UMC800 Control Builder

Function Block Reference Guide

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About This Document

Abstract

The **"Control Builder" configuration software** program is used for UMC800 Controller and Operator Interface configuration and operates on a Windows '95™- or Windows NT-based PC. The software program uses graphic symbols and line drawing connections to create custom control strategies. Menus are provided in the software to allow selection of screens for the operator interface and to customize screen access methods and operator keys. Completed configurations are loaded into the control system using a dedicated communication port in the controller.

References

The following list identifies all documents that may be sources of reference for material discussed in this publication.

Document Title	Doc ID
UMC800 Controller Technical Overview	51-52-03-24
UMC800 Controller Installation and User Guide	51-52-25-61
UMC800 Operator Interface User Guide	51-52-25-62
UMC800 RS232 Communications Manual	51-52-25-76
UMC800 Modbus® Communications Manuals	51-52-25-87

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our industrial automation and control customers.

Honeywell Organization	WWW Address (URL)
Corporate	*http://www.honeywell.com*
Sensing and Control	*http://www.honeywell.com/sensing*
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	Organization	Phone Number	
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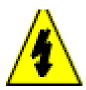
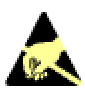
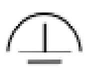
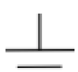
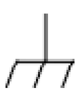
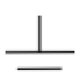
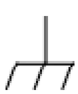
Asia Pacific	Honeywell Asia Pacific Hong Kong	(852) 2829-8298	
Europe	Honeywell PACE, Brussels, Belgium	[32-2] 728-2111	
Latin America	Honeywell, Sunrise, Florida U.S.A.	(854) 845-2600	

Symbol Definitions

The following table lists those symbols that may be used in this document to denote certain conditions.

Symbol	Definition
DANGER	This **DANGER** symbol indicates an imminently hazardous situation, which, if not avoided, **will result in death or serious injury**.
WARNING	This **WARNING** symbol indicates a potentially hazardous situation, which, if not avoided, **could result in death or serious injury**.
CAUTION	This **CAUTION** symbol may be present on Control Product instrumentation and literature. If present on a product, the user must consult the appropriate part of the accompanying product literature for more information.
CAUTION	This **CAUTION** symbol indicates a potentially hazardous situation, which, if not avoided, **may result in property damage**.
	**WARNING** **PERSONAL INJURY:** Risk of electrical shock. This symbol warns the user of a potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 Vdc may be accessible. **Failure to comply with these instructions could result in death or serious injury.**
	ATTENTION, Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices
	Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	Functional earth terminal. Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to protective earth at the source of supply in accordance with national local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

Contents

Tables

Figures

Introduction

Overview

Purpose of this section

This Reference Guide presents detailed reference data for each function block. The reference data is organized in **alphabetical** order by the Function Block type identification label.

There is a list of Function Blocks **grouped in categories** as they appear on the Control Builder.

The presented data covers each control block's:

- function,
- inputs/outputs,
- point name,
- configuration parameters
- index numbers (used for reading [RCON] and writing [WCON] block parameter constants)

ATTENTION

Select the index number of the required parameter from the specific function block reference data and enter it in the appropriate field in the "Read Constant Properties" (RCON) or "Write Constant Properties" (WCON) dialog box.

- technical reference
- examples

Of course, data varies based on what is pertinent for each function block since they do not all have a point name or configuration parameters and do not all require technical reference information.

Reader assumptions

It is assumed that you are familiar with the operation of the UMC800 Control Builder, and that you have read the following manual.

- UMC800 Control Builder User's Guide (51-52-25-63)

Function Block Groups

Introduction

Table 1 lists the Function Blocks by category.

Table 1 Function block by category

Category	Block Type	Reference Page
Loop Blocks	Analog Input (AI)	14
	Analog Out (AO)	36
	Time Prop Out (TPO)	261
	PID (PID)	185
	On-Off (ONOF)	162
	Carbon Potential (CARB)	44
	Loop Switch (LPSW)	117
	Mode Switch (MDSW)	141
	Mode Flags (MDFL)	143
	3 Position Step (TPSC)	263
	Write Tuning Constants (WTUN)	285
	Auto Manual Bias (AMB)	24
SP Program	Programmer (SPP)	227
	Recipe Selector (RCP)	210
	Event Decoder (SPEV)	224
	Synchronizer (SYNC)	252
Setpoint Scheduler	Setpoint Scheduler (SPS)	237
	State Switch (STSW)	246
	State Flag (STFL)	245
	Setpoint Scheduler Aux (SPSA)	241
	Event Decoder (SPEV)	224
Logic	Discrete Input (DI)	78
	8 Discrete Inputs (8DI)	80
	Discrete Output (DO)	84
	8 Discrete Outputs (8DO)	86
	Pushbutton (PB)	179
	Frequency Input (FI)	94
	Pulse Input (PI)	182
	2 Input AND (2AND)	30
	4 Input AND (4AND)	32
	8 Input AND (8AND)	34
	2 Input OR (2OR)	172
	4 Input OR (4OR)	174
	8 Input OR (8OR)	176
	Exclusive OR (XOR)	291
	NOT (NOT)	157
	Digital Switch (DSW)	89
	Trigger (TRIG)	277
	Latch (LTCH)	120
	Toggle Flip-Flop (TGFF)	256
	Free-Form Logic (BOOL)	41
	Pushbutton (PB)	179
	Four Selector Switch (FSS)	97

Category	Block Type	Reference Page
Fast Logic	Discrete Input (DI) 8 Discrete Inputs (8DI) Discrete Output (DO) 8 Discrete Outputs (8DO) 2 Input AND (2AND) 4 Input AND (4AND) 8 Input AND (8AND) 2 Input OR (2OR) 4 Input OR (4OR) 8 Input OR (8OR) Exclusive OR (XOR) NOT (NOT) Digital Switch (DSW) Trigger (TRIG) Latch (LTCH) Toggle Flip-Flop (TGFF) System Monitor (FSYS)	78 80 84 86 30 32 34 172 174 176 291 157 89 277 120 256 100
Counters/Timers	Resettable Timer (RTMR) Periodic Timer (PT) Up Down Counter (UPDN) Off Delay Timer (OFDT) On Delay Timer (ONDT)	219 205 279 160 158
Math	Scale and Bias (SCB) Addition (ADD) Subtract (SUB) Multiply (MUL) Divide (DIV) 4 Input ADD (4ADD) 4 Input SUB (4SUB) 4 Input MUL (4MUL) Free Form Math (MATH)	222 11 247 152 83 12 248 154 122
Calculations	Compare (CMPR) Deviation Compare (DCMP) Absolute Value (ABS) Square Root (SQRT) Mass Flow (MSF) Max-Min-Ave-Sum (MMA) Negate (NEG) Relative Humidity (RH) Dewpoint (DEWP) Totalize (TOT) Continuous Average (CAVG)	64 70 9 243 149 145 156 212 75 258 61
Alarm Monitor	High Monitor (HMON) Low Monitor (LMON) System Monitor (ASYS) Analog Alarm (ALM)	103 115 38 20
Signal Selector	High Selector (HSEL) Low Selector (LSEL) Analog Switch (SW) Rotary Switch (RSW) Bumpless Transfer (XFR)	110 119 250 217 289

Category	Block Type	Reference Page
Auxiliary	Function Generator (FGEN) Lead Lag (LDLG) High-Low Limiter (HLLM) Velocity Limiter (VLIM) Rate of Change (ROC) Read Constant (RCON) Write Constant (WCON) Write Variable (WVAR) Track and Hold (TAHD) BCD Translator (BCD) Digital Encoder (DENC) Hand/Off/Auto (HOA) Device Control (DC)	90 112 101 281 214 208 283 287 254 39 73 105 65
Communications	Modbus Read (MBR) Modbus Slave (MBS) Modbus Write (MBW)	126 130 137

Function Blocks

Introduction

While you can determine the function of many blocks just from their labels and Input/output abbreviations, the purpose of others may be a complete mystery. This section is designed to familiarize you with function blocks in general and provide detailed reference data for each block.

In this section

A listing of each function block type and respective reference page follows.

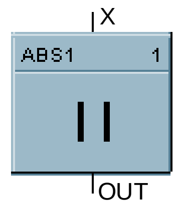
Function Block Type Identification Label		See Page
8DO	(8 Digital Outputs)	86
DSW	(Digital Switch)	89
FGEN	(Function Generator)	90
FI	(Frequency Input)	94
FSS	(Four-Selector Switch)	97
FSYS	(System Monitor-Fast Logic)	100
HLLM	(High-Low Limiter)	101
HMON	(High Monitor)	103
HOA	(Hand/Off/Auto)	105
HSEL	(High Selector)	110
LDLG	(Lead Lag)	112
LMON	(Low Monitor)	115
LPSW	(Loop Switch)	117
LSEL	(Low Selector)	119
LTCH	(Latch)	120
MATH	(Free Form Math)	122
MBR	(Modbus Read)	126
MBS	(Modbus Slave)	130
MBW	(Modbus Write)	137
MDSW	(Mode Switch)	141
MDFL	(Mode Flag)	143
MMA	(Min-Max-Average-Sum)	145
MSF	(Mass Flow)	149
MUL	(Multiplication - 2 Inputs)	152
4MUL	(Multiplication - 4 Inputs)	154
NEG	(Negate)	156
NOT	(Not Boolean Logic)	157
ONDT	(On Delay Timer)	158
OFDT	(Off Delay Timer)	160
ON/OFF	(On/Off Control)	162
2OR	(OR - 2 Inputs)	172
4OR	(OR - 4 Inputs)	174

Function Block Type Identification Label		See Page
8OR	(OR - 8 Inputs)	176
PB	(Pushbutton)	179
PI	(Pulse Input)	182
PID	(Proportional, Integral, Derivative)	185
PT	(Periodic Timer)	205
RCON	(Read Configuration Parameter Data)	208
RCP	(Recipe Selector)	210
RH	(Relative Humidity)	212
ROC	(Rate of Change)	214
RSW	(Rotary Switch)	217
RTMR	(Resettable Timer)	219
SCB	(Scale and Bias)	222
SPEV	(Setpoint Programmer Event Decoder)	224
SPP	(Setpoint Programmer)	227
SPS	(Setpoint Scheduler)	237
SPSA	(Setpoint Scheduler Auxiliary)	241
SQRT	(Square Root)	243
STFL	(Setpoint Scheduler State Flags)	245
STSW	(Setpoint Scheduler Switch)	246
SUB	(Subtraction - 2 Inputs)	247
4SUB	(Subtraction - 4 Inputs)	248
SW	(Analog Switch)	250
SYNC	(Synchronize)	252
TAHD	(Track and Hold)	254
TGFF	(Toggle Flip Flop)	256
TOT	(Totalizer)	258
TPO	(Time Proportional Output)	261
TPSC	(Three Position Step Control)	263
TRIG	(Trigger)	277
UPDN	(UP/Down Counter)	279
VLIM	(Velocity (rate) Limiter)	281
WCON	(Write Constant)	283

ABS Function Block

Description

The **ABS** label stands for **Absolute Value**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Calculate the absolute value of a single analog variable input.

- OUT = [X]

Input

X = Analog value to be modified.

Output

OUT = modified value.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

ABS example

Figure 1 shows a Function Block Diagram configuration using an ABS function block to calculate the absolute value of the deviation between two analog inputs.

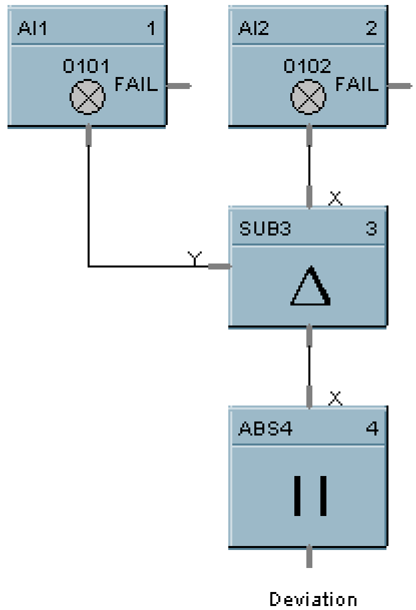
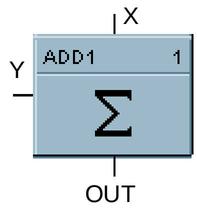


Figure 1 ABS function block example

ADD Function Block

Description

The **ADD** label stands for **Addition Mathematical Operation (2 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Add two inputs (X,Y) to get an output.

- **OUT** = X + Y

Input

X = First Analog Input
Y = Second Analog Input

Output

OUT = Sum of analog values

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

ADD example

Figure 2 shows a Function Block Diagram using an ADD function block to find the total flow rate as the sum of Flow 1 and Flow 2.

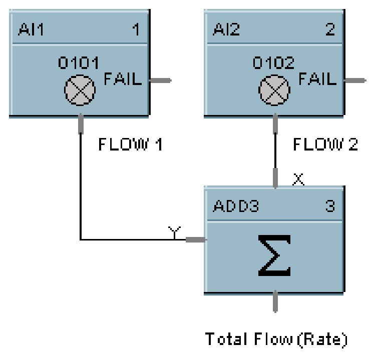
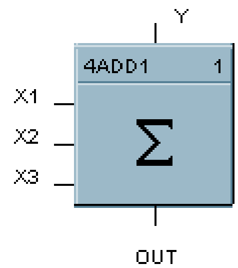


Figure 2 ADD function block example

4ADD Function Block

Description

The **4ADD** label stands for **Addition Mathematical Operation (4 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Add FOUR inputs (X1, X2, X3,Y) to get an output.

- **OUT** = X1+ X2 + X3 + Y

Input

X1 = First Analog Input
X2 = Second Analog Input
X3 = Third Analog Input
Y = Fourth Analog Input

ATTENTION

All four inputs must be connected or unused inputs inverted. Unconnected inputs default to zero.

Output

OUT = Sum of the analog values

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

4ADD example

Figure 3 shows a Function Block diagram using a 4ADD function block to find the total Flow rate as the sum of Flow 1, Flow, 2, Flow 3, and Flow 4.

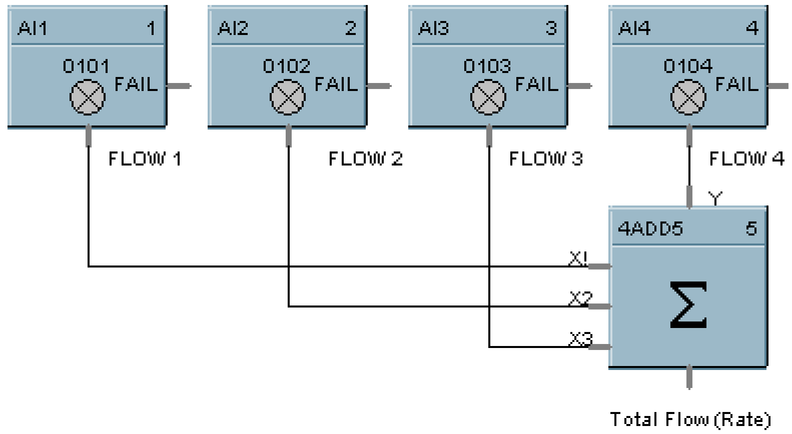
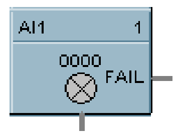


Figure 3 4ADD function block example

AI Function Block

Description

The **AI** label stands for **Analog Input**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Out

Function

Read value of an Analog Input from a specified real I/O address. Convert analog input value to corresponding output (OUT) in engineering units based on the necessary scaling and conversions performed.

LINEAR - Converts analog input value to corresponding output in units based on a linear 0 % to 100 % scale and specified high and low range values.

OUT = Scale x Input value + Bias

where

:

$$\text{Scale} = \frac{\text{High range value - Low range value}}{100}$$

Input value = Analog Value in percent

T/C or RTD - Converts analog input value in engineering units using the range of Input Type.

ATTENTION

The failsafe detection on this input block configured for 4-20mA range is:

Low Detection: -3.2mA
High Detection: 21.6mA

Outside of the range the flag (Input Fail) is ON. There is no detection from 0 to 4 mA, but the block continues to work and provide data which could be compared via an Alarm Block.

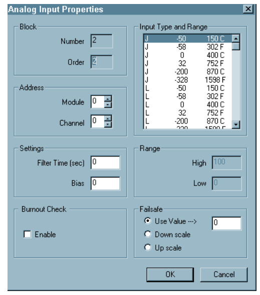
Input

Analog value from specified real I/O address.

Output

OUT =
Analog Input value in engineering units.
FAIL =
Digital status of channel
Digital Low (0) = OK
Digital High (1) = Open sensor or failed input channel.

Configuration parameters



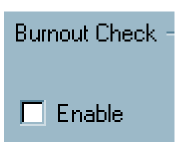
This is a view of the AI Properties Dialog box.

You must configure the AI function block parameters to the desired values or selections that match your operating requirements.

Table 2 describes the parameters and the value or selection.

Table 2 Analog input configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order for Block	Read Only. See “Configure" Menu, ”Execution Order” to change.
Address	**I/O Module**		Address of selected I/O module (must match model selection guide)	Enter a value: from 1 to 6
	Channel		Channel on selected I/O Module	Enter a value: from 1 to 4
Input Type and Range	**Input Type and Range**	N/A	Thermocouple Input types RTD Input types Linear Input types	Select from list box. See Table 3 for Input Type and Range
Range	**High Range Value**	N/A	For Linear Inputs Only - output value that corresponds to 100 % input value For example: Actuation Input = 4-20mA Process variable = Flow Range of Flow = 0 to 250 gal/min High Range Display Value = 250 Low range Display Value = 0 Then 20mA = 250, 4mA = 0	Enter a value: ± 99999 to ± 99999
	Low Range Value	N/A	For Linear Inputs Only - output value that corresponds to 0 % input value For example: See “High Range Value”	Enter a value: ± 99999 to ± 99999

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Settings	**Filter Time (sec)**	N/A	A software digital filter is provided for the input designated to smooth the input. You can configure the first order lag time constant from 1 to 120 seconds. 0=no filter	Enter a value: 0 to 120 seconds
	Bias	3	Bias is used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause.	Enter a value: ±9999 to ±99999
Failsafe	**Use Value field**	N/A	The output value to which the output will go to protect against the effects of failure of the equipment, such as, fuel shut-off if there is loss of flame in a furnace, or a sensor break.	Enter a value in Engineering Units ±9999 to ±99999
	Use Value	5	Use the value entered in the appropriate field.	Click on Radio button to select
	Downscale	5	**LINEAR** OUT = Value set at “Low range value” field. **T/C or RTD** OUT = Value of Low range implied by input type.	Click on Radio button to select
	Upscale		**LINEAR** OUT = Value set at “High range value” field. **T/C or RTD** OUT = Value of High range implied by input type.	Click on Radio button to select
Burnout Check		5	Burnout check enable (Thermocouples only)	Click on block to select or deselect

Failsafe rules

If the controller is unable to access the physical channel or the sensor is faulty, and:

- If Failsafe is “Use Value” — OUT = Configured Failsafe value
- If Failsafe is enabled and downscale — OUT = Range Lo (linear)
Low Range Value of input type (T/C and RTD)
- If Failsafe is enabled and upscale — OUT = Range Hi (linear)
High Range Value of input type (T/C and RTD)

Table 3 Input Types and Ranges

Input Type	Range
Thermocouple Input Types	
J	–50 to 150 ºC
J	–58 to 302 ºF
J	0 to 400 ºC
J	32 to 752 ºF
J	–200 to 870 ºC
J	–328 to 1598 ºF
L	–50 to 150 ºC
L	–58 to 302 ºF
L	0 to 400 ºC
L	32 to 752 ºF
L	–200 to 870 ºC
L	–328 to 1598 ºF
K	0 to 400 ºC
K	32 to 752 ºF
K	0 to 800 ºC
K	32 to 1472 ºF
K	0 to 1200 ºC
K	32 to 2192 ºF
K	–200 to 1370 ºC
K	–328 to 2498 ºF
N	0 to 400 ºC
N	32 to 752 ºF
N	0 to 800 ºC
N	32 to 1472 ºF
N	0 to 1200 ºC
N	32 to 2192 ºF
N	–200 to 1300 ºC
N	–328 to 2372 ºF
R	–20 to 1760 ºC
R	–4 to 3200 ºF
S	0 to 1600 ºC
S	32 to 2912 ºF

Input Type	Range
Thermocouple Input Types (cont.)	
S	–20 to 1760 ºC
S	–4 to 3200 ºF
T	–50 to 150 ºC
T	–58 to 302 ºC
T	0 to 150 ºC
T	32 to 302 ºF
T	50 to 150 ºC
T	122 to 302 ºF
T	–200 to 400 ºC
T	–328 to 752 ºF
T	–90 to 240 ºC
T	–130 to 464 ºF
U	–50 to 150 ºC
U	–58 to 302 ºF
U	0 to 150 ºC
U	32 to 302 ºF
U	50 to 150 ºC
U	122 to 302 ºF
U	–200 to 400 ºC
U	–328 to 752 ºF
NiMo	0 to 1400 ºC
NiMo	32 to 2552 ºF
W_W26	–20 to 2320 ºC
W_W26	–4 to 4208 ºF
W5W26	–20 to 2320 ºC
W5W26	–4 to 4208 ºF
PR20-40	0 to 1800 ºC
PR20-40	32 to 3272 ºF
B	40 to 1820 ºC
B	104 to 3308 ºF
MoCo*	0 to 1400 ºC
MoCo*	32 to 2552 ºF
PLTNL	–70 to 750 ºC
PLTNL	–94 to 1382 ºF
PLTNL	0 to 1380 ºC
PLTNL	32 to 2516 ºF

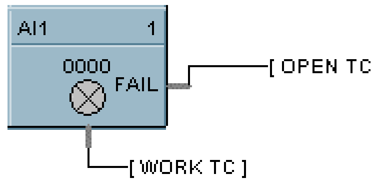
*Nickel/Nickel Moly, 1990 temp. Standard

Input Type	Range
RTD Input Types	
Pt100	–50 to 150 ºC
Pt100	–58 to 302 ºF
Pt100	0 to 100 ºC
Pt100	32 to 212 ºF
Pt100	0 to 200 ºC
Pt100	32 to 392 ºF
Pt100	0 to 400 ºC
Pt100	32 to 752 ºF
Pt100	–200 to 800 ºC
Pt100	–328 to 1472 ºF
Pt100	–90 to 240 ºC
Pt100	–130 to 464 ºF
JIS	–50 to 150 ºC
JIS	–58 to 302 ºF
JIS	0 to 100 ºC
JIS	32 to 212 ºF
JIS	0 to 200 ºC
JIS	32 to 392 ºF
JIS	0 to 400 ºC
JIS	32 to 752 ºF
JIS	–200 to 500 ºC
JIS	–328 to 932 ºF
Ni50	–80 to 320 ºC
Ni50	–112 to 608 ºF
Ni508	–80 to 150 ºC
Ni508	–112 to 302 ºF
Cu10	–20 to 250 ºC
Cu10	–4 to 482 ºF
Ohms	0 to 200
Ohms	0 to 2000

Input Type	Range
Linear Input Types	
mV	0 to 10
mV	–10 to 10
mV	0 to 20
mV	–20 to 20
mV	0 to 50
mV	–50 to 50
mV	10 to 50
mV	0 to 100
mV	–100 to 100
mV	0 to 500
mV	–500 to 500
mA	0 to 20
mA	4 to 20
V	0 to 1
V	–1 to 1
V	0 to 2
V	–2 to 2
V	0 to 5
V	–5 to 5
V	1 to 5
V	0 to 10
V	–10 to 10

Example

Figure 4 shows a Function Block Diagram configuration using an AI function block.



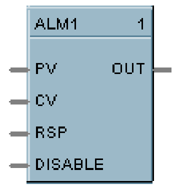
AI used for work temperature monitoring. Tag descriptors are used to identify the input. A digital tag connected to the fail output can alarm on an open sensor.

Figure 4 AI function block example

ALM Function Block

Description

The **ALM** label stands for the **Analog Alarm function.** This block is part of the *Alarms/Monitor* category. It looks like this graphically on the Control Builder.



Function

The analog alarm block accepts an analog signal as a process variable and compares it to a limit value (setpoint) to determine an alarm condition. The setpoint may be entered by the user or be another analog signal in the controller.

Alarm actions may be high, low or high deviation, low deviation or band deviation. For deviation alarming, a second analog signal provides the reference and setpoints represent deviation from the reference.

The alarm output may be inverted to create normally active digital output. A user selection for latching until acknowledged or automatically reset is provided.

A user-specified hysteresis value in the engineering units of the process variable is provided.

An on-delay time value up to 240 seconds is available to prevent momentary alarm actions. A digital reset input is available to disable alarm actions.

Alarm type function

(PV>SP) **High Process Variable/Local Setpoint**

- OUT = ON If the PV is greater than the local Setpoint
- OUT = OFF If the PV is less than the Local Setpoint minus Hysteresis

(PV>CV) **High Process Variable/Compare Value**

- OUT = ON If the PV is greater than the Compare Value (CV) i.e. Alarm Setpoint
- OUT = OFF If the PV is less than the Compare Value minus Hysteresis

(PV<SP) **Low Process Variable/Local Setpoint**

- OUT = ON If the PV is less than the Local Setpoint
- OUT = OFF If the PV is greater than the Local Setpoint + Hysteresis

(PV<CV) **Low Process Variable/Compare Value**

- OUT = ON If the PV is less than the Compare Value (CV)
- OUT = OFF If the PV is greater than the Compare Value + Hysteresis

[(PV-CV)>SP] **High Deviation Alarm**

- OUT = ON If the PV input minus the CV input is greater than the Local Setpoint
- OUT = OFF If the PV input minus the CV input is less than the Local Setpoint minus Hysteresis

[(CV-PV)>SP] **Low Deviation Alarm**

- OUT = ON If the CV input minus the PV input is greater than the local Setpoint
- OUT = OFF If the CV input minus the PV input is less than the Local Setpoint minus Hysteresis

|PV-CV|>SP **Band Deviation Alarm**

- OUT = ON If the absolute value of (PV–CV) is greater than the Local Setpoint
- OUT = OFF If the absolute value of (PV–CV) is less than the Local Setpoint minus Hysteresis

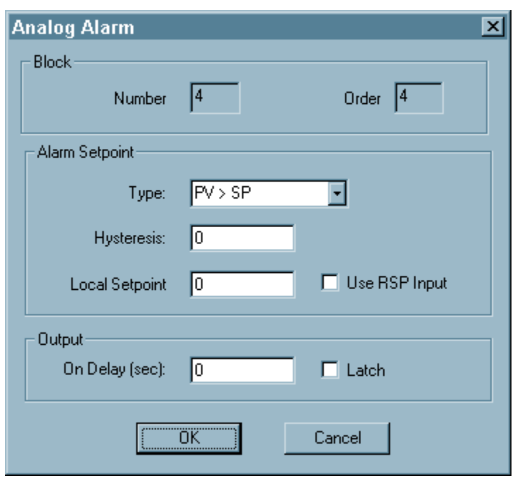
Inputs

PV = Process Variable
CV = Compare Value
RSP = Remote Setpoint
DISABLE = On disables alarm action.

Output

OUT = Output

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the ALM function block parameters to the desired value or selection that matches your operating requirements.

Table 4 describes the parameters and the value or selection.

ATTENTION

Local Setpoint is set in the Control Builder unless “Use RSP Input” is enabled. Use an Analog Variable connected to one RSP input (use RSP Input Enabled) if you want to change alarm setpoint at the operator interface via the Variable Edit Display.

Table 4 Analog alarm configuration parameters

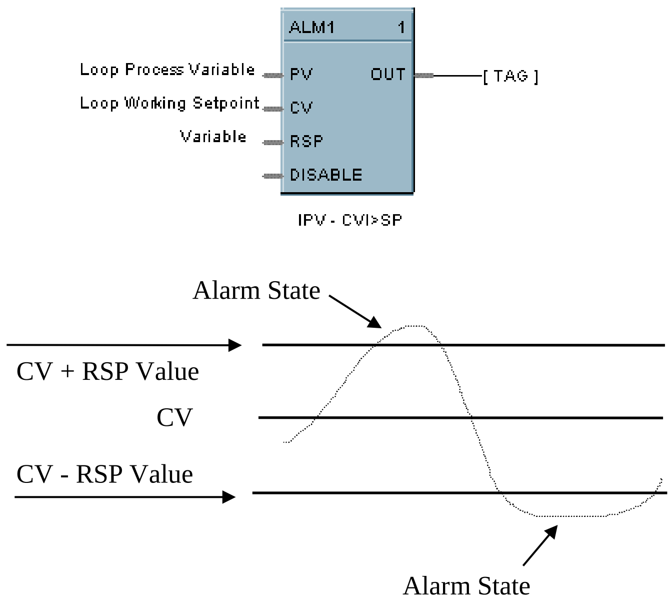
Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order for Block	Read Only. See “Configure"” Menu, ”Execution Order” to change.
Alarm Setpoint	**Type**	N/A	Alarm Action Type	**PV>SP** = High Process Variable/Local Setpoint **PV>CV** = High Process Variable /Compare Value **PV<SP** = Low Process Variable/Local Setpoint **PV<CV** = Low Process Variable /Compare Value **(PV-CV)>SP** = High Deviation Alarm **(CV-PV)>SP**= Low Deviation Alarm **IPV-CVI>SP** = Band Absolute Deviation Alarm
	Hysteresis	4	Hysteresis in engineering units can be set from 0 to the input span monitored variable.	0 to 99999.9 in Engineering Units
	Local Setpoint	0	Local Setpoint value in engineering units or a calculation from another function block via RSP (see “Use RSP Input”).	0 to 99999.9 in Engineering Units
		1	Remote Setpoint selection	Click on box to use Remote Setpoint (RSP)
Output	**Latch** 	3	ON latches the alarm output until acknowledged. *To acknowledge an alarm, it must be tagged and entered into an alarm group. This will provide for the acknowledgment from the operator interface.*	Click on Box to select
	On Delay	6	Number of seconds the alarm is active before activating OUT.	0 to 240 seconds

Example

Figure 5/Example 1 shows an ALM function block being used for Band Deviation Alarm—a control loop process variable is compared to the loops working setpoint. A variable is used as the setpoint value to allow periodic changes. (RSP enabled). The Output contains a tag identification that will be used to identify the alarm state.

Example 2 shows an ALM function block being used to alarm on PV>SP.

EXAMPLE 1



EXAMPLE 2

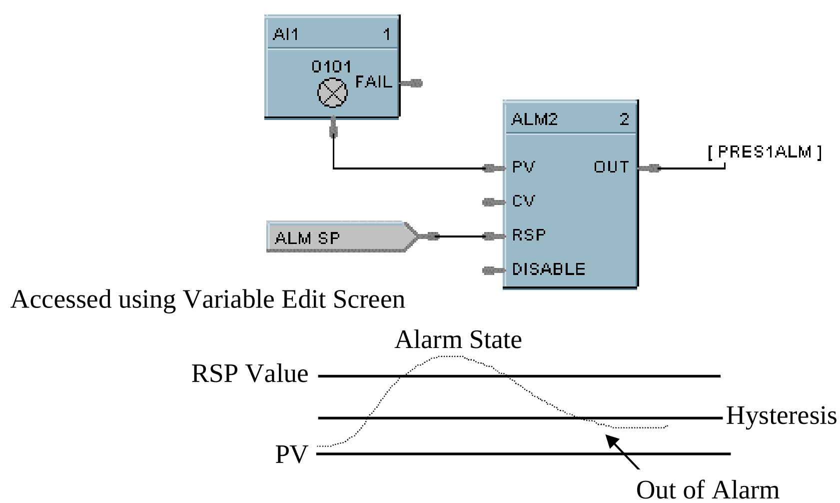
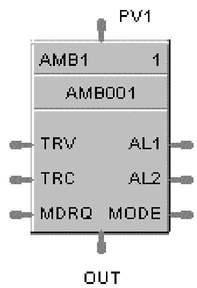


Figure 5 ALM function block example

AMB Function Block

Description

The AMB label stands for Auto/Manual Bias Function. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

On transfer from Manual to Auto; Bias is calculated to make PV + Bias = Output.

Inputs

PV1 = Process Variable Input (%)
TRV = Output Track Value in percentage (Output = TRV Value when TRC is ON).
TRC = Output Track Command—1 = enable TRV (Mode = Local Override), 0 = disable
MDRQI = External Mode Request (connected to the MDRQO output of a MDSW function block) encoded as follows:
0.0 = No Change
1.0 = Manual Mode Request
2.0 = Automatic Mode Request

Outputs

OUT = Control Output (–5 % to 105 %)
AL1 = Alarm 1
AL2 = Alarm 2
MODE = Actual Mode encoded as follows: (Connect to Mode Flags block [MDFL] to encode mode status.)
4.0 LSP AUTO
5.0 LSP MAN
7.0 LSP LO (Local Override)

Block properties

Double click on the function block to access the function block properties dialog box.

Configuration parameters

The Auto/Manual Bias properties dialog box is divided into three tab cards

GENERAL
RANGE/LIMIT
ALARMS

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 5 describes the parameters and the value or selection.

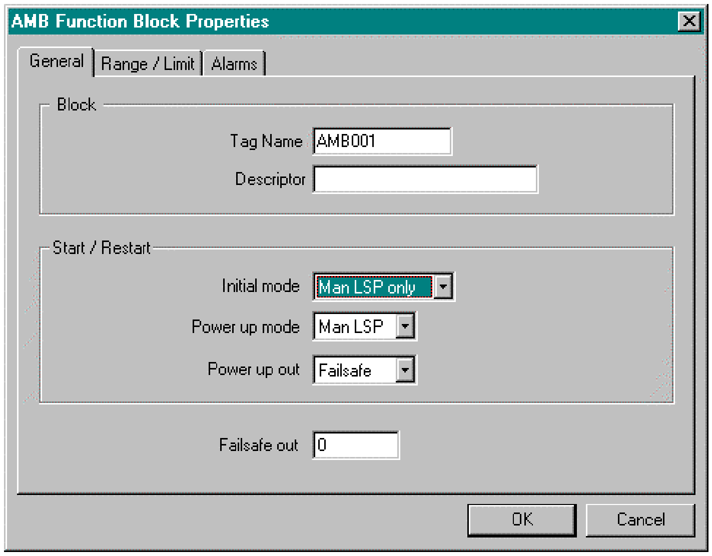


Table 5 General tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Block	**Tag Name**	N/A	8-character tag name	
	Descriptor	N/A	Block description	
Start/Restart	**Initial Mode**	N/A	Mode at NEWSTART **Newstart** is the first scan cycle following the cold start of the controller	**MAN** Manual **AUTO** Automatic
	Power up Mode	N/A	Mode at power up	**MAN** Manual **PREVIOUS** Same mode (auto or manual)
	Power Up Out	N/A	Output at Power up	**FAILSAFE** Failsafe output value. **LAST OUT** Same as at power down.
	Failsafe Out	7	Failsafe Output Value	–5 to 105 (default 0)

RANGE/LIMIT tab

It looks like this graphically on the Control Builder. Table 6 describes the parameters and the value or selection.

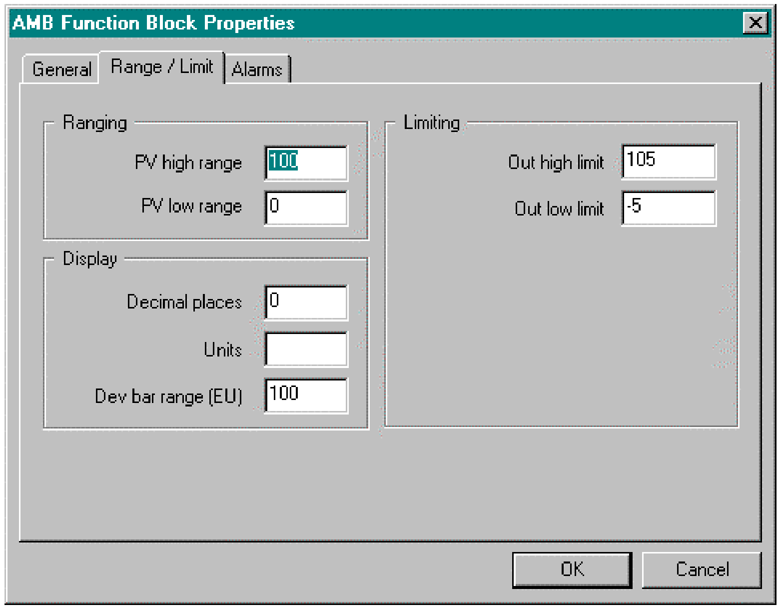


Table 6 Range/limit tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Ranging	**PV High Range**	0	PV High Range Value	–5 % to 105 %
	PV Low Range	1	PV Low Range Value	–5 % to 105 %
Display	**Decimal Places**	N/A	Number of digits to display after decimal point.	0 to 5
	Units	N/A	Text to display for EU	4 characters
	DEV Bar Range (EU)	N/A	Deviation Bar Range on the Operator Interface	–99999 to 99999
Limiting	**Out High Limit**	5	Output High Limit Value - prevents the Output from going above the value set here.	–5 % to 105 %
	Out Low Limit	6	Output Low Limit Value - prevents the Output from going below the value set here.	–5 % to 105 %

ALARMS tab

It looks like this graphically on the Control Builder. Table 7 describes the parameters and the value or selection.

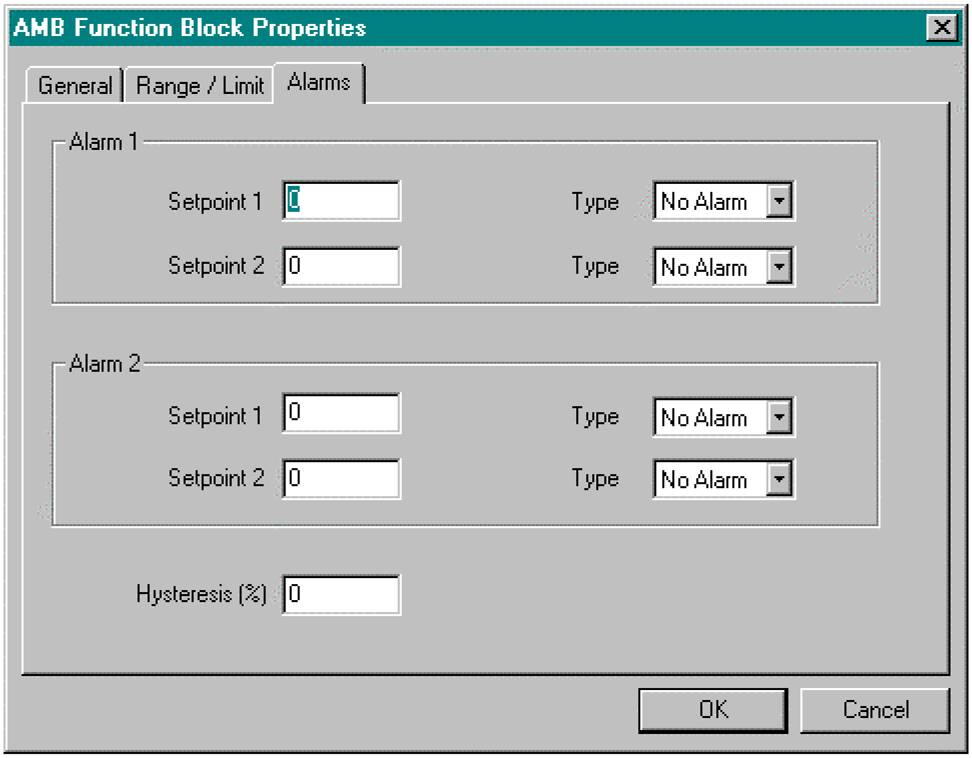
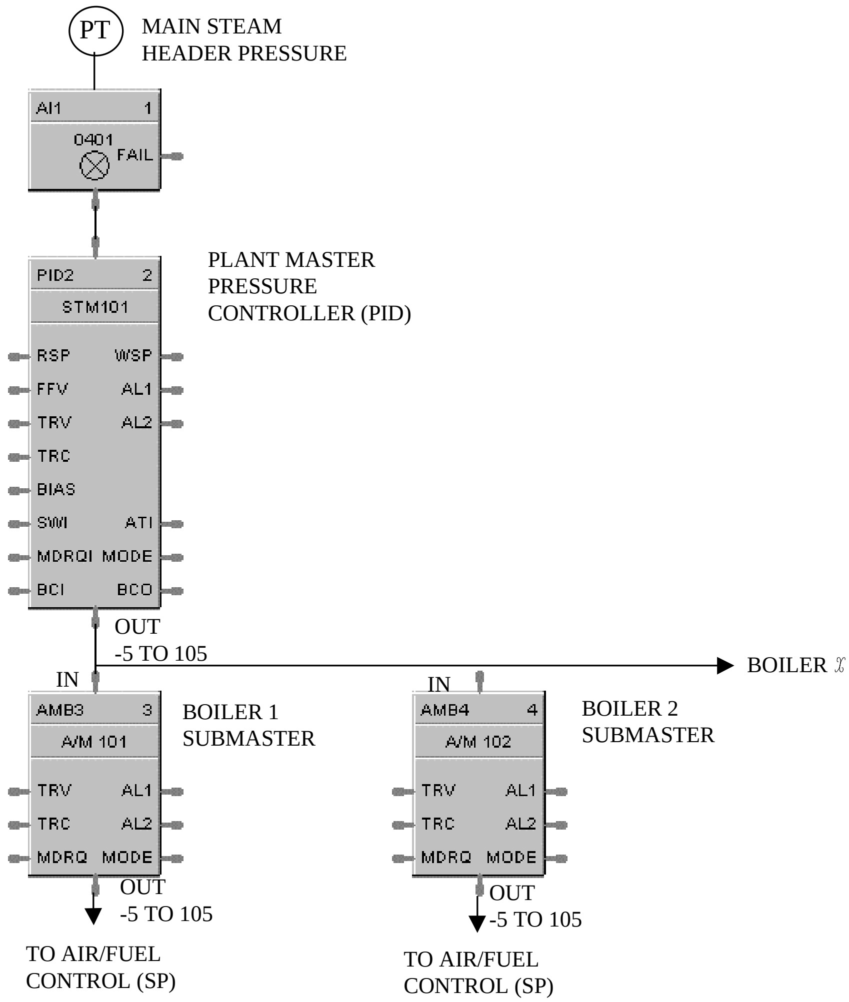


Table 7 Alarm tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Alarm 1	**Setpoint 1**	8	**Alarm 1 Setpoint 1 Value** - this is the value at which you want the alarm type chose below to activate	–5 % to +105 % (default 0)
	Type	N/A	Alarm 1 Setpoint 1 Type - select what you want Alarm 1 Setpoint 1 to represent.	Selections: NO ALARM AL_PV_HI AL_PV_LO AL_OUT_HI AL_OUT_LO
	Setpoint 2	9	Alarm 1 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 1 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm 2	**Setpoint 1**	10	Alarm 2 Setpoint 1 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 1 Type	Same as **Alarm 1 Setpoint 1**
	Setpoint 2	11	Alarm 2 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm Hysteresis	**%**	16	Alarm Hysteresis in %	0 % to 5 %

Example

Figure 6 shows an function block diagram using an AMB function block.



AMB Block (Boiler Submaster):
Operators place AMB Block to "MAN" mode to adjust fuel setpoints up or down independent of each boiler.

AMB: OUT = IN + BIAS	**MAN MODE**	Bias is automatically calculated as operator increment or decrement out value. Bias = OUT – IN
	AUTO MODE	Bias is a fixed value from the man mode calculation. Above OUT = IN + Bias

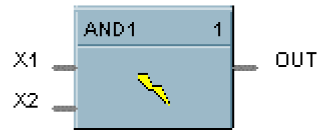
Figure 6 AMB function block example

2AND Function Block

Description

The **2AND** label stands for the **AND Boolean function (2 Inputs).** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.

OR



Fast Logic

Function

Turns digital output (OUT) **ON** when inputs X1 and X2 are **ON**. Thus,

- If *all* inputs are ON, then: **OUT = ON.**
- If *any* input is OFF, then: **OUT = OFF.**

Input

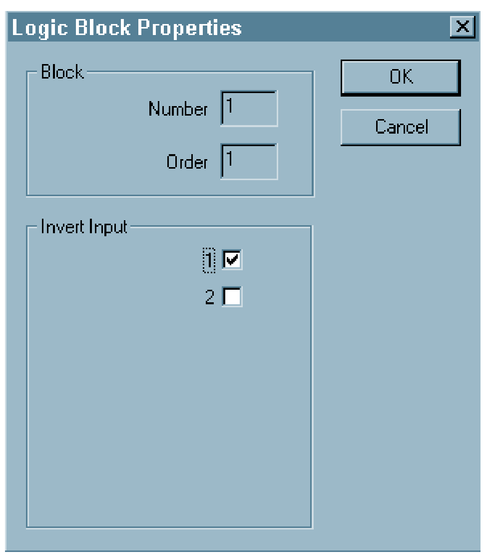
X1 = First digital signal.

X2 = Second digital signal.

Output

OUT = Digital signal controlled by status of input signals.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Input state

You can invert Input 1 or Input 2 or both. If the input is inverted, an input line that is ON is seen as OFF (“N” on Icon next to inverted input).

Example

Figure 7 shows an AND function block being used to monitor two input signals for an alarm condition.

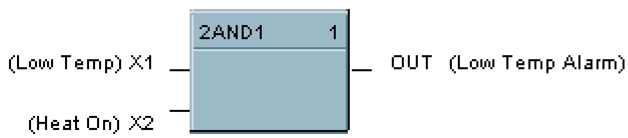
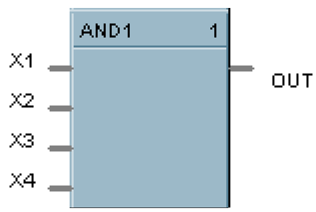


Figure 7 2AND function block example

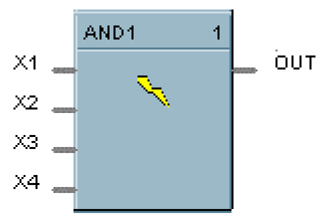
4AND Function Block

Description

The **4AND** label stands for the **AND Boolean function (4 Inputs).** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Turns digital output (OUT) **ON** when inputs X1 through X4 are **ON**. Thus,

- If all inputs are ON, then: **OUT = ON.**
- If any input is OFF, then: **OUT = OFF.**

Input

X1 = First digital signal
X2 = Second digital signal
X3 = Third digital signal
X4 = Fourth digital signal

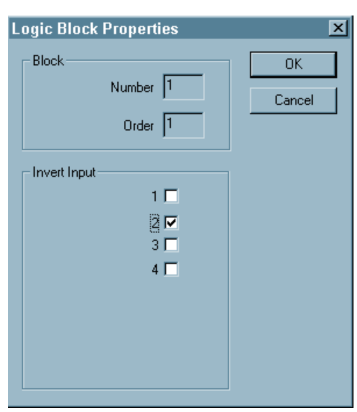
ATTENTION

Unused values must be set to 1 or inverted.

Output

OUT = Digital signal controlled by status of input signals

Block properties

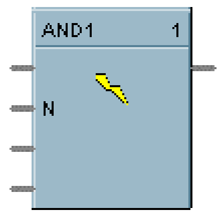


Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Input state

You can invert Input 1, 2, 3, 4, or all. If the input is inverted, an input line that is ON is seen as OFF (“N” on Icon next to inverted input).



ATTENTION

Unused values must be set to 1 or inverted.

Example

Figure 8 shows a Function Block Diagram configuration using a 4AND function block. The function block is being used to monitor 3 input signals for an alarm condition. Note unused input is terminated.

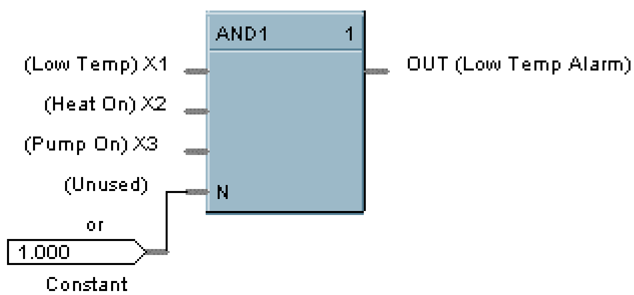
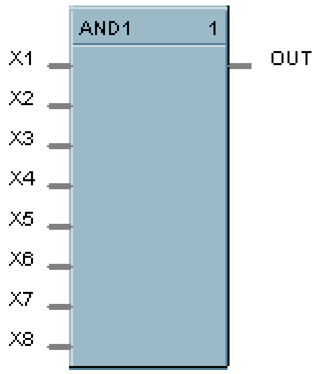


Figure 8 4AND function block example

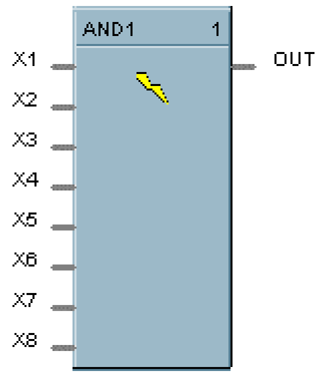
8AND Function Block

Description

The **8AND** label stands for the **AND Boolean function (8 Inputs)**. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Turns digital output (OUT) **ON** when inputs X1 through X8 are **ON**. Thus,

- If *all* inputs are ON, then: **OUT = ON.**
- If *any* input is OFF, then: **OUT = OFF.**

Input

X1 = First digital signal
X2 = Second digital signal
X3 = Third digital signal
X4 = Fourth digital signal
X5 = Fifth digital signal
X6 = Sixth digital signal
X7 = Seventh digital signal
X8 = Eighth digital signal

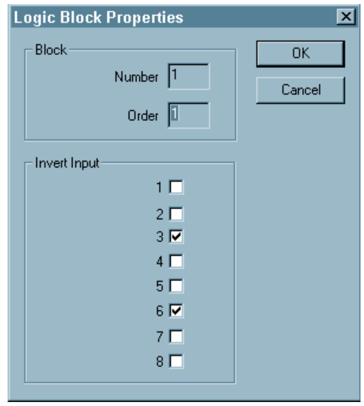
ATTENTION

Unused values must be set to 1 or inverted.

Output

OUT = Digital signal controlled by status of input signals.

Block properties

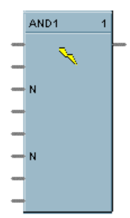


Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Input state

You can invert Input 1, 2, 3, 4, 5, 6, 7, 8 or all. If the input is inverted, an input line that is ON is seen as OFF (“N” on diagram next to inverted input).



ATTENTION

Unused values must be set to 1 or inverted.

Example

Figure 9 shows a Function Block Diagram configuration using a 8AND function block. The function block is used in a startup sequence to enable heaters when 6 input conditions are true.

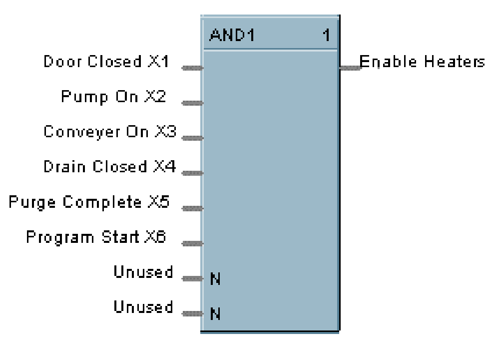
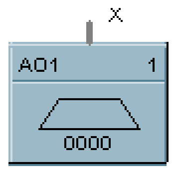


Figure 9 8AND function block example

AO Function Block

Description

The **AO** label stands for a milliamp **Analog Output**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Range High and Range Low are used to specify the Engineering Unit values for 100 % and 0 % of this block's input span. For reverse outputs, Range High may be set to a value less than Range Low.

The output range high and range low values (0-20 maximum) set the milliamp output values that correspond to the 0 % to 100 % span limits of the inputs.

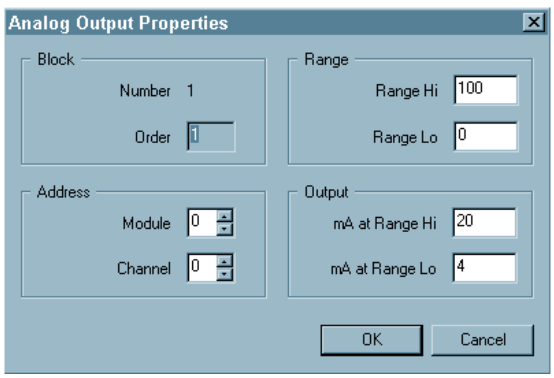
Input

X = Analog value

Output

Converted value sent to specified real I/O address.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the AO function block parameters to the desired value or selection that matches your operating requirements. Table 8 describes the parameters and the value or selection. AO's Address starts at Module 4.

Table 8 Analog output configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order for Block	Read Only. See "Configure" Menu, "Execution Order" to change.
Address	**I/O Module**		Address of selected I/O module (must match model selection guide)	Enter a value: from 4 to 10
	Channel		Channel on selected I/O Module	Enter a value: from 1 to 4
Range	**Range Hi**	1	High Range Value Engineering Unit - value of input that corresponds to 100 % output value	-99999 to 999999 Default = 100
	Range Low	2	Low Range Value Engineering Unit - value of input that corresponds to 0 % output value	-99999 to 999999 Default = 0.0
Output	**mA at range High**	3	Value of mA output that corresponds to 100 % output signal (for example: 20 mA)	0 to 20 Default = 20
	mA at Low Range	4	Value of mA output that corresponds to 0 % output signal (for example: 4 mA)	0 to 20 Default = 4

Example

Figure 10 shows a Function Block Diagram configuration using an AO function block to retransmit an analog input value. In example A, the output is from a SPP block to an external controller via the AO block. In example B, the mA output is 4 mA for an analog input of 2000.

ATTENTION

Reverse scaling is required for duplex control outputs.

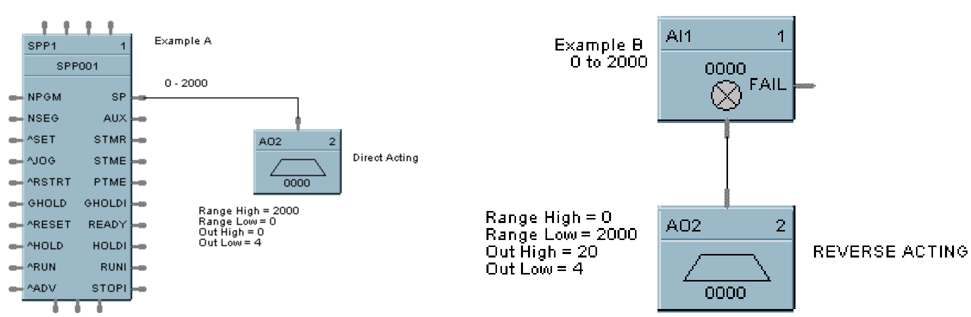


Figure 10 AO function block example

ASYS Function Block

Description

The **Analog System Status Block (ASYS)** is a function block and is part of the *Alarm/Monitor* category. It provides read access to controller status values including those related to the Analog execution cycle. The output may be connected to function block inputs. The outputs may also be connected to signal tags for operator interface monitoring. The ASYS System Monitoring block is assigned block number 249. It looks like this graphically on the Control Builder:

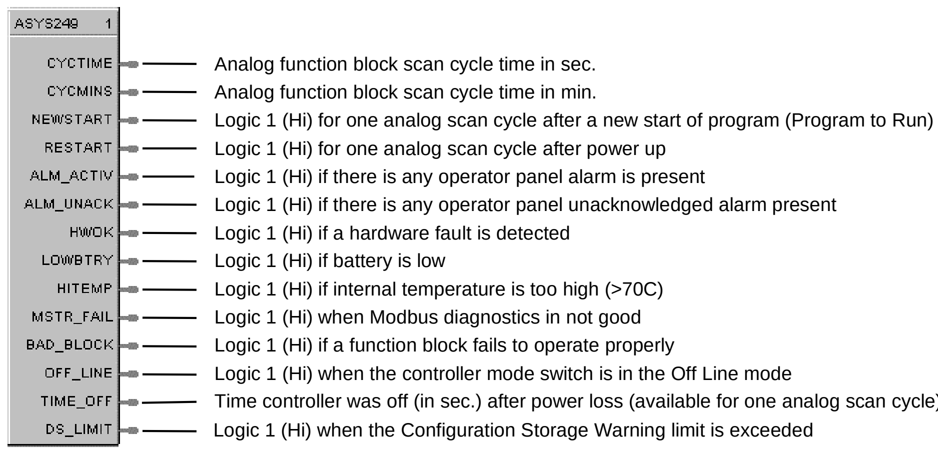


Table 9 describes the outputs for the Analog system status block.

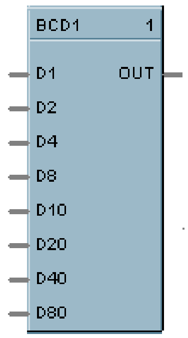
Table 9 Analog system status block outputs

Output	Description
CYCTIME	Control Block Cycle Time in seconds
CYCMINS	Control Block Cycle Time in minutes
NEWSTART	Newstart is ON for one full cycle of control block execution, following a New start of the system. For example: starting after a change from program to run.
RESTART	Restart is ON for one full cycle of control block execution, following power up.
ALM ACTIV	Alarm Active is ON if any operator panel alarm is ON.
ALMUNACK	Alarm unacknowledge is ON if any operator panel's alarm is unacknowledged.
HWOK	Hardware OK is ON if there are no faults.
LOWBTRY	Low Battery is ON if the battery is low, Off when battery is good.
HI TEMP	High CJ Temperature is ON if the CJ temperature is high.
MSTR FAIL	Communications Failure is ON when Modbus master diagnostic is not good
BAD BLOCK	Bad Block is ON when one or more blocks are not operating properly.
OFF LINE	On when Controller Mode switch is in Off Line mode.
TIME OFF	Number of seconds power was turned off. Valid for one cycle of control blocks execution following power up. Then it is cleared to zero.
DS LIMIT	ON when the configuration storage warning limit is exceeded. OFF when the storage capacity falls below the warning limit.

BCD Function Block

Description

The **BCD** label stands for **Binary Coded Decimal Translator.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

Accept up to 8 digital inputs in sequence and interprets the ON/OFF status of the first 4 inputs as a BCD value between 0 and 9 and the second 4 digits as a value between 10 and 90.

Input

D1 = Bit 0 of the BCD lower digit

D2 = Bit 1 of the BCD lower digit

D4 = Bit 2 of the BCD lower digit

D8 = Bit 3 of the BCD lower digit

D10 = Bit 0 of the BCD upper digit

D20 = Bit 1 of the BCD upper digit

D40 = Bit 2 of the BCD upper digit

D80 = Bit 3 of the BCD upper digit

Output

OUT = Analog output integer in the range of 0 to 99

OUT = (1* (1 if D1 is ON, else 0))+
(2* (1 if D2 is ON, else 0)) +
(4* (1 if D4 is ON, else 0)) +
(8* (1 if D8 is ON, else 0)) +
(10* (1 if D10 is ON, else 0)) +
(20* (1 if D20 is ON, else 0)) +
(40* (1 if D40 is ON, else 0)) +
(80* (1 if D80 is ON, else 0)))

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 11 shows a Function Block Diagram configuration using a BCD function block to select a Recipe.

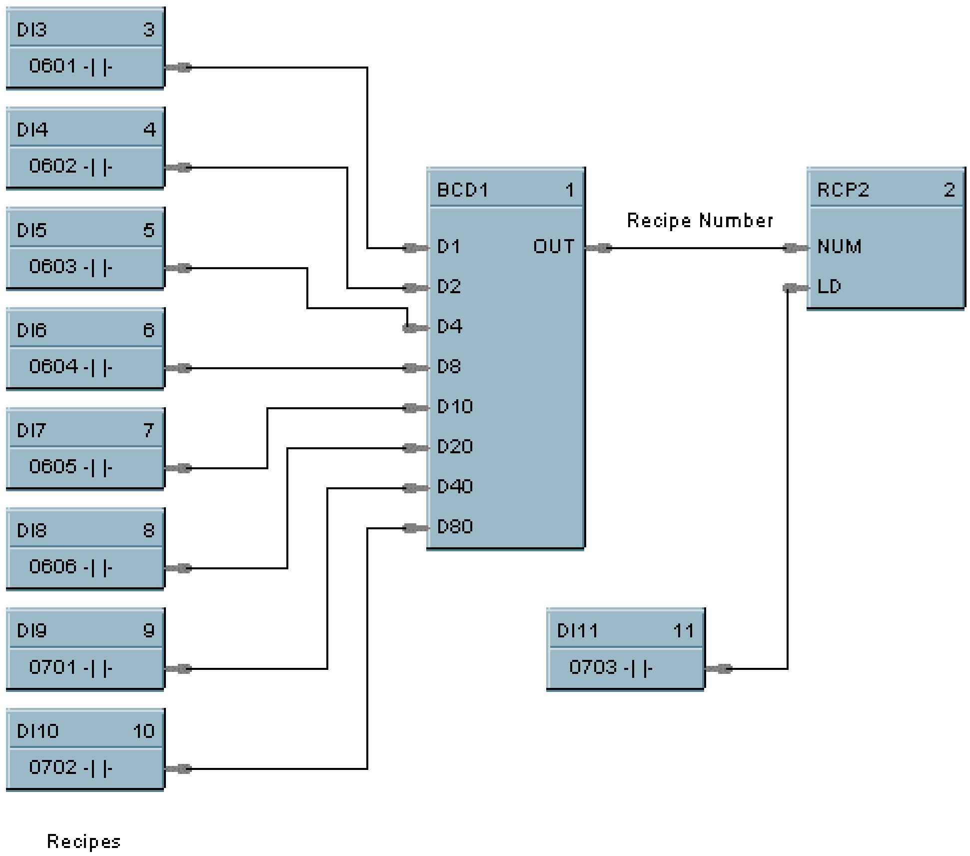
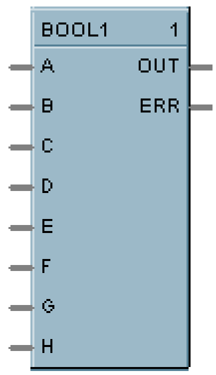


Figure 11 BCD function block example

BOOL Function Block

Description

The **BOOL** label stands for **Free Form Logic.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder.



Function

Read digital inputs A through H and calculates the output based on specified Boolean logic function.

- Offers the following Boolean logic functions:

  AND
  OR
  NOT
  XOR
  (- Left parenthesis
) - Right Parenthesis

Inputs

A = Block Input 1
B = Block Input 2
C = Block Input 3
D = Block Input 4
E = Block Input 5
F = Block Input 6
G = Block Input 7
H = Block Input 8

Output

ERR = error during execution of the equation. **Error = ON. No Error = OFF.**

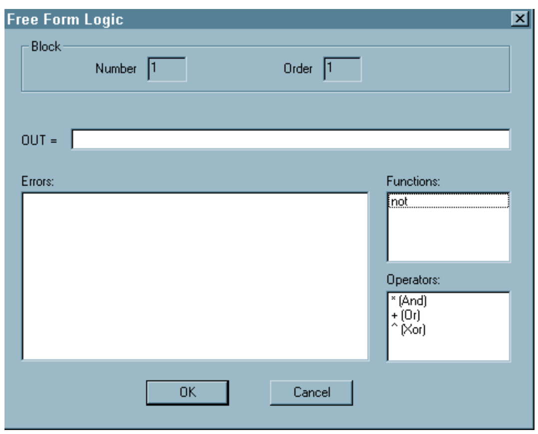
OUT = Calculated Output (ON or OFF)

A maximum of 50 tokens per equation is allowed. A token is an operator, a variable, or a pair of parentheses.

TIP

- Use only the following list of words and characters in an equation:
  - AND - logical AND,
  - OR - logical OR,
  - NOT - unary NOT,
  - XOR - exclusive OR, or
  - "( )", "[ ]", and "{ }" parentheses - three types.
- A left parenthesis must have a matching right parenthesis.
- The matching parenthesis must be the same type, that is, "( )", "[ ]", or "{ }".
- Parentheses may be nested to any depth.
- Logicals AND, OR, and XOR must have a left and right operand.
- Unary NOT must have one operand to the right, and the operand must be enclosed in parentheses; for example, NOT(G).

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the BOOL function block parameters to the desired value or selection that matches your operating requirements. Table 10 describes the parameters and the value or selection.

Table 10 BOOL function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Equations	**Equation Field**	N/A	Equation Field	Enter the desired equation in this field
Functions	**Logic Functions**	N/A	NOT	Double Click on a function to select from the list box
Operators	**Logic Operations**	N/A	* (AND) + (OR) ^ (XOR)	Double Click on an operation from the list box
Errors	**Error list**	N/A	List of equation errors	

Example

Free Form Logic - Boolean Expressions

Rather than using individual logic function blocks, a boolean expression may be entered directly using the Free Form Logic block which accepts up to 8 inputs. This can save function blocks. The inputs may come from other blocks with discrete outputs, DI's, or digital signal tags. The example below is a direct entry of the Example 4 boolean expression, with the output connected to two DO's. The Free Form Logic popup dialog box is also shown indicating format for expression entry. Note that Input H is unused. You may use multiple levels of parenthesis to generate the boolean expression. You can us as many blocks as required up to the limit. This implementation uses 10 function blocks.

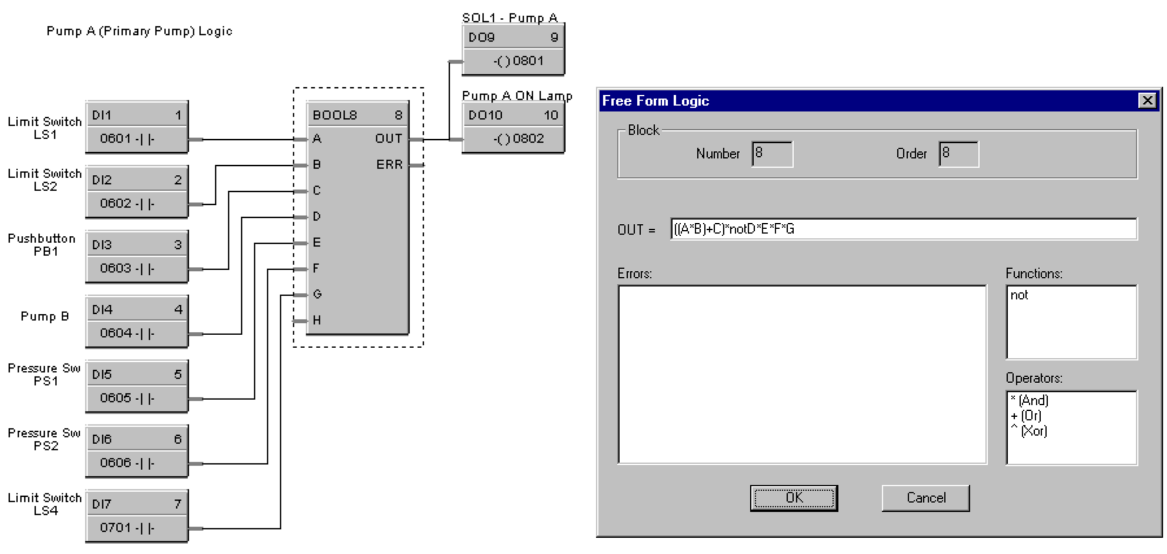
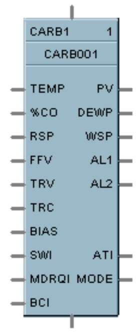


Figure 12 BOOL function block example

CARB Function Block

Description

The **CARB** label stands for **Carbon Potential.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

A combined Carbon Probe and Temperature Probe and PID algorithm determine Carbon Potential of furnace atmospheres based on a Zirconia probe input.

Input

Probe = Sensor Input from AI block (0-2 mV)

TEMP = Temperature Input (°F or °C) from AI block

%CO = Percent Carbon Monoxide 1 % to 100 %

RSP = Remote Setpoint Analog Input value in Engineering Units or Percentage (0-1.5)

FFV = Feedforward value in percentage (0 % to 100 %) The Feedforward value is multiplied by the Feedforward Gain, then directly summed into the output of the PID block.

TRV = Output Track value in Percentage. Output = TRV when TRC is on. (If control output OUT is connected back to the Track Value Input [TRV], then the Track Command Input [TRC] will function as an output hold. This may be used where input probes are undergoing burnoff.)

TRC = Output Track Command [ON, OFF] On – Enables TRV (Mode = Local Override)

BIAS = Remote Bias value for Ratio PID

SWI = Switch Inputs (from LPSW function block)
0 = No Change
1 = Initiate Autotuning
2 = Change Control Action (reverse to direct acting or direct to reverse acting)
4 = Force Bumpless Transfer
8 = Switch to Tune Set 1
16 = Switch to Tune Set 2

MDRQI = External Mode request (typically connected to the MDRQO output of a MDSW function block that encodes discrete switch inputs).

0 = No Change
1 = Manual Mode Request
2 = Auto Mode Request
4 = Local Setpoint Request
8 = Remote Setpoint Request

BCI = Back Calculation Input Value—See ATTENTION 1.

Output

PV = Calculated Process Variable (% Carbon) for monitoring

DEWPT = Calculated Dewpoint

WSP = Working Setpoint in Engineering Units for monitoring (setpoint in use)

AL1 = Alarm 1 - Digital Signal

AL2 = Alarm 2 - Digital Signal

ATI = Autotune Indicator (ON = Autotune in Progress)

MODE = Loop mode status (typically connected to the Mode Flags block for encoding). Value indicates mode as follows:

0.0	RSP AUTO
1.0	RSP MAN
2.0	RSP Initialization Manual (See ATTENTION 1)
3.0	RSP Local Override (See ATTENTION 1)
4.0	LSP AUTO
5.0	LSP MAN
6.0	LSP Initialization Manual (See ATTENTION 1)
7.0	LSP Local Override (See ATTENTION 1)

BCO - Back Calculation Output (for blocks used as Cascade Secondary)—See ATTENTION 2.

ATTENTION

1. When a request to change from Auto to manual is received and:
   - the request comes from the operator Interface, *the request is ignored*.
   - the request comes from the Mode Switch (MDSW) function block, *the request is retained and when leaving the Initialization Mode or Local Override Mode the loop will go to manual*.
2. BCO output is provided for applications where the block is used as a cascade secondary. BCI input is provided for applications where the block is used as a cascade primary. When the BCO output of a secondary loop is connected to the BCI input of a primary loop, bumpless transfer is achieved when the secondary is switched into remote setpoint (i.e., cascade) mode. In addition, the primary loop is prevented from reset windup when the secondary is decoupled from the process. The secondary is decoupled from the process when it is in local setpoint mode or manual output mode, has reached a setpoint or output limit, or is integral limiting because its BCI input. For example, see Figure 60.

Configuration parameters

The CARB properties dialog box is divided into seven tab cards

GENERAL
RSP
RANGE/LIMIT
TUNING
ACCUTUNE
ALARMS
CARBON POTENTIAL

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 11 describes the parameters and the value or selection.

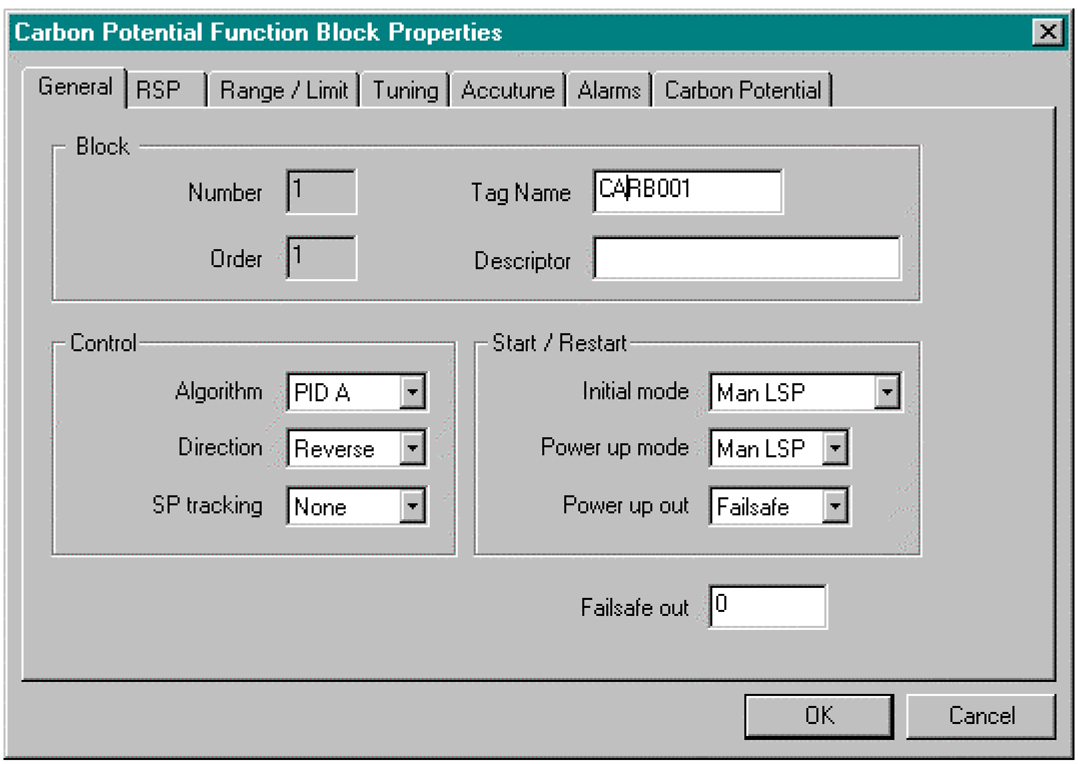


Table 11 General tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order	Read Only. See “Configure" Menu, ”Execution Order” to change.
	Tag Name		8 character tag name	
	Descriptor		Block Descriptor	
Control	**Algorithm**	N/A	Control Algorithm ***Note: In PID B, step changes in setpoint will not bump the output; the output will slew smoothly to the new value.*** ***In PID A, a step change in setpoint will result in a step change in output***.	**PID A** - is normally used for 3 mode control. The output can be adjusted somewhere between 100 % and 0 %. It applies all three control actions - Proportional (P), Integral (I), and Derivative (D) - to the error signal. **PID B** - Unlike the PID-A equation, the controller gives only an integral response to a setpoint change, with no effect on the output due to the Gain or Rate action, and gives full response to PV changes. **DUPA -** like PIDA but provides an automatic method to switch tuning constant sets for Heat/Cool applications. **DUPB -** like PIDB but provides an automatic method to switch tuning constant sets for Heat/Cool applications. NOTE: With PID B or DUPB selection, you **will not** be allowed to set RESET or RPM to 0.00 (OFF). Reset must be enabled.
	Direction	N/A	Control Action	**DIRECT** - PID action causes output to **increase** as process variable increases. **REVERSE** - PID action causes output to **decrease** as process variable increases.
	SP Tracking	N/A	Setpoint Tracking	**NONE** **TRACK PV** When control mode is “manual”, local setpoint tracks process variable. **TRACK RSP** When setpoint is “remote setpoint”, local setpoint tracks remote setpoint.

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Start/Restart	**Initial Mode**	N/A	Control Mode and Setpoint at NEWSTART **Newstart** is the first scan cycle following the cold start of the controller	**MAN LSP** Manual control and last local setpoint **AUTO LSP** Automatic control and last local setpoint. **AUTO RSP** Automatic control and remote setpoint. **MAN LSPonly** Manual control and local setpoint only. **AUTO LSPonly** Automatic control and local setpoint only*. **AUTO RSPonly** Automatic control and remote setpoint only*. *These modes will override the configured POWER UP MODE.
	Power Up Mode	N/A	Control Mode and Setpoint at power up	**MAN LSP** Manual control and last local setpoint **AM LSP** Same control mode (auto or manual) and last local setpoint. **AM LR** Same control mode (auto or manual) and setpoint (local or remote) as at power-down.
	Power Up Out	N/A	Output at Power up	**FAILSAFE** Failsafe output value. **LAST OUT** Same as at power down.
Failsafe Out	**Failsafe Out**	16	Failsafe Output Value	**–5 % to 105 %**

RSP tab

It looks like this graphically on the Control Builder. Table 12 describes the parameters and the value or selection.

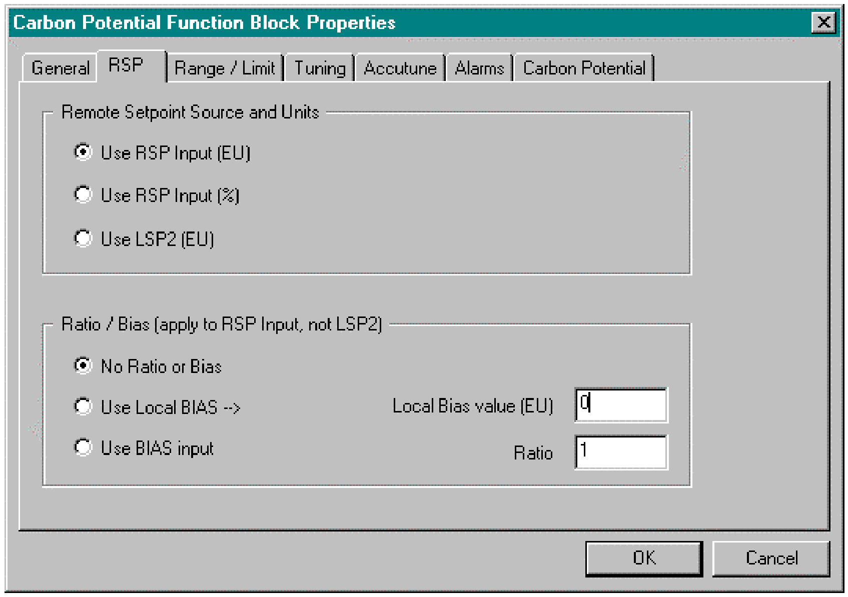


Table 12 RSP tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Remote Setpoint Source and Units	**Use RSP Input (EU)**	N/A	Use Remote Setpoint in Engineering Units	Click on radio button to select.
	Use RSP Input (%)	N/A	Use Remote Setpoint in Percent	Click on radio button to select.
	Use LSP2 (EU)	N/A	Use Local Setpoint #2 in Engineering Units	Click on radio button to select.
Ratio/Bias **(RSP Input Only)**	**No Ratio or Bias**	N/A	No ratio and bias applied to the function block	Click on radio button to select.
	Use Local Bias		Use Bias value selected on Tab	Click on radio button to select Enter value at "**Local Bias Value**" on tab.
	Use Bias Input		Use Bias value attached to an input to the block	Click on radio button to select.
	Local Bias Value (EU)	40	Local bias value in engineering units	Enter local bias value.
	Ratio	39	Gain value for Ratio PID	–20 to +20

RANGE/LIMIT tab

It looks like this graphically on the Control Builder. Table 13 describes the parameters and the value or selection.

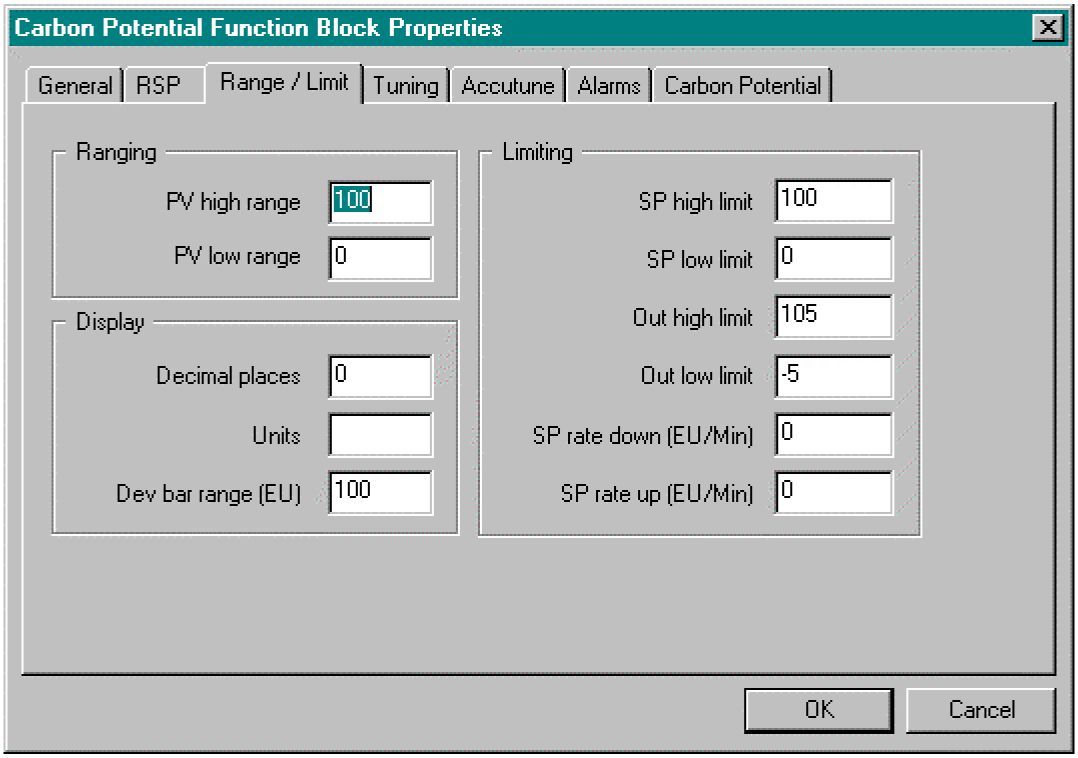


Table 13 Range/limit tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Ranging	**PV High range**	4	PV High Range Value	–99999 to 99999
	PV Low Range	5	PV Low Range Value	–99999 to 99999
Display	**Decimal Places**	N/A	Number of digits to display after decimal point.	0 to 5
	Units	N/A	Text to display for EU	4 characters
	DEV Bar Range (EU)	N/A	Deviation Bar Range on Operator Interface	–99999 to 99999
Limiting	**SP High Limit**	11	Setpoint High Limit Value - prevents the local and remote setpoints from going above the value set here.	–99999 to 99999 Used for anti-soot
	SP Low limit	12	Setpoint Low Limit Value - prevents the local and remote setpoints from going below the value set here.	–99999 to 99999
	Out High Limit	14	Output High Limit Value - is the highest value of output beyond which you do not want the automatic output to exceed	–5 % to 105 %
	Out Low Limit	15	Output Low Limit Value - is the lowest value of output beyond which you do not want the automatic output to exceed	–5 % to 105 %
	SP Rate Down	35	Setpoint Rate Down value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **down** to the new one.	0 (off) to 9999 (eu/min)
	SP Rate Up	36	Setpoint Rate Up value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **up** to the new one.	0 (off) to 9999 (eu/min)

TUNING tab

It looks like this graphically on the Control Builder. Table 14 describes the parameters and the value or selection.

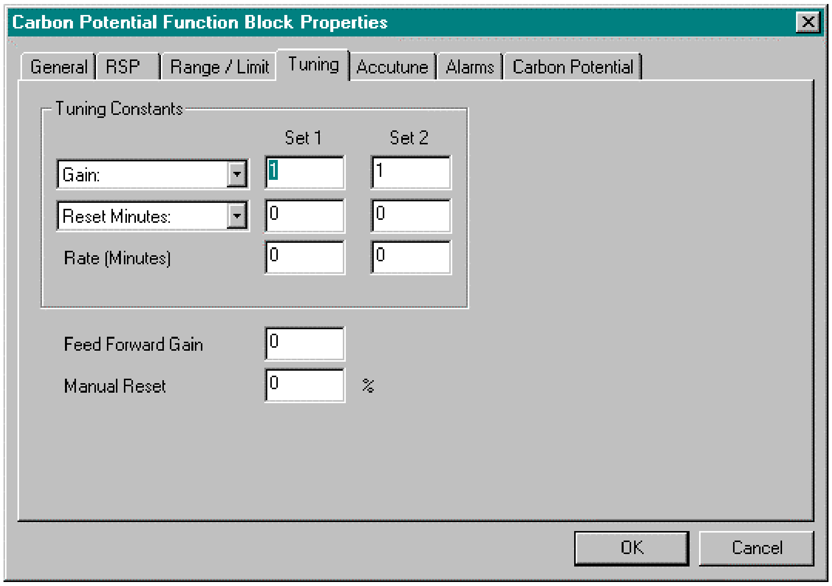


Table 14 Tuning tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Tuning Constants	**Prop Band** **or** **Gain**	0 PB1 or Gain 1 30 PB2 or gain 2	**Proportional Band (PB)** - is the percentage of the range of the measured variable for which a proportional controller will produce a 100 % change in its output. **Gain** - is the ratio of output change (%) over the measured variable change (%) that caused it. $G = \frac{100\ \%}{PB\ \%}$ where PB is the proportional Band (in %)	0.1 to 1000 0.1% to 1000 %

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
	Reset Minutes or Repeats/ Minute	2 Reset 1 32 Reset 2	**RESET** (Integral Time) - adjusts the controller's output according to both the size of the deviation (SP-PV) and the time it lasts. The amount of corrective action depends on the value of Gain. The reset adjustment is measured as how many times proportional action is repeated per minute (**Repeats/minute**) or how many minutes before one repeat of the proportional action occurs (**Minutes/repeat**).	0.02 to 50.00 ***Must be enabled for PID-B or DUP-B algorithm selections.***
	Rate Minutes	1 Rate 1 31 Rate 2	**RATE** action, in minutes affects the controller's output whenever the deviation is changing; and affects it more when the deviation is changing faster.	0 or 0.1 to 10.00 minutes 0 = OFF
Feedforward Gain	**Feed-Forward Gain**	37	Applies Gain to the Feedforward value (FFV). Feedforward Input is multiplied by this value.	0.0 to 10.0
Manual Reset	**Manual Reset**	26	MANUAL RESET- is only applicable if you do not use RESET (Integral Time).	–100 to 100 (in % of Output)

ATTENTION

DUPA and DUPB algorithm types automatically select tuning set #2 for outputs between 50 % and –5 %. Tuning set #2 must be entered for DUPA and DUPB.

ACCUTUNE tab

It looks like this graphically on the Control Builder. Table 15 describes the parameters and the value or selection.

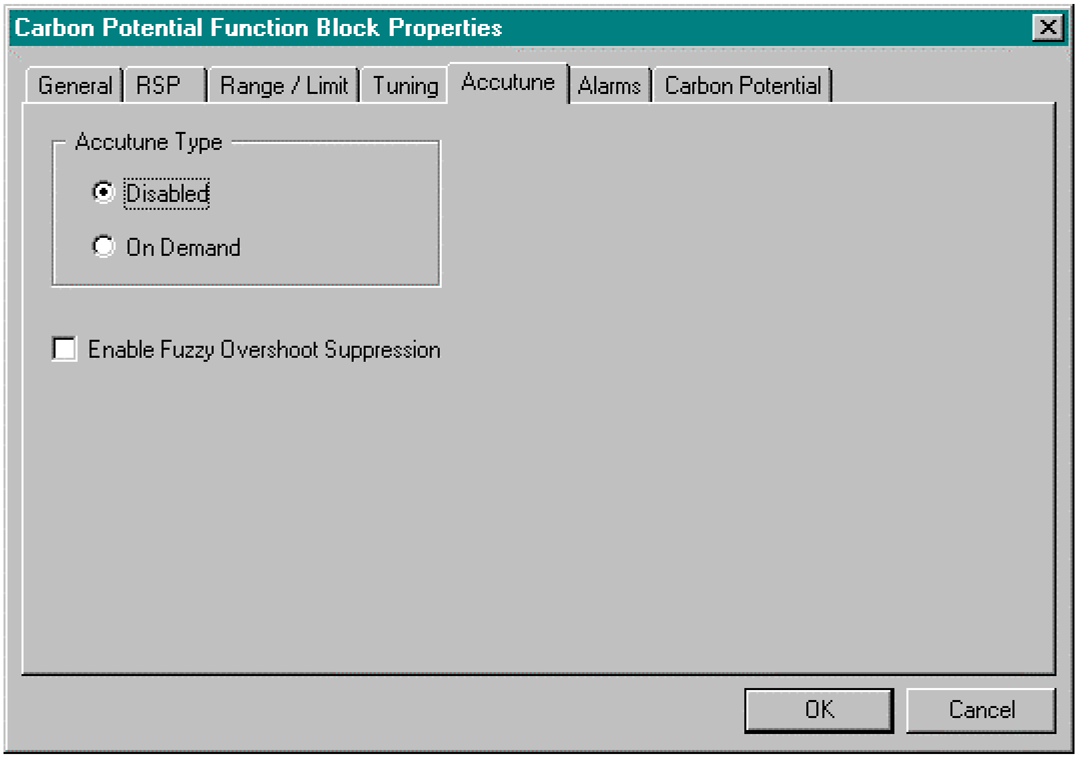


Table 15 Accutune tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Accutune Type	**Disabled**	N/A	Disables Accutune	Click on radio button to select
	On Demand		When initiated at the operator interface or the LPSW function block, the controller will start controlling to the setpoint while it identifies the process, calculates the tuning constants, and begins PID control with the correct tuning parameters.	Click on radio button to select
 **Click on block to select**		28	Fuzzy Overshoot Suppression minimizes overshoot after a setpoint change or a process disturbance. The fuzzy logic observes the speed and direction of the PV signal as it approaches the setpoint and temporarily modifies the internal controller response action as necessary to avoid an overshoot. There is no change to the CARB algorithm, and the fuzzy logic does not alter the CARB tuning parameters. This feature can be independently Enabled or Disabled as required by the application to work with "TUNE" On-Demand tuning.	

ATTENTION

Accutune is an On-demand tune only. You must provide a 0 to 1 transition to start another tuning cycle. The tuning will disturb the output to evaluate the tuning constants required.

ALARMS tab

It looks like this graphically on the Control Builder. Table 16 describes the parameters and the value or selection

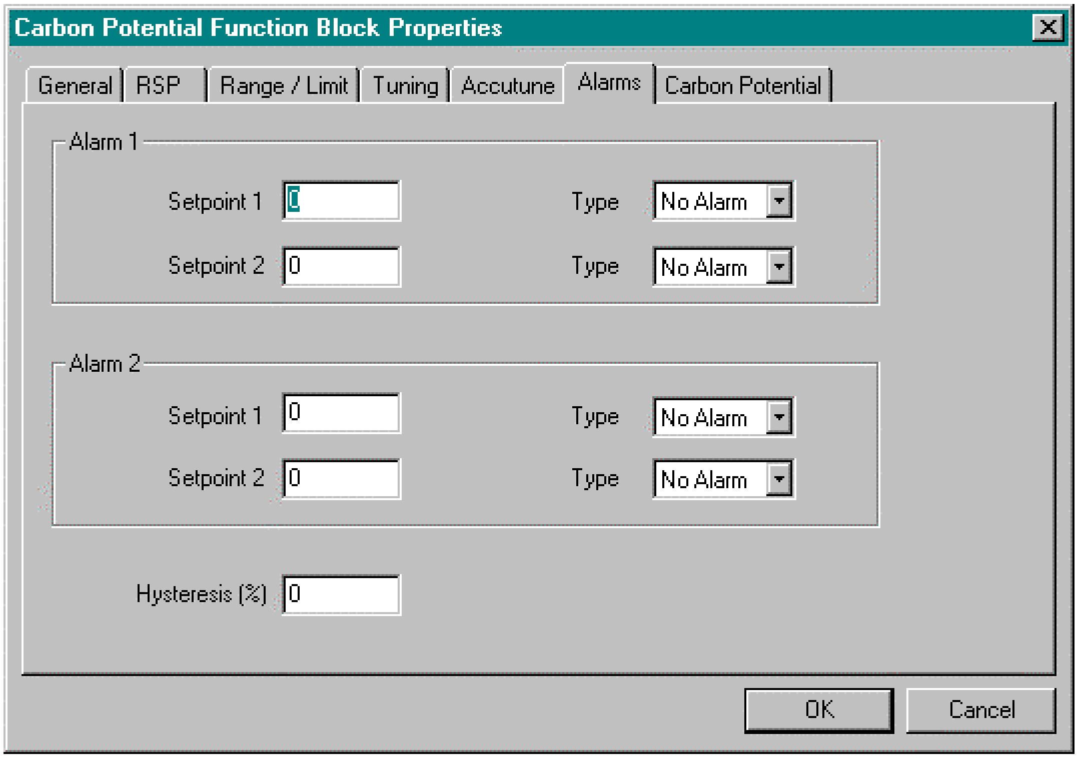


Table 16 Alarms tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Alarm 1	**Setpoint 1**	17	**Alarm 1 Setpoint 1 Value** - this is the value at which you want the alarm type chosen below to activate	–99999 to 99999 in Engineering Units
	Type	N/A	**Alarm 1 Setpoint 1 Type** - select what you want Alarm 1 Setpoint 1 to represent.	Selections: NO ALARM PV_HIGH PV_LOW DEV_HIGH DEV_LOW SP_HIGH SP_LOW OUT_HIGH OUT_LOW
	Setpoint 2	18	Alarm 1 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 1 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm 2	**Setpoint 1**	19	Alarm 2 Setpoint 1 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 1 Type	Same as **Alarm 1 Setpoint 1**
	Setpoint 2	20	Alarm 2 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm Hysteresis	**Hysteresis**	25	Alarm Hysteresis in %	0 % to 5 %

CARBON POTENTIAL tab

It looks like this graphically on the Control Builder. Table 17 describes the parameters and the value or selection.

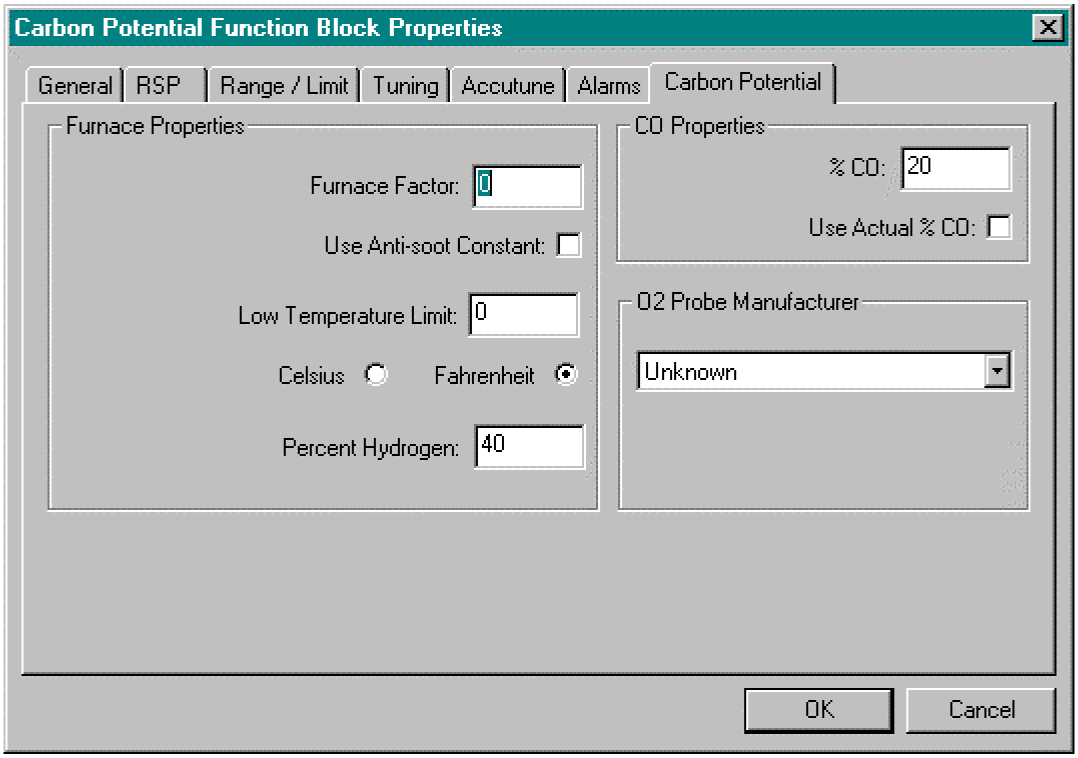


Table 17 Carbon potential tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Furnace Properties	**Furnace Factor**	45	Allows you to adjust the % Carbon as measured by the controller to agree with the results of actual shim stock tests. This adjustment may be needed to correct for specific furnace characteristics such as atmosphere differences, probe location, and furnace leaks.	–0.5 %C to +0.5 %C
		46	Activates anti-sooting feature that limits the working setpoint of the carbon control loop to a value that prevents sooting in the furnace.	Click on block to select SP HLIM is used for anti-soot.
	Low Temperature Limit	48	Holds controller output to 0 % until limit is exceeded.	0 to 2500 degrees F (1400° recommended) Unit should match C/F selection
		47	Probe temperature units for display.	Click on radio button to select
	Percent Hydrogen	50	Percent Hydrogen	1 to 100 default = 40
CO Properties	**%CO**	43	Allows you to adjust % Carbon measurement to compensate for variations in the amount of CO in the carrier gas.	2.0 to 35.0 default = 20
		44	Function block will use the actual % Carbon Monoxide that is defined through an analog input.	Click on block to select
O2 Probe Manufacturer	**Carbon Probe Vendor**	N/A	Select from Drop Down List of Manufacturers.	• Advanced Atmosphere Control Corp. • Furnace Control Corp. • Marathon Monitors • Super Systems Inc.

Example

Figure 13 shows Function Block Diagrams using a CARB function block.

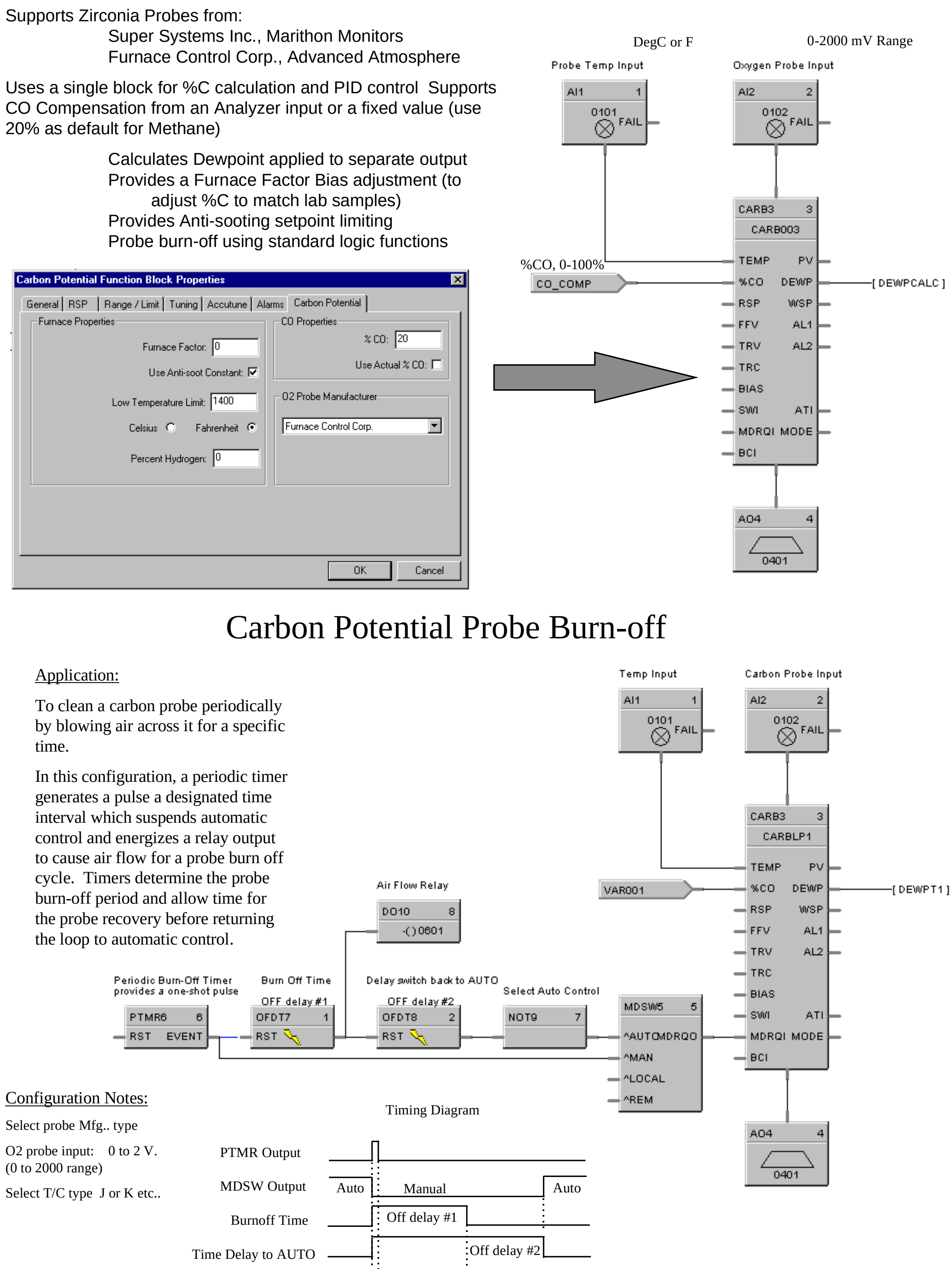
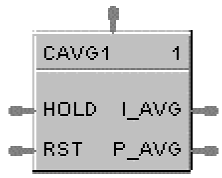


Figure 13 CARB function block examples

CAVG Function Block

Description

The **CAVG** label stands for **Continuous Average.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Provides the average value of a single analog parameter for a user specified time period, plus the running (instantaneous) average within the time period. A running average value is updated at the end of each sample period. Time periods to 1440.0 minutes are supported. At the end of the time period, the running average value is transferred to I/O process output value. A hold input allows excluding samples from the average when active.

Cold Start – On the first cycle after a cold start, the instantaneous average output is initialized to current input value, the sample counter begins to increment, and the period timer begins to decrement (assuming that Reset is OFF). The previous average output is set to zero.

Warm Start – On a warm start, the calculations continue where they left off. There is no attempt to compensate for the time the power was off or to resynchronize with the time of day.

Input

INPUT = Analog Input

RESET = Controls the sample calculations.

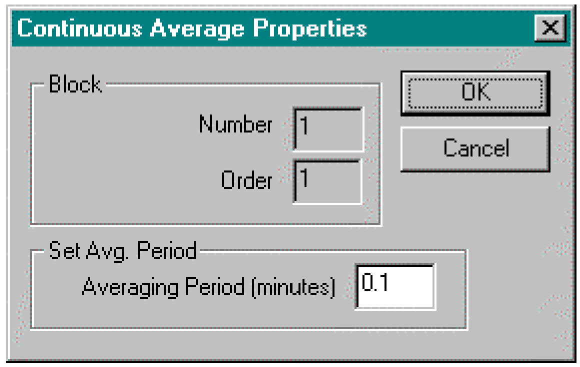
If **OFF**, the input samples are accumulated, the sample counter is incremented, the time remaining decrements and the average value is calculated and written to the outputs.
If **ON**, the outputs are held at their last values, the internal accumulators and sample counters are cleared, and the time remaining is re-initialized to the full average period.
If **ON to OFF transition**, the average output is set to the input value, and the period timer begins to decrement.
The RESET pin does not affect the previous average output value.

HOLD = If **OFF**, calculations run as normal. If **ON**, input samples are not accumulated and included in the average calculation, the time remaining continues to decrement. The output values are held at their last state prior to the OFF to ON transition.
If the averaging period elapses while **HOLD is ON**, the instantaneous average will maintain the last calculated average value, the previous average is updated to this value, the internal accumulators and sample counters are cleared, and the time remaining is re-initialized to the full averaging period.

Output

I AVG = Instantaneous calculation of the current average.
P AVG = previous calculated average value.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the CAVG function block parameters to the desired value or selection that matches your operating requirements.

Table 18 describes the parameters and the value or selection.

Table 18 Continuous average configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Avg. Period	**Averaging Period**	0	Time period in which the Continuous Average will be calculated. When the averaging period elapses, the last valid value will be set equal to the instantaneous value. The internal accumulators and sample counters will be cleared and the time remaining will be re-initialize to the full average period.	0.1 to 1440.0 in minutes

Example

Figure 14 shows a Function Block Diagram using a CAVG function block.

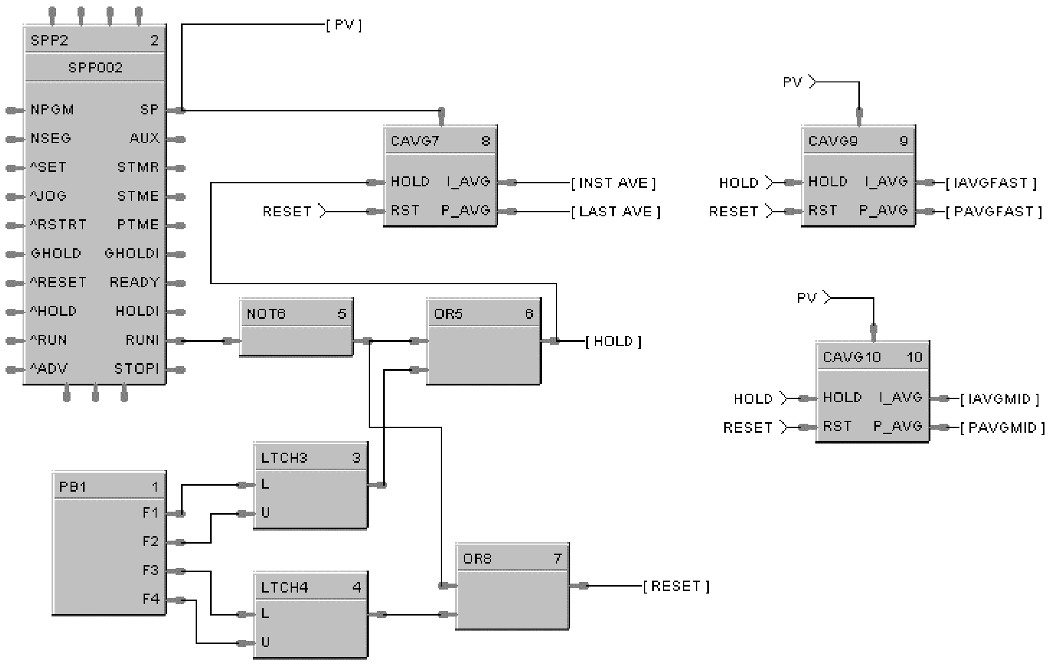
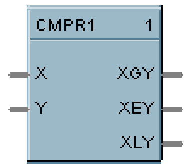


Figure 14 CAVG function block example

CMPR Function Block

Description

The **CMPR** label stands for **Comparison Calculation.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Compares value of X input to value of Y input and turns **ON** one of three outputs based on this comparison.

- If X input is greater than Y input, then: **XGY = ON.**
- If X input equals Y input, then: **XEY = ON.**
- If X input is less than Y input, then: **XLY = ON.**

Input

X = First analog value.
Y = Second analog value

Output

XGY = Digital signal state based on calculation.
XEY = Digital signal state based on calculation.
XLY = Digital signal state based on calculation.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 15 shows a Function Block Diagram using a CMPR function block to open a vent if input 1 is higher than input 2.

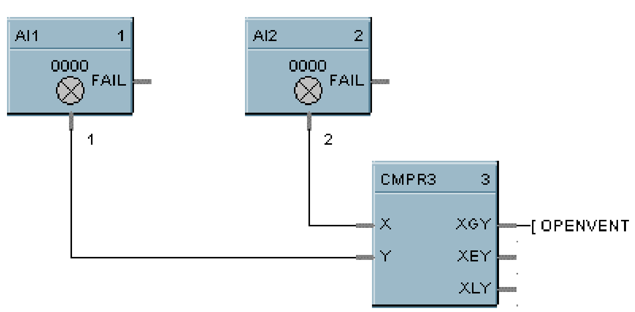
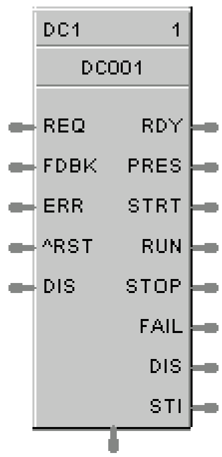


Figure 15 CMPR function block example

DC Function Block

Description

The **DC** label stands for **Device Control.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

The Device Control function block is normally used to control pumps. Based on certain events listed in Table 19 the device will be placed into one of six states: READY, PRESTART, STARTING, RUNNING, STOPPING, DISABLED, or FAILED. The READY (off state) is the initial state of the function block. Each configuration is limited to a maximumof 16 Device Control function blocks.
Forcing of outputs is NOT permitted within this block.

Inputs

REQ = (run request) when ON [Logic 1], puts the device in the Starting / Running state. When OFF, puts the device in Stopping / Ready state.

FDBK = feedback from the controlled device; ON = device has started, OFF = device has not started.

ERR = (in) – ON when the controlled device reports a failure, causes the device control to transition to the FAILED state.
OFF = No device failure.

^RST = an OFF to ON transition will manually reset the control when it is in the FAILED state and return to the READY state.

DIS = (disable) When OFF, the device control operates normally. When ON, immediately transitions to the DISABLED state, it prevents the device from starting if in the ready state or immediately shuts-down the device if it is currently starting up or running state.

Outputs

OUT = Primary block output – the output is ON in the RUNNING and STOPPING states, else OFF.

RDY = (ready) ON when the control is in the Ready State (the controlled device is off and waiting for a request to run), otherwise OFF.

PRES = (prestart) ON while in the prestart state (a request to run the device has been received and the start delay timer is >0, otherwise OFF.

STRT = (starting) ON while in the start state (start timer has expired and there is a request to start the device. The device feedback timer is started. The device is being monitored for failures),

RUN= (running) ON while in the Running state (the controlled device has completed start up (Device Feedback) and is now running; occurs after the start delay timer expires; device is being monitored for failures and feedback that it started) otherwise OFF.

STOP = (stopping) ON while in the Stopping state (the controlled device is requested to turn off; stop delay timer is running; device is being monitored for failures, interlocking and returning to the run state), otherwise OFF.

FAIL = (failed) ON when the control is in the Failed state (the controlled device reported a failure or did not start up in time; device is being monitored for a manual or automatic reset), otherwise OFF.

DIS = (disabled) ON while in the Disabled state (the controlled device is locked-out; it cannot start running until the disable input signal turns OFF), otherwise OFF.

STI = An enumeration representing the different states of the control.
Where: 0 = NOT USED, 1 = READY, 2 = PRESTART, 3 = STARTING, 4 = RUNNING,
5 = STOPPING, 6 = FAIL, 7 = DISABLE.

Conditions for transition from FAIL to READY state

One of the following conditions must occur to transition from the FAIL state to the READY state:

a) If a Feedback error is the initial reason for the failure, then a manual reset is the only method for returning to the Ready state.

b) If Automatic-Reset is selected, then you return to the Ready state when Device Failure input turns OFF.

c) If Automatic-Reset is not selected, then you return to the Ready state when Device Failure input is OFF and the Reset input transitions OFF to ON.

Monitored events and device states

Table 19 shows which events are monitored in each state.

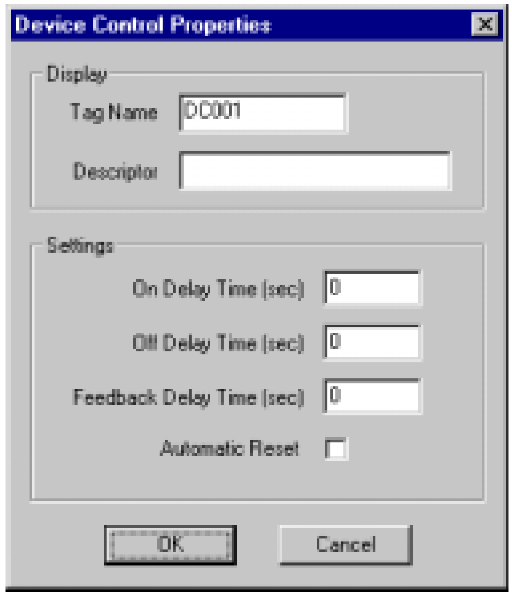
Table 19 Monitored events and device states

MONITORED EVENTS	DEVICE STATES						
	READY (Note 1)	PRE-START	START-ING	RUN-NING	DISABLED (Notes 1,2)	STOPPING	FAILED
Run Request turns ON	X					X	
Run Request turns OFF		X	X	X			
Disable (ON)	X	X	X	X		X	
Disable (OFF)					X		
Feedback from Device			X	X			
Device (ERR) Fail ON	X		X	X		X	
Device (ERR) Fail OFF							X Note 3
Reset (Rising Edge)							X
Start Delay Timer Expires (edge)		X					
Feedback Timer Expires (edge)			X	X			
Stop Delay Timer Expires (edge)						X	

Notes:

1. If a device fails while in the state of READY or DISABLE, the device failure is not recognized until the control goes into the PRESTART state.
2. There are restrictions when the control goes into the Disable state from the Running State. The device is immediately turned OFF without a Stop Delay. When the disable turns OFF, the control changes to the Ready state.
3. ERR Off (device fail) is monitored in Failed state, only if:
   a) Failed input caused the failure, and
   b) Auto Reset is enabled.

Block properties



Double click on the function block to access the function block properties dialog box.

Configuration parameters

You must configure the DC function Block parameters to the desired value or selection that matches your operating requirements. Table 20 describes the parameters and the value or selection.

Table 20 Device control function block parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Display	**Tag Name**	N/A	8-character tag name	
	Descriptor	N/A	Block description	16 characters maximum
Settings	**On Delay Time (sec)**	1	*Starting Time* – time delay between RUN request and Output ON. This parameter is configurable from the Operator Interface.	Range: 0 – 99999 seconds (default 0)
	Off Delay Time (sec)	2	Stopping Time – time delay before the Output turns OFF after and OFF request. This parameter is configurable from the Operator Interface.	Range: 0 – 99999 seconds (default 0)

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
	Feedback Delay Time (sec)	3	Feedback-Fail-Delay: if during this time-period there is no feedback from a device confirming the control is in the Running state, then the block entrs the FAIL state and Out is turned OFF. If a device sends feedback during this time-period, then this timer is reset. This parameter is configurable from the Operator Interface.	Range: 0 – 99999 seconds (default 0)
	Automatic Reset *(Click on Box to turn ON)*	0	if set to AUTO, then the block will reset itself after the failure (Fail input) turns off. If set to MANUAL, a Reset (signal input or from the Operator Interface station) is required to remove the failure condition. This parameter is determined when the block is configured.	ON = Automatic Reset (*box selected*) OFF = Manual Reset (*box deselected*)

Example

Figure 16 shows a Function Block Diagram using a Device Control function block to control a pump to fill a tank.

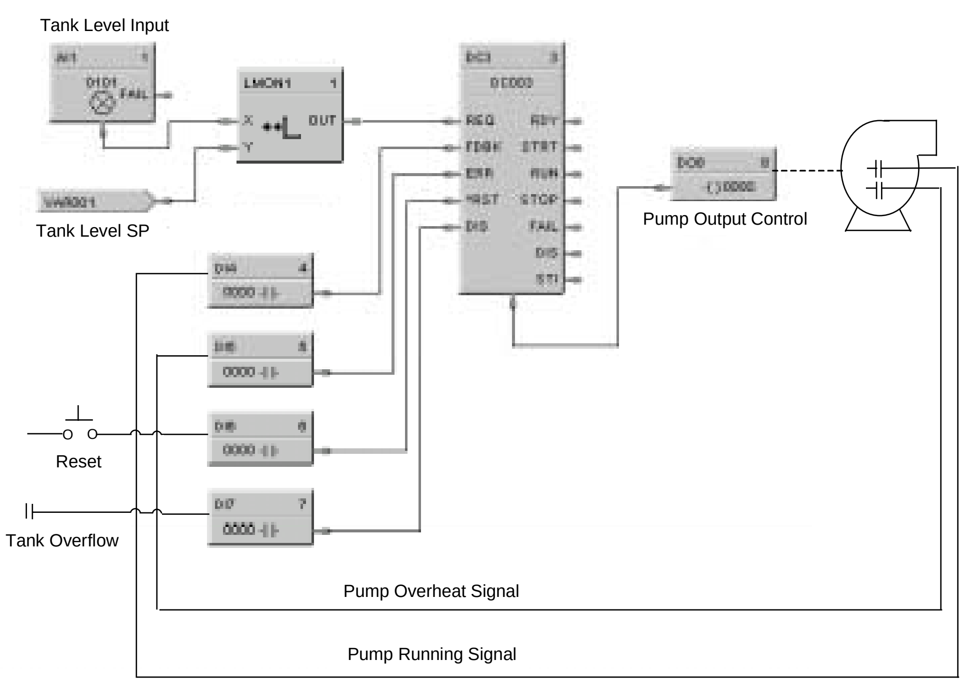
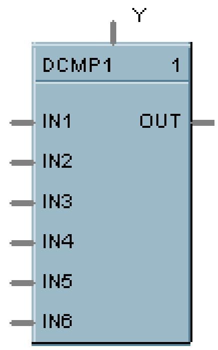


Figure 16 DC function block example

DCMP Function Block

Description

The **DCMP** label stands for **Deviation Compare.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Compares up to 6 analog inputs to a + or – user-entered deviation setpoint to a 7th input reference value and sets the output true if any input exceeds the deviation value from the reference value. Output is off if all inputs are less than the deviation.

ATTENTION

When the reference input is the average of the 6 inputs, the block performs deviation from average.

Input

IN1 = Input 1
IN2 = Input 2
IN3 = Input 3
IN4 = Input 4
IN5 = Input 5
IN6 = Input 6
Y =Reference Input

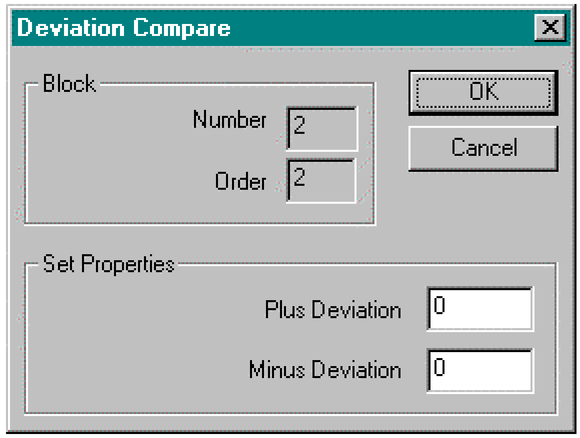
ATTENTION

All inputs should be used or a single value should be connected to multiple inputs. Unused inputs will default to 0.

Output

OUT = Hi (1) when any input exceeds the specified deviation from the reference value.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the DCMP function block parameters to the desired value or selection that matches your operating requirements.

Table 21 describes the parameters and the value or selection.

Table 21 DCMP configuration parameters

Properties Group	Parameter	Parameter Description	Value or Selection
Set Properties	**Plus Deviation**	Plus value deviation from reference point	Within the range of the inputs
	Minus Deviation	Minus value deviation from reference point	Within the range of the inputs

Example

Figure 17 shows a Function Block Diagram using a DCMP function block to hold a setpoint program if any of 6 work thermocouples deviate from the setpoint by more than the ± Deviation Limits.

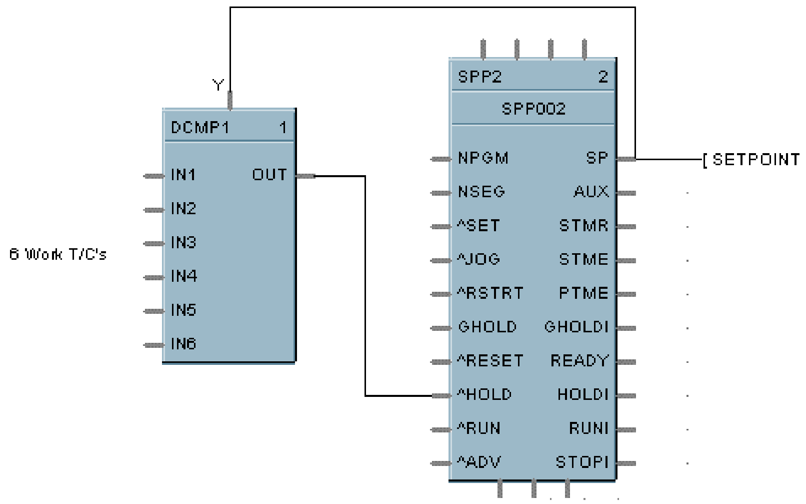


Figure 17 DCMP function block example

DENC Function Block

Description

The **DENC** label stands for **Digital Encoder.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.

Function

This block's main function is to totalize the number of ON states from up to 16 digital signals. The block digitally encodes up to 16 digital inputs to a single floating point output value.

Forcing of the output is not permitted.

Inputs

Sixteen digital inputs: Example: ON causes the input to be included in the total output. Unconnected pins default to OFF.

IN 1	= Digital Input 1	IN 9	= Digital Input 9
IN 2	= Digital Input 2	IN 10	= Digital Input 10
IN 3	= Digital Input 3	IN 11	= Digital Input 11
IN 4	= Digital Input 4	IN 12	= Digital Input 12
IN 5	= Digital Input 5	IN 13	= Digital Input 13
IN 6	= Digital Input 6	IN 14	= Digital Input 14
IN 7	= Digital Input 7	IN 15	= Digital Input 15
IN 8	= Digital Input 8	IN 16	= Digital Input 16

Outputs

ICNT = Sum of the Inputs set to ON.

DENC = Not Used

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 18 shows a Function Block Diagram using a DENC function block using multiple digital status to select an appropriate setpoint for a flow loop.

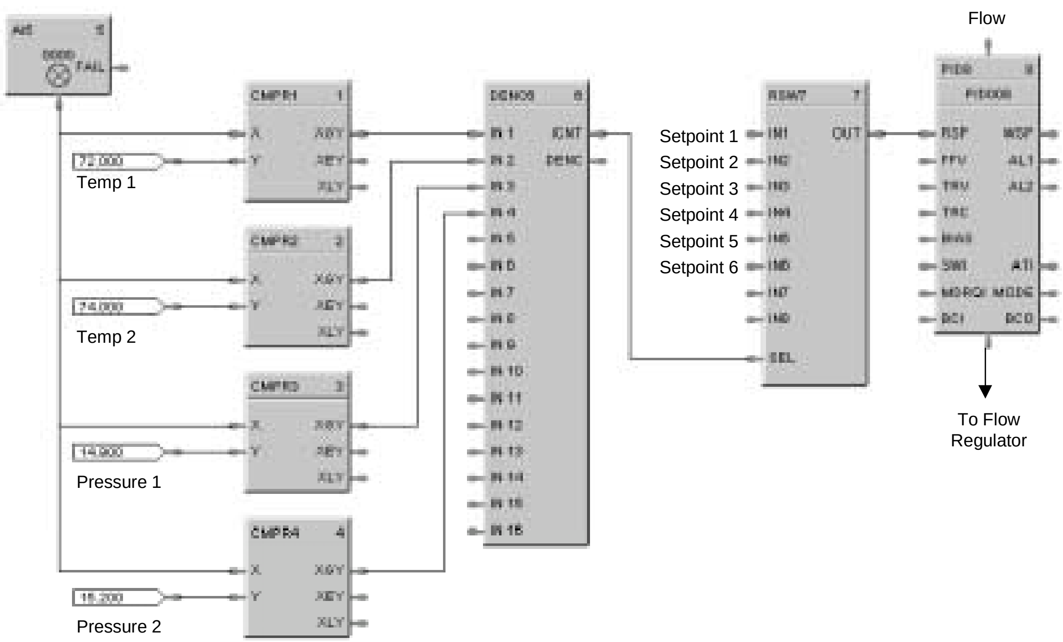
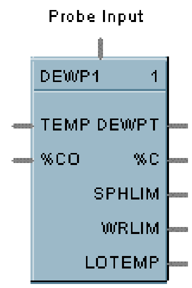


Figure 18 DENC function block example

DEWP Function Block

Description

The **DEWP** label stands for **Dewpoint** Calculation. This block is part of the *Calculations* category. It looks like this graphically on the Control builder.



Function

Monitors Dewpoint or Carbon Potential, or uses a Zirconia Probe sensor input to supply a Dewpoint PV to a PID function block for Dewpoint control. Use in conjunction with other blocks including a PID to generate more elaborate control strategies than that provided by the Carbon potential (CARB) function block.

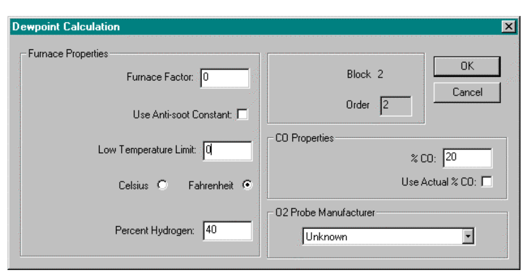
Inputs

Probe = Oxygen Sensor Input from AI (0-2 mV)
TEMP = Temperature Input (°F or °C) from AI Input
%CO = Percent Carbon Monoxide Input 1 - 100 %

Outputs

DEWPT = Calculated Dewpoint Output
%C = Calculated Percent Carbon Output
SPHLIM = Control Setpoint High Limit for Anti-soot.
WRLIM = Command to write the setpoint high limit.
LOTEMP = ON when TEMP is <= calculated low temperature dropoff.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the DEWP function Block parameters to the desired value or selection that matches your operating requirements. Table 22 describes the parameters and the value or selection.

Table 22 Dewpoint function block parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Furnace Properties	**Furnace Factor**	2	Allows you to adjust the % Carbon as measured by the controller to agree with the results of actual shim stock tests. This adjustment may be needed to correct for specific furnace characteristics such as atmosphere differences, probe location, and furnace leaks.	–0.5 %C to +0.5 %C
		3	Activates anti-sooting feature that limits the working setpoint of the carbon control loop to a value that prevents sooting in the furnace.	Click on block to select SP HLIM is used for anti-soot.
	Low Temperature Limit	5	Holds controller output to 0 % until limit is exceeded.	0 to 2500 degrees F (1400° recommended) Unit should match C/F selection
		4	Probe temperature units for display.	Click on radio button to select
	Percent Hydrogen	7	Percent Hydrogen	1 to 100 default = 40
CO Properties	**%CO**	0	Allows you to adjust % Carbon measurement to compensate for variations in the amount of CO in the carrier gas.	2.0 to 35.0 default = 20
		1	Function block will use the actual % Carbon Monoxide that is defined through an analog input.	Click on block to select
O2 Probe Manufacturer	**Carbon Probe Manufacturer**	N/A	Select from Drop Down List of Manufacturers.	• Advanced Atmosphere Control Corp. • Furnace Control Corp. • Marathon Monitors • Super Systems Inc.

Example

Figure 19 shows a Function Block Diagram using a DEWP function block. This application uses the Dew Point function block to calculate dew point based on using a carbon probe. A typical example might be for control of an endothermic atmosphere generator. Alternatively, a Honeywell dew point transmitter could be used for a more direct measurement.

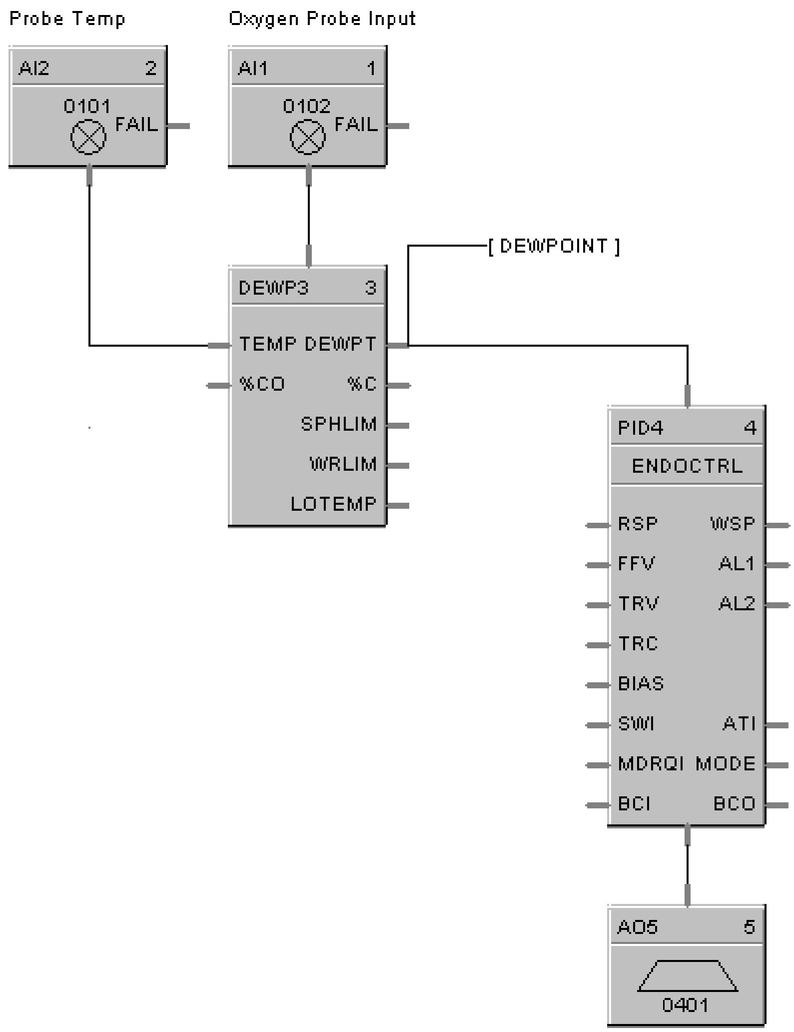


Figure 19 DEWP function block example

DI Function Block

Description

The **DI** label stands for **Discrete Input.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.

OR

Fast Logic

Function

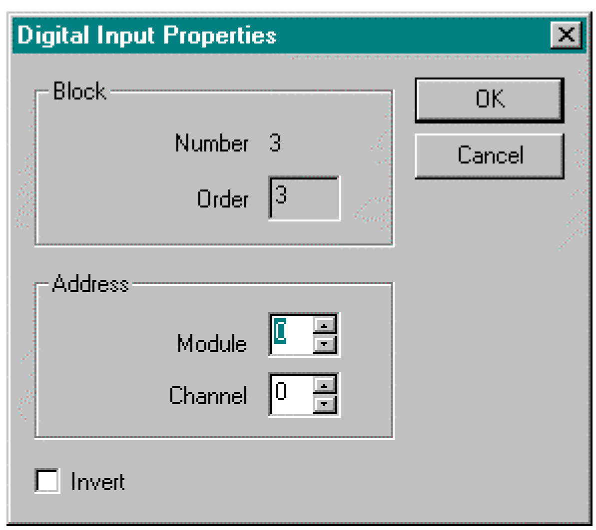
Discrete input blocks are used to process the digital status of a specific channel of a discrete input module. Each block requires a module and channel number during configuration. The Input status may be inverted.

If Digital Point is ON, then OUT = ON.

Output

OUT = Digital Signal

Block properties



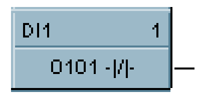
Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the DI function Block parameters to the desired value or selection that matches your operating requirements. Table 23 describes the parameters and the value or selection.

Table 23 Digital input configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Address	**I/O Module**	0	Address of select I/O Module	From 6 to 16
	Channel		Channel on selected I/O Module	From 1 to 6
		1	If INVERT is selected, OUT = inverse of physical input. The slash will be present in the CONTACT symbol only when the invert box is selected on the dialog box. (See below.) 	

Example

Figure 20 shows a Function Block Diagram using DI function blocks in a basic Series Parallel Circuit.

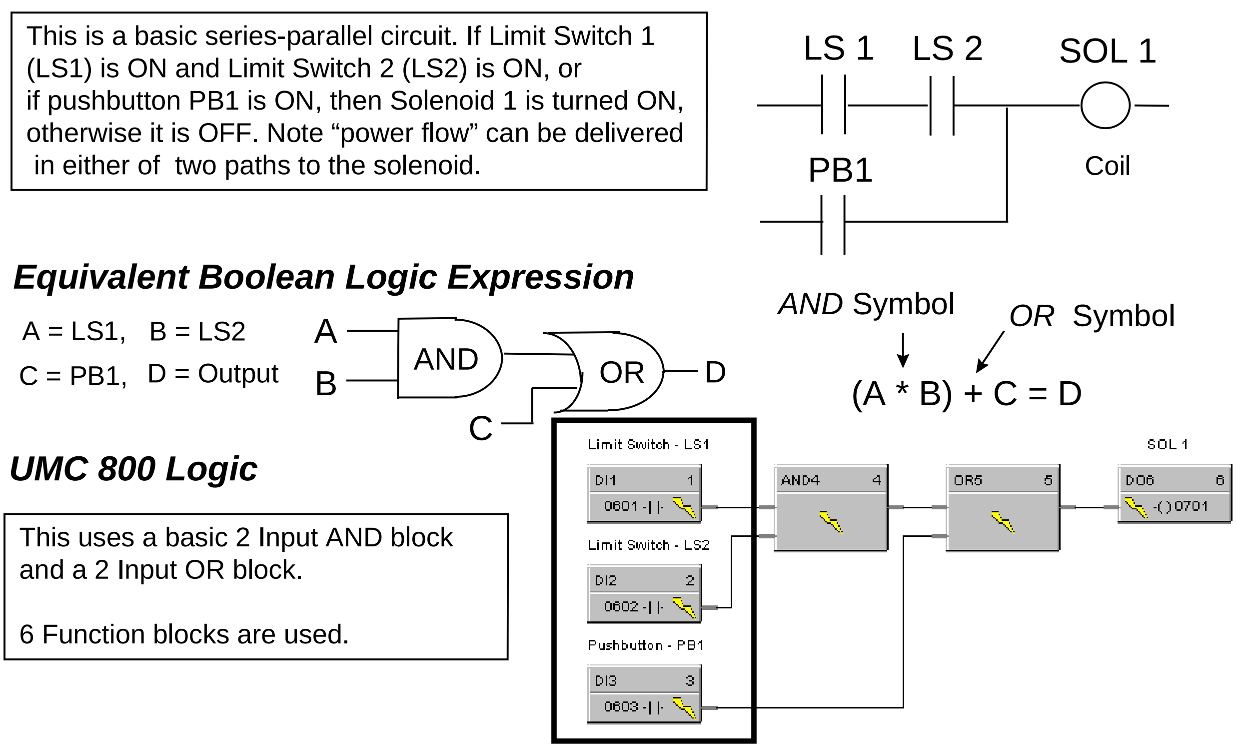
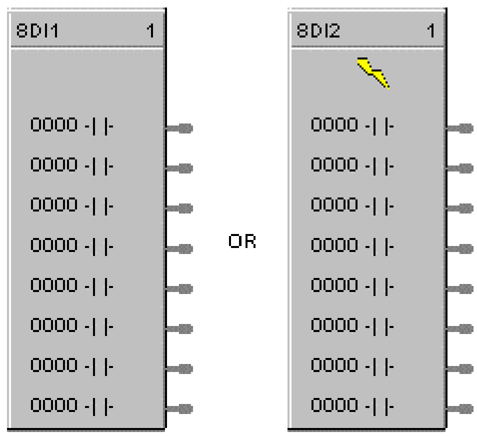


Figure 20 Digital input function block example

8DI Function Block

Description

The **8DI** label stands for **Eight Point Digital Inputs.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



Function

Provides read access for up to 8 physical digital inputs.

It minimizes the number of blocks required to configure all of the Digital I/O required in a system. Digital input blocks are used to process the digital status of specific channels of a digital input module. Each block input requires a module and channel number during configuration.

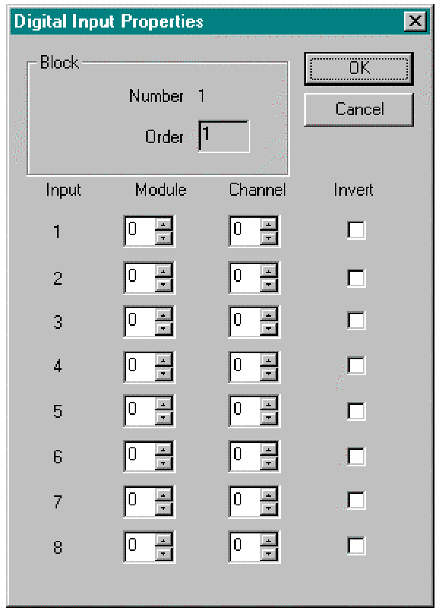
The Input status may be inverted.

If Digital Point is ON, then OUT = ON.

Output

OUT D1= Digital Signal
OUT D2= Digital Signal
OUT D3= Digital Signal
OUT D4= Digital Signal
OUT D5= Digital Signal
OUT D6= Digital Signal
OUT D7= Digital Signal
OUT D8= Digital Signal

Block properties



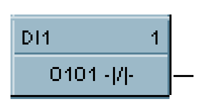
Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

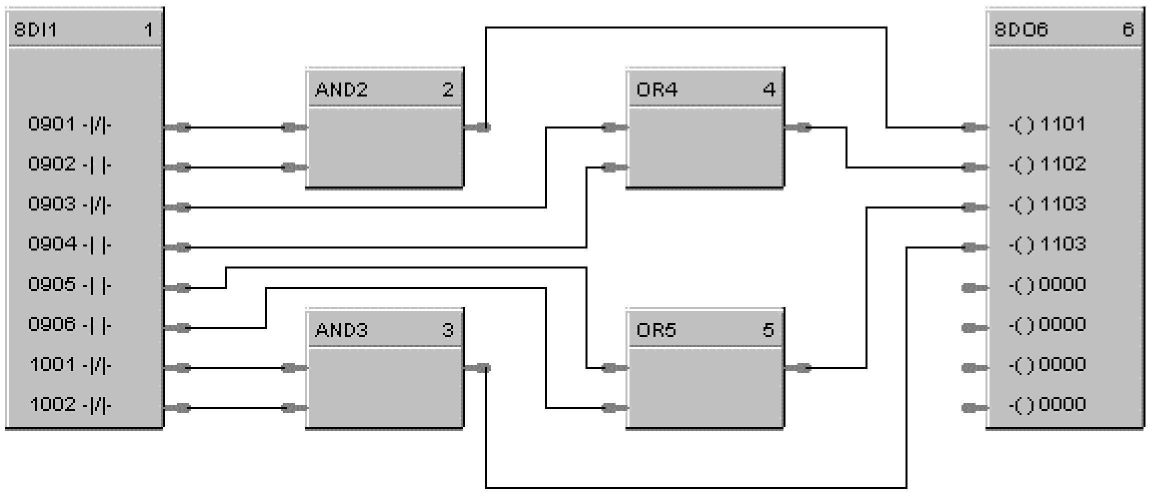
You must configure the 8 point DI function Block parameters to the desired value or selection that matches your operating requirements. Table 24 describes the parameters and the value or selection.

Table 24 Eight Digital input configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Input 1 through Input 8	**I/O Module**	0	Address of selected I/O Module	From 1 to 16
	Channel		Channel on selected I/O Module	From 1 to 6
		1	If INVERT is selected, OUT = inverse of physical input. The slash will be present in the CONTACT symbol only when the invert box is selected on the dialog box. (See below.) 	

Example

Figure 21 shows a Function Block Diagram using 8 point DI function blocks.



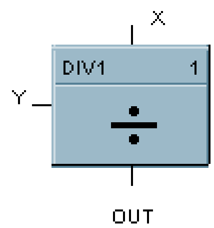
In this example, two blocks are used for a total of 12 digital I/O points.

Figure 21 8Point DI function block example

DIV Function Block

Description

The **DIV** label stands for **Division** Mathematical operation. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Divides one input (X) by another (Y)

- If Y = 0, then OUT = 0 and block status is set to error; otherwise, **OUT = X ÷ Y.**

Input

X = First analog value
Y = Second analog value

Output

OUT = Calculated Value

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 22 shows a Function Block Diagram using a DIV function block.

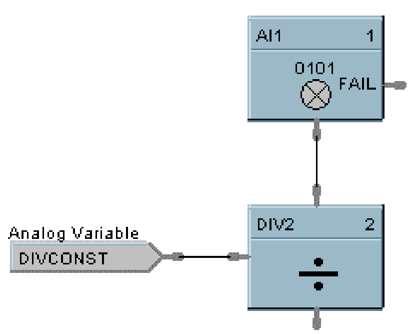
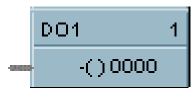


Figure 22 DIV function block example

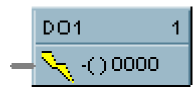
DO Function Block

Description

The **DO** label stands for **Digital Output.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Provides a digital status from the algorithms and functions to physical logic output hardware. Each block requires a module and channel number during configuration. The output status may be inverted.

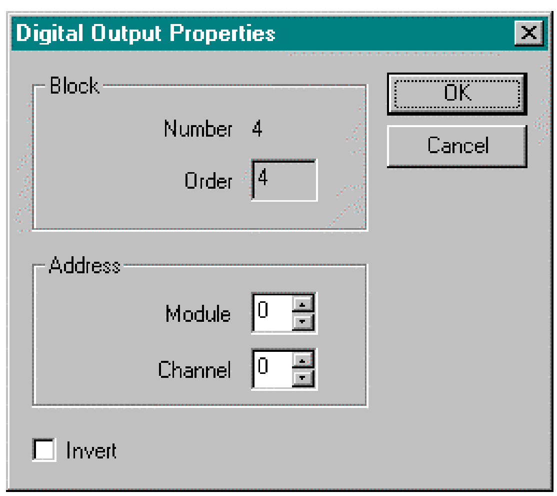
Input

X = Input Status Signal

Output

None

Block properties



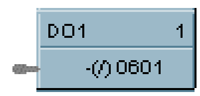
Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the DO function Block parameters to the desired value or selection that matches your operating requirements. Table 25 describes the parameters and the value or selection.

Table 25 Digital output configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Address	**I/O Module**	N/A	Address of select I/O Module	From 1 to 16
	Channel		Channel on selected I/O Module	From 1 to 6
		1	If INVERT is selected, Invert IN before writing to output The slash will be present in the COIL symbol only when the invert box is selected on the dialog box. (See below.) 	

Example

Figure 23 shows a Function Block Diagram using a DO function block. A digital output signal from PID block AL1 will turn the Digital Output block ON & OFF for remote alarming. This output could be OR'd with other alarm outputs if going to a common alarm relay.

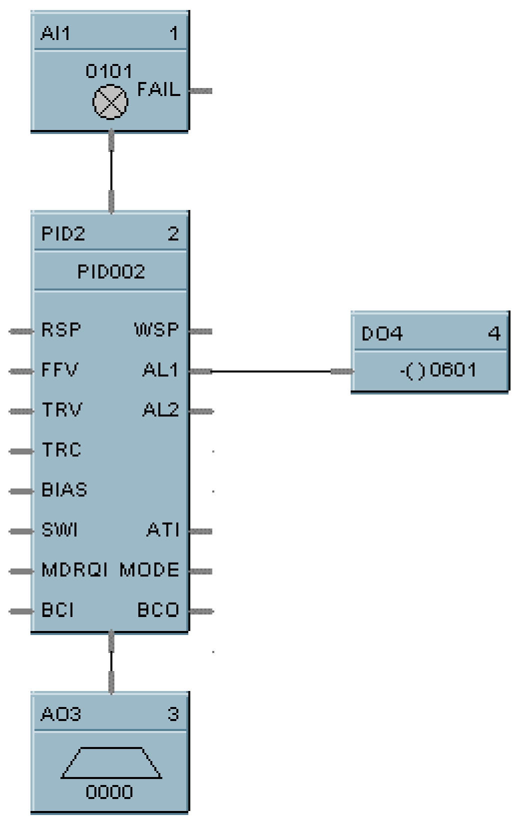
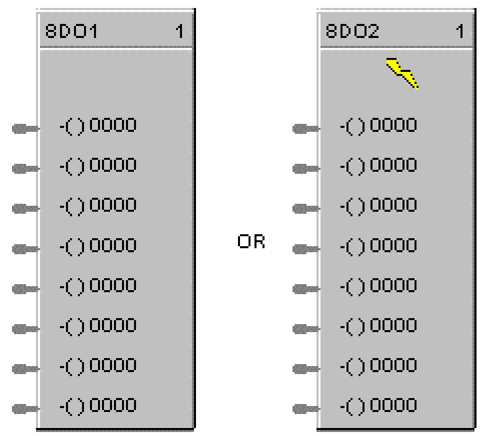


Figure 23 DO function block example

8DO Function Block

Description

The **8DO** label stands for **Eight Point Digital Outputs.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



Function

Provides write access to any physical digital output. (All read at the same time) It minimizes the number of blocks required to configure all of the digital I/O required in the system. It provides a digital status from the algorithms and functions to physical logic output hardware. Each block output requires a module and channel number during configuration. The output status may be inverted.

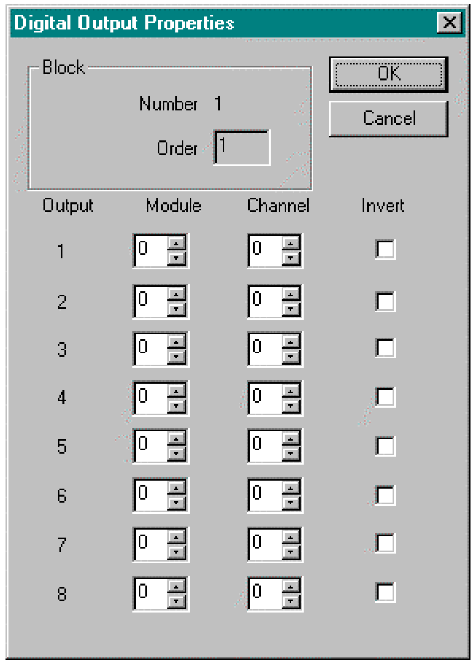
Input

IN D1 = Input Status Signal
IN D2 = Input Status Signal
IN D3 = Input Status Signal
IN D4 = Input Status Signal
IN D5 = Input Status Signal
IN D6 = Input Status Signal
IN D7 = Input Status Signal
IN D8 = Input Status Signal

Output

None

Block properties



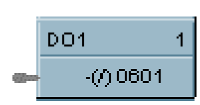
Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the 8Point DO function Block parameters to the desired value or selection that matches your operating requirements. Table 26 describes the parameters and the value or selection.

Table 26 Eight Digital output configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Output 1 through 8	**I/O Module**	N/A	Address of select I/O Module	From 1 to 16
	Channel		Channel on selected I/O Module	From 1 to 16
			NOTE: ***If you don’t want to use an output pin, leave the Module # and Channel # at 0.***	
		1	If INVERT is selected, Invert IN before writing to output The slash will be present in the COIL symbol only when the invert box is selected on the dialog box. (See below.) 	

Example

Figure 24 shows a Function Block Diagram using a 8 Point DO function block.

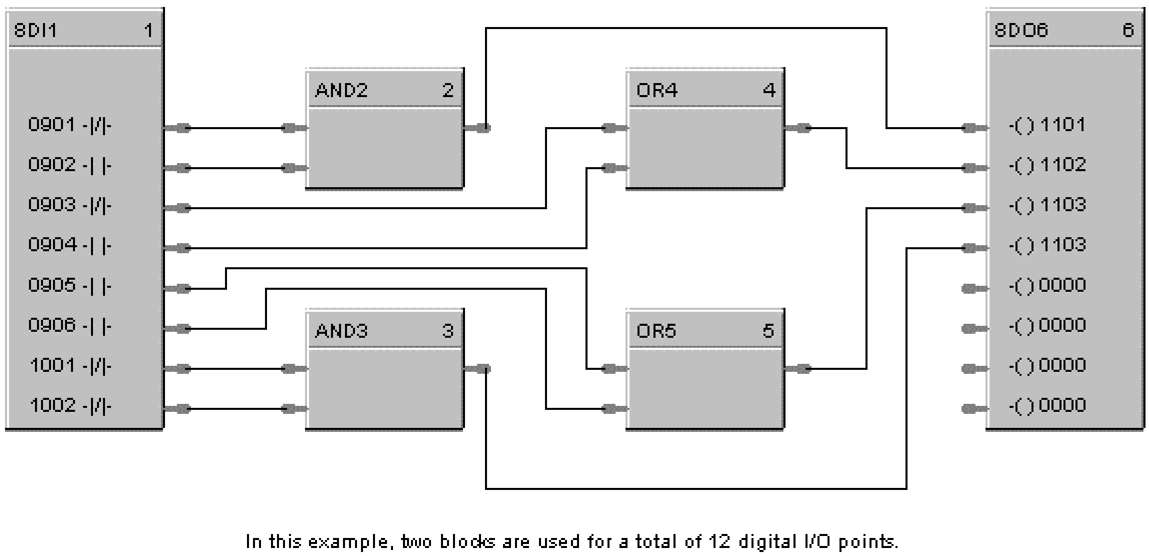
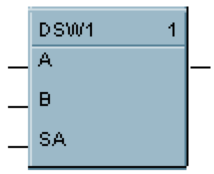


Figure 24 8 Point DO function block example

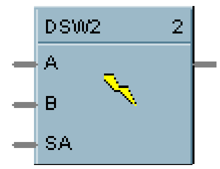
DSW Function Block

Description

The **DSW** label stands for **Digital Switch.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Sets the output of the block equal to either input A or Input B depending on the value of input SA. If input SA (Select A) is ON, then OUT = Input A, otherwise OUT = Input B.

Input

A = 1st of two inputs to select from.

B = 2nd of two inputs to select from.

SA = Select A

Output

Out = If SA is ON, then A, else B.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 25 shows an example of a DSW function block. The output is switched **between two digital inputs** based on the ON or OFF state of the **control input**. Output = A input state when SA input is OFF and B input state when SA input is ON.

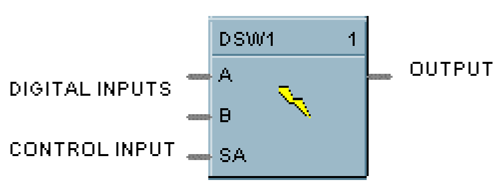
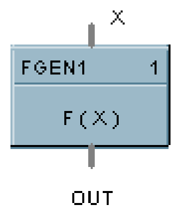


Figure 25 DSW function block example

FGEN Function Block

Description

The **FGEN** label stands for **Function Generator - 10 Segment**. This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder:



Function

Generate output characteristic curve based on up to 11 configurable "Breakpoints" for both input (X) and Output (OUT) values.

OUT = interpolation of OUT (Yb) values for segment in which X falls.

- If X <= X (1), then OUT = OUT (1)
- If X >= X (11), then OUT = OUT (11)

ATTENTION

The X(n) value must be < X(n+1) value. Thus, if fewer than 11 breakpoints are needed, be sure to configure any unneeded breakpoints with the same X and OUT values used for the previous breakpoint.

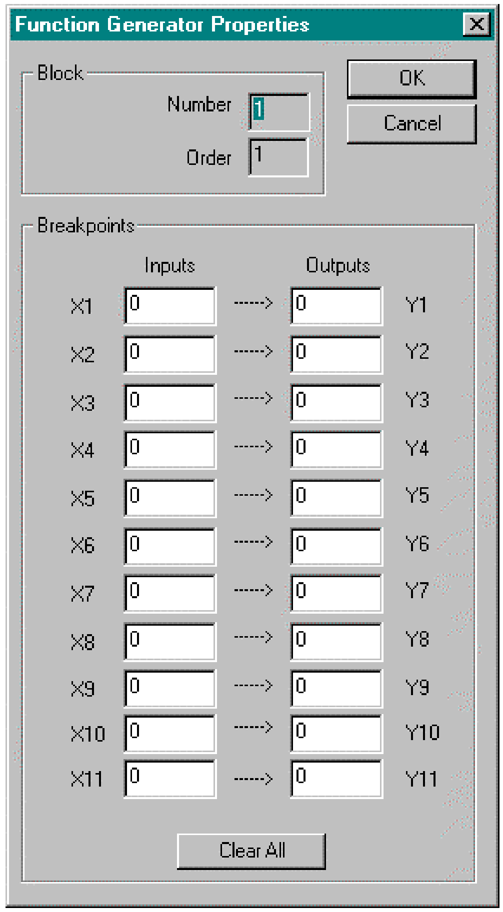
Input

X = Analog Value

Output

OUT = Calculated Analog Value

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the FGEN function Block parameters to the desired value or selection that matches your operating requirements. Table 27 describes the parameters and the value or selection.

Table 27 Function generator configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Block Order**			Read Only. See "Configure" Menu, "Execution Order" to change.
Breakpoints	**X1**	0	X-value at Input Breakpoint 1	–99999 to 999999
	X2	1	X-value at Input Breakpoint 2	–99999 to 999999
	X3	2	X-value at Input Breakpoint 3	–99999 to 999999
	X4	3	X-value at Input Breakpoint 4	–99999 to 999999
	X5	4	X-value at Input Breakpoint 5	–99999 to 999999
	X6	5	X-value at Input Breakpoint 6	–99999 to 999999
	X7	6	X-value at Input Breakpoint 7	–99999 to 999999
	X8	7	X-value at Input Breakpoint 8	–99999 to 999999
	X9	8	X-value at Input Breakpoint 9	–99999 to 999999
	X10	9	X-value at Input Breakpoint 10	–99999 to 999999
	X11	10	X-value at Input Breakpoint 11	–99999 to 999999
	Y1	11	Y-value at Output Breakpoint 1	–99999 to 999999
	Y2	12	Y-value at Output Breakpoint 2	–99999 to 999999
	Y3	13	Y-value at Output Breakpoint 3	–99999 to 999999
	Y4	14	Y-value at Output Breakpoint 4	–99999 to 999999
	Y5	15	Y-value at Output Breakpoint 5	–99999 to 999999
	Y6	16	Y-value at Output Breakpoint 6	–99999 to 999999
	Y7	17	Y-value at Output Breakpoint 7	–99999 to 999999
	Y8	18	Y-value at Output Breakpoint 8	–99999 to 999999
	Y9	19	Y-value at Output Breakpoint 9	–99999 to 999999
	Y10	20	Y-value at Output Breakpoint 10	–99999 to 999999
	Y11	21	Y-value at Output Breakpoint 11	–99999 to 999999
Clear All Button		Click on button to clear all breakpoint values.		

Examples

Figure 26 shows a function block diagram using a FGEN function block to characterize the PID control loop output for control valve operation using 9 breakpoints.

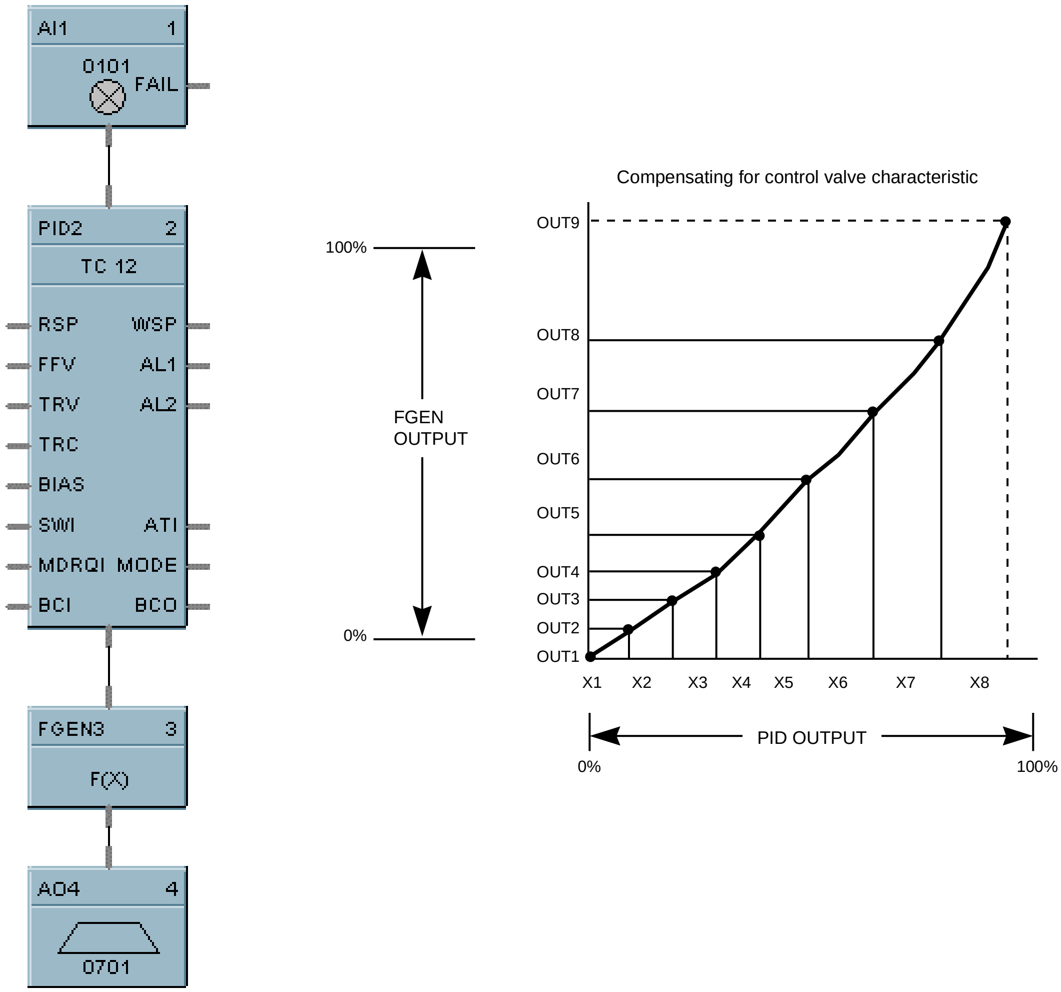
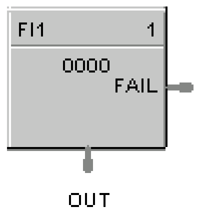


Figure 26 FGEN function block example

FI Function Block

Description

The **FI** label stands for **Frequency Input.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder.



Function

This function block reads a single frequency channel from a pulse-frequency-input module. It scales inputs from the module to user-configured engineering units per unit time. The function is used for measuring speed and flow rate. The frequency high and low limits are sent to the module and the module will respond with FAIL or the frequency input value.

Inputs

None

Outputs

FAIL = A Boolean value that turns ON when the Pulse/Frequency input module reports a failure.

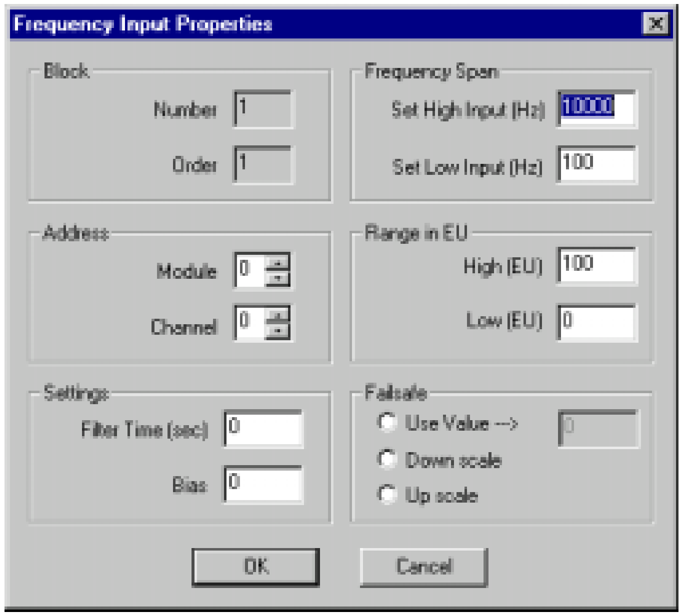
OUT = The frequency input value in engineering units (after needed ranges, bias, or failsafe conditions have been applied).

The formula for calculating the Output value is:

$$OUT = \left(\frac{FREQ_{IN} - FREQ_{ZERO}}{FREQ_{SPAN} - FREQ_{ZERO}} \right) * \left(EU_{HIGH} - EU_{LOW} \right) + EU_{LOW} + BIAS$$

The generic forcing of outputs is not permitted.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the FI function Block parameters to the desired value or selection that matches your operating requirements. Table 22 describes the parameters and the value or selection.

Table 28 Frequency input function block parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Address	**I/O Module**	N/A	Address of select I/O Module	From 1 to 16
	Channel	N/A	Channel on selected I/O Module	From 1 to 4
Settings	**Filter Time (sec)**	2	Filter Time Constant	0 – 120 seconds Default = 0
	Bias	3	Bias value applied to the Output	0-100000 EU Default = 0
Frequency Span	**Set High Input (Hz)**	9	Frequency High Input Highest value of the input device – must be larger than the lower Input	10Hz to 100KHz Default = 10KHz
	Set Low Input (Hz)	8	Frequency LOwLimit Low value of the input device	10Hz to 100KHz Default = 100Hz

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Range in EU	**High (EU)**	6	Out high limit in EU	0-1000000 EU Default = 100
	Low (EU)	7	Out low limit in EU	0-1000000 EU Default = 0
Failsafe	**Use Value**	4	The output value to which the output will go to protect against the effects of failure of the equipment	Failsafe value in Engineering Units
	Downscale	N/A	Use Range Low	Click on Radio button to select
	Upscale	N/A	Use Range High	Click on Radio button to select

Example

Figure 27 shows a Function Block Diagram using a FI function block for a Flow control loop with Pulse output and Flowmeter input.

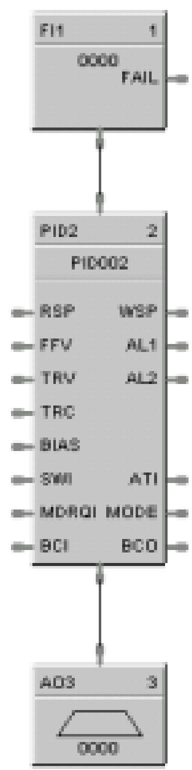
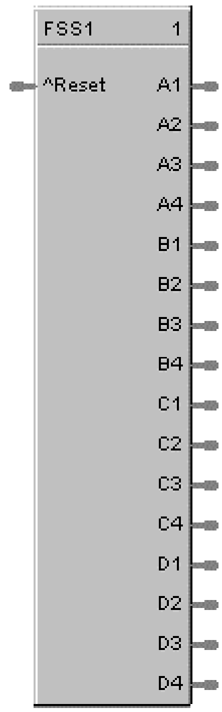


Figure 27 FI function block example

FSS Function Block

Description

The **FSS** label stands for **Four-Selector Switch**. This block is part of the *Logic* category. It looks like this graphically on the Control Builder:



Function

Provides 16 digital outputs in groups of four. A dedicated display allows activating of only one output per group while other outputs are turned off.

Inputs

RESET = Off to ON requests a reset state. Reset Input turns on #1 output of all 4 groups.

Outputs

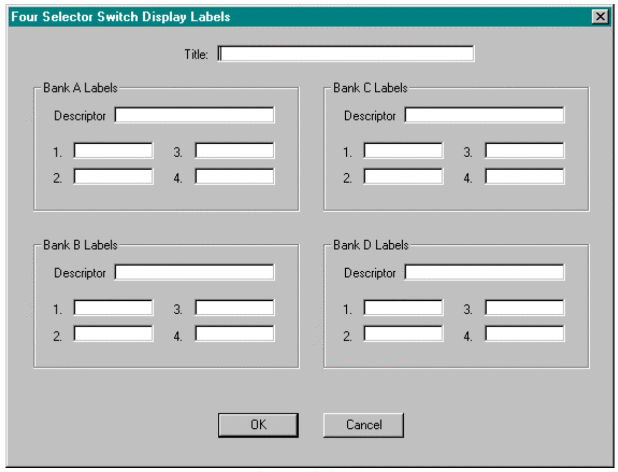
A1, A2, A3, A4 = Bank A Output 1 through Output 4
B1, B2, B3, B4 = Bank B Output 1 through Output 4
C1, C2, C3, C4 = Bank C Output 1 through Output 4
D1, D2, D3, D4 = Bank D Output 1 through Output 4

ATTENTION

Only one output ON per group, A, B, C, D.

If the Operator Interface makes a request and RESET occurs on the same cycle, RESET will take precedence.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the FSS function Block parameters to the desired value or selection that matches your operating requirements. Table 29 describes the parameters and the value or selection.

Table 29 Four selector switch configuration parameters for operator interface display

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Title			Enter a Title for the block	24 characters
Bank x Labels	**Descriptor**		Enter a Descriptor for Bank x Labels	16 characters
X = A, B, C, or D	**Bank x Label 1**		Enter a label name for display	6 characters
	Bank x Label 2		Enter a label name for display	6 characters
	Bank x Label 3		Enter a label name for display	6 characters
	Bank x Label 4		Enter a label name for display	6 characters

Example

Figure 28 shows a FFS function block and its associated display.

ATTENTION

The Four Selector group display is directly associated with the Four Selector Function Block. Pressing O/I Keys F1 through F4 call up a dialog box that allows changes to the output selection for the associated block.

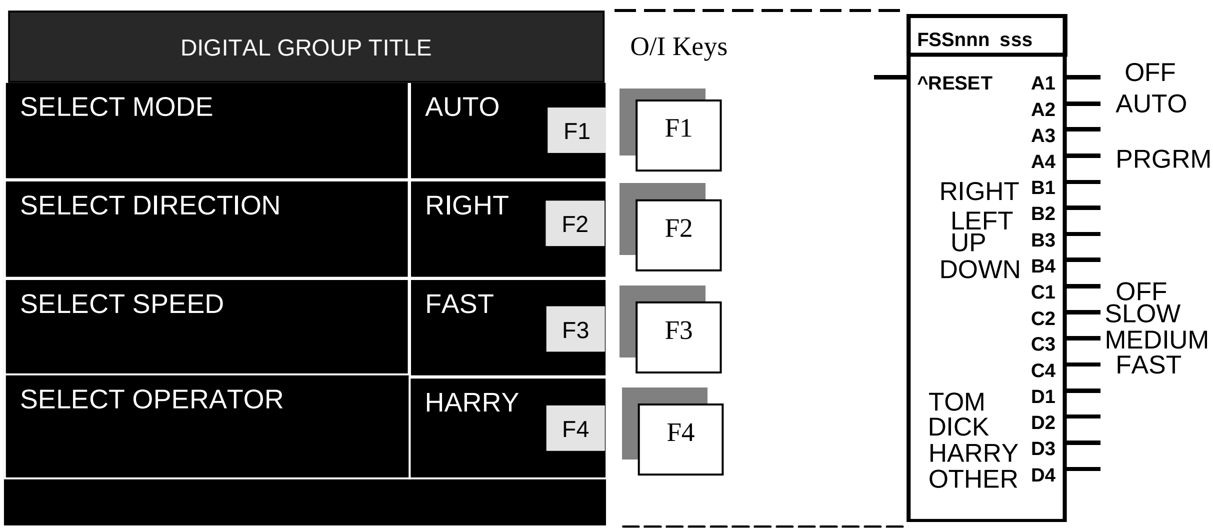


Figure 28 FSS function block example

FSYS Function Block

Description

The **Fast Logic Status Block (FSYS)** is a function block and is part of the *Fast Logic* category. It provides read access to controller status values including those related to the Fast Logic execution cycle. The output may be connected to function block inputs. The outputs may also be connected to signal tags for operator interface monitoring. The FSYS System Monitoring block is assigned block number 250. It looks like this graphically on the Control Builder:

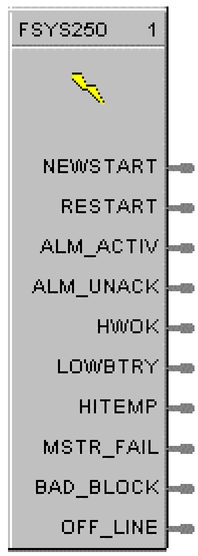


Table 30 describes the outputs for the Fast Logic system status block.

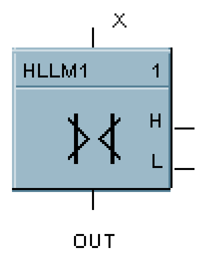
Table 30 Fast logic system status block outputs

Output	Description
NEWSTART	Newstart is ON for one full scan cycle of Fast Logic control block execution, following a cold start of the controller. For example: starting after a change from program to run.
RESTART	Restart is ON for one full scan cycle of Fast Logic control block execution, following the warm start of the controller.
ALM ACTIV	Alarm Active is ON if any operator panel alarm is ON.
ALMUNACK	Alarm unacknowledge is ON if any operator panel's alarm is unacknowledged.
HWOK	Hardware OK is ON if there are no faults.
LOWBTRY	Low Battery is ON if the battery is low, Off when battery is good.
HI TEMP	High CJ Temperature is ON if the CJ temperature is high.
MSTR FAIL	Communications Failure is ON when Modbus master diagnostic is not good
BAD BLOCK	Bad Block is ON when one or more blocks are not operating properly.
OFF LINE	Off Line is ON when the controller mode switch is in the Off Line mode.

HLLM Function Block

Description

The HLLM label stands for **High Low** limiter. This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder:



Function

Provide high-low limit for an analog (**X**) value.

Turns ON H or L digital output if input exceeds or falls below set limits.

- If X < or = Low Limit value, then: **OUT = LoLlM; L = ON; H = OFF.**
- If X > or = High Limit value, then: **OUT = HiLlM; L = OFF; H= ON.**
- If X > Low Limit value and < high Limit value, then: **OUT = X; L = OFF; H = OFF.**

Input

X = Analog Value

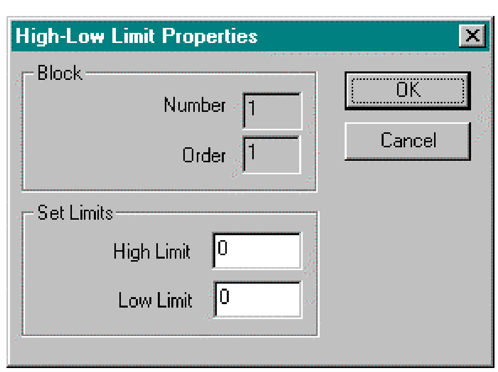
Output

OUT = Analog value within limits

L = Low Limit digital indication

H= High Limit digital indication

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the HLLM function Block parameters to the desired value or selection that matches your operating requirements. Table 31 describes the parameters and the value or selection.

Table 31 High low limit configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Limits	**High Limit**	0	High limit value for analog (X) value	–99999 to 999999
	Low Limit	1	Low limit value for analog (X) value	–99999 to 999999

Example

Figure 29 shows a Function Block Diagram using an HLLM function block to provide a remote setpoint signal within specified limits to a PID Control Loop.

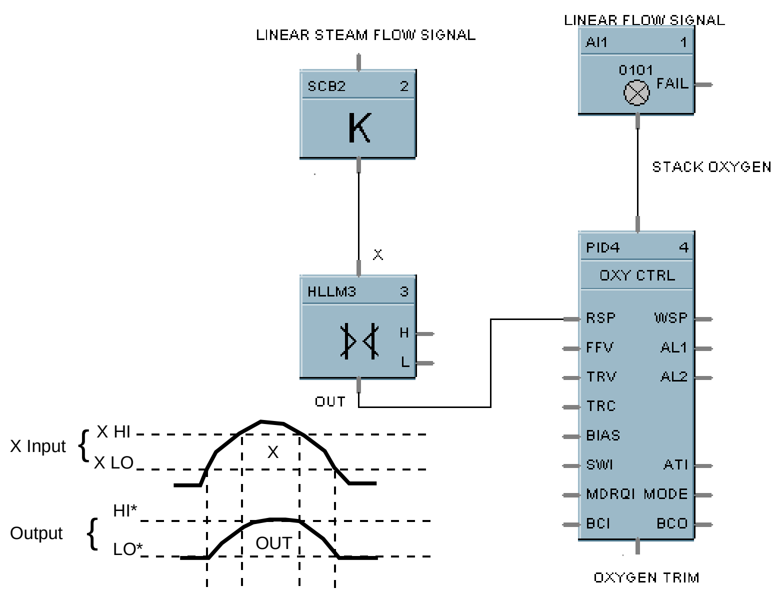
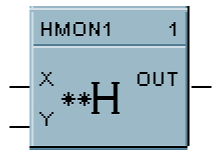


Figure 29 HLLM function block example

HMON Function Block

Description

The **HMON** label stands for **High Monitor.** This block is part of the *Alarm/Monitor* category. It looks like this graphically on the Control Builder.



Function

Monitors two analog input values (X and Y) and turns ON a digital output if X exceeds Y.
A hysteresis adjustment is provided to prevent output cycling.

- If X > Y, then **OUT = ON.**
- If X < or = (Y – Hysteresis), then **OUT = OFF.**
- If (Y – Hysteresis) < X < Y, then **OUT = Previous State.**

Input

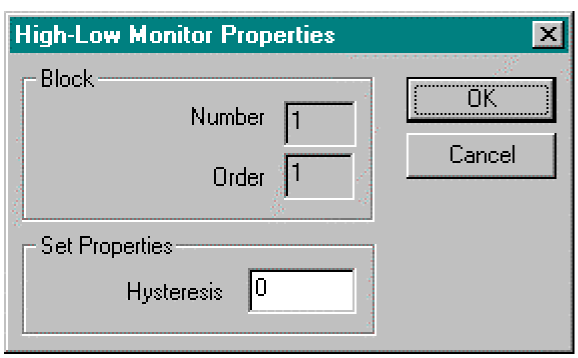
X = Analog value.

Y = Analog value

Output

OUT = Digital signal

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the HMON function Block parameters to the desired value or selection that matches your operating requirements. Table 32 describes the parameters and the value or selection.

Table 32 High monitor function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Properties	**Hysteresis**	0	An adjustable overlap of the On/Off states of the output.	0 to the Span of Y input in Engineering units**.**

Example

Figure 30 shows a Function Block Diagram using an HMON function block. It shows a typical output signal response provided by an HMON function block.

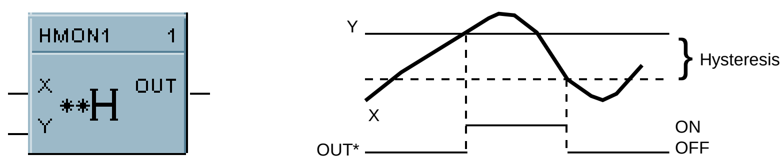
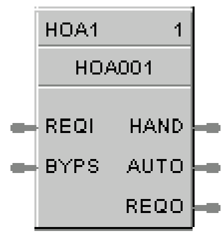


Figure 30 HMON function block example

HOA Function Block

Description

The **HOA** label stands for **Hand/Off/Auto Switch.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

The Hand – Off – Auto (HOA) switch function block permits state change requests from a Local Operator Interface or a Remote source. The block states are: BYPASS (external manual operation of a device), HAND (manual operation from an operator interface), AUTO (default – requests are operated automatically), or OFF (relay to be switched to Bypass, Hand, or Auto)

The HOA switch is also used with the Device Control (DC) function block to comprise a Pump Control algorithm which is used to manipulate the state of a controlled device (pump).

Each configuration is limited to a maximumof 16 HOA function blocks.
Forcing of outputs is NOT permitted within this block.

Input

REQI = If the current state of the block is AUTO, then REQO output (on/off) equals the REQI input (on/off)

BYPS = If ON, the REQO output is forced off and any state change requests are ignored. If OFF, the block returns to its previous state (Hand, Off, Auto)

Output

HAND = ON when the block is in the HAND state, else OFF. Device is in manual operation from an operator interface; prevents automatic operation; this state forces the REQO output ON.

AUTO = On when block is in AUTO state, else OFF. Requests are operated automatically.

REQO = This is ON when in the HAND state, or when in the AUTO state and the REQI input signal is ON. OFF when in the OFF or BYPASS state.

Note. Both HAND and AUTO are OFF in the OFF and BYPASS states.

Block properties

The **HAND/OFF/AUTO** properties dialog box is divided into two tab cards:

GENERAL
FEEDBACK SIGNAL

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 33 describes the parameters and the value or selection.

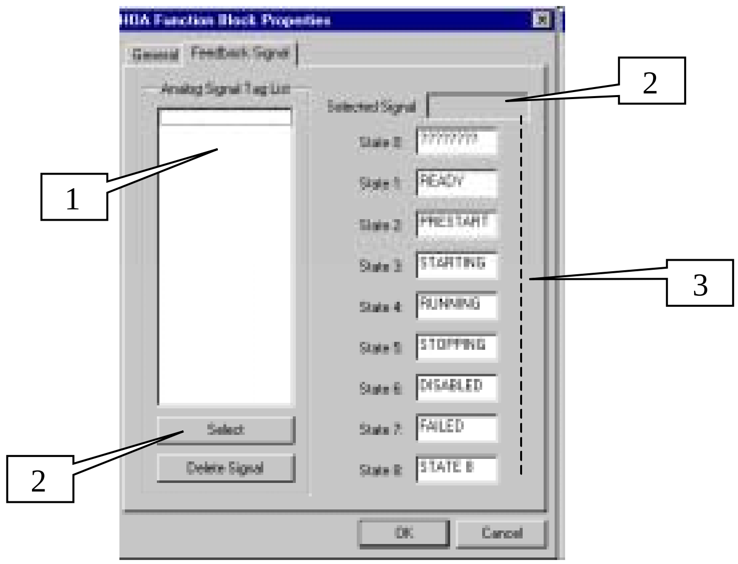
Table 33 HOA general tab parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Display	**Tag Name**	N/A	8-character tag name	
	Descriptor	N/A	Block description	
Settings	**HOA Source**	N/A	Determines which devices have permission to write Hand-Off-Auto state change requests	**Local** (Local Operator Interface) **Remote** (Serial Communications) **Local/Remote** Default = Local/Remote
	Initial State	N/A	Start-up state of the function block. User can change the current state from the operator interface if the **HOA Source** is **Local** or **Both**	**OFF** **HAND** **AUTO**

FEEDBACK SIGNAL tab

It looks like this graphically on the Control Builder. Table 34 describes the parameters and the value or selection. The feedback signal is used for display purposes.

When the HOA block is used in conjunction with a Device Control (DC) block, the feedback is typically referenced to the (STI) status output pin of the DC block. The sample text shown in Table 34 would correspond to the states of the DC block.



To select a Feedback signal and to define state text for the enumerated value of the feedback signal, proceed with the sequence 1 through 3 below.

Table 34 HOA feedback signal tab parameters

Sequence Number	Parameter Field	Action	Selections	Comments
1		Click on a signal tag in the list	Select from all configured Analog Signal tags listed	

Sequence Number	Parameter Field	Action	Selections		Comments
2		Click “Select” at the bottom of the “*Analog Signal Tag List*” to place highlighted signal tag into the “Selected Signal” field			 The selection is placed in the Selected Signal field on the dialog box. Click on “Delete Signal” at the bottom of the “*Analog Signal Tag List*” to remove a signal tag from field.
3		The state text will be selected for the display based on the numerical value (0 through 8) of the specified analog signal.	<u>Default Text</u> ???????? READY PRESTART STARTING RUNNING STOPPING FAILED DISABLED STATE 8	Enumerated value of selected <u>signal</u> 0 1 2 3 4 5 6 7 8	You can highlight any state and change the text to whatever you desire for that state. ???????? = Block not used

Example

Figure 32 shows a Function Block Diagram using an HOA function block in conjunction with a Device Control (DC) block and an external HOA switch for pump control. The level signal input and Compare (CMPR) function are used to determine pump On/Off demand.

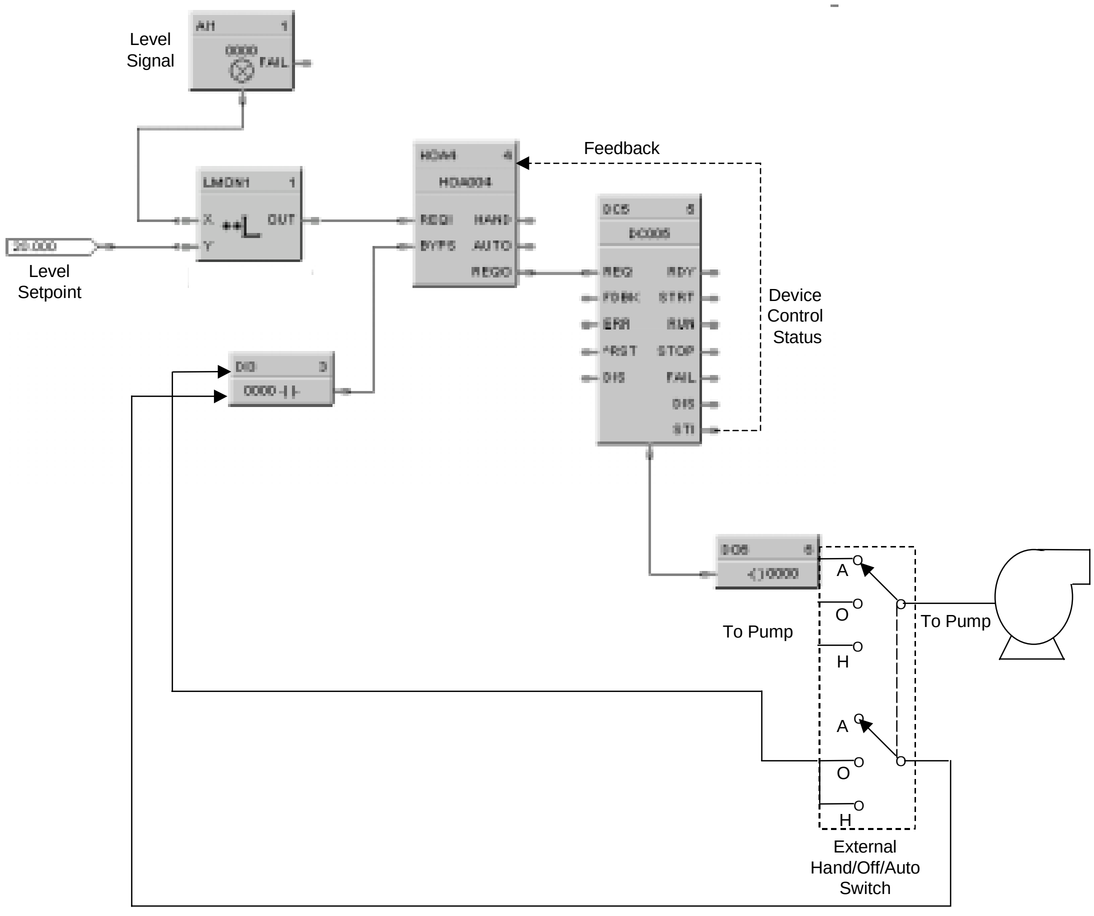
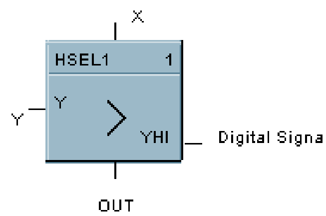


Figure 31 HOA function block example

HSEL Function Block

Description

The **HSEL** label stands for **High Selector.** This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Function

Selects higher of two analog input values (X and Y) for output.
Indicates when Y is higher than X.

- If X > or = Y, then: **OUT = X; YHI = OFF.**
- If X < Y, then: **OUT = Y; YHI = ON.**

Input

X = Analog value
Y = Analog value

Output

OUT = Higher analog value
YHI = Digital signal. (ON when Y>X.)

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 32 shows a Function Block Diagram using an HSEL function block to monitor two analog inputs to activate an alarm signal tag.

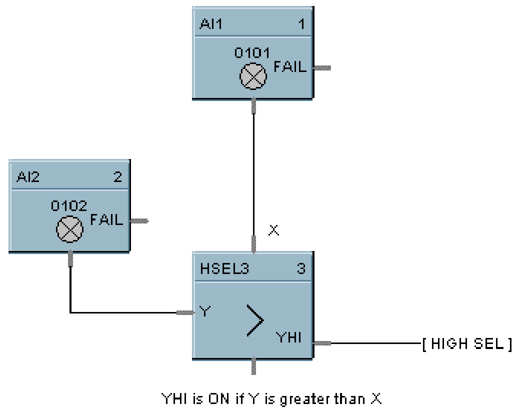
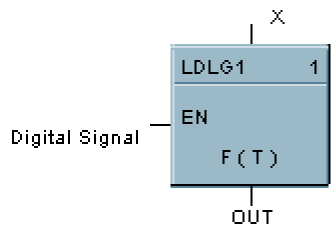


Figure 32 HSEL Function Block Example

LDLG Function Block

Description

The **LDLG** label stands for **Lead/Lag.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

Modifies an analog input value (X) to include LEAD (T2) and LAG (T1) time constants of from 0 to 99 minutes, when a digital input (EN) is ON.

- If EN = ON, then:

$$\mathbf{OUT = \frac{1 + sT2}{1 + sT1} \; x \; X}$$

s = Laplace operator

If T1 = 0, then:

$$\mathbf{OUT = last\ X + \frac{T2}{t}\ (X - last\ X)}$$

last X = *Input value from execution cycle.*

t = *Duration of previous cycle time in minutes.*

If T2 = 0, then the block functions as a digital lag filter.

- If EN = OFF, or initial start, then: **OUT = X.**

Inputs

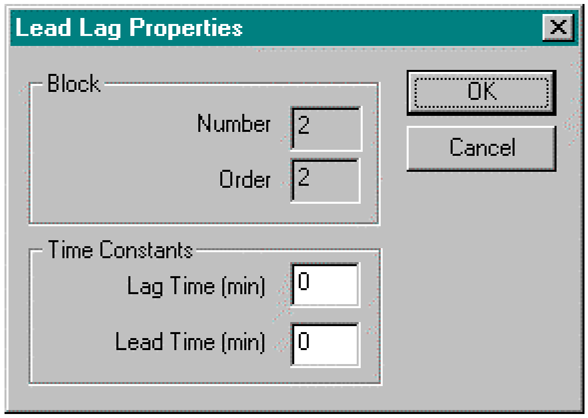
X = Analog value (Primary Input)

EN = Digital signal (Enable)

Output

OUT = Analog value as modified

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the LDLG function Block parameters to the desired value or selection that matches your operating requirements. Table 35 describes the parameters and the value or selection.

Table 35 Lead lag configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Time Constants	**Lag Time (min)**	0	T1 - Lag Time Constant	0.00 to 99.00 minutes
	Lead Time (min)	1	T2 - Lead Time Constant NOTE: If T2 is set to 0, function becomes a lag filter.	0.00 to 99.00 minutes

Example

Figure 33 shows a Function Block Diagram using an LDLG function block to modify the PV signal for the remote setpoint input of the PID control loop.

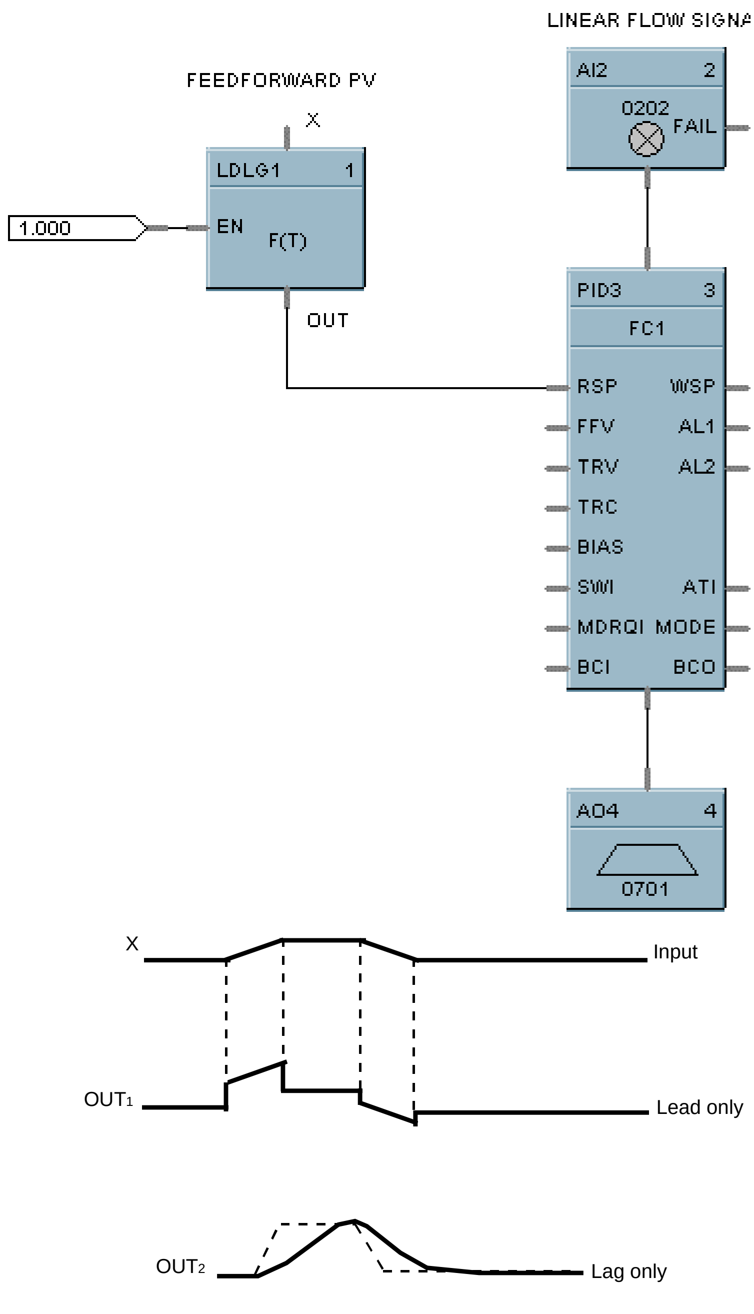
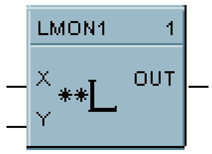


Figure 33 LDLG function block example

LMON Function Block

Description

The **LMON** label stands for **Low Monitor.** This block is part of the *Alarm/Monitor* category. It looks like this graphically on the Control Builder.



Function

Monitors two analog input values (X and Y), and turns ON a digital output if X is less than Y. A hysteresis adjustment is provided to prevent output cycling.

- If X < Y, then: **OUT = ON.**
- If X > or = (Y + Hysteresis), then: **OUT = OFF.**
- If (Y + Hysteresis) > X > Y, then: **OUT = Previous State.**

Input

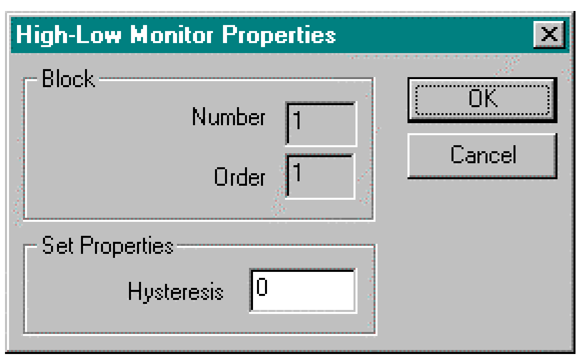
X = Analog value.

Y = Analog value

Output

OUT = Digital signal

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the LMON function Block parameters to the desired value or selection that matches your operating requirements. Table 36 describes the parameters and the value or selection.

Table 36 Low monitor function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Properties	**Hysteresis**	0	An adjustable overlap of the On/Off states of the output.	0 to the Span of Y input in Engineering units**.**

Example

Figure 34 shows a Function Block Diagram using an LMON function block. It shows a typical output response provided by a LMON function block.

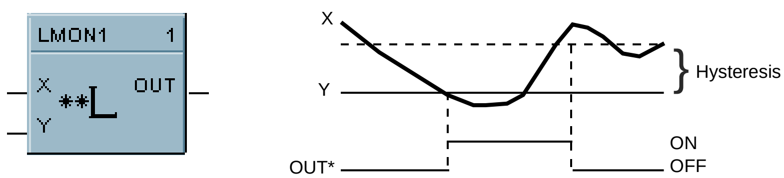
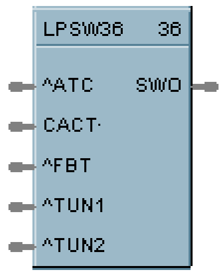


Figure 34 LMON function block example

LPSW Function Block

Description

The **LPSW** label stands for **Loop Switch.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Digital interface to control loops to initiate autotuning, change control action, force bumpless transfer, select tuning set. Connects to a PID, TPSC, or CARB function blocks.

Inputs

^ATC = Autotune Command (OFF to ON initiates Autotuning)**

CACT = Change Control Action (ON changes Control Action)

^FBT = Force Bumpless Transfer (OFF to ON Forces Bumpless Transfer)**

^TUN1 = Tune Set 1 (OFF to ON switches to Tune Set 1*)**

^TUN2 = Tune Set 2 (OFF to ON switches to Tune Set 2)**

** Switch to Tune Set 1 overrides concurrent command to switch to Tune Set 2*

*** Not available for ON/OFF function Block*

Output

SWO = The output of this block must connect to the SW1 input of a PID, CARB, and TPSC function block.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 35 shows a Function Block Diagram using an LPSW function block

Function: Digital interface to initiate:

- Autotuning
- Change Control Action: Direct/Reverse Action
- Force Bumpless Transfer (rebalance the algorithm)
- Select Tuning Set #1
- Select Tuning Set #2

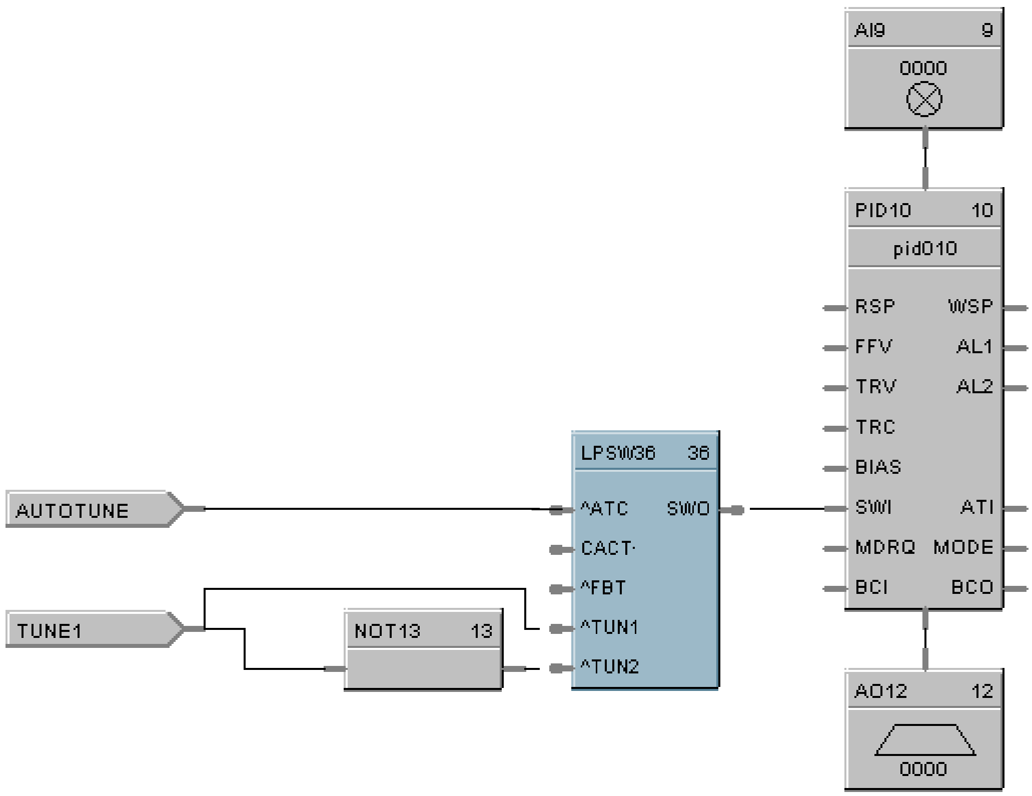
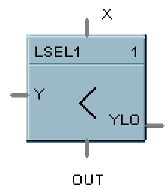


Figure 35 LPSW function block example

LSEL Function Block

Description

The **LSEL** label stands for **Low Selector.** This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Function

Selects lower of two analog input values (X & Y) for output.
Indicates when Y is lower than X.

- If X < or = Y, then: **OUT = X; YLO = OFF.**
- If X > Y, then: **OUT = Y; YLO = ON.**

Input

X = Analog value
Y = Analog value

Output

OUT = Lower analog value
YLO = Digital signal (ON when Y<X)

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 36 shows a Function Block Diagram using an LSEL function block to monitor two analog inputs to activate an alarm signal tag.

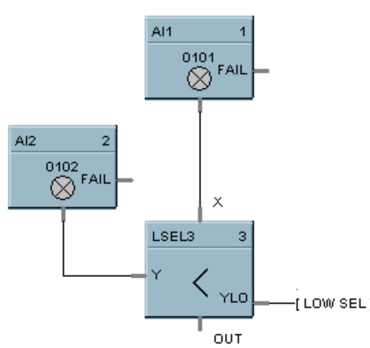


Figure 36 LSEL function block example

LTCH Function Block

Description

The **LTCH** label stands for **Latch.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.

OR

Fast Logic

Function

Latches output (OUT) ON when latch input (L) turns ON and maintain latched output until unlatch input (U) turns ON. Note that latch input must be OFF for unlatch input to work.

- If U = ON, then: **OUT = OFF.**
- If L = ON, then: **OUT = ON.**
- Else, **OUT = Previous State.**

Input

L = Latch Command Digital signal.

U = Unlatch Command Digital signal.

Output

OUT = Digital signal

Block properties

Double click on the function block to access the function block properties dialog box.

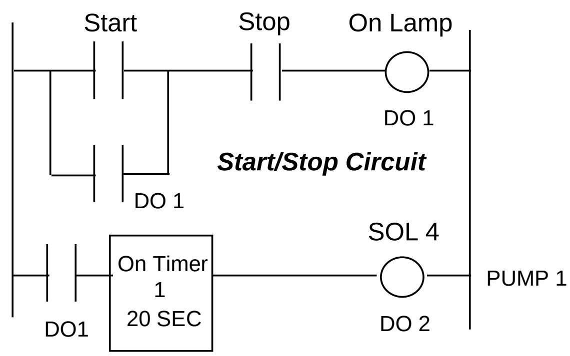
Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 37 shows a Function Block Diagram using an LTCH function block.

PLC Ladder Logic

An ON Delay timer is added to a basic Start/Stop circuit which activates the ON Lamp. In ladder logic, the DO1 contact status is used to activate the timer and latch in the start pushbutton action. After 20 sec., SOL4 (DO2) is turned ON which is held as long as DO1 is ON.



UMC 800 Logic

The Start/Stop latch circuit is used since no external confirmation is needed. In this example, the Operator Panel pushbutton switches (F1 and F2) are used to substitute for panel switches. The Push Button function block is used to assign Start to F1 and Stop to F2. The latch output turns on the ON Lamp and starts the timer. After 20 sec., Solenoid 4 is activated. Note: the ON and OFF Delay timers are reset after timeout or if the logic state to the input goes to logic 0 (or low).

5 Function Blocks

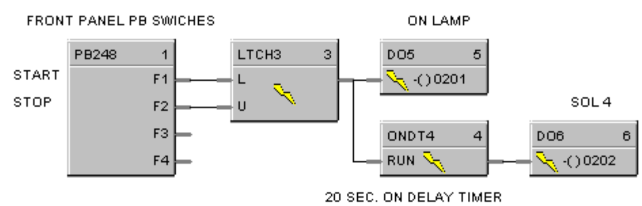
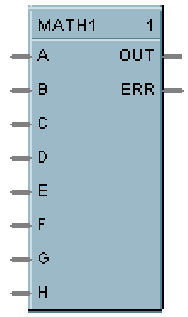


Figure 37 LTCH function block example

MATH Function Block

Description

The **MATH** label stands for **Free Form Math.** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Read inputs A through H and calculates the output based on specified general purpose calculation. OUT is calculated from an equation entered here.

- Offers the following general purpose calculation functions:
  - abs = addition,
  - EXP = exponential (ln^{-1}),
  - Ln = natural log (log base e),
  - Log 10 = log base 10,
  - neg (Unary) - = negation,
  - sqrt = Square Root,
  - + = addition,
  - – = subtraction,
  - * = multiplication,
  - / = division,
  - ^ = raised to power of (x^y)
  - (= left parenthesis,
  -) = right parenthesis, and
- A maximum of either 50 tokens (note 1) per equation or 100 characters per line is allowed, whichever is first exceeded.

ATTENTION

A token is an operation, variable, or pair of parenthesis; the end of an equation counts as one token.

Inputs

IN A – block input 1
IN B – block input 2
IN C – block input 3
IN D – block input 4
IN E – block input 5
IN F – block input 6
IN G – block input 7
IN H – block input 8

Output

ERR = ON if block detects an error on any of the following operations:

- division by 0
- fractional root of a negative number (for example: -2**0.5)
- zero to the zero power
- LOG10 or LN of a negative number or 0
- result of x^y is greater than 1.7E + 308.
- result of EXP (x) is greater than 3.4E + 308 or less than 3.4E -308.

ATTENTION

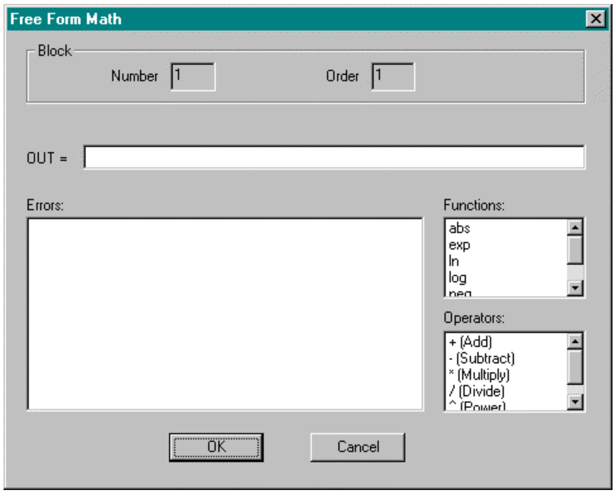
- For the above rules, groups of constants will be combined and treated as one constant.
- Any number less than or equal to 3.4E -308 is considered 0.

OUT = Calculated Output

ATTENTION

- Use only the following words and characters in equations
  - +; -; *; /: ^; EXP; LOG10; Ln; Negative (Unary minus);
  - ' ' Blank space (ignored)
  - 'a' . . 'h' Variables (operand) either a constant or tag
  - ( ), [ ], { } Parentheses - 3 types
- A left parenthesis must have a matching right parenthesis.
- The matching parenthesis must be the same type - e.g., ( ), [ ], or { }.
- Parentheses may be nested to any depth.
- Infix operators: +, -, *, /, ^ must have a left and right operand.
- If the '-' operator only has a right operand, it is interpreted as the Unary minus.
- Function operators: EXP, LOG10, Ln must have an operand to the right, and the operand must be enclosed in parentheses.
  Example: EXP(A), LOG10(b), LN(c).

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the MATH function Block parameters to the desired value or selection that matches your operating requirements. Table 37 describes the parameters and the value or selection.

Table 37 Math function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Equations	**Equation Field**	N/A	OUT= [equation]	Enter the desired equation in this field
Functions	**Math Functions**	N/A	abs, exp, In, log, neg, sqrt	Double Click on a function to select from the list box
Operators	**Math Operations**	N/A	+ (add) - (subtract) * (multiply) / (divide) ^ (power)	Double Click on an operation from the list box
Errors	**Error list**	N/A	List of equation errors	

Example

Figure 38 shows a Function Block Diagram using a MATH function block to determine a general-purpose calculation output.

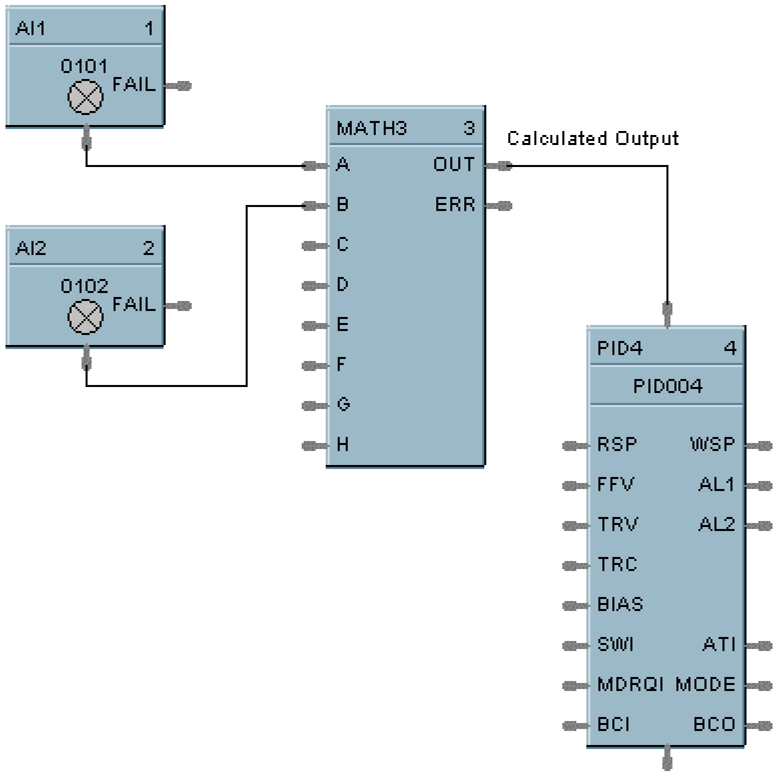
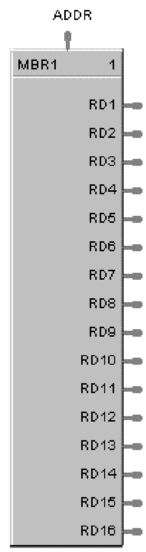


Figure 38 MATH function block example

MBR Function Block

Description

The **MBR** label stands for **Modbus Read.** This block is part of the *Communications* category. It looks like this graphically on the Control Builder.



Function

A communication function block that expands the read capability of the Modbus Slave function block to 16 additional data points. Multiple blocks may be connected to the same Modbus Slave block.

The Modbus read block has no inputs and 16 outputs. Up to 16 registers can be configured as the source of data for the outputs.

The configuration data for each point will consist of:

- the address of the source device on the Modbus link,
- the register address of the desired data,
- and the register type: Integer, Float, or Bit Packed.

The sixteen outputs can be connected or tagged in the same manner as any other function block output.

Inputs

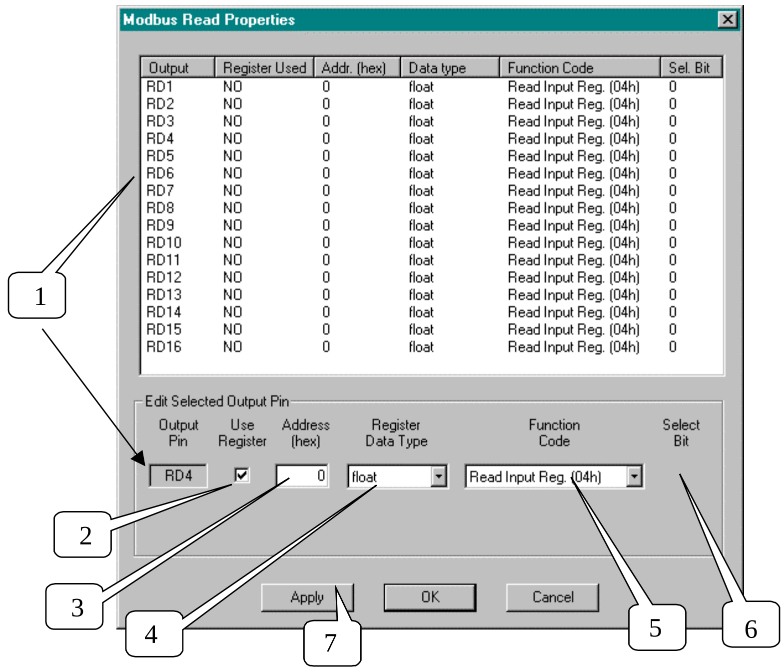
ADDR = Slave address from associated MBS block. (Must be connected to a MBS block)

Outputs

RD1 through RD16 – Last read value from selected address

Block properties

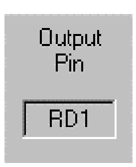
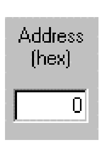
Double click on the function block to access the function block properties dialog box.

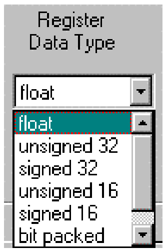
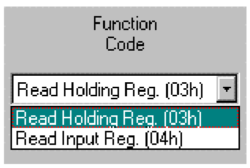
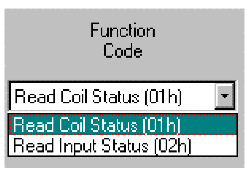
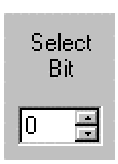


Configuration parameters

You must configure the MBR function Block Output Pins as shown in the “Edit Selected Output Pin” portion of the dialog box. Follow the numbered sequence shown above referring to Table 38.

Table 38 MBR function block configuration parameters

Sequence Number	Parameter Field	Action	Selections	Comments
1		Click on an Output Pin from the list of pins in the upper portion of the dialog box.	RD1 through RD16	The selected Output Pin will appear in the Output Pin Field.
2		Click on the “Use Register” field to assign a register to the Output pin.	RD1 through RD16	YES will be indicated in the “Register used” column when you select “Apply
3		Type in the address of the register (in Hex) on the slave device		

Sequence Number	Parameter Field	Action	Selections	Comments
4		From the drop down menu, select the Register Data Type	• Float • Unsigned 32 • Signed 32 • Unsigned 16 • Signed 16 • Bit Packed • Single Bit	If read as an integer, the output is converted to a floating point.
5	 	Select a function code for **"Float, Unsigned, Signed, or Bit Packed"** register data type Select a function code for **"Single Bit"** Register data type.	• Read Holding Reg – Function Code 03 • Read Input Registers – Function Code 04 • Read Coil Status – Function Code 01 • Read Input Status – Function Code 02	Function code 03 or Function code 04 is used to read the contents of input registers in the slave. Function code 01 is used to read a slave's coil's (discrete output's) ON/OFF status of the slave device in a binary data format. Function code 02 is used to read a slave's input's (discrete input's) ON/OFF status of the slave device in a binary data format. Output is floating point equivalent (0.0 or 1.0). NOTE: Refer to the Communications manual for the function codes supported by the specific device.
6		Select which bit (0-15) to read when Register Data Type = Bit Packed	0 to 15	If read as a bit packed number, you must select which bit to mask (0-15). The output will be the floating-point equivalent (0.0 or 1.0) of the masked bit.
7	You must press [APPLY] to accept the register changes.			

Example

Figure 39 shows a Function Block Diagram using Modbus function blocks.

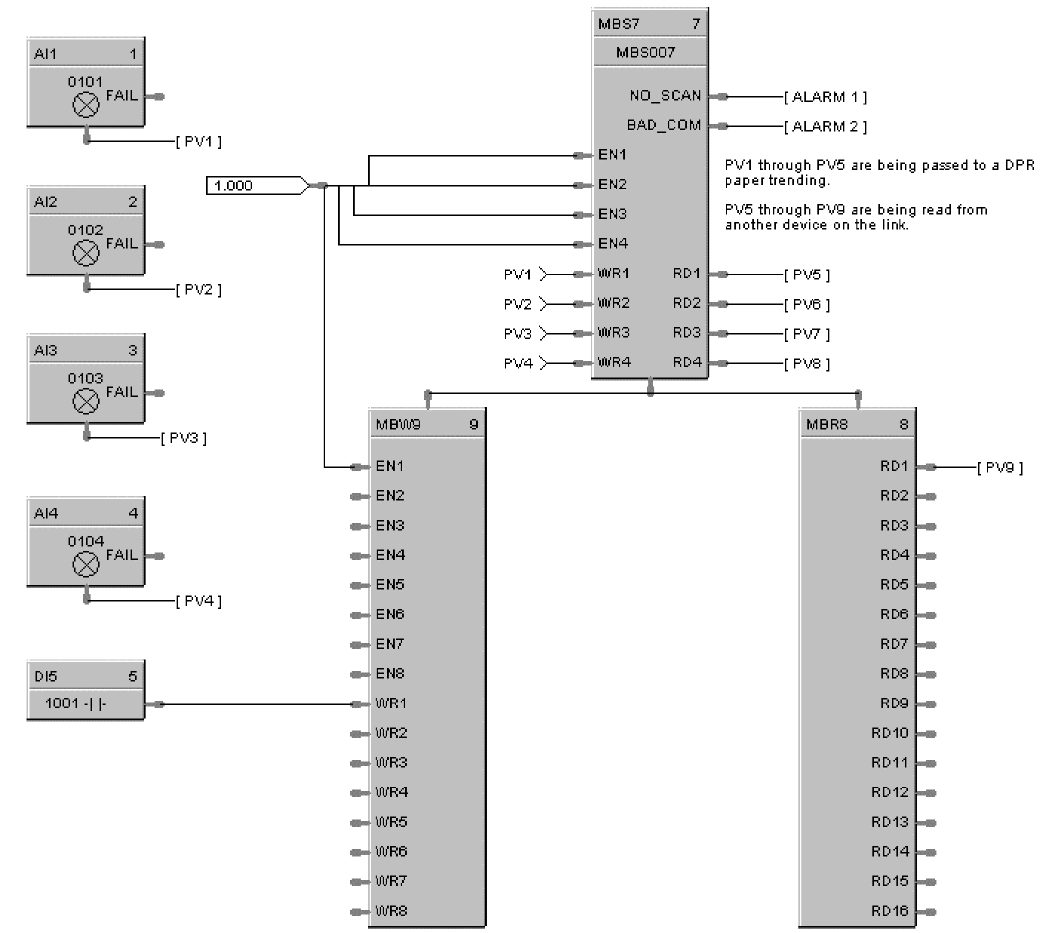
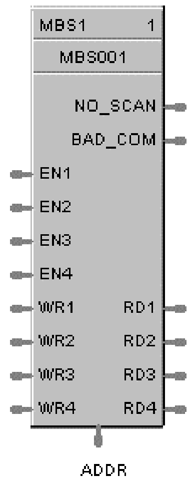


Figure 39 MBR function block example

MBS Function Block

Description

The **MBS** label stands for **Modbus Slave Status.** This block is part of the *Communications* category. It looks like this graphically on the Control Builder.



Function

A communication function block that is internally assigned to optional Communication Port B that allows the controller to act as a master device and communicate with slave devices using the Modbus protocol. Requires one block per slave device, up to 16 devices maximum. Only one block may be assigned to each slave device. It supports 4 read and 4 write parameters plus provides digital indication of communication integrity.

Inputs

EN1 through EN4 = [ON] Data value written once per scan

WR1 through WR4 = Values to be written to the selected register

ATTENTION

- This block does not support bit packing and single bit writing.
- If the register is an integer data type, the floating point input will be rounded up prior to writing to the address register.
- Message Broadcasting is not supported on the UMC800.

Outputs

RD1 through RD4 = Last read value from the selected address

NO_SCAN = Scan Indication
ON = Device is "Out of Scan"
OFF = Device is "In Scan".

BAD_COM = Communications Indication
ON = Bad quality or device not defined
OFF = Good Communications

ADDR = Slave Address for use with MBR and MBW function blocks

---

ATTENTION

- Integer values are converted to floating point values prior to output.
- If a Modbus slave device does not respond to a request, the last output value will be maintained.

Block properties

Double click on the function block to access the function block properties dialog box.

Configuration parameters

The ON/OFF properties dialog box is divided into Three tab cards:

GENERAL
READ
WRITE

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 39 describes the parameters and the value or selection.

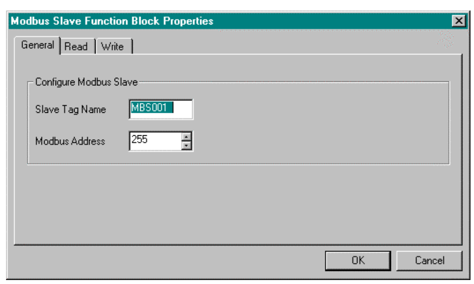


Table 39 MBS Block General tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Configure Modbus Slave	Slave Tag Name	1	Description of Slave Device	8-character tag name Slave address and Tag Name must be unique within a control file.
	Modbus Address	2	Address of Slave device on the Modbus link	Enter unique address between 1 and 247 Default MB address = 255 which means slave will **NOT** be in scan

READ tab

It looks like this graphically on the Control Builder. Table 40 describes the parameters and the value or selection.

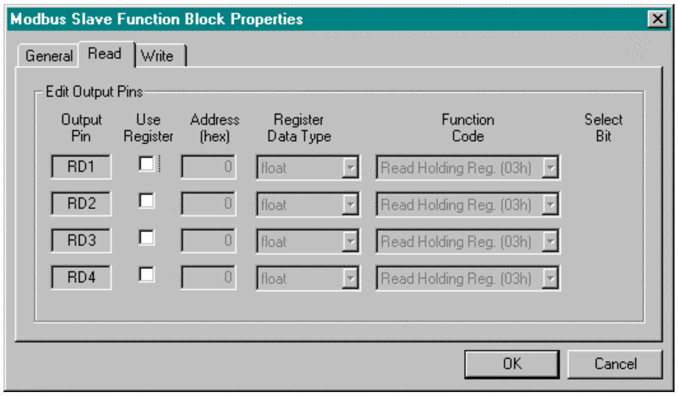


Table 40 MBS Block Read tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Edit Output Pins	**Output Pin**	1	Output pin designation	Register request assigned to RD1, RD2, RD3, or RD4 pin
	Use Register	2	Register Request	Click on the “Use Register” field to assign a register to the Output pin.
	Address (hex)		Register Address	Type in the address of the Read register (in Hex) on the slave device **NOTE: A single configuration may contain up to 256 enabled registers.**
	Register Data Type		Register data type	From the drop down menu, select the Register Data Type • Float • Unsigned 32 • Signed 32 • Unsigned 16 • Signed 16 • Bit Packed • Single Bit If read as an integer, output is converted to floating point equivalent.

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
	Function Code		Several standard Modbus RTU function codes are supported. These standard function codes provide basic support for IEEE 32-bit floating point numbers and 16-bit integer register representation of instrument's process data	Function code **03 – Read Holding Registers** or Function code **04 – Read Input Registers** is used to read the contents of input registers in the slave. **Supported Data Types for Function Codes 03 and 04.** From the drop down menu, select a function code for **"Float, Unsigned, Signed, or Bit Packed"** register data type Function code **01 – Read Coil Status** is used to read the coil's (discrete output's) ON/OFF status of the slave device in a binary data format. Function code **02 – Read Input Status** is used to read the input's (discrete input's) ON/OFF status of the slave device in a binary data format. **Supported Data Types for Function Codes 01 and 02.** Select a function code for **"Single Bit"** Register data type. NOTE: Refer to the Communications manual for the function codes supported by the specific device.
	Select Bit	23-26	Bit to read when Read register's data type = Bit Packed You must then select which bit to mask (0-15). The output will be the floating-point equivalent (0.0 or 1.0) of the masked bit.	0-15

Write tab

It looks like this graphically on the Control Builder. Table 41 describes the parameters and the value or selection.

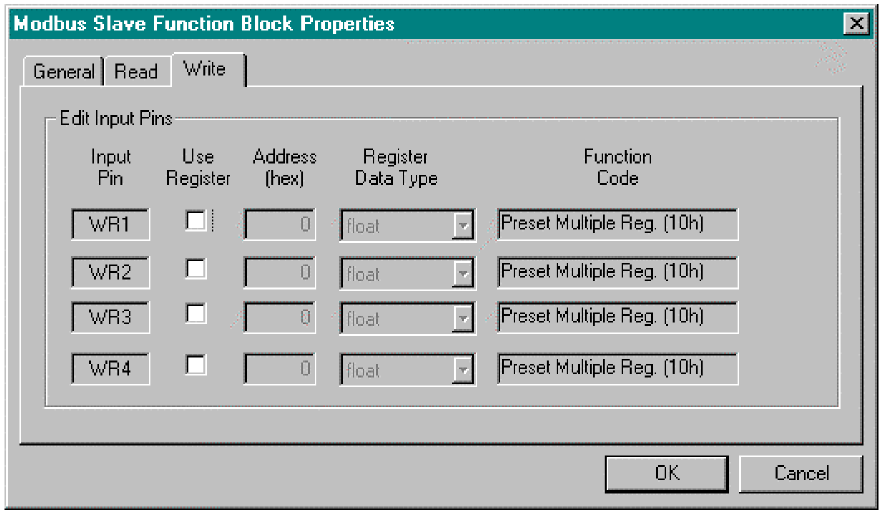


Table 41 MBS Block Write tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Edit Input Pins	**Input Pin**		Input pin designation	Register request assigned to WR1,WR2,WR3, or WR4 pin
	Use Register		Register Request	Click on the “Use Register” field to assign a register to the Input pin.
	Address (hex)		Register Address	Type in the address of the Write register (in Hex) on the slave device
	Register Data Type		Register data type	From the drop down menu, select the Register Data Type • Float • Unsigned 32 • Signed 32 • Unsigned 16 • Signed 16

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
	Function Code		Several standard Modbus RTU function codes are supported. These standard function codes provide basic support for IEEE 32-bit floating point numbers and 16-bit integer register representation of instrument's process data Preset Single Registers – Function Code 06 Preset Multiple Registers – Function Code 10 hex	The function code for **"Unsigned 16 or Signed 16,"** register data type is **06 – Preset Single Registers*** presets integer value into a single register.. The function code for **"Float, Unsigned 32 or Signed 32,"** register data type is **10 hex – Preset Multiple Registers*** presets values into holding registers. **automatically selected when you select "Register Data Type"* NOTE: Refer to the Communications manual for the function codes supported by the specific device.

Example

Figure 40 shows a Function Block Diagram using an Modbus function blocks.

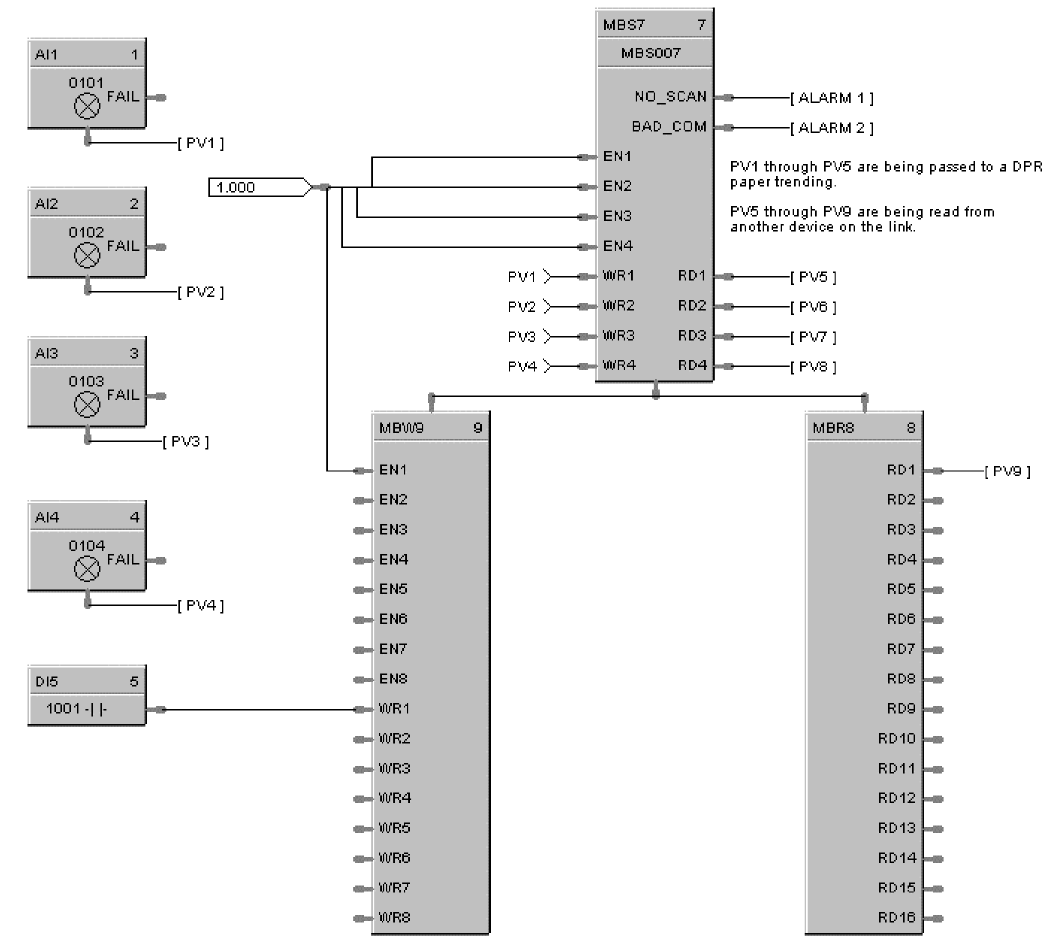
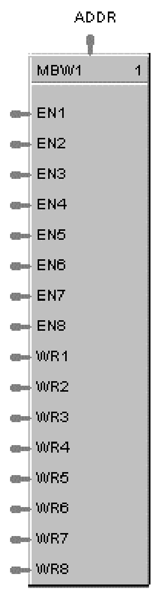


Figure 40 MBS function block example

MBW Function Block

Description

The **MBW** label stands for **Modbus Write.** This block is part of the *Communications* category. It looks like this graphically on the Control Builder.



Function

A communication function block that expands the write capability of the Modbus Slave function block to 8 additional data points. Multiple blocks may be connected to the same Modbus Slave block.

The Modbus write block has 8 inputs and no outputs. The Modbus destination for each of the eight inputs can be configured. An enable pin lets the data value be written once per scan.

The configuration data for each point will consist of : the address of the destination device on the Modbus link, the register address of the desired data, and the register type: Integer or Float.

Inputs

EN1 through EN8 = [ON] Data value is written once per scan

WR1 through WR8 = Value to be written to the selected register address.

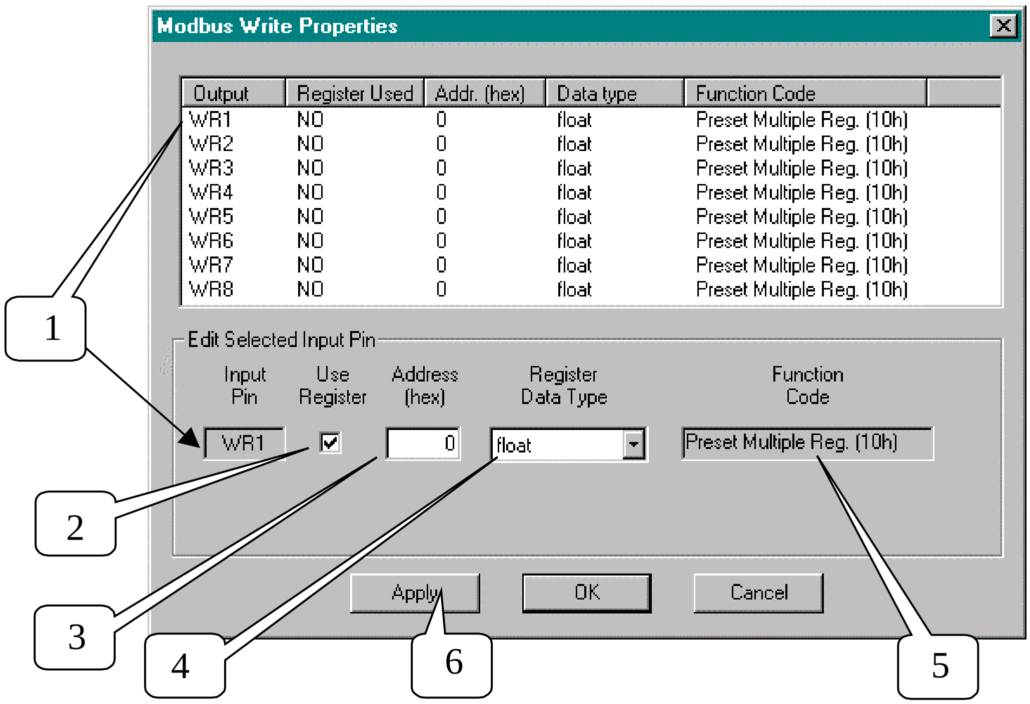
ADDR = Slave address from associated MBS block. *(Must be connected to MBS block)*

Outputs

None

Block properties

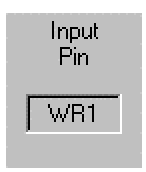
Double click on the function block to access the function block properties dialog box.

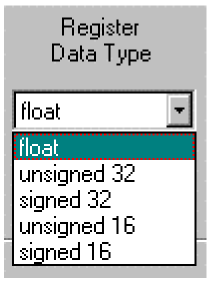
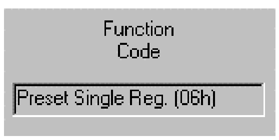
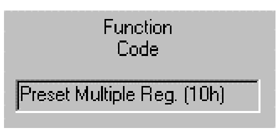


Configuration parameters

You must configure the MBW function Block Input Pins as shown in the “Edit Selected Input Pin” portion of the dialog box. Follow the numbered sequence shown above referring to Table 42.

Table 42 MBW function block configuration parameters

Sequence Number	Parameter Field	Action	Selections	Comments
1		Click on an Input Pin from the list of pins in the upper portion of the dialog box. The selected Input Pin will appear in the “Input Pin” Field.	WR1 through WR8	
2		Click on the “Use Register” field to assign a register to the Input pin. YES will be indicated in the “Register Used” column when you select “Apply” .	WR1 through WR8	

Sequence Number	Parameter Field	Action	Selections	Comments
3		Type in the address of the register (in Hex) on the slave device		
4		From the drop down menu, select the Register Data Type	• Float • Unsigned 32 • Signed 32 • Unsigned 16 • Signed 16	Several standard Modbus RTU function codes are supported. These standard function codes provide basic support for IEEE 32-bit floating point numbers and 16-bit integer register representation of instrument's process data. (see Sequence Number 5 below)
5	 	The function code for **"Unsigned 16 or Signed 16** register data type is (06)* The function code for **"Float, Unsigned 32 or Signed 32** register data type is (10 hex)* **automatically selected when you select "Register Data Type"*	• Preset Single Registers – Function Code 06 • Preset Multiple Registers – Function Code 10 hex	Function code 06 presets integer value into a single register. Function Code 10 hex presets values into holding registers. NOTE: Refer to the Communications manual for the function codes supported by the specific device.
6	You must press [APPLY] to accept the register changes.			

Example

Figure 41 shows a Function Block Diagram using an Modbus function blocks.

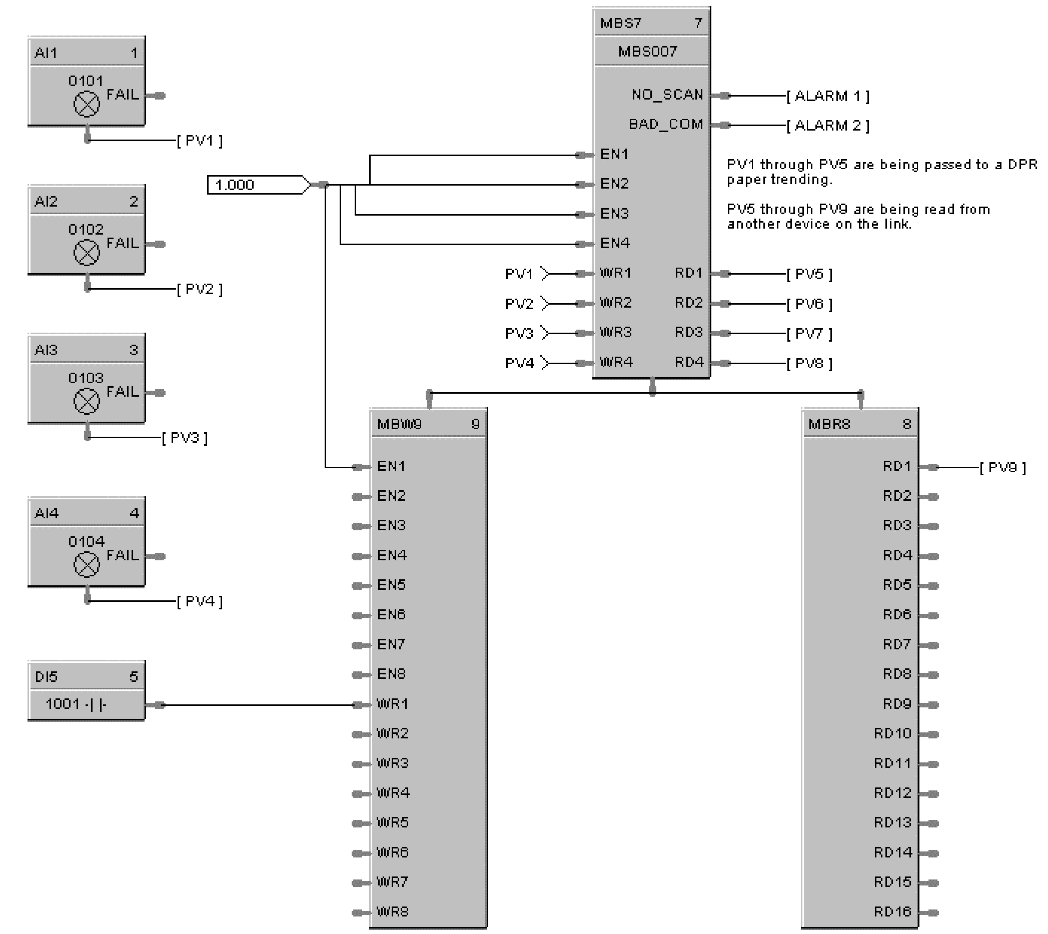
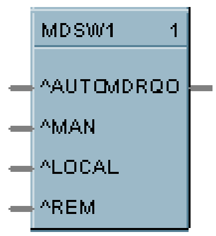


Figure 41 MBW function block example

MDSW Function Block

Description

The **MDSW** label stands for **Mode Switch.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Digital interface to control loops to select automatic or manual modes and/or local or remote setpoint. Connects to PID, ON/OFF, CARB, or TPSC mode block input.

Inputs

AUTO = Automatic Output mode (OFF to ON* sets MDRQO to Automatic control mode)

MAN = Manual Output mode (OFF to ON* sets MDRQO to Manual control mode)

LOCAL = Local Setpoint mode (OFF to ON* sets MDRQO to Local Setpoint mode)

REM = Remote Setpoint mode (OFF to ON* sets MDRQO to Remote Setpoint mode)

** for one control cycle*

Output

MDRQO (Mode Request Output) = The output of this block must connect to the MDRQI input of a PID, CARB, TPSC, or ON/OFF function block.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 42 shows a Function Block Diagram using an MDSW function block.

Application: External mode switching of the PID Block - changing a loop to MAN, to AUTO, to LOCAL SP, or REMOTE SP.

ATTENTION

Mode switching is also provided as an integral part of the Operator Panel, Loop Displays.

The MDSW (Mode Switch) Function Block is used exclusively with the MDRQI (Mode Request Input) of the PID, ON/OFF, CARB< or TPSC Function Block. Its output provides encoded switch commands to the PID Block.

All inputs are OFF to ON edge-triggered, requiring a separate input for each action. The example shows digital inputs as the transfer inputs but any digital status could be used.

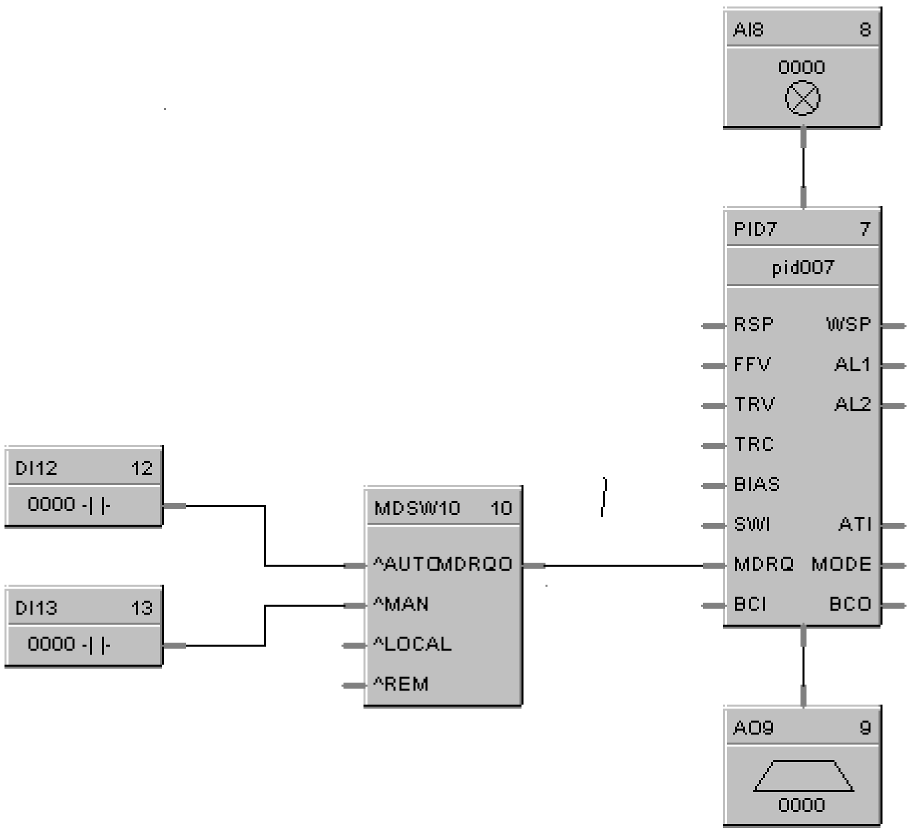
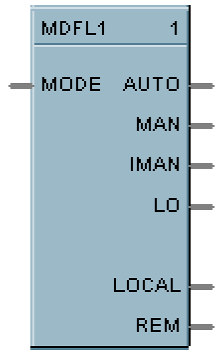


Figure 42 MDSW function block example

MDFL Function Block

Description

The **MDFL** label stands for **Mode Flag.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Turns ON the output that corresponds to the current value of MODE.

Turns OFF all other outputs.

Input

The MODE input must connect to the MODE output of a PID, CARB, TPSC, or ONOFF function block.

Output

REM = ON	If MODE = Remote Setpoint
LOCAL = ON	If MODE = Local Setpoint
AUTO = ON	If MODE = Automatic Control
MAN = ON	If MODE = Manual Control
IMAN = ON	If MODE = Loop in Initialization Manual
LO = ON	If MODE = Local Override

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 43 shows a Function Block Diagram using an MDFL function block. The mode output of the PID Block is used exclusively with the MDFL (Mode Flags) Block.

Any of the status outputs may be referenced by a Signal Tag or may be transferred externally using a DO.

The output shown is ON when in Manual and OFF when in Automatic.

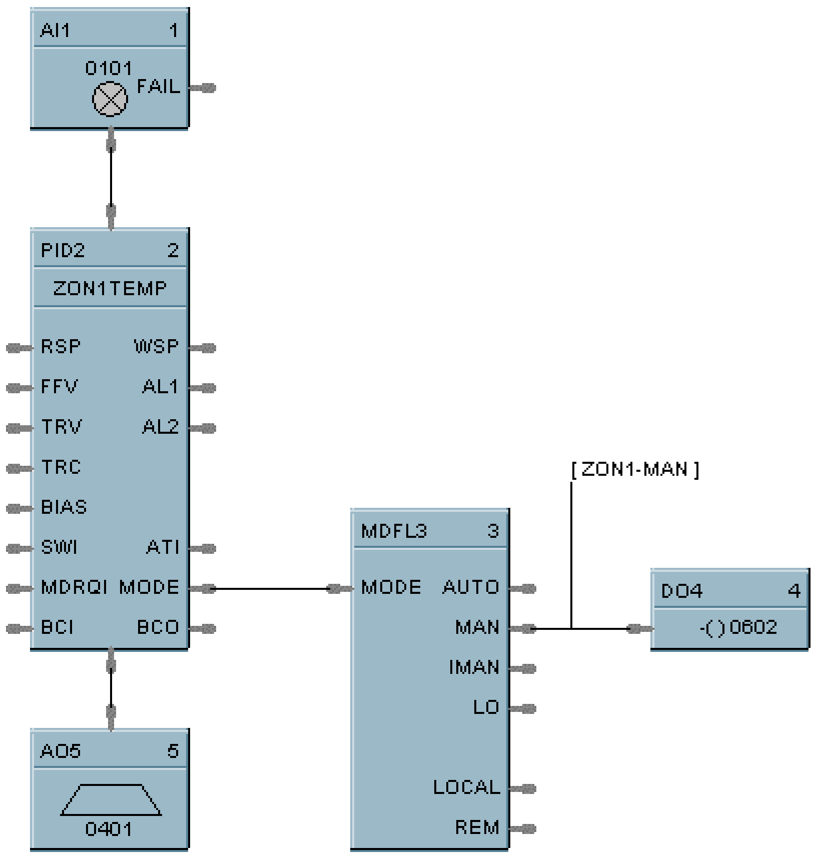
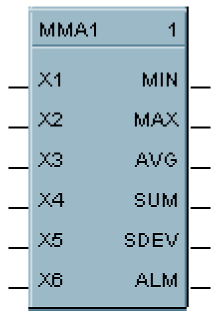


Figure 43 MDFL function block example

MMA Function Block

Description

The **MMA** label stands for **Min-Max-Average-Sum.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Accepts inputs from up to six analog input values (X1 - X6) and calculates these values for output:

- MIN - Minimum input value
- MAX - Maximum input value
- AVG - Average of the 6 input values
- SUM - Sum of the 6 input values
- DEV - Standard deviation of the 6 input values
- ALM - Alarm output for deviations

Turns ON ALM when any input is outside the configured number of standard deviations when the configuration parameter DEV > 0.

- If DEV configured = 0, then:
  - no standard deviation is calculated;
  - all inputs connected to the block are used to calculate the MIN, MAX, AVG, AND SUM outputs.
- If DEV configured 0, then:
  - the standard deviation is calculated for the number of inputs connected to the block, and
  - all inputs connected to the block are used to calculate the MIN, MAX, AVG, and SUM outputs.
- If DEV configured > 0, then:
  - the standard deviation is calculated for the number of inputs connected to the block, and SDEV = result;
  - any inputs that deviate more than the configured number (DEV) of standard deviations from the average are not used to calculate the MIN, MAX, AVG, and SUM outputs;
  - if any input deviates more than the configured number (DEV) of standard deviations, ALM turns ON;

- if all inputs deviate more than the configured number (DEV) of standard deviations, then the MIN, MAX, AVG, and SUM outputs all equal zero (0), and ALM turns ON.

- Standard Deviation (SDEV) = $\sqrt{\dfrac{\sum_{i=1}^{i=n} (X_i - \overline{X})^2}{n}}$

where: $\overline{X}$ = AVG
n = the number of connected inputs.

Input

X1 = First analog value.

X2 = Second analog value.

X3 = Third analog value.

X4 = Fourth analog value.

X5 = Fifth analog value.

X6 = Sixth analog value.

Output

MIN = Calculated minimum analog value.

MAX = Calculated maximum analog value.

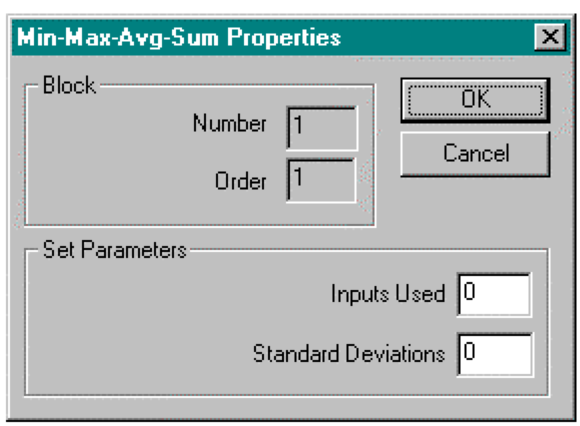
AVG = Calculated average of analog values.

SU = Calculated sum of analog values.

SDEV = Square root of Z divided by N, where Z = the sum of individual squared deviations from the average of the first n inputs.

ALM = Digital signal for alarm indication.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the MMA function Block parameters to the desired value or selection that matches your operating requirements. Table 43 describes the parameters and the value or selection.

Table 43 Min/Max/Ave/Sum function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Calculation Parameters	**Inputs Used**	N/A	Number of inputs connected to block (Connect inputs in numerical order; that is, unused inputs from the bottom up - X6, X5, etc.) Unused inputs default to 0.	1 to 6
	Standard Deviations	1	Number of standard deviations within which inputs are used for calculation	–99999 to 99999 <0 No Standard Deviation =0 Standard Deviation with no alarm >0 Standard Deviation with alarm

Example

Figure 44 shows a Function Block Diagram using an MMA function block. In this application, control is determined by automatic selection of the lowest or highest sensor, such as a thermocouple. As shown the MMA block is configured for highest (MAX).

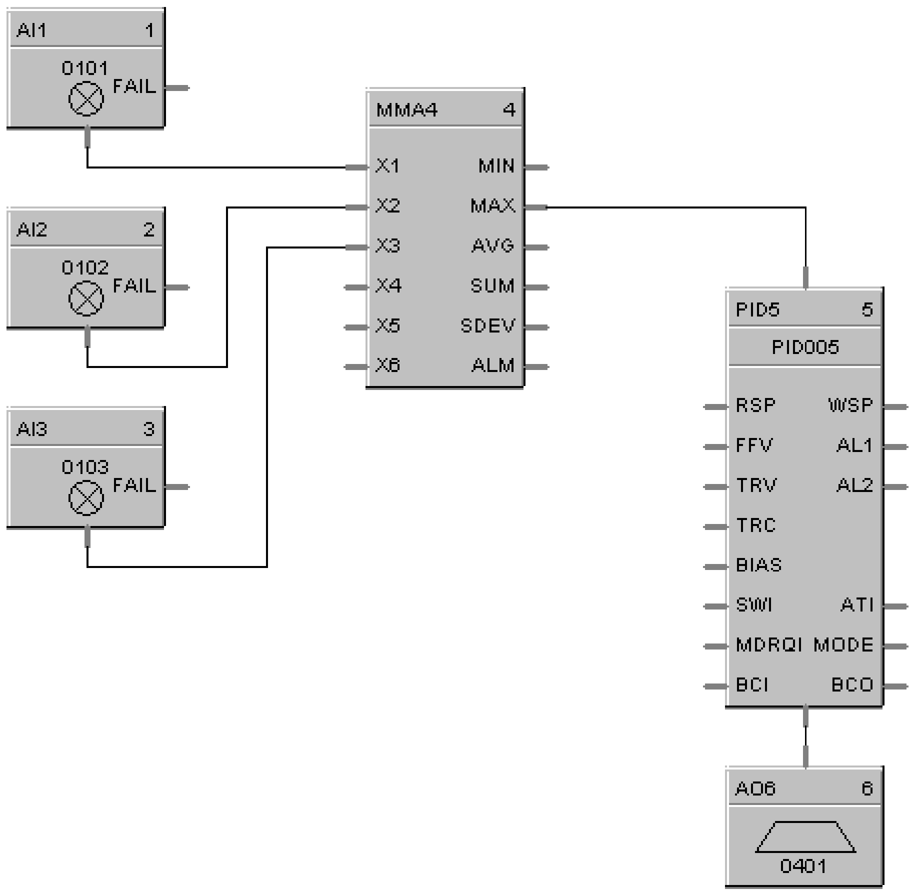
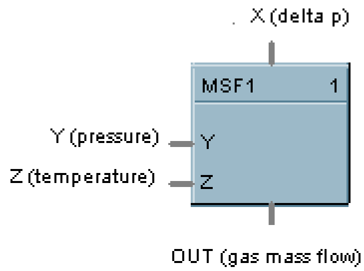


Figure 44 MMA function block example

MSF Function Block

Description

The **MSF** label stands for **Mass Flow Calculation.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Calculates gas mass flow (OUT) from differential pressure input value (X) that represents a pressure drop across an orifice plate (for example). It accepts two other inputs to include pressure (Y) and/or temperature (Z) compensation in the calculation. The calculation includes square root extraction.

- **OUT = Kq * sqrt [(dP * P) / T]**

Kq	=	Orifice Constant
dP	=	Differential pressure which
	=	(Kx * X) + Bx; *where:*

Kx = Delta pressure scaled for desired engineering units
X = Analog input value
Bx = Delta pressure bias in desired engineering units

P	=	Absolute gas pressure which
	=	(Ky * Y) + By; *where:*

Ky = Pressure scaler for desired engineering units
Y = Gas pressure analog input value
By = Pressure bias in desired engineering units

T	=	Absolute gas temperature which
	=	(Kz * Z) + Bz; *where:*

Kz = Temperature scaler for desired engineering units
Z = Gas temperature analog input value
Bz = Temperature bias in desired engineering units

If (Kz Z) + Bz = 0, then: OUT = 0*

- If calculation is <= Dropoff, OUT = 0, else OUT = Calculation

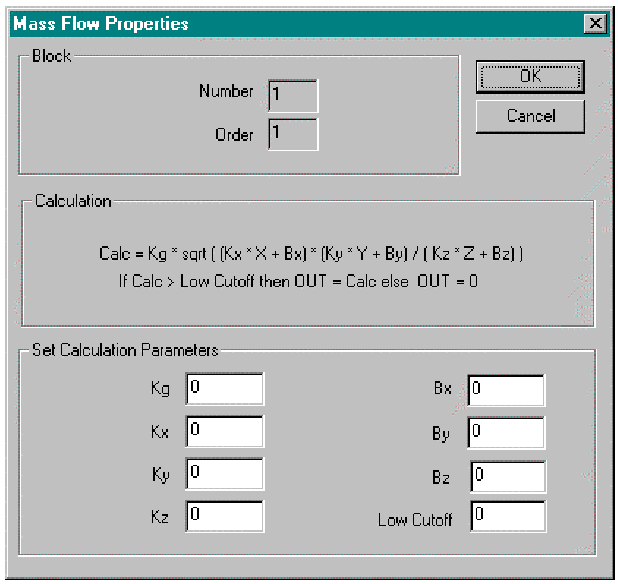
Input

X = Differential pressure analog value.
Y = Gas pressure analog value.
Z = Gas Temperature analog value.

Output

OUT = Calculated analog value

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the MSF function Block parameters to the desired value or selection that matches your operating requirements. Table 44 describes the parameters and the value or selection.

Table 44 Mass flow function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Calculation Parameters	**K_q**	0	Orifice constant	–99999 to 999999
	K_x	1	Delta pressure scaler	–99999 to 999999
	K_y	2	Pressure scaler	–99999 to 999999
	K_z	3	Temperature scaler	–99999 to 999999
	B_y	4	Pressure bias	–99999 to 999999(EU)
	B_x	5	Delta pressure bias	–99999 to 999999(EU)
	B_z	6	Temperature bias	–99999 to 999999(EU)
	Low Cutoff	7	Low Dropoff Value sets the output to zero when the calculation is below this limit.	0 to 99999 in Engineering Units

Example

Figure 45 shows a MSF Function Block Diagram using inputs to calculate a mass flow output.

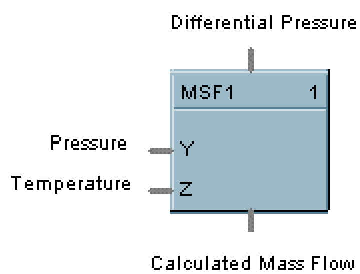
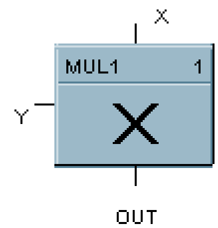


Figure 45 MSF function block example

MUL Function Block

Description

The **MUL** label stands for **Multiplication Mathematical operation (2 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Multiplies one analog input value (X) by another (Y).

- **OUT = X * Y**

Input

X = First analog value

Y = Second analog value

Output

OUT = Calculated analog value

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 46 shows a Function Block Diagram using a MUL function block

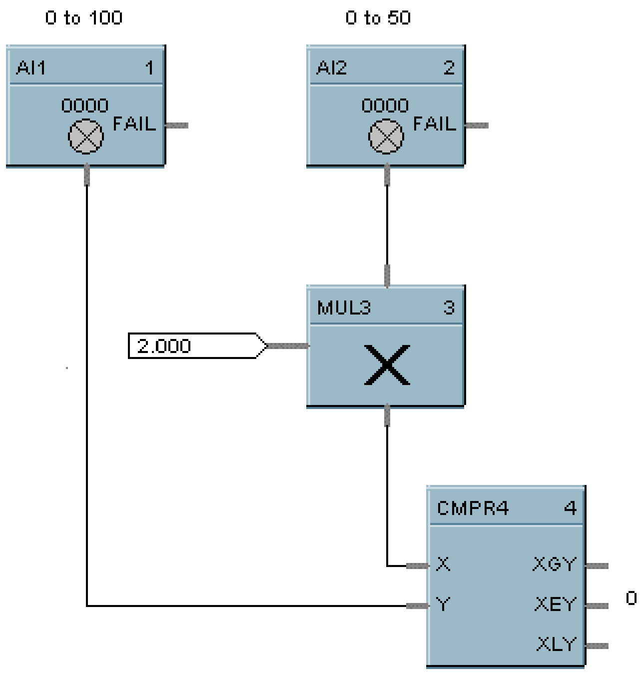
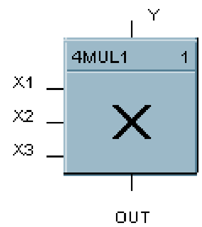


Figure 46 MUL function block example

4MUL Function Block

Description

The **4MUL** label stands for **Multiplication Mathematical Operation (4Inputs)**. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Multiplies four inputs to get an output.

Input

X1 = First analog value
X2 = Second analog value
X3 = Third Analog value
Y = Fourth Analog value

ATTENTION

All four inputs must be connected. Unconnected inputs default to zero. If only three inputs are needed, the fourth should be connected to a constant value of 1.

Output

OUT = Calculated analog value

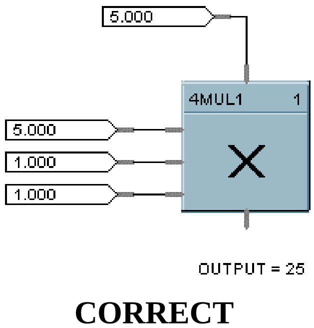
Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Example

Figure 47 shows correct and incorrect example of a 4MUL function block. Note that all unused inputs must be connected to a constant value of one.



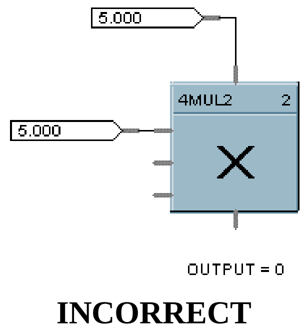
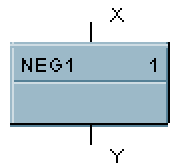


Figure 47 4MUL function block example

NEG Function Block

Description

The **NEG** label stands for **Negate**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Convert a value to the opposite sign; i.e., +5 IN = –5 OUT, –6 IN = +6 OUT.
(Invert sign of an analog value.)

Input

X = positive or negative analog value

Output

Y = analog value of opposite sign from input

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Example

Figure 48 shows a Function Block Diagram using a NEG function block.

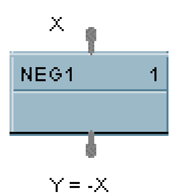
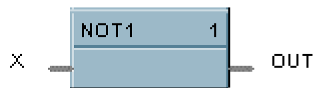


Figure 48 NEG function block example

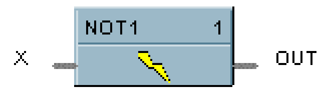
NOT Function Block

Description

The **NOT** label stands for the **NOT Boolean logic function or Logic Inverter**. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Reverse state of a digital input (X).

- **OUT = Opposite state of X**
  If X = ON, then: **OUT = OFF**.
  IF X = OFF, then: **OUT = ON**.

Input

X = Digital signal

Output

OUT = Complement of input signal

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Example

Figure 49 shows a Function Block Diagram using a NOT function block. Use a single input to place a loop in manual when the input is ON (1) and return to Auto when OFF (0).

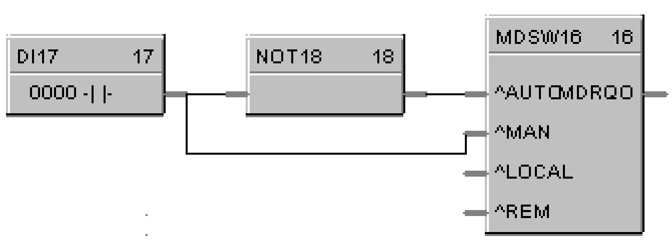


Figure 49 NOT function block example

ONDT Function Block

Description

The **ONDT** label stands for the **On Delay Timer**. This block is part of the *Fast Logic and Counters/Timers* categories. It looks like this graphically on the Control Builder.

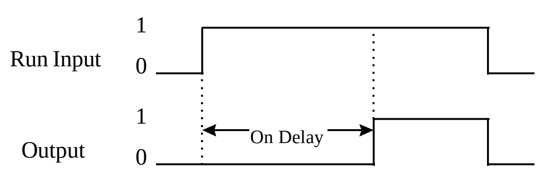
Function

Provides an ON state logic output delayed by a user specified delay time after an OFF to ON transition of the RUN input.

An ON to OFF transition of the RUN input before the delay time has elapsed causes the timer to reset. Transitions from OFF to ON of the input are not delayed.

- If RUN is OFF, then OUT = OFF
- If previous RUN input is OFF and RUN is ON, then TIMER = DELAY, else if timer is not zero, then TIMER = TIMER -1.
- If RUN is ON and TIMER is 0, then OUT = ON (delay time has timed out).

Timing Diagram



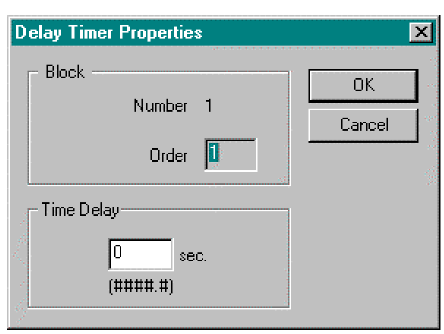
Input

RUN = Logic Input

Output

OUT = Logic Output

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the ONDT function Block parameters to the desired value or selection that matches your operating requirements. Table 45 describes the parameters and the value or selection.

Table 45 On delay timer function block example

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Time Delay	**Time delay**	0	Delay Time - specifies the amount of time the ON state logic output will occur after an OFF to ON transition of the RUN input.	0.1 sec, 0 to 9999.9 Enter as 0.1 to 99999 in 0.1 increments

Example

Figure 50 shows a Function Block Diagram using an ONDT function block.

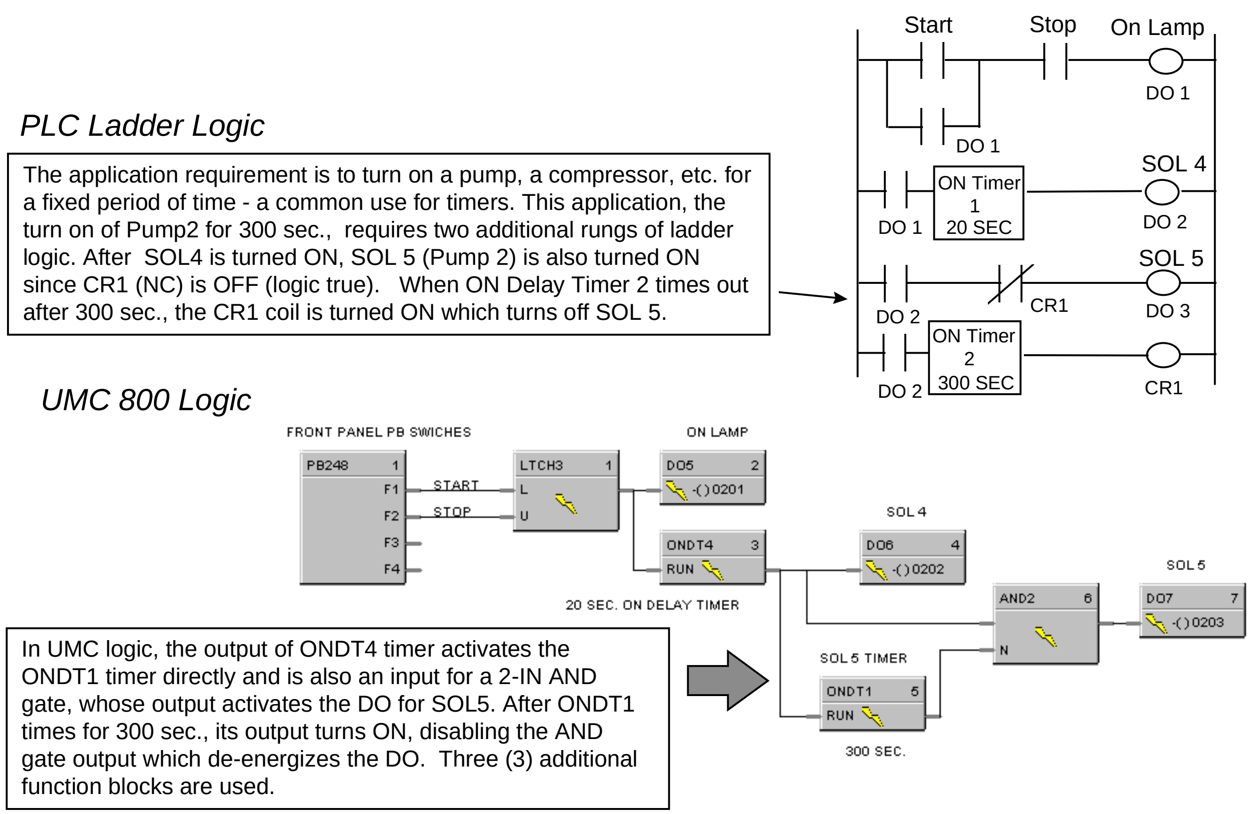


Figure 50 ONDT function block example

OFDT Function Block

Description

The **OFDT** label stands for the **Off Delay Timer**. This block is part of the *Fast Logic and Counters/Timers* categories. It looks like this graphically on the Control Builder.

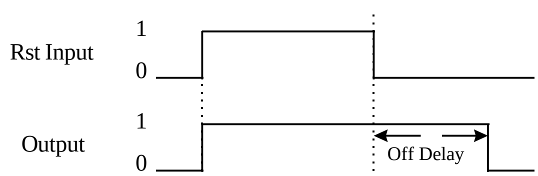
Function

Provides an OFF state logic output delayed by a user specified delay time after an On to OFF transition of the RESET input.

An OFF to ON transition of the RESET input before the delay time has elapsed causes the timer to reset. Transitions from OFF to ON of the input are not delayed.

- IF RESET is ON, then OUT = ON.
- If previous RESET input is ON and RESET is OFF, then TIMER = DELAY.
- If RESET is OFF and TIMER is not 0, then time = TIMER – 1.
- If RESET is OFF and TIMER is 0, then OUT = OFF (delay time is reset).

Timing Diagram



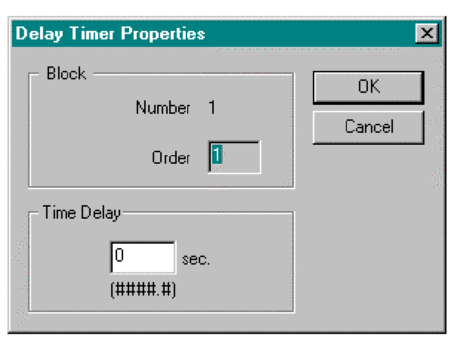
Input

RST = Logic Input

Output

OUT = Logic Output

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the OFDT function Block parameters to the desired value or selection that matches your operating requirements. Table 46 describes the parameters and the value or selection.

Table 46 Off delay timer configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Time Delay	**Time delay**	0	Delay Time - specifies the amount of time the OFF state logic output will occur after an ON to OFF transition of the Reset input.	0.1 sec, 0 to 9999.9 Enter as 0.1 to 99999 in 0.1 increments

Example

Figure 51 shows a Function Block Diagram using an OFDT function block.

An OFF delay timer block output is ON as long as the RST input is logic HI (ON). It can be used for time duration but must be triggered by an ON to OFF transition on the Reset input. This can be accomplished using Trigger blocks to create one-shot pulses which last one scan cycle. The fast logic trigger pulse will last 100 ms. while the normal logic trigger pulse will last the complete scan cycle for analog blocks. Use according to application need. A Periodic timer output pulse may also be used to start the timer for the OFF delay.

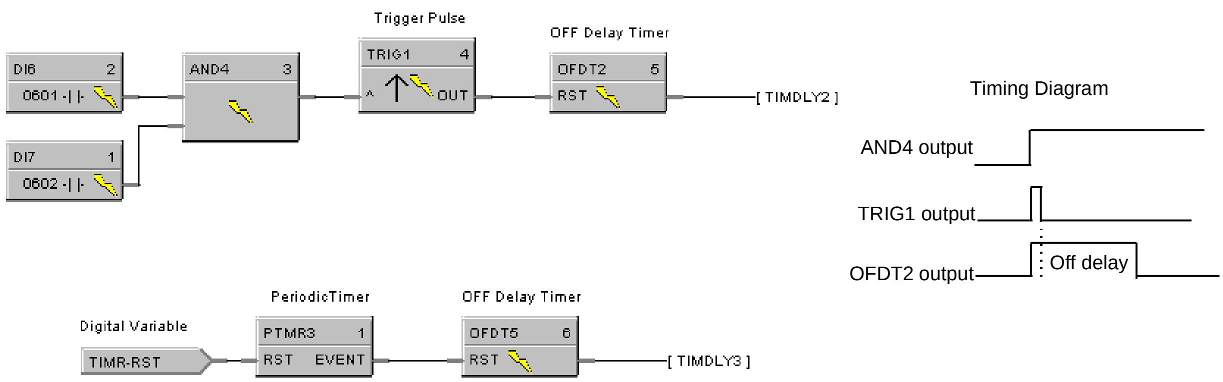
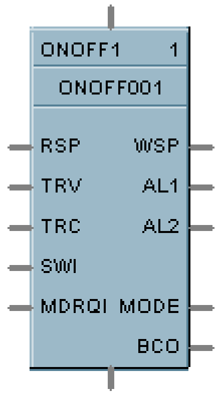


Figure 51 OFDT function block example

ON/OFF Function Block

Description

The **ON/OFF** label stands for the **On/Off Control function**. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Provide ON/OFF control. The output is either ON (100 %) or OFF (0 %).

Inputs

RSP = Remote Setpoint (% or EU per SP Units)

TRV = Track Value Output—1 = ON, 0 = OFF

TRC = Track Value Command—1 = enable, 0 = disable (Mode = Local Override)

SWI = Switch Inputs (from LPSW function block)

MDRQI= External Mode Request (connected to the MDRQO output of a MDSW function block) encoded as follows:

0.0 = No Change
1.0 = Manual Mode Request
2.0 = Automatic Mode Request
4.0 = Local Setpoint Request
8.0 = Remote Setpoint Request

Outputs

WSP = Working Setpoint in Engineering Units for monitoring

AL1 = Alarm 1

AL2 = Alarm 2

MODE = Actual Mode encoded as follows: (Connect to Mode Flags block [MDFL] to encode mode status.)

0.0	RSP AUTO
1.0	RSP MAN
2.0	RSP Initialization Manual (See ATTENTION)
3.0	RSP Local Override (See ATTENTION)
4.0	LSP AUTO
5.0	LSP MAN
6.0	LSP Initialization Manual (See ATTENTION)
7.0	LSP Local Override (See ATTENTION)

BCO = Back Calculation Output (for blocks used as Cascade Secondary

---

ATTENTION

When a request to change from Auto to manual is received and:

- the request comes from the operator Interface, the request is ignored.
- the request comes from the Mode Switch (MDSW) function block, *the request is retained and when leaving the Initialization Mode or Local Override Mode the loop will go to manual.*

Block properties

Double click on the function block to access the function block properties dialog box.

Configuration parameters

The ON/OFF properties dialog box is divided into four tab cards:

GENERAL
RSP
RANGE/LIMIT
ALARMS

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 47 describes the parameters and the value or selection.

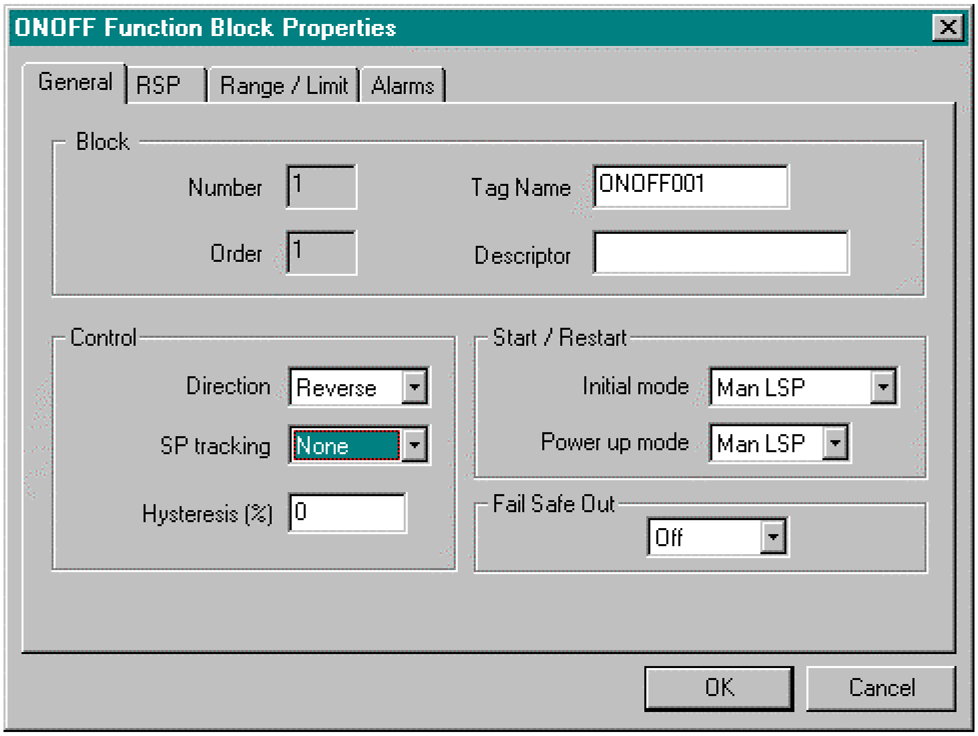


Table 47 General tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order	Read Only. See "Configure" Menu, "Execution Order" to change.
	Tag Name	N/A	8-character tag name	
	Descriptor	N/A	Block description	
Control	**Direction**	N/A	Control Action	**REVERSE** - Proportional action causes output to decrease as process variable increases. **DIRECT** - Proportional action causes output to increase as process variable increases.
	SP Tracking	N/A	Setpoint Tracking	**NONE** **TRACK PV** - When control mode is "manual", local setpoint tracks process variable. **TRACK RSP** - When setpoint is remote setpoint, local setpoint tracks remote setpoint.
	Hysteresis	13	Output Hysteresis	0 % to 10 % of input span
Start/Restart	**Initial Mode**	N/A	Control Mode and Setpoint at NEWSTART **Newstart** is the first scan cycle following the cold start of the controller	**MAN LSP** - Manual control and last local setpoint **AUTO LSP -** Automatic control and last local setpoint. **AUTO RSP -** Automatic control and remote setpoint. **MAN LSPonly** - Manual control and local setpoint only. **AUTO LSPonly** - Automatic control and local setpoint only*. **AUTO RSPonly** - Automatic control and remote setpoint only*. **These modes will override the configured POWER UP MODE.*
	Power up Mode	N/A	Control Mode and Setpoint at power up	**MAN LSP** - Manual control and last local setpoint **AM LSP** - Same control mode (auto or manual) and last local setpoint. **AM LR -** Same control mode (auto or manual) and setpoint (local or remote) as at power-down.
	Failsafe Out	23	Failsafe Output Selection	ON OFF

RSP tab

It looks like this graphically on the Control Builder. Table 48 describes the parameters and the value or selection.

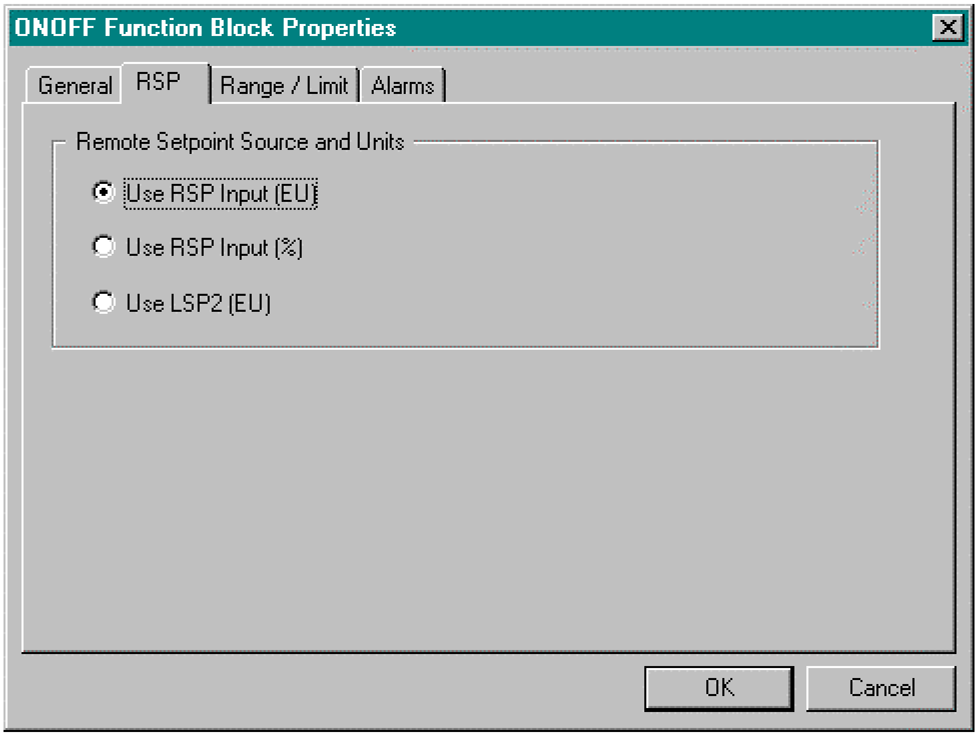


Table 48 RSP tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Remote Setpoint Source and Units	**Use RSP Input (EU)**	N/A	Use Remote Setpoint in Engineering Units	Click on radio button to select
	Use RSP Input (%)		Use Remote Setpoint in Percent	Click on radio button to select
	Use LSP2 (EU)		Use Local Setpoint #2 in Engineering Units	Click on radio button to select

RANGE/LIMIT tab

It looks like this graphically on the Control Builder. Table 49 describes the parameters and the value or selection.

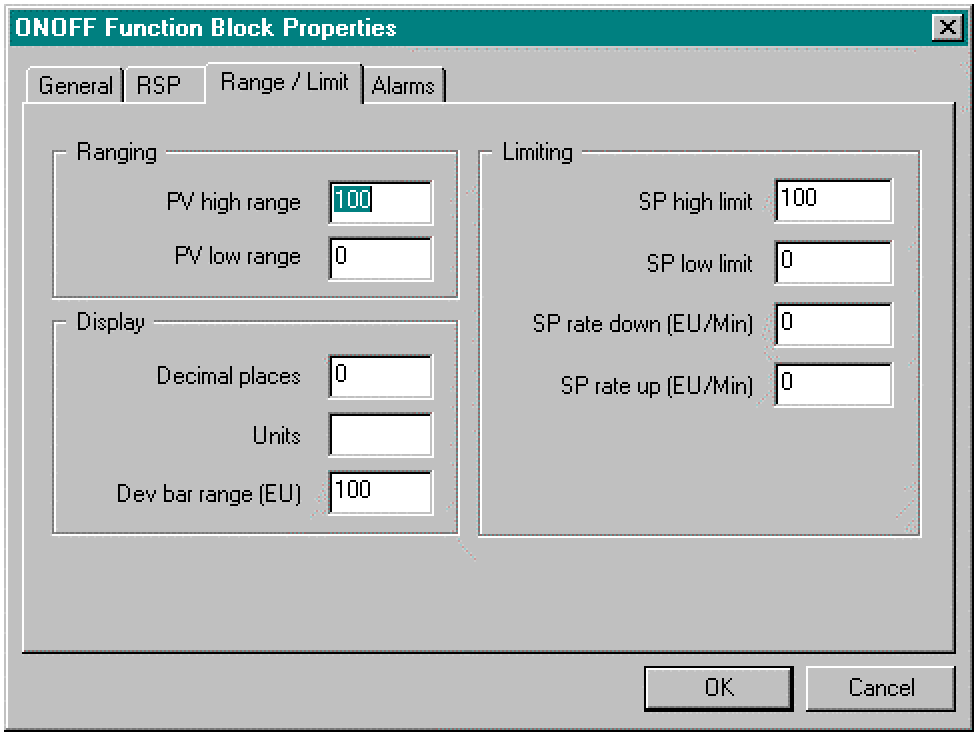


Table 49 Range/limit tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Ranging	**PV High range**	0	PV High Range Value	–99999 to 99999
	PV Low Range	1	PV Low Range Value	–99999 to 99999
Display	**Decimal Places**	N/A	Number of digits to display after decimal point.	0 to 5
	Units	N/A	Text to display for EU	4 characters
	DEV Bar Range (EU)	N/A	Deviation Bar Range on the Operator Interface	–99999 to 99999
Limiting	**SP High Limit**	6	Setpoint High Limit Value - prevents the local and remote setpoints from going above the value set here.	–99999 to 99999
	SP Low limit	7	Setpoint Low Limit Value - prevents the local and remote setpoints from going below the value set here.	–99999 to 99999
	SP Rate Down	9	Setpoint Rate Down value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **down** to the new one.	0 (off) to 9999 (eu/min)
	SP Rate Up	10	Setpoint Rate Up value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **up** to the new one.	0 (off) to 9999 (eu/min)

ALARMS tab

It looks like this graphically on the Control Builder. Table 50 describes the parameters and the value or selection.

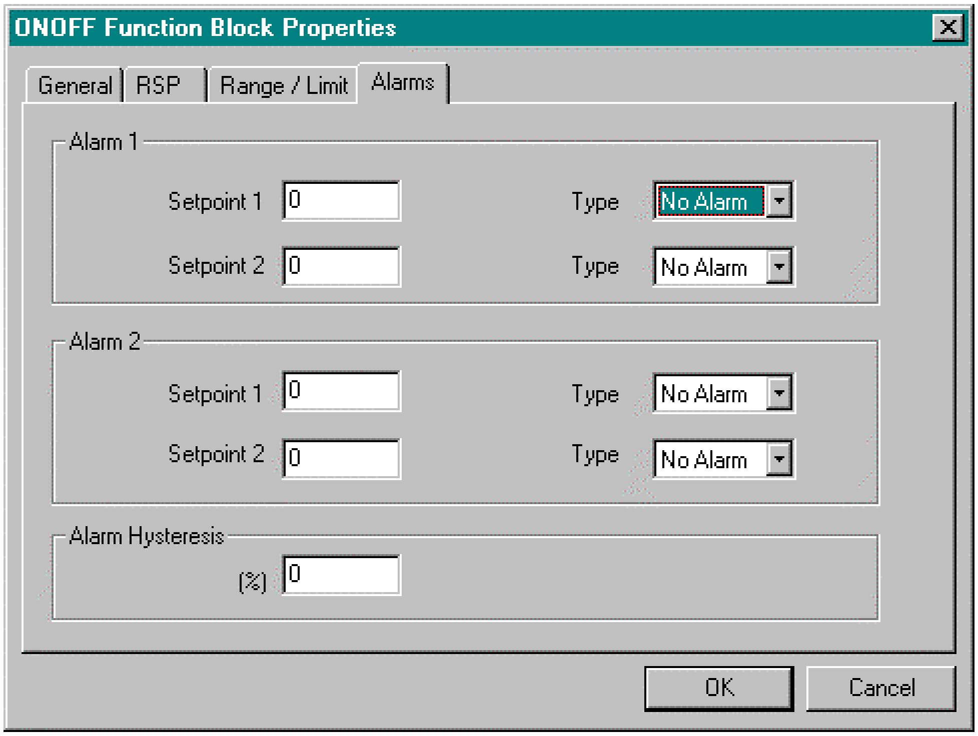


Table 50 Alarm tab configuration parameters

Properties Function	Parameter	Index #	Parameter Description	Value or Selection
Alarm 1	**Setpoint 1**	14	**Alarm 1 Setpoint 1 Value** - this is the value at which you want the alarm type chose below to activate	–99999 to 99999 in Engineering Units
	Type	N/A	Alarm 1 Setpoint 1 Type - select what you want Alarm 1 Setpoint 1 to represent.	Selections: NO ALARM PV_HIGH PV_LOW DEV_HIGH DEV_LOW SP_HIGH SP_LOW OUT_HIGH OUT_LOW
	Setpoint 2	15	Alarm 1 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 1 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm 2	**Setpoint 1**	16	Alarm 2 Setpoint 1 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 1 Type	Same as **Alarm 1 Setpoint 1**
	Setpoint 2	17	Alarm 2 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm Hysteresis	**%**	22	Alarm Hysteresis in %	0 % to 5 %

Example

Figure 52 shows a Function Block Diagram using an ON/OFF function block.

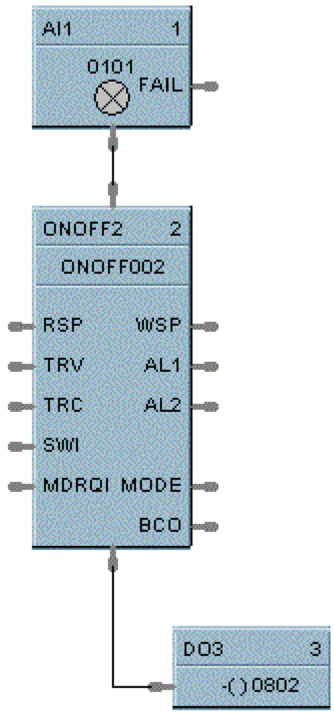
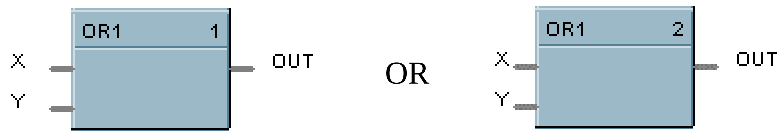


Figure 52 ON/OFF function block example

2OR Function Block

Description

The **2OR** label stands for the inclusive **OR (2 Inputs) Boolean logic function**. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



Fast Logic

Function

Monitors two digital input signals (X, Y) to set state of digital output signal (OUT).

- If X = OFF and Y = OFF, then **OUT = OFF.**
- If X = ON and/**or** Y = ON, then: **OUT = ON.**

Input

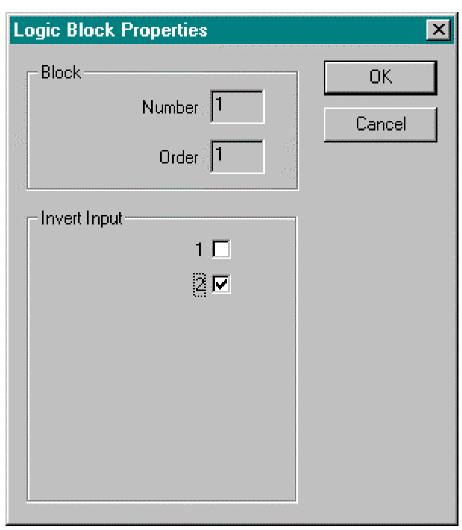
X = First digital signal.

Y= Second digital signal.

Output

OUT = Digital signal controlled by status of input signals

Block properties

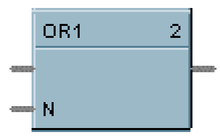


Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Input state

You can invert Input 1 or input 2 or both. If the input is inverted, an input line that is ON is seen as OFF. (“N” appears on Icon next to the inverted input.)



Example

Figure 53 shows a Function Block Diagram using a 2OR function block.

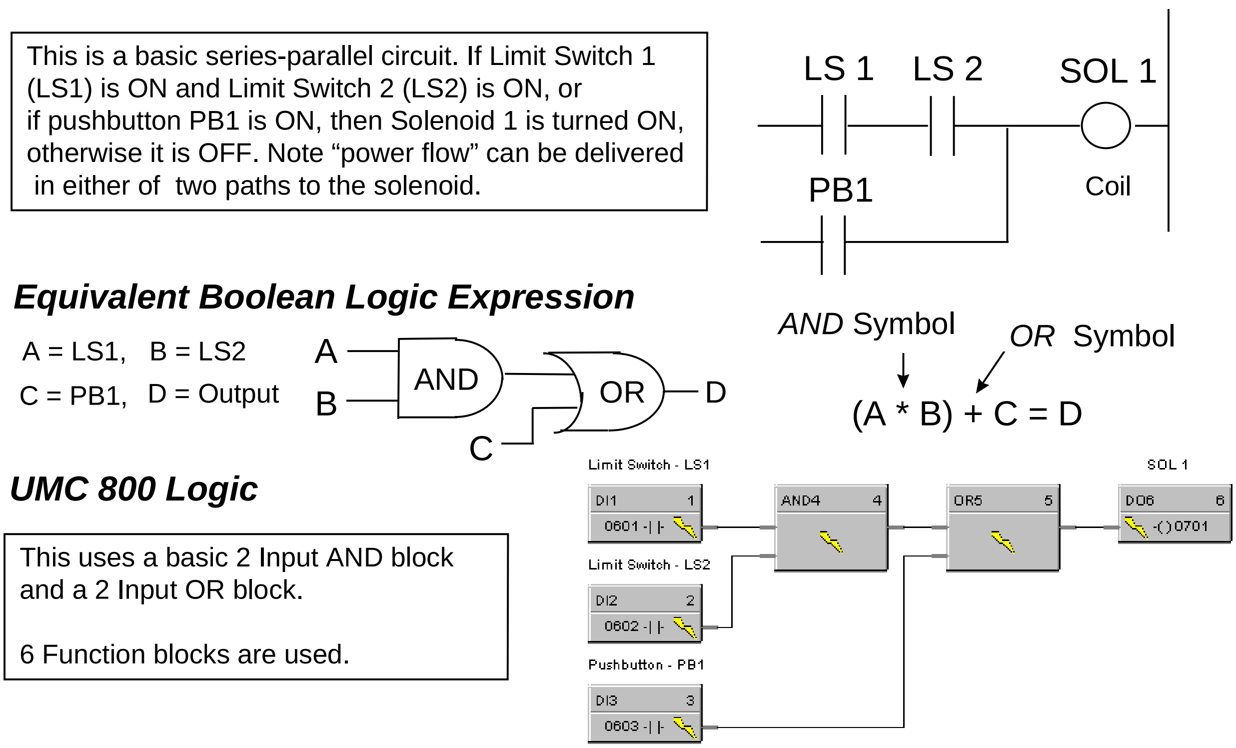
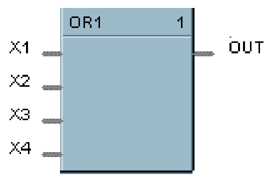


Figure 53 2OR function block example

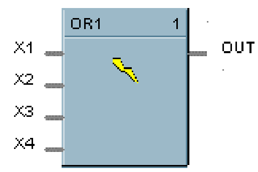
4OR Function Block

Description

The **4OR** label stands for the inclusive **OR (4 Inputs) Boolean logic function**. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Turns digital output (OUT) **OFF** when inputs X1 through X4 are **OFF**. Thus,

- If input X1 **or** X2 **or** X3 **or** X4 is **ON**, then: **OUT = ON**.
- If all inputs are OFF, then: **OUT = OFF**.

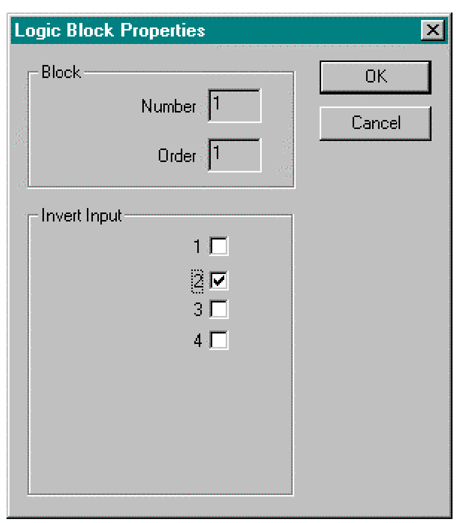
Input

X1 = First digital signal
X2 = Second digital signal
X3 = Third digital signal
X4 = Fourth digital signal

Output

OUT = Digital signal controlled by status of input signals

Block properties

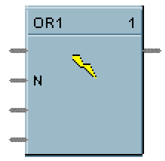


Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Input state

You can invert Input 1, 2, 3, 4, or all. If the input is inverted, an input line that is ON is seen as OFF. (“N” appears on the Icon next to the inverted input.)



ATTENTION

Unused Inputs default to 0.

Example

Figure 54 shows a Function Block Diagram using a 4OR function block.

Output = X1 or X2 or X3 or $\overline{X4}$

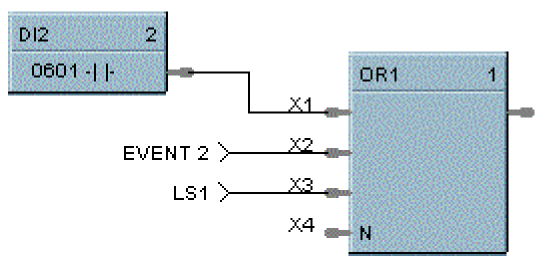
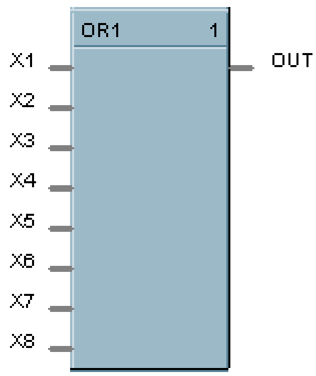


Figure 54 4OR function block example

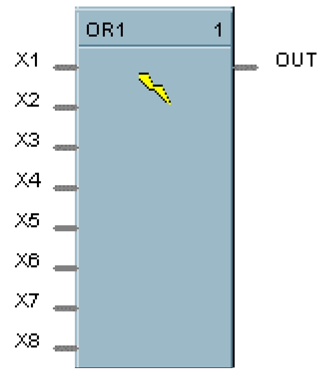
8OR Function Block

Description

The **8OR** label stands for the inclusive **OR (8 Inputs) Boolean logic function**. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR



Fast Logic

Function

Turns digital output (OUT) OFF when inputs X1 through X8 are off, thus:

- If input X1 **o**r X2 **or** X3 **or** X4 **or** X5 **or** X6 **or** X7 **or** X8 is **ON**, then: **OUT = ON.**
- If all inputs are OFF, then: **OUT = OFF.**

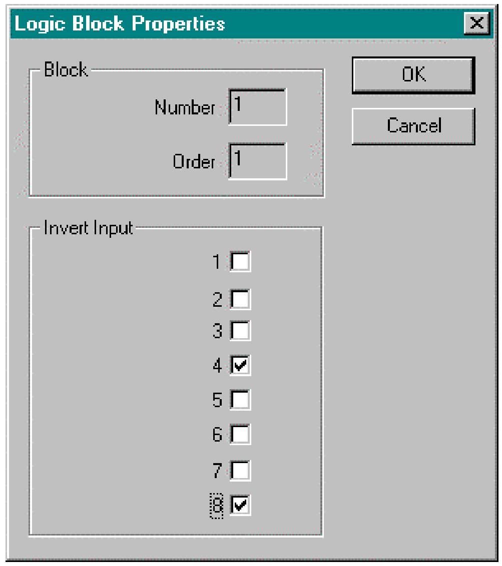
Input

X1 = First digital signal
X2 = Second digital signal
X3 = Third digital signal
X4 = Fourth digital signal
X5 = Fifth digital signal
X6 = Sixth digital signal
X7 = Seventh digital signal
X8 = Eight digital signal.

Output

OUT = Digital signal controlled by status of input signals

Block properties

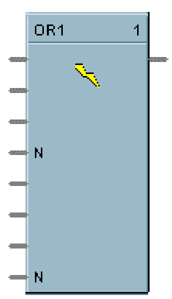


Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Input state

You can invert Input 1, 2, 3, 4, 5, 6, 7, 8 or all. If the input is inverted, an input line that is ON is seen as OFF. (“N” appears on the ICON next to the inverted input.)



CAUTION

Unused Inputs default to 0.

Example

Figure 55 shows a Function Block Diagram using an 8OR function block.

Output = X1 **or** X2 **or** X3 **or** $\overline{X4}$ **or** X5 **or** $\overline{X6}$ **or** $\overline{X7}$ **or** $\overline{X8}$

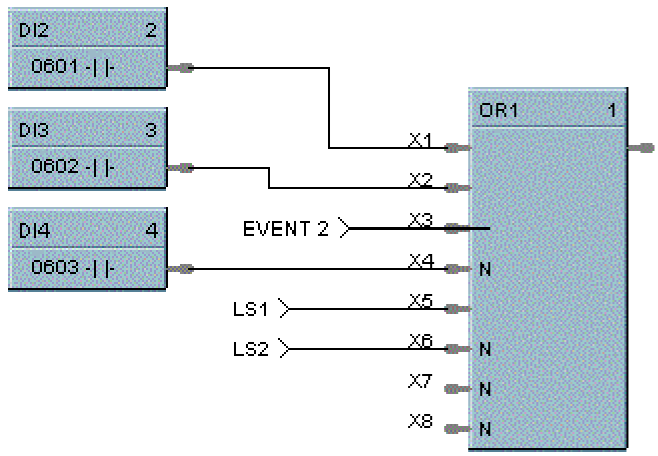
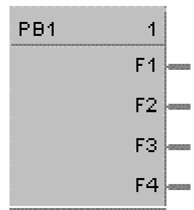


Figure 55 8OR function block example

PB Function Block

Description

The **PB** label stands for the inclusive **Pushbutton**. This block is part of the *Logic* category. It looks like this graphically on the Control Builder.

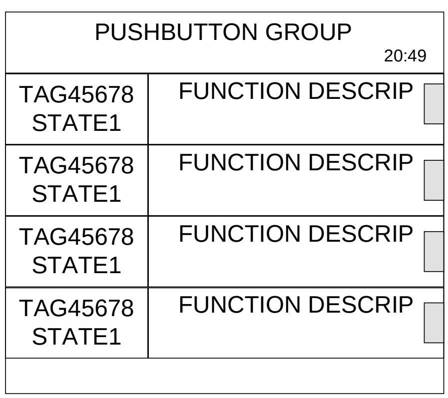


Function

Provides the interface from the operator panel to the logic functions of the controller. Provides a one-shot logic ON in response to pressing the corresponding function key on the operator interface.

This selection lets you **configure** the Pushbutton function display that will provide the interface to the four logic operator keypad keys (F1 through F4). You can do this for up to four Pushbutton blocks giving you 4 groups (total 16 pushbuttons) that can be set up for selection on your display buttons (1-8).

When you select a pushbutton group on a display button (1-8), the operator interface will display the pushbutton function group screen and buttons F1-F4 on the operator interface will display the information that has been set up for that group.



Pushbutton Function Group Screen

Output

F1 = Provide 1 shot logic ON in response to pressing Pushbutton F1
F2 = Provide 1 shot logic ON in response to pressing Pushbutton F2
F3 = Provide 1 shot logic ON in response to pressing Pushbutton F3
F4 = Provide 1 shot logic ON in response to pressing Pushbutton F4

Configuration

Double click on the function block to access the “Pushbutton Display Configuration” dialog box.

Configuration procedure

Follow the procedure in Table 51 to configure the Pushbutton Function Groups.

Table 51 Pushbutton function group configuration

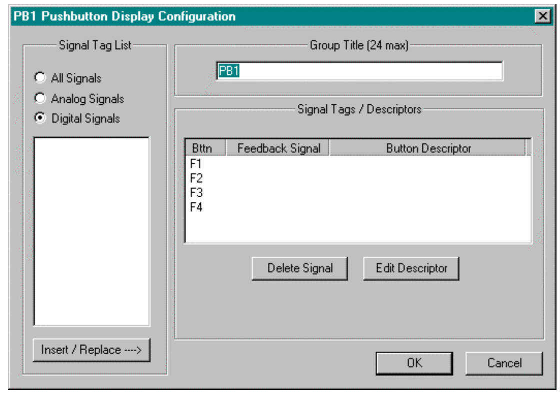
<table>
<tr>
<td>

- There are four pushbuttons that can be configured for each block.

You can assign just a label for the display using the Output descriptor.

You can also select signal tags from the "Signal Tag List" if you require a feedback signal to be shown on the pushbutton display.

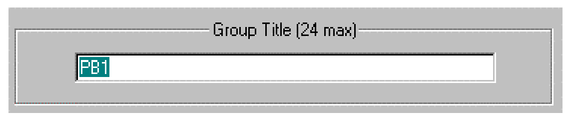
</td>
<td>



</td>
</tr>
<tr>
<td>

- Enter the Group Title Text in the appropriate field.

</td>
<td>



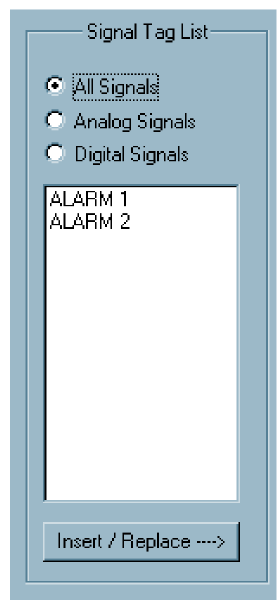
</td>
</tr>
<tr>
<td>

The "Signal Tag List" field shows all the Signal Tags that have been configured on the Function Block Diagram. Select "All Signals", "Analog Signals", or "Digital Signals".

- **To Add a Digital Signal tag to a Pushbutton location:**
  Click on a signal tag in the list, then click on "Insert/Replace". The selected Signal tag will be placed in the next available position in the "Signal Tags/Descriptors" field.

- **To Insert a Digital Signal tag to a Pushbutton location:**
  Select a position in the "Signal Tags/Descriptors" field., then click on INSERT. (You must click in the *first* column of the Selected Signal Tag list to select a row.) The selected Signal tag will be placed in the position chosen, and other signal tags will move down as required. You may only insert to the occupied portion of the list. An attempt to insert to any empty row will place the new item in the first empty row.

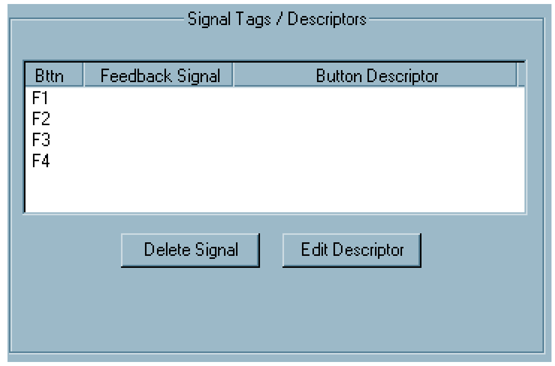
</td>
<td>



</td>
</tr>
</table>

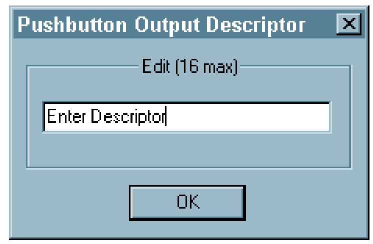
The selected Signal Tag will be placed in the “Signal Tags/Descriptors” field

- **Repeat** selection for up to 4 Pushbuttons.
- To **delete** a selected Tag, click on the position of the tag and click “Delete”.



- To Add or Edit and output descriptor to the display, click on the “Bttn” number and then on “Edit Descriptor” and type in the descriptor in the Edit field.
- Click “**OK**”.

You can assign Pushbutton Configuration Groups to Display Buttons, refer to Display Buttons (1-8) Configuration in the Control Builder User’s Guide.



Example

Figure 56 is an overview of a pushbutton configuration.

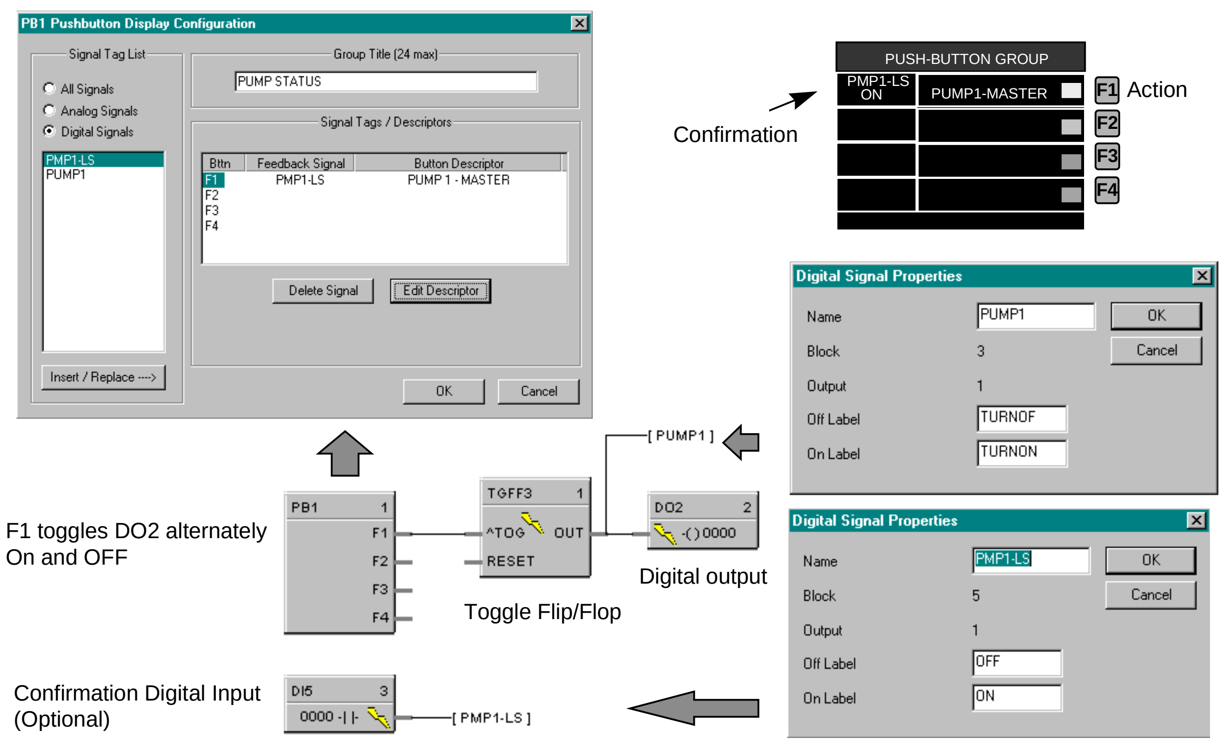
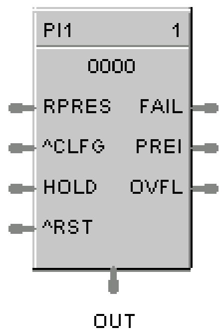


Figure 56 PB function block example

PI Function Block

Description

The **PI** label stands for **Pulse Input.** This block is part of the *Logic* category. It looks like this graphically on the Control Builder.



Function

This function block reads a single input channel from a pulse-frequency-input module. It scales inputs from the module to user-configured engineering units corresponding to accumulated pulses. The scaling typically represents a quantity. The preset values, reset, preset action, hold and clear flags are sent to the module and the module will respond with FAIL, counter overflow indicator (OVFL), preset indicator (PREI) and accumulated pulse counts.

Input

RPRESS = Remote preset count value (in EU); used to determine the status of the PREI output
PREI = OFF, [0] when count is less than the RPRESS value, else ON)
^CLFG = Clear flags. An OFF to ON transition clears the FAIL and OVFL flags to zero.
HOLD = A Boolean value when set to ON holds the pulse counter at its current value.
^RST = when the HOLD input is set to ON, an OFF to ON transition resets the pulse counter to zero. It also clears the FAIL and OVFL flags.

Output

FAIL = Failed Input Indication. A Boolean value that turns ON when the Pulse/Frequency Input module reports a failure. This is cleared by the ^CLFG or ^RST inputs.
PREI = A Boolean value that turns ON when the accumulated pulse count => preset count. (Note 1.)
OVFL = Overflow flag. This turns ON when the counter on the module overflows. This is cleared by the ^CLFG or ^RST inputs.
OUT = The accumulated Engineering Unit (EU) count. The forcing of OUT is permitted within this block.

Note 1. Due to the delay in messaging and the response time of the module, there can be a lag between the PREI output of the function block versus the DO on the module. The function block output can lag the digital output on the card by as much as one scan cycle period.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the PI function Block parameters to the desired value or selection that matches your operating requirements. Table 22 describes the parameters and the value or selection.

Table 52 Pulse input function block parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Address	**I/O Module**	N/A	Address of select I/O Module	From 1 to 16
	Channel	N/A	Channel on selected I/O Module	From 1 to 6
Pulse Weight	**EU per Pulse**	1	Number of EU per Pulse	0-99999 EU Default = 1
Preset	**Use Remote**	4	Remote Preset Count Click on radio button to turn ON	**ON** = Use Remote Preset **OFF** = Use Local Preset Default = ON
	Use Local	3	Local Preset Count in EU. Used to determine the ststus of the PREI output. Click on radio button to select.	0 = no alarming
	Preset Action	2	Preset Action determines how the PREI and the associated digital output on the module react when the counter reaches the preset value.  = **ON**	**OFF** = (latch) the hardware module output latches ON until reset. The PREI latches ON until the module acknowledges the Reset. **ON** = (trigger) the hardware module output turns ON for 1 second. The PREI turns ON for approximately 1 second. Default = ON

Example

Figure 57 shows a Function Block Diagram using a Pulse Input Module and PI function block to control the amount of material flowing into a tank. A counter is used to count fill cycles.

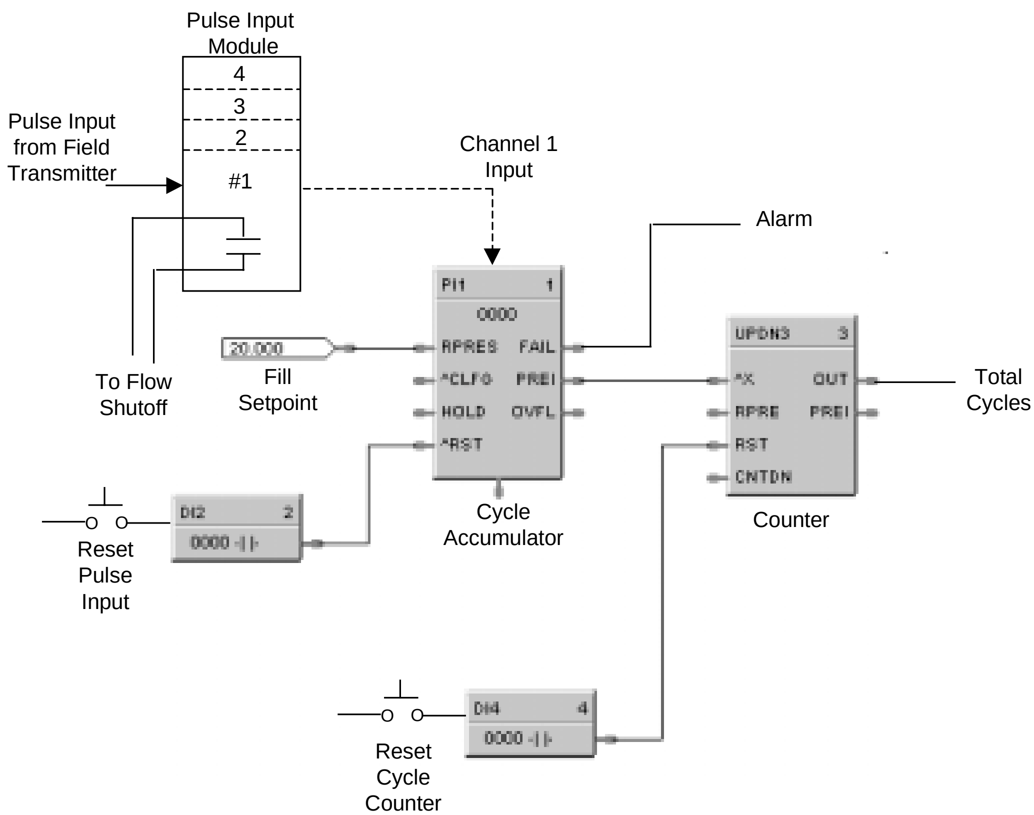
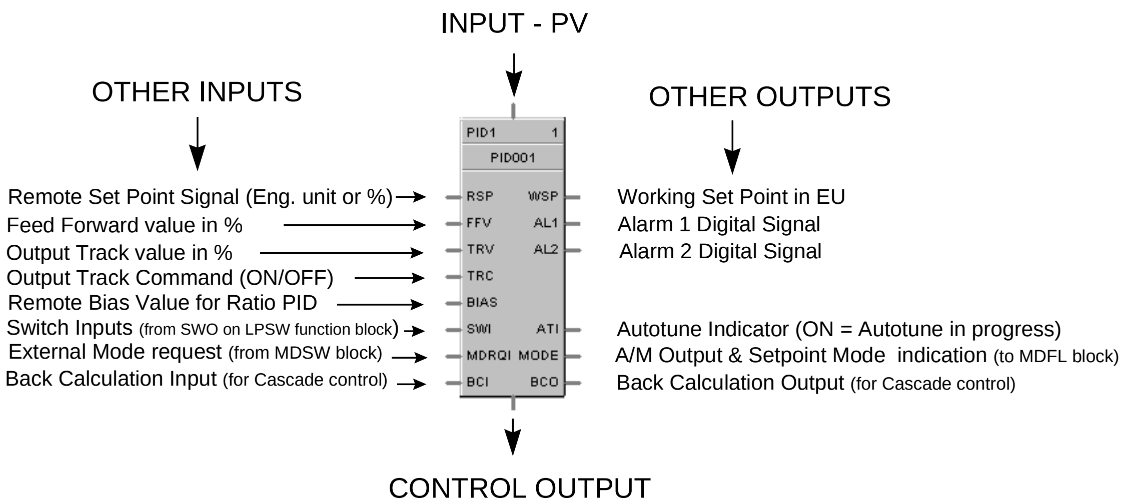


Figure 57 PI function block example

PID Function Block

Description

The **PID** label stands for **Proportional, Integral, Derivative (3-mode)** control action. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Provides Proportional (P), Integral (I) and Derivative (D), (3-mode) control action based on the deviation or error signal created by the difference between the setpoint (SP) and the Process variable analog input value (PV).

It provides two digital output signals for alarms based on configured parameters.

The PID function block provides for Feedforward, Cascade, and Ratio control.

Automatic tuning with Fuzzy Logic Overshoot Suppression can be configured.

Digital inputs may be used to set control mode, select the setpoint source, change control action plus other discrete actions.

For examples of PID Control, refer to:

Basic PID Configuration
Duplex Control
Cascade Control
Ratio Control
Cascade Control of Boiler Drum Level
Cascade Control of a Boiler Drum Level - 3 Element Feedwater Control

Inputs

PV = Process Variable Analog Input value in Engineering Units to be controlled

RSP = Remote Setpoint Analog Input value in Engineering Units or Percent to provide external setpoint

FFV = Feedforward value in percent. The Feedforward value is multiplied by the Feedforward Gain, then directly summed into the output of the PID block.

TRV = Output Track value in Percentage (PID Output = TRV Input when TRC = ON.)

TRC = Output Track Command [ON, OFF] (On -Enables TRV.) (Mode = Local Override)

BIAS = Remote Bias value for Ratio PID

SWI = Switch Inputs (from SWO on LPSW function block)
- 0 = No Change
- 1 = Initiate Autotuning
- 2 = Change Control Action
- 4 = Force Bumpless Transfer
- 8 = Switch to Tune Set 1
- 16 = Switch to Tune Set 2

MDRQI = External Mode request (typically connected to the MDRQO output of a MDSW function block that encoded discrete switch inputs).
- 0 = No Change
- 1 = Manual Mode Request
- 2 = Auto Mode Request
- 4 = Local Mode Request
- 8 = Remote Mode Request

BCI = Back Calculation Input (for blocks used as Cascade Primary)—See ATTENTION 2.

Outputs

OUT = Control Output

WSP = Working Setpoint in Engineering Units for monitoring

AL1 = Alarm 1 - Digital Signal

AL2 = Alarm 2 - Digital Signal

ATI = Autotune Indicator (ON = Autotune in Progress)

MODE = Loop mode status (typically connected to the Mode Flags block for encoding). Value indicates modes as follows:

0.0	RSP AUTO
1.0	RSP MAN
2.0	RSP Initialization Manual (See ATTENTION 1)
3.0	RSP Local Override (See ATTENTION 1)
4.0	LSP AUTO
5.0	LSP MAN
6.0	LSP Initialization Manual (See ATTENTION 1)
7.0	LSP Local Override (See ATTENTION 1)

BCO - Back Calculation Output (for blocks used as Cascade Secondary)—See ATTENTION 2.

ATTENTION

1. When a request to change from Auto to manual is received and:
   - the request comes from the operator Interface, *the request is ignored*.
   - the request comes from the Mode Switch (MDSW) function block, *the request is retained and when leaving the Initialization Mode or Local Override Mode the loop will go to manual*.
2. BCO output is provided for applications where the block is used as a cascade secondary. BCI input is provided for applications where the block is used as a cascade primary. When the BCO output of a secondary loop is connected to the BCI input of a primary loop, bumpless transfer is achieved when the secondary is switched into remote setpoint (i.e., cascade) mode. In addition, the primary loop is prevented from reset windup when the secondary is de-coupled from the process. The secondary is de-coupled from the process when it is in local setpoint mode or manual output mode or has reached a setpoint or output limit or is integral limiting because of it's BCI input. For example, see Figure 60.

Block properties

Double click on the function block to access the function block properties dialog box.

Dialog box structure

The PID properties dialog box is divided into six tab cards

GENERAL
RSP
RANGE/LIMIT
TUNING
ACCUTUNE
ALARMS

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 53 describes the parameters and the value or selection.

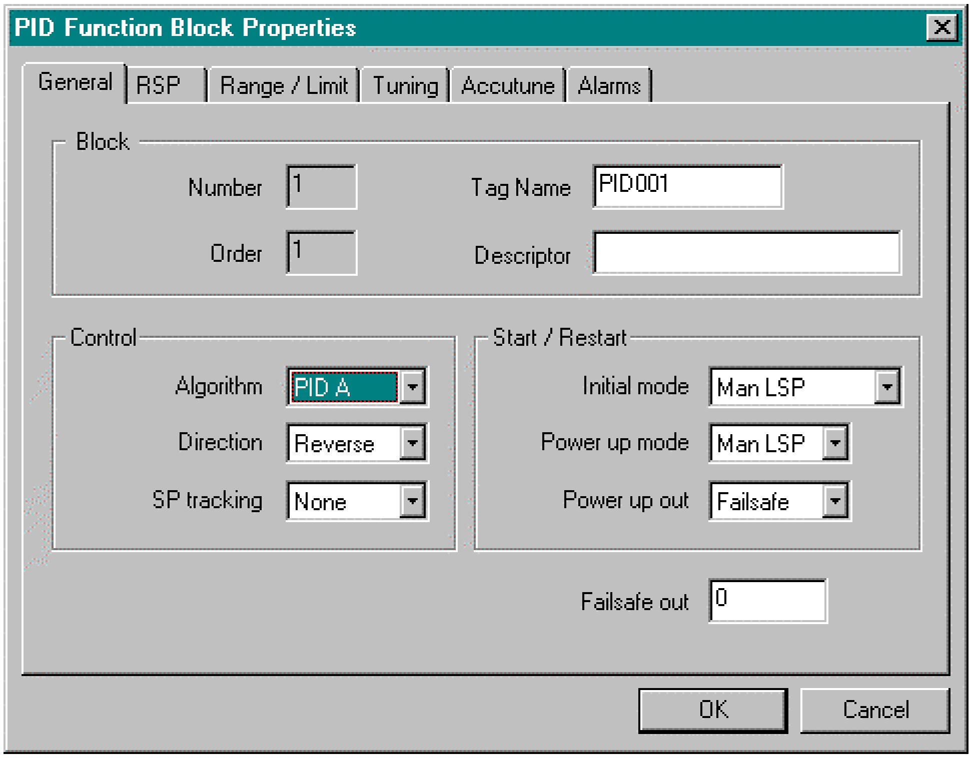


Table 53 General tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order	Read Only. See “Configure" Menu, ”Execution Order” to change.
	Tag Name	N/A	8 character tag name	
	Descriptor	N/A	Block descriptor	
Control	**Algorithm**	N/A	Control Algorithm ***Note: In PID B, step changes in setpoint will not bump the output; the output will slew smoothly to the new value.*** ***In PID A, a step change in setpoint will result in a step change in output***.	**PID A** - is normally used for 3 mode control. The output can be adjusted somewhere between 100 % and 0 %. It applies all three control actions - Proportional (P), Integral (I), and Derivative (D) - to the error signal. **PID B** - Unlike the PID-A equation, the controller gives only an integral response to a setpoint change, with no effect on the output due to the Gain or Rate action, and gives full response to PV changes. **DUPA -** like PID A but provides an automatic method to switch tuning constant sets for Heat/Cool applications. **DUPB -** like PID B but provides an automatic method to switch tuning constant sets for Heat/Cool applications. NOTE: With PID B or DUPB selection, you **will not** be allowed to set RESET or RPM to 0.00 (OFF). Reset must be enabled.
	Direction	N/A	Control Action	**DIRECT** - PID action causes output to **increase** as process variable increases. **REVERSE** - PID action causes output to **decrease** as process variable increases.
	SP Tracking	N/A	Setpoint Tracking	**None** **Track PV** - When control mode is “manual”, local setpoint tracks process variable. **Track RSP** - When setpoint is “remote setpoint”, local setpoint tracks remote setpoint.

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Start/ Restart	**Initial Mode**	N/A	Control Mode and Setpoint at NEWSTART **Newstart** is the first scan cycle following the cold start of the controller	**MAN LSP -** Manual control and last local setpoint **AUTO LSP** - Automatic control and last local setpoint. **AUTO RSP** - Automatic control and remote setpoint. **Man LSPonly** - Manual control and local setpoint only. **Auto LSPonly** - Automatic control and local setpoint only*. **Auto RSPonly** - Automatic control and remote setpoint only*. **These modes will override the configured POWER UP MODE.*
	Power Up Mode	N/A	Control Mode and Setpoint at power up	**MAN LSP** - Manual control and last local setpoint **AM LSP** - Same control mode (auto or manual) and last local setpoint. **AM LR** - Same control mode (auto or manual) and setpoint (local or remote) as at power-down.
	Power Up Out	N/A	Output at Power up	**LAST OUT** - Same as at power down. **FAILSAFE** - Failsafe output value.
Failsafe Out	**Failsafe Out**	16	Failsafe Output Value	–5 % to 105 %

RSP tab

It looks like this graphically on the Control Builder. Table 54 describes the parameters and the value or selection.

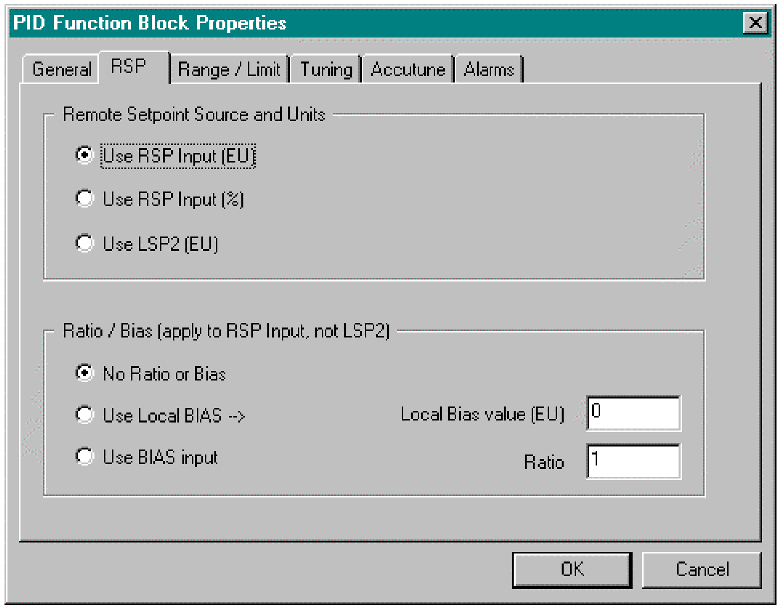


Table 54 RSP tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Remote Setpoint Source and Units	**Use RSP Input (EU)**	N/A	Use Remote Setpoint in Engineering Units	Click on radio button to select
	Use RSP Input (%)		Use Remote Setpoint in Percent	Click on radio button to select
	Use LSP2 (EU)		Use Local Setpoint #2 in Engineering Units	Click on radio button to select
Ratio/Bias	**No Ratio or Bias**	N/A	No ratio and bias applied to the function block	Click on radio button to select
(RSP Input Only)	**Use Local Bias**		Use Bias value selected on Tab	Click on radio button to select Enter value at “**Local Bias Value**” on tab.
	Use Bias Input		Use Bias value attached to an input to the block	Click on radio button to select
	Local Bias Value (EU)	40	Local bias value in engineering units	Enter local bias value –99999 to 99999
	Ratio	39	Gain value for Ratio PID	–20 to +20

RANGE/LIMIT tab

It looks like this graphically on the Control Builder. Table 55 describes the parameters and the value or selection.

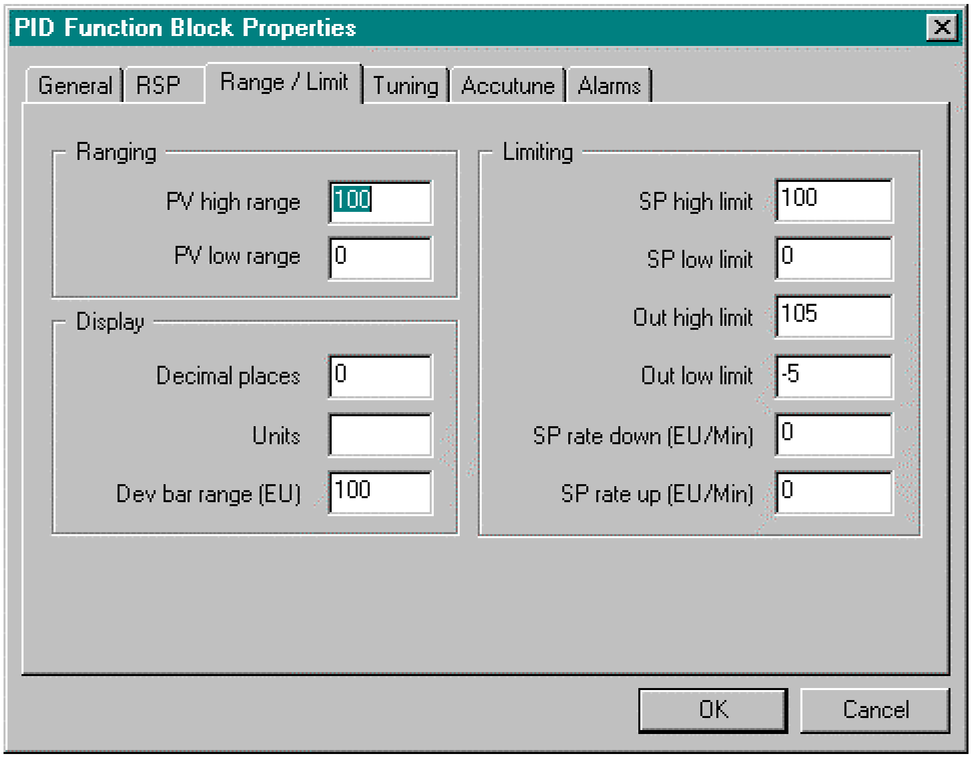


Table 55 Range/limit tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Ranging	**PV High Range**	4	PV High Range Value	–99999 to 99999
	PV Low Range	5	PV Low Range Value	–99999 to 99999
Display	**Decimal Places**	N/A	Number of digits to display after decimal point.	0 to 5
	Units	N/A	Text to display for EU	4 characters
	DEV Bar Range (EU)	N/A	Deviation Bar Range on the Operator Interface	–99999 to 99999
Limiting	**SP High Limit**	11	Setpoint High Limit Value - prevents the local and remote setpoints from going above the value set here.	–99999 to 99999
	SP Low Limit	12	Setpoint Low Limit Value - prevents the local and remote setpoints from going below the value set here.	–99999 to 99999
	Out High Limit	14	Output High Limit Value - is the highest value of output beyond which you do not want the automatic output to exceed	–5 % to 105 %
	Out Low Limit	15	Output Low Limit Value - is the lowest value of output beyond which you do not want the automatic output to exceed	–5 % to 105 %
	SP Rate Down	35	Setpoint Rate Down value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **down** to the new one.	0 (off) to 9999 (eu/min)
	SP Rate Up	36	Setpoint Rate Up value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **up** to the new one.	0 (off) to 9999 (eu/min)

TUNING tab

It looks like this graphically on the Control Builder. Table 56 describes the parameters and the value or selection.

ATTENTION

Use of Tune SET 1 or 2 can be selected via input (SWI) from the Loop Switch block output (SWO) or, in the case of DUP_A or DUP_B, automatically depending on the value of the previous output (≥ 50 % or < 50 %).

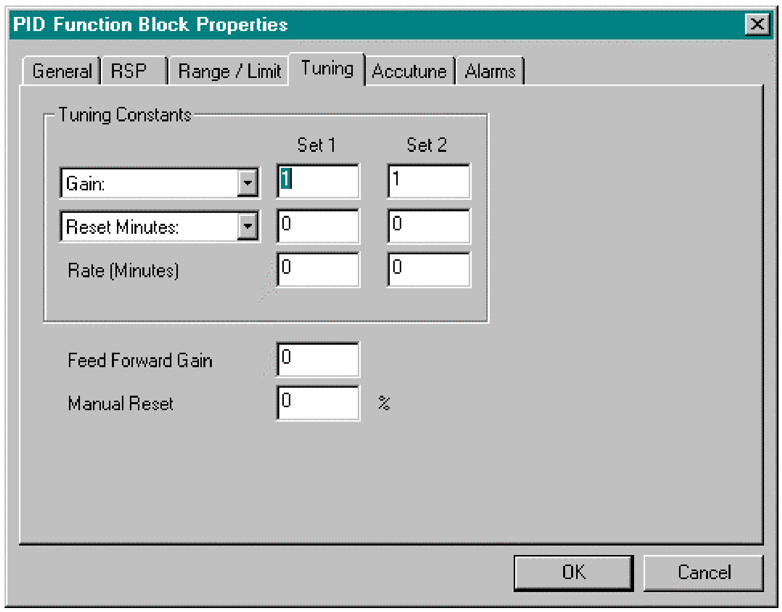


Table 56 Tuning tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Tuning Constants	**Prop Band** **or** **Gain**	0 PB1 or Gain1 30 PB2 or Gain2	Proportional Band (PB) - is the percentage of the range of the measured variable for which a proportional controller will produce a 100 % change in its output. Gain - is the ratio of output change (%) over the measured variable change (%) that caused it. $G = \frac{100\ \%}{PB\ \%}$ where PB is the proportional Band (in %)	0.1 to 1000 0.1 % to 1000 % ATTENTION: Enter values for tuning set 1 and tuning set 2 in specified fields.
	Reset Minutes **or** **Repeats per Minute**	2 Reset1 or 32 Reset2	RESET (Integral Time) - adjusts the controller's output according to both the size of the deviation (SP-PV) and the time it lasts. The amount of corrective action depends on the value of Gain. The reset adjustment is measured as how many times proportional action is repeated per minute (Repeats/minute) or how many minutes before one repeat of the proportional action occurs (Minutes/repeat).	0.02 to 50.00 *Must be enabled for PID-B or DUP-B algorithm selections.*
	Rate Minutes	1 Rate1 or 31 Rate2	RATE action, in minutes affects the controller's output whenever the deviation is changing; and affects it more when the deviation is changing faster.	0 or 0.1 to 10.00 minutes 0 = OFF
Feedforward Gain	**Feedforward Gain**	37	Applies Gain to the feedforward value (FFV). Feedforward Input is multiplied by this value.	0.0 to 10.0
Manual Reset	**Manual Reset**	26	MANUAL RESET- is only applicable if you do not use RESET (Integral Time) Allows correction of output to account for load changes to bring the PV up to setpoint.	–100 to 100 (in % of Output)

ACCUTUNE tab

It looks like this graphically on the Control Builder. Table 57 describes the parameters and the value or selection.

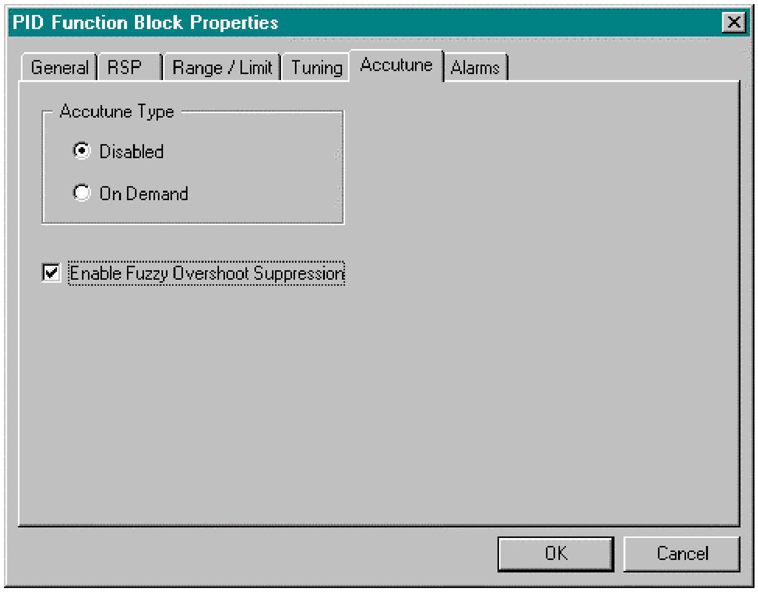


Table 57 Accutune tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Accutune Type	**Disabled**	N/A	Disables Accutune	Click on radio button to select.
	On Demand		When initiated, the controller will start controlling to the setpoint while it identifies the process, calculates the tuning constants, and begins PID control with the correct tuning parameters.	Click on radio button to select.
 Enable Fuzzy Overshoot Suppression **Click on block to select**		28	Fuzzy Overshoot Suppression minimizes overshoot after a setpoint change or a process disturbance. The fuzzy logic observes the speed and direction of the PV signal as it approaches the setpoint and temporarily modifies the internal controller response action as necessary to avoid an overshoot. There is no change to the PID algorithm, and the fuzzy logic does not alter the PID tuning parameters. This feature can be independently Enabled or Disabled as required by the application to work with “TUNE” On-Demand tuning.	

ATTENTION

Accutune is an On-demand tune only. You must provide a 0 to 1 transition to start another tuning cycle. The tuning will disturb the output to evaluate the tuning constants required.

ALARMS tab

It looks like this graphically on the Control Builder. Table 58 describes the parameters and the value or selection.

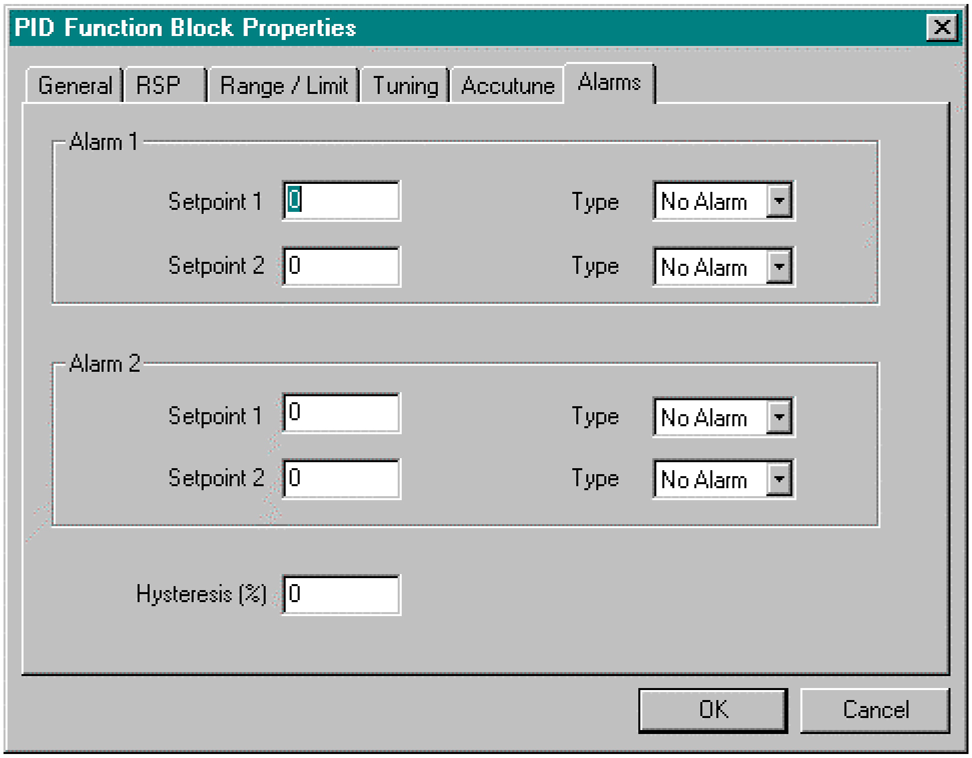


Table 58 Alarms tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Alarm 1	**Setpoint 1**	17	**Alarm 1 Setpoint 1 Value** - this is the value at which you want the alarm type chose below to activate	–99999 to 99999 in Engineering Units Within the PV range when alarm type is PV or SP Within PV span when alarm type is DEV –5 % to 105 % when alarm type is output.
	Type	N/A	**Alarm 1 Setpoint 1 Type** - select what you want Alarm 1 Setpoint 1 to represent.	Selections: NO ALARM PV_HIGH High PV Alarm PV_LOW Low PV Alarm DEV_HIGH High Deviation alarm DEV_LOW Low Deviation alarm SP_HIGH High Setpoint alarm SP_LOW Low Setpoint alarm OUT_HIGH High Output alarm OUT_LOW Low Output alarm
	Setpoint 2	18	Alarm 1 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 1 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm 2	**Setpoint 1**	19	Alarm 2 Setpoint 1 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 1 Type	Same as **Alarm 1 Setpoint 1**
	Setpoint 2	20	Alarm 2 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm Hysteresis	**%**	25	Alarm Hysteresis in %	0 % to 5 %

Example 1 - Basic PID configuration example

Figure 58 shows a Function Block Diagram using a simplified PID Configuration (reference only) and its basic Configuration.

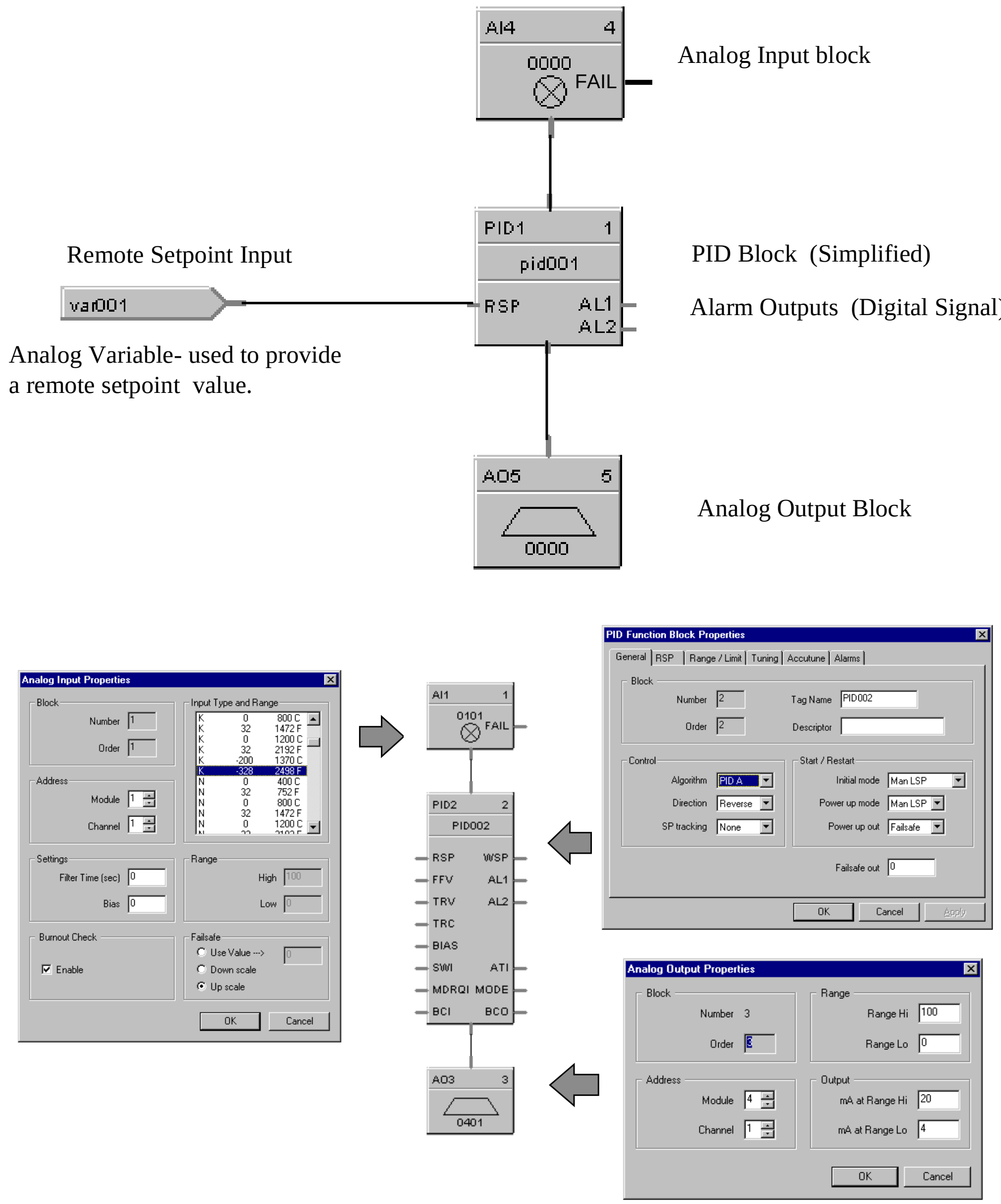


Figure 58 PID function block example

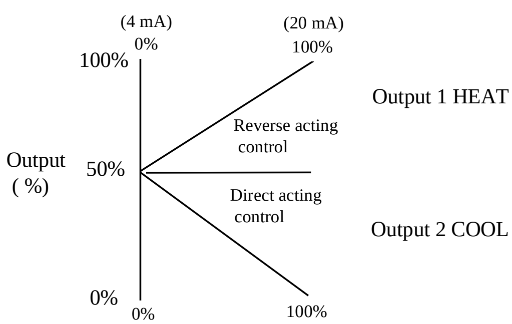
Example 2 - Duplex control - PID with heat/cool (duplex) output

Use standard PID Function Block

- Select PID A Duplex or PID B Duplex
- Set to Reverse acting
- Use Tuning Constant Set #1 from 50% to 100% Heat Output
- Use Tuning Constant Set #2 from 50 % to 0% Cool Output

Choose Output Types for Heat and Cool (Current/Current, Current/Time Proportioning, Time Prop./ Time Prop., etc.), connect each to PID block output.

Use output block scaling to set duplex output spans. Set output scaling Range Lo and Hi to 50 - 100 % for heat output and 50% to 0% for cooling output, respectively. You may need to adjust range limits for overlap or deadband as required.



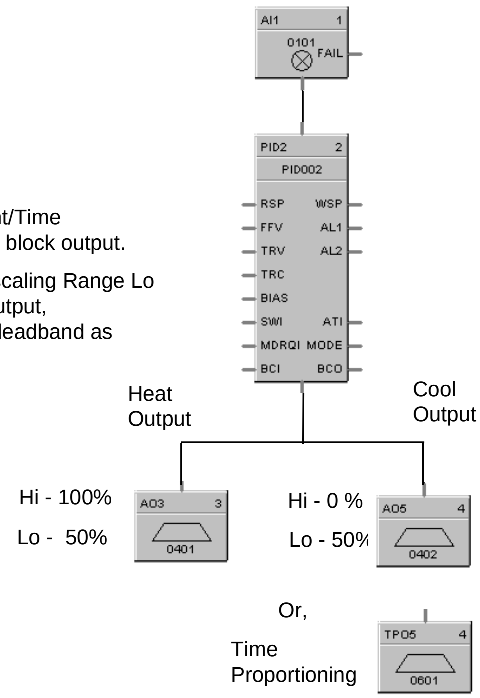


Figure 59 Duplex control example

Example 3 - Cascade control

The Cascade loop uses 2 PID blocks with the Back Calculation pin of the secondary connected to the primary loop. This transfers values back to the primary loop to adjust the PID for changes due to manual control.

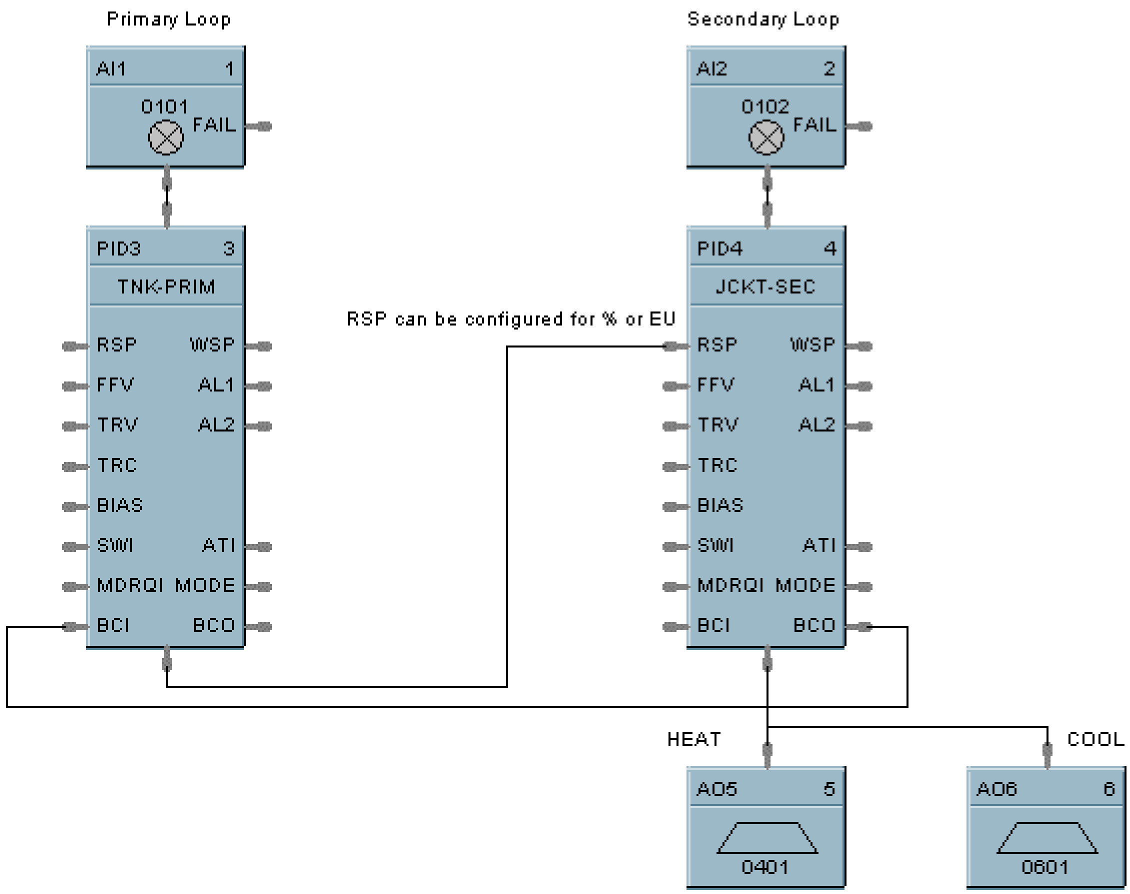
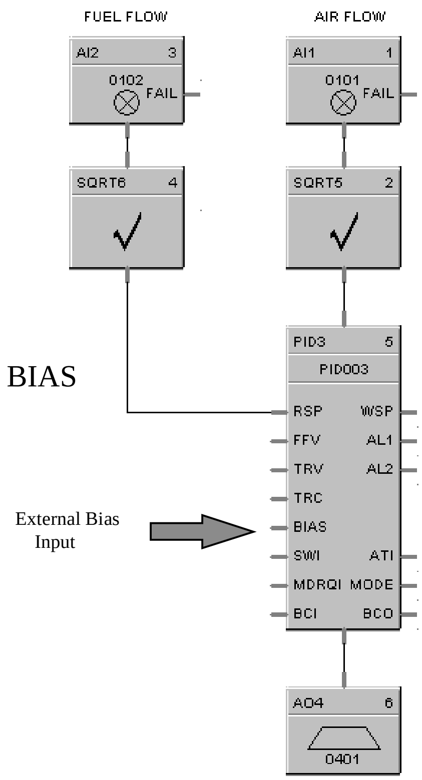


Figure 60 Cascade control example

Example 4 - Ratio control

The RATIO control loop requires selection of the remote SP of the PID for ratio control. The Ratio and Bias values are available for adjustment from the Control Setup screen of the Operator Interface. The Bias may be a local value or come from an external source such as an O2 analyzer trim arrangement. You may elect to use % for the ratioed inputs (typically for boiler applications) or Eng. Units (EU) (for feed flows to a reactor, for example).



Air (controlled variable)= Ratio x Fuel (RSP, or wild variable) + BIAS

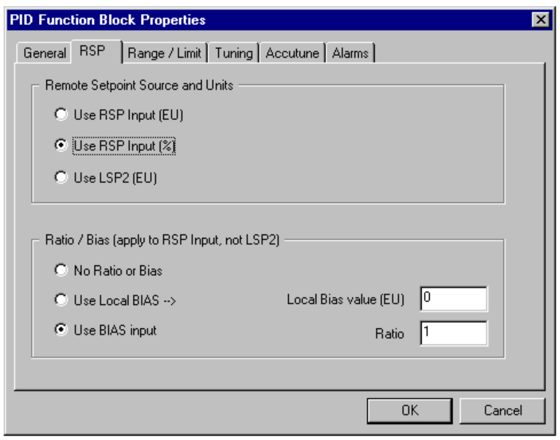


Figure 61 Ratio control example

Example 5 - Cascade control of a boiler drum level - basic

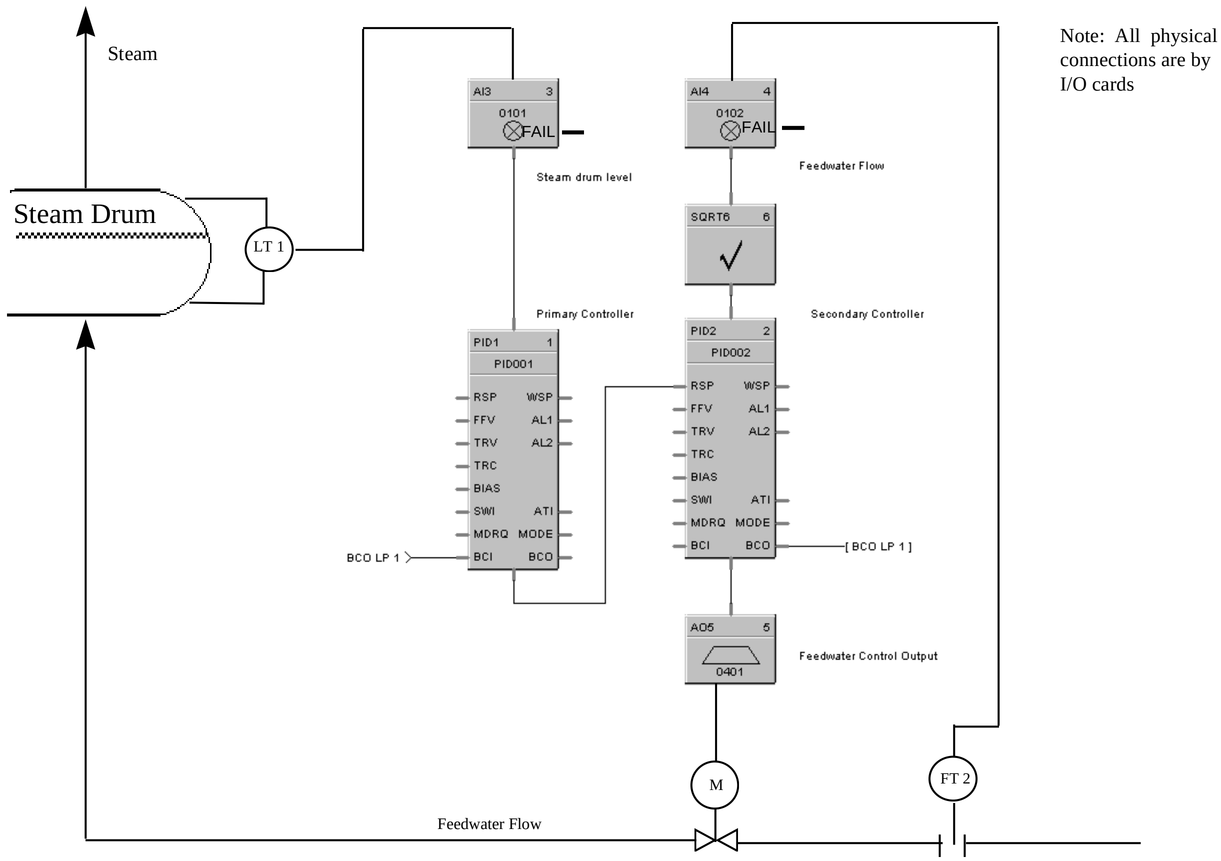


Figure 62 Cascade control of a boiler drum level - basic

Example 6 - Cascade control of a boiler drum level - 3 element feedwater control

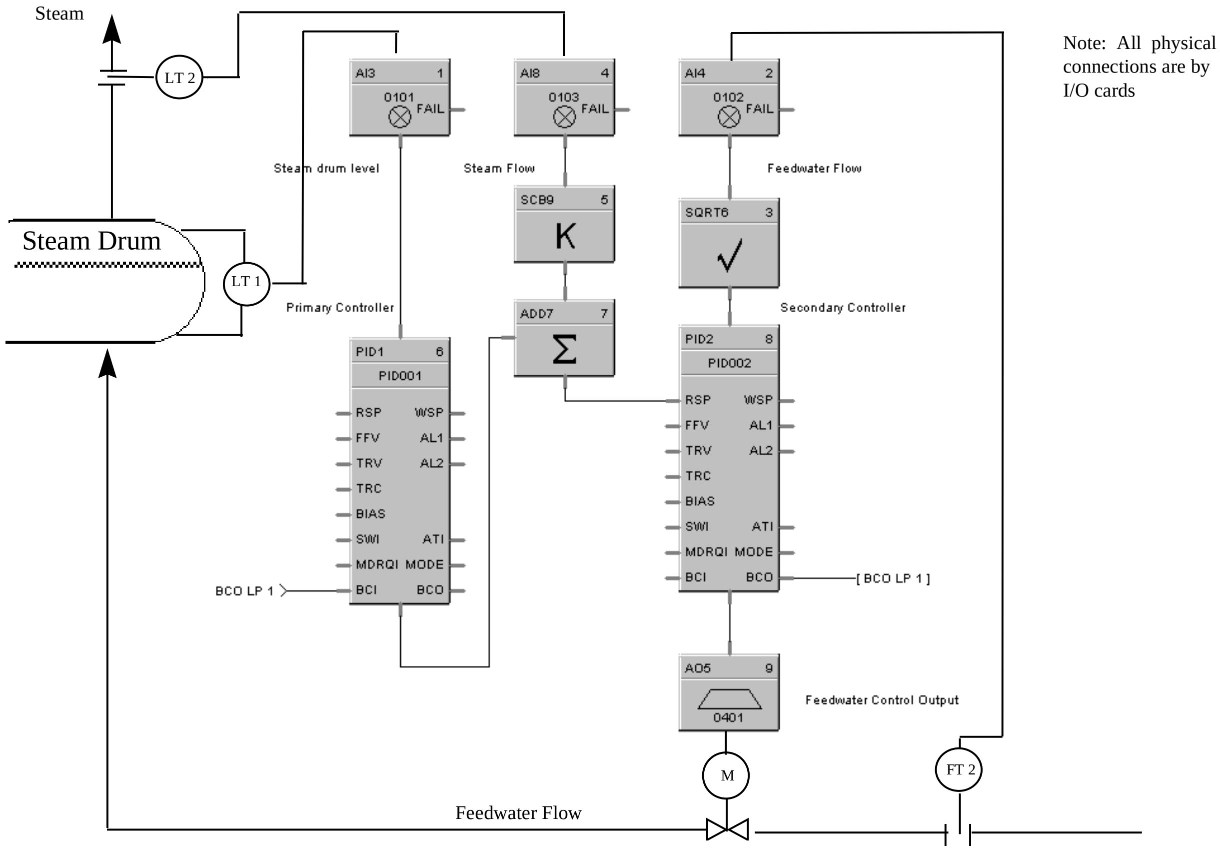
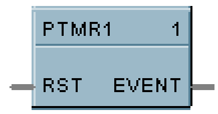


Figure 63 Cascade control of a boiler drum level - 3 element feedwater control

PT Function Block

Description

The **PT** label stands for **Periodic Timer**. This block is part of the *Counters/Timers* category. It looks like this graphically on the Control Builder.



Function (1 or 2)

4. *Time/Cycle:* Generates a discrete output pulse at a specified start time based on the real-time clock and at specified time periods thereafter.
   Start Times = Month, Day, Hour, Minute, Second
   Cycle Periods = Monthly, Weekly, Daily
   Time Cycle Periods Within a Day = Hours (0-23) Minutes (0-59) Seconds (0-59)
   NOTE: Once started, period repeats until reset.

5. *Reset Cycle:* Generates a digital output based on a digital input and at regular intervals thereafter.
   Time Start = ON to OFF transition of reset input.
   Cycle Time Period = Hours (0-23) Minutes (0-59) Seconds (0-59)

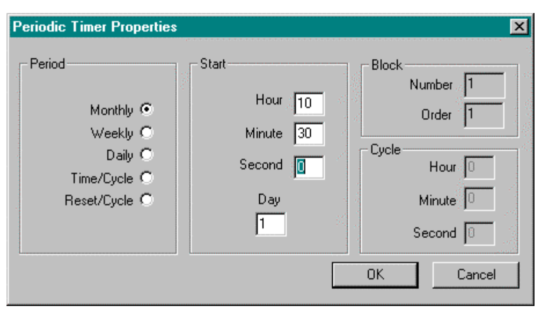
Input

RST = Reset/Enable (ON = Output disable, OFF = Output enable)

Output

OUT = Logic State. Output turns ON for one scan cycle when elapsed time matches setpoint time (One-shot)

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the PT function block parameters to the desired value or selection that matches your operating requirements. Table 59 describes the parameters and the value or selection.

Table 59 PT function block configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Block Order**	N/A		Read Only. See "Configure" Menu, "Execution Order" to change.
Period	**Monthly**	N/A	Output turns ON once a month for one scan cycle. If the current month's last day is less than 31 it will turn ON on the last day of the month. Reset/Enable: ON = Hold off output OFF = Run	Enter ***START*** - **Day** (Days >31 = 31), **Hour, Minute, Seconds**
	Weekly	N/A	Output turns ON once a week for one scan cycle. Reset/Enable: ON = Hold off output OFF = Run	Enter at ***START*** - **Day** (Monday through Sunday), **Hour, Minute, Seconds**
	Daily	N/A	Output turns ON once a day for one scan cycle. Reset/Enable: ON = Hold off output OFF = Run	Enter at ***START*** - **Hour, Minute, Seconds**
	Time/Cycle	N/A	Timer starts at a specific time of day then output pulses on/off on a time interval. Once started, start time is ignored until reset. Reset Input: ON = stops cycle and holds off start OFF = enables start time	Enter at ***START*** - **Hour, Minute, Seconds** Enter at *CYCLE* - Hour, Minute, Second
	Reset/Cycle	N/A	Timer starts on an ON (1) to OFF (0) transition of the reset input, then output pulses on/off on a time interval. Once started, the cycle continues until the reset turns on. Reset Input: ON = stops cycle and holds off start OFF = Output turns ON for one scan cycle at ON to OFF transition and cycle begins.	Enter at ***CYCLE*** - **Hour, Minute, Second**

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Start	**Hour**	N/A	Start Hour	0 through 23
	Minute	N/A	Start Minute	0 through 59
	Second	N/A	Start Second	0 through 59
	Day	N/A	Start Day	**Monthly** - 1 - 31 (Days >31 = 31) If the current month's last day is less than 31 it will turn ON on the last day of the month. **Weekly** -Monday through Sunday
Cycle	**Hour**	N/A	Cycle Hour	0 through 23
	Minute	N/A	Cycle Minutes	0 through 59
	Second	N/A	Cycle Seconds	0 through 59

Example

Figure 64 shows a Function Block Diagram using a PT function block.

An OFF delay timer block output is ON as long as the RST input is logic HI (ON). It can be used for time duration but must be triggered by an ON to OFF transition on the Reset input. This can be accomplished using Trigger blocks (TRIG) to create one-shot pulses which last one scan cycle. The fast logic trigger pulse will last 100 ms. while the normal logic trigger pulse will last the complete scan cycle for analog blocks. Use according to application need. A **Periodic Timer (PT)** output pulse may also be used to start the timer for the OFF delay for time duration.

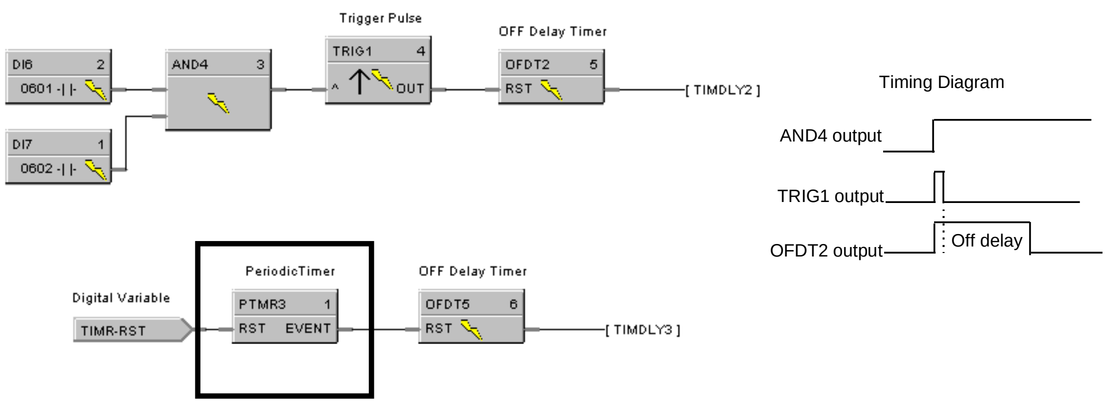
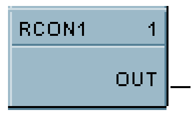


Figure 64 PT function block example

RCON Function Block

Description

The **RCON** label stands for **Read Constant Parameter Data**. This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



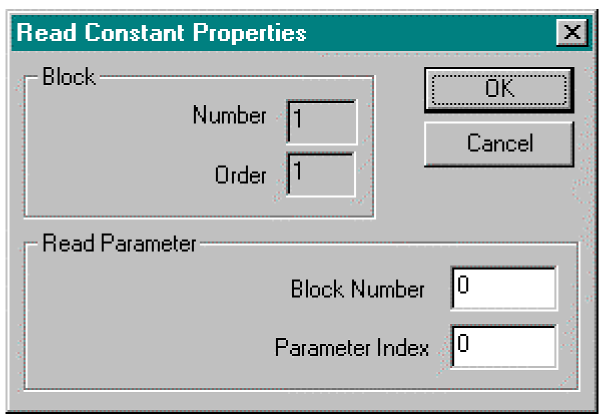
Function

Reads the numerical value of selected configuration parameter in a given function block**. *Select the index number of the required parameter from the specific function block reference data and enter it in the appropriate field in the "Read Constant Properties" dialog box.***

Output

OUT = Analog value of parameter

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the RCON function Block parameters to the desired value or selection that matches your operating requirements. Table 60 describes the parameters and the value or selection.

Table 60 Read constant configuration data

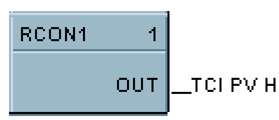
Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Read Parameters	**Block Number**	N/A	Number of control block that contains desired configuration parameter	1 to 250
	Parameter Index	N/A	Index number of configuration parameter to be read.	Select the index number of the required parameter from the specific function block reference data

TIP

The main purpose of this control block is to make a block configuration parameter (constant) available for display. To do this, you must enter the corresponding parameter index number for the selected configuration parameter. ***Select the index number of the required parameter from the specific function block reference data and enter it in the appropriate field in the "Read Constant Properties" dialog box.***

RCON Example

Figure 65 shows a Function Block Diagram using the RCON function block.



ATTENTION

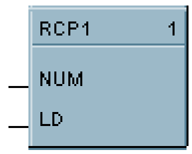
The process variable High Range Value for a PID block (Index #4) may be displayed at the Operator Panel with the Analog Signal Tag name TC1 PV HI, and/or the process variable may be used as an input to another control block.

Figure 65 RCON function block example

RCP Function Block

Description

The **RCP** label stands for **Recipe Selector**. This block is part of the *Setpoint Program* category. It looks like this graphically on the Control Builder.



Function

Used to initiate loading of recipe values into a chosen set of controller variables. Inputs include recipe number and load command. Loads numbered RECIPE (NUM) when digital signal (LD) is ON into the various blocks of the controller.

- If LD = OFF to ON, then: **Recipe numbered (NUM) is loaded in place of the current set of variable values**.

Input

NUM = Recipe number (1-50).

LD = Load recipe - OFF to ON will load the recipe.

TIP

The recipe is loaded at the time of block execution. If using multiple RECIPE blocks, they may counteract. Also, use the lowest execution numbers.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

ATTENTION

The recipe is loaded while the LD signal is on. It is not a one time load, it is a continuous load while the LD signal is on.

If the OI operator attempts to change a variable value (done by means of the Variable Edit display on the OI), the operator’s changes will immediately be overwritten by the loading recipe since it also contains the variable.

To correct this problem, configure a one-shot trigger signal between LD and its signal. This will cause LD to go on for one scan cycle instead of staying on.

Example

Figure 66 shows a Function Block Diagram using an RCP function block. The BCD block selects a recipe number and the RCP block loads the recipe in place of the current set of recipe variables.

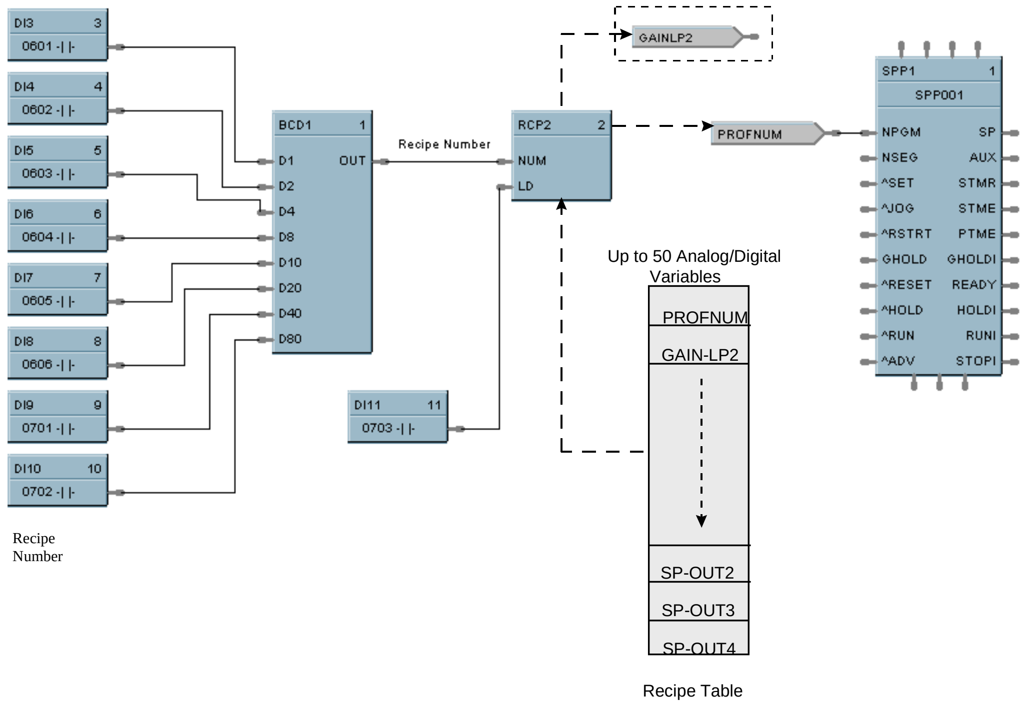
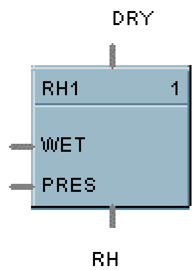


Figure 66 RCP function block example

RH Function Block

Description

The **RH** label stands for **Relative Humidity**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Calculates RH as a function of wet bulb temperature, dry bulb temperature and atmospheric pressure.

0-100 % RH is output as a floating point number between 0 and 100.

Input

DRY = Dry Bulb Temperature (°F, metric = °C)

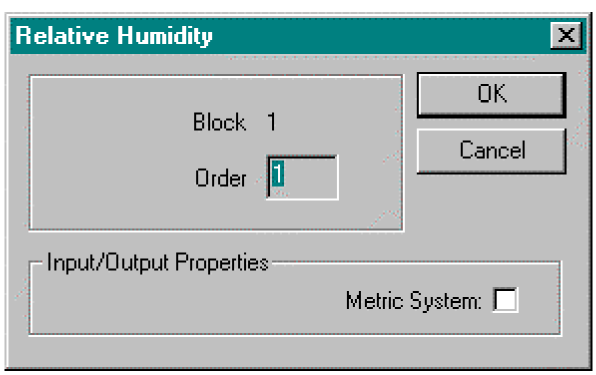
WET = Wet Bulb Temperature (°F, metric = °C)

PRES = Atmospheric Pressure (psi, metric = Pa)

Output

RH = Relative Humidity (0-100)

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Metric system

Click on this box to select Metric Units. Table 61 lists the units for the inputs and outputs.

Table 61 Metric units

Metric	ON	OFF
DRY	°C	°F
WET	°C	°F
PRES	Pa	PSI

TIP

It is physically impossible for the wet bulb to be warmer than the dry bulb. If this appears to be the case, it implies a problem with the sensors, and will result in a RH greater than 100 %. Downstream blocks should detect that situation and react promptly.

Example

Figure 67 shows an RH function block example.

A setup parameter allows inputs to be in Degrees F or Degrees C. When Degrees F is selected, pressure is assumed to be in PSIA. When Degrees C is selected, pressure is assumed to be in Pa. (101325 Pa = 1 std. Atmosphere.

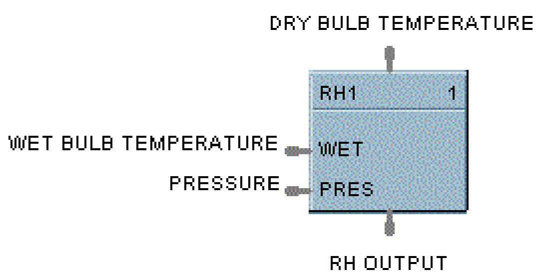
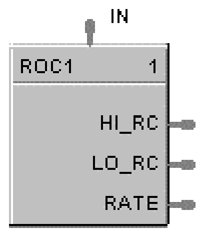


Figure 67 RH function block example

ROC Function Block

Description

The **ROC** label stands for **Rate of Change.** This block is part of the Auxiliary category. It looks like this graphically on the Control Builder.



Function

Provides:

- an analog output representing units per minute change of the analog input.
- compare setpoints for high and low rate of change.
- compare selections for increasing, decreasing or both directions of change.
- a logic 1(ON) output when input rate exceeds high rate setpoint
- a logic 1(ON) output when input rate is less than the low rate setpoint.

Inputs

IN = Analog Input

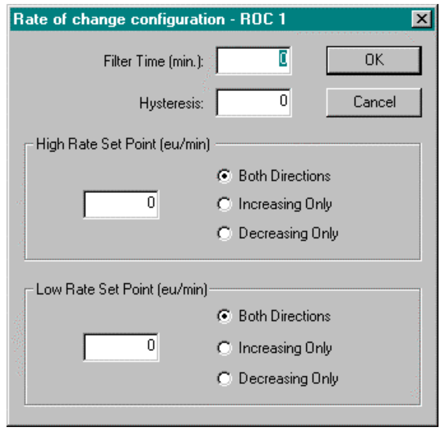
Outputs

HI_RC = ON if input rate exceeds High Rate setpoint

LO_RC = ON if input rate is less than the Low Rate setpoint

RATE = Analog Output representing Engineering Units per minute of change of the Analog Input

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the ROC function Block parameters to the desired value or selection that matches your operating requirements. Table 62 describes the parameters and the value or selection.

Table 62 ROC configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Filter Time Constant		0	Filter Time Constant	0.0 to 3.0 minutes
Setpoint Limits	**High Rate**	1	High Rate of Change setpoint	0 (off) to 99999.9 eu/min
	Low Rate	2	Low Rate of Change setpoint	0 (off) to 99999.9 eu/min
Direction Rate High		3	High Rate Direction • Both • Increasing only • Decreasing only	Click on radio button to select
Direction Rate Low		4	Low Rate Direction • Both • Increasing only • Decreasing only	Click on radio button to select
Hysteresis		5	Hysteresis	0-999

Example

Figure 68 illustrates various responses for the Rate Of Change Function Block. You can also use the ROC block to alarm if Rate exceeds the Preset Setpoint Limit.

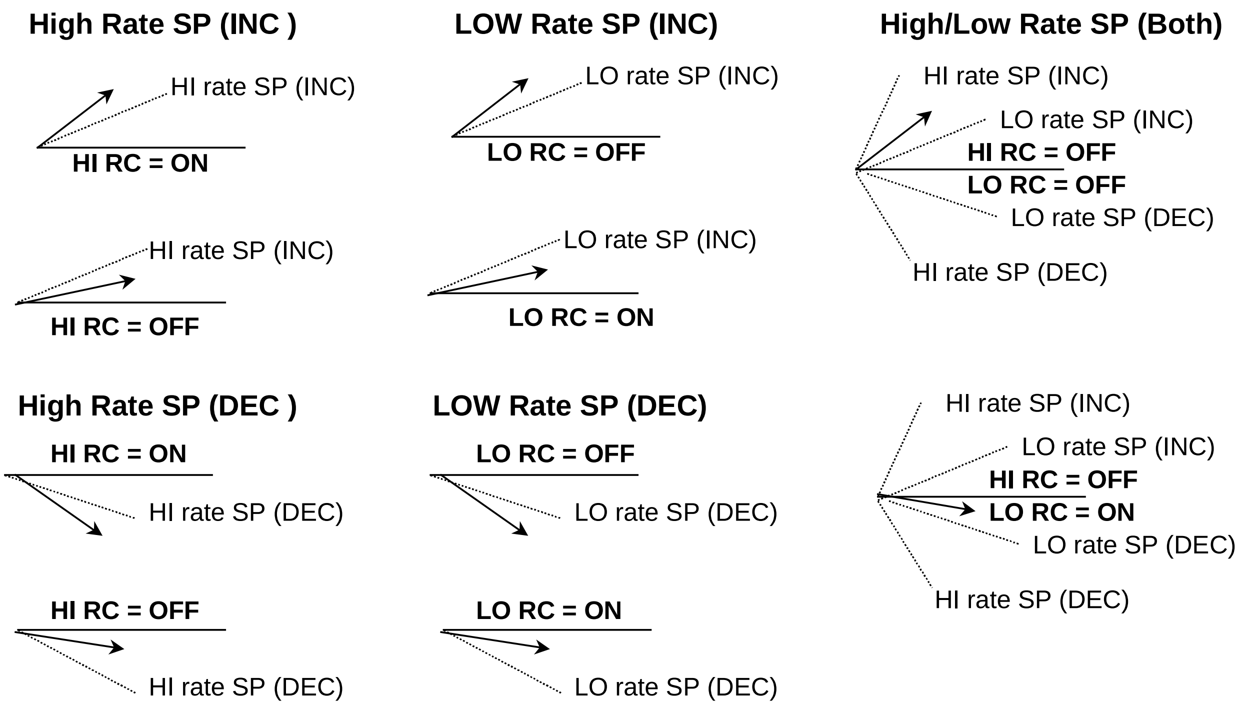


Figure 68 ROC function block responses

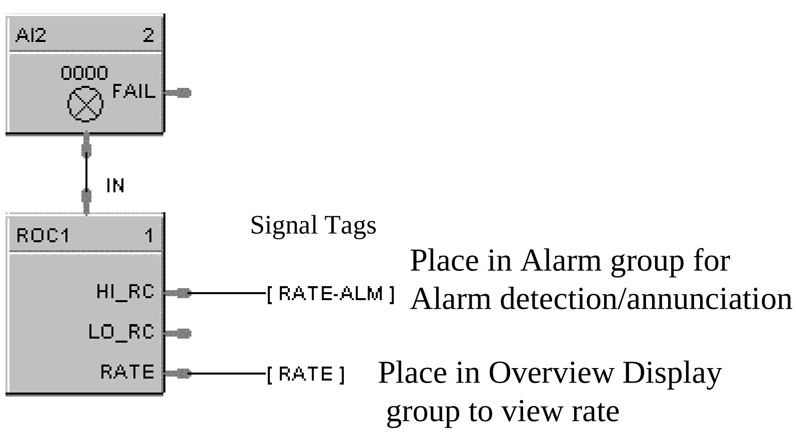
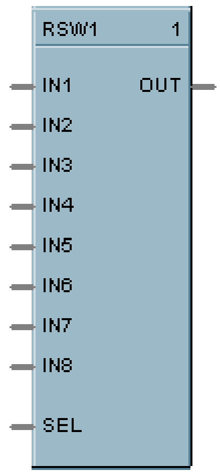


Figure 69 ROC function block example

RSW Function Block

Description

The **RSW** label stands for **Rotary Switch**. This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Function

The single output value is selected from up to 8 analog inputs by a number of from 1 to 8.

ATTENTION

Numbers less than one select input one as the output. Numbers greater than eight select Input 8 as the output.

Input

IN1 = Input 1
IN2 = Input 2
IN3 = Input 3
IN4 = Input 4
IN5 = Input 5
IN6 = Input 6
IN7 = Input 7
IN8 = Input 8
SEL = Selects Input # to Output

Output

OUT = Output Value

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 70 shows how a RSW function block works. It selects an output value from up to 8 analog values or number inputs.

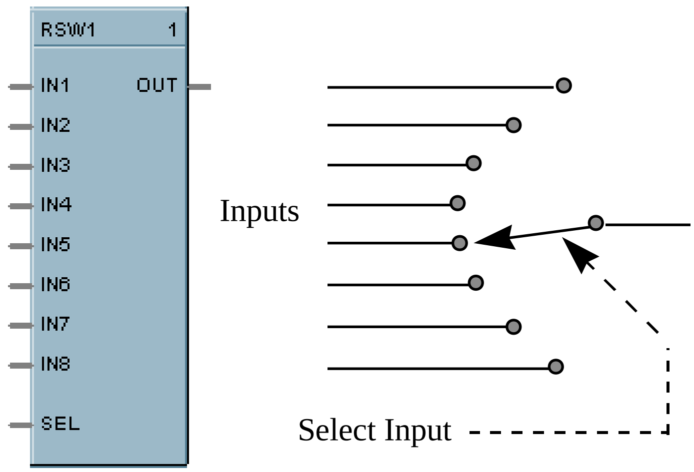
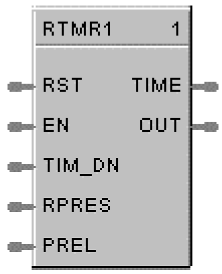


Figure 70 RSW function block example

RTMR Function Block

Description

The **RTMR** label stands for **Resettable Timer**. This block is part of the *Counters/Timers* category. It looks like this graphically on the Control Builder.



Function

The Resettable Timer block has the following attributes:

- Provides increasing or decreasing timing base on an enable input.
- Increasing time from 0 or preload value.
- Decreasing time from preset or preload value.
- Increasing time provides digital output upon reaching Preset
- Decreasing time provides digital output upon reaching zero
- Reset input sets increasing timer to zero.
- Reset input sets decreasing timer to preset value.
- Preset value may be internal, or remote via a dedicated input
- Inc./Dec. selection is via digital input.

Inputs

RST = Off to On transition, Reset

EN = ENABLE ON = run; timer is counting
OFF = Timer is stopped; output (TIMER) held at last value

TIM_DN = ON (time down); OFF (time up)

RPRES = Remote Preset (0.0 – 99999.9)
If *Time-up*, RPRES represents **Stop** value in seconds
If *Time -down*, RPRES represents **Start** value in seconds

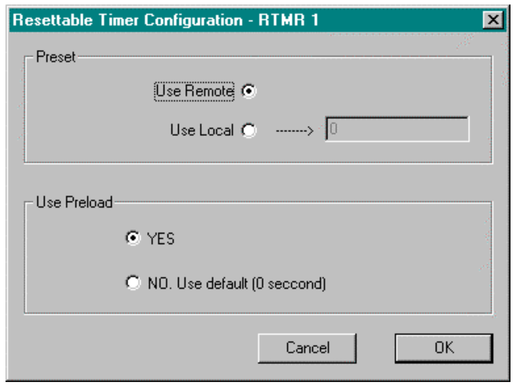
PREL = Preload (0.0 – 99999.9)
If *Time-up*, PREL represents **Start** value in seconds
If *Time-down*, PREL represents **Start** value in seconds

Outputs

TIME = current value of time in seconds

OUT = Output (Digital) turned ON when Preset value is reached or time reaches 0, depending on TIMDN input status

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the RTMR function Block parameters to the desired value or selection that matches your operating requirements. Table 63 describes the parameters and the value or selection.

Table 63 RTMR configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Presets	**Local Preset**	0	Local Preset	Click Radio Button to select Enter a value in the field 1 to 99999
Remote Preset		1	ON = use remote preset	Click on radio button to select
Use Preload		2	YES = use external preload rather than zero for starting or stopping NO = Use default (0 second)	Click on radio button to select

Timing diagram

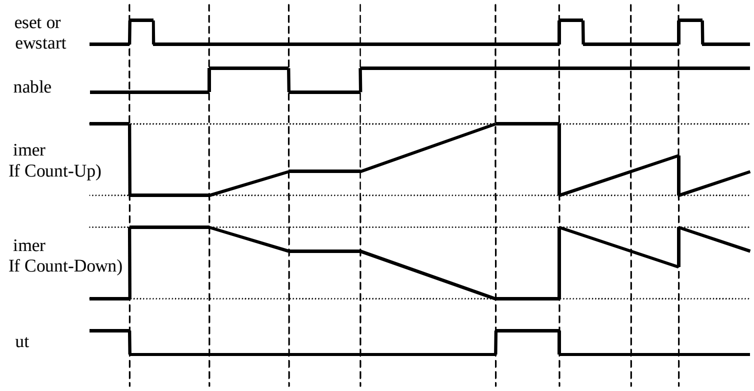
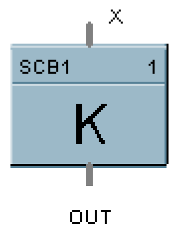


Figure 71 Timing diagram for resettable timer

SCB Function Block

Description

The **SCB** label stands for **Scale and Bias**. This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Multiplies an analog input value (X) by a scaling constant (K) and adds Bias to it.

- OUT = (K * X) + BIAS

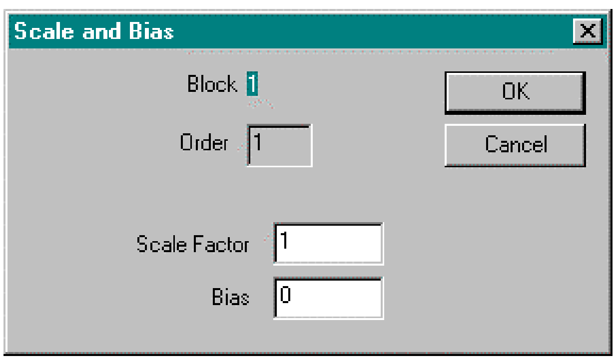
Input

X = Analog Value

Output

OUT = Modified Analog Value

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the SCB function Block parameters to the desired value or selection that matches your operating requirements. Table 64 describes the parameters and the value or selection.

Table 64 SCB configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
	Scale Factor	0	K - Multiplier (scaling) constant	–99999 to 99999
	Bias	1	Bias Constant - is used to compensate the input for drift of an input value due to deterioration of a sensor, or constant offset to an input.	–99999 to 99999

Example

Figure 72 shows function block diagrams using a SCB function block.

Example 1
Scale Factor = 5
Bias = 1000

Example 2
Scale Factor = 1
Bias = 460

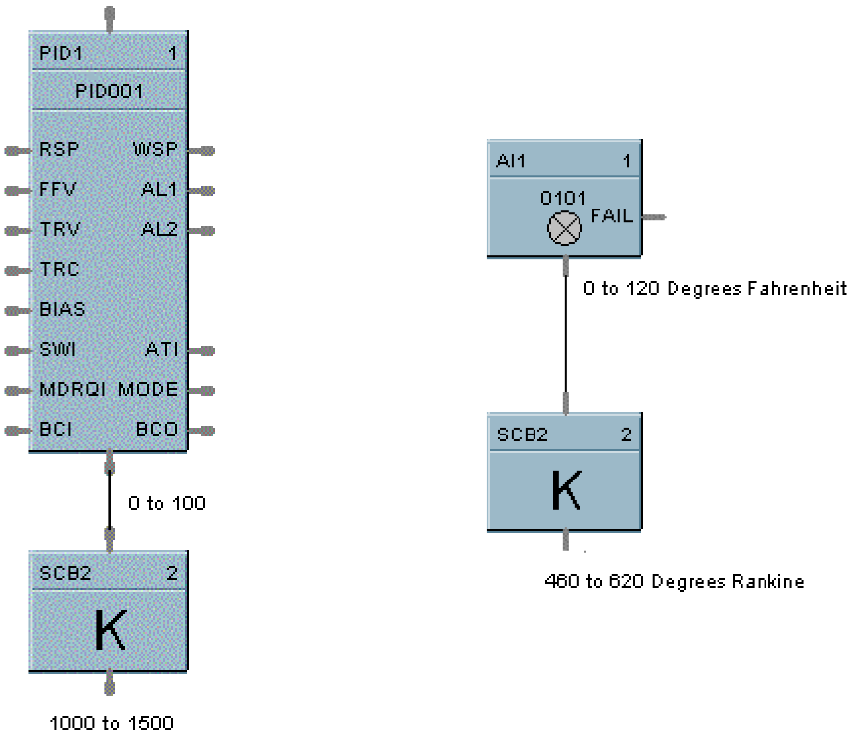
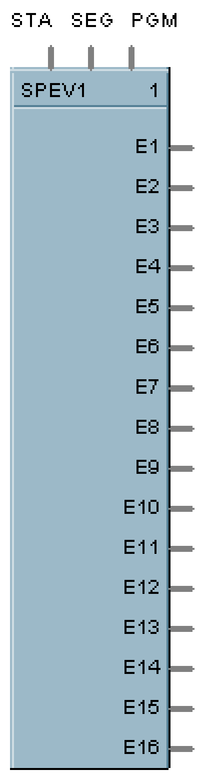


Figure 72 SCB function block examples

SPEV Function Block

Description

The **SPEV** label stands for **Setpoint Programming Events**. This block is part of the *Setpoint Program* category. It looks like this graphically on the Control Builder.



Function

Sets up to sixteen digital event outputs that may be ON or OFF on a per segment basis. Inputs include program number, segment number, and program state (READY, RUN, HOLD, GHOLD, STOP) from setpoint program block.

- If Program Number (PGM) = 0, Segment Number (SEG) = 0, or Program State (STA) is RESET; then: **E1 to E16 = OFF**.
- Otherwise, **E1 to E16 =** as specified in program (PGM), segment (SEG).

Inputs

PGM = Profile number (1 to 70).
SEG = Segment number (1 to 50).
STA = Program State (Ready, Run, Hold, Ghold, Stop).

ATTENTION

SPEV inputs must be connected directly to corresponding outputs of SPP (Setpoint Program) or SPS (Setpoint Scheduler) block.

In Stop state, events stay in the state defined in the last segment.

Outputs

E1 = Digital signal - segment event 1
E2 = Digital signal - segment event 2
E3 = Digital signal - segment event 3
E4 = Digital signal - segment event 4
E5 = Digital signal - segment event 5
E6 = Digital signal - segment event 6
E7 = Digital signal - segment event 7
E8 = Digital signal - segment event 8
E9 = Digital signal - segment event 9
E10 = Digital signal - segment event 10
E11 = Digital signal - segment event 11
E12 = Digital signal - segment event 12
E13 = Digital signal - segment event 13
E14 = Digital signal - segment event 14
E15 = Digital signal - segment event 15
E16 = Digital signal - segment event 16

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 73 shows a function block diagram using a SPEV function block to provide event outputs for a setpoint programmer.

The SP programmer event output status may be directed to digital outputs, part of control logic, or be directed to signal tags for use anywhere within the control configuration.

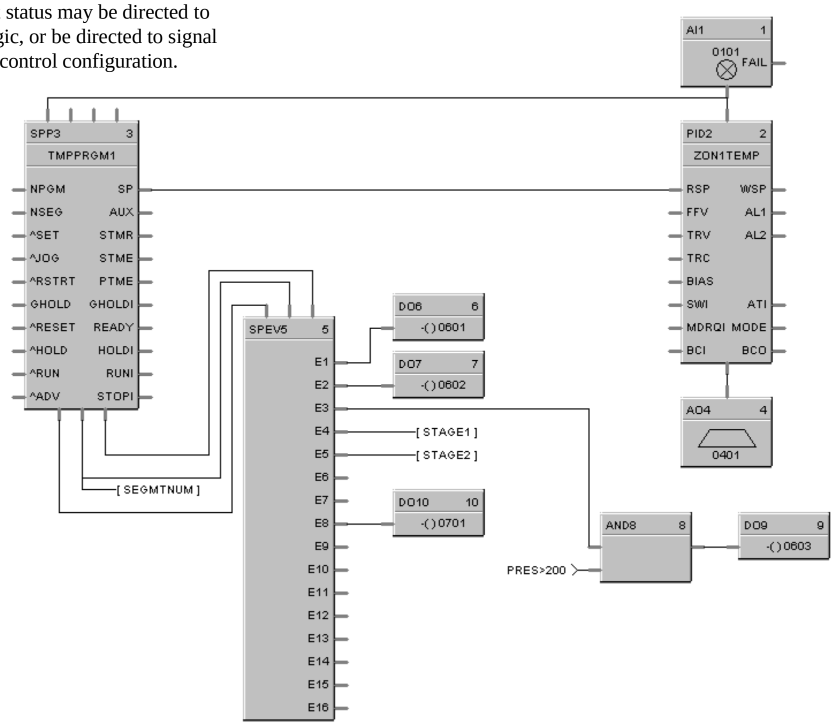
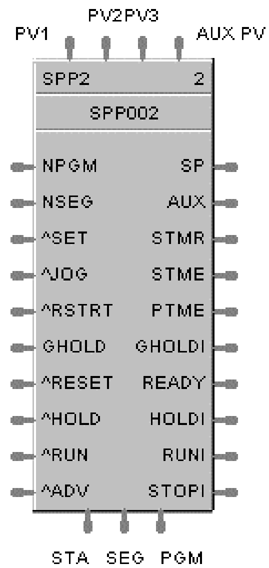


Figure 73 SPEV function block example

SPP Function Block

Description

The **SPP** label stands for **Setpoint Programmer**. This block is part of the *Setpoint Program* category. It looks like this graphically on the Control Builder.



Function

Runs a setpoint ramp/soak program that produces a setpoint output on a time-based profile that is loaded into the block. Up to 4 SPP blocks may be included in a system configuration. A single profile may be from 2 to 50 segments in length. Up to 70 profiles are stored in the controller's memory. Each segment of the profile may be a ramp or soak except the last segment must be a soak.

In addition to the main ramp and soak output value, a second (AUX) analog value is available for each step of the program. This output is a fixed soak value that may be used to provide a setpoint value for a secondary control loop in the process. [For example, see *Example 4 - Using the setpoint programmer AUX output (page 235)*.]

A Setpoint guarantee function is provided that holds the program if a process variable exceeds a predefined deviation from setpoint. Selections allow setpoint guarantee to be active for the entire program, for soak segments only, or for user specified segments, or for no segments. [For example, see *Example 1 - PID with setpoint programmer and guaranteed soak (page 232)*.]

Up to 3 Process Variables may be configured as inputs to the block for setpoint guarantee.

Input

PV1 = Process Variable #1 value in engineering units, for deviation check.

PV2 = Process Variable #2 value in engineering units, for deviation check.

PV3 = Process Variable #3 value in engineering units, for deviation check.

Aux PV = Aux PV for Aux PV Display.

NPGM = New profile number (1 to 70). *See ATTENTION.*

NSEG = New start segment number (1 to 99). When connected, it is used in conjunction with the SET input of the block to set the current segment of the profile to the value of NSEG. *See ATTENTION.*

^SET = Pulse input to load NPGM and NSEG numbers.

^JOG = Pulse input to Jog to a predefined segment.

RSTRT = Pulse input for restart action after power interruption [For example, see *Example 5 - Controlled Restart after Power Loss (page 236)*.]

GHOLD = Guaranteed soak hold - changes program state from RUN to GHOLD when turned ON and GHOLD to run when OFF.

^RESET = Pulse input RESETS program, when turned ON.*

^HOLD = Pulse input puts program in HOLD, when turned ON. Run needed to restart.

^RUN = Pulse input puts program in RUN, when turned ON; except when program is in GHOLD state.

^ADV = Pulse Input for advance of segment.

**For example, see Example 3 - Alternate methods for actuating SP programmer START/HOLD/RESET functions (page 234).*

ATTENTION

When connected to variables, it is not necessary to pulse input on SET to accomplish the program or segment load function. In this case, changes to the value of the variables will be automatically detected by the block.

If either or both NPGM and NSEG are connected directly to analog variables and that analog variable should change (for example: via a recipe load), then the Setpoint Programmer block will immediately use the new value internally.

If NPGM or NSEG is connected to any other function type then their values are loaded into the SP Programmer only when ^SET goes through a positive transition.

Output

SP = Programmed setpoint value in engineering units

AUX = Second non-ramping auxiliary setpoint output in engineering units. [For example, see *Example 4 - Using the setpoint programmer AUX output (page 235)*.]

STMR = Time Remaining in current segment - in minutes.

STME = Time Elapsed in current segment - in minutes.

PTME = Time Elapsed in program - in minutes

GHOLDI = Guaranteed soak hold indication - turns on if PV is outside guaranteed soak band and Guaranteed Soak is enabled.

READY = Program Reset state indication

HOLDI = Program Hold state indication

RUNI = Program Run state indication

STOPI = Program Stop indication (Program Complete)

PGM = Current Profile Number (1 to 70) - connect to PGM input on SPEV block.

SEG = Current Segment Number (1 to 50) - connect to SEG input on SPEV block.

STA = Current program state (RESET, HOLD, RUN, GHOLD, STOP). Connected to STA input of the SPEV block

ATTENTION

The program states are:

- 0 = Until block is first executed after power up
- 1 = Reset
- 2 = Hold
- 3 = Run
- 4 = GHold
- 5 = Stop

TIP

- If the first step of a profile is a ramp, the program will start the ramp from the value of PV Input 1. If the first step of a profile is a soak, the program will start from the soak value. If consistent starting values are required, begin all profiles with a soak.
- The PV inputs are used to determine PV–SP deviation for guaranteed soak segments.
- Valid program numbers begin with 1. Valid segment numbers begin with 1.
- The GHOLD output is not affected by the status of the GHOLD input.
- The RST, HLD, RUN, JOG, ADV, SET, RESTART inputs are activated only when the respective input changes from OFF to ON. A maintained ON input has no different affect than a pulsed ON input (that is, it has no effect until it turns OFF and then back ON again).
- The program may be changed (with some exceptions) from the current state to a new state by the operator as well as by inputs to the SPP block. Table 65 lists the resulting states.
- Concerning changing program state, if more than one function block input is on in the same execution cycle, RESET has priority over HOLD and RUN, and GHOLD has priority over RUN.
- Also, function block inputs will override inputs from the Operator Panel that occur during the same execution cycle. And finally, state changes from the Operator Panel are processed on the basis of the “last change wins.”
- At the beginning of a segment, STME will be 0 for one execution cycle to permit start of segment detection by other blocks.
- At the end of a segment, STMR will be 0 for one execution cycle to permit end of segment detection by other blocks.
- If RESTART is On, the block will use PV1 as a starting value and ramp at Restart Rate back to the last SP value, then complete the remaining portion of the segment. Restart Rate is a property of the profile (program)
- “Fastforward” (i.e. Verify) is initiated through the operator interface. It is not an input pin. Fastforward is a way to check for proper functioning of the profile’s events and outputs, without having to wait for the profile to execute at its normal speed. When FASTFORWARD is ON, the program will run at a speed 60 times faster. When FASTFORWARD is OFF, the program will run at normal speed.

Table 65 SPP inputs and current state

Input	Current State				
	RESET	**HOLD**	**RUN**	**GHOLD**	**STOP**
RESET	RESET	RESET	RUN	RESET	RESET
HOLD	HOLD	HOLD	HOLD	HOLD	STOP
RUN	RUN	RUN	RUN	GHOLD	STOP
GHOLD	RESET	HOLD	GHOLD	GHOLD	STOP

Restart scenario options

Table 66 is a list of Restart Scenario options for the Setpoint Program.

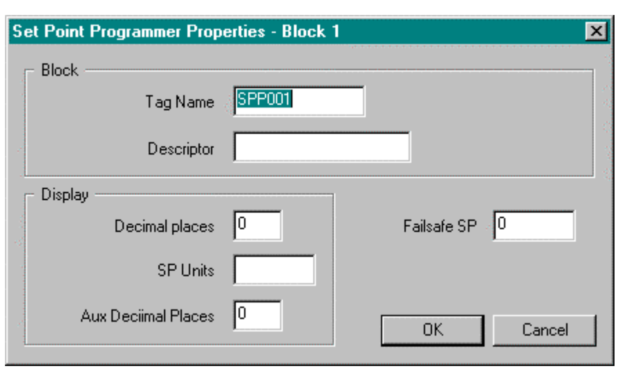
Table 66 Restart scenario options

1	No Action taken	Program will start at the point where it was prior to power down.
2	Use the Restart feature of the Setpoint Programmer with a configurable Ramp Rate.	This feature will use the PV (connected to PV1) as the initial starting point for the Setpoint and will use a configurable ramp rate for the profile. When the temperature gets to the original Setpoint prior to power down, the program will continue. ***See Figure 78, Scenario A.***
3	Use the Restart feature of the Setpoint Programmer with a configurable Ramp Rate and use a compare function so that the restart will apply only after a certain time.	You may gate this Restart input to the programmer to only apply after a certain time off and/or a certain segment if desired using Compare function blocks. ***See Figure 78, Scenario B.***

ATTENTION

Be sure to configure the Restart Ramp Rate when a controlled restart is being configured. If not the default value of 0 will cause the programmer to freeze.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the SPP function Block parameters to the desired value or selection that matches your operating requirements. Table 67 describes the parameters and the value or selection.

Table 67 SPP configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Tag Name**	N/A	8 character tag name	
	Descriptor	N/A	Block descriptor	
Display	**Decimal Places**	N/A	Number of places to display after the decimal point	0-5
	SP Units	N/A	Engineering unit descriptor	4 Characters
	Aux Decimal Places	N/A	Number of places to display after the decimal point	4 Characters
Failsafe SP	**Failsafe Setpoint**	0	Failsafe Setpoint Value	–9999 to 9999 Engineering Units

Example 1 - PID with setpoint programmer and guaranteed soak

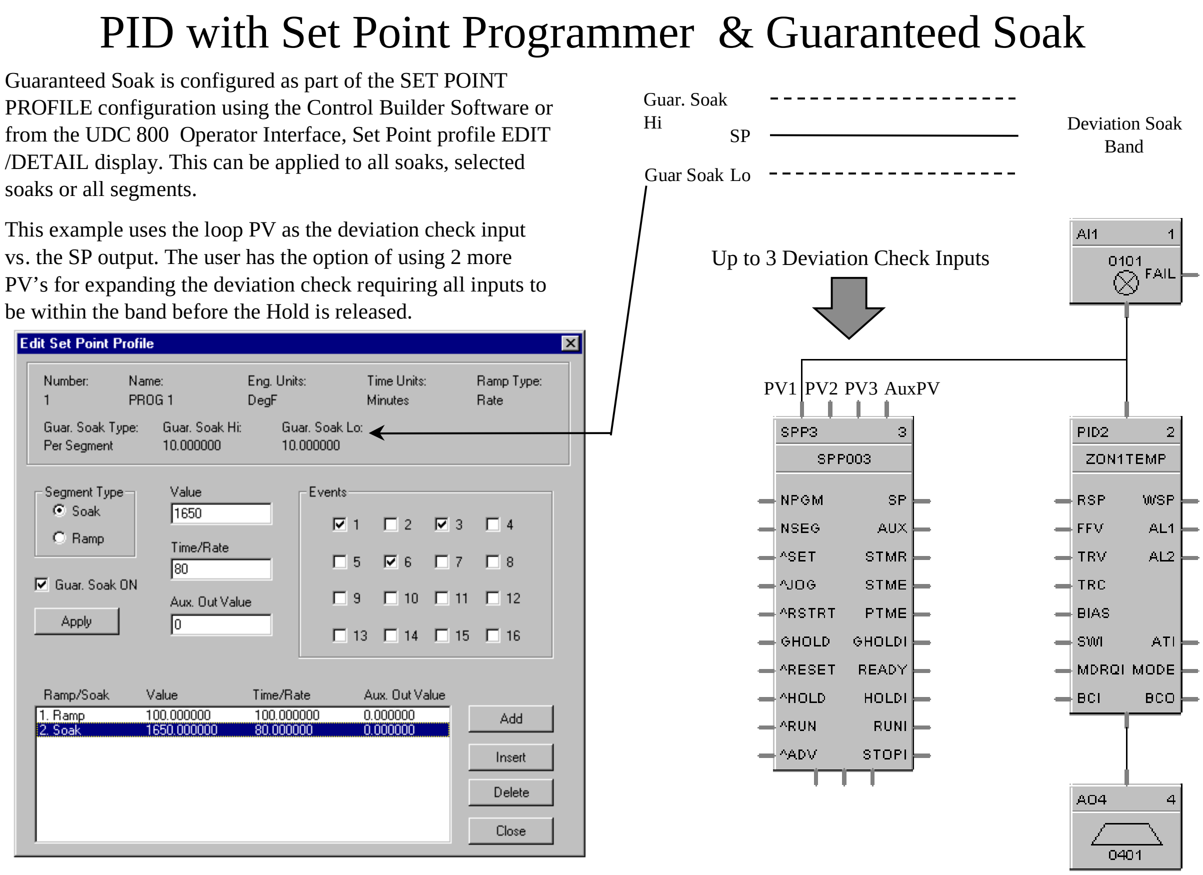


Figure 74 PID with setpoint programmer and guaranteed soak

Example 2 - PID with setpoint programmer and event outputs

The SP programmer event output status may be directed to digital outputs, part of control logic, or be directed to signal tags for use anywhere within the control configuration.

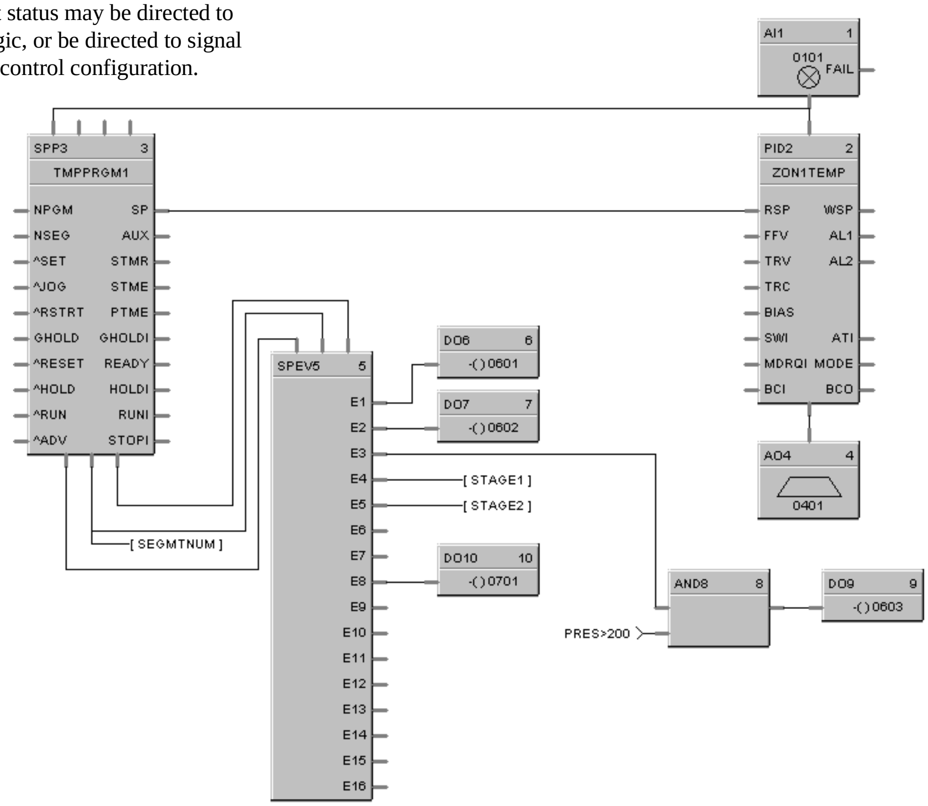


Figure 75 PID with setpoint programmer and event outputs

Example 3 - Alternate methods for actuating SP programmer START/HOLD/RESET functions

Two methods are shown

The pushbutton block will tie this function to the Pushbutton screen display. Pushbuttons will provide a one-shot output each time they are pressed.

Using the Digital variable block this function can be displayed on the OVERVIEW display.

Note: Since Digital variables are turned ON and OFF from the overview display, once turned ON they must be manually turned OFF, to be used a second time.

Note: Control Builder Software will not allow the output of two block to be tied together.

Connections are shown for DEMO only of an alternative connection.

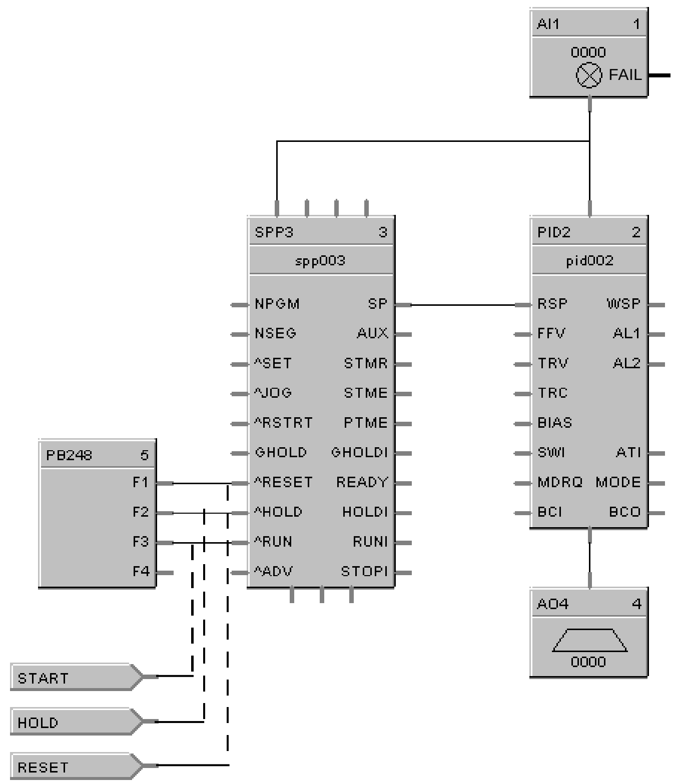
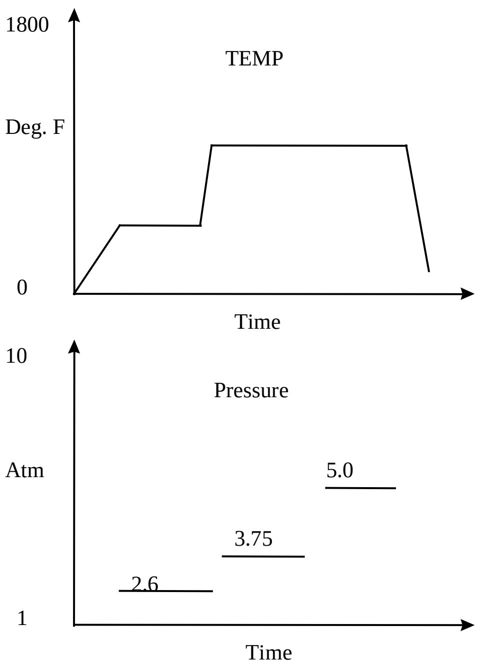


Figure 76 Alternate methods for actuating SP programmer START/HOLD/RESET functions

Example 4 - Using the setpoint programmer AUX output

The Auxiliary output of the Set Point Programmer (SPP) block can be used to drive the RSP of a secondary PID control block on a level basis. This precludes the use of another SPP block. A different (or same) set point can be configured for each programmer step. This can be used to program pressure, %C, etc. for a second control loop. Both PID loops can be shown on the same SP Programmer display. The PV for the secondary PID block is connected to the top right pin of the SPP block to allow view of the PV on the SP Programmer display.



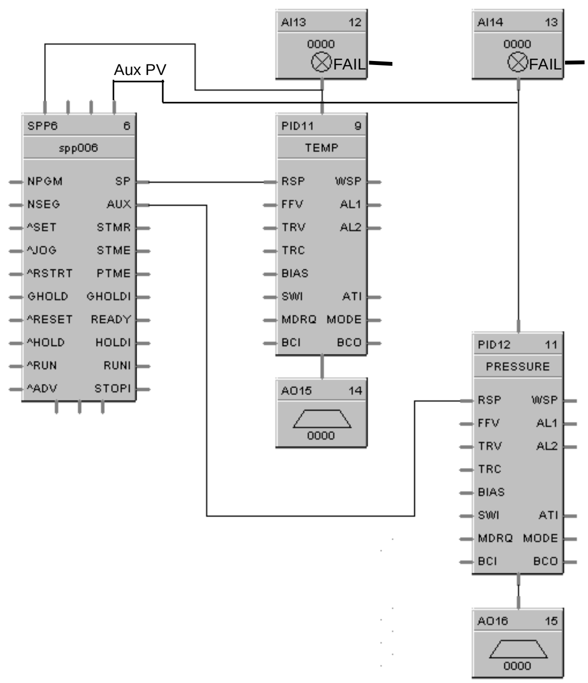


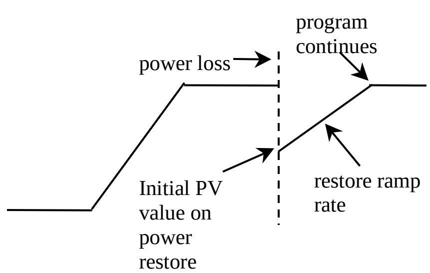
Figure 77 Using the setpoint programmer AUX output

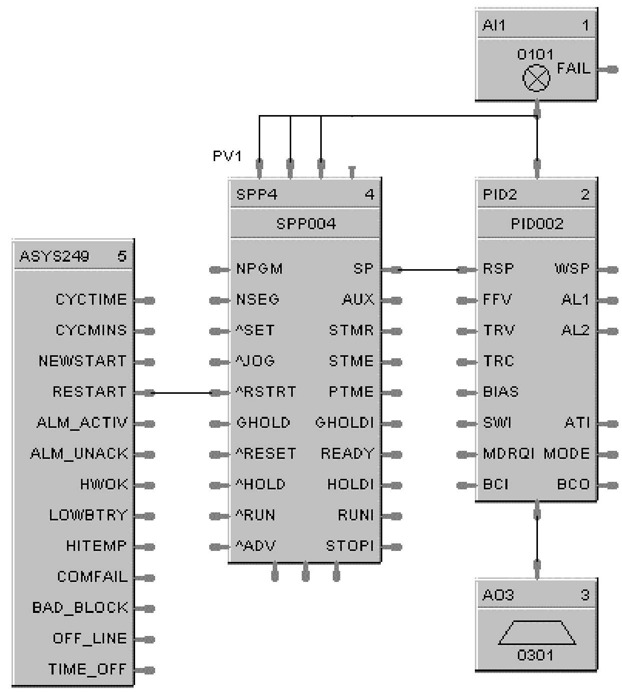
Example 5 - Controlled Restart after Power Loss

SCENARIO A

To prevent stress to the work in a furnace on power up after a power loss, you may use the Restart feature of the SP programmer. This feature will use the PV (connected to PV1) as the initial starting point for the Setpoint and will use a configurable ramp rate for the profile. When the temperature gets to the original Setpoint prior to power down, the program will continue. You may gate this Restart input to the programmer to only apply after a certain time off and/or a certain segment if desired using Compare function blocks.

This example uses the System Monitor block to provide a restart pulse to the programmer Restart input after power restore. This will initiate the restart procedure.

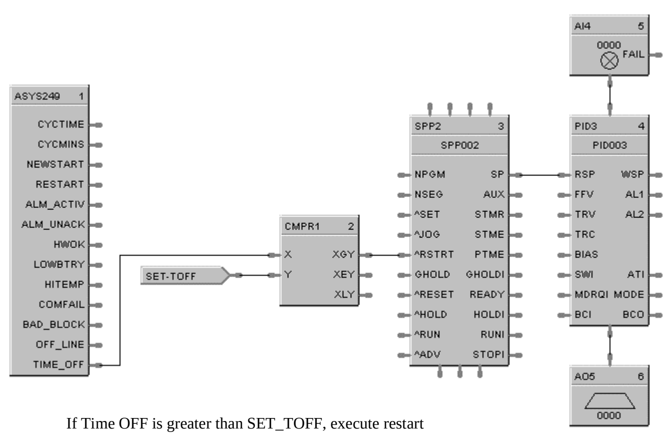




SCENARIO B

A System Monitor block output (RESTART) is on for the first scan cycle after a power loss plus TIME_OFF output indicates the time the power has been off. A Compare block can be used to evaluate the time off and cause an output to initiate the restart if greater than a set amount.

Time Off is in seconds.



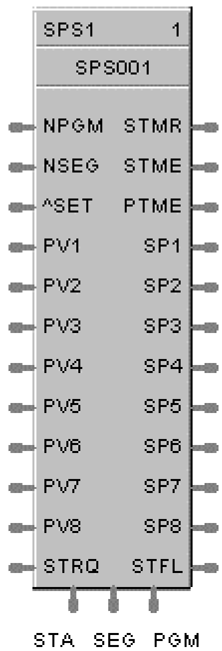
If Time OFF is greater than SET_TOFF, execute restart
NOTE: Execution sequence relative to SPP block

Figure 78 Controlled restart after power loss

SPS Function Block

Description

The **SPS** label stands for **Master Setpoint Scheduler**. This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Overview

The objective of the Setpoint Scheduler is to provide a sequence of multiple setpoint outputs (both analog and digital) which are referenced to a common time base. Five setpoint schedule block types will be implemented:

- Master Setpoint Scheduler Block (SPS)
- Auxiliary Setpoint Block *[SPSA Function Block (page 241)]*
- Digital Event Block *[SPEV Function Block (page 224)]*
- State Switch Block *[STSW Function Block (page 246)]*
- State Flags Block *[STFL Function Block (page 245)]*

A suite of Setpoint Scheduler blocks is comprised of one master Setpoint Block (required) and optionally, one Digital Event, one Auxiliary Setpoint, one State Switch, and/or one State Flags block.

See Figure 79 for a Setpoint Scheduler Function Block Suite.

SPS Block Function

The Master (SPS) block supports up to 8 ramp or soak outputs operating on a common time base. It accepts one PV for each setpoint. Setpoint guarantee is provided for the master (SPS) block setpoints with a single symmetrical value for each setpoint output. You can assign a failsafe value for each setpoint.

Inputs

NPGM = Program Number (when SET is ON)

NSEG = Starting Segment Number (when SET is ON)

^SET = Pulse Input to load PGM and SEG numbers

PV1 = 1st Process Variable

PV2 = 2nd Process Variable

PV3 = 3rd Process Variable

PV4 = 4th Process Variable

PV5 = 5th Process Variable

PV6 = 6th Process Variable

PV7 = 7th Process Variable

PV8 = 8th Process Variable

STRQ = for connection to the STQR output of the STSW function block. (See Figure 79.) The STSW block encodes discrete inputs to a form that will convey change mode requests from the STSW block:

0.0	No Change
1.0	Jog State
2.0	Guaranteed Hold State
4.0	Reset State
8.0	Hold State
16.0	Run State
32.0	Advance state

Outputs

PGM = Current Program Number

SEG = Current Segment number

STA = Program State (Reset, Run, Hold, Ghold, Stop).

SP1 **=** Setpoint #1 Output (EU)

SP2 **=** Setpoint #2 Output (EU)

SP3 **=** Setpoint #3 Output (EU)

SP4 **=** Setpoint #4 Output (EU)

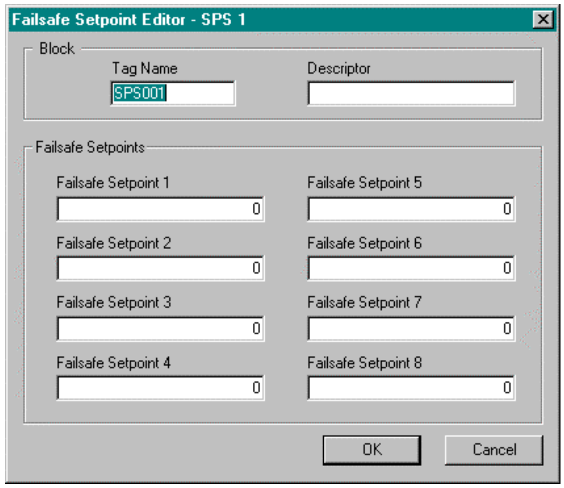
SP5 **=** Setpoint #5 Output (EU)

SP6 **=** Setpoint #6 Output (EU)

SP7 **=** Setpoint #7 Output (EU)

SP8 **=** Setpoint #8 Output (EU)

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the SPS Function Block parameters to the desired value or selection that matches your operating requirements. Table 68 describes the parameters and the value or selection.

Table 68 SPS configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Tag Name**	N/A	8 character tag name	
	Descriptor	N/A	Block descriptor	
Failsafe Setpoints		0	Failsafe Setpoint 1	Value in EU
		1	Failsafe Setpoint 2	Value in EU
		2	Failsafe Setpoint 3	Value in EU
		3	Failsafe Setpoint 4	Value in EU
		4	Failsafe Setpoint 5	Value in EU
		5	Failsafe Setpoint 6	Value in EU
		6	Failsafe Setpoint 7	Value in EU
		7	Failsafe Setpoint 8	Value in EU

Failsafe Value is the initial value when exiting the program mode. Default Failsafe value is 0.0.

Setpoint scheduler example

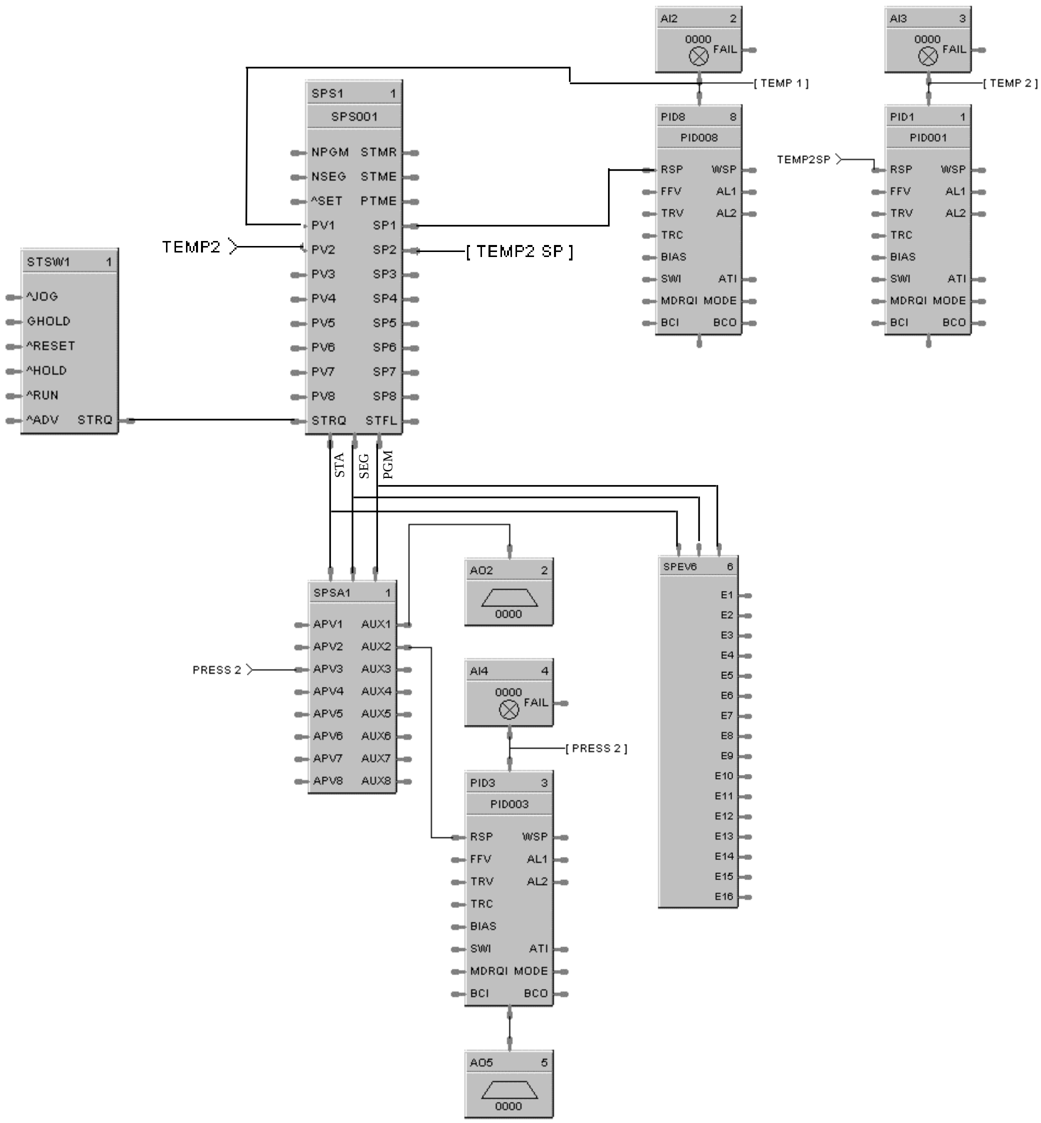
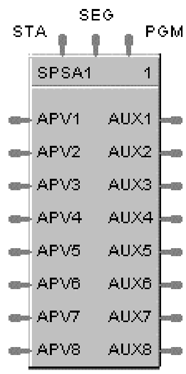


Figure 79 Setpoint scheduler function block suite

SPSA Function Block

Description

The **SPSA** label stands for **Setpoint Scheduler Auxiliary Setpoint Block**. This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Function

The eight setpoint outputs of the Auxiliary Setpoint block are set to the current step value. The current step is an input to the block and must be connected to the step output of a Master Scheduler block. At the end of a step, the outputs of the slave block go directly to the next step value. That is, Ramps are not supported.

Inputs

PGM = Current Program Number

SEG = Current Segment number

STA = Program State (Reset, Run, Hold, Ghold, Stop).

APV1 = 1st Auxiliary Process Variable (EU)
APV2 = 2nd Auxiliary Process Variable (EU)
APV3 = 3rd Auxiliary Process Variable (EU)
APV4 = 4th Auxiliary Process Variable (EU)
APV5 = 5th Auxiliary Process Variable (EU)
APV6 = 6th Auxiliary Process Variable (EU)
APV7 = 7th Auxiliary Process Variable (EU)
APV8 = 8th Auxiliary Process Variable (EU)

Outputs

AUX 1 = Auxiliary Output #1
AUX 2 = Auxiliary Output #2
AUX 3 = Auxiliary Output #3
AUX 4 = Auxiliary Output #4
AUX 5 = Auxiliary Output #5
AUX 6 = Auxiliary Output #6
AUX 7 = Auxiliary Output #7
AUX 8 = Auxiliary Output #8

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

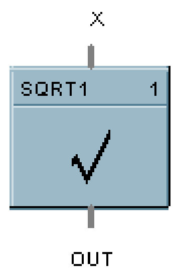
Example

Figure 79 shows a Function Block Diagram (Setpoint Scheduler Suite) using a SPSA function block.

SQRT Function Block

Description

The **SQRT** label stands for **Square Root**. This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Extracts the square root of the analog input (X) as long as the input is greater than the configured DROPOFF value.

- If X > DROPOFF, then: OUT = square root of X.
- Otherwise, OUT = 0.

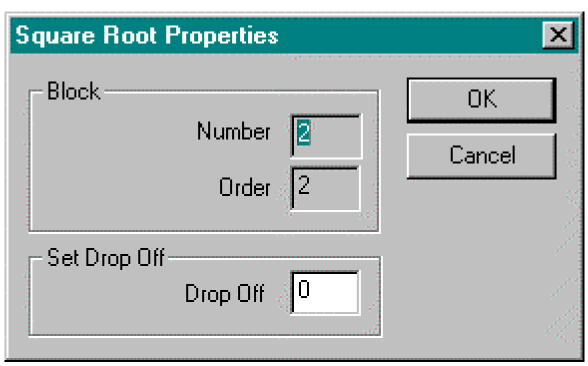
Input

X = Analog value for square root extraction

Output

OUT = Square Root value

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the SQRT function Block parameters to the desired value or selection that matches your operating requirements. Table 69 describes the parameters and the value or selection.

Table 69 SQRT configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Dropoff	**Dropoff**	0	Minimum Input for Square Root	0 to 99999 Must be set at > = 0

Example

Figure 80 shows a Function Block Diagram using a SQRT function block.

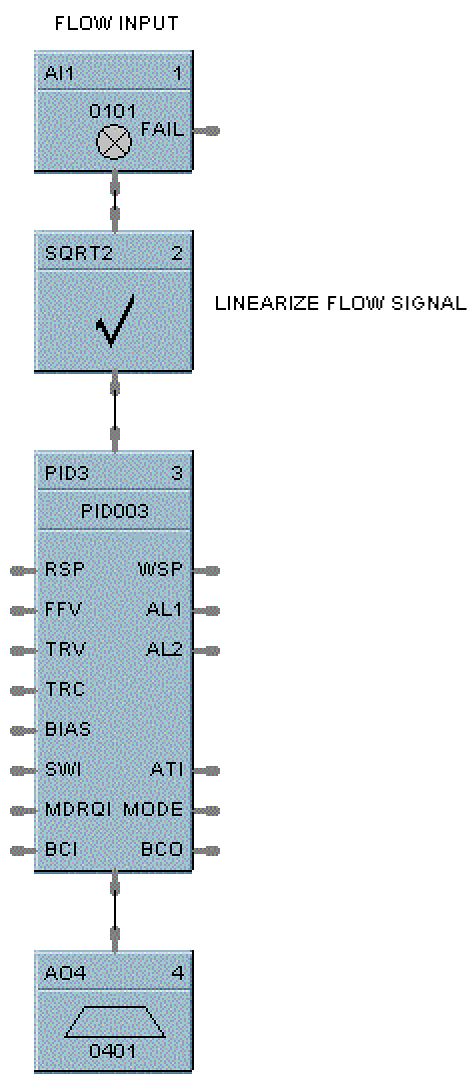
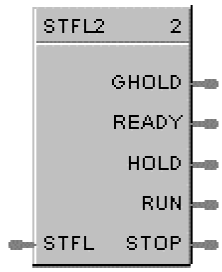


Figure 80 SQRT function block example

STFL Function Block

Description

The **STFL** label stands for the **Setpoint Scheduler State Flags.** This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Function

Connects to Master block (SPS) via dedicated connection and provides logic 1(ON) state digital outputs for Scheduler modes. The State Flags block accepts the encoded master block state as an input and produces digital outputs corresponding to the current value of STFL.

Inputs

STFL = this input is connected to the STFL output of the SPS function block. (See Figure 79.)

Outputs

GHOLD = ON if state = 1.0, else OFF

READY = ON if state = 2.0, else OFF

HOLD = ON if state = 4.0, else OFF

RUN = ON if state = 8.0, else OFF

STOP = ON if state = 16.0, else OFF

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

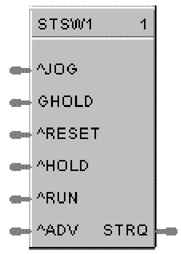
Example

Figure 79 shows a Function Block Diagram (Setpoint Scheduler Suite) using a STFL function block.

STSW Function Block

Description

The **STSW** label stands for the **Setpoint Scheduler State Switch.** This block is part of the *Setpoint Scheduler* category. It looks like this graphically on the Control Builder.



Function

Connects to Master block (SPS) via dedicated connection and accepts digital inputs to cause scheduler mode changes. The State Switch block accepts state request digital inputs and produces an encoded output for input to the master (SPS) block.

Inputs

^JOG = OFF to ON requests JOG state
GHOLD = ON = guaranteed Hold State; ON to OFF and previous state was RUN, then return to RUN mode.
^RESET = OFF to ON requests RESET state
^RUN = OFF to ON requests RUN state
^ADV = OFF to ON requests ADVANCE state

Outputs

STRQ = for connection to the STQR input of the SPS function block. This block encodes discrete inputs to a form that will convey change mode requests to the SPS block:

0.0	No Change
1.0	Jog State
2.0	Guaranteed Hold State
4.0	Reset State
8.0	Hold State
16.0	Run State
32.0	Advance state

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

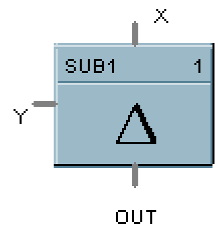
Example

Figure 79 shows a Function Block Diagram (Setpoint Scheduler Suite) using a STSW function block.

SUB Function Block

Description

The **SUB** label stands for the **Subtraction mathematical operation (2 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Subtracts one input (X) from another (Y) to obtain an output.

- OUT = X–Y

Input

X = First analog value

Y = Second analog value

Output

OUT = Calculated Value

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 81 shows a Function Block Diagram using a SUB function block.

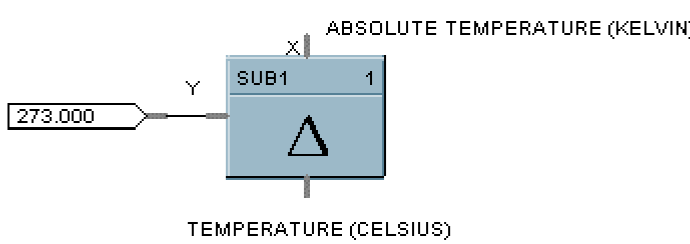
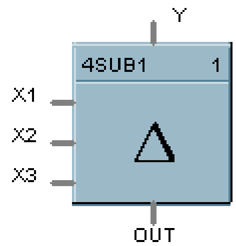


Figure 81 SUB function block example

4SUB Function Block

Description

The **4SUB** label stands for the **Subtraction mathematical operation (4 Inputs).** This block is part of the *Math* category. It looks like this graphically on the Control Builder.



Function

Subtracts three analog inputs (X1, X2, X3) from Y input to get an output.

Input

X1 = First analog input
X2 = Second analog input
X3 = Third analog input
Y = Fourth analog input (number to subtract from)

ATTENTION

All four inputs must be connected. Unconnected inputs default to zero.

Output

OUT = Calculated Value

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 82 shows a Function Block Diagram using a 4SUB function block.
Y – X1 – X2 – X3 = OUT

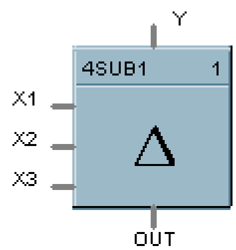
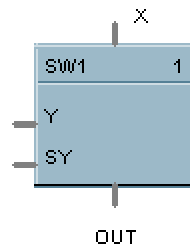


Figure 82 4SUB function block example

SW Function Block

Description

The **SW** label stands for **Analog Switch**. This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Function

Selects input Y for output when digital input signal (SY) is ON.

- If SY = ON, then; **OUT = Y**
- Otherwise, **OUT = X**

Input

X = First analog value

Y = Second analog value

SY = Where ON selects Y command digital signal.

Output

OUT = Selected value

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 83 shows a Function Block Diagram using an SW function block to select control signal for output.

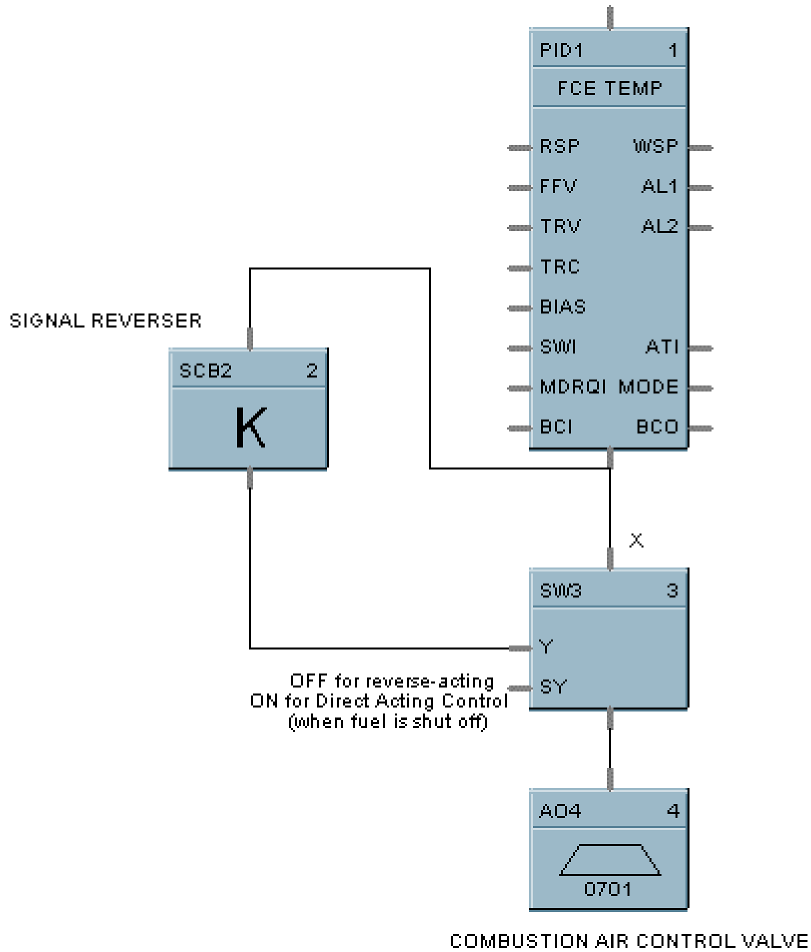
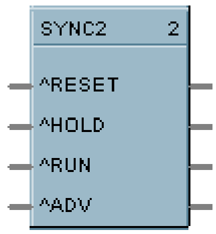


Figure 83 SW function block example

SYNC Function Block

Description

The **SYNC** label stands for **Synchronize**. This block is part of the *Setpoint Program* category. It looks like this graphically on the Control Builder.



Function

Used to synchronize the operation of two setpoint programs given the run. Hold and reset signals from each program.

Input (available for logic control of programmer)

RST = RESET command, when turned ON.

HLD = HOLD command, when turned ON.

RUN = RUN command, when turned ON.

ADV = ADVANCE command, when turned ON

Output

The status of each programmer connected to the output pins of the block are monitored. A change in state of any of the programmers is transferred to the other programmers. This occurs regardless of input pin connections. Use of block inputs is optional.

ATTENTION

Ghold status is not transferred between programmers with this block.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 84 shows a Function Block Diagram using a SYNC function block.

Function: Synchronizes changes in setpoint program state for multiple SPP function blocks when the state of any connected SPP is changed from the Operators Panel or via a remote connection. (Analog and digital I/O blocks required to complete this function are not shown.)

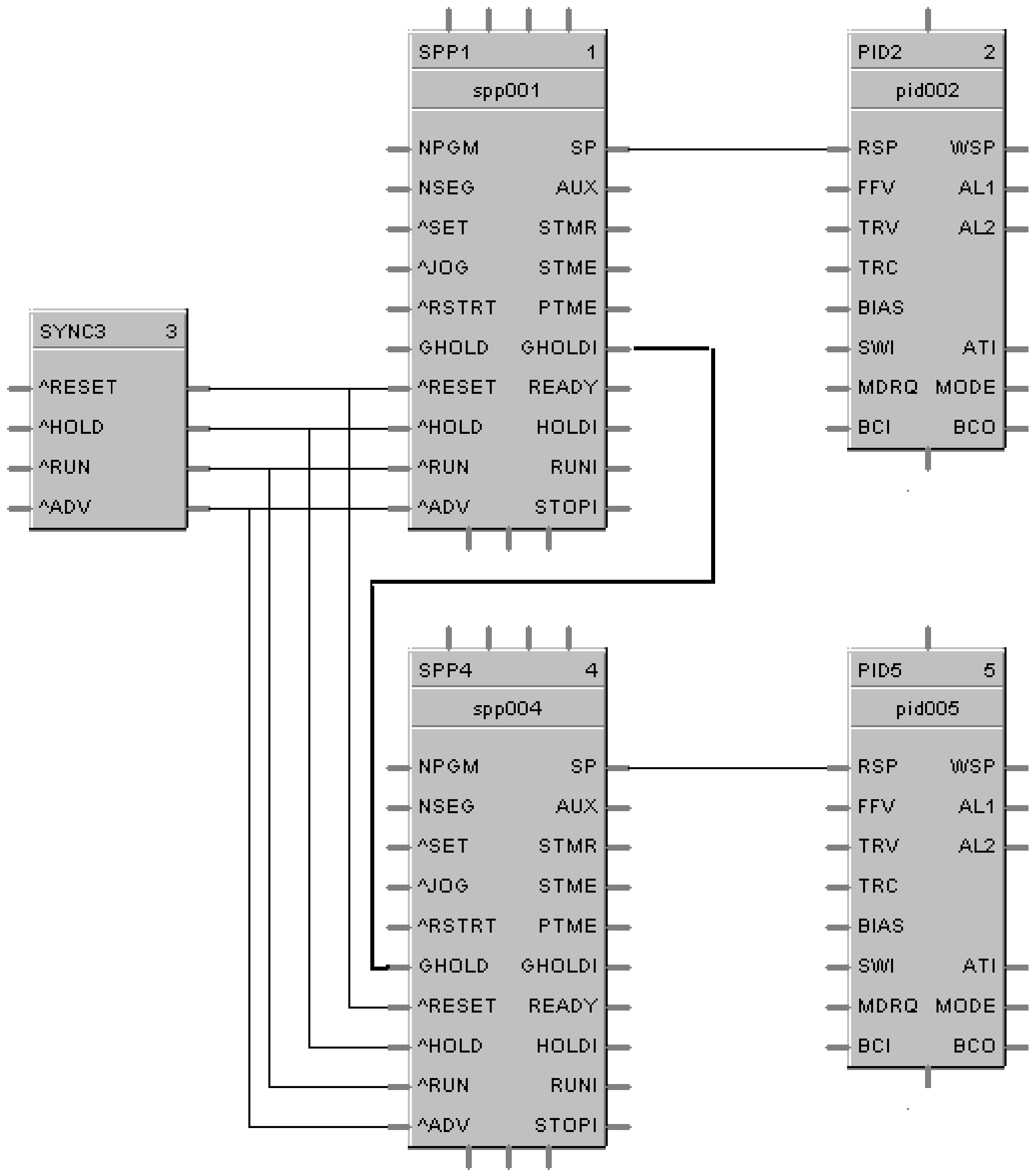
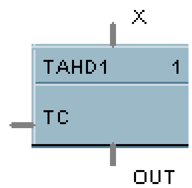


Figure 84 SYNC function block example

TAHD Function Block

Description

The **TAHD** label stands for **Track and Hold.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

Provides an output that tracks the value of the input (X), when a digital input signal (TC) is On; or when TC is OFF, holds output at last value of X.

- If TC = ON, then: OUT = X (TRACK)
- If TC = OFF, then: OUT = Last value of X (HOLD)

Input

TC = Track command signal, when turned ON.
X = Value to be tracked.

Output

OUT = track and hold value of X

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 85 shows a function block diagram using a TAHD function block to track the Input signal for a PID control loop in conjunction with a digital input.

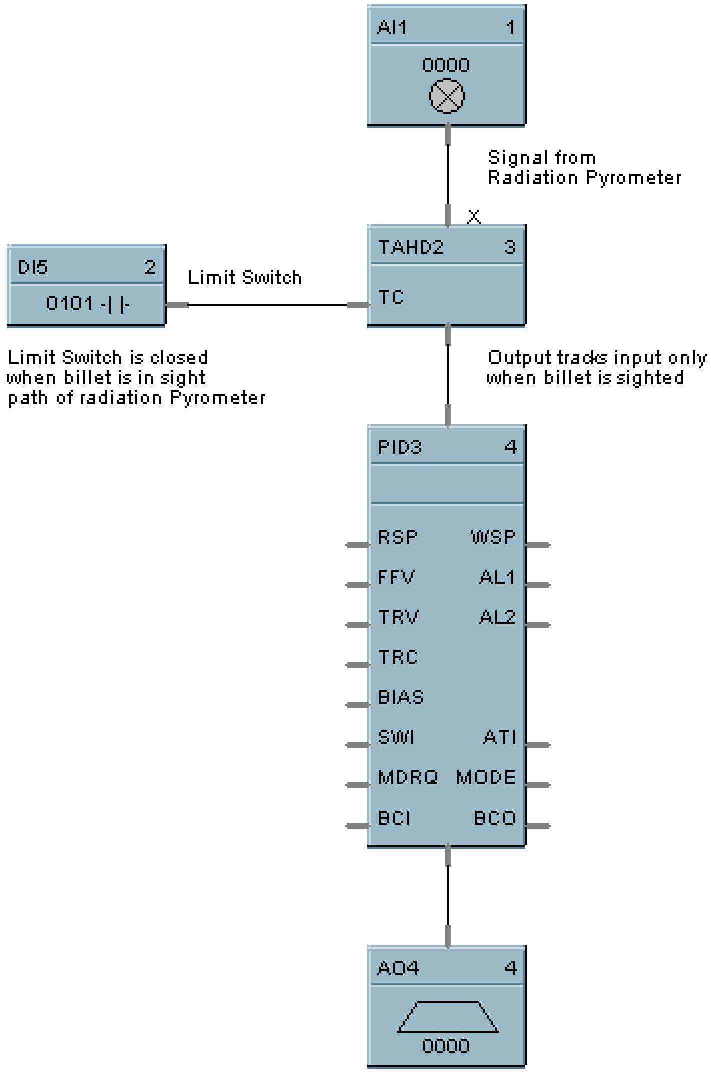
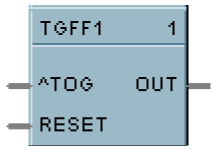


Figure 85 TAHD function block example

TGFF Function Block

Description

The **TGFF** label stands for **Toggle Flip-Flop.** This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.



OR

Fast Logic

Function

Provides an ON state output when a digital input goes from OFF to ON and the previous state of the output was OFF, and an OFF state output when the digital input goes from OFF to ON and the previous state of the output was ON.

- OUT = ON when ^TOG changes from OFF to ON and the previous state of OUT was *OFF*.
- OUT = OFF when ^TOG changes from OFF to ON and the previous state of OUT was *ON*.
- Reset sets output to OFF, regardless of current state.

Input

^TOG = Digital Input
RESET = Digital input ON   Input = OFF output

Output

OUT = Digital Output

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 86 shows a Function Block Diagram using a TGFF function block and how to tag the output.

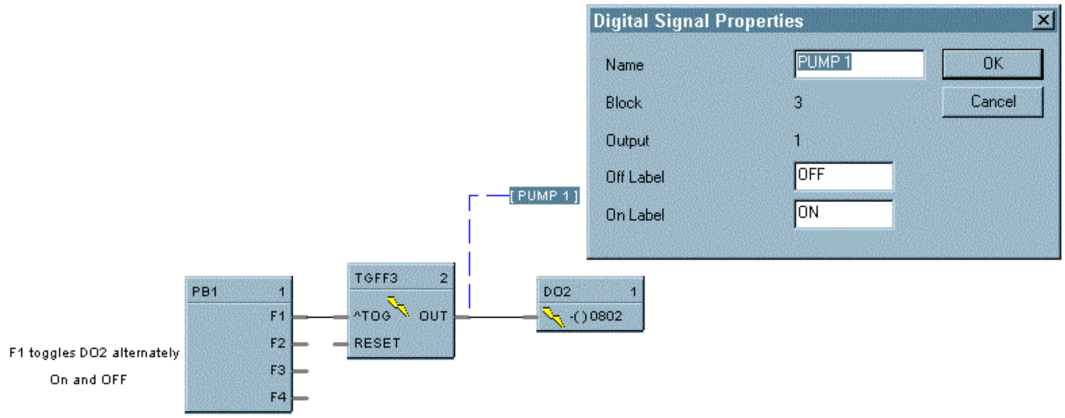
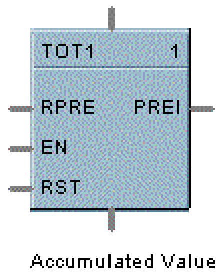


Figure 86 TGFF function block example

TOT Function Block

Description

The **TOT** label stands for **Totalizer.** This block is part of the *Calculations* category. It looks like this graphically on the Control Builder.



Function

Integrates an Analog variable using a specified rate. Rate may be in units per second, minute, hour, or day.

A preset is provided to reset the value when a specific quantity has been accumulated and provide a digital status output.

Separate digital enable and reset inputs are provided.

Accumulated value may increment from 0 to preset for increasing totals or decrement from the preset to 0 for decreasing totals.

Inputs

RPRE = Remote Preset Value in Engineering Units

EN = When the enable input is ON, the input value is integrated to a preset value. (Value HOLD when EN = OFF.)

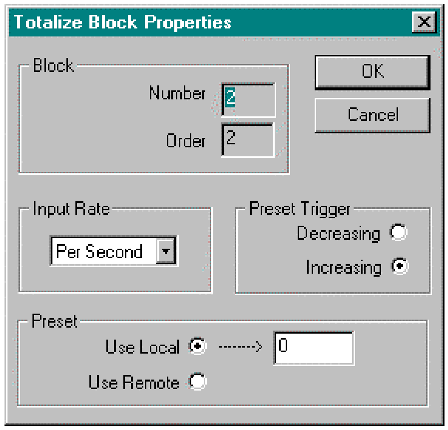
RST = ON resets the output to zero. (Accumulated value set to 0.)

Output

PREI = Digital output, ON when the output = Preset Value. Upon reaching the preset value the digital output is enabled for one scan and the totalizer restarts from 0.

OUT = Accumulated value in engineering units.

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the TOT function Block parameters to the desired value or selection that matches your operating requirements. Table 70 describes the parameters and the value or selection.

Table 70 TOT configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order	Read Only. See “Configure" Menu, ”Execution Order” to change.
Input Rate	**Input Rate**	N/A	Input rate	Select: Per Second Per Minute Per Hour Per Day
Use Preset	**Use Local**	N/A	Local Preset	Click on Radio Button to select and enter value in Local Preset field
		1	Local Preset Value	1 to 999999
	Use Remote	N/A	Remote Preset	Click on Radio Button to select
Preset Trigger	**Decreasing**	N/A	Select this to decrement from preset down to zero	Click on Radio Button to select
	Increasing	N/A	Select this to accumulate from 0 to preset value	Click on Radio Button to select

Example

Figure 87 shows Function Block Diagrams using a TOT function block.

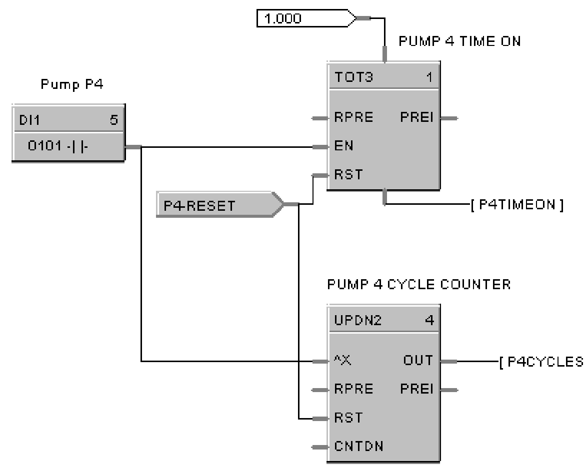
EXAMPLE 1

In UMC ON Delay timers are not retentive - if the RUN input is logic 0, the timer is reset. A retentive timer has an Enable and a Reset input. As long as the timer is not reset, time will be accumulated when the Enable Input is logic 1 (ON). This permits recording the time a device such as a pump has been on.

This example uses a Totalizer function block as a retentive timer. If a fixed input of 1 is provided to the block using a Numeric Constant, the totalizer will time up to 1 at the input rate selected (per sec, per min., per hr, or per day). For example, if the “per hr” rate were selected, the output would be 1.0 after 1 hour, 2.0 after 2 hours, etc, up to the Preset value.

A counter is shown to count the number of pump cycles (On to OFF transitions).

The P4-RESET Digital Variable is used to reset the timer and counter



EXAMPLE 2 - FLOW TOTALIZATION

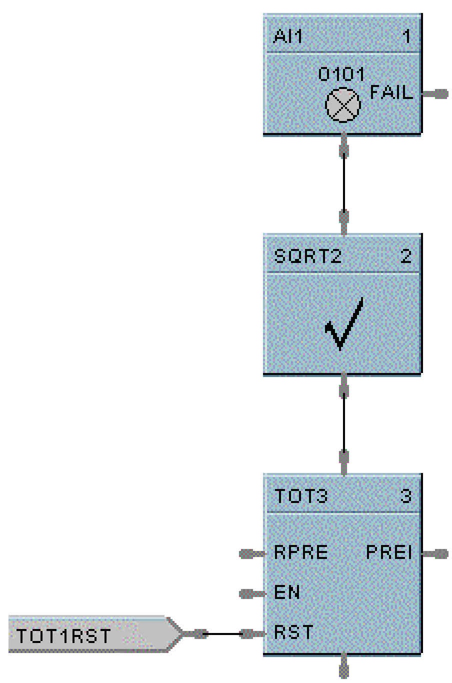
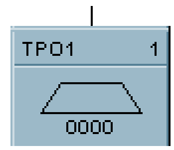


Figure 87 TOT function block examples

TPO Function Block

Description

The **TPO** label stands for **Time Proportional Output.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

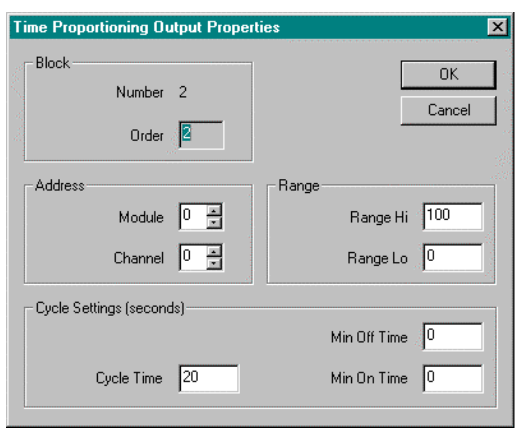
Proportions the amount of ON time and OFF time of a Digital Output over a user defined cycle time.

- On Time = [cycle time * (IN - range lo)] / (range hi - range lo)
- OFF Time = cycle time - On Time
- If On Time < minimum ON time, then On Time = 0.0
- If OFF Time < minimum OFF time, then OFF Time = 0.0.

Input

Analog Input value in Percent (%)

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the TPO function Block parameters to the desired value or selection that matches your operating requirements. Table 71 describes the parameters and the value or selection.

Table 71 TPO configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Address	**I/O Module**	0	Address of selected I/O module	Enter a value: from 1 to 16
	Channel		Channel on selected I/O Module	Enter a value: from 1 to 4
Range	**Range Hi**	1	High Range Value	–9999 to 9999 Default = 100
	Range Lo	2	Low Range Value	–9999 to 9999 Default = 0
Cycle Settings	**Cycle Time**	3	Output Cycle Time	1 to 120 seconds Default = 20
	Min Off Time	4	Minimum OFF time	to 15.0 seconds Default = 0.0
	Min On Time	5	Minimum ON time	to 15.0 seconds Default = 0.0

Example

Figure 88 shows a Function Block Diagram using a TPO function block. Time Proportioning outputs are commonly used for electrically heated applications where regulating the amount of ON time vs. OFF time of a heater is used to control temperature. In the example the TPO output is used to activate a relay output to control a heater.

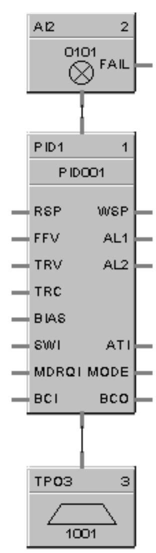
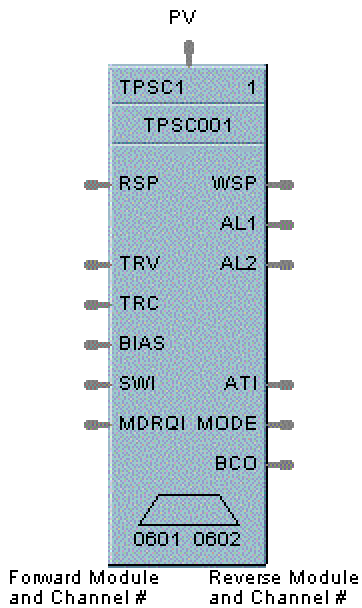


Figure 88 TPO function block example

TPSC (3POS) Function Block

Description

The **TPSC (3POS)** label stands for **Three Position Step Control** operation. This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

This block combines a PID controller with 3 position step control output functions to provide motor position control without position sensing. Allows the control of a valve or other actuator having an electric motor driven by two digital output channels; one to move the motor upscale, the other to move it downscale, without a feedback slidewire linked to the motor shaft.

Inputs

PV = Process Variable Analog Input value in Engineering Units
RSP = Remote Setpoint Analog Input value in Engineering Units or Percent
TRV = Output Track value in Percentage (PID Output = TRV Input when TRC = ON.)
TRC = Output Track Command [ON, OFF] (On -Enables TRV) (Mode = Local Override)
BIAS = Remote Bias value for Ratio PID
SWI = Switch Inputs (from SWO on LPSW function block)

- 0 = No Change
- 1 = Initiate Autotuning
- 2 = Change Control Action
- 4 = Force Bumpless Transfer
- 8 = Switch to Tune Set 1
- 16 = Switch to Tune Set 2

MDRQI = External Mode request (typically connected to the MDRQO output of a MDSW function block.

- 0 = No Change
- 1 = Manual Mode Request
- 2 = Auto Mode Request
- 4 = Local Mode Request
- 8 = Remote Mode Request

Outputs

WSP = Working Setpoint in Engineering Units for monitoring
AL1 = Alarm 1 - Digital Signal
AL2 = Alarm 2 - Digital Signal
ATI = Autotune Indicator (ON = Autotune in Progress)
MODE = Loop mode status (typically connected to the Mode Flags block for encoding). Value indicates modes as follows:

0.0	RSP AUTO
1.0	RSP MAN
2.0	RSP Initialization Manual (See ATTENTION)
3.0	RSP Local Override (See ATTENTION)
4.0	LSP AUTO
5.0	LSP MAN
6.0	LSP Initialization Manual (See ATTENTION)
7.0	LSP Local Override (See ATTENTION)

BCO - Back Calculation Output (for blocks used as Cascade Secondary). This block can *only* be used as a cascade secondary; therefore, no BCI input is provided.

ATTENTION

When a request to change from Auto to manual is received and:

- the request comes from the operator Interface, *the request is ignored*.
- the request comes from the Mode Switch (MDSW) function block, *the request is retained and when leaving the Initialization Mode or Local Override Mode the loop will go to manual*.

Block properties

Double click on the function block to access the function block properties dialog box.

Dialog box structure

The TPCS properties dialog box is divided into six tab cards

GENERAL
RSP
RANGE/LIMIT
TUNING
ACCUTUNE
ALARMS
MOTOR

Click on the tab to access the properties for that tab.

GENERAL tab

It looks like this graphically on the Control Builder. Table 72 describes the parameters and the value or selection.

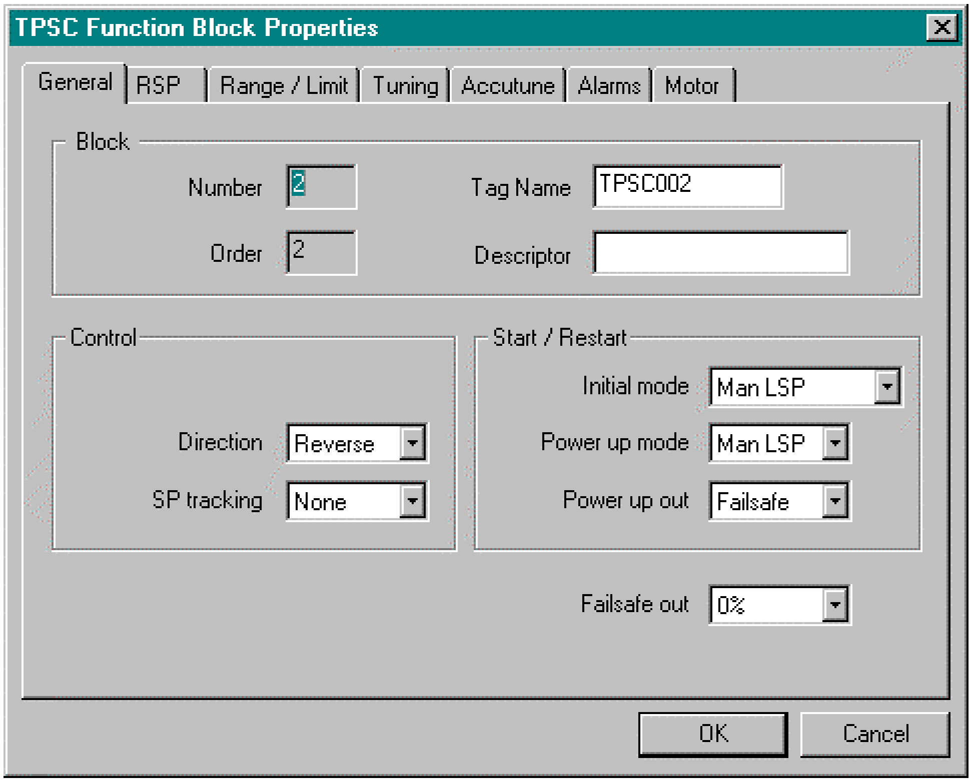


Table 72 General tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Block	**Order**	N/A	Execution Order	Read Only. See "Configure" Menu, "Execution Order" to change.
	Tag Name	N/A	8 character tag name	
	Descriptor	N/A	Block descriptor	
Control	**Direction**	N/A	Control Action	**DIRECT** - Proportional action causes output to **increase** as process variable increases. **REVERSE** - Proportional action causes output to **decrease** as process variable increases.
	SP Tracking	N/A	Setpoint Tracking	**None** **Track PV** - When control mode is "manual", local setpoint tracks process variable. **Track RSP** - When setpoint is "remote setpoint", local setpoint tracks remote setpoint.

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Start/Restart	**Initial Mode**	N/A	Control Mode and Setpoint at NEWSTART **Newstart** is the first scan cycle following the cold start of the controller	**MAN LSP** - Manual control and last local setpoint. **AUTO LSP** - Automatic control and last local setpoint. **AUTO RSP** - Automatic control and remote setpoint. **Man LSPonly** - Manual control and local setpoint only. **Auto LSPonly** - Automatic control and local setpoint only*. **Auto RSPonly** - Automatic control and remote setpoint only*. **These modes will override the configured POWER UP MODE.*
	Power Up Mode	N/A	Control Mode and Setpoint at power up	**MAN LSP** - Manual control and last local setpoint. **AM LSP** - Same control mode (auto or manual) and last local setpoint. **AM LR** - Same control mode (auto or manual) and setpoint (local or remote) as at power-down.
	Power Up Out	N/A	Output at Power up	**LAST OUT** - Same as at power down. **FAILSAFE** - Failsafe output value.
Failsafe out	**Failsafe Output**	13	Failsafe Output Value	Selections: 0 % 100 %

RSP tab

It looks like this graphically on the Control Builder. Table 73 describes the parameters and the value or selection.

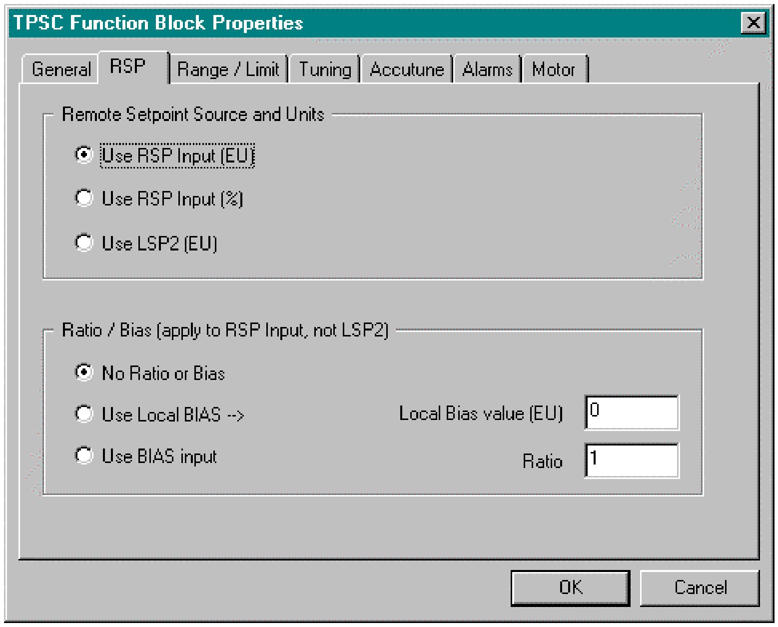


Table 73 RSP tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Remote Setpoint Source and Units	**Use RSP Input (EU)**	N/A	Use Remote Setpoint in Engineering Units	Click on radio button to select
	Use RSP Input (%)	N/A	Use Remote Setpoint in Percent	Click on radio button to select
	Use LSP2 (EU)	N/A	Use Local Setpoint #2 in Engineering Units	Click on radio button to select
Ratio/Bias **(RSP Input Only)**	**No Ratio or Bias**	N/A	No ratio and bias applied to the function block	Click on radio button to select
	Use Local Bias	N/A	Use Bias value selected on Tab	Click on radio button to select Enter value at "**Local Bias Value**" on tab.
	Use Bias Input	N/A	Use Bias value attached to an input to the block	Click on radio button to select
	Local Bias Value (EU)	38	Local bias value in engineering units	Enter local bias value –99999 to 99999
	Ratio	37	Gain value for Ratio PID	–20 to +20

RANGE/LIMIT tab

It looks like this graphically on the Control Builder. Table 74 describes the parameters and the value or selection.

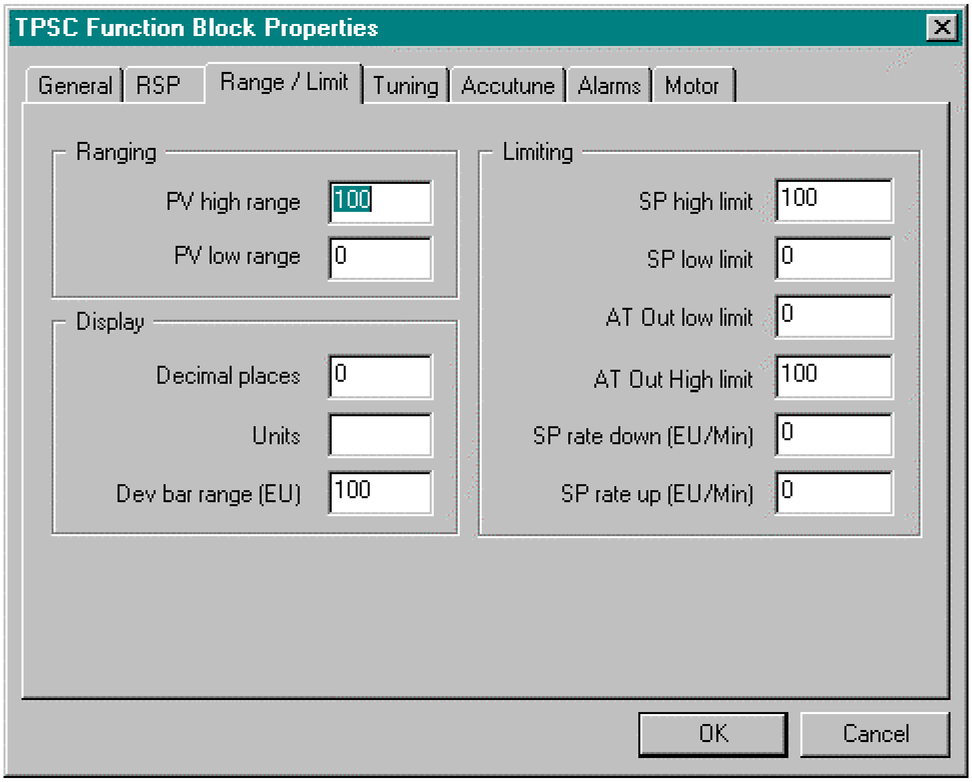


Table 74 Range/limit tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Ranging	**PV High Range**	3	PV High Range Value	–99999 to 99999
	PV Low Range	4	PV Low Range Value	–99999 to 99999
Display	**Decimal Places**	N/A	Number of digits after decimal point for display	0-5
	Units	N/A	Engineering units for display	up to 4 characters
	DEV Bar Range (EU)	N/A	Deviation Bar Range on the Operator Interface	–99999 to 99999
Limiting	**SP High Limit**	10	Setpoint High Limit Value - prevents the local and remote setpoints from going above the value set here.	–99999 to 99999
	SP Low Limit	11	Setpoint Low Limit Value - prevents the local and remote setpoints from going below the value set here.	–99999 to 99999
	Out High Limit	25	Autotuning Output High Limit Value - is the highest value of the output beyond which the motor no longer affects the process.	0 % to 100 %
	Out Low Limit	26	Autotuning Output Low Limit Value - is the lowest value of the output beyond which the motor no longer affects the process.	0 % to 100 %
	SP Rate Down	34	Setpoint Rate Down value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **down** to the new one.	0 (off) to 9999 (eu/min)
	SP Rate Up	35	Setpoint Rate Up value - when making a setpoint change, this is the rate at which setpoint will change from the original setpoint **up** to the new one.	0 (off) to 9999 (eu/min)

TUNING tab

It looks like this graphically on the Control Builder. Table 75 describes the parameters and the value or selection.

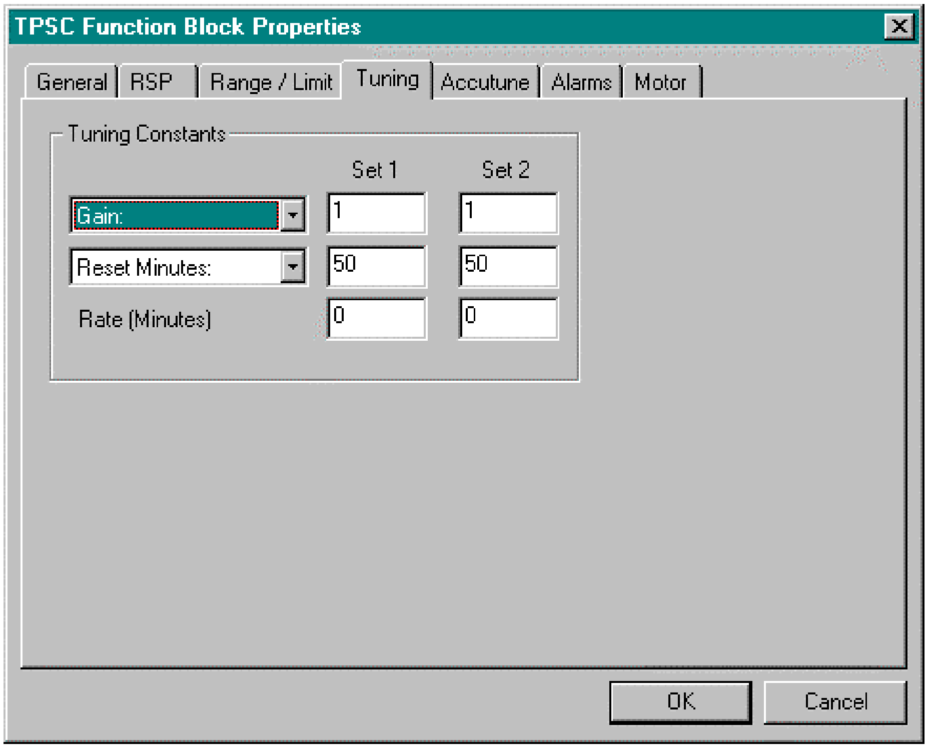


Table 75 Tuning tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Tuning Constants	**Prop Band** **or** **Gain**	0 PB1 or Gain1 29 PB2 or Gain2	**Proportional Band (PB)** - is the percentage of the range of the measured variable for which a proportional controller will produce a 100 % change in its output. **Gain** - is the ratio of output change (%) over the measured variable change (%) that caused it. $G = \frac{100\ \%}{PB\ \%}$ where PB is the Proportional Band (in %)	0.1 to 1000 0.1 % to 1000 % **ATTENTION: Enter values for tuning set 1 and tuning set 2 in specified fields.**
	Reset Minutes **or** **Repeats per Minute**	2 Reset1 or 31 Reset2	**RESET** (Integral Time) - adjusts the controller's output according to both the size of the deviation (SP-PV) and the time it lasts. The amount of corrective action depends on the value of Gain. The reset adjustment is measured as how many times proportional action is repeated per minute (**Repeats/minute**) or how many minutes before one repeat of the proportional action occurs (**Minutes/repeat**).	0.02 to 50.00
	Rate Minutes	1 Rate1 or 30 Rate2	**RATE** action, in minutes affects the controller's output whenever the deviation is changing; and affects it more when the deviation is changing faster.	0 or 0.1 to 10.00 minutes 0 = OFF

ACCUTUNE tab

It looks like this graphically on the Control Builder. Table 76 describes the parameters and the value or selection.

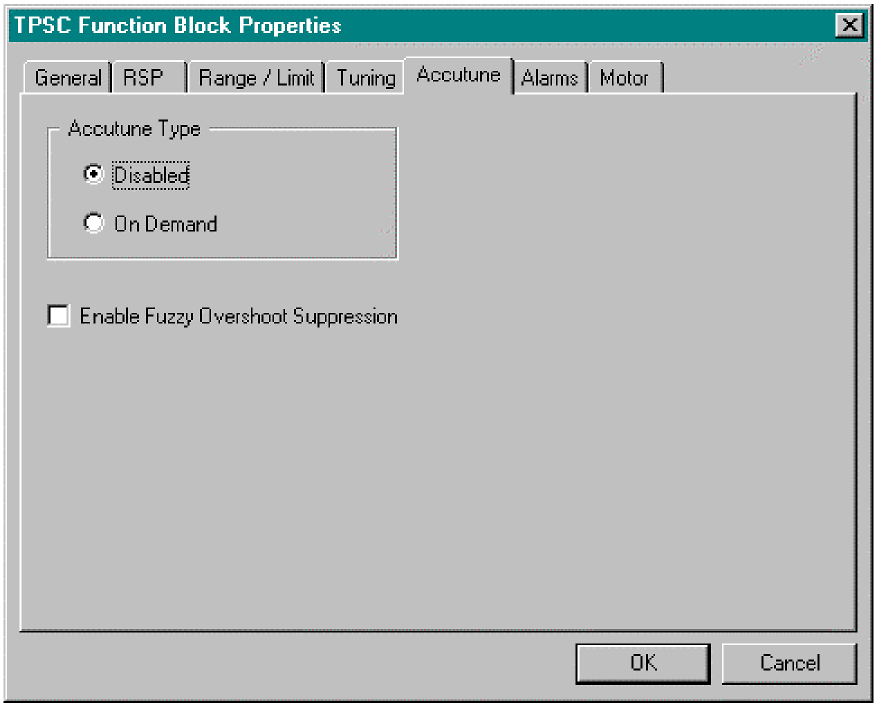


Table 76 Accutune tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Accutune Type	**Disabled**	N/A	Disables Accutune	Click on radio button to select
	On Demand	N/A	When initiated, the controller will start controlling to the setpoint while it identifies the process, calculates the tuning constants, and begins TPSC control with the correct tuning parameters.	Click on radio button to select
 **Click on block to select**		27	Fuzzy Overshoot Suppression minimizes overshoot after a setpoint change or a process disturbance. The fuzzy logic observes the speed and direction of the PV signal as it approaches the setpoint and temporarily modifies the internal controller response action as necessary to avoid an overshoot. There is no change to the TPSC algorithm, and the fuzzy logic does not alter the TPSC tuning parameters. This feature can be independently Enabled or Disabled as required by the application to work with "TUNE" On-Demand tuning.	

ALARMS tab

It looks like this graphically on the Control Builder. Table 77 describes the parameters and the value or selection.

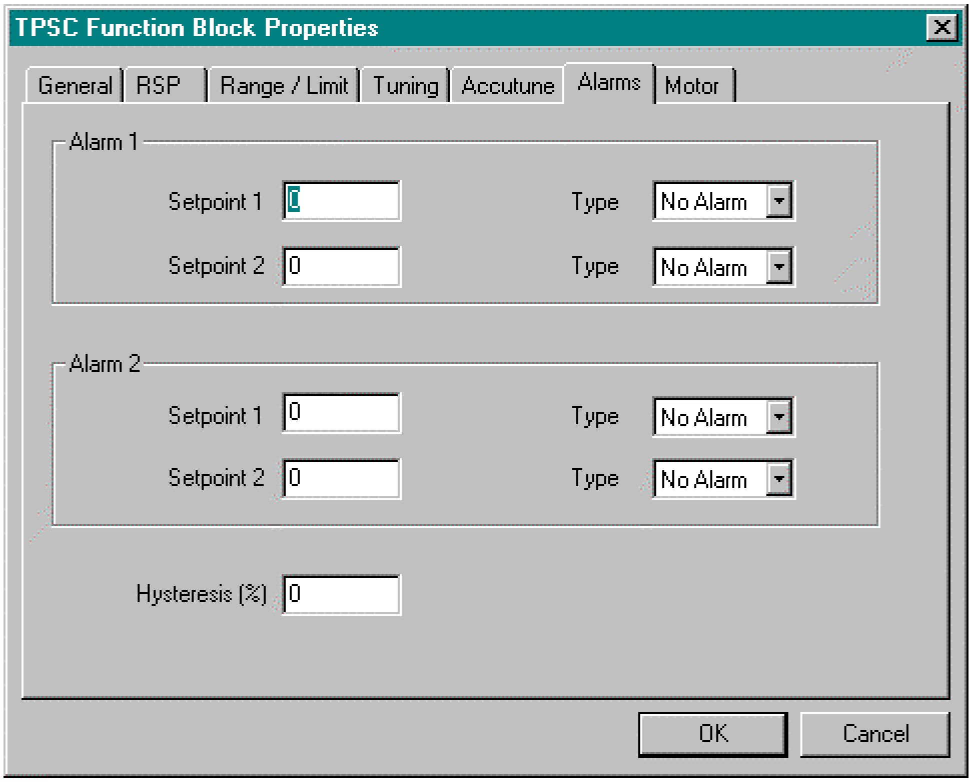
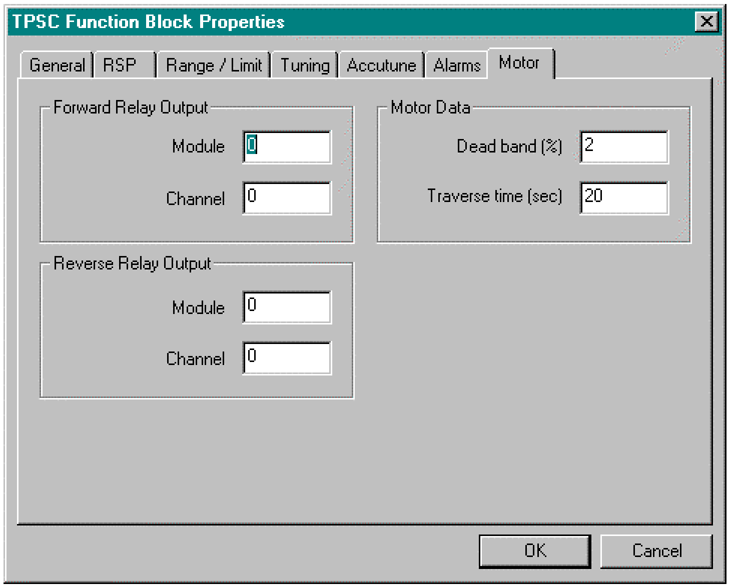


Table 77 Alarms tab configuration parameters

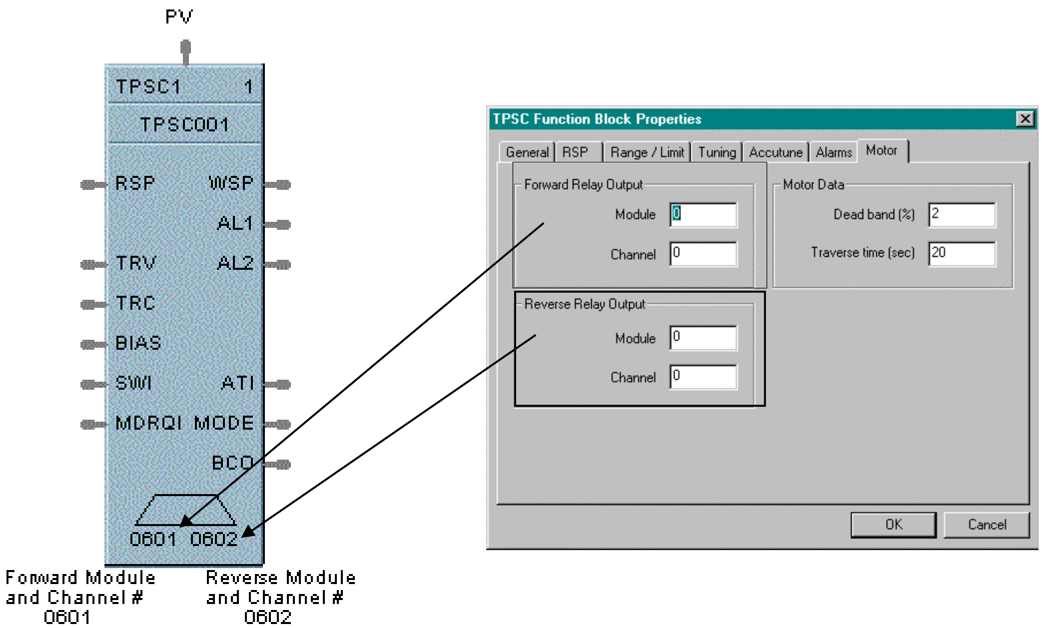
Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Alarm 1	**Setpoint 1**	14	**Alarm 1 Setpoint 1 Value** - this is the value at which you want the alarm type chose below to activate	–99999 to 99999 in Engineering Units Within the PV range when alarm type is PV or SP Within PV span when alarm type is DEV –5 % to 105 % when alarm type is output.
	Type	N/A	Alarm 1 Setpoint 1 Type - select what you want Alarm 1 Setpoint 1 to represent.	Selections: NO ALARM PV_HIGH High PV Alarm PV_LOW Low PV Alarm DEV_HIGH High Deviation alarm DEV_LOW Low Deviation alarm SP_HIGH High Setpoint alarm SP_LOW Low Setpoint alarm OUT_HIGH High Output alarm OUT_LOW Low Output alarm
	Setpoint 2	15	Alarm 1 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 1 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm 2	**Setpoint 1**	16	Alarm 2 Setpoint 1 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 1 Type	Same as **Alarm 1 Setpoint 1**
	Setpoint 2	17	Alarm 2 Setpoint 2 Value	Same as **Alarm 1 Setpoint 1**
	Type	N/A	Alarm 2 Setpoint 2 Type	Same as **Alarm 1 Setpoint 1**
Alarm Hysteresis	**%**	22	Alarm Hysteresis in %	0 % to 5 %

MOTOR tab

It looks like this graphically on the Control Builder. Three Position Step control is accomplished by assigning the motor control relays physical address under this tab. Table 78 describes the parameters and the value or selection.



Example



ATTENTION

TPSC output addresses are not checked for redundant assignment or mismatch with controller hardware; therefore, use caution to insure unique address and correct I/O module.

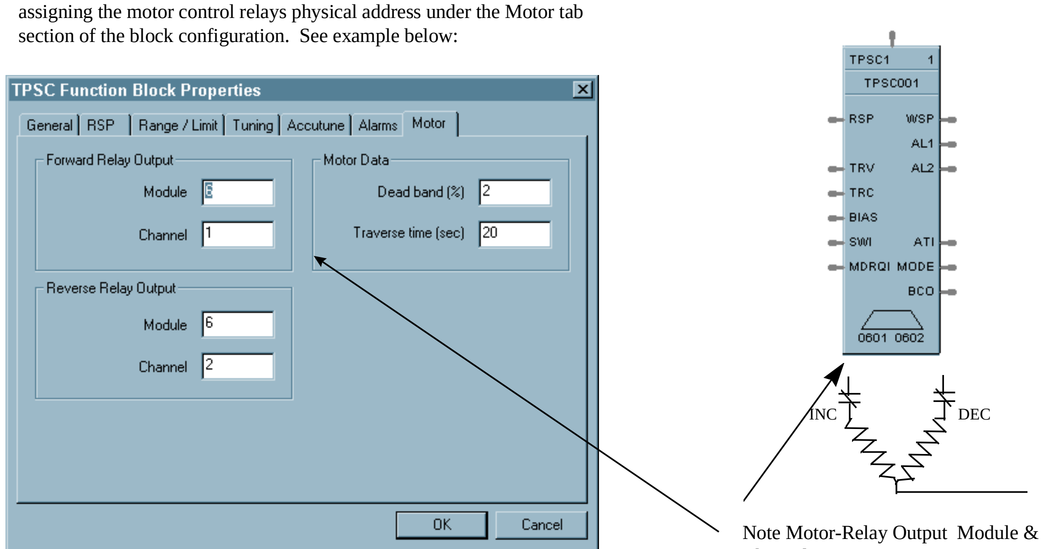
Table 78 Motor tab configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Forward Relay Output	**Module**	41	Module Number for Forward Motor Direction	1 to 16
	Channel		Channel Number for Forward Motor Direction	1 to 4
Reverse Relay Output	**Module**	42	Module Number for Reverse Motor Direction	1 to 16
	Channel		Channel Number for Reverse Motor Direction	1 to 4
Motor Data	**Deadband (%)**	43	Deadband is an adjustable gap in which neither output operates	0.5 % to 5 %
	Traverse Time (sec)	N/A	Motor Travel Time - the time it takes the motor to travel from 0 % to 100 %	0 to 1800 seconds

Example

Figure 89 shows a Function Block Diagram using a TPSC function block

3 position step control(without slidewire feedback) is accomplished by assigning the motor control relays physical address under the Motor tab section of the block configuration. See example below:



Note Motor-Relay Output Module & Channel # assignment:

0601- Forward motor direction

0602 - Reverse motor direction

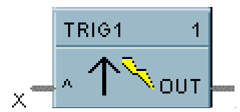
Figure 89 TPSC function block example

TRIG Function Block

Description

The **TRIG** label stands for **Trigger or “One Shot”** operation. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.

OR



Fast Logic

Function

Turns a Logic output (OUT) ON for one logic scan cycle, when a logic input (X) goes from OFF to ON.

- If X = ON and previous value of X was OFF, then: OUT = ON (one scan)
- Otherwise, OUT = OFF

Input

X = Trigger command signal

Output

OUT = triggered pulse

ATTENTION

The duration of the logic pulse output is one function block execution cycle. The duration of the fast logic pulse output is 100 ms, or the fast logic cycle time.

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Example

Figure 90 shows a Function Block Diagram using a TRIG function block. An OFF delay timer block output is ON as long as the RST input is logic HI (ON). It can be used for time duration but must be triggered by an ON to OFF transition on the Reset input. This can be accomplished using **Trigger blocks (TRIG)** to create one-shot pulses which last one scan cycle. The fast logic trigger pulse will last 100 ms. while the normal logic trigger pulse will last the complete scan cycle for analog blocks. Use according to application need. A Periodic timer output pulse may also be used to start the timer for the OFF delay.

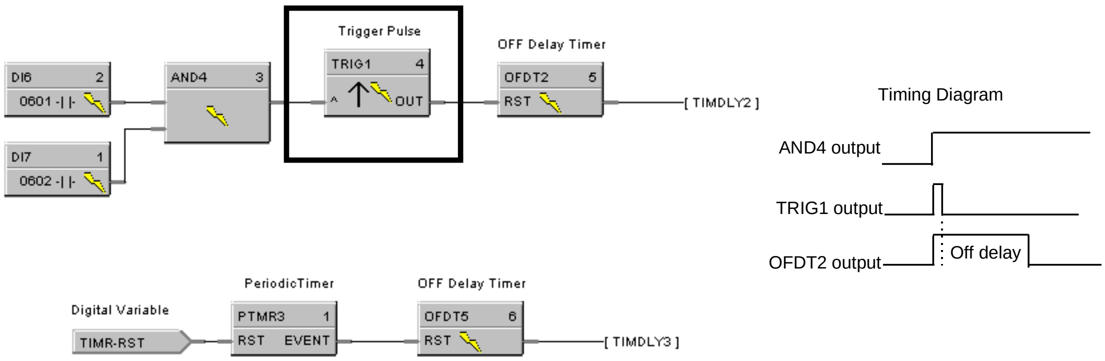
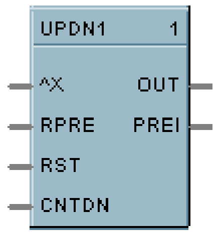


Figure 90 TRIG function block example

UPDN Function Block

Description

The **UPDN** label stands for **UP/DOWN Counter.** This block is part of the *Counters/Timers* category. It looks like this graphically on the Control Builder.



Function

The output counts the number of rising edge logic transactions on the input to the block up to a preset value (RPRE or LPRE). When the preset value is reached, a logic output (PREI) is enabled until a Reset input (RST) resets the block. Value may be set to increase to the preset value or decrease from the preset value.

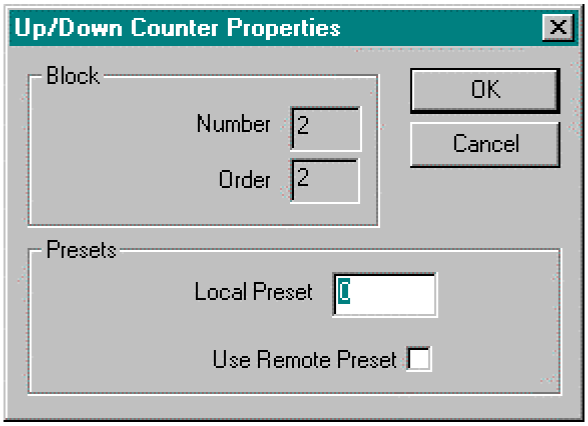
Inputs

^X = Positive Edge Detect Count Input
RPRE = Remote Preset
RST = ON resets the count
CNTDN = ON counts down

Outputs

OUT = Output
PREI = Preset Indicator

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the UPDN function Block parameters to the desired value or selection that matches your operating requirements. Table 79 describes the parameters and the value or selection.

Table 79 Up/down configuration parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Presets	**Local Preset**	0	Local Preset	1 to 99999
Use Remote Preset		1	On selects remote preset	Click on Box to select

Example

Figure 91 shows a Function Block Diagram using a UPDN function block. This example uses a Totalizer function block as a retentive timer. If a fixed input of 1 is provided to the block using a Numeric Constant, the totalizer will time up to 1 at the input rate selected (per sec, per min., per hr, or per day). For example, if the “per hr” rate were selected, the output would be 1.0 after 1 hour, 2.0 after 2 hours, etc, up to the Preset value.

A counter is shown to count the number of pump cycles (On to OFF transitions).

The P4-RESET Digital Variable is used to reset the timer and counter

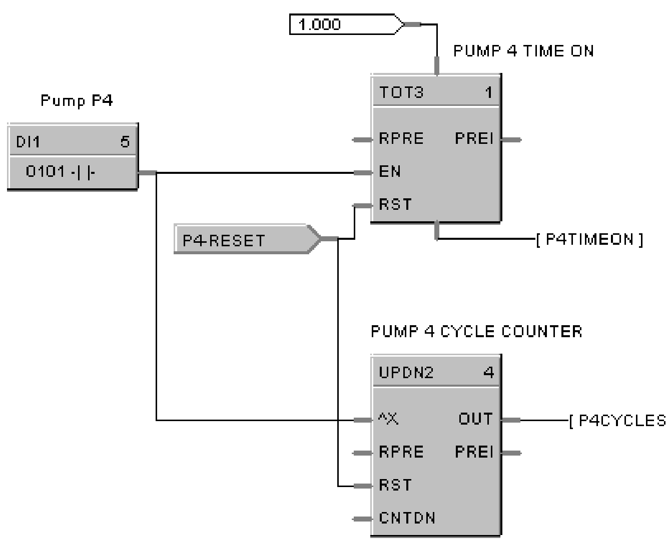
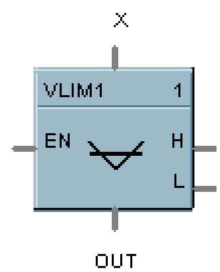


Figure 91 UPDN function block example

VLIM Function Block

Description

The **VLIM** label stands for **Velocity (Rate) Limiter.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

Limits the rate at which an analog input value (X) can change, when a digital input signal (EN) is ON. Individual rate of change limits are configured for an increasing and a decreasing X, respectively.

Separate digital status outputs indicate when High (H) or Low (L) rate limits are active.

- If EN = OFF or system state = NEWSTART*, then:
  OUT = X,
  L = OFF,
  H = OFF.
- If EN = ON and OUT < X, then:
  OUT moves toward X at Increasing RATE limit,
  L = OFF,
  H = ON until OUT = X.
- If EN = ON and OUT > X, then:
  OUT moves toward X at Decreasing RATE,
  L = ON until OUT = X,
  H = OFF.

**** Newstart** is the first scan cycle following the cold start of the controller.*

Input

X = Analog Value (Primary Input)

EN = Enable Input command

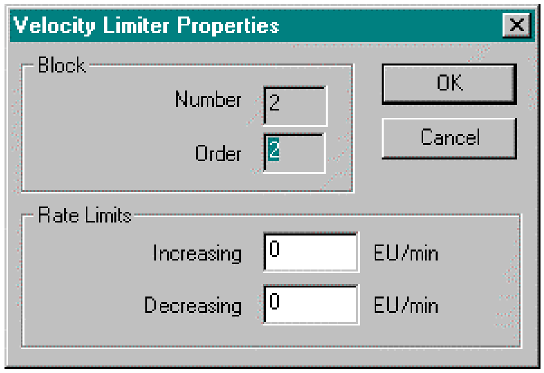
Output

OUT = Rate Limited Input Value

H = High Rate alarm indication

L = Low Rate alarm indication

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the VLIM function Block parameters to the desired value or selection that matches your operating requirements. Table 80 describes the parameters and the value or selection.

Table 80 VLIM Configuration Parameters

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Limits	**Increase Rate Limit**	0	Limits the *increasing* rate at which the analog input value can change	0 to 99999 (eu/min)
	Decrease Rate Limit	1	Limits the *decreasing* rate at which the analog input value can change	0 to 99999 (eu/min)

Example

Figure 92 shows a VLIM function block that limits the increasing or decreasing rate at which the output can change based on user specified limits when the Enable input is ON (1).

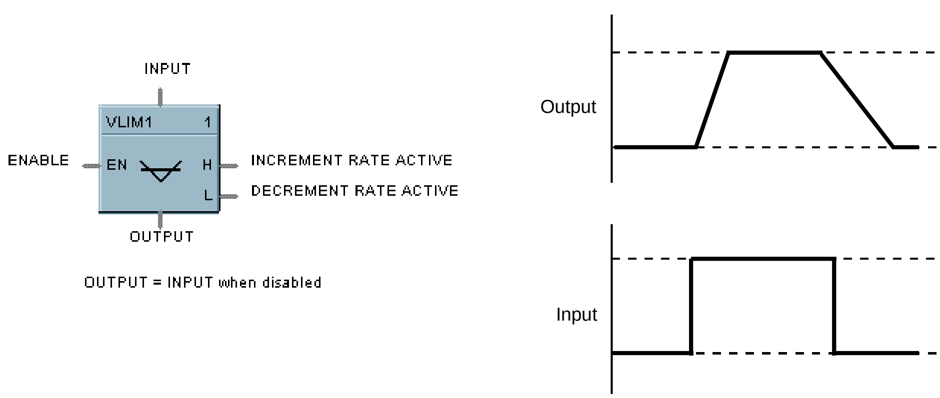
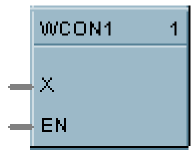


Figure 92 VLIM function block example

WCON Function Block

Description

The **WCON** label stands for **Write Constant**. This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

Writes the numerical value of selected configuration parameter to a given control block. ***Select the index number of the required parameter from the specific function block reference data and enter it in the appropriate field in the "Write Constant Properties" dialog box.***

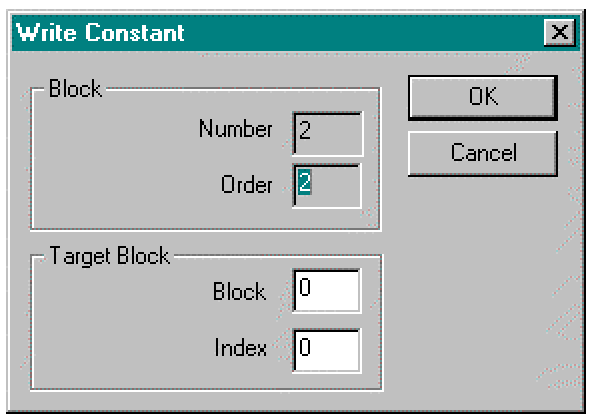
- If EN is ON, change the selected parameter to the value of X.

Input

X = Value to be written (invalid for parameters of type other than BOOL or REAL)

EN = Enable command

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the WCON function Block parameters to the desired value or selection that matches your operating requirements. Table 81 describes the parameters and the value or selection.

Table 81 Write configuration data

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Write Parameters	**Block Number**	N/A	Number of control block that contains desired configuration parameter	1 to 250
	Parameter Index #	N/A	Index number of configuration parameter to be modified	Select the index number of the required parameter from the specific function block reference data

Example

Figure 93 shows a Function Block Diagram using a WCON function block to write a new On Delay Timer, time delay value.

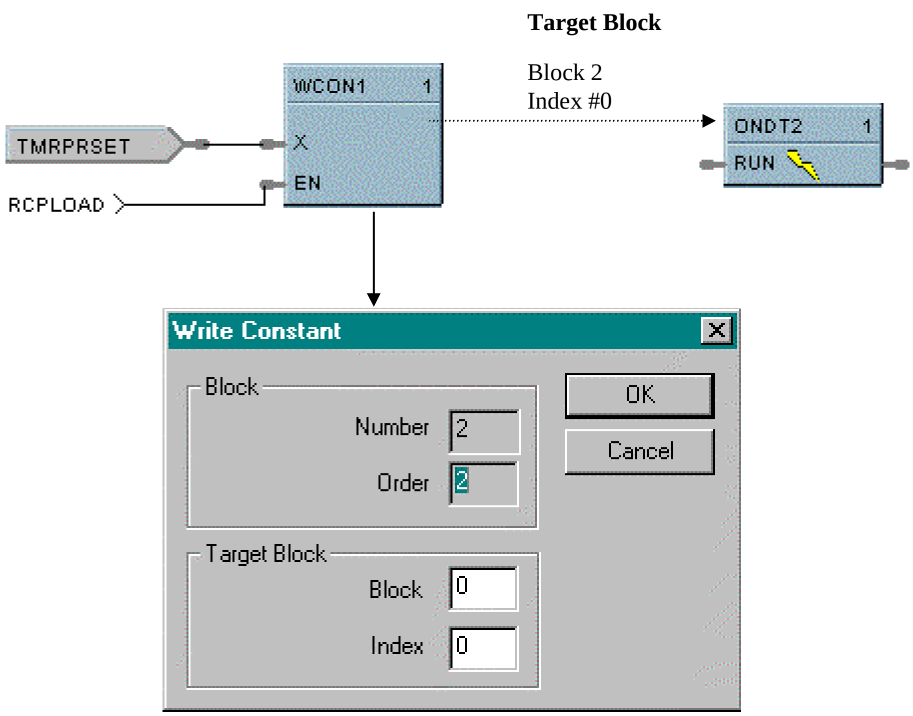
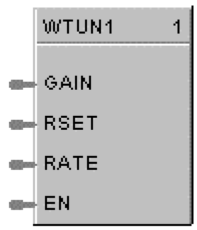


Figure 93 WCON function block example

WTUN Function Block

Description

The **WTUN** label stands for **Write Tuning Constants.** This block is part of the *Loops* category. It looks like this graphically on the Control Builder.



Function

Writes the numerical value of Gain, Rate, and Reset to a Target PID, TPSC, or CARB block without any operator interaction.

Select the target block number from the specific function block diagram and enter it in the appropriate field in the "Write Tune Constants" dialog box.

- If EN is ON, then the tuning constants are set to the Gain, Rate, and Reset input values..

ATTENTION

Invalid for block number whose type is other than PID, CARB, or TPSC.

If the target block is in AUTO mode, tuning parameter change will cause a bump in the output.

If any input value is "out-of-range", no values will be written.

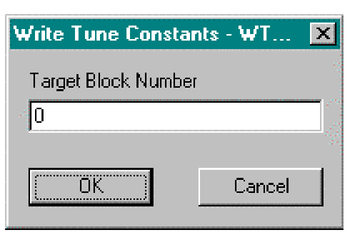
Input

GAIN = Value for GAIN tuning constant
RSET = Value for RESET tuning constant (Integration time)
RATE = Value for RATE tuning constant (Derivative time)
EN = Enable command

ATTENTION

The three analog inputs can originate as recipe items or be calculated for adaptive control.

Target block number



Double click on the function block to access the "Target Block Number" dialog box.

Enter the Target Block number in the appropriate field. **Selections are from 1 to 248.**

Example

Figure 94 shows a Function Block Diagram using a WTUN function block to write Tuning Parameters to a PID function block.

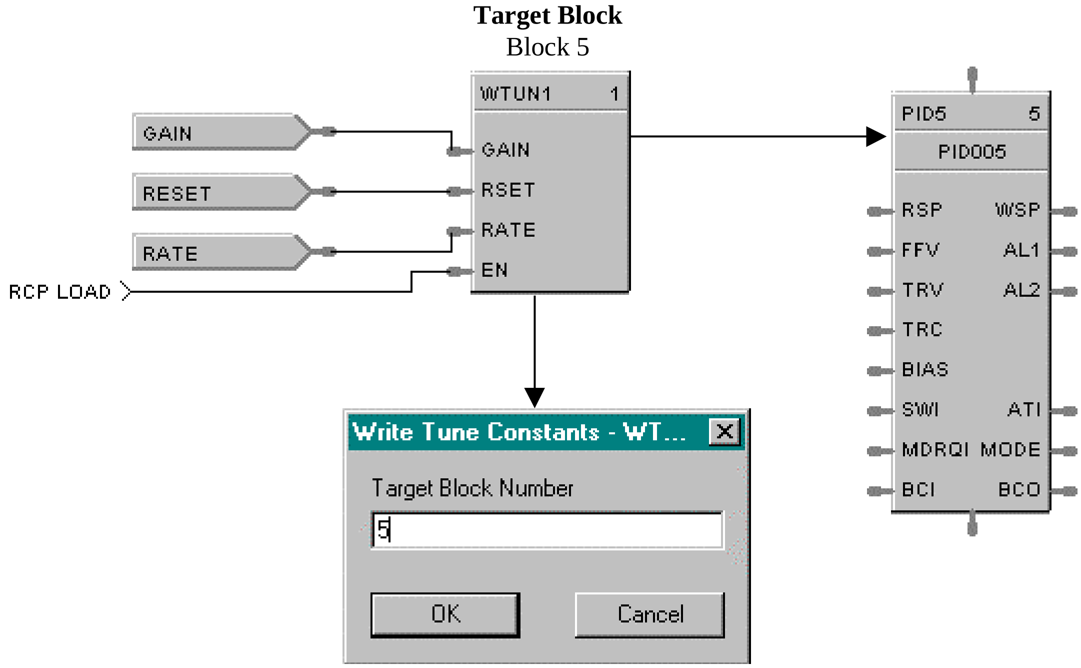
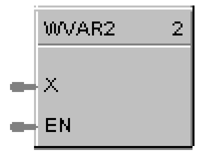


Figure 94 WTUN function block example

WVAR Function Block

Description

The **WVAR** label stands for **Write Variable.** This block is part of the *Auxiliary* category. It looks like this graphically on the Control Builder.



Function

Writes a new value to a selected Variable number.

Select the target variable number from the specific function block reference data and enter it in the appropriate field in the "Write Variable Number" dialog box.

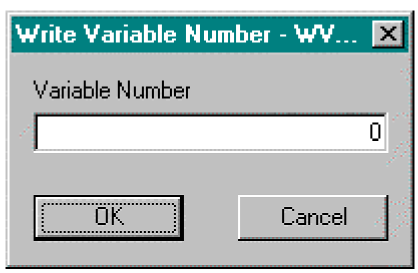
- If EN is ON, then the Variable selected is set to the value of X.(For example: X = a constant value)

Inputs

X = Value to be written to the selected variable

EN = Enable command

Target write variable number

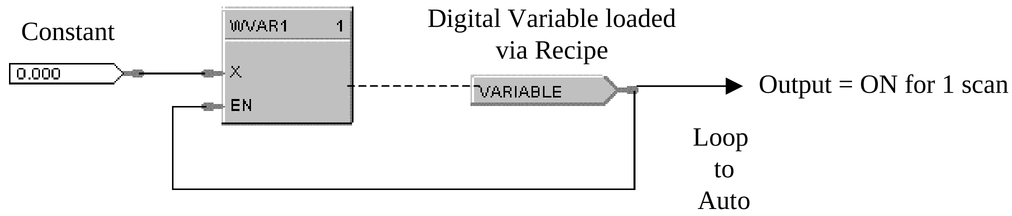


Double click on the function block to access the "Write Variable Number" dialog box.

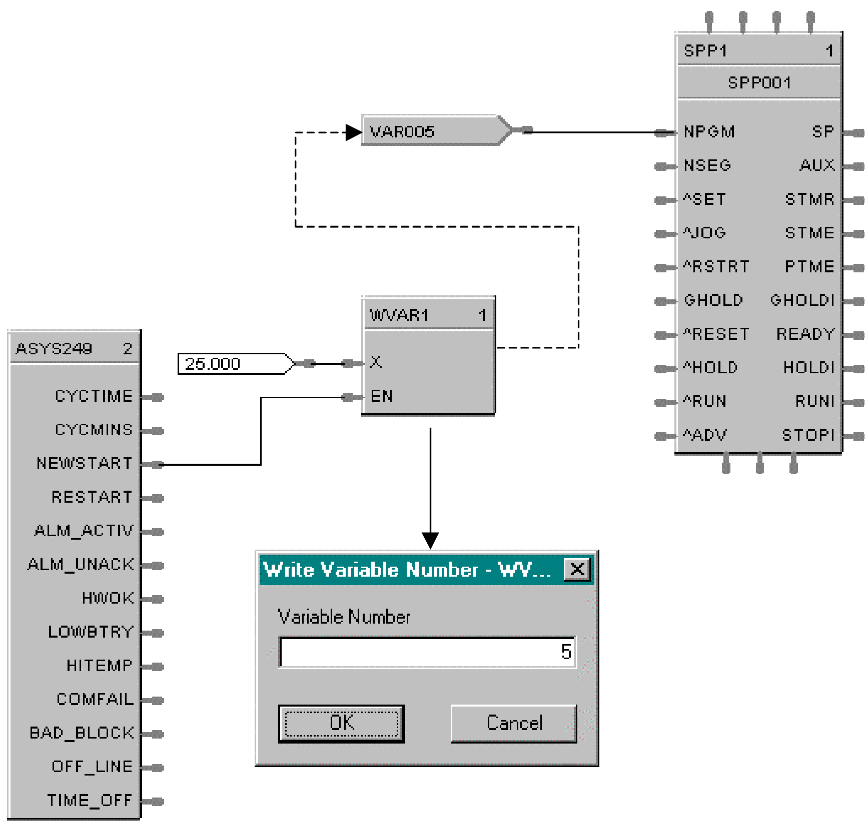
Enter the Target Variable number in the appropriate field. **Selections are from 1 to 150.**

Example

Figure 95 shows two examples of Function Block Diagrams using a WVAR function block.



Using a Write Variable to write 0 (OFF) to a digital variable after being set to 1, (ON) by a recipe. Digital variable is ON for one scan cycle



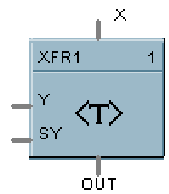
On a Cold Start, this will load Setpoint Program #25 into the SPP block

Figure 95 WVAR function block examples

XFR Function Block

Description

The **XFR** label stands for **Bumpless Analog Transfer Switch**. This block is part of the *Signal Selectors* category. It looks like this graphically on the Control Builder.



Function

Provide "bumpless" switching between two analog input values (X, Y) that is triggered by a digital input signal (*SY). When switched, the output ramps to the new value at a specified rate.

The rate at which the output (OUT) changes to a switched value (Y or X) is set by YRATE and XRATE configuration values, respectively.

- If SY is switched to ON, then: **OUT changes to Y value at YRATE**.
- If SY is switched to OFF, then: **OUT changes to X value at XRATE**.
- When OUT reaches the selected target input, OUT tracks the selected input (until SY changes).

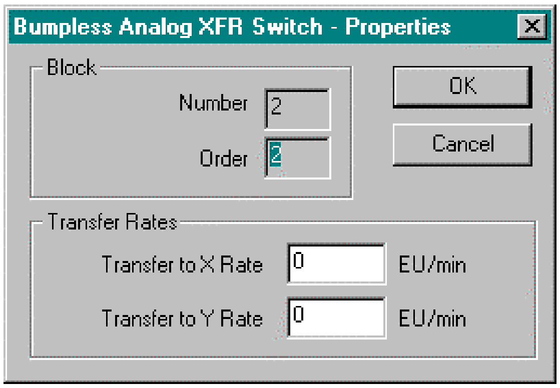
Input

X	= First analog value.
Y	= Second analog value.
SY	= Switch to Y command digital signal

Output

OUT = Selected Value

Block properties



Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting “Execution Order” in the “Configure” menu and arrange the order to suit your control strategy.

Configuration parameters

You must configure the XFR function block parameters to the desired value or selection that matches your operating requirements. Table 82 describes the parameters and the value or selection.

Table 82 XFR switch configuration data

Properties Group	Parameter	Index #	Parameter Description	Value or Selection
Set Transfer Rates	**Transfer to X Rate**	0	Rate at which output changes from Y to X in engineering units per minute	0 to 99999 Must be set at > = 0
	Transfer to Y Rate	1	Rate at which output changes from X to Y in engineering units per minute	0 to 99999 Must be set at > = 0

Example

Figure 96 shows a Function Block Diagram using a XFR function block. It shows a typical switch action for a XFR function block.

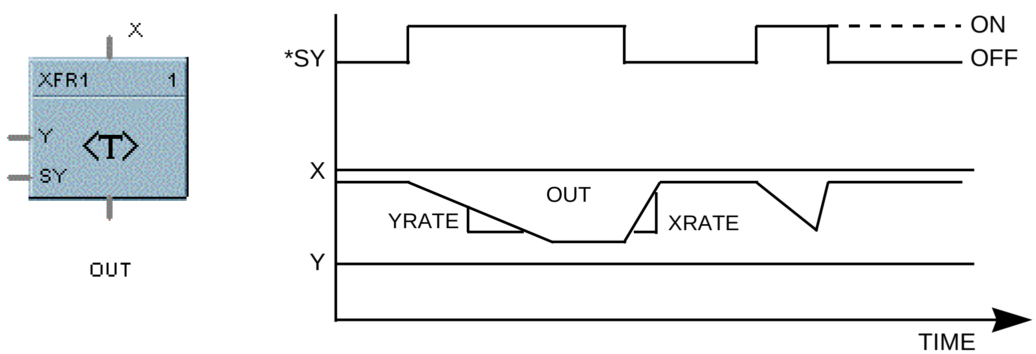


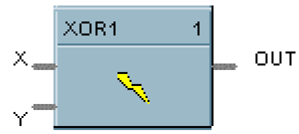
Figure 96 XFR function block example

XOR Function Block

Description

The **XOR** label stands for the **Exclusive OR** Boolean operation. This block is part of the *Logic* and *Fast Logic* categories. It looks like this graphically on the Control Builder.

OR



Fast Logic

Function

Turns a digital output signal (OUT) ON if only one of two digital input signals (X, Y) is ON. Otherwise, the output is OFF.

- If X = OFF and Y = ON, then: **OUT = ON.**
- If X = ON and Y = OFF, then: **OUT = ON.**
- If X = ON and Y = ON, or X = OFF and Y = OFF, then **OUT = OFF.**

Input

X = First Digital Signal
Y = Second Digital Signal

Output

OUT = resultant digital signal

Block properties

Double click on the function block to access the function block properties dialog box.

Block Order (Read Only)
You can change the assigned execution order number by selecting "Execution Order" in the "Configure" menu and arrange the order to suit your control strategy.

Example

Figure 97 shows a Function Block Diagram using a XOR function block. In the example, if pressure input 1 or 2 is high or low, flow is disabled. If only one pressure input is ON, flow is enabled.

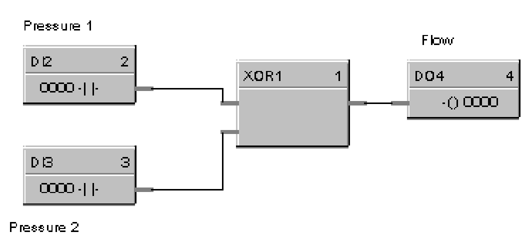


Figure 97 XOR function block example

Index

–D–

–E–

–F–

–G–

–H–

–P, Q–

–R–

–S–

–T–

–U–

–V–

–W–

–X, Y, Z–

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