

LogicView for FFB



MAY / 22
LogicView for FFB

Version 3



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INTRODUCTION

This configuration manual for the DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers is divided as follows:

1. **Ladder Logic:** The control elements of a control strategy available in the LogicView for FFB are described at chapter 1. The symbols and notation are in compliance with IEC-61131-3.
2. **Function Blocks:** The chapter 2 presents detailed descriptions of all function blocks available in the LogicView for FFB.
3. **LogicView for FFB:** The chapter 3 describes Smar's software LogicView for FFB. This is the application used to configure the hardware of a control system (I/O Modules, Power Supplies, controllers, etc), and implement ladder logic (including ladder network elements and function blocks).
4. **General example:** The chapter 4 presents a general example using the LogicView for FFB.

We suggest reading initially chapters 1 and 2 and then go to chapter 3 that describes clearly how to implement the elements described in the first two chapters. However, user is free to start reading from chapter 3 prior to the other ones and consult chapters 1 and 2 any time it is necessary.

NOTE

This document is a description of all function blocks and ladder logic elements implemented in the controllers DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95 and DF97. Besides this document presents a description of how to configure and edit ladder networks through Smar's Logicview for FFB. This document also describes details of this software.

Smar reserves the right to change any part of this manual without prior notice.

Note that different versions of these controllers have different types of data, function blocks and generic characteristics.

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NETWORK ELEMENTS (LADDER ELEMENTS)

This section will help you understand the meaning of the network ladder elements and the network tools.

The Network Elements

As mentioned before, Logicview for FFB uses symbols and notations defined in the IEC-61131-3 standard and some additional ones used in languages other than ladder.

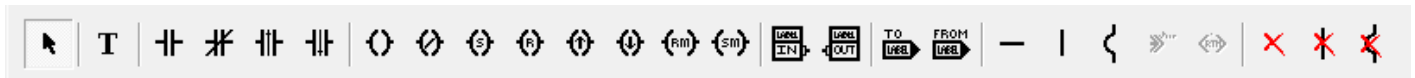










Fig 1.1 - Network Toolbox.

Definitions of the Network Tool Box Elements (IEC-61131-3 standard - Ladder)

-  **Normally Open Contact**
The state of the left link is copied to the right link if the state of the associated Boolean variable is ON. Otherwise, the state of the right link is OFF.
-  **Normally Closed Contact**
The state of the left link is copied to the right link if the state of the associated Boolean variable is OFF. Otherwise, the state of the right link is OFF.
-  **Positive Transition-Sensing Contact**
The state of the right link is ON from one evaluation of this element to the next when a transition of the associated variable from OFF to ON is sensed at the same time that the state of the left link is ON. The state of the right link shall be OFF at all other times.
-  **Negative Transition-Sensing Contact**
The state of the right link is ON from one evaluation of this element to the next when a transition of the associated variable from ON to OFF is sensed at the same time the state of the left link is ON. The state of the right link shall be OFF at all other times.
-  **Coil**
The state of the left link is copied to the associated Boolean variable and to the right link.
-  **Negated Coil**
The state of the left link is copied to the right link. The inverse of the state of the left link is copied to the associated Boolean variable, that is, if the state of the left link is OFF, then the state of the associated variable is ON, and vice versa.
-  **Set (Latch) Coil**
The associated Boolean variable is set to the ON state when the left link is in the ON state, and remains set until reset by a RESET Coil.
-  **Reset (Unlatch) Coil**
The associated Boolean variable is reset to the OFF state when the left link is in the ON state, and remains reset until set again by a SET coil.



Positive Transition-Sensing Coil

The state of the associated Boolean variable is ON from one evaluation of this element to the next when a transition of the left link from OFF to ON is sensed. The state of the left link is always copied to the right link.



Negative Transition-Sensing Coil

The state of the associated Boolean variable is ON from one evaluation of this element to the next when a transition of the left link from ON to OFF is sensed. The state of the left link is always copied to the right link.



Reset Retentive (Memory) Coil

The associated Boolean variable is reset to OFF state when the left link is in the ON state, and remains reset until set by a SET coil. The associated Boolean variable will be retentive to the memory.

Note: The action of this coil is identical to RESET (Unlatch) Coil, except that the associated boolean variable is automatically saved in the memory.



Set Retentive (Memory) Coil

The associated boolean variable is set to ON state when the left link is in the ON state, and remains set until reset by a RESET Coil. The associated boolean variable will be retentive to the memory.

Note: The action of this coil is identical to SET (Latch) Coil, except that the associated boolean variable is automatically saved in the memory.



Horizontal Connecting Line

Use this tool to draw a connecting line from left to right in the marked cell.



Vertical Connecting Line

Use this tool to draw a connecting line from the right side of the marked cell downward.



Eliminate Vertical Connecting Line

This tool eliminates the vertical connecting line. Place the selection box in the element that has the vertical line the user wishes to eliminate.



Delete Object

Use this tool to delete an object inserted in the cell. It has the same function of the keyboard "Delete" button.



Selection

Use this tool to select a network element – contact or coil. The selected element will be red.



Add Note

Use this tool to insert a note (text) in the cell. To select this note, click on it with the "Selection" tool and it will be red. After selected, the note can be removed with keyboard "Delete" button or it can be moved, by clicking and dragging the mouse. The text of the inserted note will be in the color defined in **Tools**→**Options**→**Interface**.

Definitions of the Network Tool Box Elements (IEC-61131-3 standard – other languages)



Normally Open Contact

The state of the left link is copied to the right link if the state of the associated variable is ON. Otherwise, the state of the right link is OFF.



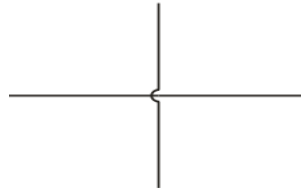
Coil

The state of the left link is copied to the associated Boolean variable and to the right link.



Gap Wire

Use this tool to draw a connecting line, gap wire, on the right side of the marked cell. It is a vertical line that passes through a horizontal one, without the occurrence of a cross between them, i.e., the vertical flow does not influence the horizontal flow and vice versa. See the following example :



NOTE

For this function to take effect there must be a vertical line previously at the location where you want to insert the gap wire.



Eliminates Gap Wire

To eliminate the gap wire is necessary to position the selection frame in the element which has the gap wire.

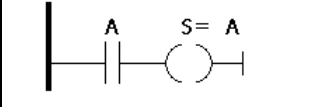
NOTE

When the gap wire is eliminated, it automatically becomes a normal vertical line.

Boolean Logic

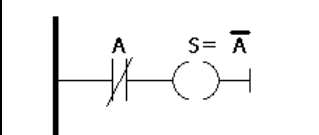
The association of relays and coils creates Boolean functions. Below we present a brief summary of these functions and Boolean Algebra.

Normally Open Relay

Diagram	State Table	
	A	S
	0	0
	1	1

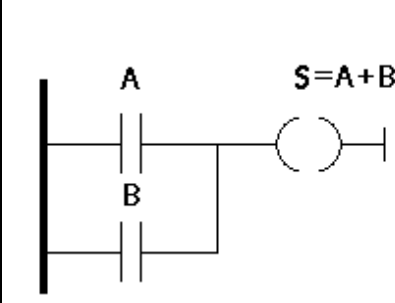
When the state of A changes from 0 to 1 the contact A closes and the flow goes from the power rail (on the left) to the right powering the coil S.

Normally Closed Relay

Diagram	State Table	
	A	S
	0	1
	1	0

The operation of a normally closed relay is the same to that of a normally open relay, except backwards. That is, when the state of A changes from 0 to 1, the contact A opens and current does not flow from the power rail to the right (through the contact A circuit).

Logical Function OR

Diagram	State Table		
	A	B	S
	0	0	0
	0	1	1
	1	0	1
	1	1	1

Relays A and B are normally open. With the association of both we implement the OR function. The coil is powered when any of the two relays is closed.

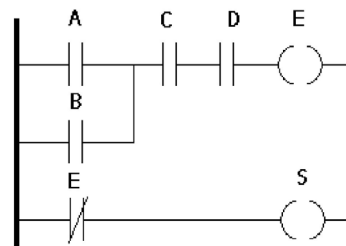
Logical Function AND

Diagram	State Table		
	A	B	S
	0	0	0
	0	1	0
	1	0	0
	1	1	1

Relays A and B are normally open. The coil S is powered when A and B are equal to 1 at the same time. Otherwise, power will not flow from the left side (power rail) to the right side.

Boolean Equations

By using relays and coils it is possible to implement Boolean functions. For example, consider the diagram below:



The S output depends on the state of the relays A, B, C, D and on the coil E. E depends on the values of A,B,C and D. So:

$$E = (A + B).C.D$$

$$S = \overline{E}$$

Boolean Algebra

Boolean equations as shown above may become very complicated, however the result might be simplified using the boolean algebra. Below is a summary of properties of the Boolean Algebra.

1	$A.1 = A$
2	$A.0 = 0$
3a	$A.A = A$
3b	$A\overline{A} = 0$
4a	$A + \overline{A} = 1$
4b	$A + A = A$
5	$A + 1 = 1$
6	$A.B + A.C = A.(B + C)$
7	$A + A.B = A$
8	$A.(B + C) = A.B + A.C$
9a	$\overline{A + B} = \overline{A}.\overline{B}$
9b	$\overline{A.B} = \overline{A} + \overline{B}$

When these expressions become too complex we suggest that you use the Karnaugh map in order to simplify them. This information is easily found on any Digital Electronics Book.

FUNCTION BLOCKS

Introduction

This is a complete and updated reference of the Function Blocks (FB) supported by the DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers. This chapter presents block diagrams with inputs, outputs, and configuration parameters. It also includes detailed explanations of each block, how they work, how to configure each one of them. Besides, a few examples are presented in order to help understand and utilize the Function Blocks.

The data types used by LogicView for FFB are shown in the table below:

Reference	Data Type	Number of bits
BOOL	Boolean	1
LONG	Integer	32 Unsigned
FLOAT	Float	32

Each function block has a table that shows all inputs, outputs, parameters and variables of each block.

- I - Inputs: They can be a variable from another FB, or from an I/O card, or user-configured.
- P - Parameters: They are the values internally used by the function blocks.
- O - Outputs: Variables resulting from the processing of the block.

ATTENTION

A comma is not accepted in place of a decimal point.
(E.g., for 9/5, you should write 1.8 instead of 1,8. If you write 1,8 the program will read 18.)

EN Input and EO Output

Every function has an **EN** input and an **EO** output, except those with a “r” sub-index (e.g. TPr) and CTUr which has only **EN** input.

EN input is set to enable the function block that should be processed. If **EN** is false, all outputs change to zero and the FB is not executed.

EO changes to true logic to indicate that the function was successfully executed.

Available function blocks in alphabetic order

FUNCTION NAME	DESCRIPTION
ABS	Absolute Value
ACC	Pulse Accumulator
ACC_N	Pulse Accumulator
ACMT	Time Accumulator
ACMTh	Reduced Time Accumulator
ACMTr	Reduced Time Accumulator
ADD	Addition
ADDr	Reduced Addition
AI	Simple Analog Input
AIh	Analog Inputs for HART device
AI-Seta	Quad Alarm
ALM	Double Alarm
AND2-AND8	Bitwise AND of 2 to 8 inputs
AOh	Analog Outputs for HART device
APID	Advanced PID
ARAMP	Automatic Up and Down Ramp
BINT	Byte to Int Conversion
BTB	Byte to Bits Conversion
BTI1	Boolean to Int Conversion
BTI2	BCD to Int Conversion
BWL1	Bitwise Logic 1
BWL1r	Reduced Bitwise Logic 1
BWL2	Bitwise Logic 2
BWL2r	Reduced Bitwise Logic 2
CDN	Down-Counter
CDNr	Reduced Down-Counter
CONST	Constants
CUDr	Reduced Up-Down Counter
CUP	Up-Counter
CUPr	Reduced Up-Counter
CTUD	Up-Down Counter
CTUr	Reduced Pulse Up-Counter 2
DIF	Inequality
DIV	Division
EPID	Enhanced PID
EQ	Equality
EQr	Reduced Equality
ETOT	Enhanced TOT
GT	Decreasing Sequence
GTr	Reduced Decreasing Sequence
GTE	Decreasing Monotonic Sequence
GTEr	Reduced Decreasing Monotonic Sequence
ITB1	Integer to Boolean Conversion
ITB2	Integer to BCD Conversion
LIN	Linearization
LLAG	Lead Lag
LONG	LONG Converter
LMT	Limiter
LT	Increasing Sequence
LTr	Reduced Increasing Sequence
LTE	Increasing Monotonic Sequence
LTEr	Reduced Increasing Monotonic Sequence
MAI	Multiple Analog Inputs
MAIx	Multiple Analog Inputs for IOR or HART
MAO	Multiple Analog Outputs
MAOx	Multiple Analog Outputs for IOR or HART
MATH	Mathematic Equation for Signal Processing

FUNCTION NAME	DESCRIPTION
MAX	Maximum
MAXr	Reduced Maximum
MDL	Modulus
MIN	Minimum
MINr	Reduced Minimum
MUL	Multiplication
MULr	Reduced Multiplication
MUX1	Multiplexer for Boolean Inputs
MUX1r	Reduced Multiplexer for Boolean Inputs
MUX2	Multiplexer for Float Inputs
MUX2r	Reduced Multiplexer for Float Inputs
NOT	Bitwise NOT
NOT1	Bitwise Not for Boolean Input
NOT2	Bitwise Not – Bit a Bit
OR2-OR8	Bitwise OR of 2 to 8 inputs
OSEL	Output Selection
PID	PID Controller
PTC	Pressure and Temperature Compensation
RS	Reset Set
RSr	Reduced Reset Set
RTA	Real Time Clock Alarm
SBT	Subtraction
SEL1	Binary Selection for Boolean Inputs
SEL2	Binary Selection for Float Inputs
SMPL	Sample Hold with Up and Down
SPG	Set Point Generator
SQR	Square Root
SR	Set Reset
SRr	Reduced Set Reset
STATUS	System Status
STP	Step Control
STSh	Status for HART Variables
TEMP	Temperature
TOF	Off-Delay Timer
TOFr	Reduced Off-Delay Timer
TON	On-Delay Timer
TONr	Reduced On-Delay Timer
TOT	Totalization
TP	Pulse Timer
TPr	Reduced Pulse Timer
TRC	Truncation
VDA-OC	Open Command Valve Discrepancy Alarm
VDA-CC	Close Command Valve Discrepancy Alarm
XLIM	Cross Limit and Rate-Of-Change

Function Blocks Listed by Functional Groups

Timer/Counter Functions

MNEMONIC	DESCRIPTION
ACMT	Time Accumulator
ACMTr	Reduced Time Accumulator
ACMTh	Reduced Time Accumulator
CDN	Down-Counter
CDNr	Reduced Down-Counter
CUP	Up-Counter
CUPr	Reduced Up-Counter
CUDr	Reduced Up-Down Counter
CTUD	Up-Down Counter
CTUr	Reduced Pulse Up-Counter 2
RS	Reset Set
RSr	Reduced Reset Set
RTA	Real Time Clock Alarm
SR	Set Reset
SRr	Reduced Set Reset
TOF	Off-Delay Timer
TOFr	Reduced Off-Delay Timer
TON	On-Delay Timer
TONr	Reduced On-Delay Timer
TP	Pulse Timer
TPr	Reduced Pulse Timer

Data Manipulation Functions

MNEMONIC	DESCRIPTION
BINT	Byte to Int Conversion
BTB	Byte to Bits Conversion
BTI1	Boolean to Int Conversion
BTI2	BCD to Int Conversion
BWL1	Bitwise Logic 1
BWL1r	Reduced Bitwise Logic 1
BWL2	Bitwise Logic 2
BWL2r	Reduced Bitwise Logic 2
CONST	Constants
ITB1	Integer to Boolean Conversion
ITB2	Integer to BCD Conversion
LONG	LONG Converter
MUX1	Multiplexer for Boolean Inputs
MUX1r	Reduced Multiplexer for Boolean Inputs
MUX2	Multiplexer for Float Inputs
MUX2r	Reduced Multiplexer for Float Inputs
NOT1	Bitwise Not for Boolean Input
NOT2	Bitwise Not – Bit a Bit
OSEL	Output Selection
SEL1	Binary Selection for Boolean Inputs
SEL2	Binary Selection for Float Inputs
TRC	Truncation

Math Functions

MNEMONIC	DESCRIPTION
ABS	Absolute Value
ADD	Addition
ADDr	Reduced Addition
AND2-AND8	Bitwise AND of 2 to 8 inputs
DIV	Division
MDL	Modulus
MUL	Multiplication
MULr	Reduced Multiplication
NOT	Bitwise NOT
OR2-OR8	Bitwise OR of 2 to 8 inputs
SBT	Subtraction
SQR	Square Root

Comparison Functions

MNEMONIC	DESCRIPTION
Al-Seta	Quad Alarm
ALM	Double Alarm
DIF	Inequality
EQ	Equality
EQr	Reduced Equality
GT	Decreasing Sequence
GTr	Reduced Decreasing Sequence
GTE	Decreasing Monotonic Sequence
GTEr	Reduced Decreasing Monotonic Sequence
LMT	Limiter
LT	Increasing Sequence
LTr	Reduced Increasing Sequence
LTE	Increasing Monotonic Sequence
LTEr	Reduced Increasing Monotonic Sequence
MAX	Maximum
MAXr	Reduced Maximum
MIN	Minimum
MINr	Reduced Minimum

Process Control Functions

MNEMONIC	DESCRIPTION
APID	Advanced PID
ARAMP	Automatic Up and Down Ramp
EPID	Enhanced PID
ETOT	Enhanced TOT
LLAG	Lead Lag
LIN	Linearization
MATH	Mathematic Equation for Signal Processing
PID	PID Controller
PTC	Pressure and Temperature Compensation
SPG	Set Point Generator
SMPL	Sample Hold with Up and Down
STP	Step Control
TOT	Totalization
VDA-OC	Open Command Valve Discrepancy Alarm
VDA-CC	Close Command Valve Discrepancy Alarm
XLIM	Cross Limit and Rate-Of-Change

Input/Output Functions

MNEMONIC	DESCRIPTION
ACC	Pulse Accumulator
ACC_N	Pulse Accumulator
AI	Simple Analog Input
AIh	Analog Inputs for HART device
AOh	Analog Outputs for HART device
MAI	Multiple Analog Inputs
MAIx	Multiple Analog Inputs for IOR or HART
MAO	Multiple Analog Outputs
MAOx	Multiple Analog Outputs for IOR or HART
STATUS	System Status
STSh	Status for HART Variables
TEMP	Temperature

Time and Count Related Functions

Accumulator Timer (ACMT)

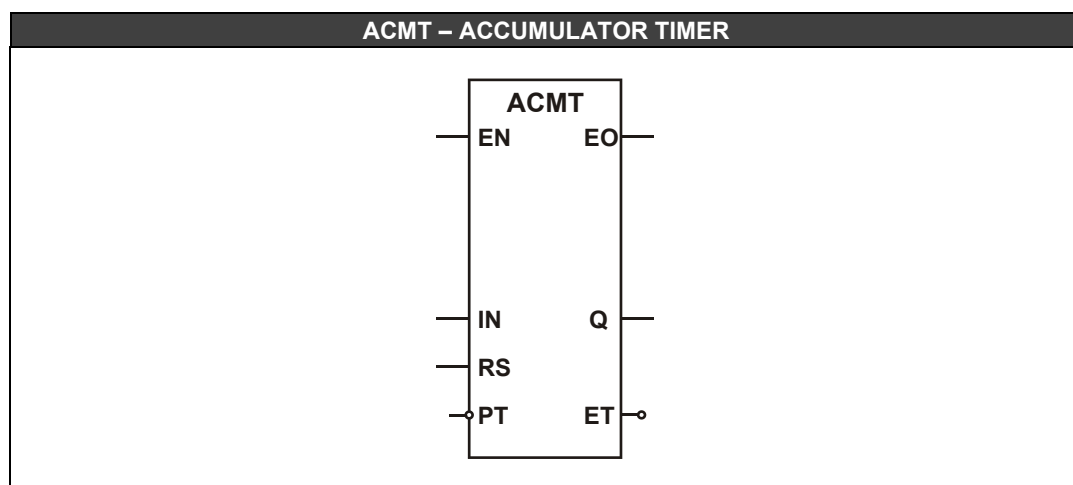
Description

In this function block, when the **EN** input is true, and the **IN** input is in true logic state, the time that **IN** stays true is accumulated.

If **IN** changes to false, the time counting freezes until **IN** returns to true. When the time defined in **PT** is reached, the **Q** output changes to true. The time is in milliseconds.

If the **RS** input changes to true, **Q** and **ET** outputs are cleared. The **RS** value predominates over the **IN** value.

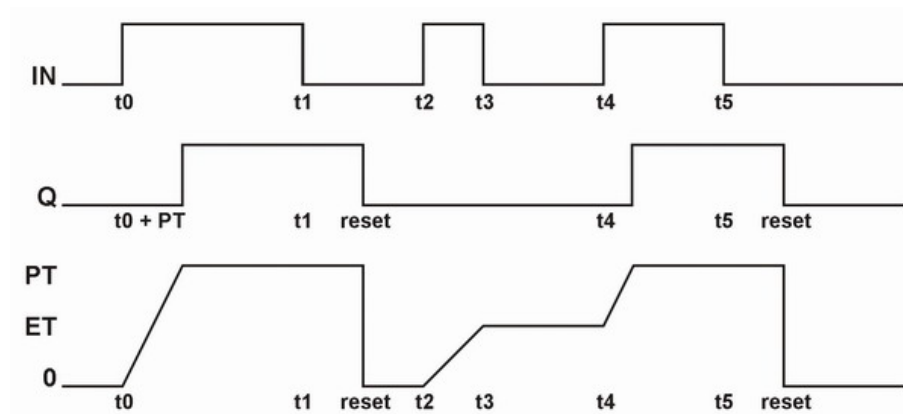
If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	PT	PROGRAMMED TIME	LONG
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

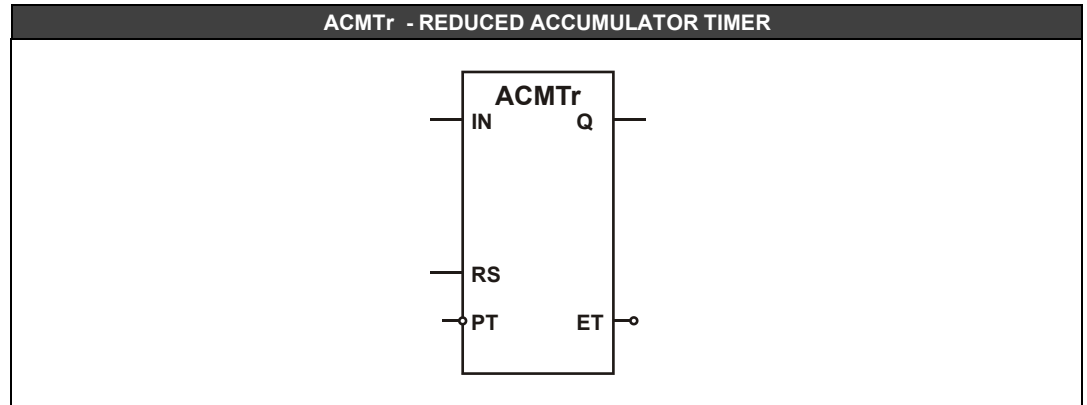
I: Input. P: Parameter. O: Output

Accumulator Timer Function - Timing diagrams



Reduced Accumulator Timer (ACMTr)

This function block works exactly like the ACMT block, but it does not have the **EN** input and the **EO** output.

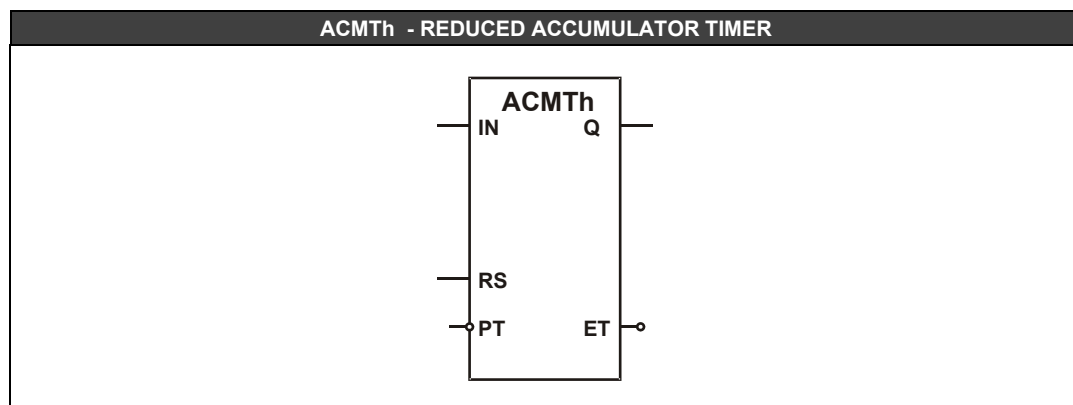


CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	PT	PROGRAMMED TIME (MILISECONDS)	LONG
O	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME (MILISECONDS)	LONG

I: Input. **P:** Parameter. **O:** Output

Reduced Accumulator Timer (ACMTh)

This function block works exactly like the ACMTr block, but the time of **ET** output and **PT** input are configured in hours.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	PT	PROGRAMMED TIME (HOURS)	LONG
O	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME (HOURS)	LONG

I: Input. **P:** Parameter. **O:** Output

Pulse Down-Counter (CDN)

Description

The **CDN** function counts the 0 (false) to 1 (true) logic state transitions. When the **EN** input is true, this function counts the transitions (from false to true) in the **IN** input and decreases the **CV** value.

When **CV** reaches zero, the **Q** output changes to true and stays there until the **LD** input changes to true. At this moment the **Q** output comes back to false and **CV** is loaded with the **PV** value.

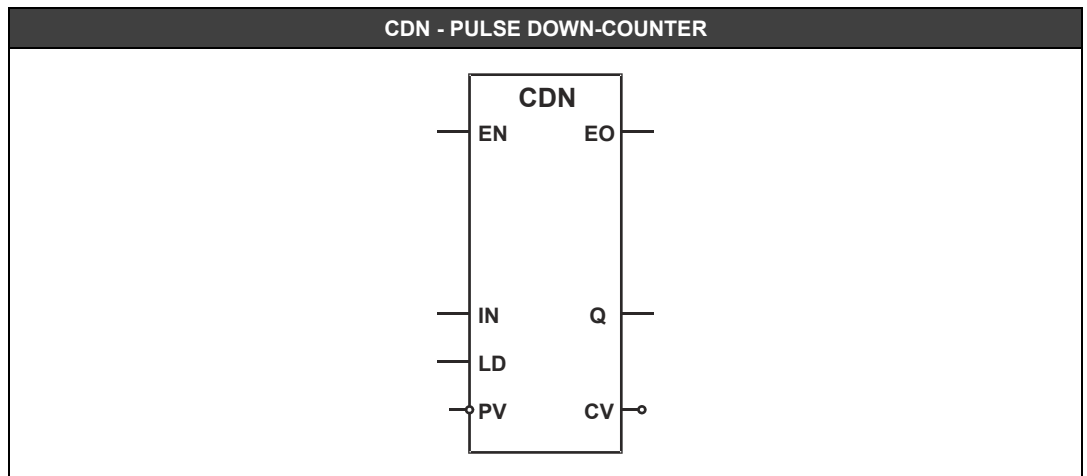
If the **EN** input is false, all Boolean outputs are held in zero (false) and **CV** is loaded with the **PV** value.

Internal Counter CV

In this block input, a digital input is connected. Every time an ascending transition occurs, **CV** decreases by one unit. When the internal count reaches zero the **Q** output changes to true.

LD (Load)

If **LD** is true the **Q** output comes back to false and **CV** is loaded with **PV** value.

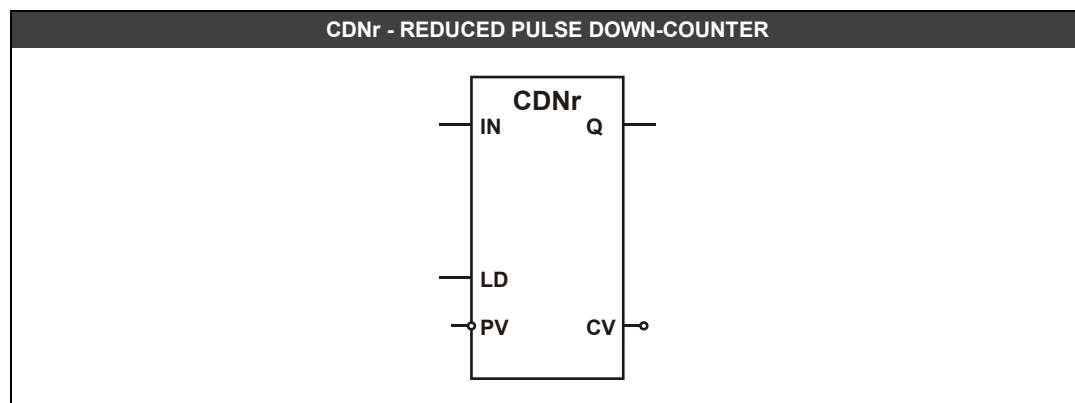


CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	LD	LOAD	BOOL
	PV	PROGRAMED VALUE	LONG
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

Reduced Pulse Down-Counter (CDNr)

This function block works exactly like the CDN block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	LD	LOAD	BOOL
	PV	PROGRAMED VALUE	BOOL
O	Q	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

Pulse Up-Down Counter (CTUD)

Description

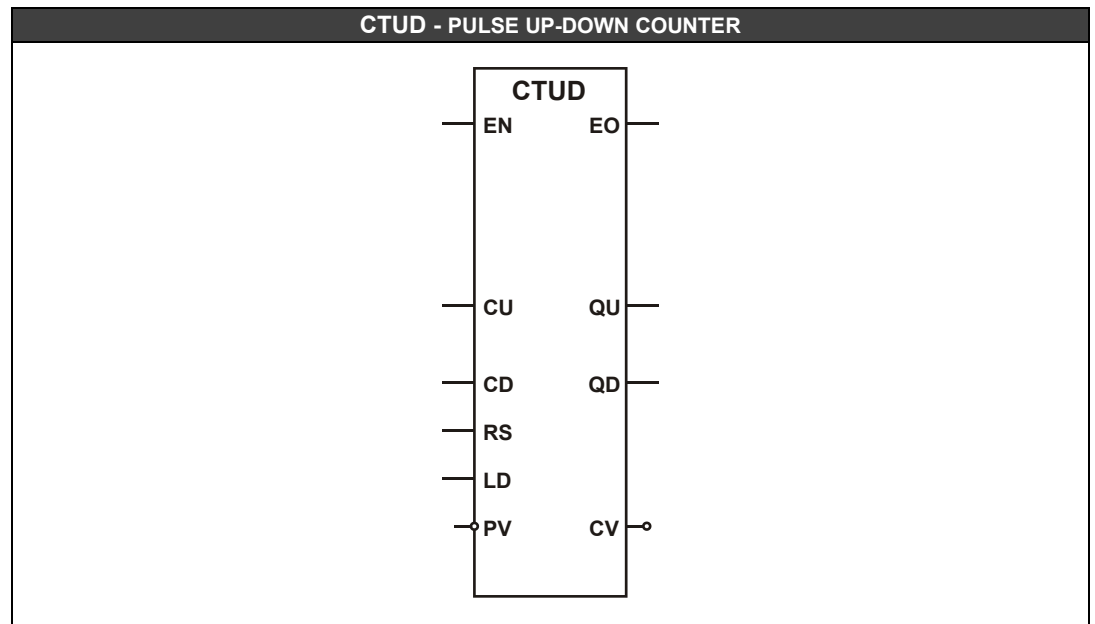
When the **EN** input is true this function counts the false to true logic state transitions in **CU** input and increases the **CV** value. If there are true to false transitions in **CD** input the **CV** value will be decreased.

If **CV** value reaches the **PV** value the **QU** output is held in true. If the **CV** value reaches zero the **QD** output is held in true.

If **RS** goes to true, **QU** is held in false, **QD** in true and **CV** in zero.

If **LD** input goes to true, **QD** is held in false, **QU** in true, and **CV** is loaded with **PV** value.

The **LD** input predominates over the **RS** input. While **RS** or **LD** are true, the counting is held. If **EN** input is false, every Boolean output is held in zero, and **CV** is loaded with **PV** value.

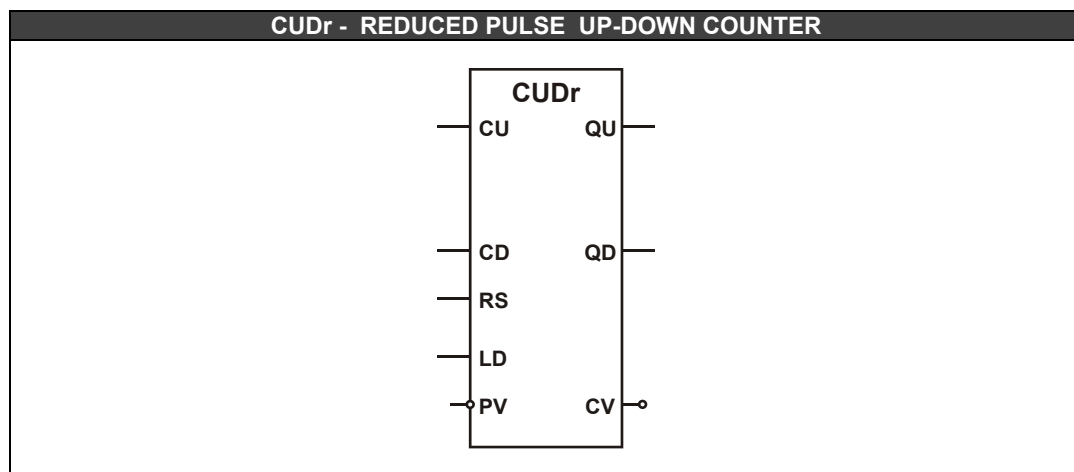


CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	CU	PULSE INPUT	BOOL
	CD	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	LD	LOAD	BOOL
	PV	PROGRAMMED VALUE	LONG
O	EO	OUTPUT ENABLED	BOOL
	QU	BLOCK OUTPUT	BOOL
	QD	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

Reduced Pulse Up-Down Counter (CUDr)

This function block works exactly like the CTUD block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	CU	PULSE INPUT	BOOL
	CD	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	LD	LOAD	BOOL
	PV	PROGRAMMED VALUE	LONG
O	QU	BLOCK OUTPUT	BOOL
	QD	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

Pulse Up-Counter (CUP)

Description

The CUP function counts the transitions from 0 (false) to 1 (true). When the **EN** input is true, this function counts false to true logic state transitions in the **IN** input, and increases the **CV** value.

When **CV** reaches the value defined in **PV**, the **Q** output changes to true and stays there until the **RS** input goes to true. At this moment the **Q** output comes back to false.

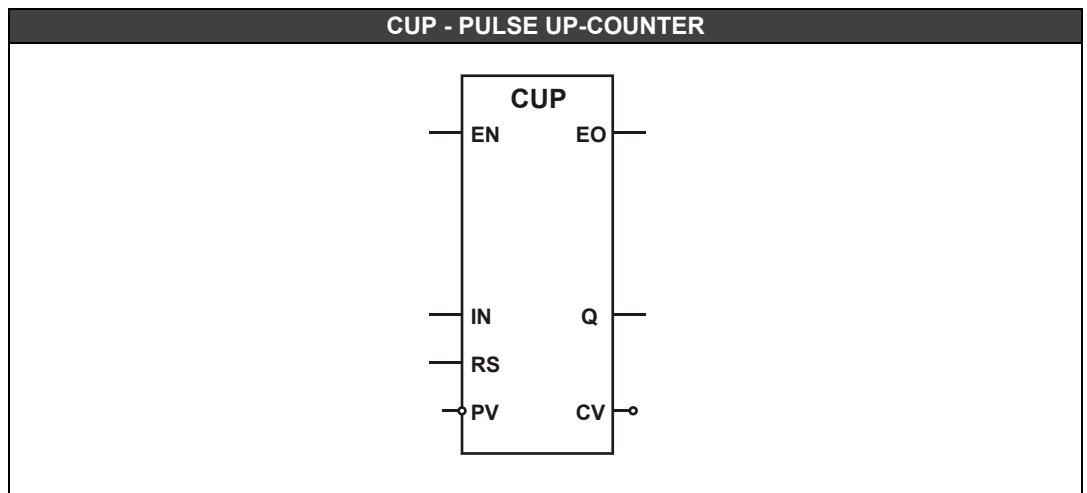
If the **EN** input is false, all outputs are held in zero (false).

Internal CV Counter

Every time an ascending transition occurs in the block input, the CV is increased by one unit. When the internal count reaches the value defined in **PV**, the **Q** output changes to true.

RS (Reset)

If the **RS** input is true the counter will be cleared. While **RS** is true, the counting is held.

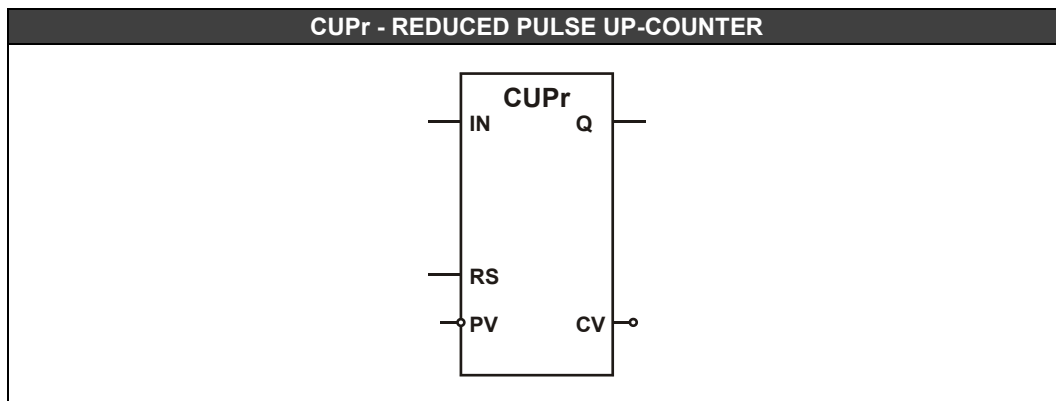


CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	PV	PROGRAMMED VALUE	LONG
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

Reduced Pulse Up-Counter (CUPr)

This function block works exactly like the CUP block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	RS	BLOCK RESET	BOOL
	PV	PROGRAMMED VALUE	LONG
O	Q	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

Reduced Pulse Up-Counter 2(CTUr)

Description

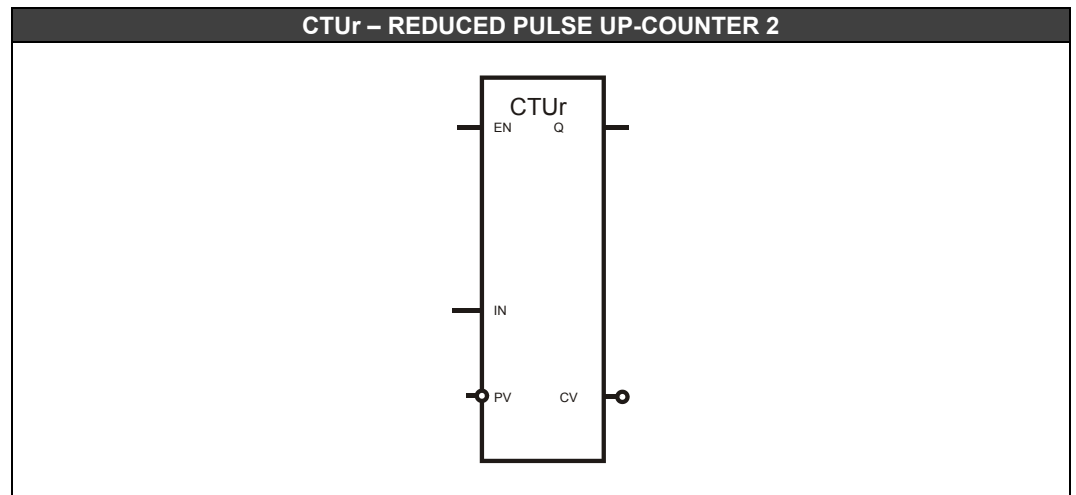
The CTUr function counts the transitions from 0 (false) to 1 (true). When the **EN** input is true, this function counts false to true logic state transitions in the **IN** input, and increases the **CV** value.

When **CV** reaches the value defined in **PV**, the **Q** output changes to true and stays there until the **EN** input goes to false. At this moment the **Q** output comes back to false.

If the **EN** input is false, all outputs are held in zero (false).

Internal Counter CV

Every time an ascending transition occurs in the block input, the CV is increased by one unit. When the internal count reaches the value defined in **PV**, the **Q** output changes to true.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	PV	PROGRAMMED VALUE	LONG
O	Q	BLOCK OUTPUT	BOOL
	CV	CURRENT COUNTING VALUE	LONG

I: Input. P: Parameter. O: Output

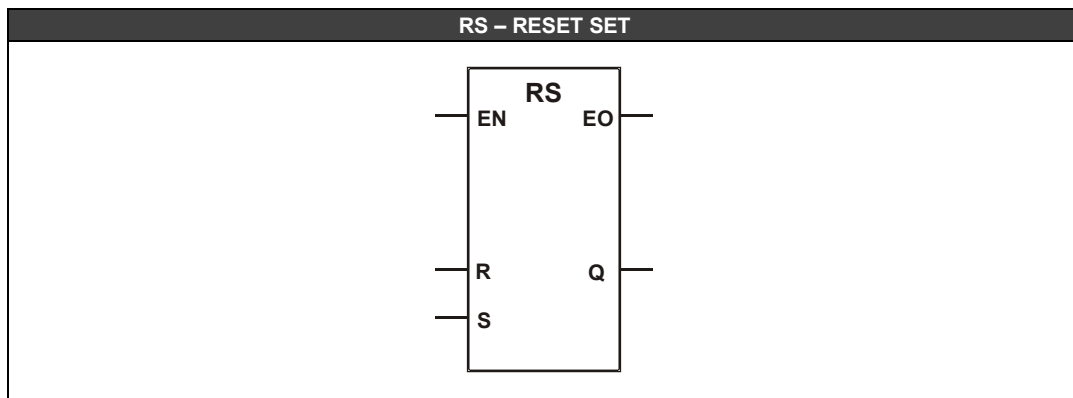
Reset Set (RS)

Description

When **EN** input is true, this function block works as follows:

If the **R** input is true the **Q** output goes to false. If the **S** input is true **Q** goes to true. If the two inputs are true **Q** is held in false.

If the **EN** input is false, all outputs are held in zero (false).



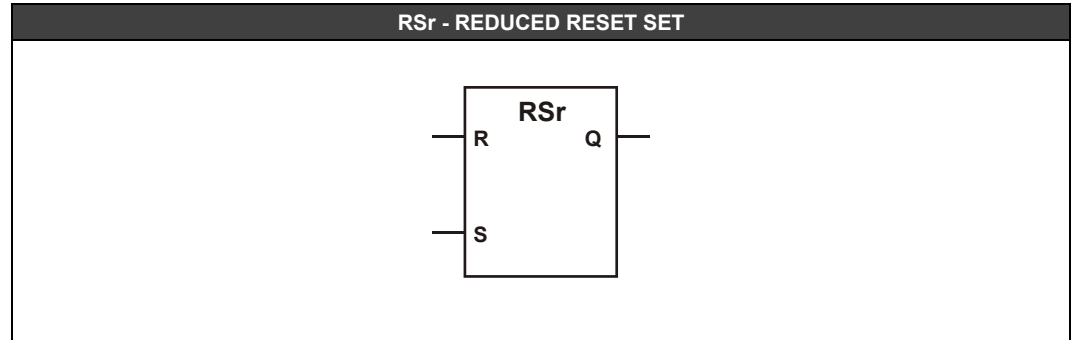
CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	R	BLOCK RESET	BOOL
	S	SET	BOOL
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL

I: Input. P: Parameter. O: Output

Reduced Reset Set (RSr)

Description

This function block works exactly like the RS block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	R	BLOCK RESET	BOOL
	S	SET	BOOL
O	Q	BLOCK OUTPUT	BOOL

I: Input. P: Parameter. O: Output

Real Time Alarm (RTA)

Description

When the **EN** input is true, this FB works like a clock alarm. A date (**DT**) and an hour (**HR**) are set by the user to trigger the alarm.

When the specified time is reached by the local time, which is configured in the time zone of Windows operational system that the block is configured, the output **ALM** changes to true (logic level 1) if it was in false (logic level 0). This change means that the alarm was triggered.

If a true signal is applied in **RS** (RESET), the **ALM** output will return to false. While **RESET** signal is held in true new block triggers will be disabled.

If the **EN** input is false, all outputs are held in zero (false).

The block has three configuration parameters that will indicate date, hour and an alarm trigger frequency. These parameters are:

Date Parameter

The user may select this parameter, choosing a specific date to trigger the alarm. The user has to configure the desired date in this format: Year/Month/Day. The year has to be configured in 4 digits format and has to be in 2005 to 2037 interval.

Periodicity Parameter

The user may configure the alarm trigger periodicity. The options are:

One-Shot: the block triggers once in the date and hour configured;

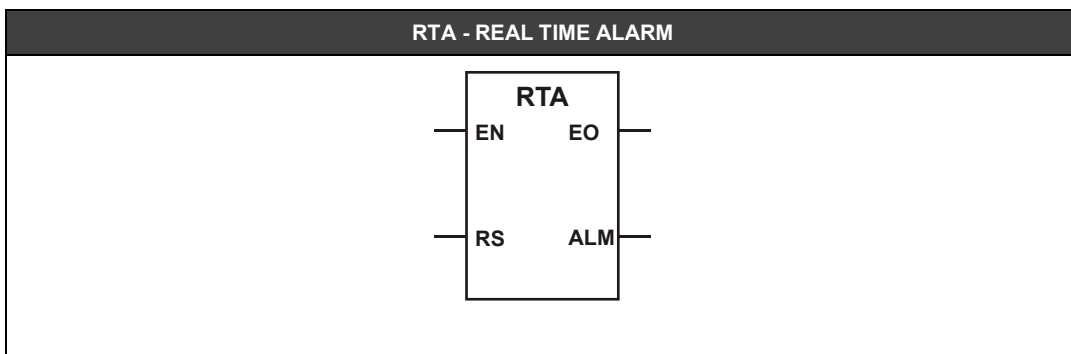
Daily: the block triggers daily at the same hour that was configured in **HR**;

Weekly: the block triggers weekly at the same week day of the first week day trigger.

Monthly: the block triggers monthly on the same month day of the first month day trigger.

Hour Parameter

The user must set the hour desired for the alarm to be active. This hour must be set in the format HR: MIN: SEC, where the HR, MIN and SEC parameters are hours, minutes and seconds, respectively.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	RS	BLOCK RESET	BOOL
P	DT	SECOND	DATE
	PER	MINUTE	PERIODICITY
	HR	HOUR	HOUR
O	EO	OUTPUT ENABLED	BOOL
	ALM	ALARM	BOOL

I: Input. **P**: Parameter. **O**: Output

IMPORTANT

1. The RTC (Real Time Clock) of the controller in which the RTA will be executed must be configured according to the official local time.
2. The RTC of the DFI302 controller can be configured manually, via Batch Download option of FBTools, and when available, automatically kept synchronized via SNTP. For further information refer to the FBTools help and Server Manager appendix in the Studio302 manual, respectively.
3. The user has to take care with the changes at the beginning and end of daylight saving time. The important thing is, when changing the time, for ahead or back, you must do the same change in the controller.

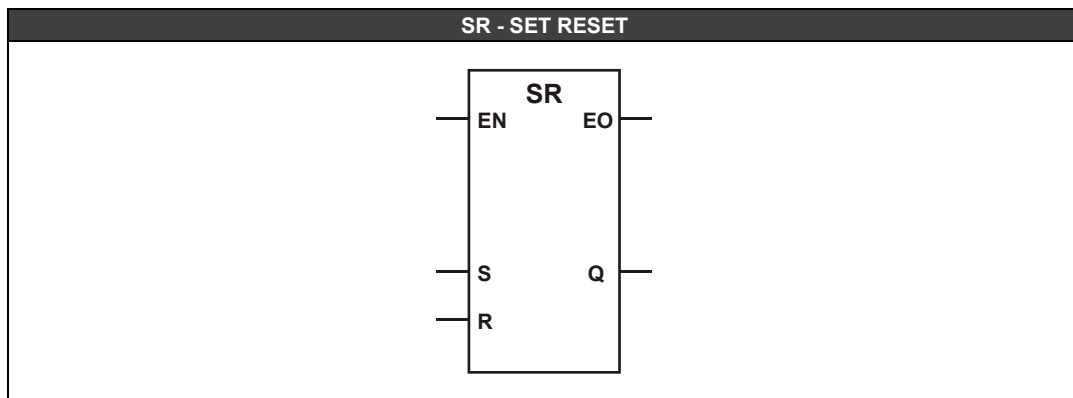
Set Reset (SR)

Description

When **EN** input is true this function block works in this way:

If the **S** input is true, the **Q** output goes to true. If the **R** input is true **Q** goes to false. If the two inputs are true **Q** is held in true.

If the **EN** input is false, all outputs are held in zero (false).



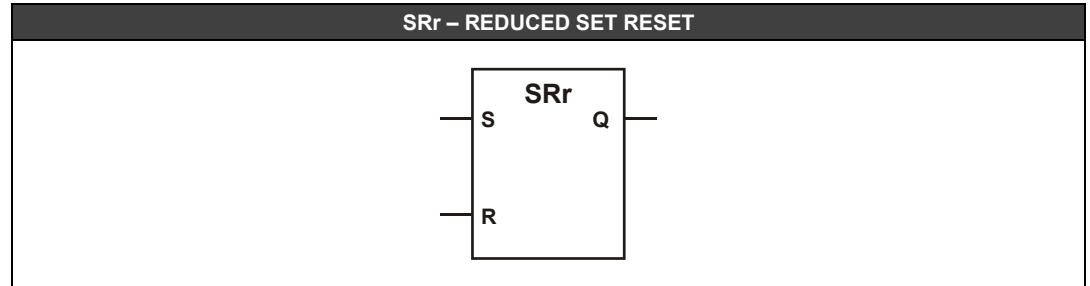
CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	S	SET	BOOL
	R	BLOCK RESET	BOOL
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL

I: Input. P: Parameter. O: Output

Reduced Set Reset (SRr)

Description

This function block works exactly like the SR block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	S	SET	BOOL
	R	BLOCK RESET	BOOL
O	Q	BLOCK OUTPUT	BOOL

I: Input. P: Parameter. O: Output

Off-Delay Timer (TOF)

Description

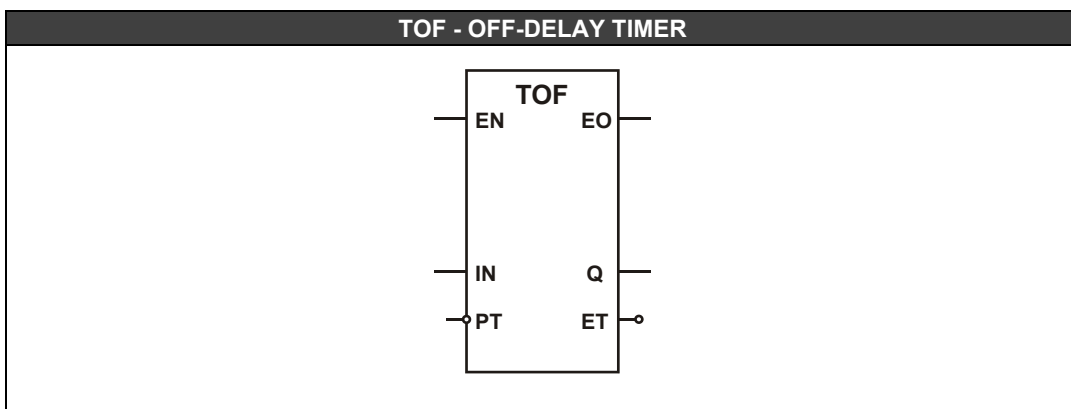
When the **EN** input is true, this function holds the true state of the **IN** input in the **Q** output for a time period previously defined, after the **IN** input changes to false. The time period is defined in **PT** parameter and its unit is milliseconds.

If **IN** changes to true, before **Q** goes to false, **Q** will stay on true state and the time period will start again in the moment that **IN** goes to false.

If the **EN** input is false, all outputs are held in zero (false).

PT Input

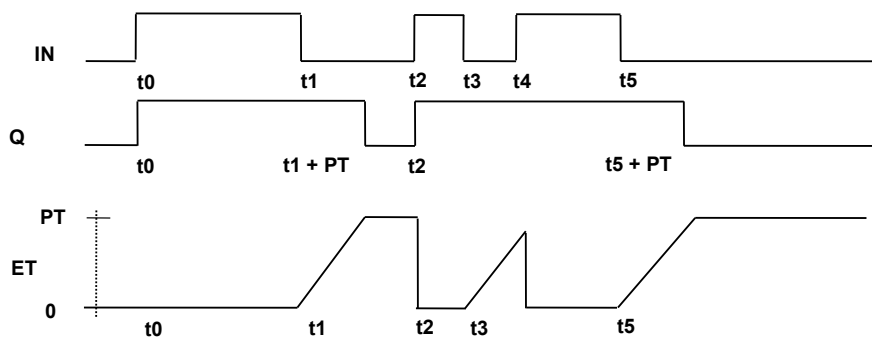
The **PT** input can be connected to a function block output, a FFB or a fixed value.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	PT	PROGRAMMED TIME	LONG
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

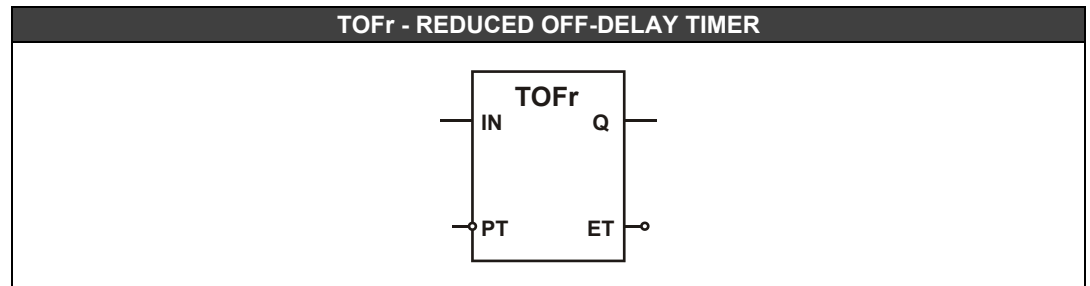
I: Input. P: Parameter. O: Output

Off-Delay Timer Function - Timing diagrams



Reduced Off-Delay Timer (TOFr)

This function block works exactly like the TOF block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	PT	PROGRAMMED TIME	LONG
O	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

I: Input. P: Parameter. O: Output

On-Delay Timer (TON)

Description

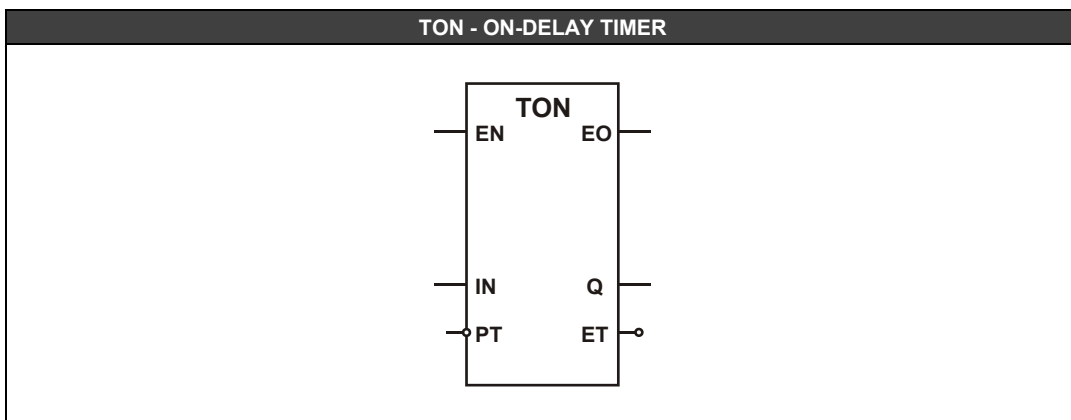
When the **EN** input is true, this function causes a delay in the false to true transition in the **Q** output for a specific time interval previously defined, after the **IN** input changes to true. The time interval is defined in the **PT** parameter and its unit is milliseconds.

If **IN** changes to false, before **Q** goes to true, **Q** will stay on false state and the time interval will start again when **IN** goes to true.

If the **EN** input is false, all outputs are held in zero (false).

PT Input

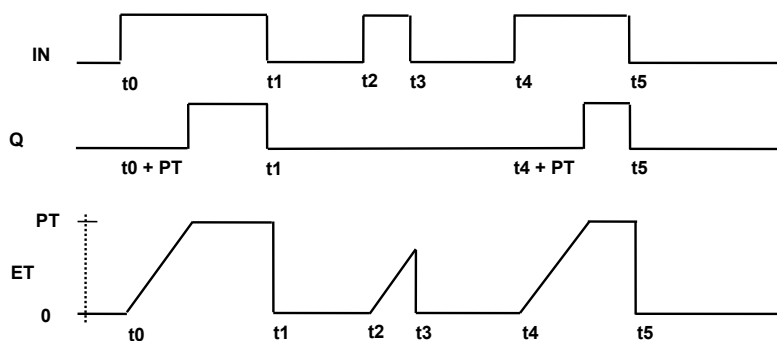
The **PT** input can be connected to a function block output, a FFB or a fixed value.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	PT	PROGRAMMED TIME	LONG
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

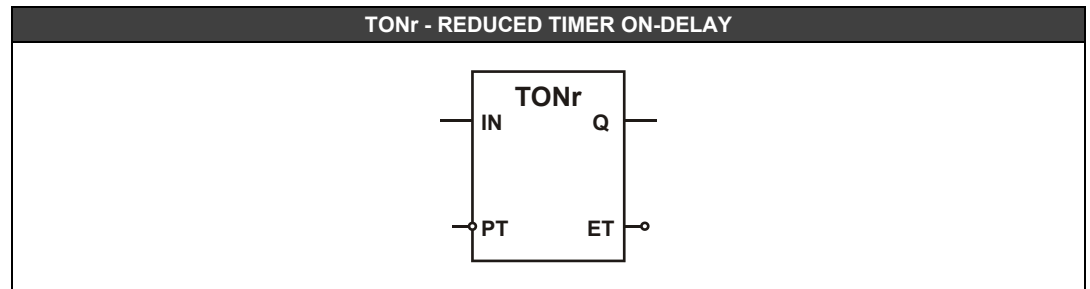
I: Input. P: Parameter. O: Output

On-Delay Timer Function - Timing diagrams



Reduced On-Delay Timer (TONr)

This function block works exactly like the TON block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	PT	PROGRAMMED TIME	LONG
O	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

I: Input. P: Parameter. O: Output

Pulse Timer (TP)

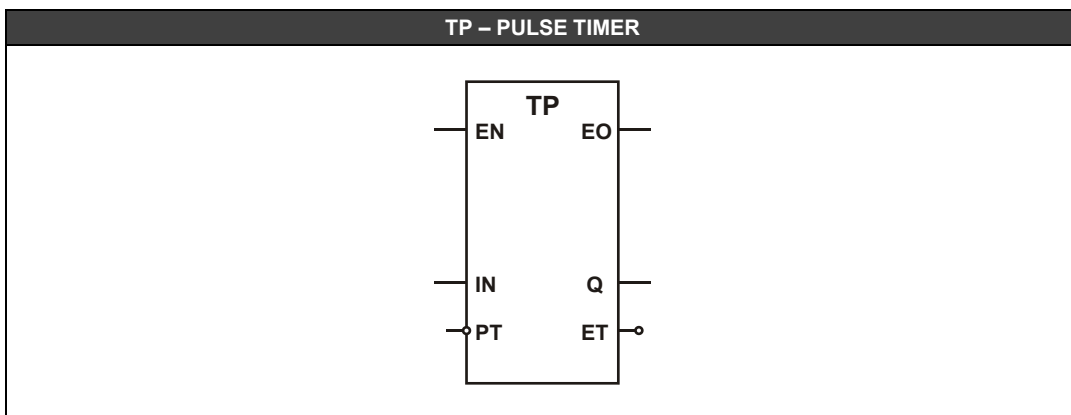
Description

When the **EN** input is true, this FB generates a pulse with fixed duration in the **Q** output for each rising transition (false to true) in the **IN** input. The time interval is defined in the **PT** parameter and its unit is milliseconds.

The transitions in the **IN** input will be ignored while the output is active. If the **EN** input is false, all outputs are held in zero (false).

PT Input

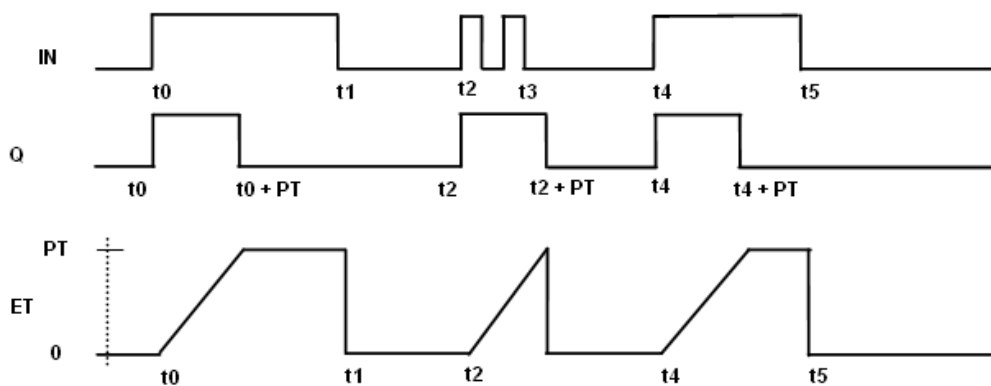
The **PT** input can be connected to a function block output, a FFB or a fixed value.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PULSE INPUT	BOOL
	PT	PROGRAMMED TIME	LONG
O	EO	OUTPUT ENABLED	BOOL
	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

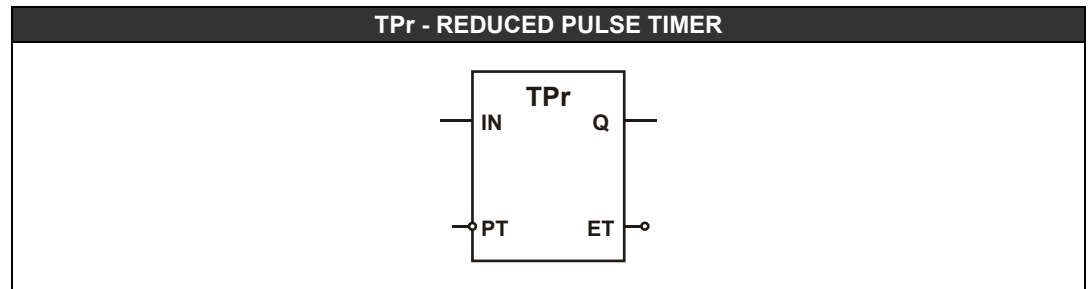
I: Input. P: Parameter. O: Output

Pulse Timer Function - Timing diagrams



Reduced Pulse Timer (TPr)

This function block works exactly like the TP block, but it does not have the **EN** input and the **EO** output.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	PULSE INPUT	BOOL
	PT	PROGRAMMED TIME	LONG
O	Q	BLOCK OUTPUT	BOOL
	ET	CURRENT ELAPSED TIME	LONG

I: Input. P: Parameter. O: Output

Data Manipulation Functions

Byte to Int Conversion (BINT)

Description

This function, when **EN** is true, converts a byte composed by the 8 boolean inputs (**IN8-IN7-IN6-IN5-IN4-IN3-IN2-IN1**) to an integer number and places it in the **OUT** output.

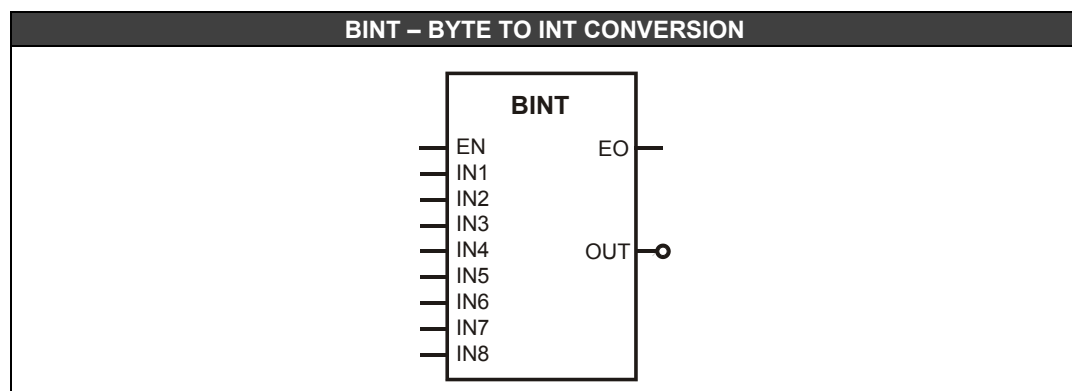
Conversion

The byte composed by the inputs is converted to an integer number.

For example, if the inputs are:

IN1 = 1
 IN2 = 1
 IN3 = 1
 IN4 = 0
 IN5 = 0
 IN6 = 0
 IN7 = 1
 IN8 = 1

That is, the input is 11000111 (binary) or C7 (hexadecimal). The block output will be 199.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1 (LSB)	BOOL
	IN2	INPUT 2	BOOL
	IN3	INPUT 3	BOOL
	IN4	INPUT 4	BOOL
	IN5	INPUT 5	BOOL
	IN6	INPUT 6	BOOL
	IN7	INPUT 7	BOOL
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT (INPUT VALUE CONVERTED TO INTEGER)	LONG

I: Input. P: Parameter. O: Output

Byte to Bits Conversion (BTB)

Description

When the **EN** is true, the BTB function converts the first byte of a LONG data type in 8 parallel outputs, each one of them representing one bit.

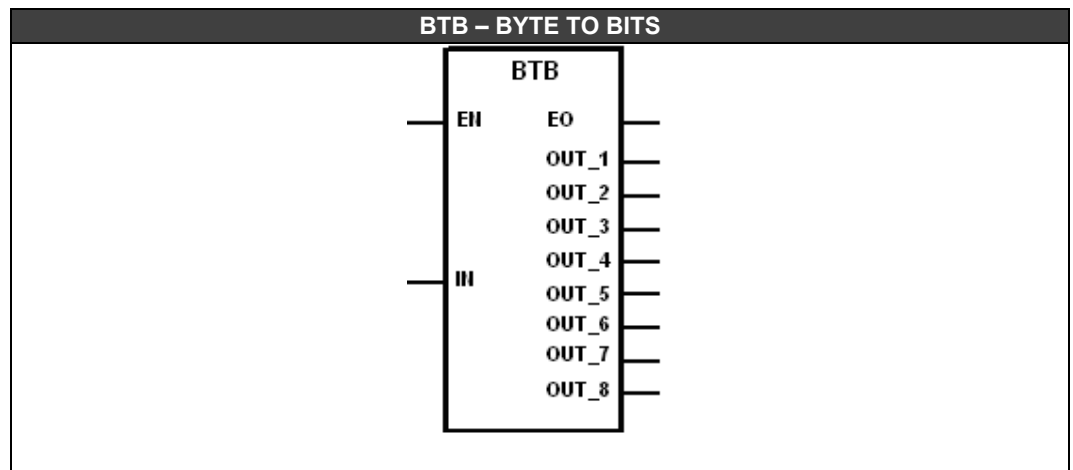
If the **EN** input is false, all outputs are held in zero (false).

Conversion

The block input is a LONG data type, to the effect conversion, is considered only the least significant byte which is decomposed in OUT_1 to OUT_8 outputs.

The input data can be deriving from another function block, e.g., the BROUT output of the TEMP block (DF45 – temperature module). In this case, the OUT_1 to OUT_8 outputs will represent the burnout status of each one of the temperature module inputs.

The OUT_1 to OUT_8 outputs can be used as FB inputs, e.g. the BWL1 or the NOT1 blocks.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	BLOCK INPUT	LONG
O	ENO	OUTPUT ENABLED	BOOL
	OUT_1	BIT 0 (LSB)	BOOL
	OUT_2	BIT 1	BOOL
	OUT_3	BIT 2	BOOL
	OUT_4	BIT 3	BOOL
	OUT_5	BIT 4	BOOL
	OUT_6	BIT 5	BOOL
	OUT_7	BIT 6	BOOL
	OUT_8	BIT 7 (MSB)	BOOL

I: Input. P: Parameter. O: Output

Boolean to Int Conversion (BTI1)

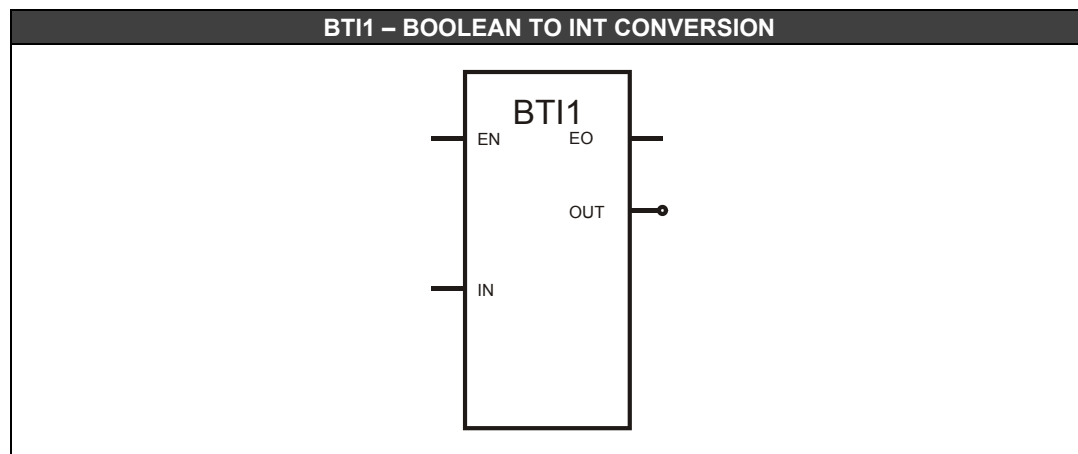
Description

This function, when **EN** is true, converts the **IN** boolean input state to an integer number and places it in the **OUT** output.

Conversion

If the **IN** logic state is false, the **OUT** output will be "0".

If the **IN** logic state is true, the **OUT** output will be "1".



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	BOOL
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT (INPUT STATE CONVERTED TO INTEGER)	LONG

I: Input. P: Parameter. O: Output

BCD to Int Conversion (BTI2)

Description

This function, when **EN** is true, converts BCD value in the **IN** input to an integer number and places it in the **OUT** output.

Conversion

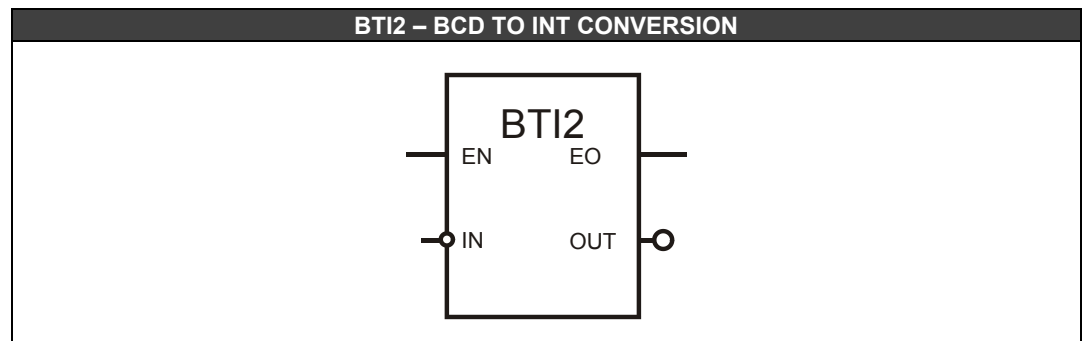
A 2-digit number on BCD has the following format:

BIT7-BIT6-BIT5-BIT4 _____ BIT3-BIT2-BIT1-BIT0

Each set of 4 bits composes a digit. For example: the number 10. If expressed in the BCD code it is written as 10. The first digit can be written in the binary form as 0001, and the second as 0000. So, 10BCD= 0001 0000Binary.

It is common to confuse the BCD code with the binary representation. However, each group of 4 bits only represents one digit varying from 0 to 9. There can't be a representation on BCD like 12 9BCD, even though 12 can be expressed by 4 bits.

The BCD code is typically used in 7 segment displays. Each segment represents a BCD digit. The above representation may be extended to N digits, always noting that each digit varies only from 0 to 9.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT (INPUT VALUE CONVERTED TO INTEGER)	LONG

I: Input. **P:** Parameter. **O:** Output

Bitwise Logic 1 (BWL1)

Description

This function allows implementation of the logic functions using a function block. Six different function blocks can be set: **AND**, **NAND**, **OR**, **NOR**, **XOR** and **NXOR**. The user chooses the type of logic operation during the BWL1 block setting and this block will perform this logic function.

The number of block inputs is configured by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs). The block does the operations among the bits which are represented by each digital input.

Prm = "0": AND Function

The logic function **AND** for two inputs - **IN1** and **IN2** – has the **OUT** output given by the Boolean expression: **OUT = IN1.IN2**. This will result in a state table as shown below:

IN1	IN2	OUT
0	0	0
0	1	0
1	0	0
1	1	1

Prm = "1": Function OR

The logic function **OR** for two inputs - **IN1** and **IN2** – has the **OUT** output given by the Boolean expression: **OUT = IN1+IN2**. This will result in a state table as shown below:

IN1	IN2	OUT
0	0	0
0	1	1
1	0	1
1	1	1

Prm = "2": Function XOR

The logic function **XOR** for two inputs - **IN1** and **IN2** – has the **OUT** output given by the Boolean expression:

$$OUT = IN1\overline{IN2} + \overline{IN1}IN2$$

This will result in a state table as shown below:

IN1	IN2	OUT
0	0	0
0	1	1
1	0	1
1	1	0

Prm = "3": Function NAND

This function associates the **AND** and **NOT** functions. So, the logic output is the **inverted AND** logic function.

Prm = "4": Function NOR

This function associates the **OR** and **NOT** functions. So, the logic output is the **inverted OR** logic function.

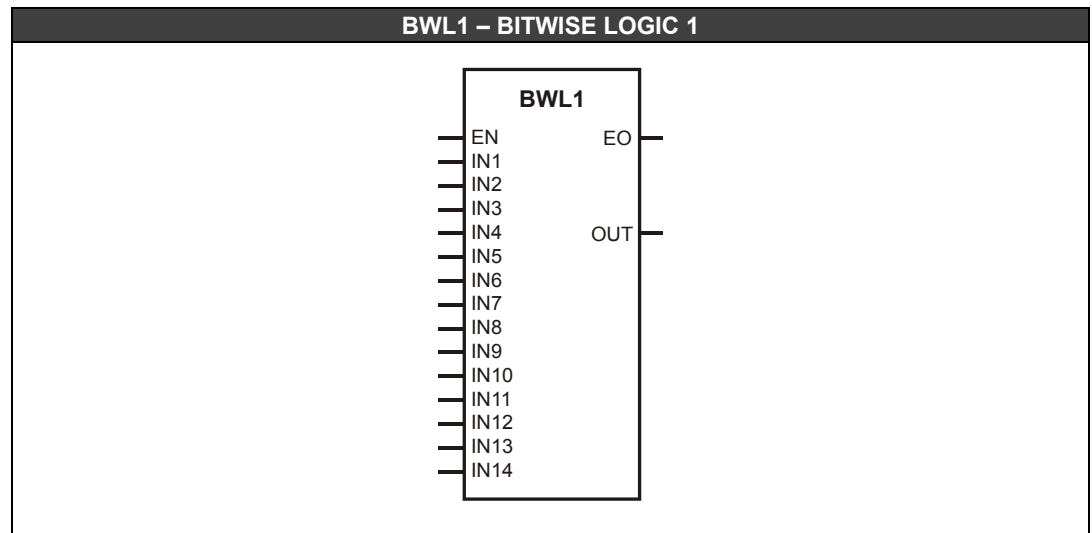
Prm = "5": Function NXOR

This function associates the **AND** and **XOR** functions. So, the logic output is the **inverted XOR** logic function.

The BWL1 block allows expansion up to 14 inputs. In the table below we present the logic functions for more than 2 inputs and their respective outputs.

INPUTS					OUTPUTS					
IN1	IN2		INn-1	INn	AND	NAND	OR	NOR	XOR	NXOR
0	0		0	0	0	1	0	1	0	1
0	0		0	1	0	1	1	0	1	0
0	0		1	0	0	1	1	0	1	0
0	0		1	1	0	1	1	0	0	1
		...					1	0		
1	1		1	0	0	1	1	0	1	0
1	1		1	1	1	0	1	0	0	1

If the **EN** input is false, the output is held in zero (false). If the Prm value is greater than 5, the **EO** and **OUT** outputs will be zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	BOOL
	IN2	INPUT 2	BOOL
	IN3	INPUT 3	BOOL
	IN4	INPUT 4	BOOL
	IN5	INPUT 5	BOOL
	IN6	INPUT 6	BOOL
	IN7	INPUT 7	BOOL
	IN8	INPUT 8	BOOL
	IN9	INPUT 9	BOOL
	IN10	INPUT 10	BOOL
	IN11	INPUT 11	BOOL
	IN12	INPUT 12	BOOL
	IN13	INPUT 13	BOOL
IN14	INPUT 14	BOOL	
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	BOOL
P	Prm	LOGICAL OPERATION	LONG
	N_IN	NUMBER OF INPUTS	LONG

I: Input. P: Parameter. O: Output

Reduced Bitwise Logic 1 (BWL1r)

Description

This function allows implementation of the logic functions using a function block. Six different function blocks can be set: **AND**, **NAND**, **OR**, **NOR**, **XOR** and **NXOR**. The user chooses the type of logic operation during the BWL1r block setting and this block will perform this logic function.

The block does the operations among the bits which are represented by the two digital inputs.

Prm = "0": AND Function

The logic function **AND**, for the **IN1** and **IN2** inputs, has the **OUT** output given by the Boolean expression: **OUT = IN1.IN2**. This will result in a state table as shown below:

IN1	IN2	OUT
0	0	0
0	1	0
1	0	0
1	1	1

Prm = "1": Function OR

The logic function **OR** for the **IN1** and **IN2** inputs has the **OUT** output given by the Boolean expression: **OUT = IN1+IN2**. This will result in a state table as shown below:

IN1	IN2	OUT
0	0	0
0	1	1
1	0	1
1	1	1

Prm = "2": Function XOR

The logic function **XOR** for the **IN1** and **IN2** inputs has the **OUT** output given by the Boolean expression:

$$OUT = \overline{IN1}IN2 + IN1\overline{IN2}$$

This will result in a state table as shown below:

IN1	IN2	OUT
0	0	0
0	1	1
1	0	1
1	1	0

Prm = "3": Function NAND

This function associates the **AND** and **NOT** functions. So, the logic output is the **inverted AND** logic function.

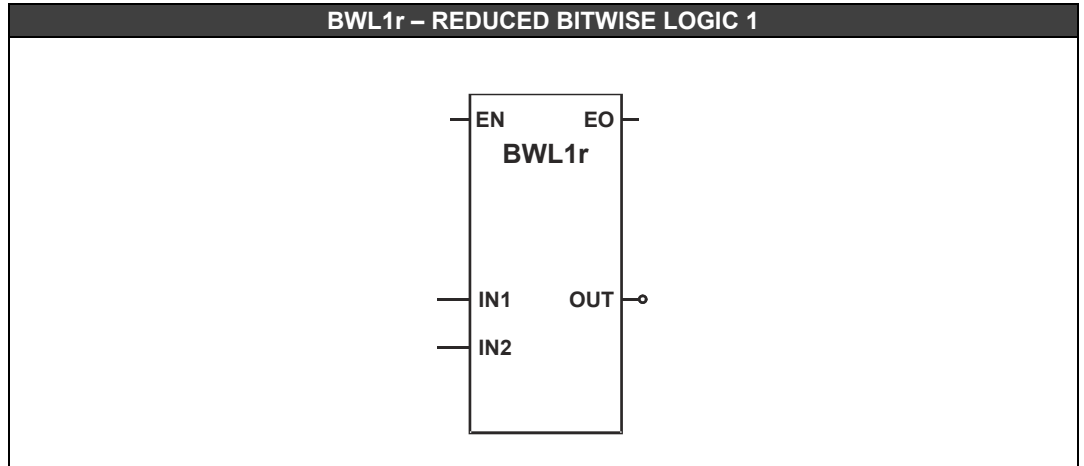
Prm = "4": Function NOR

This function associates the **OR** and **NOT** functions. So, the logic output is the **inverted OR** logic function.

Prm = "5": Function NXOR

This function associates the **NOT** and **XOR** functions. So, the logic output is the **inverted XOR** logic function.

If the **EN** input is false, the output is held in zero (false). If the Prm value is greater than 5, the **EO** and **OUT** outputs will be zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	BOOL
	IN2	INPUT 2	BOOL
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	BOOL
P	Prm	LOGICAL OPERATION	LONG

I: Input. P: Parameter. O: Output

Bitwise Logic 2 (BWL2)

Description

This function allows implementation of the logic functions using a function block. Six different function blocks can be set: **AND**, **NAND**, **OR**, **NOR**, **XOR** and **NXOR**. The user chooses the type of logic operation during the BWL2 block setting and this block will perform this logic function.

The number of block inputs is configured by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs). The block does the operations among the bits which are represented by each digital input.

Prm = "0": Function AND

The logic function **AND** for two inputs - **IN1** and **IN2** – has the **OUT** output given by the Boolean expression: **OUT = IN1.IN2**. This will result in a state table as shown below:

```
IN1= (BIT17)(BIT16)(BIT15)(BIT14)(BIT13)(BIT12)(BIT11)(BIT10)
IN2= (BIT27)(BIT26)(BIT25)(BIT24)(BIT23)(BIT22)(BIT21)(BIT20)
OUT= (BIT17ANDBIT27).....(BIT10ANDBIT20)
```

```
Example: IN1= 00001111
IN2= 11110000
OUT= 00000000
```

PRM = "1": Function OR

The logic function **OR** for two inputs - **IN1** and **IN2** – has the **OUT** output given by the Boolean expression: **OUT = IN1+IN2**. This will result in a state table as shown below:

```
IN1= (BIT17)(BIT16)(BIT15)(BIT14)(BIT13)(BIT12)(BIT11)(BIT10)
IN2= (BIT27)(BIT26)(BIT25)(BIT24)(BIT23)(BIT22)(BIT21)(BIT20)
OUT= (BIT17ORBIT27).....(BIT10ORBIT20)
```

```
Example: IN1= 00001111
IN2= 11110000
OUT= 11111111
```

Prm = "2": Function XOR

The logic function **XOR** for two inputs - **IN1** and **IN2** – has the **OUT** output given by the Boolean expression:

$$OUT = IN1.\overline{IN2} + \overline{IN1}.IN2$$

This will result in a state table as shown below:

```
IN1= (BIT17)(BIT16)(BIT15)(BIT14)(BIT13)(BIT12)(BIT11)(BIT10)
IN2= (BIT27)(BIT26)(BIT25)(BIT24)(BIT23)(BIT22)(BIT21)(BIT20)
OUT= (BIT17XORBIT27).....(BIT10XORBIT20)
```

```
Example: IN1= 01011100
IN2= 11110000
OUT= 10101100
```

Prm = "3": Function NAND

This function associates the **AND** and **NOT** functions. So, the logic output is the **inverted AND** logic function.

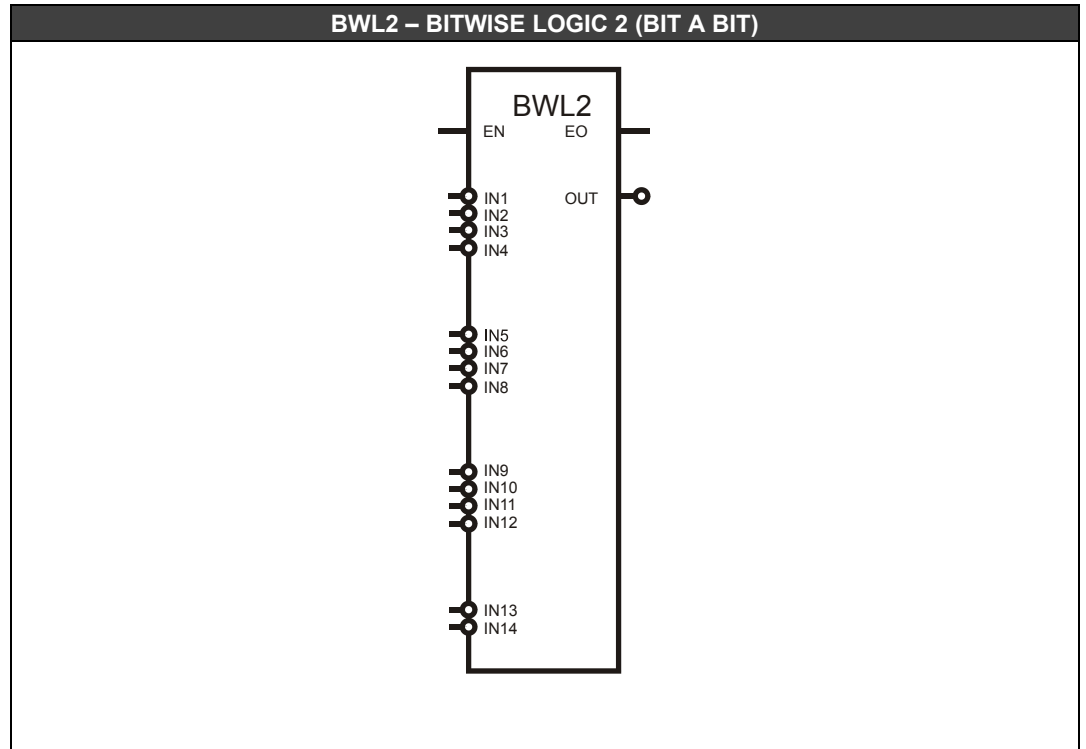
Prm = "4": Function NOR

This function associates the **OR** and **NOT** functions. So, the logic output is the **inverted OR** logic function.

Prm = "5": Function NXOR

This function associates the **XOR** and **NOT** functions. So, the logic output is the **inverted XOR** logic function.

If the **EN** input is false, the output is held in zero (false). If the Prm value is greater than 5, the **EO** and **OUT** outputs will be zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	LONG
	IN2	INPUT 2	LONG
	IN3	INPUT 3	LONG
	IN4	INPUT 4	LONG
	IN5	INPUT 5	LONG
	IN6	INPUT 6	LONG
	IN7	INPUT 7	LONG
	IN8	INPUT 8	LONG
	IN9	INPUT 9	LONG
	IN10	INPUT 10	LONG
	IN11	INPUT 11	LONG
	IN12	INPUT 12	LONG
	IN13	INPUT 13	LONG
IN14	INPUT 14	LONG	
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	LONG
P	Prm	LÓGICAL OPERATION	LONG
	N_IN	NUMBER OF INPUTS	LONG

I: Input. P: Parameter. O: Output

Reduced Bitwise Logic 2 (BWL2r)

Description

This function allows implementation of the logic functions using a function block. Six different function blocks can be set: **AND**, **NAND**, **OR**, **NOR**, **XOR** and **NXOR**. The user chooses the type of logic operation during the BWL2r block setting and this block will perform this logic function.

The block does the operations among the bits which are represented by the two digital inputs.

Prm = "0": Function AND

The logic function **AND**, for the **IN1** and **IN2** inputs, has the **OUT** output given by the Boolean expression: **OUT = IN1.IN2**. This will result in a state table as shown below:

```
IN1= (BIT17)(BIT16)(BIT15)(BIT14)(BIT13)(BIT12)(BIT11)(BIT10)
IN2= (BIT27)(BIT26)(BIT25)(BIT24)(BIT23)(BIT22)(BIT21)(BIT20)
OUT= (BIT17ANDBIT27).....(BIT10ANDBIT20)
```

```
Example: IN1= 00001111
IN2= 11110000
OUT= 00000000
```

PRM = "1": Function OR

The logic function **OR** for the **IN1** and **IN2** inputs has the **OUT** output given by the Boolean expression: **OUT = IN1+IN2**. This will result in a state table as shown below:

```
IN1= (BIT17)(BIT16)(BIT15)(BIT14)(BIT13)(BIT12)(BIT11)(BIT10)
IN2= (BIT27)(BIT26)(BIT25)(BIT24)(BIT23)(BIT22)(BIT21)(BIT20)
OUT= (BIT17ORBIT27).....(BIT10ORBIT20)
```

```
Example: IN1= 00001111
IN2= 11110000
OUT= 11111111
```

Prm = "2": Function XOR

The logic function **XOR** for the **IN1** and **IN2** inputs has the **OUT** output given by the Boolean expression:

$$OUT = \overline{IN1.IN2} + \overline{\overline{IN1.IN2}}$$

This will result in a state table as shown below:

```
IN1= (BIT17)(BIT16)(BIT15)(BIT14)(BIT13)(BIT12)(BIT11)(BIT10)
IN2= (BIT27)(BIT26)(BIT25)(BIT24)(BIT23)(BIT22)(BIT21)(BIT20)
OUT= (BIT17XORBIT27).....(BIT10XORBIT20)
```

```
Example: IN1= 01011100
IN2= 11110000
OUT= 10101100
```

Prm = "3": Function NAND

This function associates the **AND** and **NOT** functions. So, the logic output is the **inverted AND** logic function.

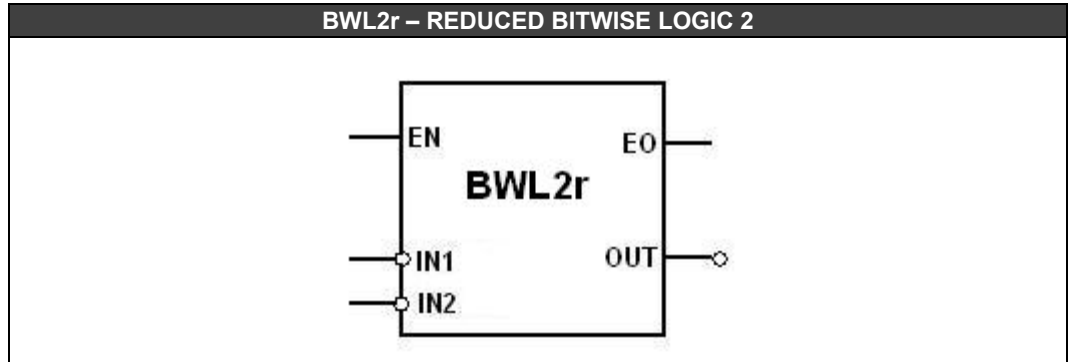
Prm = "4": Function NOR

This function associates the **OR** and **NOT** functions. So, the logic output is the **inverted OR** logic function.

Prm = "5": Function NXOR

This function associates the **XOR** and **NOT** functions. So, the logic output is the **inverted XOR** logic function.

If the **EN** input is false, the output is held in zero (false). If the Prm value is greater than 5, the **EO** and **OUT** outputs will be zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	LONG
	IN2	INPUT 2	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	LONG
P	Prm	LOGICAL OPERATION	LONG

I: Input. P: Parameter. O: Output

Constants (CONST)

Description

When **EN** input is true, this FB sends constant values to the **OUT1**, **OUT2** and **OUT3** outputs. These constant values are set during the block configuration in the LogicView for FFB. These constants only will be sent to the block outputs when the **EN** input is true.

If the **EN** input is false, all outputs are held in zero (false).

P1, P2 and P3 Parameters

The user must insert the constant values in these parameters.

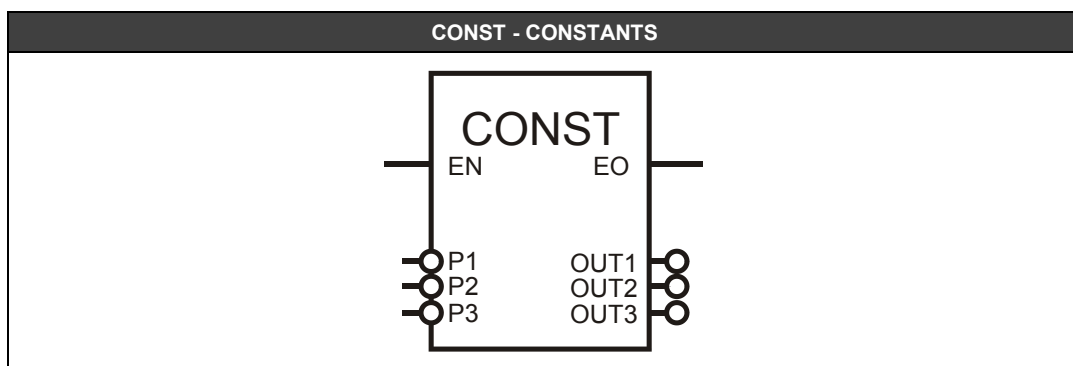
For example:

P1= 32

P2=346.87

P3= -456.5

When **EN** is true, **OUT1**, **OUT2** and **OUT3** will indicate: 32/ 346.87/ -456.5.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	P1	VALUE OF CONSTANT 1	FLOAT
	P2	VALUE OF CONSTANT 2	FLOAT
	P3	VALUE OF CONSTANT 3	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT1	OUTPUT WITH VALUE SET IN P1	FLOAT
	OUT2	OUTPUT WITH VALUE SET IN P2	FLOAT
	OUT3	OUTPUT WITH VALUE SET IN P3	FLOAT

I: Input. **P:** Parameter. **O:** Output

Integer to Boolean Conversion (ITB1)

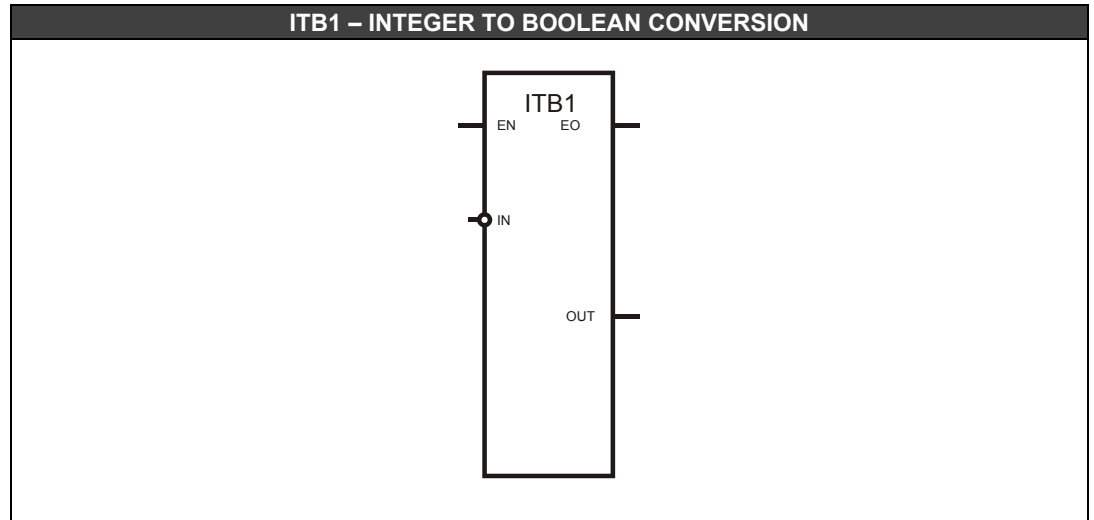
Description

This function, when **EN** is true, converts an integer number that is in the **IN** input to a boolean state and places it in the **OUT** output.

Conversion

If the least significant bit in the **IN** input is "0", the **OUT** output will have the false logic state.

If the least significant bit in the **IN** input is "1", the **OUT** output will have the true logic state.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT (THE INPUT LEAST SIGNIFICANT BIT CONVERTED TO A LOGIC STATE)	BOOL

I: Input. P: Parameter. O: Output

Integer to BCD Conversion (ITB2)

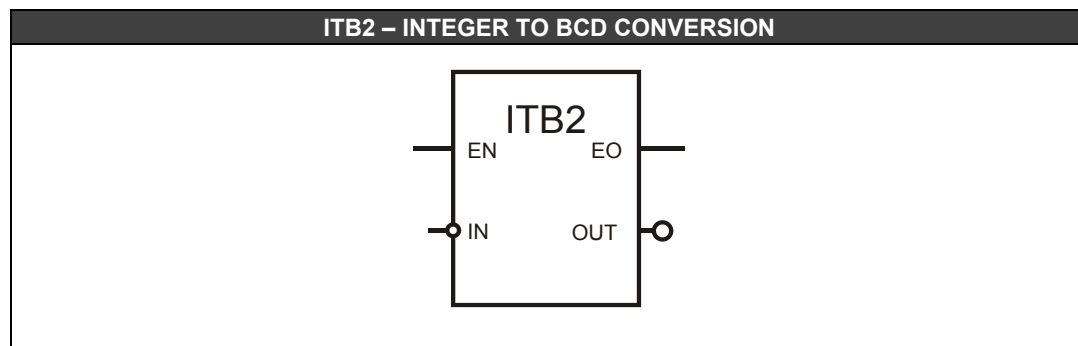
Description

This function, when **EN** is true, converts an integer number to the BCD format and places the result in the **OUT** output.

Conversion

The integer data in the **IN** input will be converted to BCD, if it is less than 99. If the input is greater than 99, the output will be 99BCD (1001 1001).

For example: If in the **IN** input is read 12, in the **OUT** output will be 12BCD or 0001 0010.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT (INPUT VALUE CONVERTED TO BCD)	LONG

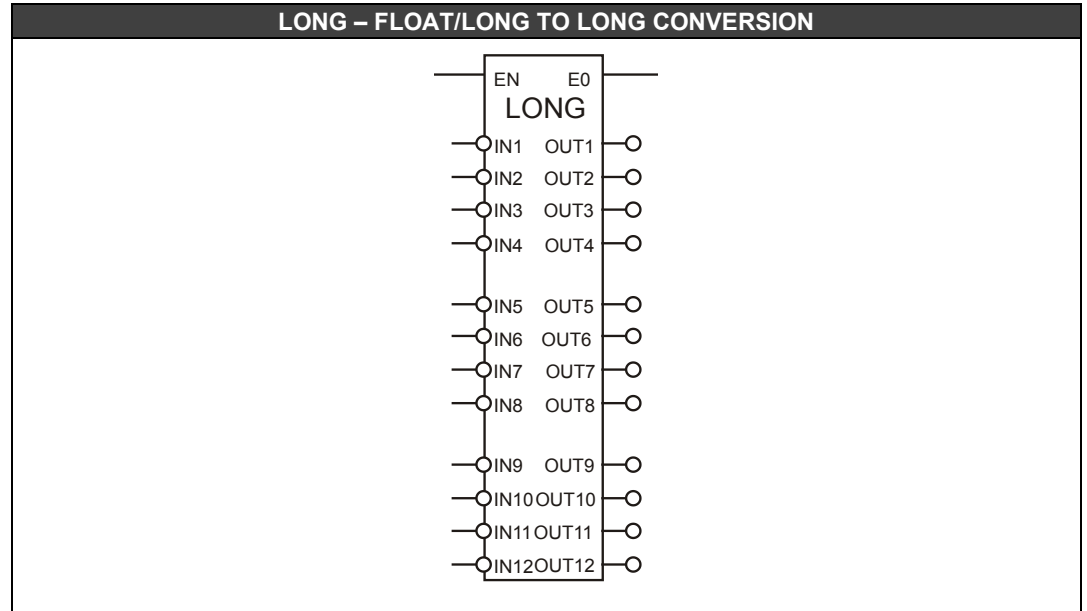
I: Input. P: Parameter. O: Output

Float/Long to Long Conversion (LONG)

Description

This function, when **EN** is true, multiplies the integer or float values of the **INx** inputs by the value defined in the **MUL** parameter, converts in LONG and places the result in the respective **OUTx** outputs.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	LONG/FLOAT
	IN2	INPUT 2	LONG/FLOAT
	IN3	INPUT 3	LONG/FLOAT
	IN4	INPUT 4	LONG/FLOAT
	IN5	INPUT 5	LONG/FLOAT
	IN6	INPUT 6	LONG/FLOAT
	IN7	INPUT 7	LONG/FLOAT
	IN8	INPUT 8	LONG/FLOAT
	IN9	INPUT 9	LONG/FLOAT
	IN10	INPUT 10	LONG/FLOAT
	IN11	INPUT 11	LONG/FLOAT
	IN12	INPUT 12	LONG/FLOAT
P	MUL	MULTIPLIER FACTOR	FLOAT
O	E0	OUTPUT ENABLED	BOOL
	OUT1	OUTPUT 1	LONG
	OUT2	OUTPUT 2	LONG
	OUT3	OUTPUT 3	LONG
	OUT4	OUTPUT 4	LONG
	OUT5	OUTPUT 5	LONG
	OUT6	OUTPUT 6	LONG
	OUT7	OUTPUT 7	LONG
	OUT8	OUTPUT 8	LONG
	OUT9	OUTPUT 9	LONG
	OUT10	OUTPUT 10	LONG
	OUT11	OUTPUT 11	LONG
	OUT12	OUTPUT 12	LONG

I: Input O: Output P: Parameter

Multiplexer for Boolean Inputs (MUX1)

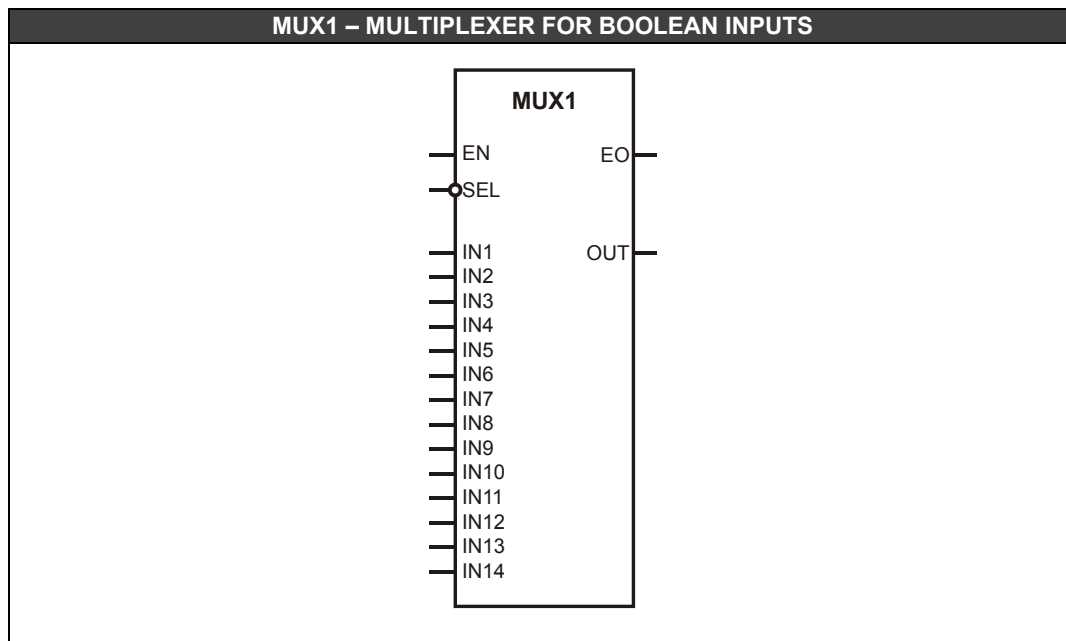
Description

This function, when **EN** is true, selects one of the **IN** inputs and places its value in the **OUT** output. The selection is done in according to the value in the **SEL** input.

Output Selection

If **SEL** is equal to "0", the selected output will be **IN1**. If **SEL** is equal to "1" the selected output will be **IN2** and so on. If **SEL** is greater than the number of possible inputs (N-1) the **INn** output will be selected. In this case, **EO** output goes to false indicating the **SEL** input is out of range. If the number **N_IN** is greater than 14 or less than 2, the **EO** and **OUT** outputs go to zero (false).

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	INPUT SELECTION	LONG
	IN1	INPUT 1	BOOL
	IN2	INPUT 2	BOOL
	IN3	INPUT 3	BOOL
	IN4	INPUT 4	BOOL
	IN5	INPUT 5	BOOL
	IN6	INPUT 6	BOOL
	IN7	INPUT 7	BOOL
	IN8	INPUT 8	BOOL
	IN9	INPUT 9	BOOL
	IN10	INPUT 10	BOOL
	IN11	INPUT 11	BOOL
	IN12	INPUT 12	BOOL
IN13	INPUT 13	BOOL	
IN14	INPUT 14	BOOL	
P	N_IN	NUMBER OF INPUTS	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	BOOL

I: Input. **P:** Parameter. **O:** Output

Reduced Multiplexer for Boolean Inputs (MUX1r)

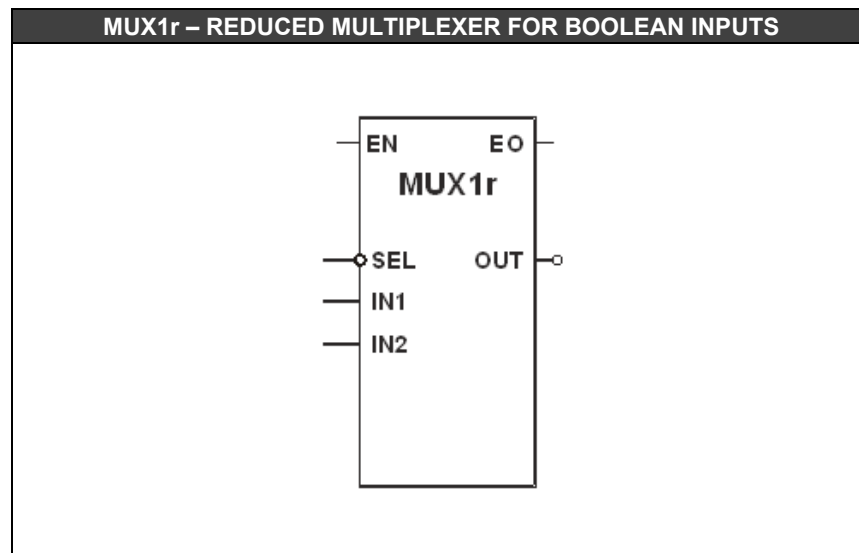
Description

This function, when **EN** is true, selects one of the two inputs and places its value in the **OUT** output. The selection is done in according to the value in the **SEL** input.

Output Selection

If **SEL** is equal to "0", the selected output will be **IN1**, for others values of **SEL** the selected output will be **IN2**.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	INPUT SELECTION	LONG
	IN1	INPUT 1	BOOL
	IN2	INPUT 2	BOOL
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	BOOL

I: Input. P: Parameter. O: Output

Multiplexer for Float Inputs (MUX2)

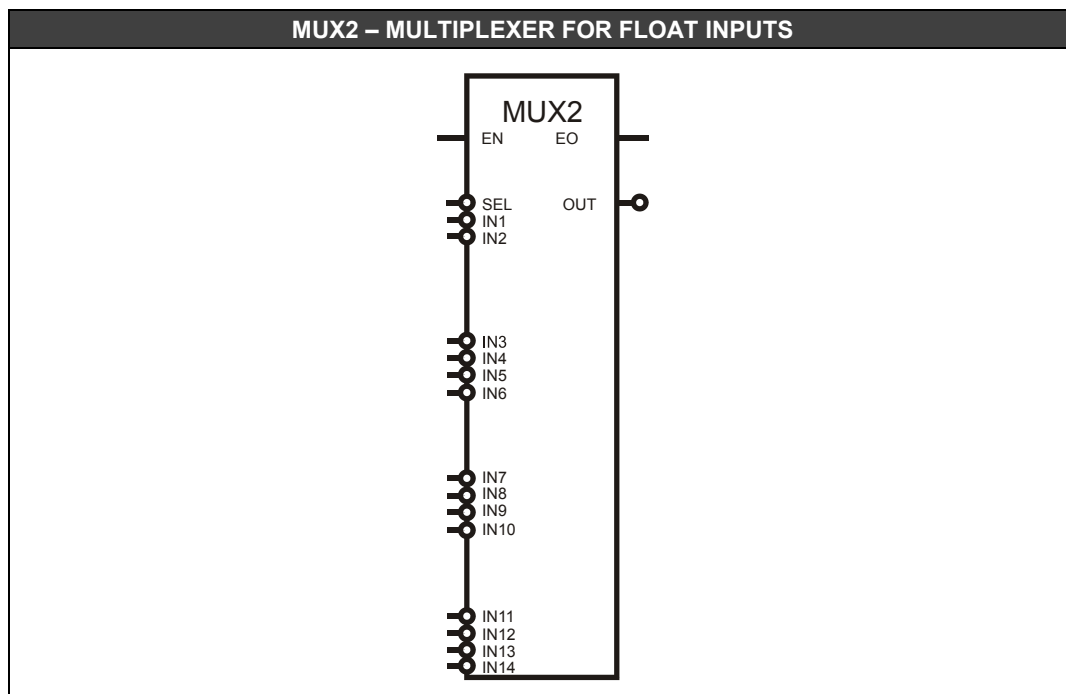
Description

This function, when **EN** is true, selects one of the **IN** inputs and places its value in the **OUT** output. The selection is done in according to the value in the **SEL** input.

Output Selection

If **SEL** is equal to "0", the selected output will be **IN1**. If **SEL** is equal to "1" the selected output will be **IN2** and so on. If **SEL** is greater than the number of possible inputs (N-1) the **INn** output will be selected. In this case, **EO** output goes to false indicating the **SEL** input is out of range. If the number **N_IN** is greater than 14 or less than 2, the **EO** and **OUT** outputs go to zero (false).

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	INPUT SELECTION	LONG
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
IN13	INPUT 13	FLOAT	
IN14	INPUT 14	FLOAT	
P	N_IN	NUMBER OF INPUTS	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	FLOAT

I: Input. P: Parameter. O: Output

Reduced Multiplexer for Float Inputs (MUX2r)

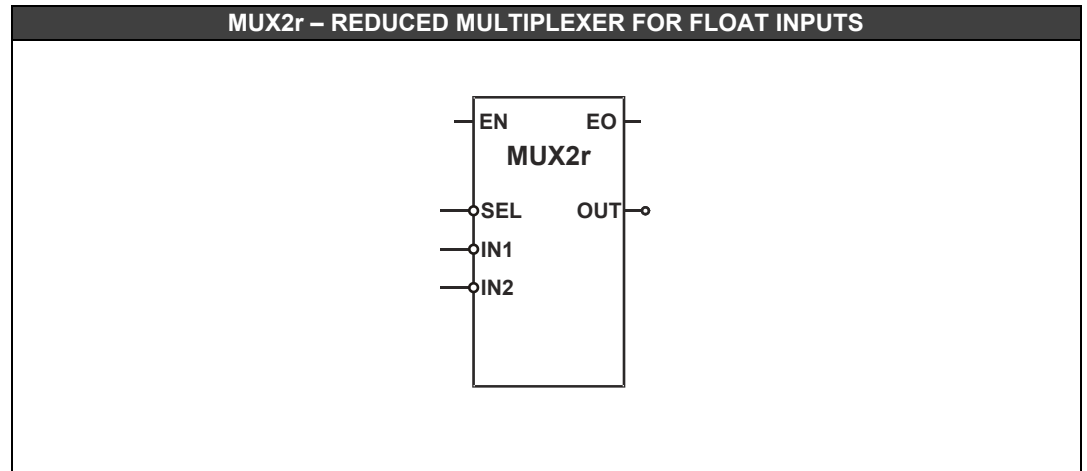
Description

This function, when **EN** is true, selects one of the two inputs and places its value in the **OUT** output. The selection is done in according to the value in the **SEL** input.

Output Selection

If **SEL** is equal to "0", the selected output will be **IN1**, for others values of **SEL** the selected output will be **IN2**.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	INPUT SELECTION	LONG
	IN1	INPUT 1	FLOAT
O	IN2	INPUT 2	FLOAT
	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	FLOAT

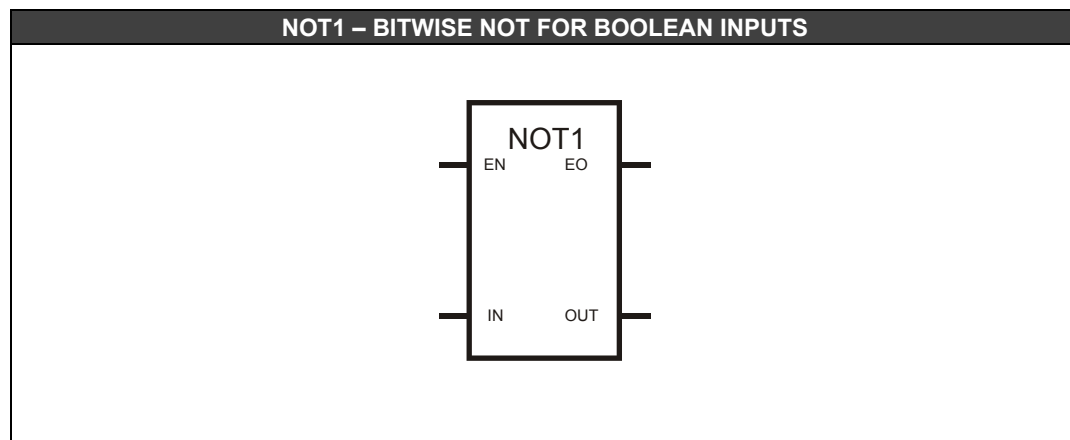
I: Input. P: Parameter. O: Output

Bitwise Not for Boolean Inputs (NOT1)

Description

This function, when **EN** is true, inverts the logic state of the Boolean data in the **IN** input. If the input is "true", i.e. e, logic level "1", the NOT1 block output will be "false" (logic level "0") and vice-versa.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	FLOAT

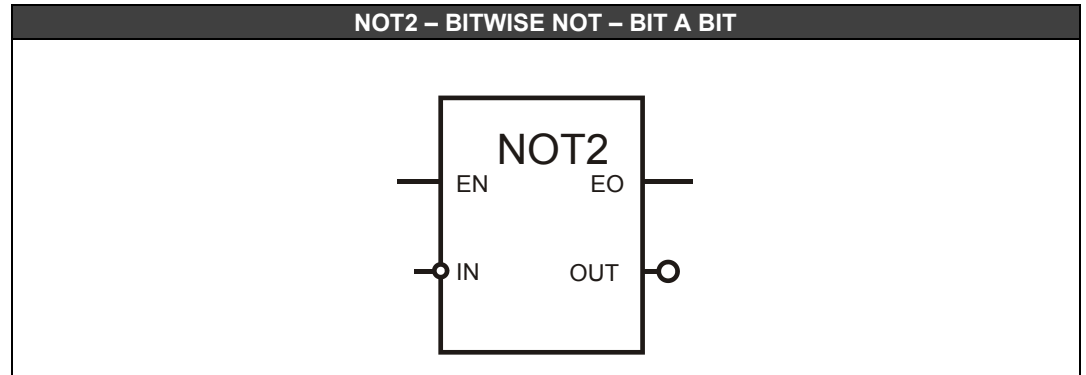
I: Input. P: Parameter. O: Output

Bitwise Not Bit a Bit (NOT2)

Description

This function, when **EN** is true, inverts the input logic level. The least significant byte of the input will have each one of its bits logically inverted. The operation is done bit a bit, for example: if the input has the least significant byte equals to "10011000" (binary), the output will be "01100111" (binary).

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	LONG
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	LONG

I: Input. P: Parameter. O: Output

Output Binary Selection (OSEL)

Description

This function, when **EN** is true, allows the user to select one output to where the input value (**IN**) will be sent. If the **SEL** input is false (0), then the **OUT1** output will be selected. Otherwise, **OUT2** is selected.

If the **OUT1** output is selected, the **Prm2** parameter defines the desired value to the **OUT2** output, as follows:

Prm2 = true: sends zero to the **OUT2** output.

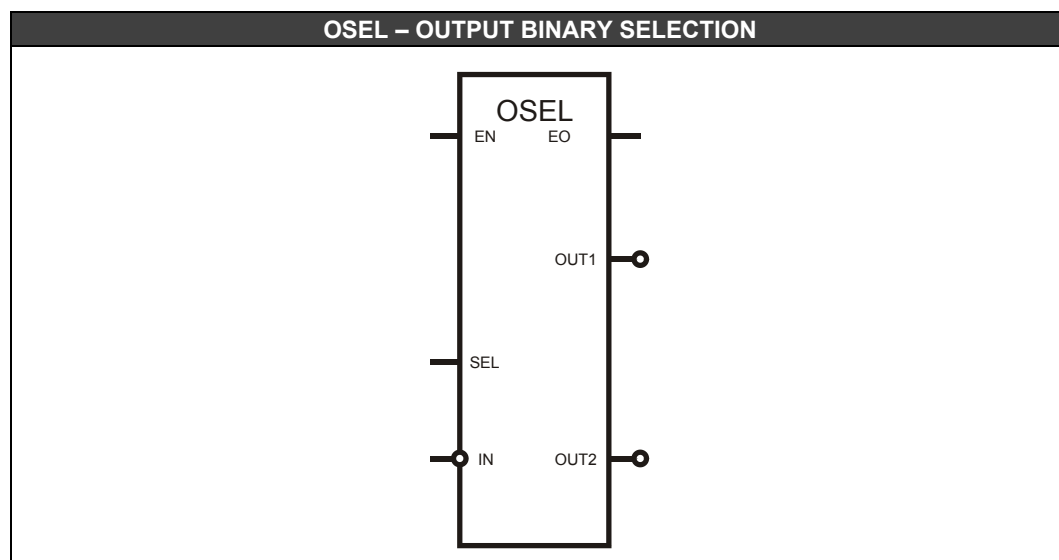
Prm2 = false: keep the last value of the **OUT2** output.

If the **OUT2** output is selected, the **Prm1** parameter defines the desired value to the **OUT1** output, as follows:

Prm1 = true: sends zero to the **OUT1** output.

Prm1 = false: keep the last value of the **OUT1** output.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	OUTPUT SELECTION	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT1	OUTPUT 1	FLOAT
	OUT2	OUTPUT 2	FLOAT
P	Prm1	VALUE SELECTION FOR OUT1 NOT SELECTED	BOOL
	Prm2	VALUE SELECTION FOR OUT2 NOT SELECTED	BOOL

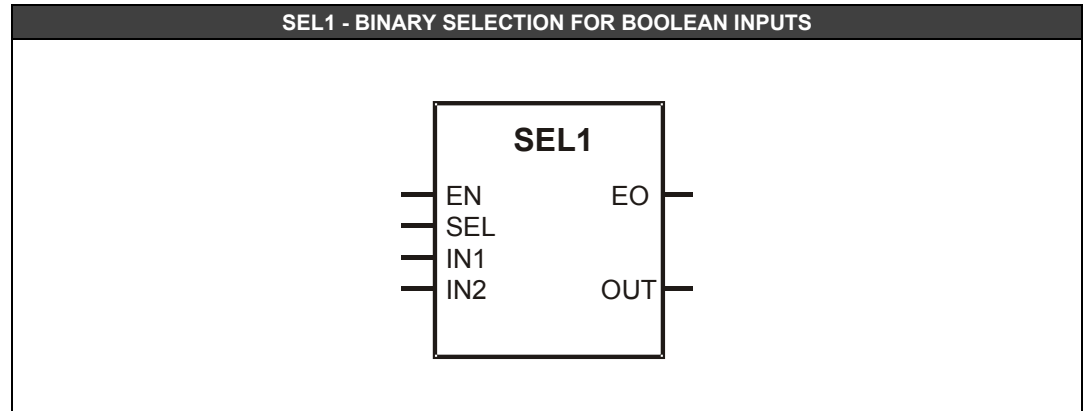
I: Input. P: Parameter. O: Output

Binary Selection for Boolean Inputs (SEL1)

Description

When **EN** is true, this FB is used to select between two inputs **IN1** and **IN2** and it will redirect them to the **OUT** output. The **SEL** input works as a selection switch. If **SEL** is false, **IN1** will be sent to **OUT**. Otherwise, **IN2** will be sent to the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	INPUT SELECTION	BOOL
	IN1	INPUT VALUE	BOOL
	IN2	INPUT VALUE	BOOL
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT VALUE	BOOL

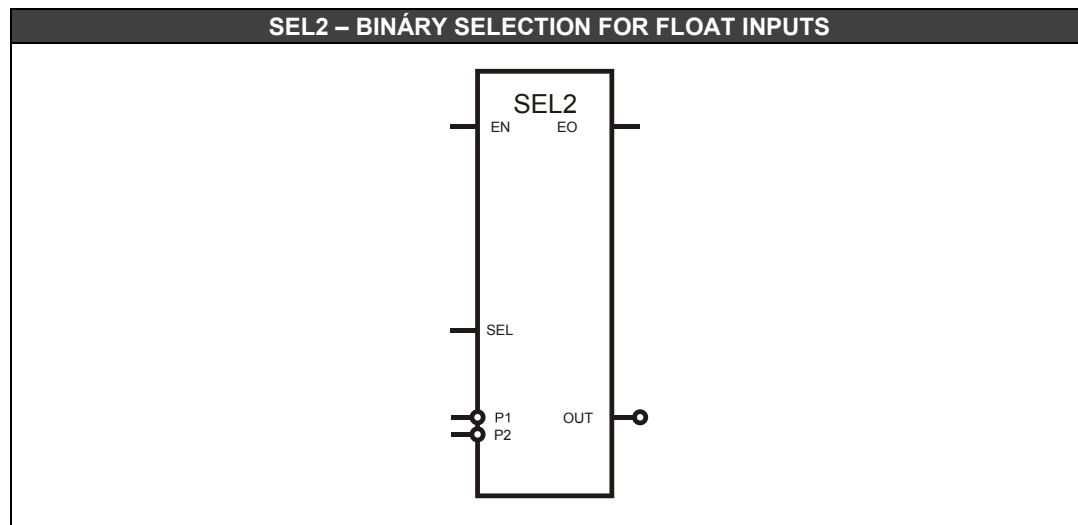
I: Input. **P:** Parameter. **O:** Output

Binary Selection for Float Inputs (SEL2)

Description

This function, when **EN** is true, is used to select between two inputs **P1** e **P2** and it will redirect them to the **OUT** output. The **SEL** input works as a selection switch. If **SEL** is false, **P1** will be sent to **OUT**. Otherwise, **P2** will be sent to the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEL	INPUT SELECTION	BOOL
	P1	INPUT 1	FLOAT
	P2	INPUT 2	FLOAT
O	EO	OUTPUT SELECTION	BOOL
	OUT	BLOCK OUTPUT	FLOAT

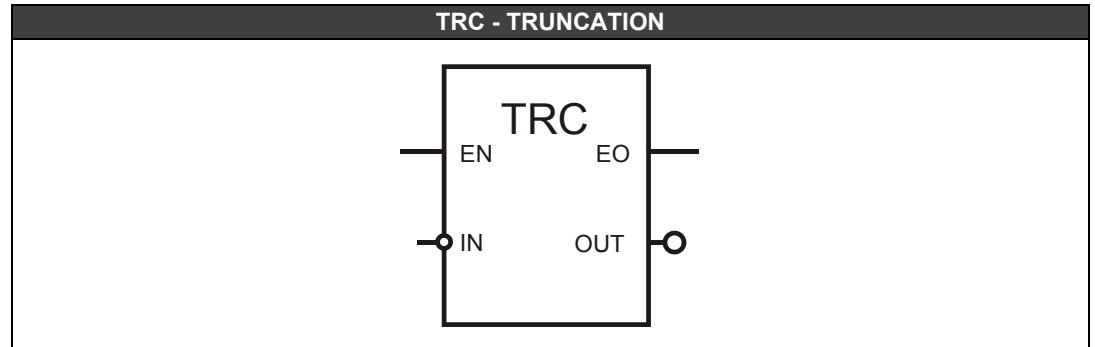
I: Input. P: Parameter. O: Output

Truncation (TRC)

Description

This function, when **EN** is true, truncates a real number and the output will have only the integer part of the input number.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	FLOAT

I: Input. P: Parameter. O: Output

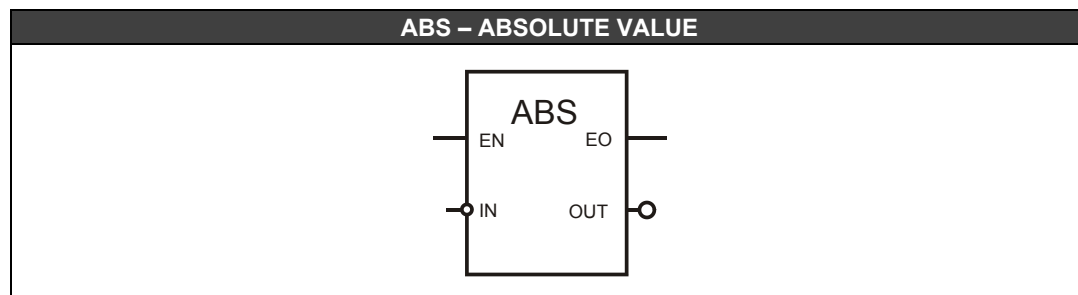
Mathematical Functions

Absolute Value (ABS)

This function, when **EN** is true, finds the absolute value of the **IN** input and places the result in the **OUT** output.

For example, if the **IN** input is -0.78987 the **OUT** output will be 0.78987 .

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	BLOCK INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	BLOCK OUTPUT. ABSOLUTE VALUE OF INPUT.	FLOAT

I: Input. P: Parameter. O: Output

Addition (ADD)

Description

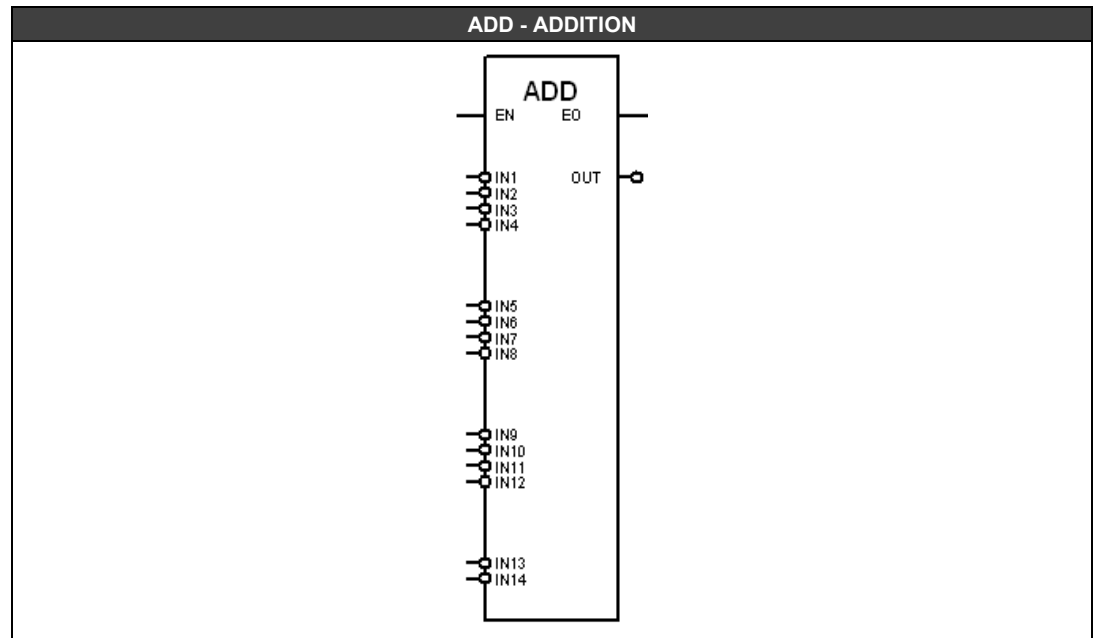
When **EN** is true, this function adds the values of the used inputs and places the result in the **OUT** output.

The inputs that will be used are defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs). For example:

N_IN = 5

The **OUT** output will be **IN1 + IN2 + IN3 + IN4 + IN5**

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT VALUE	FLOAT
P	N_IN	NUMBER OF INPUTS	LONG

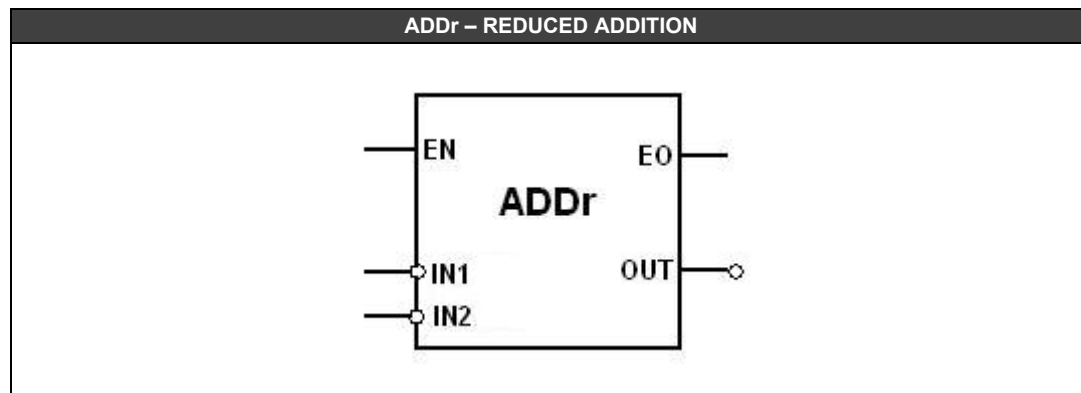
I: Input. P: Parameter. O: Output

Reduced Addition (ADDr)

Description

When **EN** is true, this function adds the values of the **IN1** and **IN2** inputs and places the result in the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT VALUE	FLOAT

I: Input. P: Parameter. O: Output

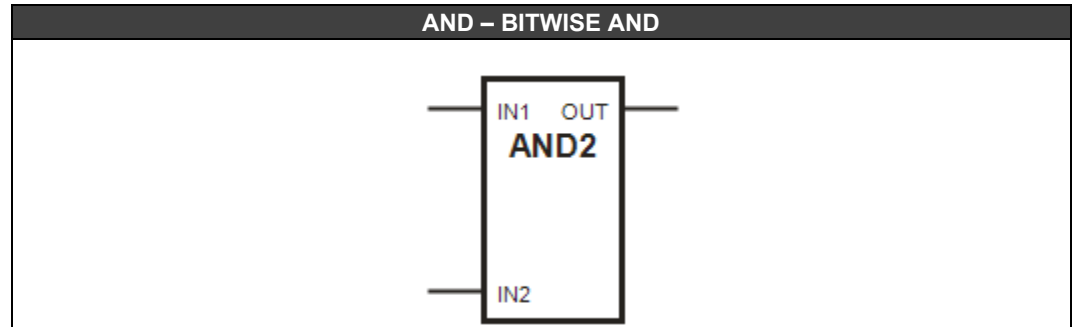
Bitwise AND of 2 to 8 inputs (AND2-AND8)

Description

This function performs the bitwise AND for the inputs **IN1** and **IN2** up to **IN8** and places the result in the **OUT** output.

Truth table:

If IN1 up to INn is equal to 1, OUT output will be equal to 1, otherwise will be 0.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN1	INPUT 1	BOOL
	INn	INPUT n	BOOL
O	OUT	OUTPUT VALUE	BOOL

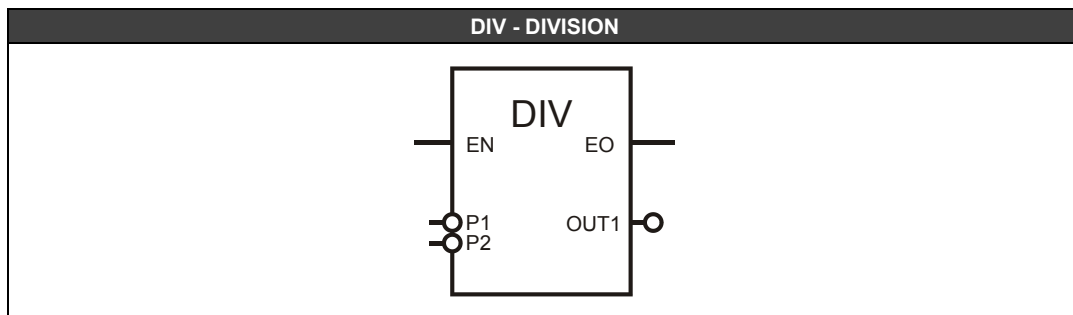
I: Input. P: Parameter. O: Output

Division (DIV)

Description

When **EN** input is true, this function divides **P1** by **P2**, and places the result in the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	P1	DIVIDEND INPUT	FLOAT
	P2	DIVISOR INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	DIVISION RESULT	FLOAT

I: Input. P: Parameter. O: Output

Modulus (MDL)

Description

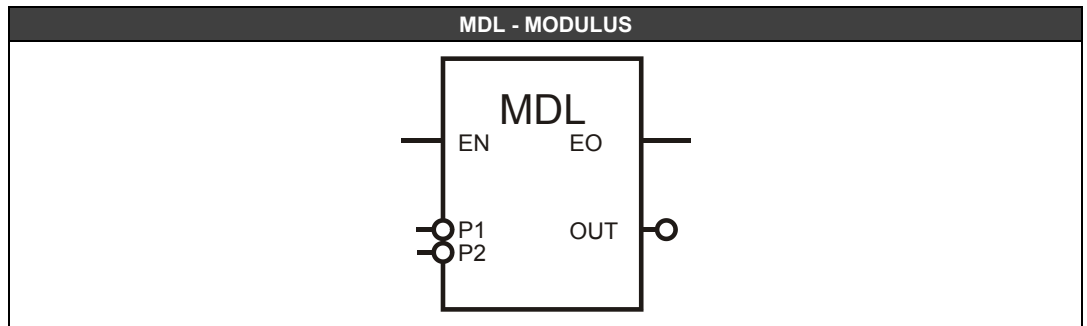
When the **EN** input is true, this FB takes the rest of the division of **P1** by **P2** and places the result in the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).

Operation

For example: P1= 25 and P2= 7, the **OUT** output will be 4 because:

$$\begin{array}{r} 25 \quad | \quad 7 \\ 4 \leftarrow 3 \end{array}$$



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	P1	DIVIDEND INPUT	FLOAT
	P2	DIVISOR INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	REST OF DIVISION	FLOAT

I: Input. **P:** Parameter. **O:** Output

Multiplication (MUL)

Description

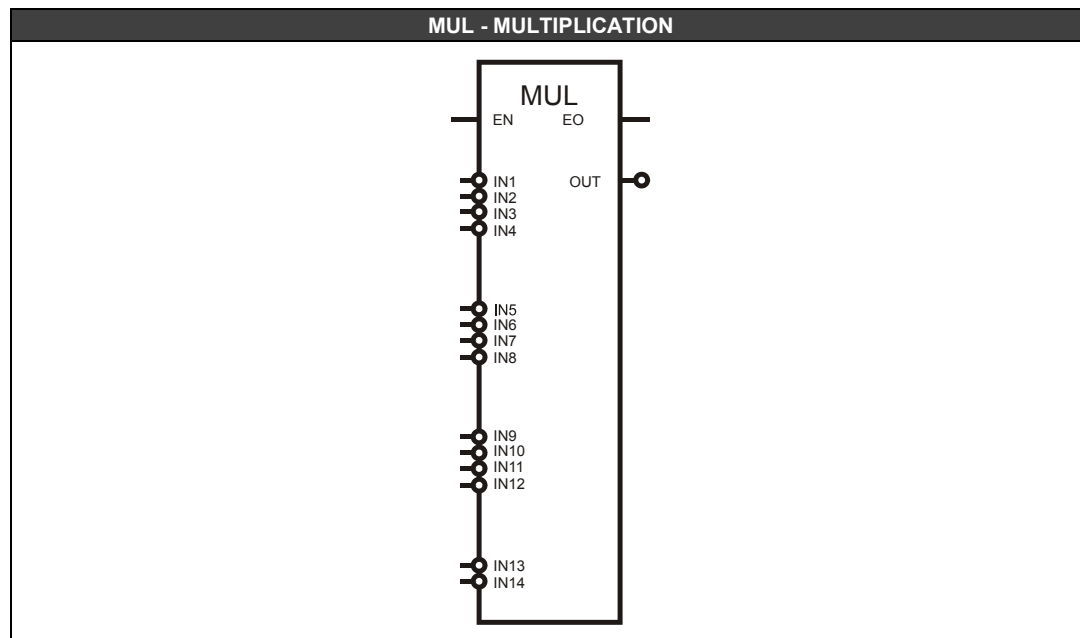
When **EN** input is true, this function multiplies the values of the used inputs and places the result in the **OUT** output.

The inputs that will be used are defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs). For example:

N_IN = 5

The **OUT** output will be $IN1 * IN2 * IN3 * IN4 * IN5$

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	MULTIPLICATION RESULT	FLOAT
P	N_IN	NUMBER OF INPUTS	LONG

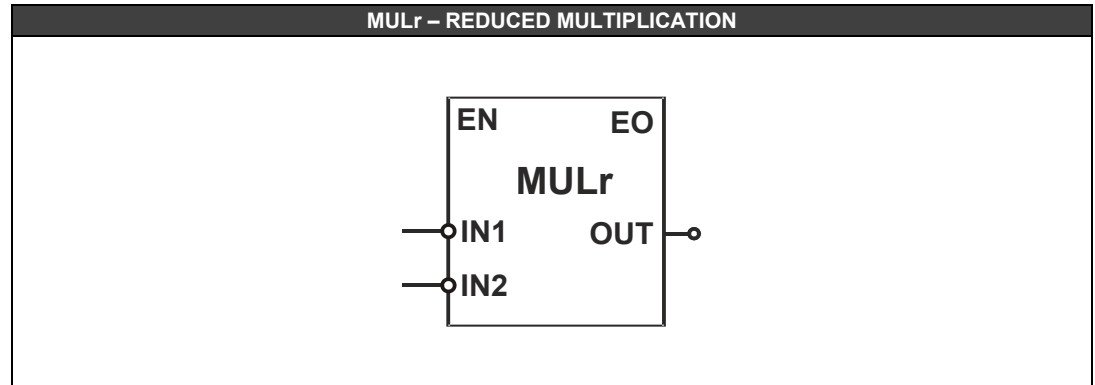
I: Input. P: Parameter. O: Output

Reduced Multiplication (MULr)

Description

When **EN** input is true, this function multiplies the values of the **IN1** and **IN2** inputs and places the result in the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).



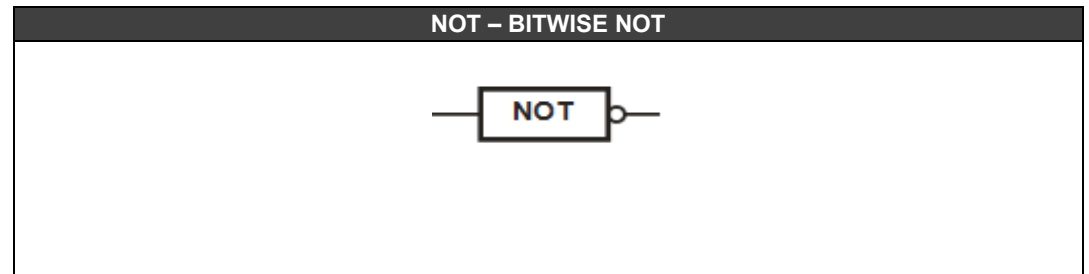
CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	MULTIPLICATION RESULT	FLOAT

I: Input. P: Parameter. O: Output

Bitwise NOT (NOT)

Description

This function inverts the logic state of the Boolean data in the IN input. If the input is “true”, i.e., logic level “1”, the NOT block output will be “false” (logic level “0”) and vice versa.



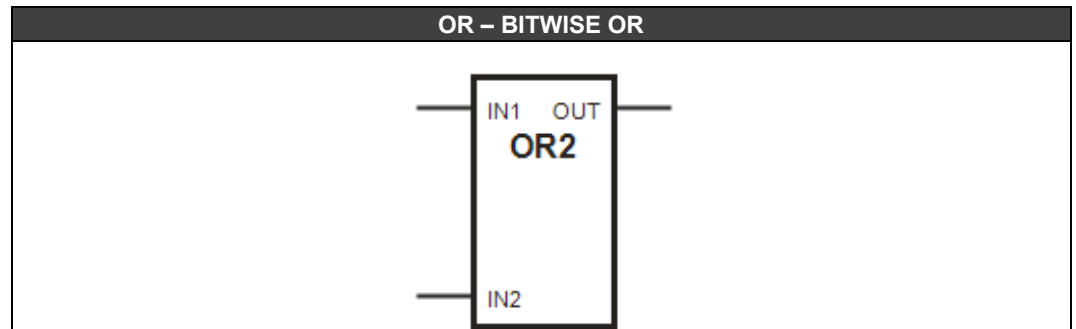
Bitwise OR of 2 to 8 inputs (OR2-OR8)

Description

This function performs the bitwise **OR** for the inputs **IN1** and **IN2** up to **IN8** and places the result in the **OUT** output.

Truth table:

If IN1 up to INn is equal to 0, OUT output will be equal to 0, otherwise will be 1.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN1	INPUT 1	BOOL
	INn	INPUT n	BOOL
O	OUT	OUTPUT VALUE	BOOL

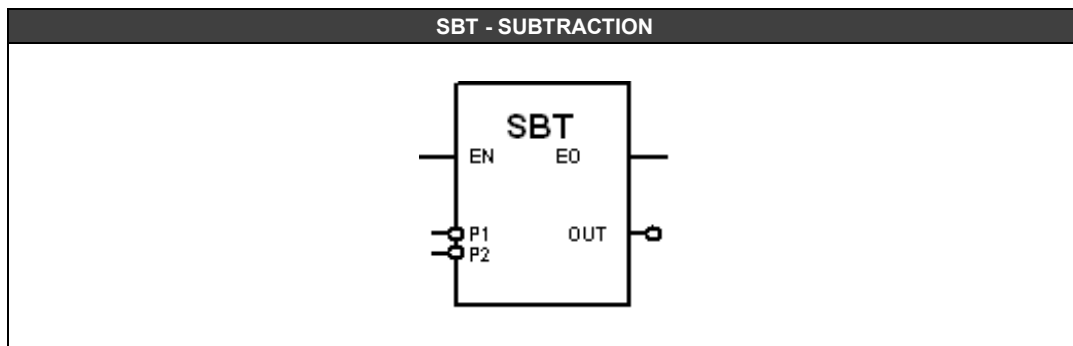
I: Input. P: Parameter. O: Output

Subtraction (SBT)

Description

When **EN** input is true, this function subtracts **P1** from **P2** and places the result in the **OUT** output.

If the **EN** input is false, all outputs are held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	P1	FIRST ELEMENT OF SUBTRACTION	FLOAT
	P2	SECOND ELEMENT OF SUBTRACTION	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	SUBTRACTION RESULT	FLOAT

I: Input. P: Parameter. O: Output

Square Root (SQR)

Description

This function, when **EN** is true, will calculate the square root of the **IN** input and places the result in the **OUT** output. If the **IN** input is negative, the result is zero and **EO** output goes to false.

Selecting the data type

The input and output data type (Regular or Percentage) is selected by the **Prm1** parameter.

If the option is Regular (**Prm1** = false), the block calculates the input square root.

If the option is Percentage (**Prm1** = true), the block has two sub-options:

- **PERC** parameter = false:

$$OUT = 10 * \sqrt{IN}$$

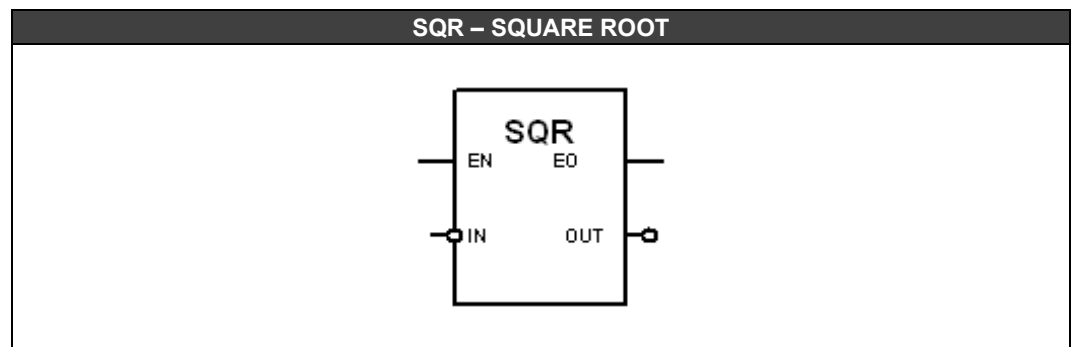
- **PERC** parameter = true:

$$OUT = 100 * \sqrt{IN}$$

Leveling

If the **IN** input value is less than the specified value in the **CTO** parameter, the **OUT** output will be zero. If a negative value was specified in **CTO**, it will be assumed the value is zero.

If the **EN** input is false, the output is held in zero (false).



I: Input. P: Parameter. O: Output

CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	BLOCK OUTPUT	FLOAT
P	Prm1	INPUT AND OUTPUT DATA TYPE (REGULAR OR PERCENTAGE)	BOOL
	PERC	SELECTS THE CALCULATION METHOD TO THE PERCENTAGE INPUT	BOOL
	CTO	CUT-OFF	FLOAT

Comparison Functions

Quad Alarm (AI-Seta)

Description

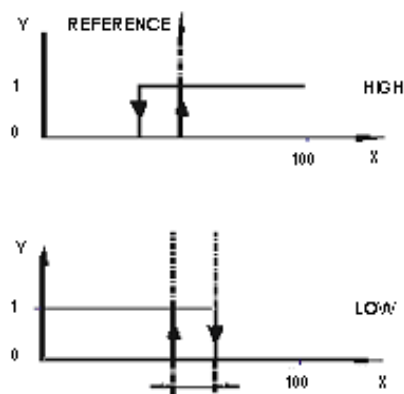
This function, when **EN** is true, works as a quad alarm, that is, it compares an input signal at **IN** with four reference values: **LL**, **L**, **H** and **HH**.

The variable that will be compared is connected to **IN** input and the reference signal in the **LL**, **L**, **H** and **HH** inputs are added to the values of **AGL**, **AGLL**, **AGH** and **AGHH** internal parameters, respectively. These comparisons will trigger the **LLow**, **Low**, **High** and **HHigh** outputs if they are smaller, smaller, bigger and bigger, respectively.

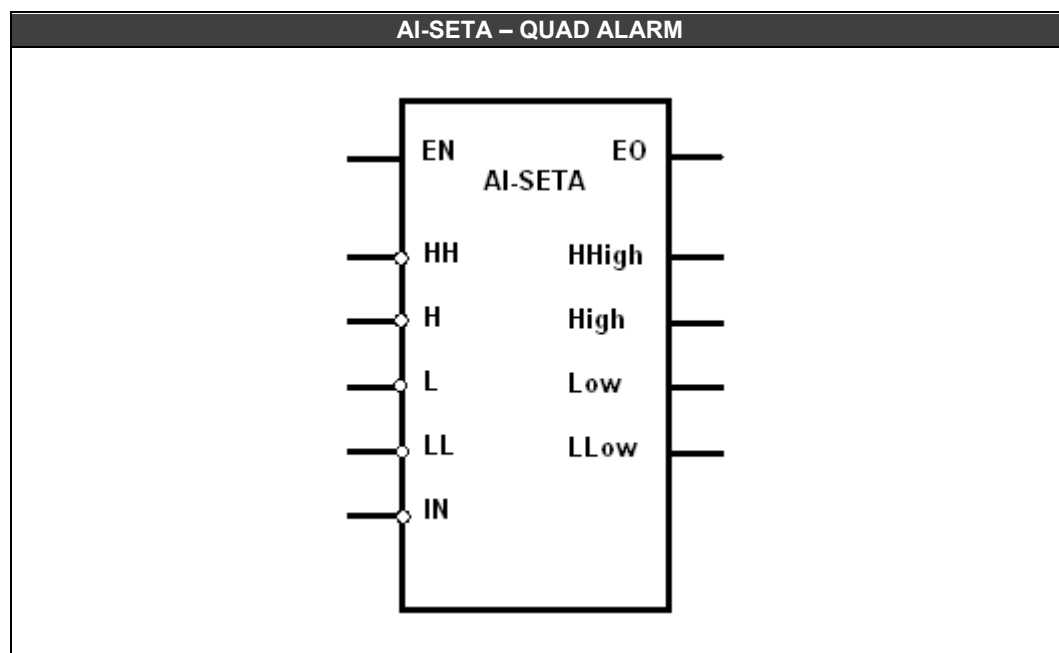
The **State** internal parameter indicates if the outputs are normal in 0 and in alarm in 1, or vice versa.

To avoid oscillation of the output signal when the variable is very close to the reference, a hysteresis value can be set by the **DBL**, **DBLL**, **DBH** and **DBHH** parameters.

The block works according to the following figure:



Alarm with hysteresis



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT	FLOAT
	LL	REFERENCE FOR LOW LOW ALARM	FLOAT
	L	REFERENCE FOR LOW ALARM	FLOAT
	H	REFERENCE FOR HIGH ALARM	FLOAT
	HH	REFERENCE FOR HIGH HIGH ALARM	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	LLow	LOW LOW ALARM OUTPUT	BOOL
	Low	LOW ALARM OUTPUT	BOOL
	High	HIGH ALARM OUTPUT	BOOL
	HHigh	HIGH HIGH ALARM OUTPUT	BOOL
P	STATE	STATE OF ALARM TRIGGER	LONG
	DBLL	HYSTERESIS OF LL ALARM	FLOAT
	AGLL	VALUE ADDED TO THE REFERENCE TO CALCULATE THE LL ALARM	FLOAT
	DBL	HYSTERESIS OF L ALARM	FLOAT
	AGL	VALUE ADDED TO THE REFERENCE TO CALCULATE THE L ALARM	FLOAT
	DBH	HYSTERESIS OF H ALARM	FLOAT
	AGH	VALUE ADDED TO THE REFERENCE TO CALCULATE THE H ALARM	FLOAT
	DBHH	HYSTERESIS OF HH ALARM	FLOAT
	AGHH	VALUE ADDED TO THE REFERENCE TO CALCULATE THE HH ALARM	FLOAT

I: Input. P: Parameter. O: Output

Double Alarm (ALM)

Description

This function, when **EN** is true, works as a double alarm, that is, it has two independent alarm comparators.

In the first comparator, the compared variable is connected to the **IN1** input, and the reference signal in the **REF1** input is added to internal parameter value **ARG1**. The second comparator is equal to the first, that is, the **IN2** and **REF2** inputs are used as the same way as **IN1**, **REF1** and **ARG1**.

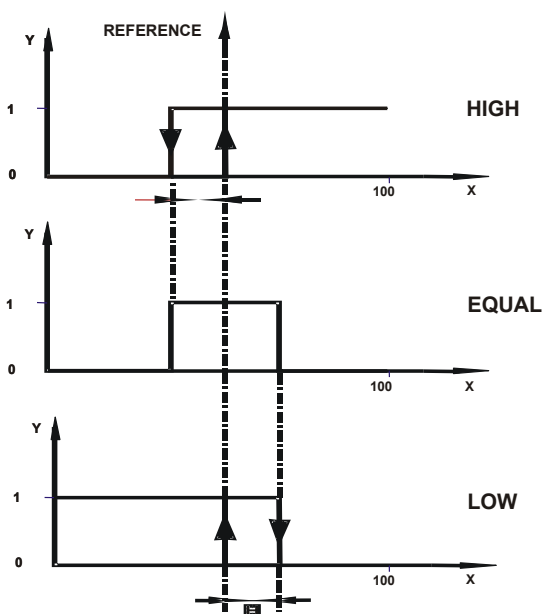
Each comparator can be configured independently to generate alarm's output according to these options:

- Variable \leq Reference \rightarrow Low Alarm
- Variable \geq Reference \rightarrow High Alarm
- Variable = Reference \rightarrow Equality Alarm

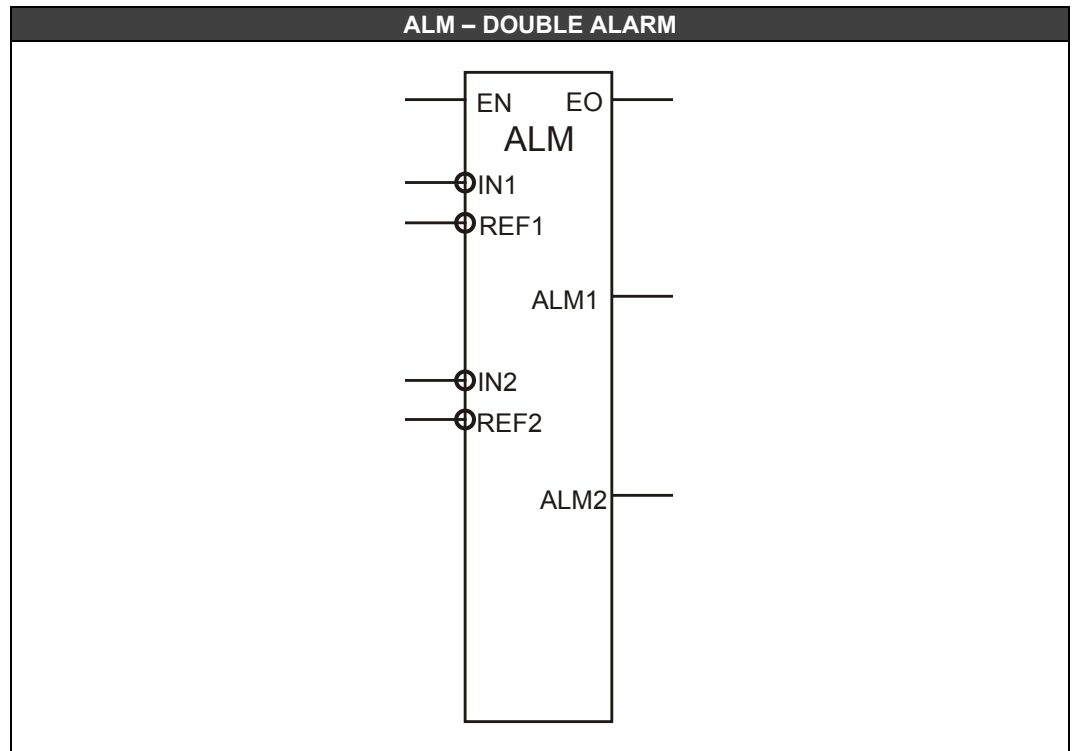
The reference is the sum of **REF1** input (or **REF2**) with the **ARG1** parameter value (or **ARG2**).

To avoid output signal oscillation when the variable is very close to the reference, a hysteresis value can be adjusted through **DBN1** parameter (or **DBN2**).

The block works as follows:



Alarm Action with Hysteresis



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT FOR ALARM1	FLOAT
	REF1	REFERÊCE FOR ALARM1	FLOAT
	IN2	INPUT FOR ALARM2	FLOAT
	REF2	REFERÊCE FOR ALARM2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	ALM1	OUTPUT ALARM1	BOOL
	ALM2	OUTPUT ALARM2	BOOL
P	TYPE1	ALARM1 TYPE	LONG
	DBN1	ALARM1 HYSTERESIS	FLOAT
	ARG1	VALUE ADDED TO REFERENCE TO CALCULATE ALARM1	FLOAT
	TYPE2	ALARM2 TYPE	LONG
	DBN2	ALARM2 HYSTERESIS	FLOAT
	ARG2	VALUE ADDED TO REFERENCE TO CALCULATE ALARM2	FLOAT

I: Input. P: Parameter. O: Output

Inequality (DIF)

Description

When **EN** input is true, this function holds the **OUT** output in true if **IN1 – IN2** is greater than **DBN** (Dead Zone). Otherwise, the **OUT** output is held in false.

The **DBN** parameter is configured by the user.

If the **EN** input is false, the output is held in zero (false).

Example:

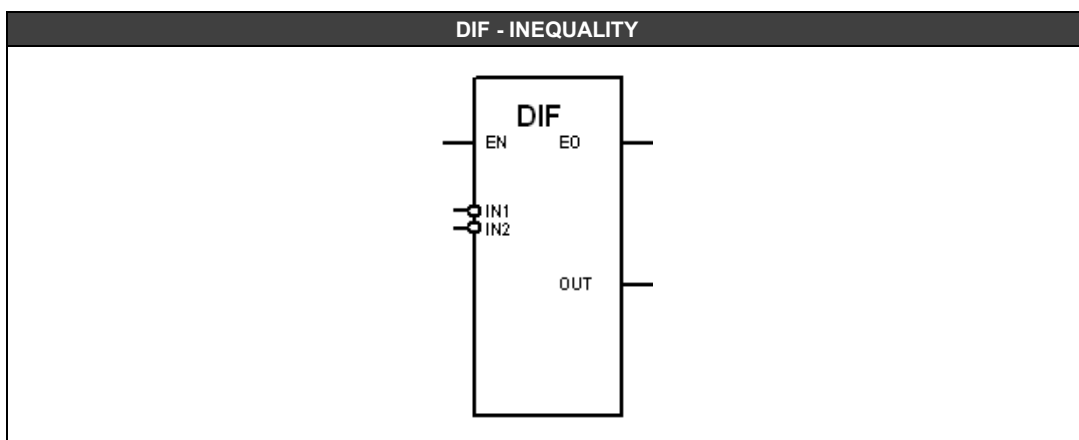
IN1= 0.78

IN2= 0.70

IN1 - IN2=0.08

DBN= 0.05

In this case the **OUT** output is true, because the configured value for **DBN** (0.05) indicates, in the example above, **IN1** is different from **IN2**.



CLASS	MNEM	DESCRIPTION	TYPE
I	IN	OUTPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL
P	DBN	DEAD ZONE	FLOAT

I: Input. P: Parameter. O: Output

Equality (EQ)

Description

This function, when **EN** is true, holds the **OUT** output in true if the input values do not have a deviation greater than the Dead Zone (**DBN**) of the **IN1** input. Otherwise, if the input values are different, the **OUT** output is held in false.

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

The EQ block is indicated when the user desires to compare variables in terms of equality. The **DBN** parameter is a tool to determine how close each one of these measurements needs to be for they are considered equal.

DBN Parameter and Operation

In case of only two inputs are used (**IN1** and **IN2**) this function block performs as an equal-with-dead-zone comparison, so the **OUT** output will be true only if $ABS(IN1-IN2) \leq DBN$

For example: We have 3 inputs (**N_IN** = 3), **DBN** is equal to 10, and **IN1**= 12, **IN2**=21 and **IN3**= 5.

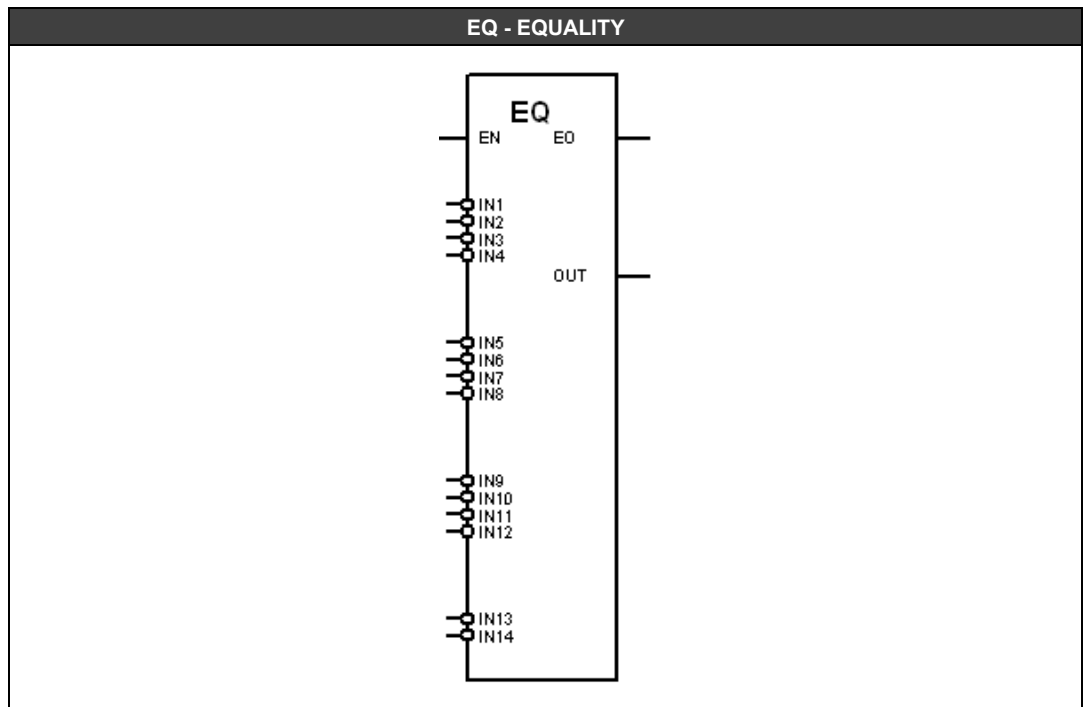
So,

$$ABS(IN1-IN2) = 9 < 10$$

$$ABS(IN1-IN3) = 7 < 10$$

Thus, as **DBN** = 10, **OUT** is equal to true.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL
P	N_IN	NUMBER OF INPUTS	LONG

I: Input. P: Parameter. O: Output

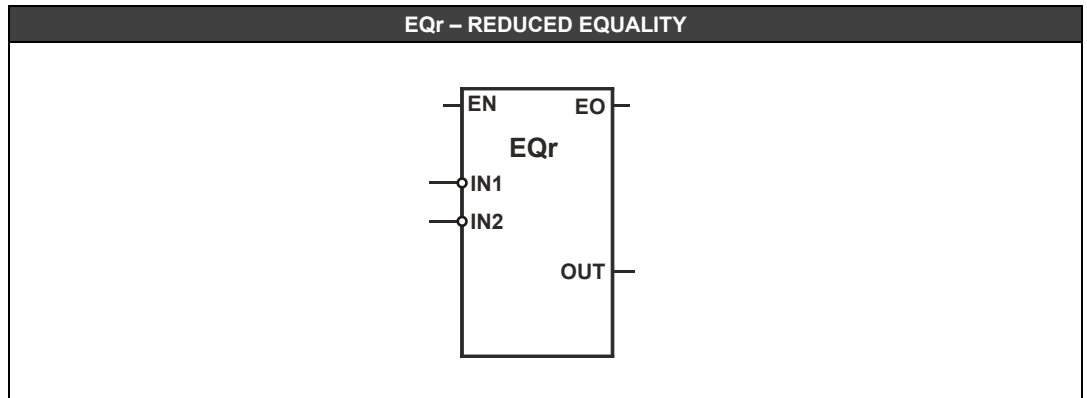
Reduced Equality (EQr)

Description

This function, when **EN** is true, holds the **OUT** output in true if the input values do not have a deviation greater than the Dead Zone (**DBN**) of the **IN1** input. Otherwise, if the input values are different, the **OUT** output is held in false.

The EQ block is indicated when the user desires to compare variables in terms of equality. The **DBN** parameter is a tool to determine how close each one of these measurements needs to be for they are considered equal.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL

I: Input. P: Parameter. O: Output

Decreasing Sequence (GT)

Description

When **EN** input is true, this function holds the **OUT** output in true if the input values (**IN1** to **INn**) are in a decreasing order, i.e.:

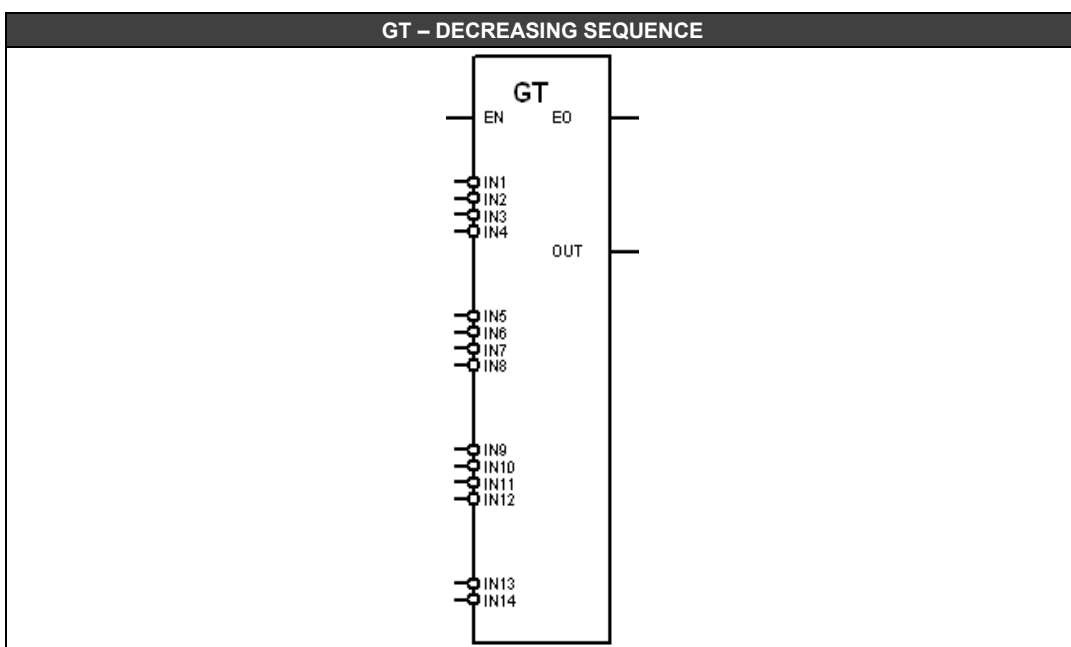
$$IN1 > IN2 > IN3 > IN4 \dots \dots \dots INn-1 > INn.$$

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

In case of only two inputs are used (**IN1** and **IN2**) this function block performs as a comparison greater than, and **OUT** output becomes true if **IN1 > IN2**.

If the **EN** input is false, the output is held in zero (false).

It is possible to use this expression to implement conditional blocks that compare two inputs and then make a decision (the output state changes to 1 and enables another block).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL
P	N_IN	NUMBER OF INPUTS	LONG

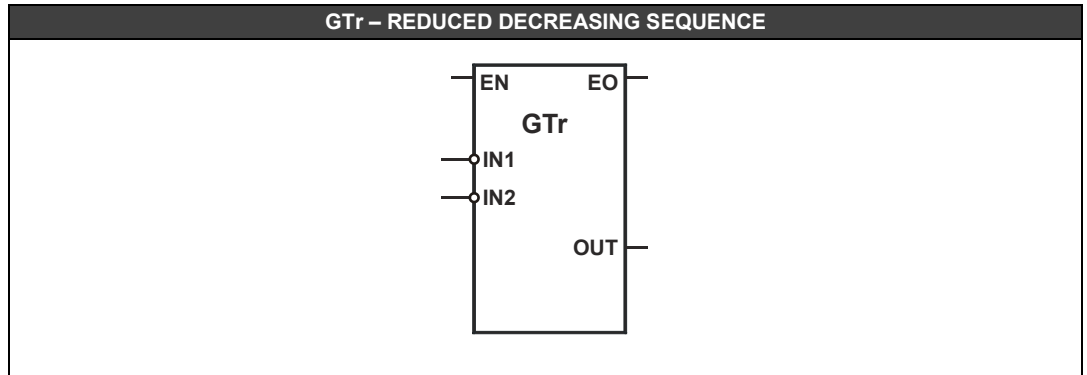
I: Input. **P:** Parameter. **O:** Output

Reduced Decreasing Sequence (GTr)

Description

When **EN** input is true, this function block performs as a comparison greater than, and **OUT** output becomes true if **IN1**>**IN2**.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL

I: Input. P: Parameter. O: Output

Decreasing Monotonic Sequence (GTE)

Description

When **EN** input is true, this function holds the **OUT** output in true if the input values (**IN1** to **INn**) are disposed in a decreasing monotonic sequence.

A decreasing monotonic sequence is a sequence of numbers that two adjacent elements are related by $IN_{n-1} \geq IN_n$, i.e.:

IN1, IN2, IN3.....INn-2, INn-1, INn

Where:

IN1 \geq IN2

IN2 \geq IN3

...

INn-2 \geq INn-1

INn-1 \geq INn

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

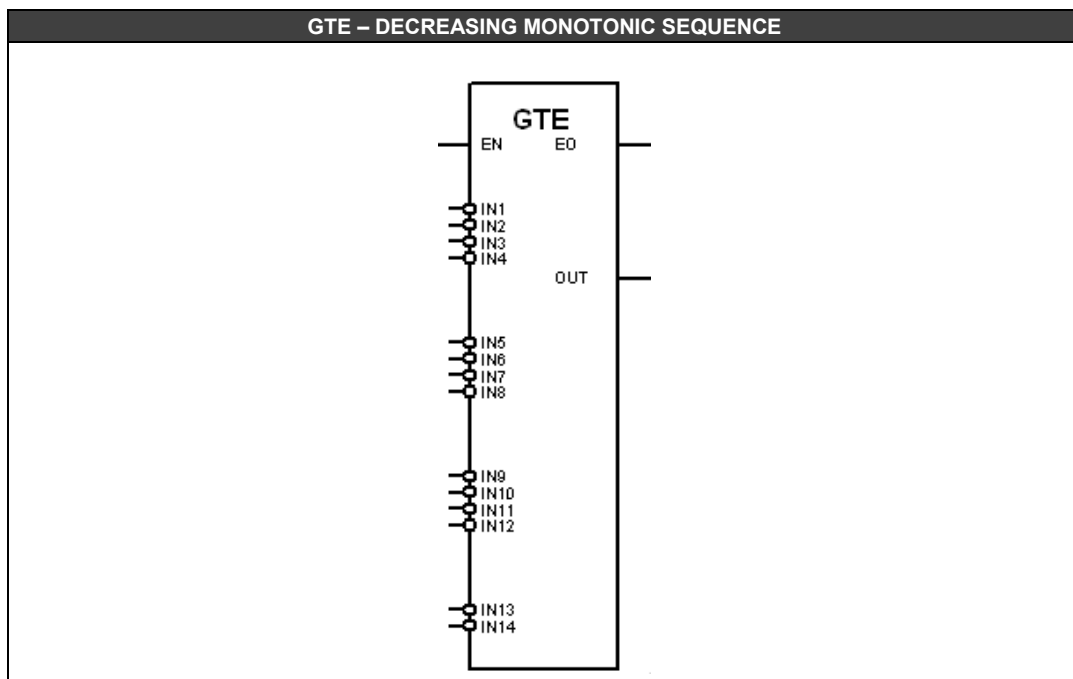
Operation

An example of decreasing monotonic sequence is: **12, 8, 8, 5, 3, and 1**.

In case of only two inputs are used (**IN1** e **IN2**), this function block performs as a comparison of greater-or-equal to, and the **OUT** output becomes true if **IN1 \geq IN2**.

If the **EN** input is false, the output is held in zero (false).

It is possible to use this expression to implement conditional blocks that compare two inputs and then make a decision (the output state changes to 1 and enables another block).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL
P	N_IN	NUMBER OF INPUTS	LONG

I: Input. P: Parameter. O: Output

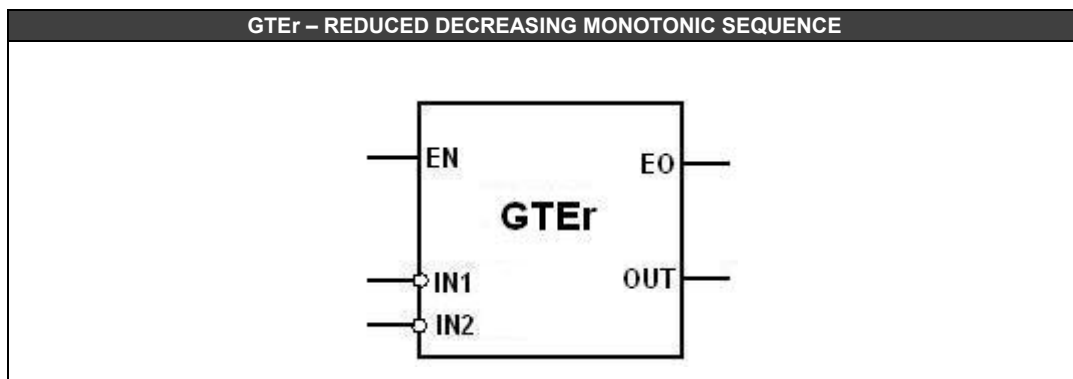
Reduced Decreasing Monotonic Sequence (GTEr)

Description

When **EN** input is true, this function block performs as a comparison of greater-or-equal to, and the **OUT** output becomes true if $IN1 \geq IN2$.

If the **EN** input is false, the output is held in zero (false).

It is possible to use this expression to implement conditional blocks that compare two inputs and then make a decision (the output state changes to 1 and enables another block).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL

I: Input. P: Parameter. O: Output

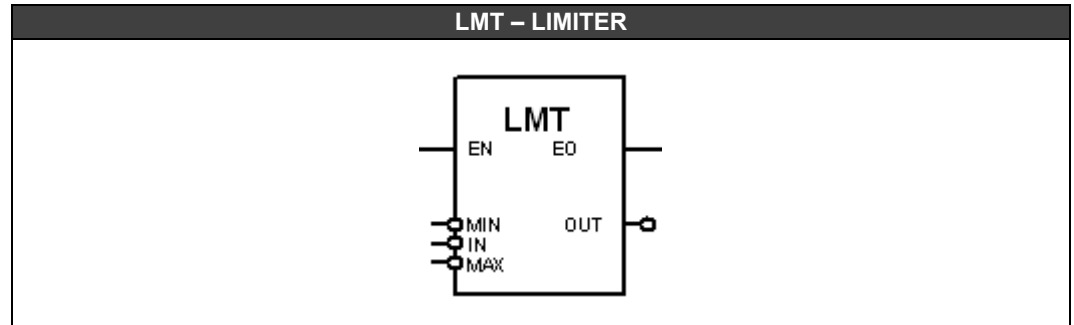
Limiter (LMT)

Description

This function, when **EN** input is true, limits the **IN** input between the **MIN** and **MAX** input values and places the result in the **OUT** output.

Suppose the user desires to limit a signal input between 1 and 10. In this case the user has to configure the **MIN** input with the value 1 and the **MAX** input with the value 10. The signal that will be limited has to be connected in the **IN** input. When the upper limit is exceeded the **OUT** output is equal to 10 and when the bottom limit is reached the **OUT** output is 1.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	MIN	LIMITER MINIMUM LIMIT	FLOAT
	IN	INPUT THAT WILL BE LIMITED	FLOAT
O	MAX	LIMITER MAXIMUM LIMIT	FLOAT
	EO	OUTPUT ENABLED	BOOL
	OUT	LIMITED BLOCK OUTPUT	FLOAT

I: Input. P: Parameter. O: Output

Increasing Sequence (LT)

Description

When **EN** input is true, this function holds the **OUT** output in true if the input values (**IN1** to **INn**) are in an increasing order, i.e.

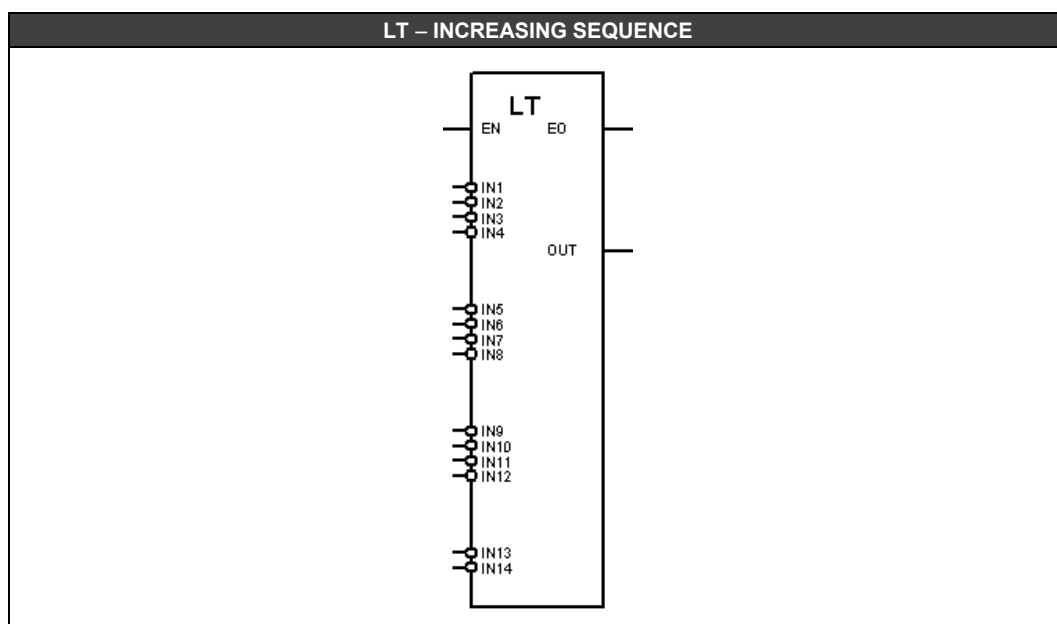
$$IN1 < IN2 < IN3 < IN4 \dots \dots \dots IN_{n-1} < IN_n.$$

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

In case of only two inputs are used (**IN1** and **IN2**) this function block performs as a comparison less than, and **OUT** output becomes true if **IN1 < IN2**.

If the **EN** input is false, the output is held in zero (false).

It is possible to use this expression to implement conditional blocks that compare two inputs and then make a decision (the output state changes to 1 and enables another block).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	OUTPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL
P	N_IN	NUMBER OF INPUTS	LONG

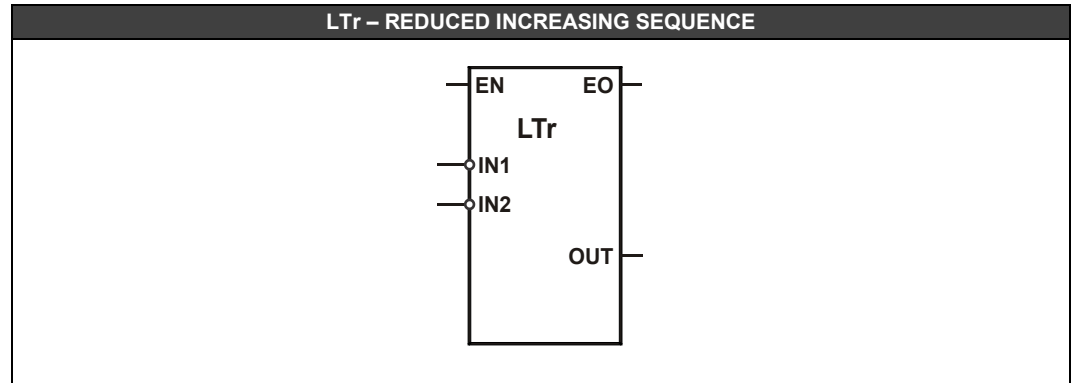
I: Input. P: Parameter. O: Output

Reduced Increasing Sequence (LTr)

Description

When **EN** input is true, this function block performs as a comparison less than, and **OUT** output becomes true if **IN1**<**IN2**.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	OUTPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL

I: Input. P: Parameter. O: Output

Increasing Monotonic Sequence (LTE)

Description

When **EN** input is true, this function holds the **OUT** output in true if the input values (**IN1** to **INn**) are in an increasing monotonic order.

An increasing monotonic sequence is a sequence of numbers that two adjacent elements are related by $IN_{n-1} \leq IN_n$, i.e.:

IN1, IN2, IN3,.....,INn-2, INn-1, INn

Where:

IN1 \leq IN2

IN2 \leq IN3

...

INn-2 \leq INn-1

INn-1 \leq INn

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

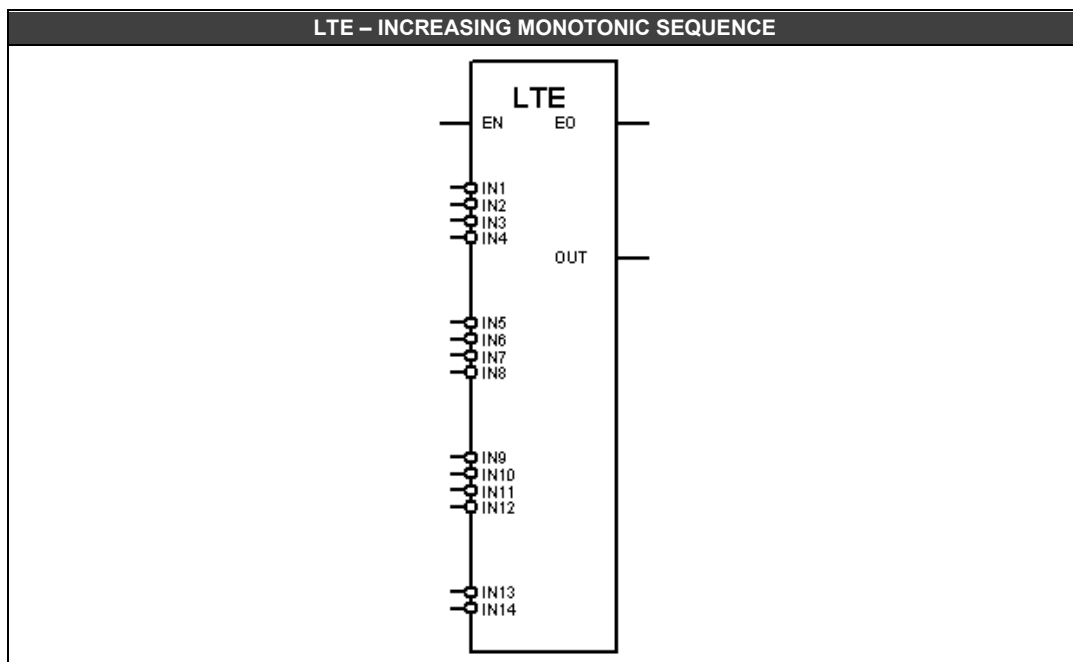
Operation

An example of increasing monotonic sequence is: **1,1,3,3,4,5,6,7,8,7,8**

In case of only two inputs are used (**IN1** e **IN2**), this function block performs as a comparison of less-or-equal to, and the **OUT** output becomes true if **IN1 \leq IN2**.

If the **EN** input is false, the output is held in zero (false).

It is possible to use this expression to implement conditional blocks that compare two inputs and then make a decision (the output state changes to 1 and enables another block).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL
P	N_IN	NUMBER OF INPUTS	LONG

I: Input. P: Parameter. O: Output

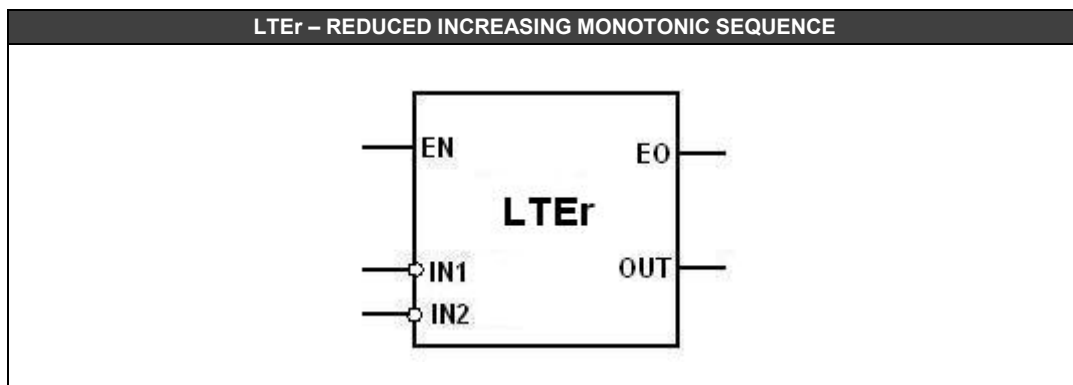
Reduced Increasing Monotonic Sequence (LTER)

Description

When **EN** input is true, this function block performs as a comparison of less-or-equal to, and the **OUT** output becomes true if $IN1 \leq IN2$.

If the **EN** input is false, the output is held in zero (false).

It is possible to use this expression to implement conditional blocks that compare two inputs and then make a decision (the output state changes to 1 and enables another block).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	LOGIC COMPARISON RESULT	BOOL

I: Input. **P:** Parameter. **O:** Output

Maximum (MAX)

Description

This function, when **EN** is true, selects the maximum value of the used inputs (**IN1** to **INn**) and places it in the **OUT** output.

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

Operation

Suppose we have 4 inputs and their values are:

IN1 = 5.899

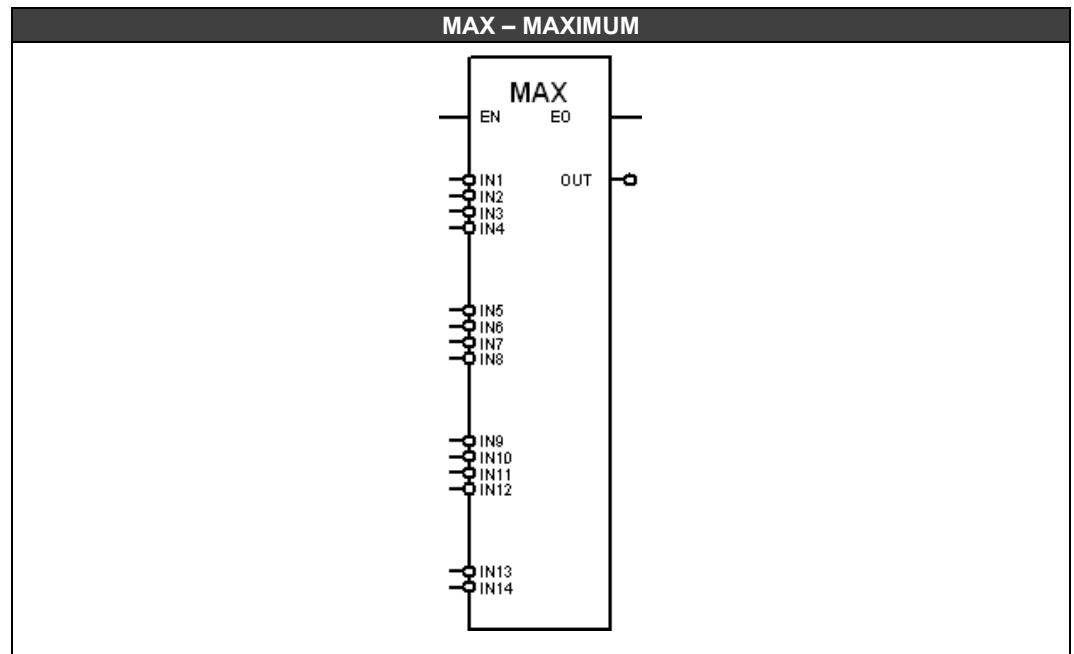
IN2 = 7.9000

IN3 = 10.899

IN4 = 23.90

The output generated by the MAX function block will be **IN4** or 23.90.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	
	
	IN13	INPUT 13	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	MAXIMUM INPUT VALUE	FLOAT

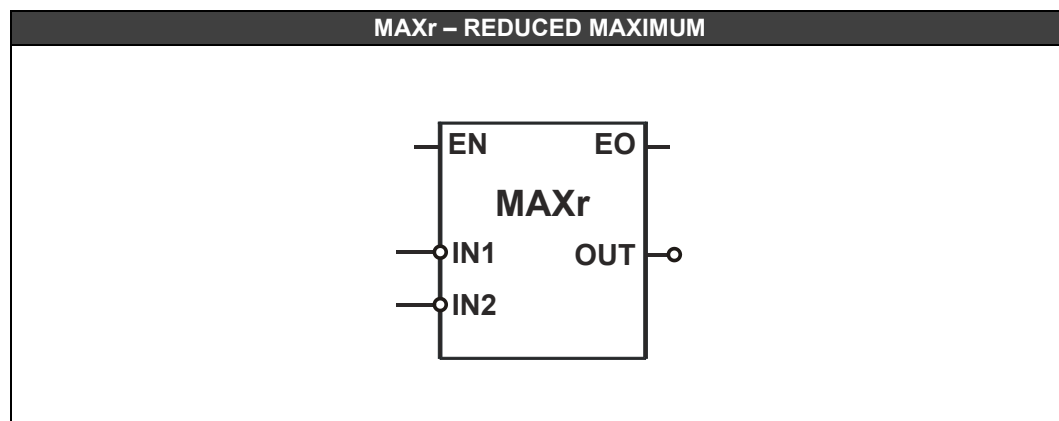
I: Input. P: Parameter. O: Output

Reduced Maximum (MAXr)

Description

This function, when **EN** is true, selects the maximum value of the **IN1** and **IN2** inputs and places it in the **OUT** output.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	MAXIMUM INPUT VALUE	FLOAT

I: Input. P: Parameter. O: Output

Minimum (MIN)

Description

This function, when **EN** is true, selects the minimum value of the used inputs (**IN1** to **INn**) and places it in the **OUT** output.

The number of block inputs is defined by the **N_IN** parameter (minimum of 2 and maximum of 14 inputs).

Operation

Suppose we have 4 inputs and their values are:

IN1 = 5,899

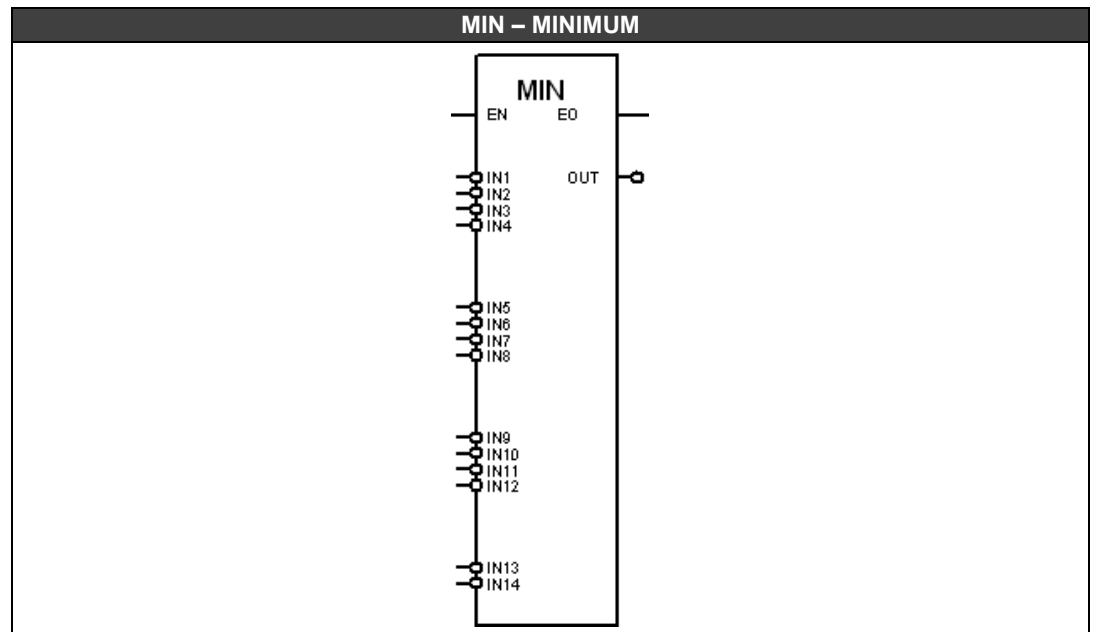
IN2 = 7.9000

IN3 = 10.899

IN4 = 23.90

The output generated by the MIN function block will be **IN1** or 5.899.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
	IN3	INPUT 3	FLOAT
	IN4	INPUT 4	FLOAT
	IN5	INPUT 5	FLOAT
	IN6	INPUT 6	FLOAT
	IN7	INPUT 7	FLOAT
	IN8	INPUT 8	FLOAT
	IN9	INPUT 9	FLOAT
	IN10	INPUT 10	FLOAT
	IN11	INPUT 11	FLOAT
	IN12	INPUT 12	FLOAT
	IN13	INPUT 13	FLOAT
IN14	INPUT 14	FLOAT	
O	EO	OUTPUT ENABLED	BOOL
	OUT	MINIMUM INPUT VALUE	FLOAT
P	N_IN	NUMBER OF INPUTS	LONG

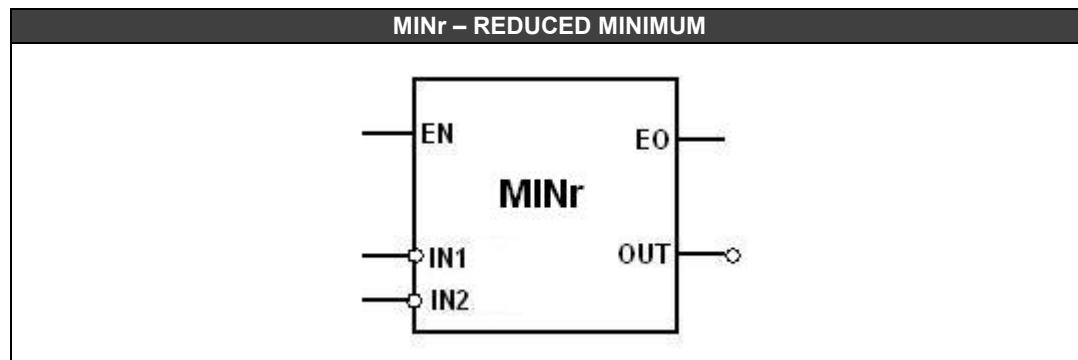
I: Input. P: Parameter. O: Output

Reduced Minimum (MINr)

Description

This function, when **EN** is true, selects the minimum value of the **IN1** and **IN2** inputs and places it in the **OUT** output.

If the **EN** input is false, the output is held in zero (false).



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN1	INPUT 1	FLOAT
	IN2	INPUT 2	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	MINIMUM INPUT VALUE	FLOAT

I: Input. P: Parameter. O: Output

Process Control Functions

Advanced PID (APID)

Description:

This function block, when **EN** is true does the PID controller. The acclaimed PID algorithm for continuous process control, associated with the configuration flexibility of the operation settings through parameterization, allows the utilization of this block to a variety of applications and control strategies.

This block supplies several options of algorithm settings having as a basis the Proportional (P), Integral (I) and Derivative (D) terms that may be applied in error or just to the process variable (PV). This block also supplies three outputs for alarms, one is for deviation alarm and two can be configured.

This block allows selection of the following control types: PI-Sampling, Quadratic Error, GAP and Adaptive Gain.

The user may set limits of anti-reset windup (only applied to the integral term). Besides, the user might choose the type of the PID algorithm: ISA or parallel, direct action or reverse, manual to automatic control transference, bumpless or hard.

PID type

It is defined by the **PID** parameter.

PID = 0: PI.D type.

PID = 1: PID type.

PID = 2: I.PD type.

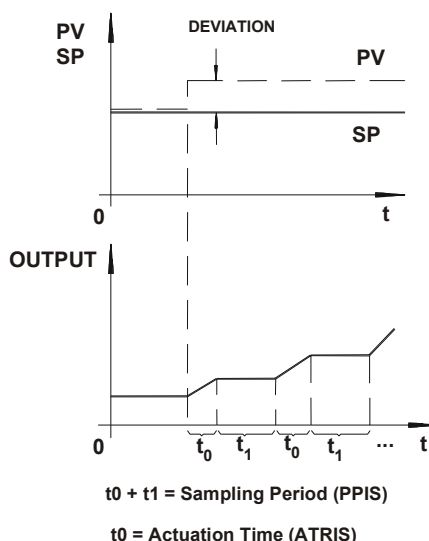
PID = 3: PI-SAMPLING type.

PI.D: **P** and **I** actions act over the error and the **D** action over the process variable. In this way, the output signal tracks set point changes according to the proportional and integral actions, but there is no undesired variation due to the derivative action. It is the most recommended type for most applications with set point adjustable by the user.

PID: **P**, **I** and **D** actions act over the error thus the output signal changes when there are changes in the processes variable or in the set point. It is recommended for ratio control or to cascade slave control.

I.PD: In this type only the integral action acts over the error. The set point changes producing soft output signal variations. It is recommended for a process that cannot have sudden changes in the variable due to the set point change. It is the case of heating process with high gain.

PI-SAMPLING: In this option, when there is a deviation, the output signal changes according to the PI algorithm during a time t_0 , which is adjusted by **ATRIS** parameter. Then, the output signal is kept constant during a time t_1 , where the total cycle period (t_0+t_1) is adjusted by **PPIS** parameter. If the deviation persists, the output signal will vary again during t_0 , and will remain constant during t_1 . This type is recommended for processes with high dead time.



PI-Sampling

Algorithm Type (ALG)

It is defined by the **ALG** parameter.
 ALG = false: Parallel algorithm or Ideal
 ALG = true: ISA algorithm or Non-Interactive

$$PARALLEL : MV(t) = K_p e(t) + \frac{1}{T_R} \int e(t)dt + T_D \frac{de(t)}{dt}$$

$$ISA : MV(t) = K_p [e(t) + \frac{1}{T_R} \int e(t)dt + T_D \frac{de(t)}{dt}]$$

Action Type

Some processes require that the output signal (manipulated variable - MV) increases when the process variable (PV) increases, while most of the other applications require the opposite. The choice of the action type is done by **ACT** parameter.

PARAMETER	ACTION TYPE	ERROR	EFFECT
ACT = false	Reverse	$e = SP - PV$	Output decreases with the increase of PV.
ACT = true	Direct	$e = PV - SP$	Output increases with the increase of PV.

Error type – Linear/Quadratic (TYERR)

In the deviation or linear error (**TYERR = 0**), the considered error in the PID calculations is given by:

Reverse Action: $e = SP - PV$ "Output decreases when PV increases"

Direct Action: $e = PV - SP$ "Output increases when PV increases"

There are processes where the deviations in relation to the set point are preferable to disturbances caused by the controller on downstream processes. Therefore, the control actuation should be small for small deviations and increase gradually with the size of the deviation. A typical example of this type of process is the level control of a tank which the set point is not as important as the flow stability downstream the tank. This type of process can be controlled with adaptative gain, control with gap, or quadratic error.

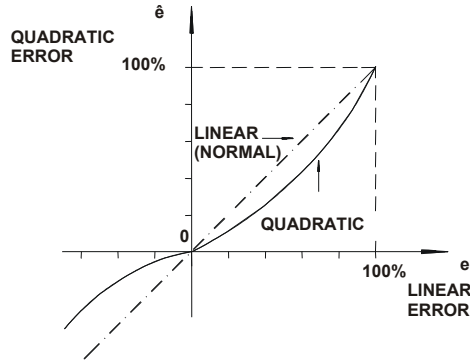
The quadratic error (**TYERR = 1**), the error to be considered in the PID calculations is given by:

Reverse Action: $e = SP - PV$ "Output decreases when PV increases"

Direct Action: $e = PV - SP$ "Output increases when PV increases"

$$\hat{e} = \frac{e \cdot |e|}{100}$$

\hat{e} : Error to be considered in the APID calculation.



Quadratic Error x Normal Error

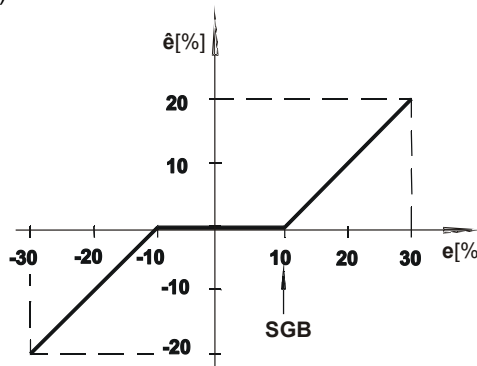
GAP Control (SGB and SGGAP)

There are applications which the control is unstable near the set point due to actuator dead band, noise or other reasons. In this case, it is advisable to have a controller with a differentiated action around the set point.

The GAP control or GAP with adaptative gain can be used to solve this problem.

Example:

Considered error (\hat{e}) for a GAP control with a band equals to $\pm 10\%$ (**SGB=10**) and special gain equals to zero (**SGGAP=0**).

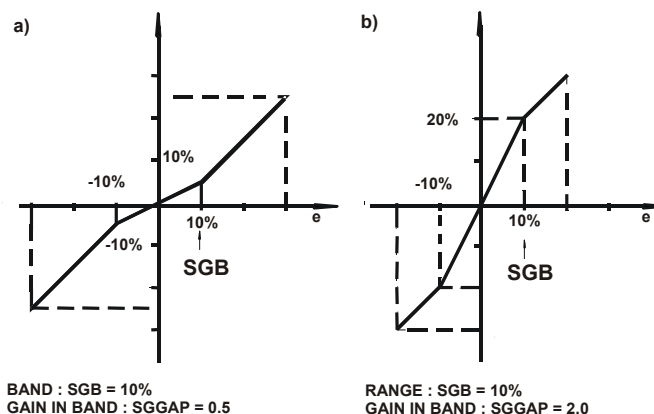


Gap Control with Special Gain=0

Some processes may require a special gain within the band. In such cases, it is possible to select a factor at parameter **SGGAP** which multiplies the error, thus making the error to be considered in the APID calculations to be:

$$\hat{e} = e \cdot \text{SGGAP}$$

Thus, the control action will be, within the "GAP", faster when **SGGAP>1** and slower when **SGGAP<1**. For **SGGAP=0** (null band) the GAP control is not activated.



GAP control with Special Gain a) Gain < 1, (b) Gain > 1

Control with Adaptive Gain (INVAG, ADAPG, Coordinates X/Y)

The adaptive gain modifies the PID constants by a factor **G**. This factor **G** follows a curve of 10 points (x,y) as a function of variable type which is defined by **INVAG** parameter where the curve intermediate values are calculated by linear interpolate method. The options for variables types are:

- INVAG = 0: SP** (set point)
- INVAG = 1: PV** (process variable)
- INVAG = 2: DEV** (deviation or error)
- INVAG = 3: OUT** (output signal)
- INVAG = 4: EXT** (external variable).

The points of the adaptive gain curve are given as percentage of the selected variable on the axis of the abscissa (X) and by the gain **G** on the axis of ordinate (Y). The gain modifies the tuned constants **KP**, **TR** and **TD** as follows:

$$K_P' = G \cdot K_P$$

$$T_R' = \frac{T_R}{G}$$

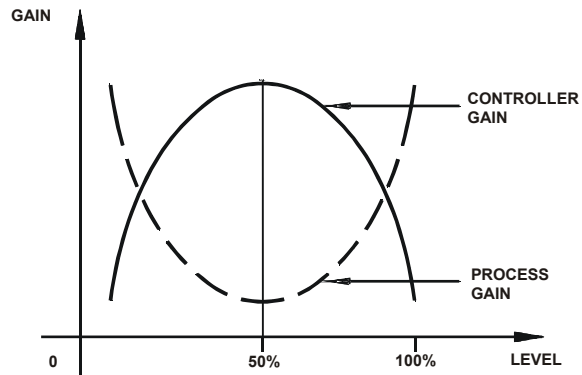
$$T_D' = G \cdot T_D$$

Gain **G** may affect the **PID**, **PI**, **P**, **I** and **D** actions. Selection is performed by parameter **ADAPG** which also inhibits adaptive gain action when **ADAPG = 0** (not used).

- ADAPG = 0 : not used**
- ADAPG = 1 : PID**
- ADAPG = 2 : PI**
- ADAPG = 3 : P**
- ADAPG = 4 : I**
- ADAPG = 5 : D**

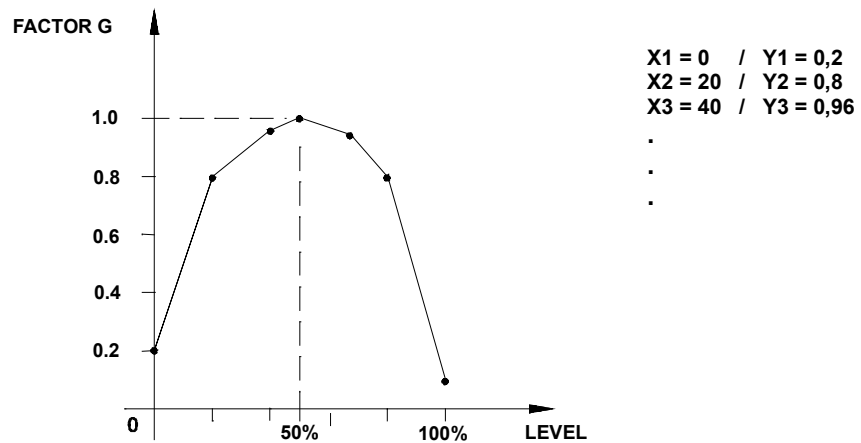
The adaptive gain is recommended for highly nonlinear controls. A classic example of adaptive gain is the level control of a boiler.

The volume variations are nonlinear with the level variations. The dotted line in the following figure shows the volume gain with the level. Note that the volume varies slowly (low gain), around 50% level and varies very fast (high gain) around the level extremes. The control action must have a gain that is the inverse of the process gain. This is shown by the continuous line in the following figure.



Process Gain x Controller Gain

The adaptive gain can be configured as showed in the next figure. This curve can be represented by the following points.



Gain Curve as Function of PV

Notes:

1. The pairs (x,y) have to be inserted in an increasing order of x values, starting by (x1,y1) pair and without jump the indexes.
2. It is not necessary to use all 10 points of the curve, but it will be necessary to repeat the values of X and Y of the last point of the desired curve in the other unused items.
3. It is fundamental to use the 0% and the 100% of the determining variable (-100% and +100% of error).
4. It is recommendable programming the variable up to 102%, since the variable may be above 100%.
5. Tuning is normally done for G = 1. In the example, the control becomes slower above, or below, 50% of the level.
6. Adaptive gain is also very useful for pH control.

Anti-Reset Windup by integral term (AWL and AWH)

Usually the control algorithm automatically stops the contribution of the integral mode when the output signal reaches the lower or upper limits configured through the **AWL** and **AWH** parameters. Contributions of the proportional and derivative modes are not affected.

The special feature of this block's algorithm is the option of adjustment of those limits. When the **AWH** limit is greater than **OUTH** limit, the **OUT** output is kept in the **OUTH** value, but internally, the algorithm continues the integral calculation up to **AWH** limit. The user may avoid this case configuring the **AWH** limit to a value less than or equals to **OUTH**, allowing quicker responses and avoiding overshoot in heating processes, for example. The same idea is applicable to the lower limits (**AWL** and **OUTL**).

OUT output limits (CLIM, OUTL and OUTH)

The **OUT** output limits are defined by **OUTL** and **OUTH** parameters.
The values applied in these two parameters must be among **-2%** and **102%**.

The **CLIM** parameter defines which mode (automatic/manual) will be applied the **OUTL** and **OUTH** limits.

CLIM = 0 : AUTO/MAN (in both modes)
CLIM = 1 : AUTO (only in automatic)

In any operation mode which is possible to write in the **OUT** output, if the written value is out of the configured limits, the output will be kept in the previous value.

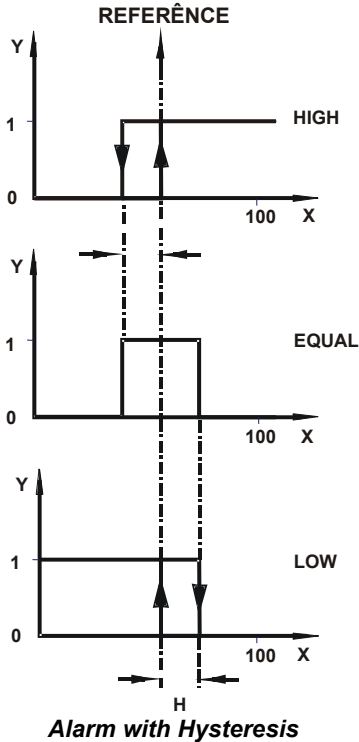
Deviation Alarm (DEVAL, MTDA, ALM)

The alarm can be set for the desired deviation limit (**DEVAL**) and for how long this deviation may be tolerated without alarm activation (**MTDA**). For example, if **DEVAL=5** and **MTDA=30**, thus the **ALM** output will be activated (logic level 1) if a deviation of 5% remains for more than 30 seconds.
For **MTDA=0** (infinite time) the deviation alarm is not activated (without alarm).

Alarms which can be configured (ALM1, INAL1, TYPE1, DBN1, REF1, ALM2, INAL2, TYPE2, DBN2, REF2)

The alarms **ALM1** and **ALM2** are independents and can be configured. They are activated through their parameters, comparing the reference value **REFx** and the selected variable in **INALx** (SP or MV). Is possible to select the comparison type **TYPEx**, checking if **INALx** is above (High), below (Low) or equal (Equal) to **REFx**.

To avoid output signal oscillation when the variable is very close to the reference, a hysteresis value can be adjusted through the **DBNx** parameter. See the next figure.



PID constants (KP, TR, TD, FB input and BIAS parameters)

KP – Proportional gain.

TR – Integral time in minutes/repeats, thus, bigger **TR** means less integral action. It can be understand as the necessary time to increase/decrease the output of error value (parallel PID), keeping it constant.

TD – Derivative time is given in minutes. The derivative time is calculated using a false derivation, i.e., an action similar to a lead/lag controller, in which the lag constant is $\text{Alfa} \cdot \text{TD}$. In this block implementation the Alfa factor is equal to 0.13.

BIAS – This parameter will allow the adjustment of the initial output value (in percentage) when the control is transferred from manual to automatic. The applied value in this parameter has to be among **0%** and **100%**. The use of this input can be done through the selection of **TRS** parameter.

FB – Through this input is possible to adjust the initial output value when the control is transferred to manual. The applied value in this input has to be among **0%** and **100%**. The use of this input can be done through the selection of **TRS** parameter.

A/M Input (Automatic/Manual)

If **A/M** is true, the APID will be in automatic control and if **A/M** is false the APID will be in manual control.

Types of transference from Manual to Automatic (TRS)

The output value of APID block is defined by the **TRS** parameter.

TRS = 0 (Bumpless) :

In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output.

When the block switches from manual to automatic, it starts the calculation from last output value in manual mode.

TRS = 1 (Bumpless + BIAS) :

In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output.

When the block switches from manual to automatic, it starts the calculation from **BIAS** parameter value.

TRS = 2 (Bumpless + FB) :

In manual mode, the block output value is equal to the inserted value in the **FB** input. In this case it may not write in the **OUT** output.

When the block switches from manual to automatic, it starts the calculation from **FB** input value.

TRS = 3 (Hard) :

In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output.

When the block switches from manual to automatic, it starts the calculation from last output value in manual mode + proportional term (**KP** x error).

TRS = 4 (Hard + BIAS) :

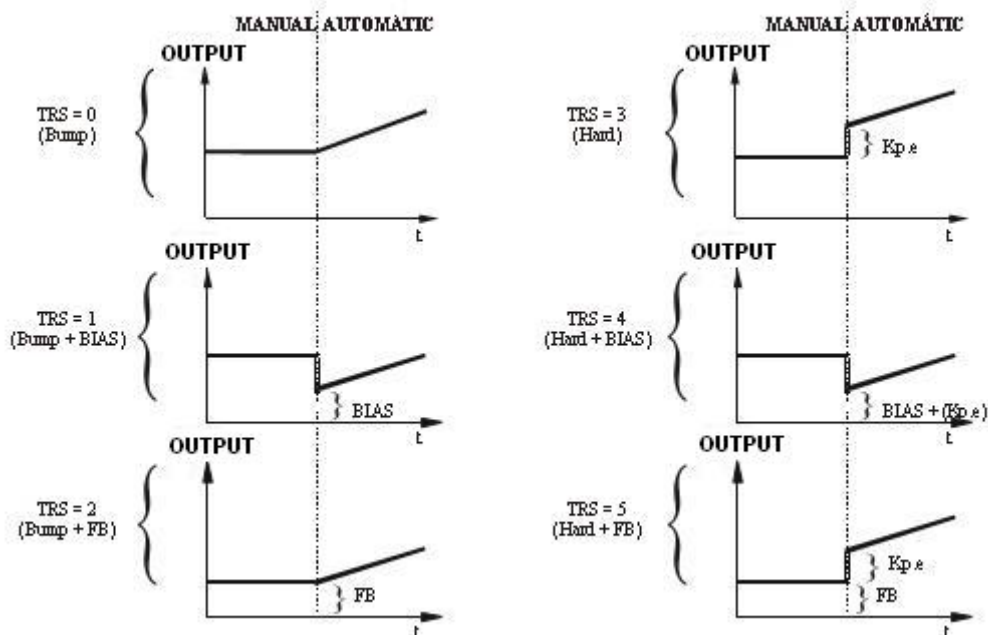
In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output.

When the block switches from manual to automatic, it starts the calculation from **BIAS** parameter value + proportional term (**KP** x error).

TRS = 5 (Hard + FB) :

In manual mode, the block output value is equal to the inserted value in the **FB** input. In this case it may not write in the **OUT** output.

When the block switches from manual to automatic, it starts the calculation from **FB** input value + proportional term (**KP** x error).



Manual to Automatic Transference

NOTE

Before the block status changing, from **Manual to Automatic**, is recommended adjust the error to zero, with **SP** equals to **PV** value.

Security value (SEC_V, SEC, SECL, SECH and PRIOR)

If **SEC** is true, the defined value in the **SEC_V** input will pass to the **OUT** output. The **SECL** and **SECH** parameters are used to define the possible limits values (lower and upper) of configuration for the **SEC_V** input. If the input has values out of the range defined by **SECL** and **SECH**, the output value will be kept in the limits values. The values applied to **SECL** and **SECH** limits have to be among **0%** and **100%**.

The security value always act over the automatic mode and to the manual mode, **PRIOR** parameter defines the security priority over this mode.

PRIOR = 0 : **Man/Sec/Auto** (the security will not act over manual mode)

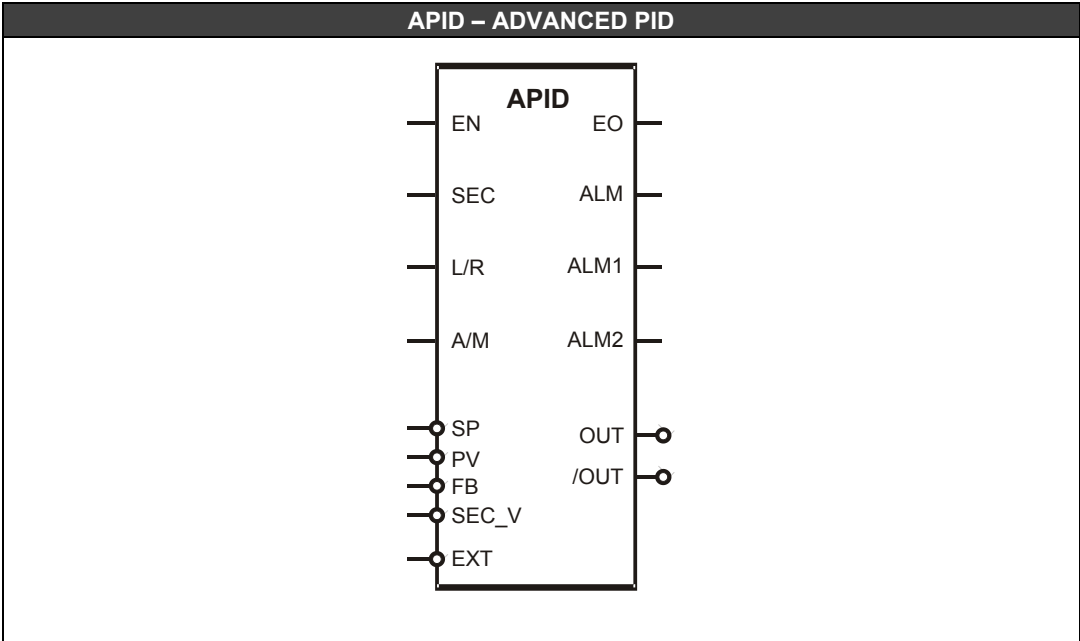
PRIOR = 1 : **Sec/Man/Auto** (the security will act over both modes)

Local Set Point (L/R, SPL, SPLL and SPLH)

The **L/R** input defines if the set point used in the integration will be remote (**SP** input) or local (**SPL** internal parameter). If **L/R** is true, the local will be used, if is false the remote will be used. The local set point value is limited by **SPLL** and **SPLH** parameters.

If **SPL** is configured with values out of the range defined by **SPLL** and **SPLH**, the **SPL** value will be kept in one of theses limits. This limit is valid for **SP** and **PV**, with the same action type of **SPL**.

These limits also have a second function, which is to define the values' range for the action of **SP** and **PV** variables, i.e., utilization of engineering values. The default values for these limits are 0 and 100, that is, **PV** and **SP** are in percentage. However, changing the default values of **SPLL** and **SPLH**, will be possible work with any values' range for **PV** and **SP**, i.e., they are considered in engineering units.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEC	SECURITY MODE ENABLED	BOOL
	L/R	SET POINT SELECTION - LOCAL (1) OR REMOTE (0)	BOOL
	A/M	MODE SELECTION - MANUAL (0) OR AUTOMATIC (1)	BOOL
	SP	SET POINT	FLOAT
	PV	PROCESS VARIABLE	FLOAT
	FB	IF A/M IS FALSE, THE INPUT CONNECTED TO FB PASS TO THE OUT OUTPUT	FLOAT
	SEC_V	IF SEC IS TRUE, THE INPUT CONNECTED TO SEC_V WILL PASS TO THE OUT OUTPUT	FLOAT
	EXT	EXTERNAL VARIABLE TO DETERMINE THE ADAPTATIVE GAIN	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	ALM	DEVIATION ALARM	BOOL
	ALM1	ALARM THAT CAN BE CONFIGURED 1	BOOL
	ALM2	ALARM THAT CAN BE CONFIGURED 2	BOOL
	OUT	OUTPUT	FLOAT
	/OUT	INVERTED OUTPUT	FLOAT
P	KP	PROPORTIONAL GAIN	FLOAT
	TR	INTEGRAL TIME (MIN/REP)	FLOAT
	TD	DERIVATIVE CONSTANT TERM (MIN)	FLOAT
	AWL	ANTI-RESET WINDUP LOWER LIMIT	FLOAT
	AWH	ANTI-RESET WINDUP UPPER LIMIT	FLOAT
	OUTL	LOWER LIMIT FOR OUT OUTPUT	FLOAT
	OUTH	UPPER LIMIT FOR OUT OUTPUT	FLOAT
	BIAS	BIAS	FLOAT
	PID	DEFINES THE PID CONTROL TYPE OVER THE ERROR AND PROCESS VARIABLE	LONG
	ALG	DEFINES THE ALGORITHM TYPE USED	BOOL
	ACT	DEFINES THE ACTION TYPE - DIRECT/REVERSE	BOOL
	TRS	DEFINES THE TRANSFERENCE TYPE FROM AUTOMATIC TO MANUAL	LONG
	CLIM	DEFINES IF AWL AND AWH LIMITS ARE VALID FOR AUTO/MAN MODES OR ONLY FOR AUTO	LONG
	PRIOR	DEFINES THE PRIORITY OF SECURITY VALUE	LONG
	SPL	DEFINES THE LOCAL SET POINT VALUE	FLOAT
	SPLL	LOWER LIMIT OF LOCAL SET POINT AND PV/SP	FLOAT
	SPLH	UPPER LIMIT OF LOCAL SET POINT AND PV/SP	FLOAT
	SECL	LOWER LIMIT OF SECURITY VALUE	FLOAT
	SECH	UPPER LIMIT OF SECURITY VALUE	FLOAT
	SGB	BAND (GAP) TO BE CONSIDERED TO GAP CONTROL	FLOAT
	SGGAP	SPECIAL GAIN INSIDE GAP	FLOAT
	TYERR	ERROR TYPE LINEAR/QUADRATIC	LONG
	DEVAL	DEVIATION ALARM LIMIT	FLOAT
	MTDA	MAXIMUM TIME FOR DEVIATION ALARM	FLOAT
	ADAPG	ACTION OF ADAPTATIVE GAIN	LONG
	INVAG	INPUT VARIABLE TYPE FOR THE ADAPTATIVE GAIN	LONG
	PPIS	SAMPLING PERIOD OF PI-SAMPLING	FLOAT
	ATPIS	ACTUATION TIME OF PI-SAMPLING	FLOAT
	INAL1	ALARM 1 INPUT	LONG
	TYPE1	ALARM 1 TYPE	LONG
	DBN1	ALARM 1 HYSTERESIS	FLOAT
	REF1	ALARM 1 REFERENCE VALUE	FLOAT
	INAL2	ALARM 2 INPUT	LONG
TYPE2	ALARM 2 TYPE	LONG	
DBN2	ALARM 2 HYSTERESIS	FLOAT	
REF2	ALARM 2 REFERENCE VALUE	FLOAT	
X1...X10	X COORDINATES FOR CURVE OF ADAPTATIVE GAIN	FLOAT	
Y1...Y10	Y COORDINATES FOR CURVE OF ADAPTATIVE GAIN	FLOAT	

I: Input. P: Parameter. O: Output

Automatic Up and Down Ramp (ARAMP)

Description:

This function, when **EN** is true, increases or decreases the **OUT** output in a linear way based on a pre-established time interval. This function block may be used to create a time database to an automatic set point generator when it is used together with the linearization block or a simple ramp.

In a set point application the ARAMP block is prepared to generate a 0 to 100 % output in a time interval which tracking the set point curve. The ARAMP output will be connected to the input of the LIN function (linearization) set with a set point profile curve.

Selecting the IN input and the OUT output formats (PERC parameter)

PERC = false: the **IN** input and the **OUT** output values are given in percentage (0 – 100%).

PERC = true: the **IN** input and the **OUT** output values are given in the 0 – 10000 format.

Time Selection

The block time basis can be selected in minutes, seconds or hours, according to the requirements of the application, by the parameter **T_SEL**. This parameter has the following values: 0: seconds, 1: minutes, 2: hours. This selection affects directly the chosen value for the **FTIME** parameter.

FTIME and IC_DC Parameter

FTIME is the time which the output takes to change from 0 to 100 %. The change direction is given by the **IC_DC** input. If this input is true, the **OUT** output will be gradually decreased with speed defined by the **FTIME** parameter, otherwise, the output will be increased with the speed defined in the **FTIME** parameter.

Pause Command

The **PAUSE** command freezes the **OUT** output. So the output can be increased or decreased through the selection of the **UP** and **DOWN** inputs.

UP and DOWN Command, ASPD Parameter

The **UP** and **DOWN** inputs will advance or revert the **OUT** output to a desired value using the manual speed adjustment by the **ASPD** parameter. This parameter configures the speed of manual actuation.

LOWL and HIGHL Parameter

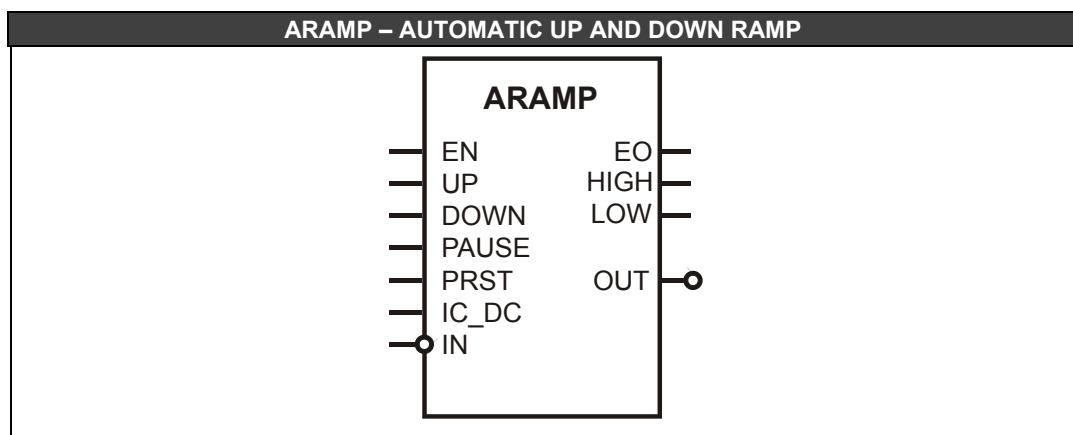
The **LOWL** parameter configures the bottom limit of the ramp generated by the ARAMP function block while the **HIGHL** parameter configures the upper limit of the output ramp. It starts from the value in the **IN** input and goes to the maximum value, set in the **HIGHL** parameter. If the input value is less than **LOWL**, the initial value of the ramp will be equal to **LOWL**.

HIGH and LOW Alarms

When the output ramp reaches the bottom limit (**LOWL**) or the upper limit (**HIGHL**), the alarms **LOW** and **HIGH** will be turned on. The **LOW** output goes to true if the bottom limit is reached. Similarly, if the upper limit is reached the output **HIGH** goes to true.

ACCEL Parameter

It is the manual acceleration of actuation. When the block output is a parabola, the **ACCEL** parameter allows fine adjustment of the output, allowing more definition of the output rate of change.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	UP	MOVES OUTPUT FORWARD ACCORDING TO ASPD	BOOL
	DOWN	REVERTS OUTPUT ACCORDING TO ASPD	BOOL
	PAUSE	FREEZES OUTPUT	BOOL
	PRST	RAMP RESET	BOOL
	IC_DC	OUTPUT WILL BE INCREASED OR DECREASED	BOOL
	IN	BLOCK INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	HIGH	RAMP UPPER LIMIT ALARM	BOOL
	LOW	RAMP BOTTOM LIMIT ALARM	BOOL
	OUT	OUTPUT RAMP	FLOAT
P	T_SEL	SELECTION OF THE TIME BASE (HOURS, MINUTES OR SECONDS)	LONG
	FTIME	TIME (SECONDS) TO CHANGE THE OUTPUT FROM 0 TO 100 %	LONG
	ASPD	MANUAL ACTUATION SPEED IN % PER SECOND.	LONG
	ACCEL	INITIAL MANUAL ACCELERATION OF ACTUATION	LONG
	LOWL	BOTTOM LIMIT OF REGISTER	FLOAT
	HIGHL	UPPER LIMIT OF REGISTER	FLOAT
	PERC	SELECTS THE INPUT AND THE OUTPUT FORMATS BETWEEN "0 - 10000" AND "0 - 100%"	BOOL

I: Input. P: Parameter. O: Output

Enhanced PID (EPID)

Description:

This function block, when **EN** is true does the PID controller. The acclaimed PID algorithm for continuous process control, associated with the configuration flexibility of the operation settings through parameterization, allows the utilization of this block to a variety of applications and control strategies.

This block supplies several options of algorithm settings having as a basis the Proportional (P), Integral (I) and Derivative (D) terms that may be applied in error or just to the process variable (PV). This block also provide three outputs for alarms, one is for deviation alarm and two can be configured.

This block allows selection of the following control types: PI-Sampling, Quadratic Error and GAP.

The user may set limits of anti-reset windup (only applied to the integral term). Besides, the user might choose the type of the PID algorithm: ISA or parallel, direct action or reverse, manual to automatic control transference, bumpless or hard.

PID type

It is defined by the **PID** parameter.

PID = 0: PI.D type.

PID = 1: PID type.

PID = 2: I.PD type.

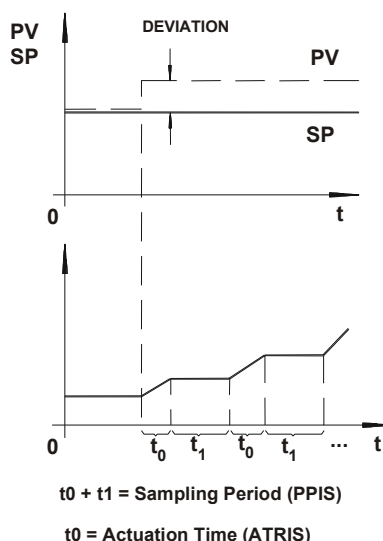
PID = 3: PI-SAMPLING type.

PI.D: **P** and **I** actions act over the error and the **D** action over the process variable. In this way, the output signal tracks set point changes according to the proportional and integral actions, but there is no undesired variation due to the derivative action. It is the most recommended type for most applications with set point adjustable by the user.

PID: **P**, **I** and **D** actions act over the error thus the output signal changes when there are changes in the processes variable or in the set point. It is recommended for ratio control or to cascade slave control.

I.PD: In this type only the integral action acts over the error. The set point changes producing soft output signal variations. It is recommended for a process that cannot have sudden changes in the variable due to the set point change. It is the case of heating process with high gain.

PI-SAMPLING: In this option, when there is a deviation, the output signal changes according to the PI algorithm during a time t_0 , which is adjusted by **ATRIS** parameter. Then, the output signal is kept constant during a time t_1 , where the total cycle period (t_0+t_1) is adjusted by **PPIS** parameter. If the deviation persists, the output signal will vary again during t_0 , and will remain constant during t_1 . This type is recommended for processes with high dead time.



PI-Sampling

Algorithm Type (ALG)

It is defined by the **ALG** parameter.
 ALG = false: Parallel algorithm or Ideal
 ALG = true: ISA algorithm or Non-Interactive

$$PARALLEL : MV(t) = K_p e(t) + \frac{1}{T_R} \int e(t) dt + T_D \frac{de(t)}{dt}$$

$$ISA : MV(t) = K_p \left[e(t) + \frac{1}{T_R} \int e(t) dt + T_D \frac{de(t)}{dt} \right]$$

Action Type

Some processes require that the output signal (manipulated variable - MV) increases when the process variable (PV) increases, while most of the other applications require the opposite. The choice of the action type is done by **ACT** parameter.

PARAMETER	ACTION TYPE	ERROR	EFFECT
ACT = false	Reverse	$e = SP - PV$	Output decreases with the increase of PV.
ACT = true	Direct	$e = PV - SP$	Output increases with the increase of PV.

Error type – Linear/Quadratic (TYERR)

In the deviation or linear error (**TYERR = 0**), the considered error in the PID calculations is given by:

Reverse Action: $e = SP - PV$ "Output decreases when PV increases"

Direct Action: $e = PV - SP$ "Output increases when PV increases"

There are processes where the deviations in relation to the set point are preferable to disturbances caused by the controller on downstream processes. Therefore, the control actuation should be small for small deviations and increase gradually with the size of the deviation. A typical example of this type of process is the level control of a tank where the set point is not as important as the flow stability downstream the tank. This type of process can be controlled with adaptative gain, control with gap, or quadratic error.

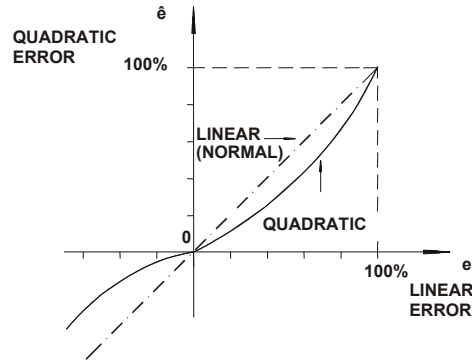
The quadratic error (**TYERR = 1**), the error to be considered in the PID calculations is given by:

Reverse Action: $e = SP - PV$ "Output decreases when PV increases"

Direct Action: $e = PV - SP$ "Output increases when PV increases"

$$\hat{e} = \frac{e \cdot |e|}{100}$$

\hat{e} : Error to be considered in the EPID calculation.



Quadratic Error x Normal Error

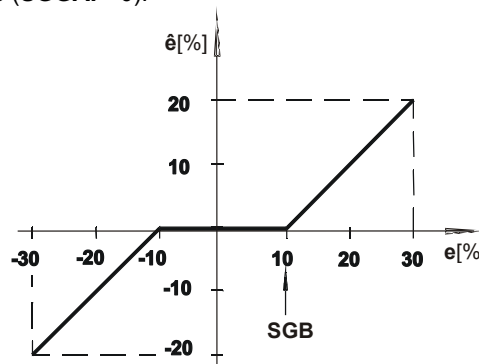
GAP Control (SGB and SGGAP)

There are applications where the control is unstable near the set point due to actuator dead band, noise or other reasons. In this case, it is advisable to have a controller with a differentiated action around the set point.

The GAP control or GAP with adaptative gain can be used to solve this problem.

Example:

Considered error (\hat{e}), in percentage, for a GAP control with a band equals to $\pm 10\%$ (**SGB=10**) and special gain equals to zero (**SGGAP=0**).

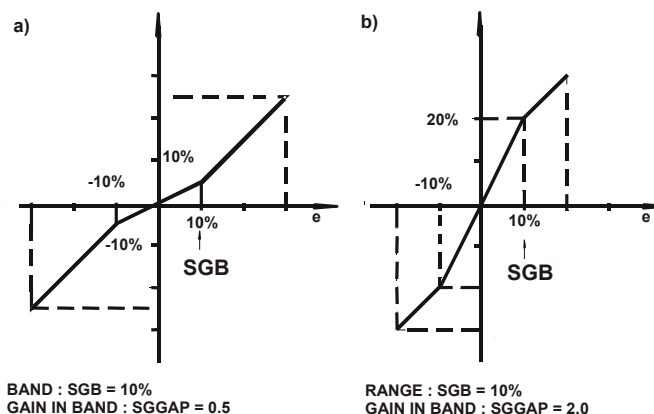


Gap Control with Special Gain=0

Some processes may require a special gain within the band. In such cases, it is possible to select a factor at parameter **SGGAP** which multiplies the error, thus making the error to be considered in the EPID calculations to be:

$$\hat{e} = e \cdot \text{SGGAP}$$

Thus, the control action will be, within the "GAP", faster when **SGGAP>1** and slower when **SGGAP<1**. For **SGGAP=0** (null band) the GAP control is not activated.



GAP control with Special Gain a) Gain < 1, (b) Gain > 1

Anti-Reset Windup by integral term (AWL and AWH)

Usually the control algorithm automatically stops the contribution of the integral mode when the output signal reaches the lower or upper limits configured through the **AWL** and **AWH** parameters. Contributions of the proportional and derivative modes are not affected.

The special feature of this block's algorithm is the option of adjustment of those limits. When the **AWH** limit is greater than **OUTH** limit, the **OUT** output is kept in the **OUTH** value, but internally, the algorithm continues the integral calculation up to **AWH** limit. The user may avoid this case configuring the **AWH** limit to a value less than or equals to **OUTH**, allowing quicker responses and avoiding overshoot in heating processes, for example. The same idea is applicable to the lower limits (**AWL** and **OUTL**).

OUT output limits (CLIM, OUTL and OUTH)

The **OUT** output limits are defined by **OUTL** and **OUTH** parameters. The values applied in these two parameters must be among **-2%** and **102%**.

The **CLIM** parameter defines which mode (automatic/manual) will be applied the **OUTL** and **OUTH** limits.

CLIM = 0 : AUTO/MAN (in both modes)
CLIM = 1 : AUTO (only in automatic)

In any operation mode which is possible to write in the **OUT** output, if the written value is out of the configured limits, the output will be kept in the previous value.

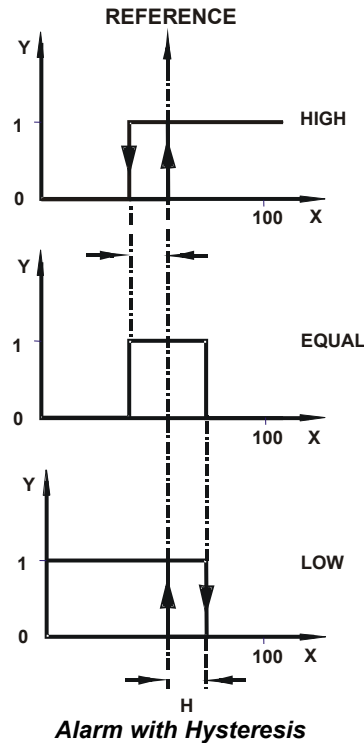
Deviation Alarm (DEVAL, MTDA, ALM)

The alarm can be set for the desired deviation limit (**DEVAL**) and for how long this deviation may be tolerated without alarm activation (**MTDA**). For example, if **DEVAL=5** and **MTDA=30**, thus the "**ALM**" output will be activated (logic level 1) if a deviation of 5% remains for more than 30 seconds. For **MTDA=0** (infinite time) the deviation alarm is not activated (without alarm).

Alarms which can be configured (ALM1, INAL1, TYPE1, DBN1, REF1, ALM2, INAL2, TYPE2, DBN2, REF2)

The alarms **ALM1** and **ALM2** are independents and can be configured. They are activated through their parameters, comparing the reference value **REFx** and the selected variable in **INALx** (SP or MV). Is possible to select the comparison type **TYPEx**, checking if **INALx** is above (High), below (Low) or equal (Equal) to **REFx**.

To avoid output signal oscillation when the variable is very close to the reference, a hysteresis value can be adjusted through the **DBNx** parameter. See the next figure.



PID constants (KP, TR, TD, FB input and BIAS parameters)

KP – Proportional gain.

TR – Integral time in minutes/repeats, thus, bigger **TR** means less integral action. It can be understand as the necessary time to increase/decrease the output of error value (parallel PID), keeping it constant.

TD – Derivative time is given in minutes. The derivative time is calculated using a false derivation, i.e., an action similar to a lead/lag controller, in which the lag constant is Alfa***TD**. In this block implementation the Alfa factor is equal to 0.13.

BIAS – This parameter will allow the adjustment of the initial output value when the control is transferred from manual to automatic. The applied value in this parameter has to be among **0%** and **100%**. The use of this input can be done through the selection of **TRS** parameter.

FB – Through this input is possible to adjust the initial output value when the control is transferred to manual. The applied value in this input has to be among **0%** and **100%**. The use of this input can be done through the selection of **TRS** parameter.

A/M Input (Automatic/Manual)

If **A/M** is true, the EPID will be in automatic control and if **A/M** is false the EPID will be in manual control.

Types of transference from Manual to Automatic (TRS)

The output value of EPID block is defined by the **TRS** parameter.

TRS = 0 (Bumpless) :

In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output. When the block switches from manual to automatic, it starts the calculation from last output value in manual mode.

TRS = 1 (Bumpless + BIAS) :

In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output. When the block switches from manual to automatic, it starts the calculation from **BIAS** parameter value.

TRS = 2 (Bumpless + FB) :

In manual mode, the block output value is equal to the inserted value in the **FB** input. In this case it may not write in the **OUT** output. When the block switches from manual to automatic, it starts the calculation from **FB** input value.

TRS = 3 (Hard) :

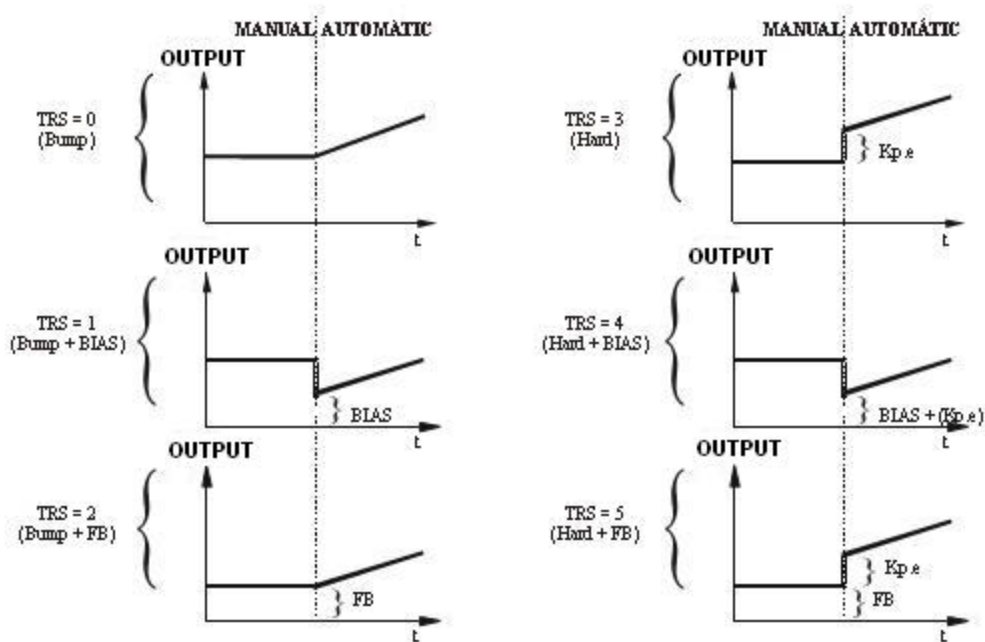
In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output. When the block switches from manual to automatic, it starts the calculation from last output value in manual mode + proportional term (**KP x error**).

TRS = 4 (Hard + BIAS) :

In manual mode, the block output value is equal to the last output value in automatic mode. In this case it may write in the **OUT** output. When the block switches from manual to automatic, it starts the calculation from **BIAS** parameter value + proportional term (**KP x error**).

TRS = 5 (Hard + FB) :

In manual mode, the block output value is equal to the inserted value in the **FB** input. In this case it may not write in the **OUT** output. When the block switches from manual to automatic, it starts the calculation from **FB** input value + proportional term (**KP x error**).



Manual to Automatic Transference

NOTE

Before the block status changing, from **Manual** to **Automatic**, is recommended adjust the error to zero, with **SP** equals to **PV** value.

Security value (SEC_V, SEC, SECL, SECH and PRIOR)

If **SEC** is true, the defined value in the **SEC_V** input will pass to the **OUT** output. The **SECL** and **SECH** parameters are used to define the possible limits values (lower and upper) of configuration for the **SEC_V** input. If the input has values out of the range defined by **SECL** and **SECH**, the output value will be kept in the limits values.

The security value always act over the automatic mode and to the manual mode, **PRIOR** parameter defines the security priority over this mode.

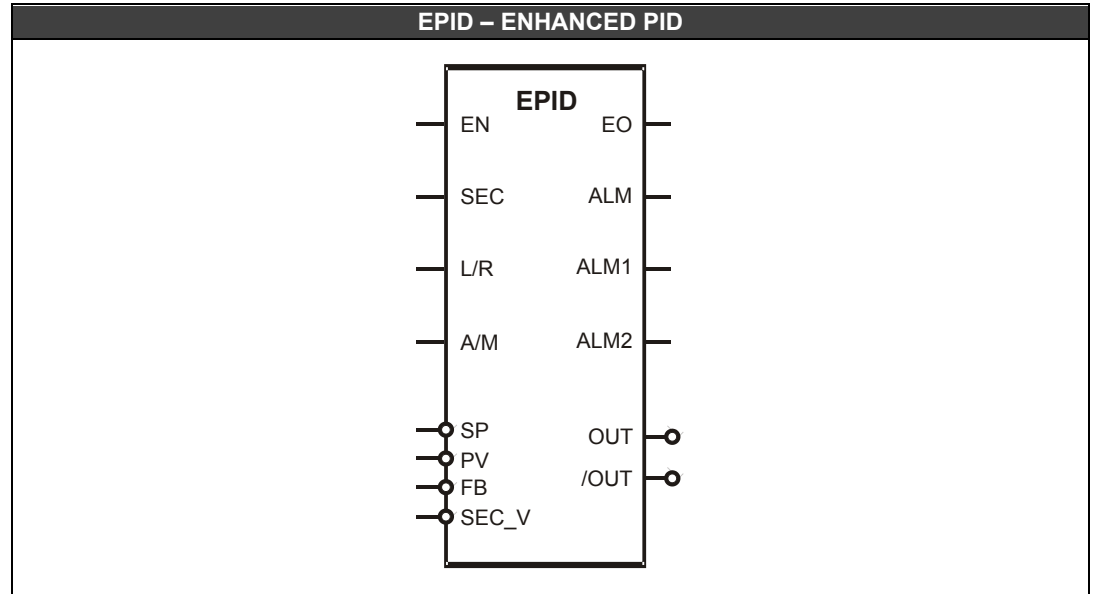
- PRIOR = 0 : Man/Sec/Auto** (the security will not act over manual mode)
- PRIOR = 1 : Sec/Man/Auto** (the security will act over both modes)

Local Set Point (L/R, SPL, SPLL and SPLH)

The **L/R** input defines if the set point used in the integration will be remote (**SP** input) or local (**SPL** internal parameter). If **L/R** is true, the local will be used, if is false the remote will be used. The local set point value is limited by **SPLL** and **SPLH** parameters.

If **SPL** is configured with values out of the range defined by **SPLL** and **SPLH**, the **SPL** value will be kept in one of these limits. This limit is valid for **SP** and **PV**, with the same action type of **SPL**.

These limits also have a second function, which is to define the values' range for the action of **SP** and **PV** variables, i.e., utilization of engineering values. The default values for these limits are 0 and 100, that is, **PV** and **SP** are in percentage. However, changing the default values of **SPLL** and **SPLH**, will be possible work with any values' range for **PV** and **SP**, i.e., they are considered in engineering units.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	SEC	SECURITY MODE ENABLED	BOOL
	L/R	SET POINT SELECTION – LOCAL (1) OR REMOTE (0)	BOOL
	A/M	MODE SELECTION - MANUAL (0) OR AUTOMATIC (1)	BOOL
	SP	SET POINT	FLOAT
	PV	PROCESS VARIABLE	FLOAT
	FB	IF A/M IS FALSE, THE INPUT CONNECTED TO FB PASS TO THE OUT OUTPUT	FLOAT
	SEC_V	IF SEC IS TRUE, THE INPUT CONNECTED TO SEC_V WILL PASS TO THE OUT OUTPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	ALM	DEVIATION ALARM	BOOL
	ALM1	ALARM THAT CAN BE CONFIGURED 1	BOOL
	ALM2	ALARM THAT CAN BE CONFIGURED 2	BOOL
	OUT	OUTPUT	FLOAT
	/OUT	INVERTED OUTPUT	FLOAT
P	KP	PROPORTIONAL GAIN	FLOAT
	TR	INTEGRAL TIME (MIN/REP)	FLOAT
	TD	DERIVATIVE CONSTANT TERM (MIN)	FLOAT
	AWL	ANTI-RESET WINDUP LOWER LIMIT	FLOAT
	AWH	ANTI-RESET WINDUP UPPER LIMIT	FLOAT
	OUTL	LOWER LIMIT FOR OUT OUTPUT	FLOAT
	OUTH	UPPER LIMIT FOR OUT OUTPUT	FLOAT
	BIAS	BIAS	FLOAT
	PID	DEFINES THE PID CONTROL TYPE OVER THE ERROR AND PROCESS VARIABLE	LONG
	ALG	DEFINES THE ALGORITHM TYPE USED	BOOL
	ACT	DEFINES THE ACTION TYPE - DIRECT/REVERSE	BOOL
	TRS	DEFINES THE TRANSFERENCE TYPE FROM AUTOMATIC TO MANUAL	LONG
	CLIM	DEFINES IF OUTL AND OUTH LIMITS ARE VALID FOR AUTO/MAN MODES OR ONLY FOR AUTO	LONG
	PRIOR	DEFINES THE PRIORITY OF SECURITY VALUE	LONG
	SPL	DEFINES THE LOCAL SET POINT VALUE	FLOAT
	SPLL	LOWER LIMIT OF LOCAL SET POINT AND PV/SP	FLOAT
	SPLH	UPPER LIMIT OF LOCAL SET POINT AND PV/SP	FLOAT
	SECL	LOWER LIMIT OF SECURITY VALUE	FLOAT
	SECH	UPPER LIMIT OF SECURITY VALUE	FLOAT
	SGB	BAND (GAP) TO BE CONSIDERED TO GAP CONTROL	FLOAT
	SGGAP	SPECIAL GAIN INSIDE GAP	FLOAT
	TYERR	ERROR TYPE LINEAR/QUADRATIC	LONG
	DEVAL	DEVIATION ALARM LIMIT	FLOAT
	MTDA	MAXIMUM TIME FOR DEVIATION ALARM	FLOAT
	PPIS	SAMPLING PERIOD OF PI-SAMPLING	FLOAT
	ATPIS	ACTUATION TIME OF PI-SAMPLING	FLOAT
	INAL1	ALARM 1 INPUT	LONG
	TYPE1	ALARM 1 TYPE	LONG
	DBN1	ALARM 1 HYSTERESIS	FLOAT
	REF1	ALARM 1 REFERENCE VALUE	FLOAT
INAL2	ALARM 2 INPUT	LONG	
TYPE2	ALARM 2 TYPE	LONG	
DBN2	ALARM 2 HYSTERESIS	FLOAT	
REF2	ALARM 2 REFERENCE VALUE	FLOAT	

I: Input. P: Parameter. O: Output

Enhanced TOT (ETOT)

Description:

This block gives the input totalization. This totalization is the integral of the input times a scale factor **FCF** that allows the user to configure the totalization in 3 different operation modes. If the application requires the computing of instantaneous totalized volume, use the ETOT function block to accomplish this task. The time basis of this calculation is seconds.

The flow generally is given in Engineering Units (EU) by units of time. For example:

A 1 m³/s flow as input of the ETOT function block will have as output volume in m³. Suppose the application needs the energy value of an electrical device. The ETOT block allows calculating the value of this energy by the instantaneous power expression:

$$Energy = \int Pot(t)dt$$

and Pot(t)= V(t).I(t), where V(t) is the instantaneous voltage and I(t) is the instantaneous current.

OUT output and TU parameter

The time interval while the output is totalized is according to the value set in **TU**. The **OUT** output is the totalization value.

MEM output

It stores the totalization value before the last reset.

HIGH and PHIGH outputs

If the totalization becomes greater than or equal to the values configured in **TRIP** and **PTRIP**, the **HIGH** and **PHIGH** outputs are activated respectively.

CutOff parameter

The totalization is not performed if the input flow value is less than or equal to **CutOff** value.

FCF parameter

The **FCF** parameter allows the ETOT function block to operate in 4 different modes:

a) **IN** is FLOAT and represents flow in Engineering Units (EU):

FCF must be equal to 1 to the totalization is done without any EU scale factor. (or adjust the factor that you wish to use) For example:

The “**Q**” flow is measured in m³/h. One hour has 3600 seconds. So, the **TU** value must be equal to 3600. Suppose a constant flow of 60 m³/h. The totalization is given by the expression:

$$TOT(t) = \int_0^{t(\text{seconds})} \frac{FCF}{TU} * IN(t)dt = \int_0^{t(\text{seconds})} \frac{1}{3600} * 60dt = \int_0^{t(\text{seconds})} \frac{1}{60} dt [m^3]$$

So, after 1 minute or 1/60 hour or 60 seconds the TOT value will be:

$$TOT[m^3] = \int_0^{60} \frac{1}{60} dt = 1m^3$$

Each 1/60 hours or each 1 minute the block totalizes the input and shows this value in the output.

Since:

60 m3 _____ 1 hour

1 m3 _____ t (time interval when the totalization is displayed)

So, t= 1/60 h or 1 minute.

b) **IN** is FLOAT and represents the flow in percentage:

In this case the input will be seen as a percentage represented by a float number in the range 0 to 100%. **FCF** must be equal to the maximum flow value in engineering units (flow at 100%) to the totalization to be given in EU. The **TU** parameter setting is similar to the previous item. The totalization will be displayed in the EU configured.

c) **IN** is INTEGER:

In this case the input will be interpreted as an integer number in the range 0 to 10000 (0% and 100%, respectively). **FCF** must be equal to the maximum flow in EU divided by 10000. Suppose a maximum flow of 1 m³/s and a constant flow of 0.5 m³/s. The **FCF** value is equal to the maximum flow divided by 10000, or 0.0001. The **TU** value, in this case, is 1 because the totalization unit is m³. A 0.5 m³/s input is equal to 5000 or 50 % of the scale. Thus:

$$OUT = \int_0^t \frac{FCF}{TU} * IN\%(t) dt = \int_0^t 0.0001 * 5000 dt = 0.5t(m^3)$$

So, in one minute (or 60 seconds) the totalized value is 30 m³.

d) **FCF** is less than zero:

When the block is totalizing a negative flow, the totalization is decreased. When the flow is positive the totalization is increased. When **FCF** is greater than zero, i.e. positive, the ETOT function block only accepts positive flows.

RST Input

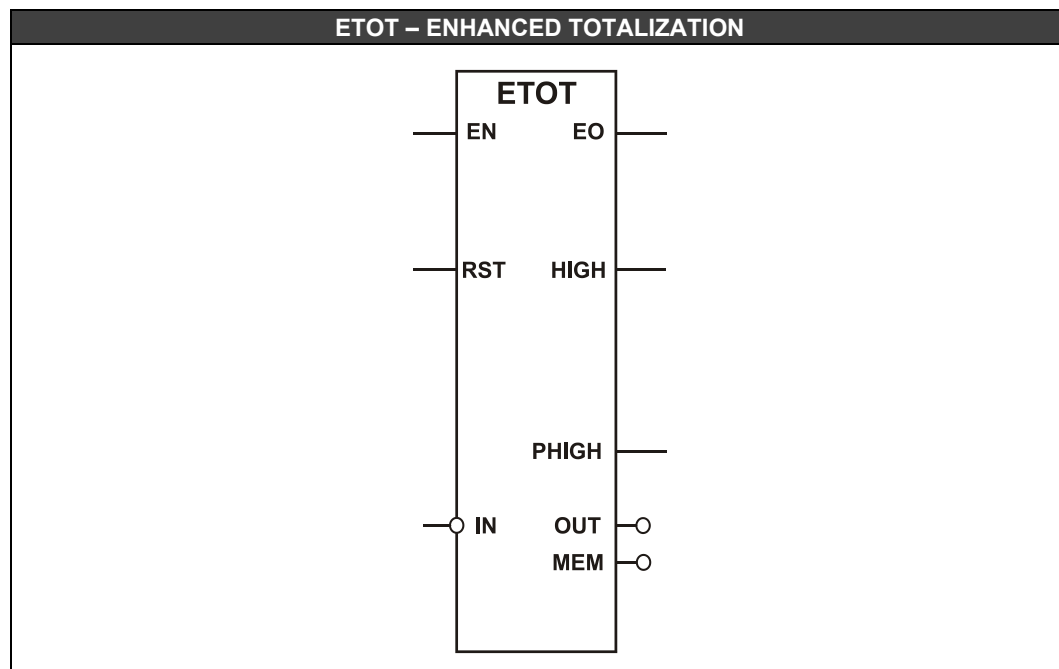
If the **RST** input is changed to true, the totalization is restarted and the internal registers of the ETOT function block are cleared.

OpMode Parameter

It indicates the operation mode:

AUTO/DEMAND: In this mode the ETOT function block is restarted through a true value on the **RST** input or when the totalization value reaches the **TRIP** value.

DEMAND: In this mode the ETOT function block is restarted through the **RST** input.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	RST	CLEARs THE TOTALIZATION	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	HIGH	ALARM WHICH INDICATES WHEN THE TOTALIZATION REACHES THE TRIP VALUE	
	PHIGH	ALARM WHICH INDICATES WHEN THE TOTALIZATION REACHES THE PTRIP VALUE	
	MEM	STORES THE TOTALIZATION VALUE WHEN OCCURS A RESET.	BOOL
	OUT	TOTALIZED OUTPUT	FLOAT
P	TU	TOTALIZATION VALUE FOR ONE UNITY OF COUNTING	FLOAT
	FCF	FACTOR OF FLOW RATE	FLOAT
	OpMode	INDICATES THE OPERATION MODE, IF THE RESET IS ON DEMAND OR WHEN REACHES THE TRIP VALUE	FLOAT
	TRIP	VALUE THAT GENERATES THE HIGH ALARM	FLOAT
	PTRIP	VALUE THAT GENERATES THE PHIGH ALARM	FLOAT
	CutOff	IF THE IN INPUT IS LESS THAN THIS VALUE THE OUTPUT DOES NOT TOTALIZE	FLOAT

I: Input. P: Parameter. O: Output

Linearization (LIN)

Description:

When **EN** is true, this block simulates a function using a table of points (coordinates **x,y**). Intermediate values are calculated using the linear interpolation method. Each block can implement curves with up to 10 points, if it needs more points just arrange others blocks **LIN** in series to obtain the necessary curves. The user should set a table of points; **X** and **Y** pairs, which represent the function. At each value in the **X_n** input there is a correspondent **Y_n** output value, i.e., this block creates a $f(x)$ function.

Selecting the OUT output formats (PERC parameter)

PERC = 0: false:

This option is used in percentage operations with real numbers, for example 21.56%. In this case, the output value (**OUT**) is a real number. For example, if the calculated value is 20.45, then the output value will be 20.45, or if the calculated value is 20.55 the output value will be 20.55.

PERC = 1: true:

This option is used in percentage operations with integer values (0 to 10000) where 0 represents 0%, 2156 represents 21.56%, and 10000 represents 100.00%.

In this case, the output value (**OUT**) is an integer number. For example, if the calculated value is 20.45, then the output value will be 20, or if the calculated value is 20.55, then the output value will be 21.

Bypass

If the **PASS** input is true, the **LIN** block passes the block input value to the output as defined in the **PERC** parameter.

Serial Behavior

When an application requires more than 10 points, LIN function block may be put in series. The block serial behavior is defined by the **TYPE** parameter, as follows:

TYPE = 0: ALONE (unique block)

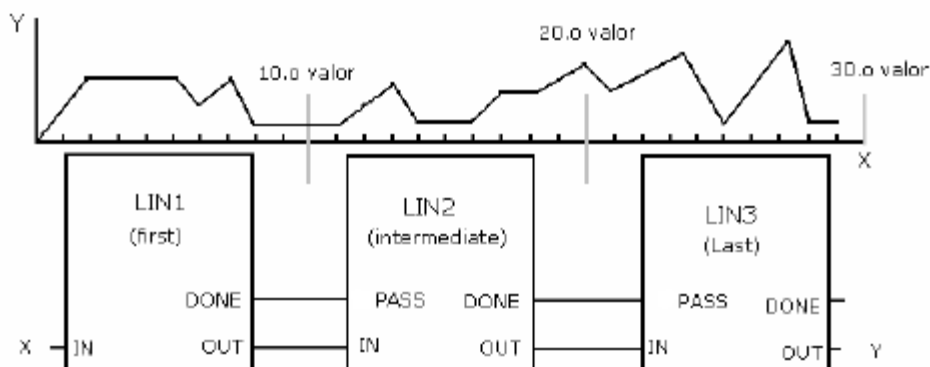
TYPE = 1: FIRST (first block)

TYPE = 2: INTERMEDIATE (intermediate block)

TYPE = 3: LAST (last block)

The **DONE** output must be connected to the **PASS** input of the next **LIN** block. The first block of the arrangement must be set as **FIRST** and all intermediate blocks as **INTERMEDIATE** and the last block as **LAST**.

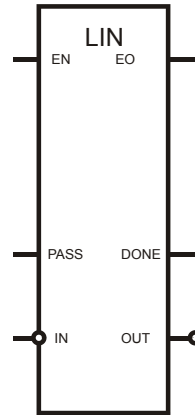
For example, an application that requires 30 points to represent a function will have the following configuration



NOTES

- The pairs (x,y) must be inserted in an increasing order of the “X” values, beginning in the (x1,y1) pair and without jump the indexes.
- It is not necessary to use all 10 points provided by the block for curve generation, but it will be necessary to repeat the values of X and Y of the last point of the desired curve in the other unused items. For example, the curve desired use (x1,y1) until the pair (x5,y5), then the other pairs should be configured with the same values of (x5,y5).
- The values inserted for the coordinate X must be the same type (values in percent or engineering unit) of the **IN** input value and the values inserted for the coordinate Y must be the same type of the expected value in the **OUT** output.

LIN – LINEARIZATION



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	PASS	PASSES THE INPUT TO THE OUTPUT WITHOUT ANY PROCESSING	BOOL
	IN	BLOCK INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	DONE	ENABLES THE NEXT LIN BLOCK IN AN APPLICATION IN SERIES.	BOOL
	OUT	BLOCK OUTPUT	FLOAT
P	TYPE	DEFINES THE SERIAL BEHAVIOR TYPE	LONG
	X1	X TO THE FIRST POINT	FLOAT
	Y1	Y TO THE FIRST POINT	FLOAT
	X2	X TO THE SECOND POINT	FLOAT
	Y2	Y TO THE SECOND POINT	FLOAT
	:		
	X9	X TO THE NINTH POINT	FLOAT
	Y9	Y TO THE NINTH POINT	FLOAT
	X10	X TO THE LAST POINT	FLOAT
	Y10	Y TO THE LASTPOINT	FLOAT
PERC	SELECTS THE OUTPUT FORMATS (REAL OR INTEGER NUMBERS)	BOOL	

I: Input. P: Parameter. O: Output

LEAD LAG (LLAG)

Description:

This is a dynamic compensation block that may operate with a derivative function as well as with a lead-lag compensation function. Selection of either function is done with parameter **DER**.

The LLAG block provides dynamic compensation of the **IN** parameter. The user would configure the **K1** and **K2** parameters to obtain the desired input/output relationship.

DERIVATIVE FUNCTION (DER = true)

While operating in the derivative mode, the block performs the following transfer function:

$$O(s) = \frac{T_D s}{1 + T s} I(s)$$

Where

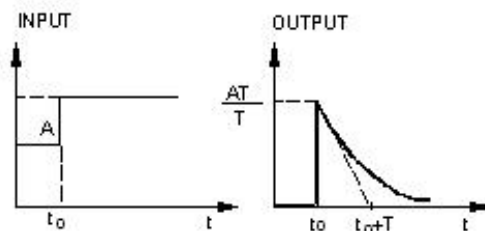
$I(s)$ and $O(s)$ - Laplace transform of input and output signals, respectively.

T_D - Derivative constant, adjusted by **K2** parameter (seconds)

T - "Lag" constant, adjusted by **K1** parameter (seconds)

When $T > 0$, the output signal represents the input rate of change in the period determined by T_D . For example, if the signal input varies at a rate of 15% per second and $T_D = 6$ seconds, the output signal will be $15 * 6 = 90\%$ while the input signal keeps its rate of change. The output returns to zero when the input becomes constant.

When $T < 0$, the output signal is submitted to a lag. The response to a step signal with amplitude A is shown in the next figure.



Response of derivative function with a lag at IN input

This function is used when the rate of change of a variable is desired.

LEAD-LAG FUNCTION AND TIME CONSTANT (DER=false)

When operating in the lead-lag mode, the block implements the following transfer function.

$$O(s) = \frac{1 + T_D s}{1 + T s} I(s)$$

Where

T_D - "Lead" constant, adjusted by **K2** parameter (seconds)

T - "Lag" constant, adjusted by **K1** parameter (seconds)

The **K1** parameter specifies the time constant for the block. Based on a step change in the input this is the time to reach 63.2% of the step value.

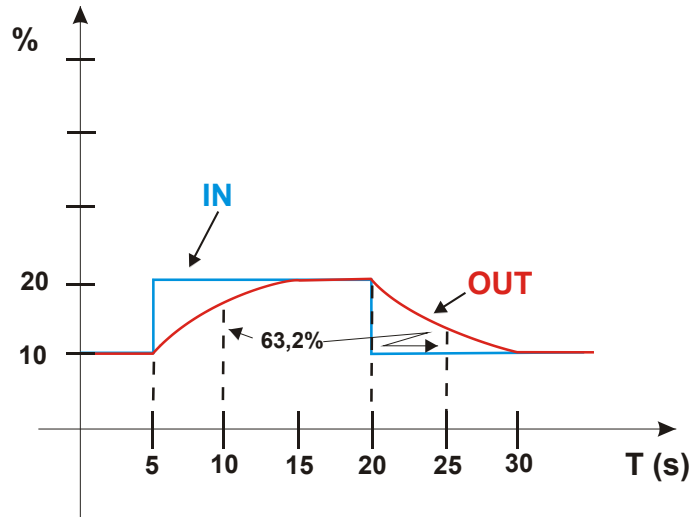
The **K2** parameter specifies the gain or impulse applied to the input.

In both cases, the **FLW** parameter forces the output to track the input. In this way, when **FLW** is true, the **OUT** output will have the input value, and the lead-lag algorithm will not be executed.

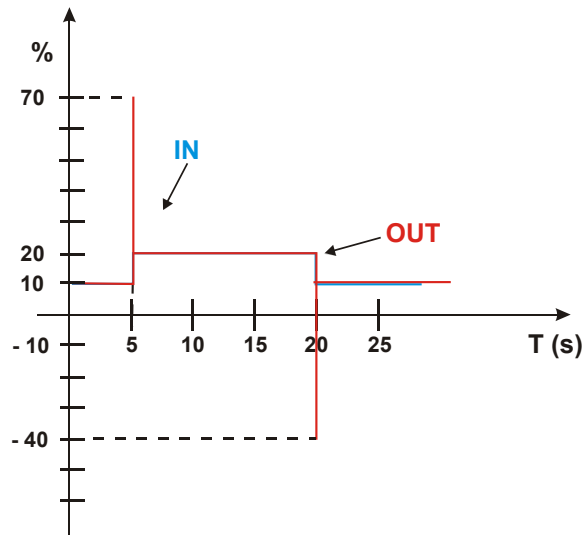
Applications Examples:

Initially, it considers an input signal $IN = 10$. This input receives a positive step change equals to 10% in $t = 5s$. In $t = 20s$, the input receives a negative step change equals to 10%. The LLAG action can be observed for the following cases:

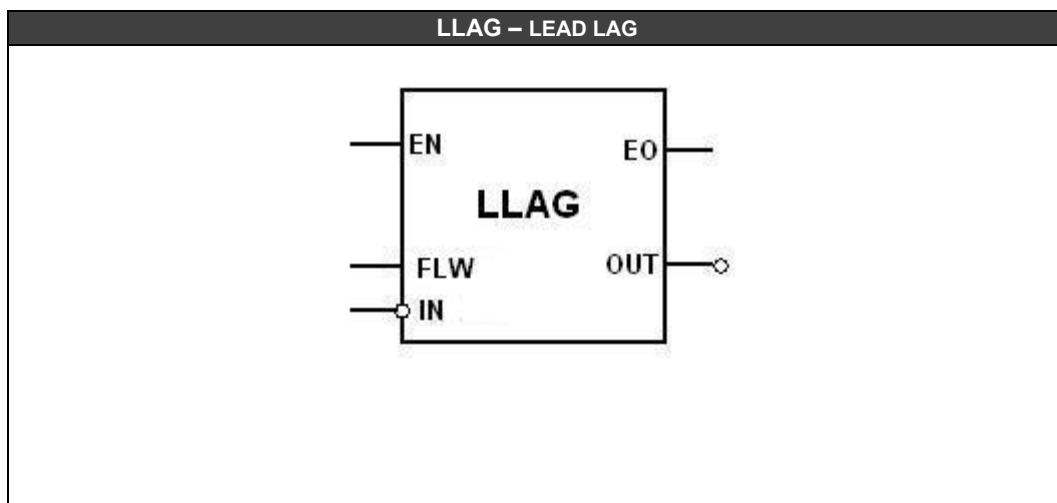
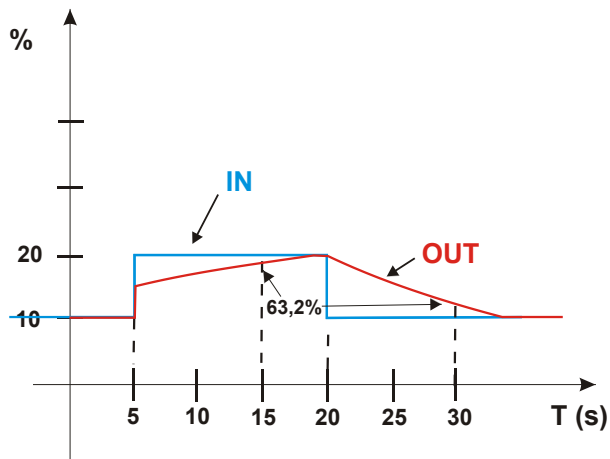
1) $K2 = 0$ and $K1 = 5$



2) $K2 = 5$ and $K1 = 0$



3) $K_2 = 5$ and $K_1 = 10$



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	INPUT VALUE	FLOAT
	FLW	OUTPUT FOLLOWS THE INPUT	BOOL
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	FLOAT
P	K1	FILTER'S CHARACTERISTIC TIME IN SECONDS, AND A FIRST ORDER EXPONENTIAL FILTER.	FLOAT
	K2	LEAD CONSTANT TIME (IN SECONDS)	FLOAT

I: Input. P: Parameter. O: Output

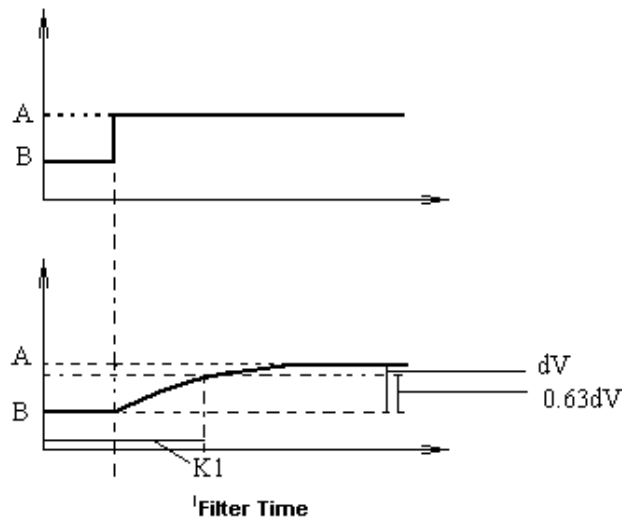
Mathematical Equation for Signal Processing (MATH)

Description

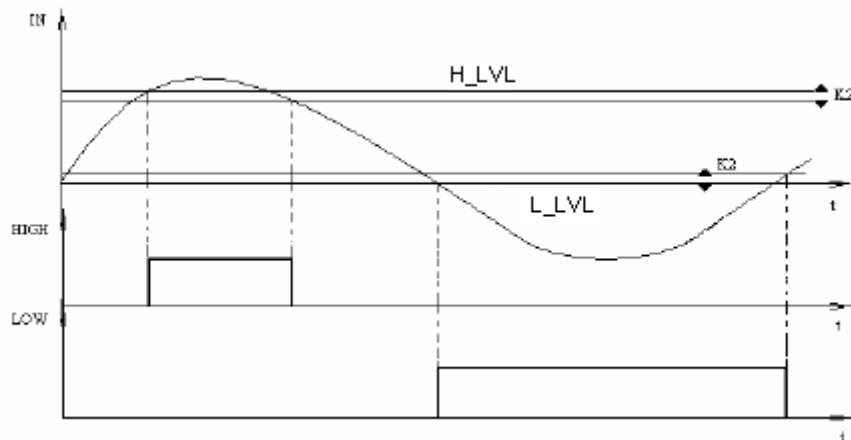
This function, when **EN** is true, uses an equation that filters the input signal. The filter used is a first order exponential filter. The **IN1** input receives the signal.

Characteristic Filter Time (K1)

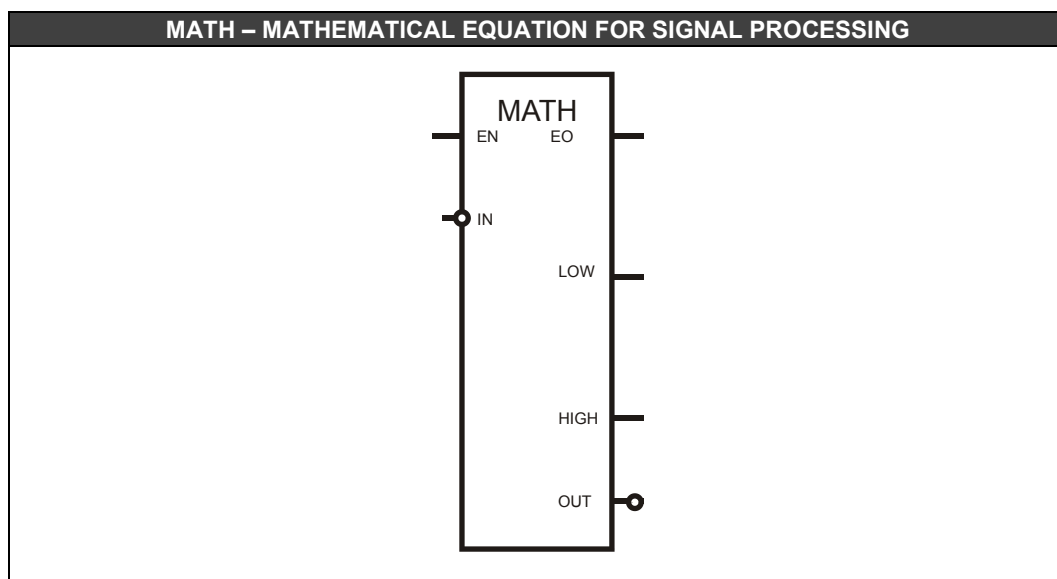
The **K1** parameter is the characteristic time filter in seconds. Consider a step input. When the output signal reaches 63% of the step value, the time measured until this moment is defined as characteristic time.



Hysteresis K2 and HIGH and LOW alarms



When the input reaches the value set in **H_LVL**, the **HIGH** output will change to true until the input goes beyond $(H_LVL - K2)$. Similarly, when the input reaches **L_LVL**, the **LOW** output will go to true until the input goes beyond $(L_LVL + K2)$.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	IN	PROCESSING SIGNAL	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	LOW	BOTTOM LIMIT ALARM	BOOL
	HIGH	UPPER LIMIT ALARM	BOOL
	OUT	OUTPUT AFTER FILTER	FLOAT
P	K1	CHARACTERISTIC TIME IN SECONDS. IT IS A FIRST ORDER EXPONENTIAL FILTER.	FLOAT
	K2	HYSTERESIS ALARM PROCESSING HIGH AND LOW. IT MUST BE A NON NEGATIVE VALUE	FLOAT
	L_LVL	LOWER LIMIT FOR ALARM PROCESSING AFTER THE DIGITAL FILTER.	FLOAT
	H_LVL	UPPER LIMIT FOR ALARM PROCESSING AFTER THE DIGITAL FILTER.	FLOAT

I: Input. P: Parameter. O: Output

PID Controller (PID)

Description:

This function, when **EN** is true, does the PID controller. The acclaimed PID algorithm for continuous process control, associated with the configuration flexibility of the operation settings through parameterization, allows the utilization of this block to a variety of applications and control strategies.

This block supplies several options of algorithm settings having as a basis the Proportional (P), Integral (I) and Derivative (D) terms that may be applied in error or just to the process variable (PV).

The user may set limits of anti-reset windup (only applied to the integral term). Besides, the user might choose the type of the PID algorithm: ISA or parallel, direct action or reverse, manual to automatic transference bumpless or hard.

Selecting the SP, PV and FB inputs formats and the OUT output format (PERC parameter)

PERC = false: the **SP**, **PV** and **FB** input values and the **OUT** output value are given in percentage (0 – 100%).

PERC = true: the **SP**, **PV** and **FB** input values and the **OUT** output value are given in 0 – 10000 format.

PID Type

It is defined by the **PID** parameter.

PID = 0: PI.D type.

PID = 1: PID type.

PID = 2: I.PD type.

PI.D: P and I actions act over the error and the D action over the process variable. In this way, the output signal tracks set point changes according to the proportional and integral action, but there is no undesired variation due to the derivative action. It is the most recommended type for most applications with set point adjustable by the user.

PID: P, I and D actions act over the error thus the output signal is changed when there are changes in the processes variable or in the set point. It is recommended for ratio control or to cascade slave control.

I.PD: In this type only the integral action acts over the error. The set point changes produce soft output signal variations. It is recommended for a process that cannot have sudden changes in the variable due to the set point change. It is the case of heating process with high gain.

Algorithm Type

It is defined by the **ALG** parameter.

ALG = false: Parallel algorithm

ALG = true: ISA algorithm

$$PARALLEL : MV(t) = K_p e(t) + \frac{1}{T_R} \int e(t) dt + T_D \frac{de(t)}{dt}$$

$$ISA : MV(t) = K_p \left[e(t) + \frac{1}{T_R} \int e(t) dt + T_D \frac{de(t)}{dt} \right]$$

Action Type

Some processes require that the output signal (manipulated variable-MV) does not increase when the process variable increases, while most of the other applications require the opposite.

PARAMETER	ACTION TYPE	ERROR	EFFECT
ACT = false	Reverse	$e = SP - PV$	Output decreases with the increase of PV.
ACT = true	Direct	$e = PV - SP$	Output increases with the increase of PV.

TRF input

If the **TRF** input is true, the PID will be in manual control. If **TRF** is false the PID will be in automatic control.

Type of transference from Manual to Automatic

It is defined by the **TRS** parameter.

TRS = 0: bumpless & **FB** input does not connected.

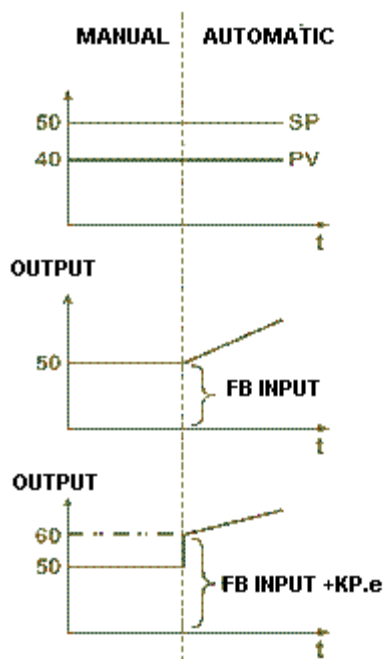
TRS = 1: bumpless & **FB** input connected.

TRS = 2: hard & **FB** input does not connected.

TRS = 3: hard & **FB** input connected.

Bumpless: During switching from manual to automatic, the PID block will start calculations from the last manual value, i.e., there is not a jump in the block output.

Hard: During switching from manual to automatic, the PID block will supply as first value in automatic the last manual value plus the proportional term.



Anti Saturation by the integral term (AWL and AWU)

Usually the control algorithm automatically stops the contribution of the integral mode when the output signal reaches the 0 or 100% limits. Contributions of proportional and derivative modes are not affected.

A unique characteristic of the algorithm is the possibility to set these limits. For example, in narrowing those limits through the **AWL** and **AWU** parameters, we can get faster answers while avoiding overshoot in the heating process.

PID Constants (KP, TR, TD and BIAS)

KP –Proportional Gain

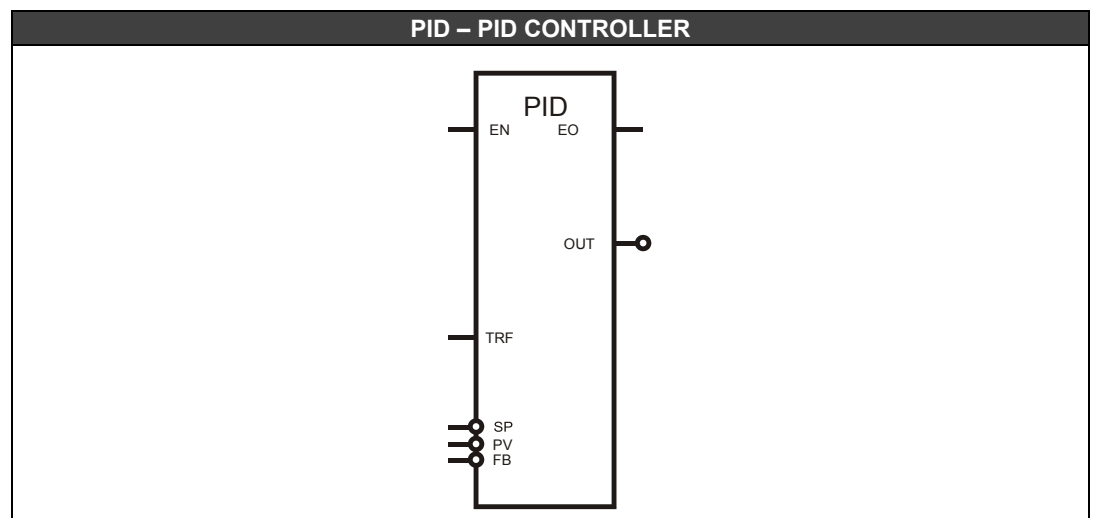
TR – Integral time in minutes per repeats, so, the larger is this parameter the shorter is the integral action. It can be interpreted as the necessary time to the output to be increased or decreased of the error value (Parallel PID), keeping it constant.

TD – Derivative time is given in minutes. The derivative time is calculated using a false derivation, i.e., an action similar to a lead/lag controller, in which the lag constant is Alfa***TD**. In this block implementation the Alfa factor is equal to 0.13.

BIAS – This parameter will allow the adjustment of the initial output value when the control is transferred from manual to automatic. This can be done only if the **FB** input is disconnected.

NOTE

BIAS, AWL and AWU are percentage values.



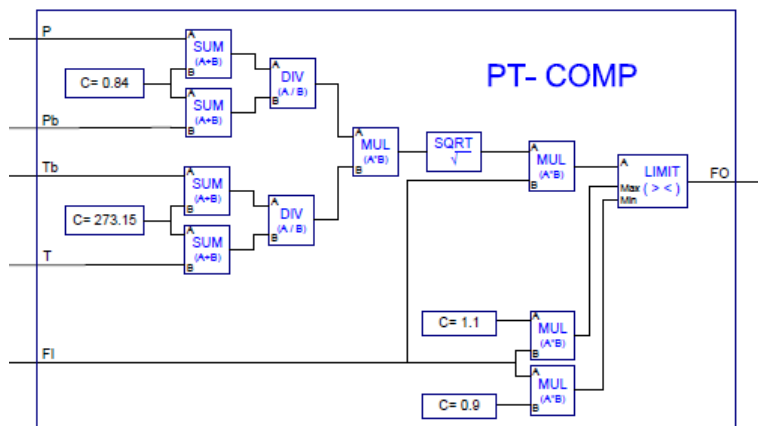
CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	TRF	SELECTS MANUAL OR AUTOMATIC WORKING	BOOL
	SP	SETPOINT	FLOAT
	PV	PROCESS VARIABLE	FLOAT
	FB	IF TRF IS TRUE, THE INPUT CONNECTED TO FB IS PASSED TO THE OUTPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT (MANIPULATED VARIABLE)	FLOAT
P	KP	PROPORTIONAL GAIN	FLOAT
	BIAS	BIAS	FLOAT
	AWL	ANTI-RESET FINAL LOWER LIMIT	FLOAT
	AWU	ANTI-RESET FINAL UPPER LIMIT	FLOAT
	TR	INTEGRAL TIME (MIN/REP)	FLOAT
	TD	DERIVATIVE FACTOR (MIN)	FLOAT
	PERC	SELECTS THE INPUT AND THE OUTPUT FORMATS BETWEEN "0 - 10000" AND "0 - 100%"	BOOL
	TRS	DEFINES THE TRANSFERENCE TYPE AUTOMATIC TO MANUAL	FLOAT

I: Input. P: Parameter. O: Output

Pressure and Temperature Compensation (PTC)

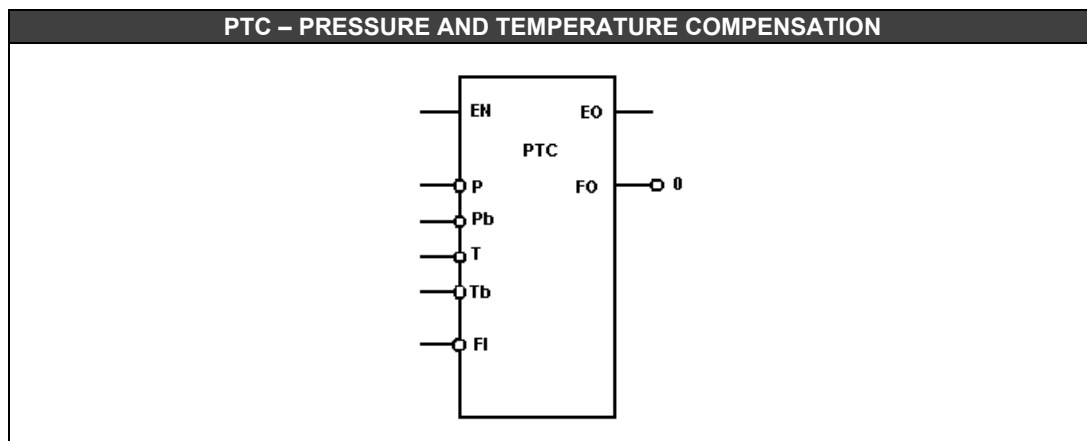
Description

This function block, when **EN** is true, performs the pressure and temperature compensation defined by the block diagram and equation as follows:



$$FO = \text{LIMIT} [\text{SQRT}((P + 0.84) / (Pb + 0.84)) * (Tb + 273.15) / (T + 273.15)) * FI]$$

FI = Measured Flow Rate
 P = Measured Pressure [Bar G]
 T = Measured Temperature (Deg C)
 FO = Compensated Flow Rate
 Pb = Base Pressure [Bar G] : To be defined per each case
 Tb = Base Temperature (Deg C) : To be defined per each case



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	P	MEASURED PRESSURE	FLOAT
	Pb	BASE PRESSURE	FLOAT
	T	MEASURED TEMPERATURE	FLOAT
	Tb	BASE TEMPERATURE	FLOAT
	T	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	FO	OUTPUT	FLOAT
P	K1	CONSTANT	FLOAT
	K2	CONSTANT	FLOAT
	K3	CONSTANT	FLOAT
	K4	CONSTANT	FLOAT

I: Input. P: Parameter. O: Output

Set Point Generator (SPG)

Description

The set point generator block is normally used to generate a set point to a PID block in applications like temperature control, batch reactors, etc. In those applications, the set point shall follow a certain profile in function of the time. When **EN** is true, the algorithm is enabled.

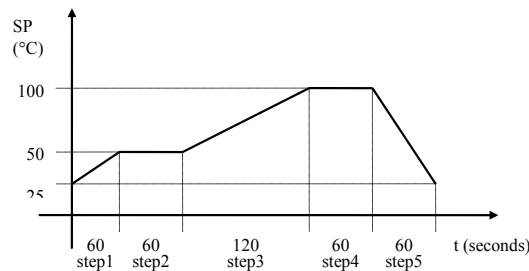
The curve is defined by ten segments or steps. Each segment is defined by initial value [**VALx**] and time duration [**DURx**]. The initial value of the next segment defines if the previous segment will increase, will decrease or will keep constant. The curve is given by:

VALx (Starting value) - Eleven analog point values defining the initial value of each segment, in engineering units.

DURx (Time duration) - Ten analog point values defining the duration, in seconds, of each segment. A zero value defines the last segment.

The two arrays define the set point value (y-axis) in function of the time (t-axis). Between two given points, the set point is calculated by interpolation. As each segment is defined by [**VALx**]_i, [**DURx**]_i and [**VALx**]_{i+1}, a template with "n" segments will need **n+1** starting values and **n** time durations. As example, the two following arrays define the curve shown in the chart below:

	1	2	3	4	5	6
VALx	25	50	50	100	100	25
DURx	60	60	120	60	60	0



Setpoint Curve

The position in the time axis (t-axis) is controlled by an internal timer. This timer is started by a transition from false to true at **STR** input. Once started, it runs up to reach the sum of the durations calculated by **DURx** parameter.

The timer resets (that is, it is positioned in the starting point of the curve), if the **RESET** input is 1. After resetting, a new Start is waited in order to reinitialize the timer again. When the **RESET** input is used and while its value is 1, the block is kept in reset. So, the timer will be available to start only after the **RESET** parameter changes to 0.

Every time that a trigger of SPG block via **STR** happens, necessarily, to do a new trigger, it is necessary first to do a **RESET**.

The timer may be interrupted at any moment changing the discrete signal **PAUSE** from false to true. The timer will reinitialize when **PAUSE** is set to false and none condition interrupts the timer.

The timer is also interrupted by a **PAUSE** caused by a deviation between **BKIN** input and the generated set point (Deviation=**BKIN** – **OUT**). The deviation is set in **ADEV** (percentage). The timer stops and returns to normal operation when the deviation is within the prescribed limits. If the **ADEV** value is 0%, it will not be considered. Another way to discard this value is to connect the **OUT** output to **BKIN** input.

In both cases, which the timer is in **PAUSE**, the **P_ST** output goes to 1.

The set point is in the “y” axis, while the time is in the “t” axis. The set point value is available at output **OUT**.

Three outputs inform the current point of the curve:

ST_PS - Informs the current segment or step.

TM_PN - Informs the time elapsed since the beginning of the current step.

TM_PT - Informs the time elapsed since the beginning of the curve.

When the end of the cycle is reached, the **END** output goes to true, and keeps in this state until the timer's reset. If the **AT_CY** parameter is true, the cycle is continually repeated until the timer is reset or paused.

The time scale (seconds, minutes or hours) is configured through the **TIME** parameter.

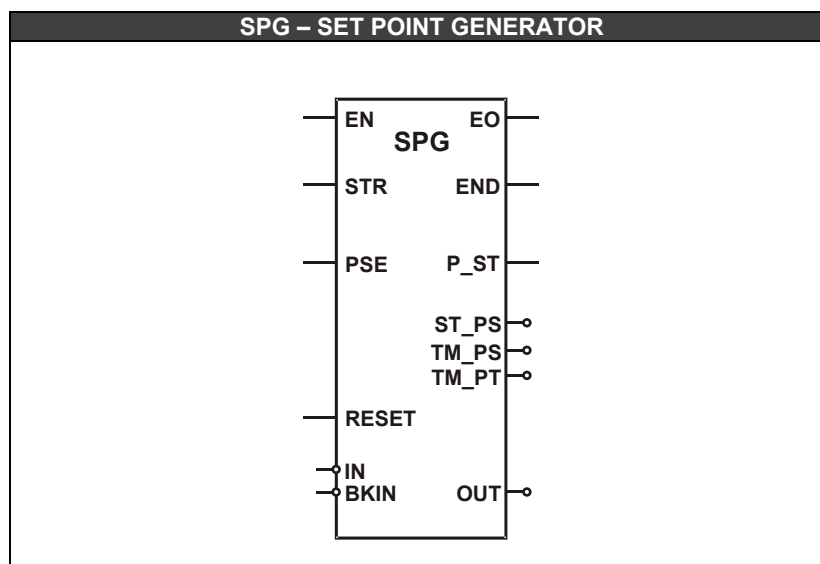
The **TRK** parameter indicates to the timer if it will start from table's beginning (**None**), from a specific time value (**Time**), or from a specific value of engineering unit (**Value**). If **Time** or **Value** is configured, the beginning is defined in the **IN** input.

Through the **TIME** parameter the time scale is configured in seconds, minutes or hours. The **TRK** parameter indicates to timer if it will start from the beginning of the table (**None**), from a specific time value (**Time**) or from a specific value in engineering units (**Value** or **Segm**).

In case of **Value**, it will start from the first point found in the curve, independent of the segment. In case of **Segm**, it will start from a specific value in engineering unit, inside a specific segment if it was defined in **SEGM** parameter. In case of **Time**, **Value** or **Segm** is configured, the initial value is defined in the **IN** input.

If **Time** is configured, at **IN** will be the time (initial value) that will start the generation. If **Value** or **Segm** is configured, at **IN** will be the initial curve value that will start the generation. In case **Segm** is configured, also have to be considered in which segment will be the initial value that is configured at **SEGM** parameter.

That is, at **IN** always will be the initial value that may be time or an engineering unit value. If **Time**, **Value** or **Segm** are not configured, they will be **None**, the generation will start at time = 0 s.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	STR	STARTS TIMER	BOOL
	PSE	PAUSES TIMER	BOOL
	RESET	RESETS TIMER	BOOL
	IN	BLOCK INPUT THAT DEFINES THE CURVE'S BEGINNING	FLOAT
	BKIN	INPUT VALUE COMPARED WITH THE OUTPUT TO CALCULATE THE DEVIATION	FLOAT
O	EO	INPUT ENABLED	BOOL
	END	INDICATES CYCLE END	BOOL
	P_ST	INDICATES IF THE ALGORITHM IS IN PAUSE	BOOL
	ST_PS	CURRENT SEGMENT OR STEP	FLOAT
	TM_PS	ELAPSED TIME SINCE THE BEGINNING OF CURRENT STEP (SECONDS)	FLOAT
	TM_PT	ELAPSED TIME SINCE THE BEGINNING OF CURVE (SECONDS)	FLOAT
	OUT	BLOCK OUTPUT	FLOAT
P	VAL1	INITIAL VALUE 1	FLOAT
	VAL2	INITIAL VALUE 2	FLOAT
	:		
	VAL10	INITIAL VALUE 10	FLOAT
	VAL11	FINAL VALUE	FLOAT
	DUR1	TIME OF FIRST SEGMENT	FLOAT
	DUR2	TIME OF SECOND SEGMENT	FLOAT
	:		
	DUR10	TIME OF TENTH SEGMENT	FLOAT
	AT_CY	UNINTERRUPTED CYCLE	BOOL
	TIME	TIME SCALE	LIST
	TRK	TYPE OF BEGINNING OF CURVE	LIST
	SEGM	DEFINES WHICH SEGMENT THE CURVE WILL BEGIN	LONG
	ADEV	MAXIMUM DEVIATION ALLOWED (PERCENTAGE)	FLOAT

I: Input. P: Parameter. O: Output

Sample Hold with Up and Down (SMPL)

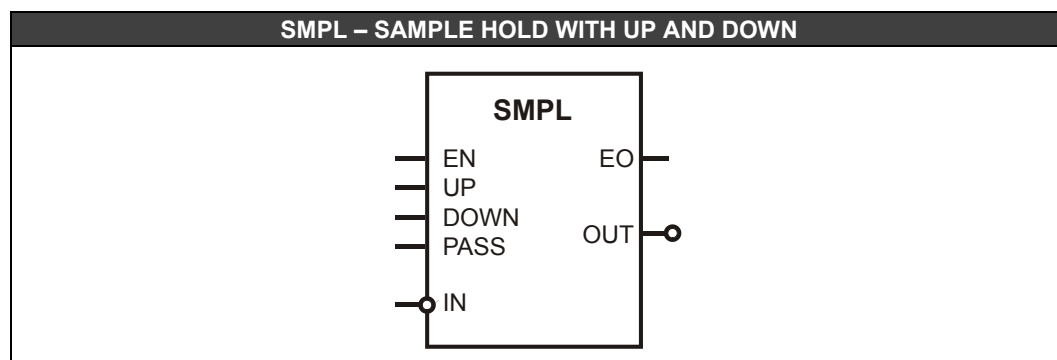
Description:

This function block, when **EN** is true, samples the value of the **IN** input and places it in a register when the **PASS** input changes from true to false. The register value can be increased or decreased using the **UP** and **DOWN** inputs. The speed of this increment or decrement is defined by the **ASPD** parameter. This block may be used with a PID block.

Selecting the IN input and the OUT output formats (PERC parameter)

PERC = false: the **IN** input and the **OUT** output values are given in percentage (0 – 100%).

PERC = true: the **IN** input and the **OUT** output values are given in 0 – 10000 format.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	UP	INCREASES THE COUNTER	BOOL
	DOWN	DECREASES THE COUNTER	BOOL
	PASS	PLACES THE REGISTER VALUE IN THE OUTPUT	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	OUT	OUTPUT	FLOAT
P	ACCEL	ACCELERATION FACTOR - INCREMENT OR DECREMENT	LONG
	ASPD	SPEED OF ACTUATION IN % PER SECOND	LONG
	L_LMT	LOWER LIMIT	FLOAT
	H_LMT	UPPER LIMIT	FLOAT
	PERC	SELECTS THE INPUT AND THE OUTPUT FORMATS BETWEEN "0 - 10000" AND "0 - 100%"	BOOL

I: Input. **P:** Parameter. **O:** Output

CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	EO	OUTPUT ENABLED	BOOL
O	OUT1	MODULE STATUS DEFINED IN RACK1/SLOT1	BOOL
	OUT2	MODULE STATUS DEFINED IN RACK2/SLOT2	BOOL
	OUT3	MODULE STATUS DEFINED IN RACK3/SLOT3	BOOL
	OUT4	MODULE STATUS DEFINED IN RACK4/SLOT4	BOOL
	OUT5	MODULE STATUS DEFINED IN RACK5/SLOT5	BOOL
	OUT6	MODULE STATUS DEFINED IN RACK6/SLOT6	BOOL
	OUT7	MODULE STATUS DEFINED IN RACK7/SLOT7	BOOL
	OUT8	MODULE STATUS DEFINED IN RACK8/SLOT8	BOOL
P	RACK1	MODULE'S RACK WHICH STATUS WILL BE IN OUT1	LONG
	SLOT1	MODULE'S SLOT WHICH STATUS WILL BE IN OUT1	LONG
	RACK2	MODULE'S RACK WHICH STATUS WILL BE IN OUT2	LONG
	SLOT2	MODULE'S SLOT WHICH STATUS WILL BE IN OUT2	LONG
	RACK3	MODULE'S RACK WHICH STATUS WILL BE IN OUT3	LONG
	SLOT3	MODULE'S SLOT WHICH STATUS WILL BE IN OUT3	LONG
	RACK4	MODULE'S RACK WHICH STATUS WILL BE IN OUT4	LONG
	SLOT4	MODULE'S SLOT WHICH STATUS WILL BE IN OUT4	LONG
	RACK5	MODULE'S RACK WHICH STATUS WILL BE IN OUT5	LONG
	SLOT5	MODULE'S SLOT WHICH STATUS WILL BE IN OUT5	LONG
	RACK6	MODULE'S RACK WHICH STATUS WILL BE IN OUT6	LONG
	SLOT6	MODULE'S SLOT WHICH STATUS WILL BE IN OUT6	LONG
	RACK7	MODULE'S RACK WHICH STATUS WILL BE IN OUT7	LONG
	SLOT7	MODULE'S SLOT WHICH STATUS WILL BE IN OUT7	LONG
	RACK8	MODULE'S RACK WHICH STATUS WILL BE IN OUT8	LONG
	SLOT8	MODULE'S SLOT WHICH STATUS WILL BE IN OUT8	LONG

I: Input. P: Parameter. O: Output

Step Control (STP)

Description:

This function is used in combination with the PID block. Connect the PID block output to the **DMV** input to make an ON_OFF or ON_NONE_OFF control. The ON_OFF establishes the open and close control of valves during a particular time interval. The ON_NONE_OFF control allows the open and close control of valves according to the rate of variation in the PID output or in the **DMV** input.

Selecting the DMV input format (parameter PERC)

PERC = false: the **DMV** input value is given in percentage (0 – 100%).

PERC = true: the **DMV** input value is given in 0 – 10000 format.

Valves opening time (VOT)

This parameter must be adjusted with the approximated time that is necessary to open totally the valve or close it totally.

Minimum Pulse Width (WPL)

The user should configure the minimum pulse width per 0.1 seconds through the **WPL** parameter, and the time for total excursion of the control element.

Control Type (CTRL)

The user has to select the control type, i.e., **ON_OFF** or **ON_None_OFF**.

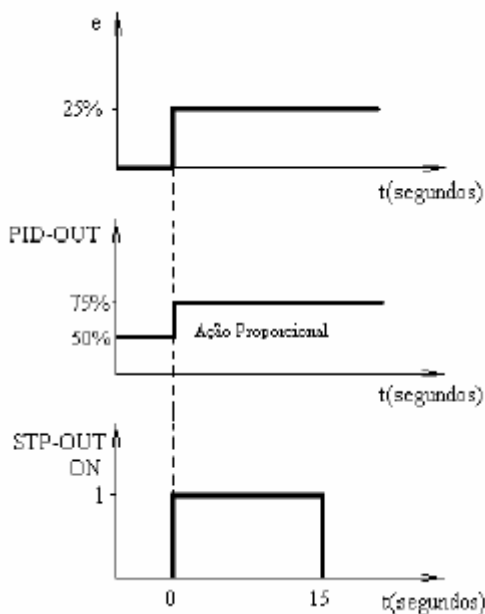
- **ON_OFF Control (CTRL = 1)**

In this control mode, the block compares the **DMV** input with the **ON_T** and **OFF_T** parameters:

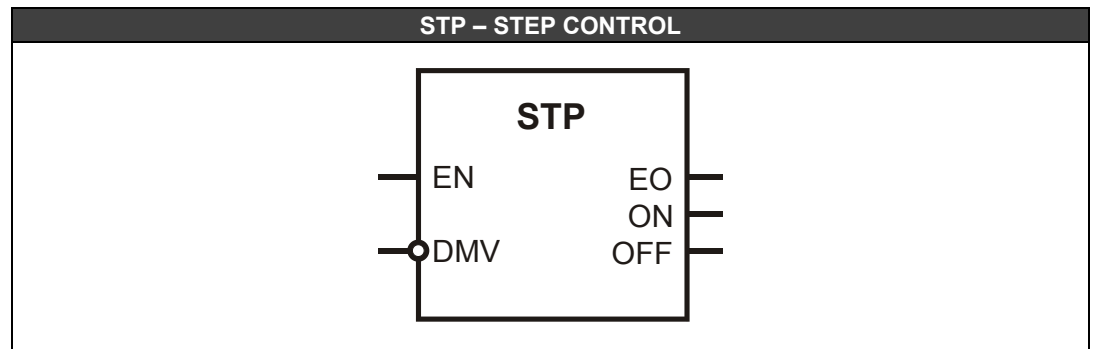
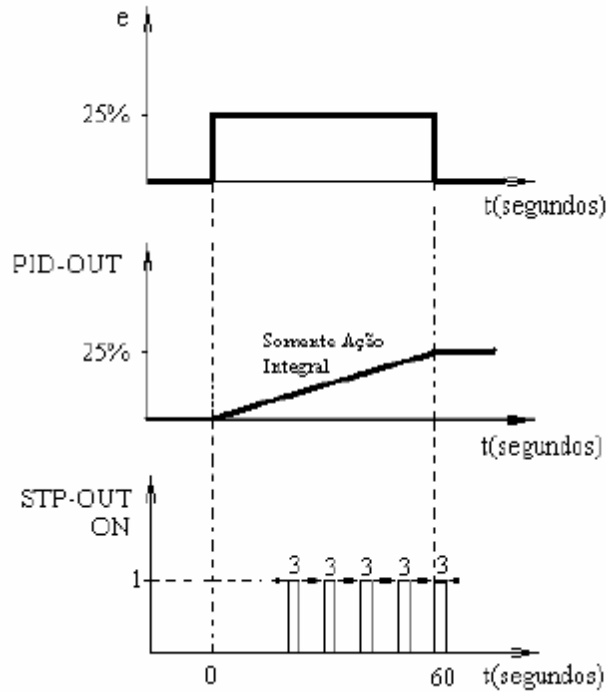
- If the **DMV** input is greater than **ON_T**, the **ON** output is ON (true) and the **OFF** output is OFF (false).
- If the **DMV** input is less than **OFF_T**, the **ON** output is OFF (false) and the **OFF** output is ON (true).
- If the **DMV** input value is between **OFF_T** and **ON_T**, the **ON** and **OFF** outputs will assume the last state.

- **ON_None_OFF control (CTRL = 0)**

A PID that has only the proportional action with gain $K_P=1$ and VOT equal to 1 minute. Suppose that in the instant $t = 0$ a step with error of 25% is applied. Thus, the valve opening is 25% of 1 minute, or $0.25 \cdot TR = 15$ seconds. The figure below shows this example:



Integral action of a PID is equal to a series of pulses with minimum size equal to **WPL** and the frequency determined by the integral time of the PID block (TR) and by the control deviation. The pulse frequency is given by the TR value. The **WPL** value is fixed and determined during the block setting. Suppose TR= 1 minute and WPL= 3 seconds and a step with error of 25% is applied in the input. A standard controller would increase or decrease the output of 25% on 1 minute (TR). To make the valve have an opening time (VOT) equal to 1 minute, 15 seconds are needed (25% of 60 seconds), because WPL= 3 seconds. So, 5 pulses with width equal to 3 seconds are required. The output remains in this functioning mode while the PID output keeps the same rate of change.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	DMV	BLOCK INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	ON	HIGH LEVEL OUTPUT (OPEN)	BOOL
	OFF	LOW LEVEL OUTPUT (CLOSE)	BOOL
P	VOT	VALVE OPENING TIME IN 0.1s	FLOAT
	WPL	MINIMUM PULSE WIDTH PER 0.1s	FLOAT
	CTRL	CONTROL TYPE	LONG
	PERC	SELECTS THE INPUT AND THE OUTPUT FORMATS BETWEEN "0 - 10000" AND "0 - 100%"	BOOL
	ON_T	THRESHOLD (%) TO SET THE ON OUTPUT	FLOAT
	OFF_T	THRESHOLD (%) TO SET THE OFF OUTPUT	FLOAT

I: Input. P: Parameter. O: Output

Totalization (TOT)

Description:

This block gives the input totalization. This totalization is the integral of the input times a scale factor FCF that allows the user to configure the totalization in 3 different operation modes. If your application requires the computing of instantaneous totalized volume, use the TOT function block to accomplish this task. The time basis of this calculation is seconds.

The flow generally is given in Engineering Units (EU) by units of time. For example:

A 1 m³/s flow as input of the TOT function block will have as output volume in m³. Suppose the application needs the energy value of an electrical device. The TOT block allows calculating the value of this energy by the instantaneous power expression:

$$Energy = \int Pot(t)dt$$

and Pot(t)= V(t).I(t), where V(t) is the instantaneous voltage and I(t) is the instantaneous current.

OUT output and TU parameter

The time interval while the output is totalized is according to the value set in **TU**. The integration (totalization) is kept in an internal register that goes up to 8000000 units. The **OUT** output is the totalization value.

The dl output

The maximum totalization value is 8000000 and the minimum is -8000000. Every time the function block output reaches these values the **dl** output changes from false to true during a time interval. The **dl** output is a counter that counts how many times this "false to true" operation was done.

FCF parameter

The **FCF** parameter allows the TOT function block to operate in 4 different modes:

a) **IN** is FLOAT and represents flow in Engineering Units (EU):

FCF must be equal to 1 to the totalization is done without any EU scale factor. (or adjust the factor that you wish to use) For example:

The "**Q**" flow is measured in m³/h. One hour has 3600 seconds. So, the **TU** value must be equal to 3600. Suppose a constant flow of 60 m³/h. The totalization is given by the expression:

$$TOT(t) = \int_0^{t(\text{seconds})} \frac{FCF}{TU} * IN(t)dt = \int_0^{t(\text{seconds})} \frac{1}{3600} * 60dt = \int_0^{t(\text{seconds})} \frac{1}{60} dt [m^3]$$

So, after 1 minute or 1/60 hour or 60 seconds the TOT value will be:

$$TOT[m^3] = \int_0^{60} \frac{1}{60} dt = 1m^3$$

Each 1/60 hours or each 1 minute the block totalizes the input and shows this value in the output.

Since:

60 m3 _____ 1 hour

1 m3 _____ t (time interval when the totalization is displayed)

So, t= 1/60 h or 1 minute.

b) **IN** is FLOAT and represents the flow in percentage:

In this case the input will be seen as a percentage represented by a float number in the range 0 to 100%. **FCF** must be equal to the maximum flow value in engineering units (flow at 100%) to the totalization to be given in EU. The **TU** parameter setting is similar to the previous item. The totalization will be displayed in the EU configured.

c) **IN** is INTEGER:

In this case the input will be interpreted as an integer number in the range 0 to 10000 (0% and 100%, respectively). **FCF** must be equal to the maximum flow in EU divided by 10000. Suppose a maximum flow of 1 m³/s and a constant flow of 0.5 m³/s. The **FCF** value is equal to the maximum flow divided by 10000, or 0.0001. The **TU** value, in this case, is 1 because the totalization unit is m³. A 0.5 m³/s input is equal to 5000 or 50 % of the scale. Thus:

$$OUT = \int_0^t \frac{FCF}{TU} * IN\%(t)dt = \int_0^t 0.0001 * 5000dt = 0.5t(m^3)$$

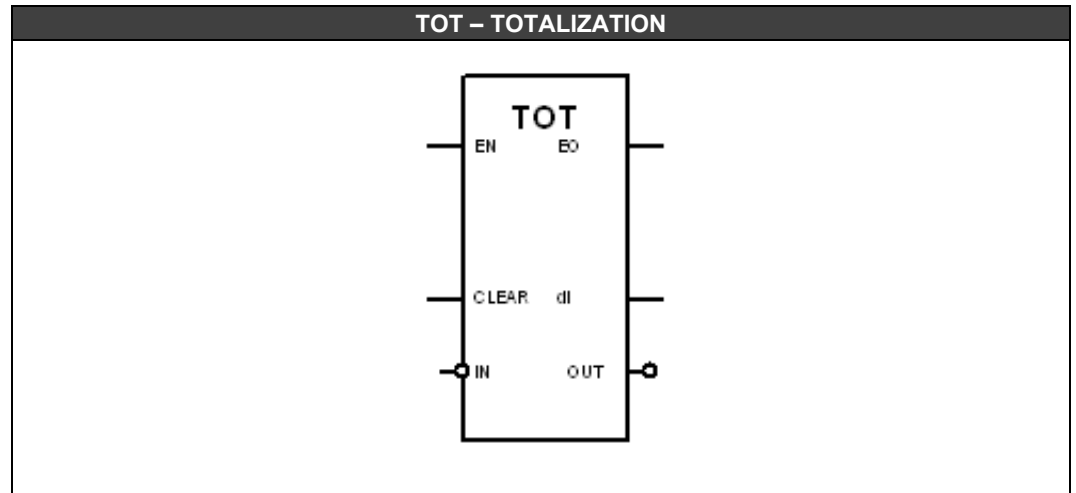
So, in one minute (or 60 seconds) the totalized value is 30 m³.

d) **FCF** is less than zero:

When the block is totalizing a negative flow, the totalization is decreased. When the flow is positive the totalization is increased. When **FCF** is greater than zero, i.e. positive, the TOT function block only accepts positive flows.

CLEAR Input

If the **CLEAR** input is changed to true, the totalization is restarted and the internal registers of the TOT function block are cleared.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	CLEAR	CLEAR THE TOTALIZATION	BOOL
	IN	INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	dl	ALARM WHICH INDICATES WHEN THE TOTALIZATION REACHES -8.000.000 OR 8.000.000. IN THIS CASE dl= ON.	BOOL
	OUT	TOTALIZED OUTPUT	FLOAT
P	TU	TOTALIZATION VALUE FOR ONE UNITY OF COUNTING	FLOAT
	FCF	FACTOR OF FLOW RATE	FLOAT

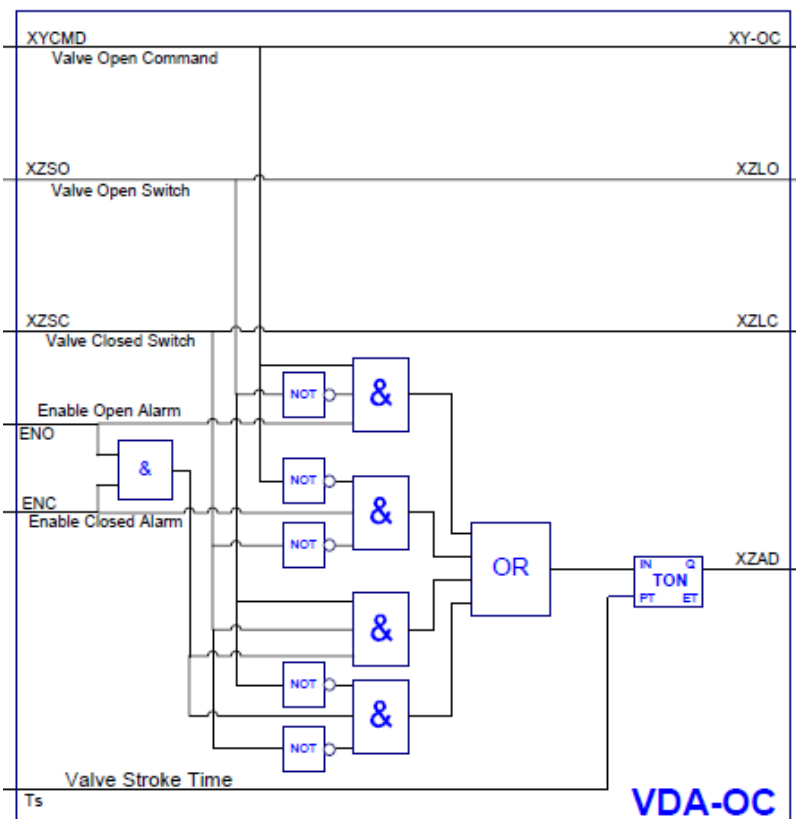
I: Input. P: Parameter. O: Output

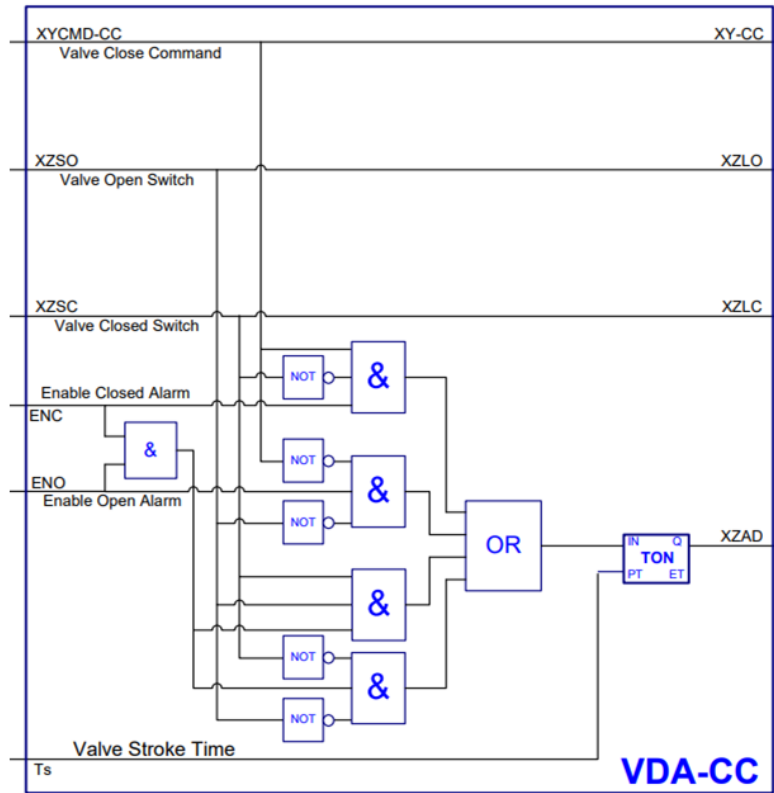
Open Command Valve Discrepancy Alarm (VDA-OC) Close Command Valve Discrepancy Alarm (VDA-CC)

Description:

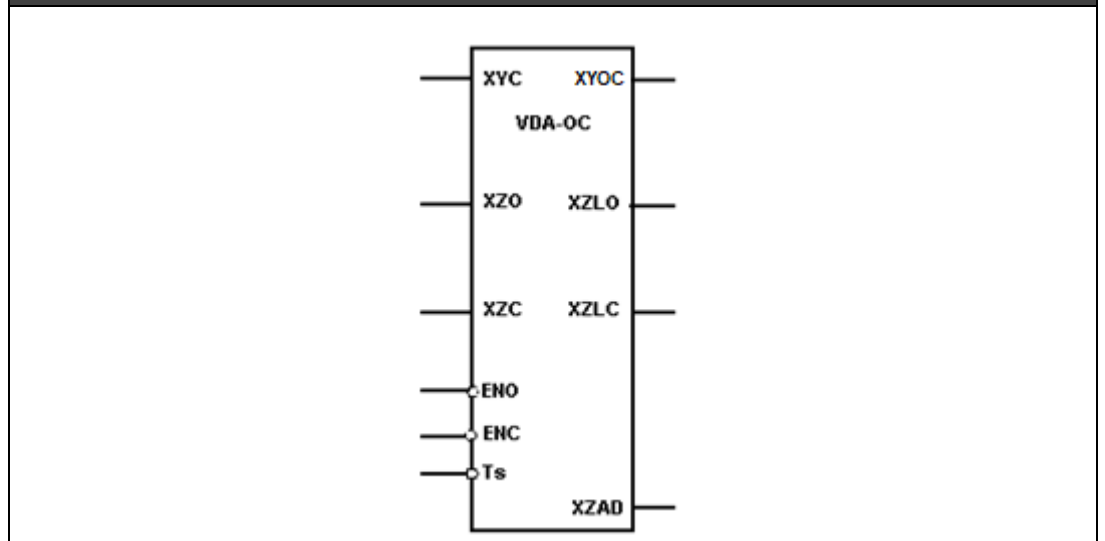
These function blocks perform the valve opening and closing control, defined by the diagrams below.

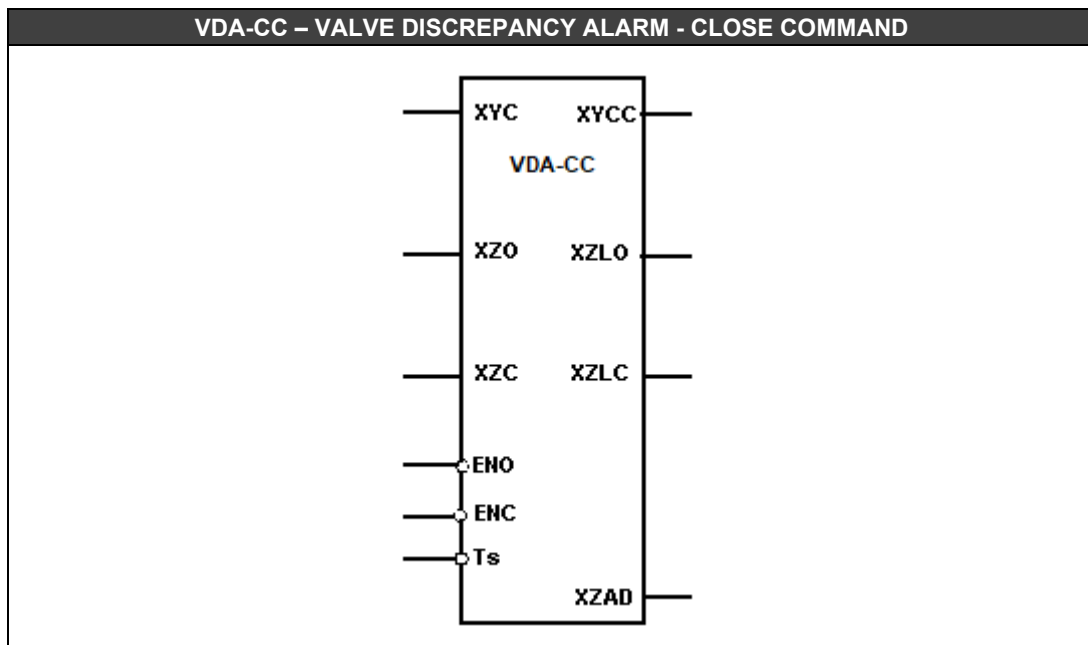
An alarm is generated at the **XZAD** output of the respective function block if the valve does not respond to the opening or closing command within the time defined by the user at **Ts** input for it to reach the limit switch.





VDA-OC – VALVE DISCREPANCY ALARM - OPEN COMMAND





CLASS	MNEM	DESCRIPTION	TYPE
I	XYC	INPUT ENABLED	BOOL
	XZO	VALVE OPEN SWITCH	BOOL
	XZC	VALVE CLOSED SWITCH	BOOL
	ENO	ENABLE OPEN ALARM	BOOL
	ENC	ENABLE CLOSED ALARM	BOOL
	Ts	INTERNAL TIMER INPUT	LONG
O	XYOC	OUTPUT ENABLED	BOOL
	XYCC	OUTPUT ENABLED	BOOL
	XZLO	VALVE OPEN SWITCH STATUS	BOOL
	XZLC	VALVE CLOSED SWITCH STATUS	BOOL
	XZAD	OUTPUT	FLOAT

I: Input. P: Parameter. O: Output

Cross Limit and Rate-Of-Change (XLIM)

Description:

This function, when **EN** is true, limits a signal between static and dynamic values and also controls the rate of change. The **OUT** output (%) is the filtered result of the **A** input (%).

Selecting the A and B input formats and the OUT output format (PERC parameter)

PERC = false: the **A** and **B** input values and the **OUT** output value are given in percentage (0 - 100%).

PERC = true: the **A** and **B** input values and the **OUT** output value are given in 0 – 10000 format.

Static and Dynamic Limitation

- Static

To limit statically a signal, the **B** input is disconnected. The **A** signal is limited between **BL** and **BH** (user's settings).

- Dynamic

If the **B** input is connected, it is possible to limit dynamically the **A** input through the **B** input. To achieve more flexibility, these limits are changeable with individual gain and bias.

Rate of Change (MODE parameter)

The rate of change limit may be applied in three ways, increasing, decreasing or in a specific direction. There are 4 types of rate of change available:

MODE = 0 : none direction is verified.

MODE = 1: verify only the negative direction.

MODE = 2: verify only the positive direction.

MODE = 4: verify both directions.

BL and BH Parameters

If $A \leq BL$ the **OUT** output is equal to **BL**.

If $BL < A < BH$ the **OUT** output is equal to **A**.

If $A \geq BH$ the **OUT** output is equal to **BH**.

GH and GL Parameters

If $A \leq B \cdot GL + BL$, the **OUT** output is equal to **B · GL + BL**.

If $B \cdot GL + BL < A < B \cdot GH + BH$, the **OUT** output is equal to **A**.

If $A \geq B \cdot GH + BH$, the **OUT** output is equal to **B · GH + BH**.

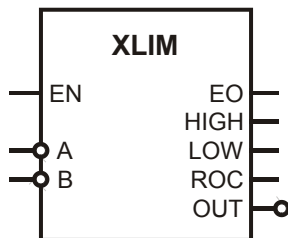
DB Parameter and LOW and HIGH Outputs

This function has two outputs to indicate if the low (**LOW**) or high (**HIGH**) limits were reached. The **DB** parameter can be adjusted to generate a hysteresis, avoiding output oscillation while the variable is close to the limit value.

RAT Parameter and ROC Output

The **ROC** output goes to true when the signal rate of change reaches the value set in the parameter **RAT**. When the **A** input changes faster than **RAT**, the variation in the output is kept inside the value fixed by **RAT** until the **A** input signal decreases to a value inferior to **RAT**. The **ROC** alarm in this interval is on high logic level.

XLIM – CROSS LIMIT AND RATE-OF-CHANGE



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	A	A INPUT	FLOAT
	B	B INPUT	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	HIGH	UPPER LIMIT ALARM	BOOL
	LOW	LOWER LIMIT ALARM	BOOL
	ROC	ALARM OF RATE OF CHANGE	BOOL
	OUT	OUTPUT	FLOAT
P	MODE	VERIFY BOTH/ONLY POSITIVE/ONLY NEGATIVE/NONE	LONG
	GL	BOTTOM LIMIT GAIN	FLOAT
	BL	BOTTOM LIMIT BIAS	FLOAT
	GH	UPPER LIMIT GAIN	FLOAT
	BH	UPPER LIMIT BIAS	FLOAT
	DB	DEAD ZONE (HYSTHERESIS) %	FLOAT
	RAT	SPEED OF MAXIMUM VARIATION % PER SECOND	FLOAT
PERC	SELECTS THE INPUT AND THE OUTPUT FORMATS BETWEEN "0 - 10000" AND "0 - 100%"	BOOL	

I: Input. P: Parameter. O: Output

Input/Output Functions

Pulse Accumulator (ACC)

Description

The Pulse Accumulator Block works with the DF41, DF42, and DF67 Modules (Modules of pulse inputs) with the purpose of accumulating pulses that are coming from an external source. The pulse input is configured in the **IN** input parameter.

IMPORTANT

The **IN** parameter has to be configured obligatorily with the slot's specific point where the module is inserted. The rule for filling is **RRSGP** where RR: rack, S: slot, G: group (0 or 1) and P: point (0 to 7). Examples:

- 214 – Rack 0, slot 2, group 1 and point 4.
- 12307 – Rack 12, slot 3, group 0 and point 7.

When the **EN** input is true (logical level 1), at each control cycle, the pulses accumulated in the module are read and added to the **TOT** accumulator. After the pulses are read, the pulse accumulator module is cleared and a new counting begins. To clear the **TOT** pulse counter, it is necessary a false to true logic state transition in the **CLRA** input.

The Q output

This function block can also give the information of “pulse speed” (flow) in a time interval that can be configured by the user in the **MP** parameter. The **Q** output will keep showing an updated value of accumulated pulses on each **MP** time interval.

The MEM output

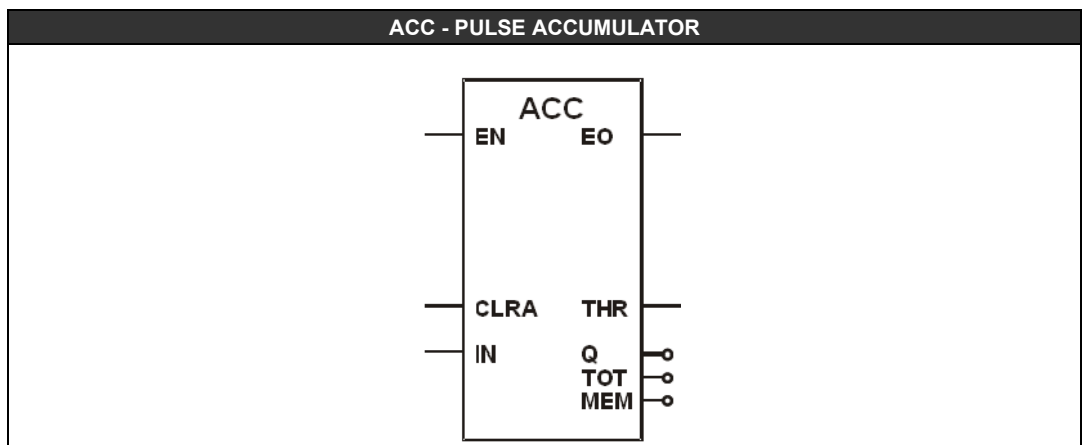
The **MEM** output is updated with the pulses accumulated in **TOT** after the counter is cleared, that is, in an ascending transition in **CLRA** input the **TOT** counter is cleared and its current value is sent to the **MEM** output.

The THR output

The **THR** (Threshold) output is controlled by the **TR_ON** and **TR_OFF** parameters (DF41, DF42 or DF67 module configuration parameters). At each **MP** time period, it is verified if the number of pulses accumulated is greater than **TR_ON** or less than **TR_OFF**. If the number of pulses is greater than **TR_ON**, the **THR** output will be set on logic level 1 and will only be set on logic level 0 if the accumulated value is less than **TR_OFF**.

Accumulator Mode

The ACC function block accumulates pulses in the **TOT** register. The **TOT** counting is from 0 to $(2^{32} - 1)$.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	CLRA	CLEARs THE ACCUMULATOR	BOOL
O	EO	OUTPUT ENABLED	BOOL
	THR	THRESHOLD OUTPUT	BOOL
	Q	PULSES ACCUMULATED IN MP PERIOD	LONG
	TOT	ACCUMULATED PULSES VALUE	LONG
	MEM	ACCUMULATED PULSE VALUES PROCEEDING FROM CN THAT ARE TRANSFERRED TO MEM	LONG
P	IN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

Pulse Accumulator (ACC_N)

Description

This function block is similar to the previous block, except for the numbers of inputs and pulse accumulators and also because there is no flow indication. It can work with four pulse inputs. They are configured in the **IN1**, **IN2**, **IN3** and **IN4** parameters.

IMPORTANT

The **IN1** to **IN4** parameters have to be configured obligatorily with the slot's specific points where the module is inserted. The rule for filling is **RRSGP** where RR: rack, S: slot, G: group (0 or 1) and P: point (0 to 7). Examples:

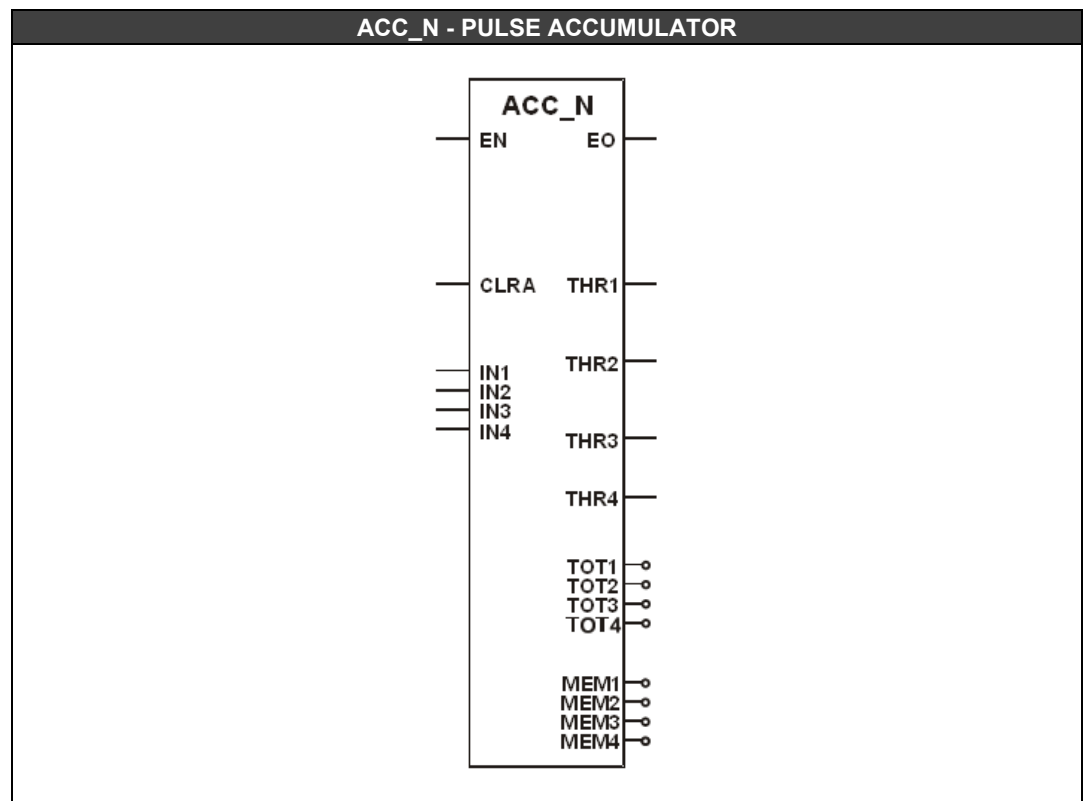
- 214 – Rack 0, slot 2, group 1 and point 4.
- 12307 – Rack 12, slot 3, group 0 and point 7.

In an ascending transition in the **CLRA** input all **TOT** counters are cleared simultaneously. The accumulated values in **TOT1**, **TOT2**, **TOT3** and **TOT4** are transferred to the **MEM1**, **MEM2**, **MEM3** and **MEM4** outputs.

The Threshold values of the **THR1**, **THR2**, **THR3** and **THR4** outputs are true or false after the configuration of the **TR_ON**, **TR_OFF** and **MP** parameters (configuration parameters of each point of the module – DF41, DF42 or DF67). Their functioning is similar to **THR** of ACC block.

CLRA Input

Every time there is a transition in the **CLRA** input from zero to one, **TOT** outputs are cleared and their respective values are transferred to the **MEM** outputs.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	CLRA	CLEAR THE ACCUMULATOR	BOOL
O	EO	OUTPUT ENABLED	BOOL
	MEM1	ACCUMULATED PULSE VALUES PROCEEDING FROM IN1 THAT ARE TRANSFERRED TO MEM1	LONG
	MEM2	ACCUMULATED PULSE VALUES PROCEEDING FROM IN2 THAT ARE TRANSFERRED TO MEM2	LONG
	MEM3	ACCUMULATED PULSE VALUES PROCEEDING FROM IN3 THAT ARE TRANSFERRED TO MEM3	LONG
	MEM4	ACCUMULATED PULSE VALUES PROCEEDING FROM IN4 THAT ARE TRANSFERRED TO MEM4	LONG
	TOT1	ACCUMULATED PULSES VALUE PROCEEDING FROM IN1	LONG
	TOT2	ACCUMULATED PULSES VALUE PROCEEDING FROM IN2	LONG
	TOT3	ACCUMULATED PULSES VALUE PROCEEDING FROM IN3	LONG
	TOT4	ACCUMULATED PULSES VALUE PROCEEDING FROM IN4	LONG
	THR1	THRESHOLD OUTPUT 1	BOOL
	THR2	THRESHOLD OUTPUT 2	BOOL
	THR3	THRESHOLD OUTPUT 3	BOOL
	THR4	THRESHOLD OUTPUT 4	BOOL
P	IN1	CHANNEL 1	LONG
	IN2	CHANNEL 2	LONG
	IN3	CHANNEL 3	LONG
	IN4	CHANNEL 4	LONG

I: Input. P: Parameter. O: Output

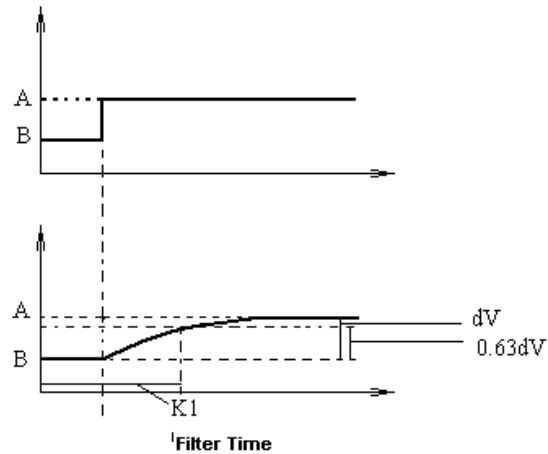
Simple Analog Input (AI)

Description:

This function block, when **EN** is true, reads the analog input module's value associated with **CN** (channel) and places it in the **OUT** output. Besides, the block has some more features. The **CN** input has to be RRRSGP type, where R=rack, S=slot, G=group and P=point.

Filter's Characteristic Time (K1)

The **K1** parameter is the filter's characteristic time in seconds. Consider a step input. When the output signal reaches 63% of the step value, the time measured until this moment is defined as characteristic time.



Square Root:

If the **SQR** parameter is TRUE, the block calculates the square root of analog input value. If the input is negative, the output is zero.

With **SQR** in TRUE, if **MUL** parameter is TRUE, the following equation is applied:

$$OUT = 10 * \sqrt{IN}$$

If the analog input has a value less than the specified value in the **CTO** parameter, the output will receive a value equals to zero (leveling). If a negative value is specified to **CTO**, the value that will be considered is zero.

Offset:

The **Off** parameter defines an offset value that will be added to the converted value by AI function block.

Burnout output:

If the **BRT** output is true, it indicates that the input is in burnout, that is, the input has a value 2% greater than the scale upper limit or it has a value 2% less than scale lower limit.

In burnout, the **BRTY** parameter indicates which action type will have the **OUT** output:

None: in the output will be the input real value.

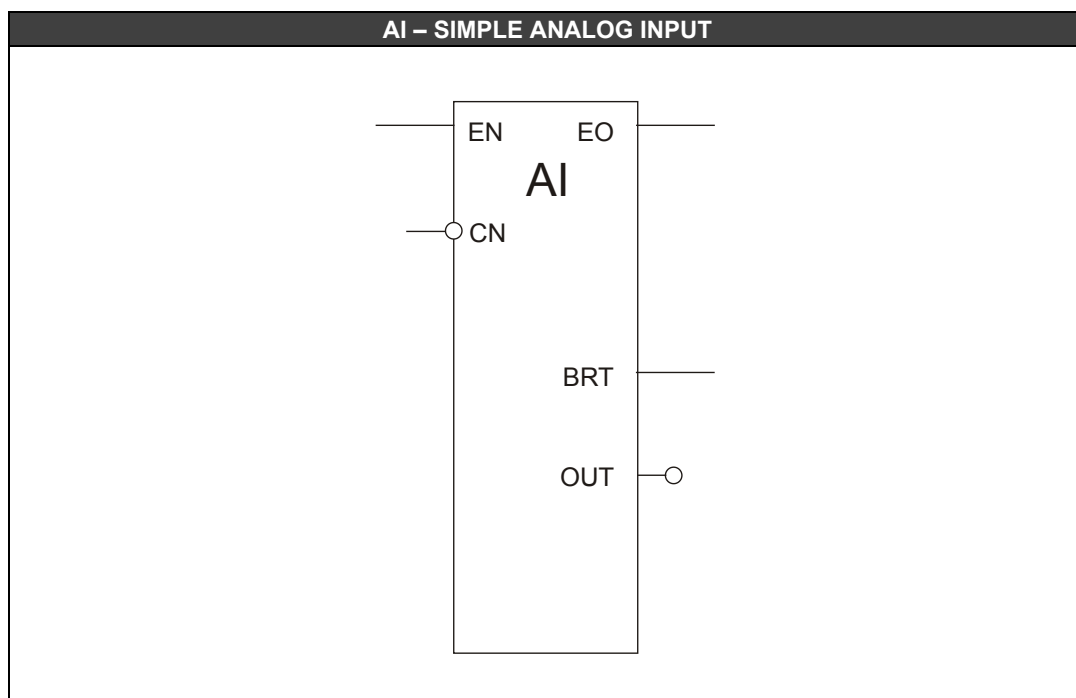
Low: the output will keep a value which is 2% less than scale lower limit.

High: the output will keep a value which is 2% greater than scale upper limit.

If there is not an analog input, or the CPU cannot read it, the output depends of **BRTY** parameter:

None/High: the output will keep a value which is 125% greater than scale upper limit.

Low: the output will keep a value which is 125% less than scale lower limit.



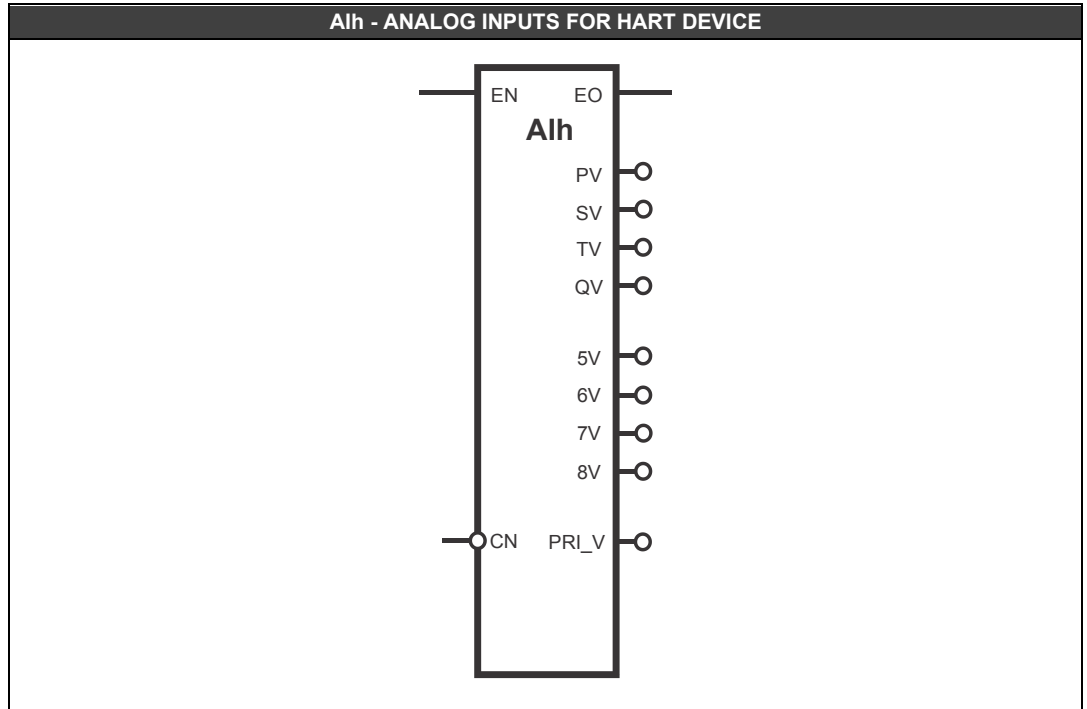
CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	CN	CHANNEL	LONG
O	EO	OUTPUT ENABLED	BOOL
	BRT	BURNOUT OUTPUT	BOOL
	OUT	CONVERTED OUTPUT	FLOAT
P	SQR	SQUARE ROOT ENABLED	BOOL
	CTO	CUT-OFF	FLOAT
	MUL	MULTIPLIES THE SQUARE ROOT BY 10	FLOAT
	K1	FILTER'S CHARACTERISTIC TIME IN SECONDS, AND A FIRST ORDER EXPONENTIAL FILTER.	FLOAT
	OFF	OFFSET VALUE	FLOAT
	BRTY	INDICATION OF BURNOUT TYPE	LONG

I: Input. P: Parameter. O: Output

Analog Inputs for HART Device (Alh)

Description

When **EN** input is true, this function block reads the values of the HART input device associated to **CN** (Channel), and places them in the **PRI_V**, **PV**, **SV**, **TV**, **QV**, **5V**, **6V**, **7V** and **8V** outputs.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
O	PRI_V	OUTPUT FOR THE CURRENT VALUE	FLOAT
	PV	OUTPUT FOR THE PV VALUE	FLOAT
	SV	OUTPUT FOR THE SV VALUE	FLOAT
	TV	OUTPUT FOR THE TV VALUE	FLOAT
	QV	OUTPUT FOR THE QV VALUE	FLOAT
	5V	OUTPUT FOR THE 5V VALUE	FLOAT
	6V	OUTPUT FOR THE 6V VALUE	FLOAT
	7V	OUTPUT FOR THE 7V VALUE	FLOAT
	8V	OUTPUT FOR THE 8V VALUE	FLOAT
P	EO	OUTPUT ENABLED	BOOL
	CN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRSx0** where RR: rack, S: slot, and **x** is the device connected to the DF116, from 0 to 7

Examples:

- 200 – Rack 0, slot 2, device 0
- 12350 – Rack 12, slot 3, device 5

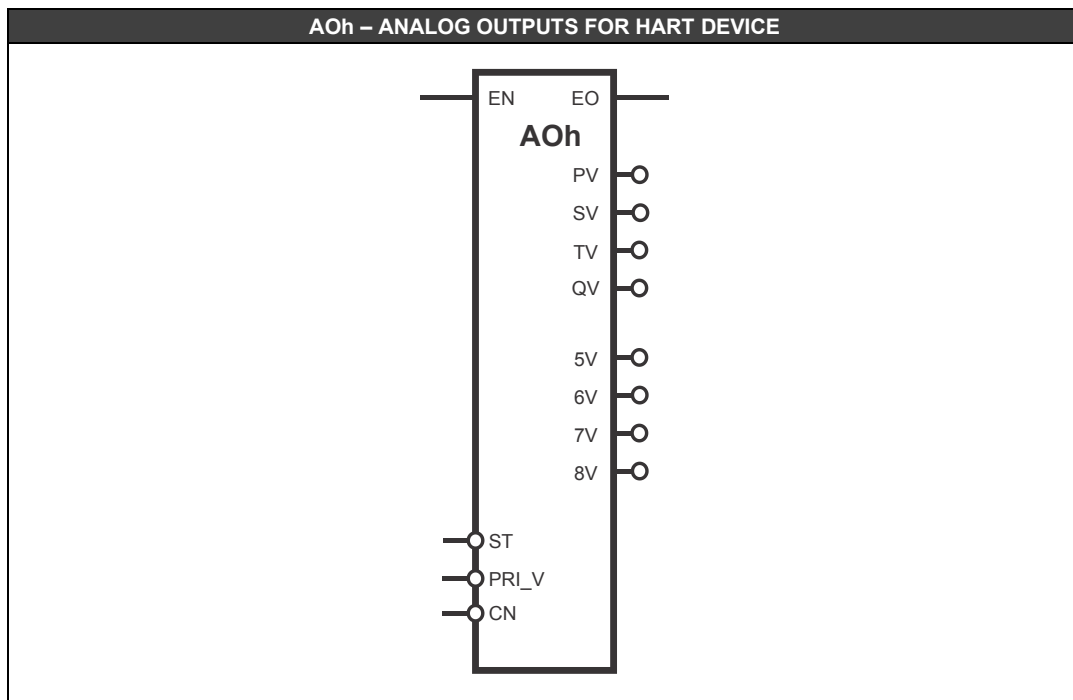
The **Alh** block access only one HART device.

Analog Outputs for HART Device (AOh)

Description

When **EN** input is true, this function block reads the values of the HART output device (actuator) associated to **CN** (Channel), and places them in the **PV**, **SV**, **TV**, **QV**, **5V**, **6V**, **7V** and **8V** outputs and writes in the **PRI_V** the current value.

If **EN** is false, the current value will be written in **ST** input.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	ST	CURRENT VALUE WHEN EN IS FALSE	FLOAT
	PRI_V	INPUT FOR THE CURRENT VALUE	FLOAT
O	PV	OUTPUT FOR THE PV VALUE	FLOAT
	SV	OUTPUT FOR THE SV VALUE	FLOAT
	TV	OUTPUT FOR THE TV VALUE	FLOAT
	QV	OUTPUT FOR THE QV VALUE	FLOAT
	5V	OUTPUT FOR THE 5V VALUE	FLOAT
	6V	OUTPUT FOR THE 6V VALUE	FLOAT
	7V	OUTPUT FOR THE 7V VALUE	FLOAT
	8V	OUTPUT FOR THE 8V VALUE	FLOAT
	EO	OUTPUT ENABLED	BOOL
P	CN	CHANNEL	LONG

I: Input. **P:** Parameter. **O:** Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRSx0** where RR: rack, S: slot and **x** is the device connected to the DF117, from 0 to 7. Examples:

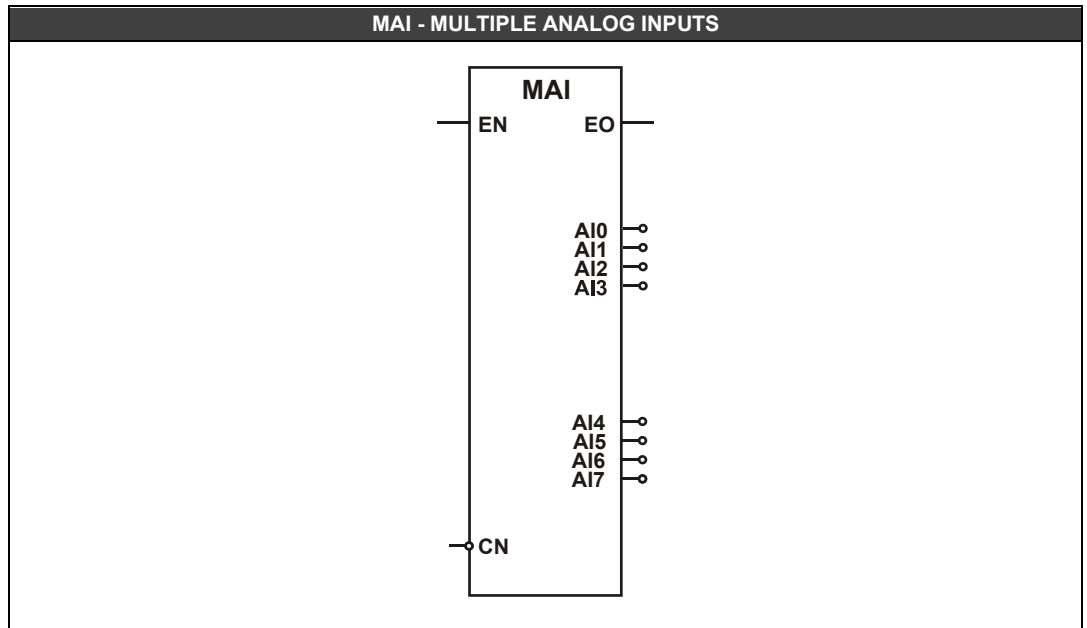
- 200 – Rack 0, slot 2, device 0
- 12350 – Rack 12, slot 3, device 5

The **AOh** block access only one HART device.

Multiple Analog Inputs (MAI)

Description

When **EN** input is true, this function block reads the values of the analog input module associated in **CN** (channel), and places them in the **AI0**, **AI1**, **AI2**, **AI3**, **AI4**, **AI5**, **AI6** and **AI7** outputs.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
O	AI0	OUTPUT 0	FLOAT
	AI1	OUTPUT 1	FLOAT
	AI2	OUTPUT 2	FLOAT
	AI3	OUTPUT 3	FLOAT
	AI4	OUTPUT 4	FLOAT
	AI5	OUTPUT 5	FLOAT
	AI6	OUTPUT 6	FLOAT
	AI7	OUTPUT 7	FLOAT
	EO	OUTPUT ENABLED	BOOL
P	CN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRS00** where RR: rack and S: slot. Examples:

- 200 – Rack 0, slot 2.
- 12300 – Rack 12, slot 3.

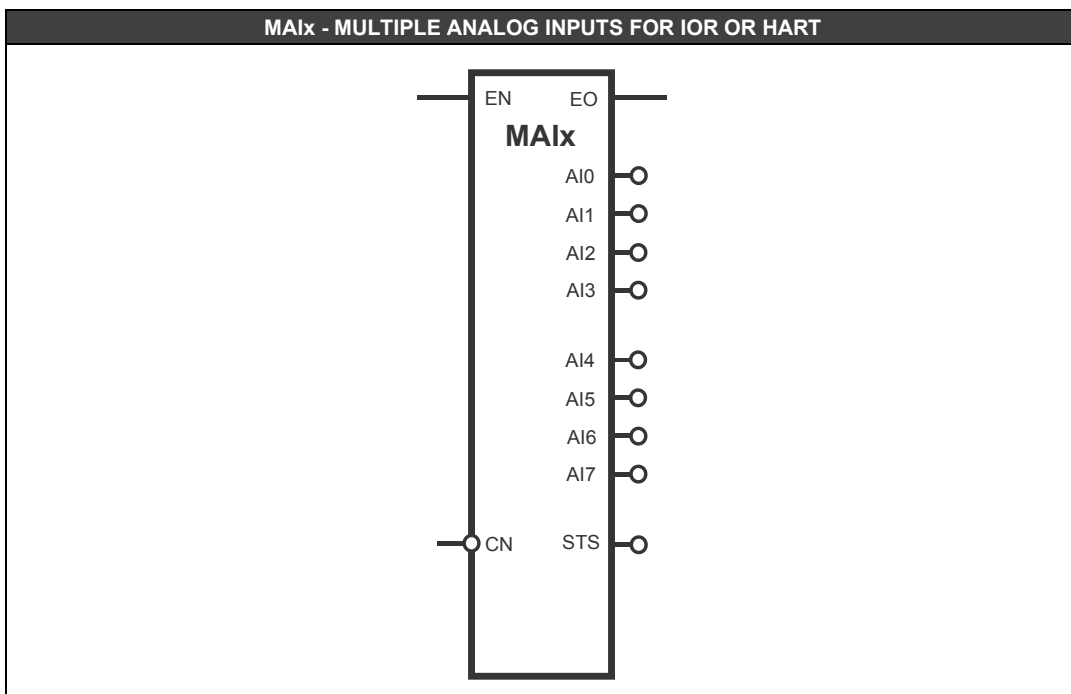
Multiple Analog Inputs for IOR or HART (MAIx)

Description

When **EN** input is true, this function block reads the values of the analog input module, associated to **CN** (Channel), and places them in the **AI0**, **AI1**, **AI2**, **AI3**, **AI4**, **AI5**, **AI6** and **AI7** outputs.

For the IOR modules (Redundant I/O), the 8 inputs in the module correspond to the block output values. For the HART modules, the block outputs correspond to the values of input primary current of the 8 devices connected to the module's channels.

It also generates in the **STS** output the status of the inputs, each bit corresponding to an input, where 0 indicates "good" and 1 "bad".



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
O	AI0	OUTPUT 0	FLOAT
	AI1	OUTPUT 1	FLOAT
	AI2	OUTPUT 2	FLOAT
	AI3	OUTPUT 3	FLOAT
	AI4	OUTPUT 4	FLOAT
	AI5	OUTPUT 5	FLOAT
	AI6	OUTPUT 6	FLOAT
	AI7	OUTPUT 7	FLOAT
	EO	OUTPUT ENABLED	BOOL
	STS	INDIVIDUAL INPUT STATUS	LONG
P	CN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRS00** where RR: rack and S: slot. Examples:

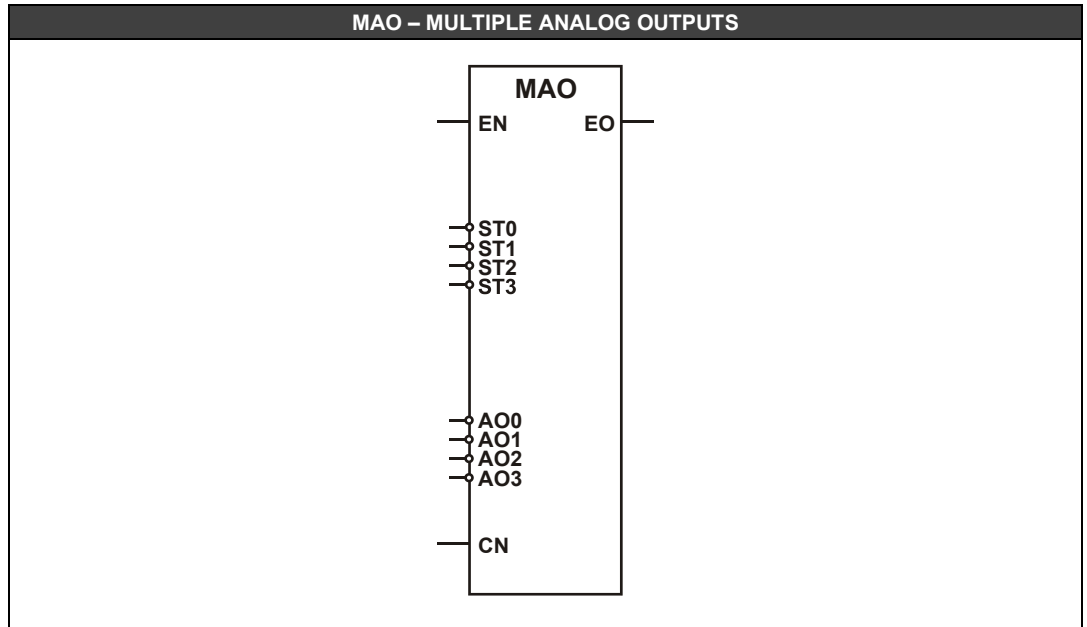
- 200 – Rack 0, slot 2.
- 12300 – Rack 12, slot 3.

Multiple Analog Outputs (MAO)

Description

When **EN** input is true, this function block places the linked or configured values in the **A0**, **A1**, **A2** and **A3** inputs in the respective outputs of the analog output module associated in **CN** (channel).

The **ST0**, **ST1**, **ST2** and **ST3** inputs are the fault state values that will be attributed to the module outputs in case **EN** is false.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	AO0	INPUT 0	FLOAT
	AO1	INPUT 1	FLOAT
	AO2	INPUT 2	FLOAT
	AO3	INPUT 3	FLOAT
	ST0	FAULT STATE VALUE 0	FLOAT
	ST1	FAULT STATE VALUE 1	FLOAT
	ST2	FAULT STATE VALUE 2	FLOAT
	ST3	FAULT STATE VALUE 3	FLOAT
O	EO	OUTPUT ENABLED	BOOL
P	CN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRS00** where RR: rack and S: slot. Examples:

- 200 – Rack 0, slot 2.
- 12300 – Rack 12, slot 3.

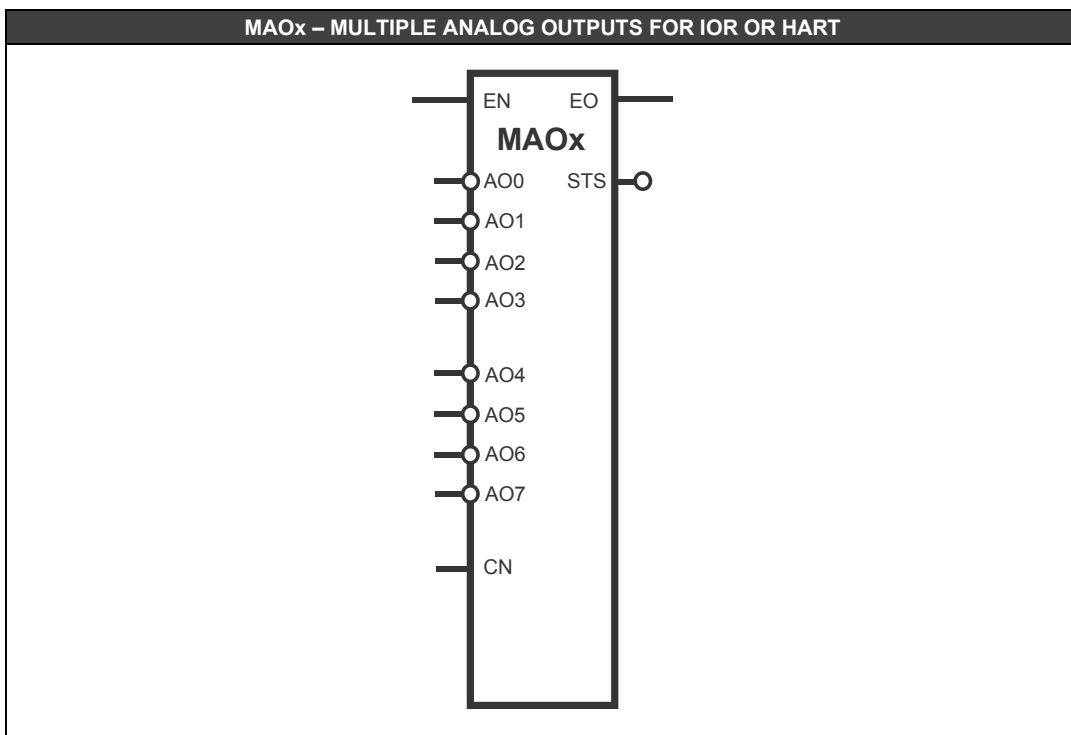
Multiple Analog Outputs for IOR or HART (MAOx)

Description

When **EN** input is true, this function block writes the values of the **AO0**, **AO1**, **AO2**, **AO3**, **AO4**, **AO5**, **AO6** and **AO7** inputs in the analog output module, associated to **CN** (Channel).

For the IOR modules (Redundant I/O), the module's outputs correspond to the input values of the 8 block channels. For the HART modules, the block inputs correspond to the values of output primary current of the 8 devices connected to the module's channels.

It also generates in the **STS** output the status of the outputs, each bit corresponding to an output, where 0 indicates "good" and 1 "bad".



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	AO0	OUTPUT 0	FLOAT
	AO1	OUTPUT 1	FLOAT
	AO2	OUTPUT 2	FLOAT
	AO3	OUTPUT 3	FLOAT
	AO4	OUTPUT 4	FLOAT
	AO5	OUTPUT 5	FLOAT
	AO6	OUTPUT 6	FLOAT
O	EO	OUTPUT ENABLED	BOOL
	STS	INDIVIDUAL OUTPUT STATUS	LONG
P	CN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRS00** where RR: rack and S: slot. Examples:

- 200 – Rack 0, slot 2.
- 12300 – Rack 12, slot 3.

System Status (Status)

Description:

This function, when **EN** is true, allows configuring 8 boolean variables which inform the I/O module status. This block is recommended for a better monitoring of the functional state of each used I/O module. Thus the system can be advised if some I/O module have a failure. So that is easier to find a damaged module.

NOTE

The GLL number which is printed in the circuit board must be higher than 1100, otherwise the module will not support identification by the Status block.

Parameters:

The programming of the monitored I/O module is done defining a pair of parameters - **RACKi** and **SLOTi**.

RACK1: defines the I/O module's rack which status will be monitored in the **OUT1** output.

SLOT1: defines the I/O module's slot which status will be monitored in the **OUT1** output.

RACK2: defines the I/O module's rack which status will be monitored in the **OUT2** output.

SLOT2: defines the I/O module's slot which status will be monitored in the **OUT2** output.

RACK3: defines the I/O module's rack which status will be monitored in the **OUT3** output.

SLOT3: defines the I/O module's slot which status will be monitored in the **OUT3** output.

RACK4: defines the I/O module's rack which status will be monitored in the **OUT4** output.

SLOT4: defines the I/O module's slot which status will be monitored in the **OUT4** output.

RACK5: defines the I/O module's rack which status will be monitored in the **OUT5** output.

SLOT5: defines the I/O module's slot which status will be monitored in the **OUT5** output.

RACK6: defines the I/O module's rack which status will be monitored in the **OUT6** output.

SLOT6: defines the I/O module's slot which status will be monitored in the **OUT6** output.

RACK7: defines the I/O module's rack which status will be monitored in the **OUT7** output.

SLOT7: defines the I/O module's slot which status will be monitored in the **OUT7** output.

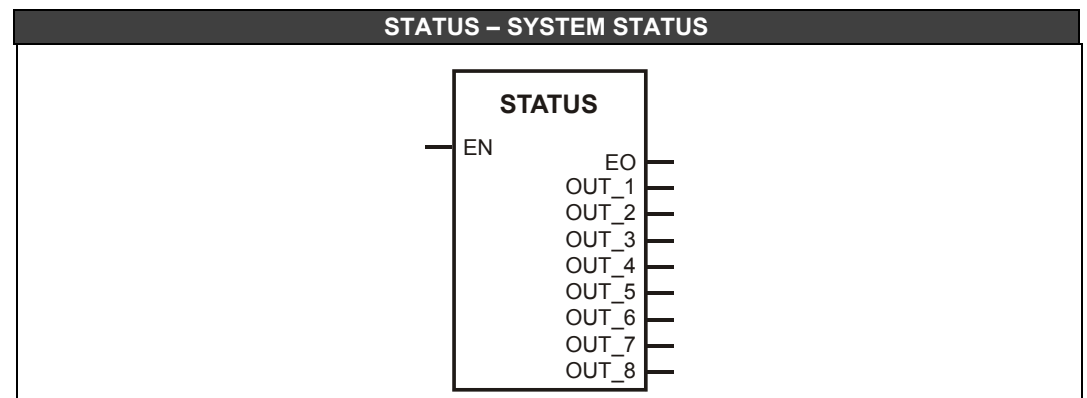
RACK8: defines the I/O module's rack which status will be monitored in the **OUT8** output.

SLOT8: defines the I/O module's slot which status will be monitored in the **OUT8** output.

Status meaning and outputs:

0: Status = I/O module "good".

1: Status = I/O module "bad".



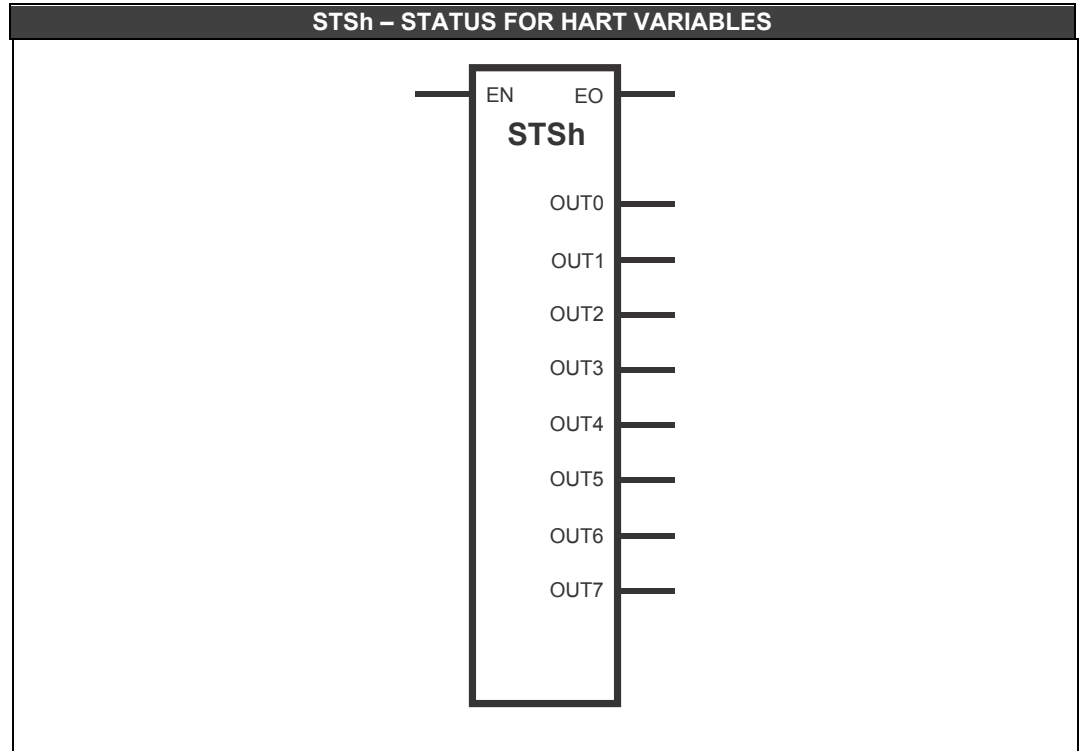
CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	EO	OUTPUT ENABLED	BOOL
O	OUT1	MODULE STATUS DEFINED IN RACK1/SLOT1	BOOL
	OUT2	MODULE STATUS DEFINED IN RACK2/SLOT2	BOOL
	OUT3	MODULE STATUS DEFINED IN RACK3/SLOT3	BOOL
	OUT4	MODULE STATUS DEFINED IN RACK4/SLOT4	BOOL
	OUT5	MODULE STATUS DEFINED IN RACK5/SLOT5	BOOL
	OUT6	MODULE STATUS DEFINED IN RACK6/SLOT6	BOOL
	OUT7	MODULE STATUS DEFINED IN RACK7/SLOT7	BOOL
	OUT8	MODULE STATUS DEFINED IN RACK8/SLOT8	BOOL
P	RACK1	MODULE'S RACK WHICH STATUS WILL BE IN OUT1	LONG
	SLOT1	MODULE'S SLOT WHICH STATUS WILL BE IN OUT1	LONG
	RACK2	MODULE'S RACK WHICH STATUS WILL BE IN OUT2	LONG
	SLOT2	MODULE'S SLOT WHICH STATUS WILL BE IN OUT2	LONG
	RACK3	MODULE'S RACK WHICH STATUS WILL BE IN OUT3	LONG
	SLOT3	MODULE'S SLOT WHICH STATUS WILL BE IN OUT3	LONG
	RACK4	MODULE'S RACK WHICH STATUS WILL BE IN OUT4	LONG
	SLOT4	MODULE'S SLOT WHICH STATUS WILL BE IN OUT4	LONG
	RACK5	MODULE'S RACK WHICH STATUS WILL BE IN OUT5	LONG
	SLOT5	MODULE'S SLOT WHICH STATUS WILL BE IN OUT5	LONG
	RACK6	MODULE'S RACK WHICH STATUS WILL BE IN OUT6	LONG
	SLOT6	MODULE'S SLOT WHICH STATUS WILL BE IN OUT6	LONG
	RACK7	MODULE'S RACK WHICH STATUS WILL BE IN OUT7	LONG
	SLOT7	MODULE'S SLOT WHICH STATUS WILL BE IN OUT7	LONG
	RACK8	MODULE'S RACK WHICH STATUS WILL BE IN OUT8	LONG
	SLOT8	MODULE'S SLOT WHICH STATUS WILL BE IN OUT8	LONG

I: Input. P: Parameter. O: Output

Status for HART Variables (STSh)

Description:

This function, when **EN** is true, allows viewing the status of up to 8 variables of HART devices connected to the HART modules' channels, where 0 indicates "good" and 1 "bad".



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	EO	OUTPUT ENABLED	BOOL
O	OUT0	STATUS OF THE VARIABLE DEFINED IN CN0	BOOL
	OUT1	STATUS OF THE VARIABLE DEFINED IN CN1	BOOL
	OUT2	STATUS OF THE VARIABLE DEFINED IN CN2	BOOL
	OUT3	STATUS OF THE VARIABLE DEFINED IN CN3	BOOL
	OUT4	STATUS OF THE VARIABLE DEFINED IN CN4	BOOL
	OUT5	STATUS OF THE VARIABLE DEFINED IN CN5	BOOL
	OUT6	STATUS OF THE VARIABLE DEFINED IN CN6	BOOL
	OUT7	STATUS OF THE VARIABLE DEFINED IN CN7	BOOL
P	CN0	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN1	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN2	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN3	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN4	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN5	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN6	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG
	CN7	VARIABLE CHANNEL WHOSE STATUS WILL BE MONITORED	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN0...7** parameters must be configured with the channel of the HART variable whose status will be monitored. The rule for filling is **RRSGP**, where **RR**: rack; **S**: slot of HART module; **G**: group (position of the HART device in the module), and **P**: point indicating the variable that will be monitored, according to the following table:

0: PV
1: SV
2: TV
3: QV
4: 5V
5: 6V
6: 7V
7: 8V
8: primary current

Examples:

Monitor the TV status of the HART device connected to the second channel of the HART module that is on rack 3, slot 1:

CNx= 3112

Monitor the PV status of the HART device connected to the fifth channel of the HART module that is on rack 12, slot 2:

CNx= 12240

Monitor the primary current status of the HART device connected to the first channel of the HART module that is on rack 1, slot 0:

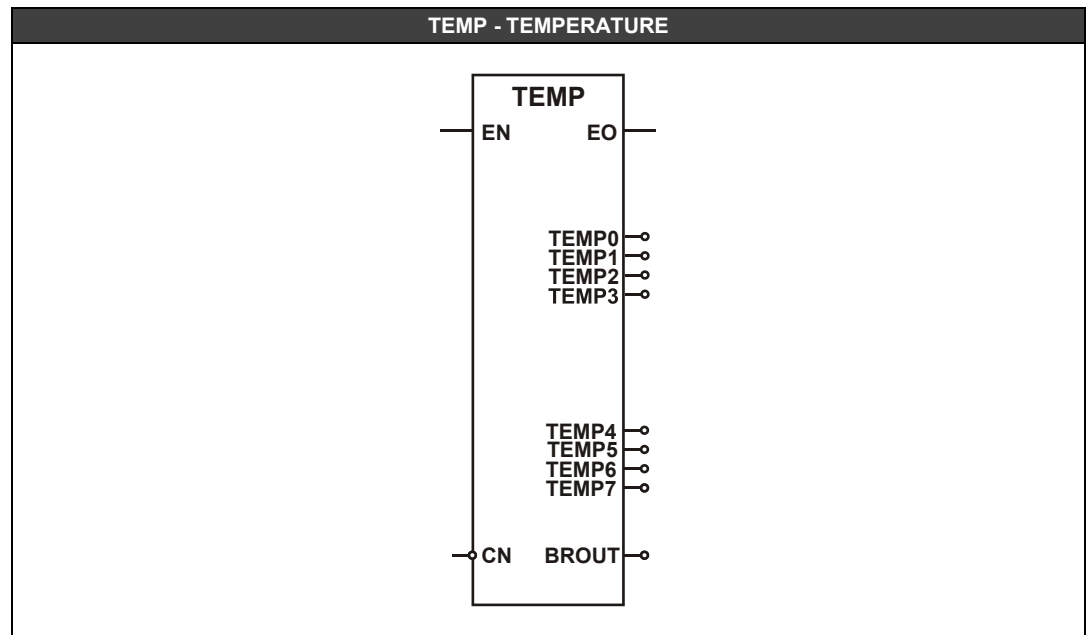
CNx= 1008

Temperature (TEMP)

Description

When **EN** input is true, this function block reads the values of the temperature module associated in **CN** (channel), and places them in the **TEMP0**, **TEMP1**, **TEMP2**, **TEMP3**, **TEMP4**, **TEMP5**, **TEMP6** and **TEMP7** outputs.

The **BROUT** output parameter indicates if there is fault in one of the temperature inputs of the module. Each input corresponds to one bit, out of an eight bits total. The logic level 0 indicates normal operation and the logic level 1 indicates fault. This output has to be used with BTB block which separates each bit from the presented value.



CLASS	MNEM	DESCRIPTION	TYPE
I	EN	INPUT ENABLED	BOOL
	EO	OUTPUT ENABLED	BOOL
O	TEMP0	TEMPERATURE OUTPUT 0	FLOAT
	TEMP1	TEMPERATURE OUTPUT 1	FLOAT
	TEMP2	TEMPERATURE OUTPUT 2	FLOAT
	TEMP3	TEMPERATURE OUTPUT 3	FLOAT
	TEMP4	TEMPERATURE OUTPUT 4	FLOAT
	TEMP5	TEMPERATURE OUTPUT 5	FLOAT
	TEMP6	TEMPERATURE OUTPUT 6	FLOAT
	TEMP7	TEMPERATURE OUTPUT 7	FLOAT
	BROUT	BURN OUT	LONG
P	CN	CHANNEL	LONG

I: Input. P: Parameter. O: Output

IMPORTANT

The **CN** parameter has to be configured obligatorily with the slot's base channel where the module is inserted. The rule for filling is **RRS00** where RR: rack and S: slot. Examples:

- 200 – Rack 0, slot 2.
- 12300 – Rack 12, slot 3.

THE LOGICVIEW FOR FFB

Introduction

This chapter presents the essentials for the use of the **LogicView for FFB** software for the advanced Smar Controllers - DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95 and DF97. It will show how to create, download and troubleshoot on ladder logic configurations that will be executed in these controllers.

The user, before reading this chapter, should read the chapters 1 and 2 of this manual to get familiar with the ladder elements and function blocks.

The **LogicView for FFB** application software is based on Microsoft Windows and is therefore operated in the same basic way as other Windows applications, i.e. through menus, browsing, copy and paste, buttons, drop down lists, etc. It is assumed that the user is already familiar with Windows interface.

Installation

Operating System

The **LogicView for FFB**, like another integral part of **SYSTEM302**, runs in Windows operating system. For further details refer to **SYSTEM302 Installation Guide**.

Before Installation Begins

Check minimum resources in the **SYSTEM302 Installation Guide**. It is recommended (and sometimes mandatory), that all applications are closed before installing the **SYSTEM302**.

Installing

The installation should automatically start a few seconds after the installation DVD is inserted in the driver. If after inserting the DVD into the driver the installation does not start automatically, go to the directory containing the application and run the AUTORUN executable file. The installation program will run and guide the user throughout the installation procedure. For further details refer to **SYSTEM302 Installation Guide**.

License

After installing the **SYSTEM302** the user has to run the **LicenseView** application and authorized the installed products, such as the **LogicView for FFB**. For further information about how to get the license refer to the **SYSTEM302 Installation Guide**.

The user can work in Demo mode; however, there are some restrictions:

- Starting a new configuration the user can work with only one ladder diagram. All functions will be kept.
- If the user tries to open a configuration with more than one diagram a message will appear informing that in Demo mode is not possible work with files with more than one diagram and the file will not open.



Fig 3. 1- Demo mode error



Removing the Hardkey

If the **LogicView for FFB** is licensed through a hardkey and it is removed while the software is running, in 9 minutes the **LogicView for FFB** is closed. Before this, the software will ask if the user wants to save the configuration. When the hardkey is removed the next message will appear.



Fig 3. 2- Warning – The application will shutdown

Click **Ok** and the countdown will start.

If the hardkey is restored before the countdown is finished (nine minutes) the counting will be canceled. If the hardkey is not restored the **LogicView for FFB** will be closed, but the user will be warned. See the figure below.



Fig 3. 3- Warning – The licensed time has been expired

The user may monitor the countdown in the Status bar, in the lower-left side. At each minute the message *“This application will shutdown in x minute(s)!”* will appear, indicating to the user the remaining time.

Using the LogicView for FFB

Launching the application

To start an application, the user should click **Start** → **Programs** → **System302** → **Studio302** → **Studio302**.

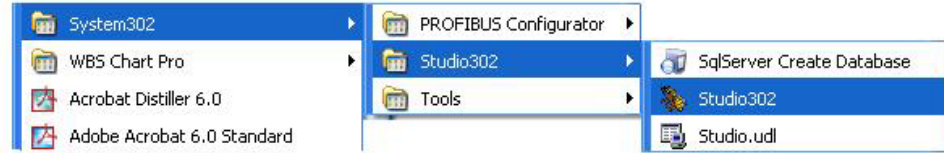


Fig 3. 4- Launching a Studio302 application

The following window will appear and the **LogicView for FFB** can be executed from this window in **Template Mode**. The user has to click the icon showed below at the toolbar under the main menu.

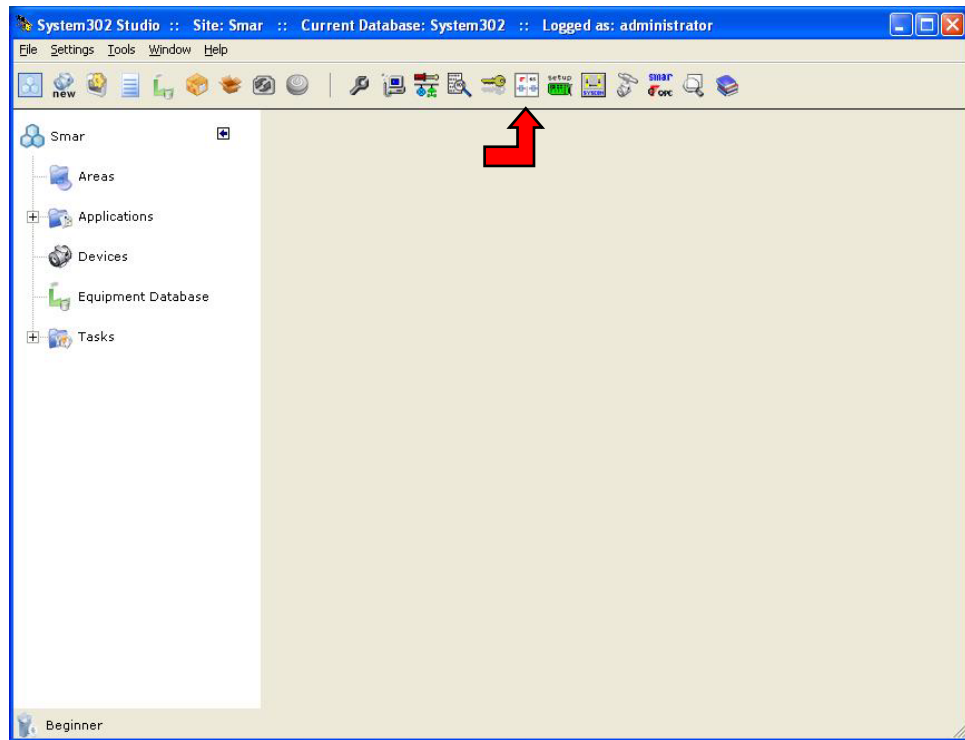


Fig 3. 5- Starting a LogicView for FFB application

After that, the user has to choose the **New FFB Logic Template** option. The LogicView for FFB will run on **Template Mode**. See the next figure.

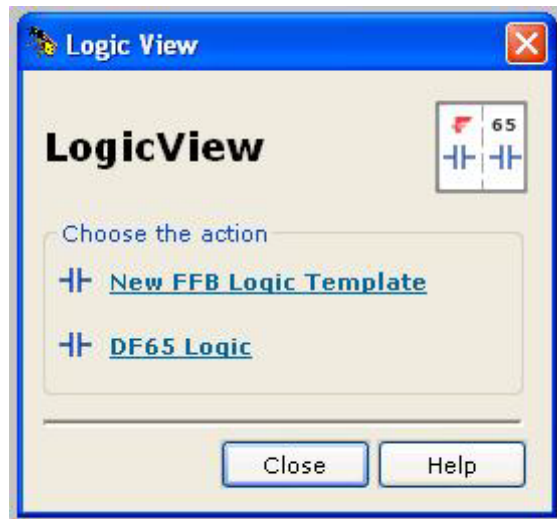


Fig 3. 6- Starting a LogicView for FFB application

In the **Instance Mode** the user has to run the **Syscon** and from there, after the logic is edited, the **LogicView for FFB** will be executed.

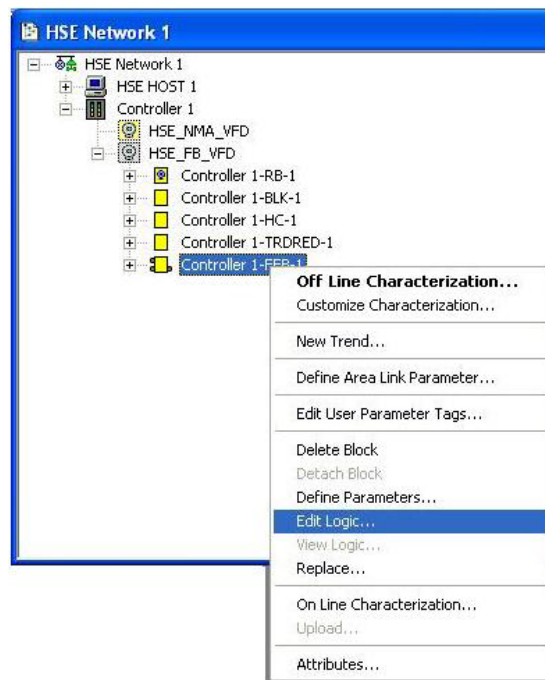


Fig 3. 7- Editing the logic - Instance Mode

Instance Mode

Typically, the access to **LogicView for FFB** for creation or modification of discrete logic of flexible function block (FFB) will be done from a FFB instance created by **Syscon** as shown in the next figure. A FFB Instance can be considered as “real” block that can be transferred via download to a linking device. The instance HAS Device Descriptor information and for this reason is EXCLUSIVE for the configuration that contains this block.

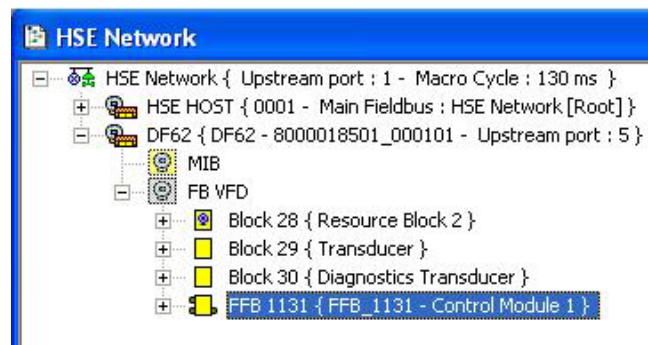


Fig 3. 8- FFB Block in Syscon

After inserting the FFB block in **Syscon**, the user has to define its parameters. Only then the discrete logic can be edited. Right-click **FFB block**, and choose **Define Parameters**. The figure below will open:

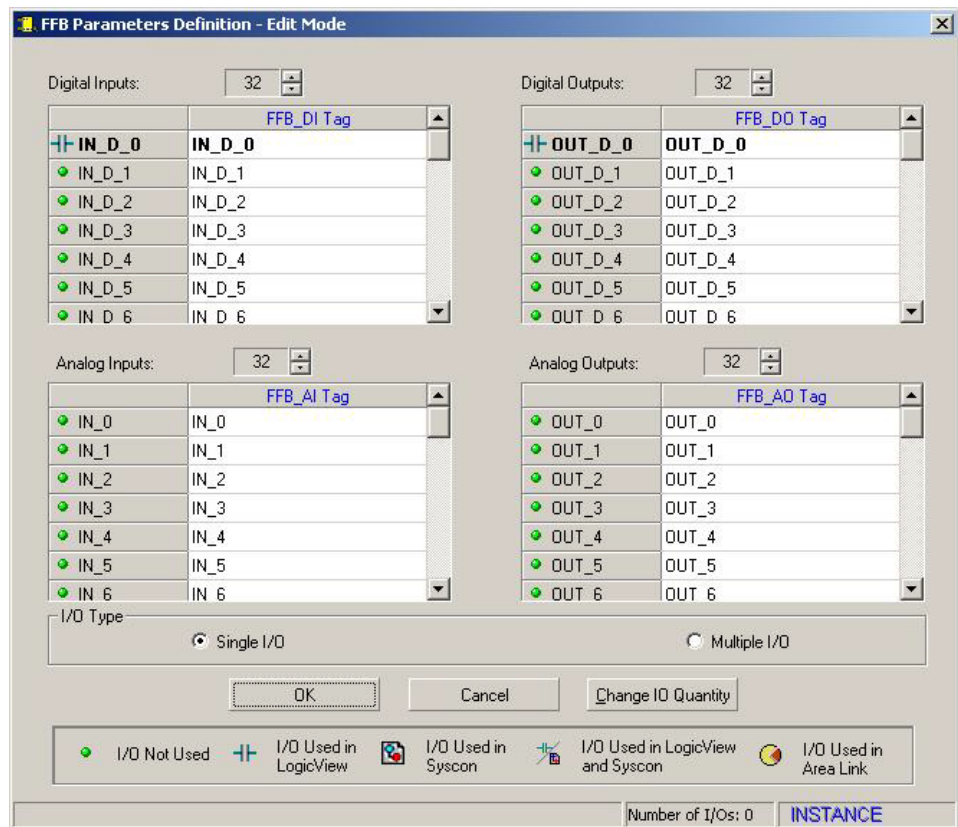


Fig 3. 9- Defining the FFB parameters

NOTE

From the 7.3 version of **SYSTEM302**, the FFB is automatically created, with the following number of parameters: 32 DO, 32 DI, 32 AO, 32 AI, 4 DO64, 4 DI64, 4 AI16, and 4 AO16, these last four types are created for the FFB2.

Here, the user can configure the number of analog and digital inputs and outputs: Analog Inputs, Analog Outputs, Digital Inputs, Digital Outputs, Analog Inputs16, Analog Outputs16, Digital Inputs64 or Digital Outputs64, respectively. After the user clicks **OK** the points DI, DO, AI, AO, DI64, DO64, AI16, and AO16 are generated. In **I/O Type** option are chosen how many and what parameters will be configured. In **Single I/O** option DI, DO, AI, and AO are configured. In **Multiple I/O** option DI64, DO64, AI16, and AO16 are configured. They will allow an information exchange between continuous control, which uses FOUNDATION™ fieldbus technology, and discrete control. For further details about **FFB Parameters Definition** see the **Syscon's** manual. See the following figure.

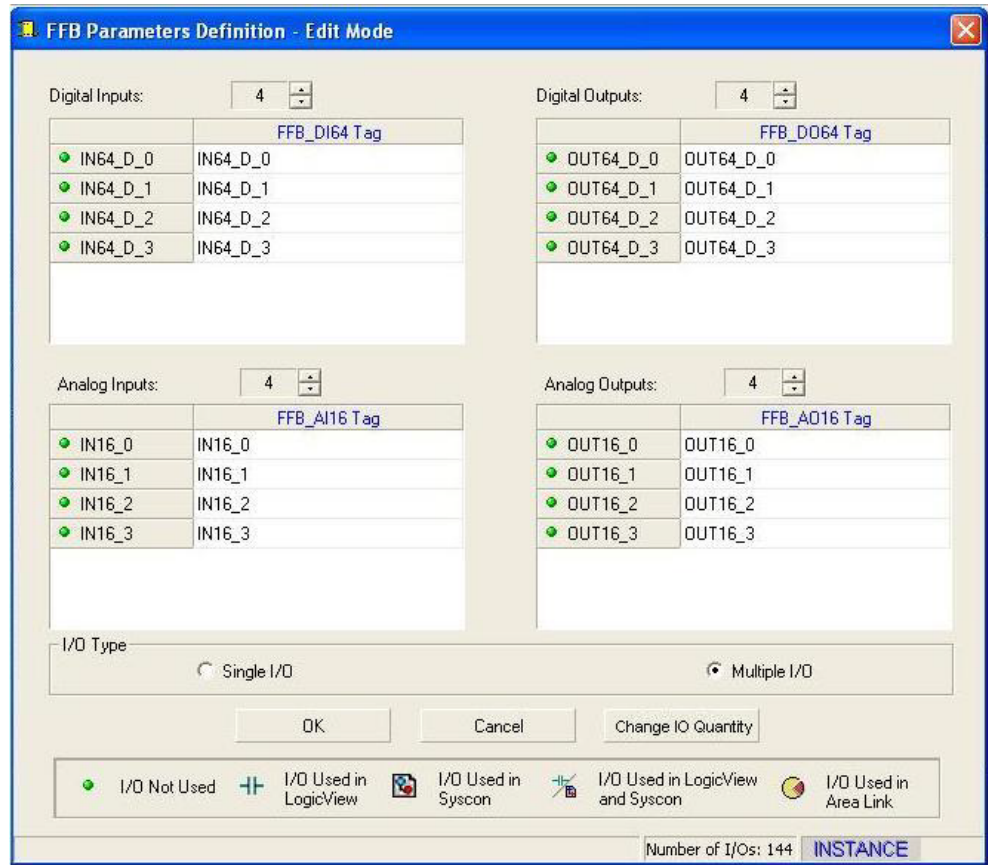


Fig 3. 10- Defining the FFB parameters

When the FFB parameters are already defined the user should edit the ladder logic. Right-click **FFB** block, and then, in **Edit Logic**. The **LogicView for FFB** will be launched in Instance Mode.

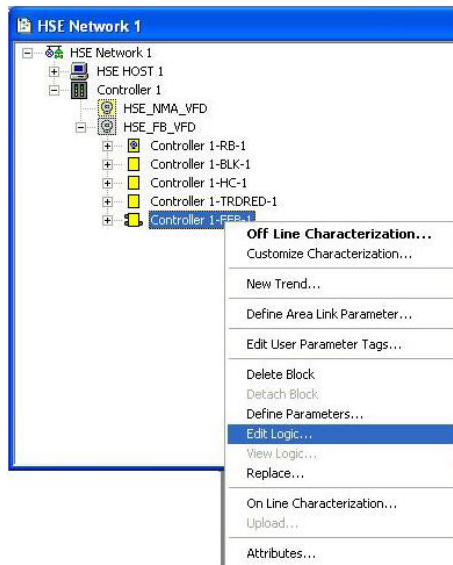


Fig 3. 11 - Editing the logic - Instance Mode

This operation mode can be identified by a **FFB LOGIC** Tag at the left bottom of the **LogicView for FFB** main window. See the following figure:

FFB LOGIC

Fig 3. 12- Instance Mode identification

The FFB block tag which is linked to the instance will appear in the upper-left corner of the title bar, between **LogicView for FFB** and the filename that was generated in the Instance mode.

In this mode the **LogicView for FFB** will edit only the FFB instance from which the "Edit Logic" command was processed. For this reason, operations like "New", "Open" or "Save As" will not be available, except for the "Save" command.

All ladder logic commands will be allowed. The user can create and/or modify the discrete logic. The FFB on instance mode is a real block, thus it is possible to download the logic to the corresponding equipment.

NOTE

The filenames generated in this mode have extension "pgi"

If is necessary changing the FFB parameters definition at **Syscon**, through the procedure mentioned above, i.e., right-clicking FFB block, the **Define Parameters Tool** window can appear as in the following figure:

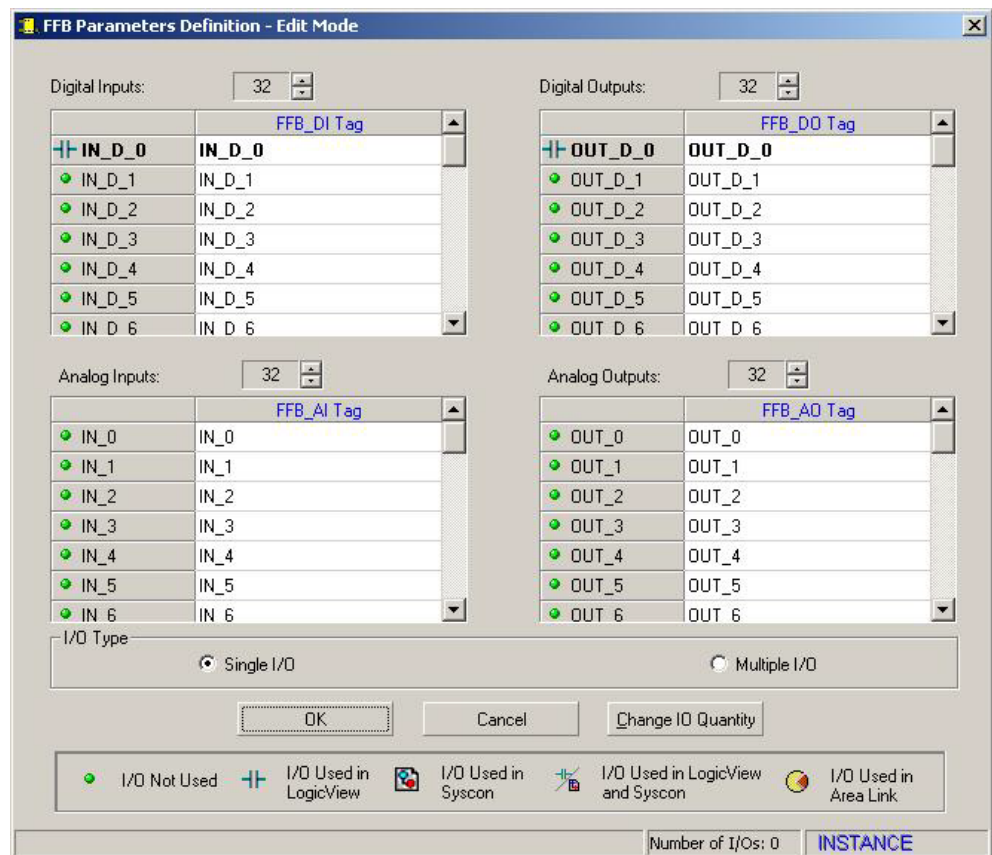






Fig 3. 13- Changing the I/O parameters of FFB


In the last figure the tool shows the FFB inputs/outputs status, i.e., if a specific input or output is being used at **Syscon** and/or **LogicView for FFB**. The conditions are as follows

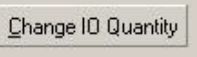
 : It means that the current state of FFB input/output is "**Not Used**". Thus the tag of this point will be available to change and can be edited;

 : It means that the current state of FFB input/output is "**Used in LogicView**". Thus, this point is already associated in internal logic of FFB which is being edited and its tag will not be available to change, it is blocked for editing;

 : It means that the current state of FFB input/output is **"Used in Syscon"**. Thus, this point is already used in a **Syscon** control strategy which contains the FFB that is being edited and its tag will not be available to change, it is blocked for editing;

 : It means that the current state of FFB input/output is **"Used in LogicView and Syscon"**. Thus, this point was already used as mentioned above, simultaneously in both tools and its tag will not be available to change, it is blocked for editing.

 : It means that the current state of FFB input/output is **"Defined by user as a parameter which will be used in Area Link"**. Thus, its tag will not be available to change, it is blocked for editing.

NOTE
It is possible to "force" the editing of input/output tags. For this just click the button


When the user forces the tags editing the following message will appear.



Fig 3. 14 – Warning - Unblocking the editing of used points

By clicking **Yes (Sim)**, the tool will unblock all inputs/outputs which were with the editing protected. Thus all I/O points automatically take on the **"Not Used"** status.

Each block parameter is showed in the window with its respective user tag (defined in **Syscon**) or with a default tag, if it has not already a user defined tag. To change the tags right-click the FFB block icon on **Syscon** (in the **Process Cell**, **Fieldbus** or **Strategy** window) and click **Edit User Parameter Tags**. The **User Parameter Tag** dialog box will open. For further information refer to **Syscon** manual.

IMPORTANT
To reflect the tags changes in LogicView for FFB is necessary to save the configuration in Syscon .

The FFB allows the use of more advanced data types and the block is initially created with a predefined amount of points identified as **Multiple I/O** in the **Define Parameters** window. By selecting this option, multiple points will be shown in the window and their edition is identical to the simple points (**Single IO**).

After modify a FFB parameters, which was previously created, click **OK** and the following message will appear:

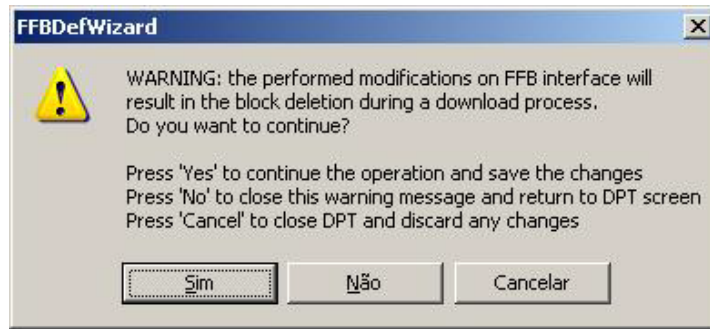


Fig 3. 15 – Warning – Changing a FFB already created

The options of the message box above means:

Yes (Sim): by clicking it the changes will be confirmed and the FFB will be modified according to the user operations;

No (Não): by clicking it the message box is closed and the user can continue the editing;

Cancel (Cancelar): by clicking it any changes are discarded and the tool is closed.



Modifying a FFB already defined

When the user modifies a FFB, which was previously defined and it was used in a control strategy, the block may be deleted during a download process, creating inconsistencies in the plant. It is recommended do a complete download in the bridge or gateway which has modified the FFB.

Template Mode

A FFB Template is another way to work with flexible function block and that allows its reuse in different configurations. A FFB template is a "model" of flexible function block that can be reused in different fieldbus configurations.

Since it is only a "model", a FFB Template CANNOT be transferred via download to a linking device. The main technical characteristic of FFB Template is it DOES NOT HAVE Device Descriptor information. However, this characteristic contributes to the flexibility and reuse of the block in its applications.

The procedure to launch the **LogicView for FFB** in "FFB Templates" editing mode is to click the **LogicView** icon in the toolbar or the **Tasks** item of **Studio302**. See the figure 3.5. Another way is from **Studio302 Logics** window, right-clicking **New Logic Template** option.

The procedure described above will launch the **LogicView for FFB** in Template editing mode. This operation mode can be identified by the **LOGIC** tag at the left bottom side of the work area, as in the next figure:

LOGIC

Fig 3. 16 - Template Mode

When a new template is created the user has to give a tag to it. See the following figure.

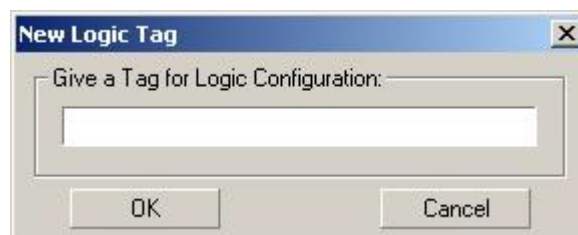


Fig 3. 17 – New template's tag

In this mode the **LogicView for FFB** will be able to create and modify only the templates of flexible blocks. For this reason, operations such as "New", "Open", "Save As" and "Save" will be enabled. The ladder logic operations and the definition of FFB parameters will be totally enabled, thus the discrete configuration can be done without restrictions. However, the user cannot download the logic to the controller because it is only a "model" of FFB.

NOTE
The filenames generated in this mode have "pgt" extension.

To use in **Syscon** a FFB Template that was created in **LogicView for FFB**, it is necessary to create an instance block based on **Template**, so that the Device Descriptor information is created by the system and the block is ready to be downloaded to the device. A FFB instance created from a Template inherits all of its characteristics (Parameters Definition and Internal Logic).

The creation of a FFB instance from a Template is done in **Syscon** from the **Replace** option of the FFB menu. See the figure below:

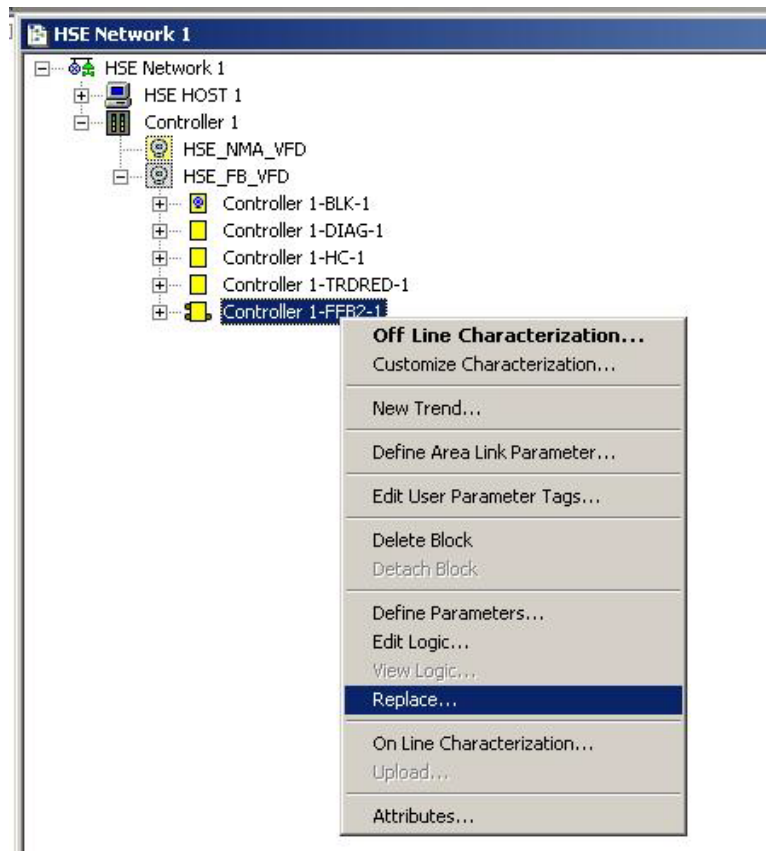


Fig 3. 18 - Insertion of a FFB via template

A list of FFB Templates which were created by the user will be shown. Select one of them and click **OK**. A FFB instance will be automatically generated by the system and incorporated to **Syscon** Control Module.

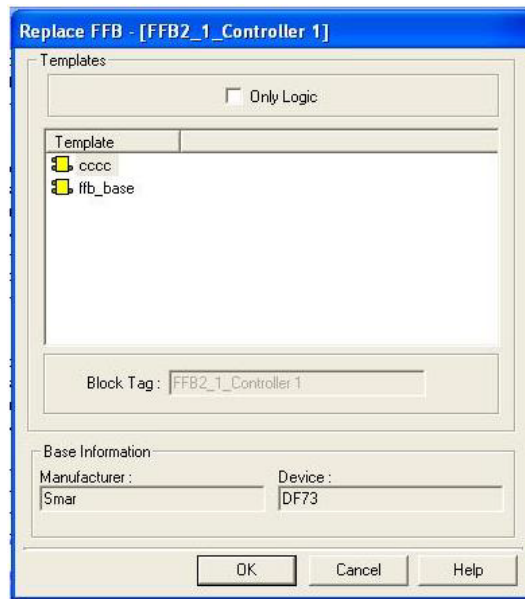


Fig 3. 19 - New FFB via template

If the user wants just to replace the FFB internal algorithm (logic), the **Only Logic** option on the previous figure has to be selected. Click **OK** to finish.

IMPORTANT

Some important notes about **Instances** and **Templates** of FFB:

- The modifications on a FFB template will affect only the FFB instances that are created **AFTER** the modification is done. Any instance created **BEFORE** the FFB template modification will not be affected by this modification;
- Two different configurations can have instances of FFB created from the same FFB template; however these instances will be **DISTINCTS** (because the “Device Descriptors” have different characteristics). The creation of FFB instance is automatic in the moment of its use and it is managed by the system;
- The modifications on an instance do not affect the template from which it was created.

Supervision Only Mode

In this mode several “LogicViews” can be launched simultaneously in a same workstation. All operations of changing the logic configuration are locked. The user can only view the configuration, supervise, monitor discrete and analog variables, and also write them. But being on **SUPERVISION ONLY** mode the changes in variables are not persisted to files, only in the CPU acted.

The **LogicView for FFB** automatically is launched in **SUPERVISION ONLY** mode when an instance is open and a logic is already opened. This mode works only on instances, it does not affect templates.

The **SUPERVISION ONLY** mode is indicated in the title bar, and by background color which can be changed by the user. See the following figure.

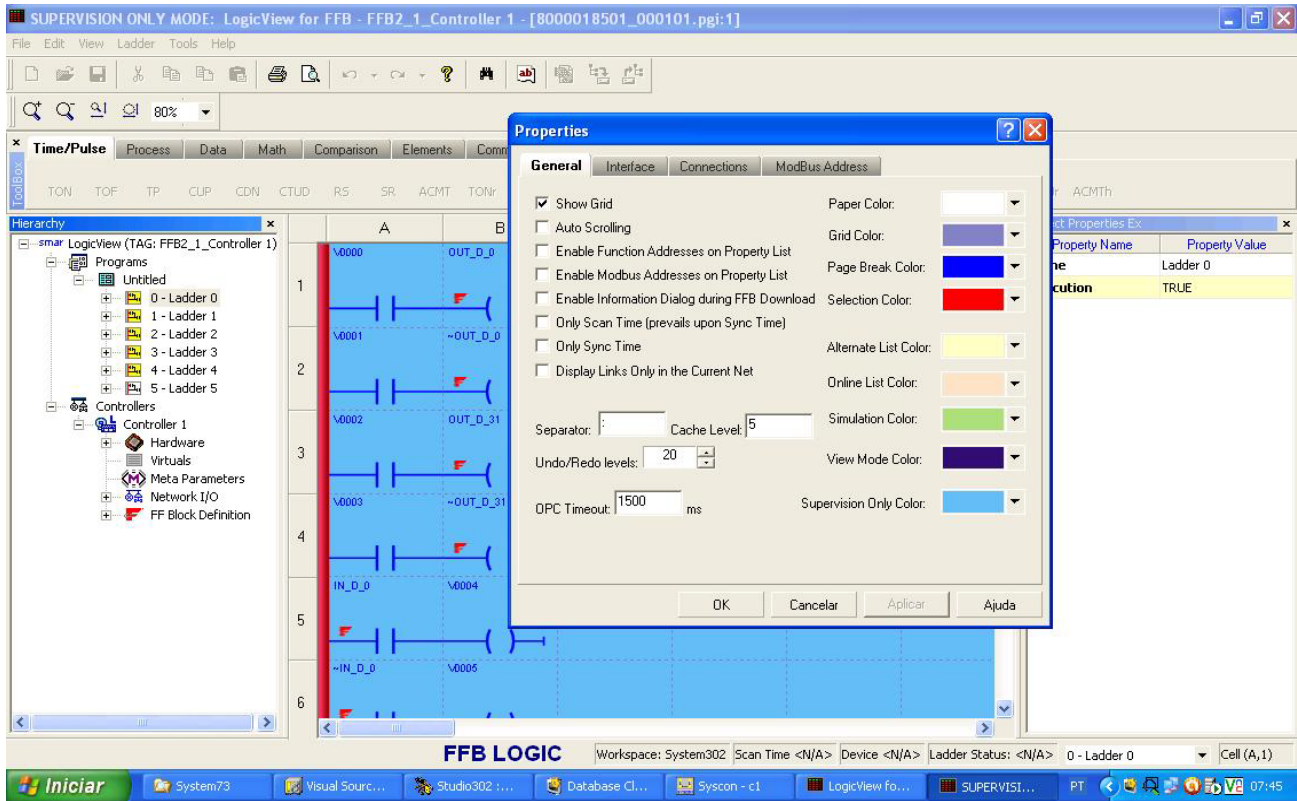


Fig 3. 20 – Supervision Only mode

Simulation Mode

This mode is used for simulation of **SYSTEM302** control strategies through the **SimulationView** tool. Both **Syscon** and **LogicView for FFB** must be **Online** to simulate the strategies. For further details on how to configure and operate in simulation mode see the **SimulationView** manual.

The **Simulation** mode is indicated in the title bar and by work area background which can be changed by user. See the following figure.

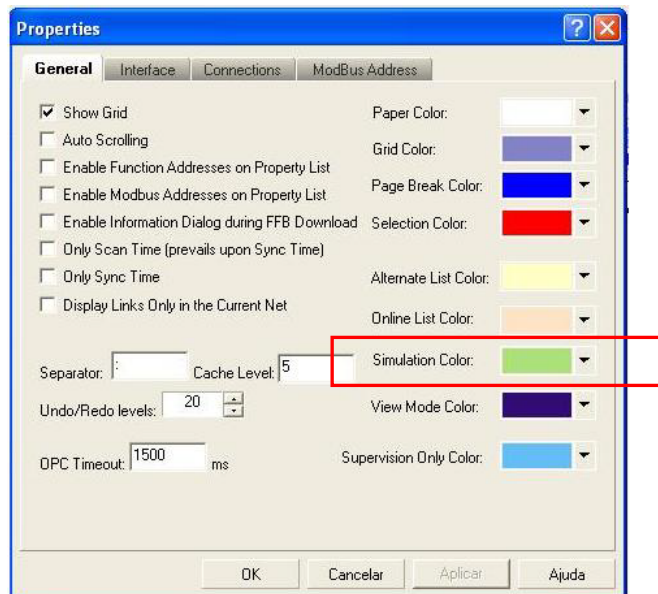


Fig 3. 21 – Option for changing the color of Simulation mode

View Mode

This mode is only for viewing ladder logic associated with FFB block. At **Syscon**, right-click the FFB icon and select **View Logic**. The **LogicView for FFB** runs in **View** mode and no changes can be done.



Ladder network evaluation

A ladder network evaluation by the **LogicView for FFB** is done by line from left to right. The user always has to keep this characteristic in mind when he is doing the configuration. See the figure below.

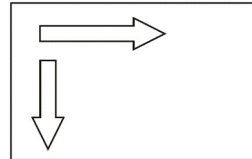


Fig 3. 22 - Ladder network evaluation

In **LogicView for DF65** the ladder evaluation is done by column from top to bottom. That is why the user has to be careful when he is configuring the **LogicView for FFB**. See the next example.

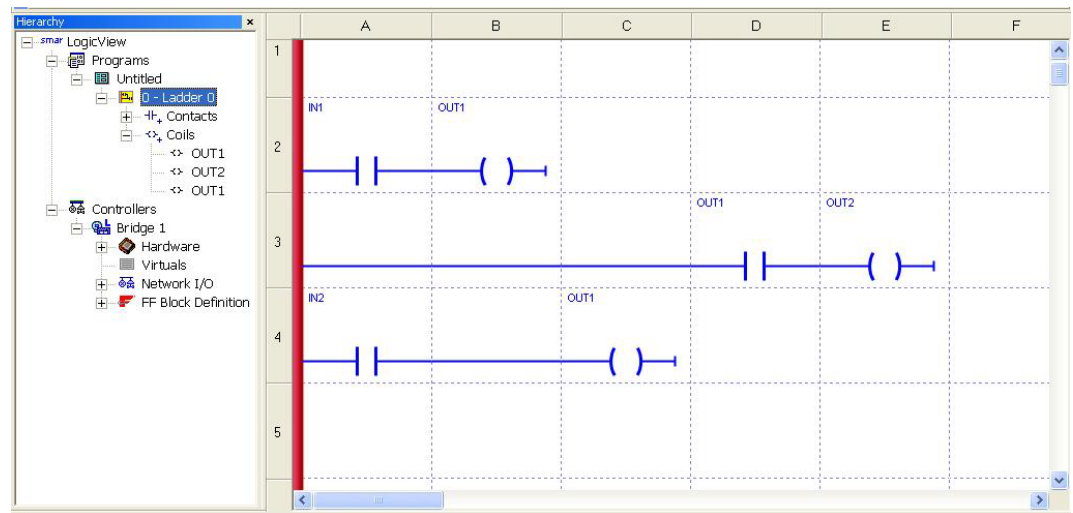


Fig 3. 23 - Ladder evaluation example

In **DF65**, OUT2 will be activated after IN2 is activated because the ladder execution sequence is by column. In the new controllers, OUT2 will be activated after IN1 is activated, because the ladder execution is by row.

Acknowledging the work area

When the **LogicView for FFB** is opened, in **Template Mode** or **Instance Mode**, the window below will open. In this example, a simple ladder logic is already configured.

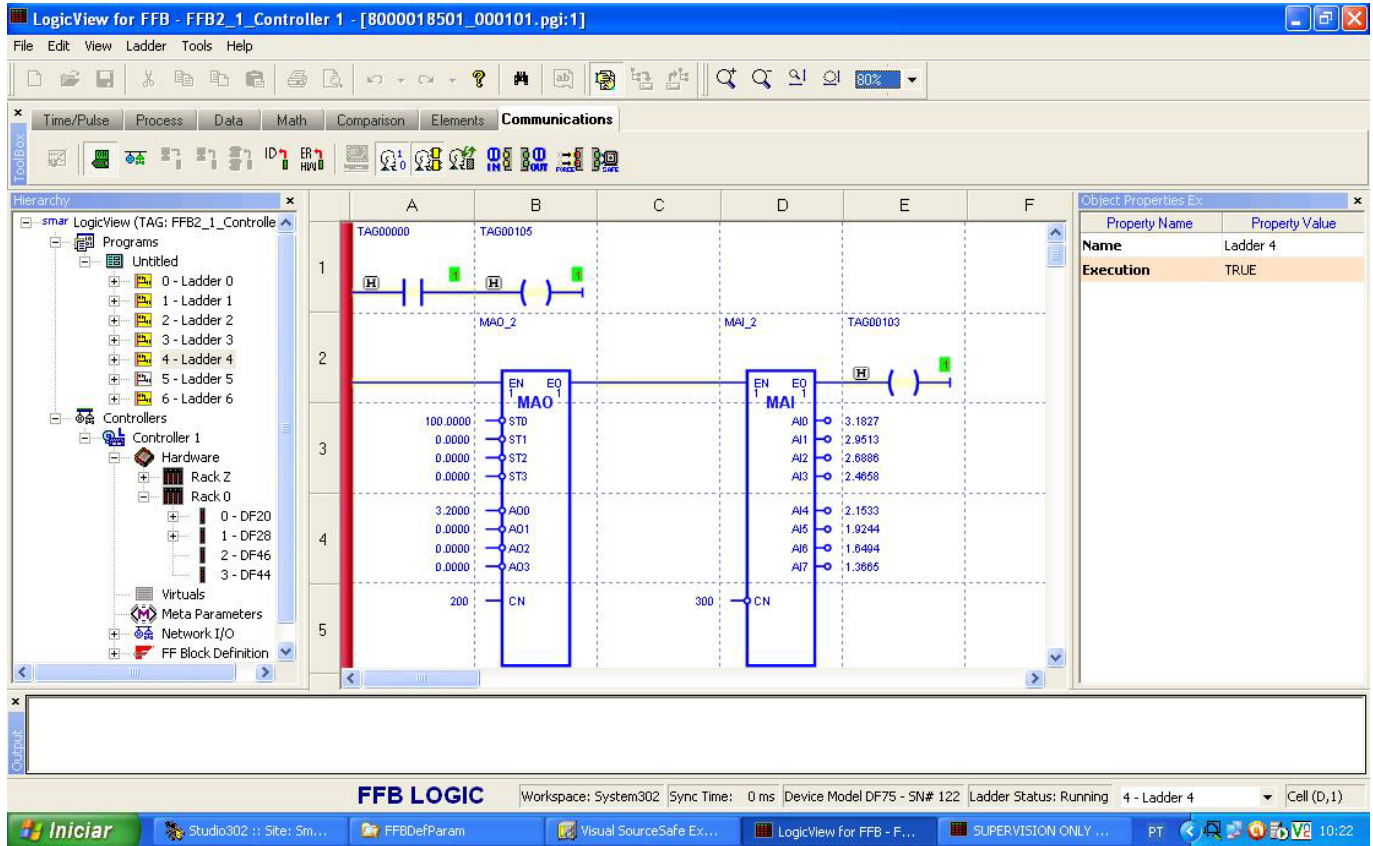


Fig 3. 24 - Work area

The work area of **LogicView for FFB** has basically 7 sub-areas:

- Main Menu
- Toolbars
- Hierarchy
- Object Properties
- Ladder Drawing Area
- Output
- Status Bar

Each one of them will be described in details. By default, all of them will be open when the user starts the **LogicView for FFB**. The Main Menu, Status Bar, and Ladder Drawing Area cannot be closed.

Main Menu

All software basic functions can be found in the main menu. Each one of them can be opened with the shortcut ALT + first letter of desired item. Every submenu will be detailed in the next topics.



Fig 3. 25 - Main Menu

File Menu

By clicking **File**, or through the shortcut ALT+ F, the following menu will open:

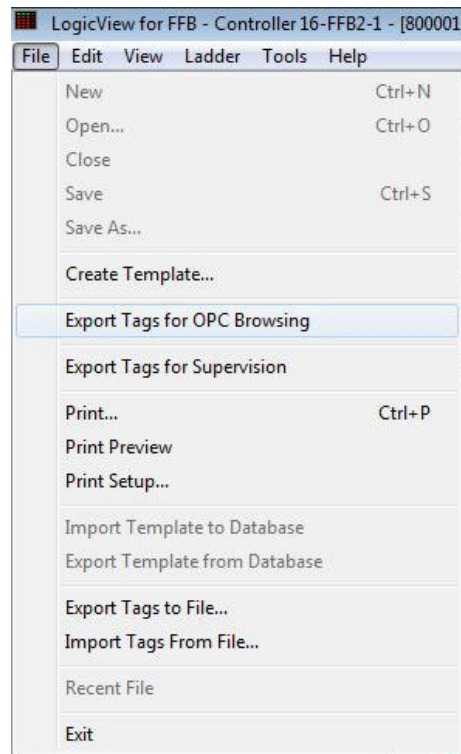


Fig 3. 26 - File Menu

This menu has all Windows default options such as, New, Open, Close, Print, etc. They work like any kind of Windows application. If the user is in **Template Mode** and choose the **New** option the **LogicView for FFB** will create the new file with an empty Rack Z and a Rack 0 with the slot 0 filled with the DF50 power supply and the slot 1 filled with the DF75 controller.

The user can choose if the Rack Z (DF78 or DF92) will be used or not in the hardware configuration. This rack has to be used for power supplies and controllers redundancy. For further details see the DF1302's manual.

Further details about the hardware configuration will be shown in the **Hierarchy – Hardware configuration** topic.

Save/Save As Procedure

When the **Save As** option is chosen, the user has to give a tag to the configuration. See the following figure.

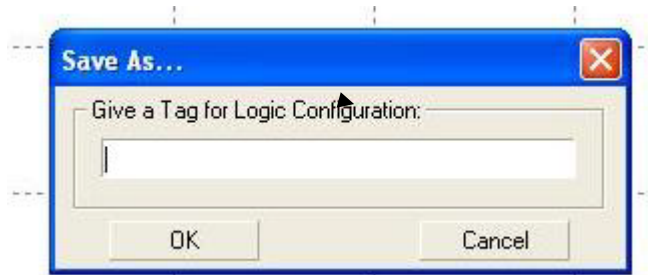


Fig 3. 27 – Saving FFB Templates

If the user tries to give an existent tag to the template, the following message will appear. The user has to choose another one.



Fig 3. 28 – Tag already exists

NOTE
The Save As option is available only for FFB Templates.

Create Template

This option is used to create an instance's template and replicate it in any other CPU, regardless of CPU type defined in the original instance. Clicking this option the following message will appear.

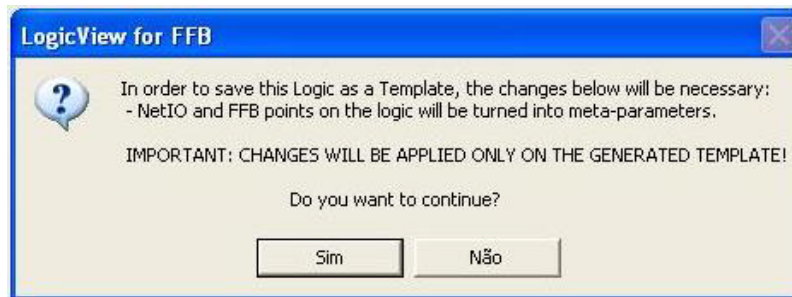


Fig 3. 29 – Confirming the template's creation

The user is informed that all NetIO and FFB points, which are dependent of CPU model, will be turned into metaparameters. And then, the user has to give a tag to the template. Automatically it is created and the original instance remains open. This new template can be accessed via **Studio302 Logics** window.

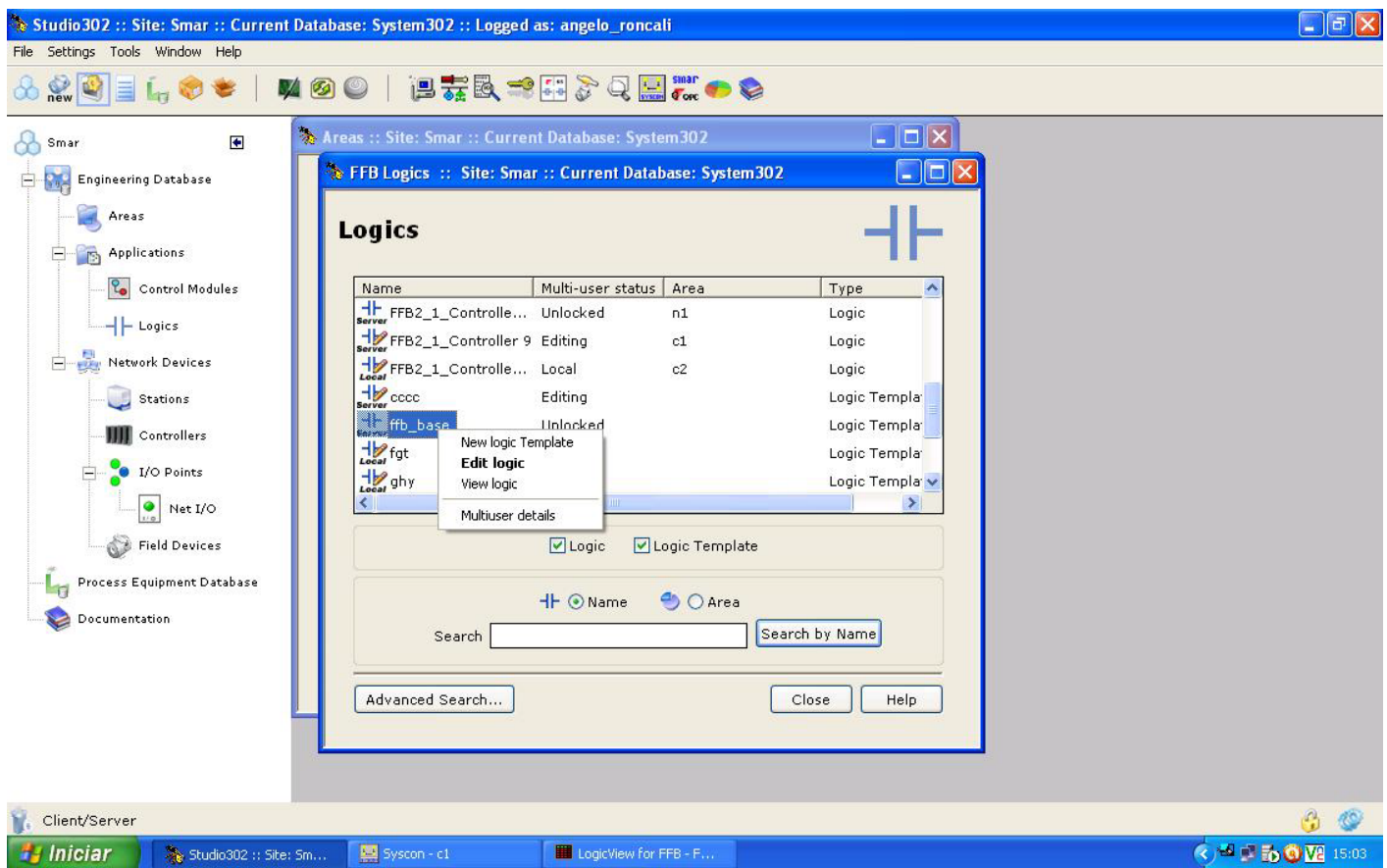


Fig 3. 30 – Studio302 Logics window

Export Tags for OPC Browsing

The **Export Tags for OPC Browsing** operation updates the Taginfo.ini file with all tags from the opened logic, enabling them for browsing without downloading the configuration to the controller.

NOTE

This is the same operation as **Export Tags for OPC Browsing** of **Syscon** menu. The difference is of scope, i.e., while **Logic View for FFB** performs the export tags only of the opened logic, the same operation in **Syscon** exports all tags from all logics used in the configuration (i.e., Area).

This operation can be done by clicking the  button in the main toolbar.

Export Tags for Supervision

In **Instance Mode**, after doing a tag changing in the ladder configuration the user may do an “Export tags” operation without going to **Syscon**. The **Syscon** export all the configuration tags at once, so this is a slow procedure. Click **File** → **Export Tags for Supervision**, and the user needs to find the path where is placed the taginfo.ini file. This file can be at local machine or at a machine which is accessed remotely via dcom by the DFIOleServer.

The **Export Tags for Supervision** operation must be used to update the OPC Server database with the tags used in the logic for the Supervisory to access these OPC tags.

NOTE

An **Export Tags for Supervision** is always automatically done after a download of the logic.

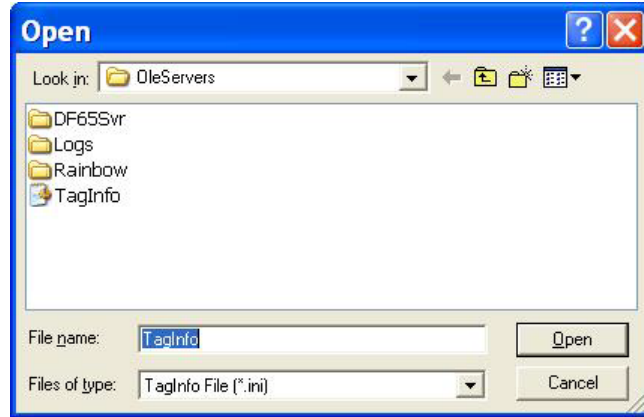


Fig 3. 31 – TagInfo.ini file

The tags will be exported and the next message will appear.




Fig 3. 32 – Export Tags

Print Options

Print Setup

Clicking this option the user can configure the printer and its properties as in other Windows applications.

Print Preview

Click **File** → **Print Preview**, or the icon  in the Main Bar, and the window below will appear.

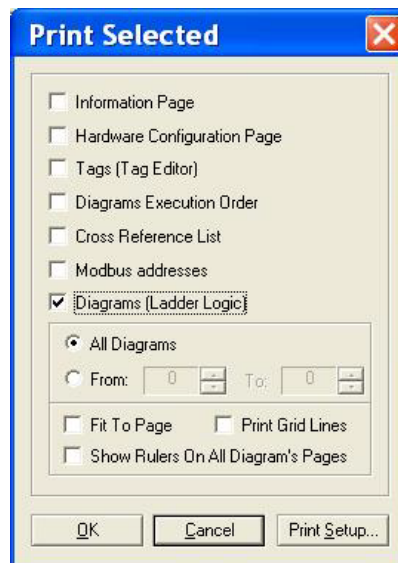


Fig 3. 33 – Print Options

The user can choose which information wants to print and how will be the print. The options are:

Information page: The information about the project which were inserted in the **Object Properties** window, for example, the company's name, plant, project, controller (device), etc will be printed if this item was selected.

Hardware configuration page

Selecting this option a list of the hardware configuration will be printed as in the figure below.

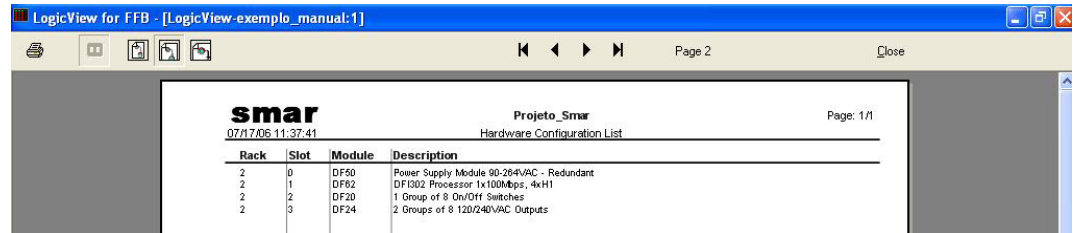


Fig 3. 34 – Hardware Configuration List

Tags (Tag Editor)

Selecting this option a list of the configuration tags will be printed. See the next figure.

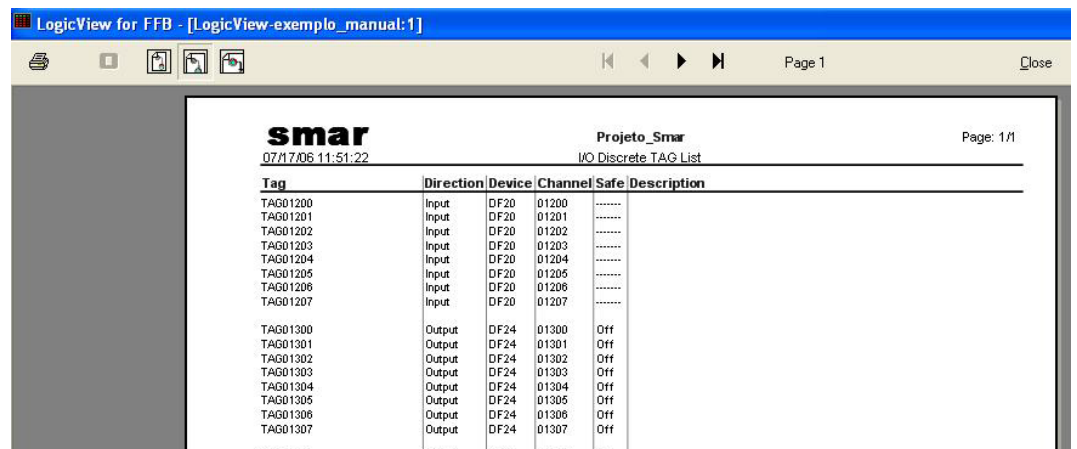


Fig 3. 35 – Tag List

Diagrams Execution Order

Selecting this option a list with the ladder diagrams execution order will be printed.

Cross Reference List

Selecting this option a cross reference list of the configuration tags will be printed indicating the respective diagrams where they are used. See the next figure.

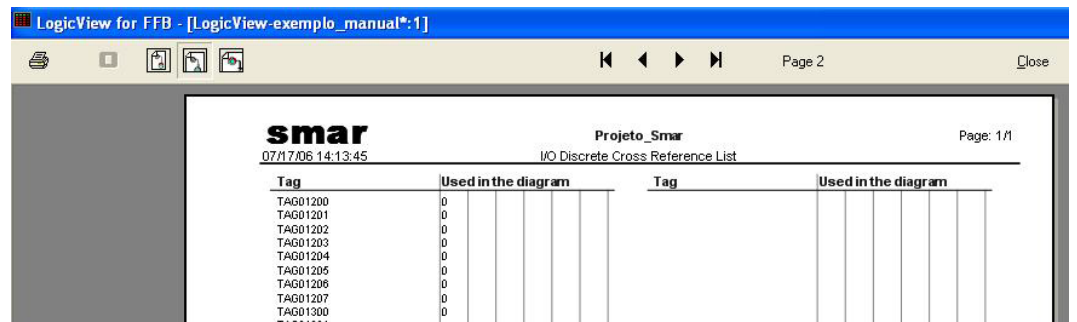


Fig 3. 36 – Tag List – Cross Reference

Modbus Addresses

Selecting this option a Modbus addresses list of the configuration tags and their groups will be printed indicating the respective Modbus addresses where they are used. See the next figure.

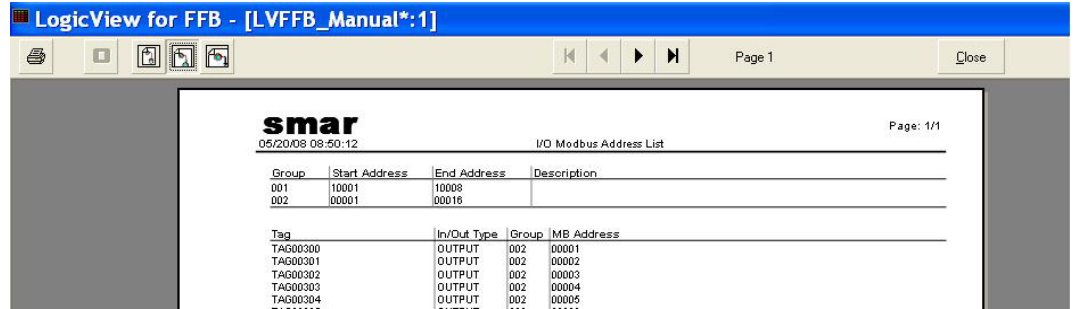



Fig 3. 37 – Tag List – Cross Reference

Diagrams

The ladder diagrams can be printed of the several ways. Select the Diagrams (Ladder Logic) option and the following options will be enabled and should be selected according to user needs:

- All Diagrams – Indicates that all diagrams will be printed.
- From xx to yy – Indicates which diagrams will be printed. For example, “From 0 to 4” indicates that will be printed the diagrams 0, 1, 2, 3 and 4.
- Fit to page – The diagram will be printed in only one page.
- Print grid lines – The grid lines will be printed with the diagrams.
- Show rulers on all diagram’s pages – The ruler which indicates the cells’ numeration of the Ladder Drawing Area will be printed on all pages. If this option is not selected, the ruler will be printed only in the pages which diagrams are directly linked to it.

Print

Click **File**→**Print**, or the icon  in the Main bar, and a window equals to the figure 3.33 will appear. The user should select the options which he wants as was explained in the previous topic. The difference is that after select the options and click **OK** the configuration file will be printed immediately.

Page Order

In the upper right corner of the print page there is the **Page Order** information. See the figure below.

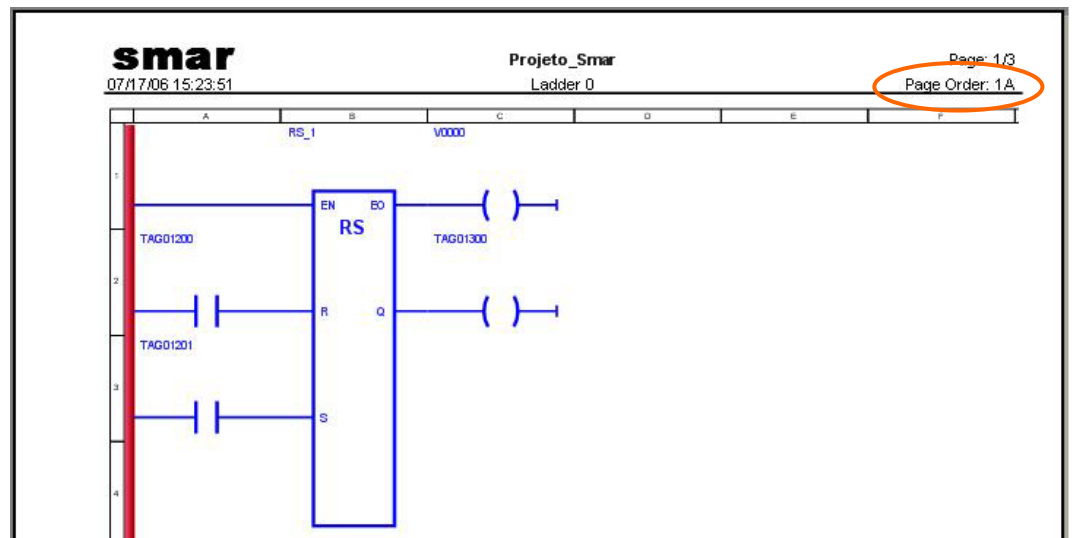


Fig 3. 38 – Page Order

The code indicates the line and the row of the print mounting order when the **Fit to page** option is not selected. For example, the Ladder 0 diagram showed above will be printed in 3 pages. The user has to mount the diagram as showed in the following figure to see all information:



Fig 3. 39 – Page Order – Print Mounting

Import Template to Database and Export Template from Database Options

The **LogicView for FFB** has a feature to import and export FFB Templates, which allows the file interchange among the workstations.

Exporting a FFB Template

To export a FFB Template, choose the **Export Template from Database** option in the **File** menu and the following window will be shown.

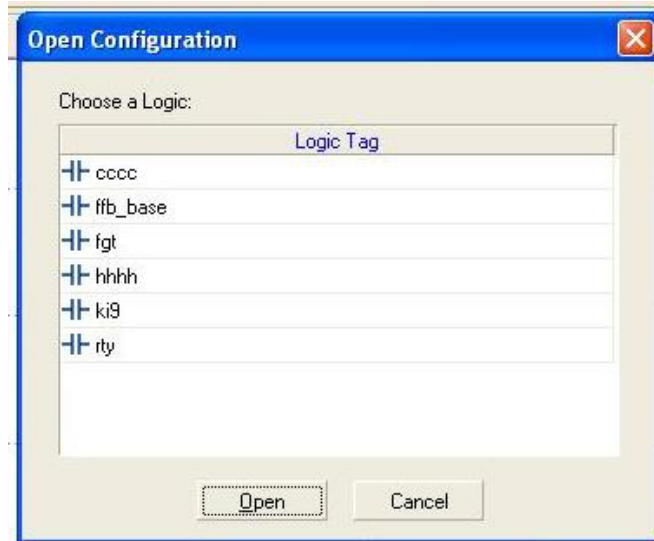


Fig 3. 40 – Selecting a template file

The user has to choose the logic tag, which will be exported, and then click the **Open** button. The following dialog box will be shown.

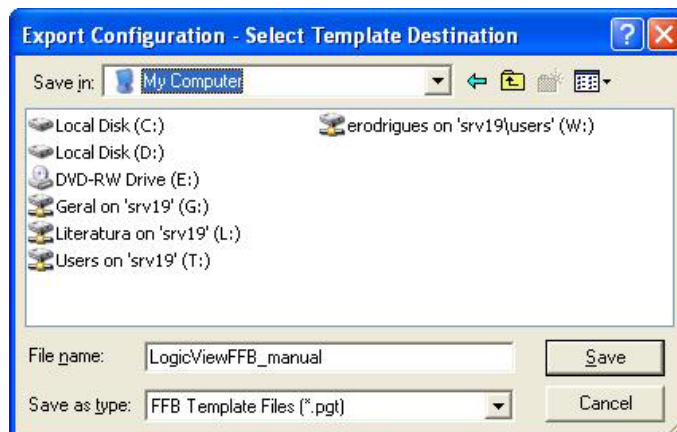


Fig 3. 41 – Selecting a template destination

In this dialog box, the user has to choose the destination folder of the templates which will be exported and for this reason the directory and folder selection is **free**. After the destination folder selection (or even creation a new one from de available tools of this dialog box), just click **Save**.

The **LogicView for FFB** will export the files relating to the chosen template (except those with .dpt and .pgt extension) in the selected destination folder.

Importing a FFB Template

To import a FFB Template, choose the **Import Template to Database** option in the **File** menu and the following window will be shown.

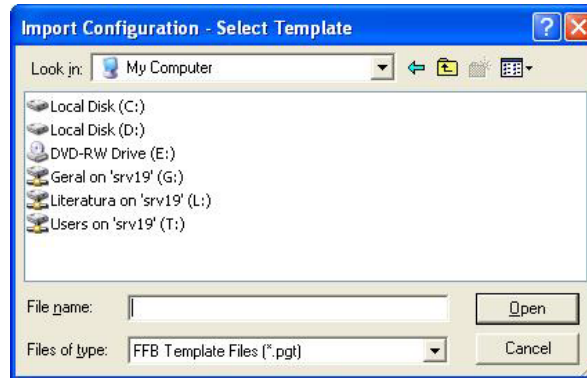


Fig 3. 42 – Selecting a template file

In this dialog box, the user has to choose the template file which will be imported and for this reason the directory and folder selection is **free**. After the file selection, just click **Open**.

After import, the user will request a tag to the template in question

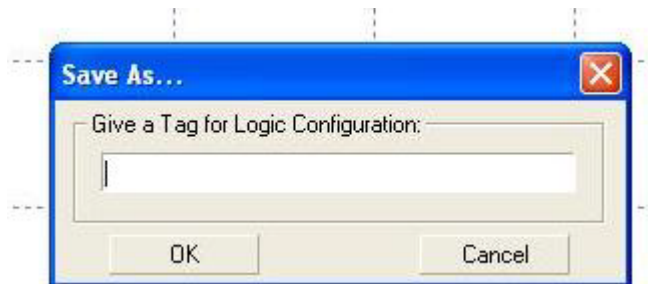


Fig 3. 43 – Giving a tag to template

The **LogicView for FFB** will import the files relating to the chosen template (except those with .dpt and .pgt extension) from the selected origin folder and will create all the necessary references to the Integrated System management.

When the import process finishes, the **LogicView for FFB** will open the FFB template file newly imported.

NOTE

The **Import Template to Database** and **Export Template from Database** options are available only when the **LogicView for FFB** is already opened in Template mode. For further details see the Template Mode topic.

Edit Menu

By clicking **Edit**, or through the shortcut ALT+ E, the following menu will open:

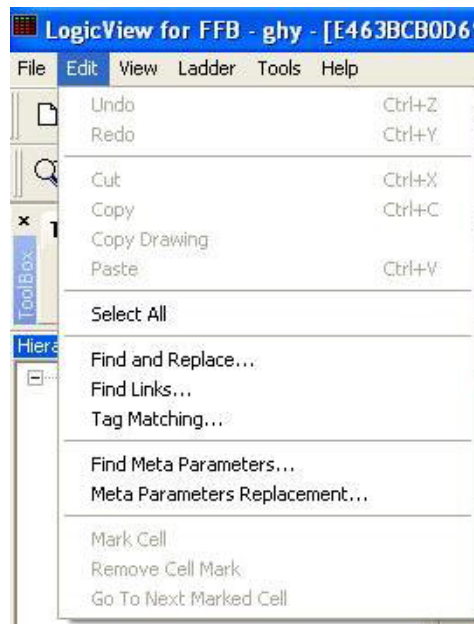


Fig 3. 44 - Edit Menu

“Intelligent” Copy/Paste

The **LogicView for FFB** has a smart feature to copy parameters of logic diagrams.

The common operations on Windows such as Copy, Cut, Paste are applied to a set of selected elements of a logic diagram (through the button ) and they are available in **LogicView for FFB** as follows:

- **Copy Drawing:** this command only copies the ladder drawing (contacts, coils and function blocks, etc) removing tags and links;
- **Cut:** this command “cut” the selected group, removing it from the drawing area;
- **Copy:** this command copies the selected group, keeping, besides the drawing, all its valid characteristics (see below);
- **Paste:** use this command to paste the group which was copied or cut.

When the **Paste** command is performed, the **LogicView for FFB** will evaluate the conditions to keep the valid characteristics of the elements group that will be inserted on the diagram.

- **1st Paste performed after a Cut:** In this case will be maintained beyond the drawing, all characteristics of the group (tags and function blocks links);
- **2nd Paste (or more) after a Cut:** In this case the behavior will be identical to **Paste after a Copy** (see below).
- **Paste after a Copy:** In this case, the drawing will be maintained and the **LogicView for FFB** can perform some of the changes below, as appropriate:
 - Contacts and Coils: they are maintained exactly as they were, with their associated tags if they exist;
 - Function Blocks: links between function blocks and analog output points (FFB or NetIO) will be removed (each output point can only be used once in a function block link);
 - Function Blocks (internal links): internal links among function blocks will be maintained.

In this case will be maintained beyond the drawing, all characteristics of the group.

IMPORTANT

The function blocks tags are changed at each paste command to maintain the uniqueness of the tags. The **LogicView for FFB** automatically redo all connections among function blocks because of these changes.

Example of behavior with function blocks:

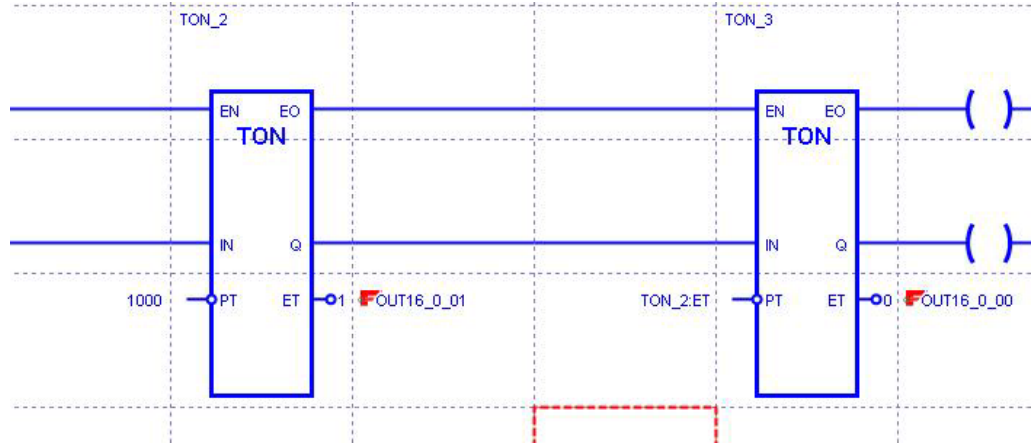


Fig 3. 45 – Example of intelligent copy/paste

In the diagram above there are two function blocks, with a link to each other (**TON2:ET** linked to **TON3:PT**) and their **ET** points are linked to FFB analog output points.

According to what has been described, the operation of **Cut** by selecting all elements of the diagram above, followed by **Paste** will keep all the characteristics and the result is the same as the figure above.

However, from the second **Paste** (and therefore the **TON_2** and **TON_3** blocks are already in the logic diagram), the result will be as in the following figure:

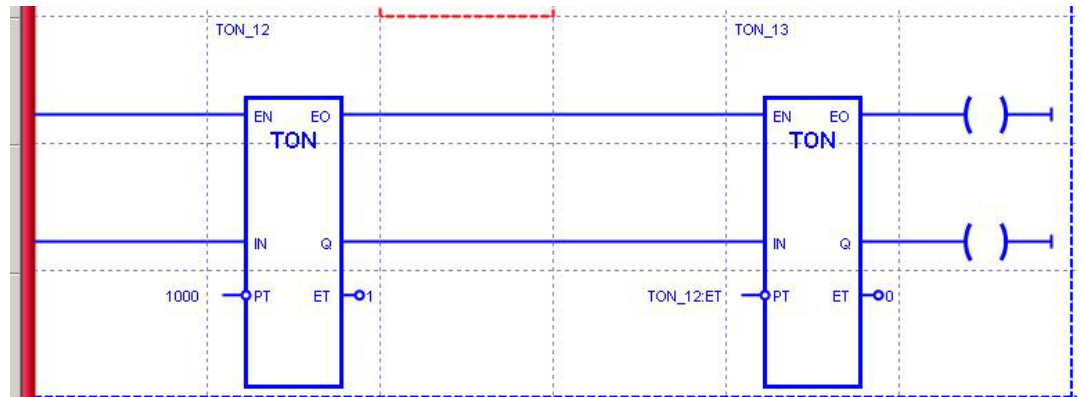


Fig 3. 46 – Example of intelligent copy/paste using function blocks

The **LogicView for FFB** removed the links of function blocks with the FFB analog points, because they are already been used in the **TON_2** and **TON_3** blocks, and renamed the function blocks to maintain the tags integrity (**TON_12** and **TON_13**). The link between blocks was maintained, now is **TON_12:ET** linked to **TON_13:PT**, the function blocks tags changing was reflected in the links.

IMPORTANT

This same behavior would have occurred with only one command **Copy** followed by **Paste**.

In another example, if only the **TON_3** block of the figure 3.45 is selected for a **Copy** operation followed by **Paste**, the result is the following figure:

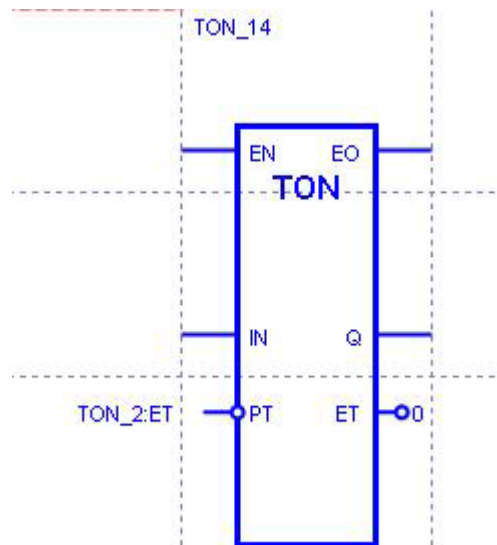


Fig 3. 47 – Example of intelligent copy/paste

As in the previous example, the **LogicView for FFB** removed the function blocks links with the FFB analog points and renamed the function block to maintain the integrity of tags.

However, as only the **TON_3** block was copied, the link between it and the **TON_2** block was maintained, now is **TON_2:ET** linked to **TON_14:PT**.

The elements of the ladder drawing area can select all at once. Just click **Edit**→ **Select All**.

Find and Replace

The elements tags on the ladder network can be found and replaced with the command **Edit**→ **Find and Replace**. The next window will appear:

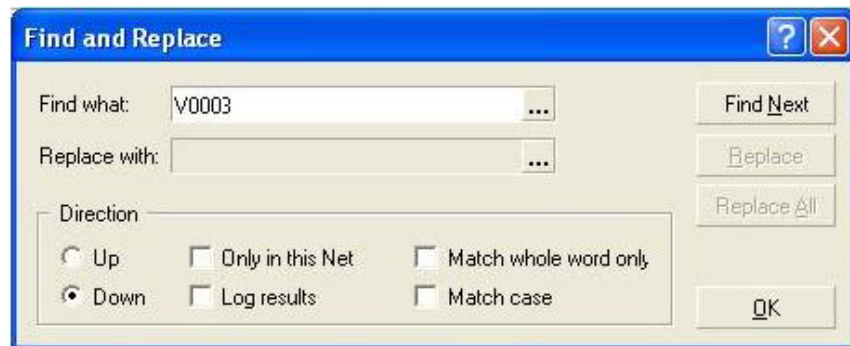



Fig 3. 48 – Find and Replace

The **Find** command searches for the tags of contacts, coils and function blocks and the **Replace** command only replaces the contacts and coils tags. If the user wants to find a tag in the network just write it in **Find what** and then click **Find Next** button. The **LogicView for FFB** will find it and the cell where the tag is will be selected.

To replace a tag, select the respective tag by clicking . A window with the available tags will appear. To select a tag, click **Select**. See the next figure:

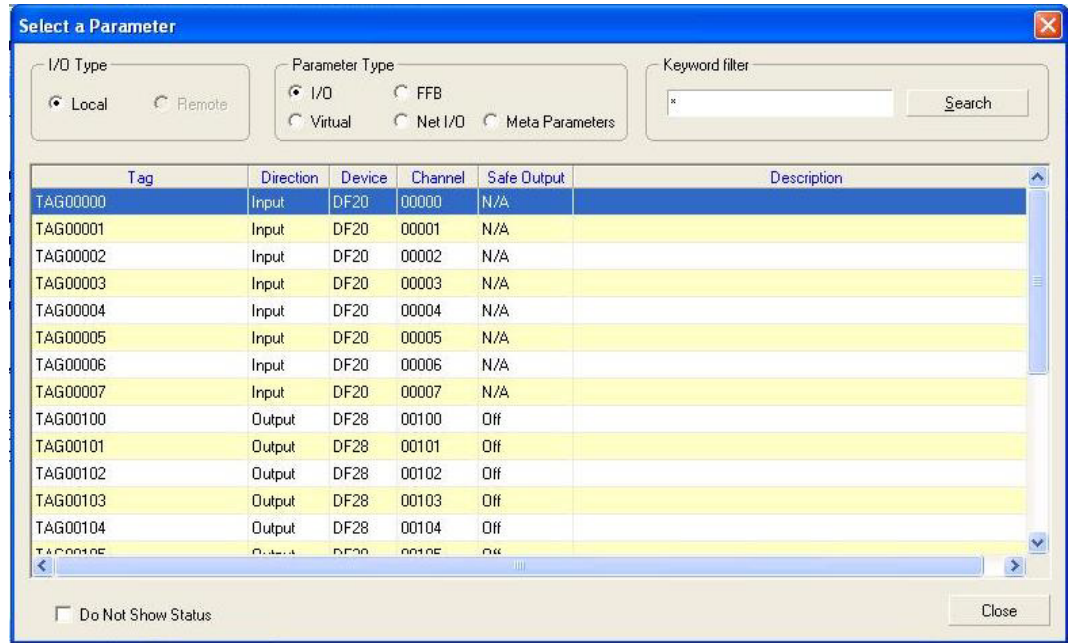


Fig 3. 49 – Selecting a parameter

After selecting the tag, the software will return to the **Find and Replace** window and the user can replace the tag clicking **Replace** (for one element) or **Replace All** (for all elements of the same type). To canceling the command click **Cancel**.

The user may choose the searching direction – **Up** or **Down**, and if the searching will be only in the selected net – **Only in this net**. When the user chooses the **Log results** option, in the **Output** window will appear a list informing the cells which the chosen tag was found. See the example in the figure below:

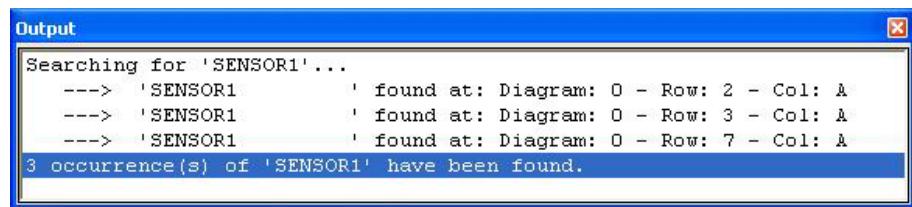


Fig 3. 50 – List informing the cells which the chosen tag was found

- | NOTES |
|---|
| <ul style="list-style-type: none"> • The Find and Replace commands distinguish lower case and upper case, and whole words. • The Undo and Redo commands only act on the insertion and removal of ladder elements. |

Find Links: this option allows finding function blocks which have links with the selected parameter from a list.

It can be launched from **Edit menu**, according to the next figure:

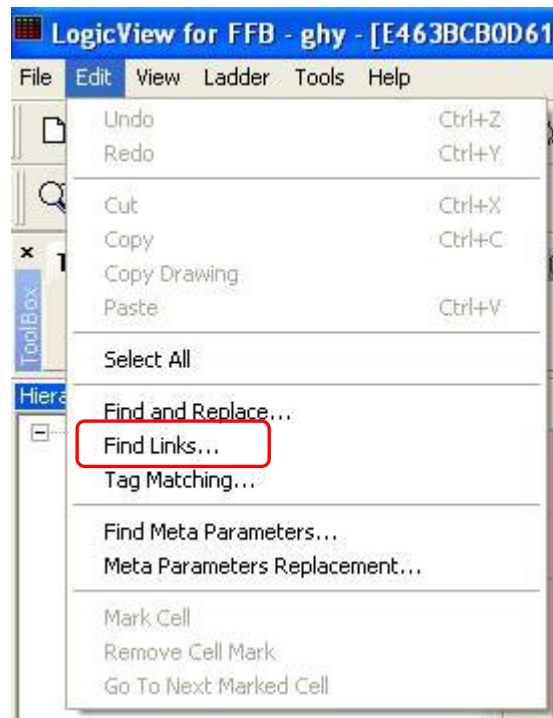


Fig 3. 51 – Find links option

When that option is chosen the following window will appear:

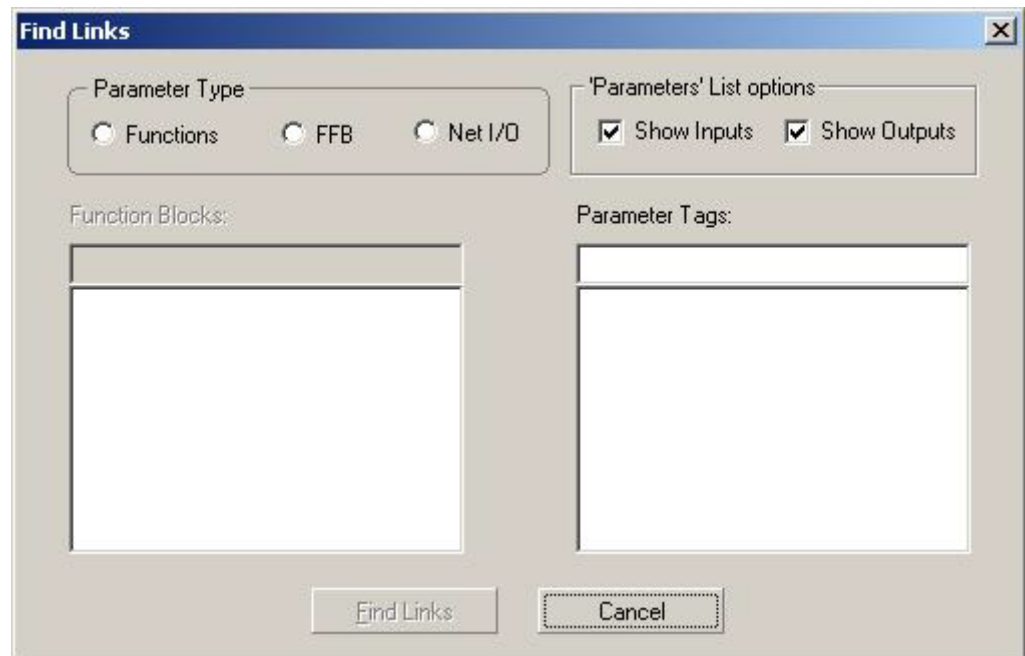


Fig 3. 52 – Find links window

The window's elements are as follows:

Parameter Type: in this box is possible to select the parameter type which will be available for searching: function block parameters (Functions), flexible function block parameters (FFB), and net I/O parameters (NetIO);

'Parameters' List options: it allows selecting if the parameters list will show only the inputs (Show Inputs) or outputs (Show outputs) points;

Using the **Parameter Type** options:

- By clicking **Functions**, the set of available function block tags will be listed on the window's left side (Function Blocks). When a function block from this list is selected, the tags of its analog points will be listed on the window's right side (Parameter Tags).
- By clicking **FFB** or **NetIO** options, the set of available tags will be listed on the window's right side (Parameter Tags). This set can be filtered according to the box **'Parameters' List options** (described previously).

To find the links, the user has to select a tag from the list at right, and click **Find Links**. The searching procedure will find all function blocks which have links with the selected point, showing the results at the log results window (Output View). See the next figure.

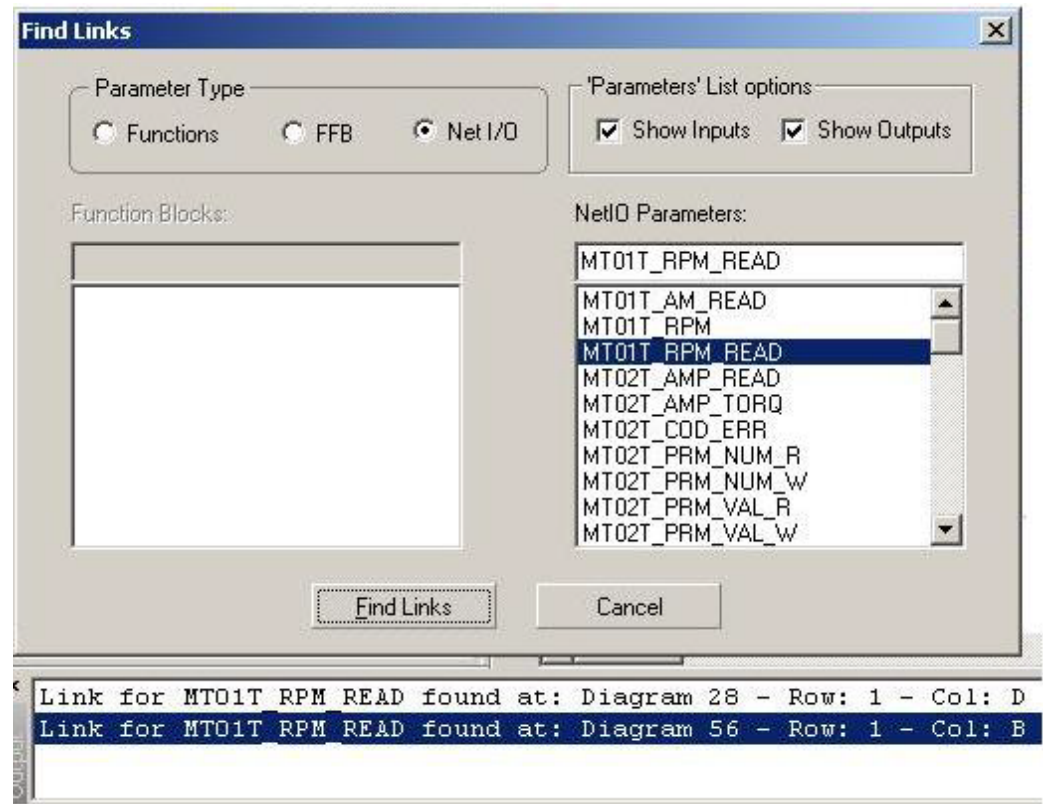


Fig 3. 53 – Window of results of a find links process

In the results list, to explore a specific function block, just double-click the desired line. The **Logicview for FFB** will mark this block in the software's main window. If links with the selected point are not found, a window with the message **"No link(s) found!"** will appear.

NOTE

If the user chooses an output point the Find links procedure will work as described previously, that is, finding all function blocks which make links with the selected point.

However, if the user chooses an input point, the searching mechanism will find the only function block whose output point is linked to the selected point. This behavior is equal to the **Go to Out** function in the context menu of a ladder diagram.

The **Tag Matching** option allows replacing a set of variables in the ladder diagram elements quickly and efficiently by another set of variables previously defined in LogicView for FFB.

The Tag Matching operation is done only for the diagram which was selected in the diagram's list and showed in the **LogicView for FFB** screen.

This feature is in the **Edit → Tag Matching** menu.

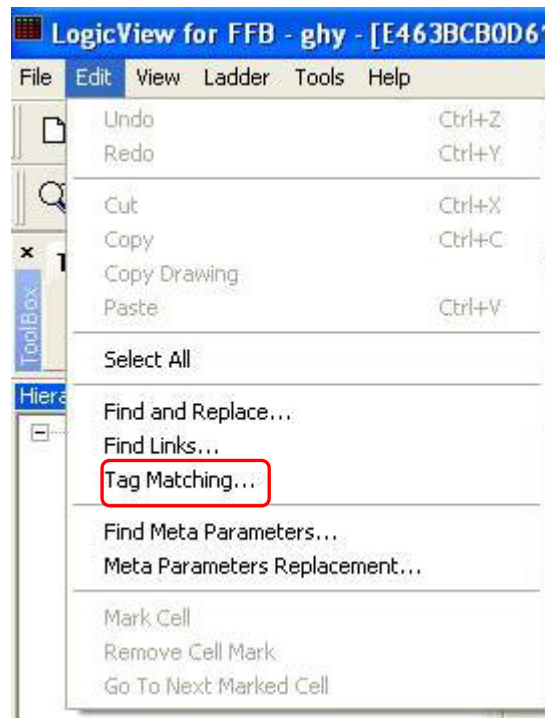


Fig 3. 54 – Tag Matching option

When selecting **Tag Matching**, the following window will appear:

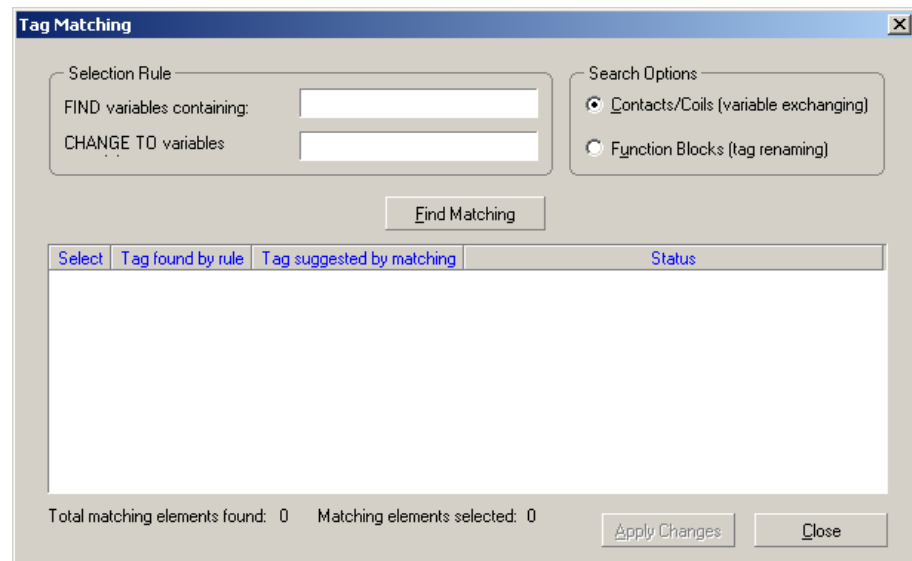


Fig 3. 55 – Tag Matching window

The window's elements are as follows:

Search Options: the available options for the matching operation are:

- **Contacts/Coils (variable exchanging):** for contacts and coils the matching operation will find those whose tags are in according to the **Selection Rule**, which will be described later, verifying one by one if the variable's replacement is possible.
- **Function Blocks (tag renaming):** for function blocks the variables replacement is not possible. The available option allows renaming the tags of a set function blocks which are in according to the **Selection Rule**.

Selection Rule: the fields to edit the selection rule allow the user to enter the tags' characters which will be found and replaced in the diagram, similar to a Find/Replace procedure.

The first edition field is **FIND variables containing:** (or **FIND Functions' Tags containing,** if the **Function Blocks (tag renaming)** option is selected) has to be filled with the characters of the tags which will be found for a possible replacement.

The second edition field, **CHANGE TO variables,** has to be filled with the characters of the elements' tags which will replace those found by the first field (**FIND variables containing**). If the **Function Blocks (tag renaming)** option is selected, this edition field will show the text "**RENAME Function's Tag to:**" indicating that the operation will not be to change variables, it will be to change tags.

To better understand **Tag Matching**, see the example below.

The user has a set of variables previously defined, and needs quickly to change a set of variables in contacts and/or coils whose tags finish in "1" by other variables whose tags finish in "10". The **Tag Matching** window has to be filled as follows.

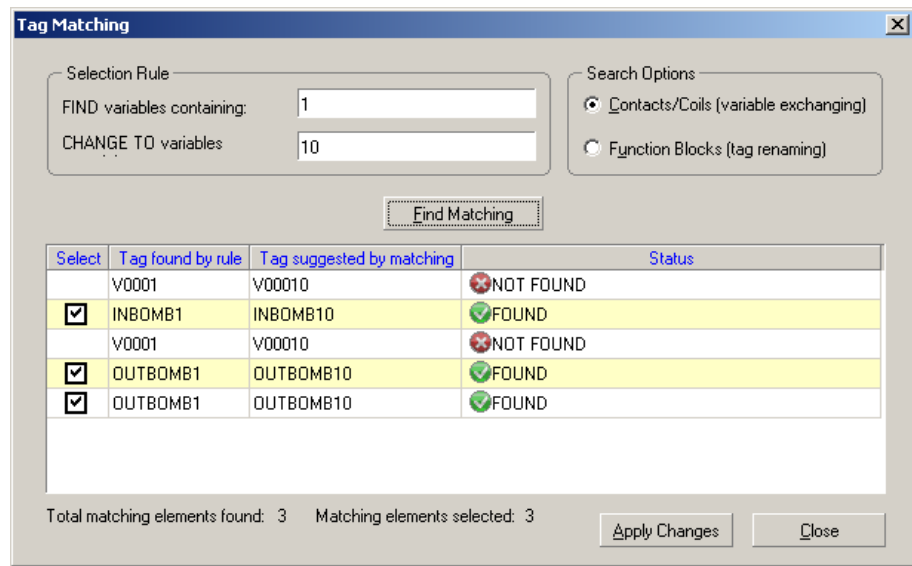


Fig 3. 56 – Tag Matching example

By clicking **Find Matching**, the association procedure will search variables in contacts or coils which have the character "1" in their tags. When variables with this characteristic are found, the matching procedure replaces the character "1" by "10" (typed in the **CHANGE TO variables** field), creating a new tag.

And then, the procedure searches variables with this new generated tag and verifies if it is possible to replace a variable by another (analysis of compatibility). The variables found will be showed in the list, with the status of compatibility among them.

In the above example in the first line, the association procedure found a variable V0001 (shown in the column **Tag found by rule**) already defined in **LogicView for FFB**. For the selection rule defined in the example, "1" should change to "10" which forms a new tag V00010. The search engine could not find any variable defined in LogicView for FFB with this tag (for the variables replacement could be performed), indicated by the status **NOT FOUND** in the last column of the table.

In the second line, the association procedure found a variable INBOMB1, and by the selection rule, should change the variable by another called INBOMB10. As this variable was already defined in **LogicView for FFB**, the association procedure found the variable and checked their compatibility for the variables replacement. In this case there is compatibility and the operation is allowed, indicated by the status **FOUND** in the table.

In cases where the variable exists, but there is no compatibility between them, for example, if a variable is associated with a coil - which only allows output variables - and the procedure finds an input variable with the tag in according to the selection rule, this is not a valid replacement. The operation will not be enabled, and the status will be indicated as **FOUND BUT NOT COMPATIBLE** in the table, as in the following example.

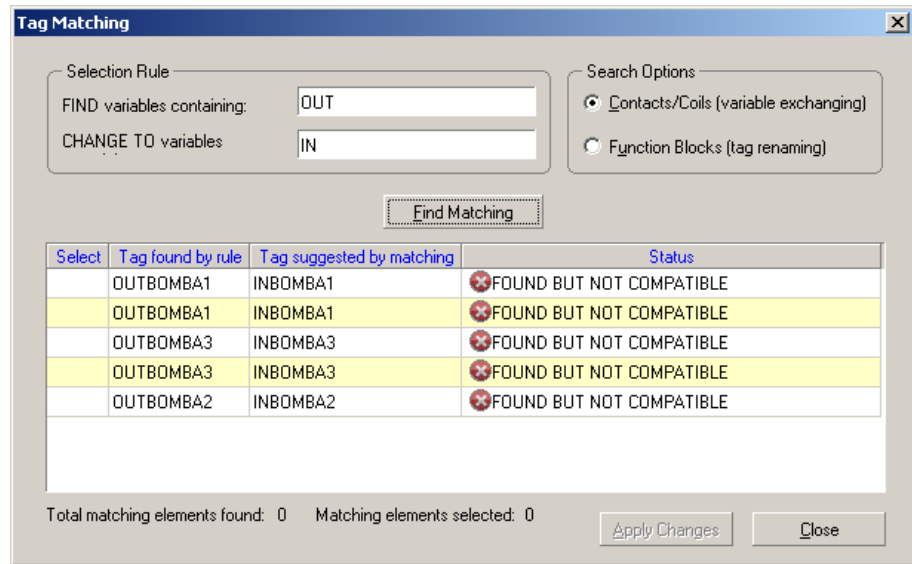


Fig 3. 57 – Tag Matching example– verifying the compatibility

The user can select in the table which variables replacement operations have to be done by the **Select** column, as shown in figure above. When you click the **Apply Changes** button, all replacements will be effective in the selected ladder diagram.

Example for Function Blocks:

If the user just wants to rename a set of function blocks the Tag Matching also can be used.

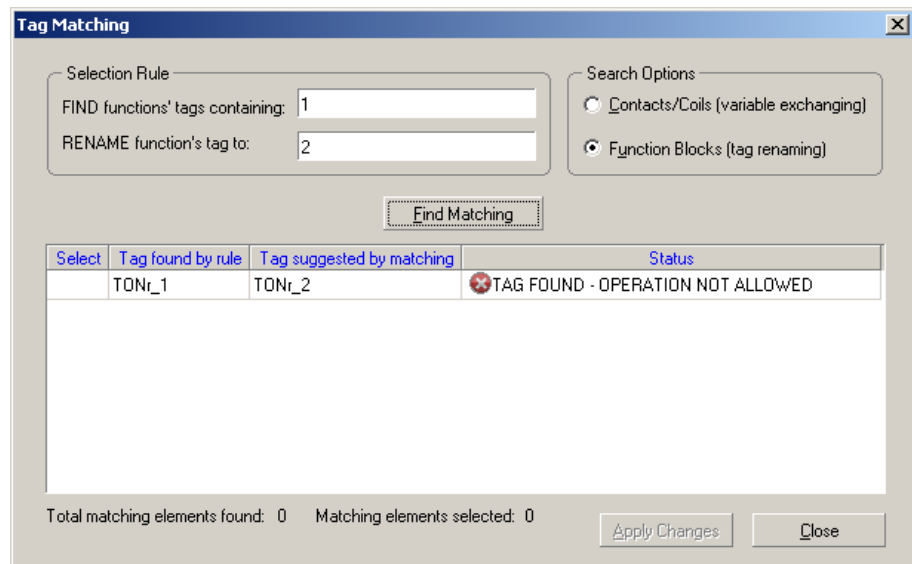


Fig 3. 58 – Tag Matching example– renaming function blocks

In the above example, the user tried to find all function blocks whose tags have “1”,and then, rename them changing “1” to “2”. For example, TONr_1 to TONr_2. The association procedure found a tag TONr_2, which exists in the configuration, and for this reason you cannot rename the tag, indicated by the status **TAG FOUND - OPERATION NOT ALLOWED**.

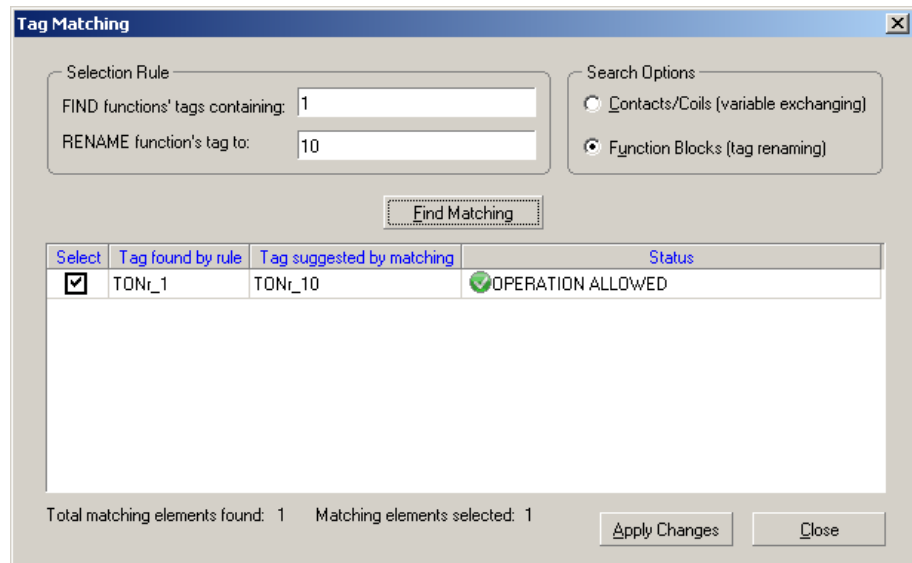


Fig 3. 59 – Tag Matching example – renaming function blocks

In the above example, the user tried to find all function blocks whose tags have “1”, and then, rename them changing “1” to “10”. For example, TONr_1 to TONr_10. The association procedure did not find any TONr_10 and, for this reason, it is possible to rename the tag, indicated by the status **OPERATION ALLOWED**.

Meta Parameters

The **LogicView for FFB** has the following conventional parameters types:

- **Reals (I/O)**: parameters associated to hardware;
- **Virtuals**: auxiliary variables to implement discrete logic. They are created on **LogicView for FFB** and belong exclusively to the logic configuration which they were defined.
- **FFB**: input and output parameters of Flexible Function Block (FFB), created through the **Define Parameters Tool (DPT)**;
- **NetIO**: input and output parameters resulting from network mapping (Profibus, AS-i or DeviceNet) through the **Mapping Tool** applicative.

The meta parameter is a special element of **LogicView for FFB** and its purpose is to make easier the logics reuse through special replacement mechanisms which will be described later. For this reason it is a temporary variable, without specific type that can be associated to a discrete element (contact/coil) or can be used in function blocks links.

A meta parameter is identified by the prefix **#** and it can be created manually by user or automatically by **LogicView for FFB** when the templates are created and when the logics are imported from Logic Library.

Thus, as the FFB and NetIO points, the meta parameters have value and status, and are divided as follows:

- Digital Input (DI);
- Digital Output (DO);
- Analog Input (AI);
- Analog Output (AO).

That is, a meta parameter is defined by value, status and tag and it does not have memory address. For example, for a meta parameter with tag BOMBA_1:

- **#BOMBA_1** (value of meta parameter BOMBA_1)
- **#~BOMBA_1** (status of meta parameter BOMBA_1)

It is possible has conventional parameters defined and used in the logic together with meta parameters making an hybrid logic. This maximizes the incremental development of logics and the total or partial reuse of them.

NOTE

If there is at least one meta parameter in the ladder diagram the following operations will be blocked.

- Simulation;
- Download via **Syscon**
- Be Online on **LogicView for FFB**

The **LogicView for FFB** will compile normally a configuration with meta parameters, allowing that the user find and correct common errors of discrete interlocking structure.

However, when attempting to perform operations not allowed on hybrid logic, error messages are shown as the following figures:

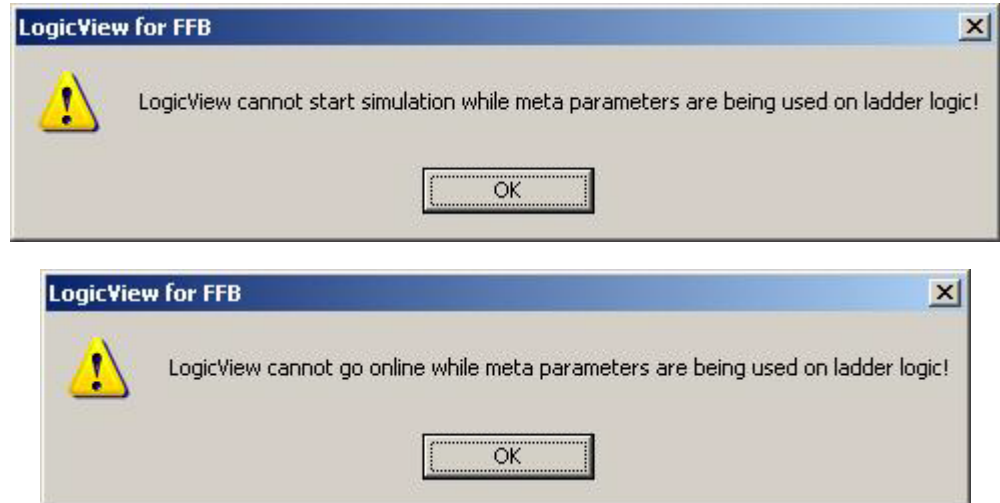



Fig 3. 60 – Error messages – operations not allowed in hybrid logics

Creating meta parameters

To create meta parameters, just select in the **Hierarchy** window the  **Meta Parameters** option and define its quantity in the **Object Properties** window, as in the next figure:

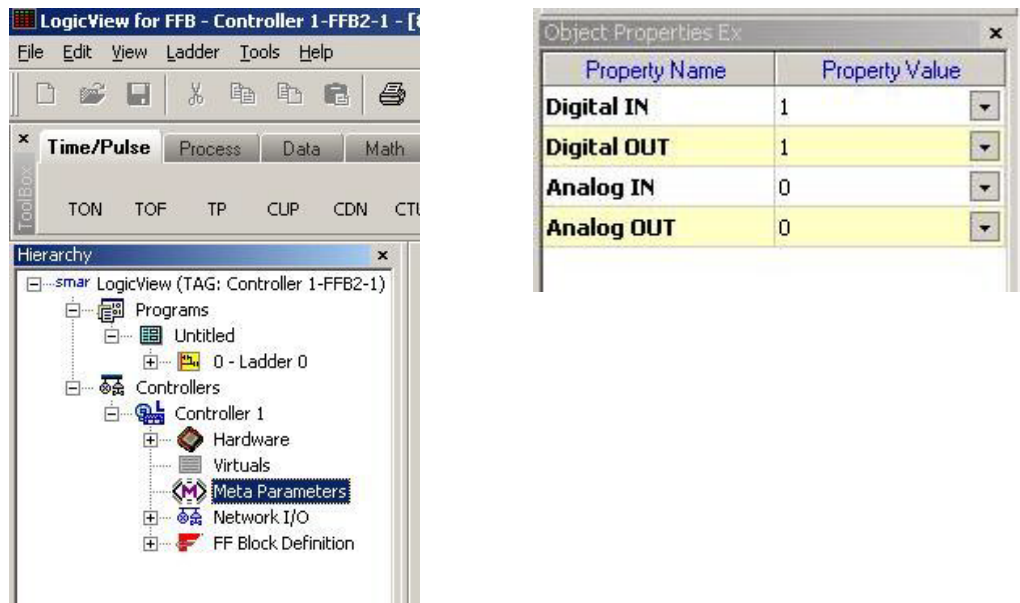


Fig 3. 61 – Creating meta parameters

Editing meta parameters

To edit meta parameters, the **Properties Editor** window can be used. See the following figure.

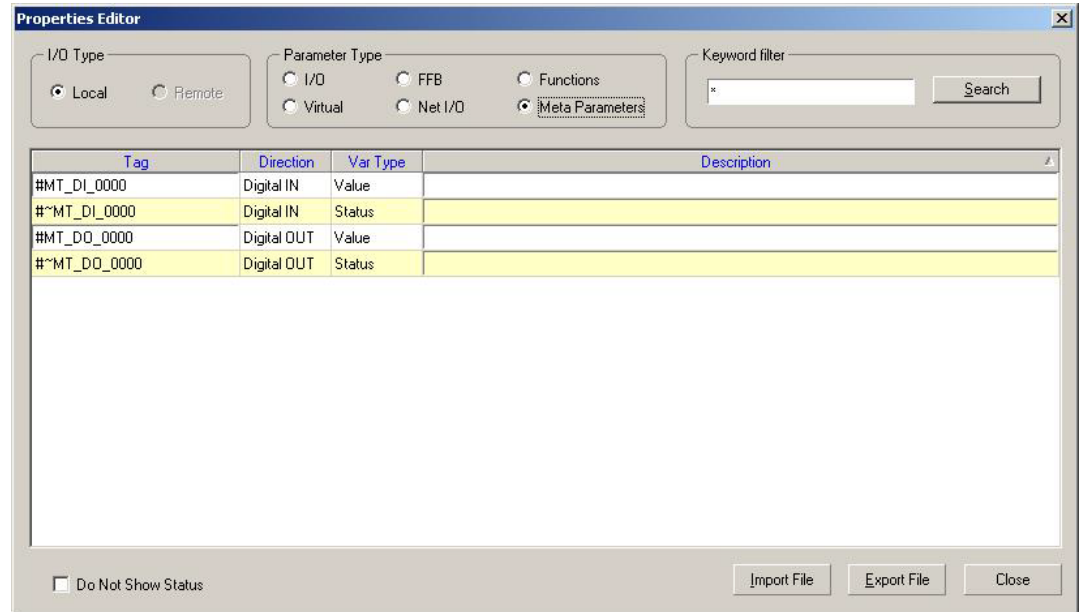


Fig 3. 62 – Editing meta parameters

The association of meta parameters to contacts, coils or function blocks is exactly the same way as to other types (I/O, Virtuals, FFB or NetIO points). The logic resulting from the combination of common parameters with meta parameters can be seen in the following figure.

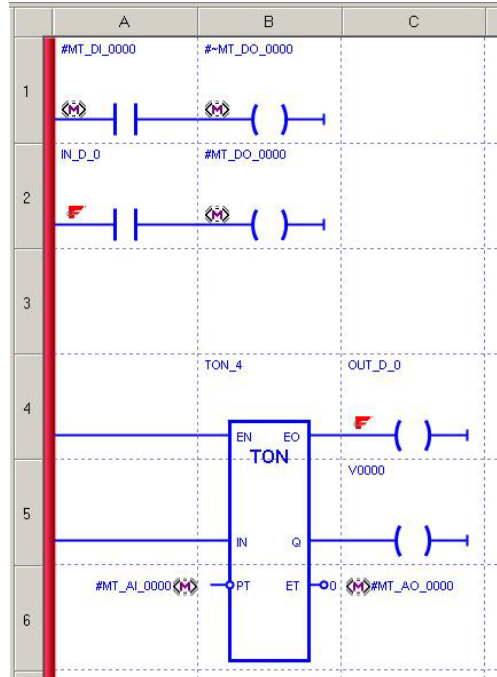


Fig 3. 63 – Example of hybrid logic, with meta parameters

An entire logic configuration can be created with meta parameters, without specifying hardware information, defining FFB points or even the mapping of network points (NetIO). This logic can be “converted” in a conventional logic through an automatic mechanism of **LogicView for FFB** named **Meta-Tag Replacement** that will be described later.

Finding Meta parameters

To find the meta parameters used in the logic configuration, the **LogicView for FFB** has the **Find Meta Parameters...** option, in the **Edit** menu:

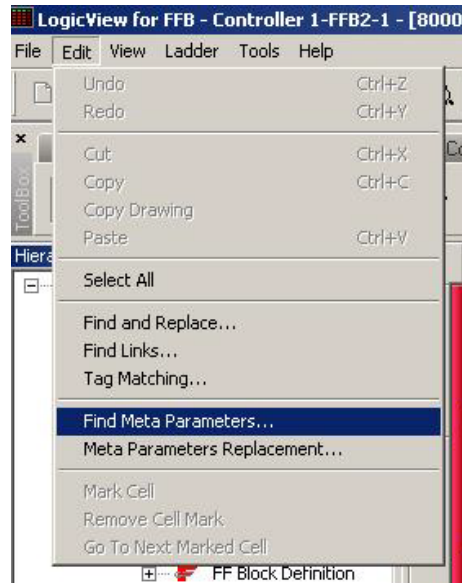


Fig 3. 64 – Finding meta parameters

By selecting this option the following window will appear. Select a specific diagram in **Only on this diagram** or else a complete search in **All Diagrams**:

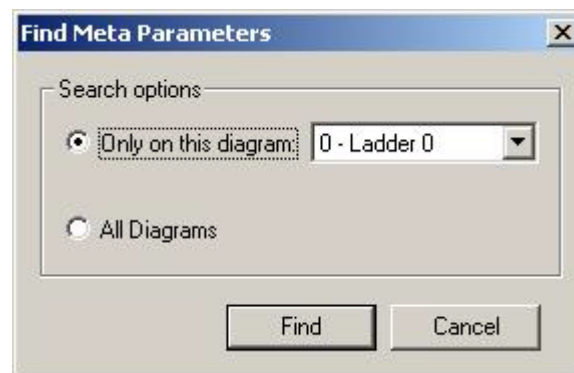


Fig 3. 65 – Find meta parameters window

After choosing the search option, just click **Find** and the search results will be shown in the **Output** window:

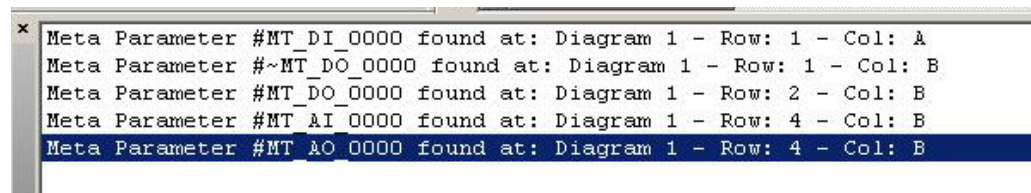


Fig 3. 66 – Search results for meta parameters

Replacing meta parameters by conventional variables

A logic may have a great number of meta parameters and, at some moment, they will need to be replaced by conventional parameters (or variables) to become the hybrid logic in conventional logic. In other words, the logic can be applied usually in an automation plant.

To perform the replacement operation, the **LogicView for FFB** has the **Meta Parameters Replacement** option in the **Edit** menu:

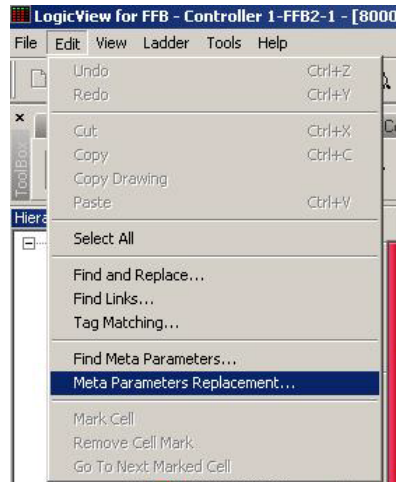


Fig 3. 67 – Meta parameters replacement option

By choosing this option, the following window will appear.

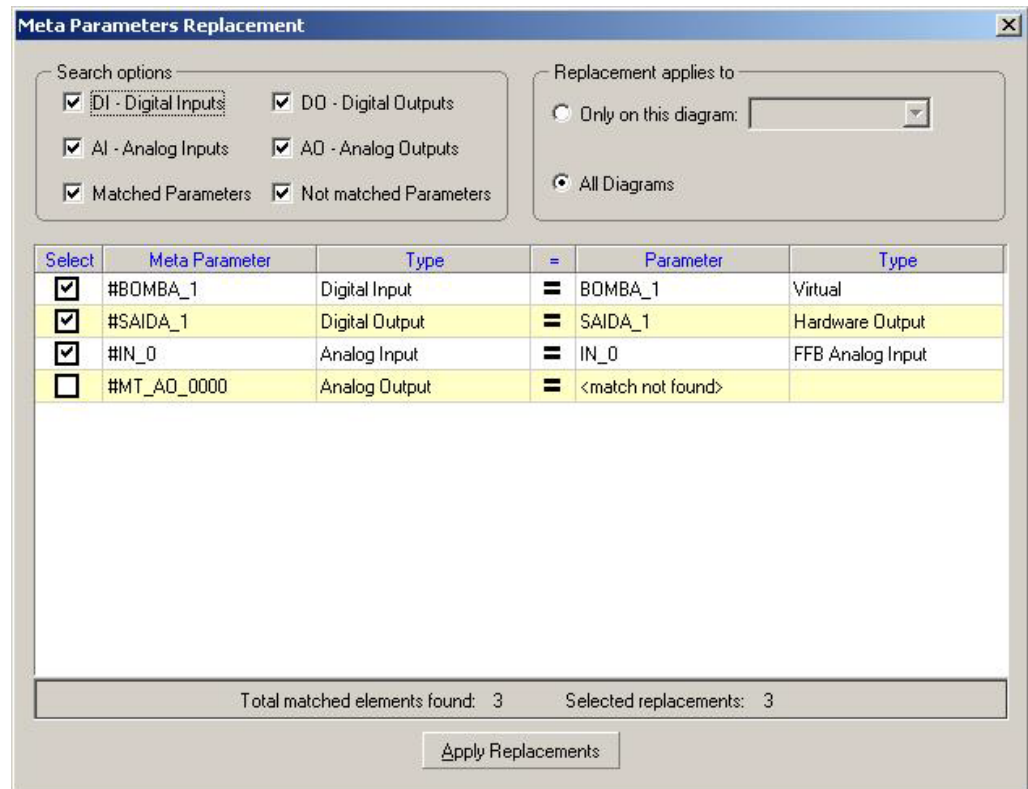


Fig 3. 68 – Meta parameters replacement window

The **LogicView for FFB** performs the process of **tag matching** in all meta parameters that are being used in the configuration. The result will be as follows:

- **Matched Parameters:** They are variables (I/O, Virtuals, FFB or NetIO) whose tags are equivalents to the meta parameters tags. In the previous example, "#BOMBA_1" and "BOMBA_1" are equivalent tags. Besides the tags matching, an evaluation of type compatibility, between the meta parameter and the equivalent variable, is performed. For example, if the tags match, but the meta parameter is AI type while the corresponding variable is DO type, the replacement is not valid. When the types are compatible and the tags match, the table is automatically filled with a replacement "suggestion".
- **Not Matched Parameters:** When the **LogicView for FFB** does not find a conventional variable that can be suggested on the table, because it does not find a tag matching or because the variables are not compatible, the message **<match not found>** will be shown in the **Parameter** table column.

In this window also are available the following options:

- **Search Options:** it has the search options of the meta parameters that will be shown on the table: DI, DO, AI or AO;
- **Matched Parameters:** shows only the meta parameters that have a corresponding variable for replacement;
- **Not Matched Parameters:** shows only the meta parameters that does not have a corresponding variable for replacement;
- **Replacement Applies to:** this box allows choosing if the meta parameters replacement by conventional parameters will be applied to all logic diagrams or to a specific diagram.

The table columns have the following meaning:

- **Select:** Allows selecting or not the meta parameter for replacement in the logic configuration. Those that do not have an attributed conventional variable for replacement cannot be selected on this column.
- **Meta Parameter:** shows the meta parameters tags used in the logic configuration;
- **Type:** identifies the meta parameter type (DI, DO, AI, AO);
- **Parameter:** shows the conventional parameter tags that will replace the corresponding meta parameters;
- **Type:** identifies the conventional parameter type (Virtual, Hardware, FFB DI, etc).

On the table, the user can still make the choice of the conventional parameter that will replace the meta parameter in the logic. Therefore, either the suggestion offered by **LogicView for FFB** can be changed or fill the attributions whose status is **<match not found>**.

To choose a variable just right-click the desired table line and choose **Assign a parameter...**option:

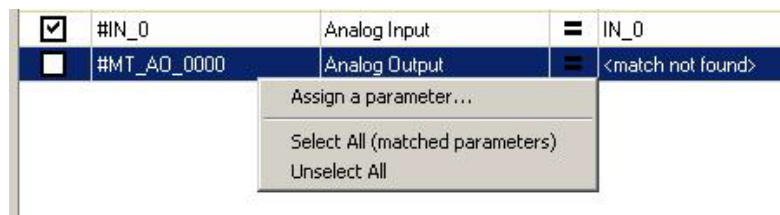


Fig 3. 69 – Meta parameters manual attribution

By clicking **Assign a parameter...**, the variable selection window will appear:

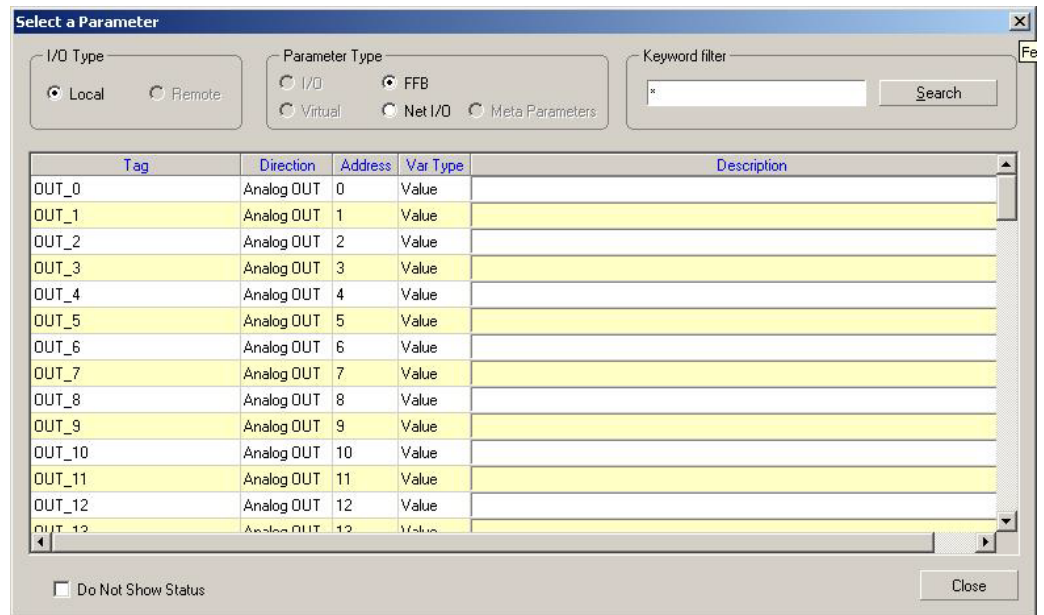


Fig 3. 70 – Parameters selection

The **LogicView for FFB** will filter the parameter type that is compatible with the meta parameter that will be replaced. To choose the variable, just double-click it.

To apply the selected replacements, click the **Apply Replacements** button and the **LogicView for FFB** will perform automatically the replacements in the logic configuration.

NOTE

All meta parameters used in the logic configuration must be replaced, and in this way, the configuration can be normally used in the plant.

The meta parameters are an useful feature of **LogicView for FFB** that increase and make more flexible the creation and reuse of logic configurations allowing the user has options to develop the automation project.

For further details about meta parameters, refer to **Logic Lybrary** topic.

To marking a cell, just select it and go to **Edit**→ **Mark Cell**. The marked cell will have a blue symbol on the top right side. See following figure (cell B,1):

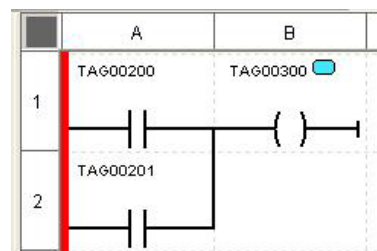


Fig 3. 71 – Marking a cell

To deleting the mark just go in **Edit**→ **Remove Cell Mark**.

NOTE

The mark can not be saved in the file; it will only be activated while the **LogicView for FFB** is running.

When the ladder drawing has more than one marked cell the user can use the **Edit**→ **Go to Next Marked Cell** option. To use this function, first, the user has to select a marked cell. Clicking **Edit**→ **Go to Next Marked Cell** the next marked cell on the ladder execution sequence will be immediately selected and will blink in a yellow background, as in the next figure.

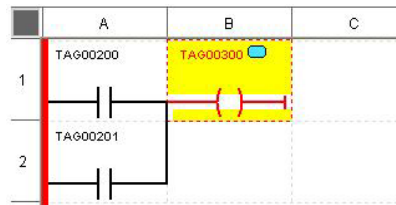


Fig 3. 72 - Go to next marked cell

View Menu

By clicking **View**, or through the shortcut ALT+ V, the following menu will open:



Fig 3. 73 - View Menu

The View menu offers options to enable or disable the many kinds of toolbars: Main, Hierarchy, Object Properties, Output, Zoom, and Toolbox. The user has to click the desired option to enable or disable it. These options will be detailed in **Toolbars** topic.

The **View** menu also has options to show the hardware configuration and the code generated. These items are detailed below.

Hardware configuration

By clicking **View**→**Hardware Configuration** the **LogicView for FFB** will show a window with rack and slots occupation and also showing which ones are available. The rack configuration can be changed. When clicking the desired slot, an option list will open like in the figure below. The hardware configuration will be detailed in the **Hierarchy**→ **Hardware** topic.

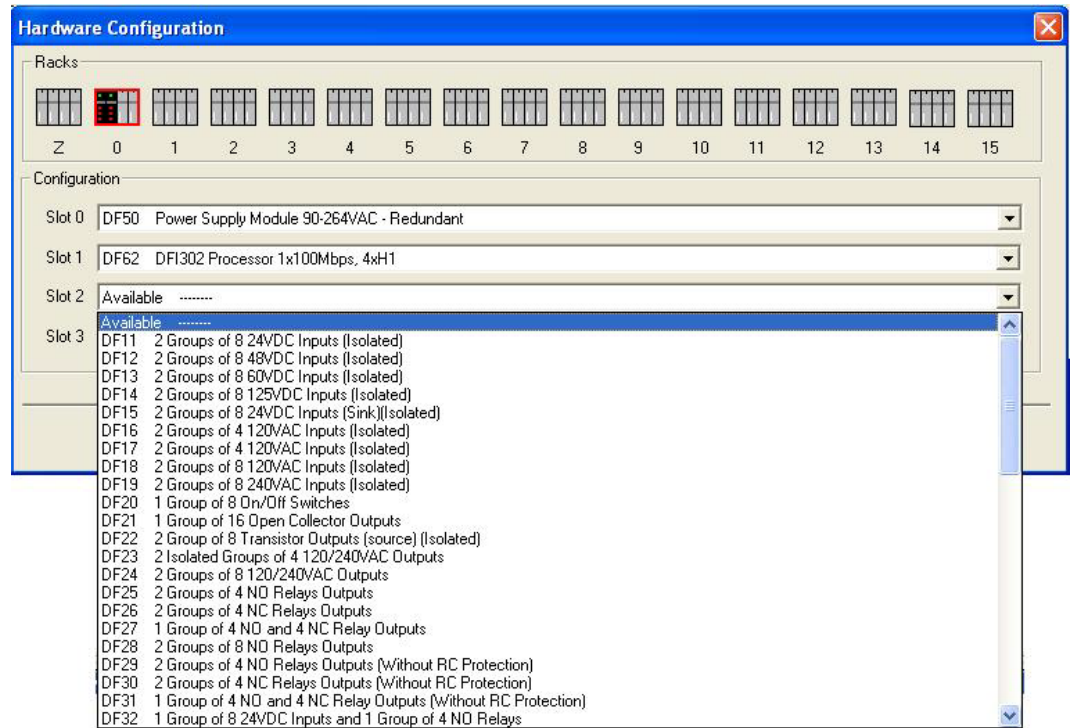


Fig 3. 74 - Hardware Configuration Window

Code Generated

Code Generated is the pseudocode generated by **LogicView for FFB** and it is downloaded on the device, via **LogicView for FFB**, or directly to it, in case of simulation, and it is executed by virtual machine 1131. Normally this information will be used only for debug. In case of fail, this information can be saved in a file and sent to Smar's technical support.

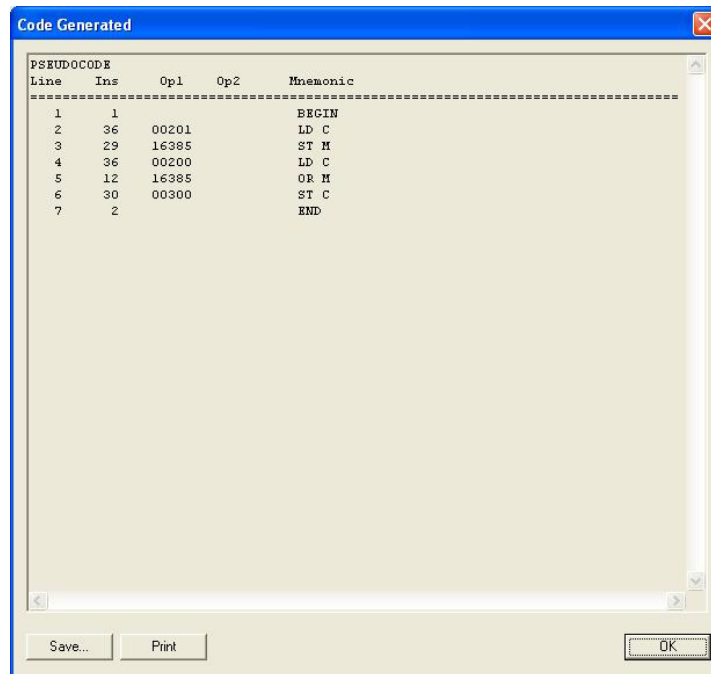


Fig 3. 75 - Code Generated window

Ladder Menu

By clicking **Ladder**, or through the shortcut ALT+ L, the following menu will open:

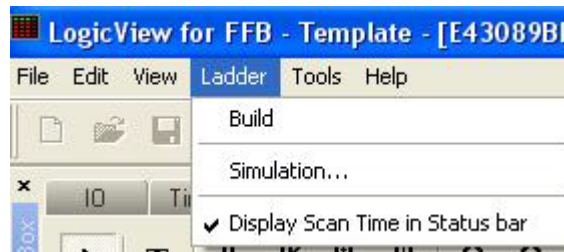


Fig 3. 76- Ladder Menu

Build is the command for pseudocode generation which will be executed by virtual machine 1131. The **Build** command generates the code that is showed on **View**→ **Code generated**.

The **Simulation** option is available only in **offline** mode. When the user clicks **Simulation** a window will open showing the racks configuration. The contacts will appear in logical state zero (0) in the ladder drawing area. See the next figure. In this example only the Rack 0 is being used.

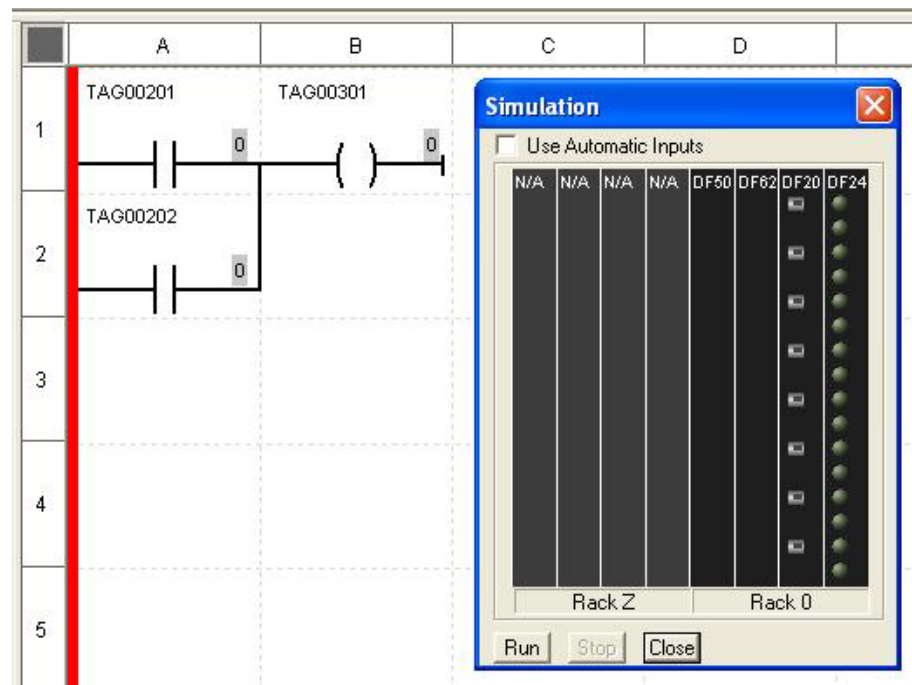


Fig 3. 77 - Simulation window

When the user clicks **Run** button, in the lower side of the window, the simulation starts. To real I/Os the values can be changed on the screen. In order to change them, just click desired input and the high level (1) will be attributed for the input. In the **Simulation** window the high level of the inputs is represented by red color and in the outputs the high level is represented by green color.

In the ladder drawing area the simulation will be represented with high level (1) in green and low level (0) in red. See the next figure.

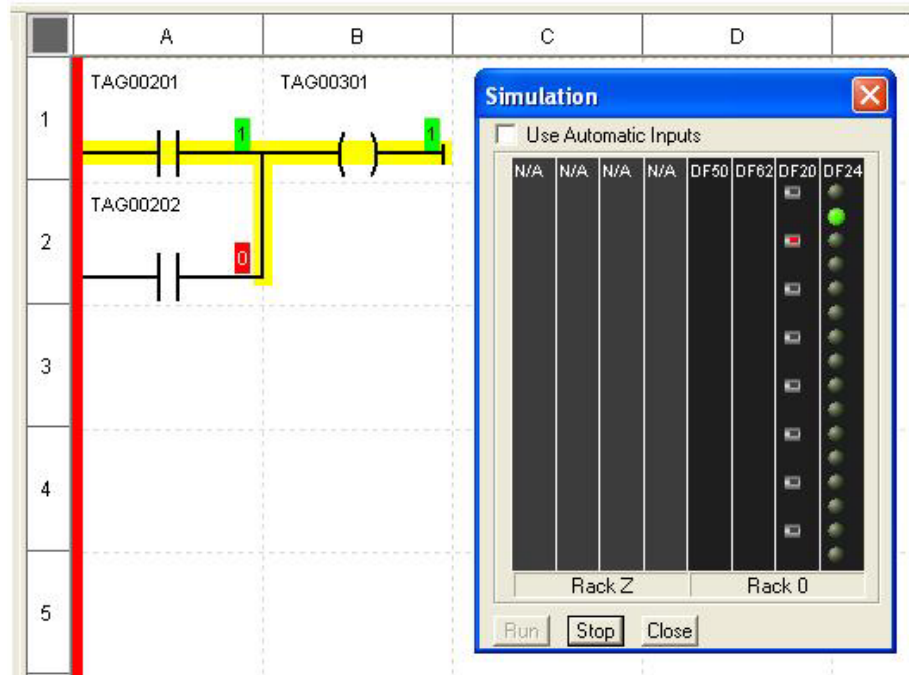


Fig 3. 78 - Simulation Example

The simulation can be stopped by clicking on the **Stop** button. The changes made in the **Simulation** window will not affect the outputs before the **Run** button is clicked again.

To finishing the application, click the **Close** button.

Simulating with virtual variables

When there are virtual variables in the configuration, the user can change the virtual variable value right-clicking the element and then in **Toggle Value** in the simulation. Automatically the virtual variable value is inverted, that is, the false state value (0) will become true (1) and vice-versa.

NOTE

The virtual variable value also can be changed as described above when the ladder is supervised.

After selecting the desired values, the simulation occurs as in the previous case where there were only real I/Os.

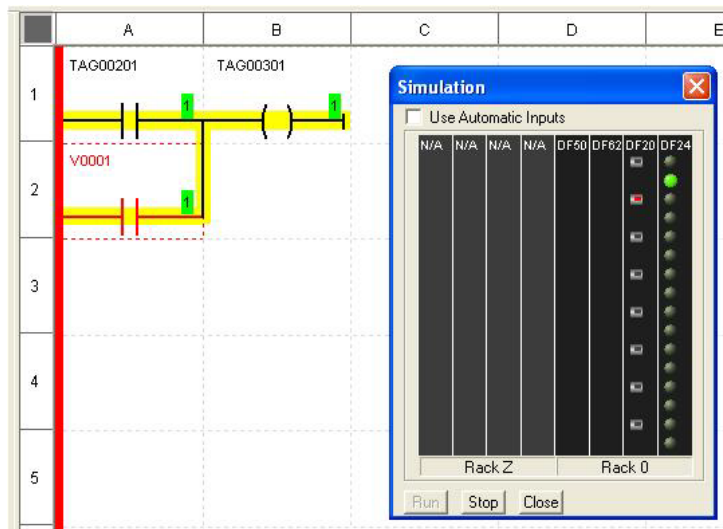


Fig 3. 79 - Simulation with a virtual variable

NOTE

Any module can be used for simulation except the temperature, pulse and analog input modules. They cannot be simulated in this **LogicView for FFB** version.

If in the simulation some functions are accessing those modules (MAI, TEMP, ACC and ACC_N) the analog outputs of these functions will keep always in zero.

The option **Display Scan Time in Status bar** will be always active and cannot be disabled. The **Scan Time**, showed at the **LogicView for FFB** bottom bar (Status Bar), is the scan time, which is the time that one logic cycle takes to be executed in the device.

To choose the device in which the “scan time” will be monitored, the user has to click **Stop/Run**



icon, next to the icon used to connect to the **Server**. Besides serving to trigger or stop the ladder execution in the device, the icon **Stop/Run** is used to enable time scan requests, just to define the device. There will be always one device only on which the logic was downloaded.

The information about the **Scan Time** can be obtained just connecting to the **Server**. This time will appear in the Status bar.

Tools Menu

By clicking **Tools**, or through the shortcut ALT+ T, the following menu will open:

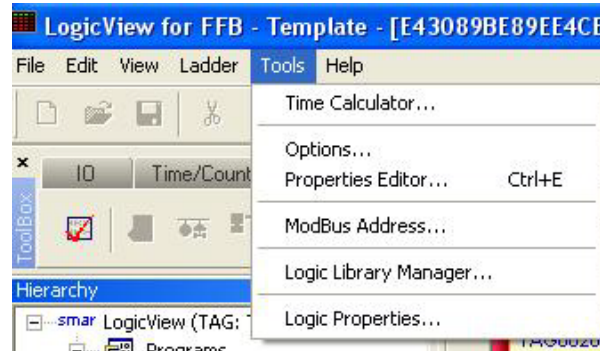


Fig 3. 80 - Tools Menu

The **Time Calculator** option can convert the time values given in hours, minutes, seconds and milliseconds (HH:MM:SS:MS) to milliseconds, seconds, minutes or hours. The user has to enter the value that will be converted in **From**, choose conversion unit in **To**, and then click **Convert**. The conversion result will be shown in **Result**. See the next figure.

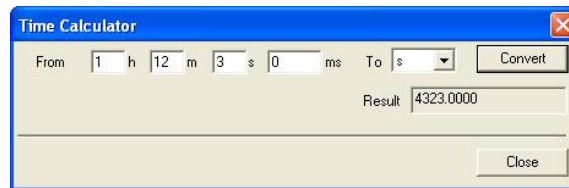


Fig 3. 81 - Time Calculator

The work area appearance and connections can be configured in **Options**. As shown in the figure below, in the **General** tab, the user may configure the drawing area background color, the grid color, the page break color, the object selection color and the cell background color of the **Object properties**. Besides, in this tab the grid may be configured if it will be shown or not, the auto scrolling, if the function blocks parameters addresses and Modbus addresses will be shown in the **Object Properties** window and also the Undo/Redo levels. The user may disable the confirmation dialog box (about keeping or not the CPU running) when the configuration download is done via **Syscon**. It is possible for user to decide if will be showed alternatively Scan Time or Sync Time, only Scan Time or only Sync Time in the Status bar.

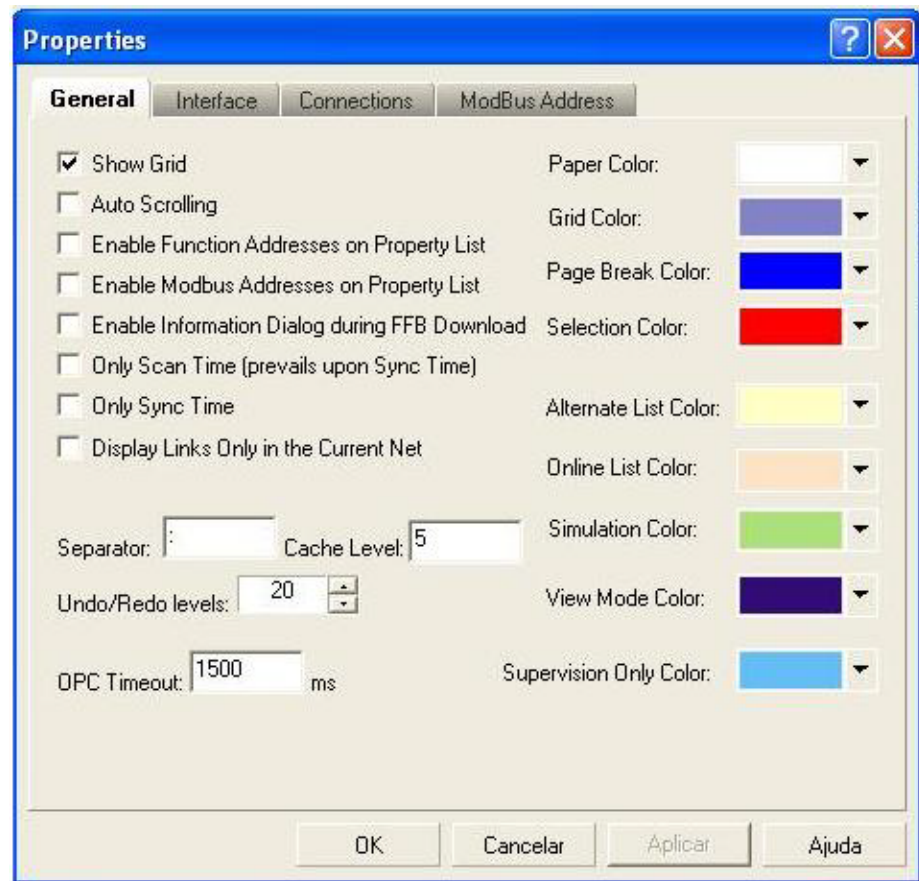


Fig 3. 82 - Configuring the workspace appearance (1)

The user can define the tag separation symbol when they appear in **TagView**, for example. The default symbol is : (colon). Some characters are not accepted. If the user tries use these kinds of characters a message **Invalid Char** will appear. The **OPCTimeout** parameter indicates the time that the **LogicView for FFB** must wait for the OPC Server's response to a request done to the CPU which the **LogicView for FFB** is already connected. It is especially useful in cases where the communication with the CPU is wireless.

The user can choose the "Cache Level" which defines the maximum number of ladders which will be in cache during the supervision. This value must be between 1 and 9.

If the **Enable Information Dialog during FFB Download** option is selected, during the download process (it will be described later) a message will appear, only for information. See the next figure.

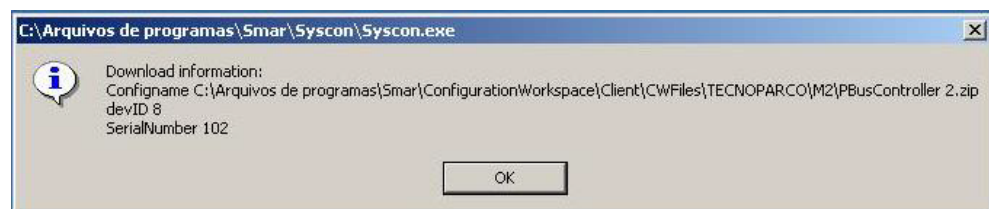


Fig 3. 83 – Download information

In the **Interface** tab the font text, which are showed in the ladder drawing area, and its color may be configured. The ladder elements color also may be changed. In the window right side there are color configuration options which will be used in the simulation and in the online mode. In addition, the user can configure if the icons that represent the types of parameters or links used in the logic will be displayed or not in the drawing area. See the next figure.

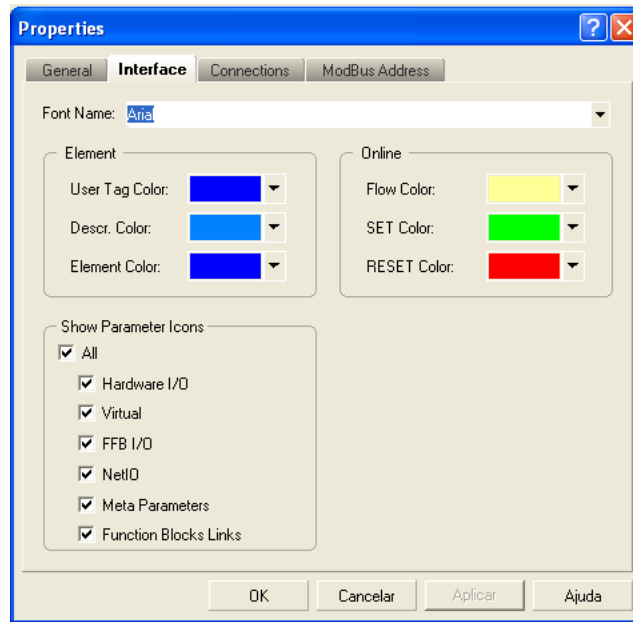


Fig 3. 84 - Configuring the workspace appearance (2)

Each type of parameter or link has a specific icon. To represent the NetIO, there is an icon for each type of supported protocol: Profibus, DeviceNet and AS-i.

- V – virtual point
- H – I/O point
- F <blue> - Function point
- F <red> - FFB point
- P - Profibus point
- D – DeviceNet point
- A - AS-i point

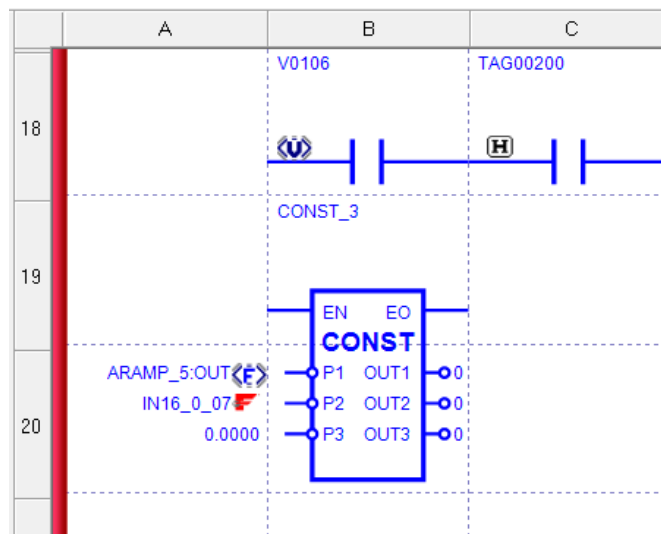


Fig 3. 85 – Icons informing the types of parameters and links

As shown in the next figure, in the **Connections** tab, the user can configure the **Scan Time** in seconds. This option indicates how frequently the **Scan Time** will be requested. It has to be between 10 and 60 seconds.

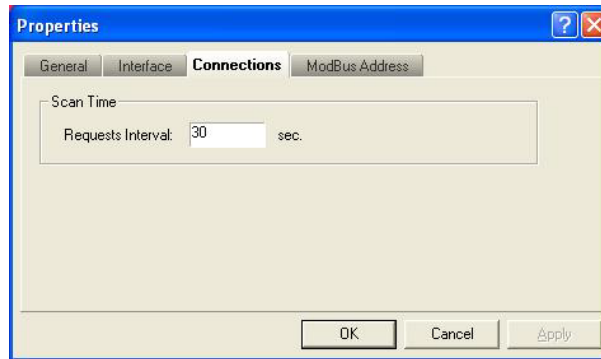


Fig 3. 86 - Configuring the Scan Time

Modbus addresses attribution

IMPORTANT
<ul style="list-style-type: none"> The functions described in this section are available for DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers. For the functions related to Modbus work in DF73, DF75, DF79, DF81, DF89, DF95 and DF97 is necessary to configure correctly the MBCF block at Syscon with the serial communication parameters, with the correct DEVICE_ADDRESS, and the ON_APPLY parameter configured as Apply. Those controllers always will be a Slave serial/TCP simultaneously. For further details refer to Function Blocks manual. The functions for the Modbus are also available to DF62 and DF63 controllers, working exactly as for other controllers. However, they need a specific firmware, as both the DF62, and DF63, can also have their Modbus functions working via function blocks of Syscon. The two ways are mutually exclusive; the firmware defines which mode the controller works.

Modbus Address

In this option (**Tools** → **Options** → **ModBus Address**) the user can choose the Modbus addressing mode. The default option is **Automatic**. If the user is in **Automatic** mode and changes to **Manual** the **LogicView for FFB** keeps the addresses generated by the **Automatic** mode, but they can be changed in according to the application needs.

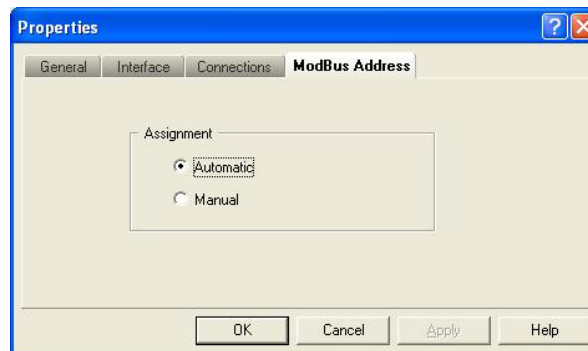


Fig 3. 87 - Configuring the Modbus Addressing

Changing from **Manual** to **Automatic** the registered addresses in the previous mode will be lost and will be in the **Automatic** mode standard. The user will be warned by the following message.

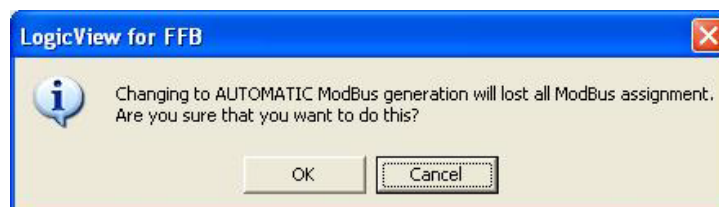


Fig 3. 88 – Changing the Modbus Addressing from Manual to Automatic

In the following table are the Modbus addresses ranges which are used for each element type. The analog values FLOAT or LONG (with 4 bytes) use two consecutive Modbus addresses.

Item	Initial address	End Address
Discrete IO Input	10001	11024
NetIO DI (Value), DI, DO, AI, AO (Status) Input	10001	11024
Discrete IO Output	1	1024
NetIO DO (Value) Output	1	1024
FFB_DI, DI64 (Value/Status) AI, AI16 (status) Input	11025	11536
FFB_DO, DO64 (Value/Status) AO, AO16 (status) Output	1025	1536
FFB_AI, AI64 (Value) Input	30001	30511
NetIO AI (Value) Input	30001	30511
FFB_AO, AO16 (Value) Output	40001	40511
NetIO AO (Value) Output	40001	40511
Virtual Variables Output	1537	5999
Function Blocks Input	40513	44997
Function Blocks Output	40513	44997
Internal Function Blocks	40513	44997

Table 3.1 – Modbus Addresses

In **Manual** mode, if elements are removed from the ladder, gaps will remain, which are addresses empties intervals. Any new inserted element will be with an empty Modbus address and the user has to insert the new address.

In **Automatic** mode, if there are gaps, the **LogicView for FFB**, will fill them as new elements are inserted in the configuration.

TIP
<p>A way for remove gaps from the Automatic mode is to do the following procedure: In Tools→Options→ModBus Address changes from Manual, click Ok, come back to Automatic and click Ok again.</p>

When the user clicks **Tools**→**ModBus Address** and chooses the element type a window as the following will appear.

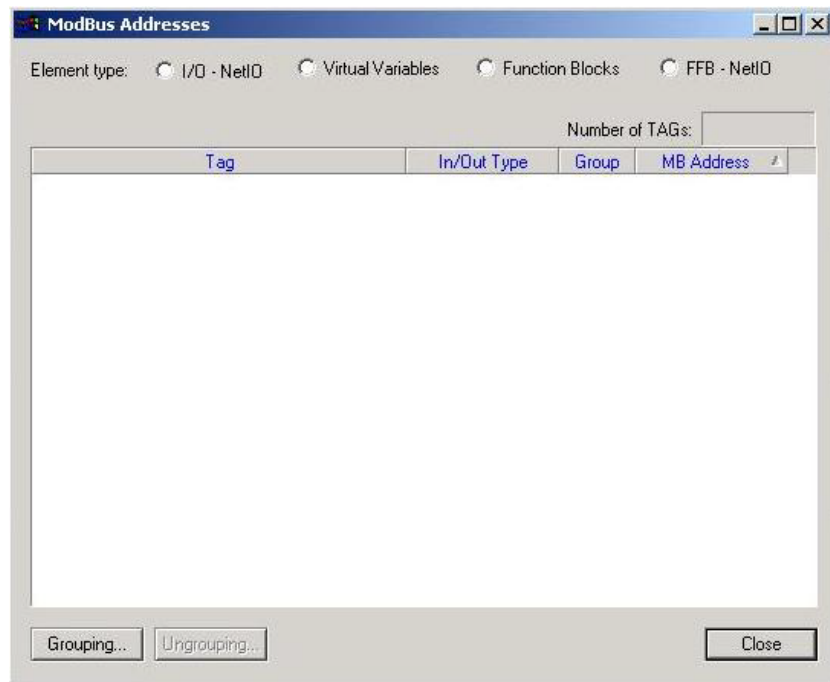


Fig 3. 89 – Visualizing the Modbus Addressing

In the previous figure is possible to see the tags, types, groups and Modbus addresses of the configuration's elements.

Attributing addresses in Manual mode

Grouping and Ungrouping

By default a group for each element type is created (Inputs or Outputs). In case the user needs, new groups can be created, also is possible remove them.

To create new groups, first, is necessary to have available Modbus address. Select the tags which will form the new group (the selection may be done in the Windows standard mode with the Shift or Ctrl keys) and click **Ungrouping**. The following message will appear.



Fig 3. 90 – Removing groups

Confirm or cancel the operation. In case the address is not free the following message will appear.



Fig 3. 91 – Error creating groups (1)

The selected tags must be of the same type (Inputs or Outputs), otherwise the following message will appear.

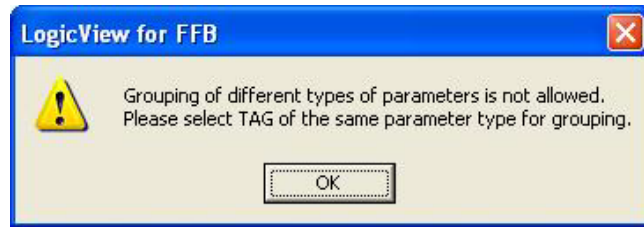


Fig 3. 92 – Error creating groups (2)

With free addresses new groups can be created, just click **Grouping** and the following window will appear.

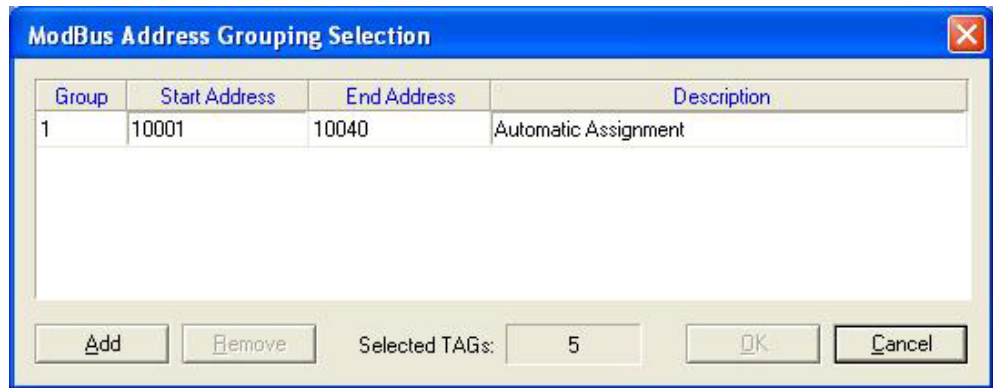


Fig 3. 93 – Creating or attributing groups

Click **Add** and a new group will be created. The user can define the range's initial address respecting the predefined values in the table 3.1. In case the initial address is out of specified range, messages as the following will appear.

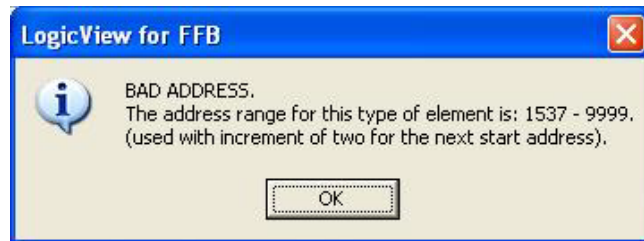


Fig 3. 94 – Error attributing addresses to groups (1)

Besides respect the predefined ranges, the user should be attentive for does not give even initial address to the elements' groups with analog inputs or analog outputs. The following message will appear.



Fig 3. 95 – Error attributing addresses to groups (2)

If the quantity of the selected elements exceeds the address free range the following message will appear. Redefine the addresses or groups.



Fig 3. 96 – Error attributing addresses to elements

To attribute a group to an element, with a free address, just select it, click **Grouping**, then in the desired group, and double-click or click **Ok**.

If a group is defined, more elements are inserted and do not fit in the range, the following message will appear.

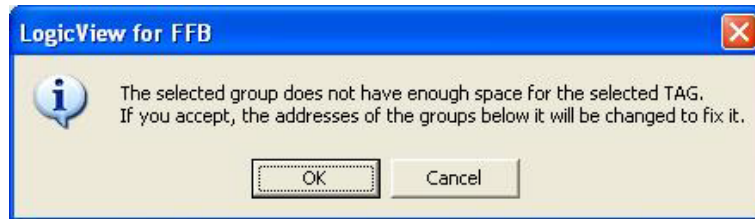


Fig 3. 97 – Group does not have enough space

Clicking **Ok** the addresses will be reordered and clicking **Cancel** the operation is canceled.

The groups can be removed; however, all elements associated to these groups will be without addresses, that is, with empty addresses. To remove a group just select it and click **Remove**. See the next figure.

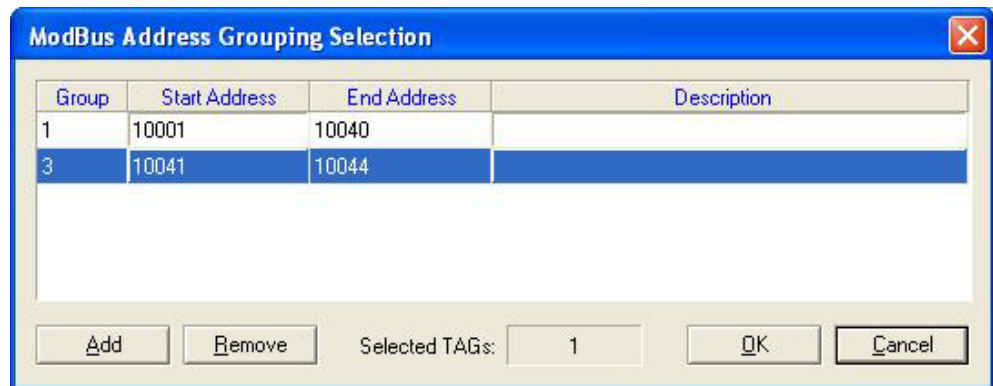


Fig 3. 98 – Removing groups

A warning message will appear to confirm the operation. See the next figure.



Fig 3. 99 – Warning - Removing groups

The addresses associated to a group can be changed, however, this implicates that the addresses of subsequent groups will change too. A warning message will appear asking the user to confirm the operation.

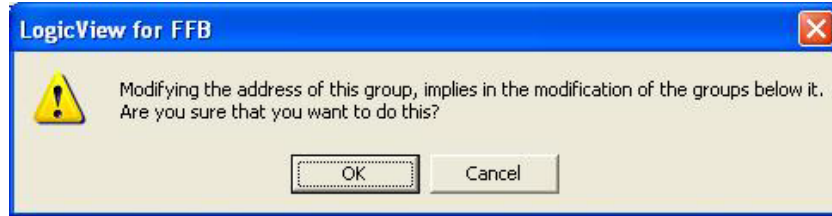


Fig 3. 100 – Warning – Modifying a group address

NOTES

- When hardware modules are removed from the configuration, the associated tags to their inputs and outputs will have their Modbus addresses freed.
- The inputs and outputs of the function blocks only will appear in the Modbus addresses list if the I/O signals are analog.
- The Modbus addresses limit for functions is 44997. If there are more function parameters, exceeding that limit, and the user needs to supervise points via Modbus which does not appear in the table generated automatically, set the Modbus addresses in manual mode and add the point in place of another non used point.

In the **Properties Editor** option of **Tools** menu, shown in the figure below, the user can change the tags of inputs, outputs, virtual variables, function blocks, meta parameters, the FFB and NetIO inputs and outputs, and also change their respective descriptions. The Safe Output values of the real variables can be changed and the function blocks can be configured as if the user was in the **Work Area**, in the **Object Properties** window.

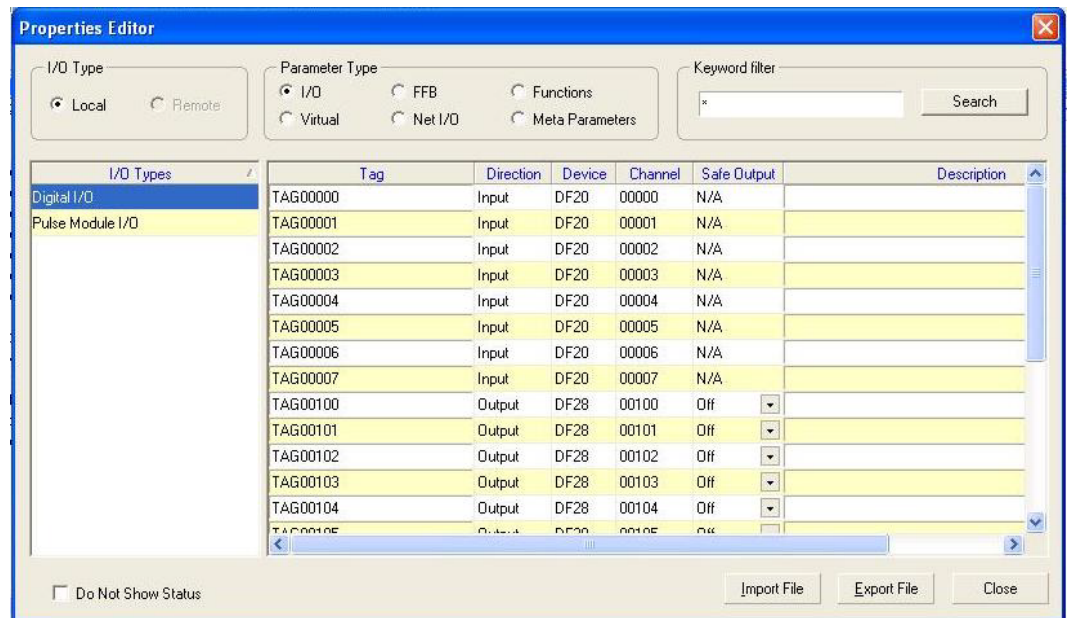


Fig 3. 101 – Changing the Tags

Just choose in the **Parameter Type** filter the desired tags type and a list will be updated to reflect the filter choice.

By double-clicking the desired parameter the editing mode will be enabled and thus the tag can be changed. The same procedure can be done by clicking the descriptions fields.

The changes that were done in this editor will affect all logic elements, which use those tags, in all project diagrams; independent of their execution mode (even the disabled diagrams will be updated).

The tags only can have alphanumeric characters and the underscore character. The tags also cannot have spaces. Invalid characters automatically are not allowed in tags.

NOTE

The virtual variables tags, the inputs and outputs tags can have until 16 characters.

Besides the tags, the elements descriptions will be shown in the ladder drawing area.

There are other important features in **Properties Editor** which are the **Import File** and **Export File** options. The tags and descriptions of parameters type I/O and Virtual can be exported to a txt file and later they can be manipulated at Microsoft Excel. This file can be imported by **LogicView for FFB** with the **Import File** option. The file imported/exported is txt type.

All tags and their descriptions will be exported if any line is marked. If one line is selected the data will be exported from that selected line. By clicking **Export File**, a window will open requesting the file's name and where it will be saved. Click **Save**.

Open the exported file at Excel, and do the necessary changes. The following window will open:



Fig 3. 102 – Opening a txt file at Excel (1)

Click **Next**. The following window will appear:

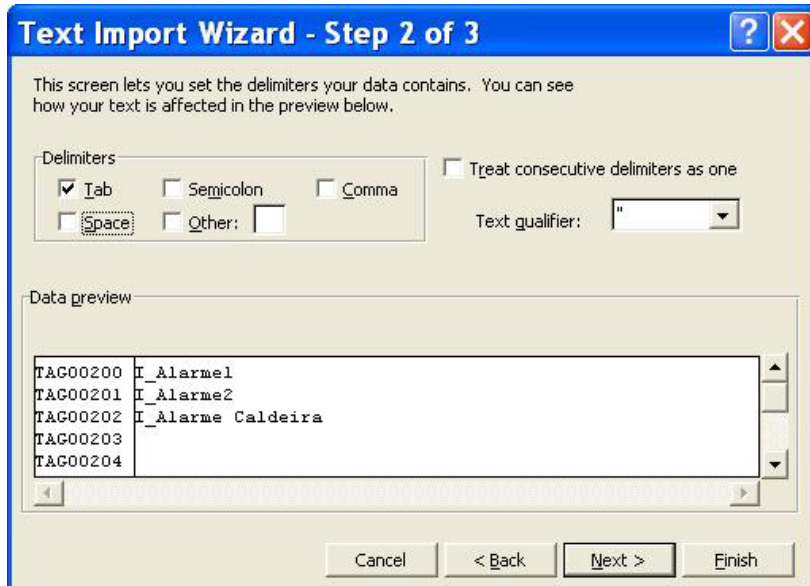


Fig 3. 103 – Opening a txt file at Excel (2)

Select **Tab** and click **Next**. The following window will appear:

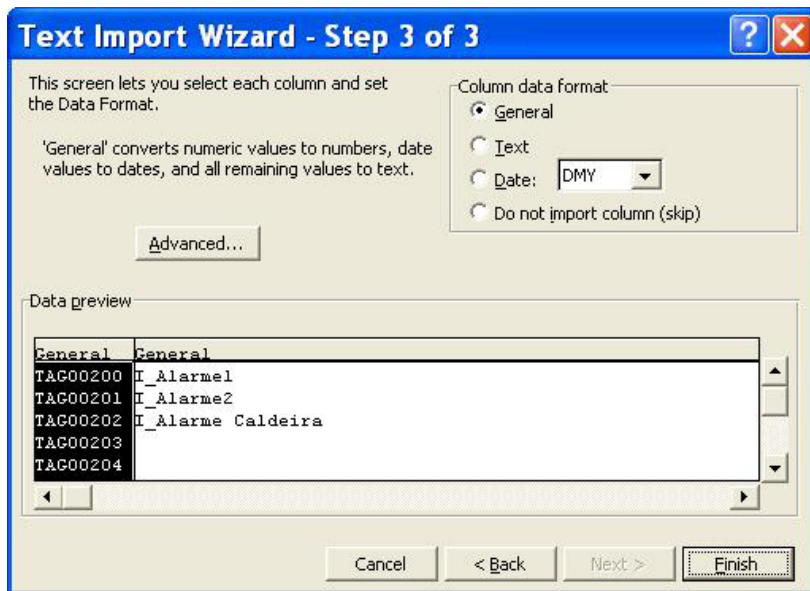


Fig 3. 104 – Opening a txt file at Excel (3)

Select **General**, click **Finish**, and do the necessary changes in the tags and descriptions. When the file is saved the following message will appear.

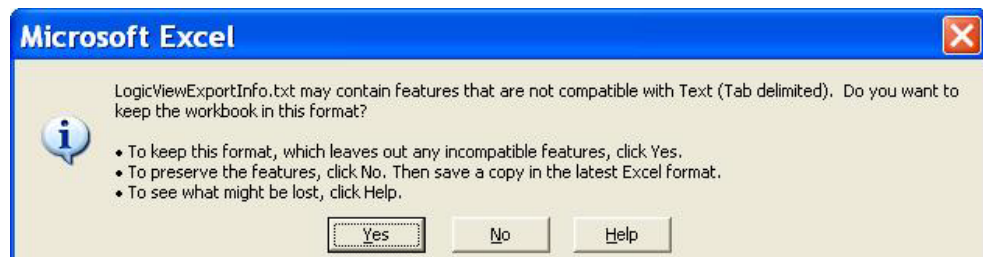


Fig 3. 105 – Saving a txt file at Excel

Click **Yes**. Just click **Import File** to import a file, and choose the txt file. The data are imported

automatically. If any line is marked the tags and parameters descriptions are imported from the first line. If a line is selected the parameters will be replaced from the selected line. The user will be warned about operations which can cause problems. See the following example. The warning appears because the quantity of imported lines is higher than the available lines at **Properties Editor**.

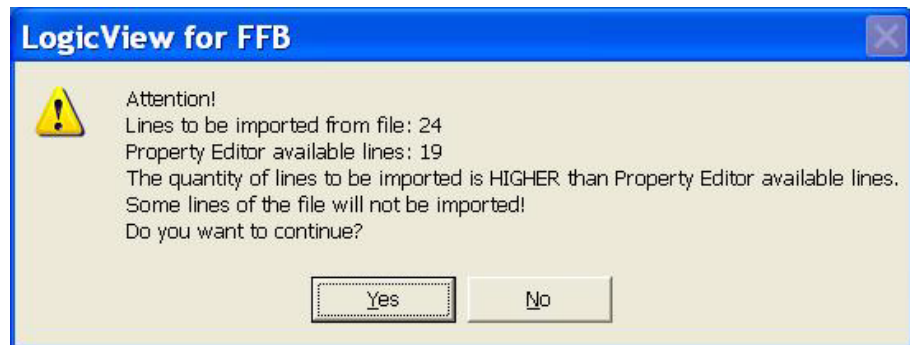


Fig 3. 106 – Importing a txt file

Logic Library

The **Logic Library** is an efficient way to reuse logics and templates creation for treatment of well known process in discrete automation area. To understand the logic library of **LogicView for FFB** is necessary to understand the following concepts:

- **Library Logic Element:** a “logic of library” corresponds to a logic diagram (ladder) of **LogicView for FFB** or part of it that can be exported for later reuse. The user gives a name and a description to each “library logic” when it is created.
- **Library File:** it can be understood as a container or “logic bank”. Each library file can have one or more “logic of library” (see above). The library files can be created during the exporting process (described later) and they receive appropriated name and description, defined by user.

To create a logic of library, first the user has to select the logic that will be copied. Right-click and choose the **Export to Library** option. The next dialog box will appear.

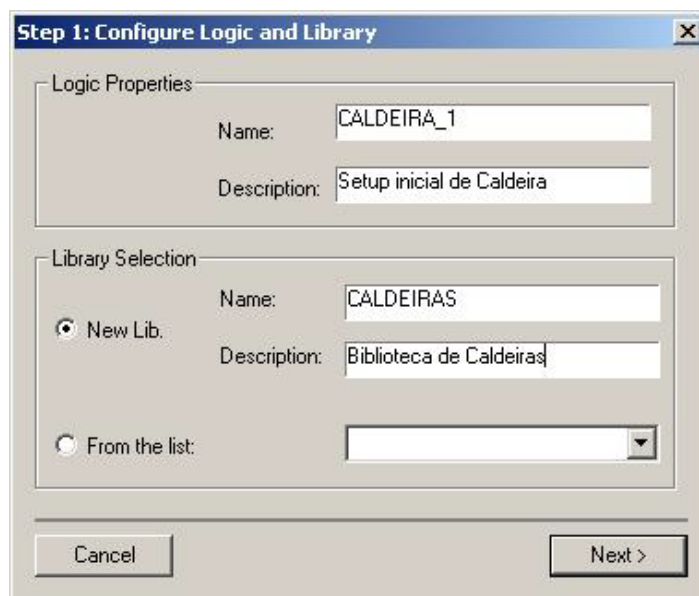


Fig 3. 107 – Export to Logic Library option

In the **Logic Properties** box the user will define a name to the logic that is being exported, with a description (optional).

In the **Library Selection** box there are two options:

- **New Lib.:** this option is used to create a new library with a description (optional). If already

exists the library, the following message will appear:

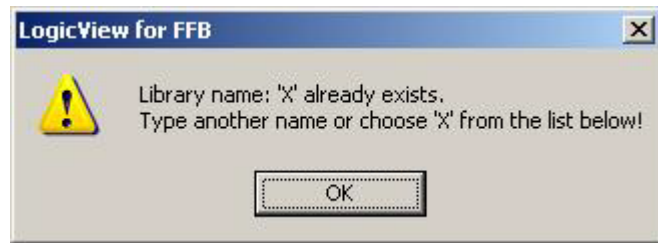


Fig 3. 108 – Error message

In this case, choose the **From the list** option.

- **From the List:** this option allows the user to select an available library in the list of logic library.

It is possible to export more than one “logic” to the same library, but only one by time. If already exists in the selected library a logic with the same name of the one that is being exported, the following message will appear:

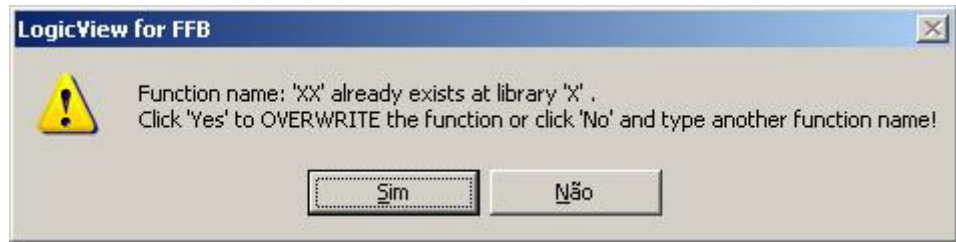


Fig 3. 109 – Error message

The user has the option to replace the former logic to the one that is being exported by clicking **Yes**. Otherwise, click **No**, and change the information in the window of figure 3.107.

In the **From the list** option an existing library can be chosen or a new one can be created by selecting the **New** option. Give a name and a description. Each library can have several logics. Give the names and fill out the necessary descriptions. Click **Next** and the logic will be exported.

NOTE

The logics selected for exportation cannot have meta parameters. If the selected logic has at least one meta parameter, an error message such as the figure below will appear:

An error message dialog box titled "LogicView for FFB" with a yellow warning icon. The text inside says: "Cell associated with Meta-parameter '#MT_DO_0000' cannot be exported! Remove or replace the meta-parameter and then export the cell". There is an "OK" button at the bottom.

After defining the data of figure 3.107, the following window will appear.

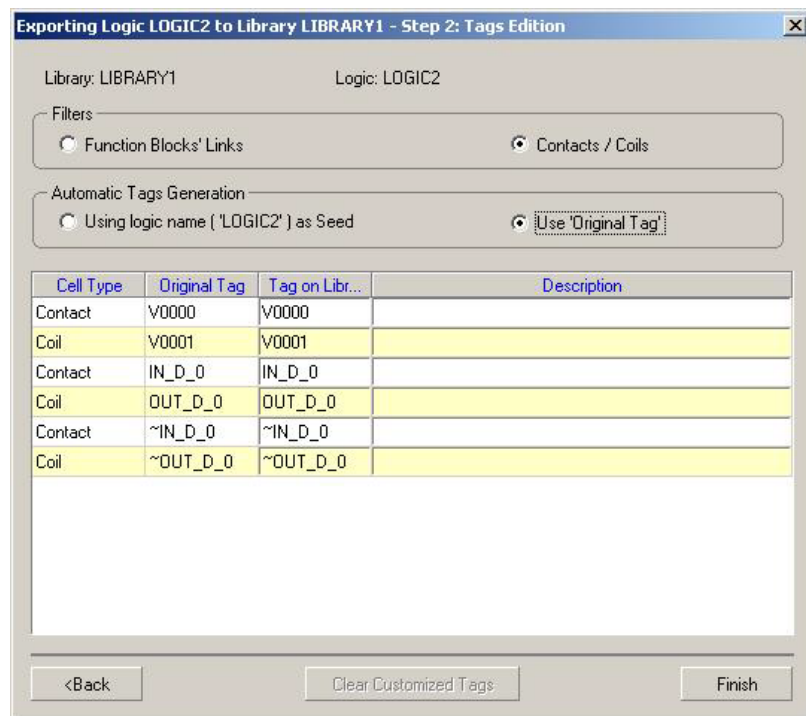


Fig 3. 110 –Tags edition during exporting process to Logic Library(1)

In this window, the tags can be customized, and also the descriptions of the parameters that will be exported. The characterization, or personalization, of tags involves editing the contents of **Tag on Library** and **Description** columns on the window of the previous figure.

The **Filters** box allows alternating the table viewing between discrete elements, contacts and coils, and function block links.

Contacts and Coils: the table will show the exported elements, their tags in the diagram (**Original Tag**), their tags in the logic library (**Tag on Library**) and their descriptions (**Description**).

NOTE

Only contacts and coils that have association with some variable (I/O, Virtual, FFB, NetIO) will be shown on the list. Contacts and coils without association (without tag) will not be shown and only their drawing will be exported.

Function Blocks: the table will show in the **F. Parameter** column the function blocks parameters that have links with FFB or NetIO points (numeric values or links among function blocks will not be shown). The **Linked To** column shows the point that the parameter is linked and the **Tag On Library** column shows the tag that will be exported to the library. See the example in the following figure.

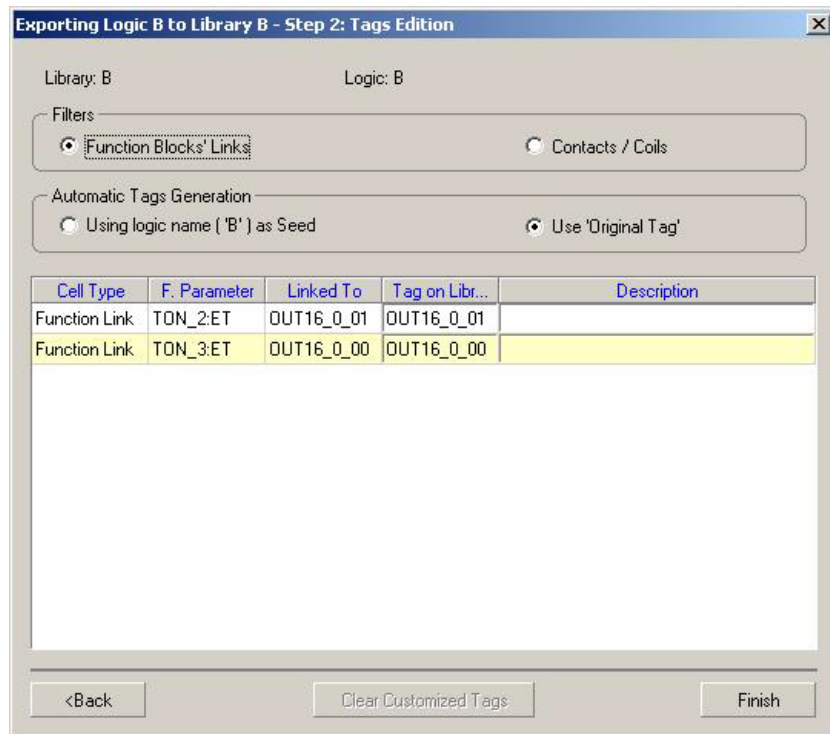


Fig 3. 111 –Tags edition during exporting process to Logic Library(2)

NOTE

The **LogicView for FFB** will perform a consistency checking of the links among function blocks. Inconsistent links will be removed in exportation. For example the function block **TT** has a link to the **YY** block, but this block was not selected to be exported. In this case the link of **TT** will be removed in the exporting process.

The **Automatic Tags Generation** has two automatic customizing options:

- **Use Original Tag** (default): this option repeats in the **Tag On Library** column the same tag of the **Original Tag** column (for contacts and coils) or the **Linked To** column (for function blocks).
- **Use Logic name ('xxxxx') as Seed**: this option uses the name of library logic (defined in the window of figure 3.107) as base for automatic generation of all tags that will be exported to the library, with numeric indexing. For example, if the name of library logic is **L1** the generated parameters will be **L1_001**, **L1_002**, etc.

If the user wants customize the tags, is possible edit them one by one. Just click the tag and change it.

NOTES

- The manual tags edition has priority over automatic tags generation, i.e., tags, which were manually changed by user, are no longer affected by the available options of **Automatic Tags Generation** box. If the user wants to cancel all manual edits and reuse the automatic options, click **Clear Customized Tags** button.
- Changes in tags of points that have value and status will be automatically reflected in their counterpart, i. e., an edition of the tag value will be updated in the respective status tag, and vice-versa. The **LogicView for FFB** maintains the consistency among the exported parameters.
- All tags used in the library are converted in meta parameters during the exporting process. For further details refer to Meta Parameters topic.

When the edition of tags and their descriptions finished, click **Finish** and the logic will be exported to the library.



Any modifications, such as link reset or tags personalization will be applied **ONLY** to the library logic that is being exported. The configuration logic diagram is not modified during the exportation to the logic library.

Managing and Importing Library Logics

To import a logic click **Tools**→**Logic Library Manager** or right-click in the ladder drawing area and select **Logic Library Manager**. The next window will open:

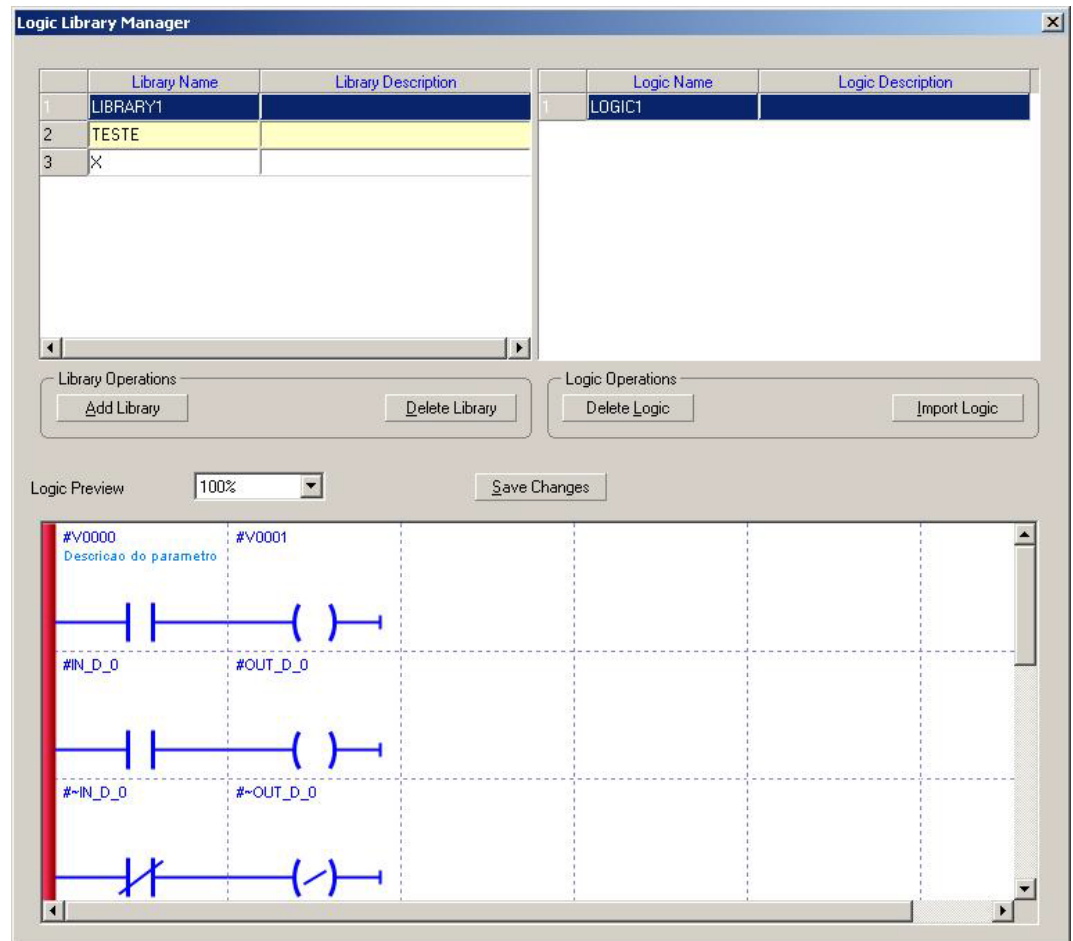


Fig 3. 112 –Importing a logic

This window shows the logic libraries that are available in your workstation. When a library is selected, its logics will be shown.

- Some library management options are available:
- **Add Library:** creates a new logic library (empty).
 - **Delete Library:** remove a logic library;
 - **Delete Logic:** remove the selected logic.

When a library or a logic is removed, a confirmation message similar to the following figure will appear:



Fig 3. 113 –Confirmation message: the library will be deleted

The user can also rename the libraries and logics as well as their descriptions.



After to perform the changes, is necessary to click **Save Changes** button to effect the operations (editing, creation or removing of libraries and/or logics). A confirmation message similar to the following figure will appear:

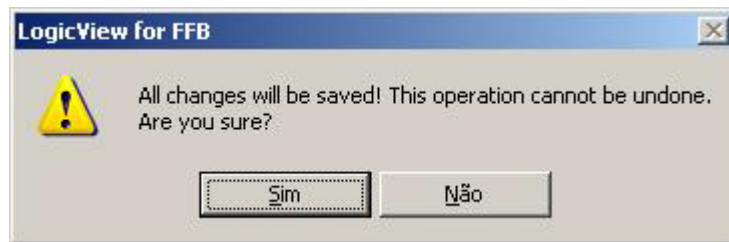


Fig 3. 114 –Confirmation message: saving the changes

Importing a logic of library to LogicView for FFB

Choose the desired library, and then the logic. The drawing will appear in the window bottom part. In **Logic Preview** field can be chosen the view zoom. Click **Import Logic** and the following window will appear.

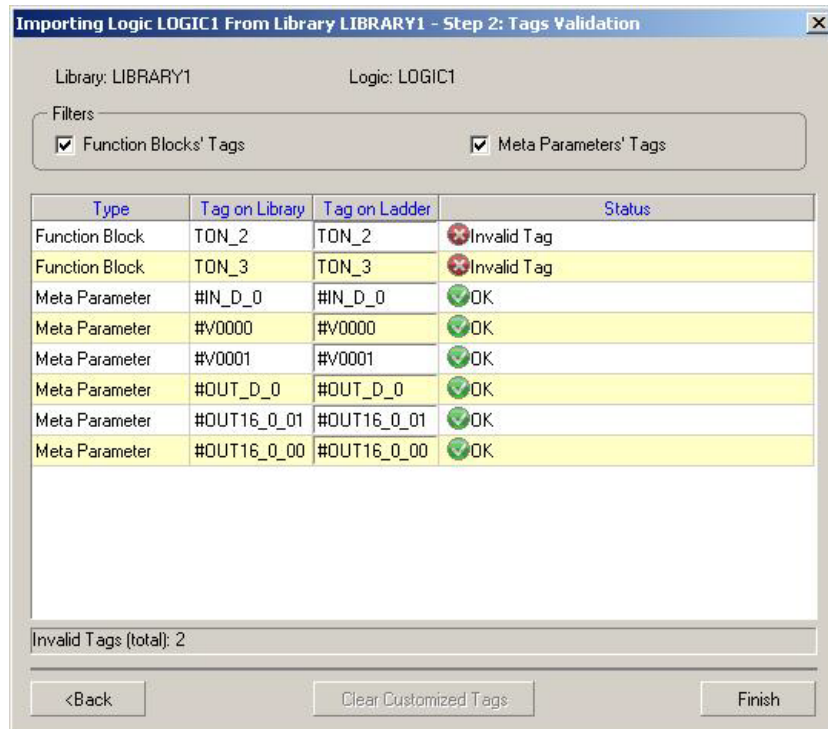


Fig 3. 115 –Importing logic from library

In this window will be shown the meta parameters tags of the logic that will be imported to **LogicView for FFB**. The table items are:

- **Type:** this column identifies the parameter as function block tag or meta parameter;
- **Tag on Library:** this column shows the tag that was exported to the library;
- **Tag on Ladder:** this column shows the element tag that will be imported to the **LogicView for FFB** and it can be edited and modified;
- **Status:** this column shows if the tag defined in **Tag on Ladder** column can be imported or not, depending on criteria of compatibility and integrity of tags.

The **Filters** box allows viewing the tags of function blocks, meta parameters or both.

During the importing process, the **LogicView for FFB** checks the tags compatibility between the ones of the logic that will be imported and those already defined and used in the discrete logic (ladder). If there is some compatibility problem, the tag will be marked with **Invalid Tag** in the **Status** column and must be changed.

NOTES
<p>Examples of tags incompatibility:</p> <ul style="list-style-type: none"> • Function blocks: if the ladder already has some function block with the same tag of a function block of the logic that is being imported, this tag will be marked as Invalid Tag. • Meta parameters: if the ladder has some meta parameter with a tag equals to a meta parameter defined in the logic that is being imported, they must be of the same type (Digital Input, Digital Output, Analog Input, Analog Output). If they have different types (DI X DO) the meta parameter tag will be marked as Invalid Tag.

All tags changes can be undone by clicking **Clear Customized Tags** button. Click **Finish** to conclude the importing process. The following window will appear.



Fig 3. 116 – Logic was successfully copied



The importing only can be performed if all tags statuses are **OK**. Otherwise, the following error message will appear and the importing process will return to the window of figure 3.115.

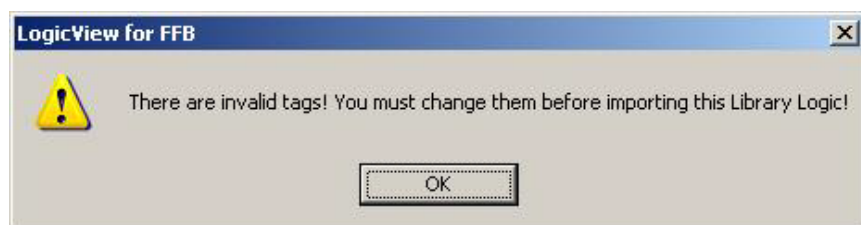


Fig 3. 117 –Importing error

NOTE
<p>The imported logic can be pasted more than once in the ladder configuration. However, from the second “paste”, the LogicView for FFB will check the data consistency and to apply the procedure described on Intelligent Copy/Paste topic.</p>

Click **Ok**, and paste the copied logic in the desired area.

Help Menu

By clicking **Help**, or through the shortcut ALT+ H, the following menu will open:



Fig 3. 118 - Help Menu

In this menu, the installed software version can be viewed and the software help is available.

Toolbars


Here the details of **LogicView for FFB** toolbars will be presented. They can be enabled or disabled as seen in the **View Menu** topic.


Main Bar





Fig 3. 119 – Main Tool Bar

Besides the basic Windows options (**New, Open, Save, Cut, Copy, Paste, Print, Print Preview** and **Help**) this toolbar has some new options: **Copy Drawing, Commit, Export Tags for OPC Browsing, Find and Replace** and **Revert**.

The **Copy Drawing**  command works just like the Windows Copy command. The selected drawing will be copied, but the associated tags will not.

The **Export Tags for OPC Browsing**  command updates the Taginfo.ini file with all tags of the open logic, enabling them to search without downloading the configuration on the controller.


The **Commit** command works as follows: clicking on its icon  , the files that were created or modified locally are sent to the multi-user server.


To discard the alterations made to a local file and restore the original configuration file click the icon **Revert**,  , on the Main toolbar. For further details about Multi-User Mode refer to the **Syscon Manual**.

Zoom Bar



Fig 3. 120 – Zoom Bar


The user can zoom out the ladder drawing area by clicking  and then clicking the work area. The zoom will increase in 10% at each click the window.

The user can zoom in the ladder drawing area by clicking  and then clicking the work area. The zoom will decrease in 10% at each click the window.

The button  allows seeing the full page.

The button  allows fitting the page on the window.

NOTE

To disable the zoom functions just press the ESC key or in the Select button 

Toolbox

The **Toolbox** toolbar has eight tabs with different function block types: IO, Time/Counter, Process, Data, Math, Comparison and Elements. Also there is a **Communication** tab with functions related to online mode, simulation, supervision and others. This tab will be explained separately later.




Fig 3. 121 - Toolbox

Each one of these function blocks, distributed in six tabs – **IO**, **Time/Counter**, **Process**, **Data**, **Math**, and **Comparison**, were detailed in chapter 2. In this topic only will show the insertion and configuration of these functions in a ladder network. The **Elements** tab will be described separately.

With the F5 to F8 keys the user has the toolbox control. Press the **F5 key to move to left** in the function blocks tabs (IO, Time/Counter, Process, Data, Math, Comparison and Elements) of the toolbox. Press the **F6 key to move to right** in the function block tabs.

After the user has chosen a tab, for example Math, press the **F7 key to move to left among the elements** of this tab. Press the **F8 key to move to right among the tab elements**.

To insert a function block, click the desired function block in the toolbar. Move the mouse over the network. Note the mouse icon changes to . Click any cell to insert the function block.

There are some restrictions to where the blocks can be inserted in the Ladder Drawing Area. They are related to the block size and elements in the vicinity. Therefore, it might happen that the user has to select another place to insert the function block. The next message will appear:



Fig 3. 122 - Alert about element insertion in a cell

After inserting the block, it has to be configured in the **Object Properties** window. The items that appear in light gray cannot be changed by the user.

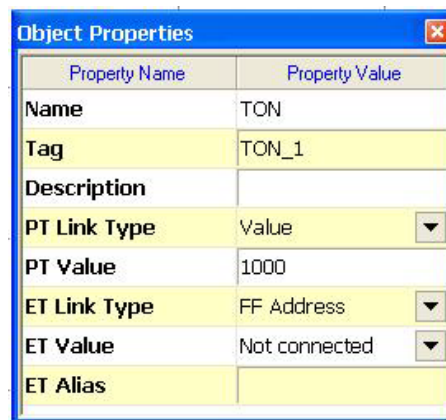


Fig 3. 123 - Object Properties window

In this case the items **TAG**, **PT Link Type**, **PT Value**, **ET Link Type**, and **ET Value** can be changed. To change the function block's tag double-click the right cell of the **TAG**. The editing mode will be enabled and the user will be able to write the desired tag.

In **PT Link Type** the options are:

- **Value** – Numerical value that has to be inserted by the user and that will be downloaded.
- **Address** – Indicates that the function block input is linked to some block output.
- **FF Address** – Indicates that the function block input is linked to some FFB analog output.
- **NetIO Address** – Indicates that the function block input is linked to some NetIO analog output.
- **Meta Parameter** – Indicates that the function block input is linked to a meta parameter analog output type.

If in **PT Value** the available options will depend on what was chosen in **PT Link Type**. If **Value** was chosen the user has to enter a numerical value. If the inserted value is out of the allowed interval the following message will appear:



Fig 3. 124 - Error – Invalid value

If in **PT Link Type** was chosen **Address** the available options in **PT Link** will be **Not Connected** or the function blocks outputs.

If in **PT Link Type** was chosen **FF Address** the available options in **PT Link** will be **Not Connected** or the FFB analog outputs.

If in **PT Link Type** was chosen **NetIO Address** the available options in **PT Link** will be **Not Connected** or the NetIO analog outputs.

If in **PT Link Type** was chosen **Meta Parameter** the available options in **PT Link** will be **Not Connected** or meta parameters analog outputs.

At in **ET Link type** there are the options for linking the function block's output – **FF Address**, **NetIO Address**, and **Meta Parameter**. Depending on the chosen type the block's output will be linked to an analog input of the FFB, NetIO, or meta parameter.

The configurable items will vary according to the chosen function block. If the **SEL2** block is inserted, for example, the configurable items in the **Object Properties** window will be:

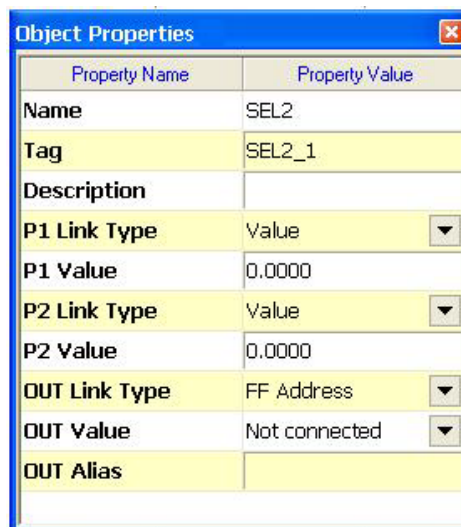


Fig 3. 125 - Object Properties window – SEL2 function block

In this case, the items **TAG**, **P1 Link Type**, **P1 Value**, **P2 Link Type**, **P2 Value**, **OUT Link Type** and **OUT Value** can be changed.

To change the function block tag double-click the right cell of the **TAG**. The editing mode will be enabled and the user will be able to write the desired TAG.

In **P1** and **P2 Link Type** the options are:

- **Value** – Numerical value that has to be inserted by the user and that will be downloaded.
- **Address** – Indicates that the function block input is linked to some block output.
- **FF Address** – Indicates that the function block input is linked to some FFB analog output.
- **NetIO Address** – Indicates that the function block input is linked to some NetIO analog output.
- **Meta Parameter** – Indicates that the function block input is linked to a meta parameter analog output type.

In **P1** and **P2 Value** the available options will depend on what was chosen in **P1** and **P2 Link Type**, respectively. If **Value** was the choice, the user has to enter a numerical value.

If **Address** was chosen in **P1** and **P2 Link Type**, the available options in **P1** and **P2 Value** will be **Not Connected** or the function blocks outputs.

If **FF Address** was chosen in **P1** and **P2 Link Type**, the available options in **P1** and **P2 Value** will be **Not Connected** or the FFB analog outputs.

If **NetIO Address** was chosen in **P1** and **P2 Link Type**, the available options in **P1** and **P2 Value** will be **Not Connected** or the NetIO analog outputs.

If **Meta Parameter** was chosen in **P1** and **P2 Link Type**, the available options in **P1** and **P2 Value** will be **Not Connected** or the meta parameters analog outputs.

The **OUT Link Type** can be a **FF Address**, **NetIO Address**, or **Meta Parameter** and, in this case, **OUT Value** can be **Not Connected** or the available links in FFB (FB Address), in the NetIO, or in the meta parameters.

If a configuration is done in **Syscon** with a FFB which has DI, DO, AI and AO, and in **LogicView for FFB** configures a function such as timer, when the link types (PT and ET) as FF Address are defined, the AIs and AOs, which were created in FFB, will be available for link.

Links among inputs and outputs of the function blocks

Inputs and outputs can be linked. Select the function block and in the **Object Properties** window configure the link type which is necessary to the input – **Address**, **FF Address**, **NetIO Address**, or **Meta Parameter**.

Choose the output which the input will be linked. In this situation, right-clicking a menu will appear. The penultimate menu item is **Output Link**, which shows all inputs that are linked to that output, according to the example showed in the next figure.

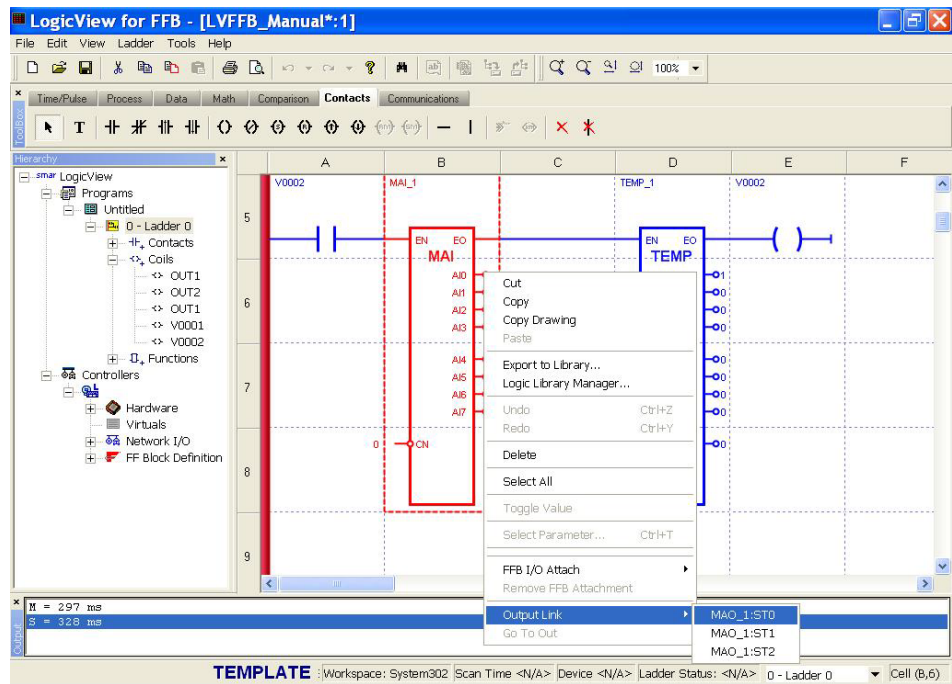


Fig 3. 126 – Output link option

A more practical way to link a function output to an input is to position the mouse on the output the user wants to link (at this point the mouse cursor turns into a hand symbol indicating that it is on a function analog output parameter) and press the **SHIFT** key. Thus, the output parameter is stored. By placing the mouse on the input to make the link (the cursor again takes the form of a hand) and pressing the **SHIFT** key, the link is automatically performed.

IMPORTANT

To perform this operation, the focus must be in the ladder drawing area.

If an input has a link, and right-clicking it, the next figure will appear:

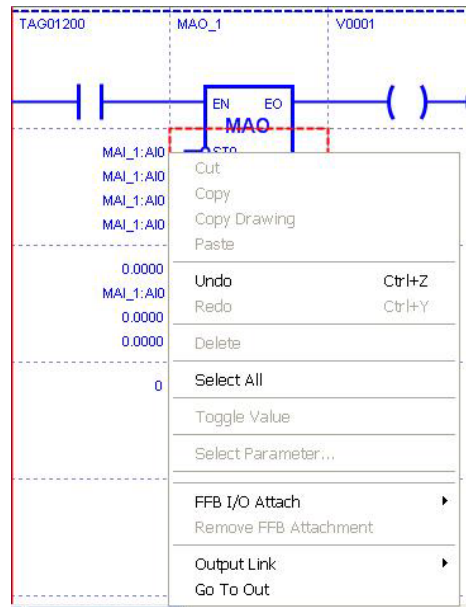


Fig 3. 127 – Go to Out option

The last option - **Go to Out** command, moves to the function which is linked with this input. If there are links in the output, when you click some linked inputs inside **Output Link** option, it also moves to the function that has the link.

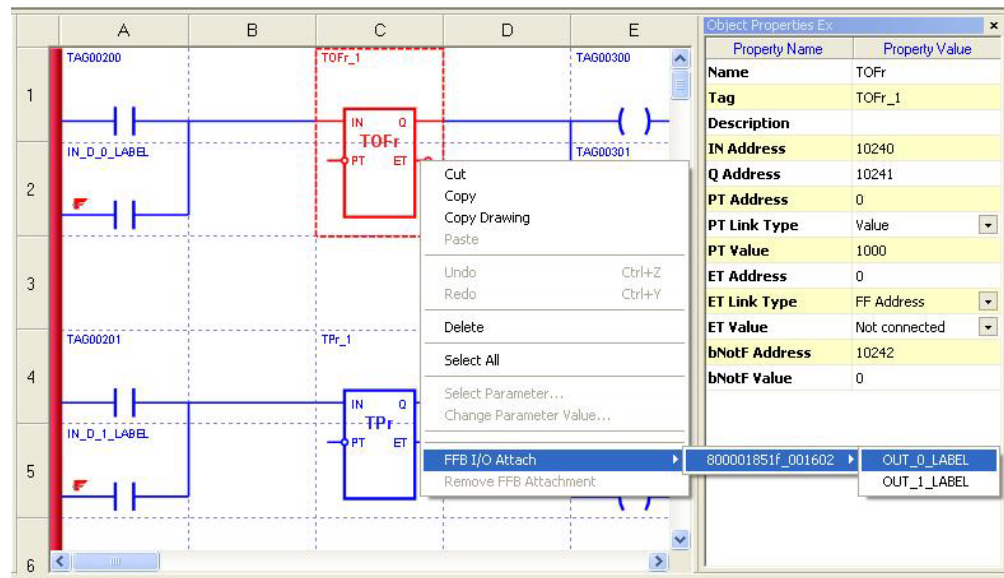


Fig 3. 129 - FFB I/O Attach command

Given a Function Block input such as PT, the IN_x points that are deriving from FFB will be available for link and in a Function Block output such as ET, the OUT_x points that go to FFB will be available for link.

The IN_x points can be linked to several function block inputs. The OUT_x points can only receive a single link from a function block. Therefore, as the OUT_x points are linked, the number of available points for link decreases.

If a function block point is linked to a FFB analog point, the user can remove this link by right-clicking the element and then clicking **Remove FFB Attachment**.

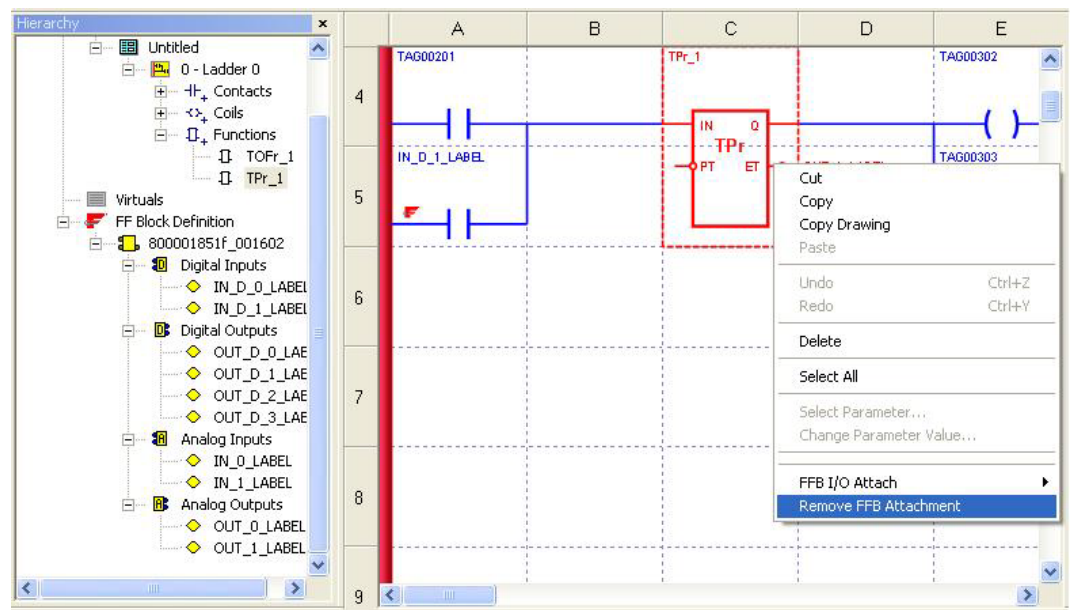


Fig 3. 130 - Remove FFB Attachment command

If the point has a link it is indicated by the link name which appears beside it. If the link with an analog point is a FFB, IN or OUT, the FFB point name appears beside the analog point.

If a function block input is linked to a function block output, beside this input will appear the output name which it is linked. In the outputs only will appear the links names with the FFB. See the next figure.

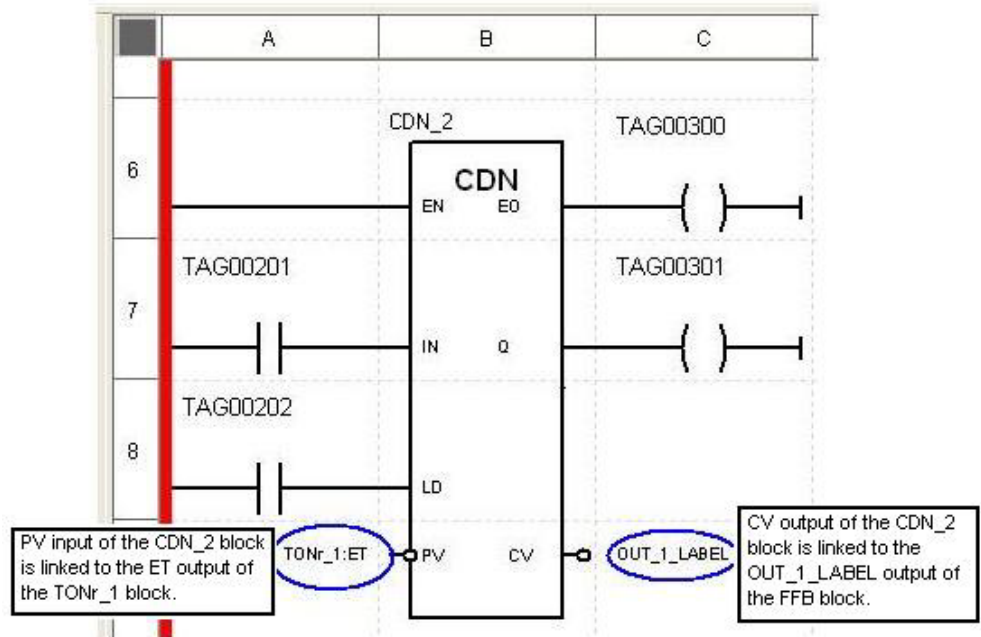


Fig 3. 131 – Links in the functional block inputs and outputs

Elements Tab

Each one of these symbols below was described at chapter 1. To understand how they work, please, read the chapter 1. This topic presents how to insert these elements to build the Ladder logic.

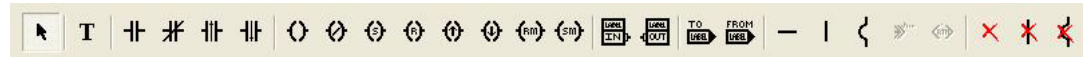


Fig 3. 132 – Elements Tab

With this toolbar the ladder elements can be inserted or deleted, and then programs in ladder networks can be created and edited.

To add a ladder element in the network, select an element (contacts, coils, verticals or horizontals connecting lines) in the **Elements Tab** of **LogicView for FFB**. Click the element that will be added and place it on the desired cell in the ladder drawing area. The **LogicView for FFB** automatically inserts this element.

The **LogicView for FFB** has a “check-as-you-go” feature that prevents the user to insert elements that do not be applicable to a specific cell. In this case, the following message will appear.



Fig 3. 133 - Alert about element insertion in a cell

The chosen element can be inserted how many times that will be necessary without having to click again **Elements Tab**. To cancel the command, press the ESC key, on the **Select** button, or on another element, to insert the element.

As soon as a logical element is inserted it can be referred by its default Tag or by a user Tag.

NOTE

After inserting an element type of contact or coil and associates some tag to it, the element can be replaced by another of the same type without deleting the element that will be replaced. The exchange is immediate, just choose the new element in the **Elements** tab and place it in the desired cell. The tag will not be changed.

After inserting the elements the user has to configure them. It can be done in two different ways:

- Double-click the element. The window below will open:

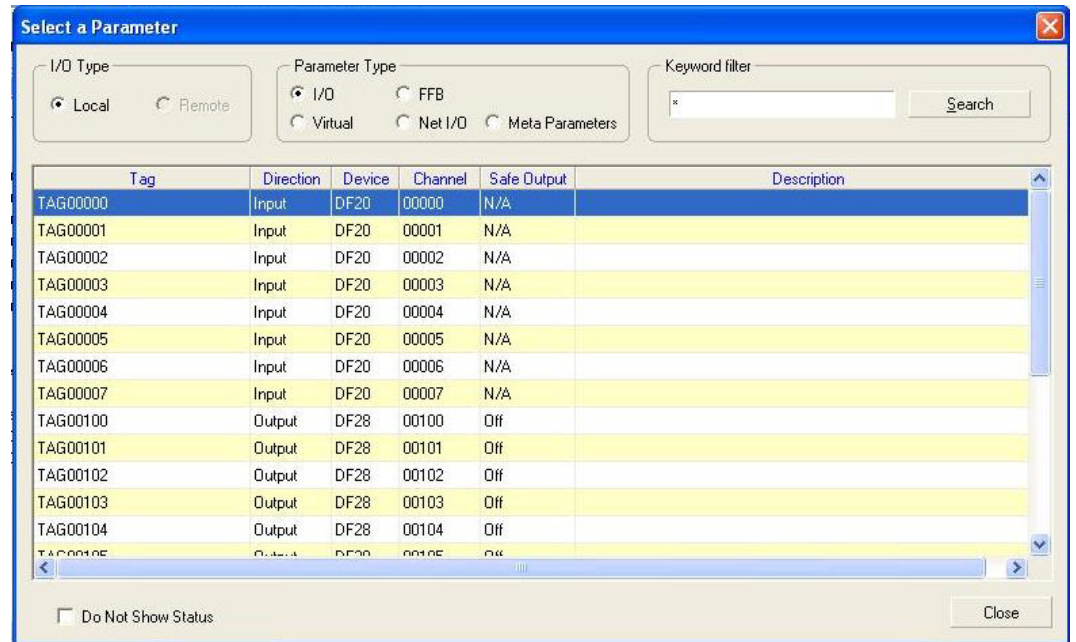


Fig 3. 134 - Selecting the parameter

In this window the user has to configure the parameter type – I/O, Virtual, FFB, Meta Parameter or Net I/O. In case of FFB discrete points, the status value is represented by the same tag of point value, followed by a tilde (~) in front of the tag.

IMPORTANT

In the logic any status value always will be 1 (true) if the status value is **Bad** or **Uncertain**, and 0 (false) if the value is **Good**.

When a parameter type is selected a list with possible items, their default tags, installation's local and Safe Output values appears. The user has to choose what suits him best. It is not possible to edit the tags and safe output values in this window.

If after setting the parameter, the user presses the **ALT** key plus the left mouse button, the **Stamp** function will be activated, in which the mouse cursor takes the form of a stamp. With this function the user can replicate the same tag to other elements; just keeping pressed the **ALT** key, and clicking the left mouse button.

The **Stamp** function for contacts and coils is also activated by clicking the element. Thus, the element is stored. By pressing the **ALT** key plus simple click on any contact or coil, the element is replicated.

The **Stamp** function can also be used similarly for functions. The internal and the input parameters, without links, are stored and can be replicated in another function of the same type of the original.

IMPORTANT

The stamp function only can be performed if the focus is on the ladder drawing area.

- Right-click the element. The next window will open:

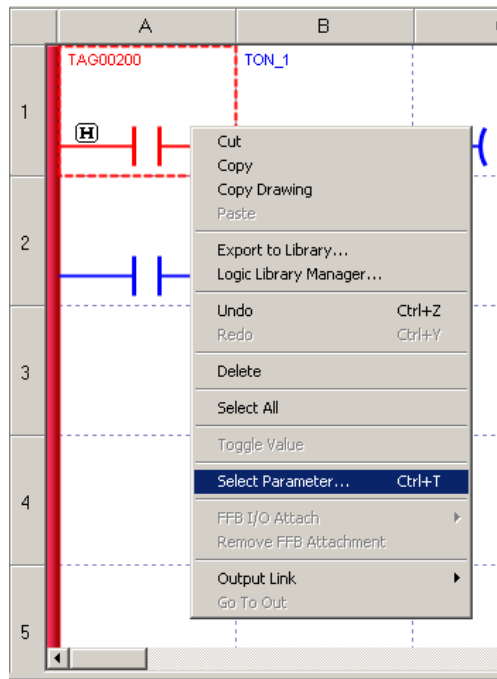


Fig 3. 135 - Selecting the parameter

When the user selects the **Select Parameter** option a window as the one in figure 3.138 will open and the procedure is the same as the one described in the topic above.

Inserting tags in the elements

When the user inserts contacts or coils a tag can be given to them via grid. By clicking a contact or coil without tag the following option appear in the **Object Properties** window.



Fig 3. 136 - Inserting new tag

Write the parameter's tag. Confirm the operation, and the following window will appear:

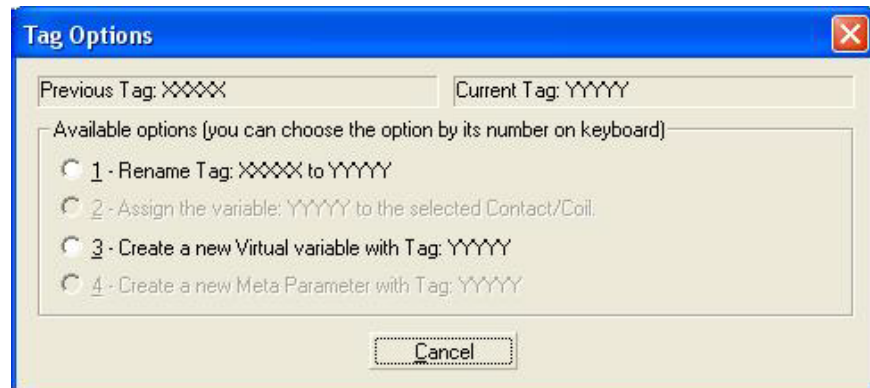


Fig 3. 137 – Tag Options window

The available options, related to edited tag, are showed in the previous figure. These options are:

- **Rename Tag: XXXXX to YYYYY:** When it is available, this option will change the former tag by the tag typed by user. All elements with the former tag will be automatically updated with the new tag.
- **Assign variable: YYYYY to the selected Contact/Coil:** If **LogicView for FFB** finds a parameter with the same tag typed by user which is compatible with the edited discrete element (contact or coil), this option will associate this parameter to the contact or coil of ladder.
- **Create a new Virtual variable with Tag YYYYY:** This option will create a virtual parameter, and then associate it to a discrete element of ladder (contact or coil) which is being edited. This new virtual parameter will be inserted in the virtual tags list and can be seen at **Tools -> Properties Editor -> Virtual**;
- **Create a new Meta Parameter with Tag YYYYY:** This option will create a meta parameter, and then associate it to a discrete element of ladder which is being edited.

When the previous figure appears, **LogicView for FFB** will automatically disable the options which are not compatible and/or are not available at the moment (for example, the options 1 and 2 are mutually exclusive, i.e., whenever a parameter with the tag typed by the user already exists, it is not possible only to rename the tag, the only available option is to assign a contact or coil to the existing variable).

To select an option just click the desired item or type the corresponding number of the option on the keyboard (1 to 4). To cancel the operation (option 4) you can press **ESC**.

If the tag typed by the user belongs to a Function Block, the **LogicView for FFB** shows the following error message.



Fig 3. 138 – Error message – unavailable operation

This message indicates that is not possible to perform any operation with the typed tag because it belongs to a function block that is being used in the ladder. Click **Ok**. The tag edition will be canceled, and the former value will be restored.

If the tag, typed by user, is a parameter which is not compatible with the contact or coil, for example the edited element is a coil and the typed tag is an input real point, the following error message will appear:



Fig 3. 139 – Error message – unavailable operation

This message indicates that is not possible to perform any operation with the typed tag because it belongs to a previously created parameter, and is not compatible with the contact or coil actually being edited. Click **Ok**. The tag's edition will be canceled, and the former value will be restored.

Communication tab

If the user is **Offline** the **Communication tab** will appear as in the figure below.



Fig 3. 140 – Offline Communication Tab

Build



The **Build** button  activates the command to generate the pseudocode that will be executed by the virtual machine 1131, as explained previously. If there is an error in the ladder logic, such as missing connections in the element, the following message will appear.



Fig 3. 141 - Build error

If the message above appears, the error specification will appear in the **Output bar**, and when clicked, the **LogicView for FFB** indicates the error point in the ladder drawing area.

Simulation

The **Simulation** button  was explained in the **Ladder Menu** topic.

Online

Click **Online** button  and the next window will appear:



Fig 3. 142 - Server settings window

The user has to choose between **Local** and **Remote**, and then click **Connect** button. When the user tries to connect a device and it is not found the **Scan time** and the **Ladder Status**, in the **Status bar**, will be **N/A** (Not available).

If the user is in **Online** mode the **Communication tab** will appear like in the figure below:



Fig 3. 143 - Online Communication Tab

The controller type (with that the **LogicView for FFB** will connect) and its serial number are

obtained from the Database. This information is saved on Database by the **Save** command of **Syscon** after the commissioning. Otherwise the following message will appear:



ATTENTION

If the **LogicView for FFB** sends an error message, about failure when connecting to controller, follow the steps below to analyze this condition:

- 1) Use the **FBTools** to try a connection to controller.
- 2) On DOS *prompt*:
 - Use the **ping** command to verify the connection with the controller.
 - Use the **netstat -n** command. The answer should be *TCP ip_pc:4988 ip_df:random_port ESTABLISHED*

Probably one of these two conditions will fail. In this case, the possible causes of failure are:

- 1) Wrong IP configuration on **Server Manager** (Check on Settings→Network→ General).
- 2) Firewall or antivirus are blocking the connection between the controller and computer. Disabling them, the connection is established.
- 3) Difference in configuration of the subnet mask of the network cards. Usually it is set to 255.255.255.0. Both the computer as the controller, the mask should have the same configuration to establish the connection. To verify this configuration on computer, at DOS prompt use **ipconfig** command. On controller, use the **FBTools** or the **webserver**. For further information refer to **DFI302** manual.

Downloading the configuration



The **Download Configuration** button allows downloading the instance configuration, the configuration 1131.



ATTENTION

The first download of a configuration always has to be done by **Syscon**.

If trying to download a configuration before the device is commissioned or the configuration is not saved, the following message will appear:

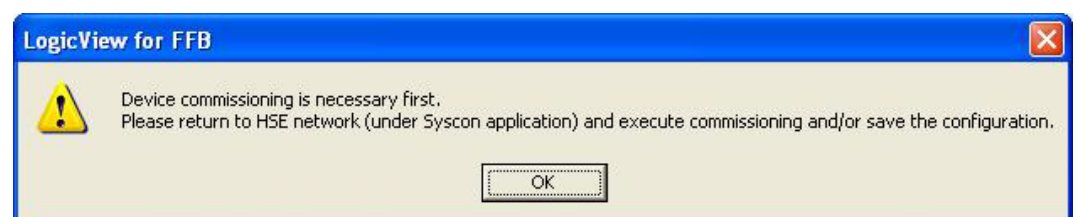


Fig 3. 144 – Download error (1)

Return to **Syscon** to commission the devices and save the configuration.

If the first download was not done via **Syscon** or if the FFB tag was changed or reviewed when executing new Define parameters, the **LogicView for FFB** will show the following message when downloading via **LogicView for FFB**.



Fig 3. 145 – Download error (2)


The user has to return to **Syscon** and download a device.

After the user has done the first download via Syscon, he may be done others via **LogicView for FFB**. But, the user has to choose if the CPU will continue in running mode, or not, or if the download process will be canceled.

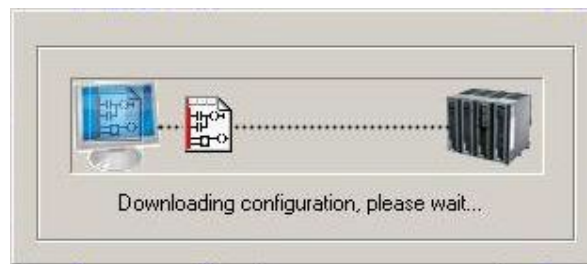
Click **Download Configuration** button  and the following window will appear:



Fig 3. 146 – Keeping the CPU in running mode

ATTENTION	
	When the Stop command is executed: <ul style="list-style-type: none"> • The discrete outputs go to Safe Mode. • The analog outputs of the MAO functional block will assume the defined values in ST0, ST1, ST2 and ST3.

During the download via **LogicView for FFB** an animation appear. See the following figure.



3. 147 – Downloading the configuration

Other error messages related with the configuration downloading

Downloading the logic via Syscon



Fig 3. 148 – Error - Download via Syscon

Possible cause: Failure in Ethernet communication between the device and the OPC Server or there is a problem with the firmware.

Solution: Verify the Ethernet communication. If the failure persists, contact the Smar technical support.

Downloading the logic via LogicView for FFB



Fig 3. 149 – Error - Download via LogicView for FFB

Possible cause: Failure in Ethernet communication between the device and the OPC Server or there is a problem with the firmware.

Solution: Verify the Ethernet communication. If the failure persists, contact the Smar technical support.

Downloading the logic via LogicView for FFB or via Syscon

All cases below refer to problems when the user tries to download the logic, via **Syscon** or via **LogicView for FFB**: The messages will appear in windows:

1) **1131 Build Error:** Error in the logic. Run the **LogicView for FFB** (Edit Logic) and executes the **Build command**, and thus you can verify where is the error. In the **Output** window will appear the errors, click them and the **LogicView for FFB** will indicate the error in the **Ladder Drawing Area**.

2) **Data is too large to be compiled, please refer to LogicView User Guide to check about limitations Code: Tags: Funct:** The **LogicView for FFB** will show the number of bytes produced by the logic's code, the number of used tags and the number of functions. See below the Smar controllers limits (for further details refer to the DFI302 manual)

DF75: 120000 bytes, 2000 functions;
DF73, DF79, DF81, DF95, DF97: 120000 bytes, 1200 functions;
DF62 and DF63: 20000 bytes, 300 functions;
HFC302: 5000 bytes, 300 functions;
DF89: 60000 bytes, 1200 functions.

The build command in the **LogicView for FFB** gives this information to the user.

3) All errors below indicate a failure in a download command. Repeat the operation. If the error persists, contact the Smar technical support.

1131 Code Download Error
 1131 Disc. Cfg Download Error
 1131 Ana Cfg Download Error
 1131 Disc. Points Download Error
 1131 Real Points Download Error
 1131 Disc. Safe Download Error
 1131 Pulse Download Error
 1131 Extra Long Download Error
 1131 Extra Float Download Error
 1131 Long Download Error
 1131 Float Download Error
 1131 Tags Download Error
 1131 Cfg File Download Error
 1131 FFB Download Error
 1131 FFB Link Download Error
 1131 ID Modules Error

- 1131 Internal Bool Parameters Error
- 1131 MB AI Error
- 1131 MB AO Error
- 1131 MB DI Error
- 1131 MB DO Error

- 1131 Num Net IO Error
- 1131 Net IO DO Error
- 1131 Back/Fore Times Error

4) **1131 Temp Download Error:** Failure in the download sequence or failure in the temperature module configuration.

Uploading the function parameters


With the **Upload Function Parameters**  button the user updates the function blocks parameters. By clicking it the next message will appear:



Fig 3. 150 – Confirming upload

After confirm the operation, **LogicView for FFB** will update the function blocks parameters and the following message will appear informing the operation success.



Fig 3. 151 – Upload has finished

In the **Output Window** will appear a parameters list whose values has changed – **NewValue** and **OldValue**. See the following figure.

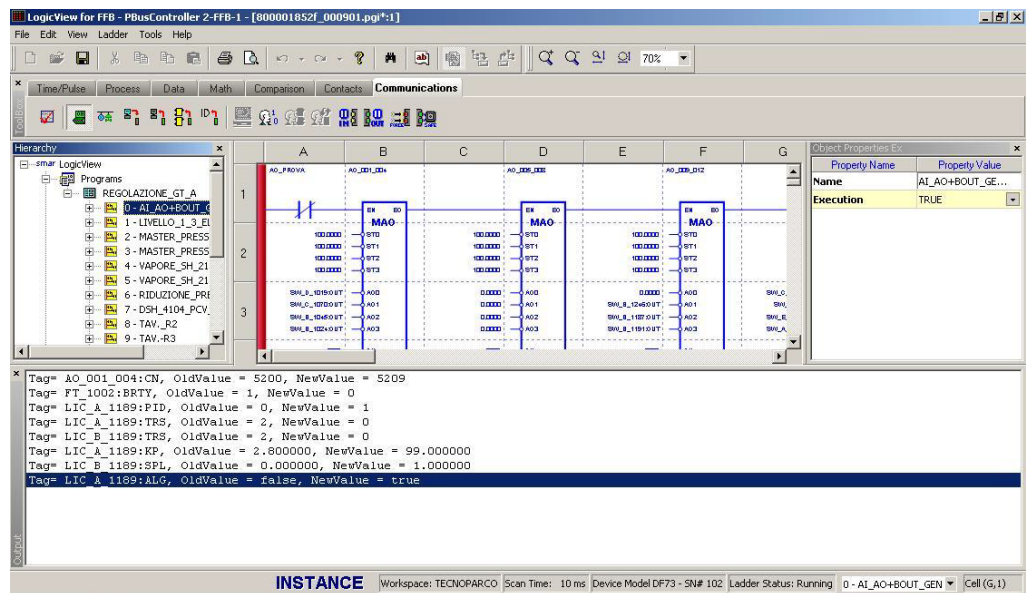


Fig 3. 152 – Updated parameters list

In **OldValue** is shown the value which is in the configuration file. In **NewValue** is shown the value from the controller. When the user clicks, in the **Output Window**, in the line of changed parameter, the **LogicView for FFB** shows the function highlighted in the ladder.

NOTE

If the user does not want to change the configuration file just exit from **LogicView for FFB** without save it.

Get Hardware IDs



By clicking in the **Get Hardware IDs** button the **LogicView for FFB** searches the current I/O hardware installation and compares with the configuration done via software. A window as the following will appear:

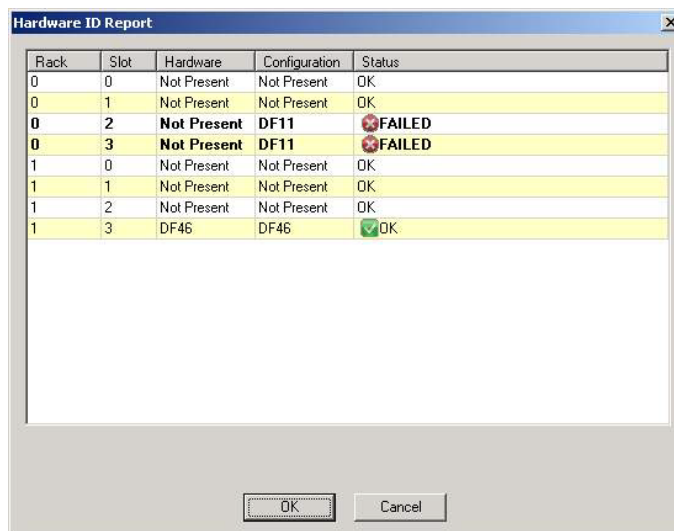


Fig 3. 153 – Comparing the hardware with Get Hardware IDs function

NOTE

The **Get Hardware IDs** function only recognizes the physical installation of the I/O modules whose hardware have the GLL number, that is printed in the circuit board, higher than 1100.

Get Hardware Errors



By clicking **Get Hardware Errors** button, the user gets information about hardware conflicts that occurred when configuring hardware access in Syscon and **LogicView for FFB** simultaneously. Possible conflicts can occur when accessing the same output via function blocks or via ladder logic, or if there are conflicting configurations for the temperature module (DF45).

The information about possible conflicts is available in the **Output** window, see the following figure. In this example is indicated that the point 1 of the module in rack 0, slot 1 is being used by ladder and function blocks simultaneously. In this case, the point's value will be defined by blocks. To solve the problem the user has to remove the conflicting point of the ladder or function blocks.

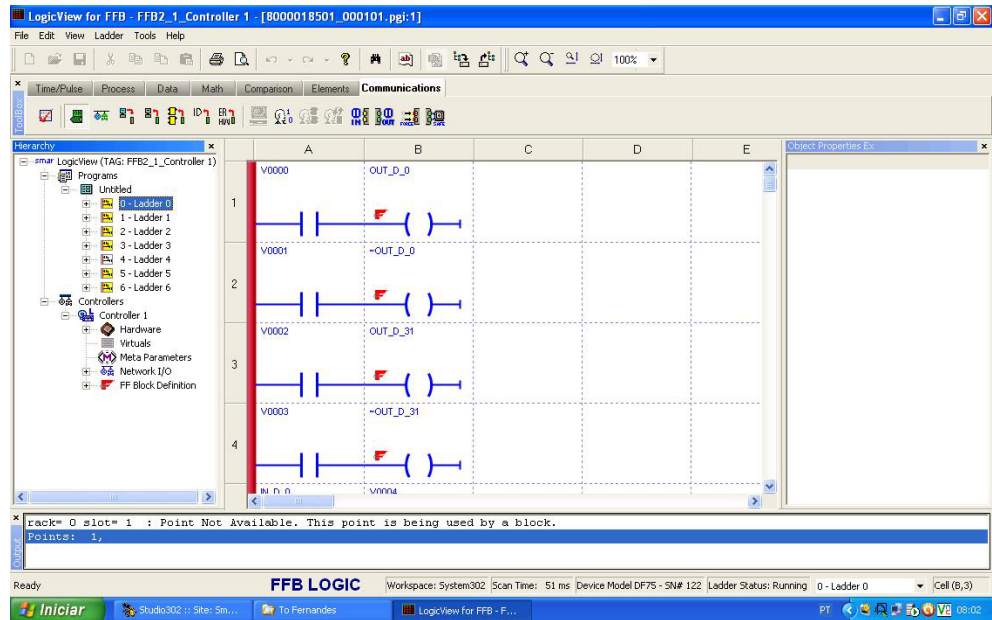


Fig 3. 154 – Comparing the hardware with Get Hardware Errors function

If conflicts do not occur, the message **No Errors** will appear.

IMPORTANT	
<ul style="list-style-type: none"> • If there is usage conflict or point configuration conflict by ladder or by function blocks, the preference will always be function blocks. • When the Supervision starts the Get Hardware Errors function is performed automatically. 	

Upload Configuration



By clicking the **Upload configuration** button, the **LogicView for FFB** does an upload of the entire configuration which is running in the controller. This option is available for DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers.

Supervision

The **LogicView for FFB** supervises of two ways: discrete points supervision (default) and function blocks' analog points supervision.



The **Discrete Supervision** button allows monitoring the discrete points during the ladder execution in online mode. Firstly, in order to supervise the ladder execution the user has to do the Export Tags in **Syscon**. If the elements are gray the ladder is not being supervised. If only the **Discrete Supervision** button is selected the analog points will appear as five interrogation points (?????).



To supervise analog points click **Function Blocks Supervision** button. The **LogicView for FFB** cannot supervise only the analog points. This button enables the points' supervision of function

blocks inputs and function blocks outputs. To enable the supervision of function internal parameters,

and consequently the grid, click the button  **Get Internal Function Parameters**. This action does an upload of internal parameters of all functions, and in this condition, is possible to update any of these parameters, entering a new value in the grid and pressing <Enter>.

When the user chooses to supervise the logic, it is done a comparison between the configuration that is in the controller and the one that is in the **LogicView for FFB**. If they are equals, the points are supervised normally. If they are different, the next message will appear, with the **Upload**, **Download** and **Online** options. For neither of those, close the dialog box. This message will appear to the DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers. For the HFC302, DF62 and DF63 there is a single option which is to download the configuration.

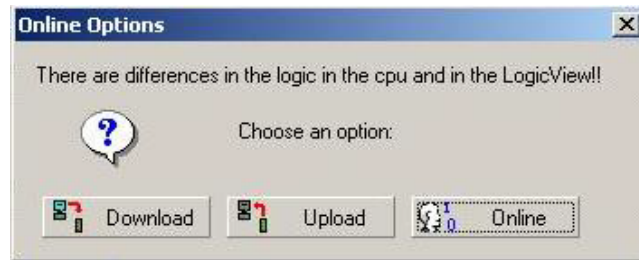



Fig 3. 155 – Options before supervision

NOTE

If the LogicView for FFB cannot read the modules (corresponding hardware) of the MAI and TEMP analog functions, the output value goes to 125% F.S..

Ladder execution modes

Stop/Run

The **Stop/ Run** button  allows the user to execute or stop the ladder. Click it and the next figure will open.

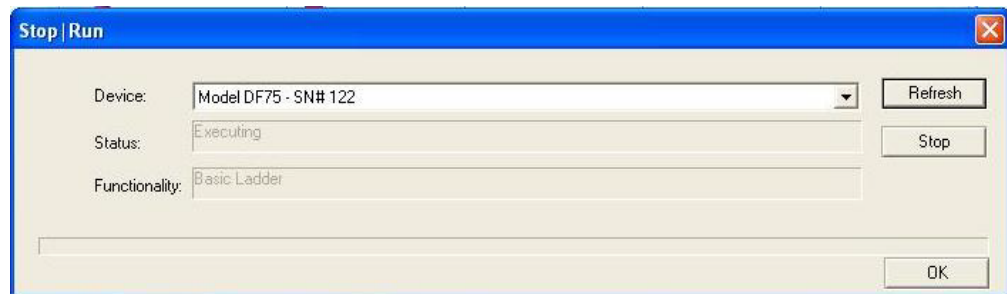


Fig 3. 156 - Stop/Run Window

Besides triggering and stopping the ladder execution in the device, the **Stop/Run** icon enables the time scan request, just to define the device. Only one device will appear - the one on which the logic was downloaded. In **Run** the inputs are not scanned, the ladder executes and the outputs are updated.

In **Stop** the ladder does not execute, the inputs are not scanned and the outputs are not updated. If the ladder is in **Stop**, the Toggle Value is enabled and the user can modify the outputs manually (in supervision). Just right-click the selected output, then in Toggle Value and the output value will be inverted.

ATTENTION

When the **Stop** command is executed:

- The discrete outputs go to Safe Mode.
- The analog outputs of the MAO functional block will assume the defined values in ST0, ST1, ST2 and ST3.




Freeze in  – In this mode the inputs are not scanned, the ladder executes and the outputs are updated. By clicking the icon the next message will appear confirming the operation:



Fig 3. 157 – Confirming the Freeze In mode

Is possible to change the Toggle Value of the discrete inputs and FFB. Just right-click the input, then Toggle Value and the input value will be inverted. The CPU can be in **Run** or **Stop** mode.


Freeze out  – In this mode the inputs are scanned, the ladder executes and the outputs are not updated. They keep the last value. By clicking the icon the next message will appear confirming the operation:



Fig 3. 158 – Confirming the Freeze Out mode

Is possible to change the Toggle Value of the discrete outputs. Just right-click the output, then Toggle Value and the output value will be inverted. The CPU can be in **Stop** mode.


Safe Mode  - In this mode the inputs are scanned, the ladder executes, but the outputs keep the safe values set by user. By clicking the icon the next message will appear confirming the operation:



Fig 3. 159 – Confirming the Safe mode


Force Mode  – In this mode the hardware inputs are scanned, the ladder executes, the outputs are updated and the user can act over the inputs which no exist in hardware. By clicking the icon the next message will appear confirming the operation:



Fig 3. 160 – Confirming the Force mode

It is possible to change the Toggle Value of the discrete inputs and FFB. Just right-click the input, then Toggle Value and the input value will be inverted. The CPU can be in **Run** or **Stop** mode.



ATTENTION

- The execution modes may be simultaneous.
- If some execution modes are activated and **LogicView for FFB** goes to offline, when it came back to online the execution mode will be kept. For example, the **LogicView for FFB** is online and Freeze In is the execution mode. When it goes go offline and came back to online, the execution mode will be Freeze In automatically.

Hierarchy

This window can be enabled or disabled through the **View Menu**. In the **Hierarchy** window the user can verify all the project structure. Every **Hierarchy** item will be detailed in this topic.

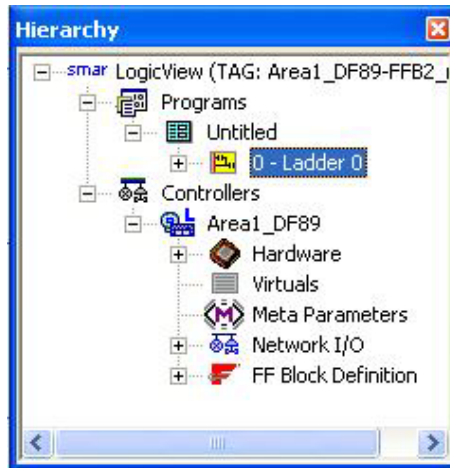


Fig 3. 161 – Hierarchy Window

Information about the project

The **LogicView for FFB** allows information about the project to be inserted. Click **LogicView** on the tab **Hierarchy** that will enable in the **Object Properties** window several items in which the user can insert information about the project, for example, the company's name, plant, project, controller (device), etc.

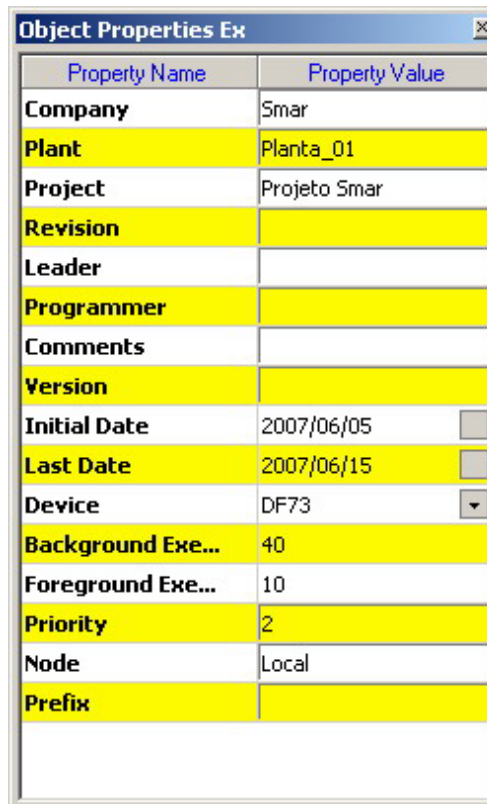


Fig 3. 162 – Project information window

Priority – This parameter defines the priority which the controller executes the logic in comparison with the other tasks of the system. See the following table.

Priority	DF62	DF63	DF73	DF75	DF79	DF81	DF89	DF95	DF97
0	Very High			X					
0.6	Intermediate .6			X					
0.7	Intermediate .7	X	X	X	X	X	X	X	X
0.8	Intermediate .8	X	X	X	X	X	X	X	X
0.9	Intermediate .9	X	X	X	X	X		X	X
1	High	X	X	X	X	X		X	X
2	Average	X	X	X	X	X	X	X	X
3	Low	X	X	X	X	X	X	X	X
4-9	Not used								
10 - 99	Adjustable Low, Foreground = 10 Background = P x 10	X	X	X	X	X	X	X	X

P = priority

Foreground/Background – Visualization of the logic execution rate in comparison with the other tasks of the system. The values are changed according with the priority chosen.

Hardware

The user can configure the hardware that will execute the ladder logic in this window. Here the racks can be inserted, removed and configured. The **LogicView for FFB** shows a window with the racks and their slots in use and also which ones are available. The racks configuration can be changed.

Right-click **Hierarchy** → **Hardware** and the following options are available:

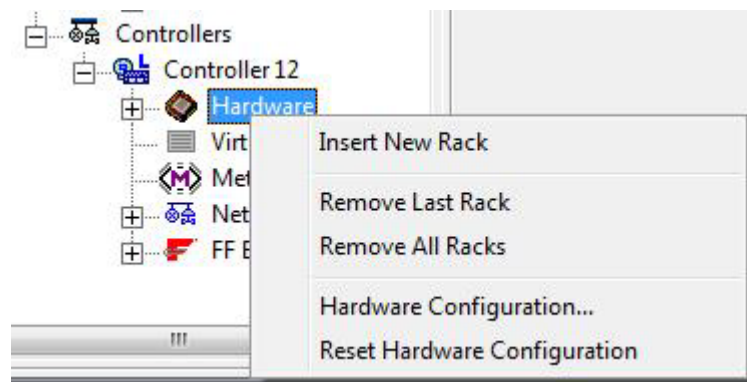


Fig 3. 163 - Hardware Options in Hierarchy Window

Insert New Rack – With this option as many racks can be inserted as needed for the application. Besides the rack Z (DF78 or DF92) up to 16 racks can be included, numbered from 0 to 15. As they are included those that are empty will be light gray. See the next figure:

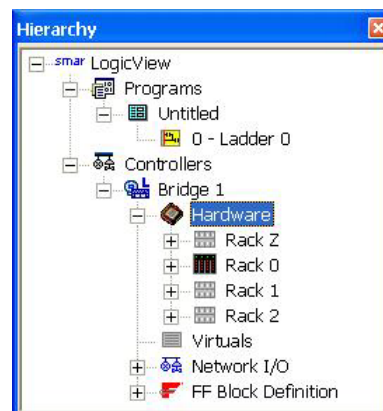


Fig 3. 164 - Inserting racks

Remove Last Rack – When the user chooses this option the last rack will be removed from the application. It does not matter if the rack is empty or not. This option will be disabled if the last available rack is the Rack 0.

Remove All Racks – With this option the user can remove all inserted racks simultaneously, except the racks Z and 0. It does not matter if the racks are empty or not.

ATTENTION
The operations **Remove Last Rack** and **Remove All Racks** cannot be undone.

Reset Hardware Configuration - With this option the user can change from conventional I/O to redundant I/O, or vice-versa, but all original hardware configuration will be lost and all digital I/O points will be converted to meta parameters.

Hardware Configuration – With this option the user can choose the modules which will work in the ladder logic. Initially, the user has to choose which type of I/O platform will be used, conventional or redundant. This operation cannot be undone. See the next figure.

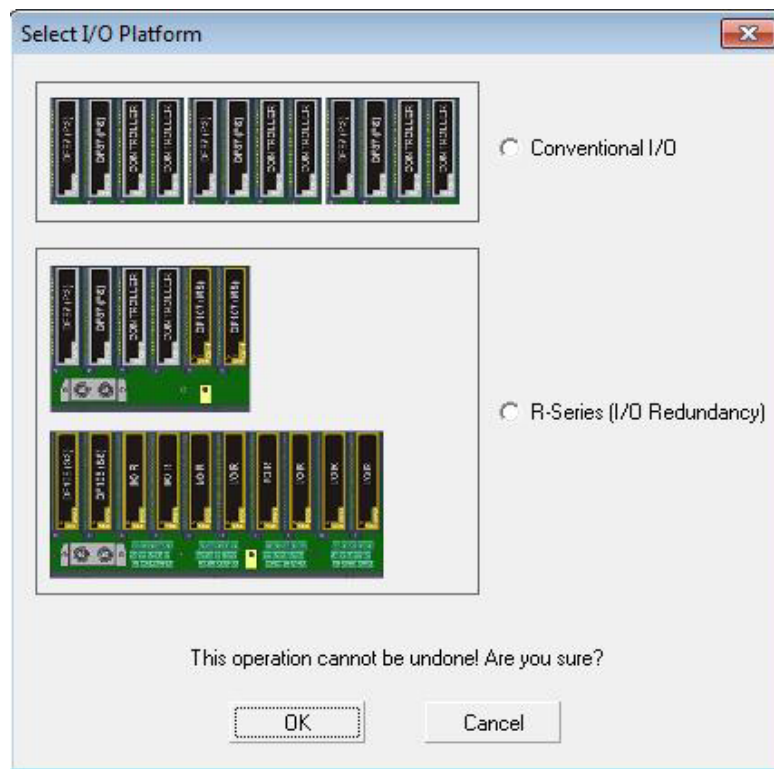


Fig 3. 165 – Choosing the I/O module type

If the user chooses conventional I/O modules the following window will open:

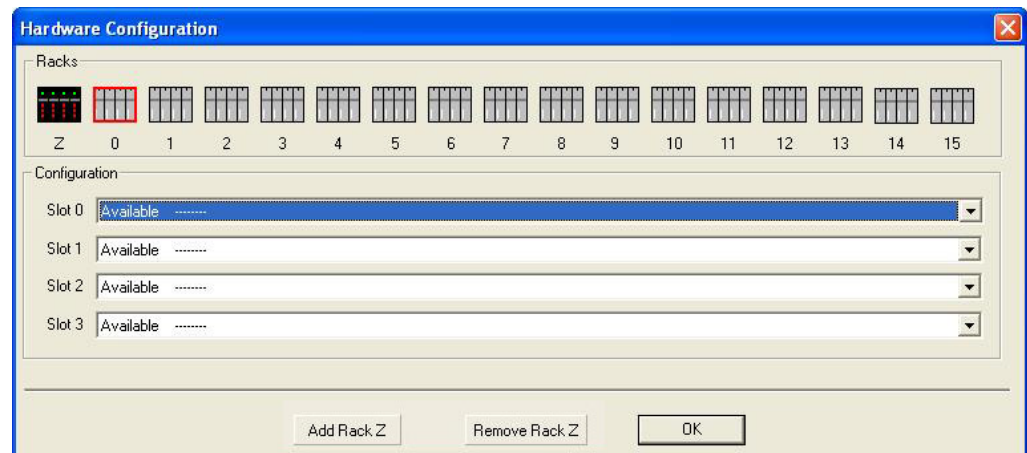


Fig 3. 166 - Configuring the Hardware

If the user chooses redundant I/O modules the following window will open:

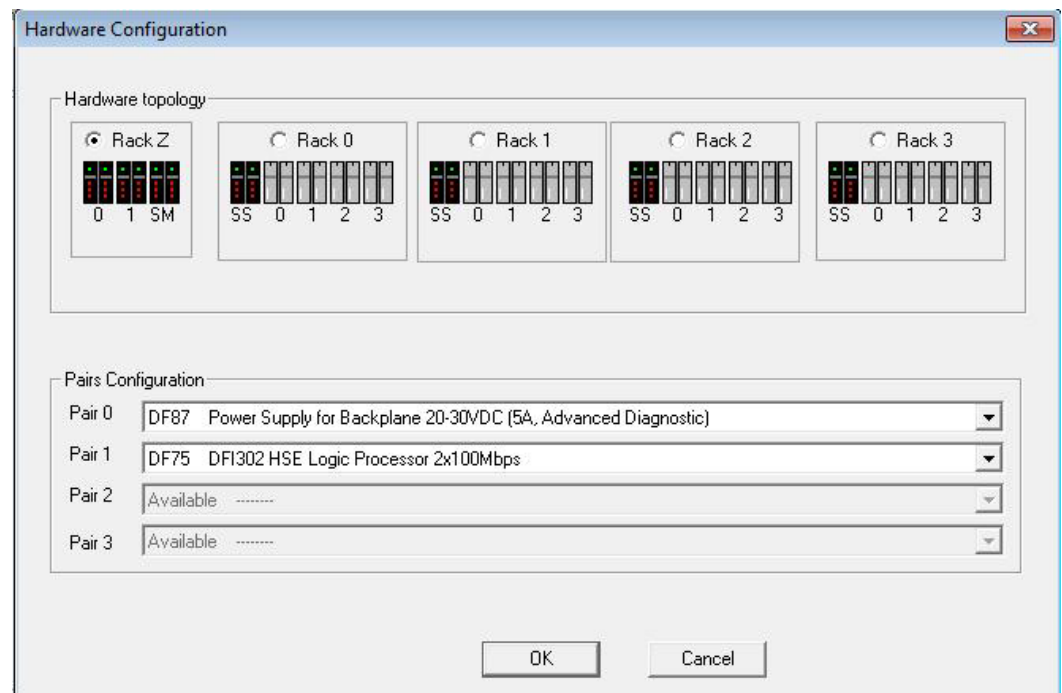


Fig 3. 167 - Configuring the hardware for I/O redundant module

In the **Menu File** topic was presented that if the user is in the **Template Mode** and creates a new project with the **File** → **New** option the **LogicView for FFB** will create the new file with an empty Rack Z and a Rack 0 with the slot 0 filled with the DF50 power supply and the slot 1 filled with the DF62 controller.

The user can choose if the Rack Z (DF78 or DF92) will be used or not in the hardware configuration. This rack has to be used for power supplies and controllers redundancy. For further details see the DF1302's manual.

The Rack Z can be inserted at any time in the **Instance Mode** and in the **Template Mode**. Click **Add Rack Z** button and it will be inserted. Automatically the power supply and the CPU which were in the slots 0 and 1 of the Rack 0 will be transferred to the respective slots in the Rack Z. In this way, the slots 0 and 1 of the Rack 0 will be available, and the Rack Z will have the power supply and CPU redundancy. See the next figure.

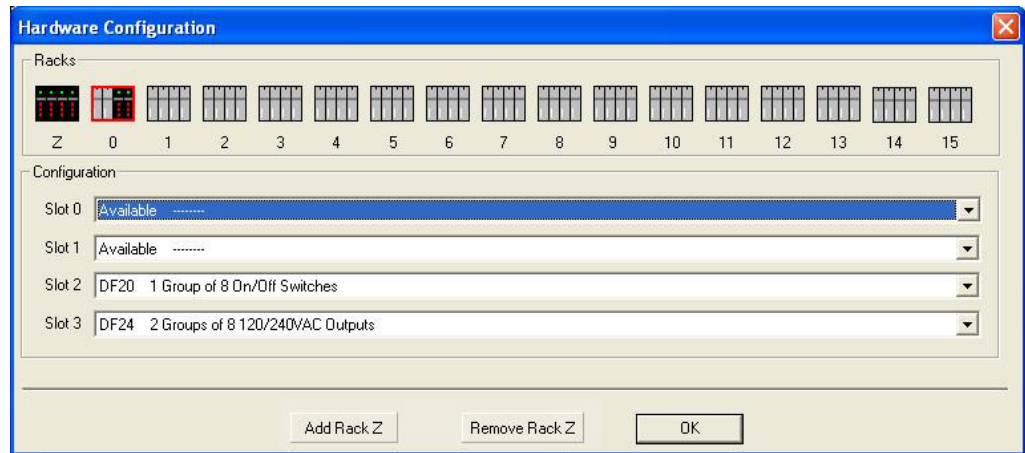


Fig 3. 168 – Including the Rack Z

If the user tries to access the Rack Z without insert it before, the following message will appear:



Fig 3. 169 – Error – Rack Z is not available

In the Rack Z slots 0 and 1 only can be used power supplies, and they can be different. If the user tries to insert some module which does not be a power supply, the next message will appear:



Fig 3. 170 – Error – Inserting modules in the Rack Z (1)

In the Rack Z the slots 2 and 3 only can be used the controllers (CPUs), and they have to be of the same type. If the user inserts DF73 in the slot 2 automatically the slot 3 also will be configured with the DF73 and vice-versa. If the user tries to insert some module which does not be a CPU, the next message will appear:



Fig 3. 171 – Error – Inserting modules in the Rack Z (2)

When the user starts a **LogicView for FFB** project the Rack Z is created, but it is empty. In a new **LogicView for FFB** project the Rack 0 has the slots 0 and 1 occupied. In the slot 0 there will be the power supply (DF50), and in the slot 1 there will be the controller.

The slots 0 and 1 only can be configured with a power supply and a controller, respectively, in this case which the Rack Z is not being used. The Rack 0 slots 2 and 3 and all slots of the racks 1 to 15

can be configured which any module type, except controllers. If the user tries to insert some controller, the next message will appear:



Fig 3. 172 – Error – Inserting CPU in wrong slot

If the work is being done on Template mode, the controller type – DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95 or DF97 can be changed. This choice will depend on the user application.

If the Instance mode is being used, the controller is already configured by **Syscon** and, in this case, it cannot be changed.



Fig 3. 173 – Error – Changing the CPU in the Instance Mode

The Rack Z can be removed by clicking the **Remove Rack Z** button. Automatically the power supplies, which were in the slots 0 and 1 of the Rack Z, and the controllers, which were in the slots 2 and 3 of the Rack Z, will be transferred to the respective slots in the Rack 0.

If the slots 0 and 1 of the Rack 0 were already filled, the user cannot remove the Rack Z. The following messages will appear:



Fig 3. 174 – Error – Removing the Rack Z (1)



Fig 3. 175 – Error – Removing the Rack Z (2)

Choosing the modules – When the desired slot is clicked, an options list will open. See the figure below.

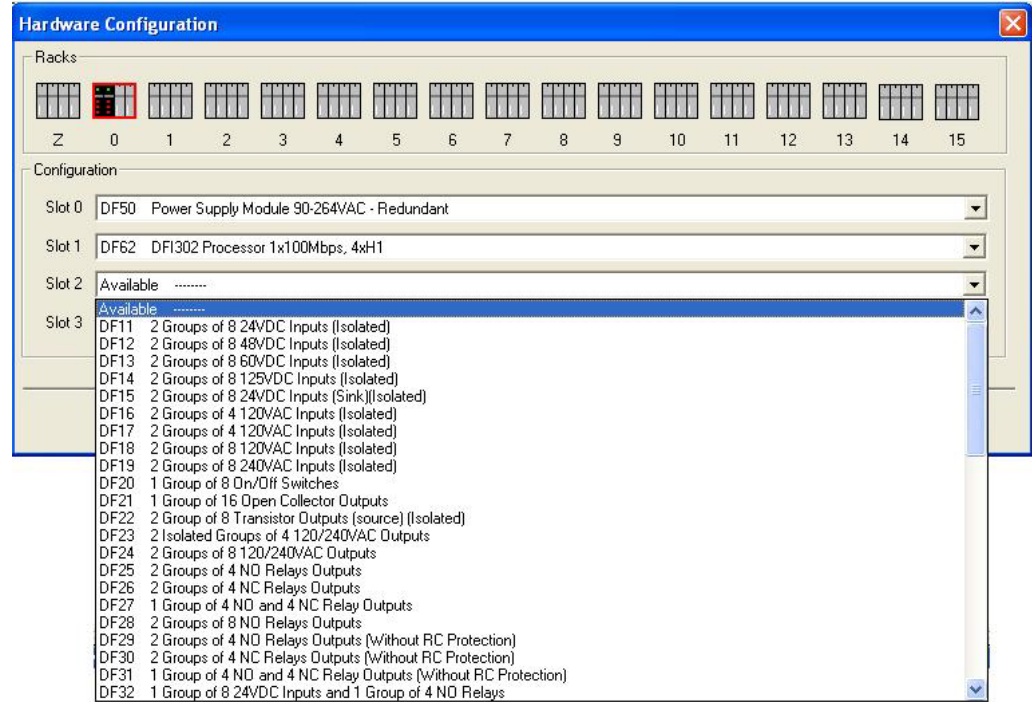


Fig 3. 176- Configuring the Hardware

Choose which modules are needed in this application, click them, and they will be automatically set in the rack. Click **OK**.

The racks' occupation can be seen in the **Hierarchy** window. See the next figure.

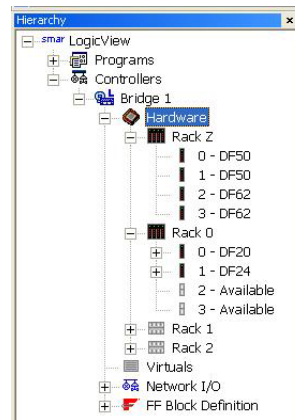


Fig 3. 177 - Racks' occupation

The user can copy the rack's configuration and paste it in another rack. For this, the user has to right-click the source rack and chooses **Copy Configuration**. To paste the copied configuration just go to the target rack and choose **Paste Configuration**. If there were any configuration in the target place, the **LogicView for FFB** will replace it with the new one.

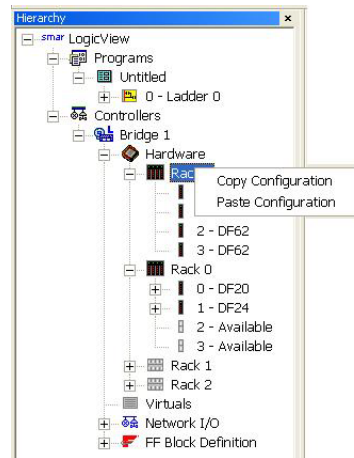


Fig 3. 178 - Copy and Paste the rack's configuration

If the user wants to copy and paste only one module the procedure is similar to the one mentioned above. Right-click the source module and choose **Copy Module**. The module will be copied and it can be pasted in another slot. For that, just choose the target slot, right-click it and choose **Paste Module**. See the next figure.

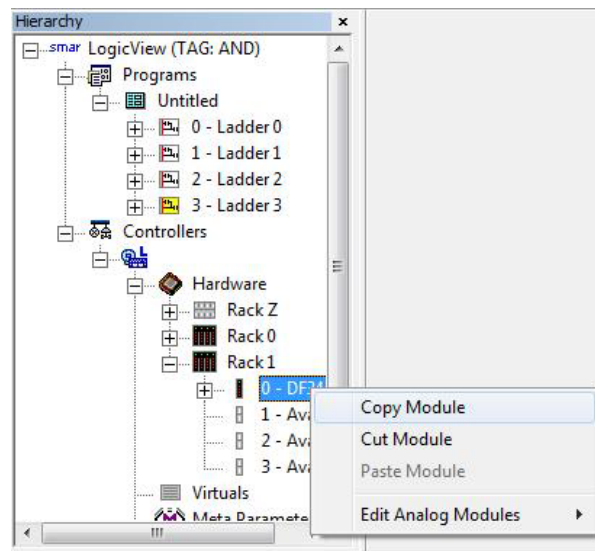


Fig 3. 179 - Copy and Paste the module's configuration

It is also possible to move the modules, doing first the **Cut Module** operation and then **Paste Module**. When performing these operations, the elements, whose tags are different from default tags, will keep them and they will refer to the point in the new module position. If the element has a default tag, for example, TAG01000, it will be renamed according to the new point position, following the notation TAGRRSGP, where R = Rack, S = Slot, G = Group and P = Point.

Configuring the Safe Output Values

The user can configure the modules safe output values in case of fail. In the example below the Rack 0 has a DF24 module. The user has to right-click the desired output and chooses the desired value – **On** or **Off**. By default, all outputs are configured with **Off** when the project is started.

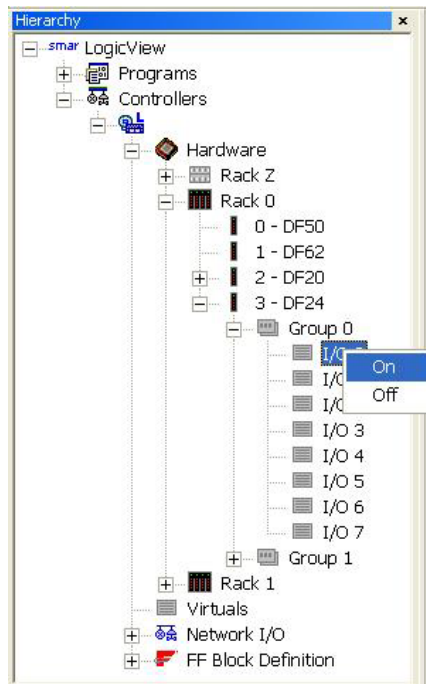


Fig 3. 180 – Configuring the safe output values (1)

The safe values also can be configured in the **Object Properties** window. Select the output, double-click the **Safe Output Value** right cell and choose the desired value – **On** or **Off**. See the next figure.

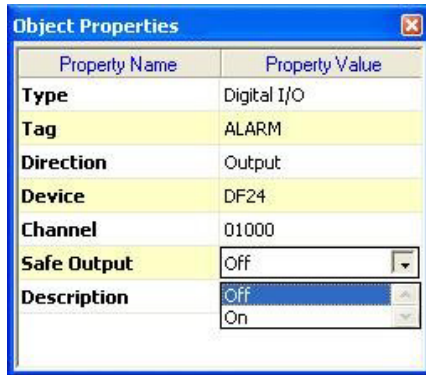


Fig 3. 181 – Configuring the safe output values (2)

At **Tools** → **Properties Editor** the safe values can be configured. Click the output which will be configured and choose On or Off. See the following figure.

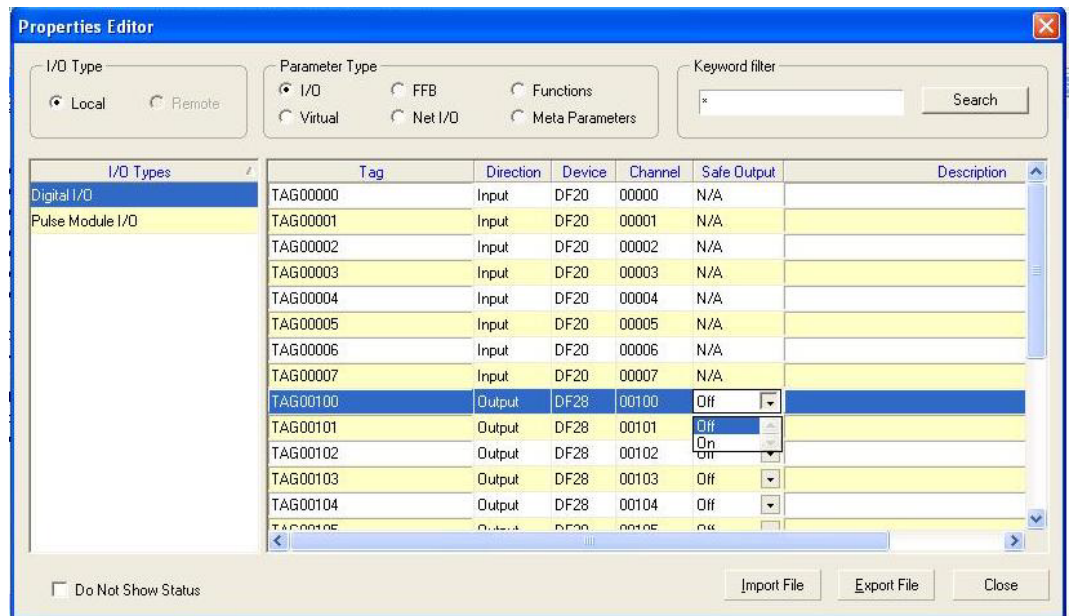


Fig 3. 182 – Configuring the safe output values (3)

Changing the tags

The tags can be changed in the **Object Properties** window if the user clicks on the desired element – virtual variables, I/O or function blocks – in the **Hierarchy** window. Select the element; double-click the **Tag** right cell in the **Object Properties** window and write the new tag.

The tags only can have alphanumeric characters and the underscore character. The tags also cannot have spaces. Otherwise, the following messages will appear.

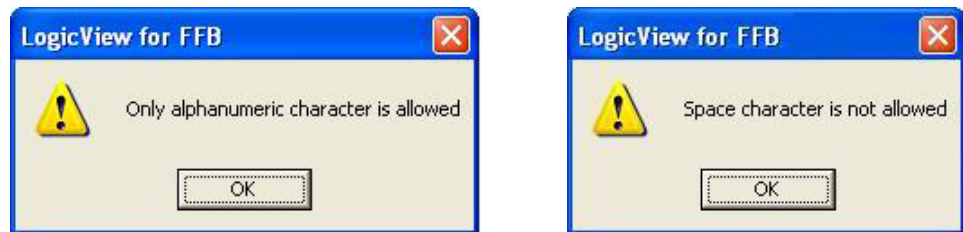


Fig 3. 183 – Error – Changing the tags with not allowed characters

The user will be notified if the selected element has a blank tag. See the next figure.



Fig 3. 184 – Error – Blank tag

NOTE
 The virtual variables tags, the input and output tags can have until 16 characters. The functional blocks tags can have until 10 characters.

The functional blocks tags are single. If the user tries to give an existent tag to the functional block,

the next message will be shown.



Fig 3. 185 – Error – Tag already exists

NOTE
The tags also can be changed in **Tools** → **Properties editor**.

Inserting a description

The user can insert an element description to facilitate its identification. Select the element; double-click the **Description** right cell in the **Object Properties** window and write the description which can have until 64 characters.



Fig 3. 186 – Inserting a description

Special Modules

Some types of analog modules can be edited – analog inputs, analog outputs, pulse inputs, and temperature.

Analog Input Modules

The available analog input modules are DF43, DF44, and DF57. After inserting them as described previously, they have to be configured.

By right-clicking the module, the module’s configuration window will open. For this select the options **Edit Analog Modules**, and then **Edit Module Inputs**. See the next figure.

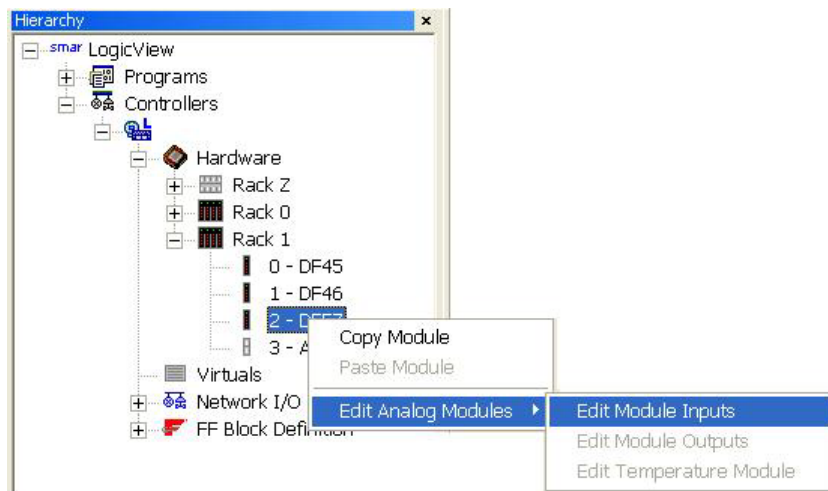


Fig 3. 187 - Configuring the analog input modules

The window of the next figure will appear and there, the module configuration can be changed. Each channel, or point, has a configuration independent from the eight other ones. Select the desired channel through the **Select Channel** option. The default configuration for all channels is showed in the next figure.

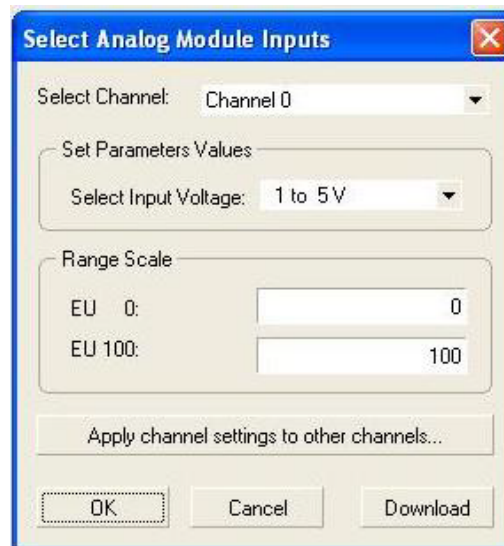


Fig 3. 188 - Changing the configuration of analog input modules

The **Select Input Voltage** option corresponds to the range of values in the channel input. The allowed types are:

- 1 to 5 V (default);
- 0 to 5 V (default);
- -10 to 10 V (default);
- 0 to 10 V (default);

ATTENTION

Observe the module's physical configuration and the jumpers that will be placed in the manual's module.

To modify the engineering unit for data presentation, follow the next rule:

- Eng. Unit 0 (EU0) is the minimum value.
- Eng. Unit 100 (EU100) is the maximum value.

If $EU0 = 0$ and $EU100 = 1$, the presented value will be from 0 to 10000 (discrete) from the input range, that is, if the **Select Input Voltage** is equal to “1 to 5 V”, the value 0 in the block output will correspond to an input of 1 V in the channel and the value 10000 in the block output will correspond to an input of 5 V in the channel. Intermediate values in the voltage input will be presented in the output like interpolated values between 0 and 10000.

For other $EU0$ and $EU100$ values, the presented value will be in the specified $EU0$ and $EU100$ input range, that is, if the **Select Input Voltage** is equal to “1 to 5 V”, and the value of $EU0$ is equal to 10 and the value of $EU100$ is equal to 50, in the block output we have for an input of 1 V in the channel, the output will be 10, and for an input of 5 V in the channel, we have in the block output the value 50. Intermediate values in the voltage input will be presented in the output as interpolated values between $EU0$ and $EU100$.

The **Apply channel settings to other channels** button can be used if the user wants to replicate the configuration done to one channel to the others. Just select the channels as in the following figure.

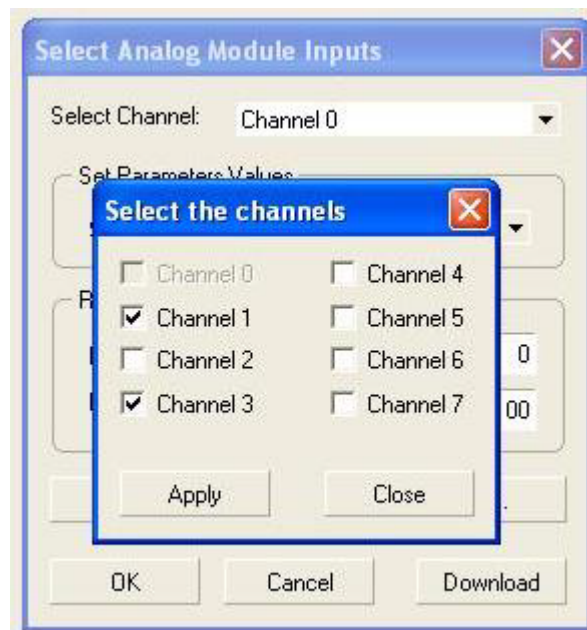


Fig 3. 189 – Selecting channels to replicate the configuration

NOTES
<ul style="list-style-type: none"> • Always configure $EU0 < EU100$. • The Download option can be used, when LogicView for FFB is online, to download only the scales, if they were changed. • A configuration download of the all modules of the same type will be done, and not only of the module which was changed.

Analog output module

The available analog output module is the DF46. After inserting it as described previously, it has to be configured.

With a right-click the module, open the module’s configuration window by selecting the options **Edit Analog Modules**, and then **Edit Module Outputs**. See the next figure.

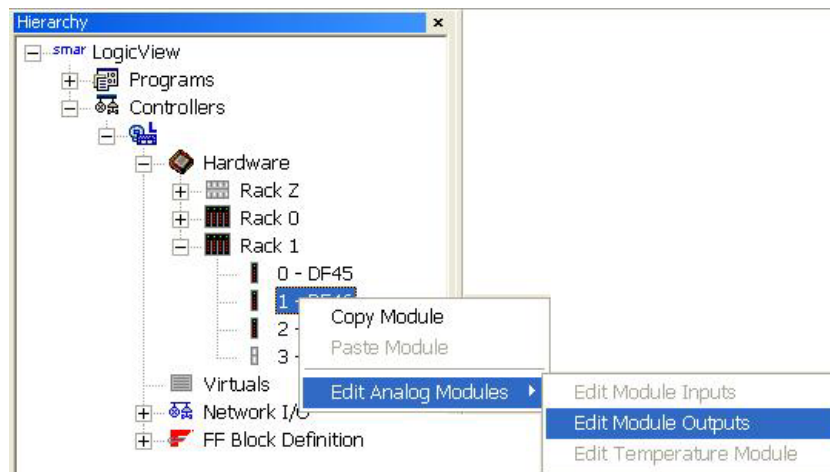


Fig 3. 190 - Configuring the analog output module

The window of the next figure will appear, and there the module configuration can be changed. Each channel, or point, has a configuration independent from the other four ones. Select the desired channel through the option **Select Channel**. The default configuration for all channels is showed in the figure below.

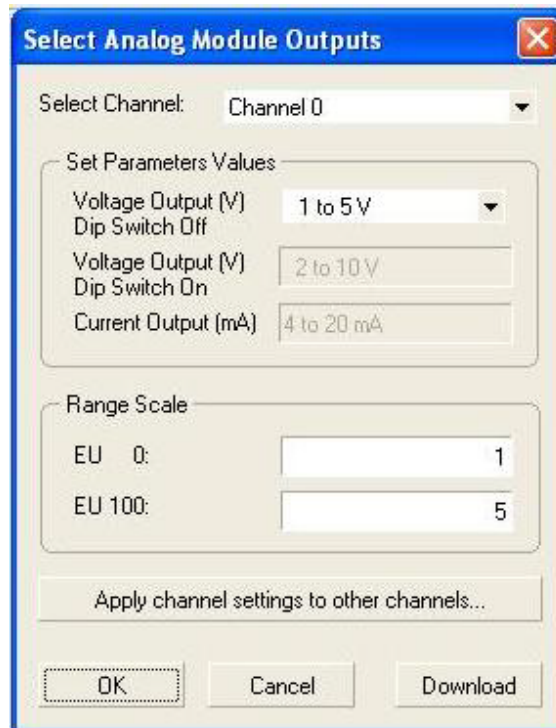


Fig 3. 191 - Changing the analog output module configuration

The **Voltage Output (V)** option corresponds to the range of values in the channel output. If the output is in current, the corresponding selected value is in **Current Output (mA)**. The allowed types are:

- 1 to 5 V (default)
- 0 to 5 V (default)
- -5 to 5 V (default)

The engineering unit to the input block can be modified, follow the next rule:

- Eng. Unit 0 (EU0) is the minimum value.
- Eng. Unit 100 (EU100) is the maximum value.

If EU0 = 0 and EU100 = 1, the input value has to be between 0 and 10000 which will be converted in the output range, that is, if **Voltage Output (V)** is equal to “1 to 5 V”, the value 0 in the block input will correspond to an output of 1 V in the channel, and the value 10000 in the block input will correspond to an output of 5 V in the channel. Intermediate values in the input will be presented in the output as interpolated values between 1 and 5V.

For other EU0 and EU100 values, the input value will be converted to the specified range in EU0 and EU100, that is, if **Voltage Output (V)** is equal to “1 to 5 V”, the EU0 value is equal to 10 and the EU100 value is equal to 50, if the block input is 10, it will correspond to an output of 1 V in the channel. If the block input is 50, it will correspond to an output of 5 V in the channel. Intermediate values in the input will be presented in the output as interpolated values between 1 and 5V.

The **Apply channel settings to other channels** button can be used if the user wants to replicate the configuration done to one channel to the others. Just select the channels as in the following figure.

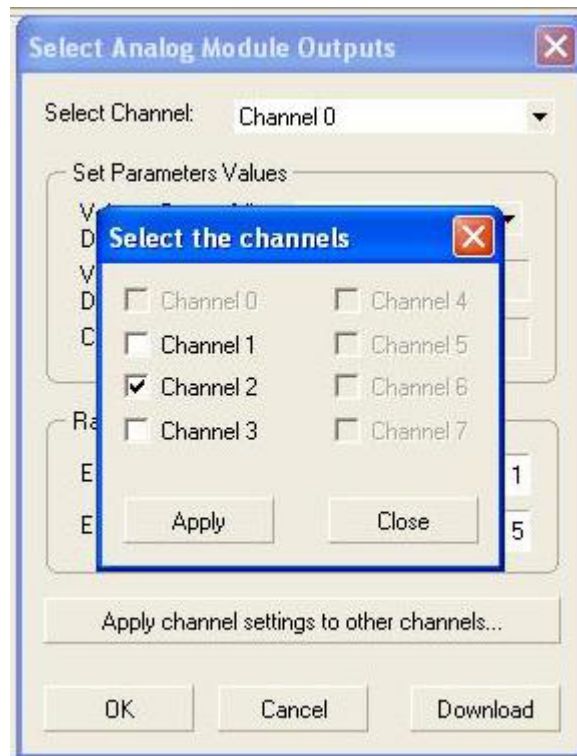


Fig 3. 192 – Selecting channels to replicate the configuration

NOTES

- Always configure EU0 < EU100.
- The **Download** option can be used, when **LogicView for FFB** is online, to download only the scales, if they were changed.
- A configuration download of the all modules of the same type will be done, and not only of the module which was changed.

Pulse input modules

The available pulse input modules are DF41, DF42, and DF67. After inserting them, as described previously, they must be configured.

The point configuration of the pulse input modules is done individually. For this, expand the “tree” of I/Os as in the following figure.

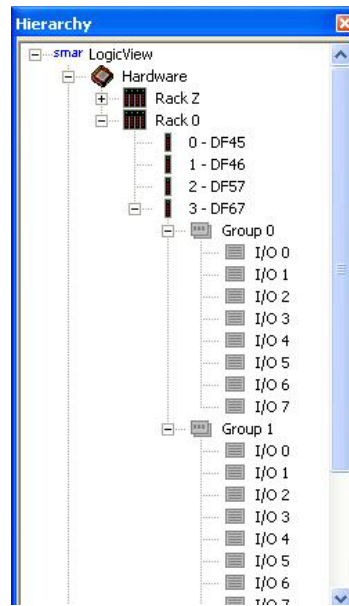


Fig 3. 193 – Configuring the pulse input modules

Each input must be configured in the **Object Properties** window, where the following configuration parameters are available:

Description – Point's description.

- Q Value for THR On – Hysteresis upper limit of flow to set the THR outputs of the ACC and ACC_N blocks.
- Q Value for THR Off – Hysteresis lower limit of flow to reset the THR outputs of the ACC and ACC_N blocks.

OBSERVATION

Always configure Q Value for THR Off < Q Value for THR On.

- Pulse Count Period – Period (in ms) for the flow calculation, e.g., when wanting to know the flow in a time interval from 2 to 2 seconds configure this parameter with 2000 (2 seconds is equal to 2000 milliseconds).

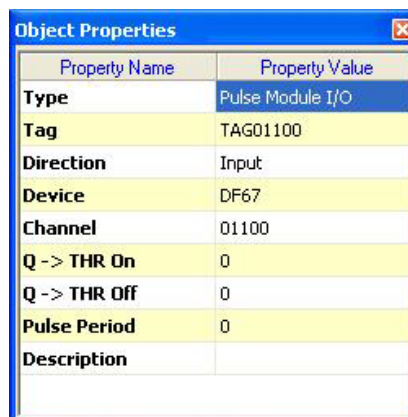


Fig 3. 194 - Configuring the Pulse Count Period

Temperature module

The available temperature module is the DF45. After inserting it, as described previously, it must be configured.

Right-click the module, and open its configuration window by selecting the options **Edit Analog Modules** and then, **Edit Temperature Module**.

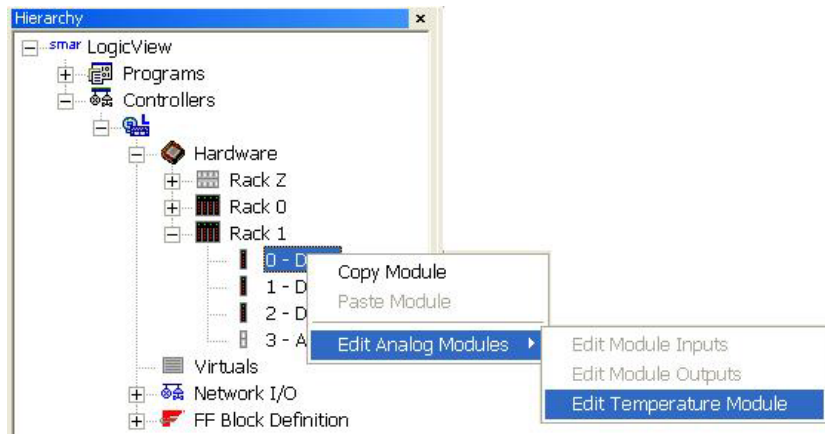


Fig 3. 195 – Configuring the temperature module

The window on the next figure will appear and the module configuration can be changed. Each channel, or point, has a configuration independent from the other eight ones. Select the desired channel through the option **Select Channel**. The default configuration for all channels is showed in the figure below.

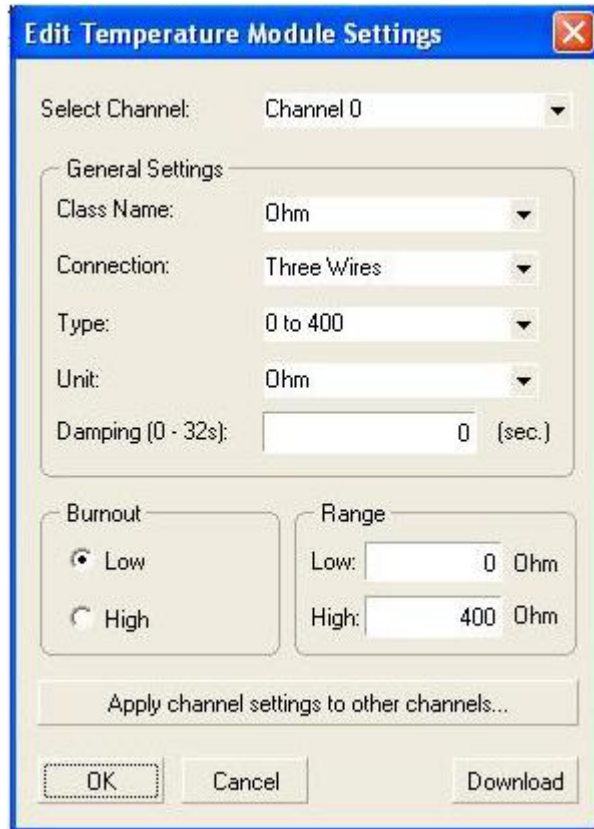


Fig 3. 196 - Changing the temperature module configuration

The **Apply channel settings to other channels** button can be used if the user wants to replicate the configuration done to one channel to the others. Just select the channels as in the following figure.

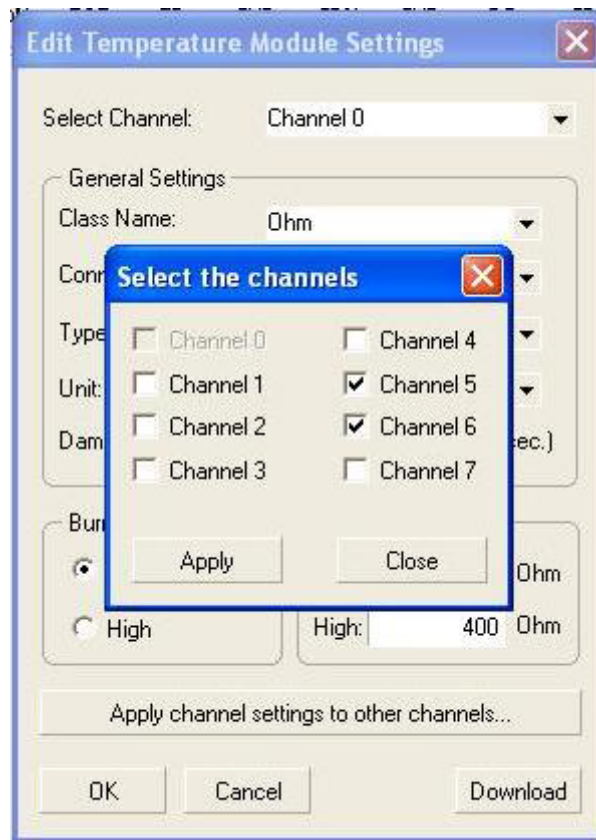


Fig 3. 197 – Selecting channels to replicate the configuration

NOTES

- The **Download** option can be used, when **LogicView for FFB** is online, to download only the scales, if they were changed.
- A configuration download of the all modules of the same type will be done, and not only of the module which was changed.

The checking of engineering unit and the connection's type is related to the sensor class. The table below shows the available relationships.

Class	Class Name	Connection	Connection name	Type	Type Name	Min	Max
1	RTD	1	Differential	1	Cu10 GE	-270	270
1	RTD	1	Differential	2	Ni120 DIN	-320	320
1	RTD	1	Differential	3	Pt50 IEC	-1050	1050
1	RTD	1	Differential	4	Pt100 IEC	-1050	1050
1	RTD	1	Differential	5	Pt500 IEC	-1050	1050
1	RTD	1	Differential	6	Pt50 JIS	-850	850
1	RTD	1	Differential	7	Pt100 JIS	-800	800
1	RTD	2	2 Wires	1	Cu10 GE	-20	250
1	RTD	2	2 Wires	2	Ni120 DIN	-50	270
1	RTD	2	2 Wires	3	Pt50 IEC	-200	850
1	RTD	2	2 Wires	4	Pt100 IEC	-200	850
1	RTD	2	2 Wires	5	Pt500 IEC	-200	450
1	RTD	2	2 Wires	6	Pt50 JIS	-200	600
1	RTD	2	2 Wires	7	Pt100 JIS	-200	600
1	RTD	3	3 Wires	1	Cu10 GE	-20	250
1	RTD	3	3 Wires	2	Ni120 DIN	-50	270
1	RTD	3	3 Wires	3	Pt50 IEC	-200	850
1	RTD	3	3 Wires	4	Pt100 IEC	-200	850
1	RTD	3	3 Wires	5	Pt500 IEC	-200	450
1	RTD	3	3 Wires	6	Pt50 JIS	-200	600
1	RTD	3	3 Wires	7	Pt100 JIS	-200	600
2	TC	1	Differential	151	B NBS	-1600	1600
2	TC	1	Differential	152	E NBS	-1100	1100
2	TC	1	Differential	153	J NBS	-600	900
2	TC	1	Differential	154	K NBS	-1550	1550
2	TC	1	Differential	155	N NBS	-1400	1400
2	TC	1	Differential	156	R NBS	-1750	1750
2	TC	1	Differential	157	S NBS	-1750	1750
2	TC	1	Differential	158	T NBS	-600	600
2	TC	1	Differential	159	L DIN	-1100	1100
2	TC	1	Differential	160	U DIN	-800	800
2	TC	2	2 Wires	151	B NBS	100	1800
2	TC	2	2 Wires	152	E NBS	-100	1000
2	TC	2	2 Wires	153	J NBS	-150	750
2	TC	2	2 Wires	154	K NBS	-200	1350
2	TC	2	2 Wires	155	N NBS	-100	1300
2	TC	2	2 Wires	156	R NBS	0	1750
2	TC	2	2 Wires	157	S NBS	0	1750
2	TC	2	2 Wires	158	T NBS	-200	400
2	TC	2	2 Wires	159	L DIN	-200	900
2	TC	2	2 Wires	160	U DIN	-200	600
3	mV	1	Differential	213	-500 to 500	-500	500
3	mV	1	Differential	214	-5000 to 5000	-5000	5000
3	mV	2	2 Wires	201	-6 to 22	-6	22
3	mV	2	2 Wires	202	-10 to 100	-10	100
3	mV	2	2 Wires	203	-50 to 500	-50	500
4	Ohm	1	Differential		-100 to 100	-100	100
4	Ohm	1	Differential		-400 to 400	-400	400
4	Ohm	2	2 Wires	51	0 to 100	0	100
4	Ohm	2	2 Wires	52	0 to 400	0	400
4	Ohm	2	2 Wires	53	0 to 2000	0	2000
4	Ohm	3	3 Wires	51	0 to 100	0	100
4	Ohm	3	3 Wires	52	0 to 400	0	400
4	Ohm	3	3 Wires	53	0 to 2000	0	2000

Table 3.2 – Sensor Classes

The range can be configured within the maximum range specified in the table. These values will be used in **Burnout**.

HART modules configuration

The available HART modules are DF116 (input) and DF117 (output). After inserting them as described above, they have to be configured.

Right-click the module to open its configuration window. Select the **Edit Analog Modules** option, and then, **Edit Module Inputs** (for DF116) or **Edit Module Outputs** (for DF117). The following window will open:

Fig 3. 198 – Configuring the HART modules

So, the module configuration can be changed. Each module has 8 channels. One device can be connected per channel. Select the desired channel with the **Select Channel** option. The standard configuration is showed on the figure above. For each device, the respective **VAR_CODES** of the **PV, SV, TV, QV, 5V, 6V, 7V** and **8V** variables can be configured. The valid values are from 0 to 255. The block engineering unit, corresponding to current value, can be changed as follows:

- Eng. Unit 0 (EU0): minimum value, corresponding to the 4 mA value for the current.
- Eng. Unit 100 (EU100): maximum value, corresponding to the 20 mA value for the current.

The **Apply channel settings to other channels** button can be used if the user wants to replicate the configuration done to one channel to the others. Just select the channels. For the DF117 the option to configure the safe behavior, **Safe Behavior**, is enabled. It indicates to what value will go the primary current of the HART device if it enters in safe mode: 3.6 mA or 21 mA.

NOTES

- The **Download** option can be used, when **LogicView for FFB** is online, to download only the “var codes” and the “safe behavior”, for the DF117.
- A configuration download of the all modules of the same type will be done, and not only of the module which was changed.

Redundant I/O modules configuration

- **Digital input module - DF111**

All redundant digital input points have, besides a variable representing the point's value (0 or 1), a variable representing their status (0 - good or 1 – bad). The status tag is the same of the value followed by ~ (tilde) before the tag. The statuses are read only type.

Property Name	Property Value
Variable	Digital I/O
Tag	TAG00000
Direction	Input
Device	DF111
Channel	00000
Safe Output	N/A
Description	
=====	=====
Variable	Digital I/O
Tag	~TAG00000
Direction	Input
Device	DF111
Channel	00020
Description	

Fig 3. 199 – Value and status of the DF111 module

- **Digital output module - DF112**

All redundant digital output points have, besides a variable representing the point's value (0 or 1), a variable representing their status (0 - good or 1 – bad). The status tag is the same of the value followed by ~ (tilde) before the tag. The statuses are read only type.

Each value has a respective safe value which can be **On** (1) or **Off** (0). And each point also has a safe behavior, that in case of digital outputs may be the last value or the value configured as safe value. See the following figure.

Property Name	Property Value
Variable	Digital I/O
Tag	TAG00000
Direction	Output
Device	DF112
Channel	00000
Safe Behaviour	Safe Value <input type="button" value="v"/>
Safe Output	Off <input type="button" value="v"/>
Description	
=====	=====
Variable	Digital I/O
Tag	~TAG00000
Direction	Output
Device	DF112
Channel	00020
Description	

Fig 3. 200 – Value and status of the DF112 module

- **Analog input module - DF113**

After inserting the module as described above, it has to be configured. Right-click the module to open its configuration window. Select the **Edit Analog Modules** option, and then, **Edit Module Inputs**. The following window will open:

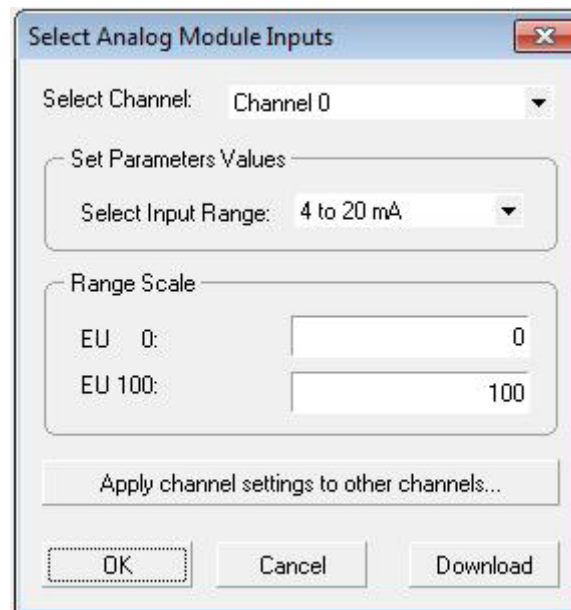


Fig 3. 201 – Configuring the analog input modules

So, the module configuration can be changed. Each module has 8 channels. Each channel, or point, has an independent configuration. Select the desired channel with the **Select Channel** option. The standard configuration is showed on the figure above.

The **Select Input Range** option corresponds to values range in the channel input. The allowed types are:

- 4 to 20 mA
- 0 to 20 mA

The engineering unit can be modified, follow the next rule:

- Eng. Unit 0 (EU0) is the minimum value.
- Eng. Unit 100 (EU100) is the maximum value.

The presented value the **MAIx** block will be in the specified range in EU0 and EU100 related to the input range. For example, if **Select Input Range** is equal to **4 to 20 mA**, the EU0 value is equal to **10** and the EU100 value is equal to **50**, the block output is 10, it will correspond to an input of 4 mA in the channel. If the block input is 20 mA, the block output is 50. Intermediate values in the current input will be presented in the output as interpolated values between EU0 and EU100.

The **Apply channel settings to other channels** button can be used if the user wants to replicate the configuration done to one channel to the others.

NOTES

- Always configure EU0 < EU100.
- The **Download** option can be used, when **LogicView for FFB** is online, to download only the scales, if they were changed.
- A configuration download of all modules of the same type will be done, and not only of the module which was changed.

- **Analog output module - DF114**

After inserting the module as described above, it has to be configured. Right-click the module to open its configuration window. Select the **Edit Analog Modules** option, and then, **Edit Module Outputs**. The following window will open:

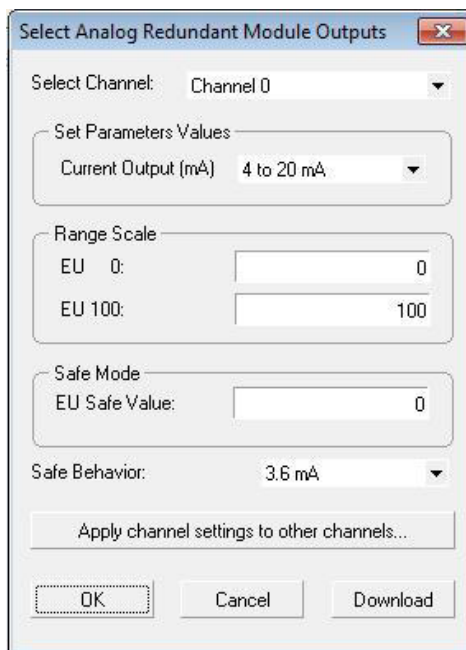


Fig 3. 202 – Configuring the redundant analog output modules

So, the module configuration can be changed. Each module has 8 channels. Each channel, or point, has an independent configuration. Select the desired channel with the **Select Channel** option. The standard configuration is shown on the figure above.

The **Current Output (mA)** option corresponds to values range in the channel input. The allowed types are:

- 4 to 20 mA
- 0 to 20 mA
- 0 to 21 mA

The engineering unit can be modified, follow the next rule:

- Eng. Unit 0 (EU0) is the minimum value.
- Eng. Unit 100 (EU100) is the maximum value.

The presented value in the **MAOx** block input will be in the specified range in EU0 and EU100 related to the output range. For example, if **Current Output (mA)** is equal to **4 to 20 mA**, the EU0 value is equal to **10** and the EU100 value is equal to **50**, the block input is 10, it will correspond to an output of 4 mA in the channel. If the block input is 50, the block output is 20 mA. Intermediate values in the input between EU0 and EU100 will be presented in the current output as interpolated values between 4 and 20 mA.

For each output point can be configured a safe value in the **EU Safe Value** parameter, and a safe behavior in **Safe Behavior**, there are four modes:

- **3.6 mA**: the point will generate 3.6 mA in the output;
- **21 mA**: the point will generate 21 mA in the output;
- **Safe Value**: the point will go to the safe value configured to it;
- **Last Value**: the point will keep the last value before changing to safe mode.

The **Apply channel settings to other channels** button can be used if the user wants to replicate the configuration done to one channel to the others.

NOTES

- Always configure EU0 < EU100.
- The **Download** option can be used, when **LogicView for FFB** is online, to download only the scales, if they were changed.
- A configuration download of all modules of the same type will be done, and not only of the module which was changed.

Programs

A program is a set of ladders. The number of ladders that can be implemented will depend on the elements quantity in each ladder, and on the controller capacity. In the **Programs** window the ladder networks of the application can be managed.

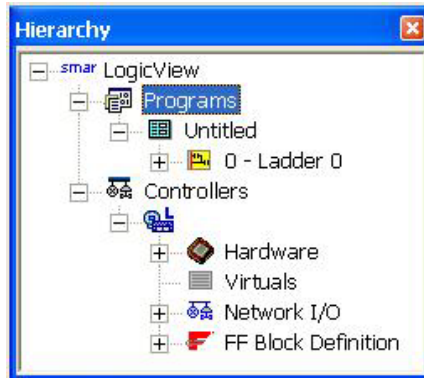


Fig 3. 203 - The Programs item in the Hierarchy window

To give a name to the program, click **Untitled** and double-click the right cell of **Name**, in the **Object Properties** window. In this place, the user should write the program's name.



Fig 3. 204 – Changing the program's name

Diagrams can be inserted right-clicking on the program's name, and then choosing **Insert New Diagram**. When a new diagram is inserted, a build is done automatically.

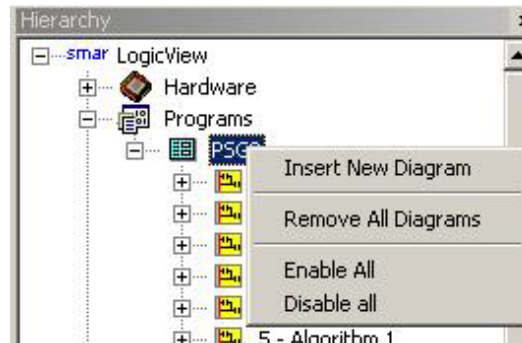


Fig 3. 205 - Inserting ladder diagrams

If the user decreases the number of diagrams (or delete some diagrams) the **LogicView for FFB** will show the next message. The user must confirm or not the operation.



Fig 3. 206 - Confirming the changing number of ladder diagrams

The user can remove all diagrams at once. Click the program's name, and then in **Remove All**. All diagrams will be removed. The user must also to confirm the operation.

The user can enable or disable all diagrams by right-clicking on the program's name, and then in **Enable All** or **Disable All**, respectively. See the figure 3.205. If the ladder is enabled its symbol will be filled with yellow. Otherwise, it will not be filled.

To change the diagram position in the program, right-click the diagram and choose the desired move – **Move Up** or **Move Down**. It will change the diagram execution order in the program.

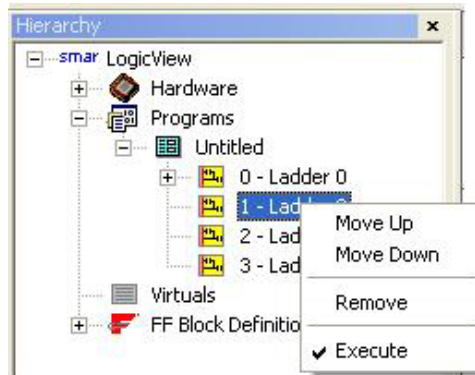


Fig 3. 207 - Changing the ladder diagram position

The ladder diagram can be removed easily. Right-click it, and then in **Remove**. The **LogicView for FFB** will show a window asking you to confirm the operation.

The diagrams can be enabled or disabled individually. In the figure above the diagram 2 is enabled. If the user wants to disable it just remove the symbol ✓ from **Execute**. When the **Execute** option is done, a build is done automatically.

The execution or not of the diagram also can be defined in the **Object Properties** window. See the next figure.



Fig 3. 208 - Changing the ladder diagram execution

The user may change the ladder diagram's name, just click it, for example in **0 – Ladder 0**, and double-click the right cell of **Name**, in the **Object Properties** window. In this place, the user should write the ladder's name. This name should have until 64 characters.

Virtuals

This item defines the number of virtual parameters.



Fig 3. 209 - Defining the virtual parameters

Click it, and the **Object Properties** window will appear as the following figure.

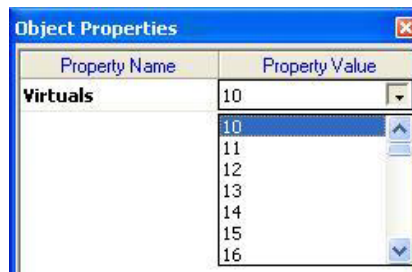


Fig 3. 210 – Object Properties - Defining the virtual parameters quantity

In **Virtuals** the user can define the number of ladder diagram virtual parameters. The default number is 10, which can be changed by the user up to 4096.

Choosing a virtual parameter in the **Ladder Drawing Area**, the user can change its tag in the **Object Properties** window. Just double-click the right cell of **Tag** and the editing mode will be enabled. With double-click the right cell of **Description**, the user can change or insert a description which identifies better the virtual parameter. See the figure below.

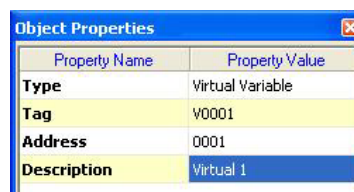



Fig 3. 211 – Object Properties - Defining the virtual parameters

Decreasing the number of virtual parameters - For example a ladder diagram has 15 virtual parameters. The virtual parameters which occupy the 0013 and 0014 addresses are being used in the diagram. Suppose the user decreases the number of virtual parameters to 10. Automatically the parameters of the 0013 and 0014 addresses will be removed from the diagram. The user will be

advised about the problem only when he executes a **Build** command . In the **Output** window will appear the detected errors. See the next picture.

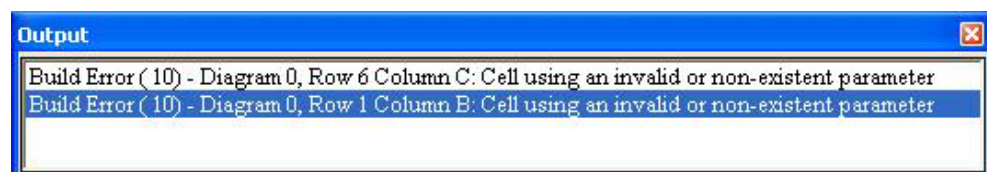


Fig 3. 212 – Error – decreasing the number of virtual parameters

FF Block Definition

This item is used to define the following FFB parameters: Digital Inputs, Digital Outputs, Analog Inputs or Analog Outputs.

Right-click the project's name and the option **Define FFB Parameters** will appear.

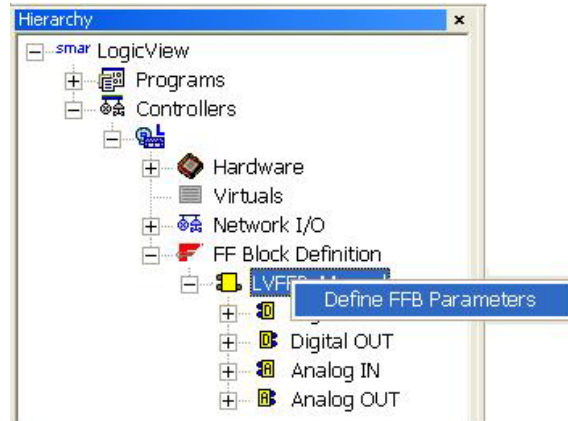


Fig 3. 213 - The FF Block Definition item of Hierarchy window

Choose that item and the following window will appear. There the user can configure the number of analog and digital inputs and outputs. The tags can be edited. Double-click IN_D_0 cell, for example, and the edit mode will be enabled. See the next figure.

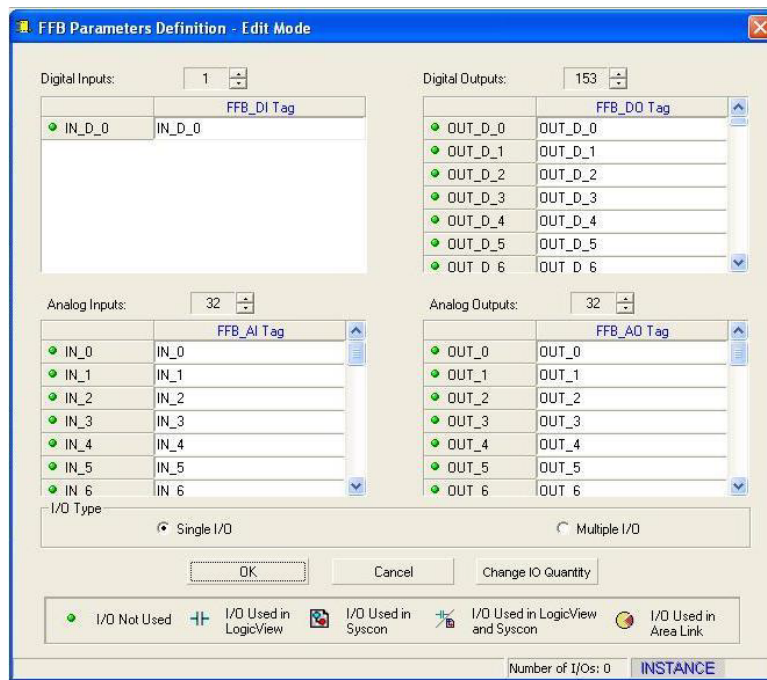


Fig 3. 214 – Defining the FFB parameters

This procedure can be done via **Syscon**, in Instance mode, before editing the logic. For further details refer to **Syscon** manual.

The FFB input and output tags are single. If the user tries to give an existent tag to a FFB parameter, the next message will appear.



Fig 3. 215 – Error – Changing a tag of the FFB parameters

NOTE

When a FFB block is used in a control strategy is recommended to foresee extras parameters for future usage avoiding an impact of stopping the control during an incremental download. It will be necessary when a new strategy with new parameters were included. When new FFB parameters are added, as well as a change of parameter's name, the devices' DDs will be redefined, and this will demand a wider download, resulting in deleted links and deleted blocks, and the re-establishment of them. The utilization of extras parameters, which were previously defined, will not redefine new DDs and will demand only the establishment of new links which will use the reserved parameters.

Object properties

In this window the user can verify the properties of the selected element and change them if necessary.

The object properties can be enabled by double-clicking the object or through the View Menu, as presented previously.

Property Name	Property Value
Type	Digital I/O
Tag	SENSOR3
Direction	Input
Device	DF11
Channel	00202
Safe Output	N/A
Description	


Fig 3. 216 – The Object Properties window


The items in light gray cannot be changed by the user. The items that can be edited are written in black. The options will vary according to the selected element.

In the available items, double-click, and a dropdown list will appear. Then choose the option that suits you best.

Ladder Drawing Area

This is the place where the ladder logic is built. It has 80 rows (from 1 to 80) and 32 columns (from A to FF), i.e., 2560 cells.

The inserted elements (contacts, coils and function blocks) can be deleted with the DEL key or through the button .

The vertical connections can be deleted through the button .

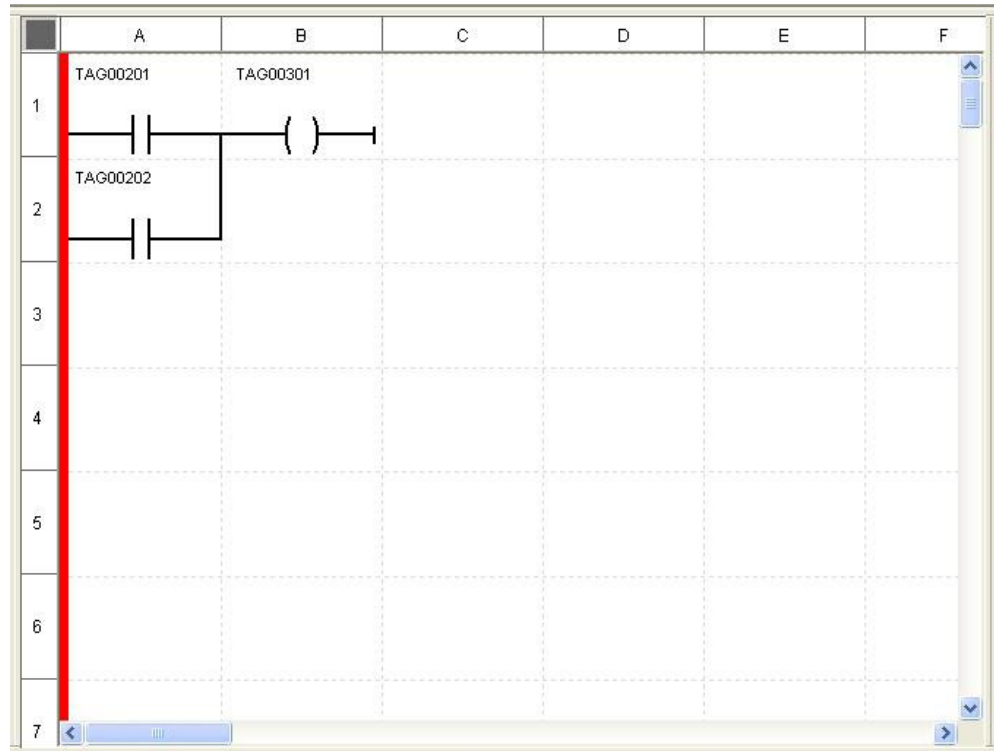


Fig 3. 217 - Ladder Drawing Area

There are some restrictions to where the blocks and elements can be inserted, concerning the block size and elements in the vicinity. Sometimes another place must be selected to insert the function block or the element. The next message will appear:



Fig 3. 218 - Alert about element insertion in a cell

Insert/Remove Blank Line

The **LogicView for FFB** has a feature to insert and remove blank lines in a ladder diagram. It makes the logic edition and/or changes easier.

To insert or remove diagram lines, select a cell, and right-click. The following menu will open.

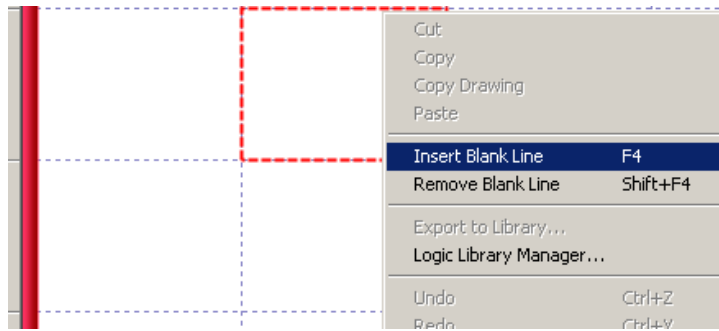


Fig 3. 219 – Insert/Remove Blank Line Menu

The shortcut keys – F4 to insert a line and Shift+F4 to remove a line can also be used.

If you can not move the elements for lack of available space at the bottom of the diagram, the following message will appear:

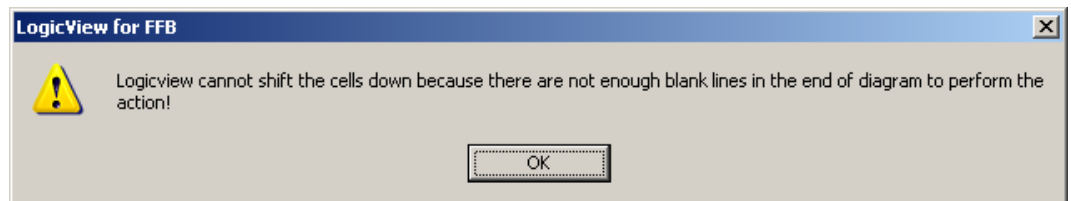


Fig 3. 220 – Error – Inserting blank lines

Removing a blank line will move all elements of the diagram upwards from the selected line. If the selected line is not blank, the following error message will appear:



Fig 3. 221 – Error – Removing blank lines

Output

This is the window where the user can see the ladder statistics and the configuration errors. The window can be enabled or disabled through the **View Menu**, as presented previously. It can also be enabled by clicking **Build** or **Simulation**. The next window will open:

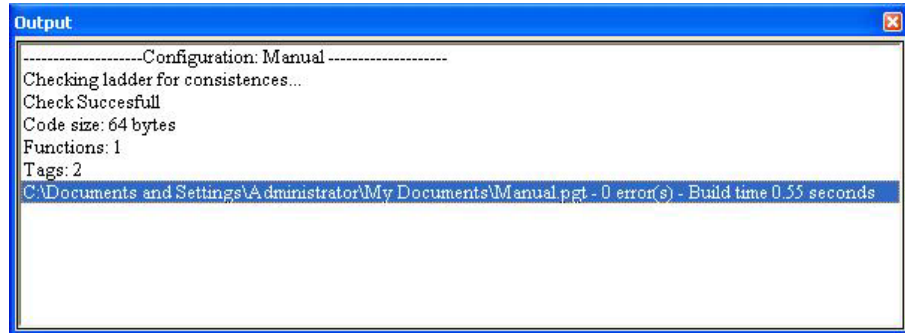


Fig 3. 222 - The Output window

If clicking **Build** and the **LogicView for FFB** detects some error, it will be showed in the **Output** window. See the next figure:

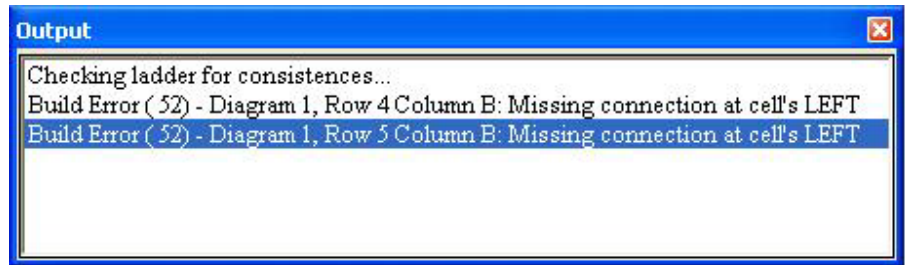


Fig 3. 223 - Build errors in the Output window

In the example above two errors were detected. Click any of the errors in the **Output** window and the **LogicView for FFB** will take the user straight to the error. The error's point will blink in a yellow background in the ladder drawing area.

Status Bar

This is the part of work area that displays important information about the application status.



Fig 3. 224 – Status Bar

- Workspace: indicates in which active work area the instance is working.
- Scan time: it was already explained in the **Ladder Menu** item.
- Sync Time: Time for redundant controllers to keep synchronized. Zero means no synchronism or not ready. When Sync Time equal Scan Time, the controllers are being synchronized each execution cycle. In item Options (menu Tools), it is possible for user to decide if will be showed either alternatively, only Scan Time or only Sync Time).
- Device: shows from which device is requested the scan time. E.g.: Device Model DF62 - SN # 100
- Ladder Status: indicates if the ladder is running (**Running**), if it is stopped (**Stopped**) or if is in **Standby**. This last status indicates that the CPU is a secondary of the redundant pair.
- Ladder: indicates which ladder is being visualized.
- Cell: indicates in which cell is the cursor is.

NOTES

- The information about the Scan Time and the ladder execution can be obtained direct in the Status bar.
- When the user tries to connect a device and it is not found the **Scan time** and the **Ladder Status**, in the Status bar, will be **N/A** (Not available).

LADDER LOGIC EXAMPLE WITH LOGICVIEW FOR FFB

Process Description

The next figure is a ladder logic example of a part of a fire warning system. The **Fire Area** is monitored by three smoke detectors - **SENSOR1**, **SENSOR2** and **SENSOR3**. There is also a manual switch **SW1** which can be used to trigger the alarm.

Some smoke detectors can be unreliable and can erroneously indicate the presence of fire. To prevent false alarms, the system only triggers the alarm if two or more detectors are tripped. It is possible by simply checking for the various combinations of detectors. If two detectors are tripped the alarm is triggered. The alarm is represented by the SR functional block.

The alarm only is cleared by pushing the **Clear_Alarm** switch. If any smoke detector is ON a LED will light in the control room to warn the operators.

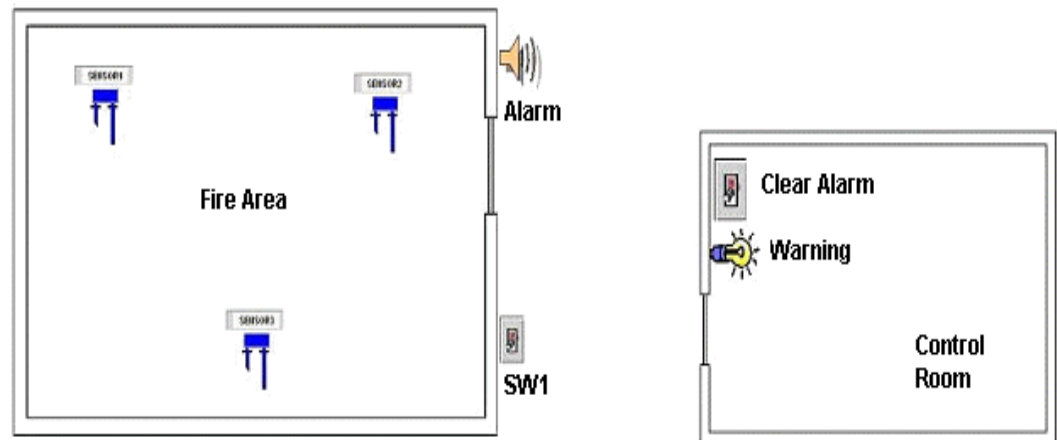



Fig 4. 1 – Fire Alarm System

Starting the project

Run the System302 and in the Studio302 screen, chooses the LogicView icon .

A window will appear and the user has to choose **New FFB Logic Template**. The **LogicView for FFB** will run in template mode.

Create a new project; give a name to it and save the file.

If the user wants to fill the project information click **Smart LogicView**, in the **Hierarchy** window, and then in the **Object Properties** window fill the fields. This step is optional and can be done at any moment.

Configuring the Hardware

Right-click **Hardware**, in the **Hierarchy** window, and then in **Hardware Configuration**. The next window will appear.

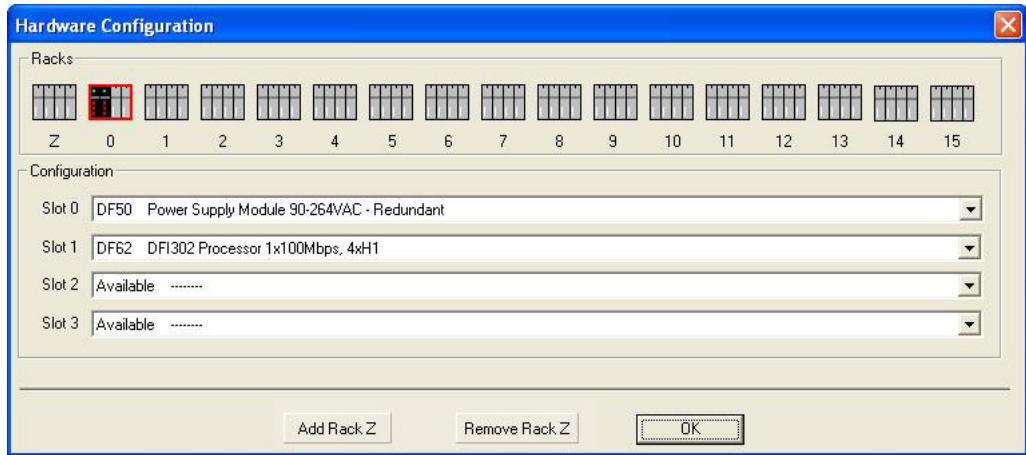


Fig 4. 2 – Configuring the Hardware (1)

In the rack 0 already will be the DF50 and the DF62 which are, respectively, the power supply and the controller. In the slot 2 choose the DF11, where will be plug in the sensors, and in the slot 3 choose the DF20, where will be plug in the SW1 and Clear_Alarm switches.

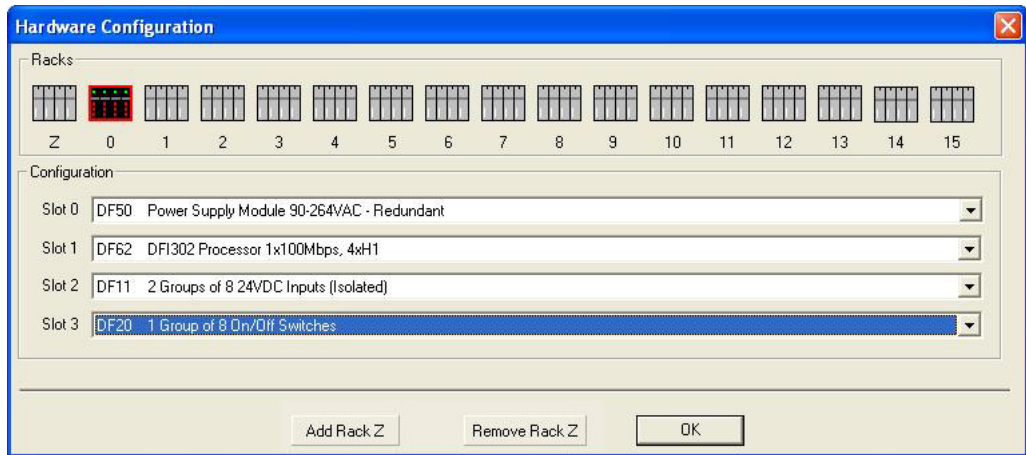


Fig 4. 3 – Configuring the Hardware (2)

Click rack 1, slot 0 and choose the DF24, where will be plug in the alarm and the warning LED. Click **OK**.

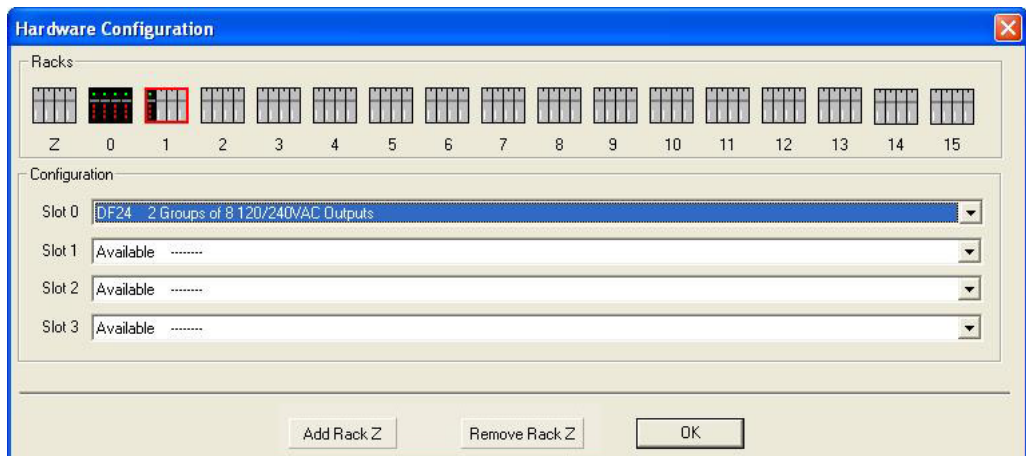


Fig 4. 4 – Configuring the Hardware (3)

Now the hardware is configured, the next step is to draw the ladder logic.

Drawing the Ladder Logic

Insert the elements in the ladder drawing area. To know how is the insertion procedure; you may refer to the “Toolbox” topic.

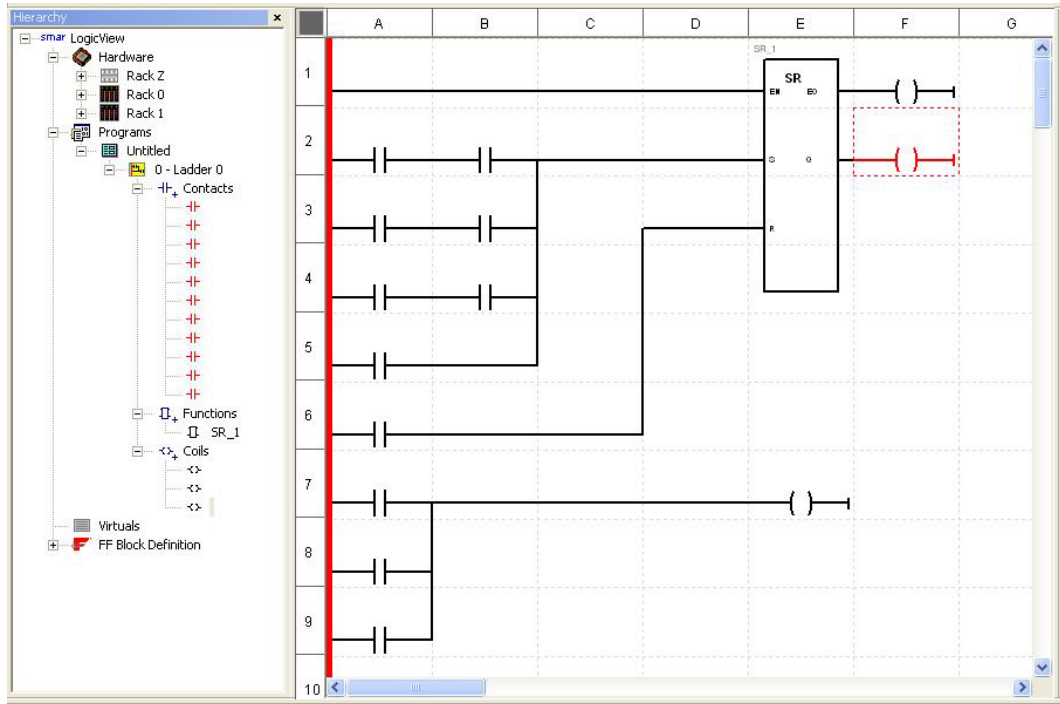


Fig 4. 5 – Drawing the Ladder Logic

Note that when the elements are inserted, they appear in the **Hierarchy** window.

The next step is to define the tags and select the parameters. To better visualization and comprehension of the ladder, edit the coils and contacts tags. Go to the **Tools** menu and choose the **Tags editor** option. The next window will appear:

I/O Types	Tag	Direction	Device	Channel	Safe Output	Descri
Digital I/O	SENSOR1	Input	DF11	00200	N/A	
Pulse Module I/O	SENSOR2	Input	DF11	00201	N/A	
	SENSOR3	Input	DF11	00202	N/A	
	TAG00203	Input	DF11	00203	N/A	
	TAG00204	Input	DF11	00204	N/A	
	TAG00205	Input	DF11	00205	N/A	
	TAG00206	Input	DF11	00206	N/A	
	TAG00207	Input	DF11	00207	N/A	
	TAG00210	Input	DF11	00210	N/A	
	TAG00211	Input	DF11	00211	N/A	
	TAG00212	Input	DF11	00212	N/A	
	TAG00213	Input	DF11	00213	N/A	
	TAG00214	Input	DF11	00214	N/A	
	TAG00215	Input	DF11	00215	N/A	

Fig 4. 6 – Editing the Tags

Double-click TAG00200 and the editing mode will be enabled. Write SENSOR1. Repeat the procedure to the following tags:

TAG00201 - SENSOR2
 TAG00202 - SENSOR3
 TAG00300 – SW1
 TAG00301 – CLEAR_ALARM
 TAG01000 – ALARM
 TAG01001 – FIRE_WARNING
 V0000 – EO

Now is necessary associate the hardware elements, and their respective tags, with the ladder elements. For this, select the element, right-click and then click **Select parameter**. Choose the parameters as in the figure below.

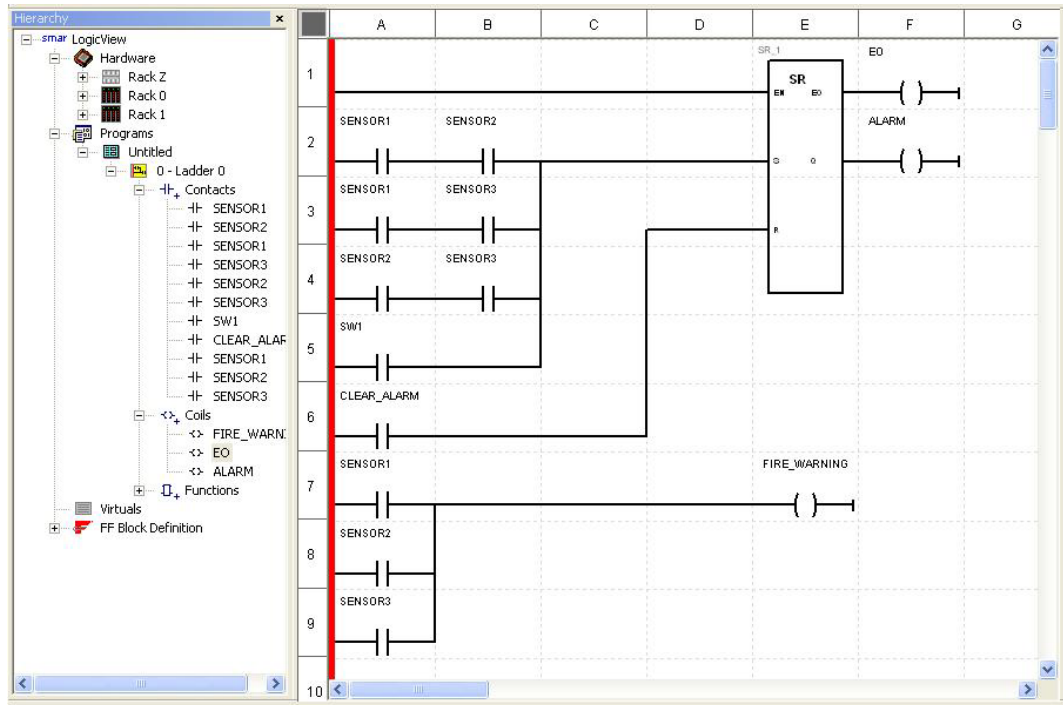


Fig 4.7 – Selecting the Parameters

Save the file, and then click **Build** .

The user can click in the desired item in the **Hierarchy** window or in the element in the ladder drawing area and in the **Object Properties** window will appear their properties.

SR Function Block

When **EN** input is true this function block works in this way:

If the **S** input is true, the **Q** output goes to true. If the **R** input is true **Q** goes to false. If the two inputs are true **Q** is held in true. If the **EN** input is false, all outputs are held in zero (false).

Alarm Simulation with the Simulation Option

Click the **Simulation** button , activate the SENSOR1, click **Run**.

Suppose the SENSOR 1 has detected smoke, the alarm will not be triggered, only the warning LED will light. It is represented by the contact FIRE_WARNING. See the next figure.

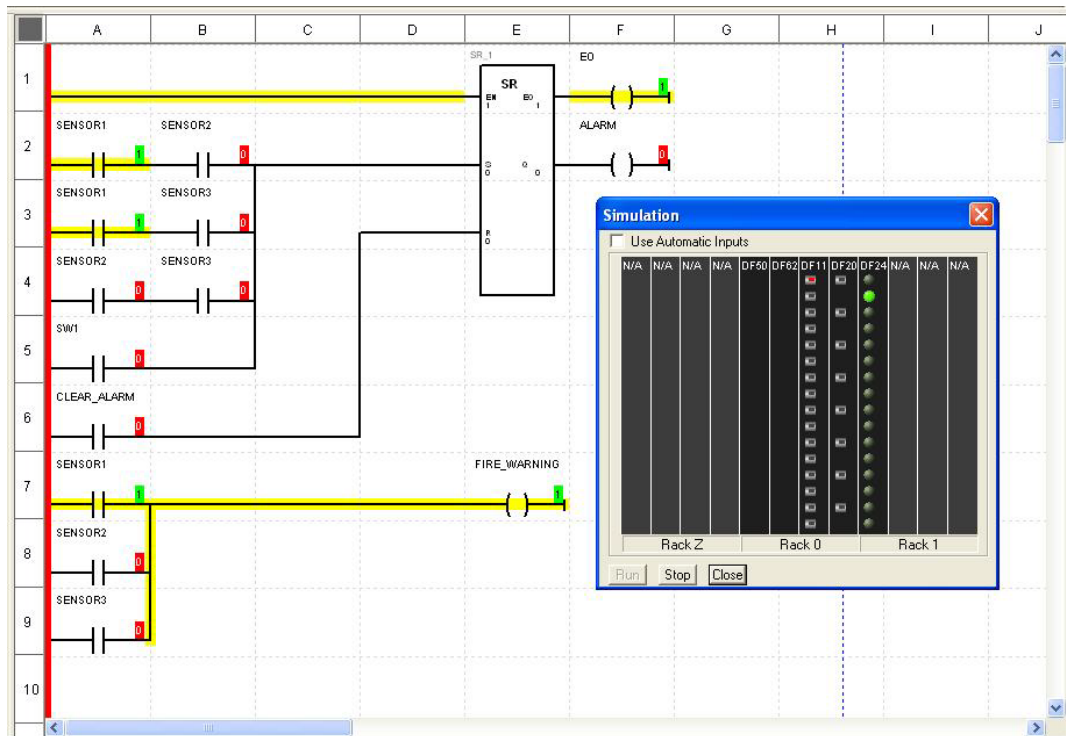


Fig 4. 8 – Simulation – Sensor 1 Activated

Suppose the SENSOR3 also detects smoke. Activate the SENSOR3 in the rack 0 and see that the alarm is triggered.

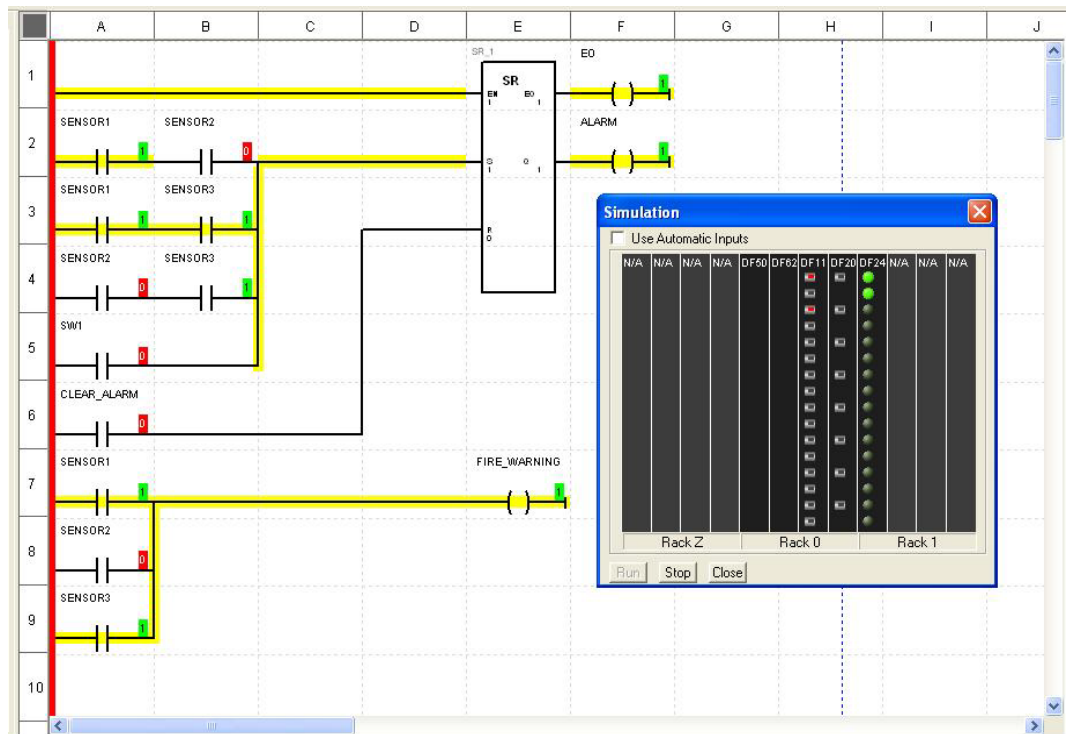


Fig 4. 9 – Simulation – Sensors 1 and 3 Activated

The alarm will keep activated even after the sensors do not detect the smoke anymore. The alarm will be deactivated only if the manual switch CLEAR_ALARM is activated.

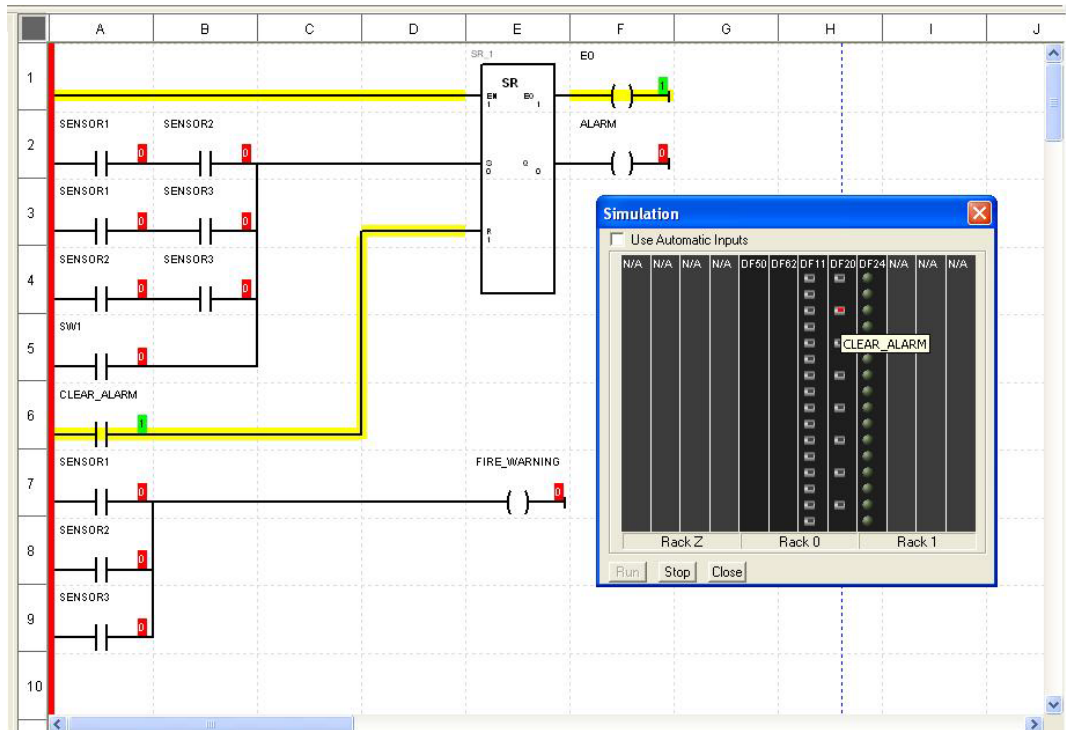


Fig 4. 10 – Simulation – Activating the Clear_Alarm

The alarm can be triggered manually by the **SW1** switch. Note that the **S** input has priority over the **R** input.

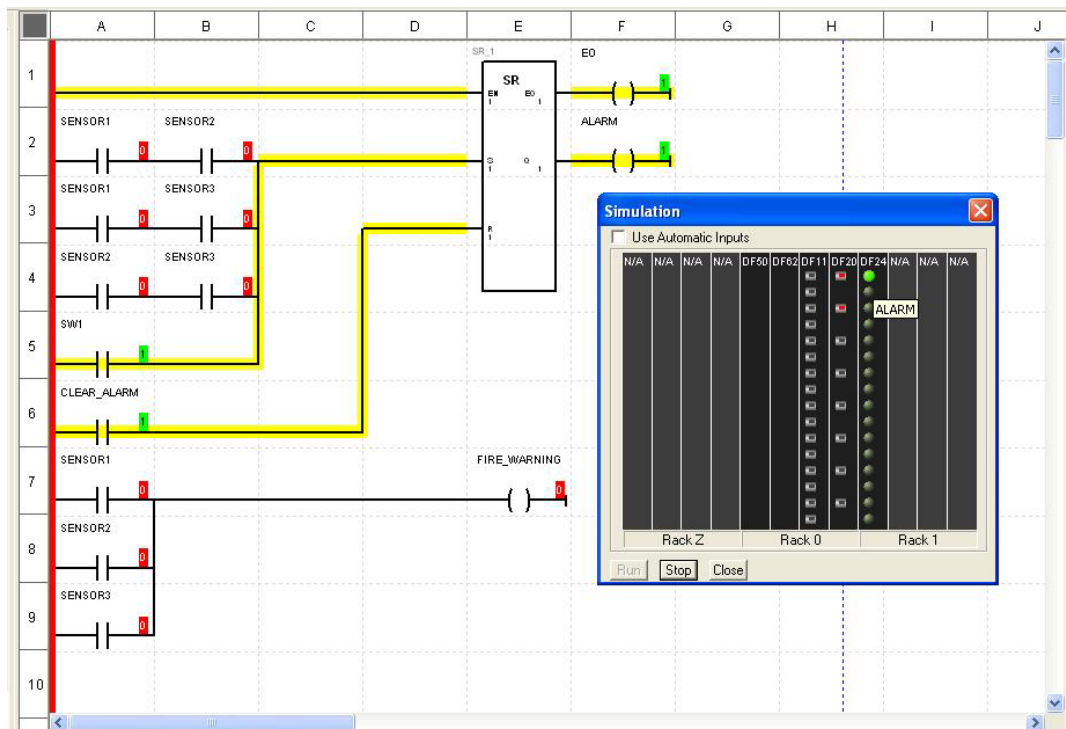


Fig 4. 11 – Simulation – Activating the Alarm with the SW1 Switch

To finish the application click **Close**.