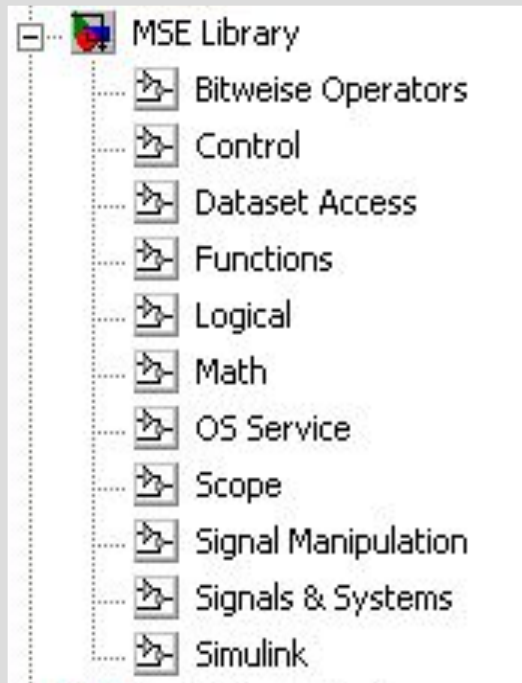


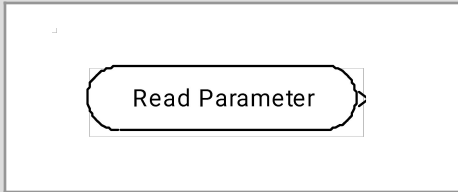
MSE block library for Simulink

Library – a function description language for an engineer



- Minimum set of elementary operations for composing control functions
- Integration with the data preparation system
- Automatic data scaling in operations
- Automatic data conversion into binary form and vice versa
- Advanced diagnostics of data using accuracy
- Automatic generation of efficient code

Dataset Access Section



Read Parameter

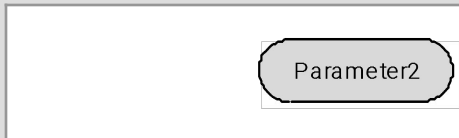
A universal function for accessing a parameter. When reading tables it makes interpolation.

Name	Type	Bit resolution
Parameter1	RAM-scalar	1
Parameter2	RAM-scalar	1
Parameter3	RAM-scalar	0.3
Vector1	ROM-vector	1
Matrix1	ROM-matrix	1

Simulink model



```
Parameter2_DA = Parameter1_DA;
```



```
Parameter2_DA = (int16_T)(((int32_T)Parameter3_DA) * 3 / 10 );
```



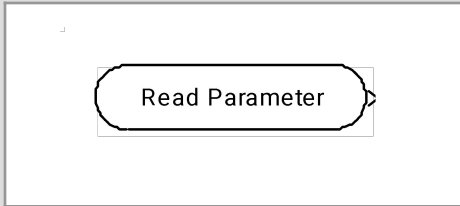
```
Parameter2_DA = Vector1_DA;
```



```
Parameter2_DA = Matrix1_DA;
```

C code

Dataset Access Section



Read Parameter without Interpolation

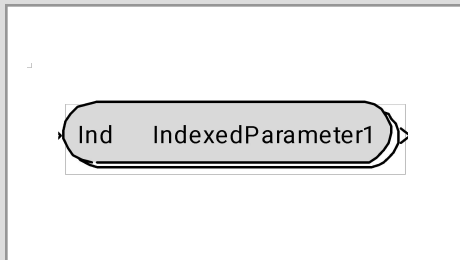
Extracts data from the nearest node of a parameter-table. It's used for calculation of dynamic table data.

Simulink model

C code



```
Parameter1_DA = Vector1_DA;
```

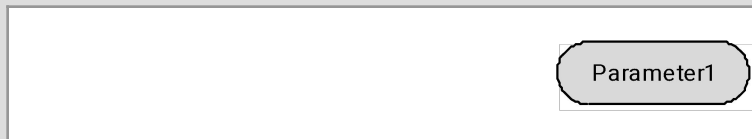


Read Indexed Parameter

Reads parameters representing linear data arrays, for example corresponding to a number of engine cylinders. It's similar to the "Read Parameter" block.

Simulink model

C code

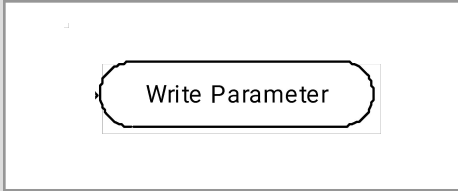


```
Parameter1_DA = IndexedParameter1_DA[Index_DA];
```

Dataset Access Section

Write Parameter

Writes a value into a specified parameter.

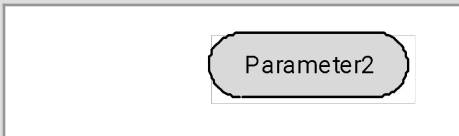


Name	Type	Bit resolution
Parameter1	RAM-scalar	1
Parameter2	RAM-scalar	0.3
VarMatrix1	RAM-matrix	1

Simulink model



```
Parameter1_DA = (int16_T)7;
```

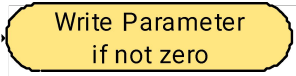


```
Parameter2_DA = (int16_T)(7 * 10 / 3 );
```



```
Matrix2_DA = (int16_T)7;
```

Dataset Access Section

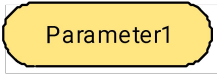


Write Parameter
if not zero

Simulink model

Write if not zero

Writes into a parameter all but zero values. It's often used for writing codes of errors.



Parameter1

Simulink model

C code

```
int16_T tmpVar_slnt16_0;  
tmpVar_slnt16_0 = (int16_T)7;  
if (tmpVar_slnt16_0 != 0) Parameter1_DA = tmpVar_slnt16_0;
```

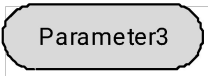


Write & Read
Parameter

Simulink model

Write & Read Parameter

Checks the presence of external control over a parameter. If it's controlled, writes external data into the parameter. Otherwise writes an input signal value.

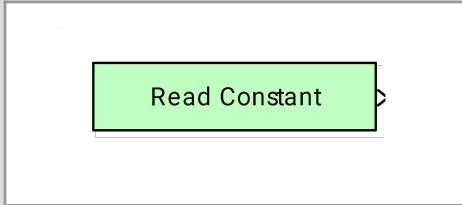


Parameter3

C code

```
if (Parameter2_DA_KEY)  
    Parameter2_DA_EXT = Parameter1_DA;  
else  
    Parameter2_DA = Parameter1_DA;  
    Parameter3_DA = Parameter2_DA;
```

Dataset Access Section



Compile Time Constant

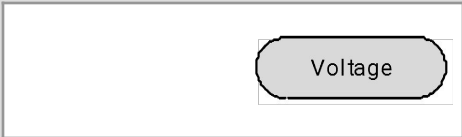
A constant value from a parameter set which doesn't require place in system's memory.

Name	Type	Bit resolution
Voltage	RAM-scalar	4.89 mV
SupplyVoltage	Constant	4.89 mV
RefVoltage	Constant	19.6 mV

Simulink model

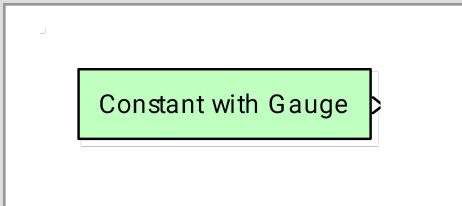


```
Voltage_DA = CONST_SupplyVoltage;
```



```
Voltage_DA = ((int16_T)CONST_RefVoltage) * 341 / 85;
```

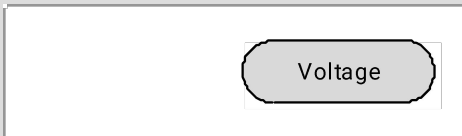
C code



Constant with Bit Gauge

A constant that isn't included in a parameters set. It's used inside a model only.

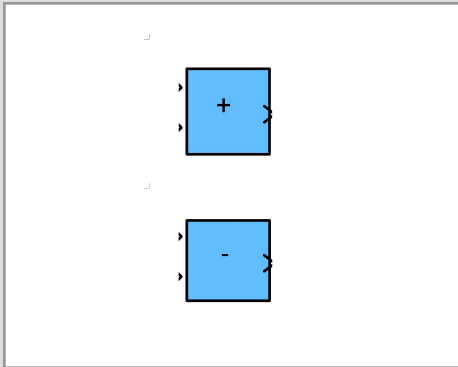
Simulink model



```
Voltage_DA = 675;
```

C code

Math Section



Add / Subtract

Adds (subtracts) values of input parameters.

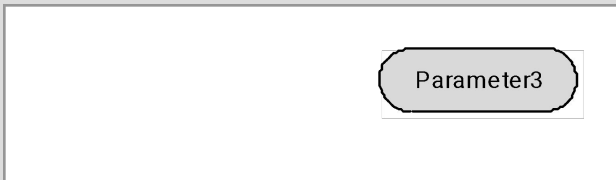
Allows operations only for parameters having the same combination of its basic units.

Automatically chooses the best representation for the output signal.

During modeling makes diagnosis of arithmetic overflow.

Name	Bit resolution
Parameter1	1
Parameter2	0.3
Parameter3	0.3

Simulink model



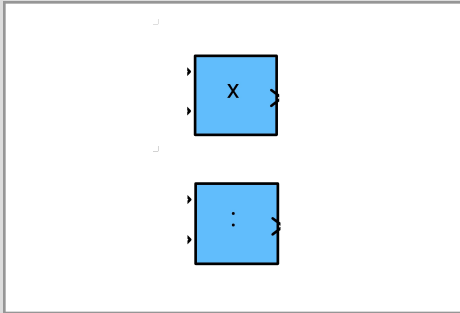
```
Parameter3_DA = (int16_T)(((int32_T)( Parameter1_DA +  
(int16_T)(((int32_T)Parameter2_DA) * 3 / 10 ))) * 10 / 3 );
```



```
Parameter3_DA = (int16_T)(((int32_T)( Parameter1_DA -  
(int16_T)(((int32_T)Parameter2_DA) * 3 / 10)))) * 10 / 3 );
```

C code

Math Section



Multiple / Divide

Multiplies (divides) values of input parameters.

Allows operations for that input signals which give the same combination of basis units as output signal has.

During modeling makes diagnosis of output signal overflow (division by zero).

Name	Bit resolution
Parameter1	1
Parameter2	0.3
Parameter3	0.3

Simulink model



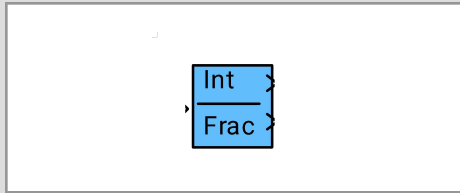
C code

```
Parameter3_DA = ( (int16_T)((int32_T)Parameter1_DA) *  
((int32_T)Parameter2_DA));
```



```
Parameter3_DA = ( (int16_T)((((int32_T)Parameter1_DA) * 100) /  
Parameter2_DA) / 9 );
```


Math Section

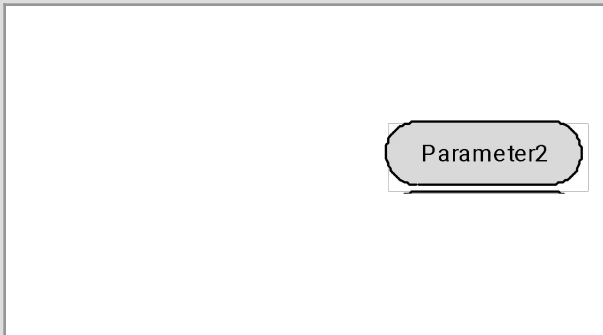


Integer / fractional

Splits a physical value of an input signal to its integer and fractional parts.

Name	Bit resolution
Parameter1	0.3
Parameter2	1
Parameter3	0.3

Simulink model



C code

```
int16_T block_B_IntegerFractional_o1;
```

```
int16_T block_B_IntegerFractional_o2;
```

```
block_B_IntegerFractional_o2 = Parameter1_DA % 3;
```

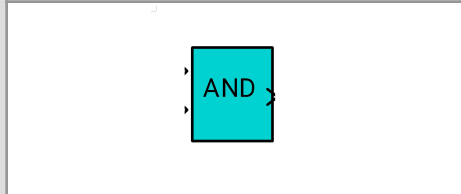
```
block_B_IntegerFractional_o1 = Parameter1_DA - block_B_IntegerFractional_o2;
```

```
Parameter3_DA = block_B_IntegerFractional_o2;
```

```
Parameter2_DA = (int16_T)(((int32_T)block_B_IntegerFractional_o1) * 3 / 10 );
```

Logical Section

An input value is TRUE (1) if it is nonzero and FALSE (0) if it is zero. The output type is specified with block settings. An output value is 1 if TRUE and 0 if FALSE.



AND

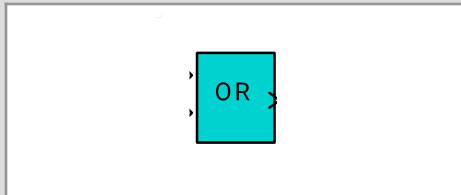
Performs the AND logical operation on its inputs. TRUE if all inputs are TRUE

Simulink model



C code

```
Parameter4_DA = ( ( Parameter1_DA && Parameter2_DA &&
Parameter3_DA) ? 1 : 0);
```



OR

Performs the OR logical operation on its inputs. TRUE if at least one input is TRUE

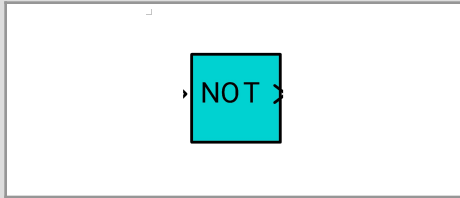
Simulink model



C code

```
Parameter4_DA = ( ( Parameter1_DA || Parameter2_DA ||
Parameter3_DA) ? 1 : 0);
```

Logical Section



NOT

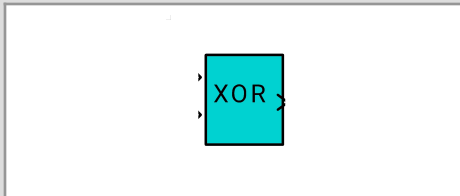
Performs the NOT logical operation on its input. TRUE if the input is FALSE.

Simulink model



C code

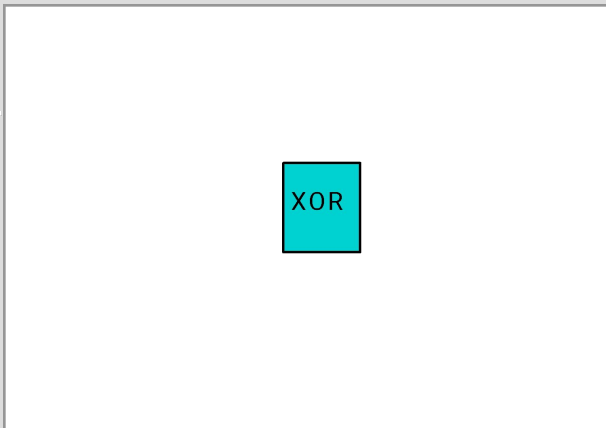
```
Parameter2_DA = ( Parameter1_DA ? 0 : 1);
```



XOR

Performs the XOR logical operation on its inputs. TRUE if only one input is TRUE.

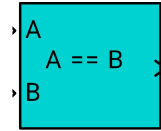
Simulink model



C code

```
uint8_T block_B_Xor;  
  
block_B_Xor = 0;  
if (Parameter1_DA != 0)  
    ++block_B_Xor;  
if (Parameter2_DA != 0)  
    ++block_B_Xor;  
block_B_Xor = block_B_Xor == 1 ? 1 : 0;  
Parameter3_DA = block_B_Xor;
```

Logical Section



If

Sets the output into 1 if a specified condition for two inputs is true otherwise into 0. Available conditions are =, ≠, ≤, ≥, <, >.

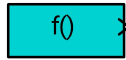
Simulink model



C code

```
Parameter3_DA = ( (Parameter1_DA <= Parameter2_DA) ? 1 : 0);
```

Control Section

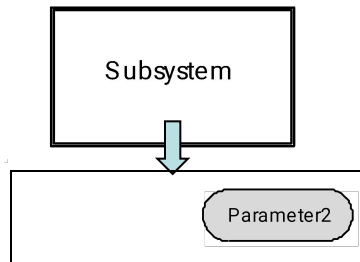


Function Call

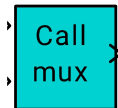
Runs the linked subsystem.

Simulink model

C code



```
Parameter2_DA = Parameter1_DA;
```

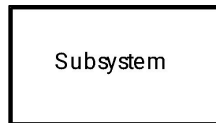


Call Multiplexer

Allows to run one subsystem by means of several signals of the function-call type.

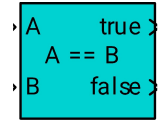
Simulink model

C code



```
void block_Subsystem(int_T controlPortIdx, int_T tid)
{
    // Operators of Subsystem;
}
block_Subsystem(0, 0);
block_Subsystem(1, 0);
block_Subsystem(2, 0);
block_Subsystem(3, 0);
```

Control Section

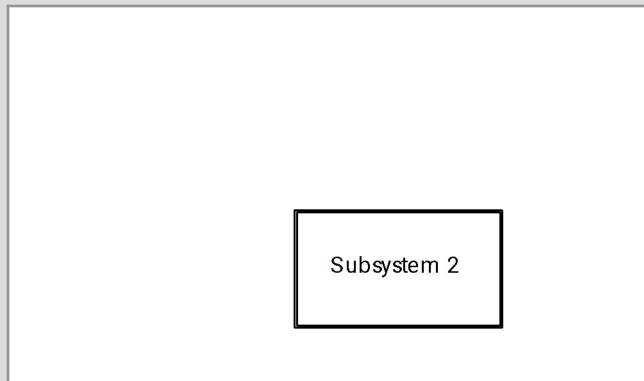


If

Checks the specified condition for two inputs and then it runs one of the linked subsystems according to the comparison result.

Name	Bit resolution
Parameter1	1
Parameter2	0.3

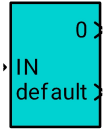
Simulink model



C code

```
if (Parameter1_DA >= (int16_T)(((int32_T)Parameter2_DA) * 3 / 10 ))
{
    // Operators of Subsystem1;
}
else
{
    // Operators of Subsystem2;
}
```

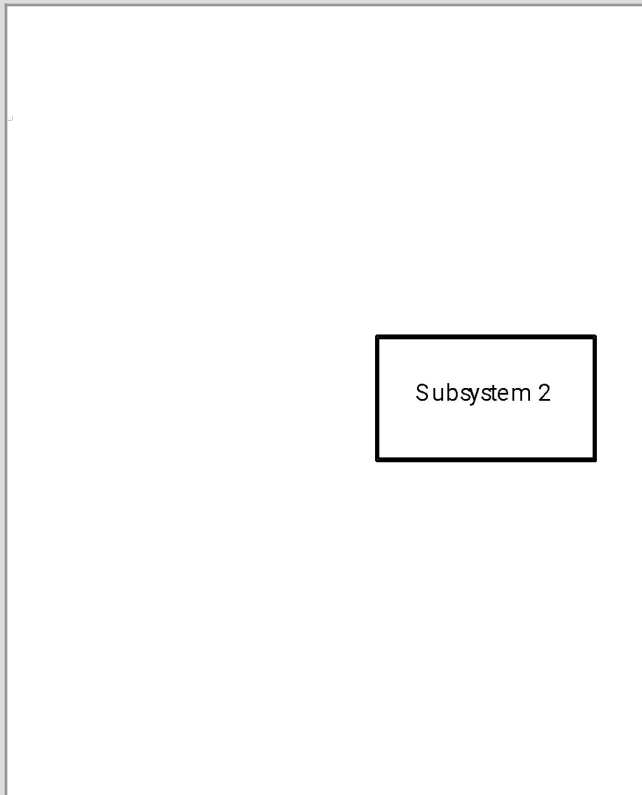
Control Section



Case

Calls one of two or greater subsystems connected to its output ports depending on an input signal value.

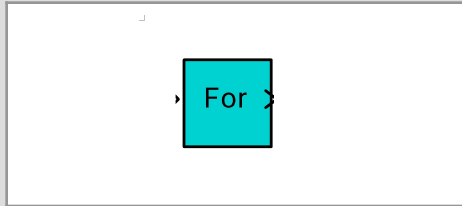
Simulink model



C code

```
switch (Variant_DA)
{
  case 0:
  {
    // Operators of Subsystem1;
  }
  break;
  case 1:
  {
    // Operators of Subsystem2;
  }
  break;
  default:
  {
    // Operators of Subsystem3;
  }
}
```

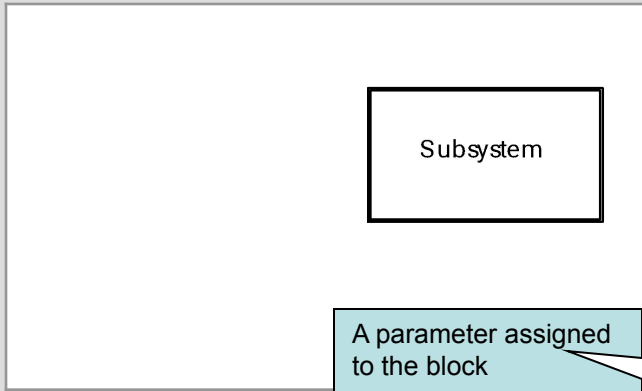
Control Section



For

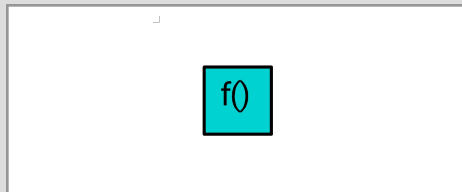
Calls cyclic execution of a subsystem connected to its output port. An iteration number is set by an input parameter value.

Simulink model



C code

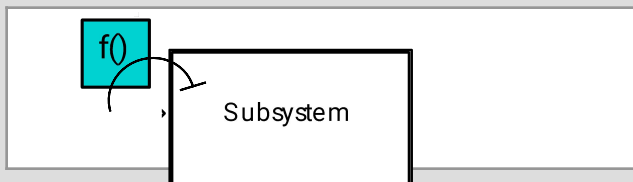
```
int16_T tmpVar_slInt16_0;  
  
for (tmpVar_slInt16_0 = 0; tmpVar_slInt16_0 < Parameter1_DA;  
    tmpVar_slInt16_0++)  
{  
    Index_DA = tmpVar_slInt16_0;  
    // Operators of Subsystem;  
}
```



Trigger

Allows to call a subsystem with a signal of a function-call type.

Simulink model



C code

```
// Operators of Subsystem called by a condition;
```


Signal Manipulation Section

A cyan rectangular block with the text "Change to Gauge" inside. It has an input arrow on the left and an output arrow on the right.

Change Bit Description

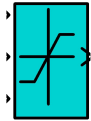
Converts an input gauge into the output one.

Simulink model

A grey rounded rectangular block with the text "Parameter2" inside.

C code

```
Parameter2_DA = ( (int16_T)(((int32_T)Parameter1_DA) * 10 / 3 ));
```



Saturation

Limits its input signal value within upper and lower thresholds. The block requires the same bit gauges for all input signals.

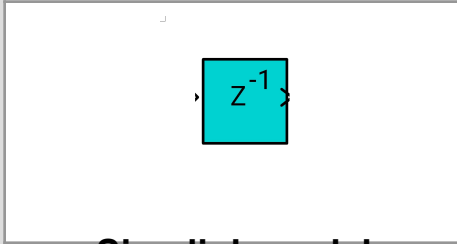
Simulink model

A grey rounded rectangular block with the text "VoltageLim" inside.

C code

```
int16_T block_B_Saturation;  
  
If (Voltage_DA < 205) block_B_Saturation = 205;  
else if (Voltage_DA > 1023) block_B_Saturation = 1023;  
else block_B_Saturation = Voltage_DA;  
VoltageLim_DA = block_B_Saturation;
```

Signal Manipulation Section

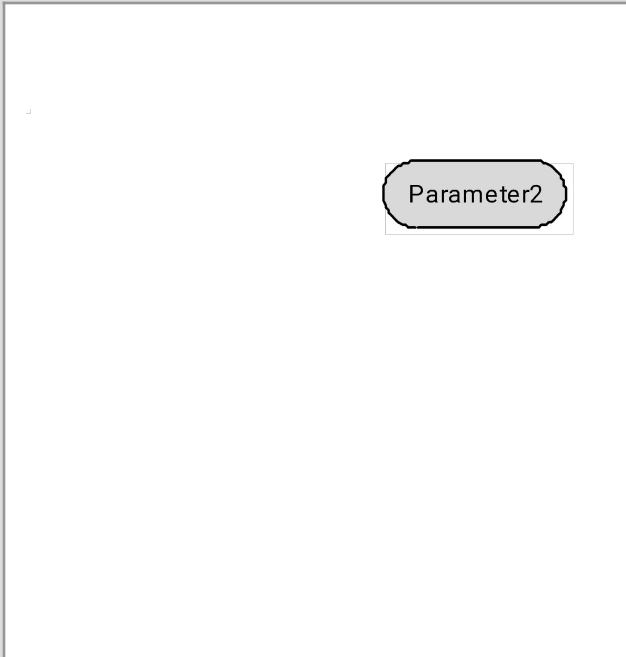


Simulink model

Delay

Assigns the last input signal value to its output signal. That is it realizes one model step delay.

C code



```
int16_T block_B_Delay;
```

```
int16_T block_B_ReadParameter1;
```

```
DISABLE_OPTIMIZATION
```

```
block_B_Delay = Buffer_DA;
```

```
ENABLE_OPTIMIZATION
```

```
Parameter2_DA = block_B_Delay;
```

```
block_B_ReadParameter1 = Parameter1_DA;
```

```
DISABLE_OPTIMIZATION
```

```
if (block_B_Delay == Buffer_DA)
```

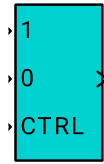
```
{
```

```
    Buffer_DA = block_B_ReadParameter1;
```

```
}
```

```
ENABLE_OPTIMIZATION
```

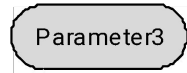
Signal Manipulation Section



Multiport Switch

Sends an input signal value to its output port. Index of the input port is defined by a value of its control signal.

Simulink model



C code

```
int16_T block_B_MultiportSwitch;
```

```
switch (Variant_DA)
```

```
{
```

```
  case 0:
```

```
    block_B_MultiportSwitch = Parameter1_DA;
```

```
    break;
```

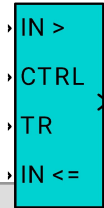
```
  default:
```

```
    block_B_MultiportSwitch = Parameter2_DA;
```

```
}
```

```
Parameter3_DA = block_B_MultiportSwitch;
```

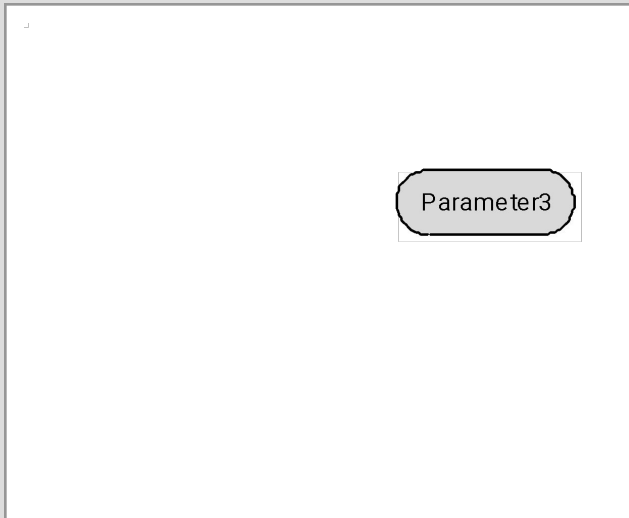
Signal Manipulation Section



Two-In Switch

Sends to its output port signals from the port “IN <=“ or “IN >” depending on a comparison result of the control signal “CTRL” with the threshold TR”.

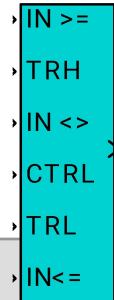
Simulink model



C code

```
int16_T block_B_TwainSwitch;  
  
if (Value_DA > Threshold_DA)  
{  
    block_B_TwainSwitch = Parameter2_DA;  
}  
else  
{  
    block_B_TwainSwitch = Parameter1_DA;  
}  
Parameter3_DA = block_B_TwainSwitch;
```

Signal Manipulation Section

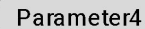


› IN >=
› TRH
› IN <>
› CTRL
› TRL
› IN <=

Three-In Switch

Compares a value of the “CTRL” signal with the threshold values “TRL” and “TRH”. Depending on a comparison result sends the signal “IN <=”, “IN <>” or “IN >=” to its output port.

Simulink model



Parameter4

C code

```
int16_T block_B_ThreeinSwitch;  
  
if (Value_DA >= HighThreshold_DA)  
{  
    block_B_ThreeinSwitch = Parameter3_DA;  
}  
else if (Value_DA <= LowThreshold_DA)  
{  
    block_B_ThreeinSwitch = Parameter1_DA;  
}  
else  
{  
    block_B_ThreeinSwitch = Parameter2_DA;  
}  
Parameter4_DA = block_B_ThreeinSwitch;
```

Signal Manipulation Section

- IN >=
- TRH
- CTRL >
- TRL
- IN <=

Simulink model

Parameter3

Switch with hysteresis

A signal from the port “IN<=“ is sent to the output until a signal of the port “CTRL” is lower than the one of “TRH”. As soon as a “CTRL” value exceeds a “TRH” level a “IN >=“ signal is sent to the output. It’s kept until a “CTRL” value is higher than a “IN <=“ value.

C code

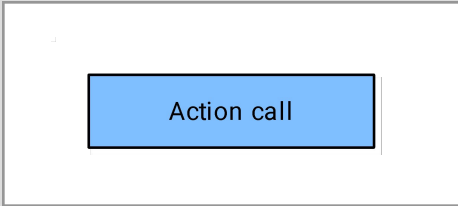
```
uint16_T block_tmp_SwitchwithHysteresis; // static
int16_T block_B_SwitchwithHysteresis;

if (ControlValue_DA >= HighThreshold_DA)
{
    block_tmp_SwitchwithHysteresis = 1;
}
else if (ControlValue_DA <= LowThreshold_DA)
{
    block_tmp_SwitchwithHysteresis = 0;
}
if (block_tmp_SwitchwithHysteresis)
{
    block_B_SwitchwithHysteresis = Parameter2_DA;
}
else
{
    block_B_SwitchwithHysteresis = Parameter1_DA;
}
Parameter3_DA = block_B_SwitchwithHysteresis;
```

OS Service Section

Action Call

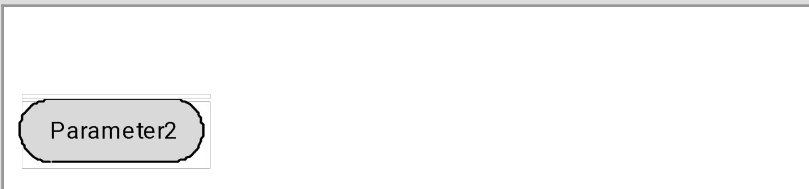
Calls an external function with input and output parameters.



Name	Bit resolution	Action inputs	Bit resolution
Parameter1	1	Input1	1
Parameter2	0.3	Input2	1

Simulink model

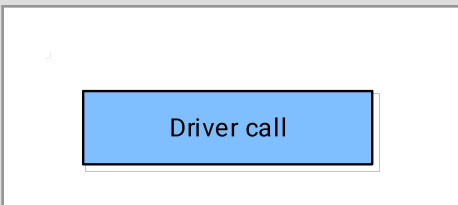
C code



```
Action_SET_PARAM(Parameter1_DA,  
((int16_T)(((int32_T)Parameter2_DA) * 3 / 10 )));
```

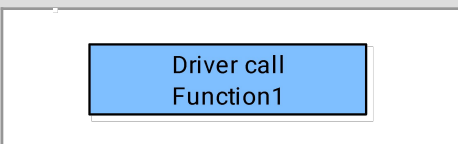
Driver Call

Calls an external function without parameters.



Simulink model

C code

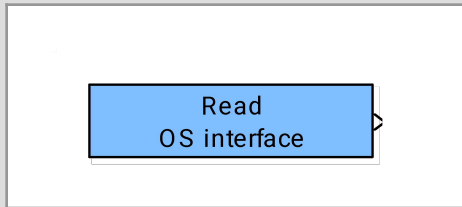


```
Function1();
```

OS Service Section

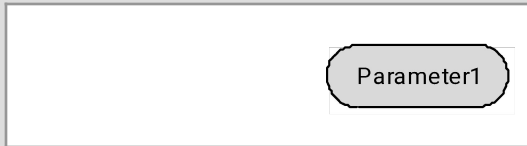
Read System Variable

Reads a system variable to transmit its value from the system software level to the application software level.



Simulink model

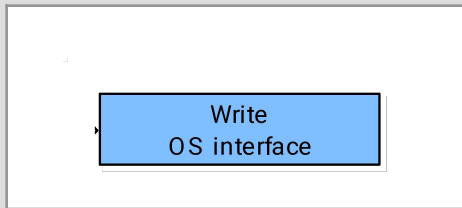
C code



```
Parameter1_DA = OSVariable1;
```

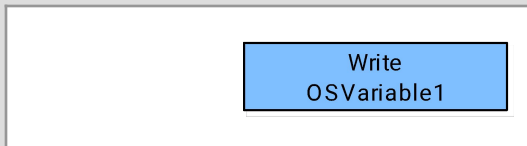
Write System Variable

Writes a parameter into a system variable to transmit its value from the application software level to the system software level.



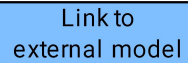
Simulink model

C code



```
OSVariable1 = Parameter1_DA;
```


OS Service Section

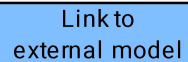


Link to
external model

Link to External Model

Calls an external model located in an external file.

Simulink model



Link to
external model

C code

```
Model1_step();
```

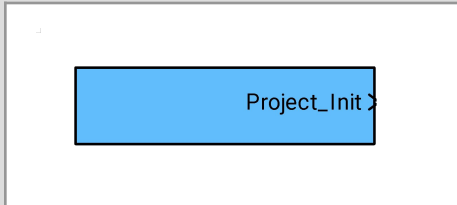
```
void Model_initialize(boolean_T firstTime)
```

```
{  
  if (firstTime) {  
    Model1_initialize(1);  
  }  
}
```

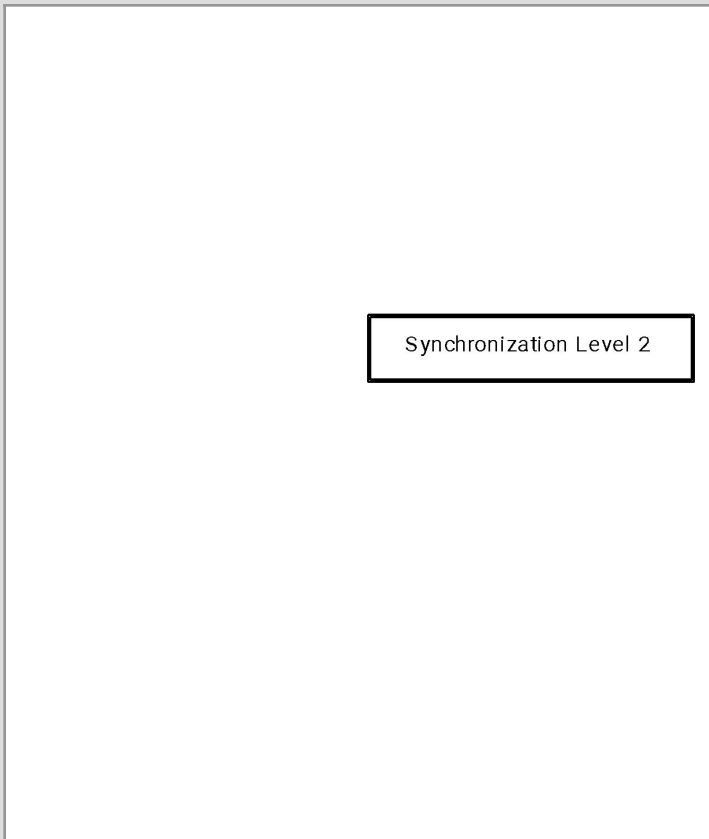
OS Service Section

OS Scheduler

Provides running synchronization levels containing control functions.



Simulink model



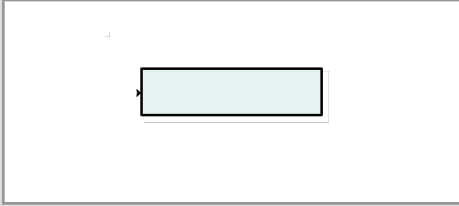
C code

```
void _Level1()
{
    // Operators of subsystem 'Synchronization Level 1'
}
void _Level2()
{
    // Operators of subsystem 'Synchronization Level 2'
}
void Project_Init()
{
    // Operators of subsystem 'Initialization'
}

const _FUNC_XHUGE TaskTable[LEVELS_COUNT] = { // Functions
    _Level1, _Level2 };

const unsigned char PriorsTable[LEVELS_COUNT] = { // Priorities
    0x00, 0x00, 0x00 };
```

Bitwise Operators Section



Get Bits

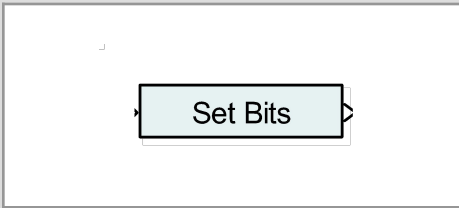
Returns bit values extracted from an input parameter.

Simulink model



C code

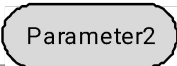
```
Parameter3_DA = ( (Parameter1_DA & 0x4) == 0x4 ? 1 : 0);  
Parameter2_DA = ( (Parameter1_DA & 0x1) == 0x1 ? 1 : 0);  
Parameter4_DA = ( (Parameter1_DA & 0x8000) == 0x8000 ? 1 : 0);
```



Set Bits

Sets bits of an output parameter according to a specified bit mask.

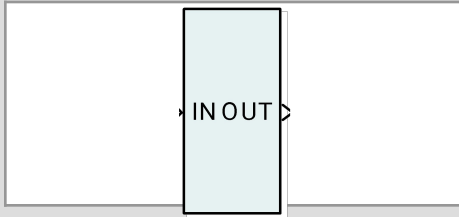
Simulink model



C code

```
Parameter2_DA = ( Parameter1_DA | 0x8085);
```

Bitwise Operators Section



Pack Bits

Sets bits of an output parameter according to input logical parameters.

Simulink model



C code

```
uint16_T block_B_PackBits;
```

```
block_B_PackBits = LogicParameter1_DA != 0 ? Parameter1_DA | 0x1 :  
    Parameter1_DA & 0xFFFE;
```

```
block_B_PackBits = LogicParameter2_DA != 0 ? block_B_PackBits | 0x4 :  
    block_B_PackBits & 0xFFFB;
```

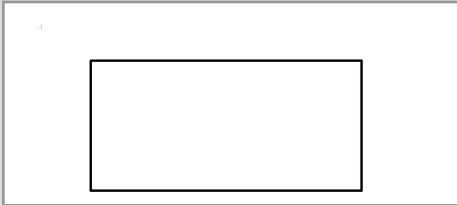
```
block_B_PackBits = LogicParameter3_DA != 0 ? block_B_PackBits | 0x8000 :  
    block_B_PackBits & 0x7FFF;
```

```
Parameter2_DA = block_B_PackBits;
```

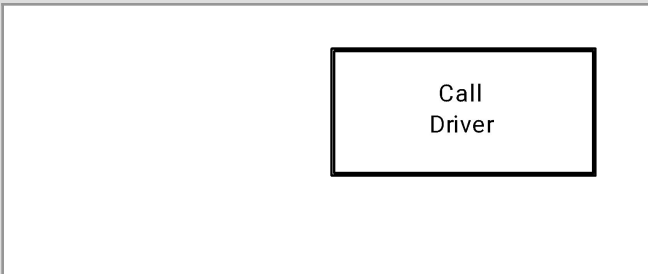
Signals & Systems Section

Subsystem

It is a container for the library blocks.



Simulink model



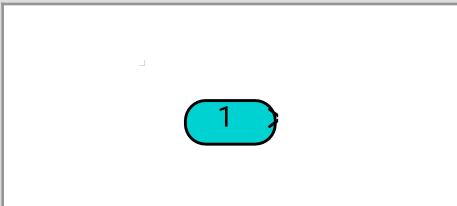
C code

```
// Operators of subsystem 'Calculation of Operators'
```

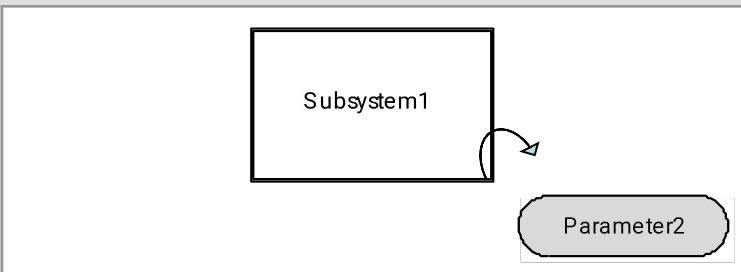
```
// Operators of subsystem 'Call Driver'
```

Input Port

Transmits a signal to a subsystem.



Simulink model



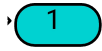
C code

```
Parameter2_DA = ( Parameter1_DA);
```

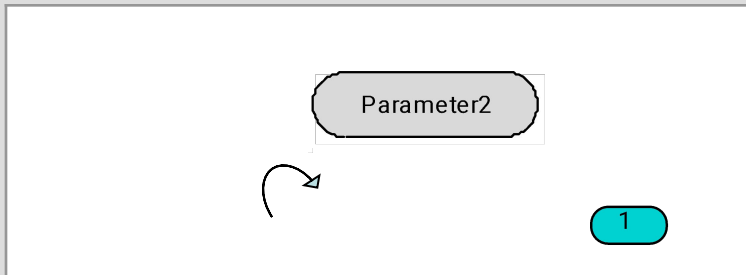
Signals & Systems Section

Output Port

Transmit a signal out of a subsystem.



Simulink model



C code

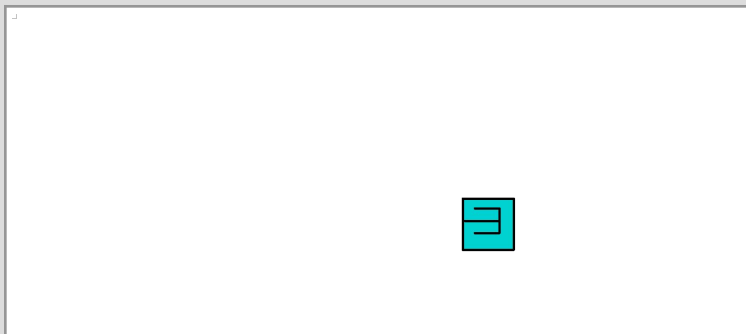
```
Parameter2_DA = ( Parameter1_DA);
```

Terminator

Terminates unused branches.



Simulink model



C code

```
if (Parameter1_DA >= Parameter2_DA)
{
    // Operators of subsystem 'Subsystem1'
}
else
{
}
```