Synergy Controller General Logic Programming Features

Introduction

Tidal Engineering's Synergy Controllers, including the Synergy Micro 2, Synergy Quattro, and the ¼ DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functionality of a chamber controller and a data logger and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards. With the flexibility afforded by their multiple communication ports; Ethernet (10/100 Base-T), GPIB/IEEE 488, and RS-232, these controllers are perfect for today's dynamic testing environments.

The Synergy Controller software currently implements more than 30 high level functions or algorithms called primitives which are designed to drive compressors, heaters, fans, and various refrigeration and humidity control components.

In addition, starting in Version 3.0.14, Build 961 these controllers have a variety of general purpose programming features that can be used to implement control logic such as timers, thermostatic (On/Off) output functions, time proportioning outputs, selectors functions, and logic output (And, Or, Nand and Nor) functions . This application describes these general purpose primitives and provides examples.

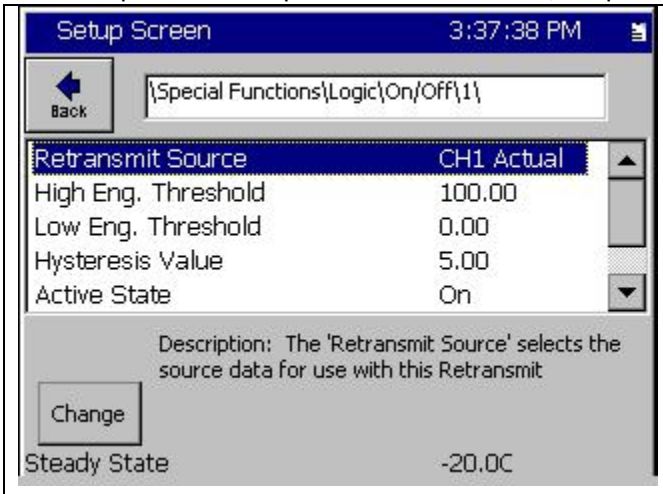
ON/OFF Thermostatic Primitive

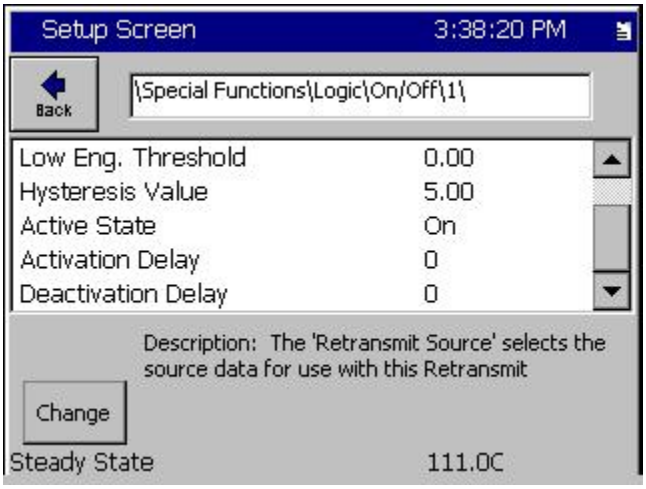
The ON/OFF Thermostatic Primitive (referred to as On/Off primitive below) is full featured two threshold thermostatic output with programmable Activation and De-activation timers. The output is active when the source variable is within the limits defined by the High and Low Engineering Thresholds and the output is not active when the source variable is outside these thresholds. The output value of the primitive in the Active state can be set to On or Off. In addition, hysteresis can enabled around the switch-points to prevent chatter and Activation and De-Activation Delay timers are individually settable.

The functionality of the On/Off primitive in its simplest form is as follows:

When the Active State parameter is set to On (1)	When the Active State parameter is set to Off (0)
$f(x) = \begin{cases} 0, & x < Low\ Eng.Threshold \\ 0, & x > High\ Eng.Threshold \\ 1, & otherwise \end{cases}$	$f(x) = \begin{cases} 1, & x < Low\ Eng.Threshold \\ 1, & x > High\ Eng.Threshold \\ 0, & otherwise \end{cases}$

The setup folders and parameters for the On/Off primitive are as follows:





Retransmit Source parameter defines the Control variable x in the equation above. ONOFF#_SRC

High Eng. Threshold parameter defines the high threshold; when the source parameter is above this threshold, the primitive output is inactive. ONOFF#_ENGMAX

Low Eng. Threshold parameter defines the Low threshold; when the source parameter is below this threshold, the primitive output is inactive. ONOFF#_ENGMIN

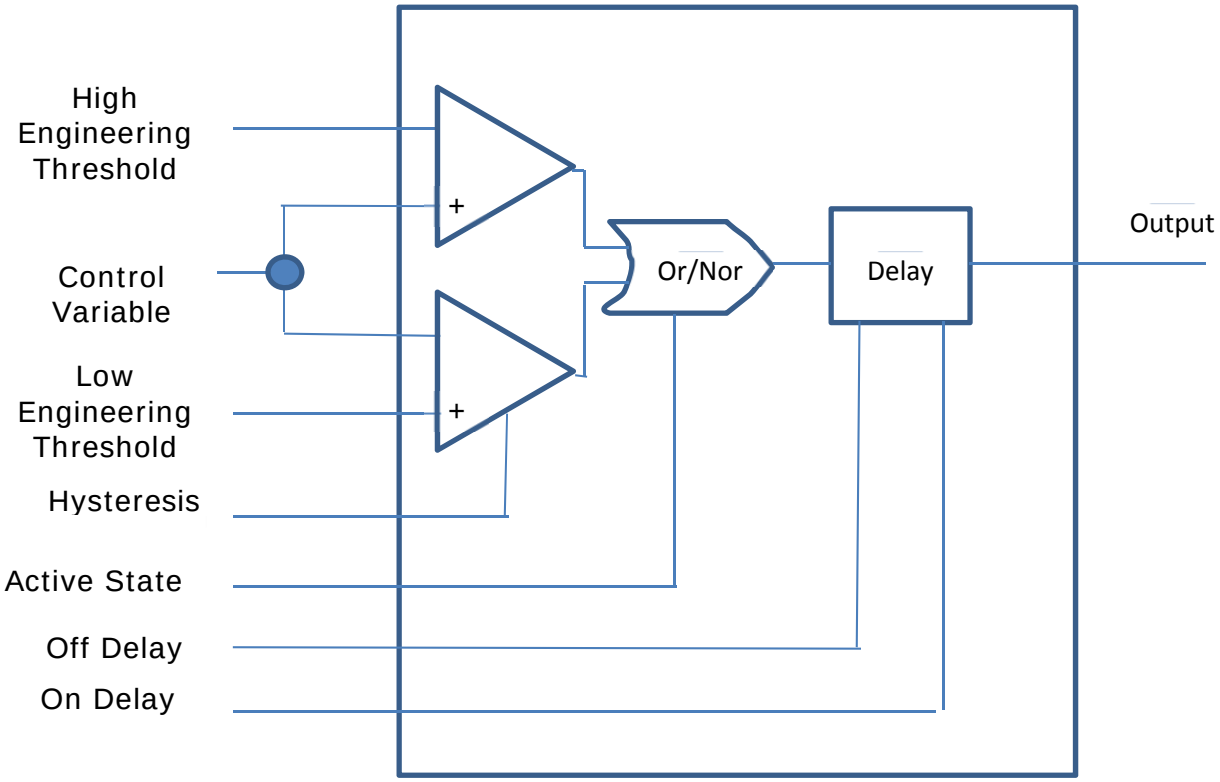
Hysteresis Parameter defines the switching Hysteresis. ONOFF#_HYST

Active State Parameter defines value of the output in the active state, On or Off. ONOFF#_ACTST

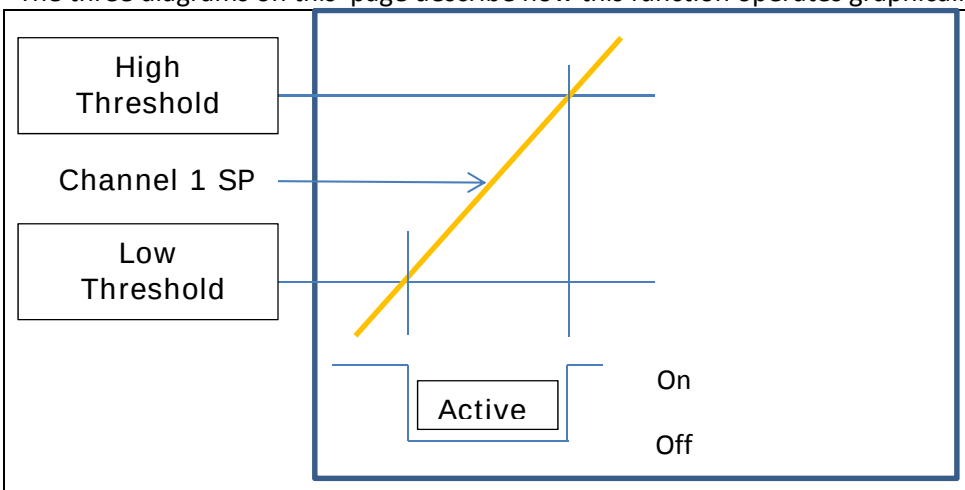
Activation Delay is the number of seconds of delay before the output state changes after the source parameter gets inside the threshold limits. ONOFF#_ONT

De-Activation Delay is the number of seconds of delay before the output state changes after the source parameter goes outside the threshold limits. ONOFF#_OFFT

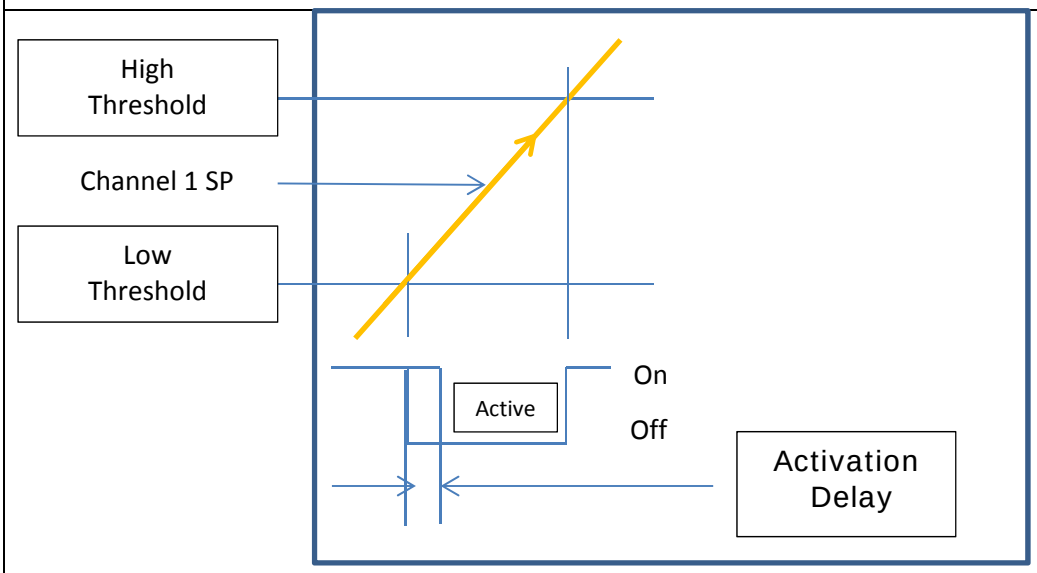
Block Diagram ON/OFF Primitive



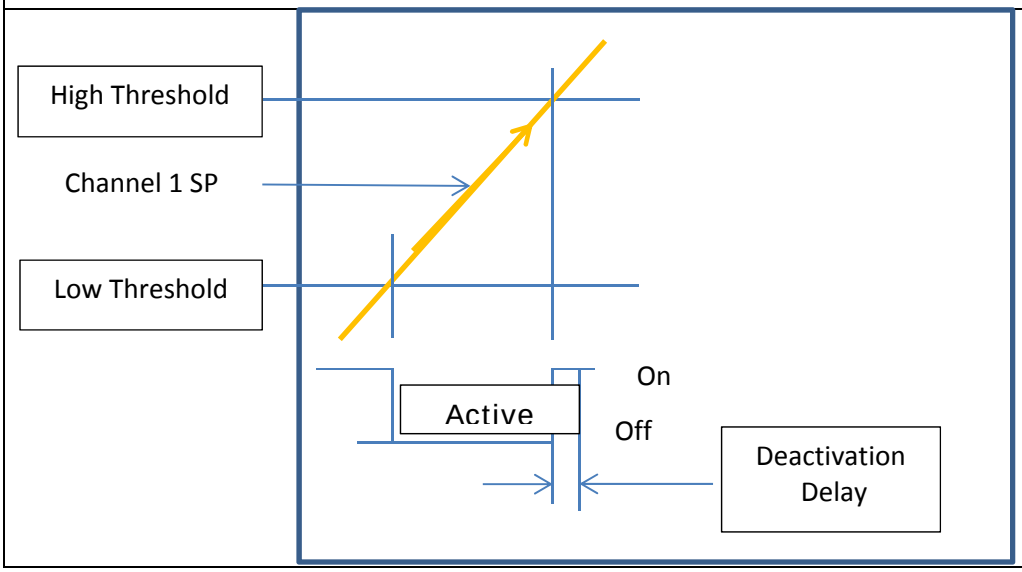
The three diagrams on this page describe how this function operates graphically.



On/Off Output with No Delay



On/Off Output with Activation Delay Active



On/Off Output With Deactivation Delay

On/Off Primitive Function Commands

Command Noun	Actions	Syntax	Arguments	Examples
ON/Off Function Control Variable	ONOFF#_SRC Set	= ONOFF#_SRC ARG1	# - On/Off Instance 1-8 ARG1: 1-18	= ONOFF1_SRC 8 Set Source to CH1 Cool PID
	ONOFF#_SRC Query	? ONOFF#_SRC	# - On/Off Instance 1-8	? ONOFF1_SRC Response: 8
On/Off Function High Threshold	ONOFF#_ENGMAX Set	= ONOFF#_ENGMAX ARG1	# - On/Off Instance 1 - 8 ARG1: -200 to 5000	= ONOFF7_ENGMAX 30
	ONOFF#_ENGMAX Query	? ONOFF#_ENGMAX	# - On/Off Instance 1 - 8	? ONOFF7_ENGMAX Response: 30
On/Off Function Low Threshold	ONOFF#_ENGMIN Set	= ONOFF#_ENGMIN ARG1	# - On/Off Instance 1 - 8 ARG1: -200 to 5000	= ONOFF7_ENGMIN 10
	ONOFF#_ENGMIN Query	? ONOFF#_ENGMIN	# - On/Off Instance 1 - 8	? ONOFF7_ENGMIN Response: 10
On/Off Function Hysteresis	ONOFF#_HYST Set	= ONOFF#_HYST ARG1	# - On/Off Instance 1 - 8 ARG1: 0 -999	= ONOFF8_HYST 1.5
	ONOFF#_HYST Query	? ONOFF#_HYST	# - On/Off Instance 1 - 8	? ONOFF8_HYST Response: 1.5
On/Off Function Active State	ONOFF#_ACTST Set	= ONOFF#_ ACTST ARG1	# - On/Off Instance 1 - 8 ARG1: 0 - 3600 Seconds	= ONOFF 8_ ACTST 1
	ONOFF#_ ACTST Query	? ONOFF#_ ACTST	# - On/Off Instance 1 - 8	? ONOFF 8_ ACTST Response: 1
On/Off Function Activation (ON) Delay Timer	ONOFF#_ONT Set	= ONOFF#_ONT ARG1	# - Logic Instance 1 - 8 ARG1: 0 - 3600 Seconds	= ONOFF7_ONT 30
	ONOFF#_ONT Query	? ONOFF#_ONT	# - Logic Instance 1 - 8	? ONOFF7_ONT Response: 30
On/Off Function Deactivation (OFF) Delay Timer	ONOFF#_OFFT Set	= ONOFF#_OFFT ARG1	# - Logic Instance 1 - 8 ARG1: 0 - 3600 Seconds	= ONOFF8_OFFT 120
	ONOFF#_OFFT Query	? ONOFF#_OFFT	# - Logic Instance 1 - 8	? ONOFF8_OFFT Response: 120

Control Variable IDs

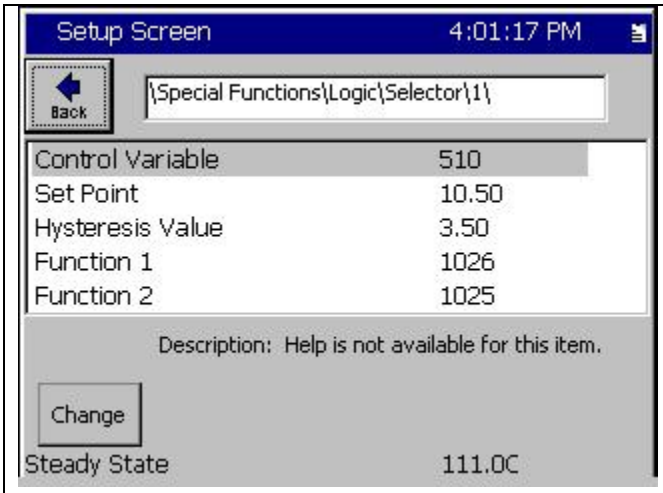
0 - Off	**7 - CH1 Heat PID**	**14 - CH2 Cascade Air**
1 - CH1 Actual	**8 - CH1 Cool PID**	**15 - CH3 Cascade Air**
2 - CH2 Actual	**9 - CH2 Heat PID**	**16 - CH1 Full PID**
3 - CH3 Actual	**10 - CH2 Cool PID**	**17 - CH2 Full PID**
4 - CH1 Setpoint	**11 - CH3 Heat PID**	**18 - CH3 Full PID**
5 - CH2 Setpoint	**12 - CH3 Cool PID**	
6 - CH3 Setpoint	**13 - CH1 Cascade Air**	

Selector Primitive Function

The Selector Primitive's output selects between two inputs based on the value of the Control Variable. The Function 1 input is copied to the Primitive's output when the value of when the Control Variable is less than the Set point and Function 2 input is copied to the Primitive's output when the Control Variable is less than or equal to the threshold.

The function of this primitive in its simplest form is as follows:

$$f(x) = \begin{cases} Function\ 1, & x > Threshold \\ Function\ 2, & x \leq Threshold \end{cases}$$



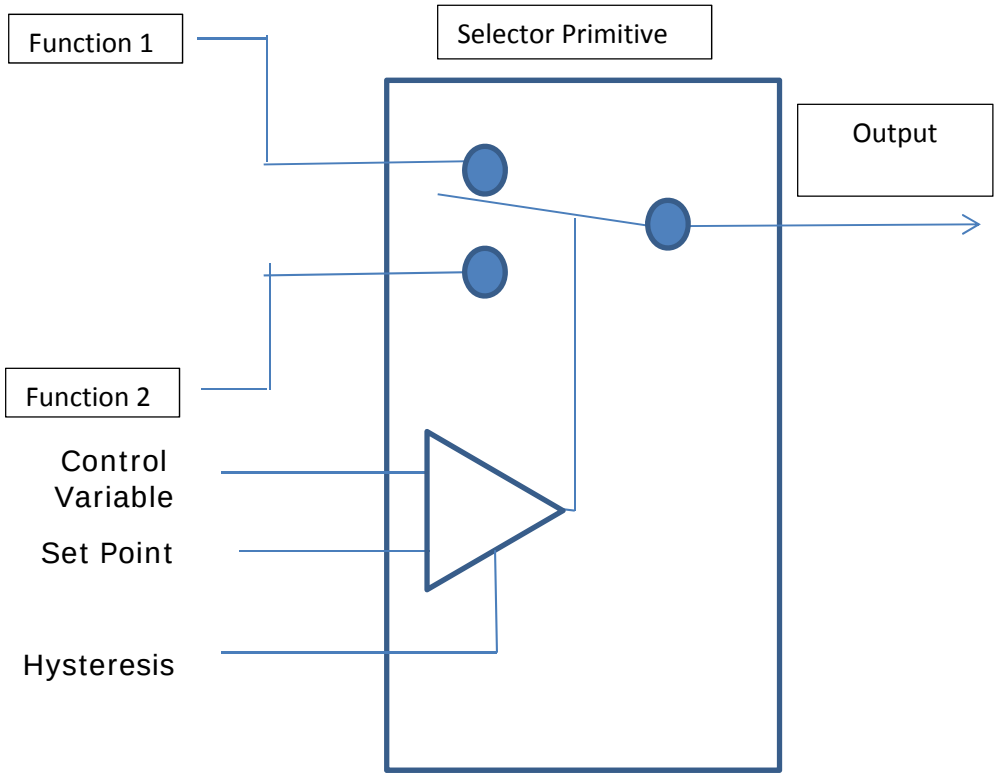
Control Variable parameter defines the source variable x in the equation above.
SELECTOR#_SRC

Set Point parameter defines the threshold that the source variable is compared with.
SELECTOR#_SP

Hysteresis Value Parameter defines the switching Hysteresis
SELECTOR#_HYST

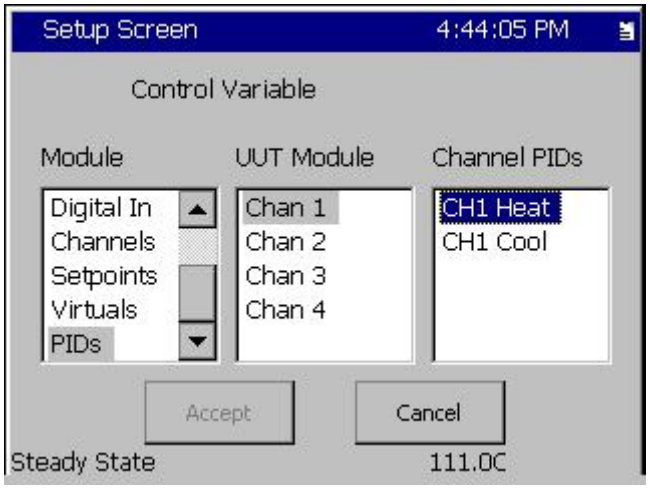
Function 1 parameter is used to select the Function 1 variable.
SELECTOR#_FUNC1

Function 2 parameter is used to select the Function 2 variable.
SELECTOR#_FUNC2



Selector Primitive Function Commands

Command Noun	Actions	Syntax	Arguments	Examples
Selector Primitive Control Variable	SELECTOR#_SRC Set	'= SELECTOR#_SRC ARG1	# - Selector Instance 1-8 ARG1: 110 - 1299	= SELECTOR1_SRC 1211 Set to Channel 1 PID Heat
	SELECTOR#_SRC Query	? SELECTOR#_SRC	# - Selector Instance 1-8	? SELECTOR1_SRC Response: 1211
Selector Primitive Set Point	SELECTOR#_SP Set	= SELECTOR#_SP ARG1	# - Selector Primitive 1 - 8 ARG1: Setpoint, float	= SELECTOR7_SP 30
	SELECTOR#_SP Query	? SELECTOR#_SP	# - Selector Primitive 1 - 8	? SELECTOR7_SP? Response: 30
Selector Primitive Hysteresis	SELECTOR#_HYST Set	= SELECTOR#_HYST ARG1	# - Selector Primitive 1 - 8 ARG1: Hysteresis, float	= SELECTOR8_HYST 120
	SELECTOR#_HYST Query	? SELECTOR#_HYST	# - Selector Primitive 1 - 8	? SELECTOR8_ HYST Response: 120
Selector Primitive Functions	SELECTOR#_FUNCn Set	= SELECTOR#_FUNCn ARG1	**# - Selector Instance 1-8** **n – 1 or 2** ARG1: Function	= SELECTOR1_FUNC1 1025 Set Function 1 to Output 25
	SELECTOR #_FUNCn Query	? SELECTOR#_FUNCn	# - Selector Instance 1-8 n – 1 or 2	? SELECTOR1_FUNC1 Response: 1025

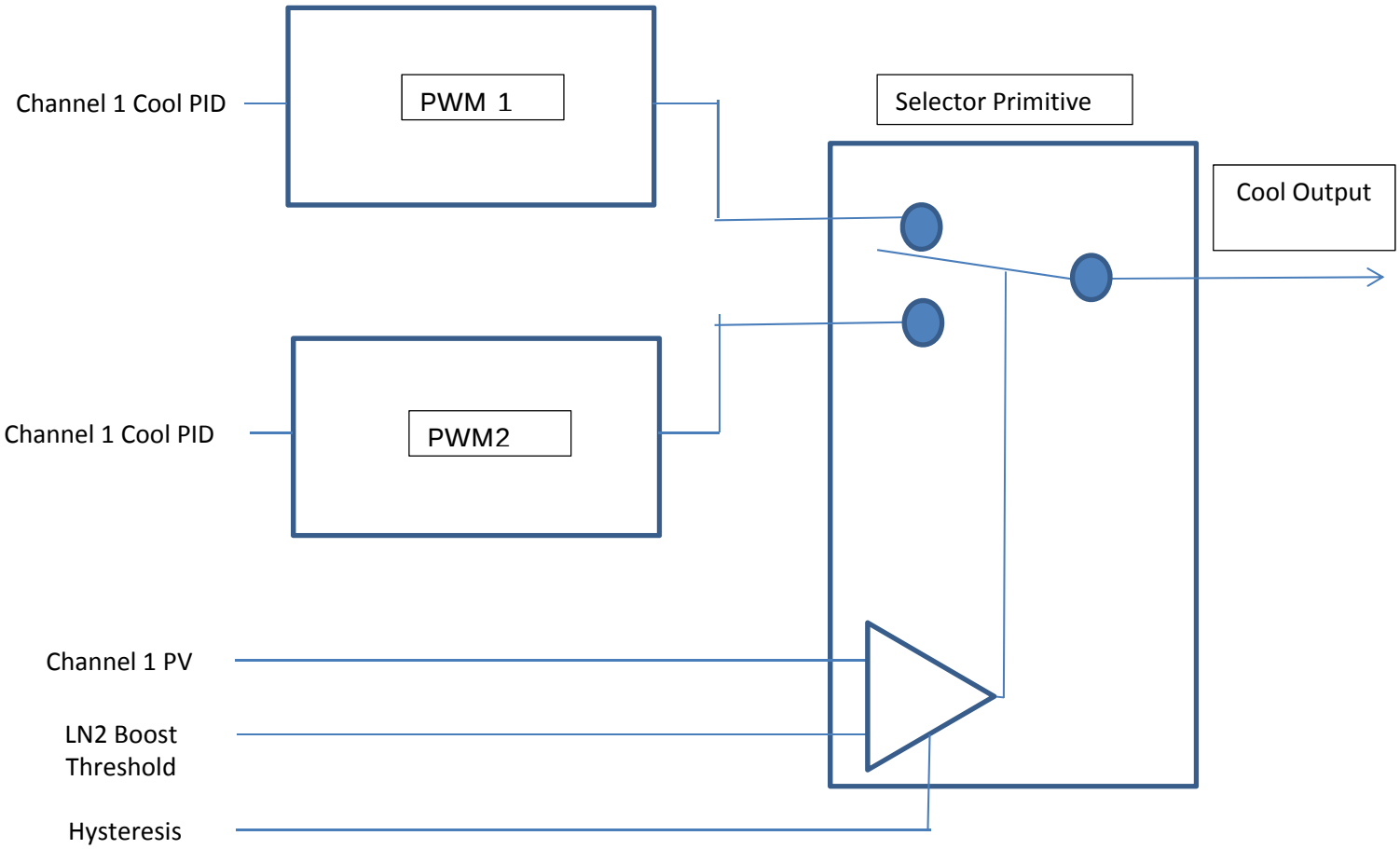


Function IDs

Command Noun	Screen Identifier	Code	Example
Digital Inputs	Digital In	400 + n	416 is Digital Input 16
Digital Outputs	Outputs	1000 + n	1030 is Digital Output 30
Constants	Constant	1110 is False 1120 is True	1110 is False 1120 is True
Not Digital Inputs	!Digital In	1400 + n	1405 is Not Digital Input 5
Not Digital Outputs	!Outputs	1300 + n	1330 is Not Digital Output 30

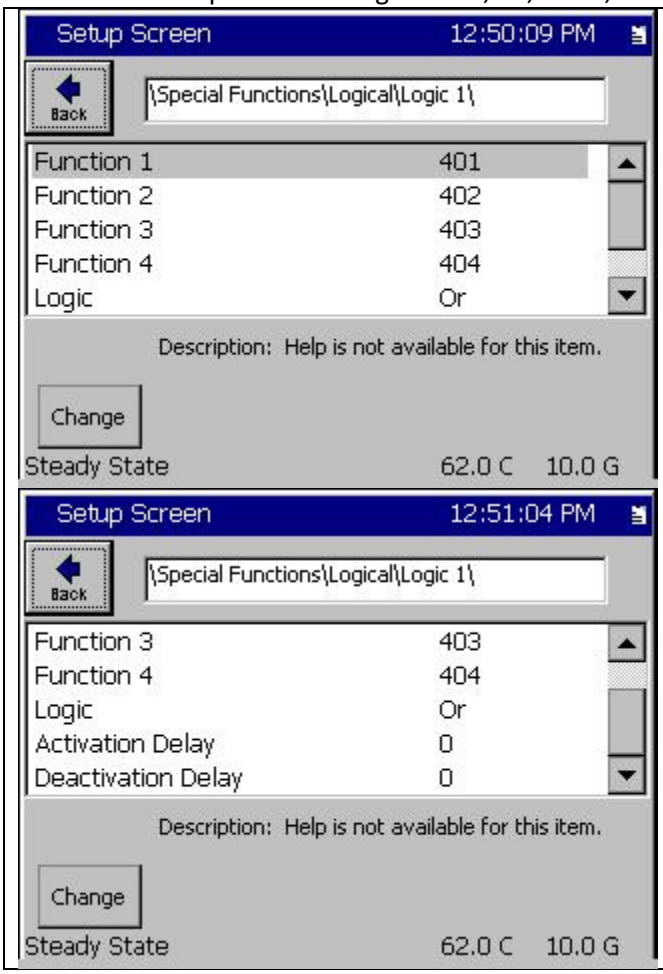
Selector output example

This Output switches between PWM1 and PWM 2 using the Selector Primitive.
PWM1 and PWM2 can be setup for different PV conditions.
The Selector Source variable is set to Actual Channel 1 (PV) and the threshold is setup for the switch temperature.



Logical Primitive Function

This function implements a Logical And, Or, Nand, Nor.

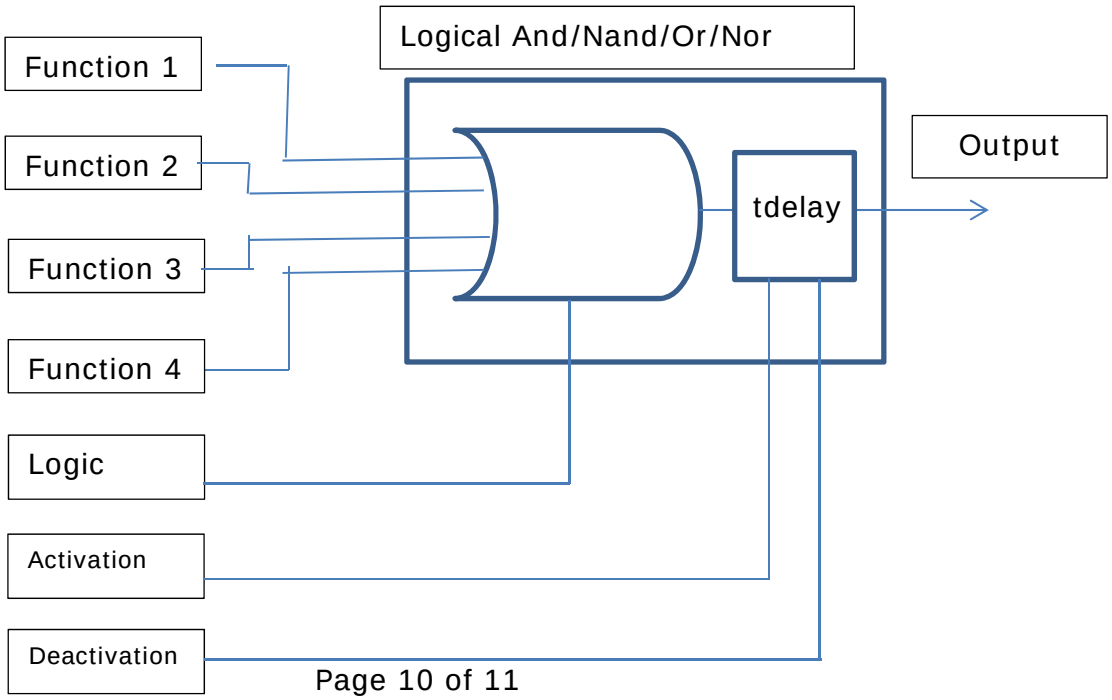


Function n Four input functions are selected from a drop down list.
LOGIC#_FUNCn

Logic set to And, Or, Nand, Nor.
LOGIC#_TYPE

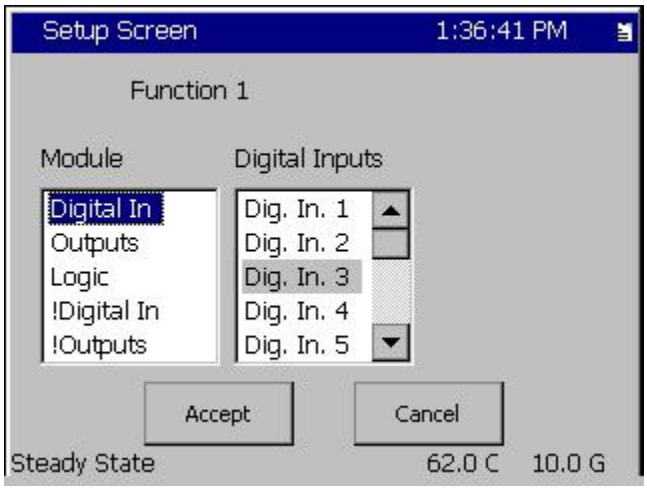
Activation Delay is the number of seconds of delay before the output state changes after the source parameter gets inside the threshold limits.
LOGIC#_ONT

De-Activation Delay is the number of seconds of delay before the output state changes after the source parameter goes outside the threshold limits.
LOGIC#_OFFT



Logic Primitive Function Commands

Command Noun	Actions	Syntax	Arguments	Examples
Logic Primitive Input Functions	LOGIC#_FUNCn Set	= LOGIC#_FUNCn ARG1	# - Logic Instance 1-8 n 1-4 ARG1: Seem table below	= LOGIC1_FUNC2 1003 Set Log 1 Function 2 to Output 3
	LOGIC#_FUNCn Query	? LOGIC#_FUNCn	# - Logic Instance 1-8 n 1-4	? LOGIC1_FUNC2 Response: 1003
Logic Primitive Function Type	LOGIC#_TYPE Set	= LOGIC#_TYPE ARG1	# - Logic Instance 1-8 ARG1: 0 - AND 1 - OR 2 - NAND 3 - NOR	= LOGIC1_TYPE 2
	LOGIC#_TYPE Query	? LOGIC#_TYPE	# - Logic Instance 1-8	? LOGIC1_TYPE Response: 2
Logic Primitive Activation (ON) Delay	LOGIC#_ONT Set	= LOGIC#_ONT ARG1	# - Logic Primitive 1 - 8 ARG1: 0 - 3600 Seconds	= LOGIC7_ONT 30
	LOGIC#_ONT Query	? LOGIC#_ONT	# - Logic Primitive 1 - 8	? LOGIC7_ONT Response: 30
Logic Primitive Deactivation (OFF) Delay	LOGIC#_OFFT Set	= LOGIC#_OFFT ARG1	# - Logic Primitive 1 - 8 ARG1: 0 - 3600 Seconds	= LOGIC8_OFFT 120
	LOGIC#_OFFT Query	? LOGIC#_OFFT	# - Logic Primitive 1 - 8	? LOGIC8_OFFT Response: 120



Variable IDs

Command Noun	Screen Identifier	Code	Example
Digital Inputs	Digital In	400 + n	416 is Digital Input 16
Digital Outputs	Outputs	1000 + n	1030 is Digital Output 30
Constants	Logic	1110 is False 1120 is True	1110 is False 1120 is True
Not Digital Inputs	!Digital In	1400 + n	1405 is Not Digital Input 5
Not Digital Outputs	!Outputs	1300 + n	1330 is Not Digital Output 30

About the Synergy Controller Family

Tidal Engineering's Synergy Controllers, both the Synergy Micro 2 and the ¼ DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functions of a chamber controller and a data logger and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

Synergy Controller feature highlights includes:

- ➔ Color touch screen
- ➔ Ethernet, RS-232 and GPIB communications
- ➔ Built in 100 MB Data logger with USB drive support
- ➔ Data Acquisition, up to 64 T-type thermocouples (Optional)
- ➔ Built-in Web Server for remote control; WebTouch Remote ™
- ➔ Compatible with Synergy Manager for PC based control, monitoring and programming.
- ➔ Built-in FTP Server for factory automation and test and measurement applications

For more information regarding these controllers please see the full Synergy Controller Technical Manual on our website at http://www.tidaleng.com/synergy.htm

About Tidal Engineering

Headquartered in Randolph, NJ, Tidal Engineering Corporation has been designing and building award-winning embedded hardware and software for test and measurement and data acquisition applications since 1992. The company is recognized for technical expertise in such areas as Embedded IEEE 488, and turnkey SCADA (Supervisory Control and Data Acquisition) systems.

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