Reference Manual

PlantPAx
Process Automation System

Rockwell Automation Library of Process Objects: Boolean Logic with Snapshot (P_Logic)

Version 3.1





Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

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If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Notes:

This document is updated throughout for version 3.1 of the Rockwell Automation Library of Process Objects. Changes for this revision are marked by change bars shown in the right margin.

Software Compatibility and Content Revision

Table 1 - Summary of Changes

Topic	Page
Changed title from 'PlantPAx® Library of Process Objects' to 'Rockwell Automation Library of Process Objects'	Front Cover
Changed version of Rockwell Automation Library of Process Objects from 3.0 to 3.1	5, 10, 11
Changed references to Knowledgebase Answer ID 62682 to Product Compatibility and Download Center	5, 10
Visualization Files - added Important note concerning the order in which files must be imported	10
Input Parameters tables - added 'Alias For' column and aliases	12
Output Parameters tables - added 'Err_' parameter type to bullet list before output table	13
Operations - added Simulation section	17

For the latest compatible software information and to download the Rockwell Automation Library of Process Objects, see the Product Compatibility and Download Center at http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page.

For general library considerations, see Rockwell Automation Library of Process Objects, publication PROCES-RM002.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

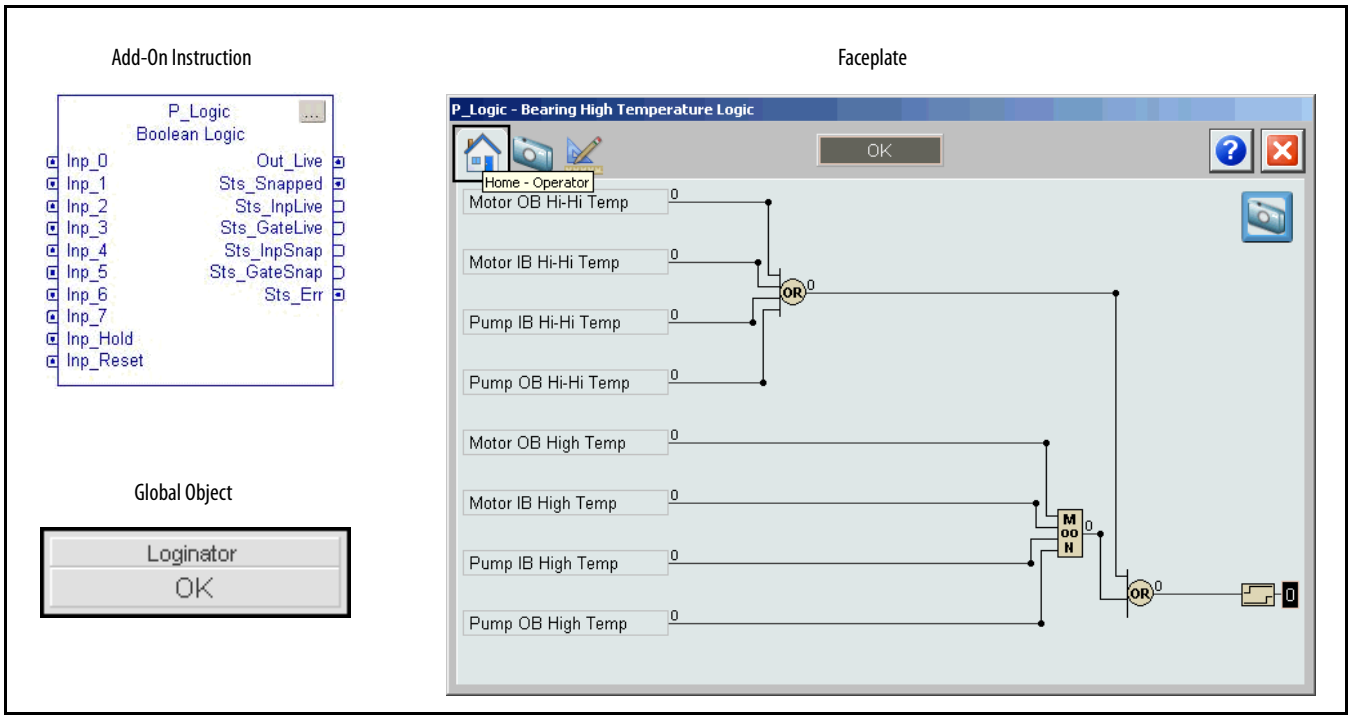
Resource	Description
PlantPAx Process Automation System Selection Guide, publication PROCES-SG001	Provides information for assisting with the equipment procurement for your PlantPAx system.
PlantPAx Process Automation System Reference Manual, publication PROCES-RM001	Provides characterized recommendations for implementing your PlantPAx system.
Rockwell Automation Library of Process Objects, publication PROCES-RM002	Provides general considerations for the PlantPAx system library of process objects.
FactoryTalk® View Machine Edition User Manual, publication VIEWME-UM004	Provides details on how to use this software package for creating an automation application.
FactoryTalk View SE Edition User Manual, publication VIEWSE-UM006	Provides details on how to use this software package for developing and running human-machine interface (HMI) applications that can involve multiple users and servers, distributed over a network.
Logix5000™ Controllers Add-On Instructions Programming Manual, publication 1756-PM010	Provides information for designing, configuring, and programming Add-On Instructions.
Rockwell Automation Library of Process Objects: Common Alarm Block (P_Alarm) Reference Manual, publication SYSLIB-RM002	Details how to monitor an input condition to raise an alarm. Information includes acknowledging, resetting, inhibiting, and disabling an alarm. Generally the P_Alarm faceplate is accessible from the Alarms tab.

You can view or download publications at http:/www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley® distributor or Rockwell Automation sales representative.

Boolean Logic with Snapshot (P_Logic)

The P_Logic (Boolean Logic with Snapshot) Add-On Instruction executes up to eight gates of configurable Boolean logic. Gate types available include AND, OR, XOR (Exclusive-OR), Set/Reset, Select, and Majority. Each gate provides up to four input conditions that are individually invertible. (The P_Logic instruction does not need a NOT gate.)

The P_Logic Add-On Instruction also provides a snapshot capability, enabling it to record its current state (with an optional timestamp) upon change in output state, on Operator or Program command, or based on a logic loopback input.



Guidelines

Use this instruction in these situations:

- You want to implement an Interlock or Permissive condition that is more complicated than the simple OR-ing or AND-ing provided by the P_Intlk (Interlocks) or P_Perm (Permissives) Add-On Instructions.
- You want to implement some Boolean (combination) logic that can be reconfigured from the HMI online, or which requires the snapshot capability for saving a copy of the logic state with a timestamp.

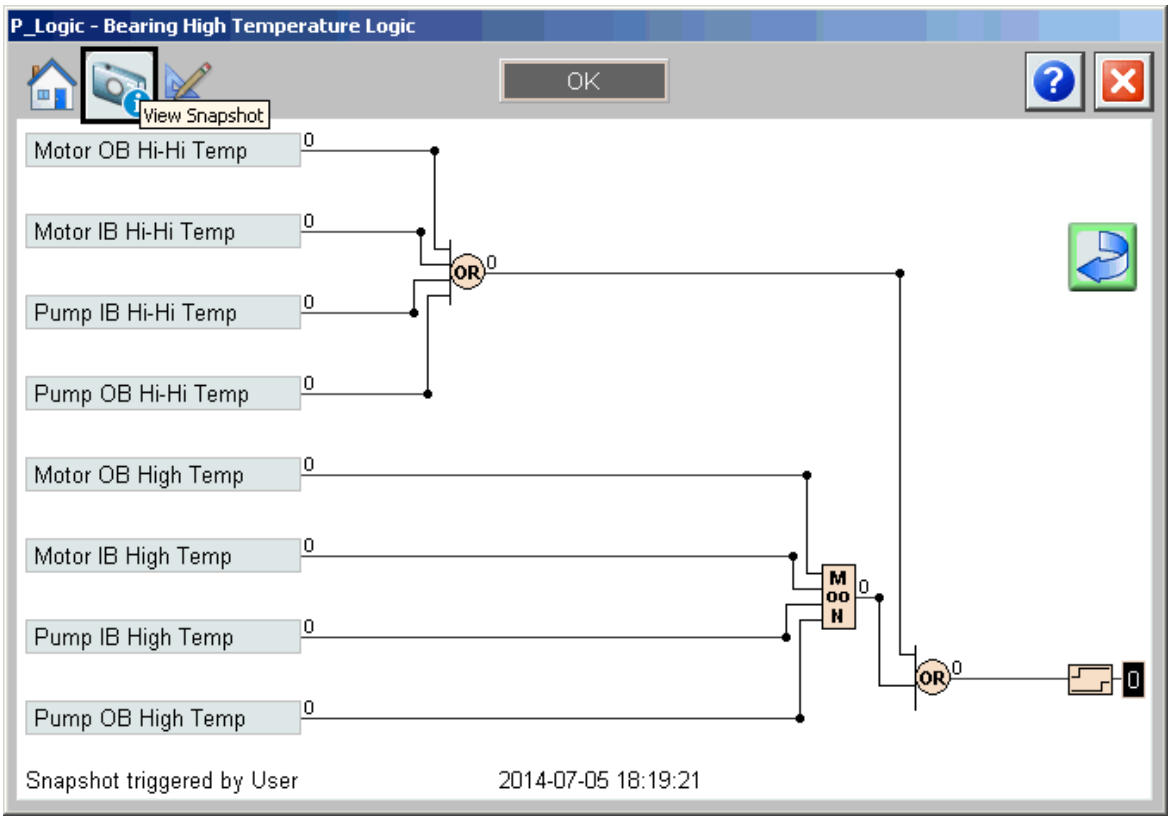
- You have more than the 16 interlock conditions or permissive conditions provided by the P_Intlk and P_Perm Add-On Instructions, but some of the conditions can be grouped together under one identification. For example, all of the bearing overtemperature signals for a pump and motor (Pump Inboard Bearing, Pump Outboard Bearing, Motor Inboard Bearing, and Motor Outboard Bearing) can be ORed together in a P_Logic instruction and the result presented to a P_Intlk instruction as a single 'Bearing Overtemp' condition.

Do **not** use this instruction in these situations:

- You are implementing simple interlocks and permissives that can be handled by the P_Intlk and P_Perm instructions directly. These instructions have the ability to permit operation or trip operation on either the low- or high-state of a condition (configurable inverting).
- You require logic that is beyond the P_Logic Add-On Instruction capabilities or which is extremely time critical. The P_Logic instruction provides only eight inputs, eight gates, and one output with on-delay and off-delay timing, and it is implemented with table-driven code. Use hard-coded logic in native controller languages instead. The native programming languages are faster and provide functionality beyond what the P_Logic instruction can do.

Functional Description

The diagram shows the functional characteristics of the P_Logic Add-On Instruction. Boolean Logic descriptions are in the Help file on page 30.



The Boolean Logic Add-On Instruction provides the following capabilities:

- Provides up to eight Boolean inputs and eight logic gates.
- Each gate has four inputs. Each input can be enabled or disabled. Each gate input can be normal or inverted. Each enabled gate input can be linked to a source, which is an instruction input or the result of a preceding gate.
- Each of the eight gates can be configured in one of the following ways:
  - Logical AND: The gate's output is **true** if **all** of the enabled gate inputs (after configured inversions) are **true**. An AND gate can have 1...4 inputs enabled.
  - Logical OR: The gate's output is **true** if **any** of the enabled gate inputs (after configured inversions) are **true**. An OR gate can have 1...4 inputs enabled.
  - Logical XOR (Exclusive OR): The gate's output is **true** if an **odd** number of the enabled gate inputs (after configured inversions) are **true**. An XOR gate can have 1...4 inputs enabled.
  - Set-Reset: The gate's output is set **true** if one of its Set inputs is true, and is cleared to **false** if one of its Reset inputs is true. The gate's four inputs are:
    Input 1: SET (dominant)
    Input 2: RESET (dominant)
    Input 3: SET
    Input 4: RESET

    See page 16 for Set-Reset rules.
  - Select: If input 3 is **false**, the state of input 1 is passed to the gate output. If input 3 is **true**, the state of input 2 is passed to the gate output. A Select gate must have input 3 enabled and either or both of inputs 1 and 2 enabled.
  - Majority (labeled 'MooN' for 'M out of N'): The gate's output is set **true** if a majority of its inputs (after configured inversions) are **true** (2 out of 2, 2 out of 3, or 3 out of 4). A Majority gate can have 2...4 inputs enabled.
- Provides configurable on-delay time and off-delay time for the instruction's output.
- Provides a snapshot capability, that captures the state of the instruction (all input states, gate states, and output state) for use later (until reset). The snapshot capability can be used to capture the state of the logic at the time that it tripped or shut down equipment, even if the logic states change after the shutdown. The snapshot is optionally timestamped from the controller clock (year, month, day, hour, minute, second, microsecond).

- Provides options to enable the following snapshot trigger conditions:
  - Capture snapshot on Operator Command (OCmd_Snap).
  - Capture snapshot on Program Command (PCmd_Snap).
  - Capture snapshot when the output transitions from 0 to 1.
  - Capture snapshot when the output transitions from 1 to 0.
  - Capture snapshot of previous scan's state when a loopback input becomes **true**. This last capability enables the snapshot to be captured in a case where the P_Logic output condition was the first-out condition in a downstream P_Intlk block. The first-out indication from the P_Intlk instruction can be looped back to the P_Logic instruction's Inp_Hold input to hold the last-scan state in the snapshot (including last scan's timestamp).

Required Files

Add-On Instructions are reusable code objects that contain encapsulated logic that can streamline implementing your system. This lets you create your own instruction set for programming logic as a supplement to the instruction set provided natively in the ControlLogix® firmware. An Add-On Instruction is defined once in each controller project, and can be instantiated multiple times in your application code as needed.

Controller File

The P_Logic_3_1-**00**_AOI.L5X Add-On Instruction must be imported into the controller project to be able to be used in the controller configuration. The service release number (boldfaced) can change as service revisions are created.

Visualization Files

The following files for this Add-On Instruction can be downloaded from the Product Compatibility and Download Center at http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page.

IMPORTANT Files must be imported in the following order: image files, then global object files, and then graphic files. This order is required to properly configure the visualization files.

Table 2 - P_Logic Visualization File Types

Application Type	File Type	FactoryTalk View SE	FactoryTalk View ME	Description
Graphics - Displays	GFX	(RA-BAS) P_Logic-Config	(RA-BAS-ME) P_Logic-Config	The Configuration Display used for the object.
		(RA-BAS) P_Logic-Faceplate	(RA-BAS-ME) P_Logic-Faceplate	The faceplate display used for the object.
		(RA-BAS) P_Logic-Help	(RA-BAS-ME) P_Logic-Help	The help display used for the object.
		(RA-BAS) Common-AnalogEdit	Not Applicable	Faceplate used for analog input data entry. The FactoryTalk View ME faceplates use the native analog input data entry so no file is required.

Table 2 - P_Logic Visualization File Types

Application Type	File Type	FactoryTalk View SE	FactoryTalk View ME	Description
Graphics - Global Objects	GGFX	(RA-BAS) Common Faceplate Objects	(RA-BAS-ME) Common Faceplate Objects	Common global objects used on Process Object faceplates.
		(RA-BAS) Process Faceplate Misc Objects	(RA-BAS-ME) Process Faceplate Misc Objects	Global objects used on Miscellaneous Process Object faceplates.
		(RA-BAS) Process Graphics Library	(RA-BAS-ME) Process Graphics Library	Display elements used to build process graphics.
		(RA-BAS) Process Help Objects	(RA-BAS-ME) Process Help Objects	Global objects used for help on Process Objects help displays.
Graphics - Images	PNG	All .png files in the images folder	All .png files in the images folder	These are the common icons used in the global objects and faceplates for all Process Objects. When PNG graphic formats are imported they are renamed like a BMP file but retain a PNG format.
HMI Tags	CSV	N/A	FTVME_PlantPAxLib_Tags_3_1_**00**.csv (1)	These tags must be imported into the FactoryTalk View ME project to support switching tabs on any Process Object faceplate.
Macros	MCR	NavToObject	N/A	This macro must be imported into the FactoryTalk View SE project to support faceplate-to-faceplate navigation by tagname.

(1) The service release number (boldfaced) can change as service revisions are created.

Controller Code

This section describes the parameter references for this Add-On Instruction.

Boolean Logic Input Structure

Input parameters include the following:

- Input data elements (Inp_) are typically used to connect field inputs from I/O modules or signals from other objects.
- Configuration data elements (Cfg_) are used to set configurable capabilities and features of the instruction, and to request specific actions while the instruction is in Program mode.
- Command data elements (PCmd_, OCmd_) are used by program logic, operators, and maintenance personnel to request instruction actions.

Table 3 - P_Logic Input Parameters

Input Parameter	Data Type	Alias For	Default	Description
EnableIn	BOOL		1	**Ladder Diagram:** If the rung-in condition is true, the instruction's Logic routine executes. If the rung-in condition is false, the instruction's EnableInFalse routine executes. **Function Block Diagram:** If true, or not connected, the instruction's Logic routine executes. If the parameter is exposed as a pin and wired, and the pin is false, the instruction's EnableInFalse routine executes. **Structured Text:** No effect. The instruction's Logic routine executes.
Inp_0…Inp_7	BOOL	Wrk_Src.0…Wrk_Src.7	0	Logic Input 0…7.
Inp_Hold	BOOL		0	1 = Hold previous state in Snapshot. 0 = Pass live states to Snapshot.
Inp_Reset	BOOL		0	Input parameter used to programmatically reset alarms. When set to 1, all alarms requiring reset are reset.
Cfg_UseInpHold	BOOL		0	1 = Use Inp_Hold to capture Snapshot. 0 = Use Cmds or Output transition to capture Snapshot.
Cfg_UsePCmd	BOOL		1	1 = Enable Snapshot on PCmd_Snap 0 --> 1 (edge).
Cfg_UseOCmd	BOOL		1	1 = Enable Snapshot on OCmd_Snap 0 --> 1 (edge).
Cfg_UseOut01	BOOL		1	1 = Enable Snapshot on Output 0 --> 1 (rising edge).
Cfg_UseOut10	BOOL		0	1 = Enable Snapshot on Output 1 --> 0 (falling edge).
Cfg_TSonSnap	BOOL		0	1 = Generate a TimeStamp when Snapshot occurs
Cfg_SnapOver	BOOL		0	1 = New Snapshot overwrites without reset. 0 = Save first Snapshot until reset.
Cfg_OnDelay	DINT		0	Output ON delay time (seconds).
Cfg_OffDelay	DINT		0	Output OFF delay time (seconds).
PCmd_Snap	BOOL		0	• Set PCmd_Snap to 1 to capture input, gate states in Snapshot • This parameter resets automatically.
PCmd_Reset	BOOL		0	• Set PCmd_Reset to 1 to reset (re-arm) snapshot latch • This parameter resets automatically
OCmd_Snap	BOOL		0	Operator command to capture Input, Gate states in Snapshot.
OCmd_Reset	BOOL		0	Operator command to Reset (re-arm) Snapshot Latch.

Boolean Logic Output Structure

Output parameters include the following:

- Output data elements (Out_) are the primary outputs of the instruction, typically used by hardware output modules; however, they can be used by other application logic.
- Value data elements (Val_) are numeric outputs of the instruction for use by the HMI. Values can also be used by other application logic or software packages.
- Status data elements (Sts_) are bit outputs of the instruction for use by the HMI. Status bits also can be used by other application logic.
- Error data elements (Err_) are bit outputs of the instruction used to identify the reason for configuration errors.
- Ready data elements (Rdy_) are bit outputs of the instruction used by the HMI to enable or disable Command buttons and setting entry fields.

Table 4 - P_Logic Output Parameters

Output Parameter	Data Type	Description
EnableOut	BOOL	Enable Output: The EnableOut signal is not manipulated by this instruction. Its output state always reflects EnableIn input state.
Out_Live	BOOL	Condition of Logic Output (result) after delay.
Out_Snap	BOOL	Condition of Logic Output (result) when at Snapshot.
Val_DelayPctLive	DINT	Output OnDelay or OffDelay percent complete: live.
Val_DelayPctSnap	DINT	Output OnDelay or OffDelay percent complete: Snapshot.
Val_SnapInit	DINT	Snapshot Initiator: 1= OCmd 2 = PCmd 3 = Out 0-->1 4 = Out 1-->0 5 = Inp_Hold
Sts_Snapped	BOOL	1 = Snapshot has been triggered. 0 = Snapshot showing live states.
Sts_InpLive	SINT	Live Input Status bits: (bit# = input#).
Sts_GateLive	SINT	Live Gate Result Status bits: (bit# = gate#).
Sts_InpSnap	SINT	Snapshot of Input Status bits: (bit# = input#).
Sts_GateSnap	SINT	Snapshot of Gate Result Status bits: (bit# = gate#).
Sts_GateSrc1Live	SINT	Live wire state for Source 1…4 of each gate (bit# = gate#).
Sts_GateSrc2Live		
Sts_GateSrc3Live		
Sts_GateSrc4Live		
Sts_GateSrc1Snap	SINT	Snapshot of wire state for Source 1…4 of each gate (bit# = gate#).
Sts_GateSrc2Snap		
Sts_GateSrc3Snap		
Sts_GateSrc4Snap		
Sts_OutInvLive	BOOL	Output after inverter but before TON/TOF timers.
Sts_OutInvSnap	BOOL	Snapshot of Output after inverter but before TON/TOF.

Table 4 - P_Logic Output Parameters

Output Parameter	Data Type	Description
Sts_Err	BOOL	1 = Error in configuration: see detail bits for reason.
Err_GateFunc	SINT	1 = Error in each Gate's Function Code (use 0…6).
Err_GateSrcPtr	SINT	1 = Error in each Gate's Source Pointer (use 0…15).
Err_GateSrcMask	SINT	1 = Error in each Gate's Mask (source used) configuration (qty, choice).
Err_OutSrcPtr	BOOL	1 = Error in Output's Source Pointer (use 0…15).
Err_Timer	BOOL	1 = Error in Output's On Delay or Off Delay Preset (use 0…2,147,483).
Rdy_Snap	BOOL	1 = Ready to receive OCmd_Snap (enables button).
Rdy_Reset	BOOL	1 = Ready to receive OCmd_Reset (enables button).
P_Logic	BOOL	Unique Parameter Name for auto-discovery.

Boolean Logic Local Configuration Tags

Configuration parameters that are array, string, or structure data types cannot be configured as parameters for Add-On Instructions. Configuration parameters of these types appear as local tags in the Add-On Instruction. Local tags can be configured through the HMI faceplates or in RS Logix™ 5000 software by opening the Instruction Logic of the Add-On Instruction instance and then opening the Data Monitor on a local tag. These parameters cannot be modified by using controller logic or RSLogix 5000 software export/import functionality.

Table 5 - P-Logic Local Configuration Tags

Configuration Parameter	Data Type	Default	Description
Cfg_0StText	STRING_8	'OK'	Text to display in Out = 0 State
Cfg_1StText	STRING_8	'TRIPPED'	Text to display in Out = 1 State
Cfg_Desc	STRING_40	'Configurable Boolean Logic Block'	Description for display on HMI. This string is shown in the title bar of the faceplate.
Cfg_GateFunc	DINT[8]		Function code for gate M:
Cfg_GateFunc[0]		0	0 = Gate not used
Cfg_GateFunc[1]		0	1 = AND
Cfg_GateFunc[2]		0	2 = OR
Cfg_GateFunc[3]		0	3 = XOR
Cfg_GateFunc[4]		0	4 = M out of N (majority gate)
Cfg_GateFunc[5]		0	5 = Set-Reset (latch)
Cfg_GateFunc[6]		0	6 = Select (switch gate)
Cfg_GateFunc[7]		0	
Cfg_GateSrc1Inv	SINT	2#0000_0000	Gate M Source #1 is Inverted (M by bit) (1 = invert)
Cfg_GateSrc1Mask	SINT	2#0000_0000	Gate M Source #1 is Used (M by bit) (1 = used)

Table 5 - P-Logic Local Configuration Tags

Configuration Parameter	Data Type	Default	Description
Cfg_GateSrc1Ptr Cfg_GateSrc1Ptr[0] Cfg_GateSrc1Ptr[1] Cfg_GateSrc1Ptr[2] Cfg_GateSrc1Ptr[3] Cfg_GateSrc1Ptr[4] Cfg_GateSrc1Ptr[5] Cfg_GateSrc1Ptr[6] Cfg_GateSrc1Ptr[7]	DINT[8]	{...}	Pointer to Gate M Source #1: 0…7 = inputs 8…15 = gate outputs
Cfg_GateSrc2Inv	SINT	2#0000_0000	Gate M Source #2 is Inverted (M by bit) (1 = invert)
Cfg_GateSrc2Mask	SINT	2#0000_0000	Gate M Source #2 is Used (M by bit) (1 = used)
Cfg_GateSrc2Ptr Cfg_GateSrc2Ptr[0] Cfg_GateSrc2Ptr[1] Cfg_GateSrc2Ptr[2] Cfg_GateSrc2Ptr[3] Cfg_GateSrc2Ptr[4] Cfg_GateSrc2Ptr[5] Cfg_GateSrc2Ptr[6] Cfg_GateSrc2Ptr[7]	DINT[8]	{...}	Pointer to Gate M Source #2: 0…7 = inputs 8…15 = gate outputs)
Cfg_GateSrc3Inv	SINT	2#0000_0000	Gate M Source #3 is Inverted (M by bit) (1 = invert).
Cfg_GateSrc3Mask	SINT	2#0000_0000	Gate M Source #3 is Used (M by bit) (1 = used).
Cfg_GateSrc3Ptr Cfg_GateSrc3Ptr[0] Cfg_GateSrc3Ptr[1] Cfg_GateSrc3Ptr[2] Cfg_GateSrc3Ptr[3] Cfg_GateSrc3Ptr[4] Cfg_GateSrc3Ptr[5] Cfg_GateSrc3Ptr[6] Cfg_GateSrc3Ptr[7]	DINT[8]	{...}	Pointer to Gate M Source #3: 0…7 = inputs 8…15 = gate outputs
Cfg_GateSrc4Inv	SINT	2#0000_0000	Gate M Source #4 is Inverted (M by bit) (1 = invert).
Cfg_GateSrc4Mask	SINT	2#0000_0000	Gate M Source #4 is Used (M by bit) (1 = used).
Cfg_GateSrc4Ptr Cfg_GateSrc4Ptr[0] Cfg_GateSrc4Ptr[1] Cfg_GateSrc4Ptr[2] Cfg_GateSrc4Ptr[3] Cfg_GateSrc4Ptr[4] Cfg_GateSrc4Ptr[5] Cfg_GateSrc4Ptr[6] Cfg_GateSrc4Ptr[7]	DINT[8]	{...} 0	Pointer to Gate M Source #4: 0…7 = inputs 8…15 = gate outputs)
Cfg_HasNav	SINT	2#0000_0000	Set bits indicate which Navigation buttons are enabled.

Table 5 - P-Logic Local Configuration Tags

Configuration Parameter	Data Type	Default	Description
Cfg_InpTxt Cfg_InpTxt[0] Cfg_InpTxt[1] Cfg_InpTxt[2] Cfg_InpTxt[3] Cfg_InpTxt[4] Cfg_InpTxt[5] Cfg_InpTxt[6] Cfg_InpTxt[7]	STRING_20[8]	{...}	Short HMI description of each Input.
Cfg_Label	STRING_20	'Configurable Logic'	Label for graphic symbol displayed on HMI. This string appears on the graphic symbol.
Cfg_NavTag Cfg_NavTag[0] Cfg_NavTag[1] Cfg_NavTag[2] Cfg_NavTag[3] Cfg_NavTag[4] Cfg_NavTag[5] Cfg_NavTag[6] Cfg_NavTag[7]	STRING_20[8]	 '' '' '' '' '' '' '' ''	Tagnames for destinations of Navigation buttons.
Cfg_OutSrcInv	BOOL	0	Out Source (before Min Duration Timer) is Inverted (1=invert).
Cfg_OutSrcPtr	DINT	0	Source bit for Output (0…7 = inputs, 8…15 = gates).
Cfg_Tag	STRING_20	'P_Logic'	Description for display on HMI. This string is shown in the title bar of the faceplate.

Operations

This section describes the primary operations for the P_Logic Add-On Instruction.

Configuring the Logic in a P_Logic Instance

A P_Logic instruction instance can be configured from the RSLogix 5000 software tag monitor, but it's much easier to configure the logic from the HMI.

Rules for Set-Reset Gate

The following rules apply for a Set-Reset gate:

- The dominant inputs (1 and 2) take precedence over the non-dominant (3 and 4) inputs in a Set-Reset Gate.
- If Input 1 is **true** and Input 2 is **false**, the gate's output is Set to **true**.
- If Input 1 is **false** and Input 2 is **true**, the gate's output is Reset to **false**.
- If both Input 1 and Input 2 are **true**. the gate's output is not changed.
- If both Input 1 and Input 2 are **false**, Inputs 3 and 4 determine the output:
  - If Input 3 is **true** and Input 4 is **false**, the gate's output is Set to **true**.
  - If Input 3 is **false** and Input 4 is **true**, the gate's output is Reset to **false**.

  - If both Input 3 and Input 4 are **true**, the gate's output is not changed.
  - If both Input 3 and Input 4 are **false**, the gate's output is not changed.
- A Set-Reset gate must have at least one **set** input (either dominant or non-dominant) and one **reset** input (either dominant or non-dominant) enabled.

Operating Modes

The P_Logic Add-On Instruction has no modes and does not use the P_Mode Add-On Instruction. The Operator and Program snapshot commands, if enabled, and reset commands are accepted at any time.

Alarms

The P_Logic Add-On Instruction does not provide any alarms. If an alarm is required, use P_Din or use the interlock alarm of the device, such as P_Motor.

One of the following applies:

- The inputs to a P_Logic instruction often come from status pins of P_Din (Discrete Input) or P_AIn (Analog Input) instructions that provide alarms for these input conditions (for example, TargetDisagree, High, Low, High-High, Low-Low).
- The output of a P_Logic instruction is typically used as an interlock condition, and the interlocked device typically provides an 'Interlock Trip' alarm.
- If an alarm is required for one of the P_Logic instruction's inputs or outputs, a P_Alarm instruction can be added to the application logic containing the P_Logic instance.

Simulation

The Boolean Logic Add-On Instruction does not have a Simulation capability.

Execution

The following table explains the handling of instruction execution conditions.

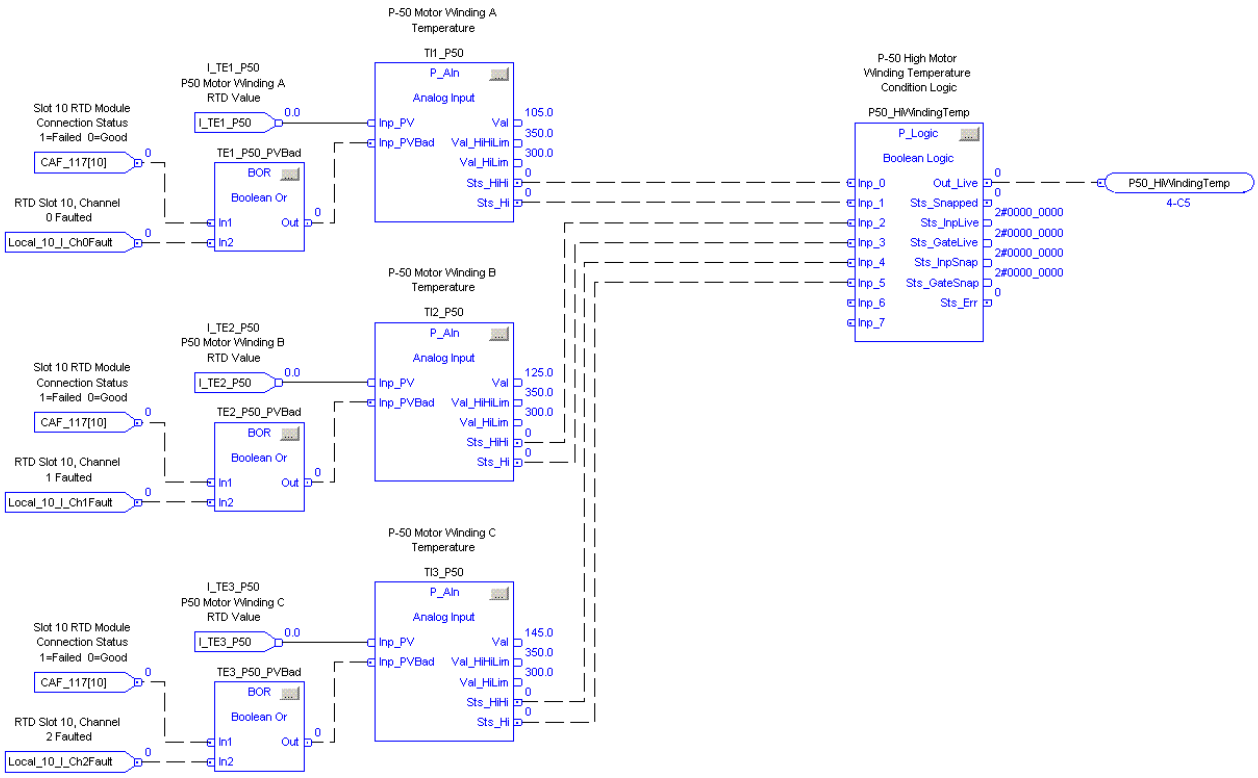
Condition	Description
Prescan	Resets the output on-delay and off-delay timers; clears the snapshot timestamp and data; clears any commands received while controller was in Program mode.
EnableIn False	Clears output to false (off) and resets the output on-delay and off-delay timers.
Postscan	No SFC Postscan logic is provided.

Refer to the Logix5000 Controllers Add-On Instructions Programming Manual, publication 1756-PM010, for more information.

Programming Example

This example uses the P_Logic instruction to perform advanced interlocking logic, based on the winding temperatures of a motor. P_Logic is easier to configure through the faceplate, but this example walks through the parameter settings to fully illustrate the example.

In this example, there is a motor with three RTDs measuring temperature of the windings. To prevent damage to the windings, the motor must be interlocked if any of the three windings are above the high-high temperature limit, or if the majority of the windings are above the high temperature limit. P_Logic is being used to perform this function. The output of this logic feeds the interlock of the motor elsewhere in logic.



The input parameters (Inp_0, Inp_1, Inp_2, Inp_3, Inp_4, Inp_5) are connected to the status outputs of the three winding temperature inputs. Three of the eight gates (0...7) in P_Logic are used in this example (1, 5, 6). Gate 1 is the OR of the three high-high status bits. Gate 5 checks if the majority of the high status bits are true. Gate 6 ORs the outputs of Gates 1 and 5 to set the output of P_Logic.

To set up the gate functions (Gates 1 and 6 as OR and Gate 5 as Majority), use the following settings:

- Cfg_GateFunc[1] = 2
- Cfg_GateFunc[5] = 6
- Cfg_GateFunc[6] = 2

Gate 1 is set up to look at the three high-high status inputs (Inp_0, Inp_2, and Inp_4) by using the following settings:

- Cfg_GateSrc1Mask.1 = 1, Cfg_GateSrc1Ptr[1] = 0
- Cfg_GateSrc2Mask.1 = 1, Cfg_GateSrc2Ptr[1] = 2
- Cfg_GateSrc3Mask.1 = 1, Cfg_GateSrc3Ptr[1] = 4

Gate 5 is set up to look at the three high status inputs (Inp_1, Inp_4, and Inp_5) by using the following settings:

- Cfg_GateSrc1Mask.5 = 1, Cfg_GateSrc1Ptr[5] = 1
- Cfg_GateSrc2Mask.5 = 1, Cfg_GateSrc2Ptr[5] = 3
- Cfg_GateSrc3Mask.5 = 1, Cfg_GateSrc3Ptr[5] = 5

Lastly, Gate 6 is set up to look at the outputs of gates 1 and 5 by using the following settings:

- Cfg_GateSrc1Mask.6 = 1, Cfg_GateSrc1Ptr[6] = 9
- Cfg_GateSrc2Mask.6 = 1, Cfg_GateSrc2Ptr[6] = 13

Cfg_OutSrcPtr needs to be set to 14 to take the output from Gate 6 and make it the output (Out_Live) of the P_Logic block.

The on-delay time is then set to 5 seconds to prevent spurious trips of the output (Cfg_OnDelay = 5).

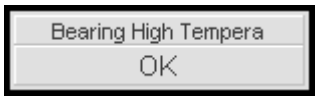
Lastly, the string descriptions are used to provide documentation for you on the faceplate. In this example, they are set as follows:

- Cfg_0StText = OK
- Cfg_1StText = Tripped
- Cfg_Desc = Winding High Temperature Logic
- Cfg_Label = Configurable Logic
- Cfg_Tag = P_Logic
- Cfg_InpTxt[0] = Winding A Hi-Hi Temp
- Cfg_InpTxt[1] = Winding A Hi Temp
- Cfg_InpTxt[2] = Winding B Hi-Hi Temp
- Cfg_InpTxt[3] = Winding B Hi Temp
- Cfg_InpTxt[4] = Winding C Hi-Hi Temp
- Cfg_InpTxt[5] = Winding C Hi Temp

Display Elements

The P_Logic Instruction has display elements (global objects) for use on process graphic displays. These elements provide you with the following:

- Information on the object's current state
- Touch field to open the object's faceplate
- Tooltip to display the object's configured tag and description



Status/Quality Indicators

One of these symbols appears when the described condition is true.

Graphic Symbol	Description
	Invalid configuration
	Information available (snapshot taken)

TIP When the Invalid Configuration indicator appears, you can find which configuration setting is invalid by following the indicators. Click the graphic symbol to open the faceplate. The Invalid Configuration indicator appears next to the appropriate tab at the top of the faceplate to guide you in finding the configuration error. Once you navigate to the tab, the misconfigured item is flagged with this indicator or appears in a magenta box.

For the Boolean Logic with Snapshot Instruction, the Invalid Configuration Indicator appears under the following conditions:

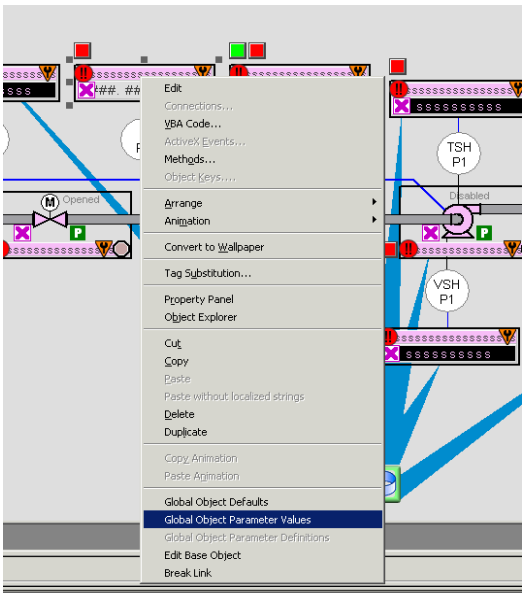
- Any logic gate has an invalid function code.
- Any logic gate has an invalid source for one of its inputs.
- The output has an invalid source defined.
- Any logic gate configured to be used has no inputs exposed.
- A Set-Reset gate has an invalid set of inputs exposed. A Set-Reset gate must have at least one Set Input exposed and one Reset Input exposed. Inputs are the following:
  - Input 1: Set (dominant)
  - Input 2: Reset (dominant)
  - Input 3: Set
  - Input 4: Reset

- A Selector Gate has an invalid set of inputs exposed. A Selector Gate must have at least one of its A or B Inputs exposed and its Select Input exposed. Inputs are the following:
  - Input 1: A input
  - Input 2: B input
  - Input 3: Select input (0 = Select A, 1 = Select B)
  - Input 4: not used, must not be exposed
- A Majority Gate has only one Input exposed
- The Output's On Delay or Off Delay time is set to a value less than zero or greater than 2,147,483 seconds.

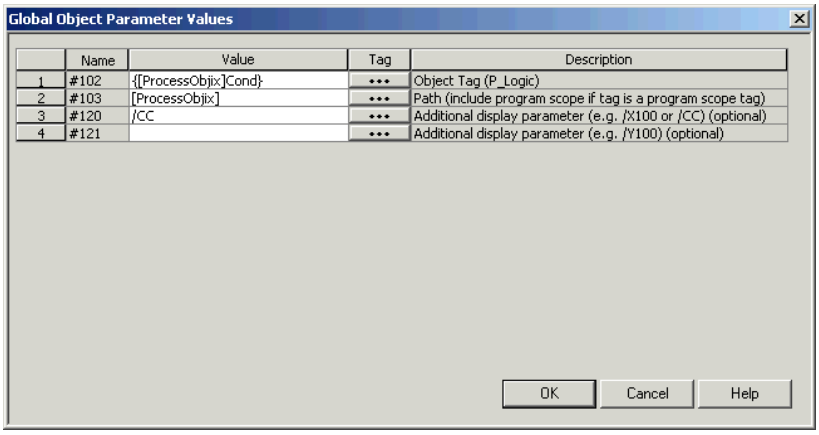
Using Display Elements

The global objects for P_Logic can be found in the global object file (RA-BAS) Process Graphics Library.ggfx. Follow these steps to use a global object.

1. Copy it from the global object file and paste it in the display file.
2. In the display file, right-click the global object and choose Global Object Parameter Values.



The Global Object Parameter Values dialog box appears.



The global object parameters are as follows.

Parameter	Required	Description
#102	Y	Object tag to point to the name of the associated object Add-On Instruction in the controller.
#103	Y	Path used for display navigation features to other objects. Include program scope if tag is a program scope tag.
#120	N	Additional parameter to pass to the display command to open the faceplate. Typically used to define position for the faceplate.
#121	N	Additional parameter to pass to the display command to open the faceplate. if defining X and Y coordinate, separate parameters so that X is defined by #120 and Y is defined by #121. This lets the same parameters be used in subsequent display commands originating from the faceplate.

3. Type the tag or value in the Value column as specified in the Description column.

   TIP You can click the ellipsis (…) to browse and select a tag.

   Values for items marked '(optional)' can be left blank.

4. Click OK.

Faceplate

The P_Logic faceplate consists of three tabs and each tab consists of one or more pages.

Each faceplate contains the value of local configuration tags Cfg_Tag and Cfg_Desc in the title bar.

Click the appropriate icon at the top of the faceplate to access a specific tab.

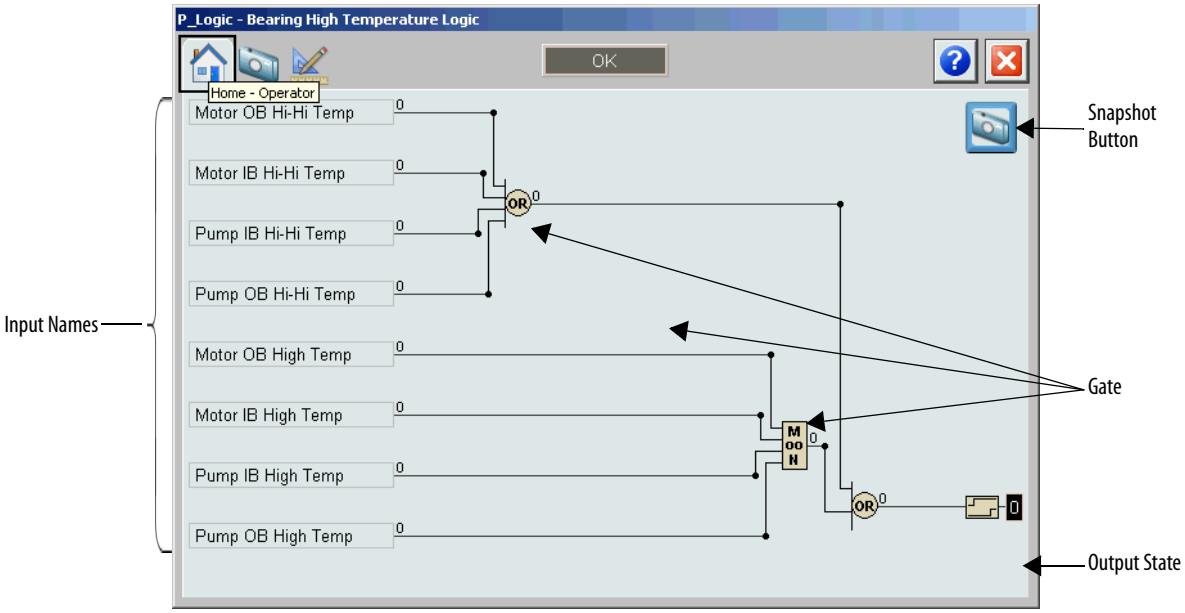
The faceplate provides the means for operators, maintenance personnel, engineers, and others to interact with the P_Logic Instruction instance, including viewing its status and values and manipulating it through its commands and settings.

Operator Tab

The Faceplate initially opens to the Operator ('Home') tab. From here, an operator can monitor the device status and manually operate the device.

The Operator tab shows the following information:

- The eight Boolean inputs and eight logic gates, with each gate having a maximum of four sources.
- Configurable operator snapshot command button creates an image of the logic.
- Provides a progress indicator for the on-delay time and off-delay time for the instruction's output. See Engineering Tab on page 26 for on-delay and off-delay configuration.



The following table shows the functions included on the Operator tab.

Table 6 - Operator Tab Description

Function	Action	Security
Input Name	Click to navigate to the Input object faceplate.	None
	Click to take a snapshot of the current state. **IMPORTANT:** When you take a snapshot, the View Snapshot tab is automatically displayed.	Manual Device Operation (Code B)
Gate	Click one of the gates to access the Gate Configuration display for that gate.	See Gate Configuration Display on page 29.

View Snapshot Tab

The View Snapshot tab shows an image of the Operator faceplate when the snapshot was taken. The display's background turns from gray to white to indicate capture. The View Snapshot has the same functionality as the operator faceplate plus a Reset button.

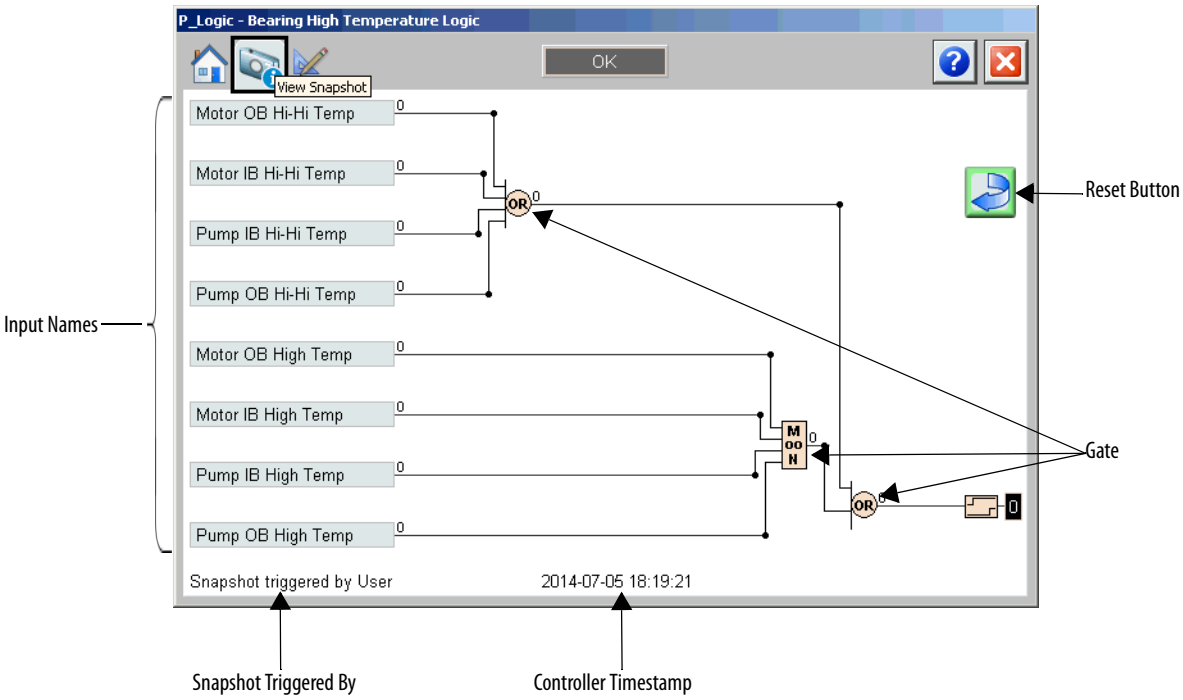


Table 7 - View Snapshot Tab Description

Function	Action	Security
	Click to reset the snapshot function so that another snapshot can be triggered. **IMPORTANT:** If 'Allow a new snapshot to overwrite an existing snapshot without a snapshot reset' is checked. (See Engineering Tab on page 26.) A reset is not needed to trigger another snapshot.	Normal operation of Devices (Code A)
Input Names	Click to navigate to the Input object faceplate.	None
Gate	Click one of the gates to access the Gate Configuration display for that gate.	See Gate Configuration Display on page 29.

Engineering Tab

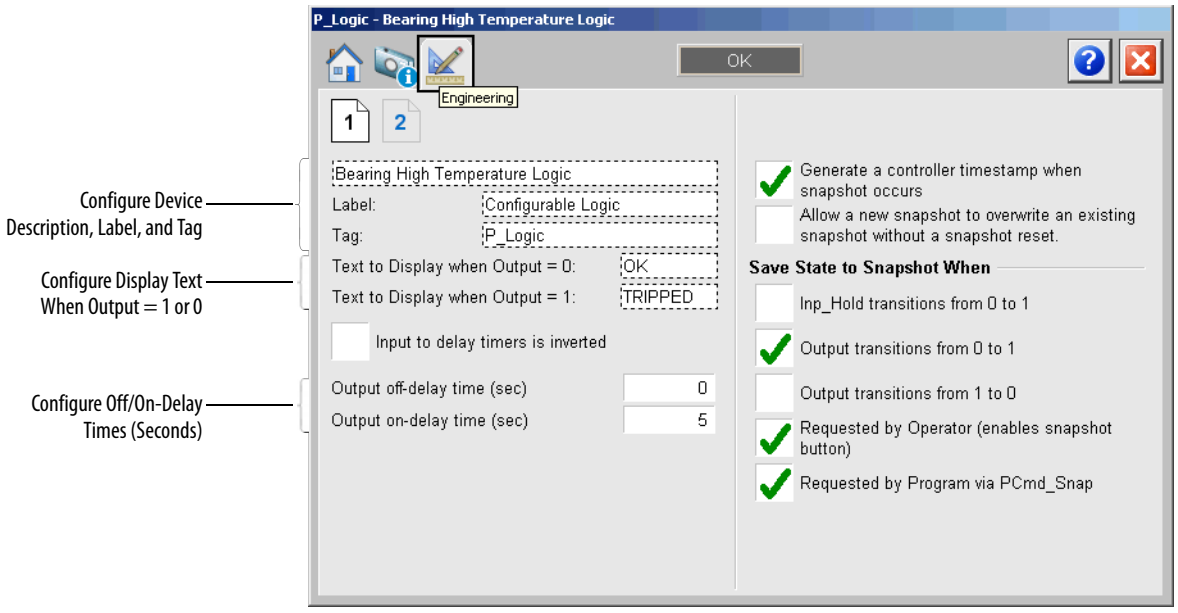
The Engineering tab provides access to device configuration parameters and ranges, options for device and I/O setup, displayed text, and faceplate-to-faceplate navigation settings, and for initial system commissioning or later system changes.

The Engineering page is divided into two pages.

Engineering Tab Page 1

Page 1 of the Engineering tab shows the following information:

- Description, label, and tag
- Timestamp configuration text
- Output display text and delay time configuration
- Condition options to save a snapshot



The following table lists the functions on page 1 of the Engineering tab.

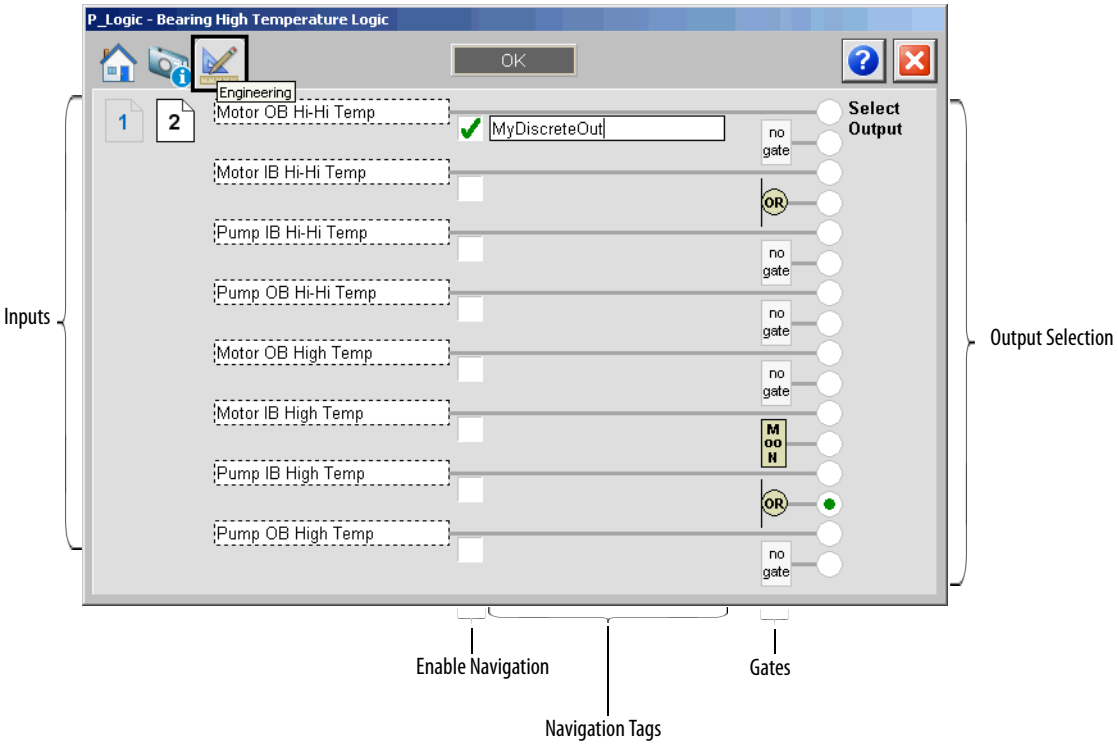
Table 8 - Engineering Tab Page 1 Description

Function	Action	Security	Configuration Parameters
Description	Type the description to show on the Faceplate title bar.	Engineering Configuration (Code E)	Cfg_Desc
Label	Type the label to show on the graphic symbol.		Cfg_Label
Tag	Type the tag name to show on the faceplate and tooltip. **TIP:** Pausing the mouse over this field displays a tooltip with the configured Logic tag/path.		Cfg_Tag
Text to Display when Output = 0	Type the text to display on the faceplate when output = 0.		Cfg_0StText
Text to Display when Output = 1	Type the text to display on the faceplate when output = 1.		Cfg_1StText
Input to delay timers is inverted	Check to invert the selected output before it is passed to the output delay timers.		Cfg_OutSrcInv
Output Off delay time (seconds)	Type a value for the output off-delay time.		Cfg_OffDelay
Output On delay time (seconds)	Type a value for the output on-delay time.		Cfg_OnDelay
Generate a controller timestamp when snapshot occurs	Check to generate a timestamp whenever a snapshot triggers.		Cfg_TSonSnap
Allow a new snapshot to overwrite an existing snapshot without a snapshot reset	Check to allow a new snapshot t'o be triggered without having to reset the previous snapshot.		Cfg_SnapOver

Table 8 - Engineering Tab Page 1 Description

Function	Action	Security	Configuration Parameters
Save State to Snapshot When: Inp_Hold transitions from 0 to 1	Check to trigger a snapshot when the Inp_Hold signal transitions from 0 to 1.	Engineering Configuration (Code E)	Cfg_UseInpHold
Save State to Snapshot When: Output transitions from 0 to 1	Check to trigger a snapshot when the Output signal transitions from 0 to 1.		Cfg_UseOut01
Save State to Snapshot When: Output transitions from 1to 0	Check to trigger a snapshot when the Output signal transitions from 1 to 0.		Cfg_UseOut10
Save State to Snapshot When: Requested by Operator (enables snapshot button)	Check to trigger a snapshot when the Operator clicks Snapshot.		Cfg_UseOCmd
Save State to Snapshot When: Requested by program via PCmd_Snap	Check to trigger a snapshot by when program logic sets PCmd_Snap.		Cfg_UsePCmd

Engineering Tab Page 2



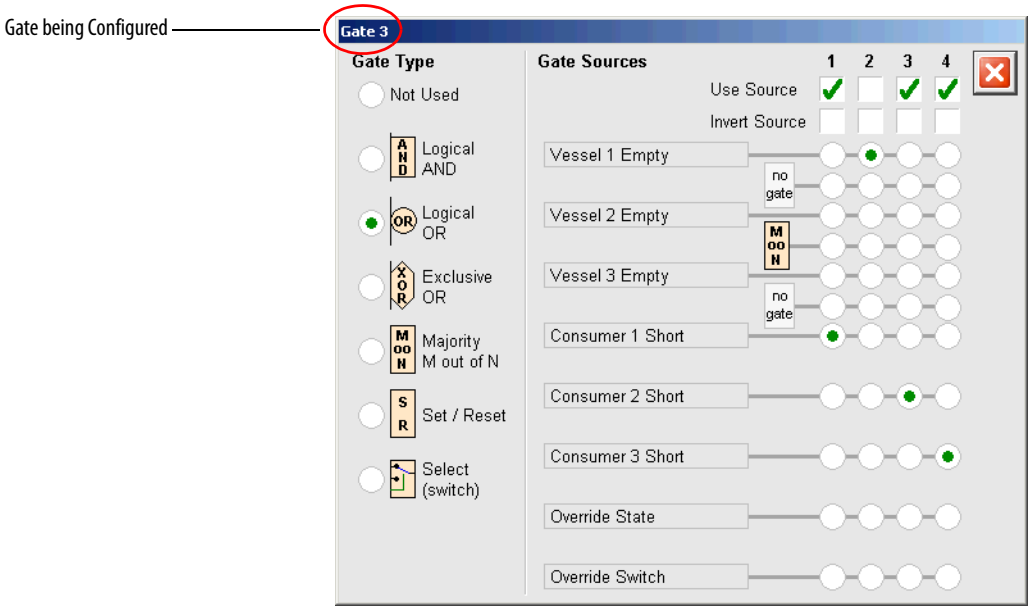
The following table lists the functions on the Engineering tab page 2.

Table 9 - Engineering Tab Page 2 Description

Function	Action	Security	Configuration Parameters
Input	Type a description for each input.	Engineering Configuration (Code E)	Cfg_InpTxt
Enable Navigation	Check to enable navigation to input object.		None
Navigation Tag	Type the tag name of the input object.		Cfg_NavTag
Gate symbol	Click a gate to open the Gate Configuration Display for that gate.		None
Select Output	Click to select which value to use as the output for P_Logic.		

Gate Configuration Display

This gate configuration display appears if a gate is clicked in the Operator, View Snapshot, or Engineering tabs.

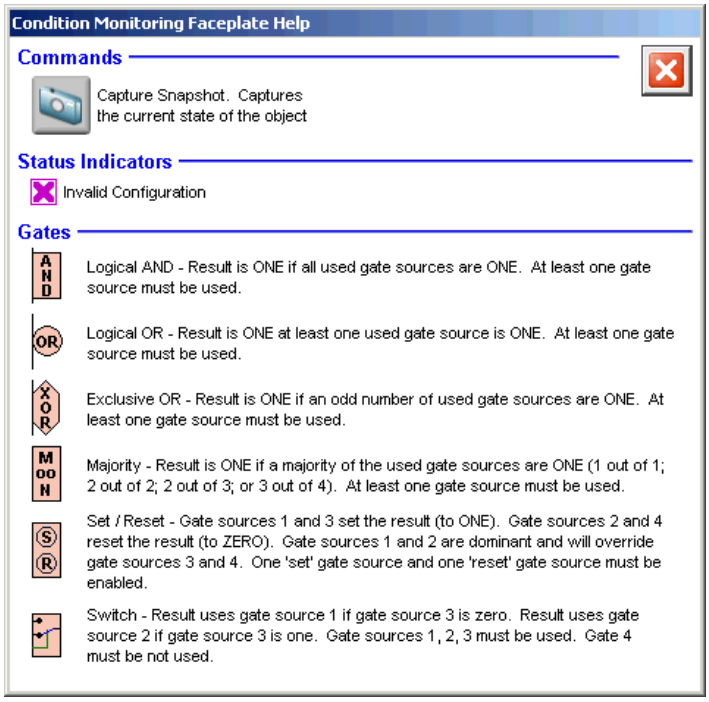


The following table lists the functions on the gate configuration display.

Table 10 - Gate Configuration Message Box Description

Function	Action	Security
Gate Type	Click to select a gate type.	Engineering Configuration (Code E)
Use Source	Click to select which inputs of the gate are enabled (1…4).	
Invert Source	Click to invert the source coming into the gate.	
Select Source	Select which input or gate output is to be used as the source to the gate. The gate outputs that are available depend on which gate is being configured; you can only link to link to an earlier gate. For example, Gate 3 can link to the outputs of Gates 0…2, but not to outputs of Gates 3…7.	

Boolean Logic with Snapshot Faceplate Help



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