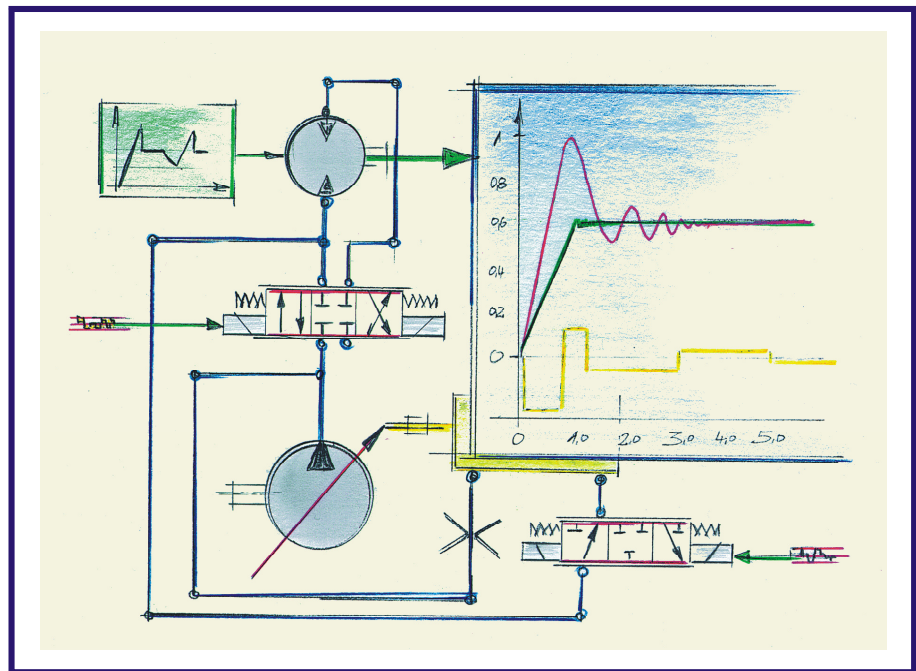


Component Manual

Control



DSH^{plus}

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In the course of further development of the software, parts of this manual can lose their validity.

Introduction

The component manual describes the components of the library. In accordance with the component categories in the library, the manual subdivides itself into several parts:

- Component library Hydraulics
- Component library Pneumatics
- Component library Control,
- Component library Mechanics
- Component library Thermal Hydraulics
- Component library Modules
- Component library Miscellaneous

The **HYDRAULICS** part contains all hydraulic components of the library. This includes pumps and motors, flow valves, pressure valves, check valves, and directional valves as well as accumulators and pipes.

The **PNEUMATICS** part of the library includes many components for pneumatic systems. The components range from cylinders and resistors to directional valves and sensors.

In the manual part **MECHANICS** the mechanical components are described. These are the masses and the spring damper components as well as other mechanical components.

The component library of *DSHplus* includes analog and digital components for control tasks that are explained in the chapter **CONTROL**.

The **THERMAL HYDRAULICS** part contains thermal hydraulic components of the library. This includes pumps and motors and directional valves as well as accumulators and pipes.

The component manual should help to select the right component for a model and to parameterize it. Furthermore, there is information about the kind of modeling of the components, e. g. whether they were modeled in accordance with the physical qualities of the real components or whether only their dynamic characteristics were taken.

The **MODULES** contains the components for the *DSHplus*-STC and for the sub model prepare. The part **MISCELLANEOUS** contains other components to which the nodes in particular belong.

All components are described according to the same scheme. The following page shows an example component with which the scheme is explained.

ComponentName

Symbol of the component

Symbol

Sketch

Drawing of the component

Connectors and Variables

Name	Type	Unit	Description
<i>Hydraulic connector</i>	Hydr	Unit	<i>short description</i>
<i>Hydraulic volume less connector</i>	Hvol	Unit	<i>short description</i>
<i>Thermal hydraulic connector</i>	THydr	Unit	<i>short description</i>
<i>Pneumatic connector</i>	Pneu	Unit	<i>short description</i>
<i>Signal input</i>	In		<i>short description</i>
<i>Signal output</i>	Out		<i>short description</i>
<i>Mechanical connector</i>	Mech		<i>short description</i>
<i>Internal variable</i>	V		<i>short description</i>

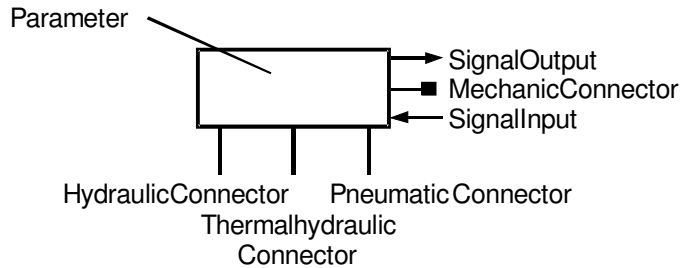
Parameters

Name	Value	Unit	Description
<i>Parameter name</i>	<i>Value</i>	<i>Unit</i>	<i>short description</i>

Notes

Remarks about function and application

Comments to the example component:

	The component symbol is the symbol with which a component appears in the library and in the model.														
	The component with its parameters and its connectors is represented in the component drawing according to the following figure:  The arrows at the component specify whether the connector is an input, an output or a mechanical connection. The direction of state variables is defined by a coordinate system.														
	In the table Connectors and Variables , all connectors and variables of a component are listed.														
	The connectors and variables of a component can be subdivided into different types. They are characterized in the column Type in accordance with: <table> <tbody> <tr> <td>Hydr:</td><td>hydraulic connector</td></tr> <tr> <td>Pneu:</td><td>pneumatic connector</td></tr> <tr> <td>Thydr:</td><td>thermal hydraulic connector</td></tr> <tr> <td>In:</td><td>input of a signal</td></tr> <tr> <td>Out:</td><td>output of a signal</td></tr> <tr> <td>Mech:</td><td>mechanical connector</td></tr> <tr> <td>V:</td><td>internal variable (state variable)</td></tr> </tbody> </table>	Hydr:	hydraulic connector	Pneu:	pneumatic connector	Thydr:	thermal hydraulic connector	In:	input of a signal	Out:	output of a signal	Mech:	mechanical connector	V:	internal variable (state variable)
Hydr:	hydraulic connector														
Pneu:	pneumatic connector														
Thydr:	thermal hydraulic connector														
In:	input of a signal														
Out:	output of a signal														
Mech:	mechanical connector														
V:	internal variable (state variable)														
	Units (column Unit) were assigned to the variables. In so far as the customer does not change the Units, the graphic or numeric edition of the variables occurs with these Units. The units for the values of the other connectors are listed only for better understanding.														
	In the parameter list, all parameters are listed with its Values and Units with which a component is described.														
	The Notes give further remarks to the function and the application of the component.														
	The following spelling is used: COMPONENTNAME <i>Parameters, Connectors and Variables</i>														

Contents

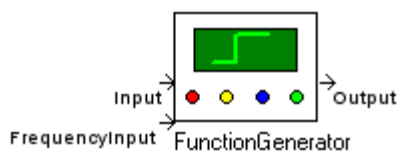
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Control

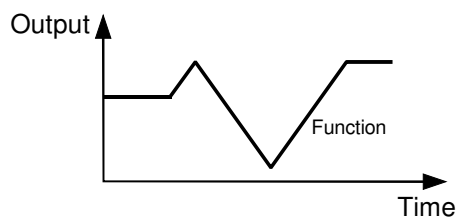
Sources

FunctionGenerator



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal, that can be used to start the generator
FrequencyInput	In		signal which determines the frequency of the periodic function
Output	Out	-	output signal

Parameters

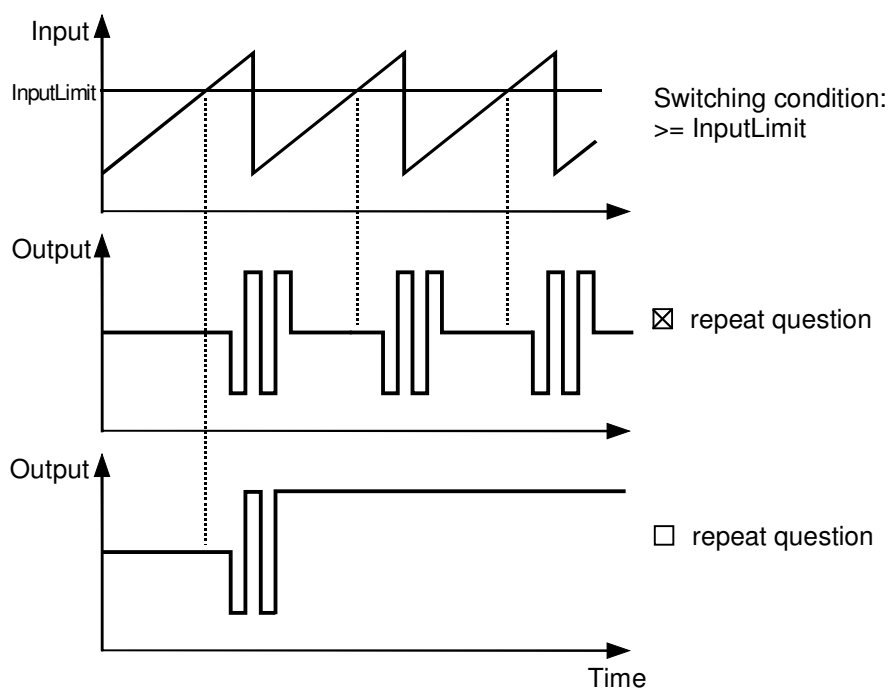
Name	Value	Unit	Description
NominalMode	-	-	type of function
Frequency	0	Hz	frequency of function or starting frequency of the sweep function
Amplitude	0	-	amplitude (see Notes)
Offset	0	-	offset of the output value
PhaseShift	0	deg	phase shift

Start	0	s	initiation time of the function
Duration	999	s	duration of the function
Field of Characteristic	-1	-	number of the look-up table
InputLimit	0	-	critical value at which the function starts when a switching condition is chosen
Repetitions	1	-	number of repetitions of the function (each time the period <i>Start</i> + <i>Duration</i> is repeated)
Endfrequency	0	Hz	final frequency of the sweep function
RepeatQuestion	0	-	switch for the repetition of the function
Comparation	2	-	switching condition for the <i>InputLimit</i>
FactorX	1	-	stretching or compressing factor of input values of the look-up table
FactorY	1	-	stretching or jolting factor of input values of the look-up table

Notes

The component FunctionGenerator is used to produce signals by which e. g. other components are controlled.

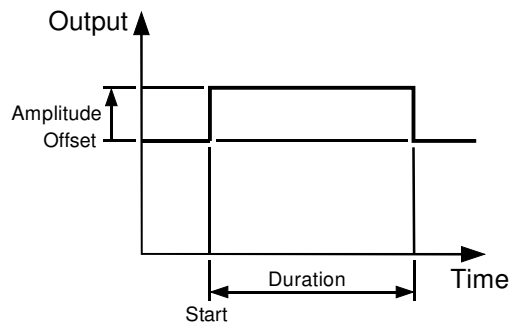
The start time of the function can be controlled via the input signal: depending on the switching condition ($\leq$ or $\geq$) the function starts as soon as the input exceeds and/or falls below the InputLimit. The parameter RepeatQuestion determines whether the function either remains at its end value after reaching the end point of time or is carried out again, as soon as the switching condition is fulfilled again after a complete run. The end of the function is either temporally determined (switch *time controlled* value *duration*) or depends on the input signal (switch *event controlled*). The function stops in case of exceeding or falling below the input limit (complementary to the start).



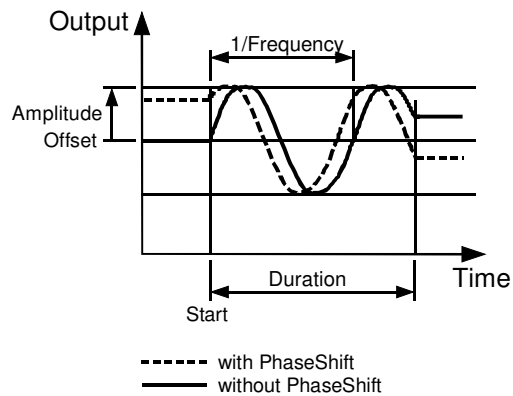
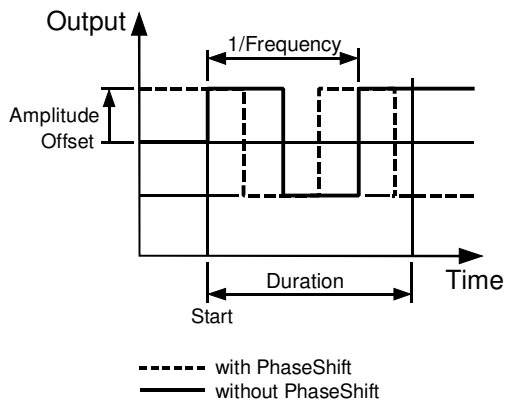
The respective boundary value of the function is output before *Start* and after the *Duration* of the function if nothing else is specified.

For the parameterization of the FUNCTIONGENERATOR an own dialog is used which differs from the standard parameter dialog.

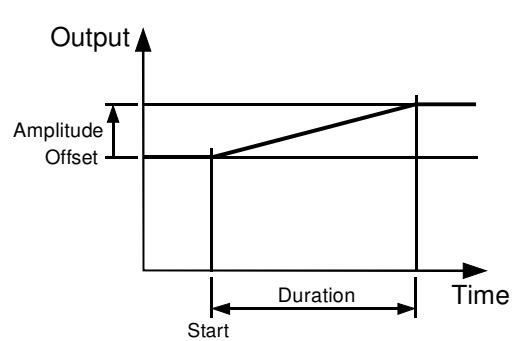
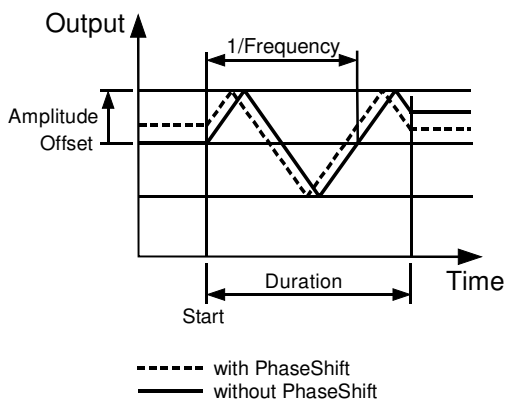
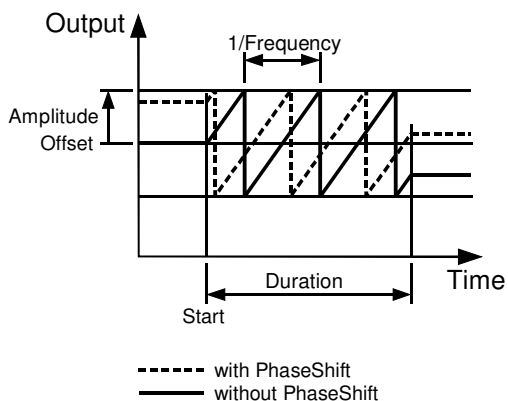
The following functions can be selected:

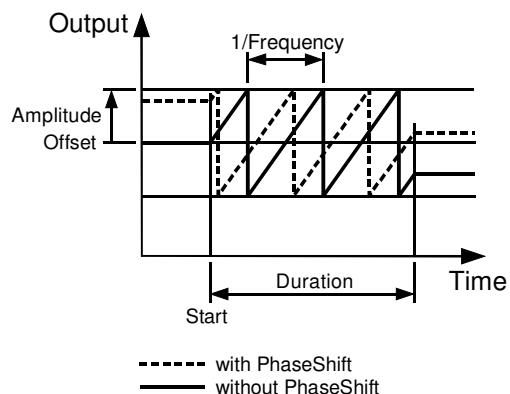
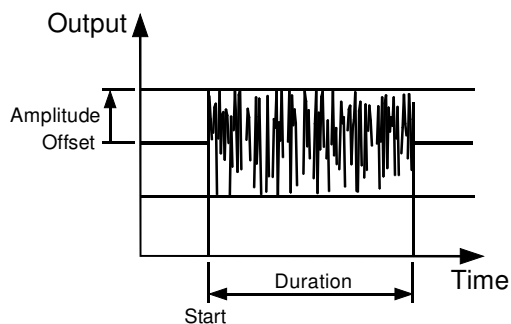
Constant

Before *Start* and after *Duration* the *Offset* is output.

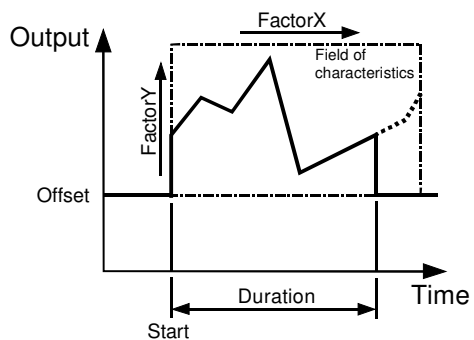
Sine**Rectangle**

For the rectangle function without a phase shift the output value is zero for $time \leq Start$.

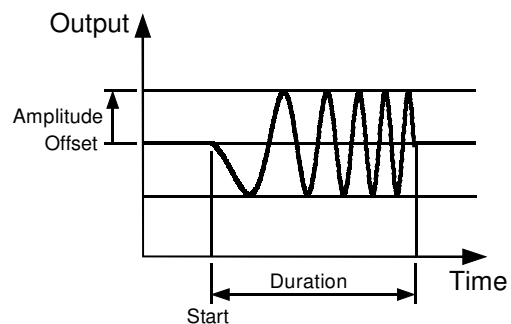
Ramp**Triangle****Sawtooth, rising flank**

Sawtooth, dropping flank**Noise**

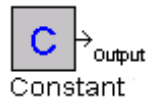
The noise is computed of a random function.

Look-up table

Before the *Start* and after the *Duration* of the look-up table function *Offset* is output. If the *Duration* is shorter than the look-up table it is clipped.

Sweep

The sweep function creates a sine signal of which the frequency continuously raises from *Frequency* to *Endfrequency*. This signal can also be used to initiate a system to effect a frequency analysis.

Constant**Symbol**

Sketch**Connectors and Variables**

Name	Type	Unit	Description
Output	Out	-	

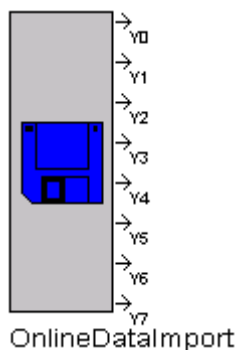
Parameters

Name	Value	Unit	Description
Value	0	-	

Notes

The component Constant describes the constant value given out by the element.

OnlineDataImport



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Y0	Out	-	Output signal 1
Y1	Out	-	Output signal 2
Y2	Out	-	Output signal 3
Y3	Out	-	Output signal 4
Y4	Out	-	Output signal 5
Y5	Out	-	Output signal 6
Y6	Out	-	Output signal 7
Y7	Out	-	Output signal 8

Parameters

Name	Value	Unit	Description
Channel 0	1	0	Time channel (standard)
Channel 1	1	0	Signal on Y0
Channel 2	1	0	Signal on Y1
Channel 3	1	0	Signal on Y2
Channel 4	1	0	Signal on Y3
Channel 5	1	0	Signal on Y4
Channel 6	1	0	Signal on Y5
Channel 7	1	0	Signal on Y6
Channel 8	1	0	Signal on Y7

Notes

The component `ONLINE_DATA_IMPORT` proceeds measured data or simulation results. The input takes place during the simulation.

The component `ONLINEDATAIMPORT` computes the output signal according to the following equation: The component `ONLINEDATAIMPORT` is used to read measured data or simulation results into the running DSHplus simulation. The data is used as actuation signals for the DSHplus model or as reference values. The output is calculated with the following equation.

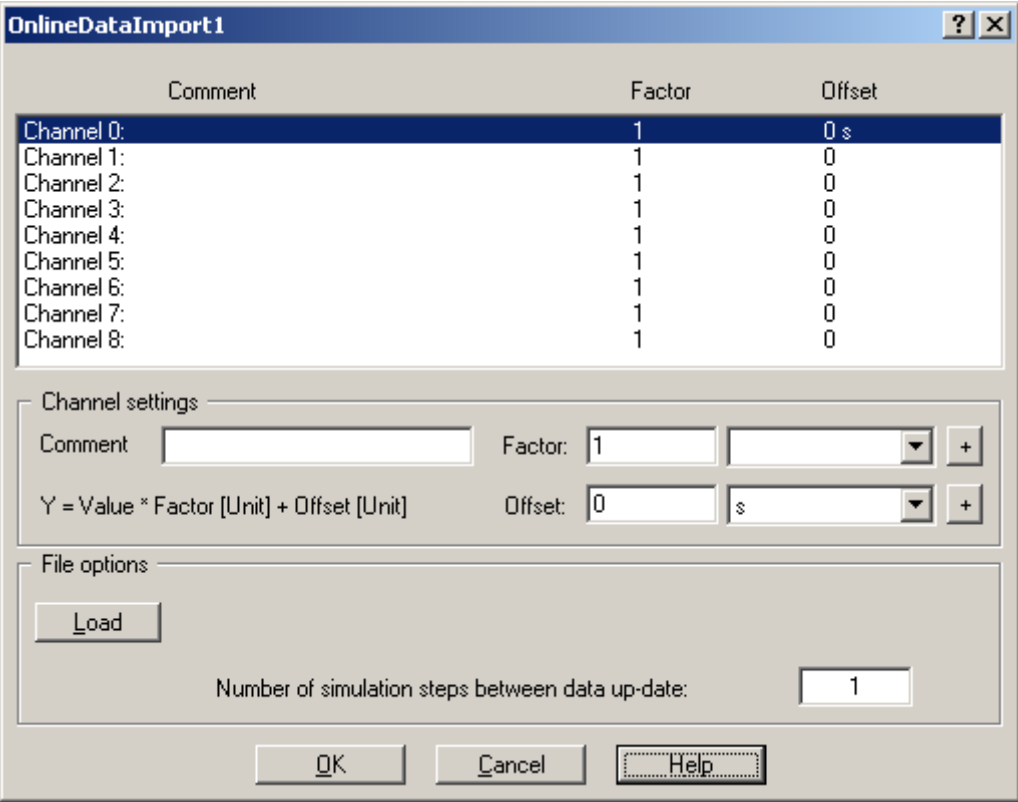
$$Y = \text{Value} * \text{Factor} [\text{Unit}] + \text{Offset} [\text{Unit}].$$

The following files are supported:

Diadem-files	: *.dat
Text- files	: *.txt
MATLAB- files	: *.mat

The parameterization of the component occurs about a special dialog, which is different from the others. The parameterization arises moreover in more then one dialog. First dialog opens after a double-click on the component and has the same name. In the upper area you'll find the *Channel* with *Comment*, *Factor* and *Offset*. *Channel 0* is normally occupied by the timeline.

The parameterization of the comments, the factors and the offsets with the corresponding units takes place in the **Channel Settings**. The button  loads all the available units. In the File Options you set the number of simulation steps between data -update. If the sampling frequency of the measured data is smaller than the simulation sampling frequency, the change of the simulation steps is suggestive.



Comment	Factor	Offset
Channel 0:	1	0 s
Channel 1:	1	0
Channel 2:	1	0
Channel 3:	1	0
Channel 4:	1	0
Channel 5:	1	0
Channel 6:	1	0
Channel 7:	1	0
Channel 8:	1	0

Channel settings

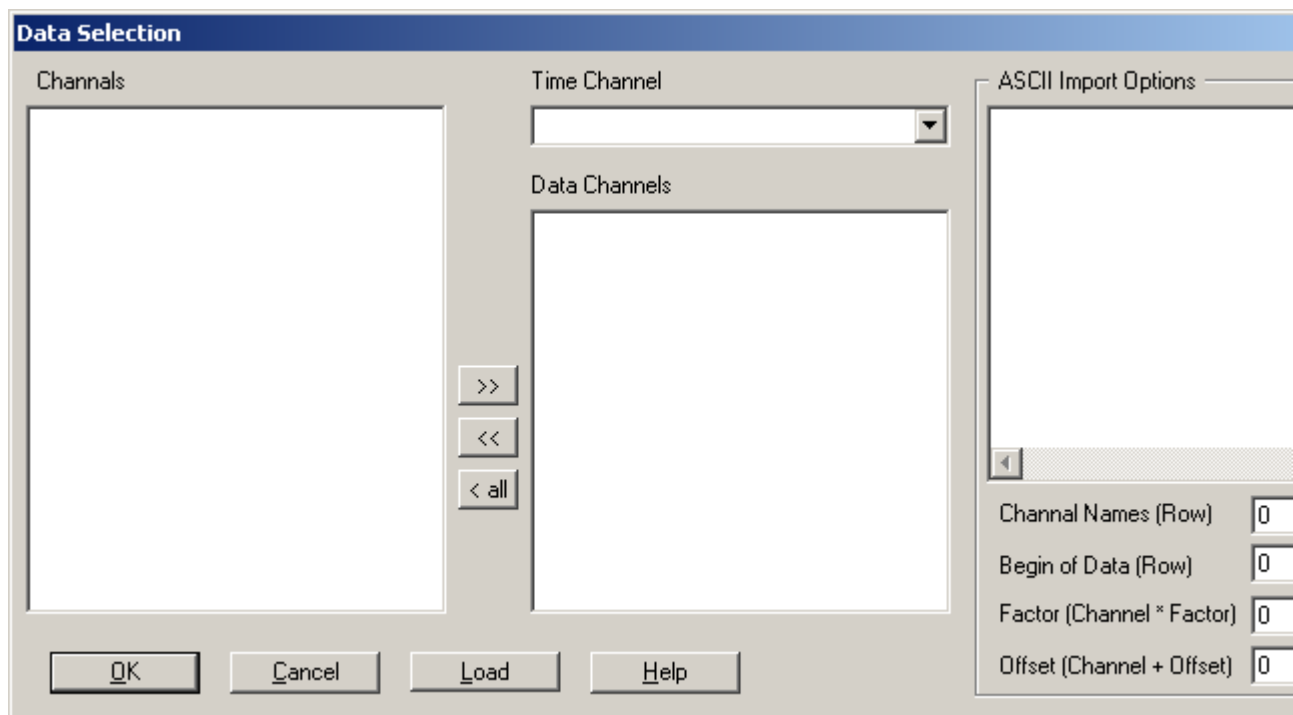
Comment: Factor: Offset:

Y = Value * Factor [Unit] + Offset [Unit]

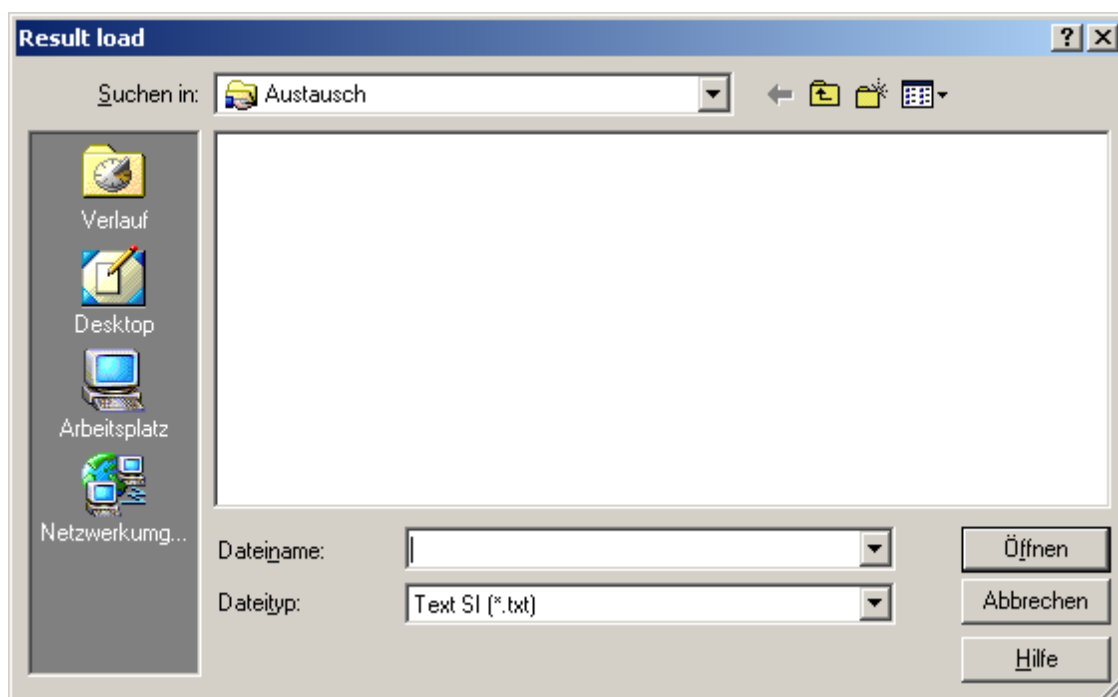
File options

Number of simulation steps between data up-date:

With **Load** the dialog *Data Selection* opens. With the button **Load** the relevant source file with information has to be loaded.

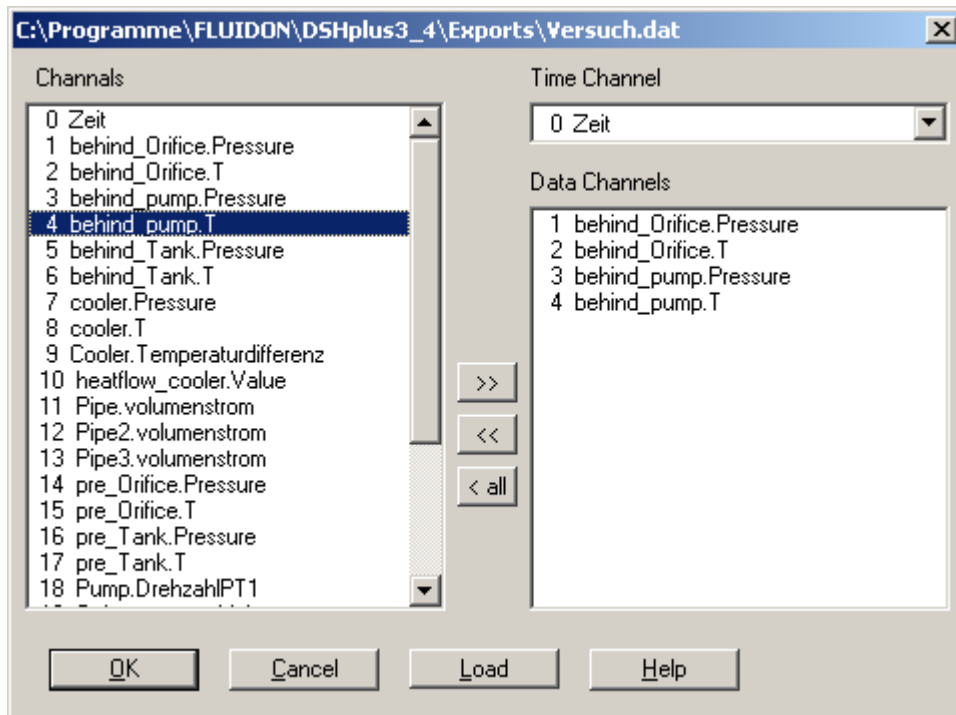


Therefore the dialog **Result load** opens to locate the file. With **OK** the file is loaded.



The further empty dialog **Data selection** shows now in the left window all saved channels. If the source file is a *.txt-file, the starting line of the channel names and the starting line of the correspondent data has to add in the ASCII-Import options. If other file formats are used, these options are suppressed.

The individual **Channels** are loaded or deleted separately or deleted as a whole to **Data Channels** with the buttons in the middle of the dialog or can be assigned or deleted by double click. If the file contains more than one timeline, you can assign the relevant timeline about the dropdown list **Time Channel**. Every **Channel** can be loaded recurrently to the field **Data Channel**.



*Dialog **Data Selection** after the source file loading with the origin path as dialog name
and assigned data channels*

After **OK** the parameterization dialog shows the loaded channels to set the parameters of each channel.

Comment	Factor	Offset
Channel 0: Zeit	0	1
Channel 1: behind_Orifice.Pressure	1 bar	1
Channel 2: behind_Orifice.T	0	1
Channel 3: behind_pump.Pressure	0	1
Channel 4: behind_pump.T	0	1
Channel 5: empty	0	1
Channel 6: empty	0	1
Channel 7: empty	0	1
Channel 8: empty	0	0

Channel Settings

Comment: Factor:

Y = Value * Factor [Unit] + Offset [Unit] Offset:

File Options

Versuch.dat

Number of simulation steps between data up-date:

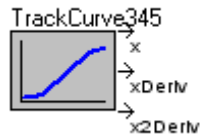
Parameter dialog OnlineDataImport

After the load, the file name is shown besides the button Load. Each channel is parameterized with a Factor and an Offset with its units. The comments are placed with channel names of the loaded data automatically.

The change of the Number of the simulation steps between data up-date effects that the loaded values are not shown with the saved sample frequency.

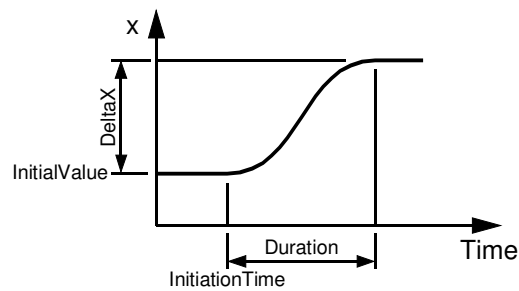
This value should be increased if the loaded values has a smaller sample frequency than the sample frequency in the actual simulation.

TrackCurve345



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
x	Out	-	nominal value (x)
xDot	Out	-	first derivation of the nominal value ($\dot{x}$)
x2Dot	Out	-	second derivation of the nominal value ($\ddot{x}$)

Parameters

Name	Value	Unit	Description
InitiationTime	0	s	initiation time of the function
Duration	1	s	duration of the function
InitialValue	0	-	offset at the beginning of the function
DeltaX	1	-	difference between <i>Initial-Value</i> and final value

Notes

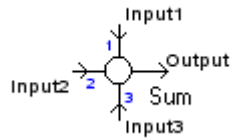
The component TRACKCURVE345 creates a function whose second derivation ($x2Dot$) is smooth.

This function can be used to preset a time depending nominal value with which an impact stress free point to point movement of a drive can be simulated. The course *DeltaX* from the one point to the other one will pass through in *Duration*. The blending function is generated by a 3-4-5- polynomial.

Before the *InitiationTime* the *InitialValue* is output, after the *Duration* the output value amounts to *InitialValue + DeltaX*.

Mathematical Functions

Sum



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Input3	In	-	input signal 3
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Factor1	1	-	factor of input signal 1
Factor2	1	-	factor of input signal 2
Factor3	1	-	factor of input signal 3

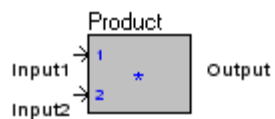
Notes

The component SUM computes the output signal according to the following equation

$$\text{Output} = \text{Factor1} \cdot \text{Input1} + \text{Factor2} \cdot \text{Input2} + \text{Factor3} \cdot \text{Input3}.$$

For the component SUM two different symbols are available.

Product



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

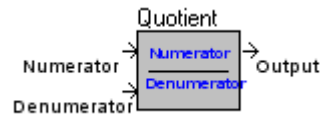
Name	Value	Unit	Description
-	-	-	-

Notes

The component PRODUCT computes the output signal according to the following equation:

$$Output = Input1 \cdot Input2.$$

Quotient



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Numerator	In	-	input signal 1
Denominator	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
FactorNumerator	1	-	Numerator proportionality factor
FactorDenominator	1	-	Denominator proportionality factor
Zeropointdefinition	0	-	

Notes

The component QUOTIENT computes the output signal according to the following equation

$$Output = Numerator * FactorNumerator / Denominator * FactorDenominator.$$

If $Denominator = 0$ then $Output = 0$.

Dependant of the parameter Zeropointdefinition the Output is calculated as follows if the denominator is near zero:

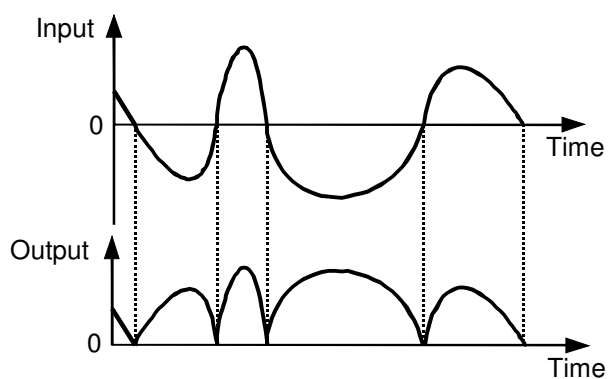
- 0 -> Output = 0
- > 0 Output = ∞
- < 0 Output = $-\infty$

AbsoluteValue



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

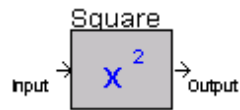
Name	Value	Unit	Description
-	-	-	-

Notes

The component ABSOLUTEVALUE computes the output signal according to the following equation:

$$Output = |Input|.$$

Square



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

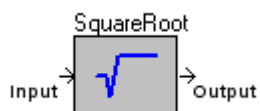
Name	Value	Unit	Description
-	-	-	-

Notes

The component SQUARE computes the output signal according to the following equation

$$Output = Input * Input.$$

SquareRoot



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

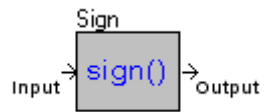
Name	Value	Unit	Description
-	-	-	-

Notes

The component SQUAREROOT computes the output signal according the following equation

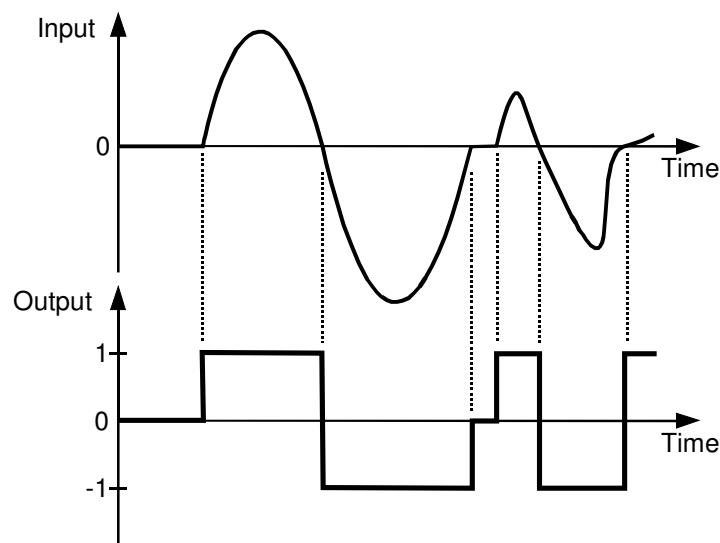
$$Output = \text{sign}(Input) * \text{sqrt}(\text{abs}(Input)).$$

Sign



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
-	-	-	-

Notes

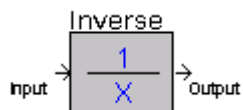
The component SIGN computes the signal according to the following equation:

Output = *sign* (*Input*) with.

$$\text{sign}(x) = \begin{cases} 1 & \text{if } x > 0 \\ 0 & \text{if } x = 0 \\ -1 & \text{if } x < 0 \end{cases}$$

Attention: the name of the component must not be 'sign' because it is a C++ keyword.

Inverse



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In		input signal
Output	Out		output signal

Parameters

Name	Value	Unit	Description
-	-	-	-

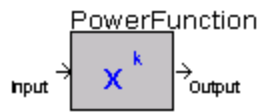
Notes

The component INVERSE computes the output signal according the following equation

$$Output = 1 / Input.$$

The result is 0 if the input value is smaller than the internal barrier Epsilon.

PowerFunction



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

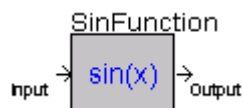
Name	Value	Unit	Description
K	1.	-	exponent of the computation

Notes

The component POWERFUNCTION computes the output signal according the following equation

$$Output = Input^k.$$

SinFunction



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
ArcSineFlag	0	-	flag to select the equation for each computation

Notes

The component `SINFUNCTION` computes the output signal according to the following equation if the parameter *ArcSineFlag* = 0

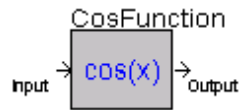
$$Output = \sin (Input).$$

If the parameter *ArcSineFlag* = 1 the component `SINFUNCTION` computes the output signal according to the following equation

$$Output = \arcsine (Input).$$

The `ARCUSINEFUNCTION` is defined only between the values -1 and 1. The input values are checked for the affiliation in this interval. If the limits are violated an advance notice will be given and the input value will be limited to the valid boundary value.

CosFunction



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
ArcCosinusFlag	0	-	flag to select the equation for each computation

Notes

If the parameter *ArcCosinusFlag* = 0, the component CosFUNCTION computes the output signal according to the following equation

$$Output = \cos (Input).$$

If the parameter *ArcCosinusFlag* = 1, the component CosFUNCTION computes the output signal according to the following function

$$Output = \arccos (Input).$$

The ARCUSCOSINUSFUNCTION is defined only between the values -1 and 1. The input values are checked for the affiliation in this interval. If the limits are violated an advance notice will be given and the input value will be limited to the valid boundary value.

TanFunction



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
ArcTangensFlag	0	-	flag to select the equation for each computation

Notes

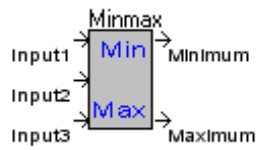
If the parameter *ArcTangensFlag* = 0, the component TANFUNCTION computes the output signal according to the following equation

$$Output = \tan (Input).$$

If the parameter *ArcTangensFlag* = 1, the component TANFUNCTION computes the output signal according to the following equation

$$Output = \arctan (Input).$$

MinMax



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Input3	In	-	input signal 3
Minimum	Out	-	lowest input signal
Maximum	Out	-	highest input signal

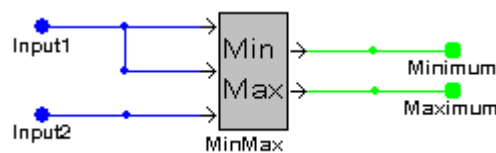
Parameters

Name	Value	Unit	Description
-	-	-	-

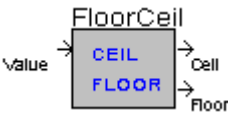
Notes

The component MinMax computes the highest and/or lowest value of a maximum of three input signals.

If the *Maximum* and *Minimum* of only two input signals should be computed, two input connectors have to be connected to the same signal. This prevents the free input from getting the value *Zero*.



FloorCeil



Symbol

Sketch

Connectors and Variables

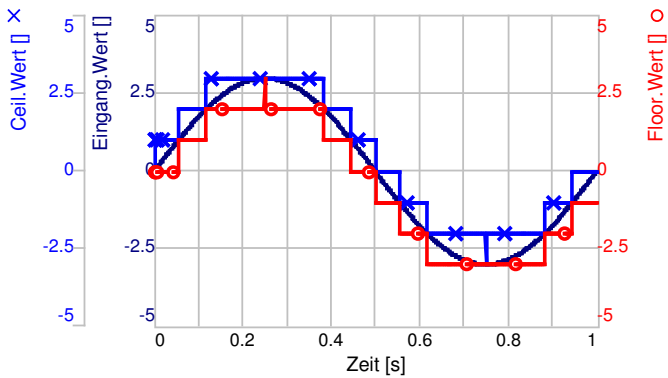
Name	Type	Unit	Description
Value	In	-	Input signal
Ceil	Out	-	Upper output signal
Floor	Out	-	Bottom output signal

Parameters

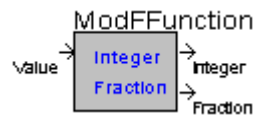
Name	Value	Unit	Description
-	-	-	-

Notes

The component FLOORCEIL separates the input signal in two parts. The output *Ceil* passes the nearest smaller integer value of the input signal. *Floor* passes the next greater integer value of the input signal.



ModFFunction



Symbol

Sketch

Connectors and Variables

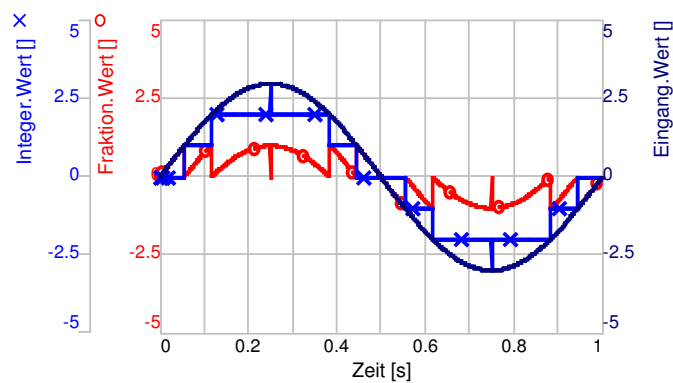
Name	Type	Unit	Description
Value	In	-	Input signal
Integer	Out	-	Integer value of the input value
Fraction	Out	-	fraction value of the input

Parameters

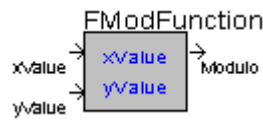
Name	Value	Unit	Description
-	-	-	-

Notes

The component MODFFUNCTION separates the input signal in two parts. The *integer* part and the *fraction*.



FModFunction



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Xvalue	In	-	Input signal
Yvalue	In	-	Input signal
Modulo	Out	-	Output signal

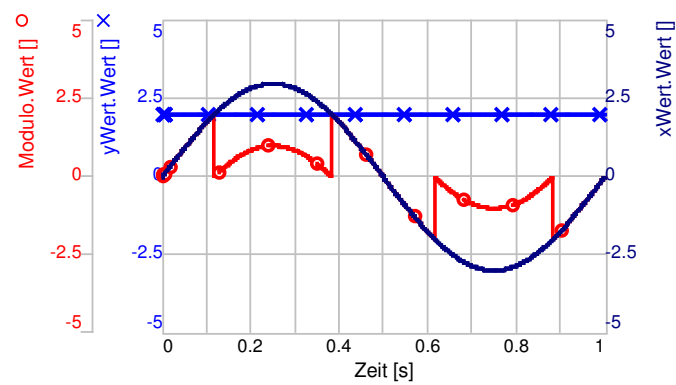
Parameter

Name	Value	Unit	Description
-	-	-	-

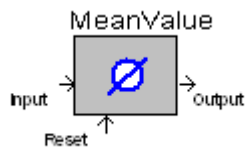
Notes

The component FmodFunction calculates the Modulo as follows:

$$x = ay + f \ (0 < f < y)$$

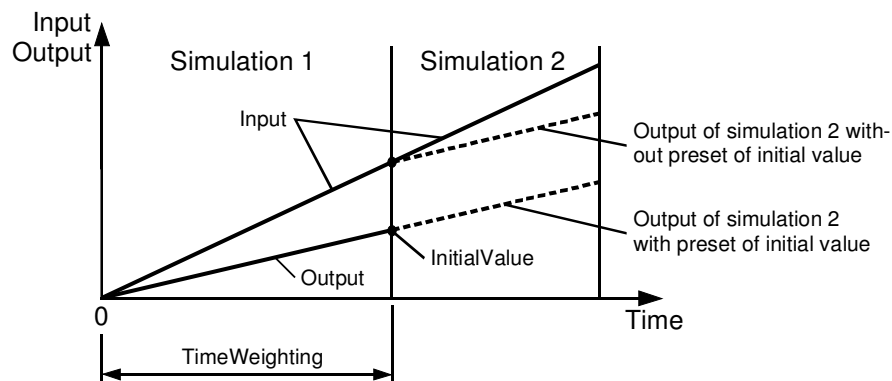


MeanValue



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
IntegratedInput	V	-	internal variable
Output	Out	-	output signal
Reset	In	-	reset input signal

Parameters

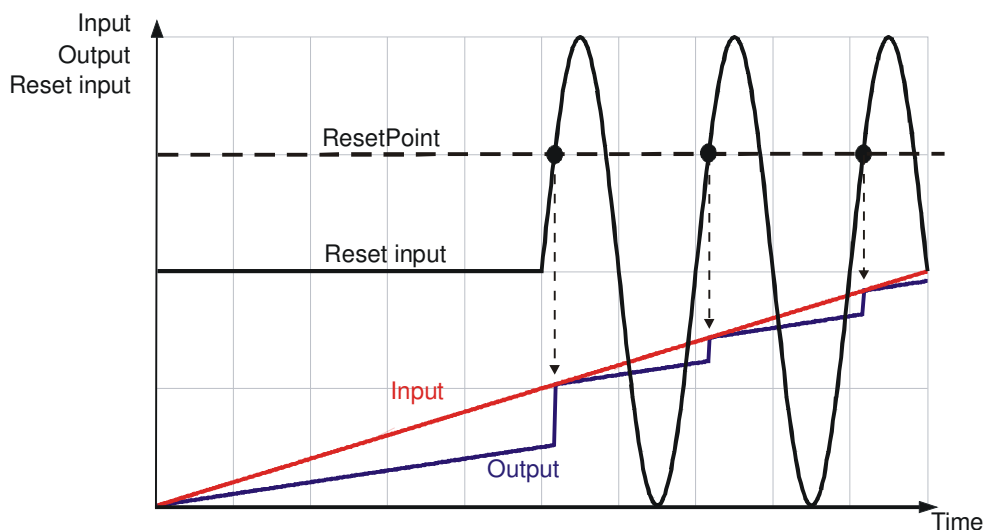
Name	Value	Unit	Description
InitialValue	0	-	starting value of the mean value
TimeWeighting	0	s	time weighting of the <i>InitialValue</i>
ResetPoint	0	-	threshold for the reset of the mean value

Notes

The component MEANVALUE computes the mean value of a signal from the simulation start-up until the current simulation time. *InitialValue* and *TimeWeighting* allows to define the initial value of the mean value. The *InitialValue* enters into the mean value multiplied with *TimeWeighting*.

If the initial values of a simulation e. g. are based on the final values of the previous simulation, the mean value of the first simulation can enter the second via the *Initial-Value*. Through it the mean value is determined over both simulations. In this case the *TimeWeighting* amount to the duration of the first simulation. If the *InitialValue* is not preset, the mean value is only computed of the values of the second simulation.

By defining a *ResetPoint* and connecting the *Reset* signal input the mean value can be reseted during the simulation time.



The output of the mean value is reseted everytime the *Reset* input signal overcomes the threshold defined by the parameter *ResetPoint*.

QualityCriterion



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal
Input2	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Factor Input1	1	-	Proportionality factor weighting the Input 1
Factor Input 2	-1	-	Proportionality factor weighting the Input 2
Start time	0	s	Start of the quality calculation
Reset time	1.e98-	s	Reset time of Start time
Stop time	1.e99-	s	End of the quality calculation
Criterion	ITAE	-	Used quality criterion

Notes

The component QualityCriterion calculates the quality of an optimization.

On principle it is desirable, to use only one quality criterion to evaluate the changes directly. As many described applications show in the literature, the integral or surface criteria had been proved for this as suitably.

As well as for the response as for the disturbance the total area of the control deviation $e(t) = w(t) - y(t)$ is used for the description of the deviation from the ideal control loop. Here from, the integral criterion is defined in regard of the optimization as follows.

$$I_k = \int_0^{\infty} f_k[e(t)]dt = I_k(r_1, r_2, \dots, r_n) \equiv \text{Min.}$$

Thus, a integral criterion always pursuits to minimize I_k , which occurs by the selection of the free design parameter of the controller parameter $r_1, r_2, \dots, r_n$.

Because of the different demands of the fluid technical systems, like for example a very small delay time T_u or no overshooting $e_{\max} = \text{minimal}$, the function $f_k[e(t)]dt$ has to be selected case dependant.

The component QUALITYCRITERION includes the following criterions:

$I_2 = \int_0^{\infty} e(t) dt \quad (\text{IAE})$ Integral Absolute Value of Error	Absolute value control area , appropriate for not monoton oscillations, long winded estimation
$I_3 = \int_0^{\infty} e^2(t) dt \quad (\text{ISE})$ Integral Squared Value of Error	Squared control area , strong consideration of high control deviations for greater adjusting times, in many cases analytic calculation possible
$I_4 = \int_0^{\infty} e(t) t dt \quad (\text{ITAE})$ Integral of Time multiplied Absolute Value of Error	Time multiplied linear area , like I_2 , considers also the adjusting length of time
$I_5 = \int_0^{\infty} e^2(t) t dt \quad (\text{ITSE})$ Integral of Time multiplied Squared Value of Error	Time multiplied squared area , like I_2 , considers also the adjusting length of time

The choice of the criterion occurs in the special parameter dialog with the parameter *Criterion*.

QualityCriterion1

Criterion: **ITAE**

Factor Input1: 1.00000E+01

Factor Input2: -1.00000E+00

Start time: 0.00000E+00

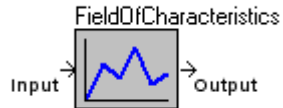
Reset time: 1.00000E+98

Stop time: 1.00000E+99

OK Cancel Help

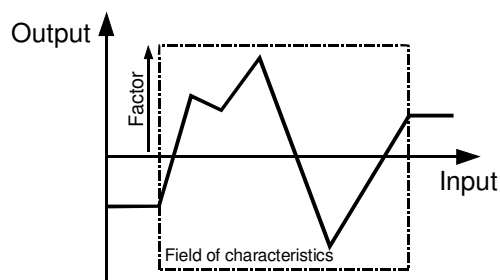
Functions and Tables

FieldOfCharacteristics



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
FieldOfCharacteristics	-1	-	number of the look-up table (-1: no look-up table loaded, 0: first look-up table)
Factor	1	-	stretching or jolting factor of the output values of the look- up table

Notes

The component FIELDOFCHARACTERISTICS allows to represent non-linear one-dimensional functions via a look-up table.

The *Output* is computed of the input signal and the one-dimensional look-up table function:

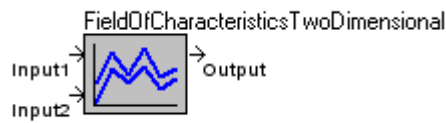
$$\text{Output} = \text{Factor} \cdot f_{\text{Look-up table}}(\text{Input})$$

The look-up table can be extended and/or compressed in y direction with the parameter *Factor*.

If the input signal is outside of the range of the look-up table, the respective boundary value is taken. The units of input and output are freely selectable.

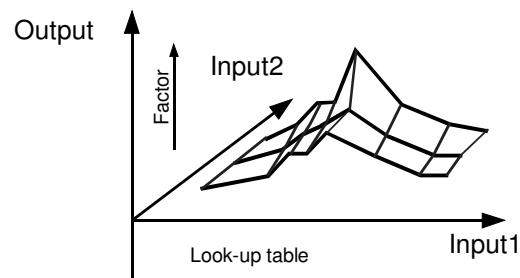
The look-up table is entered via an own editor and selected by means of its name in the parameter dialog of the component.

FieldOfCharacteristicsTwoDimensional



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
FieldOfCharacteristics	-1	-	number of the look-up table (-1: no look-up table loaded, 0: first look-up table)
Factor	1	-	stretching or jolting factor of the output values of the look-up table

Notes

The component FIELDOFCHARACTERISTICS2DOWENSIONAL allows to represent non-linear two-dimensional functions via a look-up table.

The *Output* is computed of the input signal and the two-dimensional look-up table function:

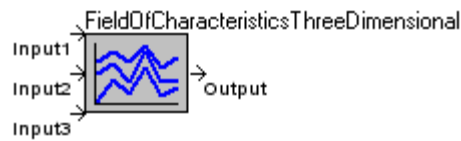
$$Output = Factor \cdot f_{Look-up\ table}(Input1, Input2)$$

The look-up table can be extended and/or compressed in y direction with the parameter *Factor*.

If the input signal is outside of the range of the look-up table, the respective boundary value is taken. The units of input and output are freely selectable.

The look-up table is entered via an own editor and selected by means of its name in the parameter dialog of the component.

FieldOfCharacteristicsThreeDimensional



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal1
Input2	In	-	input signal2
Input3	In	-	input signal3
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
FieldOfCharacteristics	-1	-	number of the look-up table (-1: no look-up table loaded, 0: first look-up table)
Factor	1	-	stretching or jolting factor of the output values of the look-up table

Notes

The component `FIELDOFCHARACTERISTICS3D` allows to represent non-linear three-dimensional functions via a look-up table.

The *Output* is computed of the input signal and the two-dimensional look-up table function:

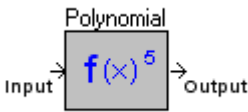
$$\text{Output} = \text{Factor} \cdot f_{\text{Look-up table}}(\text{Input1}, \text{Input2}, \text{Input3})$$

The look-up table can be extended and/or compressed in y direction with the parameter *Factor*.

If the input signal is outside of the range of the look-up table, the respective boundary value is taken. The units of input and output are freely selectable.

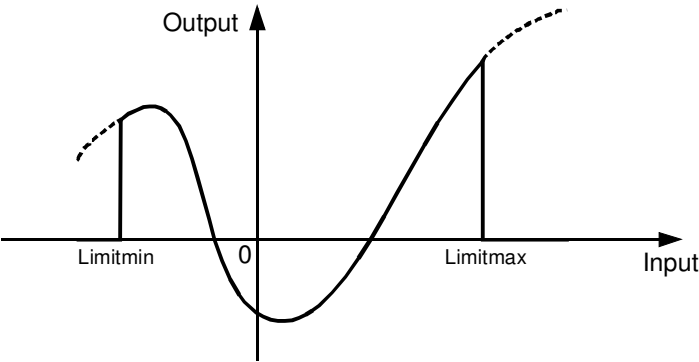
The look-up table is entered via an own editor and selected by means of its name in the parameter dialog of the component.

Polynomial



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal (x_E)
Output	Out	-	output signal (x_A)

Parameters

Name	Value	Unit	Description
a0	0	-	coefficient a_0
a1	0	-	coefficient a_1
a2	0	-	coefficient a_2
a3	0	-	coefficient a_3
a4	0	-	coefficient a_4
a5	0	-	coefficient a_5
LimitMin	-1.e99	-	lower limit of the input signal
LimitMax	1.e99	-	upper limit of the input signal

Notes

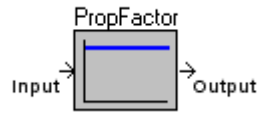
The component POLYNOMIAL computes the signal according to the following equation

$$x_A = a_5x^5 + a_4x^4 + a_3x^3 + a_2x^2 + a_1x^1 + a_0 \text{ .}$$

The parameters *LimitMin* and *LimitMax* limit the input values of the function. If the input signal exceeds the limits the *Output* is set to *Zero*.

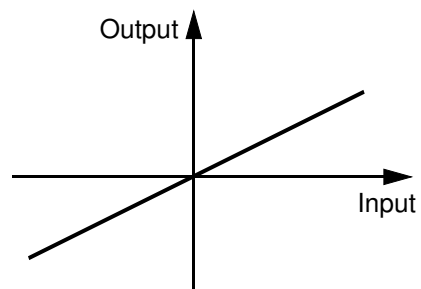
Transfer Functions

PropFactor



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal one
Input1	In	-	input signal two
Input2	In	-	input signal three
Output	Out	-	output signal one
Output1	Out	-	output signal two
Output2	Out	-	output signal three

Parameters

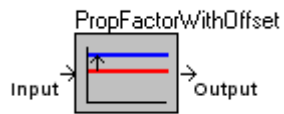
Name	Value	Unit	Description
Kp	1	-	proportionality factor

Notes

The component PROPFACTOR transmits the signal according to the following equation:

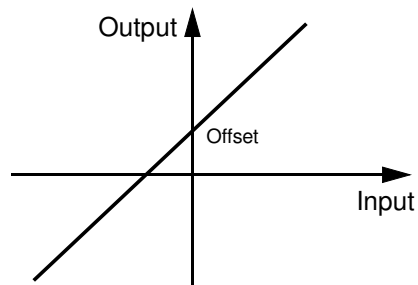
$$Output = Kp \cdot Input.$$

PropFactorWithOffset



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

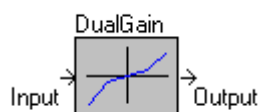
Name	Value	Unit	Description
Factor	1	-	proportionality factor
Offset	0	-	displacement of function

Notes

The component PROPFACTORWITHOFFSET transmits the signal according to the following equation:

$$Output = Factor \cdot Input + Offset.$$

DualGain



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Kp1_p	1	-	Proportionality factor positives input signal
Kp2_p	1	-	Proportionality factor 2 positives input signal
Threshold_p	1	-	Positive switching threshold
Kp1_n	0	-	Proportionality factor negative input signal
Kp2_n	0	-	Proportionality factor negative input signal
Threshold_n	0	-	Negative switching threshold

Notes

The component DualGain is like a P-controller, whose amplifications and thresholds can be setup separately for a negative and positive input signal.

If the parameters $Kp1_n$, $Kp2_n$ and $Threshold_n = 0$, then it's true for

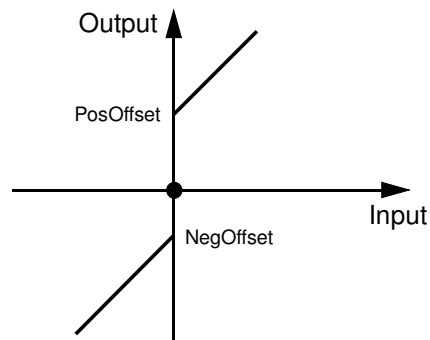
$$\begin{aligned}
 Kp1_p &= Kp1_n \\
 Kp2_p &= Kp2_n \\
 -Threshold_p &= Threshold_n
 \end{aligned}$$

SignedOffset



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

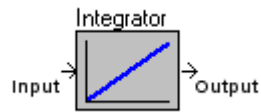
Name	Value	Unit	Description
PosOffset	0	-	offset at positive input signal
NegOffset	0	-	offset at negative input signal
ZeroDefinition	0	-	Zero point definition

Notes

The component `PROPFACORSIGNEDOFFSET` transmits the signal according to the following equations:

$$\begin{aligned}
 \text{Output} &= \text{Input} + \text{NegOffset} && \text{for } \text{Input} < 0 \\
 \text{Output} &= 0 && \text{for } \text{Input} = 0 \\
 \text{Output} &= \text{Input} + \text{PosOffset} && \text{for } \text{Input} > 0
 \end{aligned}$$

Integrator



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Ki	1	1/s	factor
OutputMax	1e99	-	upper limit of integrator output
OutputMin	-1e99	-	lower limit of the integrator

Notes

The component INTEGRATOR transmits the signal according to the following equations:

$$\text{Derivation} = K_i * \text{Input}$$

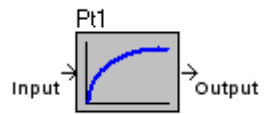
$$\text{Derivation} = 0 \text{ for } \text{Output} \geq \text{OutputMax} \ \&\& \ \text{Derivation} > 0$$

or

$$\text{Derivation} = 0 \text{ for } \text{Output} \leq \text{OutputMin} \ \&\& \ \text{Derivation} < 0$$

$$\text{Output} = \int \text{Derivation} \, dt.$$

PT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal (x_E)
Output	Out	-	output signal (x_A)

Parameters

Name	Value	Unit	Description
Kp	1	-	Factor
T	1	s	time constant true for: $x_{E\ n} < x_{E\ n+1}$
TDecreasing	0	-	time constant true for: $x_{E\ n} > x_{E\ n+1}$

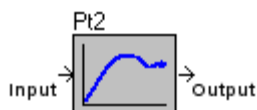
Notes

The component PT1 transmits the signal according to the following equation:

$$T \cdot \dot{x}_A + x_A = Kp \cdot x_E.$$

It is true: TDecreasing = T , for TDecreasing = 0

PT2



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal (x_E)
Velocity	V	1/s	internal variable ($\dot{x}_A$)
Output	Out	-	output signal (x_A)

Parameters

Name	Value	Unit	Description
Eigenfrequency	0	Hz	Eigenfrequency ($\omega_0/2\pi$)
Damping	1	-	damping coefficient (D)
Kp	1	-	factor
Velocitymax	1E99	1/s	limit
Velocitymin	-1E99	1/s	limit

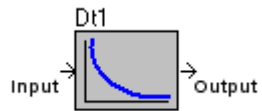
Notes

The component PT2 transmits the signal according to the following equation:

$$\ddot{x}_A + 2 \cdot D \cdot \omega_0 \cdot \dot{x}_A + \omega_0^2 \cdot x_A = \omega_0 \cdot Kp \cdot x_E.$$

In order to model a non-linearity of the PT2 element the variable *velocity* can be limited with the parameters *velocitymax* and *velocitymin*. With these parameter set to $\pm 1E99$ 1/s, the velocity can be considered as unlimited.

This limitation is useful e. g. in the case of modeling a servo valve in order to limit the flow through a pilot stage.

DT1**Symbol**

Sketch**Connectors and Variables**

Name	Type	Unit	Description
Input	In	-	input signal (x_E)
PT1	V	-	internal variable
Output	Out	-	output signal (x_A)

Parameters

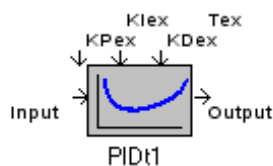
Name	Value	Unit	Description
KD	1	s	factor
T	1	ms	time constant

Notes

The component DT1 transmits the signal according to the following equation:

$$T \cdot \dot{x}_A + x_A = KD \cdot \dot{x}_E.$$

PIDt1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal (x_E)
KPex	In	-	factor of the proportional part of adapted adjustment
KIex	In	-	factor of the integrated part of adapted adjustment
KDex	In	-	factor differentiated part of adapted adjustment
Tex	In	-	time constant of adapted adjustment
I	V	-	internal variable
PT1	V	-	internal variable
Output	Out	-	output signal (x_A)

Parameters

Name	Value	Unit	Description
KP	1	-	factor of the proportional part; offset value for adaptive adjustment
KI	1	1/s	factor of integrated part; offset value for adaptive adjustment
KD	1	s	factor of the differentiated part; offset value for adaptive adjustment
T	1	ms	time constant

Name	Value	Unit	Description
IXiGr	0.	1.	amount value of the lower threshold of the input signal at which the integrator is still active
IXaGr	1.e99	1.	amount value of the upper threshold of the input signal at which the integrator is still active
Imin	-1.e99	1.	lower limit of integration value
Imax	1.e99	1.	upper limit of integration value
IReset	0	1.	Gradient of the integration
IResetGr	0	1.	Target value of the integration

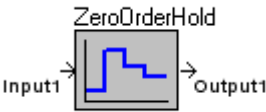
Notes

The component PIDT1 transmits the signal according to the following equation:

$$T \cdot \dot{x}_A + x_A = KP \cdot x_E + KI \cdot \int x_E dt + KD \cdot \dot{x}_E.$$

The parameters *IReset* und *IResetGr* activates a reset function, which reduces the integral part of the PIDT1-element with a constant gradient *IReset* if the input = 0.

ZeroOrderHold



Symbol

Sketch

Connectors and Variables

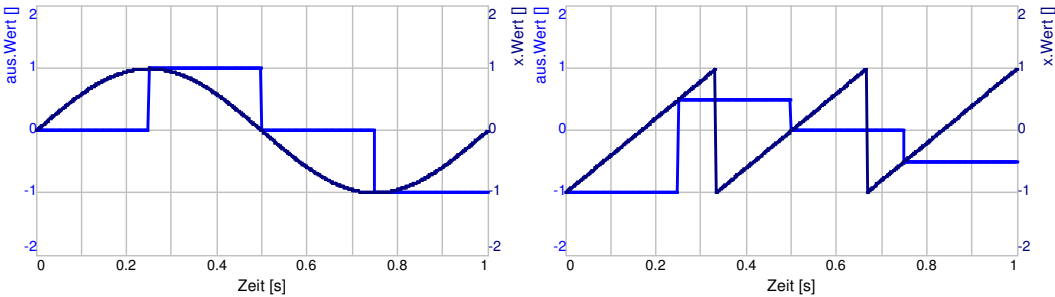
Name	Type	Unit	Description
Input1	In	-	input signal
Output1	Out	-	output signal
Input2	In	-	input signal
Output2	Out	-	output signal
Input3	In	-	input signal
Output2	Out	-	output signal

Parameters

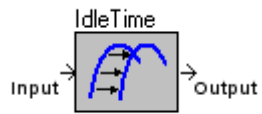
Name	Value	Unit	Description
SampleTime	1	s	The input signal is transmitted constant after the SampleTime

Notes

The component ZeroOrderHold transmits the input signal after the SampleTime for the duration $t = \text{SampleTime}$.

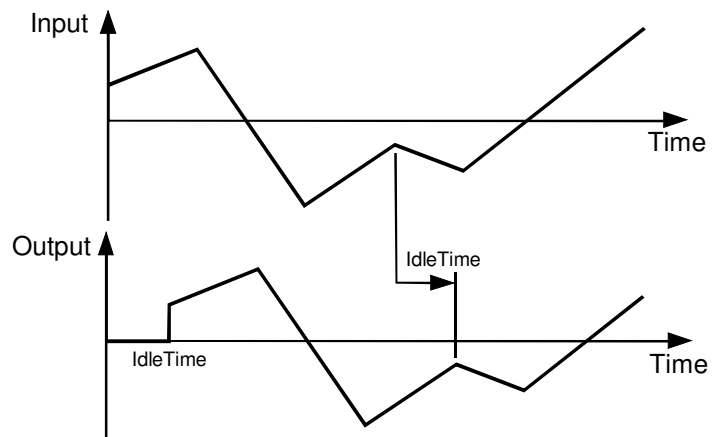


IdleTime



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

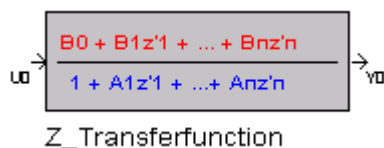
Name	Value	Unit	Description
IdleTime	0	ms	idle time

Notes

The component `IDLETIME` transmits the signal depending on the simulation time t according to the following equation:

$$\text{Output}(t) = \text{Input}(t - \text{IdleTime}).$$

Z_Transferfunction



Symbol

Sketch

$$G_m(z) = \frac{Y_M(z)}{U(z)} = \frac{B(z^{-1})}{A(z^{-1})} = \frac{b_0 + b_1 z^{-1} + \dots + b_n z^{-n}}{1 + a_1 z^{-1} + \dots + a_n z^{-n}}$$

Connectors and Variables

Name	Type	Unit	Description
U0	In	-	input signal
Y0	Out	-	output signal

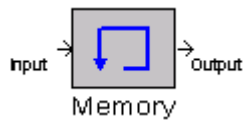
Parameters

Name	Value	Unit	Description
A0 until A9	0.	-	coefficient of the denominator polynomial
B0 until B9	0.	-	coefficient of the counter polynomial
Poles	0.	-	number of poles
Zeros	0.	-	number of zeros
Delay	0.	-	delay of the signal
PickupTime	1.	ms	period of pickup steps
Model	0.	-	Model type

Notes

The component Z_TRANSFERFUNCTION transmits the signal depending on time-discrete transferfunction which is set by the parameter A_n and B_n . More information see DSHplus-linear-systemidentification

Memory



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

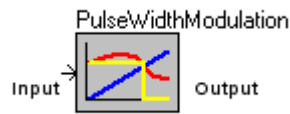
Parameters

Name	Value	Unit	Description
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Notes

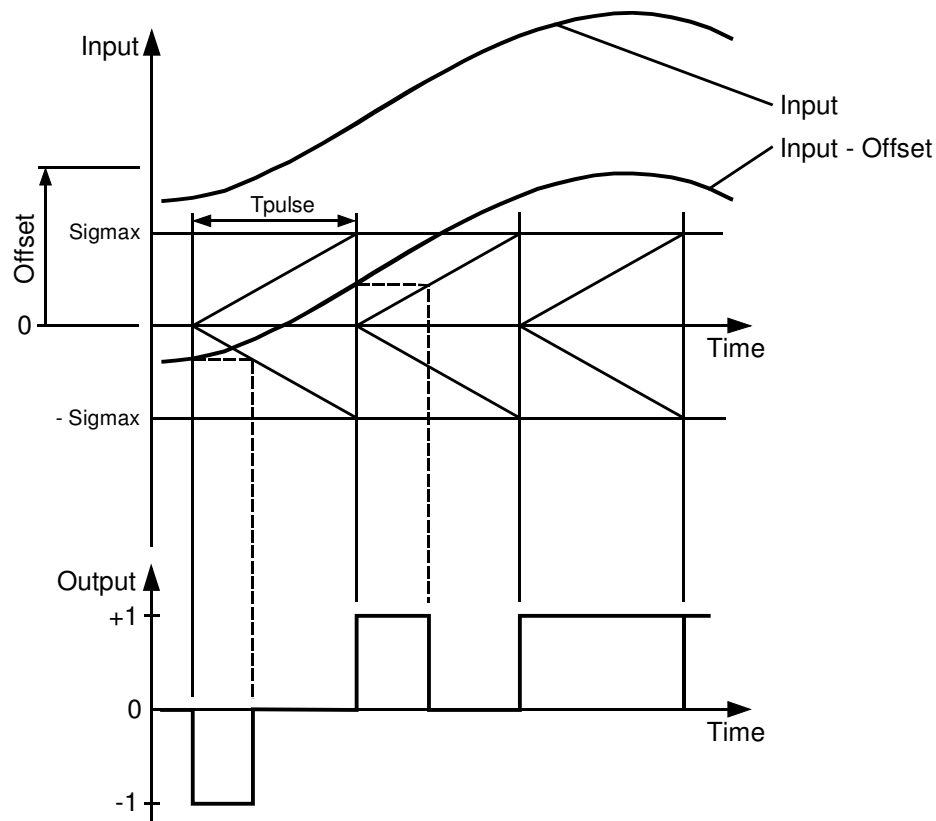
The Memory block outputs its input from the previous time step, applying a one integration step sample-and-hold to its input signal.

PulseWidthModulation



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	V	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Tpulse	100	ms	pickup time
Offset	0	V	correction of the input signal

Name	Value	Unit	Description
Sigmax	10	V	maximum value of the input signal which can be resolved

Notes

A continuous signal is converted into pulses with the component PULSEWIDTHMODULATION.

With *Offset*, the input signal can be shifted into the resolution range pre-set via *Sigmax*. If the input signal leaves the resolution range, it is cut off. The pulse time then is like the sampling time *Tpulse*.

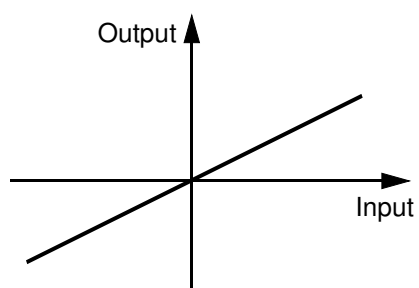
Time Discrete Transfer Functions

ZPropFactor



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Gain	1	-	proportionality factor

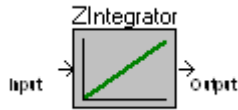
Notes

The component ZPROPFACTOR transmits the signal according to the following equation:

$$Output = Gain \cdot Input$$

The component act only with fixed step size

ZIntegrator



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
TimeConstant	10	ms	TimeConstant
OutputMax	1e99	-	upper limit of integrator output
OutputMin	-1e99	-	lower limit of the integrator

Notes

The component ZINTEGRATOR transmits the signal according to the following equations:

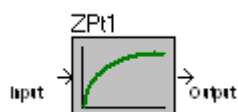
$$\frac{b_1 z^{-1}}{1 - z^{-1}}$$

For

$$b_1 = \frac{T_0}{T_I}$$

The component act only with fixed step size

ZPt1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Gain	1	-	Factor
TimeConstant	10	ms	time constant true for: $X_{E\ n} < X_{E\ n+1}$

Notes

The component ZPT1 transmits the signal according to the following equation:

$$\frac{b_1 z^{z-1}}{1 + a_1 z^{-1}}$$

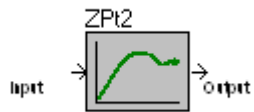
For

$$b_1 = K_p \left[1 - \exp\left(-\frac{T_0}{T_1}\right) \right]$$

$$a_1 = -\exp\left(-\frac{T_0}{T_1}\right)$$

The component act only with fixed step size

ZPt2



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Eigenfrequency	20	Hz	Eigenfrequency ($\omega_0/2\pi$)
Damping	0.4	-	damping coefficient (D)
Gain	1	-	factor
Velocitymax	1E99	1/s	limit
Velocitymin	-1E99	1/s	limit

Notes

The component ZPT2 transmits the signal according to the following equation:

$$\frac{b_1 z^{-1} + b_2 z^{-2}}{1 + a_1 z^{-1} + a_2 z^{-2}}.$$

For

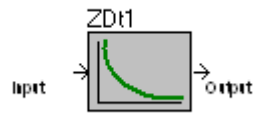
$$b_1 = K_p \left[1 - z_0 \left(\cos \omega T_0 + \frac{\delta}{\omega} \sin \omega T_0 \right) \right] \quad \delta = \frac{D}{T}$$

$$b_2 = K_p z_0 (z_0 - \cos \omega T_0 + \frac{\delta}{\omega} \sin \omega T_0) \quad \omega = \frac{\sqrt{1-D^2}}{T}$$

$$a_1 = -2z_0 \cos \omega T_0 \quad z_0 = \exp(-D \frac{T_0}{T})$$

The component act only with fixed step size

ZDt1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
TimeConstant	10	ms	time constant

Notes

The component ZDt1 transmits the signal according to the following equation:

$$\frac{b_0 + b_1 z^{-1}}{1 + a_1 z^{-1}}$$

For

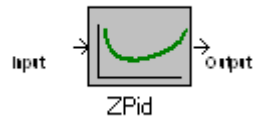
$$b_0 = \frac{T_D}{T_1}$$

$$b_1 = \frac{T_D}{T_1}$$

$$a_1 = -\exp\left(-\frac{T_0}{T_1}\right)$$

The component act only with fixed step size

ZPid



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Gain	1	-	factor of the proportional part; offset value for adaptive adjustment
TimeConstantI	10	ms	time constant of integrated part
TimeConstantD	10	ms	time constant of differentiated part

Notes

The component ZPID transmits the signal according to the following equation:

$$\frac{q_0 + q_1 z^{-1} + q_2 z^{-2}}{1 - z^{-1}}$$

For

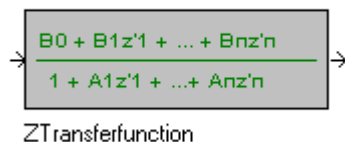
$$q_0 = K_p \left(1 + \frac{T_0}{2T_I} + \frac{T_D}{T_0} \right)$$

$$q_1 = -K_p \left(1 + \frac{T_0}{2T_I} + 2\frac{T_D}{T_0} \right)$$

$$q_2 = -K_p \frac{T_D}{T_0}$$

The component act only with fixed step size

ZTransferfunction



Symbol

Sketch

$$G_m(z) = \frac{Y_M(z)}{U(z)} = \frac{B(z^{-1})}{A(z^{-1})} = \frac{b_0 + b_1 z^{-1} + \dots + b_n z^{-n}}{1 + a_1 z^{-1} + \dots + a_n z^{-n}}$$

Connectors and Variables

Name	Type	Unit	Description
U0	In	-	input signal
Y0	Out	-	output signal

Parameters

Name	Value	Unit	Description
A0 until A9	0.	-	coefficient of the denominator polynomial
B0 until B9	0.	-	coefficient of the counter polynomial
Poles	0.	-	number of poles
Zeros	0.	-	number of zeros
Delay	0.	-	delay of the signal
PickupTime	1.	ms	period of pickup steps
Model	0.	-	Model type

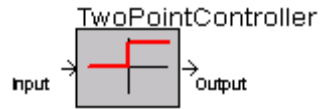
Notes

The component ZTRANSFERFUNCTION transmits the signal depending on time-discrete transferfunction which is set by the parameter A_n and B_n . More information see DSHplus-linear-systemidentification

The component act only with fixed step size

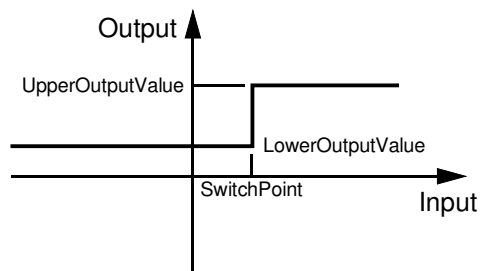
Nonlinear Functions

TwoPointController



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

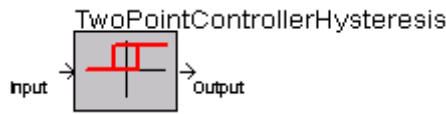
Name	Value	Unit	Description
SwitchPoint	0	-	value of the input signal at which the controller switches between the upper and lower output value
UpperOutputValue	1	-	upper output value
LowerOutputValue	0	-	lower output value

Notes

The output signal of the component `TWOPOINTCONTROLLER` switches between constant values in dependence of the input signal. The switch-over occurs according to the following conditions:

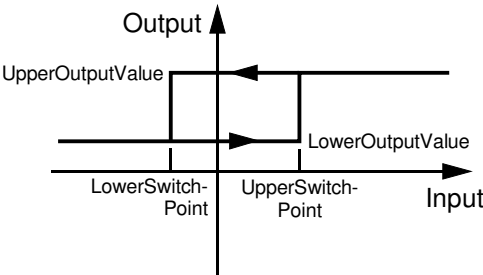
$$\begin{aligned} \text{Output} &= \text{LowerOutputValue} && \text{for } \text{Input} \leq \text{SwitchPoint} \\ \text{Output} &= \text{UpperOutputValue} && \text{for } \text{SwitchPoint} < \text{Input} \end{aligned}$$

TwoPointControllerHysteresis



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
UpperSwitchPoint	1	-	upper switch point
LowerSwitchPoint	-1	-	lower switch point
UpperOutputValue	1	-	upper output value
LowerOutputValue	0	-	lower output value

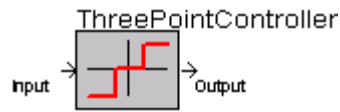
Notes

The output signal of the component TwoPOINTCONTROLLERHYSTERESIS switches between two constant values in dependence of the input signal. The switch-over occurs according to the following conditions:

$$\begin{aligned} \text{Output} &= \text{LowerOutputValue} && \text{for } \text{Input} \leq \text{LowerSwitchPoint} \\ \text{Output} &= \text{UpperOutputValue} && \text{for } \text{UpperSwitchPoint} < \text{Input} \end{aligned}$$

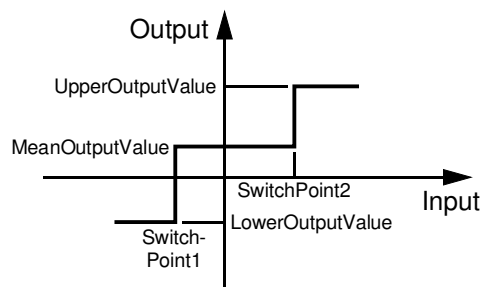
In the range $\text{LowerSwitchPoint} \leq \text{Input} \leq \text{UpperSwitchPoint}$ the output signal is in each case the output of the last simulation step.

ThreePointController



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

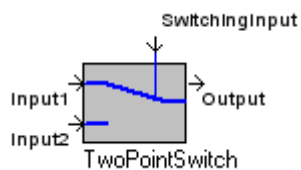
Name	Value	Unit	Description
SwitchPoint1	-1	-	lower switch point
SwitchPoint2	1	-	upper switch point
LowerOutputValue	-1	-	lower output value
MeanOutputValue	0	-	mean output value
UpperOutputValue	1	-	upper output value

Notes

The output signal of the component `THREEPOINTCONTROLLER` switches between three constant values in dependence of the input signal. The switch-over occurs according to the following conditions:

$$\begin{aligned}
 \text{Output} &= \text{LowerOutputValue} && \text{for } \text{Input} < \text{SwitchPoint1} \\
 \text{Output} &= \text{MeanOutputValue} && \text{for } \text{SwitchPoint1} \leq \text{Input} \leq \text{SwitchPoint2} \\
 \text{Output} &= \text{UpperOutputValue} && \text{for } \text{SwitchPoint2} < \text{Input}
 \end{aligned}$$

TwoPointSwitch



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Output	Out	-	output signal1
Input2	In	-	input signal 2
Output2	Out	-	output siganl2
Input3	In	-	inputsignal3
Output3	Out	-	output siganl3
Input4	In	-	input signal4
Output4	Out	-	output signal4
Input5	In	-	input siganl5
Output5	Out	-	output signal5
Input6	In	-	output signal6
Output6	Out	-	output siganl6
Input7	In	-	input signal7
Input8	In	-	input signal8
Input9	In	-	input signal9
Input10	In	-	input signal10
Input11	In	-	input signal11
Input12	In	-	input signal12
SwitchingInput	In	-	input signal for the switch control

Parameters

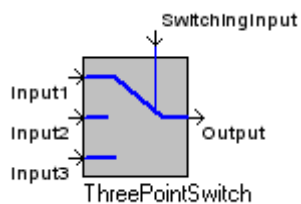
Name	Value	Unit	Description
SwitchPoint	0	-	value of the <i>SwitchingInput</i> at witch the controller switches between <i>Input1</i> and <i>Input2</i>

Notes

The component `TWOPOINTSWITCH` transmits *Input1* or *Input2* in dependence on *SwitchPoint* and *SwitchingInput* according to the following equations:

$$\begin{array}{ll} \text{Output} = \text{Input1} & \text{for } \text{SwitchingInput} \leq \text{SwitchPoint} \\ \text{Output} = \text{Input2} & \text{for } \text{SwitchPoint} < \text{SwitchingInput} \end{array}$$

ThreePointSwitch



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Output	Out	-	output signal1
Input2	In	-	input signal 2
Output2	Out	-	output signal2
Input3	In	-	input signal3
Output3	Out	-	output signal3
Input4	In	-	input signal4
Output4	Out	-	output signal4
Input5	In	-	input signal5
Input6	In	-	output signal6
Input7	In	-	input signal7
Input8	In	-	input signal8
Input9	In	-	input signal9
Input10	In	-	input signal10
Input11	In	-	input signal11
Input12	In	-	input signal12
SwitchingInput	In	-	input signal for the switch control

Parameters

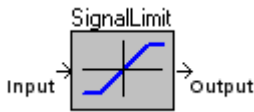
Name	Value	Unit	Description
SwitchPoint1	-1	-	lower switch point
SwitchPoint2	1	-	upper switch point

Notes

The component *THREEPOINTSWITCH* transmits *Input1*, *Input2*, or *Input3* in dependence on *SwitchPoint1*, *SwitchPoint2* and *SwitchingInput* according to the following equations:

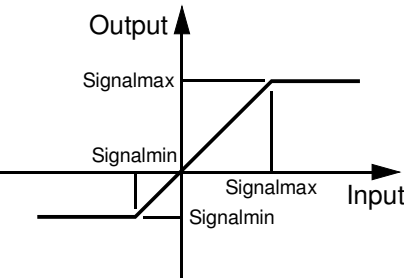
$Output = Input1$	for $SwitchingInput < SwitchPoint1$
$Output = Input2$	for $SwitchPoint1 \leq SwitchingInput \leq SwitchPoint2$
$Output = Input3$	for $SwitchPoint2 < SwitchingInput$

SignalLimit



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Signalmin	0	-	minimum value of the signal
Signalmax	0	-	maximum value of the signal

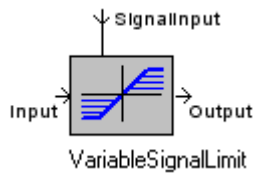
Notes

The component SIGNALLIMIT limits the input signal according to the following equations

$$Output = Signalmin$$
$$Output = Input$$
$$Output = Signalmax$$

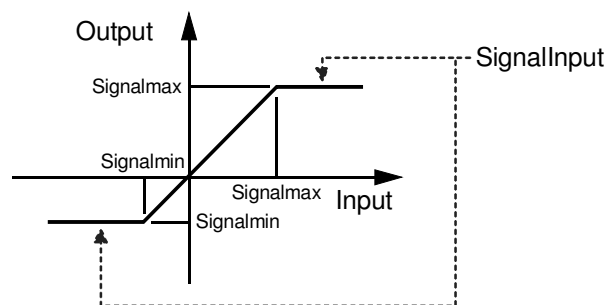
$$\text{for } Input < Signalmin$$
$$\text{for } Signalmin \leq Input \leq Signalmax$$
$$\text{for } Input > Signalmax$$

VariableSignalLimit



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Signal Input	In	-	input signal of adjustment
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Signalmin	0	-	minimum value of the signal
Signalmax	0	-	maximum value of the signal
SignalInputmax	1	-	normalization of the input signal

Notes

The component VARIABLESIGNALLIMIT limits the input signal. The limit could be variable between zero and the maximum value according to the following equations

$$\text{SignalDifInMax} = \text{Signalmax} / \text{Signalinputmax}$$

$$\text{SignalDifInMin} = \text{Signalmin} / \text{Signalinputmax}$$

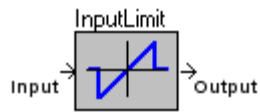
$$\text{Output} = \text{Signal}/\text{Input} * \text{SignalDifInMin} \quad \text{for } \text{SignalIn} * \text{SignalDifInMin}$$

$$\text{Output} = \text{Input} \quad \text{for } \text{SignalInput} * \text{SignalDifInMin}$$

$$\begin{aligned} & \leq Input \leq \\ & SignalInput * SignalDifInMax \\ Output = SignalInput * & \frac{SignalDifInMax}{for SignalInput * SignalDifInMax} \end{aligned}$$

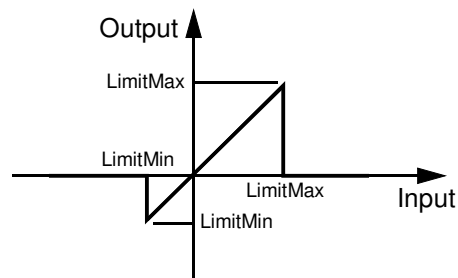
The adjustment is the result of the normalization of the SignalInput-Signal symmetric for the ranges Signalmax und Signalmin.

InputLimit



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

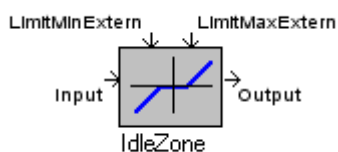
Name	Value	Unit	Description
LimitMin	0	-	minimum value of the input signal
LimitMax	0	-	maximum value of the input signal

Notes

The component INPUTLIMIT only transmits the signal within a specific range. The transfer occurs according to the following equations:

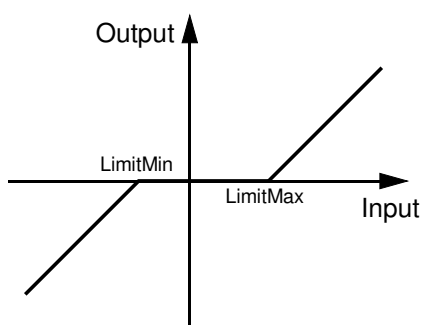
$$\begin{aligned}
 \text{Output} &= 0 && \text{for } \text{Input} < \text{LimitMin} \\
 \text{Output} &= \text{Input} && \text{for } \text{LimitMin} \leq \text{Input} \leq \text{LimitMax} \\
 \text{Output} &= 0 && \text{for } \text{LimitMax} < \text{Input}
 \end{aligned}$$

IdleZone



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal
LimitMinExtern	In	-	variable input signal for LimitMin
LimitMaxExtern	In	-	variable input signal for LimitMax

Parameters

Name	Value	Unit	Description
LimitMin	0	-	lower limit of the idle zone
LimitMax	0	-	upper limit of the idle zone

Notes

The component IDLEZONE transmits the signal according to the following equations:

$$Output = Input - LimitMin + LimitMinExtern$$

$$\text{for } Input \leq LimitMin + LimitMinExtern$$

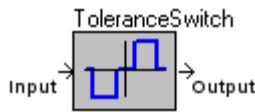
$$Output = 0$$

$$\text{for } LimitMin + LimitMinExtern < Input < LimitMax + LimitMaxExtern$$

$$Output = Input - LimitMax + LimitMaxExtern$$

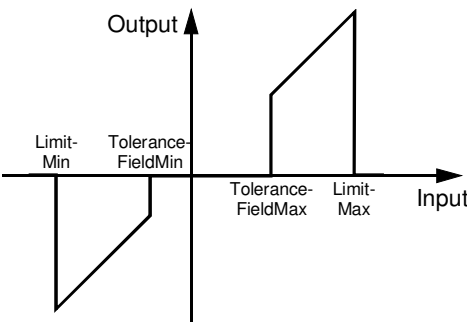
for $LimitMax + LimitMaxExtern \leq Input$

ToleranceSwitch



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
ToleranceFieldMin	-0.1	-	lower limit of the tolerance field
ToleranceFieldMax	0.1	-	upper limit of the tolerance field
LimitMin	-1	-	minimum value of the input signal
LimitMax	1	-	maximum value of the input signal

Notes

The component TOLERANCESWITCH transmits the signal according to the following equations:

$Output = 0$
 $Output = Input$
 $Output = 0$
 $Output = Input$
 $Output = 0$

for $Input < LimitMin$

for $LimitMin \leq Input \leq ToleranceFieldMin$

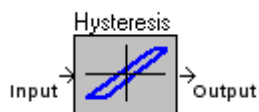
for $ToleranceFieldMin < Input < ToleranceFieldMax$

for $ToleranceFieldMax \leq Input \leq LimitMax$

for $LimitMax < Input$

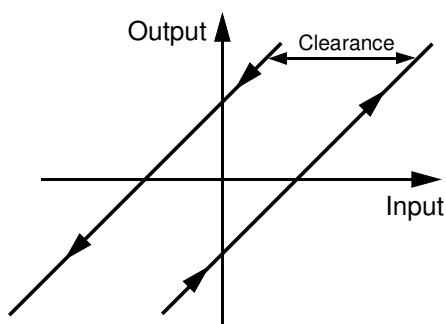
The TOLERANCESWITCH is useful for modelling a switching integrator.

Hysteresis



Symbol

Sketch



Connectors and Variables

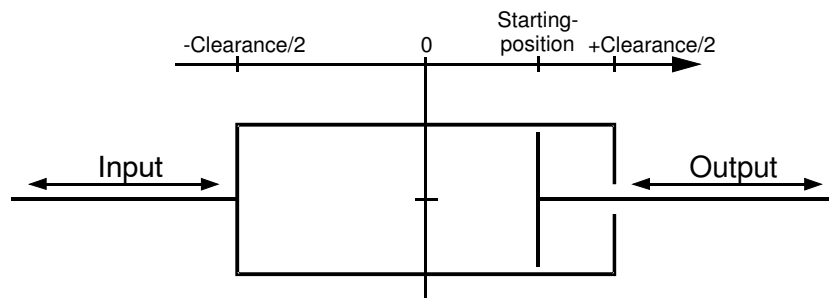
Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Clearance	1	-	clearance
StartingPosition	0	-	Position of the output signal in comparison to the input signal at the begin of the simulation. The starting position has to be between $-\text{Clearance}/2$ and $\text{Clearance}/2$.

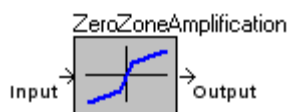
Notes

The component HYSTERESIS transmits the signal according to the following figure:



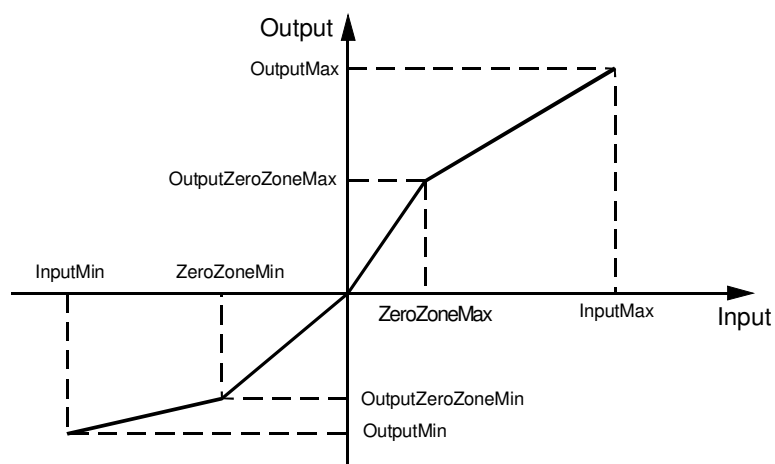
The starting position has to be between $-Clearance/2$ and $+Clearance/2$

ZeroZoneAmplification



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
InputMin	-10	-	Minimum value of the Input signal
InputMax	10	-	Maximum value of the Input signal
ZeroZoneMin	-0.1	-	Minimum value of the signal at Zero position
ZeroZoneMax	0.1	-	Maximum value of the signal at Zero position
OutputMin	-10	-	Minimum value of the output signal
OutputMax	10	-	Maximum value of the output signal

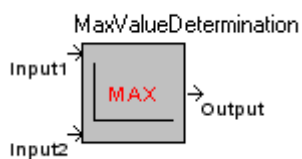
Name	Value	Unit	Description
OutputZeroZoneMin	-1	-	Minimum value of the signal at Output Zero position
OutputZeroZoneMax	1	-	Maximum value of the signal at output Zero position

Notes

The component ZEROZONEAMPLIFICATION amplifies the input signal with four different gains for four ranges.

It can be used for the transition of a positive overlapping of a valve with a controller.

MaxValueDetermination



Symbol

Sketch

Connectors and Variables

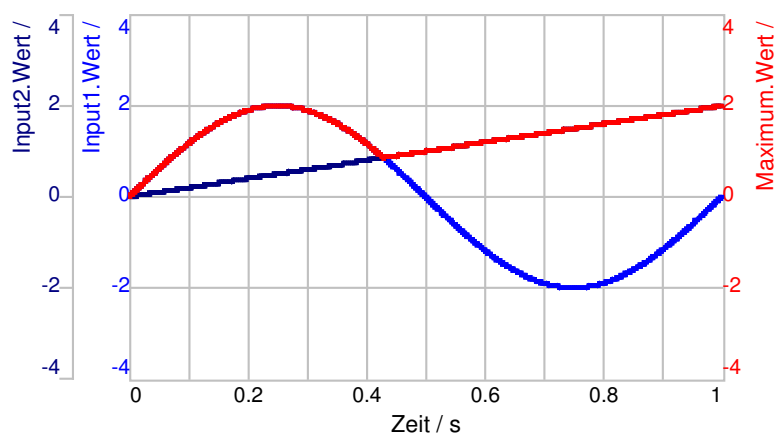
Name	Type	Unit	Description
Input1	In	-	First input signal
Input2	In	-	Second input signal
Output	Out	-	output signal

Parameters

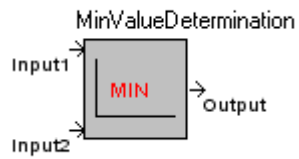
Name	Value	Unit	Description
------	-------	------	-------------

Notes

The component MAXVALUEDETERMINATION determines always the actual maximum input signal value from both input signals.



MinValueDetermination



Symbol

Sketch

Connectors and Variables

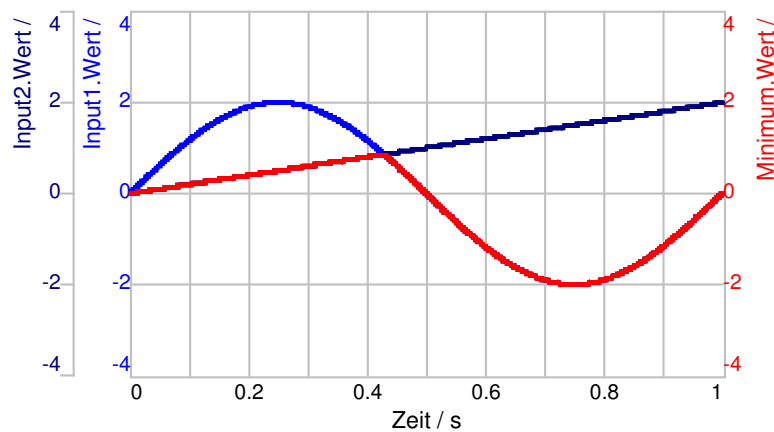
Name	Type	Unit	Description
Input1	In	-	First input signal
Input2	In	-	Second input signal
Output	Out	-	output signal

Parameters

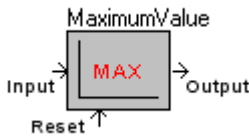
Name	Value	Unit	Description
------	-------	------	-------------

Notes

The component MINVALUEDETERMINATION determines always the actual minimum input signal value from both input signals.



MaximumValue



Symbol

Sketch

Connectors and Variables

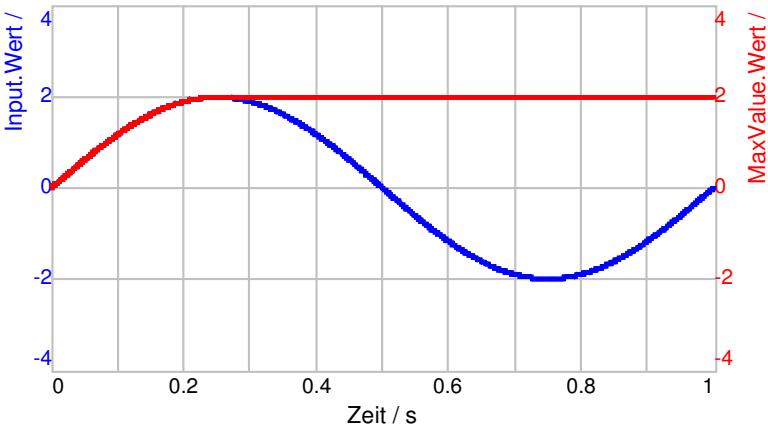
Name	Type	Unit	Description
Input	In	-	Input signal
Reset	In	-	Reset signal
Output	Out	-	output signal

Parameters

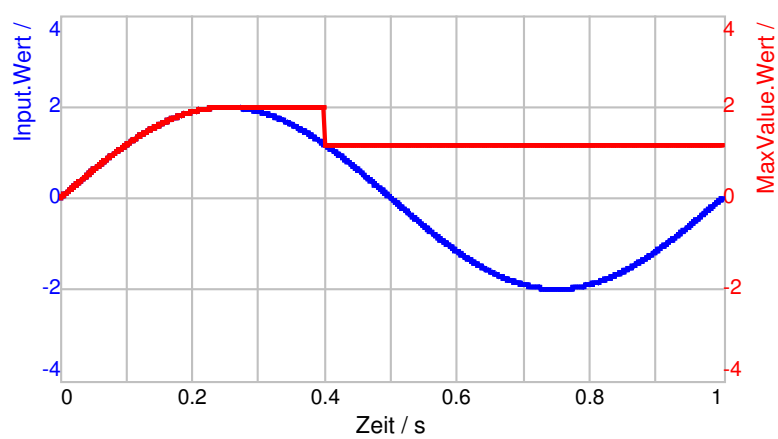
Name	Value	Unit	Description
------	-------	------	-------------

Notes

The component MAXIMUMVALUE determines always the maximum input signal value during the simulation time. Additional, it is possible to reset the output.

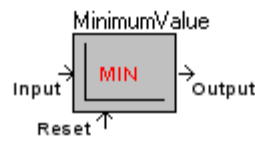


without Reset



Reset at $t = 0.4$ s

MinimumValue



Symbol

Sketch

Connectors and Variables

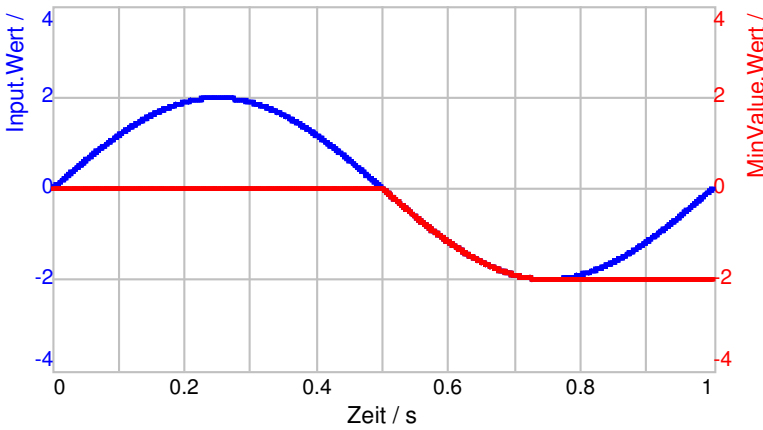
Name	Type	Unit	Description
Input	In	-	input signal
Reset	In	-	Reset signal
Output	Out	-	output signal

Parameters

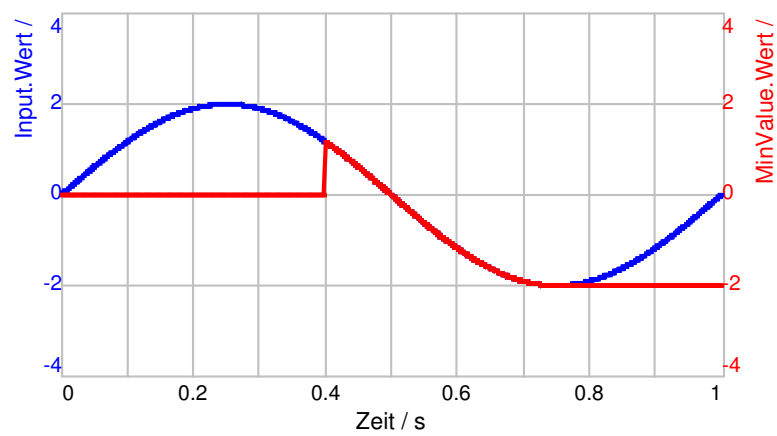
Name	Value	Unit	Description
------	-------	------	-------------

Notes

The component MINIMUMVALUE determines always the minimum input signal value during the simulation time. Additional, it is possible to reset the output.

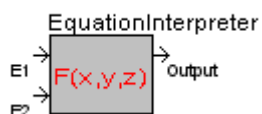


without Reset



Reset at $t = 0.4$ s

EquationInterpreter



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
E1	In	-	Input signal 1
E2	In	-	Input signal 2
Output	Out	-	Output signal

Parameters

Name	Value	Unit	Description
------	-------	------	-------------

EquationInterpreter1

Output =

Inputs

Constants

Operators

Functions

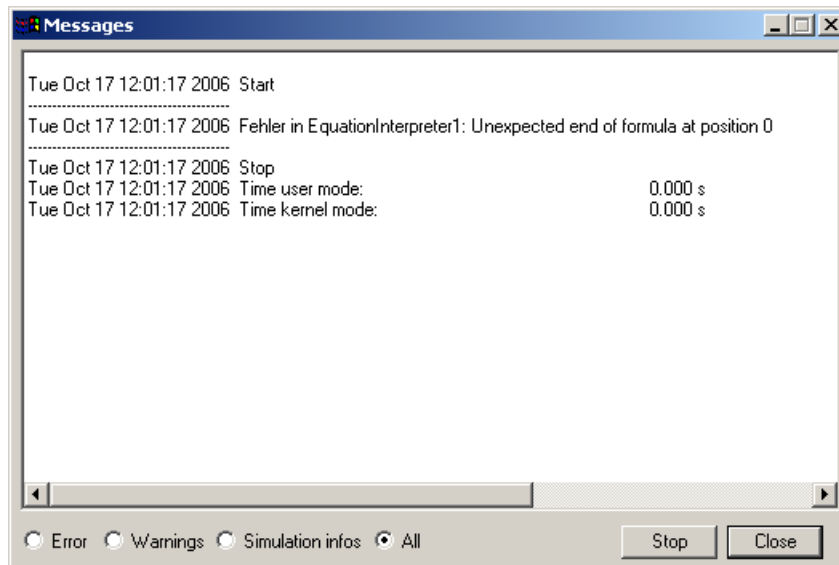
Equationinterpreter

Notes

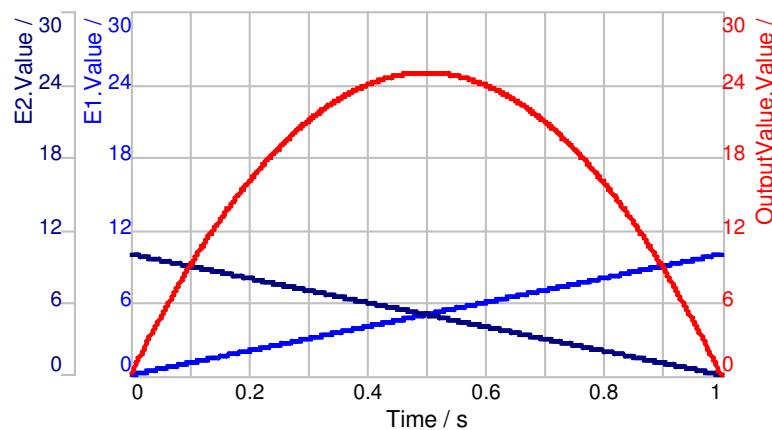
The component **EQUATIONINTERPRETER** is a component, which calculates the output value dependant on the arbitrary given user function.

The dependency has to be given in the field "**Output=**". The parameterization occurs in the shown dialogue.

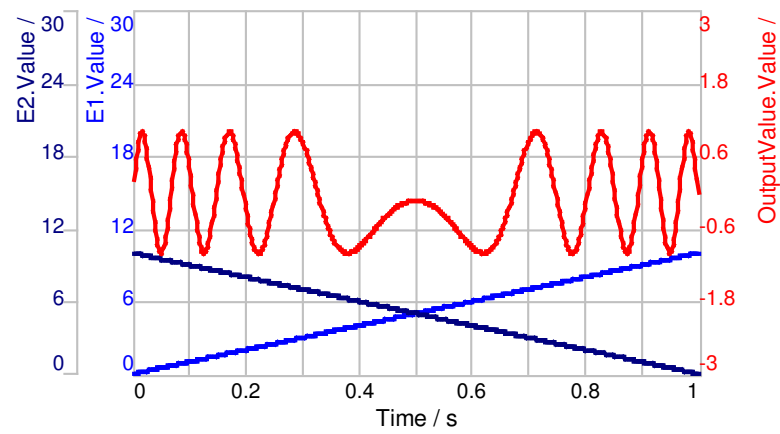
Additional operators, functions and constants are useful also the ten inputs. Ten constants are user definable.



If the **EQUATIONINTERPRETER** is not parameterized the warning above occurs in the message dialogue.



Example: $Output = E1 * E2$



Example: $Output = SIN(E1 * E2)$

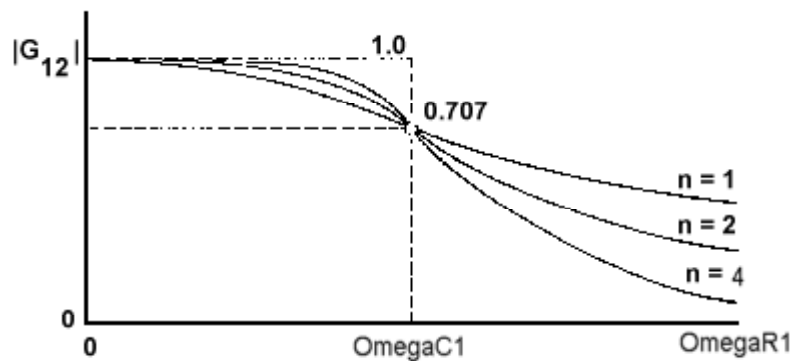
Extras

Butterworthfilter



Symbol

Sketch



$$|G_{12}(j\omega)| = \frac{1}{\sqrt{1 + \omega^{2n}}}$$

$$|G_{12}(s)| = \frac{1}{1 + a_1 s + a_2 s^2 + \dots + a_n s^n}$$

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
FilterFlag	0.	-	choice of filter type 0 = low pass 1 = high pass 2 = band pass
SignalPickupTime	1.	ms	interval in which the data were actualized

Name	Value	Unit	Description
OmegaC1	20.	Hz	limit frequency as of which the filter gets active or permeable
AmplificationC	-0.7	-	maximum amplitude damping over the chosen limit frequency
OmegaR1	25.	Hz	limit frequency as of which the filter gets completely active or permeable
AmplificationR	-10.		maximum amplitude damping over the chosen limit frequency
FilterOrder	4.	-	initial setting of the filter order 0 = automatical ordersetting
OmegaC2	20.	Hz	limit frequency of the band-pass

Notes

The component BUTTERWORTHFILTER describes a transfer function which transmits undamped signals only in a certain frequency range. Butterworth filters have a monotone amplitude frequency input and relative to conventional filters they have a minimal torsion over the filter margin.

Examples

The component BUTTERWORTHFILTER could be used as low pass, high pass and band pass. The following simulation graphs support the parameter setting of the component. The simulation starts with a sine-sweep from 0 up to 2000 Hz with normalized amplitude.

Parameter

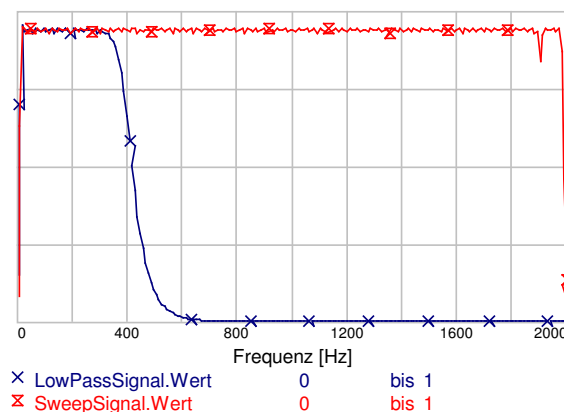
LowPass

```

FilterFlag      0
SignalPickupTime 1. ms
OmegaC1        400 Hz
AmplificationC  -0.7
OmegaR1        500 Hz
AmplificationR  -10
FilterOrder     5
OmegaC2        2000 Hz

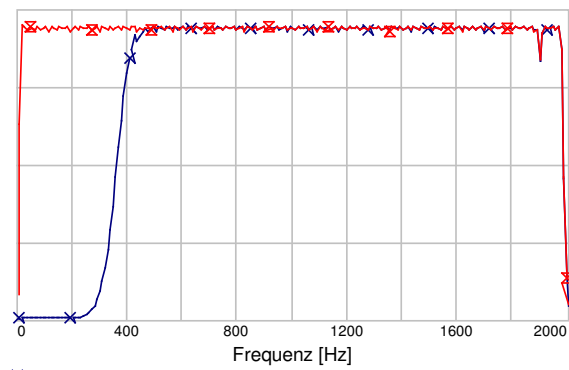
```

Filter results



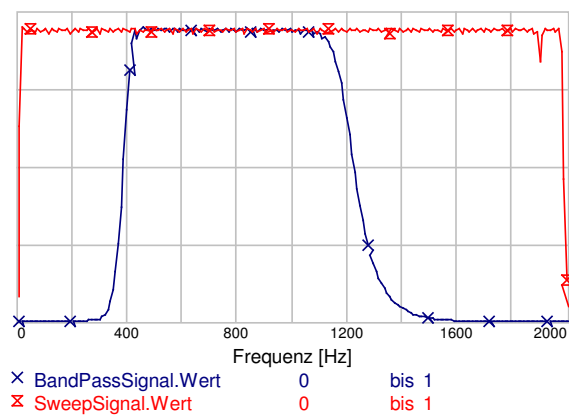
HighPass

```
FilterFlag      1
SignalPickupTime 1. ms
OmegaC1        400 Hz
AmplificationC  -0.7
OmegaR1        500 Hz
AmplificationR  -10
FilterOrder     5
OmegaC2        2000 Hz
```

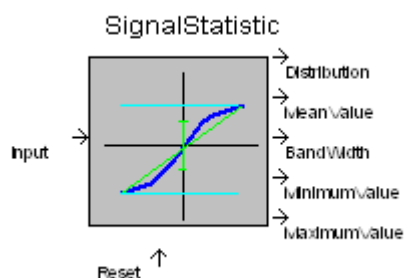


BandPass

```
FilterFlag      2
SignalPickupTime 1. ms
OmegaC1        400 Hz
AmplificationC  -0.7
Amplification    -10
FilterOrder     5
OmegaC2        1200 Hz
```



SignalStatistic



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Distribution	Out	-	distribution of input signal
BandWidth	Out	-	band width of input signal
MeanValue	Out	-	mean value of input signal
MinimumValue	Out	-	minimum value of input signal
MaximumValue	Out	-	maximum value of input signal
Reset	In	-	input connector for reset signal

Parameters

Name	Value	Unit	Description
SignalPickupTime	1	ms	interval in which the data were actualized
SamplingPoint	10	-	amount of data on which the computation is based on
ResetPoint	0	-	threshold for the reset of statistic values

Notes

The component SIGNALSTATISTIK computes the frequency distribution, the band width and the mean value of the signal. The calculation is based on the number of former data values which is defined of the parameter *PointsSampling*. The data were actualized off and

on which is specified in the parameter *SignalPickupTime*. The temporally oldest value is replaced with the current input value which the computation of the new output values takes directly into account (variable calculation).

The minimum and maximum value of the input signal can be picked up at the corresponding connectors *MinimumValue* and *MaximumValue*.

By defining a *ResetPoint* and connecting the *Reset* signal input the calculated statistic values can be reseted during the simulation time to separately analyze different phases of the simulation. The values are reseted every time the *Reset* input signal overcomes the threshold defined by the parameter *ResetPoint*.

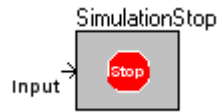
Calculation formulars

Bandwidth: $y = \max(\bar{x}_i) - \min(\bar{x}_i)$

Mean value: $y = \frac{\sum_{i=0}^n (x_i)}{n}$

Distribution: $y = \frac{\sum_{i=0}^n (x_i - x_0)^2}{n}$

SimulationStop



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Dummy	V	-	???

Parameters

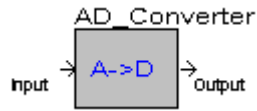
Name	Value	Unit	Description
Threshold	0.	-	threshold value
Decision	0.	-	switch if $\geq$ or $<$ is used 0 = request $<$ 1 = request $\geq$
Activ	0.	-	switch if the component is active 0 = inactive 1 = active

Notes

The component `SIMULATIONSTOP` stops the simulation when the input signal exceeds or falls below the adjusted threshold.

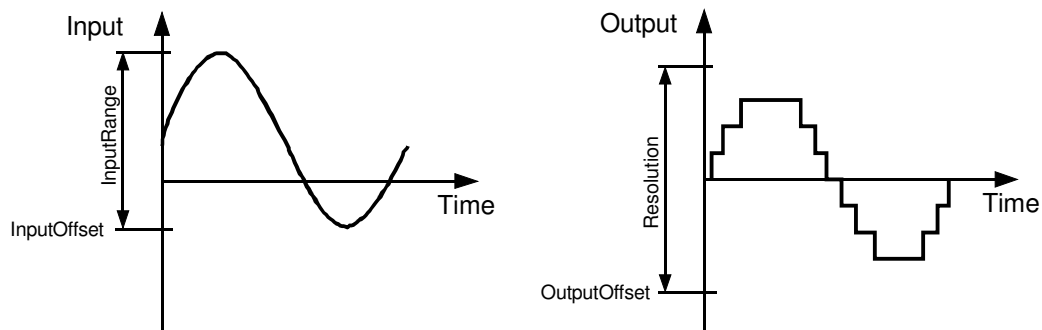
Digital Signal Elements

AD_Converter



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	V	input signal
Output	Out	-	output signal

Parameters

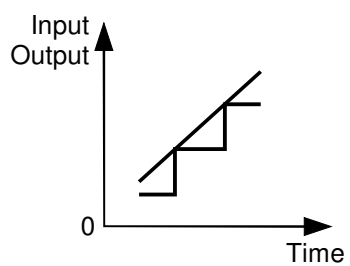
Name	Value	Unit	Description
InputOffset	-10	V	offset of the input signal
InputRange	20	V	the range of the input signal that is converted
OutputOffset	0	increments	offset of the output signal
Resolution	4095	increments	number of increments into which the input signal will be divided
Type	1	-	see Notes

Notes

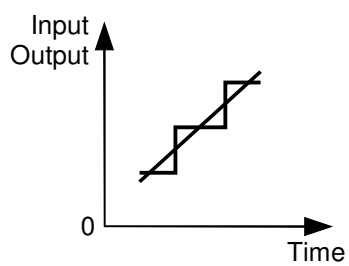
The component AD_CONVERTER is the model of an analog/digital transformer at a maximum of 32 bits resolution. Input values above and below the *InputRange* are cut off.

With the parameter *Type* three different switching thresholds can be selected:

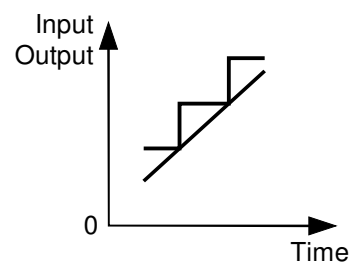
Type 1



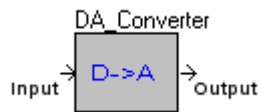
Type 2



Type 3

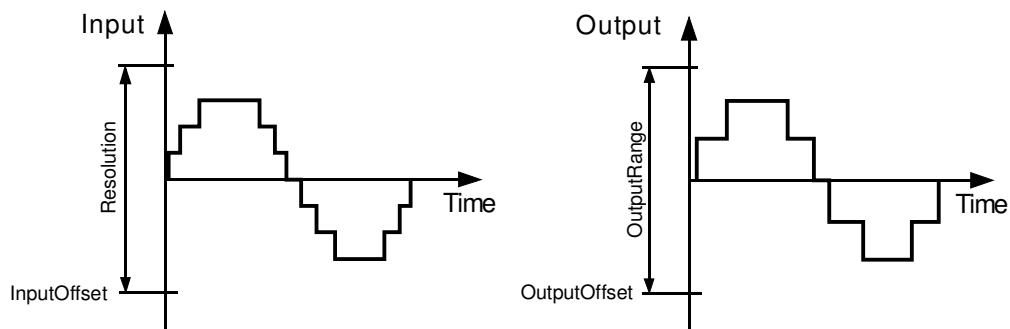


DA_Converter



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	V	output signal

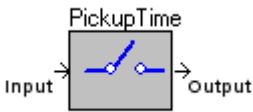
Parameters

Name	Value	Unit	Description
Resolution	4095	increments	number of increments into which the input signal is divided
InputOffset	0	increments	offset of the input signal
OutputOffset	-10	V	offset of the output signal
OutputRange	20	V	the range of the output signal into which the input signal will be converted

Notes

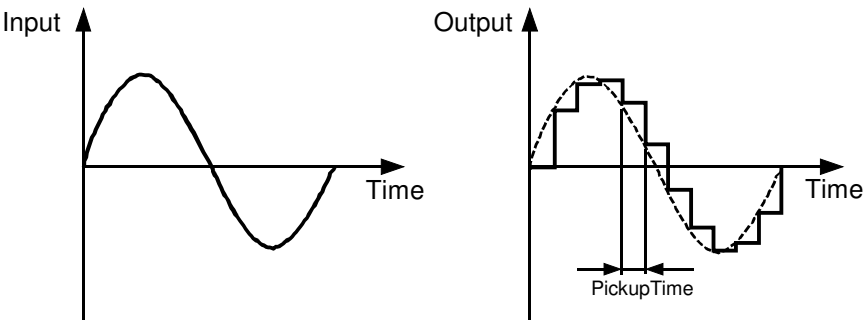
The component DA_CONVERTER is the model of an digital/analog transformer at a maximum of 32 bits resolution. Input values above InputOffset and Resolution and below InputOffset are cut off.

PickupTime



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

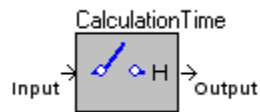
Parameters

Name	Value	Unit	Description
PickupTime	1	ms	period between two samples

Notes

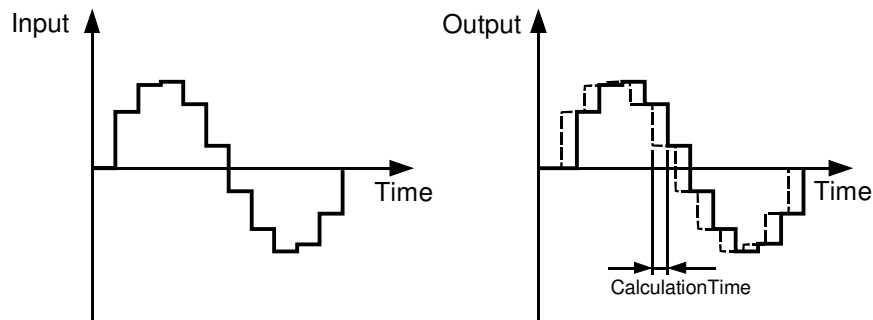
The component PICKUPTIME is the first element in a digital signal concatenation. At fixed sampling times the input signal is measured and put out up to the next sampling point. The sampling points itself are characterized by clock signals.

CalculationTime



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

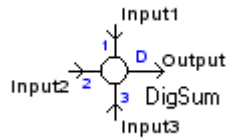
Name	Value	Unit	Description
CalculationTime	0	ms	delay between input and output signal

Notes

The component CALCULATIONTIME is the terminating component of a digital signal concatenation. At Output, an analog signal is available at which the clock signal of the PICKUPTIME was removed.

The component CALCULATIONTIME is used for modeling the time which a digital controller requires for calculation of the output variables. The parameter *CalculationTime* has to be in the range of 0 s and of the *PickupTime* the component PICKUPTIME.

DigSum



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Input3	In	-	input signal 3
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Factor1	1	-	factor of input signal 1
Factor2	1	-	factor of input signal 2
Factor3	1	-	factor of input signal 3

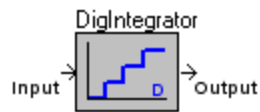
Notes

The component DigSum computes the output signal according to the equation

$$Output = Factor1 \cdot Input1 + Factor2 \cdot Input2 + Factor3 \cdot Input3.$$

After the receipt of a clock signal, the output signal is computed from the input signals and put out up to the receipt of the next clock signal.

DigIntegrator



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Ki	1	-	factor
InitialValue	0	-	<i>initial value</i> at the start of the simulation run
PickupTime	1	ms	period between two samples

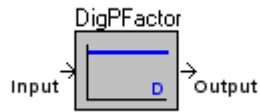
Notes

The component DIGINTEGRATOR computes the output signal according to the equation

$$Output = Output + Input \cdot Ki \cdot PickupTime.$$

After the receipt of a clock signal, the output signal is computed from the input signal and put out up to the receipt of the next clock signal.

DigPFactor



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Kp	1	-	proportionality factor

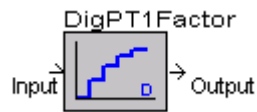
Notes

The component DigP computes the output signal according to the equation

$$Output = Kp \cdot Input.$$

After the receipt of a clock signal, the output signal is computed from the input signal and put out up to the receipt of the next clock signal.

DigPT1Factor



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
Kp	1.	-	proportionality factor
TimeConstant	1.	s	time dependent factor
PickupTime	1.	ms	period between two samples

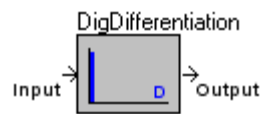
Notes

The component DigPT1 computes the output signal according to the following equation

$$Output = (Kp * Input + TimeConstant / PickupTime * Output_old) / (TimeConstant / PickupTime + 1).$$

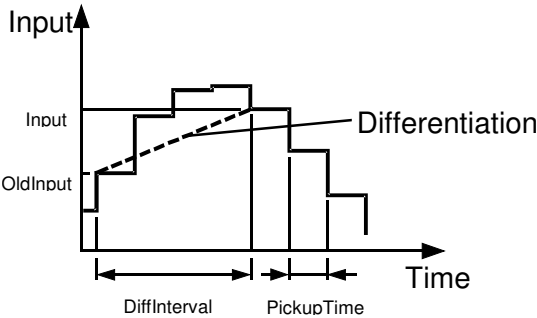
After the receipt of a clock signal, the output signal is computed from the input signal and put out up to the receipt of the next clock signal.

DigDifferentiation



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

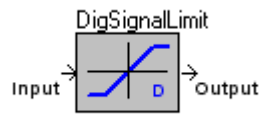
Name	Value	Unit	Description
DiffInterval	1	-	number of PickupTimes between current sample point and second sample point for the differential quotient
PickupTime	1	ms	period between two samples
KD	1	-	factor

Notes

The component DIGDIFFERENTIATION computes the derivation of a digital signal according to the equation

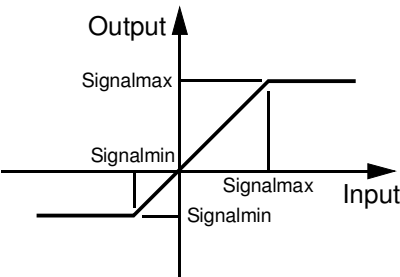
$$Ouput = KD \cdot \frac{Input - OldInput}{PickupTime \cdot DiffInterval}.$$

DigSignalLimit



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

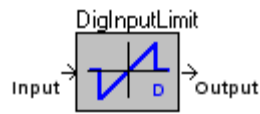
Name	Value	Unit	Description
Signalmin	0	-	minimum value of the signal
Signalmax	0	-	maximum value of the signal

Notes

The component DigSIGNALLIMIT limits the input signal according to

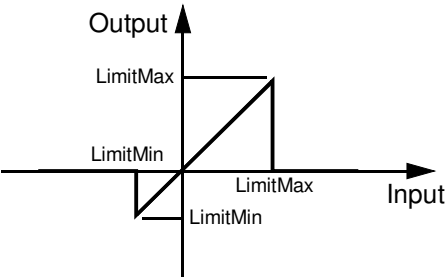
$$\begin{aligned} \text{Output} &= \text{Signalmin} && \text{for } \text{Input} < \text{Signalmin} \\ \text{Output} &= \text{Input} && \text{for } \text{Signalmin} \leq \text{Input} \leq \text{Signalmax} \\ \text{Output} &= \text{Signalmin} && \text{for } \text{Input} > \text{Signalmax}. \end{aligned}$$

DigInputLimit



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
LimitMin	0	-	minimum value of the input signal
LimitMax	0	-	maximum value of the input signal

Notes

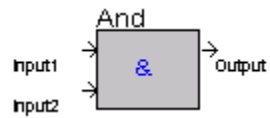
The component DIGINPUTLIMIT only transmits the signal within a specific range. The transfer occurs according to the following equations

$$Output = 0$$
$$Output = Input$$
$$Output = 0$$

$$\text{for } Input < LimitMin$$
$$\text{for } LimitMin \leq Input \leq LimitMax$$
$$\text{for } LimitMax < Input.$$

Logical Signal Elements

And



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0.	-	switching threshold of the input signal 1
SwitchingPoint2	0.	-	switching threshold of the signal input 2

Notes

The component And is a Boole's combination element following the logical function

$$Output = E_1 \cdot E_2,$$

for

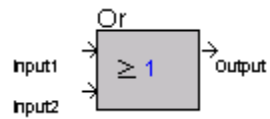
$$\begin{aligned} E_1 &= 0, \text{ if } Input1 < SwitchingPoint1, \\ E_1 &= 1, \text{ if } Input1 \geq SwitchingPoint1, \\ E_2 &= 0, \text{ if } Input2 < SwitchingPoint2, \\ E_2 &= 1, \text{ if } Input2 \geq SwitchingPoint2. \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	0
0	1	0
1	0	0
1	1	1

A Boole's combination element with And-Function is available as component in which two values are connected, which are proportional to the input signals with a delay of first order (PT1And).

Or



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0.	-	switching threshold of the input signal1
SwitchingPoint2	0.	-	switching threshold of the input signal 2

Notes

The component Or is a Boole's combination element following the logical function

$$Output = E_1 + E_2$$

for

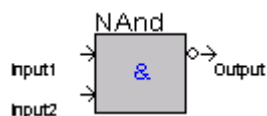
$$\begin{aligned}
 E_1 &= 0, \text{ if } Input1 < SwitchingPoint1, \\
 E_1 &= 1, \text{ if } Input1 \geq SwitchingPoint1, \\
 E_2 &= 0, \text{ if } Input2 < SwitchingPoint2, \\
 E_2 &= 1, \text{ if } Input2 \geq SwitchingPoint2.
 \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	0
0	1	1
1	0	1
1	1	1

A Boole's combination element with Or-Function is available as component in which two values are connected, which are proportional to the input signals with a delay of first order (PT1Or).

NAnd



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold of the input signal 2

Notes

The component NAnd is a Boole's combination element following the logical function

$$Output = \overline{E_1 * E_2} ,$$

for:

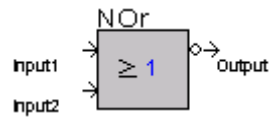
$$\begin{aligned} E_1 &= 0, \text{ if } Input1 < SwitchingPoint1, \\ E_1 &= 1, \text{ if } Input1 \geq SwitchingPoint1, \\ E_2 &= 0, \text{ if } Input2 < SwitchingPoint2, \\ E_2 &= 1, \text{ if } Input2 \geq SwitchingPoint2. \end{aligned}$$

This results in the following truth table.

E ₁	E ₂	Output
0	0	1
0	1	1
1	0	1
1	1	0

A Boole's combination element with NAnd-Function is available as component in which two values are connected, which are proportional to the input signals with a delay of first order (PT1NAnd).

NOr



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold of the input signal 2

Notes

The component NOr is a Boole's combination element following the logical function

$$Output = \overline{E_1 + E_2},$$

for:

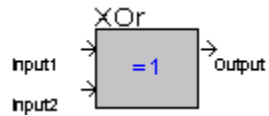
$$\begin{aligned} E_1 &= 0, \text{ if } Input1 < SwitchingPoint1, \\ E_1 &= 1, \text{ if } Input1 \geq SwitchingPoint1, \\ E_2 &= 0, \text{ if } Input2 < SwitchingPoint2, \\ E_2 &= 1, \text{ if } Input2 \geq SwitchingPoint2. \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	1
0	1	0
1	0	0
1	1	0

A Boole's combination element with NOr-Function is available as component in which two values are connected, which are proportional to the input signals with a delay of first order (PT1NOr).

XOr



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold e of the input signal 2

Notes

The component XOr is a Boole's combination element following the logical function

$$Output = E_1 \oplus E_2,$$

for:

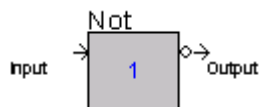
$$\begin{aligned} E_1 &= 0, \text{ if } Input1 < SwitchingPoint1, \\ E_1 &= 1, \text{ if } Input1 \geq SwitchingPoint1, \\ E_2 &= 0, \text{ if } Input2 < SwitchingPoint2, \\ E_2 &= 1, \text{ if } Input2 \geq SwitchingPoint2. \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	0
0	1	1
1	0	1
1	1	0

A Boole's combination element with XOr-Function is available as component in which two values are connected, which are proportional to the input signals with a delay of first order (PT1XOr).

Not



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1

Notes

The component Not is a function element which implements a logical negation

$$Output = \overline{E}.$$

for:

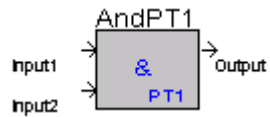
$$E = 0, \text{ if } Input1 < SwitchingPoint1, \\ E = 1, \text{ if } Input1 \geq SwitchingPoint1.$$

This results in the following truth table.

E	Output
0	1
1	0

The Not-Function is available as component in which a value is negated which is proportional to the input signal with a delay of first order (PT1Not).

AndPT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
PT1Input1	V	-	
PT1Input2	V	-	
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold of the input signal 2
Kp1	1	-	proportionality factor 1
T1	1	s	time constant 1
Kp2	1	-	proportionality factor 2
T2	1	s	time constant 2

Notes

The component AndPT1 is a Boole's combination element following the logical function

$$Output = E_1 * E_2,$$

for:

$$\begin{aligned} E_1 &= 0, \text{ if } A_1 < \text{SwitchingPoint1}, \\ E_1 &= 1, \text{ if } A_1 \geq \text{SwitchingPoint1}, \\ E_2 &= 0, \text{ if } A_2 < \text{SwitchingPoint2}, \\ E_2 &= 1, \text{ if } A_2 \geq \text{SwitchingPoint2}. \end{aligned}$$

A_1 and A_2 are proportional values with a delay of first order for the input signals *Input1* and *Input2*:

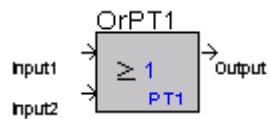
$$\begin{aligned} A_1 &= Kp1 * Input1 - T1 * (A_1)' \\ A_2 &= Kp2 * Input2 - T2 * (A_2)' \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	0
0	1	0
1	0	0
1	1	1

A Boole's combination element with And-Function is available as component in which the input signals, which are compared with the *SwitchingPoint*, are connected without the least delay (And).

OrPT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
PT1Output1	V	-	internal auxiliary variable
PT1Output2	V	-	internal auxiliary variable
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold of the input signal 2
Kp1	1	-	proportionality factor 1
T1	1	s	time constant 1
Kp2	1	-	proportionality factor 2
T2	1	s	time constant 2

Notes

The component OrPT1 is a Boole's combination element following the logical function $Output = E_1 + E_2$,

for:

$$\begin{aligned}
 E_1 &= 0, \text{ if } A_1 < \text{SwitchingPoint1}, \\
 E_1 &= 1, \text{ if } A_1 \geq \text{SwitchingPoint1}, \\
 E_2 &= 0, \text{ if } A_2 < \text{SwitchingPoint2}, \\
 E_2 &= 1, \text{ if } A_2 \geq \text{SwitchingPoint2}.
 \end{aligned}$$

A_1 and A_2 are proportional values with a delay of first order for the input signals *Input1* and *Input2*:

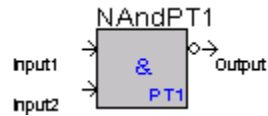
$$\begin{aligned}
 A_1 &= Kp1 * Input1 - T1 * (A_1)' \\
 A_2 &= Kp2 * Input2 - T2 * (A_2)'
 \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	0
0	1	1
1	0	1
1	1	1

A Boole's combination element with Or-Function is available as component in which the input signals, which are compared with the *SwitchingPoint*, are connected without the least delay (Or).

NAndPT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
PT1Output1	V	-	internal auxiliary variable
PT1Output2	V	-	internal auxiliary variable
Output	Out		output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold of the input signal 2
Kp1	1	-	proportionality factor 1
T1	1	s	time constant 1
Kp2	1	-	proportionality factor 2
T2	1	s	time constant 2

Notes

The component NAndPT1 is a Bool's combination element following the logical function:

$$Output = \overline{E_1 * E_2},$$

for:

$$\begin{aligned} E_1 &= 0, \text{ if } A_1 < \text{SwitchingPoint1}, \\ E_1 &= 1, \text{ if } A_1 \geq \text{SwitchingPoint1}, \\ E_2 &= 0, \text{ if } A_2 < \text{SwitchingPoint2}, \\ E_2 &= 1, \text{ if } A_2 \geq \text{SwitchingPoint2}. \end{aligned}$$

A_1 and A_2 are proportional values with a delay of first order for the input signals *Input1* and *Input2*:

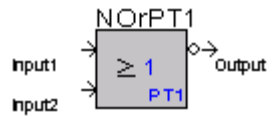
$$\begin{aligned} A_1 &= Kp1 * Input1 - T1 * (A_1)' \\ A_2 &= Kp2 * Input2 - T2 * (A_2)' \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	1
0	1	1
1	0	1
1	1	0

A Boole's combination element with NAnd-Function is available as component in which the input signals, which are compared with the *SwitchingPoint*, are connected without the least delay (NAnd).

NOrPT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
PT1Output1	V	-	internal auxiliary variable
PT1Output2	V	-	internal auxiliary variable
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal 1
SwitchingPoint2	0	-	switching threshold of the input signal 2
Kp1	1	-	proportionality factor 1
T1	1	s	time constant 1
Kp2	1	-	proportionality factor 2
T2	1	s	time constant 2

Notes

The component NOrPT1 is a Boole's combination element following the logical function

$$Output = \overline{E_1 + E_2},$$

for:

$$\begin{aligned} E_1 &= 0, \text{ if } A_1 < \text{SwitchingPoint1}, \\ E_1 &= 1, \text{ if } A_1 \geq \text{SwitchingPoint1}, \\ E_2 &= 0, \text{ if } A_2 < \text{SwitchingPoint2}, \\ E_2 &= 1, \text{ if } A_2 \geq \text{SwitchingPoint2}. \end{aligned}$$

A_1 and A_2 are proportional values with a delay of first order for the input signals *Input1* and *Input2*:

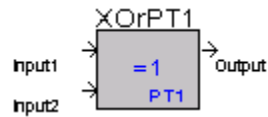
$$\begin{aligned} A_1 &= Kp1 * Input1 - T1 * (A_1)' \\ A_2 &= Kp2 * Input2 - T2 * (A_2)' \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	1
0	1	0
1	0	0
1	1	0

A Boole's combination element with NOR-Function is available as component in which the input signals, which are compared with the *SwitchingPoint*, are connected without the least delay (NOr).

XOrPT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
PT1Output1	V	-	internal auxiliary variable
PT1Output2	V	-	internal auxiliary variable
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of input signal 1
SwitchingPoint2	0	-	switching threshold of input signal 2
Kp1	1	-	proportionality factor 1
T1	1	s	time constant 1
Kp2	1	-	proportionality factor 2
T2	1	s	time constant 2

Notes

The component XOrPT1 is a Boole's combination element with following logical function

$$Output = E_1 \oplus E_2,$$

for:

$$\begin{aligned} E_1 &= 0, \text{ if } A_1 < \text{SwitchingPoint1}, \\ E_1 &= 1, \text{ if } A_1 \geq \text{SwitchingPoint1}, \\ E_2 &= 0, \text{ if } A_2 < \text{SwitchingPoint2}, \\ E_2 &= 1, \text{ if } A_2 \geq \text{SwitchingPoint2}. \end{aligned}$$

A_1 and A_2 are proportional values with a delay of first order for the input signals *Input1* and *Input2*:

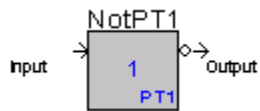
$$\begin{aligned} A_1 &= Kp1 \cdot Input1 - T1 \cdot (A_1)' \\ A_2 &= Kp2 \cdot Input2 - T2 \cdot (A_2)' \end{aligned}$$

This results in the following truth table.

E_1	E_2	Output
0	0	0
0	1	1
1	0	1
1	1	0

A Boole's combination element with XOR-Function is available as component in which the input signals, which are compared with the *SwitchingPoint*, are connected without the least delay (XOr).

NotPT1



Symbol

Sketch

Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
PT1	V	-	internal auxiliary variable
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	switching threshold of the input signal
T1	1	s	time constant

Notes

The component NotPT1 is a function element which implements a logical negation

$$Output = E_1 * E_2,$$

for

$$E = 0, \text{ if } A < \text{SwitchingPoint1},$$

$$E = 1, \text{ if } A \geq \text{SwitchingPoint1}.$$

A_1 is a proportional value with a delay of first order for the input signal *Input1*:

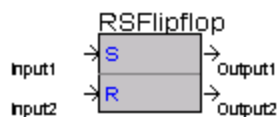
$$A = Input - T1 * (A)'$$

This results in the following truth table.

E	Output
0	1
1	0

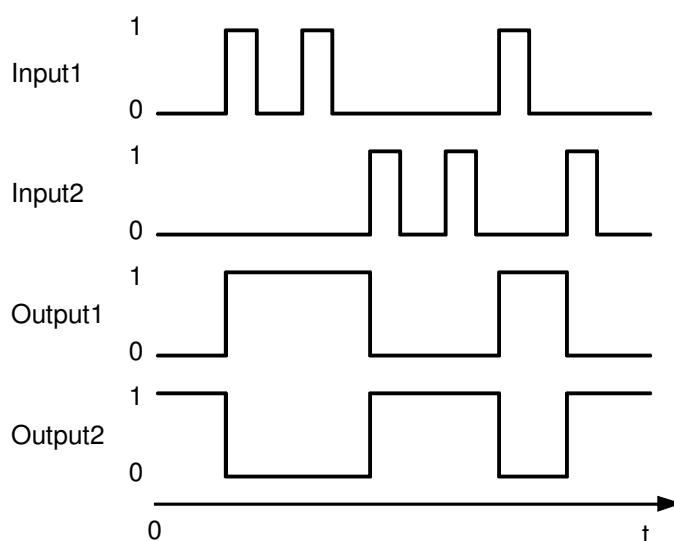
The Not-Function is available as component in which the input signal, which is compared with the *SwitchingPoint*, is negated without the least delay (Not).

RSFlipflop



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Output1	Out	-	output signal 1
Output2	Out	-	output signal 2

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0.	-	threshold at which input 1 will be activated
SwitchingPoint2	0.	-	threshold at which input 2 will be activated
Output1True	1.	-	value which will be put out, if the output 1 is activ
Output1False	0.	-	value which will be put out, if the output 1 is inactiv

Name	Value	Unit	Description
Output2True	1.	-	value which will be put out, if the output 2 is activ
Output2False	0.	-	value which will be put out, if the output 2 is inactiv
Output1Initial	1.	-	defines the initial condition of the element

Notes

The component RSFLIPFLOP is a flipflop. The output *Output1* assumes the value of *Output1True* and the Output *Output2* the value *Output2False* if the input value *Input1* exceeds the switching point *SwitchingPoint1*. The outputs retain their values independent of the input value *Input1* (storage of the value *Input1*).

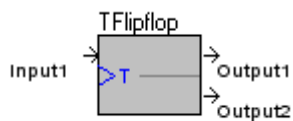
If the input *Input2* exceeds the switching point *SwitchingPoint2* and if the input *Input1* underruns the switching point *SwitchingPoint1* at the same time, the output *Output1* assumes the value of *Output1False* and the output *Output2* assumes the value of *Output2True* (storage of the value *Input2*).

At flipflops the values of the outputs are always complementary to each other.

The available component stores always if the both input values are above of each switching point.

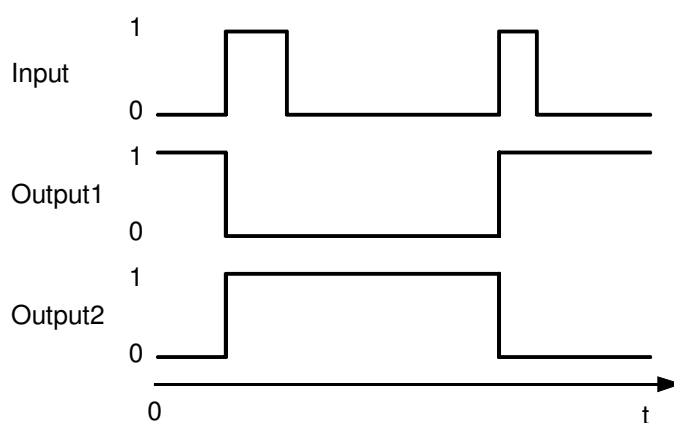
A function element with RSFlipflopFunction is also available as component in which the input signals, which are compared with the switching points, are interconnected with delay (RSFLIPFLOPPT1).

TFlipflop



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Output1	Out	-	output signal 1
Output2	Out	-	output signal 2

Parameters

Name	Value	Unit	Description
SwitchingPoint	0.	-	threshold at which the switch takes place
Output1True	1.	-	value which will be put out if the output 1 is activ
Output1False	0.	-	value which will be put out if the output 1 is inactiv
Output2True	1.	-	value which will be put out if the output 2 is activ
Output2False	0.	-	value which will be put out if the output 2 is inactiv

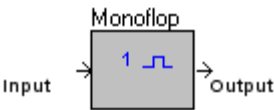
Name	Value	Unit	Description
Output1Initial	1.	-	defines the initial condition of the element

Notes

The component TFLIPFLOP is a binary denominator. If the value *Input1* exceeds the value of the *SwitchingPoint* the values of the variables at the outputs change into the complementaries. The outputs are not affected if the value of *Input1* is lower than the value of the *SwitchingPoint*.

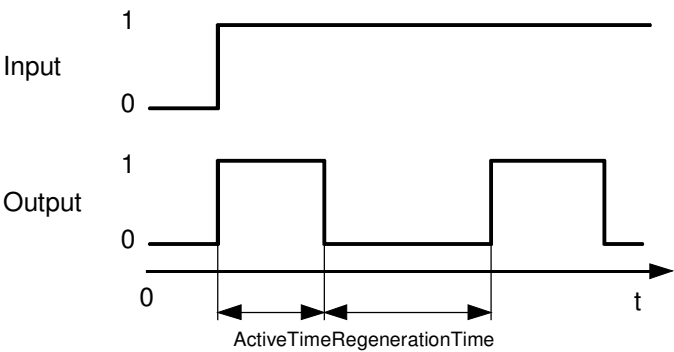
A function element with TFlipflopFunction is also available as component in which the input signal, which is compared with the switching point, is interconnected with delay (TFLIPFLOPPT1).

Monoflop



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint	0	-	threshold at which the switch takes place
ActiveTime	1	-	period in which the output is activ
RegenerationTime	0	-	time delay after which the element will be able to get activ
OutputTrue	1	-	value which will be put out if the output is activ
OutputFalse	0	-	value which will be put out if the output is inactiv

Notes

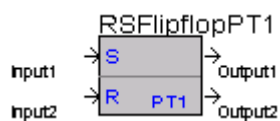
The component MONOFLOP is a trigger element. The *Output* assumes the value of *Output-True* if the *Input* exceeds the *SwitchingPoint*. The *Output* retains its value in the period which is defined independent of the duration of the input signal.

But, after the *RegenerationTime* is elapsed the component can be activated again.

If there is still an input signal the component will be activated again, otherwise the *OutputFalse* will be put out.

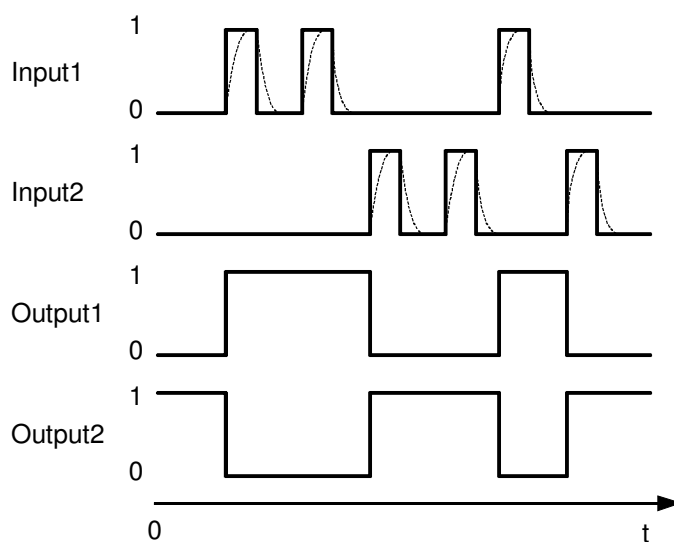
A function element with MonoflopFunction is also available as component in which the input signal, which is compared with the switching point, is interconnected with delay (MONOFLOPPT1).

RSFlipflopPT1



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal 1
Input2	In	-	input signal 2
Input1PT1	V	-	internal auxiliary variable
Input2PT2	V	-	internal auxiliary variable
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingPoint1	0	-	threshold at which input 1 will be activated
SwitchingPoint2	0	-	threshold at which input 2 will be activated
T1	1.	s	time constant
T2	1.	s	time constant

Name	Value	Unit	Description
Output1True	1.	-	value which will be put out, if the output 1 is activ
Output1False	0.	-	value which will be put out, if the output 1 is inactiv
Output2True	1.	-	value which will be put out, if the output 2 is activ
Output2False	0.	-	value which will be put out, if the output 2 is inactiv
InitialOutput1	1.	-	defines the initial condition of the element

Notes

The component RSFLIPFLOPPT1 is a flipflop in which the input signals are transmitted for internal computation with a delay of first order.

The output *Output1* assumes the value *Output1True* and the output *Output2* assumes the value *Output2False*, if the value *Input1PT1* exceeds the switching point *SwitchingPoint1*. The outputs retain their values independent of the value *Input1PT1* (storage of the value *Input1PT1*).

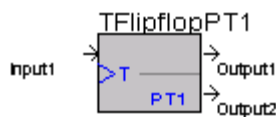
If the input *Input2PT1* exceeds the switching point *SwitchingPoint2* and if the input *Input1PT1* underruns the switching point *SwitchingPoint1* at the same time, the output *Output1* assumes the value of *Output1False* and the output *Output2* assumes the value of *Output2True* (storage of the value *Input2PT1*).

The values of the outputs are always complementary to each other at flipflops.

The available component stores always if the both input values are above of each switching point.

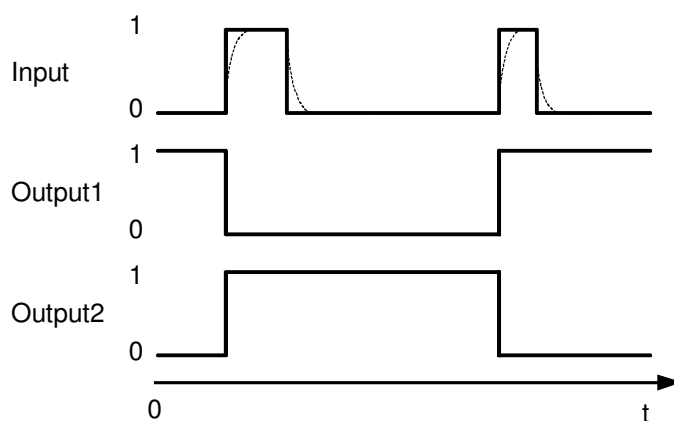
A function element with RSFlipflopFunction is also available as component in which the input signals, which are compared with the switching points, are interconnected without the least delay (RSFLIPFLOP).

TFlipflopPT1



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input1	In	-	input signal
PT1	V	-	internal auxiliary variable
Output1	Out	-	output signal 1
Output2	Out	-	output signal 2

Parameters

Name	Value	Unit	Description
SwitchingPoint	0.	-	threshold at which the switch takes place
T	1.	s	time constant
Output1True	1.	-	value which will be put out if the output 1 is activ
Output1False	0.	-	value which will be put out if the output 1 is inactiv
Output2True	1.	-	value which will be put out if the output 2 is activ
Output2False	0.	-	value which will be put out if the output 2 is inactiv

Name	Value	Unit	Description
InitialOutput1	1.	-	defines the initial condition of the element

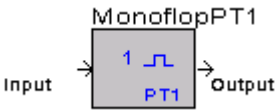
Notes

The component TFLIPFLOPPT1 is a binary denominator in which the input signals are transmitted for internal computation with a delay of first order .

If the value of element PT1 exceeds the value of the *SwitchingPoint* the values of the variables at the outputs change into the complementaries. The outputs are not affected if the value of element PT1 is lower than the value of the *threshold*.

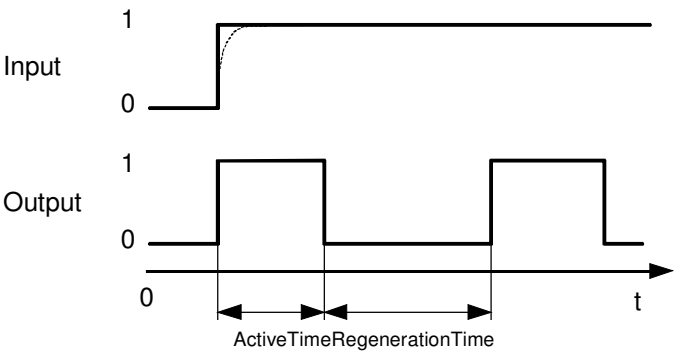
A function element with TFlipflopFunction is also available as component in which the input signal, which is compared with the switching point, is interconnected with delay (TFLIPFLOP).

MonoflopPT1



Symbol

Sketch



Connectors and Variables

Name	Type	Unit	Description
Input	In	-	input signal
PT1	V	-	internal auxiliary variable
Output	Out	-	output signal

Parameters

Name	Value	Unit	Description
SwitchingTime	0.	-	threshold at which the switch takes place
ActiveTime	1.	-	period in which the output is activ
RegenerationTime	0.	-	time delay after which the element will be able to get activ
T	1.	s	time constant
OutputTrue	1.	-	value which will be put out if the output is activ
OutputFalse	1.	-	value which will be put out if the output is inactiv

Notes

The component MONOFLOPPT1 is trigger element in which the value *Input* is transmitted for internal computation with a delay of first order .

The *Output* assumes the value of *OutputTrue* if the value of element PT1 exceeds the value *SwitchingPoint*. The *Output* retains the value in the period which is defined independent of the duration of the input signal.

But, after the *RegenerationTime* is elapsed the component can be activated again. If there is still an input signal the component will be activated again, otherwise the *Output-False* will be put out.

A function element with MonoflopFunction is also available as component in which the input signal, which is compared with the switching point, is interconnected without the least delay (MONOFLOP).