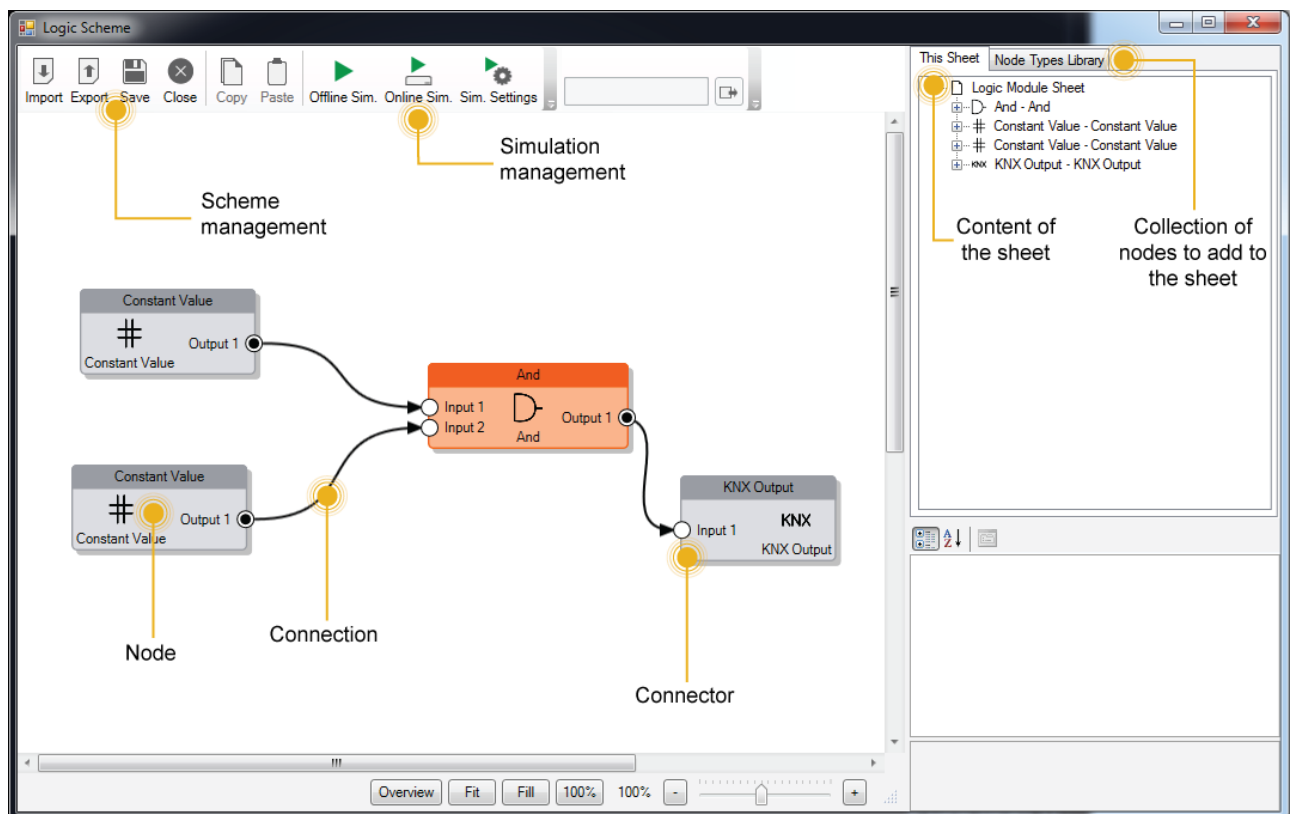


# Logic Module

- Scheme management
- Simulation management
- Nodes, Connectors and Connection
  - Input nodes
  - Output nodes
  - Analog nodes
  - Counter nodes
  - Logic nodes
  - Timer nodes
  - Math nodes

## 4. Logic Examples

Each logic scheme represents a **sheet** containing block units. In the sheet it is possible to add several kinds of **nodes**, each one of them corresponding to a specific function in the server. The interaction of the node is defined by its **connectors** which are inputs and outputs of the node. Several nodes can be linked together by creating **connections** among the nodes. A connection is a link that starts from an output connector in a node and ends in an input connector.



## Scheme management

The logic scheme can be managed with the following buttons in the toolbar:

- **Import** It imports the block diagram contained in a XML file into the current logic scheme.  
*This operation overwrites completely the logic scheme!*

- **Export** It exports the current logic scheme in an XML file so that can be used inside other logic schemes. *This operation doesn't save the current logic scheme inside the Configurator but just exports it!*
- **Save** It saves the current logic scheme inside Configurator.
- **Close** It closes the logic scheme editor window.

## Simulation management

The simulation feature allows to predict and debug what will happen when the block diagram will be executed inside the Thinknx server. Inside Thinknx Logic Module there are two kinds of simulation: **Offline Simulation** and **Online Simulation**.

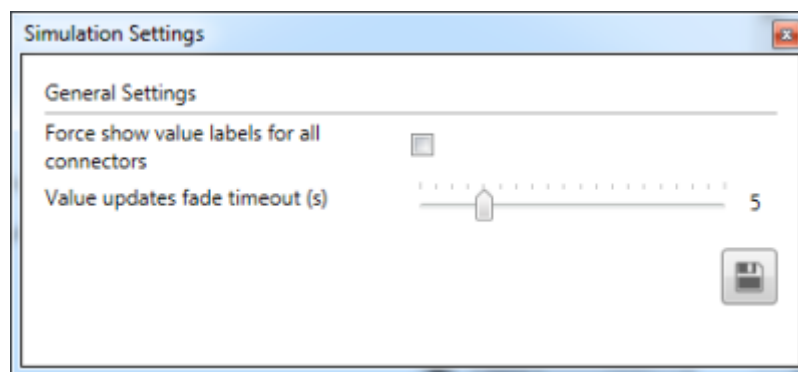
**Offline simulation** simulates the behavior of the server by executing the block diagram inside Configurator and showing in realtime the values passing by all inputs and outputs of the nodes. In this way the user keeps trace of the values due some input values.

**Online simulation** connects to Thinknx server and provides feedback regarding the execution of the block diagram directly inside the server.



Online simulation only works if the Configurator is in the same local network of the server. The IP needed for the connection corresponds to Local IP address specified in the System object.

The feedback provided while the simulation is running can be managed with some parameters by clicking the **Sim. Settings** button in the toolbar:

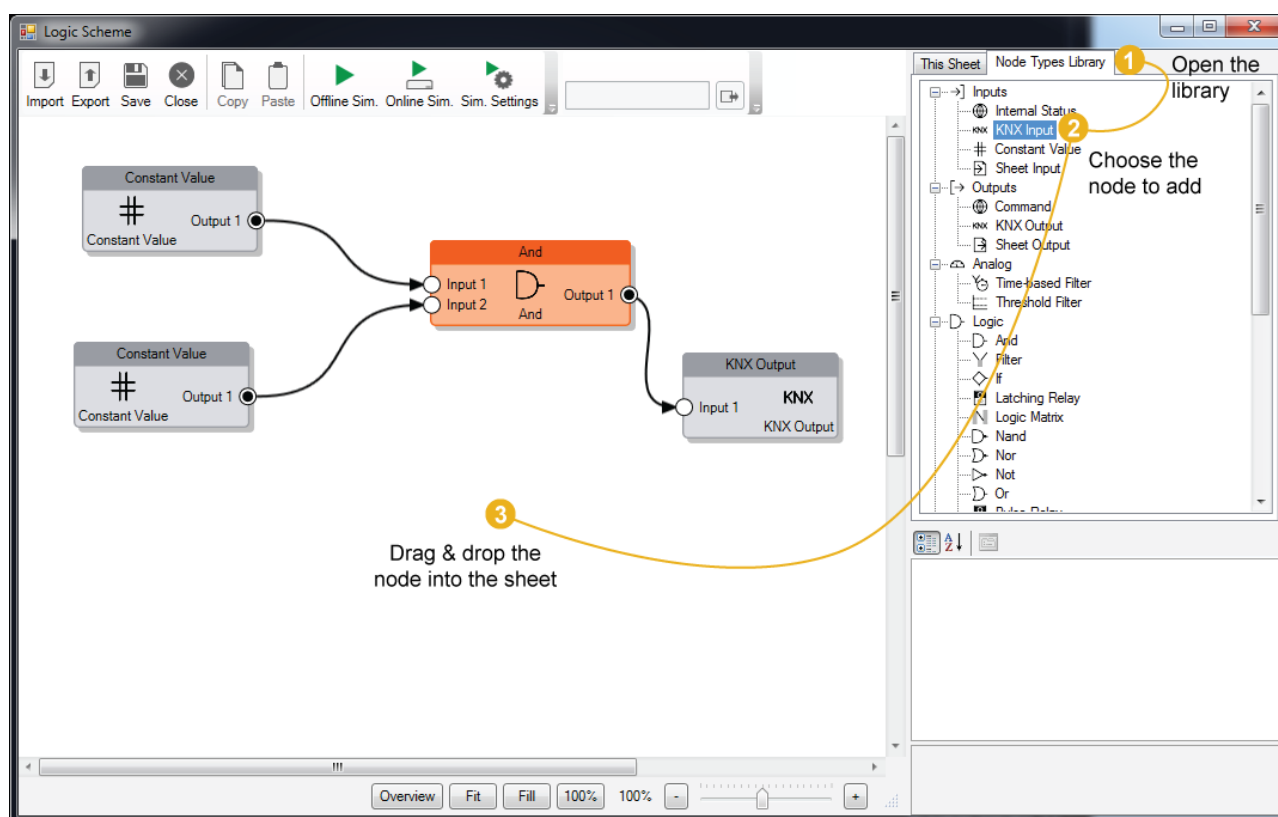


- **Force show value labels for all connectors** During a simulation, when the value passing by a connector is updated, a box showing the value appears beside the connector. To force this box to always be shown during simulation, check this box.
- **Value updates fade timeout** If the previous checkbox is unchecked, it indicates the time the update will be shown on the screen.

## Nodes, Connectors and Connections

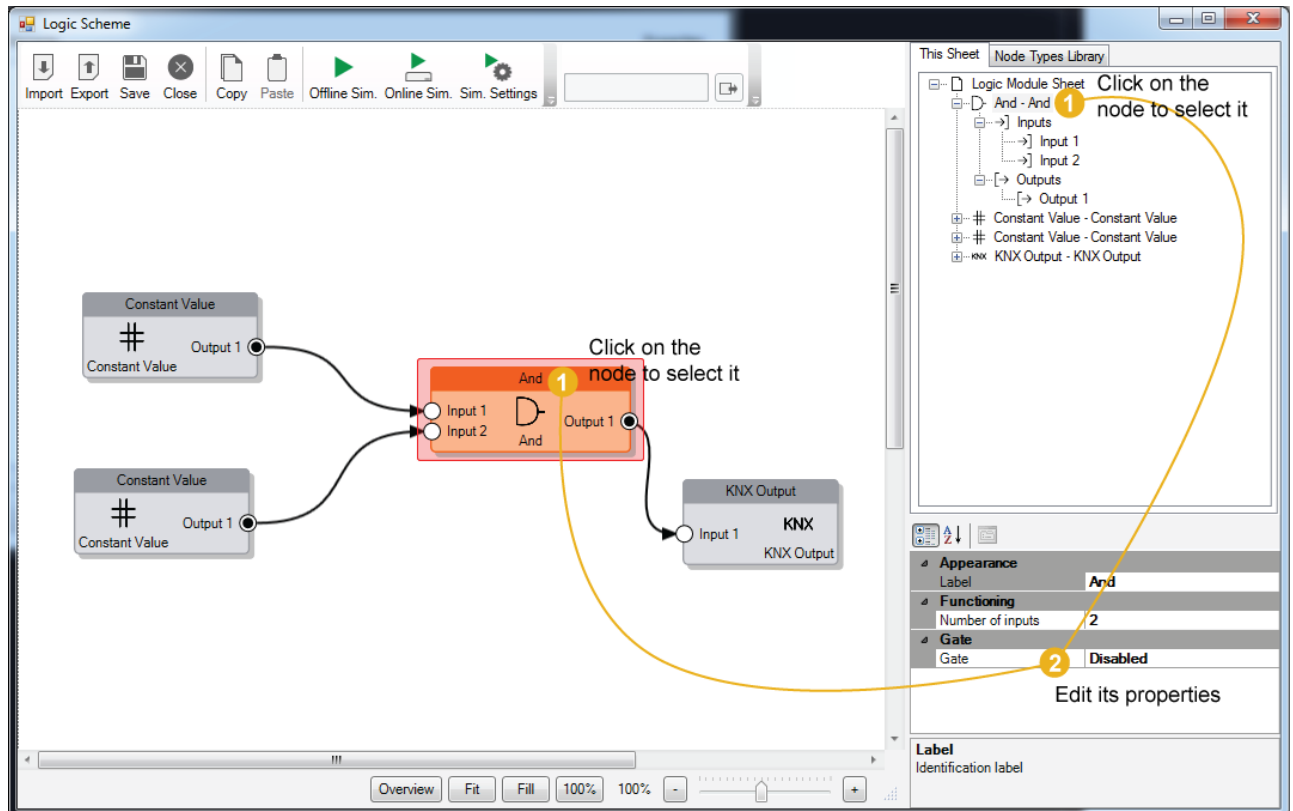
### Create a node

To create a node, open the “Node Types Library” and drag the desired node into the sheet. For each node it is possible to edit its properties by clicking on it.



## Edit a node

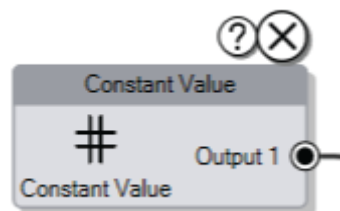
By selecting the node, the property grid gets populated with its properties, by editing them the behavior of the node will change.



Every connector in the node has its own properties to describe its behavior. To edit them, click on the connector and the properties will be displayed in the property grid.

It is possible to select multiple nodes by pressing the *Shift* key.

## Delete a node



To delete a node, select it and press Del key, or click on the little X icon which appears by moving the mouse over the node. After the node has been deleted, all the connection associated to the node will be removed.

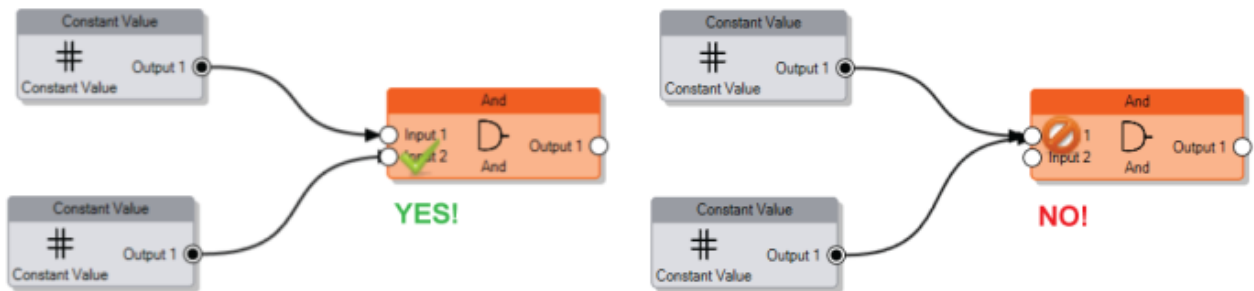
## Create a connection between nodes

To build the block diagram, it is necessary to link the nodes among each other. To create a connection click and hold one connector in the node and drag the mouse until the connector of the destination node. Before releasing the mouse, if the connection respects the standard rules among nodes, a green check will appear near the destination connector.



Connections can be established ONLY between an output connector and an input connector belonging to different nodes.

One output connector can link to several input connectors but one input connector can link to just one output connector!

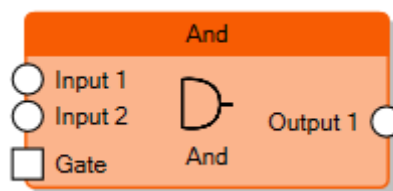


## Data compatibility among nodes

There are no limitation in the creation of a new connection due to data compatibility, the incoming values will be automatically converted to the expected input type following these rules:

- **Bit to Number** When a logic output (a bit) is connected to an analog input (a number), the system will convert the logic 0 (False) to 0 and the logic 1 (True) to 1.
- **Number to Bit** When an analog output (a number) is connected to a logic input (a bit), the system will convert the analog value to a logic 0 (False) if it is equal to 0, and to a logic 1 (True) for all the other values.
- **String to Bit** When a string coming from an input node is connected to a logic input, the system will convert the string to a logic 1 (True) only if the string is equal to 1 or to "true".
- **String to Number** When a string is connected to an analog input, the string value is converted into a number.

## Gate connector



Except for input and output nodes, all the nodes can be enabled and disabled with the **Gate** connector. To show the Gate connector on the node, the **Gate** property on the node must be enabled.



When a node is disabled, the computation is not performed and no values are sent to the output connectors even if an input connector receives a new value.

By selecting the Gate connector it is possible to edit its properties which determine the behavior of the node:

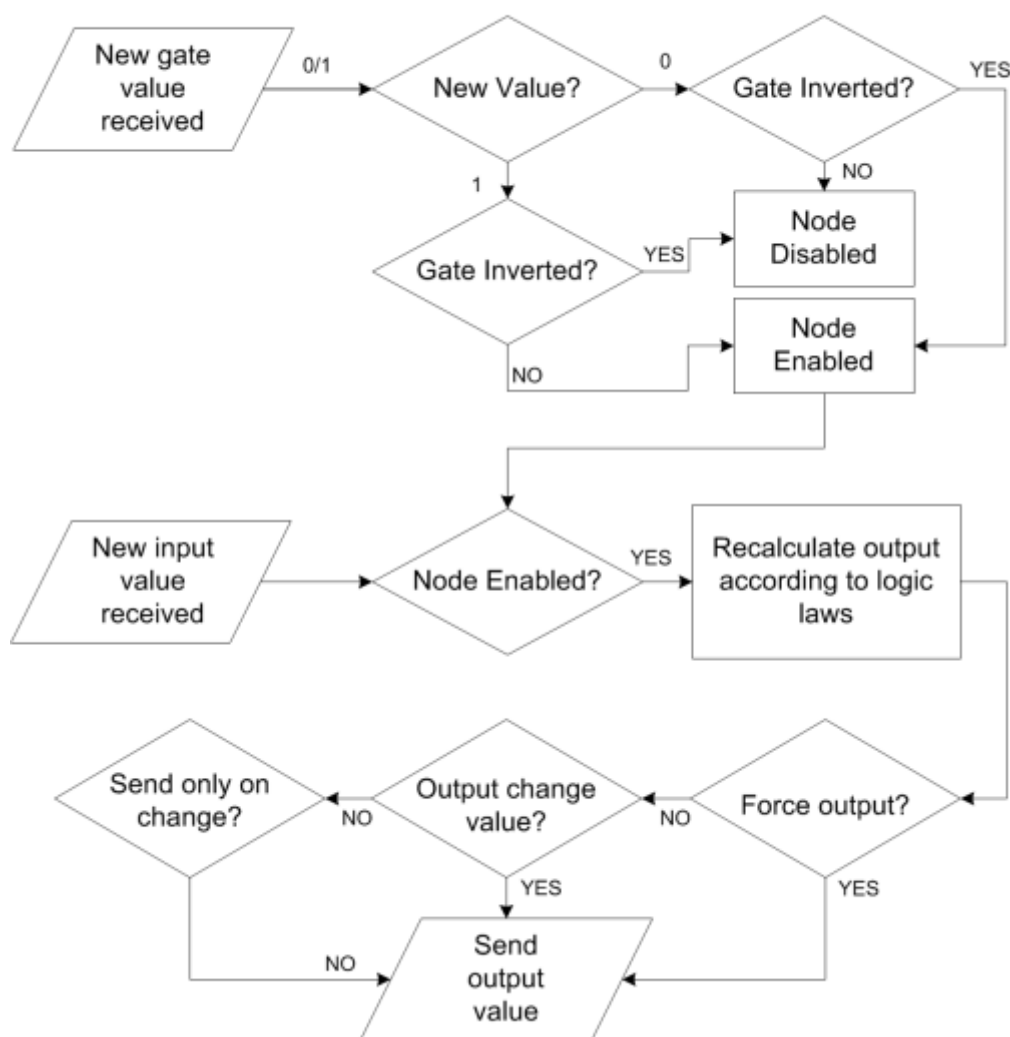
- **Inverted gate** If disabled, the node is enabled when the connector's value is 1 and disabled when the connector's value is 0. By enabling this property, the behavior will be inverted (0 = node enabled, 1 = node disabled).
- **Force output sending** If enabled, when the node gets enabled, the values of all the output connectors are refreshed independently by the **Output sending behaviour** property of the corresponding output connector.



When the Gate property is enabled, if the Gate connector is not connected to any other node, the node is disabled by default. Otherwise, if the Gate connector is connected to a node but it is not receiving any value from the source of the connection, the node is still disabled.

The picture below describes the behaviour of the Gate in the node:

## GATE BEHAVIOUR FOR LOGIC MODULE

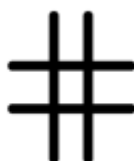


## Input nodes

The scheme should be able to read values coming from the plant as the the inputs of the block diagram or just provide some constants in the logic.

There are several kinds of **Input nodes** that can be used for this purpose:

### Constant Value



It represents a constant inside the block diagram. It can be a number, a bit or a string.

- **Value:** the value assigned to the constant.

### KNX Input

# KNX

It represents an input coming from the KNX bus.

- **Input type:** the datatype of the value to read from KNX.
- **KNX group:** the KNX group address.
- **Value at startup:** policy to determine which value to assign to the input at the beginning of the execution of the logic scheme.
  - *'Read current value':* indicates that the input starting value is equivalent to the value of the KNX group.
  - *'Wait for a new telegram':* indicates that the input doesn't take any value until the receiving of a new telegram.
  - *'0 until first telegram':* indicates that the input takes value 0 until the receiving of the first telegram.
  - *'1 until first telegram':* indicates that the input takes value 1 until the receiving of the first telegram.

## Sheet Input



## System Status



It represents an input coming from a status of a System object in the Configurator. For example, a feedback coming from Sonos.

- **System status:** the system status to read. To edit this property, click on the right button of the property text field.

## Output Connector

All the input nodes have only one output connector and the input value of these nodes will pass through it. In this connector it is possible to define the policy that will be used to forward the value to the connected nodes through the property:



- **Output sending behavior** It indicates when the value has to be forwarded to the connected nodes.
  - *'On result change'* indicates that the result is sent only when different from the previous one.
  - *'When a new input telegram is received'* indicates that the result is sent whenever the server receives a value update from the source of the input.



During *Offline Simulation* it is possible to simulate the value updates by manually typing them in the toolbar panel.

## Output nodes

The scheme generates one or more output values to send on the KNX bus, commands to perform, etc. The output nodes represent the kind of action to perform with these values.

There are several kinds of **Output nodes** that can be used for this purpose:

### Command



It represents the command to be executed when a value on the input connector is received.

- **Trigger** It determines the behaviour of the node for the command execution:
  - *On trigger* If selected, a new **Trigger** input connector is added to the node, which executes the command whenever the connector value is 1 (or 0 if the connector is inverted)
  - *On parameter value change* If selected and the parameters are input connectors of the node, whenever the value of an input connector is updated, executes the command
- 2. **Command** It is the command to execute. If the selected command has parameters, they are added to the property grid as new node properties, and for each parameter it is possible to assign a value or to make it become an input connector for the node so that the value for the parameter is dynamic.

### KNX Output

# KNX

It represents the KNX group on which the value will be sent.

- **KNX group**: the KNX group address.
- **Output type**: the datatype of the value to write on KNX.

## Sheet Output

*coming soon*

## Input connectors

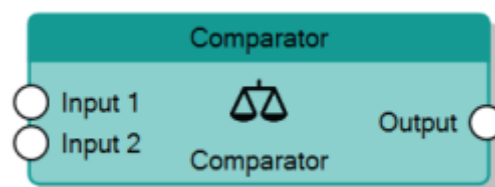
All the input connectors of output nodes have the following properties:

- **Trigger** Whenever a new value is received on the connector, if this property is enabled, the node triggers the “output action”.

## Analog nodes

The Analog nodes represent a collection of node which perform analog operations.

### Comparator/2 Points Regulator



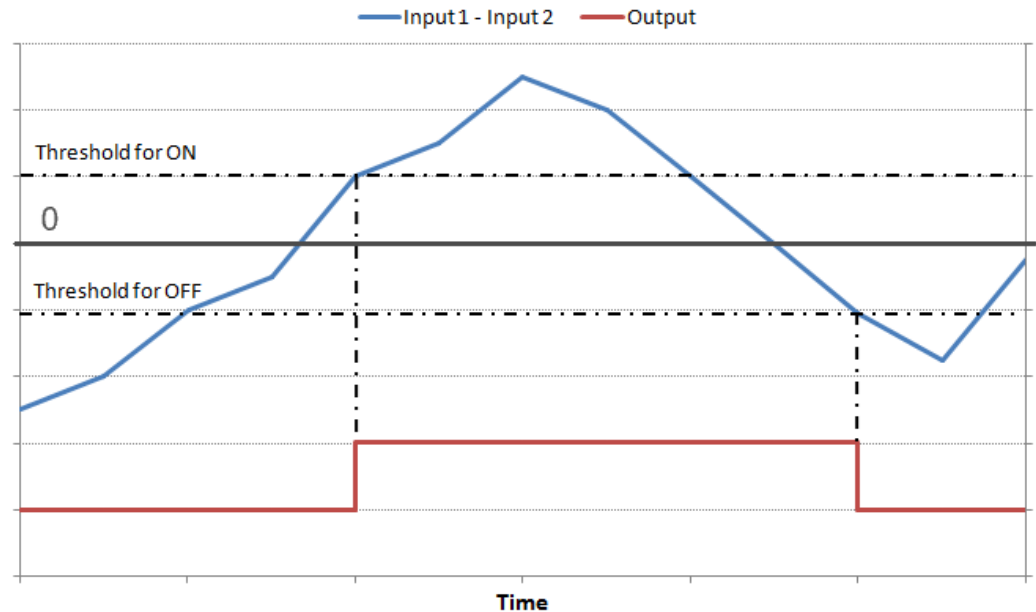
The Comparator node accepts numeric values for **Input 1** connector and **Input 2** connector and generates a pulse as the result of the comparison between the two inputs. If the difference between the two input values is greater than the value specified in the **Threshold for ON** property of the node, a logic 1 is sent to the **Output** connector. Instead, if the difference is lower than the value specified in the **Threshold for OFF** property, a logic 0 is sent to the **Output** connector.

When the the difference is among the two threshold values, the previous state of the output is maintained.





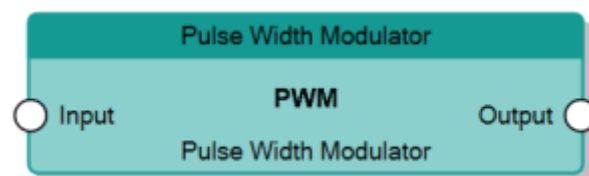
This node is really useful for temperature regulation because it acts as a 2 Points Regulator, preventing frequent switching of the output.



Behaviour of Comparator

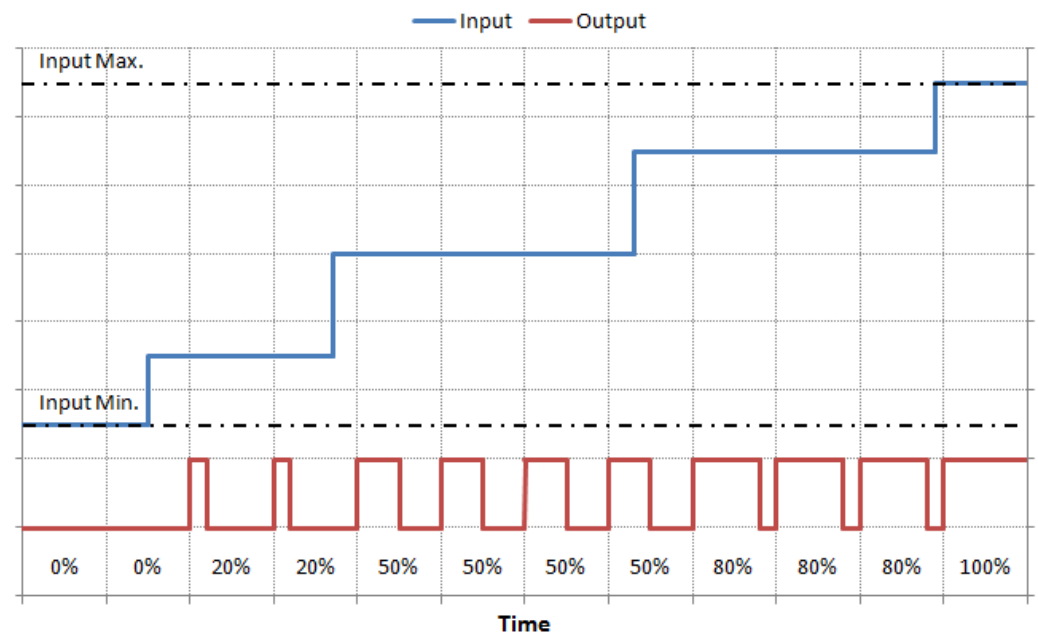
## PID Controller

## Pulse Width Modulator



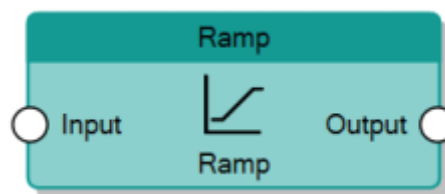
The Pulse Width Modulator node converts an analog input into a pulse where the ON/OFF ratio depends on the modulated value of the **Input** connector. The node computes the ratio of the **Input** value with the **Input Min.** property and the **Input Max.** property and applies it to the **Period** of the output pulse to determine the ON time.

The ratio is calculated at every expiration of the **Period** and thus it considers the actual value of the **Input** connector in that moment.



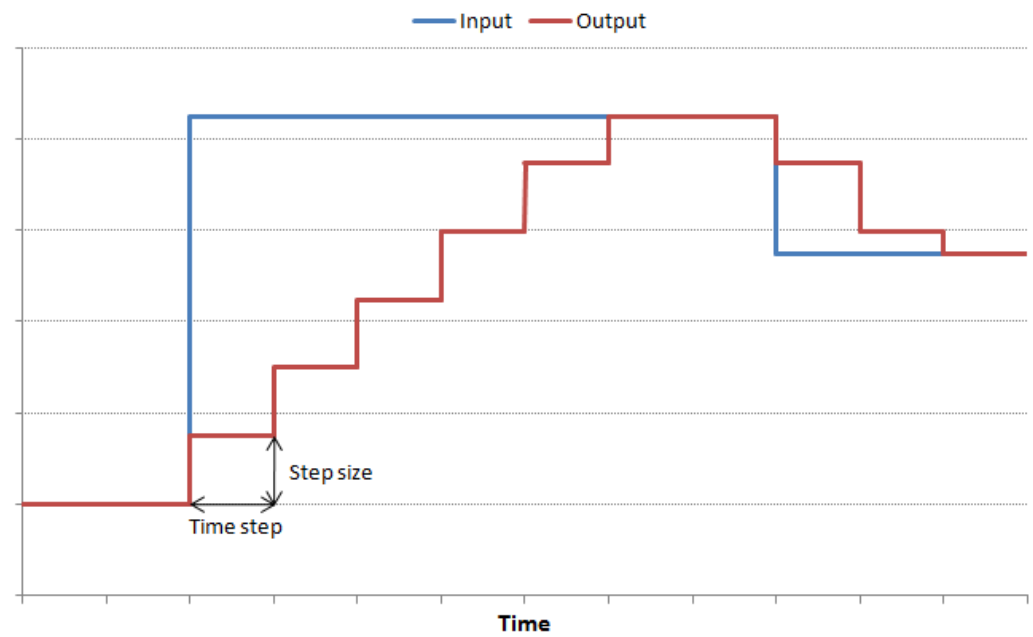
Behaviour of PWM

## Ramp



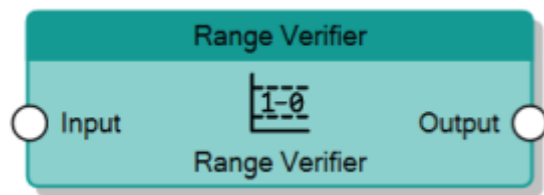
The Ramp node increases or decreases in a linear way the value of the **Output** connector until it reaches the value of the **Input** connector. The linear increment consists of adding (or subtracting) to the **Output** a value represented by the **Step size** property every time interval specified by the **Time step** property.

The value of the **Output** can't go beyond the **Input** value, so the node reduces the step to adapt the output to the input.

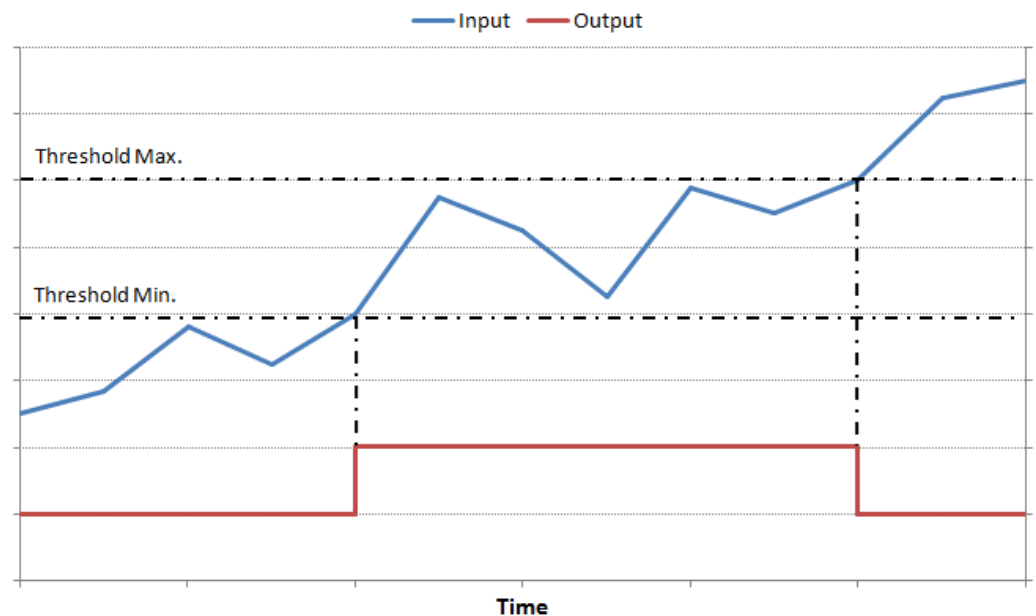


Behaviour of Ramp

### Range Verifier

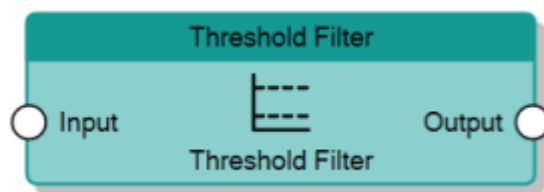


The Range Verifier node, given the analog value of the **Input** connector, checks if it is included between two threshold values, specified with the properties **Threshold Min.** and **Threshold Max.**, and sends 1 to the **Output** connector if the condition is verified, otherwise 0.

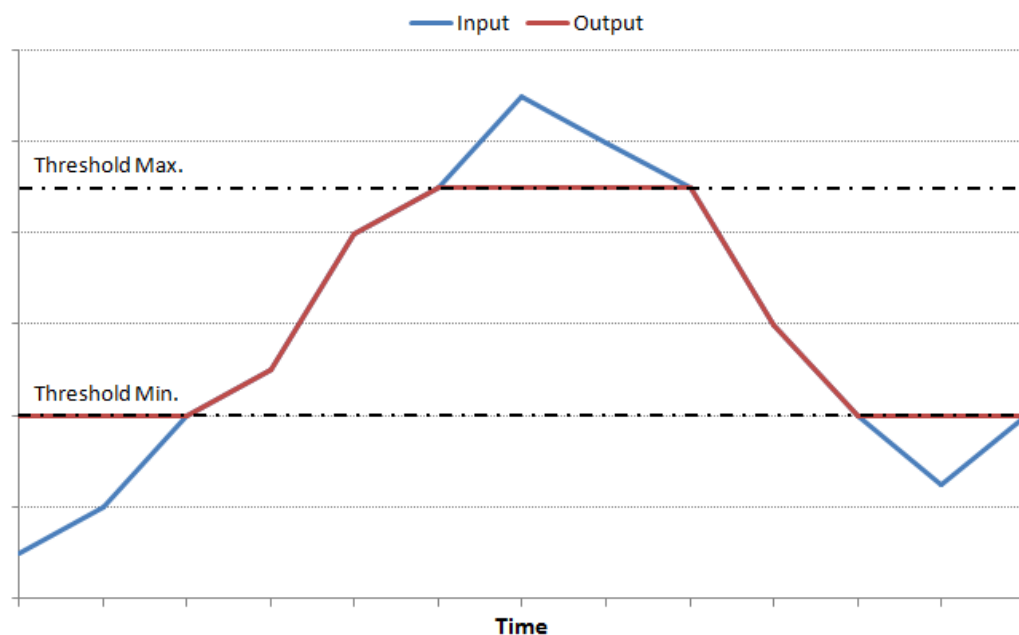


Behaviour of Range Verifier

### Threshold Filter



The Threshold Filter node, given an analog value on the **Input** connector, sends it to the **Output** connector if the value is included between the values specified by the two properties **Threshold Min.** and **Threshold Max.**, otherwise it sends the value of the reached threshold. It is possible to exclude one of the two thresholds by editing the **Filter type** property of the node.



Behaviour of Threshold Filter with Filter Type set to *Minimum and maximum thresholds*

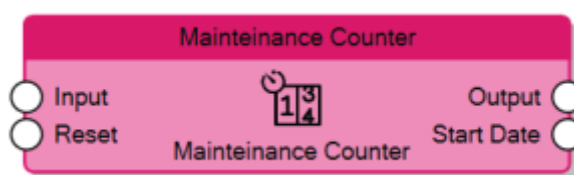
### Time-based Filter

## Counter nodes

The Counter nodes, given an input (number or bit), perform a counting operation on the input and send it to the output.

There are several kinds of **Counter nodes** that can be used for this purpose:

### Maintenance Counter

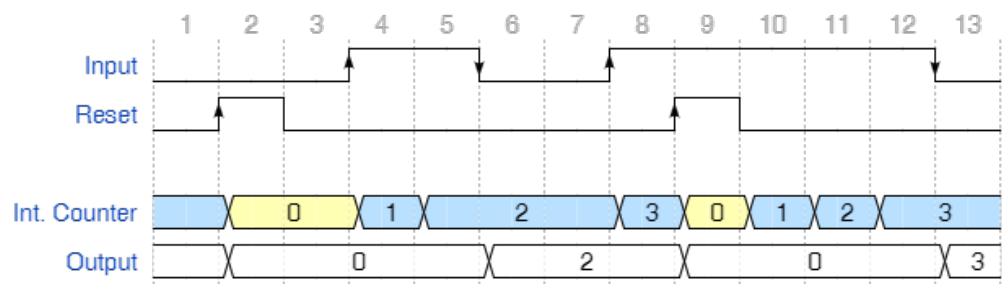


The Maintenance Counter counts the total time the **Input** connector value is 1 and forwards it to the **Output** connector whenever the **Input** receives a falling edge on the signal. The unit of measure of the time is defined through the **Time UoM** property of the node.

If the **Reboot survive** property of the node is enabled, the counter value is persistent which it means that it doesn't get lost when the server reboots and after the reboot, the counter increments the last saved value; otherwise, the counter value gets resetted every time the server reboots.

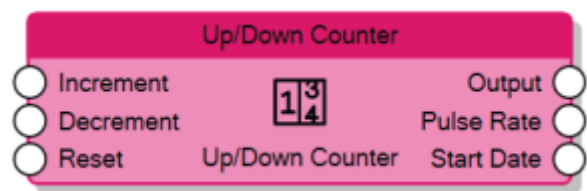
The **Start Date** output connector sends the last date and time the counter received a Reset signal. When the **Reset** input receives 1, the counter gets

resetted, **Output** goes to 0 and **Start Date** is updated, the counting will start again only after Reset goes back to 0.



Behaviour of Maintenance Counter

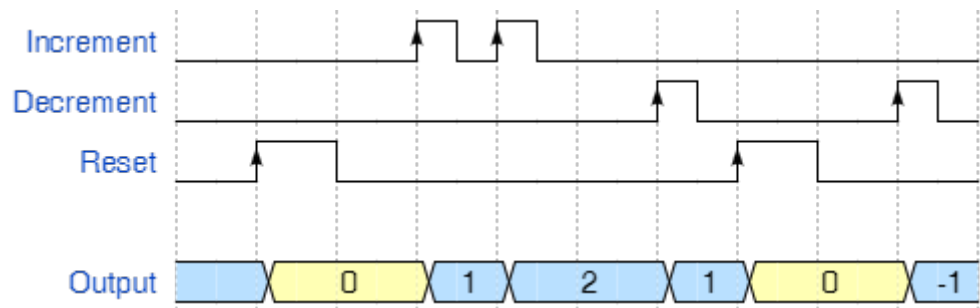
Up/Down Counter



The Up/Down Counter increases the counter whenever the **Increment** input receives a rising edge and it decrements the counter whenever the **Decrement** input receives a rising edge.

If the **Reboot survive** property of the node is enabled, the counter value is persistent which it means that it doesn't get lost when the server reboots and after the reboot, the counter increment/decrement the last saved value; otherwise, the counter value gets resetted every time the server reboots.

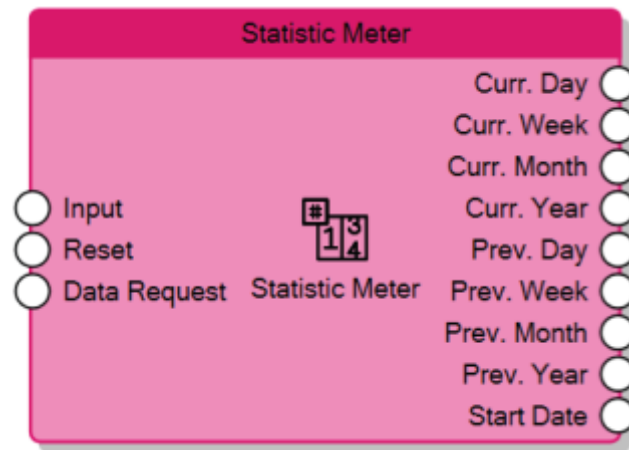
The **Start Date** output connector sends the last date and time the counter received a Reset signal. When the **Reset** input receives 1, the counter gets resetted, **Output** goes to 0 and **Start Date** is updated; the counting will start again only after Reset goes back to 0.



Behaviour of Up/Down Counter

Statistic Meter





The Statistic Meter reads the numeric value of the **Input** connector and calculates:

- *Current day total* on the **Curr. Day** output connector
- *Current week total* on the **Curr. Week** output connector
- *Current month total* on the **Curr. Month** output connector
- *Current year total* on the **Curr. Year** output connector
- *Previous day total* on the **Prev. Day** output connector
- *Previous week total* on the **Prev. Week** output connector
- *Previous month total* on the **Prev. Month** output connector
- *Previous year total* on the **Prev. Year** output connector

The counted values are persistent, which it means that they don't get lost when the server reboots.

The **Start Date** output connector sends the last date and time the counter received a Reset signal. When the **Reset** input receives 1, the counter gets resetted, all the outputs go to 0 and **Start Date** is updated, the counting will start again only after Reset goes back to 0.

Whenever the **Data Request** input connector receives 1, the node refreshes the values of the outputs.



To make the Statistic Meter operational the first time it is loaded into the server, it needs to receive 1 on the Reset input connector or on the Gate connector (if enabled).

## Output connectors

All the output connectors of the counter nodes have particular properties to manage the policies to send the values:

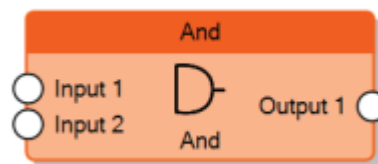
- **Output sending behaviour** The connector value will be updated depending on the following criteria:
  - *On new value reception* Whenever the node updates the value, it sends it to the connector.

- *After a fixed time interval* The node sends the value to the connector at the expiration of a specified time interval, independently by the fact that the value has changed or not.
  - *On over-threshold change* The node will compare the latest computed value with the previous one, if the difference between the two values overcrosses a predefined threshold it will send it to the connector. The threshold represents the ratio between the gap of the two values and the previously stored value.
  - *On over-threshold change and after time* This option combines the advantages of both previously explained techniques. The node will send the value when over-threshold change occurs and, in any case, after a fixed time interval.
2. **Store time interval** Time interval to wait before the node sends the value to the connector.
  3. **Change percentage** Minimum change percentage required to send the value to the connector. To be sent, the new value has to differ from the previous value more than the percentage applied to the previous value.

## Logic nodes

Logic nodes represent all the operations to manipulate bits. Except some special nodes, it is always possible to edit the number of inputs of the node with the property **Number of inputs**.

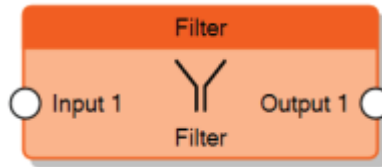
And



The And node sends 1 on the output only when all the inputs are 1.

Input 1	Input 2	Output
0	0	0
0	1	0
1	0	0
1	1	1

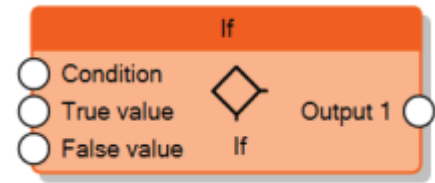
Filter



The Filter node forwards to the output the value coming from the input connector following some policies determined by the following properties:

- **Filter type:** It indicates the value assigned to the output depending on the input value.
  - $'1 \rightarrow - / 0 \rightarrow -'$  (*disabled*) indicates that no values are assigned to the output.
  - $'1 \rightarrow - / 0 \rightarrow 0'$  if input is equal to 1, no value assigned to the output. If input is equal to 0, 0 will be sent to the output.
  - $'1 \rightarrow - / 0 \rightarrow 1'$  if input is equal to 1, no value sent to the output. If input is 0, 1 is sent to the output
  - $'1 \rightarrow - / 0 \rightarrow Toggle'$  if input is equal to 1, no value will be sent to the output. If input is equal to 0, the output will toggle.
  - $'1 \rightarrow 0 / 0 \rightarrow -'$  If input is 1, output will be set to 0. If input is 0, no value will be sent to the output.
  - $'1 \rightarrow 0 / 0 \rightarrow 1$  (*inversion*) indicates that the input value is inverted and then sent to the output.
  - $'1 \rightarrow 1 / 0 \rightarrow -'$  indicates that if the input is 1, 1 is assigned to the output, if the input is 0, no values are assigned to the output.
  - $'1 \rightarrow 1 / 0 \rightarrow 0$  (*pass all*) indicates that both of the input values are sent to the output.
  - $'1 \rightarrow Toggle / 0 \rightarrow -'$  indicates that if the input is 1 the output value is inverted, if the input is 0 no values are assigned to the output.
  - $'1 \rightarrow Toggle / 0 \rightarrow Toggle'$  for every input value (both 0 or 1), the output will toggle.
- 2. **Delay:** It indicates if it is necessary to wait for a time interval before sending the output value.
  - *'Do not use'*: disables the property so no delays are applied.
  - *'Use if input is 1'*: applies the delay only if the input is 1.
  - *'Use if input is 0'*: applies the delay only if the input is 0.
  - *'Use always'*: applies the delay for any input value.
- 3. **Delay base time:** It indicates the measurement unit of the time interval of the delay.
- 4. **Delay factor:** It indicates the value of the time interval of the delay.

If



The If node evaluates the value of the input **Condition**, if it is equal to 1 sends the **True value** input value to the output, otherwise it sends the **False value** input value.

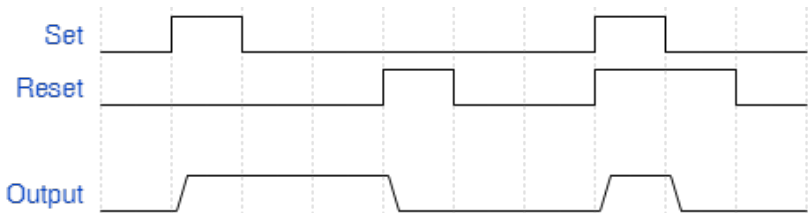
Latching Relay



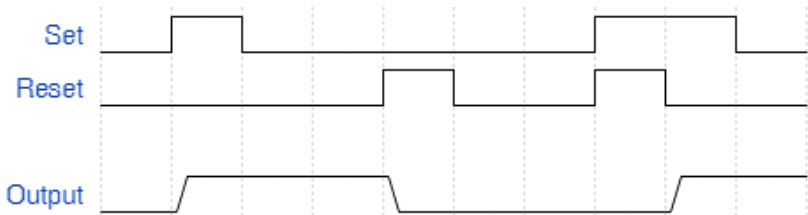
The Latching Relay node sends 1 to the output when the input **Set** is set to 1 and sends 0 to the output when the input **Reset** is set to 1. When both Set and Reset are 0, the previous state of the output is maintained.

The **Behaviour** property determines whether Set or Reset must be dominant when both of them are 1.

Set	Reset	Output
0	0	prev. status
0	1	0
1	0	1
1	1	Set or Reset



Behavior of node when Set input is dominant



## Behavior of node when Reset input is dominant

### Logic Matrix



The Logic Matrix, given some inputs determined by the **Number of inputs** property and some outputs determined by the **Number of outputs** property, forwards the value of a selected input to a selected output. The selection of inputs and outputs is decided by the value of two inputs, **Input selector** and **Output selector**.

The **Data type** property determines the inputs and outputs data type managed by the matrix; if it is set to *1 bit Boolean*, the inputs and outputs are the standard connectors for all the logic nodes as explained [here](#), otherwise the **Inverted** property on the connectors won't be available.

### Input and Output selectors

These connectors have two properties to define their behaviour:

- **Default control value** It indicates the default input/output with a number [0-255] representing the 0-base index of the input/output.
- **Update every control value** If enabled in the Input selector, outputs will be updated for every value received by the Input selector. If disabled, outputs will be refreshed only when the selected input receives a new value or, if this property is enabled in the Output selector, when the Output selector receives a new value.

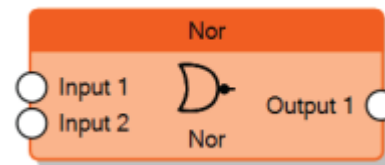
### Nand



The Nand node is the opposite of the [And node](#), sends 0 on the output only when all the inputs are 1.

Input 1	Input 2	Output
0	0	1
0	1	1
1	0	1
1	1	0

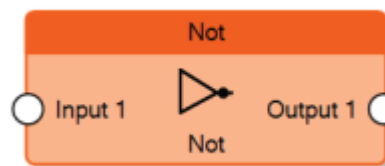
[Nor](#)



The Nor node is the opposite of the [Or node](#), sends 1 on the output only when all the inputs are 0.

Input 1	Input 2	Output
0	0	1
0	1	0
1	0	0
1	1	0

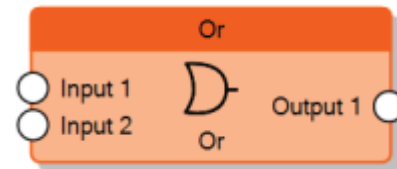
[Not](#)



The Not node accepts just one input, it inverts the value of the input.

Input	Output
0	1
1	0

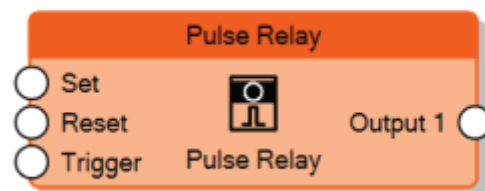
[Or](#)



The Or node sends 1 on the output when at least one input is equal to 1.

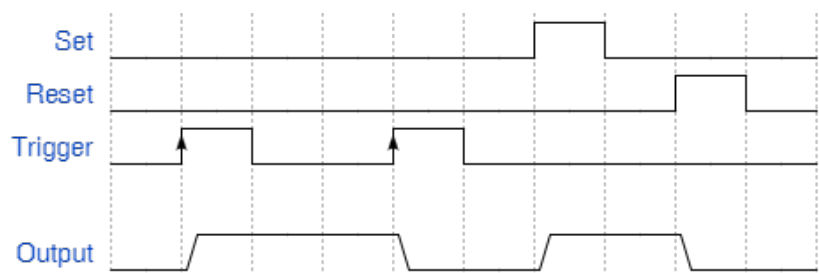
Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	1

### Pulse Relay



The Pulse Relay node sends 1 to the output when the input **Set** is set to 1 and sends 0 to the output when the input **Reset** is set to 1. When both Set and Reset are 0, the previous state of the output is maintained. Whenever the input **Trigger** receives a rising edge signal, Set and Reset are ignored and the output is toggled.

The **Behaviour** property determines whether Set or Reset must be dominant when both of them are 1.



Behavior of node when Set input is dominant



The Pulse Relay it is used to transform a pulse input in a toggle switch! Set and Reset inputs are optional, if they are not connected to any other nodes, the Trigger input is the only



input which controls the output.

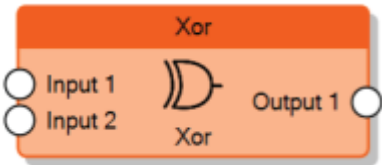
Xand



The Xand node sends 1 on the output only when all the inputs are equal.

Input 1	Input 2	Output
0	0	1
0	1	0
1	0	0
1	1	1

Xor



The Xor node sends 1 on the output when the inputs don't have the same value.

Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	0

Input connectors

All the input connectors of logic nodes have the following properties:

- **Trigger** Whenever a new value is received on the connector, if this property is enabled, the node triggers the computation and sends the values to the output connectors.
- **Inverted input** If enabled the connector inverts the



received value. If the value on the connector is inverted, a red symbol appears beside the connector.

## Output connectors

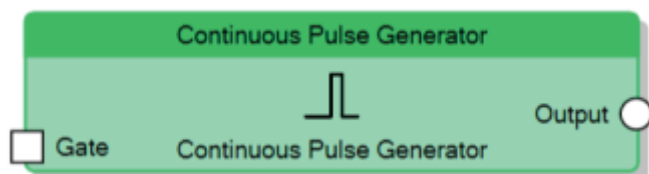
All the output connectors of logic nodes have the following properties:

- **Output sending behavior** It indicates when the value has to be forwarded to the connected nodes.
  - *'On result change'* indicates that the result is sent only when different from the previous one.
  - *'When a new input telegram is received'* indicates that the result is sent whenever the server receives a value update from the source of the input.
- 2. **Inverted output** If enabled the connector inverts the value to send. If the value on the connector is inverted, a red symbol appears beside the connector.

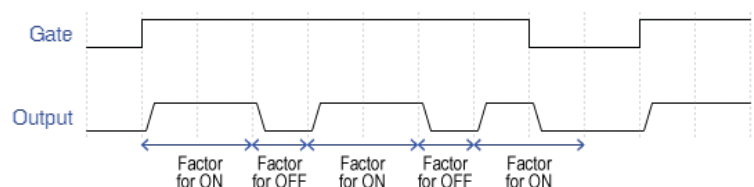
## Timer nodes

The Timer nodes represent time-based operations inside the scheme.

### Continuous Pulse Generator



The Continuous Pulse Generator node, for all the time the value of the **Gate** connector is 1, generates pulses with the ON time specified by the **Factor for ON** property and the OFF time specified by the **Factor for OFF** property.



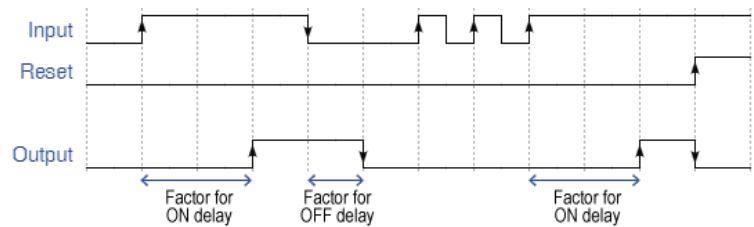
Behaviour of Continuous Pulse Generator

### On/Off Delay



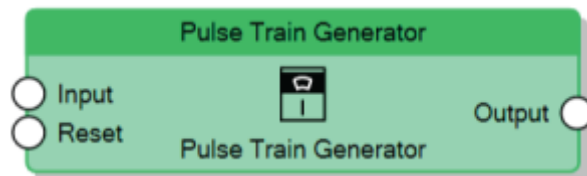
The On/Off Delay node, for every rising edge of the **Input** connector signal, generates a rising edge on the **Output** connector after a delay specified by the **Factor for ON delay** property. When the **Input** signal has a falling edge, the node generates a falling edge on the **Output** connector after a delay specified by the **Factor for OFF delay** property.

When the value of the **Reset** connector is 1, the node immediately sends 0 to the **Output** connector.



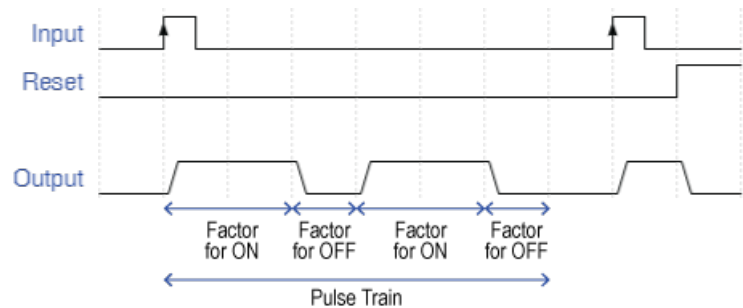
Behaviour of On/Off Delay

### Pulse Train Generator



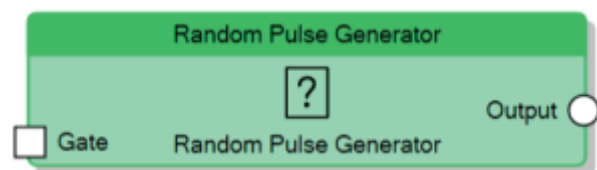
The Pulse Train Generator node, for every rising edge of the **Input** connector signal, generates a train of pulses on the **Output** connector with the ON time specified by the **Factor for ON** property and the OFF time specified by the **Factor for OFF** property. The number of sequential pulses to generate is determined by the **Pulse number** property.

When the value of the **Reset** connector is 1, the node immediately sends 0 to the **Output** connector.



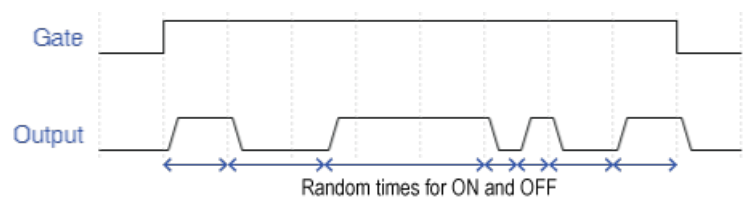
Behaviour of Pulse Train Generator  
with Pulse Number = 2

### Random Generator



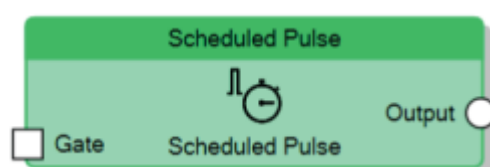
The Random Pulse Generator node, for all the time the **Gate** connector value is 1, generates pulses with random times for ON and OFF.

The random time for ON will be included between **Minimum factor for ON** property and **Maximum factor for ON** property; the random time for OFF will be included between **Minimum factor for OFF** property and **Maximum factor for OFF** property.



Behaviour of Random Pulse  
Generator

### Scheduled Pulse

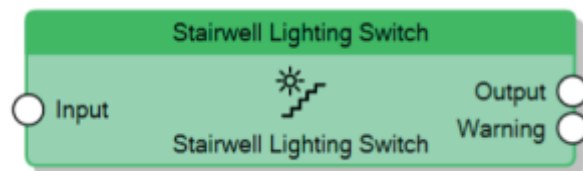


The Scheduled Pulse node, if the **Gate** connector value is 1,

generates a pulse at a precise time of the day.

The time is specified by the **Scheduled Time** property, the pulse generated has a period determined by the properties **Factor for pulse duration** and **Time base for pulse duration**.

### Stairwell Lighting Switch

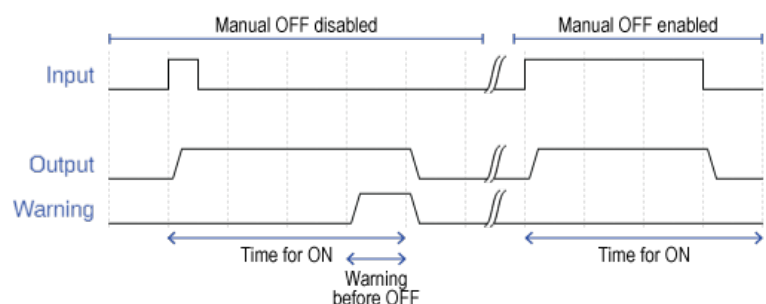


The Stairwell Lighting Switch node, when the **Input** connector value is 1, sends 1 to the **Output** connector and then starts a timer, at the expiration of the timer it sends 0 to the **Output** connector.

The timer is set to the time defined in the **Time for ON** property of the node and if the property **Retriggerable** is enabled, the timer restarts whenever the **Input** connector receives 1.

If the property **Manual OFF** is enabled, when the **Input** connector value goes to 0 the node sends 0 to the **Output** connector and automatically stops the timer; otherwise the expiration of the timer is the only condition to send 0 to the **Output** connector.

The **Warning** connector value goes to 1 before the timer expires until the **Output** connector is 1. The time for warning is specified through the **Warning before OFF** property.



Behaviour of Stairwell Lighting Switch

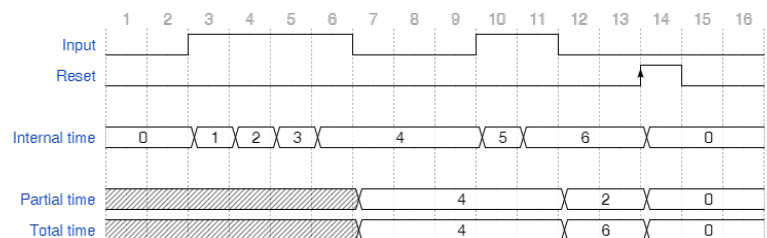
### Stopwatch



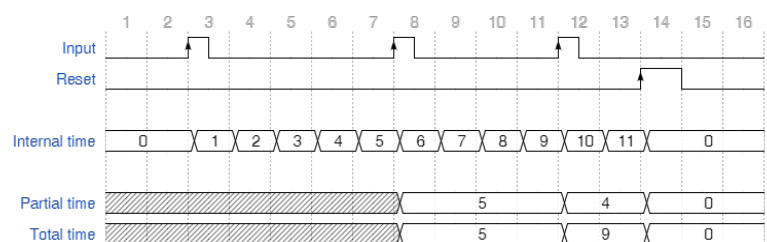
The Stopwatch node measures provides two modalities to determine how it should start counting time which are specified by the **Trigger policy** property:

- *Switch* The Stopwatch starts counting time when the **Input** connector value goes to 1, it pauses when the **Input** value goes to 0. Whenever the node pauses, it sends the time the **Input** value has been 1 to the **Partial time** connector and the total counted time to the **Total time** connector.
- *Toggle* The Stopwatch starts counting when it receives the first rising edge on the **Input** connector, all the other times it receives a rising edge it sends the time passed between the current rising edge and the previous one to the **Partial time** connector, and the total counted time to the **Total time** connector.

When the **Reset** connector value is 1, the node stops counting the time and sends 0 to both **Partial time** and **Total time**, it will start counting again only after the **Reset** value goes to 0.



Behaviour of Stopwatch with  
Trigger policy *Switch*



Behaviour of Stopwatch with  
Trigger policy *Toggle*

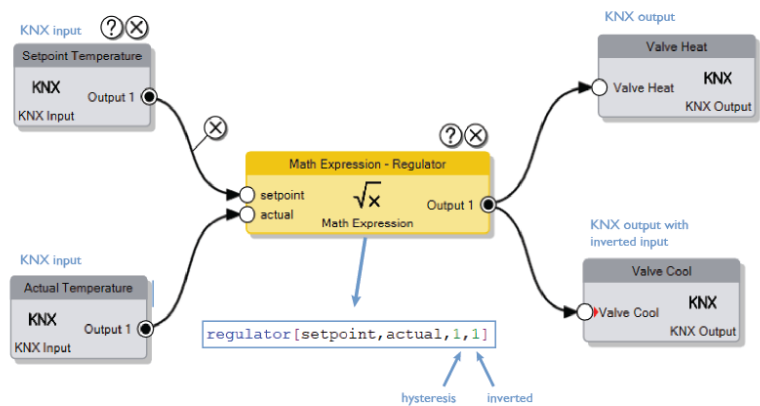
## Math nodes

The Math nodes represent all the arithmetical operation that can be performed inside the scheme.

- **Abs**: It computes the absolute value of the given input value and sends the result to the output connector
- **Add**: It computes the addition of  $n$  input values and sends the result to the output connector
- **Average**: It computes the arithmetic mean of  $n$  input values and sends the result to the output connector
- **Division**: It computes the division of two inputs and sends the result to the output connector
- **Linear Combination**
- **Logarithm**: It computes the logarithm given two inputs, which represent base and argument of the logarithm, and sends the result to the output connector
- **Math Expression**
- **Max**: Given  $n$  inputs, it sends to the output the maximum value among the inputs
- **Min**: Given  $n$  inputs, it sends to the output the minimum value among the inputs
- **Multiplication**: It computes the multiplication of  $n$  input values and sends the result to the output connector
- **Pow**: It computes the exponentiation given two inputs, which represent base and exponent, and sends the result to the output connector
- **Remainder**: It computes the division of two inputs and sends the *remainder* to the output connector
- **Round**: Given an input, it rounds the value to the closest integer and sends it to the output connector
- **Subtract**: It computes the subtraction of  $n$  input values and sends the result to the output connector

## Logic Examples

[Temperature Regulator](#)



Example 1: Temperature Regulator

Using the Math Expression bloc and the function “Regulator”, it is possible to implement a regulation on an output given a setpoint and an actual temperature value. The two additional inputs in the expression are the “hysteresis” value, and the possibility to invert the result (1= inverted, 0= normal). The example shown in the picture above will send value 1 to Heat Valve and 0 to Cool Valve in case Setpoint > Actual, and value 0 to Heat Valve and 1 to Cool Valve in case Setpoint < Actual.

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