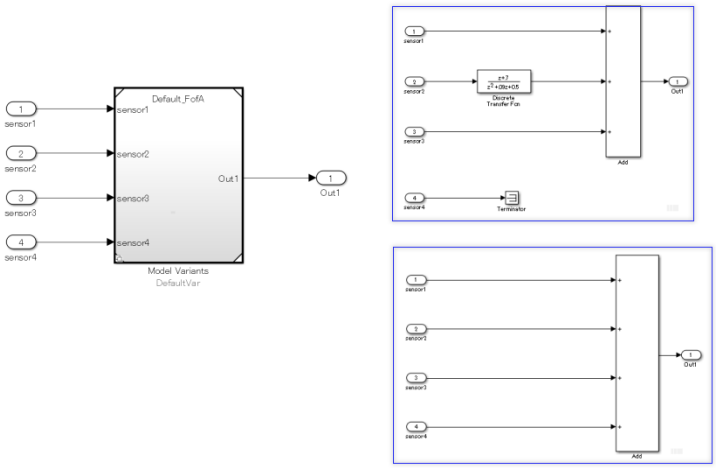
Sub ID b

The number of inputs/outputs for a Variant Model block shall be the same as its referenced model.

Custom Parameter

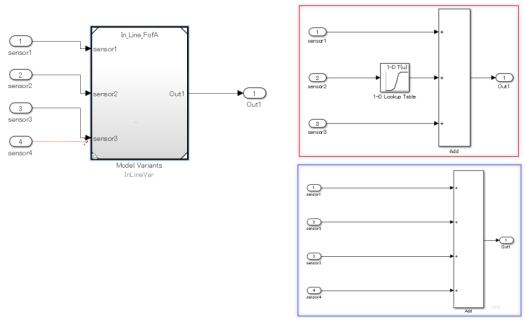
Not Applicable

Example — Correct



Example — Incorrect

The number of inputs to the referenced model is different than the inputs to the Variant Model block.



Rationale

Sub IDs a, b:

- Unconnected signals can be unintentionally overlooked when the number of inputs/outputs is different.

Verification

Model Advisor check: “Check for missing ports in Variant Subsystems” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0020, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Types of Subsystems”
- “Model Reference Basics”
- “Create a Simple Variant Model”

Introduced in R2020a

na_0036: Default variant

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

Variant subsystems shall be configured so that one subsystem is always selected. This is achieved by using one of these methods:

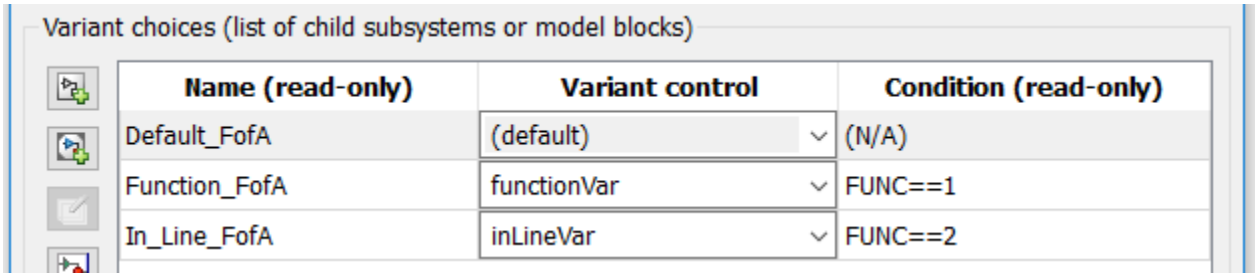
- Use the default variant for the variant.
- Define conditions that exhaustively cover all possible values of the conditional variables. For example, define conditions for true and false values of a Boolean.

Custom Parameter

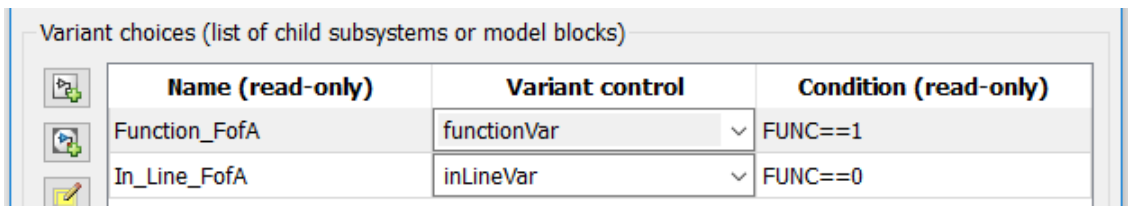
Not Applicable

Example — Correct

A default variant is used.

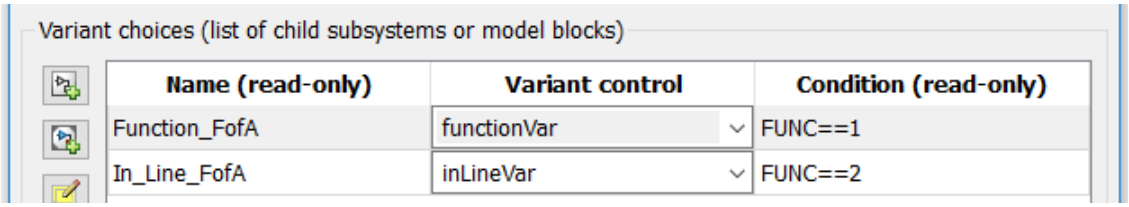


`FUNC` is a logical type.



Example — Incorrect

An active subsystem will not exist when FUNC is not 1 or 2.



Sub ID b

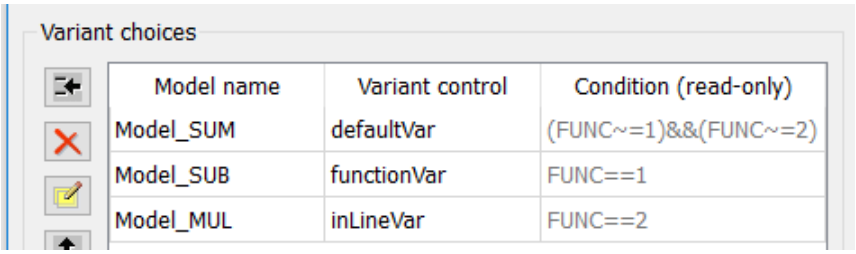
Model variant conditions shall be set so all values that can be applied to conditional variable signals are configured so one subsystem is always selected. For example, a condition is prepared for the variable signal value being true, as well as false.

Custom Parameter

Not Applicable

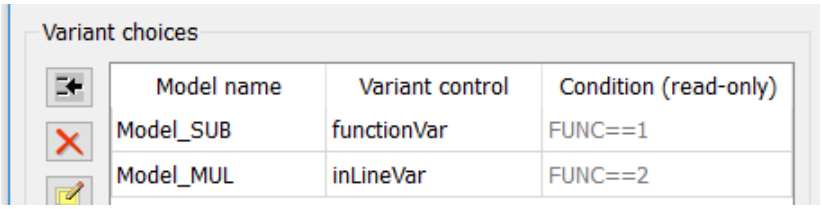
Example — Correct

The condition is set so that all values for the conditional variable are covered.



Example — Incorrect

An active subsystem will not exist when FUNC is not 1 or 2.



Rationale

Sub IDs a, b:

- Prevents the omission of conditions.
- There may not be an active subsystem when conditions are omitted.

Verification

Model Advisor check: “Check use of default variants” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0036, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Variant Subsystems”
- “Propagate Variant Conditions from Variant Source Blocks to Subsystem Blocks”

Introduced in R2020a

na_0037: Use of single variable for variant condition

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Variant conditions shall be used to prohibit compound conditions that are formed from multiple variables.

Exception

Conditional expressions that are formed from multiple variables can be used when using default variants.

Custom Parameter

Not Applicable

Example — Correct

The variant condition is set by a single condition that is formed from multiple variables.

The usage of enumerated type variables is recommended in a condition equation. This example uses numerical values to improve readability.

Name	Submodel Configuration	Variant Control	Condition
na0037a_OK			
Variant Subsystem			
Default_FofA		DefaultVar	(INLINE==0)&&(FUNC==0)
Function_FofA		FunctionVar	FUNC==1
InLineVar_FofA		InLineVar	INLINE==1

Example — Incorrect

The variant condition is set by a compound condition that is formed from multiple variables.

Name	Submodel Configuration	Variant Control	Condition
na0037a_NG			
Variant Subsystem			
AutoTrans		autoTrans	(INLINE==0)&&(transType==5)
Default_4speed		defaultTrans	(((INLINE==0)&&(transType==3))==0)&&(FUNC==0)&&(transType~=2)
ManualTrans		manualTrans	(FUNC==1)||(transType==2)

Rationale

Sub ID a:

- Complicates the conditions, which makes it difficult to determine which subsystem will become active. This can result in conditions being omitted.
- When conditions are omitted, there is a risk that there may not be an active subsystem.

Verification

Model Advisor check: “Check use of single variable variant conditionals” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0037, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “What Are Variants and When to Use Them”
- “Introduction to Variant Controls”

Introduced in R2020a

Stateflow

- “Stateflow Blocks / Data / Events” on page 4-2
- “Stateflow Diagram” on page 4-27
- “Conditional Transition / Action” on page 4-80
- “Label Description” on page 4-141
- “Miscellaneous” on page 4-167

Stateflow Blocks / Data / Events

db_0123: Stateflow port names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

The name of a Stateflow input/output shall be the same as the corresponding signal.

Exception

Reusable Stateflow blocks can have different port names.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Improves readability.
- Code generation may not be possible.

Verification

Model Advisor check: “Check for names of Stateflow ports and associated signals” (Simulink Check)

Last Changed

R2020a

See Also

- “Set Data Properties” (Stateflow)
- “Reusable Components in Charts” (Stateflow)

Introduced in R2020a

db_0125: Stateflow local data

Sub ID Recommendations

- NA-MAAB — a, b, c, d
- JMAAB — a, b, c, d

MATLAB Versions

All

Rule

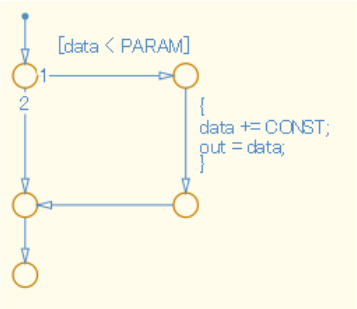
Sub ID a

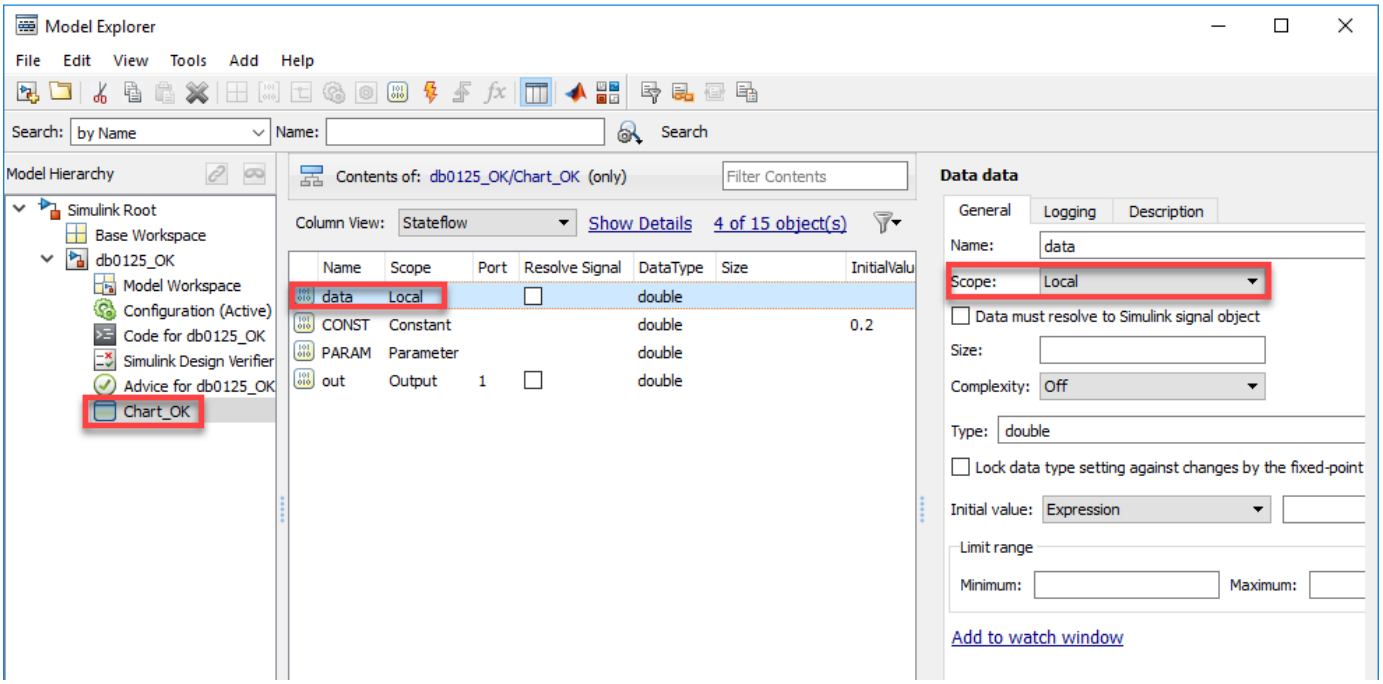
Data objects shall not be defined with Scope set to `Local` at the machine level.

Custom Parameter

Not Applicable

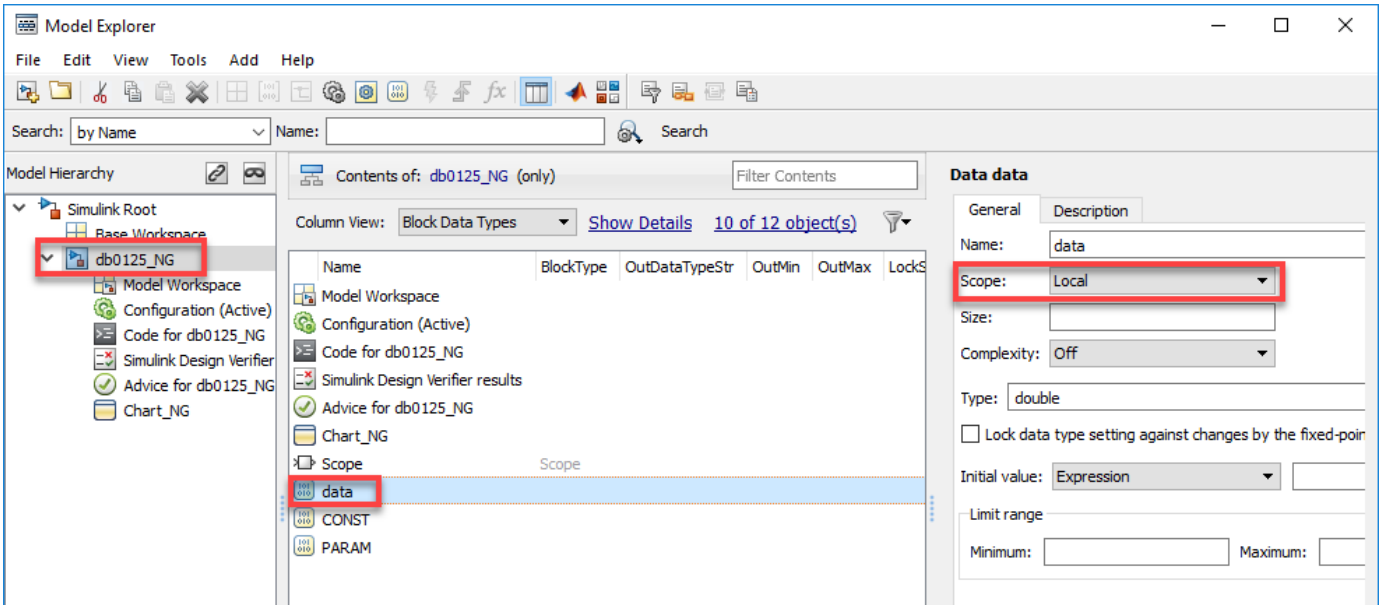
Example — Correct





Example — Incorrect

Scope has set `Local` local data at the machine level.



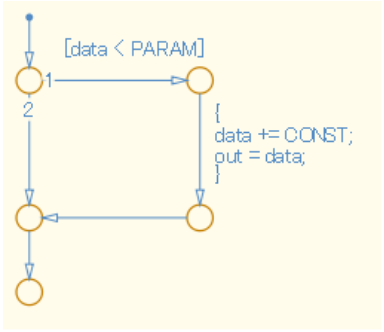
Sub ID b

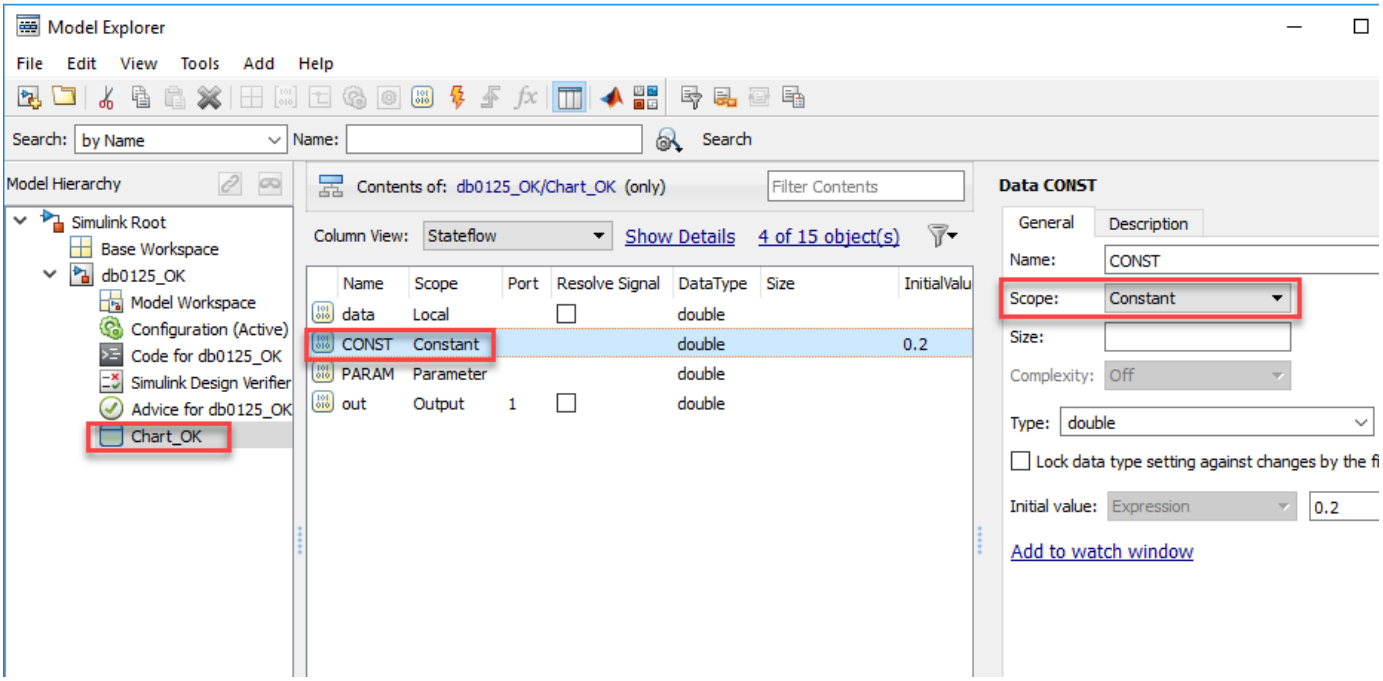
Data objects shall not be defined with Scope set to `Constant` at the machine level.

Custom Parameter

Not Applicable

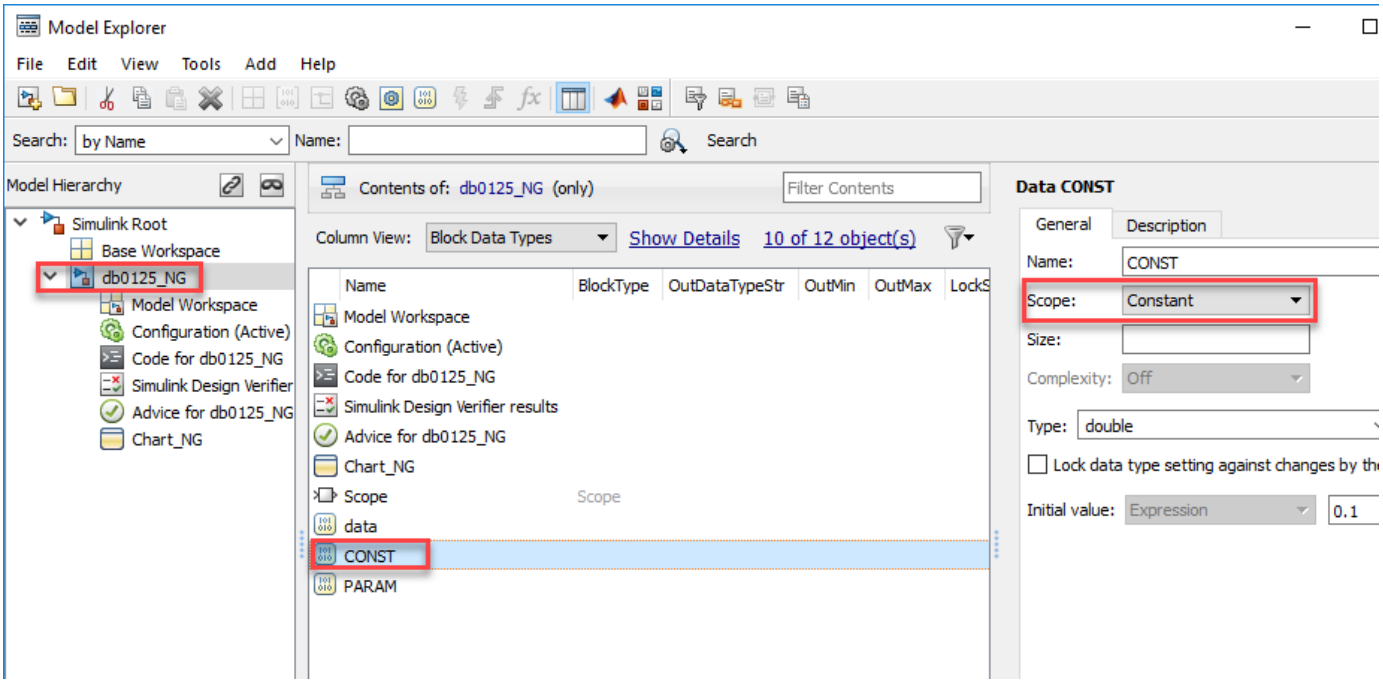
Example — Correct





Example — Incorrect

Scope has set `Constant` local data at the machine level.



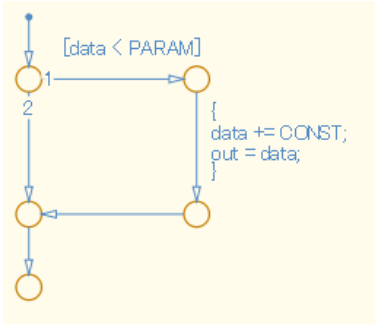
Sub ID c

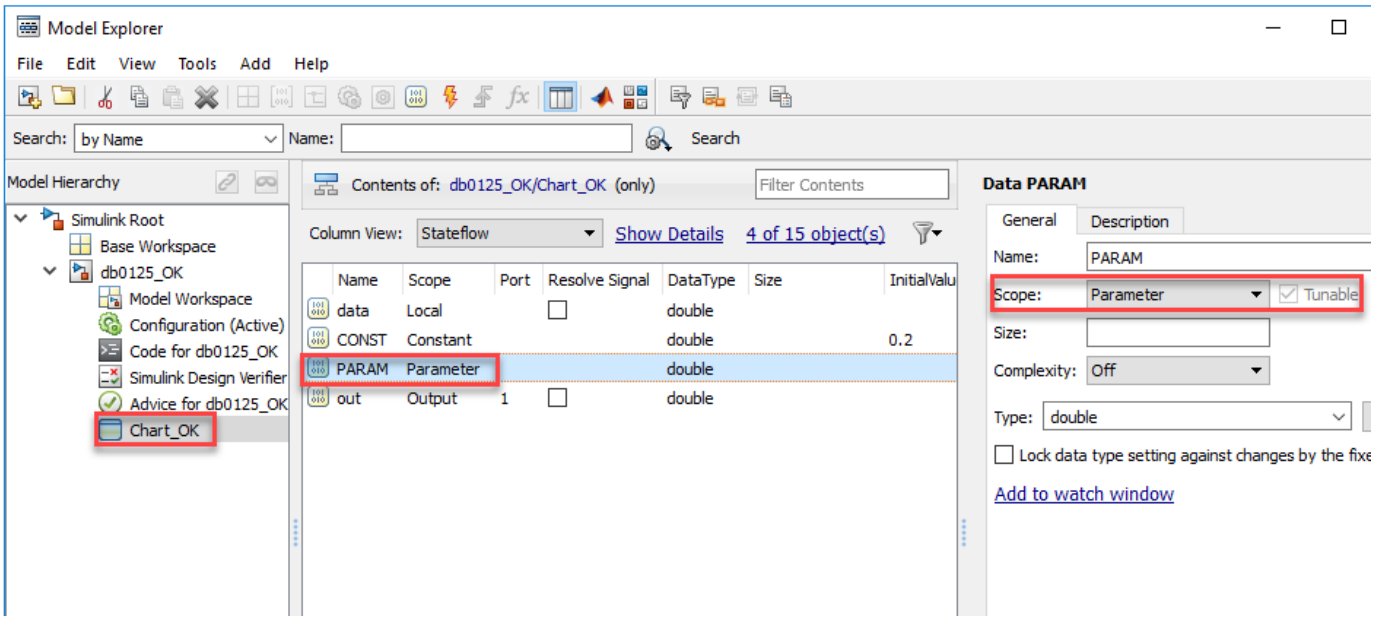
Data objects shall not be defined with Scope set to `Parameter` at the machine level.

Custom Parameter

Not Applicable

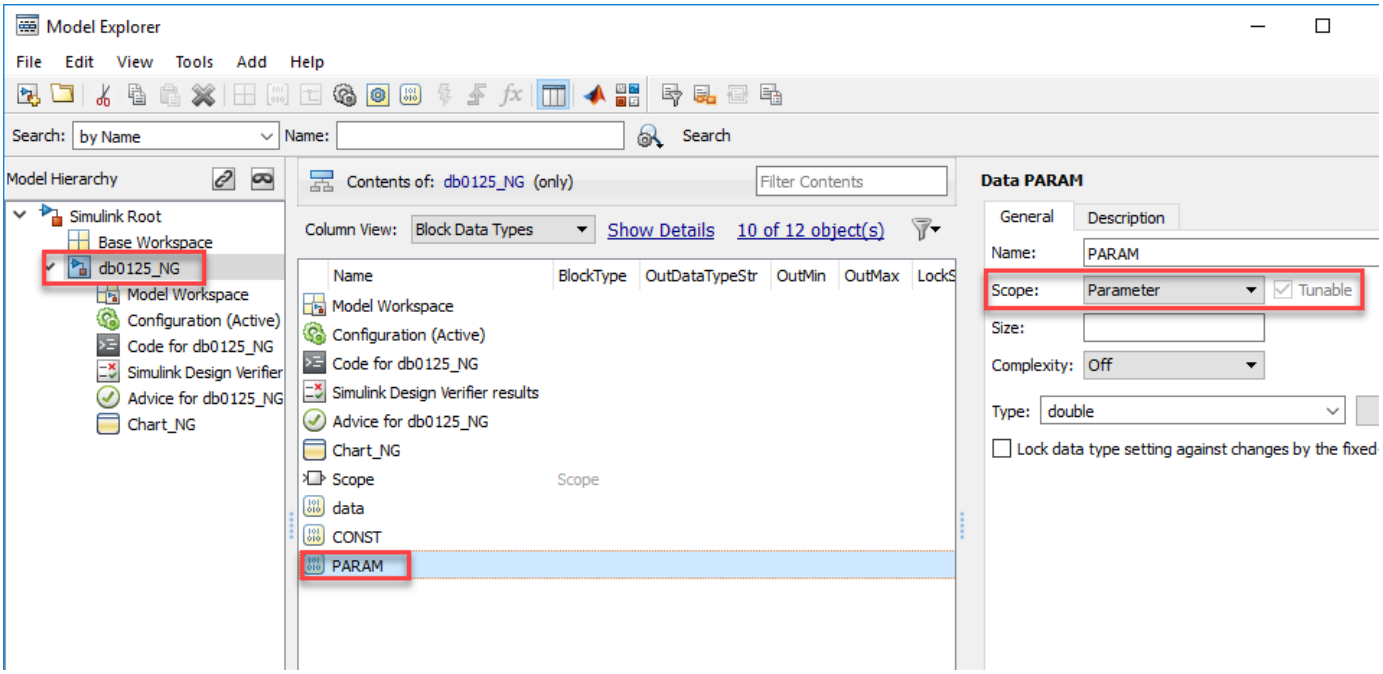
Example — Correct





Example — Incorrect

Scope has set `Parameter` local data at the machine level.



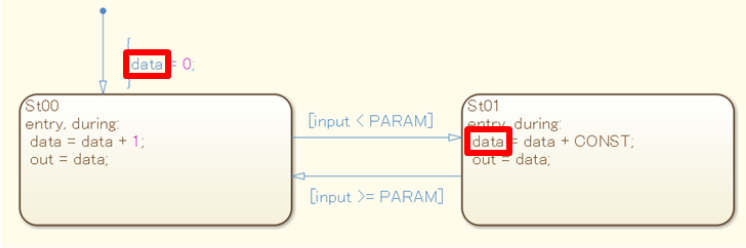
Sub ID d

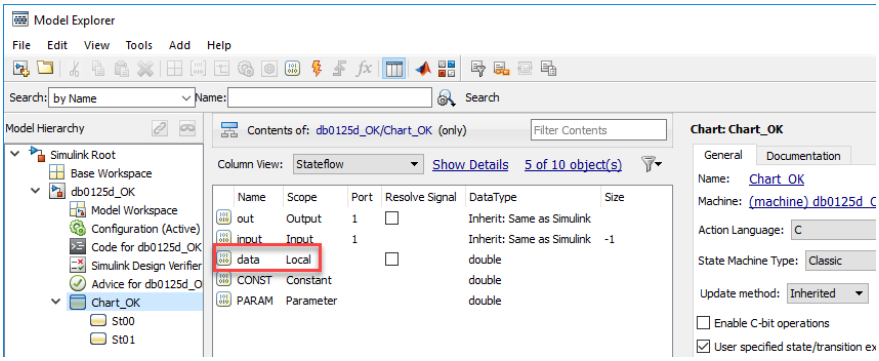
A Stateflow block with parent-child relationships shall not include local data with the same name.

Custom Parameter

Not Applicable

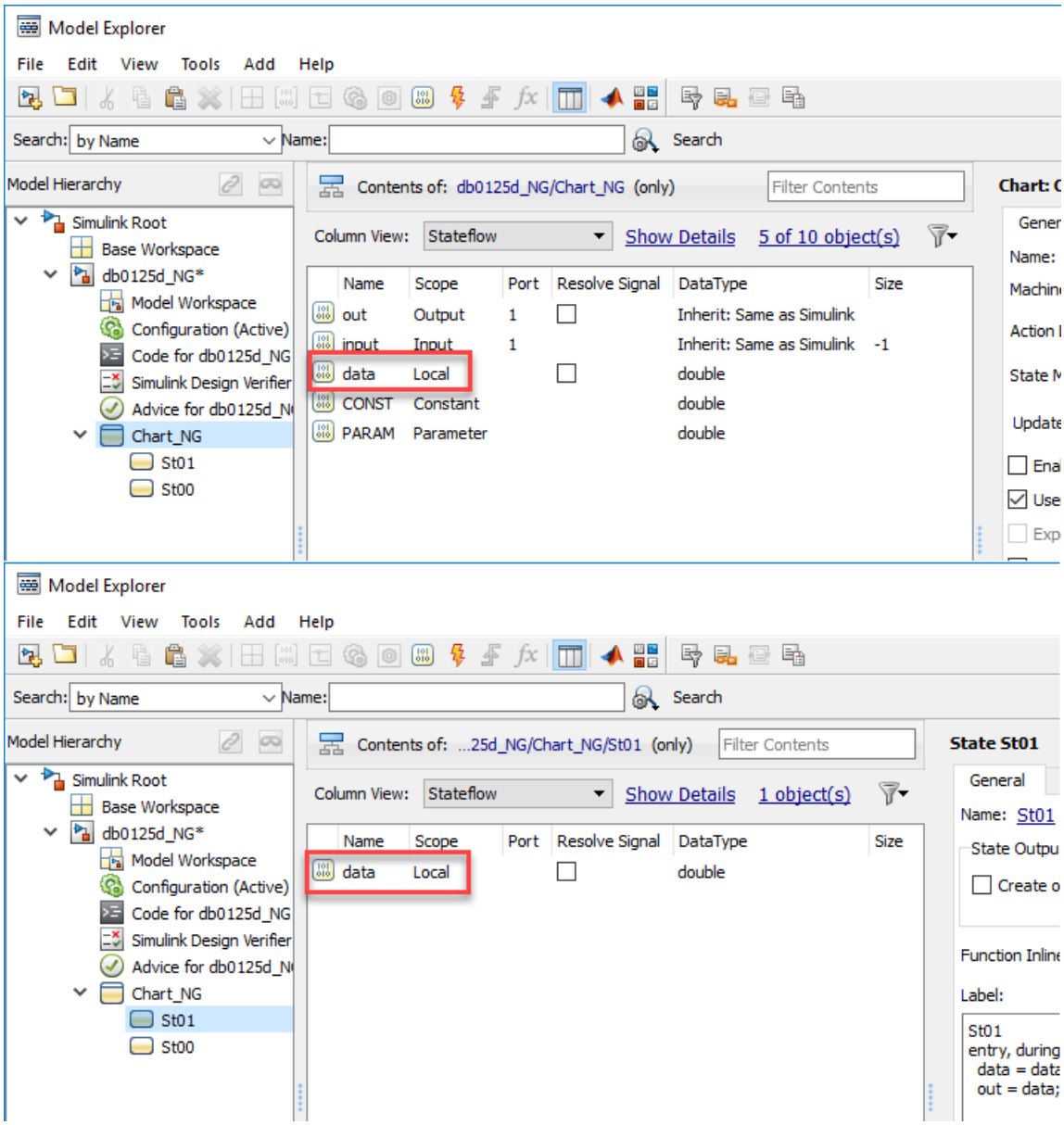
Example — Correct





Example — Incorrect

A Stateflow block with parent-child relationships has local data with the same name.



Rationale

Sub ID a:

- When local data is defined at the machine level, it is shared with all blocks in the model. The data will not behave like a local variable and can be influenced by any operation.
- Adherence to the rules prevent the definition from disappearing when copying a Stateflow block to another model.

Sub IDs b, c:

- Adherence to the rules prevent the definition from disappearing when copying a Stateflow block to another model.

Sub ID d:

- When a Stateflow block with parent-child relationships includes local data with the same name, readability decreases due to lack of clarity with regard to the influence of the local data.

Verification

Model Advisor check: “Check definition of Stateflow data” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0125, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Stateflow Data Properties” (Stateflow)
- “Use the Model Explorer with Stateflow Objects” (Stateflow)
- “Use State Hierarchy to Design Multilevel State Complexity” (Stateflow)

Introduced in R2020a

db_0126: Defining Stateflow events

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

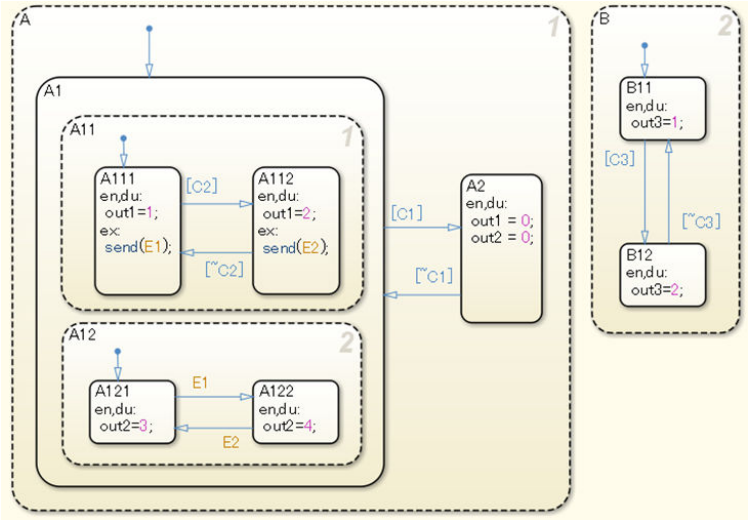
MATLAB Versions

All

Rule

Sub ID a

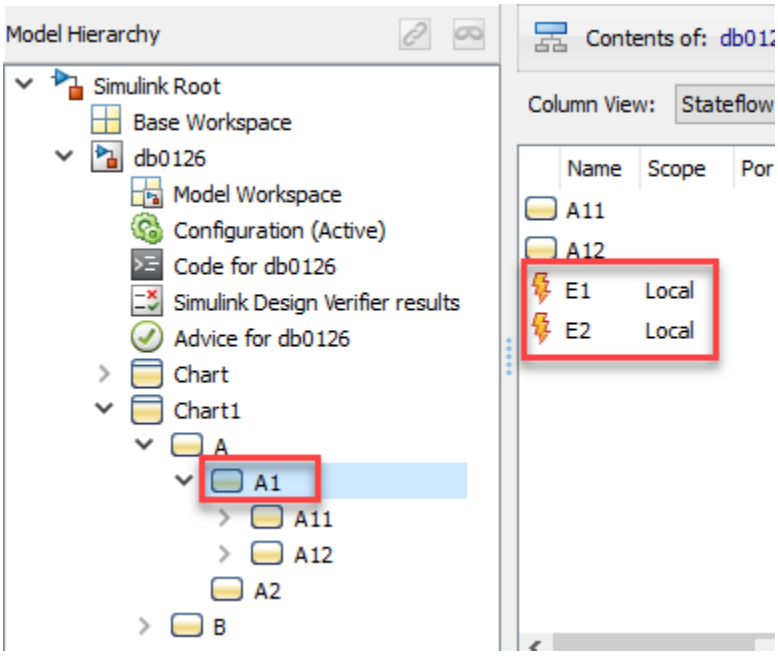
Stateflow events shall be defined by the smallest scope level in the Stateflow block being used.



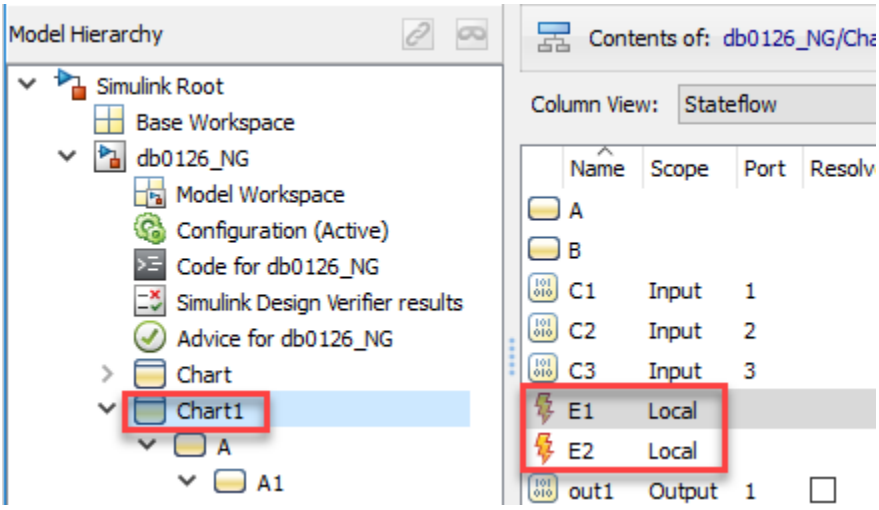
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Limiting use locations increases reliability.

Verification

Model Advisor check: “Check definition of Stateflow events” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0126, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Synchronize Model Components by Broadcasting Events” (Stateflow)
- “Use the Model Explorer with Stateflow Objects” (Stateflow)

Introduced in R2020a

jc_0701: Usable number for first index

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

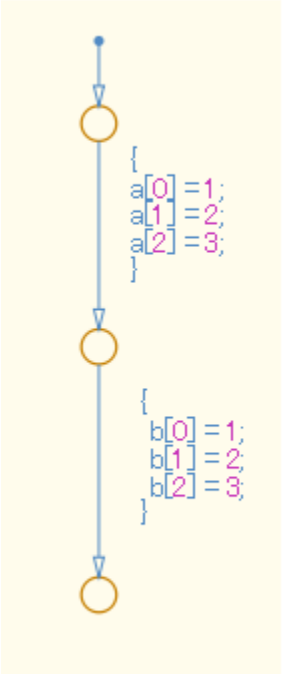
Sub ID a1

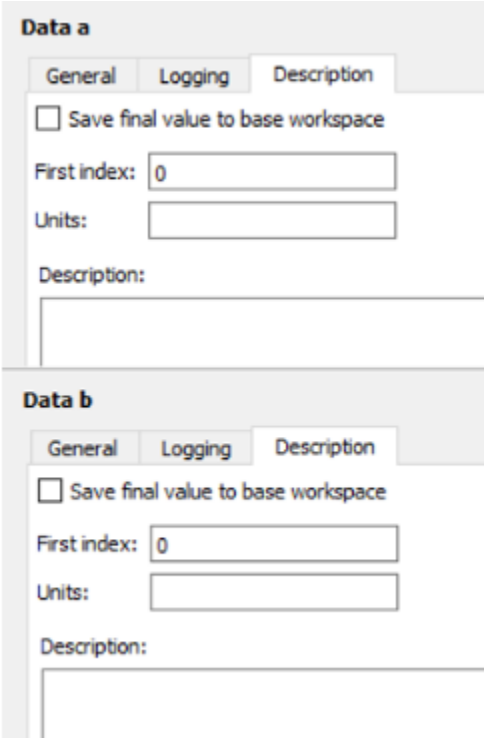
When Stateflow Chart property **Action Language** is set to `C`, Stateflow data property **First Index** shall be set to `0`.

Custom Parameter

Not Applicable

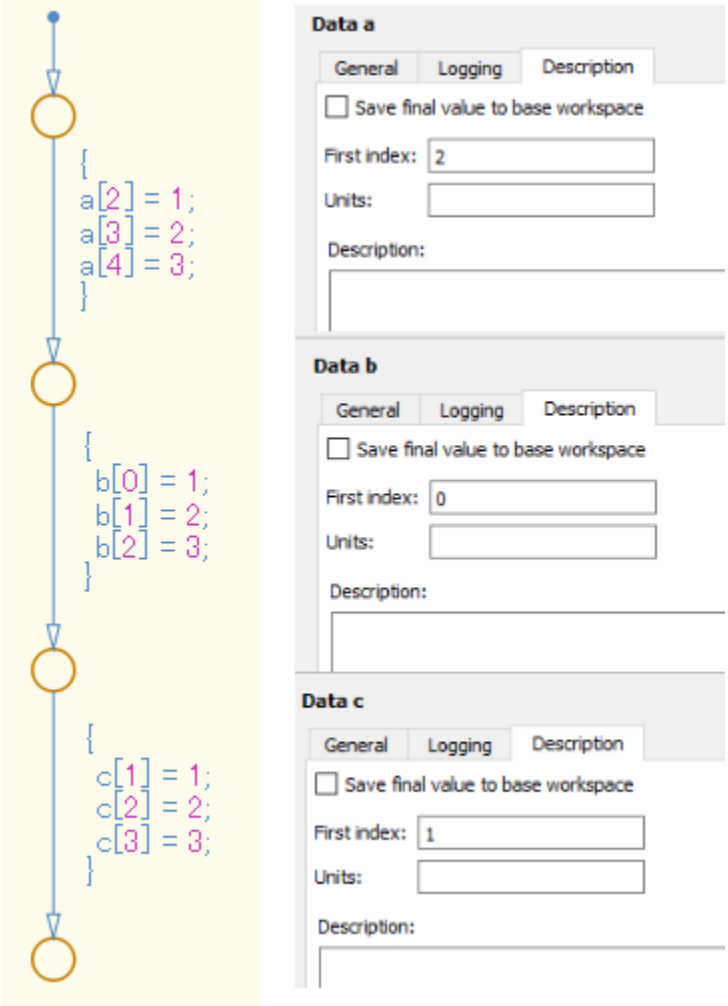
Example — Correct





Example — Incorrect

First Index is set to a combination of `0`, `1`, and `2`.



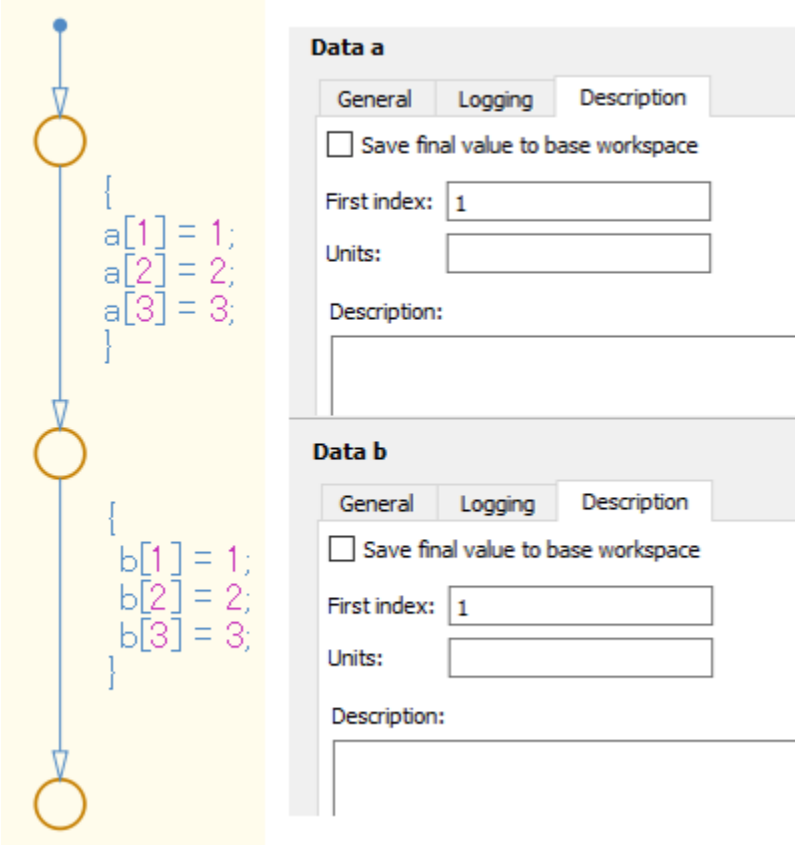
Sub ID a2

When Stateflow Chart property **Action Language** is set to `C`, Stateflow data property **First Index** shall be set to `1`.

Custom Parameter

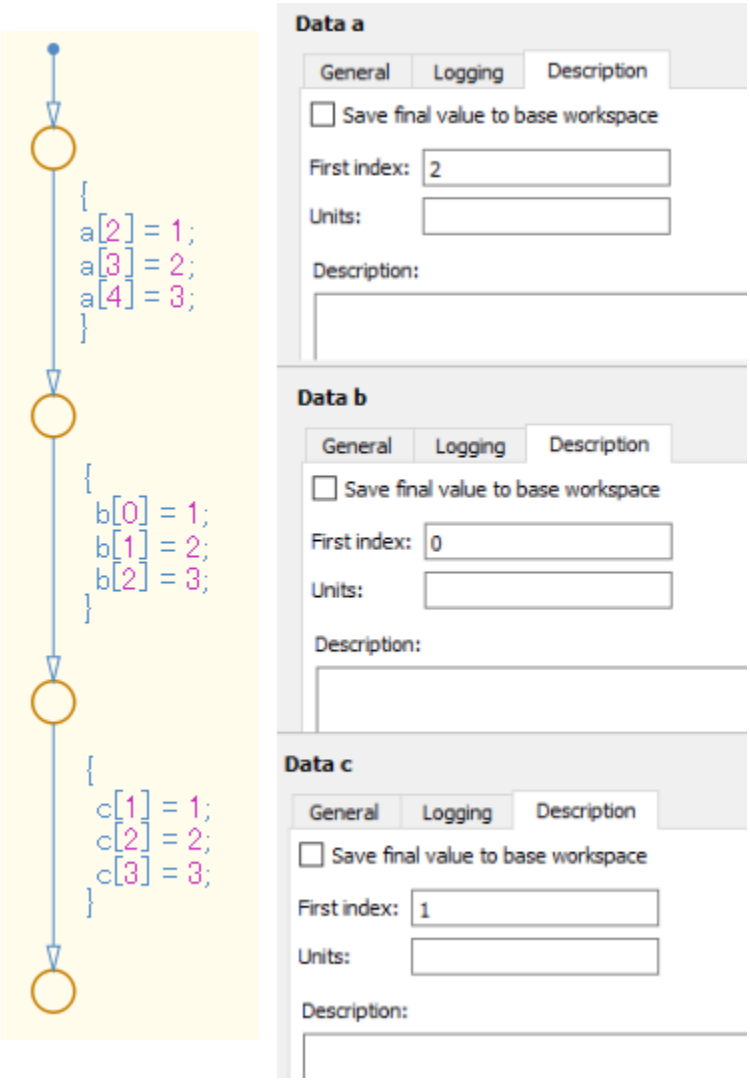
Not Applicable

Example — Correct



Example — Incorrect

First Index is set to a combination of `0`, `1`, and `2`.



Rationale

Sub ID a1:

- Logic becomes easier to understand when **First Index** is uniform.

Sub ID a2:

- Logic becomes easier to understand when **First Index** is uniform. However, C language is 0-based, which decreases the readability of the code as the index calculation process is 1-based. This is reflected in the generated code.

Verification

Model Advisor check: “Check usable number for first index” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0701, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Differences Between MATLAB and C as Action Language Syntax” (Stateflow)
- “Set Data Properties” (Stateflow)

Introduced in R2020a

jc_0712: Execution timing for default transition path

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Stateflow Chart property **Execute (Enter) Chart at Initialization**} shall not be selected.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Using the same settings for each Stateflow Chart prevents the model from being misinterpreted.
- Use caution when referencing an input signal using the default transition line when property**Execute (Enter) Chart at Initialization** is selected.

Verification

Model Advisor check: “Check execution timing for default transition path” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0712, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)
- “Execution of a Stateflow Chart” (Stateflow)

Introduced in R2020a

jc_0722: Local data definition in parallel states

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

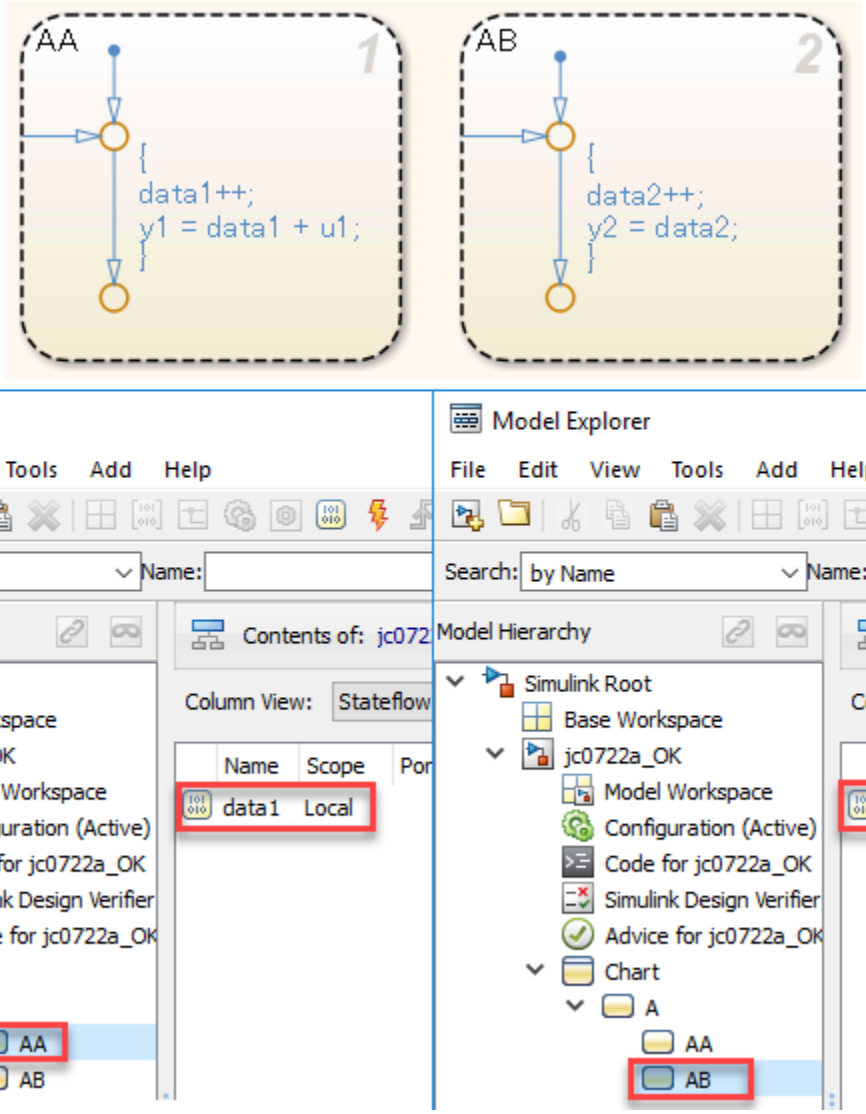
Local variables that are completed in one state shall be defined in that state.

Custom Parameter

Not Applicable

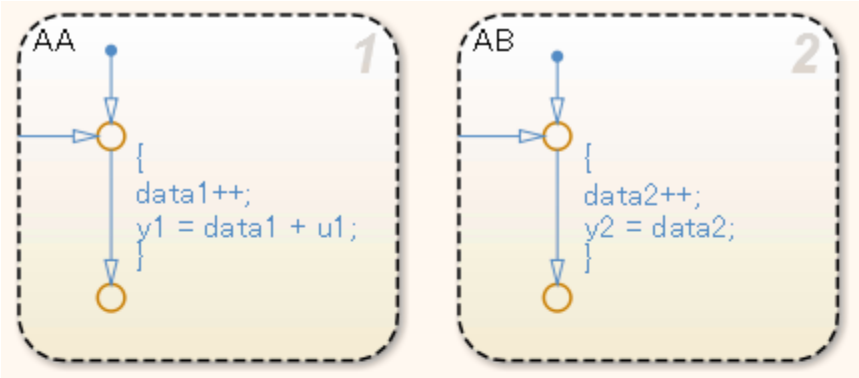
Example — Correct

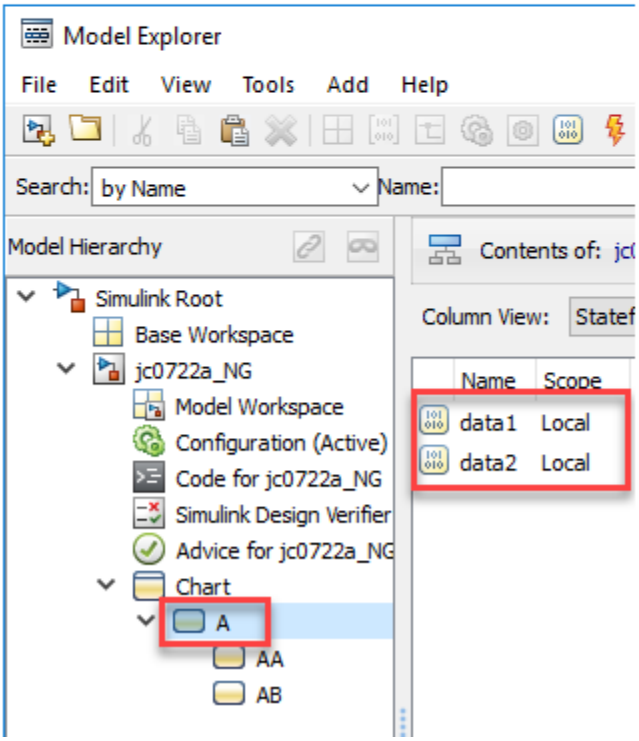
Local variables are defined in the state being used.



Example — Incorrect

Local variables are not defined in the state being used.





Rationale

Sub ID a:

- Readability and maintainability can be improved by explicitly limiting the valid range of the variables, thereby avoiding unintended references and changes.

Verification

Model Advisor check: “Check scope of data in parallel states” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0722, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)
- “Parallel and Exclusive States” (Stateflow)

Introduced in R2020a

Stateflow Diagram

jc_0797: Unconnected transitions / states / connective junctions

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

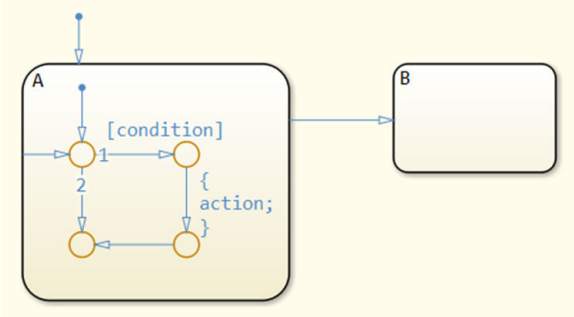
Sub ID a

Stateflow Chart shall not have unconnected transitions.

Custom Parameter

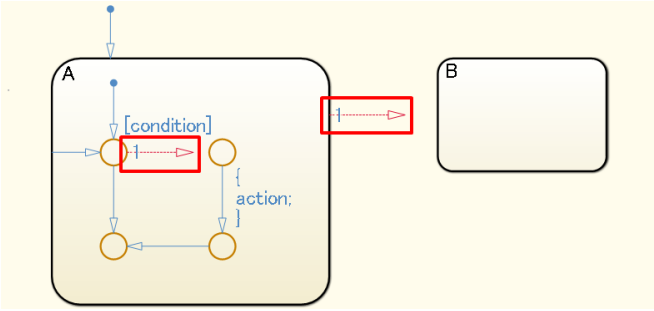
Not Applicable

Example — Correct



Example — Incorrect

There are unconnected transitions.



Sub ID b

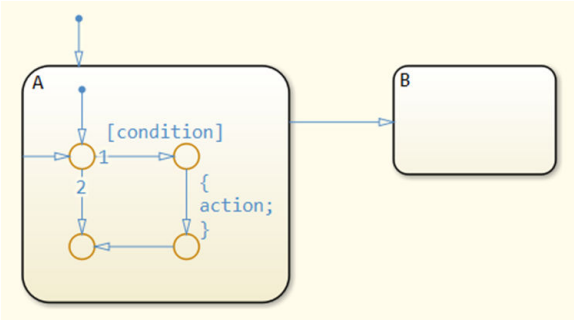
Stateflow Chart shall not have unconnected exclusive (OR) states and connective junctions without a transition source.

Custom Parameter

Not Applicable

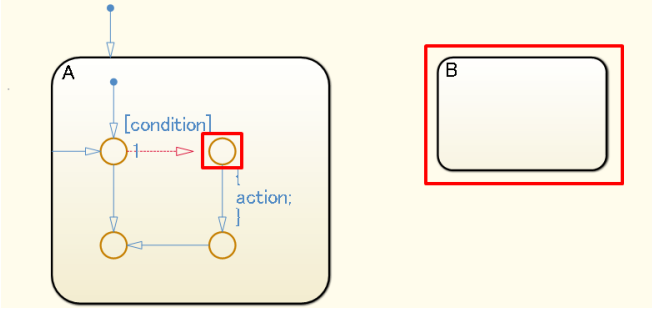
Example — Correct

Does not have unconnected exclusive (OR) states or connective junctions without a transition source.



Example — Incorrect

There are unconnected exclusive (OR) states and connective junctions without a transition source.



Rationale

Sub IDs a, b:

- Unconnected transitions can result in adverse effects, such as misinterpretation of simulation results or failure to generate code.

Verification

Model Advisor check: “Check for unconnected objects in Stateflow Charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0797, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)
- “Combine Transitions and Junctions to Create Branching Paths” (Stateflow)
- “Define Exclusive and Parallel Modes by Using State Decomposition” (Stateflow)
- “Transition Between Exclusive States” (Stateflow)
- “Represent Multiple Paths by Using Connective Junctions” (Stateflow)

Introduced in R2020a

db_0137: States in state machines

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

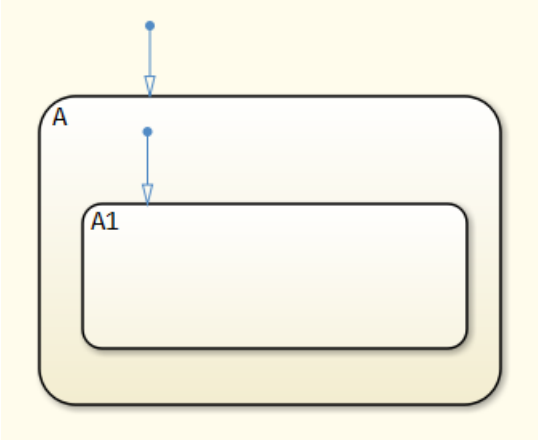
When the **Decomposition** for the Chart block or State is set to `OR (Exclusive)`, there shall be at least two states in the hierarchy.

Custom Parameter

Not Applicable

Example — Incorrect

The hierarchy contains only one state when the **Decomposition** option is set to `OR (Exclusive)`



Rationale

Sub ID a:

- Redundant descriptions impair readability.
- Generated code includes unnecessary state variables.

Verification

Model Advisor check: “Check for state in state machines” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0137, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)
- “Define Exclusive and Parallel Modes by Using State Decomposition” (Stateflow)

Introduced in R2020a

jc_0721: Usage of parallel states

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

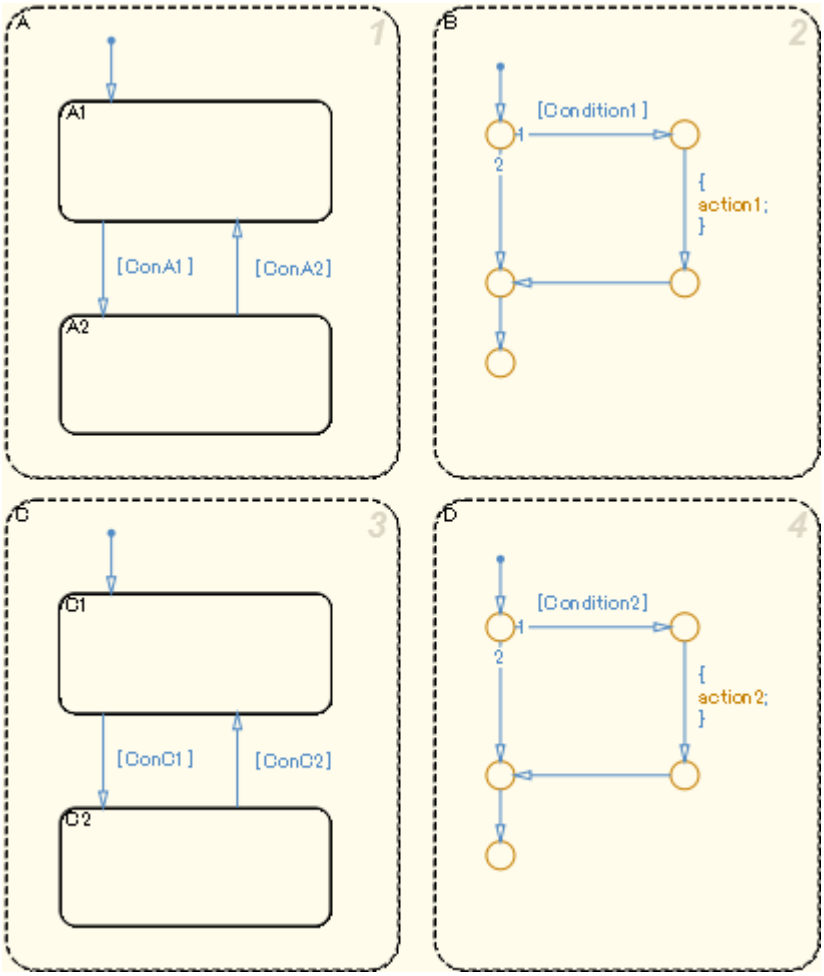
Sub ID a

Substates of parallel states shall not be parallel states.

Custom Parameter

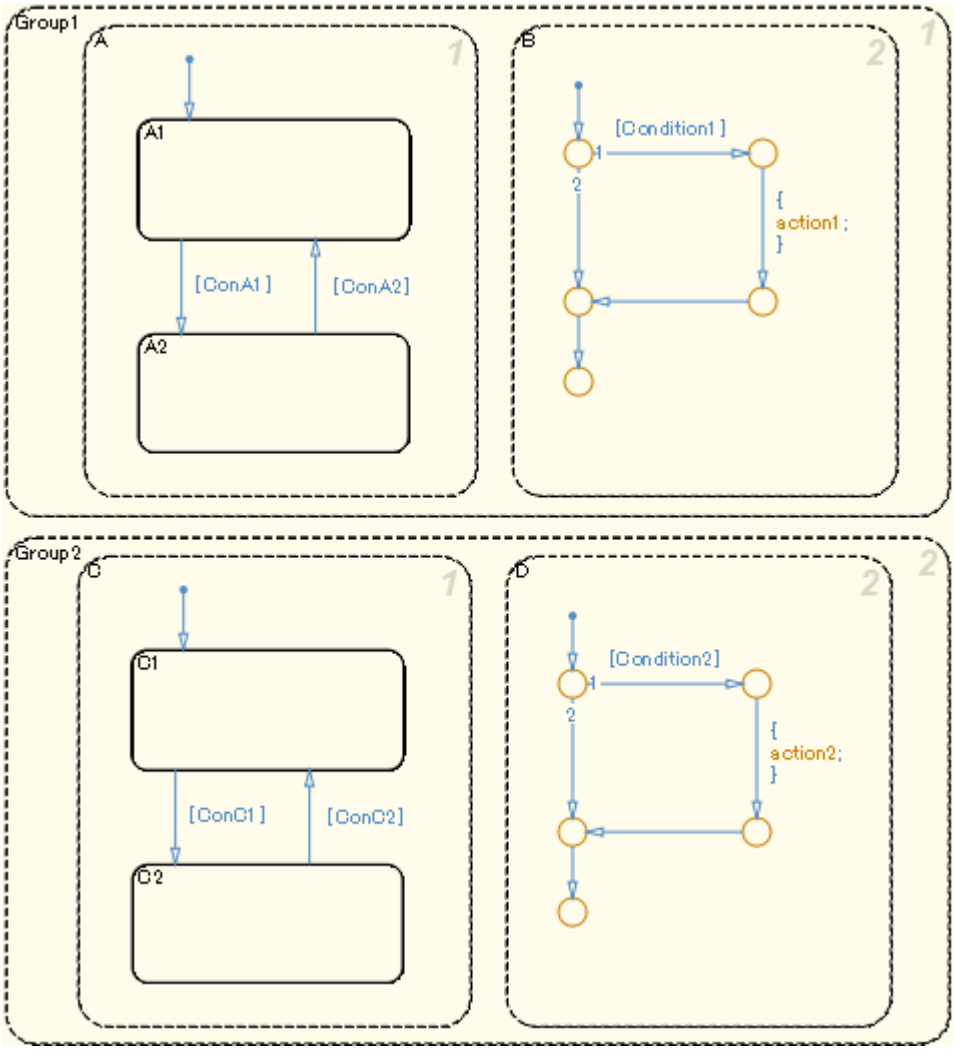
Not Applicable

Example — Correct



Example — Incorrect

Substates of parallel states are parallel states.



Rationale

Sub ID a:

- Behavior is not affected by nesting parallel states in a parent superstate.
- Hierarchization of the parallel state decreases readability.

Verification

Model Advisor check: “Check usage of parallel states” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0721, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)
- “Parallel and Exclusive States” (Stateflow)
- “Use State Hierarchy to Design Multilevel State Complexity” (Stateflow)

Introduced in R2020a

db_0129: Stateflow transition appearance

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e
- JMAAB — a, b, c, d, e

MATLAB Versions

All

Rule

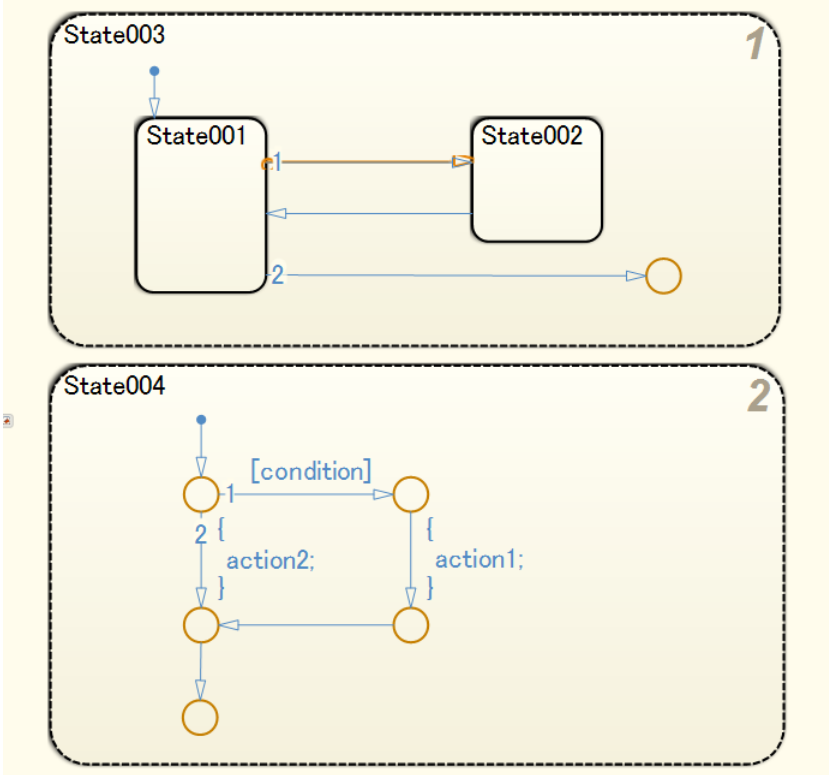
Sub ID a

Transition lines shall not cross over one another.

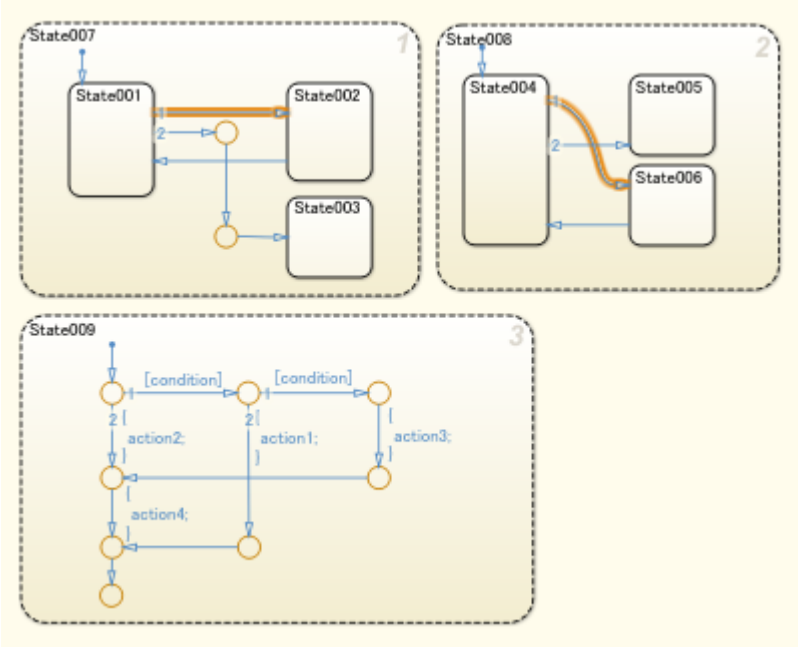
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



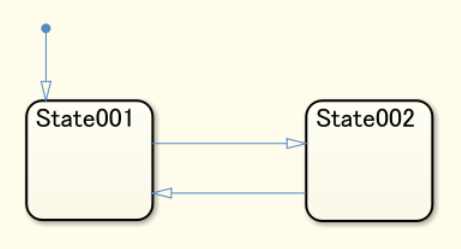
Sub ID b

Transition lines shall not overlap other transition lines.

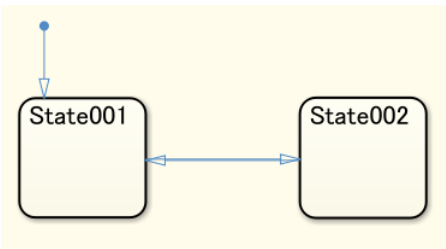
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



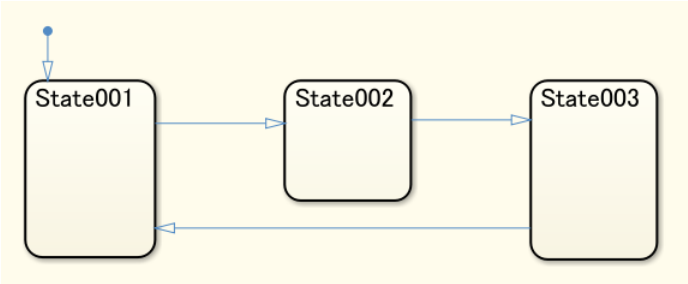
Sub ID c

Transition lines shall not cross over states.

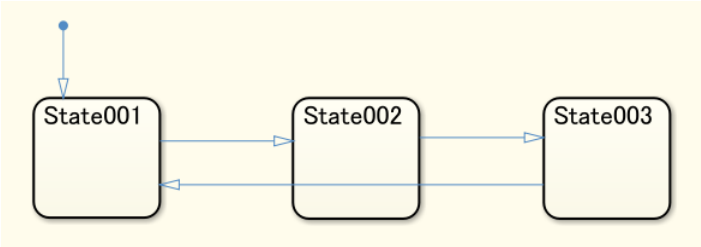
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID d

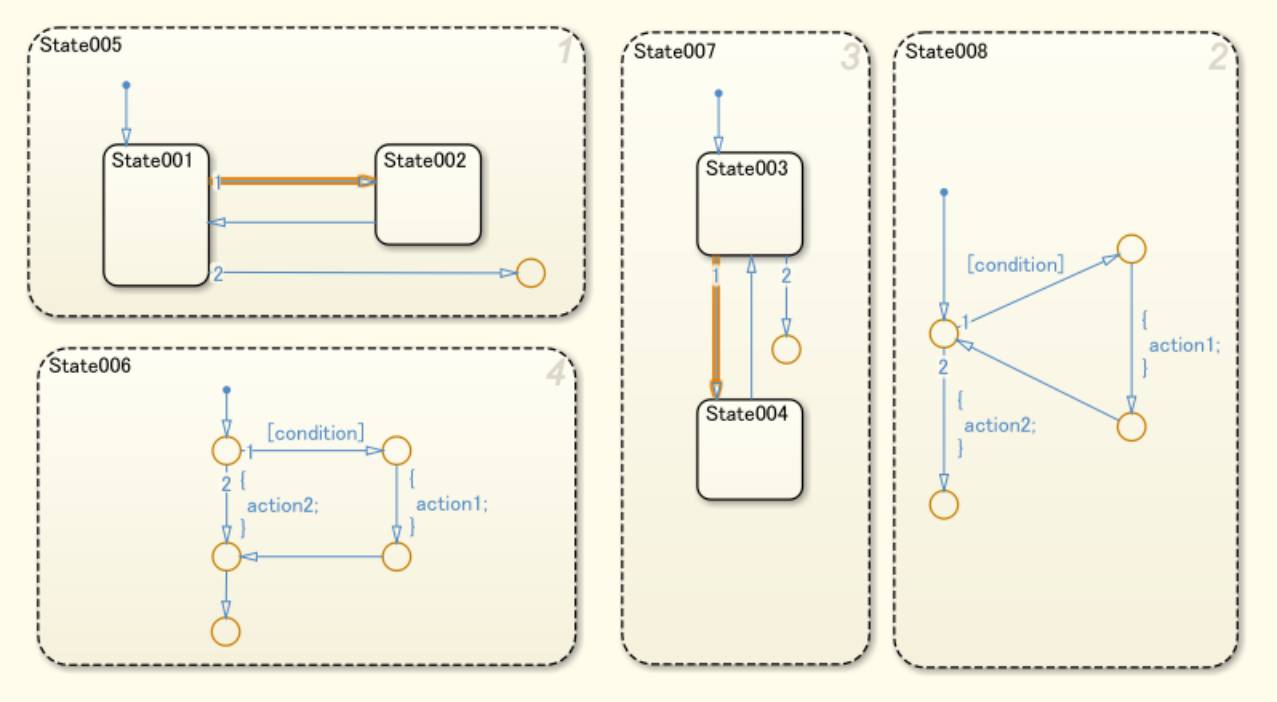
Transition lines shall be drawn vertically or horizontally.

Diagonal lines can be used for flow charts.

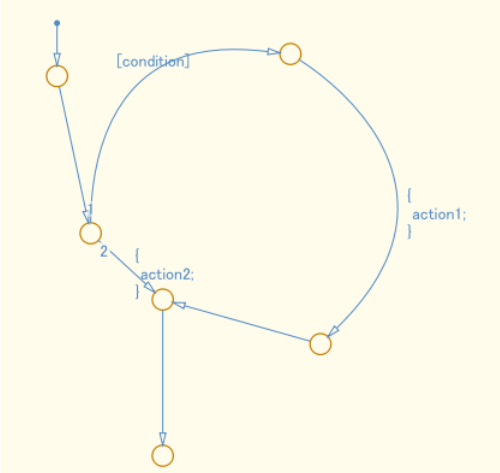
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



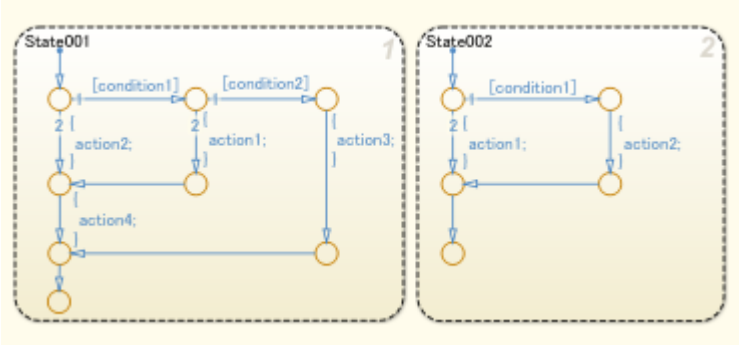
Sub ID e

Unnecessary connective junctions shall not be used.

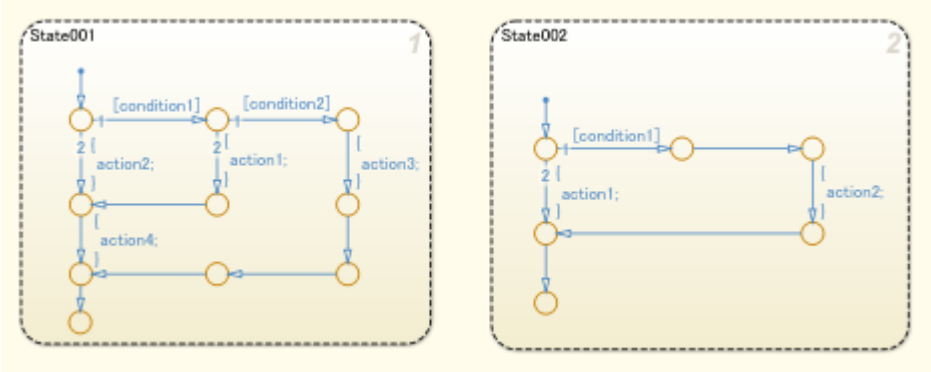
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Difficult to understand the relationship between states when transition lines cross.

Sub ID b:

- Difficult to understand the relationship between states when transition lines overlap.

Sub ID c:

- Difficult to understand the relationship between states when transition lines cross over states.

Sub ID d:

- Consistent application of transition lines improves readability.

Sub ID e:

- Transitions can be difficult to understand when unnecessary connective junctions are used.

Verification

Model Advisor check: “Check for Stateflow transition appearance” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0129, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

jc_0531: Default transition

Sub ID Recommendations

- NA-MAAB — a, b, c, d, e, f, g
- JMAAB — a, b, c, d, e, f, g

MATLAB Versions

All

Rule

Sub ID a

When **Decomposition** of a Stateflow Chart is `Exclusive (OR)`, the default transition shall connect at the top of the Chart block.

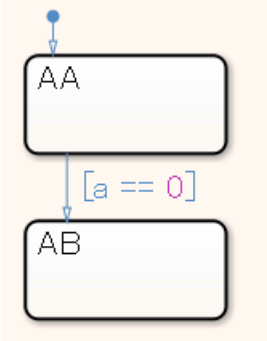
When **Decomposition** of the state is `Exclusive (OR)`, the default transition shall connect immediately beneath the state.

Custom Parameter

Not Applicable

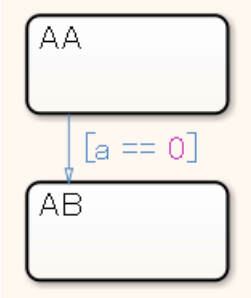
Example — Correct

The default transition line is connected at the top.



Example — Incorrect

The default transition line is not connected.



Sub ID b

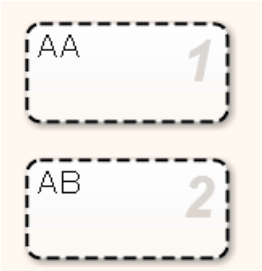
When **Decomposition** is set to “Parallel (AND)”, the default transition line shall not be connected.

Custom Parameter

Not Applicable

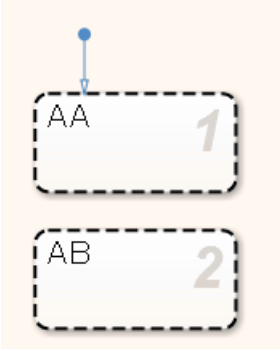
Example — Correct

Decomposition of the parent object for states AA and AB is set to `Parallel (AND)`, which makes states AA and AB parallel states. The default transition line is not connected for these parallel states.



Example — Incorrect

A default transition line is connected for parallel state AA.



Sub ID c

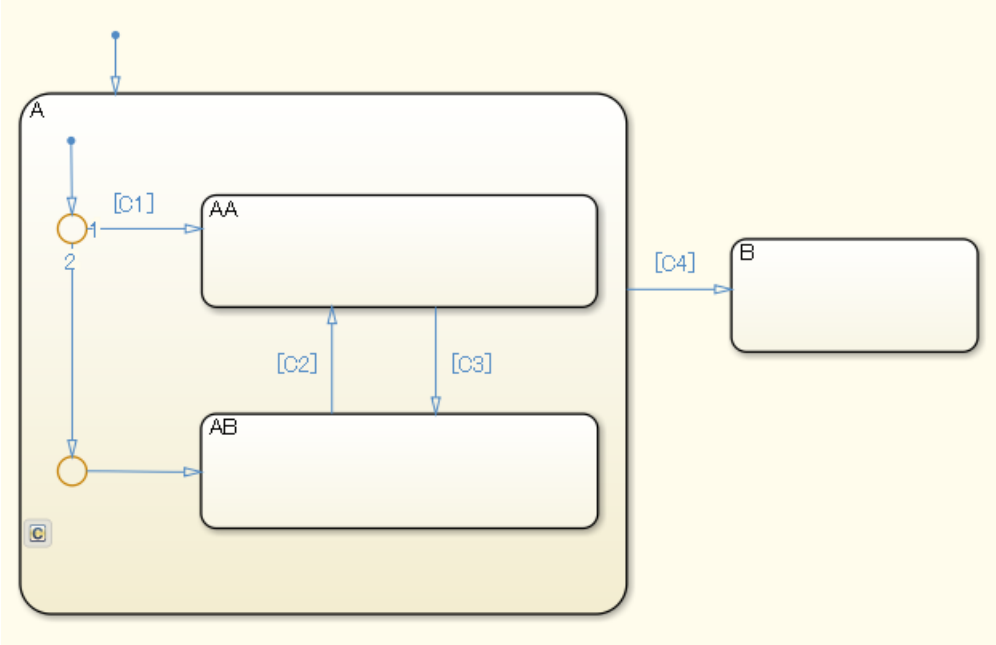
A level shall not have multiple default transitions.

Custom Parameter

Not Applicable

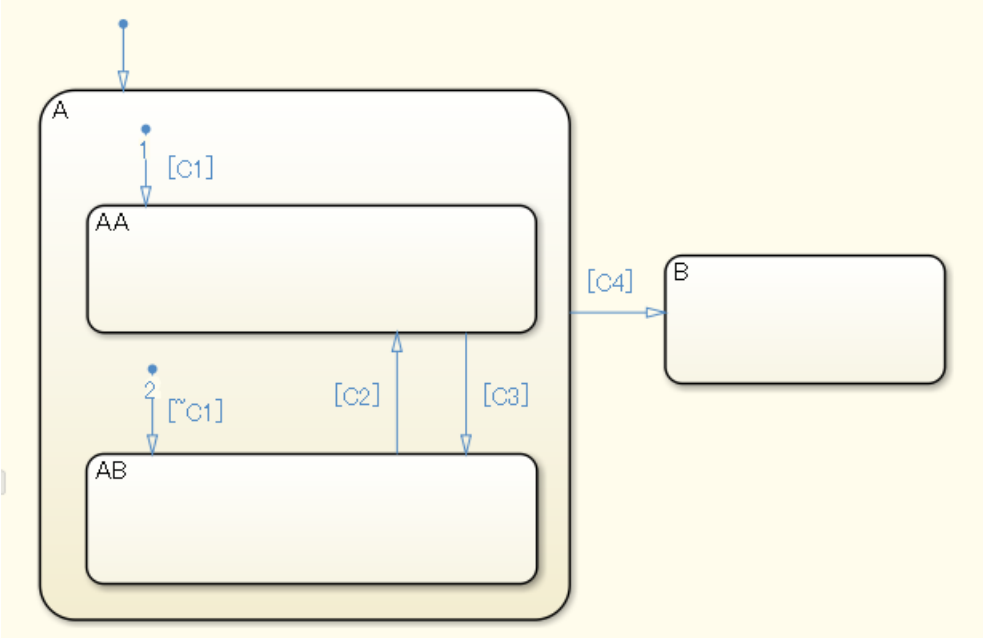
Example — Correct

The level does not have multiple default transitions



Example — Incorrect

Multiple default transitions are included in the same level of state A.



Sub ID d

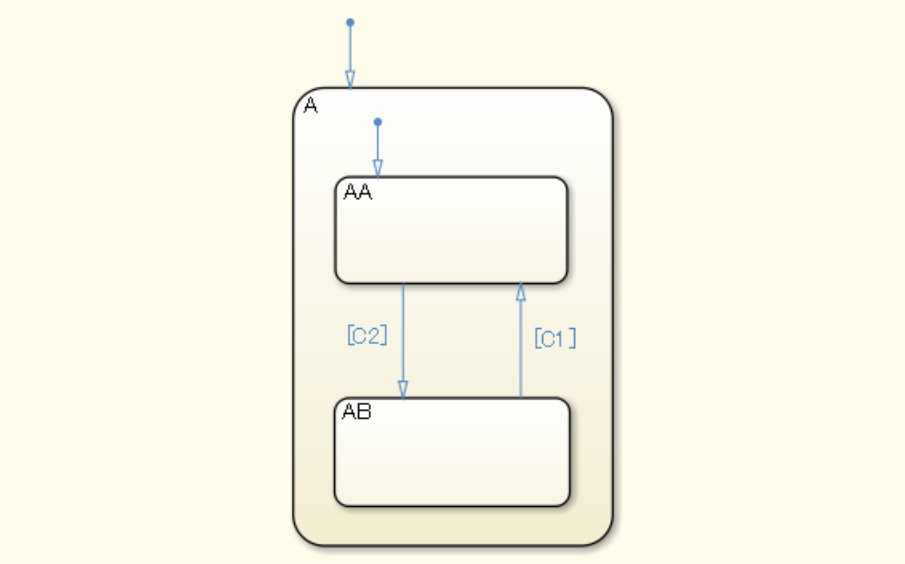
Default transitions shall be connected directly and positioned vertically to the upper part of the state or connective junction.

Custom Parameter

Not Applicable

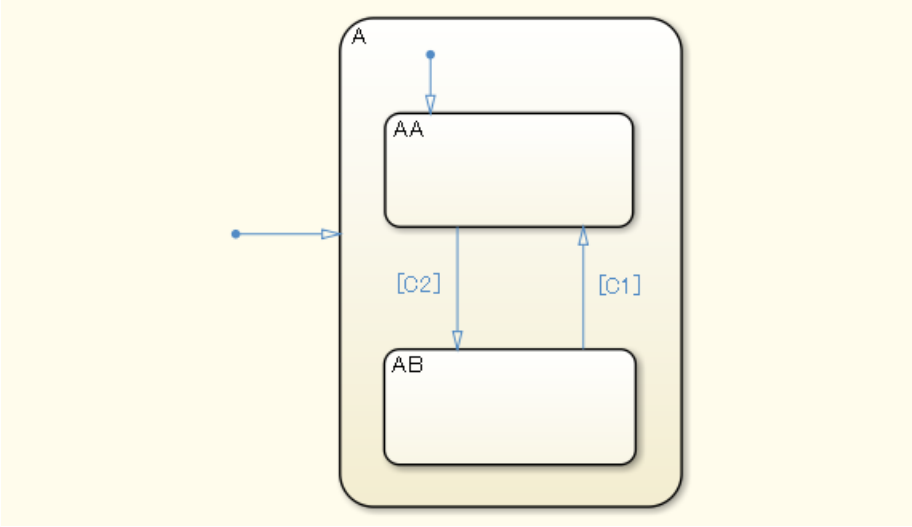
Example — Correct

The default transition is connected vertically to the upper part of the state.



Example — Incorrect

The default transition of state A is not connected vertically to the upper part of the state.



Sub ID e

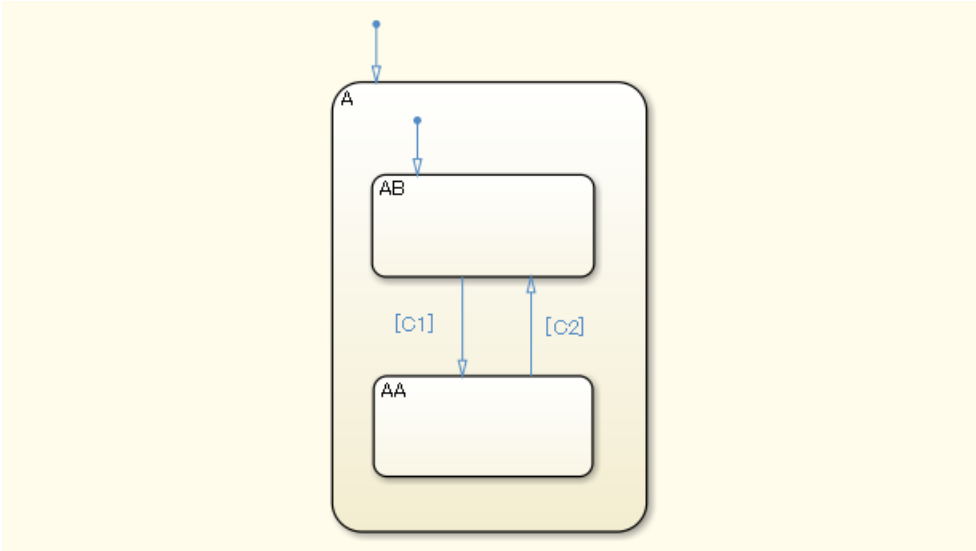
The destination state or destination connective junction for the default transition shall be positioned to the top left in the same level.

Custom Parameter

Not Applicable

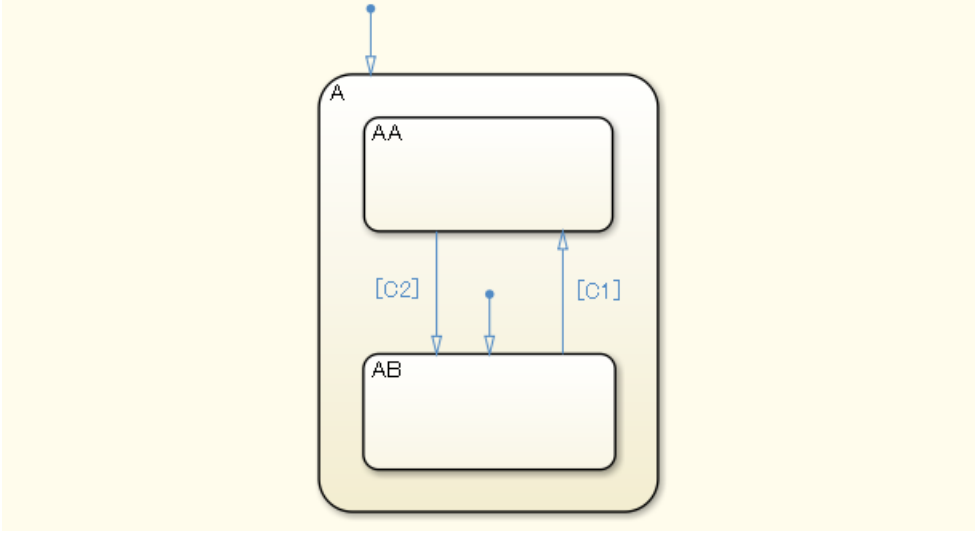
Example — Correct

The default transition is positioned to the top left in the same level.



Example — Incorrect

The default transition of state AB is not positioned to the top left in the same level.



Sub ID f

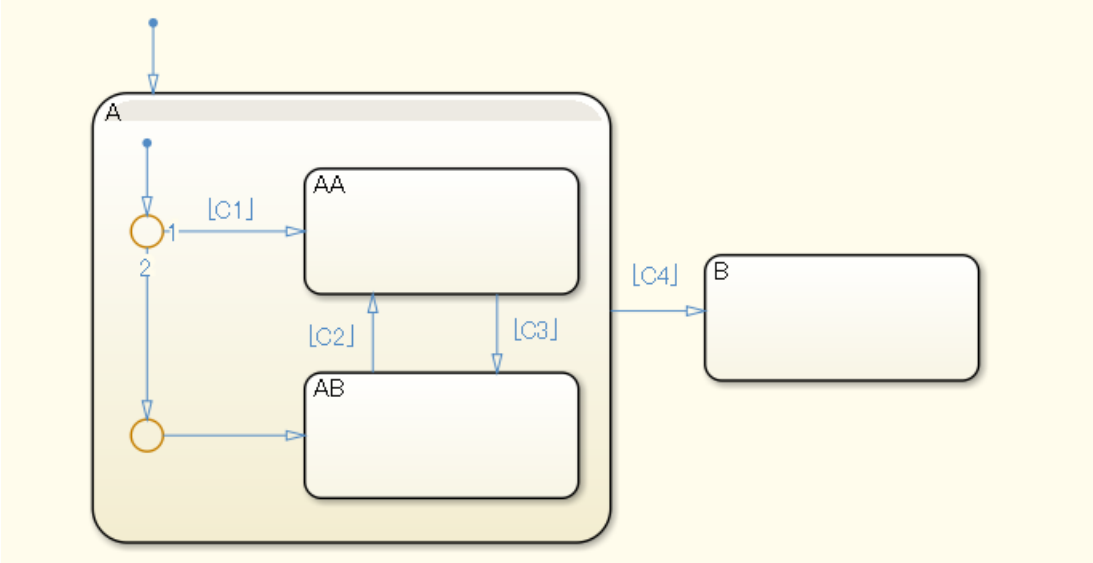
Default transitions shall not extend beyond the boundaries of the state.

Custom Parameter

Not Applicable

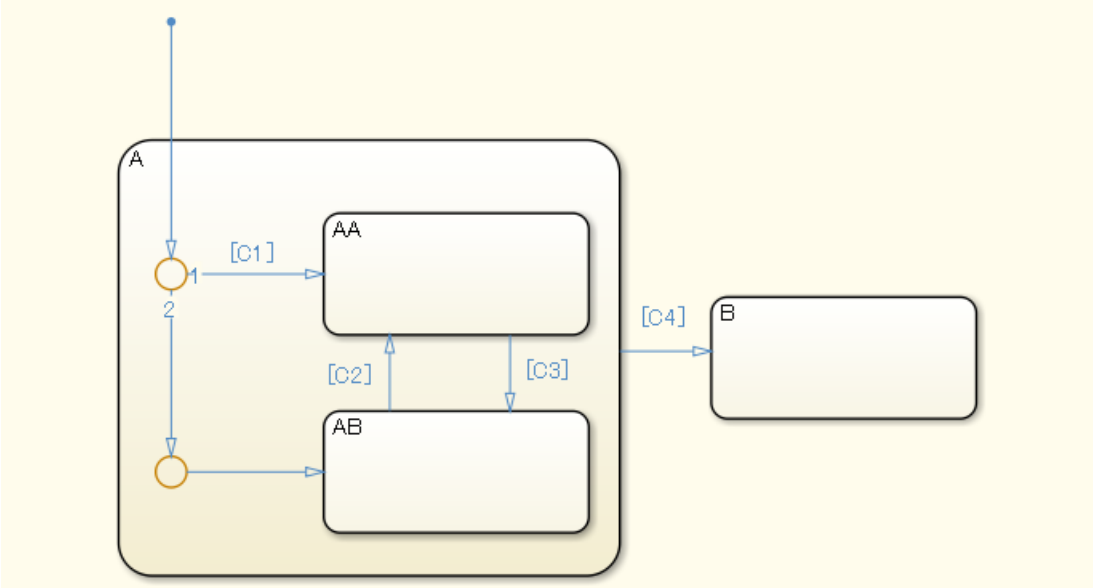
Example — Correct

The default transition is within the boundaries of the state.



Example — Incorrect

The default transition extends beyond the boundaries of the state.



Sub ID g

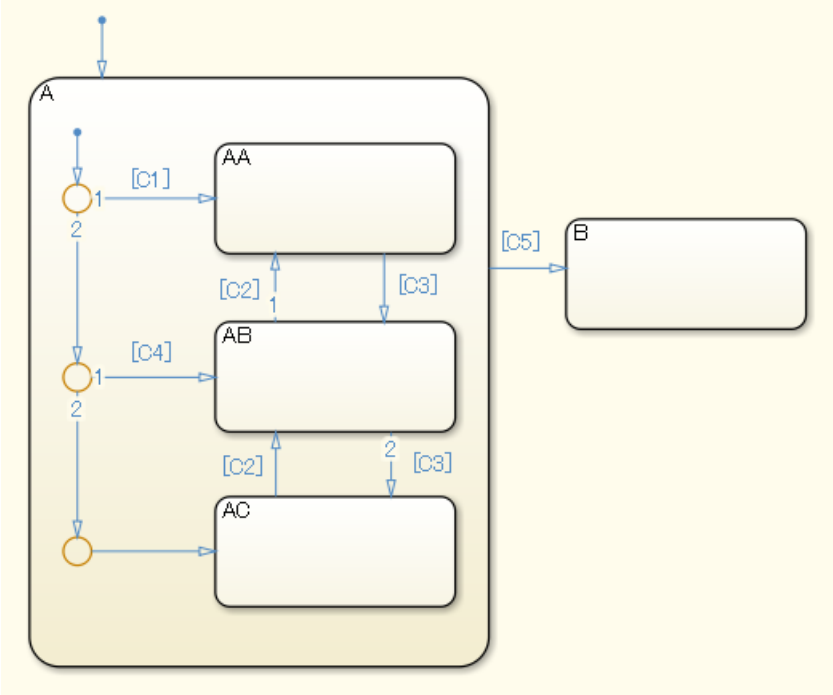
Configuration parameter **No unconditional default transitions** shall be set to `Error` to ensure that in the transition path for the default transition, the path with the lowest priority is an unconditional transition.

Custom Parameter

Not Applicable

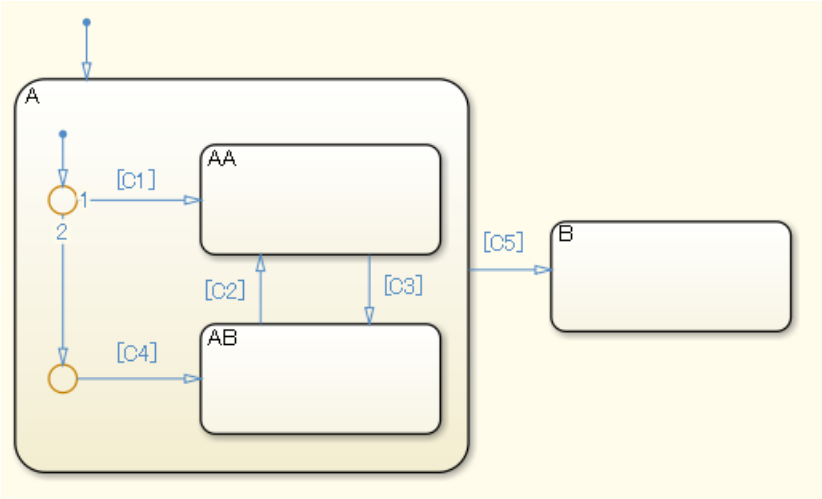
Example — Correct

The path with the lowest priority in the transition path for the default transition is an unconditional transition.



Example — Incorrect

The path with the lowest priority in the transition path for the default transition is not an unconditional transition.



Rationale

Sub ID a:

- Simulation errors can occur when a state chart does not include default transition lines.
- When default transitions are included in a flow chart, it is impossible to determine whether this is intentional or through failure to insert them.

Sub ID b:

- Readability improves when there are no unnecessary default transitions.

Sub ID c:

- The state may not function as intended and produce a warning when multiple default transitions are included in the same level.

Sub ID d:

- Readability decreases when there are curves or variations in the angle or position of default transitions.

Sub ID e:

- Readability decreases when there are variations in the position of the transition destination state or transition destination connective junction for the default transition.

Sub ID f

- Readability decreases when a default transition extends beyond the boundary of a state and intersects with state boundaries and expressions.

Sub ID g:

- When there is not an unconditional transition in the transition path of the default transition, the transition destination disappears if all conditions of the transition path are not met. This can result in unintended behavior.

Verification

Model Advisor check: “Check default transition placement in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0531, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Define Exclusive and Parallel Modes by Using State Decomposition” (Stateflow)
- “Transition Between Operating Modes” (Stateflow)
- “How Stateflow Objects Interact During Execution” (Stateflow)

Introduced in R2020a

jc_0723: Prohibited direct transition from external state to child state

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

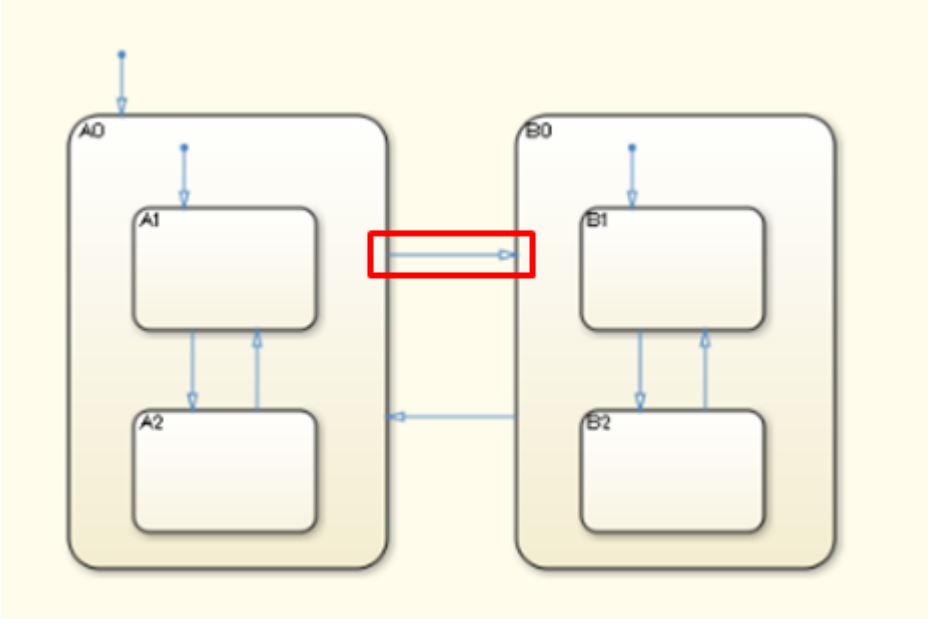
Transitions from one state directly to an external child state shall be prohibited.

Custom Parameter

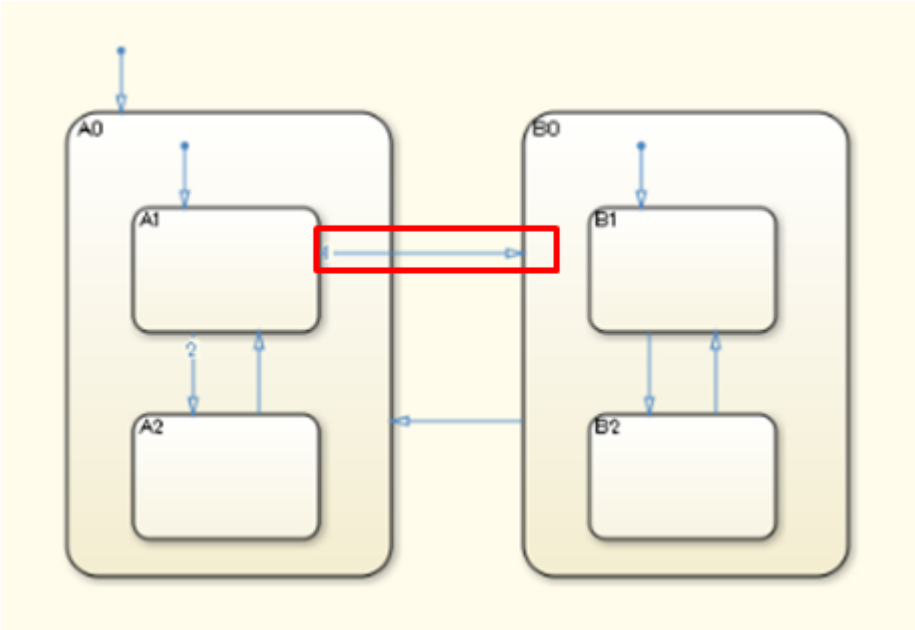
Not Applicable

Example — Correct

Transition from parent state to parent state.

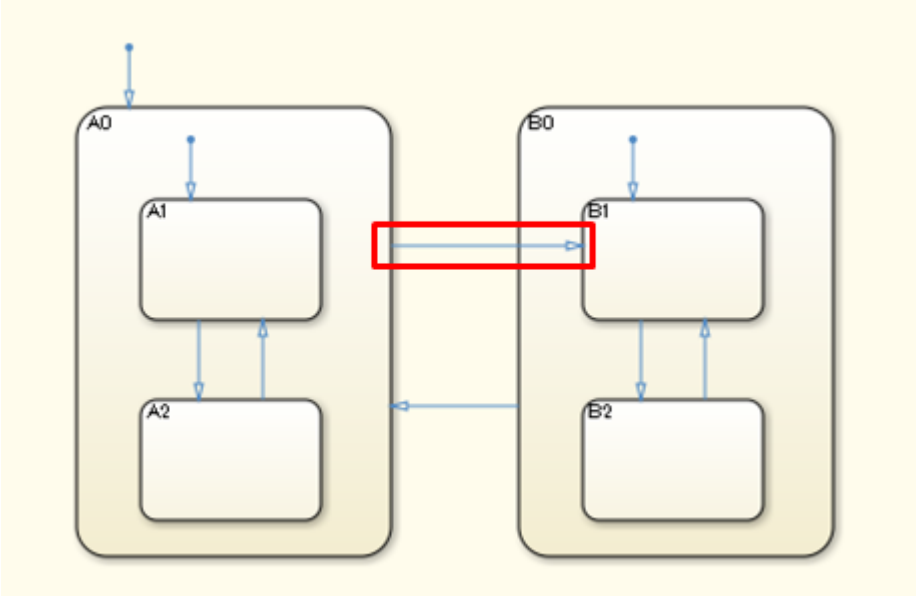


Transition from child state to another parent state.

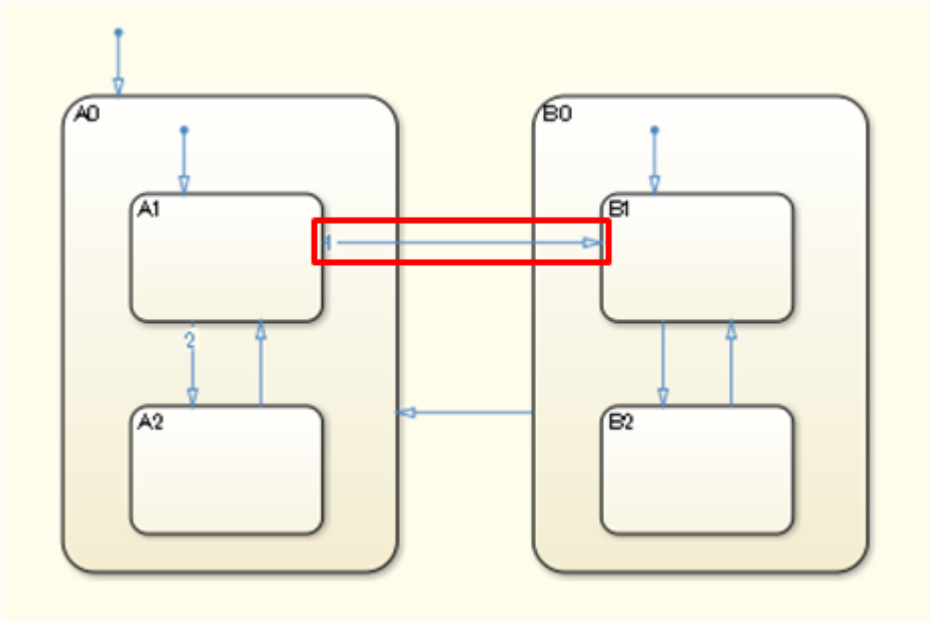


Example — Incorrect

Direct transition from an external state to a child state in a different state.



Direct transition from an external child state to a child state in a different state.



Rationale

Sub ID a:

- Direct transitions between child states can complicate the states and decrease readability.

Verification

Model Advisor check: “Check usage of transitions to external states” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0723, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

jc_0751: Backtracking prevention in state transition

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

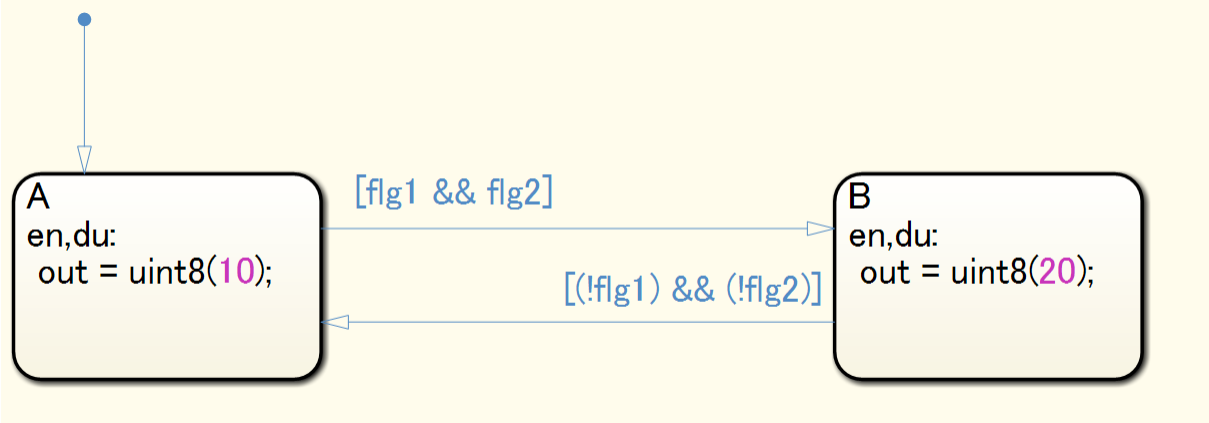
Connective junctions shall not be used to separate complex conditions.

Custom Parameter

Not Applicable

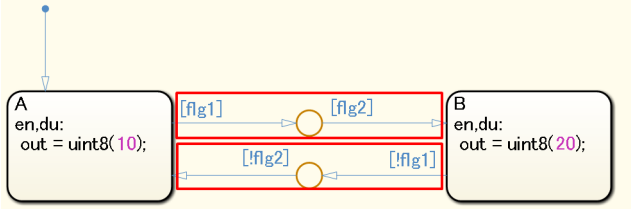
Example — Correct

Connective junctions are not used to separate complex conditions.



Example — Incorrect

Connective junctions are used to separate complex conditions.



Rationale

Sub ID a:

- Deviation from the rule can cause backtracking, which results in unintended behavior.

Verification

Model Advisor check: “Check for unexpected backtracking in state transitions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0751, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)
- “Combine Transitions and Junctions to Create Branching Paths” (Stateflow)
- “Evaluate Transitions” (Stateflow)

Introduced in R2020a

jc_0760: Starting point of internal transition

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

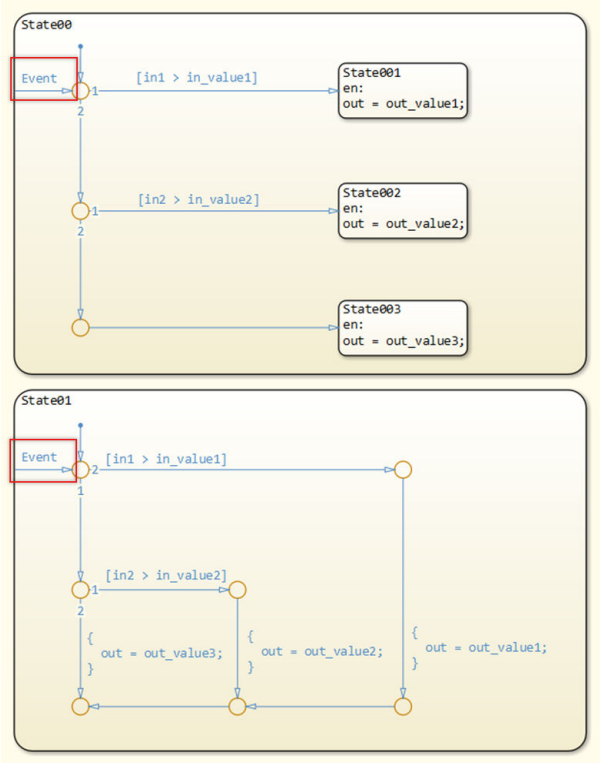
Internal transition lines shall start from the left edge of the state.

Custom Parameter

Not Applicable

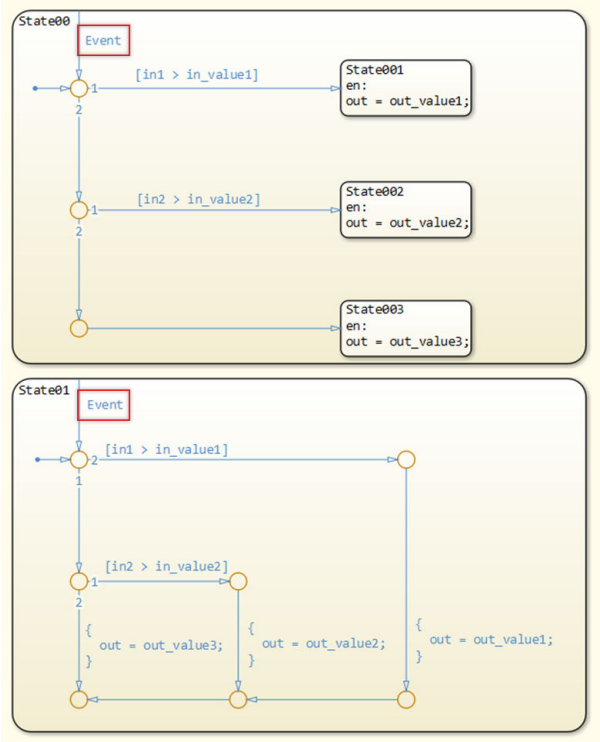
Example — Correct

The inner transition line begins at the left edge of the state.



Example — Incorrect

The inner transition line does not begin at the left edge of the state.



Rationale

Sub ID a:

- Adherence to the rule improves readability.

Verification

Model Advisor check: “Check starting point of internal transition in Stateflow” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0760, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Control Chart Execution by Using Inner Transitions” (Stateflow)

Introduced in R2020a

jc_0763: Usage of multiple internal transitions

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

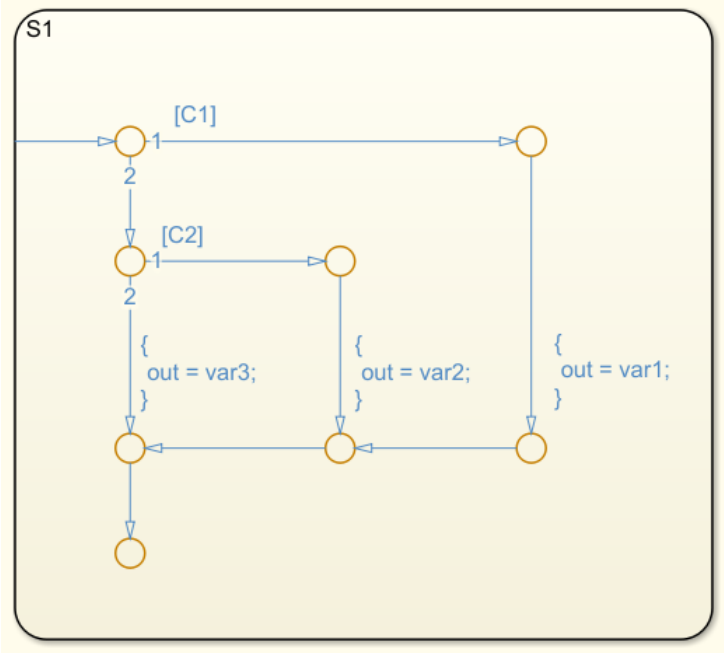
Sub ID a1

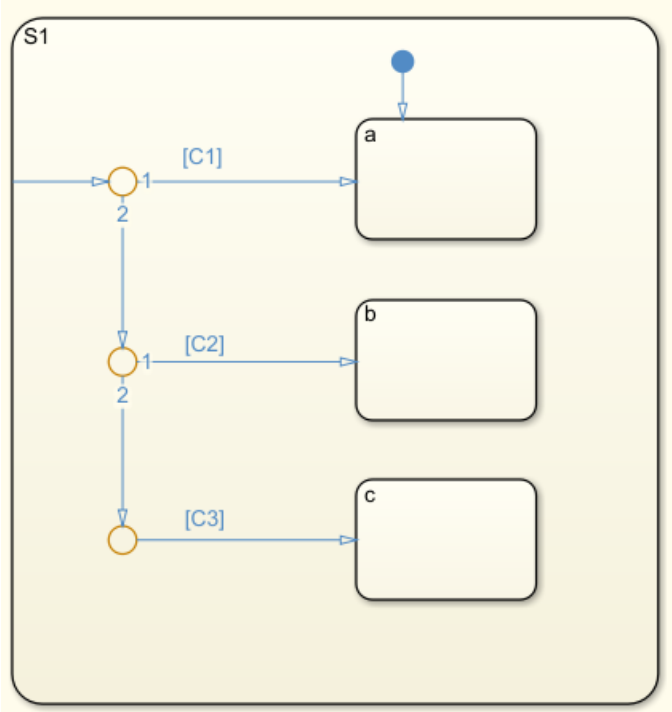
Multiple internal transitions shall not be used in a single state.

Custom Parameter

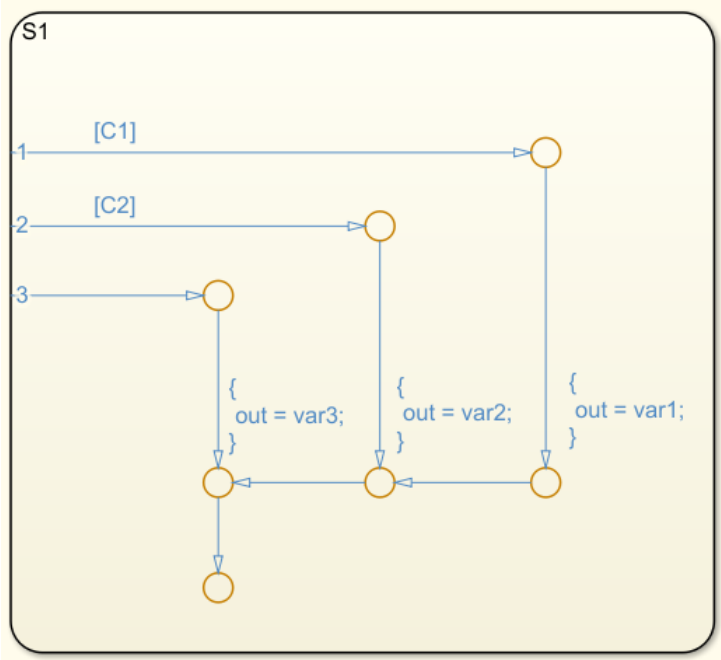
Not Applicable

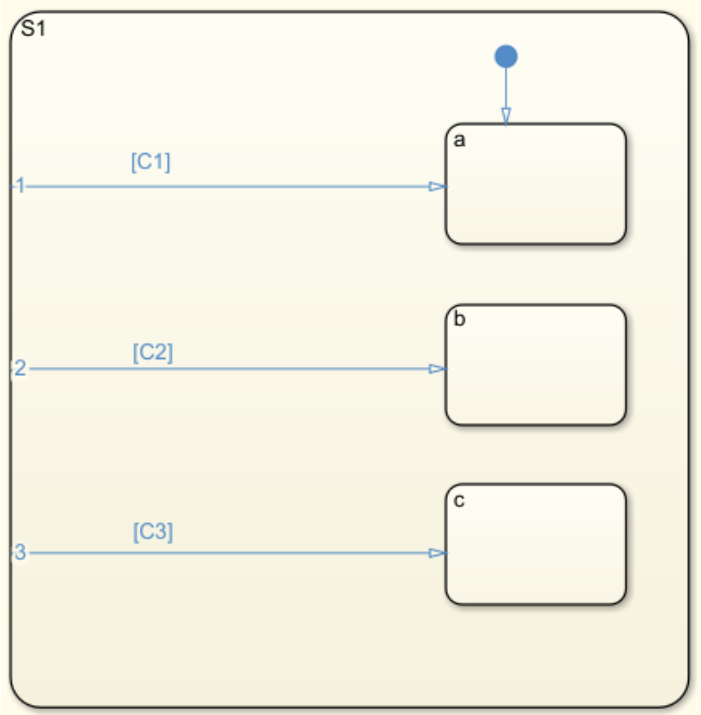
Example — Correct





Example — Incorrect





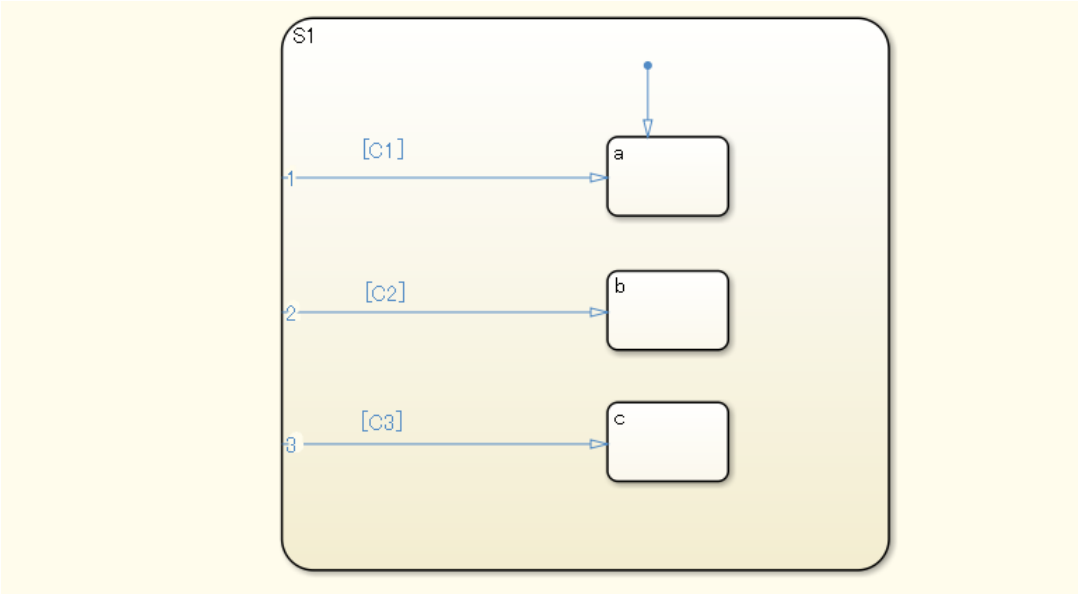
Sub ID a2

When multiple internal transitions are used in a single state, they shall be listed from top to bottom in the order of execution.

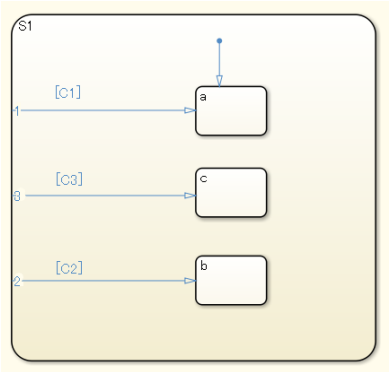
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a1:

- The number of transition conditions is unclear when multiple internal transitions are used. By limiting the use of internal transitions to a single use, transitions are clearer and readability improves.

Sub ID a1:

- Using multiple internal transitions can prevent transition lines from crossing and simplifies state transitions.
- Arranging internal transitions in execution order improves readability.

Verification

Model Advisor check: “Check usage of internal transitions in Stateflow states” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0763, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Overview of Stateflow Objects” (Stateflow)
- “Transition Between Operating Modes” (Stateflow)
- “Types of Chart Execution” (Stateflow)

Introduced in R2020a

jc_0762: Prohibition of state action and flow chart combination

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

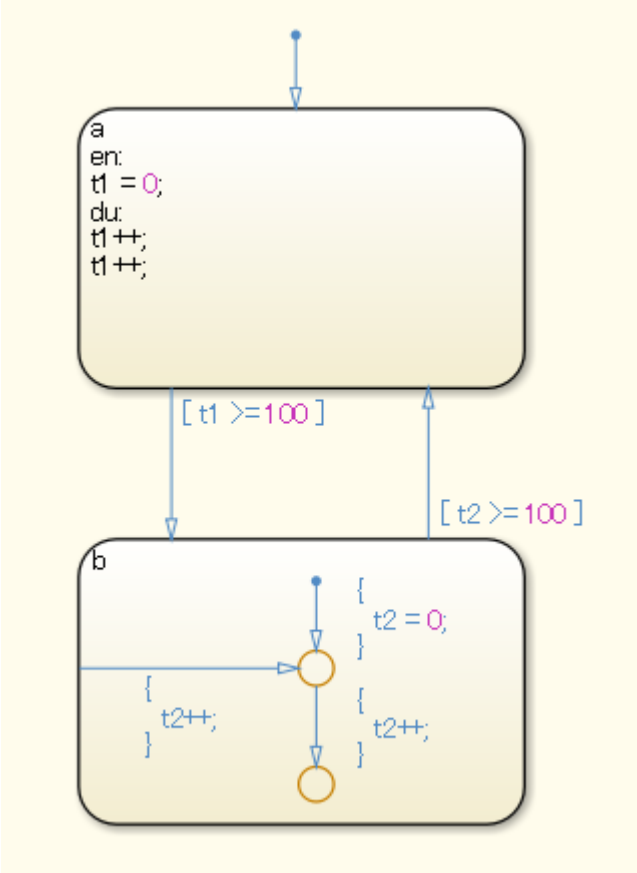
A state shall not include state actions (`en`, `du`, or `ex`) and flow charts.

Custom Parameter

Not Applicable

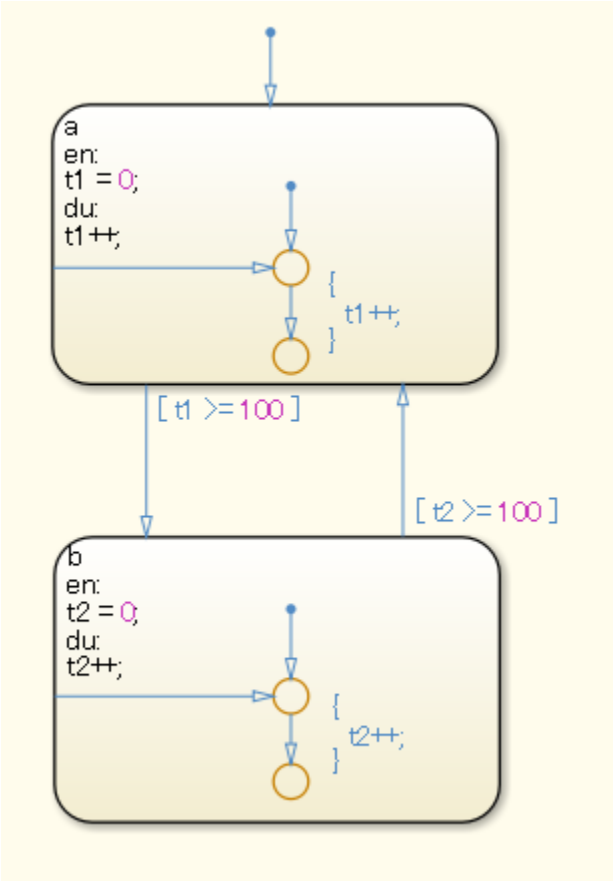
Example — Correct

Within the state, only a state action is described.



Example — Incorrect

The state includes state actions en and du and also a flow chart.



Rationale

Sub ID a:

- The execution order becomes difficult to understand, which decreases readability.

Verification

Model Advisor check: “Check prohibited combination of state action and flow chart” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0762, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Create Flow Charts in Stateflow” (Stateflow)
- “Represent Operating Modes by Using States” (Stateflow)

Introduced in R2020a

db_0132: Transitions in flow charts

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

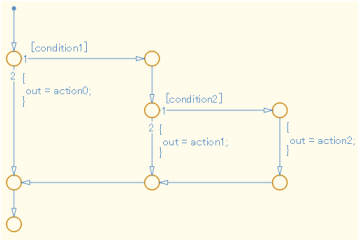
Sub ID a

Transition actions shall not be used in flow charts.

Custom Parameter

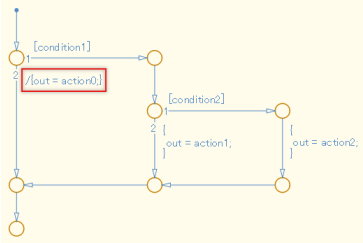
Not Applicable

Example — Correct



Example — Incorrect

Transition actions are used.



Sub ID b

In a flow chart, the condition shall be positioned on a horizontal transition line and the condition action shall be positioned on a vertical transition line.

Exception

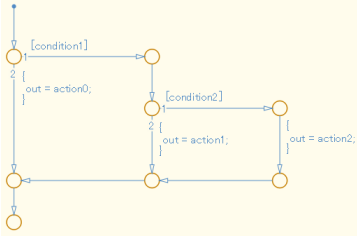
Diagonal transition lines in loop constructs.

Custom Parameter

Not Applicable

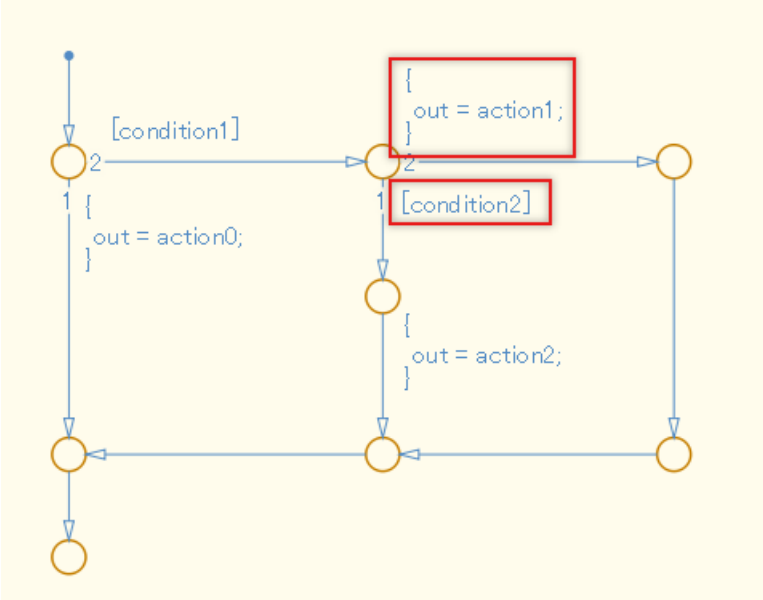
Example — Correct

The condition is positioned on a horizontal transition line and the condition action is on a vertical transition line.



Example — Incorrect

The condition is positioned on a vertical transition line and the condition action is on a horizontal transition line.



Rationale

Sub ID a:

- The transition action in a flow chart is not executed.

Sub ID b:

- Consistent positioning of conditions and condition actions improves readability.

Verification

Model Advisor check: “Check transitions in Stateflow Flow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0132, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

jc_0773: Unconditional transition of a flow chart

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

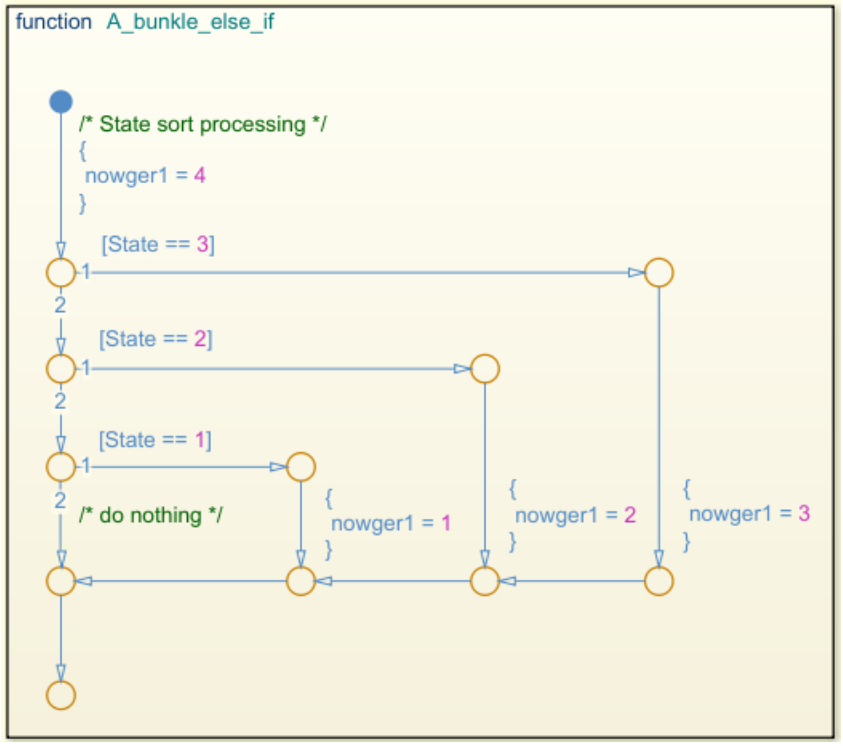
Sub ID a

When a transition line with a transition condition originates from a connective junction, the unconditional transition line shall also begin from that junction.

Custom Parameter

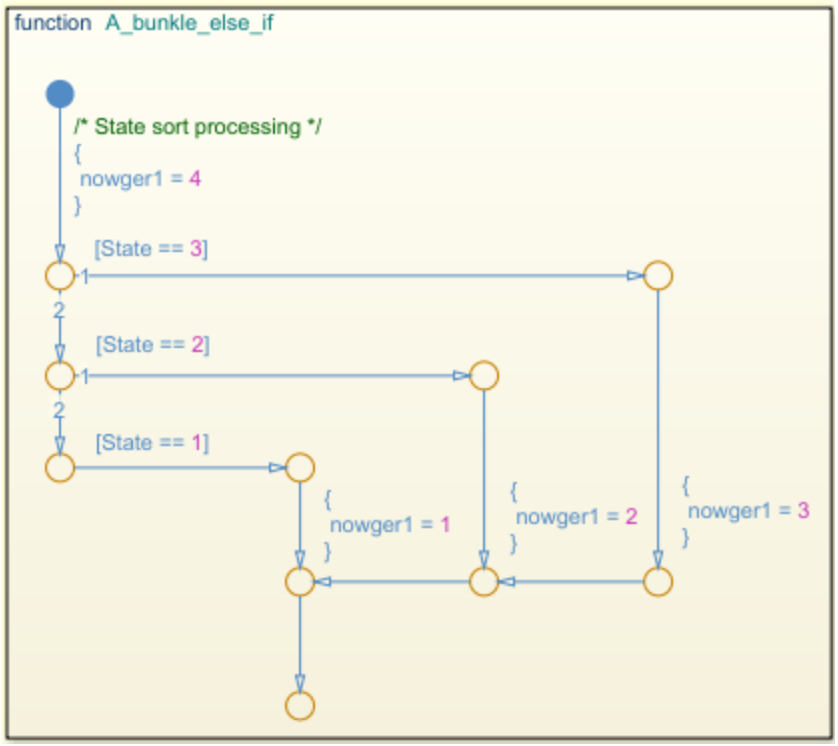
Not Applicable

Example — Correct



Example — Incorrect

There is not an unconditional transition line.



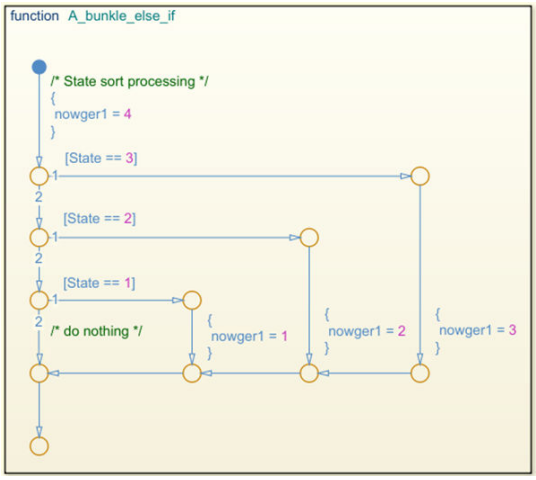
Sub ID b

The **execution order** for unconditional transitions shall be set to the last value.

Custom Parameter

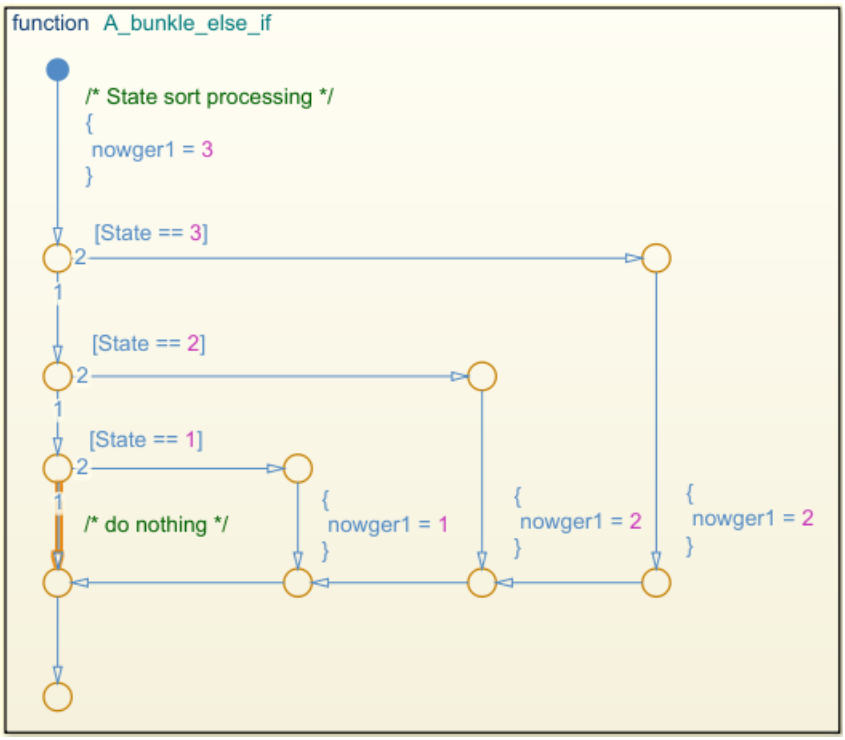
Not Applicable

Example — Correct



Example — Incorrect

The **execution order** for unconditional transitions is not the last value.



Rationale

Sub ID a:

- Prevents unintended behavior that results from backtracking. Setting an unconditional transition explicitly defines the behavior for when the condition is not met.

Sub ID b:

- Setting the unconditional transition to take precedence can prevent unintended behavior.

Verification

Model Advisor check: “Check usage of unconditional transitions in flow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0773, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

- “Transition Between Operating Modes” (Stateflow)
- “Execution of a Stateflow Chart” (Stateflow)

Introduced in R2020a

jc_0775: Terminating junctions in flow charts

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

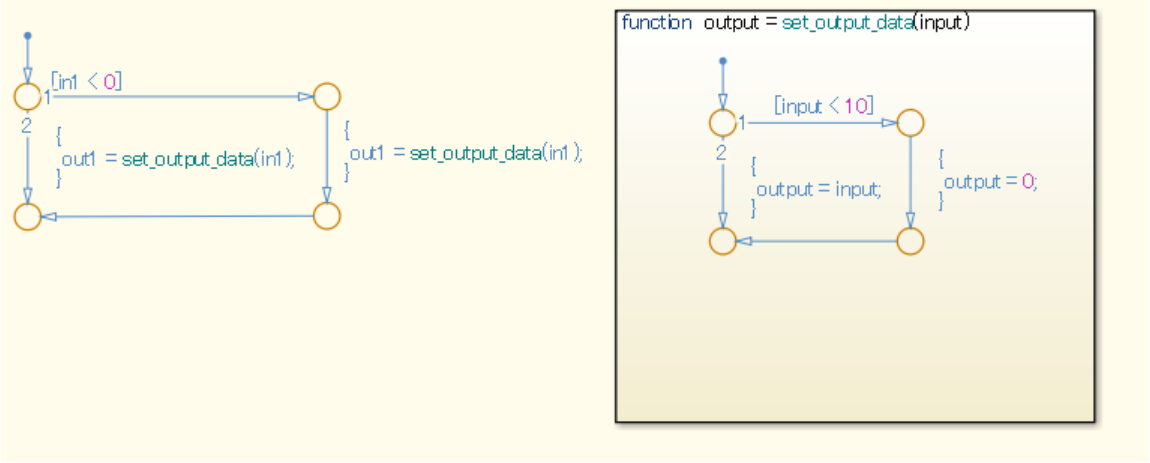
Sub ID a1

Only one terminating junction shall be used.

Custom Parameter

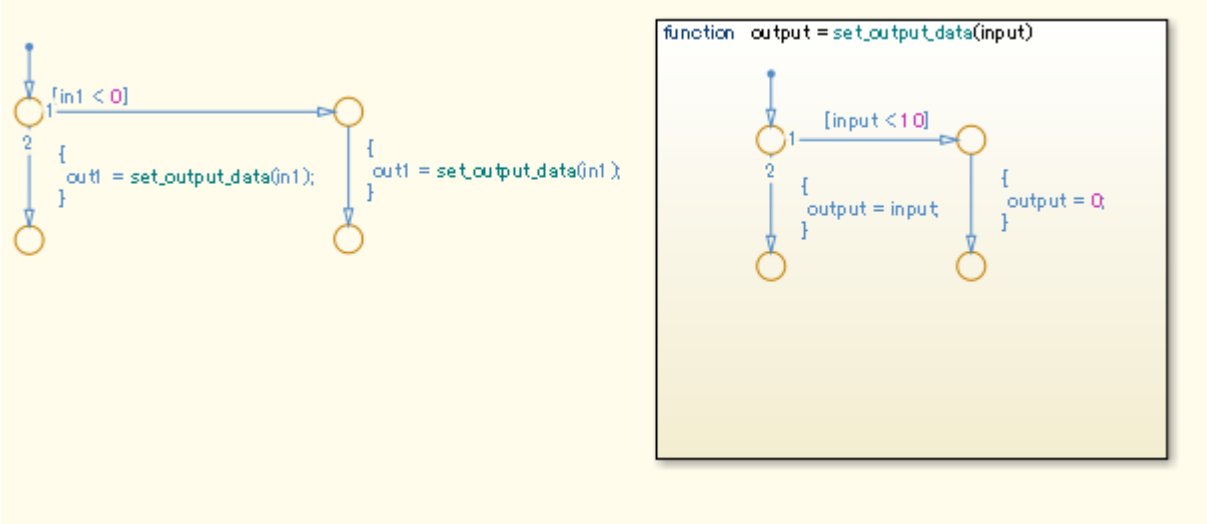
Not Applicable

Example — Correct



Example — Incorrect

There is more than one terminating junction.



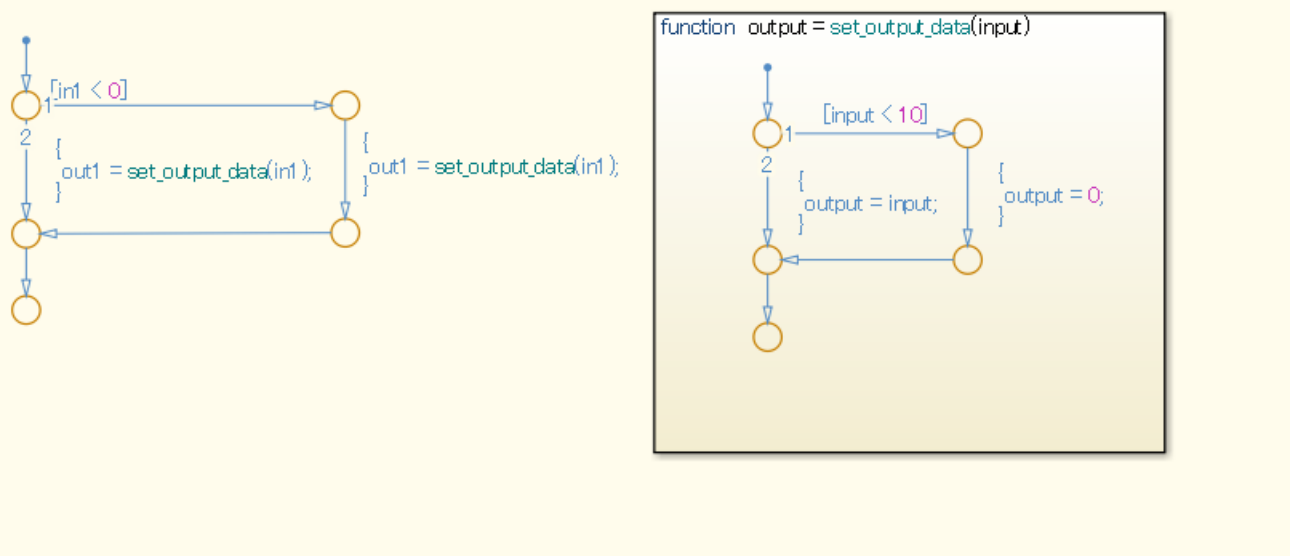
Sub ID a2

One terminating junction with a single unconditional transition as the input shall be used.

Custom Parameter

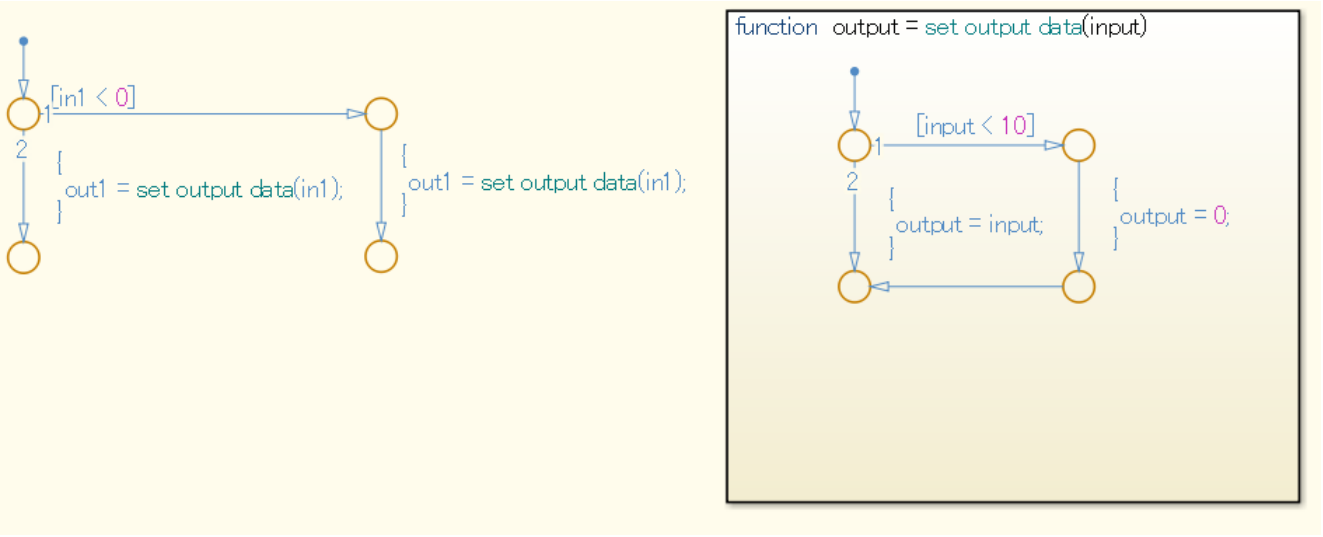
Not Applicable

Example — Correct



Example — Incorrect

There is more than one terminating junction and input.



Rationale

Sub IDs a1, a2

- One terminating junction improves understanding of the logic end point.
- Using a consistent style for terminating junction improves readability.

Verification

Model Advisor check: “Check terminal junctions in Stateflow” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline: jc_0775, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Evaluate Transitions” (Stateflow)
- “Represent Multiple Paths by Using Connective Junctions” (Stateflow)

Introduced in R2020a

jc_0738: Usage of Stateflow comments

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a, b

MATLAB Versions

All

Rule

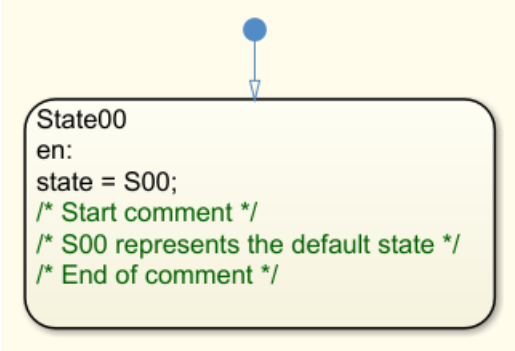
Sub ID a

When Chart parameter **Action Language** is set to `C`, `/*...*/` comment nesting shall not be used.

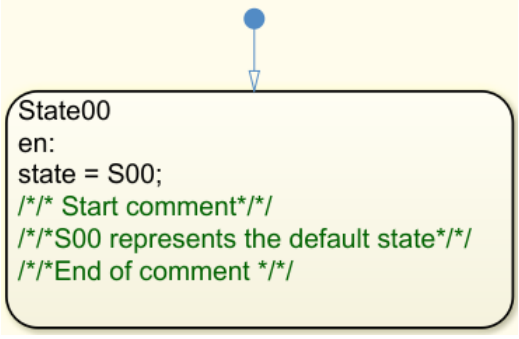
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



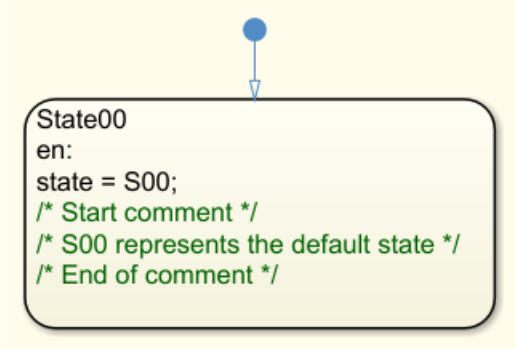
Sub ID b

When Chart parameter **Action Language** is set to `C`, new line characters for comments `/* */` shall not be used in the middle of a single comment.

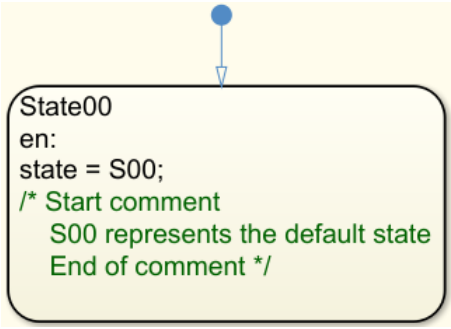
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- The compiler can misinterpret the comments as a program.

Sub ID b:

- A line break in the middle of a comment makes it difficult to determine whether the part being edited is in the comment. There is also a possibility that the comment is nested.
- When Chart parameter **Action Language** is set to `MATLAB`, comments must use `%`.

Verification

Model Advisor check: “Check usage of Stateflow comments” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0738, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Differences Between MATLAB and C as Action Language Syntax” (Stateflow)
- “Modify the Action Language for a Chart” (Stateflow)

Introduced in R2020a

Conditional Transition / Action

jc_0790: Action language of Chart block

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

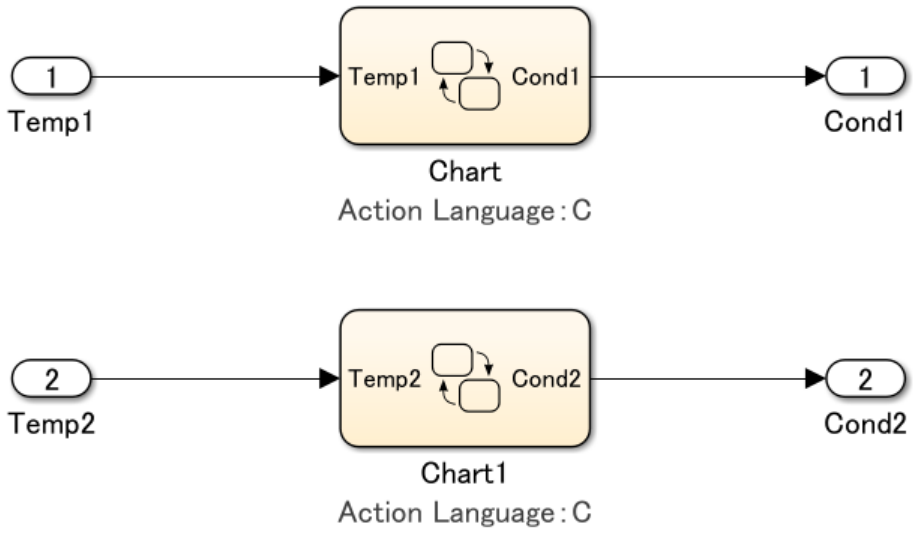
Stateflow Chart property **Action Language** shall be set to `C`.

Custom Parameter

Not Applicable

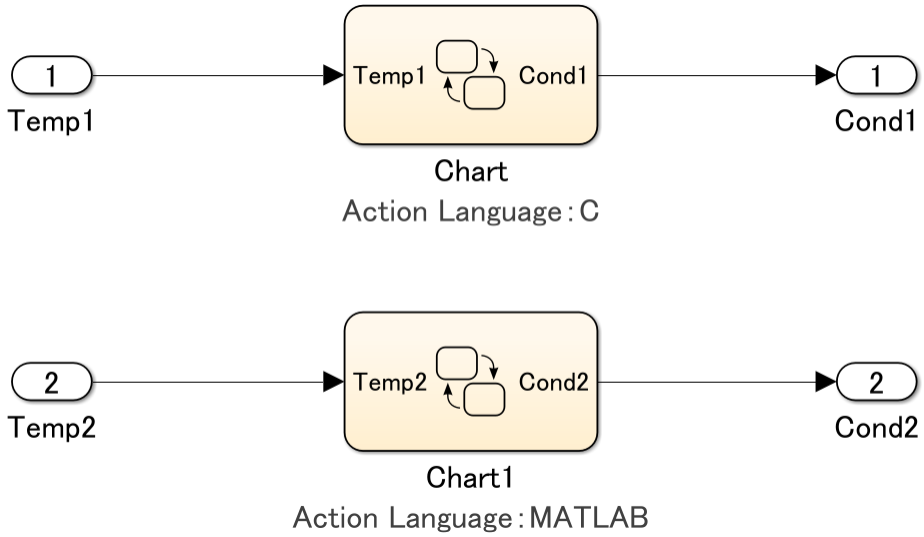
Example — Correct

The **Action Language** is set to `C`.



Example — Incorrect

The **Action Language** is set to `MATLAB`.



Rationale

Sub ID a:

- Using a consistent action language improves readability because there is not a difference in syntax.
- Easier to maintain consistency between the model and the generated code when using C as the action language as compared to MATLAB.
- Easier to understand the model for users who are familiar with the C programming language.

Verification

Model Advisor check: “Check Stateflow chart action language” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0790, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Modify the Action Language for a Chart” (Stateflow)
- “Differences Between MATLAB and C as Action Language Syntax” (Stateflow)

Introduced in R2020a

jc_0702: Use of named Stateflow parameters and constants

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Stateflow block shall not use numeric literal.

Exceptions

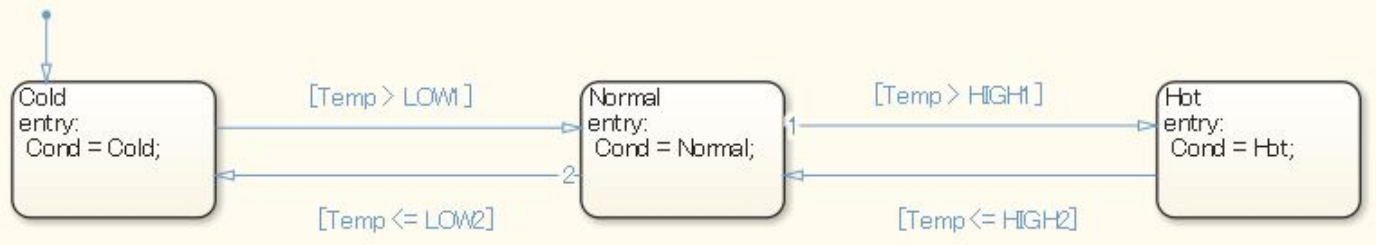
- Initial value is 0
- Increment, decrement 1

Custom Parameter

Not Applicable

Example — Correct

Numeric literals are not used.

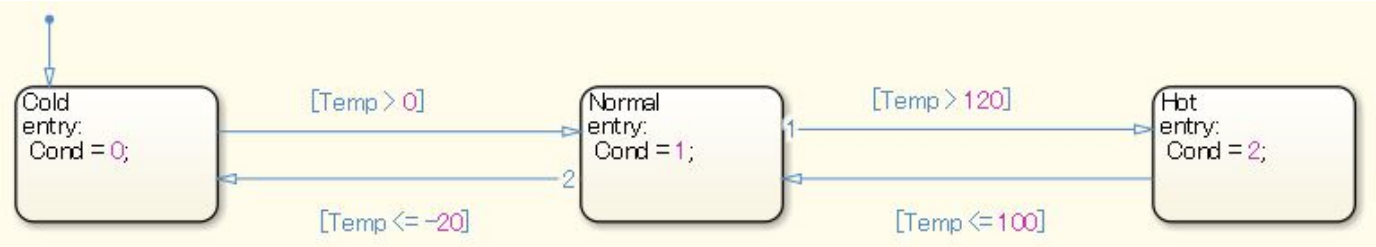


jc0702a_OK_parameter.m

```
1
2 -     HIGH1=100;
3 -     HIGH2=120;
4 -     LOW1=0;
5 -     LOW2=10;
```

Example — Incorrect

Numeric literals are used.



Rationale

Sub ID a:

- Only the modeler will understand the purpose of the value when numeric literals are used to write constants, which decreases readability.
- Constants that are intended for calibration are generated in the code using numeric literals.

Verification

Model Advisor check: “Check usage of numeric literals in Stateflow” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0702, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Guidelines for Naming Stateflow Objects” (Stateflow)

Introduced in R2020a

jm_0011: Pointers in Stateflow

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

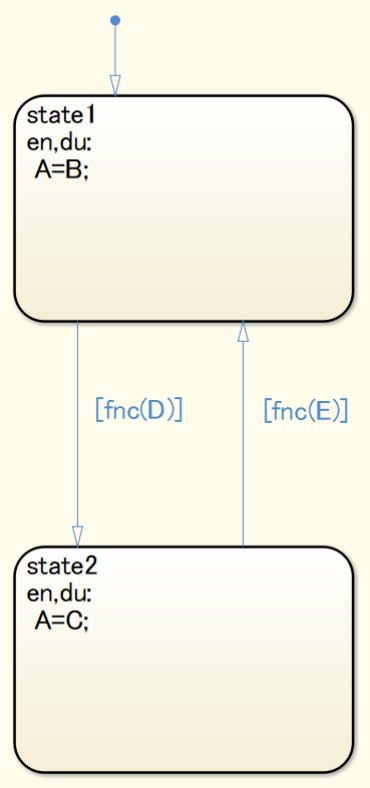
Sub ID a

Stateflow Chart shall not use pointer variables.

Custom Parameter

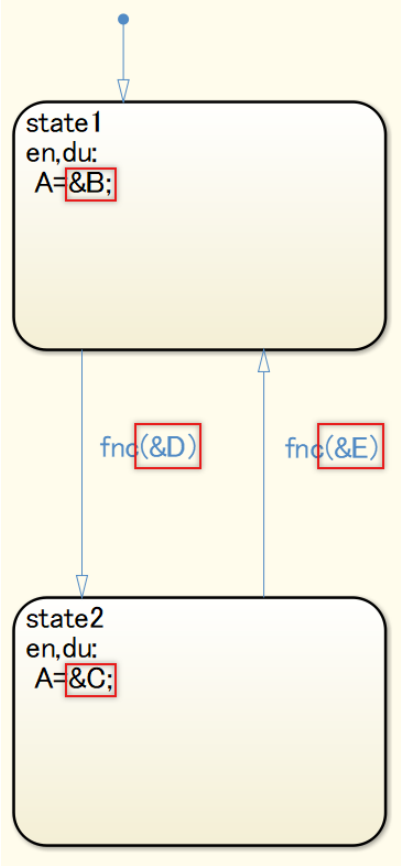
Not Applicable

Example — Correct



Example — Incorrect

Pointer variables are used.



Rationale

Sub ID a:

- Readability is impaired when pointer variables are used.
- Code generation may not be possible.

Verification

Model Advisor check: “Check for pointers in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jm_0011, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

- “Pointer and Address Operations” (Stateflow)

Introduced in R2020a

jc_0491: Reuse of Stateflow data

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

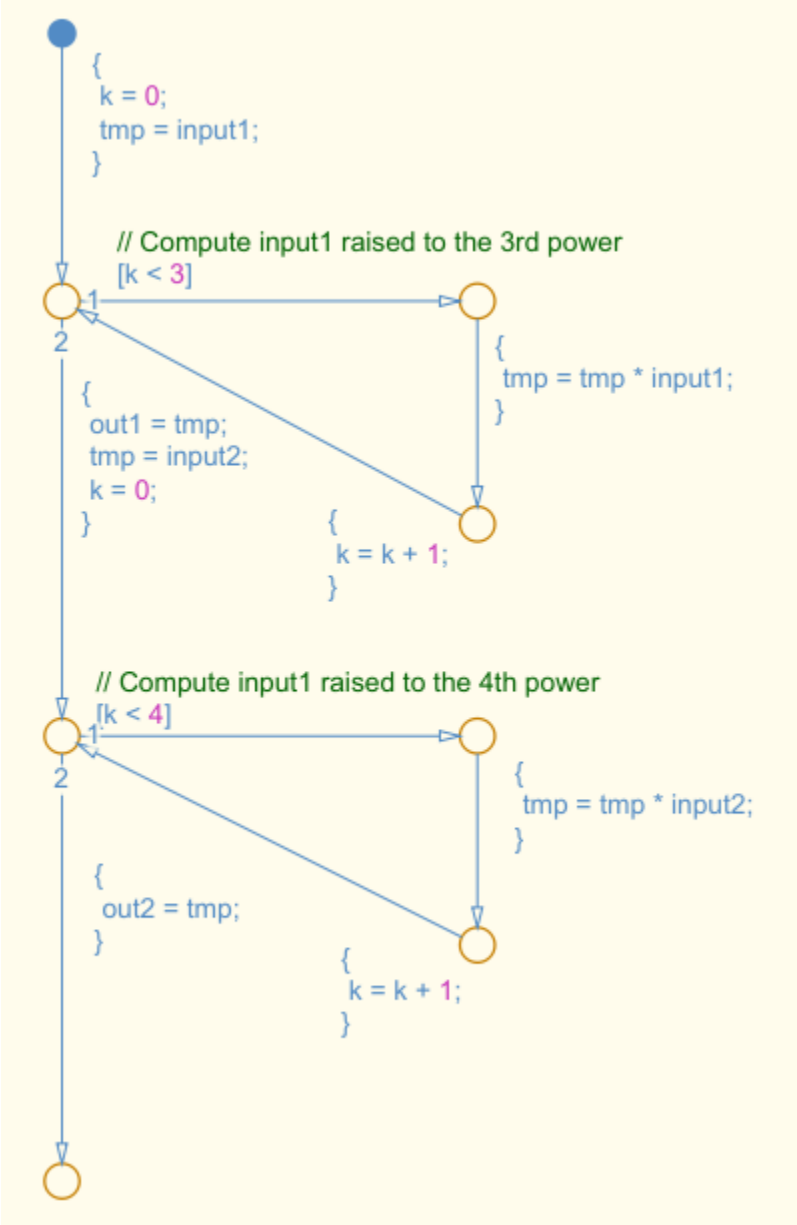
A variable shall not have multiple meanings (usages) in a single Stateflow Chart.

Custom Parameter

Not Applicable

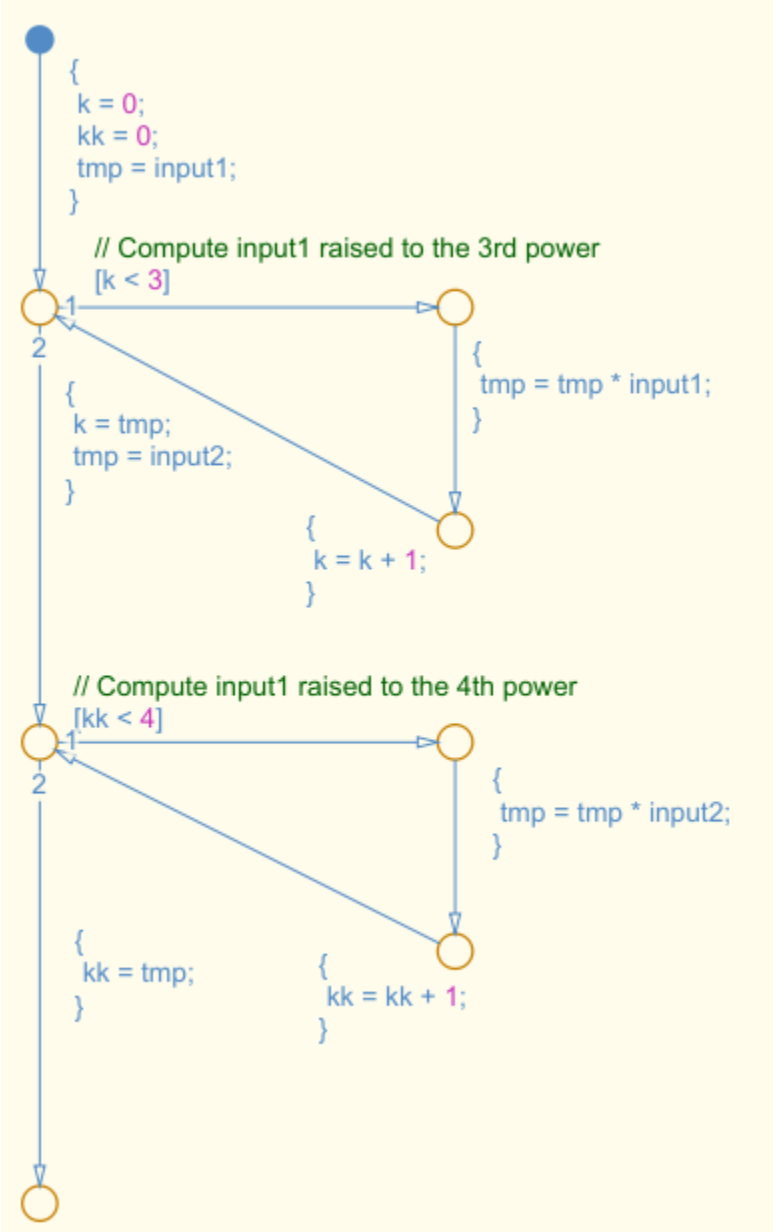
Example — Correct

Variable does not have multiple usages.



Example — Incorrect

Variables k and kk have multiple usages in the Stateflow Chart.



Rationale

Sub ID a:

- Variables can be misinterpreted when the variable name is different than the meaning of the numerical value that is assigned to the variable.

Verification

Model Advisor check: Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jc_0491, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Construct and Run a Stateflow Chart” (Stateflow)

Introduced in R2020a

jm_0012: Usage restrictions of events and broadcasting events

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a1/a2/a3

MATLAB Versions

All

Rule

Sub ID a1

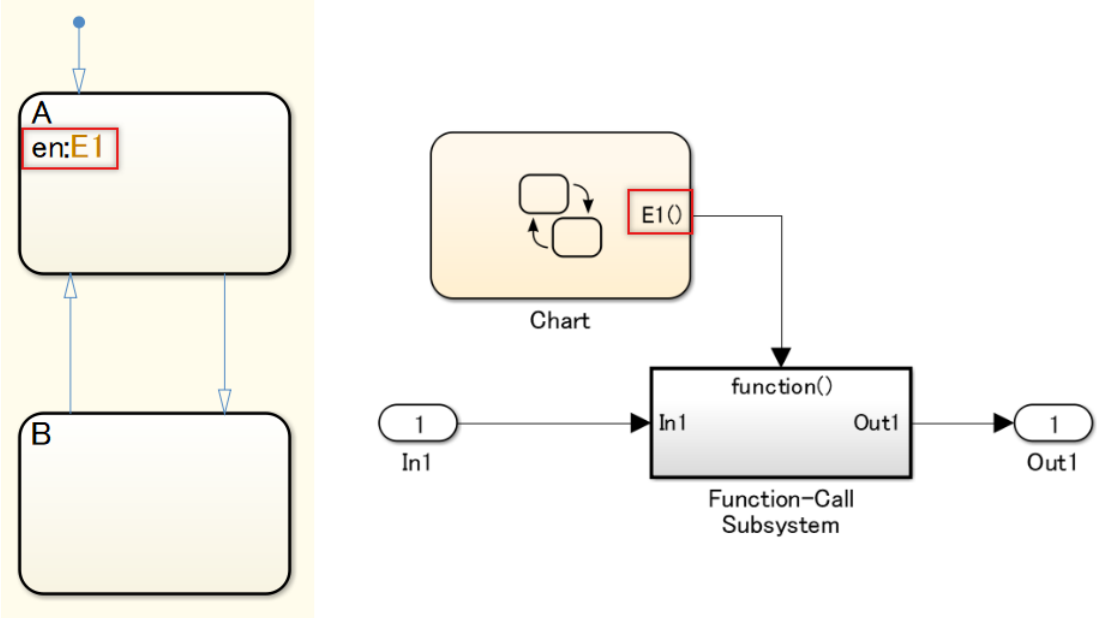
Stateflow events shall be used only in Stateflow Chart output.

Custom Parameter

Not Applicable

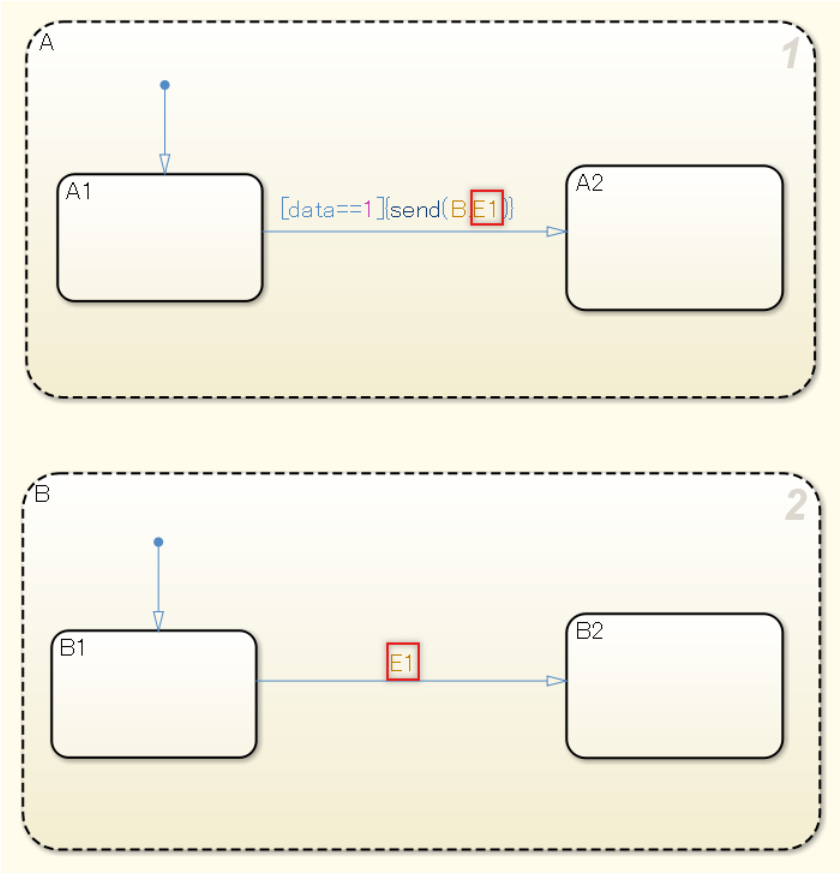
Example — Correct

Event is used only in the Stateflow Chart output.



Example — Incorrect

Event is used other than in the Stateflow Chart output.



Sub ID a2

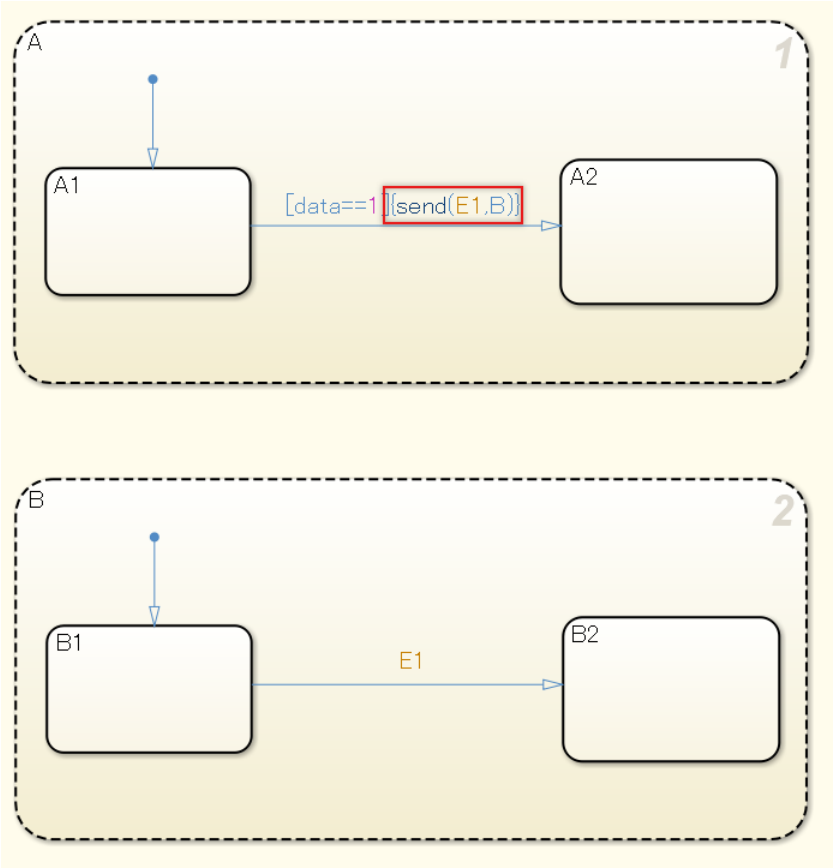
The `send` syntax `send(event_name, state_name)` shall be used to broadcast Stateflow events.

Custom Parameter

Not Applicable

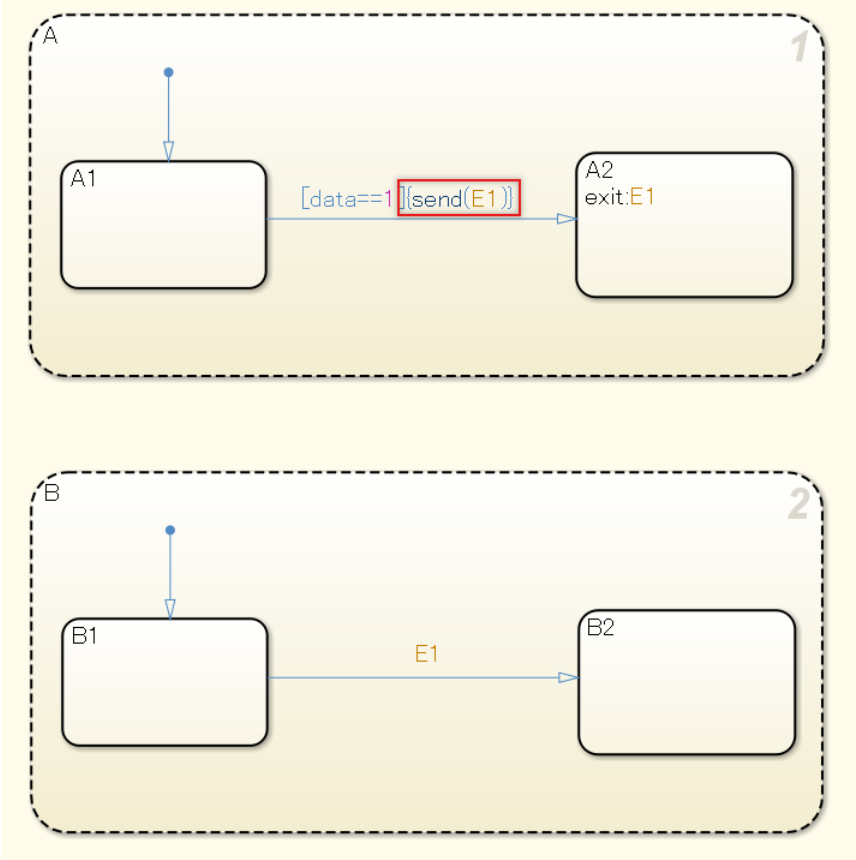
Example — Correct

Event is broadcast using the `send` syntax.



Example — Incorrect

The state that receives the broadcast has not been defined in the `send` syntax.



Sub ID a3

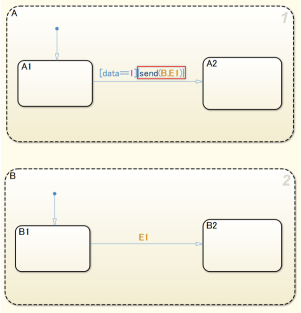
The `send` syntax `send(state_name.event_name)` with the qualified event name shall be used to broadcast Stateflow events.

Custom Parameter

Not Applicable

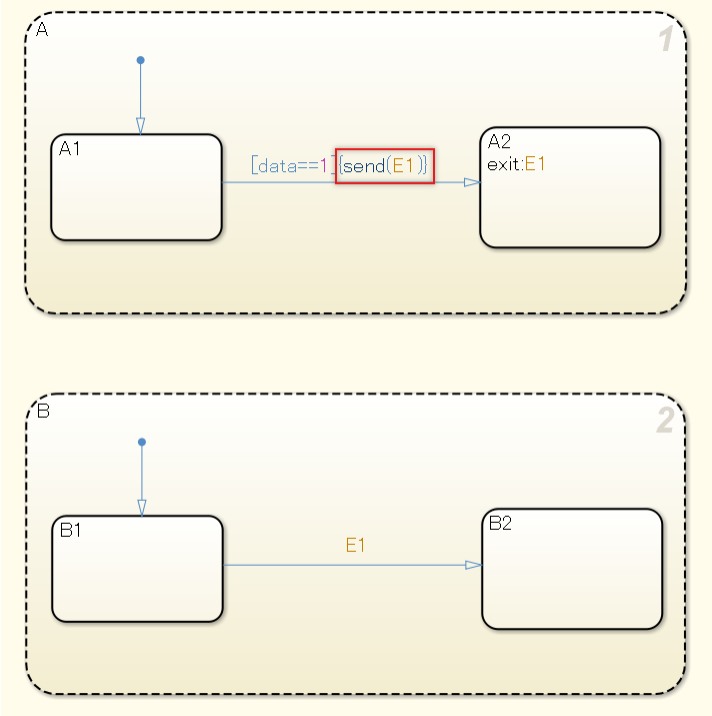
Example — Correct

The qualified event name is used in the event being broadcast.



Example — Incorrect

The state that receives the broadcast has not been described in the `send` syntax.



Rationale

Sub ID a1:

- Recursive processing in a chart is prevented by using Stateflow events in the Stateflow Chart output only.

Sub IDs a2, a3:

- Improves readability because transitions that are triggered by events are clearly identified.

Verification

Model Advisor check: “Check for usage of events and broadcasting events in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jm_0012, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Events” (Stateflow)
- “Use Events to Execute Charts” (Stateflow)

- “Broadcast Local Events to Synchronize Parallel States” (Stateflow)

Introduced in R2020a

jc_0733: Order of state action types

Sub ID Recommendations

- NA-MAAB — a, b
- JMAAB — a, b

MATLAB Versions

All

Rule

Sub ID a

Basic state action types shall be stated in this order:

`entry (en)`

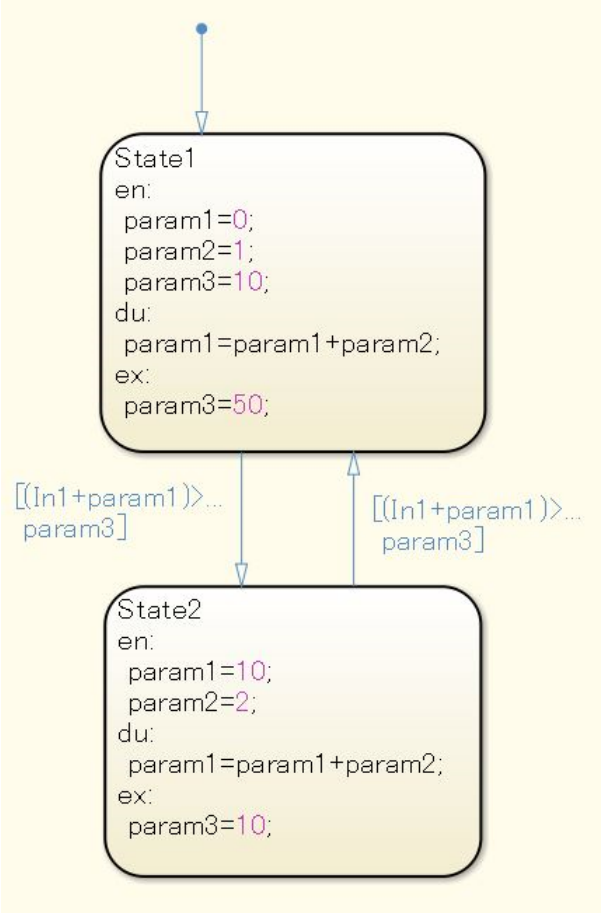
`during (du)`

`exit (ex)`

Custom Parameter

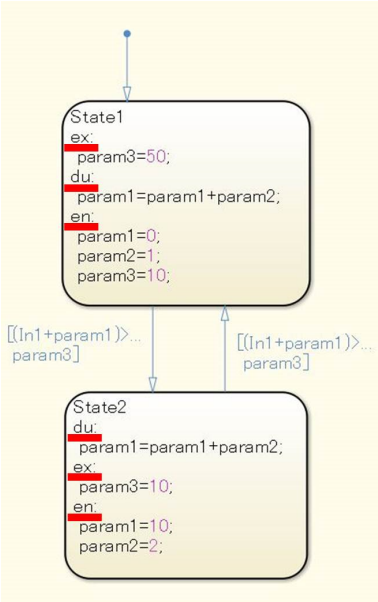
Not Applicable

Example — Correct



Example — Incorrect

Action types are out of order.



Sub ID b

Combined state action types shall be stated in this order:

`entry (en)`

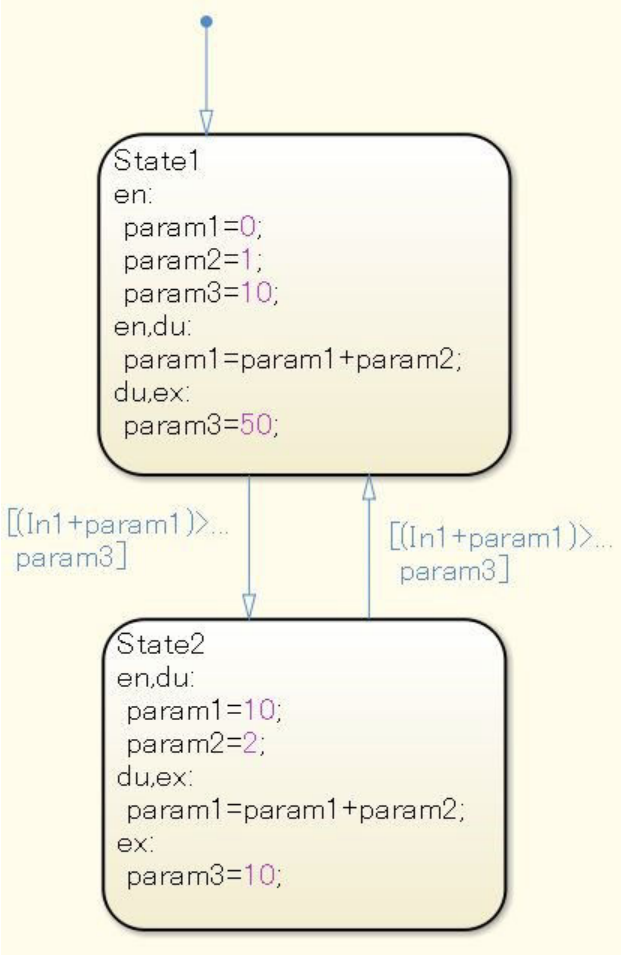
`during (du)`

`exit (ex)`

Custom Parameter

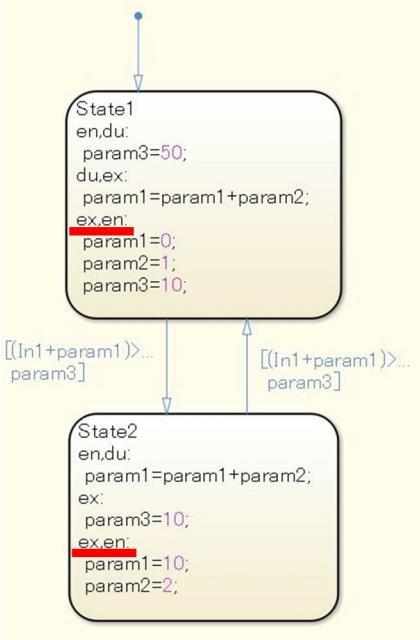
Not Applicable

Example — Correct



Example — Incorrect

Action types are out of order



Rationale

Sub ID a:

- Consistent modelling improves readability and maintainability.

Verification

Model Advisor check: “Check order of state action types” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0733, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)
- “During Actions” (Stateflow)
- “Exit a State” (Stateflow)

Introduced in R2020a

jc_0734: Number of state action types

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

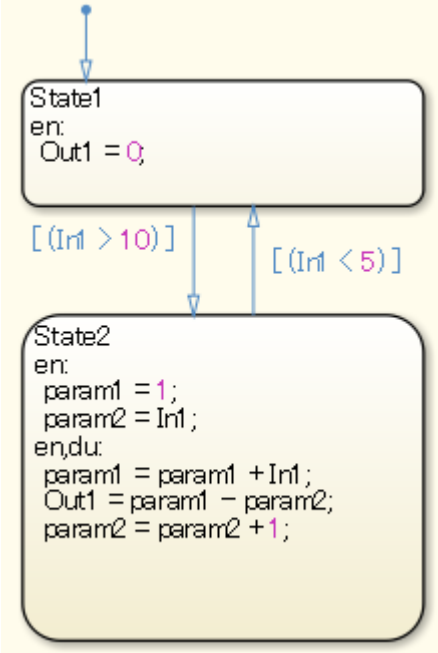
Sub ID a

State action types shall not describe the same thing more than twice.

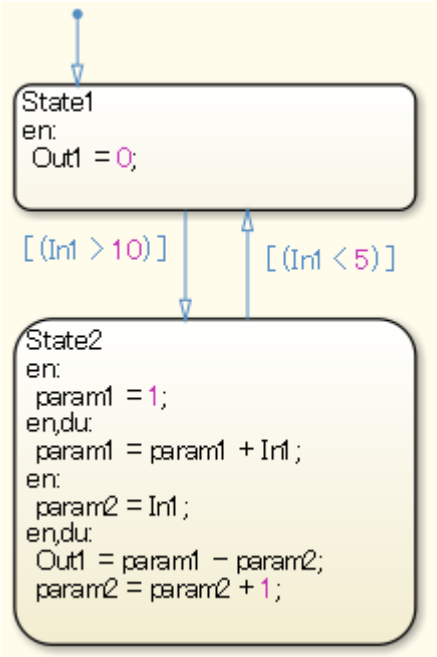
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- The execution order will differ depending on the order in which they are described.
- Execution order can be difficult to understand when the action type is described multiple times.

Verification

Model Advisor check: “Check repetition of Action types” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0734, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)

Introduced in R2020a

jc_0740: Limitation on use of exit state action

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

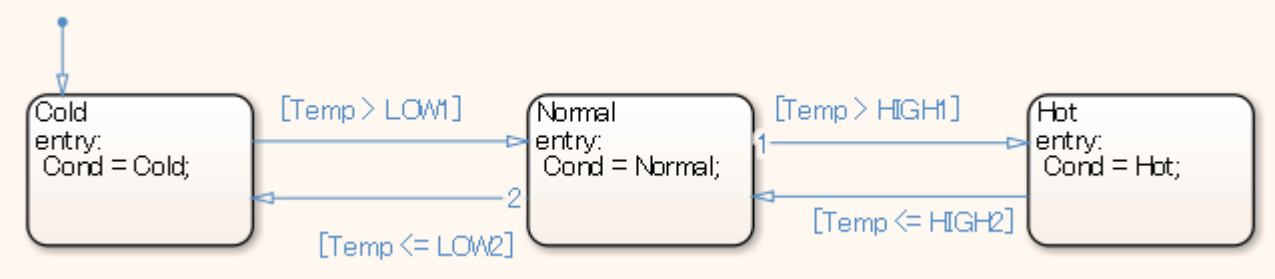
Sub ID a

State action type `exit(ex)` shall not be used.

Custom Parameter

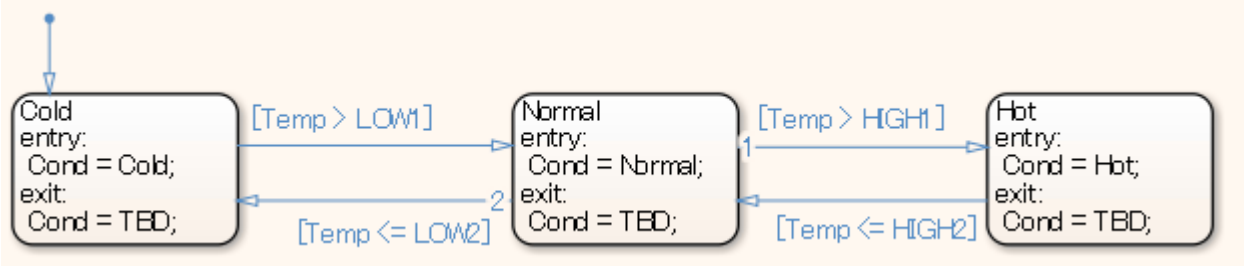
Not Applicable

Example — Correct



Example — Incorrect

This example illustrates how the model behavior in Stateflow Chart is misinterpreted. It appears that TBD is output when state action type `exit(ex)` is used, but it is in fact being overwritten by the state action type entry of the transition destination state. It is not outputted by the Stateflow Chart.



Rationale

Sub ID a:

- Execution timing can be difficult to understand when state action type `exit(ex)` is used in combination with a conditional action, a transition action, or state action type `entry(en)`. This can result in misinterpretation of the model behavior.

Verification

Model Advisor check: “Check if state action type 'exit' is used in the model” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0740, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Exit a State” (Stateflow)

Introduced in R2020a

jc_0741: Timing to update data used in state chart transition conditions

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

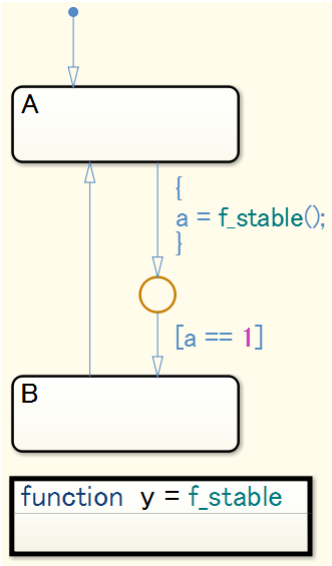
Sub ID a

Variables that are used in a state transition condition shall not use state action du to perform an update.

Custom Parameter

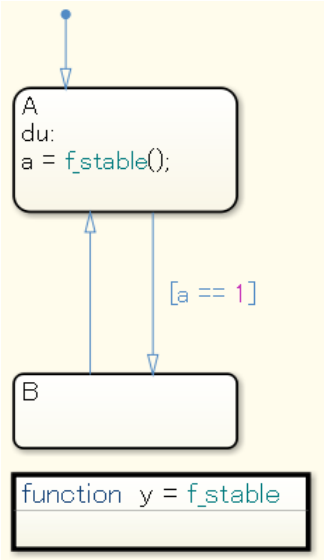
Not Applicable

Example — Correct



Example — Incorrect

State action du is used to perform an update.



Rationale

Sub ID a:

- The execution order of the transition condition and implement of `during` can be difficult to understand, which increases the risk of errors.

Verification

Model Advisor check: “Check updates to variables used in state transition conditions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0741, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)
- “Represent Operating Modes by Using States” (Stateflow)
- “Execution of a Stateflow Chart” (Stateflow)

Introduced in R2020a

jc_0772: Execution order and transition conditions of transition lines

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

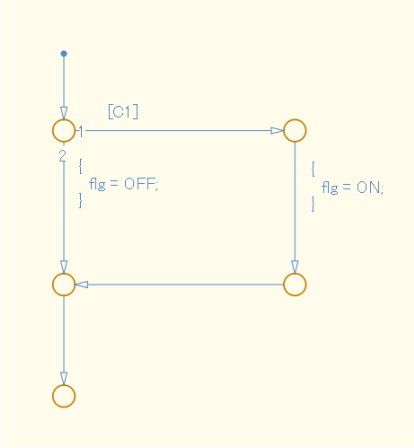
All transition paths shall be executable by setting configuration parameter:

- (R2011b to R2016a) **Set Transition shadowing** to `error`.
- (R2016b and later) Set **Unreachable execution path** to `error`.

Custom Parameter

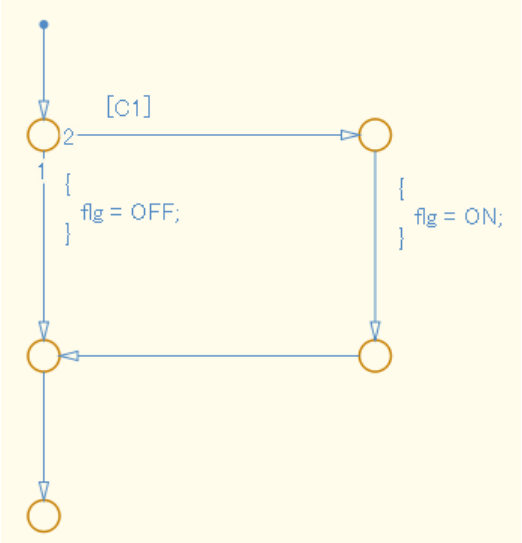
Not Applicable

Example — Correct



Example — Incorrect

Execution order 1 is an unconditional transition and conditional expression `[C1]` is described in execution condition 2.



Rationale

Sub ID a:

- An unconditional transition that is in a position other than the last in the execution order causes the subsequent transition to be a dead path, which results in unintended simulation behavior.

Verification

Model Advisor check: “Check usage of transition conditions in Stateflow transitions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0772, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)
- “Types of Chart Execution” (Stateflow)
- “Execution of a Stateflow Chart” (Stateflow)

Introduced in R2020a

jc_0753: Condition actions and transition actions in Stateflow

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

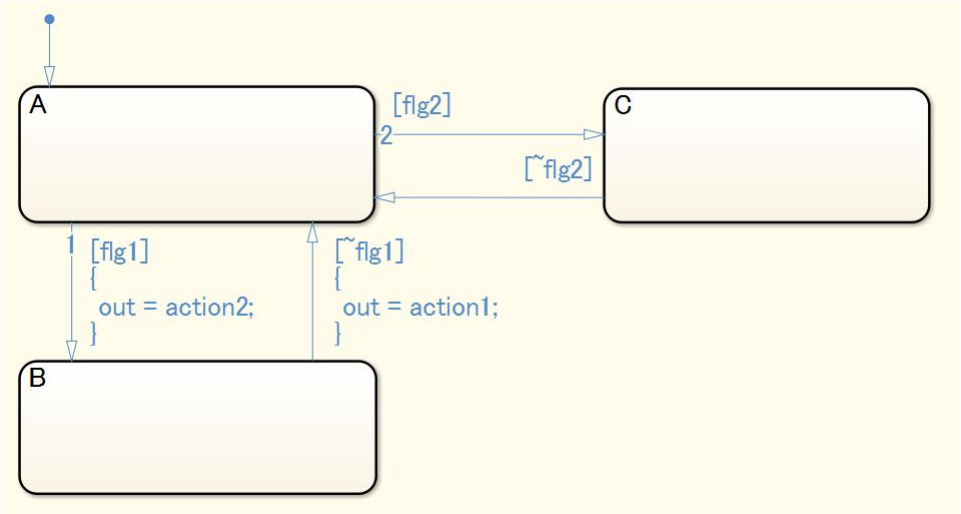
Transition actions shall not be used in a Stateflow Chart.

Custom Parameter

Not Applicable

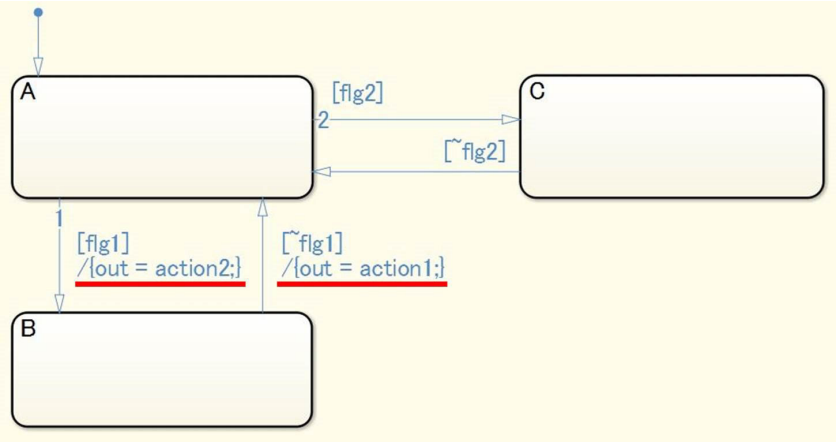
Example — Correct

Only a condition action is used.



Example — Incorrect

A transition action is used.



Sub ID a2

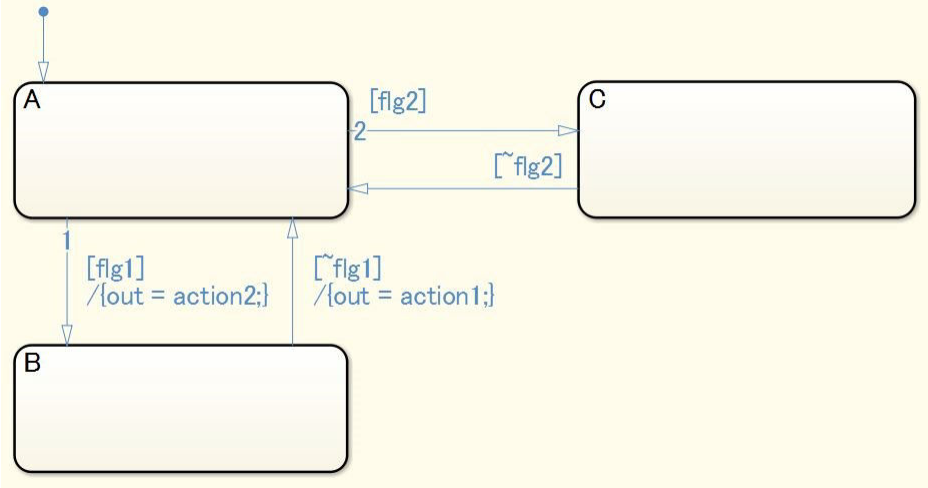
Condition actions and transition actions shall not be combined in the same Stateflow Chart.

Custom Parameter

Not Applicable

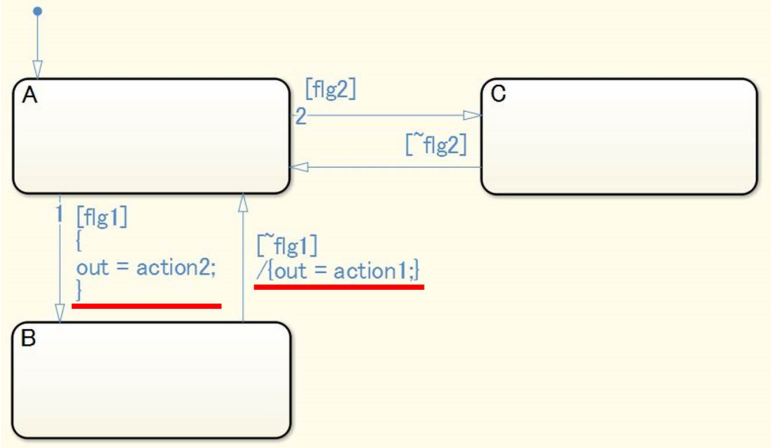
Example — Correct

Either a condition action or a transition action can be used. (The following diagram illustrates a transition action.)



Example — Incorrect

Includes both a condition action and a transition action.



Rationale

Sub ID a1:

- Prevents confusion with a condition action, thus improving readability.

Sub ID a2:

- A condition action executes upon entering a transition. A transition action executes after determining whether it can transition to the next state. Adherence to the rule prevents confusion between a conditional action and a transition action.

Verification

Model Advisor check: “Check condition actions and transition actions in Stateflow” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0753, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Condition and Transition Actions” (Stateflow)

Introduced in R2020a

jc_0711: Division in Stateflow

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

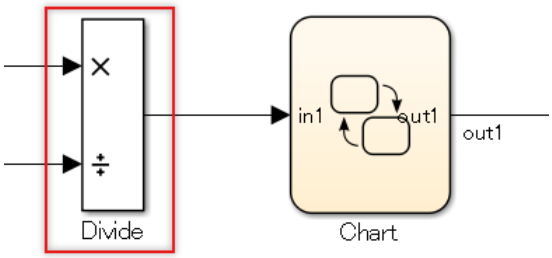
Variables, constants, or parameters in Stateflow Chart shall not be used to perform division operations.

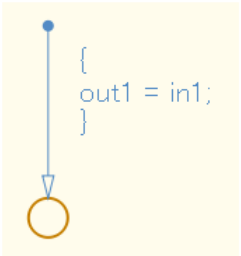
Custom Parameter

Not Applicable

Example — Correct

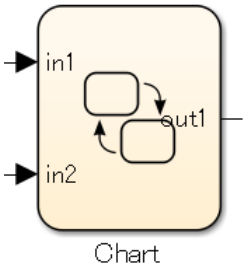
Division is performed outside of the Stateflow Chart.

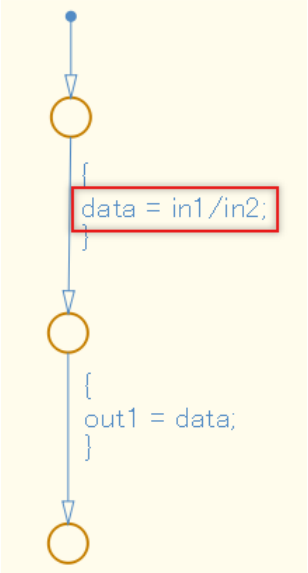




Example — Incorrect

Division occurs within the Stateflow Chart.





Sub ID a2

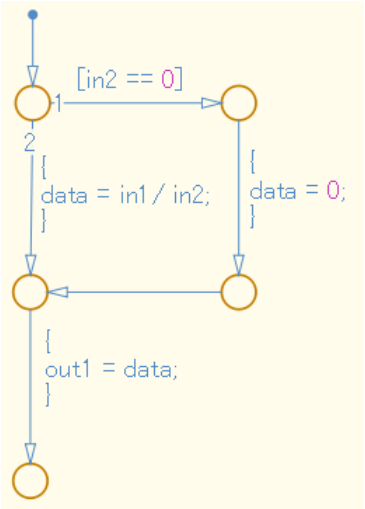
When division occurs in a Stateflow Chart, the process shall prevent division by zero.

Custom Parameter

Not Applicable

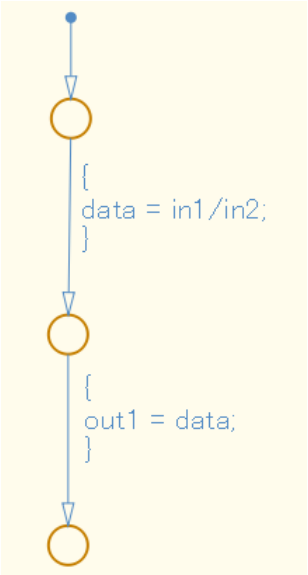
Example — Correct

The process is defined to prevent division by zero.



Example — Incorrect

The process does not prevent division by zero.



Rationale

Sub ID a1, a2:

- Deviation from the rule can cause unintended operation and code generation results.

Verification

Model Advisor check: Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jc_0711, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Fixed-Point Operations in Stateflow Charts” (Stateflow)

Introduced in R2020a

db_0127: Limitation on MATLAB commands in Stateflow blocks

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

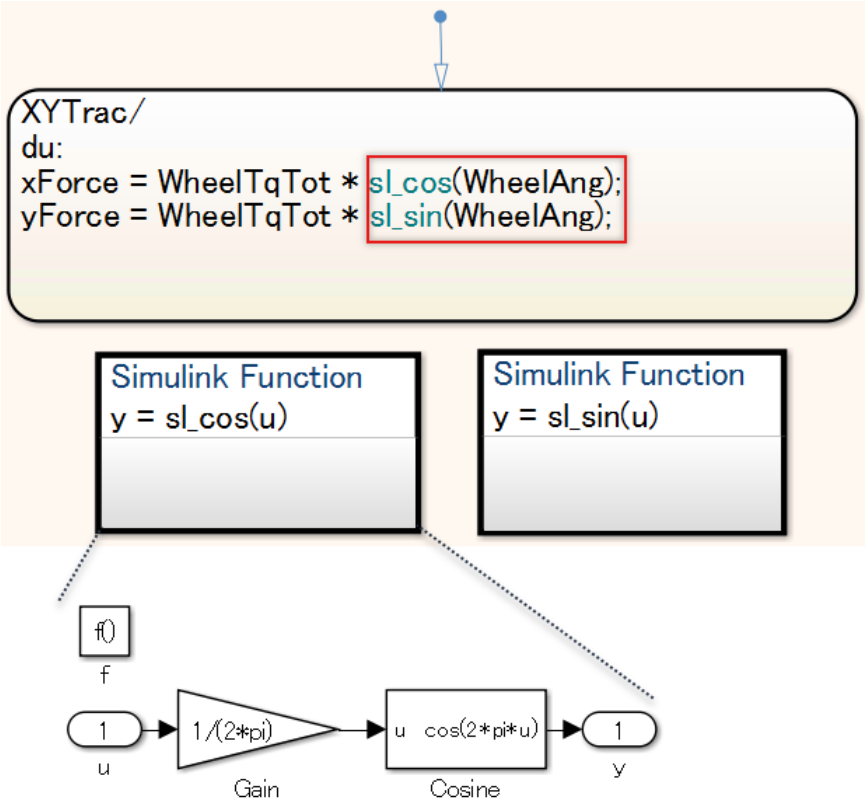
MATLAB commands shall not be used in Stateflow blocks.

Custom Parameter

Not Applicable

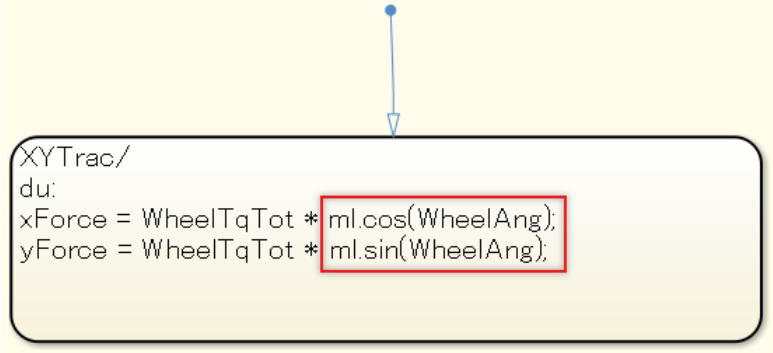
Example — Correct

MATLAB commands are not used in Stateflow blocks.



Example — Incorrect

A MATLAB command is used in the Stateflow block.



Sub ID a2

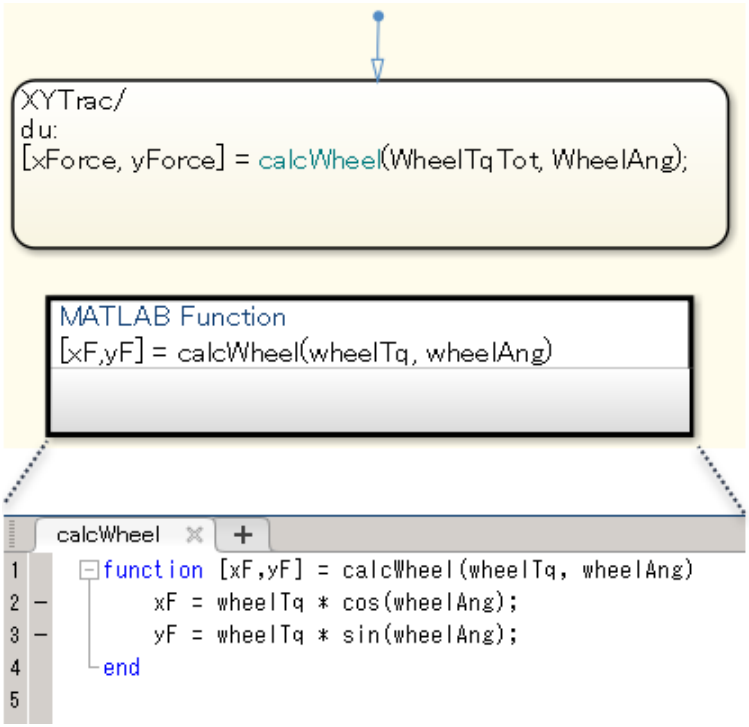
When a MATLAB command is used in Stateflow blocks, it shall be accessed only by using MATLAB Function block.

Custom Parameter

Not Applicable

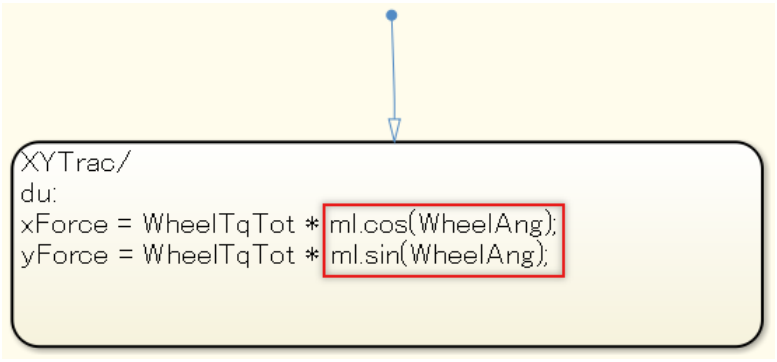
Example — Correct

The MATLAB command is accessed by using the MATLAB Function block.



Example — Incorrect

A MATLAB Function block is not used for a MATLAB command.



Rationale

Sub ID a1:

- Not all MATLAB commands are supported for code generation. As a result, code may not be generated for these unsupported MATLAB commands.

Sub ID a2:

- Not all MATLAB commands are supported for code generation. As a result, code may not be generated for these unsupported MATLAB commands.
- Readability improves when C and MATLAB action languages are described separately.

Verification

Model Advisor check: “Check for MATLAB expressions in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline db_0127, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- MATLAB Function
- “Stateflow Programmatic Interface” (Stateflow)
- “Differences Between MATLAB and C as Action Language Syntax” (Stateflow)

Introduced in R2020a

jc_0481: Use of hard equality comparisons for floating point numbers in Stateflow

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

These equality comparison operators shall not be used in floating-point operands:

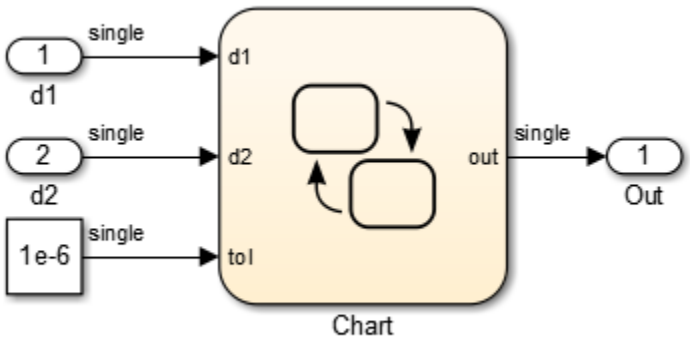
- ==
- !=
- ~=

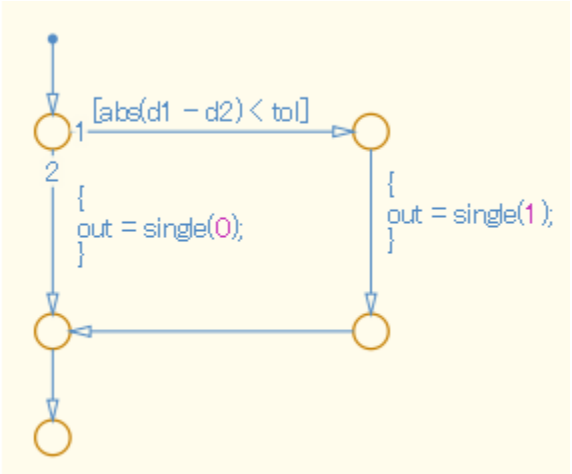
Custom Parameter

Not Applicable

Example — Correct

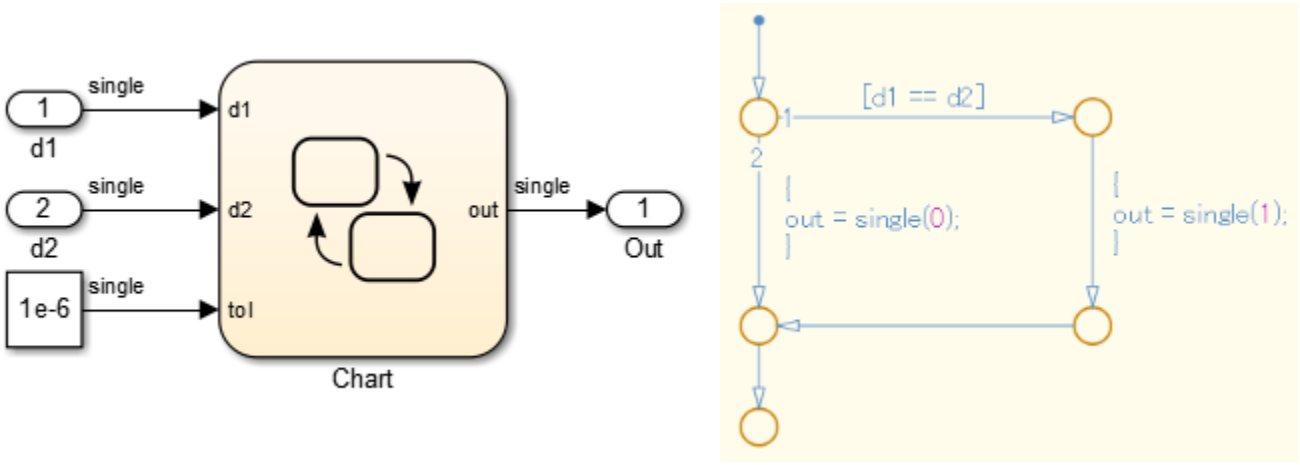
Equality comparison operators are not used in floating-point operands.





Example — Incorrect

Equality comparison operator == is used in floating-point operands.



Rationale

Sub ID a:

- Due to the nature of the floating-point data type, as it contains an error, the result of the equivalence comparison operation may be false when it was expected to be true.

Verification

Model Advisor check: “Check usage of floating-point expressions in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0481, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Fixed-Point Data in Stateflow Charts” (Stateflow)
- “Relational Operations”

Introduced in R2020a

na_0001: Standard usage of Stateflow operators

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b1/b2/b3, c

MATLAB Versions

All

Rule

Sub ID a

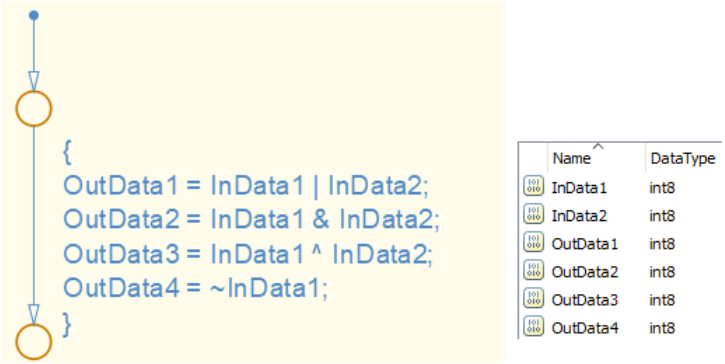
When Stateflow Chart property **Action Language** is set to C, operators (&, |, ^, ~) shall be used only for bit operations.

Custom Parameter

Not Applicable

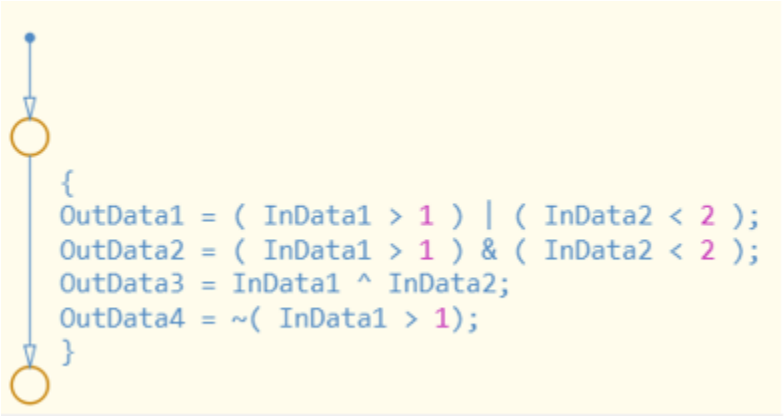
Example — Correct

Operators (&, |, ^, ~) are used for bit operations.



Example — Incorrect

Operators (&, |, ^, ~) are not used for bit operations.



Name	DataType
InData1	double
InData2	double
OutData1	boolean
OutData2	boolean
OutData3	double
OutData4	boolean

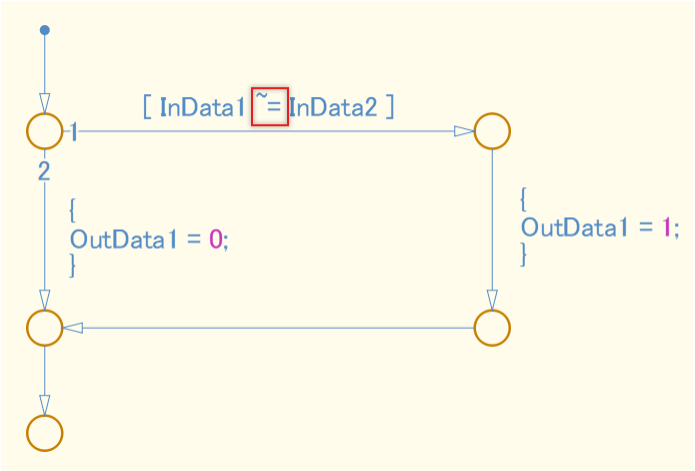
Sub ID b1

When Stateflow Chart property **Action Language** is set to C, operator ~= shall be used for inequality operations.

Custom Parameter

Not Applicable

Example — Correct



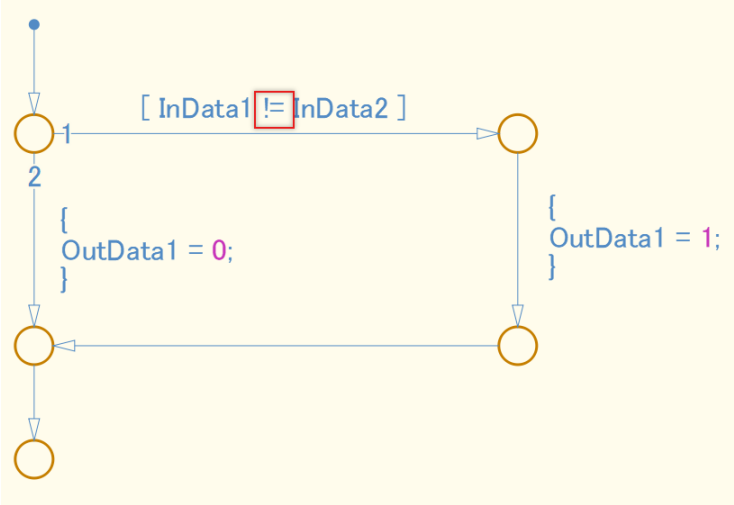
Sub ID b2

When Stateflow Chart property **Action Language** is set to C, operator != shall be used for inequality operations.

Custom Parameter

Not Applicable

Example — Correct



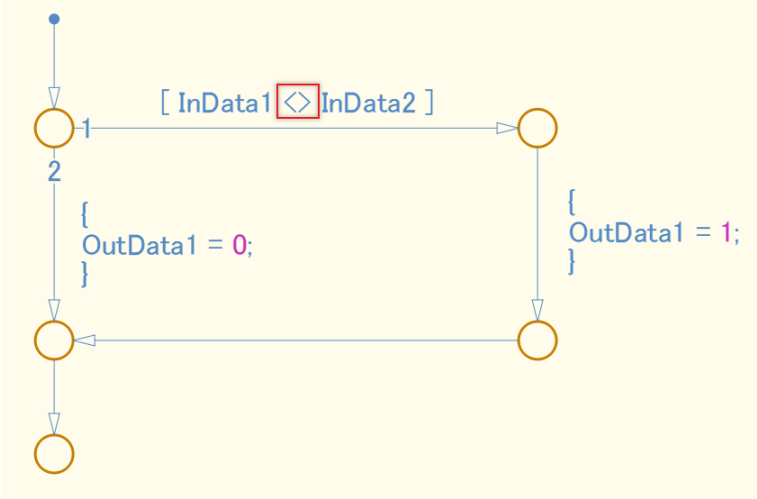
Sub ID b3

When Stateflow Chart property **Action Language** is set to `C`, operator `<>` shall be used for inequality operations.

Custom Parameter

Not Applicable

Example — Correct



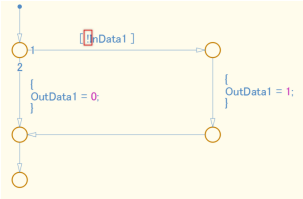
Sub ID c

When Stateflow Chart property **Action Language** is set to `C`, operation `!` shall be used for logical negation.

Custom Parameter

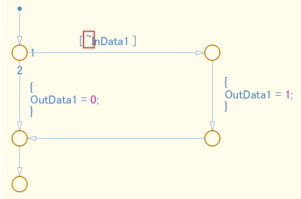
Not Applicable

Example — Correct



Example — Incorrect

An operator other than ! should be used for logical negation.



Rationale

Sub ID a:

- When either of these Stateflow Chart properties are set as follows:
  - **Action Language** is set to `MATLAB`
  - **Action Language** is set to `C` and **Enable C-Bit Operations** is selected

  && and &, || ,and |, have the same calculation function. However, when && and & or || and | are combined in the same chart, it can be difficult to determine whether these are separate calculation functions or the same calculation function.

Sub IDs b1, b2, b3:

- Consistent use of equality operators improves readability.

Sub ID c:

- Consistent use of logical negation operators improves readability.
- When **C-bit operations are enabled** is selected, the function of the ! operator remains the same and is not affected by logic changes that result from changing the setting.

Verification

Model Advisor check: “Check Stateflow operators” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0001, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Modify the Action Language for a Chart” (Stateflow)
- “Differences Between MATLAB and C as Action Language Syntax” (Stateflow)

Introduced in R2020a

jc_0655: Prohibition of logical value comparison in Stateflow

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

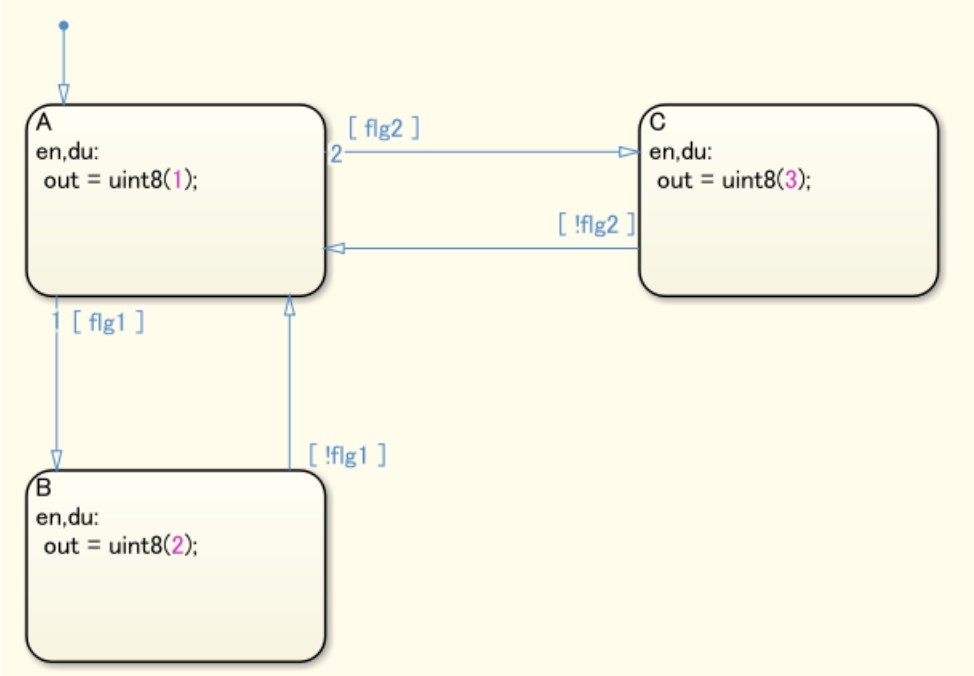
Logical constants shall not be compared to each other.

Custom Parameter

Not Applicable

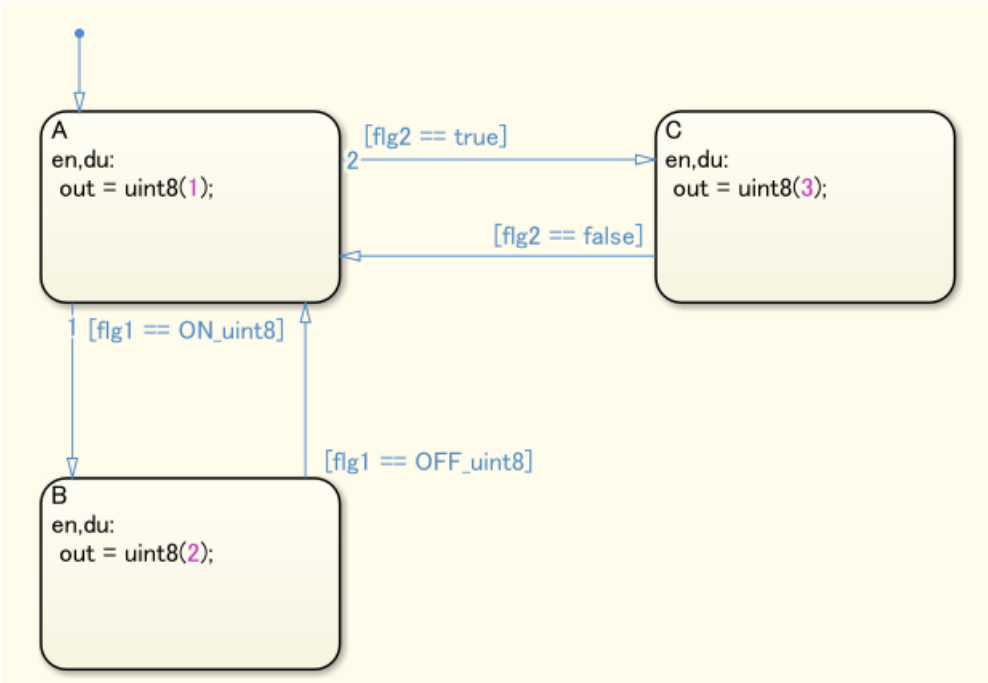
Example — Correct

Logical constants are not compared to each other.



Example — Incorrect

Logical constants are compared to each other.



Rationale

Sub ID a:

- Readability improves with consistent use of `boolean-valued signal==true(boolean type constant)` or `(boolean-valued signal)` for logical signal condition expressions.
- Prevents redundancy in the model.
- Deviation from the rule can cause unexpected issues.

Verification

Model Advisor check: “Check prohibited comparison operation of logical type signals” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0655, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0451: Use of unary minus on unsigned integers

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

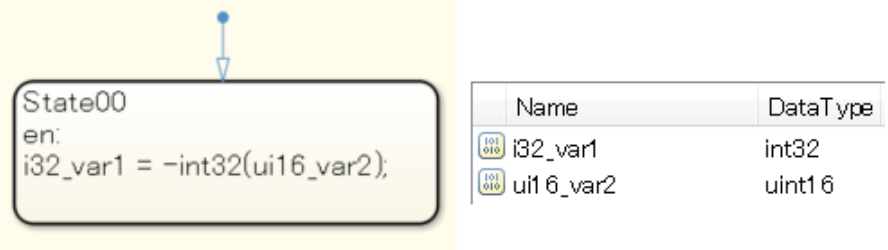
Sub ID a

Unary minus shall not be used on unsigned integers.

Custom Parameter

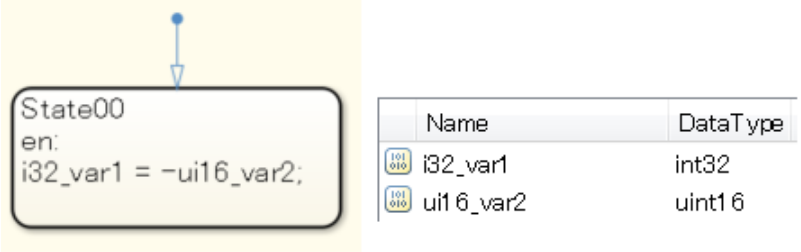
Not Applicable

Example — Correct



Example — Incorrect

Negative values cannot be input into 16-bit environments. (Negative values can be input into 32-bit environments.)



Rationale

Sub ID a:

- As the results are depend on the execution environment, unintended results can occur.

Verification

Model Advisor check: “Check usage of unary minus operations in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0451, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Data Types Supported by Simulink”
- “Unary Minus of Matrix Input”

Introduced in R2020a

jc_0802: Prohibited use of implicit type casting in Stateflow

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

All operations, including substitution, comparison, arithmetic, etc., shall be performed between variables of the same data type.

The data type of the actual arguments and the formal arguments in a function call shall be the same.

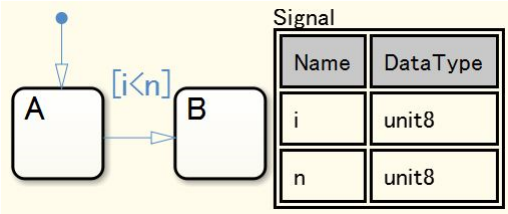
Custom Parameter

Not Applicable

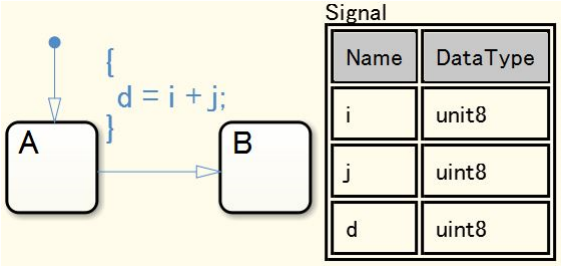
Example — Correct

Variables use the same data type for calculations.

Example: Comparison operation

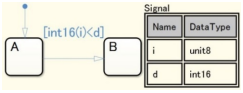


Example: Arithmetic operations and assignment operations (compound expressions)

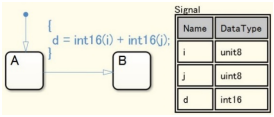


Variables have different data types but are explicitly typecast before calculation.

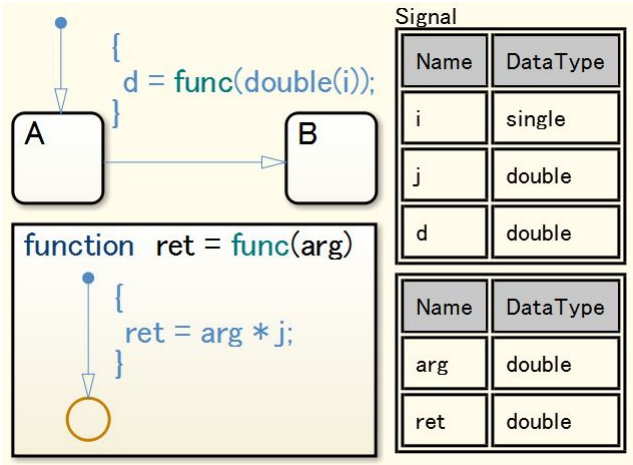
Example: Comparison operation



Example: Arithmetic operations and assignment operations (compound expressions)



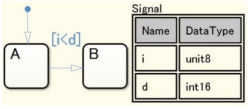
The data type of actual arguments and formal arguments in the function call are the same.



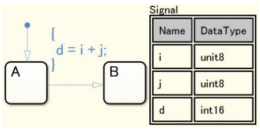
Example — Incorrect

Variables use different data types for calculations.

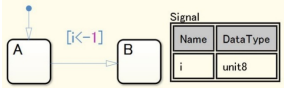
Example: Comparison operation



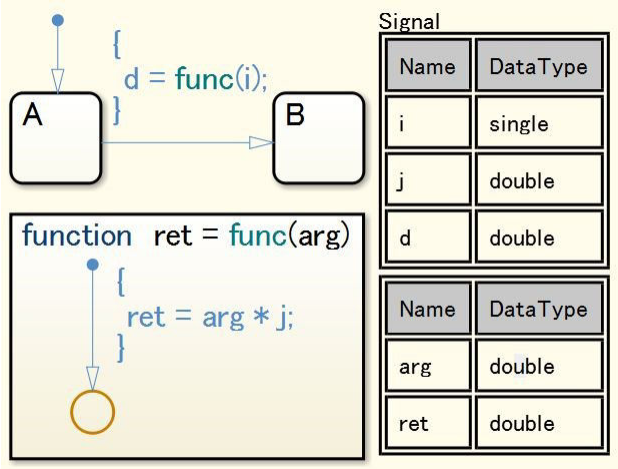
Example: Arithmetic operations and assignment operations (compound expressions)



Calculations are performed between unsigned integer type variables and signed integers.



The data type of actual arguments and formal arguments in the function call are different.



Rationale

Sub ID a:

- Implicit data type conversion can produce unexpected results.

Verification

Model Advisor check: “Check for implicit type casting in Stateflow” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0802, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Type Cast Operations” (Stateflow)
- “Differences Between MATLAB and C as Action Language Syntax” (Stateflow)

Introduced in R2020a

jc_0803: Passing values to library functions

Sub ID Recommendations

- NA-MAAB — a1/a2, b1/b2, c1/c2,
- JMAAB — a1/a2, b1/b2, c1/c2, d1/d2

MATLAB Versions

All

Rule

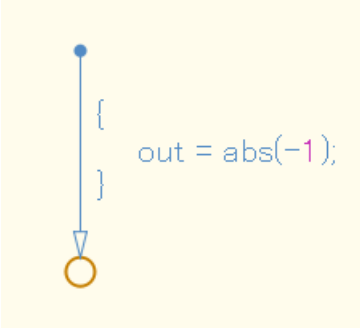
Sub ID a1

A minimum value for the signed integer type shall not be provided when using the `abs` library function.

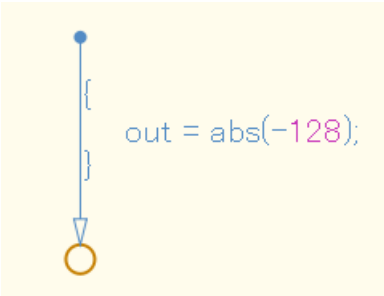
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID a2

The `abs` library function shall not be used.

Custom Parameter

Not Applicable

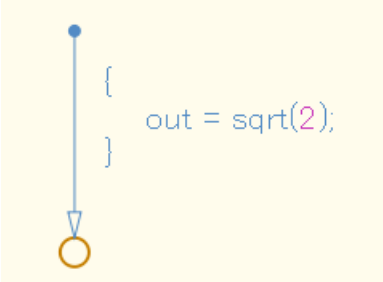
Sub ID b1

A negative number shall not be entered when using the `sqrt` library function.

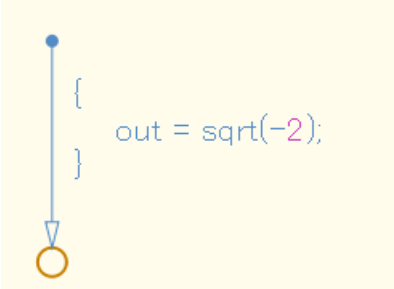
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID b2

The `sqrt` library function shall not be used.

Custom Parameter

Not Applicable

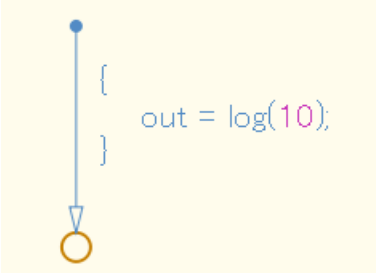
Sub ID c1

A negative number shall not be entered when using the `log` and `log10` library functions.

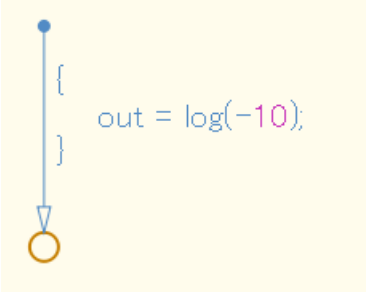
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID c2

The `log` and `log10` library functions shall not be used.

Custom Parameter

Not Applicable

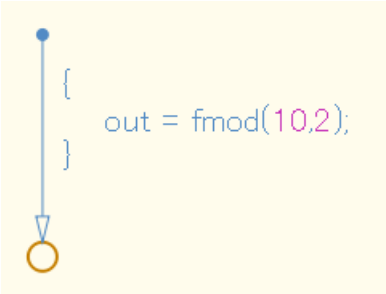
Sub ID d1

Zero shall not be entered for the second argument when using the `fmod` library function.

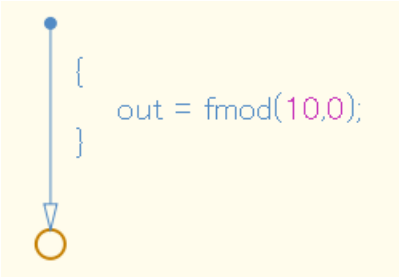
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Sub ID d2

The `fmod` library function shall not be used.

Custom Parameter

Not Applicable

Rationale

Sub IDs a1, b1, c1, d1

- The behavior of a library function when an invalid value has been passed is dependent on the processing system and may result in unintended behavior.

Sub IDs a2, b2, c2, d2

- To avoid duplicate modelling of the same guard process in Simulink and Stateflow, use Simulink to perform arithmetic operations

Verification

Model Advisor check: Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jc_0803, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Library Development” (Embedded Coder)

Introduced in R2020a

Label Description

jc_0732: Distinction between state names, data names, and event names

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

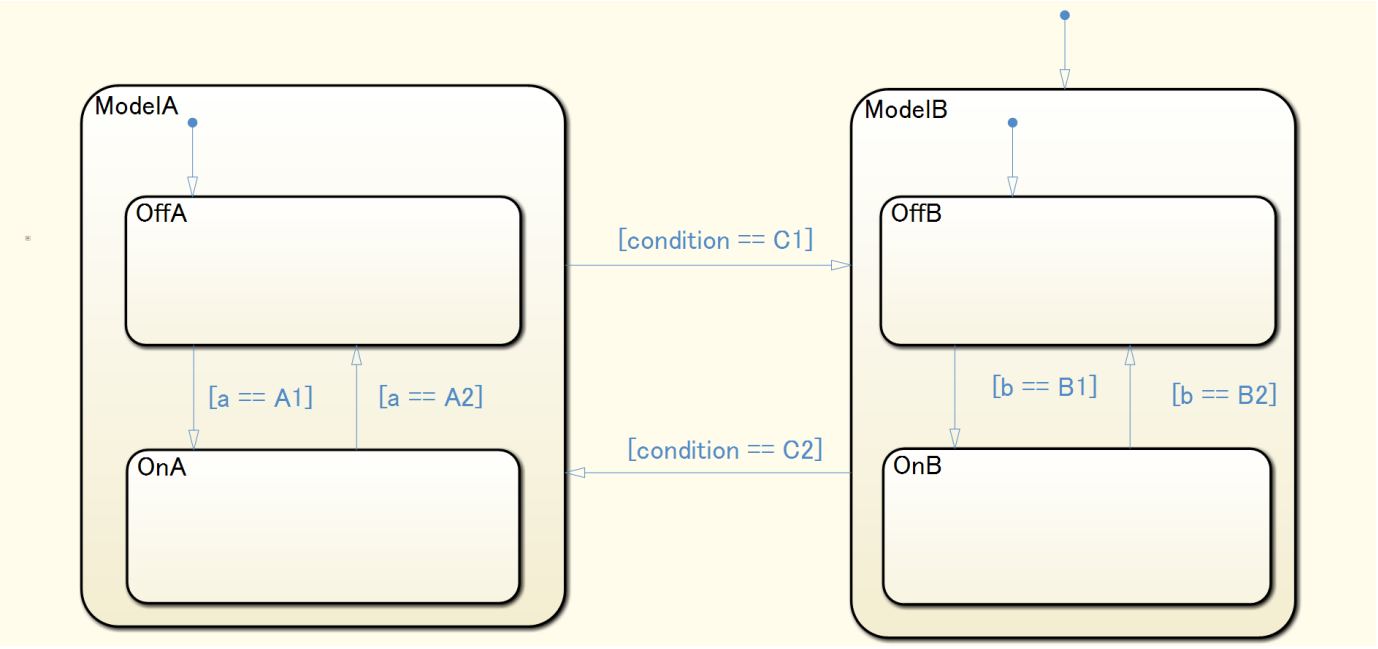
Sub ID a

An identical name shall not be used for states, data (inputs and outputs, local data, constants, parameters, data store memory), or event names in a single Stateflow Chart.

Custom Parameter

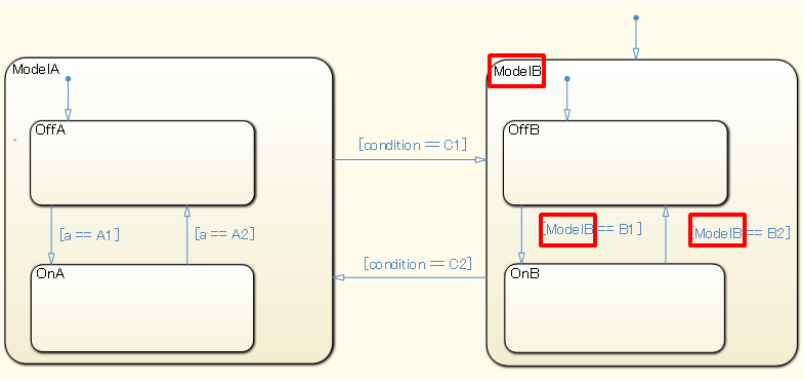
Not Applicable

Example — Correct



Example — Incorrect

Names are duplicated.



Rationale

Sub ID a:

- Using unique names prevent misunderstanding.

Verification

Model Advisor check: “Check uniqueness of Stateflow State and Data names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0732, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0730: Unique state name in Stateflow blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

State names in Stateflow Chart block shall be unique.

The content of linked atomic subcharts can be treated as another Stateflow Chart block.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Readability is impaired.
- Deviation from the rule can cause unintended code behavior.

Verification

Model Advisor check: “Check uniqueness of State names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0730, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)
- “Atomic Subcharts” (Stateflow)

Introduced in R2020a

jc_0731: State name format

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

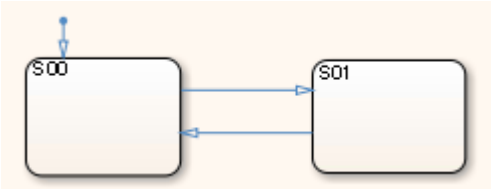
Sub ID a

The state name shall be followed by a new line that does not include a slash (/).

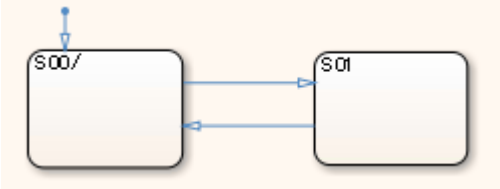
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Readability improves when state names are described consistently.

Verification

Model Advisor check: “Check usage of State names” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0731, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)

Introduced in R2020a

jc_0501: Format of entries in a State block

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

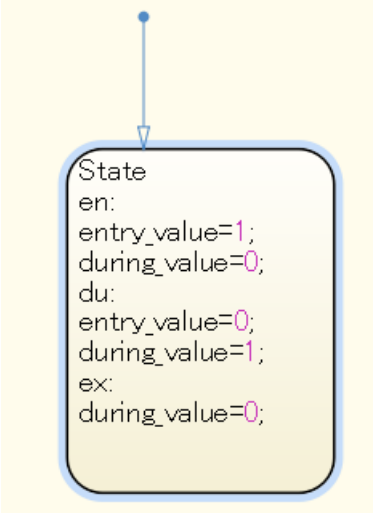
Sub ID a

A state action statement shall not be written on the same line as a state action type.

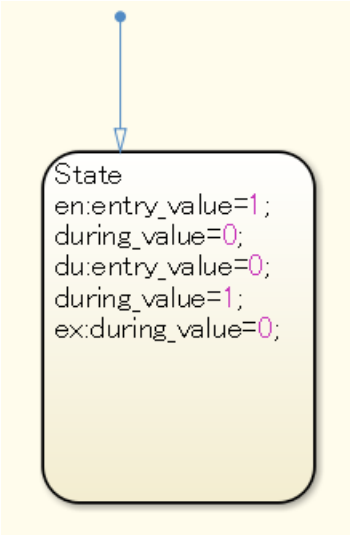
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Readability is impaired.

Verification

Model Advisor check: “Check entry formatting in State blocks in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0501, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Represent Operating Modes by Using States” (Stateflow)

Introduced in R2020a

jc_0736: Uniform indentations in Stateflow blocks

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a, b, c

MATLAB Versions

All

Rule

Sub ID a

State action types shall not have blank spaces at the start of a line.

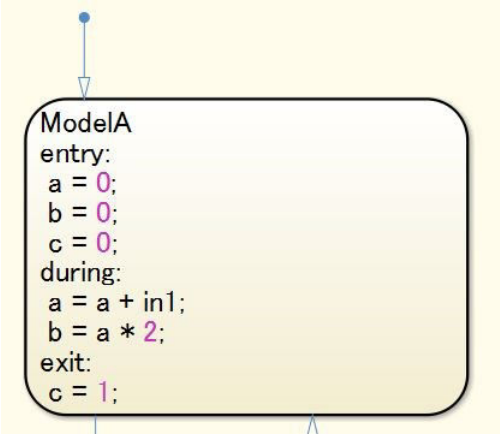
Executable statements shall have one single-byte space at the start of the line.

Custom Parameter

Number of single-byte spaces

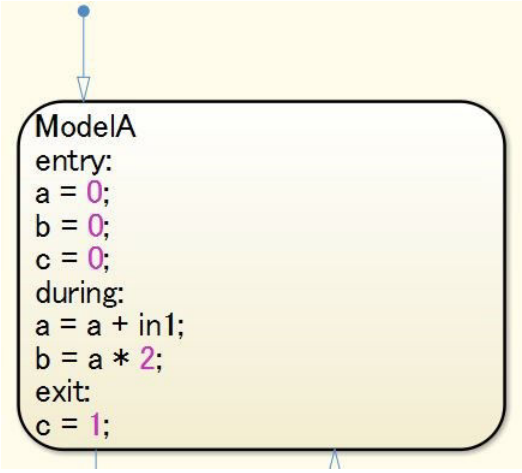
Example — Correct

Executable statements use one single-byte space at the start of the line.



Example — Incorrect

Executable statements do not have a single-byte space at the start of the line.



Sub ID b

A blank space shall not be entered before the following:

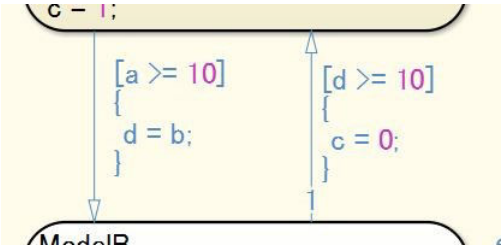
- [of a transition condition
- { of a condition action
- / of a transition action

Custom Parameter

Not Applicable

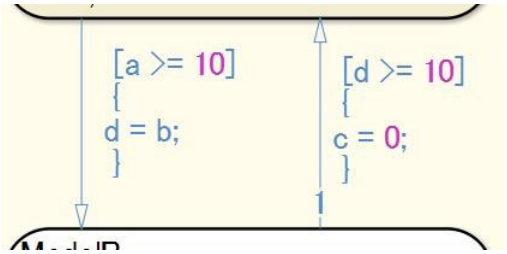
Example — Correct

A blank space is not entered before the [and { of the transition label condition, condition action, and transition action.



Example — Incorrect

A blank space is entered before the [and { of the transition label condition, condition action, and transition action.



Sub ID c

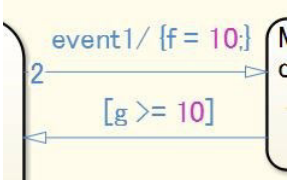
At least one single-byte space shall be entered after the / of a transition action.

Custom Parameter

Number of single-byte spaces

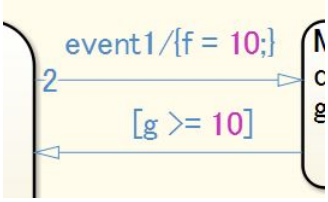
Example — Correct

Single-byte spaces are entered after the / of the transition action.



Example — Incorrect

There are no single-byte spaces after the / of the transition action.



Rationale

Sub ID a:

- Using uniform indents before the executable statement clarifies the link between the state action type of a state label and the execution statement, improving readability.

Sub ID b:

- Using uniform indents for transition conditions, condition actions, and transition actions improves readability.

Sub ID c:

- Consistent use of blank spaces improves readability.

Verification

Model Advisor check: “Check indentation of code in Stateflow states” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0736, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

jc_0739: Describing text inside states

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

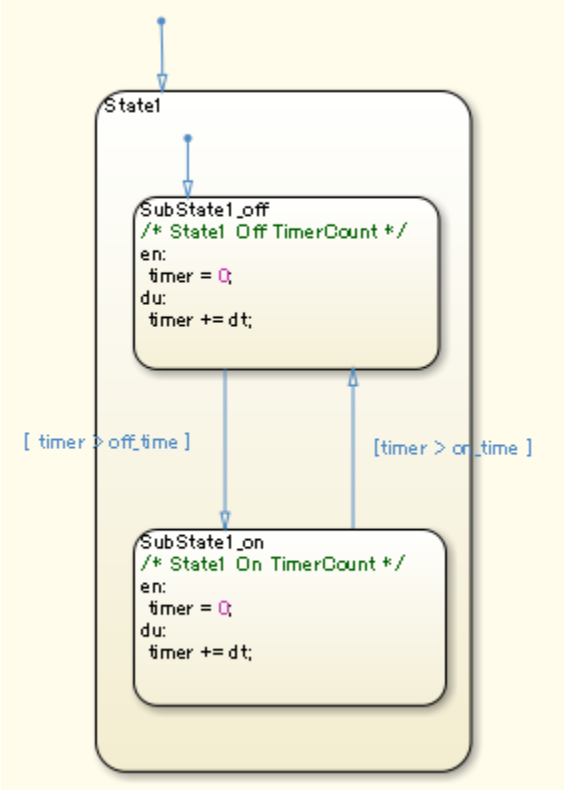
Sub ID a

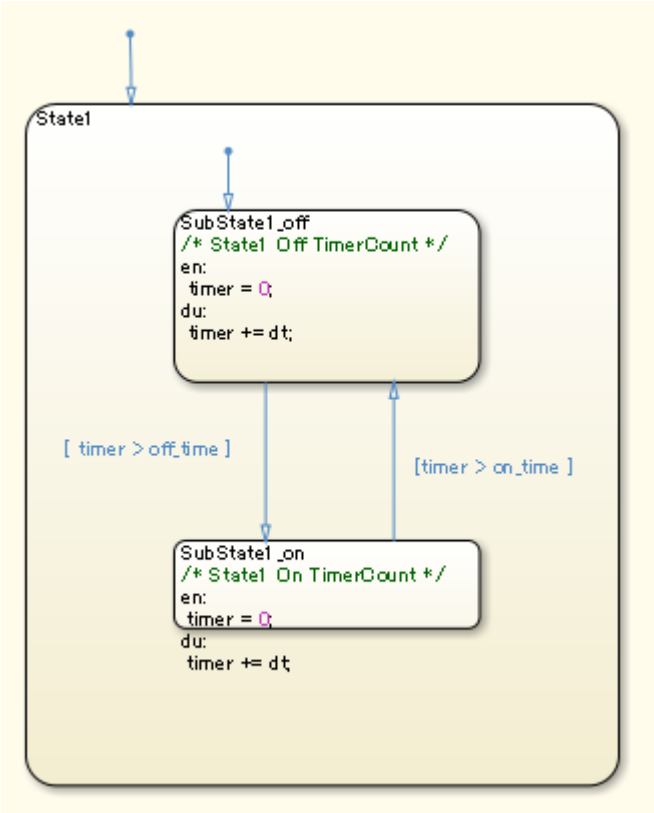
Text inside a state shall not extend beyond the boundaries of the state

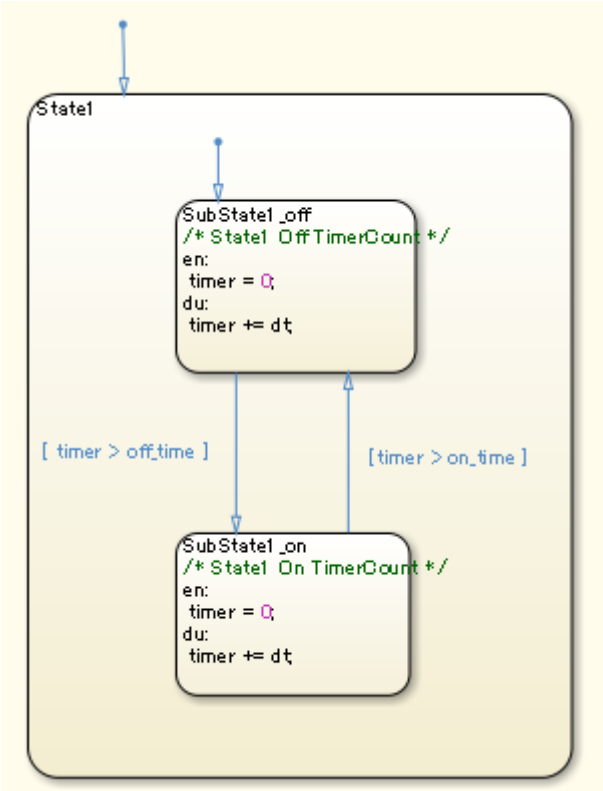
Custom Parameter

Not Applicable

Example — Incorrect




State1
SubState1_off
/* State1 Off TimerCount */
en:
timer = 0;
du:
timer += dt;
[timer > off_time]
[timer > on_time]
SubState1_on
/* State1 On TimerCount */
en:
timer = 0;
du:
timer += dt;


State1
SubState1_off
/* State1 Off TimerCount */
en:
timer = 0;
du:
timer += dt;
[timer > off_time]
[timer > on_time]
SubState1_on
/* State1 On TimerCount */
en:
timer = 0;
du:
timer += dt;

Rationale

Sub ID a:

- When the text inside a state extends beyond its boundaries, it can be difficult to determine which state the text belongs.

Verification

Model Advisor check: “Check for usage of text inside states” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0739, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.

Introduced in R2020a

jc_0770: Position of transition label

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

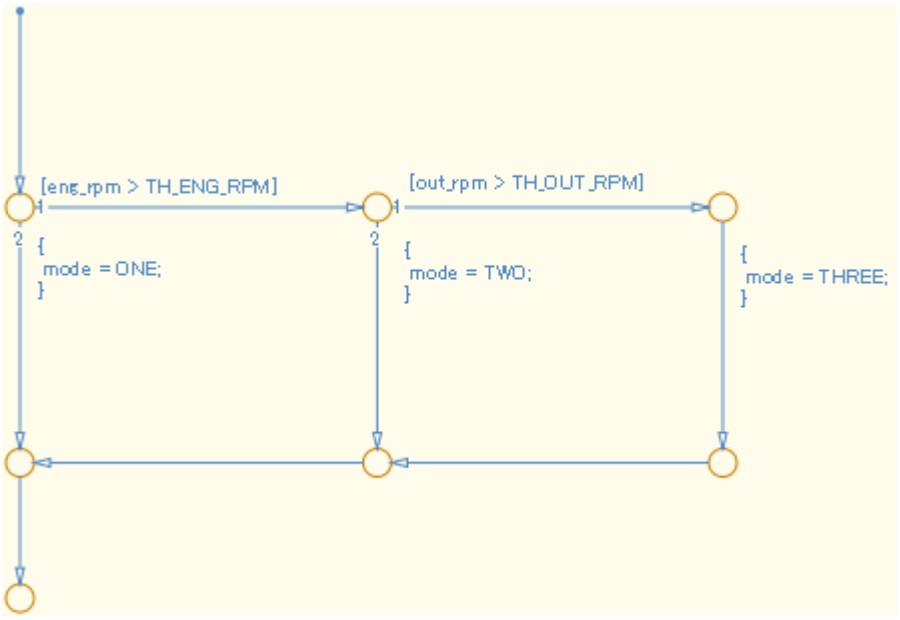
Transition labels are positioned at the transition line point of origin.

Custom Parameter

Not Applicable

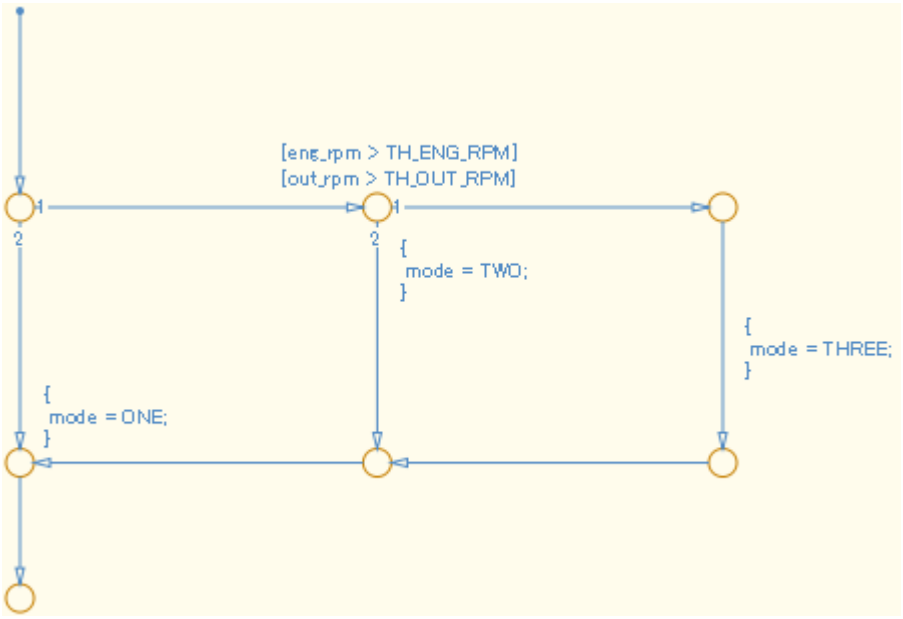
Example — Correct

Transition labels are positioned at the point of origin.



Example — Incorrect

The positioning of transition labels is inconsistent and do not correspond to the transition line.



Sub ID a2

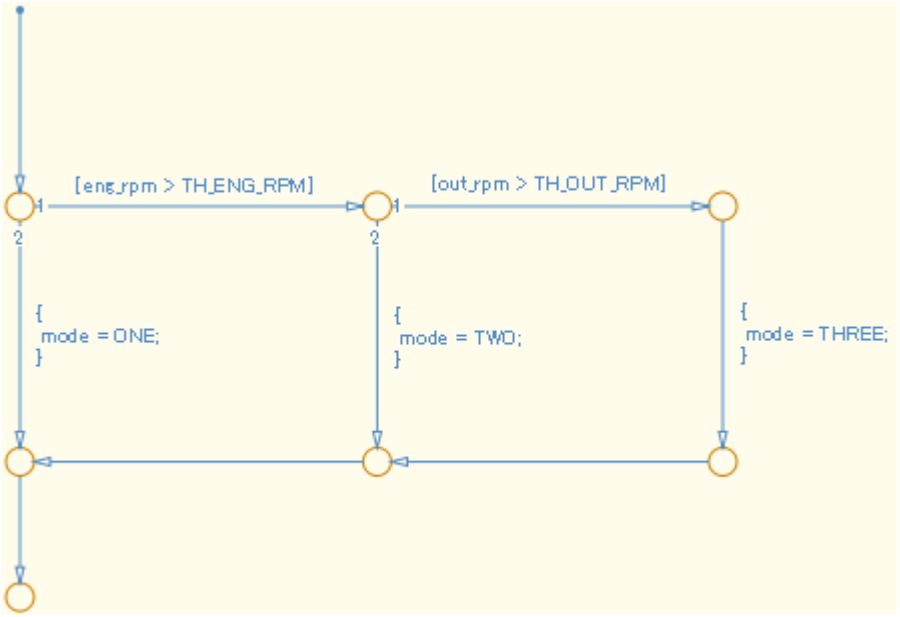
Transition labels are positioned near the center of the transition line.

Custom Parameter

Not Applicable

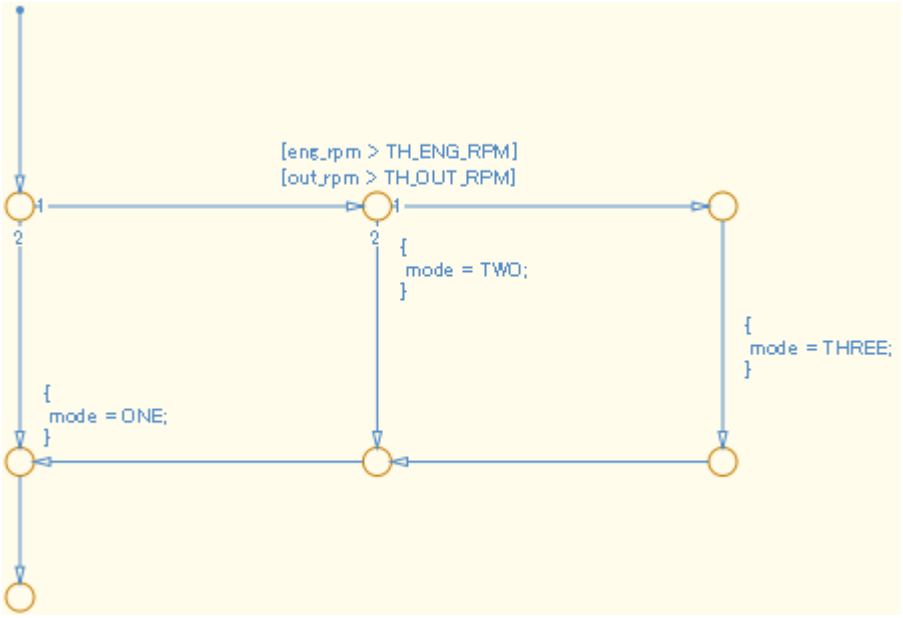
Example — Correct

Transition labels are positioned near the center of the transition line.



Example — Incorrect

The positioning of transition labels is inconsistent and do not correspond to the transition line.



Rationale

Sub IDs a1, a2:

- Consistent positioning of transition labels makes the correspondence between label and line easier to understand.

Verification

Model Advisor check: “Check placement of Label String in Transitions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0770, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

jc_0771: Comment position in transition labels

Sub ID Recommendations

- NA-MAAB — a1/a2
- JMAAB — a1/a2

MATLAB Versions

All

Rule

Sub ID a1

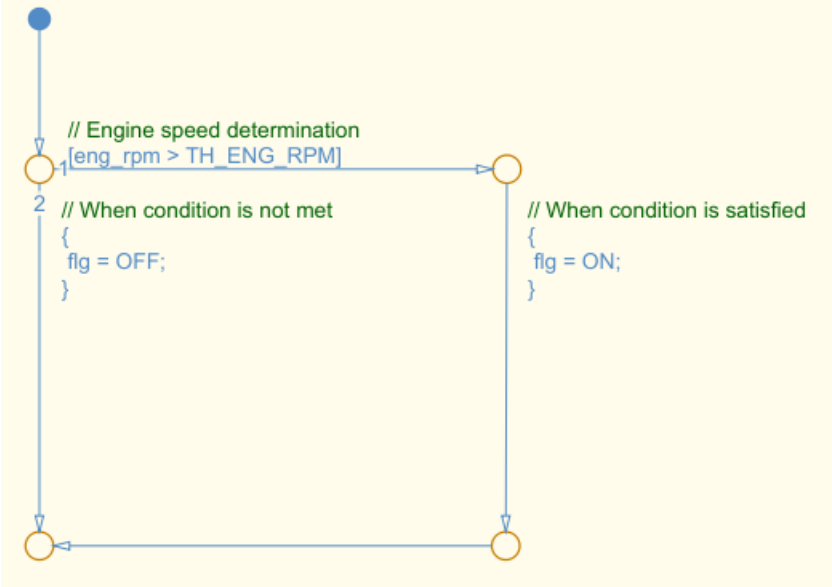
Comments in transition labels shall be positioned above transition conditions, condition actions, transition actions, and Stateflow events.

Custom Parameter

Not Applicable

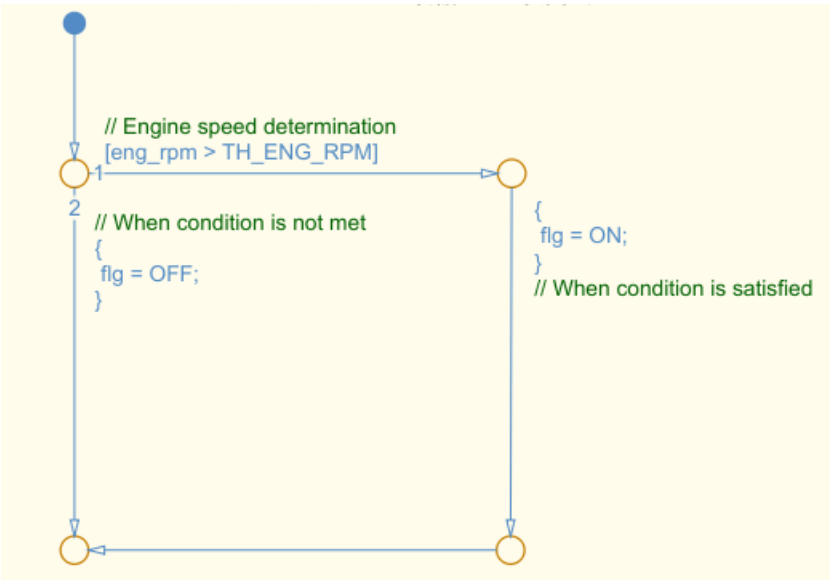
Example — Correct

The position of the comments in the transition label is uniform.



Example — Incorrect

The position of the comments in the transition label is inconsistent.



Sub ID a2

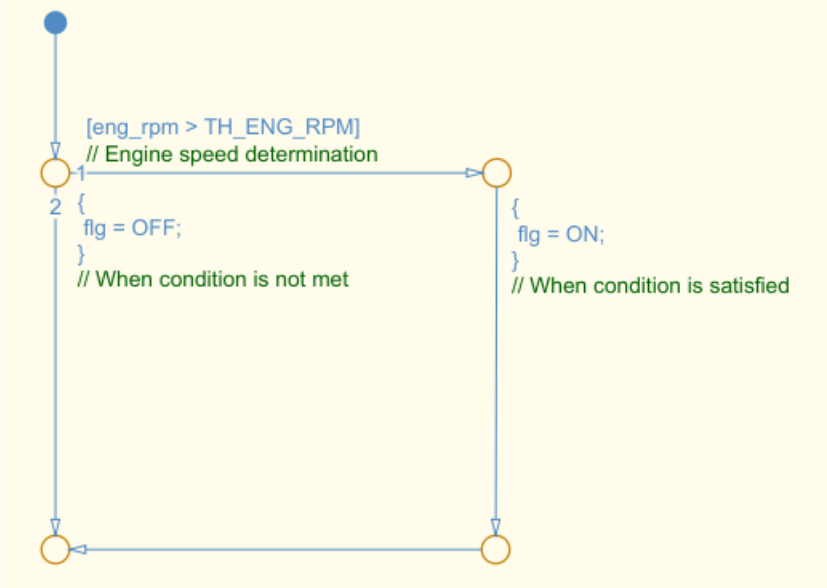
Comments in transition labels shall be positioned below transition conditions, condition actions, transition actions, and Stateflow events.

Custom Parameter

Not Applicable

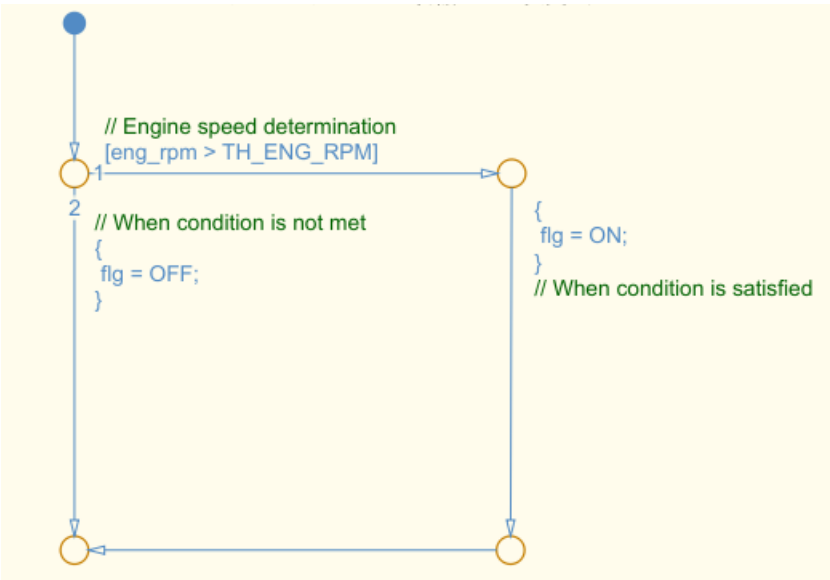
Example — Correct

The position of the comments in the transition label is uniform.



Example — Incorrect

The position of the comments in the transition label is inconsistent.



Rationale

Sub IDs a1, a2:

- Uniform positioning of comments in transition labels clarifies to which transition condition, condition action, transition action, or Stateflow event the label corresponds.

Verification

Model Advisor check: “Check position of comments in transition labels” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0771, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)
- “Add Descriptive Comments in a Chart” (Stateflow)

Introduced in R2020a

jc_0752: Condition action in transition label

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Parentheses in condition actions shall use only curly brackets on a single line.

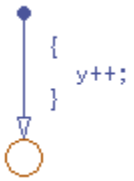
A new line shall start before and after curly brackets.

Custom Parameter

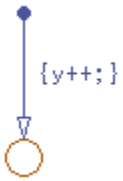
Not Applicable

Example — Correct

Note: The example is for a flow chart, but the rule also applies to state transitions.



Example — Incorrect



Rationale

Sub ID a:

- Clarifying condition actions improves readability.

Verification

Model Advisor check: “Check usage of parentheses in Stateflow transitions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0752, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

jc_0774: Comments for through transition

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

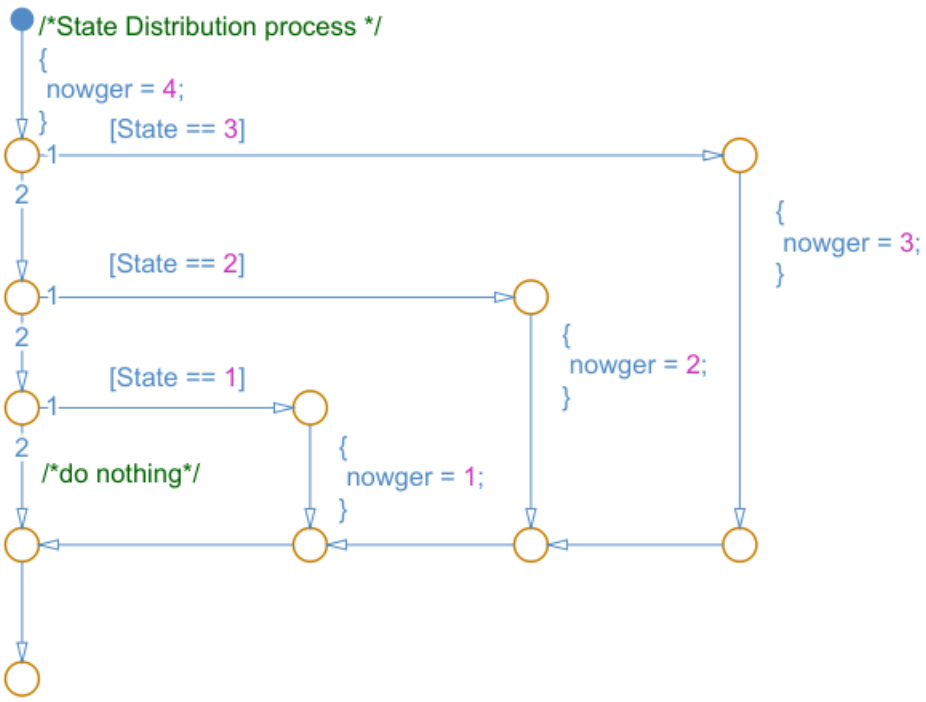
When there is no processing within an unconditional transition, a clarifying comment shall be written on the transition label.

Custom Parameter

Not Applicable

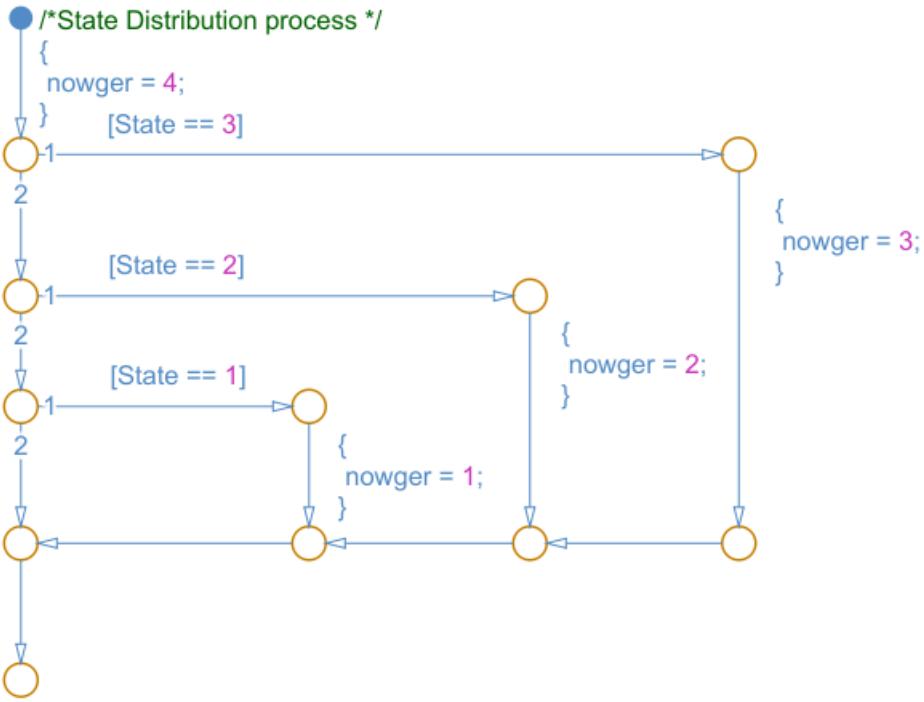
Example — Correct

The clarifying comment `/*do nothing*/` is provided.



Example — Incorrect

A clarifying comment is not provided on the condition path, so it is difficult to determine whether the lack of action is intentional.



Rationale

Sub ID a:

- Clarifies that the processing is deliberately excluded.
- The comment that is added to a transition label is also included in the generated code.

Verification

Model Advisor check: “Check for comments in unconditional transitions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0774, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Add Descriptive Comments in a Chart” (Stateflow)
- “Transition Between Operating Modes” (Stateflow)

Introduced in R2020a

Miscellaneous

jc_0511: Return values from a graphical function

Sub ID Recommendations

- NA-MAAB — No recommendations
- JMAAB — a

MATLAB Versions

All

Rule

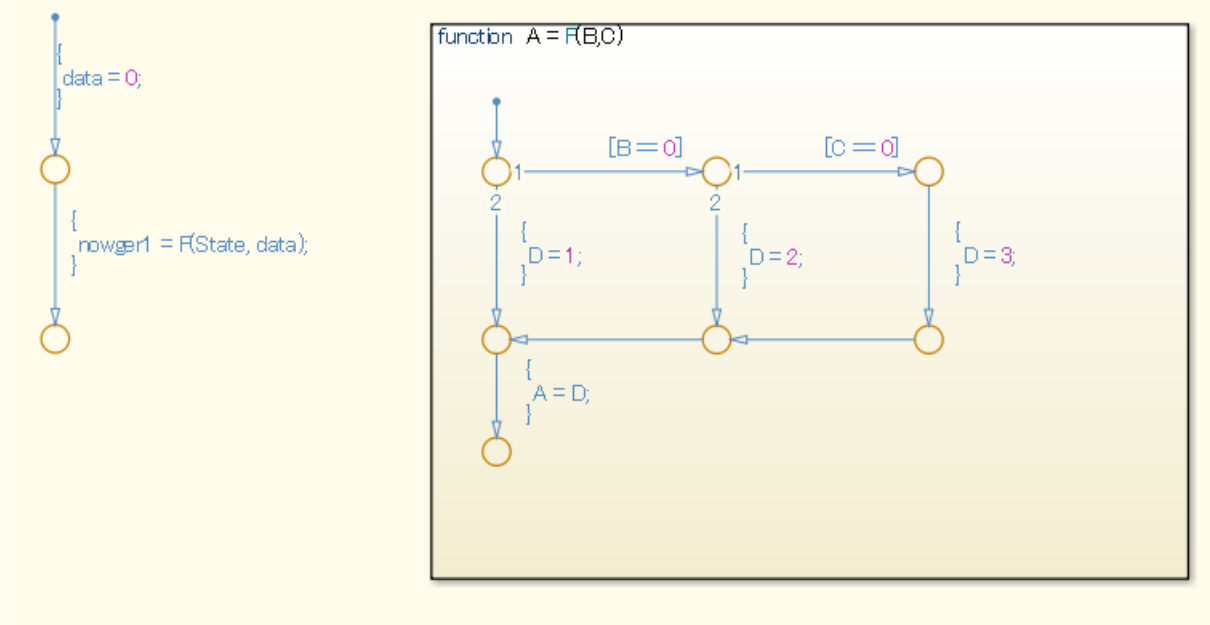
Sub ID a

The return value for graphical functions shall be set in one place only.

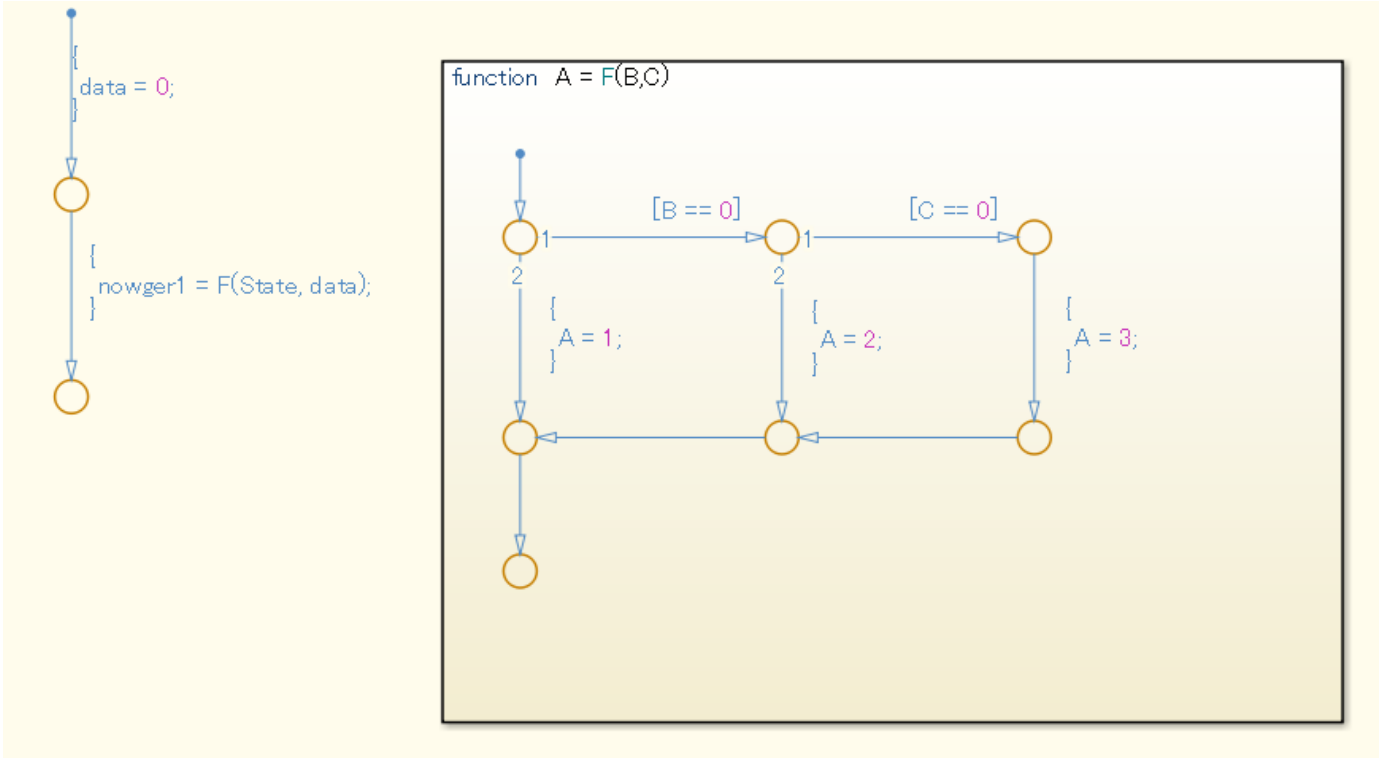
Custom Parameter

Not Applicable

Example — Correct



Example — Incorrect



Rationale

Sub ID a:

- Modifications to the output name is limited to prevent the changes from being missed or overlooked.

Verification

Model Advisor check: “Check return value assignments in Stateflow graphical functions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0511, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Create Flow Charts in Stateflow” (Stateflow)
- “Create Flow Charts by Using Pattern Wizard” (Stateflow)

Introduced in R2020a

jc_0804: Prohibited use of recursive calls with graphical functions

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

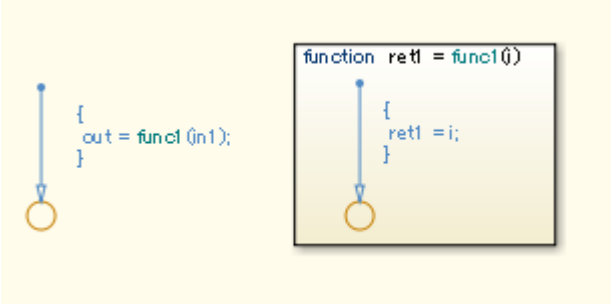
Calls from a graphical function to itself and calls between graphical functions shall be prohibited.

Custom Parameter

Not Applicable

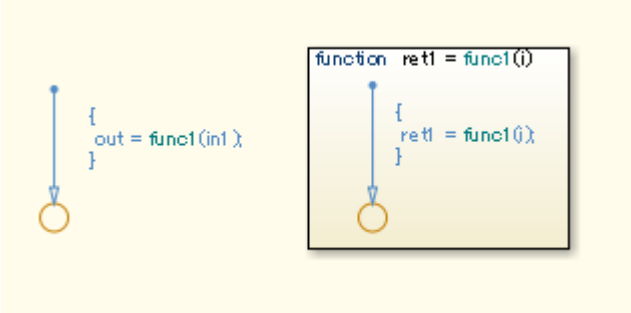
Example — Correct

Processing is performed within the graphical function.

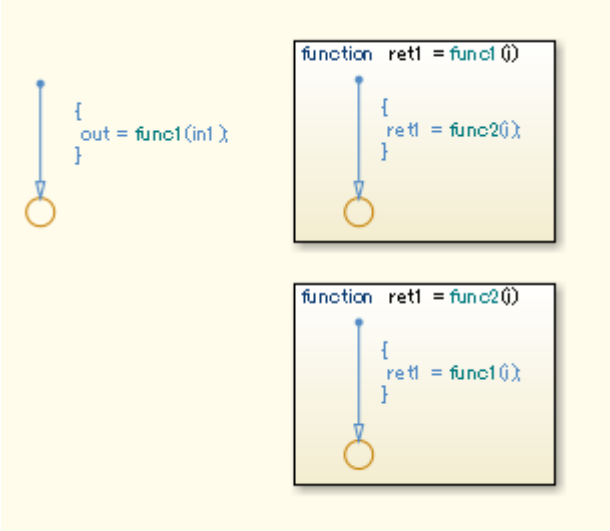


Example — Incorrect

The graphical function is calling itself.



Graphical functions are calling each other.



Rationale

Sub ID a:

- Readability decreases. Deviation from the rule can cause unintended overflows and infinite loops.

Verification

Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- JMAAB guideline jc_0804, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Reuse Logic Patterns by Defining Graphical Functions” (Stateflow)
- “How Stateflow Objects Interact During Execution” (Stateflow)

Introduced in R2020a

na_0042: Usage of Simulink functions

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

When using a Simulink Function block in a Stateflow Chart, one or more of the following conditions shall be met:

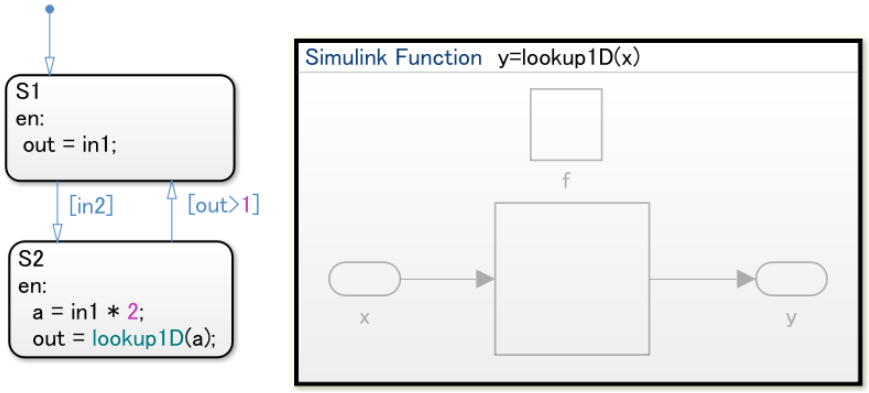
- Input/output variables shall use only local Stateflow Chart data in the Simulink Function block.
- Input/output variables shall use only local Stateflow Chart data and input data in the Simulink Function block.
- The Simulink Function block shall be called from multiple places in the Stateflow Chart.
- The Simulink Function block shall not be called at every time step.

Custom Parameter

Not Applicable

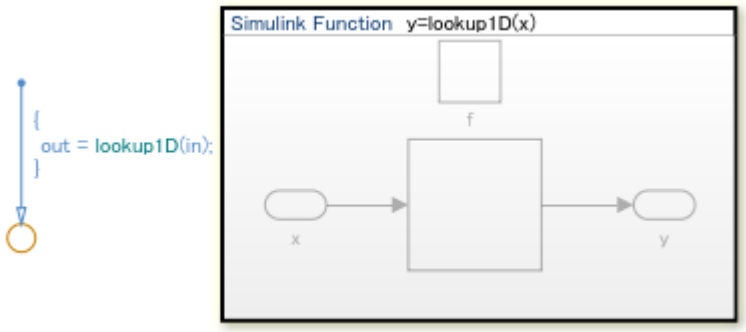
Example — Correct

The Simulink Function block lookup1D is not called from every time step and, therefore, can be used.



Example — Incorrect

The Simulink Function block lookup1D is called from every time step and, therefore, cannot be used (out is the Stateflow output data)



Rationale

Sub ID a:

- To improve model readability, the use of the Simulink Function block should be used with caution in charts.

Verification

Model Advisor check: “Check usage of Simulink function in Stateflow” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0042, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Simulink Functions Overview”
- “Add a Simulink Function to a Model”

Introduced in R2020a

na_0039: Limitation on Simulink functions in Chart blocks

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

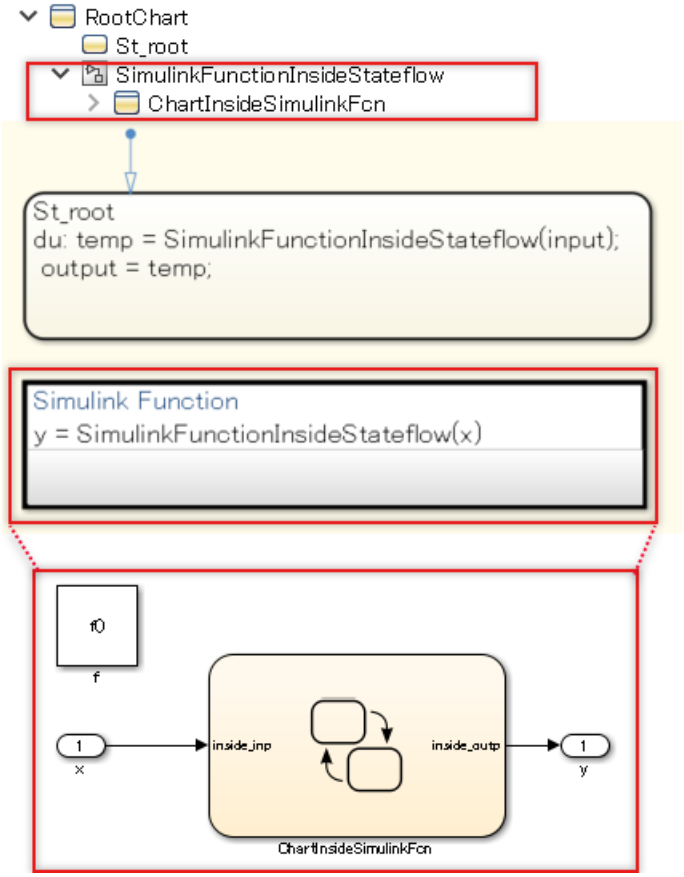
Sub ID a

Stateflow blocks shall not be used in Simulink Function blocks that are included in a Stateflow Chart.

Custom Parameter

Not Applicable

Example — Incorrect



Rationale

Sub ID a:

- Readability decreases and can result in design errors.

Verification

Model Advisor check: “Check use of Simulink in Stateflow charts” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0039, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Simulink Functions Overview”

- “Add a Simulink Function to a Model”

Introduced in R2020a

MATLAB

- “MATLAB Appearance” on page 5-2
- “MATLAB Data and Operations” on page 5-6
- “MATLAB Usage” on page 5-13

MATLAB Appearance

na_0025: MATLAB Function header

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

The MATLAB Function block shall have a descriptive header.

Information in the header can include, but is not limited to:

- Function name
- Description of function
- Assumptions and limitations
- Description of changes from previous versions
- Lists of inputs and outputs

Custom Parameter

Not Applicable

Example

```
%% Function Name: NA_0025_Example_Header
%
% Description: An example of a header file
%
% Assumptions: None
%
% Inputs:
%     List of input arguments
%
% $Revision: R2020a$
% $Author: MathWorks Advisory Board (MAB)$
% $Date: November 20, 2019$
%-------------------------------------------------------
```

Rationale

Sub ID a:

- Improves readability, model simulation, testability, and workflow.
- Code generation may not be possible.

Verification

Adherence to this modeling guideline cannot be verified by using a Model Advisor check.

Last Changed

R2020a

See Also

- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”

Introduced in R2020a

na_0018: Number of nested if/else and case statement

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

The number of nested levels in `if` /`else` and `case` statements shall be limited, typically to three levels.

Custom Parameter

Maximum nested levels

Rationale

Sub ID a:

- Improves readability
- Code generation may not be possible.

Verification

Model Advisor check: “Check nested conditions in MATLAB Functions” (Simulink Check)

Last Changed

R2020a

See Also

- “Loops and Conditional Statements”

Introduced in R2020a

MATLAB Data and Operations

na_0024: Shared data in MATLAB functions

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

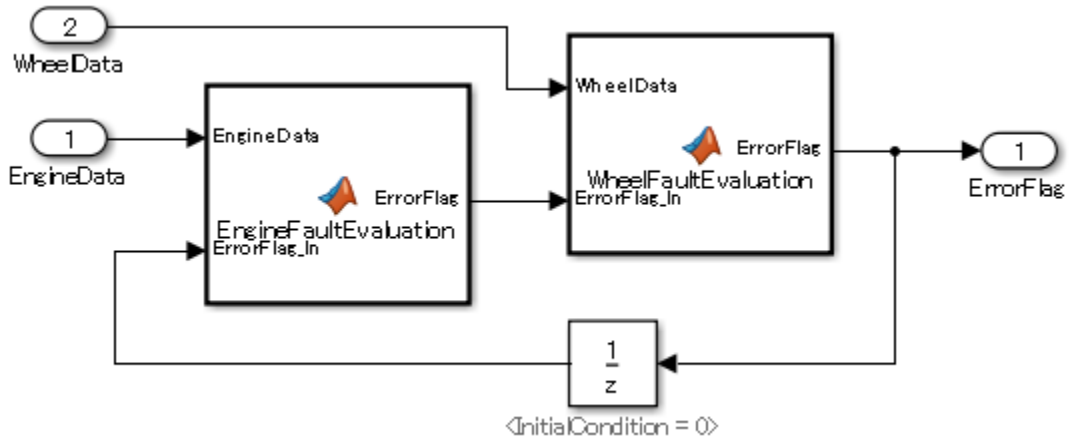
Sub ID a

Signal lines shall be used to connect data that is shared between MATLAB Function blocks.

Custom Parameter

Not Applicable

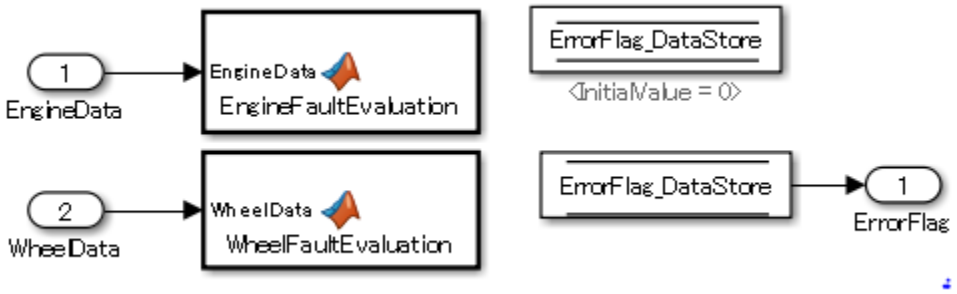
Example — Correct




```
function ErrorFlag = EngineFaultEvaluation(EngineData,ErrorFlag_In)
%#codegen
    RMP_HIGH = 10000;
    RMP_LOW = 10;
    HIGHRPMFAULT = 2^1;
    LOWRPMFAULT = 2^2;
    ErrorFlag = ErrorFlag_In;
    if EngineData > RPM_HIGH
        ErrorFlag = bitor(ErrorFlag,HIGHRPMFAULT);
    end
    if EngineData < RPM_LOW
        ErrorFlag = bitor(ErrorFlag,LOWRPMFAULT);
```

```
    end

function ErrorFlag = WheelFaultEvaluation(WheelData,ErrorFlag_In)
%#codegen
    SLIP_HIGH = 1000;
    WHEELSLIP = 2^3;
    ErrorFlag = ErrorFlag_In;
    if WheelData > SLIP_HIGH
        ErrorFlag = bitor(ErrorFlag,WHEELSLIP);
    end
end
```

Example — Incorrect




```
function EngineFaultEvaluation(EngineData)
%#codegen
    global ErrorFlag_DataStore
    RMP_HIGH = 10000;
    RMP_LOW = 10;
    HIGHRPMFAULT = 2^1;
    LOWRPMFAULT = 2^2;
    if EngineData > RPM_HIGH
        ErrorFlag_DataStore = bitor(ErrorFlag_DataStore,HIGHRPMFAULT);
    end
    if EngineData < RPM_LOW
        ErrorFlag_DataStore = bitor(ErrorFlag_DataStore,LOWRPMFAULT);
    end

function WheelFaultEvaluation(WheelData)
%#codegen
    global ErrorFlag_DataStore
    SLIP_HIGH = 1000;
    WHEELSLIP = 2^3;
    if WheelData > SLIP_HIGH
        ErrorFlag_DataStore = bitor(ErrorFlag_DataStore,WHEELSLIP);
    end
end
```

Rationale

Sub ID a:

- When a data store is used, the readability of the data flow decreases and can lead to errors in the update reference timing.

Verification

Model Advisor check: “Check MATLAB code for global variables” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0024, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”
- “Signal Lines”
- “Resolve Signal Objects for Output Variables”

Introduced in R2020a

na_0031: Definition of default enumerated value

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Method `getDefaultValue()` shall be used to explicitly define the default value of an enumeration.

Custom Parameter

Not Applicable

Example — Correct

See “Specify a Default Enumerated Value”

```
classdef BasicColors < Simulink.IntEnumType
  enumeration
    Red(0)
    Yellow(1)
    Blue(2)
  end
  methods (Static)
    function retVal = getDefaultValue()
      retVal = BasicColors.Blue;
    end
  end
end
```

Example — Incorrect

```
classdef(Enumeration) BasicColors < Simulink.IntEnumType
  enumeration
    Red(0)
    Yellow(1)
    Blue(2)
  end
end
```

Rationale

Sub ID a:

- When an enumerated type does not have a clearly defined a default value, the first enumeration string that is described will be defined as the default, which may not be as intended.

Verification

Model Advisor check: “Check usage of enumerated values” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0031, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Use Enumerated Data in Simulink Models”
- “Define Enumerated Data Types” (Stateflow)
- “Instantiate Enumerations”

Introduced in R2020a

na_0034: MATLAB Function block input/output settings

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

The data type in the model explorer shall be defined for input and output to the MATLAB Function block.

Custom Parameter

Not Applicable

Rationale

Sub ID a:

- Defining the data type for input and output to the MATLAB Function block helps prevent simulation errors and unexpected behavior.

Verification

Model Advisor check: “Check input and output settings of MATLAB Functions” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0034, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”

Introduced in R2020a

MATLAB Usage

na_0016: Source lines of MATLAB Functions

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

The length of MATLAB functions shall be limited. The recommended limit is 60 lines of code. Sub-functions can use an additional 60 lines of code.

This restriction applies to MATLAB functions that reside in the Simulink block diagram and external MATLAB files with a `.m` extension.

Custom Parameter

Maximum effective lines of code per function

Rationale

Sub ID a:

- Improves readability and workflow
- Code generation may not be possible.

Verification

Model Advisor check: “Check lines of code in MATLAB Functions” (Simulink Check)

Last Changed

R2020a

See Also

- “Program a MATLAB Function in a Chart” (Stateflow)
- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”

Introduced in R2020a

na_0017: Number of called function levels

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

The number of sub-function levels shall be limited, typically to three levels.

MATLAB Function blocks that reside in the Simulink block diagram level counts as the first level, unless it is simply a wrapper for an external MATLAB file with a `.m` extension. This includes functions that are defined within the block and those in separate `.m` files.

Exclusions

The following function types are excluded from the number of levels:

- Standard utility functions, such as built-in functions `sqrt` or `log`
- Commonly used custom utility functions

Custom Parameter

Maximum function call levels

Rationale

Sub ID a:

- Improves readability and testability

Verification

Model Advisor check: “Check the number of function calls in MATLAB Function blocks” (Simulink Check)

Last Changed

R2020a

See Also

- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”
- “Program a MATLAB Function in a Chart” (Stateflow)
- “Exponents and Logarithms”

Introduced in R2020a

na_0021: Strings in MATLAB functions

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

Assignment statements for strings shall not be used in MATLAB functions.

Custom Parameter

Not Applicable

Example — Incorrect

An assignment statement for strings is being used in the MATLAB function.

```
function y = fcn(u)
%#codegen

str = 'A';

    for i = 1:u
        str = [str 'B'];
    end

    if strcmp(str, 'ABB')
        y = int16(1);
    else
        y = int16(0);
    end
end
```

Rationale

Sub ID a:

- MATLAB functions store strings as character arrays. As a result, storing strings of different lengths in the same variable does not support dynamic memory allocation, which prevents the strings from being stored.

  Consider using enumerated types when a string is used in a Switch Case block

Verification

Model Advisor check: “Check usage of character vector inside MATLAB Function block” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline na_0021, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Implement MATLAB Functions in Simulink with MATLAB Function Blocks”
- “Program a MATLAB Function in a Chart” (Stateflow)

Introduced in R2020a

na_0022: Recommended patterns for Switch/Case statements

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — Not supported

MATLAB Versions

All

Rule

Sub ID a

`Switch`/`Case` statements shall use constant values for `Case` arguments.

Input variables shall not be used in `Case` arguments.

Custom Parameter

Not Applicable

Example — Correct

```
function outVar = NA_0022_Pass(SwitchVar)
%#codegen
    switch SwitchVar
        case Case_1_Parameter % Parameter
            outVar = 0;
        case NA_0022.Case_2 % Enumerated Data Type
            outVar = 2;
        otherwise
            outVar = 10;
    end
end
```

Example — Incorrect

```
function outVar = NA_0022_Fail(Case_1,Case_2,Case_3,SwitchVar)
%#codegen
    switch SwitchVar
        case Case_1
            outVar = 1;
        case Case_2
            outVar = 2;
        case Case_3
            outVar = 3;
        otherwise
            outVar = 10;
```

```
    end
end
```

Rationale

Sub ID a:

- Improves model simulation and testability.
- Code generation may not be possible.

Verification

Model Advisor check: “Check usage of recommended patterns for Switch/Case statements” (Simulink Check)

Last Changed

R2020a

See Also

- “Loops and Conditional Statements”

Introduced in R2020a

jc_0801: Prohibited use of the /* and */ comment symbols

Sub ID Recommendations

- NA-MAAB — a
- JMAAB — a

MATLAB Versions

All

Rule

Sub ID a

As comment symbols `/*` and `*/` are automatically assigned in the generated code, the symbol shall not be used in:

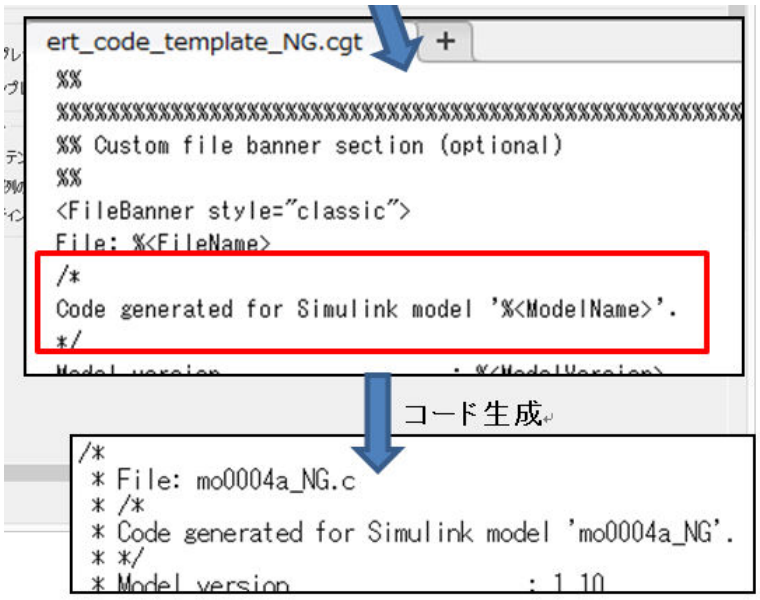
- Code Generate Templates (`.cgt`) files
- `mpt.Signal` description
- `mpt.Parameter` description

Custom Parameter

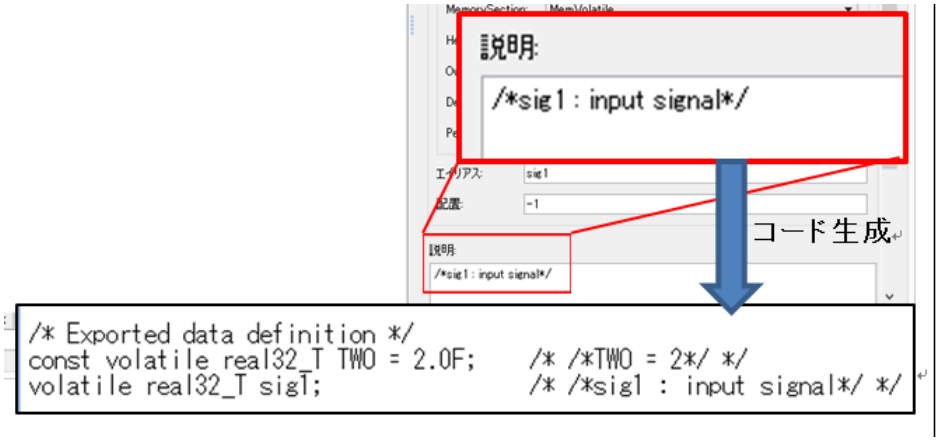
Not Applicable

Example — Incorrect

Included in a `.cgt` file.



Included in the `mpt.Signal` description.



Rationale

Sub ID a:

- Since comment symbols `/*` and `*/` are automatically assigned in the generated code, comments can be unintentionally nested and behave differently than expected.

Verification

Model Advisor check: “Check for use of C-style comment symbols” (Simulink Check)

Last Changed

R2020a

See Also

- JMAAB guideline jc_0801, which is available in *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow* on the MathWorks website.
- “Code Generation Template (CGT) Files” (Embedded Coder)
- “MPT Data Object Properties” (Embedded Coder)
- “Specify Comment Style for C/C++ Code” (Embedded Coder)
- “Add Custom Comments for Variables in the Generated Code” (Embedded Coder)

Introduced in R2020a

Considerations

- “Considerations for Determining Guideline Operation Rules” on page 6-2
- “Considerations for Applying Guidelines to a Project” on page 6-5

Considerations for Determining Guideline Operation Rules

Prior to selecting the modeling guidelines to adopt for your project, it is important that you consider various aspects of your project and models, such as:

- “Process Definition and Development Environment” on page 6-2
- “MATLAB and Simulink Versions” on page 6-2
- “MATLAB and Simulink Settings” on page 6-2
- “Usable Blocks” on page 6-3
- “Using Optimization and Configuration Parameters” on page 6-3

Process Definition and Development Environment

The model base development that utilizes simulation is suitable for developing a safe product. However, this does not mean that a system is safe simply because the design can be simulated. While high quality control and functions is necessary, the process definition and development environment being used is equally important. The foundation for a safe system is determined at the start of the project, long before development begins.

MATLAB and Simulink Versions

The version of MATLAB and Simulink that is used at each development stage is determined at the start of the project. That version must be used by everyone during that development stage.

Different MATLAB versions can be used for different stages in the development process. For example, you can generate and verify the code in R2017b and then use Simulink Design Verifier™ to develop test cases R2020a.

It is necessary to regularly check the bug report published by MathWorks, which are available on the MathWorks website at https://www.mathworks.com/support/bugreports. Depending on the bug, a version change may be required; a decision that can be reversed if necessary. During this evaluation, it is important to consider risk from both:

- Malfunctions that result from a bug
- Result from upgrading the version

It is necessary to always have a process that allows adaptation to the latest version and to appropriately evaluate and judge what is the safest option.

MATLAB and Simulink Settings

MATLAB and Simulink settings shall adhere to the project. It is important that Simulink settings that affect appearance are applied consistently across the project.

Options to be unified include:

- Simulink environment settings:
  - New model standard font settings (block, line, annotation)
- Mask (Edit mask):

    - Icons and Ports
- Information display:
    - Library links
    - Sample Time
    - (Block) Sorted execution order
    - (Signals and ports) Wide Non-scalar Lines
    - (Signals and ports) Port data types

See guidelines:

- na_0004: Simulink model appearance settings
- db_0043: Model font and font size

Usable Blocks

There are many blocks in Simulink, however, not all are suitable for all aspects of a project. For example, only some blocks are suitable for generating production-quality code. Or, depending on the block, a function using a combination of basic blocks can be represented by using one block. Usable blocks and design should be defined and limited to the requirements and specifications of the project.

Significantly limiting the number of available blocks can cause adverse effects, such decreased readability due to variation within the descriptions for the same function, decreased code efficiency, and increased user libraries.

You must register custom blocks in the project's user library.

See guideline db_0143: Usable block types in model hierarchy for defining usable blocks

Using Optimization and Configuration Parameters

It is important to consider how you are using optimization options and configuration parameters for your project.

Optimization Parameters

Optimization options significantly affect generated code. Closely evaluate and apply the optimization options with regards to how they impact the security and safety considerations for your project or product.

As an example of how optimization parameters can impact a process:

For embedded automotive products, it is critical that processing time is fast and RAM/ROM requirement are minimal. To accommodate these requirements, optimization parameters are applied on the **Conditional Input Branch Execution** pane. These optimization parameters improve the computation rate by executing only where the condition holds during execution of the conditional branch by using the Switch block.

In contrast, for the aviation industry, the **Conditional Input Branch Execution** pane is disabled because stabilizing the execution speed is key. Calculation on both sides is preferred in order to maintain a stable computation time, even if calculation is needed only on the side where the condition holds.

Configuration Parameters

Consider these configuration parameters:

Hardware Implementation Settings

Describes model system hardware characteristics, including products and test hardware configuration setup for simulation and code generation. Configure these parameters so they are compatible with the microcomputer that the project uses. Unintended utility functions can be inserted if signed integer division rounding is undefined.

Model Reference Settings

Specified when using model references. Refers to options to include other models in this model, options to include this model in another model, and build options of simulation and code generation targets.

Simulation Target Setting

Configures a simulation target of a model with MATLAB Function, Stateflow Chart (Stateflow), or Truth Table (Stateflow) blocks.

High-Integrity Configuration Settings

For additional information about the high-integrity configuration settings, see “Configuration Parameter Considerations” in the “High-Integrity System Modeling” guidelines.

Code Generation Configuration Settings

For additional information the about the code generation configuration settings, see the “Code Generation” modeling guidelines.

Considerations for Applying Guidelines to a Project

It is important that you consider the following when applying modeling guidelines to a project:

- “Using the Model Analysis Process When Applying Guidelines” on page 6-5
- “Adoption of the Guideline Rule and Process Settings” on page 6-5
- “Setting the Guideline Rule Application Field and the Clarifying the Exclusion Condition” on page 6-5
- “Parameter Recommendations in the Guidelines” on page 6-6
- “Verifying Adherence to the Guidelines” on page 6-6
- “Modifying Adherence to the Guidelines” on page 6-6

Using the Model Analysis Process When Applying Guidelines

Model design specification should be defined prior to reviewing the guidelines. Doing so makes the process of determining which guidelines to apply and the implementation of the guidelines more efficient.

For example, the analysis of a simple model can use function `sldiagnostics` to investigate how often a specific block is used. Adjust the operation rules list by specifying blocks that are frequently used and those that are not.

Furthermore, reusability at a later stage is improved by adding rules that:

- Unify description styles
- Anticipate in advance the man-hours needed to correct models
- Measuring tendencies, such as where to place blocks that have feedback status variables (Unit Delay block), whether the Unit Delay block should be inside or outside the subsystem, or whether the Abs block should be set on the output side of the subsystem, and if it should process at the input side after receiving a signal.

Adoption of the Guideline Rule and Process Settings

At the start of the project, it should be determined which guidelines apply to each development process. The guidelines should be evaluated and applied so that they correspond with the development process. Considerations may include questions such as:

- • Will the guideline be applied only at the code generation stage?
  - Will the adopted guideline rule change for each process stage?

Setting the Guideline Rule Application Field and the Clarifying the Exclusion Condition

The field to which the guidelines apply must be determined. For example, guidelines can be:

- Limited to a model that represents the AUTOSAR field of application
- Applied to a general software field, such as where models implement interrupts (add processes that prohibit interruption during calculation).

- Specific to fields where general engineers edit the models. The intention of these rules is to ensure that the models are easily understandable in those fields.

  Note Specialized fields can be excluded from the constraints of these guidelines by limiting the scope and applying unique set of guidelines that are specific in this environment.

Specialized fields, such as those where modelers design custom library blocks, are not typically targeted by these guidelines.

Furthermore, when having a control model that is operated with Rapid Control Prototyping (RCP) , the entire model should not be set as a target; instead, the field needs to be limited. It is necessary to generate the code and review the areas that are implemented in the built-in microcomputer as well as the areas that are not. These guidelines do not apply to control models such as those scheduler models that are made solely for RCP and are not implemented, or for interface sections with blocks that correspond to drivers such as CAN and PWM signals for operating actual machines.

Parameter Recommendations in the Guidelines

Guidelines should not be adopted as they are written without further evaluation.

Implementation of guideline rules and parameter recommendations should be evaluated to determine the impact on the project and the development processes being used. In addition, consideration needs to be taken as to the effect on other guidelines and how applying custom parameters can affect simulation or code generation.

Verifying Adherence to the Guidelines

At the beginning of a project, it is important to determine how and when the project will be evaluated to ensure adherence to the guidelines.

The decision whether to use an automated checking mechanism (third part or internal) or perform manual checks is very important. Also, the stage at which the checks occur, as well as developing a system for revising the check rule criteria, is important.

Automated checking can significantly reduce the time required for review. It is recommended that an additional, manual review also be performed by a skilled person, even if everything can be checked automatically.

Modifying Adherence to the Guidelines

The decision to apply a guideline or a rule can change. When doing so, it is important to specify a process and procedure for determine the root cause of the request and evaluate the potential impact the change can have on the project and the organization.

When evaluating the change request, first listen to the needs of the modeler and determine the root cause of the request. When the request is based on the user not understanding block usage or a guideline rule, training should occur instead of revising the rule.

The procedure to relax the rules as needed should be implemented when there are restrictions due to company objectives and control specifications or hardware (such as microcomputers).

A

Using Simulink and Stateflow

Understanding Model Architecture

When evaluating the modeling guidelines for your project, it is important that you understand the architecture of your controller model, such the function/subfunction layers, schedule layer, control flow layer, section layer, and data flow layer.

Hierarchical Structure of a Controller Model

This section provides a high-level overview of the hierarchical structuring in a basic model, using a controller model as an example. This table defines the layer concepts in a hierarchy.

	Layer concept	**Layer purpose**
Top Layer	Function layer	Broad functional division
	Schedule layer	Expression of execution timing (sampling, order)
Bottom Layer	Sub function layer	Detailed function division
	Control flow layer	Division according to processing order (input → judgment → output, etc.)
	Selection layer	Division (select output with Merge) into a format that switches and activates the active subsystem
	Data flow layer	Layer that performs one calculation that cannot be divided

When applying layer concepts:

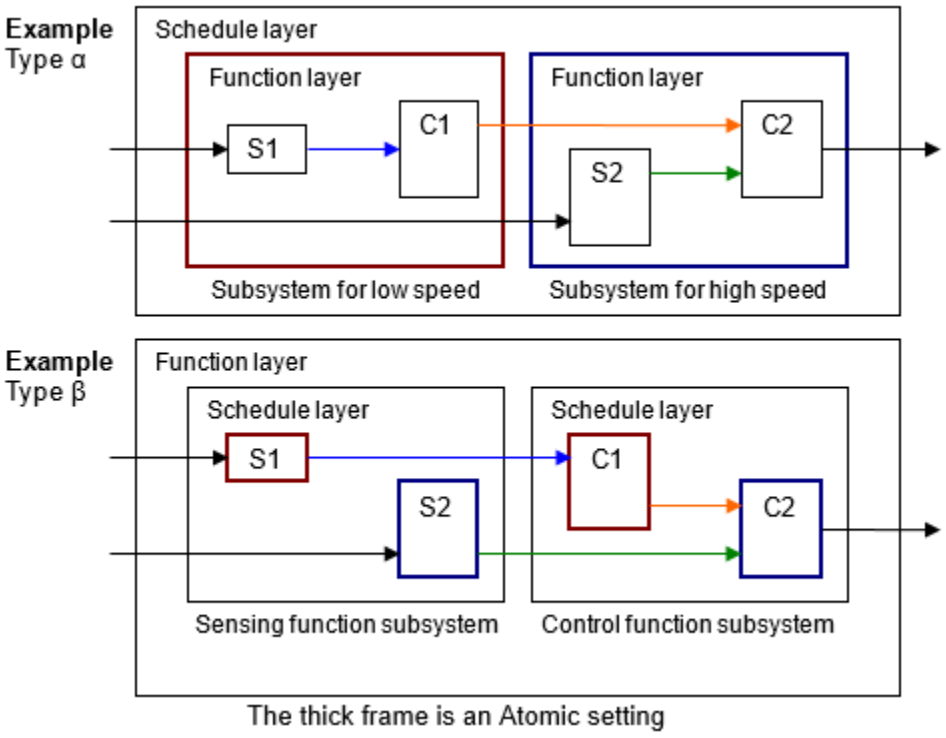
- Layer concepts shall be assigned to layers and subsystems shall be divided accordingly.
- When a layer concepts is not needed, it does not need to be allocated to a layer.
- Multiple layer concepts can be allocated to one layer.

When building hierarchies, division into subsystems for the purpose of saving space within the layer shall be avoided.

Top Layer

Layout methods for the top layer include:

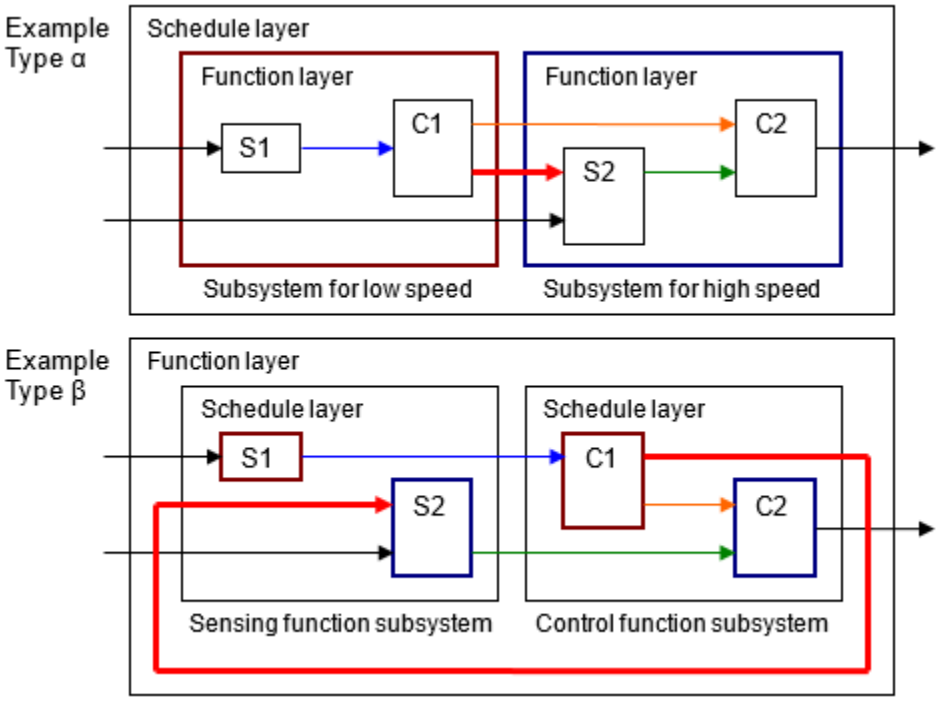
- Simple control model — Represents both the function layer and schedule layer in the same layer. Here, function is execution unit. For example, a control model has only one sampling cycle and all functions are arranged in execution order
- Complex control model Type α — The schedule layer is positioned at the top. This method makes integration with the code easy, but functions are divided, and the readability of the model is impaired.
- Complex control model Type β — Function layers are arranged at the top and schedule layers are positioned below the individual function layers.



Function Layers and Sub-Function Layers

When modeling function and sub-function layers:

- Subsystems shall be divided by function, with the respective subsystems representing one function.
  - One function is not always an execution unit so, for that reason, the respective subsystem is not necessarily an atomic subsystem. In the type β example below, it is more appropriate for a function layer subsystem to be a virtual subsystem. Algebraic loops are created when these change into atomic subsystems.
  - Individual functional units shall be described.
  - When the model includes multiple large functions, consider using model references for each function to partition the model.



Schedule Layers

When scheduling layers:

- System sampling intervals and execution priority shall be set. Use caution when setting multiple sampling intervals. In connected systems with varying sampling intervals, ensure that the system is split for each sampling interval. This minimizes the RAM needed to store previous values in the situation where the processing of signals values differs for fast cycles and slow cycles.
- Priority ranking shall be set. This is important when designing multiple, independent functions. When possible, computation sequence for all subsystems should be based on subsystem connections.
- Two different types of priority rankings shall be set, one for different sampling intervals and the other for identical sampling rates.

There are two types of methods that can be used for setting sampling intervals and priority rankings:

- For subsystems and blocks, set the block parameter **sample time** and block properties **priority**.
- When using conditional subsystems, set independent priority rankings to match the scheduler.

Patterns exist for many different conditions, such as the configuration parameters for custom sampling intervals, atomic subsystem settings, and the use of model references. The use of a specific pattern is closely linked to the code implementation method and varies significantly depending on the status of the project. Models that are typically affected include:

- Models that have multiple sampling intervals
- Models that have multiple independent functions
- Usage of model references

- Number of models (and whether there is more than one set of generated code)

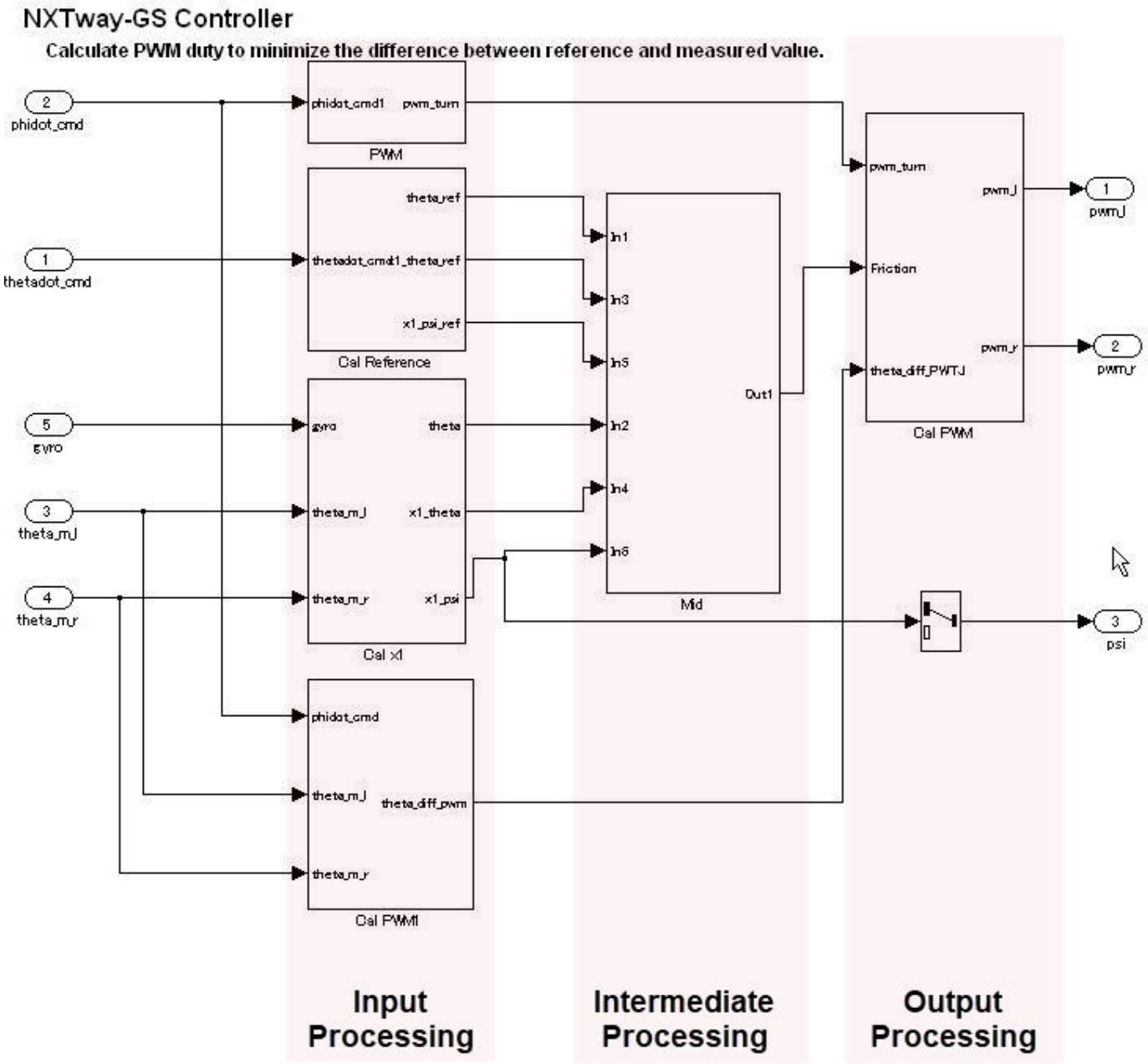
For the generated code, affected factors include:

- Applicability of a real-time operating system
- Consistency of usable sampling intervals and computation cycles to be implemented
- Applicable area (application domain or basic software)
- Source code type: AUTOSAR compliant - not compliant - not supported.

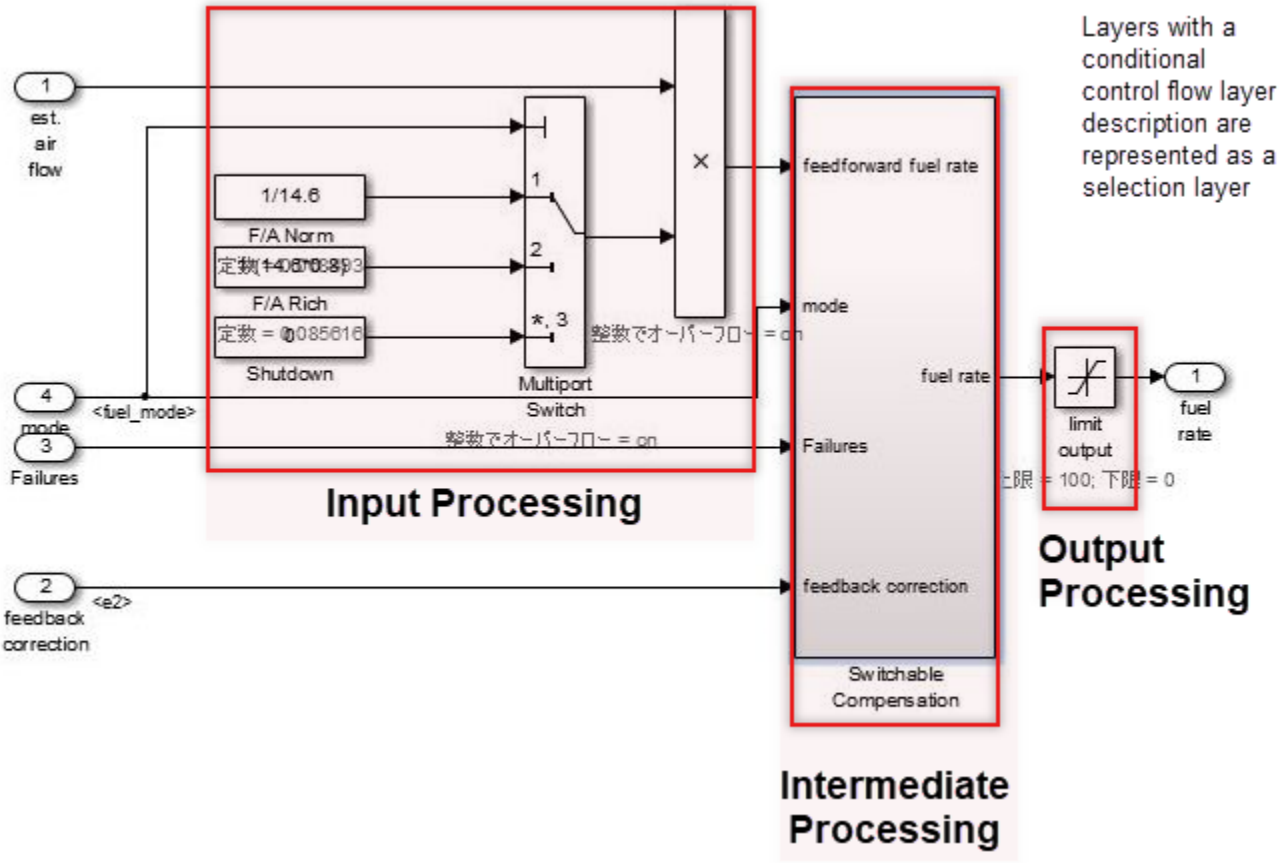
Control Flow Layers

In the hierarchy, the control layer expresses all input processing, intermediate processing, and output processing by using one function. The arrangement of blocks and subsystems is important in this layer. Multiple, mixed small functions should be grouped by dividing them between the three largest stages of input processing, intermediate processing and output processing, which forms the conceptual basis of control. The general configuration occurs close to the data flow layer and is represented in the horizontal line. The difference in a data flow layer is its construction from multiple subsystems and blocks.

In control flow layers, the horizontal direction indicates processing with different significance; blocks with the same significance are arranged vertically.



Block groups are arranged horizontally and are given a provisional meaning. Red borders, which signify the delimiter for processing that is not visible, correspond to objects called virtual objects. Using annotations to mark the delimiters makes it easier to understand.



Control flow layers can co-exist with blocks that have a function. They are positioned between the sub-function layer and the data flow layer. Control flow layers are used when:

- The number of blocks becomes too large
- All is described in the data flow layer
- Units that can be given a minimum partial meaning are made into subsystems

Placement in the hierarchy organizes the internal layer configuration and makes it easier to understand. It also improves maintainability by avoiding the creation of unnecessary layers.

When the model consists solely of blocks and does not include a mix of subsystems, if the horizontal layout can be split into input/intermediate/output processing, it is considered a control flow layer.

Selection Layers

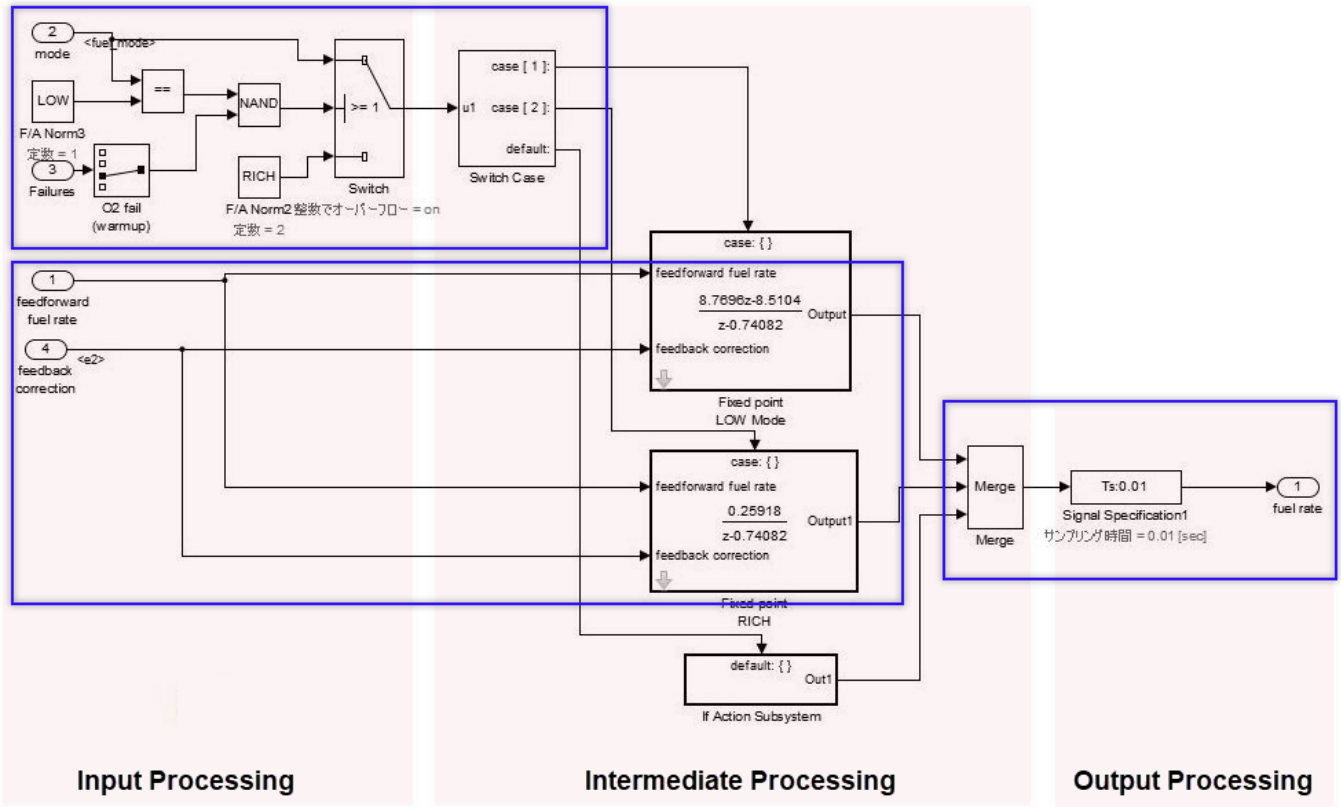
When modeling selection layers:

- Selection layers should be written vertically or side-by-side. There is no significance to which orientation is chosen.
- Selection layers shall mix with control flow layers.

When a subsystem has switch functions that allow only one subsystem to run depending on the conditional control flow inside the red border, it is referred to as a selection layer. It is also described as a control flow layer because it structures input processing/intermediate processing (conditional control flow)/output processing.

In the control flow layer, the horizontal direction indicates processing with different significance. Parallel processing with the same significance is structured vertically. In selection layers, no significance is attached to the horizontal or vertical direction, but they show layers where only one subsystem can run. For example:

- Switching coupled functions to run upwards or downwards, changing chronological order
- Switching the setting where the computation type switches after the first time (immediately after reset) and the second time
- Switching between destination A and destination B



Data Flow Layers

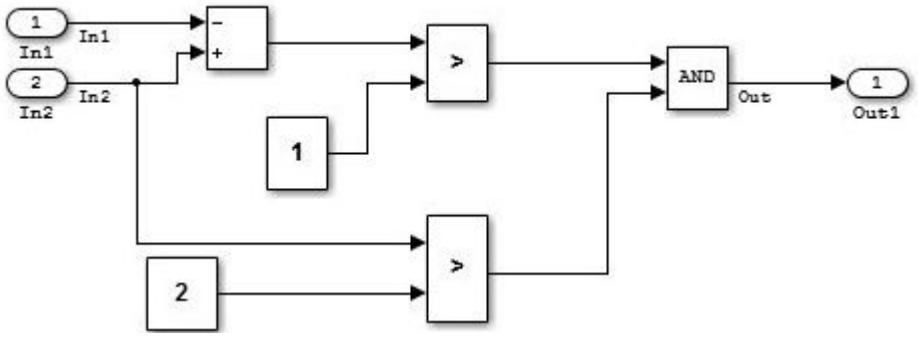
A data flow layer is the layer below the control flow layer and selection layer.

A data flow layer represents one function as a whole; input processing, intermediate processing and output processing are not divided. For instance, systems that perform one continuous computation that cannot be split.

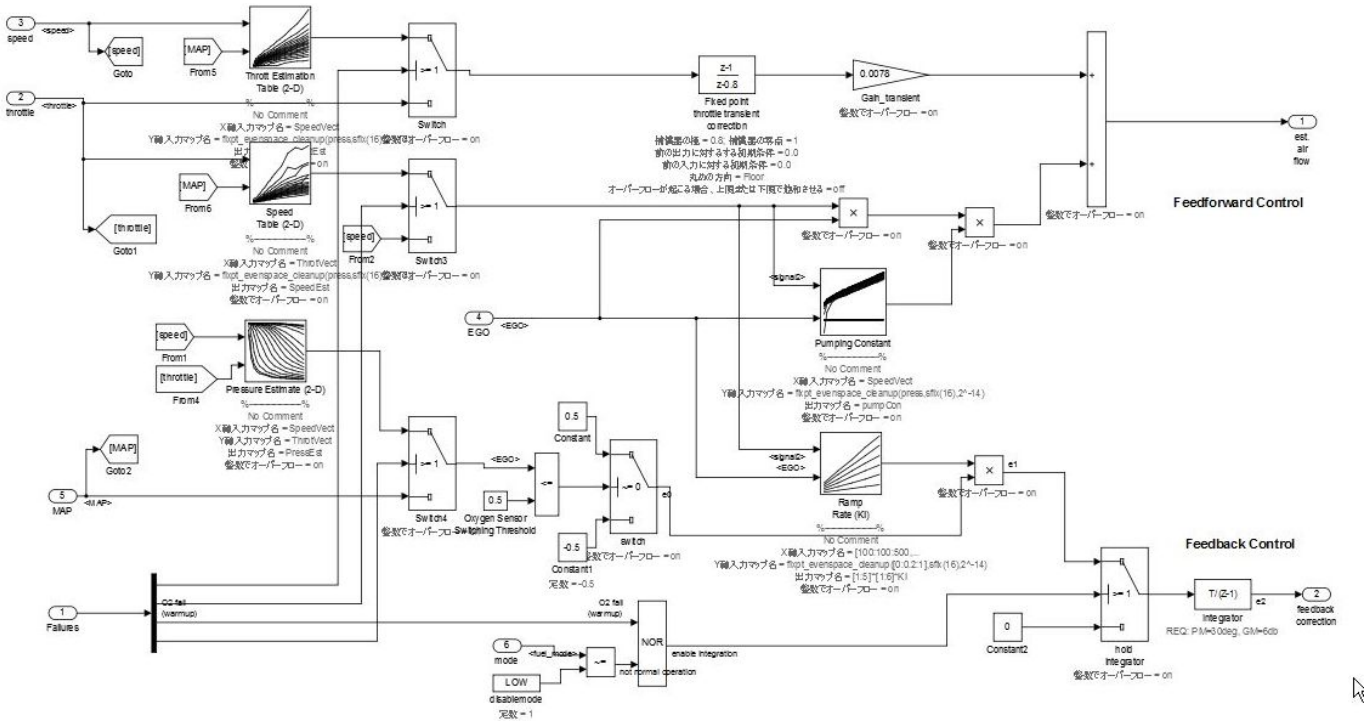
Data flow layers cannot coexist with subsystems apart from those where exclusion conditions apply. Exclusion conditions include:

- Subsystems where reusable functions are set
- Masked subsystems that are registered in the Simulink standard library
- Masked subsystems that are registered in a library by the user

Example of a simple data flow layer.



Example of a complex data flow layer.



When input processing and intermediate processing cannot be clearly divided as described above, they are represented as a data flow layer.

A data flow layer becomes complicated when both the feed forward reply and feedback reply from the same signal are computed at the same time. Even when the number of blocks in this type of cases is large, the creation of a subsystem should not be included in the design when the functions cannot be clearly divided. When meaning is attached through division, it should be designed as a control flow layer.

Relationship between Simulink Models and Embedded Implementation

Running an actual micro controller requires embedding the code that is generated from the Simulink model into the micro controller. This requirement affects the configuration Simulink model and is dependent on:

- The extent to which the Simulink model will model the functions
- How the generated code is embedded
- The schedule settings on the embedded micro controller

The configuration is affected significantly when the tasks of the embedded micro controller differs from those modeled by Simulink.

Scheduler Settings in Embedded Software

The scheduler in embedded software has single-task and multi-task settings.

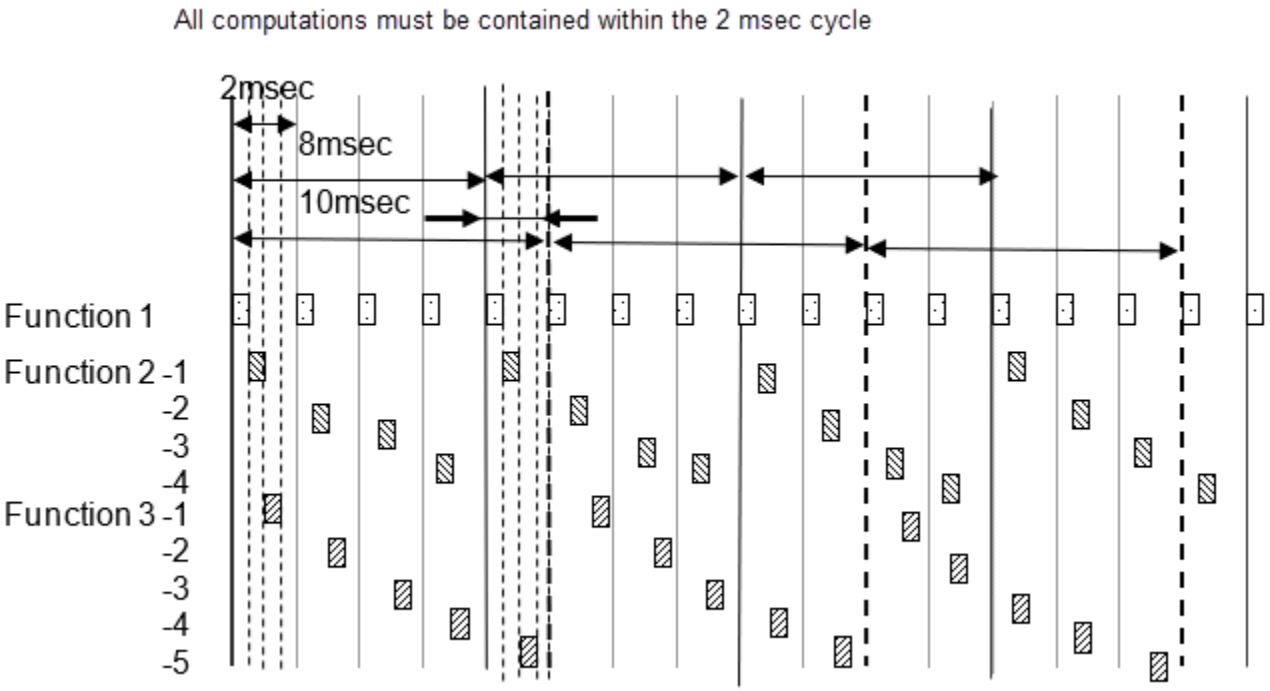
Single-task schedule settings

A single-task scheduler performs all processing by using basic sampling. Therefore, when processing of longer sampling is needed, the function is split so the CPU load is as evenly distributed as possible, and then processed using basic sampling. However, as equal splitting is not always possible, functions may not be able to be allocated to all cycles.

For example, basic sampling is 2 millisecond, and sampling rates of 2 millisecond, 8 millisecond and 10 millisecond exist within the model. An 8 millisecond function is executed once for every four 2 millisecond cycles, and a 10 millisecond function is executed once for every five. The number of executions is counted every 2 millisecond and the sampling function specified by this frequency is executed. Attention needs to be paid to the fact that the 2 millisecond, 8 millisecond and 10 millisecond cycles are all computed with the same 2 millisecond. Because all computations need to be completed within 2 millisecond, the 8 millisecond and 10 millisecond functions are split into several and adjusted so that all 2 millisecond computations are of an almost equal volume.

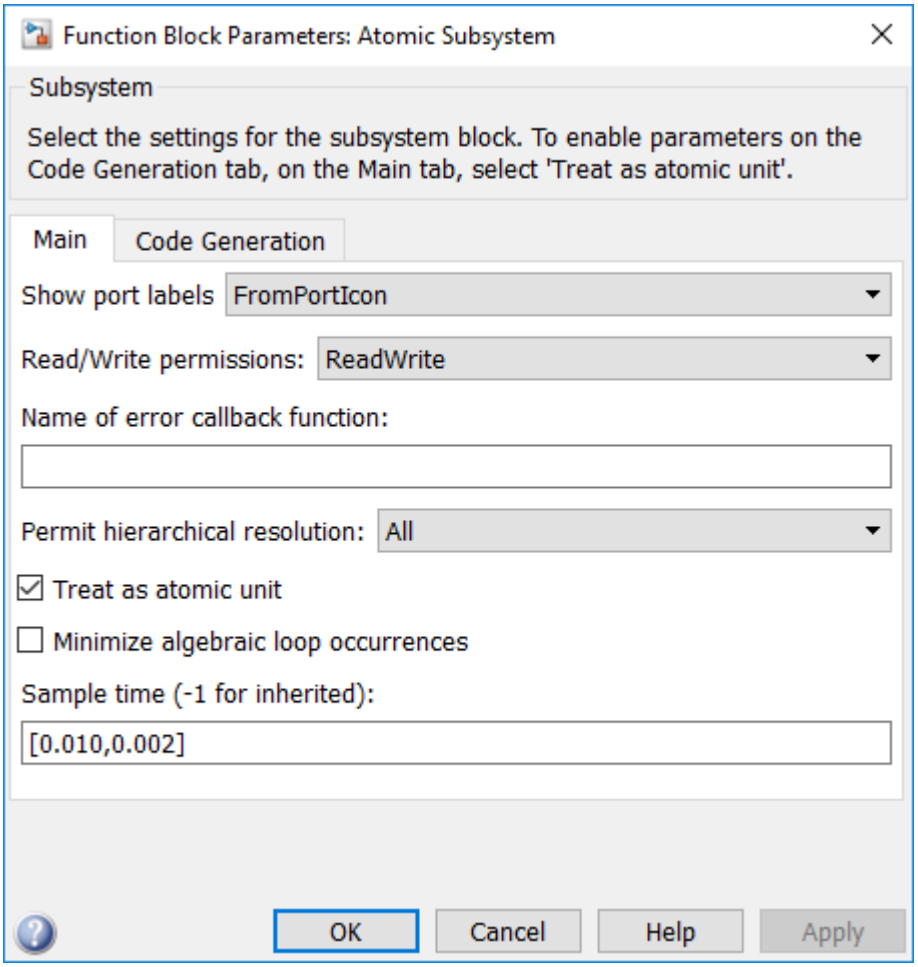
The following diagram shows the 8 millisecond function split into 4 and the 10 millisecond function split into 5.

Functions	Fundamental frequency	Offset
	8millisecond	0millisecond
2-2	8millisecond	2millisecond
2-3	8millisecond	4millisecond
2-4	8millisecond	6millisecond
3-1	10millisecond	0millisecond
3-2	10millisecond	2millisecond
3-3	10millisecond	4millisecond
3-4	10millisecond	6millisecond
3-5	10millisecond	8millisecond



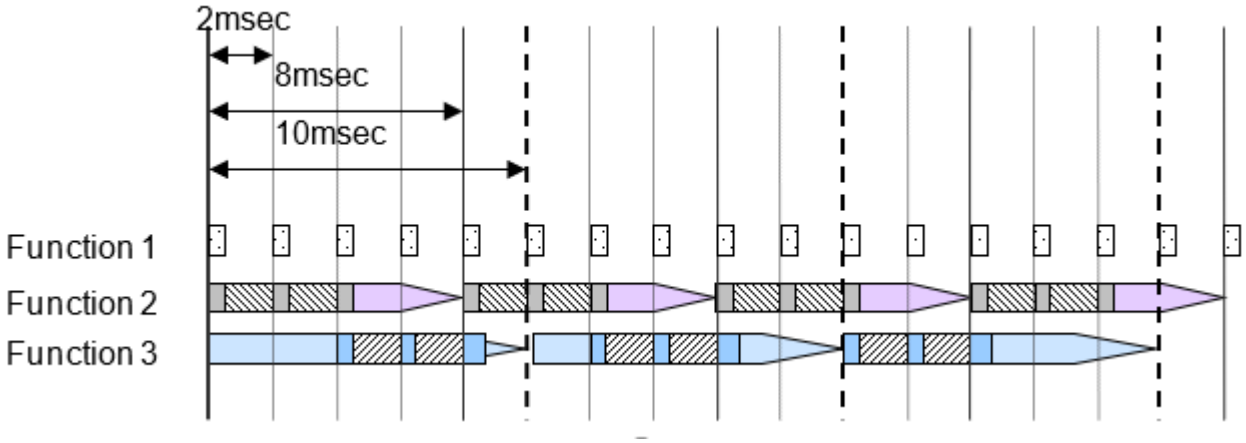
To set frequency-divided tasking:

1. Clear configuration parameter “Treat each discrete rate as a separate task”.
2. For the Atomic Subsystem block parameter **Sample time**, enter the sampling period offset values. A subsystem for which a sampling period can be specified is referred to as an atomic subsystem.



Multi-task scheduler settings

Multi-task sampling is executed by using a real-time OS that supports multi-task sampling. In single-task sampling, equalizing the CPU load is not done automatically, but a person divides the functions and allocates them to the appointed task. In multi-task sampling, the CPU performs the computations automatically in line with the current status; there is no need to set detailed settings. Computations are performed and results are output starting from the task with the highest priority, but the task priorities are user-specified. Typically, fast tasks are assigned highest priority. The execution order for this task is user-specified.



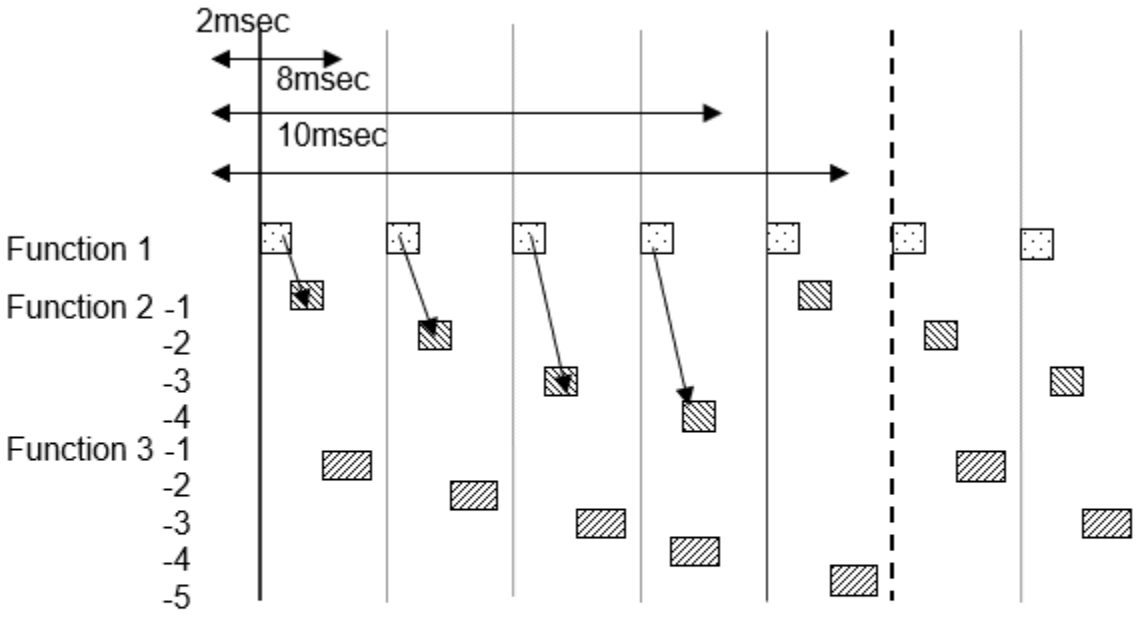
It is important that computations are completed within the cycle, including slow tasks. When the processing of a high priority computation finishes and the CPU is available, the computation for the system with the next priority ranking begins. A high priority computation process can interrupt a low priority computation, which is then aborted so the high priority computation process can execute first.

Effect of Connecting Subsystems with Sampling Differences

If subsystem B with a 20 millisecond sampling interval uses the output of subsystem A with a 10 millisecond sampling interval, the output result of subsystem A can change while subsystem B is computing. If the values change partway through, the results of subsystem B's computation may not be as expected. For example, a comparison is made in subsystem B's first computation with the subsystem A output, and the result is computed with the conditional judgment based on this output. At this point, the comparison result is true. It is then compared again at the end of subsystem B; if the output from A is different, then the result of the comparison can be false. Generally, in this type of function development it may happen that the logic created with true, true has become true, false, and an unexpected computation result is generated. To avoid this type of malfunction, when there is a change in task, output results from subsystem A are fixed immediately before they are used by subsystem B as they are used in a different RAM from that used by the subsystem A output signals. In other words, even if subsystem A values change during the process, the values that subsystem B are looking at is in a different RAM, so no effect is apparent.

When a model is created in Simulink and a subsystem is connected that has a different sampling interval in Simulink, Simulink automatically reserves the required RAM.

However, if input values are obtained with a different sampling interval through integration with hand-coded code, the engineer who does the embedding work should design these settings. For example, in the RTW concept using AUTOSAR, different RAMs are all defined at the receiving and exporting side.



If Function 2 uses the computation results of Function 1, computation results for Function 1 do not change during computation for Functions 2-1, 2-2, 2-3, but there is a possibility that Functions 2-1, 2-2, 2-3 use different values that have been computed on the respective different time axes.

Allocate different RAM for signal values with a different rates

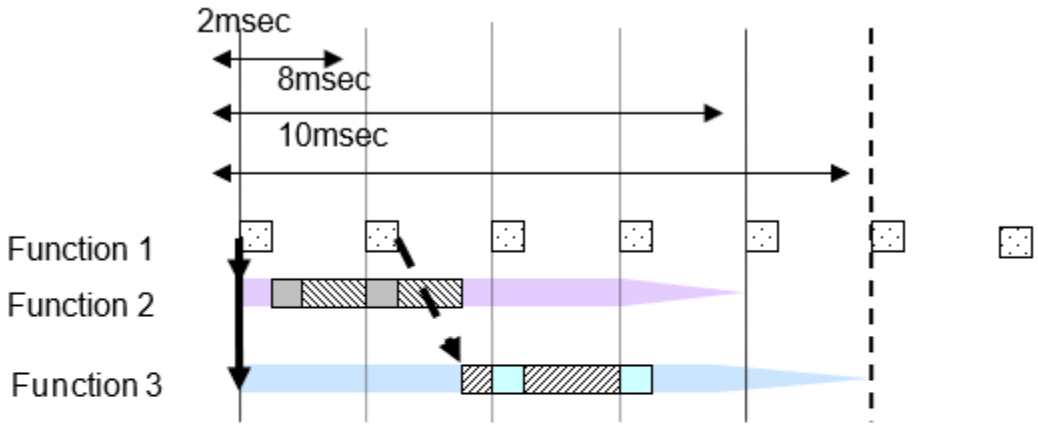
Single-task scheduler settings

Signal values are the same within the same 2 millisecond cycle, but when there are different 2 millisecond cycles, the computation value differs from the preceding one. When Function 2-1 and 2-2 uses signal A of Function 1, be aware that 2-1 and 2-2 uses results from different times.

Multi-task scheduler settings

For multi-task, you cannot specify at what point to use the computation result to use. With multi-task, always store signals for different tasks in new RAM.

Before new computations are performed within the task, all values are copied.



Do not immediately use values that are being updated.

The value should be held at the beginning of the task.

If Function 2 uses the computation results of Function 1, it is possible that computation results from Function 1 will replace them while Function 2 is computing. For that reason, computation results that vary at the point when computation starts for each sampling are typically stored in a different RAM.

Using Simulink and Stateflow in Modeling

When using Stateflow, Simulink is required for inputs, outputs, and structuring. Stateflow alone can perform a variety of formula processing. When using Simulink, complex state variables can be realized through methods, such as using the Switch Case block.

Either Simulink or Stateflow can be used to model specific parts of control, however, the application of either product in the development workflow is based on the user's understanding of the underlying algorithms and, ultimately, comes down to the organization to determine which tool is best suited for their needs. Determining whether Simulink or Stateflow should be used for design should be determined by a group of people in accordance with the task. Whether implementation in Stateflow is done by using state transitions or with flow charts should also be specified.

In most cases, Stateflow is less efficient with regards to RAM. Therefore, Simulink has an advantage in computations that use simple formulas. In addition, Simulink is more advantageous for situations where state variables are operated with simple flip-flops and the Relay block. When evaluating whether to use Simulink or Stateflow in a project, these topics should be taken into consideration:

- Increasing RAM: There must always be a RAM available for visualization of Stateflow inputs, outputs and internal variables.
- Equation error handling: When general computational formulas are used internally, the user designs ways to prevent overflow.
- Splitting and separating functions: When performing calculations that use Simulink outside of Stateflow, there is a possibility that they may split, thus reducing readability. There are also times where readability may improve. This can be difficult to judge.

There are cases where Stateflow has more efficient code than Simulink for optimum expressions that are close to code, but most of these result in a model that is difficult to understand. If code already exists, it is more advantageous to use S-functions instead of Stateflow modelling. Stateflow can note computations where specific arrangements are specified, or computations using for-loops, more efficiently than Simulink, but in recent years it has also become convenient to use MATLAB language for descriptions. If needed, consider using MATLAB language for modelling.

For Stateflow models, when dealing with states as described below, readability improves by describing them as state transitions:

- Different output values are output for identical inputs.
- Multiple states exist (as a guide, three or more).
- States with meaningful names instead of just numbers.
- Inside a state, initialization (first time) and differentiation during execution (after the second time) is required.

For instance, in flip-flop circuits, different values are outputted for inputs. State variables are limited to 0 and 1. However, a meaningful name cannot be added to each state simply by retaining boolean type numbers. There is also no distinction between initialization and execution within the state. Thus, only one flip-flop applies out of the four above, so Simulink is more beneficial.

In Stateflow, situations that can be represented as states are implemented as state transitions and conditional branches that are not states are implemented as flow charts. Truth tables are classified as a conditional branch implementation method. When designing states as state transitions by using Stateflow, `Classic` should be selected as the state machine type so that it is implemented as software into the control system's embedded micro controller.

HDL Coder™ is supported by Stateflow. When using HDL Coder, `Mealy` or `Moore` must be selected; `Moore` mode is more appropriate when protection is required against internal electric leaks.

Note HDL Coder use cases are not described in these guidelines.

Simulink Functionality

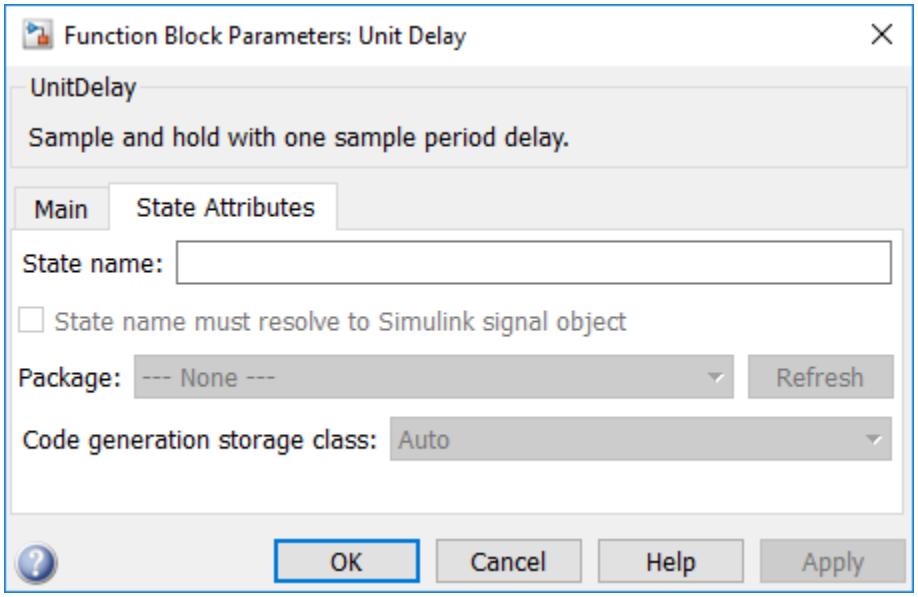
This section provides information about using Simulink for modeling.

Blocks with State Variables

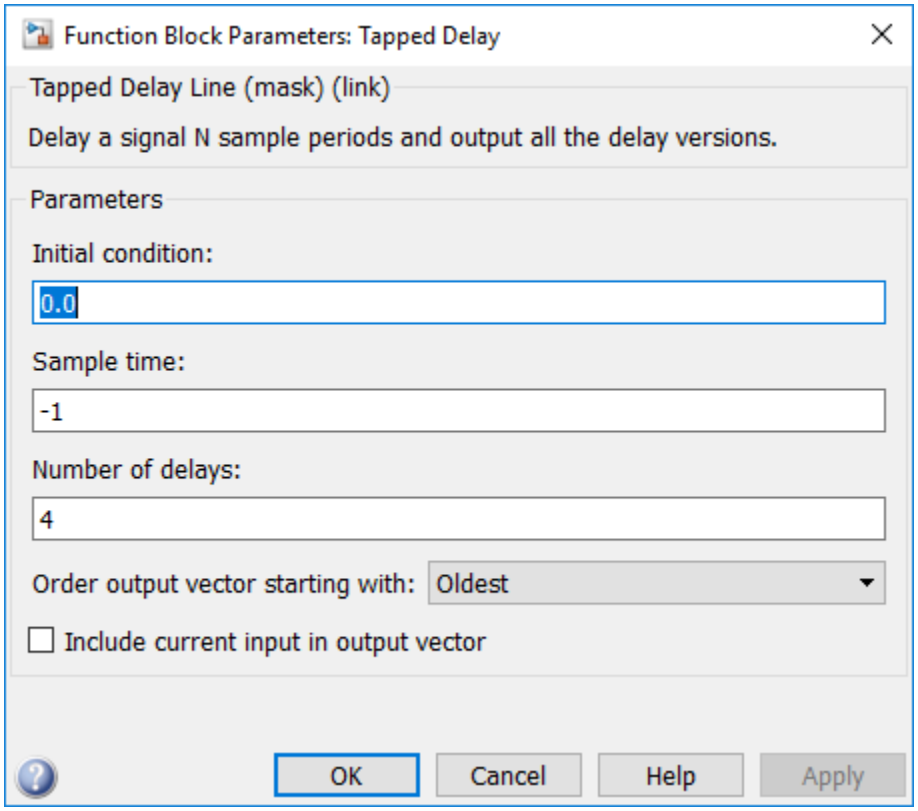
Blocks with state variables are primarily grouped into Simulink and discrete types.

For most of these blocks, the user can set the state attributes and initial values by using the block parameters. A conditional subsystem can have state variables, depending on the structure pattern.

In this example, the Unit Delay block has state attributes.



In this example, the Tapped Delay block does not have state attributes.

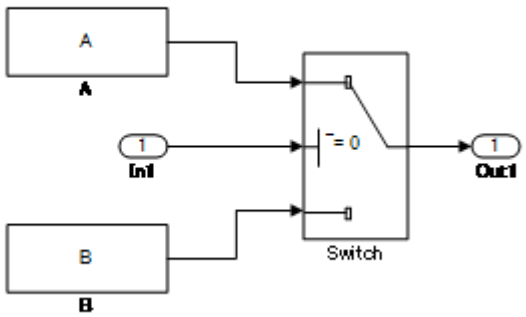


See guideline: jc_0640

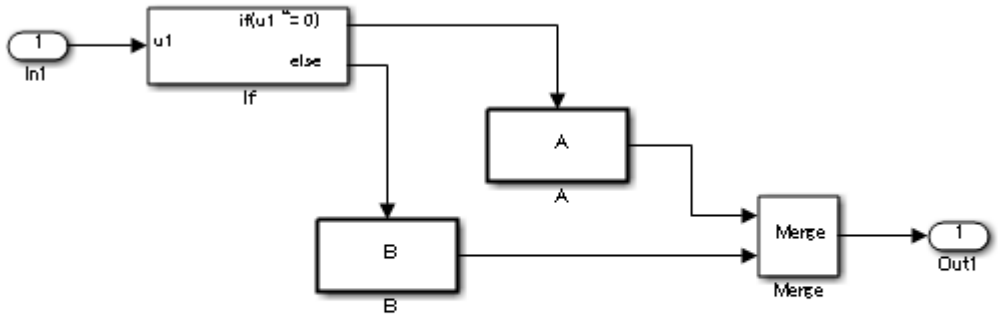
Branch Syntax with State Variables

The Switch block and conditional subsystems behave differently when state variables are used.

Depending on the configuration setting, when any state variable exists, the Switch block generally executes subsystem A when the condition of the control port is satisfied. If the condition is not satisfied, it executes only subsystem B without calculating subsystem A. However, when the subsystem A contains a state variable, calculation for the state variable within the subsystem A is processed even when the conditions of the control port are not satisfied.



In the conditional subsystem, subsystem A is calculated when the condition is satisfied. When is not satisfied, subsystem B is calculated instead of subsystem A, regardless of the existence of any state variables in subsystem A.



The reset action in a recalculation can be specified by using the {Action Port} setting.

The behavior of subsystem A when using a Switch block and a conditional control flow is listed in the following tables. Familiarize yourself with these behaviors to determine which structure, the Switch block, or conditional subsystem is most suitable for the intended purpose.

This table shows the behavior of subsystem A

Control port condition	(in subsystem A) State variables	Switch	Conditional subsystem
Hold	No	Executed	Executed
	Yes		
Not hold	No	Not executed	Not executed
	Yes	Minimally-processed *Executed calculations related to the state variables	

This table provides the initialization timing of subsystem A.

	Action Port	Initialize

Switch	—	First time only
Conditional subsystem	Hold	First time only
	Reset	At returned by condition

See guidelines:

- jc_0656: Usage of Conditional Control blocks
- jc_0657: Retention of output value based on conditional control flow blocks and Merge blocks

Subsystems

A subsystem is used for compiling various blocks and subsystems.

Subsystems can also be used for other purposes. Usage methods that are not functional subsystems include:

- Mask display of the subsystem is used to describe the outline or display fixed form documents, such as "classified"
- The open functions (callback functions in the block properties) of the subsystem is used for running several tools or displaying explanatory text separate from the model
- Subsystems whose setting have changed to a mask subsystem (a subsystem that was simply set to `NoReadOrWrite`) by a user with administrative rights to make a change, but other users cannot see the content.

These non-typical subsystems are outside of the scope of the guidelines and, if excluded, should be put on an exclusion list managed within the project.

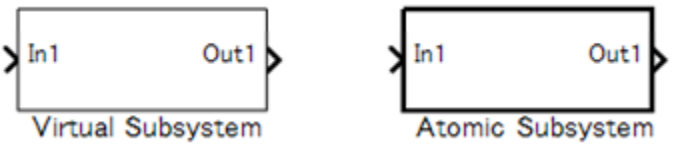
See guidelines:

- jc_0201: Usable characters for subsystem names
- jc_0243: Length restriction for subsystem names
- db_0143: Usable block types in model hierarchy
- db_0144: Use of subsystems
- db_0141: Signal flow in Simulink models
- jc_0653: Delay block layout in feedback loops
- jc_0171: Clarification of connections between structural subsystems
- jc_0602: Consistency in model element names
- jc_0081: Inport and Outport block icon display
- db_0081: Unconnected signals and blocks

Atomic Subsystems and Virtual Subsystems

There are two types of subsystems, Virtual subsystem and Atomic subsystems. The primary difference between these subsystems is whether the subsystem is treated as a single execution unit. The virtual subsystem is the default subsystem block.

In a model, the border for a Virtual subsystem is thin as compared the border for the Atomic subsystem, which is thick and bold.

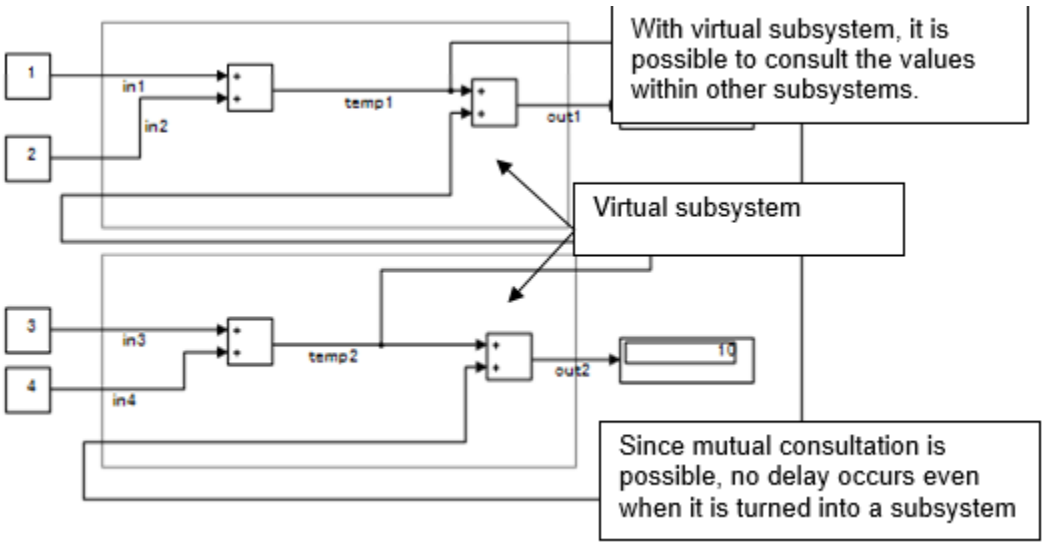


Virtual Subsystems

A block that provides a visual representation is known as a "virtual block". For example, a Mux block that compiles several signal lines, a From block that hands out the signal, and a Goto block that corresponds to a virtual block. Since the subsystem block in the default setting only constitutes a visual hierarchical structure, these blocks are considered virtual blocks. The subsystem is referred to as a virtual subsystem.

Consider a subsystem that consults an external calculation result within a subsystem, as shown in the following example. This system is calculated from these four equations.

- temp1= in1 + in2
- temp2= in3 + in4
- out1= in1 + in2 + temp2
- out2= temp1 + in3 + in4



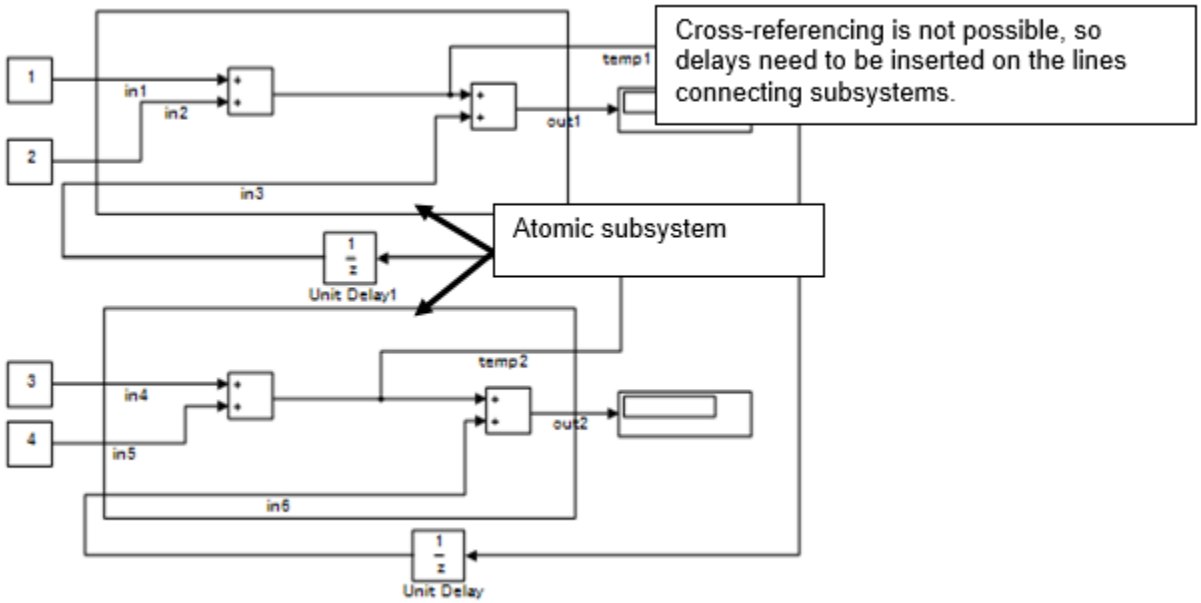
Atomic Subsystems

An atomic subsystem is detached from the external system and is not subject to cross-border optimization. Atomic subsystems do not use the results of the internal calculations of each subsystem. Therefore, interim output value will use a calculation result that is delayed by a session.

- temp1= in1 + in2
- temp2= in4 + in5
- out1= in1+ in2 + in3
- out2= in4+ in5 + in6

- in3= temp2
- in6= temp1

Atomic subsystems prohibit the direct referencing of the interim calculation results to other subsystems.



Notes on atomic subsystems:

- Atomic subsystems can select C-source function settings.
- As explained above, the internal section of an atomic subsystem will become encapsulated (objectified).
- Depending on the relationship before and after, a static RAM section should be secured inside the subsystem for the output signal.
- Atomic subsystems (including the addition of function settings) should be used with caution. Factor setting will not simply have a factor name inserted within a C code. It should be acknowledged that it is described as a mathematically independent system and the conditions under which an atomic subsystem can be used should be reviewed.
- Include the relationship with the structure layer; it is necessary to determine an operation rule per project and to determine its relationship with the guideline rules.

Signal Name

Signals can be named and are referred to as signal names. When a signal is named, that signal name is displayed as a label. Updates to labels are reflected in the signal name and are also displayed.

The signal name can be propagated to a signal line via a branched signal line or port block and displayed as a signal name.

See guidelines:

- jc_0222: Usable characters for signal and bus names

- jc_0245: Length restriction for signal and bus names

Code can be generated by associating a signal name with a signal object (Simulink object or `mpt` object). Type setting is configured through the data dictionary, setting of the storage class is optional. The recommended data type settings for these blocks include:

- For Inport blocks, set **data type**} to `auto`.
- For Outport blocks, **data type**} to `auto`.
- For Sum blocks, set the output **data type** to `Inherit via back propagation`.

See guideline jc_0644: Type setting.

Vector Signals/Path Signal

Individual scalar signals that compose a vector shall have common functions, data type, and units.

Signals that do not fulfill the conditions as a vector can only be grouped as a bus signal. The Bus Selector block shall be used only with bus signal inputs. It shall not be used to extract a scalar signal from a vector signal.

The following table is an example of a vector signal.

Types of vector	Size
Row vector	[1 n]
Column vector	[n 1]
Wheel speed subsystem	[1 wheel number]
Cylinder vector	[1 cylinder number]
Location vector based on a 2-dimensional coordination points	[1 2]
Location vector based on 3-dimensional coordination points	[1 3]

The following table is an example of a bus signal.

Bus type	Factor
Sensor bus	Force vectors
	Location
	Wheel speed vector [Θlf, Θrf, Θlr, Θrr]
	Acceleration
	Pressure
Controller bus	Sensor bus
	Actuator bus
Serial data bus	Circulating water temperature
	Engine speed, front passenger seat door open

See guidelines:

- na_0010: Usage of vector and bus signals
- jc_0222: Usable characters for signal and bus names
- jc_0245: Length restriction for signal and bus names
- db_0097: Position of labels for signals and buses
- jc_0630: Usage of Multiport Switch blocks
- jc_0659: Usage restrictions of signal lines input to Merge blocks

Enumerated Types

Enumerated type data refers to data that is restricted to a determined numerical value.

The type of blocks that can be used in an enumerated type in Simulink is limited.

To use an enumerated type, you must define the enumerate type by using `.m` file on MATLAB. For additional information about defining enumeration data types, see “Use Enumerated Data in Simulink Models”.

Stateflow Functionality

This section provides information about using Stateflow for modeling.

Operators Available for Stateflow

For additional information about the Stateflow operators, see “Supported Operations for Chart Data” (Stateflow).

See guidelines:

- na_0001: Standard usage of Stateflow operators
- jc_0655: Prohibition of logical value comparison in Stateflow

Differences Between State Transition and Flow Chart

Stateflow can represent both a state transition and a flow chart.

Stateflow allows a flow chart to be designed within a state transition diagram.

An entry action is represented as a flow chart in a state, which starts from a default transition and moves to junctions through transition lines, as illustrated below. Starting from an internal transition line allows a *during* action to be represented in the flow chart.

A flow chart cannot maintain its active state between updates. As a result, a flow chart always ends at a terminating junction (a connective junction that has no valid outgoing transitions).

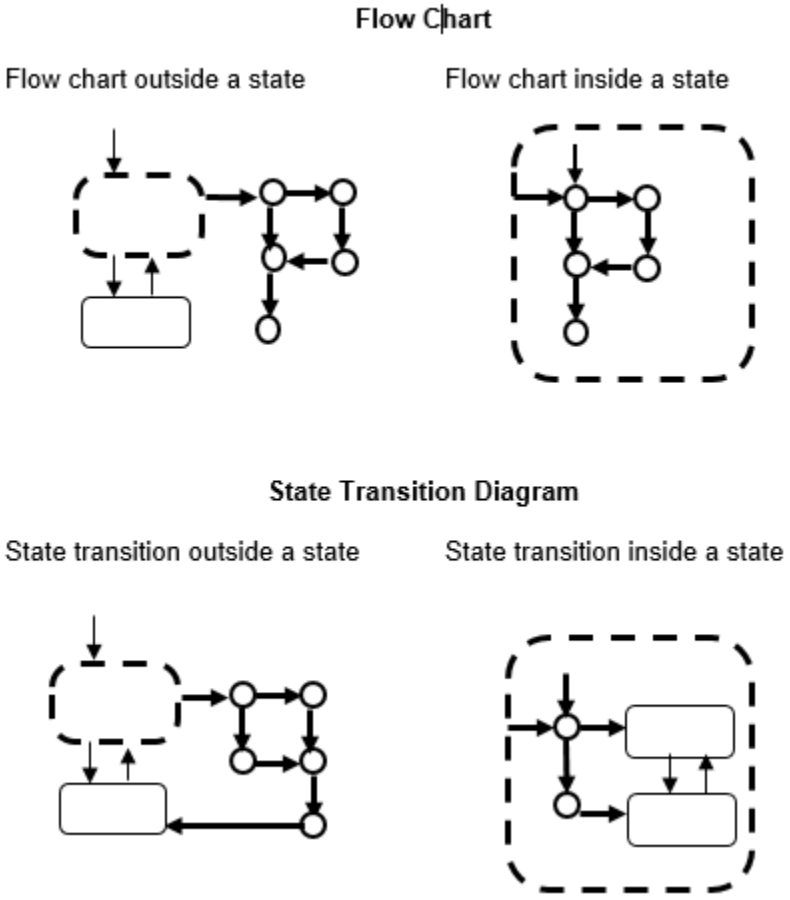
In contrast, a state transition diagram stores its current state in memory to preserve local data and active state between updates. As a result, state transition diagrams can begin executing where they left off in the previous time step. This means that state transitions are suitable for modeling reactive or supervisory systems that depend on history.

This table defines the start and end points for a flow chart and state transition diagram.

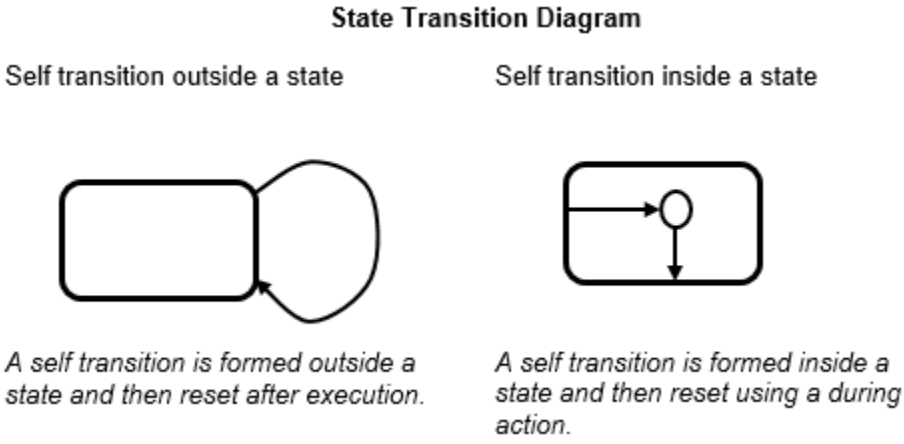
	Start point	End point

Flow chart	Default transition	All terminations from the state are connected to the connective junction.
State transition diagram	Default transition	Either termination should be connected to the state

This illustration shows the difference between a general flow chart and state transition diagram



Mixture of flow charts and state transition diagrams with self-transition has more strict constraints.

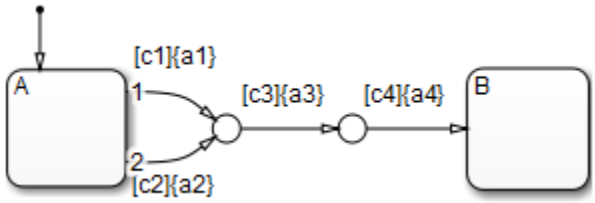


See guidelines:

- db_0132: Transitions in flow charts
- jc_0752: Condition action in transition label

Backtrack

This example shows the behavior of transitions with junctions that force backtracking behavior in flow charts. The chart uses implicit ordering of outgoing transitions.



Initially, state A is active and transition conditions c1, c2, and c3 are true. Transition conditions c4 is false.

1. The chart root checks to see if there is a valid transition from state A.

   There is a valid transition segment marked with the transition condition c1 from state A to a connective junction, therefore:

   a. Transition condition c1 is true, so action a1 executes.
   b. Transition condition c3 is true, so action a3 executes.
   c. Transition condition c4 is not true and, therefore, the control flow backtracks to state A.
2. The chart root checks to see if there is another valid transition from state A.

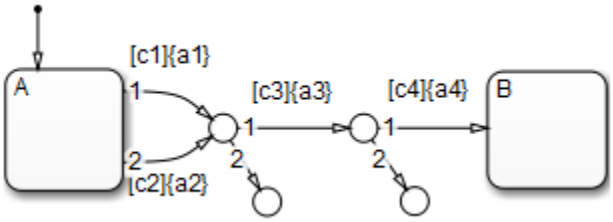
   There is a valid transition segment marked with the transition condition c2 from state A to a connective junction, therefore:.

   a. Transition condition c2 is true, so action a2 executes.
   b. Transition condition c3 is true, so action a3 executes.

c Transition condition c4 is not true and, therefore, the control flow backtracks to state A.

3 The chart goes to sleep.

To resolve this issue, consider adding unconditional transition lines to terminating junctions. The terminating junctions allow flow to end if either c3 or c4 is not true. This design leaves state A active without executing unnecessary actions.



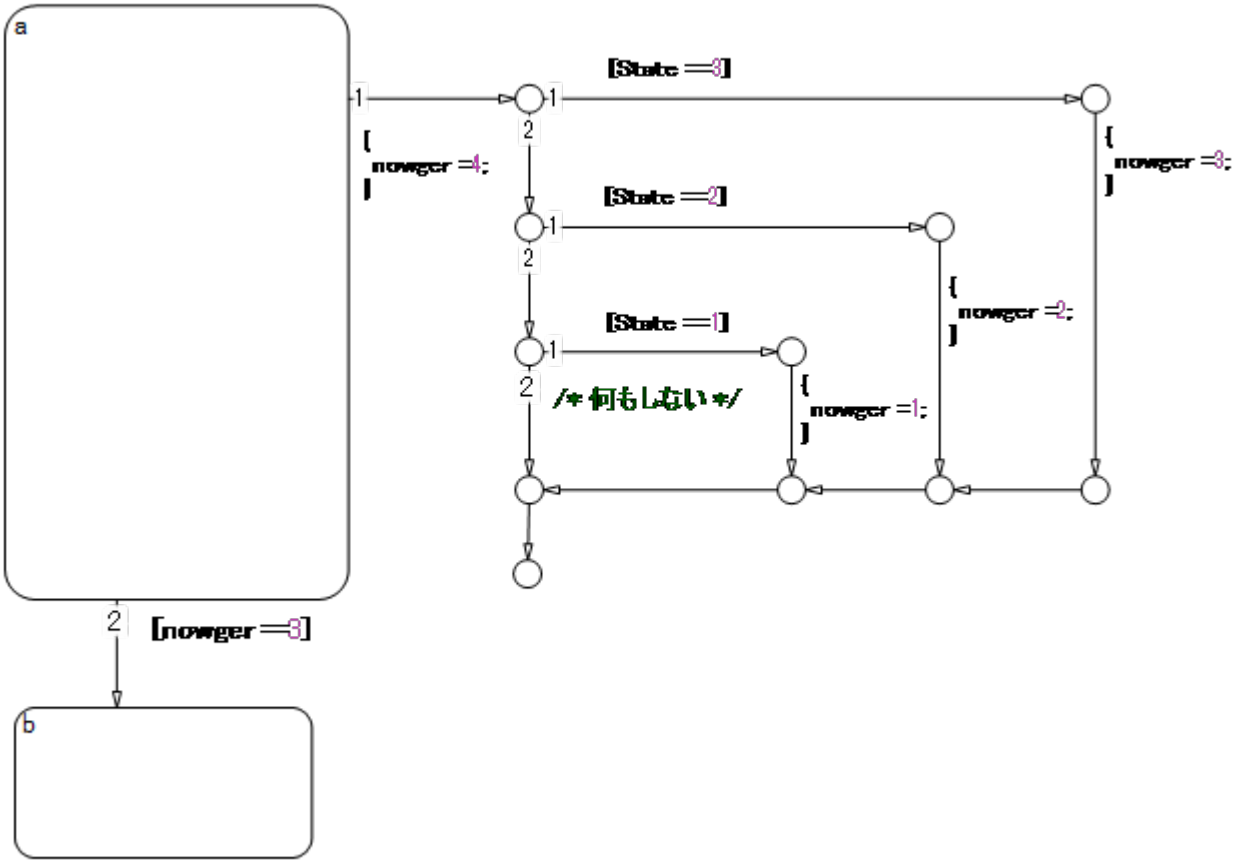
See guidelines:

- jc_0751: Backtracking prevention in state transition
- jc_0773: Unconditional transition of a flow chart

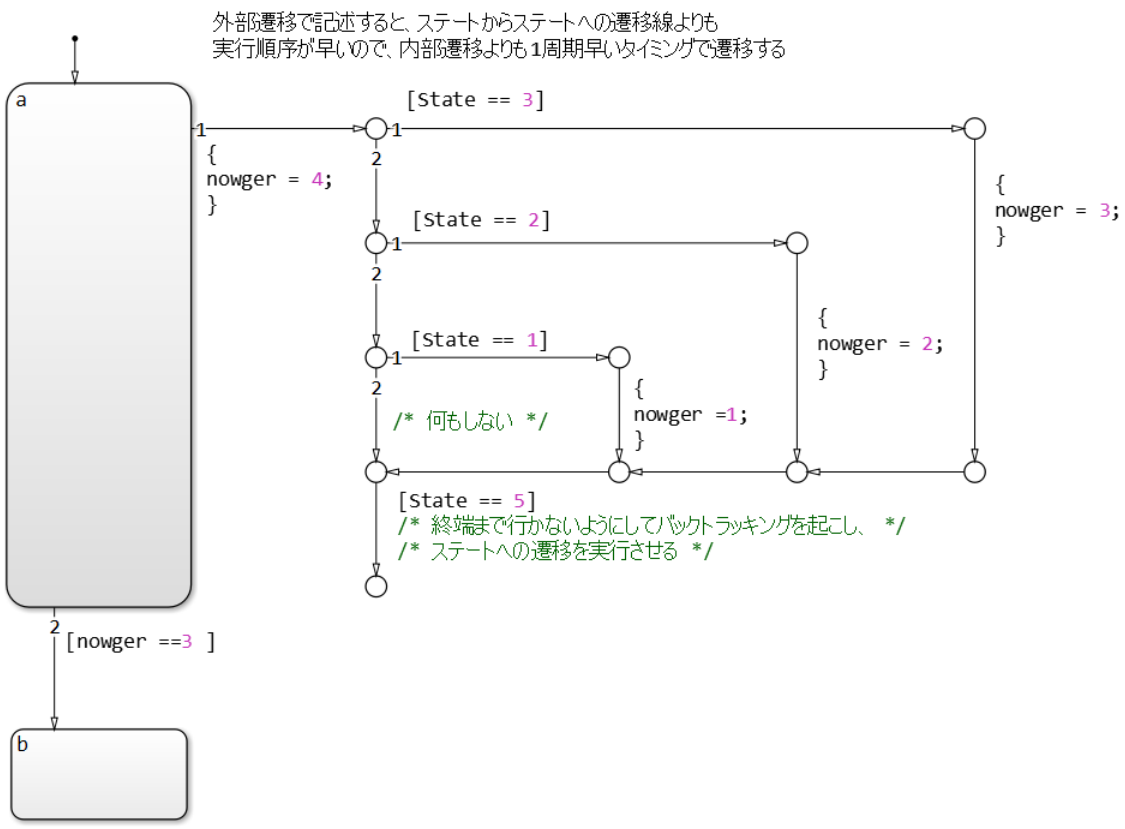
Flow Chart Outside the State

A flow chart associated with a state can be written inside or outside of the state; however, be attentive to the execution order and backtracking.

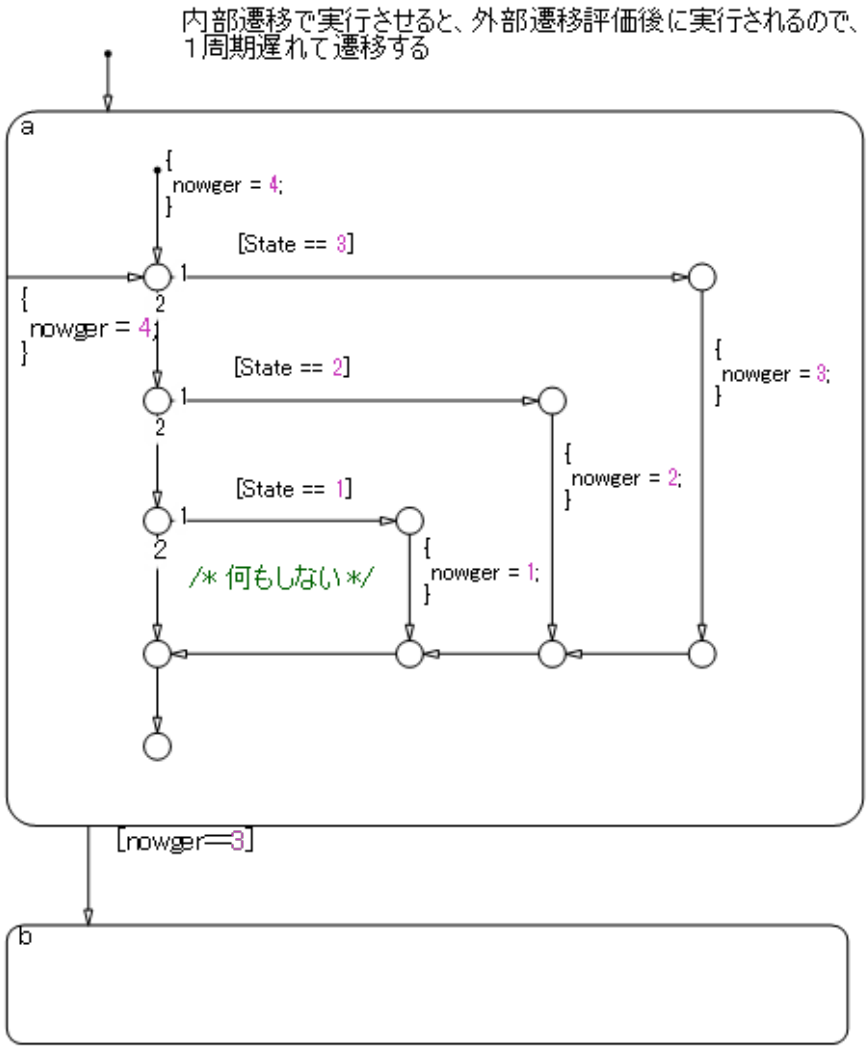
The following flow chart, which evaluates transition from a to b after executing the flow chart outside the state, appears to execute the transition within the same period as that of a newer calculation. However, the transition line to b is not evaluated if the termination point is reached by calculating the transition outside the state. This is a state transition diagram which always stays at a.



Done correctly, as shown below, the transition condition is not positioned at the termination of the external flow chart, allowing the transition line from a to b to be evaluated after the flow chart is executed. This enables the external flow chart to execute before the transition, and to be evaluated using the most recent value at the instant of the transition. Note that this chart contains a dead path where the transition condition will never hold, which can cause an error when the specification is changed in the future. Use this chart structure with caution.



In contrast, the following flow chart is inside a state, which means that the internal flow chart is always calculated when executing state a and can be described as an easily comprehensible structure without dead paths. However, it should be noted that, as a performance characteristic, when state a is executed, the transition from a to b is evaluated in the cycle following that in which the internal flow chart is calculated. Due to this characteristic, the timing of the execution of calculations and transitions for the external flow chart may be off. Use with caution.



See guidelines:

- jc_0751: Backtracking prevention in state transition
- jc_0773: Unconditional transition of a flow chart

Pointer Variables

This code sample is from model `sf_custom`. To open the model, enter the following on the MATLAB command line:

```
openExample('sf_custom')
```

In model `sf_custom`, click **Open my_header.h**.

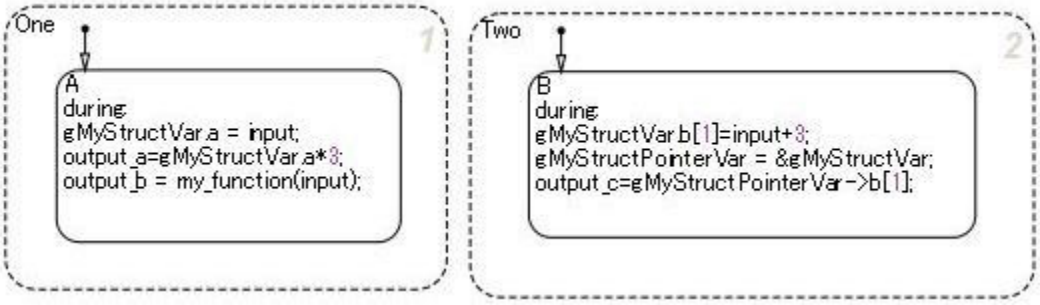
```
#include "tmwtypes.h"

extern real_T my_function(real_T x);

/* Definition of custom type */
```

```
typedef struct {
    real_T a;
    int8_T b[10];
}MyStruct;

/* External declaration of a global struct variable */
extern MyStruct gMyStructVar;
extern MyStruct *gMyStructPointerVar;
```

In model `sf_custom`, click **Open my_function.c**.

```
#include "my_header.h"
#include <stdio.h>

/* Definition of global struct var */
MyStruct gMyStructVar;
MyStruct *gMyStructPointerVar=NULL;

real_T my_function(real_T x)
{
    real_T y;

    y=2*x;

    return(y);
}
```

`gMyStructVar` is not defined in Stateflow. Typically, functions of `my_function` are called from C source for use in Stateflow. However, direct reference to global variables exposed by the C source is also available from Stateflow.



Initialization

This section provides information about using initialization values.

Initial Value Setting in Initialization

When a signal needs to be initialized, the initial values shall be set correctly.

When initial values are set inside a block, use an initial value list that includes annotations so you can visually confirm the initial values input.

Cases that require initial values include:

- When state variables are defined AND blocks that have state variables are used.
  - Use the internal block settings.
  - Use the external input values.
- When state variables are defined AND initial values are enabled for a block when a specific configuration is performed.
  - Set initial values in Merge blocks.
  - Use signals registered in the data dictionary.
- When signal settings (with RAM) have been defined that can be referenced from the outside.
  - Use signals registered in the data dictionary.

Initial Values of Signals Registered in the Data Dictionary

Set initial values for signals registered in the data dictionary.

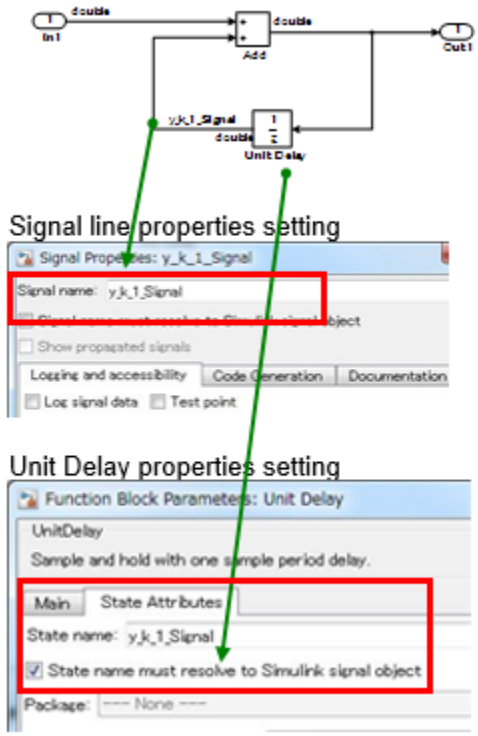
- Discrete block groups, such as Unit Delay and Data Store Memory, have state variables.

  In the case of automatic code generation, the signal name, type, and initial value can be set for state variables by matching it to the signal in the data dictionary (associated with Simulink signal objects). When using a signal defined in the data dictionary for a state variable, the respective initial values should conform to the same value.
- When using a signal defined in the data dictionary for a state variable

  For discrete blocks, such as Unit Delay and Data Store Memory, settings are performed not when using signals defined in the data dictionary for the block output line, but for the state variables inside the block. Even when the signal name of the data dictionary is assigned to the signal line, RAM is reserved in duplicate, which is a waste of RAM.

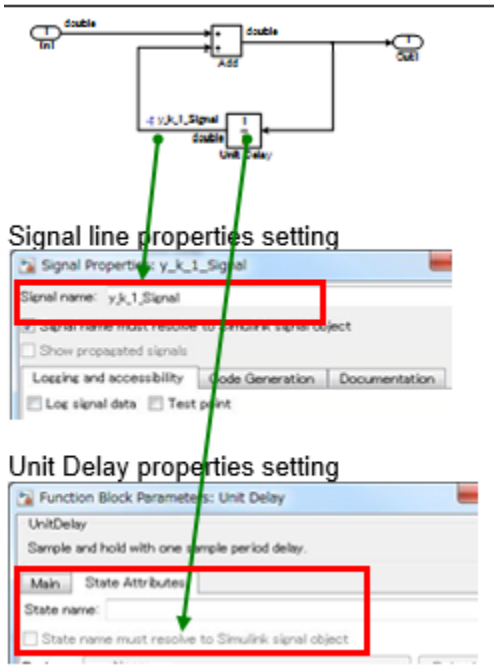
Example — Correct

Signal is defined for the state variables inside the block. The signal name is defined and block parameter **State name must resolve to Simulink signal object** is selected.



Example — Incorrect

Signal is defined for the output signal of the block that has state variables. The signal name is defined and block parameter **State name must resolve to Simulink signal object** is not selected.

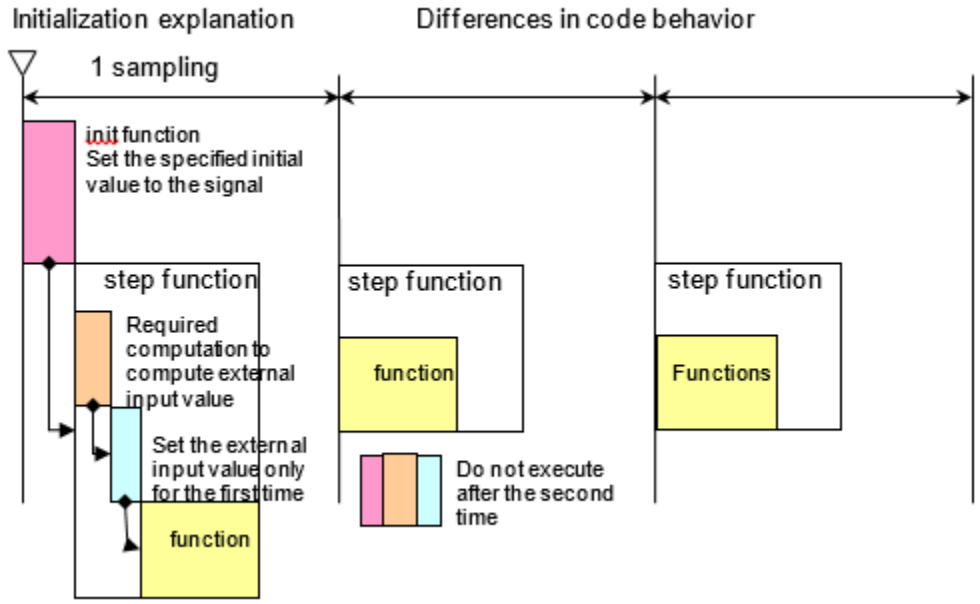


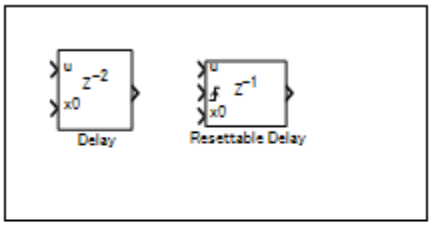
Signal objects that are defined in the Workspace can be automatically associated with signal objects and signal names of the same name by using `disableimplicitsignalresolution(modelname)`. However, for state variables inside the block, they are associated with the state variables inside the block and the signal name of the same name. If a globally set signal is associated with two variables at the same time, it is better to perform settings so that the state variables inside a block and the signal label on the signal line have different names, otherwise the model cannot be simulated.

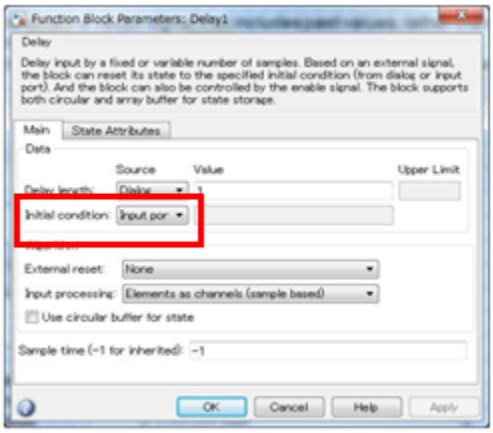
Block Whose External Input Value is the Initial Value

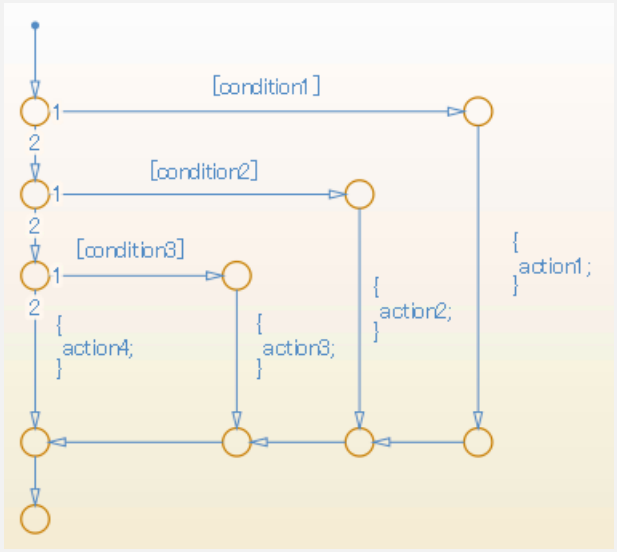
When setting the initial value during initialization, the `init` function is called to set the signal to either the value inside of the block or to the initial value that is defined in the data dictionary. Next, the step function (the data flow executive function) is executed. Here, the external input value is set as the initial value. When modelling, be attentive to the execution functions and execution timing for initialization. This is demonstrated in the following image.

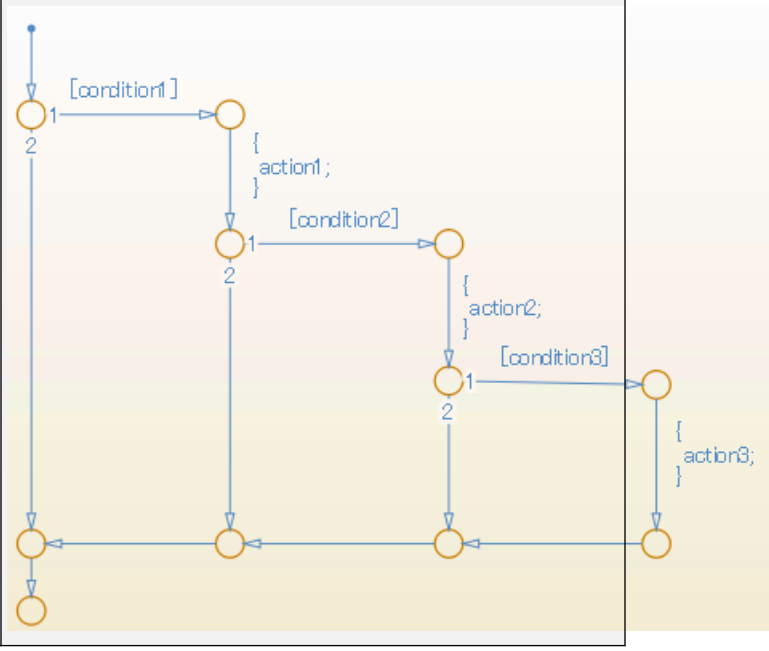
The following image







`If`, `elseif`, `else` construct
 	
`if (condition1) {`
`  action1;`
`}`
`else if (condition2) {`
`  action2;`
`}`
`else if (condition3) {`
`  action3;`
`}`
`else {`
`  action4;`
`}`
	

Cascade of `if` construct.
 	
`if (condition1) {`
`  action1;`
`  if (condition2) {`
`  action2;`
`  if (condition3) {`
`  action3;`
`  }`
`  }`
`}`
	

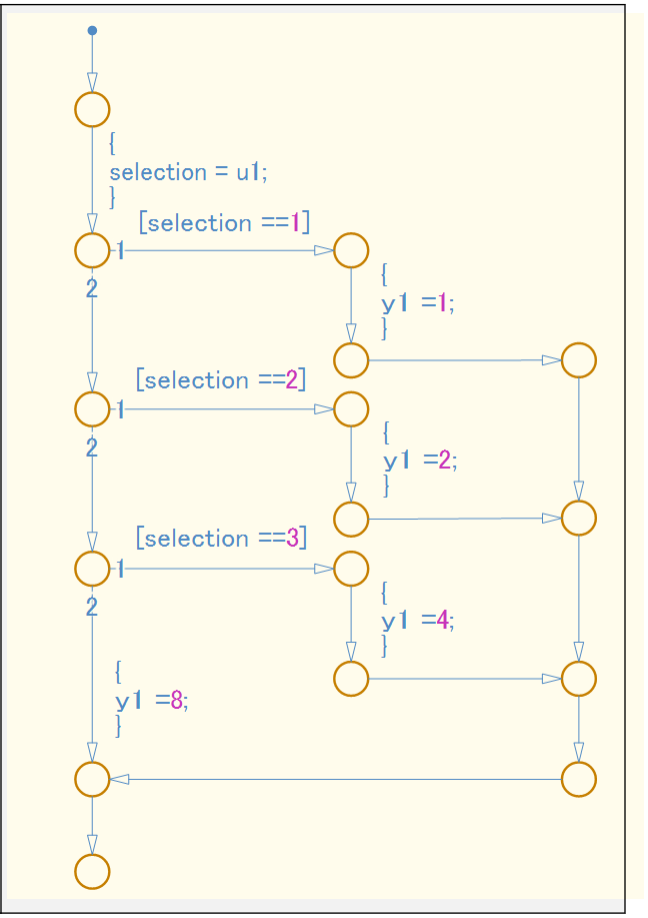
Flow Chart Patterns for Case Constructs

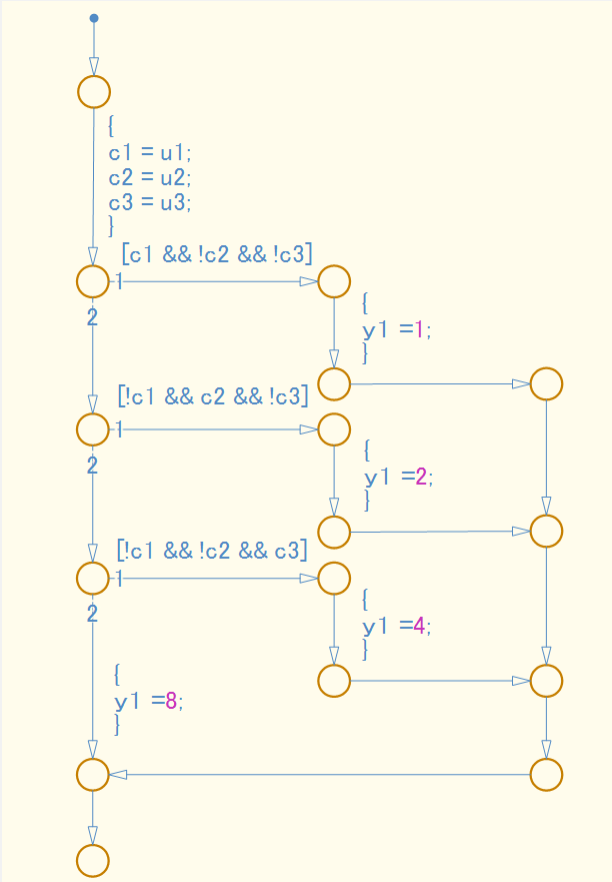
These patterns shall be used for case constructs in Stateflow flow charts.

Function	Flow Chart Pattern

Case construct with exclusive selection.

```
selection = u1;
switch (selection) {
    case 1:
        y1 = 1;
        break;
    case 2:
        y1 = 2;
        break;
    case 3:
        y1 = 4;
        break;
    default:
        y1 = 8;
}
```

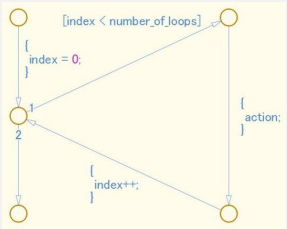


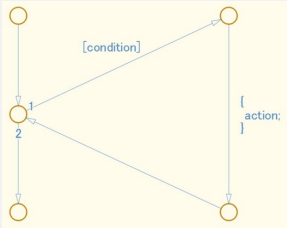
Case construct with exclusive conditions.
 	
`c1 = u1;`
`c2 = u2;`
`c3 = u3;`
`if (c1 && ! c2 && ! c3) {`
`  y1 = 1;`
`}`
`elseif (! c1 && c2 && ! c3) {`
`  y1 = 2;`
`}`
`elseif (! c1 && ! c2 && c3) {`
`  y1 = 4;`
`}`
`else {`
`  y1 = 8;`
`}`
	

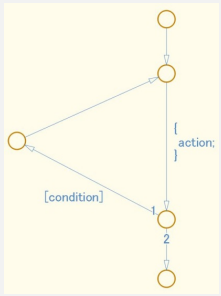
Flow Chart Patterns for Loop Constructs

These patterns shall be used to create loop constructs in Stateflow flow charts.

Function	Flow Chart Pattern

For loop construct
 	
`for ( index = 0;`
`  index < number_of_loops;`
`  index++ )`
`{`
`  action;`
`}`
	

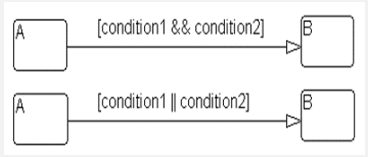
While loop construct
 	
`while ( condition )`
`{`
`  action;`
`}`
	

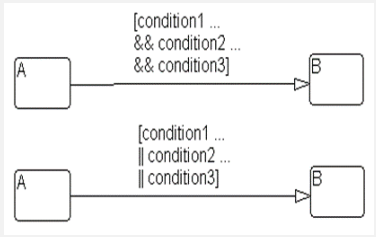
Do While loop construct.
 	
`do`
`{`
`  action;`
`}`
`while ( condition )`
	

State Machine Patterns for Conditions

These patterns shall be used for conditions within Stateflow state machines

Function	State Machine Pattern
One condition `(condition)`	

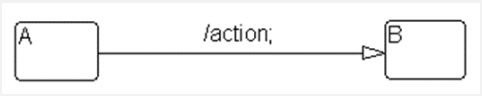
Up to three conditions, short form
 	
(The use of different logical operators in this form is not allowed, use sub conditions instead)
 	
`(condition1 && condition2)`
`(condition1 || condition2)`
	

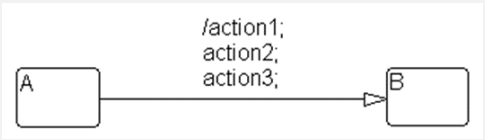
Two or more conditions, multiline form
 	
A subcondition is a set of logical operations, all of the same type, enclosed in parentheses.
 	
(The use of different operators in this form is not allowed, use sub conditions instead.)
 	
`(condition1 ...`
`&& condition2 ...`
`&& condition3)`
 	
`(condition1 ...`
`|| condition2 ...`
`|| condition3)`
	

State Machine Patterns for Transition Actions

These patterns shall be used for transition actions within Stateflow state machines.

Function	State Machine Pattern

One transition action. `action;`	

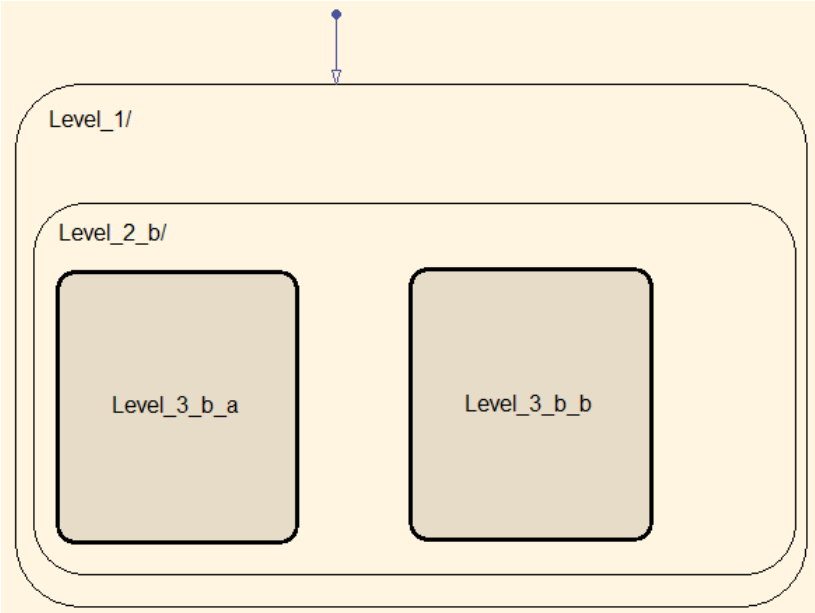
Two or more transition actions, multiline form
 	
(Two or more transition actions in one line are not allowed.)
 	
`action1;`
`action2;`
`action3;`
	

jc_0321Limiting State Layering

Within a single viewer (subviewer), multiple layering shall be limited by defining constraints for a single view (subview). Subcharts shall be used to switch the screen when defined constraint goals are exceeded.

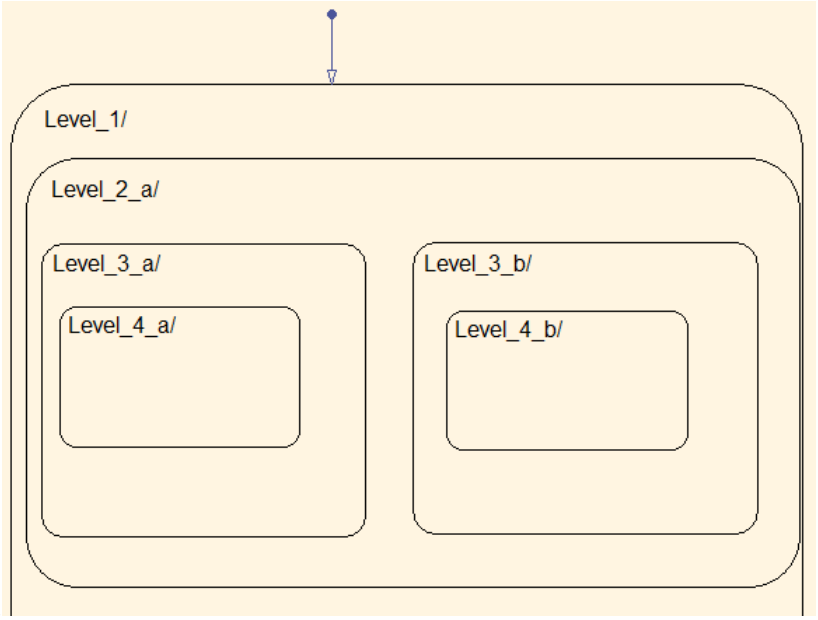
Example — Recommended

The fourth level is encapsulated in a subchart.



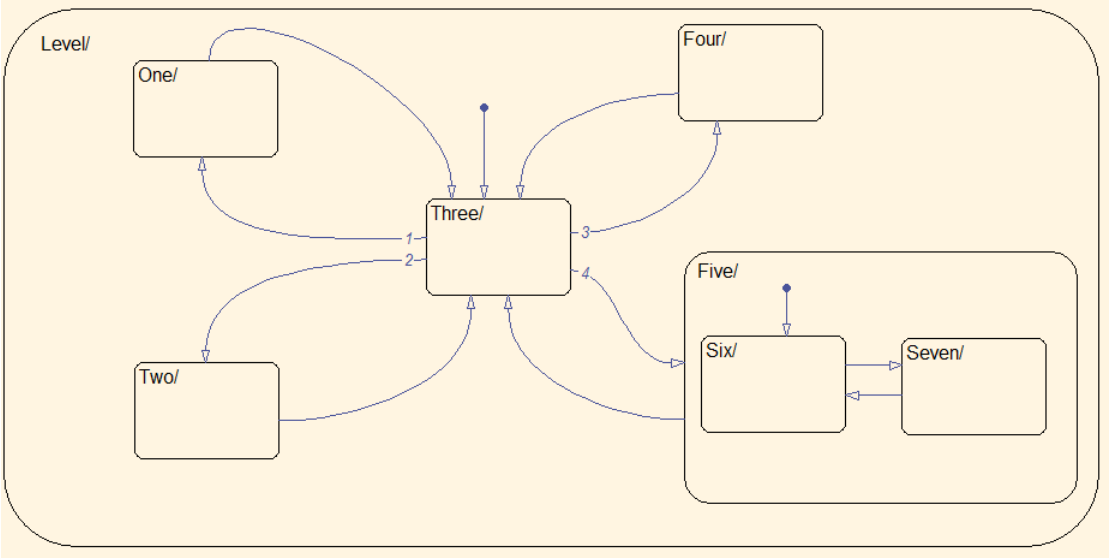
Example — Not Recommended

The constraint goal is set to three levels, but Level_4_a and Level_4_b have more than three levels and are nested.



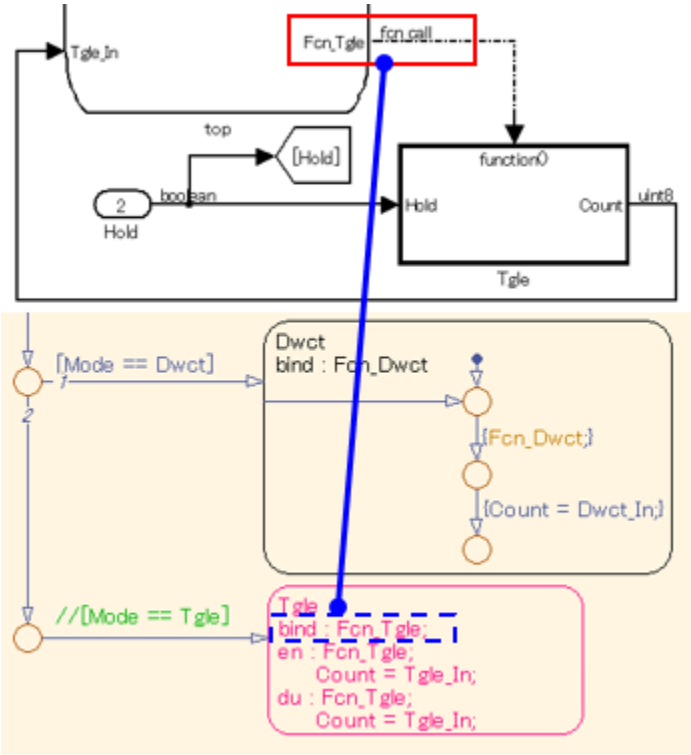
Number of States per Stateflow Container

The number of states per Stateflow container shall be determined by the number of states that can be viewed in the diagram. All states should be visible and readable.



Function Call from Stateflow

If a state exists in the Function-Call Subsystem of the call target, and a “reset” of the state is required when the state of the caller becomes inactive, the caller shall use a bind action.



Function Types Available in Stateflow

The functions types used in Stateflow shall be dependent on the required processing.

For graphical functions, use:

- `If`, `elseif`, `else` logic

For Simulink functions, use:

- Transfer functions
- Integrators
- Table look-ups

For MATLAB functions, use:

- Complex equations
- `If`, `elseif`, `else` logic

Glossary

Atomic Subsystem

A subsystem block that executes the structural subsystem as a single unit. Conditional subsystems, Stateflow Chart, and MATLAB Function blocks are considered atomic subsystems.

Basic Blocks

Built-in blocks in the standard Simulink library. Blocks with undefined internal processing, such as subsystems, are not considered basic blocks

Basic blocks can include:

- Inport
- Outport
- Ground
- Terminator
- Constant
- Scope
- Saturation
- Unit Delay
- Delay
- Discrete-Time Integrator
- Switch
- Gain
- Product
- Relational Operator
- Logical Operator

Block

All blocks (type=block), including:

- Subsystems
- Models
- Charts (unless otherwise stated).

Standard Simulink library blocks are divided into two categories:

- Basic blocks
- Structural subsystems

Built-in MATLAB functions

MATLAB functions and scripts.

Combined State Action Type

A combination of two or more of these basic state action types:

- entry (`en`), during (`du`)
- during (`du`), exit (`ex`)
- entry (`en`), exit (`ex`)
- entry (`en`), during (`du`), exit (`ex`)

Conditional Input Block

Includes Trigger, Enable, Function-Call Subsystem, Reset blocks.

Conditional Subsystem

A subsystem with conditional input ports.

Delay Block

Two meanings:

1. The previous value reference block that is placed in the loop route to specify the execution order in an algebraic loop (circular reference). Uses Unit Delay and Memory blocks.

   (As of R2021b at later) The Delay block can also be used
2. A block that retains past values. Uses Unit Delay, Memory, Delay, and Tapped Delay blocks.

Calculation Block

Blocks whose block type is "sum" that carry out addition and subtraction operations. Includes Add, Subtract, Sum, Sum of Elements blocks.

Flow Chart

The part of a model that describes the action for the transition condition by using transition conditions and condition actions. The start point is the default transition line or internal transition line. The end point is the connective junction. Does not include states that are between the start and end points. Graphical functions and the inside of states can be modelled as flow charts

Machine Level

The root subsystem of a Simulink model with Stateflow blocks.

Multiplication and Division Block

Blocks whose block type is "product" that carry out division and multiplication operations. Includes Product, Divide, and Product of Elements blocks.

Parameters

When modifications have not been made, this term refers to constants that are defined in the base workspace and/or model workspace.

Port Label Name

The input and output port labels of a structural subsystem.

The names of Inport and Outport blocks are placed in a subsystem by default. Names of Stateflow input and output data are displayed by default.

The display option can be changed when masking a subsystem.

Reserved MATLAB words

MATLAB keywords and built-in MATLAB functions.

State

An atomic subchart is considered a state.

State Action Type

Basic state action types and combined state action types.

Stateflow Block

Includes Chart, State Transition Table, and Truth Table blocks.

Subsystem

A subsystem that can be internally modeled by using Simulink.

Even when the block type is "subsystem", blocks that describe the inside (other than Simulink) of a model, such as Chart, MATLAB Function blocks, are not included. The Model block also is not included.