PlantPAx Process Control Instructions

1756 ControlLogix, 1756 GuardLogix, 1769 CompactLogix, 1769 Compact GuardLogix, 1789 SoftLogix, 5069 CompactLogix, Emulate 5570

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Patrick Files

Rockwell Automation

Reference Manual

Original Instructions

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.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

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

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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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).

Rockwell Automation recognizes that some of the terms that are currently used in our industry and in this publication are not in alignment with the movement toward inclusive language in technology. We are proactively collaborating with industry peers to find alternatives to such terms and making changes to our products and content. Please excuse the use of such terms in our content while we implement these changes.

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This manual provides a programmer with details about the available PlantPAx process instruction set for a Logix-based controller.

If you design, program, or troubleshoot safety applications that use GuardLogix controllers, refer to the GuardLogix Safety Application Instruction Set Safety Reference Manual, publication 1756-RM095.

This manual is one of a set of related manuals that show common procedures for programming and operating Logix 5000™ controllers.

For a complete list of common procedures manuals, refer to the Logix 5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

The term Logix 5000 controller refers to any controller that is based on the Logix 5000 operating system.

Studio 5000 environment

The Studio 5000 Automation Engineering & Design Environment® combines engineering and design elements into a common environment. The first element is the Studio 5000 Logix Designer® application. The Logix Designer application is the rebranding of RSLogix 5000® software and will continue to be the product to program Logix 5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000® environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. The Studio 5000 environment is the one place for design engineers to develop all elements of their control system.

Additional resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications webpage, available at http://ab.rockwellautomation.com	Provides declarations of conformity, certificates, and other certification details.

View or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact the local Rockwell Automation distributor or sales representative.

Purpose of this manual

This manual provides a programmer with details about each available PlantPAx process instruction for a Logix-based controller. This manual also gives you guidance and examples to monitor and process discrete and analog inputs and outputs for controlling devices.

Rockwell Automation recognizes that some of the terms that are currently used in our industry and in this publication are not in alignment with the movement toward inclusive language in technology. We are proactively collaborating with industry peers to find alternatives to such terms and making changes to our products and content. Please excuse the use of such terms in our content while we implement these changes.

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The software included in this product contains copyrighted software that is licensed under one or more open source licenses. Copies of those licenses are included with the software. Corresponding Source code for open source packages included in this product are located at their respective web site(s).

Alternately, obtain complete Corresponding Source code by contacting Rockwell Automation via the Contact form on the Rockwell Automation website: http://www.rockwellautomation.com/global/about-us/contact/contact.page
Please include "Open Source" as part of the request text.

A full list of all open source software used in this product and their corresponding licenses can be found in the OPENSOURCE folder. The default installed location of these licenses is `C:\Program Files (x86)\Common Files\Rockwell\Help\<Product Name>\Release Notes\OPENSOURCE\index.htm`.

PlantPAx instructions

The PlantPAx built-in instructions monitor and process discrete and analog inputs and outputs for controlling devices.

Available Instructions

Ladder Diagram, Function Block, Structured Text

PAH	PAI	PAID	PAIM	PAO	PBL	PCMDSRC	PD4SD
PDBC	PDI	PDO	PDOSE	PFO	PHLS	PINTLK	PLLS
PMTR	PNPOS	PPERM	PPID	PPTC	PRI	PRT	PTST
PVLV	PVLVMP	PVLVS	PVSD				

To:	Use this instruction:
Provide HART digital data for an intelligent analog device alongside the analog input (PAI) or analog output (PAO) instruction for that device.	Process Analog HART (PAH)
Monitor one analog value, such as from a channel of analog input module.	Process Analog Input (PAI)
Monitor one analog Process Variable (PV) by using two analog input signals.	Process Dual Sensor Analog Input (PAID)
Monitors one analog process variable (PV) by using up to eight analog input signals.	Process Multi Sensor Analog Input (PAIM)
Manipulate an analog output to control a field device.	Process Analog Output (PAO)
Executes up to eight gates of configurable Boolean logic.	Process Boolean Logic (PBL)
Select the Command Source for a device.	Process Command Source (PCMDSRC)
Control and monitor feedback from a discrete 2-state, 3-state, or 4-state device in a variety of modes.	Process Discrete 2-, 3-, or 4-State Device (PD4SD)

To:	Use this instruction:
Generate outputs to provide data and alarms on deadbands and thresholds.	Process Deadband Controller (PDBC)
Monitor one discrete condition, such as from a channel of a discrete input module.	Process Discrete Input (PDI)
Manipulate a discrete output to control a field device.	Process Discrete Output (PDO)
Control an ingredient addition that uses a flow meter to measure the quantity of ingredient added.	Process Dosing (PDOSE)
Send one primary analog output signal to multiple secondary users or devices.	Process Analog Fanout (PFO)
Select the highest or the lowest of up to six incoming controlled variables (CVs) and send the selected CV as output.	Process High or Low Selector (PHLS)
Collect, or sum up, the interlock conditions that stop or de-energize a running or energized piece of equipment.	Process Interlocks (PINTLK)
Control a parallel group of motors, such as a set of pumps with a common intake source and discharge destination.	Process Lead Lag Standby Motor Group (PLLS)
Monitor and control a fixed single-speed, two-speed, or reversing motor.	Process Motor (PMTR)
Control and monitor feedback from a circular or linear discrete device with up to 30 positions.	Process n-Position Device (PNPOS)
Collect, or sum up, the permissive conditions that allow a piece of equipment to energize.	Process Permissives (PPERM)
Manipulate the Control Variable (CV) in regulatory control loops in response to Process Variable (PV) readings and Setpoint (SP, the target PV) settings.	Process Proportional + Integral + Derivative (PPID)
Calculate a flow at standard temperature and pressure.	Process Pressure/Temperature Compensated Flow (PPTC)
Prevent large motors from starting repeatedly.	Process Restart Inhibit (PRI)
Record the total run time and number of instances the motor or other equipment starts.	Process Run Time and Start Counter (PRT)
Calculate the volume of product in an upright cylindrical tank, given the level of the product and the tank calibration table.	Process Tank Strapping Table (PTST)
Operate a two-position, single-solenoid operated valve, a dual-solenoid operated valve, or a motor-operated valve in various modes; monitor hand-operated two-position valves.	Process Valve (PVLV)
Control and monitor feedback from a mix-proof valve in various modes and states.	Process Mix Proof Valve (PVLVMP)
Monitor a two-state (open and close) valve and record statistics for stroke times and stroke counts.	Process Valve Statistics (PVLVS)
Monitor and control a variable-speed motor using an AC (variable frequency) or DC drive.	Process Variable Speed Drive (PVSD)

Process Analog HART (PAH)

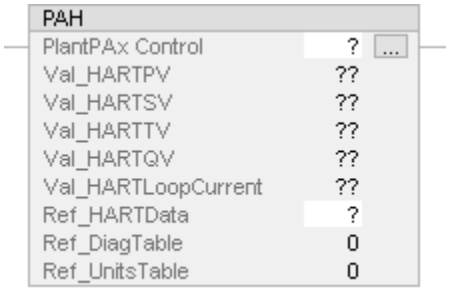
This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Analog HART (PAH) instruction is used to provide HART digital data for an intelligent analog device alongside the analog input (PAI) or analog output (PAO) instruction for that device. It provides:

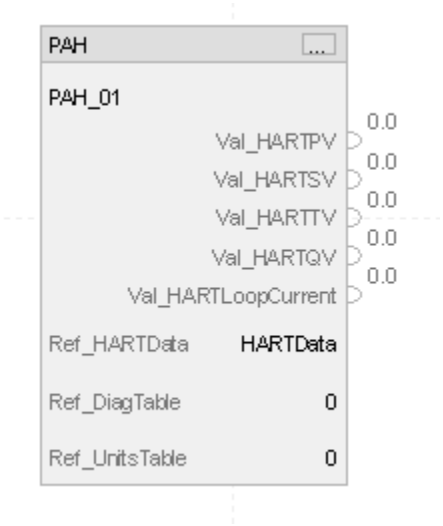
- HART Dynamic Variables (PV, SV, TV and QV) values with engineering units and variable status, and the digital value of the device's analog loop current (in milliamps DC).
- Analog range (min, at 4 mA, and max, at 20 mA).
- Analog units of measure.
- Device information such as Tag and Description text.
- Additional device status (HART "Command 48 additional status" bit array).
- Lookup of diagnostic message and severity based on the Command 48 bits that are set (for the first three diagnostics found in the array).
- Additional status information received from the device via HART, such as Field Device Status bits.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PAH(PAH_tag, Ref_HARTData, Ref_DiagTable, Ref_UnitsTable)

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx ControlPlantPAx Control	P_ANALOG_HART	tag	Data structure required for proper operation of instruction.
Ref_HARTData	PAX_HART_DEVICE:I:0	tag	HART device data for PlantPAx.
Ref_DiagTable	P_HART_CODE_DESC_STATUS[2]	tag	Lookup table for diagnostic bit number (to message and status).
Ref_UnitsTable	RAC_CODE_DESCRIPTION[2]	tag	Lookup table for units of measure code (to units text).

The PAX_HART_DEVICE:I:0 data type is associated with the Add-On Profile for Highly Integrated HART modules such as the 5094-IF8IH.

P_ANALOG_HART Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request to re-initialize. The instruction clears this operand automatically. Default is true.
Cfg_HasHARTPV	BOOL	Not Visible	Not Required	Input	1 = Has a HART digital PV, display on faceplate; 0 = HART digital PV not used. Default is false.
Cfg_HasHARTSV	BOOL	Not Visible	Not Required	Input	1 = Has a HART digital SV, display on faceplate; 0 = HART digital SV not used. Default is false.
Cfg_HasHARTTV	BOOL	Not Visible	Not Required	Input	1 = Has a HART digital TV, display on faceplate; 0 = HART digital TV not used. Default is false.
Cfg_HasHARTQV	BOOL	Not Visible	Not Required	Input	1 = Has a HART digital QV, display on faceplate; 0 = HART digital QV not used. Default is false.
Cfg_UseHARTVarSts	BOOL	Not Visible	Not Required	Input	1 = Use HART Communication Status to generate SrcQ, 0 = assume good. Default is true.
Cfg_UseHARTText	BOOL	Not Visible	Not Required	Input	1 = Use text received from HART device, 0 = use extended properties for text. Default is false.
Cfg_HARTPVDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for HART PV display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_HARTSVDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for HART SV display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_HARTTVDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for HART TV display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_HARTQVDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for HART QV display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available for navigation. Default is false.
Cfg_HasNav	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a related analog input or output object is available for navigation. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Set_VirtualHARTPV	REAL	Not Visible	Not Required	Input	HART PV used in Virtual (when Sts_Virtual = 1) (PV engineering units). Default is 0.0.
Set_VirtualHARTSV	REAL	Not Visible	Not Required	Input	HART SV used in Virtual (when Sts_Virtual = 1) (SV engineering units). Default is 0.0.
Set_VirtualHARTTV	REAL	Not Visible	Not Required	Input	HART TV used in Virtual (when Sts_Virtual = 1) (TV engineering units). Default is 0.0.
Set_VirtualHARTQV	REAL	Not Visible	Not Required	Input	HART QV used in Virtual (when Sts_Virtual = 1) (QV engineering units). Default is 0.0.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	This output state always reflects EnableIn input state.
Val_HARTPV	REAL	Visible	Not Required	Output	Digital HART PV value in PV engineering units (after Substitution, if used).
Val_HARTSV	REAL	Visible	Not Required	Output	Digital HART SV value in SV engineering units (after Substitution, if used).
Val_HARTTV	REAL	Visible	Not Required	Output	Digital HART TV value in TV engineering units (after Substitution, if used).
Val_HARTQV	REAL	Visible	Not Required	Output	Digital HART QV value in QV engineering units (after Substitution, if used).
Val_HARTLoopCurrent	REAL	Visible	Not Required	Output	Digital HART value for Loop Current in milliamps.
Val_InpRawMinFromHART	REAL	Not Visible	Not Required	Output	Analog input unscaled signal minimum from HART module (in module units).
Val_InpRawMaxFromHART	REAL	Not Visible	Not Required	Output	Analog input unscaled signal maximum from HART module (in module units).
Val_PVEUMinFromHART	REAL	Not Visible	Not Required	Output	Analog input scaled range minimum from HART device (in engineering units).
Val_PVEUMaxFromHART	REAL	Not Visible	Not Required	Output	Analog input scaled range maximum from HART device (in engineering units).
Sts_eHARTDiagCode1	INT	Not Visible	Not Required	Output	HART Diagnostic Code #1 (bit number in Command 48, 255 = none).
Sts_eHARTDiagCode2	INT	Not Visible	Not Required	Output	HART Diagnostic Code #2 (bit number in Command 48, 255 = none).
Sts_eHARTDiagCode3	INT	Not Visible	Not Required	Output	HART Diagnostic Code #3 (bit number in Command 48, 255 = none).

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_bHARTDiagSts	SINT	Not Visible	Not Required	Output	Overall HART diagnostic status, .0 = Info, .1 = Maintenance Required, .2 = Off Specification, .3 = Function Check, .4 = Failed.
Sts_bHARTDiagSts1	SINT	Not Visible	Not Required	Output	Diagnostic status for HART Diagnostic Code #1, .0 = Info, .1 = Maintenance Required, .2 = Off Specification, .3 = Function Check, .4 = Failed.
Sts_bHARTDiagSts2	SINT	Not Visible	Not Required	Output	Diagnostic status for HART Diagnostic Code #2, .0 = Info, .1 = Maintenance Required, .2 = Off Specification, .3 = Function Check, .4 = Failed.
Sts_bHARTDiagSts3	SINT	Not Visible	Not Required	Output	Diagnostic status for HART Diagnostic Code #3, .0 = Info, .1 = Maintenance Required, .2 = Off Specification, .3 = Function Check, .4 = Failed.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = Using virtual PV instead of the input from the device (Inp_PVData) to calculate output. 0 = The instruction uses input parameter Inp_PVData to calculate output. Sts_Virtual is a copy of Inp_Virtual.
Sts_ConnectionFault	BOOL	Not Visible	Not Required	Output	1 = HART data input connection fault, 0 = connection OK.
Sts_DvcMalfunction	BOOL	Not Visible	Not Required	Output	1 = HART device reports it has a malfunction.
Sts_CurrentSaturated	BOOL	Not Visible	Not Required	Output	1 = HART reports analog current is limited.
Sts_CurrentFixed	BOOL	Not Visible	Not Required	Output	1 = Loop Current set to fixed value via HART command.
Sts_CurrentMismatch	BOOL	Not Visible	Not Required	Output	1 = Loop Current reported via HART does not match analog signal.
Sts_DiagnosticActive	BOOL	Not Visible	Not Required	Output	1 = HART data input diagnostic active.
Val_DiagnosticSeqCount	SINT	Not Visible	Not Required	Output	HART data input diagnostic sequence count (per change in diagnostic data, wraps).

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ_HARTPV	SINT	Not Visible	Not Required	Output	Source and quality of HART digital PV (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ_HARTSV	SINT	Not Visible	Not Required	Output	Source and quality of HART digital SV (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ_HARTTV	SINT	Not Visible	Not Required	Output	Source and quality of HART digital TV (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ_HARTQV	SINT	Not Visible	Not Required	Output	Source and quality of HART digital QV (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ_HARTLoopCurrent	SINT	Not Visible	Not Required	Output	Source and quality of HART loop current value (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
Sts_eSts	SINT	Not Visible	Not Required	Output	Device confirmed status: 0 = Live, 1 = diagnostic information, 2 = maintenance required, 3 = off-spec (uncertain), 4 = function check (substituted), 5 = failure, 6 = HART communication lost, 7 = Virtualized.
Sts_eFault	INT	Not Visible	Not Required	Output	Device fault status: 0 = None, 1 = a dynamic variable is bad, 2 = device diagnostic indicates a failure, 3 = HART communication lost, 4 = module connection fault, 5 = device reports malfunction.
Val_HARTRevision	SINT	Not Visible	Not Required	Output	HART Spec major revision received from device.

Private Input Members	Data Type	Description
MCmd_Physical	BOOL	Maintenance command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
Sts_sHARTDesc	String_16	Description text from HART device.
Sts_sHARTDiagMsg1	String_32	HART device diagnostic message #1.
Sts_sHARTDiagMsg2	String_32	HART device diagnostic message #2.
Sts_sHARTDiagMsg3	String_32	HART device diagnostic message #3.

Private Output Members	Data Type	Description
Sts_sHARTPVEU	String_16	Text of HART digital PV's engineering units.
Sts_sHARTQVEU	String_16	Text of HART digital QV's engineering units.
Sts_sHARTSVEU	String_16	Text of HART digital SV's engineering units.
Sts_sHARTTag	String_32	Tag text from HART device.
Sts_sHARTTVEU	String_16	Text of HART digital TV's engineering units.
Sts_sPVEU	String_16	Text of analog PV's engineering units.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Ref_HARTData	PAX_HART_DEVICE:I:O	Visible	Required	InOut	HART data from I/O module assembly.
Ref_DiagTable	P_HART_CODE_DESC_STATUS[2]	Visible	Required	InOut	Lookup table for diagnostic bit number (to message and status).
Ref_UnitsTable	RAC_CODE_DESCRIPTION[2]	Visible	Required	InOut	Lookup table for units of measure code (to units text).

PAX_HART_DEVICE:I:O Structure

The PAX_HART_DEVICE:I:O structure is the input assembly subtype used by Highly-Integrated HART I/O modules to provide all the HART data required for this instruction:

Members	Data Type	Description
RunMode	BOOL	Always 0, not used by this instruction
ConnectionFaulted	BOOL	The network connection to the I/O module has been lost
DiagnosticActive	BOOL	I/O module has at least one diagnostic available
DiagnosticSequenceCount	SINT	This count increments each time the diagnostic information from the I/O module changes. It counts to +127, then loops back to -128, skipping zero.
CurrentSaturated	BOOL	The analog signal has reached its minimum or maximum value and does not represent the actual process variable
CurrentFixed	BOOL	The analog signal has been fixed by command and does not represent the actual process variable
MoreStatusAvailable	BOOL	At least one Command 48 (additional device status) bit is set and diagnostics should be displayed
CurrentMismatch	BOOL	I/O module reports digital value for loop current and actual analog loop current disagree significantly
ConfigurationChanged	BOOL	Device reports configuration data (scaling, text, units) have changed
Malfunction	BOOL	Device reports malfunction detected
LoopCurrent	CHANNEL_AI:I:O	HART digital value for device analog loop current (mA DC)
PV	CHANNEL_AI_HART:I:O	HART dynamic Primary Variable with units and status
SV	CHANNEL_AI_HART:I:O	HART dynamic Secondary Variable with units and status
TV	CHANNEL_AI_HART:I:O	HART dynamic Tertiary Variable with units and status
QV	CHANNEL_AI_HART:I:O	HART dynamic Quaternary Variable with units and status
Static	AB_5000_HART_Static_Struct:I:O	HART "static" data, such as device scale range, analog signal units of measure, and device text strings for description and tag name
ChDataAtSignal4	REAL	The value provided by the I/O module analog channel when a 4.0 mA DC signal is received, provided for scaling use by an associated PAI or PAO instruction

Members	Data Type	Description
ChDataAtSignal20	REAL	The value provided by the I/O module analog channel when a 20.0 mA DC signal is received, provided for scaling use by an associated PAI or PAO instruction

P_HART_CODE_DESC_STATUS Structure

The P_HART_CODE_DESC_STATUS structure is used to look up the diagnostic text and device status associated with a particular Command 48 diagnostic bit. The device provides a 200-bit (25 byte) array of data, where each bit set indicates a particular diagnostic condition. An array of members of this type is used to allow the instruction to display a text description and status for a given bit.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the diagnostic bit lookup function is not performed.

Members	Data Type	Description
Code	DINT	Diagnostic code. This is the diagnostic bit number (0 to 199) in the array of 200 bits returned in HART Command 48 (Additional Device Status), or -1 if no diagnostic bit is set.
Desc	STRING_32	Diagnostic text.
bSts	SINT	Device Status (bitmapped): .0 = Information .1 = Maintenance Required .2 = Off Specification .3 = Function Check .4 = Failed

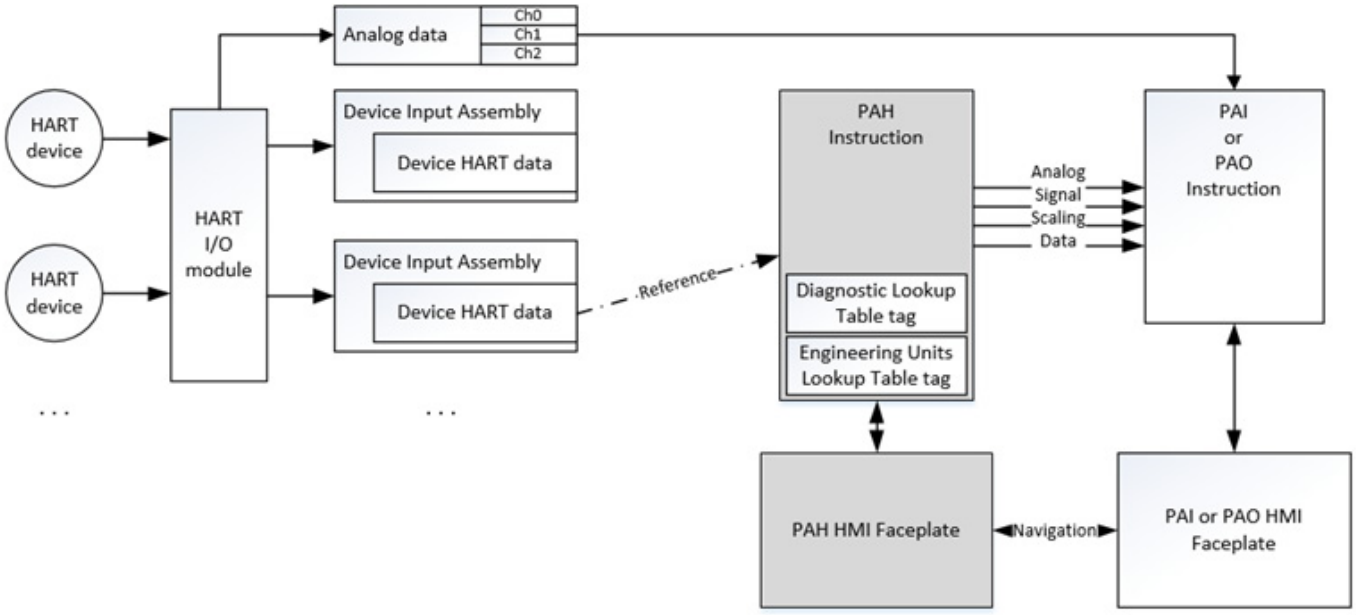
RAC_CODE_DESCRIPTION[x] Structure

The RAC_CODE_DESCRIPTION[x] structure is an array of engineering unit code numbers and corresponding engineering units text pairs, used as a lookup table. The instruction searches the table for the engineering units code received from the device and displays the corresponding engineering unit text for the variable. This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the unit code lookup function is not performed.

Members	Data Type	Description
Code	DINT	Code for which to look up Description.
Desc	STRING	Description for given Code.

Operation

This diagram illustrates functionality of the PAH instruction:



Virtualization

Use virtualization for instruction testing and operator training. Command virtual operation using program command PCmd_Virtual or maintenance command MCmd_Virtual. After finishing virtual operation, use program command PCmd_Physical or maintenance command MCmd_Physical to return to normal physical device operation.

When Virtualization is active, the output dynamic variable (PV, SV, TV, QV) values of the PAH instruction are set using Virtual value settings (Set_VirtualPV, etc.) and I/O faults are ignored. Manipulate the instruction to operate as if a working HART process device were present.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Engineering units for raw analog signal
- Engineering units for analog signal PV
- Engineering units for HART PV
- Engineering units for HART SV
- Engineering units for HART TV
- Engineering units for HART QV
- Label for HART PV
- Label for HART SV

Monitor the PAH Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Instruction flagged for initialization on first scan / first run
Instruction first run	Internal data such as pointers and timers are initialized
Rung-condition-in is false	Set rung-condition-out to rung-condition-in. The instruction executes. HART data, units and status are provided.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes. HART data, units and status are provided.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Instruction flagged for initialization on first scan / first run
Instruction first run	Internal data such as pointers and timers are initialized
Instruction first scan	Internal data such as pointers and timers are initialized
EnableIn is false	EnableOut is set to false. The instruction executes. HART data, units and status are provided.
EnableIn is true	EnableOut is set to true. The instruction executes. HART data, units and status are provided.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

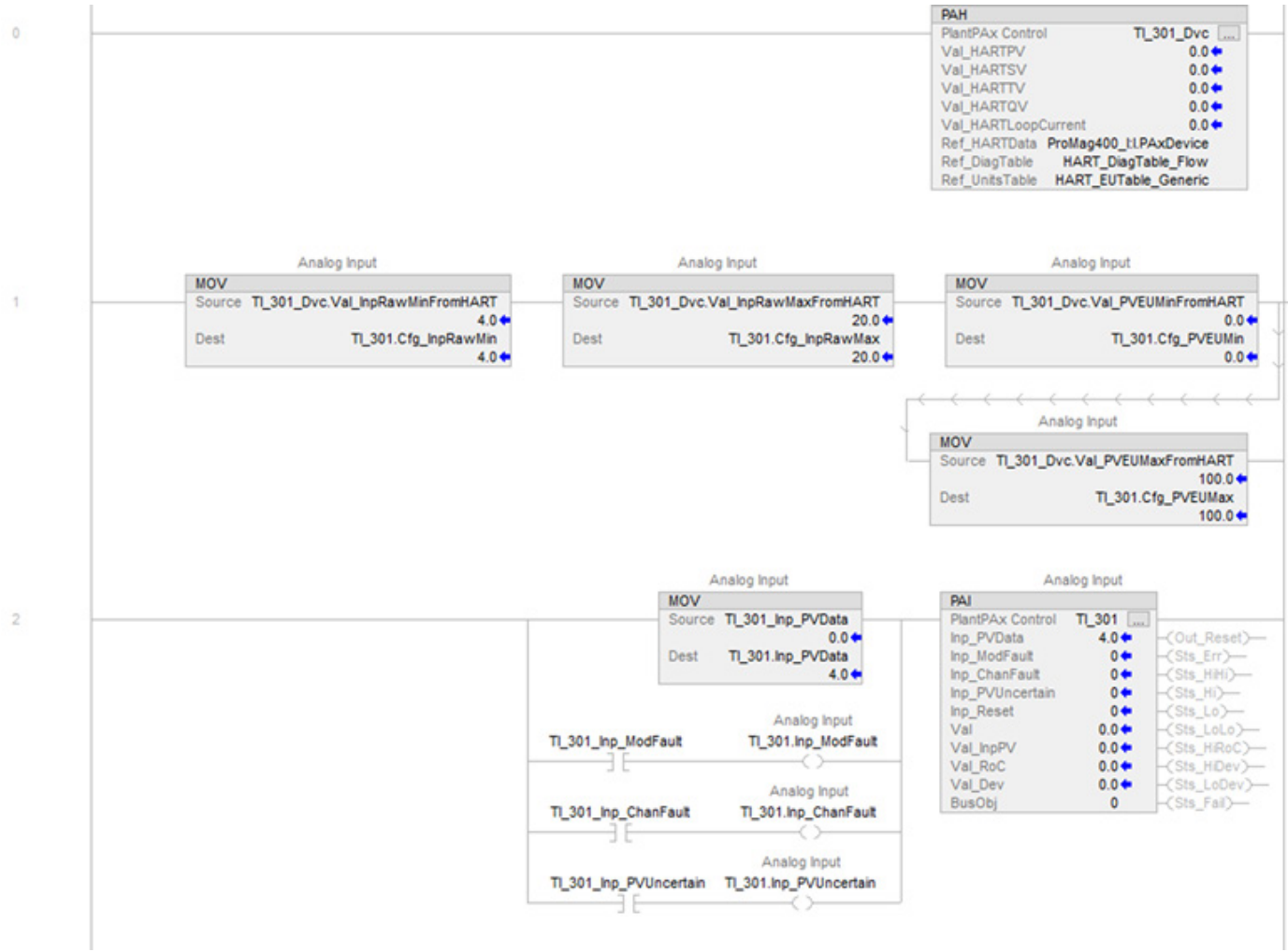
In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

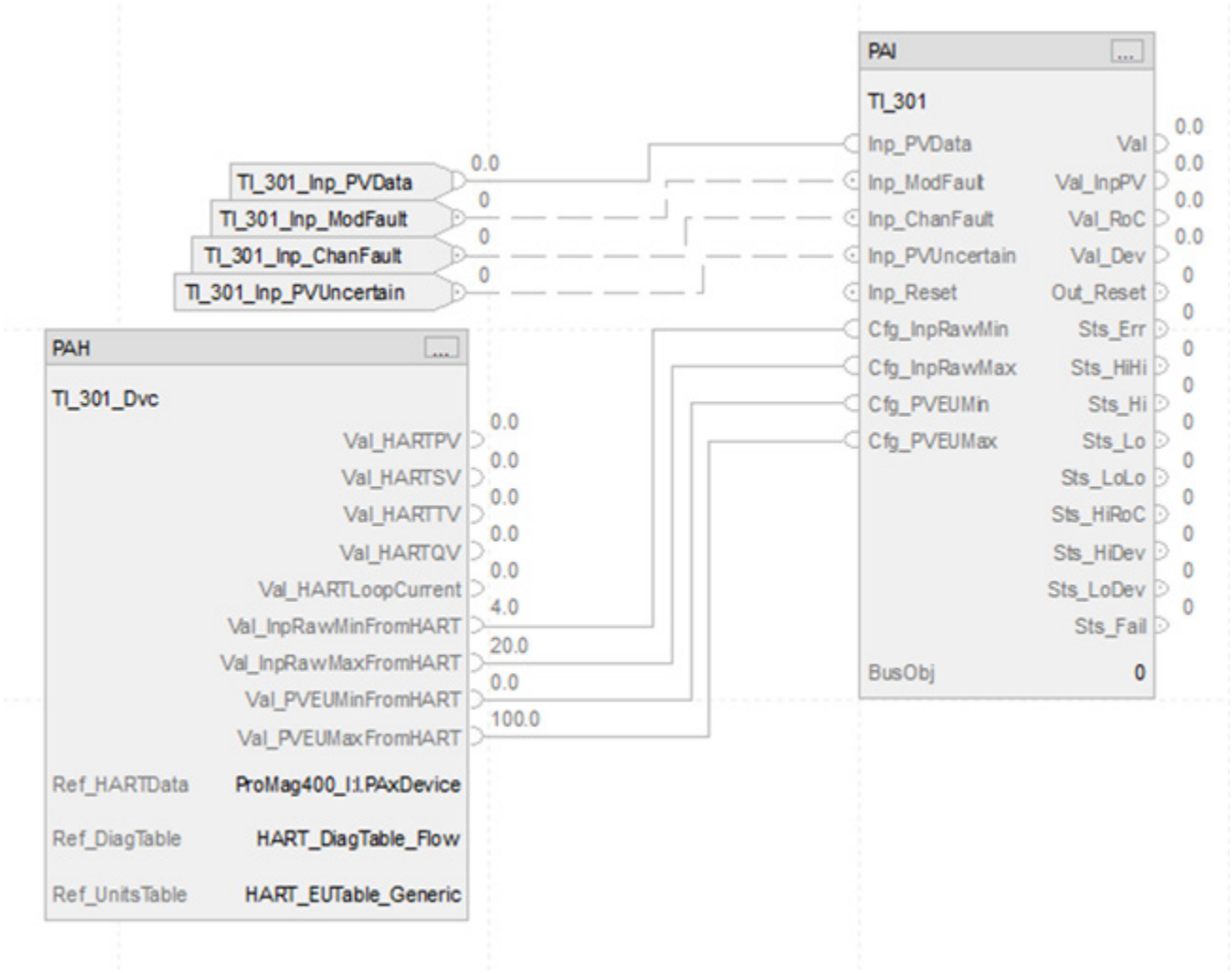
Example

In the following example, the PAH instruction is used alongside a PAI (Process Analog Input) instruction. The PAI provides processing for the analog (4 to 20 mA DC) signal from the HART analog input module, and the PAH instruction provides processing for the digital HART data overlaid upon the analog signal, received from the same field device. As a result, an analog real-time signal is provided for closed-loop control (not shown), and four digital dynamic variables are provided for additional process monitoring.

Ladder Diagram



Function Block Diagram



Structured Text

```
PAH(TI_301_Dvc, ProMag400_I:I.PAxDevice, HART_DiagTable_Flow,
HART_EUTable_Generic);

TI_301.Cfg_InpRawMin:=TI_301_Dvc.Val_InpRawMinFromHART;

TI_301.Cfg_InpRawMax:=TI_301_Dvc.Val_InpRawMaxFromHART;

TI_301.Cfg_PVEUMin:=TI_301_Dvc.Val_PVEUMinFromHART;

TI_301.Cfg_PVEUMax:=TI_301_Dvc.Val_PVEUMaxFromHART;

TI_301.Inp_PVData:=TI_301_Inp_PVData;

TI_301.Inp_ModFault:=TI_301_Inp_ModFault;

TI_301.Inp_ChanFault:=TI_301_Inp_ChanFault;

TI_301.Inp_PVUncertain:=TI_301_Inp_PVUncertain;
```

PAI(TI_301, 0);

Process Analog Input (PAI)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

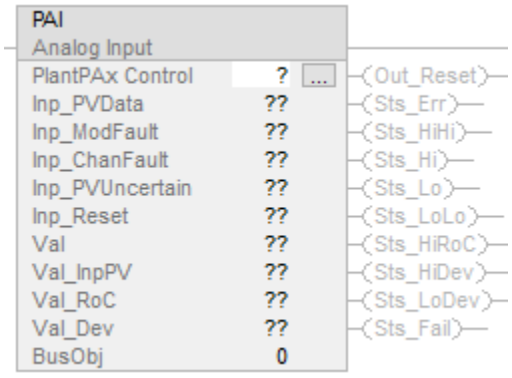
The Process Analog Input (PAI) instruction monitors an analog input and checks for alarm conditions. Use the PAI instruction to process a signal from a channel of an analog input module. Use the PAI instruction with any analog (REAL) signal.

The PAI instruction:

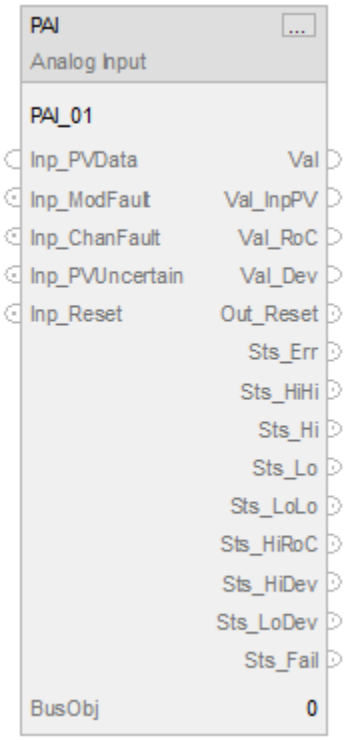
- Monitors one analog input channel.
- Scales the input Process Value (PV) from raw, input card units to engineering display units.
- Filters PV to reduce signal noise.
- Monitors PV source, PV quality and PV out-of-range condition.
- Overrides input PV in maintenance.
- Supports virtual PV for use in instruction testing, demonstration, or operator training.
- Calculates the PV deviation from reference, or setpoint, value.
- Calculates the PV rate of change.
- Captures Min and Max PV excursion values.
- Triggers alarms on PV failure, PV level, and PV deviation from the reference and PV rate of change.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PAI(PAI tag, BusObj);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_ANALOG_INPUT	tag	Data structure required for proper operation of the instruction.
BusObj	BUS_OBJ	tag	Bus component

P_ANALOG_INPUT Structure

Public members are standard, visible tag members that are programmatically accessible. Private, or hidden, members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request to re-initialize. The instruction clears this operand automatically. Default is true.
Inp_PVData	REAL	PV signal from sensor or input (PV units). Valid = any float. Default is 4.0.
Inp_SmartDvcSts	DINT	Current code provided by SMART device on Inp_PVData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_SmartDvcDiagAvailable	BOOL	1 = SMART Device diagnostics is available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_ModFault	BOOL	1 = I/O module failure or module communication status bad, 0 = OK. Default is false.
Inp_ChanFault	BOOL	1 = I/O channel fault or failure, 0 = OK. Default is false.
Inp_OutOfSpec	BOOL	1 = PV out of specification (PV uncertain, from device). Default is false.
Inp_FuncCheck	BOOL	1 = Function check (PV substituted, from device). Default is false.
Inp_MaintReqd	BOOL	1 = Maintenance required (from device). Default is false.
Inp_PVUncertain	BOOL	Indicates the channel data accuracy is undetermined. 1 = The channel data is uncertain. This input sets Sts_PVUncertain if not in Virtual. Default is false.
Inp_PVNotify	SINT	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_HiHiGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.

Public Input Members	Data Type	Description
Inp_HiGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_LoGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_LoLoGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_HiRoCGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_HiDevGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_LoDevGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_OoRGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled, 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_Reset	BOOL	1 = Reset shed latches and cleared alarms. Default is false.
Cfg_AllowDisable	BOOL	1 = Allow maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	1 = Allow operator to shelve alarms. Default is true.
Cfg_ClampSB	REAL	Clamping snap-to band, to clamp when PV gets near to limit (% of PV span). Valid = 0.0 to 100.0 percent of span. Default is 0.0.
Cfg_InpRawMin	REAL	Input (unscaled) minimum for scaling. Must be set to the range of the signal connected to the Inp_PVData (raw PV) input. The input is then scaled to the values set by Cfg_PVEUMin and Cfg_PVEUMax. Valid = any float not equal to Cfg_InpRawMax Default is 4.0.
Cfg_InpRawMax	REAL	Input (unscaled) maximum for scaling. Must be set to the range of the signal connected to the Inp_PVData (raw PV) input. The input is then scaled to the values set by Cfg_PVEUMin and Cfg_PVEUMax. Valid = any float not equal to Cfg_InpRawMin Default is 20.0.
Cfg_PVEUMin	REAL	PV (output) minimum for scaling to engineering units. Valid = any float not equal to Cfg_PVEUMax Default is 0.0.
Cfg_PVEUMax	REAL	PV (output) maximum for scaling to engineering units. Valid = any float not equal to Cfg_PVEUMin. Tip: The analog input instruction supports reverse scaling. Either the raw (Input) or engineering (Scaled) range can be reversed (maximum less than minimum). Default is 100.0.

Public Input Members	Data Type	Description
Cfg_Ref	REAL	Reference setting for deviation alarms (engineering units). Valid = any float. Default is 0.0.
Cfg_FiltWLag	REAL	Filter cutoff frequency (radian/second). Valid = any float >= 0.0. Default is 0.0.
Cfg_FiltOrder	DINT	Filter order: 0 = no filtering, 1 = 1st order low-pass filter, 2 = 2nd order low-pass filter. Default is 0.
Cfg_RateTime	REAL	Rate of change time base (seconds), use 1.0 for units/second, 60.0 for units/minute, 3600.0 for units/hour, 86400.0 for units/day. Valid = any float greater than zero. Default is 1.0.
Cfg_PVHiLim	REAL	PV clamping high limit (engineering units). Valid = any float greater than or equal to Cfg_PVLoLim. Default is 1.50E+38.
Cfg_PVLoLim	REAL	PV clamping low limit (engineering units). Valid = any float less than or equal to Cfg_PVHiLim. Default is - 1.5E+38.
Cfg_PVReplaceVal	REAL	Value to use to replace PV when action = replace (engineering units). Valid = any float. Default is 0.0.
Cfg_HiHiLim	REAL	High-High status threshold (engineering units). Valid = any float. Default is 1.50E+38.
Cfg_HiHiDB	REAL	The deadband that is applied to the alarm limit. This is used to prevent a noisy signal from generating spurious alarms. Valid = any float >= 0.0. Tip: If the High-High alarm limit (Cfg_HiHiLim) is 90 and the High-High alarm deadband (Cfg_HiHiDB) is 5, the High-High alarm is generated when the output (PV filtered, Val) rises above 90 and is cleared once the output (Val) falls below 85 (90 minus 5). Default is 1.0.
Cfg_HiHiGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_HiLim	REAL	High status threshold (engineering units). Valid = any float. Default is 1.50E+38.
Cfg_HiDB	REAL	The deadband that is applied to the alarm limit (engineering units). Default is 1.0.
Cfg_HiGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_LoLim	REAL	Low status threshold (engineering units). Valid = any float. Default is -1.5E+38.
Cfg_LoDB	REAL	The deadband that is applied to the alarm limit (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_LoGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_LoLoLim	REAL	Low-Low status threshold (engineering units). Valid = any float. Default is -1.5E+38.
Cfg_LoLoDB	REAL	The deadband that is applied to the alarm limit (engineering units). Default is 1.0.
Cfg_LoLoGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_HiRoCLim	REAL	High rate of change status threshold (engineering units). Valid = any float >= 0.0. Default is 1.50E+38.

Public Input Members	Data Type	Description
Cfg_HiRoCDB	REAL	The deadband that is applied to the alarm limit (engineering units). Valid any float >= 0.0 and <Cfg_HiRoCLim. If Cfg_HiRoCLim=0.0 then the only valid setting is Cfg_HiRoCDB=0.0. Default is 1.0.
Cfg_HiRoCGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_HiDevLim	REAL	High deviation status threshold (engineering units). Valid = any float >= 0.0. Default is 1.50E+38.
Cfg_HiDevDB	REAL	The deadband that is applied to the alarm limit (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_HiDevGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_LoDevLim	REAL	Low Deviation status threshold (engineering units). Valid = any float <= 0.0. Default is -1.5E+38.
Cfg_LoDevDB	REAL	The deadband that is applied to the alarm limit (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_LoDevGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_OoRHiLim	REAL	High out of range status threshold (raw units). Valid = any float. Default is 20.733334.
Cfg_OoRLoLim	REAL	Low out of range status threshold (raw units). Valid = any float. Default is 3.6666667.
Cfg_OoRDB	REAL	The deadband that is applied to the alarm limit (raw units). Valid = any float >= 0.0. Default is 0.06666667.
Cfg_OoRGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_OoROnDly	REAL	The minimum time (seconds) the gated raw PV must remain above the upper (Cfg_OoRHiLim) or below the lower (Cfg_OoRLoLim) limit for the status Sts_OoR to be set. On-delay time is used to avoid unnecessary alarm when the raw PV only briefly overshoots Cfg_OoRHiLim or undershoots Cfg_OoRLoLim. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_OoROffDly	REAL	The time (second) the gated raw PV must stay within each status threshold to clear the status. Off-delay time is used to reduce chattering alarm. Tip: If Cfg_OoROffDly is five seconds, the gated raw PV must be below the status limit (Cfg_OoRHiLim) minus deadband (Cfg_OoRDB) for five seconds before the status is returned to normal. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_StuckTime	REAL	Time with no change in input to raise stuck status (second). Valid = 0.0 to 2147483.0 seconds. Default is 60.0.
Cfg_InpOoRAction	SINT	PV action on out of range: 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 1.
Cfg_InpOoRQual	SINT	Out of range flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 3.

Public Input Members	Data Type	Description
Cfg_InpStuckAction	SINT	PV action on stuck (unchanging): 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 1.
Cfg_InpStuckQual	SINT	Stuck (unchanging) flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 1.
Cfg_InpNaNAction	SINT	PV action on not a number: 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 2.
Cfg_InpNaNQual	SINT	PV not a number flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 3.
Cfg_ModFaultAction	SINT	PV action on I/O module fault: 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 2.
Cfg_ModFaultQual	SINT	I/O module fault Flag as: 1 = Good, 2= Uncertain, 3 = Bad. Default is 3.
Cfg_ChanFaultAction	SINT	PV action on channel fault: 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 2.
Cfg_ChanFaultQual	SINT	I/O channel fault flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 3.
Cfg_OutOfSpecAction	SINT	PV action on out of spec (from device): 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 1.
Cfg_OutOfSpecQual	SINT	Inp_PVUncertain flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 2.

Public Input Members	Data Type	Description
Cfg_FuncCheckAction	SINT	PV action on function check (from device): 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 3.
Cfg_FuncCheckQual	SINT	Function check flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 3.
Cfg_MaintReqdAction	SINT	PV action on maintenance required (from device): 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 3.
Cfg_MaintReqdQual	SINT	Maintenance required flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 3.
Cfg_CfgErrAction	SINT	PV action on Instruction configuration error: 1 = Pass input PV through unchanged, 2 = Hold last good PV value, 3 = Replace PV value with Cfg_PVReplaceVal. Default is 3.
Cfg_CfgErrQual	SINT	Instruction configuration error flag as: 1 = Good, 2 = Uncertain, 3 = Bad. Default is 3.
Cfg_CtrlHiHiLim	REAL	Current high-high control threshold (engineering units). Valid = any float. Default is 1.50E+38.
Cfg_CtrlHiHiDB	REAL	High-High control deadband (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_CtrlHiLim	REAL	Current high control threshold (engineering units). Valid = any float. Default is 1.50E+38.
Cfg_CtrlHiDB	REAL	High control deadband (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_CtrlLoLim	REAL	Current low control threshold (engineering units). Valid = any float. Default is -1.5E+38.
Cfg_CtrlLoDB	REAL	Low control deadband (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_CtrlLoLoLim	REAL	Current low-low control threshold (engineering units). Valid = any float. Default is -1.5E+38.
Cfg_CtrlLoLoDB	REAL	Low-Low control deadband (engineering units). Valid = any float >= 0.0. Default is 1.0.
Cfg_HasSmartDvc	BOOL	1 = Enable a button on the HMI that could be used to call up a SMART Device faceplate (diagnostics). Default is false.
Cfg_HasRoC	BOOL	1 = PV rate of change made visible in HMI. Default is false.
Cfg_HasDev	BOOL	1 = PV Deviation made visible in HMI. Default is false.

Public Input Members	Data Type	Description
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.
Cfg_HasOutNav	BOOL	1 = Tells HMI to enable navigation to a connected output object, 0 = No connected output object. Default is false.
Cfg_HasPVNav	BOOL	1 = Tells HMI to enable navigation to a connected process variable object. Default is false.
Cfg_HasHistTrend	SINT	Has Historical Trend. This enables navigation to the Device Historical Trend Faceplate from the HMI. 0 = No external historical trend, 1 = Datalog historical trend, 2 = Historian historical trend. Default is 0.
Cfg_FailOnUncertain	BOOL	1 = Raise Sts_Fail (and fail alarm) if PV quality is uncertain, 0 = Raise Sts_Fail (and fail alarm) only if PV quality is bad (scaling configuration error, PV is NaN or Inf, I/O fault or raw PV is out of range. Default is false.
Cfg_NoSubstPV	BOOL	Disables the maintenance substitution feature. 0 = The Substitute PV Maintenance function is enabled, 1 = The Substitute PV Maintenance function is disabled. When Cfg_NoSubstPV is 0, the commands MCmd_SubstPV and MCmd_InpPV are used to select the input PV or the substitute PV. Sts_SubstPV is set to 1 when the substitute PV is selected. Default is false.
Cfg_SetTrack	BOOL	1 = Set_VirtualPV tracks Val_InpPV in virtual. MSet_SubstPV tracks Val_InpPV when substitution is not active. 0 = No tracking. Default is true.
Cfg_SclngTyp	SINT	Scaling Type 0 = none, 1 = Linear, 2 = Square Root. Default is 1.
Cfg_PVDecPlcs	SINT	Number of decimal places for process variable display. Valid = 0 to 6. Default is 2.
Cfg_CnfrmReqd	SINT	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Program owner request ID (non-zero) or release (zero). Default is 0.
Set_VirtualPV	REAL	PV used in virtual (Sts_Virtual = 1) (engineering units). Default is 0.0.
PCmd_ClearCapt	BOOL	Set PCmd_ClearCapt to 1 to clear the captured minimum/maximum PV excursion values. The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	Description
PCmd_Virtual	BOOL	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
XCmd_ClearCapt	BOOL	External command to clear the captured minimum/maximum PV excursion values. The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	This output state always reflects EnableIn input state.
Val	REAL	Analog input value in engineering units (after Substitute PV, if used). Extended Properties of this member: Units - Engineering units (text) used for the analog input.
Val_InpPV	REAL	Analog input value in engineering units (actual, before Substitute PV selection).
Val_RoC	REAL	Analog value Rate of Change (engineering units/rate time).
Val_Dev	REAL	Calculated deviation from reference (engineering units).
Val_PVMinCapt	REAL	Captured PV minimum (excursion) since last cleared (engineering units). Default is 1.5E+38.
Val_PVMaxCapt	REAL	Captured PV maximum (excursion) since last cleared (engineering units). Default is -1.5E+38.
Val_PVEUMin	REAL	Minimum of scaled range = MIN (Cfg_PVEUMin, Cfg_PVEUMax).
Val_PVEUMax	REAL	Maximum of scaled range = MAX (Cfg_PVEUMin, Cfg_PVEUMax).
Out_SmartDvcSts	DINT	Status code of a SMART Device provided by Inp_SmartDvcSts. Out_SmartDvcSts is a copy of Inp_SmartDvcSts.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_SmartDvcDiagAvailable	BOOL	1 = Diagnostics of a SMART Device is currently available. Typically used to indicate device requires action to keep operating as expected. Sts_SmartDvcDiagAvailable is a copy of Inp_SmartDvcDiagAvailable.
Sts_PVGood	BOOL	1 = PV quality is Good (not flagged as Bad or Uncertain).
Sts_PVUncertain	BOOL	Indicates the channel data accuracy is undetermined. 1 = The channel data is uncertain. This output is set by Inp_PVUncertain (if not in Virtual).
Sts_PVBad	BOOL	1 = PV quality is flagged as Bad.
Sts_InpStuck	BOOL	1 = Input is stuck (unchanging).
Sts_InpNaN	BOOL	1 = Input is not a number (floating point exception).
Sts_OutOfSpec	BOOL	1 = Working outside specifications (from device).
Sts_FuncCheck	BOOL	1 = Function check (PV simulated/replaced at device).
Sts_MaintReqd	BOOL	1 = Maintenance is required (from device).
Sts_UseInp	BOOL	1 = Using input to calculate PV (not replaced or held).
Sts_HoldLast	BOOL	1 = Analog PV being held at last good value.
Sts_Clamped	BOOL	1 = Analog PV being clamped at Low or High Limit.
Sts_Replaced	BOOL	1 = Analog PV being replaced with configured value.
Sts_SubstPV	BOOL	1 = Using substitute PV (Override).
Sts_InpPV	BOOL	1 = Using input PV (Normal).

Public Output Members	Data Type	Description
Sts_Virtual	BOOL	1 = Using virtual PV instead of the input from the device (Inp_PVData) to calculate output. 0 = The instruction uses input operand Inp_PVData to calculate output. Sts_Virtual is a copy of Inp_Virtual.
SrcQ_IO	SINT	Source and quality of primary input or output (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
SrcQ	SINT	Source and quality of primary value or status (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
Sts_bSts	SINT	Device confirmed status: 0 = PV Good, Sts_bSts.0: PV Uncertain, Sts_bSts.1: PV Bad, Sts_bSts.2: PV Substituted. PV is Good if Sts_PVUncertain = 0 and Sts_PVBad = 0, PV is Uncertain if Sts_PVUncertain = 1, PV is Bad if Sts_PVBad = 1, PV is Substituted if Sts_SubstPV or Sts_Virtual = 1.

Public Output Members	Data Type	Description
Sts_bFault	INT	Device fault status: 0 = None, Sts_bFault.0: Low, Sts_bFault.1: High, Sts_bFault.2: Low Deviation, Sts_bFault.3: High Deviation, Sts_bFault.4: Low Low, Sts_bFault.5: High High, Sts_bFault.6: High Rate of Change, Sts_bFault.7: Fail, Sts_bFault.8: Configuration Error.
Sts_eNotify	SINT	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyHiHi	SINT	HiHi alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyHi	SINT	Hi alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLo	SINT	Lo alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLoLo	SINT	LoLo alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyHiRoC	SINT	HiRoC alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyHiDev	SINT	HiDev alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLoDev	SINT	LoDev alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFail	SINT	Fail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_MaintByp	BOOL	1 = The Device has a maintenance bypass function active.
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrRaw	BOOL	1 = Error in configuration: Raw input scaling Min = Max.
Sts_ErrEU	BOOL	1 = Error in configuration: Scaled EU Min = Max.
Sts_ErrFiltWLag	BOOL	1 = Error in configuration: Filter cutoff frequency.
Sts_ErrFiltOrder	BOOL	1 = Error in configuration: Filter order.
Sts_ErrRateTime	BOOL	1 = Error in configuration: PV Rate of Change time base.
Sts_ErrHiHiDB	BOOL	1 = Error in configuration: Cfg_HiHiDB deadband is < 0.0.
Sts_ErrHiHiGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrHiDB	BOOL	1 = Error in configuration: Cfg_HiDB deadband is < 0.0.
Sts_ErrHiGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrLoDB	BOOL	1 = Error in configuration: Cfg_LoDB deadband is < 0.0.
Sts_ErrLoGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrLoLoDB	BOOL	1 = Error in configuration: Cfg_LoLoDB deadband is < 0.0.
Sts_ErrLoLoGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrHiRoCDB	BOOL	1 = Error in configuration: Cfg_HiRoCDB deadband is invalid.

Public Output Members	Data Type	Description
Sts_ErrHiRoCGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrHiDevDB	BOOL	1 = Error in configuration: Cfg_HiDevDB deadband is < 0.0.
Sts_ErrHiDevGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrLoDevDB	BOOL	1 = Error in configuration: Cfg_LoDevDB deadband is < 0.0.
Sts_ErrLoDevGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrOoRDB	BOOL	1 = Error in configuration: Cfg_OoRDB deadband is < 0.0.
Sts_ErrOoRGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrOoROnDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrOoROffDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrStuckTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrCmdCnfrmTimeOutTime	BOOL	1 = Error in configuration: Command confirmation timer preset (use 0.0 to 2147483.0).
Sts_ErrAlm	BOOL	1 = Error in tag-based alarm settings.
Sts_Alm	BOOL	1 = An alarm is active.
Sts_AlmInh	BOOL	1 = An alarm is shelved or disabled.
Sts_IOFault	BOOL	IO Fault status is set to 1 if there is a Module fault (Inp_ModFault = 1) or Channel fault (Inp_ChanFault = 1) and PV is not virtual.
Sts_HiHiCmp	BOOL	PV comparison result, 1 = High-High.
Sts_HiHiGate	BOOL	PV High-High gate delay status, 1 = done.
Sts_HiHi	BOOL	1 = Analog input is above High-High limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_HiHi.AlarmElement
Sts_HiCmp	BOOL	PV comparison result 1 = High.
Sts_HiGate	BOOL	PV High gate delay status, 1 = done.
Sts_Hi	BOOL	1 = Analog input is above High limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_Hi.AlarmElement
Sts_LoCmp	BOOL	PV comparison result 1 = Low.
Sts_LoGate	BOOL	PV Low gate delay status, 1 = done.
Sts_Lo	BOOL	1 = Analog input is below Low limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_Lo.AlarmElement
Sts_LoLoCmp	BOOL	PV comparison result 1 = Low-Low.
Sts_LoLoGate	BOOL	PV Low-Low gate delay, status 1 = done.
Sts_LoLo	BOOL	1 = Analog input is below Low-Low limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_LoLo.AlarmElement
Sts_HiRoCCmp	BOOL	PV comparison result 1 = High Rate of Change.
Sts_HiRoCGate	BOOL	PV High Rate of Change gate delay status, 1 = done.

Public Output Members	Data Type	Description
Sts_HiRoC	BOOL	1 = Analog input Rate of Change is above High limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_HiRoC.AlarmElement
Sts_HiDevCmp	BOOL	PV comparison result 1 = High Deviation.
Sts_HiDevGate	BOOL	PV High Deviation gate delay, status 1 = done.
Sts_HiDev	BOOL	1 = Analog input Deviation is above High limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_HiDev.AlarmElement
Sts_LoDevCmp	BOOL	PV comparison result, 1 = Low Deviation.
Sts_LoDevGate	BOOL	PV Low Deviation delay status, 1 = done.
Sts_LoDev	BOOL	1 = Analog input Deviation is below Low limit. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_LoDev.AlarmElement
Sts_OoRHiCmp	BOOL	PV comparison result, 1 = High Out of Range.
Sts_OoRLoCmp	BOOL	PV comparison result, 1 = Low Out of Range.
Sts_OoRCmp	BOOL	PV comparison result, 1 = Out of Range.
Sts_OoRGate	BOOL	PV Out of Range gate delay status, 1 = done.
Sts_OoR	BOOL	1 = Analog raw input is above High raw limit or below Low raw limit.
Sts_Fail	BOOL	1 = Analog input failed. At least one of the following conditions holds: PV scaling configuration error, raw PV is out of range or not a number, input module or input channel fault, device reports PV uncertain (if configured for). There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAITag.@Alarms.Alm_Fail.AlarmElement
Sts_CnfrmOperCmdReq	BOOL	1 = Operator command request is awaiting confirmation.
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
XRdy_ClearCapt	BOOL	1 = Ready for XCmd_ClearCapt, enable HMI button.
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.
Val_Owner	DINT	Current object owner ID (0 = not owned).

Private Input Members	Data Type	Description
MSet_SubstPV	REAL	Maintenance-entered substitute PV in engineering units that overrides input PV when MCmd_SubstPV is 1. If not using the substitute (MCmd_SubstPV is false), the MSet_SubstPV setting tracks the Out value for bumpless transfer from input PV to substitute PV. Default = 0.0.
MCmd_SubstPV	BOOL	Maintenance command to use Substitute PV. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_InpPV	BOOL	Maintenance command to use Input PV (normal). The instruction clears this operand automatically. Default is false.
OCmd_ClearCapt	BOOL	Operator command to clear the captured minimum/maximum PV excursion values. The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to acknowledge and reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is false.
OCmd_CmdCncl	BOOL	Operator command to cancel command request. The instruction clears this operand automatically. Default is false.
OCmd_CmdCnfrm	BOOL	Operator command to confirm command request. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index.
MRdy_SubstPV	BOOL	1 = Ready for MCmd_SubstPV.
MRdy_InpPV	BOOL	1 = The instruction is ready for MCmd_InpPV command.
ORdy_ClearCapt	BOOL	1 = Ready for OCmd_ClearCapt, enable HMI button.
ORdy_Reset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
ORdy_ResetAckAll	BOOL	1 = A latched alarm or shed condition is ready to be reset or acknowledged.

Public InOut Members	Data Type	Description
BusObj	BUS_OBJ	Bus component.

BUS_OBJ Structure

The BUS_OBJ structure links the analog input instruction to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices. Items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type

shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_Fail	Alm_Fail	Raised when any of the following is true: • The PV quality is bad. The PV quality is bad if either Inp_ChanFault or Inp_ModFault input is 1. The PV bad quality check is skipped in Virtual. • The Inp_PVUncertain input is true and the instruction is configured for PV uncertain status taking effect on failure. The PV uncertain check is skipped in Virtual. • The PV is outside the configured failure limits. • The PV is infinite or not a number (floating-point exception). • The raw or engineering unit range configuration used in scaling is invalid.
Sts_HiHi	Alm_HiHi	Raised when the PV is above the High-High threshold and the associated gate is opened (Inp_HiHiGate = 1). The threshold, deadband, and gate delay are set in alarm configuration.
Sts_Hi	Alm_Hi	Raised when the PV is above the High threshold and the associated gate is opened (Inp_HiGate = 1). The threshold, deadband, and gate delay are set in alarm configuration.
Sts_Lo	Alm_Lo	Raised when the PV is below the Low threshold and the associated gate is opened (Inp_LoGate = 1). The threshold, deadband, and gate delay are set in alarm configuration.
Sts_LoLo	Alm_LoLo	Raised when the PV is below the Low-Low threshold and the associated gate is opened (Inp_LoLoGate = 1). The threshold, deadband, and gate delay are set in alarm configuration.

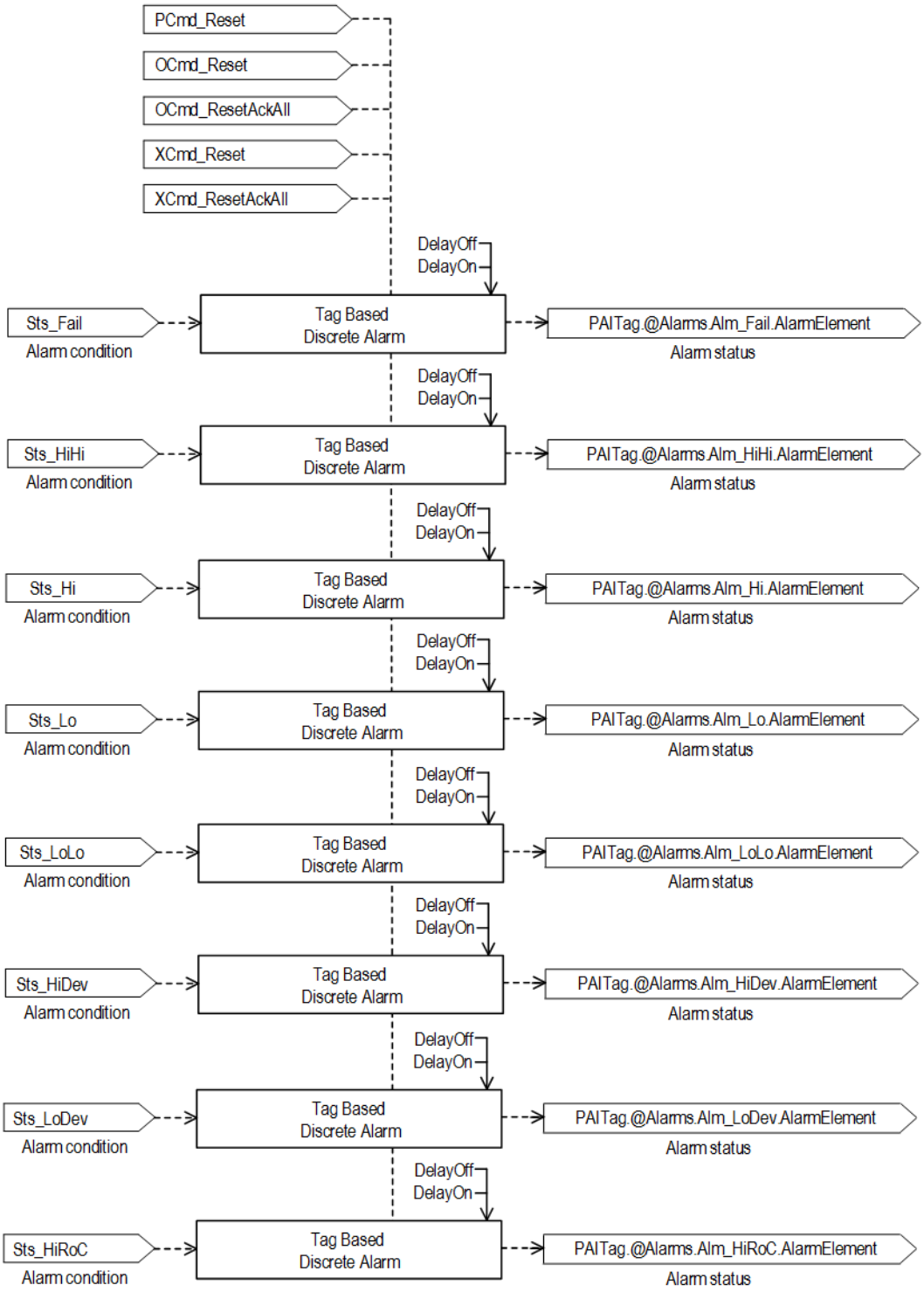
Member	Alarm Name	Description
Sts_HiDev	Alm_HiDev	Raised when the amount by which the PV exceeds the setpoint or reference is above the High Deviation threshold while the associated gate is opened (Inp_HiDevGate = 1). The threshold, deadband, and gate delay are set in alarm configuration.
Sts_LoDev	Alm_LoDev	Raised when the amount by which the PV exceeds the setpoint or reference is below the Low Deviation threshold while the associated gate is opened (Inp_LoDevGate = 1). Since the threshold is a negative number, this is the amount the PV falls below the setpoint or reference. The threshold, deadband, and gate delay are set in alarm configuration.
Sts_HiRoC	Alm_HiRoC	Raised when the amount by which the absolute value of PV rate of change exceeds High Rate of Change limit while the associated gate is opened (Inp_HiRoCGate = 1). The threshold, deadband, and gate delay are set in alarm configuration.

Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format:

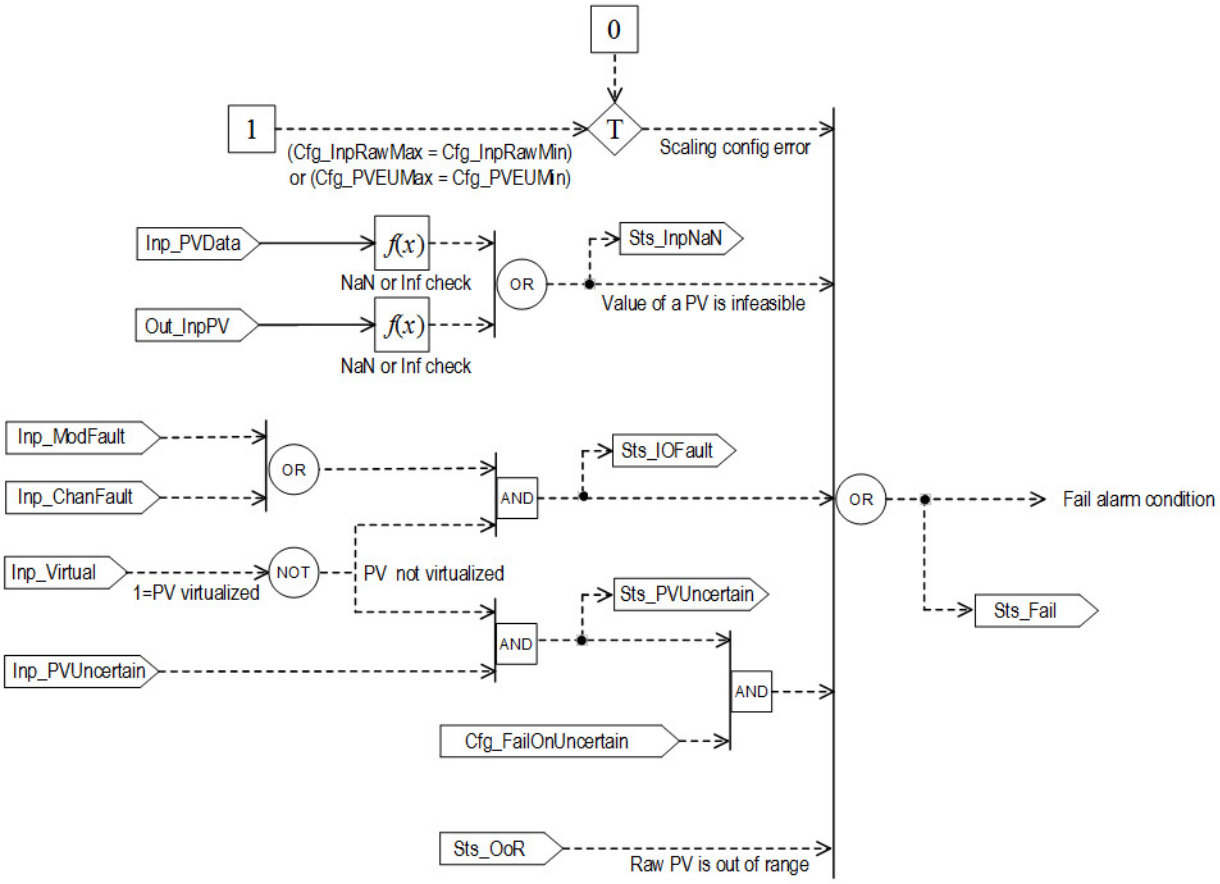
PAITag.@Alarms.AlarmName.AlarmElement

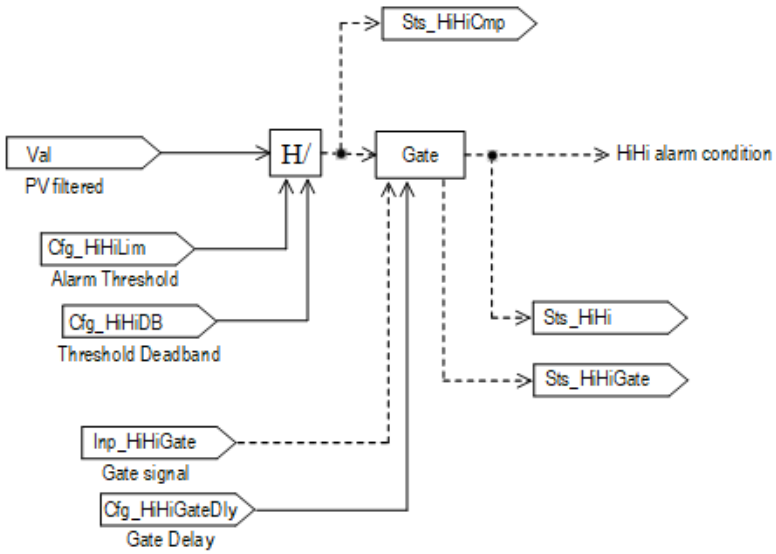
- There is a Program command that enables to Reset all alarms of the instruction (Alarm Set) at the same time.
- There are Operator commands that enable to Reset, and Reset&Acknowledge all alarms of the instruction (Alarm Set) at the same time.

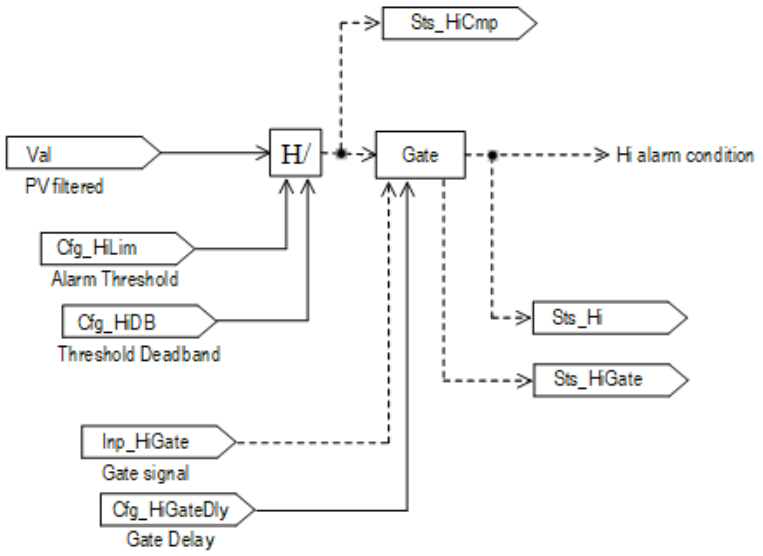
- There are External commands that enable to Reset, and Reset&Acknowledge all alarms of the instruction (Alarm Set) at the same time.

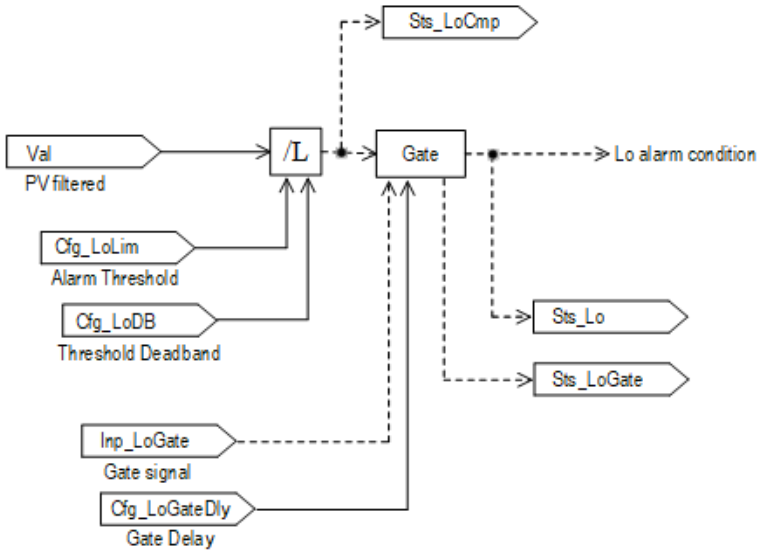


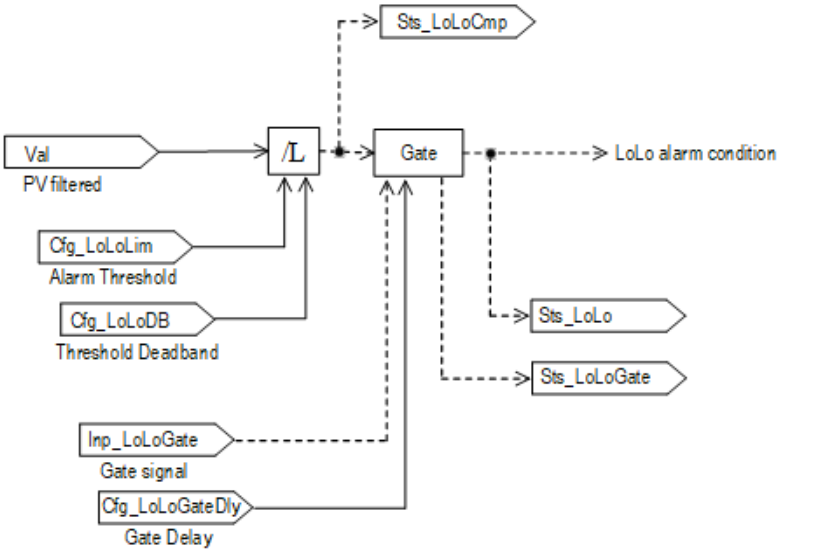
These diagrams show how Fail, High High, High, Low, Low Low, High Deviation, Low Deviation and High Rate of Change alarm conditions are calculated in the PAI instruction.

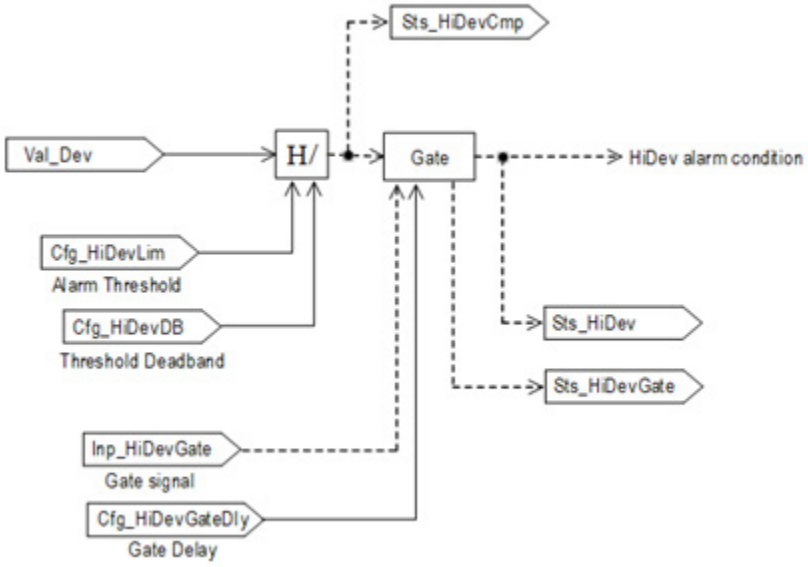


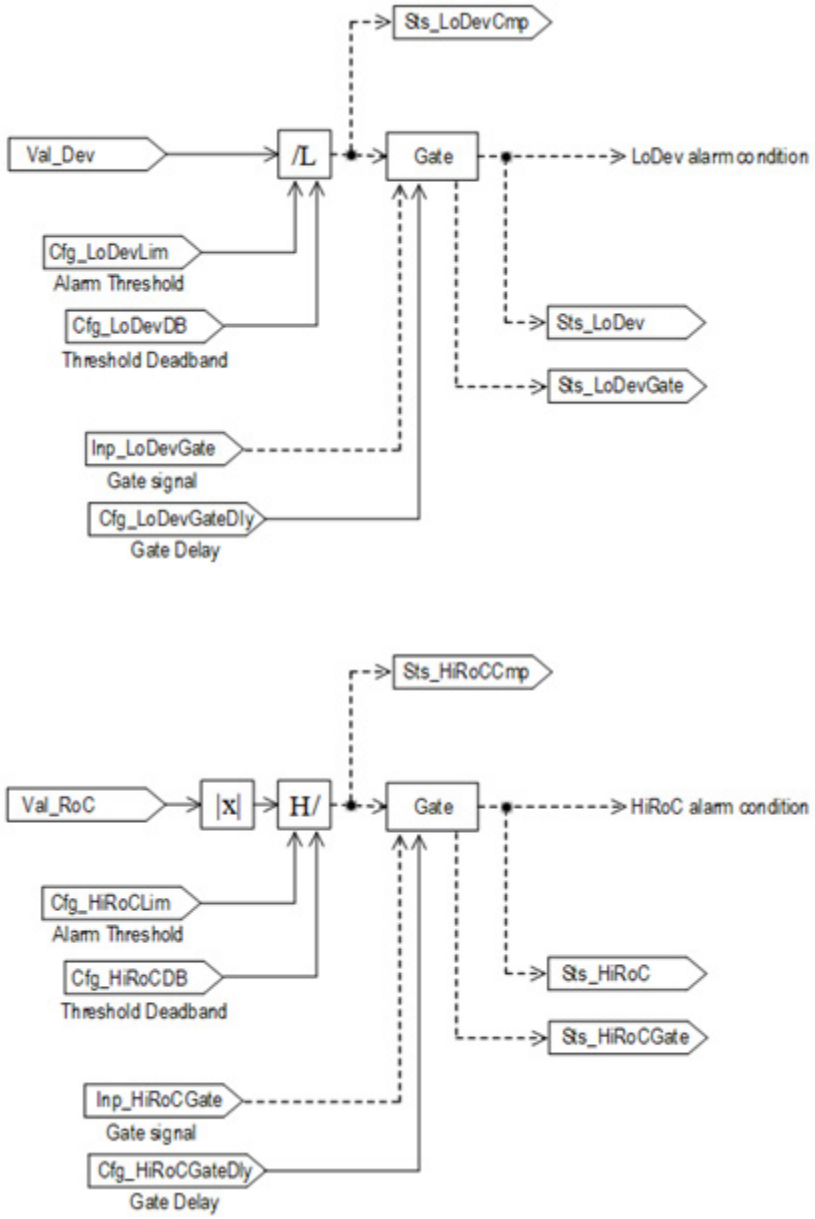



Sts_HiCmp
Val
PV filtered
H/
Gate
Hi alarm condition
Cfg_HiLim
Alarm Threshold
Cfg_HiDB
Threshold Deadband
Sts_Hi
Sts_HiGate
Inp_HiGate
Gate signal
Cfg_HiGateDly
Gate Delay


Sts_LoCmp
Val
PV filtered
/L
Gate
Lo alarm condition
Cfg_LoLim
Alarm Threshold
Cfg_LoDB
Threshold Deadband
Sts_Lo
Sts_LoGate
Inp_LoGate
Gate signal
Cfg_LoGateDly
Gate Delay


Sts_LoLoCmp
Val
PV filtered
/L
Gate
LoLo alarm condition
Cfg_LoLoLim
Alarm Threshold
Cfg_LoLoDB
Threshold Deadband
Sts_LoLo
Sts_LoLoGate
Inp_LoLoGate
Gate signal
Cfg_LoLoGateDly
Gate Delay


Sts_HiDevCmp
Val_Dev
H/
Gate
HiDev alarm condition
Cfg_HiDevLim
Alarm Threshold
Cfg_HiDevDB
Threshold Deadband
Sts_HiDev
Sts_HiDevGate
Inp_HiDevGate
Gate signal
Cfg_HiDevGateDly
Gate Delay



Operation

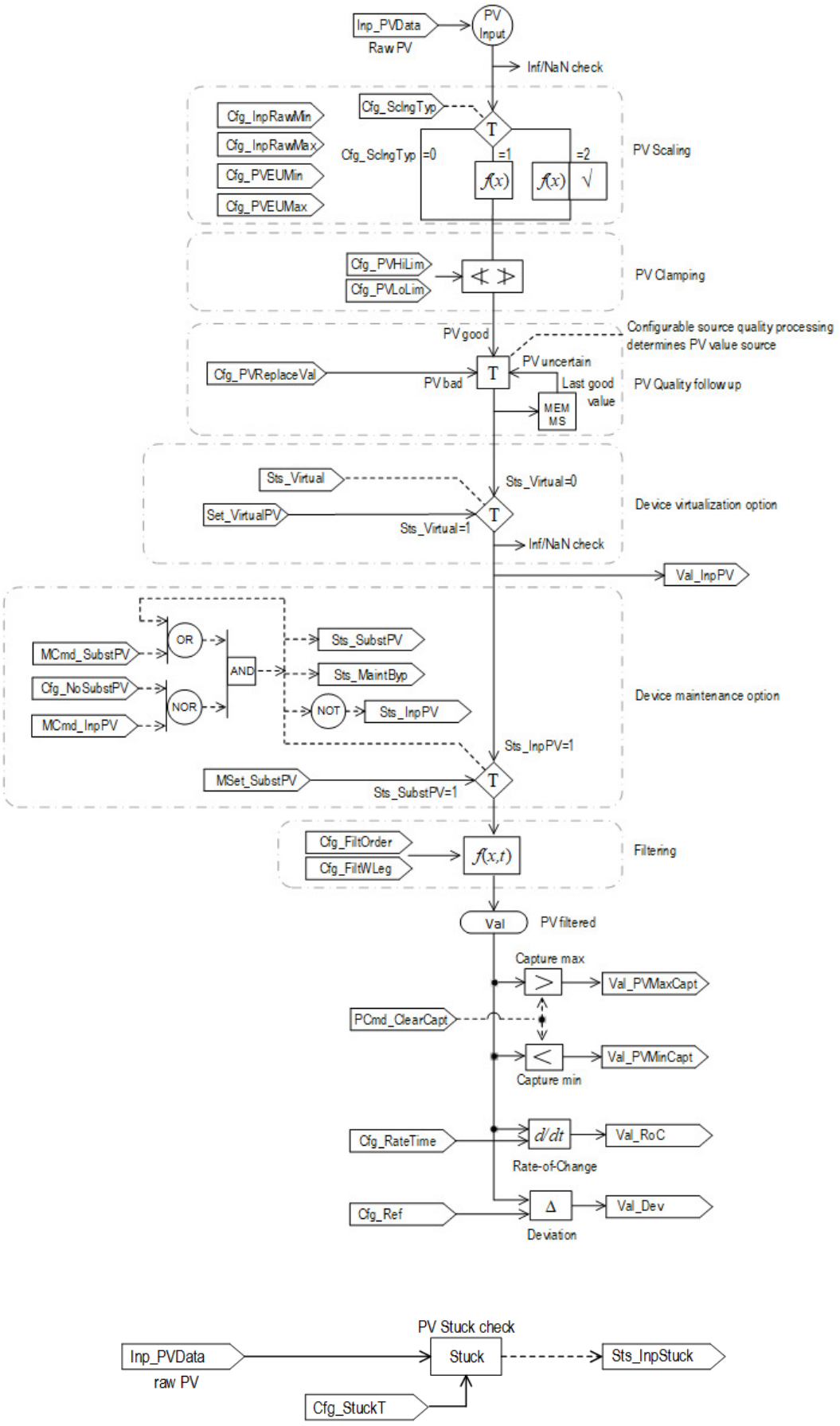
The PAI instruction:

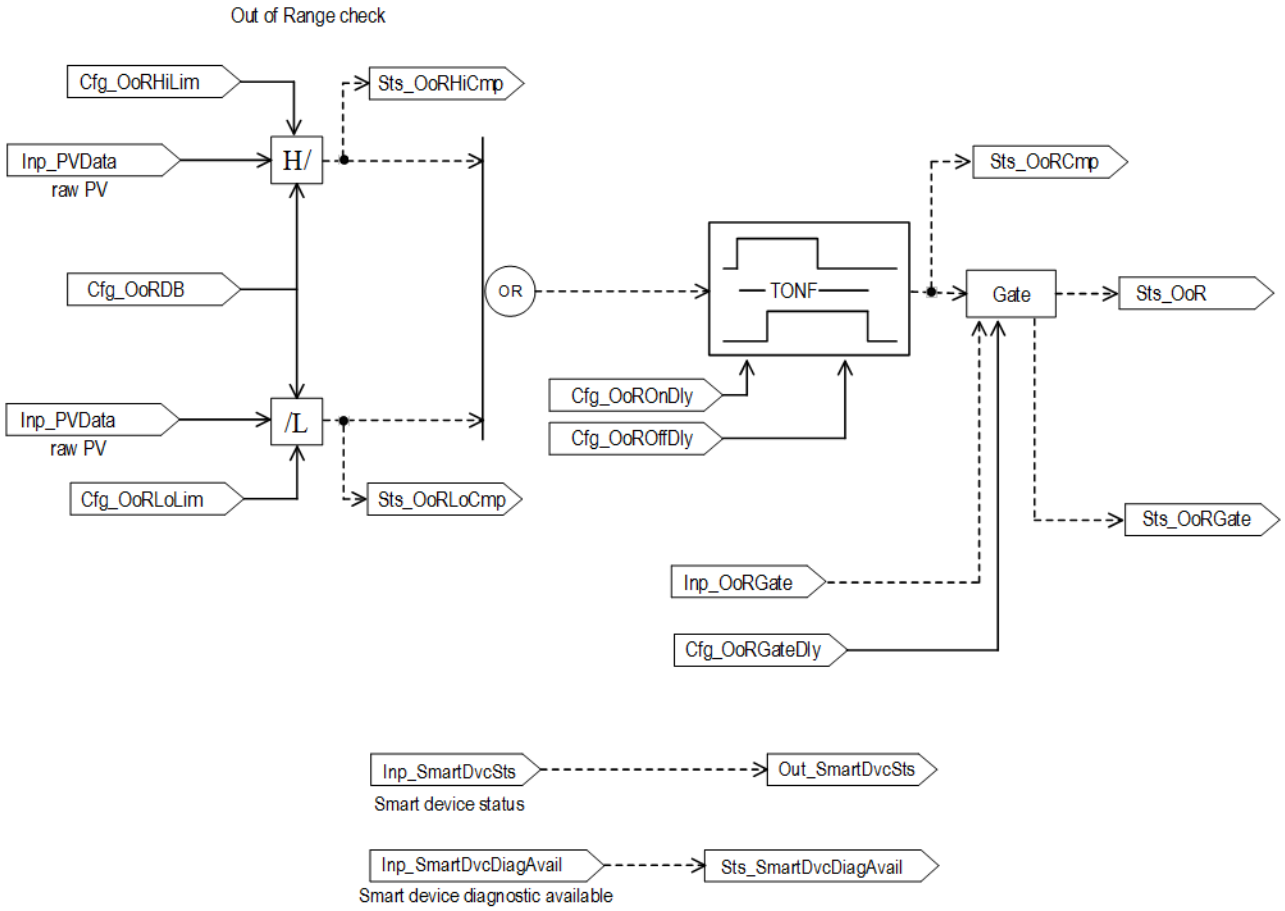
- Monitors one analog input channel for the following conditions:
  - Invalid configuration of the instruction (scaling configuration error)
  - I/O channel fault
  - I/O module fault
  - Input not-a-number (floating-point exception)
  - Raw input out of range
  - Input stuck (unchanging)
  - Out of specification (uncertain) – reported from the device

  - Function check (substitute PV entered manually) - reported from the device
  - Maintenance required - reported from the device
- For each condition, takes these actions:
  - Pass the PV through unchanged
  - Use the last good PV value
  - Apply a configured replacement PV value
- Scales the input value from raw (input card) units to engineering (display) units:
  - Linear scaling (optional)
  - Square root characterized scaling (optional).

    Tip: Square root characterized scaling is typically used with orifice plates or other pressure-differential elements for flow measurement when the transmitter does not provide square root characterization. The square root scaling in the instruction works with ± pressure differential to provide positive or negative flow values.
- Filters PV (optional) to reduce signal noise.
- Monitors PV Source, PV Quality and PV out-of-range condition.
- Supports maintenance selection of the substitute PV function to allow manual override of the input PV.
- Supports virtual PV for use in instruction testing, demonstration, or operator training.
- Provides entry of a reference (setpoint) value and calculates PV deviation from the reference value.
- Calculates the PV rate of change (RoC).
- Captures Min and Max PV excursion values.

These diagrams illustrate the functionality of the PAI instruction:





Virtualization

Use virtualization for instruction testing and operator training. Set the Inp_Virtual operand to 1 to enable virtualization. After finishing virtualization, set the Inp_Virtual operand to 0 to return to normal operation.

Virtualization enables processing the virtual input instead of normal (scaled) input PV. The instruction has operand (Set_VirtualPV) for entering virtual PV in EU. When the instruction is not in Virtual, the virtual PV setting (Set_VirtualPV) tracks the selected PV for bumpless transfer into Virtual.

Initialization

The instruction is normally initialized in the instruction first run. Re-initialization can be requested any time by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in the Logix Designer application only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- PV raw units
- PV engineering units

Monitor the PAI Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. The state of using raw input or maintenance substitute PV is not modified and persists through a controller powerup or PROG-to-RUN transition.
Instruction first run	All commands that are automatically cleared each execution are cleared and ignored. Filter is initialized. Internal timers are reset. The instruction executes normally.

Condition/State	Action Taken
Rung-condition-in is false	Set rung-condition-out to rung-condition-in. The instruction shows a status of IO fault (Sts_IOFault). The calculation of the scaled input PV value (Val_InpPV) is executed to indicate to the operator the actual input value, even though the primary PV (Val) is not updated (holds last value).
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false. The state of using raw input or maintenance substitute PV is not modified and persists through a controller powerup or PROG-to-RUN transition.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. Filter is initialized. Internal timers are reset. The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. The instruction shows a status of IO fault (Sts_IOFault). The calculation of the scaled input PV value (Val_InpPV) is executed to indicate to the operator the actual input value, even though the primary PV (Val) is not updated (holds last value).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

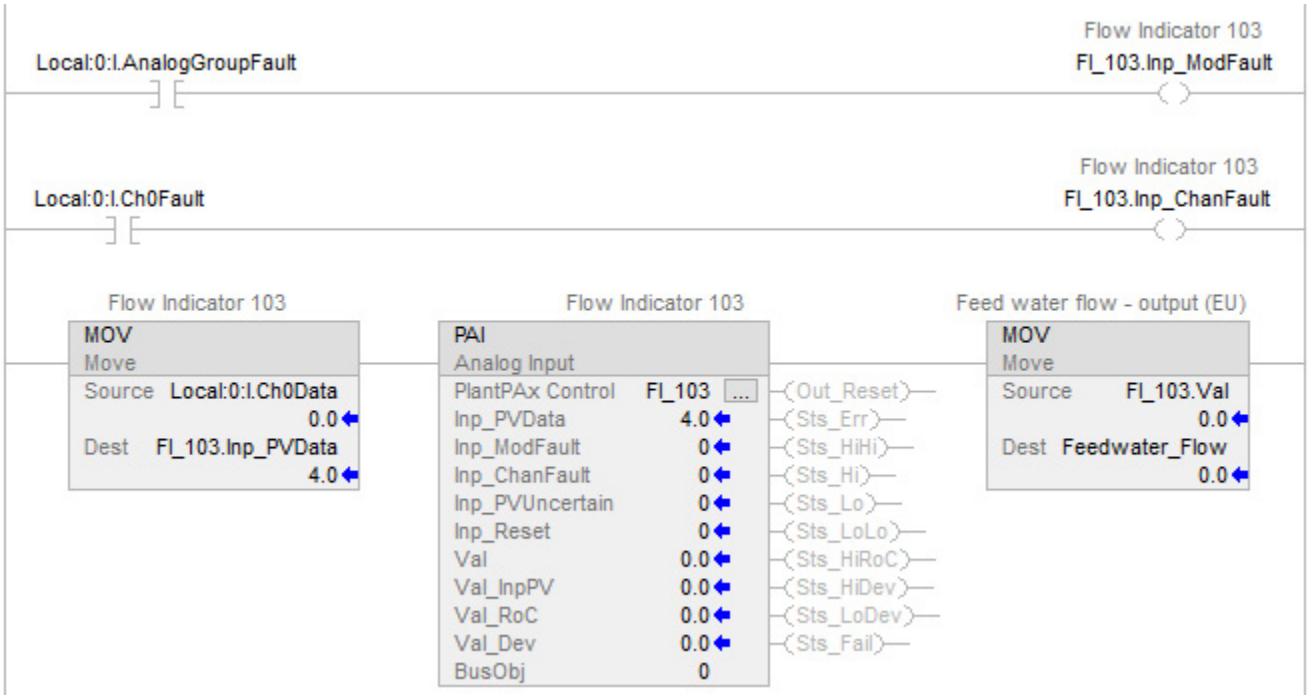
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

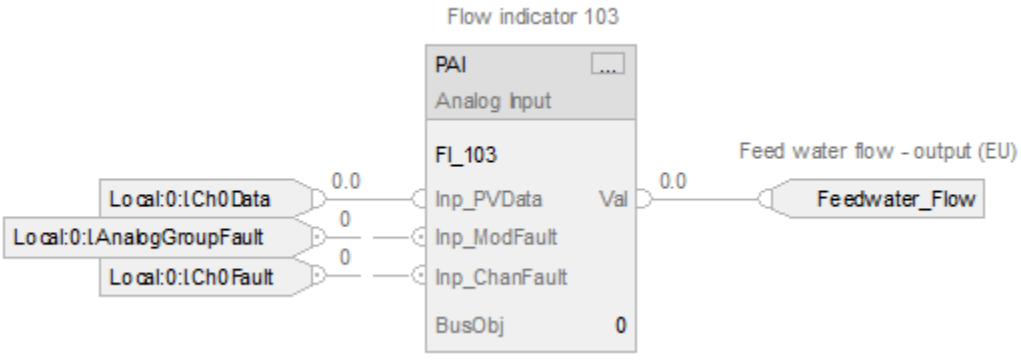
The following example shows the processing of raw analog input by the PAI instruction. The raw input value (Local:1:I.ChoData) from the analog input card is used as the raw input value (Inp_PVData) for the PAI instruction. The final output process value (Feedwater_Flow) is the fully converted, scaled, and

filtered analog value that is propagated through the system. The instruction also uses the Channel Fault and Module Fault parameters taken from the same analog input module as the process value. The Inp_ChanFault is the tag value for the channel (Local:1:I.Ch0Fault). The Inp_ModFault is the tag value for the Local:1:I.AnalogGroupFault tag, which is set when any bits in the Channel Fault word are set.

Ladder Diagram



Function Block Diagram



Structured Text

FI_103.Inp_PVData := Local:1:I.Ch0Data;

```
FI_103.Inp_ModFault := Local:1:I.AnalogGroupFault;

FI_103.Inp_ChanFault := Local:1:I.Ch0Fault;

PAI(FI_103);

Feedwater_Flow := FI_103.Out;
```

Process Dual Sensor Analog Input (PAID)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

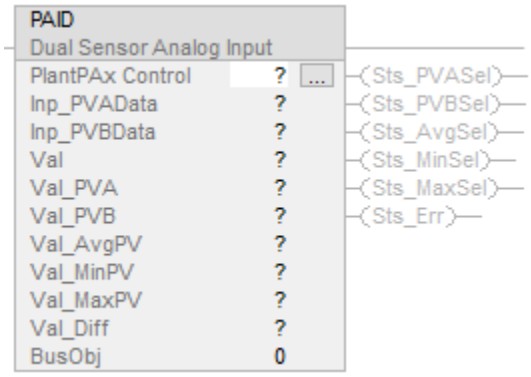
The Process Dual Sensor Analog Input (PAID) instruction monitors one analog Process Variable (PV) by using two analog input signals, from sources such as dual sensors, dual transmitters, and dual input channels. The PAID instruction monitors conditions of the channels and reports configured PV quality. The PAID instruction has functions for input selection, averaging, and failure detection. Additional functions, such as for filtering and alarming, are done by a downstream PAI block.

The PAID Instruction provides:

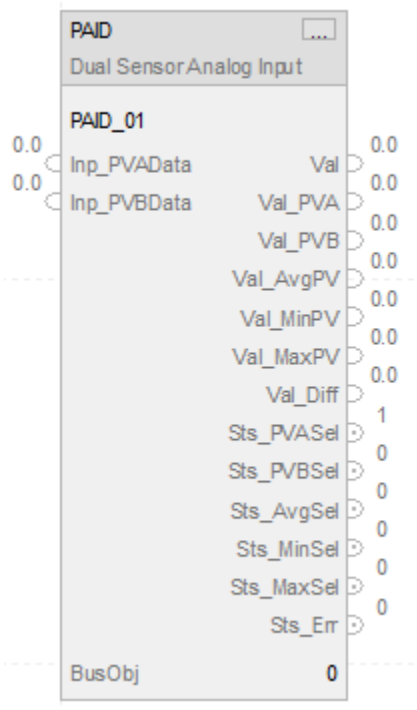
- Selection of the sensor or input A value, the sensor or input B value, the average of the two, the lesser of the two, or the greater of the two as the PV value.
- Input Source and Quality monitoring for uncertain or bad input for each sensor, transmitter, or input, plus monitoring of each signal for out-of-range condition. If one PV is bad, failed, or out or range, the other PV is automatically selected.
- Warning alarm if the difference between the two sensor PVs exceeds a configured limit.
- Warning alarm if only one PV has good quality.
- Warning alarm if neither PV has good quality; for example, if both are uncertain.
- Failure alarm if both PVs are bad; for example, each PV has bad quality (Inp_PVABad or Inp_PVBBad) or is outside the configured failure range.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PAID (PAIDTag, o);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_ANALOG_INPUT_DUAL	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component

P_ANALOG_INPUT_DUAL Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_PVAData	REAL	PV signal from sensor or input A (PV units). Valid = any float. Default is 0.0.
Inp_PVASrcQ	SINT	Input source and quality, from channel A object, if available (enumeration). Default is 0.
Inp_PVANotify	SINT	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcASts	DINT	Current code provided by SMART Device on Inp_PVAData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.

Public Input Members	Data Type	Description
Inp_PVBData	REAL	PV signal from sensor or input B (PV units). Valid = any float. Default is 0.0.
Inp_PVBSrcQ	SINT	Input source and quality, from channel B object, if available (enumeration). Default is 0.
Inp_PVBNotify	SINT	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcBSts	DINT	Current code provided by SMART Device on Inp_PVBData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVABad	BOOL	Signal quality or communication status for input A: 1 = Bad, 0 = OK. Default is false.
Inp_PVAUncertain	BOOL	Signal quality for input A: 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcADiagAvailable	BOOL	1 = SMART Device on Inp_PVAData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVBBad	BOOL	Signal quality or communication status for input B: 1 = Bad, 0 = OK. Default is false.
Inp_PVBUncertain	BOOL	Signal quality for input B: 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcBDiagAvailable	BOOL	1 = SMART device on Inp_PVBData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_DiffGate	BOOL	The gate input used for status detection. 1 = The corresponding analog input threshold monitoring is enabled. 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Cfg_AllowDisable	BOOL	1 = Allow maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	1 = Allow operator to shelve alarms. Default is true.
Cfg_UseInpSrcQPVA	BOOL	1 = Use PVA SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVB	BOOL	1 = Use PVB SrcQ input for rejection decisions. Default is false.
Cfg_HasPVNav	BOOL	1 = Tells HMI to enable navigation to a connected PV (Val) object. Default is false.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more information is available for navigation. Default is false.

Public Input Members	Data Type	Description
Cfg_HasNav	SINT	Set bits indicate which navigation buttons are enabled .0=PVA, .1=PVB Default is 0.
Cfg_PVEUMin	REAL	PV (Output) minimum for display PV units. Valid = any float. Default is 0.0.
Cfg_PVEUMax	REAL	PV (Output) maximum for display PV units. Valid = any float. Default is 100.0.
Cfg_DiffLim	REAL	Signal difference status limit for PV units, difference. Valid = any nonnegative float. Default is 1.50E+38.
Cfg_DiffDB	REAL	Signal difference status deadband for PV units, difference. Valid = any nonnegative float. Default is 1.0.
Cfg_DiffGateDly	REAL	The time (seconds) after the gate input activates before the threshold detection is enabled. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_OoRHiLim	REAL	Out-of-range (fail) high limit for input units. Valid = any float. Default is 103.958336.
Cfg_OoRLoLim	REAL	Out-of-range (fail) low limit for input units. Valid = any float. Default is -2.0833333.
Cfg_OoRDB	REAL	Out-of-range (fail) high or low deadband for input units. Valid = any nonnegative float. Default is 0.41666666.
Cfg_AllowOper	BOOL	1 = Oper is allowed to control PV selection. Default is false.
Cfg_AllowProg	BOOL	1 = Prog is allowed to control PV selection. Default is false.
Cfg_AllowExt	BOOL	1 = Ext is allowed to control PV selection. Default is false.
Cfg_PVDecPlcs	SINT	Number of decimal places for PV display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_CnfrmReqd	SINT	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Program owner request ID (non-zero) or release (zero) (Valid = any integer). Default is 0.
PCmd_SelA	BOOL	Program command to select sensor A PV. Default is false.
PCmd_SelB	BOOL	Program command to select sensor B PV. Default is false.
PCmd_SelAvg	BOOL	Program command to select average (A,B) PV. Default is false.
PCmd_SelMin	BOOL	Program command to select minimum (A,B) PV. Default is false.
PCmd_SelMax	BOOL	Program command to select maximum (A,B) PV. Default is false.
PCmd_Reset	BOOL	Program command to reset all alarms requiring reset. Default is false.
XCmd_SelA	BOOL	External command to select sensor A PV. Default is false.

Public Input Members	Data Type	Description
XCmd_SelB	BOOL	External command to select sensor B PV. Default is false.
XCmd_SelAvg	BOOL	External command to select average (A,B) PV. Default is false.
XCmd_SelMin	BOOL	External command to select minimum (A,B) PV. Default is false.
XCmd_SelMax	BOOL	External command to select maximum (A,B) PV. Default is false.
XCmd_Reset	BOOL	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output - System Defined Parameter
Val	REAL	Selected analog PV , including substitute PV, if used (PV units).
Val_PVA	REAL	Analog value (actual) from input A (PV units).
Val_PVB	REAL	Analog value (actual) from input B (PV units).
Val_AvgPV	REAL	Analog value average of input A and input B (PV units).
Val_MinPV	REAL	Analog value minimum of input A and input B (PV units).
Val_MaxPV	REAL	Analog value maximum of input A and input B (PV units).
Val_InpPV	REAL	Selected PV, before substitution, for example (PV units).
Val_Diff	REAL	Difference between input A and input B PVs (PV units).
Val_PVEUMin	REAL	Minimum of PV range = minimum (Cfg_PVEUMin, Cfg_PVEUMax) (PV units).
Val_PVEUMax	REAL	Maximum of PV range = maximum (Cfg_PVEUMin, Cfg_PVEUMax) (PV units).
Out_SmartDvcSts	DINT	Status code of a SMART device provided by Inp_SmartDvcASts or Inp_SmartDvcBSts. Highest status code selected.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_SmartDvcDiagAvailable	BOOL	1 = Diagnostics of a SMART device is currently available. Typically used to indicate one of the devices requires action to keep operating as expected.
Sts_PVASel	BOOL	1 = Input A selected for PV.
Sts_PVBSel	BOOL	1 = Input B selected as PV.
Sts_AvgSel	BOOL	1 = Average (A,B) selected as PV.
Sts_MinSel	BOOL	1 = Minimum (A,B) selected as PV.
Sts_MaxSel	BOOL	1 = Maximum (A,B) selected as PV.
Sts_PVBad	BOOL	1 = PV bad quality or out of range.
Sts_PVUncertain	BOOL	1 = PV value is uncertain (quality).
SrcQ_IOA	SINT	Source and quality of primary I/O (enumeration).
SrcQ_IOB	SINT	Source and quality of primary I/O (enumeration).
SrcQ_IO	SINT	Source and quality of primary I/O (enumeration).
SrcQ	SINT	Source and quality of primary Val or Sts (enumeration).
Sts_eSts	SINT	Device confirmed status (enum): 0 = PV Good, 1: PV Uncertain, 2: PV Bad.
Sts_eFault	INT	Device fault status (enum): 0 = None, 16 = One good PV, 19 = No good PV, 26 = High difference, 32 = Fail, 34 = Bad configuration.

Public Output Members	Data Type	Description
Sts_eNotify	SINT	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyOneGood	SINT	Only one good PV alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyNoneGood	SINT	No good PV alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyDiff	SINT	Input Difference alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFail	SINT	Fail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_Err	BOOL	1 = Error in config, see detail bits for reason.
Sts_ErrEU	BOOL	1 = Error in config: Cfg_PVEUMax cannot equal Cfg_PVEUMin.
Sts_ErrDiffDB	BOOL	1 = Error in configuration: Cfg_LoDevDB deadband is < 0.0.
Sts_ErrDiffGateDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrOoRDB	BOOL	1 = Error in configuration: Cfg_OoRDB deadband is < 0.0.
Sts_ErrAlm	BOOL	1 = Error in logix tag-based alarm settings.
Sts_Alm	BOOL	1 = An alarm is active.
Sts_AlmInh	BOOL	1 = An alarm is shelved or disabled.
Sts_OneGood	BOOL	1 = Only one good PV (other is bad or uncertain).
Sts_NoneGood	BOOL	1 = No good PV (both bad, or one bad or one uncertain).
Sts_DiffCmp	BOOL	Signal difference comparison result 1 = high difference.
Sts_DiffGate	BOOL	Signal difference gate delay status, 1 = done.
Sts_Diff	BOOL	1 = High signal difference detected.
Sts_Fail	BOOL	1 = Total signal failure (both bad or out of range).
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
XRdy_SelA	BOOL	1 = Ready for XCmd_SelA, enable HMI button.
XRdy_SelB	BOOL	1 = Ready for XCmd_SelB, enable HMI button.
XRdy_SelAvg	BOOL	1 = Ready for XCmd_SelAvg, enable HMI button.
XRdy_SelMin	BOOL	1 = Ready for XCmd_SelMin, enable HMI button.
XRdy_SelMax	BOOL	1 = Ready for XCmd_SelMax, enable HMI button.
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.
Val_Owner	DINT	Current object owner ID (0 = not owned).

Private Input Members	Data Type	Description
OCmd_Reset	BOOL	Operator command to reset all alarms requiring reset. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset and acknowledge all alarms. Default is false.
OCmd_SelA	BOOL	Operator command to select sensor A PV. Default is false.
OCmd_SelAvg	BOOL	Operator command to select average(A,B) PV. Default is false.
OCmd_SelB	BOOL	Operator command to select sensor B PV. Default is false.
OCmd_SelMax	BOOL	Operator command to select maximum(A,B) PV. Default is false.
OCmd_SelMin	BOOL	Operator command to select minimum(A,B) PV. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index. Default is 0.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables HMI button).
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll (enables HMI button).
ORdy_SelA	BOOL	1 = Ready for OCmd_SelA (enables HMI button).
ORdy_SelAvg	BOOL	1 = Ready for OCmd_SelAvg.
ORdy_SelB	BOOL	1 = Ready for OCmd_SelB (enables HMI button).
ORdy_SelMax	BOOL	1 = Ready for OCmd_SelMax (enables HMI button).
ORdy_SelMin	BOOL	1 = Ready for OCmd_SelMin (enables HMI button).

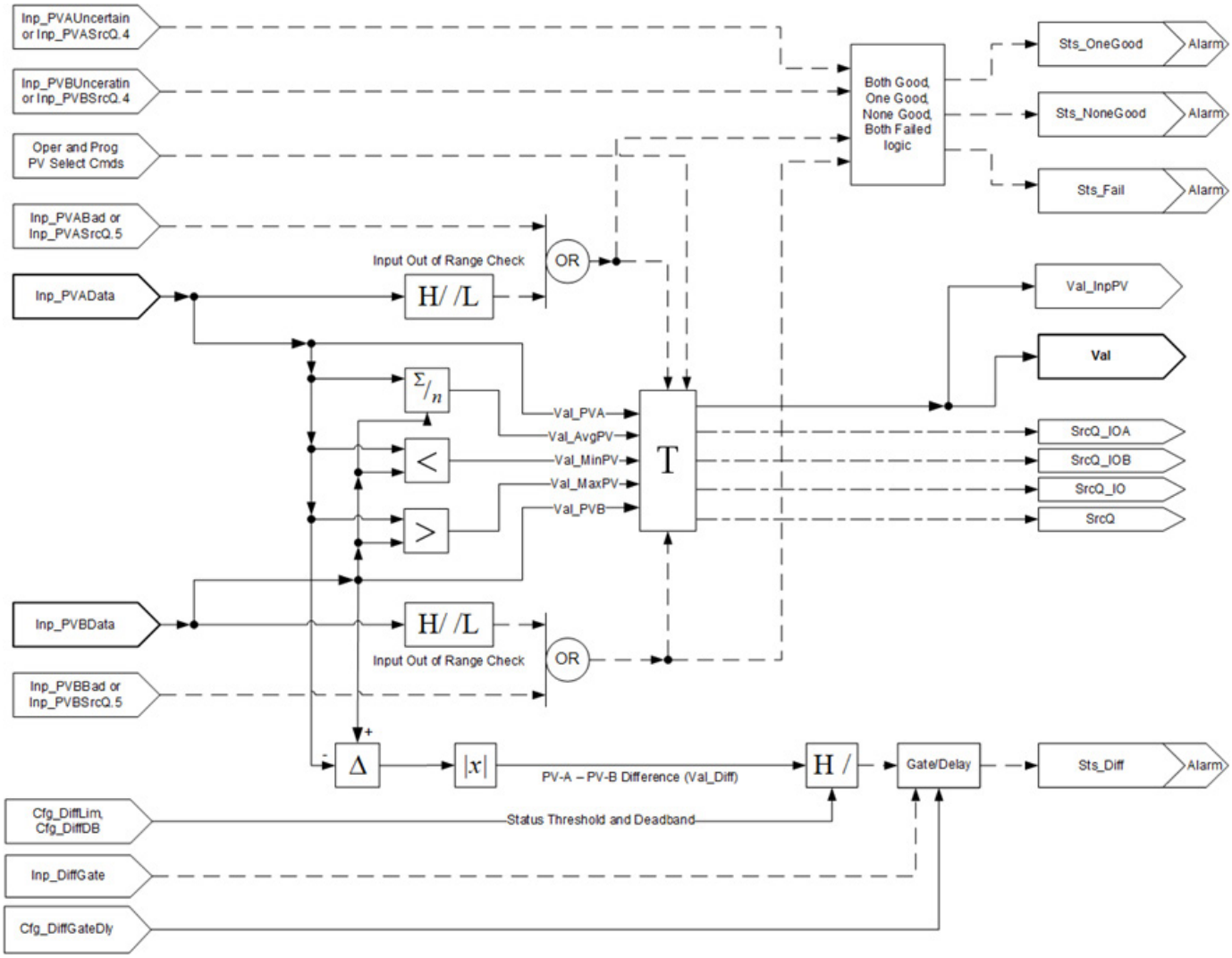
Public InOut Members	Data Type	Description
BusObj	BUS_OBJ	Bus component

BUS_OBJ Structure

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Operation

This diagram illustrates the functionality of the PAID instruction:



Alarms

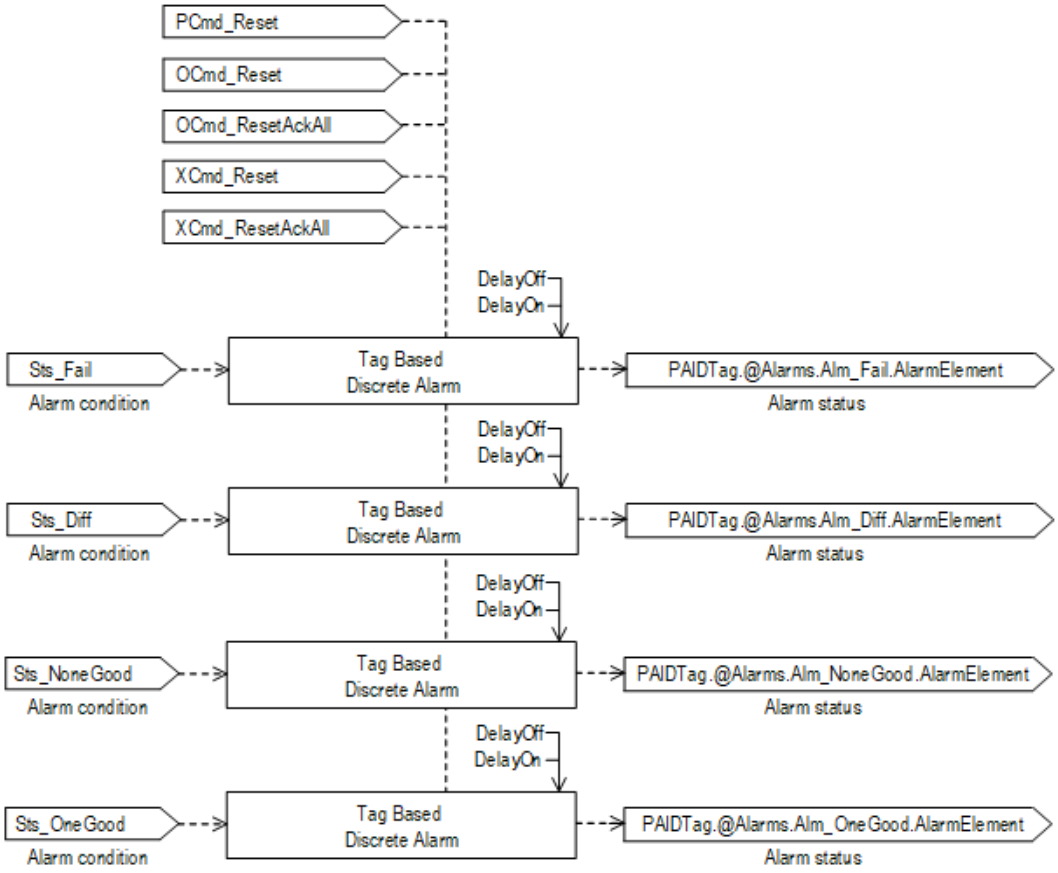
Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_Fail	Alm_Fail	Raised when the two sensor PVs are bad or out of range.
Sts_Diff	Alm_Diff	Raised when a high signal difference is detected between the two sensors PVs exceeds a configured limit.
Sts_NoneGood	Alm_NoneGood	Raised when neither PV has good quality (for example, if both are uncertain).
Sts_OneGood	Alm_OneGood	Raised when only one PV has a good quality.

Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format:

PAIDTag.@Alarms.AlarmName.AlarmElement

There are Program, Operator, and External commands that enable the Reset and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PDO instruction.



Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the Logix Designer configuration dialog box.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link

- More Information
- Selected Analog PV engineering units – Units metadata of Val member, Val.@Units.
- Analog input A description – Label metadata of Inp_PVADataData member, Inp_PVADataData.@Label.
- Analog input B description – Label metadata of Inp_PVBDataData member, Inp_PVBDataData.@Label.
- Allow Navigation Object Tag Name Output – Navigation metadata of PAID member Val tag.
- Allow Navigation Object Tag Name Input A – Navigation metadata of PAID member Inp_PVADataData tag.
- Allow Navigation Object Tag Name Input B – Navigation metadata of PAID member Inp_PVBDataData tag

Monitor the PAID Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out clears to false.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. The instruction executes normally.

Condition/State	Action Taken
Rung-condition-in is false	Rung-condition-out is cleared to false. All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. Latched alarms are reset. Clear Bus Object commands and HMI Bus Object Index Execute Bus command on receipt for Disable, Enable, Suppress, Unsuppress all alarms. Execute Bus command status propagation. Internal timers are reset.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. Latched alarms are reset. Clear Bus Object commands and HMI Bus Object Index Execute Bus command on receipt for Disable, Enable, Suppress, Unsuppress all alarms. Execute Bus command status propagation. Internal timers are reset.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

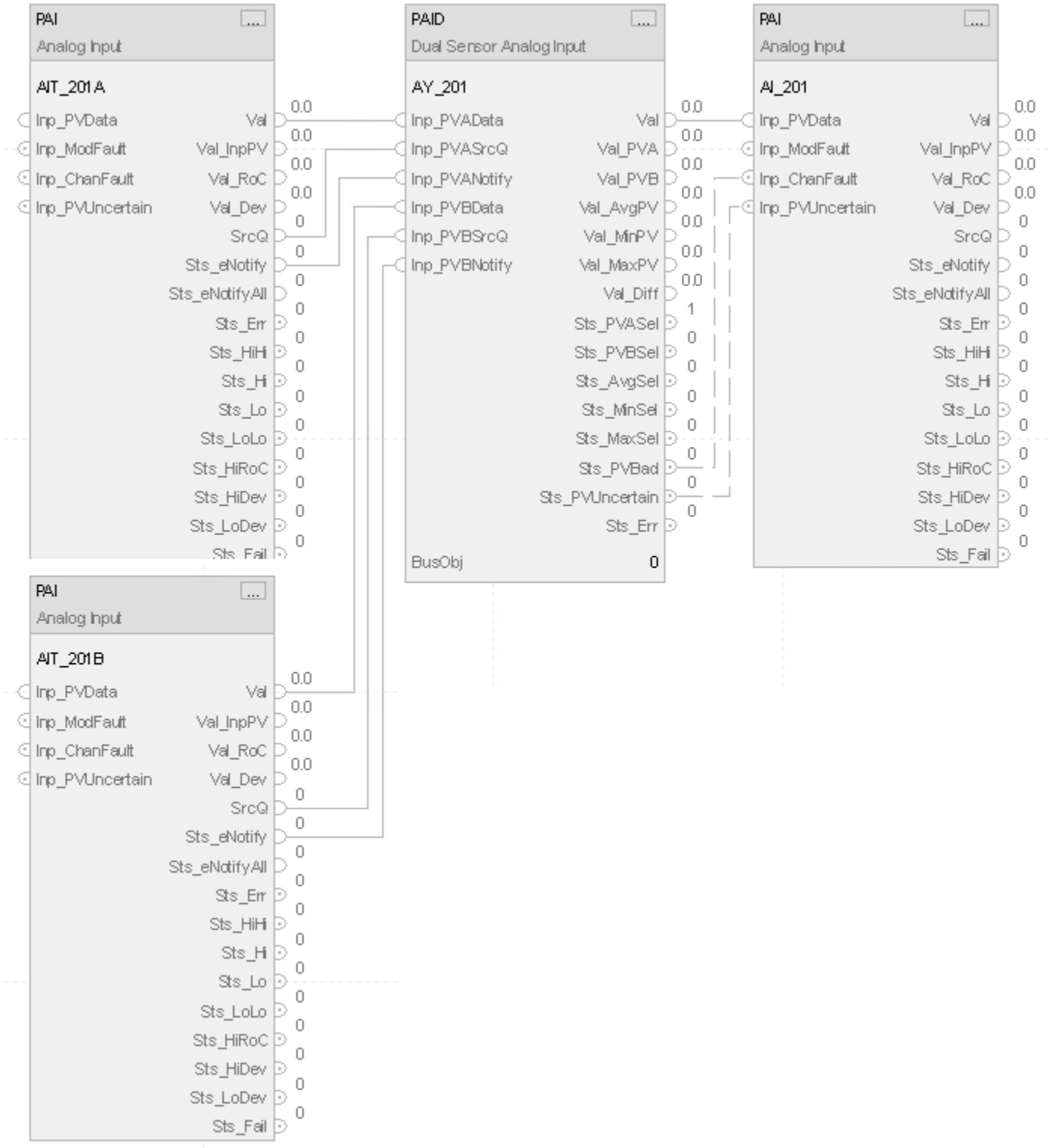
This example uses the PAID instruction to monitor one analog Process Variable (PV) using two analog input signals (dual sensors, dual transmitters). The PAID instruction allows you to select one sensor, the other sensor, or the average, minimum or maximum of either sensors. If difference between the two input signals exceeds a configured limit, an Alarm is generated.

In this example, an application uses two analog sensors (A, B). The average of these analogs is used elsewhere in logic to control a separate application element.

The Inp_PVAData and Inp_PVBData parameters are connected to the values from the two analog transmitters. The fault status of each of these sensors is tied to the bad input of the instruction (for example, Inp_PVABad). The output parameters Val, Sts_PVBad and Sts_PVUncertain, can then be connected to the Inp_PVData, Inp_PVUncertain and Inp_ChanFault for control.

Ladder Diagram

Function Block Diagram



Structured Text

```
PAI(AIT_201A);
```

```
PAI(AIT_201B);

AY_201.Inp_PVAData := AIT_201A.Val;

AY_201.Inp_PVASrcQ := AIT_201A.SrcQ;

AY_201.Inp_PVANotify := AIT_201A.Sts_eNotify;

AY_201.Inp_PVBData := AIT_201B.Val;

AY_201.Inp_PVBSrcQ := AIT_201B.SrcQ;

AY_201.Inp_PVBNotify := AIT_201B.Sts_eNotify;

PAID(AY_201,0);

AI_201.Inp_PVData := AY_201.Val;

AI_201.Inp_ChanFault := AY_201.Sts_PVBad;

AI_201.Inp_PVUncertain := AY_201.Sts_PVUncertain;

PAI(AI_201);
```

Process Multi Sensor Analog Input (PAIM)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Multi Sensor Analog Input (PAIM) instruction monitors one analog process variable (PV) by using up to eight analog input signals from sources such as sensors, transmitters, and input channels. The PAIM instruction has functions for input selection, averaging, and failure detection. Additional functions, such as filtering and alarming, are done by a downstream PAI block.

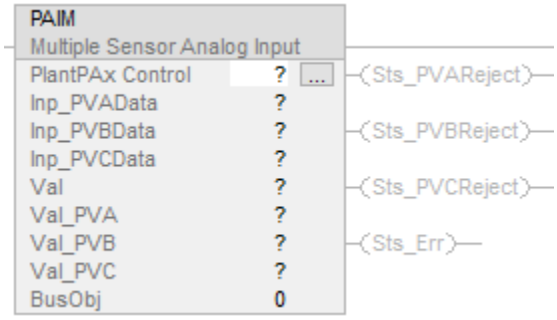
The PAIM instruction provides:

- Configuration to use between two and eight input signals.
- Input Source and Quality monitoring of inputs, plus monitoring of each signal for out of range condition. Rejection from the PV calculation of inputs that are out of range, flagged as bad, infinite, or not a number (floating-point exception values).
- Calculation of the average (mean) or median of the inputs in use as the PV value.
- Selectable rejection from the PV calculation of inputs that are outside tau standard deviations from the mean, with a minimum of four required inputs, or inputs that are outside a user-defined deviation from the mean.
- Configuration of the minimum number of good, unrejected input signals required to have a good PV value, and an alarm if the required number of good inputs is not met.
- Configuration of which PV to use if there are only two unrejected signals remaining: the lesser, the greater, or the average of the two.
- An alarm if any inputs configured to be used are rejected.

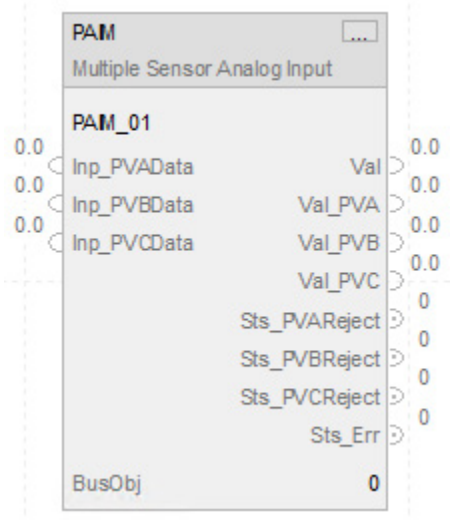
- An alarm if the number of unrejected inputs is equal to the minimum number required to be good, meaning the next input failure results in a PV failure.
- Display elements, plus a faceplate with bar graph PV indication, mode selection, alarm limit entry and alarm display, configuration, acknowledgment, trending, and maintenance and engineering configuration and setup.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PAIM (PAIMTag, o);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_ANALOG_INPUT_MULTI	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component

P_ANALOG_INPUT_MULTI Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_PVAData	REAL	Visible	Not Required	Input	PV signal from sensor or input A (PV units). Valid = any float. Default is 0.0.
Inp_PVASrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel A object, if available (enumeration). Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_PVANotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcASts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVAData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVBData	REAL	Visible	Not Required	Input	PV signal from sensor or input B (PV units). Valid = any float. Default is 0.0.
Inp_PVBSrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel B object, if available (enumeration). Default is 0.
Inp_PVBNotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcBSts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVBData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVCData	REAL	Visible	Not Required	Input	PV signal from sensor or input C (PV units). Valid = any float. Default is 0.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_PVCSrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel C object, if available (enumeration). Default is 0.
Inp_PVCNotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcCSts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVCData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVDData	REAL	Not Visible	Not Required	Input	PV signal from sensor or input D (PV units). Valid = any float. Default is 0.0.
Inp_PVDSrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel D object, if available (enumeration). Default is 0.
Inp_PVDNotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcDSts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVDData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_PVEData	REAL	Not Visible	Not Required	Input	PV signal from sensor or input E (PV units). Valid = any float. Default is 0.0.
Inp_PVESrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel E object, if available (enumeration). Default is 0.
Inp_PVENotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcESts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVEData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVFData	REAL	Not Visible	Not Required	Input	PV signal from sensor or input F (PV units). Valid = any float. Default is 0.0.
Inp_PVFSrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel F object, if available (enumeration). Default is 0.
Inp_PVFNotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_SmartDvcFSts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVFData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVGData	REAL	Not Visible	Not Required	Input	PV signal from sensor or input G (PV units). Valid = any float. Default is 0.0.
Inp_PVGSrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel G object, if available (enumeration). Default is 0.
Inp_PVGNotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcGSts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVGData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVHData	REAL	Not Visible	Not Required	Input	PV signal from sensor or input H (PV units). Valid = any float. Default is 0.0.
Inp_PVHSrcQ	SINT	Not Visible	Not Required	Input	Input source and quality, from channel H object, if available (enumeration). Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_PVHNotify	SINT	Not Visible	Not Required	Input	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_SmartDvcHSts	DINT	Not Visible	Not Required	Input	Current code provided by SMART device on Inp_PVHData. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_PVABad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input A 1 = Bad, 0 = OK. Default is false.
Inp_PVAUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input A, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcADiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVAData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVBBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input B 1 = Bad, 0 = OK. Default is false.
Inp_PVBUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input B, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcBDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVBData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVCBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input C 1 = Bad, 0 = OK. Default is false.
Inp_PVCUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input C, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcCDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVCData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVDBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input D 1 = Bad, 0 = OK. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_PVDUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input D, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcDDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVDData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVEBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input E 1 = Bad, 0 = OK. Default is false.
Inp_PVEUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input E, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcEDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVEData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVFBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input F 1 = Bad, 0 = OK. Default is false.
Inp_PVFUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input F, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcFDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVFData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVGBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input G 1 = Bad, 0 = OK. Default is false.
Inp_PVGUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input G, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcGDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVGData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Inp_PVHBad	BOOL	Not Visible	Not Required	Input	Signal quality or communication status for input H 1 = Bad, 0 = OK. Default is false.
Inp_PVHUncertain	BOOL	Not Visible	Not Required	Input	Signal quality for input H, 1 = Uncertain, 0 = OK. Default is false.
Inp_SmartDvcHDiagAvailable	BOOL	Not Visible	Not Required	Input	1 = SMART device on Inp_PVHData diagnostics available. Typically used to indicate device requires action to keep operating as expected. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow operator to shelve alarms. Default is true.
Cfg_HasPVA	BOOL	Not Visible	Not Required	Input	1 = Inp_PVAData is connected in logic. Default is true.
Cfg_HasPVB	BOOL	Not Visible	Not Required	Input	1 = Inp_PVBData is connected in logic. Default is true.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasPVC	BOOL	Not Visible	Not Required	Input	1 = Inp_PVCData is connected in logic. Default is true.
Cfg_HasPVD	BOOL	Not Visible	Not Required	Input	1 = Inp_PVDData is connected in logic. Default is false.
Cfg_HasPVE	BOOL	Not Visible	Not Required	Input	1 = Inp_PVEData is connected in logic. Default is false.
Cfg_HasPVF	BOOL	Not Visible	Not Required	Input	1 = Inp_PVFData is connected in logic. Default is false.
Cfg_HasPVG	BOOL	Not Visible	Not Required	Input	1 = Inp_PVGData is connected in logic. Default is false.
Cfg_HasPVH	BOOL	Not Visible	Not Required	Input	1 = Inp_PVHData is connected in logic. Default is false.
Cfg_UsePVA	BOOL	Not Visible	Not Required	Input	1 = Inp_PVAData should be used in PV calculation if good. Default is true.
Cfg_UsePVB	BOOL	Not Visible	Not Required	Input	1 = Inp_PVBData should be used in PV calculation if good. Default is true.
Cfg_UsePVC	BOOL	Not Visible	Not Required	Input	1 = Inp_PVCData should be used in PV calculation if good. Default is true.
Cfg_UsePVD	BOOL	Not Visible	Not Required	Input	1 = Inp_PVDData should be used in PV calculation if good. Default is false.
Cfg_UsePVE	BOOL	Not Visible	Not Required	Input	1 = Inp_PVEData should be used in PV calculation if good. Default is false.
Cfg_UsePVF	BOOL	Not Visible	Not Required	Input	1 = Inp_PVFData should be used in PV calculation if good. Default is false.
Cfg_UsePVG	BOOL	Not Visible	Not Required	Input	1 = Inp_PVGData should be used in PV calculation if good. Default is false.
Cfg_UsePVH	BOOL	Not Visible	Not Required	Input	1 = Inp_PVHData should be used in PV calculation if good. Default is false.
Cfg_RejectUncertain	BOOL	Not Visible	Not Required	Input	1 = Reject an input if its quality is uncertain. Default is false.
Cfg_UseStdDev	BOOL	Not Visible	Not Required	Input	1 = Reject outside tau standard deviations; 0 = Reject ouside Cfg_AbsDev from mean. Default is false.
Cfg_CalcAvg	BOOL	Not Visible	Not Required	Input	1 = Calculate average of good inputs; 0 = calculate median of good inputs. Default is false.
Cfg_UseInpSrcQPVA	BOOL	Not Visible	Not Required	Input	1 = Use PVA SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVB	BOOL	Not Visible	Not Required	Input	1 = Use PVB SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVC	BOOL	Not Visible	Not Required	Input	1 = Use PVC SrcQ input for rejection decisions. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_UseInpSrcQPVD	BOOL	Not Visible	Not Required	Input	1 = Use PVD SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVE	BOOL	Not Visible	Not Required	Input	1 = Use PVE SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVF	BOOL	Not Visible	Not Required	Input	1 = Use PVF SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVG	BOOL	Not Visible	Not Required	Input	1 = Use PVG SrcQ input for rejection decisions. Default is false.
Cfg_UseInpSrcQPVH	BOOL	Not Visible	Not Required	Input	1 = Use PVH SrcQ input for rejection decisions. Default is false.
Cfg_HasPVNav	BOOL	Not Visible	Not Required	Input	1 = Tells HMI to enable navigation to a connected PV (Val) object. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available. Default is false.
Cfg_HasNav	SINT	Not Visible	Not Required	Input	Set bits indicate which navigation buttons are enabled .0=PVA, .1=PVB, ..., .7=PVH Default is 0.
Cfg_MinGood	DINT	Not Visible	Not Required	Input	Minimum good inputs for good PV [1..number of "Cfg_Has" inputs]. Default is 2.
Cfg_CalcWhen2	DINT	Not Visible	Not Required	Input	PV calculation when only 2 good inputs: 0 = average, 1 = minimum, 2 = maximum. Default is 0.
Cfg_PVEUMin	REAL	Not Visible	Not Required	Input	PV (Output) minimum for display PV units. Valid = any float. Default is 0.0.
Cfg_PVEUMax	REAL	Not Visible	Not Required	Input	PV (Output) maximum for display PV units. Valid = any float. Default is 100.0.
Cfg_AbsDevLim	REAL	Not Visible	Not Required	Input	Absolute deviation threshold for PV units. Valid = any nonnegative float: reject ouside this deviation from mean. Default is 10.0.
Cfg_OoRHiLim	REAL	Not Visible	Not Required	Input	Out-of-range (fail) high limit for PV units. Valid = any float). Default is 103.958336.
Cfg_OoRLoLim	REAL	Not Visible	Not Required	Input	Out-of-range (fail) low limit for PV units. Valid = any float. Default is -2.0833333.
Cfg_OoRDB	REAL	Not Visible	Not Required	Input	Out-of-range (fail) deadbandfor PV units. Valid = any nonnegative float. Default is 0.41666666.
Cfg_PVDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for PV display. Valid = 0,1,2,3,4,5,6. Default is 2.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program owner request ID (non-zero) or release (zero) (Valid = any integer). Default is 0.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program command to reset all alarms requiring Reset. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter
Val	REAL	Visible	Not Required	Output	Selected analog PV (including substitute PV, if used) (PV units).
Val_PVA	REAL	Visible	Not Required	Output	Analog value (actual) from input A (PV units).
Val_PVB	REAL	Visible	Not Required	Output	Analog value (actual) from input B (PV units).
Val_PVC	REAL	Visible	Not Required	Output	Analog value (actual) from input C (PV units).
Val_PVD	REAL	Not Visible	Not Required	Output	Analog value (actual) from input D (PV units).
Val_PVE	REAL	Not Visible	Not Required	Output	Analog value (actual) from input E (PV units).
Val_PVF	REAL	Not Visible	Not Required	Output	Analog value (actual) from input F (PV units).
Val_PVG	REAL	Not Visible	Not Required	Output	Analog value (actual) from input G (PV units).
Val_PVH	REAL	Not Visible	Not Required	Output	Analog value (actual) from input H (PV units).
Val_InpPV	REAL	Not Visible	Not Required	Output	Selected PV (PV units).
Val_PVEUMin	REAL	Not Visible	Not Required	Output	Minimum of PV range = Min (Cfg_PVEUMin, Cfg_PVEUMax) (PV units).
Val_PVEUMax	REAL	Not Visible	Not Required	Output	Maximum of PV range = Max (Cfg_PVEUMin, Cfg_PVEUMax) (PV units).
Out_SmartDvcSts	DINT	Not Visible	Not Required	Output	Status code of a SMART device provided by Inp_SmartDvcASts or Inp_SmartDvcBSts or Inp_SmartDvcCSts or Inp_SmartDvcDSts or Inp_SmartDvcESts or Inp_SmartDvcFSts or Inp_SmartDvcGSts or Inp_SmartDvcHSts. Highest status code selected.
Val_NumPVs	DINT	Not Visible	Not Required	Output	Number of PVs that are currently used in calculating Val_CalcPV.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_SmartDvcDiagAvailable	BOOL	Not Visible	Not Required	Output	1 = Diagnostics of a SMART device is currently available. Typically used to indicate one of the devices requires action to keep operating as expected.
Sts_PVBad	BOOL	Not Visible	Not Required	Output	1 = At least one input channel PV is bad quality or out of range.
Sts_PVUncertain	BOOL	Not Visible	Not Required	Output	1 = At least one input channel PV value is uncertain quality.
Sts_PVAReject	BOOL	Visible	Not Required	Output	1 = Input A rejected, not used to calculate PV.
Sts_PVBReject	BOOL	Visible	Not Required	Output	1 = Input B rejected, not used to calculate PV.
Sts_PVCReject	BOOL	Visible	Not Required	Output	1 = Input C rejected, not used to calculate PV.
Sts_PVDReject	BOOL	Not Visible	Not Required	Output	1 = Input D rejected, not used to calculate PV.
Sts_PVEReject	BOOL	Not Visible	Not Required	Output	1 = Input E rejected, not used to calculate PV.
Sts_PVFReject	BOOL	Not Visible	Not Required	Output	1 = Input F rejected, not used to calculate PV.
Sts_PVGReject	BOOL	Not Visible	Not Required	Output	1 = Input G rejected, not used to calculate PV.
Sts_PVHReject	BOOL	Not Visible	Not Required	Output	1 = Input H rejected, not used to calculate PV.
SrcQ_IOA	SINT	Not Visible	Not Required	Output	Source and quality of Input A (enumeration).
SrcQ_IOB	SINT	Not Visible	Not Required	Output	Source and quality of Input B (enumeration).
SrcQ_IOC	SINT	Not Visible	Not Required	Output	Source and quality of Input C (enumeration).
SrcQ_IOD	SINT	Not Visible	Not Required	Output	Source and quality of Input D (enumeration).
SrcQ_IOE	SINT	Not Visible	Not Required	Output	Source and quality of Input E (enumeration).
SrcQ_IOF	SINT	Not Visible	Not Required	Output	Source and quality of Input F (enumeration).
SrcQ_IOG	SINT	Not Visible	Not Required	Output	Source and quality of Input G (enumeration).
SrcQ_IOH	SINT	Not Visible	Not Required	Output	Source and quality of Input H (enumeration).
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of calculated PV (enumeration).
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary Val/Sts (enumeration).
Sts_eSts	SINT	Not Visible	Not Required	Output	Device confirmed status (enum): 0 = PV Good, 1: PV Uncertain, 2: PV Bad.
Sts_eFault	INT	Not Visible	Not Required	Output	Device fault status (enum): 0 = None, 17 = Any Reject, 18 = Min Good, 32 = Fail, 34 = Bad Config.
Sts_eNotify	SINT	Not Visible	Not Required	Output	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAnyReject	SINT	Not Visible	Not Required	Output	Any Reject alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyMinGood	SINT	Not Visible	Not Required	Output	Min Good alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFail	SINT	Not Visible	Not Required	Output	Fail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Device has a maintenance bypass function active.
Sts_Err	BOOL	Visible	Not Required	Output	1 = Error in config, see detail bits for reason.
Sts_ErrEU	BOOL	Not Visible	Not Required	Output	1 = Error in config: Cfg_PVEUMax cannot equal Cfg_PVEUMin.
Sts_ErrHas	BOOL	Not Visible	Not Required	Output	1 = Error in config: at least one Cfg_HasPVx must be 1.
Sts_ErrUse	BOOL	Not Visible	Not Required	Output	1 = Error in config: at least one Cfg_UsePVx must be 1.
Sts_ErrMinGood	BOOL	Not Visible	Not Required	Output	1 = Error in config: Cfg_MinGood must be in the range [1..8].
Sts_ErrOoRDB	BOOL	Not Visible	Not Required	Output	1 = Error in configuration: Cfg_OoRDB deadband is < 0.0.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in logix tag-based alarm settings.
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = An alarm is shelved, disabled or suppressed: display icon.
Sts_AnyReject	BOOL	Not Visible	Not Required	Output	1 = At least one input has been rejected.
Sts_MinGood	BOOL	Not Visible	Not Required	Output	1 = At minimum required number of good inputs, next reject/fail will result in bad PV.
Sts_Fail	BOOL	Not Visible	Not Required	Output	1 = Total signal failure (too many inputs rejected).
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Not Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable HMI button.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object owner ID (0 = not owned).

Private Input Members	Data Type	Description
OCmd_Reset	BOOL	Operator command to reset all alarms requiring reset. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset and acknowledge all alarms. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index. Default is 0.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables HMI button).
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll (enables HMI button).

Public InOut Members	Data Type	Description
BusObj	BUS_OBJ	Bus component

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component

BUS_OBJ Structure

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgment
Out_CmdAck	DINT	Resultant command acknowledgments
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete tag-based alarms are defined for these members.

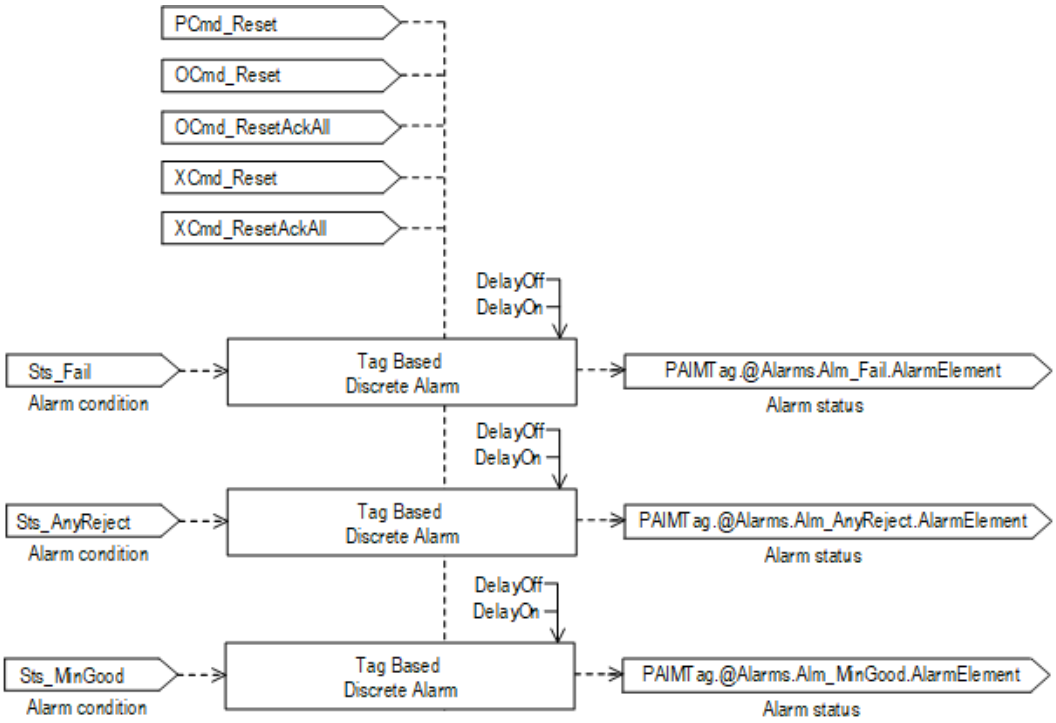
Member	Alarm name	Description
Sts_Fail	Alm_Fail	Raised when the two sensor PVs are bad or out of range.
Sts_AnyReject	Alm_AnyReject	Raised when any inputs configured to be used are rejected.
Sts_MinGood	Alm_MinGood	Raised when the number of unrejected input is equal to the minimum number required to be good, meaning the next input failure results in a PV failure.

Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format:

PAIMTag.@Alarms.AlarmName.AlarmElement

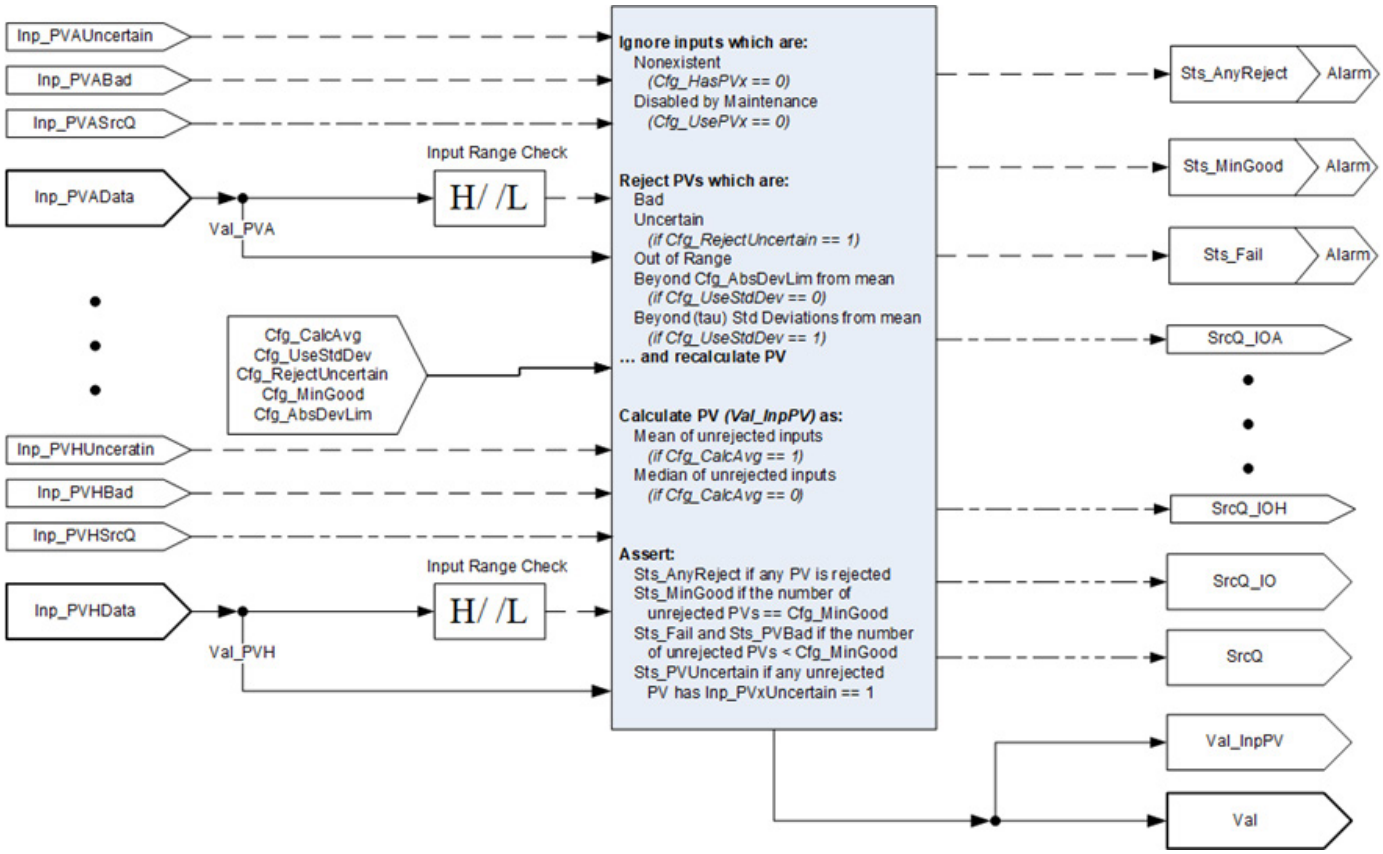
There are Program, Operator, and External commands that enable the Reset and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the

same time. This diagram shows how the commands interact with the PAIM instruction.



Operation

This diagram illustrates the functionality of the PAIM instruction:



Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- More Information

- Selected Analog PV engineering units – Units of Val member, Val.@Units.
- Analog input A description – Description of Inp_PVAData member, Inp_PVAData.@Label.
- Analog input B description – Description of Inp_PVBData member, Inp_PVBData.@Label
- Analog input C description – Description of Inp_PVCData member, Inp_PVCData.@Label.
- Analog input D description – Description of Inp_PVDData member, Inp_PVDData.@Label.
- Analog input E description – Description of Inp_PVEData member, Inp_PVEData.@Label.
- Analog input F description – Description of Inp_PVFData member, Inp_PVFData.@Label.
- Analog input G description – Description of Inp_PVGData member, Inp_PVGData.@Label.
- Analog input H description – Description of Inp_PVHData member, Inp_PVHData.@Label.
- Analog input A navigation – Navigation metadata of Inp_PVAData member.
- Analog input B navigation – Navigation metadata of Inp_PVBData member.
- Analog input C navigation – Navigation metadata of Inp_PVCData member.
- Analog input D navigation – Navigation metadata of Inp_PVDData member.
- Analog input E navigation – Navigation metadata of Inp_PVEData member.
- Analog input F navigation – Navigation metadata of Inp_PVFData member.
- Analog input G navigation – Navigation metadata of Inp_PVGData member.
- Analog input H navigation – Navigation metadata of Inp_PVHData member.

Monitor the PAIM Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out clears to false.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. Ensure the constants for the Thompson Tau test logic have not been zeroed out. The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false. All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. Latched alarms are reset. Clear Bus Object commands and HMI Bus Object Index Execute Bus command on receipt for Disable, Enable, Suppress, Unsuppress all alarms. Execute Bus command status propagation. Internal timers are reset.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. Ensure the constants for the Thompson Tau test logic have not been zeroed out. The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.

Condition/State	Action Taken
EnableIn is false	EnableOut is cleared to false. All commands that are automatically cleared on each execution are cleared and ignored. PSet_Owner and Val_Owner are set to 0. Latched alarms are reset. Clear Bus Object commands and HMI Bus Object Index Execute Bus command on receipt for Disable, Enable, Suppress, Unsuppress all alarms. Execute Bus command status propagation. Internal timers are reset.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

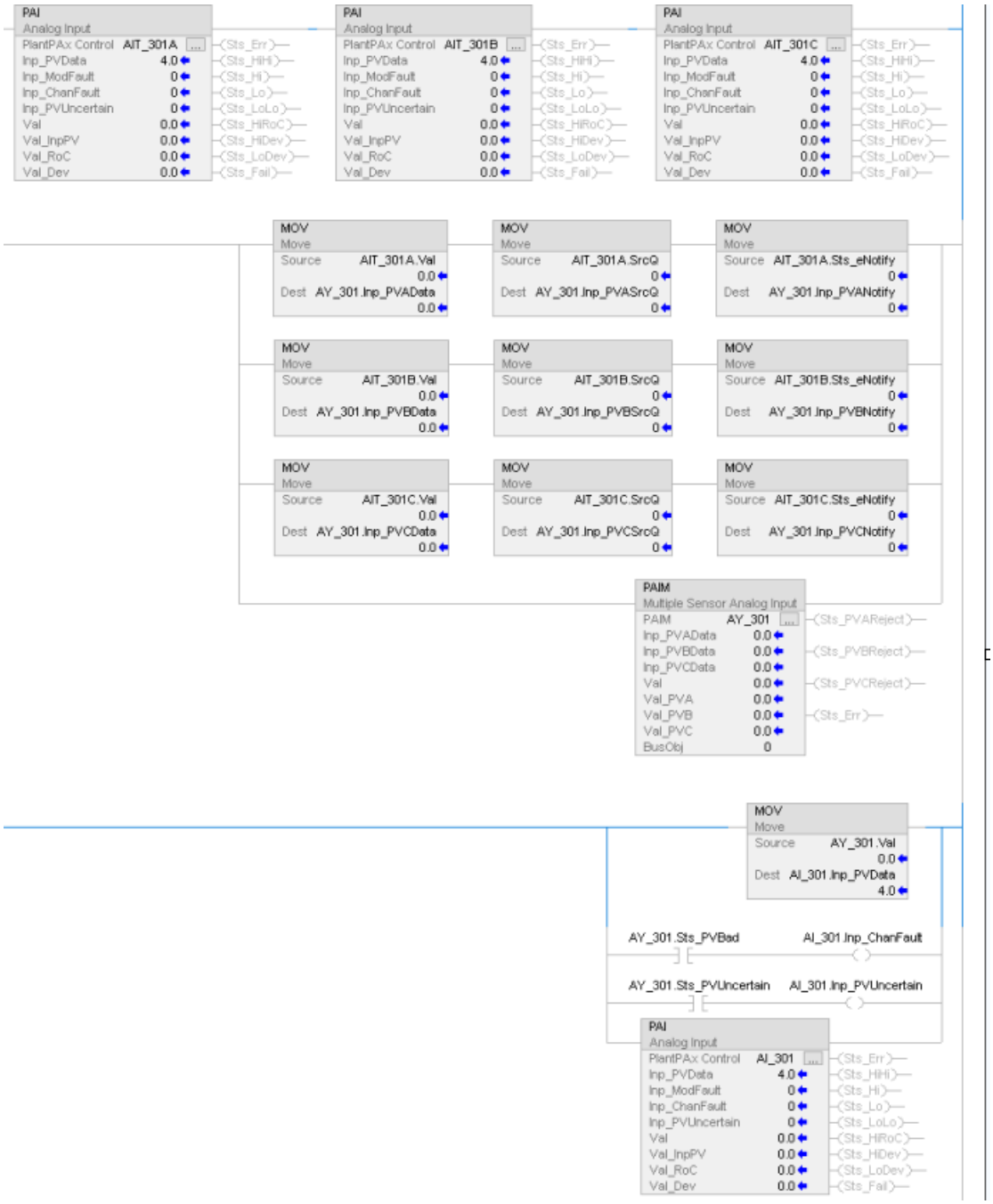
The example uses the PAIM instruction to monitor one analog Process Variable (PV) by using up to eight analog input signals (sensors, transmitters). The PAIM instruction allows you to display a temperature, pressure, level, or other PV on a user interface or use the PV in control logic, and the following apply:

- Have three or more sensors for that PV, for example, six thermocouples.
- Calculate a PV with the mean or median of the sensor input values.

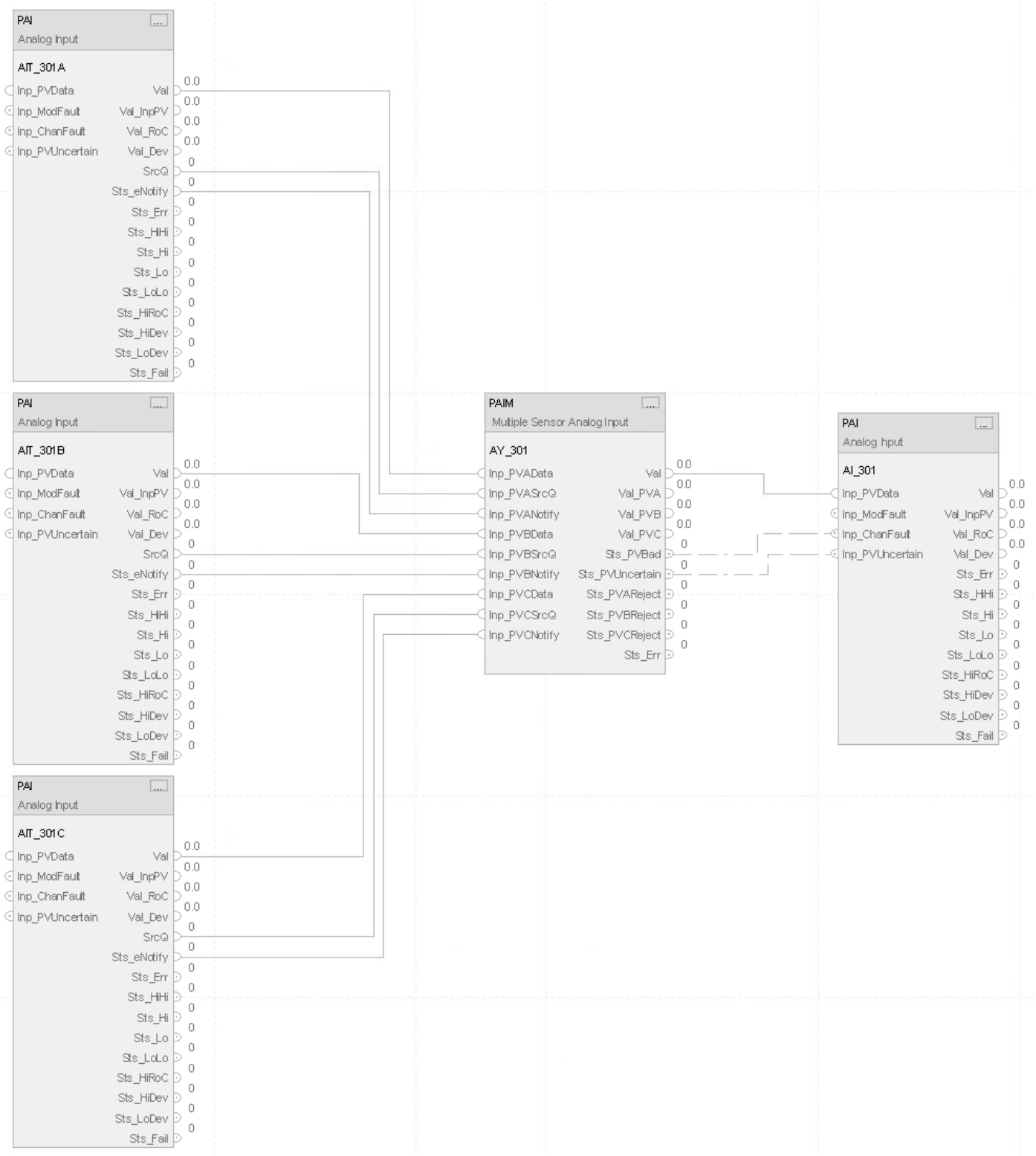
The example uses the PAIM instruction to average multiple sensors for a single PV. In this example, an application uses three analog sensors (A, B, C). The average of these analogs is used elsewhere in logic to control a separate application element.

The Inp_PVAData, Inp_PVBData, and Inp_PVCData parameters are connected to the values from the three analog transmitters. The fault status of each sensor is tied to the bad input of the PAIM (for example, Inp_PVABad). The output parameters Val, Sts_PVBad and Sts_PVUncertain, can then be connected to the Inp_PVData, Inp_PVUncertain and Inp_ChanFault for control.

Ladder Diagram



Function Block Diagram



Structured Text

PAI(AIT_301A);

```
PAI(AIT_301B);
PAI(AIT_301C);
AY_301.Inp_PVAData := AIT_301A.Val;
AY_301.Inp_PVASrcQ := AIT_301A.SrcQ;
AY_301.Inp_PVANotify := AIT_301A.Sts_eNotify;
AY_301.Inp_PVBData := AIT_301B.Val;
AY_301.Inp_PVBSrcQ := AIT_301B.SrcQ;
AY_301.Inp_PVBNotify := AIT_301B.Sts_eNotify;
AY_301.Inp_PVCData := AIT_301C.Val;
AY_301.Inp_PVCSrcQ := AIT_301C.SrcQ;
AY_301.Inp_PVCNotify := AIT_301C.Sts_eNotify;
PAIM(AY_301);
AI_301.Inp_PVData := AY_301.Val;
AI_301.Inp_ChanFault := AY_301.Sts_PVBad;
AI_301.Inp_PVUncertain := AY_301.Sts_PVUncertain;
PAI(AI_301);
```

Process Analog Output (PAO)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Analog Output (PAO) instruction drives an analog output and checks for alarm conditions. Use the PAO instruction for a channel of an analog output module. Use the PAO instruction with any analog (REAL) signal.

The PAO instruction:

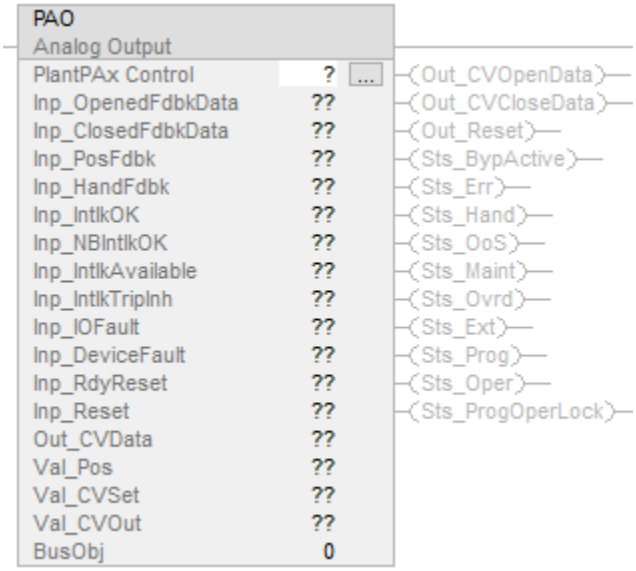
- Monitors one analog output channel for I/O fault input and raises alarm on an I/O fault.
- Operates in Hand, Out of Service, Maintenance, Override, Program, and Operator modes.
- Provides Operator and Program commands to set an Analog Control Variable (CV, or output) to a specific value. The entered CV is scaled from engineering units to raw (output module) units.
- Monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable).

Tip: An alarm initiates when an interlock causes the Analog Output CV to change. The PAO instruction enables bypassing interlocks.

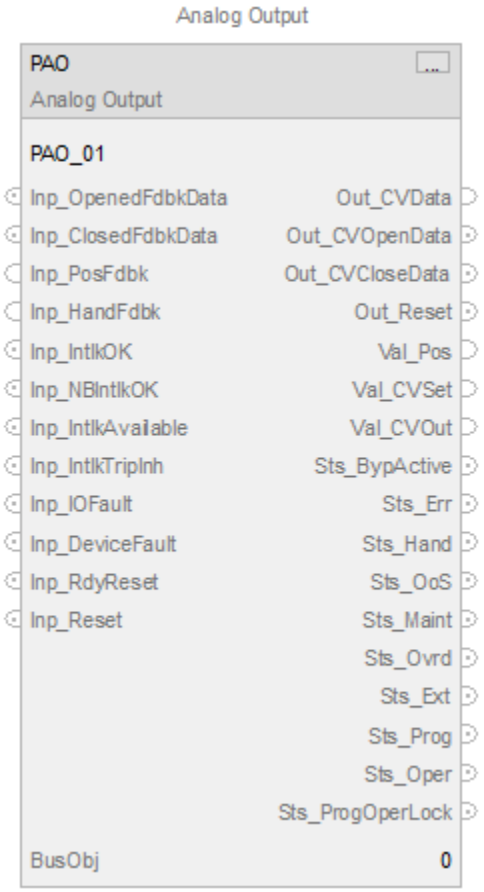
- Allows overriding CV in Override mode.
- Allows analog output ramping with configurable rate of change limits.
- Reads Tieback input (REAL) and a Hand mode request input (BOOL). When Hand mode is asserted, the CV is forced to follow the Tieback value.
- Provides an Available status, when in Program mode and operating normally, for use by higher-level automation logic to determine
- if the logic is able to manipulate the analog output.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PAO(PAO tag, BusObj);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See *Data Conversions*.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_ANALOG_OUTPUT	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component

P_ANALOG_OUTPUT Structure

Public members are standard, visible tag members that are programmatically accessible. Private, or hidden, members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request to re-initialize. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Owner device command. 0 = None, Inp_OwnerCmd.10 = Operator Lock, Inp_OwnerCmd.11 = Operator Unlock, Inp_OwnerCmd.12 = Program Lock, Inp_OwnerCmd.13 = Program Unlock, Inp_OwnerCmd.14 = Acquire Maintenance, Inp_OwnerCmd.15 = Release Maintenance, Inp_OwnerCmd.16 = Acquire External, Inp_OwnerCmd.17 = Release External. Default is 0.
Inp_OpenedFdbkData	BOOL	Feedback from opened limit switch of the device. 1 = Device confirmed opened. Default is false.
Inp_ClosedFdbkData	BOOL	Feedback from closed limit switch of the device. 1 = Device confirmed closed. Default is false.
Inp_PosFdbk	REAL	Feedback from actual device position PV (CV engineering units). Valid any float. Default is 0.0.
Inp_HandFdbk	REAL	CV feedback used in Hand source (CV engineering units). Valid any float. Default is 0.0.
Inp_IntlkOK	BOOL	1 = Bypassable and non-bypassable interlocks OK, analog output can be set. Default is true.
Inp_NBIntlkOK	BOOL	1 = Non-bypassable interlocks OK, analog output can be set if bypassable interlocks are bypassed. Default is true.
Inp_IntlkAvailable	BOOL	1 = Interlock availability OK. Default is false.
Inp_IntlkTripInh	BOOL	1 = Inhibit interlock trip status. Default is false.
Inp_SmartDvcSts	DINT	Current code provided by SMART device on Inp_PosFdbk. The code is copied to Out_SmartDvcSts allowing a user to monitor the device status on HMI for diagnostic lookup purposes. Valid = 0 to maximum positive number. Default is 0.
Inp_SmartDvcDiagAvailable	BOOL	1 = SMART Device diagnostics is available. Typically used to indicate device requires action to keep operating as expected. Default is false.

Public Input Members	Data Type	Description
Inp_IOFault	BOOL	Indicates the IO data is inaccurate. 0 = The IO data is good, 1 = The IO data is bad, causing fault. This input sets Sts_IOFault, if the device is not virtual, which raises IOFault Alarm. Default is false.
Inp_DeviceFault	BOOL	Indicates the device fault (overload, etc.). 0 = The device is good, 1 = The device is bad, causing fault. This input sets Sts_DeviceFault (if the device is not virtual) which raises Device alarm (if the device is not virtual). Default is false.
Inp_Hand	BOOL	1 = Acquire Hand (typically permanently set to local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	1 = Acquire Override (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCV	REAL	CV target in Override (engineering units). Valid any float. Default is 0.0.
Inp_ExtInh	BOOL	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Inp_RdyReset	BOOL	1 = Related object, reset by this object, is ready to be reset. Default is false.
Inp_Reset	BOOL	1 = Reset shed latches and cleared alarms. Default is false.
Cfg_AllowDisable	BOOL	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	1 = Allow Operator to shelve alarms. Default is true.
Cfg_StuckTime	REAL	Time with no change in input position while neither feedback from limit switch Closed nor Opened is on to raise stuck status (second). Valid = 0.0 to 2147483.0 seconds. Default is 60.0.
Cfg_HasSmartDvc	BOOL	1 = Enable a button on the HMI that could be used to call up a SMART Device faceplate (Diagnostics). Default is false.
Cfg_SetTrack	BOOL	1 = When the owner is Program the operator settings track the program settings. When the owner is Operator the program settings track the operator settings; and the virtual inputs match the output values (transitions are bumpless), 0 = No tracking. Default is true.
Cfg_ShedHold	BOOL	1 = Hold output on interlock. 0 = Go to Cfg_CVIntlk on interlock. Default is false.
Cfg_SkipRoCLim	BOOL	1 = Skip rate of change limiting in Maintenance or Override and on interlock. Default is false.
Cfg_SetTrackOvrdHand	BOOL	1 = Program/Operator settings track Override/Hand CV. Default is false.
Cfg_FdbkFail	BOOL	1 = Feedback from limit switches is invalid if both feedback inputs are set. 0 = Feedback from limit switches is invalid if both feedback inputs are cleared. Default is true.
Cfg_HasOpenedFdbk	BOOL	1 = Device provides opened feedback signal. Default is false.

Public Input Members	Data Type	Description
Cfg_HasClosedFdbk	BOOL	1 = Device provides closed feedback signal. Default is false.
Cfg_HasPosFdbk	BOOL	1 = Device provides position PV feedback signal. Default is true.
Cfg_UseOpenedFdbk	BOOL	1 = Use device opened feedback for failure checking. Default is false.
Cfg_UseClosedFdbk	BOOL	1 = Use device closed feedback for failure checking. Default is false.
Cfg_UsePosFdbk	BOOL	1 = Use device position PV feedback signal. Default is true.
Cfg_HasCombinedFdbk	BOOL	1 = Device provides opened, closed and position feedback signals to be used. Default is false.
Cfg_UseCombinedFdbk	BOOL	1 = Use device opened, closed and position feedback signals to determine the opened and closed status. The combined signals will be used for the position status. Default is false.
Cfg_HasPulseOut	BOOL	1 = Device provides pulse output (Open, Close). Default is false.
Cfg_HasOutNav	BOOL	1 = Tells HMI to enable navigation to a connected output object. Default is false.
Cfg_OvrdIntlk	BOOL	1 = Override bypasses (ignores) bypassable interlocks. 0 = Override abides by all interlock conditions. Default is false.
Cfg_ShedOnDeviceFault	BOOL	1 = Set output to interlock CV and alarm on Device fault. 0 = Alarm only on Device fault. Default is true.
Cfg_ShedOnIOFault	BOOL	1 = Set output to interlock CV and alarm on I/O fault. 0 = Alarm only on I/O fault. Default is true.
Cfg_CVLoLim	REAL	Minimum CV for limiting (engineering units). Valid any float less than or equal to Cfg_CVHiLim. Default is 0.0.
Cfg_CVHiLim	REAL	Maximum CV for limiting (engineering units). Valid any float greater than or equal to Cfg_CVLoLim. Default is 100.0.
Cfg_CVRoCIncrLim	REAL	Maximum allowed CV rate of change increasing value (CVEU/second). The CV rate of change is unlimited when increasing if Cfg_CVRoCIncrLim = 0.0. Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_CVRoCDecrLim	REAL	Maximum allowed CV rate of change decreasing value (engineering units/second). The CV rate of change is unlimited when decreasing if Cfg_CVRoCDecrLim = 0.0. Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_CVIntlk	REAL	CV target when interlocked, if not Cfg_ShedHold (engineering units). Valid any float. Default is 0.0.
Cfg_CVEUMin	REAL	CV minimum for scaling (engineering units). Valid any float not equal to Cfg_CVEUMax. Default is 0.0.
Cfg_CVEUMax	REAL	CV maximum for scaling (engineering units). Valid any float not equal to Cfg_CVEUMin. Default is 100.0.
Cfg_CVRawMin	REAL	CV minimum for scaling (I/O raw units). Valid any float not equal to Cfg_CVRawMax. Default is 0.0.
Cfg_CVRawMax	REAL	CV maximum for scaling (I/O raw units). Valid any float not equal to Cfg_CVRawMin. Default is 100.0.
Cfg_MaxInactiveCV	REAL	When Val_CVOut is greater than this value (CV engineering units) set Sts_Active (for HMI). Valid any float. Default is 0.0.

Public Input Members	Data Type	Description
Cfg_HiDevLim	REAL	High deviation (actual position minus target position) status threshold (engineering units). Valid = 0.0 to maximum positive float. Default is 1.50E+38.
Cfg_LoDevLim	REAL	Low deviation (actual position minus target position) status threshold (engineering units). Valid = -(maximum float) to 0.0. Default is -1.50E+38.
Cfg_DevDly	REAL	The minimum time (seconds) the deviation must remain above the upper (Cfg_HiDevLim) or below the lower (Cfg_LoDevLim) limit for the status Sts_Dev to be set. On-delay time is used to avoid unnecessary alarm when the deviation only briefly overshoots Cfg_HiDevLim or undershoots Cfg_LoDevLim. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_CycleTime	REAL	Open and Close pulse output overall period (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
Cfg_OpenRate	REAL	Rate at which device moves when opening (engineering units/second). Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CloseRate	REAL	Rate at which device moves when closing (engineering units/second). Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_MaxOnTime	REAL	Open and Close pulse output maximum On time (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 5.0.
Cfg_MinOnTime	REAL	Open and Close pulse output minimum On time (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 1.0.
Cfg_BumpTime	REAL	Time to bump device open or close (used when device position (PV) feedback is not available) (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_DeadTime	REAL	Additional time on first pulse after stop or direction change. Additional pulse time in seconds to overcome friction in the device. Deadtime is added to the open time or close time when the device changes direction or is stopped. Valid = 0.0 to Cfg_MaxOnTime seconds. Default is 0.0.
Cfg_MaxClosedPos	REAL	Position (PV value) above which device (valve) is assumed open if feedback from Opened limit switch is not used. Default is 0.0.
Cfg_HasIntlkObj	BOOL	1 = Tells HMI an interlock object (for example, P_Intlk) is used for Inp_IntlkOK and navigation to the interlock objects faceplate is enabled. **Important:** The name of the interlock object in the controller must be this PAO object's name with the suffix _Intlk. For example, if the PAO instruction has the name PAOut123, then its interlock object must be named PAOut123_Intlk. Default is false.
Cfg_HasOper	BOOL	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	1 = Operator Locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	1 = Program Locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	1 = Maintenance exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	1 = Maintenance Out of Service exists, can be selected. Default is true.

Public Input Members	Data Type	Description
Cfg_OvrdOverLock	BOOL	1 = Override supersedes Program/Operator Lock, 0 = Do not override Lock. Default is true.
Cfg_ExtOverLock	BOOL	1 = External supersedes Program/Operator Lock, 0 = Do not override Lock. Default is false.
Cfg_ProgPwrUp	BOOL	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Normal Source: 1 = Program if no requests; 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	1 = PCmd_Prog used as a Level. Default is false.
Cfg_PCmdLockAsLevel	BOOL	1 = PCmd_Lock used as a Level (1 = Lock, 0 = Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	1 = XCmd_Acq used as Level (1 = Acquire, 0 = Release). Default is false.
Cfg_CVDecPlcs	SINT	Number of decimal places for control variable display. Valid = 0 to 6. Default is 2.
Cfg_CnfrmReqd	SINT	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
Cfg_CVPwrUpSel	SINT	Selection of power up CV. 0 = Use Cfg_CVPwrUp, 1 = No change (from last power down), 2 = Use Inp_PosFdbk if available (Cfg_CVPwrUp otherwise). Default is 0.
Cfg_CVPwrUp	REAL	CV initial value used on power up (engineering units). Valid any float. Default is 0.0.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.
Cfg_HasPosFdbkNav	BOOL	1 = Tells HMI to enable navigation to a connected positive feedback object. Default is false.
Cfg_HasHistTrend	SINT	Has historical trend. This enables navigation to the device historical trend faceplate from the HMI. 0 = No external historical trend, 1 = Datalog historical trend, 2 = Historian historical trend. Default is 0.
PSet_CV	REAL	Program setting of controlled variable, output (engineering units). Valid any float. Default is 0.0.
PSet_Owner	DINT	Program owner request ID (non-zero) or release (zero). Default is 0.

Public Input Members	Data Type	Description
PCmd_Oper	BOOL	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Program command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Program command to select Normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_Virtual	BOOL	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
XSet_CV	REAL	External setting of controlled variable, output (engineering units). Default is 0.0.
XCmd_Acq	BOOL	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_BumpClose	BOOL	External command to bump device closed (used when device position feedback is not available). Default is false.
XCmd_BumpOpen	BOOL	External command to bump device open (used when device position feedback is not available). Default is false.
XCmd_Rel	BOOL	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output. This output state always reflects EnableIn input state.
Out_CVData	REAL	CV output in raw (I/O Card) units. Extended properties of this member: Engineering Unit - Raw units (text) used for the analog output.
Out_CVOpenData	BOOL	1 = Pulse output to drive device open.
Out_CVCloseData	BOOL	1 = Pulse output to drive device closed.

Public Output Members	Data Type	Description
Val_Dev	REAL	Calculated deviation value (actual position minus target position) (engineering units).
Val_Pos	REAL	Device actual position (PV) from feedback (in engineering units).
Val_CVSet	REAL	Value of selected CV setting before rate limiting, in engineering units.
Val_CVOut	REAL	Value of CV Output after optional rate limiting, in engineering units. Extended Properties of this member: Engineering Unit - Engineering units (text) used for the analog output.
Val_CVEUMin	REAL	Minimum of scaled range in engineering units = MIN (Cfg_CVEUMin, Cfg_CVEUMax).
Val_CVEUMax	REAL	Maximum of scaled range in engineering units = MAX (Cfg_CVEUMin, Cfg_CVEUMax).
Out_SmartDvcSts	DINT	Status code of a SMART Device provided by Inp_SmartDvcSts. Out_SmartDevSts is a copy of Inp_SmartDvcSts.
Out_OwnerSts	DINT	Status of command source, owner command handshake and ready status. 0 = None, Out_OwnerSts.10 = Operator Lock, Out_OwnerSts.11 = Operator Unlock, Out_OwnerSts.12 = Program Lock, Out_OwnerSts.13 = Program Unlock, Out_OwnerSts.14 = Acquire Maintenance, Out_OwnerSts.15 = Release Maintenance, Out_OwnerSts.16 = Acquire External, Out_OwnerSts.17 = Release External, Out_OwnerSts.18 = Has Maintenance, Out_OwnerSts.19 = External Override Lock, Out_OwnerSts.20 = Has External, Out_OwnerSts.21 = Has Operator, Out_OwnerSts.22 = Has Program, Out_OwnerSts.30 = Not Ready.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_SmartDvcDiagAvailable	BOOL	1 = Diagnostics of a SMART Device is currently available. Typically used to indicate device requires action to keep operating as expected. Sts_SmartDvcDiagAvailable is a copy of Inp_SmartDvcDiagAvailable.
Sts_CVInfNaN	BOOL	1 = Selected CV is infinite or not a number (1.$, 1.#NaN).
Sts_PosInfNaN	BOOL	1 = Inp_PosFdbk is infinite or not a number (1.$, 1.#NaN).
Sts_BumpOpen	BOOL	1 = Bump Open requested or active.
Sts_BumpClose	BOOL	1 = Bump Close requested or active.
Sts_PosStuck	BOOL	1 = Position is stuck (unchanging) while neither feedback from limit switch Closed nor Opened is on.
Sts_Ramping	BOOL	1 = CV is ramping to target.
Sts_Clamped	BOOL	1 = CV set being clamped at Low or High Limit.
Sts_WindupHi	BOOL	1 = Analog output winding up High, to Inp_WindupHi of the master controller.
Sts_WindupLo	BOOL	1 = Analog output winding up Low, to Inp_WindupLo of the master controller.
Sts_SkipRoCLim	BOOL	1 = Rate of change limiting was skipped this scan (Maintenance, Override, Interlock, Hand).
Sts_Active	BOOL	1 = CV is greater than Cfg_MaxInactiveCV, show graphic symbol as Active.
Sts_FdbkFail	BOOL	1 = Feedbacks are in an invalid state.
Sts_Virtual	BOOL	1 = The instruction treats the device as virtual. The instruction acts as normal but the output is kept de-energized (Out_CVData=0). 0 = The instruction operates the device normally. Sts_Virtual is a copy of Inp_Virtual.

Public Output Members	Data Type	Description
SrcQ_IO	SINT	Source and quality of primary input or output (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
SrcQ	SINT	Source and quality of primary value or status (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
Sts_bFdbk	SINT	Device feedback: 0 = None, Sts_bFdbk.0: Moving, Sts_bFdbk.1: Closed, Sts_bFdbk.2: Opened, Sts_bFdbk.3: Failure, Sts_bFdbk.4: Stuck.
Sts_bSts	SINT	Device status: 0 = At target, Sts_bSts.0: Ramping down, Sts_bSts.1: Ramping up, Sts_bSts.2: Clamped at minimum, Sts_bSts.3: Clamped at maximum, Sts_bSts.4: Out of Service, Sts_bSts.5: Bump open, Sts_bSts.6: Bump close.

Public Output Members	Data Type	Description
Sts_bFault	SINT	Device fault status: 0 = None, Sts_bFault.0: Feedback fault, Sts_bFault.1: IO fault, Sts_bFault.2: Device fault, Sts_bFault.3: Configuration error.
Sts_eNotify	SINT	Alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	Alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	IOFault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyDeviceFault	SINT	DeviceFault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyDev	SINT	Deviation alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	IntlkTrip alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_eSrc	INT	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.
Sts_bSrc	INT	Active selection bitmap for HMI totem pole with command source request selection: Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed Out of Service (rung false), Sts_bSrc.2: Maintenance Out of Service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_Available	BOOL	1 = Analog output available for control by automation (Program).
Sts_Bypass	BOOL	1 = Bypassable interlocks are bypassed.
Sts_BypActive	BOOL	1 = Interlock bypassing active (bypassed or maintenance).

Public Output Members	Data Type	Description
Sts_MaintByp	BOOL	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	1 = Device is not ready, see detail bits (Sts_Nrdyxxx) for reason.
Sts_NrdyOoS	BOOL	1 = Device is not ready: Device disabled by Maintenance.
Sts_NrdyCfgErr	BOOL	1 = Device is not ready: Configuration Error.
Sts_NrdyIntlk	BOOL	1 = Device is not ready: Interlock Not OK.
Sts_NrdyIOFault	BOOL	1 = Device is not ready: IO Fault (Shed requires Reset).
Sts_Err	BOOL	1 = Error in configuration: see detail bits (Sts_Errxxx) for reason.
Sts_ErrCVRaw	BOOL	1 = Error in configuration: Raw output scaling Min = Max.
Sts_ErrCVEU	BOOL	1 = Error in configuration: Cfg_CVEUMax <= Cfg_CVEUMin.
Sts_ErrCVRoCDecrLim	BOOL	1 = Error in configuration: Invalid decreasing rate of change.
Sts_ErrCVRoCIncrLim	BOOL	1 = Error in configuration: Invalid increasing rate of change.
Sts_ErrLimit	BOOL	1 = Error in configuration: CV High Limit < CV Low Limit.
Sts_ErrHiDevLim	BOOL	1 = Error in configuration: Cfg_HiDevLim.
Sts_ErrLoDevLim	BOOL	1 = Error in configuration: Cfg_LoDevLim.
Sts_ErrDevDly	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrCycleTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrOpenRate	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrCloseRate	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrStuckTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrMaxOnTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrMinOnTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrBumpTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrDeadTime	BOOL	1 = Invalid timer preset (use 0.0 to 2147483.0).
Sts_ErrCmdCnfrmTimeOutTime	BOOL	1 = Error in configuration: Command confirmation timer preset (use 0.0 to 2147483.0).
Sts_ErrAlm	BOOL	1 = Error in Logix Tag-based alarm settings.
Sts_Hand	BOOL	1 = Hand is selected (supersedes OoS, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	1 = Out of Service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	1 = External is selected (supersedes Program, Operator).
Sts_Prog	BOOL	1 = Program is selected.
Sts_ProgLocked	BOOL	1 = Program is selected and locked.
Sts_Oper	BOOL	1 = Operator is selected.
Sts_OperLocked	BOOL	1 = Operator is selected and locked.
Sts_ProgOperSel	BOOL	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	1 = Selection equals the Normal (Program or Operator).
Sts_ExtReqInh	BOOL	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	1 = Maintenance acquire command received this scan.
Sts_Alm	BOOL	1 = An alarm is active.
Sts_AlmInh	BOOL	1 = An alarm is shelved or disabled.
Sts_IOFault	BOOL	1 = IO Fault Status Bad. 0 = OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Access alarm elements using this format: PAOTag.@Alarms.Alm_IOFault.AlarmElement

Public Output Members	Data Type	Description
Sts_DeviceFault	BOOL	Device Fault status: 1 = Bad, 0 = OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Access alarm elements using this format: PAOTag.@Alarms.Alm_DeviceFault.AlarmElement
Sts_Dev	BOOL	1 = Deviation (actual position minus target) outside limits, 0 = Deviation within limits. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PAOTag.@Alarms.Alm_Dev.AlarmElement
Sts_IntlkTrip	BOOL	1 = Status: CV held or forced by interlock NOT OK. There is a predefined default discrete Logix Tag based alarm for the status. Set standard configuration members of the discrete Logix Tag based alarm. Access alarm elements using this format: PAOTag.@Alarms.Alm_IntlkTrip.AlarmElement
Sts_CnfrmOperCmdReq	BOOL	1 = Operator command request is awaiting confirmation.
Sts_CnfrmOperSPReq	BOOL	1 = Operator set point request is awaiting confirmation.
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.
Val_Owner	DINT	Current Object Owner ID (0 = not owned).

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control / Command Source Selection
OSet_CV	REAL	Operator setting of controlled variable (output) in engineering units. Default = 0.
MCmd_Bypass	BOOL	Maintenance command to bypass all bypassable interlocks. The instruction clears this operand automatically. Default is false.
MCmd_Check	BOOL	Maintenance command to check (not bypass) all interlocks. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
OCmd_BumpClose	BOOL	Operator Command to bump device closed (used when device position feedback is not available).
OCmd_BumpOpen	BOOL	Operator Command to bump device open (used when device position feedback is not available).
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock or release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to acknowledge and reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is false.
OCmd_CmdCncl	BOOL	Operator command to cancel command request. The instruction clears this operand automatically. Default is false.
OCmd_CmdCnfrm	BOOL	Operator command to confirm command request. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index.
MRdy_Bypass	BOOL	1 = Ready to receive MCmd_Bypass, enable data entry field.
MRdy_Check	BOOL	1 = Ready to receive MCmd_Check, enable data entry field.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_BumpClose	BOOL	1 = Ready for OCmd_BumpClose, enable HMI button.
ORdy_BumpOpen	BOOL	1 = Ready for OCmd_BumpOpen, enable HMI button.
ORdy_CV	BOOL	1 = Ready to receive OSet_CV (enables data entry field).
ORdy_Reset	BOOL	1 = At least one alarm or shed condition requires reset.
ORdy_ResetAckAll	BOOL	1 = At least one alarm or latched shed condition requires reset or acknowledgement.

Public InOut Members	Data Type	Usage	Description
BusObj	BUS_OBJ	InOut	Bus component.

BUS_OBJ Structure

The BUS_OBJ structure links the analog output instruction to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower-level devices to higher-level control and fans out commands from higher-level control to lower-level devices. Items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete Logix Tag based alarms are defined for the following members.

Member	Alarm Name	Description
Sts_IOFault	Alm_IOFault	IO Failure. Raised when the Inp_IOFault input is true. Use this input to indicate to the instruction that a connection with the module is in fault. This input also indicates if a module reports field power loss/no load/short circuit is occurring for its I/O. If the I/O Fault is configured as a shed fault, the device is commanded Off and cannot be commanded to another state until reset. The alarm condition is not raised when in Virtual.
Sts_DeviceFault	Alm_DeviceFault	Device Confirmed Failure. Raised when the Inp_DeviceFault input is true. The Device fault alarm condition is not raised when in Virtual.

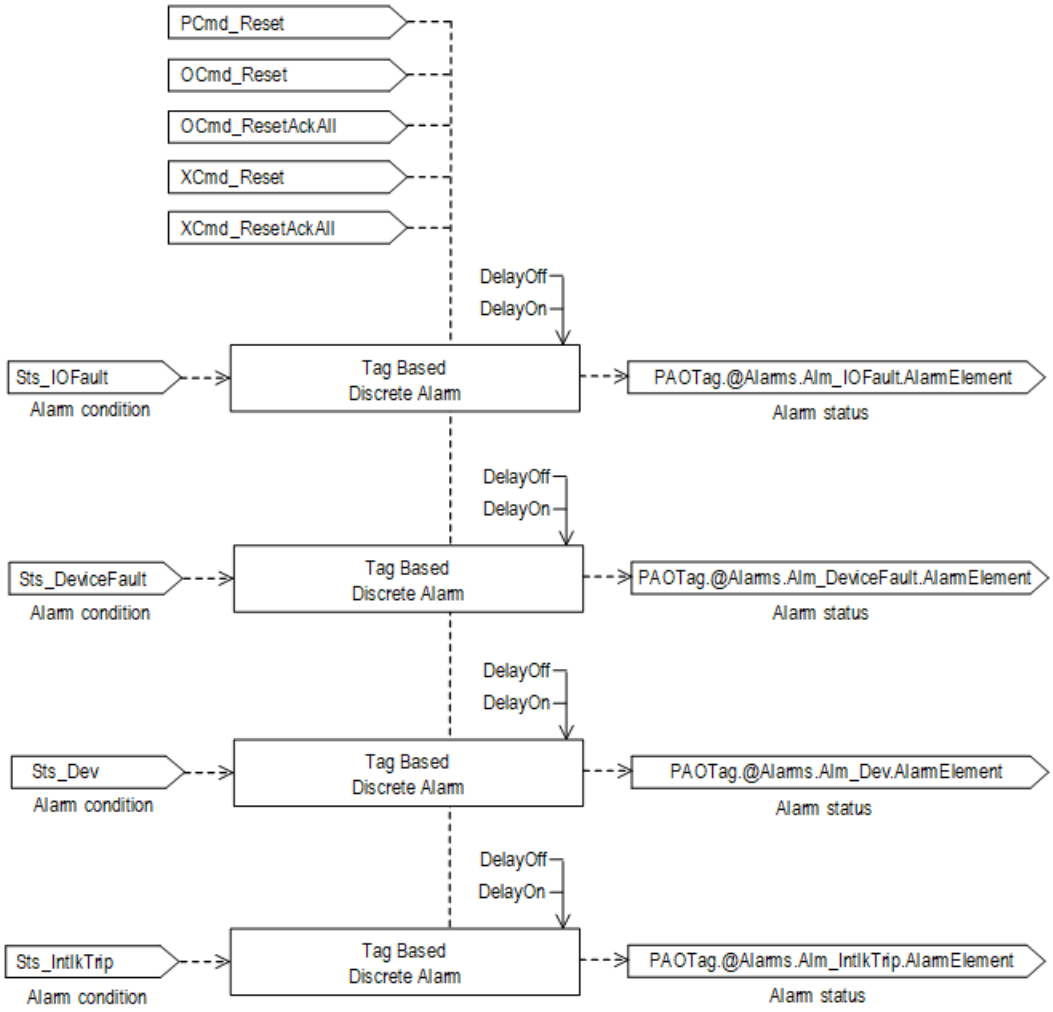
Member	Alarm Name	Description
Sts_Dev	Alm_Dev	Deviation alarm. Raised when the difference between desired device position and actual device position is greater than High limit or lower than Low limit., i.e. if the following is true: ((Val_CVOut-Val_Pos) > Cfg_HiDevLim) OR ((Val_CVOut-Val_Pos) < Cfg_LoDevLim)
Sts_IntlkTrip	Alm_IntlkTrip	Interlock Trip alarm. Raised when an interlock not-OK condition causes the device to transition from the On state or a pulsing state to the Off state. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.

Mark the alarm as used or unused and set standard configuration members of the discrete Logix Tag based alarm. Access alarm elements using this format:

PAOTag.@Alarms.AlarmName.AlarmElement

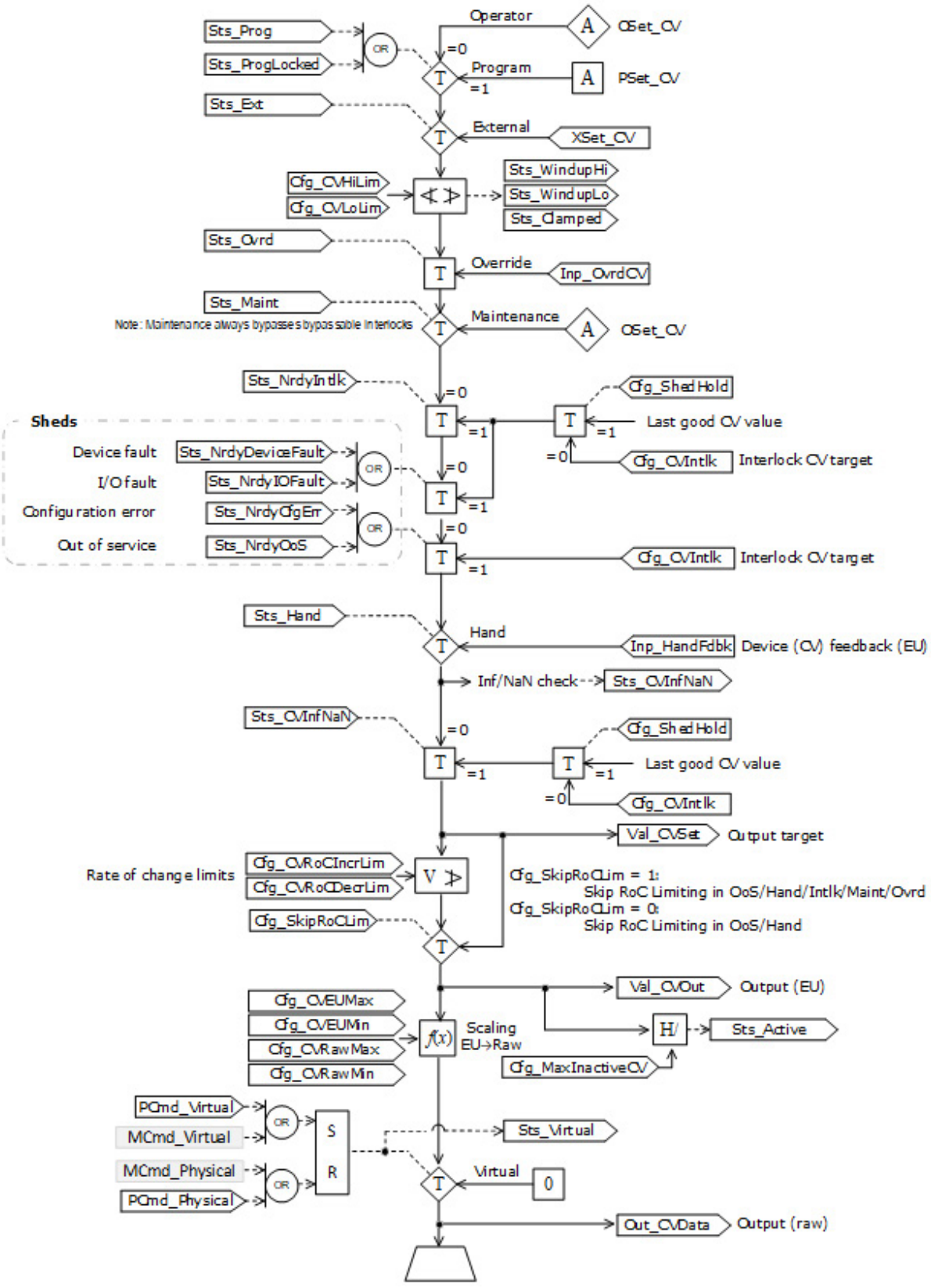
The Program commands for each alarm enable users to Acknowledge, Suppress, Unsupress and Unshelve the Alarm. These commands are propagated to corresponding commands (ProgAck, ProgSuppress, ProgUnsupress, ProgUnshelve) of the tag-based alarm.

There are also Program commands that enable users to Acknowledge, Reset, Suppress and Unsuppress all alarms of the instruction or an alarm set at the same time.

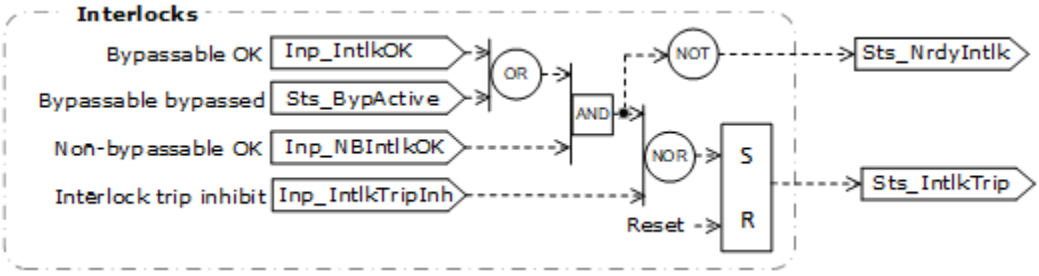


Operation

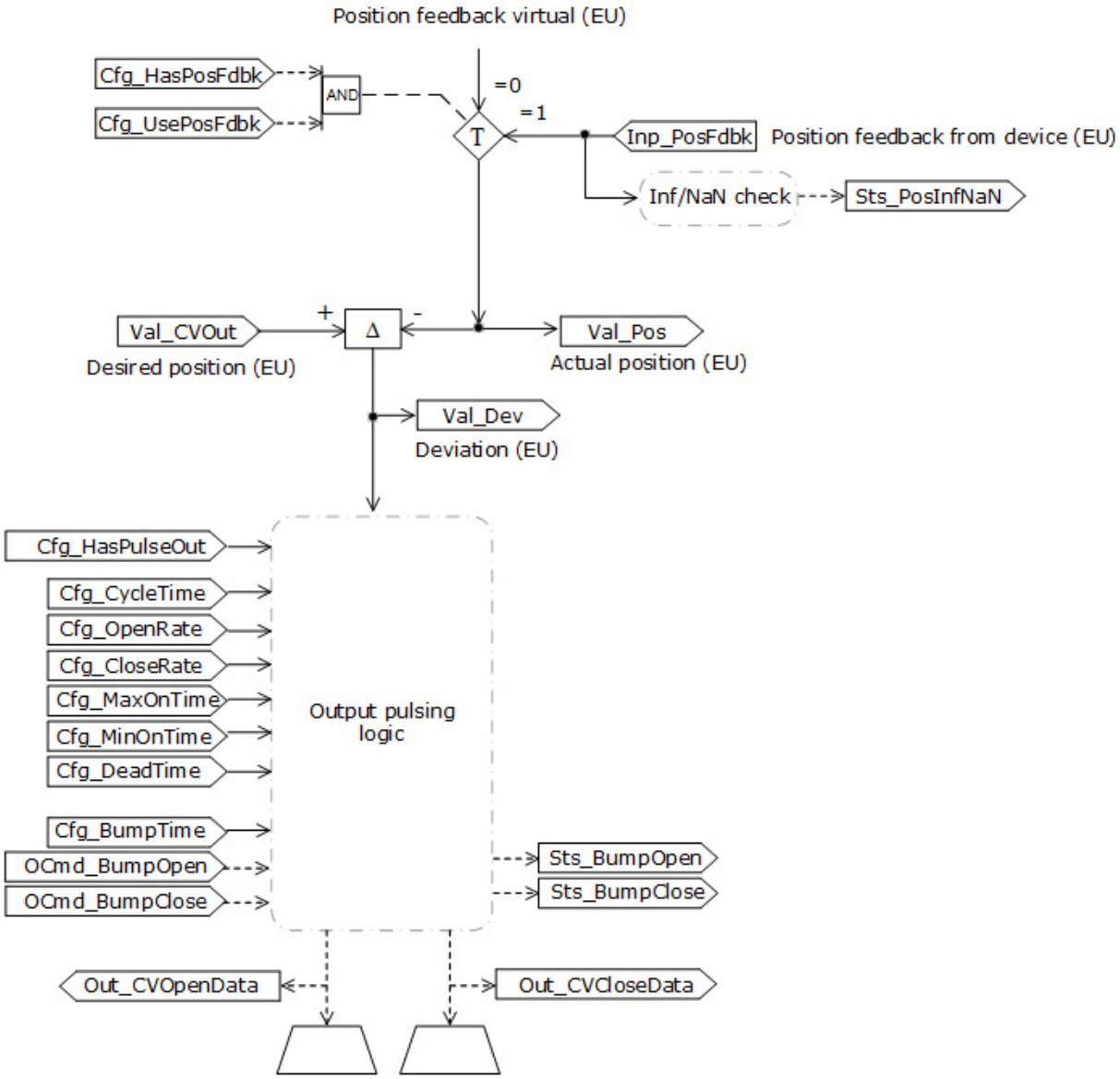
The following diagram illustrates the functionality of the PAO instruction:



The following diagram explains logic for Interlock trip status:



The following diagram illustrates the functionality of the PAO instruction for a pulsed device:



Virtualization

When Virtualization is active, the output of the analog output holds at zero and I/O faults are ignored. Manipulate the instruction to operate as if a

working analog output is present. Do this for instruction testing and operator training. Set the Inp_Virtual operand to 1 to enable virtualization. After finishing virtualization, set the Inp_Virtual operand to 0 to return to normal operation.

Configuration of Strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in the Logix Designer application only.

- Description
- Label for graphic symbol
- Tag name
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- CV raw units – EngineeringUnit information from Out_CVData tag
- CV engineering units – EngineeringUnit information from Val_CVOut tag
- Path to an object with more information – Navigation information from Cfg_HasMoreObj member of P_ANALOG_INPUT structure, Cfg_HasMoreObj.@Navigation
- Path to an object with output CV information – Navigation information from Val_CVOut member of P_ANALOG_INPUT structure, Val_CVOut.@Navigation
- Path to an object with output data information - Navigation information from Inp_PosFdbk member of P_ANALOG_INPUT structure, Inp_PosFdbk.@Navigation

Command Source

The instruction uses the following command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Logic outside the instruction owns control of the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. (Highest Priority command source)
Out-of-Service	The instruction is disabled and has no owner.
Maintenance	Maintenance owns control of the device and supersedes Operator, Program, and Override control. Operator commands and settings from the HMI are accepted. Bypassable interlocks and permissives are bypassed, and device timeout checks are not processed.

Command Source	Description
Override	Priority logic owns control of the device and supersedes Operator and Program control. Override Input (Inp_OvrdCmd) is accepted. If so configured, bypassable interlocks and permissives are bypassed.
Program locked	Program logic owns control of the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from the Program unless Cfg_OvrdOverLock = 1.
Program	Program logic owns control of the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator owns control of the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator owns control of the device. Operator commands (OCmd_) from the HMI are accepted. (Lowest Priority command source)

The instruction is able to enable/disable the following operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations on control forcing the nearest valid configuration.

The core control model deals specifically with the arbitration of the source of the commands and parameters currently being accepted by the receiving function. More specifically, whether the source is:

- A programmatic entity, one which resides entirely within the processing environment, or
- An external interface entity, one which issues commands and parameters external and asynchronously to the processing environment.

These sources are known as Prog (Program) and Oper (Operator) control, respectively.

The optional ability to lock into one control source or the other is required to ensure that the other control source cannot acquire privilege when the designer wants to prevent it.

Core Command Source Model

The core control model consists of the following control sources: Oper, OperLocked, Prog, ProgLocked. The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources acting independent of the base Operator/Program state machine.

Enabling control sources as Configuration

The individual control sources may be enabled or disabled by the user. The default configuration utilizes the entire base model. The differentiation being that upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program will be the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands will win when simultaneously asserted.

Automatic reset of commands

All commands are treated as 'one-shot-latched.' This means that all commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. Example: If the Prog is disabled, the destination of the OCmd_Prog command is directed to the ProgLocked state instead of the Prog state. This is done to maintain the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated then there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition. But serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

Higher priority command sources which operate independently within the model: Override, Maintenance, Out-of-Service, In-Service and Hand.

Monitoring the PAO Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See *Index Through Arrays* for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 1(never scanned).
Instruction first run	All commands that are automatically cleared each execution are cleared and ignored. The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition. PSet_Owner and Sts_Owner are set to 0.
Rung-condition-in is false	The instruction is put Out of Service if Inp_Hand=0. The output is de-energized. All alarms are cleared. Command source selection processing proceeds as normal except that all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Prog and Sts_Oper) are cleared to 0. Commands are still received for Maintenance, Operator, and Program and are processed behind the scenes, just as they are in Hand mode.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
Instruction first scan	See Instruction first run in the Ladder Diagram table.
EnableIn is false	See Rung-condition-in is false in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

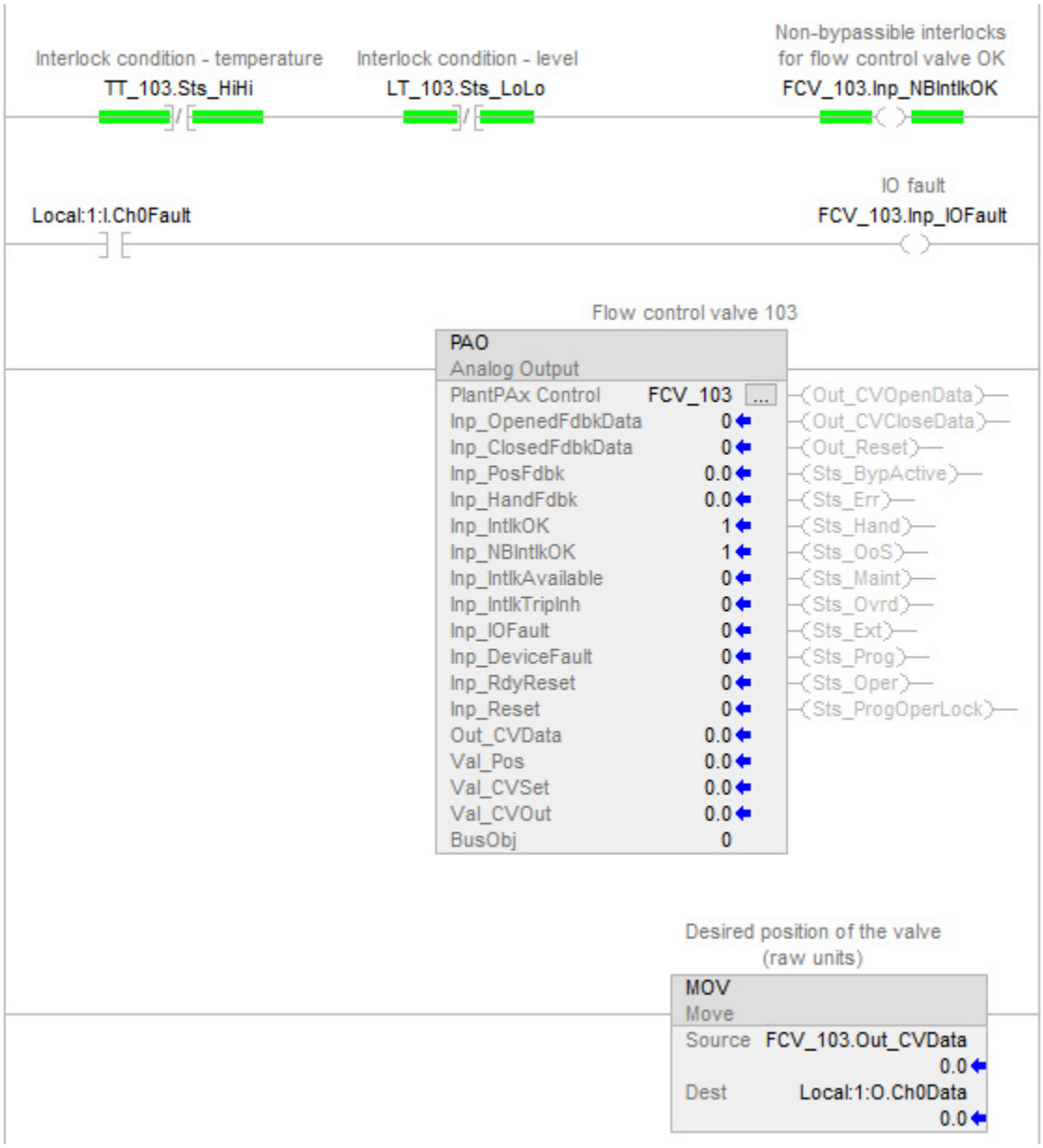
In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

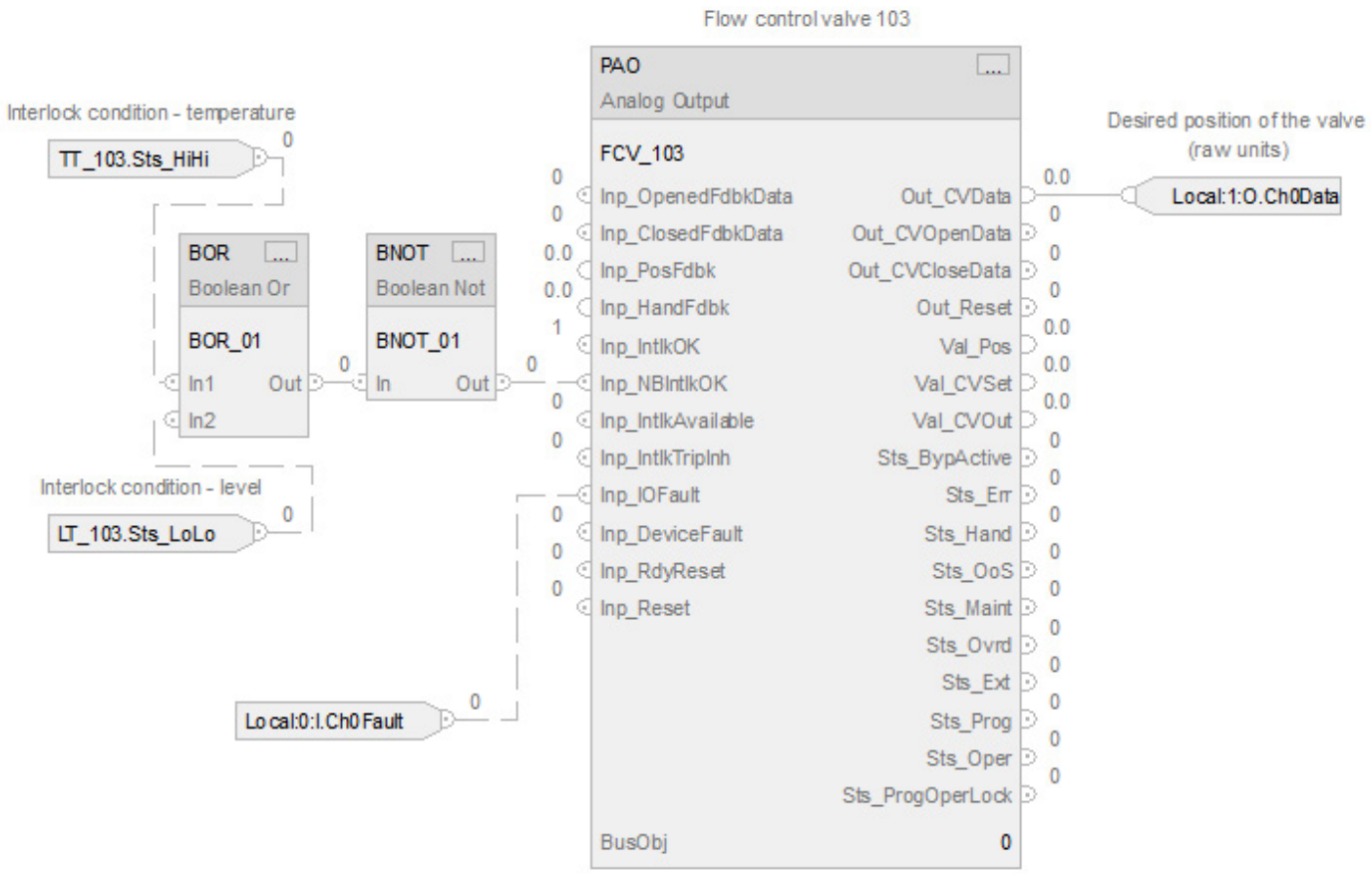
Example 1: Analog valve

The following example provides a demonstration of using a PAO instruction to control a valve. During normal operation, the operator sets the valve position using PAO through the HMI faceplate. This example also includes interlock conditions low-low level and high-high temperature provided by outputs of PAI instructions. The interlock conditions are used as inputs by PAO to set the valve (Local:0:O.Ch0Data = Out_CVData) to an interlock position (for example, closed). This is done by setting the PAO configuration parameter Cfg_Intlk to 0.

Ladder Diagram



Function Block Diagram



Structured Text

```
FCV_103.Inp_NBIntlkOK := NOT(TT_103.Sts_HiHi OR LT_103.Sts_LoLo);

FCV_103.Inp_IOFault := Local:0:I.Ch0Fault;

PAO(FCV_103, 0);

Local:1:O.Ch0Data := FCV_103.Out_CVData;
```

Example 2: Manual loading station

This example uses the PAO instruction to implement a manual loading station for a pressure control valve that is used to regulate gas supply to a process. The control valve in our example has opened and closed limit switches and a position feedback. The desired valve position is provided by the operator through the HMI faceplate.

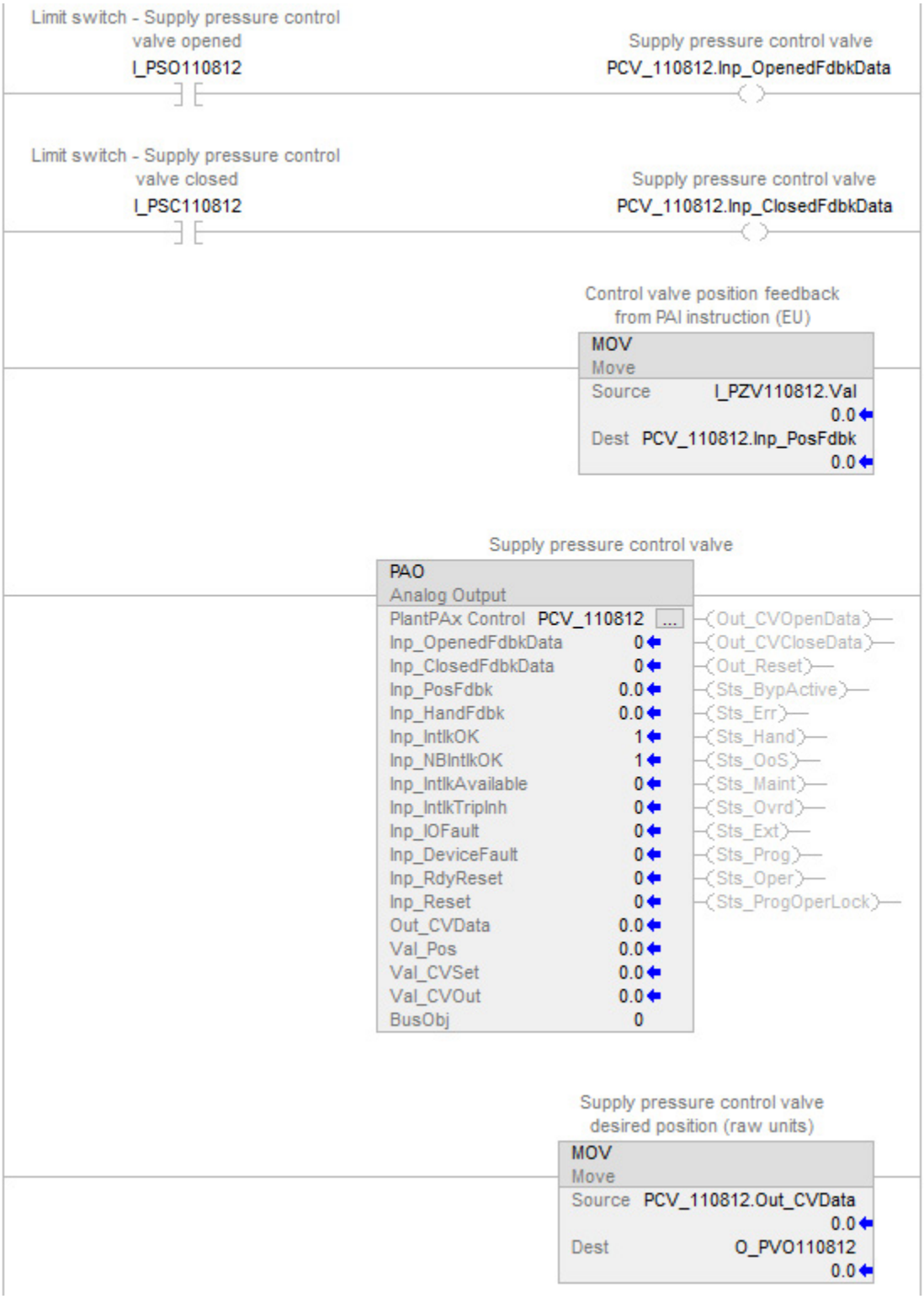
The field inputs for position feedback, opened limit switch, and closed limit switch are connected to the instruction inputs Inp_PosFdbk, Inp_OpenedFdbkData, and Inp_ClosedFdbkData. The Out_CVData is connected to the field output going to the valve.

The parameters Cfg_HasOpenedFdbk and Cfg_HasClosedFdbk are both set to 1 so the instruction knows the field is providing opened and closed limit switches. The parameters Cfg_UseOpenedFdbk and Cfg_UseClosedFdbk are set to 1 so that these limit switches are used to determine device status.

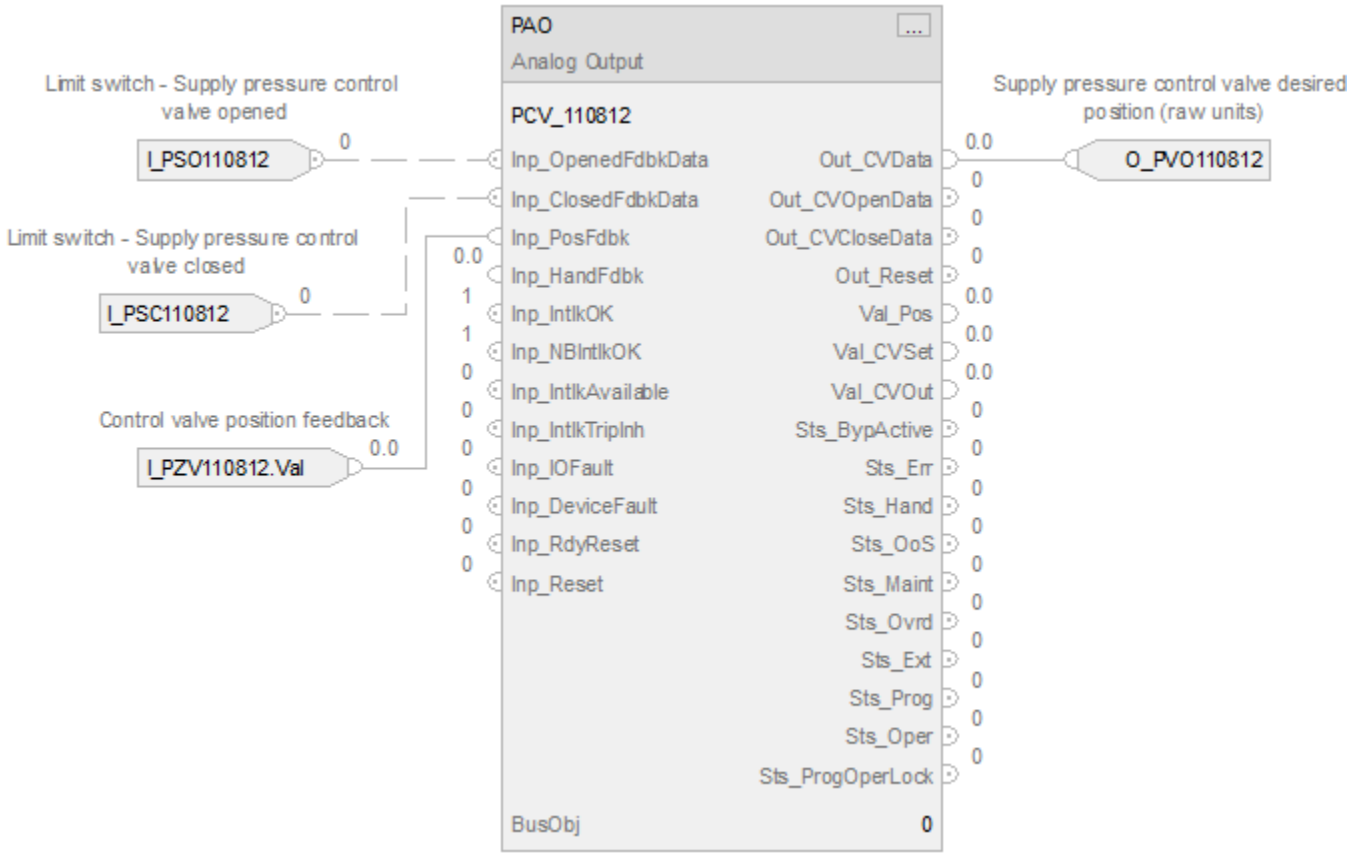
The analog output card is expecting an output in units of 4…20 mA; however, the faceplate shows the value in terms of 0…100% open. Therefore, the scaling parameters are set as follows. Cfg_CVEUMin=0, Cfg_CVEUMax=100, Cfg_CVRawMin=4, Cfg_CVRawMax=20.

The valve position feedback is provided in CV engineering units, percent in our particular case, via PAI instruction.

Ladder Diagram



Function Block Diagram



Structured Text

```
PCV_110812.Inp_OpenedFdbkData := I_PSO110812;

PCV_110812.Inp_ClosedFdbkData := I_PSC110812;

PCV_110812.Inp_PosFdbk := I_PZV110812.Val;

PAO(PCV_110812, 0);

O_PV110812 := PCV_103.Out_CVData;
```

Example 3: Ratchet valve

This example uses the PAO instruction to automate a ratcheting valve that is driven open or closed by using two discrete outputs to control flow. The flow valve in our example has a position feedback. The desired valve position is provided by an output of a control algorithm that is elsewhere in logic.

In this example, the field inputs for position feedback are wired (or connected) to the instruction input Inp_PosFdbk. Out_CVOpenData and Out_CVCloseData are connected to the field outputs going to the valve. The

input to the instruction to set valve position is wired to PSet_CV. Cfg_ProgNormal is set to 1 so the instruction defaults to Program mode.

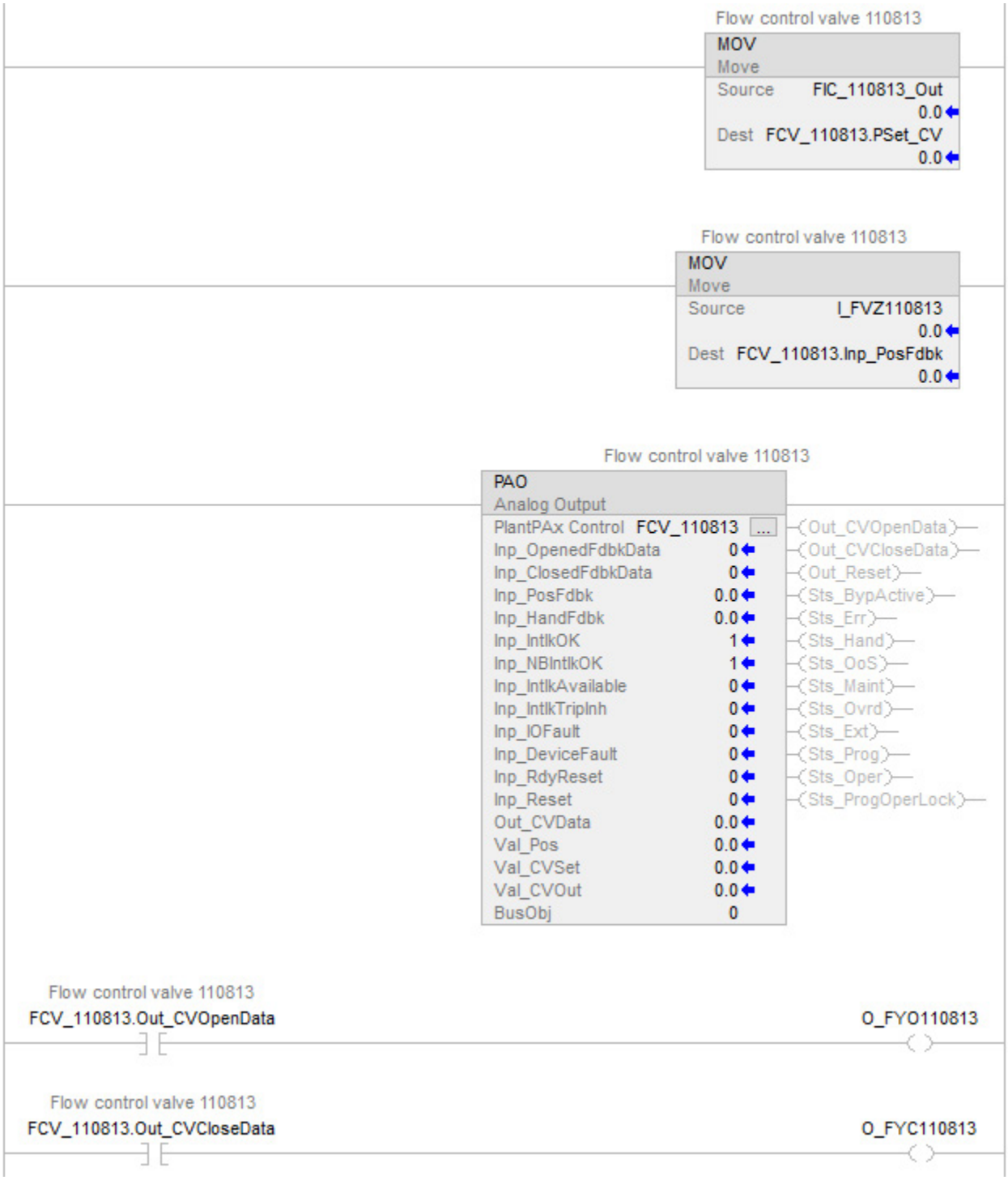
The analog output is not used; however, the faceplate shows the value of Val_CVOut in terms of 0...100% open, CV in engineering units. Therefore, the scaling parameters are set as follows. Cfg_CVEUMin=0, Cfg_CVEUMax=100, Cfg_CVRawMin=0 (default), Cfg_CVRawMax=100 (default)

The feedback signal is provided in CV engineering units via PAI instruction which scales the signal from feedback raw units to CV engineering units.

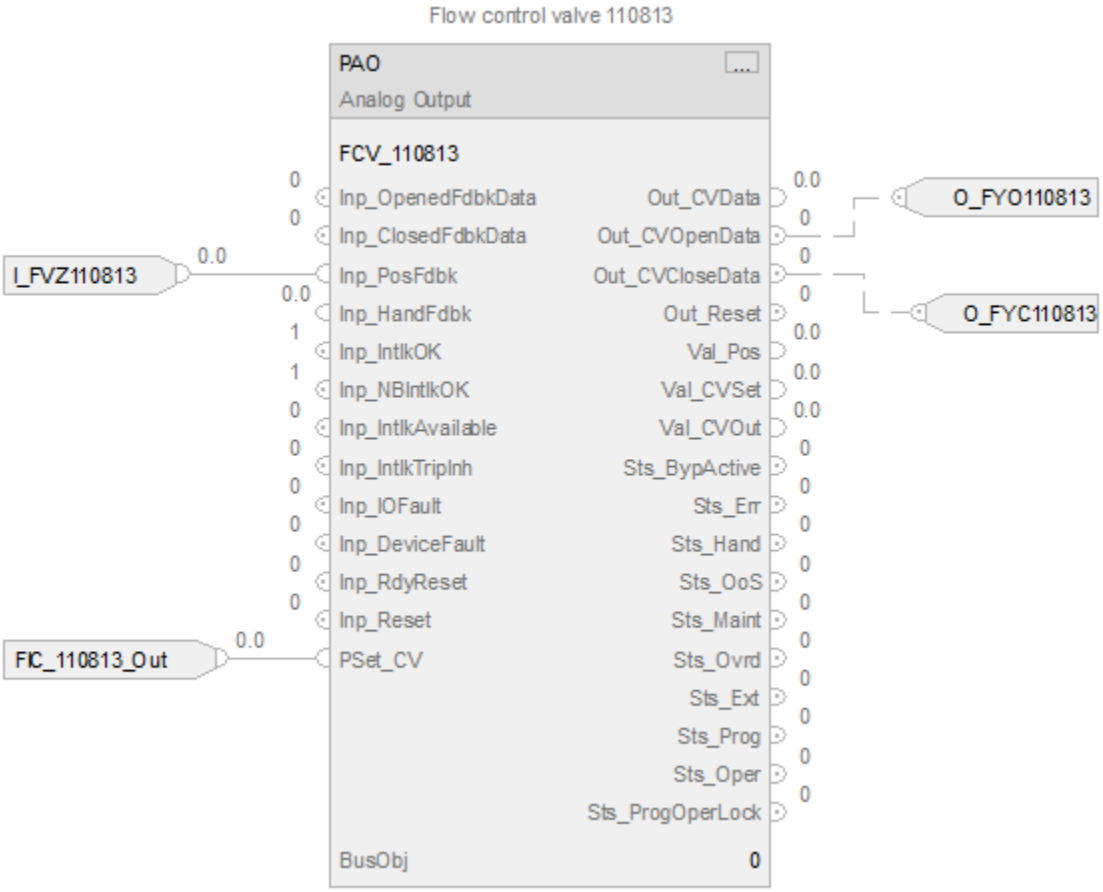
In this example, the ratcheting control valve is to be adjusted by cycling the open or close valve command for a period of time proportional to the amount the valve is to be moved. Cfg_CycleTime is set to 10, to define the overall period of the cycle to cycle on and off the open or close output. Cfg_OpenRate and Cfg_CloseRate are both set to 1, which means the required valve output is energized 1 second for every 1% difference between the target position and the actual position provided by feedback.

Cfg_MaxOnTime is set to 5 so that the output is energized for no more than 5 seconds of the 10-second cycle time to allow for the valve to move, and the feedback to be verified before the next cycle. Cfg_MinOnTime is set to 1 so that the output does not pulse if the calculated pulse time is less than 1 second.

Ladder Diagram



Function Block Diagram



Structured Text

```
FCV_110813.PSet_CV := FIC_110813_Out;
FCV_110813.Inp_PosFdbk := I_FVZ110813;
PAO(FCV_110813, 0);
O_FYO110813 := FCV_110813.Out_CVOpenData;
O_FYC110813 := FCV_110813.Out_CVCloseData;
```

See also

Process Analog Output feedback processing on page 129

PAO feedback processing

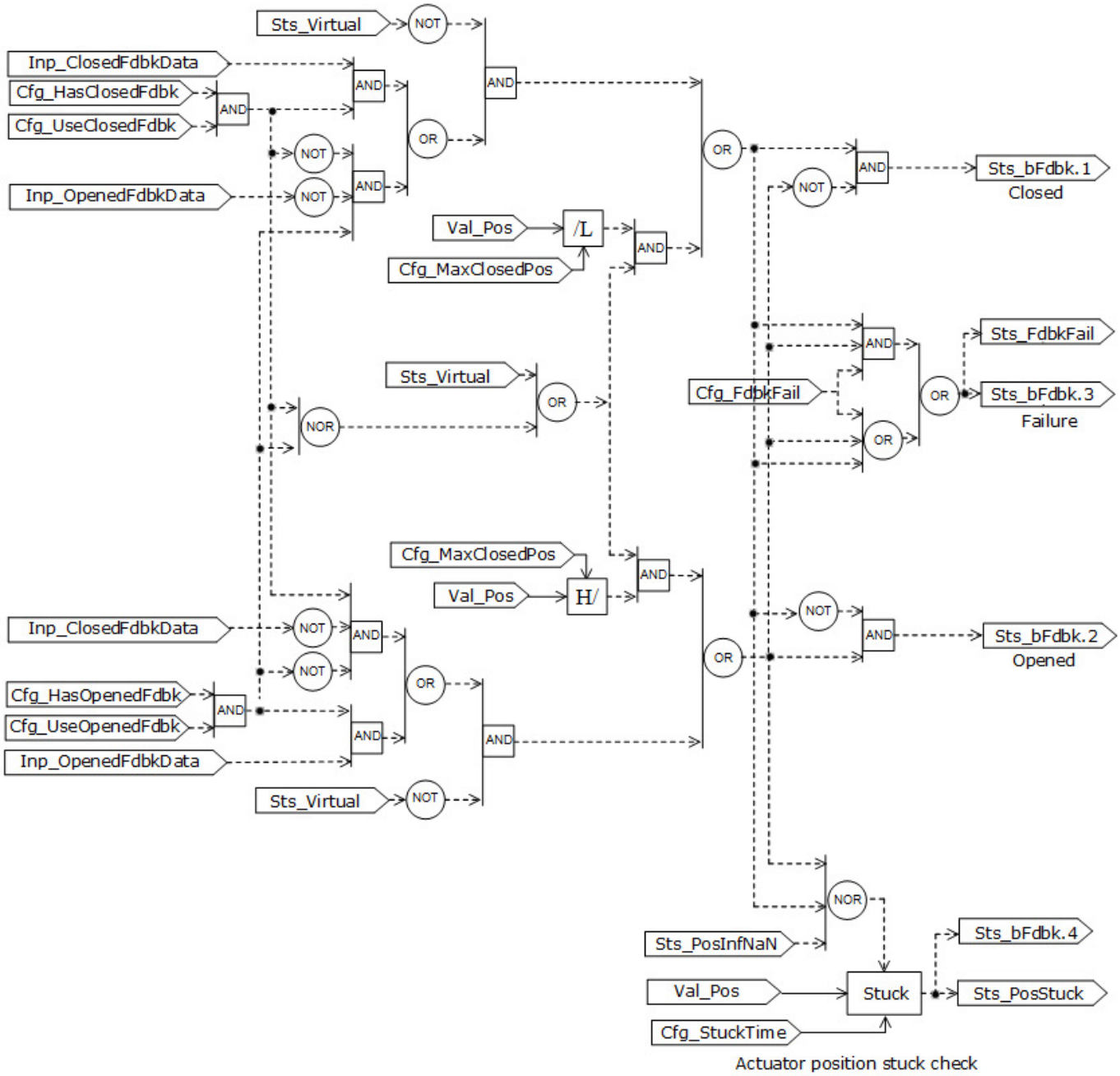
The Process Analog Output (PAO) instruction evaluates feedback signals from limit switches provided by the device. The instruction reports device Open in one of these conditions:

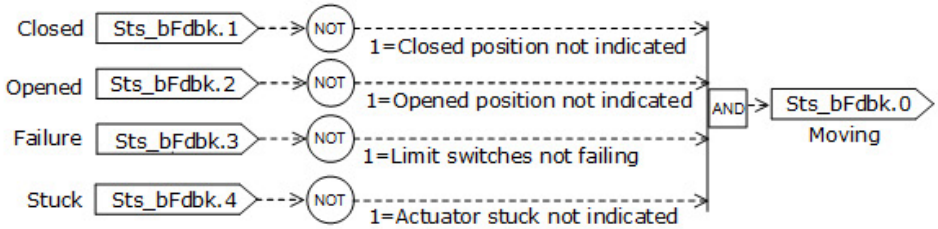
- Instruction is in virtual and Open limit switch is used and activated.
- Instruction is not in virtual, Open limit switch is not used, Closed limit is used but not activated.
- Instruction is in virtual, and Val_Pos > Cfg_MaxClosedPos.
- No limit switch in use and Val_Pos > Cfg_MaxClosedPos.

The instruction reports device Closed in one of these conditions:

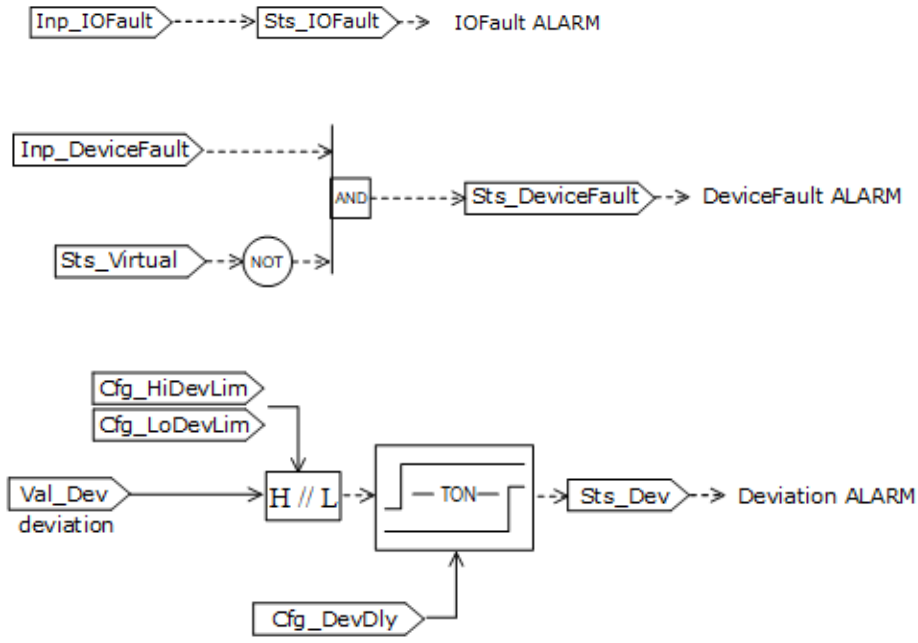
- Instruction is not in virtual, Closed limit switch is used and activated.
- Instruction is not in virtual, Open limit switch used and not activated, Closed limit switch not used.
- Instruction is in virtual and Val_Pos ≤ Cfg_MaxClosedPos.
- No limit switch in use and Val_Pos ≤ Cfg_MaxClosedPos.

Instruction logic used in processing of feedback from limit switches and device/actuator confirmed position is shown in this diagram.





These diagrams show logic involved in IO fault, device fault, and deviation out of range alarm conditions:



Pulse Output

The PAO instruction can be used in connection with a pulse-driven device, typically a valve, if the instruction is configured for pulse outputs (Cfg_HasPulseOut=1). The instruction generates pulses with duration modulated by the position error, difference (Val_Dev) between desired position calculated by the instruction (Val_CVOut), and device confirmed actual position (Val_Pos). Actual position is either provided by the device via feedback (Inp_PosFdbk) or simulated by the instruction if the physical feedback is not available or used.

Pulses are generated in cycles, one pulse per cycle. Pulses cannot be too short and too long to minimize wear of the equipment, device, or actuator. These time constraints are user defined as Cfg_MinOnTime and Cfg_MaxOnTime. Cycle duration Cfg_CycleTime is also user defined.

The instruction uses three parameters associated with assumed behavior of the device or actuator, rate at which the device moves when opening Cfg_OpenRate, rate at which the device moves when closing Cfg_CloseRate, and delay Cfg_DeadTime in device or actuator reaction when the device or actuator is commanded to open or close. If the device or actuator responds to the Open/Close pulse with delay, e.g. due to stiction, compensate for the delay by entering Cfg_DeadTime. Uncompensated delay results in steady state position error.

IMPORTANT Failure to set correct values for Cfg_OpenRate, Cfg_CloseRate, and Cfg_DeadTime can result in undesired moves of the device or actuator.

The pulsing logic provides functionality of a position control loop. Pulse width is calculated for a cycle.

For Val_Dev /DIAGRAM_PATH_SPECIFIER>0 open pulse time is calculated as:

PulseDuration = min(Val_Dev/Cfg_OpenRate + Cfg_DeadTime, Cfg_MaxOnTime),

Val_OpenTime = PulseDuration, for PulseDuration ≥ Cfg_MinOnTime,

Val_OpenTime = 0, for PulseDuration < Cfg_MinOnTime.

For Val_Dev <0 pulse close time is calculated as:

PulseDuration = min(-Val_Dev/Cfg_CloseRate + Cfg_DeadTime, Cfg_MaxOnTime),

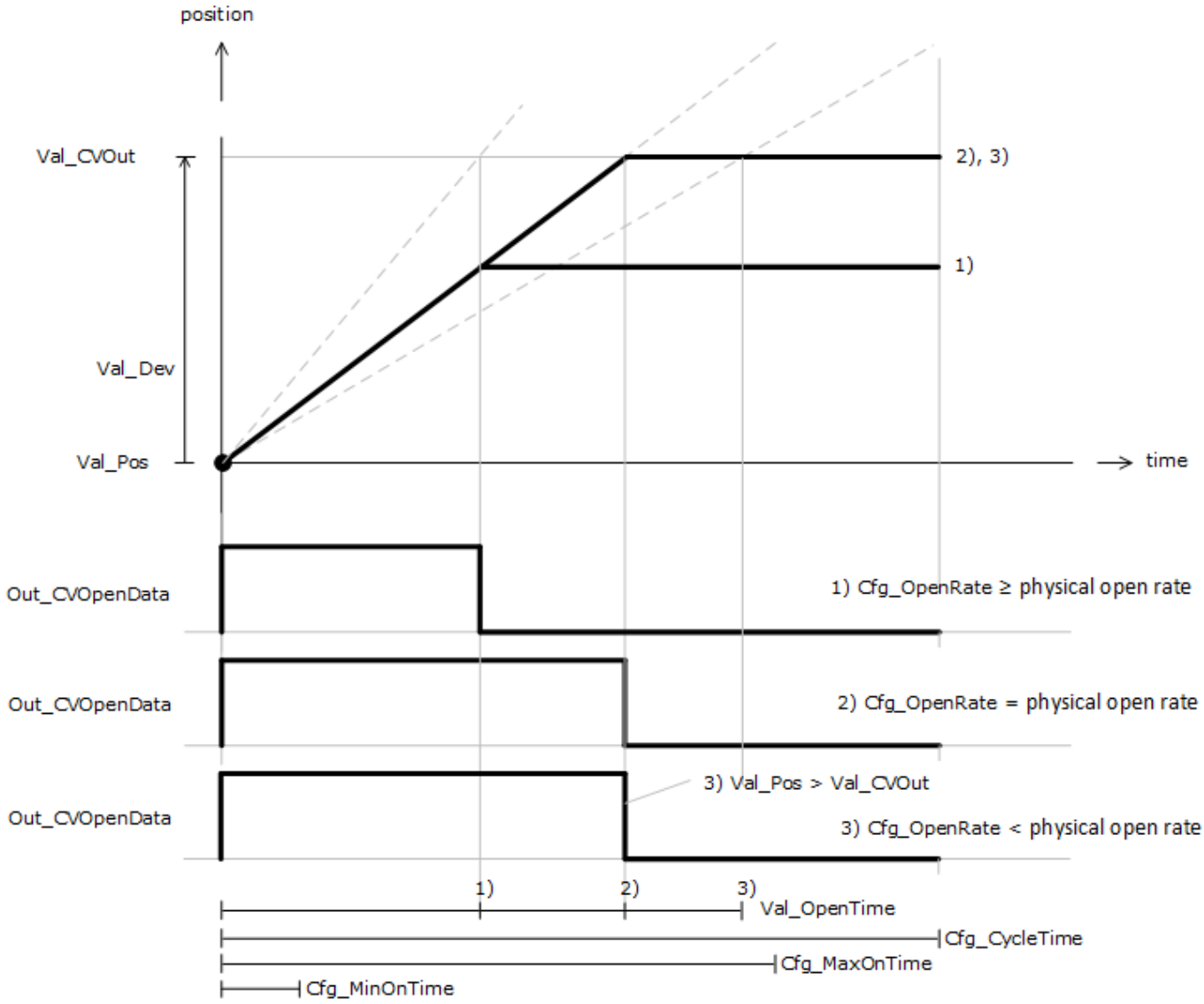
Val_CloseTime = PulseDuration, for PulseDuration ≥ Cfg_MinOnTime,

Val_CloseTime = 0, for PulseDuration < Cfg_MinOnTime.

These diagrams provide examples of device/actuator response to step in desired position, Val_CVOut, for different settings of configuration parameters.

This diagram demonstrates OpenTime for a cycle resulting from actual setting of instruction parameters. Three cases are shown for different

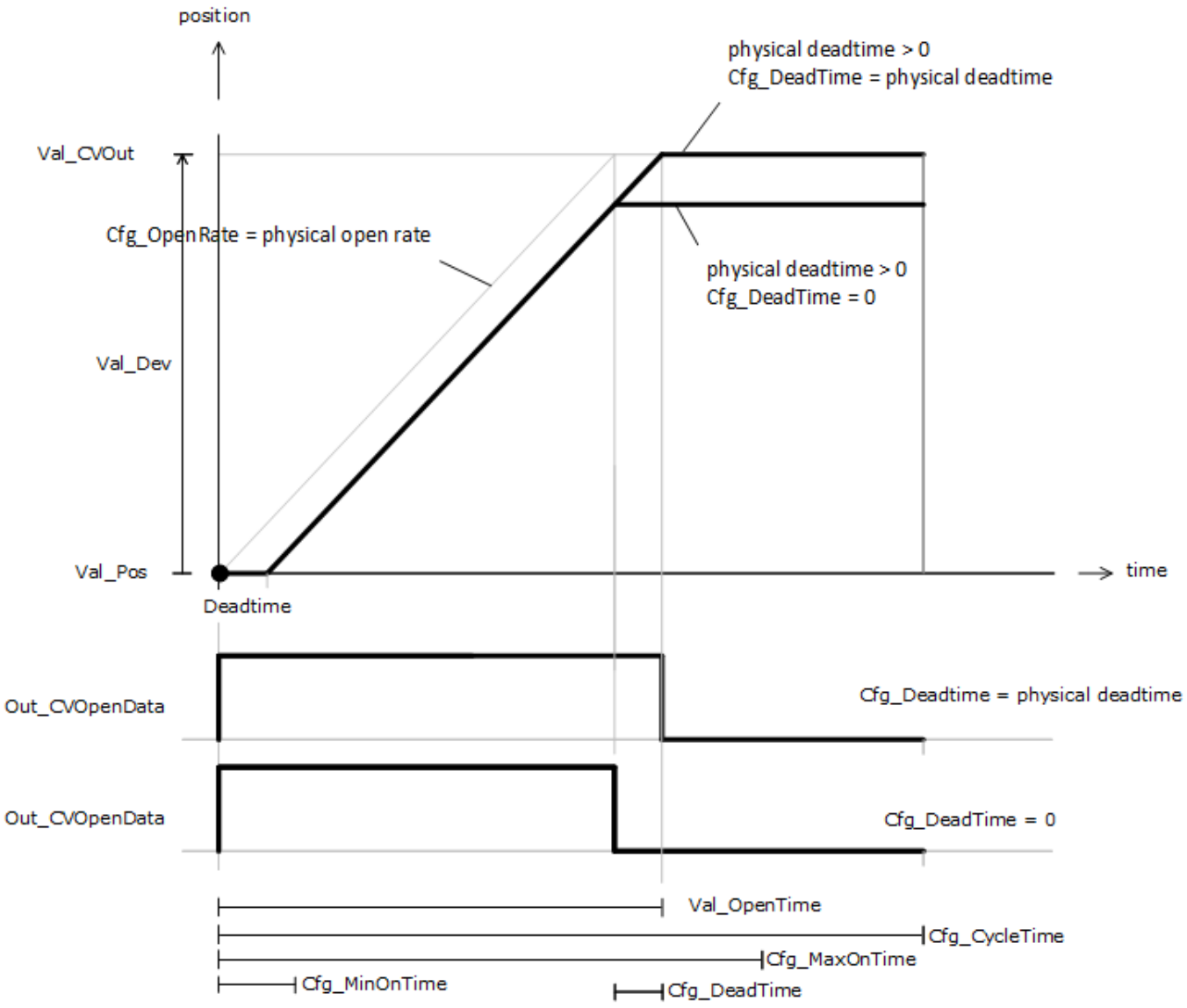
relations between entered Cfg_OpenRate compared to the real open rate of the device/actuator.



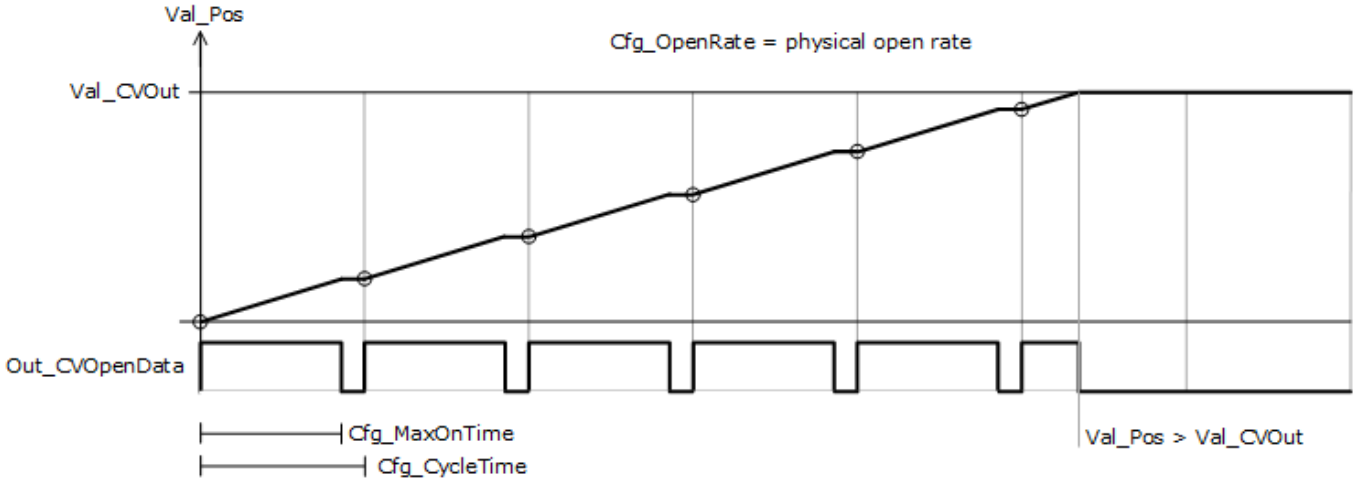
When the device starts to move or reverses direction, the instruction delays calculated Val_Pos by configured dead time (Cfg_DeadTime).

This figure demonstrates OpenTime for a cycle resulting from actual setting of instruction parameters and a device or actuator responding to the

command with delay. The diagram shows two cases: delay ignored and delay compensated.

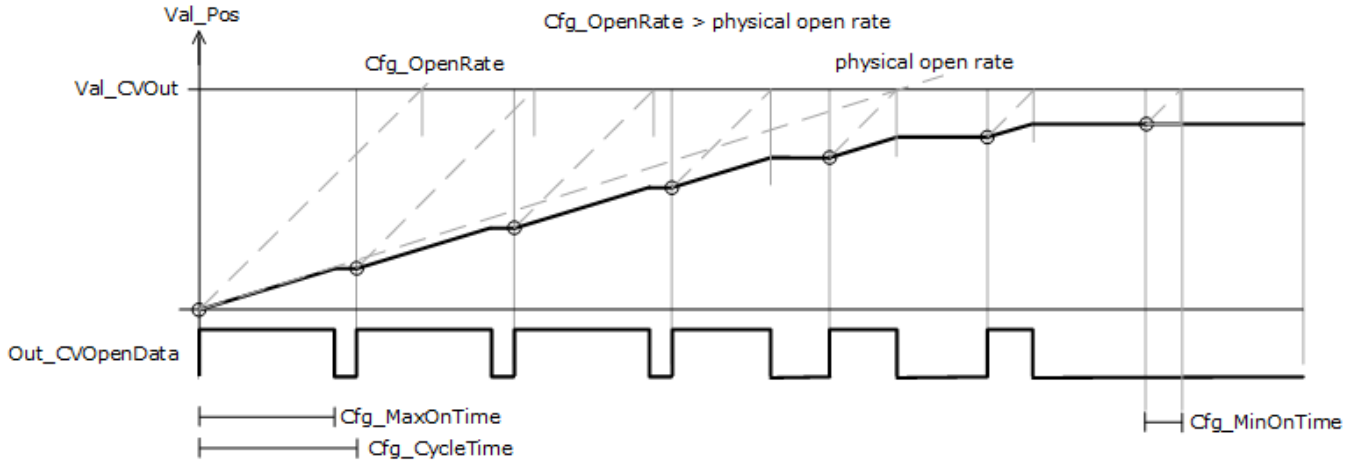


The following figures show a sequence of pulses for various instruction parameter settings and actuator behavior. In this diagram, the constant speed of the actuator is equal to Cfg_OpenRate or Cfg_CloseRate when in move.



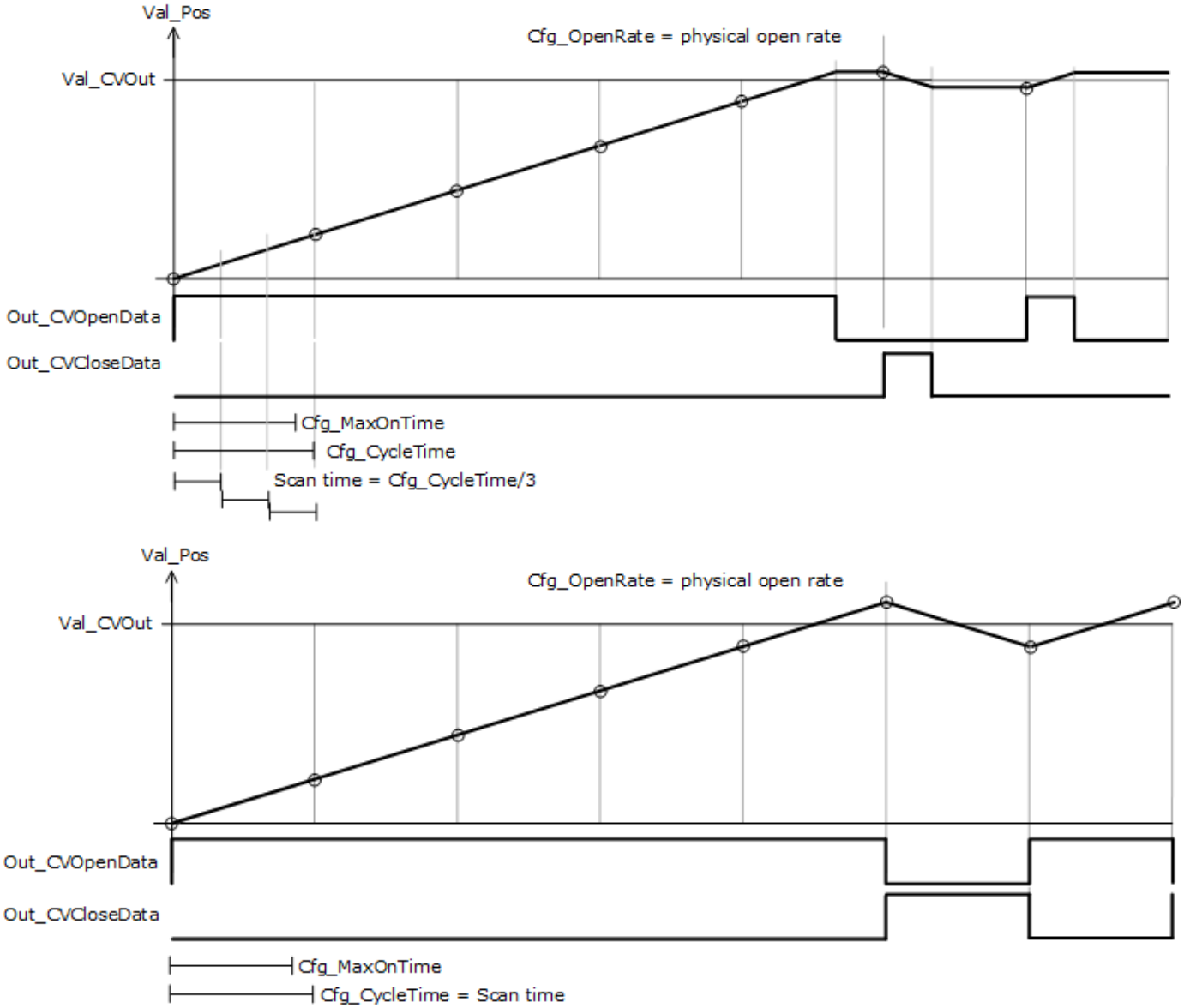
When configured rate Cfg_OpenRate is faster than the physical rate of the device, and position feedback is provided by the device, the position response differs. The Open pulse gets shorter when approaching the desired position until it violates the configured minimal On time (Cfg_MinOnTime), preventing the instruction from continuing pulsing.

Do not use the pulsing function of the instruction when position feedback is not used, Val_Pos is calculated by the instruction, and configured rate Cfg_OpenRate differs from physical rate of the device.

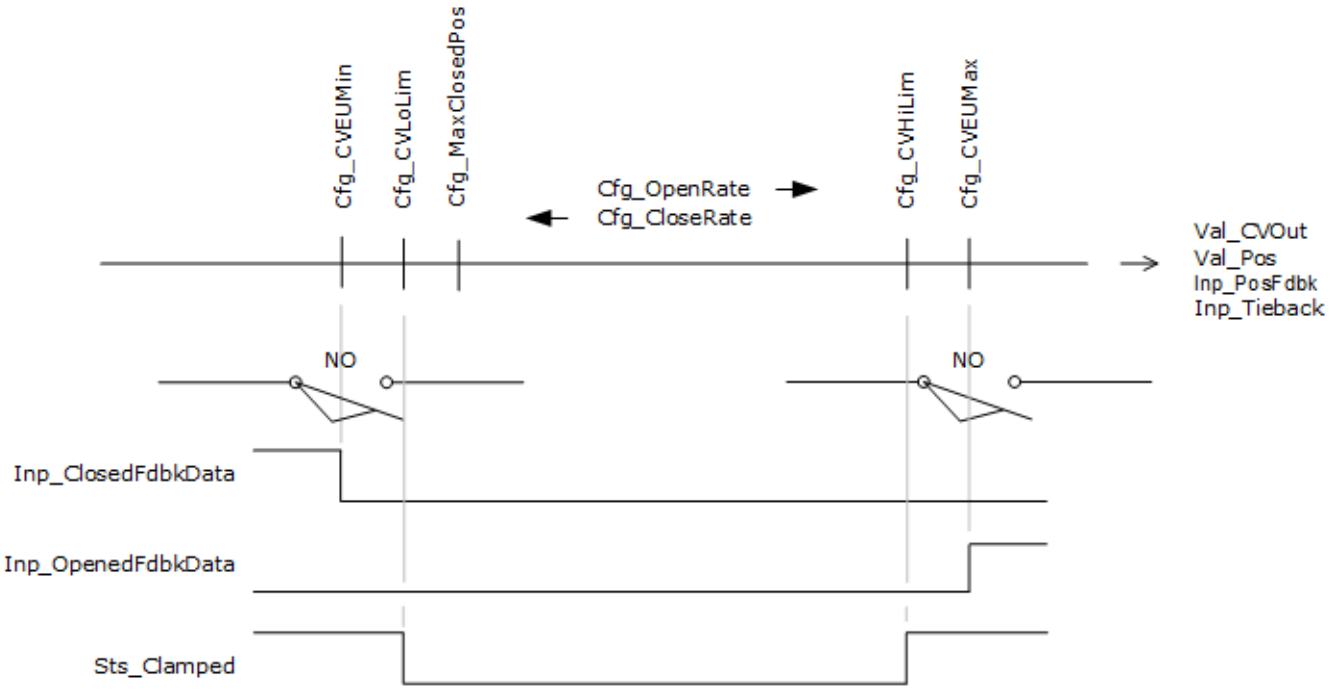


IMPORTANT Scan time of the instruction must be much shorter than Cfg_CycleTime. Failure to follow this recommendation can result in undesired movement of the device or actuator.

These figures show how larger scan time affects moves of the device or actuator driven by instruction pulse outputs.



The relationship between limit settings associated with device or actuator position is shown in the figure below for signals provided by normally open limit switches.



Position feedback simulation

When position feedback Inp_PosFdbk is not available, position Val_Pos is calculated. In virtual, or if the position feedback is not available, the position feedback is calculated from the last scan position, actual scan time, and configured open (closed) rate:

Val_Pos = Val_Pos + ScanTime*Cfg_OpenRate when opening,

Val_Pos = Val_Pos - ScanTime*Cfg_CloseRate when closing,

Val_Pos = max(min(Val_Pos,Cfg_CVEUMax),Cfg_CVEUMin).

When not in virtual and when position feedback is not available, the instruction relies on limit switch availability to reset the calculated position when limits are reached. Val_Pos is set to Cfg_CVEUMax if Open limit switch is activated and Closed limit switch is not active or not used. Val_Pos is set to Cfg_CVEUMin if Closed limit switch is activated and Open limit switch is not active or not used.

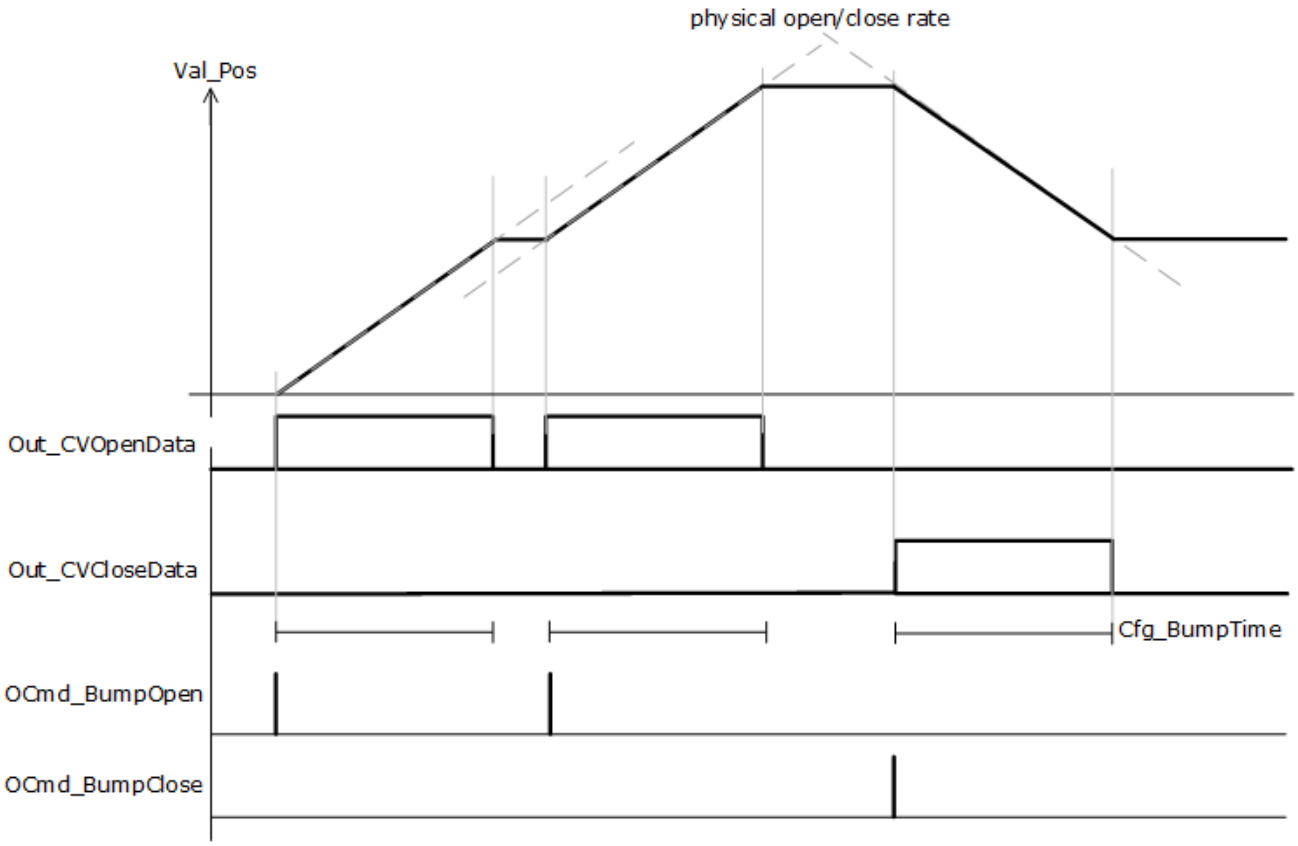
Bumping

The instruction can request the device to increment its position without position feedback. The user requests a bump to pulse the output. The pulse

output is energized for configurable duration of time Cfg_BumpTime ≤ Cfg_CycleTime, as shown in the figure below.

The instruction is ready to execute bump open or bump close command when:

- Bump timer is greater than zero (zero disables the bump function), and
- Position feedback is infinite, not a number, or there is an I/O fault, or there is a device fault, and
- Device is in Operator or Maintenance mode, and
- Previous bump operation is not active, and
- Device is not at the end of travel, or limit switch is not being used, for the target direction of travel.



Operator command request confirmation

The PAO instruction allows an operator to use operator setting OSet_CV and command requests OCmd_BumpOpen, OCmd_BumpClose. Enforced security might require the request to be confirmed or canceled before the selected command executes. The instruction checks the security rules inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd=0, no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd=1 the instruction waits for confirmation OCmd_CmdCnfrm=1 and/or cancellation OCmd_CmdCncl=1. For Cfg_CnfrmReqd=2 or 3, eSignature is needed before the confirmation and cancellation is enabled.

Process Boolean Logic (PBL)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

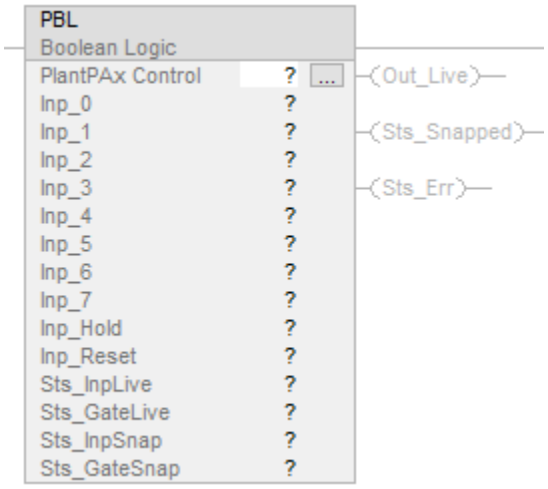
The Process Boolean Logic with Snapshot (PBL) instruction executes up to eight gates of configurable Boolean logic. Gate types available include AND, OR, XOR (Exclusive-OR), Set/Reset, Select, and Majority. Each gate provides up to four input conditions that are individually invertible using a configuration setting.

The PBL Instruction can record its current state:

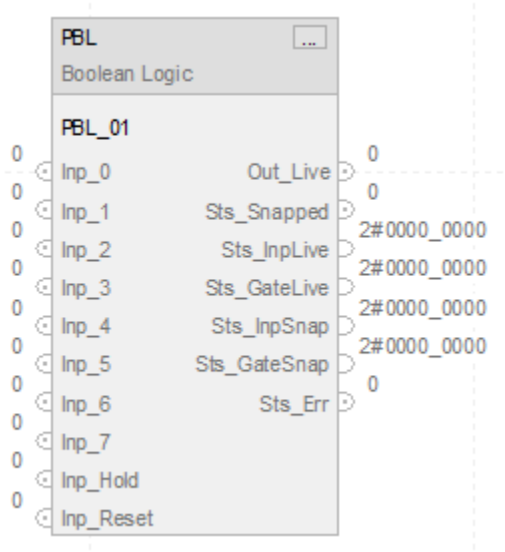
- After a change in output state.
- On Operator or Program command.
- Based on a logic loopback input.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PBL(PBL tag);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PBL	P_BOOLEAN_LOGIC	tag	Data structure required for proper operation of instruction.

P_BOOLEAN_LOGIC Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.

Public Input Members	Data Type	Description
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_0	BOOL	Logic input 0. Default is false.
Inp_1	BOOL	Logic input 1. Default is false.
Inp_2	BOOL	Logic input 2. Default is false.
Inp_3	BOOL	Logic input 3. Default is false.
Inp_4	BOOL	Logic input 4. Default is false.
Inp_5	BOOL	Logic input 5. Default is false.
Inp_6	BOOL	Logic input 6. Default is false.
Inp_7	BOOL	Logic input 7. Default is false.
Inp_Hold	BOOL	1 = Hold previous states in snapshot; 0 = Pass live states to snapshot. Default is false.
Inp_Reset	BOOL	1 = Reset snapshot latch, show live states. Default is false.
Cfg_UseInpHold	BOOL	1 = Use Inp_Hold to snap state; 0 = Use Cmds or Output transition to snap. Default is false.
Cfg_UsePCmd	BOOL	1 = Enable snapshot on PCmd_Snap 0 --> 1(edge). Default is true.
Cfg_UseOCmd	BOOL	1 = Enable snapshot on OCmd_Snap 0 --> 1(edge). Default is true.
Cfg_UseOut01	BOOL	1 = Enable snapshot on Output 0 --> 1(rising edge). Default is true.
Cfg_UseOut10	BOOL	1 = Enable snapshot on Output 1 --> 0 (falling edge). Default is false.
Cfg_TimestampOnSnap	BOOL	1 = Generate a timestamp when snapshot occurs. Default is false.
Cfg_SnapOver	BOOL	1 = New snapshot overwrites without reset, 0 = Save first snapshot until reset. Default is false.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more information is available. Default is false.
Cfg_HasNav	SINT	Set bits indicate which navigation buttons are enabled. Default is 2#0000_0000.
Cfg_OnDly	REAL	Output ON delay time (seconds). Valid = 0.0 to 2147483.0 Default is 0.0.
Cfg_OffDly	REAL	Output OFF delay time (seconds). Valid = 0.0 to 2147483.0 Default is 0.0.
Cfg_CnfrmReqd	SINT	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.

Public Input Members	Data Type	Description
PCmd_Snap	BOOL	Program command to capture Input, Gate states in snapshot. Default is false.
PCmd_Reset	BOOL	Program command to reset (re-arm) snapshot latch. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output. This output state always reflects EnableIn input state.
Out_Live	BOOL	Condition logic output (result) after delay.
Out_Snap	BOOL	Condition logic output (result) at snapshot.
Val_DlyPctLive	DINT	Output OnDelay or OffDelay percent complete: live.
Val_DlyPctSnap	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_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Snapped	BOOL	1 = Snapshot has been triggered, 0 = Snapshot showing live states.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
Sts_InpLive	SINT	Live input status bits: .0 to .7 = Inp_0 to Inp_7.
Sts_GateLive	SINT	Live gate result status bits: .0 to .7 = Gate 0 to 7.
Sts_InpSnap	SINT	Snapshot of input status bits: .0 to .7 = Inp_0 to Inp_7.
Sts_GateSnap	SINT	Snapshot of gate result status bits: .0 to .7 = Gate 0 to 7.
Sts_GateSrc1Live	SINT	Live wire state for source 1 of each gate (bit# = gate#).
Sts_GateSrc2Live	SINT	Live wire state for source 2 of each gate (bit# = gate#).
Sts_GateSrc3Live	SINT	Live wire state for source 3 of each gate (bit# = gate#).
Sts_GateSrc4Live	SINT	Live wire state for source 4 of each gate (bit# = gate#).
Sts_GateSrc1Snap	SINT	Snapshot of wire state for source 1 of each gate (bit# = gate#).
Sts_GateSrc2Snap	SINT	Snapshot of wire state for source 2 of each gate (bit# = gate#).
Sts_GateSrc3Snap	SINT	Snapshot of wire state for source 3 of each gate (bit# = gate#).
Sts_GateSrc4Snap	SINT	Snapshot of wire state for source 4 of each gate (bit# = gate#).
Sts_OutInvertLive	BOOL	Output after inverter but before TON/TOF timers.
Sts_OutInvertSnap	BOOL	Snapshot of output after inverter but before TON/TOF.
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrGateFunc	SINT	1 = Error in each gate's function code (use 0 to 6).
Sts_ErrGateSrcPtr	SINT	1 = Error in each gate's source pointer (use 0 to 15).
Sts_ErrGateSrcMask	SINT	1 = Error in each gate's mask (source used) configuration (qty, choice).
Sts_ErrOutSrcPtr	BOOL	1 = Error in output's source pointer (use 0 to 15).
Sts_ErrTimer	BOOL	1 = Error in output's On Delay or Off Delay preset (use 0.0 to 2147483.0).

Private Input Members	Data Type	Description
Cfg_GateFunc	DINT[8]	Function code for gate M (1 = AND, 2 = OR, 3 = XOR, 4 = 2oo3, 5 = Set-Reset).
Cfg_GateSrc1Invert	SINT	Gate M Source #1 is Inverted (M by bit) (1 = invert). Default is 2#0000_0000.
Cfg_GateSrc1Mask	SINT	Gate M Source #1 is Used (M by bit) (1 = used). Default is 2#0000_0000.
Cfg_GateSrc1Ptr	DINT[8]	Pointer to Gate M Source #1 (0...7 = inputs, 8...15 = gate outputs).
Cfg_GateSrc2Invert	SINT	Gate M Source #2 is Inverted (M by bit) (1 = invert). Default is 2#0000_0000.
Cfg_GateSrc2Mask	SINT	Gate M Source #2 is Used (M by bit) (1 = used). Default is 2#0000_0000.
Cfg_GateSrc2Ptr	DINT[8]	Pointer to Gate M Source #2 (0...7 = inputs, 8...15 = gate outputs).

Private Input Members	Data Type	Description
Cfg_GateSrc3Invert	SINT	Gate M Source #3 is Inverted (M by bit) (1 = invert). Default is 2#0000_0000.
Cfg_GateSrc3Mask	SINT	Gate M Source #3 is Used (M by bit) (1 = used). Default is 2#0000_0000.
Cfg_GateSrc3Ptr	DINT[8]	Pointer to Gate M Source #3 (0...7 = inputs, 8...15 = gate outputs).
Cfg_GateSrc4Invert	SINT	Gate M Source #4 is Inverted (M by bit) (1 = invert). Default is 2#0000_0000.
Cfg_GateSrc4Mask	SINT	Gate M Source #4 is Used (M by bit) (1 = used). Default is 2#0000_0000.
Cfg_GateSrc4Ptr	DINT[8]	Pointer to Gate M Source #4 (0...7 = inputs, 8...15 = gate outputs).
Cfg_HasNav	SINT	Set bits indicate which navigation buttons are enabled. Default is 2#0000_0000.
Cfg_OutSrcInvert	BOOL	Out source (before minimum duration timer) is inverted (1 = invert). Default is false.
Cfg_OutSrcPtr	DINT	Source bit for Output (0...7 = inputs, 8...15 = gates). Default is 0.
HMI_Const	SINT[9]	Constants (for use in HMI indirection of parameters).
OCmd_Reset	BOOL	Operator command to reset (re-arm) snapshot latch. Default is false.
OCmd_Snap	BOOL	Operator Command to capture input, gate states in snapshot. Default is false.

Private Output Members	Data Type	Description
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables button).
ORdy_Snap	BOOL	1 =Ready for OCmd_Snap (enables button).
Val_LastGate	DINT[8]	Last gate pin which uses this gate result (0 = not used, 1...32 = gates, 33 = output).
Val_LastInp	DINT[8]	Last gate pin which uses this input (0 = not used, 1...32 = gates, 33 = output) For animation.
Val_SnapTimestamp	DINT[7]	Snapshot timestamp [0] = year, [1] = month, [2] = day, [3] = hour, [4] = minute, [5] = second, [6] = usecond.

Operation

The PBL instruction:

- Provides up to eight Boolean inputs and eight logic gates.
- Each gate has four inputs. Each input can be enabled or disabled and 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
- Use one of these methods to configure the eight gates:
  - 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 up to four 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 up to four 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 up to four 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

- 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. A majority would consist of 2 out of 2, 2 out of 3, or 3 out of 4. A Majority gate can have two, three, or four inputs enabled.

- Provides a snapshot capability that captures the state of the instruction for use later, until reset: all input states, gate states, and output state. The snapshot capability captures 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 with the year, month, day, hour, minute, second, or microsecond.
- Provides options to enable these 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 capability captures the snapshot when the PBL output condition is the first-out condition in a downstream PINTLK block. The first-out indication from the PINTLK instruction can be looped back to the PBL instruction's Inp_Hold input to hold the last-scan state in the snapshot, including last scan's time stamp.

Implementation

Use the PBL instruction in these situations:

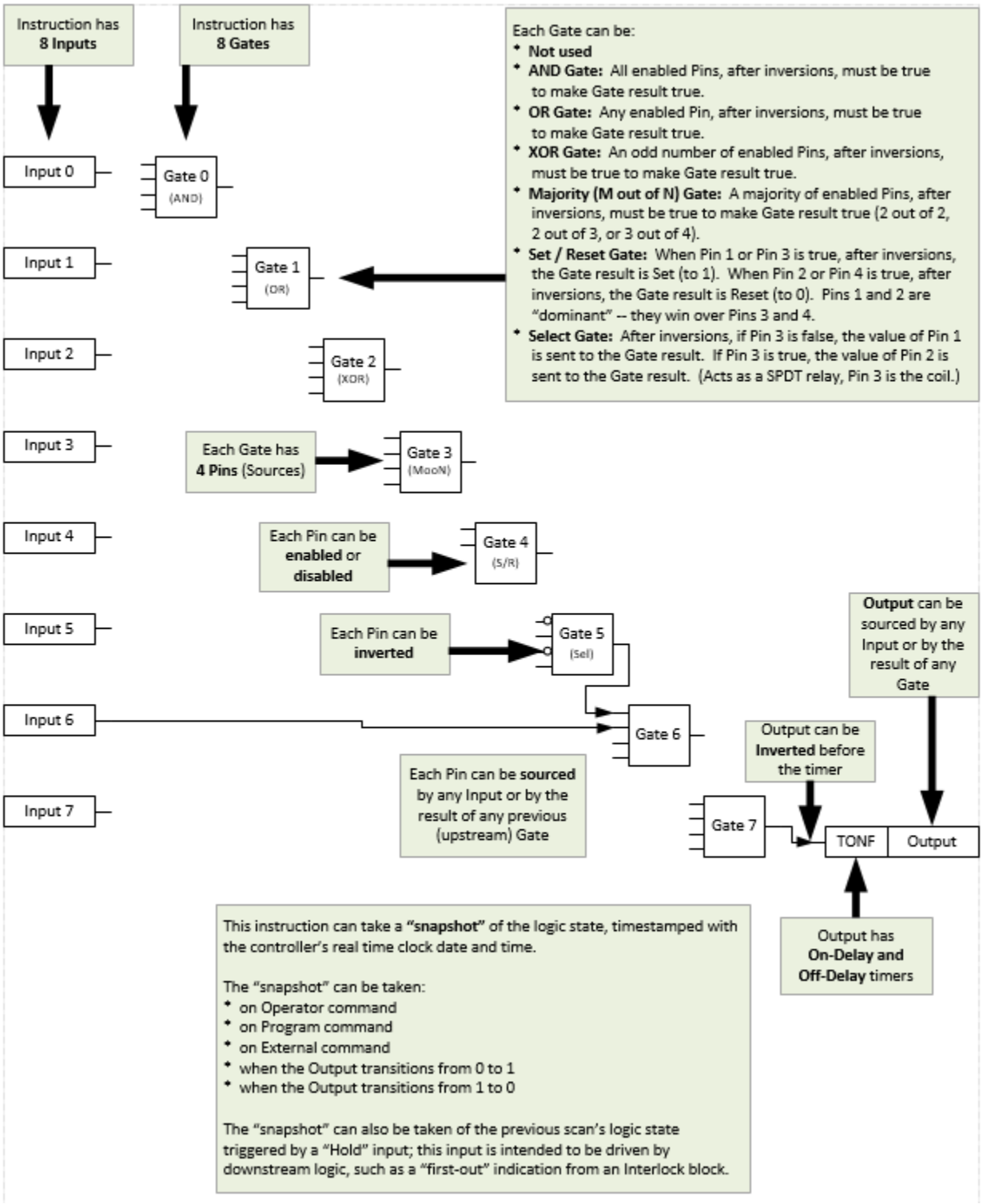
- A project requires an Interlock or Permissive condition that is more complicated than the simple OR-ing or AND-ing provided by the PINTLK (Interlocks) or PPERM (Permissives) Add-On Instructions.

- A project requires 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.
- A project contains more than the 16 interlock conditions or permissive conditions provided by the PINTLK and PPERM 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 PBL instruction and the result presented to a PINTLK instruction as a single Bearing Overtemp condition.

Do not use this instruction in these situations:

- A project requires simple interlocks and permissives that can be handled by the PINTLK and PPERM instructions directly. These instructions can permit operation or trip operation.
- A project requires logic that is beyond the PBL Add-On Instruction capabilities or which is extremely time critical. The PBL 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 built-in controller languages instead. The built-in programming languages are faster and provide functionality beyond what the PBL instruction can do.

This diagram illustrates the functionality of the PBL instruction:



Configuration

A maximum of eight gates can be configured using these tags:

Cfg_GateFunc[M] – This configuration is an array which defines the gate function. M = the gate number, 0-7.

- 1 = Logical AND Gate
- 2 = Logical OR Gate
- 3 = Logical XOR Gate
- 4 = Majority of Outputs are true
- 5 = Set/Reset
- 6 = A/B Selector

Each gate has four input pins. Each input pin can be enabled or disabled using this tag:

Cfg_GateSrc#Mask: This configuration is a SINT value that masks the gates (0-7) that are enabled for that input pin in a binary format. # = the input pin number (1-4). If the mask bit is high then the gate for that particular input pin is enabled.

Examples:

- Cfg_GateSrc1Mask.0 = 1 input pin 1 of gate 0 is enabled
- Cfg_GateSrc2Mask.1 = 1 input pin 2 of gate 1 is enabled
- Cfg_GateSrc3Mask.3 = 1 input pin 3 of gate 3 is enabled
- Cfg_GateSrc4Mask.0 = 1 input pin 4 of gate 0 is enabled

Each gate input pin can be normal or inverted.

Cfg_GateSrc#Invert: This configuration is a SINT value which inverts an input. # = the input pin number (1-4).

Examples:

- Cfg_GateSrc1Invert.0 = 1 input pin 1 of gate 0 is inverted.
- Cfg_GateSrc2Invert.2 = 1 input pin 2 of gate 2 is inverted
- Cfg_GateSrc3Invert.3 = 1 input pin 3 of gate 3 is inverted
- Cfg_GateSrc4Invert.6 = 1 input pin 4 of gate 6 is inverted

Each enabled gate input pin can be linked to a source, either an instruction input or the result of a preceding gate.

Cfg_GateSrc#Ptr[M] - This configuration is an array that defines the source for the input pin on each gate. Where # = the input pin number (1-4), and M = the gate number (0-7). A value of 0-7 represents an instruction input. A value of 8-15 represents the result of a preceding gate. Tip: A gate can only be used as an input into another gate with a higher gate value.

Examples:

- Cfg_GateSrc1Ptr[0] = 2 states that Inp_2 is configured in Gate 0 on pin 1.
- Cfg_GateSrc2Ptr[0] = 3 states that Inp_3 is configured in Gate 0 on pin 2.
- Cfg_GateSrc3Ptr[2] = 8 states that Gate 0 result is configured in Gate 2 on pin 3.

- Cfg_GateSrc4Ptr[7] = 12 states that Gate 4 result is configured in Gate 7 on pin 4.

Configure the output using these tags:

- Cfg_OutSrcPtr – This configuration determines which input/gate will be the output. A value of 0-7 represents an instruction input. A value of 8-15 represents the result of a gate.
- Cfg_OutSrcInvert – This configuration determines if the output will be inverted.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- State name strings for 0-state and 1-state
- More Information

Monitor the PBL Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Resets the output on-delay and off-delay timers; clears the snapshot time stamp and data; clears any commands received while controller was in Program mode.
Instruction first run	Resets the output on-delay and off-delay timers; clears the snapshot time stamp and data; clears any commands received while controller was in Program mode.
Rung-condition-in is false	Clears output to false (off) and resets the output on-delay and off-delay timers.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Resets the output on-delay and off-delay timers; clears the snapshot time stamp and data; clears any commands received while controller was in Program mode.
Instruction first run	Resets the output on-delay and off-delay timers; clears the snapshot time stamp and data; clears any commands received while controller was in Program mode.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Clears output to false (off) and resets the output on-delay and off-delay timers.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

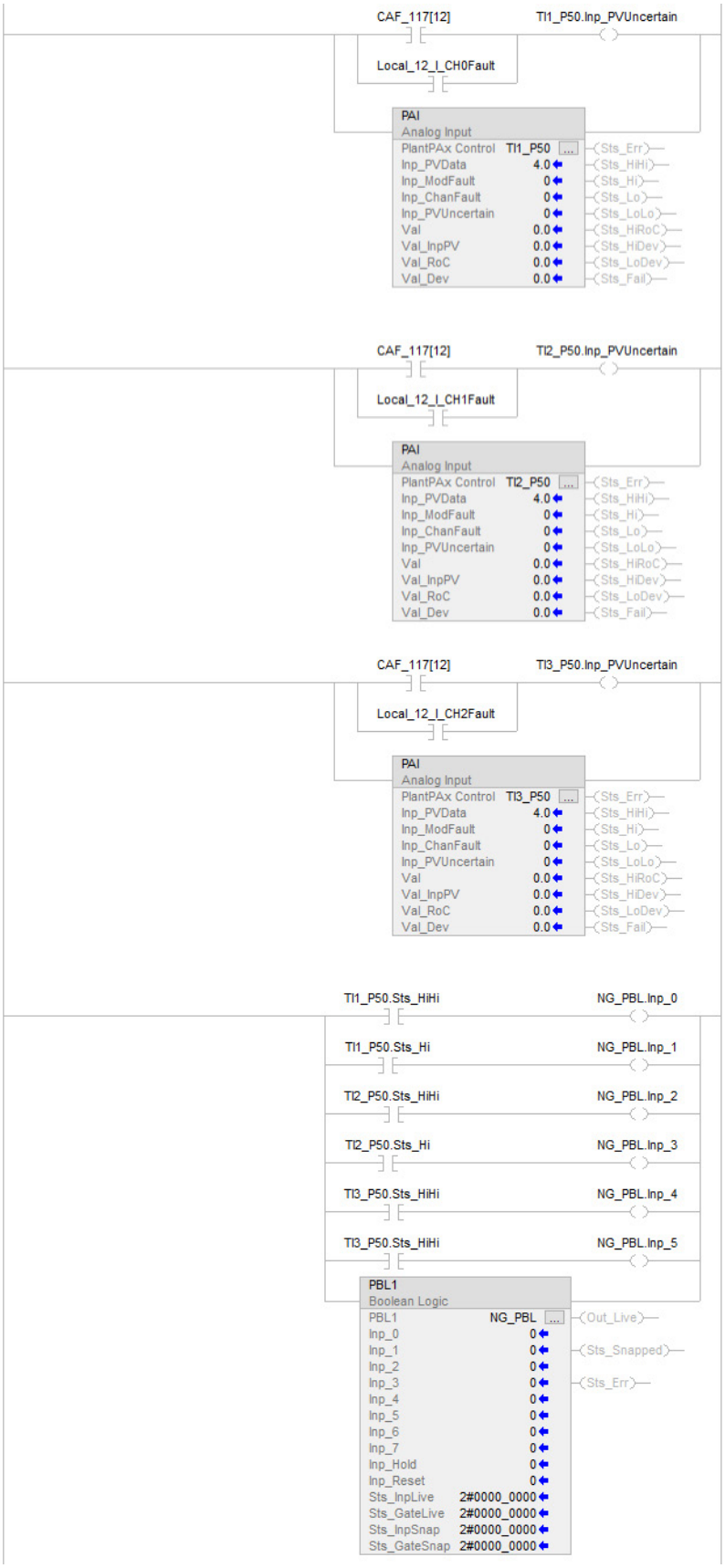
This example uses the PBL instruction to perform advanced interlocking logic that is based on the winding temperatures of a motor. This example navigates the parameter settings to fully illustrate the example.

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:

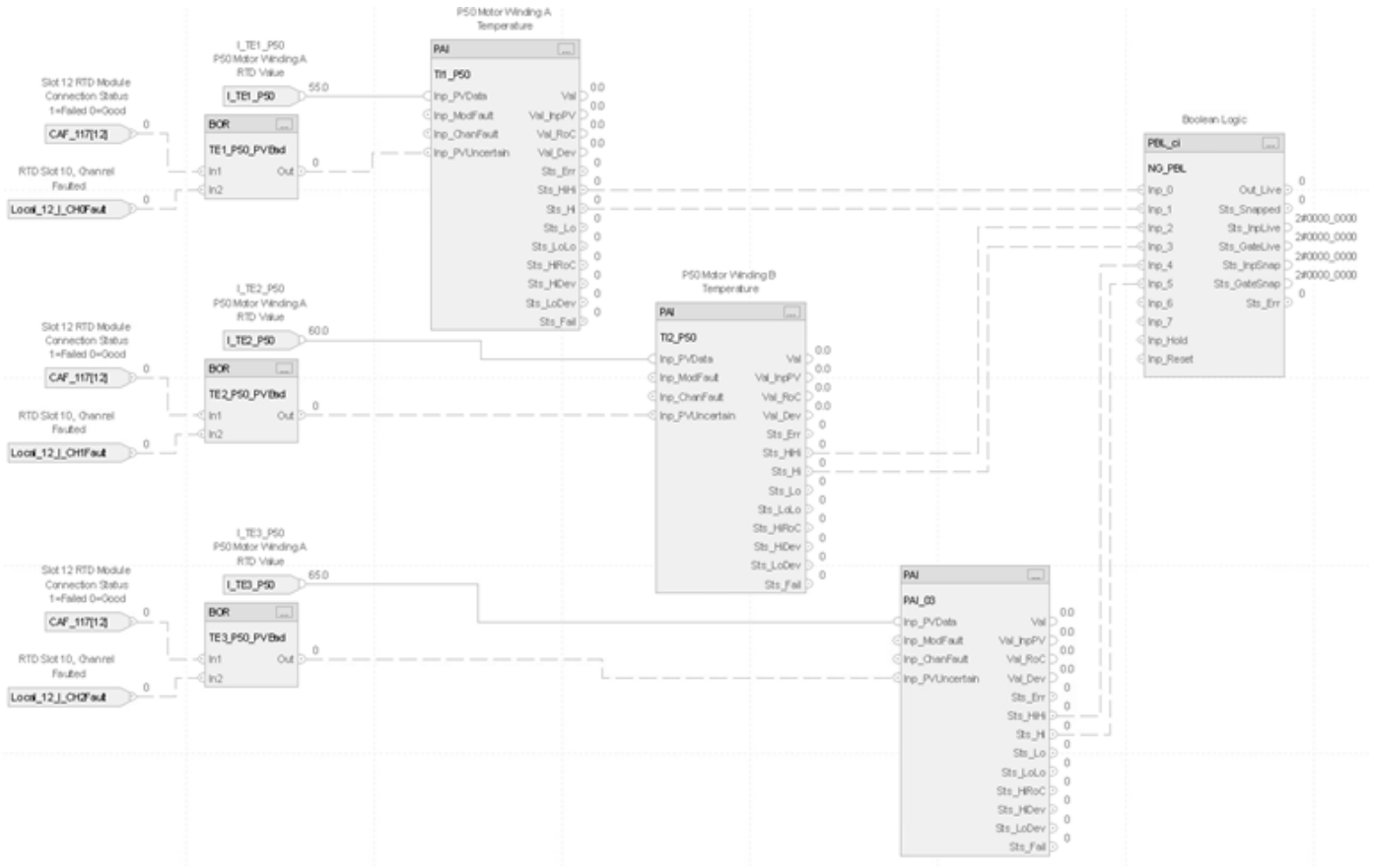
- Any of the windings are above the high-high temperature limit.
- The majority of the windings are above the high temperature limit.

PBL performs this function. The output of this logic feeds the interlock of the motor elsewhere in logic.

Ladder Diagram



Function Block Diagram



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. PBL 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 PBL 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 PBL.

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

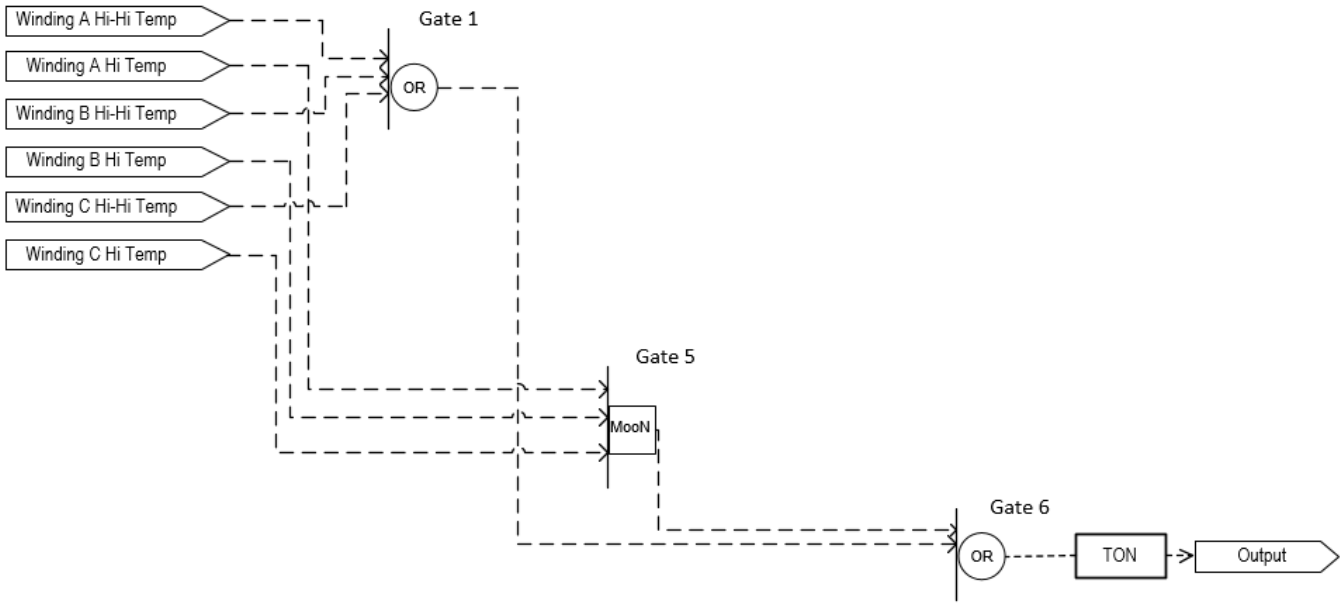
- Cfg_GateSrc1Mask.6 = 1, Cfg_GateSrc1Ptr[6] = 9
- Cfg_GateSrc2Mask.6 = 1, Cfg_GateSrc2Ptr[6] = 13

Cfg_OutSrcPtr needs to be set to 14 to take the output from Gate 6 and make it the output (Out_Live) of the PBL block. The on-delay time is then set to 5 seconds to prevent spurious trips of the output (Cfg_OnDly = 5).

Lastly, the descriptions provide documentation on the faceplate. In this example, these are the description settings:

- Out_Live.@State0 = OK
- Out_Live.@State1 = Tripped
- Inp_0.@Label = Winding A Hi-Hi Temp
- Inp_1.@Label = Winding A Hi Temp
- Inp_2.@Label = Winding B Hi-Hi Temp
- Inp_3.@Label = Winding B Hi Temp
- Inp_4.@Label = Winding C Hi-Hi Temp
- Inp_5.@Label = Winding C Hi Temp

This diagram illustrates the functionality of the example:



Structured Text

```
TI1_P50.Inp_PVData := I_TE1_P50;
TI1_P50.Inp_PVUncertain := (CAF_117[12] OR Local_12_I_CH0Fault);
PAI(TI1_P50);
TI2_P50.Inp_PVData := I_TE2_P50;
TI2_P50.Inp_PVUncertain := (CAF_117[12] OR Local_12_I_CH1Fault);
PAI(TI2_P50);
TI3_P50.Inp_PVData := I_TE3_P50;
TI3_P50.Inp_PVUncertain := (CAF_117[12] OR Local_12_I_CH2Fault);
PAI(TI3_P50);
TI1_P50.Sts_HiHi := NG_PBL.Inp_0;
TI1_P50.Sts_Hi := NG_PBL.Inp_1;
TI2_P50.Sts_HiHi := NG_PBL.Inp_2;
TI2_P50.Sts_Hi := NG_PBL.Inp_3;
TI3_P50.Sts_HiHi := NG_PBL.Inp_4;
TI3_P50.Sts_Hi := NG_PBL.Inp_5;
PBL(NG_PBL);
```

Process Command Source (PCMDSRC)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

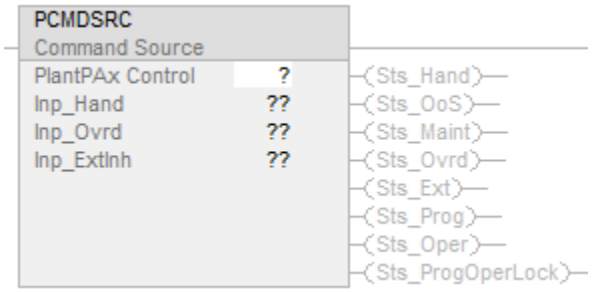
The Process Command Source (PCMDSRC) instruction selects the command source for a device.

The instruction includes these command sources:

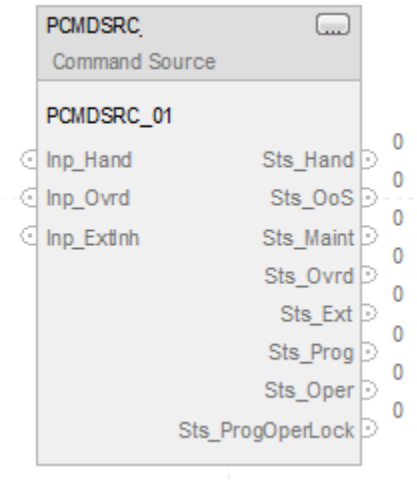
- Hand
- Out-of-Service
- Maintenance
- Override
- External
- Program locked
- Program
- Operator locked
- Operator

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PCMDSRC (PCMDSRC tag);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_COMMAND_SOURCE	tag	Data structure required for proper operation of the instruction.

P_COMMAND_SOURCE Structure

Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_OwnerCmd	DINT	Owner device command: 0 = None, Inp_OwnerCmd.10 = Operator Lock, Inp_OwnerCmd.11 = Operator Unlock, Inp_OwnerCmd.12 = Program Lock, Inp_OwnerCmd.13 = Program Unlock, Inp_OwnerCmd.14 = Acquire Maintenance, Inp_OwnerCmd.15 = Release Maintenance, Inp_OwnerCmd.16 = Acquire External, Inp_OwnerCmd.17 = Release External, Inp_OwnerCmd.29 = Echo. Default is 0.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when re-initialization is needed. The instruction clears this operand automatically. Default is true.
Inp_Hand	BOOL	1 = Acquire Hand (typically permanently set to local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	1 = Acquire Override (higher priority program logic), 0 = Release Override. Default is false.
Inp_ExtInh	BOOL	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is true.
Cfg_HasOper	BOOL	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	1 = Operator Locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	1 = Program Locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	1 = Maintenance exists, can be selected. Default is true.

Input Members	Data Type	Description
Cfg_HasMaintOoS	BOOL	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	1 = Override supersedes Program/Operator Lock, 0 = Do not override Lock. Default is true.
Cfg_ExtOverLock	BOOL	1 = External supersedes Program/Operator Lock, 0 = Do not override Lock. Default is false.
Cfg_ProgPwrUp	BOOL	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Normal Source: 1 = Program if no requests, 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	1 = PCmd_Prog used as a Level. Default is false.
Cfg_PCmdLockAsLevel	BOOL	1 = PCmd_Lock used as a Level (1=Lock, 0=Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	1 = XCmd_Acq used as Level (1 = Acquire, 0 = Release). Default is false.
PCmd_Oper	BOOL	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Program command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Program command to lock Program (disallow Operator). The instruction clears this parameter automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Program command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.

Input Members	Data Type	Description
MCmd_Rel	BOOL	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
XCmd_Acq	BOOL	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.

Output Members	Data Type	Description
EnableOut	BOOL	Enable output. This output state always reflects EnableIn input state.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_eSrc	INT	The current command source is shown with status bits: Sts_eSrc.0: Lock, Sts_eSrc.1: Normal, Sts_eSrc.2: Hand, Sts_eSrc.3: Maintenance, Sts_eSrc.4: Override, Sts_eSrc.5: Program, Sts_eSrc.6: Operator, Sts_eSrc.7: Out of Service, Sts_eSrc.8: External.

Output Members	Data Type	Description
Sts_bSrc	INT	Active selection bitmap (for HMI totem pole with command source request selection) Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed Out of Service (rung false), Sts_bSrc.2: Maintenance Out of Service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_Hand	BOOL	1 = Hand is selected (supersedes OoS, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	1 = Out of Service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	1 = External is selected (supersedes Program, Operator).
Sts_Prog	BOOL	1 = Program is selected.
Sts_ProgLocked	BOOL	1 = Program is selected and Locked.
Sts_Oper	BOOL	1 = Operator is selected.
Sts_OperLocked	BOOL	1 = Operator is selected and Locked.
Sts_ProgOperSel	BOOL	Program/Operator selection (latch) state: 1 = Program, 0=Operator.
Sts_ProgOperLock	BOOL	Program/Operator lock (latch) state, 1 = Locked, 0=Unlocked.
Sts_Normal	BOOL	1 = Selection equals the Normal (Program or Operator).
Sts_ExtReqInh	BOOL	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	1 = Maintenance Acquire command received this scan.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
XRdy_Acq	BOOL	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	1 = Ready for XCmd_Rel, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.

Output Members	Data Type	Description
Out_OwnerSts	DINT	Status of command source, owner command handshake and ready status: 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready

Operation

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. (Highest priority command source)
Out-of-Service	The instruction is disabled and has no owner.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (e.g. field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from the Program unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. (Lowest priority command source)

The instruction enables or disablesthese operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists

- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a command source prevents the other command source from acquiring privilege.

Core command source model

The core control model consists of these command sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other command sources may be present in the model but act as overriding command sources, acting independent of the base Operator/Program state machine.

Enabling command sources as configuration

The individual command sources may be enabled or disabled by the user. The default configuration uses the entire base model; upon power-up of the processing environment the command source will be the designated default. Some combinations of enabled command sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. This means that all commands are automatically cleared when the instruction executes and processes them.

Changing Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Prog is disabled, the destination of the OCmd_Prog command is directed to the ProgLocked state instead of the Prog state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Initialization

The instruction is normally initialized in the instruction first run. Re-initialization can be requested any time by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1 (default value).

Monitor the PCMDSRC Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out clears to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition.
Rung-condition-in is false	The instruction is put Out of Service if Inp_Hand=0. The output is de-energized. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.

Condition/State	Action Taken
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. The instruction is put Out of Service if Inp_Hand=0. The output is de-energized. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

PCMDSRC operating model

The core control model for the Process Command Source (PCMDSRC) instruction consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enabling control sources as Configuration

The individual control sources can be enabled or disabled by the user. The default configuration uses the entire base model; upon power-up of the

processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot latched. This means that all commands are automatically cleared when the instruction executes and processes them.

Changing Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. Example: If the Prog is disabled, the destination of the OCmd_Prog command is directed to the ProgLocked state instead of the Prog state. This change of destination maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated, there would be no way to accomplish this. This change of destination is only done in configurations where it would cause no conflict or race condition. It preserves as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Process Discrete 2-, 3-, or 4-State Device (PD4SD)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

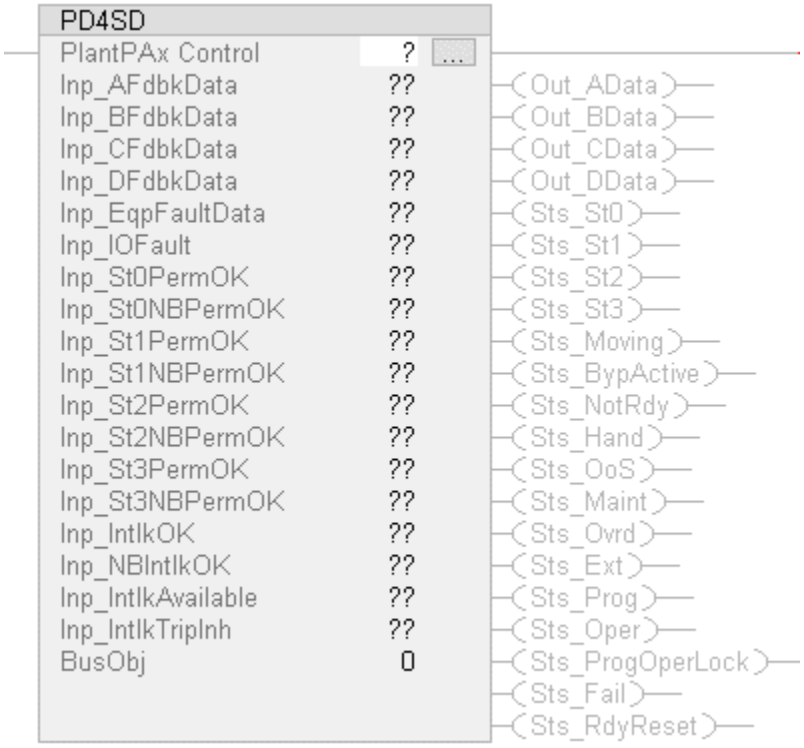
The Process Discrete 2-, 3-, or 4-State Device (PD4SD) instruction controls and monitors feedback from a discrete 2-state, 3-state, or 4-state device in a variety of modes, monitoring for fault conditions. These devices include multiple-speed motors or multiple-position valves.

The PD4SD instruction:

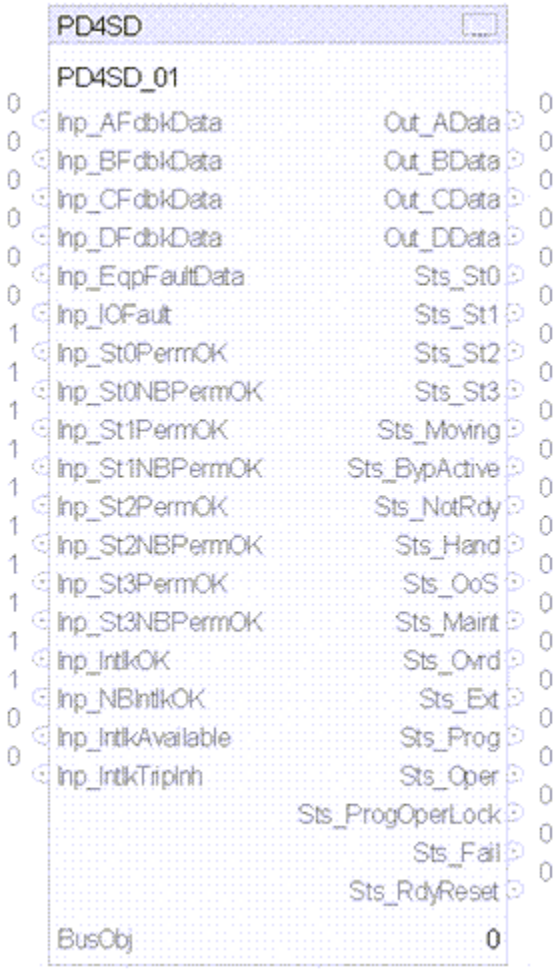
- Provides configuration for two, three, or four selectable states for the device.
- Provides Operator, Program, and External commands to select one of the two, three, or four states of the device.
- Controls four discrete outputs, with configurable states of each output in the various device states. Each output can be set, cleared, or left in last state in a given device state.
- Monitors four discrete feedback inputs, with configurable states (including *must be on*, *must be off*, and *don't care*) for each input in the various device states for monitoring the actual position of the device.
- Provides configurable text labels for each of the states.
- When feedback inputs are used, detects failure to reach the target state, after a configurable time, and alarms the failure. Optionally sheds to the default state (state 0) on a feedback failure.
- Monitors Permissive conditions that allow commanding the device to each state.
- Monitors Interlock conditions that return the device to its default state (state 0).
- Provides simulation of a normal working device, while holding the outputs to the real device de-energized, for use in testing or operator training.
- Monitors I/O communication status, providing an alarm on an I/O fault. Optionally, sheds to the default state on an I/O fault condition.
- Provides an Available status when in Program command source and operating normally for use by automation logic to determine if the logic can manipulate the device.
- Operates from Hand, Maintenance, Override, External, Program, and Operator command sources.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PD4SD(PD4SDTag, BusObj)

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_DISCRETE_4STATE	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component.

P_DISCRETE_4STATE Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command (bitmapped): All bits off = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .29 = Echo. Default is 0.
Inp_AFdbkData	BOOL	Visible	Not Required	Input	Feedback A from device. Default is false.
Inp_BFdbkData	BOOL	Visible	Not Required	Input	Feedback B from device. Default is false.
Inp_CFdbkData	BOOL	Visible	Not Required	Input	Feedback C from device. Default is false.
Inp_DFdbkData	BOOL	Visible	Not Required	Input	Feedback D from device. Default is false.
Inp_EqpFaultData	BOOL	Visible	Not Required	Input	Equipment fault from device: 1 = Faulted. Default is false.
Inp_IOFault	BOOL	Visible	Not Required	Input	1 = I/O communication is faulted, 0 = I/O communication is OK. Default is false.
Inp_St0PermOK	BOOL	Visible	Not Required	Input	1 = Permissives are OK, device can be commanded to State 0. Default is true.
Inp_St0NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable permissives are OK, device can be commanded to State 0. Default is true.
Inp_St1PermOK	BOOL	Visible	Not Required	Input	1 = Permissives are OK, device can be commanded to State 1. Default is true.
Inp_St1NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable permissives are OK, device can be commanded to State 1. Default is true.
Inp_St2PermOK	BOOL	Visible	Not Required	Input	1 = Permissives are OK, device can be commanded to State 2. Default is true.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_St2NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable permissives are OK, device can be commanded to State 2. Default is true.
Inp_St3PermOK	BOOL	Visible	Not Required	Input	1 = Permissives are OK, device can be commanded to State 3. Default is true.
Inp_St3NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable permissives are OK, device can be commanded to State 3. Default is true.
Inp_IntlkOK	BOOL	Visible	Not Required	Input	1 = Interlocks are OK, device can be commanded, 0 = Interlocks are not OK, device is driven to State 0. Default is true.
Inp_NBIntlkOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable interlocks are OK, device can be commanded, 0 = Interlocks are not OK, device is driven to State 0. Default is true.
Inp_IntlkAvailable	BOOL	Visible	Not Required	Input	1 = Interlock availability is OK, show Sts_IntlkAvailable if device is ready except for interlocks. Default is false.
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit reporting of Sts_IntlkTrip and interlock trip alarm. Default is false.
Inp_RdyReset	BOOL	Not Visible	Not Required	Input	1 = Related object, reset by this object, is ready to be reset. Default is false.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire Hand command source (typically hardwired local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override command source (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCmd	SINT	Not Visible	Not Required	Input	Override device command: 0 = No command, 1 = State 0, 2 = State 1, 3 = State 2, 4 = State 3. Default is 0.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External command source acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit audible alert, 0 = Allow audible alert. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset shed latches and cleared alarms. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator to shelve alarms. Default is true.
Cfg_NumStates	SINT	Not Visible	Not Required	Input	Number of device states. Valid = 2 to 4. Default is 2.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_bSt0OutWrite	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, overwrite that output in State 0. If bit = 0, do not write that output in State 0. Default is 2#0000_1111.
Cfg_bSt0OutState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: When written, if bit = 1, write 1 to that output in State 0. If bit = 0, write 0 to that output in State 0. Default is 2#0000_0001.
Cfg_bSt1OutWrite	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, overwrite that output in State 1. If bit = 0, do not write that output in State 1. Default is 2#0000_1111.
Cfg_bSt1OutState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: When written, if bit = 1, write 1 to that output in State 1. If bit = 0, write 0 to that output in State 1. Default is 2#0000_0010.
Cfg_bSt2OutWrite	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, overwrite that output in State 2. If bit = 0, do not write that output in State 2. Default is 2#0000_1111.
Cfg_bSt2OutState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: When written, if bit = 1, write 1 to that output in State 2. If bit = 0, write 0 to that output in State 2. Default is 2#0000_0100.
Cfg_bSt3OutWrite	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, overwrite that output in State 3. If bit = 0, do not write that output in State 3. Default is 2#0000_1111.
Cfg_bSt3OutState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: When written, if bit = 1, write 1 to that output in State 3. If bit = 0, write 0 to that output in State 3. Default is 2#0000_1000.
Cfg_bSt0FdbkCheck	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, check that feedback bit to verify State 0. If bit = 0, don't check that feedback bit (don't care). Default is 2#0000_0000.
Cfg_bSt0FdbkState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If checking, if bit = 1, that feedback input is 1 in State 0. If bit = 0, that feedback input is 0 in State 0. Default is 2#0000_0001.
Cfg_bSt1FdbkCheck	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, check that feedback bit to verify State 1. If bit = 0, don't check that feedback bit (don't care). Default is 2#0000_0000.
Cfg_bSt1FdbkState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If checking, if bit = 1, that feedback input is 1 in State 1. If bit = 0, that feedback input is 0 in State 1. Default is 2#0000_0010.
Cfg_bSt2FdbkCheck	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, check that feedback bit to verify State 2. If bit = 0, don't check that feedback bit (don't care). Default is 2#0000_0000.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_bSt2FdbkState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If checking, if bit = 1, that feedback input is 1 in State 2. If bit = 0, that feedback input is 0 in State 2. Default is 2#0000_0100.
Cfg_bSt3FdbkCheck	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If bit = 1, check that feedback bit to verify State 3. If bit = 0, don't check that feedback bit (don't care). Default is 2#0000_0000.
Cfg_bSt3FdbkState	SINT	Not Visible	Not Required	Input	Bitmask, bits .0 - .3: If checking, if bit = 1, that feedback input is 1 in State 3. If bit = 0, that feedback input is 0 in State 3. Default is 2#0000_1000.
Cfg_ePwrUpState	SINT	Not Visible	Not Required	Input	Powerup state: 0 = De-energized, 1 = Outputs for State 0, 2 = Outputs for State 1, 3 = Outputs for State 2, 4 = Outputs for State 3, 5 = Outputs for feedback state. Default is 0.
Cfg_StOonShed	BOOL	Not Visible	Not Required	Input	1 = Go to State 0 on interlock or shed, 0 = Hold position on interlock or shed. Default is false.
Cfg_HasSt0PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_St0Perm inputs, enable navigation. Default is false.
Cfg_HasSt1PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_St1Perm inputs, enable navigation. Default is false.
Cfg_HasSt2PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_St2Perm inputs, enable navigation. Default is false.
Cfg_HasSt3PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_St3Perm inputs, enable navigation. Default is false.
Cfg_HasIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_Intlk inputs, enable navigation. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available, enable navigation. Default is false.
Cfg_OperSt0Prio	BOOL	Not Visible	Not Required	Input	1 = OCmd_St0 is accepted any time, 0 = OCmd_St0 is accepted only when Operator command source is selected. Default is false.
Cfg_ExtSt0Prio	BOOL	Not Visible	Not Required	Input	1 = XCmd_St0 is accepted any time, 0 = XCmd_St0 is accepted only when External command source is selected. Default is false.
Cfg_OCmdResets	BOOL	Not Visible	Not Required	Input	1 = A new Operator state command resets fault, 0 = A reset command is required to clear fault. Default is false.
Cfg_XCmdResets	BOOL	Not Visible	Not Required	Input	1 = A new External state command resets fault, 0 = A reset command is required to clear fault. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores bypassable permissives and interlocks, 0 = Override uses all permissives and interlocks. Default is false.
Cfg_ShedOnFail	BOOL	Not Visible	Not Required	Input	1 = Go to State 0 and alarm on position fail, 0 = Alarm only. Default is true.
Cfg_ShedOnIOFault	BOOL	Not Visible	Not Required	Input	1 = Go to State 0 and alarm on I/O fault, 0 = Alarm only. Default is true.
Cfg_ShedOnEqpFault	BOOL	Not Visible	Not Required	Input	1 = Go to State 0 and alarm on equipment fault, 0 = Alarm only. Default is true.
Cfg_HornOnChange	BOOL	Not Visible	Not Required	Input	1 = Sound horn on any state change, 0 = Sound horn only on leaving State 0. Default is false.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) command source exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator Locked command source exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) command source exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program Locked command source exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External command source exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance command source exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	Not Visible	Not Required	Input	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator Locked, 0 = Don't supersede Program/Operator Locked. Default is true.
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator Locked, 0 = Don't supersede Program/Operator Locked. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program command source, 0 = Power up to Operator command source. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal command source: 1 = Program, 0 = Operator. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority: 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = Program/Operator selection follows PCmd_Prog as level (1 for Program, 0 for Operator), 0 = PCmd_Prog is used as edge to select Program, PCmd_Oper selects Operator. Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = Program lock selection follows PCmd_Lock as level (1 for locked, 0 for unlocked), 0 = PCmd_Lock is used as edge to select Program Locked, PCmd_Unlock selects Program (unlocked). Default is false.
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = External selection follows XCmd_Acq as level (1 to acquire External, 0 to release External), 0 = XCmd_Acq is used as edge to acquire External, XCmd_Rel is used to release External. Default is false.
Cfg_OutAPulseTime	REAL	Not Visible	Not Required	Input	Time to pulse Out_AData (seconds). Valid = 0.0 to 2147483.0, 0.0 = Output held continuously. Default is 0.0.
Cfg_OutBPulseTime	REAL	Not Visible	Not Required	Input	Time to pulse Out_BData (seconds). Valid = 0.0 to 2147483.0, 0.0 = Output held continuously. Default is 0.0.
Cfg_OutCPulseTime	REAL	Not Visible	Not Required	Input	Time to pulse Out_CData (seconds). Valid = 0.0 to 2147483.0, 0.0 = Output held continuously. Default is 0.0.
Cfg_OutDPulseTime	REAL	Not Visible	Not Required	Input	Time to pulse Out_DData (seconds). Valid = 0.0 to 2147483.0, 0.0 = Output held continuously. Default is 0.0.
Cfg_StartHornTime	REAL	Not Visible	Not Required	Input	Time to sound audible on device state change (seconds). Valid = 0.0 to 1000.0, 0.0 = Disabled. Default is 0.0.
Cfg_VirtualFdbkTime	REAL	Not Visible	Not Required	Input	Time to simulate reaching target state when virtualized (seconds). Valid = 0.0 to 2147483.0. Default is 2.0.
Cfg_FailTime	REAL	Not Visible	Not Required	Input	Time to receive state feedback before declaring failure (seconds). Valid = 0.0 to 2147483.0. Default is 10.0.
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator command confirmation or e-signature type required: 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program ownership request: Non-zero Owner ID = Acquire, 0 = Release. Default is 0.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program Command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program Command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_St0	BOOL	Not Visible	Not Required	Input	Program Command to set device to State 0. The instruction clears this operand automatically. Default is false.
PCmd_St1	BOOL	Not Visible	Not Required	Input	Program Command to set device to State 1. The instruction clears this operand automatically. Default is false.
PCmd_St2	BOOL	Not Visible	Not Required	Input	Program Command to set device to State 2. The instruction clears this operand automatically. Default is false.
PCmd_St3	BOOL	Not Visible	Not Required	Input	Program Command to set device to State 3. The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program Command to select Program command source. The instruction clears this operand automatically if Cfg_PCmdProgAsLevel = 0. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program Command to select Operator command source. The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program Command to lock Program command source and disallow Operator. The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program Command to unlock Program command source and allow Operator to acquire. The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program Command to select normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
XCmd_St0	BOOL	Not Visible	Not Required	Input	External Command to set device to State 0. The instruction clears this operand automatically. Default is false.
XCmd_St1	BOOL	Not Visible	Not Required	Input	External Command to set device to State 1. The instruction clears this operand automatically. Default is false.
XCmd_St2	BOOL	Not Visible	Not Required	Input	External Command to set device to State 2. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
XCmd_St3	BOOL	Not Visible	Not Required	Input	External Command to set device to State 3. The instruction clears this operand automatically. Default is false.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External Command to acquire command source. The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External Command to release command source, accepted if Cfg_ExtAcqAsLevel = 0. The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External Command to acknowledge all alarms and reset latched alarms and shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter
Out_AData	BOOL	Visible	Not Required	Output	Output A to device.
Out_BData	BOOL	Visible	Not Required	Output	Output B to device.
Out_CData	BOOL	Visible	Not Required	Output	Output C to device.
Out_DData	BOOL	Visible	Not Required	Output	Output D to device.
Out_HornData	BOOL	Not Visible	Not Required	Output	Output to sound horn prior to commanded state change.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status (bitmapped): All bits off = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. 0 = Use Inp_InitializeReq to reinitialize.
Sts_St0	BOOL	Visible	Not Required	Output	1 = Device confirmed in State 0.
Sts_St1	BOOL	Visible	Not Required	Output	1 = Device confirmed in State 1.
Sts_St2	BOOL	Visible	Not Required	Output	1 = Device confirmed in State 2.
Sts_St3	BOOL	Visible	Not Required	Output	1 = Device confirmed in State 3.
Sts_Moving	BOOL	Visible	Not Required	Output	1 = Device not yet confirmed in commanded state.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_Horn	BOOL	Not Visible	Not Required	Output	1 = Sounding horn prior to commanded state change.
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction treats device as virtual, acting as if controlling a working device, but the outputs are kept de-energized, 0 = The instruction operates the physical device normally.
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output: 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status: 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Device feedback: 0 = None/Moving/Unknown, 1 = State 0, 2 = State 1, 3 = State 2, 4 = State 3.
Sts_eCmd	SINT	Not Visible	Not Required	Output	Device command: 0 = None, 1 = State 0, 2 = State 1, 3 = State 2, 4 = State 3.
Sts_eSts	SINT	Not Visible	Not Required	Output	Device status: 0 = Powerup/Reset, 1 = State 0, 2 = State 1, 3 = State 2, 4 = State 3, 5 = Moving, 6 = Horn, 7 = Out of service.
Sts_eFault	SINT	Not Visible	Not Required	Output	Device fault status: 0 = None, 16 = Position fail, 17 = Device fault, 32 = I/O fault, 34 = Configuration error.
Sts_eOutState	SINT	Not Visible	Not Required	Output	State of outputs to physical device: 0 = De-energized, 1 = State 0, 2 = State 1, 3 = State 2, 4 = State 3, 5 = Horn.
Sts_eNotify	SINT	Not Visible	Not Required	Output	Summary alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	Summary alarm status including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	Not Visible	Not Required	Output	I/O fault alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFail	SINT	Not Visible	Not Required	Output	Device fail alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	Not Visible	Not Required	Output	Interlock trip alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyEqpFault	SINT	Not Visible	Not Required	Output	Device-reported equipment fault alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_eSrc	INT	Not Visible	Not Required	Output	Current command source: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program Locked, 34 = Program default (Normal), 64 = Operator, 65 = Operator Locked, 66 = Operator default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (EnableIn false), 256 = External.
Sts_bSrc	INT	Not Visible	Not Required	Output	Active command source selections (bitmapped, for HMI): .0 = Hand, .1 = Programmed Out of Service (EnableIn false), .2= Maintenance Out of Service, .3 = Maintenance, .4 = Override, .5 = External, .6 = Program Locked, .7 = Program (unlocked), .8 = Operator Locked, .9 = Operator (unlocked).
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Device has been acquired by Program and is ready and available for control.
Sts_IntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Device can be acquired by Program and is available for control when interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks and permissives are bypassed.
Sts_BypActive	BOOL	Visible	Not Required	Output	1 = Interlock/permissive bypassing is active (bypassed by command or in Maintenance command source).
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	Visible	Not Required	Output	1 = Device not ready, see Sts_NrdyXxx detail bits for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Device not ready, configuration error.
Sts_NrdyEqpFault	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device-reported equipment fault, shed requires reset.
Sts_NrdyFail	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device failure, shed requires reset.
Sts_NrdyIntlk	BOOL	Not Visible	Not Required	Output	1 = Device not ready, interlock not OK.
Sts_NrdyIOFault	BOOL	Not Visible	Not Required	Output	1 = Device not ready, I/O fault, shed requires reset.
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device is Out of Service.
Sts_NrdyPerm	BOOL	Not Visible	Not Required	Output	1 = Device not ready, permissives not OK, device is not allowed to change state. 0 = Device ready or partially ready, some permissives may be not OK, device can be commanded to at least one other state.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_NrdyPrioSt0	BOOL	Not Visible	Not Required	Output	1 = Device not ready, Operator or External issued priority State 0 Command, shed requires reset.
Sts_Err	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, see Sts_ErrXxx detail bits for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Logix tag-based alarm settings invalid.
Sts_ErrOutAPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_OutAPulseTime invalid. Valid = 0.0 to 2147483.0, 0.0 = Output held continuously.
Sts_ErrOutBPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_OutBPulseTime invalid. Valid = 0.0 to 2147483.0, 0.0 = Output held continuously.
Sts_ErrOutCPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_OutCPulseTime invalid. Valid = 0.0 to 2147483.0, 0.0 = Output held continuously.
Sts_ErrOutDPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_OutDPulseTime invalid. Valid = 0.0 to 2147483.0, 0.0 = Output held continuously.
Sts_ErrVirtualFdbkTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_VirtualFdbkTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrFailTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_FailTime invalid. Valid = 0.0 to 2147483.0.
Sts_Hand	BOOL	Visible	Not Required	Output	1 = Hand command source is selected.
Sts_OoS	BOOL	Visible	Not Required	Output	1 = Out of Service command source is selected.
Sts_Maint	BOOL	Visible	Not Required	Output	1 = Maintenance command source is selected.
Sts_Ovrd	BOOL	Visible	Not Required	Output	1 = Override command source is selected.
Sts_Ext	BOOL	Visible	Not Required	Output	1 = External command source is selected.
Sts_Prog	BOOL	Visible	Not Required	Output	1 = Program (unlocked) command source is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program Locked command source is selected.
Sts_Oper	BOOL	Visible	Not Required	Output	1 = Operator (unlocked) command source is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator Locked command source is selected.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Visible	Not Required	Output	Program/Operator lock (latch) state: 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selected command source is the normal source (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External command source selection is inhibited, External is not available in current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program command source selection is inhibited, Program is not available in current state.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Command to acquire Maintenance command source was received this scan.
Sts_CmdConflict	BOOL	Not Visible	Not Required	Output	1 = Conflicting commands received this scan.
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = An alarm is shelved or disabled.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_IOFault	BOOL	Not Visible	Not Required	Output	1 = I/O communication fault. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PD4SD_tag.@Alarms.Alm_IOFault.AlarmElement.
Sts_Fail	BOOL	Visible	Not Required	Output	1 = Device position failure. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PD4SD_Tag.@Alarms.Alm_Fail.AlarmElement.
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Interlock trip, device was set to State 0 by an interlock not OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PD4SD_Tag.@Alarms.Alm_IntlkTrip.AlarmElement.
Sts_EqpFault	BOOL	Not Visible	Not Required	Output	1 = Device-reported equipment fault. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PD4SD_Tag.@Alarms.Alm_EqpFault.AlarmElement.
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable button.
XRdy_St0	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_St0, enable button.
XRdy_St1	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_St1, enable button.
XRdy_St2	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_St2, enable button.
XRdy_St3	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_St3, enable button.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable button.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object Owner ID, 0 = not owned.

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Command source selection.
MCmd_Acq	BOOL	Maintenance Command to acquire Maintenance command source. The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance Command to bypass all bypassable interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_Check	BOOL	Maintenance Command to remove bypass and check all interlocks and permissives. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_IS	BOOL	Maintenance Command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance Command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance Command to select Physical device operation. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance Command to release Maintenance command source. The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance Command to select Virtual device operation. The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator Command to select Operator Locked command source and disallow Program. The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator Command to select configured normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator Command to select Operator (unlocked) command source. The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator Command to select Program (unlocked) command source. The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator Command to acknowledge all alarms and reset latched alarms and shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_St0	BOOL	Operator Command to set device to State 0. The instruction clears this operand automatically. Default is false.
OCmd_St1	BOOL	Operator Command to set device to State 1. The instruction clears this operand automatically. Default is false.
OCmd_St2	BOOL	Operator Command to set device to State 2. The instruction clears this operand automatically. Default is false.
OCmd_St3	BOOL	Operator Command to set device to State 3. The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator Command to unlock Operator command source and allow Program to acquire. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display.
HMI_eCmdState	SINT	Device target state: 0 = None, 1 = State 0, 2 = State 1, 3 = State 2, 4 = State 3.

Private Output Members	Data Type	Description
HMI_St0PermOK	BOOL	1 = Permissives are OK to go to State 0.
HMI_St1PermOK	BOOL	1 = Permissives are OK to go to State 1.
HMI_St2PermOK	BOOL	1 = Permissives are OK to go to State 2.
HMI_St3PermOK	BOOL	1 = Permissives are OK to go to State 3.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset, enable HMI button.
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll, enable HMI button.
ORdy_St0	BOOL	1 = Ready for OCmd_St0, enable HMI button.
ORdy_St1	BOOL	1 = Ready for OCmd_St1, enable HMI button.
ORdy_St2	BOOL	1 = Ready for OCmd_St2, enable HMI button.
ORdy_St3	BOOL	1 = Ready for OCmd_St3, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component.

BUS_OBJ Structure

The BUS_OBJ structure links the device to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices, and items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status

Members	Data Type	Description
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete Logix 5000 tag-based alarms are defined for these members:

Member	Alarm Name	Description
Sts_IntlkTrip	Alm_IntlkTrip	Device held or set to State 0 by an interlock Not OK.
Sts_IOFault	Alm_IOFault	I/O fault.
Sts_Fail	Alm_Fail	Device failure.
Sts_EqpFault	Alm_EqpFault	Device equipment failure.

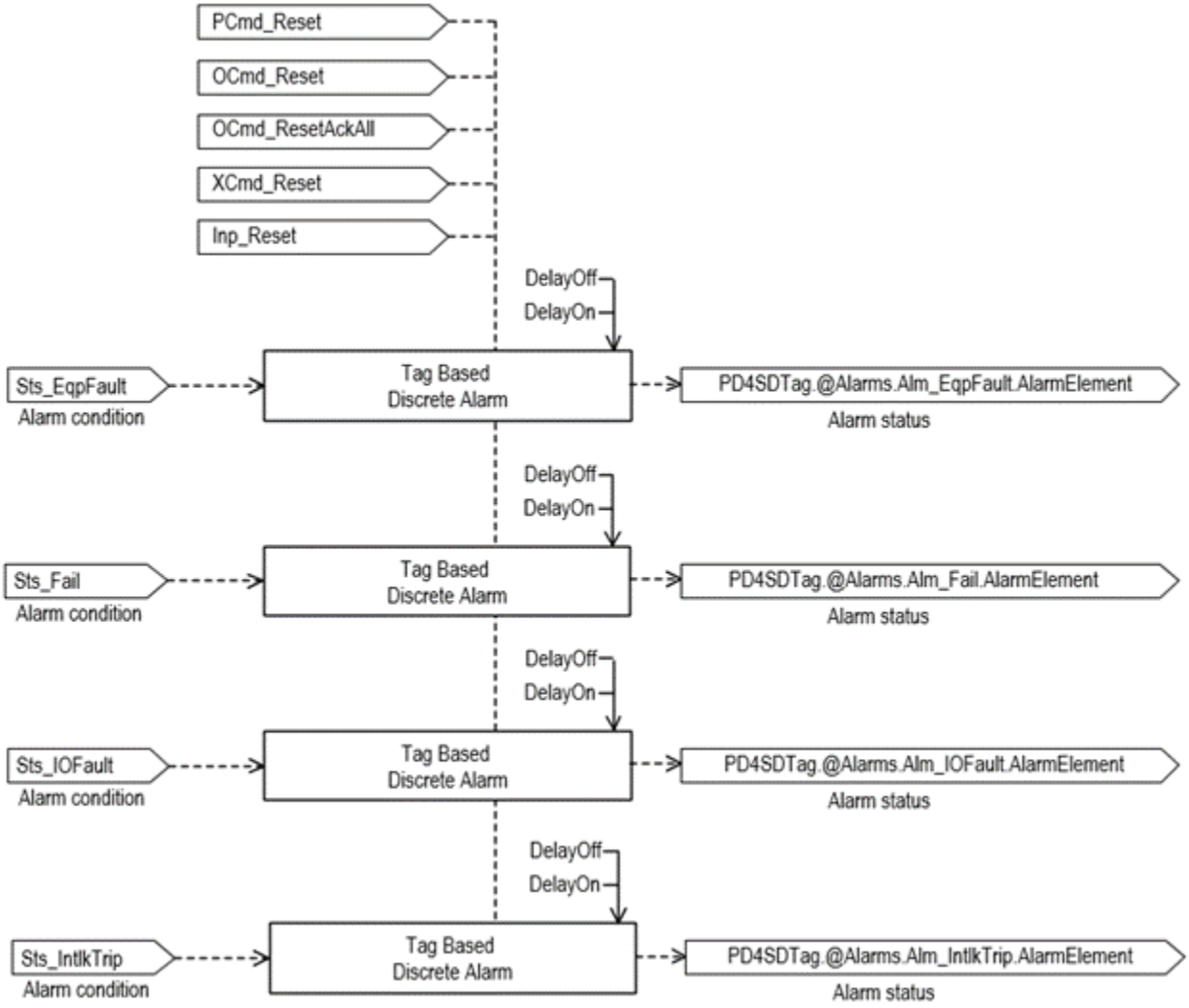
Mark the alarm as used or unused and set standard configuration members of the discrete Logix tag-based alarm. Use this format to access alarm elements:

Tag.@Alarms.AlarmName.AlarmElement

The PD4SD instruction uses these alarms:

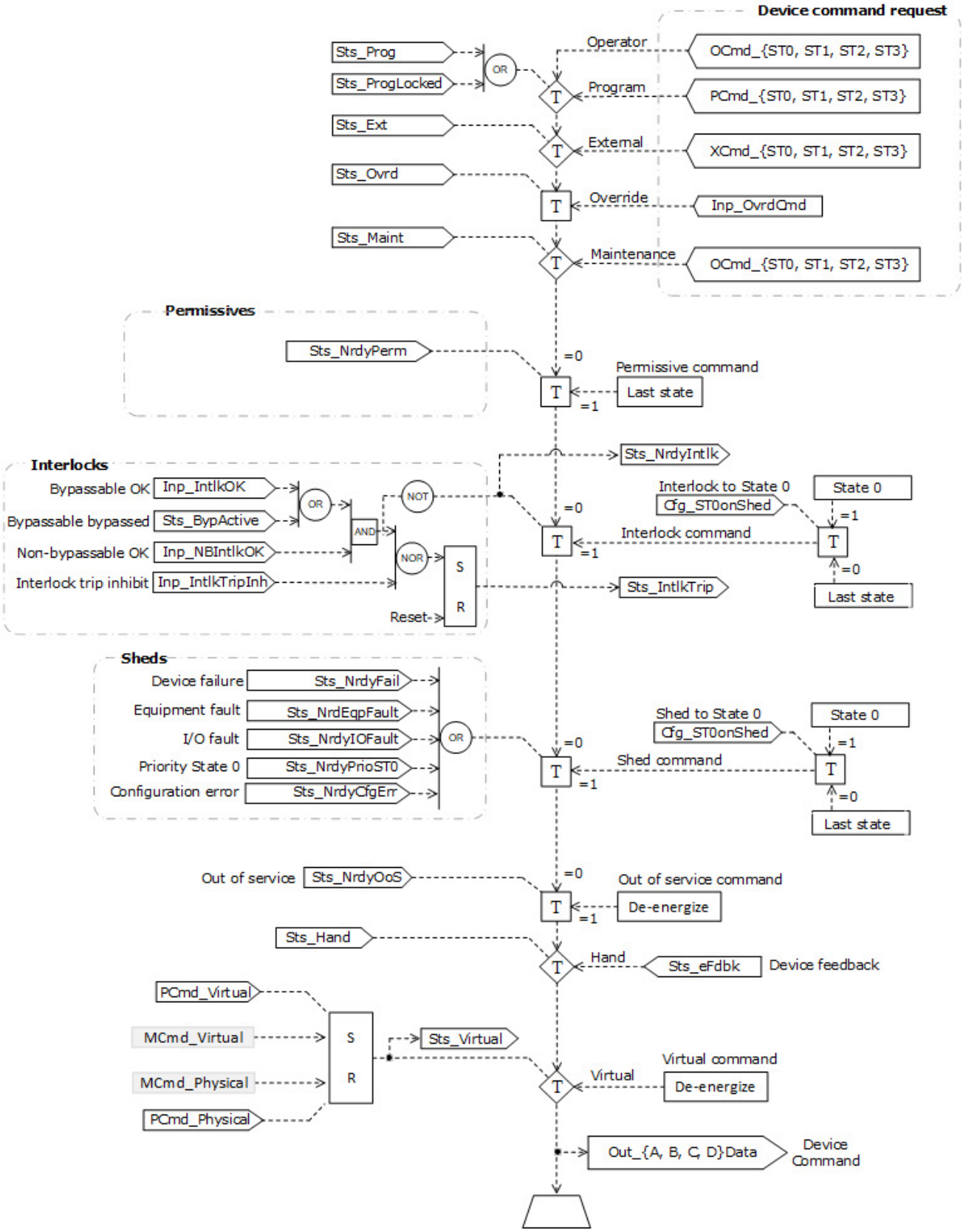
- Raises the Interlock Trip alarm when an interlock not-OK condition occurs and the device is not in state 0. The device can be configured to be commanded to state 0 when an interlock trip occurs. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.
- Raises the I/O Fault alarm when the Inp_IOFault input is true. This input is usually used to indicate to the instruction that a communication failure has occurred for its I/O. If the I/O Fault is configured as a shed fault, the device transitions to the state 0 and remains there until the fault clears and the device is reset.
- Raises the Equipment Fault alarm when the Inp_EqpFault input is true. If the Equipment Fault is configured as a shed fault, the device transitions to the state 0 and remains there until the fault clears and the device is reset.
- Raises the Fail alarm when the device is commanded to a state, but the device feedback does not confirm that the device is in that state within the configured failure time. If the Failure is configured as a shed fault, the device transitions to the state 0 and remains there until the fault clears and the device is reset.

Program, Operator, and External commands reset latched alarms, and reset and acknowledge all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PD4SD instruction.

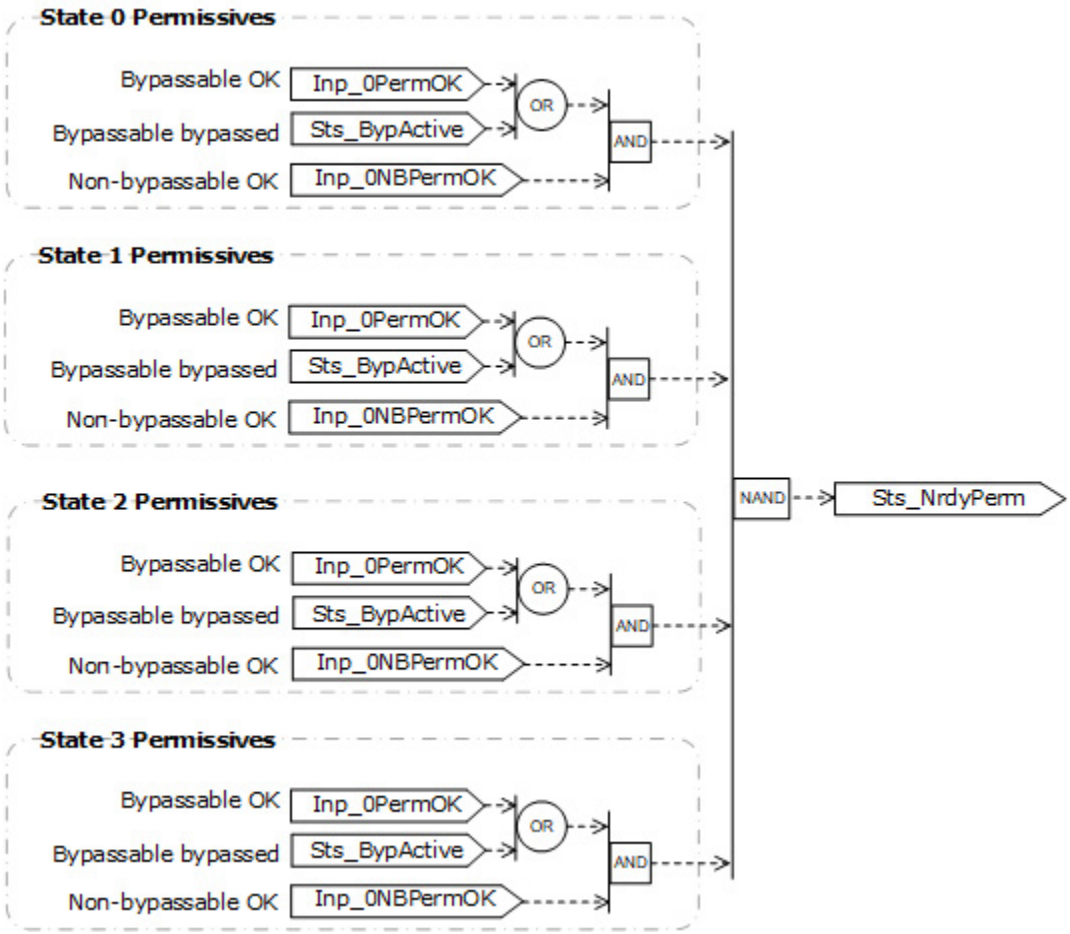


Operation

This diagram illustrates functionality of the PD4SD instruction:



This diagram shows logic of permissives associated with commands of the PD4SD instruction:



Operator command request confirmation

The PD4SD instruction enables these operator commands and settings:

- OCmd_St0
- OCmd_St1
- OCmd_St2
- OCmd_St3

Enforced security might require the request to be confirmed or canceled before the selected command executes or setting is accepted. The instruction checks the security rules inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd = 0, no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd = 1, the instruction waits for operator confirmation or cancelation of the command. If Cfg_CnfrmReqd = 2 or 3, eSignature is needed before command confirmation is enabled.

Virtualization

Use virtualization for instruction testing and operator training. Command virtual operation using program command PCmd_Virtual or maintenance command MCmd_Virtual. After finishing virtual operation, use program command PCmd_Physical or maintenance command MCmd_Physical to return to normal physical device operation.

When Virtualization is active, the device outputs of the PD4SD instruction hold at 0, virtual feedback of a working device is provided, and I/O faults are ignored. Setting of Cfg_VirtualFdbkTime operand delays the echo of the feedback status of the device. Manipulate the instruction to operate as if a working device is present.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates, used in FactoryTalk View, and for the Studio 5000 Logix Designer configuration dialog box. The strings are set to extended properties of tag items.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Navigation to an object with more information
- Command Labels for States 0 through 3
- Target State Labels for States 0 through 3
- Name of Interlock Trip Alarm
- Name of I/O Fault Alarm
- Name of Position Fail Alarm
- Name of Lock Fail Alarm

Command Source

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled. Device commands and settings from any source are not accepted.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (for example, field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog

- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enable control sources as Configuration

The user can enable and disable individual control sources. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. Commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Program state is disabled, the destination of the OCmd_Prog command becomes the Program Locked state instead of the Program state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Monitor the PD4SD Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The device is de-energized.
Instruction first run	Any commands received before first scan are discarded. The device is treated as if it were returning from Hand mode: the instruction state is set based on the position feedback received from the device. If the device does not have position feedback or the position feedback is invalid, the device is set to the 'unknown/powerup' state.
Rung-condition-in is false	Handled the same as if the device is taken Out of Service by command. The device outputs are de-energized, and the device Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. The rung-condition-out continues as false.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The device is de-energized.
Instruction first run	Any commands received before first scan are discarded. The device is treated as if it were returning from Hand mode: the instruction state is set based on the position feedback received from the device. If the device does not have position feedback or the position feedback is invalid, the device is set to the 'unknown/powerup' state.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the device is taken Out of Service by command. The device outputs are de-energized, and the device Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. EnableOut is set to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic, it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Examples

In the following example, the PD4SD instruction controls a cooling fan that has three fixed speeds (low, medium, high) and an off state. The cooling fan is considered a four-state device. In this example, three digital outputs are used to set the speed setting (when all three are off, the fan is commanded off) and three digital inputs provide feedback on the actual fan state (when all three are off, the fan is off).

In this example, the four cooling fan states are configured as shown in these tables. (In this example, Output A is set so it can be used for display purposes even though Output A is not used by the cooling fan device.)

State 0 (Off):

	Output		Feedback	
	Write	Value	Required	State
	Yes	1	No	
	Yes	0	Yes	0
	Yes	0	Yes	0
	Yes	0	Yes	0

State 1 (Low):

	Output		Feedback	
	Write	Value	Required	State
A	Yes	0	No	
B	Yes	1	Yes	1
C	Yes	0	Yes	0
D	Yes	0	Yes	0

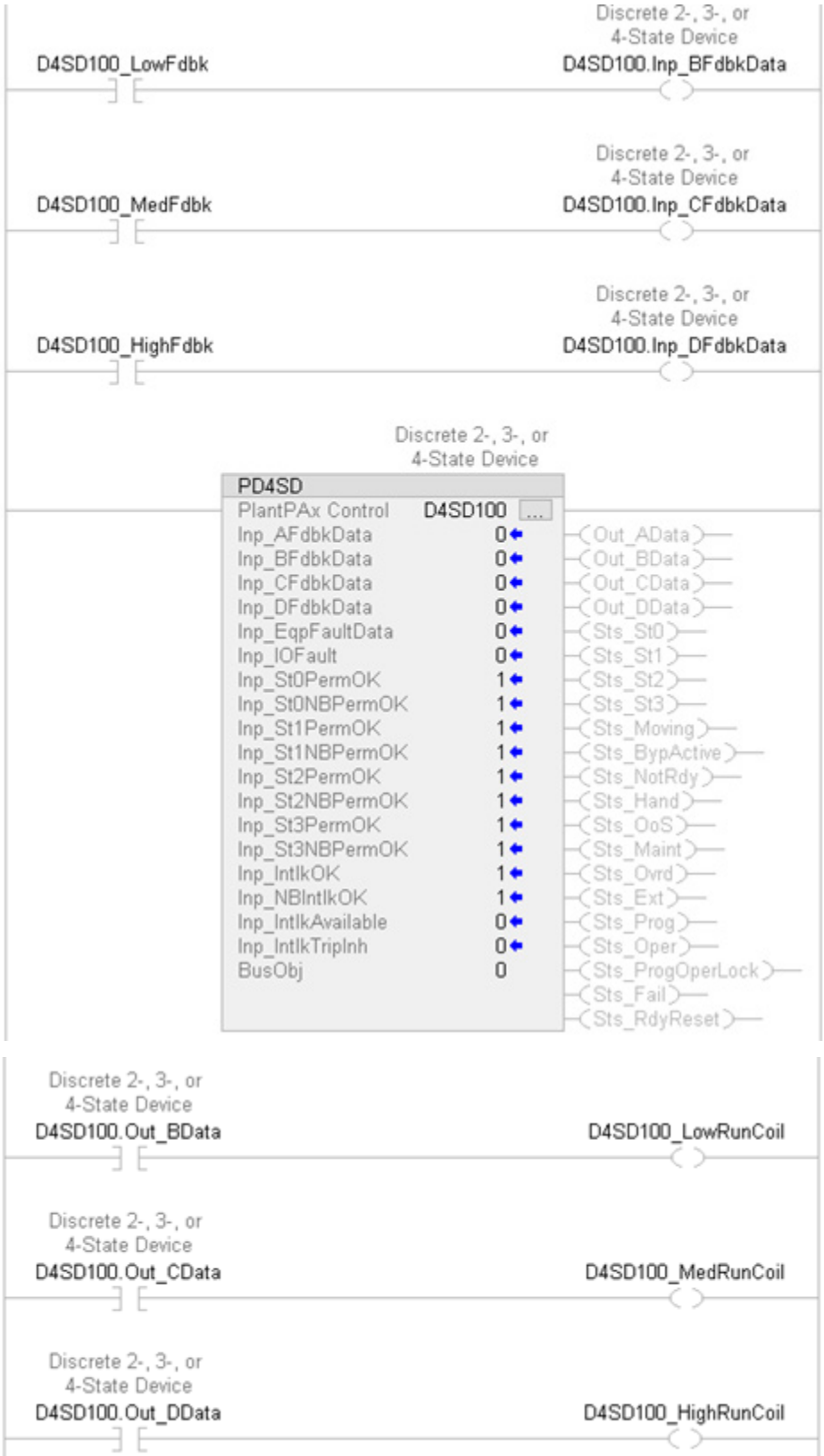
State 2 (Medium):

	Output		Feedback	
	Write	Value	Required	State
A	Yes	0	No	
B	Yes	0	Yes	0
C	Yes	1	Yes	1
D	Yes	0	Yes	0

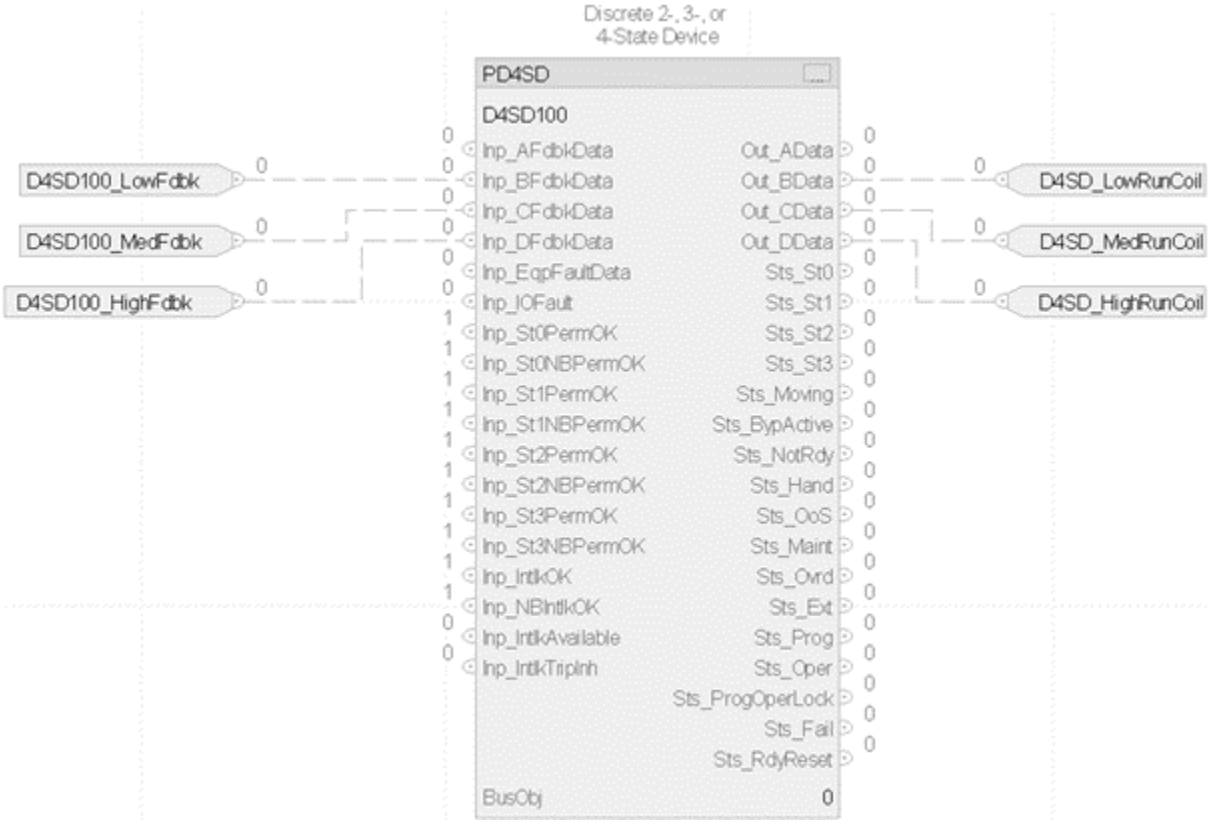
State 3 (High):

	Output		Feedback	
	Write	Value	Required	State
A	Yes	0	No	
B	Yes	0	Yes	0
C	Yes	0	Yes	0
D	Yes	1	Yes	1

Ladder diagram



Function Block Diagram



Structured text

```
D4SD100.Inp_BFdbkData:=D4SD100_LowFdbk
D4SD100.Inp_CFdbkData:=D4SD100_MedFdbk
D4SD100.Inp_DFdbkData:=D4SD100_HighFdbk
PD4SD(D4SD100, 0);
D4SD100_LowRunCoil:=D4SD100.Out_BData;
D4SD100_MedRunCoil:=D4SD100.Out_CData;
D4SD100_HighRunCoil:=D4SD100.Out_DData;
```

Process Deadband Controller (PDBC)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

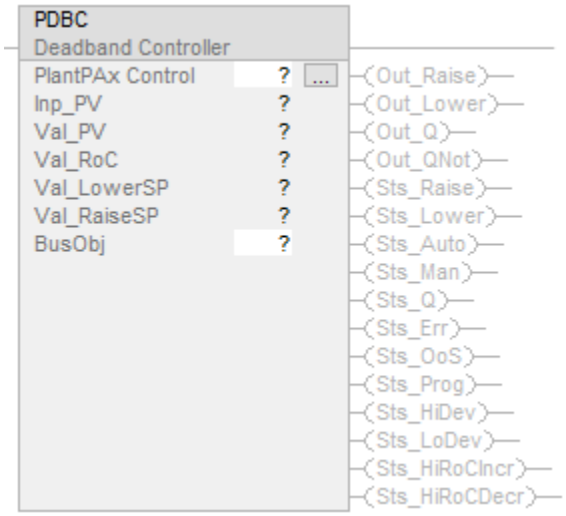
The Process Deadband Controller (PDBC) provides:

- A Raise output, which is activated when the PV is less than the entered Raise threshold, and a Lower output, which is activated when the PV is greater than the entered Lower threshold.
- Q and Q-Not outputs. Q is set when the PV falls below the Raise threshold and cleared when the PV rises above the Lower threshold; Q-Not is the inverse of Q.

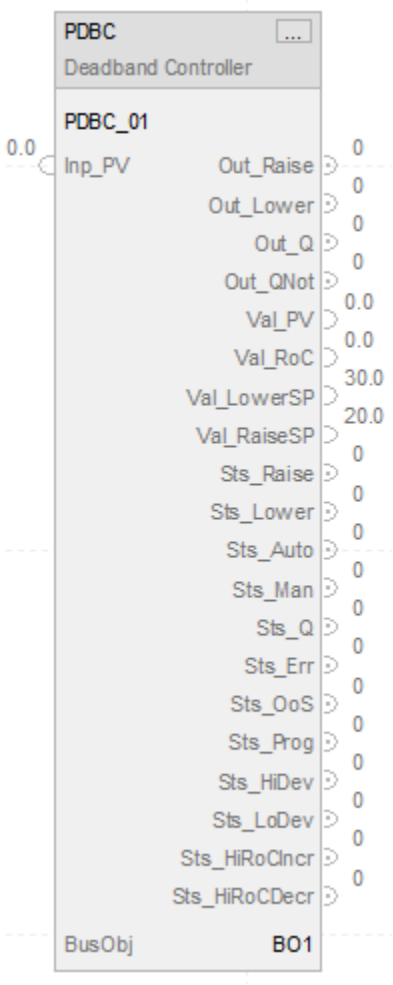
- High and Low Deviation alarms with configurable thresholds and deadbands. These alarms can provide notification that the PV is approaching an out-of-control condition.
- Alarms for High PV Rate of Change Increasing and High PV Rate of Change Decreasing. These alarms can provide notification that the PV is changing faster than expected.
- Operation in Manual and Automatic Loop Modes. In Automatic Loop Mode, the outputs are triggered by the control algorithm to keep the PV within limits. In Manual Loop Mode, the operator directly manipulates the Raise and Lower outputs from the HMI.
- Operation in Operator, Program, Override, and Maintenance command sources.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PDBC(PDBCTag, o);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_DEADBAND	tag	PDBC structure
BusObj	BUS_OBJ	tag	Bus component

P_ DEADBAND Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	Use this request when reinitializing. Default is true.
Inp_PV	REAL	Process variable being controlled (engineering units). Valid = Any float. Default is 0.0.
Inp_PVSrcQ	SINT	Input source and quality from channel object, if available (enumerator). Valid = 0 to 32. Default is 0.
Inp_PVNotify	SINT	Related process variable object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_PVBad	BOOL	1 = Process variable or input/output communications status bad, 0 = Process variable and input/output communications healthy. Default is false.
Inp_OvrdCmd	SINT	Override command: 0 = No command, 1 = Raise, 2 = Lower, 3 = None, 4 = Manual, 5 = Auto. Default is 0.
Inp_OvrdRaiseSP	REAL	Override mode raise setpoint (engineering units). Valid = Any float. Default is 0.0.
Inp_OvrdLowerSP	REAL	Override mode lower setpoint (engineering units). Valid = Any float. Default is 0.0.
Inp_HiDevGate	BOOL	The gate input used for high deviation status detection. 1 = The corresponding analog input threshold monitoring is enabled. 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_LoDevGate	BOOL	The gate input used for low deviation status detection. 1 = The corresponding analog input threshold monitoring is enabled. 0 = detection is disabled and the corresponding status output is forced off. Default is true.

Public Input Members	Data Type	Description
Inp_HiRoCIncrGate	BOOL	The gate input used for high rate of change (increasing) status detection. 1 = The corresponding analog input threshold monitoring is enabled. 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_HiRoCDecrGate	BOOL	The gate input used for high rate of change (decreasing) status detection. 1 = The corresponding analog input threshold monitoring is enabled. 0 = detection is disabled and the corresponding status output is forced off. Default is true.
Inp_OwnerCmd	DINT	Owner device command: Inp_OwnerCmd.0 = None, Inp_OwnerCmd.10 = Operator lock, Inp_OwnerCmd.11 = Operator unlock, Inp_OwnerCmd.12 = Program lock, Inp_OwnerCmd.13 = Program unlock, Inp_OwnerCmd.14 = Acquire maintenance, Inp_OwnerCmd.15 = Release maintenance, Inp_OwnerCmd.16 = Acquire external, Inp_OwnerCmd.17 = Release external. Default is 0.
Inp_ExtInh	BOOL	1 = Inhibit external acquisition, 0 = Allow external acquisition. Default is false.
Inp_Hand	BOOL	1 = Acquire hand (typically hardwired local), 0 = Release hand. Default is false.
Inp_Ovrd	BOOL	1 = Acquire override (higher priority program logic), 0 = Release override. Default is false.
Cfg_PVDecPlcs	SINT	Number of decimal places for process variable display. Valid = 0 to 6. Default is 2.
Cfg_SetTrack	BOOL	1 = PSets track OSets in operator, OSets track PSets in program, 0 = no tracking. Default is false.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.
Cfg_HasPVNav	BOOL	1 = Tells HMI to enable navigation to a connected process variable object. Default is false.
Cfg_HasOutNav	BOOL	1 = Tells HMI to enable navigation to a connected output object, 0 = No connected output object. Default is false.
Cfg_PVEUMin	REAL	Input process variable range minimum (engineering units). Valid = Any float. Default is 0.0.
Cfg_PVEUMax	REAL	Input process variable range maximum (engineering units). Valid = Any float. Default is 100.0.
Cfg_SPHiLim	REAL	Setpoint high limit clamp (engineering units). Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_SPLoLim	REAL	Setpoint low limit clamp (engineering units). Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_RaiseDB	REAL	Deadband for the raise output (above raise limit). Valid = 0.0 to (Cfg_SPHiLim - Cfg_SPLoLim). Default is 1.0.
Cfg_LowerDB	REAL	Deadband for the lower output (below lower limit). Valid = 0.0 to (Cfg_SPHiLim - Cfg_SPLoLim). Default is 1.0.
Cfg_RateTime	REAL	Rate of change time base (seconds), use 1.0 for units/second, 60.0 for units/minute, 3600.0 for units/hour, 86400.0 for units/day. Valid = any float greater than zero. Default is 1.0.

Public Input Members	Data Type	Description
Cfg_HiDevLim	REAL	High deviation status threshold (engineering units). Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_HiDevDB	REAL	High deviation status deadband (engineering units). Valid = 0.0 to high deviation threshold. Default is 1.0.
Cfg_LoDevLim	REAL	Low deviation status threshold (engineering units). Valid = minimum negative float to 0.0. Default is -99.0.
Cfg_LoDevDB	REAL	Low deviation status deadband (engineering units). Valid = 0.0 to -(low deviation threshold). Default is 1.0.
Cfg_HiDevGateDly	REAL	High deviation status gate delay (seconds). Time .Inp_HiDev must be 1 before high deviation condition is checked. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_LoDevGateDly	REAL	Low deviation status gate delay (seconds). Time .Inp_LoDev must be 1 before low deviation condition is checked. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_HiRoCIncrLim	REAL	Program - entered high rate of change (increasing) status threshold (engineering units / rate time). Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_HiRoCIncrDB	REAL	High rate of change (increasing) status deadband (engineering units / rate time). Valid = 0.0 to Cfg_HiRoCIncrLim. Default is 1.0.
Cfg_HiRoCIncrGateDly	REAL	High rate of change (increasing) status gate delay (seconds). Valid = 0.0 to 2147483.0. Default is 0.0.
Cfg_HiRoCDecrLim	REAL	Program - entered high rate of change (decreasing) status threshold (engineering units / rate time). Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_HiRoCDecrDB	REAL	High rate of change (decreasing) status deadband (engineering units / rate time). Valid = 0.0 to Cfg_HiRoCDecrLim. Default is 1.0.
Cfg_HiRoCDecrGateDly	REAL	High rate of change (decreasing) status gate delay (seconds). Valid = 0.0 to 2147483.0. Default is 0.0.
Cfg_ExtAcqAsLevel	BOOL	1 = XCmd_Acq used as level (1 = Acquire, 0 = Release). Default is false.
Cfg_ExtOverLock	BOOL	1 = External supersedes program / Operator Lock, 0 = Don't override Lock. Default is false.
Cfg_HasExt	BOOL	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	1 = Maintenance exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	1 = Maintenance out of service exists, can be selected. Default is true.
Cfg_HasOper	BOOL	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	1 = Operator locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	1 = Program locked exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	1 = Override supersedes program / operator lock, 0 = Don't override lock. Default is true.

Public Input Members	Data Type	Description
Cfg_PCmdLockAsLevel	BOOL	1 = .PCmd_Lock used as a Level (1 = Lock, 0 = Unlock). Default is false.
Cfg_AllowDisable	BOOL	1 = Allow maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	1 = Allow operator to shelve alarms. Default is true.
Cfg_PCmdPriority	BOOL	1 = Program commands take priority, 0 = Operator commands take priority. Default is false.
Cfg_PCmdProgAsLevel	BOOL	1 = PCmd_Prog used as a level. Default is false.
Cfg_ProgNormal	BOOL	Normal source: 1 = Program if no requests, 0 = Operator if no requests. Default is false.
Cfg_ProgPwrUp	BOOL	1 = Power up to program mode, 0 = Power up to operator mode. Default is false.
Cfg_CnfrmReqd	SINT	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_LowerSP	REAL	Program setting for raise setpoint (engineering units). Valid = Any float. Default is 30.0.
PSet_RaiseSP	REAL	Program setting for raise setpoint (engineering units). Valid = Any float. Default is 20.0.
PSet_Owner	DINT	Program owner request ID (non-zero) or release (zero). Valid = Any integer greater or equal to 0. Default is 0.
XSet_LowerSP	REAL	External setting for lower setpoint (engineering units). Valid = Any float. Default is 30.0.
XSet_RaiseSP	REAL	External setting for raise setpoint (engineering units). Valid = Any float. Default is 20.0.
PCmd_Raise	BOOL	Program command to set output to raise, when in program manual. 1 = Raise. The instruction clears this operand automatically. Default is false.
PCmd_Lower	BOOL	Program command to set output to lower, when in program manual. 1 = Lower. The instruction clears this operand automatically. Default is false.
PCmd_None	BOOL	Program command to clear raise, lower outputs, when in program manual. 1 = Clear .PCmd_Raise and PCmd_Lower. The instruction clears this operand automatically. Default is false.
PCmd_Auto	BOOL	Program command to select automatic loop mode. 1 = Select automatic loop mode. The instruction clears this operand automatically. Default is false.
PCmd_Man	BOOL	Program command to select manual loop mode. 1 = Select manual loop mode. The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Program Command to reset shed latches and cleared alarms. 1 = Reset shed latches and cleared alarms. The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Program command to lock program (disallow operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.

Public Input Members	Data Type	Description
PCmd_Normal	BOOL	Program command to select normal command source (operator or program). The instruction clears this operand automatically. Default is false.
PCmd_Oper	BOOL	Program command to select operator (program to operator). The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Program command to select program (operator to program). The instruction clears this operand automatically. Default is false.
PCmd_Unlock	BOOL	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
XCmd_Raise	BOOL	External command to set output to raise, when in external manual. 1 = Lower. The instruction clears this operand automatically. Default is false.
XCmd_Lower	BOOL	External command to set output to lower, when in external manual. 1 = Lower. The instruction clears this operand automatically. Default is false.
XCmd_None	BOOL	External command to clear raise, lower outputs, when in external manual. 1 = Clear XCmd_Raise and XCmd_Lower. The instruction clears this operand automatically. Default is false.
XCmd_Auto	BOOL	External command to select automatic loop mode. 1 = select automatic loop mode. The instruction clears this operand automatically. Default is false.
XCmd_Man	BOOL	External command to select manual loop mode. 1 = Select manual loop mode. The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	External command to reset shed latches and cleared alarms. 1 = Reset shed latches and cleared alarms. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_Acq	BOOL	External command to acquire ownership (operator/program/override/maintenance to external). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	External command to release ownership, if Cfg_ExtAcqAsLevel = 0 (external to operator/program/override/maintenance). The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output - This output state always reflects EnableIn input state.
Out_Raise	BOOL	Output to drive process variable to raise.
Out_Lower	BOOL	Output to drive process variable to lower.
Out_Q	BOOL	1 = Setpoint raised, 0 = Setpoint lowered.
Out_QNot	BOOL	1 = Setpoint lowered, 0 = Setpoint raised.

Public Output Members	Data Type	Description
Out_OwnerSts	DINT	Status of command source, owner command handshake and ready status: Out_OwnerSts.0 = None, Out_OwnerSts.10 = Operator lock, Out_OwnerSts.11 = Operator unlock, Out_OwnerSts.12 = Program lock, Out_OwnerSts.13 = Program unlock, Out_OwnerSts.14 = Acquire maintenance, Out_OwnerSts.15 = Release maintenance , Out_OwnerSts.16 = Acquire external, Out_OwnerSts.17 = Release external, Out_OwnerSts.18 = Has maintenance, Out_OwnerSts.19 = External override lock, Out_OwnerSts.20 = Has External, Out_OwnerSts.21 = Has operator, Out_OwnerSts.22 = Has program, Out_OwnerSts.30 = Not ready.
Val_PV	REAL	Process variable value (engineering units). (scaled range between minimum and maximum).
Val_RoC	REAL	Process variable rate of change value (engineering units / rate time).
Val_LowerSP	REAL	Accepted value for lower setpoint (engineering units).
Val_RaiseSP	REAL	Accepted value for raise setpoint (engineering units).
Val_PVEUMin	REAL	Minimum of scaled range, minimum between Cfg_PVEUMin and Cfg_PVEUMax.
Val_PVEUMax	REAL	Maximum of scaled range, maximum between Cfg_PVEUMin and Cfg_PVEUMax.
Val_Owner	DINT	Current object owner ID, 0 = Not owned.
SrcQ_IO	DINT	Source and quality of primary input / output (enumeration).
SrcQ	DINT	Source and quality of primary value / status (enumeration).
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Raise	BOOL	1 = Process variable below raise setpoint, Out_Raise = 1.
Sts_Lower	BOOL	1 = Process variable above lower setpoint, Out_Lower = 1.
Sts_Auto	BOOL	1 = Current loop mode is automatic.
Sts_Man	BOOL	1 = Current loop mode is manual.
Sts_Q	BOOL	1 = Out_Q = 1, Out_QNot = 0.
Sts_Available	BOOL	1 = Loop available for manipulation in program mode.
Sts_NotRdy	BOOL	1 = Device not ready, see detail bits for reason.
Sts_NrdyCfgErr	BOOL	1 = Device not ready: Configuration error.
Sts_NrdyOoS	BOOL	1 = Device is not ready: Device disabled by maintenance.
Sts_AlmInh	BOOL	1 = An alarm is inhibited, disabled or suppressed (Display icon on HMI).
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_ErrXXX) for reason.
Sts_ErrEU	BOOL	1 = Error in configuration: Scaled engineering units Cfg_PVEUMin = Cfg_PVEUMax.
Sts_ErrRateTime	BOOL	1 = Error in configuration: Process variable rate of change time base.
Sts_ErrAlm	BOOL	1 = Error in configuration: Alarm minimum on time or severity.
Sts_OoS	BOOL	1 = Out of service is selected (supersedes maintenance, override, external, program, operator).
Sts_Prog	BOOL	1 = Program mode is selected.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
Sts_HiDevCmp	BOOL	Process variable high deviation comparison result = 1.
Sts_HiDevGate	BOOL	Process variable high deviation gate delay status, 1 = Done.
Sts_HiDev	BOOL	1 = Analog input deviation is above high limit. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Access alarm elements in this format: PDBCTag.@Alarms.Alm_HiDev.AlarmElement.

Public Output Members	Data Type	Description
Sts_LoDevCmp	BOOL	Process variable low deviation comparison result = 1.
Sts_LoDevGate	BOOL	Process variable low deviation gate delay status, 1 = Done.
Sts_LoDev	BOOL	1 = Analog input deviation is below low limit. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Access alarm elements in this format: PDBCTag.@Alarms.Alm_HiRoCIncr.AlarmElement.
Sts_HiRoCIncrCmp	BOOL	Process variable high rate of change (increasing) comparison result = 1.
Sts_HiRoCIncrGate	BOOL	Process variable high rate of change (increasing) gate delay status, 1 = Done.
Sts_HiRoCIncr	BOOL	1 = Analog input PV rate of change (increasing) is above high limit. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Access alarm elements in this format: PDBCTag.@Alarms.Alm_HiRocIncr.AlarmElement.
Sts_HiRoCDecrCmp	BOOL	Process variable high rate of change (decreasing) comparison result = 1.
Sts_HiRoCDecrGate	BOOL	Process variable high rate of change (decreasing) gate delay status, 1 = Done.
Sts_HiRoCDecr	BOOL	1 = Analog input PV rate of change (decreasing) is above high limit. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Access alarm elements in this format: PDBCTag.@Alarms.Alm_HiRocDecr.AlarmElement.
Sts_eNotify	SINT	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyHiDev	SINT	High Deviation Gate alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyHiRoCDecr	SINT	High Rate of Change (Decreasing) alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyHiRoCIncr	SINT	High Rate of Change (Increasing) alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLoDev	SINT	Low Deviation alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_Alm	BOOL	1 = An alarm is active.
Sts_ErrHiDevGateDly	BOOL	1 = Error in configuration: Cfg_HiDevGateDly value is invalid.
Sts_ErrLoDevGateDly	BOOL	1 = Error in configuration: Cfg_LoDevGateDly value is invalid.
Sts_ErrHiRoCIncrGateDly	BOOL	1 = Error in configuration: Cfg_HiRoCIncrGateDly value is invalid.
Sts_ErrHiRoCDecrGateDly	BOOL	1 = Error in configuration: Cfg_HiRoCDecrGateDly value is invalid.
Sts_Oper	BOOL	1 = Operator mode is selected.
Sts_Maint	BOOL	1 = Maintenance is selected (supersedes override, external, program, operator).
Sts_Ext	BOOL	1 = External is selected (supersedes program and operator).
Sts_Ovrd	BOOL	1 = Override is selected (supersedes external, program, operator).
Sts_eFault	INT	Device Fault Status: 0 = None, 1 = Low deviation, 2 = High deviation, 3 = High rate of change (decreasing), 4 = High rate of change (increasing), 5 = Input source bad, 6 = Configuration error.

Public Output Members	Data Type	Description
Sts_eSts	INT	Device status: 0 = Deadband, Q is off, 1 = Deadband Q is on, 2 = Above lower SP, 3 = Below lower SP, 4-7 = same, in manual, 8 = Out of service
Sts_bSrc	INT	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0 = Hand, Sts_bSrc.1 = Programmed out of service (rung false), Sts_bSrc.2 = Maintenance out of service, Sts_bSrc.3 = Maintenance, Sts_bSrc.4 = Override, Sts_bSrc.5 = External, Sts_bSrc.6 = Program locked, Sts_bSrc.7 = Program, Sts_bSrc.8 = Operator locked, Sts_bSrc.9 = Operator.
Sts_eSrc	INT	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.
Sts_ExtReqInh	BOOL	1 = External request inhibited, cannot get to external from current state.
Sts_Hand	BOOL	1 = Hand is selected (supersedes out of service, maintenance, override, external, program, operator).
Sts_MAcqRcvd	BOOL	1 = Maintenance acquire command received this scan (Read only).
Sts_Normal	BOOL	1 = Selection equals the normal (program or operator).
Sts_OperLocked	BOOL	1 = Operator is selected and locked.
Sts_ProgLocked	BOOL	1 = Program is selected and locked.
Sts_ProgOperLock	BOOL	Program/operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_ProgOperSel	BOOL	Program/operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgReqInh	BOOL	1 = Program request inhibited, cannot get to program from current state.
XRdy_Acq	BOOL	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	1 = Ready for XCmd_Rel, enable HMI button (Read Only).
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
Rdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.
XRdy_Auto	BOOL	1 = Ready for XCmd_Auto.
XRdy_Lower	BOOL	1 = Ready for XCmd_Lower.

Public Output Members	Data Type	Description
XRdy_Man	BOOL	1 = Ready for XCmd_Man.
XRdy_None	BOOL	1 = Ready for XCmd_None.
XRdy_Raise	BOOL	1 = Ready for XCmd_Raise.
Private Input Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index Default is 0.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (operator / program / external / override to maintenance). The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select in service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select out of service. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance command to release ownership (maintenance to operator / program / external / override). The instruction clears this operand automatically. Default is false.
OCmd_Auto	BOOL	Operator command to select automatic loop mode. Default is false.
OCmd_Lock	BOOL	Operator command to lock operator (disallow program). The instruction clears this operand automatically. Default is false.
OCmd_Lower	BOOL	Operator command to set output to lower (in manual). Default is false.
OCmd_Man	BOOL	Operator command to select manual loop mode. Default is false.
OCmd_None	BOOL	Operator command to clear raise, lower outputs (in manual). Default is false.
OCmd_Normal	BOOL	Operator command to select normal (operator or program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select operator (program to operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select program (operator to program). The instruction clears this operand automatically. Default is false.
OCmd_Raise	BOOL	Operator command to set output to raise (in manual). Default is false.
OCmd_Reset	BOOL	Operator command to reset shed latches and cleared alarms. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset shed latches and cleared alarms, plus acknowledge alarms. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock or release ownership and allow program to acquire ownership. The instruction clears this operand automatically. Default is false.
OSet_LowerSP	REAL	Operator setting for lower setpoint (engineering units). Default is 30.0.
OSet_RaiseSP	REAL	Operator setting for raise setpoint (engineering units). Default is 20.0.

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control / Command Source Selection
MCmd_Acq	BOOL	Maintenance command to acquire ownership (operator / program / external / override to maintenance). The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select in service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select out of service. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance command to release ownership (maintenance to operator / program / external / override). The instruction clears this operand automatically. Default is false.
OCmd_Auto	BOOL	Operator command to select automatic loop mode. Default is false.
OCmd_Lock	BOOL	Operator command to lock operator (disallow program). The instruction clears this operand automatically. Default is false.
OCmd_Lower	BOOL	Operator command to set output to lower (in manual). Default is false.
OCmd_Man	BOOL	Operator command to select manual loop mode. Default is false.
OCmd_None	BOOL	Operator command to clear raise, lower outputs (in manual). Default is false.
OCmd_Normal	BOOL	Operator command to select normal (operator or program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select operator (program to operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select program (operator to program). The instruction clears this operand automatically. Default is false.
OCmd_Raise	BOOL	Operator command to set output to raise (in manual). Default is false.
OCmd_Reset	BOOL	Operator command to reset shed latches and cleared alarms. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset shed latches and cleared alarms, plus acknowledge alarms. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock or release ownership and allow program to acquire ownership. The instruction clears this operand automatically. Default is false.
OSet_LowerSP	REAL	Operator setting for lower setpoint (engineering units). Default is 30.0.
OSet_RaiseSP	REAL	Operator setting for raise setpoint (engineering units). Default is 20.0.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.

Private Output Members	Data Type	Description
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
ORdy_Auto	BOOL	1 = Ready for OCmd_Auto.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Lower	BOOL	1 = Ready for OCmd_Lower.
ORdy_Man	BOOL	1 = Ready for OCmd_Man.
ORdy_None	BOOL	1 = Ready for OCmd_None.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Raise	BOOL	1 = Ready for OCmd_Raise.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables HMI button).
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll (enables HMI button).
ORdy_SP	BOOL	1 = Ready for Setpoint OSets (enables data entry fields).
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.

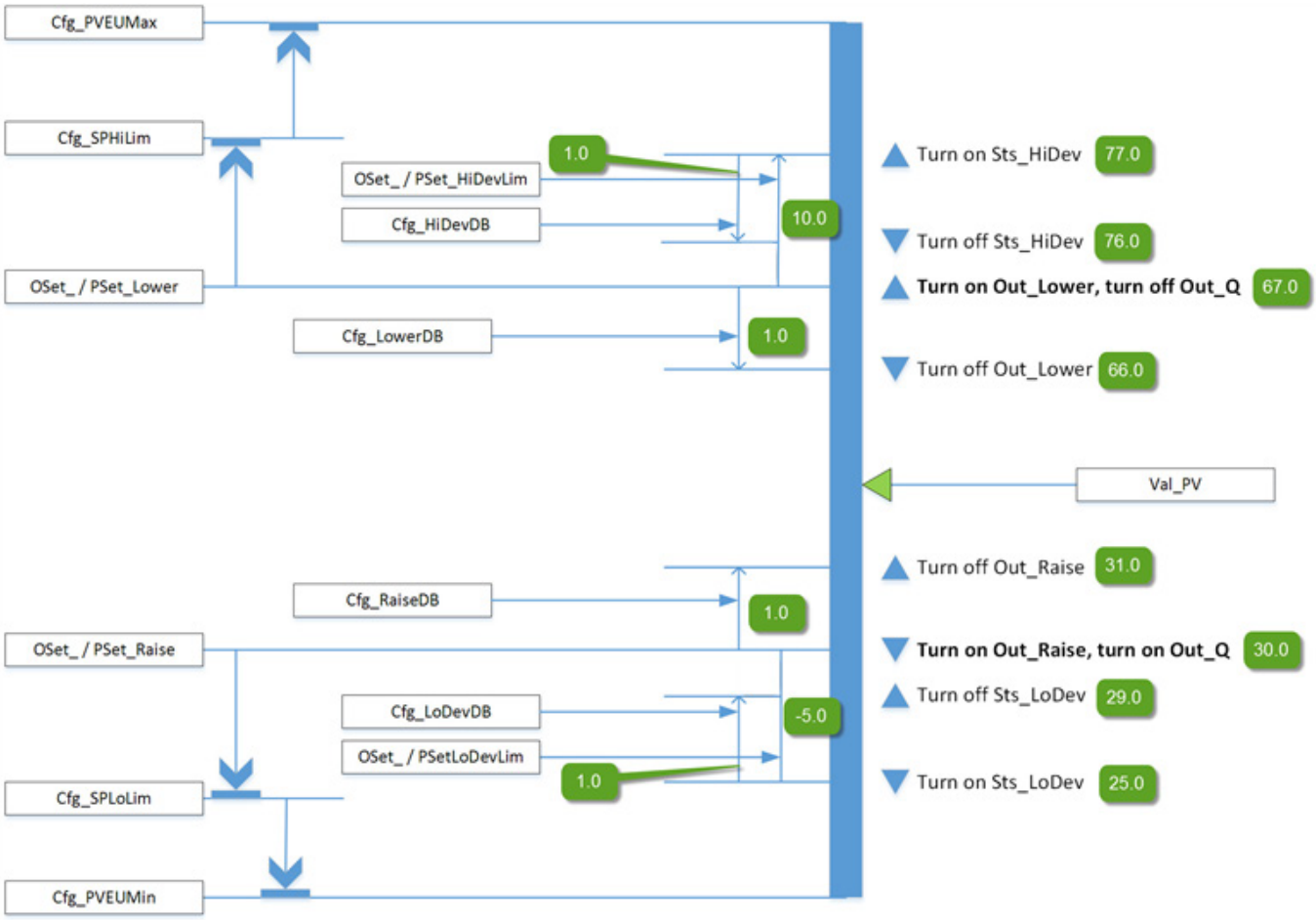
Public InOut Members	Data Type	Description
BusObj	BUS_OBJ	Bus component

BUS_OBJ Structure

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Operation

This diagram illustrates the functionality of the PDBC instruction:



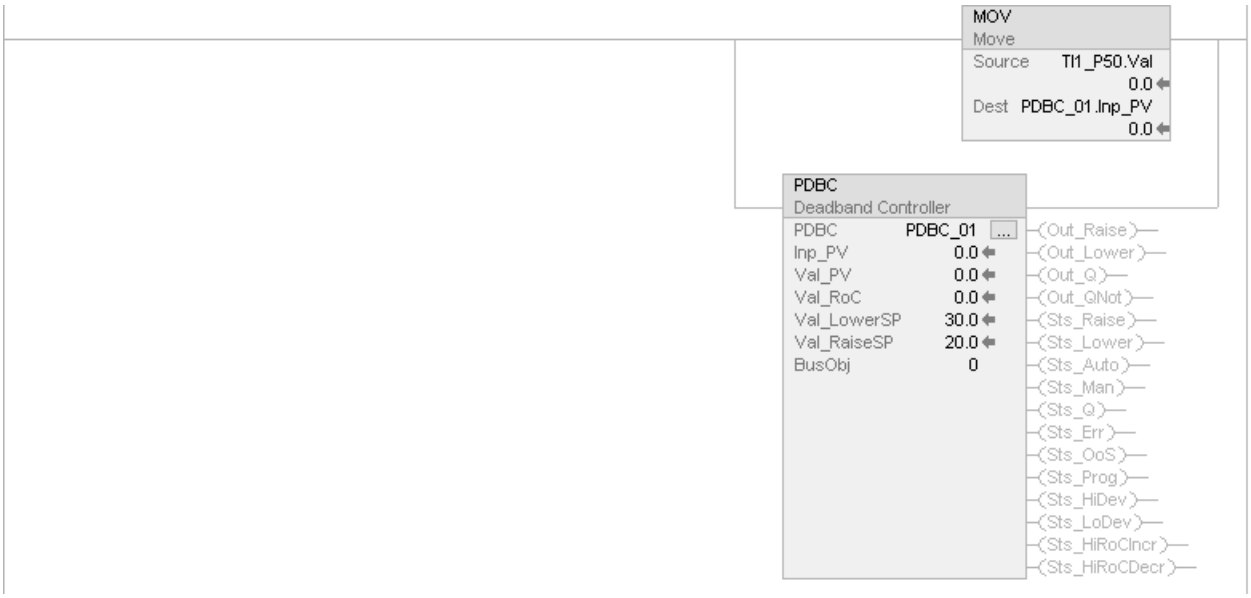
Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- More Information
- Number of decimal places
- Output Units
- Input Units
- Allow Navigation Object Tag Name Output
- Allow Navigation Object Tag Name Input

Implementation

This illustration shows normal implementation with the input condition mapped to Inp_PV on a separate branch. This approach controls an analog process variable (PV), such as temperature, level or pressure, between upper and lower control limits by triggering one or two discrete outputs.



Monitor the PDBC Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.
Instruction first run	All commands that are automatically cleared each execution are cleared and ignored. Inp_OvrdCmd is set to 0 (no command). The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition. PSet_Owner and Out_OwnerSts are set to 0.
Rung-condition-in is false	Rung-condition-out is cleared to false. The instruction is put Out of Service if Inp_Hand=0. The output is set to Interlock CV and all alarm conditions are cleared. Latched alarms are reset. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. Inp_OvrdCmd is set to 0 (no command). The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition. PSet_Owner and Val_Owner are set to 0.
Instruction first scan	See Instruction first run in the Function Block Diagram table.

Condition/State	Action Taken
EnableIn is false	EnableOut is cleared to false. The instruction is put Out of Service if Inp_Hand=0. The output is set to Interlock CV and all alarm conditions are cleared. Latched alarms are reset. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

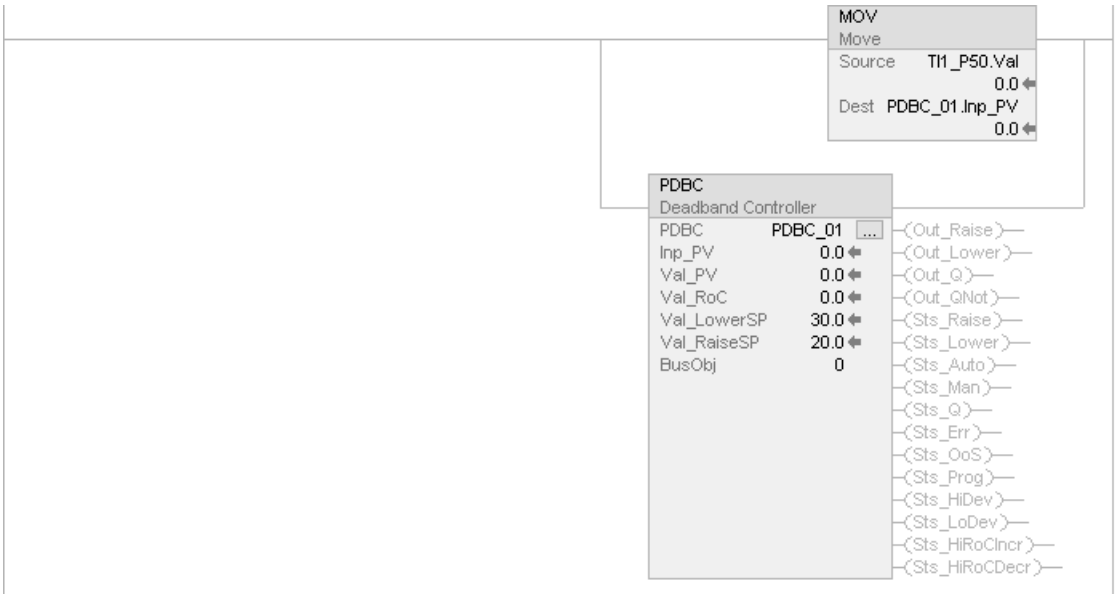
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

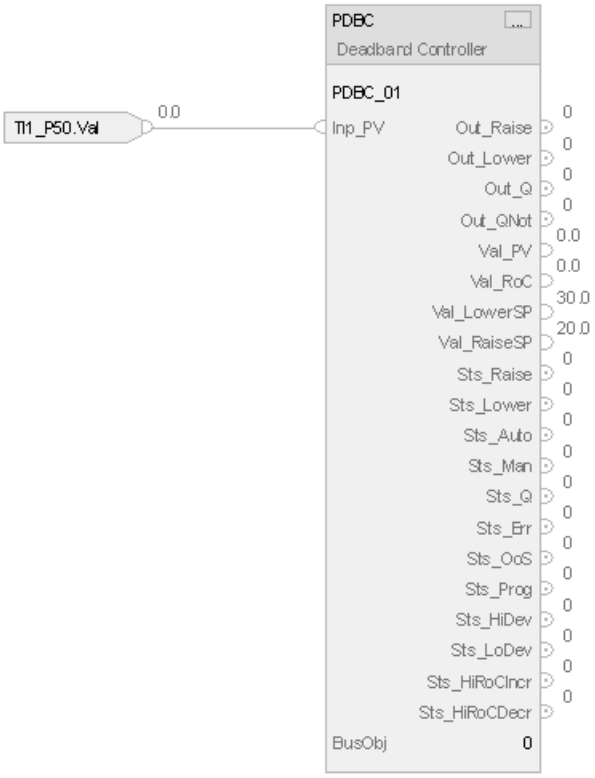
In this example, tag TI1_P50 is the temperature value monitored by the PDBC instruction. This tag provides a real indication of analog PV value.

Inp_PV is connected to the analog values tag (TI1_P50.Val) that comes from the Value output of the PAI instruction instance.

Ladder Diagram



Function Block Diagram



Structured Text

```
PDBC01.Inp_PV := TI1_P50.Out;

PDBC(PDBC_01, 0);
```

Process Discrete Input (PDI)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

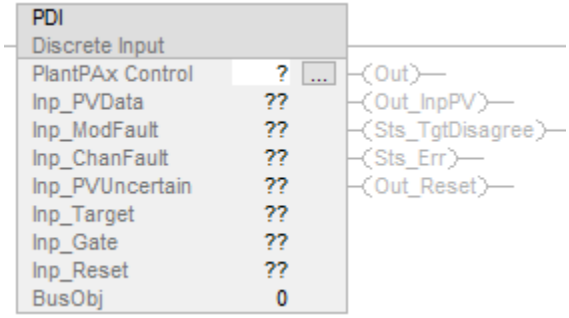
The Process Discrete Input (PDI) instruction monitors a discrete (true or false) input, and checks for alarm conditions. Use the PDI instruction to process a signal from a channel of a discrete input module. Use the PDI instruction with any discrete (BOOL) signal.

The PDI instruction provides these capabilities:

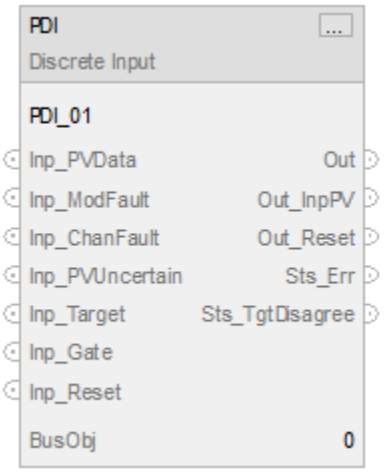
- De-bounce of the discrete input signal to filter out fast status changes by specifying a minimum time status must maintain state.
- Display of the input state; the 0-state and 1-state names are configurable. The input state is also displayed independently, even when the input is substituted.
- Target Disagree status based on comparing the input state against a target, or normal, state. The Target Disagree status is enabled by a gating input signal with a configurable gate delay. The Target Disagree status on and off delays are configurable. The Target Disagree status has an associated tag-based alarm.
- Handle a process variable (PV) fault input by displaying the fault to the operator. The PV fault has an associated tag-based alarm.
- The operator can select and manually enter a substitute PV. This manual override is made clearly visible to the operator. Optionally, the user can configure the substitute PV signal to track the Target input so that no Target Disagree status or alarm is generated.
- Support for a virtual PV for use in instruction testing, demonstration, or operator training.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PDI(PDI tag, BusObj);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PDI	P_DISCRETE_INPUT	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component. May be null.

P_DISCRETE_INPUT Structure

Public members are standard, visible tag members that are programmatically accessible. Private, or hidden, members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request to re-initialize. The instruction clears this operand automatically. Default is true.
Inp_PVData	BOOL	Input signal (process variable) from device. When EnableIn is false the instruction executes and uses the inverse of the Inp_PVData signal for processing. Default is true.
Inp_ModFault	BOOL	1 = I/O module failure or module communication status bad, 0 = OK. Default is false.
Inp_ChanFault	BOOL	1 = I/O channel fault or failure, 0 = OK. Default is false.
Inp_PVUncertain	BOOL	Indicates the channel data accuracy is undetermined. 1 = The channel data is uncertain. This input sets Sts_PVUncertain if not in Virtual. Default is false.
Inp_PVNotify	SINT	Related PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default = 0.
Inp_Target	BOOL	Target state of input. Input Inp_PVData is compared with the target state using Gate function. If not in target state, the Target Disagree status (Sts_TgtDisagree) is set to 1 and Target Disagree tag-based alarm is raised (if enabled). Default is true.
Inp_Gate	BOOL	The gate input used for status detection. 1 = Target Disagree monitoring is enabled. 0 = Target Disagree detection is disabled and the Target Disagree status output is forced off. Default is true.
Inp_Reset	BOOL	1 = Reset Shed Latches and Cleared Alarms. Default is false.
Cfg_AllowDisable	BOOL	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	1 = Allow Operator to shelve alarms. Default is true.

Public Input Members	Data Type	Description
Cfg_NoSubstPV	BOOL	Disables the maintenance substitution feature. 0 = The Substitute PV Maintenance function is enabled, 1 = The Substitute PV Maintenance function is disabled. When Cfg_NoSubstPV is 0, the commands MCmd_SubstPV and MCmd_InpPV are used to select the input PV or the substitute PV. Sts_SubstPV is set to 1 when the substitute PV is selected. Default is false.
Cfg_SubstTracksTarget	BOOL	1 = The substitute PV tracks Inp_Target, 0 = The substitute PV is set by MSet_SubstPV. Default is false.
Cfg_NormTextVis	BOOL	1 = The state text is displayed in Normal state, 0 = The state text is hidden in Normal state. Default is true.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.
Cfg_Debounce	REAL	Minimum time status must maintain state (seconds). Debounces the input PV, ensuring that the status stays in each state a minimum time. Valid = 0.0 to 2147483.0 seconds. Default = 0.0.
Cfg_GateDly	REAL	Target Disagree Gate delay (seconds). Time Inp_Gate must be 1 before Target Disagree condition is checked. Valid = 0.0 to 2147483.0 seconds. Default = 0.0.
Cfg_TgtDisagreeOffDly	REAL	Minimum time for input to agree with target to clear status (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_TgtDisagreeOnDly	REAL	Minimum time for input to disagree with target to raise status (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_CnfrmReqd	SINT	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
Set_VirtualPV	BOOL	PV used in Virtual (Sts_Virtual is 1). If the instruction is not in Virtual (Inp_Virtual is 0), the Set_VirtualPV input tracks the input PV (Inp_PVData) for bumpless transfer into Virtual. Default is false.
PCmd_Virtual	BOOL	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable output. This output state always reflects EnableIn input state.
Out	BOOL	Discrete input status (including de-bounce and manual override, if used). 0 = The discrete input is Off, 1 = The discrete input is On.
Out_InpPV	BOOL	Echo of Inp_PVData (actual raw or virtual input).
Out_Reset	BOOL	1 = Reset command has been received and accepted.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_PVUncertain	BOOL	Indicates the channel data accuracy is undetermined. 1 = The channel data is uncertain. This output is set by Inp_PVUncertain (if not in Virtual).
Sts_SubstPV	BOOL	1 = Using substitute PV (Override).
Sts_InpPV	BOOL	1 = Using input PV (Normal).
Sts_Virtual	BOOL	1 = Using virtual PV instead of the input from the device (Inp_PVData) to calculate output. 0 = The instruction uses input operand Inp_PVData to calculate output.
SrcQ_IO	SINT	Source and quality of primary input or output (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
SrcQ	SINT	Source and quality of primary value or status (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.

Public Output Members	Data Type	Description
Sts_eSts	SINT	Device confirmed status values: 0 = PV Good, 1 = PV uncertain, 2 = PV bad, 3 = PV substituted.
Sts_eFault	SINT	Device fault status values: 0 = None, 1 = Target disagree, 2 = Configuration error.
Sts_eNotify	SINT	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	IOFault alarm status enumerated values. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyTgtDisagree	SINT	TgtDisagree alarm status enumerated values. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_MaintByp	BOOL	1 = The device has a Maintenance Bypass function active.
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrGateDly	BOOL	1 = Error in configuration: Cfg_GateDly value is invalid.
Sts_ErrTgtDisagreeOffDly	BOOL	1 = Error in configuration: Cfg_TgtDisagreeOffDly value is invalid.
Sts_ErrTgtDisagreeOnDly	BOOL	1 = Error in configuration: Cfg_TgtDisagreeOnDly value is invalid.
Sts_ErrDebounce	BOOL	1 = Error in configuration: Cfg_Debounce value is invalid.
Sts_ErrAlm	BOOL	1 = Error in tag-based alarm settings.
Sts_Alm	BOOL	1 = An alarm is active.
Sts_AlmInh	BOOL	1 = An alarm is shelved or disabled.
Sts_IOFault	BOOL	IO Fault Status (0 = OK, 1 = Bad). 1 = Channel data is inaccurate. This output is set by Inp_IOFault if not in Virtual. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PDITag.@Alarms.Alm_IOFault.AlarmElement
Sts_TgtDisagreeCmp	BOOL	Input versus Target comparison result before gating. 1 = The input does not match its target.
Sts_TgtDisagreeGate	BOOL	Target Disagree Gate Delay Status. 1 = The target disagree gate is open.
Sts_TgtDisagree	BOOL	Gated input versus target comparison result. 1 = Input is not in target state. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PDITag.@Alarms.Alm_TgtDisagree.AlarmElement
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.

Private Input Members	Data Type	Description
MSet_SubstPV	BOOL	Maintenance-entered substitute PV that overrides input PV when Sts_SubstPV is 1. If not using the substitute (Sts_SubstPV is false), the MSet_SubstPV setting tracks the Out value for bumpless transfer from input PV to substitute PV. Default is false.
MCmd_SubstPV	BOOL	Maintenance command to use Substitute PV (Override input). The instruction clears this operand automatically. Default is false.
MCmd_InpPV	BOOL	Maintenance command to use Input PV (Normal). The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_Physical	BOOL	Maintenance command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to acknowledge and reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display. Default is 0.
MRdy_SubstPV	BOOL	1 = The instruction is ready for SubstPV command.
MRdy_InpPV	BOOL	1 = The instruction is ready for InpPV command.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_Reset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
ORdy_ResetAckAll	BOOL	1 = A latched alarm or shed condition is ready to be reset or acknowledged.

Public InOut Members	Data Type	Description
BusObj	BUS_OBJ	Bus component

BUS_OBJ Structure

The BUS_OBJ structure links the discrete input instruction to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices. Items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands

Members	Data Type	Description
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

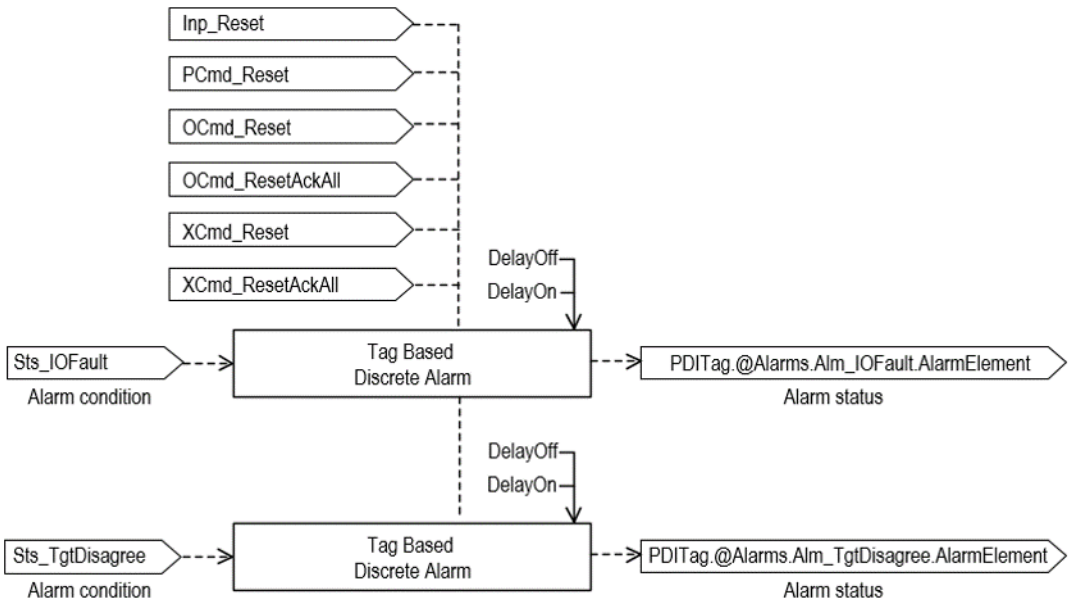
Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_TgtDisagree	Alm_TgtDisagree	Target Disagree status.
Sts_IOFault	Alm_IOFault	I/O Fault status (not generated when PV Substitution is active).

Mark the alarm as used or unused and set standard configuration members of the discrete Logix Tag based alarm. Access alarm elements using this format:

PDITag.@Alarms.AlarmName.AlarmElement

There are Program, Operator, and External commands that enable the Reset and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the instruction.



Operation

The Gate function provides the ability to raise an abnormal condition (alarm condition) when another condition is true. For example, a high vibration switch should only generate an alarm when the associated motor is running long enough to stabilize. The Inp_Gate input must be set to 1 (its default value) and the tag-based alarm for Sts_TgtDisagree enabled for alarm to occur. The alarm will not occur until the Inp_Gate input has been set for the Gate Delay (Cfg_GateDly) time.

The alarm is generated when the Inp_PVData (process variable) input is different from the Inp_Target (target) input. The Target indicates the normal condition. For example, a flow switch should indicate flow when a pump is running and should not indicate flow when a pump is stopped. The pump run status is used as the Target input, and when the switch does not match the target (within the allotted time), the Alarm (Flow Loss / Switch Failure) is generated.

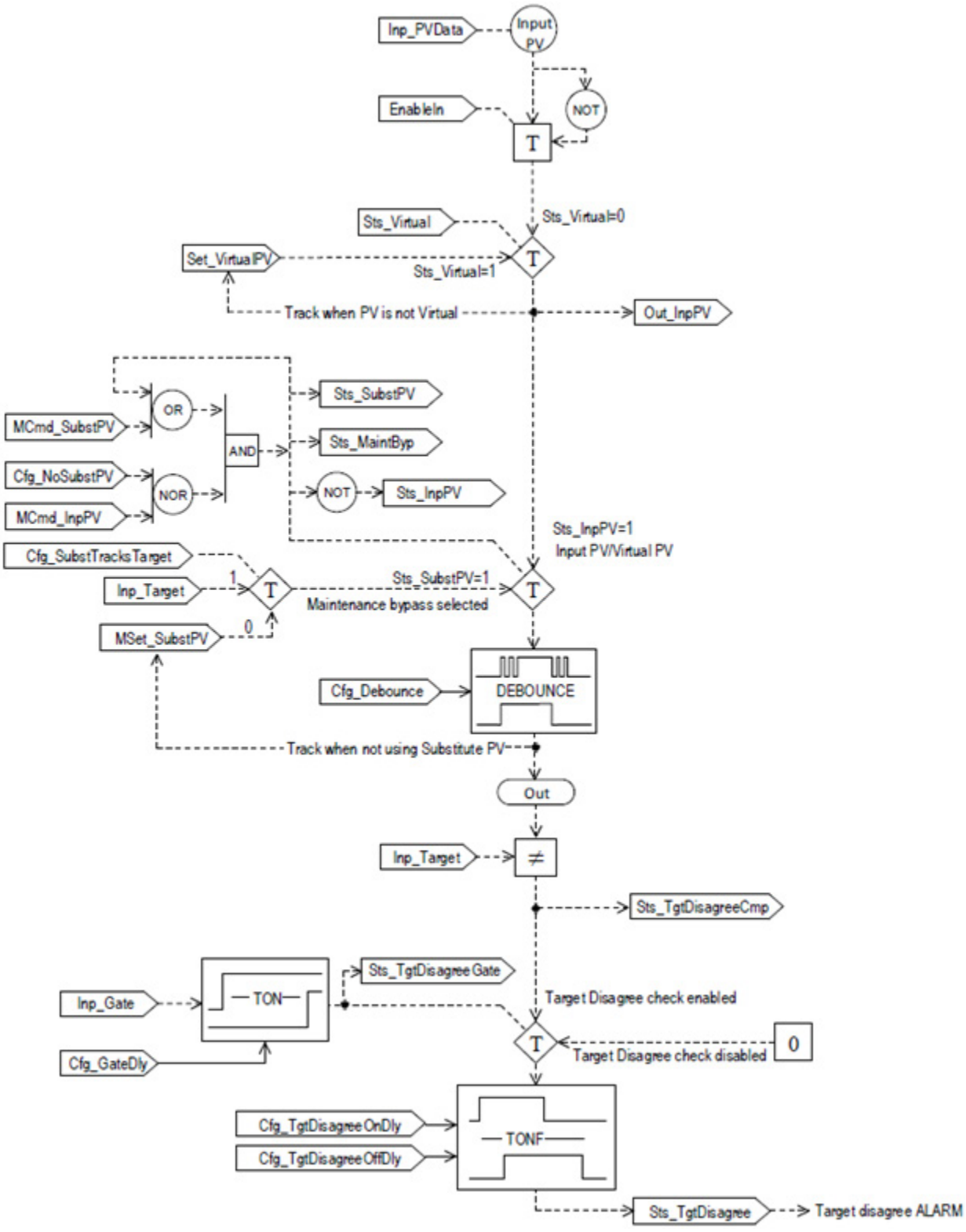
Tip: In Ladder Diagram if the rung-condition-in is false, the instruction uses the inverse of the Inp_PVData signal for processing. This allows the input to be a condition on the rung with PDI rather than mapped into Inp_PVData. To use the rung-condition-in mapping method, set Inp_PVData to 1, its default value.

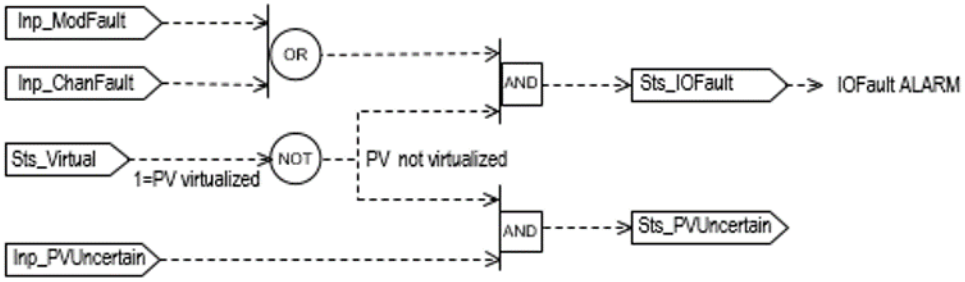
This instruction includes a substitute PV capability for a manually-entered state. This is useful when a sensor is out of order or for simulation and testing.

The Discrete Input instruction and its input, target and gate signals handle alarm conditions described by these use cases:

- Raises an alarm when the input is in a given alarm state for a configurable amount of time, such as a low level alarm from a float level switch.
- Raises an alarm when the input does not follow another given signal within a configurable amount of time, such as a flow switch which should indicate flow when an associated pump has been running for a period of time and which should indicate NO flow when the associated pump has been stopped for a period of time.
- Raises an alarm when the input is in a given alarm state for a configurable amount of time after enabled by a gating signal, such as a vibration switch on a motor, which should only alarm when the motor has been running long enough for startup vibration to have settled out.

This diagram illustrates the functionality of the PDI instruction:



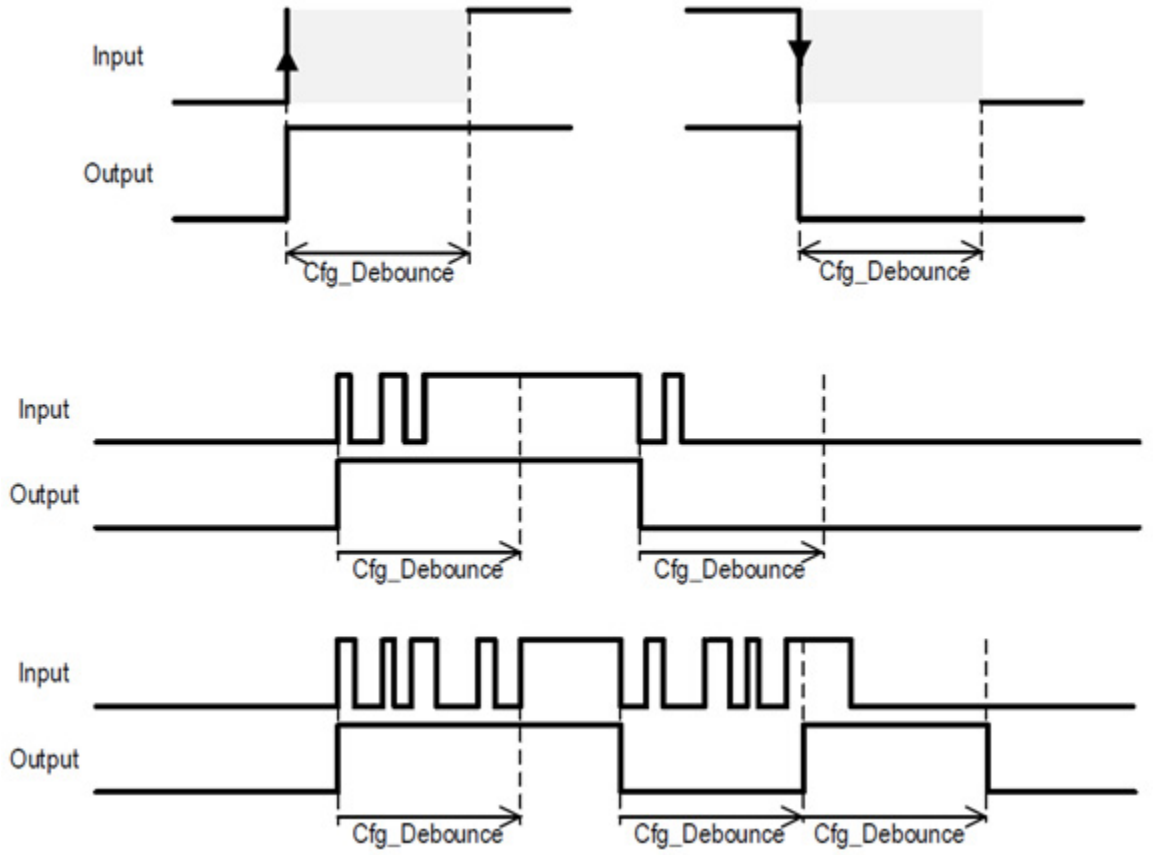


Debouncing

A bounce is a reversal of state that occurs immediately after a deliberate transition. When filtering bounces you should acknowledge the very first transition as early as possible and ignore subsequent changes until the end of a hold-off period. Use Cfg_Debouncing to specify the hold-off period in seconds.

For example, as soon as the Input PV changes state from 0 to 1, the output changes to 1 and will not then follow the Input PV back to 0 until the Cfg_Debounce time has expired. If Cfg_Debounce is set to 1 second, the output remains at 1 for at least 1 second. After 1 second, if the Input PV was then 0, the output would change to 0 and would remain at 0 for at least 1 second.

This illustration shows the Debounce operation.



Virtualization

Virtualization in PDI provides a virtual 0-state or 1-state input (Set_VirtualPV) that processes like an input. Use virtualization for instruction testing and operator training. Use PCmd_Virtual or MCmd_Virtual to enable virtualization. After finishing virtualization, use PCmd_Physical or MCmd_Physical to return to normal (physical device) operation.

Initialization

The instruction is normally initialized in the instruction first run. Re-initialization can be requested any time by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

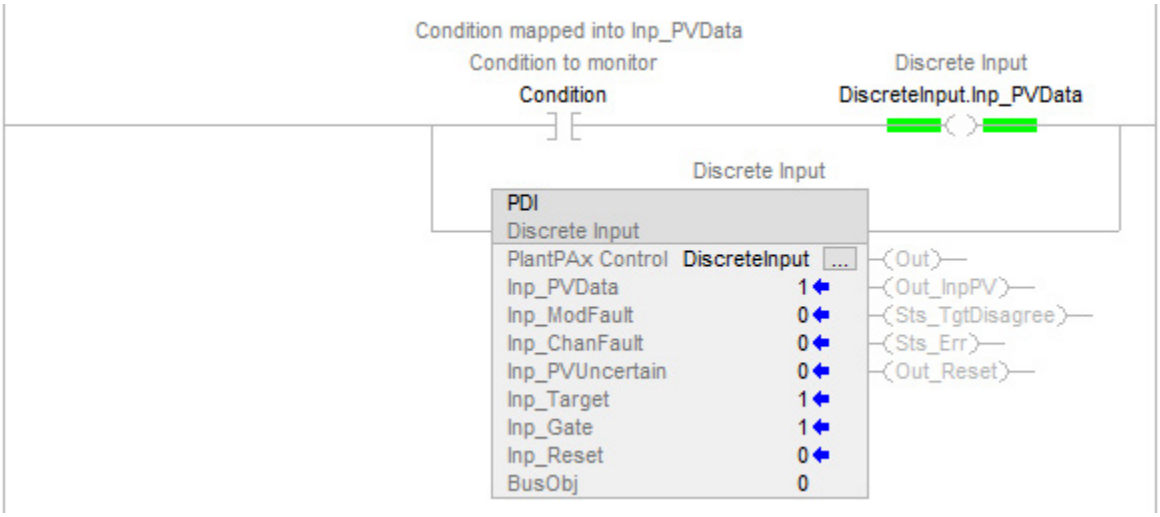
Configuration of Strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in the Logix Designer application only.

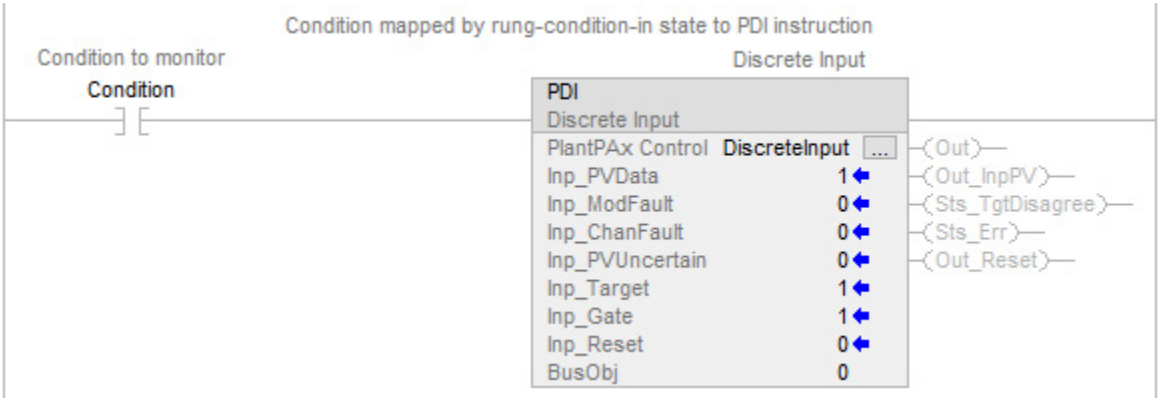
- Description
- State name strings for 0-state and 1-state
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- More Information

Implementation

This illustration shows normal implementation with the input condition mapped to Inp_PVData on a separate branch.



This illustration shows the implementation with the input condition mapped to the PDI instruction using the rung-condition-in.



Monitor the PDI Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. The state of using raw input or maintenance substitute PV is not modified and persists through a controller powerup or PROG-to-RUN transition. The state of the physical/virtual selection persists through a control power or PROG-to-Run transition.
Instruction first run	All commands that are automatically cleared each execution are cleared and ignored. The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false. The instruction executes normally, except it uses the inverse of the Inp_PVData signal for processing.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false. The state of using raw input or maintenance substitute PV is not modified and persists through a controller powerup or PROG-to-RUN transition. The state of the physical/virtual selection persists through a control power or PROG-to-Run transition.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. The instruction executes normally, except it uses the inverse of the Inp_PVData signal for processing.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.

Condition/State	Action Taken
Postscan	See Postscan in the Function Block Diagram table.

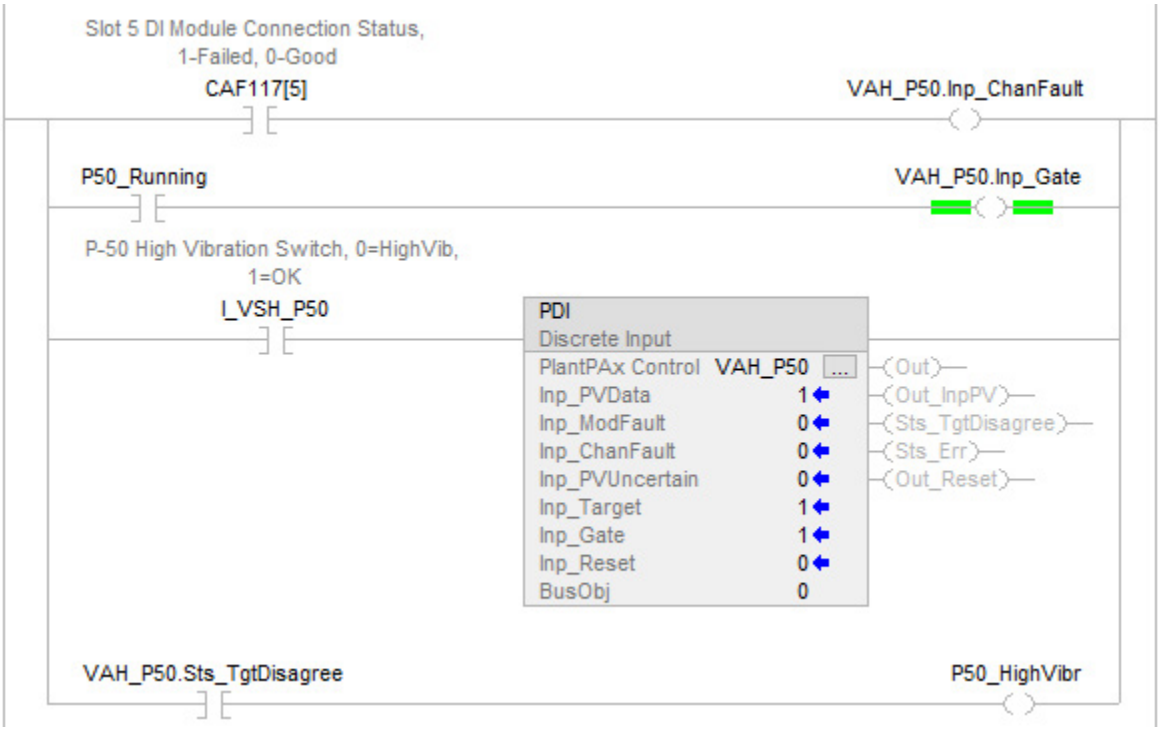
Example

In this example, tag I_VSH_P50 is the digital process value monitored by the PDI instruction. This tag provides a Boolean indication of High Vibration. The bad quality indication for the value of the process variable (Inp_ChanFault) comes from the connection status indication on the input module.

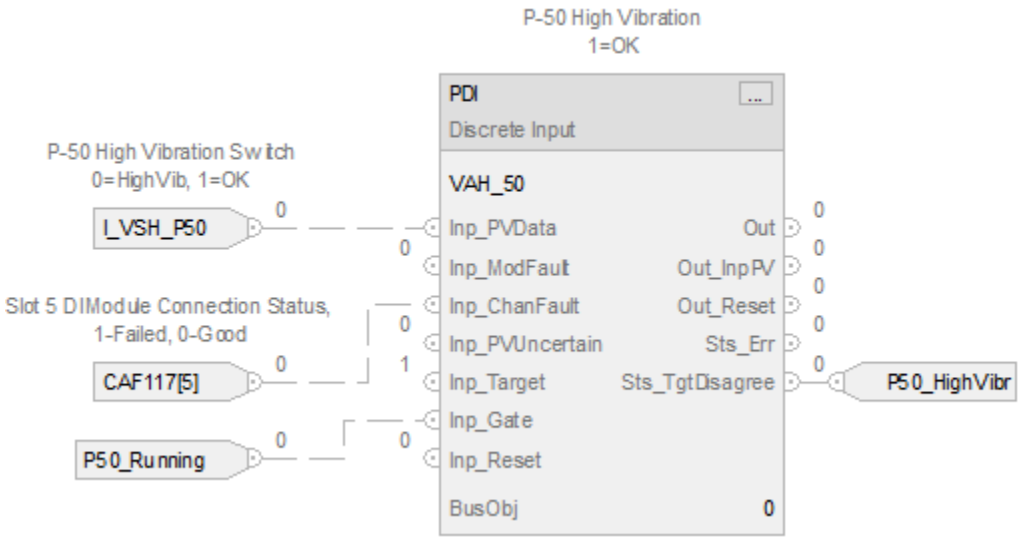
Inp_Target is defaulted to 1 indicating that the normal condition for I_VSH_P50 is also 1, and tag comments confirm that 1=OK for this process value. Inp_Gate is connected to the Motor Running status tag (P50_Running) that comes from the Sts_Running output of the P_Motor instruction instance for this motor (P50_Motor). The gate delay is configured to give the motor sufficient time after starting to settle into full normal speed run before enabling the high vibration indication (Sts_TgtDisagree) and alarm. The tag-based alarm for Target Disagree status (Sts_TgtDisagree) applies On Delay timing so the alarm will not raise until after delay time has expired.

Finally, P50_HighVibr is the output tag that indicates the status of I_VSH_P50 with appropriate gate delays based on whether the motor is running.

Ladder Diagram



Function Block Diagram



Structured Text

```
VAH_50.Inp_PV_Data := I_VSH_P50;

VAH_50.Inp_ChanFault := CAF_117[5];

VAH_50.Inp_Gate := P50_Running;

PDI(VAH_50);

P50_HighVibr := VAH_P50.Sts_TgtDisagree;
```

Process Discrete Output (PDO)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Discrete Output (PDO) instruction drives a discrete (true / false) output, monitors discrete inputs serving as feedbacks from a device driven by the discrete output, and checks for alarm conditions. Use the PDO instruction for a channel of a discrete output module. Use the PDO instruction with any discrete (BOOL) signal.

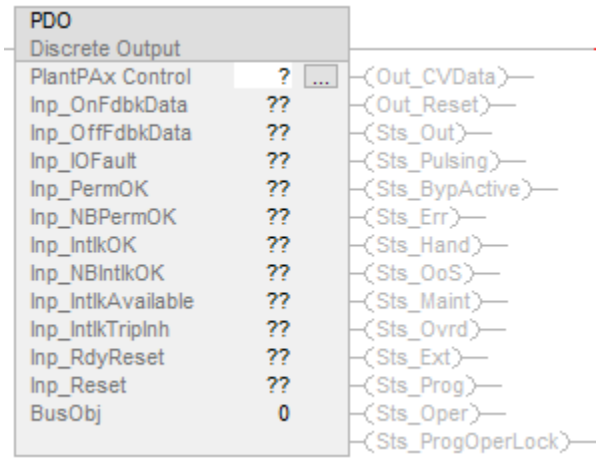
The PDO instruction:

- Controls one discrete output, with configurable text labels for the On and Off states of the output.
- Provides Operator, Program and External commands to set the output state to On or Off, to pulse the output On once, to pulse the output Off once, or to set the output to a continuous pulsing operation. Pulse times (on-time and off-time) are configurable.
- Monitors two discrete feedback inputs, monitoring the actual position of the device.

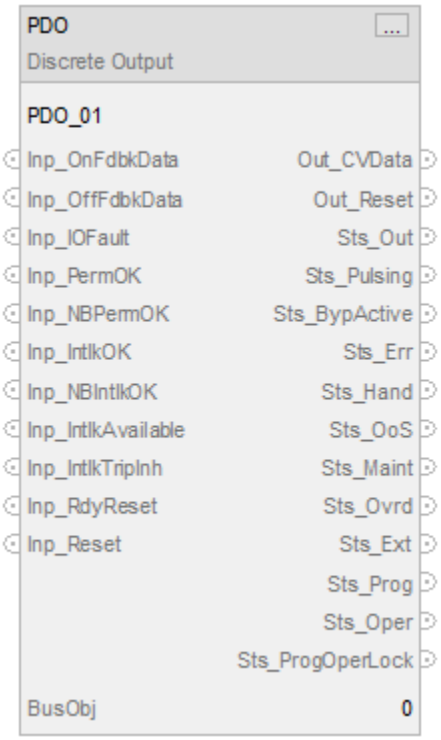
- Detects failure to reach the target state, after a configurable time, and alarms the failure when the feedback inputs are used. Optionally sheds to the de-energized state on a feedback failure.
- Monitors Permissive conditions that enable commanding the device to the On state.
- Monitors Interlock conditions that return the device to its de-energized Off state.
- Provides virtualization of a normally working device, while holding the output to the real device de-energized, for use in testing or operator training.
- Monitors I/O status and alarms on an I/O fault. Optionally sheds to the de-energized state on an I/O fault condition.
- Operates in Operator, Program, External, Override, Maintenance, Out of Service and Hand command sources.
- Provides an Available status, when in Program command source and operating normally, for use by higher-level automation logic to determine if the logic is able to manipulate the discrete output.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PDO(PDO tag, BusObj);

Operands

Important:	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_DISCRETE_OUTPUT	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component. May be null.

P_DISCRETE_OUTPUT Structure

Public members are standard, visible tag members that are programmatically accessible. Private, or hidden, members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request to re-initialize. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Owner device command. 0 = None, Inp_OwnerCmd.10 = Operator Lock, Inp_OwnerCmd.11 = Operator Unlock, Inp_OwnerCmd.12 = Program Lock, Inp_OwnerCmd.13 = Program Unlock, Inp_OwnerCmd.14 = Acquire Maintenance, Inp_OwnerCmd.15 = Release Maintenance, Inp_OwnerCmd.16 = Acquire External, Inp_OwnerCmd.17 = Release External, Inp_OwnerCmd.29 = Echo. Default is 0.
Inp_OnFdbkData	BOOL	On feedback from device. 1 = Device confirmed On. Default is false.
Inp_OffFdbkData	BOOL	Off feedback from device. 1 = Device confirmed Off. Default is false.
Inp_IOFault	BOOL	Indicates the IO data is inaccurate. 0 = The IO data is good, 1 = The IO data is bad, causing fault. This input sets Sts_IOFault, if the device is not virtual, which raises IOFault Alarm. Default is false.
Inp_PermOK	BOOL	1 = On permissives OK, device can turn On. Default is true.
Inp_NBPermOK	BOOL	1 = Non-bypassable On permissives OK, device can turn On. Default is true.
Inp_IntlkOK	BOOL	1 = Interlocks OK, device can turn On and stay On. Default is true.
Inp_NBIntlkOK	BOOL	1 = Non-bypassable interlocks OK, device can turn On and stay On. Default is true.
Inp_IntlkAvailable	BOOL	1 = Interlock Availability OK. Default is false.
Inp_IntlkTripInh	BOOL	1 = Inhibit Interlock Trip Status Default is false.
Inp_RdyReset	BOOL	1 = Related object, reset by this object, is ready to be reset. Default is false.

Public Input Members	Data Type	Description
Inp_Hand	BOOL	1 = Acquire Hand (typically permanently set to local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	1 = Acquire Override (higher priority program logic), 0 = Release Override Default is false.
Inp_OvrdCmd	SINT	Override device command: 0 = None, 1 = Off, 2 = On, 3 = Pulse off, 4 = Pulse on, 5 = Pulse continuously. Default is 0.
Inp_ExtInh	BOOL	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	1 = Inhibit audible alert, 0 = Allow audible alert. Default is false.
Inp_Reset	BOOL	1 = Reset shed latches and cleared alarms. Default is false.
Cfg_HornOnChange	BOOL	0 = Horn on energize only. 1 = Horn on any state change. Default is false.
Cfg_ExtOffPrio	BOOL	1 = XCmd_Off any time, 0 = XCmd_Off only when External selected. Default is false.
Cfg_XCmdResets	BOOL	1 = New device XCmd resets shed latches and cleared alarms, 0 = XCmdReset required. Default is false.
Cfg_AllowDisable	BOOL	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	1 = Allow Operator to shelve alarms. Default is true.
Cfg_HasPulse	BOOL	1 = Enable pulsing functions, 0 = On/Off only. Default is false.
Cfg_CompletePulse	BOOL	1 = Finish pulse in progress when commanded On or Off, 0 = Switch immediately to On or Off state when commanded. Default is false.
Cfg_FdbkFail	BOOL	1 = Both feedbacks On are invalid, 0 = Both feedbacks Off are invalid. Default is false.
Cfg_HasOnFdbk	BOOL	1 = Device provides an On feedback signal. Default is false.
Cfg_HasOffFdbk	BOOL	1 = Device provides an Off feedback signal. Default is false.
Cfg_UseOnFdbk	BOOL	1 = Use Device On feedback for failure checking. Default is false.
Cfg_UseOffFdbk	BOOL	1 = Use Device Off feedback for failure checking. Default is false.

Public Input Members	Data Type	Description
Cfg_OperOffPrio	BOOL	1 = OCmd_Off has priority, accepted any time, 0 = OCmd_Off only in Operator and Maintenance command sources. Default is false.
Cfg_OCmdResets	BOOL	1 = New Operator state command resets fault, 0 = Reset required to clear fault. Default is false.
Cfg_ShedOnIOFault	BOOL	1 = Go to Off state and alarm on IO fault, 0 = Alarm only on IO fault. **Important**: If a condition is configured to shed the device to the Off state on a fault, a reset is required to clear the shed fault to command the device to a state other than Off. Default is true.
Cfg_ShedOnFail	BOOL	1 = Go to Off state and alarm on Fail to reach position, 0 = Alarm only on Fail. **Important**: If a condition is configured to shed the device to the Off state on a fault, a reset is required to clear the shed fault to command the device to a state other than Off. Default is true.
Cfg_HasPermObj	BOOL	1 = Tells HMI a permissive object (for example, P_Perm) is used for Inp_PermOK and navigation to the permissive object's faceplate is enabled. **Important**: The name of the Permissive object in the controller must be this instruction's name with the suffix _Perm. For example, if the PDO instruction has the name PDOut123, then its Permissive object must be named PDOut123_Perm. Default is false.
Cfg_HasIntlkObj	BOOL	1 = Tells HMI an interlock object (for example, P_Intlk) is used for Inp_IntlkOK and navigation to the interlock object's faceplate is enabled. **Important**: The name of the interlock object in the controller must be this PDO object's name with the suffix _Intlk. For example, if the PDO instruction has the name PDOut123, then its interlock object must be named PDOut123_Intlk. Default is false.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.
Cfg_HasOper	BOOL	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	1 = Operator Locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	1 = Program Locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	1 = Maintenance exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	1 = Override supersedes Program/Operator Lock, 0 = Do not override Lock. Default is true.
Cfg_ExtOverLock	BOOL	1 = External supersedes Program/Operator Lock, 0 = Do not override Lock. Default is false.

Public Input Members	Data Type	Description
Cfg_ProgPwrUp	BOOL	1 = Power Up to Program, 0 = Power Up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Normal Source: 1= Program if no requests; 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	1 = PCmd_Prog used as a Level. Default is false.
Cfg_PCmdLockAsLevel	BOOL	1 = PCmd_Lock used as a Level (1 = Lock, 0 = Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	1 = XCmd_Acq used as Level (1 = Acquire, 0 = Release). Default is false.
Cfg_OvrdPermIntlk	BOOL	1 = Override ignores bypassable permissives/interlocks, 0 = Always use permissives/interlocks. Default is false.
Cfg_OnDly	REAL	Delay before initially turning output On (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.
Cfg_OffDly	REAL	Delay before initially turning output Off (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_OnPulseTime	REAL	Output On time for pulse On or pulse continuous (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.5.
Cfg_OffPulseTime	REAL	Output Off time for pulse Off or pulse continuous (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 0.5.
Cfg_OnFailTime	REAL	Time after output On to get On feedback before fault (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
Cfg_OffFailTime	REAL	Time after output Off to get Off feedback before fault (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 10.0
Cfg_StartHornTime	REAL	Time in seconds to sound audible on commanded energize. Valid = 0.0 to 1000.0 seconds, 0.0 = disabled. Default is 0.0.
Cfg_VirtualFdbkTime	REAL	Delay to echo back of On/Off status when the device is treated as virtual (seconds). Valid = 0.0 to 2147483.0 seconds. Default is 2.0.
Cfg_CnfrmReqd	SINT	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Program owner request ID (non-zero) or release (zero). Default is 0.

Public Input Members	Data Type	Description
PCmd_Virtual	BOOL	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_On	BOOL	Program command to turn device On. The instruction clears this operand automatically. Default is false.
PCmd_Off	BOOL	Program command to turn device Off. The instruction clears this operand automatically. Default is false.
PCmd_OnPulse	BOOL	Program command to pulse device (which is Off) On once. The instruction clears this operand automatically. Default is false.
PCmd_OffPulse	BOOL	Program command to pulse device (which is On) Off once. The instruction clears this operand automatically. Default is false.
PCmd_ContPulse	BOOL	Program command to pulse device continuously (blink). The instruction clears this operand automatically. Default is false.
PCmd_Oper	BOOL	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Program command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Program command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
XCmd_Acq	BOOL	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
XCmd_On	BOOL	External command to turn device On. The instruction clears this operand automatically.
XCmd_Off	BOOL	External command to turn device Off. The instruction clears this operand automatically. Default is false.
XCmd_OnPulse	BOOL	External command to pulse device (which is Off) On once. The instruction clears this operand automatically. Default is false.
XCmd_OffPulse	BOOL	External command to pulse device (which is On) Off once. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	Description
XCmd_ContPulse	BOOL	External command to pulse device continuously (blink). The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable output. This output state always reflects EnableIn input state.
Out_CVData	BOOL	Primary output. 1 = On, 0 = Off.
Out_HornData	BOOL	1 = Sound audible prior to commanded state change.
Out_Reset	BOOL	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Status of command source, owner command handshake and ready status. 0 = None, Out_OwnerSts.10 = Operator Lock, Out_OwnerSts.11 = Operator Unlock, Out_OwnerSts.12 = Program Lock, Out_OwnerSts.13 = Program Unlock, Out_OwnerSts.14 = Acquire Maintenance, Out_OwnerSts.15 = Release Maintenance, Out_OwnerSts.16 = Acquire External, Out_OwnerSts.17 = Release External, Out_OwnerSts.18 = Has Maintenance, Out_OwnerSts.19 = External Override Lock, Out_OwnerSts.20 = Has External. Out_OwnerSts.21 = Has Operator Out_OwnerSts.22 = Has Operator Locked Out_OwnerSts.23 = Has Program Out_OwnerSts.24 = Has Program Locked Out_OwnerSts.29 = Echo Out_OwnerSts.30 = Not Ready.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Out	BOOL	1 = Output is On (energized), 0 = Output is Off (de-energized).
Sts_Pulsing	BOOL	1 = Output is in a pulsing sequence.
Sts_FdbkOff	BOOL	1 = Device feedback shows device in Off state.
Sts_FdbkOn	BOOL	1 = Device feedback shows device in On state.
Sts_FdbkFail	BOOL	1 = Feedbacks are in an Invalid state (not On, Off, or Transition).
Sts_Horn	BOOL	1 = Audible alert (horn) is active.
Sts_Virtual	BOOL	1 = The instruction treats the device as virtual. The instruction acts as normal but the output is kept de-energized (Out_CVData = 0). 0 = The instruction operates the device normally.

Public Output Members	Data Type	Description
SrcQ_IO	SINT	Source and quality of primary input or output enumerated value: 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
SrcQ	SINT	Source and quality of primary value or status enumerated value: 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
Sts_eCmd	SINT	Device command: 0 = None, 1 = Off, 2 = On, 3 = Pulse off, 4 = Pulse on, 5 = Pulse continuously.
Sts_eFdbk	SINT	Device feedback: 0 = Transition, 1 = Off, 2 = On, 3 = Invalid.

Public Output Members	Data Type	Description
Sts_eSts	SINT	Device status: 0 = Off, 1= On, 2 = Pulse off, 3 = Pulse on, 4 = Pulse continuously, 5 = Turning off, 6 = Turning on, 7 = Horn 8 = Out of Service.
Sts_eFault	SINT	Device fault status: 0 = None, 1 = Feedback fault, 2 = IO fault, 3 = Configuration error.
Sts_eState	SINT	Internal Logic State (for animating STD on faceplate).
Sts_eNotify	SINT	Alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	IOFault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	Description
Sts_eNotifyOnFail	SINT	OnFail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyOffFail	SINT	OffFail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	IntlkTrip alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_eSrc	INT	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.

Public Output Members	Data Type	Description
Sts_bSrc	INT	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed Out of Service (rung false), Sts_bSrc.2: Maintenance Out of Service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_Available	BOOL	1 = Discrete output available for control by automation (Program).
Sts_IntlkAvailable	BOOL	1 = Interlock availability OK. Device can be acquired by program and is available for control when interlocks are OK.
Sts_Bypass	BOOL	1 = Bypassable interlocks are bypassed.
Sts_BypActive	BOOL	1 = Interlock bypassing active (bypassed or maintenance).
Sts_MaintByp	BOOL	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	1 = Device is not ready, for HMI use hidden detail bits (Sts_Nrdyxxx) for reason.
Sts_NrdyOoS	BOOL	1 = Device is not ready: Device disabled by Maintenance.
Sts_NrdyCfgErr	BOOL	1 = Device is not ready: Configuration error.
Sts_NrdyIntlk	BOOL	1 = Device is not ready: Interlock not OK.
Sts_NrdyPerm	BOOL	1 = Device is not ready: Permissive not OK.
Sts_NrdyPrioOff	BOOL	1 = Device is not ready: Operator or External priority Off command requires reset.
Sts_NrdyFail	BOOL	1 = Device is not ready: Device failure (Shed requires Reset).
Sts_NrdyIOFault	BOOL	1 = Device is not ready: IO Fault (Shed requires Reset).
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrOnDly	BOOL	1 = Error in configuration: Invalid OnDelay timer preset (use 0.0 to 2147483.0).
Sts_ErrOffDly	BOOL	1 = Error in configuration: Invalid OffDelay timer preset (use 0.0 to 2147483.0).
Sts_ErrOnPulseTime	BOOL	1 = Error in configuration: Invalid OnPulse timer preset (use 0.0 to 2147483.0).
Sts_ErrOffPulseTime	BOOL	1 = Error in configuration: Invalid OffPulse timer preset (use 0.0 to 2147483.0).
Sts_ErrOnFailTime	BOOL	1 = Error in configuration: Invalid OnFail timer preset (use 0.0 to 2147483.0).
Sts_ErrOffFailTime	BOOL	1 = Error in configuration: Invalid OffFail timer preset (use 0.0 to 2147483.0).
Sts_ErrStartHornTime	BOOL	1 = Error in configuration: Invalid start horn timer (use 0.0 to 1000.0).
Sts_ErrVirtualFdbkTime	BOOL	1 = Error in configuration: Invalid virtual feedback timer (use 0.0 to 2147483.0).
Sts_ErrAlm	BOOL	1 = Error in tag-based alarm settings.
Sts_Hand	BOOL	1 = Hand is selected (supersedes OoS, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	1 = Out of Service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	1 = External is selected (supersedes Program and Operator).
Sts_Prog	BOOL	1 = Program is selected.
Sts_ProgLocked	BOOL	1 = Program is selected and Locked.
Sts_Oper	BOOL	1 = Operator is selected.
Sts_OperLocked	BOOL	1 = Operator is selected and Locked.
Sts_ProgOperSel	BOOL	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	1 = Selection equals the Normal (Program or Operator).
Sts_ExtReqInh	BOOL	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	1 = Maintenance Acquire command received this scan.

Public Output Members	Data Type	Description
Sts_Alm	BOOL	1 = An alarm is active.
Sts_AlmInh	BOOL	1 = One or more alarms shelved, disabled or suppressed.
Sts_IOFault	BOOL	IO Fault status: 0 = OK, 1 = Bad. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PDOTag.@Alarms.Alm_IOFault.AlarmElement
Sts_OnFail	BOOL	1 = Device failed to turn On. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PDOTag.@Alarms.Alm_OnFail.AlarmElement
Sts_OffFail	BOOL	1 = Device failed to turn Off. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PDOTag.@Alarms.Alm_OffFail.AlarmElement
Sts_IntlkTrip	BOOL	1 = Device turned Off by an interlock Not OK. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PDOTag.@Alarms.Alm_IntlkTrip.AlarmElement
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_On	BOOL	1 = Ready for XCmd_On, enable HMI button.
XRdy_Off	BOOL	1 = Ready for XCmd_Off, enable HMI button.
XRdy_OnPulse	BOOL	1 = Ready for XCmd_OnPulse, enable HMI button.
XRdy_OffPulse	BOOL	1 = Ready for XCmd_OffPulse, enable HMI button.
XRdy_ContPulse	BOOL	1 = Ready for XCmd_ContPulse, enable HMI button.
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.
Val_Owner	DINT	Current object owner ID (0 = not owned).

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control / Command Source Selection.
MCmd_Bypass	BOOL	Maintenance command to bypass all bypassable interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_Check	BOOL	Maintenance command to check (not bypass) all interlocks. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/Override to Maintenance). The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_Rel	BOOL	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
OCmd_On	BOOL	Operator command to turn device On. The instruction clears this operand automatically. Default is false.
OCmd_Off	BOOL	Operator Command to turn device Off. The instruction clears this operand automatically. Default is false.
OCmd_OnPulse	BOOL	Operator command to pulse device that is Off, On once. The instruction clears this operand automatically. Default is false.
OCmd_OffPulse	BOOL	Operator command to pulse device that is On, Off once. The instruction clears this operand automatically. Default is false.
OCmd_ContPulse	BOOL	Operator command to pulse device continuously (blink). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms requiring reset. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display. Default is 0.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.

Private Output Members	Data Type	Description
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_On	BOOL	1 = Ready for OCmd_On, enable HMI button.
ORdy_Off	BOOL	1 = Ready for OCmd_Off, enable HMI button.
ORdy_OnPulse	BOOL	1 = Ready for OCmd_OnPulse, enable HMI button.
ORdy_OffPulse	BOOL	1 = Ready for OCmd_OffPulse, enable HMI button.
ORdy_ContPulse	BOOL	1 = Ready for OCmd_ContPulse, enable HMI button.
ORdy_Reset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
ORdy_ResetAckAll	BOOL	1 = A latched alarm or shed condition is ready to be reset or acknowledged.

Public InOut Members	Data Type	Description
BusObj	BUS_OBJ	Bus component

BUS_OBJ Structure

The BUS_OBJ structure links the discrete output instruction to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower-level devices to higher-level control and fans out commands from higher-level control to lower-level devices. Items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_IOFault	Alm_IOFault	IO Failure. Raised when the Inp_IOFault input is true. Use this input to indicate to the instruction that a connection with the module is in fault. This input also indicates if a module reports field power loss/no load/short circuit is occurring for its I/O. If the I/O Fault is configured as a shed fault, the device is commanded Off and cannot be commanded to another state until reset.
Sts_OnFail	Alm_OnFail	Device failed to turn on (On Feedback not confirmed within configured period of time). Raised when the device is commanded On, but the device feedback does not confirm that the device is actually On within the configured failure time (Cfg_OnFailTime). If the Failure is configured as a shed fault, the device is commanded Off and cannot be commanded On until reset.
Sts_OffFail	Alm_OffFail	Device failed to turn off (Off Feedback not confirmed within configured period of time). Raised when the device is commanded Off, but the device feedback does not confirm that the device is actually Off within the configured failure time (Cfg_OffFailTime).
Sts_IntlkTrip	Alm_IntlkTrip	Interlock Trip alarm. Raised when an interlock not-OK condition causes the device to transition from the On state or a pulsing state to the Off state. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.

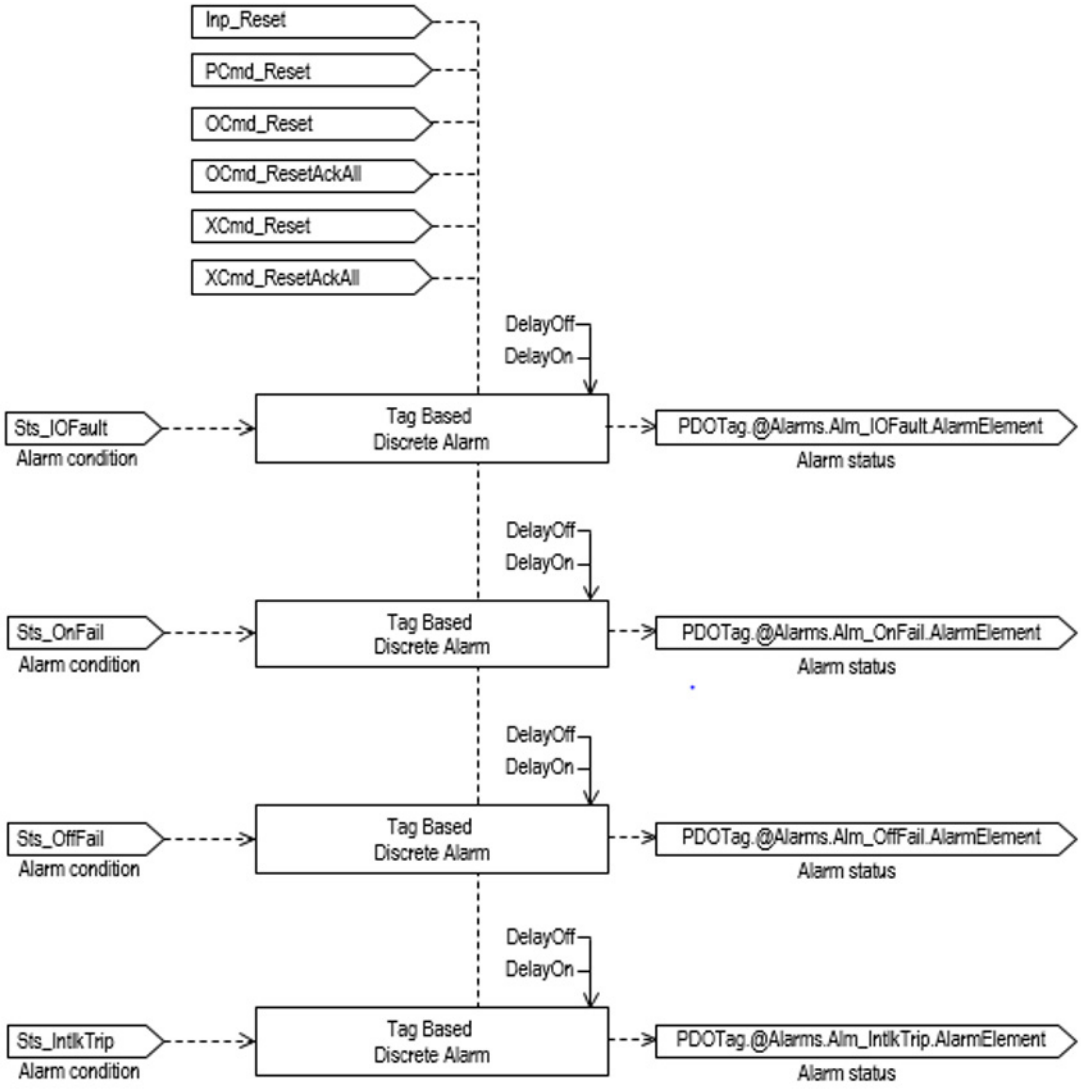
Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format:

PDOTag.@Alarms.AlarmName.AlarmElement

The PDO instruction handles alarm conditions described by these four use cases and conditions:

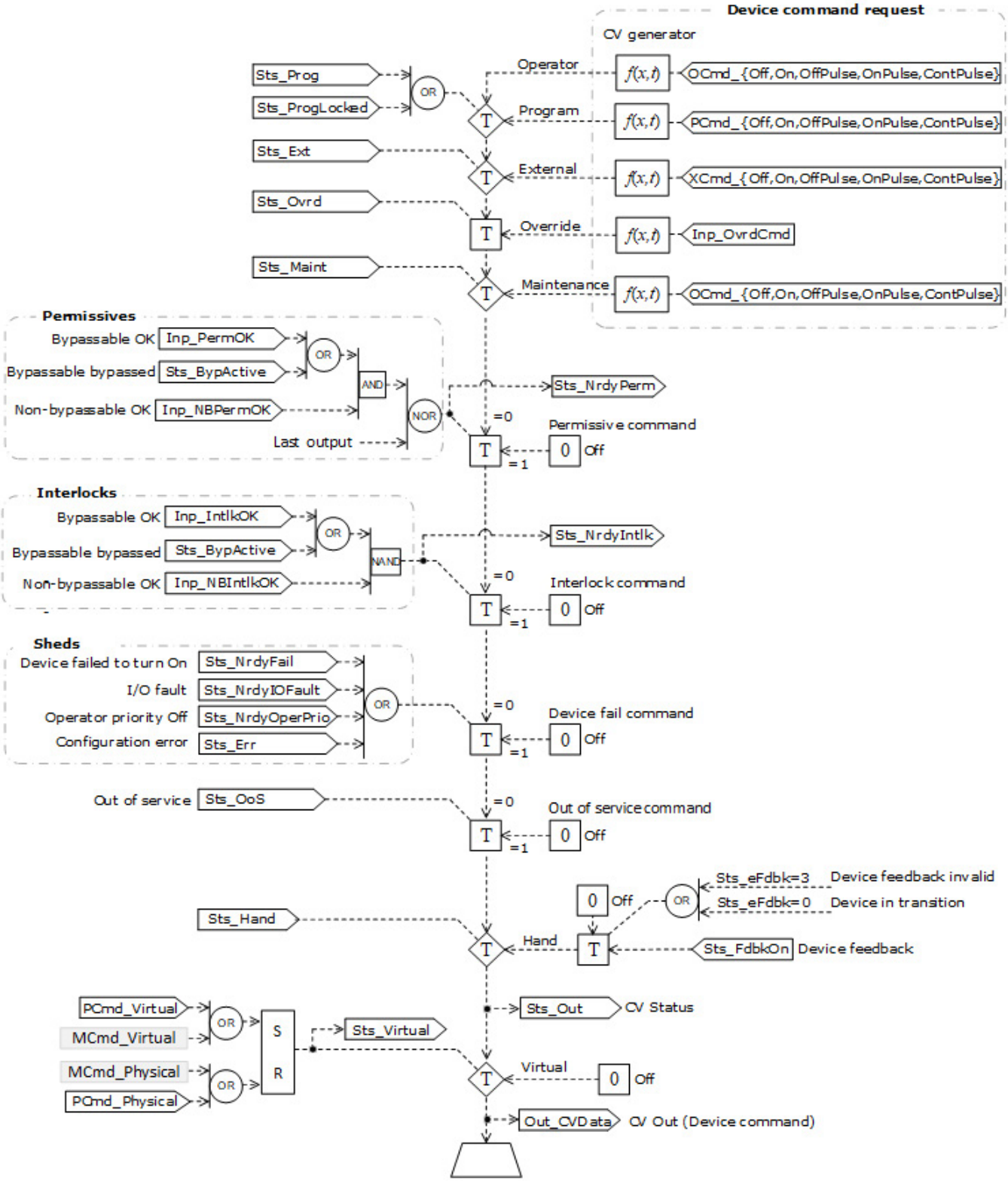
- I/O Fault Status - raised when the I/O Fault input is true. This input usually indicates to the instruction that I/O data is inaccurate and cannot be trusted for use in the application. If the I/O Fault is configured as a shed fault, the device is commanded Off and cannot be commanded to another state until reset.
- Interlock Trip Status - if interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.
- Off Feedback Fail Status - raised when the device is commanded Off, but the device feedback does not confirm that the device is actually Off within the configured failure time.
- On Feedback Fail Status - raised when the device is commanded On, but the device feedback does not confirm that the device is actually On within the configured failure time. If the Failure is configured as a shed fault, the device is commanded Off and cannot be commanded On until reset.

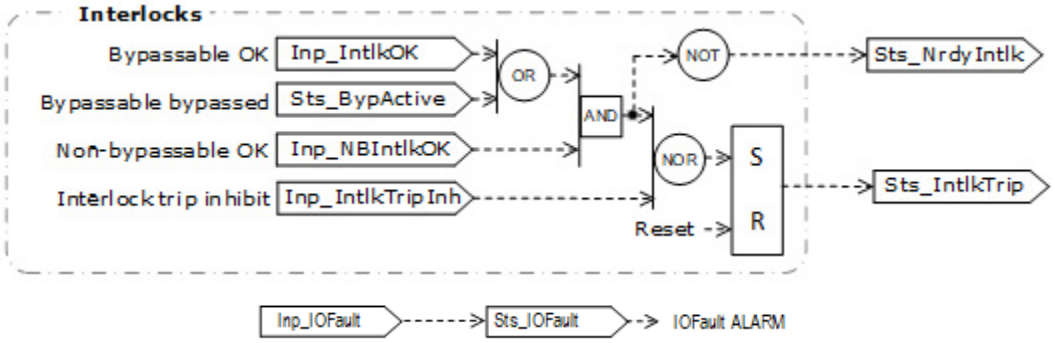
There are Program, Operator, and External commands that enable the Reset and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PDO instruction.



Operation

The following diagram illustrates functionality of the PDO instruction:





Operator command request confirmation

The PDO instruction enables operator command requests OCmd_Off, OCmd_On, OCmd_OffPulse, OCmd_OnPulse and OCmd_ContPulse. Enforced security might require the request to be confirmed or canceled before the selected command executes. The instruction checks the security rules inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd=0 no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd=1 the instruction waits for confirmation before executing. For Cfg_CnfrmReqd=2 or 3 eSignature is needed before the confirmation and cancellation is enabled.

Virtualization

Use virtualization for instruction testing and operator training. Set the Inp_Virtual operand to 1 to enable virtualization. After finishing virtualization, set the Inp_Virtual operand to 0 to return to normal operation.

When Virtualization is active, the output of the discrete output holds at 0, virtual feedback of a device is provided and I/O faults are ignored. Setting of Cfg_VirtualFdbkTime operand delays the echo of the On/Off status of the device. Manipulate the instruction to operate as if a working discrete output is present.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in the Logix Designer application only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Path to an object with more information
- Target state 0
- Target state 1
- Transition state 0
- Transition state 1
- Command button off
- Command button on
- Command button pulse off
- Command button pulse on
- Command button pulse continuously
- IOFault alarm name
- IntlkTrip alarm name
- On Fail alarm name
- Off Fail alarm name

Command Source

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. (Highest priority command source)
Out-of-Service	The instruction is disabled and has no owner.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (e.g. field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. (Lowest priority command source)

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enabling control sources as Configuration

The individual control sources may be enabled or disabled by the user. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program will be the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. This means that all commands are automatically cleared when the instruction executes and processes them.

Changing Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. Example: If the Prog is disabled, the destination of the OCmd_Prog command is directed to the ProgLocked state instead of the Prog state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated then there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Monitor the PDO Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. Inp_OvrdCmd is set to 0 (no command). The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition. PSet_Owner and Val_Owner are set to 0. If feedback is provided, Out_CVData and Sts_Out are set accordingly or cleared otherwise.
Rung-condition-in is false	Rung-condition-out is cleared to false. The instruction is put Out of Service if Inp_Hand=0. The output is de-energized and all alarm conditions are cleared. Latched alarms are reset. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.

Condition/State	Action Taken
Instruction first run	All commands that are automatically cleared on each execution are cleared and ignored. Inp_OvrdCmd is set to 0 (no command). The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. The Maintenance acquired/released state is not modified and persists through a controller powerup or PROG-to-RUN transition. PSet_Owner and Val_Owner are set to 0. If feedback is provided, Out_CVData and Sts_Out are set accordingly or cleared otherwise.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. The instruction is put Out of Service if Inp_Hand=0. The output is de-energized and all alarm conditions are cleared. Latched alarms are reset. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

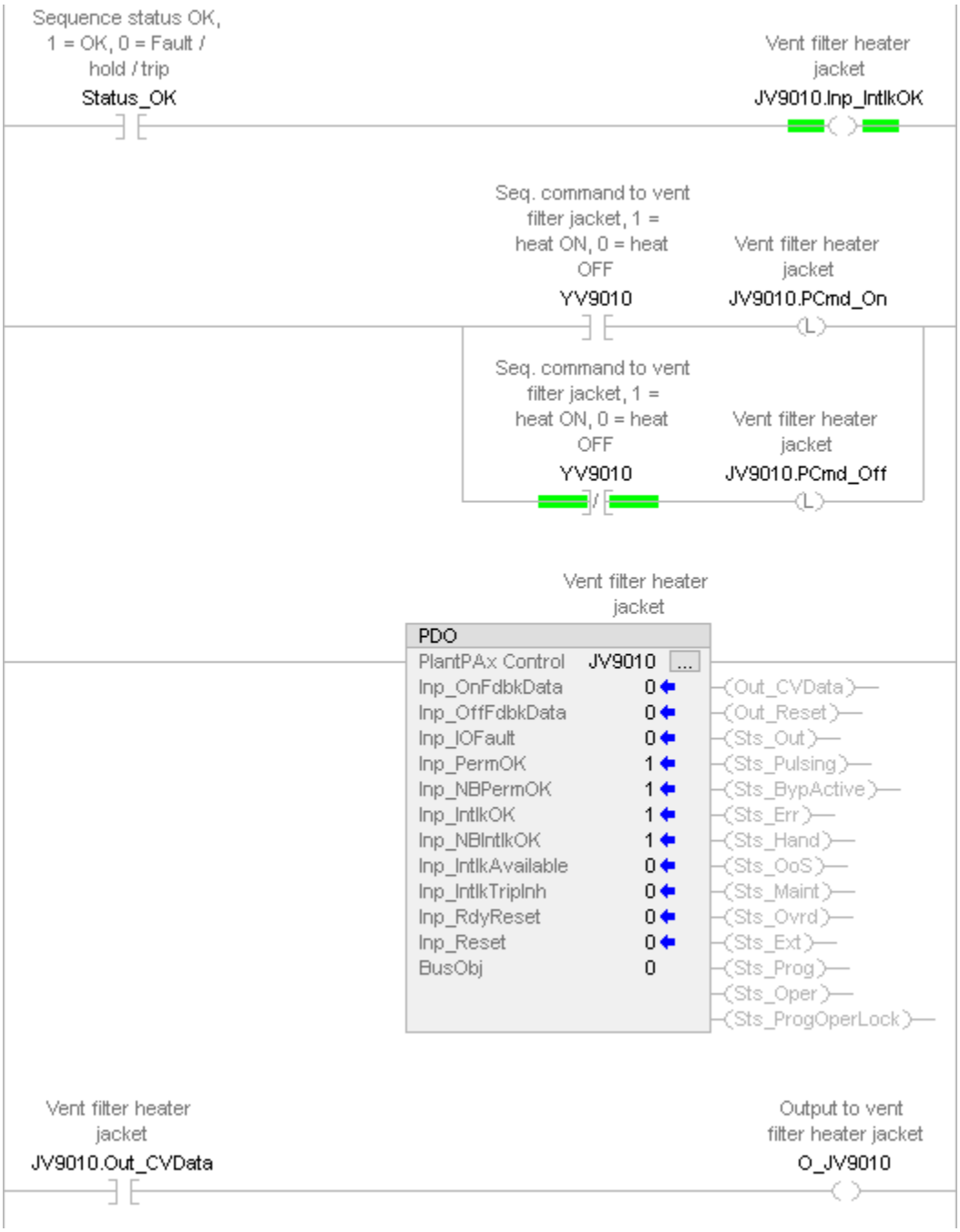
Use the PDO instruction to control a heating jacket on a vent filter. The heating jacket is being used in this case to keep the vent filter dry when there is potential for condensate buildup. The vent filter heater jacket does not provide the feedback on its status. In normal operating conditions, the vent filter heater jacket is being commanded on or off by the control sequence configured in the controller. Always command the vent filter off using the interlock associated with the status of the controlling sequence.

The controlling sequence issues a single bit for the desired state of the vent filter heater. The operand PCmd_On is connected to this bit to command the

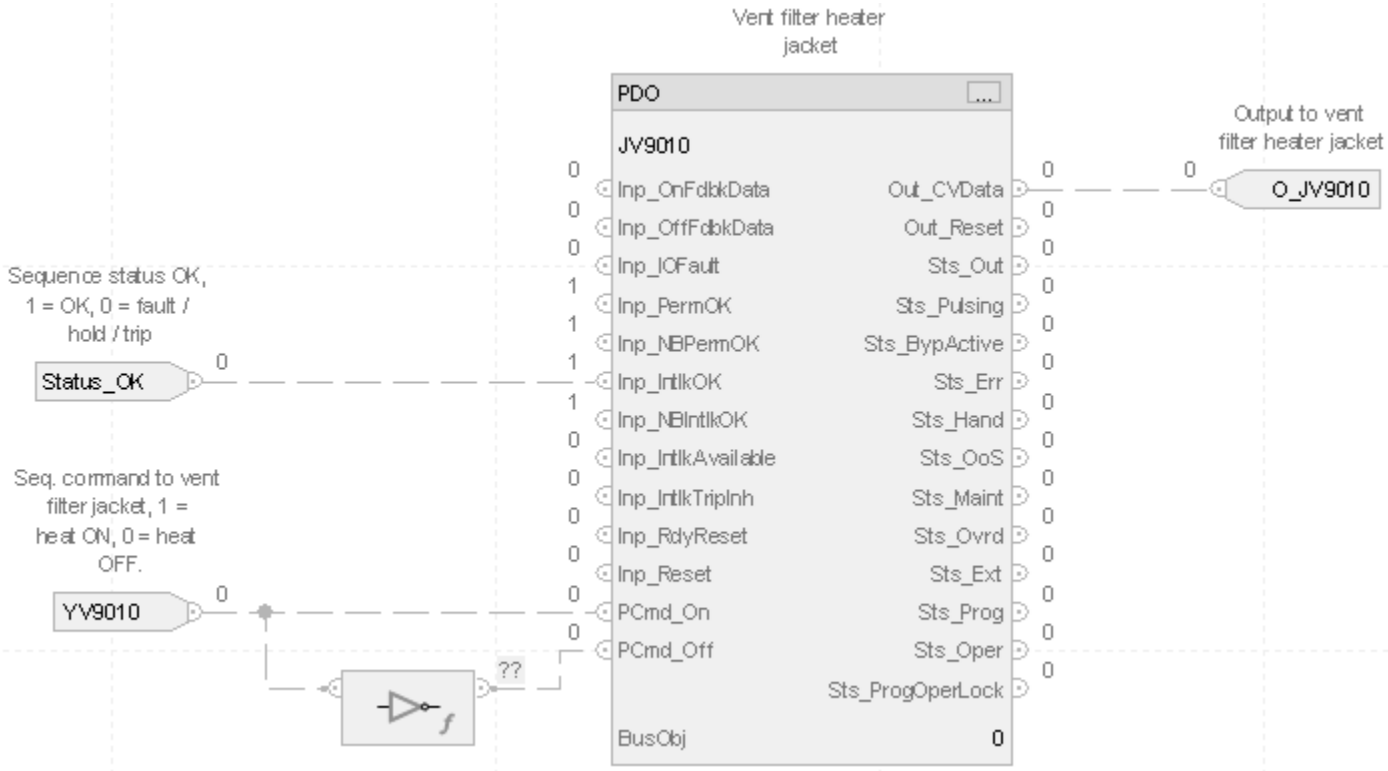
vent filter heater on. The inverse of this bit is connected to PCmd_Off to command the vent filter heater off. The operand Cfg_ProgNormal is set to 1 to indicate that the normal command source of the PDO instruction is Program, meaning it is normally commanded by the control sequence. The status of the sequence is connected to the Inp_IntlkOK operand so that the output to the vent filter heater jacket is always off when the skid is not operating properly, even if the instruction is not in Program mode. The operands Cfg_HasOnFdbk and Cfg_HasOffFdbk are both set to 0 to indicate that the vent filter heater jacket does not provide feedback on its status.

The example is shown in all three languages.

Ladder Diagram



Function Block Diagram



Structured Text

```
JV9010.Inp_IntlkOK := Status_OK;

JV9010.PCmd_On := YV9010;

JV9010.PCmd_Off := NOT(YV9010);

PDO(JV9010, 0);

O_JV9010 := JV9010.Out_CVData;
```

Process Dosing (PDOSE)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Dosing (PDOSE) instruction controls an ingredient addition that uses a flow meter to measure the quantity of ingredient added. The flow meter can be an analog flow meter (signal proportional to flow), a pulse generating flow meter (pulse count proportional to quantity delivered), or a digital flow meter providing flow rate or quantity (totalized flow) information. The instruction also controls an ingredient addition that uses a weigh scale to measure the quantity of ingredient added. The weigh scale can be on the receiving vessel, indicating gain in weight, or on the sourcing vessel,

indicating loss in weight. The weigh scale can be connected using an analog input, device network, or other connection.

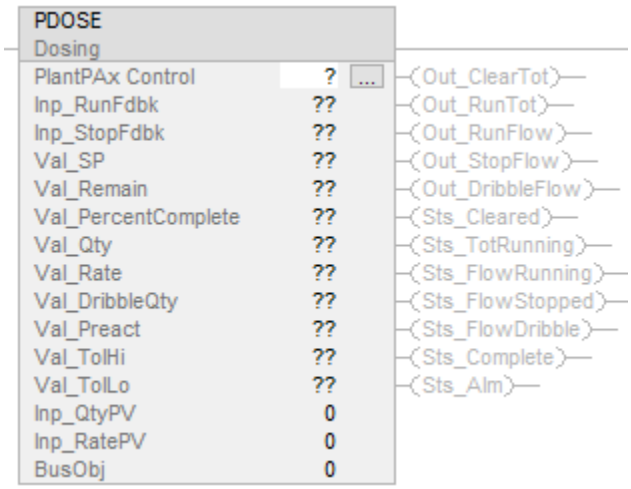
Use the PDOSE instruction to:

- Provide inputs for rate (flow rate or quantity per time) and quantity (total or pulse count).
- Use a pulse count as the Quantity process variable (PV), with configurable rollover count.
- Totalize the flow rate PV to determine the quantity delivered when the flowmeter provides a rate signal but no quantity.
- Calculate the flow rate given the quantity by differentiating with respect to time when the meter provides a total or pulse count but no rate. If the rate PV is calculated from an input quantity, the PDOSE instruction uses a first-order, lag filter on the calculated rate PV signal to reduce the impact of jitter, scan time, quantization error, or input signal noise.
- Provide a low rate cutoff function, used to ignore flow rate values near zero to deal with noise or zero calibration error in the rate signal.
- Use a flowmeter with built-in totalizer. Forwards the totalizer clear command to the flowmeter and checks that the flowmeter's total was reset.
- Provide outputs to control associated equipment, such as pumps and valves, to start and stop flow.
- Monitor the status of controlled equipment, such as pumps and valves.
- Monitor rate or quantity input communication status and provide indication of uncertain or bad rate PV or quantity PV.
- Provide program or operator entry of a quantity to deliver (setpoint) and calculate the quantity remaining to deliver and percent complete during delivery.
- Provide program or operator entry of high and low tolerance limits. Lets the program or operator initiate a tolerance check after delivery is complete. Provides a warning if under tolerance and lets the operator bump the flow to make up the shortage. The bump can be set up as a timed bump or as an operator jog-like function. Provides an alarm if over tolerance and inhibits further flow.
- Automatically switch to a lower dribble flow rate as the quantity delivered approaches setpoint. Provides operator or program entry of the dribble quantity. Provides run, dribble, and stop outputs to controlled equipment.
- Use a preact value to stop flow to account for material in the pipe, time for equipment to stop, and delays in measurement, scan, communication, and so forth. Provides operator or program entry of the preact value. Provides an optional automatic preact correction based on the error in delivery when tolerance is checked. The auto correction lets the preact learn the correct value over time.

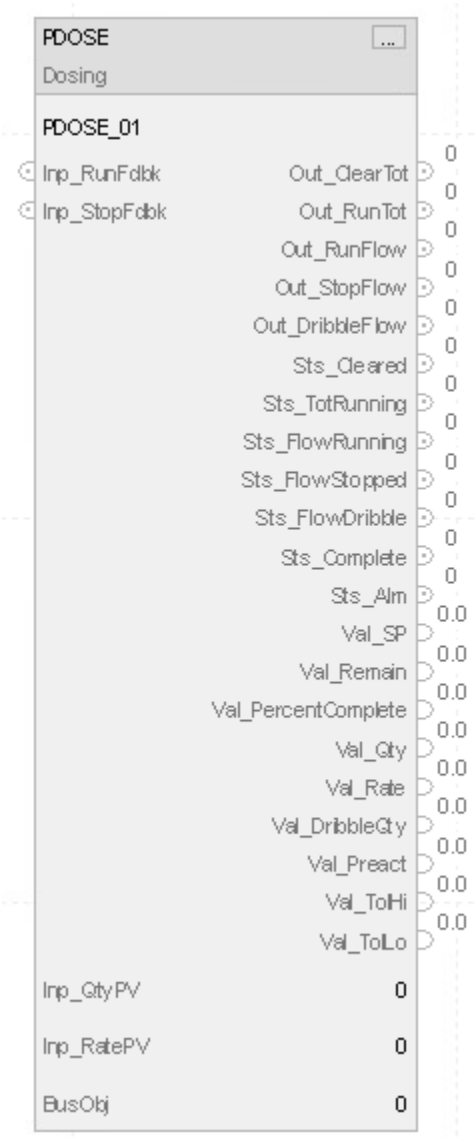
- Use the standard command source (PCMDSRC) instruction to provide ownership for entry of settings and acceptance of commands.
- Provide linear scaling of the input weight value from raw, input card units to engineering, display units.
- Provide a rate of weight change calculation (differentiation with respect to time) to generate an inferred flow rate. The calculated rate is filtered and has a low cutoff, so the rate is reported as zero when the change in weight is only from noise on the input weight signal.
- Provide outputs to control associated equipment, such as pumps and valves to start and stop flow. The operator or the program can start the ingredient addition, then pause and resume as needed.
- Monitor the status of controlled equipment, such as pumps and valves. Flow is stopped and an alarm is raised on an equipment fault or if the equipment fails to respond as commanded.
- Monitor the weight PV input quality and communication status and provides indication of uncertain or bad weight PV. Flow is stopped and an alarm is raised on a bad PV or communication loss.
- Provide a continuous monitoring function which allow continuous monitoring without SP requirement.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PDOSE (PDOSE tag, Inp_QtyPV, Inp_RatePV, BusObj);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_DOSING	tag	Data structure required for proper operation of instruction.
Inp_QtyPV	REAL	tag	Quantity from weigh scale or flowmeter (EU or pulse count).
Inp_RatePV	REAL	tag	Flow rate from flowmeter (EU/Time, see Cfg_RateTime).
BusObj	BUS_OBJ	tag	Bus component.

P_DOSING Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command. 0 = None, Inp_OwnerCmd.10 = Operator lock, Inp_OwnerCmd.11 = Operator unlock, Inp_OwnerCmd.12 = Program lock, Inp_OwnerCmd.13 = Program unlock, Inp_OwnerCmd.14 = acquire Maintenance, Inp_OwnerCmd.15 = release Maintenance, Inp_OwnerCmd.16 = acquire External, Inp_OwnerCmd.17 = release External. Default is 0.
Inp_RatePVBad	BOOL	Not Visible	Not Required	Input	1 = Rate PV input quality = Bad (Fail). Default is false.
Inp_RatePVUncertain	BOOL	Not Visible	Not Required	Input	1 = Rate PV input quality = Uncertain. Default is false.
Inp_QtyPVBad	BOOL	Not Visible	Not Required	Input	1 = Quantity PV input quality = Bad (Fail). Default is false.
Inp_QtyPVUncertain	BOOL	Not Visible	Not Required	Input	1 = Quantity PV input quality = Uncertain. Default is false.
Inp_RunFdbk	BOOL	Visible	Not Required	Input	1 = Controlled equipment is delivering (running). Default is false.
Inp_DribbleFdbk	BOOL	Not Visible	Not Required	Input	1 = Controlled equipment is delivering at dribble. Default is false.
Inp_StopFdbk	BOOL	Visible	Not Required	Input	1 = Controlled equipment is confirmed stopped. Default is false.
Inp_CtrldEqpFault	BOOL	Not Visible	Not Required	Input	Controlled equipment object or I/O status 0 = Ok, 1 = Fail. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset shed latches and cleared alarms. Default is false.
Inp_eRatePVSrcQ	SINT	Not Visible	Not Required	Input	Flow rate signal source and quality (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration. Default is 0.
Inp_eRatePVNotify					Rate PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_eQtyPVSrcQ	SINT	Not Visible	Not Required	Input	Quantity signal source and quality (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration. Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_eQtyPVNotify	SINT	Not Visible	Not Required	Input	Quantity PV object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire hand (typically hardwired local), 0 = Release hand. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override (higher priority Program logic), 0 = Release Override. Default is false.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Operator alarm disable, 0 = Disallow Operator alarm disable. Default is false.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator alarm shelve, 0 = Disallow Operator alarm shelve. Default is false.
Cfg_HasEqpFdbk	BOOL	Not Visible	Not Required	Input	1 = Controlled equipment provides run (dribble if used) and stop feedback. Default is false.
Cfg_UseEqpFdbk	BOOL	Not Visible	Not Required	Input	1 = Use run / dribble / stop feedback, 0 = Assume equipment state. Default is false.
Cfg_HasDribble	BOOL	Not Visible	Not Required	Input	1 = Slow to dribble before complete, 0 = Run full flow until complete. Default is false.
Cfg_HasRatePVNav	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an analog object (pai, etc.) is used for Inp_RatePV. Default is false.
Cfg_HasMonitoring	BOOL	Not Visible	Not Required	Input	1 = Allows continuous monitoring without setpoint requirement. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more info is available. Default is false.
Cfg_HasQtyPVNav	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an analog object (pai, etc.) is used for Inp_QtyPV. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_AutoAdjPreact	BOOL	Not Visible	Not Required	Input	1 = Enable automatic adjustment of preact after each delivery. Default is false.
Cfg_LossInQty	BOOL	Not Visible	Not Required	Input	1 = Flow reduces quantity (Transfer out), 0 = Flow increases quantity (Transfer in). Default is false.
Cfg_SetTrack	BOOL	Not Visible	Not Required	Input	1 = When the owner is Program the operator settings track the program settings. When the owner is Operator the program settings track the operator settings; and the virtual inputs match the output values (transitions are bumpless) 0 = No tracking. Default is true.
Cfg_ShedOnEqpFault	BOOL	Not Visible	Not Required	Input	1 = Stop delivery and alarm on equipment fault; 0 = Alarm only on equipment fault. Default is true.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator Lock, 0 = Don't Override lock. Default is true.
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator Lock, 0 = Don't Override lock. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal source: 1 = Program if no requests; 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Prog used as a level. Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Lock used as a level (1 = Lock, 0 = Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = XCmd_Acq used as level (1 = Acquire, 0 = Release). Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_AutoAdjPercent	REAL	Not Visible	Not Required	Input	Percentage of delivery error to auto-adjust preact. Valid = 0.0 to 100.0 (%) Default is 10.0.
Cfg_CountsPerEU	REAL	Not Visible	Not Required	Input	Number of counts in Inp_QtyPV which equal 1.0 Engineering Units. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_EUQtyMult	REAL	Not Visible	Not Required	Input	Rate to quantity Engineering Units multiplier (e.g., gal to bbl.). Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_BumpTime	REAL	Not Visible	Not Required	Input	Bump (manual top-off) time. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_ClearPulseTime	REAL	Not Visible	Not Required	Input	Time to pulse Out_ClearTot to clear External totalizer. Valid = 0.0 to 2147483.0 seconds. Default is 1.0.
Cfg_FaultTime	REAL	Not Visible	Not Required	Input	Time for equipment feedback to follow output before fault. Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
Cfg_HiFlowRateLim	REAL	Not Visible	Not Required	Input	High flow rate alarm limit. Valid = 0.0 to maximum positive float. Default is 3.40E+38.
Cfg_LoFlowRateLim	REAL	Not Visible	Not Required	Input	Low flow rate alarm limit. Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_LoRateCutoff	REAL	Not Visible	Not Required	Input	Rate below which to report zero flow (Inp_RatePV in engineering unit/time, see Cfg_RateTime). Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_MaxQty	REAL	Not Visible	Not Required	Input	Maximum allowed quantity to deliver (setpoint).Valid = 0.0 to maximum positive float. Default is 1.50E+38.
Cfg_RateFiltTimeConst	REAL	Not Visible	Not Required	Input	Filter time constant (sec) for calculated rate. Valid = 0.0 to 2147483.0 seconds. Default is 0.1.
Cfg_RateTime	REAL	Not Visible	Not Required	Input	Rate of change time base (seconds), use 1.0 for units/second, 60.0 for units/minute, 3600.0 for units/hour, 86400.0 for units/day. Valid = any float greater than zero. Default is 1.0.
Cfg_Rollover	REAL	Not Visible	Not Required	Input	Quantity rollover (e.g., max count for pulse input). Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_SettleTime	REAL	Not Visible	Not Required	Input	Time to allow flow to stop before allowing tolerance check.Valid = 0.0 to 2147483.0 seconds. Default is 1.0.
Cfg_VirtualRate	REAL	Not Visible	Not Required	Input	Rate at which to deliver when running in virtual (Engineering Units/rate time). Valid = 0.0 to maximum positive float. Default is 1.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_VirtualDribbleRate	REAL	Not Visible	Not Required	Input	Rate at which to dribble when running in virtual (Engineering Units/rate time). Valid = 0.0 to maximum positive float. Default is 0.1.
Cfg_eKeepSP	SINT	Not Visible	Not Required	Input	Ownership of Setpoint (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_eKeepStart	SINT	Not Visible	Not Required	Input	Ownership of Start commands (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_eKeepTol	SINT	Not Visible	Not Required	Input	Ownership of Tolerance commands (enumeration): 0 = follows CmdSrc, 1 = Operator, 3 = External. Default is 0.
Cfg_eKeepDribblePreact	SINT	Not Visible	Not Required	Input	Ownership of Dribble\Preact (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_HasHistTrend	SINT	Not Visible	Not Required	Input	Has Historical Trend. This enables navigation to the Device Historical Trend Faceplate from the HMI. Value of 0 = No External historical trend, 1 = Datalog historical trend, 2 = Historian histrical trend. Default is 0.
Cfg_QtyDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for quantity display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_RateDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for rate display. Valid = 0,1,2,3,4,5,6. Default is 2.
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PCmd_Bump	BOOL	Not Visible	Not Required	Input	Program command to bump delivery for under tolerance. The instruction clears this operand automatically. Default is false.
PCmd_ClearTot	BOOL	Not Visible	Not Required	Input	Program command to clear totalizer quantity. The instruction clears this operand automatically. Default is false.
PCmd_StartTot	BOOL	Not Visible	Not Required	Input	Program command to start totalizer. The instruction clears this operand automatically. Default is false.
PCmd_StopTot	BOOL	Not Visible	Not Required	Input	Program command to stop totalizer. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_StartFlow	BOOL	Not Visible	Not Required	Input	Program command to start delivery. The instruction clears this operand automatically. Default is false.
PCmd_StopFlow	BOOL	Not Visible	Not Required	Input	Program command to stop/pause delivery. The instruction clears this operand automatically. Default is false.
PCmd_CheckTol	BOOL	Not Visible	Not Required	Input	Program command to check tolerances. The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program command to select normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program command to reset all alarms requiring reset. The instruction clears this operand automatically. Default is false.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program command to select Virtual (virtualized) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program command to select Physical device operation (not virtualized). The instruction clears this operand automatically. Default is false.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program owner request ID (non-zero) or release (zero). Default is 0.
PSet_DribbleQty	REAL	Not Visible	Not Required	Input	Program setting of quantity to dribble (Engineering Units). Valid = 0.0 to maximum positive float. Default is 0.0.
PSet_Preact	REAL	Not Visible	Not Required	Input	Program setting of amount before total to stop flow (Engineering Units). Valid = 0.0 to maximum positive float. Default is 0.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PSet_SP	REAL	Not Visible	Not Required	Input	Program setting of total quantity to deliver in Engineering Units. Valid = 0.0 to maximum positive float. Default is 0.0.
PSet_TolHi	REAL	Not Visible	Not Required	Input	Program setting of high tolerance limit (ok amount > SP). Valid = 0.0 to maximum positive float. Default is 0.0.
PSet_TolLo	REAL	Not Visible	Not Required	Input	Program setting of low tolerance limit (ok amount < SP). Valid = 0.0 to maximum positive float. Default is 0.0.
XCmd_Bump	BOOL	Not Visible	Not Required	Input	External command to bump delivery for under tolerance.The instruction clears this operand automatically. Default is false.
XCmd_ClearTot	BOOL	Not Visible	Not Required	Input	External command to clear totalizer Quantity. The instruction clears this operand automatically. Default is false.
XCmd_StartTot	BOOL	Not Visible	Not Required	Input	External command to start totalizer.The instruction clears this operand automatically. Default is false.
XCmd_StopTot	BOOL	Not Visible	Not Required	Input	External command to stop totalizer.The instruction clears this operand automatically. Default is false.
XCmd_StartFlow	BOOL	Not Visible	Not Required	Input	External command to start deliver.The instruction clears this operand automatically. Default is false.
XCmd_StopFlow	BOOL	Not Visible	Not Required	Input	External command to stop/pause delivery.The instruction clears this operand automatically. Default is false.
XCmd_CheckTol	BOOL	Not Visible	Not Required	Input	External command to check tolerances.The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External command to clear shed latches and cleared alarms. Default is false.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External command to Acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XSet_DribbleQty	REAL	Not Visible	Not Required	Input	External setting of quantity to dribble (Engineering Units). Default is 0.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
XSet_Preact	REAL	Not Visible	Not Required	Input	External setting of amount before total to stop flow (Engineering Units). Default is 0.0.
XSet_SP	REAL	Not Visible	Not Required	Input	External setting of total quantity to deliver (Engineering Units). Default is 0.0.
XSet_TolHi	REAL	Not Visible	Not Required	Input	External setting of high tolerance limit (ok amount > SP). Default is 0.0.
XSet_TolLo	REAL	Not Visible	Not Required	Input	External setting of low tolerance limit (ok amount < SP). Default is 0.0.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter
Out_ClearTot	BOOL	Visible	Not Required	Output	1 = Reset external totalizer (e.g. onboard flowmeter).
Out_RunTot	BOOL	Visible	Not Required	Output	1 = Run External totalizer (e.g. onboard flowmeter).
Out_RunFlow	BOOL	Visible	Not Required	Output	1 = Deliver at full (fast) flow.
Out_StopFlow	BOOL	Visible	Not Required	Output	1 = Stop delivery equipment.
Out_DribbleFlow	BOOL	Visible	Not Required	Output	1 = Deliver at dribble (slow) flow.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status. 0 = None, .10 = Operator lock, .11 = Operator unlock, .12 = Program lock, .13 = Program unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override lock, .20 = Has External, .21 = Has Operator, .22 = Has Program, .30 = Not ready.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. use Inp_InitializeReq to reinitialize.
Sts_CalcQty	BOOL	Not Visible	Not Required	Output	1 = Integrate Inp_RatePV to get quantity, 0 = Use Inp_QtyPV.
Sts_CalcRate	BOOL	Not Visible	Not Required	Output	1 = Differentiate Inp_QtyPV to get rate, 0 = Use Inp_RatePV.
Sts_Cleared	BOOL	Visible	Not Required	Output	1 = Totalizer clear completed.
Sts_TotRunning	BOOL	Visible	Not Required	Output	1 = Totalizer running, 0 = Totalizer stopped.
Sts_FlowStarting	BOOL	Not Visible	Not Required	Output	1 = Flow is starting (Out_Run is on, feedback not showing run).

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_FlowRunning	BOOL	Visible	Not Required	Output	1 = Flow is running (Out_Run is on, feedback shows running).
Sts_FlowStopping	BOOL	Not Visible	Not Required	Output	1 = Flow is stopping (Out_Stop is on, feedback not showing stopped).
Sts_FlowStopped	BOOL	Visible	Not Required	Output	1 = Flow is stopped (Out_Stop is on, feedback shows stopped).
Sts_DribbleStarting	BOOL	Not Visible	Not Required	Output	1 = Dribble starting (Out_Dribble is on, feedback not showing dribble).
Sts_FlowDribble	BOOL	Visible	Not Required	Output	1 = Flow is dribbling (Out_Dribble is on, feedback shows dribble).
Sts_Bumping	BOOL	Not Visible	Not Required	Output	1 = Bump flow is active.
Sts_InTol	BOOL	Not Visible	Not Required	Output	1 = Total delivered is within tolerances.
Sts_Complete	BOOL	Visible	Not Required	Output	1 = Total delivered > (setpoint - preact).
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction treats the device as virtual. The instruction acts as normal but the output is kept de-energized (Out_(x)=0). 0 = The instruction operates the device normally. Sts_Virtual is a copy of Inp_Virtual.
Sts_bSrc	INT	Not Visible	Not Required	Output	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed out of service (rung false), Sts_bSrc.2: Maintenance out of service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_eCmd	SINT	Not Visible	Not Required	Output	Dosing command 0 = None, 1 = Clear Totalizer, 2 = Start Totalizer, 3 = Start Flow, 4 = Start Dribble, 5 = Bump, 6 = Stop Flow, 7 = Stop Totalizer.
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Equipment feedback 0 = None/transition, 1 = Flow stopped, 2 = Flow running, 3 = Flow dribbling, 4 = Virtualized.
Sts_eFault	SINT	Not Visible	Not Required	Output	Object fault status 0 = None, 1 = Error: bad configuration, 15 = Equipment fault.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotify	SINT	Not Visible	Not Required	Output	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyEqpFault	SINT	Not Visible	Not Required	Output	Equipment Fault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyHiFlowRate	SINT	Not Visible	Not Required	Output	Hi Flow Rate alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyLoFlowRate	SINT	Not Visible	Not Required	Output	Lo Flow Rate alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyOverTol	SINT	Not Visible	Not Required	Output	Over Tolerance alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyUnderTol	SINT	Not Visible	Not Required	Output	Under Tolerance alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyZeroFault	SINT	Not Visible	Not Required	Output	Zero Fault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eSrc	INT	Not Visible	Not Required	Output	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.
Sts_eSts	SINT	Not Visible	Not Required	Output	Dosing status: 0 = Powerup/reset/unknown, 1 = Stopped, 2 = Totalizer running, 3 = Flow running, 4 = Dribble running, 5 = Bump flow, 6 = Flow starting, 7 = Dribble starting, 8 = Flow stopping, 15 = Out of service.
Sts_UnackAlmCount	SINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Dosing available for control by automation (Program).
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = A Maintenance bypass is active, display icon.
Sts_NotRdy	BOOL	Not Visible	Not Required	Output	1 = Object not ready, see detail bits for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Object not ready: configuration error.
Sts_NrdyEqpFault	BOOL	Not Visible	Not Required	Output	1 = Object not ready: External equipment fault (fault or shed requires reset).
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Object not ready: out of service.
Sts_NrdyPVBad	BOOL	Not Visible	Not Required	Output	1 = Object not ready: PV bad quality or comm failure.
Sts_Err	BOOL	Not Visible	Not Required	Output	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in config: alarm minimum on time, shelf time, severity.
Sts_ErrBumpTime	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_BumpTime invalid.
Sts_ErrClearPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_ClearPulseTime invalid.
Sts_ErrCountsPerEU	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_CountsPerEU invalid.
Sts_ErrCutoff	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_Cutoff invalid.
Sts_ErrEUQtyMult	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_EUQtyMult invalid.
Sts_ErrFaultTime	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_FaultTime invalid.
Sts_ErrRateTime	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_RateTime invalid.
Sts_ErrLim	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_MaxQty invalid.
Sts_ErrRollover	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_Rollover invalid.
Sts_ErrRateFiltTimeConst	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_RateFiltTimeConst invalid.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_ErrSettleTime	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_SettleTime invalid.
Sts_ErrVirtual	BOOL	Not Visible	Not Required	Output	1 = Error: Cfg_VirtualDribbleRate or Cfg_VirtualRate invalid.
Sts_Hand	BOOL	Not Visible	Not Required	Output	1 = Hand is selected (supersedes Out of Service, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	Not Visible	Not Required	Output	1 = Out of service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	Not Visible	Not Required	Output	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	Not Visible	Not Required	Output	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	Not Visible	Not Required	Output	1 = External is selected (supersedes Program and Operator).
Sts_Prog	BOOL	Not Visible	Not Required	Output	1 = Program is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program is selected and locked.
Sts_Oper	BOOL	Not Visible	Not Required	Output	1 = Operator is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator is selected and locked.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Not Visible	Not Required	Output	Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selection equals the normal (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Maintenance acquire command received this scan.
Sts_Alm	BOOL	Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = One or more alarms shelved, disabled or suppressed.
Sts_EqpFault	BOOL	Not Visible	Not Required	Output	1 = Equipment fault detected.
Sts_HiFlowRate	BOOL	Not Visible	Not Required	Output	1 = Hi flow rate alarm.
Sts_LoFlowRate	BOOL	Not Visible	Not Required	Output	1 = Lo flow rate alarm.
Sts_LoRateCutoff	BOOL	Not Visible	Not Required	Output	1 = Rate PV below low rate cutoff, flow assumed to be zero.
Sts_OverTol	BOOL	Not Visible	Not Required	Output	1 = Delivery out of tolerance high.
Sts_UnderTol	BOOL	Not Visible	Not Required	Output	1 = Delivery out of tolerance low.
Sts_ZeroFault	BOOL	Not Visible	Not Required	Output	1 = Totalizer did not clear or unexpected flow.
Sts_QtyBad	BOOL	Not Visible	Not Required	Output	1 = Quantity value is Bad (PV Fail).
Sts_QtyUncertain	BOOL	Not Visible	Not Required	Output	1 = Quantity value is Uncertain.
Sts_RateBad	BOOL	Not Visible	Not Required	Output	1 = Rate value is Bad (PV Fail).
Sts_RateUncertain	BOOL	Not Visible	Not Required	Output	1 = Rate value is Uncertain.
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Not Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
Val_SP	REAL	Visible	Not Required	Output	Amount to be delivered (setpoint) (Engineering Units). Valid = 0.0 to maximum positive float.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Val_Remain	REAL	Visible	Not Required	Output	Amount yet to deliver to reach setpoint (Engineering Units). Valid = 0.0 to maximum positive float.
Val_PercentComplete	REAL	Visible	Not Required	Output	Percent complete (for progress bar on HMI) Valid = 0.0 to 100.0.
Val_QtyPV	REAL	Not Visible	Not Required	Output	Quantity from weigh scale or flowmeter (Engineering Units or pulse count). Valid = 0.0 to maximum positive float.
Val_Qty	REAL	Visible	Not Required	Output	Quantity actually delivered (totalizer output) (Engineering Units). Valid = 0.0 to maximum positive float.
Val_RatePV	REAL	Not Visible	Not Required	Output	Flow rate from flowmeter (Engineering Units/time, see Cfg_RateTime). Valid = 0.0 to maximum positive float.
Val_Rate	REAL	Visible	Not Required	Output	Current delivery rate (Engineering Units/time) (see Cfg_RateTime). Valid = 0.0 to maximum positive float.
Val_DribbleQty	REAL	Visible	Not Required	Output	Amount to be delivered at slow rate (Engineering Units). Valid = 0.0 to maximum positive float.
Val_Preact	REAL	Visible	Not Required	Output	Amount before setpoit at which flow will be stopped (Engineering Units). Valid = 0.0 to maximum positive float.
Val_TolHi	REAL	Visible	Not Required	Output	Allowed amount > Setpoint (Engineering Units). Valid = 0.0 to maximum positive float.
Val_TolLo	REAL	Visible	Not Required	Output	Allowed amount < Setpoint (Engineering Units). Valid = 0.0 to maximum positive float.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object owner ID (0 = Not owned).
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable HMI button.

Private Input Members	**Data Type**	**Description**
CmdSrc	P_COMMAND_SOURCE	Control / Command Source Selection.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select in service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select out of service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance command to select Physical device operation (not virtualized) Default is false.
MCmd_Rel	BOOL	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance command to select Virtual (virtualized) device operation Default is false.
OCmd_Bump	BOOL	Operator command to bump delivery for under tolerance. The instruction clears this operand automatically. Default is false.
OCmd_CheckTol	BOOL	Operator command to check tolerances. The instruction clears this operand automatically. Default is false.
OCmd_ClearTot	BOOL	Operator command to clear totalizer quantity. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms requiring reset. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_StartFlow	BOOL	Operator command to start deliver. The instruction clears this operand automatically. Default is false.
OCmd_StartTot	BOOL	Operator command to start totalizer. The instruction clears this operand automatically. Default is false.
OCmd_StopFlow	BOOL	Operator command to stop/pause delivery. The instruction clears this operand automatically. Default is false.
OCmd_StopTot	BOOL	Operator command to stop totalizer. The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.
OSet_DribbleQty	REAL	Operator setting of quantity to dribble (Engineering Units). Valid = 0.0 to maximum positive float. Default is 0.0.
OSet_Preact	REAL	Operator setting of amount before total to stop flow (Engineering Units). Valid = 0.0 to maximum positive float. Default is 0.0.
OSet_SP	REAL	Operator setting of total quantity to deliver (Engineering Units). Valid = 0.0 to maximum positive float. Default is 0.0.
OSet_TolHi	REAL	Operator setting of high tolerance limit (ok amount > SP). Valid = 0.0 to maximum positive float. Default is 0.0.
OSet_TolLo	REAL	Operator setting of low tolerance limit (ok amount < SP). Valid = 0.0 to maximum positive float. Default is 0.0.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index Default is 0.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.

Private Output Members	Data Type	Description
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_Bump	BOOL	1 = Ready for OCmd_Bump (enables HMI button).
ORdy_CheckTol	BOOL	1 = Ready for OCmd_CheckTol (enables HMI button).
ORdy_ClearTot	BOOL	1 = Ready for OCmd_ClearTot (enables HMI button).
ORdy_DribblePreact	BOOL	1 = Ready for OSet_DribblePreact (enables HMI entry field).
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables HMI button).
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll (enables HMI button).
ORdy_SP	BOOL	1 = Ready for OSet_SP (enables HMI entry field).
ORdy_StartFlow	BOOL	1 = Ready for OCmd_StartFlow (enables HMI button).
ORdy_StartTot	BOOL	1 = Ready for OCmd_StartTot (enables HMI button).
ORdy_StopFlow	BOOL	1 = Ready for OCmd_StopFlow (enables HMI button).
ORdy_StopTot	BOOL	1 = Ready for OCmd_StopTot (enables HMI button).
ORdy_Tol	BOOL	1 = Ready for OSet_Tol (enables HMI entry field).
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
Sts_ErrInpSrc	BOOL	1 = Error: Input Source invalid. No Rate or Quantity PV connected

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_QtyPV	REAL	Visible	Required	InOut	Quantity from weigh scale or flowmeter (Engineering Units or pulse count). Valid = 0.0 to maximum positive float.
Inp_RatePV	REAL	Visible	Required	InOut	Flow rate from flowmeter (Engineering Units/time, see Cfg_RateTime). Valid = 0.0 to 2147483.0 seconds.
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component

BUS_OBJ Structure

Use InOut parameters to link the Instruction to external tags that contain necessary data for the instruction to operate. These external tags must be of the data type shown, or NULL. All public InOut parameters for this instruction may be NULL.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements

Members	Data Type	Description
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_EqpFault	Alm_EqpFault	Equipment fault. Raised when the Inp_CtrldEqpFault input is true, or when equipment feedback signals fail to track the commanded state of the equipment within the configured time. If an equipment fault is configured as a shed fault, the flow is stopped and a reset is required to resume flow.
Sts_HiFlowRate	Alm_HiFlowRate	Above high limit. Raised when the flow rate exceeds the High Flow Rate limit, for a configured period of time.
Sts_LoFlowRate	Alm_LoFlowRate	Below low limit. Raised when the flow rate falls short of the Low Flow Rate limit, for a configured period of time.
Sts_OverTol	Alm_OverTol	Above over tolerance limit. Raised when the tolerance check is performed and the quantity delivered exceeds the setpoint by more than the High Tolerance threshold.
Sts_UnderTol	Alm_UnderTol	Below under tolerance limit. Raised when the tolerance check is performed and the quantity delivered falls short of the setpoint by more than the Low Tolerance threshold.
Sts_ZeroFault	Alm_ZeroFault	Zero fault. Raised if the dosing fails to clear, or if the dosing is cleared but then registers flow before flow is commanded to start.

Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format:

Tag.@Alarms.AlarmName.AlarmElement

PDOSETag.@Alarms.AlarmName.AlarmElement

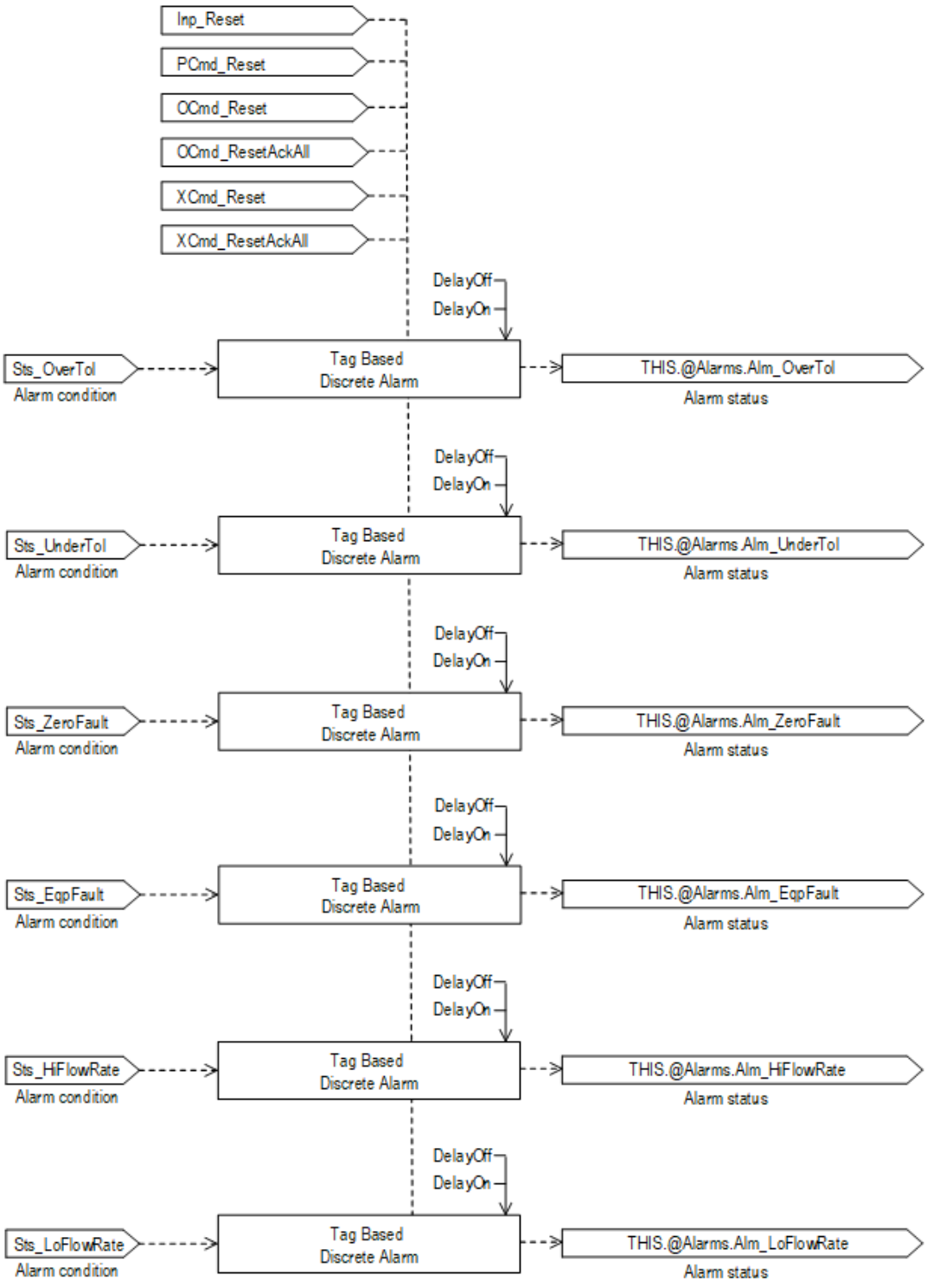
The PDOSE instruction handles alarm conditions described by these use cases and conditions:

- Equipment fault - raised when the Inp_CtrldEqpFault input is true, or when equipment feedback signals fail to track the commanded state of the equipment within the configured time. If an equipment fault is configured as a shed fault, the flow is stopped and a reset is required to resume flow.
- Above high limit - raised when the flow rate exceeds the High Flow Rate limit, for a configured period of time.
- Below low limit - raised when the flow rate falls short of the Low Flow Rate limit, for a configured period of time.
- Above over tolerance limit - raised when the tolerance check is performed and the quantity delivered exceeds the setpoint by more than the High Tolerance threshold.

- Below under tolerance limit - raised when the tolerance check is performed and the quantity delivered falls short of the setpoint by more than the Low Tolerance threshold.
- Zero fault - raised if the dosing fails to clear, or if the dosing is cleared but then registers flow before flow is commanded to start.

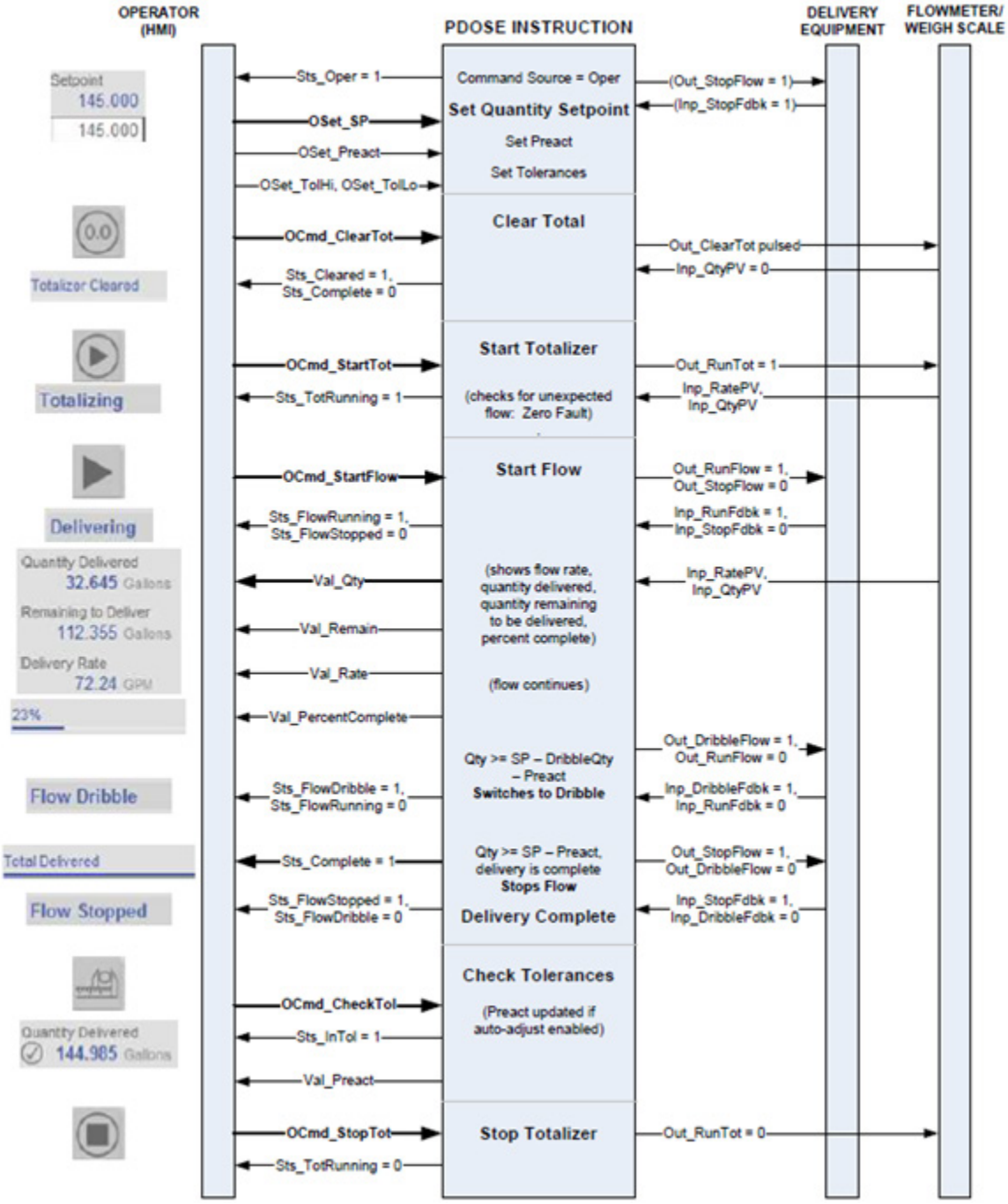
There are Program, Operator, and External commands that enable the Reset and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the

same time. This diagram shows how the commands interact with the PDOSE instruction.



Operation

This diagram illustrates the functionality of the PDOSE instruction:



Operator command request confirmation

The PDOSE instruction enables these operator command requests:

- OCmd _Bump
- OCmd_CheckTol
- OCmd_ClearTot

- OCmd_StartFlow
- OCmd_StartTot
- OCmd_StopFlow
- OCmd_StopTot
- OSet_DribbleQty
- OSet_Preact
- OSet_SP
- OSet_TolHi
- OSetTolLo

Enforced security might require the request to be confirmed or canceled before the selected command executes. The instruction checks the security rules inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd=0 no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd=1 the instruction waits for confirmation OCmd_CmdCnfrm=1 and/or cancellation For Cfg_CnfrmReqd=2 or 3 eSignature is needed before the confirmation and cancellation is enabled.

Virtualization

Use virtualization for instruction testing and operator training. Use PCmd_Virtual or MCmd_Virtual to enable virtualization. After finishing virtualization, use PCmd_Physical or MCmd_Physical to return to normal (physical device) operation.

When Virtualization is active, the instruction treats the object as virtual. The instruction acts as normal but the output is kept de-energized. The instruction can emulate a rate at which to dribble and a rate at which to deliver when running in virtual.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FactoryTalk View) and for Logix Designer configuration dialog. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up

- Instruction name
- Area name
- URL link
- More Information
- Input Quantity PV
- Input Rate PV
- Quantity PV Units
- Rate PV Units
- Alarm Equipment Fault Text
- Alarm Hi Flow Rate Text
- Alarm Lo Flow Rate Text
- Alarm Over Tolerance Text
- Alarm Under Tolerance Text
- Alarm Zero Fault Text

Command Source

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled and has no owner.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (e.g. field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enabling control sources as Configuration

The individual control sources may be enabled or disabled by the user. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. This means that all commands are automatically cleared when the instruction executes and processes them.

Changing Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Prog is disabled, the destination of the OCmd_Prog command is directed to the ProgLocked state instead of the Prog state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Monitor the PDOSE Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. Any commands that are received before first scan are discarded.
Instruction first run	Any commands received before first scan are discarded.
Rung-condition-in is false	Any commands that are received are discarded. All alarms are cleared. The command source is reported as Program Out of Service. The displayed rate is zeroed. Outputs to controlled equipment are de-energized. Other output parameters (values and status) hold their last value.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false. Any commands that are received before first scan are discarded.
Instruction first run	Any commands received before first scan are discarded.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. Latched alarms are reset. Command source selection processing proceeds except that Program and Operators commands are ignored and cleared and all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

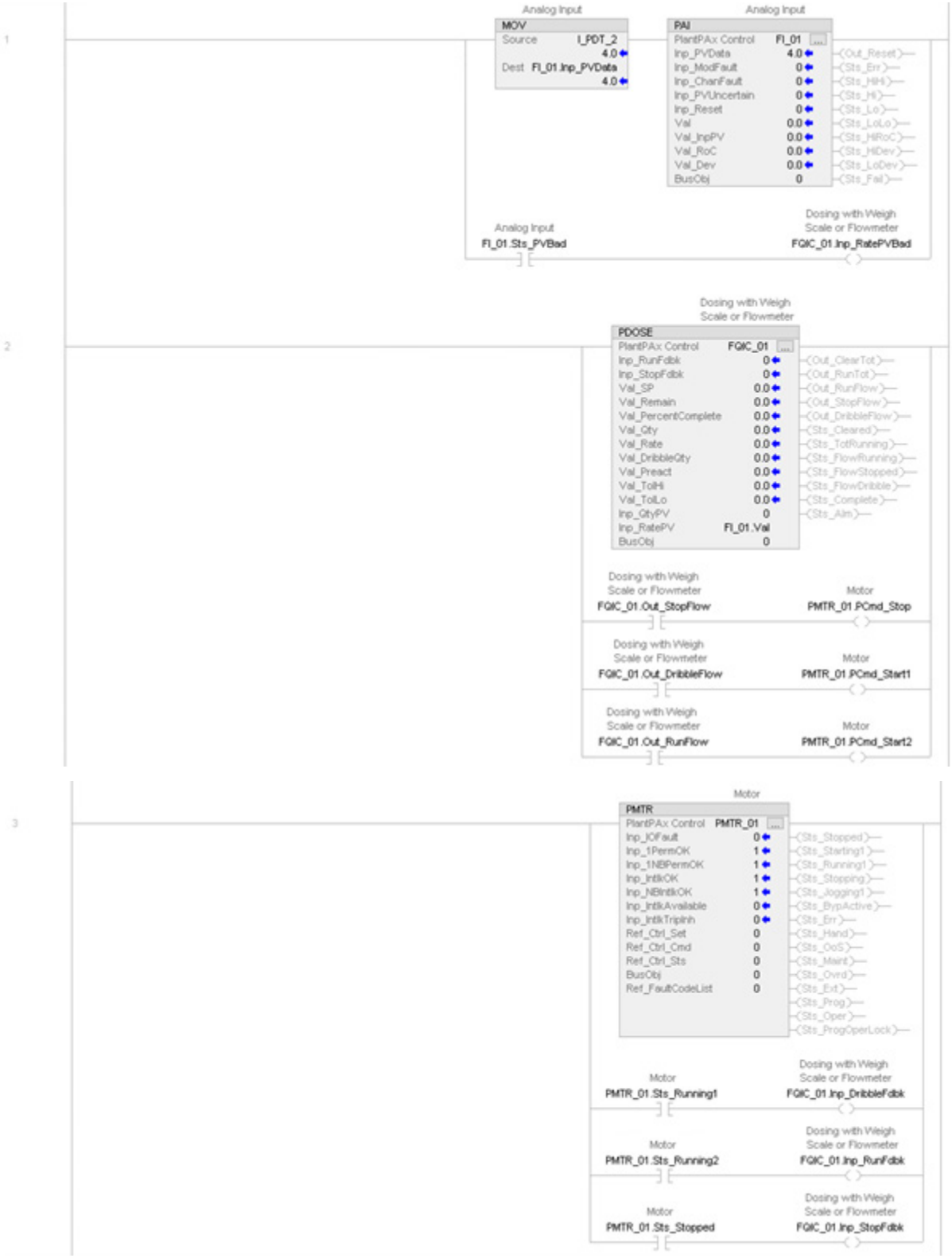
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.

Condition/State	Action Taken
Postscan	See Postscan in the Function Block Diagram table.

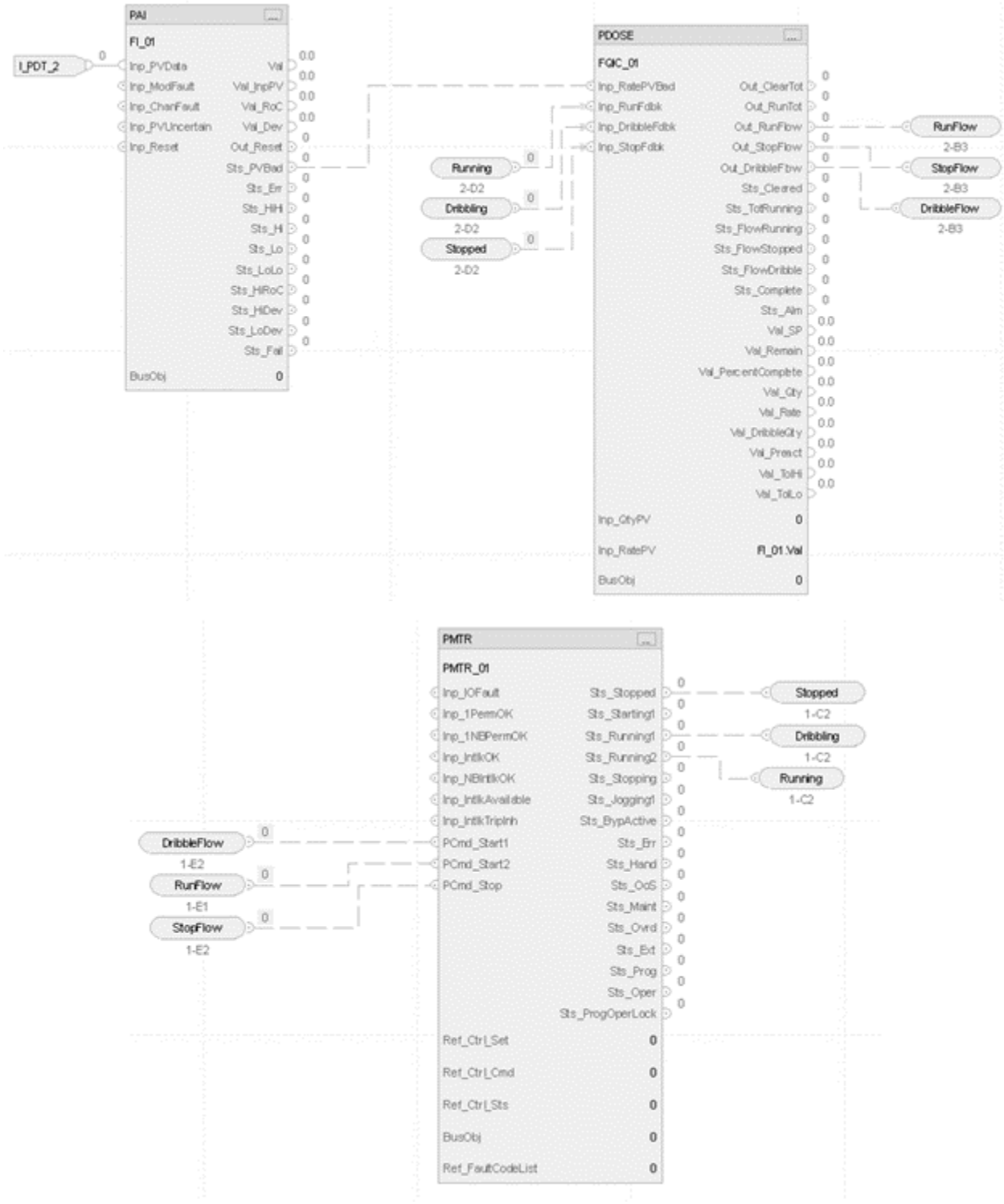
Example

This example shows an input from a flowmeter (I_PDT_2) connected to a P_AInAdv block for the conversion of differential pressure to flow. The PV representing flow (Val from P_AInAdv) is the input for the PDOSE instruction (Inp_RatePV). The Sts_PVBad for the flow value is also used by the PDOSE instruction (Inp_RatePVBad). The outputs of the PDOSE instruction (Out_RunFlow and Out_DribbleFLow) are used as inputs to a two-speed motor (P_Motor2Spd). RunFlow and DribbleFlow are connected to PCmd_RunFast and PCmd_RunSlow, respectively. The status outputs of the motor for stopped (Sts_Stopped), running slow (Sts_RunningSlow), and running fast (Sts_RunningFast) are connected back to the PDOSE block as inputs Inp_StopFdbk, Inp_DribbleFdbk, and Inp_RunFdbk.

Ladder Diagram



Function Block Diagram



Structured Text

```
FI_01.Inp_PVData:=I_PDT_2;

PAI(FI_01,0);
```

```
FQIC_01.Inp_RatePVBad:=FI_01.Sts_PVBad;
PDOSE(FQIC_01, 0, FI_01.Val, 0);
PMTR_01.PCmd_Start1:=FQIC_01.Out_DribbleFlow;
PMTR_01.PCmd_Start2:=FQIC_01.Out_RunFlow;
PMTR_01.PCmd_Stop:=FQIC_01.Out_StopFlow;
PMTR(PMTR_01, 0, 0, 0, 0, 0);
FQIC_01.Inp_DribbleFdbk:=PMTR_01.Sts_Running1;
FQIC_01.Inp_RunFdbk:=PMTR_01.Sts_Running2;
FQIC_01.Inp_StopFdbk:=PMTR_01.Sts_Stopped;
```

Process Analog Fanout (PFO)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

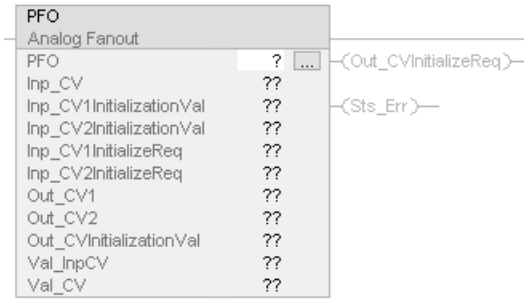
The Analog Fanout (PFO) instruction sends one primary analog output signal to multiple secondary users or devices. Each secondary output has configurable gain, offset, and clamping limits.

The Process Analog Fanout (PFO) instruction:

- Receives an input-controlled variable (CV) from a primary PID loop or analog output.
- Applies rate-of-change limiting to the input signal.
- Calculates outputs for up to eight secondary devices. Each secondary output has its own ratio (slope) and offset (intercept) from the rate-limited primary input. The ratios and offsets are configured values.
- Applies minimum and maximum clamping limits to each output (secondary) CV.
- Provides for initialization of each of its secondary CV outputs based on a request bit and a requested value from the secondary. When a particular output CV comes out of initialization, it is ramped from the initialization value to its calculated value using a configured takeup rate.
- Provides for initialization of the primary when all secondaries have requested initialization. The initialization value sent to the primary can be a fixed, configured value or a calculated value based on the CV1 (Output 1) requested initialization value, accounting for the CV1 gain and offset. Thus CV1 is the priority output.

Available Languages

Ladder Diagram



Function Block Diagram

Structured Text

PFO (PFO tag);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_ANALOG_FANOUT	tag	Data structure required for proper operation of instruction.

P_ANALOG_FANOUT Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_CV	REAL	Input CV from upstream block's output (engineering units). Default is 0.0.
Inp_CV1InitializationVal	REAL	Initialization value from downstream block #1 (Out 1 engineering units). Valid = any float. Default is 0.0.
Inp_CV2InitializationVal	REAL	Initialization value from downstream block #2 (Out 2 engineering units). Valid = any float. Default is 0.0.
Inp_CV3InitializationVal	REAL	Initialization value from downstream block #3 (Out 3 engineering units). Valid = any float. Default is 0.0.
Inp_CV4InitializationVal	REAL	Initialization value from downstream block #4 (Out 4 engineering units). Valid = any float. Default is 0.0.
Inp_CV5InitializationVal	REAL	Initialization value from downstream block #5 (Out 5 engineering units). Valid = any float. Default is 0.0.
Inp_CV6InitializationVal	REAL	Initialization value from downstream block #6 (Out 6 engineering units). Valid = any float. Default is 0.0.
Inp_CV7InitializationVal	REAL	Initialization value from downstream block #7 (Out 7 engineering units). Valid = any float. Default is 0.0.
Inp_CV8InitializationVal	REAL	Initialization value from downstream block #8 (Out 8 engineering units). Valid = any float. Default is 0.0.
Inp_CV1InitializeReq	BOOL	Initialize request from downstream block #1 1 = set Out_CV1 to Inp_CV1InitializationVal. Default is false.
Inp_CV2InitializeReq	BOOL	Initialize request from downstream block #2 1 = set Out_CV2 to Inp_CV2InitializationVal. Default is false.
Inp_CV3InitializeReq	BOOL	Initialize request from downstream block #3 1 = set Out_CV3 to Inp_CV3InitializationVal. Default is false.
Inp_CV4InitializeReq	BOOL	Initialize request from downstream block #4 1 = set Out_CV4 to Inp_CV4InitializationVal. Default is false.
Inp_CV5InitializeReq	BOOL	Initialize request from downstream block #5 1 = set Out_CV5 to Inp_CV5InitializationVal. Default is false.
Inp_CV6InitializeReq	BOOL	Initialize request from downstream block #6 1 = set Out_CV6 to Inp_CV6InitializationVal. Default is false.
Inp_CV7InitializeReq	BOOL	Initialize request from downstream block #7 1 = set Out_CV7 to Inp_CV7InitializationVal. Default is false.
Inp_CV8InitializeReq	BOOL	Initialize request from downstream block #8 1 = set Out_CV8 to Inp_CV8InitializationVal. Default is false.
Cfg_HasCV2	BOOL	1 = Output CV #2 is connected. Default is true.
Cfg_HasCV3	BOOL	1 = Output CV #3 is connected. Default is false.

Public Input Members	Data Type	Description
Cfg_HasCV4	BOOL	1 = Output CV #4 is connected. Default is false.
Cfg_HasCV5	BOOL	1 = Output CV #5 is connected. Default is false.
Cfg_HasCV6	BOOL	1 = Output CV #6 is connected. Default is false.
Cfg_HasCV7	BOOL	1 = Output CV #7 is connected. Default is false.
Cfg_HasCV8	BOOL	1 = Output CV #8 is connected. Default is false.
Cfg_FixedInitializationVal	REAL	Fixed initialization value (in Inp_CV engineering units), used if Cfg_UseFixedInitialization = 1. Valid = any float. Default is 0.0.
Cfg_UseFixedInitialization	BOOL	1 = Use Cfg_UseFixedInitialization to initialize primary, 0 = use Inp_CV1InitializationVal. Default is false.
Cfg_ShedHold	BOOL	1 = Hold output on Inf / NaN input, 0 = copy Inf / NaN through. Default is false.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more information is available. Default is false.
Cfg_HasCVNav	BOOL	1 = Tells HMI to enable navigation to a connected CV object. Default is false.
Cfg_HasNav	SINT	Set bits indicate which navigation buttons are enabled .0=CV1, .1=CV2, … .7=CV8. Default is 0.
Cfg_CVEUMin	REAL	Input CV minimum in engineering units (for scaling). Valid = any float not equal to Cfg_CVEUMax. Default is 0.0.
Cfg_CVEUMax	REAL	Input CV maximum in engineering units (for scaling). Valid = any float not equal to Cfg_CVEUMin. Default is 100.0.
Cfg_CVLoLim	REAL	Input CV minimum, Lo clamp (Inp engineering units). Valid = any float less than or equal to Cfg_CVHiLim. Default is 0.0.
Cfg_CVHiLim	REAL	Input CV maximum, Hi clamp (Inp engineering units). Valid = any float greater than or equal to Cfg_CVLoLim. Default is 100.0.
Cfg_CVRoCLim	REAL	Program setting for input CV rate of change limit, increase or decrease (Inp engineering units/seconds). Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_CV1Ratio	REAL	Configuration for CV1 ratio (m in mx+b). Valid = any float. Default is -2.0.
Cfg_CV1Offset	REAL	Configuration for CV1 offset (b in mx+b). Valid = any float. Default is 100.0.
Cfg_CV1LoLim	REAL	Output CV #1 minimum in engineering units (for clamping). Valid = any float, Cfg_CV1LoLim<= Cfg_CV1HiLim. Default is 0.0.
Cfg_CV1HiLim	REAL	Output CV #1 maximum in engineering units (for clamping). Valid = any float, Cfg_CV1HiLim>= Cfg_CV1LoLim. Default is 100.0.
Cfg_CV1TakeupRate	REAL	Rate (engineering units/seconds) at which CV1 bias is taken up after Inp_CV1InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.

Public Input Members	Data Type	Description
Cfg_CV2Ratio	REAL	Configuration for CV2 ratio (m in mx+b). Valid = any float. Default is 2.0.
Cfg_CV2Offset	REAL	Configuration for CV2 offset (b in mx+b). Valid = any float. Default is -100.0.
Cfg_CV2LoLim	REAL	Output CV #2 minimum in engineering units (for clamping). Valid = any float, Cfg_CV2LoLim<= Cfg_CV2HiLim. Default is 0.0.
Cfg_CV2HiLim	REAL	Output CV #2 maximum in engineering units (for clamping). Valid = any float, Cfg_CV2HiLim>= Cfg_CV2LoLim. Default is 100.0.
Cfg_CV2TakeupRate	REAL	Rate (engineering units/seconds) at which CV2 bias is taken up after Inp_CV2InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CV3Ratio	REAL	Configuration for CV3 ratio (m in mx+b). Valid = any float. Default is 1.0.
Cfg_CV3Offset	REAL	Configuration for CV3 offset (b in mx+b). Valid = any float. Default is 0.0.
Cfg_CV3LoLim	REAL	Output CV #3 minimum in engineering units (for clamping). Valid = any float, Cfg_CV3LoLim<= Cfg_CV3HiLim. Default is 0.0.
Cfg_CV3HiLim	REAL	Output CV #3 maximum in engineering units (for clamping). Valid = any float, Cfg_CV3HiLim>= Cfg_CV3LoLim. Default is 100.0.
Cfg_CV3TakeupRate	REAL	Rate (engineering units/seconds) at which CV3 bias is taken up after Inp_CV3InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CV4Ratio	REAL	Configuration for CV4 ratio (m in mx+b). Valid = any float. Default is 1.0.
Cfg_CV4Offset	REAL	Configuration for CV4 offset (b in mx+b). Valid = any float. Default is 0.0.
Cfg_CV4LoLim	REAL	Output CV #4 minimum in engineering units (for clamping). Valid = any float, Cfg_CV4LoLim<= Cfg_CV4HiLim. Default is 0.0.
Cfg_CV4HiLim	REAL	Output CV #4 maximum in engineering units (for clamping). Valid = any float, Cfg_CV4HiLim>= Cfg_CV4LoLim. Default is 100.0.
Cfg_CV4TakeupRate	REAL	Rate (engineering units/seconds) at which CV4 bias is taken up after Inp_CV4InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CV5Ratio	REAL	Configuration for CV5 ratio (m in mx+b). Valid = any float. Default is 1.0.
Cfg_CV5Offset	REAL	Configuration for CV5 offset (b in mx+b). Valid = any float. Default is 0.0.
Cfg_CV5LoLim	REAL	Output CV #5 minimum in engineering units (for clamping). Valid = any float, Cfg_CV5LoLim<= Cfg_CV5HiLim. Default is 0.0.
Cfg_CV5HiLim	REAL	Output CV #5 maximum in engineering units (for clamping). Valid = any float, Cfg_CV5HiLim>= Cfg_CV5LoLim. Default is 100.0.
Cfg_CV5TakeupRate	REAL	Rate (engineering units/seconds) at which CV5 bias is taken up after Inp_CV5InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.

Public Input Members	Data Type	Description
Cfg_CV6Ratio	REAL	Configuration for CV6 ratio (m in mx+b). Valid = any float. Default is 1.0.
Cfg_CV6Offset	REAL	Configuration for CV6 offset (b in mx+b). Valid = any float. Default is 0.0.
Cfg_CV6LoLim	REAL	Output CV #6 minimum in engineering units (for clamping). Valid = any float, Cfg_CV6LoLim<= Cfg_CV6HiLim. Default is 0.0.
Cfg_CV6HiLim	REAL	Output CV #6 maximum in engineering units (for clamping). Valid = any float, Cfg_CV6HiLim>= Cfg_CV6LoLim. Default is 100.0.
Cfg_CV6TakeupRate	REAL	Rate (engineering units/seconds) at which CV6 bias is taken up after Inp_CV6InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CV7Ratio	REAL	Configuration for CV7 ratio (m in mx+b). Valid = any float. Default is 1.0.
Cfg_CV7Offset	REAL	Configuration for CV7 offset (b in mx+b). Valid = any float. Default is 0.0.
Cfg_CV7LoLim	REAL	Output CV #7 minimum in engineering units (for clamping). Valid = any float, Cfg_CV7LoLim<= Cfg_CV7HiLim. Default is 0.0.
Cfg_CV7HiLim	REAL	Output CV #7 maximum in engineering units (for clamping). Valid = any float, Cfg_CV7HiLim>= Cfg_CV7LoLim. Default is 100.0.
Cfg_CV7TakeupRate	REAL	Rate (engineering units/seconds) at which CV7 bias is taken up after Inp_CV7InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CV8Ratio	REAL	Configuration for CV8 ratio (m in mx+b). Valid = any float. Default is 1.0.
Cfg_CV8Offset	REAL	Configuration for CV8 offset (b in mx+b). Valid = any float. Default is 0.0.
Cfg_CV8LoLim	REAL	Output CV #8 minimum in engineering units (for clamping). Valid = any float, Cfg_CV8LoLim<= Cfg_CV8HiLim. Default is 0.0.
Cfg_CV8HiLim	REAL	Output CV #8 maximum in engineering units (for clamping). Valid = any float, Cfg_CV8HiLim>= Cfg_CV8LoLim. Default is 100.0.
Cfg_CV8TakeupRate	REAL	Rate (engineering units/seconds) at which CV8 bias is taken up after Inp_CV8InitializeReq = 0. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_CVDecPlcs	SINT	Number of decimal places for CV display (0...6). Default is 0.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable output. This output state always reflects EnableIn input state.
Out_CV1	REAL	Output to downstream block #1 (out 1 engineering units).
Out_CV2	REAL	Output to downstream block #2 (out 2 engineering units).
Out_CV3	REAL	Output to downstream block #3 (out 3 engineering units).
Out_CV4	REAL	Output to downstream block #4 (out 4 engineering units).
Out_CV5	REAL	Output to downstream block #5 (out 5 engineering units).
Out_CV6	REAL	Output to downstream block #6 (out 6 engineering units).

Public Output Members	Data Type	Description
Out_CV7	REAL	Output to downstream block #7 (out 7 engineering units).
Out_CV8	REAL	Output to downstream block #8 (out 8 engineering units).
Out_CVInitializationVal	REAL	Initialization value to upstream block (Inp_CV engineering units).
Out_CVInitializeReq	BOOL	Initialization request to upstream block (1 = initialize).
Val_CVEUMin	REAL	Minimum of scaled range = minimum (Cfg_CVEUMin, Cfg_CVEUMax).
Val_CVEUMax	REAL	Maximum of scaled range = maximum (Cfg_CVEUMin, Cfg_CVEUMax).
Val_InpCV	REAL	Value of Inp_CV, not clamped or ramped (engineering units).
Val_CV	REAL	Value of CV after clamping and ramping (engineering units).
Val_MinCVIn1	REAL	Input CV at minimum of CV1 output (for HMI use).
Val_MaxCVIn1	REAL	Input CV at maximum of CV1 output (for HMI use).
Val_MinCVIn2	REAL	Input CV at minimum of CV2 output (for HMI use).
Val_MaxCVIn2	REAL	Input CV at maximum of CV2 output (for HMI use).
Val_MinCVIn3	REAL	Input CV at minimum of CV3 output (for HMI use).
Val_MaxCVIn3	REAL	Input CV at maximum of CV3 output (for HMI use).
Val_MinCVIn4	REAL	Input CV at minimum of CV4 output (for HMI use).
Val_MaxCVIn4	REAL	Input CV at maximum of CV4 output (for HMI use).
Val_MinCVIn5	REAL	Input CV at minimum of CV5 output (for HMI use).
Val_MaxCVIn5	REAL	Input CV at maximum of CV5 output (for HMI use).
Val_MinCVIn6	REAL	Input CV at minimum of CV6 output (for HMI use).
Val_MaxCVIn6	REAL	Input CV at maximum of CV6 output (for HMI use).
Val_MinCVIn7	REAL	Input CV at minimum of CV7 output (for HMI use).
Val_MaxCVIn7	REAL	Input CV at maximum of CV7 output (for HMI use).
Val_MinCVIn8	REAL	Input CV at minimum of CV8 output (for HMI use).
Val_MaxCVIn8	REAL	Input CV at maximum of CV8 output (for HMI use).
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_CVInfNaN	BOOL	1 = Inp_CV is infinite or not a number (1.$, 1.#NaN).
Sts_CVLimited	BOOL	1 = Output CV clamped at configured maximum/minimum.
Sts_CV1InitializationInfNaN	BOOL	1 = Inp_CV1InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV1Limited	BOOL	1 = Output CV1 clamped at configured maximum/minimum.
Sts_CV2InitializationInfNaN	BOOL	1 = Inp_CV2InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV2Limited	BOOL	1 = Output CV2 clamped at configured maximum/minimum.
Sts_CV3InitializationInfNaN	BOOL	1 = Inp_CV3InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV3Limited	BOOL	1 = Output CV3 clamped at configured maximum/minimum.
Sts_CV4InitializationInfNaN	BOOL	1 = Inp_CV4InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV4Limited	BOOL	1 = Output CV4 clamped at configured maximum/minimum.
Sts_CV5InitializationInfNaN	BOOL	1 = Inp_CV5InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV5Limited	BOOL	1 = Output CV5 clamped at configured maximum/minimum.
Sts_CV6InitializationInfNaN	BOOL	1 = Inp_CV6InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV6Limited	BOOL	1 = Output CV6 clamped at configured maximum/minimum.
Sts_CV7InitializationInfNaN	BOOL	1 = Inp_CV7InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV7Limited	BOOL	1 = Output CV7 clamped at configured maximum/minimum.
Sts_CV8InitializationInfNaN	BOOL	1 = Inp_CV8InitializationVal is infinite or not a number (1.$, 1.#NaN).
Sts_CV8Limited	BOOL	1 = Output CV8 clamped at configured maximum/minimum.
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrLim	BOOL	1 = Error in configuration: CV clamp limits crossed (maximum<minimum).
Sts_ErrEU	BOOL	1 = Error in configuration: CV scale EU minimum = maximum.
Sts_ErrCV1Lim	BOOL	1 = Error in configuration: CV1 clamp limits crossed (maximum<minimum).
Sts_ErrCV2Lim	BOOL	1 = Error in configuration: CV2 clamp limits crossed (maximum<minimum).
Sts_ErrCV3Lim	BOOL	1 = Error in configuration: CV3 clamp limits crossed (maximum<minimum).
Sts_ErrCV4Lim	BOOL	1 = Error in configuration: CV4 clamp limits crossed (maximum<minimum).

Public Output Members	Data Type	Description
Sts_ErrCV5Lim	BOOL	1 = Error in configuration: CV5 clamp limits crossed (maximum<minimum).
Sts_ErrCV6Lim	BOOL	1 = Error in configuration: CV6 clamp limits crossed (maximum<minimum).
Sts_ErrCV7Lim	BOOL	1 = Error in configuration: CV7 clamp limits crossed (maximum<minimum).
Sts_ErrCV8Lim	BOOL	1 = Error in configuration: CV8 clamp limits crossed (maximum<minimum).

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- CV Units
- Output CV Label CV1
- Output CV Label CV2
- Output CV Label CV3
- Output CV Label CV4
- Output CV Label CV5
- Output CV Label CV6
- Output CV Label CV7
- Output CV Label CV8
- CV1 EU (Engineering Units)
- CV2 EU
- CV3 EU
- CV4 EU
- CV5 EU
- CV6 EU
- CV7 EU
- CV8 EU
- Allow Navigation Object Tag Name Input CV
- Allow Navigation Object Tag Name CV1
- Allow Navigation Object Tag Name CV2
- Allow Navigation Object Tag Name CV3

- Allow Navigation Object Tag Name CV4
- Allow Navigation Object Tag Name CV5
- Allow Navigation Object Tag Name CV6
- Allow Navigation Object Tag Name CV7
- Allow Navigation Object Tag Name CV8

Monitor the PFO Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

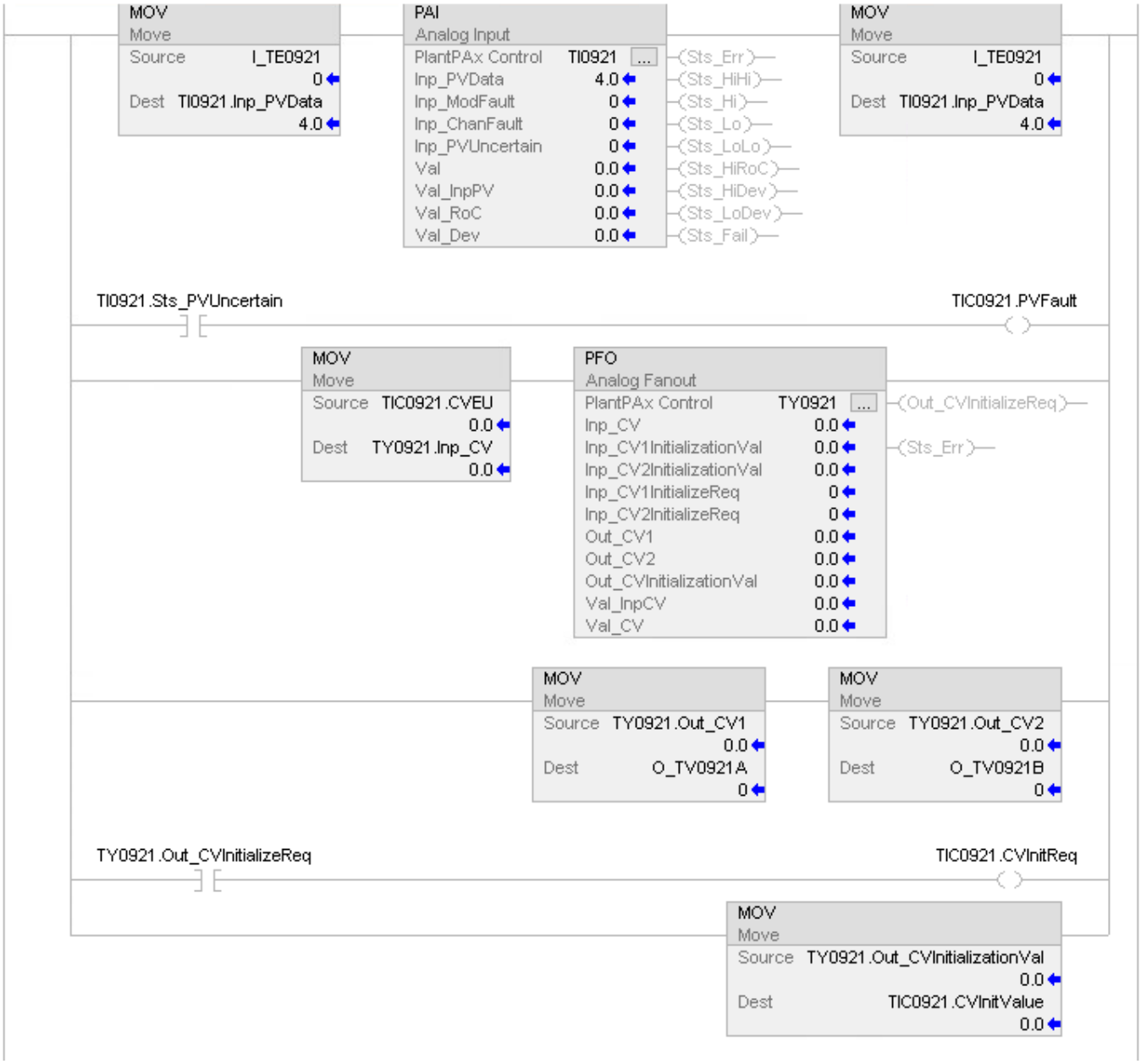
In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

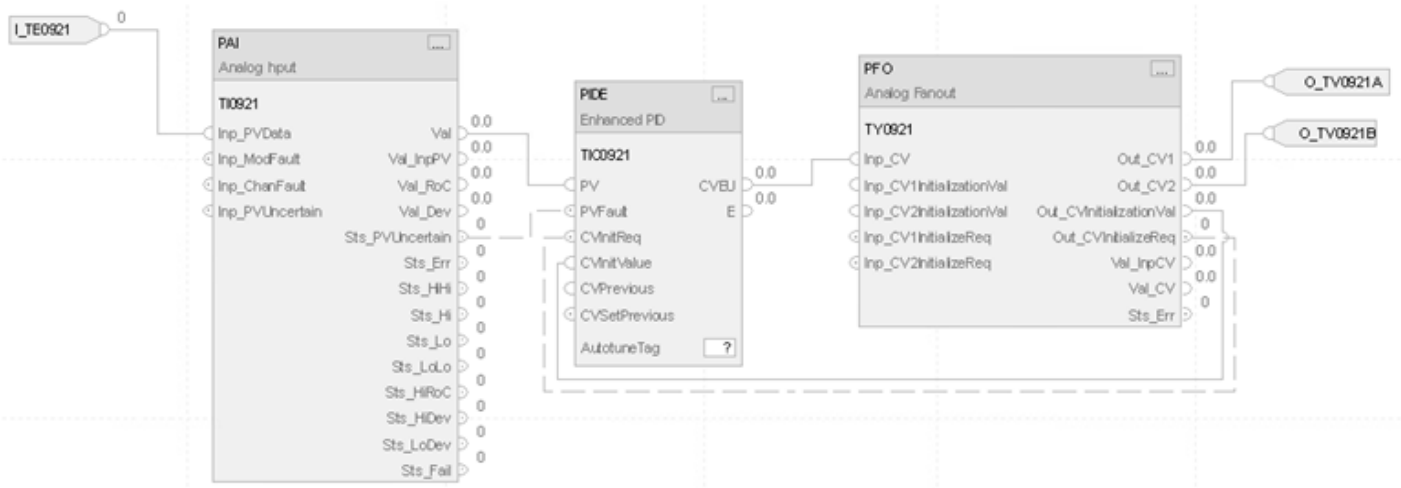
Example

In this example, the PFO instruction to implement a split range PID control strategy to control temperature of a processing vessel. The heat exchanger to the vessel jacket is fed by a steam valve to heat or a glycol valve to cool. One PID controls the temperature. The example assumes that the relative process gain between each valve and the temperature is the same.

Ladder Diagram



Function Block Diagram



Structured Text

TI0921.Inp_PVData:=I_TE0921;

PAI(TI0921);

TIC0921.PV:= TI0921.Val;

TIC0921.PVFault:=TI0921.Sts_PVUncertain;

PIDE(TIC0921);

TY0921.Inp_CV:=TIC0921.CVEU;

TIC0921.CVInitReq:=TY0921.Out_CVInitializeReq;

TIC0921.CVInitValue:=TY0921.Out_CVInitializationVal;

O_TV0921A:=TY0921.Out_CV1;

O_TV0921B:=TY0921.Out_CV2;

PFO(TY0921);

Process High or Low Selector (PHLS)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

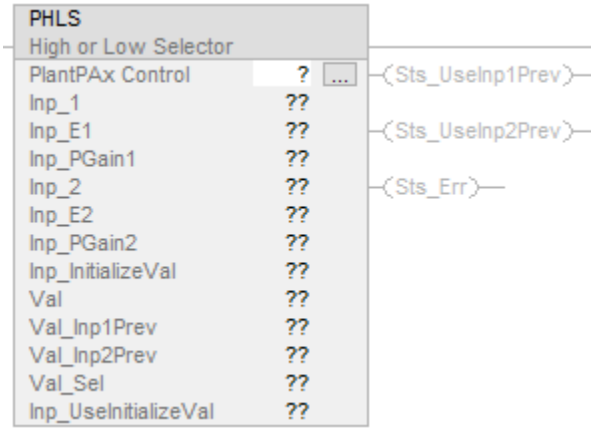
The Process High or Low Selector (PHLS) instruction selects the highest or the lowest of up to six incoming controlled variables (CVs). The instruction sends the selected CV as output and flags the unselected CVs to track the selected CV.

To avoid problems with ever-decreasing or ever-increasing output, offset the tracking value by an amount equal to the upstream PID/PIDE gain time's error value.

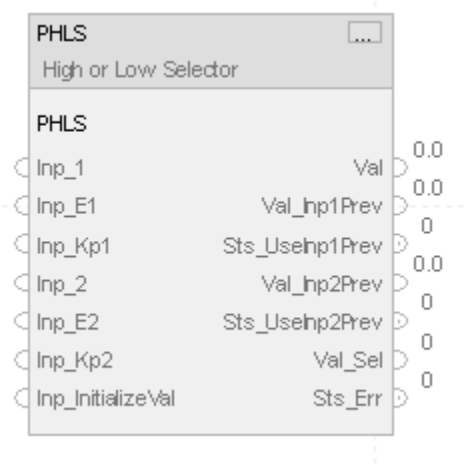
Use the PHLS instruction to implement an Override Select control strategy. An Override Select strategy provides control of a primary process variable while allowing other process variables to override the output on the final control element, which avoids exceeding constraints.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PHLS(PHLSTag);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PHLS	P_HIGH_LOW_SELECT	tag	PHLS structure

PHLS Input Structure

Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung-condition-in. Default is true.
Inp_InitializeReq	BOOL	Use this request when reinitializing. Default is false.
Inp_1	REAL	Input #1. Valid = Any float. Default is 0.0.
Inp_E1	REAL	Loop error from primary #1 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_PGain1	REAL	Proportional gain from primary #1 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_2	REAL	Input #2. Valid = Any float. Default is 0.0.
Inp_E2	REAL	Loop error from primary #2 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_PGain2	REAL	Proportional gain from primary #2 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_3	REAL	Input #3. Valid = Any float. Default is 0.0.
Inp_E3	REAL	Loop error from primary #3 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_PGain3	REAL	Proportional gain from primary #3 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_4	REAL	Input #4. Valid = Any float. Default is 0.0.
Inp_E4	REAL	Loop error from primary #4 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_PGain4	REAL	Proportional gain from primary #4 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_5	REAL	Input #5. Valid = Any float. Default is 0.0.

Input Members	Data Type	Description
Inp_E5	REAL	Loop error from primary #5 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_PGain5	REAL	Proportional gain from primary #5 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_6	REAL	Input #6. Valid = Any float. Default is 0.0.
Inp_E6	REAL	Loop error from primary #6 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_PGain6	REAL	Proportional gain from primary #6 (optional, used for offset calculation). Valid = Any float. Default is 0.0.
Inp_InitializeVal	REAL	Initialization value from downstream block. Valid = Any float. Default is 0.0.
Cfg_HiLoSel	BOOL	Selection: 1 = High - Select, 0 = Low - Select. Default is false.
Cfg_HasInp1	BOOL	1 = Inp_1 is connected. Default is true.
Cfg_UseInp1	BOOL	1 = Inp_1 is included in selection (for maintenance use). Default is true.
Cfg_Inp1Offset	BOOL	1 = Offset Inp_1, Offset = Val +/- Inp_PGain1 * Inp_E1. Default is false.
Cfg_HasInp2	BOOL	1 = Inp_2 is connected. Default is true.
Cfg_UseInp2	BOOL	1 = Inp_2 is included in selection (for maintenance use). Default is true.
Cfg_Inp2Offset	BOOL	1 = Offset Inp_2, Offset = Val +/- Inp_PGain2 * Inp_E2. Default is false.
Cfg_HasInp3	BOOL	1 = Inp_3 is connected. Default is false.
Cfg_UseInp3	BOOL	1 = Inp_3 is included in selection (for maintenance use). Default is false.
Cfg_Inp3Offset	BOOL	1 = Offset Inp_3, Offset = Val +/- Inp_PGain3 * Inp_E3. Default is false.
Cfg_HasInp4	BOOL	1 = Inp_4 is connected. Default is false.
Cfg_UseInp4	BOOL	1 = Inp_4 is included in selection (for maintenance use). Default is false.
Cfg_Inp4Offset	BOOL	1 = Offset Inp_4, Offset = Val +/- Inp_PGain4 * Inp_E4. Default is false.
Cfg_HasInp5	BOOL	1 = Inp_5 is connected. Default is false.
Cfg_UseInp5	BOOL	1 = Inp_5 is included in selection (for maintenance use). Default is false.
Cfg_Inp5Offset	BOOL	1 = Offset Inp_5, Offset = Val +/- Inp_PGain5 * Inp_E5. Default is false.
Cfg_HasInp6	BOOL	1 = Inp_6 is connected. Default is false.
Cfg_UseInp6	BOOL	1 = Inp_6 is included in selection (for maintenance use). Default is false.
Cfg_Inp6Offset	BOOL	1 = Offset Inp_6, Offset = Val +/- Inp_PGain6 * Inp_E6. Default is false.

Input Members	Data Type	Description
Cfg_DecPlcs	SINT	Number of decimal places for display. Valid = 0 to 6. Default is 2.
Cfg_HasOutNav	BOOL	1 = Tells HMI to enable navigation to a connected output object. Default is false.
Cfg_HasNav	SINT	Set bits to indicate which navigation buttons are enabled: Cfg_HasNav.0 = Inp_1, Cfg_HasNav.1 = Inp_2, Cfg_HasNav.2 = Inp_3, Cfg_HasNav.3 = Inp_4, Cfg_HasNav.4 = Inp_5, Cfg_HasNav.5 = Inp_6. Default is 0.
Cfg_OutLoLim	REAL	Output low clamping limit. Valid = any float less than or equal to Cfg_OutHiLim. Default is 0.0.
Cfg_OutHiLim	REAL	Output high clamping limit. Valid = any float greater than or equal to Cfg_OutLoLim. Default is 100.0.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.

Output Members	Data Type	Description
EnableOut	BOOL	This output state always reflects EnableIn input state.
Val	REAL	Output value (selected minimum or maximum) for downstream block.
Val_Inp1Prev	REAL	Previous (Feedback) input value for primary #1.
Sts_UseInp1Prev	BOOL	Request for primary #1 to use feedback Val_Inp1Prev.
Val_Inp2Prev	REAL	Previous (Feedback) input value for primary #2.
Sts_UseInp2Prev	BOOL	Request for primary #2 to use feedback Val_Inp2Prev.
Val_Inp3Prev	REAL	Previous (Feedback) input value for primary #3.
Sts_UseInp3Prev	BOOL	Request for primary #3 to use feedback Val_Inp3Prev.
Val_Inp4Prev	REAL	Previous (Feedback) input value for primary #4.
Sts_UseInp4Prev	BOOL	Request for primary #4 to use feedback Val_Inp4Prev.
Val_Inp5Prev	REAL	Previous (Feedback) input value for primary #5.
Sts_UseInp5Prev	BOOL	Request for primary #5 to use feedback Val_Inp5Prev.
Val_Inp6Prev	REAL	Previous (Feedback) input value for primary #6.
Sts_UseInp6Prev	BOOL	Request for primary #6 to use feedback Val_Inp6Prev.
Val_Out	REAL	Output value (selected minimum or maximum Input) for HMI.
Val_Sel	DINT	Selected input: 0 = Minimum, 1 = Inp_1, 2 = Inp_2, 3 = Inp_3, 4 = Inp_4, 5 = Inp_5, 6 = Inp_6, 7 = Maximum, 8 = Inp_InitializeVal.
Sts_Initialized	BOOL	1 = Instruction is initialized.
Sts_MaintByp	BOOL	1 = A maintenance bypass is active (display icon on HMI)
Sts_Err	BOOL	1 = Error in configuration, check Sts_ErrHas or Sts_ErrLim for reason.

Output Members	Data Type	Description
Sts_ErrHas	BOOL	1 = Configuration error: must HAVE at least one Input.
Sts_ErrLim	BOOL	1 = Configuration error: Cfg_OutHiLim less than or equal to Cfg_OutLoLim.

Alarms

The PHLS instruction does not have any alarms.

Virtualization

The PHLS instruction does not have any virtualization capability.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description - Description of PHLS Tag
- Label for graphic symbol – Label metadata of PHLS tag
- Display Library for HMI Faceplate call-up - Library metadata of PHLS tag
- Instruction name - Instruction metadata of PHLS tag
- Area name - Area metadata of PHLS tag
- URL link - URL metadata of PHLS tag
- Output Units – Engineering Unit metadata of PHLS member Val_Out tag
- Input Label Input1 – Description metadata of PHLS member Inp_1 tag
- Input Label Input2 – Description metadata of PHLS member Inp_2 tag
- Input Label Input3 – Description metadata of PHLS member Inp_3 tag
- Input Label Input4 – Description metadata of PHLS member Inp_4 tag
- Input Label Input5 – Description metadata of PHLS member Inp_5 tag
- Input Label Input6 – Description metadata of PHLS member Inp_6 tag
- Input1 EU – Engineering Unit metadata of PHLS member Inp_1 tag
- Input2 EU – Engineering Unit metadata of PHLS member Inp_2 tag
- Input3 EU – Engineering Unit metadata of PHLS member Inp_3 tag
- Input4 EU – Engineering Unit metadata of PHLS member Inp_4 tag
- Input5 EU – Engineering Unit metadata of PHLS member Inp_5 tag
- Input6 EU – Engineering Unit metadata of PHLS member Inp_6 tag
- Allow Navigation Object Tag Name Output - Navigation metadata of PHLS member Out_Val tag
- Allow Navigation Object Tag Name Input1 - Navigation metadata of PHLS member Inp_1 tag

- Allow Navigation Object Tag Name Input2 - Navigation metadata of PHLS member Inp_2 tag
- Allow Navigation Object Tag Name Input3 - Navigation metadata of PHLS member Inp_3 tag
- Allow Navigation Object Tag Name Input4 - Navigation metadata of PHLS member Inp_4 tag
- Allow Navigation Object Tag Name Input5 - Navigation metadata of PHLS member Inp_5 tag
- Allow Navigation Object Tag Name Input6 - Navigation metadata of PHLS member Inp_6 tag

Monitor the PHLS Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	All configurations has input, use input and input offset are cleared. All previous feedback, loop error, gain values is set to 0. The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false. All configurations has input, use input and input offset are cleared. All previous feedback, loop error, gain values is set to 0. The instruction is kept in its last state.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	All configurations has input, use input and input offset are cleared. All previous feedback, loop error, gain values is set to 0. The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. The instruction will hold its last selection state and output value (Val) is not updated (holds last value).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

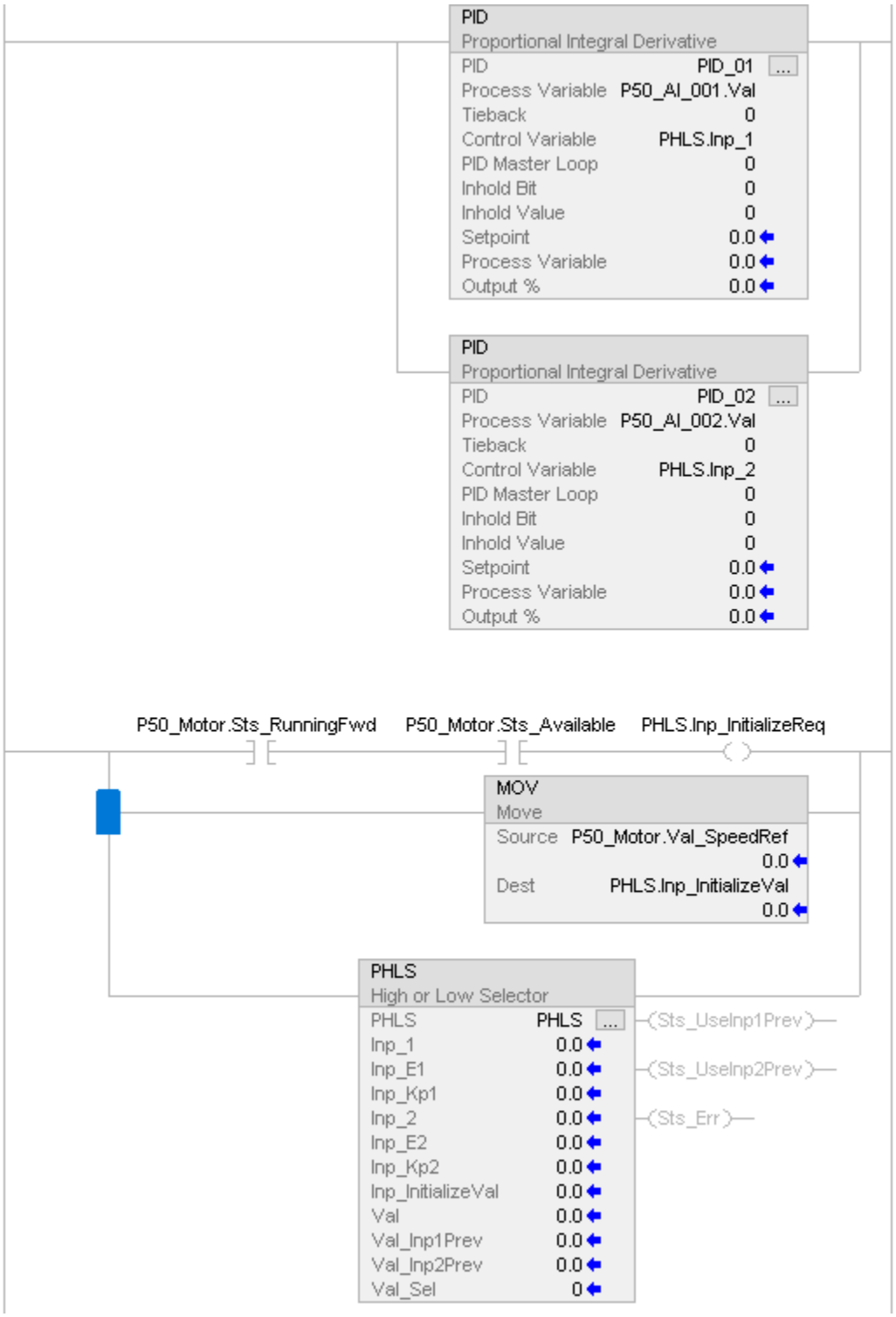
Example

The example uses the PHLS instruction to implements part of the pressure control strategy. In this case, two PIDE instructions are used as inputs. The PIDE instructions are for Suction Pressure Override Control and Discharge Pressure Control. The PIDE output values CV (CV to final control element) and E (Loop Error) are used as inputs to the PHLS instruction.

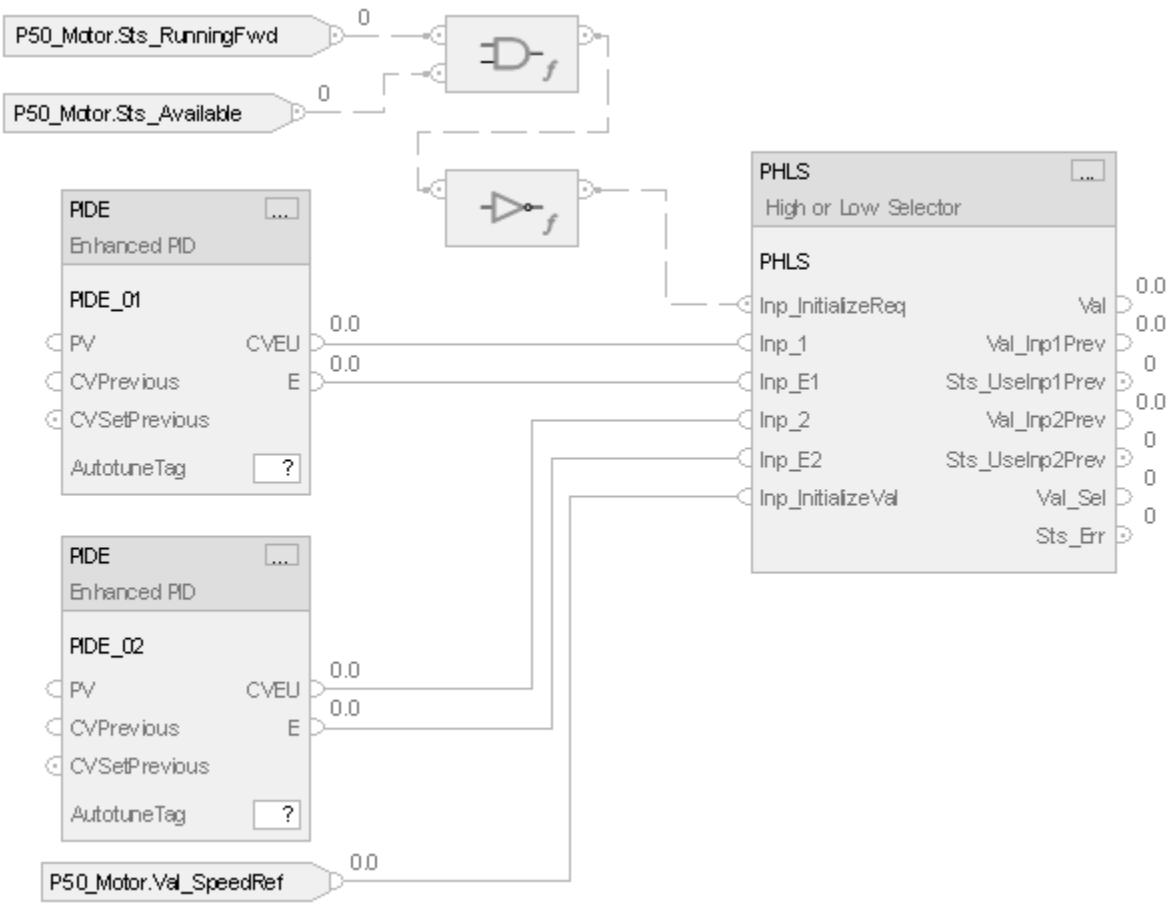
This example also shows PHLS inputs for Initial Value (Inp_InitializeVal) and initialization request (Inp_InitializeReq). In this case, the Initial Value is taken from the speed reference to the pump motor drive. The Initialization

In this example the instruction initialization request flag is set based on the motor's running and availability status.

Ladder Diagram



Function Block Diagram



Structured text

PIDE(PIDE_01);

PIDE(PIDE_02);

PHLS.Inp_1 := PIDE_01.CV;

PHLS.Inp_E1 := PIDE_01.E;

PHLS.Inp_2 := PIDE_02.CV;

PHLS.Inp_E2 := PIDE_02.E;

PHLS.Inp_InitializeVal := P50_Motor.Val_SpeedRef;

PHLS.Inp_InitializeReq := NOT(P50_Motor.Sts_RunningFwd AND P50_Motor.Sts_Available);

PHLS(PHLS);

Process Interlocks (PINTLK)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

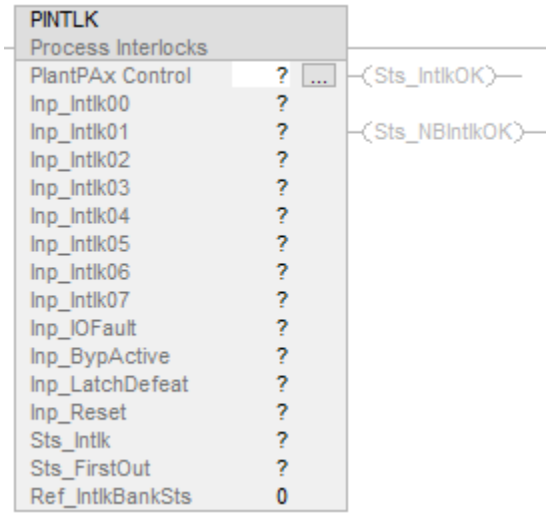
The Process Interlocks (PINTLK) instruction collects, or sums up, the interlock conditions that stop or de-energize a running or energized piece of equipment. This instruction can also help prevent equipment from starting or being energized. Interlocks are always evaluated to de-energize equipment. For permissive conditions that must be made to start the equipment, but are ignored once the equipment is running, use the Process Permissive (PPERM) instruction.

The PINTLK instruction provides:

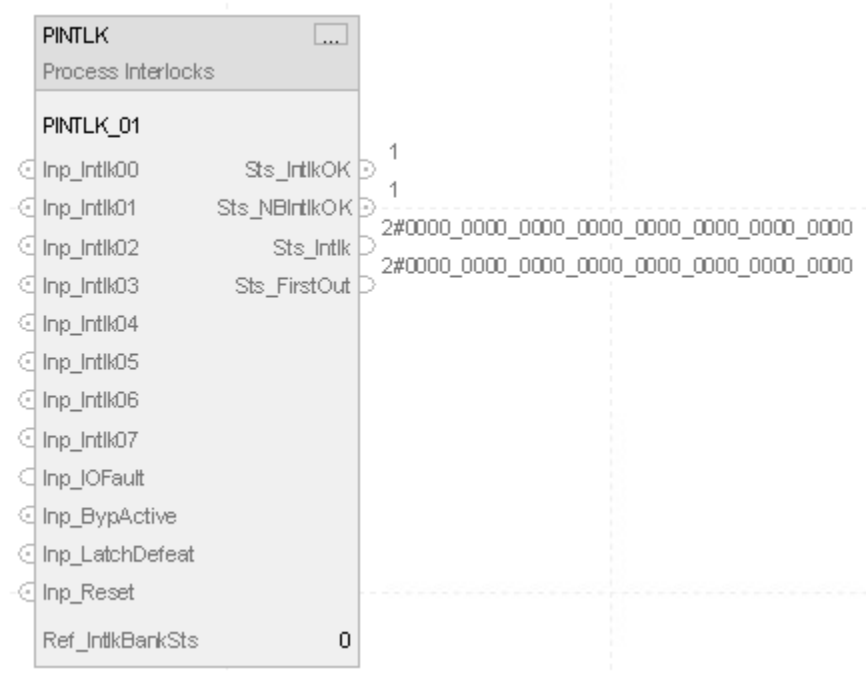
- Interlock input OK check: Each input is compared with its configured OK state. If the input is not in its OK state, it raises an interlock condition unless bypassed.
- Interlock Condition Latching: If the input is configured as latched, the interlock condition is latched until reset, unless the latch defeat input is true. If the input is not configured as latched, the interlock condition clears when the input returns to it's OK state.
- Interlock Bypass: If the input is configured as able to be bypassed and interlocks are bypassed, the input does not raise an interlock condition, even if it is not in its OK state. If the input is configured as not able to be bypassed or if interlocks are not bypassed, the input raises an interlock condition. Engineering configures which interlocks are allowed to be bypassed. Maintenance chooses which inputs to bypass from the interlocks that are allowed by engineering.
- First Out: If no interlock conditions are raised (OK to run), the first interlock condition to be raised is marked as the first out. If multiple interlock conditions are raised in the same scan, they are all marked as first out.
- Latch Defeat: A latch defeat function reduces the number of operator actions that are required to start equipment. The latch defeat input is set when the equipment is not running. When the latch defeat input is true, the latched configuration of inputs is ignored, and all interlock conditions clear when their corresponding inputs are in their OK states. This action saves the operator from having to reset before starting the equipment. When the equipment starts, the latch defeat input is turned off. Then, if an interlock condition configured as latched shuts down the equipment, it remains latched until reset.
- Summary Status: Summarizes its 32 interlock input conditions into two primary status bits:
  - Sts_IntlkOK. Indicates all interlock conditions are clear and ready to run.
  - Sts_NBIntlkOK. Indicates all interlock conditions that cannot be bypassed are clear and ready to run if interlocks are bypassed.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PINTLK (PINTLK tag, Ref_IntlkBankSts);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx	P_INTERLOCK	tag	Data structure required for proper operation of instruction.
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	tag	Reference interlock bank status.

P_INTERLOCK Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_Intlk00	BOOL	Interlock condition 00, de-energize if not in configured OK state. Default is false.
Inp_Intlk01	BOOL	Interlock condition 01, de-energize if not in configured OK state. Default is false.
Inp_Intlk02	BOOL	Interlock condition 02, de-energize if not in configured OK state. Default is false.
Inp_Intlk03	BOOL	Interlock condition 03, de-energize if not in configured OK state. Default is false.
Inp_Intlk04	BOOL	Interlock condition 04, de-energize if not in configured OK state. Default is false.
Inp_Intlk05	BOOL	Interlock condition 05, de-energize if not in configured OK state. Default is false.
Inp_Intlk06	BOOL	Interlock condition 06, de-energize if not in configured OK state. Default is false.
Inp_Intlk07	BOOL	Interlock condition 07, de-energize if not in configured OK state. Default is false.
Inp_Intlk08	BOOL	Interlock condition 08, de-energize if not in configured OK state. Default is false.
Inp_Intlk09	BOOL	Interlock condition 09, de-energize if not in configured OK state. Default is false.
Inp_Intlk10	BOOL	Interlock condition 10, de-energize if not in configured OK state. Default is false.

Public Input Members	Data Type	Description
Inp_Intlk11	BOOL	Interlock condition 11, de-energize if not in configured OK state. Default is false.
Inp_Intlk12	BOOL	Interlock condition 12, de-energize if not in configured OK state. Default is false.
Inp_Intlk13	BOOL	Interlock condition 13, de-energize if not in configured OK state. Default is false.
Inp_Intlk14	BOOL	Interlock condition 14, de-energize if not in configured OK state. Default is false.
Inp_Intlk15	BOOL	Interlock condition 15, de-energize if not in configured OK state. Default is false.
Inp_Intlk16	BOOL	Interlock condition 16 , de-energize if not in configured OK state. Default is false.
Inp_Intlk17	BOOL	Interlock condition 17 , de-energize if not in configured OK state. Default is false.
Inp_Intlk18	BOOL	Interlock condition 18 , de-energize if not in configured OK state. Default is false.
Inp_Intlk19	BOOL	Interlock condition 19 , de-energize if not in configured OK state. Default is false.
Inp_Intlk20	BOOL	Interlock condition 20 , de-energize if not in configured OK state. Default is false.
Inp_Intlk21	BOOL	Interlock condition 21 , de-energize if not in configured OK state. Default is false.
Inp_Intlk22	BOOL	Interlock condition 22 , de-energize if not in configured OK state. Default is false.
Inp_Intlk23	BOOL	Interlock condition 23 , de-energize if not in configured OK state. Default is false.
Inp_Intlk24	BOOL	Interlock condition 24 , de-energize if not in configured OK state. Default is false.
Inp_Intlk25	BOOL	Interlock condition 25 , de-energize if not in configured OK state. Default is false.
Inp_Intlk26	BOOL	Interlock condition 26 , de-energize if not in configured OK state. Default is false.
Inp_Intlk27	BOOL	Interlock condition 27 , de-energize if not in configured OK state. Default is false.
Inp_Intlk28	BOOL	Interlock condition 28 , de-energize if not in configured OK state. Default is false.
Inp_Intlk29	BOOL	Interlock condition 29 , de-energize if not in configured OK state. Default is false.
Inp_Intlk30	BOOL	Interlock condition 30 , de-energize if not in configured OK state. Default is false.
Inp_Intlk31	BOOL	Interlock condition 31 , de-energize if not in configured OK state. Default is false.
Inp_IOFault	DINT	Input register for IO fault logic. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Inp_Available	BOOL	External availability input. Default is true.
Inp_BypActive	BOOL	1 = Interlock Bypassing is currently active. Default is false.
Inp_LatchDefeat	BOOL	Set when device is de-energized. 1 =Do not latch inputs, even if configured for latching, and do not capture a new first-out. Default is false.
Inp_Reset	BOOL	1 = Reset latched interlocks and first-out. Default is false.

Public Input Members	Data Type	Description
Cfg_OKState	DINT	Bits indicate which state (0 or 1) of each input is OK to run. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Cfg_Latched	DINT	Set bits indicate which conditions are latched (sealed in). Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Cfg_StopOnly	DINT	Set bits indicate which conditions cause a stop - do not trip. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Cfg_Bypassable	DINT	Set bits indicate which conditions can be bypassed. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Cfg_HasNav	DINT	Set bits indicate which navigation buttons are enabled. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Cfg_eType00	SINT	Enumerated type of Interlock 0. Default is 6.
Cfg_eType01	SINT	Enumerated type of Interlock 1. Default is 6.
Cfg_eType02	SINT	Enumerated type of Interlock 2. Default is 6.
Cfg_eType03	SINT	Enumerated type of Interlock 3. Default is 6.
Cfg_eType04	SINT	Enumerated type of Interlock 4. Default is 6.
Cfg_eType05	SINT	Enumerated type of Interlock 5. Default is 6.
Cfg_eType06	SINT	Enumerated type of Interlock 6. Default is 6.
Cfg_eType07	SINT	Enumerated type of Interlock 7. Default is 6.
Cfg_eType08	SINT	Enumerated type of Interlock 8. Default is 6.
Cfg_eType09	SINT	Enumerated type of Interlock 9. Default is 6.
Cfg_eType10	SINT	Enumerated type of Interlock 10. Default is 6.
Cfg_eType11	SINT	Enumerated type of Interlock 11. Default is 6.
Cfg_eType12	SINT	Enumerated type of Interlock 12. Default is 6.
Cfg_eType13	SINT	Enumerated type of Interlock 13. Default is 6.
Cfg_eType14	SINT	Enumerated type of Interlock 14. Default is 6.
Cfg_eType15	SINT	Enumerated type of Interlock 15. Default is 6.
Cfg_eType16	SINT	Enumerated type of Interlock 16. Default is 6.
Cfg_eType17	SINT	Enumerated type of Interlock 17. Default is 6.
Cfg_eType18	SINT	Enumerated type of Interlock 18. Default is 6.
Cfg_eType19	SINT	Enumerated type of Interlock 19. Default is 6.
Cfg_eType20	SINT	Enumerated type of Interlock 20. Default is 6.

Public Input Members	Data Type	Description
Cfg_eType21	SINT	Enumerated type of Interlock 21. Default is 6.
Cfg_eType22	SINT	Enumerated type of Interlock 22. Default is 6.
Cfg_eType23	SINT	Enumerated type of Interlock 23. Default is 6.
Cfg_eType24	SINT	Enumerated type of Interlock 24. Default is 6.
Cfg_eType25	SINT	Enumerated type of Interlock 25. Default is 6.
Cfg_eType26	SINT	Enumerated type of Interlock 26. Default is 6.
Cfg_eType27	SINT	Enumerated type of Interlock 27. Default is 6.
Cfg_eType28	SINT	Enumerated type of Interlock 28. Default is 6.
Cfg_eType29	SINT	Enumerated type of Interlock 29. Default is 6.
Cfg_eType30	SINT	Enumerated type of Interlock 30. Default is 6.
Cfg_eType31	SINT	Enumerated type of Interlock 31. Default is 6.
Cfg_HasType	SINT	Enable selection for types from HMI. Default is 2#1111_1111.
Cfg_TypeDesc00	BOOL	Interlock type 00 description. Default is false.
Cfg_TypeDesc01	BOOL	Interlock type 01 description. Default is false.
Cfg_TypeDesc02	BOOL	Interlock type 02 description. Default is false.
Cfg_TypeDesc03	BOOL	Interlock type 03 description. Default is false.
Cfg_TypeDesc04	BOOL	Interlock type 04 description. Default is false.
Cfg_TypeDesc05	BOOL	Interlock type 05 description. Default is false.
Cfg_TypeDesc06	BOOL	Interlock type 06 description. Default is false.
Cfg_TypeDesc07	BOOL	Interlock type 07description. Default is false.
Cfg_BankID	INT	Bank ID for use with multiple banks (0 to 7). Default is 0.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more information is available. Default is false.
Cfg_CnfrmReqd	SINT	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PCmd_Reset	BOOL	Program command to reset latched interlocks. Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output - System Defined Parameter
Out_Reset	BOOL	1 = Reset external devices.
Val_FirstUpBankID	INT	Bank ID number of first up interlock.
Val_FirstUpIndex	INT	Index number of first up interlock.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_IntlkOK	BOOL	1 = OK to run, 0 = Stop.
Sts_NBIntlkOK	BOOL	1 = All non-bypassable interlocks OK to run.
Sts_Available	BOOL	1 = Available.
Sts_IntlkTripInh	BOOL	1 = Interlock trip inhibit - stops equipment but does not trip.
Sts_BypActive	BOOL	1 = Interlock bypassing is active (ignore bypassable interlocks).
Sts_FirstUpDetect	BOOL	1 = First up interlock detected.
Sts_BankIDError	BOOL	1 = Error in bank ID's, each bank ID must be unique.
Sts_LatchDefeat	BOOL	1 = Do not latch inputs even if configured for latching.
Sts_RdyReset	BOOL	1 = A latched interlock (returned to OK) is ready to be reset.
Sts_LatchMask	DINT	Latch mask- always latch based on type.
Sts_BypassMask	DINT	Bypass mask- bypass based on type.
Sts_Intlk	DINT	Individual interlock status (1 = stop, 0 = OK).
Sts_FirstOut	DINT	Interlock first out status (bit 1 is first not-OK condition).

Private Input Members	Data Type	Description
HMI_Tab	SINT	Tab to display (FTView ME). Default is 0.
MSet_Bypass	DINT	Individual condition maintenance bypass toggles. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
OCmd_Reset	BOOL	Operator command to reset latched interlocks. Default is false.

Private Output Members	Data Type	Description
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables HMI button).
Val_BankMap	DINT	Map of interlock banks detected.
Val_BankSts	DINT	Map of interlock banks statuses.

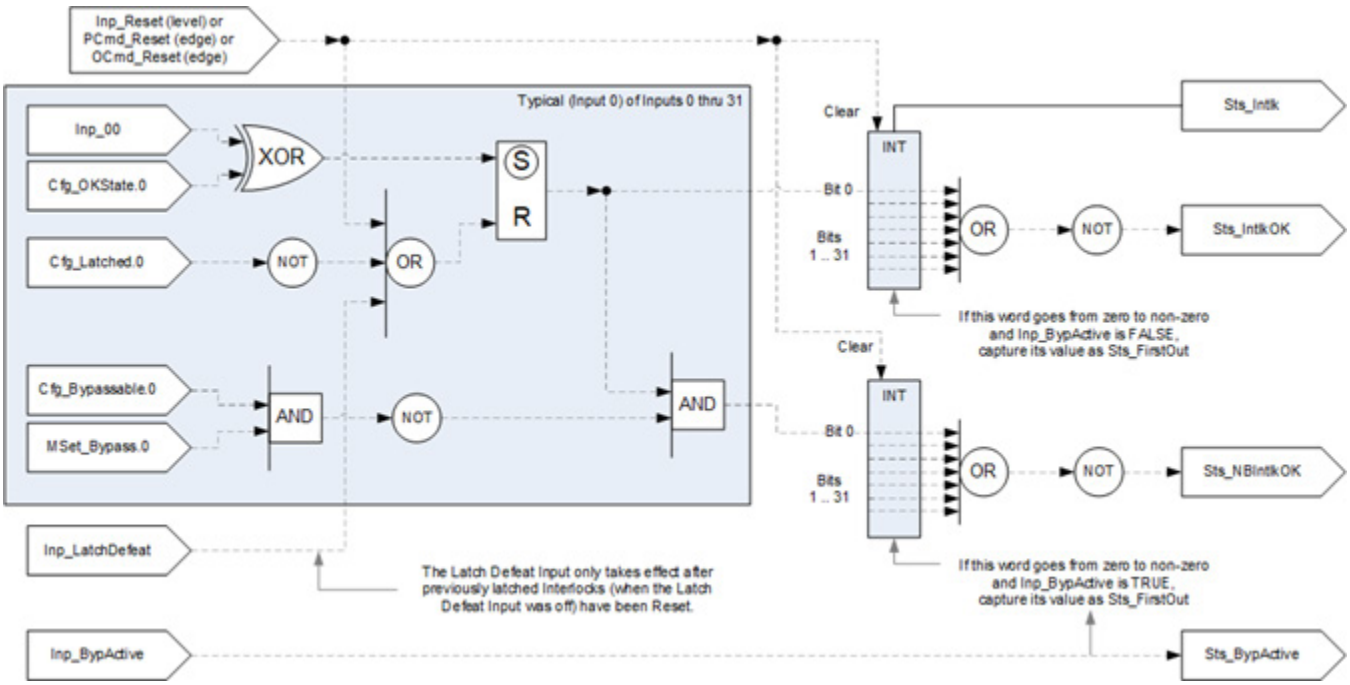
P_INTERLOCK_BANK_STATUS Structure

Members	Data Type	Description
Val_FirstUpIndex	INT	Index number of first up interlock.
Val_FirstUpBankID	INT	Bank ID number of first up interlock.
Val_BankMap	DINT	Map of interlock banks detected.
Val_BankSts	DINT	Map of interlock banks statuses.
Inp_Reset	BOOL	1 = Reset trip and first up.
Inp_BypActive	BOOL	1 = Interlock bypassing is currently active.
Inp_LatchDefeat	BOOL	1 = Do not latch.
Inp_Available	BOOL	1 = Available from preceding equipment.
Sts_BankIDError	BOOL	1 = Duplicate or invalid bank ID.

Members	Data Type	Description
Sts_IntlkOK	BOOL	Interlocks bypassable interlock status (1 = all interlocks OK to energize).
Sts_NBIntlkOK	BOOL	Interlocks non-bypassable interlock status (1=all non-bypassable interlocks OK to energize).
Sts_IntlkTripInh	BOOL	1 = Interlock trip inhibit – stops equipment but does not trip.
Sts_Available	BOOL	Availability status.(1 = Available).
Sts_FirstUpDetect	BOOL	1=First up interlock detected.
Sts_RdyReset	BOOL	1=A latched interlock (returned to OK) is ready to be reset.
Sts_PrevIntlkOK	BOOL	Previous interlocks bypassable interlock status (1 = all interlocks OK to energize).
Sts_PrevNBIntlkOK	BOOL	Previous interlocks non-bypassable interlock status (1 = all non-bypassable interlocks OK to energize).

Operation

This diagram illustrates the functionality of the PINTLK instruction:



Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Input Conditional Text

- Navigation Path
- Interlock Type
- More Information

Monitor the PINTLK Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false. If this instruction is off-scan, then set the summary interlock OK status bits to false. Only set individual interlock bypasses for conditions that are configured for bypassing. All the MSets for inputs that are NOT bypassable will be cleared.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.

Condition/State	Action Taken
EnableIn is false	EnableOut is cleared to false. If this instruction is off-scan, then set the summary interlock OK status bits to false. Only set individual interlock bypasses for conditions that are configured for bypassing. All the MSets for inputs that are NOT bypassable will be cleared.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

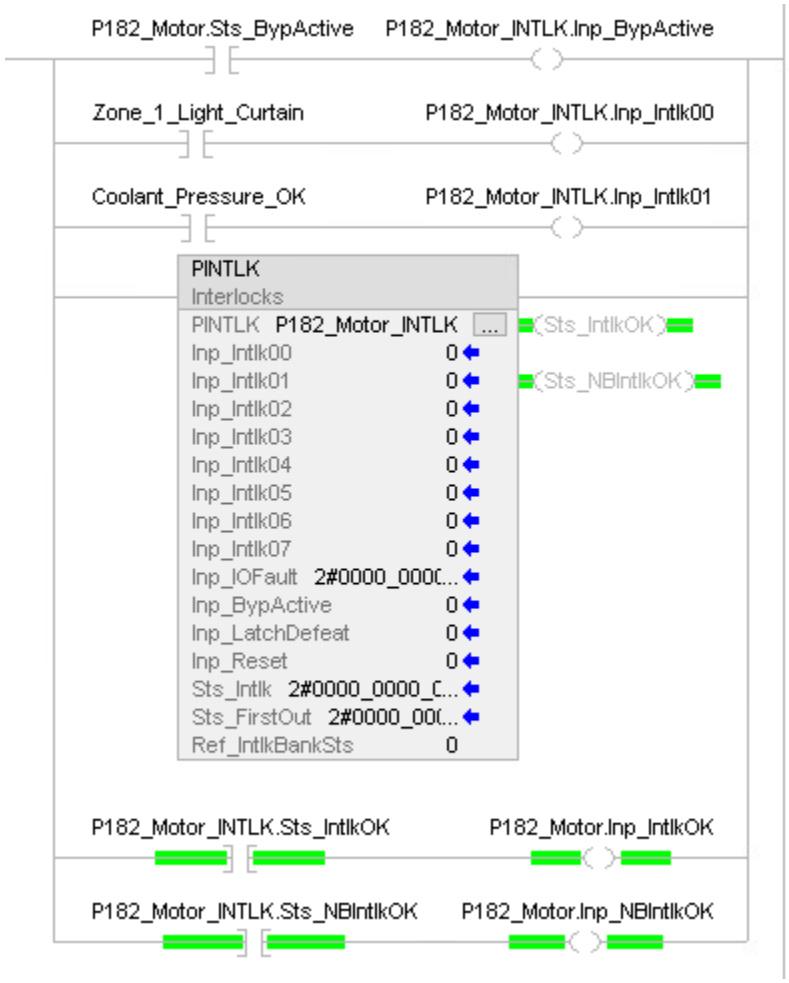
In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

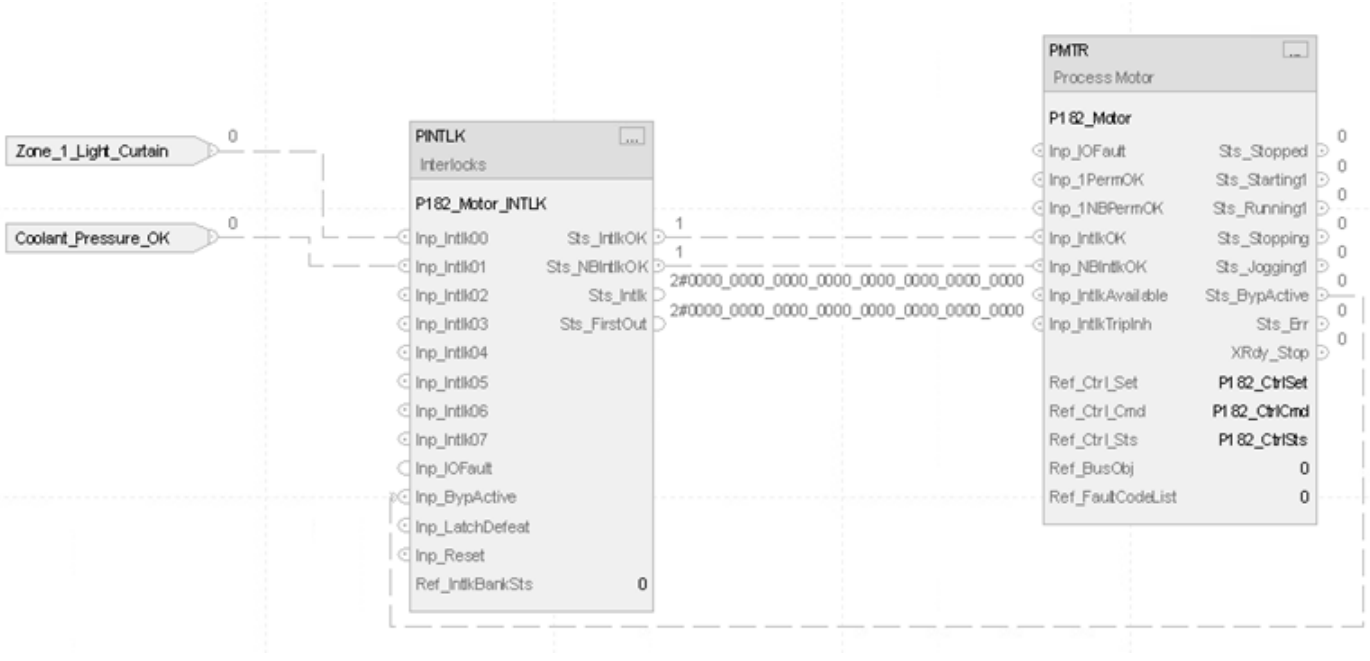
Example

This example uses the PINTLK instruction to concentrate the interlock conditions that allow the functioning of the refiner plates that are used for grinding wood as part of the pulp manufacturing process.

Ladder Diagram



Function Block Diagram



Structured Text

```
P182_Motor_INTLK.Inp_BypActive := P182_Motor.Sts_BypActive;

P182_Motor_INTLK.Inp_Intlk00 := Zone_1_Light_Curtain;

P182_Motor_INTLK.Inp_Intlk01 := Coolant_Pressure_OK;

PINTLK(P182_Motor_INTLK, 0);

P182_Motor.Inp_IntlkOK := P182_Motor_INTLK.Sts_IntlkOK;

P182_Motor.Inp_NBIntlkOK := P182_Motor_INTLK.Sts_NBIntlkOK;

PMTR(P182_Motor,P182_CtrlSet,P182_CtrlCmd,P182_CtrlSts, 0, 0);
```

Process Lead Lag Standby Motor Group (PLLS)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Lead Lag Standby Motor Group (PLLS) instruction provides control of a parallel group of motors, such as a set of pumps with a common intake source and discharge destination. The number of motors to run depends on the demand on the system. The group can be configured to consist of as few as two or as many as 30 motors. The minimum demand can be set as low as 0, so that all motors are stopped at minimum demand. The maximum demand can be set as high as the number of pumps in the group.

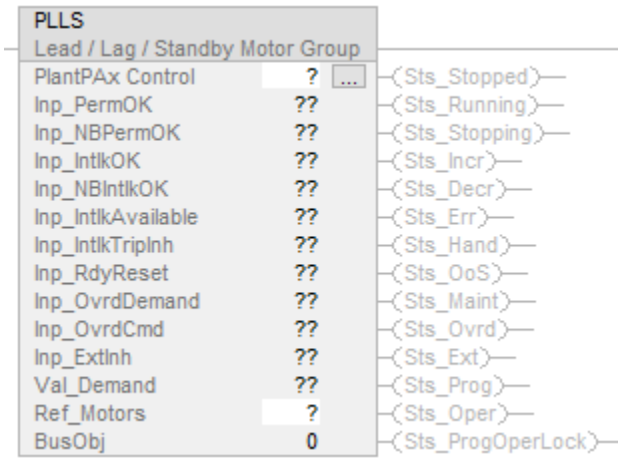
Use the PLLS instruction to:

- Control and monitor a group of 2 to 30 motors.
- Start and stop a group using Operator, Program, and Override capability.
- Allow the Operator or Program to enter a demand (the number of motors to run).
- Configure maximum demand (1 to number of motors in group).
- Configure minimum demand (0 to maximum demand).
- Configure stopping the last started motor or the first started motor (first-on-last-off or last-on-last-off).
- Configure delay between starts and configure delay between stops.
- Use start and stop commands to start or stop the motors as a group. The delay between starts or stops can be configured to sequence the motors.
- Start or stop motors as required to meet the entered demand.
- Identify (and optionally alarm) when there are not enough motors available to start (in Program Mode and ready to run) to meet the given demand.
- Identify (and optionally alarm) when there are not enough motors available to stop (in Program Mode and ready to stop) to meet the given demand.

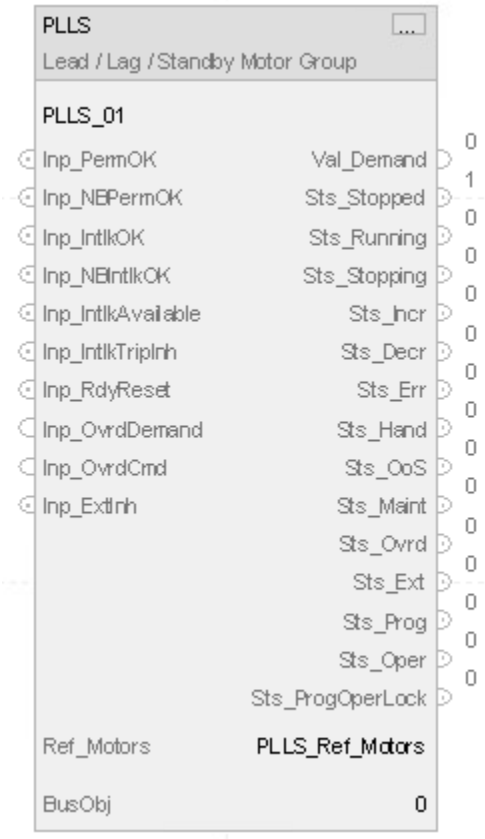
- Ability to rotate the list of motors (demote the lead, promote the others).
- Monitor Permissive conditions to allow starting the motor group.
- Monitor Interlock conditions to stop or prevent starting the motor group.
- Alarm if interlock conditions cause the group to be stopped.
- Use HMI breadcrumbs for Alarm Inhibited, Bad Configuration, Not Ready, and Maintenance Bypass Active.
- Use Available status in automation logic to determine whether the motor group can be controlled by other objects.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PLLS (PLLS tag, Ref_Motors tag, BusObj tag);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

This table describes the PLLS configuration operands.

Operand	Type	Format	Description
PlantPAx Control	P_LEAD_LAG_STANDBY	tag	Data structure required for proper operation of instruction.
Ref_Motors	P_LEAD_LAG_STANDBY_MOTOR	tag	Motor interface array.
BusObj	BUS_OBJ	tag	Bus component.

P_LEAD_LAG_STANDBY Structure

Use InOut parameters to link the instruction to external tags that contain necessary data for the instruction to operate. These external tags must be of the data type shown.

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input. Ladder Diagram. Corresponds to the rung-condition-in. Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command. 0 = None, Inp_OwnerCmd.10 = Operator Lock, Inp_OwnerCmd.11 = Operator Unlock, Inp_OwnerCmd.12 = Program Lock, Inp_OwnerCmd.13 = Program Unlock, Inp_OwnerCmd.14 = Acquire Maintenance, Inp_OwnerCmd.15 = Release Maintenance, Inp_OwnerCmd.16 = Acquire External, Inp_OwnerCmd.17 = Release External. Default is 0.
Inp_PermOK	BOOL	Visible	Not Required	Input	1 = Start permissives OK, group can start. Default is true.
Inp_NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable start permissives OK, group can start. Default is true.
Inp_IntlkOK	BOOL	Visible	Not Required	Input	1 = Interlocks OK, group can start/run. Default is true.
Inp_NBIntlkOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable interlocks OK, group can start/run. Default is true.
Inp_IntlkAvailable	BOOL	Visible	Not Required	Input	1 = Interlock availability OK. Default is false.
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit interlock trip status. Default is false.
Inp_RdyReset	BOOL	Visible	Not Required	Input	1 = Related object, reset by this object, is ready to be reset. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_Hand	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Inp_OvrdDemand	DINT	Visible	Not Required	Input	Override Mode setting for number of motors to run (MinDemand..MaxDemand). Default is 0.
Inp_OvrdCmd	DINT	Visible	Not Required	Input	Override Mode Command: 0 = None, 1 = Stop Group, 2 = Start Group, 3 = Rotate Assignments. Default is 0.
Inp_ExtInh	BOOL	Visible	Not Required	Input	Control / command source selection. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset all fault conditions and latched alarms. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow operator to shelve alarms. Default is true.
Cfg_NumMotors	DINT	Not Visible	Not Required	Input	Number of motors in this Lead / Lag / Standby Group. Valid = 2 to 30. Default is 3.
Cfg_MaxDemand	DINT	Not Visible	Not Required	Input	Maximum number of motors to run. Valid = 1 to Cfg_NumMotors. Default is 2.
Cfg_MinDemand	DINT	Not Visible	Not Required	Input	Minimum number of motors to run. Valid = 0 to Cfg_MaxDemand. Default is 0.
Cfg_StartDly	REAL	Not Visible	Not Required	Input	Time (seconds) after start or stop until next start is allowed (0..2M seconds). Valid = 0.0 to 2147483.0. Default is 10.0.
Cfg_StopDly	REAL	Not Visible	Not Required	Input	Time (seconds) after start or stop until next stop is allowed (0..2M seconds). Valid = 0.0 to 2147483.0. Default is 10.0.
Cfg_FirstOnFirstOff	BOOL	Not Visible	Not Required	Input	1 = First started is first stopped, 0 = First started is last stopped. Default is false.
Cfg_AllowRotate	BOOL	Not Visible	Not Required	Input	1 = Allow rotate (cycle lead) command to rotate motor assignments. Default is true.
Cfg_RotateOnStop	BOOL	Not Visible	Not Required	Input	1 = Rotate (cycle lead to end of list) upon stopping all motors. Default is true.
Cfg_HasPermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to permissive inputs. Default is false.
Cfg_HasIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to interlock inputs. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasNav01	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #1. Default is false.
Cfg_HasNav02	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #2. Default is false.
Cfg_HasNav03	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #3. Default is false.
Cfg_HasNav04	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #4. Default is false.
Cfg_HasNav05	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #5. Default is false.
Cfg_HasNav06	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #6. Default is false.
Cfg_HasNav07	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #7. Default is false.
Cfg_HasNav08	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #8. Default is false.
Cfg_HasNav09	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #9. Default is false.
Cfg_HasNav10	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #10. Default is false.
Cfg_HasNav11	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #11. Default is false.
Cfg_HasNav12	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #12. Default is false.
Cfg_HasNav13	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #13. Default is false.
Cfg_HasNav14	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #14. Default is false.
Cfg_HasNav15	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #15. Default is false.
Cfg_HasNav16	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #16. Default is false.
Cfg_HasNav17	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #17. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasNav18	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #18. Default is false.
Cfg_HasNav19	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #19. Default is false.
Cfg_HasNav20	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #20. Default is false.
Cfg_HasNav21	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #21. Default is false.
Cfg_HasNav22	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #22. Default is false.
Cfg_HasNav23	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #23. Default is false.
Cfg_HasNav24	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #24. Default is false.
Cfg_HasNav25	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #25. Default is false.
Cfg_HasNav26	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #26. Default is false.
Cfg_HasNav27	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #27. Default is false.
Cfg_HasNav28	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #28. Default is false.
Cfg_HasNav29	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #29. Default is false.
Cfg_HasNav30	BOOL	Not Visible	Not Required	Input	1 = enable a button on the HMI that is used to call up the faceplate for motor #30. Default is false.
Cfg_SetTrack	BOOL	Not Visible	Not Required	Input	1 = When the owner is program the operator settings track the program settings. When the owner is operator the program settings track the operator settings, and the virtual inputs match the output values (transitions are bumpless), 0 = No tracking. Default is false.
Cfg_SetTrackOvrdHand	BOOL	Not Visible	Not Required	Input	1 = program/operator settings track override/hand speed reference. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_OperStopPrio	BOOL	Not Visible	Not Required	Input	1 = OCmd_Stop any time, 0 = OCmd_Stop only when operator selected. Default is false.
Cfg_ExtStopPrio	BOOL	Not Visible	Not Required	Input	1 = XCmd_Stop any time, 0 = XCmd_Stop only when external selected. Default is false.
Cfg_OCmdResets	BOOL	Not Visible	Not Required	Input	1 = New group OCmd resets shed latches and cleared alarms, 0 = OCmdReset required. Default is false.
Cfg_XCmdResets	BOOL	Not Visible	Not Required	Input	1 = New group XCmd resets shed latches and cleared alarms, 0 = OCmdReset required. Default is false.
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores bypassable permissives/interlocks, 0 = Always use permissives/interlocks. Default is false.
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Demand	DINT	Not Visible	Not Required	Input	Program setting for number of motors to run (MinDemand...MaxDemand). Default is 0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program owner request ID (non-zero) or release (zero). Default is 0.
XSet_Demand	DINT	Not Visible	Not Required	Input	External setting for number of motors to run (MinDemand...MaxDemand). Default is 0.
PCmd_Start	BOOL	Not Visible	Not Required	Input	Program command to start motor group. Default is false.
PCmd_Stop	BOOL	Not Visible	Not Required	Input	Program command to stop motor group. Default is false.
PCmd_Rotate	BOOL	Not Visible	Not Required	Input	Program command to rotate assignments (cycle lead to end of list). Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program command to reset all alarms requiring reset. Default is false.
XCmd_Start	BOOL	Not Visible	Not Required	Input	External command to start motor group. Default is false.
XCmd_Stop	BOOL	Not Visible	Not Required	Input	External command to stop motor group. Default is false.
XCmd_Rotate	BOOL	Not Visible	Not Required	Input	External command to rotate assignments (cycle lead to end of list). Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External command to reset all alarms requiring reset. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_HasMaintOoS	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is true.
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
XCmd_Rel	BOOL	Not Visible	Not Required	Input	Control / command source selection. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output. This output state always reflects EnableIn input state.
Val_Demand	DINT	Visible	Not Required	Output	Number of motors requested to run.
Val_RotateRank	DINT	Not Visible	Not Required	Output	Motor rank (0 = Lead, etc.) which will be demoted on rotate.
Val_RotateID	DINT	Not Visible	Not Required	Output	Motor number which will be demoted on rotate.
Sts_eCmd	SINT	Not Visible	Not Required	Output	Group command 0 = None, 1 = Stop, 2 = Start.
Sts_Fdbk	SINT	Not Visible	Not Required	Output	Group Feedback 0...31 = Number of motors actually running.
Sts_eSts	INT	Not Visible	Not Required	Output	Group confirmed status: 0 = ?, 1 = Stopped, 2 = Running, 3 = Stopping, 4 = Decreasing, 5 = Increasing.
Sts_eFault	INT	Not Visible	Not Required	Output	Group fault status: 0 = None, 1 = Configuration error, 12 = Fail to start, 13 = Fail to stop.
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	Highest alarm priority and acknowledge status this object + motors (enumeration).
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Stopped	BOOL	Visible	Not Required	Output	1 = Motor group requested to stop and all motors confirmed stopped.
Sts_Running	BOOL	Visible	Not Required	Output	1 = Motor group requested to run.
Sts_Stopping	BOOL	Visible	Not Required	Output	1 = Motor group requested to stop and not all motors confirmed stopped.
Sts_Incr	BOOL	Visible	Not Required	Output	1 = Group is starting motors in sequence to get up to demand.
Sts_Decr	BOOL	Visible	Not Required	Output	1 = Group is stopping motors in sequence to get down to demand.
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Group available for control by automation (program).
Sts_IntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Device can be acquired by program and is available for start/stop control when interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks and permissives are bypassed.
Sts_BypActive	BOOL	Not Visible	Not Required	Output	1 = Interlock bypassing active (bypassed or maintenance).
Sts_NotRdy	BOOL	Not Visible	Not Required	Output	1 = Group is not ready, for HMI use hidden detail bits (Sts_Nrdyxxx) for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Group is not ready: Configuration error.
Sts_NrdyIntlk	BOOL	Not Visible	Not Required	Output	1 = Group is not ready: Interlock not OK.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Group is not ready: Group is out of service.
Sts_NrdyPrioStop	BOOL	Not Visible	Not Required	Output	1 = Group is not ready: Operator/external priority stop requires reset.
Sts_NrdyPerm	BOOL	Not Visible	Not Required	Output	1 = Group is not ready: Permissive not OK.
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = A maintenance bypass function is active.
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = One or more alarms shelved, disabled, or suppressed.
Sts_Err	BOOL	Visible	Not Required	Output	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrStartDly	BOOL	Not Visible	Not Required	Output	1 = Error in configuration: Start check timer preset (use 0.0 to 2147483.0).
Sts_ErrStopDly	BOOL	Not Visible	Not Required	Output	1 = Error in configuration: Stop check timer preset (use 0.0 to 2147483.0).
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in configuration: Alarm throttle time or severity.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object owner ID (0 = not owned).
Sts_MotorAvailable	DINT	Not Visible	Not Required	Output	Set bits indicate which motors are available for program control.
Sts_MotorStopped	DINT	Not Visible	Not Required	Output	Set bits indicate which motors are confirmed stopped.
Sts_MotorStarting	DINT	Not Visible	Not Required	Output	Set bits indicate which motors are starting.
Sts_MotorRunning	DINT	Not Visible	Not Required	Output	Set bits indicate which motors are confirmed running.
Sts_MotorStopping	DINT	Not Visible	Not Required	Output	Set bits indicate which motors are confirmed stopped.
Sts_Hand	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_OoS	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_Maint	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_Ovrd	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_Ext	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_Prog	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_Oper	BOOL	Visible	Not Required	Output	Control / command source selection.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_Normal	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_CantStart	BOOL	Not Visible	Not Required	Output	1 = Motor failed to start (one-shot).
Sts_CantStop	BOOL	Not Visible	Not Required	Output	1 = Motor failed to stop.
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Group stopped by an interlock NOT OK (one-shot).
Sts_RdyReset	BOOL	Not Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Program, .30 = Not Ready.
Sts_eSrc	INT	Not Visible	Not Required	Output	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.
Sts_bSrc	INT	Not Visible	Not Required	Output	Control / command source selection.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Control / command source selection.
Sts_ProgOperLock	BOOL	Visible	Not Required	Output	Control / command source selection.
XRdy_Acq	BOOL	Not Visible	Not Required	Output	Control / command source selection.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	Control / command source selection.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable HMI button.
XRdy_Stop	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Stop, enable HMI button.
XRdy_Start	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Start, enable HMI button.
XRdy_Rotate	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rotate, enable HMI button.

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control or Command Source Selection.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance command to bypass all bypassable interlocks and permissives. Default is false.

Private Input Members	Data Type	Description
MCmd_Check	BOOL	Maintenance command to check (not bypass) all interlocks and permissives. Default is false.
MCmd_IS	BOOL	Maintenance command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
MSet_MotorOoS	DINT	Set bits indicate which motors have been taken out of service by maintenance. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
OCmd_CmdCncl	BOOL	Operator command to cancel command request. The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms requiring reset. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset all alarms and latched shed conditions. Default is false.
OCmd_ResetPrefs	BOOL	Operator command to reset all motor preferences to 0. Default is false.
OCmd_Rotate	BOOL	Operator command to rotate assignments (cycle lead to end of list). Default is false.
OCmd_SetPrefs	BOOL	Operator command to set motor preferences. Default is false.
OCmd_Start	BOOL	Operator command to start motor group. Default is false.
OCmd_Stop	BOOL	Operator command to stop motor group. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.
OSet_Demand	DINT	Operator setting for number of motors to run (MinDemand.. MaxDemand). Default is 0.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index. Default is 0.

Private Output Members	Data Type	Description
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass (enables HMI button).
MRdy_Check	BOOL	1 = Ready for MCmd_Check (enables HMI button).
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
ORdy_Demand	BOOL	1 = Ready for OSet_Demand (enables numeric entry).
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset (enables HMI button).
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll (enables HMI button).
ORdy_Rotate	BOOL	1 = Ready for OCmd_Rotate (enables HMI button).
ORdy_Start	BOOL	1 = Ready for OCmd_Start (enables HMI button).
ORdy_Stop	BOOL	1 = Ready for OCmd_Stop (enables HMI button).
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
Sts_bStsList	SINT[32]	Rank list of motor status: [0]=lead, [1]=lag, etc.; .0 = Avaiable, .1 = Stopped, .2 = Starting, .3 = Running, .4 = Stopping, .5 = Out of Service (Maint).
Sts_eNotify	SINT	Current alarm level and acknowledgement (enumeration).
Sts_eNotifyCantStart	SINT	Current alarm level and acknowledgement (enumeration).
Sts_eNotifyCantStop	SINT	Current alarm level and acknowledgement (enumeration).
Sts_eNotifyIntlkTrip	SINT	Current alarm level and acknowledgement (enumeration).
Val_PrefList	SINT[32]	Rank list of motor preferences: [0] = lead, [1] = lag, etc...
Val_PrioList	SINT[32]	Rank list of motor priorities: [0] = lead, [1] = lag, etc...
Val_RankList	SINT[32]	Rank list of motor numbers: [0] = lead, [1] = lag, etc...
Val_UsrList	INT[32]	Rank list of user sort criteria: [0] = lead, [1] = lag, etc...

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Ref_Motors	P_LEAD_LAG_STANDBY_MOTOR[30]	Visible	Required	InOut	Motor interface array (link to 2 to 30 motors).
BusObj	BUS_OBJ	Visible	Optional	InOut	Bus component.

Alarms

Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_CantStart	Alm_CantStart	Motor can't start alarm. Raised when there are not enough motors available to start to satisfy the entered demand. Too many motors are faulted or stopped in a mode other than program.

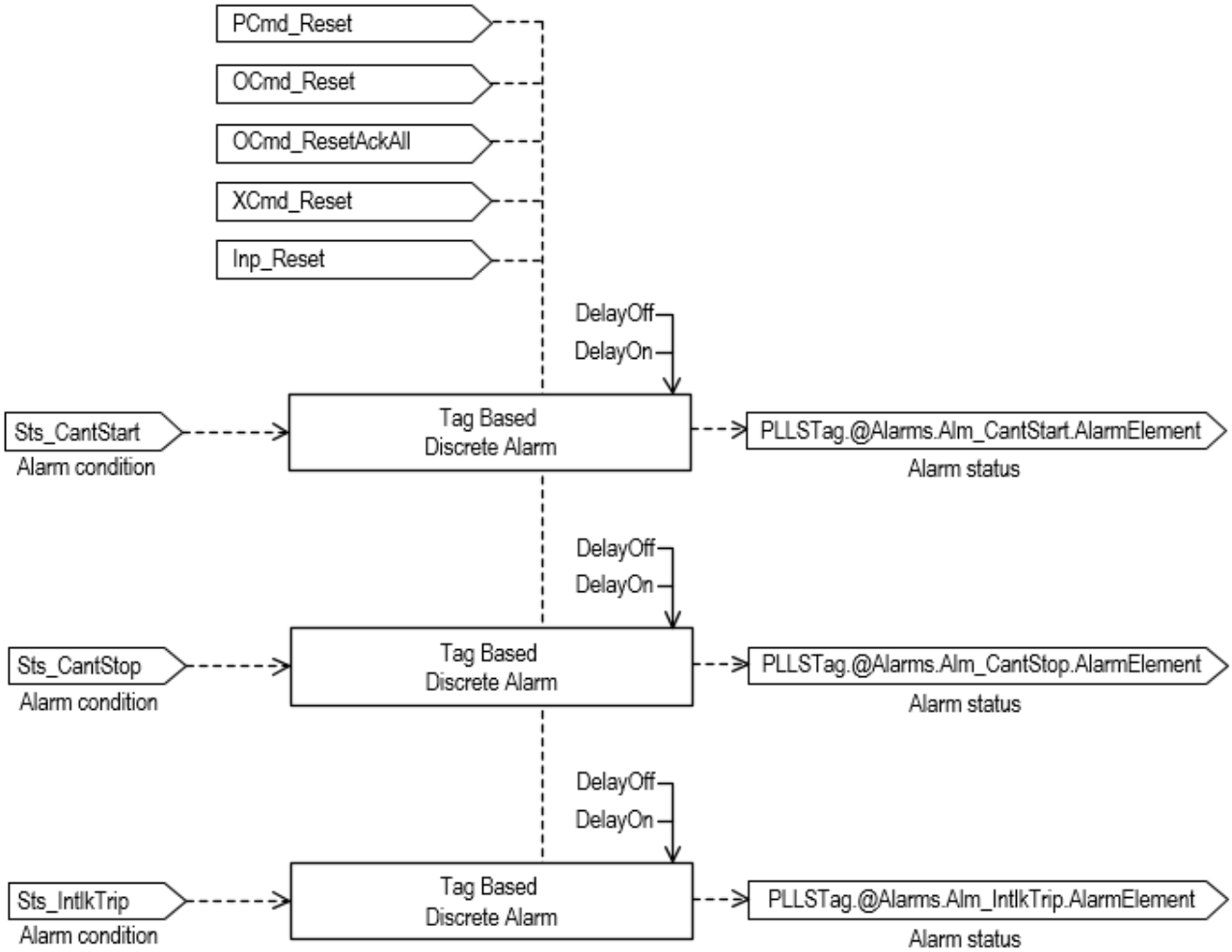
Member	Alarm Name	Description
Sts_CantStop	Alm_CantStop	Motor can't stop alarm. Raised when there are not enough motors available to stop to satisfy the entered demand. Too many motors are running in a mode other than program.
Sts_IntlkTrip	Alm_IntlkTrip	Interlock Trip alarm. Raised when the motor is running and an interlock not-OK condition causes the motor to stop. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.

Mark an alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Use this format to access alarm elements:

Tag.@Alarms.AlarmName.AlarmElement

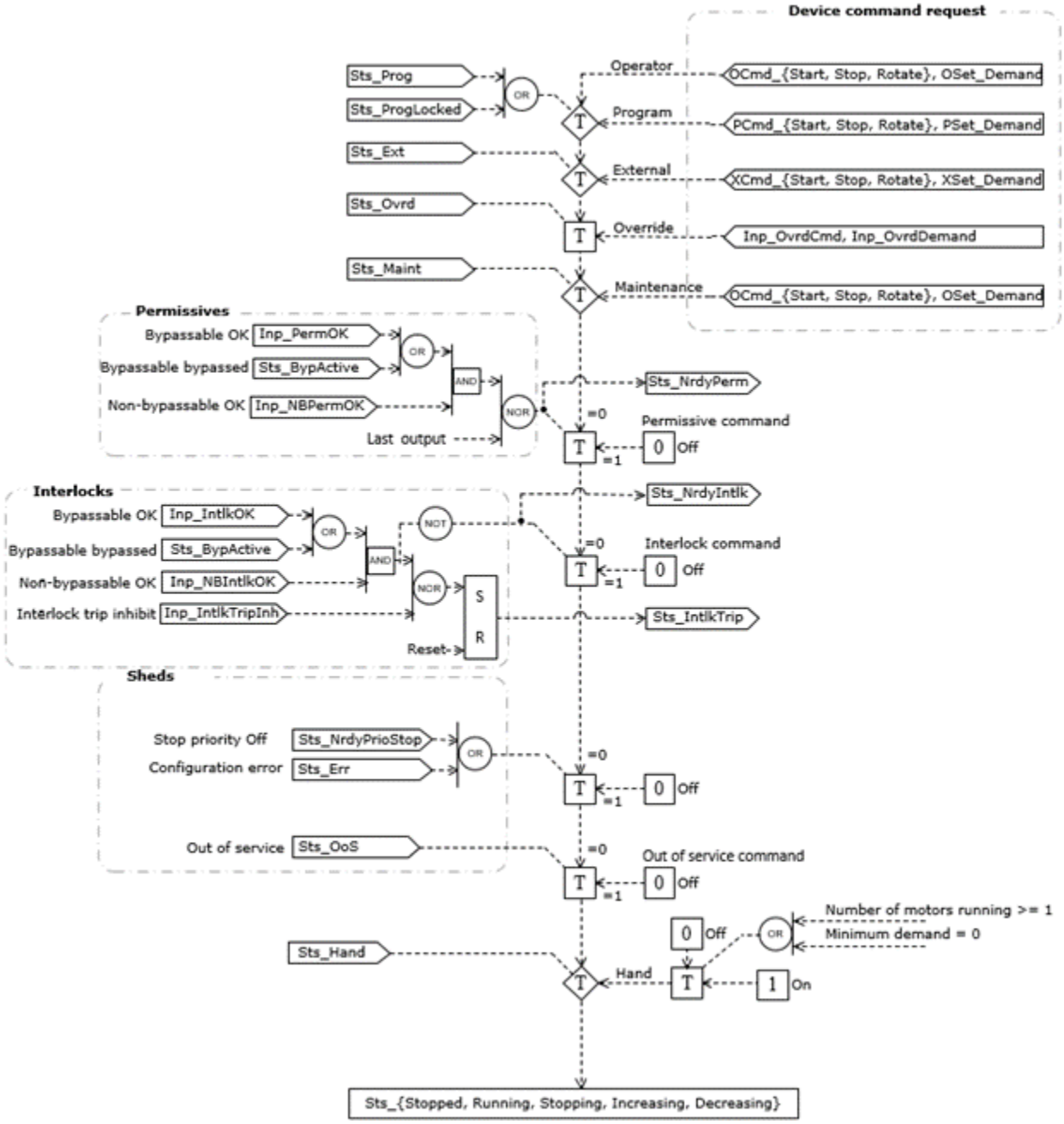
There are Program commands for each Alarm that are available to Acknowledge, Suppress, Unsupress and Unshelve the Alarm. These commands are propagated to corresponding commands (ProgAck, ProgSuppress, ProgUnsupress, ProgUnshelve) of the tag-based alarm.

There are Program, Operator, and External commands available that Acknowledge, Reset, Suppress and Unsuppress all alarms of the instruction (Alarm Set) at the same time.



Operation

This diagram illustrates the functionality of the PLLS instruction:



Configuration of Strings for HMI

Configure strings for HMI faceplates (FactoryTalk View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up

- Instruction name
- Area name
- URL link
- More Information

Implementation

An operator or other logic determines the demand for motors. The PLLS instruction determines which motors to run to meet demand. For the PLLS instruction to start and stop motors in the group, they must be available. A motor is available when it has no faults and is in Program Mode.

The PLLS instruction uses a sorting algorithm to deal with motors that are not available. If a motor is running and not available (perhaps running in Operator Mode), the motor is forced to the top of the sort. If a motor is stopped and not available (perhaps faulted), the motor is forced to the bottom of the sort. The motors that are available to start and stop are controlled to meet the demand. If the demand cannot be met because of unavailable motors, a status/alarm is provided.

The PLLS instruction uses an array of structures of the type P_LEAD_LAG_STANDBY_Motor to interface to the motors. Each interface element in the array provides the signals that are required between the PLLS instruction and one motor. Configuration data for the motor is also provided in the array. This data includes Priority and Preference values that can be used to affect the sorting of the motors. A Maintenance out of service flag that removes a motor from consideration in the sort is also included. The interface also includes a user sort value that can be used, for example, to push motors up or down the sort based on accumulated runtime or other criteria.

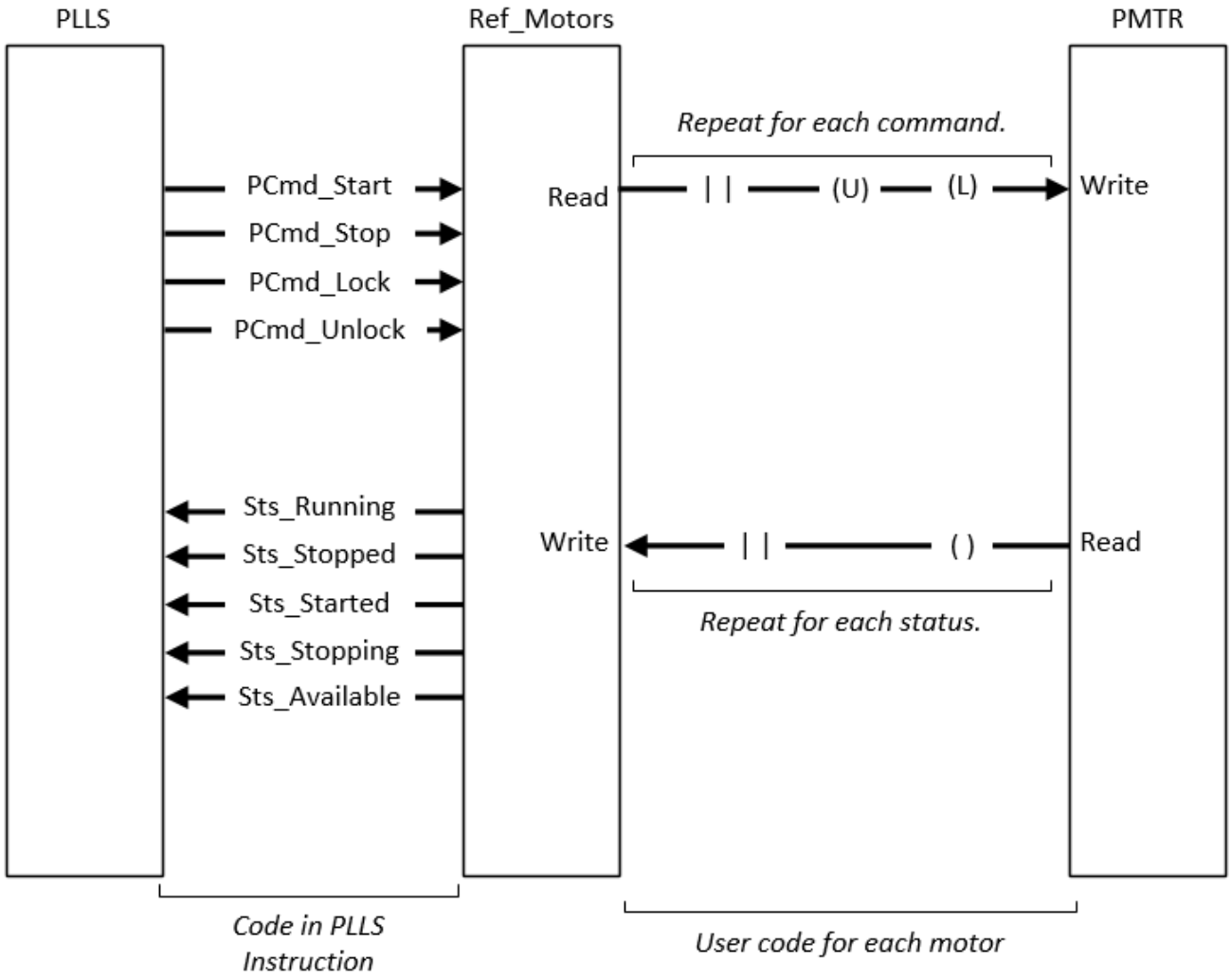
P_LEAD_LAG_STANDBY_MOTOR Array Member Content

This table describes the array members.

Members	Data Type	Description
Inp_OtherSel	DINT	Other motor selection criteria (0...255) (input to PLLS).
Inp_Demote	BOOL	Demote this motor to bottom of list (for example, on high runtime) (input to PLLS).
Cfg_Prio	DINT	Motor priority in list (0...31 -- if unused, set to 0).
OSet_Pref	DINT	Operator setting for motor preference in list (0 to 31), all else being equal.
PCmd_Start	BOOL	Program Command to start motor (output from PLLS).
PCmd_Stop	BOOL	Program Command to stop motor (output from PLLS).
PCmd_Lock	BOOL	Command to acquire and lock motor in Program (output from PLLS).
PCmd_Unlock	BOOL	Command to unlock motor from Program (output from PLLS).
Sts_Available	BOOL	Motor is in Program mode and ready to operate (input to PLLS).
Sts_Stopped	BOOL	Motor is currently confirmed stopped (input to PLLS).
Sts_Starting	BOOL	Motor is currently starting (input to PLLS).
Sts_Running	BOOL	Motor is currently confirmed running (input to PLLS).

Members	Data Type	Description
Sts_Stopping	BOOL	Motor is currently stopping (input to PLLS).
Val_Pref	DINT	This motor's current preference in list (1 = Lead, 2 = Lag, ...).
Val_Rank	DINT	This motor's current rank in list (1 = Lead, 2 = Lag, ...)

This image shows the relationship between the PLLS instruction, Ref_Motors(interface), and the PMTR instruction.

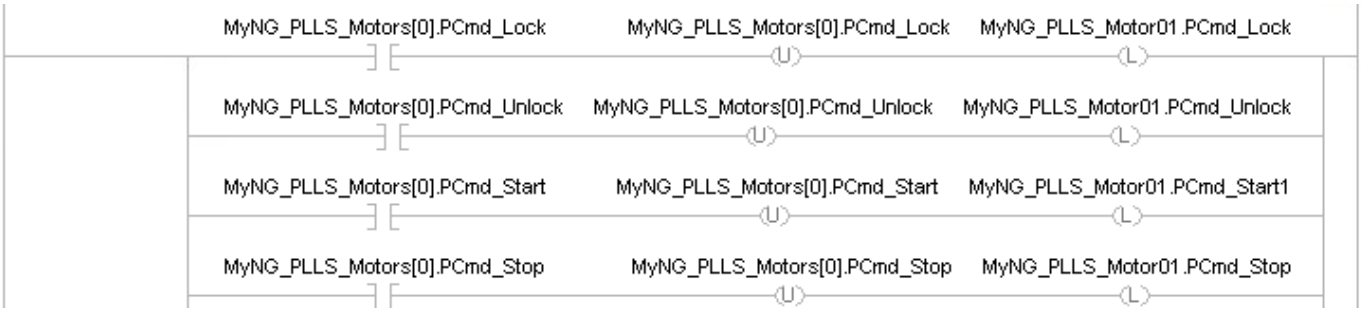


These images show an example of the ladder logic for transferring commands and motor status for one motor.

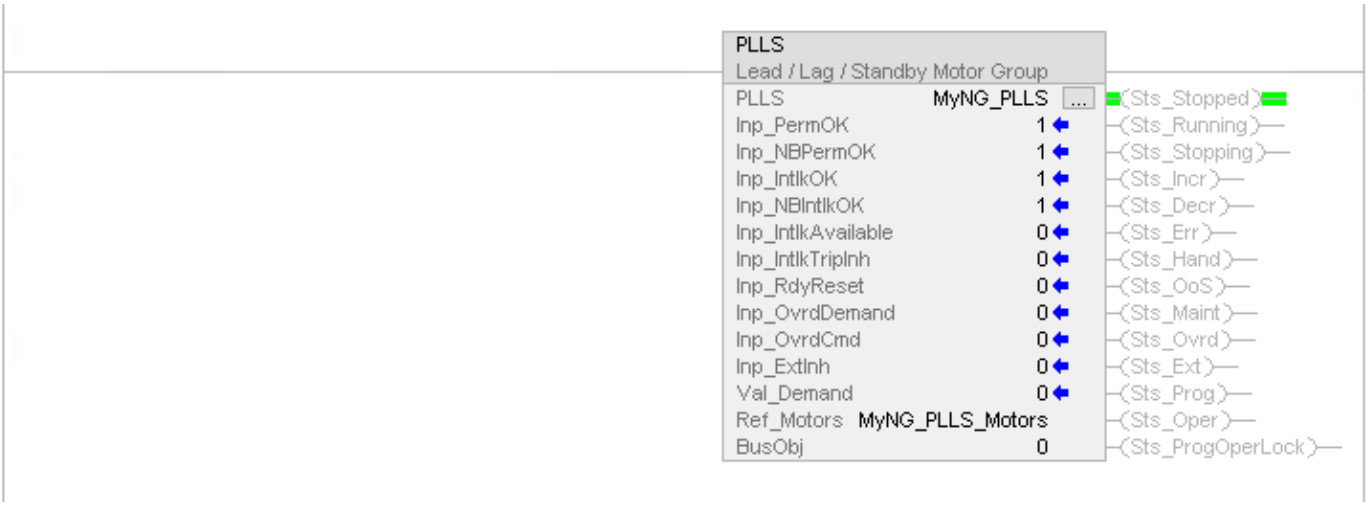
The process for forwarding each of the commands (PCmd_Lock, PCmd_Unlock, PCmd_Start, and PCmd_Stop) is:

- Test the appropriate bit in the interface to see if it is set.

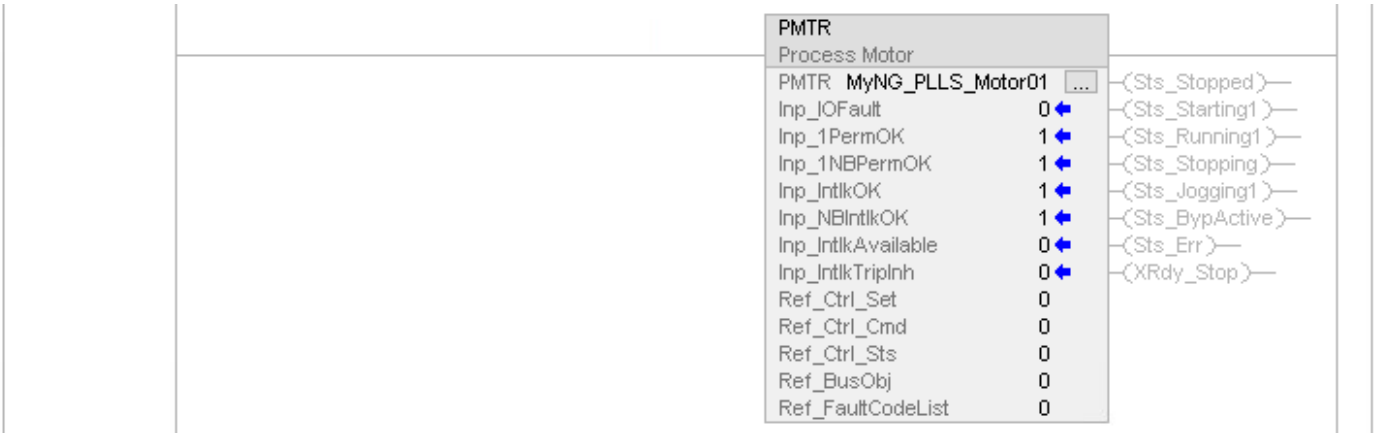
- If the bit is set, the bit is cleared and the corresponding program command on the motor is set.



- Execute the PLLS to select which motors to run.



- Next, the motor logic is executed. The motor logic uses the program commands to control the physical motor. The motor logic also receives feedback from the motor.



- The status (available, stopped, starting, running, and stopping) is read from the motor and written to the interface.

Monitor the PLLS Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Rung-condition-in is false	Handled the same as if the group is disabled by command. The motor outputs are de-energized, and the group is shown as disabled on the HMI. The mode is shown as No mode. All alarms are cleared.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the group is disabled by command. The motor outputs are de-energized, and the group is shown as disabled on the HMI. The mode is shown as No mode. All alarms are cleared.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

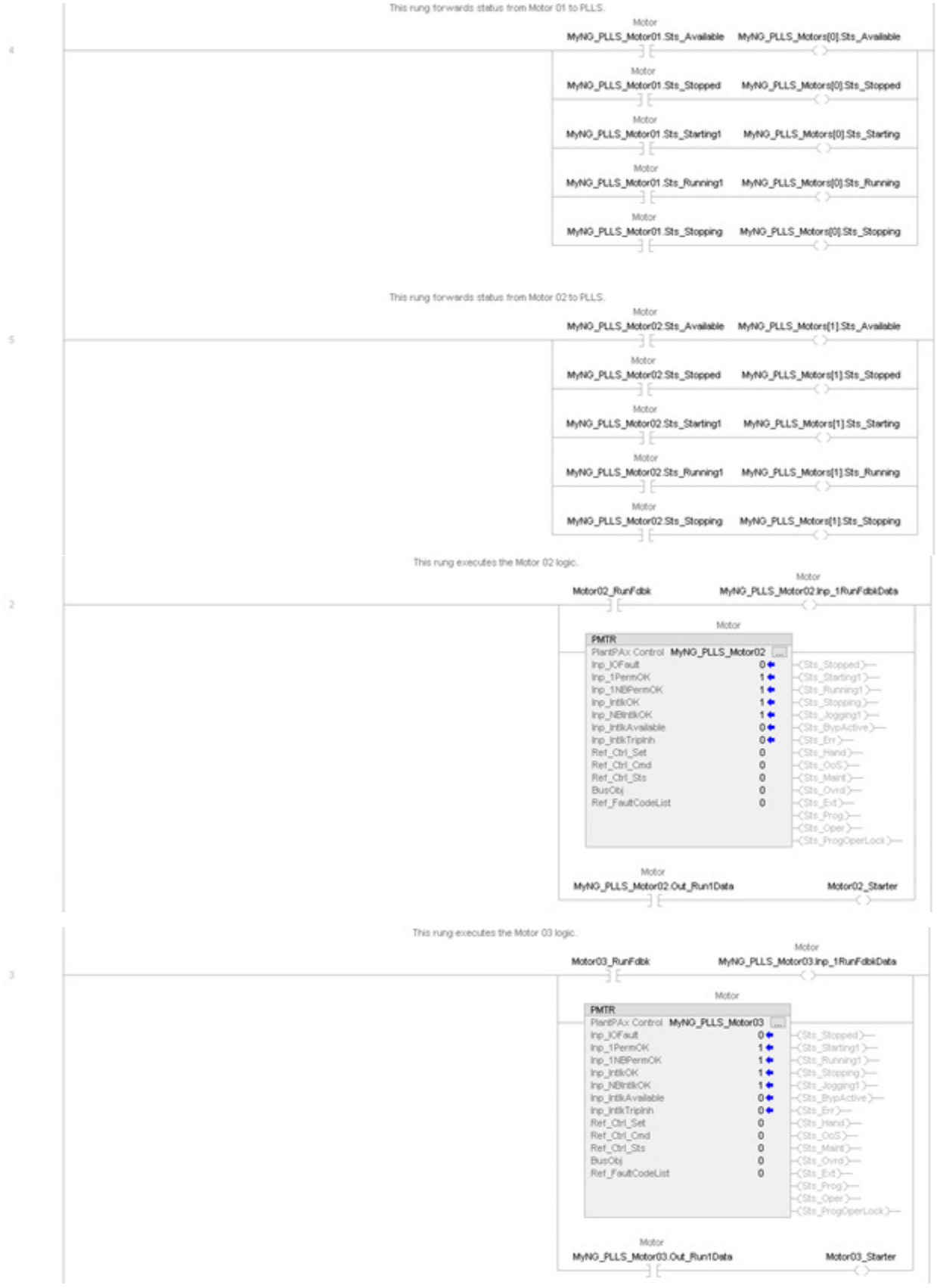
In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

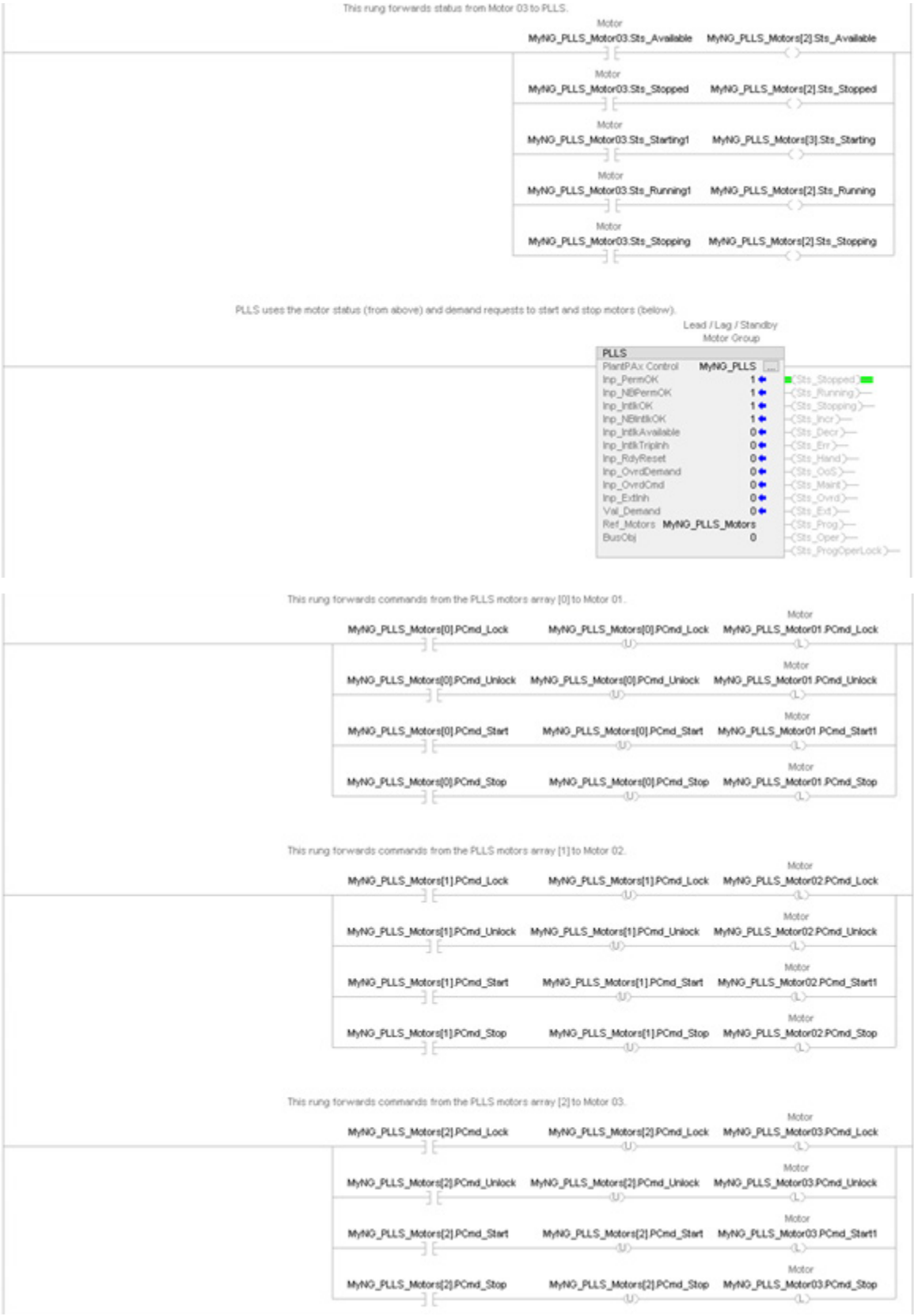
Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Example

This example shows a PLLS instruction being used to control three process motors.

Ladder Diagram


This rung forwards status from Motor 01 to PLLS.
Motor
MyNG_PLLS_Motor01.Sts_Available
MyNG_PLLS_Motors[0].Sts_Available
Motor
MyNG_PLLS_Motor01.Sts_Stopped
MyNG_PLLS_Motors[0].Sts_Stopped
Motor
MyNG_PLLS_Motor01.Sts_Starting1
MyNG_PLLS_Motors[0].Sts_Starting
Motor
MyNG_PLLS_Motor01.Sts_Running1
MyNG_PLLS_Motors[0].Sts_Running
Motor
MyNG_PLLS_Motor01.Sts_Stopping
MyNG_PLLS_Motors[0].Sts_Stopping
This rung forwards status from Motor 02 to PLLS.
Motor
MyNG_PLLS_Motor02.Sts_Available
MyNG_PLLS_Motors[1].Sts_Available
Motor
MyNG_PLLS_Motor02.Sts_Stopped
MyNG_PLLS_Motors[1].Sts_Stopped
Motor
MyNG_PLLS_Motor02.Sts_Starting1
MyNG_PLLS_Motors[1].Sts_Starting
Motor
MyNG_PLLS_Motor02.Sts_Running1
MyNG_PLLS_Motors[1].Sts_Running
Motor
MyNG_PLLS_Motor02.Sts_Stopping
MyNG_PLLS_Motors[1].Sts_Stopping
This rung executes the Motor 02 logic.
Motor02_RunFdbk
Motor
MyNG_PLLS_Motor02.Inp_1RunFdbkData
Motor
PMTR
PlantPAx Control MyNG_PLLS_Motor02
Inp_IOFault 0
Inp_1PermOK 1
Inp_1NBPermOK 1
Inp_IntlkOK 1
Inp_NBIntlkOK 1
Inp_IntlkAvailable 0
Inp_IntlkTripInh 0
Ref_Ctrl_Set 0
Ref_Ctrl_Cmd 0
Ref_Ctrl_Sts 0
BusObj 0
Ref_FaultCodeList 0
Sts_Stopped
Sts_Starting1
Sts_Running1
Sts_Stopping
Sts_Jogging1
Sts_BypActive
Sts_Err
Sts_Hand
Sts_OoS
Sts_Maint
Sts_Ovrd
Sts_Ext
Sts_Prog
Sts_Oper
Sts_ProgOperLock
Motor
MyNG_PLLS_Motor02.Out_Run1Data
Motor02_Starter
This rung executes the Motor 03 logic.
Motor03_RunFdbk
Motor
MyNG_PLLS_Motor03.Inp_1RunFdbkData
Motor
PMTR
PlantPAx Control MyNG_PLLS_Motor03
Inp_IOFault 0
Inp_1PermOK 1
Inp_1NBPermOK 1
Inp_IntlkOK 1
Inp_NBIntlkOK 1
Inp_IntlkAvailable 0
Inp_IntlkTripInh 0
Ref_Ctrl_Set 0
Ref_Ctrl_Cmd 0
Ref_Ctrl_Sts 0
BusObj 0
Ref_FaultCodeList 0
Sts_Stopped
Sts_Starting1
Sts_Running1
Sts_Stopping
Sts_Jogging1
Sts_BypActive
Sts_Err
Sts_Hand
Sts_OoS
Sts_Maint
Sts_Ovrd
Sts_Ext
Sts_Prog
Sts_Oper
Sts_ProgOperLock
Motor
MyNG_PLLS_Motor03.Out_Run1Data
Motor03_Starter

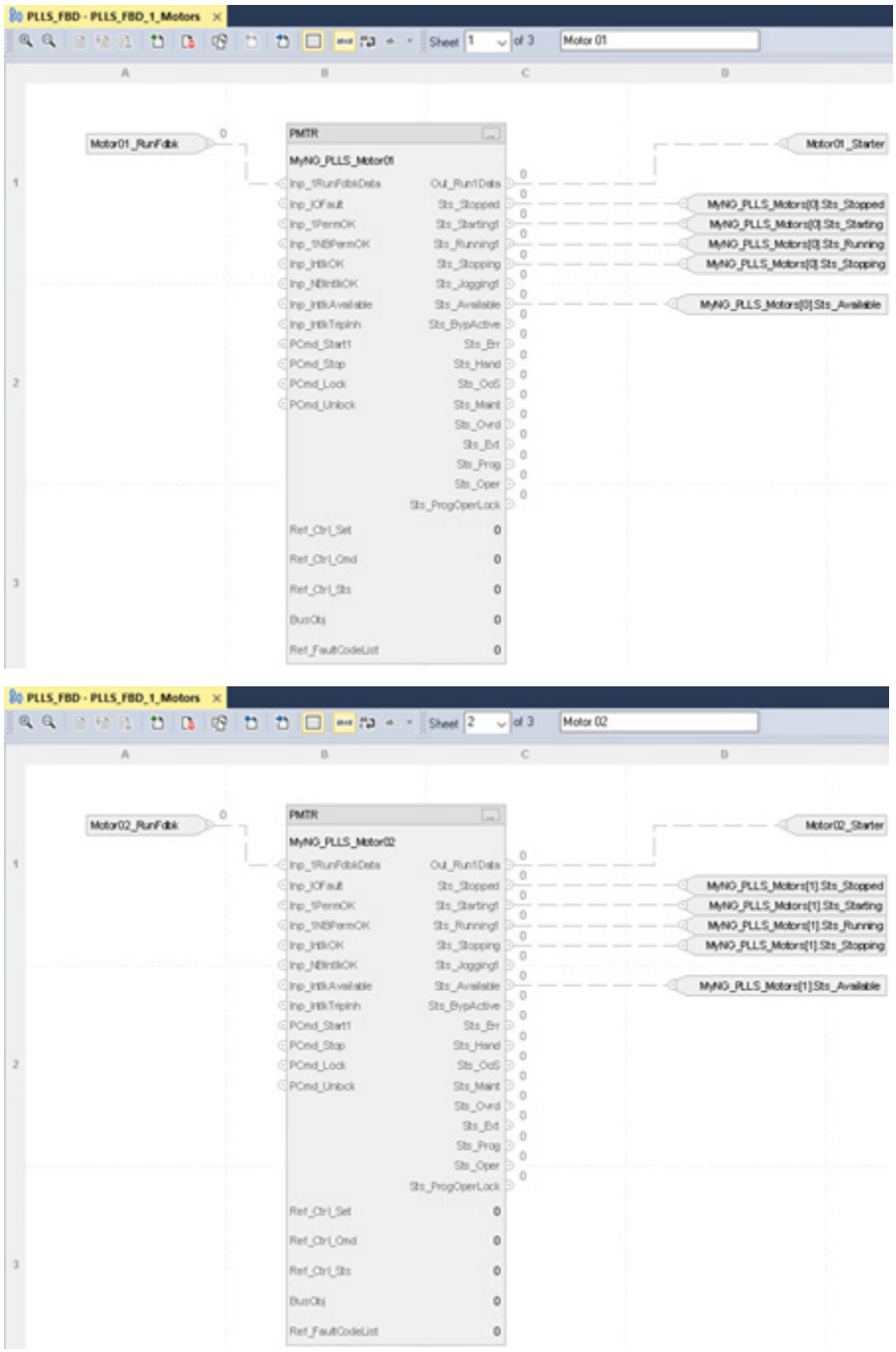

This rung forwards status from Motor 03 to PLLS.
Motor
MyNG_PLLS_Motor03.Sts_Available
MyNG_PLLS_Motors[2].Sts_Available
Motor
MyNG_PLLS_Motor03.Sts_Stopped
MyNG_PLLS_Motors[2].Sts_Stopped
Motor
MyNG_PLLS_Motor03.Sts_Starting1
MyNG_PLLS_Motors[3].Sts_Starting
Motor
MyNG_PLLS_Motor03.Sts_Running1
MyNG_PLLS_Motors[2].Sts_Running
Motor
MyNG_PLLS_Motor03.Sts_Stopping
MyNG_PLLS_Motors[2].Sts_Stopping
PLLS uses the motor status (from above) and demand requests to start and stop motors (below).
Lead / Lag / Standby
Motor Group
PLLS
PlantPAx Control MyNG_PLLS
Inp_PermOK 1
Inp_NBPermOK 1
Inp_IntlkOK 1
Inp_NBIntlkOK 1
Inp_IntlkAvailable 0
Inp_IntlkTripInh 0
Inp_RdyReset 0
Inp_OvrdDemand 0
Inp_OvrdCmd 0
Inp_ExtInh 0
Val_Demand 0
Ref_Motors MyNG_PLLS_Motors
BusObj 0
Sts_Stopped
Sts_Running
Sts_Stopping
Sts_Incr
Sts_Decr
Sts_Err
Sts_Hand
Sts_OoS
Sts_Maint
Sts_Ovrd
Sts_Ext
Sts_Prog
Sts_Oper
Sts_ProgOperLock
This rung forwards commands from the PLLS motors array [0] to Motor 01.
MyNG_PLLS_Motors[0].PCmd_Lock
MyNG_PLLS_Motors[0].PCmd_Lock
Motor
MyNG_PLLS_Motor01.PCmd_Lock
MyNG_PLLS_Motors[0].PCmd_Unlock
MyNG_PLLS_Motors[0].PCmd_Unlock
Motor
MyNG_PLLS_Motor01.PCmd_Unlock
MyNG_PLLS_Motors[0].PCmd_Start
MyNG_PLLS_Motors[0].PCmd_Start
Motor
MyNG_PLLS_Motor01.PCmd_Start1
MyNG_PLLS_Motors[0].PCmd_Stop
MyNG_PLLS_Motors[0].PCmd_Stop
Motor
MyNG_PLLS_Motor01.PCmd_Stop
This rung forwards commands from the PLLS motors array [1] to Motor 02.
MyNG_PLLS_Motors[1].PCmd_Lock
MyNG_PLLS_Motors[1].PCmd_Lock
Motor
MyNG_PLLS_Motor02.PCmd_Lock
MyNG_PLLS_Motors[1].PCmd_Unlock
MyNG_PLLS_Motors[1].PCmd_Unlock
Motor
MyNG_PLLS_Motor02.PCmd_Unlock
MyNG_PLLS_Motors[1].PCmd_Start
MyNG_PLLS_Motors[1].PCmd_Start
Motor
MyNG_PLLS_Motor02.PCmd_Start1
MyNG_PLLS_Motors[1].PCmd_Stop
MyNG_PLLS_Motors[1].PCmd_Stop
Motor
MyNG_PLLS_Motor02.PCmd_Stop
This rung forwards commands from the PLLS motors array [2] to Motor 03.
MyNG_PLLS_Motors[2].PCmd_Lock
MyNG_PLLS_Motors[2].PCmd_Lock
Motor
MyNG_PLLS_Motor03.PCmd_Lock
MyNG_PLLS_Motors[2].PCmd_Unlock
MyNG_PLLS_Motors[2].PCmd_Unlock
Motor
MyNG_PLLS_Motor03.PCmd_Unlock
MyNG_PLLS_Motors[2].PCmd_Start
MyNG_PLLS_Motors[2].PCmd_Start
Motor
MyNG_PLLS_Motor03.PCmd_Start1
MyNG_PLLS_Motors[2].PCmd_Stop
MyNG_PLLS_Motors[2].PCmd_Stop
Motor
MyNG_PLLS_Motor03.PCmd_Stop

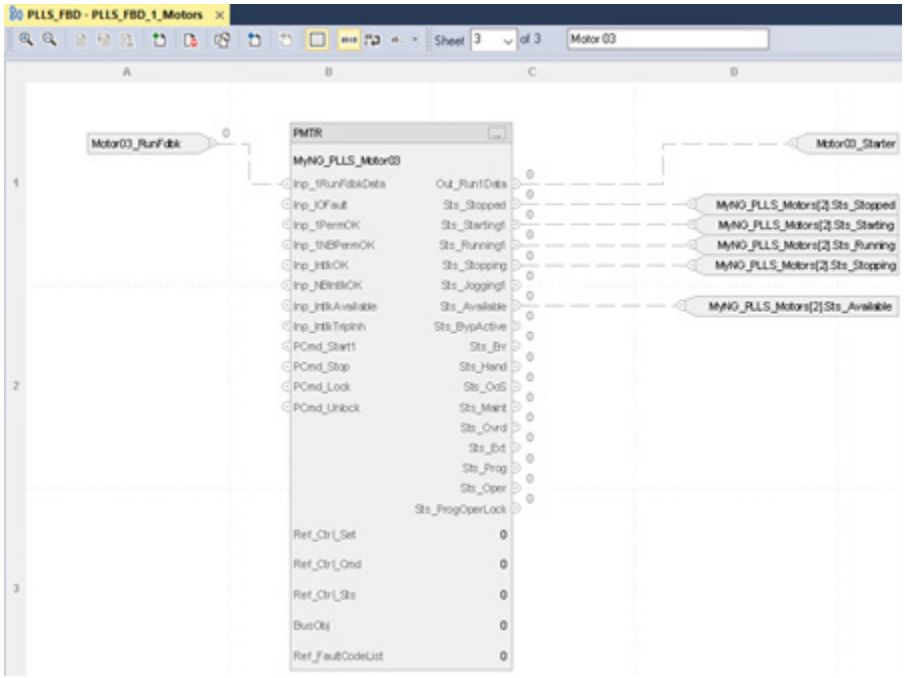
Function Block Diagram

The PLLS instruction requires four function block diagram routines to execute properly:

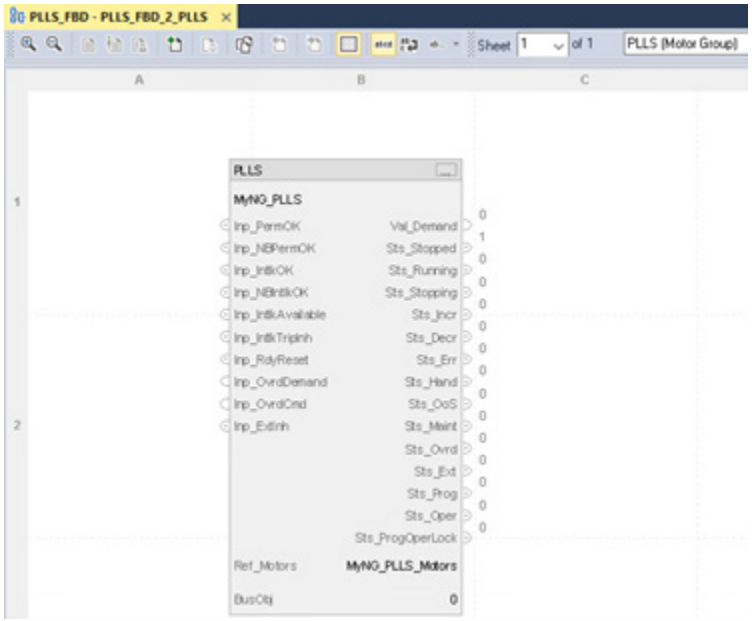
- PLLS_FBD_1_Motors routine
- PLLS_FBD_2_PLLS
- PLLS_FBD_3_ForwardCmds
- PLLS_FBD_4_ClearCmds

PLLS_FBD_1_Motors routine:

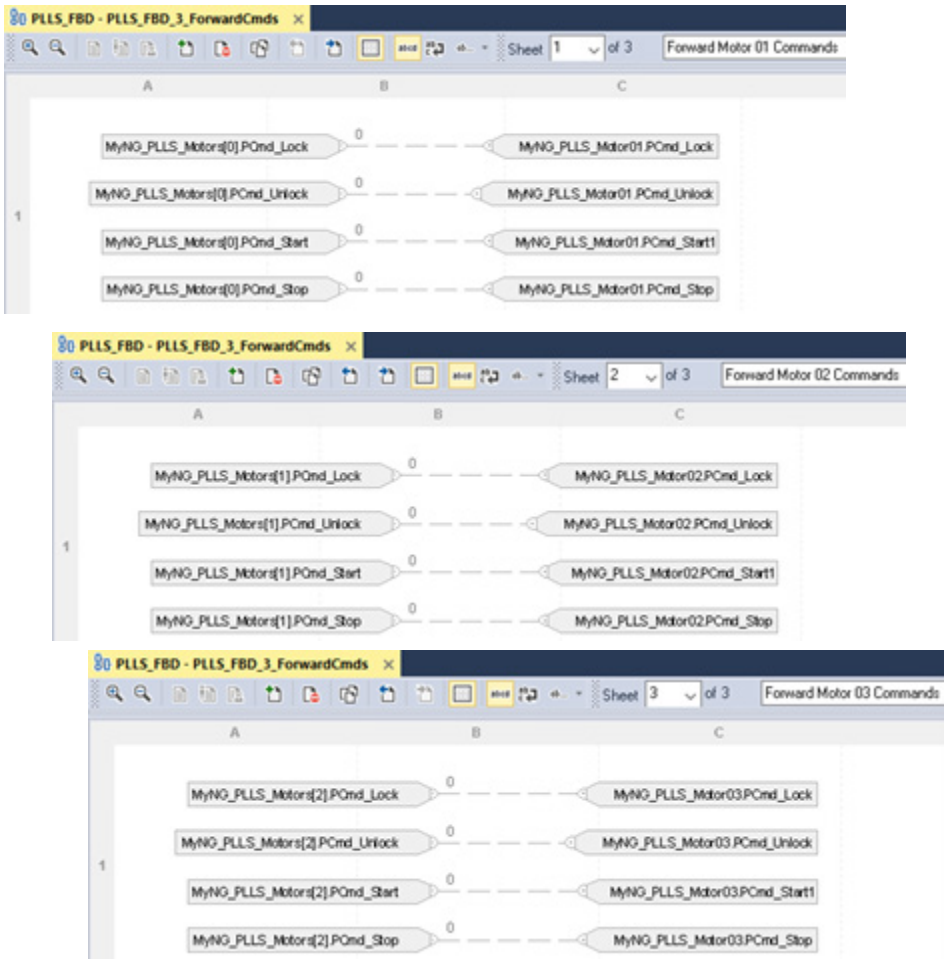




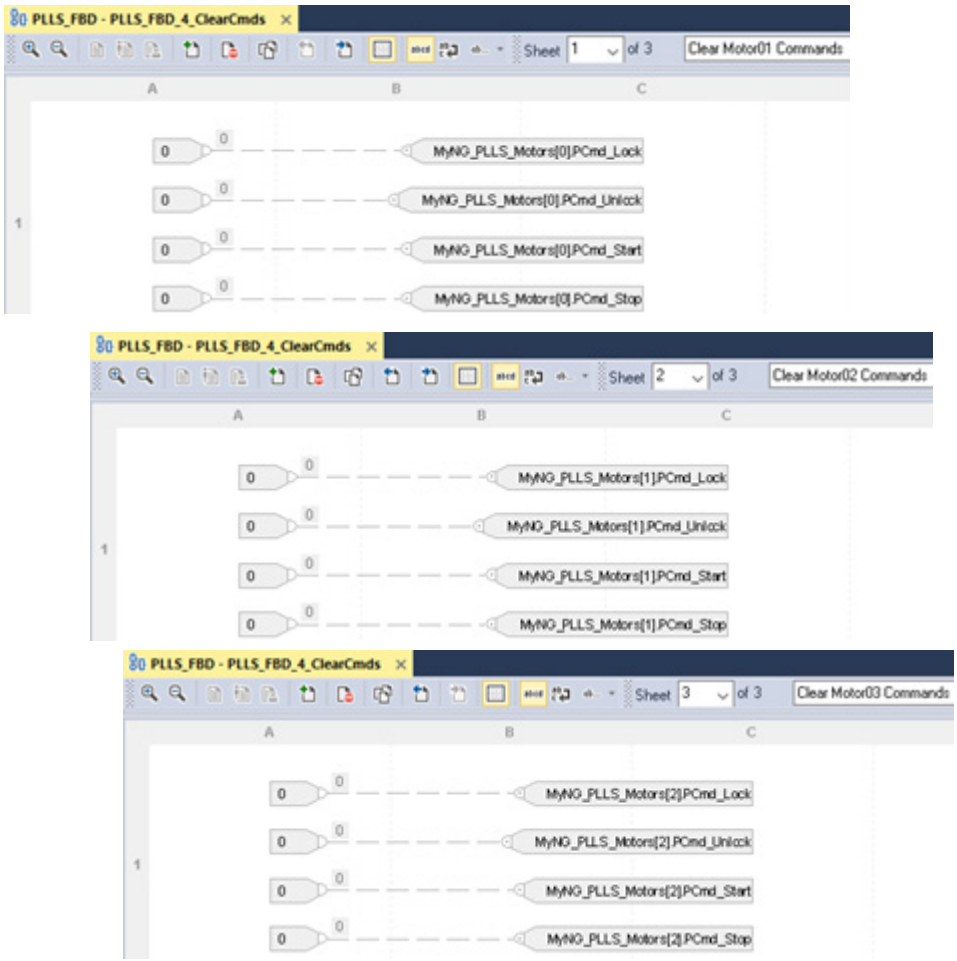
PLLS_FBD_2_PLLS routine:



PLLS_FBD_3_ForwardCmds routine:



PLLS_FBD_4_ClearCmds routine:



Structured Text

```
/* First, execute the individual motors */

/* Execute the Motor 01 logic: get run feedback input, execute PMTR, send
output to starter */

MyNG_PLLS_Motor01.Inp_1RunFdbkData := Motor01_RunFdbk;

PMTR (MyNG_PLLS_Motor01, 0, 0, 0, 0, 0);

Motor01_Starter := MyNG_PLLS_Motor01.Out_Run1Data;

/* Execute the Motor 02 logic: get run feedback input, execute PMTR, send
output to starter */

MyNG_PLLS_Motor02.Inp_1RunFdbkData := Motor02_RunFdbk;

PMTR (MyNG_PLLS_Motor02, 0, 0, 0, 0, 0);
```

```
Motor02_Starter := MyNG_PLLS_Motor02.Out_Run1Data;

/* Execute the Motor 03 logic: get run feedback input, execute PMTR, send
output to starter */
MyNG_PLLS_Motor03.Inp_1RunFdbkData := Motor03_RunFdbk;
PMTR (MyNG_PLLS_Motor03, 0, 0, 0, 0, 0);
Motor03_Starter := MyNG_PLLS_Motor03.Out_Run1Data;

/* Copy the Motor 01 Status to the PLLS array [0] */
MyNG_PLLS_Motors[0].Sts_Available := MyNG_PLLS_Motor01.Sts_Available;
MyNG_PLLS_Motors[0].Sts_Stopped := MyNG_PLLS_Motor01.Sts_Stopped;
MyNG_PLLS_Motors[0].Sts_Starting := MyNG_PLLS_Motor01.Sts_Starting1;
MyNG_PLLS_Motors[0].Sts_Running := MyNG_PLLS_Motor01.Sts_Running1;
MyNG_PLLS_Motors[0].Sts_Stopping := MyNG_PLLS_Motor01.Sts_Stopping;

/* Copy the Motor 02 Status to the PLLS array [1] */
MyNG_PLLS_Motors[1].Sts_Available := MyNG_PLLS_Motor02.Sts_Available;
MyNG_PLLS_Motors[1].Sts_Stopped := MyNG_PLLS_Motor02.Sts_Stopped;
MyNG_PLLS_Motors[1].Sts_Starting := MyNG_PLLS_Motor02.Sts_Starting1;
MyNG_PLLS_Motors[1].Sts_Running := MyNG_PLLS_Motor02.Sts_Running1;
MyNG_PLLS_Motors[1].Sts_Stopping := MyNG_PLLS_Motor02.Sts_Stopping;

/* Copy the Motor 03 Status to the PLLS array [2] */
MyNG_PLLS_Motors[2].Sts_Available := MyNG_PLLS_Motor03.Sts_Available;
MyNG_PLLS_Motors[2].Sts_Stopped := MyNG_PLLS_Motor03.Sts_Stopped;
MyNG_PLLS_Motors[2].Sts_Starting := MyNG_PLLS_Motor03.Sts_Starting1;
MyNG_PLLS_Motors[2].Sts_Running := MyNG_PLLS_Motor03.Sts_Running1;
MyNG_PLLS_Motors[2].Sts_Stopping := MyNG_PLLS_Motor03.Sts_Stopping;

/* Now execute the Lead / Lag / Standby instruction */
PLLS (MyNG_PLLS, MyNG_PLLS_Motors, 0);
```

```
/* Now take the commands coming out of PLLS and forward them to the
PMTR instances */

/* Program commands to Motor 01: */
/* Forward the Program Lock command: */
if (MyNG_PLLS_Motors[0].PCmd_Lock)
then
  MyNG_PLLS_Motors[0].PCmd_Lock := 0;
  MyNG_PLLS_Motor01.PCmd_Lock := 1;
end_if;
/* Forward the Program Unlock command: */
if (MyNG_PLLS_Motors[0].PCmd_Unlock)
then
  MyNG_PLLS_Motors[0].PCmd_Unlock := 0;
  MyNG_PLLS_Motor01.PCmd_Unlock := 1;
end_if;
/* Forward the Program Start command: */
if (MyNG_PLLS_Motors[0].PCmd_Start)
then
  MyNG_PLLS_Motors[0].PCmd_Start := 0;
  MyNG_PLLS_Motor01.PCmd_Start1 := 1;
end_if;
/* Forward the Program Stop command: */
if (MyNG_PLLS_Motors[0].PCmd_Stop)
then
  MyNG_PLLS_Motors[0].PCmd_Stop := 0;
  MyNG_PLLS_Motor01.PCmd_Stop := 1;
end_if;

/* Program commands to Motor 02: */
/* Forward the Program Lock command: */
if (MyNG_PLLS_Motors[1].PCmd_Lock)
```

```
then
  MyNG_PLLS_Motors[1].PCmd_Lock := 0;
  MyNG_PLLS_Motor02.PCmd_Lock := 1;
end_if;
/* Forward the Program Unlock command: */
if (MyNG_PLLS_Motors[1].PCmd_Unlock)
then
  MyNG_PLLS_Motors[1].PCmd_Unlock := 0;
  MyNG_PLLS_Motor02.PCmd_Unlock := 1;
end_if;
/* Forward the Program Start command: */
if (MyNG_PLLS_Motors[1].PCmd_Start)
then
  MyNG_PLLS_Motors[1].PCmd_Start := 0;
  MyNG_PLLS_Motor02.PCmd_Start1 := 1;
end_if;
/* Forward the Program Stop command: */
if (MyNG_PLLS_Motors[1].PCmd_Stop)
then
  MyNG_PLLS_Motors[1].PCmd_Stop := 0;
  MyNG_PLLS_Motor02.PCmd_Stop := 1;
end_if;

/* Program commands to Motor 03: */
/* Forward the Program Lock command: */
if (MyNG_PLLS_Motors[2].PCmd_Lock)
then
  MyNG_PLLS_Motors[2].PCmd_Lock := 0;
  MyNG_PLLS_Motor03.PCmd_Lock := 1;
end_if;
/* Forward the Program Unlock command: */
if (MyNG_PLLS_Motors[2].PCmd_Unlock)
```

```
then
  MyNG_PLLS_Motors[2].PCmd_Unlock := 0;
  MyNG_PLLS_Motor03.PCmd_Unlock := 1;
end_if;
/* Forward the Program Start command: */
if (MyNG_PLLS_Motors[2].PCmd_Start)
then
  MyNG_PLLS_Motors[2].PCmd_Start := 0;
  MyNG_PLLS_Motor03.PCmd_Start1 := 1;
end_if;
/* Forward the Program Stop command: */
if (MyNG_PLLS_Motors[2].PCmd_Stop)
then
  MyNG_PLLS_Motors[2].PCmd_Stop := 0;
  MyNG_PLLS_Motor03.PCmd_Stop := 1;
end_if;
```

PLLS Motor Sort Algorithm

To determine the order in which the motors (pumps) are started when using a Process Lead Lag Standby Motor Group (PLLS) instruction, signed integer bit patterns for each motor are sorted by numeric value. During sorting, bit patterns are evaluated in this order:

- Out of service bit
- Status value
- Priority value
- User-input value
- Preference value
- Current position value

Out of Service (Bit 31)

This bit is used to flag the motor out of service (value = 1) and automatically send it to the bottom of the list. If this bit = 0, the motor is free to operate and bits 5...30 determine its start order.

If multiple motors are out of service, bits 5...30 determine their position at the bottom of the list.

Out of service motors are not commanded and are not counted as running even if actually running.

Status Value (Bits 30...28)

The status of the motor determines the value of these bits:

- 100 - The motor is in Hand and is not available to stop
- 010 - The motor is in Auto and is free to start or stop
- 001 - The motor is Off and is not available to start

If all motors have the same value, these bits do not affect the sort; the next set of bits become the determining factor in the sort.

Priority Value (Bits 27...23)

These bits are next in the order of precedence for sorting the array list. The value of these bits corresponds to the number entered in the Motor Priority field in the Motor Configuration dialog box.

The highest priority value has a pattern of 11111 (31), the next highest priority value is 11110 (30), and so forth.

If this priority is not to be used for the sort, set the priority value to zero for every motor.

If all motors have the same value, these bits do not affect the sort; the next set of bits become the determining factor in the sort.

User-input Values (Bits 22...15)

If the Status Values are equal and the Priority values are equal, enter values in these bits to sort the motors in the array list to the desired order.

The highest user-input value has a pattern of 11111111 (255), the next highest user-input value is 11111110 (254), and so forth.

If this value is not to be used for the sort, set the value to zero for every motor.

If all motors have the same value, these bits do not affect the sort; the next set of bits become the determining factor in the sort.

Preference Value (Bits 14...10)

These bits are next in the order of precedence for determining the order of the motors in the array list. The value of these bits corresponds to the number entered in the **Motor Preference** box in the **Motor Configuration** dialog box.

The highest preference value has a pattern of 11111 (31), the next preference value is 11110 (30), and so forth.

If this value is not to be used for the sort, set the value to zero for every motor.

If all motors have the same value, these bits do not affect the sort; the next set of bits become the determining factor in the sort.

Current Position (Bits 9...5)

IMPORTANT The current position bits are the only set of bits that cannot be equal.

These bits are next in the order of precedence for determining the order of the motors in the array list. The value of these bits corresponds to the value of the current position of the motor in the list, and the value is established by the PLLS instruction. There is no user entry for this field.

- Lead motor - 11111 (31)
- First Lag motor - 11110 (30)
- Second Lag motor - 11101 (29) and so on

The Status value, Priority value, User-input value, and Preference value must be equal for all motors for the Current Position to be a determining factor in the sort.

See also

Process Lead Lag Standby Motor Group (PLLS)

Process Motor (PMTR)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Motor (PMTR) instruction monitors and controls a fixed single-speed, two-speed, or reversing motor using a full-voltage contactor or intelligent motor controller (soft starter). The motor can be run or jogged, including jogging reverse or jogging fast, as configured by the user. The interface to the hardware motor controller can be through a Device Object Interface or through individual pins. The object is a configurable, built-in combination of the existing PlantPAx P_Motor (single speed), P_Motor2Spd (two speed), P_MotorRev (reversing), and P_MotorHO (hand-operated or monitor-only) Add-on instructions in the Rockwell Automation Library of Process Objects.

Use the PMTR instruction to:

- Monitor and control a single speed, two speed, or reversing motor using a full voltage contactor (or contactor pair) or a smart motor control (soft starter). This instruction is not used with variable speed

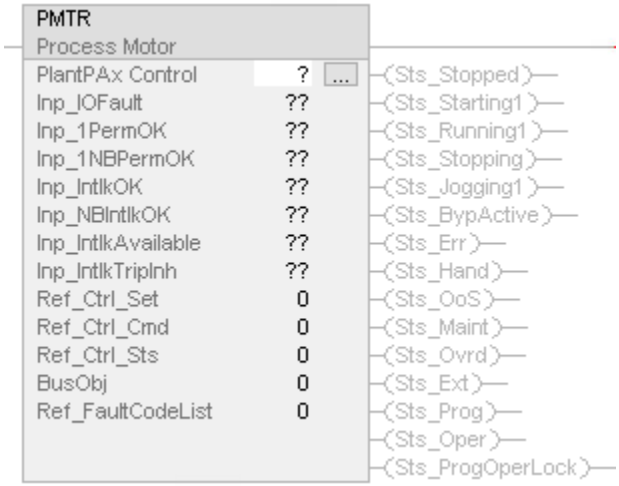
drives controlling velocity or position, and it does not use any motion axes.

- Select Operator, Program, External, Override, Maintenance, Out of Service, or Hand as the source of motor commands.
- Use the selected command source to start the motor forward.
- Use the selected command source to start the motor reverse, if configured for reversing, or start the motor at high speed, if configured for two-speed operation.
- Use the selected command source to jog the motor forward. Only Operator, External and Maintenance command sources are permitted to jog the motor.
- Use the selected command source to jog the motor reverse, if configured for reversing, or jog the motor at high speed, if configured for two-speed operation. Only Operator, External and Maintenance command sources are permitted to jog the motor.
- Monitor actual motor status, including:
  - Run feedback (including separate feedback for slow and fast for two speed operation or forward and reverse for reversing operation)
  - Motor controller ready
  - Commanded direction / speed
  - Actual direction / speed
  - Motor controller warning
  - Motor controller faulted (with fault code and description)
- Interface to a motor Device Object using a set of Power Discrete interface tags. If the interface tags are not linked (optional InOut parameters), a set of input and output parameters are used to interface to the starter or motor controller signal-by-signal.
- Search a linked Fault Code Lookup Table to provide textual motor controller fault information, or use text provided via the Power Discrete interface fault record.
- Participate in a control strategy bus (BUS_OBJ) with other devices and process instructions.
- Configure an output to pre-start warning audible (horn) with configurable alert time before starting or jogging.
- Configure virtualization, providing simulated feedback of a working motor while disabling outputs to the physical device.
- Monitor run feedback and status or alarms for failure to start in the configured time and failure to stop in the configured time.
- Monitor Permissive conditions to allow starting or jogging the motor forward / slow.
- Monitor Permissive conditions to allow starting or jogging the motor reverse / fast.
- Monitor Interlock conditions to stop and prevent starting or jogging the motor.
- Monitor I/O communication faults.

- Trigger an alarm if interlock conditions cause the motor to be stopped.
- Automatically clear latched alarms and motor controller faults when an Operator Command (Start, Stop, Jog) is received.
- Automatically clear latched alarms and motor controller faults when an External Command (Start, Stop, Jog) is received.
- Use HMI breadcrumbs for Alarm Inhibited, Bad Configuration, Not Ready, and Maintenance Bypass Active.
- Use Available status for use by automation logic to indicate whether a motor can be controlled by other objects.
- Use Alarms for Fail to Start, Fail to Stop, Interlock Trip, I/O Fault, and Motor Fault.

Available Languages

Ladder Diagram



Function Block Diagram

Structured Text

PMTR (PMTRTag, Ref_Ctrl_Set tag, Ref_Ctrl_Cmd tag, Ref_Ctrl_Sts tag, BusObj tag, Ref_FaultCodeList tag);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See *Data Conversions*.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_MOTOR_DISCRETE	tag	Data structure required for proper operation of instruction.
Ref_Ctrl_Set	RAC_ITF_DVC_PWRDISCRETE_SET	tag	Power Discrete Device Object Settings Interface.
Ref_Ctrl_Cmd	RAC_ITF_DVC_PWRDISCRETE_CMD	tag	Power Discrete Device Object Command Interface.
Ref_Ctrl_Sts	RAC_ITF_DVC_PWRDISCRETE_STS	tag	Power Discrete Device Object Status Interface.
BusObj	BUS_OBJ	tag	Bus component.
Ref_FaultCodeList	RAC_CODE_DESCRIPTION[x]	tag	Fault Code to Fault Description lookup table for intelligent motor controller.

P_MOTOR_DISCRETE Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .29 = Echo. Default is 0.
Inp_LastFaultCodeData	DINT	Not Visible	Not Required	Input	Most recent intelligent motor controller Fault Code (enumeration). Default is 0.
Inp_ReadyData	BOOL	Not Visible	Not Required	Input	1=Intelligent motor controller is ready to run. Default is true.
Inp_1RunFdbkData	BOOL	Not Visible	Not Required	Input	1=Motor is Running Forward or Slow. Default is false.
Inp_2RunFdbkData	BOOL	Not Visible	Not Required	Input	1=Motor is Running Reverse or Fast. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_AlarmData	BOOL	Not Visible	Not Required	Input	1=Intelligent motor controller has a Warning or Alarm. See controller display or manual. Default is false.
Inp_FaultedData	BOOL	Not Visible	Not Required	Input	1=Intelligent motor controller has Faulted. See controller display or manual. Default is false.
Inp_DvcNotify	SINT	Not Visible	Not Required	Input	Related device object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Inp_IOFault	BOOL	Visible	Not Required	Input	Indicates the IO data are inaccurate. 0 = The IO data are good, 1 = The IO data are bad, causing fault. If the Motor is not virtual, this input sets Sts_IOFault, which raises IOFault Alarm. Default is false.
Inp_1PermOK	BOOL	Visible	Not Required	Input	1 = Permissives OK, motor can start or jog Forward / Slow. Default is true.
Inp_1NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-Bypassable Permissives OK, motor can start or jog Forward / Slow. Default is true.
Inp_2PermOK	BOOL	Not Visible	Not Required	Input	1 = Permissives OK, motor can start or jog Reverse / Fast. Default is true.
Inp_2NBPermOK	BOOL	Not Visible	Not Required	Input	1 = Non-Bypassable Permissives OK, motor can start or jog Reverse / Fast. Default is true.
Inp_IntlkOK	BOOL	Visible	Not Required	Input	1 = Interlocks OK, motor can start or jog and keep running. Default is true.
Inp_NBIntlkOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable interlocks OK, motor can start or jog and keep running. Default is true.
Inp_IntlkAvailable	BOOL	Visible	Not Required	Input	1 = Interlock Availibility OK. Default is false.
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit Interlock Trip Status Default is false.
Inp_RdyReset	BOOL	Not Visible	Not Required	Input	1 = Related object, reset by this object, is ready to be reset. Default is false.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire Hand (typically hardwired local), 0 = Release Hand. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCmd	SINT	Not Visible	Not Required	Input	Override Command: 0 = None, 1 = Stop, 2 = Start 1 (Forward / Slow), 3 = Start2 (Reverse / Fast). Default is 0.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit audible alert, 0 = Alllow audible alert. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset Shed Latches and Cleared Alarms. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator to shelve alarms. Default is true.
Cfg_eObjType	SINT	Not Visible	Not Required	Input	Type of Motor: 0 = single-speed, 1 = reversing, 2 = 2-speed (enumeration). Default is 0.
Cfg_HasStart1	BOOL	Not Visible	Not Required	Input	1 = Motor Start1 (Forward / Slow) Command enabled and visible, 0 = Motor Start1 Command not allowed. Default is false.
Cfg_HasStart2	BOOL	Not Visible	Not Required	Input	1 = Motor Start2 (Reverse / Fast) Command enabled and visible, 0 = Motor Start2 Command not allowed. Default is false.
Cfg_HasJog1	BOOL	Not Visible	Not Required	Input	1 = Motor Jog1 (Forward / Slow) Command enabled and visible, 0 = Motor Jog1 Command not allowed. Default is false.
Cfg_HasJog2	BOOL	Not Visible	Not Required	Input	1 = Motor Jog2 (Reverse / Fast) Command enabled and visible, 0 = Motor Jog2 Command not allowed. Default is false.
Cfg_HasStop	BOOL	Not Visible	Not Required	Input	1 = Motor Stop Command enabled and visible, 0 = Instruction has no control, only monitors Motor. Default is true.
Cfg_AllowLocal	BOOL	Not Visible	Not Required	Input	1 = Allow Local Start/Stop without alarm, 0 = Start/Stop by command only. Default is false.
Cfg_HasRunFdbk	BOOL	Not Visible	Not Required	Input	1 = Motor provides feedback signal when running. Default is false.
Cfg_UseRunFdbk	BOOL	Not Visible	Not Required	Input	1 = Motor run feedback should be used for failure checking. Default is false.
Cfg_HasDvcObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a Device (e.g., overload relay) object is connected. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_Has1PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_1Perm inputs. Default is false.
Cfg_Has2PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_2Perm inputs. Default is false.
Cfg_HasIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_Intlk inputs. Default is false.
Cfg_HasResInhObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a Restart Inhibit object is connected. Default is false.
Cfg_HasRunTimeObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a Run Time / Starts object is connected. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more info is available. Default is false.
Cfg_OperStopPrio	BOOL	Not Visible	Not Required	Input	1 = OCmd_Stop accepted any time; 0 = OCmd_Stop accepted only when Oper is selected. Default is false.
Cfg_ExtStopPrio	BOOL	Not Visible	Not Required	Input	1 = XCmd_Stop accepted any time; 0 = XCmd_Stop accepted only when Ext is selected. Default is false.
Cfg_OCmdResets	BOOL	Not Visible	Not Required	Input	1 = Any Motor OCmd resets shed latches and cleared alarms; 0 = OCmdReset is required. Default is false.
Cfg_XCmdResets	BOOL	Not Visible	Not Required	Input	1 = Any Motor XCmd resets shed latches and cleared alarms; 0 = XCmdReset is required. Default is false.
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores Bypassable Perm/ Intlk; 0 = Override uses all Perm/Intlk. Default is false.
Cfg_ShedOnFailToStart	BOOL	Not Visible	Not Required	Input	1 = Stop Motor and Alarm on Fail to Start; 0 = Alarm only on Fail to Start. Default is true.
Cfg_ShedOnIOFault	BOOL	Not Visible	Not Required	Input	1 = Stop Motor and Alarm on I/O Fault; 0 = Alarm only on I/O Fault. Default is true.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator Locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program Locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	Not Visible	Not Required	Input	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator Lock, 0 = Don't override Lock. Default is true.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator Lock, 0 = Don't override Lock. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal Source: 1 = Program if no requests; 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Prog used as Level (1 = Acquire, 0 = Release). Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Lock used as a Level (1 = Lock, 0 = Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = XCmd_Acq used as Level (1 = Acquire, 0 = Release). Default is false.
Cfg_PauseTime	REAL	Not Visible	Not Required	Input	Delay in seconds with contactors open when changing speed or direction. Valid = 0.0 to 2147483.0 seconds. Default is 3.0.
Cfg_StartHornTime	REAL	Not Visible	Not Required	Input	Time in seconds to sound audible on commanded start. Valid = 0.0 to 1000.0 seconds, 0.0 = disabled. Default is 0.0.
Cfg_VirtualFdbkTime	REAL	Not Visible	Not Required	Input	Time in seconds to echo run feedback when Virtualized. Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
Cfg_FailToStartTime	REAL	Not Visible	Not Required	Input	Time in seconds after Start to receive Run Feedback before Fault. Valid = 0.0 to 2147483.0 seconds. Default is 15.0.
Cfg_FailToStopTime	REAL	Not Visible	Not Required	Input	Time in seconds after Stop to drop Run Feedback before Fault. Valid = 0.0 to 2147483,0 seconds. Default is 15.0.
Cfg_ResetPulseTime	REAL	Not Visible	Not Required	Input	Time in seconds to pulse Out_Reset to clear Motor fault. Valid = 0.0 to 2147483.0 seconds. Default is 2.0.
Cfg_MaxJogTime	REAL	Not Visible	Not Required	Input	Maximum jog time in seconds. Valid = 0.0 to 2147483.0 seconds, 0.0 = unlimited). Default is 0.0.
Cfg_eKeepStart	SINT	Not Visible	Not Required	Input	Ownership of Start commands (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_eKeepJog	SINT	Not Visible	Not Required	Input	Ownership of Jog commands (enumeration): 0 = follows CmdSrc, 1 = Operator, 3 = External. Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
Cfg_HasHistTrend	SINT	Not Visible	Not Required	Input	Has Historical Trend. This enables navigation to the Device Historical Trend Faceplate from the HMI. 0 = No external historical trend, 1 = Datalog historical trend, 2 = Historian historical trend. Default is 0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program owner request ID (non-zero) or release (zero). Default is 0.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_Start1	BOOL	Not Visible	Not Required	Input	Program command to Start Motor Forward / Slow. The instruction clears this operand automatically. Default is false.
PCmd_Start2	BOOL	Not Visible	Not Required	Input	Program command to Start Motor Reverse / Fast. The instruction clears this operand automatically. Default is false.
PCmd_Stop	BOOL	Not Visible	Not Required	Input	Program command to Stop Motor. The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program command to select Program (Operator to Program). The instruction clears this operand automatically if Cfg_PCmdProgAsLevel = 0. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program command to select Normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Not Visible	Not Required	Input	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Not Visible	Not Required	Input	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.
XCmd_Start1	BOOL	Not Visible	Not Required	Input	External command to Start Motor Forward / Slow. The instruction clears this operand automatically. Default is false.
XCmd_Start2	BOOL	Not Visible	Not Required	Input	External command to Start Motor Reverse / Fast. The instruction clears this operand automatically. Default is false.
XCmd_Stop	BOOL	Not Visible	Not Required	Input	External command to Stop Motor. The instruction clears this operand automatically. Default is false.
XCmd_Jog1	BOOL	Not Visible	Not Required	Input	External command to Jog Motor Forward / Slow. The instruction clears this operand automatically if max jog time is reached. Default is false.
XCmd_Jog2	BOOL	Not Visible	Not Required	Input	External command to Jog Motor Reverse / Fast. The instruction clears this operand automatically if max jog time is reached. Default is false.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External command to clear shed latches and cleared alarms. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Out_Run1Data	BOOL	Not Visible	Not Required	Output	1=Start/Run Motor Forward or Slow, 0=Stop Motor (for held starter type).
Out_Run2Data	BOOL	Not Visible	Not Required	Output	1=Start/Run Motor Reverse or Fast, 0=Stop Motor (for held starter type).
Out_Start1Data	BOOL	Not Visible	Not Required	Output	1=Start Motor Forward or Slow, 0=Motor left in current state.
Out_Start2Data	BOOL	Not Visible	Not Required	Output	1=Start Motor Reverse or Fast, 0=Motor left in current state.
Out_StopData	BOOL	Not Visible	Not Required	Output	1=Stop Motor, 0=Motor left in current state.
Out_ClearFaultData	BOOL	Not Visible	Not Required	Output	1=Attempt to clear Fault on intelligent motor controller.
Out_HornData	BOOL	Not Visible	Not Required	Output	1 = Sound audible prior to commanded motor start.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Stopped	BOOL	Visible	Not Required	Output	1 = Motor requested to stop and is confirmed stopped.
Sts_Starting1	BOOL	Visible	Not Required	Output	1 = Motor requested to run forward and awaiting run feedback.
Sts_Starting2	BOOL	Not Visible	Not Required	Output	1 = Motor requested to run reverse and awaiting run feedback.
Sts_Running1	BOOL	Visible	Not Required	Output	1 = Motor requested to run and is confirmed running forward.
Sts_Running2	BOOL	Not Visible	Not Required	Output	1 = Motor requested to run and is confirmed running reverse.
Sts_Stopping	BOOL	Visible	Not Required	Output	1 = Motor running / jogging requested to stop and awaiting stopped feedback.
Sts_Jogging1	BOOL	Visible	Not Required	Output	1 = Motor requested to Jog Forward.
Sts_Jogging2	BOOL	Not Visible	Not Required	Output	1 = Motor requested to Jog Reverse.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_Horn	BOOL	Not Visible	Not Required	Output	1 = Motor Audible Alert (Horn) is Active.
Sts_NotReady	BOOL	Not Visible	Not Required	Output	1 = Motor is Not Ready (cannot be started) Check alarms, stops, faults.
Sts_Alarm	BOOL	Not Visible	Not Required	Output	1 = Intelligent motor controller has an Alarm (see controller display or manual).
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction treats the Motor as virtual. The instruction acts as normal but the output is kept de-energized; 0 = The instruction operates the Motor normally. Sts_Virtual is a copy of Sts_Virtual.
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
Sts_eCmd	SINT	Not Visible	Not Required	Output	Motor Command: 0 = None, 1 = Stop, 2 = Start 1, 3 = Start 2, 4 = Jog 1, 5 = Jog 2.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Motor Feedback Status: 0 = Stopped, 1 = Running 1 (forward, slow), 2 = Running 2 (reverse, fast), 3 = Invalid (both feedbacks received)
Sts_eSts	SINT	Not Visible	Not Required	Output	Motor Status: 0 = Unknown, 1 = Stopped, 2 = Running 1, 3 = Running 2, 4 = Starting 1, 5 = Starting 2, 6 = Jogging 1, 7 = Jogging 2, 8 = Stopping, 14 = Horn, 15 = Out of Service.
Sts_eFault	SINT	Not Visible	Not Required	Output	Motor Fault Status: 0 = None, 15 = Interlock Trip, 16 = Fail to Start, 17 = Fail to Stop, 18 = Motor Fault, 32 = I/O Fault, 34 = Config Error.
Sts_eNotify	SINT	Not Visible	Not Required	Output	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyIOFault	SINT	Not Visible	Not Required	Output	IOFault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFailToStart	SINT	Not Visible	Not Required	Output	Fail to Start alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFailToStop	SINT	Not Visible	Not Required	Output	Fail to Stop alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	Not Visible	Not Required	Output	IntlkTrip alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyMotorFault	SINT	Not Visible	Not Required	Output	Motor Fault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_eFaultCode	DINT	Not Visible	Not Required	Output	First Trip Code after reset. See Motor manual or Power Discrete Object for description.
Sts_eSrc	INT	Not Visible	Not Required	Output	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.
Sts_bSrc	INT	Not Visible	Not Required	Output	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed Out of Service (rung false), Sts_bSrc.2: Maintenance Out of Service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Motor has been acquired by Program and is now available for start/stop control.
Sts_IntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Motor can be acquired by Program and is available for start/stop control when interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks are bypassed.
Sts_BypActive	BOOL	Visible	Not Required	Output	1 = Interlock bypassing active (bypassed or maintenance).

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	Not Visible	Not Required	Output	1 = Device is not ready, see detail bits (Sts_Nrdyxxx) for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Configuration error.
Sts_NrdyDvcNotReady	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Intelligent motor controller Not Ready.
Sts_NrdyFail	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Device failure (Shed requires Reset).
Sts_NrdyIntlk	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Interlock not OK.
Sts_NrdyIOFault	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: IO Fault (Shed requires Reset).
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Device disabled by Maintenance.
Sts_Nrdy1Perm	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Permissive 1 not OK.
Sts_Nrdy2Perm	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Permissive 2 not OK.
Sts_NrdyPrioStop	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Operator or External priority Stop command requires reset.
Sts_NrdyTrip	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Device Tripped, intelligent motor controller fault requires Reset.
Sts_Err	BOOL	Visible	Not Required	Output	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in Logix tag-based alarm settings.
Sts_ErrPauseTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Invalid Pause time: use 0 to 2147483.
Sts_ErrVirtualFdbkTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Virtual feedback echo time: use 0 to 2147483.
Sts_ErrFailToStartTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Fail to Start timer preset: use 0 to 2147483.
Sts_ErrFailToStopTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Fail to Stop timer preset: use 0 to 2147483.
Sts_ErrResetPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Reset Pulse timer preset: use 0 to 2147483.
Sts_ErrMaxJogTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Maximum Jog Time timer preset: use 0 to 2147483.
Sts_Hand	BOOL	Visible	Not Required	Output	1 = Hand is selected (supersedes OoS, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	Visible	Not Required	Output	1 = Out of Service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	Visible	Not Required	Output	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	Visible	Not Required	Output	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	Visible	Not Required	Output	1 = External is selected (supersedes Program and Operator).
Sts_Prog	BOOL	Visible	Not Required	Output	1 = Program is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program is selected and Locked.
Sts_Oper	BOOL	Visible	Not Required	Output	1 = Operator is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator is selected and Locked.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Visible	Not Required	Output	Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selection equals the Normal (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Program request inhibited, cannot get to Program from current state.
Sts_CmdConflict	BOOL	Not Visible	Not Required	Output	1 = Conflicting commands received this scan.
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = An alarm is shelved or disabled.
Sts_IOFault	BOOL	Not Visible	Not Required	Output	I/O Fault status: 1 = Bad, 0 = OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PMTRTag.@Alarms.Alm_IOFault.AlarmElement.
Sts_FailToStart	BOOL	Not Visible	Not Required	Output	1 = Motor failed to Start. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PMTRTag.@Alarms.Alm_FailToStart.AlarmElement.
Sts_FailToStop	BOOL	Not Visible	Not Required	Output	1 = Motor failed to Stop. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PMTRTag.@Alarms.Alm_FailToStop.AlarmElement.
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Motor stopped by an interlock Not OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PMTRTag.@Alarms.Alm_IntlkTrip.AlarmElement.
Sts_MotorFault	BOOL	Not Visible	Not Required	Output	1 = Intelligent Motor Control Fault. See control device display or user manual.
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Not Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_Start1	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Start1, enable button.
XRdy_Start2	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Start2, enable button.
XRdy_Jog1	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Jog1, enable button.
XRdy_Jog2	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Jog2, enable button.
XRdy_Stop	BOOL	Visible	Not Required	Output	1 = Ready for XCmd_Stop, enable button.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable button.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable button.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object owner ID (0 = not owned).

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control or Command Source Selection.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance command to bypass all bypassable interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_Check	BOOL	Maintenance command to check (not bypass) all interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
OCmd_Jog1	BOOL	Operator command to Jog Motor Forward / Slow. The instruction clears this operand automatically if max jog time is reached. Default is false.
OCmd_Jog2	BOOL	Operator command to Jog Motor Reverse / Fast. The instruction clears this operand automatically if max jog time is reached. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
OCmd_ResetAckAll	BOOL	Operator command to acknowledge and reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is false.
OCmd_Start1	BOOL	Operator command to Start Motor Forward / Slow. The instruction clears this operand automatically. Default is false.
OCmd_Start2	BOOL	Operator command to Start Motor Reverse / Fast. The instruction clears this operand automatically. Default is false.
OCmd_Stop	BOOL	Operator command to Stop Motor. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display. Default is 0.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_Jog1	BOOL	1 = Ready for OCmd_Jog1, enable HMI button.
ORdy_Jog2	BOOL	1 = Ready for OCmd_Jog2, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
ORdy_ResetAckAll	BOOL	1 = A latched alarm or shed condition is ready to be reset or acknowledged.
ORdy_Start1	BOOL	1 = Ready for OCmd_Start1, enable HMI button.
ORdy_Start2	BOOL	1 = Ready for OCmd_Start2, enable HMI button.
ORdy_Stop	BOOL	1 = Ready for OCmd_Stop, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
Sts_FaultDesc	STRING	Description of intelligent motor controller fault, lookup from last fault code.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Ref_Ctrl_Set	RAC_ITF_DVC_PWRDISCRETE_SET	Visible	Required	InOut	Discrete Power Automation Device Object Settings Interface.
Ref_Ctrl_Cmd	RAC_ITF_DVC_PWRDISCRETE_CMD	Visible	Required	InOut	Discrete Power Automation Device Object Command Interface.
Ref_Ctrl_Sts	RAC_ITF_DVC_PWRDISCRETE_STS	Visible	Required	InOut	Discrete Power Automation Device Object Status Interface.
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component
Ref_FaultCodeList	RAC_CODE_DESCRIPTION[1]	Visible	Required	InOut	Fault Code to Fault Description lookup table for intelligent motor controller.

RAC_ITF_DVC_PWRDISCRETE_SET Structure

The RAC_ITF_DVC_PWRDISCRETE_SET structure is the first of three structures exchanged with the associated Power Discrete Device Object to interface with the intelligent motor control device. This structure handles settings, such as the Command Inhibit, sent to the motor controller.

This parameter is used to link the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, other pins on the instruction are used to link the necessary data.

Members	Data Type	Description
InhibitCmd	BOOL	1=Inhibit user Commands from external sources; 0=AllowControl
InhibitSet	BOOL	1=Inhibit user Settings from external sources; 0=Allow

RAC_ITF_DVC_PWRDISCRETE_CMD Structure

The RAC_ITF_DVC_PWRDISCRETE_CMD structure is the second of three structures exchanged with the associated Power Discrete Device Object to interface with the intelligent motor control device. This structure handles commands, such as the start, stop, direction, and speed, sent to the motor controller. It is an InOut parameter configured as optional (May Be Null).

This parameter is used to link the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, other pins on the instruction are used to link the necessary data.

Members	Data Type	Description
bCmd	INT	Commands (Bit Overlay)
Physical	BOOL	Operate as a physical device
Virtual	BOOL	Operate as a virtual device
ResetWarn	BOOL	Reset Warning Status
ResetFault	BOOL	Reset Fault Status
Activate	BOOL	Activate Output Power Structure
Deactivate	BOOL	DeActivate Output Power Structure
CmdDir	BOOL	Command Direction; 0=Forward, 1=Reverse
Jog	BOOL	Jog Command
Fast	BOOL	Fast speed of a two-speed device
Slow	BOOL	Slow Speed of a two-speed device

RAC_ITF_DVC_PWRDISCRETE_STS Structure

The RAC_ITF_DVC_PWRDISCRETE_STS structure is the third of three structures exchanged with the associated Power Discrete Device Object to

interface with the intelligent motor control device. This structure handles status, such as the run feedback, connection status, commanded and actual direction, received from the motor controller. It is an InOut parameter configured as optional (May Be Null).

This parameter is used to link the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, other pins on the instruction are used to link the necessary data.

Members	Data Type	Description
eState	DINT	Enumerated state value: 0=Unused 1=Initializing 2=Disconnected 3=Disconnecting, 4=Connecting, 5=Idle, 6=Configuring, 7=Available
FirstWarning	RAC_UDT_EVENT	First Warning
FirstFault	RAC_UDT_EVENT	First Fault
eCmdFail	DINT	Enumerated command failure code
bSts	INT	Status (Bit Overlay)
Physical	BOOL	1=Operating as a physical device
Virtual	BOOL	1=Operating as a virtual device
Connected	BOOL	Connected Status
Available	BOOL	Available Status
Warning	BOOL	Warning
Faulted	BOOL	Faulted
Ready	BOOL	1=Device is active (Power Structure Active)
Active	BOOL	1=Device is active (Power Structure Active)
CmdDir	BOOL	Command direction; 1=Reverse, 0=Forward
ActDir	BOOL	Actual direction; 1=Reverse, 0=Forward
CmdSpd	BOOL	1 = Motor is Commanded to run fast 0 = slow
Fast	BOOL	Fast speed selected (two-speed device)
Slow	BOOL	Slow speed selected (two-speed device)

BUS_OBJ Structure

The BUS_OBJ structure is used to link the motor to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices, and items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter is used to link the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the

data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

RAC_CODE_DESCRIPTION[x] Structure

The RAC_CODE_DESCRIPTION[x] structure is an array of intelligent motor controller fault code number and fault code description pairs, used as a lookup table. The instruction searches the table for the fault code received from the motor controller and displays the corresponding fault description text.

This parameter is used to link the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the fault code lookup function is not performed. Fault descriptions will only be shown if provided through the Device Object Status interface.

Members	Data Type	Description
Code	DINT	Code for which to look up Description
Desc	STRING	Description for given Code

RAC_EVENTStructure

RAC_EVENTstructures are used by the FirstFault and FirstWarning members in the RAC_ITF_DVC_PWRDISCRETE_STS structure. These items hold the event data received from the intelligent motor controller for the first fault and first warning records in the motor controller event history.

Members	Data Type	Description
Type	DINT	1 = Status 2 = Warning 3 = Fault 4 ...n = User
ID	DINT	User definable event ID
Category	DINT	User definable category (Electrical,Mechanical,Materials,Utility,etc.)
Action	DINT	User definable event action code
Value	DINT	User definable event value or fault code
Message	STRING	Event message text
EventTime_L	LINT	Timestamp
EventTime_D	DINT[7]	Timestamp (Y,M,D,h,m,s,us)

Alarms

Discrete Logix tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_FailToStart	Alm_FailToStart	Motor failed to start within the allotted time when commanded to start
Sts_FailToStop	Alm_FailToStop	Motor failed to stop within the allotted time when commanded to stop
Sts_IntlkTrip	Alm_IntlkTrip	Motor stopped by an Interlock Not OK
Sts_IOFault	Alm_IOFault	Motor communication with controller failed
Sts_MotorFault	Alm_MotorFault	The motor controller is reporting it has a fault condition

Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Use this format to access alarm elements:

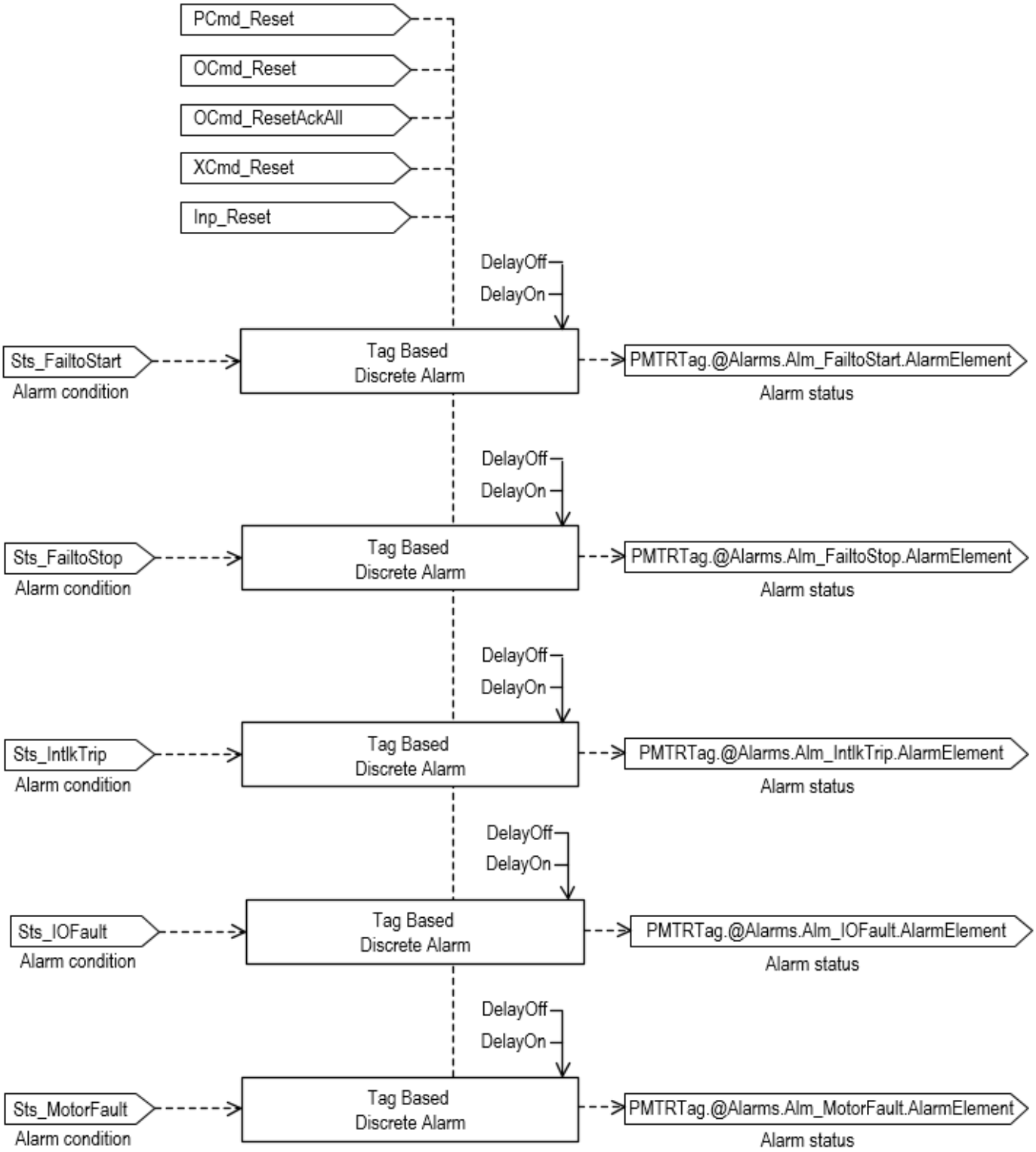
Tag.@Alarms.AlarmName.AlarmElement

The PMTR instruction uses these alarms:

- Raises the Fail to Start alarm when the motor is commanded to start but run feedback is not received within the configured failure time.
- Raises the Fail to Stop alarm when the motor is commanded to stop but run feedback does not drop within the configured failure time.
- Raises the Interlock Trip alarm when the motor is running and an interlock not-OK condition causes the motor to stop. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.
- Raises the I/O Fault alarm when I/O communication with the motor controller or other I/O device is lost. For the Power Discrete Device interface, this is detected when the Ref_Ctrl_Sts.Connected bit goes false (to 0). For the discrete signal interface, used when Ref_Ctrl_Sts is NULL, this is detected when Inp_IOFault goes true (to 1).
- Raises the Motor Fault alarm when the motor controller reports a faulted condition. For the Power Discrete Device interface, this is detected when the Ref_Ctrl_Sts.Faulted bit goes true (to 1). For the

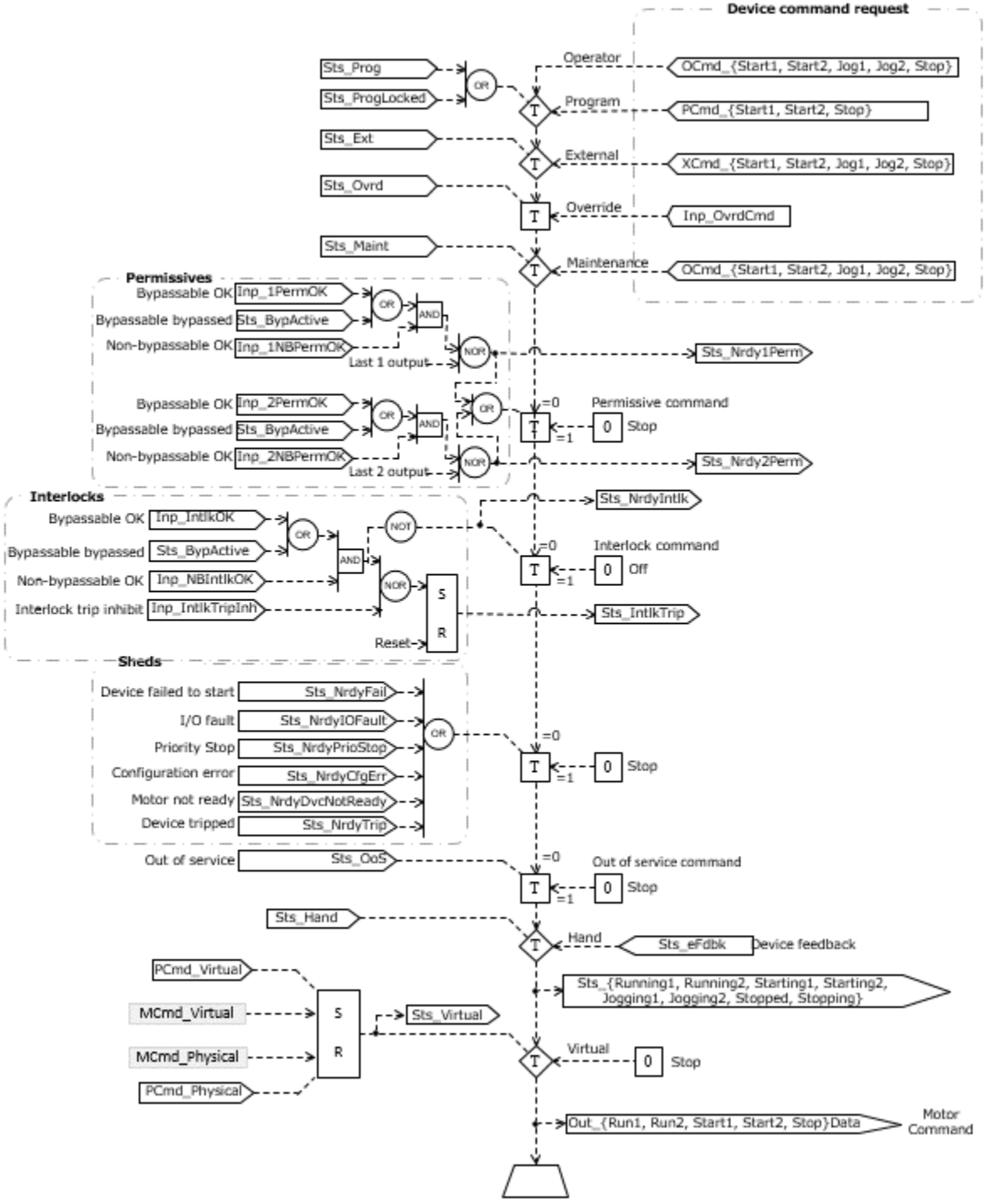
discrete signal interface, which is used when Ref_Ctrl_Sts is NULL, this is detected when Inp_Faulted goes true (to 1).

Program, Operator, and External commands enable the Reset of latched alarms, and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PMTR instruction.



Operation

This diagram illustrates functionality of the PMTR instruction:



Operator command request confirmation

The PMTR instruction enables these operator command requests:

- OCmd_Jog1

- OCmd_Jog2
- OCmd_Start1
- OCmd_Start2
- OCmd_Stop

Enforced security might require the request to be confirmed or canceled before the selected command executes. The instruction checks the security rules inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd=0 no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd=1 the instruction waits for confirmation OCmd_CmdCnfrm=1 and/or cancellation. For Cfg_CnfrmReqd=2 or 3, eSignature is needed before the confirmation and cancellation is enabled.

For more information on command sources, see *Process Motor (PMTR) Command Source*.

Virtualization

Use virtualization for instruction testing and operator training. Command to virtual operation using program command PCmd_Virtual or maintenance command MCmd_Virtual. After finishing virtual operation, use program command PCmd_Physical or maintenance command MCmd_Physical to return to normal physical device operation.

When Virtualization is active, the outputs of the PMTR instruction hold at 0, virtual feedback of a working device is provided, and I/O faults are ignored. The setting of Cfg_VirtualFdbkTime operand determines the time delay between a command to start or stop the device and the echo of the running or stopped status. Manipulate the instruction to operate as if a working motor is present.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FactoryTalk View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items.

- Description
- Label for graphic symbol

- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- More Information
- Running 1 Text
- Running 2 Text
- Name of Fail to Start Alarm
- Name of Fail to Stop Alarm
- Name of Interlock Trip Alarm
- Name of I/O Fault Alarm
- Name of Motor Fault Alarm

Implementation

The PMTR instruction monitors and controls a discrete motor. The start, stop and jog commands to the motor can come from a variety of sources, determined by an embedded instance of PCMDSRC. Available command sources are:

- Operator, through the HMI
- Program, through logic connected to the block
- External, through logic connected to the block
- Override, through logic connected to the block
- Maintenance, through the HMI
- Out of Service
- Hand (assumes the block has no control of the motor, so aligns with the actual motor status in order to achieve bumpless transfer from Hand back to one of the other command sources)

The PMTR instruction has two aspects, which can be kept by a particular command source whenever the command source selection is Operator, Program or External. Either or both of the aspects can be kept at any given time, or can follow the selection of the PCMDSRC. The aspects are:

- Start1 and Start2 commands
- Jog1 and Jog2 commands

The Jog commands cannot be kept by the Program command source.

The PMTR instruction supports virtualization. When selected to Virtual, the instruction provides status to the operator and other blocks as if a working motor were connected while keeping the outputs to the physical motor de-energized (zero). When selected to Physical, the instruction monitors and controls the physical motor device. Use Virtualization to provide off-process functional testing of higher-level control strategies or simulation for operator training.

The PMTR instruction supports interlocks, conditions that must be OK for the motor to run and which stop the motor if not OK, and permissives, conditions that must be OK for the motor to start but which are ignored once the motor is running. Bypassable permissives and interlocks can be bypassed for maintenance, while non-bypassble interlocks and permissives are always evaluated.

The PMTR instruction supports a bus for forwarding commands (fanout) and gathering status (rollup) in a hierarchy of objects. Refer to the Bus Object for more information on the commands and status (including alarm status) sent on the bus.

The PMTR instruction optionally supports the ability to look up the text to display for the most recent intelligent motor controller fault code, given a provided fault code lookup table. This table is an array of Code and Description pairs and is searched whenever the last fault code from the motor controller changes.

The PMTR instruction interface to the physical motor can be through a Power Discrete Device Object interface or by connecting individual motor controller signals to input and output pins of the instruction. Details on the Power Discrete Device Object interface are given below. Three interface tags are used, provided as InOut Parameters. These tags provide motor Settings, motor Commands, such as start forward, jog reverse and stop, and retrieve motor Status, such as connected, active (running), commanded direction and speed, actual direction and speed, warning, faulted, and extended motor controller warning and fault information.

PMTR Motor Settings: Ref_Ctrl_Set InOut Parameter (RAC_ITF_DVC_PWRDISCRETE_SET) Structure

Private Input Members	Data Type	Description
InhibitCmd	BOOL	1 = Inhibit user Commands from external sources; 0 = Allow control.
InhibitSet	BOOL	1 = Inhibit user Settings from external source, 0 = Allow.

PMTR Motor Commands: Ref_Ctrl_Cmd InOut Parameter (RAC_ITF_DVC_PWRDISCRETE_CMD) Structure

Private Input Members	Data Type	Description
bCmd	INT	Commands (bit overlay), consisting of:
Physical	BOOL	Operate as a Physical device
Virtual	BOOL	Operate as a Virtual device
ResetWarn	BOOL	Reset Warning status
ResetFault	BOOL	Reset Fault status
Activate	BOOL	Activate Output Power Structure (if speed reference is not zero, the motor will run)
Deactivate	BOOL	Deactivate Output Power Structure (motor will stop)
CmdDir	BOOL	Commanded Direction, 0 = Forward

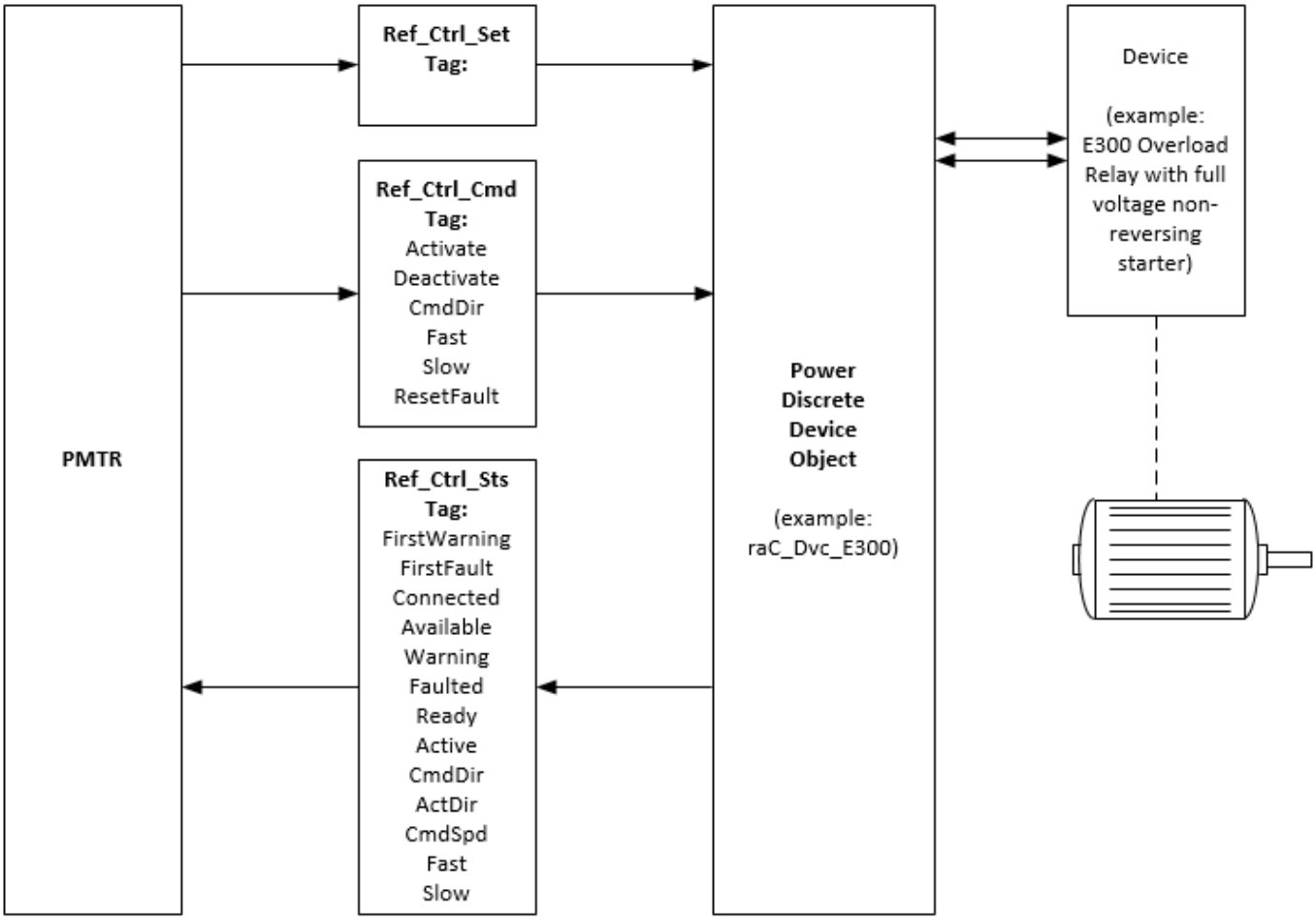
Private Input Members	Data Type	Description
Jog	BOOL	Jog Command
Fast	BOOL	Fast speed of a two-speed device
Slow	BOOL	Slow Speed of a two-speed device

PMTR Motor Status: Ref_Ctrl_Sts InOut Parameter (RAC_ITF_DVC_PWRDISCRETE_STS) Structure

Private Input Members	Data Type	Description
eState	DINT	Enumerated state value: 0 = unused, 1 = Initializing, 2 = Disconnected, 3 = Disconnecting, 4 = Connecting, 5 = Idle, 6 = Configuring, 7 = Available
FirstWarning	RAC_ITF_EVENT	First Warning, consisting of:
Type	DINT	1 = Status, 2 = Warning, 3 = Fault, 4 ... n = User
ID	DINT	User definable event ID
Category	DINT	User definable category (electrical, mechanical, materials, utility, etc.)
Action	DINT	User definable event action code
Value	DINT	User definable event value or fault code
Message	STRING	Event message text
EventTime_L	LINT	Timestamp
EventTime_D	DINT[7]	Timestamp (Yr, Mo, Da, Hr, Min, Sec, Microsec)
FirstFault	RAC_ITF_EVENT	First Fault, consisting of:
Type	DINT	1 = Status, 2 = Warning, 3 = Fault, 4 ... n = User
ID	DINT	User definable event ID
Category	DINT	User definable category (electrical, mechanical, materials, utility, etc.)
Action	DINT	User definable event action code
Value	DINT	User definable event value or fault code
Message	STRING	Event message text
EventTime_L	LINT	Timestamp
EventTime_D	DINT[7]	Timestamp (Yr, Mo, Da, Hr, Min, Sec, Microsec)
eCmdFail	DINT	Enumerated command failure code
bSts	INT	Status, consisting of:
Physical	BOOL	1 = Operating as a physical device
Virtual	BOOL	1 = Operating as a virtual device
Connected	BOOL	Connected status
Available	BOOL	Available status
Warning	BOOL	Device Warning
Faulted	BOOL	Device Faulted
Ready	BOOL	1 = Device is ready (can be activated)
Active	BOOL	1 = Device is active (power structure active, running)
CmdDir	BOOL	Commanded direction: 1 = reverse, 0 = forward
ActDir	BOOL	Actual direction (of rotation): 1 = reverse, 0 = forward
CmdSpd	BOOL	1 = Motor is Commanded to run fast 0 = slow
Fast	BOOL	Fast speed selected (two-speed device)

Private Input Members	Data Type	Description
Slow	BOOL	Slow speed selected (two-speed device)

This illustration shows the relationship between a PMTR instance and its associated Power Discrete Device Object.



Monitor the PMTR Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See *Index Through Arrays* for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor state is evaluated and the instruction aligns with the current state of the motor, as if the Hand command source were selected.
Rung-condition-in is false	Handled the same as if the motor is taken Out of Service by command. The motor outputs are de-energized, and the motor Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. The rung-condition-out continues as false.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor state is evaluated and the instruction aligns with the current state of the motor, as if the Hand command source were selected.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the motor is taken Out of Service by command. The motor outputs are de-energized, and the motor Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. EnableOut is set to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

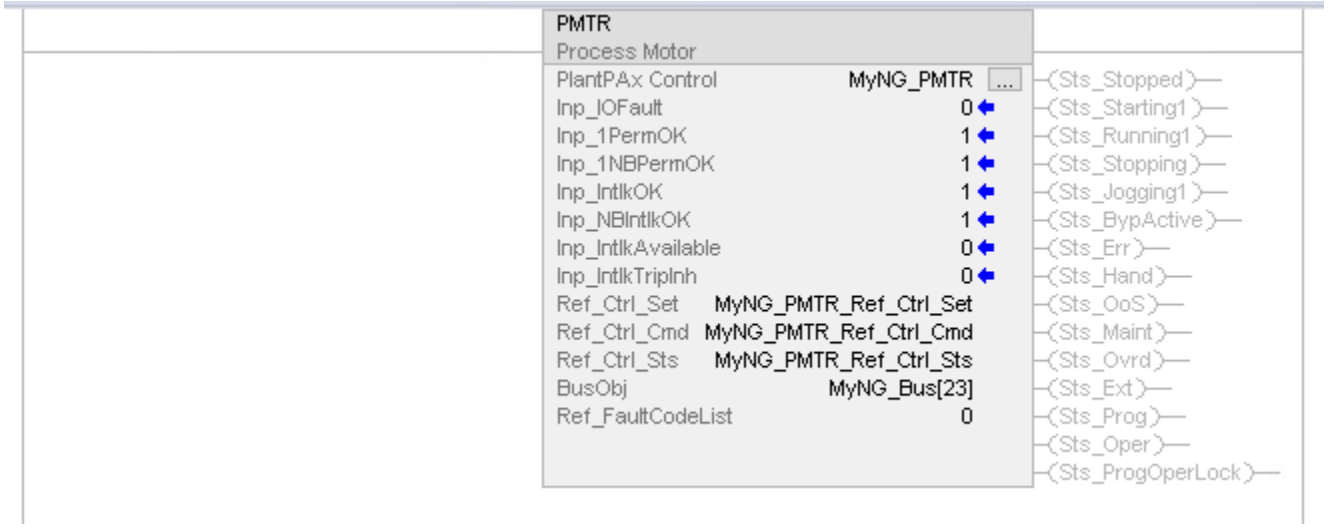
Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

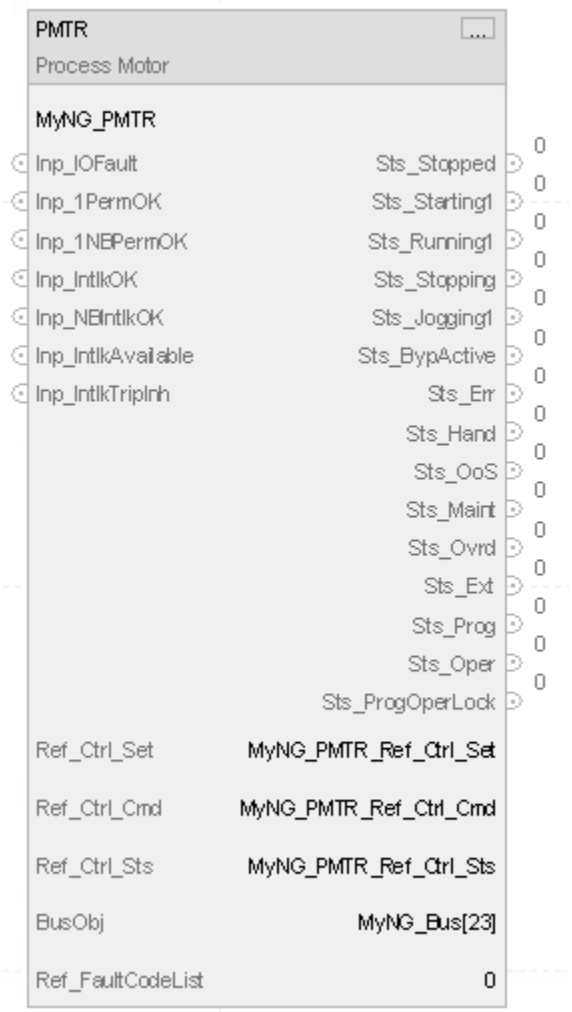
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

Ladder Diagram



Function Block Diagram



Structured Text

PMTR(MyNG_PMTR, MyNG_PMTR_Ref_Ctrl_Set, MyNG_PMTR_Ref_Ctrl_Cmd, MyNG_PMTR_Ref_Ctrl_Sts, MyNG_Bus[23], 0)

PMTR Command Source

The Process Motor (PMTR) instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled and accepts no device commands.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.

Command Source	Description
External	External logic (for exapmle, field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)
- XCmd_Acq used as a Level (1 = Acquire, 0 = release)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enable control sources as Configuration

The user can enable and disable individual control sources. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

Unless specifically configured as Level, above, all commands are treated as one-shot-latched (Edge). Commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Program state is disabled, the destination of the OCmd_Prog command becomes the Program Locked state instead of the Program state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated then there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override

- Maintenance
- Out-of-Service
- In-Service
- Hand

Process n-Position Device (PNPOS)

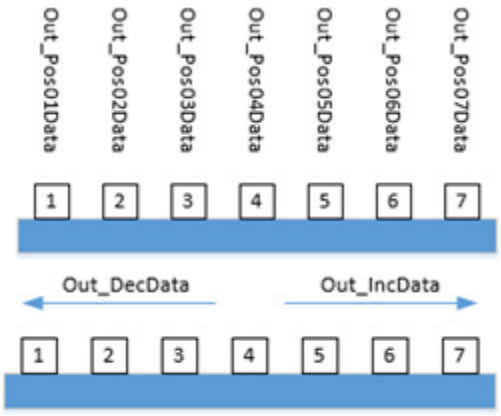
This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process n-Position Device (PNPOS) instruction controls and monitors feedback from a circular or linear discrete device with up to 30 positions. The PNPOS instruction provides outputs to select an individual position and outputs to move toward increasing positions (clockwise for a circular device) or decreasing positions (counterclockwise for a circular device).

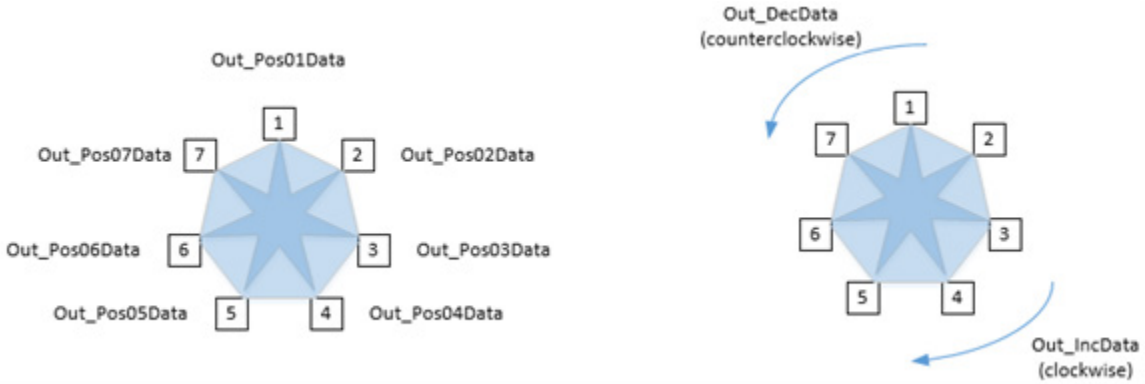
Basic functionality

These drawings illustrate the basic functionality of the PNPOS instruction.

Linear Device Outputs (7-position device):



Circular Device Outputs (7-position device):



For linear devices, the PNPOS instruction can be configured to return to Position 1 on every move, approaching the target position from the same side on each move to improve position repeatability, or move directly to the new position.

For circular devices, the PNPOS instruction can be configured to move only clockwise to increase positions (for example, 28, 29, 30, 1, 2…) or both directions by using the shortest move (for example, clockwise from 28 to 1: 28, 29, 30, 1; or counterclockwise from 2 to 29: 2, 1, 30, 29).

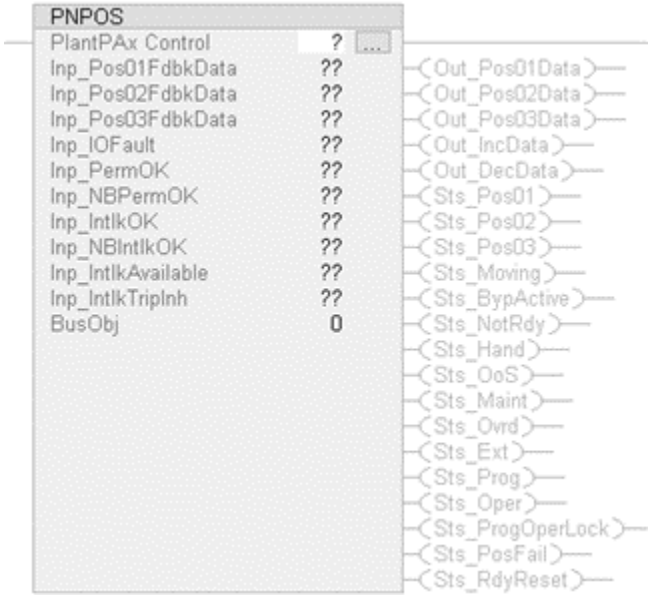
Use the PNPOS instruction to:

- Control and monitor a multi-position device (up to thirty positions), such as rotary valves, and other devices with multiple fixed positions.
- Monitor limit switches or other position feedback and display actual device position.
- Check for failure to reach the requested position within a configured time. Provide Alarm on Position Failure.
- Monitor Permissive conditions to allow moving to a new position.
- Monitor Interlock conditions to de-energize the device, or to request the device to return to Position 1. Provide an Interlock Trip Alarm if an interlock condition causes the device to de-energize or return to Position 1.
- Provide outputs to request each position and provide outputs for increasing and decreasing position.
- Provide outputs to sequence indexing cylinders for devices that use pneumatic or hydraulic devices to step through positions. The cylinders work in an Extend, Shift, Retract, Shift sequence to engage the device, and step it to the next position. The cylinder sequence reverses the Shift directions when driving circular devices counterclockwise (for devices that support bidirectional operation).
- Optionally provide handling of a position lock or seal that must be driven to an unlocked or unsealed state before moving the device and returned to a locked or sealed state after the move is completed.
- Provide capability for maintenance personnel to take the device out of service.
- If the optional lock or seal is used, provide position feedback for the lock or seal to verify the locked or unlocked state at appropriate times. Provide Alarm for Lock Failure.
- Provide a virtualization capability, responding as if a working device were present while keeping outputs de-energized. The virtualization capability can be used for activities such as system testing, operator training, or as part of a full process virtualization.
- Monitor for I/O communication faults and provide an I/O Fault Alarm.
- Provide an Available status for use by automation logic so the logic knows when it has control of the device.

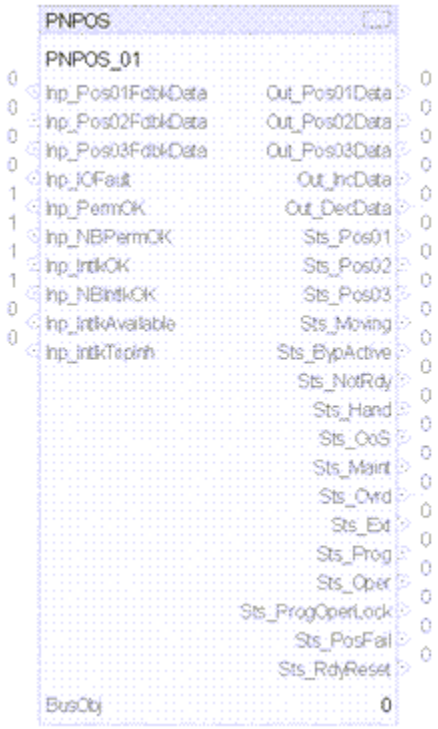
- Provide maintenance capabilities, such as the ability to bypass any bypassable interlocks or permissives or temporarily disable feedback checking.
- Operate from Hand, Maintenance, Override, External, Program, and Operator command sources.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PNPOS(PNPOSTag, BusObj);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx ControlPlantPAx Control	P_DISCRETE_N_POSITION	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component.

P_DISCRETE_N_POSITION Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command (bitmapped): All bits off = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .29 = Echo. Default is 0.
Inp_Pos01FdbkData	BOOL	Visible	Not Required	Input	Position 1 feedback: 1 = Device is confirmed at Position 1. Default is false.
Inp_Pos02FdbkData	BOOL	Visible	Not Required	Input	Position 2 feedback: 1 = Device is confirmed at Position 2. Default is false.
Inp_Pos03FdbkData	BOOL	Visible	Not Required	Input	Position 3 feedback: 1 = Device is confirmed at Position 3. Default is false.
Inp_Pos04FdbkData	BOOL	Not Visible	Not Required	Input	Position 4 feedback: 1 = Device is confirmed at Position 4. Default is false.
Inp_Pos05FdbkData	BOOL	Not Visible	Not Required	Input	Position 5 feedback: 1 = Device is confirmed at Position 5. Default is false.
Inp_Pos06FdbkData	BOOL	Not Visible	Not Required	Input	Position 6 feedback: 1 = Device is confirmed at Position 6. Default is false.
Inp_Pos07FdbkData	BOOL	Not Visible	Not Required	Input	Position 7 feedback: 1 = Device is confirmed at Position 7. Default is false.
Inp_Pos08FdbkData	BOOL	Not Visible	Not Required	Input	Position 8 feedback: 1 = Device is confirmed at Position 8. Default is false.
Inp_Pos09FdbkData	BOOL	Not Visible	Not Required	Input	Position 9 feedback: 1 = Device is confirmed at Position 9. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_Pos10FdbkData	BOOL	Not Visible	Not Required	Input	Position 10 feedback: 1 = Device is confirmed at Position 10. Default is false.
Inp_Pos11FdbkData	BOOL	Not Visible	Not Required	Input	Position 11 feedback: 1 = Device is confirmed at Position 11. Default is false.
Inp_Pos12FdbkData	BOOL	Not Visible	Not Required	Input	Position 12 feedback: 1 = Device is confirmed at Position 12. Default is false.
Inp_Pos13FdbkData	BOOL	Not Visible	Not Required	Input	Position 13 feedback: 1 = Device is confirmed at Position 13. Default is false.
Inp_Pos14FdbkData	BOOL	Not Visible	Not Required	Input	Position 14 feedback: 1 = Device is confirmed at Position 14. Default is false.
Inp_Pos15FdbkData	BOOL	Not Visible	Not Required	Input	Position 15 feedback: 1 = Device is confirmed at Position 15. Default is false.
Inp_Pos16FdbkData	BOOL	Not Visible	Not Required	Input	Position 16 feedback: 1 = Device is confirmed at Position 16. Default is false.
Inp_Pos17FdbkData	BOOL	Not Visible	Not Required	Input	Position 17 feedback: 1 = Device is confirmed at Position 17. Default is false.
Inp_Pos18FdbkData	BOOL	Not Visible	Not Required	Input	Position 18 feedback: 1 = Device is confirmed at Position 18. Default is false.
Inp_Pos19FdbkData	BOOL	Not Visible	Not Required	Input	Position 19 feedback: 1 = Device is confirmed at Position 19. Default is false.
Inp_Pos20FdbkData	BOOL	Not Visible	Not Required	Input	Position 20 feedback: 1 = Device is confirmed at Position 20. Default is false.
Inp_Pos21FdbkData	BOOL	Not Visible	Not Required	Input	Position 21 feedback: 1 = Device is confirmed at Position 21. Default is false.
Inp_Pos22FdbkData	BOOL	Not Visible	Not Required	Input	Position 22 feedback: 1 = Device is confirmed at Position 22. Default is false.
Inp_Pos23FdbkData	BOOL	Not Visible	Not Required	Input	Position 23 feedback: 1 = Device is confirmed at Position 23. Default is false.
Inp_Pos24FdbkData	BOOL	Not Visible	Not Required	Input	Position 24 feedback: 1 = Device is confirmed at Position 24. Default is false.
Inp_Pos25FdbkData	BOOL	Not Visible	Not Required	Input	Position 25 feedback: 1 = Device is confirmed at Position 25. Default is false.
Inp_Pos26FdbkData	BOOL	Not Visible	Not Required	Input	Position 26 feedback: 1 = Device is confirmed at Position 26. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_Pos27FdbkData	BOOL	Not Visible	Not Required	Input	Position 27 feedback: 1 = Device is confirmed at Position 27. Default is false.
Inp_Pos28FdbkData	BOOL	Not Visible	Not Required	Input	Position 28 feedback: 1 = Device is confirmed at Position 28. Default is false.
Inp_Pos29FdbkData	BOOL	Not Visible	Not Required	Input	Position 29 feedback: 1 = Device is confirmed at Position 29. Default is false.
Inp_Pos30FdbkData	BOOL	Not Visible	Not Required	Input	Position 30 feedback: 1 = Device is confirmed at Position 30. Default is false.
Inp_LockFdbkData	BOOL	Not Visible	Not Required	Input	1 = Device is confirmed locked/sealed in position. Default is false.
Inp_UnlockFdbkData	BOOL	Not Visible	Not Required	Input	1 = Device is confirmed unlocked/unsealed and is free to move. Default is false.
Inp_CylExtFdbkData	BOOL	Not Visible	Not Required	Input	1 = Device indexing cylinder is confirmed extended. Default is false.
Inp_CylRetrFdbkData	BOOL	Not Visible	Not Required	Input	1 = Device indexing cylinder is confirmed retracted. Default is false.
Inp_CylLeftFdbkData	BOOL	Not Visible	Not Required	Input	1 = Device indexing cylinder is confirmed in left (increasing) position. Default is false.
Inp_CylRightFdbkData	BOOL	Not Visible	Not Required	Input	1 = Device indexing cylinder is confirmed in right (decreasing) position. Default is false.
Inp_IOFault	BOOL	Visible	Not Required	Input	1 = I/O communication is faulted, 0 = I/O communication is OK. Default is false.
Inp_PermOK	BOOL	Visible	Not Required	Input	1 = Permissives are OK, device can energize. Default is true.
Inp_NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable permissives are OK, device can energize. Default is true.
Inp_IntlkOK	BOOL	Visible	Not Required	Input	1 = Interlocks are OK, device can energize, 0 = Interlocks are not OK, device must de-energize or drive to Position 1. Default is true.
Inp_NBIntlkOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable interlocks OK, device can energize, 0 = Interlocks are not OK, device must de-energize or drive to Position 1. Default is true.
Inp_IntlkAvailable	BOOL	Visible	Not Required	Input	1 = Interlock availability is OK, show Sts_IntlkAvailable if device is ready except for interlocks. Default is false.
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit reporting of Sts_IntlkTrip and interlock trip alarm. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_RdyReset	BOOL	Not Visible	Not Required	Input	1 = Related object, reset by this object, is ready to be reset. Default is false.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire Hand command source (typically hardwired local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override command source (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCmd	SINT	Not Visible	Not Required	Input	Override device command: 0 = No command, 1 = Position 1, 2 = Position 2, ..., 30 = Position 30. Default is 0.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External command source acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit audible alert, 0 = Allow audible alert. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset shed latches and cleared alarms. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator to shelve alarms. Default is true.
Cfg_NumPos	SINT	Not Visible	Not Required	Input	Number of device positions. Valid = 2 to 30. Default is 3.
Cfg_Circ	BOOL	Not Visible	Not Required	Input	1 = Positions are circular (rotary device, after Position n is Position 1), 0 = linear device (Position 1 and Position n are at ends of travel). Default is false.
Cfg_CWOnly	BOOL	Not Visible	Not Required	Input	1 = Circular (rotary) device can only rotate "clockwise", 0 = circular device is bidirectional, use shortest path. Default is false.
Cfg_ViaPos01	BOOL	Not Visible	Not Required	Input	1 = Drive linear device to Position 1 on every move, 0 = move direct to set position. Default is false.
Cfg_IntlkToPos01	BOOL	Not Visible	Not Required	Input	1 = Drive to Position 1 on interlock not OK, 0 = De-energize only on interlock not OK. Default is false.
Cfg_OutPosLatch	BOOL	Not Visible	Not Required	Input	1 = Latch position output until a new target position is set, 0 = clear position output upon reaching target position. Default is false.
Cfg_HasLock	BOOL	Not Visible	Not Required	Input	1 = Device has a lock or seal which must be unlocked/unsealed before moving. Default is false.
Cfg_HasPosFdbk	BOOL	Not Visible	Not Required	Input	1 = Device has position feedback for all positions. Default is false.
Cfg_UsePosFdbk	BOOL	Not Visible	Not Required	Input	1 = Use position feedback to verify device reached target position. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasLockFdbk	BOOL	Not Visible	Not Required	Input	1 = Device has locked/unlocked feedback. Default is false.
Cfg_UseLockFdbk	BOOL	Not Visible	Not Required	Input	1 = Use lock feedback to verify locking and unlocking of device. Default is false.
Cfg_HasCylFdbk	BOOL	Not Visible	Not Required	Input	1 = Device indexing cylinders have position feedback. Default is false.
Cfg_UseCylFdbk	BOOL	Not Visible	Not Required	Input	1 = Use indexing cylinder position feedback to verify cylinder motion. Default is false.
Cfg_HasPermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_Perm inputs, enable navigation. Default is false.
Cfg_HasIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_Intlk inputs, enable navigation. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available, enable navigation. Default is false.
Cfg_OperPos01Prio	BOOL	Not Visible	Not Required	Input	1 = OSet_Pos setting to Position 1 is accepted any time, 0 = OSet_Pos is accepted only when Operator command source is selected. Default is false.
Cfg_ExtPos01Prio	BOOL	Not Visible	Not Required	Input	1 = XSet_Pos setting to Position 1 is accepted any time, 0 = XSet_Pos is accepted only when External command source is selected. Default is false.
Cfg_OSetResets	BOOL	Not Visible	Not Required	Input	1 = A new Operator state command resets fault, 0 = A reset command is required to clear fault. Default is false.
Cfg_XSetResets	BOOL	Not Visible	Not Required	Input	1 = A new External state command resets fault, 0 = A reset command is required to clear fault. Default is false.
Cfg_SetDuringMove	BOOL	Not Visible	Not Required	Input	1 = New position setting received during move is accepted, 0 = Must wait for previous move to complete. Default is false.
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores bypassable permissives and interlocks, 0 = Override uses all permissives and interlocks. Default is false.
Cfg_ShedOnPosFail	BOOL	Not Visible	Not Required	Input	1 = De-energize device and alarm on position fail, 0 = Alarm only. Default is true.
Cfg_ShedOnLockFail	BOOL	Not Visible	Not Required	Input	1 = De-energize device and alarm on lock fail, 0 = Alarm only. Default is true.
Cfg_ShedOnIOFault	BOOL	Not Visible	Not Required	Input	1 = De-energize device and alarm on I/O fault, 0 = Alarm only. Default is true.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HornOnChange	BOOL	Not Visible	Not Required	Input	1 = Sound horn on any position change, 0 = Sound horn only on leaving Position 1. Default is false.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) command source exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator Locked command source exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) command source exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program Locked command source exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External command source exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance command source exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	Not Visible	Not Required	Input	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator Locked, 0 = Don't supersede Program/Operator Locked. Default is true.
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator Locked, 0 = Don't supersede Program/Operator Locked. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program command source, 0 = Power up to Operator command source. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal command source: 1 = Program, 0 = Operator. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority: 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = Program/Operator selection follows PCmd_Prog as level (1 for Program, 0 for Operator), 0 = PCmd_Prog is used as edge to select Program, PCmd_Oper selects Operator. Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = Program lock selection follows PCmd_Lock as level (1 for locked, 0 for unlocked), 0 = PCmd_Lock is used as edge to select Program Locked, PCmd_Unlock selects Program (unlocked). Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = External selection follows XCmd_Acq as level (1 to acquire External, 0 to release External), 0 = XCmd_Acq is used as edge to acquire External, XCmd_Rel is used to release External. Default is false.
Cfg_Retries	SINT	Not Visible	Not Required	Input	Number of retries via Position 1 before declaring failure, Valid = 0 to 3, 0 = Don't retry. Default is 3.
Cfg_ExtendDelay	REAL	Not Visible	Not Required	Input	Delay before extending cylinder to engage for move (seconds). Valid = 0.0 to 2147483.0. Default is 0.0.
Cfg_VerifyDelay	REAL	Not Visible	Not Required	Input	Delay to verify device has settled in commanded position (seconds). Valid = 0.0 to 2147483.0. Default is 1.0.
Cfg_PosCheckTime	REAL	Not Visible	Not Required	Input	Time to receive position feedback before declaring failure (seconds). Valid = 0.0 to 2147483.0. Default is 30.0.
Cfg_LockCheckTime	REAL	Not Visible	Not Required	Input	Time to receive locked/unlocked feedback before declaring lock failure (seconds). Valid = 0.0 to 2147483.0. Default is 5.0.
Cfg_VirtualPosTime	REAL	Not Visible	Not Required	Input	Time to simulate reaching target position when virtualized (seconds). Valid = 0.0 to 2147483.0. Default is 1.0.
Cfg_VirtualLockTime	REAL	Not Visible	Not Required	Input	Time to simulate lock or unlock when virtualized (seconds). Valid = 0.0 to 2147483.0. Default is 1.0.
Cfg_VirtualCylTime	REAL	Not Visible	Not Required	Input	Time to simulate index cylinder feedback when virtualized (seconds). Valid = 0.0 to 21474830. Default is 0.5.
Cfg_StartHornTime	REAL	Not Visible	Not Required	Input	Time to sound audible on device position change (seconds). Valid = 0.0 to 1000.0, 0.0 = Disabled. Default is 0.0.
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator command confirmation or e-signature type required: 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program ownership request: Non-zero Owner ID = Acquire, 0 = Release. Default is 0.
PSet_Pos	SINT	Not Visible	Not Required	Input	Program Setting of commanded position 1 to 30, 0 = No command. The instruction clears this operand automatically. Default is 0.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program Command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program Command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program Command to select Program command source. The instruction clears this operand automatically if Cfg_PCmdProgAsLevel = 0. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program Command to select Operator command source. The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program Command to lock Program command source and disallow Operator. The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program Command to unlock Program command source and allow Operator to acquire. The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program Command to select normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
XSet_Pos	SINT	Not Visible	Not Required	Input	External Setting of commanded position 1 to 30, 0 = No command. The instruction clears this operand automatically. Default is 0.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External Command to acquire command source. The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External Command to release command source, accepted if Cfg_ExtAcqAsLevel = 0. The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External Command to acknowledge all alarms and reset latched alarms and shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter
Out_Pos01Data	BOOL	Visible	Not Required	Output	Output to go to Position 1.
Out_Pos02Data	BOOL	Visible	Not Required	Output	Output to go to Position 2.
Out_Pos03Data	BOOL	Visible	Not Required	Output	Output to go to Position 3.
Out_Pos04Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 4.
Out_Pos05Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 5.
Out_Pos06Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 6.
Out_Pos07Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 7.
Out_Pos08Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 8 .
Out_Pos09Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 9.
Out_Pos10Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 10.
Out_Pos11Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 11.
Out_Pos12Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 12.
Out_Pos13Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 13.
Out_Pos14Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 14.
Out_Pos15Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 15.
Out_Pos16Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 16.
Out_Pos17Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 17.
Out_Pos18Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 18 .
Out_Pos19Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 19.
Out_Pos20Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 20.
Out_Pos21Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 21.
Out_Pos22Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 22.
Out_Pos23Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 23.
Out_Pos24Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 24.
Out_Pos25Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 25.
Out_Pos26Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 26.
Out_Pos27Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 27.
Out_Pos28Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 28.
Out_Pos29Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 29.
Out_Pos30Data	BOOL	Not Visible	Not Required	Output	Output to go to Position 30.
Out_IncData	BOOL	Visible	Not Required	Output	Output to drive to increasing position (clockwise).
Out_DecData	BOOL	Visible	Not Required	Output	Output to drive to decreasing position (counter-clockwise).
Out_UnlockData	BOOL	Not Visible	Not Required	Output	Output to unlock/unseal device.
Out_LockData	BOOL	Not Visible	Not Required	Output	Output to lock/seal device.
Out_CylExtendData	BOOL	Not Visible	Not Required	Output	Output to extend cylinder to engage position indexing device.
Out_CylRetractData	BOOL	Not Visible	Not Required	Output	Output to retract cylinder to disengage position indexing device.
Out_CylLeftData	BOOL	Not Visible	Not Required	Output	Output to index device to left (increase position).
Out_CylRightData	BOOL	Not Visible	Not Required	Output	Output to index device to right (decrease position).
Out_HornData	BOOL	Not Visible	Not Required	Output	Output to sound horn prior to commanded position change.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status (bitmapped): All bits off = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. 0 = Use Inp_InitializeReq to reinitialize.
Sts_Pos01	BOOL	Visible	Not Required	Output	1 = Device confirmed in Position 1.
Sts_Pos02	BOOL	Visible	Not Required	Output	1 = Device confirmed in Position 2.
Sts_Pos03	BOOL	Visible	Not Required	Output	1 = Device confirmed in Position 3.
Sts_Pos04	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 4.
Sts_Pos05	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 5.
Sts_Pos06	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 6.
Sts_Pos07	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 7.
Sts_Pos08	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 8.
Sts_Pos09	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 9.
Sts_Pos10	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 10.
Sts_Pos11	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 11.
Sts_Pos12	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 12.
Sts_Pos13	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 13.
Sts_Pos14	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 14.
Sts_Pos15	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 15.
Sts_Pos16	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 16.
Sts_Pos17	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 17.
Sts_Pos18	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 18.
Sts_Pos19	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 19.
Sts_Pos20	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 20.
Sts_Pos21	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 21.
Sts_Pos22	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 22.
Sts_Pos23	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 23.
Sts_Pos24	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 24.
Sts_Pos25	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 25.
Sts_Pos26	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 26.
Sts_Pos27	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 27.
Sts_Pos28	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 28.
Sts_Pos29	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 29.
Sts_Pos30	BOOL	Not Visible	Not Required	Output	1 = Device confirmed in Position 30.
Sts_Moving	BOOL	Visible	Not Required	Output	1 = Device moving to target position, not yet confirmed in position.
Sts_Horn	BOOL	Not Visible	Not Required	Output	1 = Sounding horn prior to commanded energize/position change.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction treats device as virtual, acting as if controlling a working device, but the outputs are kept de-energized, 0 = The instruction operates the physical device normally.
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output: 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status: 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
Sts_eCmd	SINT	Not Visible	Not Required	Output	Device command: 0 = None, 1 = Position 1, 2 = Position 2, ..., 30 = Position 30.
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Device feedback: 0 = Moving or unknown position, 1 = Position 1, 2 = Position 2, ..., 30 = Position 30, 31 = Multiple positions or invalid feedback.
Sts_eSts	SINT	Not Visible	Not Required	Output	Device status: 0 = Powerup/Reset, 1 = Position 1, 2 = Position 2, ..., 30 = Position 30, 31 = Moving, 32 = Horn, 33 = Out of service.
Sts_eFault	SINT	Not Visible	Not Required	Output	Device fault status: 0 = None, 16 = Position fail, 17 = Lock/Unlock fail, 32 = I/O fault, 34 = Configuration error.
Sts_eState	SINT	Not Visible	Not Required	Output	Internal state: 0 = De-energized on powerup/interlock/shed, 1 = In position, 2 = Unlocking, 3 = Moving to Position 1, 4 = Moving to requested position, 5 = Locking, 6 = Faulted.
Sts_eOutPos	SINT	Not Visible	Not Required	Output	State of position outputs to physical device: 0 = De-energized, 1 = Position 1, 2 = Position 2, ..., 30 = Position 30.
Sts_eOutState	SINT	Not Visible	Not Required	Output	State of motion outputs to physical device: 0 = Maintain position, 1 = Unlock, 2 = Decrease position, 3 = Increase position, 4 = Lock, 5 = Horn.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotify	SINT	Not Visible	Not Required	Output	Summary alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	Summary alarm status including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	Not Visible	Not Required	Output	I/O fault alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyPosFail	SINT	Not Visible	Not Required	Output	Device position fail alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyLockFail	SINT	Not Visible	Not Required	Output	Device lock/seal fail alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	Not Visible	Not Required	Output	Interlock trip alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_eSrc	INT	Not Visible	Not Required	Output	Current command source: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program Locked, 34 = Program default (Normal), 64 = Operator, 65 = Operator Locked, 66 = Operator default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (EnableIn false), 256 = External.
Sts_bSrc	INT	Not Visible	Not Required	Output	Active command source selections (bitmapped, for HMI): .0 = Hand, .1 = Programmed Out of Service (EnableIn false), .2= Maintenance Out of Service, .3 = Maintenance, .4 = Override, .5 = External, .6 = Program Locked, .7 = Program (unlocked), .8 = Operator Locked, .9 = Operator (unlocked).
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Device has been acquired by Program and is ready and available for control.
Sts_IntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Device can be acquired by Program and is available for control when interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks and permissives are bypassed.
Sts_BypActive	BOOL	Visible	Not Required	Output	1 = Interlock/permissive bypassing is active (bypassed by command or in Maintenance command source).
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	Visible	Not Required	Output	1 = Device not ready, see Sts_NrdyXxx detail bits for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Device not ready, configuration error.
Sts_NrdyPosFail	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device position failure, shed requires reset.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_NrdyLockFail	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device lock/seal failure, shed requires reset.
Sts_NrdyIntlk	BOOL	Not Visible	Not Required	Output	1 = Device not ready, interlock not OK.
Sts_NrdyIOFault	BOOL	Not Visible	Not Required	Output	1 = Device not ready, I/O fault, shed requires reset.
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device is Out of Service.
Sts_NrdyPerm	BOOL	Not Visible	Not Required	Output	1 = Device not ready, permissives not OK, device cannot be commanded to a new position.
Sts_NrdyPrioPos01	BOOL	Not Visible	Not Required	Output	1 = Device not ready, Operator or External issued priority Position 1 Command, shed requires reset.
Sts_Err	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, see Sts_ErrXxx detail bits for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Logix tag-based alarm settings invalid.
Sts_ErrExtendDelay	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_ExtendDelay invalid. Valid = 0.0 to 2147483.0.
Sts_ErrVerifyDelay	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_VerifyDelay invalid. Valid = 0.0 to 2147483.0.
Sts_ErrPosCheckTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_PosCheckTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrLockCheckTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_LockCheckTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrVirtualPosTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_VirtualPosTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrVirtualLockTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_VirtualLockTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrVirtualCylTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_VirtualCylTime invalid. Valid = 0.0 to 2147483.0.
Sts_Hand	BOOL	Visible	Not Required	Output	1 = Hand command source is selected.
Sts_OoS	BOOL	Visible	Not Required	Output	1 = Out of Service command source is selected.
Sts_Maint	BOOL	Visible	Not Required	Output	1 = Maintenance command source is selected.
Sts_Ovrd	BOOL	Visible	Not Required	Output	1 = Override command source is selected.
Sts_Ext	BOOL	Visible	Not Required	Output	1 = External command source is selected.
Sts_Prog	BOOL	Visible	Not Required	Output	1 = Program (unlocked) command source is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program Locked command source is selected.
Sts_Oper	BOOL	Visible	Not Required	Output	1 = Operator (unlocked) command source is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator Locked command source is selected.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Visible	Not Required	Output	Program/Operator lock (latch) state: 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selected command source is the normal source (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External command source selection is inhibited, External is not available in current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program command source selection is inhibited, Program is not available in current state.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Command to acquire Maintenance command source was received this scan.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = An alarm is shelved or disabled.
Sts_IOFault	BOOL	Not Visible	Not Required	Output	1 = I/O communication fault. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PNPOS_Tag.@Alarms.Alm_IOFault.AlarmElement.
Sts_PosFail	BOOL	Visible	Not Required	Output	1 = Device position failure. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PNPOS_Tag.@Alarms.Alm_PosFail.AlarmElement.
Sts_LockFail	BOOL	Not Visible	Not Required	Output	1 = Device lock/seal failure. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PNPOS_Tag.@Alarms.Alm_LockFail.AlarmElement.
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Interlock trip, device was de-energized or set to Position 1 by an interlock not OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PNPOS_Tag.@Alarms.Alm_IntlkTrip.AlarmElement.
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable button.
XRdy_Pos	BOOL	Not Visible	Not Required	Output	1 = Ready for XSet_Pos, enable entry.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable button.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object Owner ID, 0=not owned.

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Command source selection.
MCmd_Acq	BOOL	Maintenance Command to acquire Maintenance command source. The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance Command to bypass all bypassable interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_Check	BOOL	Maintenance Command to remove bypass and check all interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance Command to select In Service. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_OoS	BOOL	Maintenance Command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance Command to select Physical device operation. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance Command to release Maintenance command source. The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance Command to select Virtual device operation. The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator Command to select Operator Locked command source and disallow Program. The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator Command to select configured normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator Command to select Operator (unlocked) command source. The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator Command to select Program (unlocked) command source. The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator Command to acknowledge all alarms and reset latched alarms and shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator Command to unlock Operator command source and allow Program to acquire. The instruction clears this operand automatically. Default is false.
OSet_Pos	SINT	Operator Setting of commanded position 1 to 30, 0 = No command. The instruction clears this operand automatically. Default is 0.
Wrk_bInp	DINT	Buffer for device position feedback input bits, bit .1 thru .30. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display.
HMI_eCmdPos	SINT	Last commanded position: 0 = None, 1 = Position 1, 2 = Position 2, ..., 30 = Position 30.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.

Private Output Members	Data Type	Description
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Pos	BOOL	1 = Ready for OSet_Pos, enable HMI data entry field or command buttons.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset, enable HMI button.
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
Wrk_bOut	DINT	Buffer for position request output bits, bit .1 thru .30.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component

BUS_OBJ Structure

The BUS_OBJ structure links the device to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices, and items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete Logix tag-based alarms are defined for these members:

Member	Alarm Name	Description
Sts_IntlkTrip	Alm_IntlkTrip	Device de-energized or set to Position 1 by an interlock Not OK.
Sts_IOFault	Alm_IOFault	I/O fault.
Sts_PosFail	Alm_PosFail	Device position failure.
Sts_LockFail	Alm_LockFail	Device lock/seal failure.

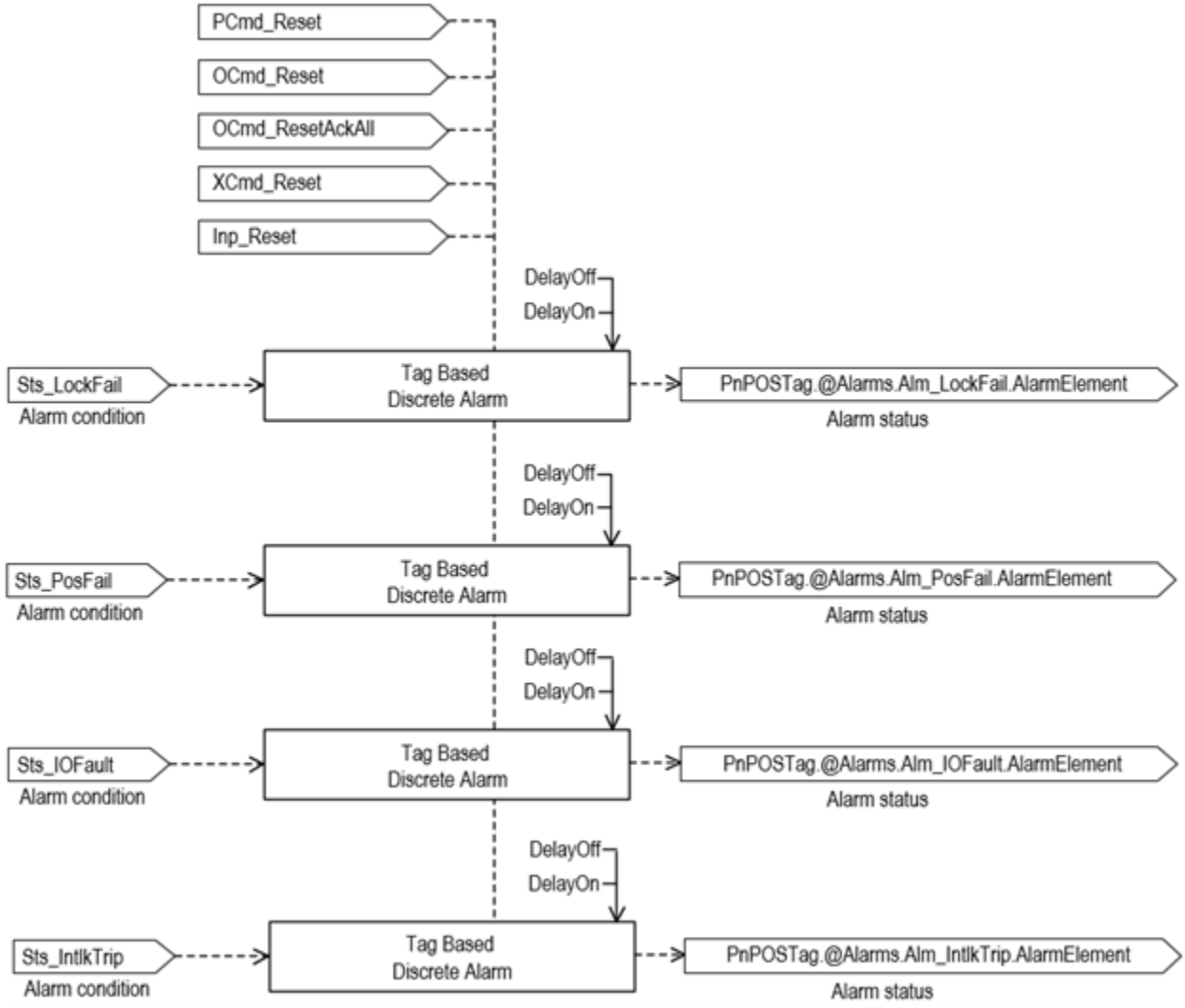
Mark the alarm as used or unused and set standard configuration members of the discrete Logix Tag based alarm. Use this format to access alarm elements:

Tag.@Alarms.AlarmName.AlarmElement

The PNPOS instruction uses the following alarms:

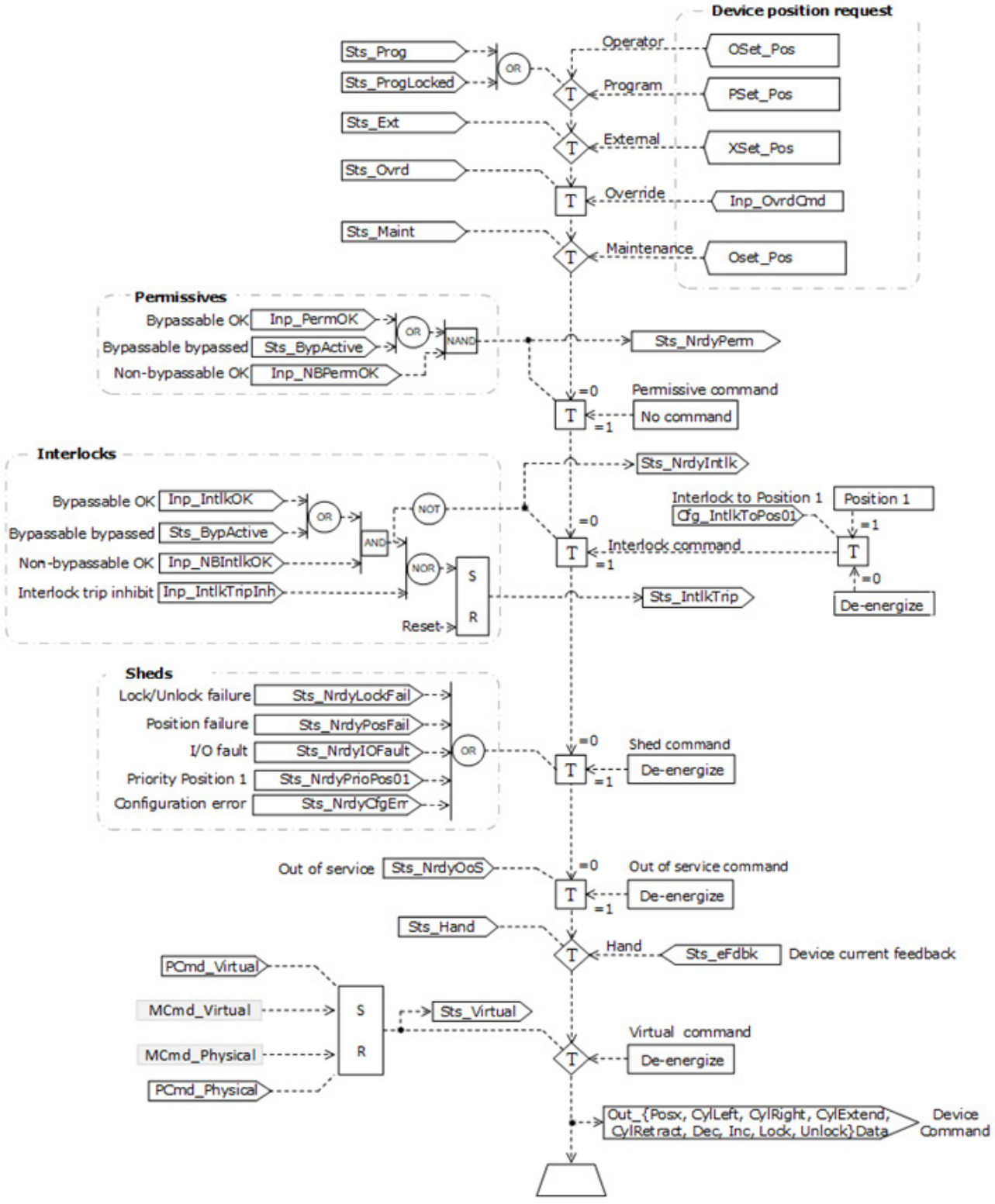
- Raises the Interlock Trip alarm when an interlock 'not OK' condition causes the device to perform its configured interlock action. The device can be configured to be driven to position 1 on interlock, and the alarm will be raised if the device is not already in position 1. Or the device can be configured to de-energize on interlock, and the alarm will be raised if outputs that are energized become de-energized.
- Raises the I/O Fault alarm when the Inp_IOFault input is true. This input is usually used to indicate to the instruction that a communication failure has occurred for its I/O. The device transitions to the Faulted state and cannot be commanded to a new state until reset.
- Raises the Lock Fail alarm when a device with a locking or sealing feature is commanded to a new position, but the lock/seal feedback failed to confirm the device unlocking before moving or failed to confirm the device locking after moving, within the time allowed. The device transitions to the Faulted state and cannot be commanded to a new state until reset.
- Raises the Position Fail alarm when the device is commanded to a new position, but the device feedback does not confirm that the device actually reached the target position within the configured failure time (Cfg_PosCheckTime). The device transitions to the Faulted state and cannot be commanded to a new position until reset.

Program, Operator, and External commands reset latched alarms, and reset and acknowledge all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PNPOS instruction.



Operation

This diagram illustrates functionality of the PNPOS instruction:



Operator command request confirmation

The PNPOS instruction enables these operator commands and settings:

- OSet_Pos

Enforced security might require the request to be confirmed or canceled before the selected command executes or setting is accepted. The instruction checks the security rules, inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd = 0, no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd = 1, the instruction waits for operator confirmation or cancelation of the command. If Cfg_CnfrmReqd = 2 or 3, eSignature is needed before command confirmation is enabled.

Virtualization

Use virtualization for instruction testing and operator training. Command virtual operation using program command PCmd_Virtual or maintenance command MCmd_Virtual. After finishing virtual operation, use program command PCmd_Physical or maintenance command MCmd_Physical to return to normal physical device operation.

When Virtualization is active, the outputs of the PNPOS instruction hold at 0, virtual feedback of a working device is provided, and I/O faults are ignored. The value of the following parameters determines the time it takes the virtual device to reach various states:

- Cfg_VirtualPosTime - time to reach target position in virtual (seconds)
- Cfg_VirtualLockTime - time to lock or unlock in virtual (seconds)
- Cfg_VirtualCylTime - time to simulate index cylinder feedback in virtual (seconds)

Manipulate the instruction to operate as if a working device is present.

Configuration of Strings for HMI

Configure strings for HMI faceplates, displayed in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Navigation to an object with more information
- Labels for Positions 1 through 30

- Name of Interlock Trip Alarm
- Name of I/O Fault Alarm
- Name of Position Fail Alarm
- Name of Lock Fail Alarm

Command Source

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled. Device commands and settings from any source are not accepted.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (for example, field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enable control sources as Configuration

The user can enable and disable individual control sources. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. Commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command.

For example, if the Program state is disabled, the destination of the OCmd_Prog command becomes the Program Locked state instead of the Program state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Monitor the PNPOS Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The device is de-energized.

Condition/State	Action Taken
Instruction first run	Any commands received before first scan are discarded. The device is treated as if it were returning from Hand mode: the instruction state is set based on the position feedback received from the device. If the feedback is valid for one position, the device is set to that position, and, if the device has the lock/seal capability enabled, the device is locked in that position. If the device does not have position feedback or the position feedback is invalid, the device is set to the unknown/powerup state.
Rung-condition-in is false	Handled the same as if the device is taken Out of Service by command. The device outputs are de-energized, and the device Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. The rung-condition-out continues as false.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The device is de-energized.
Instruction first run	Any commands received before first scan are discarded. The device is treated as if it were returning from Hand mode: the instruction state is set based on the position feedback received from the device. If the feedback is valid for one position, the device is set to that position, and, if the device has the lock/seal capability enabled, the device is locked in that position. If the device does not have position feedback or the position feedback is invalid, the device is set to the unknown/powerup state.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the device is taken Out of Service by command. The device outputs are de-energized, and the device Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. EnableOut is set to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

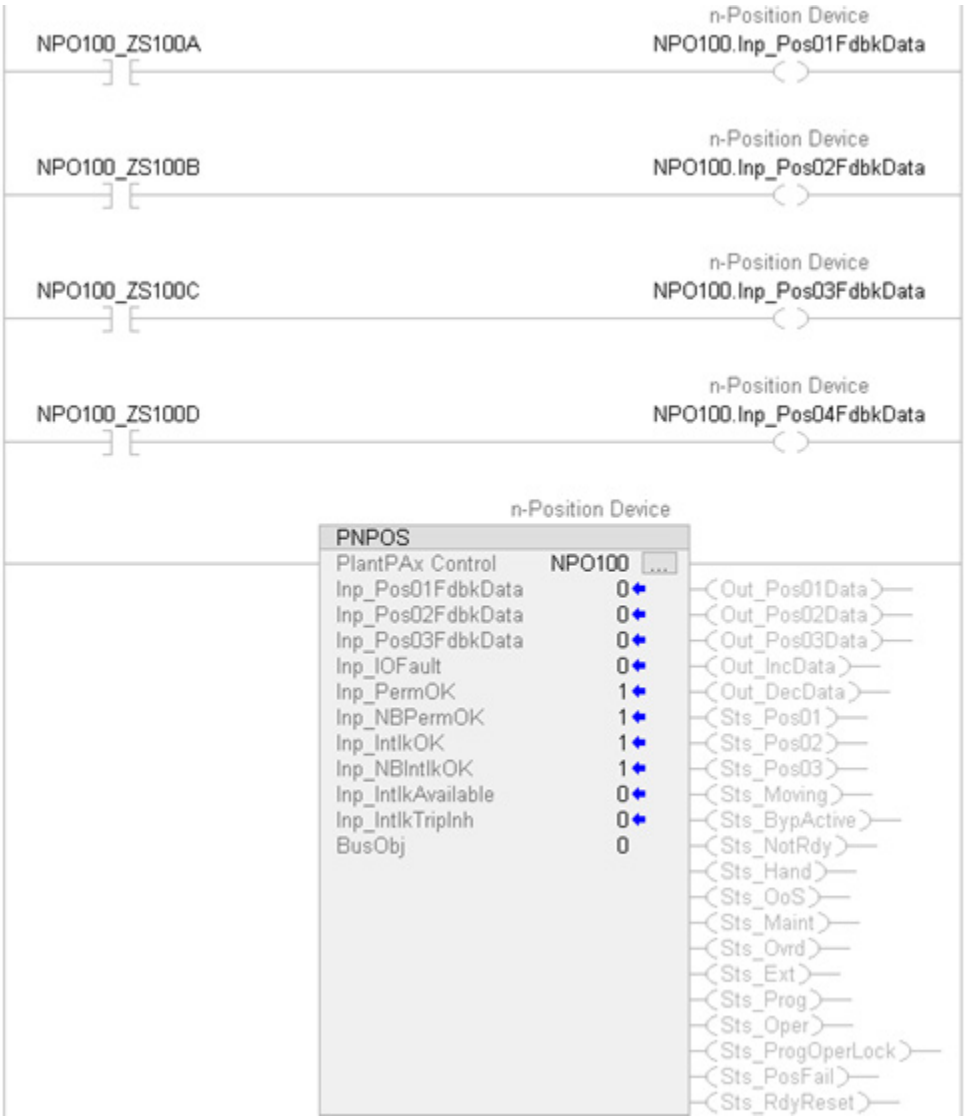
Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic, it will execute.

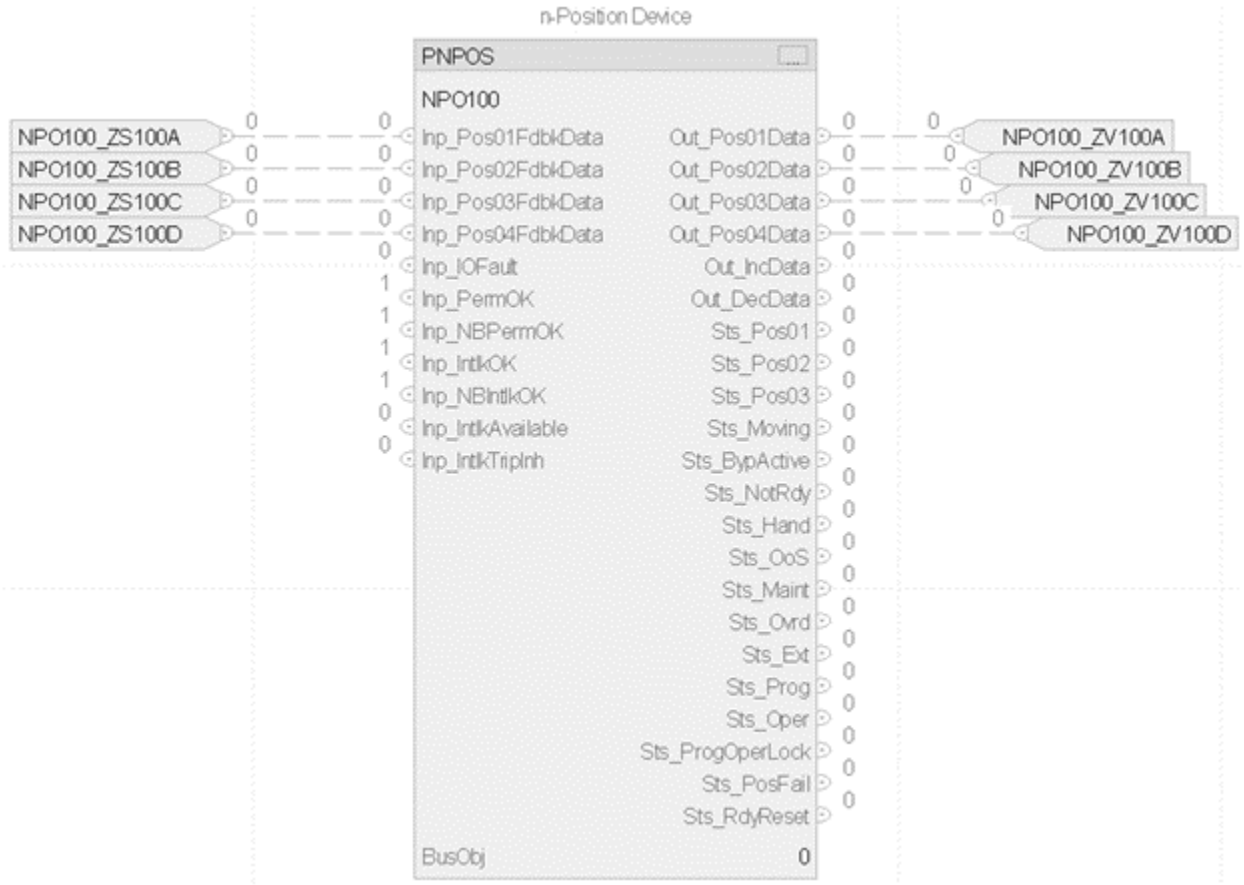
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

In this example, the PNPOS instruction is used to control a rotating selector valve with four fixed positions.



Function Block Diagram



Structured Text

```
NPO100.Inp_Pos01FdbkData:=NPO100_ZS100A
NPO100.Inp_Pos02FdbkData:=NPO100_ZS100B
NPO100.Inp_Pos03FdbkData:=NPO100_ZS100C
NPO100.Inp_Pos04FdbkData:=NPO100_ZS100D
PNPOS(NPO100, 0);
NPO100_ZV100A:=NPO100.Out_Pos01Data;
NPO100_ZV100B:=NPO100.Out_Pos02Data;
NPO100_ZV100C:=NPO100.Out_Pos03Data;
NPO100_ZV100D:=NPO100.Out_Pos04Data;
```

Process Permissives (PPERM)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

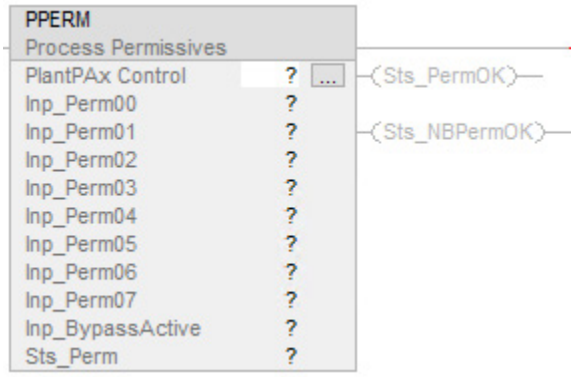
The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that allow a piece of equipment to energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.

The PPERM instruction provides:

- Permissive input OK Check. Evaluates the inputs. If all inputs are in the configured OK state, the instruction sets the All Permissives OK status to true.
- Permissive bypass. Evaluates the non-permissive inputs to bypass. If all inputs are in their configured OK state, the instruction sets the All Non-Bypassable Permissives OK status to true.
- Summary status. Summarizes its 32 permissive input conditions into two primary status bits:
  - Sts_PermOK. Indicates all permissive conditions are clear, or ready to energize.
  - Sts_NBPermOK. Indicates all permissive conditions that cannot be bypassed are clear, or ready to energize after bypassing permissive conditions.

Available Languages

Ladder Diagram



Function Block Diagram

Structured Text

PPERM (PPERM tag);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_PERMISSIVE	tag	Data structure required for proper operation of instruction.

P_PERMISSIVE Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable Input - System Defined Parameter Default is true.

Public Input Members	Data Type	Description
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitializing. The instruction clears this operand automatically. Default is true.
Inp_Perm00	BOOL	Permissive condition 00, OK to energize if in configured OK state. Default is true.
Inp_Perm01	BOOL	Permissive condition 01, OK to energize if in configured OK state. Default is true.
Inp_Perm02	BOOL	Permissive condition 02, OK to energize if in configured OK state. Default is true.
Inp_Perm03	BOOL	Permissive condition 03, OK to energize if in configured OK state. Default is true.
Inp_Perm04	BOOL	Permissive condition 04, OK to energize if in configured OK state. Default is true.
Inp_Perm05	BOOL	Permissive condition 05, OK to energize if in configured OK state. Default is true.
Inp_Perm06	BOOL	Permissive condition 06, OK to energize if in configured OK state. Default is true.
Inp_Perm07	BOOL	Permissive condition 07, OK to energize if in configured OK state. Default is true.
Inp_Perm08	BOOL	Permissive condition 08, OK to energize if in configured OK state. Default is true.
Inp_Perm09	BOOL	Permissive condition 09, OK to energize if in configured OK state. Default is true.
Inp_Perm10	BOOL	Permissive condition 10, OK to energize if in configured OK state. Default is true.
Inp_Perm11	BOOL	Permissive condition 11, OK to energize if in configured OK state. Default is true.
Inp_Perm12	BOOL	Permissive condition 12, OK to energize if in configured OK state. Default is true.
Inp_Perm13	BOOL	Permissive condition 13, OK to energize if in configured OK state. Default is true.
Inp_Perm14	BOOL	Permissive condition 14, OK to energize if in configured OK state. Default is true.
Inp_Perm15	BOOL	Permissive condition 15, OK to energize if in configured OK state. Default is true.
Inp_Perm16	BOOL	Permissive condition 16, OK to energize if in configured OK state. Default is true.
Inp_Perm17	BOOL	Permissive condition 17, OK to energize if in configured OK state. Default is true.
Inp_Perm18	BOOL	Permissive condition 18, OK to energize if in configured OK state. Default is true.
Inp_Perm19	BOOL	Permissive condition 19, OK to energize if in configured OK state. Default is true.
Inp_Perm20	BOOL	Permissive condition 20, OK to energize if in configured OK state. Default is true.
Inp_Perm21	BOOL	Permissive condition 21, OK to energize if in configured OK state. Default is true.
Inp_Perm22	BOOL	Permissive condition 22, OK to energize if in configured OK state. Default is true.

Public Input Members	Data Type	Description
Inp_Perm23	BOOL	Permissive condition 23, OK to energize if in configured OK state. Default is true.
Inp_Perm24	BOOL	Permissive condition 24, OK to energize if in configured OK state. Default is true.
Inp_Perm25	BOOL	Permissive condition 25, OK to energize if in configured OK state. Default is true.
Inp_Perm26	BOOL	Permissive condition 26, OK to energize if in configured OK state. Default is true.
Inp_Perm27	BOOL	Permissive condition 27, OK to energize if in configured OK state. Default is true.
Inp_Perm28	BOOL	Permissive condition 28, OK to energize if in configured OK state. Default is true.
Inp_Perm29	BOOL	Permissive condition 29, OK to energize if in configured OK state. Default is true.
Inp_Perm30	BOOL	Permissive condition 30, OK to energize if in configured OK state. Default is true.
Inp_Perm31	BOOL	Permissive condition 31, OK to energize if in configured OK state. Default is true.
Inp_BypassActive	BOOL	1 = Permissive bypassing is currently active. Default is false.
Cfg_OKState	DINT	Bits indicate which state (0 or 1) of each input is OK to energize. Default is 2#1111_1111_1111_1111_1111_1111_1111_1111.
Cfg_Bypassable	DINT	Set bits indicate which conditions can be bypassed. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more information is available. Default is false.
Cfg_HasNav	DINT	Set bits indicate which navigation buttons are enabled. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.

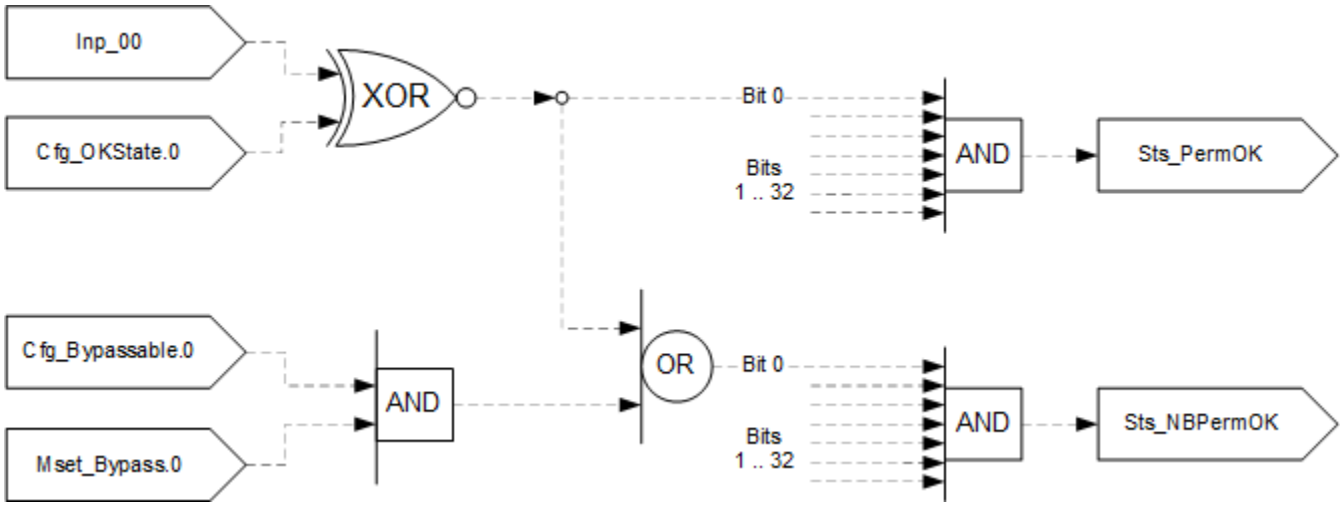
Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output - System Defined Parameter
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_PermOK	BOOL	Overall permissive status (1 = OK to energize).
Sts_NBPermOK	BOOL	Non-Bypassable permissive status (1 = all non-bypassable permissives OK to energize).
Sts_BypActive	BOOL	1 = Permissive bypassing is active (ignore bypassable permissives).
Sts_Perm	DINT	Individual permissive status (1 = OK, 0 = don't energize).

Private Input Members	Data Type	Description
MSet_Bypass	DINT	Individual condition maintenance bypass toggles. Default is 2#0000_0000_0000_0000_0000_0000_0000_0000.

Private Output Members	Data Type	Description
N/A	N/A	N/A

Operation

This diagram illustrates the functionality of the PPERM instruction:



Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Input Conditional Text
- Navigation Path
- More Information

Monitor the PPERM Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false. If this instruction is off-scan, then set the summary Permissive OK status bits to false. Only set individual permissive bypasses for conditions that are configured for bypassing. All the MSets for inputs that are NOT bypassable will be cleared.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. If this instruction is off-scan, then set the summary Permissive OK status bits to false. Only set individual permissive bypasses for conditions that are configured for bypassing. All the MSets for inputs that are NOT bypassable will be cleared.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

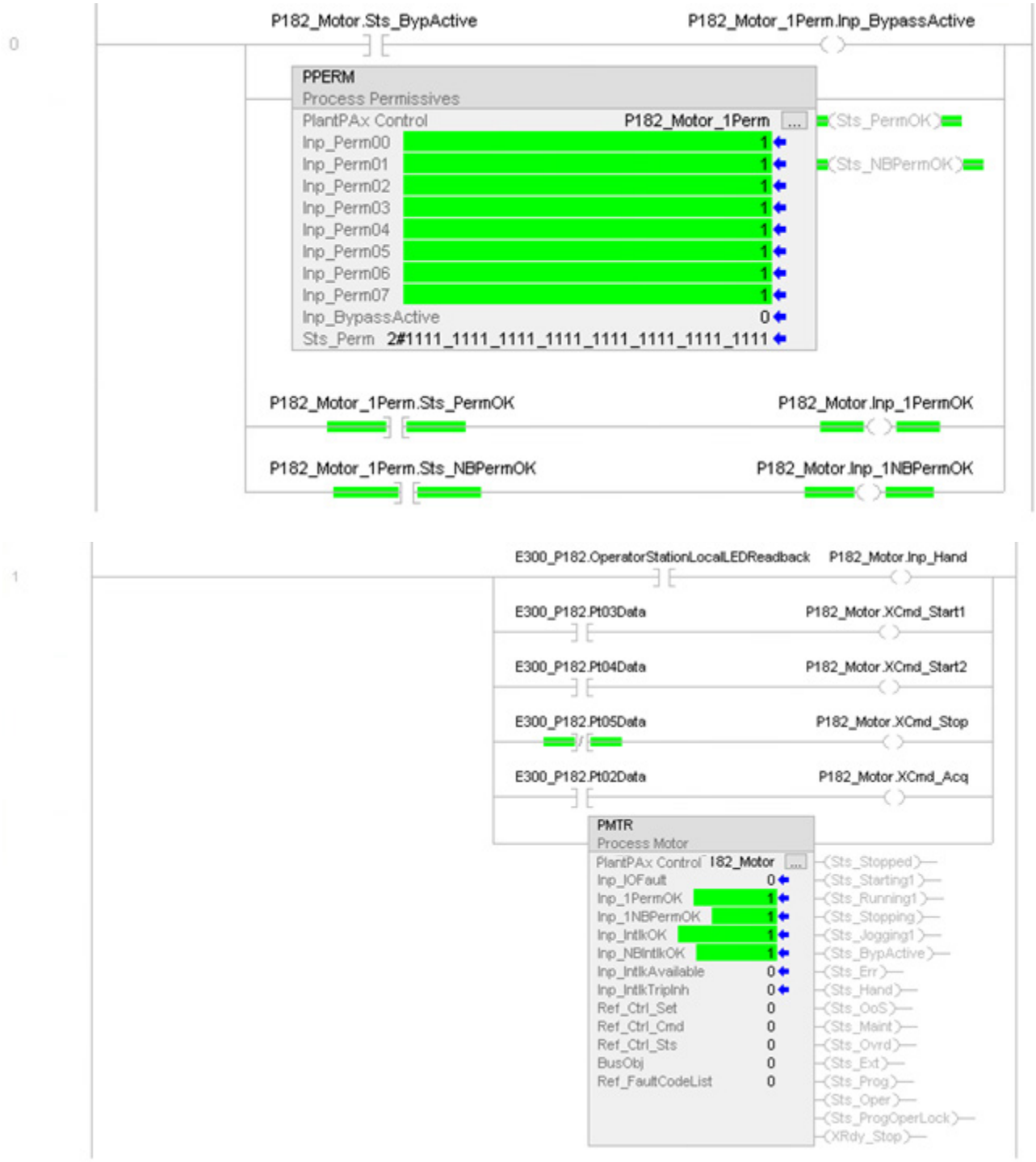
In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.

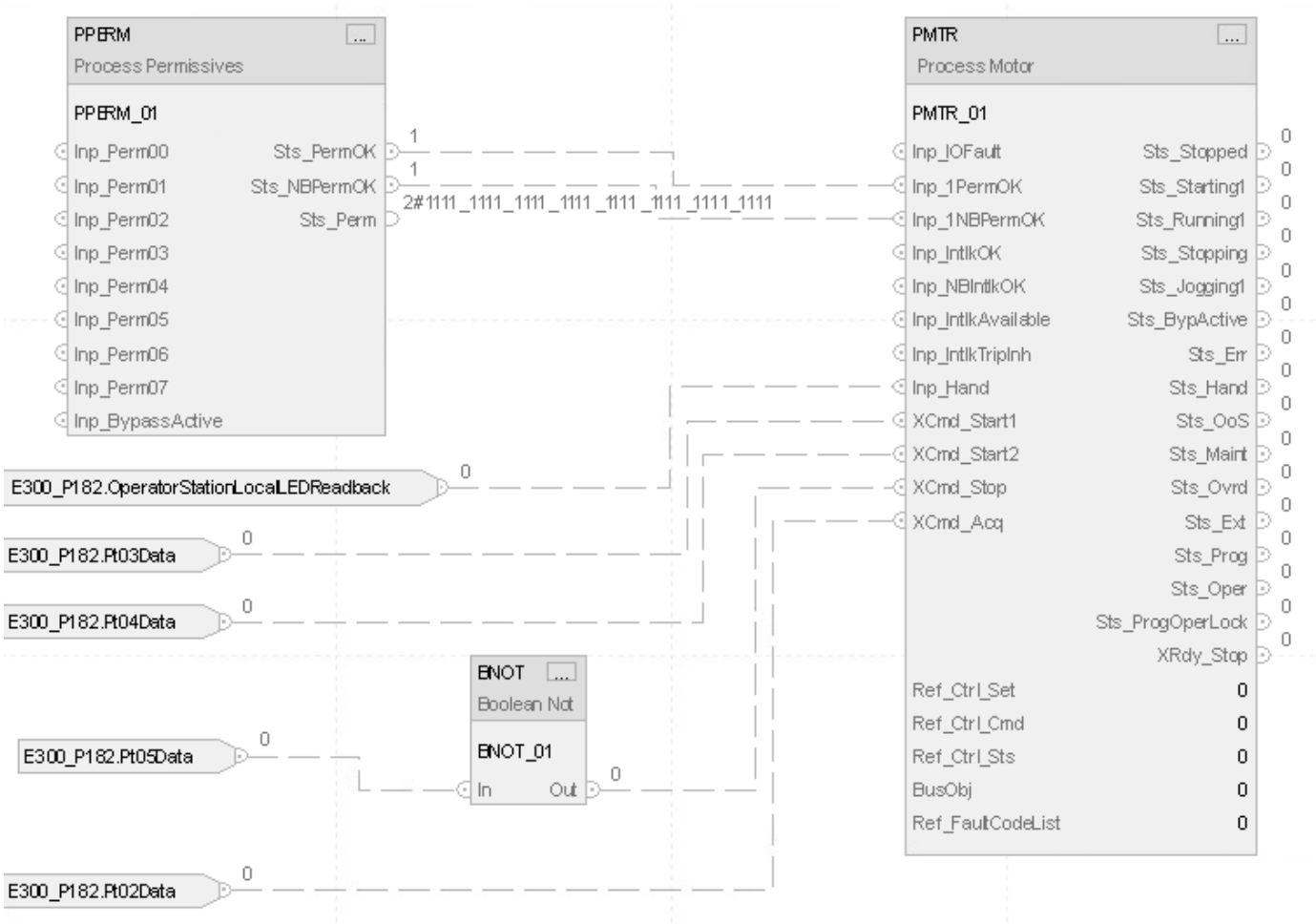
Condition/State	Action Taken
Postscan	See Postscan in the Function Block Diagram table.

Example

Ladder Diagram



Function Block Diagram



Structured Text

```
P182_Motor_1Perm.Inp_BypActive := P182_Motor.Sts_BypActive;
PPERM(P182_Motor_1Perm);
P182_Motor.Inp_1PermOK := P182_Motor_1Perm.Sts_PermOK;
P182_Motor.Inp_1NBPermOK := P182_Motor_1Perm.Sts_NBPermOK;
P182_Motor.Inp_Hand := E300_P182:I.OperatorStationLocalLEDReadback;
P182_Motor.XCmd_Start1 := E300_P182:I.Pt03Data;
P182_Motor.XCmd_Start2 := E300_P182:I.Pt04Data;
P182_Motor.XCmd_Stop := NOT(E300_P182:I.Pt05Data);
P182_Motor.XCmd_Acq := E300_P182:I.Pt02Data;
PMTR_ci(P182_Motor,P182_CtrlSet,P182_CtrlCmd,P182_CtrlSts);
```

Process Proportional + Integral + Derivative (PPID)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

Use the Process Proportional + Integral + Derivative (PPID) instruction to manipulate the Control Variable (CV) in regulatory control loops in response to Process Variable (PV) readings and Setpoint (SP, the target PV) settings.

The CV is typically used as a cascade setpoint for a secondary, or inner, control loop or is sent to an Analog Output channel on an IO card.

The PPID instruction integrates functions of the existing PID, PIDE, and P_PIDE AOI into a single built-in instruction and adds additional features.

The PPID instruction:

- Calculates CV with velocity PID algorithm. Velocity algorithm is also known as incremental algorithm. Velocity algorithm computes the CV value by summing ΔPTerm, ΔITerm, ΔDTerm, ΔFF, and CV from the previous execution of the instruction. When Inp_UseCVPrev is set, CV previous is set equal to Inp_CVPrev. When Inp_UseFFPrev is set, previous FF is set equal to Inp_FFPrev. This lets you preset CV to a specified value before output CV value is computed, CV = CV previous + ΔPTerm + ΔITerm + ΔDTerm + ΔFF. Velocity form of the PID algorithm supports bumpless transfer in parameter change.
- Provides an option to suppress bumpless transfer in gain change. When this option is selected the PID calculation behaves as a position PID algorithm where control action changes with loop error and not error change.
- Uses a two degrees of freedom PID formula for calculating CV with proportional PTerm action derived from weighted SP and PV difference (b*SP-PV), integral ITerm action derived from control error (SP-PV), and derivative DTerm action derived from change in weighted SP and PV difference (c*SP-PV). The change in weight setting in run-time is bumpless.
- Uses an error-squared (option) algorithm with CV more aggressive when error rises. The use of error square is restricted to PTerm.
- Provides Direct/Reverse action (option). The action is Direct when CV rises with PV increase (Cfg_CtrlAction=1). The action is Reverse if CV decreases with PV increase (Cfg_CtrlAction=0).
- Allows deviation deadband. CV is not sensitive to loop error variation when within the band around zero error. Configured band levels allow for additional hysteresis. The deadband level for PV approaching SP (Cfg_DevDBEnter) may be set lower than deadband level for PV going away from SP (Cfg_DevDB). The active deadband status is set for PV within deadband. Provides an option to stop CV moves or just stop the integration while leaving proportional and derivative action live when in deadband (Cfg_UseIntegDevDB).

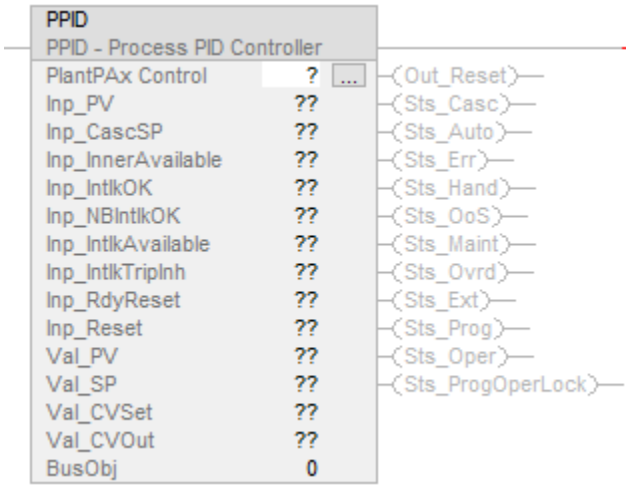
- Displays engineering units on the Logix Designer application interface. SP and PV values are displayed and entered in PV engineering units. Val_CVSet for CV target and Val_CVOut for CV output are displayed and entered in CV engineering units. The PID algorithm uses all variables scaled to percent of span internally and these values are also available as outputs Val_PVPercent, Val_SPPercent, Val_EPercent, and Val_CVPercent.
- Is configurable for Independent and Dependent gains. Interpretation of values stored in PGain, IGain and DGain tags depends on the instruction configuration.
  - Independent gains configuration: PGain = Kp … proportional gain, IGain = Ki … integral gain [1/minute], DGain = Kd … derivative gain [minutes].
  - Dependent gains configuration: PGain = K … controller gain, IGain = Ti … reset time [minutes], DGain = Td … rate time [minutes].

  Use independent gains when you want the three gains for the proportional, integral, and derivative terms to operate independently. Use dependent gains when you want an overall controller gain that affects all three terms (P, I, and D).
- Provides optional derivative smoothing (derivative limit at high frequencies). A pure derivative gives a very large amplification of measurement noise. Both dependent and independent PID algorithms can be configured for limiting the derivative term gain at high frequencies.
- Guarantees anti-windup. The PID algorithm is equipped with integral (reset) windup prevention (reset feedback). Internal windup when CV saturates is treated automatically. External windup of the inner loop indicated by Inp_WindupHi or Inp_WindupLo is also treated if the inputs are in use.
- Allows external CV tracking (option). When Cfg_UseCVTrack is set or the inner loop is not available for the PPID instruction (Inp_InnerAvailable is false), the CV tracks Inp_CVTrack value. The option is useful when the inner (secondary) loop in cascade is not able to follow CV value calculated by this outer (primary) loop PID, and Inp_WindupHi or Inp_WindupLo is either not used or not true. Tracking is allowed with configured dynamics specified in Cfg_CVTrackGain. CVTrackGain is treated as tracking gain Kt (1/minute) for independent or tracking time constant Tt (minutes) for dependent gains.
- Provides configured SP clamping and ramping: clamping (in PVEU) and ramping (in PVEU/second) of the setpoint at specified limits (separate increase and decrease rate of change limits).
- Provides configured CV clamping and ramping: clamping (in CVEU) and ramping (in CVEU/second) of CV at specified limits (separate increase and decrease rate of change limits).

- Enables CV Hand feedback.
- Supports operation from these command sources: Hand, Maintenance, Override, and full loop control (Cascade, Auto with Setpoint, Manual with CV) from External, Program, and Operator.
- Supports three automatic (Auto, Cascade, Cascade/Ratio) loop modes and one manual (Manual) loop mode.
- In Auto loop mode, setpoint (SP) in engineering units (PVEU) is read from the Program, Operator, Override or External entry. You can also enter a setpoint target in PV engineering units (PVEU) and ramp time (seconds) and use a command to trigger a built-in setpoint ramp.
- In Manual loop mode the control variable (CV) in engineering units is read from the Program, Operator, Override, or External entry.
- Monitors interlock conditions which cause output CV and SP to shed. CV shed can be configured to hold the last good CV value or to use the configured safe value. SP is shed to current PV.
- Monitors I/O communication faults.
- Supports Power-up and Initialize operations. In Power-up, the SP, CV, and Loop modes are set to configured values.
- Monitors alarm conditions for Interlock Trip, Loop Failure, High-High Deviation, High Deviation, Low Deviation, and Low-Low Deviation from the setpoint.
  - High-High Deviation status is raised when the difference between the setpoint and the process variable calculated as PV-SP exceeds configured thresholds.
  - High Deviation status is raised when the difference between the setpoint and the process variable calculated as PV-SP exceeds configured thresholds.
  - Low Deviation status is raised when the difference between the setpoint and the process variable calculated as PV-SP exceeds configured thresholds.
  - Low-Low Deviation status is raised when the difference between the setpoint and the process variable calculated as PV-SP exceeds configured thresholds.
  - Loop Failure status is raised when the PPID indicates a severe configuration error, such as invalid clamping limits, scaling limits, and deadbands. This status is also raised when PV quality is not good enough for the PID loop to work with, and when the I/O Fault input/status is true. This status is also raised when the hand feedback input is reported bad in hand.
  - Interlock Trip status is raised when an interlock not-OK condition causes the output CV to be changed to the configured Interlock CV value or held at its last value. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.

Available Languages

Ladder Diagram



Function Block Diagram

Structured Text

PPID(PPID tag, BusObj);

Operands

IMPORTANT Unexpected operation may occur if:

- Output tag operands are overwritten.
- Members of a structure operand are overwritten.
- Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See *Data Conversions*.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_PID	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component. May be null.

P_PID Structure

Public members are standard, visible tag members that are programmatically accessible. Private, or hidden, members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public input member	Data Type	Default Value	Description
EnableIn	BOOL	True	Enable input. Ladder Diagram: Corresponds to the rung condition. Default is true.
Inp_InitializeReq	BOOL	True	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request to re-initialize. When Inp_InitializeReq = 1, power up configuration values are used. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	0	Owner device command: 0 = None, Inp_OwnerCmd.10 = Operator Lock, Inp_OwnerCmd.11 = Operator Unlock, Inp_OwnerCmd.12 = Program Lock, Inp_OwnerCmd.13 = Program Unlock, Inp_OwnerCmd.14 = Acquire Maintenance, Inp_OwnerCmd.15 = Release Maintenance, Inp_OwnerCmd.16 = Acquire External, Inp_OwnerCmd.17 = Release External, Inp_OwnerCmd.29 = Echo. Default is 0.
Inp_PV	REAL	0.0	Process Variable (PVEU). Valid any float. Default is 0.0.

Public input member	Data Type	Default Value	Description
Inp_CascSP	REAL	0.0	SP in Cascade loop mode, independent PV in Ratio loop mode (PVEU). Valid any float. Default is 0.0.
Inp_FF	REAL	0.0	FeedForward term (CVEU). Valid any float between -(Cfg_CVEUMax-Cfg_CVEUMin) and (Cfg_CVEUMax-Cfg_CVEUMin). Default is 0.0.
Inp_FFPrev	REAL	0.0	Previous scan FeedForward (CVEU) when Inp_UseFFPrev = 1. Valid any float between -(Cfg_CVEUMax-Cfg_CVEUMin) and (Cfg_CVEUMax-Cfg_CVEUMin). Default is 0.0.
Inp_CVTrack	REAL	0.0	CV to track if Cfg_UseCVTrack = 1 or if Inp_InnerAvailable = 0 (CVEU). Valid any float. Default is 0.0.
Inp_CVInitialVal	PVREAL	0.0	Value to initialize the CV to per request Inp_UseCVInitialVal=1 (CVEU). Valid any float. Default is 0.0.
Inp_CVPrev	REAL	0.0	Previous scan CV, Val_CVOut (CVEU). Valid any float between Cfg_CVEUMin and Cfg_CVEUMax. Default is 0.0.
Inp_UseFFPrev	BOOL	False	1 = Use Inp_FFPrev as previous FF value, 0 = Use last scan Inp_FF value as previous FF value. Default is false.
Inp_UseCVInitialVal	BOOL	False	1 = Initialize CV to Inp_CVInitialVal. Default is false.
Inp_UseCVPrev	BOOL	False	1 = Use Inp_CVPrev as previous CV value, 0 = Use last scan value. Default is false.
Inp_WindupHi	BOOL	False	Windup high signal. When true, the CV cannot integrate in a positive direction. The signal is typically obtained from the Windup hi output from a inner loop. Default is false.
Inp_WindupLo	BOOL	False	Windup low signal. When true, the CV cannot integrate in a negative direction. The signal is typically obtained from the Windup low output from a inner loop. Default is false.
Inp_InnerAvailable	BOOL	True	1 = Inner loop is available. 0 = Inner loop is not available, PPID tracks Inp_CVTrack, typically inner loop SP or actuator position. Default is true.
Inp_IntlkOK	BOOL	True	1 = Bypassable interlocks OK, CV can be set. Default is true.
Inp_NBIntlkOK	BOOL	True	1 = Non-Bypassable interlocks OK, CV can be set. Default is true.
Inp_IntlkAvailable	BOOL	False	1 = Interlock availability OK. Default is false.
Inp_IntlkTripInh	BOOL	False	1 = Inhibit interlock trip status. Default is false.
Inp_RdyReset	BOOL	False	1 = Related object, reset by this object, is ready to be reset. Ready for ORdy_Reset, enables HMI button. Default is false.

Public input member	Data Type	Default Value	Description
Inp_CVIOFault	BOOL	False	1 = CV I/O communications status bad, 0 = OK. Default is false.
Inp_PVBad	BOOL	False	1 = PV quality or PV I/O communications status bad, 0 = OK. Default is false.
Inp_PVUncertain	BOOL	False	1 = PV value not reliable, 0 = OK. Default is false.
Inp_PVSrcQ	SINT	0	Inp_PV source status and quality: 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, simulated, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module/communications fault, 35 = Bad, invalid configuration. Default is 0.
Inp_PVNotify	SINT	0	Related PV object alarm priority and acknowledgement status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_CVNotify	SINT	0	Related CV object alarm priority and acknowledgement status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.

Public input member	Data Type	Default Value	Description
Inp_CascSPNotify	SINT	0	Related Cascade SP object alarm priority and acknowledgement status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged. Default is 0.
Inp_HiHiDevGate	BOOL	True	The gate input used for HiHi deviation status detection: 1 = The corresponding analog input threshold monitoring is enabled, 0 = Detection is disabled and the corresponding status output is forced off. Default is true.
Inp_HiDevGate	BOOL	True	The gate input used for Hi deviation status detection: 1 = The corresponding analog input threshold monitoring is enabled, 0 = Detection is disabled and the corresponding status output is forced off. Default is true.
Inp_LoDevGate	BOOL	True	The gate input used for Lo deviation status detection: 1 = The corresponding analog input threshold monitoring is enabled, 0 = Detection is disabled and the corresponding status output is forced off. Default is true.
Inp_LoLoDevGate	BOOL	True	The gate input used for LoLo deviation status detection: 1 = The corresponding analog input threshold monitoring is enabled, 0 = Detection is disabled and the corresponding status output is forced off. Default is true.
Inp_Hand	BOOL	False	1 = Acquire Hand, 0 = Release Hand. Default is false.
Inp_HandFdbk	REAL	0.0	CV feedback used when owner is Hand (CVEU). Valid any float. Default is 0.0. Default is false.
Inp_HandFdbkBad	BOOL	False	1 = CV hand feedback quality or CV hand feedback I/O communications status bad, 0 = OK. Default is false.
Inp_Ovrd	BOOL	False	1 = Acquire Override (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCmd	SINT	0	Loop mode command in Override: 0 = None, 1 = Manual, 2 = Auto, 3 = Cascade, 4 = Normal, 5 = Start SP ramp, 6 = Stop SP ramp. Default is 0.

Public input member	Data Type	Default Value	Description
Inp_OvrdSP	REAL	0.0	Loop Auto SP in Override (PVEU). Valid any float. Default is 0.0.
Inp_OvrdSPTarget	REAL	0.0	Override setting for SP target in ramp wizard (PVEU). Valid any float. Default is 0.0.
Inp_OvrdSPRampTime	REAL	0.0	Override setting for time to reach SP target in ramp wizard (seconds). Valid = 0.0 to 28800.0 seconds. Default is 0.0.
Inp_OvrdRatio	REAL	1.0	Loop Ratio in Override (unitless). Valid = 0.0 to maximum positive float. Default is 1.0.
Inp_OvrdCV	REAL	0.0	Loop Manual CV in Override (CVEU). Valid any float. Default is 0.0.
Inp_ExtInh	BOOL	False	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Inp_Reset	BOOL	False	1 = Reset shed latches and latched alarms whose conditions have returned to normal. Default is false.
Cfg_AllowDisable	BOOL	True	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	True	1 = Allow Operator to shelve alarms.
Cfg_HasRatio	BOOL	False	1 = Cascade loop mode is Ratio, 0 = Cascade loop mode is Cascade. Default is false.
Cfg_HasCasc	BOOL	False	1 = Enable the loop to be placed into Cascade/Ratio mode. Default is false.
Cfg_HasAuto	BOOL	True	1 = Enable the loop to be placed into Auto mode. Default is true.
Cfg_HasMan	BOOL	True	1 = Enable the loop to be placed into Manual mode. Default is true.
Cfg_HasSPRamp	BOOL	False	1 = Enable the SP ramp wizard function. Default is false.
Cfg_ExecTime	REAL	0.0	Execution period for PID algorithm (second). Configuring the instruction for execution period = 0.0 (default) or period shorter than instruction scan time has no effect and the PID algorithm executes every scan. For the real execution period check Val_ExecTime. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_PGain	REAL	0.0	Proportional gain Kp for independent gains or loop gain Kc for dependent gains (unitless). Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_IGain	REAL	0.0	Integral gain Ki (1/minute) for independent or reset time Ti (minutes/repeat) for dependent gains. Valid = 0.0 to maximum positive float. Default is 0.0.

Public input member	Data Type	Default Value	Description
Cfg_DGain	REAL	0.0	Derivative gain Kd (minute) for independent or rate time Td (minute) for dependent gains. Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_CVTrackGain	REAL	0.0	Tracking gain Kt (1/minute) for independent or tracking time constant Tt (minutes) for dependent gains for CV to track Inp_CVTrack if Cfg_UseCVTrack = 1. Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_UseCVTrack	BOOL	False	1 = Use Inp_CVTrack reset feedback in tracking, e.g. if PPID output is significantly faster than actuator or inner loop or in override select control.
Cfg_PSPWeight	REAL	1.0	Weight on SP in proportional term in 2DOF PID, beta gain. Valid = 0.0 to 1.5. Default is 1.0.
Cfg_DSPWeight	REAL	0.0	Weight on SP in derivative term in 2DOF PID, gamma gain. Valid = 0.0 to 1.5. Default is 0.0.
Cfg_PVTrack	BOOL	False	1 = SP tracks PV in Manual, 0 = No PV tracking. Default is false.
Cfg_GainBumpless	BOOL	True	1 = CV response to PGain and DGain change is bumpless, 0 = CV response to PGain and DGain change is not bumpless (like in position algorithm). Default is true.
Cfg_PositionBump	BOOL	False	1 = Position form of PD algorithm without bumpless transfer from Manual to Auto or Cascade. Enabled only when Cfg_IGain = 0. Change of proportional gain is not bumpless. 0 = Velocity form of PID algorithm with bumpless transfer from Manual to Auto or Cascade. Default is false.
Cfg_UseESquared	BOOL	False	1 = Use error squared for proportional action. Default is false.
Cfg_CtrlAction	BOOL	False	1 = Control action on E = PV-SP, direct action 0 = Control action on E = SP-PV, reverse action. Default is false.
Cfg_Dependent	BOOL	False	1 = Dependent gains equation, 0 = Independent gains equation. Default is false.
Cfg_UseDSmoothing	BOOL	False	1 = Use derivative smoothing. Default is false.
Cfg_DevDB	REAL	0.0	PV deviation deadband for PV going away from SP (PVEU). Valid = 0.0 to maximum positive float.
Cfg_DevDBEnter	REAL	0.0	PV deviation deadband for PV approaching SP (PVEU). Valid = 0.0 to Cfg_DevDB.
Cfg_UseIntegDevDB	BOOL	False	1 = Only integral term is suspended when PV deviation deadband status is active, proportional and derivative terms remain operational, 0 = All PID terms are suspended and CV does not move when PV deviation deadband status is active. Default is false.
Cfg_SkipCVManLim	BOOL	True	1 = Skip CV clamping in Manual loop mode and for CV from shed, 0 = Always apply CV clamping.
Cfg_SkipCVManRoC	BOOL	True	1 = Skip CV rate-of-change limiting in Manual loop mode and for CV from shed, 0 = Always apply CV rate-of-change limiting.

Public input member	Data Type	Default Value	Description
Cfg_InitializeToMan	BOOL	False	1 = Go to Manual loop mode when initialization is requested (Inp_UseCVInitialVal=1). Default is false.
Cfg_SetTrack	BOOL	True	1 = Program/Operator/External settings tracking, 0 = No settings tracking. Default is true.
Cfg_SetTrackOvrdHand	BOOL	False	1 = Program/Operator/External settings track Override/Hand inputs (CV, SP, Ratio). Default is false.
Cfg_HasIntlkObj	BOOL	False	1 = Tells HMI an interlock object (PINTLK) is connected to Inp_IntlkOK, InpNBIntlkOK, Inp_IntlkAvailable, Inp_IntlkTripInh and Inp_RdyReset. Default is false.
Cfg_HasMoreObj	BOOL	False	1 = Tells HMI an object with more info is available. Default is false.
Cfg_HasHistTrend	SINT	0	Has historical trend. This enables navigation to the device historical trend faceplate from the HMI. 0 = No external historical trend, 1 = Datalog historical trend, 2 = Historian historical trend. Default is 0.
Cfg_HasCascSPNav	BOOL	False	1 = Tells HMI to enable navigation to a connected cascade SP object. Default is false.
Cfg_HasPVNav	BOOL	False	1 = Tells HMI to enable navigation to a connected PV object. Default is false.
Cfg_HasCVNav	BOOL	False	1 = Tells HMI to enable navigation to a connected CV object. Default is false.
Cfg_HasOper	BOOL	True	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	True	1 = Operator Locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	True	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	True	1 = Program Locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	False	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	True	1 = Maintenance exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	True	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	True	1 = Override supersedes Program/Operator Lock, 0 = Do not override Lock. Default is true.
Cfg_ExtOverLock	BOOL	False	1 = External supersedes Program/Operator Lock, 0 = Do not override Lock. Default is false.
Cfg_eKeepLM	SINT	0	Loop mode ownership: 0 = Follows command source, 1 = Operator, 2 = Program, 3 = External. Default is 0.

Public input member	Data Type	Default Value	Description
Cfg_eKeepCV	SINT	0	CV ownership: 0 = Follows command source, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_eKeepSP	SINT	0	SP ownership: 0 = Follows command source, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_eKeepRatio	SINT	0	Ratio ownership: 0 = Follows command source, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_ProgPwrUp	BOOL	False	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	False	Normal source: 1 = Program if no requests, 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	False	Command priority: 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	False	1 = PCmd_Prog used as Level (1 = Prog, 0 = Oper). Default is false.
Cfg_PCmdLockAsLevel	BOOL	False	1 = PCmd_Lock used as Level (1 = Lock, 0 = Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	False	1 = XCmd_Acq used as Level (XCmd_Acq = 1 acquire external command, XCmd_Acq = 0 release external command). Default is false.
Cfg_OvrdIntlk	BOOL	False	1 = Override bypasses (ignores) bypassable interlocks. 0 = Override abides by all interlock conditions. Default is false.
Cfg_SPFailLatch	BOOL	False	1 = Latch in SP fail shed action until Reset, 0 = Return when SP is good. Default is false.
Cfg_PVFailLatch	BOOL	False	1 = Latch in PV fail shed action until Reset, 0 = Return when PV is good. Default is false.
Cfg_CVFailLatch	BOOL	False	1 = Latch in CV fail shed action until Reset, 0 = Return when CV is good. Default is false.
Cfg_LockLM	BOOL	False	Lock loop mode: 1 = Locked in loop mode configured as Normal (see Cfg_NormLM), 0 = Not locked. Default is false.

Public input member	Data Type	Default Value	Description
Cfg_NormLM	SINT	1	Loop mode defined as Normal: 0 = Disable Normal selection, 1 = Manual, 2 = Auto, 3 = Cascade. Default is 1.
Cfg_PwrUpLM	SINT	4	Loop mode defined for Powerup: 0 = No change - loop mode, CV and SP are initialized using last (powerdown) values, 1 = Manual, 2 = Auto, 3 = Cascade, 4 = Normal. Default is 4.
Cfg_PVFailTrigger	SINT	1	PV fail status response on PV quality: 0 = PV fail response on Inp_PVBad OR Inp_PVSrcQ >= 32 (PV bad), 1 = PV fail response on Inp_PVBad OR Inp_PVSrcQ >= 17 AND Inp_PVSrcQ <> 18, 2 = PV fail response on Inp_PVBad OR Inp_PVUncertain OR Inp_PVSrcQ >= 16 AND Inp_PVSrcQ <> 18. Default is 1.
Cfg_IntlkTripSPAction	SINT	0	Interlock Trip SP action: 0 = None, 1 = Hold last good, 2 = Use Cfg_SPIntlk, 3 = Set SP to current PV. Default is 0.
Cfg_SPFailSPAction	SINT	1	SP Fail SP action: 1 = Hold last good, 2 = Use Cfg_SPIntlk, 3 = Set SP to current PV. Default is 1.
Cfg_PVFailSPAction	SINT	0	PV Fail SP action: 0 = None, 1 = Hold last good, 2 = Use Cfg_SPIntlk. Default is 0.
Cfg_CVFailSPAction	SINT	0	CV Fail SP action: 0 = None, 1 = Hold last good, 2 = Use Cfg_SPIntlk, 3 = Set SP to current PV. Default is 0.
Cfg_IntlkTripCVAction	SINT	2	Interlock trip CV action: 0 = None, 1 = Hold last good, 2 = Use Cfg_CVIntlk. Default is 2.
Cfg_SPFailCVAction	SINT	1	SP Fail CV action: 0 = None, 1 = Hold last good, 2 = Use Cfg_CVIntlk. Default is 1.

Public input member	Data Type	Default Value	Description
Cfg_PVFailCVAction	SINT	1	PV Fail CV action: 1 = Hold last CV, 2 = Use Cfg_CVIntlk. Default is 1.
Cfg_CVFailCVAction	SINT	1	CV Fail CV action: 1 = Hold last good, 2 = Use Cfg_CVIntlk. Default is 1.
Cfg_IntlkTripLMAction	SINT	0	Interlock trip loop mode action: 0 = None, 1 = Manual only, 2 = Auto or Manual only. Default is 0.
Cfg_SPFailLMAction	SINT	0	SP Fail loop mode action: 0 = None, 1 = Manual only, 2 = Auto or Manual only. Default is 0.
Cfg_PVFailLMAction	SINT	0	PV Fail loop mode action: 0 = none, 1 = Manual only, 2 =Auto or Manual only. Default is 0.
Cfg_CVFailLMAction	SINT	0	CV Fail loop mode action: 0 = None, 1 = Manual only, 2 = Auto or Manual only. Default is 0.
Cfg_PVDecPlcs	SINT	2	Number of decimal places for display of PV / SP (up to six). Default is 2.
Cfg_CVDecPlcs	SINT	2	Number of decimal places for display of CV (up to six). Default is 2.
Cfg_RatioDecPlcs	SINT	2	Number of decimal places for display of Ratio (up to six). Default is 2.
Cfg_RatioLoLim	REAL	0.0	Minimum allowed Ratio value (unitless). Valid any float less than or equal to Cfg_RatioHiLim. Default is 0.0.
Cfg_RatioHiLim	REAL	1.0	Maximum allowed Ratio value (unitless). Valid any float greater than or equal to Cfg_RatioLoLim. Default is 1.0.
Cfg_SPLoLim	REAL	0.0	Minimum allowed SP value (PVEU). Valid any float less than or equal to Cfg_SPHiLim and greater than or equal to Cfg_PVEUMin. Default is 0.0.
Cfg_SPHiLim	REAL	100.0	Maximum allowed SP value (PVEU). Valid any float greater than or equal to Cfg_SPLoLim and less than or equal to Cfg_PVEUMax. Default is 100.0.
Cfg_SPRoCIncrLim	REAL	0.0	Maximum allowed SP rate of change increasing value (PVEU/second). The SP rate of change is unlimited when increasing if Cfg_SPRoCIncrLim = 0.0. Valid = 0.0 to maximum positive float. Default is 0.0.

Public input member	Data Type	Default Value	Description
Cfg_SPRoCDecrLim	REAL	0.0	Maximum allowed SP rate of change decreasing value (PVEU/second). The SP rate of change is unlimited when decreasing if Cfg_SPRoCDecrLim = 0.0. Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_SkipSPRoCLim	BOOL	False	1 = Skip setpoint RoC limiting in interlock, maintenance and override. Default is false.
Cfg_SPRampMaxDev	REAL	100.0	If absolute value of deviation exceeds this value, pause SP ramp, 0.0 = Never pause (PVEU). Valid any float from zero to (Cfg_SPHiLim - Cfg_SPLoLim). Default is 100.0.
Cfg_PVEUMin	REAL	0.0	PV minimum value for scaling from engineering units to %, PV at 0% (PVEU). Valid any float less than Cfg_PVEUMax. Default is 0.0.
Cfg_PVEUMax	REAL	100.0	PV maximum value for scaling from engineering units to %, PV at 100% (PVEU). Valid any float greater than Cfg_PVEUMin. Default is 100.0.
Cfg_CVEUMin	REAL	0.0	CV minimum value for scaling from % to engineering units (CVEU). Valid any float less than Cfg_CVEUMax. Default is 0.0.
Cfg_CVEUMax	REAL	100.0	CV maximum value for scaling from % to engineering units (CVEU). Valid any float greater than Cfg_CVEUMin.
Cfg_CVLoLim	REAL	0.0	Minimum allowed CV value (CVEU). Valid any float less than or equal to Cfg_CVHiLim and greater than or equal to Cfg_CVEUMin. Default is 0.0.
Cfg_CVHiLim	REAL	100.0	Maximum allowed CV value (CVEU). Valid any float greater than or equal to Cfg_CVLoLim and less than or equal to Cfg_CVEUMax. Default is 100.0.
Cfg_CVRoCIncrLim	REAL	0.0	Maximum allowed CV rate of change increasing value (CVEU/second). The CV rate of change is unlimited when increasing if Cfg_CVRoCIncrLim = 0.0 Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_CVRoCDecrLim	REAL	0.0	Maximum allowed CV rate of change decreasing value (CVEU/second). The CV rate of change is unlimited when decreasing if Cfg_CVRoCDecrLim = 0.0. Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_MaxInactiveCV	REAL	0.0	When Val_CVOut is greater than this value, set Sts_Active for HMI (CVEU). Valid any float. Default is 0.0.
Cfg_SPIntlk	REAL	0.0	SP value to use with interlock / bad value SP action (PVEU). Valid any float between Cfg_PVEUMin and Cfg_PVEUMax.
Cfg_CVIntlk	REAL	0.0	CV value to use with interlock / bad value CV action (CVEU). Valid any float between Cfg_CVEUMin and Cfg_CVEUMax.
Cfg_SPPwrUp	REAL	0.0	Loop SP on Powerup (PVEU) used when Cfg_PwrUpLM is not 0. The value is clamped to the SP range (Cfg_SPLoLim, Cfg_SPHiLim). Valid any float between Cfg_PVEUMin and Cfg_PVEUMax.
Cfg_CVPwrUp	REAL	0.0	Loop CV on Powerup (CVEU) used when Cfg_PwrUpLM is not 0. Value may be clamped to the configured limits (Cfg_CVLoLim, CfgHiLim) in cascade or auto, and in manual if so configured. Valid any float between Cfg_CVEUMin and Cfg_CVEUMax.

Public input member	Data Type	Default Value	Description
Cfg_CVPwrUpSel	SINT	0	Selection of Powerup (first run) CV in Auto or Cascade. 0 = Ignore Inp_InnerAvailable and always use Cfg_CVPwrUp or last (Powerdown) CV (if Cfg_PwrpUpLM = 0), 1 = Process Inp_InnerAvailable. Default is false.
Cfg_HiHiDevLim	REAL	1.5e+38	High-High PV deviation status threshold (PVEU). Valid = 0.0 to maximum positive float. Default is 1.5e+38.
Cfg_HiHiDevDB	REAL	0.0	High-High PV deviation status deadband (PVEU). Valid = 0.0 to Cfg_HiHiDevLim. Default is 0.0.
Cfg_HiHiDevGateDly	REAL	0.0	High-High PV deviation status gate delay (second). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_HiDevLim	REAL	1.5e+38	High PV deviation status threshold (PVEU). Valid = 0.0 to maximum positive float. Default is 1.5e+38.
Cfg_HiDevDB	REAL	0.0	High PV deviation status deadband (PVEU). Valid = 0.0 to Cfg_HiDevLim. Default is 0.0.
Cfg_HiDevGateDly	REAL	0.0	High PV deviation status gate delay (second). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_LoDevLim	REAL	-1.5e+38	Low PV deviation status threshold (PVEU). Valid = -maximum positive float to 0.0. Default is -1.5e+38.
Cfg_LoDevDB	REAL	0.0	Low PV deviation status deadband (PVEU). Valid = 0.0 to abs(Cfg_LoDevLim). Default is 0.0.
Cfg_LoDevGateDly	REAL	0.0	Low PV deviation status gate delay (second). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_LoLoDevLim	REAL	-1.5e+38	Low-Low PV deviation status threshold (PVEU). Valid = -maximum positive float to 0.0. Default is -1.5e+38.
Cfg_LoLoDevDB	REAL	0.0	Low-Low PV deviation status deadband (PVEU). Valid = 0.0 to abs(Cfg_LoLoDevLim). Default is 0.0.
Cfg_LoLoDevGateDly	REAL	0.0	Low-Low PV deviation status gate delay (second). Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_CnfrmReqd	SINT	0	Operator command confirmation required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Ratio	REAL	1.0	Program setting for Ratio, loop mode Cascade/Ratio and Ratio enabled (unitless). Valid = 0.0 to maximum positive float. Default is 1.0.

Public input member	Data Type	Default Value	Description
PSet_SP	REAL	0.0	Program setting for SP, loop mode Auto (PVEU). Valid any float. Default is 0.0.
PSet_SPTarget	REAL	0.0	Program setting for SP target in ramp wizard (PVEU). Valid any float. Default is 0.0.
PSet_SPRampTime	REAL	0.0	Program setting for time to reach SP target in ramp wizard (seconds). Valid = 0.0 to 28800.0 seconds. Default is 0.0.
PSet_CV	REAL	0.0	Program setting for CV when loop mode is Manual (CVEU). Valid any float. Default is 0.0.
PSet_Owner	DINT	0	Program owner request ID (non-zero) or release (zero). Default is 0.
XSet_Ratio	REAL	1.0	External setting for Ratio, loop mode Cascade/Ratio and Ratio enabled (unitless). Valid = 0.0 to maximum positive float. Default is 1.0.
XSet_SP	REAL	0.0	External setting for SP, loop mode Auto (PVEU). Valid any float. Default is 0.0.
XSet_SPTarget	REAL	0.0	External setting for SP target in ramp wizard (PVEU). Valid any float. Default is 0.0.
XSet_SPRampTime	REAL	0.0	External setting for time to reach SP target in ramp wizard (seconds). Valid = 0.0 to 28800.0 seconds. Default is 0.0.
XSet_CV	REAL	0.0	External setting for CV, loop mode Manual (CVEU). Valid any float. Default is 0.0.
PCmd_Casc	BOOL	False	Program command to select Cascade/Ratio loop mode. The instruction clears this operand automatically. Default is false.
PCmd_Auto	BOOL	False	Program command to select Auto loop mode. The instruction clears this operand automatically. Default is false.
PCmd_Man	BOOL	False	Program command to select Manual loop mode. The instruction clears this operand automatically. Default is false.
PCmd_NormLM	BOOL	False	Program command to select loop mode defined as Normal, see Cfg_NormLM. The instruction clears this operand automatically. Default is false.
PCmd_SPRampStart	BOOL	False	Program command to initiate SP ramping. The instruction clears this operand automatically. Default is false.
PCmd_SPRampStop	BOOL	False	Program command to stop SP ramping. The instruction clears this operand automatically. Default is false.
PCmd_Oper	BOOL	False	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.

Public input member	Data Type	Default Value	Description
PCmd_Prog	BOOL	False	Program command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	False	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	False	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	False	Program command to select Normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	False	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
XCmd_Casc	BOOL	False	External command to select Cascade/Ratio loop mode. The instruction clears this operand automatically. Default is false.
XCmd_Auto	BOOL	False	External command to select Auto loop mode. The instruction clears this operand automatically. Default is false.
XCmd_Man	BOOL	False	External command to select Manual loop mode. The instruction clears this operand automatically. Default is false.
XCmd_NormLM	BOOL	False	External command to select loop mode defined as Normal, see Cfg_NormLM. The instruction clears this operand automatically. Default is false.
XCmd_SPRampStart	BOOL	False	External command to initiate SP ramping. The instruction clears this operand automatically. Default is false.
XCmd_SPRampStop	BOOL	False	External command to stop SP ramping. The instruction clears this operand automatically. Default is false.
XCmd_Acq	BOOL	False	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	False	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	False	External command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	False	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public output member	Data Type	Description
EnableOut	BOOL	Enable output. This output state always reflects EnableIn input state.
Val_PV	REAL	Value of loop PV (PVEU).

Public output member	Data Type	Description
Val_Ratio	REAL	Value of loop Ratio (unitless).
Val_SPSet	REAL	Value of selected SP after clamping and before ramping (PVEU).
Val_SP	REAL	Value of SP being used after clamping and ramping (PVEU).
Val_SPTarget	REAL	Accepted setting for SP ramp target, endpoint for ramp wizard (PVEU).
Val_SPRampTime	REAL	Accepted setting for SP ramp time, time to reach target for ramp wizard (second).
Val_SPRampRoC	REAL	Calculated value of SP rate of change for ramping, from ramp wizard (PVEU/second).
Val_SPRoCIncr	REAL	Current value of SP rate of change limit increasing (PVEU/second). 0.0 = rate of change not limited.
Val_SPRoCDecr	REAL	Current value of SP rate of change limit decreasing (PVEU/second). 0.0 = rate of change not limited.
Val_E	REAL	Loop error, SP-PV for reverse action Cfg_CtrlAction = 0, PV-SP for direct action Cfg_CtrlAction = 1 (PVEU).
Val_CVSet	REAL	Loop CV after clamping and before ramping (CVEU).
Val_CVOut	REAL	Loop CV after clamping and ramping (CVEU).
Val_PVPercent	REAL	Loop PV (percent of span).
Val_SPPercent	REAL	Loop SP (percent of span).
Val_EPercent	REAL	Loop error, SP-PV for reverse action Cfg_CtrlAction = 0, PV-SP for direct action Cfg_CtrlAction = 1 (percent of span).
Val_CVOutPercent	REAL	Loop CV after ramping and clamping (percent of span).
Val_ExecTime	REAL	Actual PID algorithm execution period (second).
Out_Reset	BOOL	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Status of command source, owner command handshake and ready status: 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.

Public output member	Data Type	Description
SrcQ_IO	SINT	Source and quality of primary I/O PV quality (enumerated): 0 = Good, live, confirmed good, 1 = Good, live, assumed good, 2 = Good, no feedback, assumed good, 8 = Test, virtualized, 9 = Test, loopback, 10 = Test, manually entered, 16 = Uncertain, live, off-spec, 17 = Uncertain, substituted at device or bus, 18 = Uncertain, substituted at instruction, 19 = Uncertain, using last known good, 20 = Uncertain, using replacement value, 32 = Bad, signal failure, 33 = Bad, channel fault, 34 = Bad, module or communication fault, 35 = Bad, invalid configuration.
SrcQ	SINT	Source and quality of primary PV and CV value or status (enumerated): 0 = Good, live, confirmed good 1 = Good, live, assumed good 2 = Good, no feedback, assumed good 8 = Test, virtualized 9 = Test, loopback 10 = Test, manually entered 16 = Uncertain, live, off-spec 17 = Uncertain, substituted at device or bus 18 = Uncertain, substituted at instruction 19 = Uncertain, using last known good 20 = Uncertain, using replacement value 32 = Bad, signal failure 33 = Bad, channel fault 34 = Bad, module or communication fault 35 = Bad, invalid configuration
Sts_eSts	SINT	Loop mode: 0 = Unknown, 1 = Manual, 2 = Auto, 3 = Cascade (no Ratio), 4 = Ratio.
Sts_eFault	SINT	Loop fault: 0 = none, 1 = PV uncertain, 2 = Low PV deviation, 3 = High PV deviation, 4 = Low-Low PV deviation, 5 = High-High PV deviation, 6 = PV substituted, 7 = Interlock trip, 8 = SP fail, 9 = PV fail, 10 = CV fail, 11 = Configuration error.

Public output member	Data Type	Description
Sts_eState	SINT	Internal logic state for animating state diagram on faceplate. 0 = Manual, 1 = PV deviation in deadband, 2 = PV deviation not in deadband, 3 = SP ramping, 4 = CV ramping, 5 = Ratio clamped, 6 = SP clamped, 7 = CV clamped, 8 = Windup Lo, 9 = Windup Hi, 10 = SP held, 11 = SP set to IntlkSP, 12 = CV held, 13 = CV set to IntlkCV, 14 = Hand, 15 = Initializing.
Sts_eNotify	SINT	Highest severity alarm status. All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	Highest severity alarm status. All alarm status enumerated values including related objects for CV, PV, SP, CascSP: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyHiHiDev	SINT	High-High PV deviation alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public output member	Data Type	Description
Sts_eNotifyHiDev	SINT	High PV deviation alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLoDev	SINT	Low PV deviation alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLoLoDev	SINT	Low-Low PV deviation alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFail	SINT	Fail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	Interlock trip alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public output member	Data Type	Description
Sts_UnackAlmCount	DINT	Count of unacknowledged alarms.
Sts_Casc	BOOL	1 = Loop is in Cascade/Ratio mode.
Sts_Auto	BOOL	1 = Loop is in Auto mode.
Sts_Man	BOOL	1 = Loop is in Manual mode.
Sts_NormLM	BOOL	1 = Loop is in Normal loop mode configured in Cfg_NormLM.
Sts_Initializing	BOOL	1 = CV is initializing because of request Inp_UseCVInitialVal or when Inp_InnerAvailable=0.
Sts_WindupHi	BOOL	1 = This loop winding up High, usually connects to Inp_WindupHi of outer loop.
Sts_WindupLo	BOOL	1 = This loop winding up Low, usually connects to Inp_WindupLo of outer loop.
Sts_RatioClamped	BOOL	1 = Selected Ratio is being clamped, used in faceplate animation.
Sts_IntlkSP	BOOL	1 = SP value is being set by shed to Interlock SP.
Sts_SPHeld	BOOL	1 = SP value is being set by shed to hold last good SP.
Sts_SPShedPV	BOOL	1 = SP value is being set by shed to current PV.
Sts_SPShed	BOOL	1 = SP value from Shed, 0 = SP from Program, Operator, Override (Auto), Casc SP Input (Cascade) or PV Track (Manual).
Sts_SPTrackPV	BOOL	1 = SP value is being set by PV tracking in Manual loop mode.
Sts_SPHiClamped	BOOL	1 = Selected SP is being clamped at high limit.
Sts_SPLoClamped	BOOL	1 = Selected SP is being clamped at low limit.
Sts_SPClamped	BOOL	1 = Selected SP is being clamped, for faceplate animation.
Sts_SPRampingUp	BOOL	1 = SP is ramping up toward Val_SPSet.
Sts_SPRampingDown	BOOL	1 = SP is ramping down toward Val_SPSet.
Sts_SPRamping	BOOL	1 = SP is ramping toward Val_SPSet, 0 = Ramp complete.
Sts_SPRampWizardInProgress	BOOL	1 = SP is ramping toward SP target set by the owner in ramp wizard, 0 = Ramp complete.
Sts_SkipSPRoCLim	BOOL	1 = SP rate limiting is being skipped, for faceplate animation.
Sts_DevDBAct	BOOL	1 = PV deviation deadband active.
Sts_PVUncertain	BOOL	1 = PV input value quality is uncertain.
Sts_PVBad	BOOL	1 = PV input value, communications, quality or EU limit is bad.
Sts_SPBad	BOOL	1 = Cascade SP input value quality is bad.
Sts_FFBad	BOOL	1 = Feedforward term Inp_FF value is invalid.
Sts_FFPrevBad	BOOL	1 = Feedforward term Inp_FFPrev value is invalid.
Sts_CVInfNaN	BOOL	1 = CV value equal to +/- infinity or NaN detected.
Sts_CVBad	BOOL	1 = CV value quality is bad or invalid or CV comms fault.
Sts_CVPrevBad	BOOL	1 = Inp_CVPrev value is invalid.
Sts_HandFdbkBad	BOOL	1 = Hand FB (Tieback) value quality is bad or invalid or communication fault.
Sts_IntlkCV	BOOL	1 = CV value is being set by shed to Interlock CV.
Sts_CVHeld	BOOL	1 = CV value is being set by shed to hold last good CV.
Sts_CVShed	BOOL	1 = CV from shed, 0 = CV from Program, Operator, Override (Manual), or PID (Auto, Cascade).
Sts_CVHiClamped	BOOL	1 = CV is being clamped at high limit.
Sts_CVLoClamped	BOOL	1 = CV is being clamped at low limit.
Sts_CVClamped	BOOL	1 = Selected CV is being clamped, used in faceplate animation.
Sts_CVRampingUp	BOOL	1 = CV is ramping up toward Val_CVSet.
Sts_CVRampingDown	BOOL	1 = CV is ramping down toward Val_CVSet.
Sts_CVRamping	BOOL	1 = CV is ramping toward Val_CVSet, 0 = Ramp complete.
Sts_Active	BOOL	1 = CV is greater than Cfg_MaxInactiveCV, show graphic symbol as active.
Sts_Available	BOOL	1 = PID loop can be acquired by Program and is available for control.
Sts_CascAvailable	BOOL	1 = PID inner loop is available for cascade control with an outer loop. 0 = PID inner loop is not available, initialize outer loop to Val_SP.
Sts_ExtAvailable	BOOL	1 = PID is available for external control. 0 = PID is not available, initialize outer loop to Val_SP.
Sts_IntlkAvailable	BOOL	1 = Interlock availability OK. Device can be acquired by program and is available for control when interlocks are OK.
Sts_Bypass	BOOL	1 = Bypassable interlocks are bypassed.

Public output member	Data Type	Description
Sts_BypActive	BOOL	1 = Interlock bypassing is active (bypassed or Maintenance).
Sts_NotRdy	BOOL	1 = PPID is not ready, see detail bits for reason.
Sts_NrdyCfgErr	BOOL	1 = PPID is not ready: Configuration error.
Sts_NrdyInit	BOOL	1 = PPID is not ready while CV is initialized (Inp_UseCVInitVal = 1).
Sts_NrdyIntlk	BOOL	1 = PPID is not ready: Interlock Not OK (Shed requires reset).
Sts_NrdyFail	BOOL	1 = PPID is not ready: Fail status is on (Shed requires reset).
Sts_NrdyCVFail	BOOL	1 = PPID is not ready: CV Fail (Shed requires reset).
Sts_NrdyPVFail	BOOL	1 = PPID is not ready: PV Fail (Shed requires reset).
Sts_NrdySPFail	BOOL	1 = PPID is not ready: SP Fail (Shed requires reset).
Sts_NrdyOoS	BOOL	1 = PPID is not ready: Out of Service.
Sts_MaintByp	BOOL	1 = Device has a Maintenance bypass function active.
Sts_NrdyInner	BOOL	1 = Inner loop object is not available (Inp_InnerAvailable = 0) for this PPID.
Sts_Err	BOOL	1 = Error in PPID configuration: see detail Err bits for reason.
Sts_ErrRatioLim	BOOL	1 = Error in PPID configuration: Ratio clamping limits invalid. Cfg_RatioLoLim > Cfg_RatioHiLim.
Sts_ErrSPLim	BOOL	1 = Error in PPID configuration: SP clamping limits invalid. Cfg_SPLoLim < Cfg_PVEUMin or Cfg_SPHiLim > Cfg_PVEUMax or Cfg_SPLoLim > Cfg_SPHiLim.
Sts_ErrCVLim	BOOL	1 = Error in PPID configuration: CV clamping limits invalid. Cfg_CVLoLim < Cfg_CVEUMin or Cfg_CVHiLim > Cfg_CVEUMax or Cfg_CVLoLim > Cfg_CVHiLim.
Sts_ErrPVEU	BOOL	1 = Error in PPID configuration: PV scaling limits invalid. Cfg_PVEUMin >= Cfg_PVEUMax or Cfg_PVEUMin is +-Inf.
Sts_ErrCVEU	BOOL	1 = Error in PPID configuration: CV scaling limits invalid. Cfg_CVEUMin >= Cfg_CVEUMax or Cfg_CVEUMin is +-Inf.
Sts_ErrDevDB	BOOL	1 = Error in PPID configuration: PV deviation deadband invalid. Cfg_DevDBEnter > Cfg_DevDB, or Cfg_DevDB < 0, or Cfg_DevDBEnter < 0.
Sts_ErrExecTime	BOOL	1 = Error in PPID configuration: Execution time invalid, Cfg_ExecTime < 0.0 or Cfg_ExecTime > 2147483.0 seconds.
Sts_ErrPGain	BOOL	1 = Error in PPID configuration: PGain invalid, Cfg_PGain < 0.
Sts_ErrIGain	BOOL	1 = Error in PPID configuration: IGain invalid, Cfg_IGain < 0.
Sts_ErrDGain	BOOL	1 = Error in PPID configuration: DGain invalid, Cfg_DGain < 0.
Sts_ErrCVTrackGain	BOOL	1 = Error in PPID configuration: CV TrackGain invalid, Cfg_CVTrackGain < 0.
Sts_ErrPSPWeight	BOOL	1 = Error in PPID configuration: SP weight in proportional term invalid, Cfg_PSPWeight < 0 or Cfg_PSPWeight > 1.5.
Sts_ErrDSPWeight	BOOL	1 = Error in PPID configuration: SP weight in derivative term invalid, Cfg_DSPWeight < 0 or Cfg_DSPWeight > 1.5.
Sts_ErrSPRoCIncrLim	BOOL	1 = Error in PPID configuration: Maximum allowed SP rate of change increasing value invalid, Cfg_SPRoCIncrLim < 0.
Sts_ErrSPRoCDecrLim	BOOL	1 = Error in PPID configuration: Maximum allowed SP rate of change decreasing value invalid, Cfg_SPRoCDecrLim < 0.
Sts_ErrCVRoCIncrLim	BOOL	1 = Error in PPID configuration: Maximum allowed CV rate of change increasing value invalid, Cfg_CVRoCIncrLim < 0.
Sts_ErrCVRoCDecrLim	BOOL	1 = Error in PPID configuration: Maximum allowed CV rate of change decreasing value invalid, Cfg_CVRoCDecrLim < 0.
Sts_ErrSPIntlk	BOOL	1 = Error in PPID configuration: SP value to use with Interlock or bad value SP action invalid, value out of scale, Cfg_SPIntlk > Cfg_PVEUMax or < Cfg_PVEUMin.
Sts_ErrCVIntlk	BOOL	1 = Error in PPID configuration: CV value to use with Interlock or bad value CV action invalid, value out of scale, Cfg_CVIntlk > Cfg_CVEUMax or < Cfg_CVEUMin.

Public output member	Data Type	Description
Sts_ErrSPPwrUp	BOOL	1 = Error in PPID configuration: SP value to use in Powerup invalid, value out of scale, Cfg_SPPwrUp > Cfg_PVEUMax or < Cfg_PVEUMin.
Sts_ErrCVPwrUp	BOOL	1 = Error in PPID configuration: CV value to use in Powerup invalid, value out of scale, Cfg_CVIntlk > Cfg_CVEUMax or < Cfg_CVEUMin.
Sts_ErrAlm	BOOL	1 = Error in PPID configuration: At least one Logix tag-based alarm has invalid settings.
Sts_ErrHiHiDevLim	BOOL	1 = Error in PPID configuration: High-High PV deviation threshold invalid, Cfg_HiHiDevLim < 0.
Sts_ErrHiHiDevGateDly	BOOL	1 = Error in PPID configuration: Invalid High-High PV deviation gate delay timer preset (use 0.0 to 2147483.0).
Sts_ErrHiHiDevDB	BOOL	1 = Error in PPID configuration: High-High PV deviation deadband invalid, Cfg_HiHiDevDB < 0 or Cfg_HiHiDevDB > Cfg_HiHiDevLim.
Sts_ErrHiDevLim	BOOL	1 = Error in PPID configuration: High PV deviation threshold invalid, Cfg_HiDevLim < 0.0.
Sts_ErrHiDevGateDly	BOOL	1 = Error in PPID configuration: Invalid High PV deviation gate delay timer preset (use 0.0 to 2147483.0).
Sts_ErrHiDevDB	BOOL	1 = Error in PPID configuration: High PV deviation deadband invalid, Cfg_HiDevDB < 0 or Cfg_HiDevDB > Cfg_HiDevLim.
Sts_ErrLoDevLim	BOOL	1 = Error in PPID configuration: Low PV deviation threshold invalid, Cfg_LoDevLim > 0.
Sts_ErrLoDevGateDly	BOOL	1 = Error in PPID configuration: Invalid Low PV deviation gate delay timer preset (use 0.0 to 2147483.0).
Sts_ErrLoDevDB	BOOL	1 = Error in PPID configuration: Low PV deviation deadband invalid, Cfg_LoDevDB < 0, or > -Cfg_LoDevLim.
Sts_ErrLoLoDevLim	BOOL	1 = Error in PPID configuration: Low-Low PV deviation threshold invalid, Cfg_LoLoDevLim > 0.0.
Sts_ErrLoLoDevGateDly	BOOL	1 = Error in PPID configuration: Invalid Low-Low PV deviation gate delay timer preset (use 0.0 to 2147483.0).
Sts_ErrLoLoDevDB	BOOL	1 = Error in PPID configuration: Low-Low PV deviation deadband invalid, Cfg_LoLoDevDB < 0, or > -Cfg_LoLoDevLim.
Sts_eSrc	INT	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.
Sts_bSrc	INT	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed Out of Service (rung false), Sts_bSrc.2: Maintenance Out of Service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_Hand	BOOL	1 = Hand is selected, supersedes OoS, Maint, Ovrd, Ext, Prog, Oper.
Sts_OoS	BOOL	1 = Out of Service is selected, supersedes Maint, Ovrd, Ext, Prog, Oper.
Sts_Maint	BOOL	1 = Maintenance is selected, supersedes Ovrd, Ext, Prog, Oper.

Public output member	Data Type	Description
Sts_Ovrd	BOOL	1 = Override is selected, supersedes Ext, Prog, Oper.
Sts_Ext	BOOL	1 = External is selected, supersedes Prog, Oper.
Sts_Prog	BOOL	1 = Program is selected.
Sts_ProgLocked	BOOL	1 = Program is selected and locked.
Sts_Oper	BOOL	1 = Operator is selected.
Sts_OperLocked	BOOL	1 = Operator is selected and locked.
Sts_ProgOperSel	BOOL	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Program/Operator lock (latch) state: 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	1 = Owner selection equals what is configured as Normal (Prog or Oper).
Sts_ExtReqInh	BOOL	1 = External request inhibited.
Sts_ProgReqInh	BOOL	1 = Program request inhibited, cannot get to Program from current owner.
Sts_MAcqRcvd	BOOL	1 = Maintenance acquire command received this scan.
Sts_Alm	BOOL	1 = An alarm is active.
Sts_AlmInh	BOOL	1 = An alarm is shelved or disabled.
Sts_HiHiDevCmp	BOOL	1 = PV deviation is above High-High limit, (Val_PV-Val_SP)>Cfg_HiHiDevLim.
Sts_HiHiDevGate	BOOL	1 = PV deviation High-High gate is open.
Sts_HiHiDev	BOOL	1 = PV deviation is above High-High limit, (Val_PV-Val_SP)>Cfg_HiHiDevLim, for gate open. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.Alm_HiHiDev.AlarmElement
Sts_HiDevCmp	BOOL	1 = PV deviation is above High limit, (Val_PV-Val_SP)>Cfg_HiDevLim.
Sts_HiDevGate	BOOL	1 = PV deviation High gate is open.
Sts_HiDev	BOOL	1 = PV deviation is above High limit, (Val_PV-Val_SP)>Cfg_HiDevLim, for gate open. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.Alm_HiDev.AlarmElement
Sts_LoDevCmp	BOOL	1 = PV deviation is below Low limit, (Val_PV-Val_SP)<Cfg_LoDevLim.
Sts_LoDevGate	BOOL	1 = PV deviation Low gate is open.
Sts_LoDev	BOOL	1 = PV deviation (loop error) is below Low limit, (Val_PV-Val_SP)<Cfg_LoDevLim, for gate open. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.Alm_LoDev.AlarmElement
Sts_LoLoDevCmp	BOOL	1 = PV deviation is below Low-Low limit, (Val_PV-Val_SP)<Cfg_LoLoDevLim.
Sts_LoLoDevGate	BOOL	1 = PV deviation Low-Low gate is open.
Sts_LoLoDev	BOOL	1 = PV deviation (loop error) is below Low-Low limit, (Val_PV-Val_SP)<Cfg_LoLoDevLim, for gate open. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.Alm_LoLoDev.AlarmElement
Sts_Fail	BOOL	1 = Loop failure: PV bad, SP bad, CV bad or Hand feedback bad statuses are on or are latched on without reset. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.Alm_Fail.AlarmElement
Sts_IntlkTrip	BOOL	1 = Interlock Not OK caused loop output to hold or change. There is a predefined default discrete tag-based alarm for the status. Set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.Alm_IntlkTrip.AlarmElement
Sts_RdyReset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
Sts_RdyAck	BOOL	1 = An alarm is ready to be acknowledged.
XRdy_Acq	BOOL	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_Casc	BOOL	1 = Ready for XCmd_Casc, enable HMI button.

Public output member	Data Type	Description
XRdy_Auto	BOOL	1 = Ready for XCmd_Auto, enable HMI button.
XRdy_Man	BOOL	1 = Ready for XCmd_Man, enable HMI button.
XRdy_NormLM	BOOL	1 = Ready for XCmd_NormLM, enable HMI button.
XRdy_SPRampStart	BOOL	1 = Ready for XCmd_SPRampStart, enable HMI button.
XRdy_SPRampStop	BOOL	1 = Ready for XCmd_SPRampStop, enable HMI button.
XRdy_Reset	BOOL	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	1 = Ready for XCmd_ResetAckAll, enable HMI button.
Val_Owner	DINT	Current object owner ID, 0 = Not owned.

Private input member	Data Type	Default Value	Description
CmdSrc	P_COMMAND_SOURCE		Control or Command Source Selection.
OCmd_SPRampStart	BOOL	0	Operator command to initiate SP ramping. The instruction clears this operand automatically. Default is 0.
OCmd_SPRampStop	BOOL	0	Operator command to stop SP ramping. The instruction clears this operand automatically. Default is 0.
OSet_Ratio	REAL	1.0	Operator setting for Ratio, loop mode Cascade/Ratio and Ratio enabled (unitless). Valid = 0.0 to maximum positive float. Default is 1.0.
OSet_SP	REAL	0.0	Operator setting for Setpoint, loop mode Auto (PVEU). Valid any float. Default is 0.0.
OSet_SPTarget	REAL	0.0	Operator setting for Setpoint ramp target, endpoint for ramp wizard (PVEU). Valid any float. Default is 0.0.
OSet_SPRampTime	REAL	0.0	Operator setting for Setpoint ramp time, time to reach target for ramp wizard (seconds). Valid = 0.0 to 28800.0 seconds. Default is 0.0.
OSet_CV	REAL	0.0	Operator setting for CV, loop mode Manual (CVEU). Valid any float. Default is 0.0.
MCmd_Bypass	BOOL	0	Maintenance command to bypass all bypassable interlocks. The instruction clears this operand automatically. Default is 0.
MCmd_Check	BOOL	0	Maintenance command to check, not bypass, all interlocks. The instruction clears this operand automatically. Default is 0.
MCmd_OoS	BOOL	0	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is 0.
MCmd_IS	BOOL	0	Maintenance command to select In Service. The instruction clears this operand automatically. Default is 0.
MCmd_Acq	BOOL	0	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is 0.

Private input member	Data Type	Default Value	Description
MCmd_Rel	BOOL	0	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is 0.
OCmd_Oper	BOOL	0	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is 0.
OCmd_Prog	BOOL	0	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is 0.
OCmd_Lock	BOOL	0	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is 0.
OCmd_Unlock	BOOL	0	Operator command to unlock or release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is 0.
OCmd_Normal	BOOL	0	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is 0.
OCmd_Auto	BOOL	0	Operator command to select Automatic loop mode. The instruction clears this operand automatically. Default is 0.
OCmd_Casc	BOOL	0	Operator command to select Cascade/Ratio loop mode. The instruction clears this operand automatically. Default is 0.
OCmd_Man	BOOL	0	Operator command to select Manual loop mode. The instruction clears this operand automatically. Default is 0.
OCmd_NormLM	BOOL	0	Operator command to select loop mode configured as Normal (see Cfg_NormLM). The instruction clears this operand automatically. Default is 0.
OCmd_Reset	BOOL	0	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is 0.
OCmd_ResetAckAll	BOOL	0	Operator command to acknowledge and reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is 0.

Private output member	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index. Default is 0.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.

Private output member	Data Type	Description
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Auto	BOOL	1 = Ready for OCmd_Auto, enables HMI button.
ORdy_Casc	BOOL	1 = Ready for OCmd_Casc, enables HMI button.
ORdy_CV	BOOL	1 = Ready for OSet_CV, enables data entry field.
ORdy_Man	BOOL	1 = Ready for OCmd_Man, enables HMI button.
ORdy_NormLM	BOOL	1 = Ready for OCmd_NormLM, enables HMI button.
ORdy_Ratio	BOOL	1 = Ready for OSet_Ratio, enables data entry field.
ORdy_SP	BOOL	1 = Ready for OSet_SP, enables data entry field.
ORdy_SPRampStart	BOOL	1 = Ready for OCmd_SPRampStart, enables HMI button.
ORdy_SPRampStop	BOOL	1 = Ready for OCmd_SPRampStop, enables HMI button.
ORdy_SPTarget	BOOL	1 = Ready for OSet_SPTarget, enables data entry field.
ORdy_SPRampTime	BOOL	1 = Ready for OSet_SPRampTime, enables data entry field.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset, enables HMI button.
ORdy_ResetAckAll	BOOL	1 = At least one alarm or latched shed condition requires Reset or Acknowledgement.

Public InOut member	Data Type	Description
BusObj	BUS_OBJ	Bus component

BUS_OBJ Structure

The BUS_OBJ structure links the process PID instruction to other instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower-level devices to higher-level control and fans out commands from higher-level control to lower-level instructions. Items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands

Members	Data Type	Description
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

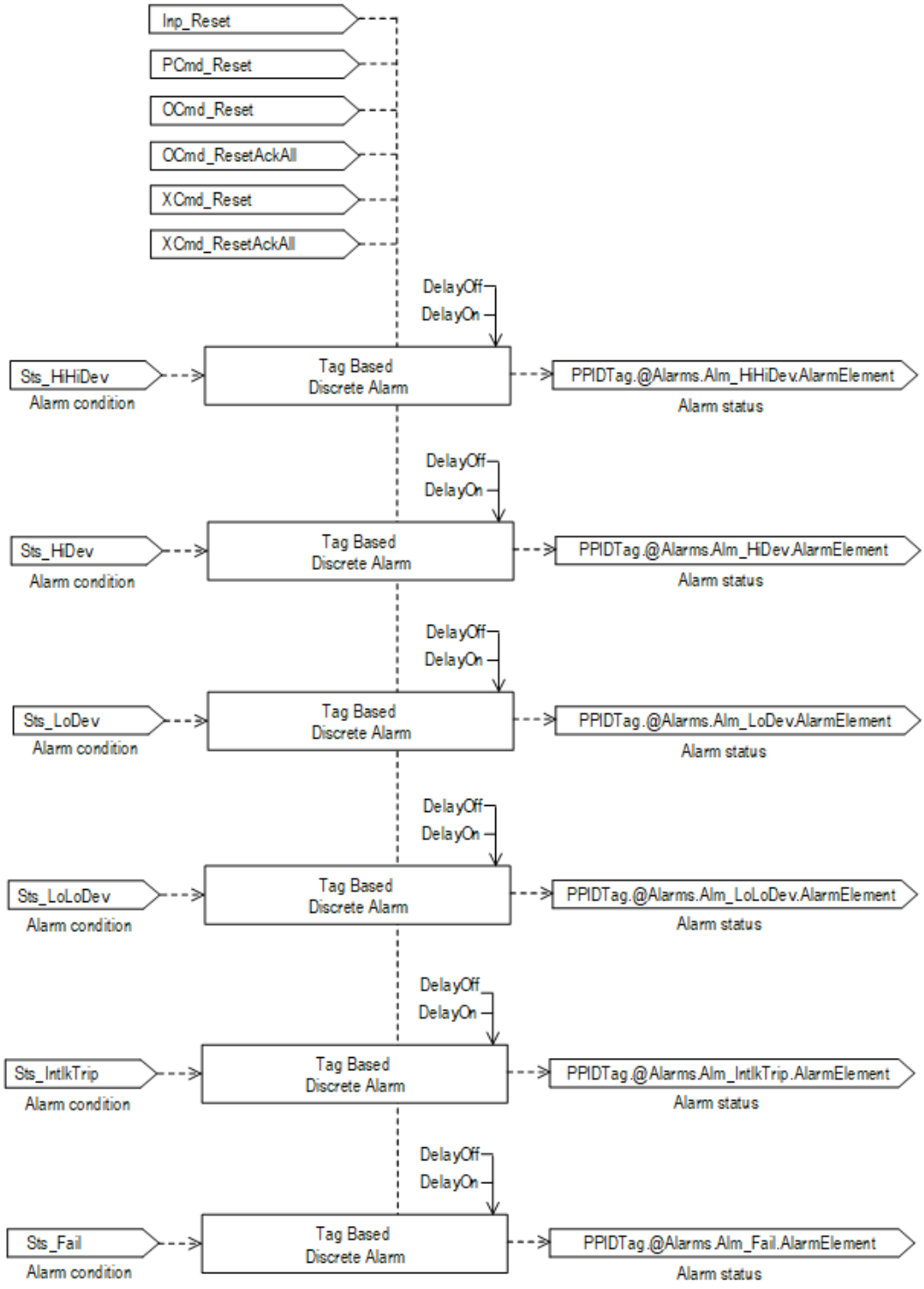
Discrete tag-based alarms are defined for these members.

Member	Alarm Name	Description
Sts_Fail	Alm_Fail	Instruction Failure. Raised when the PPID instruction reports an Instruction Fault. The Fault is reported under any of these conditions: • Setpoint (SP) bad quality, Sts_SPBad = 1, • Process variable (PV) bad quality, Sts_PVBad = 1, • Control variable (CV) bad quality, Sts_CVBad = 1, • Hand feedback (HandFdbk) bad quality, Sts_HandFdbkBad = 1.
Sts_IntlkTrip	Alm_IntlkTrip	Interlock Trip alarm. Raised when non-bypassable interlocks are not OK or bypassable interlocks are not OK when not bypassed. NAND(Inp_NBIntlkOK,(OR(Inp_IntlkOK,Stst_BypActive))).
Sts_HiHiDev	Alm_HiHiDev	High-High Deviation. Raised when the amount by which the PV exceeds the setpoint or reference is above the High-High Deviation threshold. The threshold, deadband, gating, and timing are set in configuration.
Sts_HiDev	Alm_HiDev	High Deviation. Raised when the amount by which the PV exceeds the setpoint or reference is above the High Deviation threshold. The threshold, deadband, gating, and timing are set in configuration.
Sts_LoDev	Alm_LoDev	Low Deviation. Raised when the amount by which the PV exceeds the setpoint or reference is below the Low Deviation threshold. (Since the threshold is a negative number, this reading is the amount the PV falls below the setpoint or reference.) The threshold, deadband, gating, and timing are set in configuration.
Sts_LoLoDev	Alm_LoLoDev	Low-Low Deviation. Raised when the amount by which the PV exceeds the setpoint or reference is below the Low-Low Deviation threshold. (Since the threshold is a negative number, this reading is the amount the PV falls below the setpoint or reference.) The threshold, deadband, gating, and timing are set in configuration.

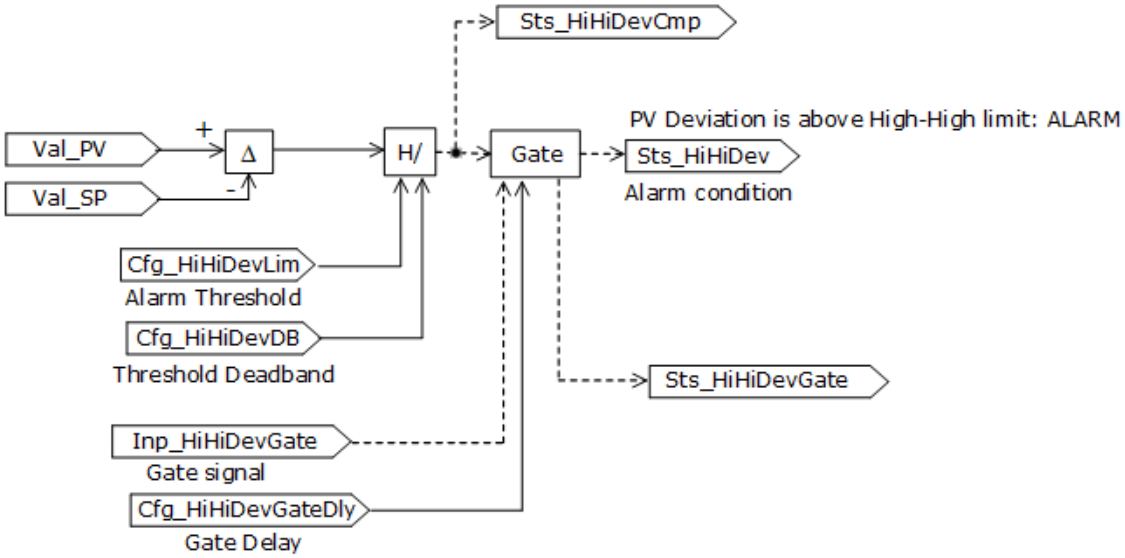
Mark the alarm as used or unused and set standard configuration members of the discrete tag-based alarm. Access alarm elements using this format: PPIDTag.@Alarms.AlarmName.AlarmElement.

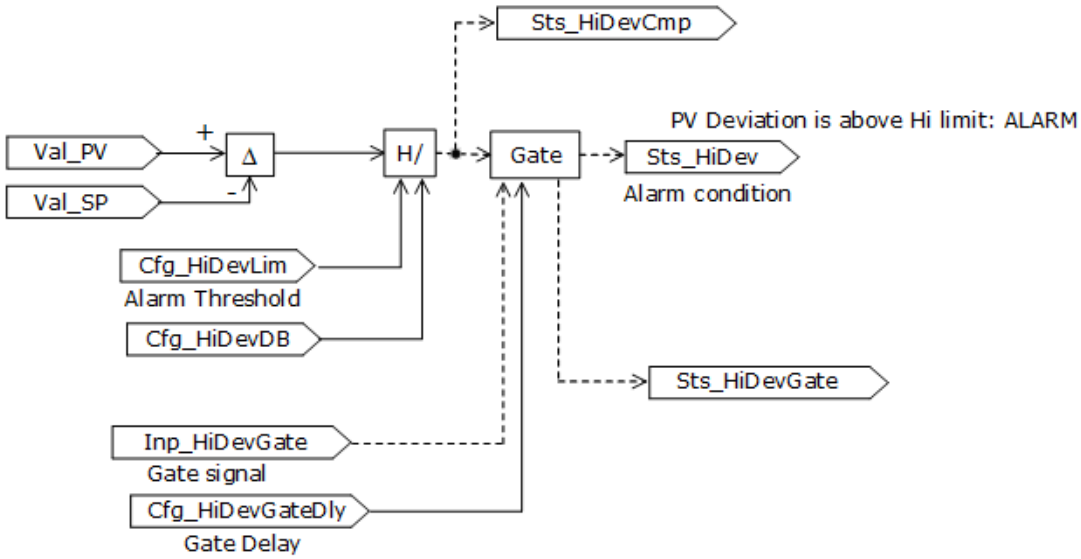
There are Program, Operator, and External commands that enable the Reset and Reset & Acknowledge of all alarms of the instruction (Alarm Set) at the

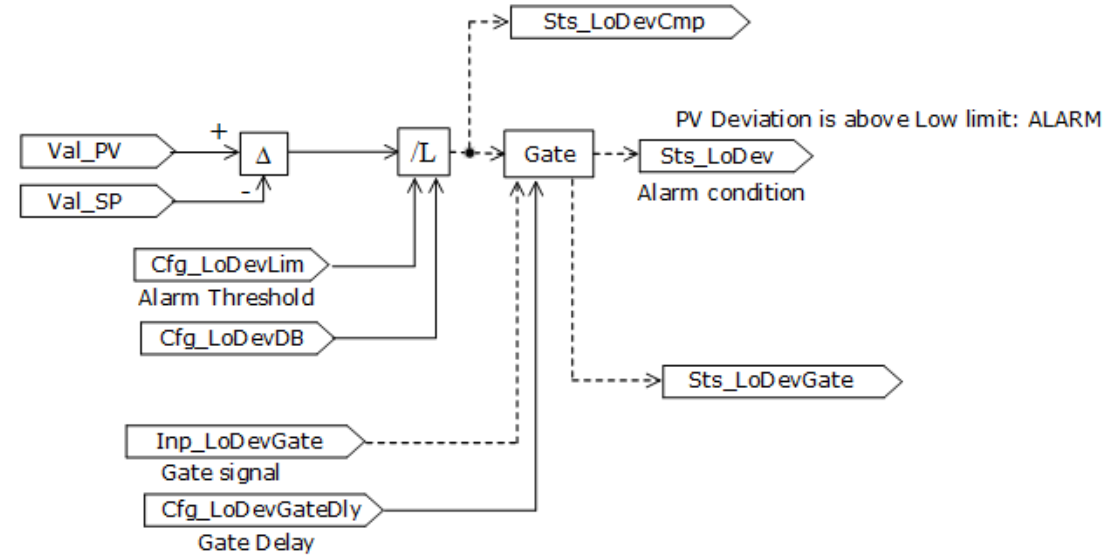
same time. This diagram shows how alarm condition interact with alarm command.

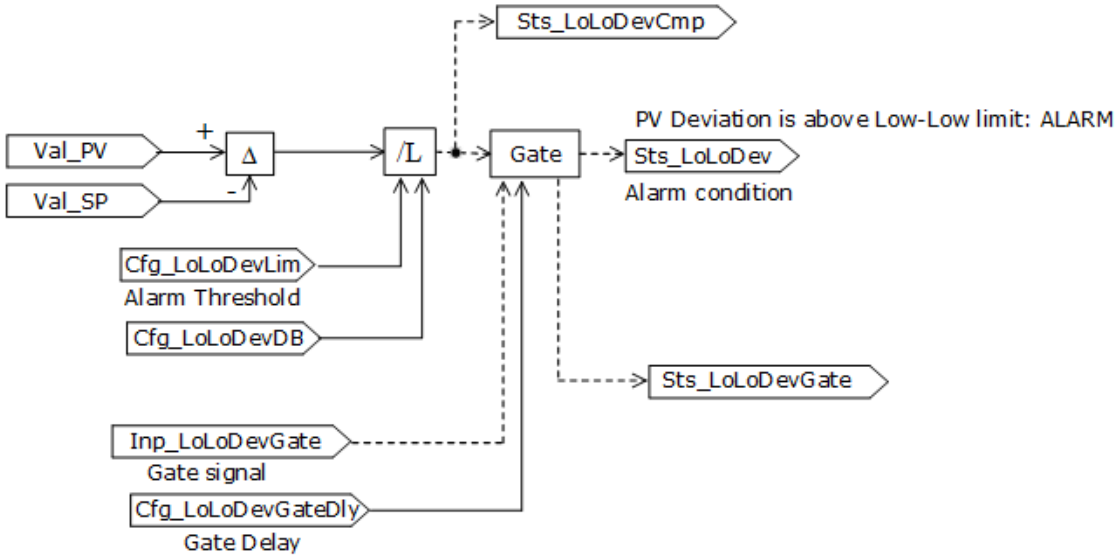


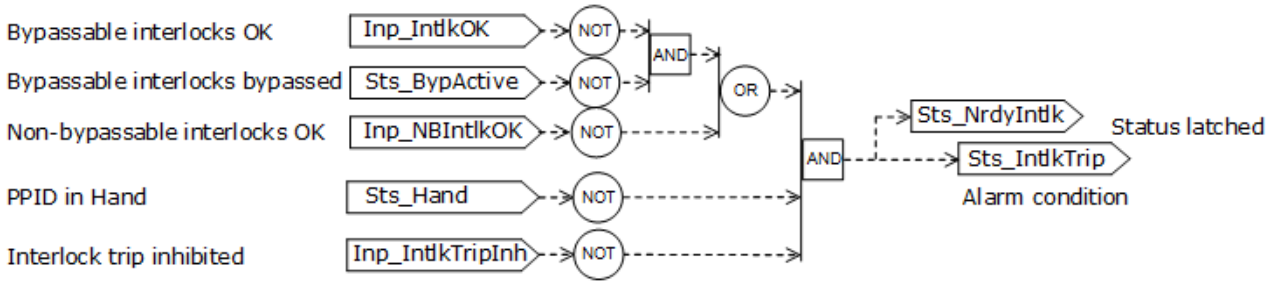
These diagrams explain how alarm condition high-high deviation, high deviation, low deviation, low-low deviation, interlock trip and fail are derived.

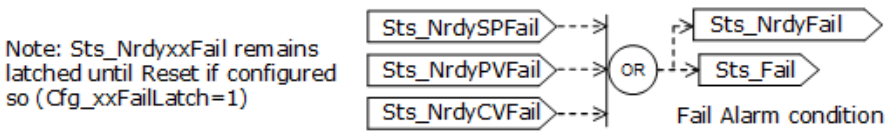





Sts_LoDevCmp
PV Deviation is above Low limit: ALARM
Val_PV
+
Δ
/L
Gate
Sts_LoDev
Alarm condition
Val_SP
-
Cfg_LoDevLim
Alarm Threshold
Cfg_LoDevDB
Sts_LoDevGate
Inp_LoDevGate
Gate signal
Cfg_LoDevGateDly
Gate Delay


Sts_LoLoDevCmp
PV Deviation is above Low-Low limit: ALARM
Val_PV
+
Δ
/L
Gate
Sts_LoLoDev
Alarm condition
Val_SP
-
Cfg_LoLoDevLim
Alarm Threshold
Cfg_LoLoDevDB
Sts_LoLoDevGate
Inp_LoLoDevGate
Gate signal
Cfg_LoLoDevGateDly
Gate Delay


Bypassable interlocks OK
Inp_IntlkOK
NOT
Bypassable interlocks bypassed
Sts_BypActive
NOT
AND
Non-bypassable interlocks OK
Inp_NBIntlkOK
NOT
OR
PPID in Hand
Sts_Hand
NOT
AND
Sts_NrdyIntlk
Status latched
Sts_IntlkTrip
Alarm condition
Interlock trip inhibited
Inp_IntlkTripInh
NOT


Note: Sts_NrdyxxFail remains latched until Reset if configured so (Cfg_xxFailLatch=1)
Sts_NrdySPFail
Sts_NrdyPVFail
Sts_NrdyCVFail
OR
Sts_NrdyFail
Sts_Fail
Fail Alarm condition

Operation

In principle the PID core algorithm calculates CV with a formula configured for dependent gains,

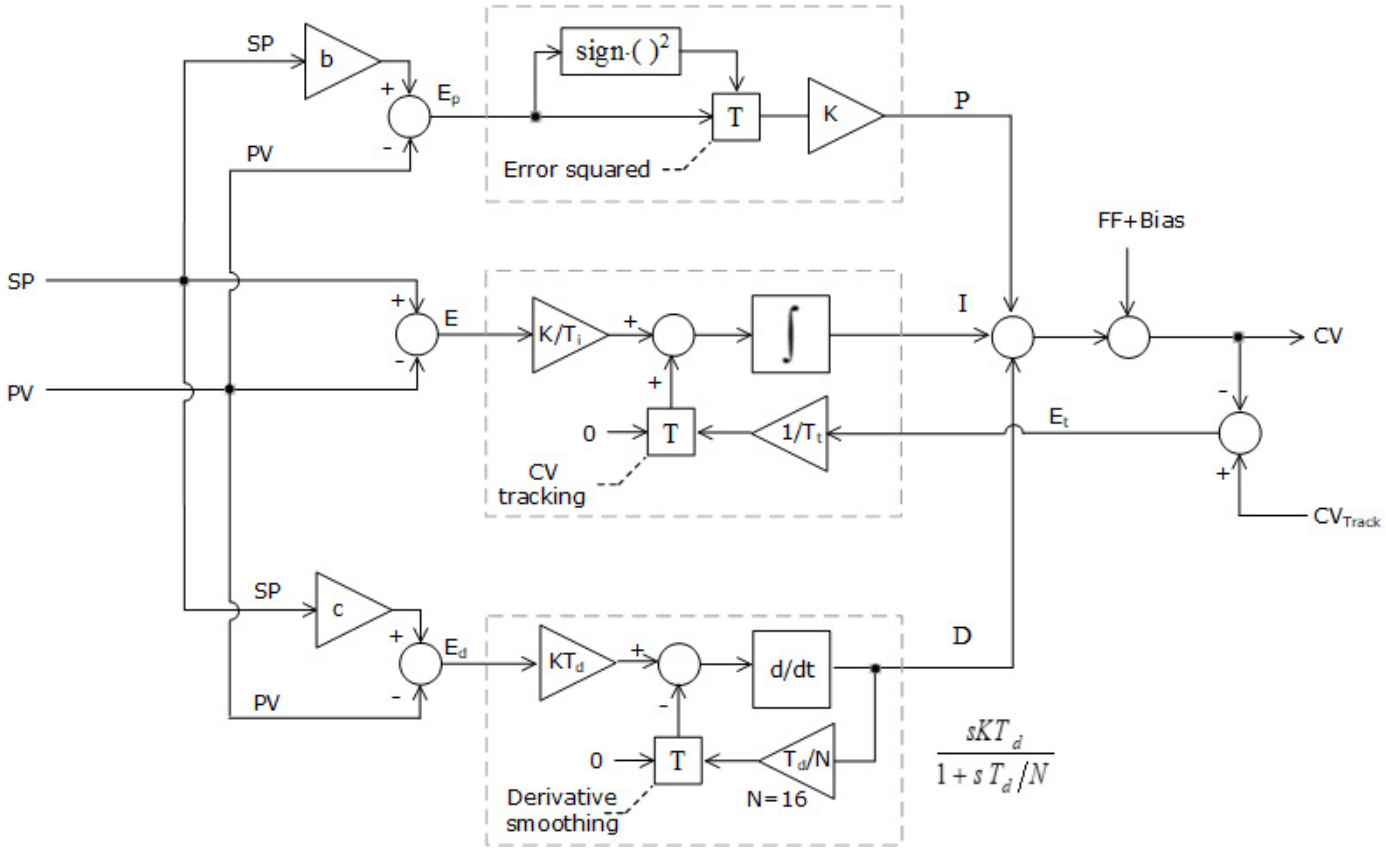
$$CV(t) = K\left[e(t) + \frac{1}{Ti}\int_{\square}^{t} e(\tau)d\tau + Td\frac{de(t)}{dt}\right] + FF(t) + Bias$$

where K is controller gain [-], Ti is reset time [minutes], Td is rate time [minutes]. Alternatively the instruction is configured for independent gains,

$$CV(t) = K_P e(t) + K_I\int_{\square}^{t} e(\tau)d\tau + K_D\frac{de(t)}{dt} + FF(t) + Bias$$

where K_P is proportional gain [-], K_I is integral gain [1/minute], and K_D is derivative gain [minutes]. Use independent gains when you want the three gains for the proportional, integral and derivative terms to operate independently.

This principle diagram illustrates additional configuration options with derivative smoothing and weighted setpoint used in error calculations entering proportional and derivative term, and error squared in proportional term and CV tracking:

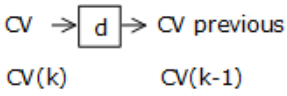


The following section uses exact tag names from P_PID structure. Variables without a prefix, such as SP, PV, CVPrev, CVTrack, FF, FFPrev, and CtrlAction, are internal variables used in calculation. Variables with prefix Inp_, Val_, of

data type REAL are in engineering units. Variables without prefix of data type REAL are in % of span.

Ts [second] is a current period of PID algorithm execution, i.e. time elapsing from the previous scan of the PPID instruction.

d is a one-scan delay operator. For example:

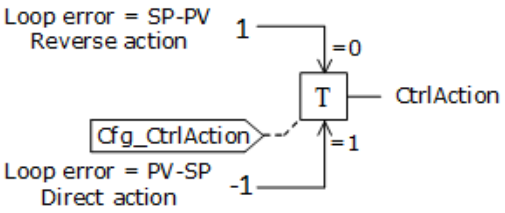


Variables entering the PID formula must be in percent of span so the PID gains do not depend on engineering units used for PV and CV. Scaling of these parameters is calculated as Perc=min(100,max(0,(EU-EUMin)/(EUMax-EUMin)*100)).

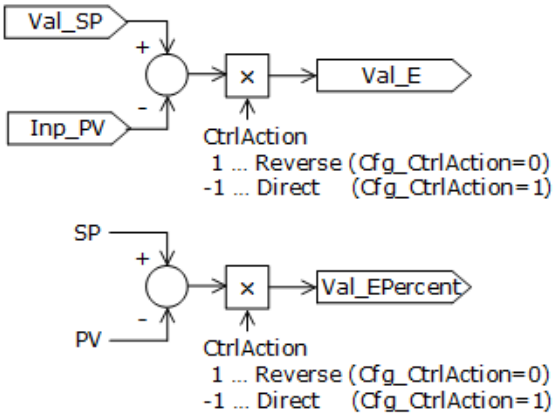
- Val_SP,
- Inp_PV,
- Inp_CVPrev,
- Inp_CVTrack,
- Cfg_CVHiLim,
- Cfg_LoLim,
- Cfg_CVRoCIncrLim,
- Cfg_CVRoCDecrLim

Scaling of Inp_FF and Inp_FFPrev is calculated as Perc=min(100,max(-100,(EU-EUMin)/(EUMax-EUMin)*100)).

Reverse/Direct control action affects loop error sign that will be used in further calculations:

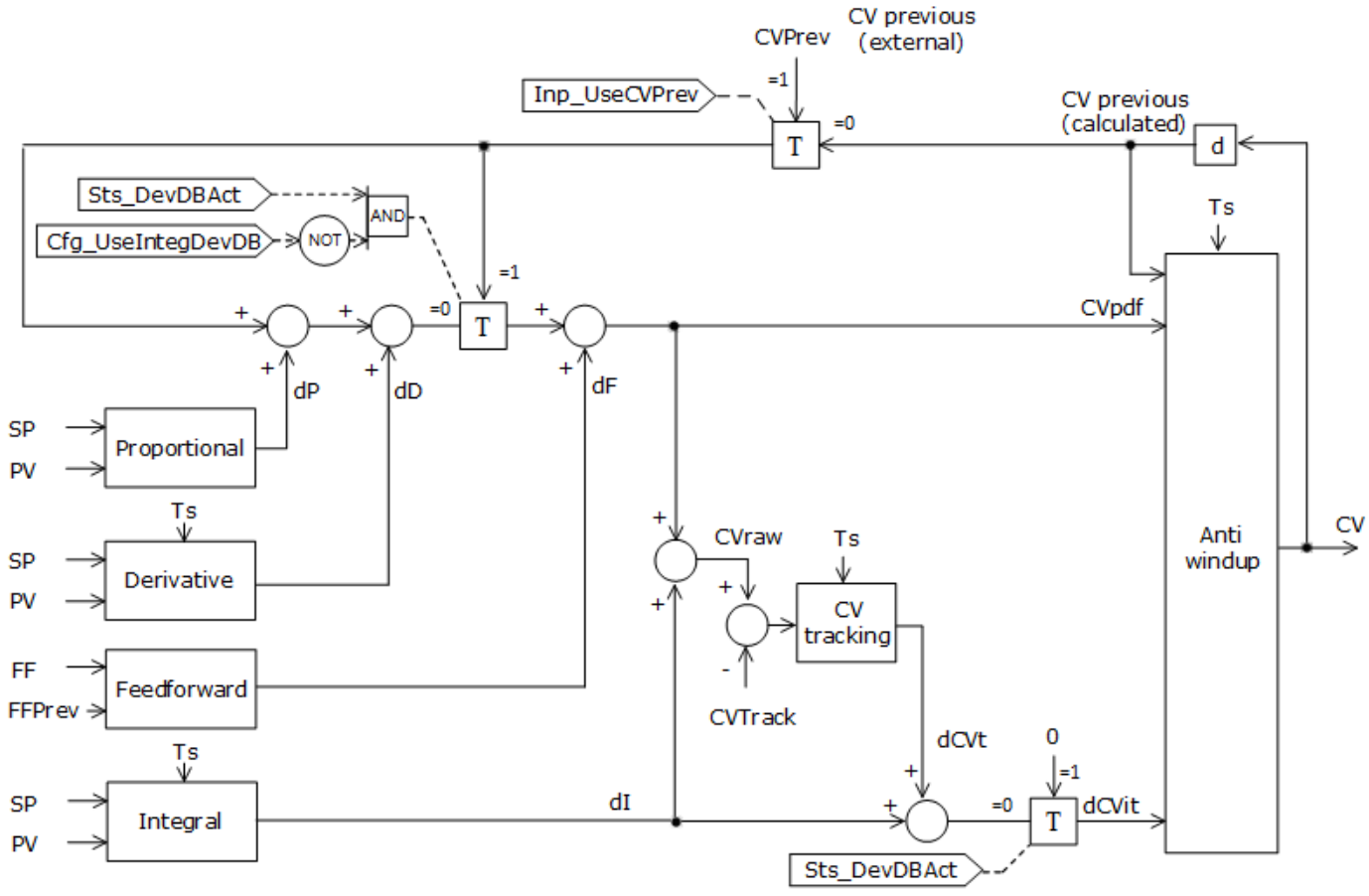


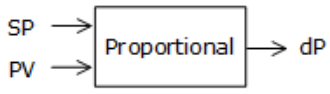
Loop error calculations:

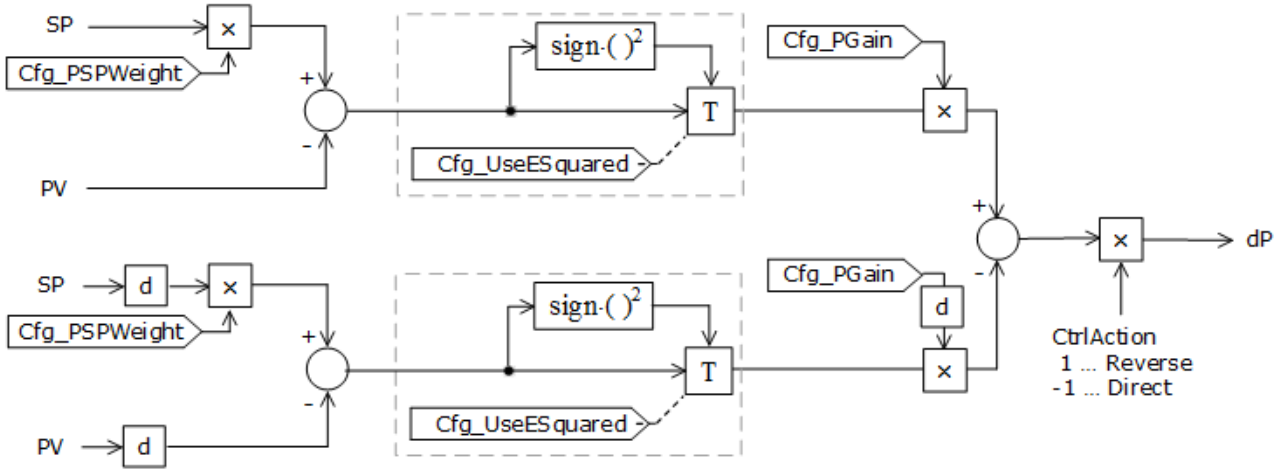


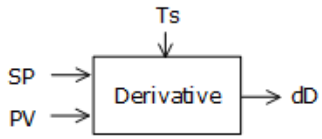
Velocity PID algorithm

This diagram of the velocity PID algorithm describes the CV calculation. Additional detailed diagrams in this section describe all PPID configuration options.









Calculation of derivative term:

Modified error calculation:

$E_c(k)$ = Cfg_DSPCoef(k) * $SP(k) - PV(k)$

$E_c(k)$ = Cfg_DSPCoef(k) * $SP(k-1) - PV(k-1)$

$\Delta E_c(k) = E_c(k) - E_c(k-1)$

= (Cfg_DSPCoef(k) * $SP(k) - PV(k)$) – (Cfg_DSPCoef(k) * $SP(k-1) - PV(k-1)$)

$\Delta E_c(k-1) = E_c(k-1) - E_c(k-2)$

= (Cfg_DSPCoef(k) * $SP(k-1) - PV(k-1)$) – (Cfg_DSPCoef(k) * $SP(k-2) - PV(k-2)$)

Contribution of derivative term if Cfg_UseDSmooting=0, Cfg_Dependent=1 and Cfg_GainBumpless=1.

$dD(k)$ = Cfg_PGain(k) * Cfg_DGain(k) * ($\Delta E_c(k) - \Delta E_c(k-1)$)

Contribution of derivative term if Cfg_UseDSmooting=0, Cfg_Dependent=1 and Cfg_GainBumpless=0.

$dD(k)$ = Cfg_PGain(k) * Cfg_DGain(k) * $\Delta E_c(k)$ – Cfg_PGain(k–1) * Cfg_DGain(k–1) * $\Delta E_c(k-1)$

Contribution of derivative term if Cfg_UseDSmooting=0, Cfg_Dependent=0 and Cfg_GainBumpless=1.

$dD(k)$ = Cfg_DGain(k) * ($\Delta Ec(k) - \Delta E_c(k-1)$)

–

Contribution of derivative term if Cfg_UseDSmooting=0, Cfg_Dependent=0 and Cfg_GainBumpless=0.

$dD(k)$ = Cfg_DGain(k) * $\Delta Ec(k)$ – Cfg_DGain(k–1) * $\Delta Ec(k-1)$

If derivative filter is enabled (Cfg_UseDSmooting=1), the calculation is as follows.

DCoef parameter for dependent gains Cfg_Dependent=1.

$$DCoef(k) = \frac{\text{Cfg_PGain(k)} \cdot \text{Cfg_DGain(k)} * 60}{Ts + \frac{\text{Cfg_DGain(k)} * 60}{N}}$$

For independent gains Cfg_Dependent=0.

$$DCoef(k) = \frac{\text{Cfg_DGain(k)} * 60}{Ts + \frac{\text{Cfg_DGain(k)} * 60}{N * \text{Cfg_PGain(k)}}}$$

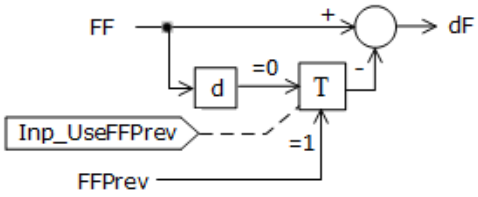
Contribution of derivative term if Cfg_UseDSmooting=1 and Cfg_GainBumpless=1.

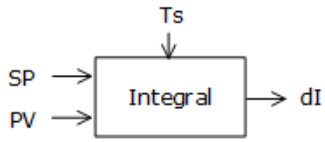
$$dD(k) = DCoef(k)\left(\left(\Delta E_c(k) - \Delta E_c(k-1)\right) + \frac{1}{N \cdot \text{Cfg_PGain(k)}} dD(k-1)\right)$$

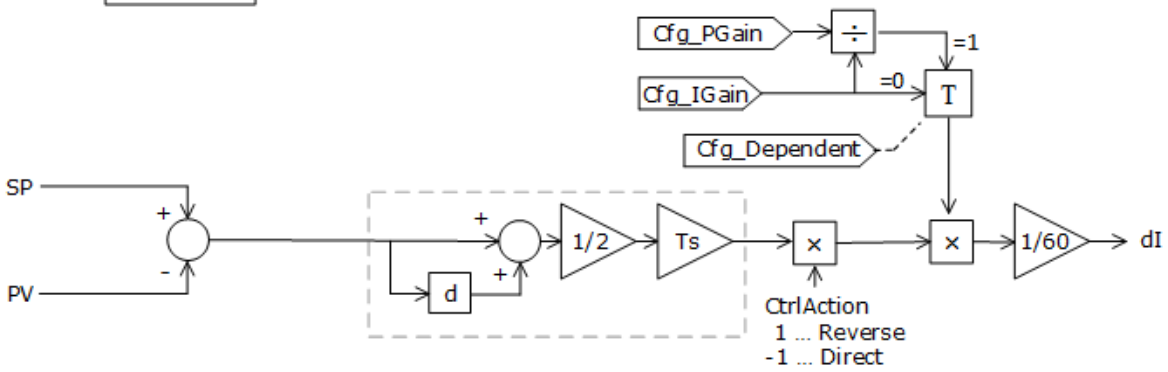
Contribution of derivative term if Cfg_UseDSmooting=1 and Cfg_GainBumpless=0.

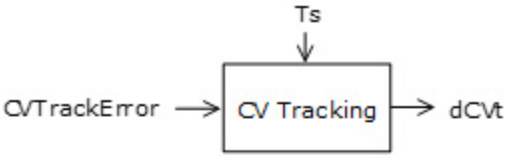
$$dD(k) = DCoef(k) \cdot \Delta E_c(k) - DCoef(k-1) \cdot \Delta E_c(k-1) + \frac{DCoef(k)}{N \cdot \text{Cfg_PGain(k)}} dD(k-1)$$

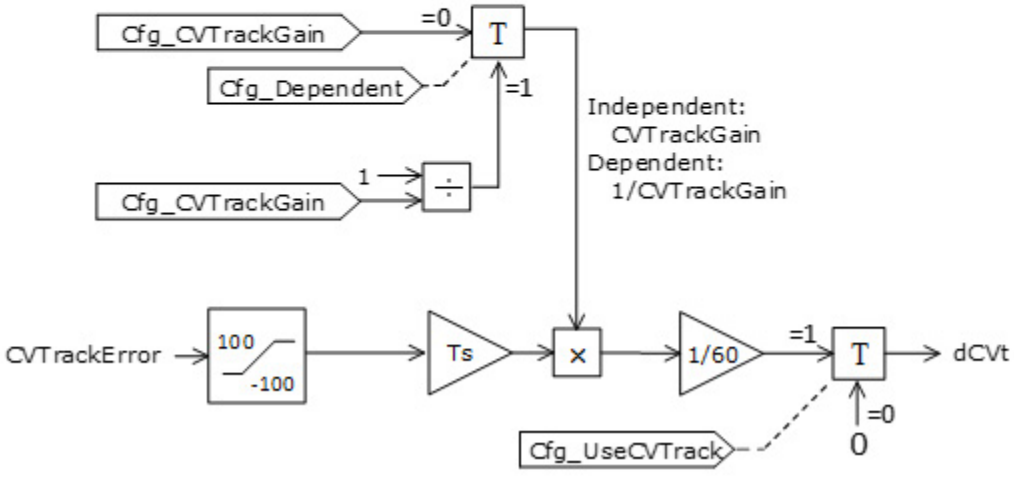
Feedforward term.







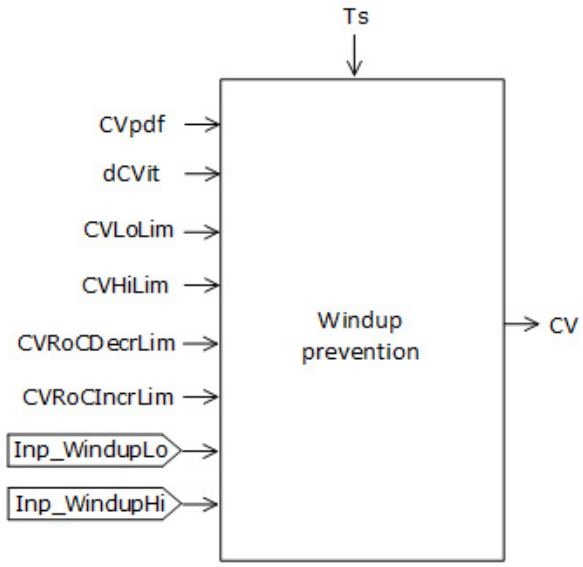


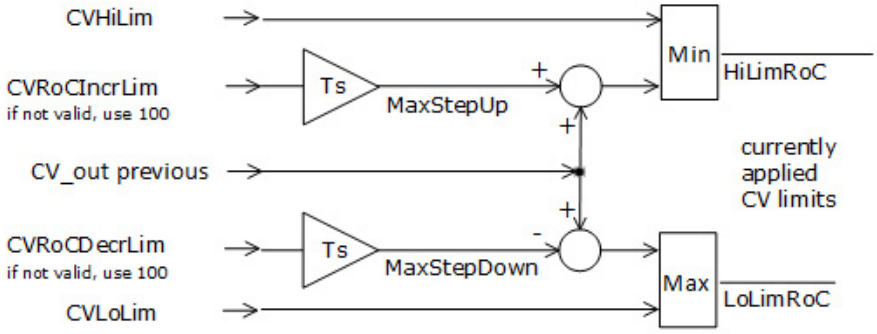


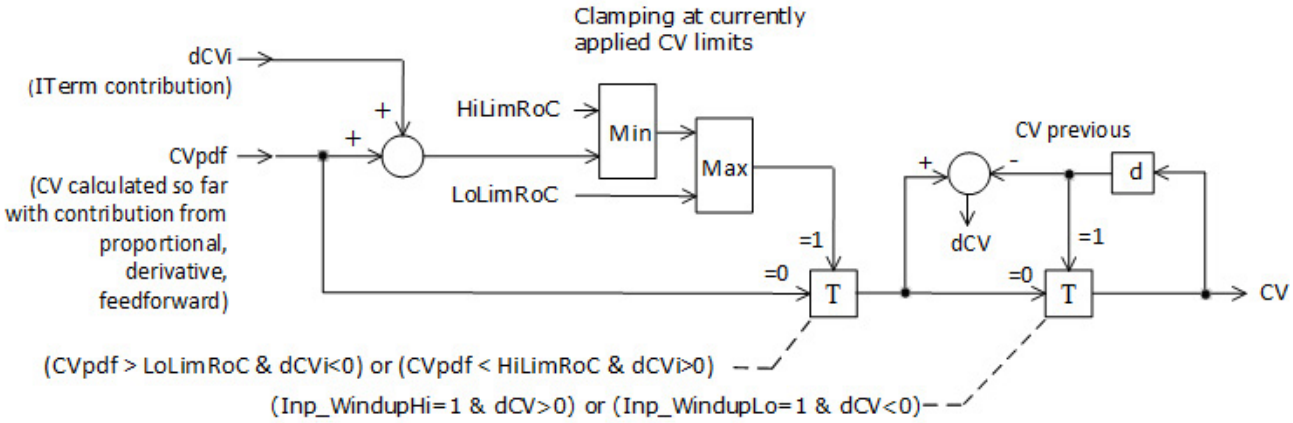
The windup prevention mechanism monitors the internal CV value and drives the integral term. The windup prevention mechanism uses these rules:

- If the internal CV is above the currently applied upper limit, do not integrate upward.
- If the internal CV is within the currently applied limits, integrate but do not violate limits.

- If the internal CV is below the currently applied lower limit, do not integrate downward.







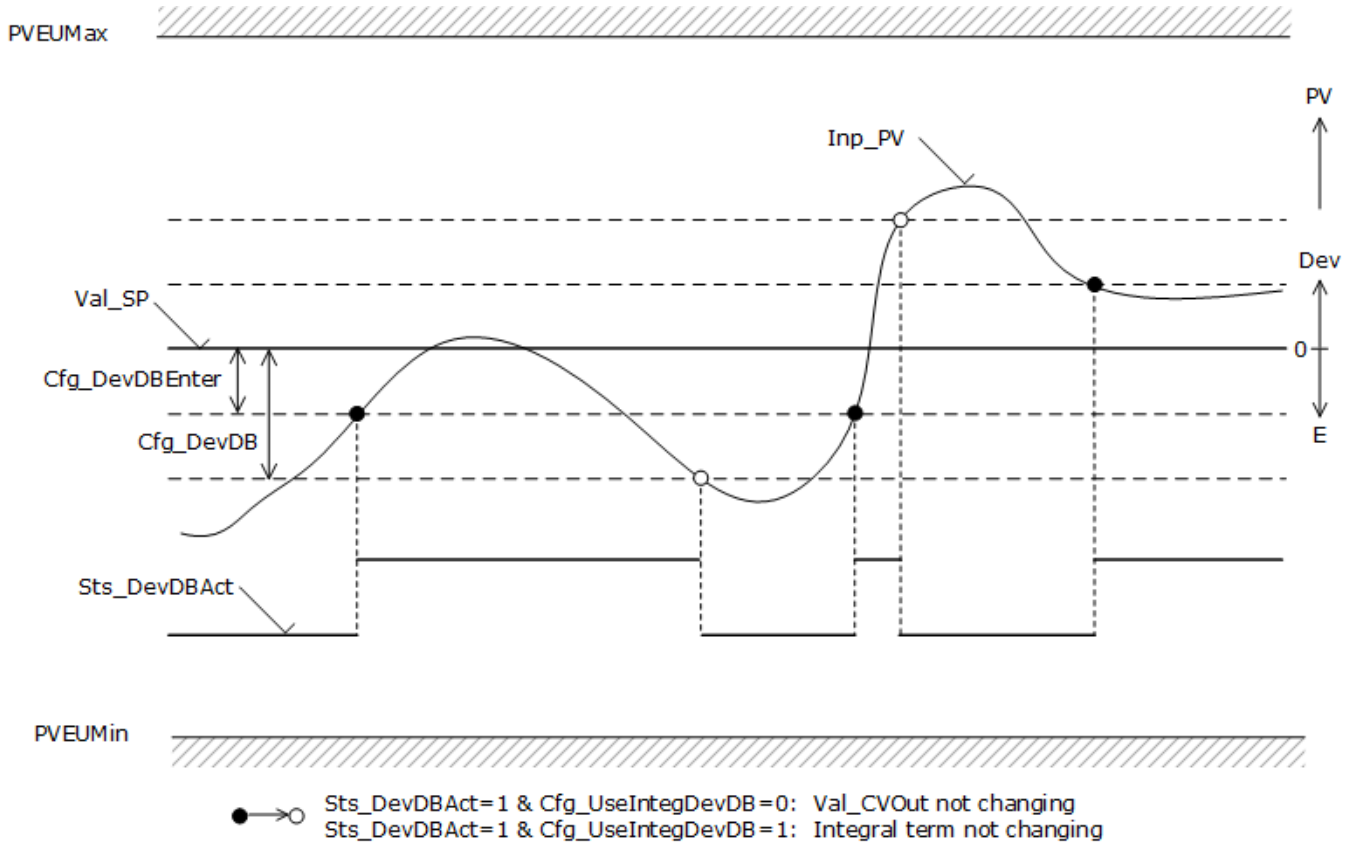
Position PID algorithm

The PPID instruction is configured for the position form of the PD algorithm without bumpless transfer from Manual to Auto or Cascade if Cfg_PositionBump = 1. This option is selected when Cfg_PositionBump = 1 and Cfg_IGain = 0 and change of proportional gain is not bumpless even if Cfg_GainBumpless =1. This feature can also be applied to the velocity PID algorithm to behave as it would work on error and not error change.

Note: The feedforward is relative to CVEUMin, though if Cfg_PositionBump = 1 the control action is calculated internally as Val_CVOutPercent = Cfg_PGain*Val_EPercent+Inp_FF/(Cfg_CVEUMax-Cfg_CVEUMin)*100 plus optional derivative term.

Deviation deadband

CV is not sensitive to loop error variation when within the band around zero error. Configured band levels allow for additional hysteresis. Deadband level for PV approaching SP (Cfg_DevDBEnter) may be set lower than deadband level for PV going away from SP (Cfg_DevDB). Active deadband status (Sts_DevDBAct) is set for PV within deadband. An option to stop CV moves or just stop the integration while leaving proportional and derivative action live when in deadband is provided (Cfg_UseIntegDevDB).



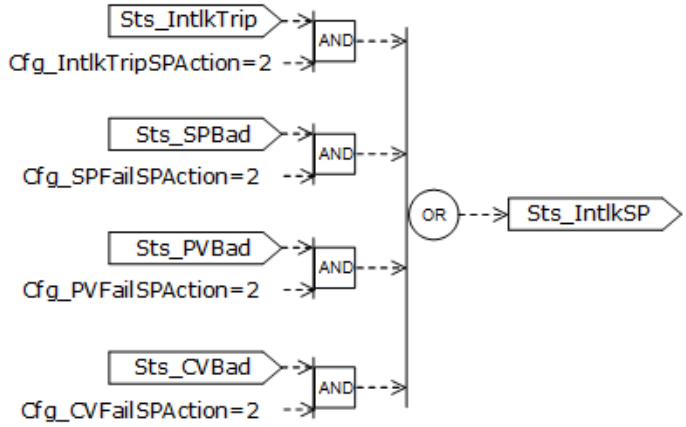
SP handling

The PPID instruction checks the setpoint for validity before the SP value is provided to the PID algorithm for processing. SP fails if:

- SP clamping limits are invalid (Sts_ErrSPLim=1), or
- PV scaling limits are invalid (Sts_ErrPVEU=1), or
- The loop mode is Cascade and cascade SP is NaN or Inf, or
- Cascade is Ratio (Cfg_HasRatio=1) and ratio clamping limits are invalid.

SP value (Val_SPSet) is shed to the configured setpoint value Cfg_SPIntlk and the status flag is set (Sts_IntlkSP=1) if:

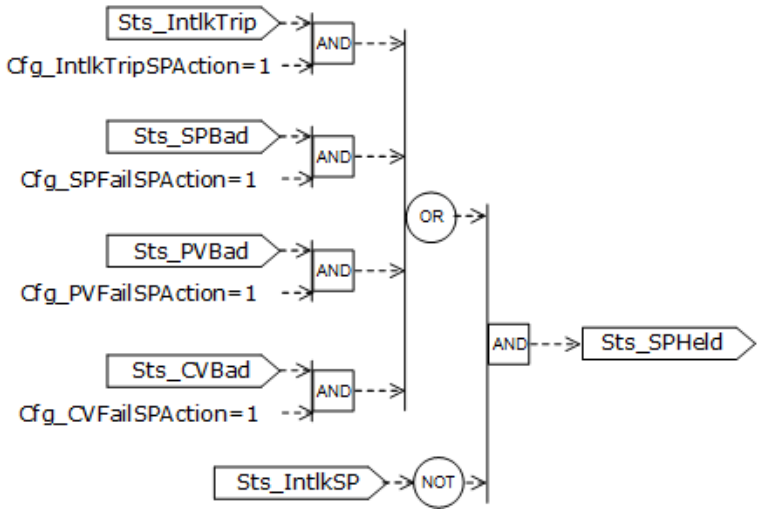
- Interlock trips and the follow up action is to use Cfg_SPIntlk as the setpoint value(Cfg_IntlkTripSPAction=2), or
- SP fails and the instruction is configured to follow with using Cfg_SPIntlk as the setpoint (Cfg_SPFailSPAction=2), or
- PV fails and the instruction is configured to use Cfg_SPIntlk as the setpoint value (Cfg_PVFailSPAction=2), or
- CV fails and the instruction is configured to use Cfg_SPIntlk as the setpoint value (Cfg_CVFailSPAction=2).



SP value holds, shed to the current SP value and the status flag is set (Sts_SPHeld=1), if:

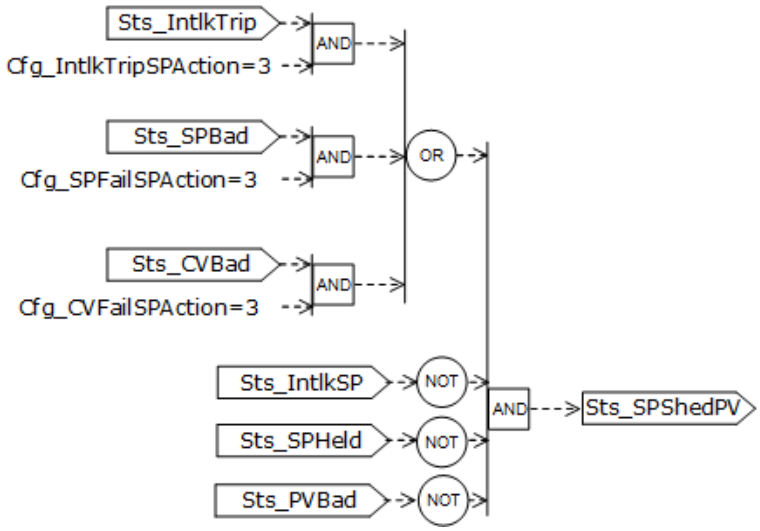
- Interlock trips and the follow up action is to leave the value unchanged (Cfg_IntlkTripSPAction=1), or
- SP fails and the instruction is configured to follow with the setpoint not changed (Cfg_SPFailSPAction=1), or
- PV fails and the instruction is configured to follow with the setpoint not changed (Cfg_PVFailSPAction=1), or

- CV fails and the instruction is configured to follow with the setpoint not changed (Cfg_CVFailSPAction=1) and higher shed priority is not applied (Sts_IntlkSP=0).



SP value sets to the current PV value (Val_SPSet=Val_PV) and the status flag is set (Sts_SPShedPV=1) if:

- Interlock trips and the follow up action is to leave the value unchanged (Cfg_IntlkTripSPAction=3), or
- SP fails and the instruction is configured to follow with the setpoint not changed (Cfg_SPFailSPAction=3), or
- CV fails and the instruction is configured to follow with the setpoint not changed (Cfg_CVFailSPAction=3) and higher shed priority is not applied (Sts_IntlkSP=0 & Sts_SPHeld=0) and PV is good (Sts_PVBad=0).



Shed conditions win over other SP selections, in Auto from Program, Operator, Override SP, in Cascade from CascSP, in Manual from PV to track.

If SP is not from shed and SP clamping limits are valid, other sources for SP value are checked.

If the loop is not Cascade and Operator has SP, OSet_SP is used.

If the loop is not Cascade and Program has SP, PSet_SP is used.

If the loop is not Cascade and External has SP, XSet_SP is used.

If the loop is not Cascade and Override is selected, Inp_OvrdSP is used.

For the loop in Cascade Inp_CascSP × Val_Ratio is used. If Cascade is not Ratio Val_Ratio=1.

The instruction is ready to receive a new SP from the operator (ORdy_SP) if:

- Tracking is not enabled (Cfg_SetTrack=0), or
- Operator has loop mode in Auto, or Operator has loop mode in Manual and SP does not track PV in Manual (Cfg_PVTrack=0), or
- Command source is Hand in Auto, or command source is Hand in Manual and SP does not track PV in Manual (Cfg_PVTrack=0), or
- Command source is Override and SP is not configured for tracking in Override (Cfg_SetTrackOvrdHand=0).

SP tracks PV value (Val_PV) and sets tracking status Sts_SPTrackPV=1 if loop mode is Manual, and instruction is configured for tracking in Manual (Cfg_PVTrack=1), and no SP shed condition is active (Sts_SPShed=0), and PV is not bad (Sts_PVBad=0).

SP is clamped at Cfg_SPHiLim and Cfg_SPLoLim and clamping status is set when clamped (Sts_SPClamped=1) if SP is not held by shed (Sts_SPHeld=0), and SP is not set to interlock SP by shed (Sts_IntlkSP=0), and SP clamping limits are valid (Sts_ErrSPLim=0).

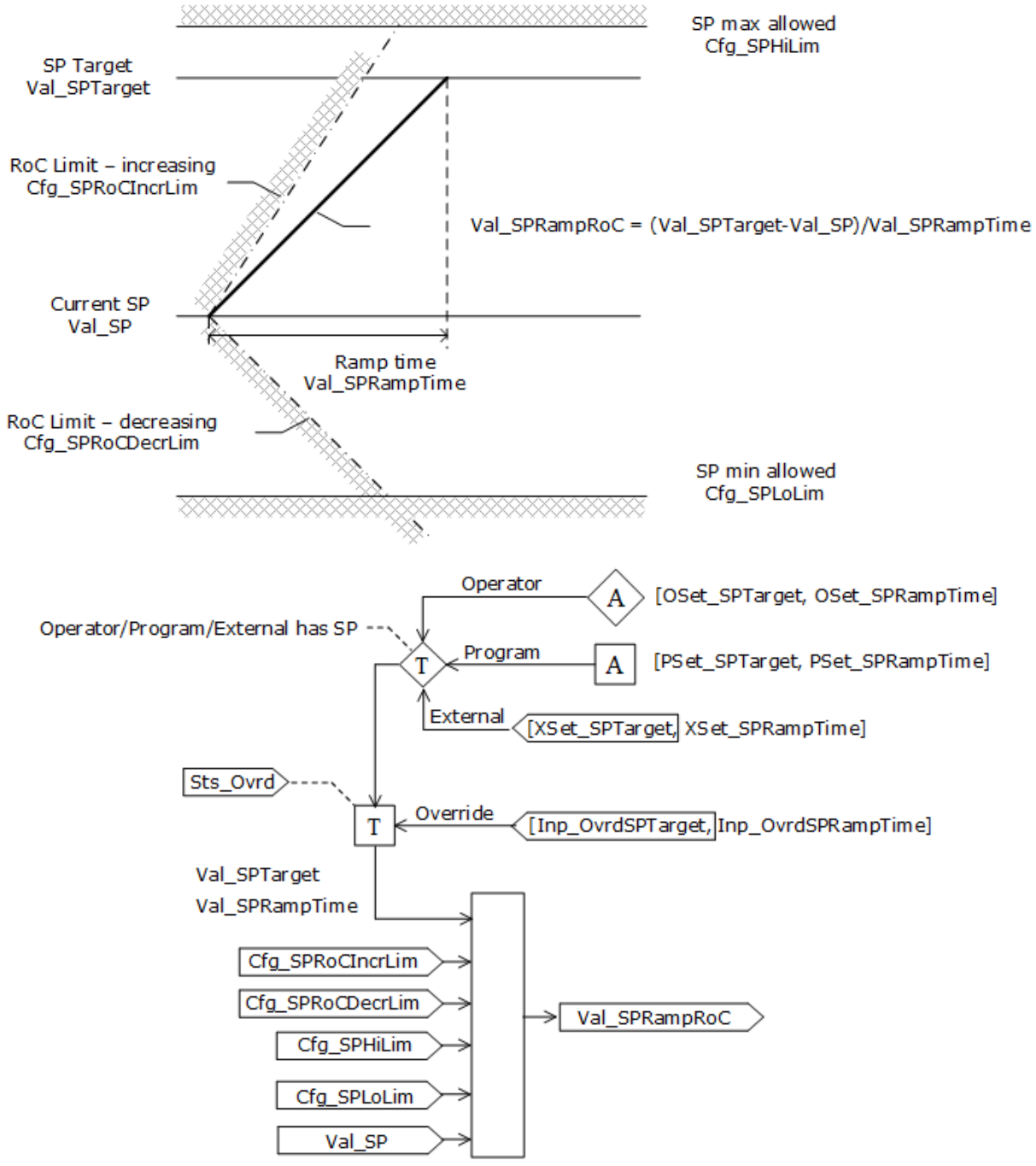
SP ramp wizard

SP ramp wizard allows Operator/Program/External/Override to enter the SP target and time to reach target (ramp time) and calculate SP moves to reach entered target in entered time when starting from current SP when the wizard is commanded to start. Ramping characteristic is defined by the SP ramp target (SPTarget) and SP ramp time (SPRampTime) as described below.

SP target and ramp time entry is permitted (ORdy_SPTarget=1, ORdy_SPRampTime=1) and Val_SPTarget copied to Val_SPSet if:

- Setpoint ramp wizard is permitted (Cfg_HasSPRamp=1), and Program/Operator/External setting is not tracked (Cfg_SetTrack=0), or

- Operator has SP in Auto, or command source is Hand in Auto loop mode.



SP ramping

Setpoint ramping prevents both CV spikes and bumps by eliminating sudden setpoint changes. Although setpoint ramping can be an advantage for single loop control or for the primary (outer) controller of a cascade configuration, neither setpoint ramping nor proportional-on-PV should be used on the secondary (inner) controller of a cascade loop, as that would degrade the responsiveness of the secondary loop.

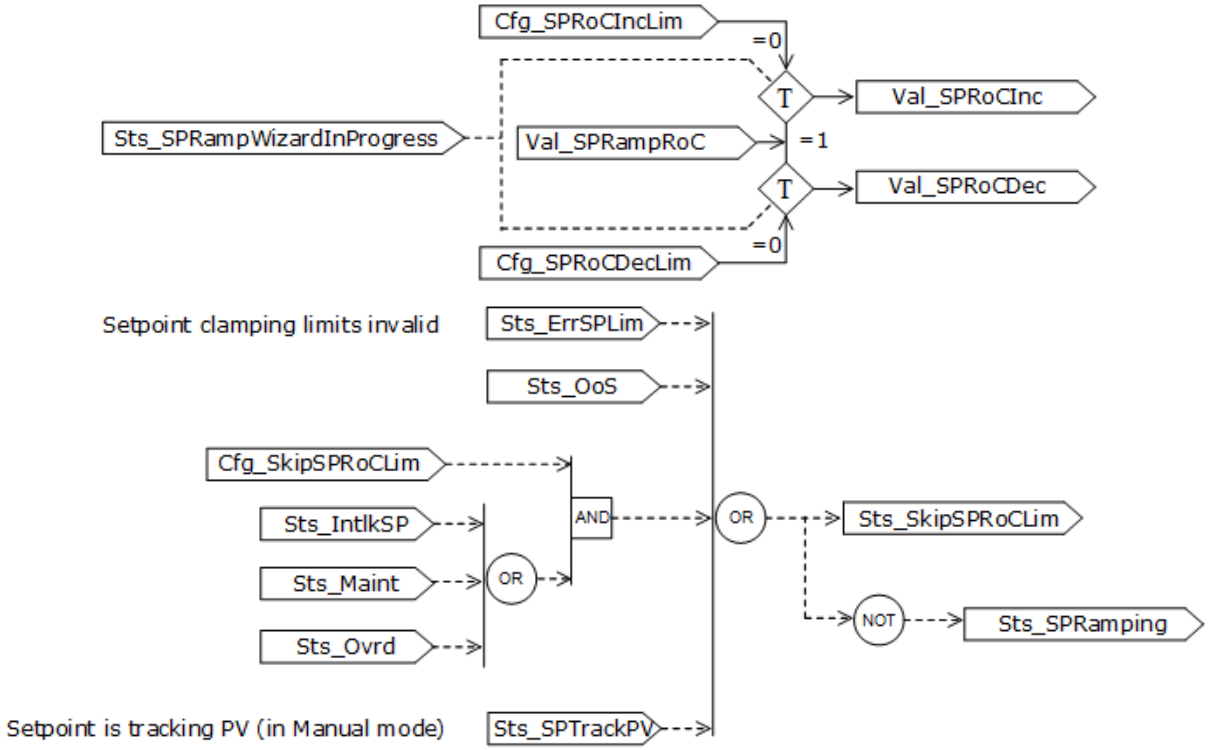
SP ramping is skipped, SP target (Val_SPSet) is used directly for final setpoint (Val_SP), skip status is set Sts_SkipSPRoCLim=1, and ramp reported complete Sts_SPRamping=0 under these conditions:

- Setpoint clamping limits are invalid, Sts_ErrSPLim=1, or
- PPID is Out of Service, or
- PPID is configured to skip RoC limiting Cfg_SkipSPRoCLim=1 and the PPID is in Interlock/Maintenance/Override, or
- SP value tracks PV value in Manual loop mode (Sts_SPTrackPV=1), or
- Current value of SP rate of change limit increasing is zero (Val_SPRoCIncr=0) and current SP target (Val_SPSet) is above current SP, or
- Current value of SP rate of change limit decreasing is zero (Val_SPRoCDecr=0) and current SP target (Val_SPSet) is below current SP.

SP ramping executes if these bullets are all true:

- not skipped (Sts_SkipSPRoCLim=0),
- the setpoint has not reached its target Val_SPSet,
- absolute value of loop deviation (|Val_E|) does not exceed configured maximum ramp deviation, |Val_E|≤ Cfg_SPRampMaxDev.

If |Val_E|> Cfg_SPRampMaxDev, then actual RoC limits Val_SPRoCDecr and Val_SPRoCIncr are set to zero and the SP does not change.



SP scaling

If PV scaling limits are valid (Sts_ErrPVEU=0) SP in PVEU is scaled to percent used in PID calculation, SP = (SPEU-Cfg_PVEUMin)/(Cfg_PVEUMax-Cfg_PVEUMin)×100.

Ratio selection and clamping

The PPID instruction is ready for the Operator to enter a Ratio if the Cascade loop mode is Ratio (Cfg_HasRatio=1), ratio clamping limits are not invalid, and the PPID instruction is not configured for tracking, or Operator has Ratio, or in Hand.

If the PPID instruction allows Cascade-Ratio (Cfg_HasRatio=1) and ratio clamping limits are not invalid, then the source for Ratio is selected based on the command source:

- PSet_Ratio if Program has Ratio,
- OSet_Ratio if Operator has Ratio,
- XSet_Ratio if External has Ratio,
- Inp_OvrdRatio if Override is selected.

If the PPID instruction allows Cascade-Ratio (Cfg_HasRatio=1) and ratio clamping limits are not invalid, Ratio is clamped at Cfg_RatioHiLim and Cfg_RatioLoLim. If clamping is active Sts_RatioClamped is set.

If the loop does not have Ratio or Ratio clamping limits are invalid, the Ratio is set to 1.0 (Val_Ratio = 1.0).

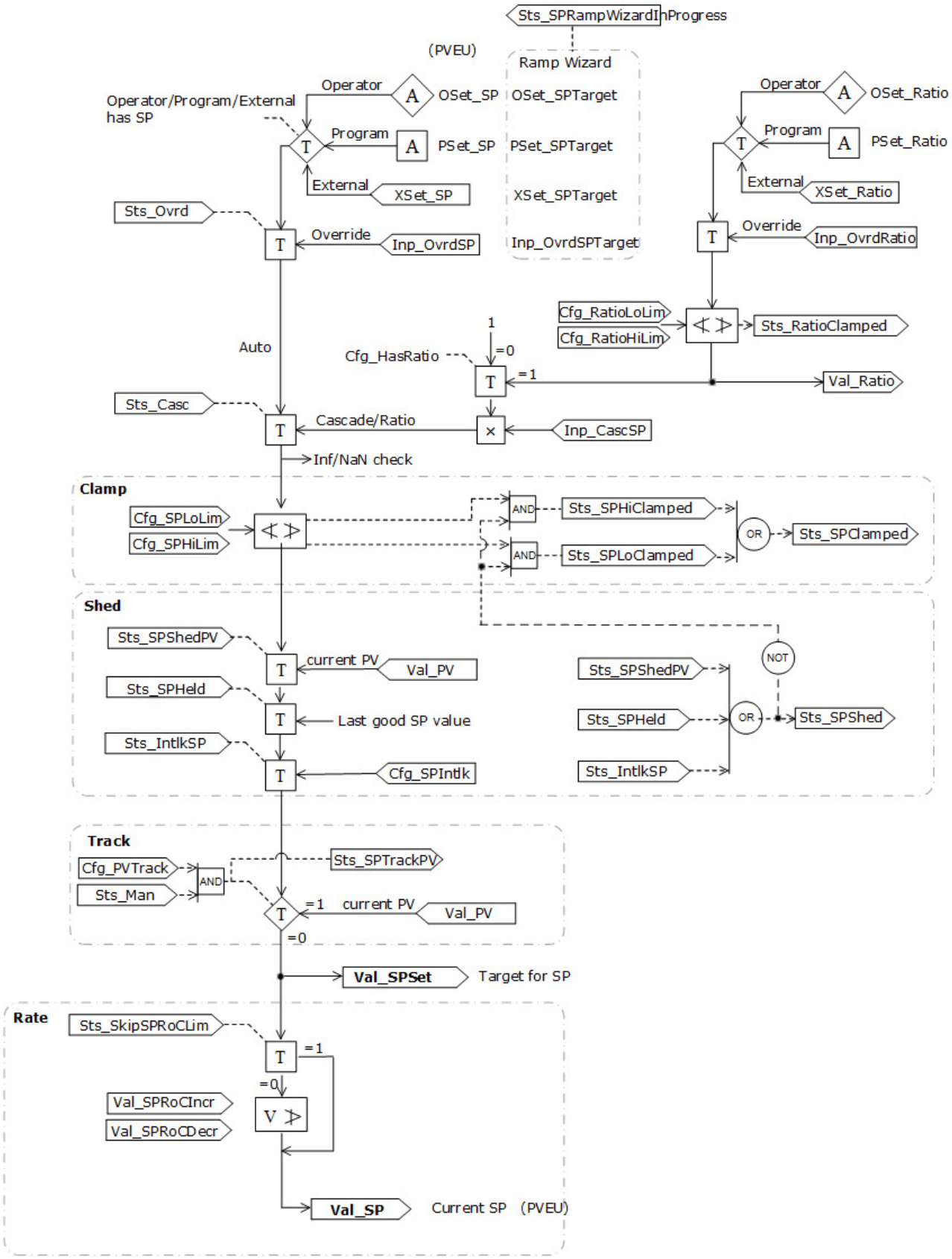
SP and Ratio tracking for bumpless transfer

Val_SPSet is copied back to all inactive SP settings to allow bumpless transfer when the SP owner changes.

SP tracking is applied if PPID is configured for it (Cfg_SetTrack=1) and:

- Loop mode is not in Override nor Hand, or
- Loop mode is in Override or Hand and PPID is configured to track in Override and Hand loop mode (Cfg_SetTrackOvrdHand=1), or
- Loop mode is in Cascade, or
- Loop mode is in Manual and Cfg_PVTrack=1.

This diagram shows the main steps in SP processing before the SP value enters the PID formula for calculating CV.



CV handling

CV selection in Manual

In Manual loop mode, if CV clamping limits are valid, the CV is selected from the active source (Program/ Operator/ External/ Override). If Program has CV, PSet_CV is selected, and so on. The PPID instruction is ready for OSet_CV (ORdy_CV=1) under the following conditions: operator entry is not configured for tracking in Program/Operator/External (Cfg_SetTrack=0), or command source is Hand or Override and operator entry is not configured for tracking in Hand or Override (Cfg_SetTrackOvrdHand=0).

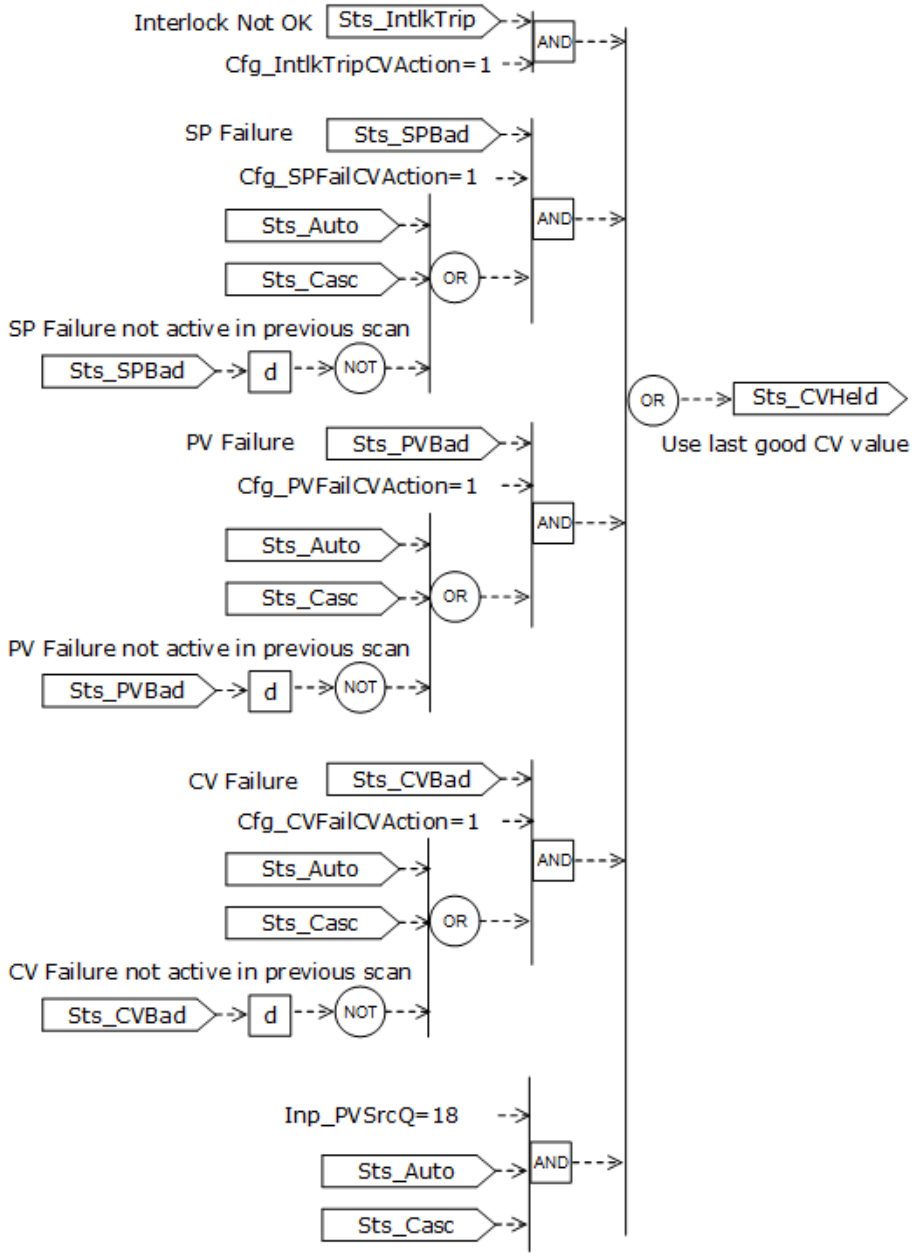
CV shed

Val_CVSet holds the last good CV value and the CV value replacement status is set (Sts_CVHeld=1) when

- Interlock trips and CV action is configured for last good CV value (Cfg_IntlkTripCVAction=1), or
- SP fails and follow up action on CV is configured for last good CV value (Cfg_SPFailCVAction=1) and the loop mode is Auto or Cascade or SP did not fail in previous scan (SP fail rising edge), or
- PV fails and follow up action on CV is configured for last good CV value (Cfg_PVFailCVAction=1) and the loop mode is Auto or Cascade or PV did not fail in previous scan (PV fail rising edge), or
- PV substituted at PAI (Inp_PVSrcQ=18) and the loop mode is Auto or Cascade, or
- CV fails and follow up action on CV is configured for last good CV value (Cfg_CVFailCVAction=1) and the loop mode is Auto or Cascade or CV did not fail in previous scan (CV fail rising edge).

For Sts_CVHeld=1 the CV is not updated.

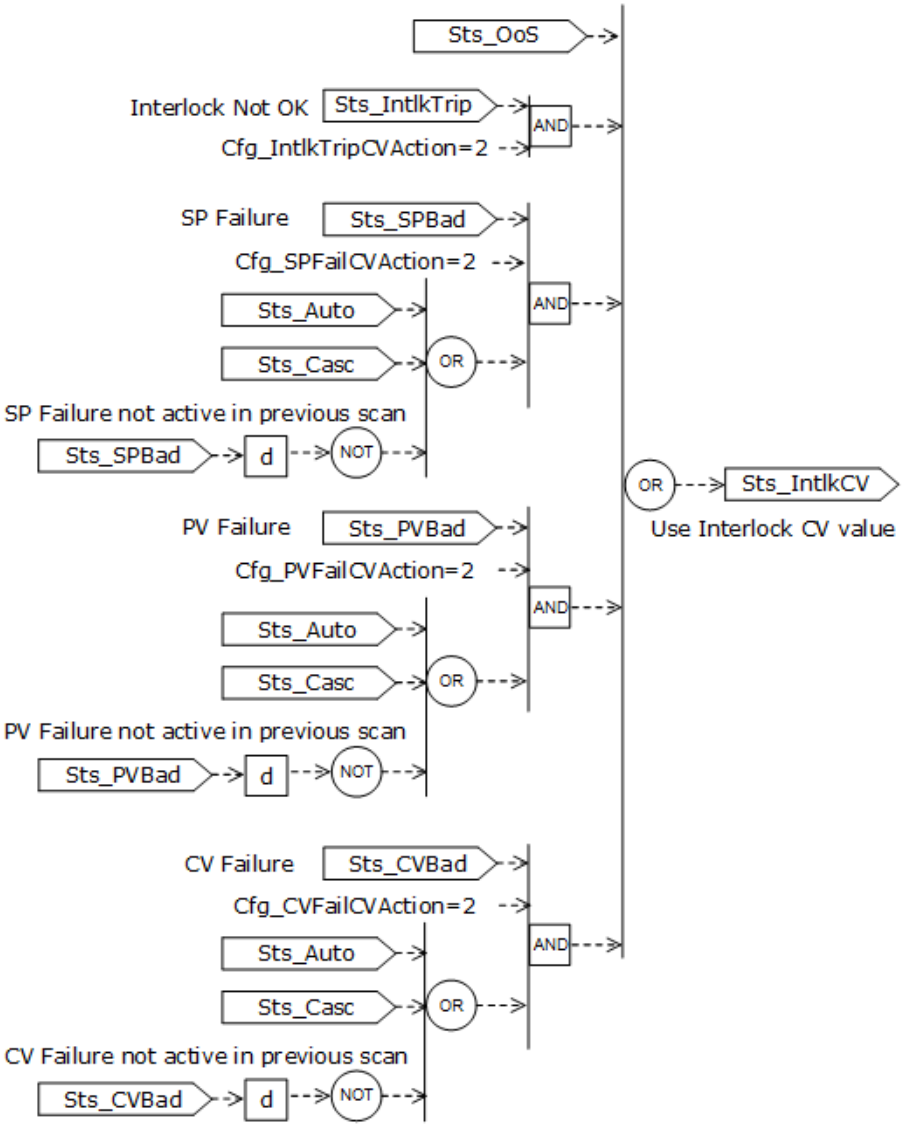
Note: When PV, CV, or SP fails, the last good CV value stays at output, but it can be still overwritten in Manual loop mode.



Val_CVSet sets to Cfg_CVIntlk and the CV value replacement status is set (Sts_IntlkCV=1) when:

- Interlock trips and CV action is configured for Cfg_CVIntlk (Cfg_IntlkTripCVAction=2), or
- SP fails and follow up action on CV is configured for Cfg_CVIntlk (Cfg_SPFailCVAction=2) and loop mode is Auto or Cascade or SP did not fail in previous scan (SP fail rising edge), or
- PV fails and follow up action on CV is configured for Cfg_CVIntlk (Cfg_PVFailCVAction=2) and loop mode is Auto or Cascade or PV did not fail in previous scan (PV fail rising edge), or
- CV fails and follow up action on CV is configured for Cfg_CVIntlk (Cfg_CVFailCVAction=2), and loop mode is Auto or Cascade or CV did not fail in previous scan (CV fail rising edge), or
- PPID is out of service.

Note: When PV, CV, or SP fails, the Cfg_CVIntlk value stays at output, but it can be still overwritten in Manual loop mode.



If CV value is being set by shed, to interlock CV or hold last good CV value, Sts_CVShed=1.

CV clamping

If CV clamping limits are valid (Sts_ErrCVLim=0) and the loop mode is not Manual, or is Manual but the configuration is set not to skip CV clamping (Cfg_SkipCVManLim=0), the calculated or set value of CV (CVSet) is clamped at Cfg_CVHiLim and Cfg_CVLoLim. The corresponding status bits (Sts_CVHiClamped, Sts_CVLoClamped, and Sts_CVClamped) are set if the CV is clamped.

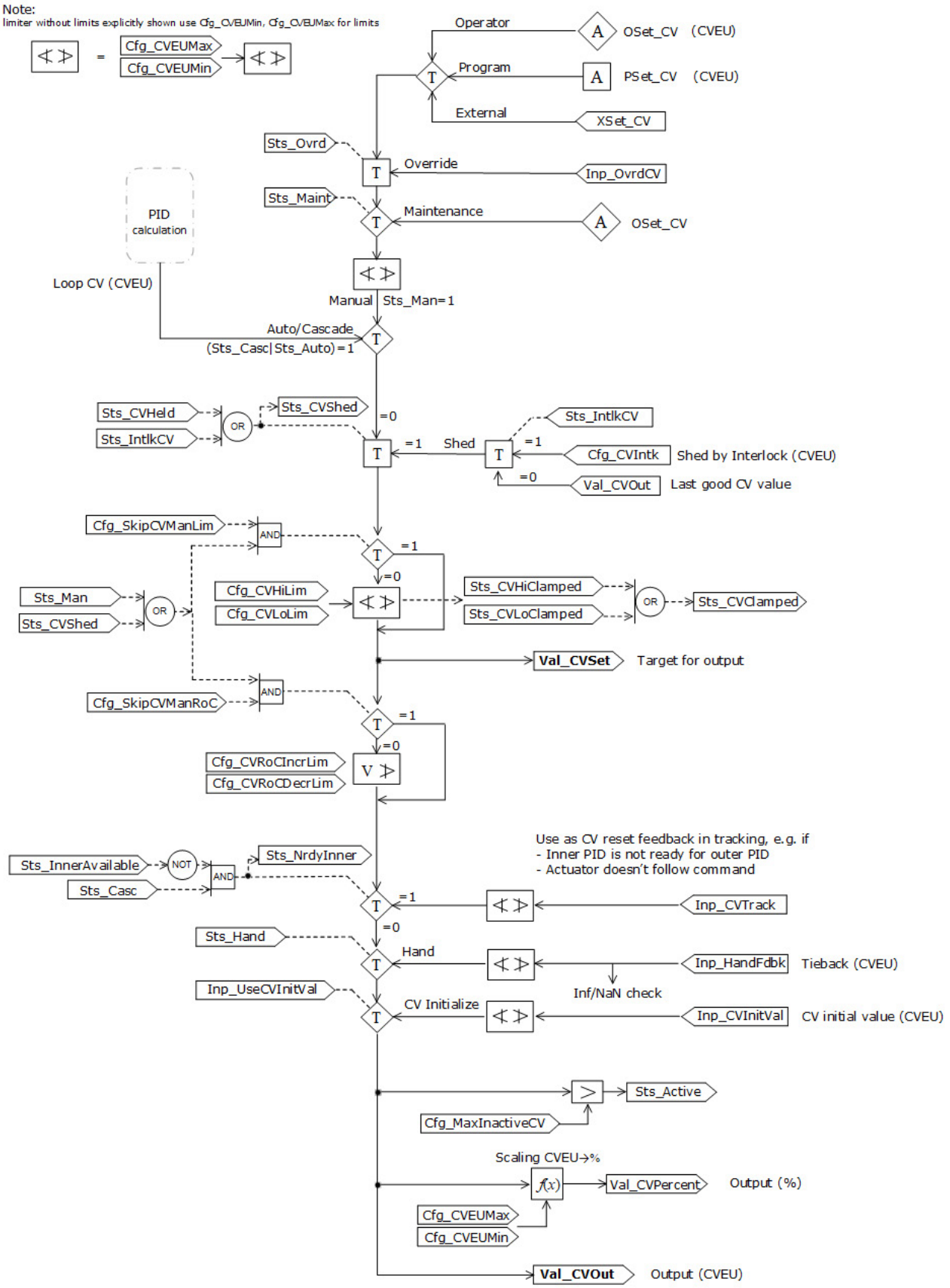
CV rate of change limiting

If the PPID instruction is not configured to skip CV RoC limiting in Manual (Cfg_SkipCVManRoC=0) and the loop mode is Manual and PPID is configured for RoC limiting (Cfg_CVRoCIncrLim>0, Cfg_CVRoCDecrLim>0) and the target value of CV is greater than CVOut_previous+Cfg_CVRoCIncrLim*Ts (Ts is current PPID scan time), the CVOut is calculated as CVOut= CVOut_previous+Cfg_CVRoCIncrLim*Ts. If the target value of CV is lower than CVOut_previous-Cfg_CVRoCDecrLim*Ts (Ts is current PPID scan time) then CVOut= CVOut_previous-Cfg_CVRoCDecrLim*Ts. If ramping is active, status bits are set (Sts_CVRampingUp/Sts_CVRampingDown=1, Sts_CVRamping=1). The status bits are cleared if CVOut reaches the target. If ramping is not active the CV target is copied to CVOut.

CV output in percent

CVOut, which is calculated in Auto/Cascade or entered from various sources in Manual, is scaled to percent and made available as Val_CVOutPercent. Val_CVOutPercent=0 if CV scaling limits are invalid.

This diagram shows the main steps in CV processing.



Interlock handling

Maintenance commands to bypass or check bypassable interlocks are processed. Interlock bypassing is active if requested (MCmd_Bypass=1). The bypassing request remains active (Sts_Bypass=1) until a maintenance command to check bypassable alarms (MCmd_Check=1) is received. Bypassing is active (Sts_BypActive=1) if requested (Sts_Bypass=1), or in Maintenance (Sts_Maint=1), or in Override (Sts_Ovrd) if the instruction is configured for bypassing interlocks in Override (Cfg_OvrdIntlk). If an Interlock is NOT OK (bypassable or not), and if any action is configured on the Interlock, the Interlock NOT OK latch is shed.

Initialization and Powerup

The instruction must be initialized to execute properly. The instruction is normally initialized automatically in the instruction first run (for example, after power up). Re-initialization can be requested any time by setting Inp_InitializeReq = 1. This operand is cleared in the instruction automatically. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1 (default value). Action performed in initialization:

- Owner command set to None,
- Override command set to None,
- Maintenance commands to bypass and check interlocks are cleared,
- Operator, Program and External commands are cleared,
- latched shed faults are cleared,
- all timers are reset.

This section defines PPID actions on Loop mode, SP and CV in initialization (Power up).

Loop mode handling in Power up Normal:

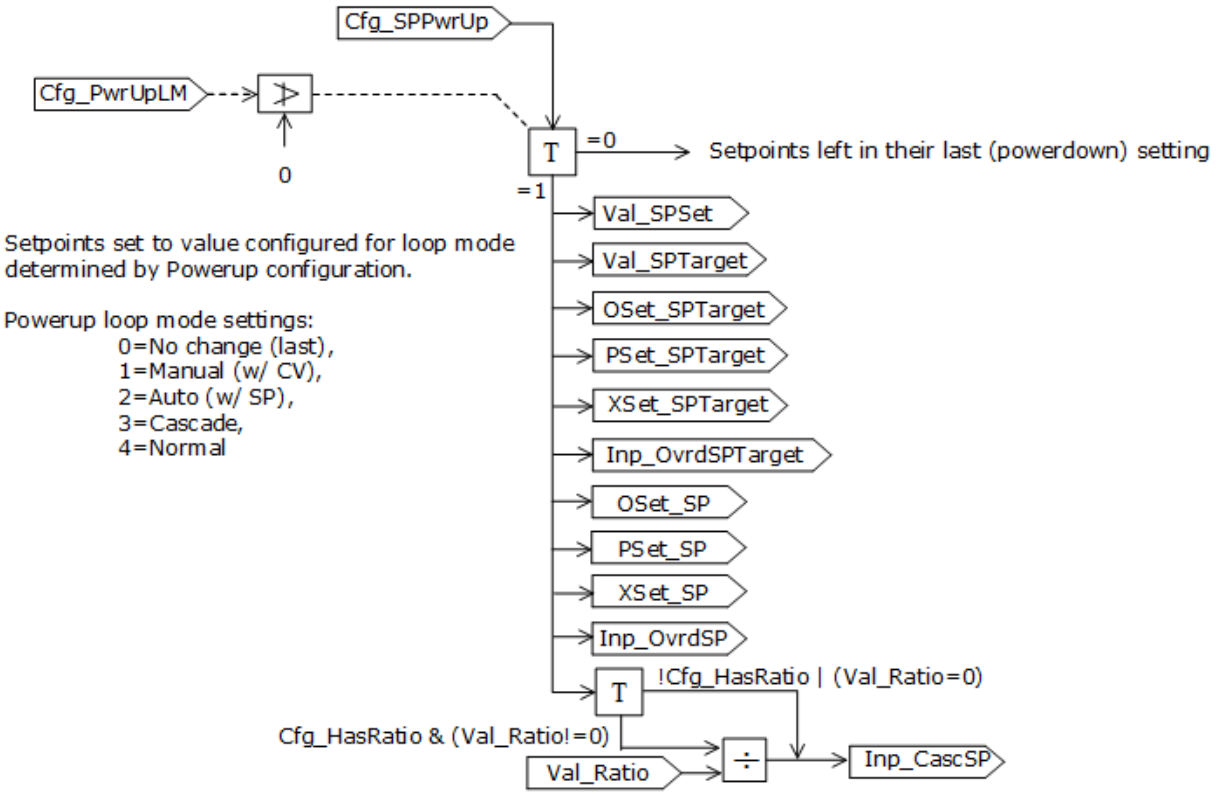
- Normal loop mode is disabled (Cfg_NormLM=0) if loop mode defined as normal is invalid (Cfg_NormLM<0 | >3), or normal loop mode is set Cascade but the instruction does not allow Cascade in configuration (Cfg_HasCasc ≠ 1 & Cfg_NormLM = 3),
- Loop mode is set to Manual if loop mode for Power up (Cfg_PwrUpLM) is Normal and normal loop mode is Manual, or loop mode for Power up in Manual,
- Loop mode is set to Auto if normal loop mode for Power up is Normal and normal loop mode is Auto, or loop mode for Power up in Auto,
- Loop mode is set to Cascade if normal loop mode for Power up is Normal and normal loop mode is Cascade, or loop mode for Power up in Cascade.

Cascade SP handling in Power up:

- Inp_CascSP = Cfg_SPPwrUp if loop mode in Powerup (Cfg_PwrUpLM) is explicitly provided as Manual/ Auto/ Cascade/ Normal and the Cascade loop mode is not Ratio, or Val_Ratio = 0,
- Inp_CascSP = Cfg_SPPwrUp × Val_Ratio if loop mode in Powerup is explicitly provided as Manual/ Auto/ Cascade/ Normal and the Cascade loop mode is Ratio and Val_Ratio ≠ 0.

SP handling in Power up. All SP inputs, interval SP values, and output SP values are overwritten by SP value configured for Power up:

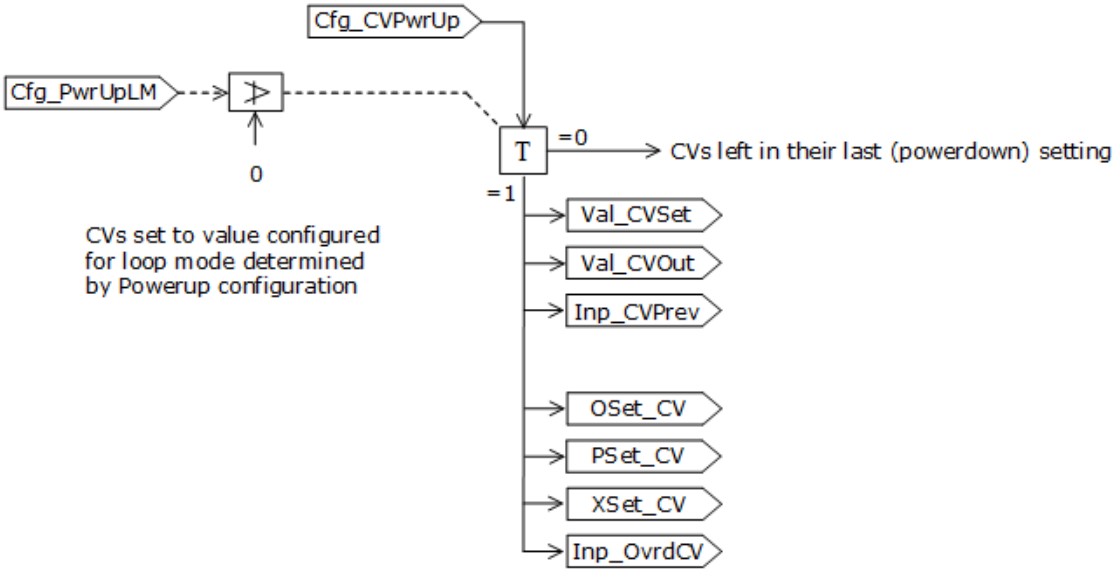
- Cfg_SPPwrUp → PSet_SP, OSet_SP, XSet_SP, Inp_OvrdSP,
- Cfg_SPPwrUp → PSet_SPTarget, OSet_SPTarget, XSet_SPTarget, Inp_OvrdSPTarget,
- Cfg_SPPwrUp → Val_SPTarget, Val_SPSet, Val_SP.



CV handling in Power up. All CV inputs, internal CV values, and output CV values are overwritten by CV value configured for Power up:

- Cfg_CVPwrUp → PSet_CV, OSet_CV, XSet_CV, Inp_OvrdCV, Inp_CVPrev,

- Cfg_CVPwrUp → Val_CVSet, Val_CVOut.



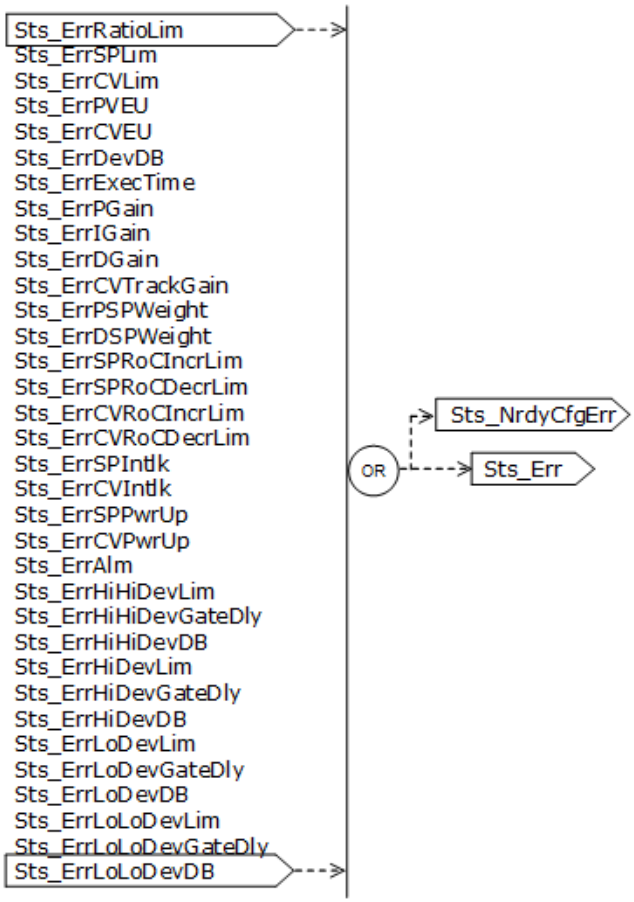
When in Auto or Cascade, CV can be initialized by inner loop CV set in Inp_CVTrack if Inp_InnerAvailable=0 and Cfg_CVPwrupSel=1. If Cfg_CVPwrupSel=0 then Inp_InnerAvailable is ignored in first run and Cfg_CVPwrup is used as initial CV.

If the loop mode was not zero for Power up (Cfg_PwrUpLM) and multiple loop modes were set internally, the instruction makes sure only one loop mode is set at a time, using this order of priority: Manual, then Auto, then Cascade. If the Powerup loop mode is 0, the loop mode, CV, and SP are left in their last (powerdown) states. Once initialization is complete the initialization request is cleared and the instruction is reported initialized (Sts_Initialized = 1).

Configuration error report

Selected parameters with Cfg_ prefix and data type REAL are examined in a validity check to prevent false actions. An error bit specific to a particular

parameter is set if the value is not valid. If an error bit is set, the global error (Sts_Err) is reported and a Fail alarm is raised.



The PPID instruction ensures a valid number of decimal places for PV and CV display in the HMI. Cfg_xxDecPlcs =2 if an invalid number is entered. The PPID instruction ensures valid action on SP/PV/CV fail. Cfg_SPFailSPAction = 1, Cfg_PVFailPVAction = 1, and Cfg_CVFailCVAction = 1 for any invalid number entered. The PPID instruction ensures valid Keep configuration on eKeepLM, CV, Ratio and SP. Cfg_eKeepxx = 0 (follows command source) if an invalid value is entered.

CV, SP, Ratio, Loop Mode ownership

Owned by Operator

The CV is owned by Operator if:

- The current command source is Operator (Sts_Oper=1) and the configuration is set to follow the command source (Cfg_eKeepCV=0), or
- the command source is Operator/Program/External and the configuration keeps the CV for Operator (Cfg_eKeepCV=1),

- or the command source is Maintenance (Sts_Maint=1).

The loop mode is owned by Operator if:

- The current owner is Operator (Sts_Oper=1) and the configuration is set to follow the command source (Cfg_eKeepLM=0), or
- the owner is Operator/Program/External and the configuration keepd the loop mode for Operator (Cfg_eKeepLM=1), or
- the owner is Maintenance (Sts_Maint=1).

The Ratio is owned by Operator if:

- The current owner is Operator (Sts_Oper=1) and the configuration is set to follow the command source (Cfg_eKeepRatio=0), or
- the owner is Operator/Program/External and the configuration keeps the Ratio for Operator (Cfg_eKeepRatio=1), or
- the owner is Maintenance (Sts_Maint=1).

The SP is owned by Operator if:

- The current owner is Operator (Sts_Oper=1) and the configuration is set to follow the command source (Cfg_eKeepSP=0), or
- the owner is Operator/Program/External and the configuration keeps the SP for Operator (Cfg_eKeepSP=1), or
- the owner is Maintenance (Sts_Maint=1).

Owned by Program

The CV is owned by Program if:

- The current owner is Program (Sts_Prog=1) and the configuration is set to follow the command source (Cfg_eKeepCV=0), or
- the owner is Operator/Program/External and the configuration keeps the CV for Program (Cfg_eKeepCV=2).

The loop mode is owned by Program if:

- The current owner is Program (Sts_Prog=1) and the configuration is set to follow the command source (Cfg_eKeepLM=0), or
- the owner is Operator/Program/External and the configuration keeps the loop mode for Program (Cfg_eKeepLM=2).

The Ratio is owned by Program if:

- The current owner is Program (Sts_Prog=1) and the configuration is set to follow the command source (Cfg_eKeepRatio=0), or
- the owner is Operator/Program/External and the configuration keeps the Ratio for Program (Cfg_eKeepRatio=2).

The SP is owned by Program if:

- The current owner is Program (Sts_Prog=1) and the configuration is set to follow the command source (Cfg_eKeepSP=0), or

- the owner is Operator/Program/External and the configuration keeps the SP for Program (Cfg_eKeepSP=2).

Owned by External

The CV is owned by External if:

- The current owner is External (Sts_Ext=1) and the configuration is set to follow the command source (Cfg_eKeepCV=0), or
- the owner is Operator/Program/External and the configuration keeps the CV for External (Cfg_eKeepCV=3).

The Loop mode is owned by External if:

- The current owner is External (Sts_Ext=1) and the configuration is set to follow the command source (Cfg_eKeepLM=0), or
- the owner is Operator/Program/External and the configuration keeps the loop mode for External (Cfg_eKeepLM=3).

The Ratio is owned by External if:

- The current owner is External (Sts_Ext=1) and the configuration is set to follow the command source (Cfg_eKeepRatio=0), or
- the owner is Operator/Program/External and the configuration keeps the Ratio for External (Cfg_eKeepRatio=3).

The SP is owned by External if:

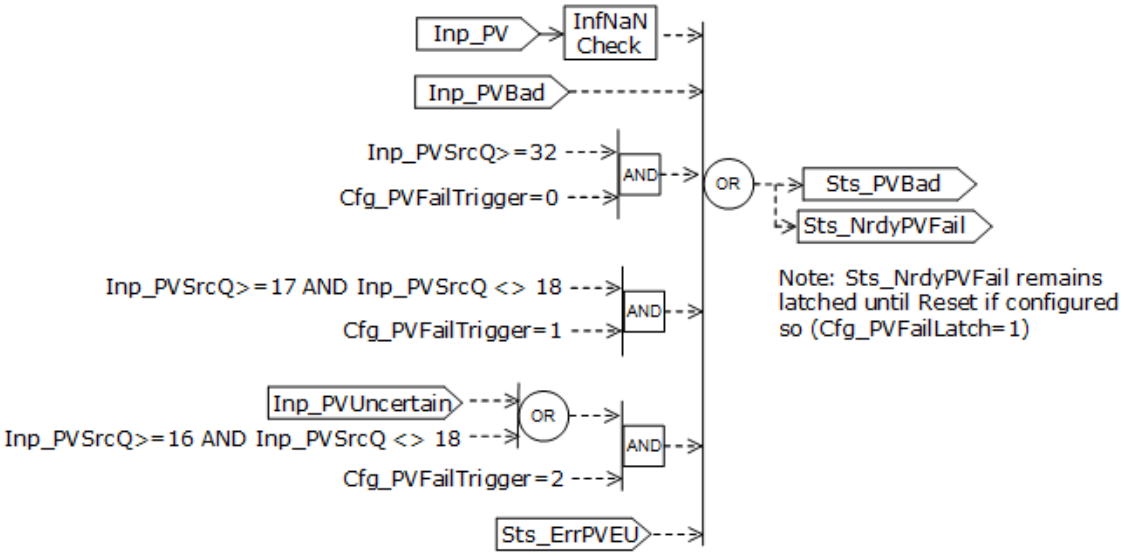
- The current owner is Program (Sts_Prog=1) and the configuration is set to follow the command source (Cfg_eKeepSP=0), or
- the owner is Operator/Program/External and the configuration keeps the SP for External (Cfg_eKeepSP=3).

PPID statuses

PV bad status

The Process variable fails in case of invalid PV scaling limits, and the PV is reported bad at source via Inp_PVBad input or quality index Inp_PVSrcQ. The PV cannot be used in PID calculations if the source quality is bad. The PV is also treated as failing if the PV is live but reported uncertain or just off-spec

and the PPID is configured for treating this situation as unacceptable (Cfg_PVFailTrigger=1 or 2).

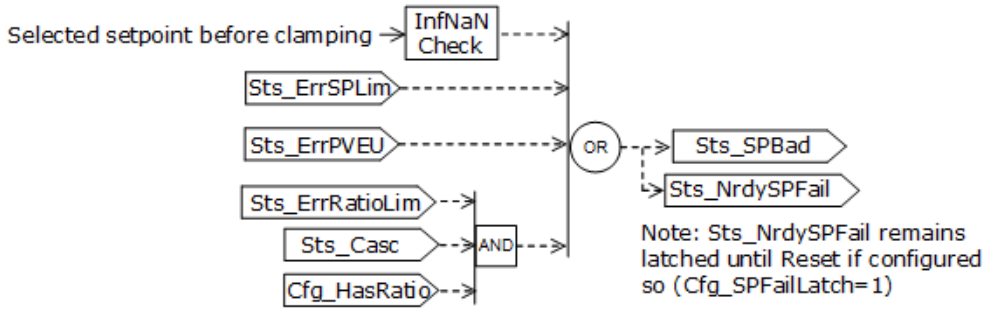


SP bad status

Setpoint fails if:

- SP clamping limits are invalid (Sts_ErrSPLim=1), or
- PV limits used in scaling are invalid (Sts_ErrPVEU=1, Max<=Min).

The failure occurs because SP is derived from PV if the loop mode is Ratio, or ratio clamping limits are invalid when the loop mode is Ratio (Sts_ErrRatioLim=1 & Cfg_HasRatio=1 & loop mode is Cascade).

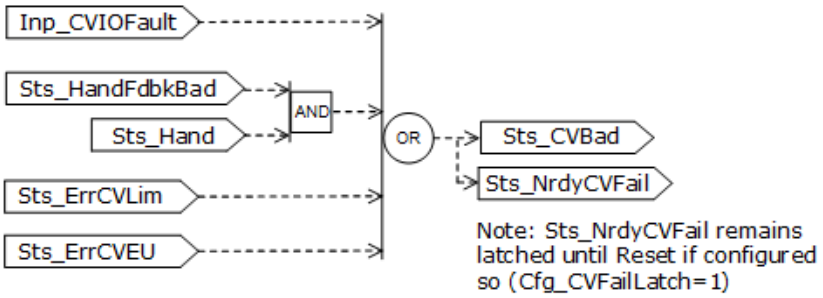


CV bad status

CV is bad if:

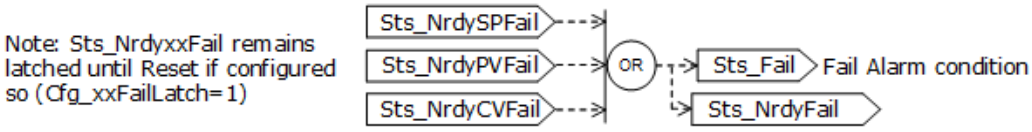
- Inp_CVIOFault=1, or
- CV clamping limits are invalid (Sts_ErrCVLim=1), or
- CV scaling limits are invalid (Sts_ErrCVEU=1),or

- Hand feedback is bad and the PPID is in Hand mode.



Loop failure status

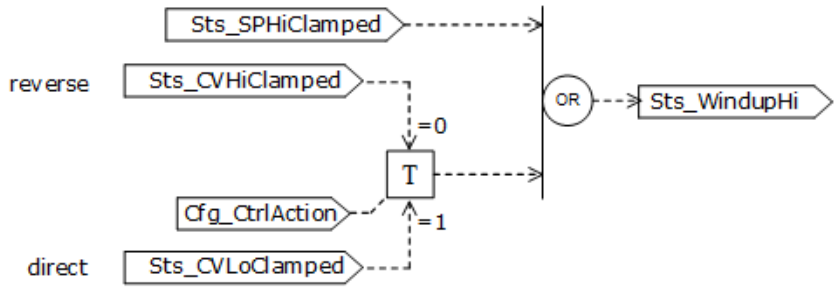
Loop failure (Sts_Fail) is set if SP, PV, or CV fails and failure shed is latched. If Sts_Fail is set the loop cannot operate normally.



Windup status

Windup status High (Sts_WindupHi) is set if:

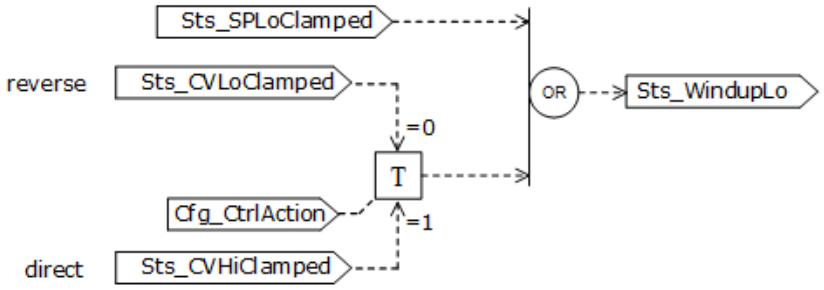
- Selected SP is clamped at high limit (Sts_SPHiClamped=1), or
- CV is clamped at high limit (Sts_CVHiClamped=1) if the PPID is configured for reverse control action (Cfg_CtrlAction=0), or
- CV is clamped at low limit (Sts_CVLoClamped=1) if the PPID is configured for direct control action (Cfg_CtrlAction=1).



Windup status Low (Sts_WindupLo) is set if:

- Selected SP is clamped at low limit (Sts_SPLoClamped=1), or
- CV is clamped at low limit (Sts_CVLoClamped=1) if the PPID is configured for reverse control action (Cfg_CtrlAction=0), or

- CV is clamped at high limit (Sts_CVHiClamped=1) if the PPID is configured for direct control action (Cfg_CtrlAction=1).



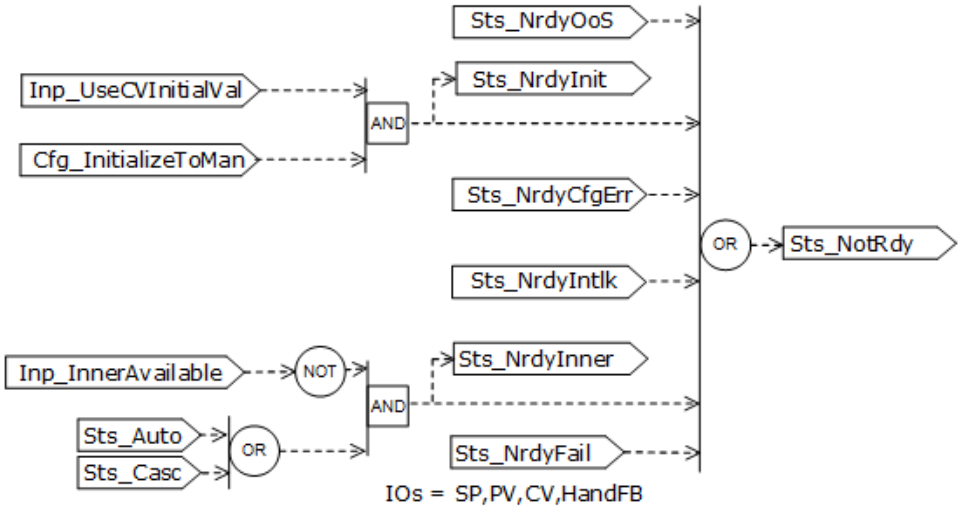
Active status

Status CV active (Sts_Active) is set if Val_CVOut is greater than Cfg_MaxInactiveCV. The HMI graphic symbol, for example, valve open, is shown for Sts_Active=1, and the inactive HMI graphic symbol, for example, valve closed, is shown when Sts_Active=0.

Not ready status

The PPID instruction is not ready (Sts_NotRdy=1) under these conditions:

- PPID is out of service (Sts_NrdyOoS=1), or
- PPID goes to Manual loop mode when initialized and Inp_CVInitialVal is used to initialize CV (Sts_NrdyInit=1), or
- PPID configuration error (Sts_NRdyCfgErr=1), or Interlock not OK (Sts_NrdyIntlk=1), or
- Inner object to this PPID, typically PID of the secondary loop, is not available (Inp_InnerAvailable=0) for Auto or Cascade mode of the PPID (Sts_Auto=1 | Sts_Casc=1), or
- Loop fails (Sts_Fail=1) because of PV/SP/CV bad value or communication failure, or Hand feedback value is invalid.



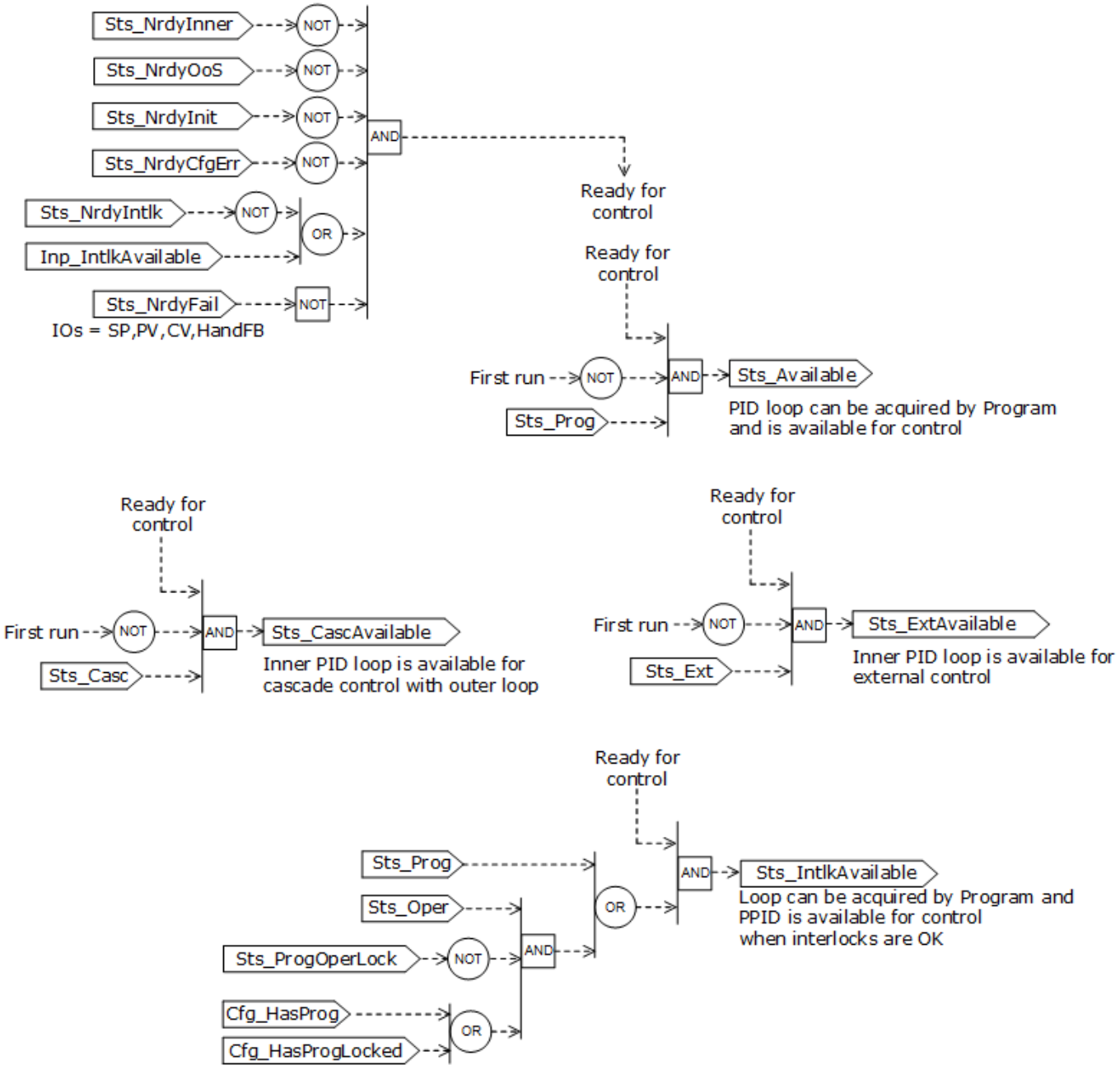
Available statuses

The PPID instruction is available (Sts_Available=1) to other objects when in Program mode, not in the first scan, and generally ready for control.

Inner loop is available for cascade control (Sts_CascAvailable=1) when in Cascade mode, not in the first scan, and generally ready for control.

Inner loop is available for external control (Sts_ExtAvailable=1) when in External mode, not in the first scan, and generally ready for control.

This diagram shows the conditions required for the instruction to be generally ready for control.



Configuration of strings for HMI

Configure strings for HMI faceplates, as seen in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure strings in the Logix Designer application only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Path to an object with more information
- Path to an object providing Cascade SP
- Path to an object providing PV
- Path to an object consuming CV
- PV/SP engineering units
- CV engineering units

Command source

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command source	Description
Hand	Hardwired logic or other logic outside the instruction owns control of the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. While in Hand mode the PID algorithm does not compute the change in CV. Val_CVOut = Inp_HandFdbk (Inp_Tieback), regardless of the control mode. Hand mode is typically used to indicate that control of the final control element was taken over by a field hand/auto station. Set Inp_Hand to request hand mode. This value is usually read as a digital input from a hand/auto station. (Highest Priority command source)
Out-of-Service	The instruction is disabled and has no owner.
Maintenance	Maintenance owns control of the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted. Bypassable interlocks are bypassed, and device timeout checks are not processed.
Override	Priority logic owns control of the device and supersedes Operator, Program and External control. Override Input (Inp_OvrdCmd) is accepted. If so configured, bypassable interlocks are bypassed.
External	External logic owns control of the device. External commands (XCmd_) are accepted.
Program locked	Program logic owns control of the device. Program commands (PCmd_) are accepted. Operator cannot take from Program. Override cannot take from Program unless Cfg_OvrdOverLock = 1.
Program	Program logic owns control of the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator owns control of the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take from Operator. Override cannot take from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator owns control of the device. Operator commands (OCmd_) from the HMI are accepted. (Lowest Priority command source)

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)
- XCmd_Acq used as a Level (1 = Acquire External, 0 = Release External)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core command source model

The core command source model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enabling control sources in configuration

The individual control sources may be enabled or disabled by the user. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Ownership default and priority

Configuration allows a user to specify whether Operator or Program will be the power-up default and specify whether Operator or Program commands will win when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. This means that all commands are automatically cleared when the instruction executes and processes them.

Changing destination states

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Prog is disabled, the destination of the OCmd_Prog command is directed to the ProgLocked state instead of the Prog state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated then there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher priority command sources

These higher priority command sources operate independently within the model: External, Override, Maintenance, Out-of-Service, In-Service, and Hand.

Command source processing and ownership arbitration

Maintenance and operator commands (MCmd_OoS, MCmd_IS, MCmd_Acq, MCmd_Rel, OCmd_Oper, OCmd_Prog, Ocmd_Lock, OCmd_Unlock, OCmd_Normal) are forwarded to the contained PCmdSrc instruction.

Maintenance and ready bits (MRdy_OoS, MRdy_IS, MRdy_Acq, MRdy_Rel, ORdy_Oper, ORdy_Prog, ORdy_Lock, ORdy_Unlock, ORdy_Normal) are copied from the contained PCmdSrc instruction in response.

The instruction sets ownership (Val_Owner) according to the order in which requests are received. If the requestor supplies a non-zero owner ID (PSet_Owner) and the current owner is none (Val_Owner = 0), the instruction assigns ownership to the requesting ID.

Monitor the PPID Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

The PID algorithm is only scanned at the configured execution rate Cfg_ExecTime. Configuring the instruction for execution period = 0.0 (default) or for a period shorter than the instruction scan time has no effect and the PID algorithm executes every scan. For the real execution period check Val_ExecTime.

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. Sts_eSrc is set to 0. Sts_bSrc is set to 0.
Instruction first run	All commands that are automatically cleared each execution are cleared and ignored. The Program/Operator selection is set based on the configuration (Cfg_ProgPwrUp). The Program or Operator lock selection is set to unlocked. Loop mode is set according to configuration (Cfg_PwrUpLM). Initial value pf SP and CV are set according to Cfg_SPPwrUp and Cfg_CVPwrUp and selected loop mode. If Cfg_PwrUpLM=0 (no change), SP and CV initial values are equal to values from last scan (e.g. before power down). PSet_Owner and Sts_Owner are set to 0.
Rung-condition-in is false	The instruction is put Out of Service if Inp_Hand=0. The output is de-energized. All alarms are cleared. Command source selection processing proceeds as normal except that all ownership status bits (Sts_Maint, Sts_Ovrd, Sts_Ext, Sts_Prog and Sts_Oper) are cleared to 0. When rung-condition-in becomes true, the instruction takes into account the commands received and sets the active command source accordingly.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	See Rung-condition-in is false in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

Examples

Example 1: PID feedback control

This example demonstrates wiring analog input and analog output instructions with a PPID instruction.

Pressure system tank level control is considered as an example of wiring analog input and analog output instruction(s) with a PPID instruction. Consider a section of water distribution system with a station pumping water from a collector tank to a tank maintaining system pressure at distribution nodes. Due to demand variation water level fluctuates so the system pressure varies. The PPID instruction helps stabilize the pressure by measuring and processing the water level as a process variable. PPID calculates the reference speed for a motor driving a pump to compensate for demand variations. The actual motor rpm is measured and fed back to the controller. This feedback enables the control scheme to read the actual motor speed when the service personnel takes over the control and manipulates with pump directly from the control panel (motor is in Hand). Components of the PID loop should track the actual rpm and be ready to take over control without any bump.

Analog input module provides level in raw units and fault signals processed by the PAI instruction (LI_30). Level in engineering units (LI_30.Val), level signal quality (LI_30.SrcQ) and alarm notification (LI_30.Sts_eNotifyAll) are wired to corresponding inputs of a PPID (LIC_31.Inp_PV, LIC_31.Inp_PVSrcQ, LIC_31.Inp_PVNotify). PPID is configured so the proper response occurs when the level signal is not reliable and should not enter PID formula for CV calculation. Set Cfg_PVFailTrigger to properly classify PV source quality. Use Cfg_PVFailSPAction, Cfg_PVFailCVAction, and Cfg_PVFailLMAction to specify the setpoint value, the value of the control variable, and the loop mode the PPID instruction uses if the PV source quality is reported as bad.

The PPID instruction should receive a signal indicating whether the downstream object driven by the PPID (the analog output instruction SZ_31 driving a motor) is active and is responding properly to the PPID instruction CV. In other words, the PPID instruction should receive a signal if the control loop is not open.

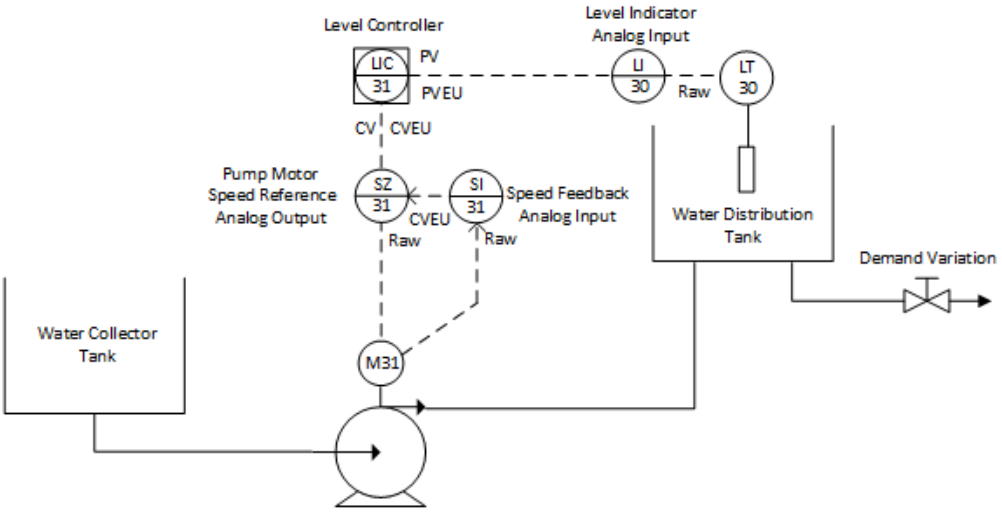
If the CV output of SZ_31 saturates (SZ_31.Sts_WindupHi=1 or SZ_31.Sts_WindupLo=1), the PPID instruction is out of control. To prevent windup, SZ_31.Sts_WindupHi and SZ_31.Sts_WindupLo are wired to LIC_31.Inp_WindupHi and LIC_31.Inp_WindupLo.

If the pump motor, the device driven by SZ_31, is in failure (M31_Fail=1), the loop is also open and both SZ_31 and LIC_31 should follow the actual device status to avoid any bump when put back in control. Actual motor rpm is measured, the rpm raw signal is scaled to engineering units by analog input instruction SI_31, and scaled value of rpm (SI_31.Val) is wired as a feedback signal to SZ_31.Inp_PosFdbk.

If service personnel have the pump motor in hand mode (M31_Hand=1), actual speed is provided separately in the M31_Fdbk tag, wired to SZ_31.Inp_HandFdbk.

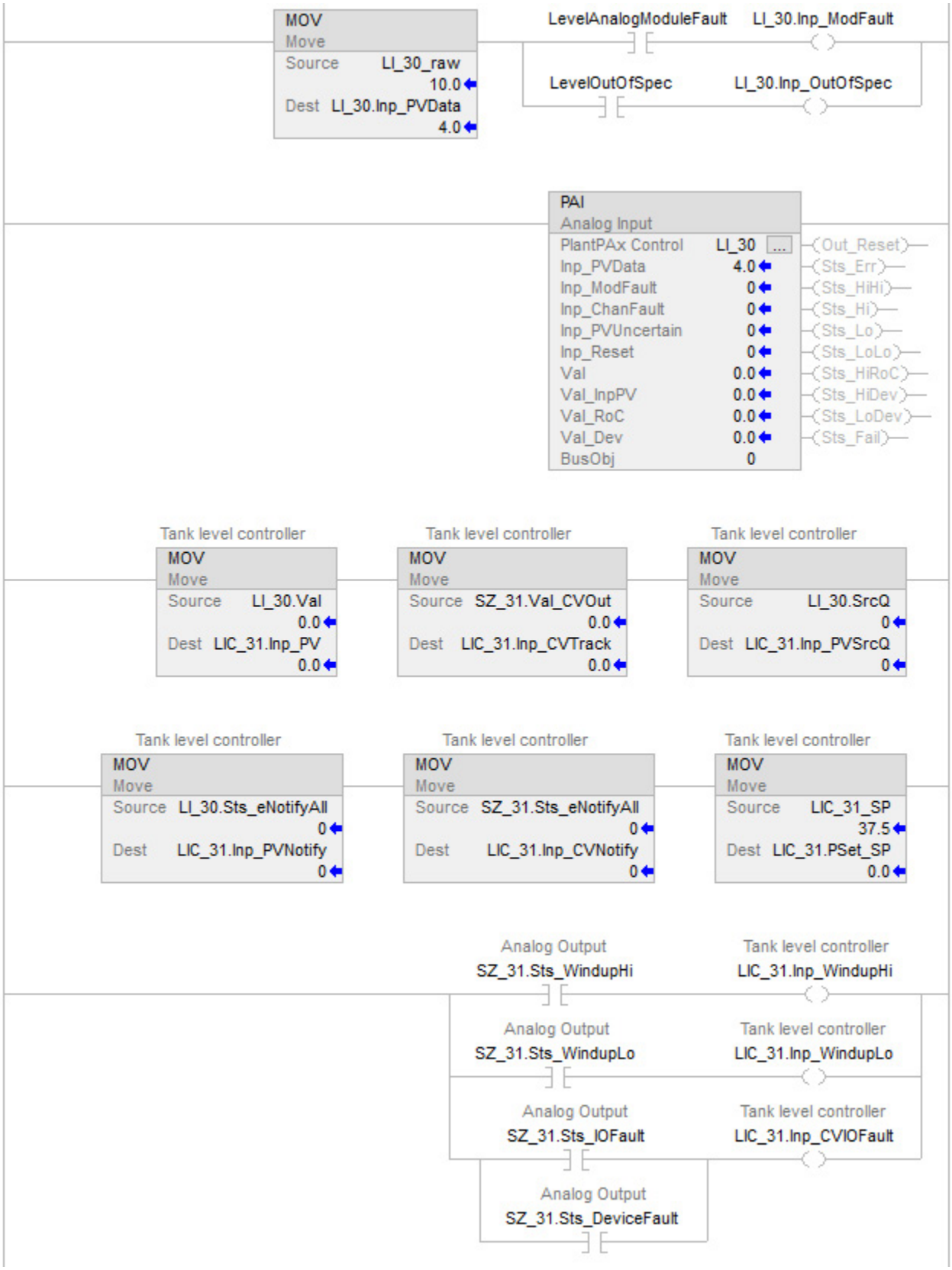
Device status is collected in analog output instruction SZ_31 and communicated upstream to the PPID instruction. The PPID instruction should be informed that the control loop is open somewhere downstream and thus the SZ_31 is not available for LIC_31. Wire SZ_31.Sts_Available to LIC_31.Inp_InnerAvailable to pass the information to the PPID. Actual speed reference should be provided to PPID for tracking purposes when control loop opens. Wire SZ_31.Val_CVOut to LIC_31.Inp_CVTrack. Other downstream problems like communication or device fault should also be fed back to the PPID so the instruction takes a configured action in response. Merge SZ_31.Sts_IOFault with SZ_31.Sts_DeviceFault, wire the result to LIC_31.Inp_CVIOFault and use LIC_31.Cfg_CVFailSPAction and LIC_31.Cfg_CVFailCVAction to configure the PPID for the follow up action.

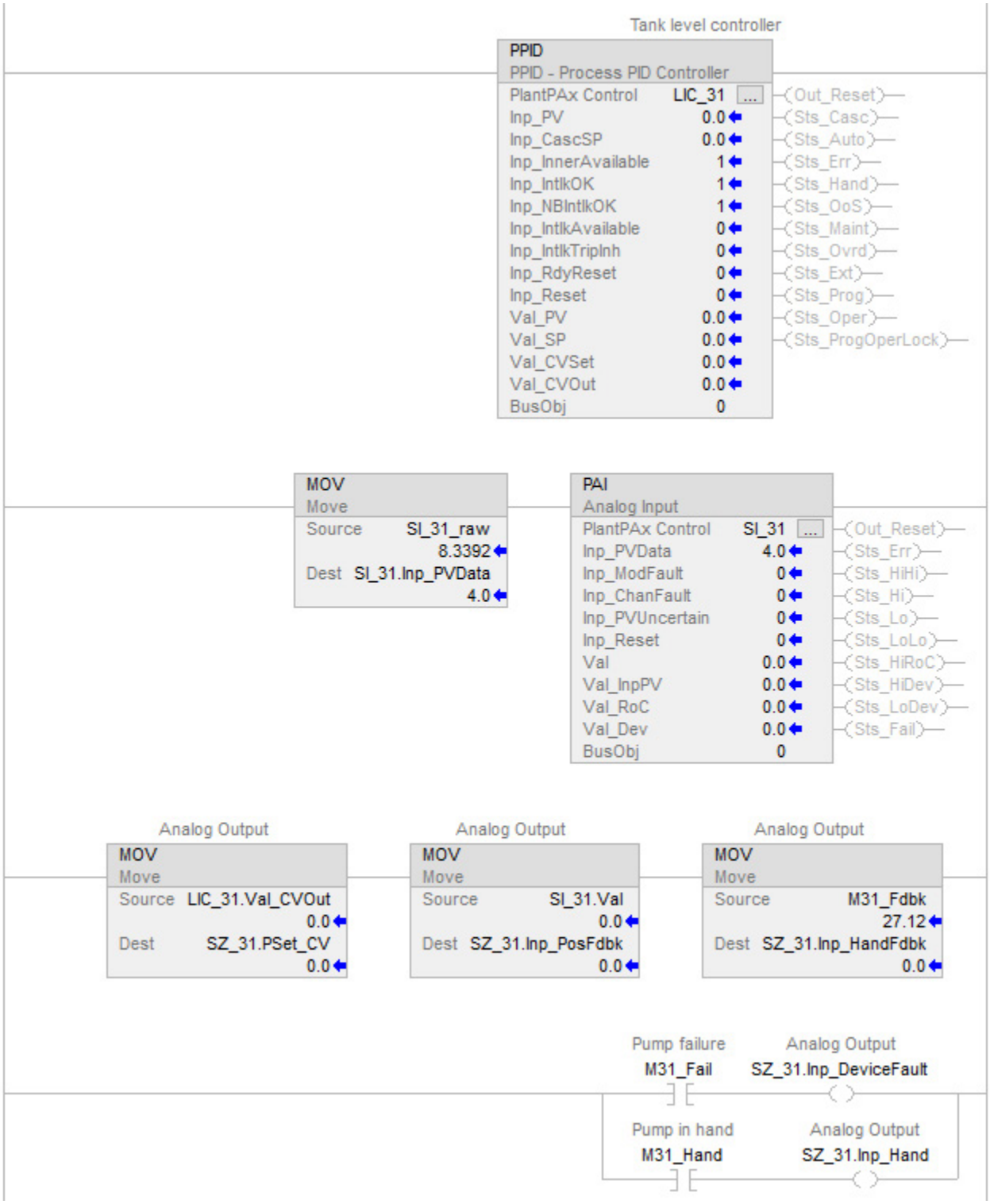
Finally update the alarm notification for the PPID and propagate the highest severity notification from SZ_31 upstream. Wire SZ_31.Sts_eNotifyAll to LIC_31.Inp_CVNotify.

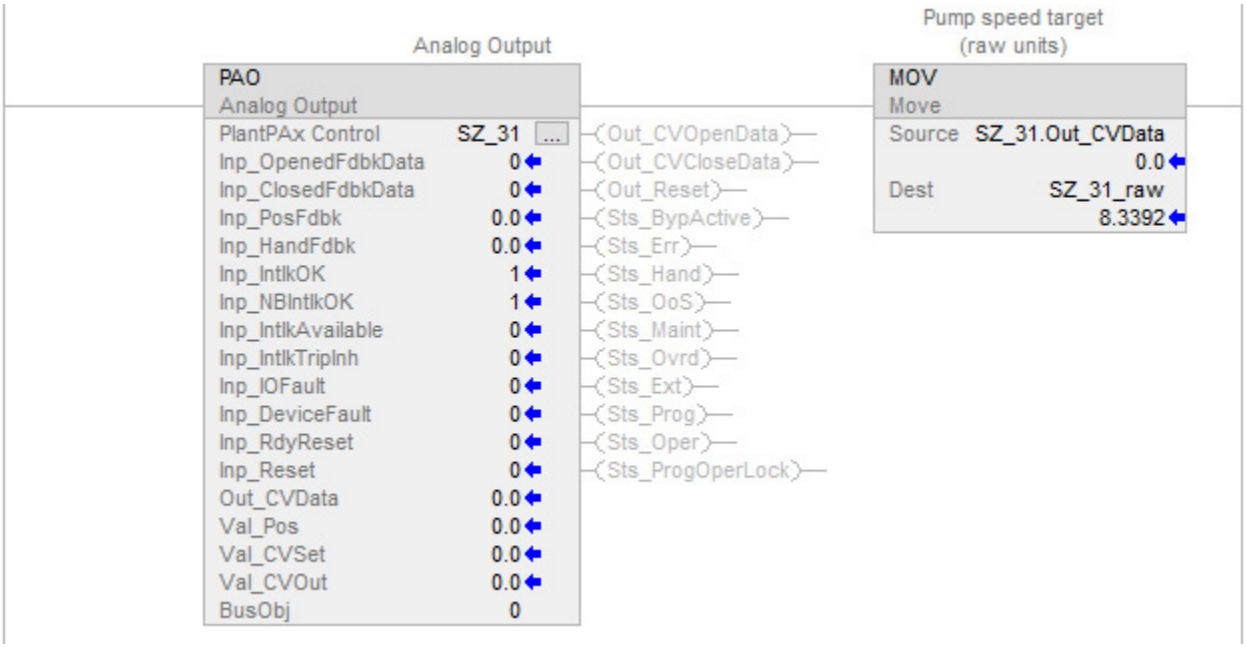


The example is shown in all three language editors.

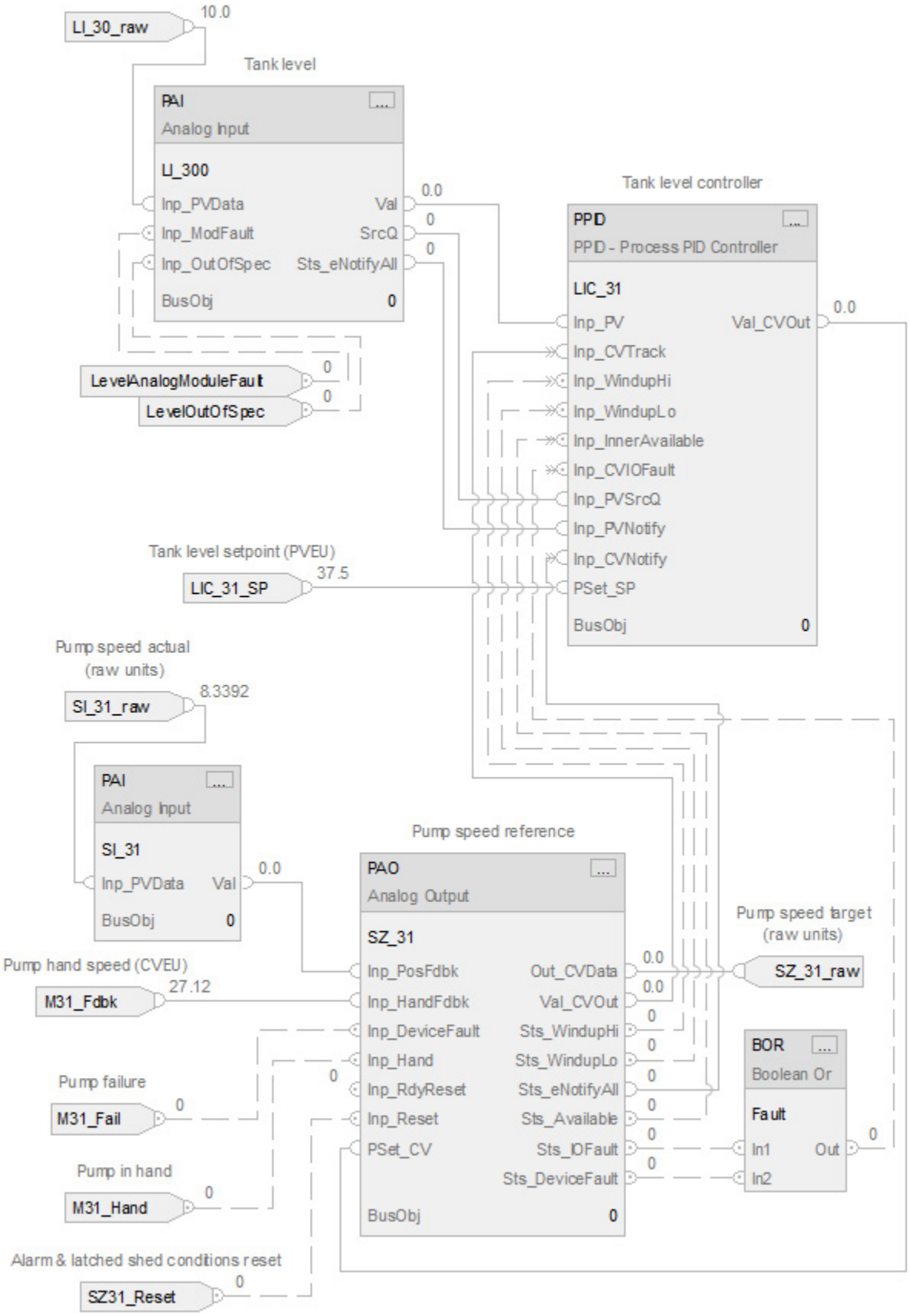
Ladder Diagram




Tank level controller
PPID
PPID - Process PID Controller
PlantPAx Control LIC_31 ...
Inp_PV 0.0
Inp_CascSP 0.0
Inp_InnerAvailable 1
Inp_IntlkOK 1
Inp_NBIntlkOK 1
Inp_IntlkAvailable 0
Inp_IntlkTripInh 0
Inp_RdyReset 0
Inp_Reset 0
Val_PV 0.0
Val_SP 0.0
Val_CVSet 0.0
Val_CVOut 0.0
BusObj 0
Out_Reset
Sts_Casc
Sts_Auto
Sts_Err
Sts_Hand
Sts_OoS
Sts_Maint
Sts_Ovrd
Sts_Ext
Sts_Prog
Sts_Oper
Sts_ProgOperLock
MOV
Move
Source SI_31_raw
8.3392
Dest SI_31.Inp_PVData
4.0
PAI
Analog Input
PlantPAx Control SI_31 ...
Inp_PVData 4.0
Inp_ModFault 0
Inp_ChanFault 0
Inp_PVUncertain 0
Inp_Reset 0
Val 0.0
Val_InpPV 0.0
Val_RoC 0.0
Val_Dev 0.0
BusObj 0
Out_Reset
Sts_Err
Sts_HiHi
Sts_Hi
Sts_Lo
Sts_LoLo
Sts_HiRoC
Sts_HiDev
Sts_LoDev
Sts_Fail
Analog Output
MOV
Move
Source LIC_31.Val_CVOut
0.0
Dest SZ_31.PSet_CV
0.0
Analog Output
MOV
Move
Source SI_31.Val
0.0
Dest SZ_31.Inp_PosFdbk
0.0
Analog Output
MOV
Move
Source M31_Fdbk
27.12
Dest SZ_31.Inp_HandFdbk
0.0
Pump failure
M31_Fail
Analog Output
SZ_31.Inp_DeviceFault
Pump in hand
M31_Hand
Analog Output
SZ_31.Inp_Hand


Analog Output
PAO
Analog Output
PlantPAx Control SZ_31
Inp_OpenedFdbkData 0
Inp_ClosedFdbkData 0
Inp_PosFdbk 0.0
Inp_HandFdbk 0.0
Inp_IntlkOK 1
Inp_NBIntlkOK 1
Inp_IntlkAvailable 0
Inp_IntlkTripInh 0
Inp_IOFault 0
Inp_DeviceFault 0
Inp_RdyReset 0
Inp_Reset 0
Out_CVData 0.0
Val_Pos 0.0
Val_CVSet 0.0
Val_CVOut 0.0
BusObj 0
Out_CVOpenData
Out_CVCloseData
Out_Reset
Sts_BypActive
Sts_Err
Sts_Hand
Sts_OoS
Sts_Maint
Sts_Ovrd
Sts_Ext
Sts_Prog
Sts_Oper
Sts_ProgOperLock
Pump speed target
(raw units)
MOV
Move
Source SZ_31.Out_CVData
0.0
Dest SZ_31_raw
8.3392

Function Block Diagram



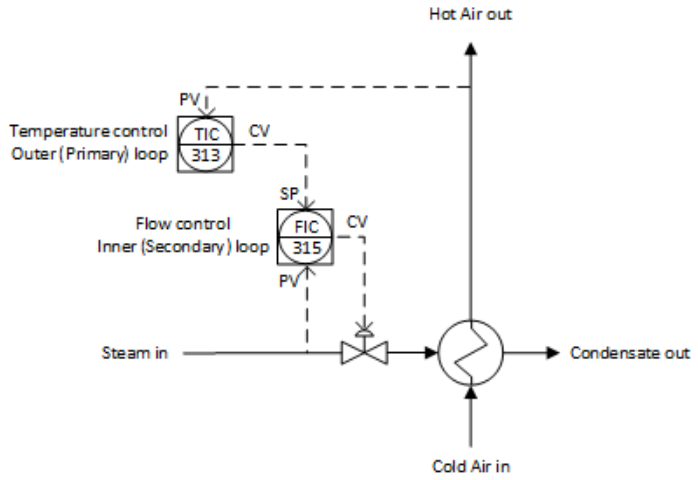
Structured Text

```
LI_30.Inp_PVData := LI_30_raw;
LI_30.Inp_ModFault := LevelAnalogModuleFault;
LI_30.Inp_OutOfSpec := LevelOutOfSpec;
PAI(LI_30,0);
LIC_31.Inp_PV := LI_30.Val;
LIC_31.Inp_CVTrack := SZ_31.Val_CVOut;
LIC_31.Inp_PVSrcQ := LIC_31.Inp_PVSrcQ;
LIC_31.Inp_PVNotify := LI_30.Sts_eNotifyAll;
LIC_31.Inp_CVNotify := SZ_31.Sts_eNotifyAll;
LIC_31.PSet_SP := LIC_31_SP;
LIC_31.Inp_WindupHi := SZ_31.Sts_WindupHi;
LIC_31.Inp_WindupLo := SZ_31.Sts_WindupLo;
LIC_31.Inp_CVIOFault := SZ_31.Sts_IOFault OR SZ_31.Sts_DeviceFault;
PPID(LIC_31,0);
SI_31.Inp_PVData := SI_31_raw;
PAI(SI_31,0);
SZ_31.PSet_CV := LIC_31.Val_CVOut;
SZ_31.Inp_PosFdbk := SI_31.Val;
SZ_31.Inp_HandFdbk := M31_Fdbk;
SZ_31.Inp_DeviceFault := M31_Fail;
SZ_31.Inp_Hand := M31_Hand;
PAO(SZ_31,0);
SZ_31_raw := SZ_31.Out_CVData;
```

Example 2: Cascade control

Cascade control is useful when externally-caused upsets to the controlled variable occur often, which then cause upsets to the process variable you are trying to control. For example, try to control the temperature of liquid in a tank by varying the amount of steam fed into a heating jacket around the tank. If the steam flow suddenly drops because of an upstream process, the temperature of the liquid in the tank eventually drops and the PPID

instruction then opens the steam valve to compensate for the drop in temperature.



In this example, a cascaded loop provides better control by opening the steam valve when the steam flow drops before the liquid temperature in the tank drops. To implement a cascaded loop, use a PPID instruction to control the steam valve opening based on a process variable signal from a steam flow transmitter. This is the inner loop of the cascaded pair. A second PPID instruction (called the outer or primary loop) uses the liquid temperature as a process variable and sends its CV output into the setpoint of the inner loop. In this manner, the outer temperature loop asks for a certain amount of steam flow from the inner steam flow loop. The steam flow loop is then responsible for providing the amount of steam requested by the temperature loop in order to maintain a constant liquid temperature.

For a cascaded pair of loops to work correctly, the inner loop must have a faster process response than the primary loop. This is because the inner loop's process must be able to compensate for any upsets before these upsets affect the outer loop's process. In this example, if steam flow drops, the steam flow must be able to increase as a result of the inner controller's action before the liquid temperature is affected.

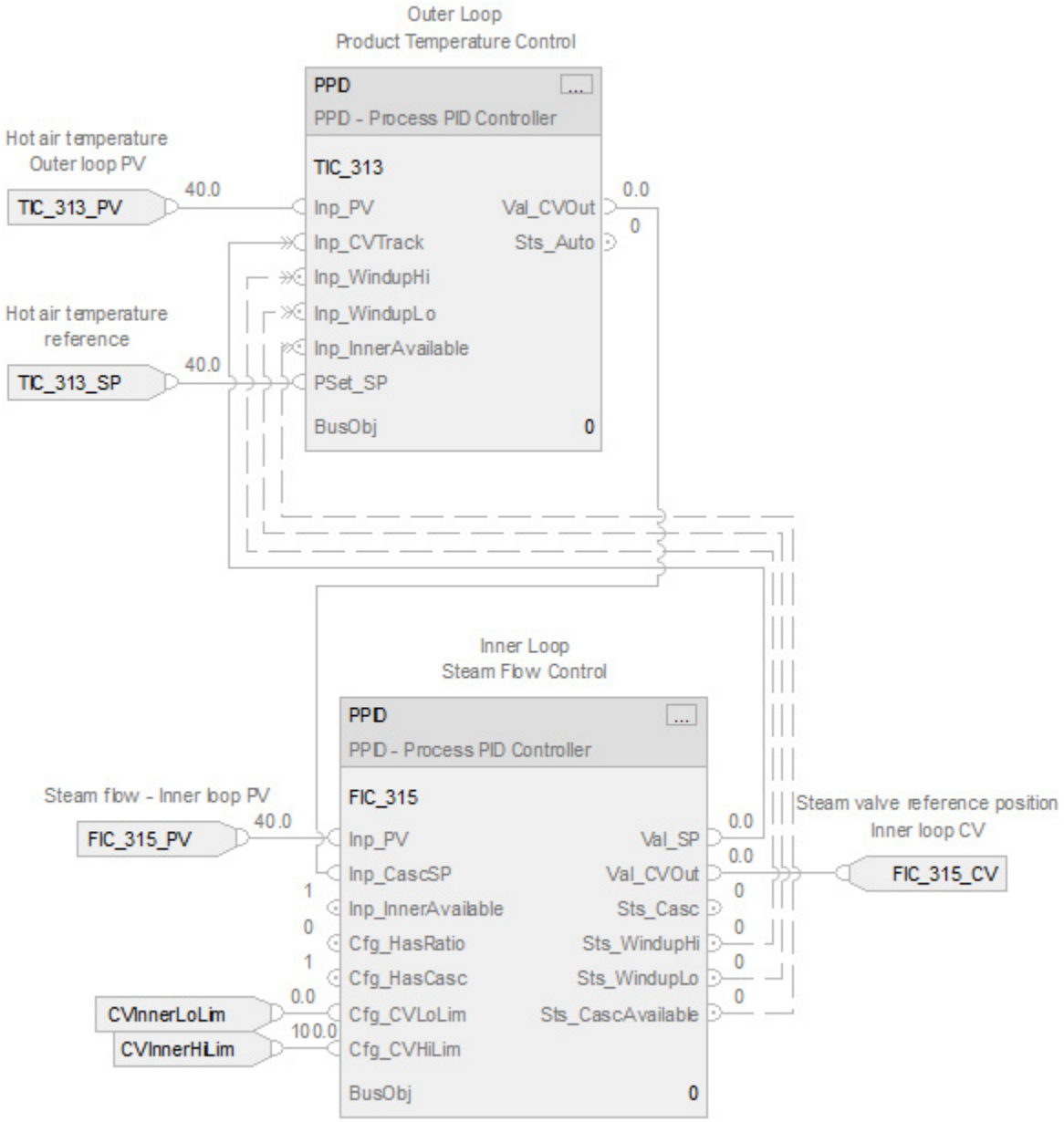
To set up a pair of cascaded PPID instructions, set the Cfg_HasCasc input parameter in the inner loop. This allows the inner loop to be placed into Cascade/Ratio mode. Next, wire the Val_CVOut from the outer loop into the Inp_CascSP parameter on the inner loop. The Inp_CascSP value is used as the SP on the inner loop when the inner loop is placed into Cascade/Ratio mode. The engineering unit range of the Val_CVOut on the outer loop should match the engineering unit range of the PV on the inner loop. This lets the outer loop scale its 0-100% value of CV into the matching engineering units used for the setpoint on the inner loop.

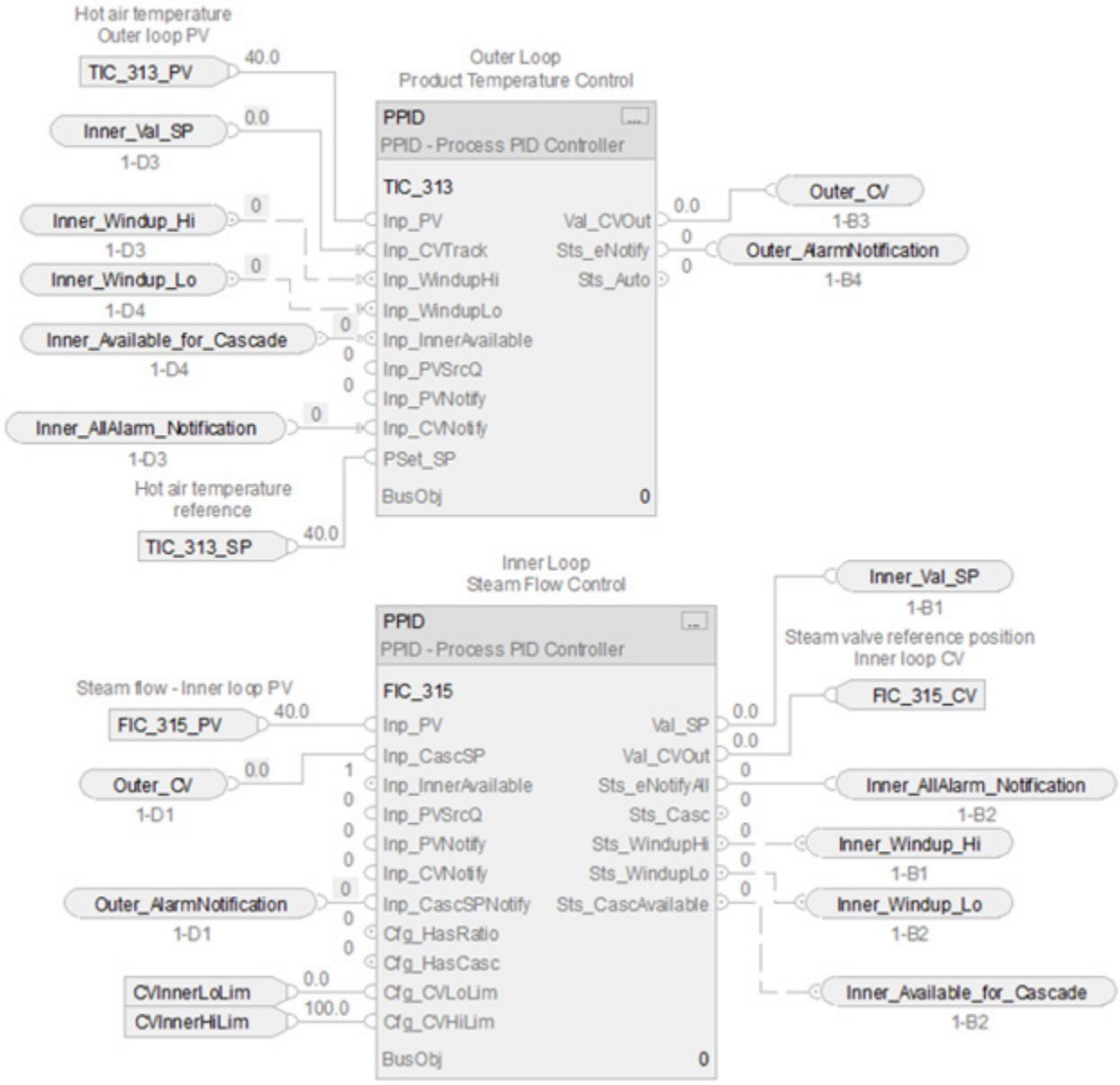
The PPID instruction has several other features to more effectively support cascade control. Wire the Sts_CascAvailable output on the inner loop PPID into the Inp_InnerAvailable input on the outer loop PPID and wire the Val_SP

output of the inner into the Inp_CVTrack input on the outer. This sets the Val_CVOut value of the outer loop to track the SP of the inner loop when the inner loop is not in Cascade/Ratio mode. This allows a bumpless transfer when you place the inner loop back into Cascade/Ratio mode. Also, wire the Sts_WindupHi and Sts_WindupLo outputs on the inner loop into the Inp_WindupHi and Inp_WindupLo inputs on the outer loop. This causes the outer loop to stop increasing or decreasing, as appropriate, its Val_CVOut value if the inner loop hits a SP limit or CV limit and eliminates any windup on the outer loop if these conditions occur.

The example is shown in FBD in two versions, with minimum wiring and extended wiring. The extended wiring shows passing alarm notification between outer and inner PID and makes signal quality input pins visible for immediate use in the application.

Function Block Diagram

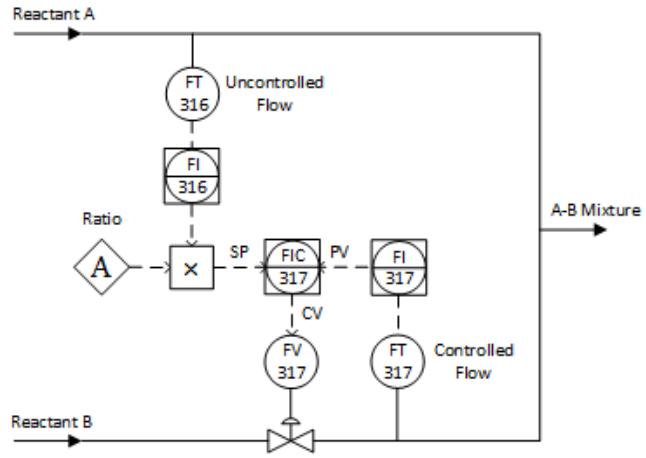




Example 3: Ratio control

Ratio control is typically used to add a fluid in a set proportion to another fluid. For example, if you want to add two reactants (say A and B) to a tank in a constant ratio, and the flow rate of reactant A may change over time because of some upstream process upsets, you can use a ratio controller to automatically adjust the rate of reactant B addition. In this example, reactant

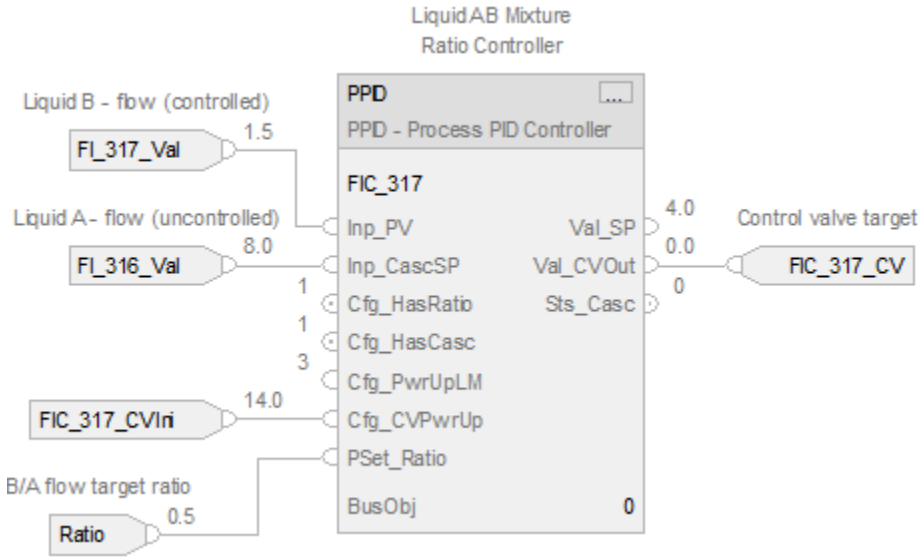
A is often called the uncontrolled or wild flow since it is not controlled by the PPID instruction. The flow of reactant B is then called the controlled flow.



To perform ratio control with a PPID instruction, set the Cfg_HasCasc and Cfg_HasRatio input parameters. Wire the uncontrolled flow into the Inp_CascSP input parameter. When in Cascade/Ratio mode, the uncontrolled flow is multiplied by either the OSet_Ratio, when in Operator control, or the PSet_Ratio, when in Program control, and the resulting value is used by the PPID instruction as the setpoint.

The example is shown in FBD.

Function Block Diagram



Example 4: Feedforward control

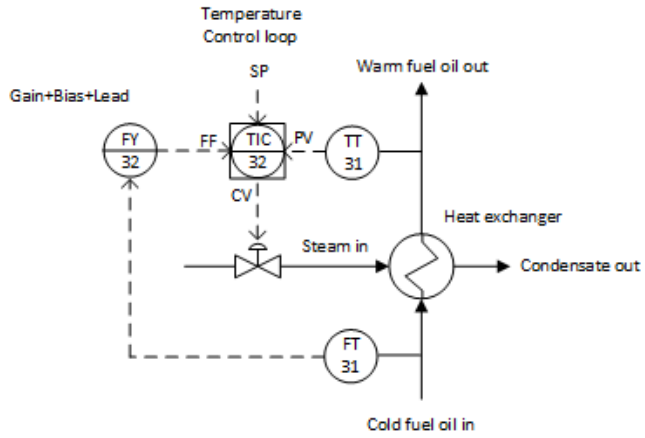
Feedforward control is a disturbance rejection strategy to deal with load change. Rather than rely on feedback to make corrective changes to a process only after some load change has driven the process variable away from

setpoint, control schemes with feedforward monitor the relevant load(s) and use that information to preemptively make stabilizing changes to the final control element such that the process variable will not be affected.

Consider a control system manipulating steam flow to the heat exchanger to maintain the discharge temperature of the oil at a constant setpoint value. The outlet temperature will suffer temporary deviations from setpoint if load conditions change. The feedback control system may be able to eventually bring the exiting oil's temperature back to setpoint, but it cannot begin corrective action until after a load has driven the oil temperature off setpoint. To improve control, build feedforward action and feedback action into the design. The feedforward action allows the control system to take corrective action in response to load changes before the process variable is affected.

In this example, the dominant load in the system is oil flow rate, caused by changes in demand at the combustion furnace where the oil is being used as fuel. Adapting this control system to include feedforward requires installing an oil flow transmitter and a gain/bias function providing feedforward action to the PID controller maintaining temperature. With feedforward control action in place, the steam flow rate immediately changes with oil flow rate, preemptively compensating for the increased or decreased heat demand of the oil. The time constant of the process with regard to steam flow changes is greater than the time constant of the process with regard to oil flow changes.

Oil flow is a wild variable. The feedforward control system can only manipulate the steam valve position in response to oil flow. The best method to help control it is to speed up the time constant of the steam flow variable, which the system can influence. The solution is to wire the output of the user-specified lead function FY_32 to Inp_FF of the PPID.

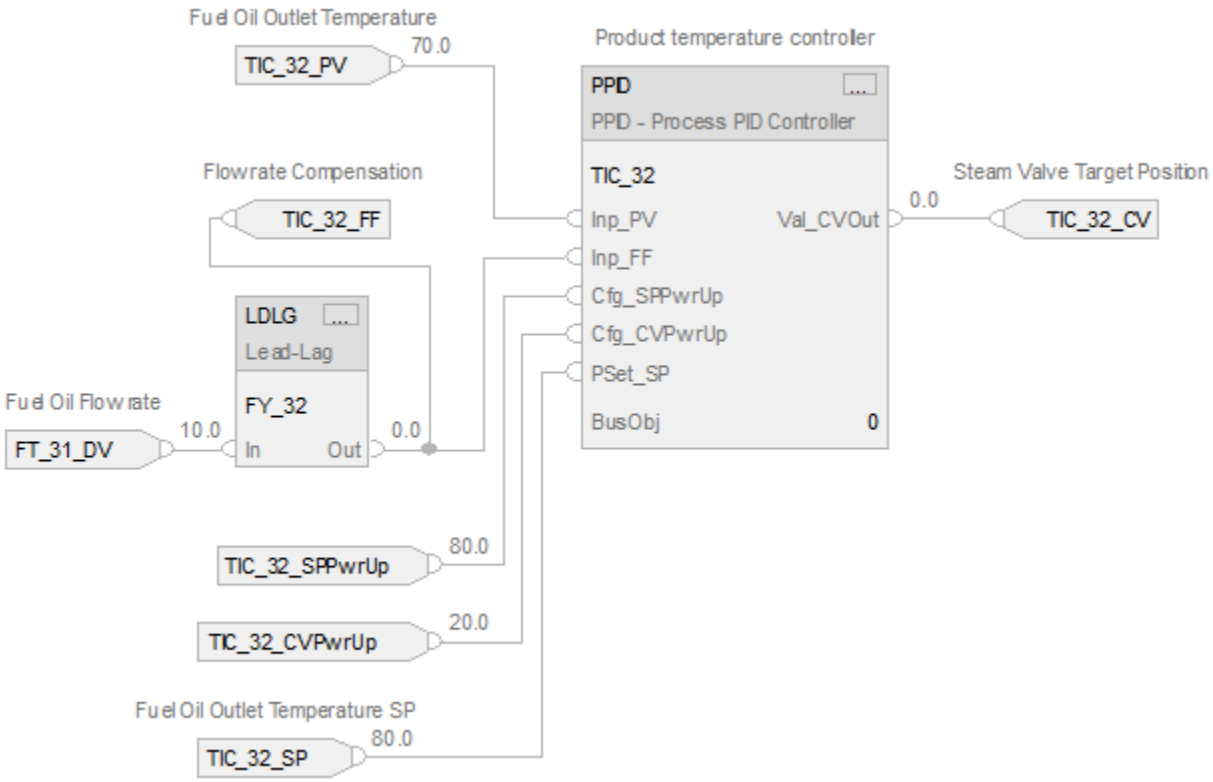


Now, when the oil flow rate to this heat exchanger suddenly increases, the lead function will add a surge to the feedforward signal, quickly opening the steam valve and sending a surge of steam to the exchanger to help overcome the naturally sluggish response of the oil temperature to changes in steam flow. The feedforward action won't be perfect with this lead function added,

but it will be substantially better than if there was no dynamic compensation added to the feedforward signal.

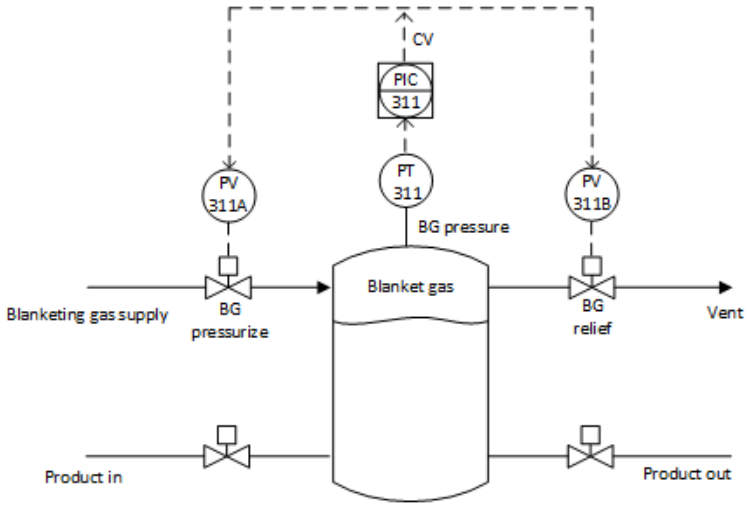
The example is shown in FBD.

Function Block Diagram



Example 5: Split-range control

Split-range control allows using a single PID Control Variable to drive more than one final control element. An application example is shown in the following figure.



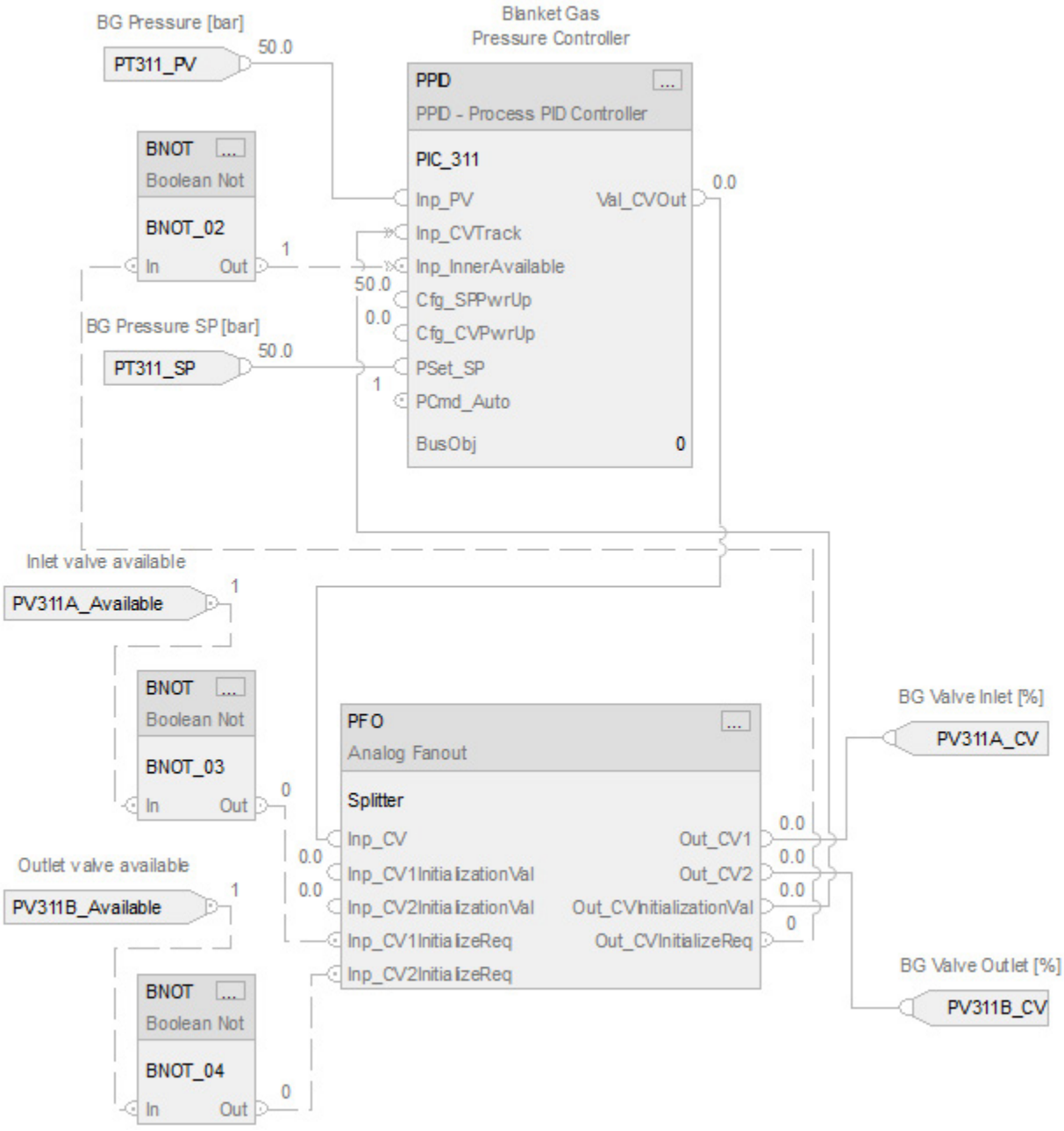
At CV=0 (Val_CVOut=0), both valves are closed. When the CV is positive, the pressurizing valve is open and the vent valve is kept closed. If the PPID instruction is configured with CV scaling limits Cfg_CVEUMax=100 and Cfg_CVEUMin=-100, then at CV=100 the pressurizing valve is wide open. When the CV is negative, the vent valve is open and the pressurizing valve is closed. At CV=-100, vent is wide open. CV splitting is done with the Process Analog Fanout (PFO) instruction.

Configure PPID with Cfg_CVEUMin=-100, Cfg_CVEUMax=100 and PFO with Cfg_CVEUMin=-100, Cfg_CVEUMax=100, Cfg_CV1Ratio=1, Cfg_CV1Offset=0, Cfg_CV1HiLim=100, Cfg_CV1LoLim=0, Cfg_CV2Ratio=-1, Cfg_CV2Offset=0, Cfg_CV2HiLim=100, Cfg_CV2LoLim=0.

The PPID instruction must receive an indication whether its downstream object can be controlled. If the downstream object is not ready for the PPID instruction, the instruction should track what the downstream block defines for the situation. Wire the negation of the initialization request (Out_CVInitializeReq) received by the PFO instruction from its downstream object to Inp_InnerAvailable of the PPID instruction. In addition, wire the PFO instruction's Out_CVInitializationVal to Inp_CVTrack of the PPID instruction. The PPID instruction will track this value when the downstream block is not ready for PPID control. The PPID instruction goes back to control without any bump if the downstream object becomes available again.

The example is shown in FBD.

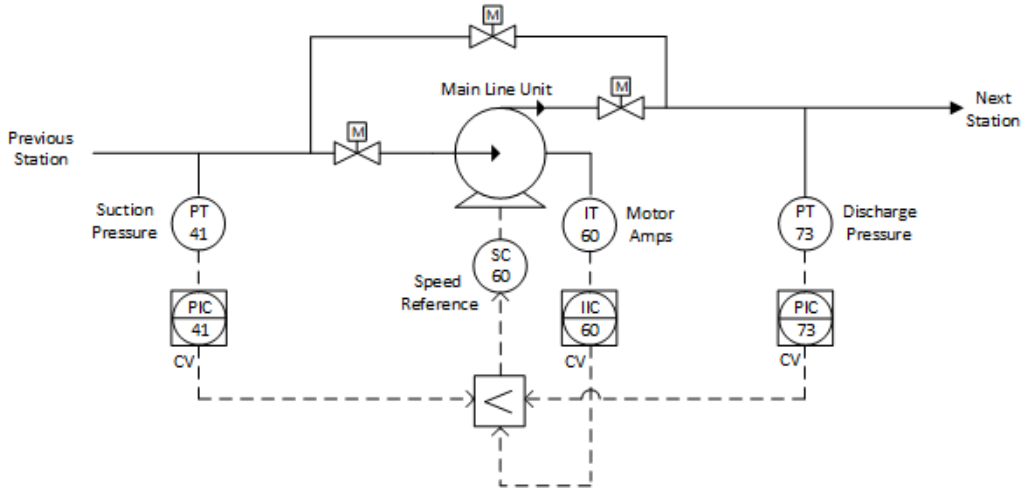
Function Block Diagram



Example 6: Override-select control

Consider the oil pipeline pump station in the figure below. In this example, the system measures suction pressure (41) and discharges pressure (73) and motor current (60). To control discharge pressure, use the variable-speed drive on the pump. The challenge is that if the suction pressure goes low, the pump cavitates. If the motor current goes too high, the drive trips and pressure upset is sent down the line. Both constraints act in the same direction. If the suction pressure goes low, the pump needs to slow down until

it recovers. If the motor current goes high, slowing down the pump reduces the power, and so reduces the motor current.



The Primary loop is the station discharge pressure. Suction pressure and motor current are Override loops. The low-select picks the lowest CV to send to the drive speed reference. Suction pressure and motor current loops' setpoints are set to the constraint threshold (where to start acting). When a constraint is approached, that loop's error gets small, its output drops, and it is selected. The selected CV is fed back to all three loops. The control scheme takes the advantage of using Inp_CVTrack for tracking final CV.

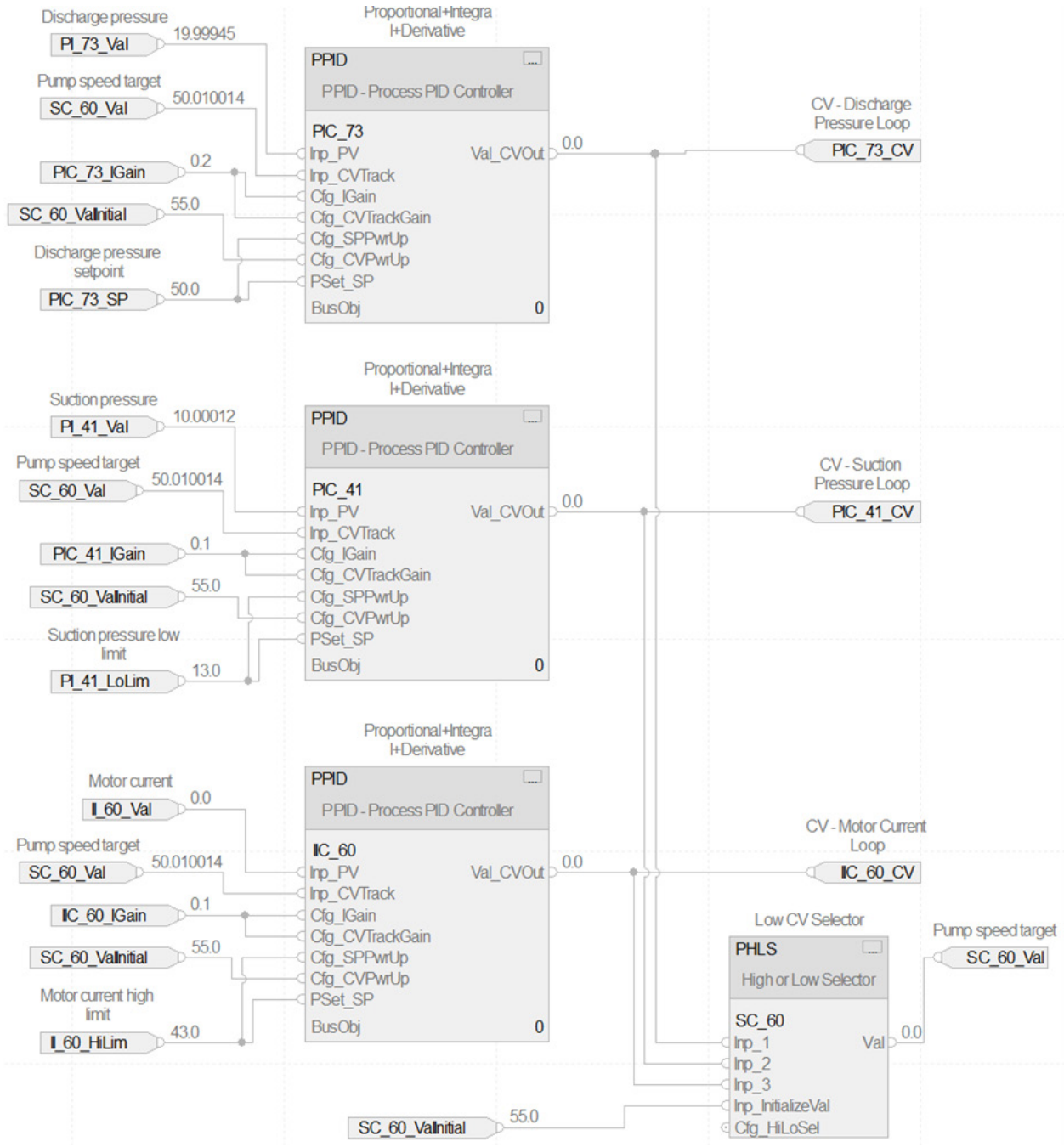
Recommended setting of the tracking parameter:

- Dependent gains (Cfg_Dependent = 1). Set Cfg_CVTrackGain = Cfg_IGain.
- Independent gains (Cfg_Dependent = 0). Set Cfg_CVTrackGain = Cfg_IGain/Cfg_PGain.

This setting leads to a steady state difference between selected (active) CV and unselected (tracking) CV equal to Cfg_PGain x Error which keeps proper leeway for the selected controller to control without unnecessarily frequent switching to another controller.

The example is shown in FBD.

Function Block Diagram

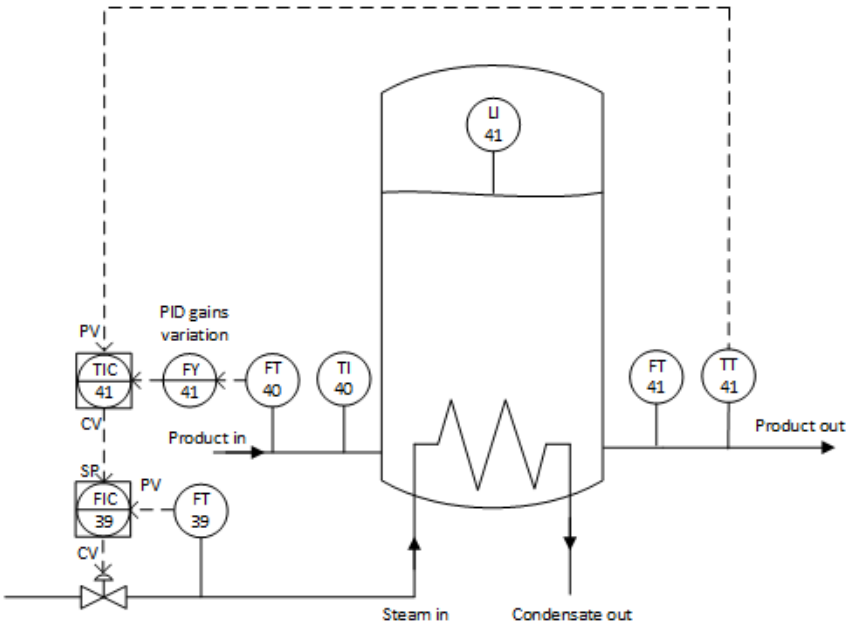


Example 7: PID gain scheduling

Consider the oil pipeline pump station in the figure below. In this example, the system measures suction pressure (41) and discharges pressure (73) and motor current (60). To control discharge pressure, use the variable-speed drive on the pump. The challenge is that if the suction pressure goes low, the pump cavitates. If the motor current goes too high, the drive trips and pressure upset is sent down the line. Both constraints act in the same direction. If the suction pressure goes low, the pump needs to slow down until

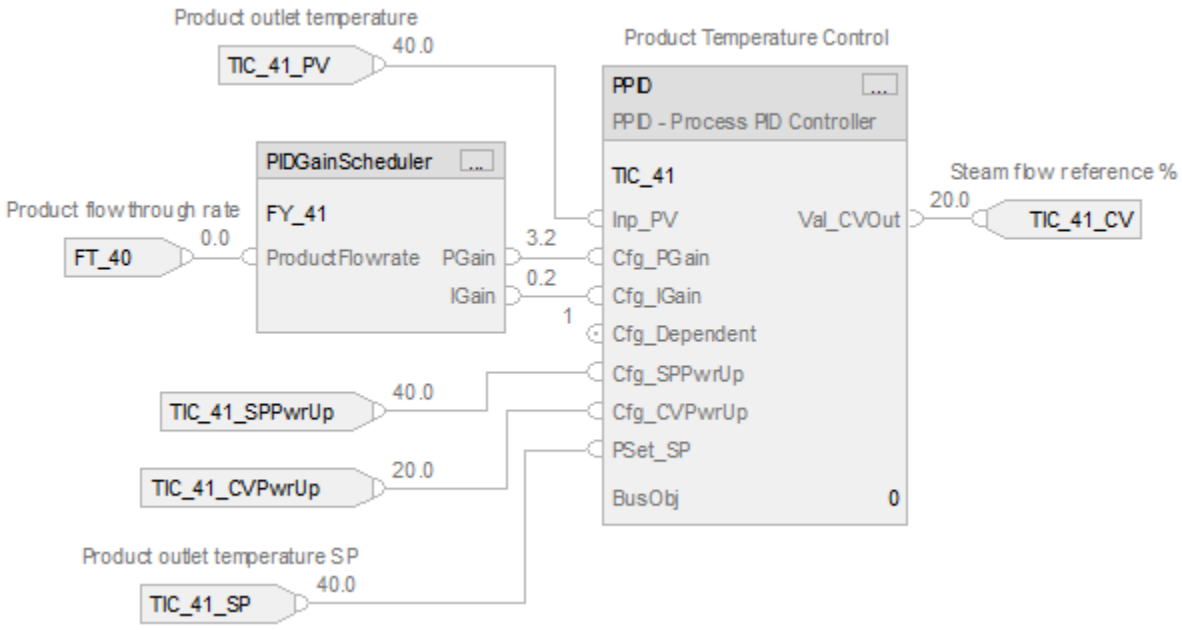
it recovers. If the motor current goes high, slowing down the pump reduces the power, and so reduces the motor current.

In this example the gain scheduling technique is used to compensate for changes in process dynamics on-the-fly. Standard temperature controller TIC_41 reads outlet temperature TT_41 (PV) and calculates reference for steam flow control loop (CV) to keep product temperature at the setpoint. PPID is configured with dependent gains (TIC_41.Cfg_Dependent=1) and the overall gain TIC_41.Cfg_PGain changes with product flow FT_40. Formula for PGain calculation is application specific. In this example PGain is calculated in PIDGainScheduler AOI as a linear function of product flowrate with bias.



The example is shown in FBD.

Function Block Diagram



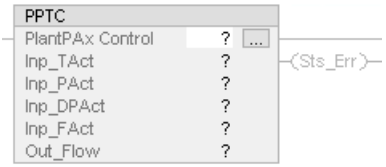
Process Pressure/Temperature Compensated Flow (PPTC)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

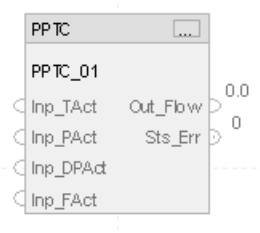
The Pressure/Temperature Compensated Flow (PPTC) instruction calculates a flow at standard temperature and pressure, essentially a mass flow rate, given a volumetric flow rate or differential pressure measurement. This instruction requires measurements of the actual temperature and pressure of the flowing gas.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PPTC(PPTC_01);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_PRESS_TEMP_COMPENSATED	tag	Data structure required for proper operation of the instruction.

P_PRESS_TEMP_COMPENSATED Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung-condition-in. Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_TAct	REAL	Actual (measured) temperature, can be absolute or common units. Valid = any float. Default is 0.0.
Inp_PAct	REAL	Actual (measured) pressure, can be absolute or common units. Valid = any float. Default is 0.0.

Public Input Members	Data Type	Description
Inp_DPAct	REAL	Actual (measured) differential pressure. Valid = any float. Default is 0.0.
Inp_FAct	REAL	Actual (measured) uncompensated flow in volumetric units. Valid = any float. Default is 0.0.
Cfg_LoFlowCutoff	REAL	If Out_Flow is less than this cutoff value, it is shown as 0.0. Valid = 0.0 to maximum positive float. Default is 0.0.
Cfg_TStd	REAL	Standard temperature in Inp_TAct units. Valid = any float. Default is 0.0.
Cfg_PStd	REAL	Standard pressure in Inp_PAct units. Valid = any float. Default is 0.0.
Cfg_TOffset	REAL	Zero input-units temperature in absolute units. Typically 273.15 Kelvins or 459.67 Rankine. Valid = 0.0 to maximum positive float. Default is 273.15.
Cfg_POffset	REAL	Zero input-units pressure in absolute units. Typically 14.696 PSIA. Valid = 0.0 to maximum positive float. Default is 14.696.
Cfg_DPRef	REAL	Reference (full-scale) differential pressure. Common value 100.0 inches WC. Valid = 0.0 to maximum positive float. Default is 100.0.
Cfg_FRef	REAL	Reference flow in volumetric units at reference dp. Valid = 0.0 to maximum positive float. Default is 1.0.
Cfg_UseDP	BOOL	1 = Use Inp_DPAct (square root curve) to calculate flow. 0 = use Inp_FAct (linear). Default is false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output. This output state always reflects EnableIn input state.
Out_Flow	REAL	Compensated flow (at standard temperature and pressure: mass flow).
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Err	BOOL	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrTStd	BOOL	1 = Invalid standard temperature (Cfg_TStd + Cfg_TOffset must be > 0.0).
Sts_ErrPStd	BOOL	1 = Invalid standard pressure (Cfg_PStd + Cfg_PStd must be > 0.0).
Sts_ErrDPRef	BOOL	1 = Invalid reference differential pressure (must be > 0.0 if DP used).
Sts_ErrFRef	BOOL	1 = Invalid reference flow (at reference DP) (must be > 0.0).

Operation

The PPTC instruction is intended as a calculation function only, between other blocks. If a faceplate or alarms are needed, the calculated output from the instruction can be sent to a PAI (analog input) instruction for alarming and display.

The PPTC instruction:

- Takes as its primary input either a volumetric flow rate or a differential pressure across a flow element, such as an orifice plate or pitot tube. When a differential pressure is used, the PPTC instruction allows

configuration of the volumetric flow rate for a given differential pressure.
- Accepts a temperature in common units (Fahrenheit or Celsius degrees) or in absolute units (Rankine degrees or Kelvins).
- Accepts a pressure in common units (PSIG, kPa Gauge, or MPa Gauge) or in absolute units (PSIA, kPa Absolute, MPa Absolute).
- Has user-configurable standard conditions, such as 14.696 PSIA and 60 °F, or 101.325 kPa and 0 °C.
- Determines flow at the specified standard conditions by using the Ideal Gas Law (PV = nRT) to adjust from the given temperature and pressure to the standard temperature and pressure.

Virtualization

Virtualization is not applicable to the PPTC instruction.

Initialization

The instruction is normally initialized in the instruction first run. Re-initialization can be requested any time by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box.

- Description – Description of PPTC tag
- Label for graphic symbol – Label metadata of PPTC tag
- Display Library for HMI Faceplate call-up – Library metadata of PPTC tag
- Instruction name – Instruction metadata of PPTC tag
- Area name – Area metadata of PPTC tag
- URL link – URL metadata of PPTC tag
- Actual differential pressure units – Engineering Unit metadata of .Inp_DPAct
- Actual uncompensated flow in volumetric units – Engineering Unit metadata of .Inp_FAct
- Actual pressure, can be abs or common units – Engineering Unit metadata of .Inp_PAct
- Actual temperature, can be abs. or common units – Engineering Unit metadata of .Inp_TAct

- Compensated flow (at standard temperature and pressure: mass Flow) units – Engineering Unit metadata of .Out_Flow

Monitor the PPTC Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	The instruction executes normally.
Rung-condition-in is false	Set rung-condition-out to rung-condition-in.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	See Instruction first run in the Ladder Diagram table.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

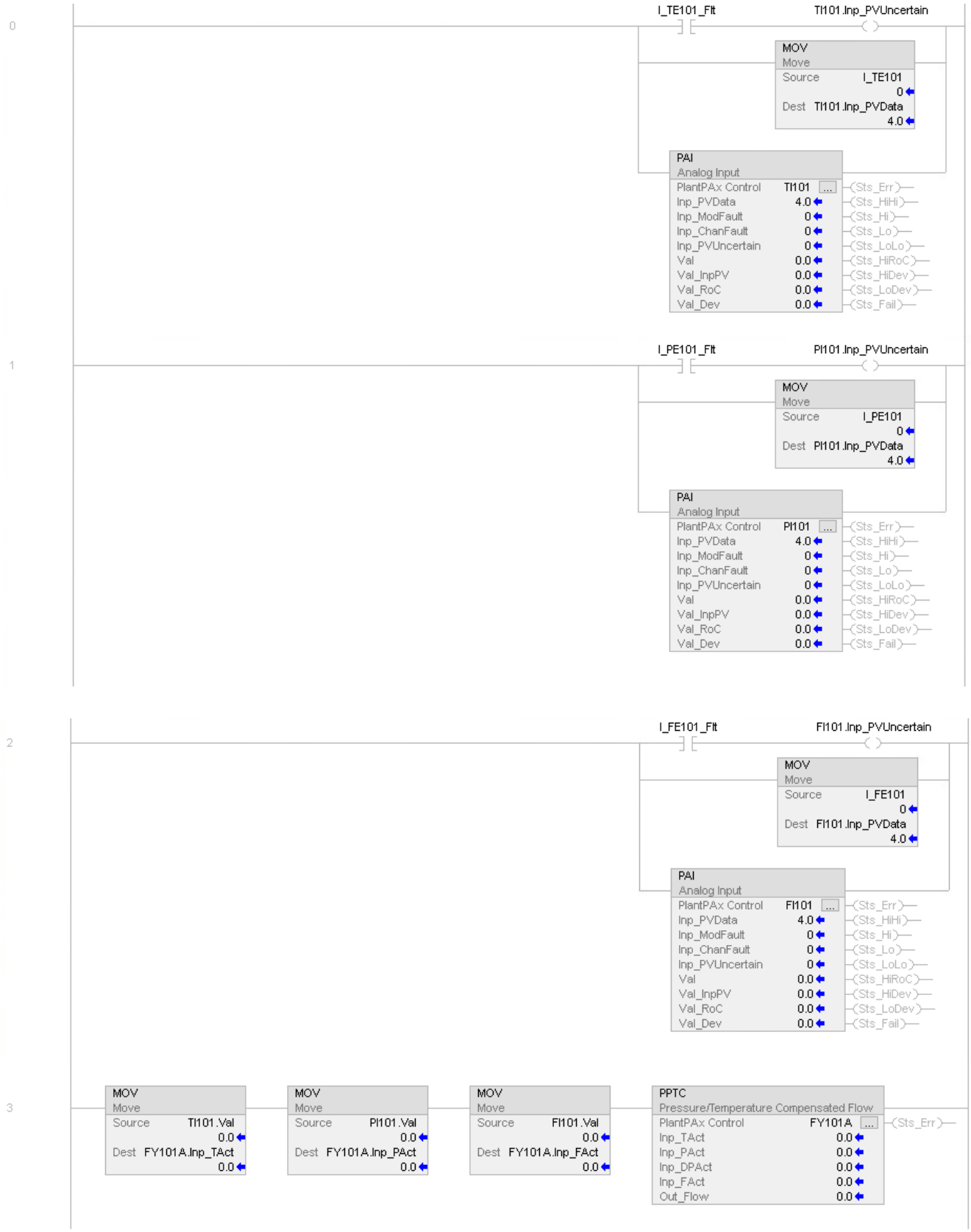
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

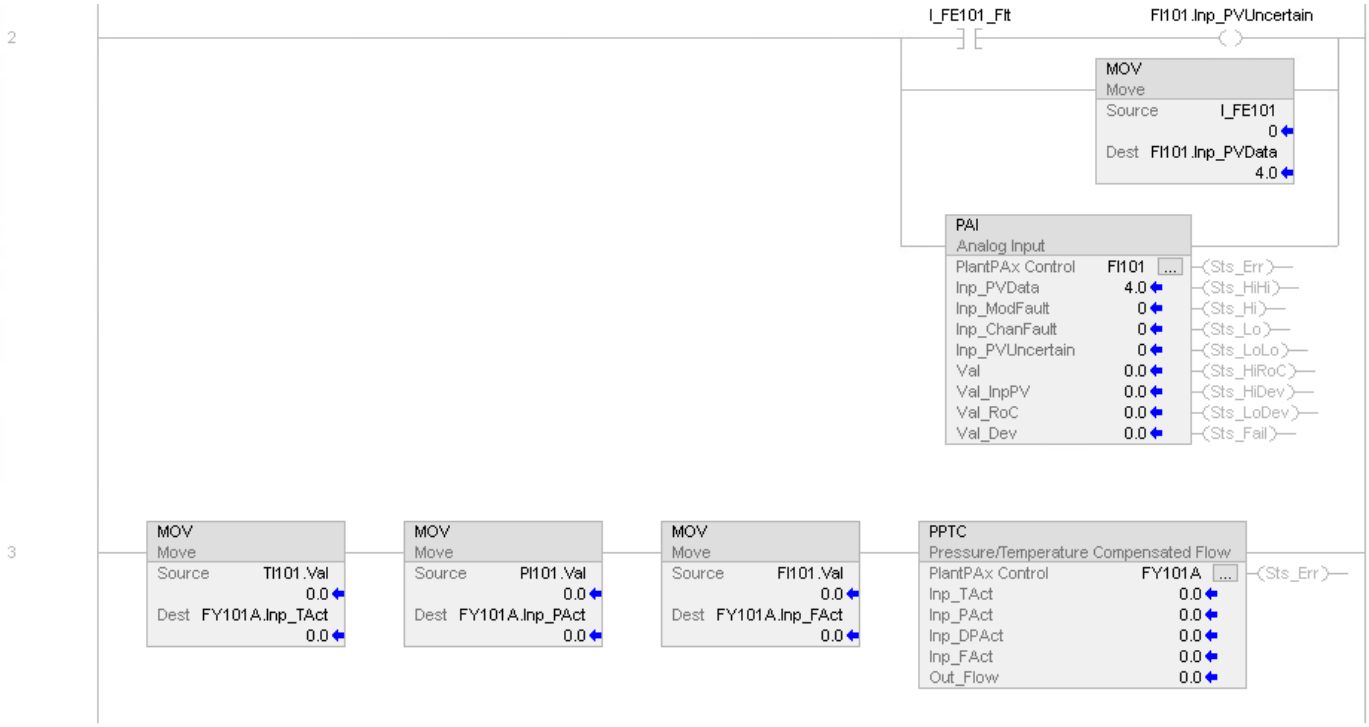
Example

In this example, the PPTC instruction to determine the flow rate of compressed nitrogen at a standard pressure and flow. This can provide a more accurate measurement for custody transfer or control calculations where there is variability in environmental conditions and the flow transmitter is not capable of performing the compensation.

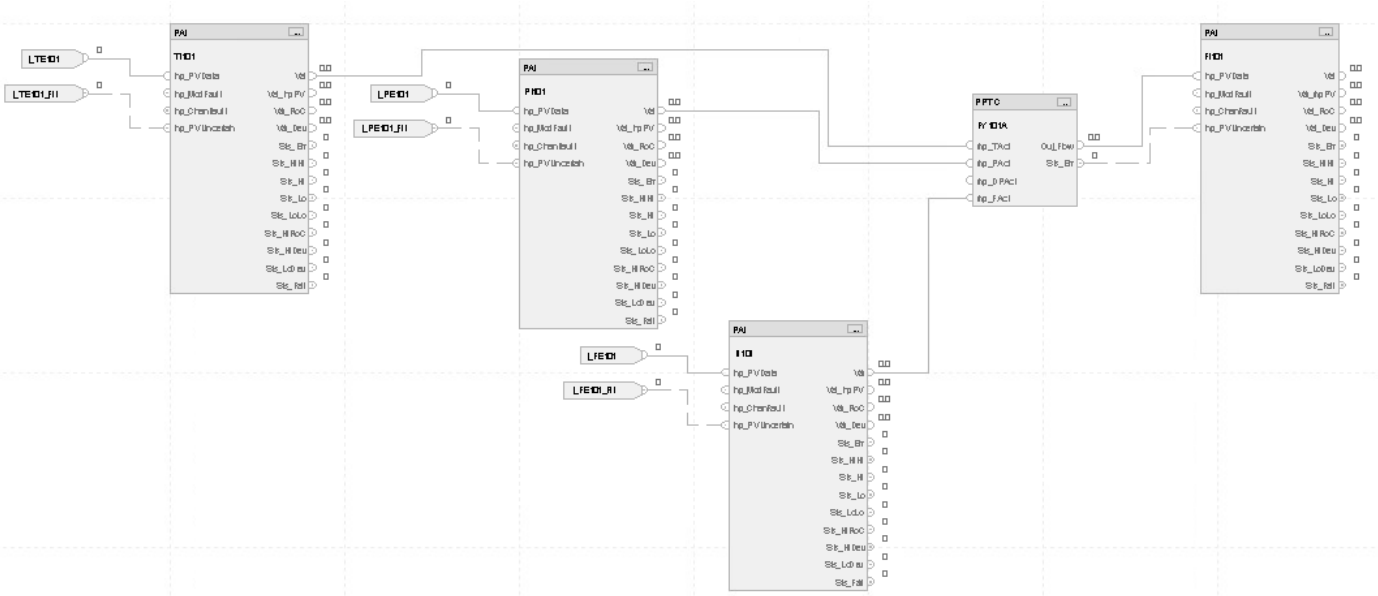
In this case, the PPTC instruction measures flow from a dp-transmitter. The transmitter provides the controller with a value that has been scaled to volumetric flow but not compensated for environmental temperature and pressure. We also have temperature and pressure measurements from where the flow is measured. In this example, the desired standard pressure and flow is 0 psig and 15 °C.

Ladder Diagram





Function Block Diagram



Structured Text

```
TI101.Inp_PVData:=I_TE101;
TI101.Inp_PVUncertain:=I_TE101_Flt;
PAI(TI101);
PI101.Inp_PVData:=I_PE101;
```

```
PI101.Inp_PVUncertain:=I_PE101_Flt;
PAI(PI101);
FI101.Inp_PVData:=I_FE101;
FI101.Inp_PVUncertain:=I_FE101_Flt;
PAI(FI101);
FY101A.Inp_Tact:=TI101.Val;
FY101A.Inp_Pact:=PI101.Val;
FY101A.Inp_Fact:=FI101.Val;
PPTC(FY101A);
FI101.Inp_PVData:=FY101A.Out_Flow;
FI101.Inp_PVUncertain:=FY101A.Sts_Err;
PAI(FI101);
```

Process Restart Inhibit (PRI)

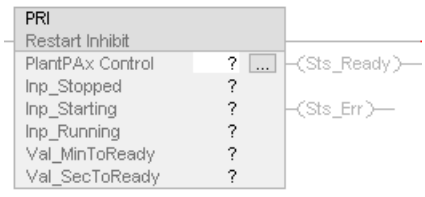
This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

Use the Process Restart Inhibit instruction for Large Motor (PRI) instruction to prevent large motors from starting repeatedly. The high starting current for a large motor causes heating. Continual starts or start attempts in a short period overheat the motor windings and damage the motor.

The PRI instruction provides a rule-based state model for restarts. Do not use the instruction to model or monitor heating and replace sensor-based motor monitoring devices. Use the instruction to avoid overstressing a motor.

Available Languages

Ladder Diagram



Function Block Diagram

Structured Text

PRI (PRI tag);

Operands

IMPORTANT Unexpected operation may occur if one of the Cold or Hot timers are set to 0.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_RESTART_INHIBIT	tag	PRI structure

P_RESTART_INHIBIT_INPUT Structure

Public members are standard (visible) Tag members that are programmatically accessible. Private (hidden) members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable Input - System Defined Parameter Default is true.
Inp_Stopped	BOOL	1 = Equipment is confirmed stopped. Default is false.
Inp_Starting	BOOL	1 = Equipment is confirmed starting, indicating a start attempt. Default is false.
Inp_Running	BOOL	1 = Equipment is confirmed running. Default is true.
Cfg_ThreeColdStarts	REAL	Time within which three starts are allowed if cold (hr) Default is 0.5.
Cfg_FirstFailCold	REAL	Time for cold motor to wait after 1st start failure before ready to start (hr) Default is 0.5.
Cfg_SubseqFailCold	REAL	Time for cold motor to wait after 2nd and subsequent start failure before ready (hr) Default is 4.0.

Public Input Members	Data Type	Description
Cfg_FirstFailHot	REAL	Time for hot motor to wait after 1st start failure before ready to start (hr) Default is 0.5.
Cfg_SubseqFailHot	REAL	Time for hot motor to wait after 2nd and subsequent start failure before ready (hr) Default is 4.0.
Cfg_HotRestartOK	REAL	Time for hot motor to run so it can immediately restart after stop (hr) Default is 1.0.
Cfg_RestartHot	REAL	Time for hot motor to wait after stop if stopped before Hot Restart OK time (hr) Default is 1.0.
Cfg_HotToCold	REAL	Time for a stopped hot motor to become cold (hr) Default is 16.0.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.

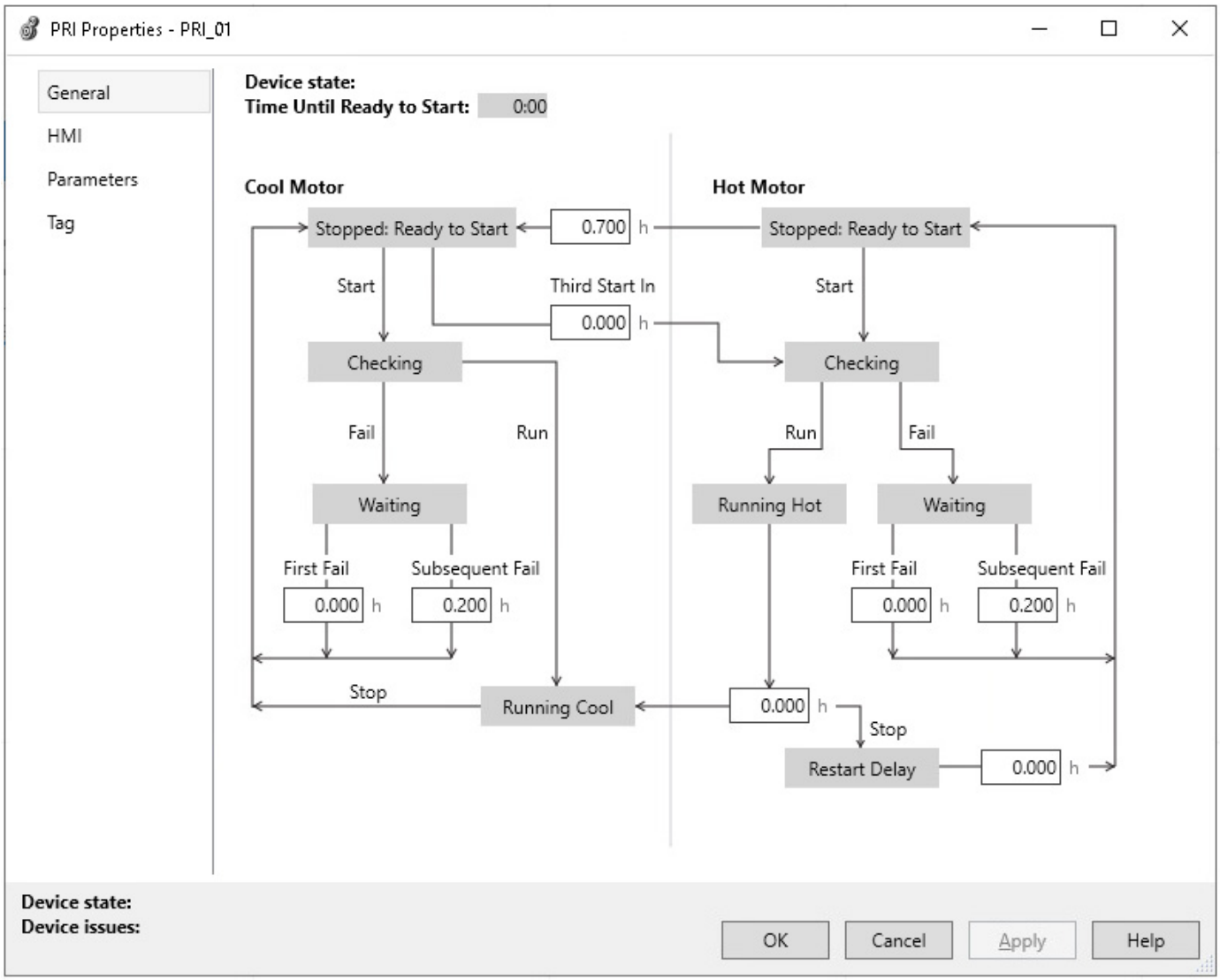
Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output - System Defined Parameter
Val_MinToReady	DINT	Minutes yet inhibited before ready to start (for display as countdown mmm:ss).
Val_SecToReady	DINT	Seconds yet inhibited before ready to start (for display as countdown mmm:ss).
Sts_bFdbk	SINT	Device feedback: 0 = None/Multiple/Unknown, 1 = Stopped, 2 = Starting, 3 = Running.
Sts_State	SINT	State number for highlighting state diagram on HMI. See Instruction Help or state diagram in reference manual.
Sts_Ready	BOOL	Permissive for equipment to start: 1 = ready to start, 0 = not ready, inhibit starting.
Sts_Err	BOOL	1 = Error in configuration: invalid time. Valid = 0.0 to 596.52 hours.
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.

Operation

The PRI instruction provides these capabilities:

- Provides a rule-based state model for restarts and is not intended to model or monitor the motor heating.
- Display of the time before ready state; the time is displayed in minutes and seconds and is configurable. The ready state is also displayed independently of the time.
- Ready status is determent by the cold ready to start time (First start) and the hot ready to start time.
- The cold ready to start time will be determent by the cold first fail time and the cold subsequent fail time.

- The hot ready to start time will be determent by the hot first fail time, the cold subsequent fail time and the hot restart delay time.



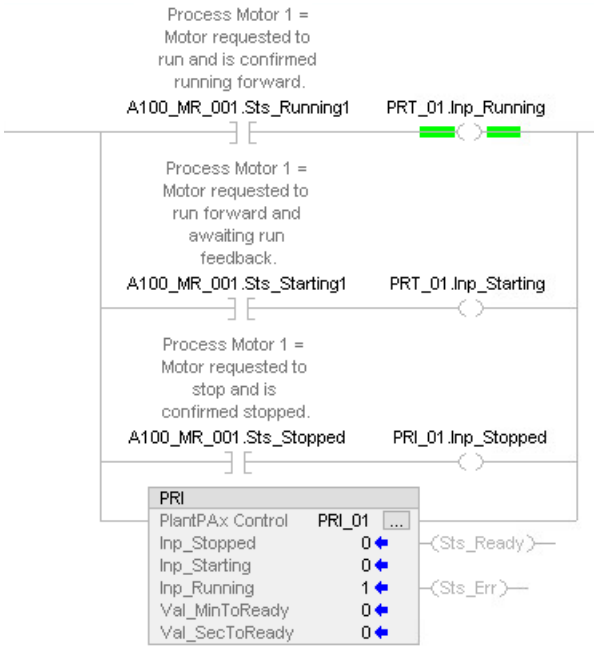
Configuration of Strings for HMI

Configure strings for HMI faceplates and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in the Logix Designer application only.

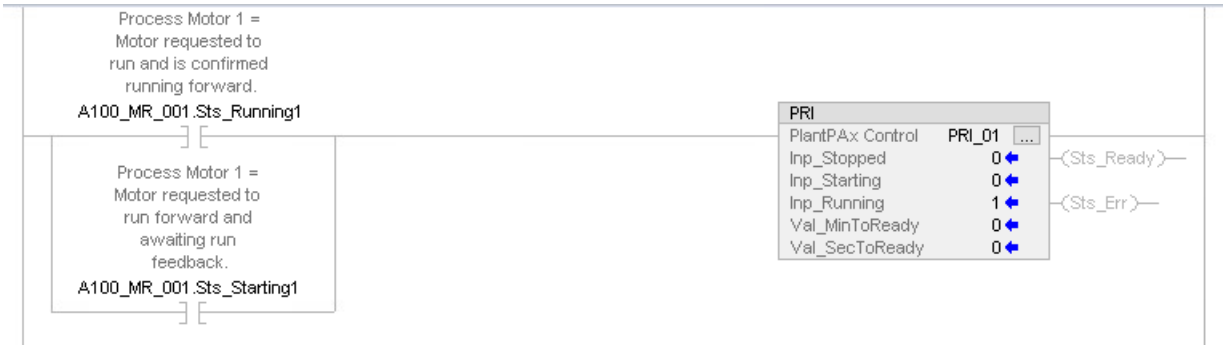
- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link

Implementation

This illustration shows normal implementation with the input condition mapped to Inp_Running, Inp_Starting, and Inp_Stopped on a separate branch.



This illustration shows the implementation with the input condition mapped to the PRI instruction using the rung-condition-in. When the rung-condition-in is false (EnableIn is false) the instruction executes normally. To use the rung-condition-in mapping method, set Inp_Running to 1, its default value.



Monitor the PRI Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	The instruction executes normally.
Rung-condition-in is false	Set rung-condition-out to rung-condition-in.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	See Instruction first run in the Ladder Diagram table.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

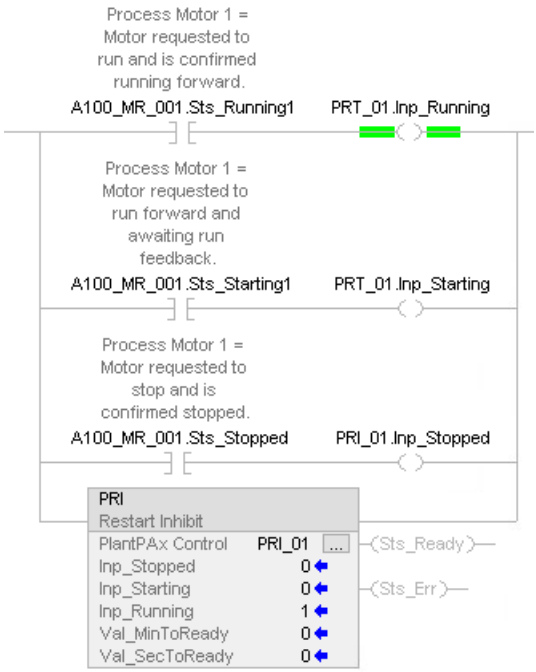
Example

In this example, tag A100_MR_001 is the motor value monitored by the PRI instruction.

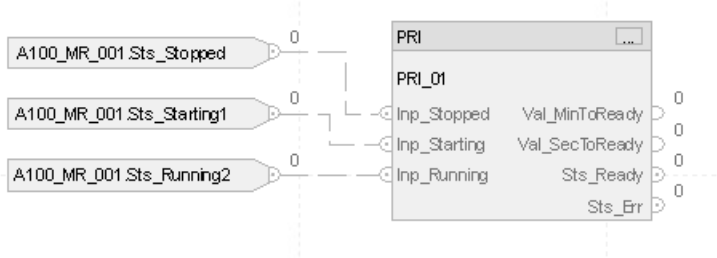
Inp_Running is connected to the Motor Running status tag (A100_MR_001.Sts_Running) that comes from the Sts_Running output of the P_Motor instruction instance for this motor (A100_MR_001). Inp_Starting is connected to the Motor Starting status tag (A100_MR_001.Sts_Starting) that comes from the Sts_Starting output of the P_Motor instruction instance for this motor (A100_MR_001). Inp_Stopped is connected to the Motor Stopped status tag (A100_MR_001.Sts_Stopped) that comes from the Sts_Stopped output of the P_Motor instruction instance for this motor (A100_MR_001).

Finally, PRI_01 is the output tag that will indicate the status of A100_MR_001 with appropriate delays and number of running and starts/attempts based on whether the motor is allowed to start again.

Ladder Diagram



Function Block Diagram



Structured Text

```
PRI_01.Inp_Stopped := A100_MR_001.Sts_Stopped;
PRI_01.Inp_Starting := A100_MR_001.Sts_Stopped;
PRI_01.Inp_Running := A100_MR_001.Sts_Running;
PRI(PRI_01);
```

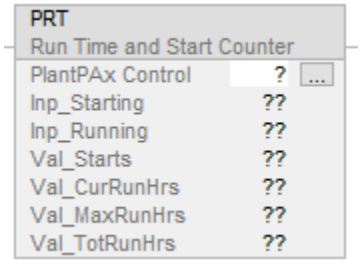
Process Run Time and Start Counter (PRT)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

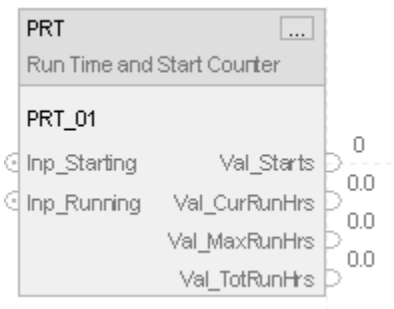
The Process Run Time and Start Counter (PRT) instruction records the total run time and number of instances the motor or other equipment starts. The PRT is a software implementation of the mechanical hour meter that displays the total motor runtime. Maintenance personnel use the run time and equipment start variables to create a maintenance schedule for the applicable equipment.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PRT(PRT_01);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PRT	P_RUN_TIME	tag	PRT structure

P_RUN_TIME Structure

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable Input – System Defined Parameter.
Inp_Starting	BOOL	1 = Equipment is starting. Default = false.
Inp_Running	BOOL	1 = Equipment is confirmed running. Default = true.
PCmd_ClearStarts	BOOL	Program Command to clear count of starts. The instruction clears this operand automatically. Default = false.
PCmd_ClearMaxHrs	BOOL	Program Command to clear the maximum, continuous runtime for any start. The instruction clears this operand automatically. Default = false.
PCmd_ClearTotHrs	BOOL	Program Command to clear the total run time. The instruction clears this operand automatically. Default = false.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output – System Defined Parameter.
Val_Starts	DINT	Total number of equipment starts or attempts.
Val_CurRunHrs	REAL	Current running time this start (hours).
Val_MaxRunHrs	REAL	Maximum continuous running time for a given start (hours).
Val_TotRunHrs	REAL	Total accumulated running time (hours).

Private Input Members	Data Type	Description
MCmd_ClearStarts	BOOL	Maintenance Command to clear count of starts. The instruction clears this operand automatically. Default = false.
MCmd_ClearMaxHrs	BOOL	Maintenance Command to clear the maximum, continuous runtime for any start. The instruction clears this operand automatically. Default = false.

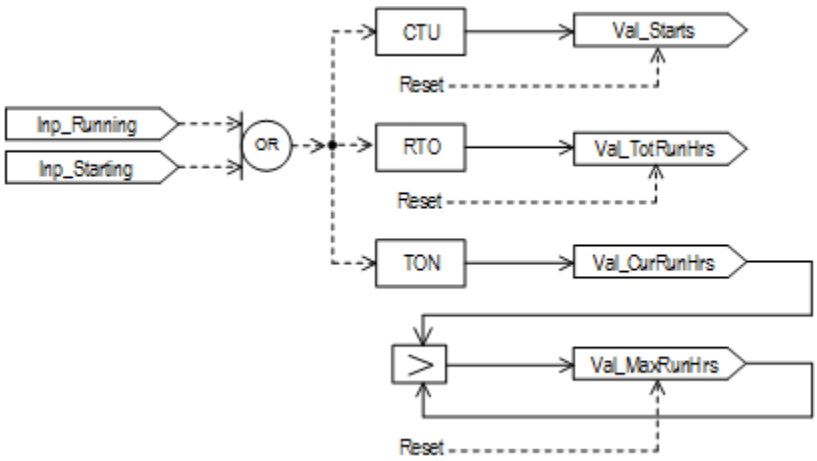
Private Input Members	Data Type	Description
MCmd_ClearTotHrs	BOOL	Maintenance Command to clear the total run time. The instruction clears this operand automatically. Default = false.

Operation

The PRT instruction:

- Accumulates and displays the total running time for the associated equipment.
- Accumulates and displays the count of starts or start attempts for the associated equipment.
- Shows the amount of run time since the last start, or the length of the current run. This total is held after the equipment is stopped, until the next start, when it is reset to zero.
- Shows the maximum amount of time for any single run; this is the highest value achieved by the previous total.
- Allows maintenance personnel, but not operators, to clear individually the total run time, starts count, or maximum single run time. This lets the times be reset when the motor or other equipment is serviced, rebuilt or replaced.

This diagram illustrates the functionality of the PRT instruction:



Configuration of Strings for HMI

Configure strings for HMI faceplates (FactoryTalk View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in the Logix Designer application only.

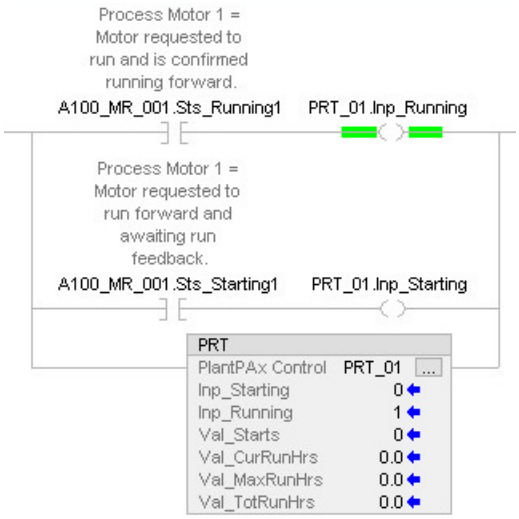
- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up

- Instruction name
- Area name
- URL link

Implementation

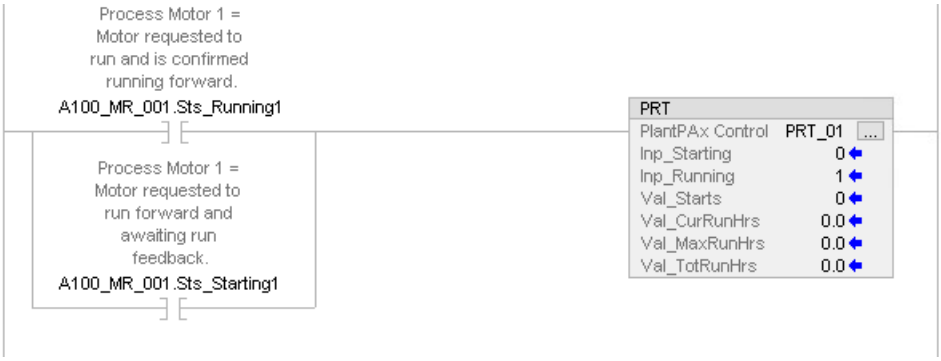
Normal Ladder implementation

This illustration shows normal implementation with the input condition mapped to Inp_Running and Inp_Starting on a separate branch.



Rung-in-condition Ladder Implementation

The PRT instruction is designed so it can be used on a Ladder Diagram rung, using the rung-in condition to provide the state of the motor, running (rung-in condition TRUE) or stopped (rung-in condition FALSE):



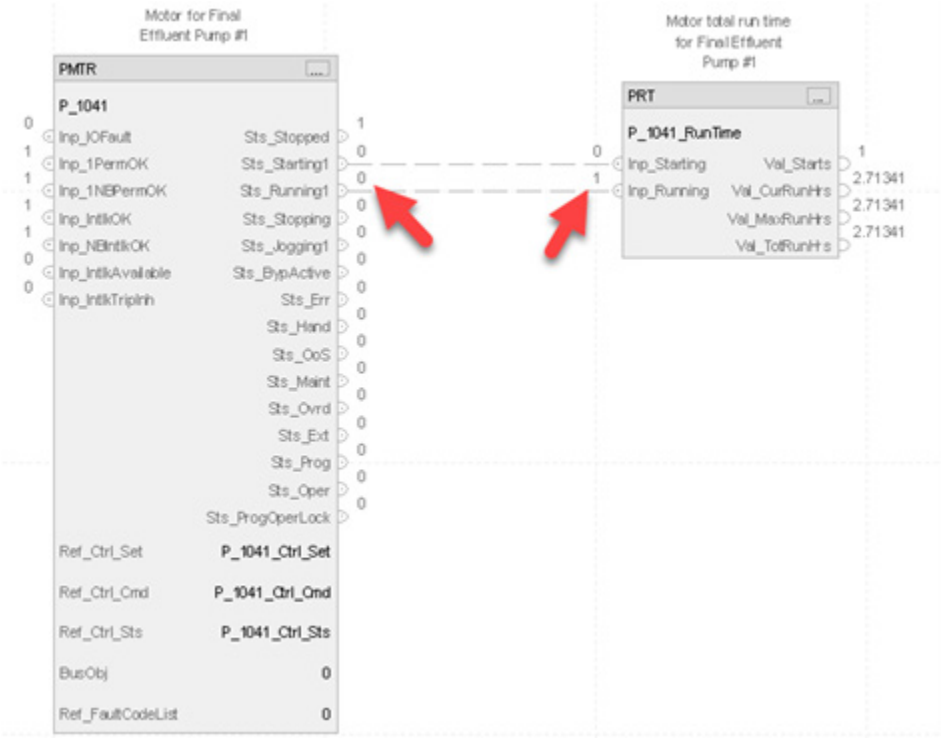
When the motor is starting or running, the main logic of the PRT instruction is executed. For this to accumulate run time, the parameter Inp_Running must be set to 1. When the motor is stopped, the rung is false and the

EnableInFalse logic of the PRT instruction is executed, and the motor is treated as stopped.

Function Block Implementation (Inp_Running pin always indicates 1)

To ensure that a Ladder Diagram implementation of this application works correctly and that starts and run time are accumulated, the PRT instruction writes a 1 into Inp_Running each scan after executing its logic. This helps avoid having the input inadvertently cleared to 0, which results in the PRT instruction treating the motor as always stopped.

A side effect of this is that when monitoring a Function Block Diagram implementation of this strategy with input pin values displayed, the Inp_Running pin will always show a value of 1, even though the logic on the wire is correctly sending a 0 to the instruction:



This is normal, and the PRT instruction correctly accumulates starts and run time.

Tip: This discrepancy is only apparent if the Function Block Diagram editor is configured to display the value of connected (wired) input pins.

To show the value of these pins in the editor:

1. In the Logix Designer application, select **Tools > Options** to open the Workstation Options dialog.
2. In the **Categories** list, select **FBD Editor**.
3. Select **Show values of Input Pins**. Make sure the **Unwired Pins Only** check box is not selected.

Monitor the PRT instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Total run time, Maximum run time and starts count are retained through a power cycle. Current run time is reset (internally only, Val_CurHours is maintained for display). All Prog, Maint, commands that are automatically cleared each execution are cleared.
Instruction first run	Total run time, Maximum run time and starts count are retained through a power cycle. Current run time is reset (internally only, Val_CurHours is maintained for display). All Prog, Maint, commands that are automatically cleared each execution are cleared.

Condition/State	Action Taken
Rung-condition-in is false	EnableIn False is treated the same as Motor Stopped: Commands are still processed, total run time is held (RTO), the Starts counter is prepared for the next start (.CU clears on CTU with AFI), and the Current Run Time is cleared (TON false). Command Processing: • This object has no Command Source and • Commands are accepted regardless of Source. Commands should be restricted to authorized personnel (typically at a maintenance level). • PCmd_ClearTotHrs: Program Command to Clear Total Runtime Hours • MCmd_ClearTotHrs: Maintenance Command to Clear Total Runtime Hours • PCmd_ClearStarts: Program Command to Clear Count of Starts • MCmd_ClearStarts: Maintenance Command to Clear Count of Starts • PCmd_ClearMaxHrs: Program Command to Clear Maximum Single Run Hours • MCmd_ClearMaxHrs: Maintenance Command to Clear Maximum Single Run Hours • The number of starts is directly reported as an integer Value. • The current hours working register is cleared, but the Value is left in place for display until the next run begins. • The Total Running Time is reported as a REAL number of Hours. (This will always be in completed tenths of an hour, like a mechanical hours counter.)
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.

Function Block Diagram

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
Instruction first scan	See Instruction first run in the Ladder Diagram table.
EnableIn is false	See Rung-condition-in is false in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.

Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic, it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

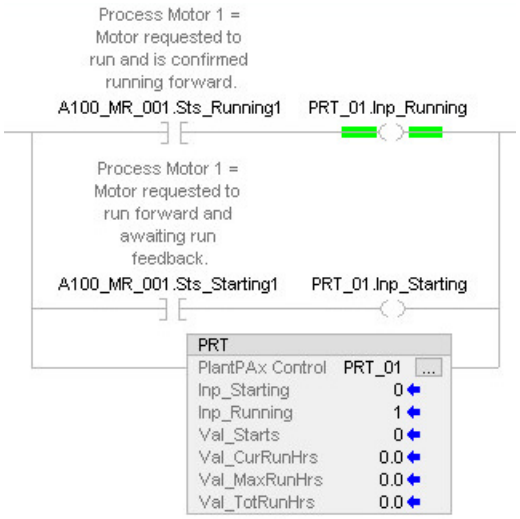
Example

In the following example, tag A100_MR_001 is the motor value monitored by the PRT instruction. This tag provides a Boolean indication of motor run time value.

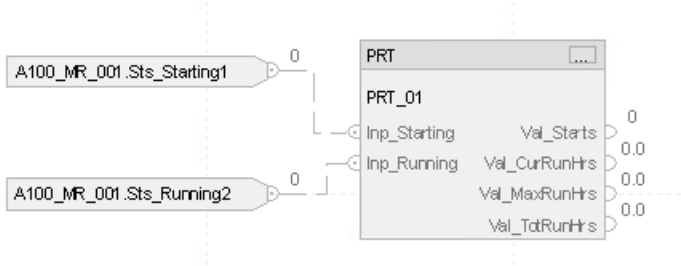
Inp_Runnung is connected to the Motor Running status tag (A100_MR_001.Sts_Running) that comes from the Sts_Running output of the P_Motor instruction instance for this motor (A100_MR_001). Inp_Starting is connected to the Motor Starting status tag (A100_MR_001.Sts_Starting) that comes from the Sts_Starting output of the P_Motor instruction instance for this motor (A100_MR_001).

Finally, A100_MR_001_RT.Val_TotRunHrs is the output tag that will indicate the total running hours of A100_MR_001. There is also current running hours (A100_MR_001_RT.Val_CurRunHrs) of the motor and maximum running hours (A100_MR_001_RT.Val_MaxRunHrs) of the motor available.

Ladder Diagram



Function Block Diagram



Structured Text

```
PRT_01.Inp_Starting:=A100_MR_001.Sts_Starting;

PRT_01.Inp_Running:=A100_MR_001.Sts_Running;

PRT(PRT_01);
```

Process Tank Strapping Table (PTST)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

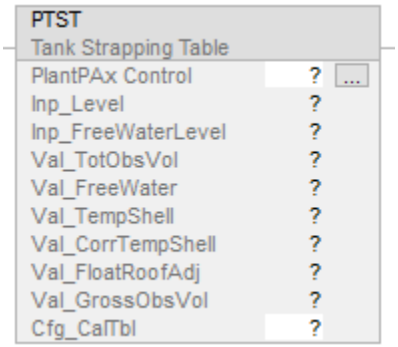
The Process Tank Strapping Table (PTST) instruction calculates the volume of product in an upright cylindrical tank, given the level of the product and the tank calibration table. The instruction can compensate for:

- Free water at the bottom of the tank, given a product/water interface level.
- Thermal expansion of the tank shell, given the coefficient of linear expansion of the shell material and product and ambient temperatures.
- A floating tank roof, given the product density is provided.

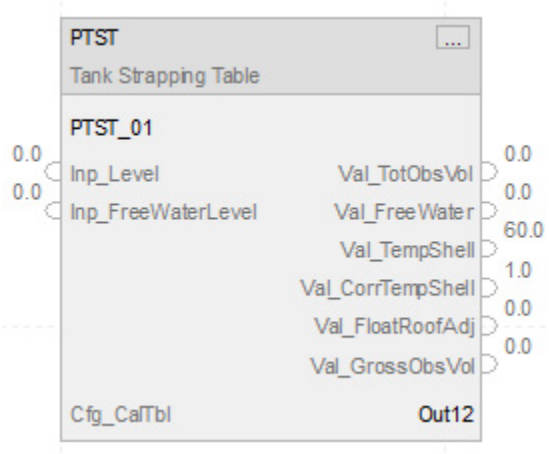
The Process Tank Strapping Table (PTST) instruction is a calculation function, between blocks.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PTST(PTST_tag, Cfg_CalTbl);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_TANK_STRAPPING_TABLE	tag	Data structure required for proper operation of instruction.
Cfg_CalTbl	P_STRAPPING_TABLE_ROW	tag	Tank calibration table, level to volume.

P_TANK_STRAPPING_TABLE Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable input. Ladder Diagram: Corresponds to the rung-condition-in. Default is true.

Public Input Members	Data Type	Description
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_Level	REAL	Tank innage level, in feet or meters. Valid = any float. Default is 0.0.
Inp_FreeWaterLevel	REAL	Tank innage free water interface level, in major level units (feet or meters). Valid = any float. Default is 0.0.
Inp_ObsAPI	REAL	Observed density, or degrees API, at product temperature. This is used for floating roof compensation to calculate displacement based on weight of roof. Valid = any float. Default is 30.5.
Inp_AvgProdTemp	REAL	Average product temperature input in degrees Fahrenheit or Celsius. Valid = any float. Default is 60.0.
Inp_AmbTemp	REAL	Ambient temperature input in degrees Fahrenheit or Celsius. Valid = any float. Default is 60.0.
Cfg_MinorPerMajor	REAL	Table minor units, in inches, centimeters, millimeters, per major unit, in feet or meters. Type 0.0 if minor units not used. Valid = any float. Default is 12.0.
Cfg_HasCorrTempShell	BOOL	0 = No correction for temperature of tank shell. 1 = Include correction for temperature of tank shell. Default is false.
Cfg_HasFloatRoofAdj	BOOL	0 = Do not use floating roof adjustment. 1 = Include floating roof adjustment to account for displacement of fluid level. Default is false.
Cfg_HasMoreObj	BOOL	1 = Tells HMI an object with more info is available. Default is false.
Cfg_CalTemp	REAL	Temperature of tank calibration (typically 60 °F or 15 °C). Valid = any float. Default is 60.0.
Cfg_ShellCoefOfExp	REAL	Tank shell linear coefficient of thermal expansion (1 per degree Fahrenheit or 1 per Celsius). Valid = any float. Default is 0.0000062.
Cfg_K	REAL	Temperature weighting (type 0.0 for insulated tank). See API MPMS 2.2A Appendix D. Valid = any float. Default is 7.0.
Cfg_FloatRoofLevel	REAL	Lowest level at which to add or subtract floating roof compensation (feet). Valid = any float. Default is 0.0.
Cfg_FloatRoofCalAPI	REAL	Degrees API for which table includes floating roof data. Valid = any float. Default is 30.5.
Cfg_FloatRoofVolPerAPI	REAL	Adjustment to table values for API <> CalAPI (volume/degrees API, typically a negative number). Valid = any float. Default is -2.5.

Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output. This output state always reflects EnableIn input state.
Val_TotObsVol	REAL	Raw total observed volume from Calibration Table (barrels, gallons, liters).
Val_FreeWater	REAL	Free water volume (barrels, gallons, liters).
Val_TempShell	REAL	Calculated tank shell temperature in degrees Fahrenheit or Celsius.
Val_CorrTempShell	REAL	Correction for temperature of tank shell (multiplier).

Public Output Members	Data Type	Description
Val_FloatRoofAdj	REAL	Floating roof adjustment volume (barrels, gallons, liters).
Val_GrossObsVol	REAL	Primary value: Gross observed volume (see API MPMS 12.1.1).
Sts_Initialized	BOOL	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_UnderMin	BOOL	Inp_Level is below lowest level in strapping table.
Sts_OverMax	BOOL	Inp_Level is above highest level in strapping table.

Public InOut Members	Data Type	Description
Cfg_CalTbl	P_STRAPPING_TABLE_ROW[2]	Tank calibration table (level to volume).

P_STRAPPING_TABLE_ROW Structure

Members	Data Type	Description
Major	REAL	Number of major units (feet, meters). Valid = 0.0 to maximum positive float.
Minor	REAL	Number of minor units (inches, centimeters, or millimeters). Valid = 0.0 to maximum positive float.
Volume	REAL	Tank volume (oil barrels, gallons, liters) at given level (feet, inches). Valid = 0.0 to maximum positive float.

Operation

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- More Information
- Gross volume units
- Free water volume units
- Raw volume units
- Calculated tank temperature units
- Correction for tank temperature units
- Floating roof adjustments volume units
- Temperature for tank calibration units
- Temperature for API units
- Level units
- Volume units

- Temperature for tank shell linear coefficient units

Monitor the PTST Instruction

Monitor from within Logix Designer. The PTST does not have an associated operator faceplate.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false.
Instruction first run	All internal statuses and calculations are reset. The instruction executes normally.
Rung-condition-in is false	Rung-condition-out is cleared to false. Calculation values is not updated (holds last value).
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	EnableOut is cleared to false.
Instruction first run	All internal statuses and calculations are reset. The instruction executes normally.
Instruction first scan	See Instruction first run in the Function Block Diagram table.
EnableIn is false	EnableOut is cleared to false. Calculation values is not updated (holds last value).
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

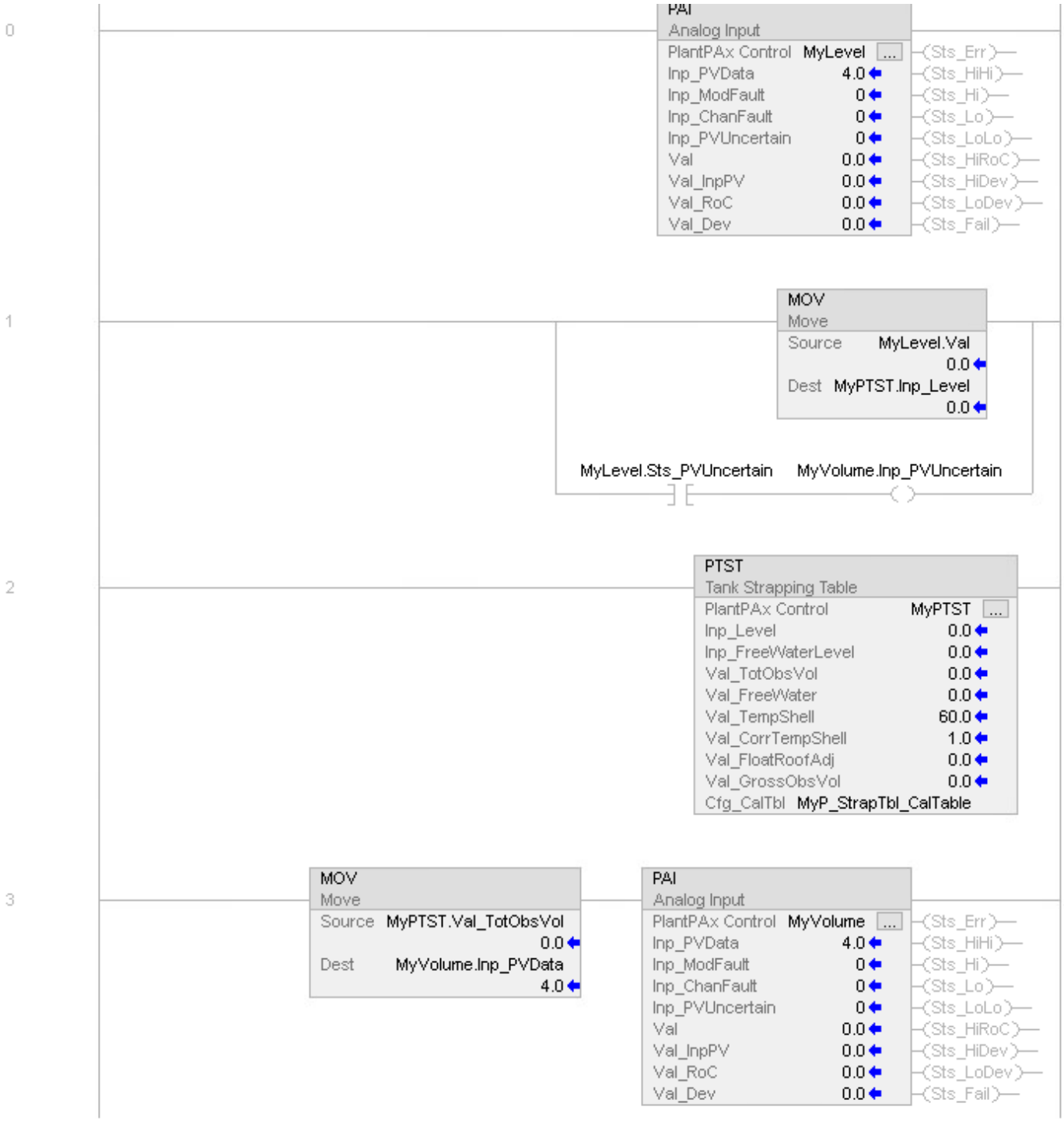
In Structured Text, EnableIn is always true during normal scan. The instruction executes when it is in the control path activated by the logic.

Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

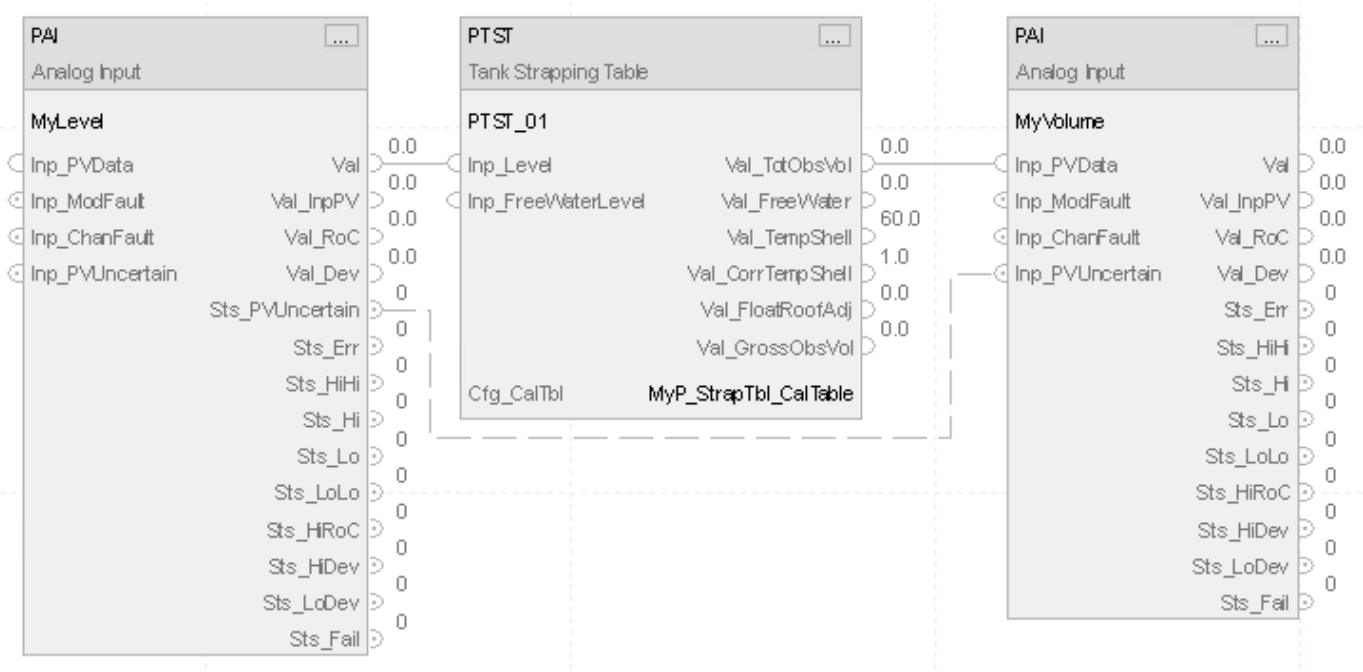
Example

In this example, the PTST instruction calculates the volume of product in a storage tank based on the measured storage tank level and storage tank strapping table information. There is no floating roof and no compensation for displacement. There are no adjustments based on temperature to account for thermal expansion of the tank.

Ladder Diagram



Function Block Diagram



The measured storage tank level connects to the PTST instruction by using the input Inp_Level. The level is in units of feet. The storage tank is four feet tall. In this example, data is in six-inch increments. The strapping table has nine rows:

Level (ft-in.)	Volume (barrels)
0-00	3.1
0-06	136.6
1-00	264.2
1-06	402.7
2-00	541.4
2-06	692.7
3-00	844.1
3-06	990.8
4-00	1137.5

To store the strapping table information in the controller, the tag MyP_StrapTbl_CalTable is created as type P_STRAPPING_TABLE_ROW [9], a nine-element array.

	.Major	.Minor	.Volume
MyP_StrapTbl_CalTable[0]	0	0	3.1
MyP_StrapTbl_CalTable[1]	0	6	136.6
MyP_StrapTbl_CalTable[2]	1	0	264.2
MyP_StrapTbl_CalTable[3]	1	6	402.7
MyP_StrapTbl_CalTable[4]	2	0	541.4
MyP_StrapTbl_CalTable[5]	2	6	692.7
MyP_StrapTbl_CalTable[6]	3	0	844.1
MyP_StrapTbl_CalTable[7]	3	6	990.8
MyP_StrapTbl_CalTable[8]	4	0	1137.5

The InOut tag Cfg_CalTbl of the PTST instruction is modified to point to the new array MyP_StrapTbl_CalTable to provide the instruction with the strapping table information. The output of PTST is then connected to another PAI instruction. The output is the calculated volume of the storage tank.

Structured Text

```
MyPTST.Inp_Level := MyLevel.Val;

MyVolume.Inp_PVUncertain := MyLevel.Sts_PVUncertain;

MyVolume.Inp_PVData := MyPTST.Val_TotObsVol;

PAI(MyLevel);

PTST(MyPTST,MyP_StrapTbl_CalTable);

PAI(MyVolume);
```

Process Valve (PVLV)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Valve (PVLV) instruction operates a two-position, single-solenoid operated valve, a dual-solenoid operated valve, or a motor-operated valve in various modes, monitoring for fault conditions. It also monitors hand-operated two-position valves. It is a built-in analogy of the existing PlantPAx P_ValveSO, P_ValveMO, and P_ValveHO add-on instructions in the Rockwell Automation Library of Process Objects.

The PVLV instruction:

- Allows ownership of the valve through the PCMDSRC instruction.
- Provides for configuration of the de-energized state of the valve: Fail Position 2 (energize to Position 1), Fail Position 1 (energize to Position 2) or Fail Last Position.
- Allows a valve to be set to Position 2 or Position 1. If the valve is so equipped, monitor Position 2/Position 1 limit switch feedback to verify that the valve is Position 2 or Position 1. Whether the valve has each of the feedback limit switches can be configured at the engineer level. Whether to use each of the feedback limit switches can be configured at the Maintenance level.
- Stops the motion of a Motor-operated Valve. Also provides a Stop Output, which is typically used to break the valve motor seal-in circuit and stop the actuating motor. If the option to allow stopping the valve is enabled, the instruction lets the operator reverse travel. For example, an operator can select Position 2 while closing, which stops the valve, then moves it in the opposite direction.

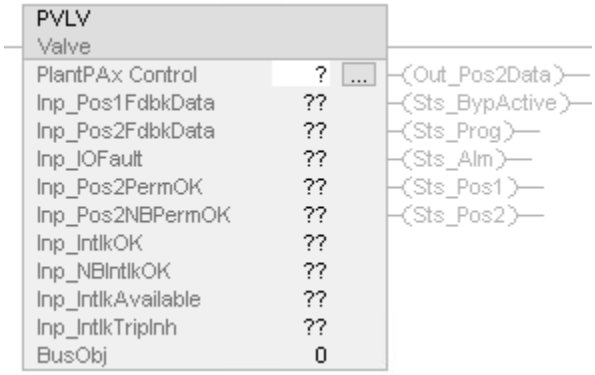
- Provides an alarm for Full Stall if the valve feedback indicates it did not move off the original position within a configured amount of time when commanded to the other position. Provides an alarm for Transit Stall if the valve feedback indicates the valve moved from the original position but did not reach the target position within a configured amount of time. The Transit Stall or Full Stall condition can optionally de-energize the output to the valve, requiring a reset.
- Provides a limit switch Failure indication if the limit switches indicate the valve is not Position 1, not Position 2, and not moving. Provides a configuration for the failure state: whether both switches are ON or both switches are OFF to indicate limit switch failure.
- Provide for Permissives (those that can be bypassed and those that cannot be bypassed) which are conditions that allow the valve to energize.
  - Permissive to energize (solenoid-operated valve)
  - Position 2 permissives (motor-operated valve)
  - Position 1 permissives (motor-operated valve)
- Provides for Interlocks (those that can be bypassed and those that cannot be bypassed) which are conditions that de-energize the valve and prevent energizing. Provides an alarm when an interlock de-energizes the valve. Allows maintenance personnel to bypass the Permissives and Interlocks.
- Allows maintenance personnel to disable, or force to remain de-energized, the solenoid valve.
- Monitors an I/O Fault input and alarm on an I/O Fault. The I/O Fault condition can de-energize the output to the valve, requiring a reset.
- In Override mode, provides an Override State input that determines whether the Override is to set the valve to Position 2 or Position 1 (default = Position 1).
- Provides a Simulation capability, where the output to the valve remains de-energized, but the instruction can be manipulated as if a working valve were present. The response delay is configurable between a command to Position 2 or Position 1 and the simulated Position 2 or Position 1 response. This same delay is used if the valve is configured with no Position 2/Position 1 feedback. This capability is often used for activities such as instruction testing and operator training.
- Provides an output for holding the valve coil energized (to Position 2 or Position 1, based on the configured fail state).
- Provides an actuator fault input for use by valves that generate a fault contact, such as actuator motor overload trip. The actuator fault condition can de-energize the outputs to the valve, requiring a reset.
- Provides the ability to trip the valve (de-energize it or drive it to a default trip position). The program (through program commands) or the operator (through the HMI faceplate) can trip the valve any time.

The trip function provides these capabilities:

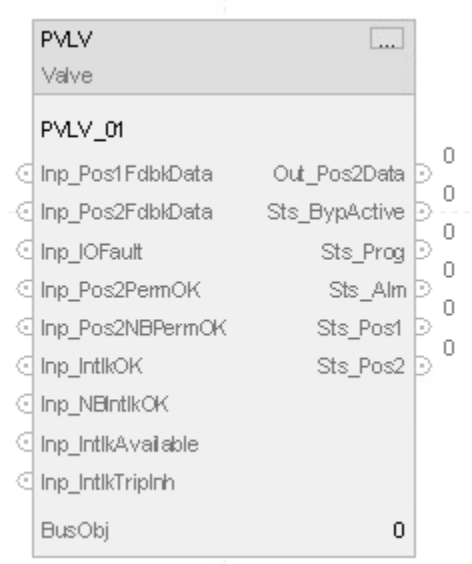
- Detect failure to reach the configured trip position when tripped and generate an appropriate alarm.
- Monitor interlock conditions to trip the valve and alarm when an interlock initiates moving the valve to its trip position.
- Provide for simulation of a working valve while disabling the trip output, for use in off-process training, testing, or simulation.
- Monitor I/O communication, and alarm and trip if the shed on I/O fault function is enabled on a communication fault.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PVLV(PVLVTag, BusObj);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx ControlPlantPAx Control	P_VALVE_DISCRETE	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component

P_VALVE_DISCRETE Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable input. Ladder Diagram: Corresponds to the rung-condition-in. Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OvrdCmd	SINT	Not Visible	Not Required	Input	Override valve command: 0 = None, 1 = Position 1, 2 = Position 2, 3 = Stop, 4 = Pulse Position 1, 5 = Pulse Position 2, 6 = Pulse continuously. Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_Pos1FdbkData	BOOL	Visible	Not Required	Input	Feedback from Position 1 limit switch of the device. 1 = Device confirmed Position 1. Default is false.
Inp_Pos2FdbkData	BOOL	Visible	Not Required	Input	Feedback from Position 2 limit switch of the device. 1 = Device confirmed Position 2. Default is false.
Inp_ActuatorFault	BOOL	Not Visible	Not Required	Input	Valve actuator fault (overload, etc.), 0 = Ok, 1 = Fault). Default is false.
Inp_IOFault	BOOL	Visible	Not Required	Input	Indicates the IO data are inaccurate. 0 = The IO data are good, 1 = The IO data are bad, causing fault. If the Valve is not virtual, this input sets Sts_IOFault, which raises IOFault Alarm. Default is false.
Inp_Pos1PermOK	BOOL	Not Visible	Not Required	Input	1 = Position 1 Permissives OK, valve can move to Position 1. Default is true.
Inp_Pos1NBPermOK	BOOL	Not Visible	Not Required	Input	1 = Non-bypassable Position 1 Permissives OK, valve can move to Position 1. Default is true.
Inp_Pos2PermOK	BOOL	Visible	Not Required	Input	1 = Position 2 Permissives OK, valve can move to Position 2. Default is true.
Inp_Pos2NBPermOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable Position 2 Permissives OK, valve can move to Position 2. Default is true.
Inp_IntlkOK	BOOL	Visible	Not Required	Input	1 = Interlocks ok, valve can energize outputs. Default is true.
Inp_NBIntlkOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable interlocks ok, valve can energize outputs. Default is true.
Inp_IntlkAvailable	BOOL	Visible	Not Required	Input	1 = Interlock availibility ok. Default is true.
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit Interlock Trip Status. Default is false.
Inp_RdyReset	BOOL	Not Visible	Not Required	Input	1 = Related object, reset by this valve, is ready to be reset. Default is false.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire hand (typically hardwired local), 0 = Release hand. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override (higher priority Program logic), 0 = Release Override. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .29 = Echo. Default is 0.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit audible alert, 0 = Alllow audible alert. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset Shed Latches and Cleared Alarms. Default is false.
Inp_VirtualPos1HO	BOOL	Not Visible	Not Required	Input	1 = Sets virtualized valve HO state to Position 1, 0 = No change. Default is false.
Inp_VirtualPos2HO	BOOL	Not Visible	Not Required	Input	1 = Sets virtualized valve HO state to Position 2, 0 = No change. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Operator alarm disable, 0 = Disallow Operator alarm disable. Default is false.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator alarm shelve, 0 = Disallow Operator alarm shelve. Default is false.
Cfg_eObjType	SINT	Not Visible	Not Required	Input	Valve object type 0 = Solenoid Operated 1 = Motor Operated 2 = Hand Operated. Default is 0.
Cfg_HasPos1Fdbk	BOOL	Not Visible	Not Required	Input	1 = Device provides Position 1 feedback signal. Default is false.
Cfg_HasPos2Fdbk	BOOL	Not Visible	Not Required	Input	1 = Device provides Position 2 feedback signal. Default is false.
Cfg_UsePos1Fdbk	BOOL	Not Visible	Not Required	Input	1 = Use device Position 1 feedback for failure checking. Default is false.
Cfg_UsePos2Fdbk	BOOL	Not Visible	Not Required	Input	1 = Use device Position 2 feedback for failure checking. Default is false.
Cfg_HasPos1PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a valve is connected to Inp_Pos1Perm inputs. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasPos2PermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a valve is connected to Inp_Pos2Perm inputs. Default is false.
Cfg_HasIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a valve is connected to Inp_Intlk inputs. Default is false.
Cfg_FailPos2	BOOL	Not Visible	Not Required	Input	1 = Fail Position 2 (energize to Position 1), 0 = Fail Position 1 (energize to Position 2). Default is false.
Cfg_FdbkFail	BOOL	Not Visible	Not Required	Input	1 = Both feedbacks Position 1/2 are ON is invalid, 0 = Both feedbacks Position 1/2 are OFF is invalid. Default is true.
Cfg_HasStop	BOOL	Not Visible	Not Required	Input	1 = Stop output can be used to break local seal-in and stop valve motion. Default is false.
Cfg_MntnOut	BOOL	Not Visible	Not Required	Input	1 = Maintain Output when commanded state reached. Default is false.
Cfg_MntnOutAlm	BOOL	Not Visible	Not Required	Input	1 = Maintain Output when commanded state reached is true and when alarm active. Default is false.
Cfg_MntnStop	BOOL	Not Visible	Not Required	Input	1 = Maintain Stop Output when stopped state reached. Default is false.
Cfg_HasTrip	BOOL	Not Visible	Not Required	Input	1 = Trip output is connected to valve, 0 = Monitor only. Default is false.
Cfg_TripPos2	BOOL	Not Visible	Not Required	Input	1 = Trip moves valve to Position 2, 0 = Trip moves valve to Position 1. Default is false.
Cfg_HasPulse	BOOL	Not Visible	Not Required	Input	1 = Enable pulsing functions, 0 = Position 1/2 only. Default is false.
Cfg_CompletePulse	BOOL	Not Visible	Not Required	Input	1 = Finish pulse in progress when Commanded to Position 2 or Position 1, 0 = Switch immediately to Position 2 or Position 1 state when Commanded to. Default is false.
Cfg_HasPulseToState	BOOL	Not Visible	Not Required	Input	1 = Enable pulsing functions to state, 0 = Enable pulsing functions to time. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a valve with more info is available. Default is false.
Cfg_HasStatsObj	BOOL	Not Visible	Not Required	Input	1 = Enable stats valve function, 0 = Position 1/2 only. Default is false.
Cfg_CoastToLS	BOOL	Not Visible	Not Required	Input	1 = Coasting into Limit Switch when stopped changes state, 0 = Stop is independent. Default is true.
Cfg_OperPos1Prio	BOOL	Not Visible	Not Required	Input	1 = OCmd_Pos1 has priority, accepted any time, 0 = OCmd_Pos1 openly in Operator and Maintenance command sources. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_OCmdResets	BOOL	Not Visible	Not Required	Input	1 = New Operator state command resets fault, 0 = Reset required to clear fault. Default is false.
Cfg_XCmdResets	BOOL	Not Visible	Not Required	Input	1 = New valve XCmd resets shed latches and cleared alarms, 0 = XCmd_Reset req'd. Default is false.
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores bypassable permissives/interlocks, 0 = Always use permissives/interlocks. Default is false.
Cfg_PCmdPos2AsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Pos2 used as a level (1 = Position 2, 0 = Position 1), 0 = The instruction clears PCmd_Pos2 operand automatically. Default is false.
Cfg_ShedOnActuatorFault	BOOL	Not Visible	Not Required	Input	1 = Stop valve and alarm on Actuator fault; 0 = alarm only on Actuator fault. Default is true.
Cfg_ShedOnIOFault	BOOL	Not Visible	Not Required	Input	1 = Stop Valve and Alarm on I/O Fault; 0 = Alarm only on I/O Fault. Default is true.
Cfg_ShedOnFailToTrip	BOOL	Not Visible	Not Required	Input	1 = Continue trip and alarm on Fail to Trip; 0 = Alarm only on Fail to Trip. Default is true.
Cfg_ShedOnFullStall	BOOL	Not Visible	Not Required	Input	1 = Stop valve and alarm on Full Stall; 0 = Alarm only on Full Stall. Default is true.
Cfg_ShedOnLossPos1	BOOL	Not Visible	Not Required	Input	1 = Stop valve and alarm on Loss Position 1; 0 = Alarm only on Loss Position 1 feedback. Default is false.
Cfg_ShedOnLossPos2	BOOL	Not Visible	Not Required	Input	1 = Stop valve and alarm on Loss Position 2; 0 = Alarm only on Loss Position 2 feedback. Default is false.
Cfg_ShedOnTransitStall	BOOL	Not Visible	Not Required	Input	1 = Stop valve and alarm on Transit stall; 0 = Alarm only on Transit stall. Default is true.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator lock, 0 = Don't Override lock. Default is true.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator lock, 0 = Don't Override lock. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal source: 1 = Program if no requests; 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Prog used as a level. Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Lock used as a level (1 = Lock, 0 = Unlock). Default is false.
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = XCmd_Acq used as level (1 = Acquire, 0 = Release). Default is false.
Cfg_Pos1Dly	REAL	Not Visible	Not Required	Input	Delay before initially activating output Position 1. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_Pos2Dly	REAL	Not Visible	Not Required	Input	Delay before initially activating output Position 2. Valid = 0.0 to 2147483.0 seconds. Default is 0.0.
Cfg_Pos1PulseTime	REAL	Not Visible	Not Required	Input	Output Position 1 time for pulse Position 1 or pulse continuous. Valid = 0.0 to 2147483.0 seconds. Default is 5.0.
Cfg_Pos2PulseTime	REAL	Not Visible	Not Required	Input	Output Position 2 time for pulse Position 2 or pulse continuous. Valid = 0.0 to 2147483.0 seconds. Default is 5.0.
Cfg_OutPulseTime	REAL	Not Visible	Not Required	Input	Time to pulse valve outputs (0 = Outputs maintained on). Valid = 0.0 to 2147483.0 seconds. Default is 5.0.
Cfg_StartHornTime	REAL	Not Visible	Not Required	Input	Time to sound audible after command request. (0 = Disabled). Valid = 0.0 to 1000.0 seconds. Default is 0.0.
Cfg_FullStallTime	REAL	Not Visible	Not Required	Input	Time after output Position 1 to get Position 1 feedback before fault. Valid = 0.0 to 2147483.0 seconds. Default is 15.0.
Cfg_TransitStallTime	REAL	Not Visible	Not Required	Input	Time after output Position 1/2 to get Position 1/2 feedback before fault. Valid = 0.0 to 2147483.0 seconds. Default is 60.0.
Cfg_TripFailTime	REAL	Not Visible	Not Required	Input	After tripped, time to reach trip position before alarm. Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
Cfg_VirtualFdbkTime	REAL	Not Visible	Not Required	Input	Delay to echo back of Position 1/2 status when the valve is treated as virtual (seconds). Default is 3.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PCmd_Pos1	BOOL	Not Visible	Not Required	Input	Program command to move valve to Position 1. The Position 1 command is ignored when Cfg_PCmdPosition 2 as level is 1. The instruction clears this operand automatically. Default is false.
PCmd_Pos2	BOOL	Not Visible	Not Required	Input	Program command to move valve to Position 2. The Position 2 command is ignored when Cfg_PCmdPosition 2 as level is 1. The instruction clears this operand automatically. Default is false.
PCmd_Pos1Pulse	BOOL	Not Visible	Not Required	Input	Program command to pulse valve that is in Position 2, to Position 1 once. The instruction clears this operand automatically. Default is false.
PCmd_Pos2Pulse	BOOL	Not Visible	Not Required	Input	Program command to pulse valve that is in Position 1, to Position 2 once. The instruction clears this operand automatically. Default is false.
PCmd_ContPulse	BOOL	Not Visible	Not Required	Input	Program command to pulse valve continuously. The instruction clears this operand automatically. Default is false.
PCmd_Trip	BOOL	Not Visible	Not Required	Input	Program command to trip valve. Default is false.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program command to reset all alarms requiring reset. The instruction clears this operand automatically. Default is false.
PCmd_Stop	BOOL	Not Visible	Not Required	Input	Program command to stop valve. The instruction clears this operand automatically. Default is false.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program owner request ID (non-zero) or release (zero). Default is 0.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program command to select normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program Command to select Virtual (simulated) device operation Default is false.
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program Command to select Physical device operation (not simulated) Default is false.
XCmd_Pos1	BOOL	Not Visible	Not Required	Input	External command to turn object Position 1. The instruction clears this operand automatically. Default is false.
XCmd_Pos2	BOOL	Not Visible	Not Required	Input	External command to turn object Position 2. The instruction clears this operand automatically. Default is false.
XCmd_Pos1Pulse	BOOL	Not Visible	Not Required	Input	External command to pulse valve that is in Position 2, to Position 1 once. The instruction clears this operand automatically. Default is false.
XCmd_Pos2Pulse	BOOL	Not Visible	Not Required	Input	External command to pulse valve that is in Position 1, to Position 2 once. The instruction clears this operand automatically. Default is false.
XCmd_ContPulse	BOOL	Not Visible	Not Required	Input	External command to pulse object continuously (blink). The instruction clears this operand automatically. Default is false.
XCmd_Trip	BOOL	Not Visible	Not Required	Input	External command to trip valve. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External command to clear shed latches and cleared alarms. Default is false.
XCmd_Stop	BOOL	Not Visible	Not Required	Input	External command to stop valve motion.the instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable output. This output state always reflects EnableIn input state.
Out_Pos1Data	BOOL	Not Visible	Not Required	Output	1 = Activate to move valve to Position 1.
Out_Pos2Data	BOOL	Visible	Not Required	Output	1 = Activate to move valve to Position 2.
Out_StopData	BOOL	Not Visible	Not Required	Output	1 = Break seal-in circuit in actuator to stop valve motion.
Out_TripData	BOOL	Not Visible	Not Required	Output	1 = Trip valve to safe/fail state.
Out_HornData	BOOL	Not Visible	Not Required	Output	1 = Sound audible prior to commanded valve start.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. use Inp_initializereq to reinitialize.
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Valve available for control by automation (Program).
Sts_IntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Valve can be acquired by Program and is available for start/stop control when interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks are bypassed.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_BypActive	BOOL	Visible	Not Required	Output	1 = Interlock bypassing active (bypassed or Maintenance).
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Valve has a Maintenance bypass function active.
Sts_NotRdy	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready, for HMI use hidden detail bits (Sts_nrdyxxx) for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: configuration error.
Sts_NrdyIntlk	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: interlock not ok.
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: object disabled by Maintenance.
Sts_NrdyPos1Perm	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: Position 1 permissive not ok.
Sts_NrdyPos2Perm	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: Position 2 permissive not ok.
Sts_NrdyPerm	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: permissive not ok.
Sts_NrdyStopPerm	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: stop permissive not ok.
Sts_Err	BOOL	Not Visible	Not Required	Output	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in logix tag-based alarm settings.
Sts_ErrFullStallTime	BOOL	Not Visible	Not Required	Output	1 = Invalid Position 1 fail timer preset (use 0.0 to 2147483.0).
Sts_ErrHas	BOOL	Not Visible	Not Required	Output	1 = Error in Config: must have at least one Limit Switch
Sts_ErrOutPulseTime	BOOL	Not Visible	Not Required	Output	1 = Invalid outpulse timer preset (use 0.0 to 2147483.0).
Sts_ErrPos1Dly	BOOL	Not Visible	Not Required	Output	1 = Invalid Position 1 delay timer preset (use 0 to 2147483.0).
Sts_ErrPos1PulseTime	BOOL	Not Visible	Not Required	Output	1 = Invalid Position 1 pulse timer preset (use 0.0 to 2147483.0).
Sts_ErrPos2Dly	BOOL	Not Visible	Not Required	Output	1 = Invalid Position 2 delay timer preset (use 0 to 2147483.0).
Sts_ErrPos2PulseTime	BOOL	Not Visible	Not Required	Output	1 = Invalid Position 2 pulse timer preset (use 0.0 to 2147483.0).
Sts_ErrTransitStallTime	BOOL	Not Visible	Not Required	Output	1 = Invalid Position 2 fail timer preset (use 0.0 to 2147483.0).
Sts_ErrTripFailTime	BOOL	Not Visible	Not Required	Output	1 = Invalid virtual feedback timer (use 0.0 to 2147483.0).
Sts_Hand	BOOL	Not Visible	Not Required	Output	1 = Hand is selected (supersedes OoS, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	Not Visible	Not Required	Output	1 = Out of service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	Not Visible	Not Required	Output	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	Not Visible	Not Required	Output	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	Not Visible	Not Required	Output	1 = External is selected (supersedes Program and Operator).
Sts_Prog	BOOL	Visible	Not Required	Output	1 = Program is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program is selected and locked.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_Oper	BOOL	Not Visible	Not Required	Output	1 = Operator is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator is selected and locked.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Not Visible	Not Required	Output	Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selection equals the normal (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Maintenance acquire command received this scan.
Sts_CmdConflict	BOOL	Not Visible	Not Required	Output	1 = Conflicting commands received this scan.
Sts_Alm	BOOL	Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = One or more alarms shelved, disabled or suppressed.
Sts_ActuatorFault	BOOL	Not Visible	Not Required	Output	1 = Actuator fault detected (input).
Sts_CmdToPos1	BOOL	Not Visible	Not Required	Output	1 = Valve commanded to Position 1, has not yet moved off Position 1 Limit Switch.
Sts_CmdToPos2	BOOL	Not Visible	Not Required	Output	1 = Valve commanded to Position 2, has not yet moved off Position 2 Limit Switch.
Sts_ErrUse	BOOL	Not Visible	Not Required	Output	1 = Error in Config: must use at least one Limit Switch
Sts_ErrVirtualFdbkTime	BOOL	Not Visible	Not Required	Output	1 = Invalid virtual feedback timer (use 0.0 to 2147483.0).
Sts_FdbkPos1	BOOL	Not Visible	Not Required	Output	1 = Valve feedback shows valve in Position 1 state.
Sts_FdbkPos2	BOOL	Not Visible	Not Required	Output	1 = Valve feedback shows valve in Position 2 state.
Sts_FdbkFail	BOOL	Not Visible	Not Required	Output	1 = Feedbacks are in an invalid state (not Position 1, Position 2, or transition).
Sts_FullStall	BOOL	Not Visible	Not Required	Output	1 = Valve full stall (failed to move at all) (one-shot).
Sts_Horn	BOOL	Not Visible	Not Required	Output	1 = Valve horn active.
Sts_LossPos1	BOOL	Not Visible	Not Required	Output	1 = Loss of Position 1 position alarm.
Sts_LossPos2	BOOL	Not Visible	Not Required	Output	1 = Loss of Position 2 position alarm.
Sts_IOFault	BOOL	Not Visible	Not Required	Output	I/O comm fault status (0 = Ok, 1 = Bad).
Sts_Moving	BOOL	Not Visible	Not Required	Output	1 = Valve not commanded to trip and is not confirmed Position 1 or Position 2.
Sts_MovingToPos1	BOOL	Not Visible	Not Required	Output	1 = Valve commanded to Position 1 and awaiting Position 1 feedback.
Sts_MovingToPos2	BOOL	Not Visible	Not Required	Output	1 = Valve commanded to Position 2 and awaiting Position 2 feedback.
Sts_Pos1	BOOL	Visible	Not Required	Output	1 = Valve commanded to Position 1 and is confirmed Position 1.
Sts_Pos2	BOOL	Visible	Not Required	Output	1 = Valve commanded to Position 2 and is confirmed Position 2.
Sts_Pulsing	BOOL	Not Visible	Not Required	Output	1 = Output is in a pulsing sequence.
Sts_Stopped	BOOL	Not Visible	Not Required	Output	1 = Valve commanded to stop and is not at either end of travel.
Sts_TransitStall	BOOL	Not Visible	Not Required	Output	1 = Valve transit stall (did not reach target position) (one-shot).

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_TripFail	BOOL	Not Visible	Not Required	Output	1 = Valve failed to trip (did not reach trip position).
Sts_Tripping	BOOL	Not Visible	Not Required	Output	1 = Valve commanded to trip and has not reached trip position.
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_NrdyTrip	BOOL	Not Visible	Not Required	Output	1 = Valve not ready: tripped (at object or by command).
Sts_NrdyIOFault	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: io fault (shed requires reset).
Sts_NrdyActuatorFault	BOOL	Not Visible	Not Required	Output	1 = Valve not ready:actuator fault (fault or shed requires reset).
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Valve tripped by an interlock not ok.
Sts_NrdyFail	BOOL	Not Visible	Not Required	Output	1 = Valve is not ready: object failure (shed requires reset).
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Not Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction treats the object as virtual. The instruction acts as normal but the output is kept de-energized (Out_ = 0). 0 = the instruction operates the object normally.
Sts_bSrc	INT	Not Visible	Not Required	Output	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0: hand, Sts_bSrc.1: Programmed out of service (rung false), Sts_bSrc.2: Maintenance out of service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_eSrc	INT	Not Visible	Not Required	Output	The current command source enumerated values: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program locked, 34 = Program by default (Normal), 64 = Operator, 65 = Operator locked, 66 = Operator by default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (rung false), 256 = External.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eCmd	SINT	Not Visible	Not Required	Output	Valve command: 0=None, 1=Position 1, 2=Position 2, 4=Stop, 8=Pulse Position 1, 16=Pulse Position 2, 32=Pulse continuously, 64=Trip
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Valve feedback: 0 = transition, 1 = Position 1, 2 = Position 2, 3 = invalid.
Sts_eFault	SINT	Not Visible	Not Required	Output	Valve fault status: 0 =None, 2 = Feedback fault, 7 = Transit stall, 8 = Full stall, 11 = Loss Position 1, 12 = Loss Position 2, 13 = Actuator fault, 14 = Trip fail, 15 = Interlock trip, 16 = Not ready fail, 18 = Not ready trip, 32 = I/O Fault, 34 = Config Error.
Sts_eNotify	SINT	Not Visible	Not Required	Output	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	All alarm status enumerated values including related valves: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eState	DINT	Not Visible	Not Required	Output	Internal logic state 1 = Position 1 2 = Position 2 9 = Position 2 command ON-DELAY 10 = Position 1 command OFF-DELAY 17 = PULSE Position 2 command ON-DELAY 18 = PULSE Position 1 command OFF-DELAY 33 = PULSE Position 2 command ON PULSE time 34 = PULSE Position 1 command OFF PULSE time 65 = PULSE CONTINUOUS command ON-DELAY 66 = PULSE CONTINUOUS command OFF-DELAY 129 = PULSE CONTINUOUS command OFF PULSE time 130 = PULSE CONTINUOUS command ON PULSE time 257 = Position 1 PULSE completion time
Sts_eSts	SINT	Not Visible	Not Required	Output	Valve status: 0 = ?, 1 = Position 1, 2 = Position 2, 3 = cmd to Position 1, 4 = cmd to Position 2, 5 = moving to Position 1, 6 = moving to Position 2, 7 = stopped, 8 = tripping, 9 = pulse Position 1, 10 = pulse Position 2, 11 = pulse continuously, 12 = moving, 14 = Horn, 15 = out of service.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyActuatorFault	SINT	Not Visible	Not Required	Output	Fail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFullStall	SINT	Not Visible	Not Required	Output	Full Stall alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	Not Visible	Not Required	Output	Interlock Trip alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	Not Visible	Not Required	Output	IO Fault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyLossPos1	SINT	Not Visible	Not Required	Output	Loss Position 1 alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyLossPos2	SINT	Not Visible	Not Required	Output	Loss Position 2 alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyTransitStall	SINT	Not Visible	Not Required	Output	Transit Stall alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyTripFail	SINT	Not Visible	Not Required	Output	Trip Fail alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status (enumerated): 0=Good, live, confirmed good, 1=Good, live, assumed good, 2=Good, no feedback, assumed good, 8=Test, virtualized, 9=Test, loopback, 10=Test, manually entered, 16=Uncertain, live, off-spec, 17=Uncertain, substituted at device or bus, 18=Uncertain, substituted at instruction, 19=Uncertain, using last known good, 20=Uncertain, using replacement value, 32=Bad, signal failure, 33=Bad, channel fault, 34=Bad, module or communication fault, 35=Bad, invalid configuration.
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output (enumerated): 0=Good, live, confirmed good, 1=Good, live, assumed good, 2=Good, no feedback, assumed good, 8=Test, virtualized, 9=Test, loopback, 10=Test, manually entered, 16=Uncertain, live, off-spec, 17=Uncertain, substituted at device or bus, 18=Uncertain, substituted at instruction, 19=Uncertain, using last known good, 20=Uncertain, using replacement value, 32=Bad, signal failure, 33=Bad, channel fault, 34=Bad, module or communication fault, 35=Bad, invalid configuration.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object owner ID (0 = Not owned).
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable HMI button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Resetackall, enable HMI button.

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control or Command Source Selection.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance command to bypass all bypassable interlocks. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_Check	BOOL	Maintenance command to check (not bypass) all interlocks. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select in service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select out of service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance Command to select Physical device operation (not simulated) Default is false.
MCmd_Rel	BOOL	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance Command to select Virtual (simulated) device operation Default is false.
OCmd_ContPulse	BOOL	Operator command to pulse valve continuously. The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Pos1	BOOL	Operator command to move valve to Position 1. The instruction clears this operand automatically. Default is false.
OCmd_Pos1Pulse	BOOL	Operator command to pulse valve that is in Position 2, to Position 1 once. The instruction clears this operand automatically. Default is false.
OCmd_Pos2	BOOL	Operator command to move valve to Position 2. The instruction clears this operand automatically. Default is false.
OCmd_Pos2Pulse	BOOL	Operator command to pulse valve that is in Position 1, to Position 2 once. The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms requiring reset. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to reset all alarms and latched shed conditions. The use of OCmd_Resetackall is restricted to HMI. The instruction clears this operand automatically. Default is false.
OCmd_Stop	BOOL	Operator command to stop valve motion. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
OCmd_Trip	BOOL	Operator command to trip valve. Default is false.
OCmd_Unlock	BOOL	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	HMI bus object index Default is 0.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready to receive OCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready to receive OCmd_Check, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_ContPulse	BOOL	1 = Ready to receive OCmd_Contpulse, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Pos1	BOOL	1 = Ready to receive OCmd_Pos1, enable HMI button.
ORdy_Pos1Pulse	BOOL	1 = Ready to receive OCmd_Pos1pulse, enable HMI button.
ORdy_Pos2	BOOL	1 = Ready to receive OCmd_Pos2, enable HMI button.
ORdy_Pos2Pulse	BOOL	1 = Ready to receive OCmd_Pos2pulse, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = At least one alarm or shed condition requires reset.
ORdy_ResetAckAll	BOOL	1 = At least one alarm or latched shed condition requires reset or acknowledgement.
ORdy_Stop	BOOL	1 = Ready for OCmd_Stop (enables HMI button).
ORdy_Trip	BOOL	1 = Ready for OCmd_trip (enables HMI button).
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component

BUS_OBJ Structure

The BUS_OBJ structure is used to link the valve to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices. Items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type

shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

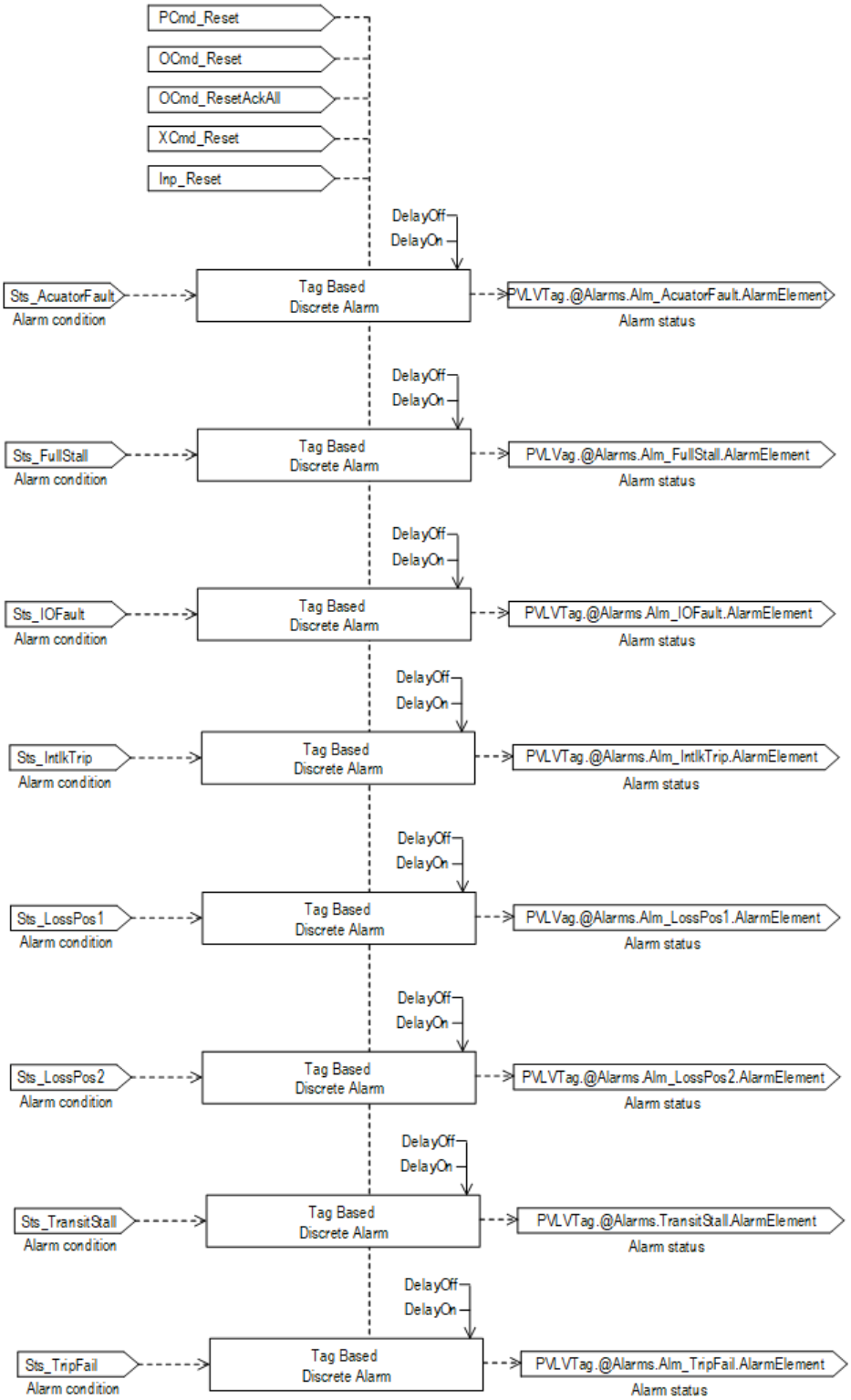
Discrete Logix tag-based alarms are defined for these members:

Member	Alarm Name	Description
Sts_AcuatorFault	Alm_AcuatorFault	Raised if the Inp_ActuatorFault input is true. This alarm is provided for use by valves that generate a fault contact, such as actuator motor overload trip.
Sts_FullStall	Alm_FullStall	Raised when the valve has and is using Position 2 and/or Position 1 limit switches, an attempt is made to Position 2 or Position 1 the valve, and the limit switches indicate that the valve did not move from its original position at all within the configured time.
Sts_IOFault	Alm_IOFault	Raised when the Inp_IOFault input is true. This input is usually used to indicate to the instruction that a communication failure has occurred for its I/O. If the I/O Fault is configured as a shed fault, the valve is commanded to Stop motion and cannot be commanded to either position until reset.
Sts_IntlkTrip	Alm_IntlkTrip	Raised when the valve is energized and an interlock Not-OK condition causes the valve to be de-energized. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock Not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock Not-OK condition initiates an interlock trip.
Sts_LossPos1	Alm_LossPos1	Raised when the valve has reached the confirmed Position 1 state and the Position 1 confirmation feedback is lost.
Sts_LossPos2	Alm_LossPos2	Raised when the valve has reached the confirmed Position 2 state and the Position 2 confirmation feedback is lost.
Sts_TransitStall	Alm_TransitStall	Raised when the valve has and is using both Position 2 and Position 1 position feedback, an attempt is made to Position 2 or Position 1 the valve, and the position feedback indicates that the valve moved off the original position but did not reach the target position within the configured transit stall time.
Sts_TripFail	Alm_TripFail	Raised when the valve has and is using the optional trip feature, an attempt is made to trip the valve, and the limit switch feedbacks show that the valve did not reach the configured tripped position (Position 2 or Position 1) within the configured fail to trip time.

Mark the alarm as used or unused and set standard configuration members of the discrete Logix tag-based alarm. Use this format to access alarm elements:

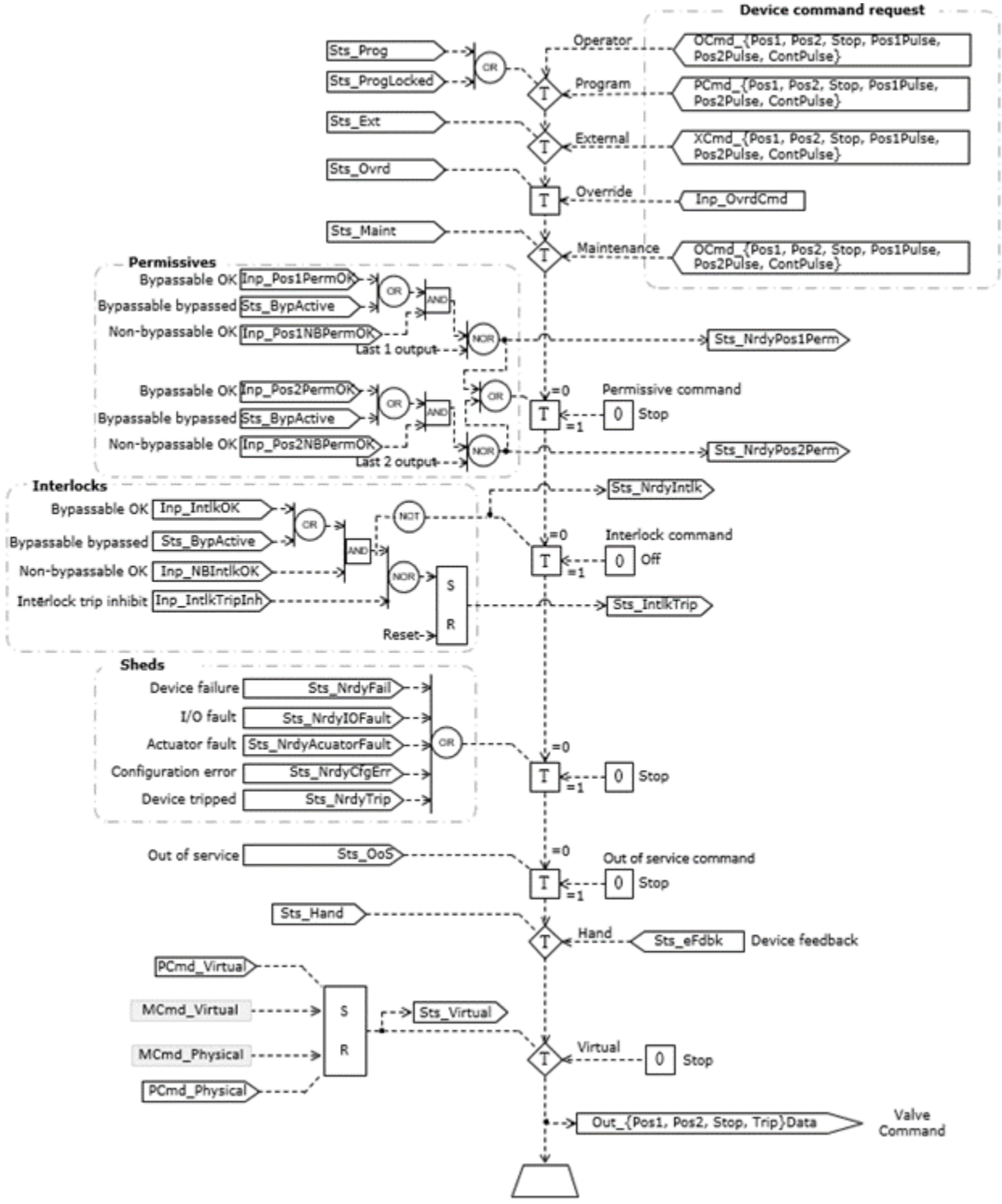
Tag.@Alarms.AlarmName.AlarmElement

Program, Operator, and External commands reset latched alarms, and reset and acknowledge all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PVLV instruction.



Operation

This diagram illustrates the functionality of the PVLV instruction:



Operator command request confirmation

The PVLV instruction enables these operator commands and settings:

- OCmd_ContPulse
- OCmd_Pos1
- OCmd_Pos1Pulse
- OCmd_Pos2
- OCmd_Pos2Pulse
- OCmd_Stop
- OCmd_Trip

Enforced security might require the request to be confirmed or canceled before the selected command executes or setting is accepted. The instruction checks the security rules inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd=0 no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd=1 the instruction waits for confirmation OCmd_CmdCnfrm=1 and/or cancellation. For Cfg_CnfrmReqd=2 or 3 eSignature is needed before the confirmation and cancellation is enabled.

Virtualization

Use virtualization for instruction testing and operator training. Use PCmd_Virtual or MCmd_Virtual to enable virtualization. After finishing virtualization, use PCmd_Physical or MCmd_Physical to return to normal (physical device) operation.

When Virtualization is active, the outputs of the PVLV instruction hold at 0, virtual feedback of a working device is provided and I/O faults are ignored. Manipulate the instruction to operate as if a working valve is present.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link

- More Information
- Position 2 Command button
- Position 1 Command button
- Stop Command button
- Pulse Position 2 Command button
- Pulse Position 1 button
- Pulse button
- Position 2 Target state
- Position 1 Target state
- Stop Target state
- Pulse Position 2 Target state
- Pulse Position 1 Target state
- Position 2 Transition state
- Position 1 Transition state
- Stop Transition state
- Pulse Position 2 Transition state
- Pulse Position 1 Transition state
- Actuator Alarm
- IO Fault Alarm
- Full Stall Alarm
- Transit Stall Alarm
- Interlock Trip Alarm
- Loss of Position 1 Alarm
- Loss of Position 2 Alarm
- Trip Fail Alarm

Monitor the PVLV Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The valve is de-energized and treated as if it were commanded to safe position.
Instruction first run	Any commands received before first scan are discarded. The valve state is evaluated and the instruction aligns with the current state of the valve, as if the Hand command source were selected.
Rung-condition-in is false	Handled the same as if the valve is taken Out of Service by command. The valve outputs are de-energized, and the valve Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. The rung-condition-out continues as false.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The valve is de-energized and treated as if it were commanded to safe position.
Instruction first run	Any commands received before first scan are discarded. The valve state is evaluated and the instruction aligns with the current state of the valve, as if the Hand command source were selected.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the valve is taken Out of Service by command. The valve outputs are de-energized, and the valve Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. EnableOut is set to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

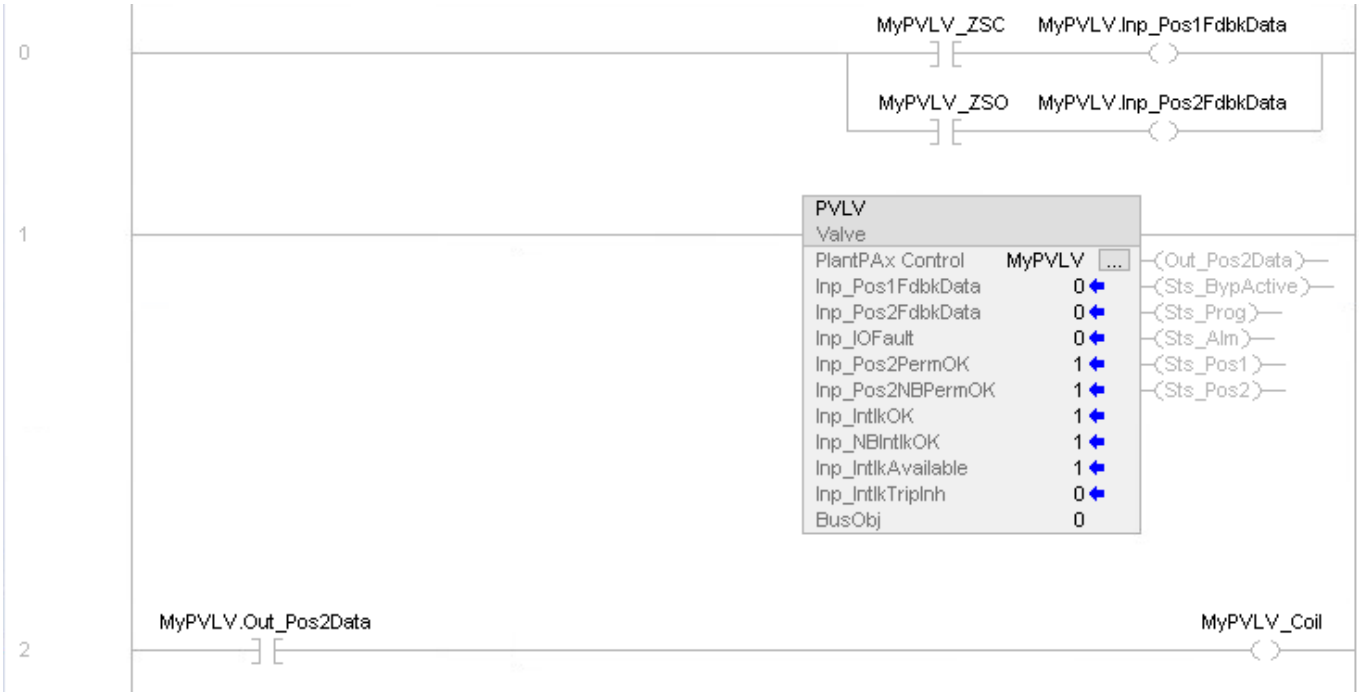
Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

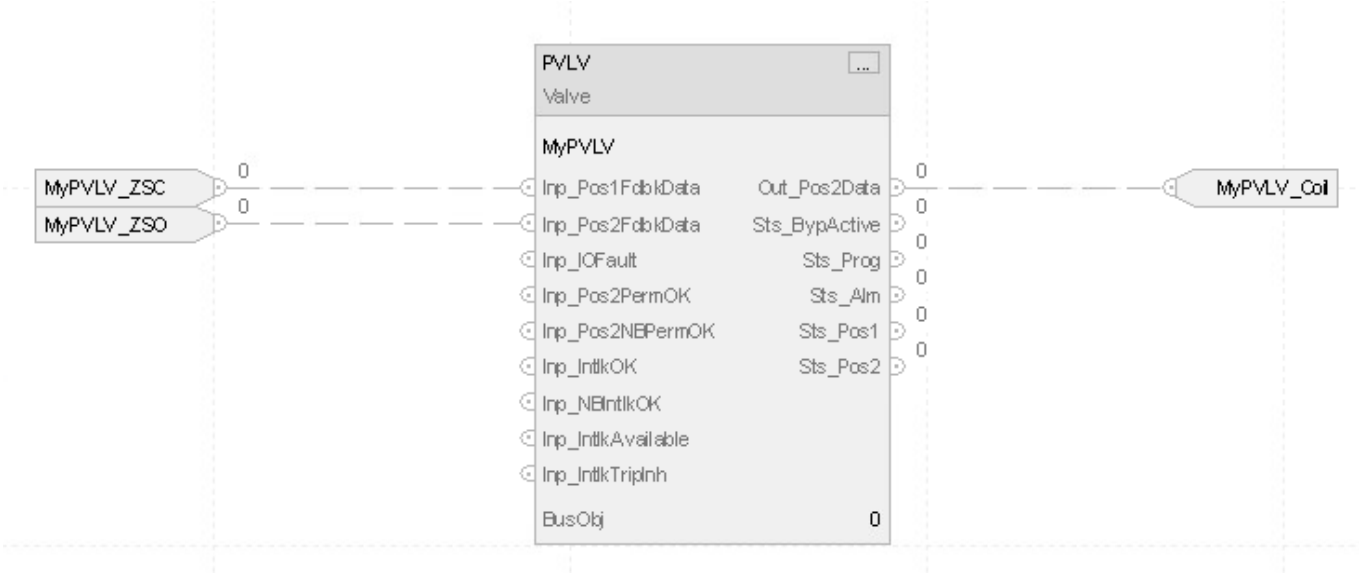
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

Ladder Diagram



Function Block Diagram



Structured Text

```
MyPVLV.Inp_Pos1FdbkData:=MyPVLV_ZSC;
```

```
MyPVLV.Inp_Pos2FdbkData:=MyPVLV_ZSO;

PVLV(MyPVLV, 0);

MyPVLV_Coil:=MyPVLV.Out_Pos2Data;
```

PVLV Command Source

The Process Valve (PVLV) instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled. Drive commands and settings from any source are not accepted.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (for example, field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enable control sources as Configuration

The user can enable and disable individual control sources. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. Commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command.

For example, if the Program state is disabled, the destination of the OCmd_Prog command becomes the Program Locked state instead of the Program state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the command was eliminated then there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

See also

Process Valve (PVLV)

Process Mix Proof Valve (PVLVMP)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Mix Proof Valve (PVLVMP) instruction controls and monitors feedback from a mix-proof valve in various modes and states, monitoring for fault conditions. This instruction supports mix-proof valves with or without additional connections for cleaning (CIP, clean-in-place) or steaming (SIP, sanitize in place).

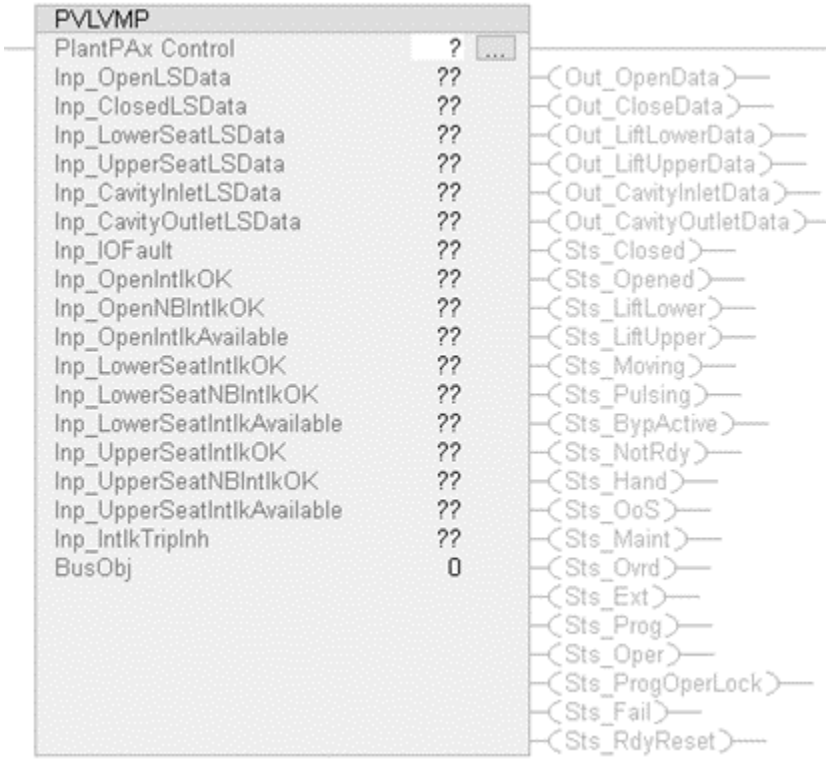
Use the PVLVMP instruction to:

- Operate a mix-proof valve with these positions:
  - Closed
  - Opened
  - CIP/SIP leakage cavity (optional)
- Operate a mix-proof valve with these positions, which can pulse the seat being cleaned, or lifted opened and closed, to provide enhanced cleaning. (As the seat is popped open and closed, the flow velocity across the seat is increased compared to the fully open seat position.) Pulse times are configurable.
  - Lift upper seat (optional)

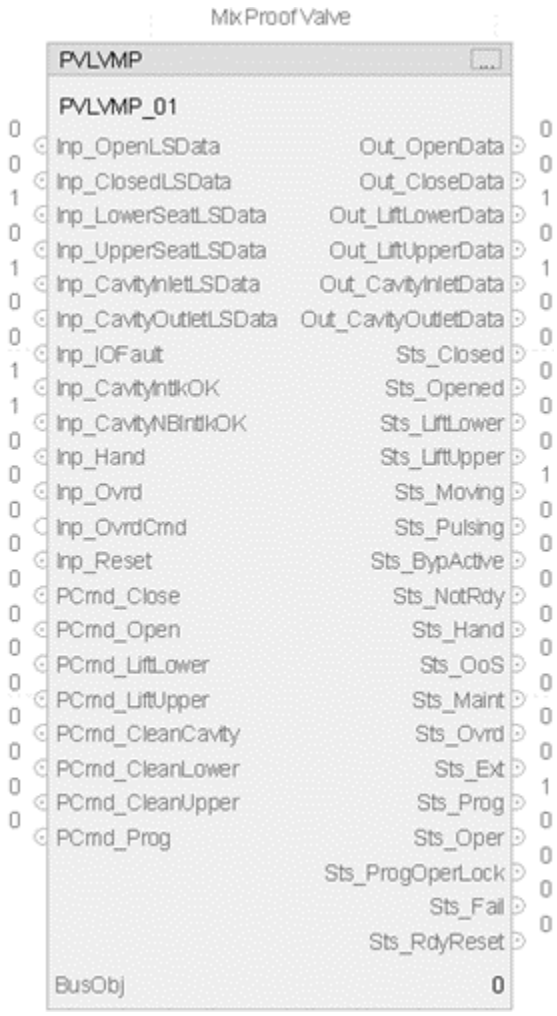
  - Lift lower seat (optional)
  - CIP/SIP upper seat (optional)
  - CIP/SIP lower seat (optional)eve
- Operate using a state model that makes sure that valve seats are sequenced properly to avoid cross-contamination.
- Provide six outputs and six inputs. The outputs in each valve state (including intermediate states) are configurable for on and off states. The inputs that verify each valve state are configurable for their required on, required off, and don't care states. Provides feedback checking to make sure that the valve reaches each position, including intermediate positions before moving to the next position. The time for feedback inputs to confirm each state is configurable.
- Display graphic symbols for mix-proof valves in 2-D layouts and 3-D (isometric) layouts for ease in building valve array and routing manifold displays.
- Allow maintenance personnel to take the valve out of service. Note that this capability is not a substitute for hard lockout/tagout (LOTO) procedures.
- Provide inputs for Interlock conditions to drive the valve to the closed state.
- Monitor for I/O communication faults, and close the valve and raise an alarm on a fault.
- Provide an available status for Program command source logic so automation code can determine whether a valve can be controlled.
- Provide a valve virtualization capability. When the mix-proof valve is set to virtual, outputs are left de-energized, and the instruction behaves as if a fully functioning valve were providing feedback.
- Operate from Hand, Maintenance, Override, External, Program, and Operator command sources.
- Provide a maintenance command to toggle a locator or beacon output.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PVLVMP(PVLVMPTag, BusObj);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_DISCRETE_MIX_PROOF	tag	Data structure required for proper operation of instruction.
BusObj	BUS_OBJ	tag	Bus component.

P_DISCRETE_MIX_PROOF Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command (bitmapped): All bits off = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .29 = Echo. Default is 0.
Inp_OpenLSData	BOOL	Visible	Not Required	Input	Valve open limit switch: 1 = Confirmed opened. Default is false.
Inp_ClosedLSData	BOOL	Visible	Not Required	Input	Valve closed limit switch: 1 = Confirmed fully closed. Default is false.
Inp_LowerSeatLSData	BOOL	Visible	Not Required	Input	Valve lower seat lift limit switch: 1 = Confirmed lower seat lifted. Default is false.
Inp_UpperSeatLSData	BOOL	Visible	Not Required	Input	Valve upper seat lift limit switch: 1 = Confirmed upper seat lifted. Default is false.
Inp_CavityInletLSData	BOOL	Visible	Not Required	Input	Valve cavity inlet limit switch: 1 = Confirmed cavity inlet opened. Default is false.
Inp_CavityOutletLSData	BOOL	Visible	Not Required	Input	Valve cavity outlet limit switch: 1 = Confirmed cavity output closed. Default is false.
Inp_IOFault	BOOL	Visible	Not Required	Input	1 = I/O communication is faulted, 0 = I/O communication is OK. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_OpenIntlkOK	BOOL	Visible	Not Required	Input	1 = Open interlocks OK, valve can open, 0 = Interlocks not OK, close valve if target/actual state is opened. Default is true.
Inp_OpenNBIntlkOK	BOOL	Visible	Not Required	Input	1 = Open non-bypassable interlocks OK, valve can open, 0 = Interlocks not OK, close valve if target/actual state is open. Default is true.
Inp_OpenIntlkAvailable	BOOL	Visible	Not Required	Input	1 = Open interlock availability is OK, show Sts_OpenIntlkAvailable if device is ready except for open interlocks. Default is false.
Inp_LowerSeatIntlkOK	BOOL	Visible	Not Required	Input	1 = Lower seat interlocks OK, valve can lift or clean lower seat, 0 = Interlocks not OK, close valve if target/actual state has lower seat lifted. Default is true.
Inp_LowerSeatNBIntlkOK	BOOL	Visible	Not Required	Input	1 = Lower seat non-bypassable interlocks OK, valve can lift or clean lower seat, 0 = Interlocks not OK, close valve if target/actual state has lower seat lifted. Default is true.
Inp_LowerSeatIntlkAvailable	BOOL	Visible	Not Required	Input	1 = Lower seat interlock availability is OK, show Sts_LowerSeatIntlkAvailable if device is ready except for lower seat interlocks. Default is false.
Inp_UpperSeatIntlkOK	BOOL	Visible	Not Required	Input	1 = Upper seat interlocks OK, valve can lift or clean upper seat, 0 = Interlocks not OK, close valve if target/actual state has upper seat lifted. Default is true.
Inp_UpperSeatNBIntlkOK	BOOL	Visible	Not Required	Input	1 = Upper seat non-bypassable interlocks OK, valve can lift or clean upper seat, 0 = Interlocks not OK, close valve if target/actual state has upper seat lifted. Default is true.
Inp_UpperSeatIntlkAvailable	BOOL	Visible	Not Required	Input	1 = Upper seat interlock availability is OK, show Sts_UpperSeatIntlkAvailable if device is ready except for upper seat interlocks. Default is false.
Inp_CavityIntlkOK	BOOL	Not Visible	Not Required	Input	1 = Cavity interlocks OK, valve can clean cavity or seat, 0 = Interlocks not OK, close valve if target/actual state has cleaning via cavity. Default is true.
Inp_CavityNBIntlkOK	BOOL	Not Visible	Not Required	Input	1 = Cavity non-bypassable interlocks OK, valve can clean cavity or seat, 0 = Interlocks not OK, close valve if target/actual state has cleaning via cavity. Default is true.
Inp_CavityIntlkAvailable	BOOL	Not Visible	Not Required	Input	1 = Cavity interlock availability is OK, show Sts_CavityIntlkAvailable if device is ready except for cavity interlocks. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit reporting of Sts_IntlkTrip and interlock trip alarm. Default is false.
Inp_RdyReset	BOOL	Not Visible	Not Required	Input	1 = Related object, reset by this object, is ready to be reset. Default is false.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire Hand command source (typically hardwired local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override command source (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCmd	SINT	Not Visible	Not Required	Input	Override device command: 0 = None, 1 = Close, 2 = Open, 3 = Lift lower seat, 4 = Lift upper seat, 5 = Clean cavity, 6 = Clean lower seat, 7 = Clean upper seat. Default is 0.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External command source acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit audible alert, 0 = Allow audible alert. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset shed latches and cleared alarms. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator to shelve alarms. Default is true.
Cfg_HasLiftLower	BOOL	Not Visible	Not Required	Input	1 = Valve supports lift lower seat state. Default is false.
Cfg_HasLiftUpper	BOOL	Not Visible	Not Required	Input	1 = Valve supports lift upper seat state. Default is false.
Cfg_HasCleanCavity	BOOL	Not Visible	Not Required	Input	1 = Valve supports clean cavity state. Default is false.
Cfg_HasCleanLower	BOOL	Not Visible	Not Required	Input	1 = Valve supports clean lower seat state. Default is false.
Cfg_HasCleanUpper	BOOL	Not Visible	Not Required	Input	1 = Valve supports clean upper seat state. Default is false.
Cfg_bOutStateSt0	SINT	Not Visible	Not Required	Input	Outputs to valve in De-energized state (state 0). Default is 2#0000_0000.
Cfg_bOutStateSt1	SINT	Not Visible	Not Required	Input	Outputs to valve in Closed state (state 1). Default is 2#0000_0001.
Cfg_bOutStateSt2	SINT	Not Visible	Not Required	Input	Outputs to valve in Close cavity outlet state (state 2). Default is 2#0010_0000.
Cfg_bOutStateSt3	SINT	Not Visible	Not Required	Input	Outputs to valve in Open state (state 3). Default is 2#0010_0010.
Cfg_bOutStateSt4	SINT	Not Visible	Not Required	Input	Outputs to valve in Lift lower seat state (state 4). Default is 2#0000_0100.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_bOutStateSt5	SINT	Not Visible	Not Required	Input	Outputs to valve in Lift upper seat state (state 5). Default is 2#0000_1000.
Cfg_bOutStateSt6	SINT	Not Visible	Not Required	Input	Outputs to valve in Clean cavity state (state 6). Default is 2#0001_0000.
Cfg_bOutStateSt7	SINT	Not Visible	Not Required	Input	Outputs to valve in Lift lower seat for cleaning state (state 7). Default is 2#0001_0100.
Cfg_bOutStateSt8	SINT	Not Visible	Not Required	Input	Outputs to valve in Clean lower seat state (state 8). Default is 2#0011_0100.
Cfg_bOutStateSt9	SINT	Not Visible	Not Required	Input	Outputs to valve in Lift upper seat for cleaning state (state 9). Default is 2#0001_1000.
Cfg_bOutStateSt10	SINT	Not Visible	Not Required	Input	Outputs to valve in Clean upper seat state (state 10). Default is 2#0011_1000.
Cfg_bFdbkStateSt0	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in De-energized state (state 0). Default is 2#0000_0000.
Cfg_bFdbkStateSt1	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Closed state (state 1). Default is 2#0000_0001.
Cfg_bFdbkStateSt2	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Close cavity outlet state (state 2). Default is 2#0010_0000.
Cfg_bFdbkStateSt3	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Open state (state 3). Default is 2#0010_0010.
Cfg_bFdbkStateSt4	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Lift lower seat state (state 4). Default is 2#0000_0100.
Cfg_bFdbkStateSt5	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Lift upper seat state (state 5). Default is 2#0000_1000.
Cfg_bFdbkStateSt6	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Clean cavity state (state 6). Default is 2#0001_0000.
Cfg_bFdbkStateSt7	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Lift lower seat for cleaning state (state 7). Default is 2#0001_0100.
Cfg_bFdbkStateSt8	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Clean lower seat state (state 8). Default is 2#0011_0100.
Cfg_bFdbkStateSt9	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Lift upper seat for cleaning state (state 9). Default is 2#0001_1000.
Cfg_bFdbkStateSt10	SINT	Not Visible	Not Required	Input	Feedback input states when valve is in Clean upper seat state (state 10). Default is 2#0011_1000.
Cfg_bFdbkReqdSt0	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in De-energized state (state 0). Default is 2#0000_1111.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_bFdbkReqdSt1	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Closed state (state 1). Default is 2#0000_1111.
Cfg_bFdbkReqdSt2	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Close cavity outlet state (state 2). Default is 2#0000_1111.
Cfg_bFdbkReqdSt3	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Open state (state 3). Default is 2#0000_1111.
Cfg_bFdbkReqdSt4	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Lift lower seat state (state 4). Default is 2#0000_0000.
Cfg_bFdbkReqdSt5	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Lift upper seat state (state 5). Default is 2#0000_0000.
Cfg_bFdbkReqdSt6	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Clean cavity state (state 6). Default is 2#0000_0000.
Cfg_bFdbkReqdSt7	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Lift lower seat for cleaning state (state 7). Default is 2#0000_0000.
Cfg_bFdbkReqdSt8	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Clean lower seat state (state 8). Default is 2#0000_0000.
Cfg_bFdbkReqdSt9	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Lift upper seat for cleaning state (state 9). Default is 2#0000_0000.
Cfg_bFdbkReqdSt10	SINT	Not Visible	Not Required	Input	Feedback inputs required (checked) to verify valve is in Clean upper seat state (state 10). Default is 2#0000_0000.
Cfg_FdbkTimeSt0	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached De-energized state (state 0) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt1	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Closed state (state 1) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt2	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Close cavity outlet state (state 2) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt3	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Opened state (state 3) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt4	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Lift lower seat state (state 4) (seconds). Valid = 0.0 to 60.0. Default is 1.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_FdbkTimeSt5	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Lift upper seat state (state 5) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt6	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Clean cavity state (state 6) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt7	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Lift lower seat for cleaning state (state 7) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt8	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Clean lower seat state (state 8) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt9	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Lift upper seat for cleaning state (state 9) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_FdbkTimeSt10	REAL	Not Visible	Not Required	Input	Time feedbacks must match required pattern to confirm valve has reached Clean upper seat state (state 10) (seconds). Valid = 0.0 to 60.0. Default is 1.0.
Cfg_PulseLiftLower	BOOL	Not Visible	Not Required	Input	1 = Pulse seat lift output when lifting lower seat, 0 = Do not pulse, lift seat continuously. Default is false.
Cfg_PulseLiftUpper	BOOL	Not Visible	Not Required	Input	1 = Pulse seat lift output when lifting upper seat, 0 = Do not pulse, lift seat continuously. Default is false.
Cfg_PulseCleanLower	BOOL	Not Visible	Not Required	Input	1 = Pulse seat lift output when cleaning lower seat, 0 = Do not pulse, clean continuously. Default is false.
Cfg_PulseCleanUpper	BOOL	Not Visible	Not Required	Input	1 = Pulse seat lift output when cleaning upper seat, 0 = Do not pulse, clean continuously. Default is false.
Cfg_HasOpenIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_OpenIntlkOK, Inp_OpenNBIntlkOK inputs, enable navigation. Default is false.
Cfg_HasLowerSeatIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_LowerSeatIntlkOK, Inp_LowerSeatNBIntlkOK inputs, enable navigation. Default is false.
Cfg_HasUpperSeatIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_UpperSeatIntlkOK, Inp_UpperSeatNBIntlkOK inputs, enable navigation. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasCavityIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to Inp_CavityIntlkOK, Inp_CavityNBIntlkOK inputs, enable navigation. Default is false.
Cfg_HasStatsObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a PVLVS object is monitoring this valve, enable navigation. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available, enable navigation. Default is false.
Cfg_OperClosePrio	BOOL	Not Visible	Not Required	Input	1 = OCmd_Close is accepted any time, 0 = OCmd_Close is accepted only when Operator command source is selected. Default is false.
Cfg_ExtClosePrio	BOOL	Not Visible	Not Required	Input	1 = XCmd_Close is accepted any time, 0 = XCmd_Close is accepted only when External command source is selected. Default is false.
Cfg_OCmdResets	BOOL	Not Visible	Not Required	Input	1 = A new Operator state command resets fault, 0 = A reset command is required to clear fault. Default is false.
Cfg_XCmdResets	BOOL	Not Visible	Not Required	Input	1 = A new External state command resets fault, 0 = A reset command is required to clear fault. Default is false.
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores bypassable permissives and interlocks, 0 = Override uses all permissives and interlocks. Default is false.
Cfg_ShedOnFail	BOOL	Not Visible	Not Required	Input	1 = Close valve and alarm on position fail, 0 = Alarm only. Default is true.
Cfg_ShedOnIOFault	BOOL	Not Visible	Not Required	Input	1 = Close valve and alarm on I/O fault, 0 = Alarm only. Default is true.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) command source exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator Locked command source exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) command source exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program Locked command source exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External command source exists, can be selected. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance command source exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	Not Visible	Not Required	Input	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator Locked, 0 = Don't supersede Program/Operator Locked. Default is true.
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator Locked, 0 = Don't supersede Program/Operator Locked. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program command source, 0 = Power up to Operator command source. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal command source: 1 = Program, 0 = Operator. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority: 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = Program/Operator selection follows PCmd_Prog as level (1 for Program, 0 for Operator), 0 = PCmd_Prog is used as edge to select Program, PCmd_Oper selects Operator. Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = Program lock selection follows PCmd_Lock as level (1 for locked, 0 for unlocked), 0 = PCmd_Lock is used as edge to select Program Locked, PCmd_Unlock selects Program (unlocked). Default is false.
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = External selection follows XCmd_Acq as level (1 to acquire External, 0 to release External), 0 = XCmd_Acq is used as edge to acquire External, XCmd_Rel is used to release External. Default is false.
Cfg_OpenPulseTime	REAL	Not Visible	Not Required	Input	Time to lift seat when pulsing for cleaning (seconds). Valid = 0.0 to 2147483.0, 0.0 = do not pulse. Default is 10.0.
Cfg_ClosePulseTime	REAL	Not Visible	Not Required	Input	Time to close seat when pulsing for cleaning (seconds). Valid = 0.0 to 2147483.0, 0.0 = do not pulse. Default is 5.0.
Cfg_StartHornTime	REAL	Not Visible	Not Required	Input	Time to sound audible on command to move from the closed position (seconds). Valid = 0.0 to 1000.0, 0.0 = Disabled. Default is 0.0.
Cfg_FailTime	REAL	Not Visible	Not Required	Input	Time to receive state feedback before declaring failure (seconds). Valid = 0.0 to 2147483.0. Default is 3.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator command confirmation or e-signature type required: 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program ownership request: Non-zero Owner ID = acquire, 0 = release. Default is 0.
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program Command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program Command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_Close	BOOL	Not Visible	Not Required	Input	Program Command to close valve. The instruction clears this operand automatically. Default is false.
PCmd_Open	BOOL	Not Visible	Not Required	Input	Program Command to cpen valve. The instruction clears this operand automatically. Default is false.
PCmd_LiftLower	BOOL	Not Visible	Not Required	Input	Program Command to lift lower seat. The instruction clears this operand automatically. Default is false.
PCmd_LiftUpper	BOOL	Not Visible	Not Required	Input	Program Command to lift upper seat. The instruction clears this operand automatically. Default is false.
PCmd_CleanCavity	BOOL	Not Visible	Not Required	Input	Program Command to clean valve leakage cavity. The instruction clears this operand automatically. Default is false.
PCmd_CleanLower	BOOL	Not Visible	Not Required	Input	Program Command to clean lower seat. The instruction clears this operand automatically. Default is false.
PCmd_CleanUpper	BOOL	Not Visible	Not Required	Input	Program Command to clean upper seat. The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program Command to select Program command source. The instruction clears this operand automatically if Cfg_PCmdProgAsLevel = 0. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program Command to select Operator command source. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program Command to lock Program command source and disallow Operator. The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program Command to unlock Program command source and allow Operator to acquire. The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program Command to select normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
XCmd_Close	BOOL	Not Visible	Not Required	Input	External Command to close valve. The instruction clears this operand automatically. Default is false.
XCmd_Open	BOOL	Not Visible	Not Required	Input	External Command to cpen valve. The instruction clears this operand automatically. Default is false.
XCmd_LiftLower	BOOL	Not Visible	Not Required	Input	External Command to lift lower seat. The instruction clears this operand automatically. Default is false.
XCmd_LiftUpper	BOOL	Not Visible	Not Required	Input	External Command to lift upper seat. The instruction clears this operand automatically. Default is false.
XCmd_CleanCavity	BOOL	Not Visible	Not Required	Input	External Command to clean valve leakage cavity. The instruction clears this operand automatically. Default is false.
XCmd_CleanLower	BOOL	Not Visible	Not Required	Input	External Command to clean lower seat. The instruction clears this operand automatically. Default is false.
XCmd_CleanUpper	BOOL	Not Visible	Not Required	Input	External Command to clean upper seat. The instruction clears this operand automatically. Default is false.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External Command to acquire command source. The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External Command to release command source, accepted if Cfg_ExtAcqAsLevel = 0. The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External Command to acknowledge all alarms and reset latched alarms and shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter
Out_OpenData	BOOL	Visible	Not Required	Output	Output to open valve: 1 = Open.
Out_CloseData	BOOL	Visible	Not Required	Output	Output to close valve: 1 = Close.
Out_LiftLowerData	BOOL	Visible	Not Required	Output	Output to lift lower valve seat: 1 = Lift.
Out_LiftUpperData	BOOL	Visible	Not Required	Output	Output to lift upper valve seat: 1 = Lift.
Out_CavityInletData	BOOL	Visible	Not Required	Output	Output to open leakage cavity cleaning inlet: 1 = Open.
Out_CavityOutletData	BOOL	Visible	Not Required	Output	Output to close leakage cavity drain/cleaning outlet: 1 = Close.
Out_LocatorData	BOOL	Not Visible	Not Required	Output	Output to valve locator lamp/beacon: 1 = Illuminated.
Out_HornData	BOOL	Not Visible	Not Required	Output	Output to sound horn prior to commanded state change.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status (bitmapped): All bits off = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. 0 = Use Inp_InitializeReq to reinitialize.
Sts_Closed	BOOL	Visible	Not Required	Output	1 = Valve closed position achieved.
Sts_Opened	BOOL	Visible	Not Required	Output	1 = Valve opened position achieved.
Sts_LiftLower	BOOL	Visible	Not Required	Output	1 = Lift valve lower seat position achieved.
Sts_LiftUpper	BOOL	Visible	Not Required	Output	1 = Lift valve upper seat position achieved.
Sts_CleanCavity	BOOL	Not Visible	Not Required	Output	1 = Clean valve leakage cavity position achieved.
Sts_CleanLower	BOOL	Not Visible	Not Required	Output	1 = Clean valve lower seat position achieved.
Sts_CleanUpper	BOOL	Not Visible	Not Required	Output	1 = Clean valve upper seat position achieved.
Sts_Moving	BOOL	Visible	Not Required	Output	1 = Valve not yet confirmed in commanded position.
Sts_Pulsing	BOOL	Visible	Not Required	Output	1 = Pulsing valve seat for cleaning.
Sts_Locator	BOOL	Not Visible	Not Required	Output	1 = Locator/beacon for identifying valve is active.
Sts_Horn	BOOL	Not Visible	Not Required	Output	1 = Sounding horn prior to commanded state change.
Sts_Physical	BOOL	Not Visible	Not Required	Output	1 = The instruction is available to control the physical valve, 0 = Instruction is not controlling the physical valve, outputs are holding the valve closed.
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction is available to control a virtual model of the valve, 0 = Instruction is not controlling the virtual model of the valve.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output: 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status: 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Device feedback: 0 = None/Moving/Unknown, 1 = Closed, 3 = Opened, 4 = Lift lower seat, 5 = Lift upper seat, 6 = Clean cavity, 8 = Clean lower seat, 10 = Clean upper seat.
Sts_eCmd	SINT	Not Visible	Not Required	Output	Device command: 0 = None, 1 = Close, 3 = Open, 4 = Lift lower seat, 5 = Lift upper seat, 6 = Clean cavity, 8 = Clean lower seat, 10 = Clean upper seat.
Sts_eSts	SINT	Not Visible	Not Required	Output	Device status: 0 = Unknown, 1 = Closed, 3 = Opened, 4 = Lift lower seat, 5 = Lift upper seat, 6 = Clean cavity, 8 = Clean lower seat, 10 = Clean upper seat, 11 = Moving, 12 = Pulse lower seat, 13 = Pulse upper seat, 14 = Horn, 15 = Out of service.
Sts_eState	SINT	Not Visible	Not Required	Output	Device state for HMI state diagram: 0 = De-energized, 1 = Closed, 2 = Closed cavity outlet, 3 = Opened, 4 = Lift lower seat, 5 = Lift upper seat, 6 = Clean cavity, 7 = Lift lower seat for cleaning, 8 = Clean lower seat, 9 = Lift upper seat for cleaning, 10 = Clean upper seat.
Sts_eFault	SINT	Not Visible	Not Required	Output	Device fault status: 0 = None, 16 = Position fail, 32 = I/O fault, 34 = Configuration error.
Sts_eOutState	SINT	Not Visible	Not Required	Output	State of outputs to physical device: 0 = De-energized, 1 = Close, 2 = Close cavity outlet, 3 = Open, 4 = Lift lower seat, 5 = Lift upper seat, 6 = Clean cavity, 7 = Lift lower seat for cleaning, 8 = Clean lower seat, 9 = Lift upper seat for cleaning, 10 = Clean upper seat, 11 = Horn.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotify	SINT	Not Visible	Not Required	Output	Summary alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	Summary alarm status including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	Not Visible	Not Required	Output	I/O fault alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFail	SINT	Not Visible	Not Required	Output	Position fail alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyIntlkTrip	SINT	Not Visible	Not Required	Output	Interlock trip alarm status: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_UnackAlmCount	SINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_eSrc	INT	Not Visible	Not Required	Output	Current command source: 0 = Logic not in use, 4 = Hand, 8 = Maintenance, 16 = Override, 32 = Program, 33 = Program Locked, 34 = Program default (Normal), 64 = Operator, 65 = Operator Locked, 66 = Operator default (Normal), 128 = Maintenance Out of Service, 129 = Programmed Out of Service (EnableIn false), 256 = External.
Sts_bSrc	INT	Not Visible	Not Required	Output	Active command source selections (bitmapped, for HMI): .0 = Hand, .1 = Programmed Out of Service (EnableIn false), .2= Maintenance Out of Service, .3 = Maintenance, .4 = Override, .5 = External, .6 = Program Locked, .7 = Program (unlocked), .8 = Operator Locked, .9 = Operator (unlocked).
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Valve has been acquired by Program and is ready and available for control.
Sts_OpenIntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Valve can be acquired by Program and is available to open when open interlocks are OK.
Sts_LowerSeatIntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Valve can be acquired by Program and is available to lift lower seat when lower seat interlocks are OK.
Sts_UpperSeatIntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Valve can be acquired by Program and is available to lift upper seat when upper seat interlocks are OK.
Sts_CavityIntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Valve can be acquired by Program and is available to clean seat or cavity when cavity interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks and permissives are bypassed.
Sts_BypActive	BOOL	Visible	Not Required	Output	1 = Interlock/permissive bypassing is active (bypassed by command or in Maintenance command source).
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	Visible	Not Required	Output	1 = Device not ready, see Sts_NrdyXxx detail bits for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Device not ready, configuration error.
Sts_NrdyFail	BOOL	Not Visible	Not Required	Output	1 = Device not ready, position fail, shed requires reset.
Sts_NrdyOpenIntlk	BOOL	Not Visible	Not Required	Output	1 = Device not ready, open interlock not OK, valve cannot open, and if opened, valve will close.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_NrdyLowerSeatIntlk	BOOL	Not Visible	Not Required	Output	1 = Device not ready, lower seat interlock not OK, valve cannot lift or clean lower seat, and if seat lifted, valve will close.
Sts_NrdyUpperSeatIntlk	BOOL	Not Visible	Not Required	Output	1 = Device not ready, upper seat interlock not OK, valve cannot lift or clean upper seat, and if seat lifted, valve will close.
Sts_NrdyCavityIntlk	BOOL	Not Visible	Not Required	Output	1 = Device not ready, cavity Interlock not OK, valve cannot clean cavity or seats, and if cleaning, valve will close.
Sts_NrdyIOFault	BOOL	Not Visible	Not Required	Output	1 = Device not ready, I/O fault, shed requires reset.
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Device not ready, device is Out of Service.
Sts_NrdyPrioClose	BOOL	Not Visible	Not Required	Output	1 = Device not ready, Operator or External priority Close Command, shed requires reset.
Sts_NrdyVirtualPhysical	BOOL	Not Visible	Not Required	Output	1 = Device not ready, valve is transitioning between physical and virtual operation.
Sts_Err	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, see Sts_ErrXxx detail bits for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Logix tag-based alarm settings invalid.
Sts_bErrFdbkTime	INT	Not Visible	Not Required	Output	Error in configuration, bit = 1 indicates which state's Cfg_FdbkTimeStX is invalid. Valid = 0.0 to 60.0.
Sts_ErrOpenPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_OpenPulseTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrClosePulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_ClosePulseTime invalid. Valid = 0.0 to 2147483.0.
Sts_ErrFailTime	BOOL	Not Visible	Not Required	Output	1 = Error in configuration, Cfg_FailTime invalid. Valid = 0.0 to 2147483.0.
Sts_Hand	BOOL	Visible	Not Required	Output	1 = Hand command source is selected.
Sts_OoS	BOOL	Visible	Not Required	Output	1 = Out of Service command source is selected.
Sts_Maint	BOOL	Visible	Not Required	Output	1 = Maintenance command source is selected.
Sts_Ovrd	BOOL	Visible	Not Required	Output	1 = Override command source is selected.
Sts_Ext	BOOL	Visible	Not Required	Output	1 = External command source is selected.
Sts_Prog	BOOL	Visible	Not Required	Output	1 = Program (unlocked) command source is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program Locked command source is selected.
Sts_Oper	BOOL	Visible	Not Required	Output	1 = Operator (unlocked) command source is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator Locked command source is selected.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Visible	Not Required	Output	Program/Operator lock (latch) state: 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selected command source is the normal source (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External command source selection is inhibited, External is not available in current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program command source selection is inhibited, Program is not available in current state.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Command to acquire Maintenance command source was received this scan.
Sts_CmdConflict	BOOL	Not Visible	Not Required	Output	1 = Conflicting commands received this scan.
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = An alarm is shelved or disabled.
Sts_IOFault	BOOL	Not Visible	Not Required	Output	1 = I/O communication fault. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVLVMP_Tag.@Alarms.Alm_IOFault.AlarmElement.
Sts_Fail	BOOL	Visible	Not Required	Output	1 = Valve position failure. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVLVMP_Tag.@Alarms.Alm_Fail.AlarmElement.
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Valve closed by an interlock not OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVLVMP_Tag.@Alarms.Alm_IntlkTrip.AlarmElement .
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_Close	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Close, enable button.
XRdy_Open	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Open, enable button.
XRdy_LiftLower	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_LiftLower, enable button.
XRdy_LiftUpper	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_LiftUpper, enable button.
XRdy_CleanCavity	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_CleanCavity, enable button.
XRdy_CleanLower	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_CleanLower, enable button.
XRdy_CleanUpper	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_CleanUpper, enable button.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable button.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object Owner ID, 0 = not owned.

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Command source selection.
MCmd_Acq	BOOL	Maintenance Command to acquire Maintenance command source. The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance Command to bypass all bypassable interlocks and permissives. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_Check	BOOL	Maintenance Command to remove bypass and check all interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance Command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance Command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance Command to select Physical device operation. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Maintenance Command to release Maintenance command source. The instruction clears this operand automatically. Default is false.
MCmd_ToggleLocator	BOOL	Maintenance Command to toggle on/off valve locator/beacon. Default is false.
MCmd_Virtual	BOOL	Maintenance Command to select Virtual device operation. The instruction clears this operand automatically. Default is false.
OCmd_CleanCavity	BOOL	Operator Command to clean valve leakage cavity. The instruction clears this operand automatically. Default is false.
OCmd_CleanLower	BOOL	Operator Command to clean valve lower seat. The instruction clears this operand automatically. Default is false.
OCmd_CleanUpper	BOOL	Operator Command to clean valve upper seat. The instruction clears this operand automatically. Default is false.
OCmd_Close	BOOL	Operator Command to close valve. The instruction clears this operand automatically. Default is false.
OCmd_LiftLower	BOOL	Operator Command to lift lower valve seat. The instruction clears this operand automatically. Default is false.
OCmd_LiftUpper	BOOL	Operator Command to lift upper valve seat. The instruction clears this operand automatically. Default is false.
OCmd_Lock	BOOL	Operator Command to select Operator Locked command source and disallow Program. The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator Command to select configured normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Open	BOOL	Operator Command to open valve. The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator Command to select Operator (unlocked) command source. The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator Command to select Program (unlocked) command source. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
OCmd_Reset	BOOL	Operator Command to reset shed latches and returned-to-normal latched alarms. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator Command to acknowledge all alarms and reset latched alarms and shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Operator Command to unlock Operator command source and allow Program to acquire. The instruction clears this operand automatically. Default is false.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display.
HMI_eCmdState	SINT	Command to valve, for use on HMI/dialog: 0 = None, 1 = Close, 3 = Open, 4 = Lift lower seat, 5 = Lift upper seat, 6 = Clean cavity, 8 = Clean lower seat, 10 = Clean upper seat.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_ToggleLocator	BOOL	1 = Ready for MCmd_ToggleLocator, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_CleanCavity	BOOL	1 = Ready for OCmd_CleanCavity, enable HMI button.
ORdy_CleanLower	BOOL	1 = Ready for OCmd_CleanLower, enable HMI button.
ORdy_CleanUpper	BOOL	1 = Ready for OCmd_CleanUpper, enables HMI button.
ORdy_Close	BOOL	1 = Ready for OCmd_Close, enable HMI button.
ORdy_LiftLower	BOOL	1 = Ready for OCmd_LiftLower, enable HMI button.
ORdy_LiftUpper	BOOL	1 = Ready for OCmd_LiftUpper, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Open	BOOL	1 = Ready for OCmd_Open, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = Ready for OCmd_Reset, enable HMI button.
ORdy_ResetAckAll	BOOL	1 = Ready for OCmd_ResetAckAll, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component

BUS_OBJ Structure

The BUS_OBJ structure links the device to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices, and items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

Alarms

Discrete Logix Designer tag-based alarms are defined for these members:

Member	Alarm Name	Description
Sts_IntlkTrip	Alm_IntlkTrip	Device de-energized or set to Position 1 by an interlock Not OK.
Sts_IOFault	Alm_IOFault	I/O fault.
Sts_Fail	Alm_Fail	Device failure.

Mark the alarm as used or unused and set standard configuration members of the discrete Logix Tag based alarm. Use this format to access alarm elements:

Tag.@Alarms.AlarmName.AlarmElement

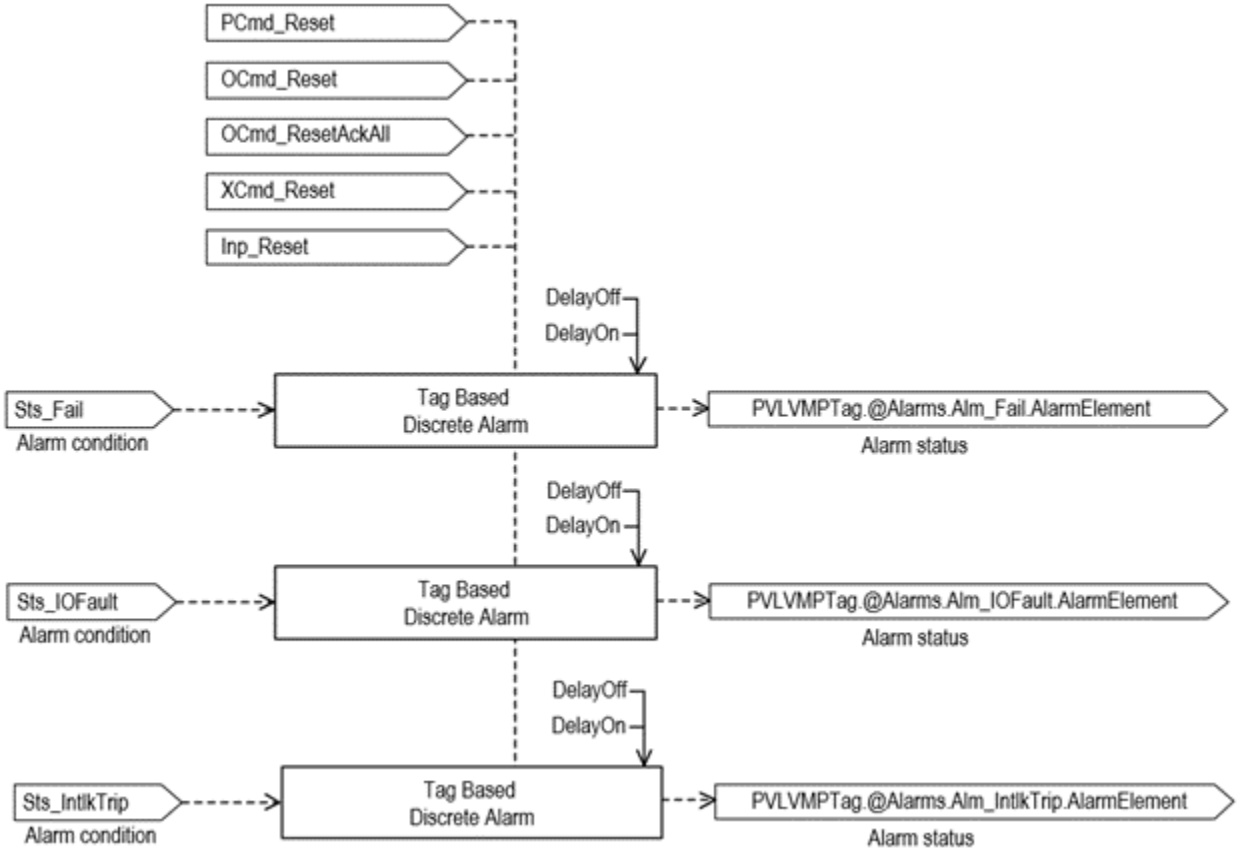
The PVLVMP instruction uses these alarms:

- Raises the Interlock Trip alarm when an interlock not-OK condition occurs for a particular state and the device is currently commanded to

that state. The device will be commanded to close when an interlock trip occurs. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.

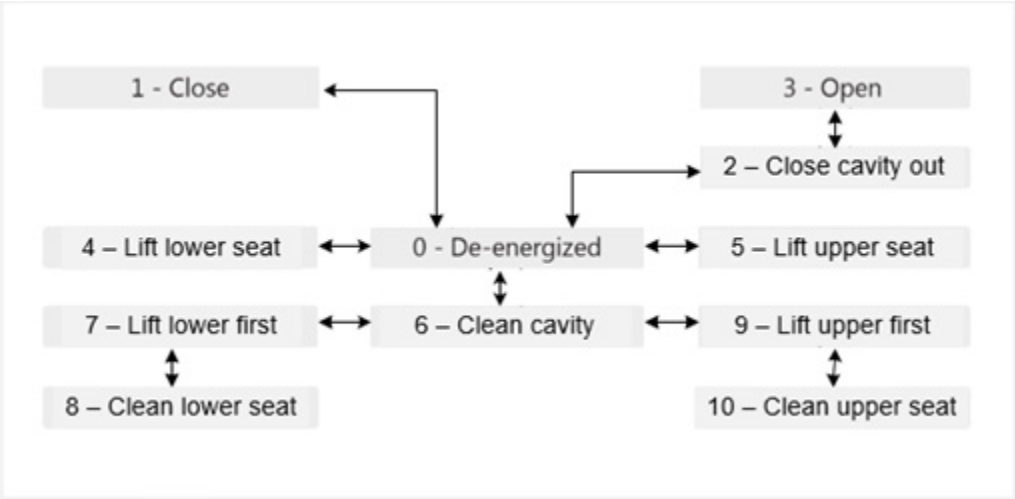
- Raises the I/O Fault alarm when the Inp_IOFault input is true. This input is usually used to indicate to the instruction that a communication failure has occurred for its I/O. If the I/O Fault is configured as a shed fault, the device will be commanded to close and will remain closed until reset.
- Raises the Fail alarm when the valve is commanded to a new position and the device feedbacks fail to confirm that the valve reached each required position within the configured failure time. If the Failure is configured as a shed fault, the valve will be commanded closed and cannot be opened until reset.

Program, Operator, and External commands reset latched alarms, and reset and acknowledge all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PVLVMP instruction.

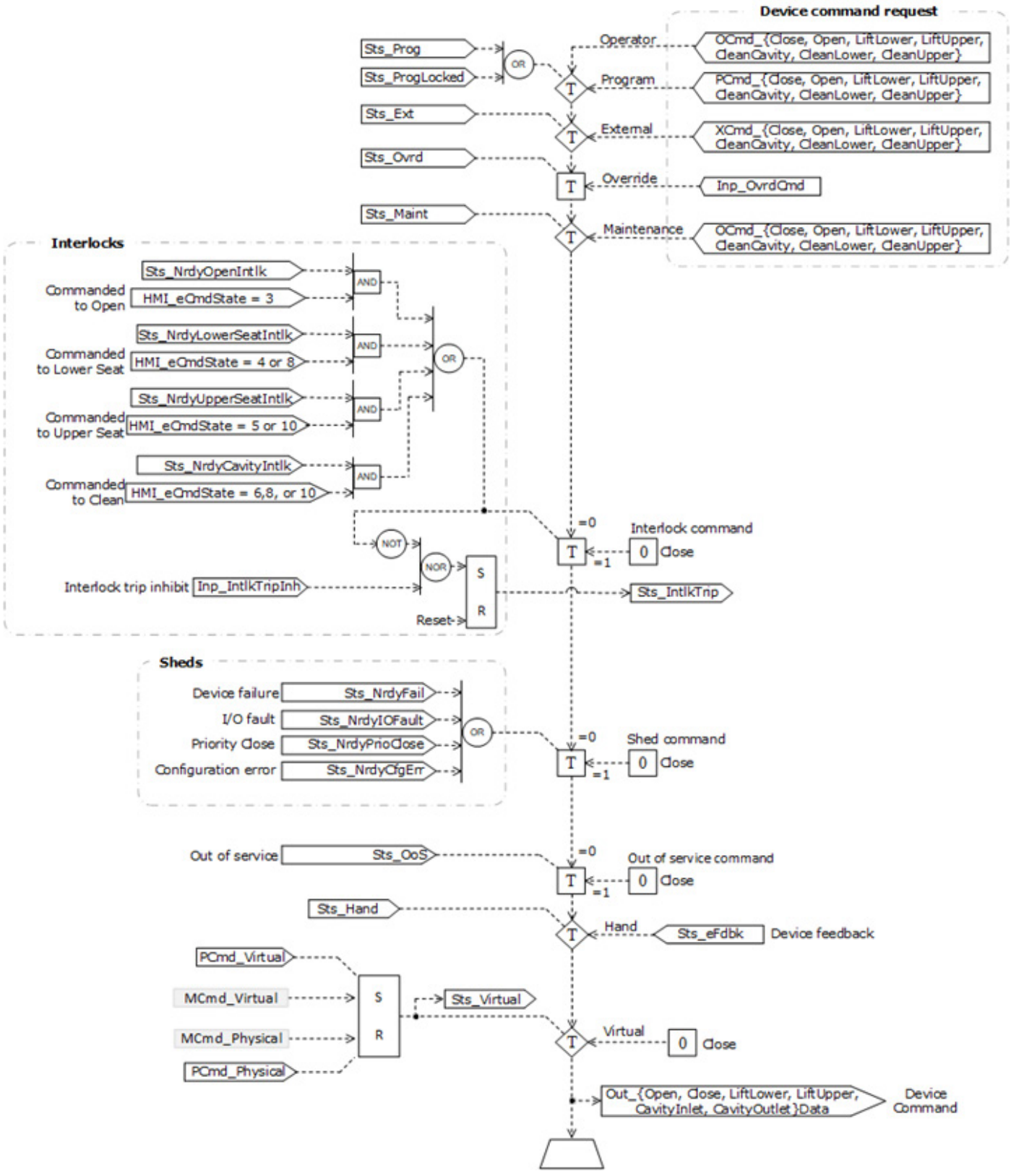


Operation

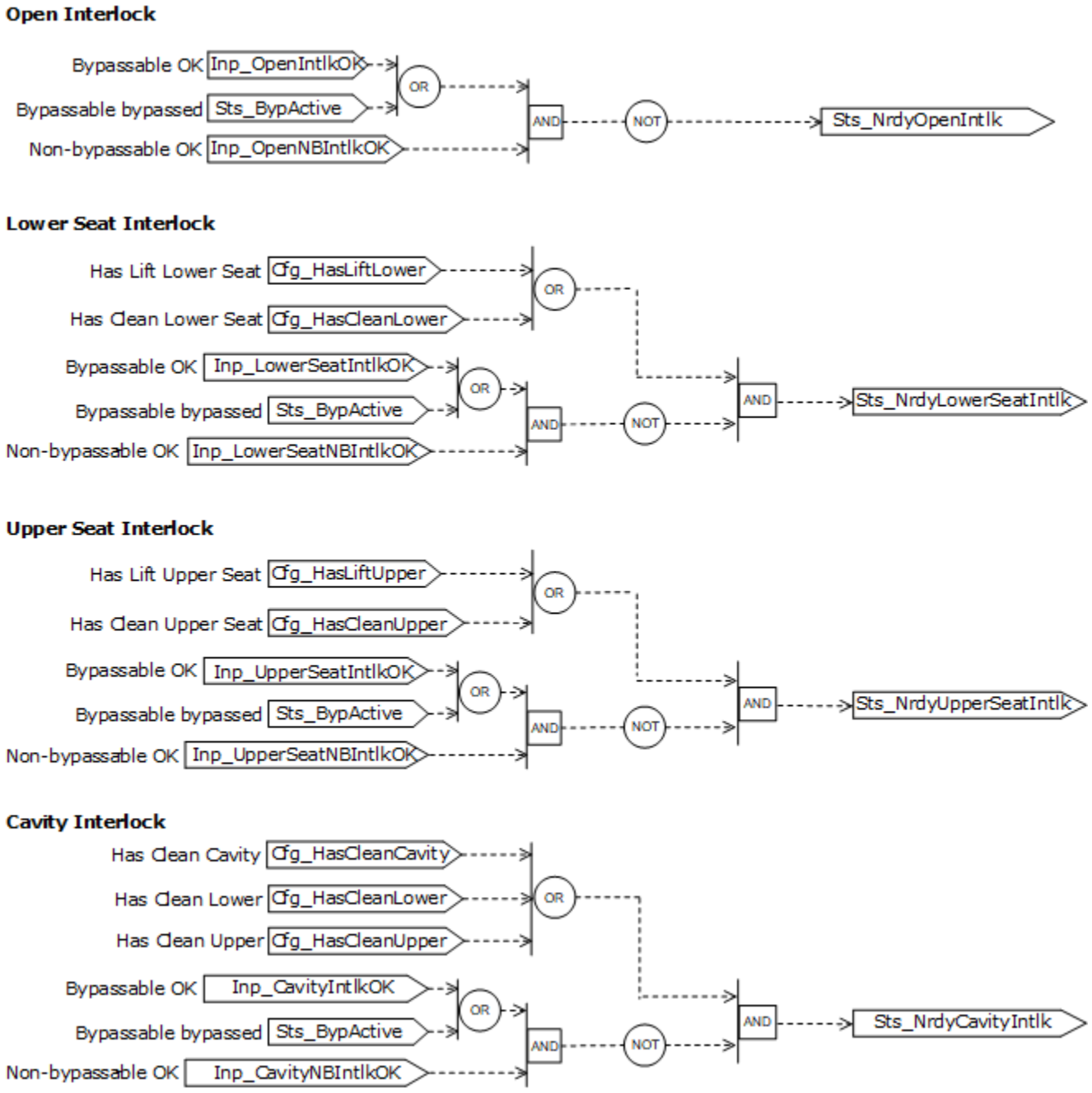
The PVLVMP instruction operates by using a state model, as shown in this diagram.



This diagram illustrates functionality of the PVLVMP instruction.



This diagram shows logic of interlocks associated with commands of the PVLVMP instruction.



Operator command request confirmation

The PVLVMP instruction enables these operator commands and settings:

- OCmd_CleanCavity
- OCmd_CleanLower
- OCmd_CleanUpper
- OCmd_Close
- OCmd_LiftLower

- OCmd_LiftUpper
- OCmd_Open

Enforced security might require the request to be confirmed or canceled before the selected command executes or setting is accepted. The instruction checks the security rules by inspecting Cfg_CnfrmReqd. If Cfg_CnfrmReqd = 0, no confirmation is required and the request executes immediately. If Cfg_CnfrmReqd = 1, the instruction waits for operator confirmation or cancelation of the command. If Cfg_CnfrmReqd = 2 or 3, eSignature is needed before command confirmation is enabled.

Virtualization

Use virtualization for instruction testing and operator training. Command virtual operation using program command PCmd_Virtual or maintenance command MCmd_Virtual. After finishing virtual operation, use program command PCmd_Physical or maintenance command MCmd_Physical to return to normal physical device operation.

When Virtualization is active, the device outputs of the PVLVMP instruction hold at 0, virtual feedback of a working device is provided, and I/O faults are ignored. Manipulate the instruction to operate as if a working valve is present.

Initialization

The instruction is normally initialized in the instruction first run. Request re-initialization by setting Inp_InitializeReq = 1. For proper initialization, when adding the instruction while performing an online edit of the code, make sure that Inp_InitializeReq = 1, the default value.

Configuration of Strings for HMI

Configure strings for HMI faceplates, displayed in FactoryTalk View, and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items.

- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link
- Navigation to an object with more information
- Name of Interlock Trip Alarm
- Name of I/O Fault Alarm
- Name of Fail Alarm

Command Source

The instruction uses these command sources. The command sources are prioritized in order from highest to lowest in this table.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled. Outputs are de-energized. Valve commands from any source are discarded. On return to In Service, the valve is commanded closed.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (for example, field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enable control sources as Configuration

The user can enable and disable individual control sources. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. Commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Program state is disabled, the destination of the OCmd_Prog command becomes the Program Locked state instead of the Program state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the

command was eliminated there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Monitor the PVLVMP Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The device is de-energized.
Instruction first run	Any commands received before first scan are discarded. The device is commanded to the closed state.
Rung-condition-in is false	Handled the same as if the device is taken Out of Service by command. The device outputs are de-energized, and the device Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. The rung-condition-out continues as false.

Condition/State	Action Taken
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The device is de-energized.
Instruction first run	Any commands received before first scan are discarded. The device is commanded to the closed state.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the device is taken Out of Service by command. The device outputs are de-energized, and the device Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. EnableOut is set to false.
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic, it executes.

Condition/State	Action taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

In this example, the PVLVMP instruction is used to implement a mix-proof valve feeding bulk material from a storage silo into a mixer. For this example, the mix-proof valve connects to the control system by using two inputs and three outputs. The valve state configurations are shown in these tables

State o (De-energized). Note: Close output is set for display purposes only:

	Output	Feedback	
	State	Required	State
Close	1	0	0
Open	0	0	0
Lift lower seat	0	1	0

	Output	Feedback	
	State	Required	State
Lift upper seat	0	1	0
Cavity in	0	0	0
Cavity out	0	0	0

State 1 (Close):

	Output	Feedback	
	State	Required	State
Close	0	0	0
Open	0	0	0
Lift lower seat	0	1	0
Lift upper seat	0	1	0
Cavity in	0	0	0
Cavity out	0	0	0

State 2 (Close cavity out):

	Output	Feedback	
	State	Required	State
Close	0	0	0
Open	1	0	0
Lift lower seat	0	1	1
Lift upper seat	0	1	1
Cavity in	0	0	0
Cavity out	0	0	0

State 3 (Open):

	Output	Feedback	
	State	Required	State
Close	0	0	0
Open	1	0	0
Lift lower seat	0	1	1
Lift upper seat	0	1	1
Cavity in	0	0	0
Cavity out	0	0	0

State 4 (Lift lower seat):

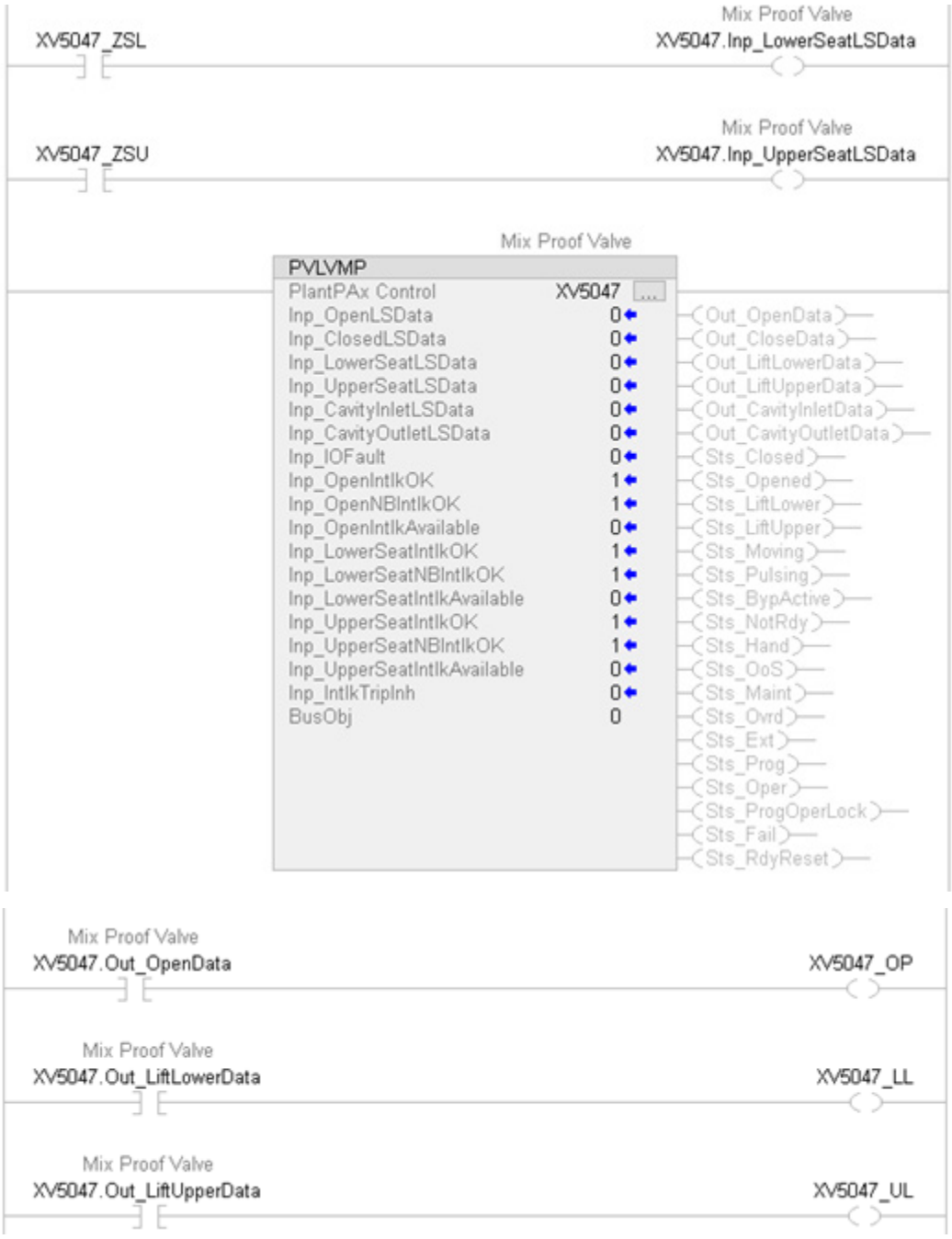
	Output	Feedback	
	State	Required	State
Close	0	0	0
Open	0	0	0
Lift lower seat	1	1	1
Lift upper seat	0	1	0
Cavity in	0	0	0

	Output	Feedback	
	State	Required	State
Cavity out	0	0	0

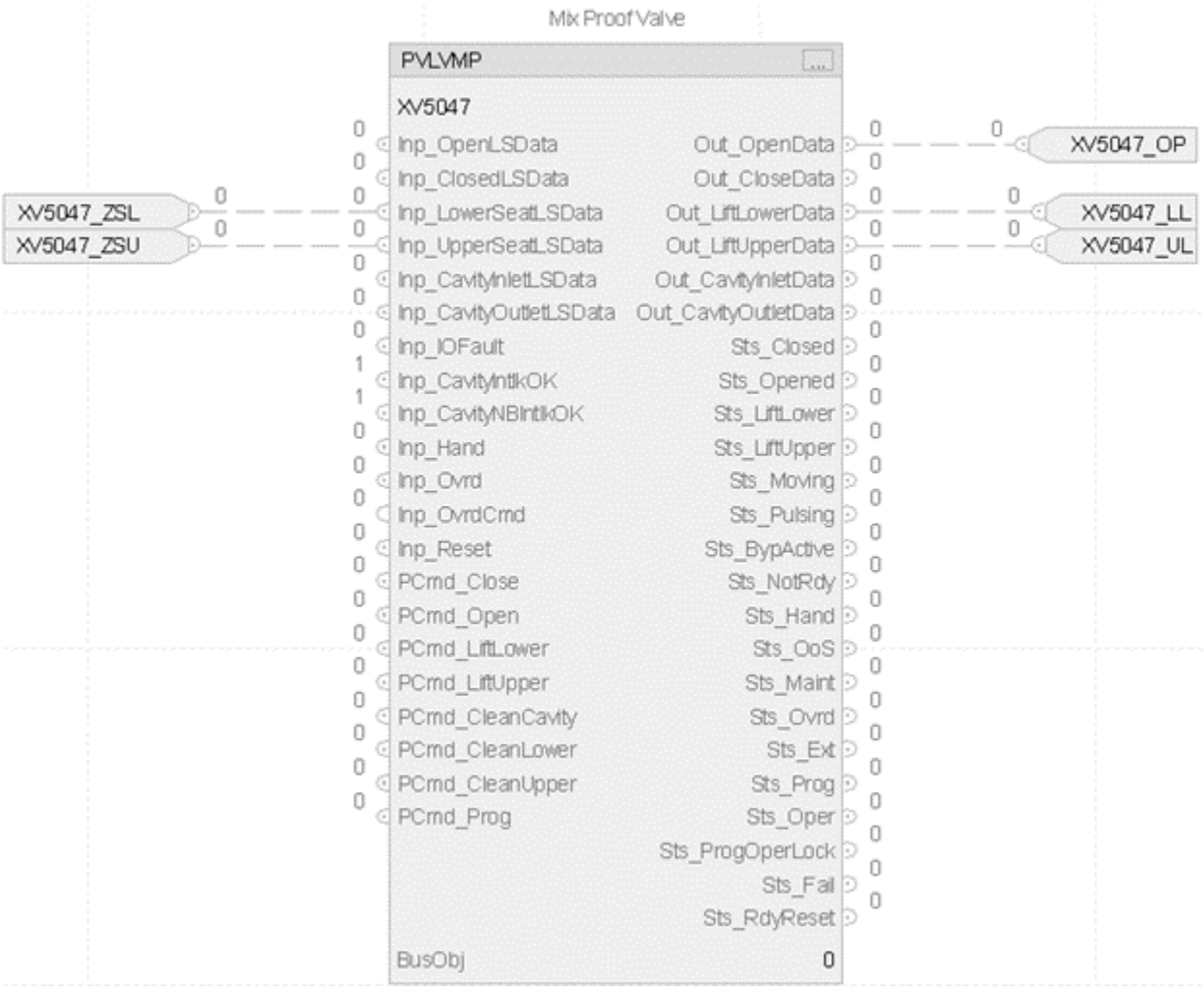
State 5 (Lift upper seat):

	Output	Feedback	
	State	Required	State
Close	0	0	0
Open	0	0	0
Lift lower seat	0	1	0
Lift upper seat	1	1	1
Cavity in	0	0	0
Cavity out	0	0	0

Ladder Diagram



Function Block Diagram



Structured Text

XV5047.Inp_LowerSeatLSData:=XV5047_ZSL

XV5047.Inp_UpperSeatLSData:=XV5047_ZSU

PVLVMP(XV5047, 0);

XV5047_OP:=XV5047.Out_OpenData;

XV5047_LL:=XV5047.Out_LiftLowerData;

XV5047_LU:=XV5047.Out_LiftUpperData;

Process Valve Statistics (PVLVS)

This information applies to the CompactLogix 5380P and ControlLogix 5580P controllers.

The Process Valve Statistics Object (PVLVS) instruction monitors a two-state (open and close) valve and records statistics for stroke times and stroke

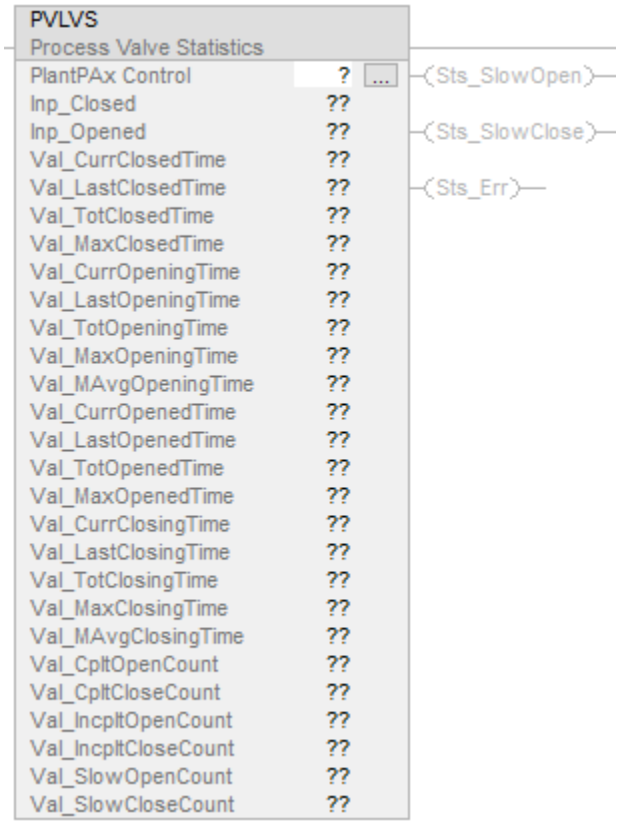
counts to aid in planning maintenance or diagnosing valve and actuator problems. The PVLVS instruction is designed to work with the PVLV (solenoid, motor, and hand operated) valve instruction.

The PVLVS instruction records these statistics:

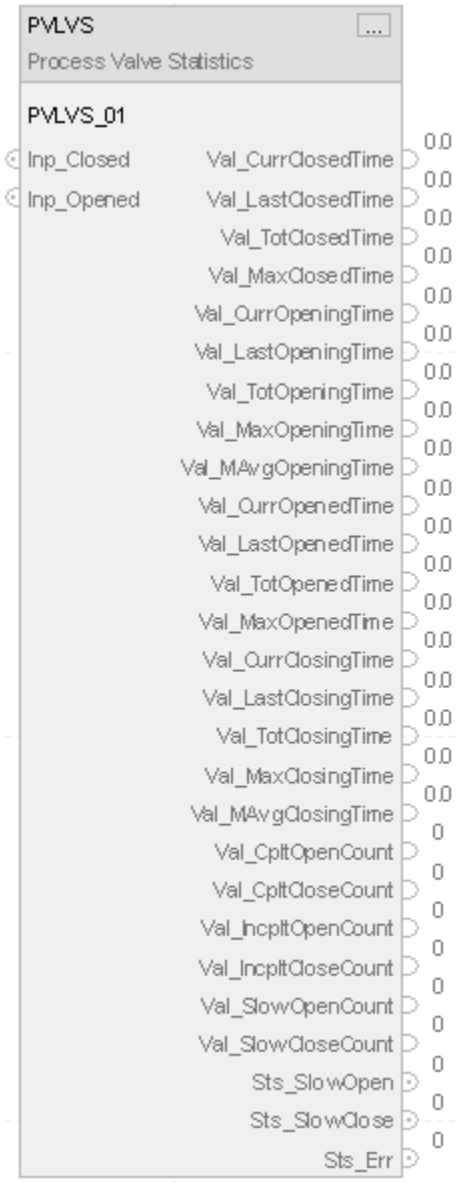
- Amount of time in the current state (closed, opening, opened, closing, stopped/other)
- Amount of time the valve was in each state the last time it was in that state (closed, opening, opened, closing, stopped/other)
- Maximum amount of time spent in each state (closed, opening, opened, closing, and stopped/other); these are the highest values achieved by the previous statistics
- Total amount of time spent in each state (closed, opening, opened, closing, stopped/other)
- Moving average of the last 10 closing (close stroke) times
- Moving average of the last 10 opening (open stroke) times
- Number of completed open strokes (from closed to opened)
- Number of completed close strokes (from opened to closed)
- Number of incomplete open strokes (from closed to opening and back to closed)
- Number of incomplete close strokes (from opened to closing and back to opened)
- Number of times the valve was in the stopped/other state
- Number of open strokes that took longer than the configured Slow Open Time
- Number of close strokes that took longer than the configured Slow Close Time

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PVLVS (PVLVS_01);

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_VALVE_STATISTICS	tag	Data structure required for proper operation of the instruction.

P_VALVE_STATISTICS Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	Description
EnableIn	BOOL	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically.
Inp_Closed	BOOL	1 = Device is confirmed Closed. Default is false.
Inp_Opened	BOOL	1 = Device is confirmed Opened. Default is false.
Inp_StopOther	BOOL	1 = Device is confirmed Stopped / Other. Default is false.
Cfg_HasStopOther	BOOL	1 = Device has Stopped or other state(s) to be monitored. Default is false.
Cfg_SlowOpenTime	REAL	Maximum time Opening (seconds) before raising Sts_SlowOpen. Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
Cfg_SlowCloseTime	REAL	Maximum time Closing (seconds) before raising Sts_SlowClose. Valid = 0.0 to 2147483.0 seconds. Default is 10.0.
PCmd_ClearTotTimes	BOOL	Program command to clear total time statistics. Default is false.
PCmd_ClearMaxTimes	BOOL	Program command to clear maximum time statistics. Default is false.
PCmd_ClearStrokeCounts	BOOL	Program command to clear stroke count statistics. Default is false.
PCmd_ClearSlowCounts	BOOL	Program command to clear device slow count statistics. Default is false.
PCmd_ClearMAvgs	BOOL	Program command to clear moving average stroke times. Default is false.

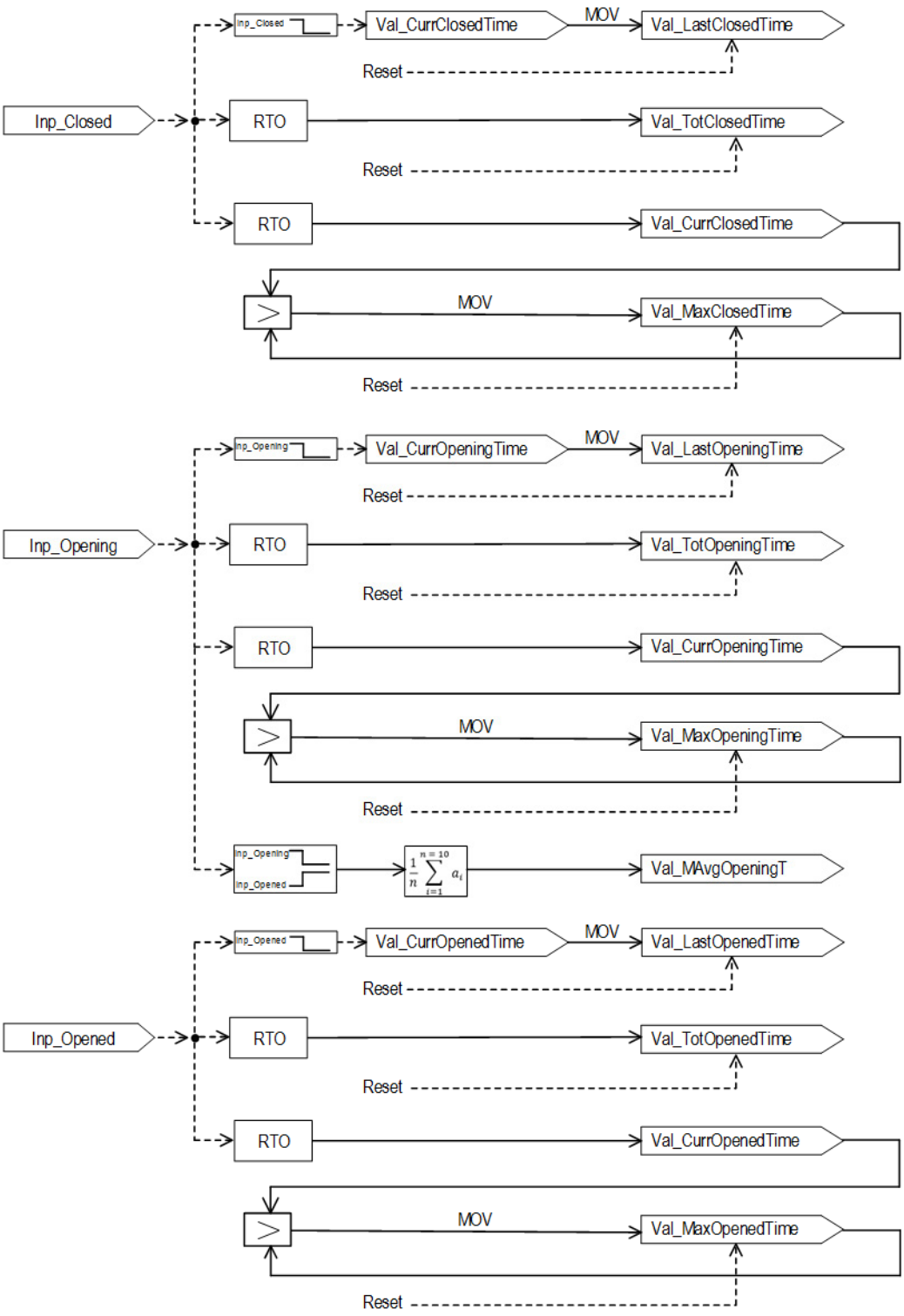
Public Output Members	Data Type	Description
EnableOut	BOOL	Enable Output - System Defined Parameter
Val_CurrClosedTime	REAL	Current time in Closed state (seconds).
Val_LastClosedTime	REAL	Time in Closed state (seconds) last time device was closed.
Val_TotClosedTime	REAL	Accumulated time in Closed state (hours).
Val_MaxClosedTime	REAL	Maximum time in Closed state (hours) of any occurrence.

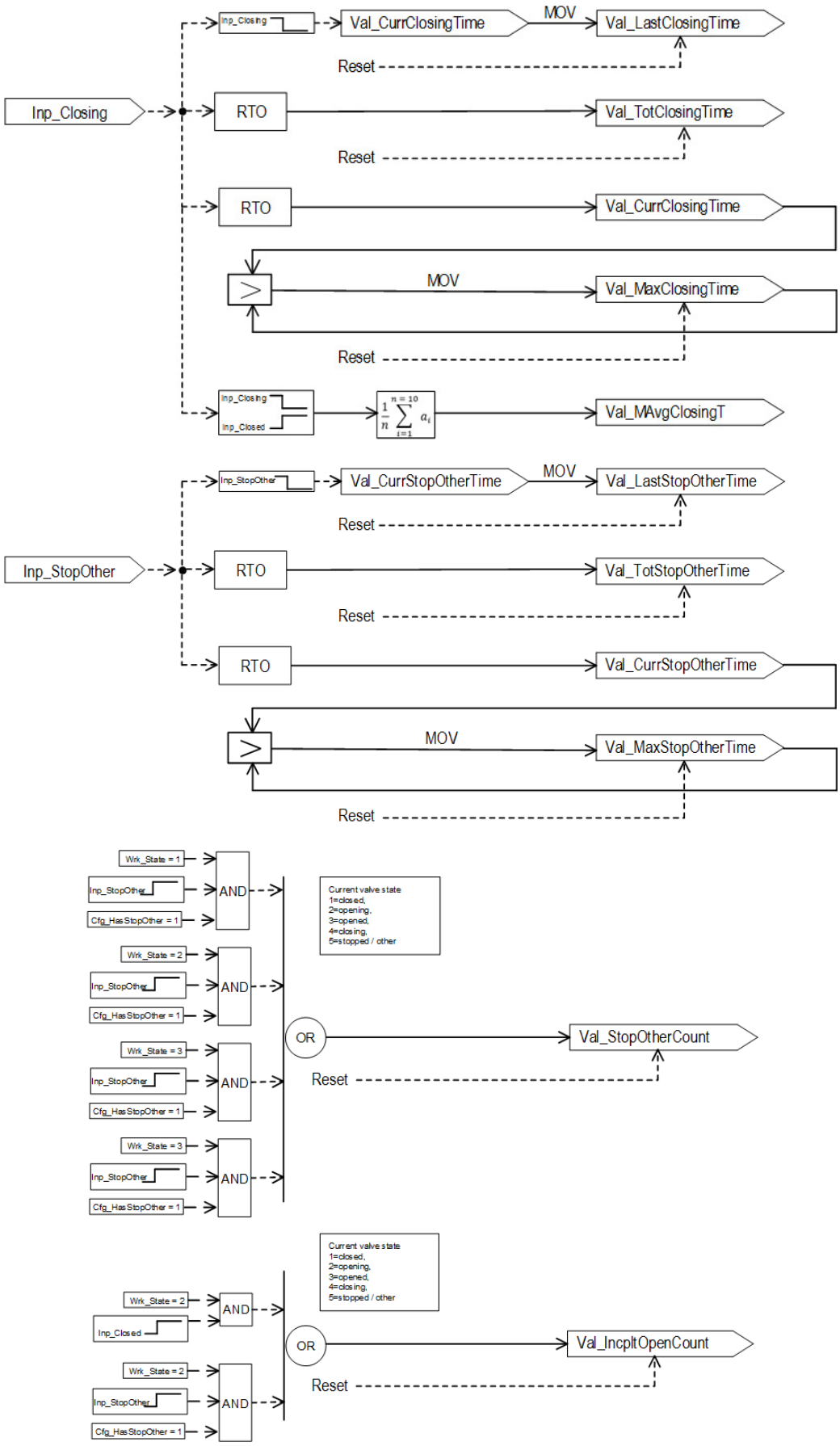
Public Output Members	Data Type	Description
Val_CurrOpeningTime	REAL	Current time in Opening state (seconds).
Val_LastOpeningTime	REAL	Time in Opening state (seconds) last time device was opening.
Val_TotOpeningTime	REAL	Accumulated time in Opening state (hours).
Val_MaxOpeningTime	REAL	Maximum time in Opening state (hours) of any occurrence.
Val_MAvgOpeningTime	REAL	Moving average Open stroke time, last 10 complete open strokes (seconds).
Val_CurrOpenedTime	REAL	Current time in Opened state (seconds).
Val_LastOpenedTime	REAL	Time in Opened state (seconds) last time device was opened.
Val_TotOpenedTime	REAL	Accumulated time in Opened state (hours).
Val_MaxOpenedTime	REAL	Maximum time in Opened state (hours) of any occurrence.
Val_CurrClosingTime	REAL	Current time in Closing state (seconds).
Val_LastClosingTime	REAL	Time in Closing state (seconds) last time device was closing.
Val_TotClosingTime	REAL	Accumulated time in Closing state (hours).
Val_MaxClosingTime	REAL	Maximum time in Closing state (hours) of any occurrence.
Val_MAvgClosingTime	REAL	Maximum time in Closing state (seconds) of any occurrence.
Val_CurrStopOtherTime	REAL	Current time in Stopped / Other state (seconds).
Val_LastStopOtherTime	REAL	Time in Stopped / Other state (seconds) last time device was stopped (or other).
Val_TotStopOtherTime	REAL	Accumulated time in Stopped / Other state (hours).
Val_MaxStopOtherTime	REAL	Maximum time in Stopped / Other state (hours) of any occurrence.
Val_CpltOpenCount	DINT	Count of complete device Open strokes (Closed to Opened).
Val_CpltCloseCount	DINT	Count of complete device Close strokes (Opened to Closed).
Val_IncpltOpenCount	DINT	Count of incomplete device Open strokes (Closed - Moving - Closed).
Val_IncpltCloseCount	DINT	Count of incomplete device Close strokes (Opened - Moving - Opened).
Val_StopOtherCount	DINT	Count of device Stopped / Other occurrences.
Val_SlowOpenCount	DINT	Count of device Slow to Open occurrences.
Val_SlowCloseCount	DINT	Count of device Slow to Close occurrences.
Sts_SlowOpen	BOOL	1 = Last Closed to Opened stroke exceeded configured time threshold.
Sts_SlowClose	BOOL	1 = Last Opened to Closed stroke exceeded configured time threshold.
Sts_Err	BOOL	1 = Configuration Error: invalid Slow Open Time or Slow Close Time.
Sts_ErrSlowCloseTime	BOOL	1 = Error in configuration: Invalid SlowCloseTime timer preset (use 0.0 to 2147483.0).
Sts_ErrSlowOpenTime	BOOL	1 = Error in configuration: Invalid SlowOpenTime timer preset (use 0.0 to 2147483.0).

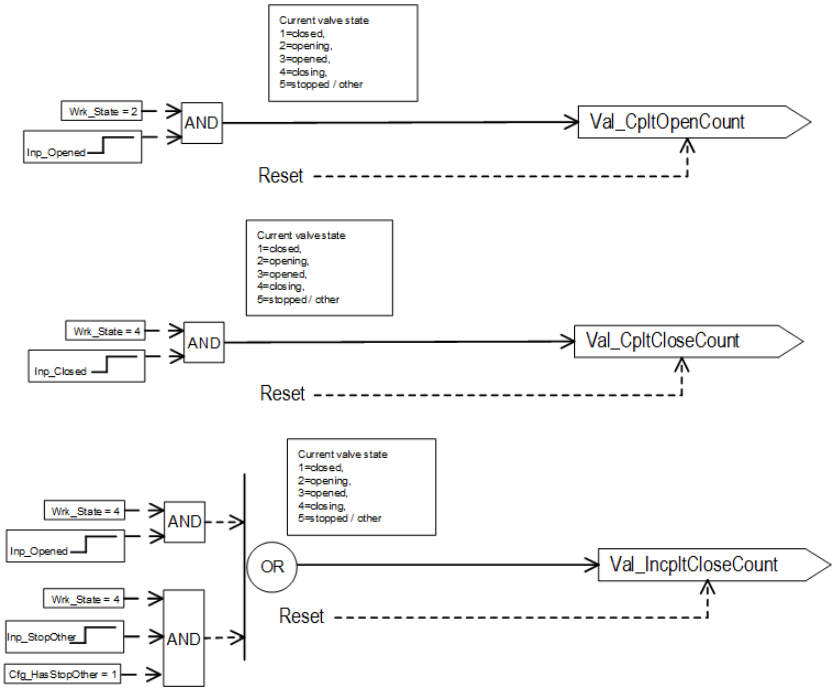
Private Input Members	Data Type	Description
MCmd_ClearMAvgs	BOOL	Maintenance command to clear moving average stroke times. Default is false.
MCmd_ClearMaxTimes	BOOL	Maintenance command to clear maximum time statistics. Default is false.
MCmd_ClearSlowCounts	BOOL	Maintenance command to clear device slow count statistics. Default is false.
MCmd_ClearStrokeCounts	BOOL	Maintenance command to clear stroke count statistics. Default is false.
MCmd_ClearTotTimes	BOOL	Maintenance command to clear total time statistics. Default is false.

Operation

These diagrams illustrate the functionality of the PVLVS instruction:




Inp_Closing
Val_CurrClosingTime
MOV
Val_LastClosingTime
Reset
Inp_Closing
RTO
Val_TotClosingTime
Reset
RTO
Val_CurrClosingTime
MOV
Val_MaxClosingTime
Reset
Inp_Closing
Inp_Closed
$\frac{1}{n}\sum_{i=1}^{n=10} a_i$
Val_MAvgClosingT
Inp_StopOther
Val_CurrStopOtherTime
MOV
Val_LastStopOtherTime
Reset
Inp_StopOther
RTO
Val_TotStopOtherTime
Reset
RTO
Val_CurrStopOtherTime
MOV
Val_MaxStopOtherTime
Reset
Wrk_State = 1
Inp_StopOther
Cfg_HasStopOther = 1
AND
Wrk_State = 2
Inp_StopOther
Cfg_HasStopOther = 1
AND
Wrk_State = 3
Inp_StopOther
Cfg_HasStopOther = 1
AND
Wrk_State = 3
Inp_StopOther
Cfg_HasStopOther = 1
AND
Current valve state
1=closed,
2=opening,
3=opened,
4=closing,
5=stopped / other
OR
Val_StopOtherCount
Reset
Wrk_State = 2
Inp_Closed
AND
Wrk_State = 2
Inp_StopOther
Cfg_HasStopOther = 1
AND
Current valve state
1=closed,
2=opening,
3=opened,
4=closing,
5=stopped / other
OR
Val_IncpltOpenCount
Reset



Configuration of Strings for HMI

Configure strings for HMI faceplates (FT View) and for the Logix Designer configuration dialog box. The strings are set to extended properties of tag items. Configure the strings in Logix Designer only.

- Valve is confirmed Stopped / Other (in Logix Designer dialog box) – Description of Inp_StopOther item.
- Description
- Label for graphic symbol
- Display Library for HMI Faceplate call-up
- Instruction name
- Area name
- URL link

Monitor the PVLVS instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Rung-condition-out is cleared to false. Total times, stroke counts and slow counts are maintained through a power cycle. Current times are cleared. The internal state is set to **unknown**. When an input shows the valve in a known condition, the main logic transitions to the corresponding state.
Instruction first run	All commands that are automatically cleared each execution are cleared and ignored. The instruction executes normally.
Rung-condition-in is false	Set rung-condition-out to rung-condition-in. If this instruction is on a false rung, or if EnableIn is false in FBD, Total times, stroke counts, and slow counts are maintained, but Current times are cleared. The internal state is set to **unknown**. Copies the current time of the previous state to its last time and resets the current time (and accumulated 10ths of hours, if applicable). The internal state is set to **unknown** (disabled). When normal execution (Logic routine) is resumed, when an input shows the valve in a known condition, a transition to the corresponding state occurs. Should scan all the retentive timers FALSE to stop them.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
Instruction first scan	See Instruction first run in the Ladder Diagram table.
EnableIn is false	See Rung-condition-in is false in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

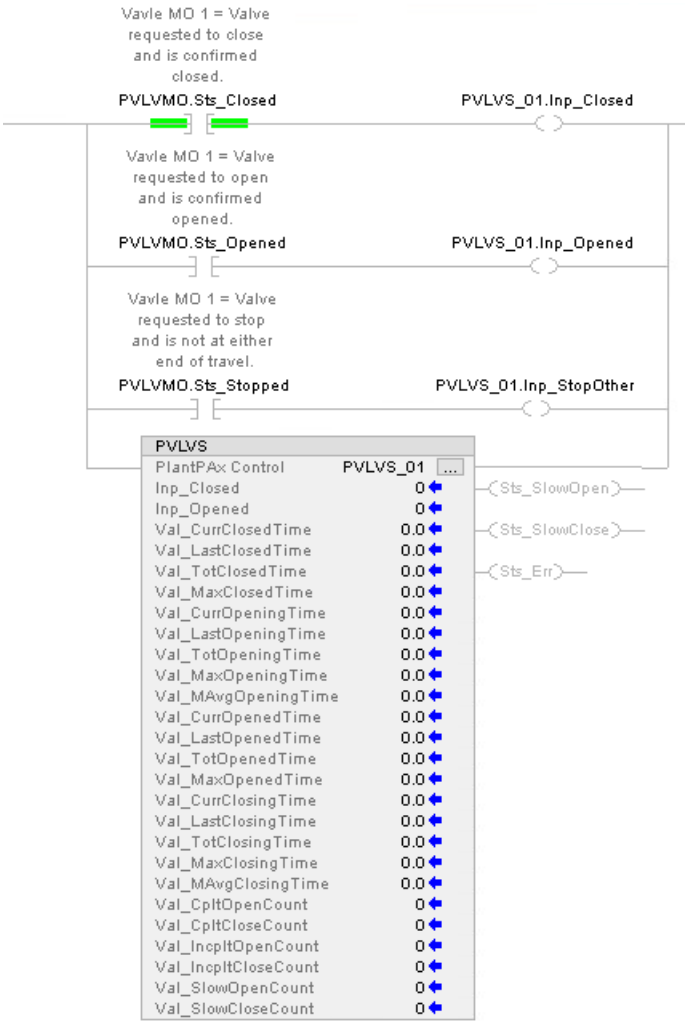
In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table.
Instruction first run	See Instruction first run in the Ladder Diagram table.
EnableIn is true	See Rung-condition-in is true in the Ladder Diagram table.
Postscan	EnableIn and EnableOut bits are cleared to false.

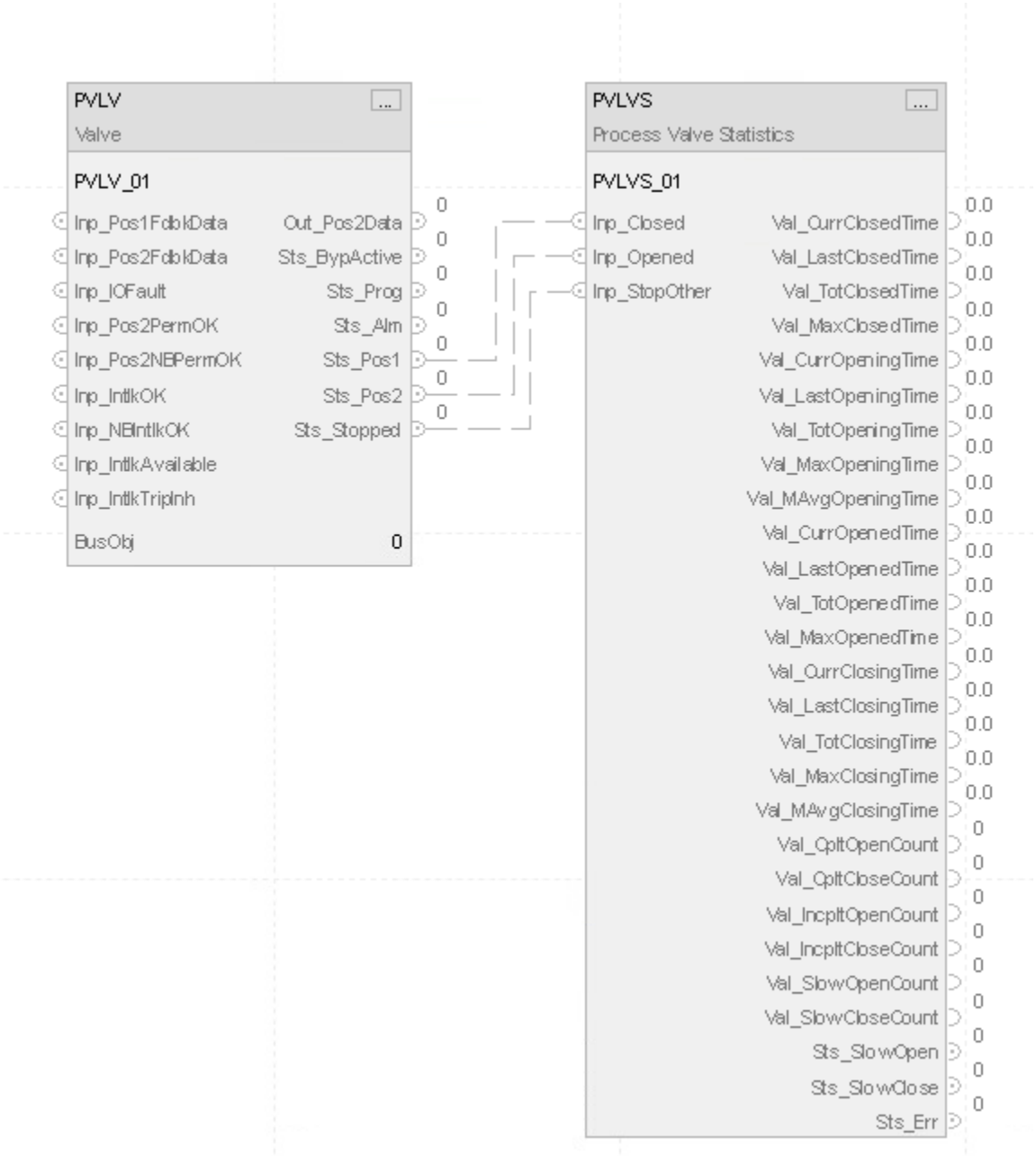
Example

This section shows how the PVLVS instruction collects statistics on a motor-operated valve. In this example, the motor-operated valve is controlled by using the PVLVS instruction. By naming the PVLVS instance tag the same as the PVLV tag plus ValveStats, the PVLVS instance tag is automatically linked at the HMI to the valve instance. In this example, the motor-operated valve is opened, closed, or the motor could stop moving while in travel before reaching either position. Statistics for all of these three states can be tracked by using the PVLVS instruction. In this example, the parameters Inp_Closed, Inp_Opened, and Inp_StopOther are connected to the parameters Sts_Closed, Sts_Opened, and Sts_Stopped of the PVLV instruction. The PVLVS instruction keeps track of completed strokes, plus open and close strokes that are slower than expected. The parameters Cfg_SlowOpenTime and Cfg_SlowCloseTime are set to 10, to indicate that any transition longer than 10 seconds is considered slow.

Ladder Diagram



Function Block Diagram



Structured Text

```
PVLVMO_ValveStat.Inp_Closed := PVLVMO.Sts_Closed;
PVLVMO_ValveStat.Inp_Opened := PVLVMO.Sts_Opened;
PVLVMO_ValveStat.Inp_StopOther := PVLVMO.Sts_Stopped;
PVLVS (PVLVMO_ValveStat);
```

Process Variable Speed Drive (PVSD)

This information applies to the ControlLogix 5380P and 5580P controllers.

The Process Variable Speed Drive (PVSD) instruction monitors and controls a variable speed motor using an AC (variable frequency) or DC drive. Use the instruction to run or jog the motor, forward or reverse. The drive interface can be through a Device Object Interface or through individual pins. The object is a built-in version of the existing P_VSD add-on instruction in the Rockwell Automation Library of Process Objects.

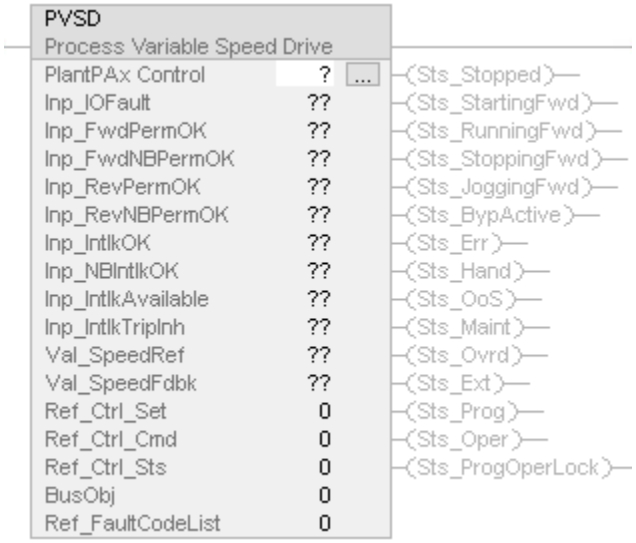
Use the PVSD instruction to:

- Control and monitor a variable speed motor using an AC or DC drive. This instruction is used with drives controlling velocity, not position, and it does not use any motion axes.
- Select Operator, Program, External, Override, Maintenance, Out of Service, or Hand as the source of drive commands and settings.
- Use the selected command source to enter a speed reference (setpoint).
- Use the selected command source to start the drive forward.
- Use the selected command source to start the drive reverse, if configured for reversing.
- Use the selected command source to jog the drive forward, if configured for jogging forward. Only Operator, External and Maintenance command sources are permitted to jog the drive forward.
- Use the selected command source to jog the drive reverse, if configured for jogging reverse. Only Operator, External and Maintenance command sources are permitted to jog the drive reverse.
- Monitor actual drive status, including:
  - Speed feedback
  - Drive ready
  - Drive active (run feedback)
  - Commanded direction
  - Actual direction
  - Accelerating
  - Decelerating
  - At speed
  - Drive warning
  - Drive faulted (with fault code and description)
- Interface to a drive Device Object using a set of Power Velocity interface tags. If the interface tags are not linked (optional InOut parameters), a set of input and output parameters are used to interface to the drive signal-by-signal.
- Search a linked Fault Code Lookup Table to provide textual drive fault information, or use text provided through the Power Velocity interface fault record.
- Participate in a control strategy bus (BUS_OBJ) with other devices and process instructions.

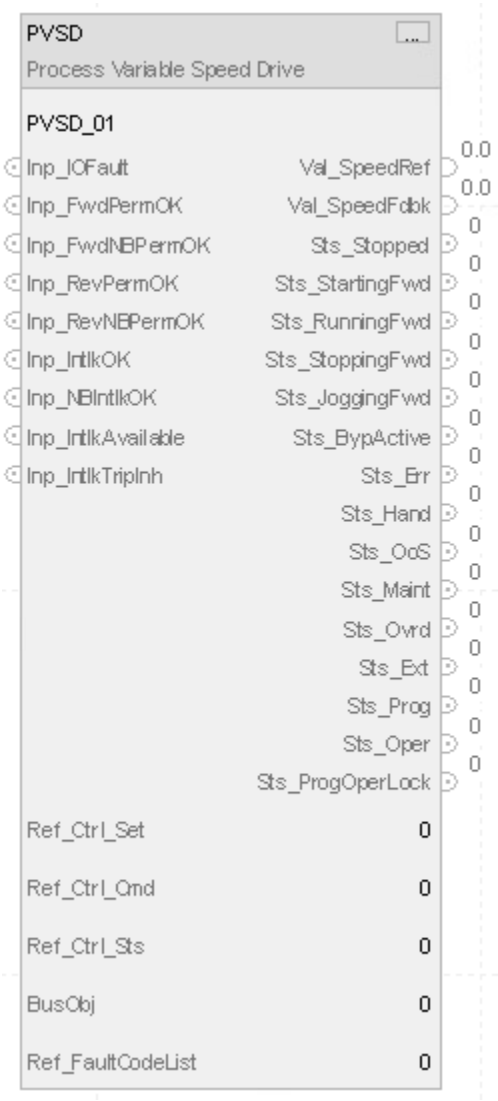
- Configure an output to provide a pre-start audible warning (horn). The time the alert sounds before starting or jogging is configurable.
- Configure virtualization, providing simulated feedback of a working drive while disabling outputs to the physical device.
- Configure scaling of the speed reference from application engineering units to drive interface units.
- Configure scaling of the speed feedback from drive interface units to application engineering units.
- Configure limiting (clamping) of the speed reference.
- Monitor run feedback and provide status and alarms for failure to start in the configured time and failure to stop in the configured time.
- Monitor permissive conditions to allow starting or jogging the motor forward.
- Monitor permissive conditions to allow starting or jogging the motor reverse.
- Monitor interlock conditions to stop and prevent starting or jogging the motor. Trigger an alarm if interlock conditions cause the motor to stop.
- Monitor I/O communication faults.
- Automatically clear latched alarms and drive faults when an Operator Command (Start, Stop, Jog) is received.
- Automatically clear latched alarms and drive faults when an External Command (Start, Stop, Jog) is received.
- Use HMI breadcrumbs for Alarm Inhibited, Bad Configuration, Not Ready, and Maintenance Bypass Active.
- Use Available status for use by automation logic to indicate whether the motor can be controlled by other objects.
- Use Alarms for Fail to Start, Fail to Stop, Interlock Trip, I/O Fault and Drive Fault conditions.

Available Languages

Ladder Diagram



Function Block Diagram



Structured Text

PVSD(*PlantPAx Control*, Ref_Ctrl_Set, Ref_Ctrl_Cmd, Ref_Ctrl_Sts, BusObj, Ref_FaultCodeList)

Operands

IMPORTANT	Unexpected operation may occur if: • Output tag operands are overwritten. • Members of a structure operand are overwritten. • Except when specified, structure operands are shared by multiple instructions.

There are data conversion rules for mixing numeric data types within an instruction. See Data Conversions.

Configuration Operands

Operand	Type	Format	Description
PlantPAx Control	P_VARIABLE_SPEED_DRIVE	tag	Data structure required for proper operation of instruction.
Ref_Ctrl_Set	RAC_ITF_DVC_PWRVELOCITY_SET	tag	Velocity Automation Device Object Settings Interface.
Ref_Ctrl_Cmd	RAC_ITF_DVC_PWRVELOCITY_CMD	tag	Velocity Automation Device Object Command Interface.
Ref_Ctrl_Sts	RAC_ITF_DVC_PWRVELOCITY_STS	tag	Velocity Automation Device Object Status Interface.
BusObj	BUS_OBJ	tag	Bus component.
Ref_FaultCodeList	RAC_CODE_DESCRIPTION[x]	tag	Fault Code to Fault Description lookup table for intelligent motor controller.

P_VARIABLE_SPEED_DRIVE Structure

Public members are standard, visible tag members that are programmatically accessible. Private, hidden members are used in HMI faceplates and are not programmatically accessible. Private members are listed in separate tables after public members.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableIn	BOOL	Not Visible	Not Required	Input	Enable Input - System Defined Parameter Default is true.
Inp_InitializeReq	BOOL	Not Visible	Not Required	Input	1 = Request to initialize the instruction. The instruction is normally initialized in instruction first run. Use this request when reinitialization is needed. The instruction clears this operand automatically. Default is true.
Inp_OwnerCmd	DINT	Not Visible	Not Required	Input	Owner device command. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .29 = Echo. Default is 0.
Inp_SpeedFdbkData	REAL	Not Visible	Not Required	Input	Speed feedback in drive (raw) units (example: 0 to 32767 in drive units represents 0 to max frequency). Default is 0.0.
Inp_DatalinkData	REAL	Not Visible	Not Required	Input	Auxiliary signal (datalink) input in drive (raw) units. Default is 0.0.
Inp_LastFaultCodeData	DINT	Not Visible	Not Required	Input	Most recent drive fault code (enumeration). Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_ReadyData	BOOL	Not Visible	Not Required	Input	1 = Drive is ready to run. Default is true.
Inp_RunningData	BOOL	Not Visible	Not Required	Input	1 = Drive is running (active). Default is false.
Inp_CommandDirData	BOOL	Not Visible	Not Required	Input	1 = Drive is commanded forward, 0 = drive is commanded reverse. Default is true.
Inp_ActualDirData	BOOL	Not Visible	Not Required	Input	1 = Drive is running forward, 0 = drive is running reverse. Default is true.
Inp_AcceleratingData	BOOL	Not Visible	Not Required	Input	1 = Drive is accelerating. Default is false.
Inp_DeceleratingData	BOOL	Not Visible	Not Required	Input	1 = Drive is decelerating. Default is false.
Inp_AtSpeedData	BOOL	Not Visible	Not Required	Input	1 = Drive is at commanded speed. Default is false.
Inp_AlarmData	BOOL	Not Visible	Not Required	Input	1 = Drive has an alarm (warning) condition. See drive display or manual for detail. Default is false.
Inp_FaultedData	BOOL	Not Visible	Not Required	Input	1 = Drive has faulted. See drive display or manual for detail. Default is false.
Inp_DvcNotify	SINT	Not Visible	Not Required	Input	Related device object alarm priority and acknowledgement status. 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Inp_IOFault	BOOL	Visible	Not Required	Input	Indicates the IO data are inaccurate. 0 = The IO data are good, 1 = The IO data are bad, causing fault. If the drive is not virtual, this input sets Sts_IOFault, which raises IOFault Alarm. Default is false.
Inp_FwdPermOK	BOOL	Visible	Not Required	Input	1 = Permissives OK, drive can start or jog forward. Default is true.
Inp_FwdNBPermOK	BOOL	Visible	Not Required	Input	1 = Non-Bypassable Permissives OK, drive can start or jog forward. Default is true.
Inp_RevPermOK	BOOL	Visible	Not Required	Input	1 = Permissives OK, drive can start or jog reverse. Default is true.
Inp_RevNBPermOK	BOOL	Visible	Not Required	Input	1 = Non-Bypassable Permissives OK, drive can start or jog reverse. Default is true.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Inp_IntlkOK	BOOL	Visible	Not Required	Input	1 = Interlocks OK, drive can start or jog and keep running. Default is true.
Inp_NBIntlkOK	BOOL	Visible	Not Required	Input	1 = Non-bypassable interlocks OK, drive can start or jog and keep running. Default is true.
Inp_IntlkAvailable	BOOL	Visible	Not Required	Input	1 = Interlock Availibility OK. Default is false.
Inp_IntlkTripInh	BOOL	Visible	Not Required	Input	1 = Inhibit Interlock Trip Status. Default is false.
Inp_RdyReset	BOOL	Not Visible	Not Required	Input	1 = Related object, reset by this object, is ready to be reset. Default is false.
Inp_Hand	BOOL	Not Visible	Not Required	Input	1 = Acquire Hand (typically hardwired local), 0 = Release Hand. Default is false.
Inp_Ovrd	BOOL	Not Visible	Not Required	Input	1 = Acquire Override (higher priority program logic), 0 = Release Override. Default is false.
Inp_OvrdCmd	SINT	Not Visible	Not Required	Input	Override Command: 0 = None, 1 = Stop, 2 = Start Forward, 3 = Start Reverse. Default is 0.
Inp_OvrdSpeed	REAL	Not Visible	Not Required	Input	Value to set Speed Reference in Override, in speed reference engineering units. Default is 0.0.
Inp_OvrdOutDatalink	REAL	Not Visible	Not Required	Input	Value to set Output Datalink in Override, in output datalink engineering units. Default is 0.0.
Inp_ExtInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit External acquisition, 0 = Allow External acquisition. Default is false.
Inp_HornInh	BOOL	Not Visible	Not Required	Input	1 = Inhibit audible alert, 0 = Alllow audible alert. Default is false.
Inp_Reset	BOOL	Not Visible	Not Required	Input	1 = Reset Shed Latches and Cleared Alarms. Default is false.
Cfg_AllowDisable	BOOL	Not Visible	Not Required	Input	1 = Allow Maintenance to disable alarms. Default is true.
Cfg_AllowShelve	BOOL	Not Visible	Not Required	Input	1 = Allow Operator to shelve alarms. Default is true.
Cfg_HasReverse	BOOL	Not Visible	Not Required	Input	1 = Drive can run or jog reverse, 0 = only allow forward operation. Default is false.
Cfg_HasJog	BOOL	Not Visible	Not Required	Input	1 = Drive jog command enabled and visible, 0 = drive jog command not allowed. Default is false.
Cfg_AllowLocal	BOOL	Not Visible	Not Required	Input	1 = Allow Local Start and Stop without alarm, 0 = Start or Stop by command only. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_HasRunFdbk	BOOL	Not Visible	Not Required	Input	1 = Drive provides feedback signal when running. Default is false.
Cfg_UseRunFdbk	BOOL	Not Visible	Not Required	Input	1 = Drive run feedback should be used for failure checking. Default is false.
Cfg_HasSpeedFdbk	BOOL	Not Visible	Not Required	Input	1 = Drive provides speed feedback. Default is false.
Cfg_UseSpeedFdbk	BOOL	Not Visible	Not Required	Input	1 = Drive speed determines running state, 0 = state determined by drive active feedback. Default is false.
Cfg_HasInpDatalink	BOOL	Not Visible	Not Required	Input	1 = A signal is connected to Inp_DatalinkData. Default is false.
Cfg_HasOutDatalink	BOOL	Not Visible	Not Required	Input	1 = A signal is connected to Out_DatalinkData. Default is false.
Cfg_HasDvcObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a device (e.g., drive) object is connected. Default is false.
Cfg_HasFwdPermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to forward permissive inputs. Default is false.
Cfg_HasRevPermObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to reverse permissive inputs. Default is false.
Cfg_HasIntlkObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object is connected to interlock inputs. Default is false.
Cfg_HasResInhObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a Restart Inhibit object is connected. Default is false.
Cfg_HasRunTimeObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI a Run Time / Starts object is connected. Default is false.
Cfg_HasMoreObj	BOOL	Not Visible	Not Required	Input	1 = Tells HMI an object with more information is available. Default is false.
Cfg_SetTrack	BOOL	Not Visible	Not Required	Input	1 = Settings track for unselected sources, 0 = no tracking of settings. Default is true.
Cfg_SetTrackOvrdHand	BOOL	Not Visible	Not Required	Input	1 = Program, Operator and External settings track when Override or Hand is selected. Default is false.
Cfg_OperStopPrio	BOOL	Not Visible	Not Required	Input	1 = OCmd_Stop accepted any time; 0 = OCmd_Stop accepted only when Oper is selected. Default is false.
Cfg_ExtStopPrio	BOOL	Not Visible	Not Required	Input	1 = XCmd_Stop accepted any time; 0 = XCmd_Stop accepted only when Ext is selected. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_OCmdResets	BOOL	Not Visible	Not Required	Input	1 = Any drive OCmd resets shed latches and cleared alarms; 0 = OCmdReset is required. Default is false.
Cfg_XCmdResets	BOOL	Not Visible	Not Required	Input	1 = Any drive XCmd resets shed latches and cleared alarms; 0 = XCmdReset is required. Default is false.
Cfg_OvrdPermIntlk	BOOL	Not Visible	Not Required	Input	1 = Override ignores Bypassable Perm/ Intlk; 0 = Override uses all Perm/Intlk. Default is false.
Cfg_ShedOnFailToStart	BOOL	Not Visible	Not Required	Input	1 = Stop Motor and Alarm on Fail to Start; 0 = Alarm only on Fail to Start. Default is true.
Cfg_ShedOnIOFault	BOOL	Not Visible	Not Required	Input	1 = Stop Motor and Alarm on I/O Fault; 0 = Alarm only on I/O Fault. Default is true.
Cfg_HasOper	BOOL	Not Visible	Not Required	Input	1 = Operator (unlocked) exists, can be selected. Default is true.
Cfg_HasOperLocked	BOOL	Not Visible	Not Required	Input	1 = Operator Locked exists, can be selected. Default is true.
Cfg_HasProg	BOOL	Not Visible	Not Required	Input	1 = Program (unlocked) exists, can be selected. Default is true.
Cfg_HasProgLocked	BOOL	Not Visible	Not Required	Input	1 = Program Locked exists, can be selected. Default is true.
Cfg_HasExt	BOOL	Not Visible	Not Required	Input	1 = External exists, can be selected. Default is false.
Cfg_HasMaint	BOOL	Not Visible	Not Required	Input	1 = Maintenance exists, can be selected. Default is true.
Cfg_HasMaintOoS	BOOL	Not Visible	Not Required	Input	1 = Maintenance Out of Service exists, can be selected. Default is true.
Cfg_OvrdOverLock	BOOL	Not Visible	Not Required	Input	1 = Override supersedes Program/Operator Lock, 0 = Don't override Lock. Default is true.
Cfg_ExtOverLock	BOOL	Not Visible	Not Required	Input	1 = External supersedes Program/Operator Lock, 0 = Don't override Lock. Default is false.
Cfg_ProgPwrUp	BOOL	Not Visible	Not Required	Input	1 = Power up to Program, 0 = Power up to Operator. Default is false.
Cfg_ProgNormal	BOOL	Not Visible	Not Required	Input	Normal Source: 1 = Program if no requests; 0 = Operator if no requests. Default is false.
Cfg_PCmdPriority	BOOL	Not Visible	Not Required	Input	Command priority. 1 = Program commands win, 0 = Operator commands win. Default is false.
Cfg_PCmdProgAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Prog used as a Level (1 = Prog, 0 = Oper). Default is false.
Cfg_PCmdLockAsLevel	BOOL	Not Visible	Not Required	Input	1 = PCmd_Lock used as a Level (1 = Lock, 0 = Unlock). Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_ExtAcqAsLevel	BOOL	Not Visible	Not Required	Input	1 = XCmd_Acq used as Level (1 = Acquire, 0 = Release). Default is false.
Cfg_DecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for speed ref/fdbk display (0 to 6). Default is 2.
Cfg_InpDatalinkDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for Input Datalink display (0 to 6). Default is 2.
Cfg_OutDatalinkDecPlcs	SINT	Not Visible	Not Required	Input	Number of decimal places for Output Datalink display (0 to 6). Default is 2.
Cfg_MinSpeedRef	REAL	Not Visible	Not Required	Input	Minimum Speed Reference in EU (for limiting). Valid = any float less than or equal to Max. Default is 0.0.
Cfg_MaxSpeedRef	REAL	Not Visible	Not Required	Input	Maximum Speed Reference in EU (for limiting). Valid = any float greater than or equal to Min. Default is 60.0.
Cfg_JogSpeedRef	REAL	Not Visible	Not Required	Input	Speed Reference to use when Jogging (EU). Valid = any float (will be clamped). Default is 10.0.
Cfg_SpeedRefRawMin	REAL	Not Visible	Not Required	Input	Speed Reference Minimum in Drive (raw) Units (for scaling). Valid = any float not equal to Max. Default is 0.0.
Cfg_SpeedRefRawMax	REAL	Not Visible	Not Required	Input	Speed Reference Maximum in Drive (raw) Units (for scaling). Valid = any float not equal to Min. Default is 60.0.
Cfg_SpeedRefEUMin	REAL	Not Visible	Not Required	Input	Speed Reference Minimum in Engineering Units (for scaling). Valid = any float less than Max. Default is 0.0.
Cfg_SpeedRefEUMax	REAL	Not Visible	Not Required	Input	Speed Reference Maximum in Engineering Units (for scaling). Valid = any float greater than Min. Default is 60.0.
Cfg_SpeedFdbkRawMin	REAL	Not Visible	Not Required	Input	Speed Feedback Minimum in Drive (raw) Units (for scaling). Valid = any float not equal to Max. Default is 0.0.
Cfg_SpeedFdbkRawMax	REAL	Not Visible	Not Required	Input	Speed Feedback Maximum in Drive (raw) Units (for scaling). Valid = any float not equal to Min. Default is 60.0.
Cfg_SpeedFdbkEUMin	REAL	Not Visible	Not Required	Input	Speed Feedback Minimum in Engineering Units (for scaling). Valid = any float less than Max. Default is 0.0.
Cfg_SpeedFdbkEUMax	REAL	Not Visible	Not Required	Input	Speed Feedback Maximum in Engineering Units (for scaling). Valid = any float greater than Min. Default is 60.0.
Cfg_InpDatalinkRawMin	REAL	Not Visible	Not Required	Input	Input Datalink Minimum in Drive (raw) Units (for scaling). Valid = any float not equal to Max. Default is 0.0.
Cfg_InpDatalinkRawMax	REAL	Not Visible	Not Required	Input	Input Datalink Maximum in Drive (raw) Units (for scaling). Valid = any float not equal to Min. Default is 100.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_InpDatalinkEUMin	REAL	Not Visible	Not Required	Input	Input Datalink Minimum in Engineering Units (for scaling). Valid = any float less than Max. Default is 0.0.
Cfg_InpDatalinkEUMax	REAL	Not Visible	Not Required	Input	Input Datalink Maximum in Engineering Units (for scaling). Valid = any float greater than Min. Default is 100.0.
Cfg_OutDatalinkMin	REAL	Not Visible	Not Required	Input	Minimum Output Datalink in EU (for limiting). Valid = any float less than or equal to Max. Default is 0.0.
Cfg_OutDatalinkMax	REAL	Not Visible	Not Required	Input	Maximum Output Datalink in EU (for limiting). Valid = any float greater than or equal to Min. Default is 100.0.
Cfg_OutDatalinkRawMin	REAL	Not Visible	Not Required	Input	Output Datalink Minimum in Drive (raw) Units (for scaling). Valid = any float not equal to Max. Default is 0.0.
Cfg_OutDatalinkRawMax	REAL	Not Visible	Not Required	Input	Output Datalink Maximum in Drive (raw) Units (for scaling). Valid = any float not equal to Min. Default is 100.0.
Cfg_OutDatalinkEUMin	REAL	Not Visible	Not Required	Input	Output Datalink Minimum in Engineering Units (for scaling). Valid = any float less than Max. Default is 0.0.
Cfg_OutDatalinkEUMax	REAL	Not Visible	Not Required	Input	Output Datalink Maximum in Engineering Units (for scaling). Valid = any float greater than Min. Default is 100.0.
Cfg_StartHornTime	REAL	Not Visible	Not Required	Input	Time in seconds to sound audible on commanded start. Valid = 0.0 to 1000.0 seconds, 0.0 = disabled. Default is 0.0.
Cfg_VirtualRampTime	REAL	Not Visible	Not Required	Input	Time in seconds to ramp speed feedback when Virtualized. Valid = 0.0 to max float. Default is 10.0.
Cfg_FailToStartTime	REAL	Not Visible	Not Required	Input	Time in seconds after Start to receive Run Feedback before Fault. Valid = 0.0 to 2147483.0 seconds. Default is 15.0.
Cfg_FailToStopTime	REAL	Not Visible	Not Required	Input	Time in seconds after Stop to drop Run Feedback before Fault. Valid = 0.0 to 2147483,0 seconds. Default is 15.0.
Cfg_ResetPulseTime	REAL	Not Visible	Not Required	Input	Time in seconds to pulse Out_Reset to clear Motor fault. Valid = 0.0 to 2147483.0 seconds. Default is 2.0.
Cfg_MaxJogTime	REAL	Not Visible	Not Required	Input	Maximum jog time in seconds. Valid = 0.0 to 2147483.0 seconds, 0.0 = unlimited). Default is 0.0.
Cfg_eKeepRef	SINT	Not Visible	Not Required	Input	Ownership of Speed Reference (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Cfg_eKeepStart	SINT	Not Visible	Not Required	Input	Ownership of Start commands (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_eKeepJog	SINT	Not Visible	Not Required	Input	Ownership of Jog commands (enumeration): 0 = follows CmdSrc, 1 = Operator, 3 = External. Default is 0.
Cfg_eKeepOutDatalink	SINT	Not Visible	Not Required	Input	Ownership of Output Datalink (enumeration): 0 = follows CmdSrc, 1 = Operator, 2 = Program, 3 = External. Default is 0.
Cfg_CnfrmReqd	SINT	Not Visible	Not Required	Input	Operator Command Confirmation Required. Represents the type of command confirmation required. 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required. Default is 0.
Cfg_HasHistTrend	SINT	Not Visible	Not Required	Input	Has Historical Trend. This enables navigation to the Device Historical Trend Faceplate from the HMI. 0 = No external historical trend, 1 = Datalog historical trend, 2 = Historian historical trend. Default is 0.
PSet_SpeedRef	REAL	Not Visible	Not Required	Input	Program Setting of Run Speed Reference (speed reference engineering units). Valid = any real, will be clamped. Default is 0.0.
PSet_OutDatalink	REAL	Not Visible	Not Required	Input	Program Setting of Output Datalink (output datalink engineering units). Valid = any real, will be clamped. Default is 0.0.
PSet_Owner	DINT	Not Visible	Not Required	Input	Program owner request ID (non-zero) or release (zero). Default is 0.
XSet_SpeedRef	REAL	Not Visible	Not Required	Input	External setting of Run Speed Reference (speed reference engineering units). Valid = any real, will be clamped. Default is 0.0.
XSet_OutDatalink	REAL	Not Visible	Not Required	Input	External setting of Output Datalink (output datalink engineering units). Valid = any real, will be clamped. Default is 0.0.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
PCmd_Virtual	BOOL	Not Visible	Not Required	Input	Program command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
PCmd_Physical	BOOL	Not Visible	Not Required	Input	Program command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
PCmd_StartFwd	BOOL	Not Visible	Not Required	Input	Program command to Start Drive Forward. The instruction clears this operand automatically. Default is false.
PCmd_StartRev	BOOL	Not Visible	Not Required	Input	Program command to Start Drive Reverse. The instruction clears this operand automatically. Default is false.
PCmd_Stop	BOOL	Not Visible	Not Required	Input	Program command to Stop Drive. The instruction clears this operand automatically. Default is false.
PCmd_Prog	BOOL	Not Visible	Not Required	Input	Program command to select Program (Operator to Program). The instruction clears this operand automatically if Cfg_PCmdProgAsLevel = 0. Default is false.
PCmd_Oper	BOOL	Not Visible	Not Required	Input	Program command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
PCmd_Lock	BOOL	Not Visible	Not Required	Input	Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0. Default is false.
PCmd_Unlock	BOOL	Not Visible	Not Required	Input	Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically. Default is false.
PCmd_Normal	BOOL	Not Visible	Not Required	Input	Program command to select Normal command source (Operator or Program). The instruction clears this operand automatically. Default is false.
PCmd_Reset	BOOL	Not Visible	Not Required	Input	Program command to reset all alarms and latched shed conditions requiring reset. The instruction clears this operand automatically. Default is false.
MCmd_Rel	BOOL	Not Visible	Not Required	Input	Maintenance command to release ownership (Maintenance to Operator/Program/External/Override). The instruction clears this operand automatically. Default is false.
OCmd_Unlock	BOOL	Not Visible	Not Required	Input	Operator command to unlock / release (allow Program to acquire) ownership. The instruction clears this operand automatically. Default is false.

Public Input Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
XCmd_StartFwd	BOOL	Not Visible	Not Required	Input	External command to Start Drive Forward. The instruction clears this operand automatically. Default is false.
XCmd_StartRev	BOOL	Not Visible	Not Required	Input	External command to Start Drive Reverse. The instruction clears this operand automatically. Default is false.
XCmd_Stop	BOOL	Not Visible	Not Required	Input	External command to Stop Drive. The instruction clears this operand automatically. Default is false.
XCmd_JogFwd	BOOL	Not Visible	Not Required	Input	External command to Jog Drive Forward. The instruction clears this operand automatically if max jog time is reached. Default is false.
XCmd_JogRev	BOOL	Not Visible	Not Required	Input	External command to Jog Drive Reverse. The instruction clears this operand automatically if max jog time is reached.. Default is false.
XCmd_Acq	BOOL	Not Visible	Not Required	Input	External command to acquire ownership (Operator/Program/Override/Maintenance to External). The instruction clears this operand automatically if Cfg_ExtAcqAsLevel = 0. Default is false.
XCmd_Rel	BOOL	Not Visible	Not Required	Input	External command to release ownership if Cfg_ExtAcqAsLevel = 0 (External to Operator/Program/Override/Maintenance). The instruction clears this operand automatically. Default is false.
XCmd_Reset	BOOL	Not Visible	Not Required	Input	External command to clear shed latches and cleared alarms. The instruction clears this operand automatically. Default is false.
XCmd_ResetAckAll	BOOL	Not Visible	Not Required	Input	External command to acknowledge and reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
EnableOut	BOOL	Not Visible	Not Required	Output	Enable Output - System Defined Parameter
Out_SpeedRefData	REAL	Not Visible	Not Required	Output	Speed reference in drive (raw) units (example: 0 to 32767 in drive units represents 0 to max frequency).
Out_DatalinkData	REAL	Not Visible	Not Required	Output	Auxiliary signal (datalink) output in drive (raw) units.
Out_RunData	BOOL	Not Visible	Not Required	Output	1 = Start/Run Drive, 0 = Stop Drive (for held starter type).
Out_StopData	BOOL	Not Visible	Not Required	Output	1 = Stop Drive, 0 = drive left in current state.
Out_StartData	BOOL	Not Visible	Not Required	Output	1 = Start Drive, 0 = drive left in current state.
Out_ClearFaultData	BOOL	Not Visible	Not Required	Output	1 = Attempt to clear Drive Fault.
Out_FwdData	BOOL	Not Visible	Not Required	Output	1 = Set drive direction to Forward.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Out_RevData	BOOL	Not Visible	Not Required	Output	1 = Set drive direction to Reverse.
Out_HornData	BOOL	Not Visible	Not Required	Output	1 = Sound audible prior to commanded motor start.
Out_Reset	BOOL	Not Visible	Not Required	Output	1 = Reset command has been received and accepted.
Out_OwnerSts	DINT	Not Visible	Not Required	Output	Status of command source, owner command handshake and ready status. 0 = None, .10 = Operator Lock, .11 = Operator Unlock, .12 = Program Lock, .13 = Program Unlock, .14 = Acquire Maintenance, .15 = Release Maintenance, .16 = Acquire External, .17 = Release External, .18 = Has Maintenance, .19 = External Override Lock, .20 = Has External, .21 = Has Operator, .22 = Has Operator Locked, .23 = Has Program, .24 = Has Program Locked, .29 = Echo, .30 = Not Ready.
Val_SpeedRef	REAL	Visible	Not Required	Output	Speed Reference (target) to drive.
Val_SpeedFdbk	REAL	Visible	Not Required	Output	Speed Feedback (actual) from drive.
Val_InpDatalink	REAL	Not Visible	Not Required	Output	Input Datalink value from drive.
Val_OutDatalink	REAL	Not Visible	Not Required	Output	Output Datalink value to drive.
Val_SpeedRefEUMin	REAL	Not Visible	Not Required	Output	Minimum of Speed Reference = MIN (Cfg_SpeedFdbkEUMin, Cfg_SpeedFdbkEUMax).
Val_SpeedRefEUMax	REAL	Not Visible	Not Required	Output	Maximum of Speed Reference = MAX (Cfg_SpeedFdbkEUMin, Cfg_SpeedFdbkEUMax).
Val_SpeedFdbkEUMin	REAL	Not Visible	Not Required	Output	Minimum of Speed Feedback = MIN (Cfg_SpeedFdbkEUMin, Cfg_SpeedFdbkEUMax).
Val_SpeedFdbkEUMax	REAL	Not Visible	Not Required	Output	Maximum of Speed Feedback = MAX (Cfg_SpeedFdbkEUMin, Cfg_SpeedFdbkEUMax).
Sts_Initialized	BOOL	Not Visible	Not Required	Output	1 = Instruction is initialized. Use Inp_InitializeReq to reinitialize.
Sts_Stopped	BOOL	Visible	Not Required	Output	1 = Drive requested to stop and is confirmed stopped.
Sts_StartingFwd	BOOL	Visible	Not Required	Output	1 = Drive requested to run forward and awaiting run feedback.
Sts_StartingRev	BOOL	Not Visible	Not Required	Output	1 = Drive requested to run reverse and awaiting run feedback.
Sts_RunningFwd	BOOL	Visible	Not Required	Output	1 = Drive requested to run and is confirmed running forward.
Sts_RunningRev	BOOL	Not Visible	Not Required	Output	1 = Drive requested to run and is confirmed running reverse.
Sts_StoppingFwd	BOOL	Visible	Not Required	Output	1 = Drive running forward requested to stop and awaiting stopped feedback.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_StoppingRev	BOOL	Not Visible	Not Required	Output	1 = Drive running reverse requested to stop and awaiting stopped feedback.
Sts_JoggingFwd	BOOL	Visible	Not Required	Output	1 = Drive requested to Jog Forward.
Sts_JoggingRev	BOOL	Not Visible	Not Required	Output	1 = Drive requested to Jog Reverse.
Sts_Horn	BOOL	Not Visible	Not Required	Output	1 = Motor Audible Alert (Horn) is Active.
Sts_CommandDir	BOOL	Not Visible	Not Required	Output	1 = Drive commanded to Forward, 0 = Reverse.
Sts_ActualDir	BOOL	Not Visible	Not Required	Output	1 = Motor rotation (actual direction) is Forward, 0 = Reverse.
Sts_Accel	BOOL	Not Visible	Not Required	Output	1 = Drive is Accelerating.
Sts_Decel	BOOL	Not Visible	Not Required	Output	1 = Drive is Decelerating.
Sts_NotReady	BOOL	Not Visible	Not Required	Output	1 = Drive is Not Ready (cannot be started) Check alarms, stops, faults.
Sts_Alarm	BOOL	Not Visible	Not Required	Output	1 = Drive has an Alarm (see drive display or manual).
Sts_AtSpeed	BOOL	Not Visible	Not Required	Output	1 = Drive is running at reference speed.
Sts_SpeedLimited	BOOL	Not Visible	Not Required	Output	1 = Speed Reference Setting exceeds configured Max/Min limit.
Sts_Virtual	BOOL	Not Visible	Not Required	Output	1 = The instruction treats the drive as virtual. The instruction acts as normal but the output is kept de-energized; 0 = The instruction operates the drive normally. Sts_Virtual is a copy of Sts_Virtual.
SrcQ_IO	SINT	Not Visible	Not Required	Output	Source and quality of primary input or output (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
SrcQ	SINT	Not Visible	Not Required	Output	Source and quality of primary value or status (enumerated): 0=Good, live, confirmed good 1=Good, live, assumed good 2=Good, no feedback, assumed good 8=Test, virtualized 9=Test, loopback 10=Test, manually entered 16=Uncertain, live, off-spec 17=Uncertain, substituted at device or bus 18=Uncertain, substituted at instruction 19=Uncertain, using last known good 20=Uncertain, using replacement value 32=Bad, signal failure 33=Bad, channel fault 34=Bad, module or communication fault 35=Bad, invalid configuration
Sts_eCmd	SINT	Not Visible	Not Required	Output	Drive Command: 0 = None, 1 = Stop, 2 = Start Forward, 3 = Start Reverse, 4 = Jog Forward, 5 = Jog Reverse.
Sts_eFdbk	SINT	Not Visible	Not Required	Output	Drive Feedback: 0 = Stopped, 1 = Running Forward, 2 = Running Reverse, 3 = Accelerating, 4 = Decelerating.
Sts_eSts	SINT	Not Visible	Not Required	Output	Drive Status: 0 = Powerup / Unknown, 1 = Stopped, 2 = Running Forward, 3 = Running Reverse, 4 = Starting Forward, 5 = Starting Reverse, 6 = Jogging Forward, 7 = Jogging Reverse, 8 = Stopping, 14 = Horn, 15 = Out Of Service.
Sts_eFault	SINT	Not Visible	Not Required	Output	Drive Fault Status: 0 = None, 15 = Interlock Trip, 16 = Fail to Start, 17 = Fail to Stop, 18 = Drive Fault, 32 = I/O Fault, 34 = Config Error.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotify	SINT	Not Visible	Not Required	Output	All alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyAll	SINT	Not Visible	Not Required	Output	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIOFault	SINT	Not Visible	Not Required	Output	IOFault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyFailToStart	SINT	Not Visible	Not Required	Output	Fail to Start alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_eNotifyFailToStop	SINT	Not Visible	Not Required	Output	Fail to Stop alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyIntlkTrip	SINT	Not Visible	Not Required	Output	IntlkTrip alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowledged.
Sts_eNotifyDriveFault	SINT	Not Visible	Not Required	Output	Drive Fault alarm status enumerated values: 0 = Not in alarm, acknowledged, 1 = Not in alarm, unacknowledged or reset required, 2 = Low severity alarm, acknowledged, 3 = Low severity alarm, unacknowledged, 4 = Medium severity alarm, acknowledged, 5 = Medium severity alarm, unacknowledged, 6 = High severity alarm, acknowledged, 7 = High severity alarm, unacknowledged, 8 = Urgent severity alarm, acknowledged, 9 = Urgent severity alarm, unacknowl
Sts_UnackAlmCount	DINT	Not Visible	Not Required	Output	Count of unacknowledged alarms.
Sts_eFaultCode	DINT	Not Visible	Not Required	Output	First Drive Fault Code after reset. See drive manual or Drive Object for description.
Sts_eSrc	INT	Not Visible	Not Required	Output	The current command source is shown with status bits: Sts_eSrc.0: Lock, Sts_eSrc.1: Normal, Sts_eSrc.2: Hand, Sts_eSrc.3: Maintenance, Sts_eSrc.4: Override, Sts_eSrc.5: Program, Sts_eSrc.6: Operator, Sts_eSrc.7: Out of Service, Sts_eSrc.8: External.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_bSrc	INT	Not Visible	Not Required	Output	Active selection bitmap (for HMI totem pole with command source request selection): Sts_bSrc.0: Hand, Sts_bSrc.1: Programmed Out of Service (rung false), Sts_bSrc.2: Maintenance Out of Service, Sts_bSrc.3: Maintenance, Sts_bSrc.4: Override, Sts_bSrc.5: External, Sts_bSrc.6: Program locked, Sts_bSrc.7: Program, Sts_bSrc.8: Operator locked, Sts_bSrc.9: Operator.
Sts_Available	BOOL	Not Visible	Not Required	Output	1 = Device has been acquired by Program and is now available for start/stop control.
Sts_IntlkAvailable	BOOL	Not Visible	Not Required	Output	1 = Device can be acquired by Program and is available for start/stop control when interlocks are OK.
Sts_Bypass	BOOL	Not Visible	Not Required	Output	1 = Bypassable interlocks are bypassed.
Sts_BypActive	BOOL	Visible	Not Required	Output	1 = Interlock bypassing active (bypassed or maintenance).
Sts_MaintByp	BOOL	Not Visible	Not Required	Output	1 = Device has a maintenance bypass function active.
Sts_NotRdy	BOOL	Not Visible	Not Required	Output	1 = Device is not ready, see detail bits (Sts_Nrdyxxx) for reason.
Sts_NrdyCfgErr	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Configuration error.
Sts_NrdyDriveNotReady	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Drive Not Ready.
Sts_NrdyFail	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Device failure (Shed requires Reset).
Sts_NrdyIntlk	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Interlock not OK.
Sts_NrdyIOFault	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: IO Fault (Shed requires Reset).
Sts_NrdyOoS	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Device disabled by Maintenance.
Sts_NrdyFwdPerm	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Forward permissive not OK.
Sts_NrdyRevPerm	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Reverse permissive not OK.
Sts_NrdyPrioStop	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Operator or External priority Stop command requires reset.
Sts_NrdyTrip	BOOL	Not Visible	Not Required	Output	1 = Device is not ready: Device Tripped (Drive Fault requires Reset).
Sts_Err	BOOL	Visible	Not Required	Output	1 = Error in configuration: See detail bits (Sts_ErrXxx) for reason.
Sts_ErrAlm	BOOL	Not Visible	Not Required	Output	1 = Error in Logix tag-based alarm settings.
Sts_ErrSpeedFdbkRaw	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Speed Fdbk Raw Min = Max.
Sts_ErrSpeedFdbkEU	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Speed Fdbk EU Min = Max.
Sts_ErrSpeedRefLim	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Speed Ref Limit Min > Max.
Sts_ErrSpeedRefEU	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Speed Ref EU Min = Max.
Sts_ErrSpeedRefRaw	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Speed Ref Raw Min = Max.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_ErrInpDatalinkRaw	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Input Datalink Raw Min = Max.
Sts_ErrInpDatalinkEU	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Input Datalink EU Min = Max.
Sts_ErrOutDatalinkLim	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Output Datalink Limits Min > Max.
Sts_ErrOutDatalinkEU	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Output Datalink EU Min = Max.
Sts_ErrOutDatalinkRaw	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Output Datalink Raw Min = Max.
Sts_ErrVirtualRampTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Virtual speed accel / decel time: use 0 to 2147483.
Sts_ErrFailToStartTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Fail to Start timer preset: use 0 to 2147483.
Sts_ErrFailToStopTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Fail to Stop timer preset: use 0 to 2147483.
Sts_ErrResetPulseTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Reset Pulse timer preset: use 0 to 2147483.
Sts_ErrMaxJogTime	BOOL	Not Visible	Not Required	Output	1 = Error in Config: Maximum Jog Time timer preset: use 0 to 2147483.
Sts_Hand	BOOL	Visible	Not Required	Output	1 = Hand is selected (supersedes OoS, Maintenance, Override, External, Program, Operator).
Sts_OoS	BOOL	Visible	Not Required	Output	1 = Out of Service is selected (supersedes Maintenance, Override, External, Program, Operator).
Sts_Maint	BOOL	Visible	Not Required	Output	1 = Maintenance is selected (supersedes Override, External, Program, Operator).
Sts_Ovrd	BOOL	Visible	Not Required	Output	1 = Override is selected (supersedes External, Program, Operator).
Sts_Ext	BOOL	Visible	Not Required	Output	1 = External is selected (supersedes Program and Operator).
Sts_Prog	BOOL	Visible	Not Required	Output	1 = Program is selected.
Sts_ProgLocked	BOOL	Not Visible	Not Required	Output	1 = Program is selected and Locked.
Sts_Oper	BOOL	Visible	Not Required	Output	1 = Operator is selected.
Sts_OperLocked	BOOL	Not Visible	Not Required	Output	1 = Operator is selected and Locked.
Sts_ProgOperSel	BOOL	Not Visible	Not Required	Output	Program/Operator selection (latch) state: 1 = Program, 0 = Operator.
Sts_ProgOperLock	BOOL	Visible	Not Required	Output	Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
Sts_Normal	BOOL	Not Visible	Not Required	Output	1 = Selection equals the Normal (Program or Operator).
Sts_ExtReqInh	BOOL	Not Visible	Not Required	Output	1 = External request inhibited, cannot get to External from current state.
Sts_ProgReqInh	BOOL	Not Visible	Not Required	Output	1 = Program request inhibited, cannot get to Program from current state.
Sts_MAcqRcvd	BOOL	Not Visible	Not Required	Output	1 = Maintenance Acquire command received this scan.
Sts_CmdConflict	BOOL	Not Visible	Not Required	Output	1 = Conflicting commands received this scan.
Sts_Alm	BOOL	Not Visible	Not Required	Output	1 = An alarm is active.
Sts_AlmInh	BOOL	Not Visible	Not Required	Output	1 = An alarm is shelved or disabled.

Public Output Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Sts_IOFault	BOOL	Not Visible	Not Required	Output	IO Fault status: 1 = Bad, 0 = OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVSDTag.@Alarms.Alm_IOFault.AlarmElement.
Sts_FailToStart	BOOL	Not Visible	Not Required	Output	1 = Drive failed to Start. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVSDTag.@Alarms.Alm_FailToStart.AlarmElement.
Sts_FailToStop	BOOL	Not Visible	Not Required	Output	1 = Drive failed to Stop. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVSDTag.@Alarms.Alm_FailToStop.AlarmElement.
Sts_IntlkTrip	BOOL	Not Visible	Not Required	Output	1 = Drive stopped by an interlock Not OK. There is a predefined default discrete Logix tag-based alarm for the status. Set standard configuration members of the discrete Logix tag-based alarm. Alarm elements can be accessed as follows: PVSDTag.@Alarms.Alm_IntlkTrip.AlarmElement.
Sts_DriveFault	BOOL	Not Visible	Not Required	Output	1 = Drive Fault, see drive display or manual for detail.
Sts_RdyAck	BOOL	Not Visible	Not Required	Output	1 = An alarm is ready to be acknowledged.
Sts_RdyReset	BOOL	Not Visible	Not Required	Output	1 = A latched alarm or shed condition is ready to be reset.
XRdy_Acq	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Acq, enable HMI button.
XRdy_Rel	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Rel, enable HMI button.
XRdy_StartFwd	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_StartFwd, enable button.
XRdy_StartRev	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_StartRev, enable button.
XRdy_JogFwd	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_JogFwd, enable button.
XRdy_JogRev	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_JogRev, enable button.
XRdy_Stop	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Stop, enable button.
XRdy_Reset	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_Reset, enable button.
XRdy_ResetAckAll	BOOL	Not Visible	Not Required	Output	1 = Ready for XCmd_ResetAckAll, enable button.
Val_Owner	DINT	Not Visible	Not Required	Output	Current object owner ID (0 = not owned).

Private Input Members	Data Type	Description
CmdSrc	P_COMMAND_SOURCE	Control or Command Source Selection.
MCmd_Acq	BOOL	Maintenance command to acquire ownership (Operator/Program/External/Override to Maintenance). The instruction clears this operand automatically. Default is false.
MCmd_Bypass	BOOL	Maintenance command to bypass all bypassable interlocks and permissives. The instruction clears this operand automatically. Default is false.

Private Input Members	Data Type	Description
MCmd_Check	BOOL	Maintenance command to check (not bypass) all interlocks and permissives. The instruction clears this operand automatically. Default is false.
MCmd_IS	BOOL	Maintenance command to select In Service. The instruction clears this operand automatically. Default is false.
MCmd_OoS	BOOL	Maintenance command to select Out of Service. The instruction clears this operand automatically. Default is false.
MCmd_Physical	BOOL	Maintenance command to select Physical device operation (not simulated). The instruction clears this operand automatically. Default is false.
MCmd_Virtual	BOOL	Maintenance command to select Virtual (simulated) device operation. The instruction clears this operand automatically. Default is false.
OCmd_JogFwd	BOOL	Operator command to Jog Drive Forward. The instruction clears this operand automatically if max jog time is reached. Default is false.
OCmd_JogRev	BOOL	Operator command to Jog Drive Reverse. The instruction clears this operand automatically if max jog time is reached. Default is false.
OCmd_Lock	BOOL	Operator command to lock Operator (disallow Program). The instruction clears this operand automatically. Default is false.
OCmd_Normal	BOOL	Operator command to select Normal (Operator or Program). The instruction clears this operand automatically. Default is false.
OCmd_Oper	BOOL	Operator command to select Operator (Program to Operator). The instruction clears this operand automatically. Default is false.
OCmd_Prog	BOOL	Operator command to select Program (Operator to Program). The instruction clears this operand automatically. Default is false.
OCmd_Reset	BOOL	Operator command to reset all alarms and latched shed conditions. The instruction clears this operand automatically. Default is false.
OCmd_ResetAckAll	BOOL	Operator command to acknowledge and reset all alarms and latched shed conditions. The use of OCmd_ResetAckAll is restricted to HMI. The instruction clears this operand automatically. Default is false.
OCmd_StartFwd	BOOL	Operator command to Start Drive Forward. The instruction clears this operand automatically. Default is false.
OCmd_StartRev	BOOL	Operator command to Start Drive Reverse. The instruction clears this operand automatically. Default is false.
OCmd_Stop	BOOL	Operator command to Stop Drive. The instruction clears this operand automatically. Default is false.
OSet_OutDatalink	REAL	Operator Setting of Output Datalink, in output datalink engineering units. Valid = any float (clamped) Default is 0.0.

Private Input Members	Data Type	Description
OSet_SpeedRef	REAL	Operator Setting of Speed Reference, in speed reference engineering units. Valid = any float (clamped) Default is 0.0.

Private Output Members	Data Type	Description
HMI_BusObjIndex	DINT	This object's index in the bus array, for use by HMI display. Default is 0.
MRdy_Acq	BOOL	1 = Ready for MCmd_Acq, enable HMI button.
MRdy_Bypass	BOOL	1 = Ready for MCmd_Bypass, enable HMI button.
MRdy_Check	BOOL	1 = Ready for MCmd_Check, enable HMI button.
MRdy_IS	BOOL	1 = Ready for MCmd_IS, enable HMI button.
MRdy_OoS	BOOL	1 = Ready for MCmd_OoS, enable HMI button.
MRdy_Physical	BOOL	1 = Ready for MCmd_Physical, enable HMI button.
MRdy_Rel	BOOL	1 = Ready for MCmd_Rel, enable HMI button.
MRdy_Virtual	BOOL	1 = Ready for MCmd_Virtual, enable HMI button.
ORdy_JogFwd	BOOL	1 = Ready for OCmd_JogFwd, enable HMI button.
ORdy_JogRev	BOOL	1 = Ready for OCmd_JogRev, enable HMI button.
ORdy_Lock	BOOL	1 = Ready for OCmd_Lock, enable HMI button.
ORdy_Normal	BOOL	1 = Ready for OCmd_Normal, enable HMI button.
ORdy_Oper	BOOL	1 = Ready for OCmd_Oper, enable HMI button.
ORdy_OutDatalink	BOOL	1 = Ready for OSet_OutDatalink, enable data entry field.
ORdy_Prog	BOOL	1 = Ready for OCmd_Prog, enable HMI button.
ORdy_Reset	BOOL	1 = A latched alarm or shed condition is ready to be reset.
ORdy_ResetAckAll	BOOL	1 = A latched alarm or shed condition is ready to be reset or acknowledged.
ORdy_SpeedRef	BOOL	1 = Ready for OSet_SpeedRef, enable data entry field.
ORdy_StartFwd	BOOL	1 = Ready for OCmd_StartFwd, enable HMI button.
ORdy_StartRev	BOOL	1 = Ready for OCmd_StartRev, enable HMI button.
ORdy_Stop	BOOL	1 = Ready for OCmd_Stop, enable HMI button.
ORdy_Unlock	BOOL	1 = Ready for OCmd_Unlock, enable HMI button.
Sts_FaultDesc	STRING	Description of motor controller fault, lookup from last fault code.

Public InOut Members	Data Type	FBD Default Visibility	FBD Wiring required	Usage	Description
Ref_Ctrl_Set	RAC_ITF_DVC_PWRVELOCITY_SET	Visible	Required	InOut	Velocity Automation Device Object Settings Interface.
Ref_Ctrl_Cmd	RAC_ITF_DVC_PWRVELOCITY_CMD	Visible	Required	InOut	Velocity Automation Device Object Command Interface.
Ref_Ctrl_Sts	RAC_ITF_DVC_PWRVELOCITY_STS	Visible	Required	InOut	Velocity Automation Device Object Status Interface.
BusObj	BUS_OBJ	Visible	Required	InOut	Bus component.
Ref_FaultCodeList	RAC_CODE_DESCRIPTION[1]	Visible	Required	InOut	Fault Code to Fault Description lookup table for intelligent motor controller.

RAC_ITF_DVC_PWRVELOCITY_SET Structure

The RAC_ITF_DVC_PWRVELOCITY_SET structure is the first of three structures exchanged with the associated Power Velocity Device Object to interface with the variable speed drive device. This structure handles settings, such as the speed reference, sent to the drive.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, other pins on the instruction are used to link the necessary data.

Members	Data Type	Description
InhibitCmd	BOOL	1 = Inhibit user Commands from external sources, 0 = Allow Commands.
InhibitSet	BOOL	1 = Inhibit user Settings from external sources, 0 = Allow Settings.
Speed	REAL	Speed reference (Hz). Valid = 0.0 to maximum drive frequency.

RAC_ITF_DVC_PWRVELOCITY_CMD Structure

The RAC_ITF_DVC_PWRVELOCITY_CMD structure is the second of three structures exchanged with the associated Power Velocity Device Object to interface with the variable speed drive device. This structure handles commands, such as start, stop and jog, sent to the drive. It is an InOut parameter configured as optional (May Be Null).

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, other pins on the instruction are used to link the necessary data.

Members	Data Type	Description
bCmd	INT	Commands (Bit Overlay):
Physical	BOOL	Operate as a physical device.
Virtual	BOOL	Operate as a virtual device.
ResetWarn	BOOL	Reset warning status.
ResetFault	BOOL	Reset fault status.
Activate	BOOL	Activate output power structure.
Deactivate	BOOL	Deactivate output power structure.
CmdDir	BOOL	Select direction: 0 = Forward, 1 = Reverse.

RAC_ITF_DVC_PWRVELOCITY_STS Structure

The RAC_ITF_DVC_PWRVELOCITY_STS structure is the third of three structures exchanged with the associated Power Velocity Device Object to interface with the variable speed drive device. This structure handles status, such as the speed feedback, active status, commanded and actual direction,

received from the drive. It is an InOut parameter configured as optional (May Be Null).

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, other pins on the instruction are used to link the necessary data.

Members	Data Type	Description
eState	DINT	Enumerated state of the device object: 0 = Unused, 1 = Initializing, 2 = Disconnected, 3 = Disconnecting, 4 = Connecting, 5 = Idle, 6 = Configuring, 7 = Available.
FirstWarning	RAC_ITF_EVENT	First warning.
FirstFault	RAC_ITF_EVENT	First fault.
eCmdFail	DINT	Enumerated command failure code.
Speed	REAL	Actual Speed (Hz).
bSts	INT	Status (Bit Overlay):
Physical	BOOL	1 = Operating as a physical device.
Virtual	BOOL	1 = Operating as a virtual device.
Connected	BOOL	1 = Connected and communicating.
Available	BOOL	1 = Device is configured and can be operated.
Warning	BOOL	1 = Device has a warning.
Faulted	BOOL	1 = Device is faulted.
Ready	BOOL	1 = Device is ready to be activated.
Active	BOOL	1 = Device is active (power structure active, drive running).
ZeroSpeed	BOOL	1 = Motor is at zero speed (not rotating).
ObjCtrl	BOOL	0 = Object has control of this device, 1 = Object does not have control of this device (for example, local HIM or I/O has control).
CmdDir	BOOL	Commanded direction: 1 = Reverse, 0 = Forward
ActDir	BOOL	Actual (rotation) direction: 1 = Reverse, 0 = Forward
Accelerating	BOOL	1 = Motor is accelerating.
Decelerating	BOOL	1 = Motor is decelerating.
AtSpeed	BOOL	1 = Motor actual speed has reached speed reference.

BUS_OBJ Structure

The BUS_OBJ structure links the variable speed drive to other devices and instructions in a complex control strategy, typically into a hierarchy. A Bus Object rolls up status and alarm information from lower level devices to higher level control and fans out commands from higher level control to lower level devices, and items link to the bus by referencing a single member of the BUS_OBJ array associated with the bus.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the Bus functions of this instruction are not available.

Members	Data Type	Description
Inp_Cmd	DINT	Input to assert commands
Out_Cmd	DINT	Resultant commands
Inp_CmdLLH	DINT	Input for level normally high commands
Out_CmdLLH	DINT	Resultant line level high commands
Inp_Sts	DINT	Input to assert status
Out_Sts	DINT	Resultant status
Inp_CmdAck	DINT	Input to assert a command acknowledgement
Out_CmdAck	DINT	Resultant command acknowledgements
Inp_SeverityMax	DINT	Input: maximum alarm severity
Out_SeverityMax	DINT	Resultant of maximum alarm severity
Cfg_CmdMask	DINT	Propagation mask for commands
Cfg_CmdLLHMask	DINT	Propagation mask for line level high commands
Cfg_StsMask	DINT	Propagation mask for status
Ref_Index	DINT	Bus array index

RAC_CODE_DESCRIPTION[x] Structure

The RAC_CODE_DESCRIPTION[x] structure is an array of drive fault code number and fault code description pairs, used as a lookup table. The instruction searches the table for the fault code received from the drive and displays the corresponding fault description text.

This parameter links the instruction to an external tag that contains necessary data for the instruction to operate. The external tag must be of the data type shown, or may be NULL. If NULL, the fault code lookup function is not performed. Fault descriptions will only be shown if provided through the Device Object Status interface.

Members	Data Type	Description
Code	DINT	Code for which to look up Description.
Desc	STRING	Description for given Code.

RAC_EVENTStructure

RAC_EVENTstructures are used by the FirstFault and FirstWarning members in the RAC_ITF_DVC_PWRVELOCITY_STS structure. These items hold the event data received from the drive for the first drive fault and first drive warning records in the drive event history.

Members	Data Type	Description
Type	DINT	Event type: 1 = Status, 2 = Warning, 3 = Fault, 4 ...n = User.
ID	DINT	User-definable event ID.
Category	DINT	User-definable category (Electrical, Mechanical, Materials, Utility, etc.).
Action	DINT	User-definable event action code.
Value	DINT	User-definable event value or fault code.
Message	STRING	Event message text.
EventTime_L	LINT	Event timestamp (64-bit microseconds format).
EventTime_D	DINT[7]	Event timestamp (year, month, day, hour, minute, second, microsecond format).

Alarms

Discrete Logix tag-based alarms are defined for these members:

Member	Alarm Name	Description
Sts_FailToStart	Alm_FailToStart	Drive failed to start within the allotted time when commanded to start.
Sts_FailToStop	Alm_FailToStop	Drive failed to stop within the allotted time when commanded to stop.
Sts_IntlkTrip	Alm_IntlkTrip	Drive stopped by an Interlock Not OK.
Sts_IOFault	Alm_IOFault	Drive communication with controller failed.
Sts_DriveFault	Alm_DriveFault	The variable speed drive is reporting it has a fault condition.

Mark the alarm as used or unused and set standard configuration members of the discrete Logix Tag based alarm. Use this format to access alarm elements:

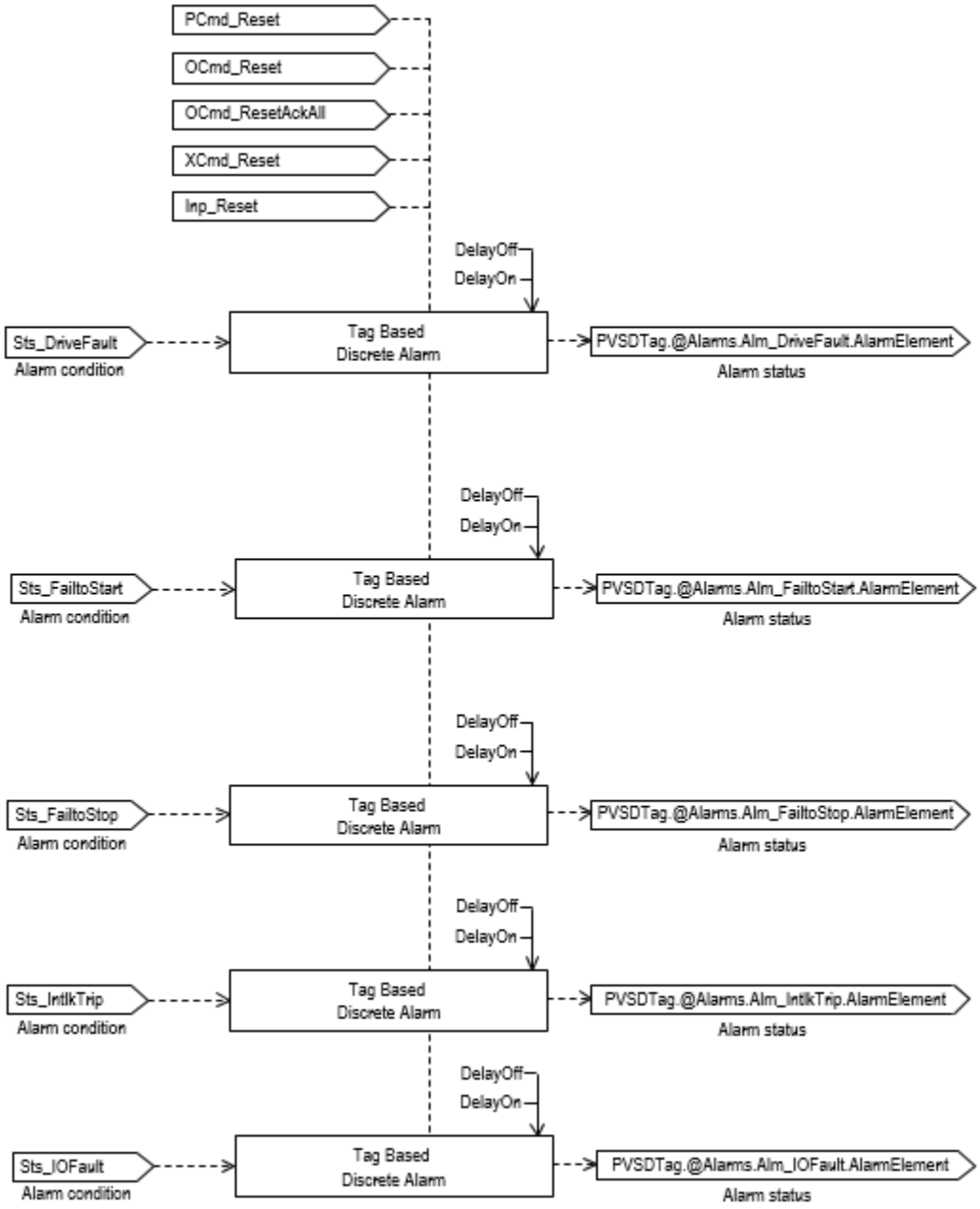
Tag.@Alarms.AlarmName.AlarmElement

The PVSD instruction uses these alarms:

- Raises the Fail to Start alarm when the drive is commanded to start but run feedback is not received within the configured failure time.
- Raises the Fail to Stop alarm when the drive is commanded to stop but run feedback does not drop within the configured failure time.
- Raises the Interlock Trip alarm when the motor is running and an interlock not-OK condition causes the motor to stop. If interlocks are not bypassed, a bypassable interlock or a non-bypassable interlock not-OK condition initiates an interlock trip. If interlocks are bypassed, only a non-bypassable interlock not-OK condition initiates an interlock trip.
- Raises the I/O Fault alarm when I/O communication with the variable speed drive is lost. For the Power Velocity Device interface, this is detected when the Ref_Ctrl_Sts.Connected bit goes false (to 0). For the discrete signal interface, used when Ref_Ctrl_Sts is NULL, this is detected when Inp_IOFault goes true (to 1).
- Raises the Drive Fault alarm when the drive reports a drive faulted condition. For the Power Velocity Device interface, this is detected when the Ref_Ctrl_Sts.Faulted bit goes true (to 1). For the discrete

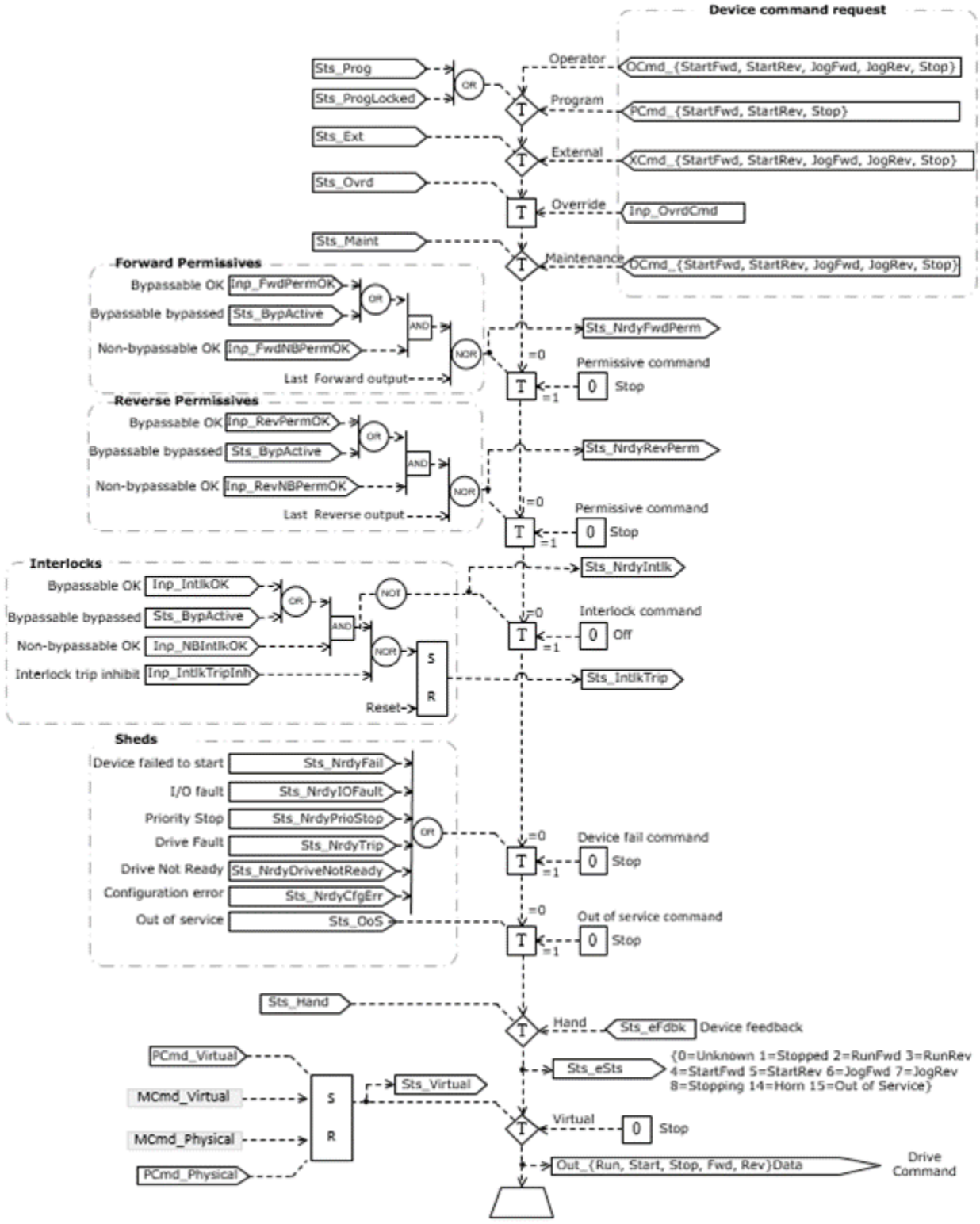
signal interface, which is used when Ref_Ctrl_Sts is NULL, this is detected when Inp_Faulted goes true (to 1).

Program, Operator, and External commands reset latched alarms, and reset and acknowledge all alarms of the instruction (Alarm Set) at the same time. This diagram shows how the commands interact with the PVSD instruction.

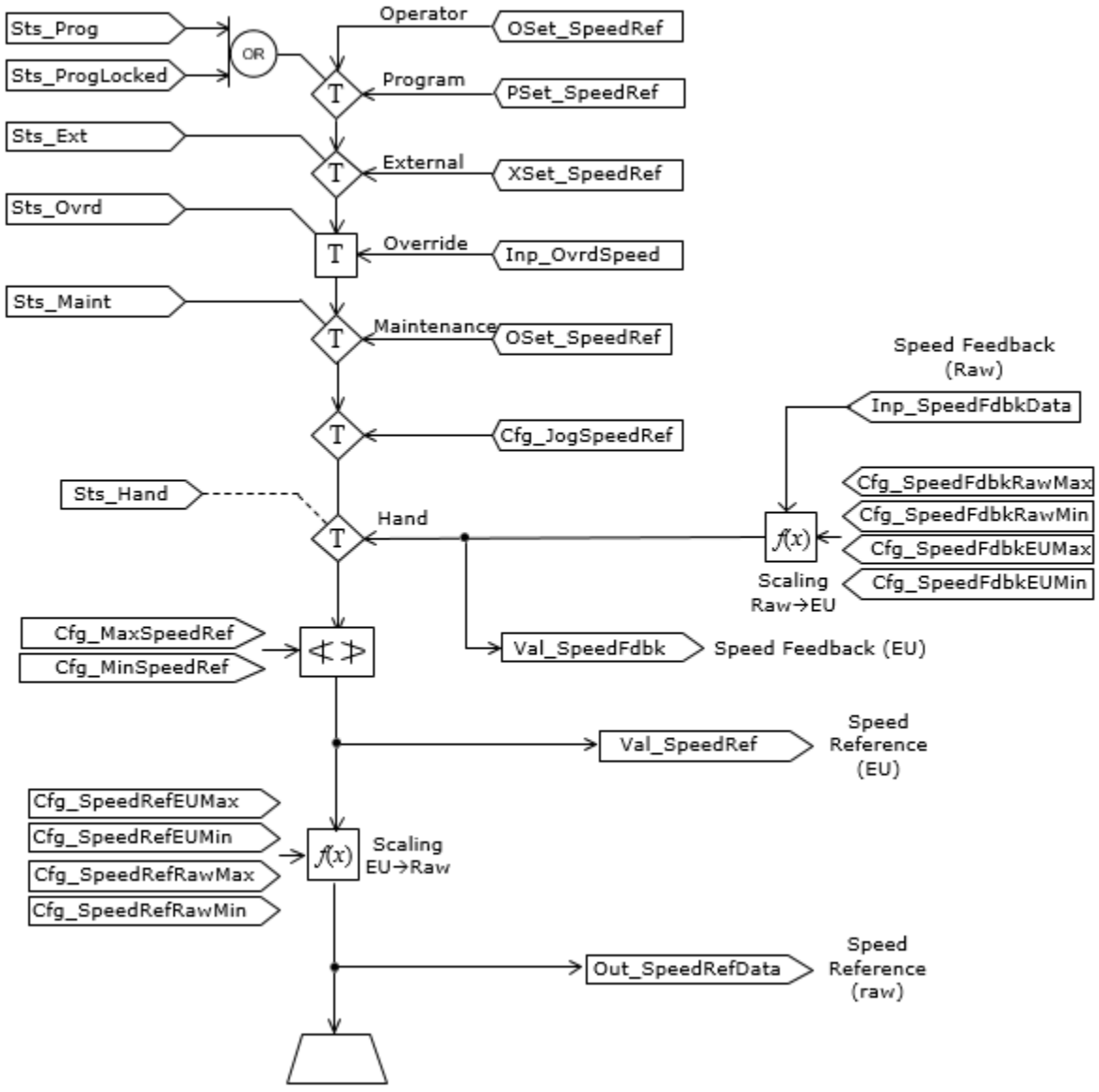


Operation

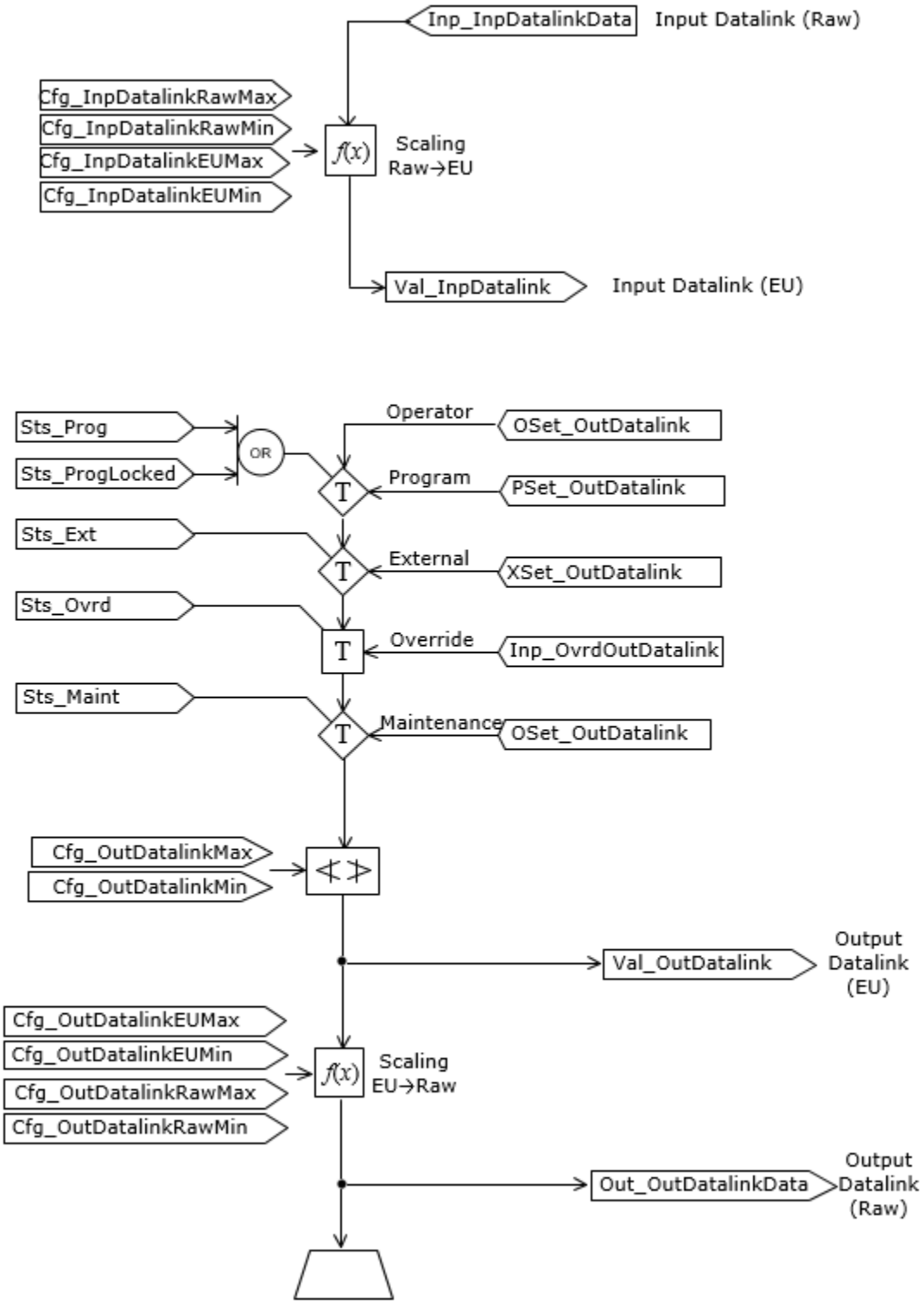
This diagram illustrates functionality of the PVSD instruction:



The second diagram illustrates the handling of the drive speed reference (setpoint) and drive speed feedback:



The third diagram illustrates the handling of the optional input datalink and output datalink functions:



Monitor the PVSD Instruction

Use the operator faceplate from the PlantPAx library of Process objects for monitoring.

Affects Math Status Flags

No.

Major/Minor Faults

None specific to this instruction. See Index Through Arrays for array-indexing faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor state is evaluated and the instruction aligns with the current state of the motor, as if the Hand command source were selected.
Rung-condition-in is false	Handled the same as if the motor is taken Out of Service by command. The motor outputs are de-energized, and the motor Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. The rung-condition-out continues as false.
Rung-condition-in is true	Set rung-condition-out to rung-condition-in. The instruction executes.
Postscan	Rung-condition-out is cleared to false.

Function Block Diagram

Condition/State	Action Taken
Prescan	Any commands received before first scan are discarded. The motor is de-energized and treated as if it were commanded to stop.
Instruction first run	Any commands received before first scan are discarded. The motor state is evaluated and the instruction aligns with the current state of the motor, as if the Hand command source were selected.
Instruction first scan	See instruction first run in the function block diagram table.
EnableIn is false	Handled the same as if the motor is taken Out of Service by command. The motor outputs are de-energized, and the motor Command Source is shown as Program Out of Service on the HMI. All alarms are cleared. EnableOut is set to false.

Condition/State	Action Taken
EnableIn is true	EnableOut is set to true. The instruction executes.
Postscan	EnableIn and EnableOut bits are cleared to false.

Structured Text

In Structured Text, EnableIn is always true during normal scan. Therefore, if the instruction is in the control path activated by the logic it will execute.

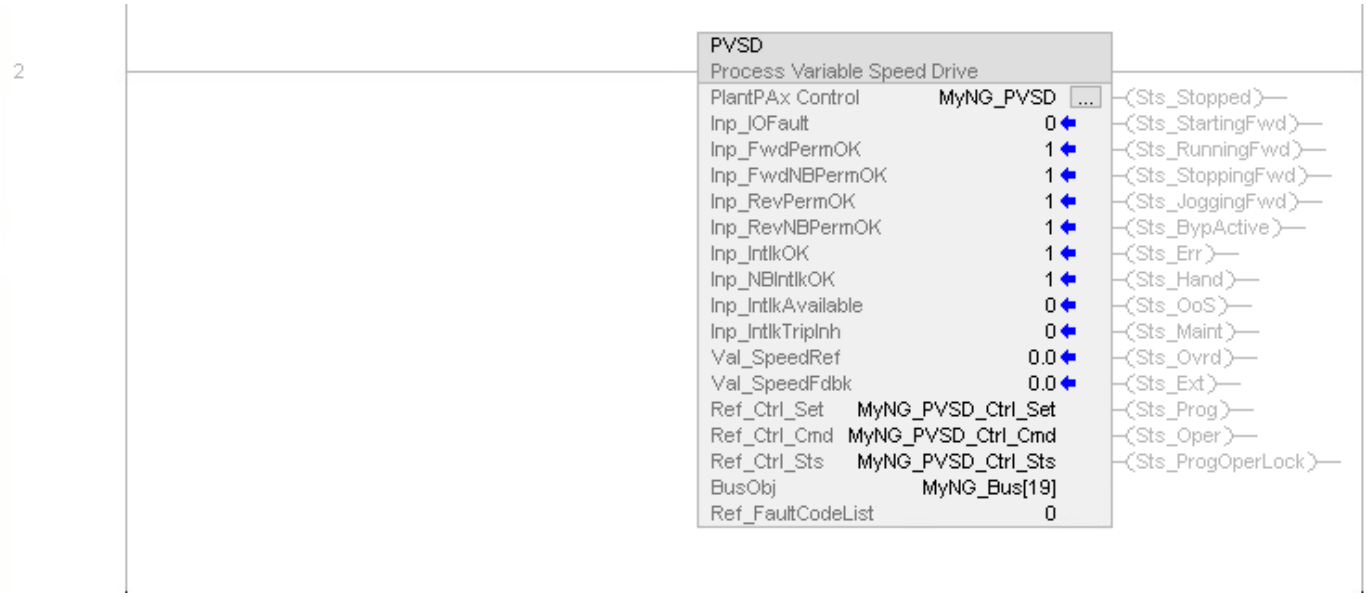
Condition/State	Action Taken
Prescan	See Prescan in the Function Block Diagram table.
Instruction first run	See Instruction first run in the Function Block Diagram table.
EnableIn is true	See EnableIn is true in the Function Block Diagram table.
Postscan	See Postscan in the Function Block Diagram table.

Example

In the following example, the first three reference (InOut parameter) tags are used to interface to a Power Velocity Device object, provided by Commercial Engineering. These tags provide the Speed Reference setting to the drive, the various activate (start), deactivate (stop), and clear fault commands to the drive, and drive status from the drive, including status such as active (running), actual speed, commanded and actual direction, and fault and warning information and test. The next InOut parameter links this drive to a bus of related devices, control modules, equipment modules and unit(s) in a hierarchy used to fan out commands and roll up status and alarm information for use in complex control strategies and sequences.

In this example, the Fault Code List parameter is not used because the textual fault information is received from the Power Velocity Device object, and no lookup from a fault code is required in this instance.

Ladder Diagram



Function Block Diagram

Structured Text

PVSD(MyNG_PVSD, MyNG_PVSD_Ctrl_Set, MyNG_PVSD_Ctrl_Cmd, MyNG_PVSD_Ctrl_Sts, MyNG_Bus[19], 0)

See also

Process Variable Speed Drive (PVSD) Command Source on page 667

PVSD Command Source

The Process Variable Speed Drive (PVSD) instruction uses these command sources. The command sources are prioritized in order from highest to lowest.

Command Source	Description
Hand	Hardwired logic or other logic outside the instruction controls the device. The instruction tracks the state of the device for bumpless transfer back to one of the other command sources. This is the highest priority command source.
Out-of-Service	The instruction is disabled. Drive commands and settings from any source are not accepted.
Maintenance	Maintenance controls the device and supersedes Operator, Program, External and Override control. Operator commands and settings from the HMI are accepted.
Override	Priority logic controls the device and supersedes Operator, Program and External control. Override Input (Inp_Ovrd) is accepted.
External	External logic (for example, field pilot control or upstream SCADA) controls the device. External commands (XCmd_) are accepted.
Program locked	Program logic controls the device. Program commands (PCmd_) are accepted. Operator cannot take control from the Program. Override cannot take control from theProgram unless Cfg_OvrdOverLock = 1.
Program	Program logic controls the device. Program commands (PCmd_) are accepted.
Operator locked	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. Program cannot take control from Operator. Override cannot take control from Operator unless Cfg_OvrdOverLock = 1.
Operator	The Operator controls the device. Operator commands (OCmd_) from the HMI are accepted. This is the lowest priority command source.

The instruction enables or disables these operations:

- Maintenance Out-of-Service exists
- Maintenance exists
- External exists
- Program (unlocked) exists
- Program locked exists
- Operator (unlocked) exists
- Operator locked exists
- PCmd_Lock used as a Level (1 = Lock, 0 = Unlock)

The instruction checks for invalid configurations of control and forces the nearest valid configuration.

The core control model arbitrates the source of the commands and parameters that the receiving function accepts. The core control model determines if the source is:

- A programmatic entity which resides entirely within the processing environment, or
- An external interface entity which issues commands and parameters external and asynchronously to the processing environment.

Locking a control source prevents the other control source from acquiring privilege.

Core Command Source Model

The core control model consists of these control sources:

- Oper
- OperLocked
- Prog
- ProgLocked

The control model defaults to this configuration. Other control sources may be present in the model but act as overriding control sources, acting independent of the base Operator/Program state machine.

Enable control sources as Configuration

The user can enable and disable individual control sources. The default configuration uses the entire base model; upon power-up of the processing environment the control source will be the designated default. Some combinations of enabled control sources are disallowed as they are either unnecessary or could create unintended changes.

Prog Power Up

Configuration allows the user to specify whether Operator or Program is the power-up default.

Prog Priority

Configuration allows the user to specify whether Operator or Program commands take priority when simultaneously asserted.

Automatic reset of commands

All commands are treated as one-shot-latched. Commands are automatically cleared when the instruction executes and processes them.

Change Destination States

Under certain configurations the destination command source for some commands may change. This is in keeping with the intent of the command. For example, if the Program state is disabled, the destination of the OCmd_Prog command becomes the Program Locked state instead of the Program state. This maintains the intent of the OCmd_Prog command: the operator entity wishes to place the function in control of the program. If the

command was eliminated then there would be no way to accomplish this. This is only done in configurations where it would cause no conflict or race condition, but serves to preserve as much user functionality as is practical.

Higher Priority Command Sources

These Higher priority command sources operate independently within the model:

- External
- Override
- Maintenance
- Out-of-Service
- In-Service
- Hand

Implementation

The PVSD instruction monitors and controls a variable speed drive. The speed reference and the start, stop and jog commands to the drive can come from a variety of sources, determined by an embedded instance of PCMDSRC. Available command sources are:

- Operator, through the HMI
- Program, through logic connected to the block
- External, through logic connected to the block
- Override, through logic connected to the block
- Maintenance, through the HMI
- Out of Service
- Hand (assumes the block has no control of the drive, so aligns with the actual drive status in order to achieve bumpless transfer from Hand back to one of the other command sources)

The PVSD instruction has four aspects, which can be kept by a particular command source whenever the command source selection is Operator, Program or External. Any or all of the aspects can be kept at any given time, or can follow the selection of the PCMDSRC. The aspects are:

- The Speed Reference setting
- Start (forward and reverse) commands
- Jog (forward and reverse) commands
- The Output Datalink setting

The Jog commands cannot be kept by the Program command source.

The PVSD instruction supports virtualization. When selected to Virtual, the instruction provides status to the operator and other blocks as if a working drive were connected while keeping the outputs to the physical drive de-

energized (zero). When selected to Physical, the instruction monitors and controls the physical variable speed drive device. Use Virtualization to provide off-process functional testing of higher-level control strategies or simulation for operator training.

The PVSD instruction supports interlocks, conditions that must be OK for the motor to run and which stop the motor if not OK, and permissives, conditions that must be OK for the motor to start but which are ignored once the motor is running. Bypassable permissives and interlocks can be bypassed for maintenance, while non-bypassble interlocks and permissives are always evalutated.

Analog values (speed reference, speed feedback, input datalink, output datalink) associated with the drive are displayed and entered in engineering units, and linear scaling is used to provide these values in raw (drive) units at the drive interface. The speed reference to the drive has rate limiting and clamping limits; the output datalink to the drive has clamping limits.

The PVSD instruction supports a bus for forwarding commands (fanout) and gathering status (rollup) in a hierarchy of objects. Refer to the Bus Object for more information on the commands and status (including alarm status) sent on the bus.

The PVSD instruction optionally supports the ability to look up the text to display for the most recent drive fault code, given a provided fault code lookup table. This table is an array of Code and Description pairs and is searched whenever the last fault code from the drive changes.

The PVSD instruction's interface to the physical drive can be through a Power Velocity Device Object interface or by connecting individual drive signals to input and output pins of the instruction. Details on the Power Velocity Device Object interface are given below. Three interface tags are used, provided as InOut Parameters. These tags provide drive Settings, such as the Speed Reference, drive Commands, such as start forward, jog reverse and stop, and retrieve drive Status, such as connected, active (running), commanded direction, actual direction, accelerating, decelerating, at speed, warning, faulted, and extended drive warning and fault information.

PVSD Drive Settings: Ref_Ctrl_Set InOut Parameter (RAC_ITF_DVC_PWRVELOCITY_SET) Structure

Private Input Members	Data Type	Description
InhibitCmd	BOOL	1 = Inhibit user Commands from external sources, 0 = allow Commands.
InhibitSet	BOOL	1 = Inhibit user Settings from external sources, 0 = Allow Settings.
Speed	REAL	Speed reference (Hz). Valid = 0.0 to maximum drive frequency.

PVSD Drive Commands: Ref_Ctrl_Cmd InOut Parameter (RAC_ITF_DVC_PWRVELOCITY_CMD) Structure

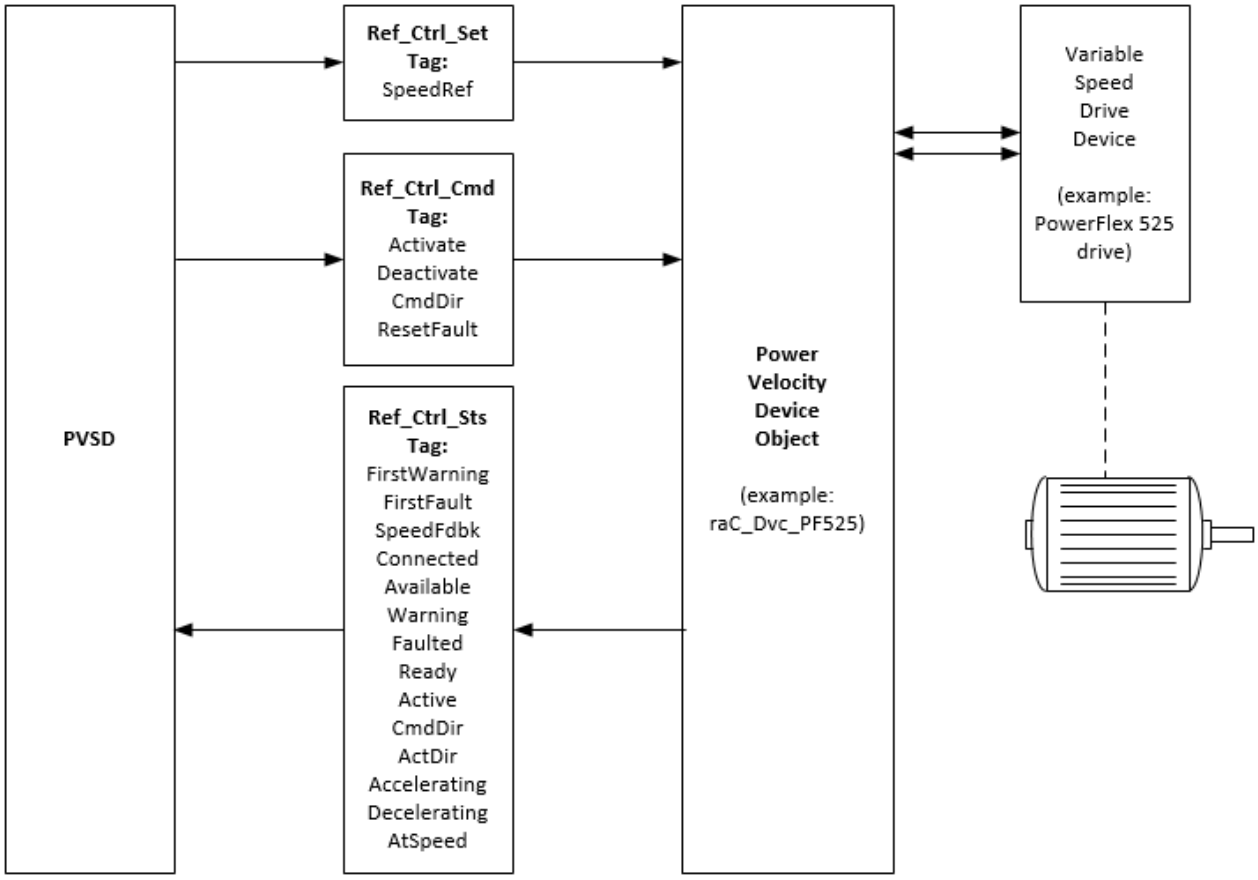
Private Input Members	Data Type	Description
bCmd	INT	Commands (bit overlay), consisting of:
Physical	BOOL	Operate as a physical device
Virtual	BOOL	Operate as a virtual device
ResetWarn	BOOL	Reset warning status
ResetFault	BOOL	Reset fault status
Activate	BOOL	Activate output power structure (if speed reference is not zero, the motor will run)
Deactivate	BOOL	Deactivate output power structure (motor will stop)
CmdDir	BOOL	Select direction: 0 = Forward, 1 = Reverse

PVSD Drive Status: Ref_Ctrl_Sts InOut Parameter (RAC_ITF_DVC_PWRVELOCITY_STS) Structure

Private Input Members	Data Type	Description
eState	DINT	Enumerated state of the device object: 0 = Unused 1 = Initializing 2 = Disconnected 3 = Disconnecting 4 = Connecting 5 = Idle 6 = Configuring 7 = Available
FirstWarning	RAC_ITF_EVENT	First Warning, consisting of:
Type	DINT	Event type: 1 = Status, 2 = Warning, 3 = Fault, 4 ... n = User
ID	DINT	User-definable event ID
Category	DINT	User-definable category (electrical, mechanical, materials, utility, etc.)
Action	DINT	User-definable event action code
Value	DINT	User-definable event value or fault code
Message	STRING	Event message text
EventTime_L	LINT	Event timestamp (64-bit microseconds format)
EventTime_D	DINT[7]	Event timestamp (year, month, day, hour, minute, second, microsecond format)
FirstFault	RAC_ITF_EVENT	First Fault, consisting of:
Type	DINT	Event type: 1 = Status, 2 = Warning, 3 = Fault, 4 ... n = User
ID	DINT	User-definable event ID
Category	DINT	User-definable category (electrical, mechanical, materials, utility, etc.)
Action	DINT	User-definable event action code
Value	DINT	User-definable event value or fault code
Message	STRING	Event message text
EventTime_L	LINT	Event timestamp (64-bit microseconds format)
EventTime_D	DINT[7]	Event timestamp (year, month, day, hour, minute, second, microsecond format)
eCmdFail	DINT	Enumerated command failure code
Speed	REAL	Actual speed (Hz)
bSts	INT	Status, consisting of:
Physical	BOOL	1 = Operating as a physical device
Virtual	BOOL	1 = Operating as a virtual device

Connected	BOOL	1 = Connected and communicating
Available	BOOL	1 = Device is configured and can be operated
Warning	BOOL	1 = Device has a warning
Faulted	BOOL	1 = Device is faulted
Ready	BOOL	1 = Device is ready to be activated
Active	BOOL	1 = Device is active (power structure active, drive running)
ZeroSpeed	BOOL	1 = Motor is at zero speed (not rotating)
ObjCtrl	BOOL	0 = Object has control of this device, 1 = Object does not have control of this device (for example, local HIM or I/O has control)
CmdDir	BOOL	Commanded direction: 1 = reverse, 0 = forward
ActDir	BOOL	Actual direction (of rotation): 1 = reverse, 0 = forward
Accelerating	BOOL	1 = Motor is accelerating
Decelerating	BOOL	1 = Motor is decelerating
AtSpeed	BOOL	1 = Motor is at commanded speed

This illustration shows the relationship between a PVSD instance and its associated Power Velocity Device Object.



Rockwell Automation support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	rok.auto/pcdc

Documentation feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Waste Electrical and Electronic Equipment (WEEE)

Note: At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current environmental information on its website at rok.auto/pec.

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