PlantPAx Control Strategies

PlantPAx Process Library Release 5.20

Allen-Bradley

by 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.

These 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).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

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.

Controller Fault Handler Control Strategy

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Internal Model Control (IMC) Control Strategies

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Modular Multivariable Control (MMC) Control Strategies

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About This Publication

The Rockwell Automation® Process Objects Library includes PlantPAx® control strategies to help reuse logic to save development time. Use this reference manual for guidance on when and how to use each control strategy.

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

The updates to this version of the publication apply to the 5.20 release of the PlantPAx process library. Screen shots are examples and might show previous versions, even though they apply to this release.

Topic	Page
Added EtherNetIP Integration chapter	55
Added FOUNDATION Fieldbus and Profibus PA Integration chapter	69
Added EtherNet/IP, FOUNDATION Fieldbus, and Profibus PA sheets to these chapters:	
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Updated the HART sheets for the Process Analog Output (PAO) Control Strategies	135
Added motor-specific and drive-specific control strategies for Process Lead Lag Standby (PLLS) Control Strategies	179
Added FOUNDATION Fieldbus, and Profibus PA control strategies for Process Tank Strapping Table (PTST)	305
Added additional drive-specific control strategies for Process Variable Speed Drive (PVSD)	339

Note: The Totalizer (TOT) Control Strategy was removed from the 5.20 release of the library as it is an embedded process controller instruction. For more information, see the Advanced Process Control and Drives Instruction Manual, publication 1756-RM006 or the online help.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation. You can view or download publications at rok.auto/literature.

Resource	Description
PlantPAx Distributed Control System Configuration and Implementation User Manual, publication PROCES-UM100	Provides system guidelines and instructions to assist with the development of your PlantPAx system.
Rockwell Automation Library of Process Objects: HART Modules for PlantPAx DCS, publication PROCES-RM010	Provides details on the integration of HART devices into a PlantPAx system or Integrated Architecture®
Rockwell Automation Library of Process Objects, publication PROCES-RM200	Describes the Add-On Instructions, PlantPAx instructions, and associated faceplates that are available to develop applications.
Rockwell Automation Sequencer Object User Manual, publication PROCES-RM202	Provides an overview of how to use the Rockwell Automation® Sequencer Object (raP_Opr_Seq).
Power Device Library Reference Manual, publication DEVICE-RM100	Provides information on objects for discrete, velocity, motion, and PowerMonitor™ devices.
I/O Device Library Reference Manual, publication DEVICE-RM200	Provides information on objects for Rockwell Automation 1756, 1769, 1734, 1794, 1738, 1732E, 1719, 5069, 5094 I/O modules, including pre-configured status and diagnostic faceplates.
Advanced Process Control and Drives and Phase and Sequence Instruction Manual, publication 1756-RM006	Provides details about the available General, Motion, Process, and Drives instruction set for a Logix-based controller.

PlantPAx Control Strategies

The PlantPAx® control strategies are routines or programs that you import into your controller project. The PlantPAx control strategies are Function Block Diagrams or Ladder Diagrams that include preconfigured process instructions that represent common control and equipment scenarios in process automation. The PlantPAx control strategies have several preconfigured arrays and tags.

See the instruction online help for complete details on the instructions in the control strategies.

Library Prerequisites

Download the latest versions of these libraries at the Product Compatibility and Download Center (PCDC).

- Power Device Library
- I/O Device Library

How to use PlantPAx Control Strategies

You can import the PlantPAx control strategies into your project with Studio 5000 Logix Designer®, or with Application Code Manager (ACM) plug-ins within Studio 5000 Logix Designer.

Import Method	Considerations
Import using Studio 5000 Logix Designer	• You can easily modify a source import file for each application: a. Import the standard routine. b. Modify the routine. c. Export the modified routine to a renamed control strategy for your application. • You must import individual routines one at a time (even when a single control strategy is comprised of multiple routines). • You **can** add routines while you are online with the controller. For more information, see Import with Studio 5000 Logix Designer on page 20.
Import using ACM plug-ins in Studio 5000 Logix Designer	• ACM process library includes a comprehensive set of PlantPAx control strategies plug-ins. • You can enter multiple control strategies at once (even when there are multiple routines per control strategy) • You can configure faceplate navigation at import. • It is difficult to modify source routines. • You **cannot** use the plug-in feature while Online with the controller. For more information, see Import with Application Code Manager Plug-ins on page 22.

Import with Studio 5000 Logix Designer

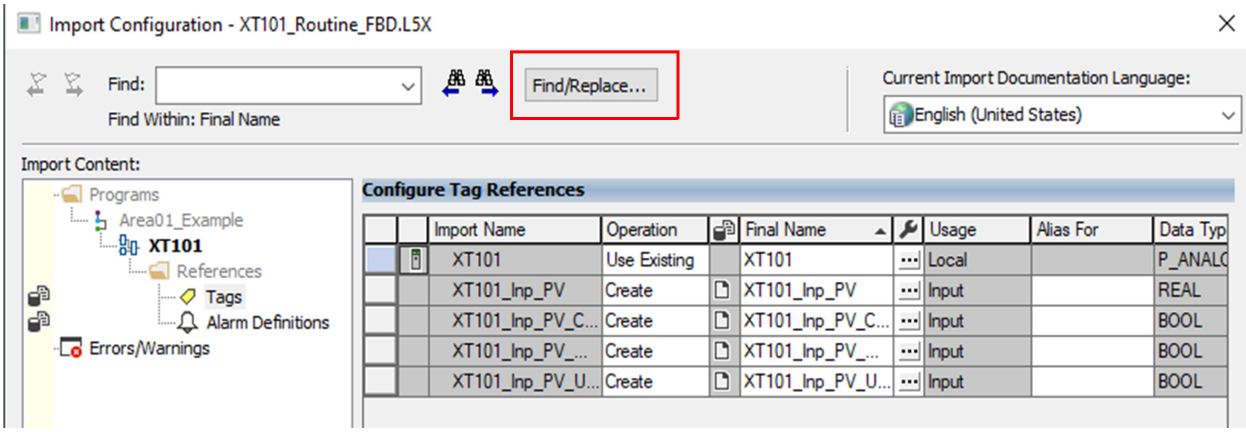
The PlantPAx control strategies are provided as folders that contain one or more routines that can be imported into an appropriate program.

For information on how to import routines and programs, see the Logix 5000® Controllers Import/Export Project Components Programming Manual, publication 1756-PM019.

When the Import Configuration window opens:

1. Select the Tags folder.

   All tags in the control strategy have a default prefix, such as XT101.
2. Use the Find/Replace button to rename the prefix to match your site's tag naming convention.

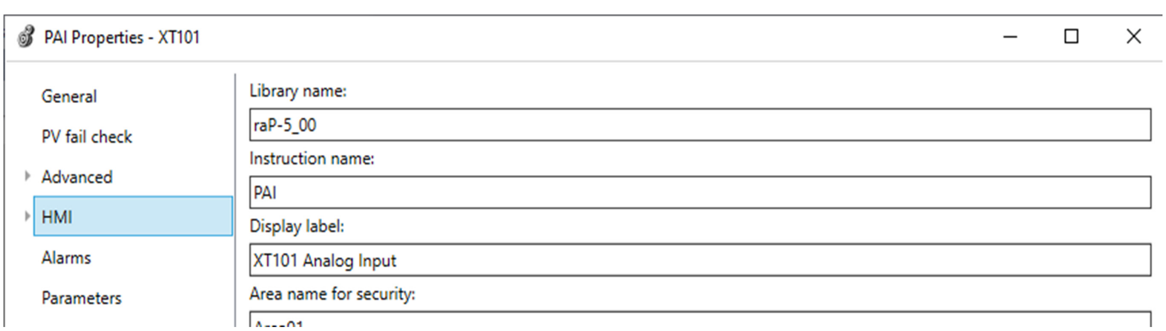


Configure the HMI Display Label

To configure the appropriate display label in the HMI complete these steps.

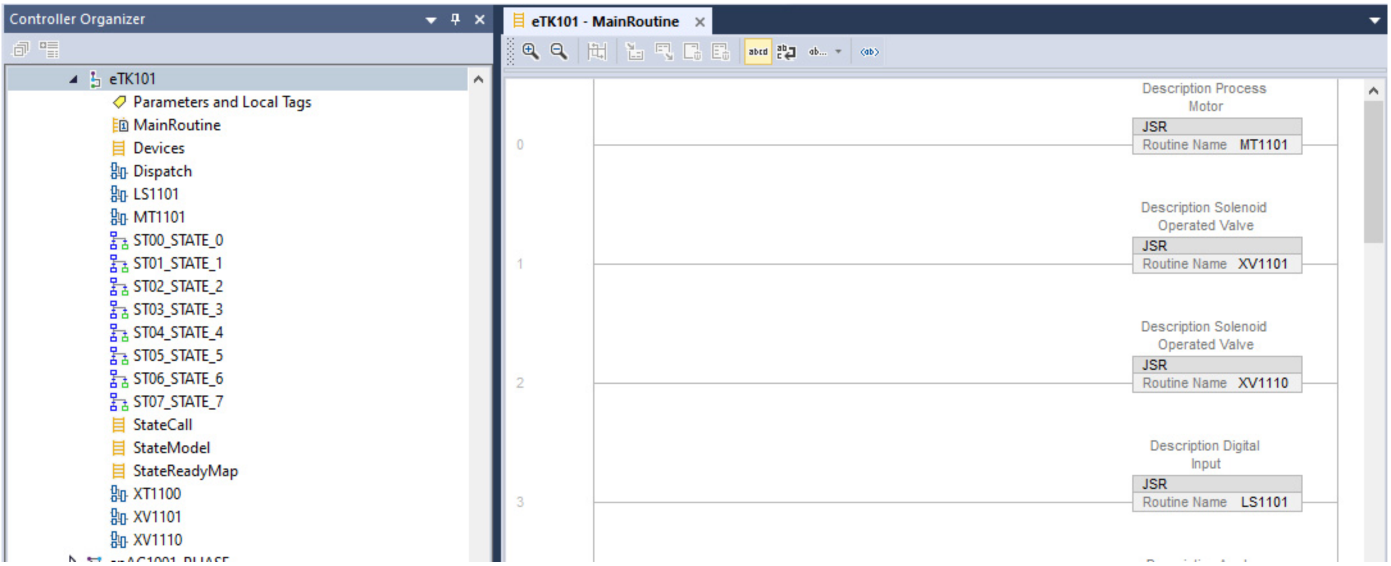
1. Select the Properties dialog box for the instruction in the control strategy.

2. On the HMI page, edit the default display label to provide an appropriate label for the operator interface components.
   - As a best practice, use a consistent labeling method throughout all projects in the system. You could use the exact tag name, or use a more readable format.
   - If you do not use the exact tag name, the display label should generally align with ANSI/ISA-5.1-2022 naming standards.



Add Main Routine Code to Execute the Imported Control Strategies

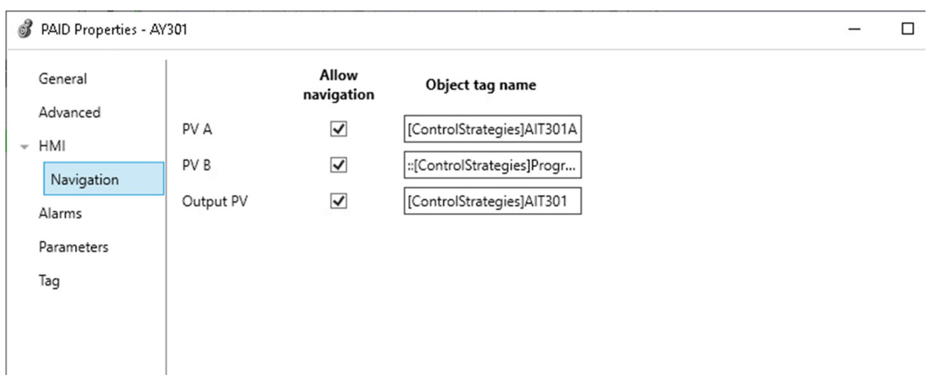
Add JSR instructions that reference the imported control strategy to the Main Routine to execute the new control strategy routines.



HMI Navigation

The process instructions in the PlantPAx control strategies support HMI navigation to other instructions in the same control strategy. To leverage this capability, you only need to specify specify the appropriate controller-scoped or program-scoped tag.

On the process instruction, select Properties > HMI> Navigation and enter the tags for the control strategy objects that you want to allow navigation to.



This example shows both controller-scoped and program-scoped tags, but you can use either for each option. Use this syntax for each tag type.

Tag Type	Syntax	Example
Controller scope	[TOPIC]TagName	[ControlStrategies]AIT301A
Program scope	::[TOPIC]Program:ProgramName.TagName	::[ControlStrategies]Program:CS_PAID.AIT301B

Import with Application Code Manager Plug-ins

The Application Code Manager (ACM) process library includes a comprehensive set of PlantPAx control strategies plug-ins for you to use in your controller projects. Follow your project plan (the spreadsheet with your devices and tags) as you add PlantPAx control strategies for devices (motors, valves, drives, and so forth) to the Studio 5000 Logix Designer application project file.

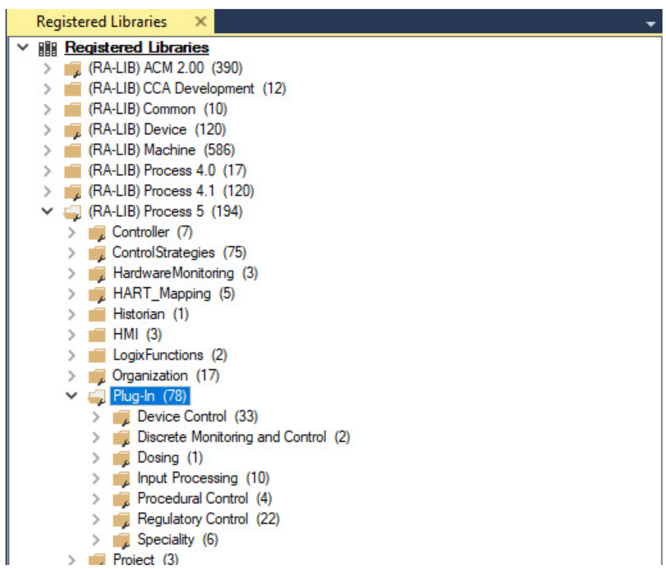
For more information, see the Application Code Manager User Manual, publication LOGIX-UM003.

IMPORTANT	• You can use ACM and ACM plug-ins to add PlantPAx control strategies only when you are **offline** with the controller. • The Library Object Import Wizard can import one or more control strategies at a time. • When adding multiple PlantPAx control strategies of the same type, rename each instance to a unique name.

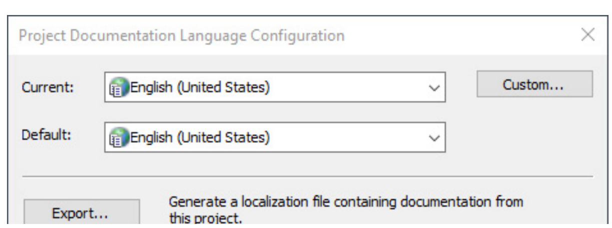
Prerequisites

Before you can use plug-ins with the Import Library Objects in Studio 5000 Logix Designer, you must do the following:

1. Verify that the Application Code Manager is installed on the workstation that has Studio 5000 Logix Designer.
2. Verify that the Application Code Manager Process Library is registered in ACM.



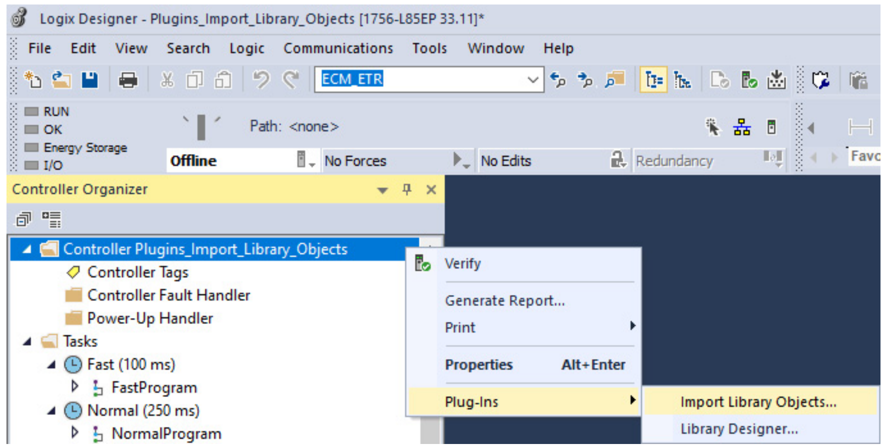
3. In the Studio 5000 Logix Designer application, go to Tools > Documentation Languages and verify that the Project Documentation Language Configuration Default is set to English (United States).



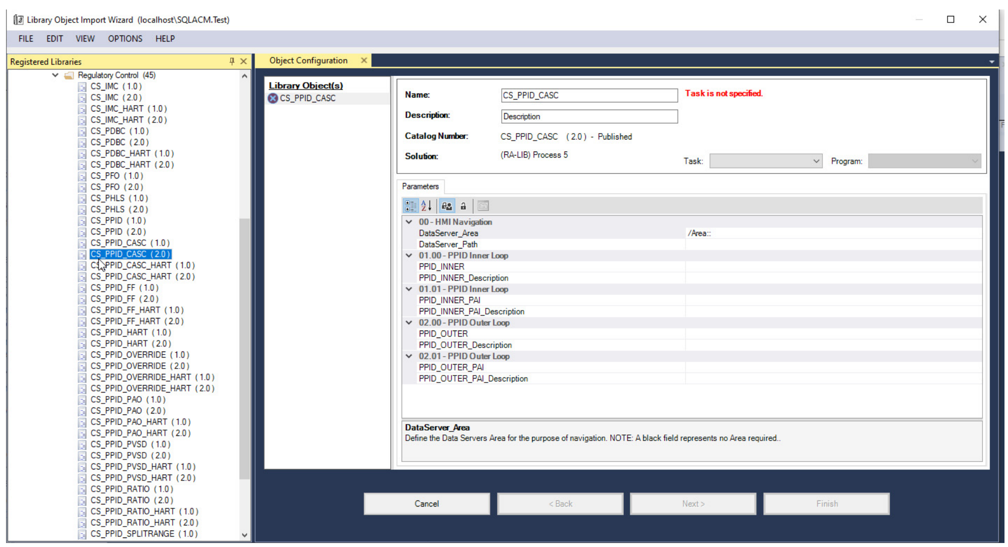
Import Library Objects (Offline Only)

This example workflow shows how to use the Library Object Import Wizard to add two PlantPAx control strategies (CS_PPID_CASC and CS_PVLVSO) into the Logix Designer Project (ACD) file.

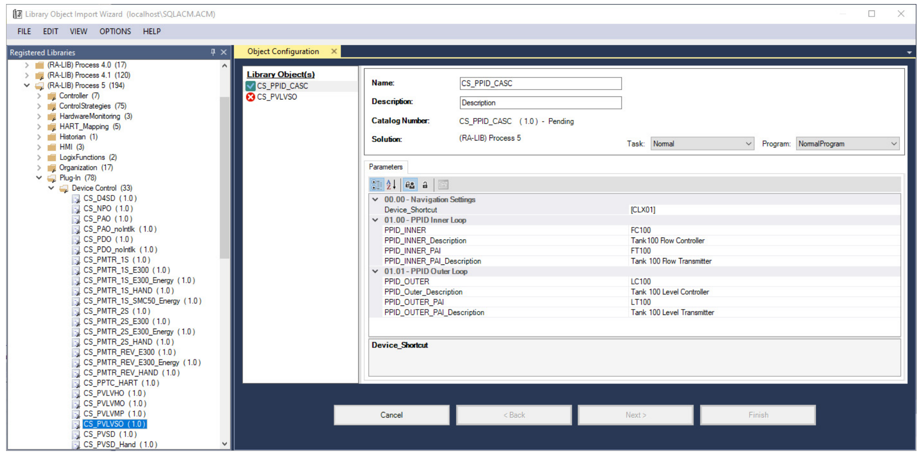
1. Open a Studio 5000 Logix Designer Project (.ACD) file.
2. Right-click on the Controller, and navigate to Plug-Ins > Import Library Objects... to launch the Library Object Import Wizard.



3. In the Library Object Import Wizard, navigate to (RA-LIB) Process 5 > Plug-In > Regulatory Control.
4. Double-click CS_PPID_CASC to add it to the Library Object(s).



5. Under Library Object(s), click CS_PPID_CASC and configure the Task and Program.

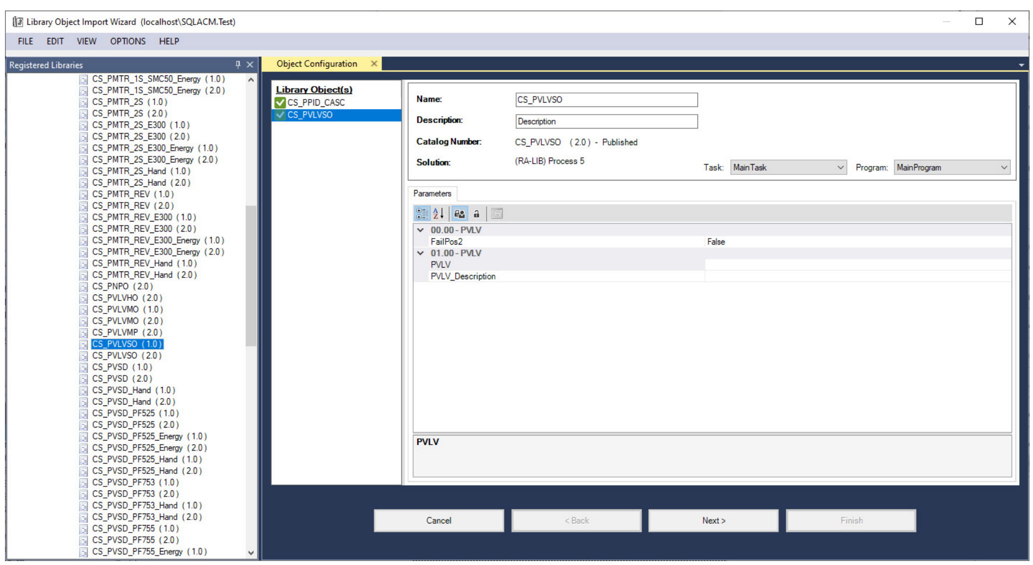


6. Configure these required parameters for the CS_PPID_CASC control strategies.

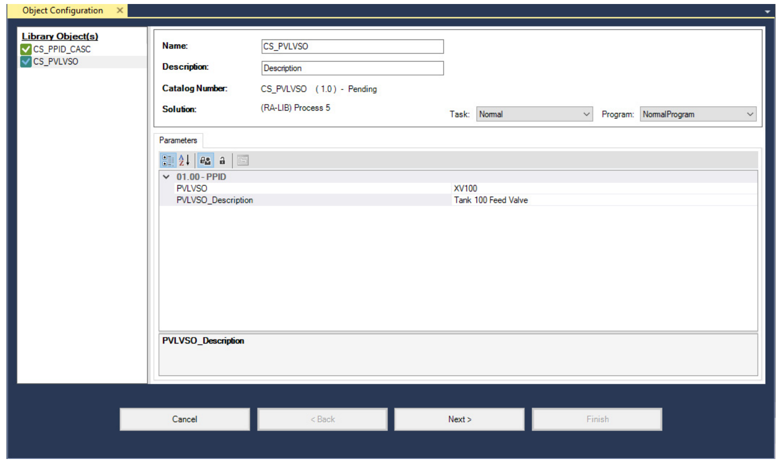
ACM Parameter	Description	Example
Device_Shortcut	Example: [TOPIC] or /Area/DATA::[TOPIC]	[CLX01]
PPID_INNER	Inner Loop Controller Tag	FC100
PPID_INNER_Description	Inner Loop Controller Tag Description	Tank 100 Flow Controller
PPID_INNER_PAI	Inner Loop Analog Input Tag	FT100
PPID_INNER_PAI_Description	Inner Loop Analog Input Tag Description	Tank 100 Flow Transmitter
PPID_OUTER	Outer Loop Controller Tag	LC100
PPID_OUTER_Description	Outer Loop Controller Tag Description	Tank 100 Level Controller
PPID_OUTER_PAI	Outer Loop Analog Input Tag	LT100
PPID_OUTER_PAI_Description	Outer Loop Analog Input Tag Description	Tank 100 Level Transmitter

7. In the Library Object Import Wizard, navigate to (RA-LIB) Process 5 > Plug-In > Device Control.

8. Double-click CS_PVLVSO to add it to the Library Object(s).



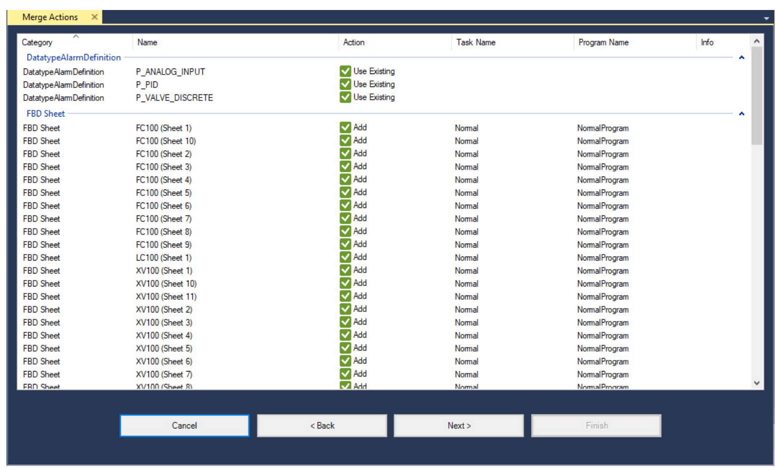
9. Under Library Object(s), click CS_PVLVSO and configure the Task and Program.



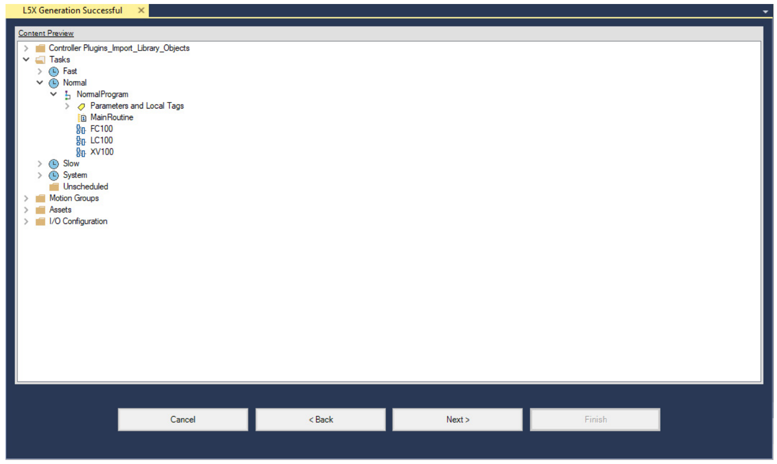
11. Configure these required parameters for the CS_PVLVSO control strategies.

ACM Parameter	Description	Example
PVLVSO	Valve Tag	XV100
PVLVSO_Description	Valve Tag Description	Tank 100 Feed Valve

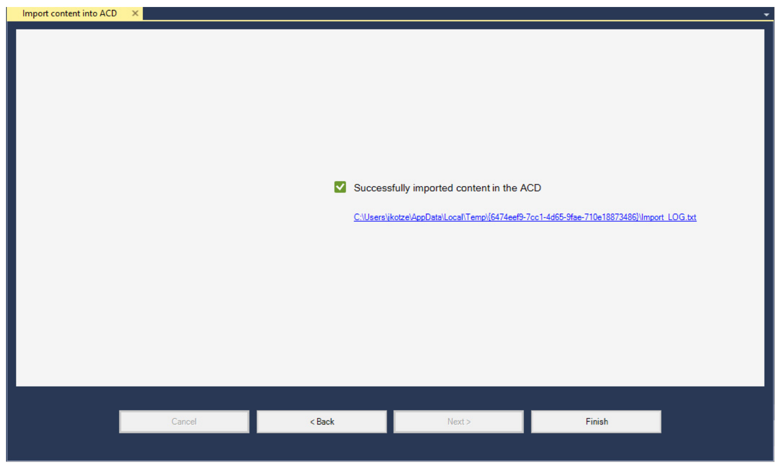
12. Click Next.
13. Review the Merge Actions window, and click Next.



14. Review the L5X Generation Successful window (expand tasks and programs), and click Next.

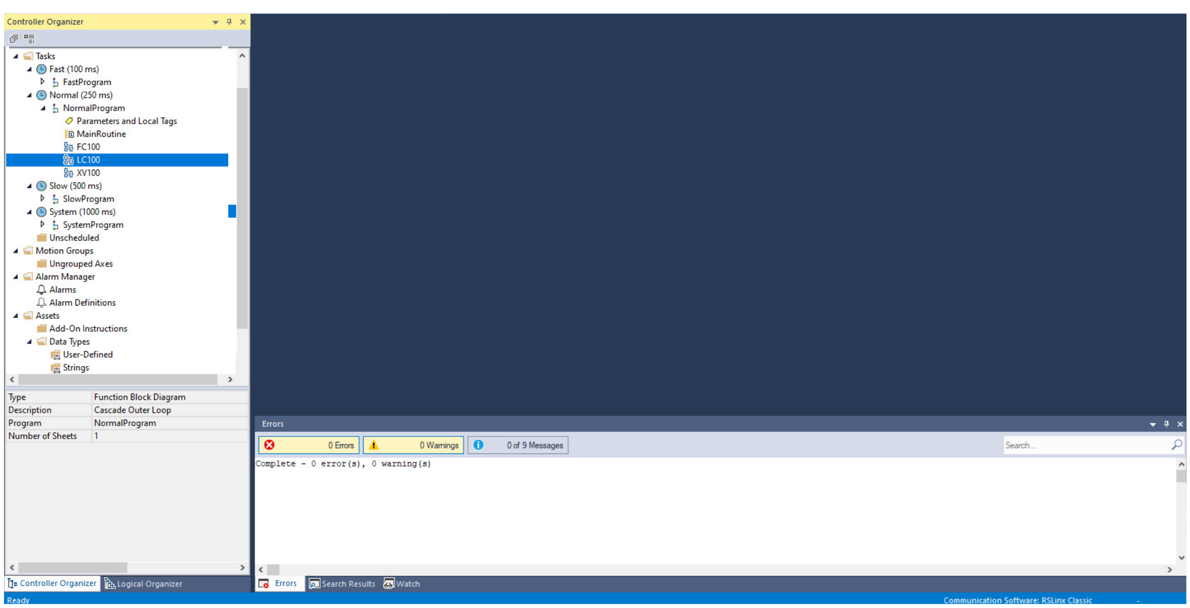


15. On the Import content into ACD window, verify that the content was imported successfully.



16. Click Finish.

17. In the Studio 5000 Logix Designer project, use the Verify Controller feature to confirm that the control strategies were added to the Logix Designer Project without creating additional errors.



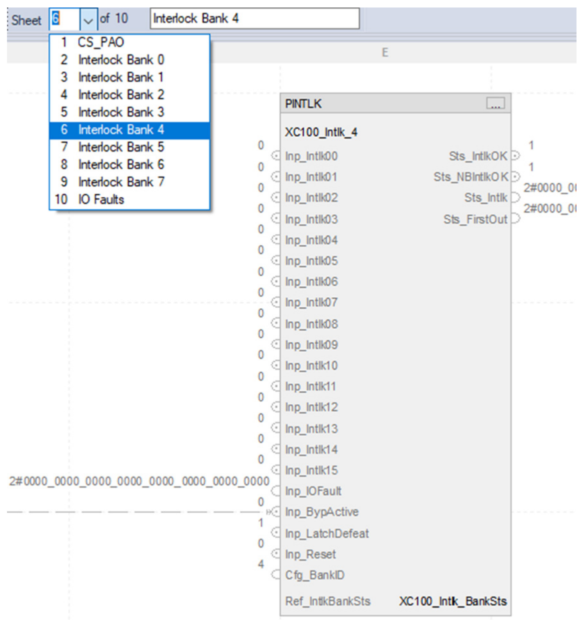
Interlock Options

The Process Interlocks (PINTLK) instruction prevents equipment from starting or being energized. Interlocks are always evaluated to de-energize equipment. For permissive conditions that must be made true to start the equipment, but are ignored once the equipment is running, use the Process Permissive (PPERM) instruction.

In each PlantPAx control strategy that has interlocks, there are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default.

If your project runs into memory constraints, you can remove unused code, such as unused interlock banks. Remove the interlock banks in order of the last to the first bank.

If you edit or add interlock sheets, make sure the PINTLK Cfg_BankID value matches the number of the interlock bank sheet. For example, Interlock Bank Sheet 4 has a PINTLK instruction where the Cfg_BankID is also 4.



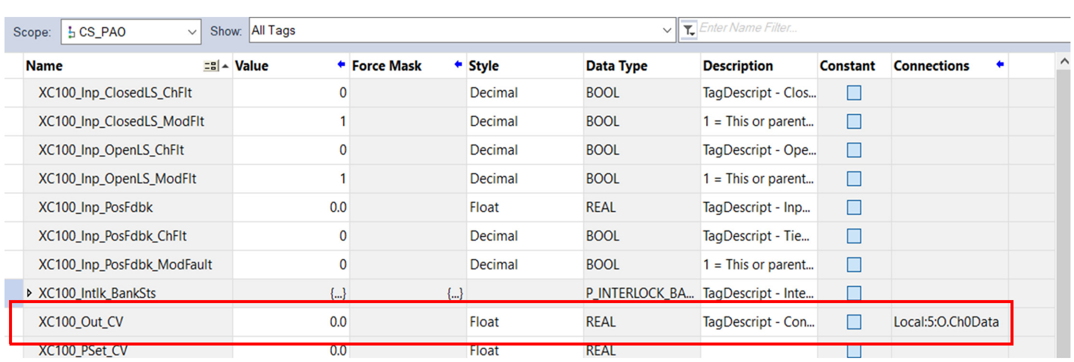
ACM creates the interlock banks sheets that you need based on your settings when you create your application.

For more information, see the online help for the PINTLK instruction.

I/O Connections

The PlantPAx control strategies have preconfigured program connections for the input and output values for the process instruction in the control strategies. These input and output values are program-scoped tags in the Parameters and Local Tags for the control strategy (not controller-scoped tags).

For example, in the PAO control strategy, the output CV is a program connection to a channel on the module.



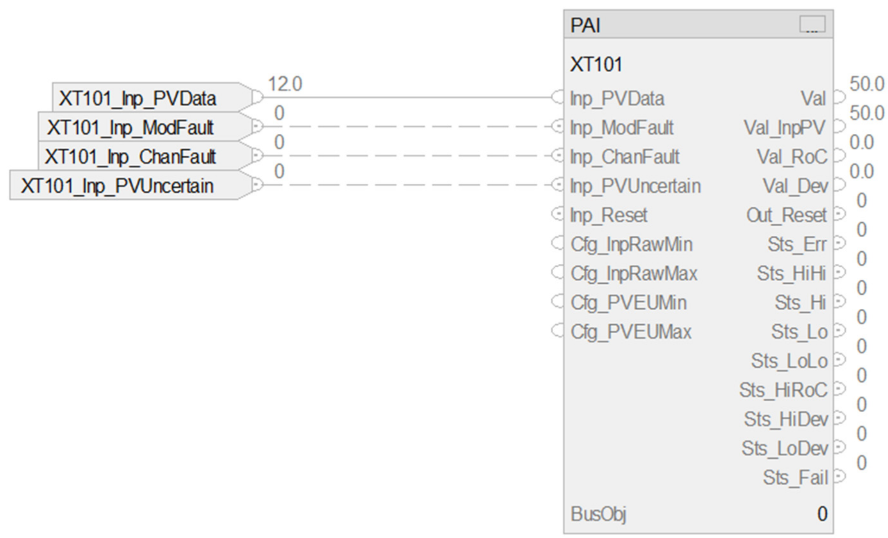
Name	Value	Force Mask	Style	Data Type	Description	Constant	Connections
XC100_Inp_ClosedLS_ChFlt	0		Decimal	BOOL	TagDescript - Clos...		
XC100_Inp_ClosedLS_ModFlt	1		Decimal	BOOL	1 = This or parent...		
XC100_Inp_OpenLS_ChFlt	0		Decimal	BOOL	TagDescript - Ope...		
XC100_Inp_OpenLS_ModFlt	1		Decimal	BOOL	1 = This or parent...		
XC100_Inp_PosFdbk	0.0		Float	REAL	TagDescript - Inp...		
XC100_Inp_PosFdbk_ChFlt	0		Decimal	BOOL	TagDescript - Tie...		
XC100_Inp_PosFdbk_ModFault	0		Decimal	BOOL	1 = This or parent...		
XC100_Intlk_BankSts	{...}	{...}		P_INTERLOCK_BA...	TagDescript - Inte...		
XC100_Out_CV	0.0		Float	REAL	TagDescript - Con...		Local:5:O.Ch0Data
XC100_PSet_CV	0.0		Float	REAL			

Map Device Tags to Input Data

In each PlantPAx control strategy, inputs to the main instructions are preconfigured to map to similar locations for input modules.

For example, a PAI control strategy for this 1756-IF16 analog input module in slot 2:

Has this logic:



And the inputs map as follows:

Input	Description
XT101_Inp_PVData	Process variable input (program-scoped tag) Source: sensor or input Program connection to Local:2:I.Ch0Data
XT101_Inp_ModFault	Controller-scoped tag Local_02.Sts_IOFault output from raP_Dvc_LgxModuleSts block for Local_02
XT101_Inp_ChanFault	Controller-scoped tag Local:2:I.CH0Fault directly from AB:1756_IF16_Float_No_Alm:I:0 module tag
XT101_Inp_PVUncertain	Controller-scoped tag Local_02.Sts_AnyChanUncertain output from raP_Dvc_LgxModuleSts block for Local_02

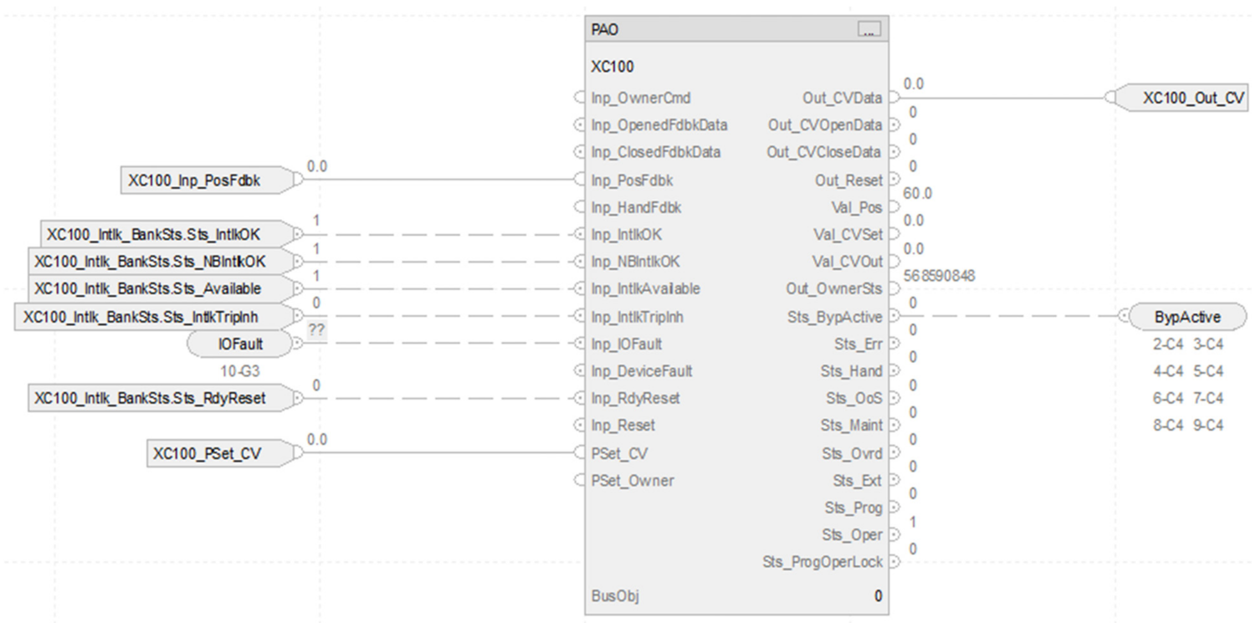
Map Tags to Output Data

In each PlantPAx control strategy, the output from the main instructions is preconfigured to map to similar locations for output modules.

For example, a PAO control strategy for this 1756-OF8 analog output module:

- [2] 1756-IF16 Local_02
- [3] 1756-L85EP RA_LIB_CS_5_00_03
- [4] 1756-IF16 Local_04
- [5] 1756-OF8 Local_05
- [6] 1756-IB16 Local_06
- [7] 1756-OB32 Local_07

Has this logic:



And the output maps as follows:

Input	Description
XC100_Out_CV	Control variable output (program-scoped tag) Program connection to Local:5:O.Ch0Data

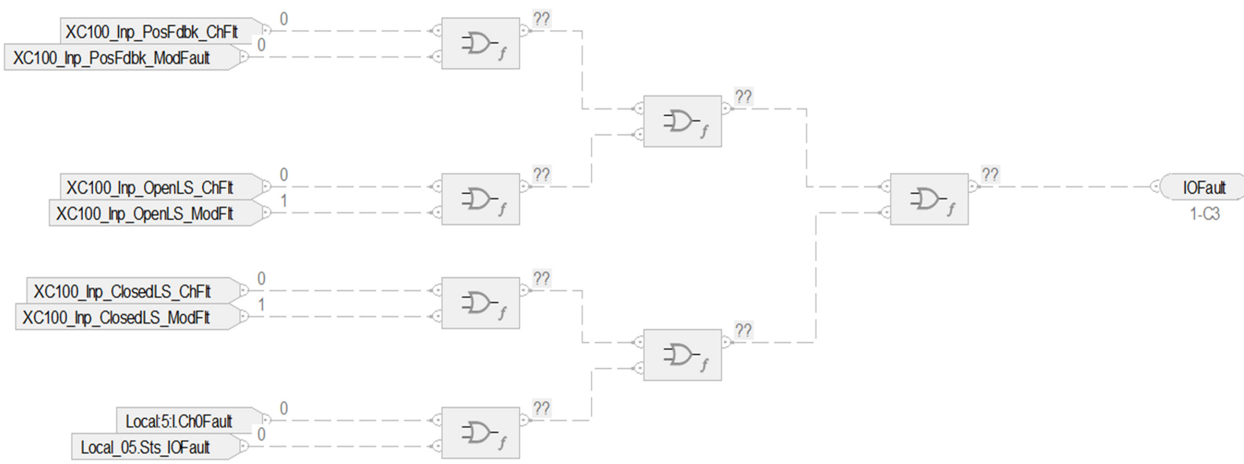
Map I/O Faults

Fault data for output modules all wire to the IOFault reference on the associated I/O Fault sheet in the PlantPAx control strategy.

For example, a PAO control strategy for this 1756-OF8 analog input module:

- [2] 1756-IF16 Local_02
- [3] 1756-L85EP RA_LIB_CS_5_00_03
- [4] 1756-IF16 Local_04
- [5] 1756-OF8 Local_05
- [6] 1756-IB16 Local_06
- [7] 1756-OB32 Local_07

Has this logic:



And has these fault tags:

Input	Description
XC100_Inp_PosFdbk_ChFault	Program-scoped tag
XC100_Inp_PosFdbk_ModFault	Program-scoped tag
XC100_Inp_OpenLS_ChFlt	Program-scoped tag
XC100_Inp_OpenLS_ModFlt	Program-scoped tag
XC100_Inp_ClosedLS_ChFlt	Program-scoped tag
XC100_Inp_ClosedLS_ModFlt	Program-scoped tag
Local5:I.Ch0Fault	Controller-scoped tag directly from Local:5:I.CH0Fault within AB:1756_OF8_Float:I:0 module tag
Local_05.Sts_IOFault	Controller-scoped tag Local_05.Sts.IOFault From raP_Dvc_LgxModuleSts block for Local_05

The program-scoped tags are preconfigured in the PlantPAx control strategy and must be mapped to the appropriate I/O points.

HART Integration

HART Data

The PlantPAx® control strategies that use HART data use a Process Analog HART (PAH) instruction to provide input to a Process Analog Input (PAI) instruction. For more information, see the PAI Control Strategy on page 111.

The examples in this chapter use Application Code Manager (ACM) to enable more efficient project development with libraries of reusable code. Application Code Manager creates modular objects with customizable configuration parameters using the reusable content. Application Code Manager can also create the associated visualization, historical, and alarming elements for a project.

PAH Configuration Considerations

Operand	Type	Description
PlantPAx control	P_ANALOG_HART	• Instance of data structure (backing tag) required for proper operation of instruction.
Ref_HARTData	PAX_HART_DEVICE:I:0	• Required data type: HART data from the I/O module assembly. • Select the HART device in your Controller Organizer. The device must support the PAxDevice data type: IOTreeObject:I.PAxDevice
Ref_DiagTable	P_HART_CODE_DESC_STATUS[2]	• Lookup table for diagnostic bit number (to message and status). • Select the correct table for your HART device; see table below.
Ref_UnitsTable	RAC_CODE_DESCRIPTION[2]	• Lookup table for units of measure code (to units text). Select _HART_EUTable_Generic.

Fully Integrated HART with FLEX 5000 I/O

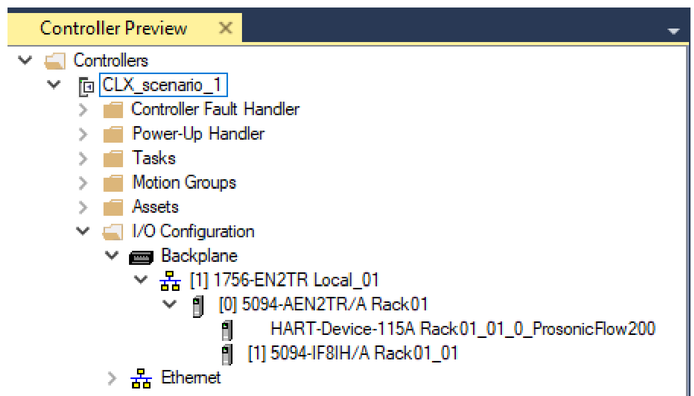
Highly-integrated HART uses a PlantPAx data type in the process controller for use with FLEX 5000® modules:

- Configuration of devices within the I/O Configuration tree (no Add-On Instruction needed)
- Device diagnostics automatically propagate to the controller project

Integrate FLEX 5000 I/O with HART Device Using PAH and PAI Instructions

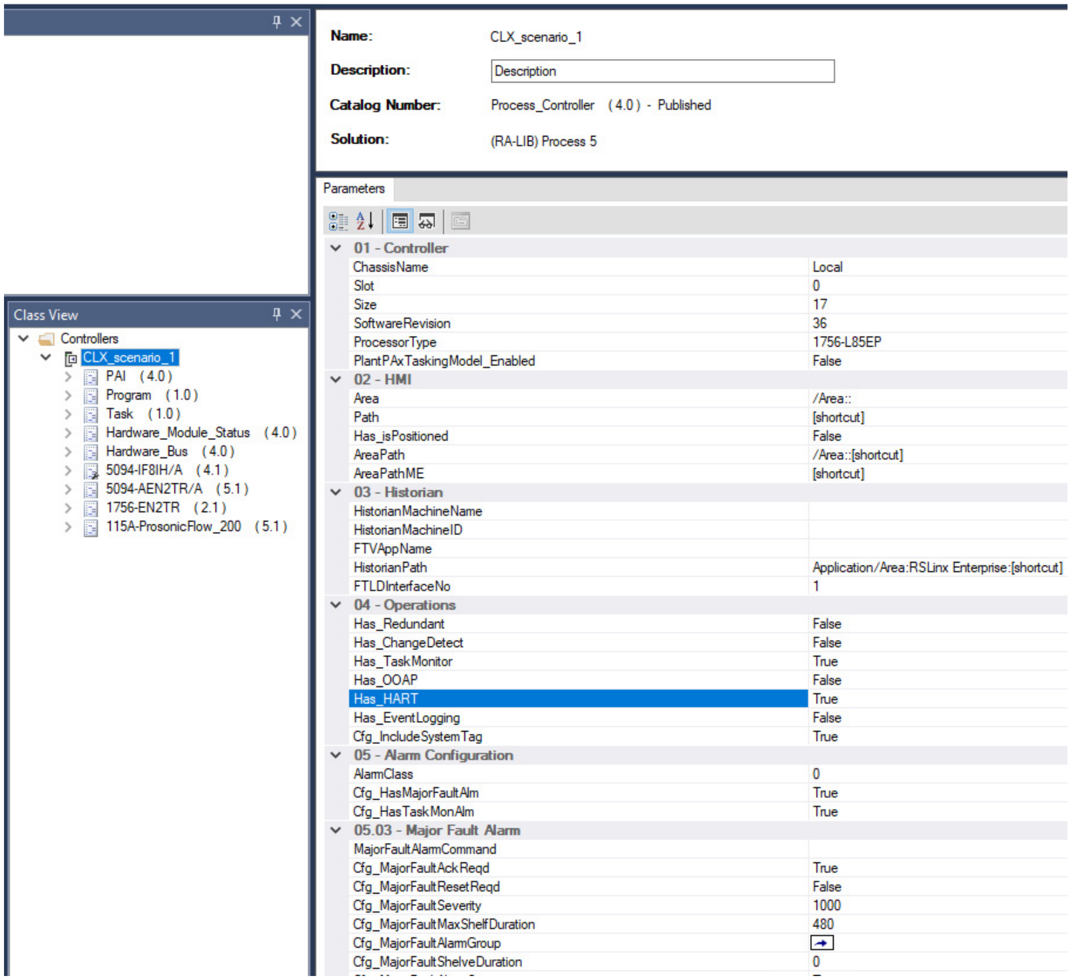
In this example, the ACM project contains:

- ControlLogix Process controller
- 1756-EN2TR communication module
- 5094-AEN2TR communication module for FLEX 5000 I/O connectivity
- 5094-IF8IH HART analog input module with an Endress+Hauser
- ProsonicFlow 200 instrument connected to Channel 0

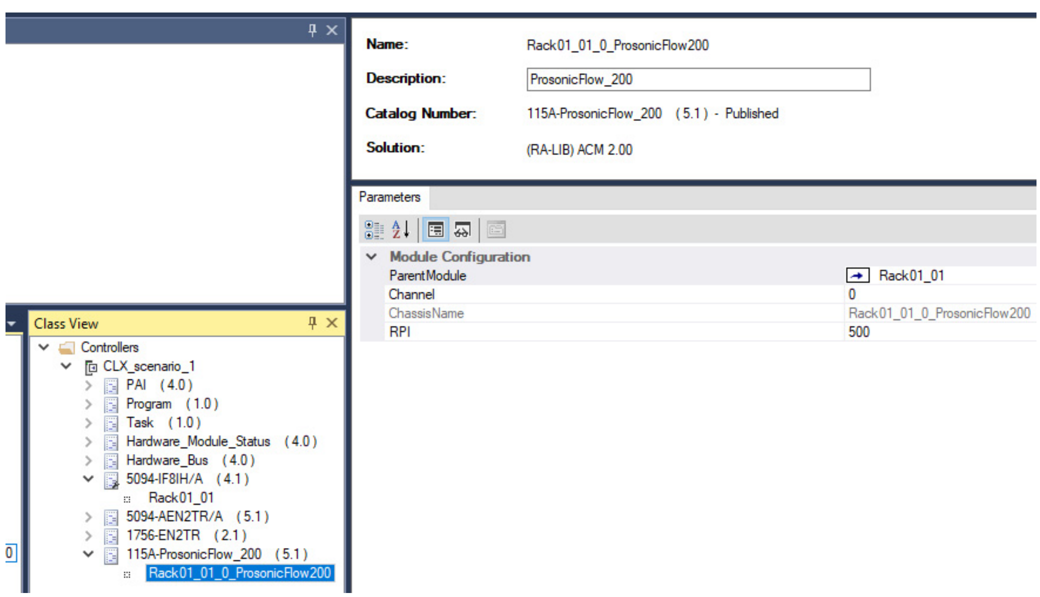


IMPORTANT	When you add multiple EtherNet/IP™ communication modules to an ACM project, remember to enter a unique IP address for each module.

1. Configure the process controller parameters that are required for your application, and set Has_HART to True.

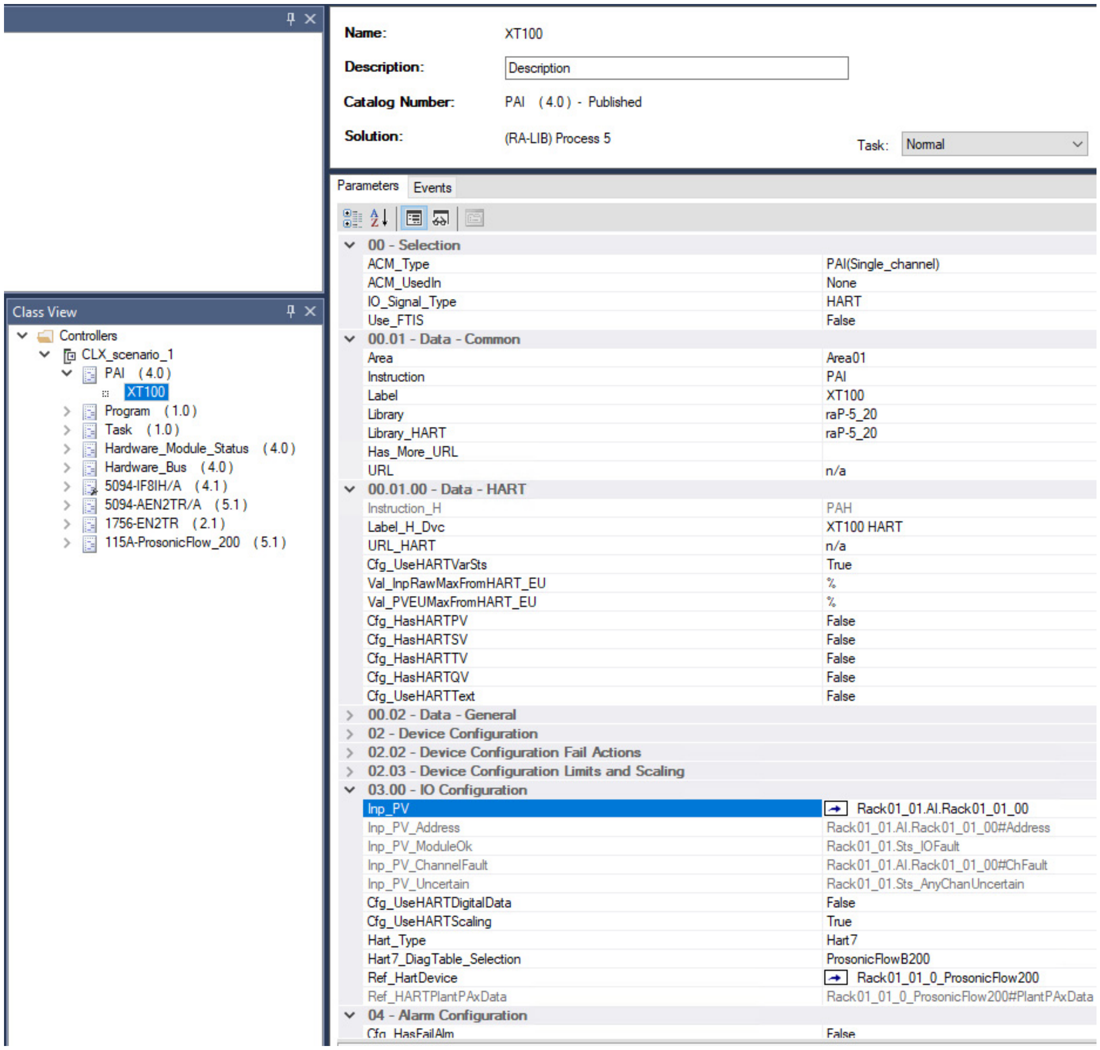


2. When you add the HART instrument, configure the ParentModule Parameter to the 1756-IF8IH module in Rack01.



3. From the Process library > Control Strategies > Input Processing folder, add a PAI instance for the analog input module and configure the Task and Program.

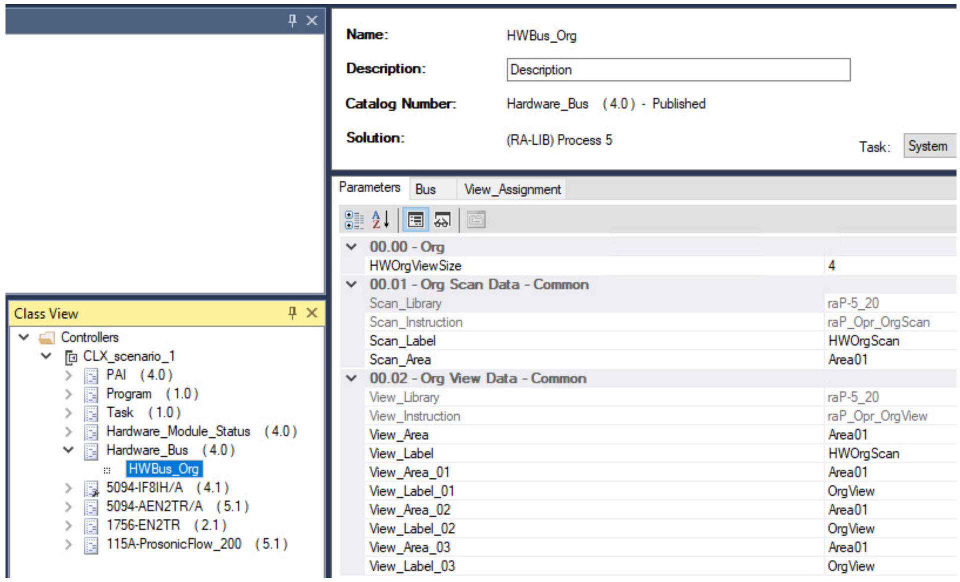
IMPORTANT	You must create an individual PAI instance for each input module in your application.



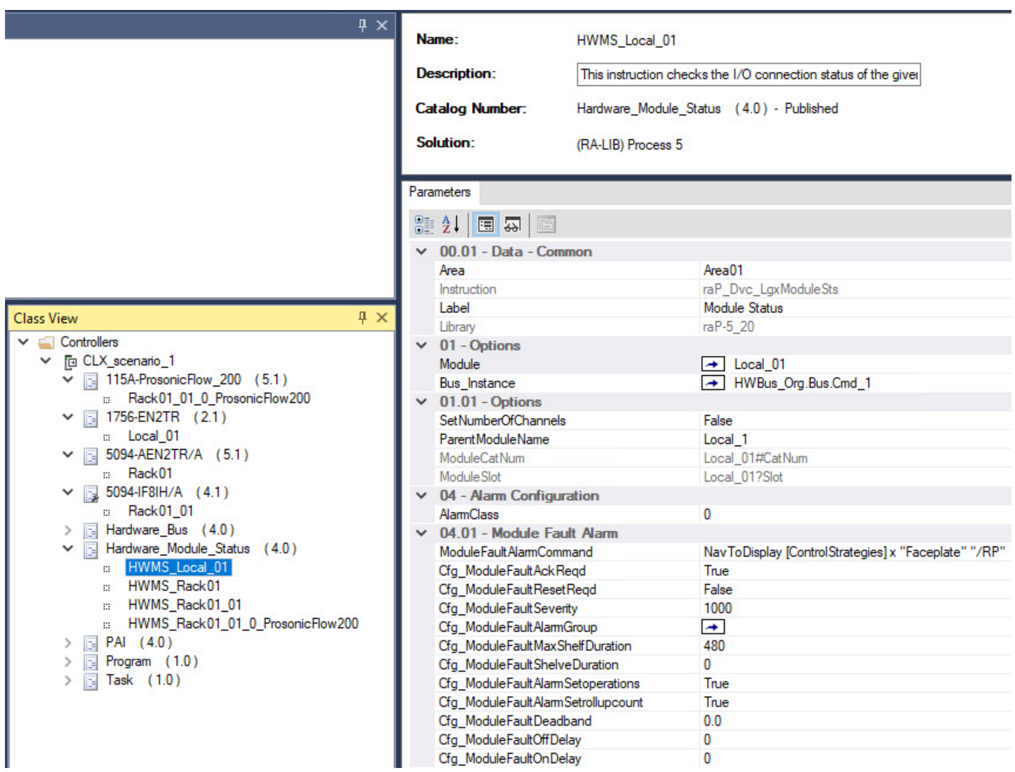
4. Configure these parameters.

ACM Parameter	Description/Value
IO_Signal_Type	HART
Inp_PV	Connect to the channel of the I/O module that is connected to the instrument.
Cfg_ UseHARTDigitalData	Not applicable, leave at default value.
Cfg_UseHARTScaling	Set to True if you want to connect the scaling parameters from the PAH module.
Hart_Type	Select the HART protocol revision (Generic, Hart, Hart5, Hart6 orHart7).
Hart7_DiagTable_Selection	Select the relevant Diag Table value for the instrument.
Ref_HartDevice	Connect to the instrument.

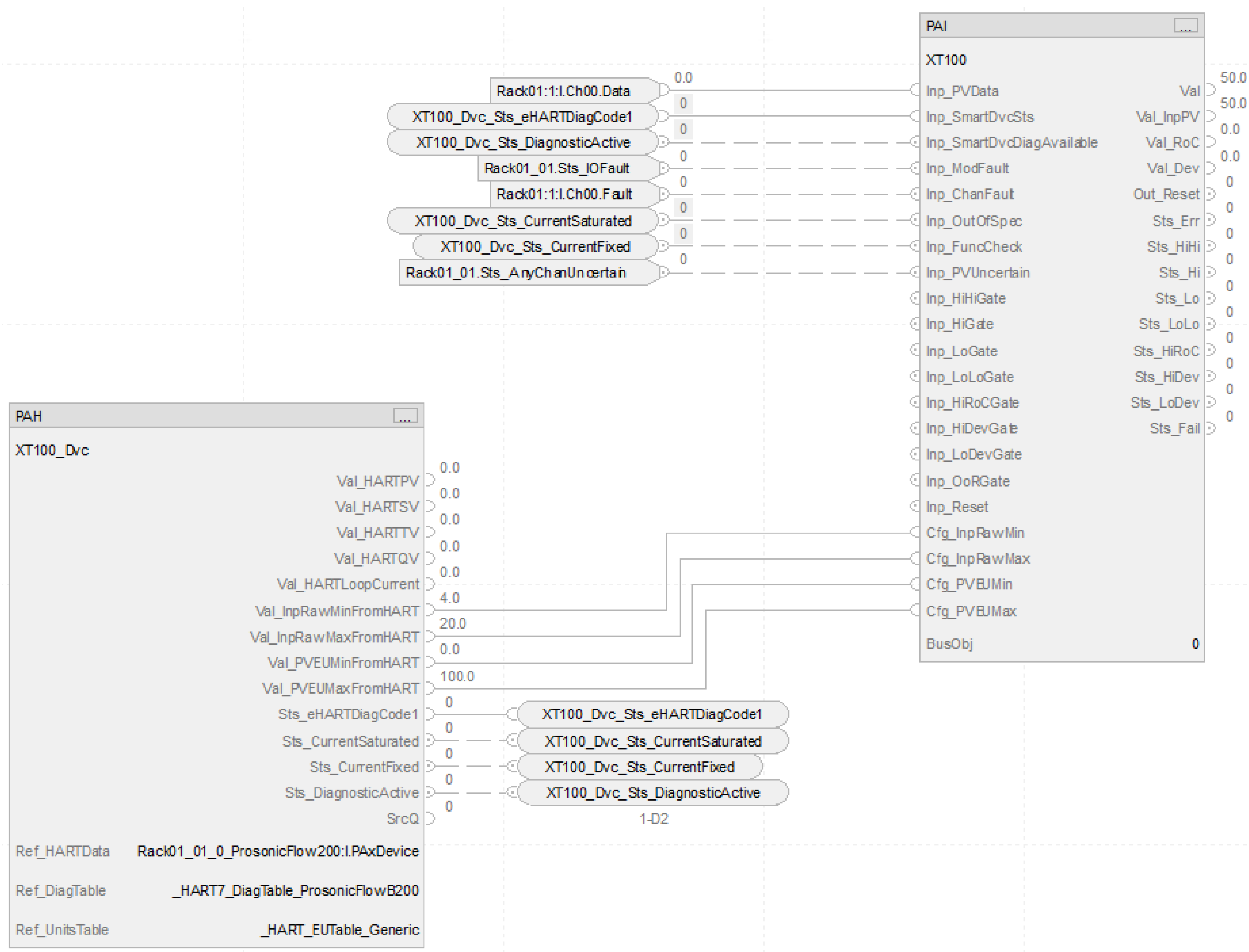
5. From the Process library > Organization > Bus folder, add a Harware_Bus object.



6. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object for each module in the project. Give each object a unique instance on the hardware bus.



7. Generate the controller ACD file.

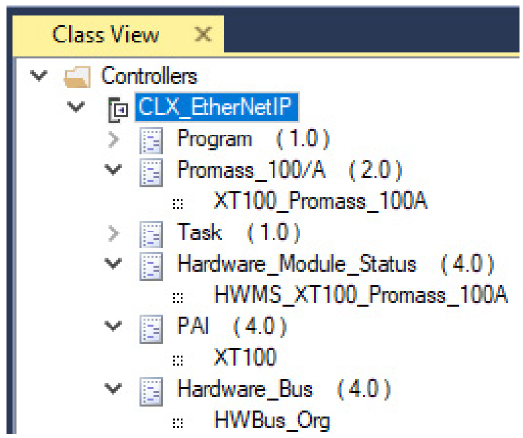


Integrate FLEX 5000 with HART Device via PV, SV, TV, or QV Values

In this example, the ACM project contains:

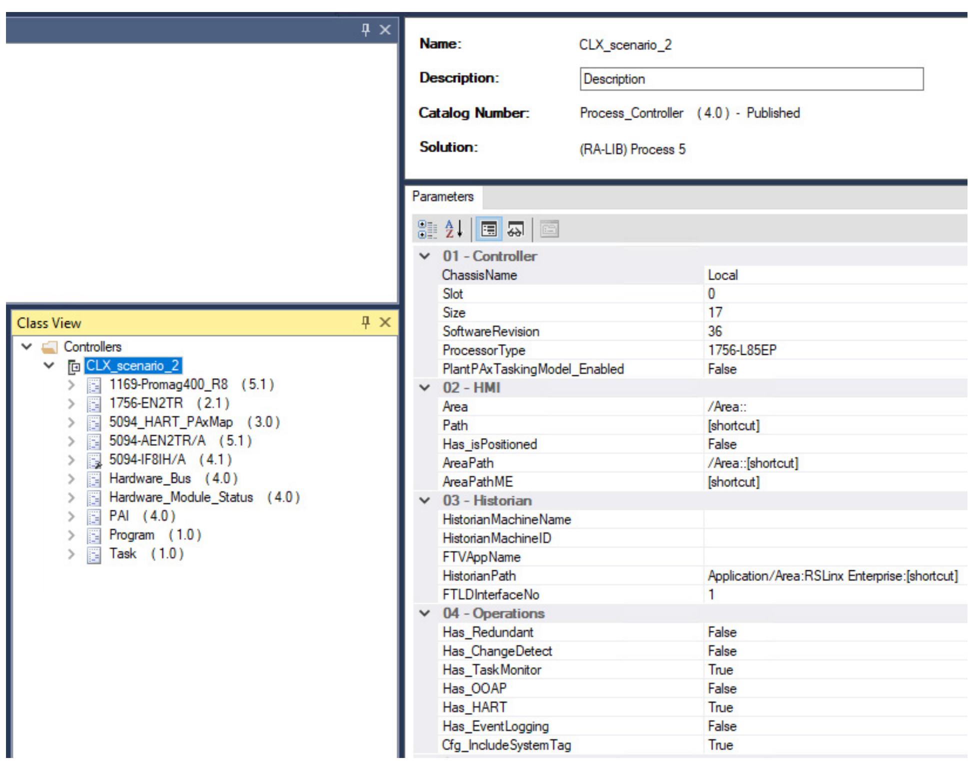
- ControlLogix Process controller
- 1756-EN2TR communication module
- 5094-AEN2TR communication module for FLEX 5000 I/O connectivity
- 5094-IF8IH HART analog input module with an Endress+Hauser
- Promag 400 revision 8 instrument connected to Channel 7

IMPORTANT	When you add multiple EtherNet/IP communication modules to an ACM project, remember to enter a unique IP address for each module.

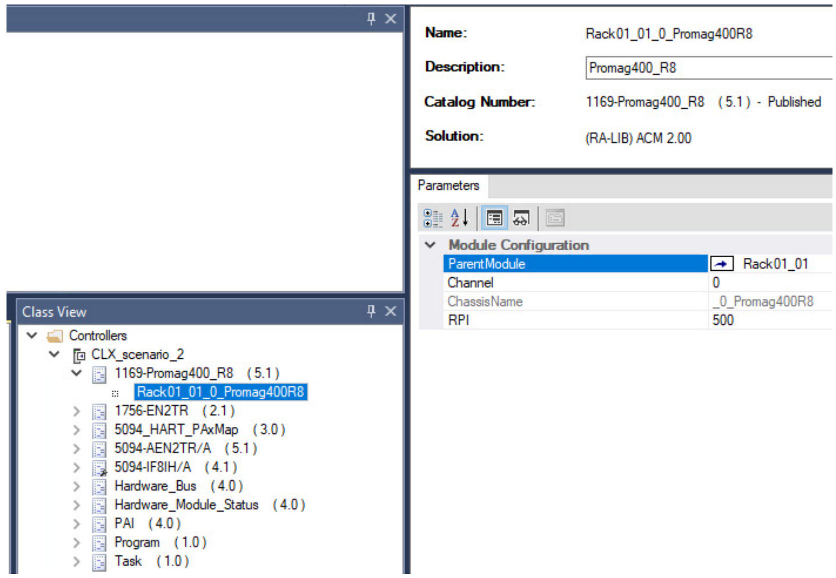


Add the devices to the ACM project and configure parameters as needed.

1. Configure the process controller parameters required for your application, and set Has_HART to True.

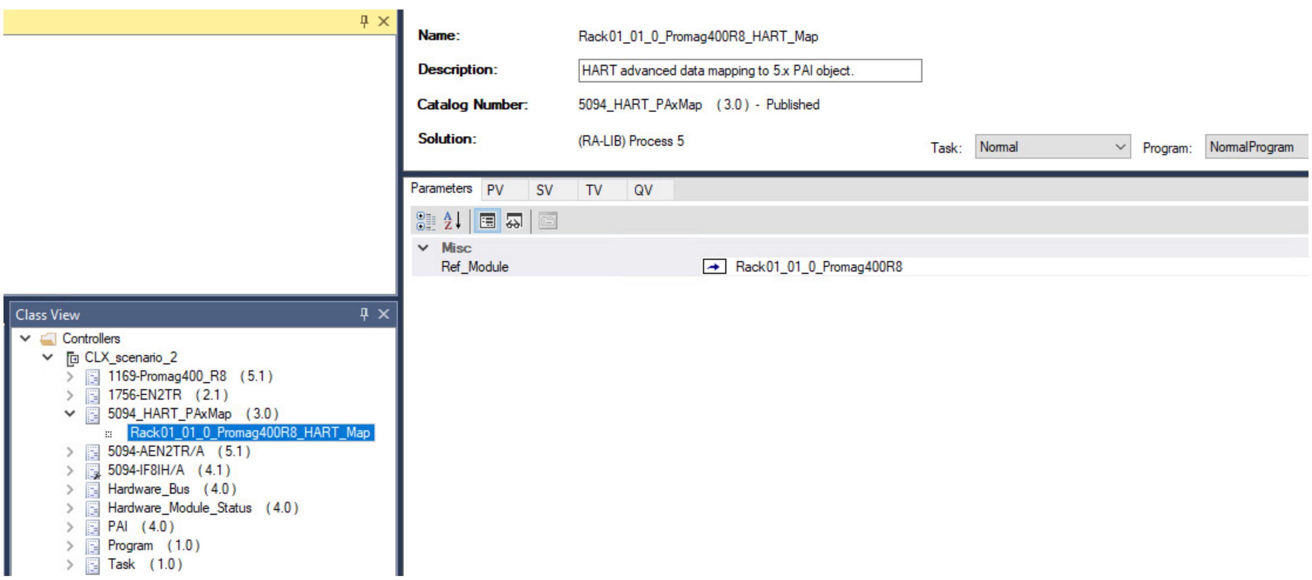


2. When you add the HART instrument, configure the ParentModule Parameter to the 1756-IF8IH module in Rack01.

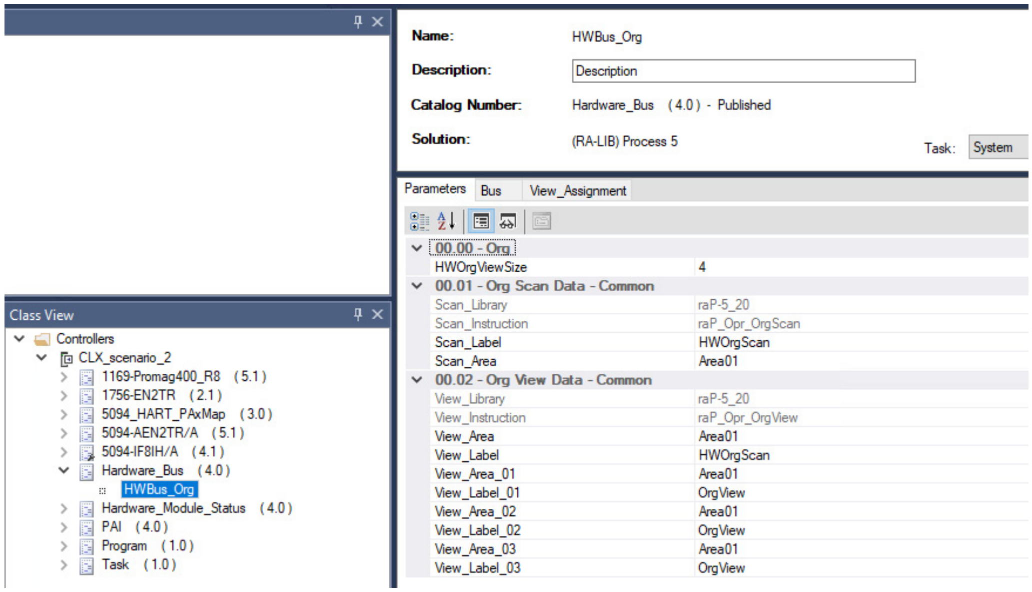


3. From Process library > HART_Mapping > HART IO Card Mapping, create an instance of the 5094_HART_PAxMap and connect to the Promag 400 revision 8 instrument.

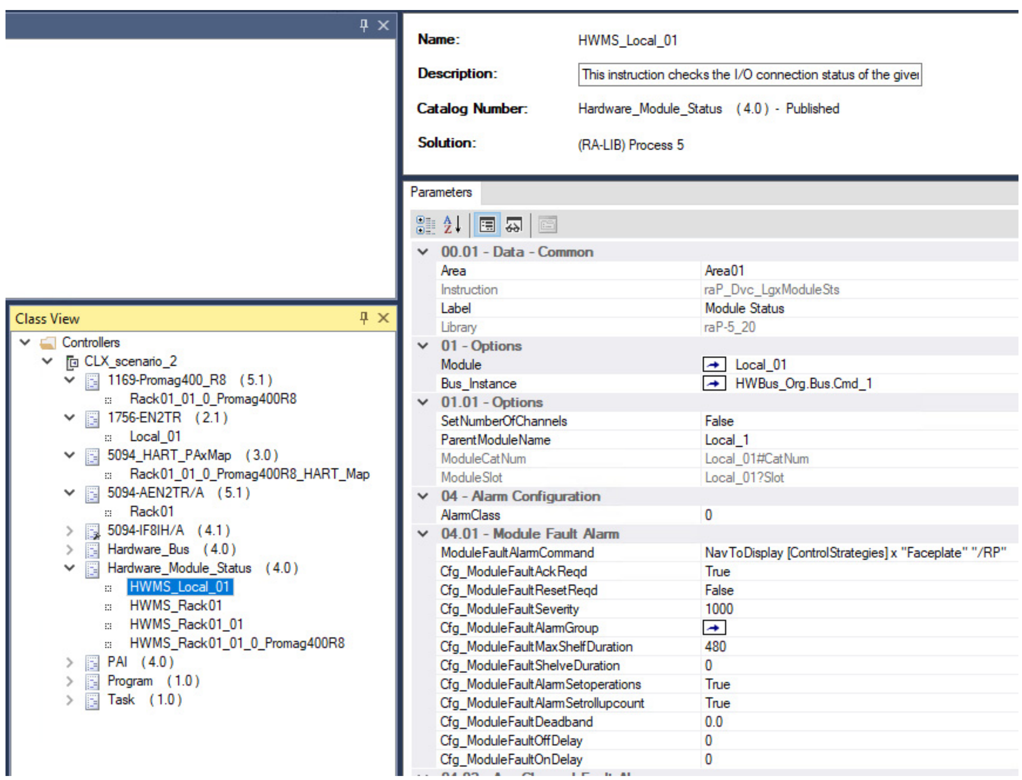
   You must have an instance of the library for each extra signal you use (PV, SV, TV, or QV).



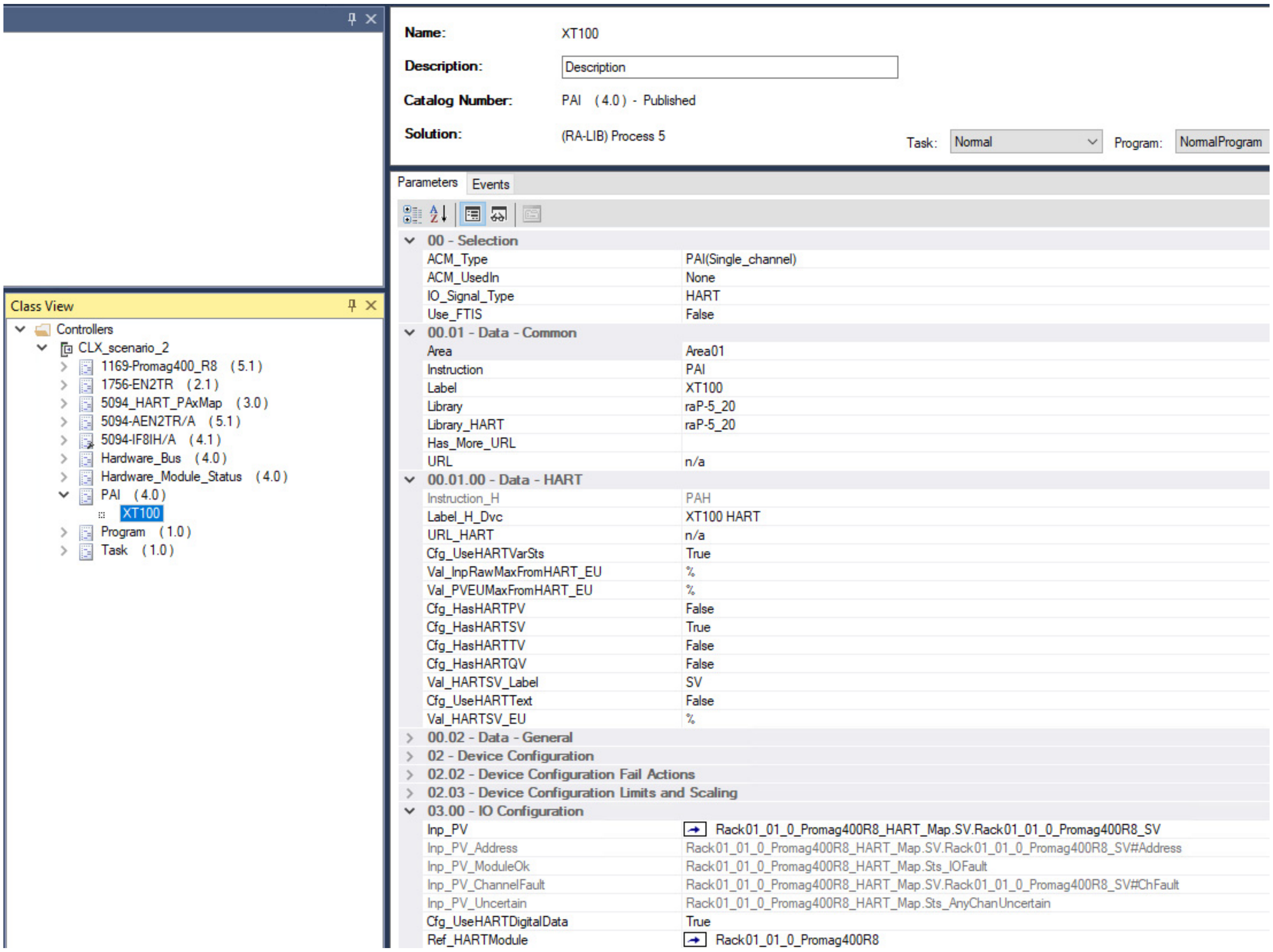
4. From the Process Library > Organization > Bus folder, add a Hardware_Bus object.



5. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object for each module in the project. Give each object a unique instance on the hardware bus.



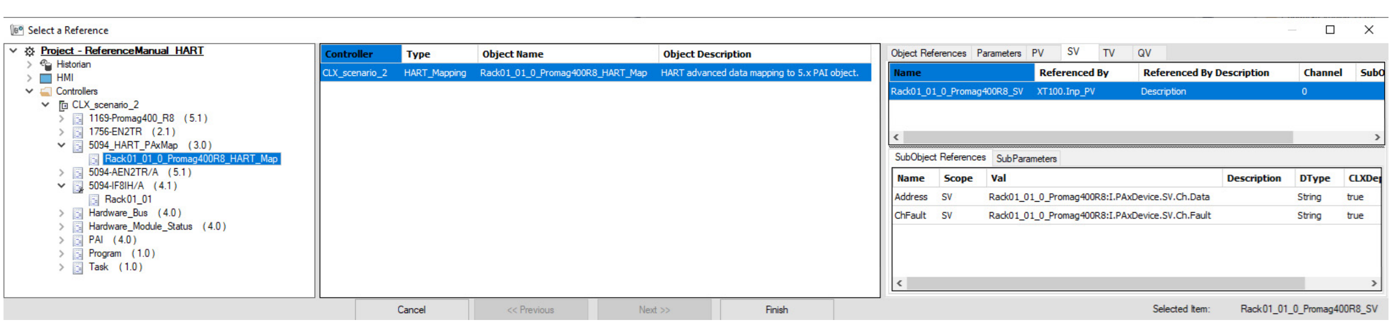
6. From the Process library > Control Strategies > Input Processing folder, add a PAI instance for the analog input module.



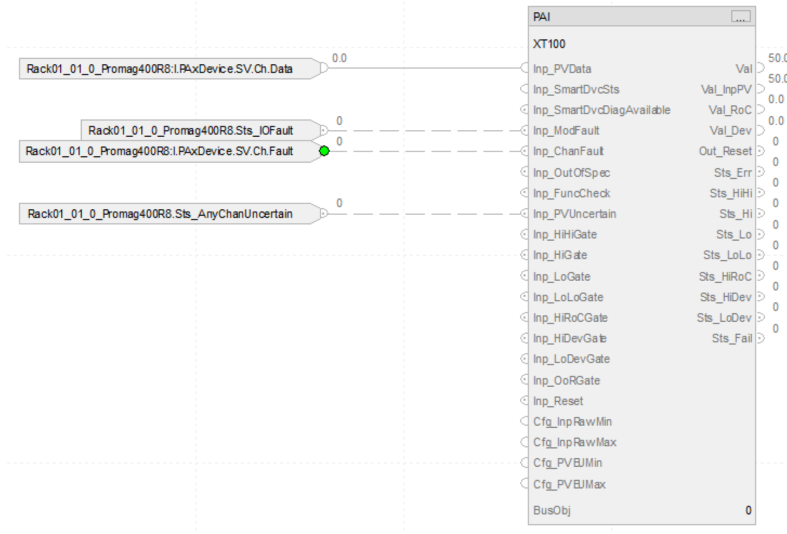
7. Configure these parameters in the I/O Configuration section.

ACM Parameter	Description/Value
Task Program	Assign a Task and Program for the PAI control strategy.
IO_Signal_Type	HART
Cfg_HasHARTxV	Set the referenced input (PV, SV, TV, QV) to true as needed.
Inp_PV	Set this reference to the PV, SV, TV, or QV of the 50.94_HART_MapIO object that was created for the HART device
Cfg_ UseHARTDigitalData	Set to True.
Ref_HARTModule	Set this reference to the 5094 module that is connected to the instrument.

This example shows the SV value as the selection for the Inp_PV connection.

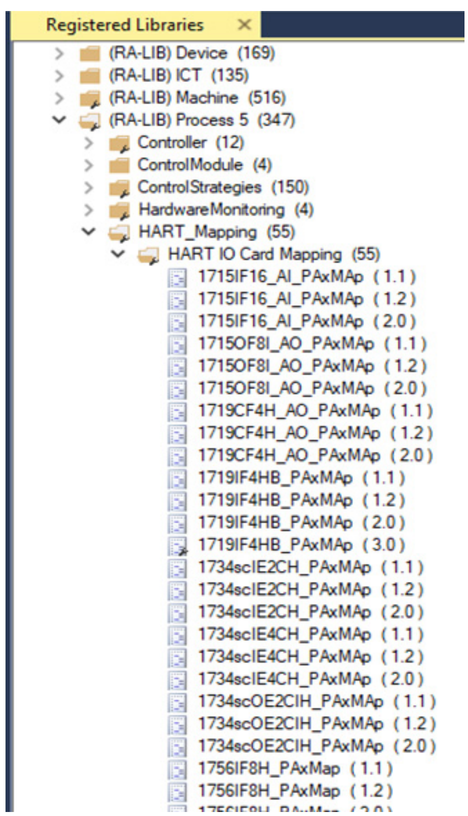


8. Generate the controller ACD file.



Integrate Other HART Modules with the Process Controller

HART modules for other I/O platforms must be used with PlantPAx 5.0 instructions in a different way than FLEX 5000 modules. There is a HART-mapping ACM library for each HART I/O module in the HART_Mapping > HART IO Card Mapping folder.

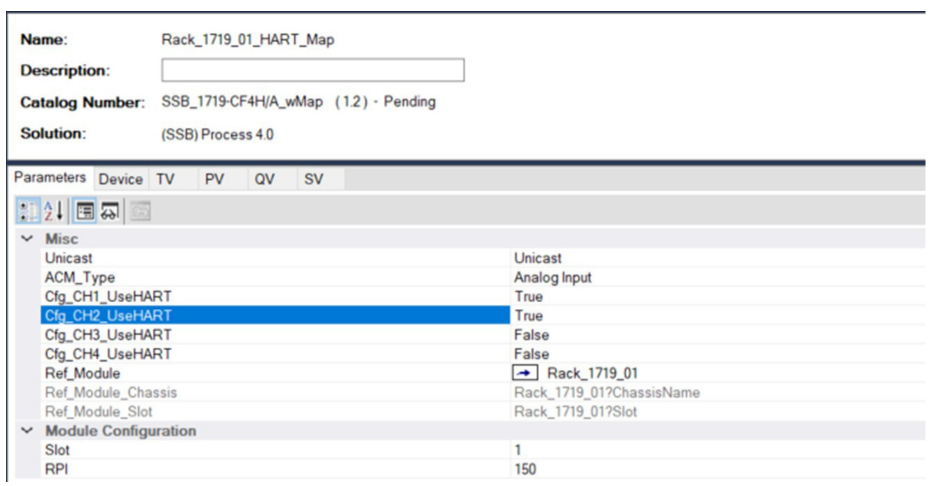


Each HART-mapping library has these features.

- For each I/O Module, you can connect to a HART device that is connected to each channel.
- The HART device information is mapped into a standard data type PAX_HART_DEVICE:I:0

◢ Rack1794_02_HART_Map_HARTDevice0	{...}	{...}		PAX_HART_DEVICE:I:0
Rack1794_02_HART_Map_HARTDevice0.RunMode	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.ConnectionFaulted	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.DiagnosticActive	0		Decimal	BOOL
▸ Rack1794_02_HART_Map_HARTDevice0.DiagnosticSequenceCount	0		Decimal	SINT
Rack1794_02_HART_Map_HARTDevice0.CurrentSaturated	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.CurrentFixed	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.MoreStatusAvailable	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.CurrentMismatch	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.ConfigurationChanged	0		Decimal	BOOL
Rack1794_02_HART_Map_HARTDevice0.Malfunction	0		Decimal	BOOL
▸ Rack1794_02_HART_Map_HARTDevice0.LoopCurrent	{...}	{...}		CHANNEL_AI:I:0
▸ Rack1794_02_HART_Map_HARTDevice0.PV	{...}	{...}		CHANNEL_AI_HART:I:0
▸ Rack1794_02_HART_Map_HARTDevice0.SV	{...}	{...}		CHANNEL_AI_HART:I:0
▸ Rack1794_02_HART_Map_HARTDevice0.TV	{...}	{...}		CHANNEL_AI_HART:I:0
▸ Rack1794_02_HART_Map_HARTDevice0.QV	{...}	{...}		CHANNEL_AI_HART:I:0
▸ Rack1794_02_HART_Map_HARTDevice0.Static	{...}	{...}		AB:5000_HART_Static_Struct:I:0
Rack1794_02_HART_Map_HARTDevice0.ChDataAtSignal4	0.0		Float	REAL
Rack1794_02_HART_Map_HARTDevice0.ChDataAtSignal20	0.0		Float	REAL

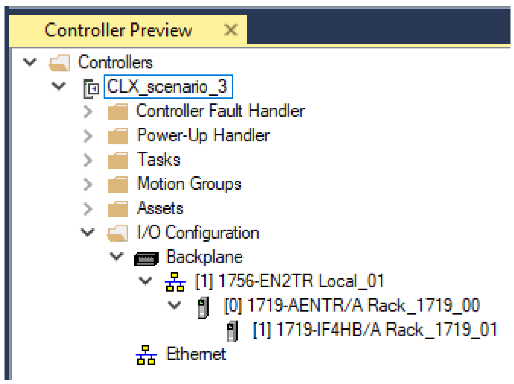
- For each channel, you can map any of the HART Digital Variables (PV, SV, TV, QV) to a PAI module.
- For each Channel of the HART module, you can connect to either the Device, PV, SV, TV, and QV (displayed as sub-objects for each mapping library).



Map HART Device to PAH from Non-FLEX 5000 I/O

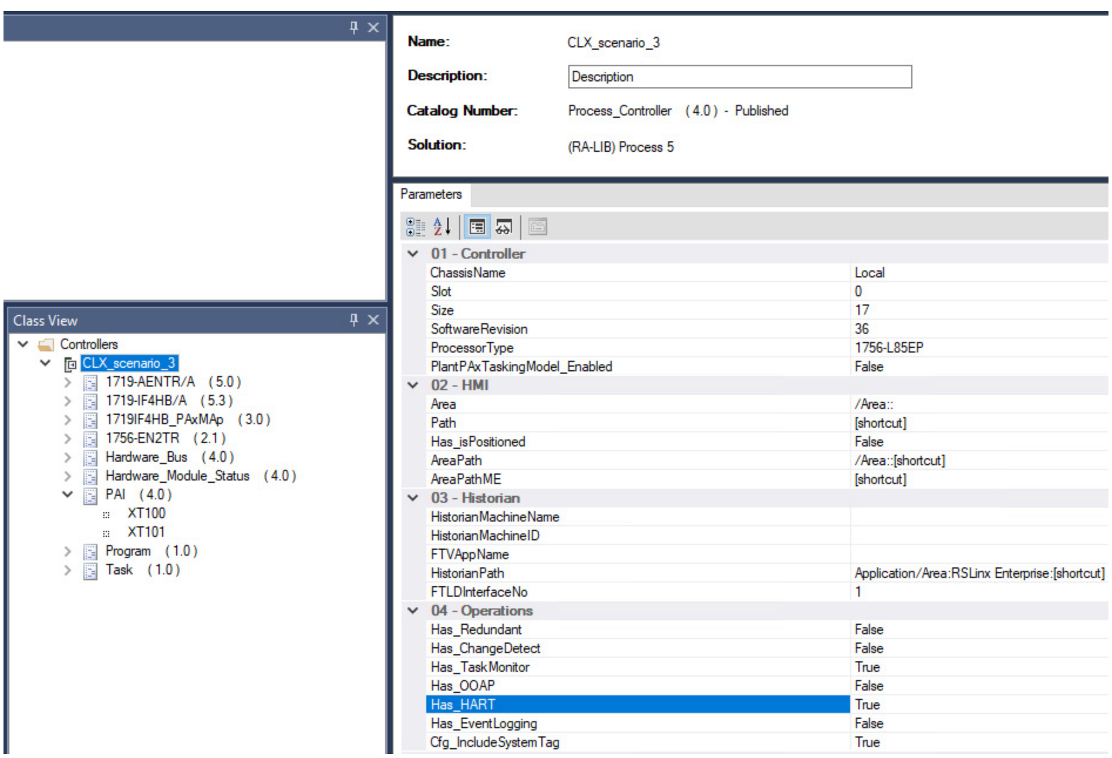
In this example, the ACM project contains:

- ControlLogix Process controller
- 1756-EN2TR communication module
- 1719-AENTR communication module connected to a 1719-IF4HB HART module
- Endress+Hauser
- ProsonicFlow 200 instrument connected to channel 1 of the 1719-IF4HB module
- Endress+Hauser
- Promag revision 9 instrument connected to channel 4 of the 1719-IF4HB module

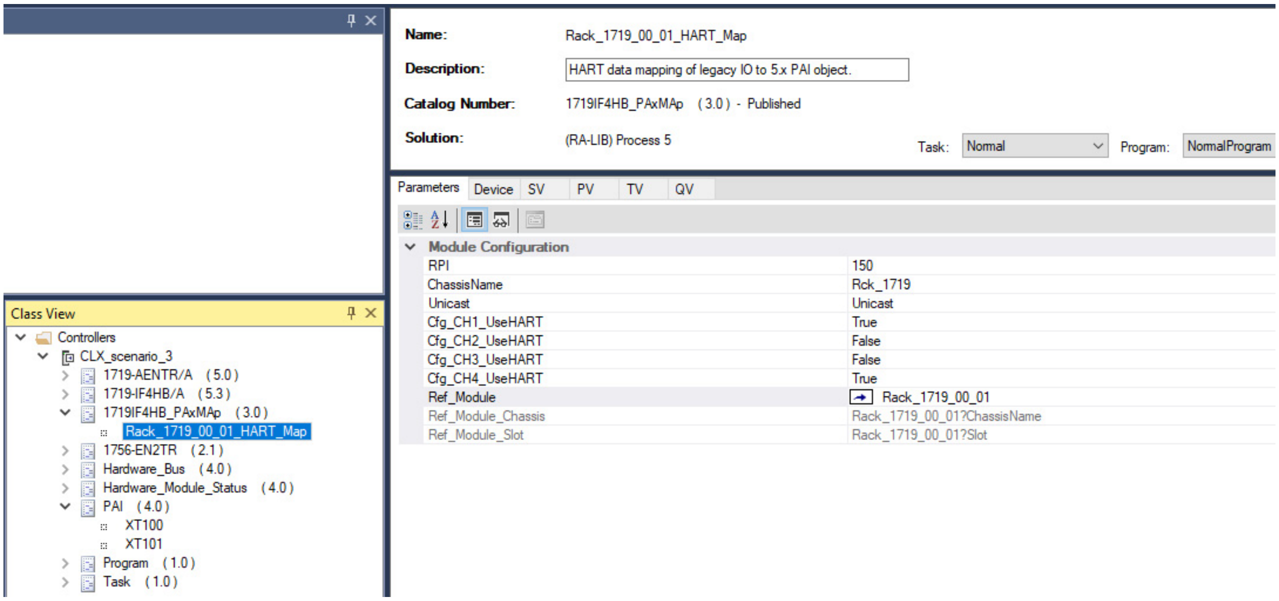


IMPORTANT	When you add the 1719-AENTR module to the ACM project, specify a unique rack name and IP address for the module.

1. Configure the process controller for parameters you need for your application, and set Has_HART to True.



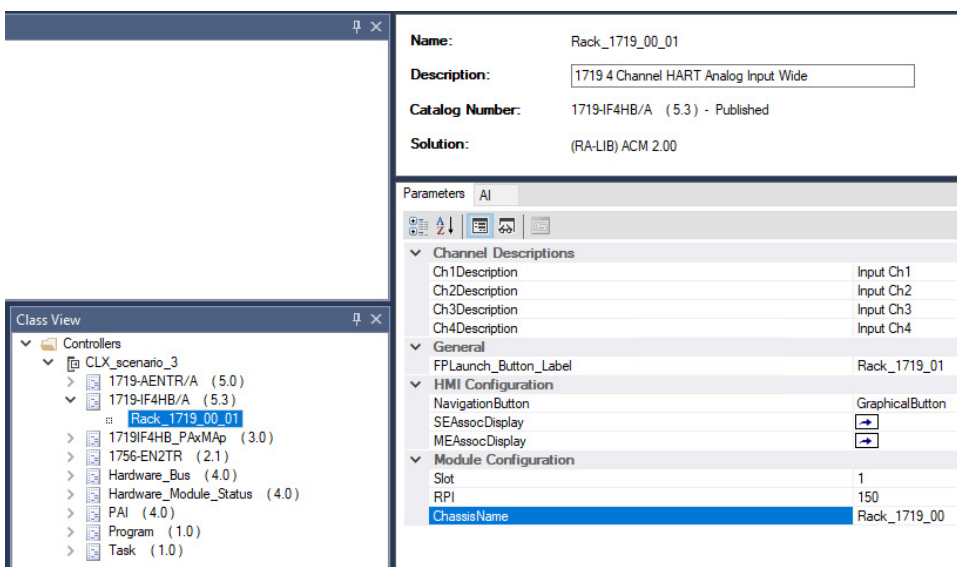
2. From Process library > HART_Mapping > HART IO Card Mapping, create an instance of the 1719-IF4HB_PAxMap and connect to the 1719-IF4HB module.



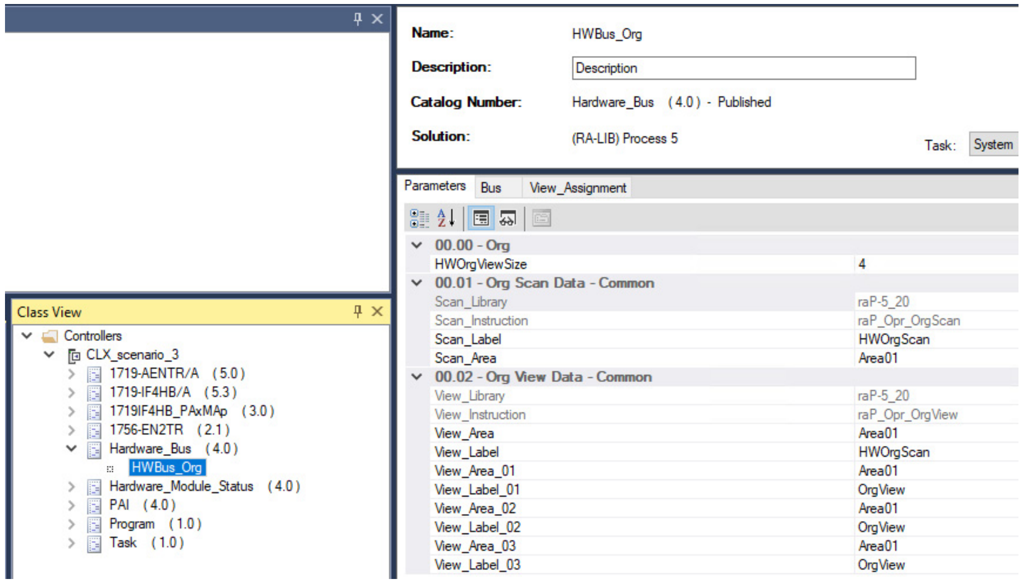
3. Configure these parameters.

ACM Parameter	Description
Cfg_CH1_UseHART	Set to True if a HART device is connected to this channel.
Cfg_CH2_UseHART	Set to True if a HART device is connected to this channel.
Cfg_CH3_UseHART	Set to True if a HART device is connected to this channel.
Cfg_CH4_UseHART	Set to True if a HART device is connected to this channel.
Ref_Module	Select the HART I/O module.

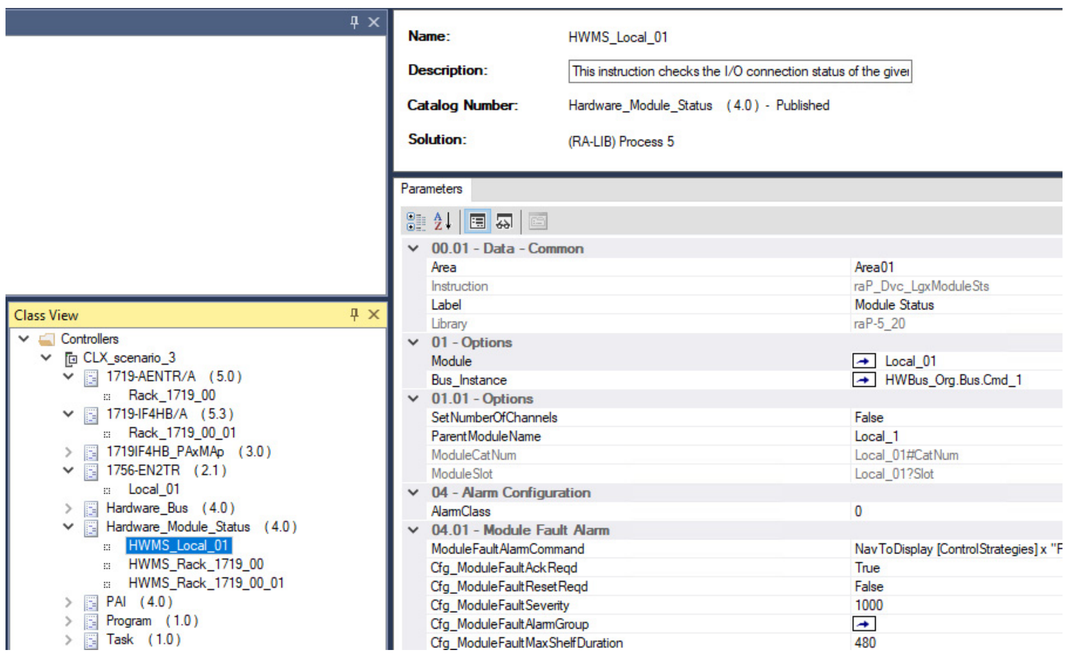
4. Change the 1719-IF4HB ChassisName to the 1719-AENTR name.



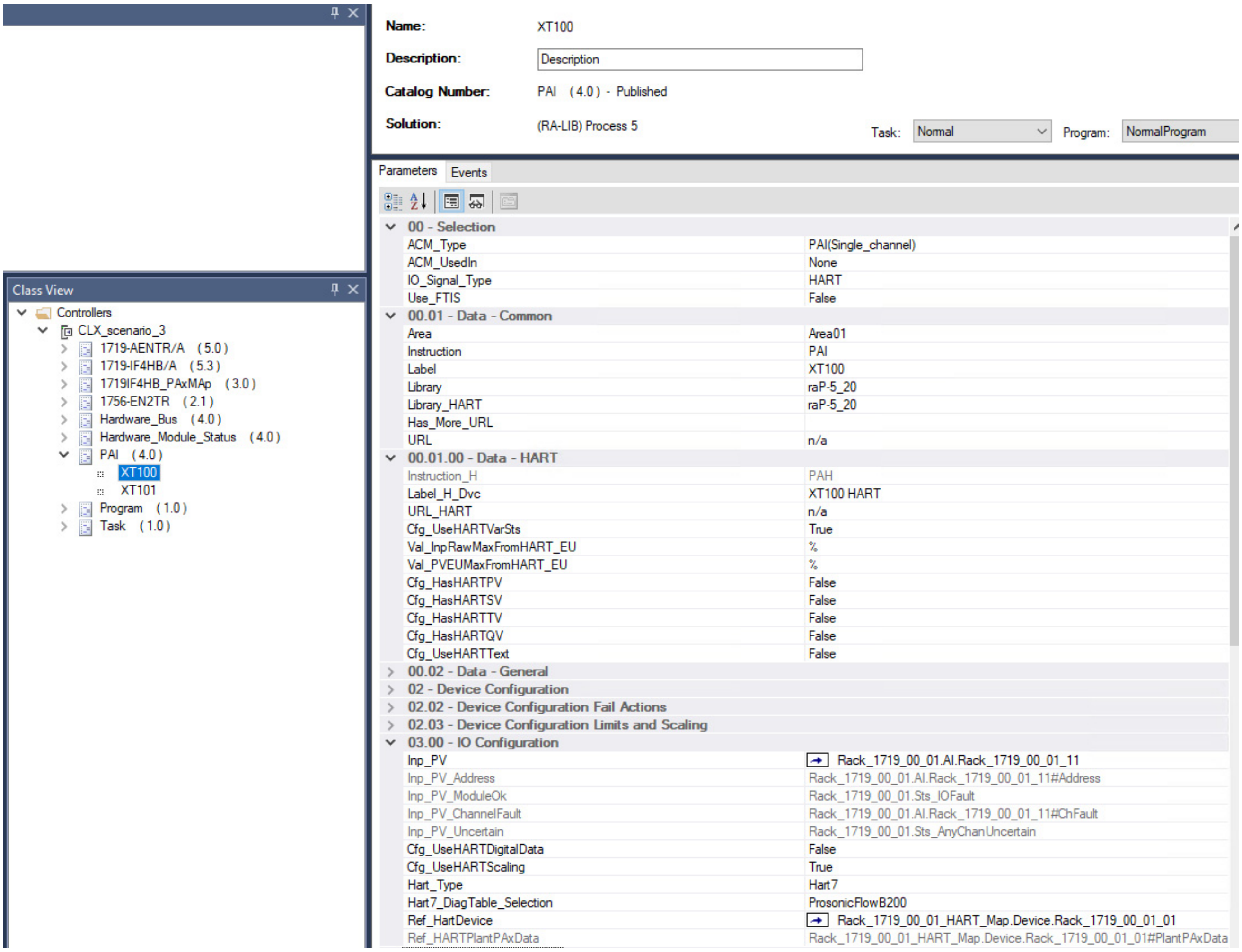
5. From the Process library > Organization > Bus folder, add a Hardware_Bus object.



6. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object for each module in the project. Give each object a unique instance on the hardware bus.



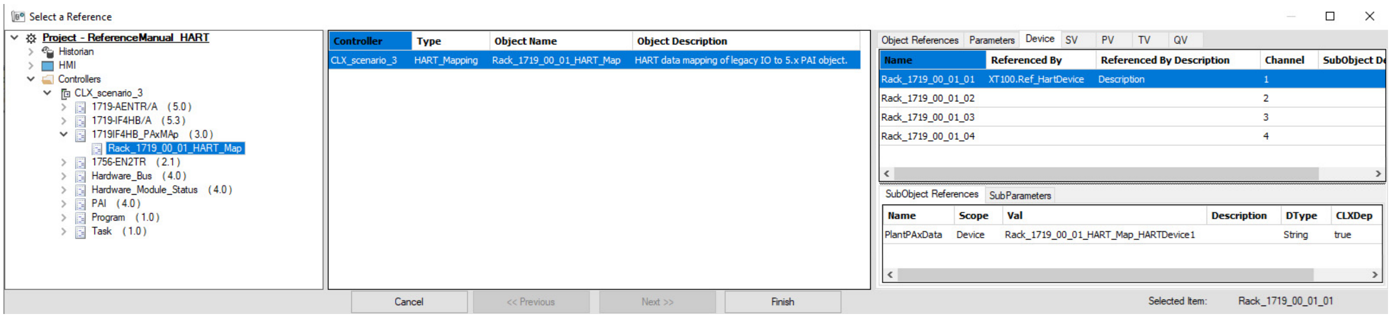
7. From the Process library > Control Strategies > Input Processing folder, add a PAI instance for each instrument.



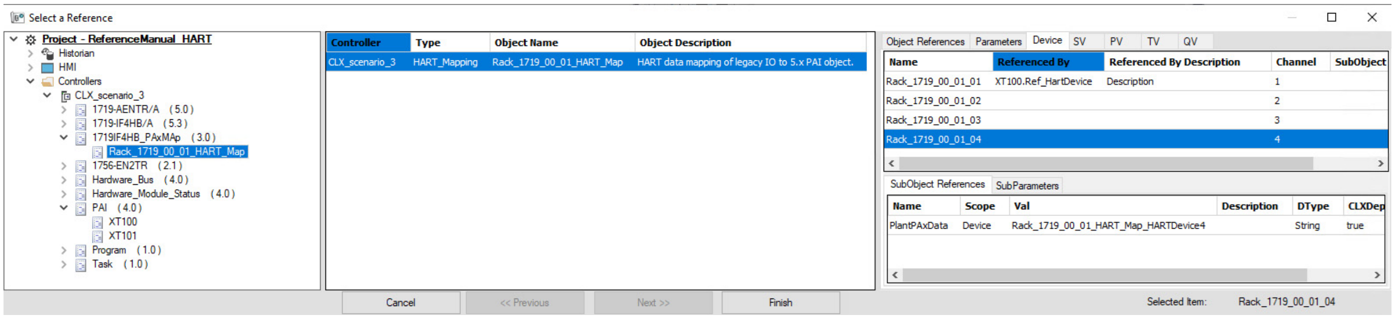
8. Configure these parameters in the I/O Configuration section.

ACM Parameter	Description/Value
Task Program	Assign a Task and Program for each PAI control strategy.
IO_Signal	HART
Cfg_HasHARTxV	Set the referenced input (PV, SV, TV, QV) to true as needed.
Inp_PV	Connect to the channel of the I/O module that is connected to the instrument.
Cfg_UseHARTDigitalData	Not applicable, leave at default value.
Hart_Type	Select the HART protocol revision (Generic, Hart, Hart5, Hart6 orHart7).
Cfg_UseHARTScaling	Set to False.
Hart7_DiagTable_Selection	Select the relevant Diag Table value for the instrument.
Ref_HartDevice	Connect to the mapping library in ACM and on the Device tab select the correct channel.

This example of the first PAI instance (XT100) shows the Ref_HartDevice for the Prosonic 200 instrument connected to channel 1 of the 1719-IF4HB module.

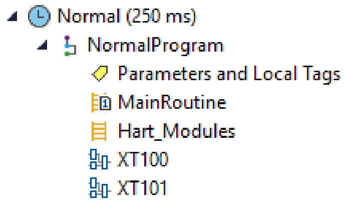


This example of the second PAI instance (XT101) shows the Promag revision 9 instrument connected to channel 4 of the 1719-IF48H module.



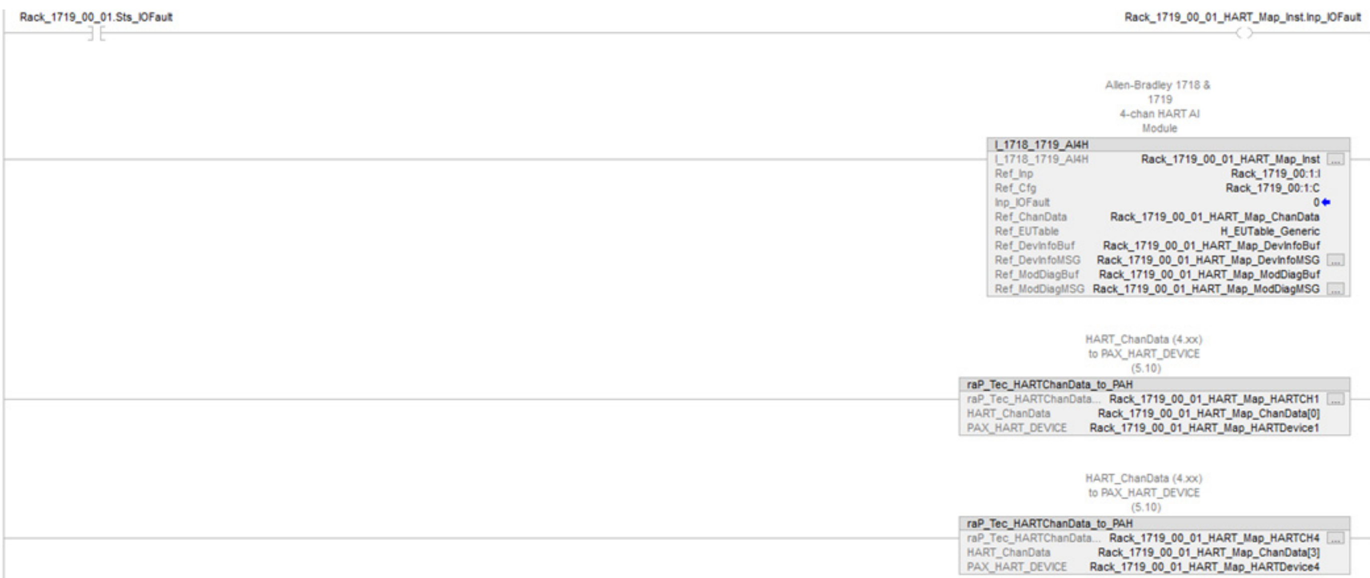
9. Generate the controller ACD file.

The controller code contains a routine for each HART instrument and a Hart_Modules routine.

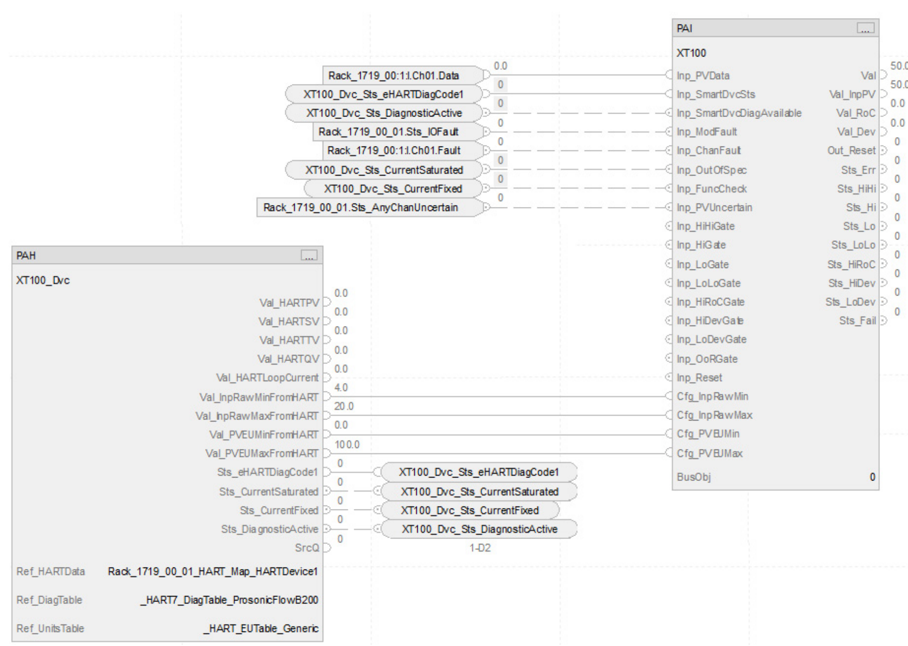


These actions occur in the Hart_Modules routine.

- An Add-On Instruction is inserted which gets the data from the HART Module (in this case I_1718_1719_AI4H).
- The HART data is mapped into an array for each device. (Rack_1719_01_HART_Map_HARTCH1 and Rack_1719_01_HART_Map_HARTCH1 CH4).
- Each element of the array is mapped into a tag of type PAX_HART_DEVICE:I:O via the Add-On Instruction rap_Tec_HARTChanData_to_PAH.

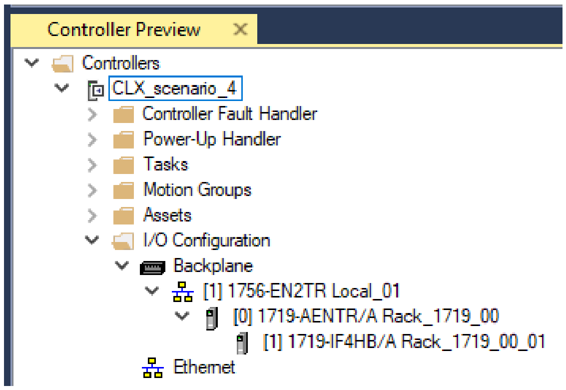


The instrument logic has no connection between the PAH module and the PAI module as the ACM parameter Cfg_UseHARTScaling is set to False.



Map HART Device Digital Data to PAI from Non-FLEX 5000 I/O

In this example, the ACM project contains:
- ControlLogix Process controller
- 1756-EN2TR communication module
- 1719-AENTR communication module connected to a 1719-IF4HB HART module
- Endress+Hauser
- ProsonicFlow 200 instrument connected to channel 2 of the 1719-IF4HB module

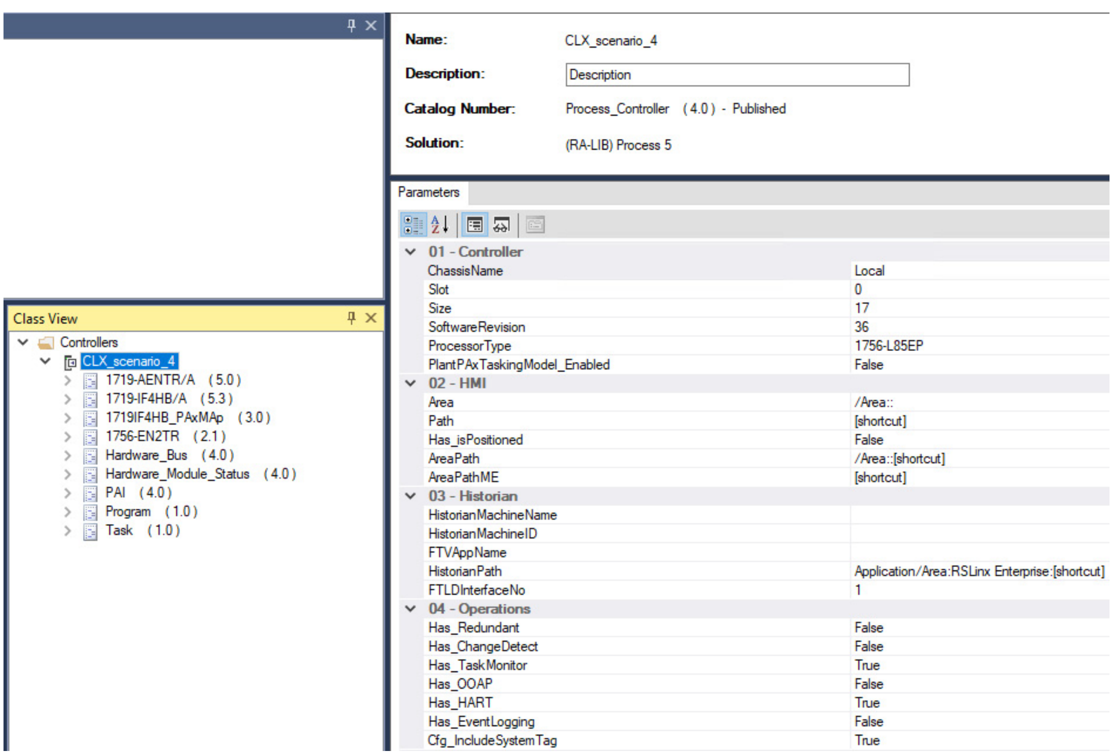


Map one of the HART digital signals (PV, SV, TV, QV) to a PAI Module. The TV of the HART device that is connected to Channel 2 of the 1719-IF4HB is connected to the PAI module.

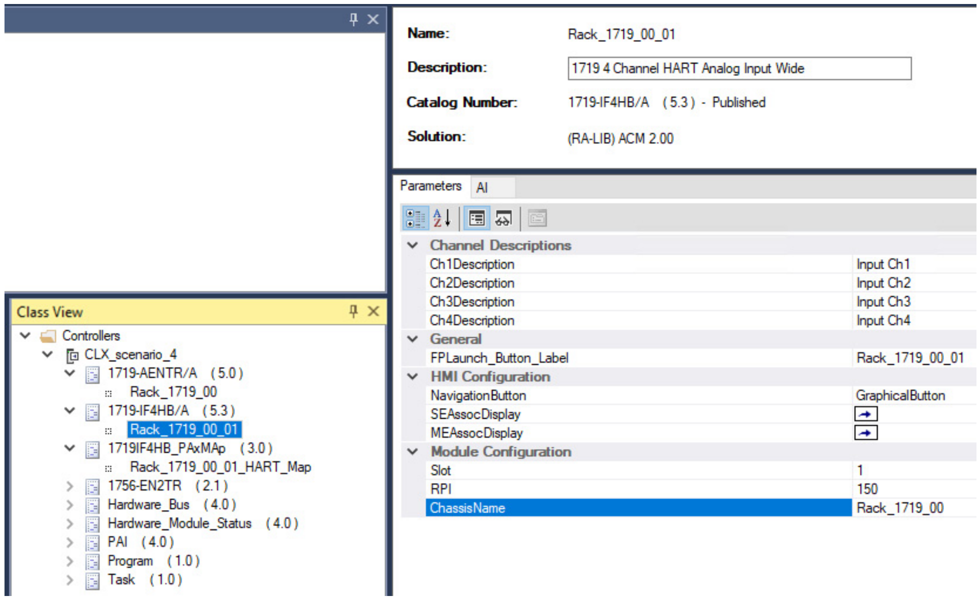
IMPORTANT	When you add the 1719-AENTR module to the ACM project, specify a unique rack name and IP address for the module.

Add the devices to the ACM project and configure the parameters as needed.

1. Configure the process controller for parameters that are required for your application, and set Has_HART to True.

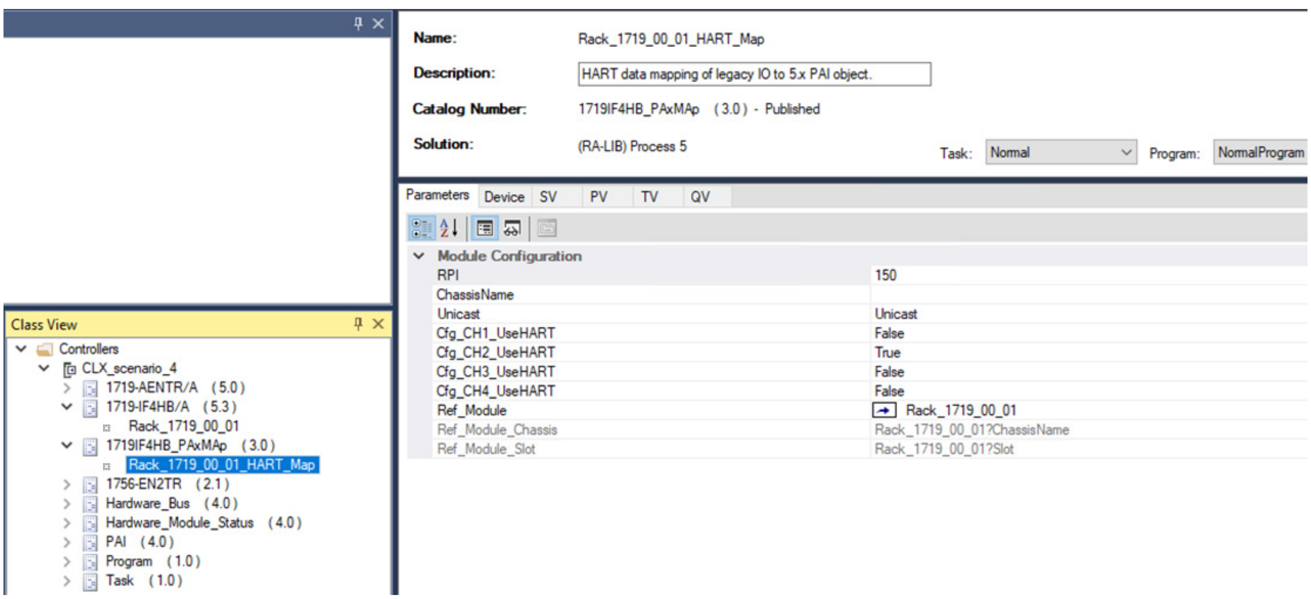


2. Change the 1719-IF4HB ChassisName to the 1719-AENTR name.



3. From Process library > HART_Mapping > HART IO Card Mapping, create an instance of the 1719-IF4HB_PAxMap and connect to the 1719-IF4HB module.

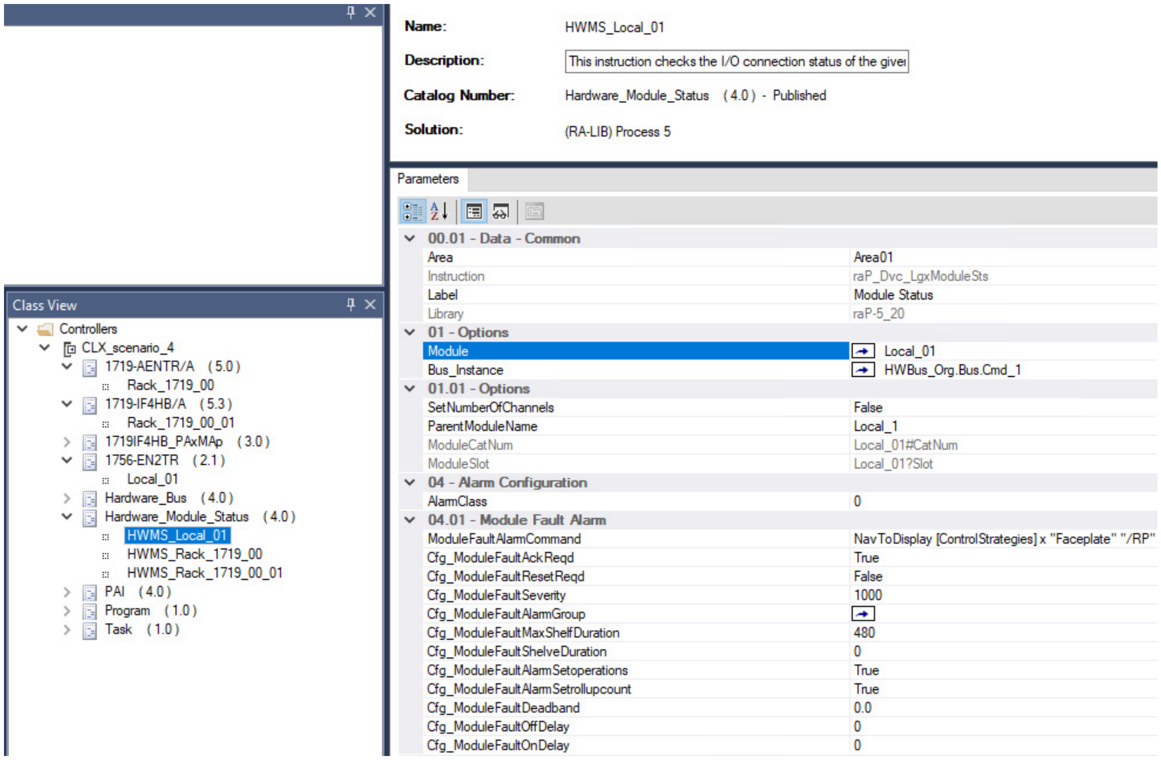
   You must have an instance of the library for each extra signal you use (PV, SV, TV, or QV).



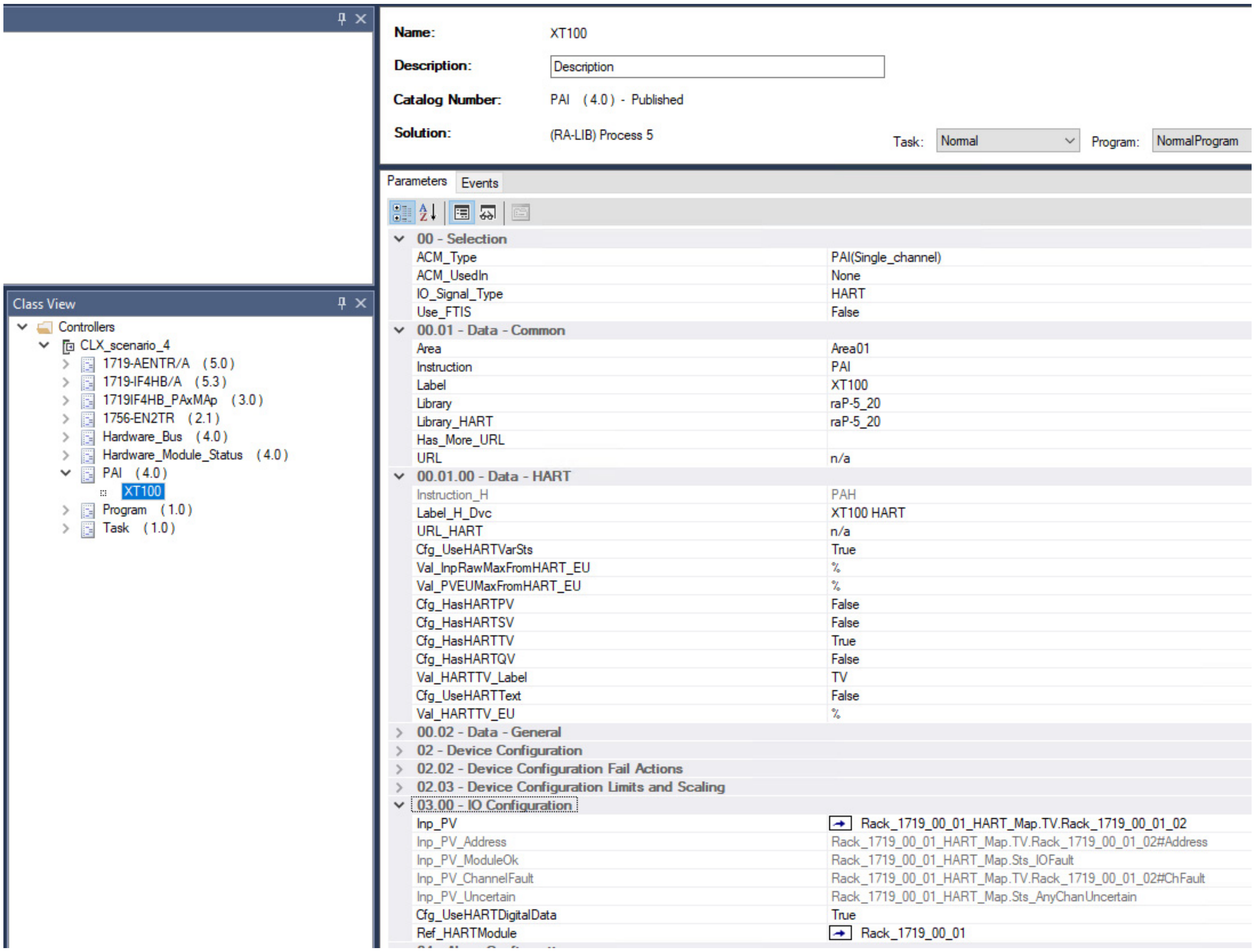
4. Configure these parameters.

ACM Parameter	Usage
Cfg_CH1_UseHART	Set to True if a HART device is connected to this channel
Cfg_CH2_UseHART	Set to True if a HART device is connected to this channel
Cfg_CH3_UseHART	Set to True if a HART device is connected to this channel
Cfg_CH4_UseHART	Set to True if a HART device is connected to this channel
Ref_Module	Select the HART I/O module

5. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object for each module in the project. Give each object a unique instance on the hardware bus.



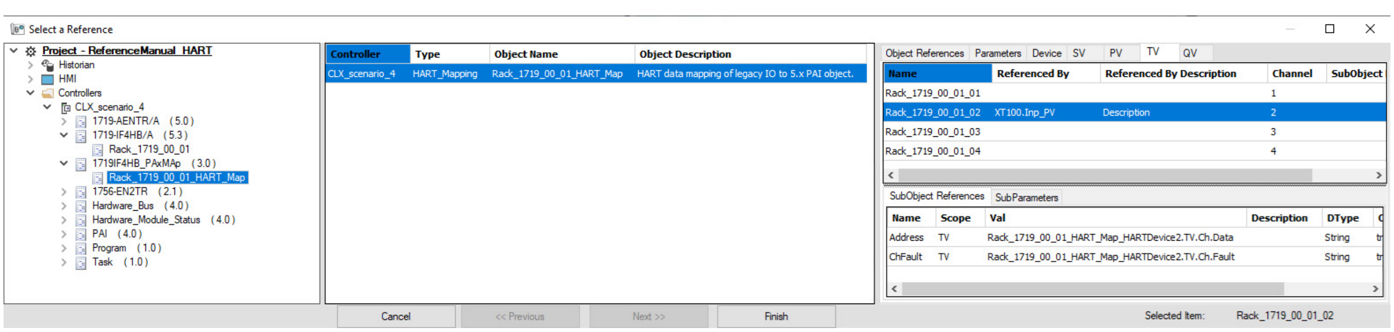
6. From the Process library > Control Strategies > Input Processing folder, add a PAI instance for each instrument and configure these parameters in the I/O Configuration section.



7. Configure these parameters.

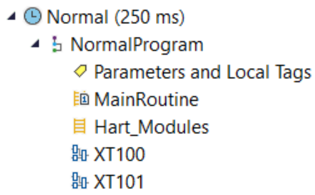
ACM Parameter	Usage
Task Program	Assign a Task and Program for the PAI control strategy.
IO_Signal	HART
Inp_PV	Set this reference to the PV, SV, TV, or QV of the HART_MapIO object that was created for the HART device
Cfg_ UseHARTDigitalData	Set to True
Ref_HARTModule	Set this reference to the HART I/O module to which the instrument is connected.

This example shows the TV value as the selection for the Inp_PV connection.



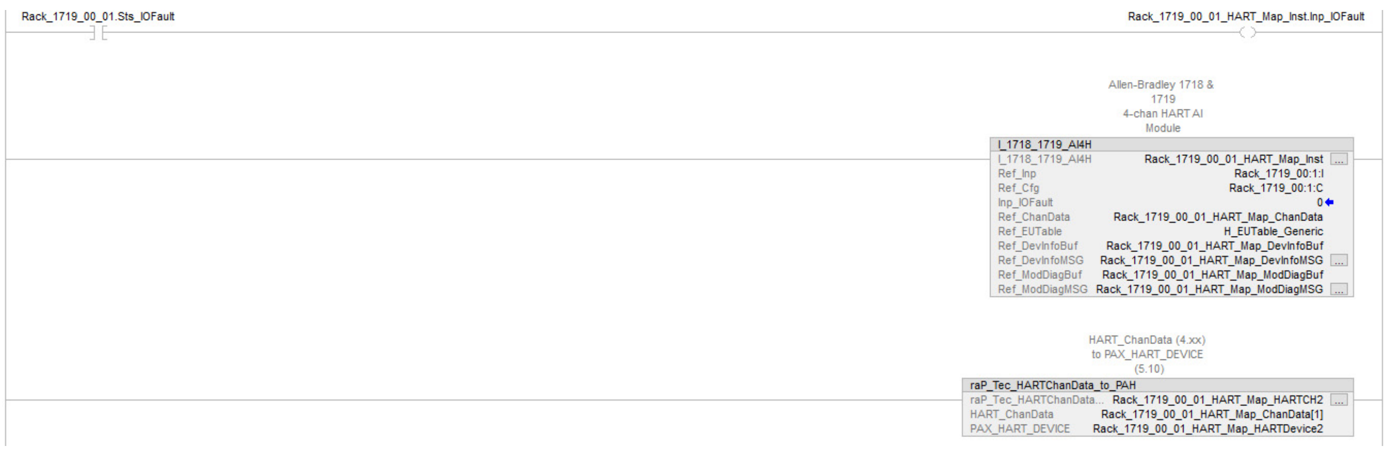
8. Generate the controller ACD file.

The controller code contains a routine for each HART instrument and a Hart_Modules routine.

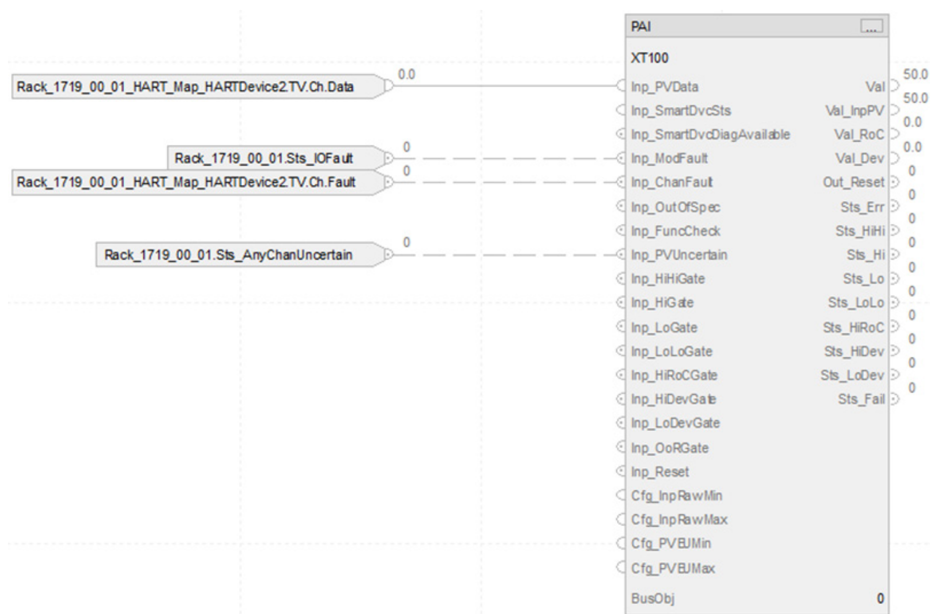


These actions occur in the Hart_Modules routine.

- An Add-On Instruction is inserted which gets the data from the HART Module (in this case I_1718_1719_AI4H).
- The HART data is mapped into an array for the device (Rack_1719_01_HART_Map_HARTCH2).
- Each element of the array is mapped into a tag of type PAX_HART_DEVICE:I:0 via the Add-On Instruction rap_Tec_HARTChanData_to_PAH.



The instrument logic has no PAH module.



Notes:

Chapter 3

EtherNet/IP Integration

EtherNet/IP Data

The PlantPAx® control strategies that use EtherNet/IP™ data use Add-On Instructions for Endress+Hauser devices to provide input to a Process Analog Input (PAI) instruction. For more information, see the PAI Control Strategy on page 113.

EtherNet/IP Module Configuration Considerations

Configuration Type	Operand	Type	Description
Module	PlantPAx control	Flowmeter/sensor AOIs: • raP_Dvc_EH_Promag100_FW2, for Promag 100 • raP_Dvc_EH_Promag300_500, for Promag 300 and Promag 500 • raP_Dvc_EH_Promag400_FW3, for Promag 400 V01 • raP_Dvc_EH_Promag400V02_Rev4, for Promag 400 V02 • raP_Dvc_EH_Promag53_FW1, for Promag 53 • raP_Dvc_EH_Promass100_FW3, for Promass 100) • raP_Dvc_EH_Promass300_500, for Promass 300 and Promass 500 • raP_Dvc_EH_Promass83_FW2, for Promass 83 • raP_Dvc_EH_Sensor, for Liquiline CM44x sensors	Instance of device required for proper operation of control strategy.
	Ref_Inp	EH:xxx_:I1:0	Required data type from the device, where xxx = device type.
	Ref_Out	EH:xxx_100:O1:0	Required data type from the device, where xxx = device type.
	Ref_Cfg	EH:xxx_100_Rev2:C:0	Required data type from the device, where xxx = device type.
	Ref_MeterData	raP_UDT_Dvc_EH_Flowmeter_Data	Passes information from module to raP_Dvc_EH_Flowmeter
	Ref_EUTable	RAC_CODE_DESCRIPTION[897]	Table of engineering unit codes Specific in-out parameters to sensor
	Ref_DiagTable	RAC_CODE_DESCRIPTION[317]	Table to reference diagnostic codes Specific in-out parameters to sensor
Flowmeter	PlantPAx control	raP_Dvc_EH_Flowmeter	Works in conjunction with EH module AOI. Receives data from Ref_MeterData tag. Optionally connected with a raP_Dvc_EH_Heartbeat AOI.
	Ref_MeterData	raP_UDT_Dvc_EH_Flowmeter_Data	Receives information from module AOI
	Ref_EUTable	RAC_CODE_DESCRIPTION[897]	Table of engineering unit codes
	Ref_DiagTable	RAC_CODE_DESCRIPTION[99]	Table to reference diagnostic codes Specific to device being used
Heartbeat	PlantPAx control	raP_Dvc_EH_Heartbeat	Provides option to do extensive self-test of device
	Ref_SendMSG	MESSAGE	Sent message to device
	Ref_SendData	DINT[9]	Sent data to device
	Ref_ReadMSG	MESSAGE	Received message from device
	Ref_ReadData	DINT[2]	Received data from device
	Ref_HeartbeatSeq	raP_UDT_Dvc_EH_Heartbeat_Seq	Sequence of steps for the test to run Specific to device being used

EtherNet/IP Instructions

The PlantPAx control strategies include EtherNet/IP options that support the EtherNet/IP devices available from Endress+Hauser. These options are available:

- EtherNet/IP control strategies use both the raP_Dvc_EH_Flowmeter instruction and the raP_Dvc_EH_Heartbeat instruction for Promag or Promass flowmeters; the heartbeat instruction provides diagnostics.
- EtherNet/IP NoHB control strategies use the raP_Dvc_EH_Flowmeter instruction for Promag or Promass flowmeters.
- EtherNet/IP Sensor control strategies use the raP_Dvc_EH_Sensor instruction for Liquiline analyzers.

For more information on these instructions, see Endress+Hauser EtherNet/IP Instrumentation for PlantPAx DCS Reference Manual, PROCES-RM212A.

Flowmeter Example - raP_Dvc_EH_Flowmeter

Control strategies with the raP_Dvc_EH_Flowmeter instruction integrate Endress+Hauser Promag and Promass flowmeters into a PlantPAx system.

- Promass meters measure flow using a Coriolis flow sensor and provide mass flow, volumetric flow, density, and other variables depending on the model chosen.
- Endress+Hauser Promag meters use a magnetic flow sensor and provide volumetric flow, mass flow, and other variable, depending on the model chosen.

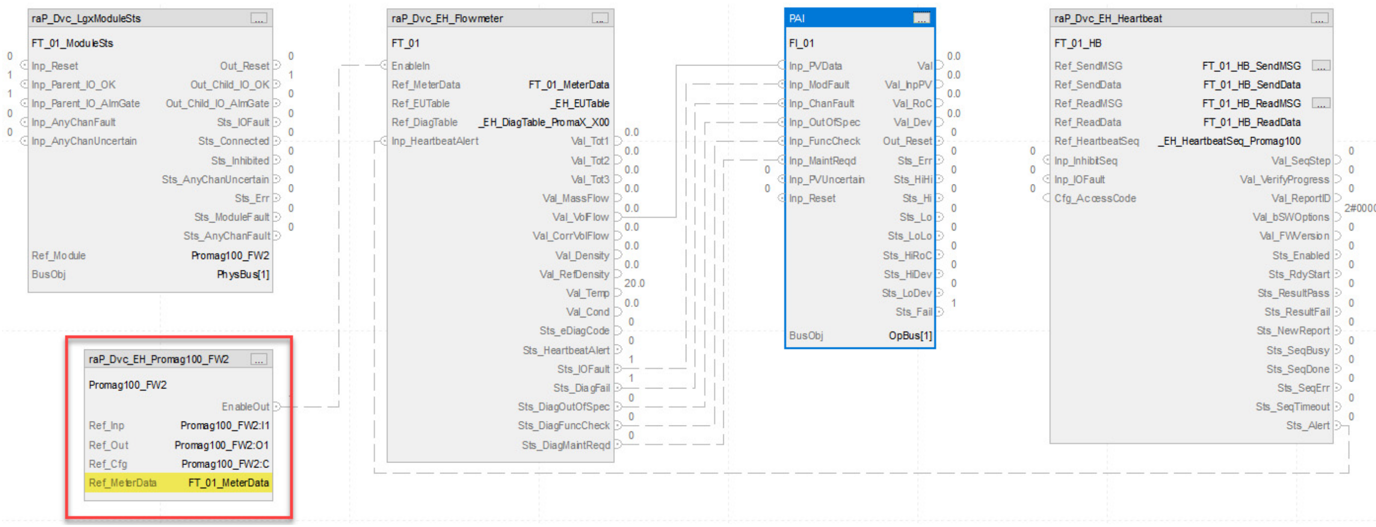
Both types of flowmeters also offer three independent totalizers as well, each with the ability to be cleared from the faceplate or from user logic. Measured variables and their status are provided to a PAI instruction for display on the HMI and for generation of alarms.

These are the primary instructions in this control strategy.

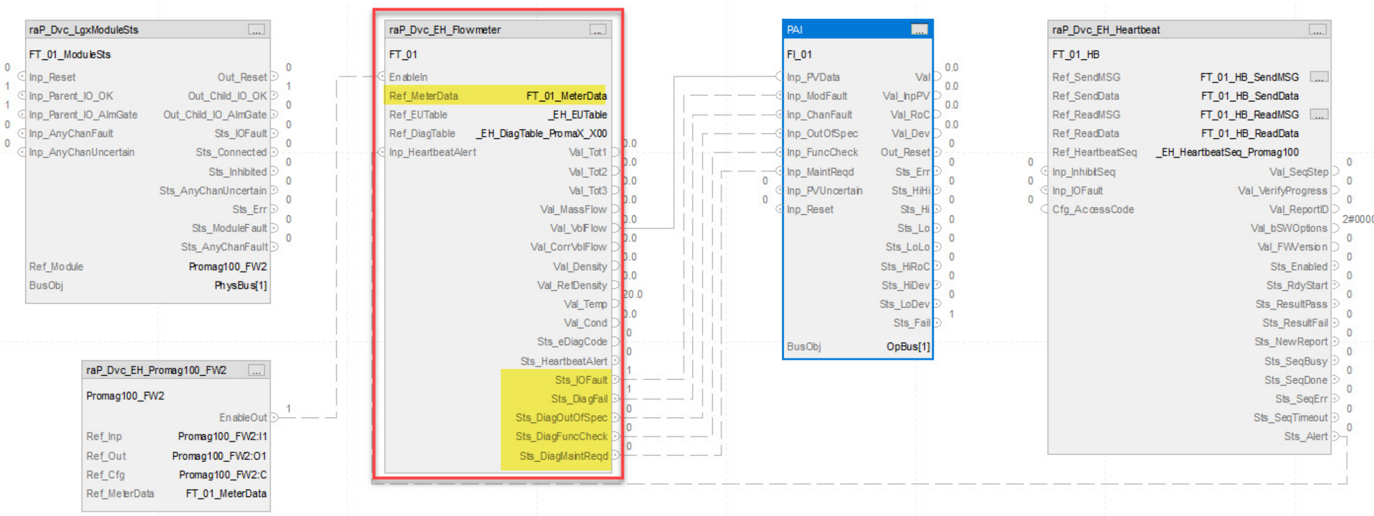
Instruction Type	Description
Model-specific instructions, where xxx = device type. • raP_Dvc_EH_Promagxxx • raP_Dvc_EH_Promassxxx	Provides data from the flowmeter to the user program in a common MeterData structure. This data structure provides meter capabilities, analog data, status, units of measure, and totalizer data for the meter, and controls for the meter's totalizers. Model-specific instructions gather and distribute the MeterData but do not have any faceplate or other user interface.
The raP_Dvc_EH_Flowmeter instruction	Consolidates the meter data in a common format. Has a faceplate that shows the data from the meter and accepts commands to control the totalizers.
One or more PAI instructions	Provides a single analog value for display on the HMI. Has a faceplate for setting alarm thresholds and displaying analog alarms.

The flow of information through the blocks is:

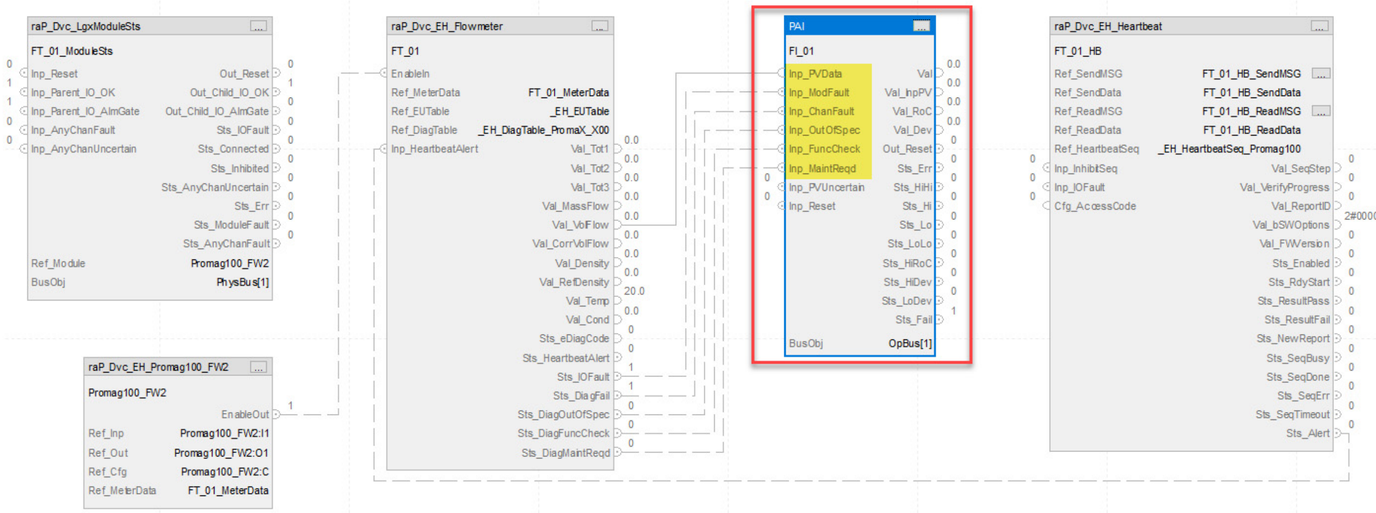
1. To interface to the flowmeter, the model-specific Add-On Instruction uses InOut parameters for the device assembly tags for Input, Configuration, and Output. It provides data in a common format to a MeterData tag through an additional InOut parameter.



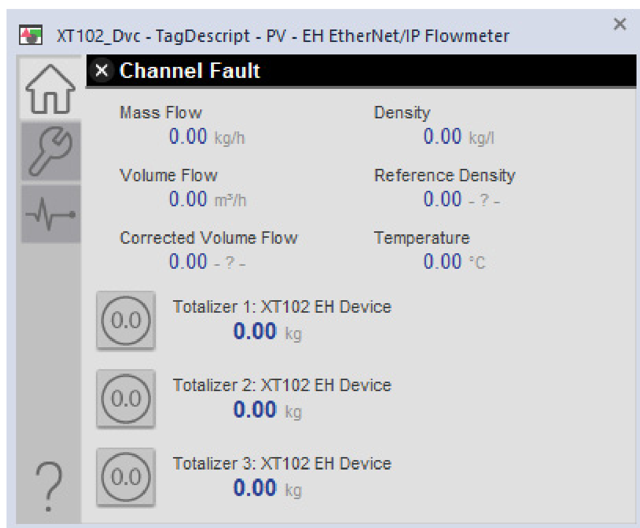
2. The raP_Dvc_EH_Flowmeter tag gets data from the MeterData tag and provides several Values (for example, Val_MassFlow) with units and status.



3. A display or alarm variable is wired to a PAI instruction, which provides those services.

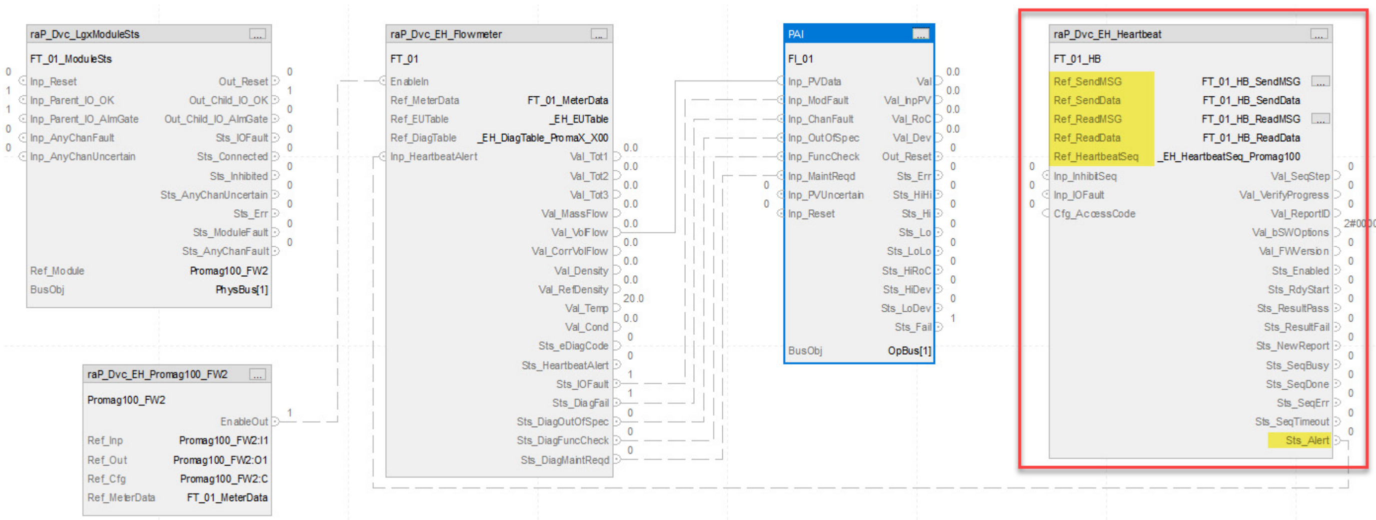


For detailed meter status and diagnostics, click the analog display object to open the PAI faceplate, then click the Smart Device button  to open the Flowmeter faceplate.

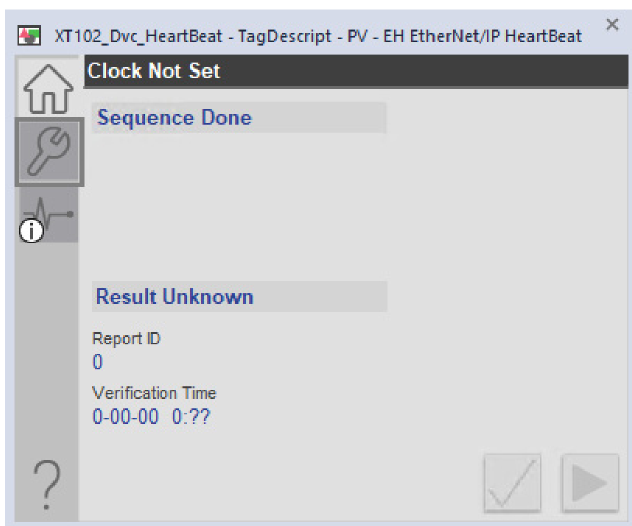


Heartbeat Example - raP_Dvc_EH_Heartbeat

Many Endress+Hauser flowmeters provide Heartbeat Verification technology, which can perform an extensive self-test of the device. From the operator faceplate, you can initiate the Heartbeat Verification, see the test progress and the overall pass/fail result. A detailed report of the test is then available from the on-device web page.



To open the Heartbeat faceplate, click the analog display object to open the PAI faceplate, then click the Heartbeat button  .



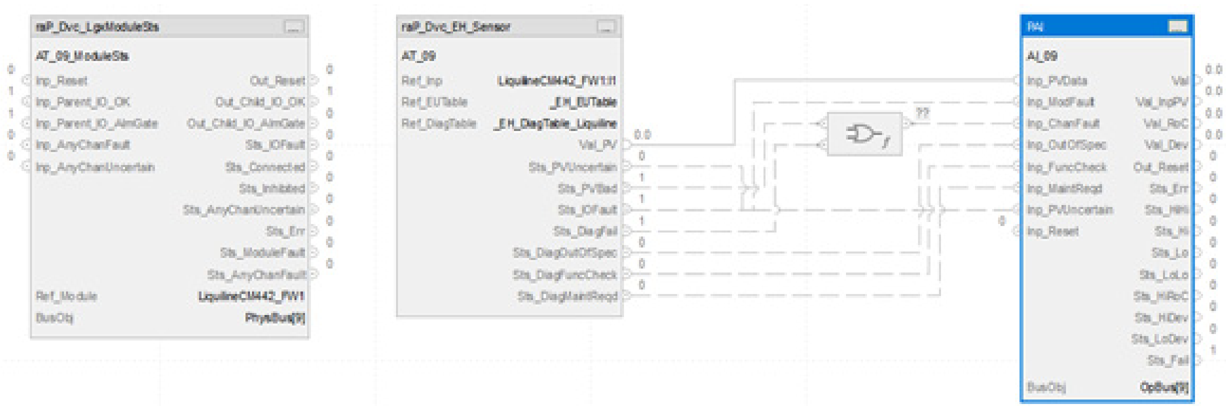
On the Heartbeat faceplate, enter the appropriate data for the test, initiate the test, monitor progress of the test, and view the final overall test result.

Control logic can also connect to the raP_Dvc_EH_Heartbeat instruction and can disable the button that initiates the Heartbeat Verification test while the process is running.

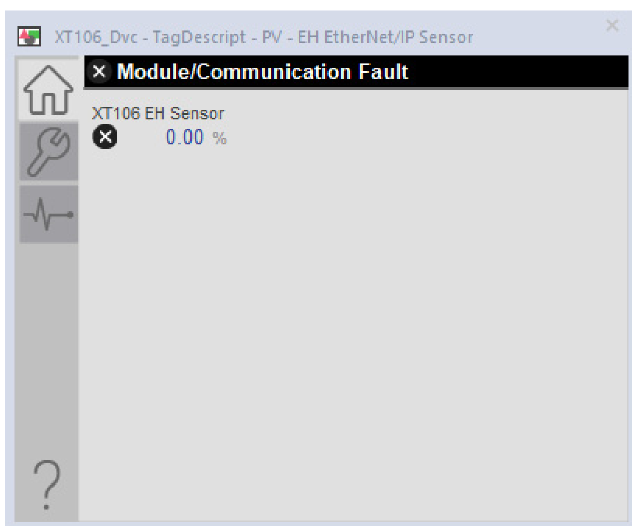
The raP_Dvc_EH_Heartbeat instruction timestamps the test using the controller clock. For a successful test, the controller time must be set to a date later than January 1, 2000.

Sensor Example - raP_Dvc_EH_Sensor

The raP_Dvc_EH_Sensor instruction is used with the Endress+Hauser Liquiline CM442, Liquiline CM444, or Liquiline CM448 analyzer to monitor an analysis probe for a variable such as pH, oxidation-reduction potential (ORP), or dissolved oxygen (DO). The raP_Dvc_EH_Sensor instruction selects one the 16 configurable analog input variables in the analyzer and presents the value, status, and units for use by a PAI instruction. The PAI instruction provides filtering and value, rate of change, and deviation alarms.



To view detailed status and diagnostics for the device, click the analog display object to open the PAI faceplate, then click the Smart Device button  to open the Sensor faceplate.



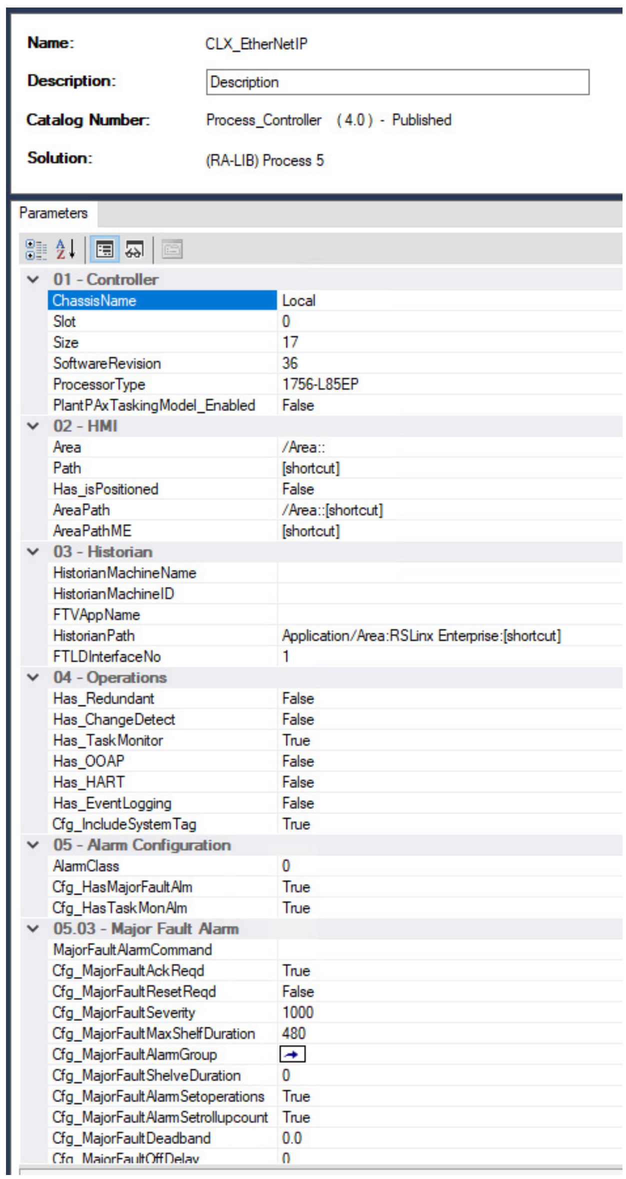
Integrate an EtherNet/IP E+H Flowmeter Device

In this example, the ACM project contains:

- ControlLogix Process controller
- Promass 100 flowmeter

IMPORTANT	When you add multiple modules to an ACM project, remember to enter a unique IP address for each module.

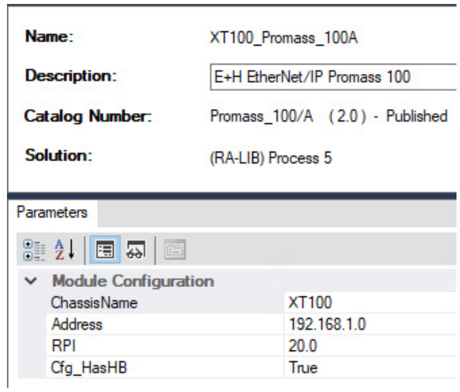
1. Configure the process controller parameters that are required for your application.



2. In the Controller Preview, add the EtherNet/IP device under the Ethernet network.

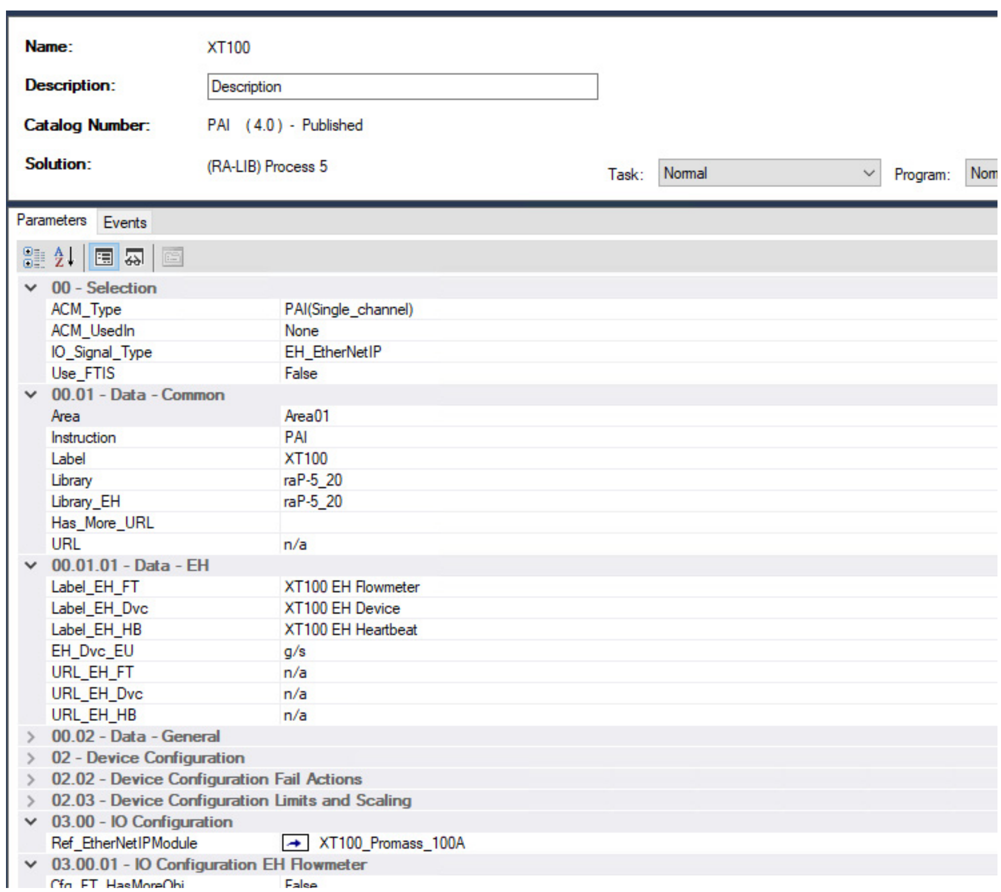
IMPORTANT	You can only add devices in the Controller Preview. You can only delete devices in the Class View.

a. Configure the chassis name, the IP address, the RPI, and if the device has Heartbeat. The chassis name should match the name of the PAI instance to which the device is connected.



3. From the Process library > Control Strategies > Input Processing folder, add a PAI instance in the Class View for the analog input module.

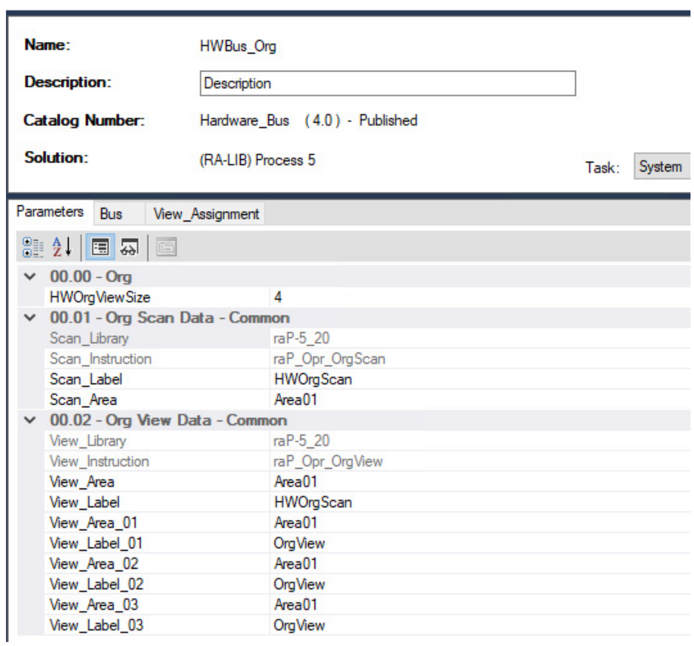
IMPORTANT	• You must create an individual PAI instance for each input module in your application. • Some parameters are only visible when certain parameters are set or populated. For example, if Cfg_HasHB is True or False in the module instance, or if the Ref_EtherNetIPModule has been populated in the PAI instance.



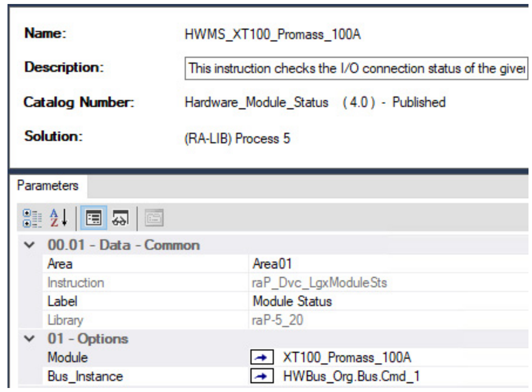
a. Configure these parameters.

ACM Parameter	Description
Task Program	Assign a Task and Program for the PAI control strategy.
IO_Signal_Type	EH_EtherNetIP
Label_EH_FT	Label for EH block
Label_EH_Dvc	Label for EH flowmeter block
Label_EH_HB	Label for EH heartbeat block
EH_Dvc_EU	EH flowmeter engineering units
URL_EH_FT	Help URL for EH block
URL_EH_Dvc	Help URL for EH flowmeter block
URL_EH_HB	Help URL for EH heartbeat block
Ref_EtherNetIPModule	Connect to the EH device (PAI name should be in EH device name)
Cfg_FT_HasMoreObj	EH Flowmeter config: 1 = Tells HMI an object with more information is available, enable navigation
Cfg_FT_Has_More_URL	EH Flowmeter config: Has more URL
Cfg_FT_CnfrmReqd	EH Flowmeter config: 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required
Cfg_HB_Has_More_URL	EH Heartbeat config: Has more URL
Cfg_HB_HasMoreObj	EH Heartbeat config: 1 = Tells HMI an object with more information is available, enable navigation
Cfg_HB_CnfrmReqd	EH Heartbeat config: 0 = None, 1 = Command confirmation required, 2 = Performer e-signature required, 3 = Performer and approver e-signature required
Cfg_AccessCode	EH Heartbeat config: Device access code
Cfg_StepTime	EH Heartbeat config: How often to trigger a message during sequence (seconds). Valid 0.1 to 10.0
Cfg_SeqTimeout	EH Heartbeat config: Maximum time to allow sequence to complete (seconds). Valid 60.0 to 3600.0
Cfg_sCustomer	EH Heartbeat config: Customer description, text sent to device for report
Cfg_sLocation	EH Heartbeat config: Location description, test sent to device for report

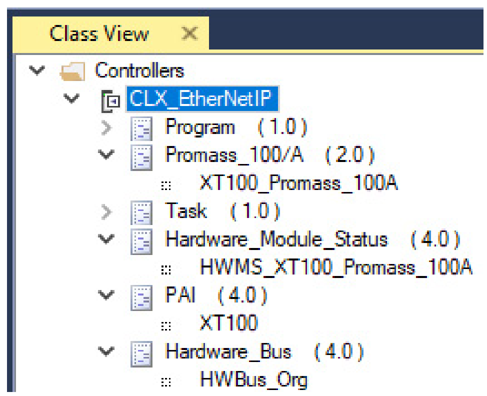
4. From the Process library > Organization > Bus folder, add a Hardware_Bus object to the Class View.



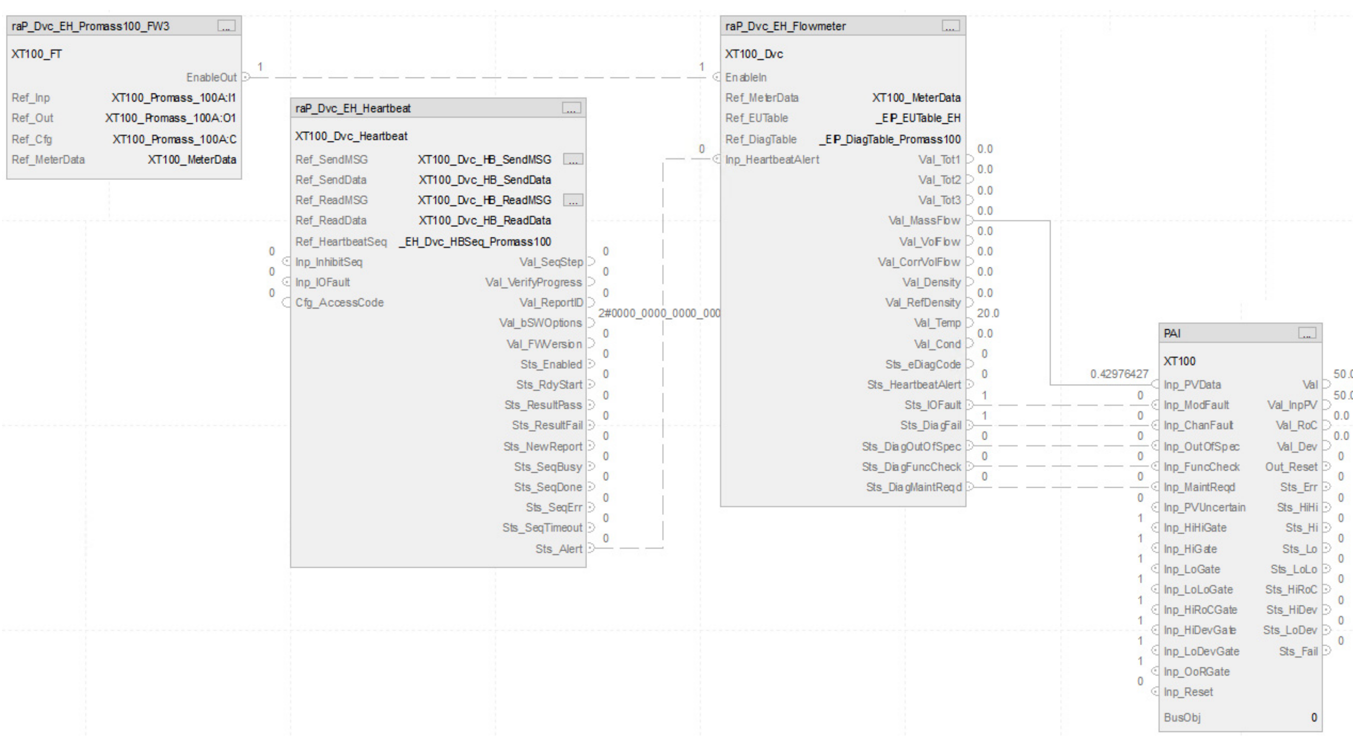
5. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object to the Class View.
   a. Configure the Module parameter for the Promass 100 module.
   b. Assign a unique Bus_Instance on the Hardware_Bus.



The Class View contains these objects:



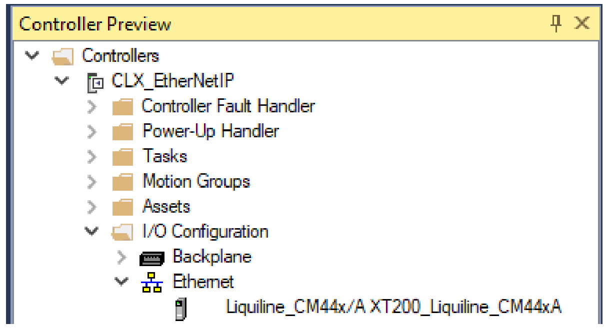
When you have added all of the devices, generate the controller ACD file.



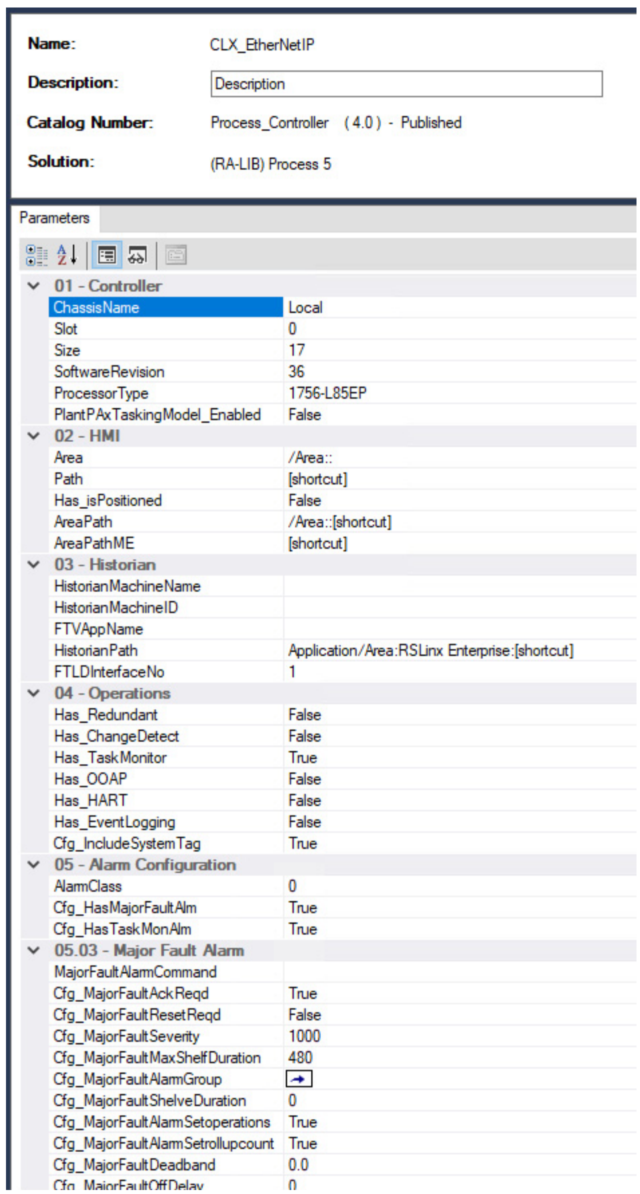
Integrate an EtherNet/IP E+H Sensor Device

In this example, the ACM project contains:

- ControlLogix Process controller
- Liquiline CM44x sensor



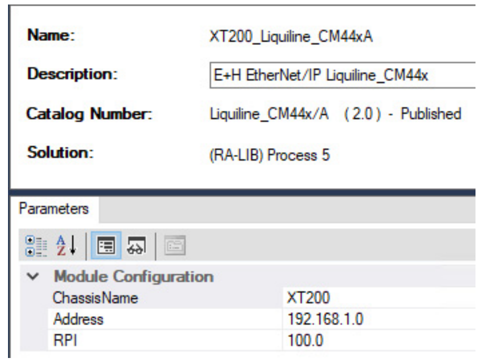
1. Configure the process controller parameters that are required for your application.



2. Add the EtherNet/IP device in the Controller Preview under the Ethernet network.

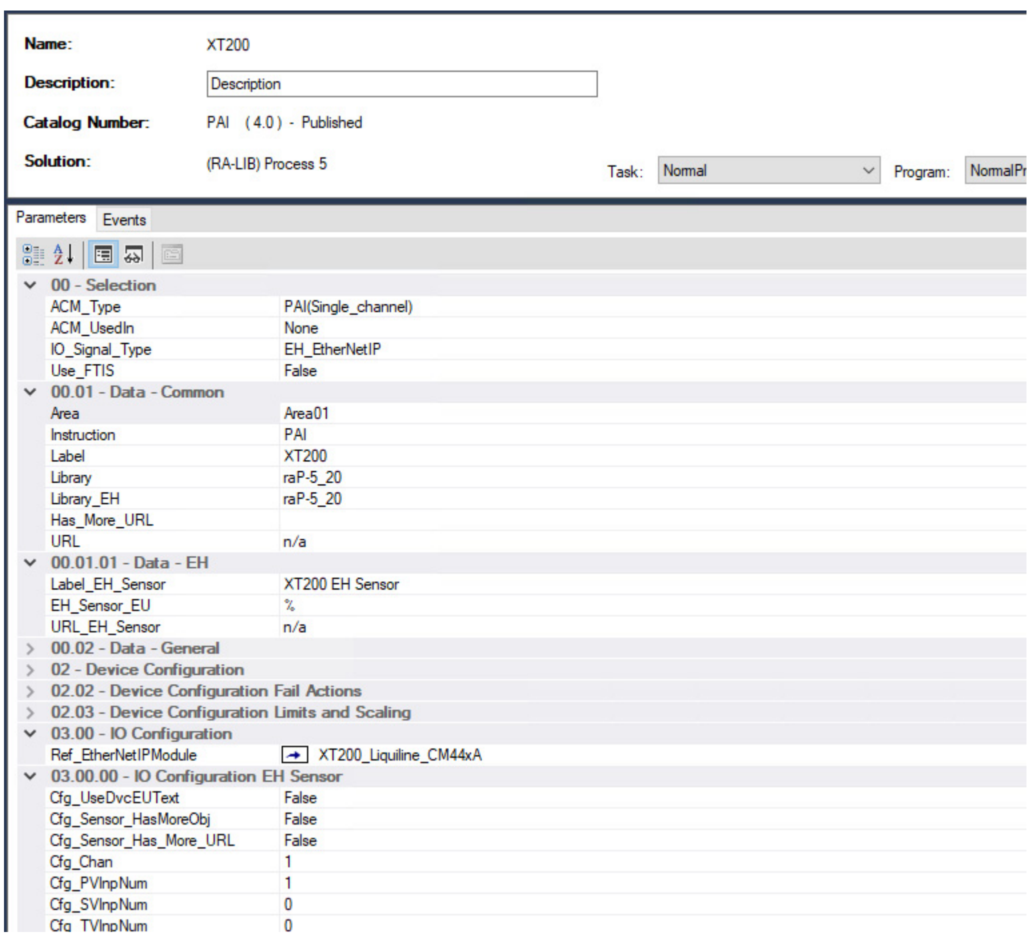
IMPORTANT	You can only add devices in the Controller Preview. You can only delete devices in the Class View.

a. Configure the chassis name, the IP address, and the RPI. The chassis name should match the name of the PAI instance to which the device is connected.



3. From the Process library > Control Strategies > Input Processing folder, add a PAI instance in the Class View for the analog input module.

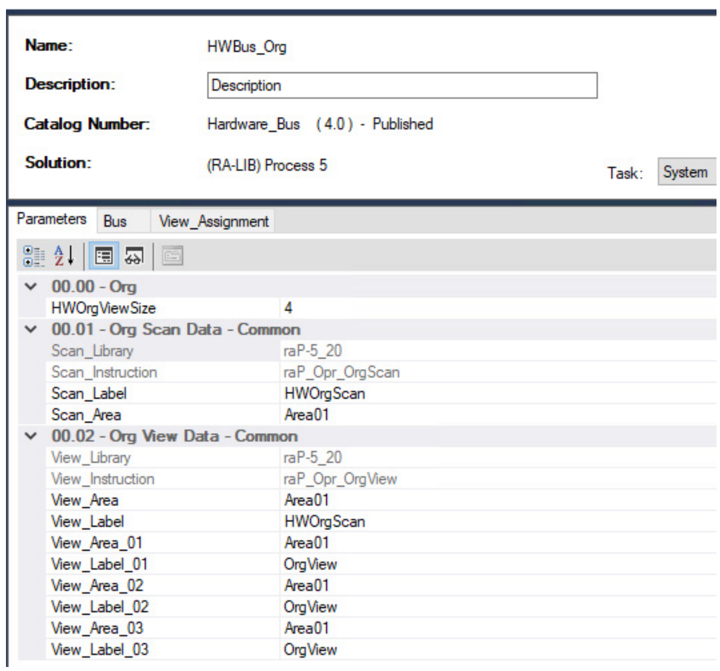
IMPORTANT	• You must create an individual PAI instance for each input module in your application. • Some parameters are only visible when certain parameters are set or populated. For example, if Cfg_HasHB is True or False in the module instance, or if the Ref_EtherNetIPModule has been populated in the PAI instance.



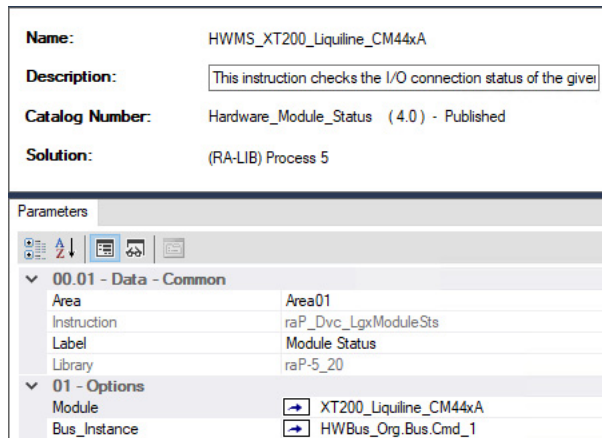
a. Configure these parameters.

ACM Parameter	Description
Task Program	Assign a Task and Program for the PAI control strategy.
IO_Signal_Type	EH_EtherNetIP
Label_EH_Sensor	Label for EH block
EH_Sensor_EU	EH block engineering units
URL_EH_Sensor	Help URL for EH block
Ref_EtherNetIPModule	Connect to the EH device (PAI name should be in EH device name)
Cfg_UseDvcEUText	EH Sensor config: 1 = Use engineering units text based on lookup of EU codes from device, 0 = use user-entered engineering units text
Cfg_Sensor_HasMoreObj	EH Sensor config: 1 = Tells HMI an object with more information is available, enable navigation
Cfg_Sensor_Has_More_URL	EH Sensor config: Has more URL
Cfg_Chan	EH Sensor config: Channel in CM44x to which the sensor/probe is connected. Valid = 1 to 8
Cfg_PVInpNum	EH Sensor config: Assigned analog input in CM44x to use for PV. Valid = 1 to 16
Cfg_SVInpNum	EH Sensor config: Assigned analog input in CM44x to use for SV. Valid = 1 to 16, 0 = SV not used
Cfg_TVInpNum	EH Sensor config: Assigned analog input in CM44x to use for TV. Valid = 1 to 16, 0 = TV not used
Cfg_FVInpNum	EH Sensor config: Assigned analog input in CM44x to use for FV. Valid = 1 to 16, 0 = FV not used
Cfg_sFVEU	EH Sensor config: Engineering units for FV display on HMI
Cfg_sPVEU	EH Sensor config: Engineering units for PV display on HMI
Cfg_sSVEU	EH Sensor config: Engineering units for SV display on HMI
Cfg_sTVEU	EH Sensor config: Engineering units for TV display on HMI

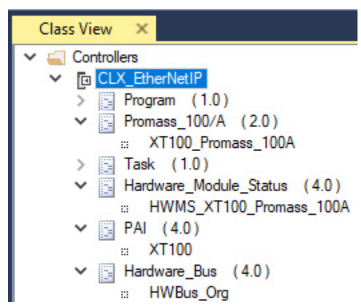
4. From the Process library > Organization > Bus folder, add a Hardware_Bus object to the Class View.



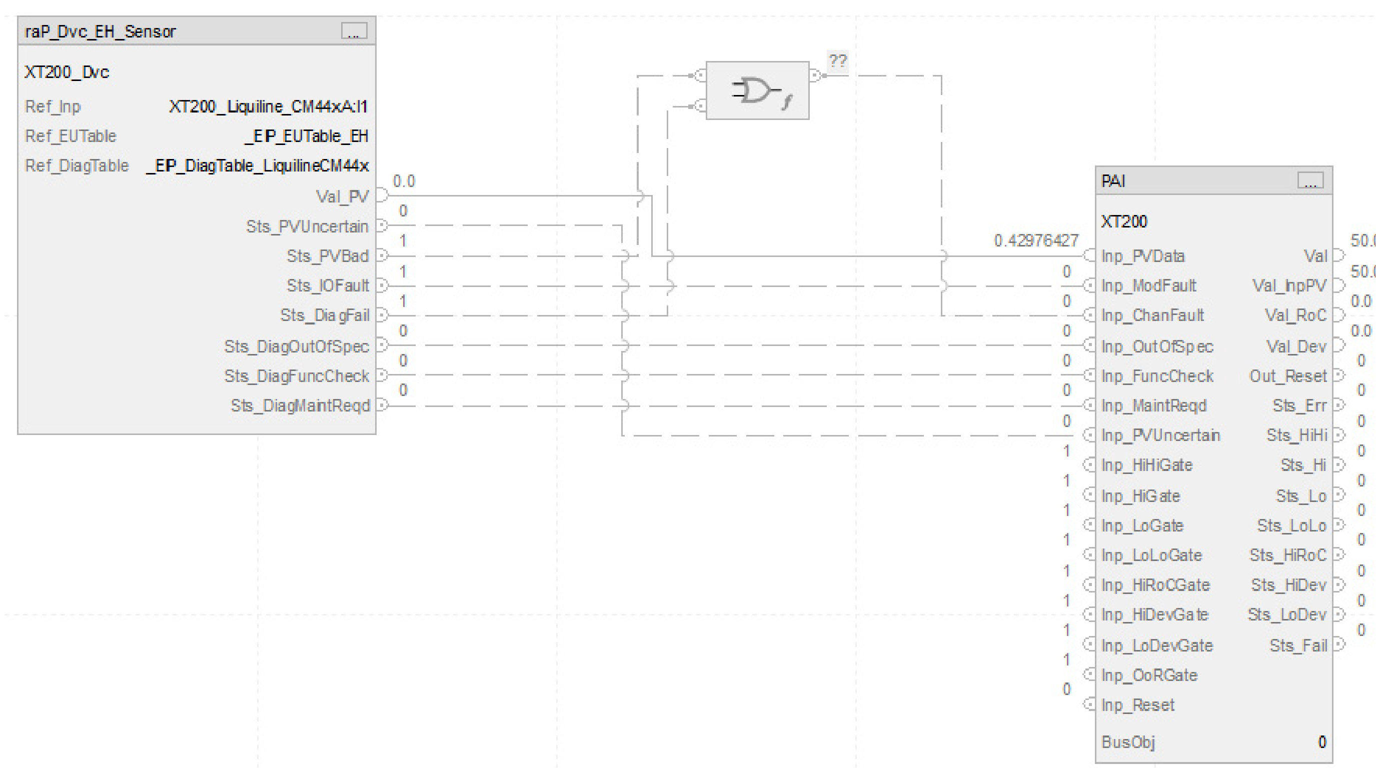
5. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object to the Class View.
   a. Configure the Module parameter for the Promass 100 module.
   b. Assign a unique Bus_Instance on the Hardware_Bus.



The Class View contrains these objects:



When you finish adding devices, generate the controller ACD file.



FOUNDATION Fieldbus and Profibus PA Integration

FOUNDATION Fieldbus and Profibus PA Instructions

The PlantPAx® control strategies include these FOUNDATION Fieldbus (FF) and Profibus PA (PA) options.

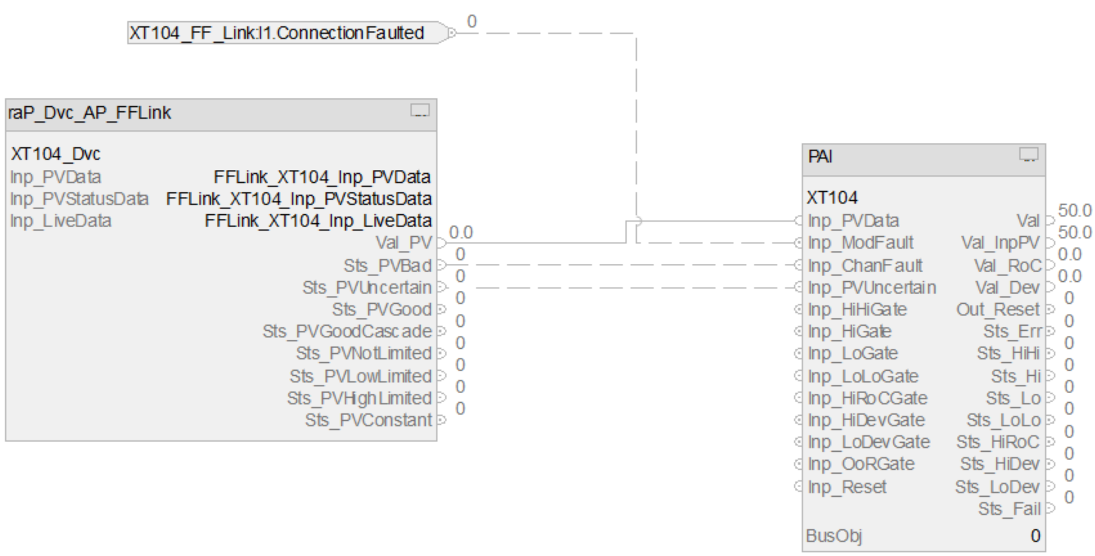
- FOUNDATION Fieldbus control strategies use the raP_Dvc_AP_FFLink instruction to integrate FOUNDATION Fieldbus devices.
- Profibus PA control strategies use the raP_Dvc_AP_PALink instruction to integrate Profibus PA devices

For more information, see Profibus PA and FOUNDATION Fieldbus Linking Devices in a PlantPAx Distributed Control System Reference Manual, publication PROCES-RM213.

Foundation Fieldbus Link Example - raP_Dvc_AP_FFLink

Control strategies with the raP_Dvc_AP_FFLink instruction integrate FOUNDATION Fieldbus devices into a PlantPAx system. This instruction transfers data from one FOUNDATION Fieldbus analog PV, mapping the REAL PV directly and mapping the PV status to a set of status bits suitable for use with the PAI instruction.

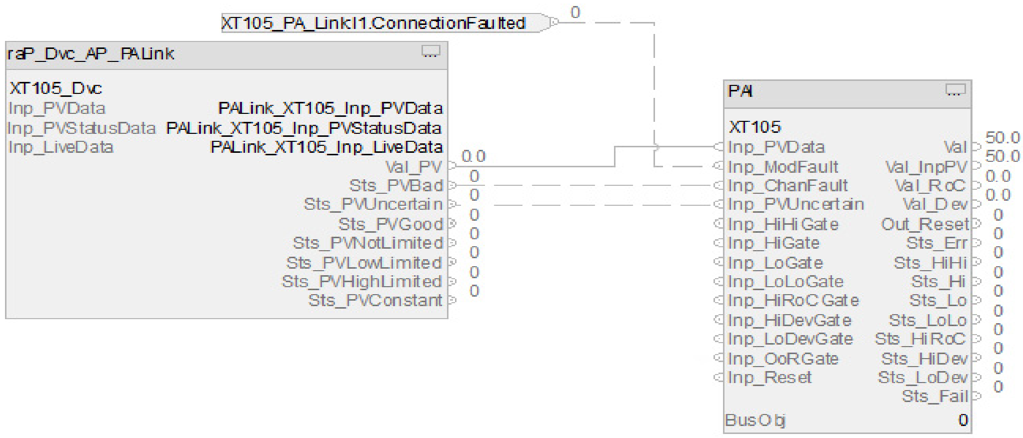
This instruction has no prescan, EnableInFalse, or postscan logic. It is intended to be executed always true in logic every scan. The instruction can be used in Ladder Diagram, Function Block Diagram, or Structured Text logic.



Profibus PA Link Example - raP_Dvc_AP_PALink

Control strategies with the raP_Dvc_AP_PALink instruction integrate Profibus PA devices into a PlantPAx system. This instruction transfers data from one FOUNDATION Fieldbus analog PV, mapping the REAL PV directly and mapping the PV status to a set of status bits suitable for use with the PAI instruction.

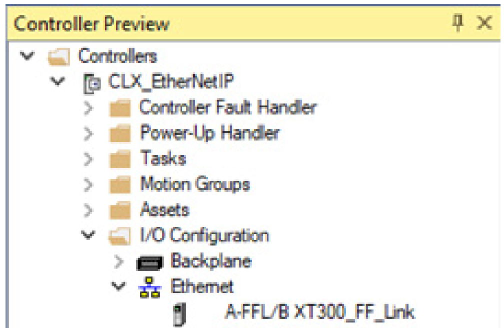
This instruction has no prescan, EnableInFalse, or postscan logic. It is intended to be executed always true in logic every scan. The instruction can be used in Ladder Diagram, Function Block Diagram, or Structured Text logic.



Integrate a FOUNDATION Fieldbus Device

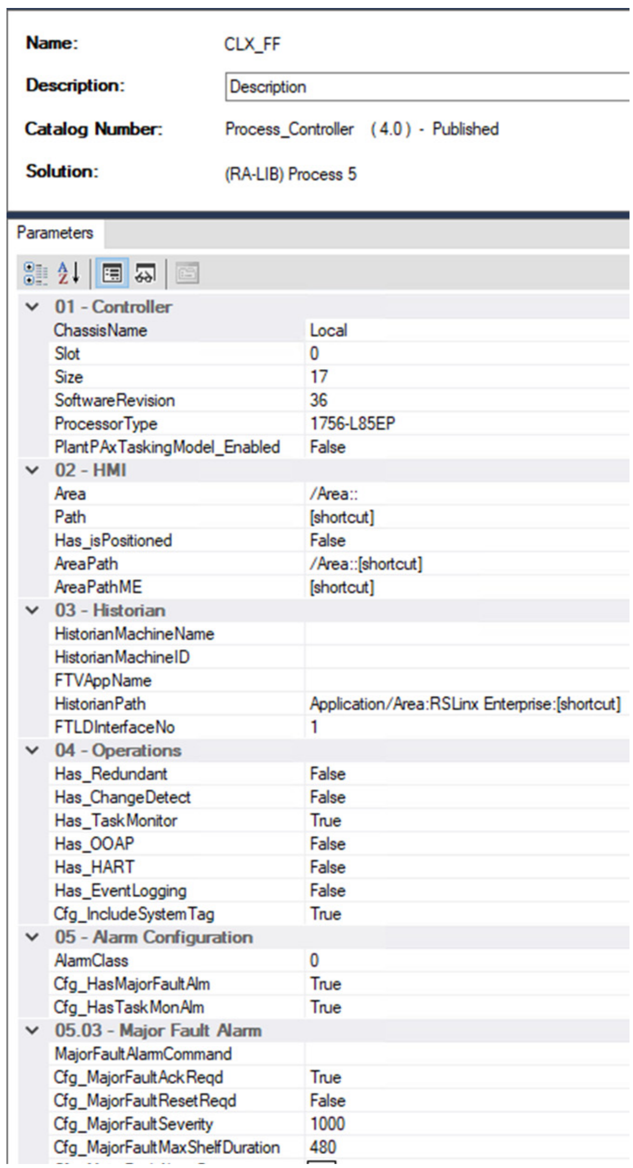
In this example, the ACM project contains:

- ControlLogix Process controller
- Aparian FOUNDATION Fieldbus Linking device



IMPORTANT	When you add multiple modules to an ACM project, remember to enter a unique IP address for each module.

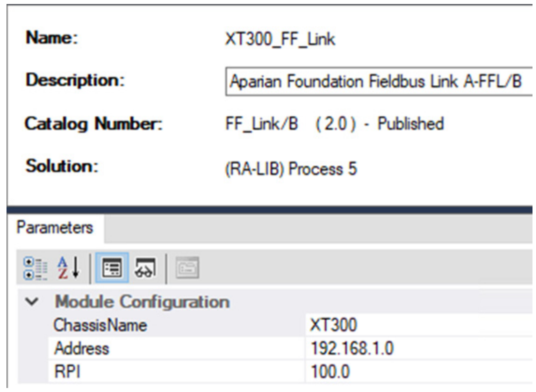
1. Configure the process controller parameters that are required for your application.



2. In the Controller Preview, add the device under the Ethernet network.

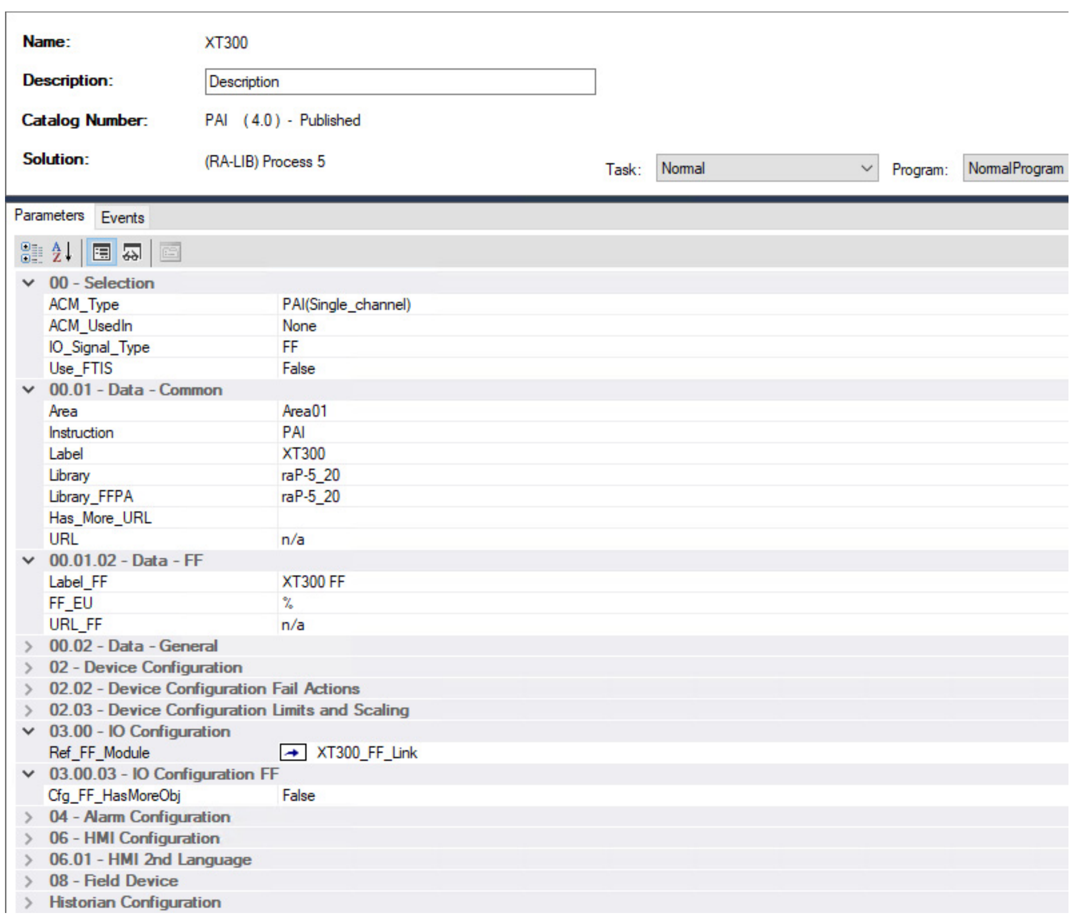
IMPORTANT	You can only add devices in the Controller Preview. You can only delete devices in the Class View.

3. Configure the chassis name, the IP address, and the RPI. The chassis name should match the name of the PAI instance to which the device is connected.



4. From the Process library > Control Strategies > Input Processing folder, add a PAI instance in the Class View for the analog input module.

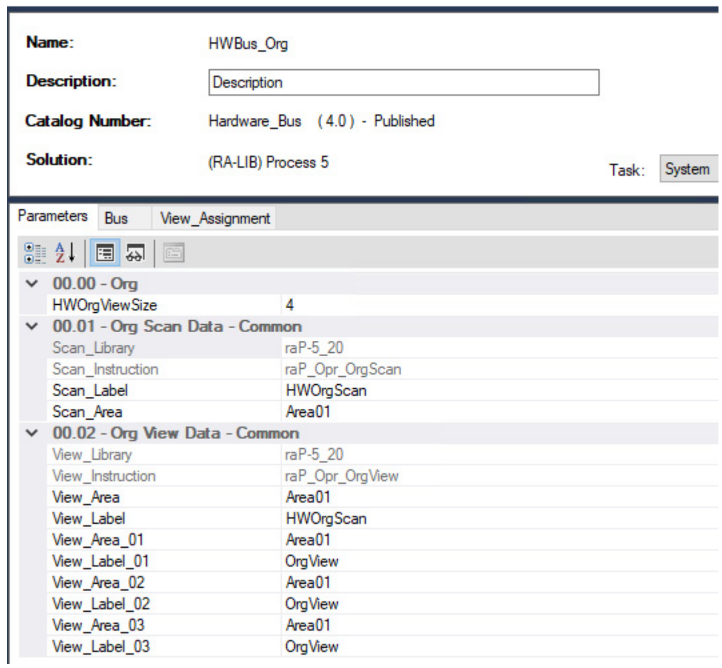
IMPORTANT	• You must create an individual PAI instance for each input module in your application. • Some parameters are only visible when certain parameters are populated. For example, if the Ref_FF_Module has been configured in the PAI instance.



a. Configure these parameters.

ACM Parameter	Description
Task Program	Assign a Task and Program for the PAI control strategy
IO_Signal_Type	FF
Label_FF	Label for Fieldbus device
FF_EU	Fieldbus engineering units
URL_FF	Help URL for Fieldbus
Ref_FF_Module	Connect to the FF device (PAI name should be in FF device name)
Cfg_FT_HasMoreObj	FF config: 1 = Tells HMI an object with more information is available, enable navigation

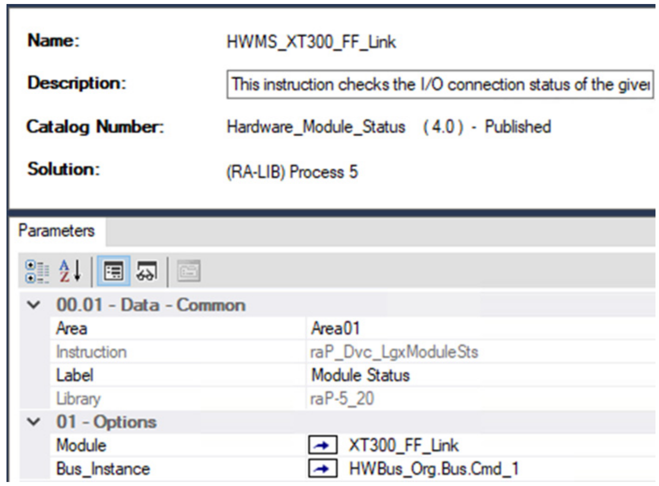
5. From the Process library > Organization > Bus folder, add a Hardware_Bus object.



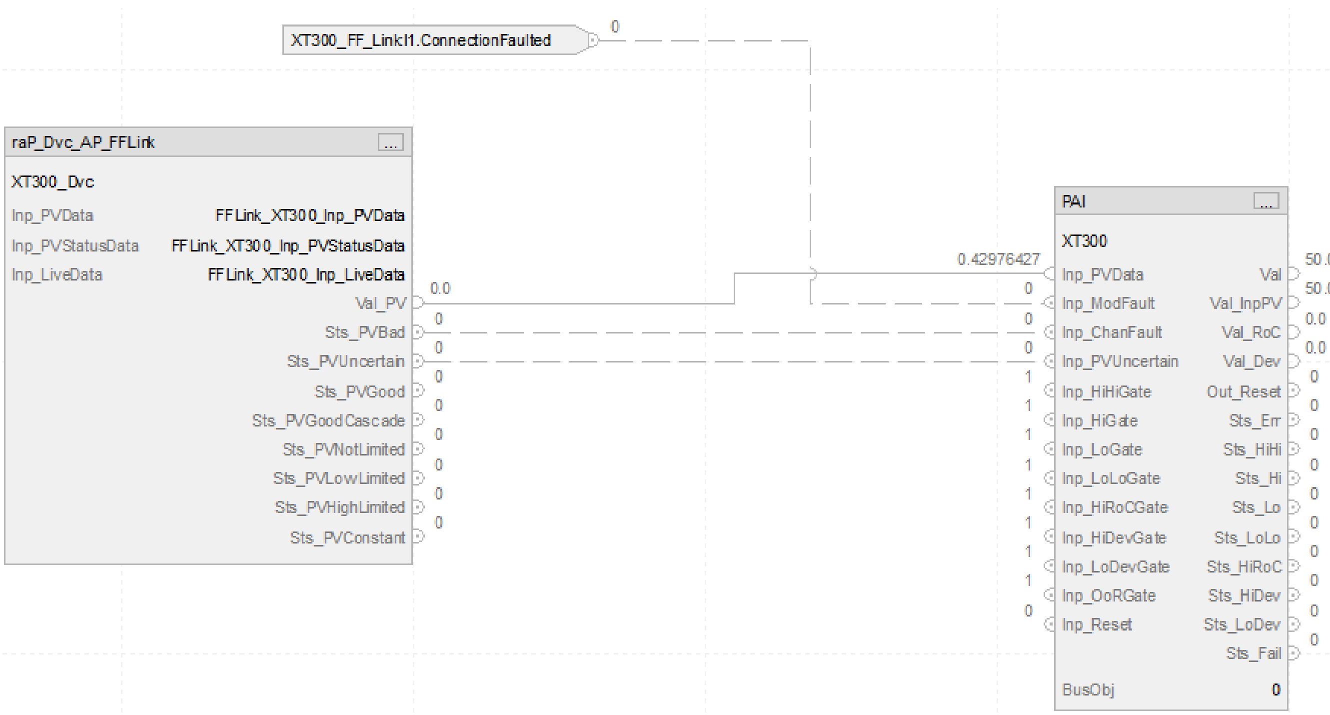
6. From the Process library > Organization > Bus folder, add a Hardware_Bus object to the Class View.

a. Configure the Module parameter for the module.

b. Assign a unique Bus_Instance on the Hardware_Bus.

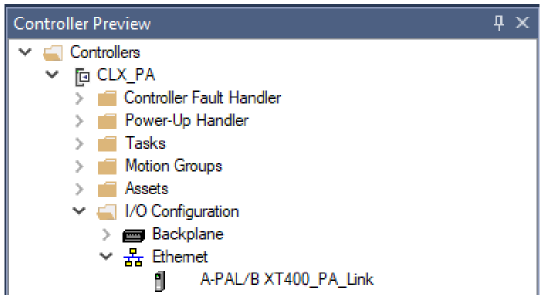


Generate the controller ACD file.



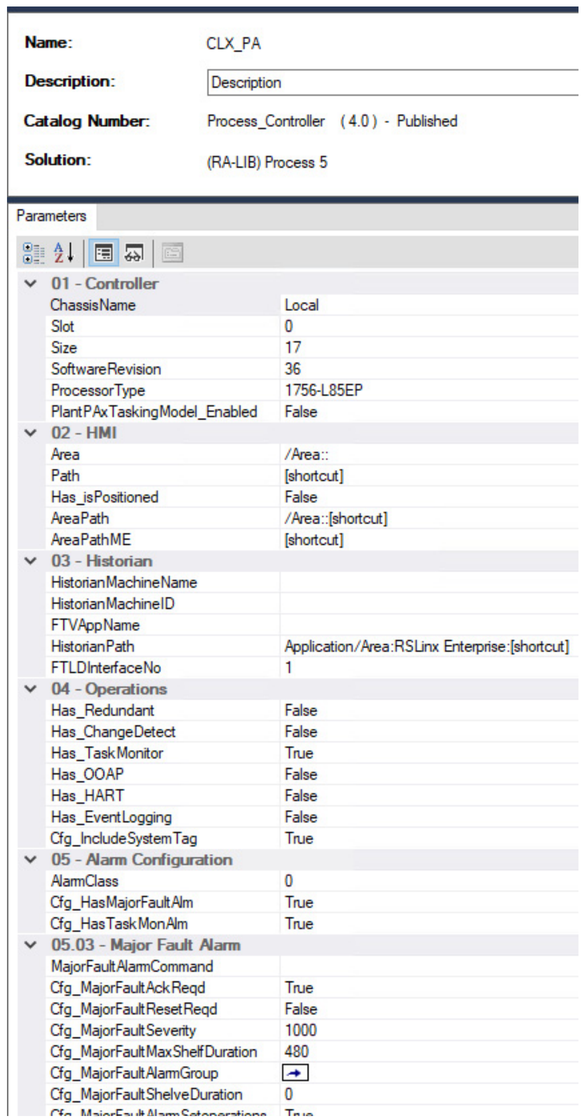
Integrate a Profibus PA Device

In this example, the ACM project contains:
- ControlLogix Process controller
- Aparian Profibus PA Fieldbus Linking device



IMPORTANT When you add multiple modules to an ACM project, remember to enter a unique IP address for each module.

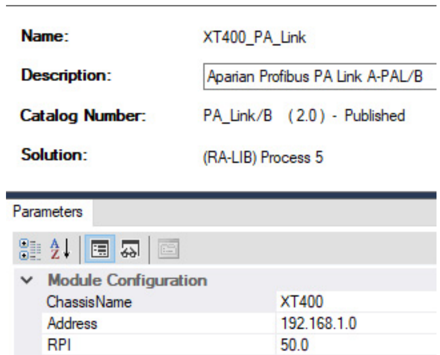
1. Configure the process controller parameters that are required for your application.



2. In the Controller Preview, add the device under the Ethernet network.

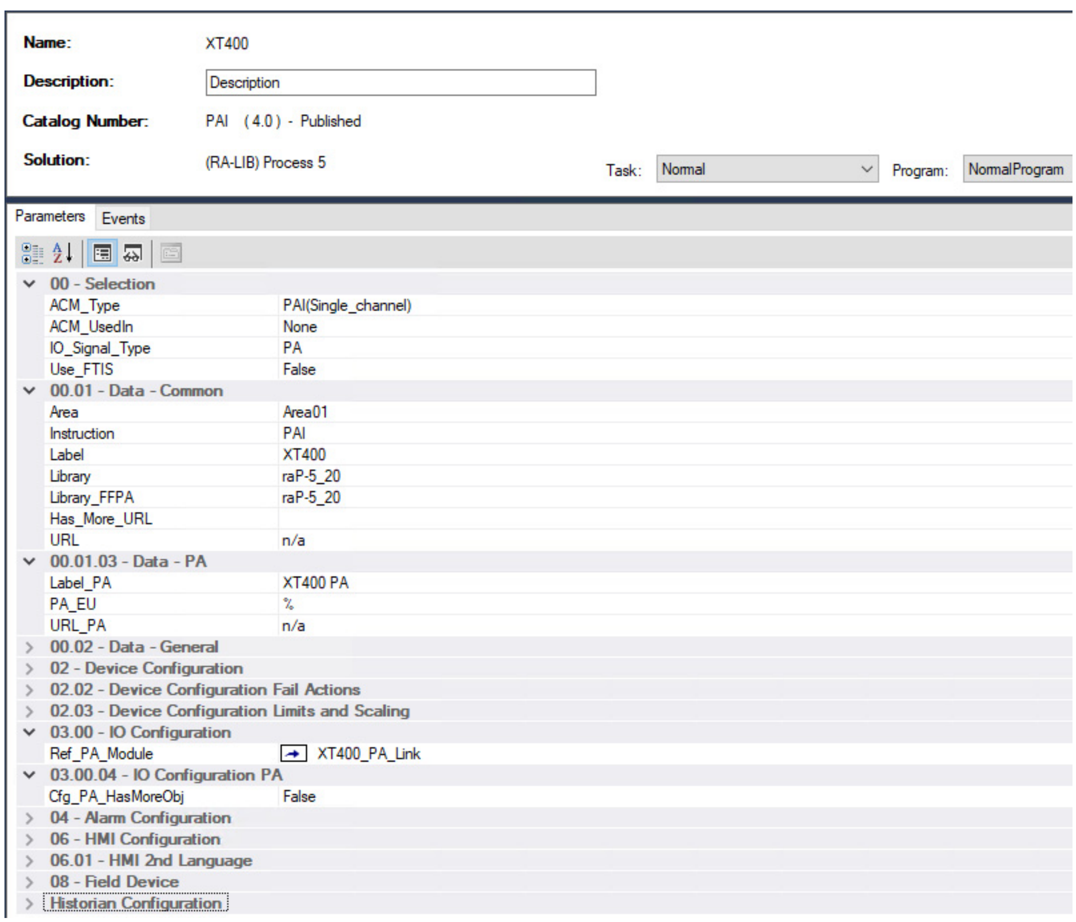
IMPORTANT	You can only add devices in the Controller Preview. You can only delete devices in the Class View.

a. Configure the chassis name, the IP address, and the RPI.The chassis name should match the name of the PAI instance to which the device is connected.



3. From the Process library > Control Strategies > Input Processing folder, add a PAI instance in the Class View for the analog input module.

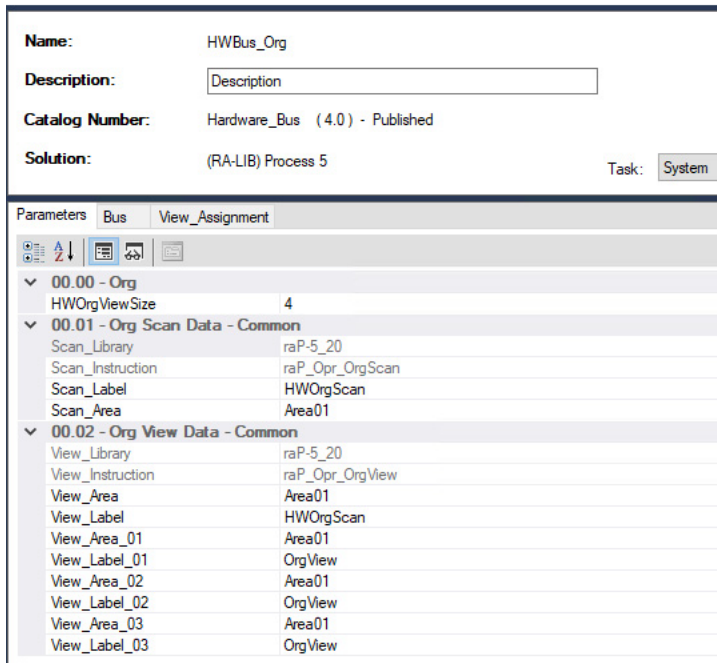
IMPORTANT	• You must create an individual PAI instance for each input module in your application. • Some parameters are only visible when certain parameters are populated. For example, if the Ref_PA_Module has been filled in yet in the PAI instance.



a. Configure these parameters.

ACM Parameter	Description
Task Program	Assign a Task and Program for the PAI control strategy
IO_Signal_Type	PA
Label_FF	Label for Profibus PA device
PA_EU	Profibus PA engineering units
URL_PA	Help URL for Profibus PA
Ref_PA_Module	Connect to the Profibus PA device (PAI name should be in PA device name)
Cfg_PA_HasMoreObj	PA config: 1 = Tells HMI an object with more information is available, enable navigation

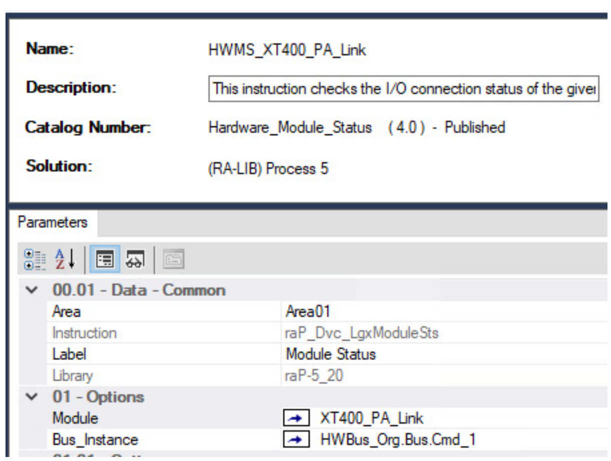
4. From the Process library > Organization > Bus folder, add a Hardware_Bus object to the Class View.



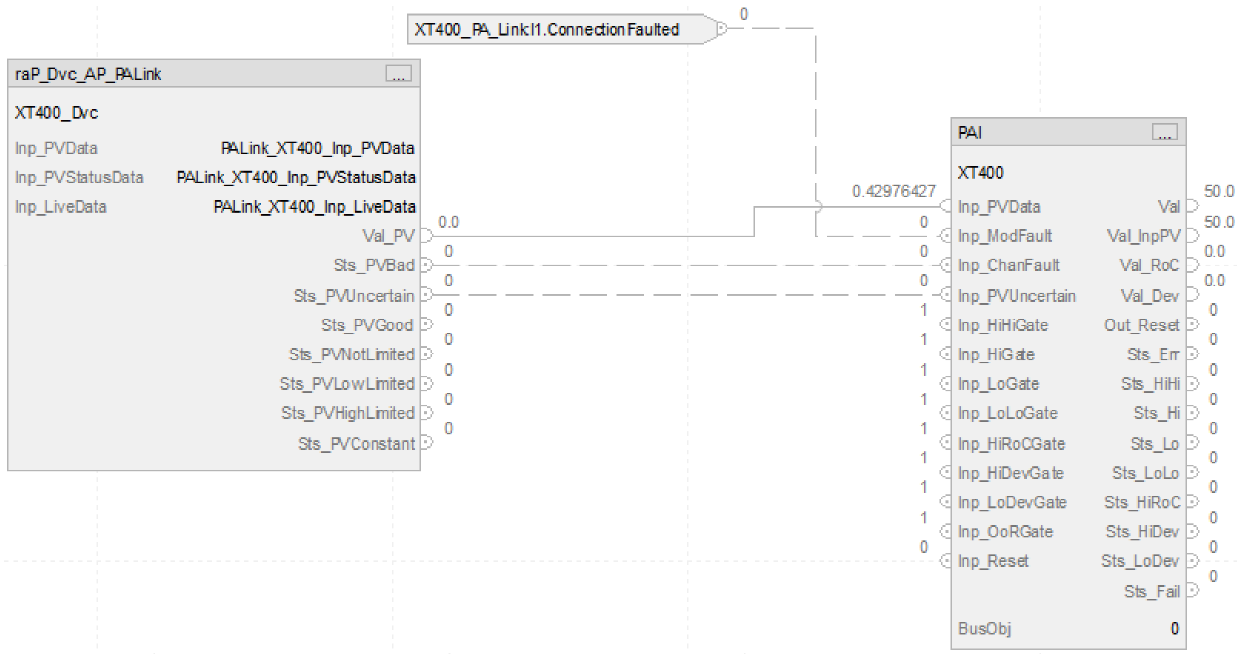
5. From the Process library > Hardware Monitoring > Specialty folder, add a Hardware_Module_Status object to the Class View.

a. Configure the Module parameter for the module.

b. Assign a unique Bus_Instance on the Hardware_Bus.



6. Generate the controller ACD file.



Controller Fault Handler Control Strategy

If a fault condition occurs that prevents an instruction from running, the instruction aborts, and the controller reports a major fault. A major fault halts logic execution and the controller switches to faulted mode (the OK status indicator flashes red). Depending on the application, you may not want all major faults to shut down the system. If you do not want all major faults to shut down the system, create a fault routine to clear the fault and let the application continue to run. The process of resuming execution after the fault clears is known as fault recovery.

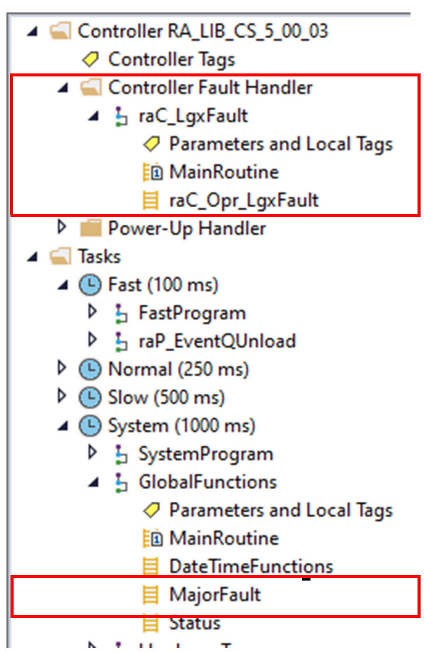
The Controller Fault Handler control strategy has the following functionality:

- Get fault information for the active fault
- Generate an alarm that a major fault occurred
- Record the last 10 major faults that occurred containing a time stamp
- Configuration to automatically clear major fault to help prevent controller from faulting (use selectively)

The Controller Fault Handler control strategy requires:

- a raC_LgxFault **program** (with raC_Opr_LgxFlt and MainRoutine **routines**) in the Controller Fault Handler folder,
- and a MajorFault **routine** in the GlobalFunctions Program.

Import the **routines** into the correct program.

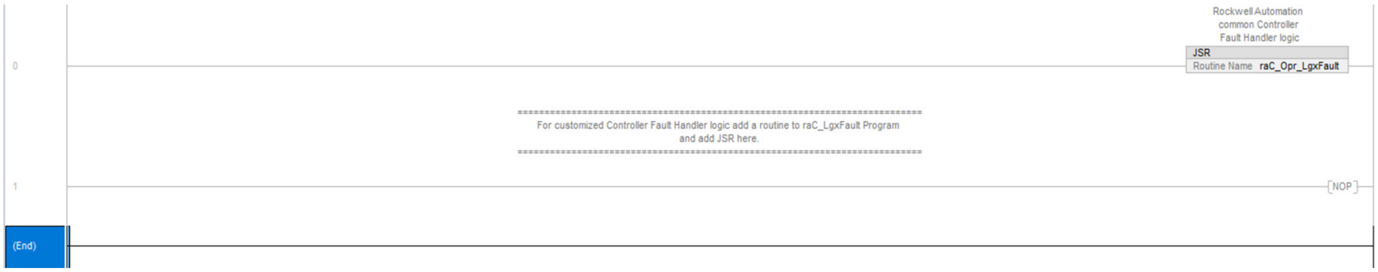


Example Programs

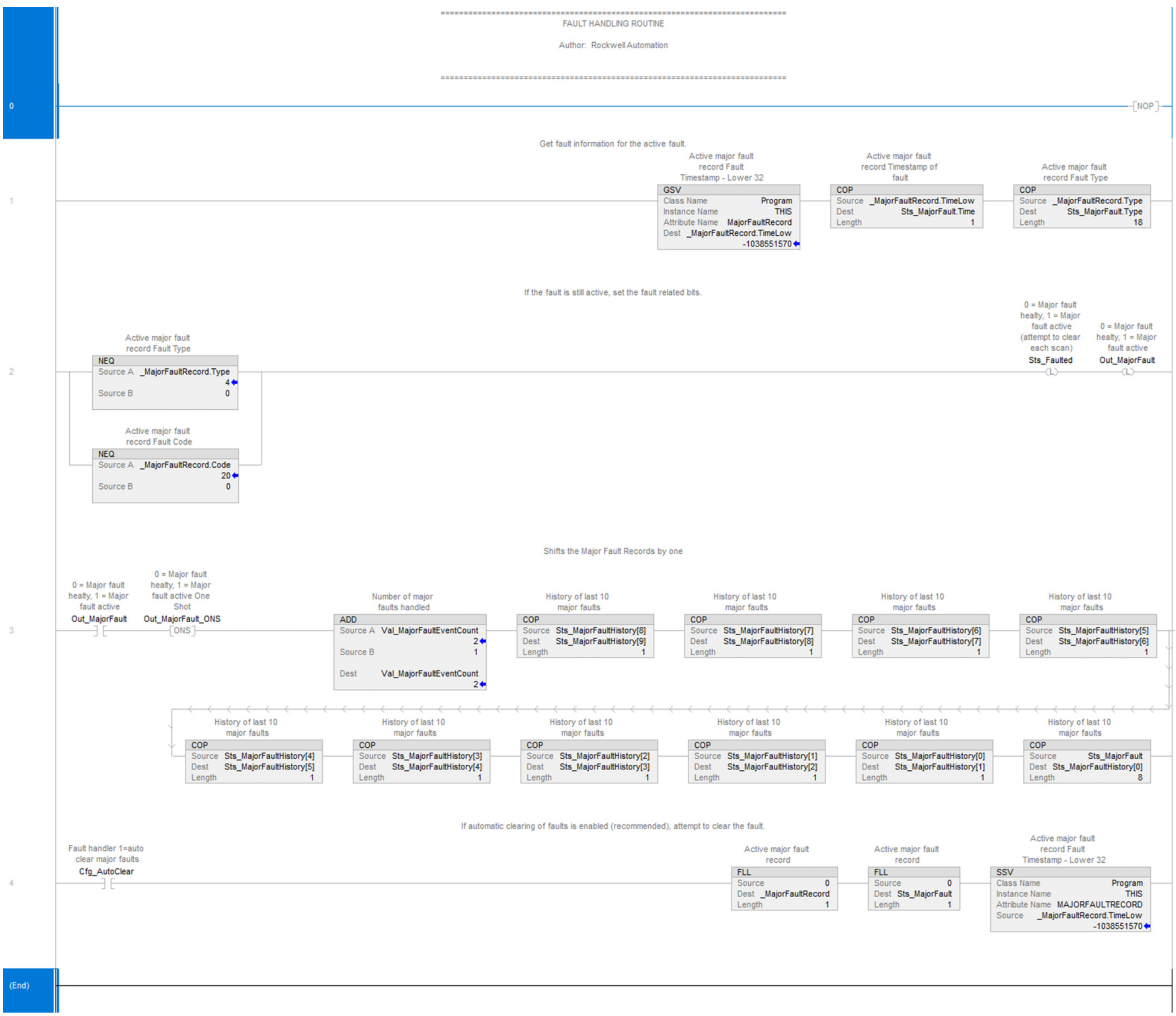
In a system that uses recipe numbers as indirect addresses, a mistyped number could produce a major fault, such as type 4, code 20.

To keep the entire system from shutting down, a fault routine clears any type 4, code 20, major faults.

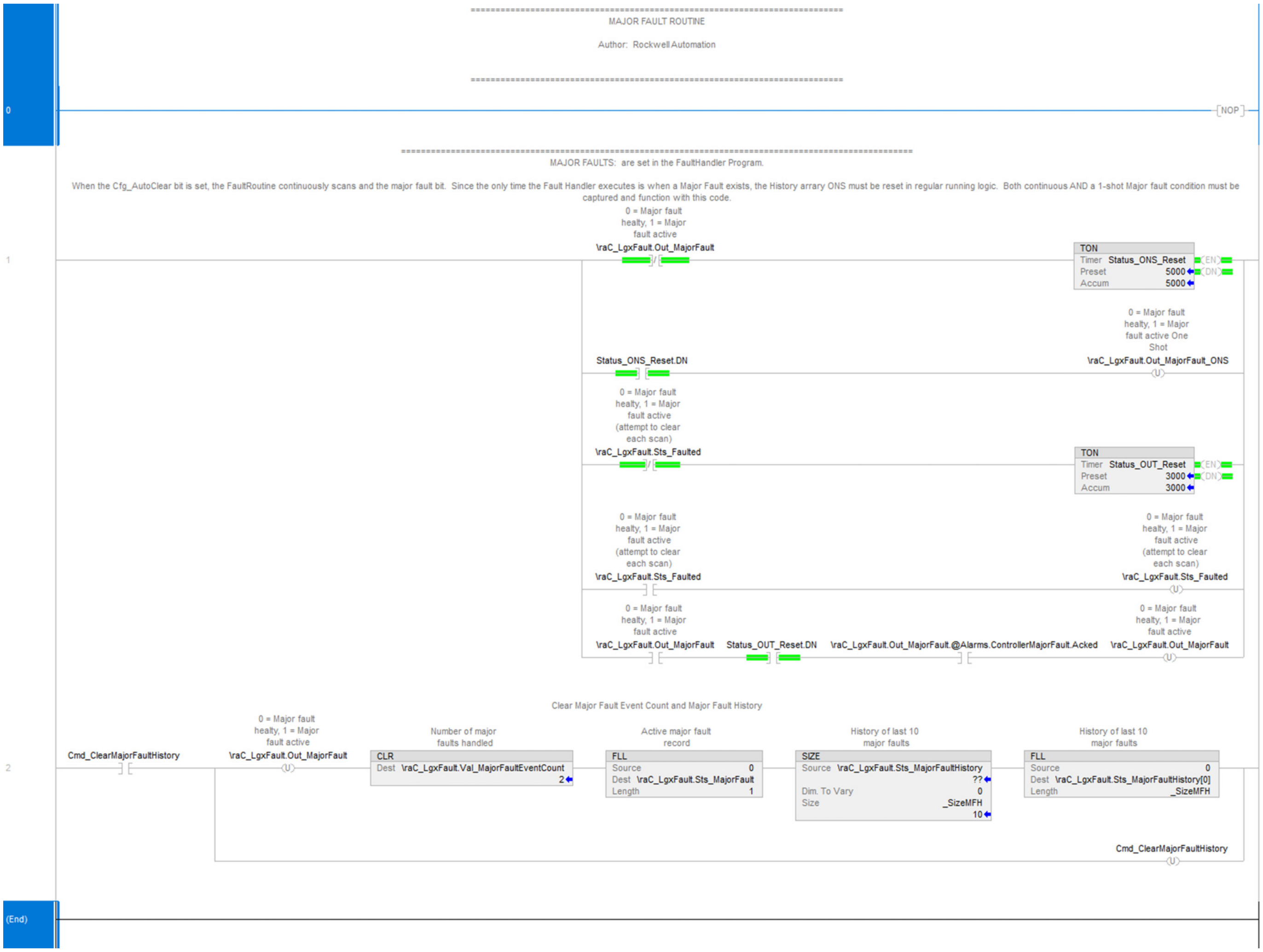
Controller Fault Handler Program: MainRoutine Routine



Controller Fault Handler Program: raC_Opr_LgxFault Routine



GlobalFunctions Program: MajorFault Routine



For more information on handling controller faults, see the Logix 5000® Controllers Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014.

Notes:

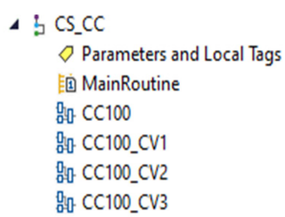
Coordinated Control (CC) Control Strategies

Use the CC control strategy to control one process variable by manipulating up to three different control variables. Any of the three outputs can be used as an input to create feed forward action in the controller. The CC instruction calculates the control variables (CV1, CV2, and CV3) in the auto mode based on the PV - SP deviation, internal models, and tuning.

The CC control strategy is a model-based instruction, where as many as three models can be configured to relate the output of each CV to the single PV. Each model is a first order plus delay (FOPD) response, which is more effective than PID controllers for controlling processes with long deadtimes. The CC control strategy coordinates the action of the CVs to limit interactions among the CVs.

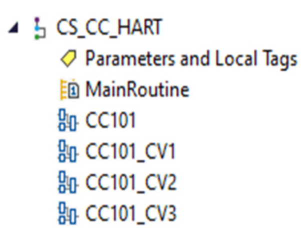
The CC control strategy is available as four routines in the process library:

Routine	Description
CC100	Coordinated Control instruction.
CC100_CV1 CC100_CV2 CC100_CV3	Control variable routines.



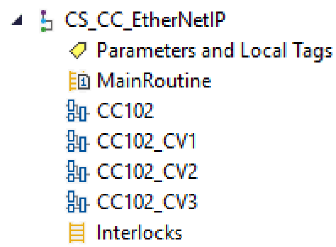
The CC HART control strategy is available as four routines in the process library:

Routine	Description
CC101	Coordinated Control instruction with HART input in the CC101 routine.
CC101_CV1 CC101_CV2 CC101_CV3	Control variable routines.



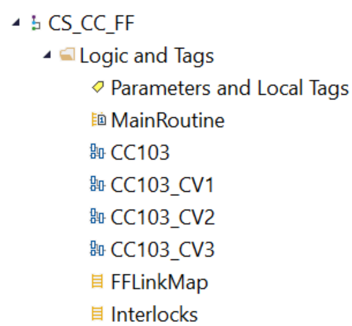
The CC EtherNetIP control strategy is available as four routines in the process library:

Routine	Description
CC102	Coordinated Control instruction with EtherNetIP input in the CC102 routine.
CC102_CV1 CC102_CV2 CC102_CV3	Control variable routines.



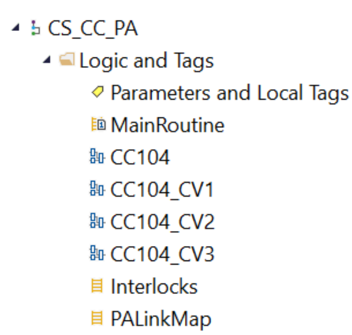
The CC FOUNDATION Fieldbus control strategy is available as four routines in the process library:

Routine	Description
CC103	Coordinated Control instruction with FOUNDATION Fieldbus input in the CC103 routine.
CC103_CV1 CC103_CV2 CC103_CV3	Control variable routines.



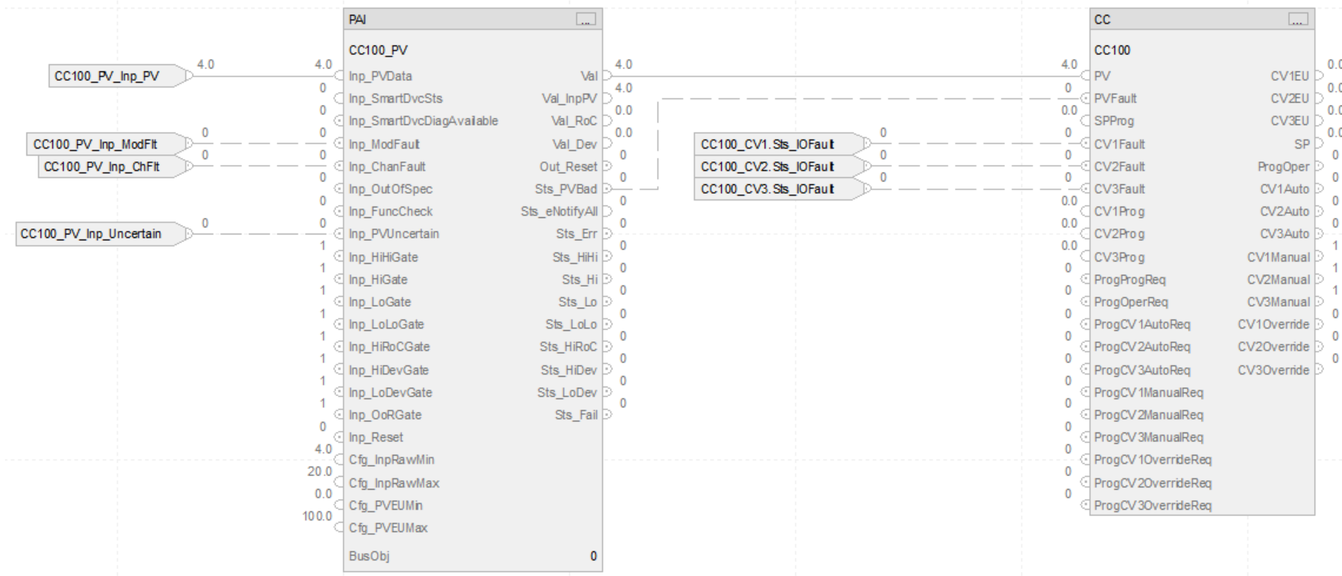
The CC Profibus PA control strategy is available as four routines in the process library:

Routine	Description
CC104	Coordinated Control instruction with Profibus PA input in the CC104 routine.
CC104_CV1 CC104_CV2 CC104_CV3	Control variable routines.



Import the appropriate control strategy as a **program** in your controller project.

CS_CC Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute CC100 for XT101

PAI Outputs to CC Inputs

Parameter	Description
Val	Value for PV parameter Process Variable (PVEU) Source: Analog input channel or upstream REAL tag representing position feedback
Sts_PVBad	Quality of PV value 1 = PV quality is flagged as Bad

Input References to CC

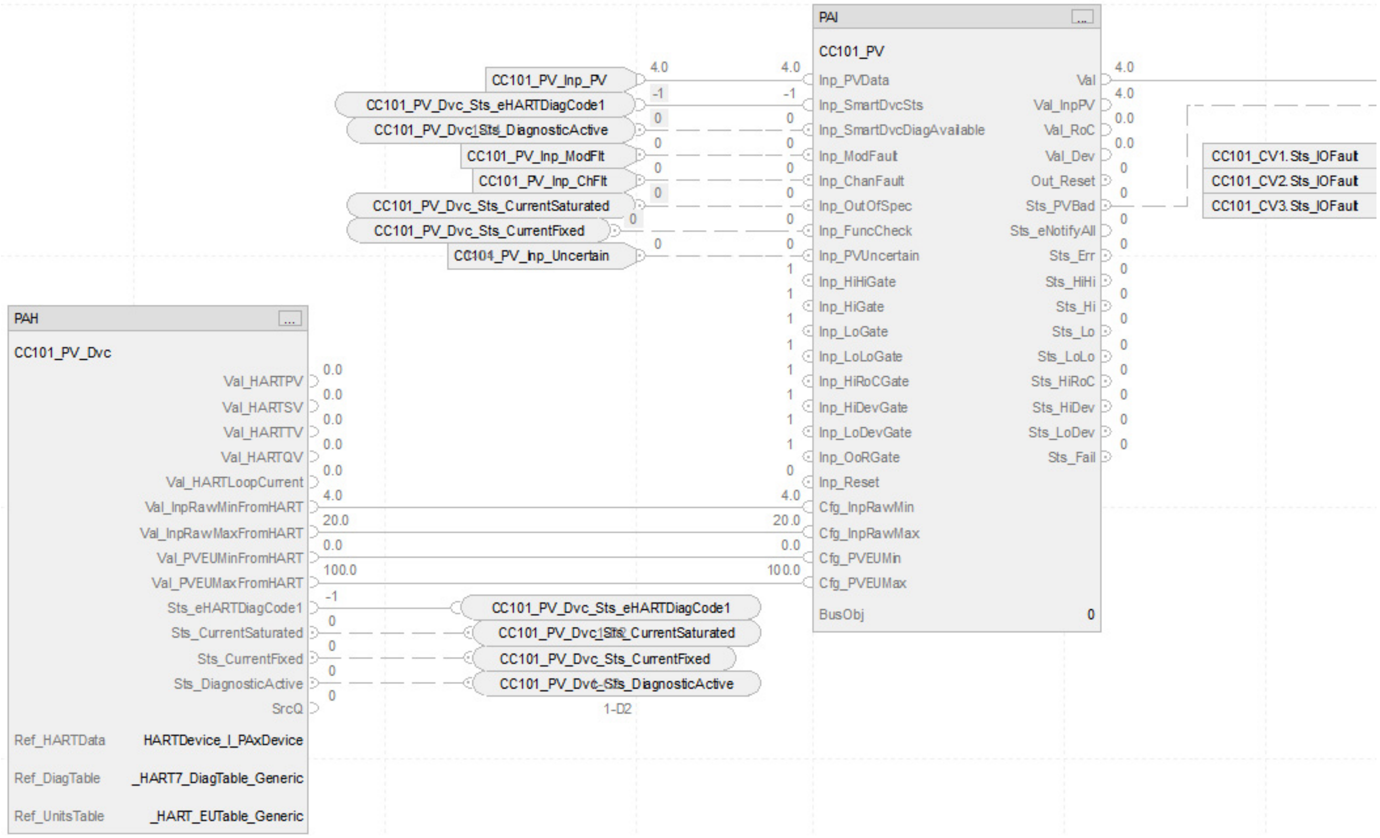
Parameter	Description
CC_100_CV1.Sts_IOFault	Control variable 1 fault input • If CV1EU controls an analog output, then CV1Fault will normally come from the analog output's fault status. • If CV1Fault is TRUE, it indicates an error on the output module, set bit in Status.
CC_100_CV2.Sts_IOFault	Control variable 2 fault input • If CV2EU controls an analog output, then CV2Fault will normally come from the analog output's fault status. • If CV2Fault is TRUE, it indicates an error on the output module, set bit in Status.
CC_100_CV3.Sts_IOFault	Control variable 3 fault input • If CV3EU controls an analog output, then CV3Fault will normally come from the analog output's fault status. • If CV3Fault is TRUE, it indicates an error on the output module, set bit in Status.

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

CC Configuration Considerations

Operand	Type	Description
CC tag	COORDINATED_CONTROL	Instance of data structure (backing tag) required for proper operation of instruction.

CS_CC_HART Sheet

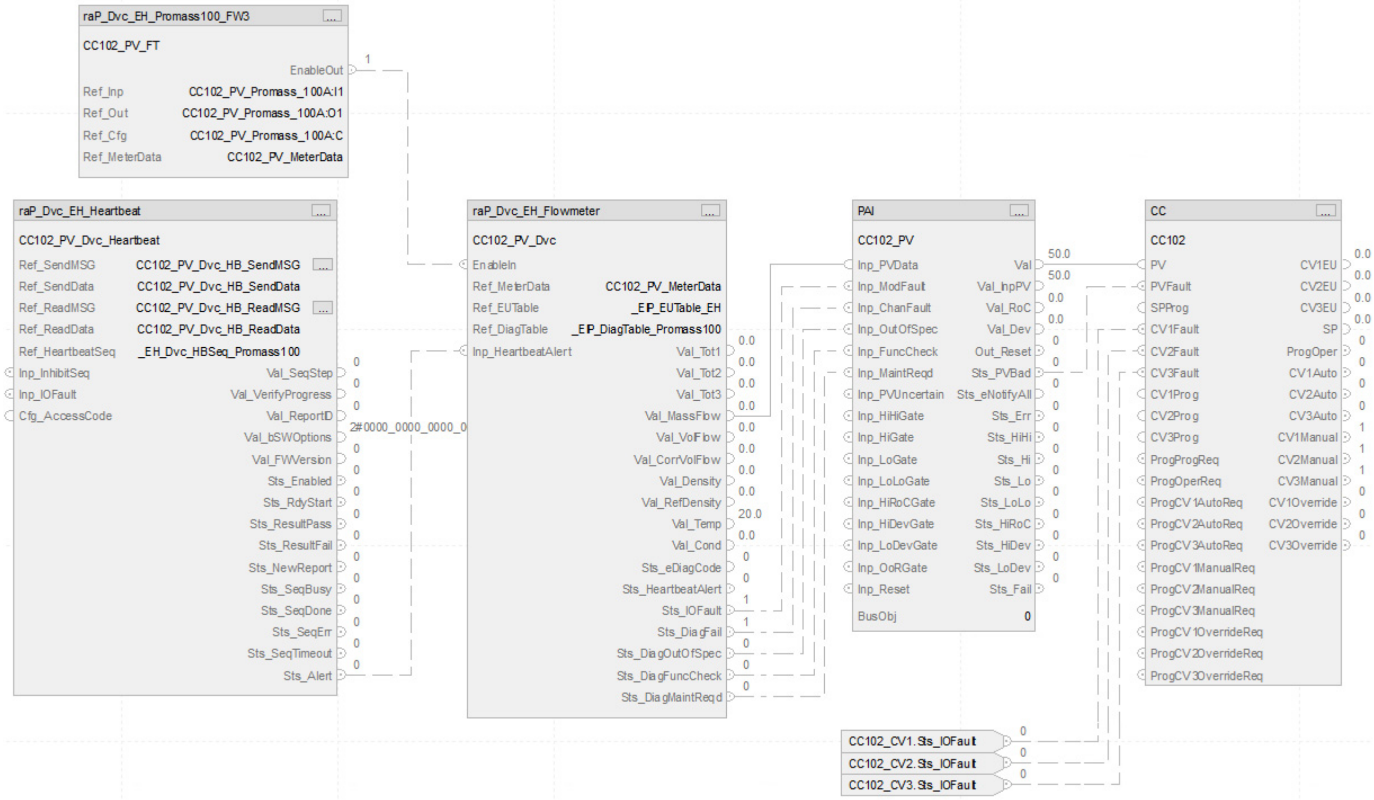


The CS_CC_Hart control strategy operates the same as the CS_CC control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute CC101 for XT100

For more information, see HART Integration on page 31.

CS_CC_EtherNetIP Sheet

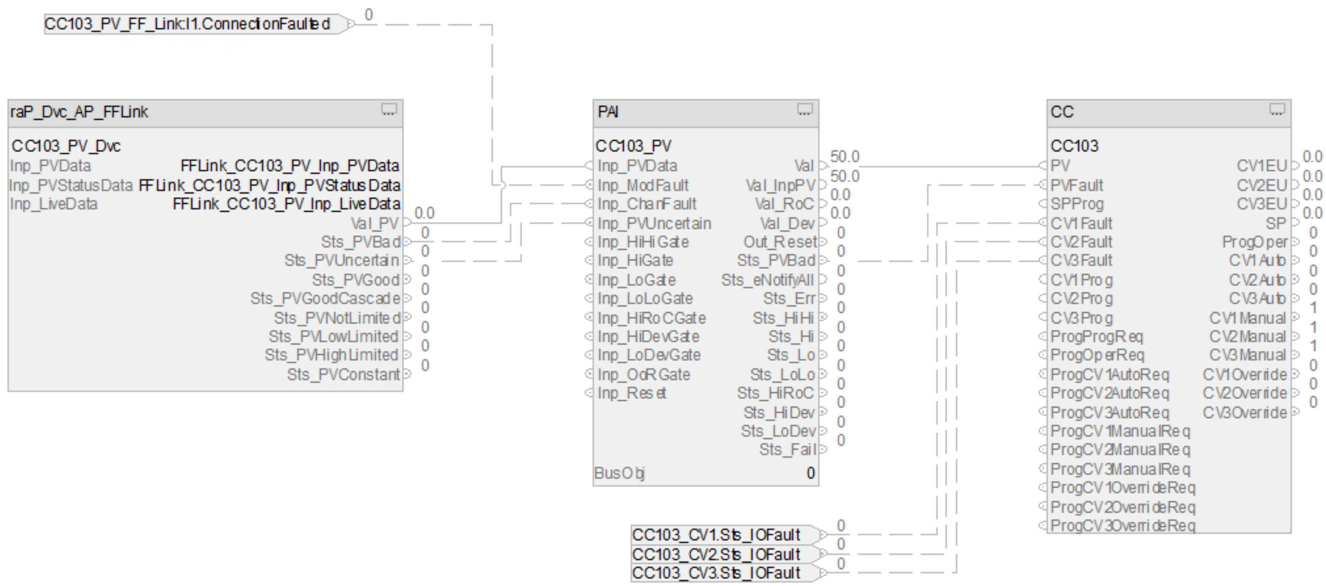


The CS_CC_EtherNetIP control strategy operates the same as the CS_CC control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute CC102 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_CC_FF Sheet

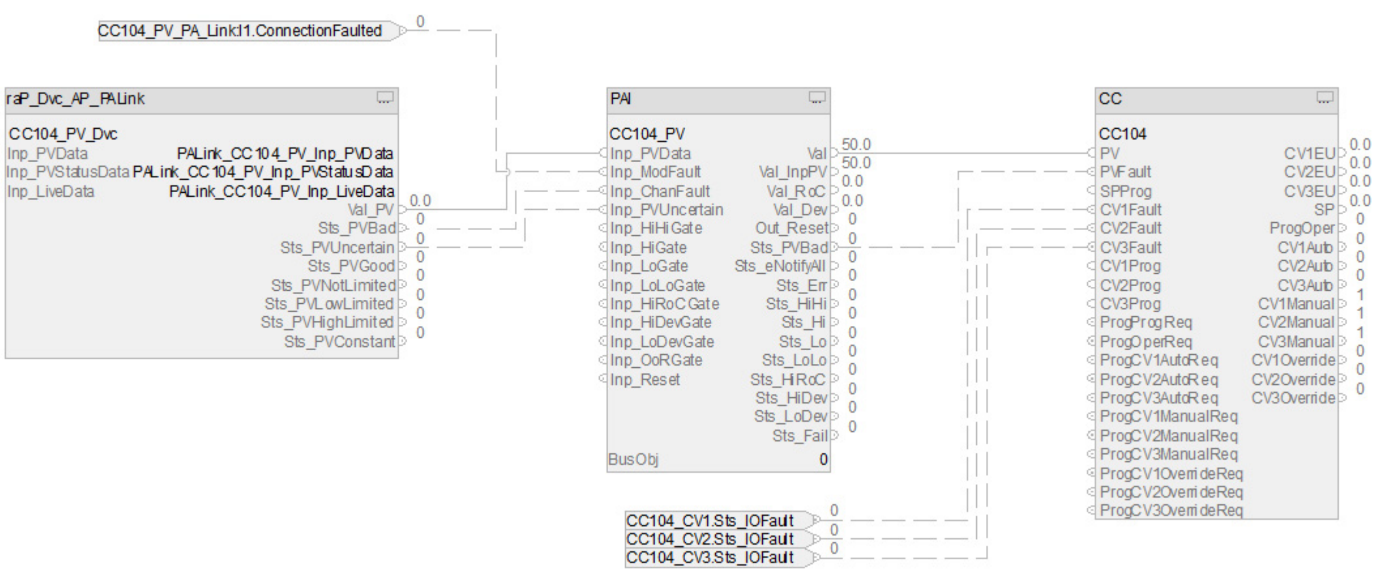


The CS_CC_FF control strategy operates the same as the CS_CC control strategy but relies on FOUNDATION Fieldbus input data.

- For information on FOUNDATION Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute CC103 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_CC_PA Sheet



The CS_CC_PA control strategy operates the same as the CS_CC control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute CC104 for XT100

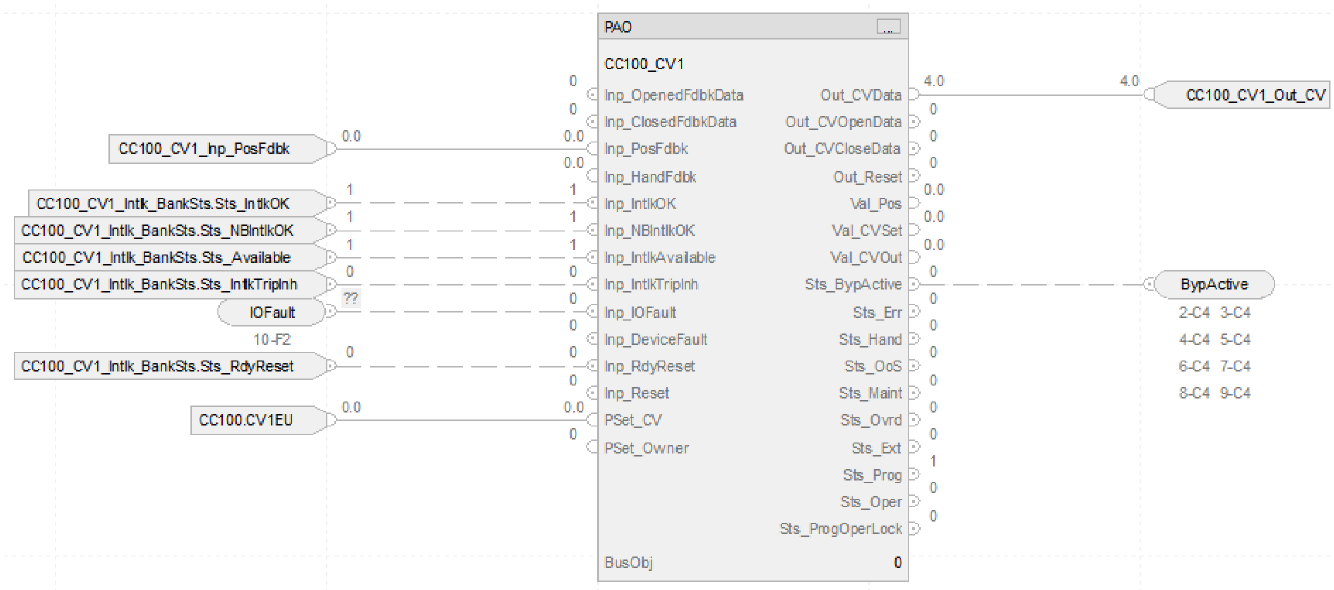
For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Control Variable Routines

This control variable routines include the PAO control strategy, with an additional input reference.

- For PAO configuration considerations, and input and output references, see CS_PAO Sheet on page 136.
- The routines also include these PAO input references:

Parameter	Description
CC100.CV1EU	Scaled control variable output for CV1. Scaled by using CV1EUMax and CV1EUMin, where CV1EUMax corresponds to 100% and CV1EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV1EU = (CV1 * CV1EUSpan / 100) + CV1EUMin CV1EU span calculation: CV1EUSpan = (CV1EUMax - CV1EUMin)
CC100.CV2EU	Scaled control variable output for CV2. Scaled by using CV2EUMax and CV2EUMin, where CV2EUMax corresponds to 100% and CV2EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV2EU = (CV2 * CV2EUSpan / 100) + CV2EUMin CV2EU span calculation: CV2EUSpan = (CV2EUMax - CV2EUMin)
CC100.CV3EU	Scaled control variable output for CV3. Scaled by using CV3EUMax and CV3EUMin, where CV3EUMax corresponds to 100% and CV3EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV3EU = (CV3 * CV3EUSpan / 100) + CV3EUMin CV3EU span calculation: CV3EUSpan = (CV3EUMax - CV3EUMin)



Notes:

Internal Model Control (IMC) Control Strategies

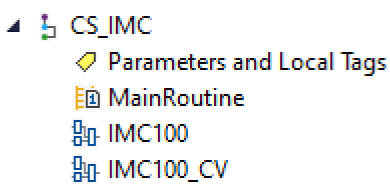
Use the IMC control strategy to control a single process variable by manipulating a single control-variable output. This control strategy performs an algorithm where the actual error signal is compared against that of an internal first-order lag plus deadtime model of the process. The IMC instruction calculates the control variable output (CV) in the Auto mode based on the PV - SP deviation, internal model, and tuning. IMC is a model-based instructions that is more effective than PID control for processes with long deadtimes.

The following IMC control strategies are available as routines in the process library:

- CS_IMC
- CS_IMC_HART
- CS_IMC_EtherNetIP
- CS_IMC_FF
- CS_IMC_PA

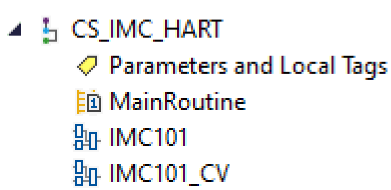
The IMC control strategy is available as two routines in the process library:

Routine	Description
IMC100	Internal Model Control instruction.
IMC100_CV1	Control variable routine.



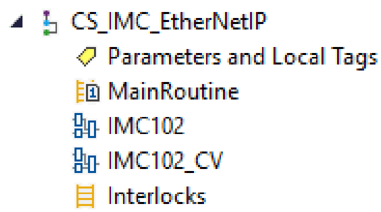
The IMC HART control strategy is available as two routines in the process library:

Routine	Description
IMC101	Internal Model Control instruction with HART input.
IMC101_CV1	Control variable routine.



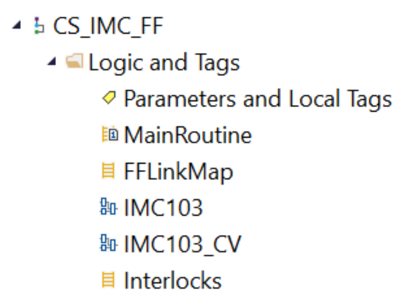
The IMC EtherNetIP control strategy is available as two routines in the process library:

Routine	Description
IMC102	Internal Model Control instruction with EtherNetIP input.
IMC102_CV	Control variable routine.



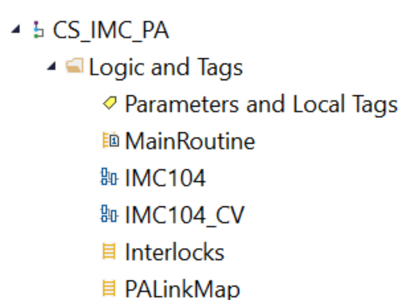
The IMC FOUNDATION Fieldbus control strategy is available as two routines in the process library:

Routine	Description
IMC103	Internal Model Control instruction with FOUNDATION Fieldbus input.
IMC103_CV	Control variable routine.



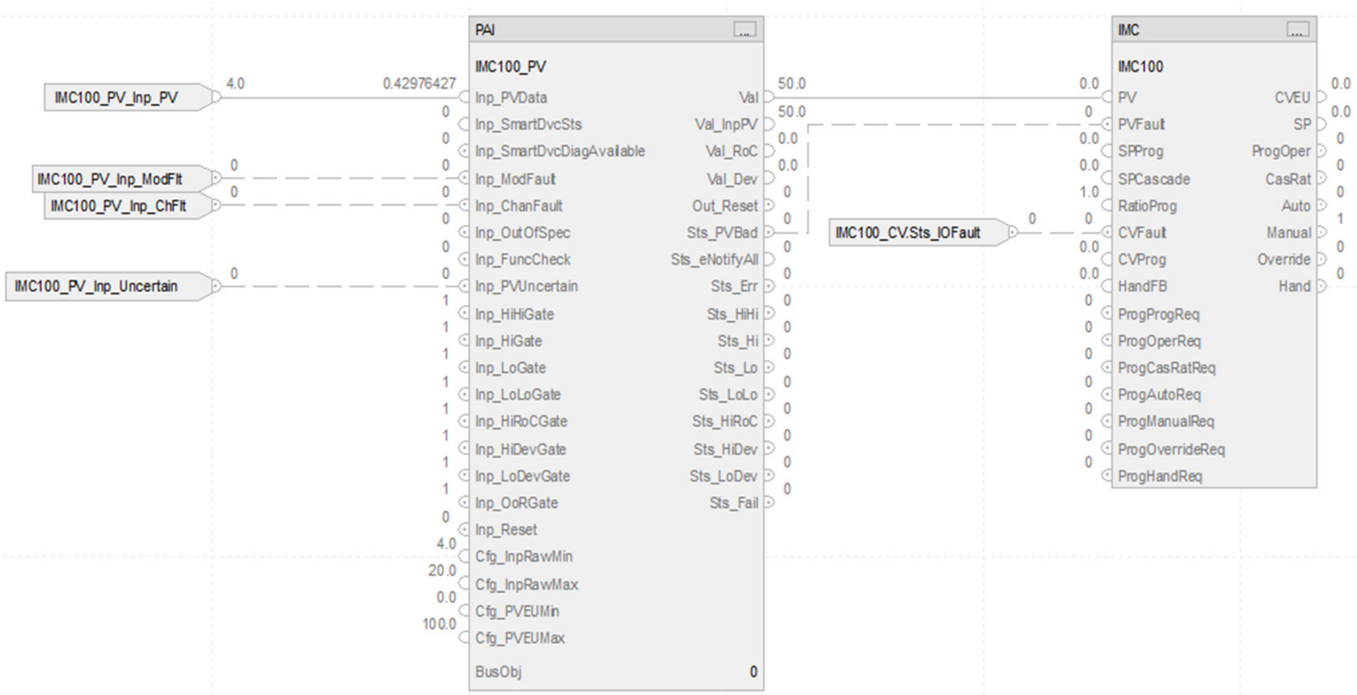
The IMC Profibus PA control strategy is available as two routines in the process library:

Routine	Description
IMC104	Internal Model Control instruction with Profibus PA input.
IMC104_CV	Control variable routine.



Import the appropriate control strategy as a **program** in your controller project.

CS_IMC Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute IMC100 for XT101

PAI Outputs to IMC Inputs

Parameter	Description
Val	Value for PV parameter Process Variable (PVEU) Source: Analog input channel or upstream REAL tag that represents position feedback
Sts_PVBad	Quality of PV value 1 = PV quality is flagged as Bad

IMC Input Reference

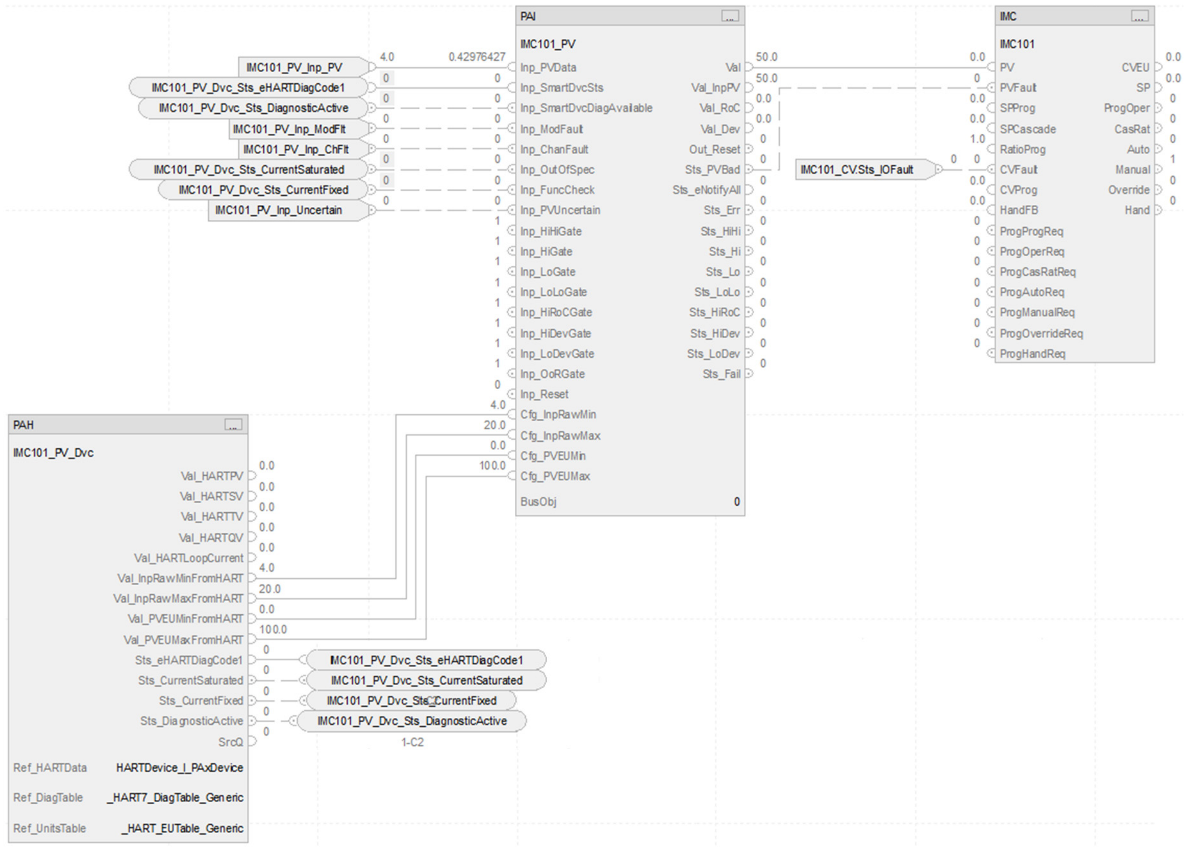
Parameter	Description
IMC_100_CV.Sts_IOFault	Control variable fault input • If CVEU controls an analog output, then CVFault normally comes from the analog output's fault status. • If CVFault is TRUE, it indicates an error on the output module, set bit in Status.

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

IMC Configuration Considerations

Operand	Type	Description
IMC tag	Internal Model Control	Instance of data structure (backing tag) required for proper operation of instruction

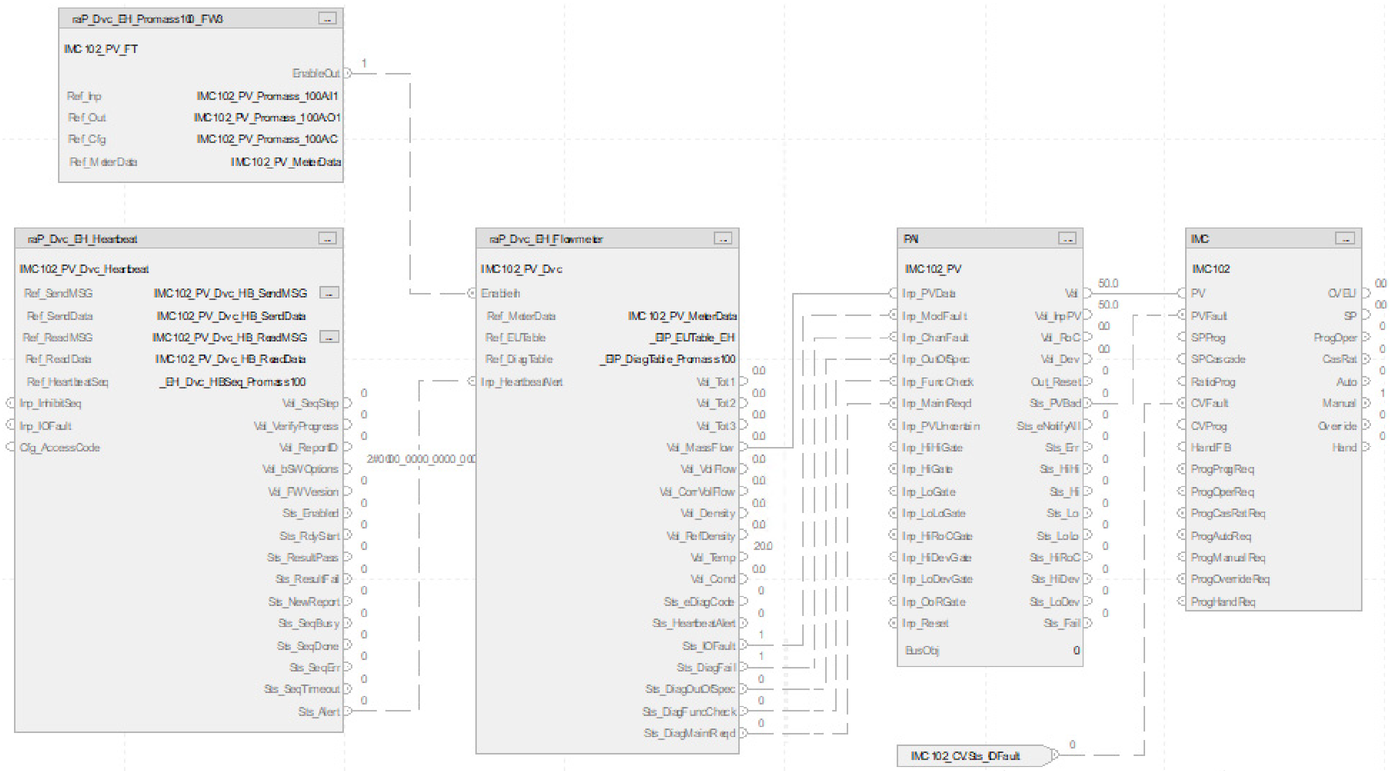
CS_IMC_HART Sheet



The CS_IMC_Hart control strategy operates the same as the CS_IMC control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111. Substitute IMC101 for XT100.
- For more information, see HART Integration on page 31.

CS_IMC_EtherNetIP Sheet

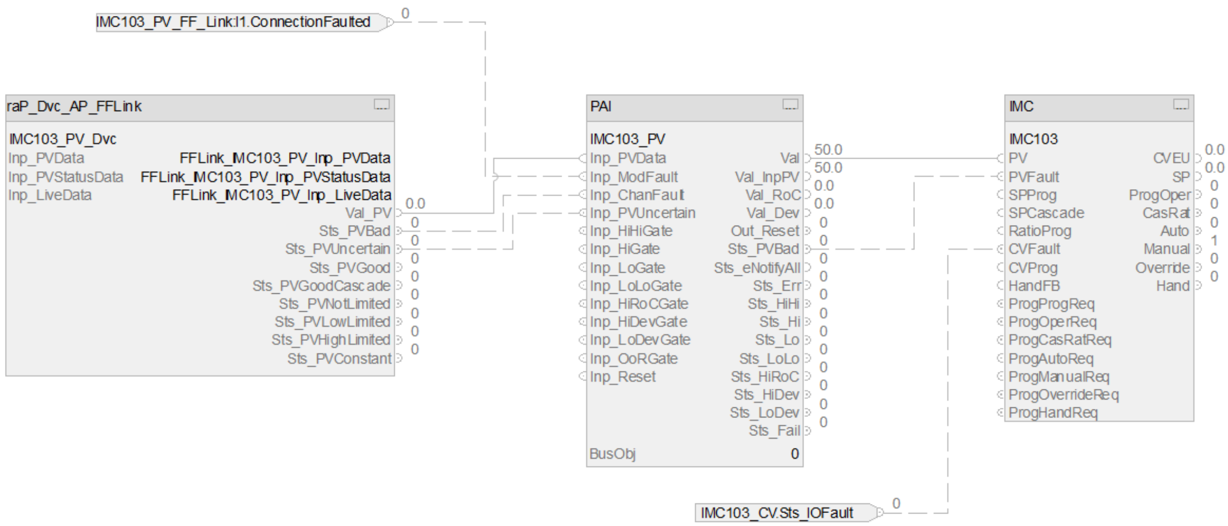


The CS_IMC_EtherNetIP control strategy operates the same as the CS_IMC control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute IMC102 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_IMC_FF Sheet



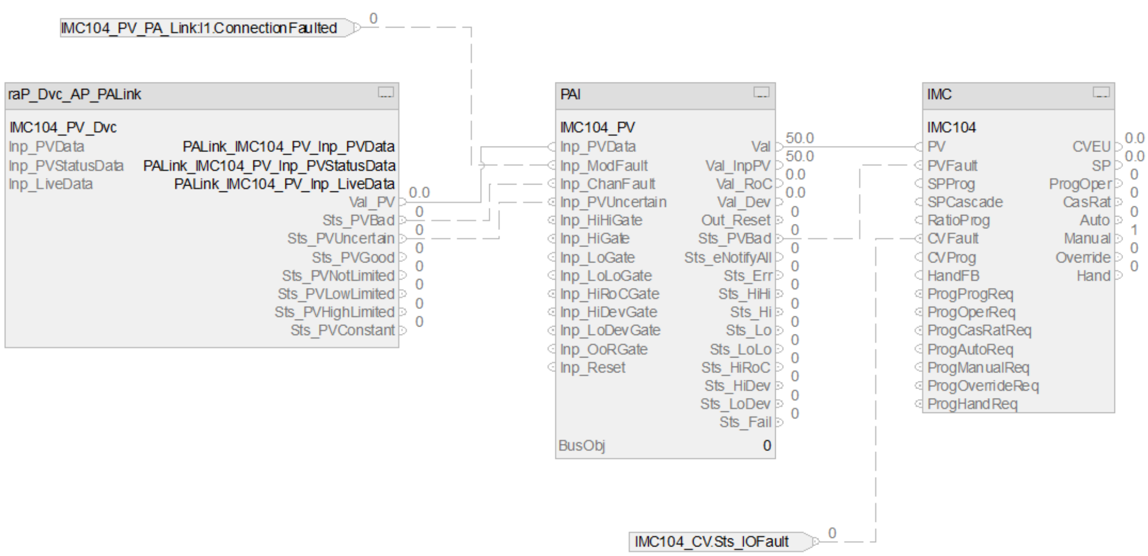
The CS_IMC_FOUNDATION Fieldbus control strategy operates the same as the CS_IMC control strategy but relies on FOUNDATION Fieldbus input data.

For information on FOUNDATION Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.

- Substitute IMC103 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_IMC_PA Sheet



The CS_IMC_PA control strategy operates the same as the CS_IMC control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute IMC104 for XT100

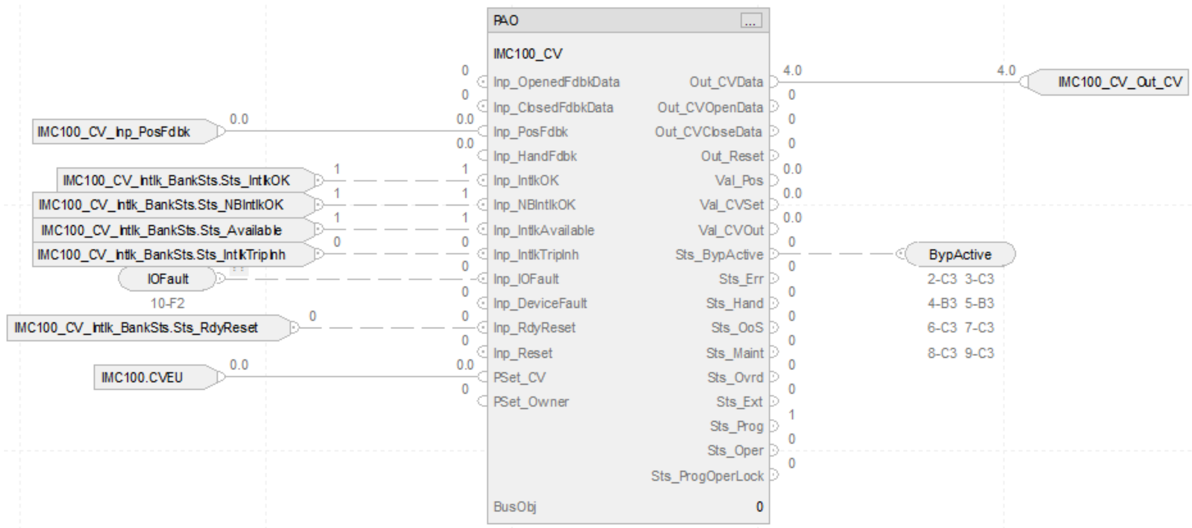
For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Control Variable Routines

This control variable routines include the PAO control strategy, with an additional input reference.

- For PAO configuration considerations, and input and output references, see CS_PAO Sheet on page 136 for details.
- The routine also includes this PAO input reference:

Parameter	Description
IMC100.CVEU	Scaled control variable output for CV1. Scaled by using CV1EUMax and CV1EUMin, where CV1EUMax corresponds to 100% and CV1EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV1EU = (CV1 * CV1EUSpan / 100) + CV1EUMin CV1EU span calculation: CV1EUSpan = (CV1EUMax - CV1EUMin)



Notes:

Modular Multivariable Control (MMC) Control Strategies

Use the MMC control strategy to control two process variables to their setpoints using as many as three control variables. The MMC instruction calculates the control variables (CV1, CV2, and CV3) in the auto mode based on the PV1 -SP1, PV2 - SP2 deviation, internal model, and tuning.

The MMC controller is a model-based instruction, where you can configure as many as six models to relate the output of each CV to the two PVs. Each model is a first order plus delay (FOPD) response, which is more effective than PID controllers at controlling processes with long deadtimes. The MMC control strategy coordinates the actions of the CVs to limit interactions among the CVs and control the 2 PVs to their respective setpoints.

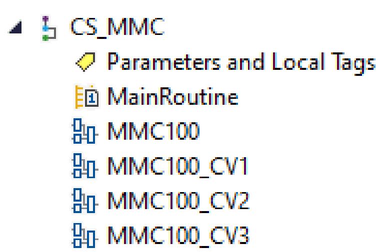
The following MMC control strategies are available as routines in the process library:

- CS_MMC
- CS_MMC_HART
- CS_MMC_EtherNetIP
- CS_MMC_FF
- CS_MMC_PA

Import the appropriate control strategy as a **program** in your controller project.

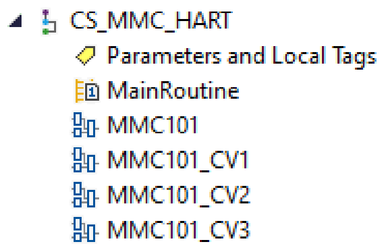
The MMC control strategy is available as four routines in the process library:

Routine	Description
MMC100	Modular Multivariable Control instruction.
MMC100_CV1 MMC100_CV2 MMC100_CV3	Control variable routines.



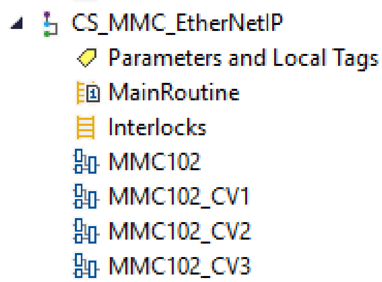
The MMC HART control strategy is available as four routines in the process library:

Routine	Description
MMC101	Modular Multivariable Control instruction with HART input in the CC101 routine.
MMC101_CV1 MMC101_CV2 MMC101_CV3	Control variable routines.



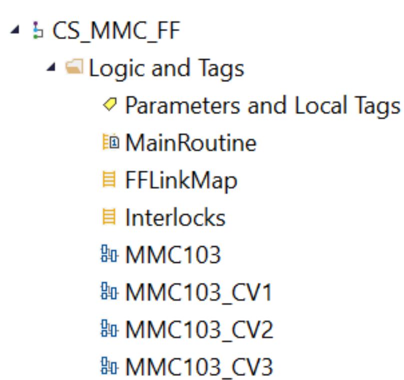
The MMC EtherNetIP control strategy is available as four routines in the process library:

Routine	Description
MMC102	Modular Multivariable Control instruction.
MMC102_CV1 MMC102_CV2 MMC102_CV3	Control variable routines.



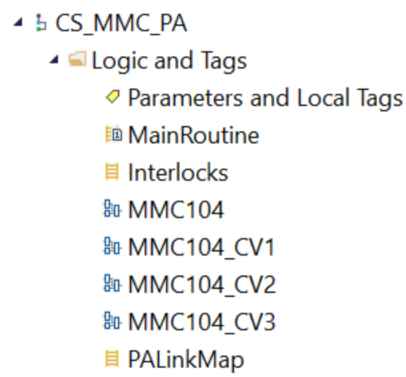
The MMC FOUNDATION Fieldbus control strategy is available as four routines in the process library:

Routine	Description
MMC103	Modular Multivariable Control instruction.
MMC103_CV1 MMC103_CV2 MMC103_CV3	Control variable routines.

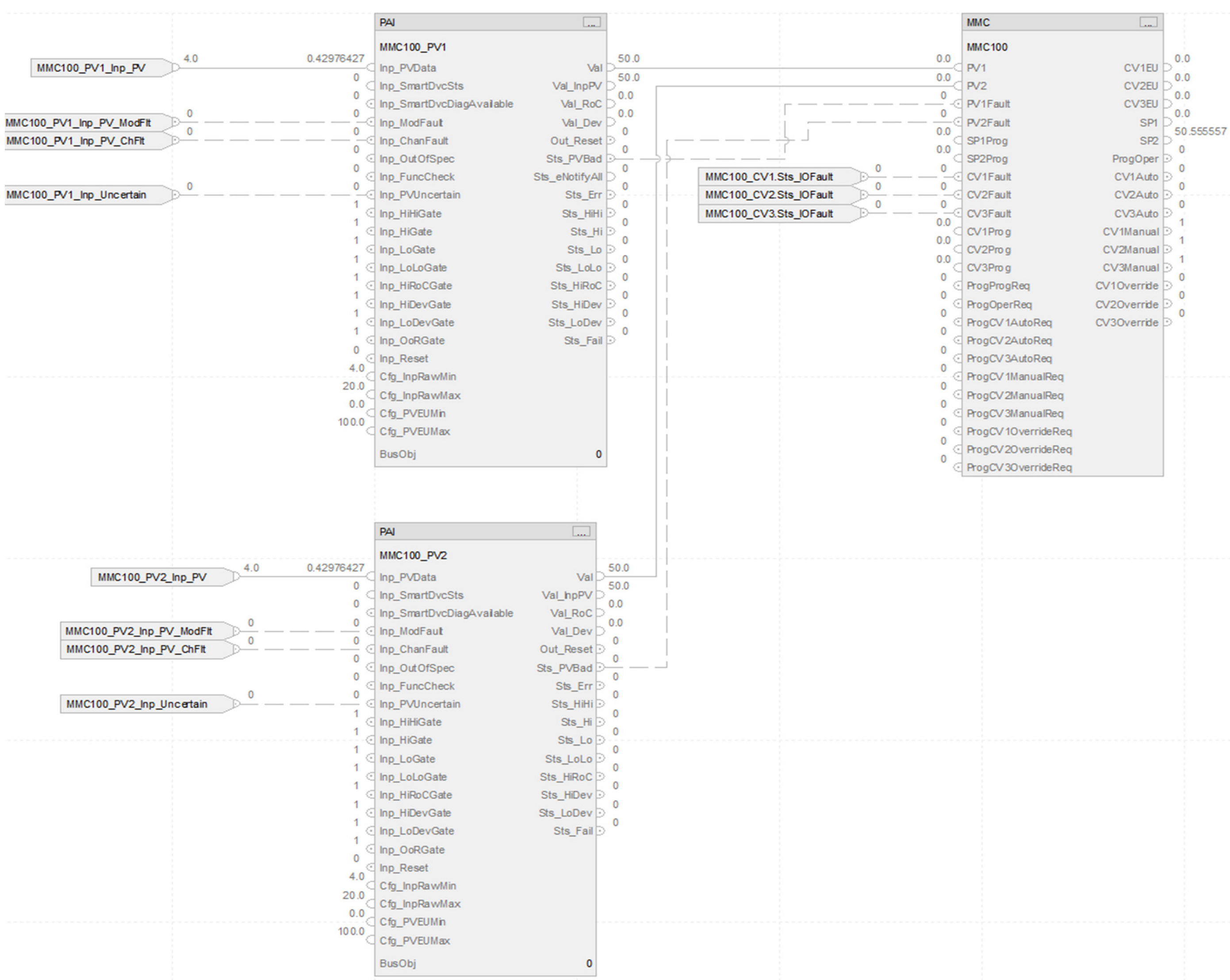


The MMC Profibus PA control strategy is available as four routines in the process library:

Routine	Description
MMC104	Modular Multivariable Control instruction.
MMC104_CV1 MMC104_CV2 MMC104_CV3	Control variable routines.



CS_MMC Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute MMC100_PV1 for the first instance of XT101
- Substitute MMC100_PV2 for the second instance of XT101

PAI Outputs to MMC Inputs

One instance for PV1 and a second instance for PV2.

Parameter	Description
Val	Value for PV parameter Process Variable (PVEU) Source: Analog input channel or upstream REAL tag that represents position feedback
Sts_PVBad	Quality of PV value 1 = PV quality is flagged as Bad

MMC Input References

Parameter	Description
MMC_100_CV1.Sts_IOFault	Control variable 1 fault input If CV1EU controls an analog output, then CV1Fault normally comes from the analog output's fault status. If CV1Fault is TRUE, it indicates an error on the output module, set bit in Status.
MMC_100_CV2.Sts_IOFault	Control variable 2 fault input If CV2EU controls an analog output, then CV2Fault normally comes from the analog output's fault status. If CV2Fault is TRUE, it indicates an error on the output module, set bit in Status.
MMC_100_CV3.Sts_IOFault	Control variable 3 fault input If CV3EU controls an analog output, then CV3Fault normally comes from the analog output's fault status. If CV3Fault is TRUE, it indicates an error on the output module, set bit in Status.

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

MMC Configuration Considerations

Operand	Type	Description
MMC tag	MODULAR MULTIVARIABLE CONTROL	Instance of data structure (backing tag) required for proper operation of instruction

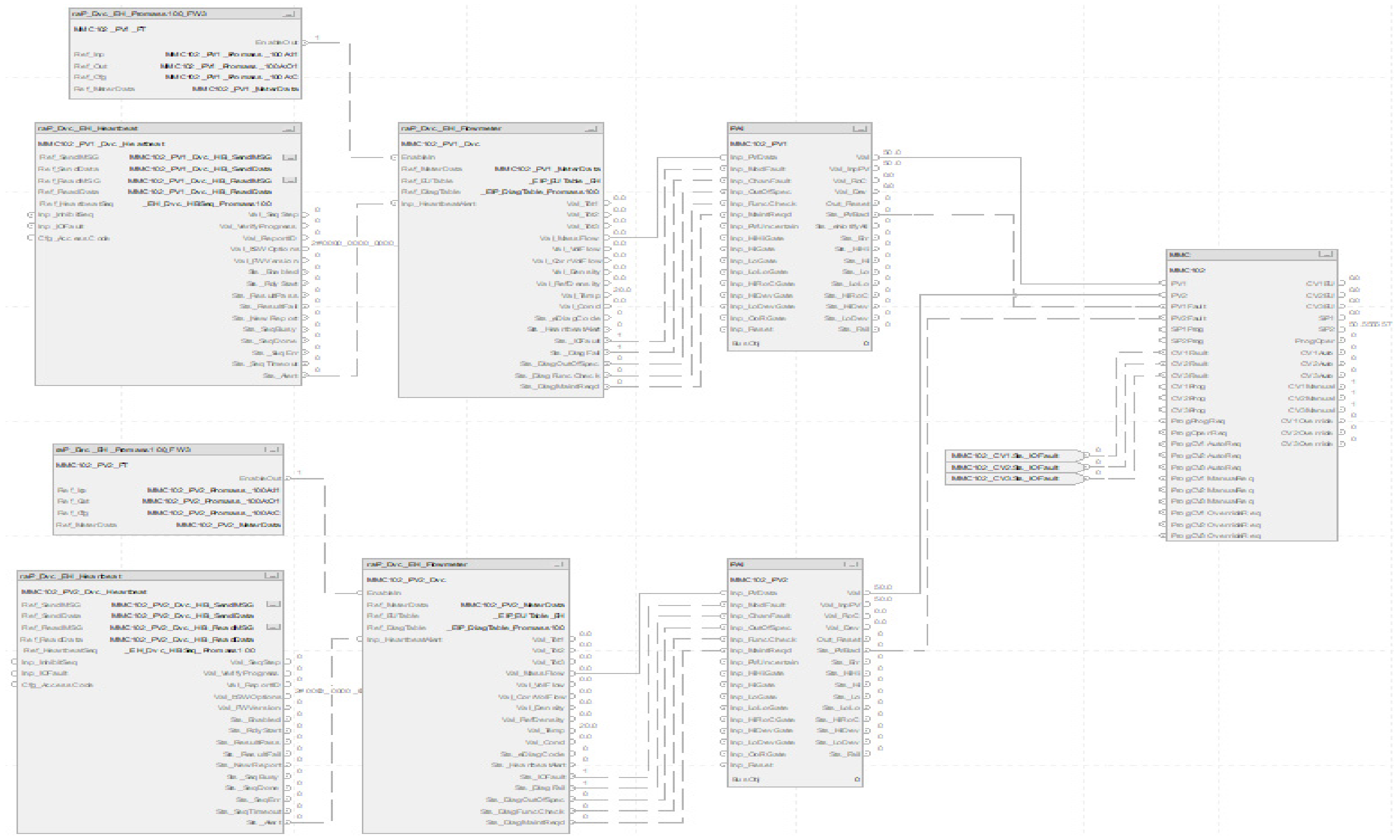
CS_MMC_HART Sheet

The CS_MMC_Hart control strategy operates the same as the CS_MMC control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
  - Substitute MMC101_PV1 for the first instance of XT100
  - Substitute MMC101_PV2 for the second instance of XT100

For more information, see HART Integration on page 31.

CS_MMC_EtherNetIP Sheet

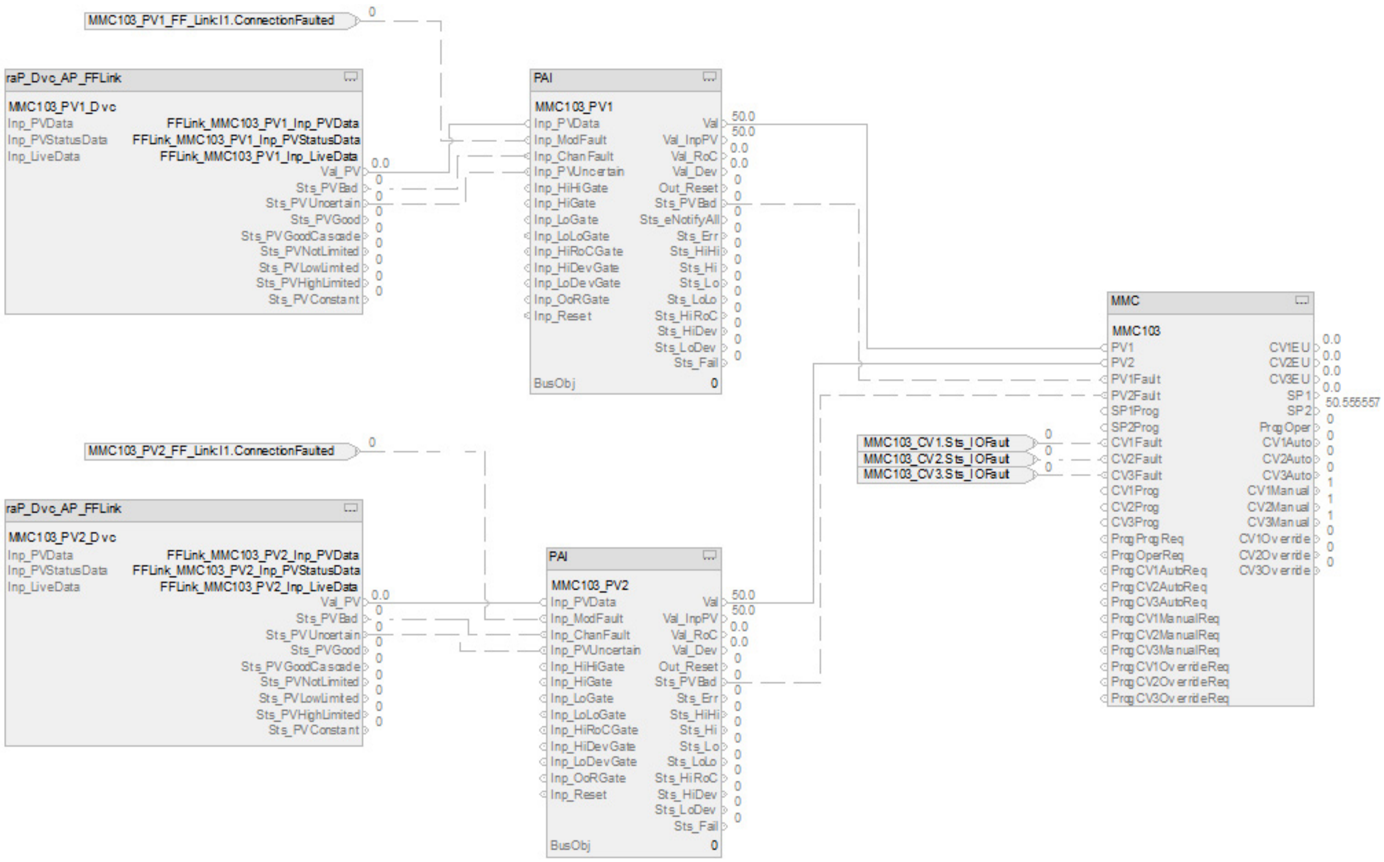


The CS_MMC_EtherNetIP control strategy operates the same as the CS_MMC control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
  - Substitute MMC102_PV1 for the first instance of XT100
  - Substitute MMC102_PV2 for the second instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_MMC_FF Sheet

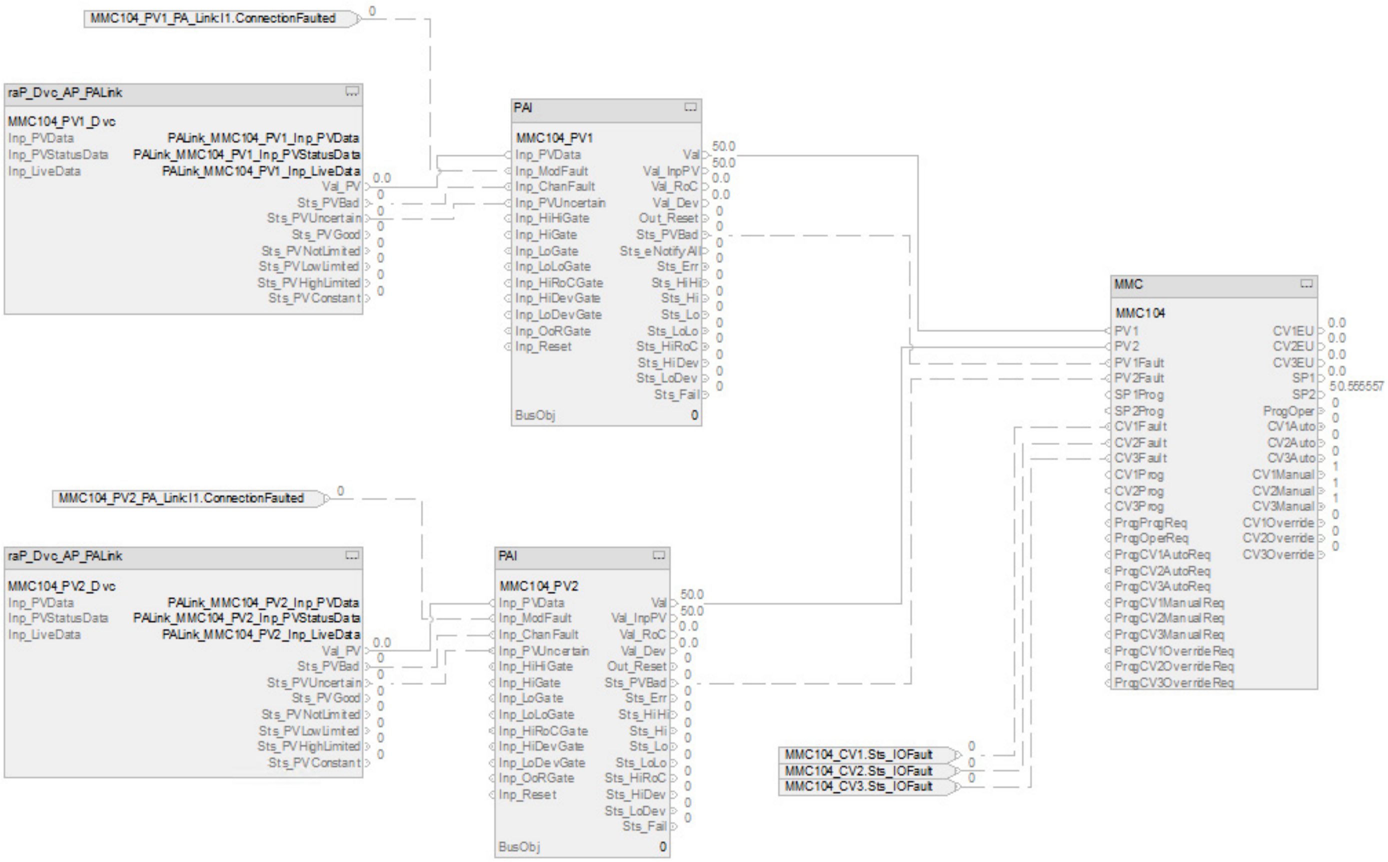


The CS_MMC_FF control strategy operates the same as the CS_MMC control strategy but relies on FOUNDATION Fieldbus input data.

- For information on FOUNDATION Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
  - Substitute MMC103_PV1 for the first instance of XT100
  - Substitute MMC103_PV2 for the second instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_MMC_PA Sheet



The CS_MMC_PA control strategy operates the same as the CS_MMC control strategy but relies on PA data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
  - Substitute MMC104_PV1 for the first instance of XT100
  - Substitute MMC104_PV2 for the second instance of XT100

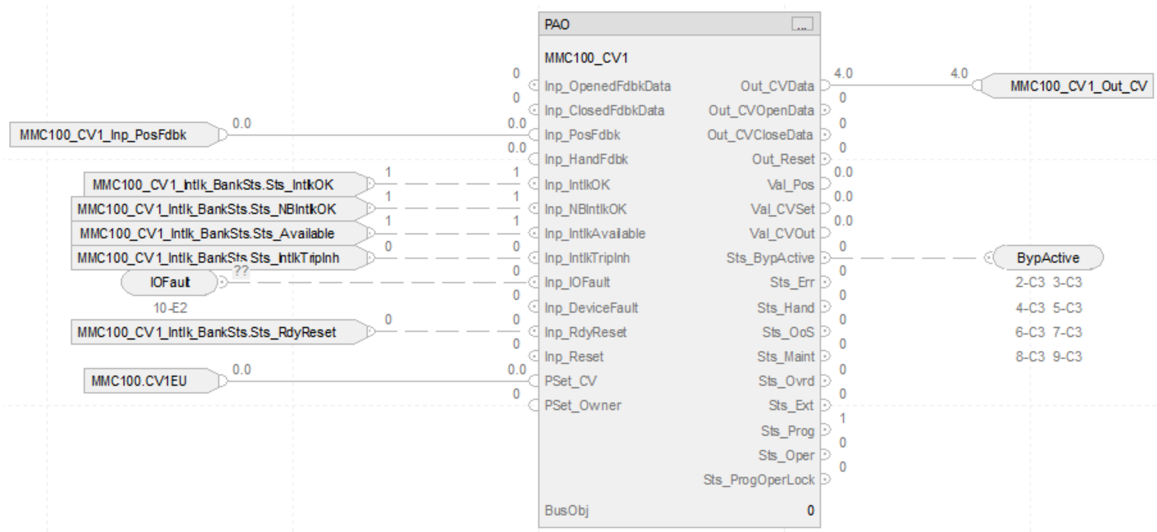
For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Control Variable Routines

This control variable routines include the PAO control strategy, with an additional input reference.

- For PAO configuration considerations, and input and output references, see CS_PAO Sheet on page 136.
- The routines also include these PAO input references:

Parameter	Description
MMC100.CV1EU	Scaled control variable output for CV1. Scaled by using CV1EUMax and CV1EUMin, where CV1EUMax corresponds to 100% and CV1EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV1EU = (CV1 * CV1EUSpan / 100) + CV1EUMin CV1EU span calculation: CV1EUSpan = (CV1EUMax - CV1EUMin)
MMC100.CV2EU	Scaled control variable output for CV2. Scaled by using CV2EUMax and CV2EUMin, where CV2EUMax corresponds to 100% and CV2EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV2EU = (CV2 * CV2EUSpan / 100) + CV2EUMin CV2EU span calculation: CV2EUSpan = (CV2EUMax - CV2EUMin)
MMC100.CV3EU	Scaled control variable output for CV3. Scaled by using CV3EUMax and CV3EUMin, where CV3EUMax corresponds to 100% and CV3EUMin corresponds to 0%. This output is typically used to control an analog output module or a secondary loop. CV3EU = (CV3 * CV3EUSpan / 100) + CV3EUMin CV3EU span calculation: CV3EUSpan = (CV3EUMax - CV3EUMin)



Notes:

Chapter 9

Process Analog Input (PAI) Control Strategies

Use a PAI control strategy to monitor an analog input and check for alarm conditions. The PAI control strategy that is included with the library download processes a signal from a channel of an analog input module, but it can be used to process any analog (REAL) signal.

The following PAI control strategies are available as routines in the process library:

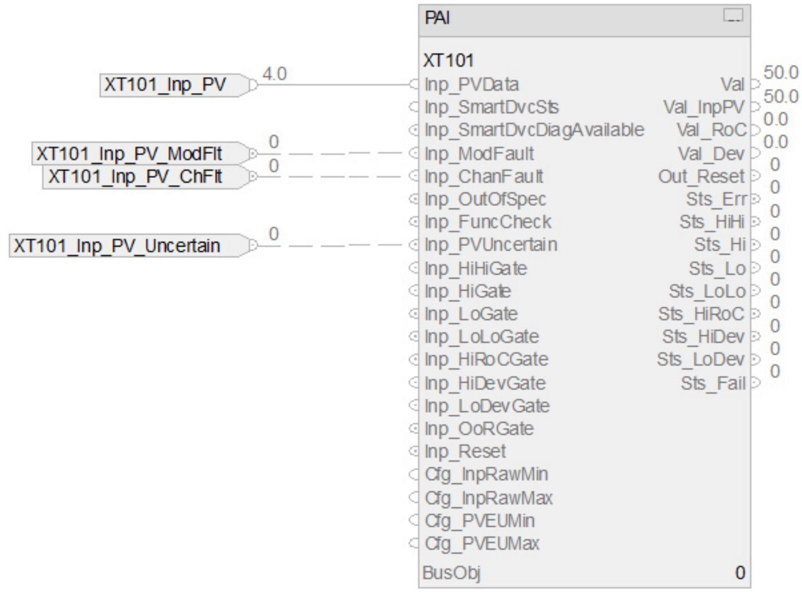
- CS_PAI
- CS_PAI_HART
- CS_PAI_EtherNetIP
- CS_PAI_EtherNetIP_NoHB
- CS_PAI_EtherNetIP_Sensor
- CS_PAI_FF
- CS_PAI_PA

Import the appropriate control strategy as a **routine** in your controller project.

Each PAI control strategy contains one Function Block sheet:

Sheet	Description
CS_PAI	Process Analog Input instruction
CS_PAI_HART	Process Analog Input instruction with HART input
CS_PAI_EtherNetIP	Process Analog Input instruction with EtherNetIP input
CS_PAI_EtherNetIP_NoHB	Process Analog Input instruction with No HB EtherNetIP input
CS_PAI_EtherNetIP_Sensor	Process Analog Input instruction with EtherNetIP Sensor input
CS_PAI_FF	Process Analog Input instruction with FOUNDATION Fieldbus input
CS_PAI_PA	Process Analog Input instruction with PA input

CS_PAI Sheet



PAI Input References

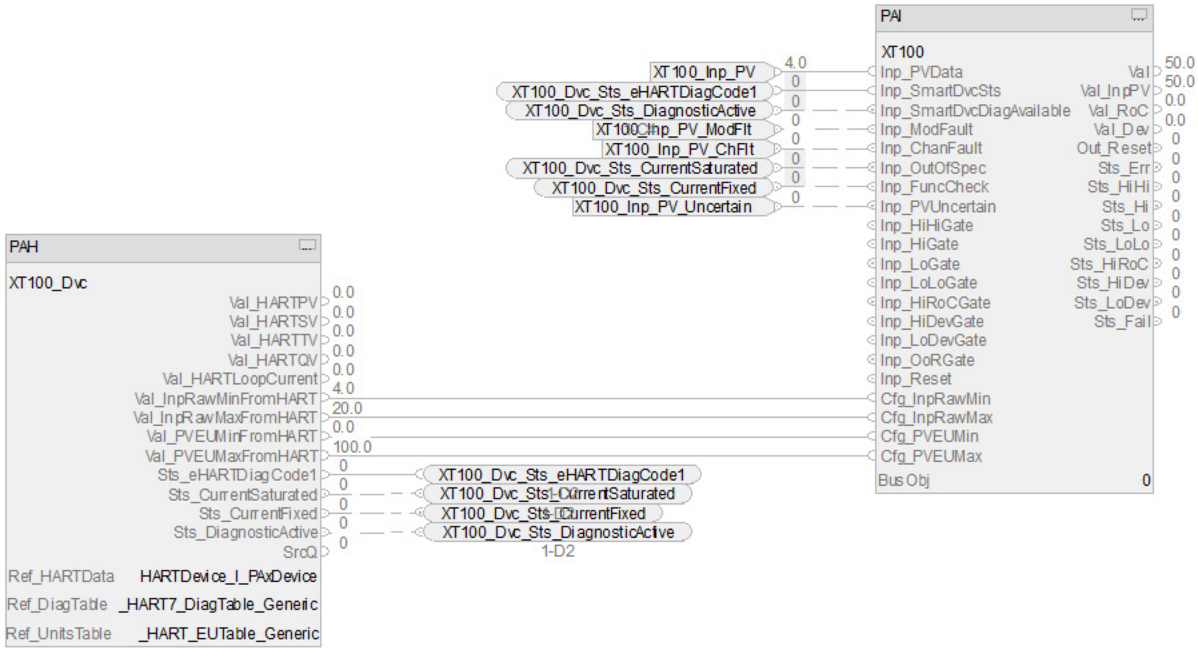
Input	Description
XT101_Inp_PVData	Process variable input Source: sensor or input
XT101_Inp_ModFault	Process variable input module fault 1 = I/O module failure or module communication status bad 0 = OK
XT101_Inp_ChanFault	Process variable input channel fault 1 = I/O channel fault or failure 0 = OK
XT101_Inp_PVUncertain	Process variable input uncertain Indicates the channel data accuracy is undetermined 1 = The channel data is uncertain This input sets Sts_PVUncertain if not in Virtual

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

PAI Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_ANALOG_INPUT	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PAI_HART Sheet



The CS_PAI_HART control strategy operates the same as the CS_PAI control strategy but relies on HART input data. Substitute XT100 for XT101.

PAH Outputs to PAI Inputs

Output	Description
Val_InpRawMinFromHART	Analog input unscaled signal minimum from HART module (in module units).
Val_InpRawMaxFromHART	Analog input unscaled signal maximum from HART module (in module units).
Val_PVEUMinFromHART	Analog input scaled range minimum from HART device (in engineering units).
Val_PVEUMaxFromHART	Analog input scaled range maximum from HART device (in engineering units).

PAH Status Outputs

Output	Description
Sts_eHARTDiagCode1	HART Diagnostic Code #1 (bit number in command 48, 255 = none)
Sts_CurrentSaturated	HART reports analog current is limited
Sts_CurrentFixed	Loop Current set to fixed value via HART command
Sts_DiagnosticsActive	HART data input diagnostic active

PAH Configuration Considerations

Operand	Type	Description
PlantPAx control	P_ANALOG_HART	Instance of data structure (backing tag) required for proper operation of instruction.
Ref_HARTData	PAX_HART_DEVICE:I:0	Required data type HART data from I/O module assembly Select the HART device in your Controller Organizer; the device must support the PAxDevice data type: IOTreeObject:I.PAxDevice
Ref_DiagTable	P_HART_CODE_DESC_STATUS[2]	Lookup table for diagnostic bit number (to message and status) Select the correct table for your HART device; see table below
Ref_UnitsTable	RAC_CODE_DESCRIPTION[2]	Lookup table for units of measure code (to units text) Select _HART_EUTable_Generic

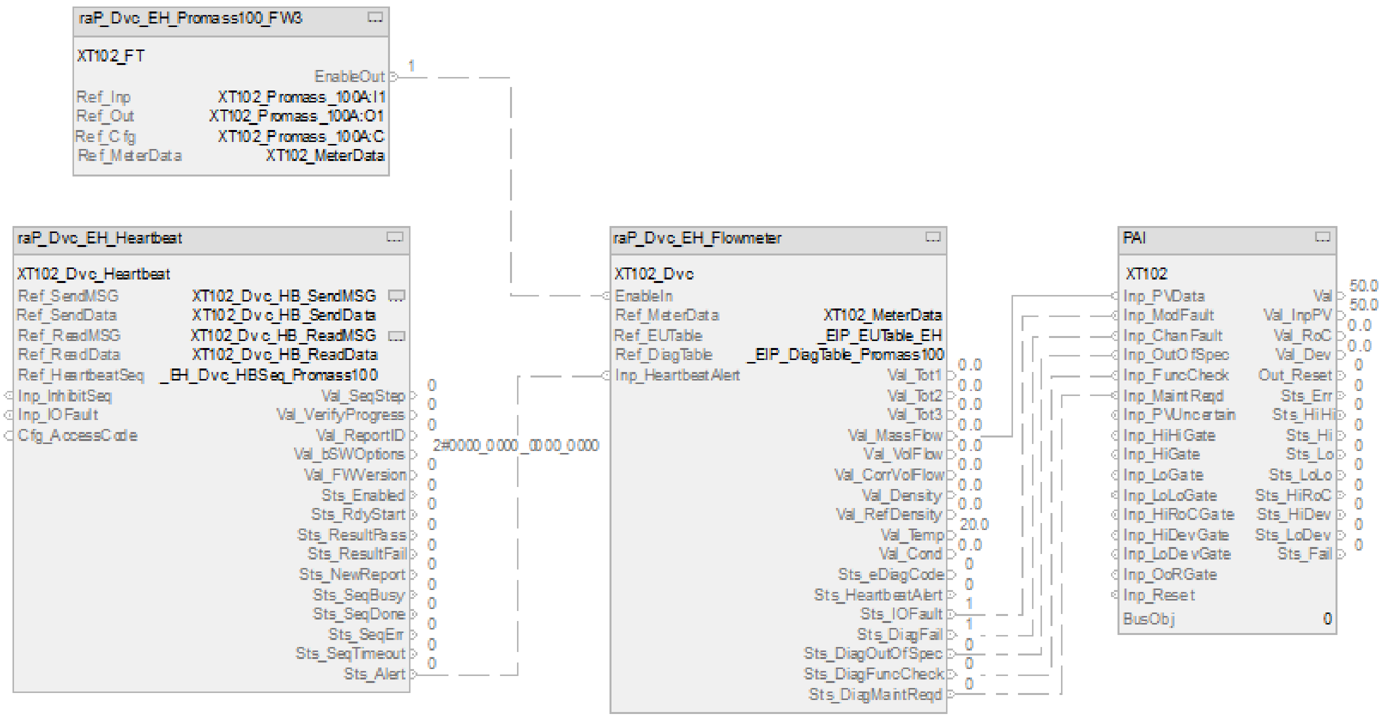
Available Diagnostic Tables

Diagnostic tables are available for these HART devices. The HART number indicates the version of the table.

Option	Description
_HART5_DiagTable_FMG_60	HART Cmd48 Diagnostic Lookup Table: E+H Gammapilot FMG 60
_HART5_DiagTable_Generic	HART Cmd48 Diagnostic Lookup Table: Generic HART5 device
_HART5_DiagTable_LevelflexM	HART Cmd48 Diagnostic Lookup Table: E+H Levelflex M
_HART5_DiagTable_MicropilotM	HART Cmd48 Diagnostic Lookup Table: E+H Micropilot M
_HART5_DiagTable_ProsonicM	HART Cmd48 Diagnostic Lookup Table: E+H Prosonic M
_HART5_DiagTable_ProsonicS	HART Cmd48 Diagnostic Lookup Table: E+H Prosonic S
_HART5_DiagTable_Prowirl73	HART Cmd48 Diagnostic Lookup Table: E+H Prowirl 73
_HART5_DiagTable_TMass65I	HART Cmd48 Diagnostic Lookup Table: E+H TMass 65I
_HART5_DiagTable_TMT162	HART Cmd48 Diagnostic Lookup Table: E+H TMT 162
_HART5_DiagTable_TMT182	HART Cmd48 Diagnostic Lookup Table: E+H TMT182 Temperature
_HART6_DiagTable_Pressure_M	HART Cmd48 Diagnostic Lookup Table: E+H Cerabar, Deltabar, Deltapilot M
_HART7_DiagTable_GammapilotFMG5x_rev1	HART Cmd48 Diagnostic Lookup Table: E+H Gammapilot FMG5x rev 1.x
_HART7_DiagTable_Generic	HART Cmd48 Diagnostic Lookup Table: Generic HART7 device
_HART7_DiagTable_LevelflexFMP5x	HART Cmd48 Diagnostic Lookup Table: E+H Levelflex FMP5x
_HART7_DiagTable_LiquilineCM44x	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline CM442 / 444 / 448
_HART7_DiagTable_LiquilineCM82_rev1	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline CM82 FW Rev. 1
_HART7_DiagTable_LiquilineM_Cond	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline M Conductivity
_HART7_DiagTable_LiquilineM_Cond_rev4	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline M Conductivity rev 4.x
_HART7_DiagTable_LiquilineM_Oxy_rev4	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline M Oxygen rev 4.x
_HART7_DiagTable_LiquilineM_Oxygen	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline M Oxygen
_HART7_DiagTable_LiquilineM_pH_rev4	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline M pH/ORP rev 4.x
_HART7_DiagTable_LiquilineM_pHORP	HART Cmd48 Diagnostic Lookup Table: E+H Liquiline M pH / ORP
_HART7_DiagTable_LiquistationCSFxx	HART Cmd48 Diagnostic Lookup Table: E+H Liquistation CSFxx
_HART7_DiagTable_Metso_ND7x_ND9x	HART Cmd48 Diagnostic Lookup Table: Metso ND7xxx and ND9xxx Positioners
_HART7_DiagTable_MicropilotFMR5x	HART Cmd48 Diagnostic Lookup Table: E+H Micropilot FMR5x
_HART7_DiagTable_MicropilotFMR6x	HART Cmd48 Diagnostic Lookup Table: E+H Micropilot FMR6x
_HART7_DiagTable_MicropilotFMR20	HART Cmd48 Diagnostic Lookup Table: E+H Micropilot FMR 20
_HART7_DiagTable_Pressure_S	HART Cmd48 Diagnostic Lookup Table: E+H Cerabar, Deltabar, Deltapilot S
_HART7_DiagTable_Promag53	HART Cmd48 Diagnostic Lookup Table: E+H Promag 53
_HART7_DiagTable_Promag100	HART Cmd48 Diagnostic Lookup Table: E+H Promag 100
_HART7_DiagTable_Promag200	HART Cmd48 Diagnostic Lookup Table: E+H Promag 200
_HART7_DiagTable_Promag300_500	HART Cmd48 Diagnostic Lookup Table: E+H Promag 300 and Promg 500
_HART7_DiagTable_Promag400	HART Cmd48 Diagnostic Lookup Table: E+H Promag 400
_HART7_DiagTable_Promag400_rev6	HART Cmd48 Diagnostic Lookup Table: E+H Promag 400 rev 6
_HART7_DiagTable_Promag400_rev9	HART Cmd48 Diagnostic Lookup Table: E+H Promag 400 rev 9
_HART7_DiagTable_Promass83	HART Cmd48 Diagnostic Lookup Table: E+H Promass 83
_HART7_DiagTable_Promass100	HART Cmd48 Diagnostic Lookup Table: E+H Promass 100
_HART7_DiagTable_Promass200	HART Cmd48 Diagnostic Lookup Table: E+H Promass 200
_HART7_DiagTable_Promass300_500	HART Cmd48 Diagnostic Lookup Table: E+H Promass 300 and Promass 500
_HART7_DiagTable_ProsonicFlow_100_rev1	HART Cmd48 Diagnostic Lookup Table: E+H Prosonic Flow 100 rev 1.x
_HART7_DiagTable_ProsonicFlow300_500rev1	HART Cmd48 Diagnostic Lookup Table: E+H Prosonic Flow 300 or 500 rev 1.x
_HART7_DiagTable_ProsonicFlowB200	HART Cmd48 Diagnostic Lookup Table: E+H Prosonic Flow B200
_HART7_DiagTable_Prowirl200	HART Cmd48 Diagnostic Lookup Table: E+H Prowirl
_HART7_DiagTable_TMT72_rev1	HART Cmd48 Diagnostic Lookup Table: E+H TMT72 rev 1
_HART7_DiagTable_TMT82	HART Cmd48 Diagnostic Lookup Table: E+H TMT82
_HART7_DiagTable_TMT162_rev4	HART Cmd48 Diagnostic Lookup Table: E+H TMT162 rev 4.x
_HART7_DiagTable_TrustSensTM37x_rev1	HART Cmd48 Diagnostic Lookup Table: E+H TrustSens TM37x rev 1.x

For more information, see HART Integration on page 31.

CS_PAI_EtherNetIP Sheet



The CS_PAI_EtherNetIP control strategy operates the same as the CS_PAI control strategy but relies on EtherNet/IP™ data. Substitute XT102 for XT101.

This control strategy uses the raP_Dvc_EH_Flowmeter instruction to integrate an Endress+Hauser flowmeter. The raP_Dvc_EH_Heartbeat heartbeat instruction provides the ability to initiate Heartbeat Verification from the operator faceplate. For more information, see EtherNet/IP Integration.

For more information on integrating E+H devices, see Endress+Hauser EtherNet/IP Instrumentation for PlantPAx DCS Reference Manual, PROCES-RM212A.

raP_Dvc_EH_Flowmeter Outputs to PAI Inputs

Output	Description
EnableOut	Enable Output - System Defined Parameter
Val_MassFlow	Mass flow rate value (Mass flow EU)

raP_Dvc_EH_Flowmeter Status Outputs

Output	Description
Sts_IOFault	I/O communication with the flowmeter is faulted
Sts_DiagFail	Diagnostic indicates device failure
Sts_DiagOutOfSpec	Diagnostic indicates device operating outside of specified accuracy
Sts_DiagFuncCheck	Diagnostic indicates device operating with substitute value
Sts_DiagMaintReqd	Diagnostic indicates device requires maintenance

raP_Dvc_EH_Flowmeter Configuration Considerations

Operand	Type	Description
PlantPAx control	raP_Dvc_EH_Flowmeter	Instance of data structure (backing tag) required for proper operation of instruction
Ref_MeterData	raP_UDT_Dvc_EH_Flowmeter_Data	Flowmeter data from E+H meter
Ref_EUTable	RAC_CODE_DESCRIPTION[1]	Lookup table for engineering unit code to text
Ref_DiagTable	RAC_CODE_DESCRIPTION[1]	Lookup table for diagnostic code to text

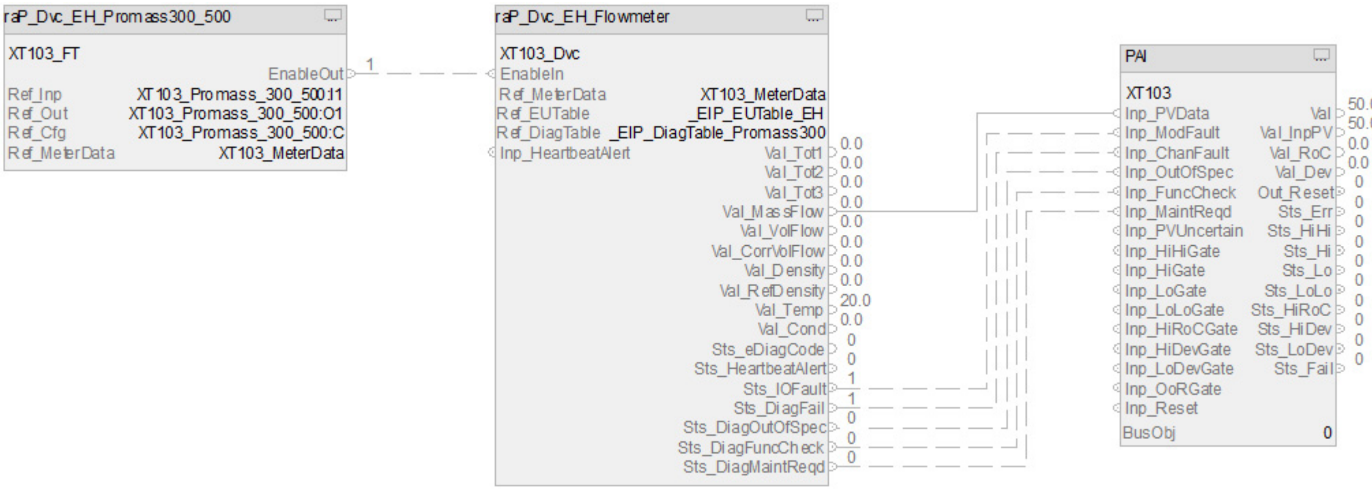
Available Diagnostic Tables

Diagnostic tables are available for these EtherNet/IP devices. The EtherNet/IP number indicates the version of the table.

Option	Description
_EIP_EUTable_EH	TagDescript - EH EtherNet/IP devices engineering units lookup table.
_EIP_DiagTable_Promass300	TagDescript - PV - EH EtherNet/IP Promass300_500 diagnostics lookup table
_EIP_DiagTable_Promass100	TagDescript - EH EtherNet/IP Promag 100/Promag 400/Promass 100 diagnostics lookup table
_EIP_DiagTable_LiquilineCM44x	TagDescript - PV - EH EtherNet/IP Liquiline CM44x diagnostics lookup table

For more information, see EtherNet/IP Integration on page 55.

CS_PAI_EtherNetIP_NoHB Sheet



The CS_PAI_EtherNetIP_NoHB control strategy operates the same as the CS_PAI control strategy but relies on EtherNet/IP NoHB data. Substitute XT103 for XT101.

This control strategy uses the raP_Dvc_EH_Flowmeter instruction to integrate an Endress+Hauser flowmeter, but without heartbeat input. For more information, see EtherNet/IP Integration on page 55.

For more information on integrating E+H devices, see Endress+Hauser EtherNet/IP Instrumentation for PlantPAx DCS Reference Manual, PROCES-RM212A.

raP_Dvc_EH_Heartbeat Outputs to raP_Dvc_EH_Flowmeter Inputs

Output	Description
Sts_Alert	Notify the raP_Dvc_EH_Flowmetef block that this block requires operator attention.

raP_Dvc_EH_Heartbeat Configuration Considerations

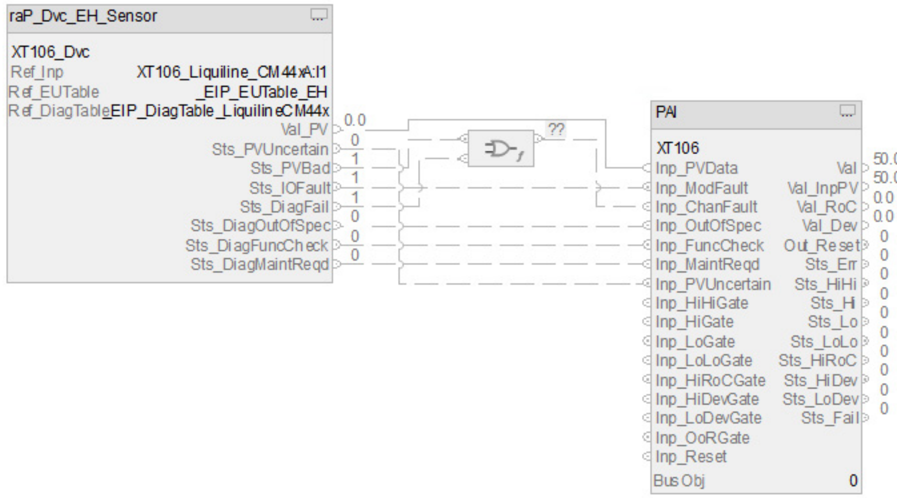
Operand	Type	Description
PlantPAx control	raP_Dvc_EH_Heartbeat	Instance of data structure (backing tag) required for proper operation of instruction
Ref_MeterData	raP_UDT_Dvc_EH_Flowmeter_Data	Flowmeter data from E+H meter on EtherNet/IP
Ref_EUTable	RAC_CODE_DESCRIPTION[1]	Lookup table for engineering unit code to text
Ref_DiagTable	RAC_CODE_DESCRIPTION[1]	Lookup table for diagnostic code to text

Available Diagnostic Tables

Diagnostic tables are available for these EtherNet/IP devices. The EtherNet/IP number indicates the version of the table.

Option	Description
_EIP_EUTable_EH	TagDescript - EH EtherNet/IP devices engineering units lookup table.
_EIP_DiagTable_Promass300	TagDescript - PV - EH EtherNet/IP Promass300_500 diagnostics lookup table
_EIP_DiagTable_Promass100	TagDescript - EH EtherNet/IP Promag 100 / Promag 400 / Promass 100 diagnostics lookup table
_EIP_DiagTable_LiquilineCM44x	TagDescript - PV - EH EtherNet/IP Liquiline CM44x diagnostics lookup table

CS_PAI_EtherNetIP_Sensor Sheet



The CS_PAI_EtherNetIP_Sensor control strategy operates the same as the CS_PAI control strategy but relies on EtherNet/IP_Sensor data. Substitute XT106 for XT101.

This control strategy uses the raP_Dvc_EH_Sensor instruction to integrate an Endress+Hauser analyzer device. For more information, see EtherNet/IP Integration on page 55.

For more information on integrating E+H devices, see Endress+Hauser EtherNet/IP Instrumentation for PlantPAx DCS Reference Manual, PROCES-RM212A.

raP_Dvc_EH_Sensor Outputs to PAI Input

Output	Description
Val_PV	Sensor primary variable (PV) value (PVEU)
Sts_PVUncertain	Device reports PV value is uncertain (quality)
Sts_IOFault	I/O communication with the flowmeter is faulted
Sts_DiagFail	Diagnostic indicates device failure
Sts_DiagOutOfSpec	Diagnostic indicates device operating outside of specified accuracy
Sts_DiagMainReqd	Diagnostic indicates device requires maintenance

raP_Dvc_EH_Sensor Configuration Considerations

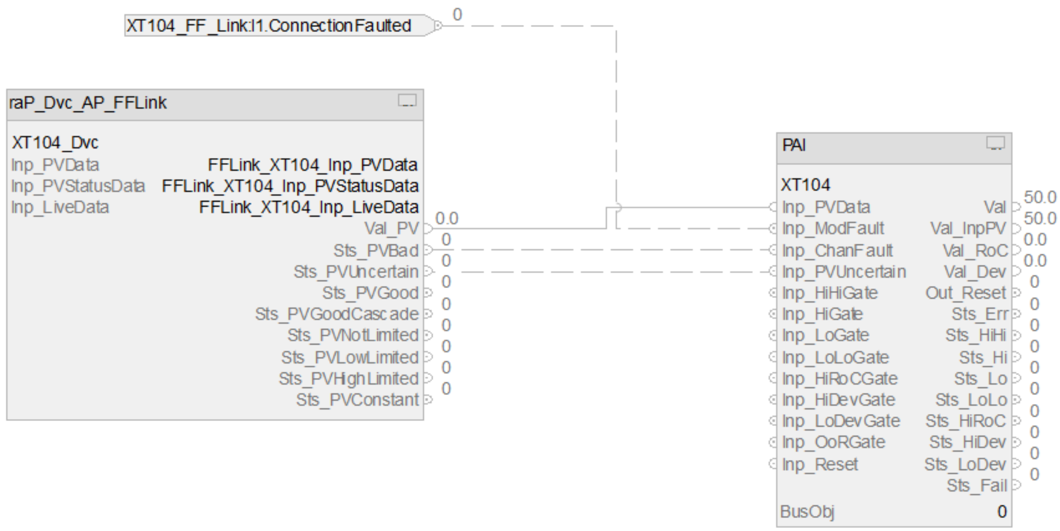
Operand	Type	Description
PlantPAx control	raP_Dvc_EH_Sensor	Instance of data structure (backing tag) required for proper operation of instruction
Ref_Inp	EH:CM44:I1:0	Input assembly: data from E+H Liquiline CM44x on EtherNet/IP
Ref_EUTable	RAC_CODE_DESCRIPTION[2]	Lookup table for engineering units code to text
Ref_DiagTable	RAC_CODE_DESCRIPTION[2]	Lookup table for diagnostic code to text

Available Diagnostic Tables

Diagnostic tables are available for these EtherNet/IP devices.

Option	Description
_EIP_EUTable_EH	TagDescript - EH EtherNet/IP devices engineering units lookup table.
_EIP_DiagTable_Promass300	TagDescript - PV - EH EtherNet/IP Promass300_500 diagnostics lookup table
_EIP_DiagTable_Promass100	TagDescript - EH EtherNet/IP Promag 100 / Promag 400 / Promass 100 diagnostics lookup table
_EIP_DiagTable_LiquilineCM44x	TagDescript - PV - EH EtherNet/IP Liquiline CM44x diagnostics lookup table

CS_PAI_FF Sheet



The CS_PAI_FF control strategy operates the same as the CS_PAI control strategy but relies on FOUNDATION Fieldbus data. Substitute XT104 for XT101.

This control strategy uses the raP_Dvc_AP_FFLink instruction to integrate a FOUNDATION Fieldbus device. For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

For more information on integrating FOUNDATION Fieldbus devices, see Profibus PA and FOUNDATION Fieldbus Linking Devices in a PlantPAx DCS Reference Manual, publication PROCES-RM213.

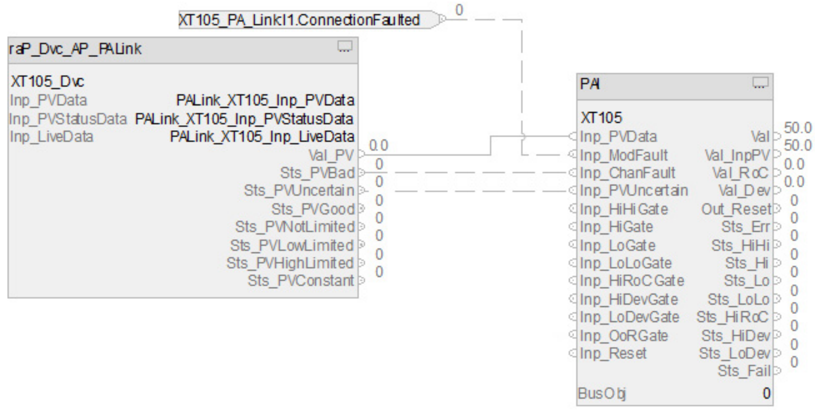
raP_Dvc_AP_FFLink Outputs to PAI Inputs

Output	Description
Val_PV	Process variable (PV engineering units). Map this output to Inp_PVData on PAI
Sts_PVBad	PV Status (quality) is bad. See detail bits for additional information. Map this output to Inp_ChanFault on PAI
Sts_PVUncertain	PV Status (quality) is uncertain. See detail bits for additional information. Map this output to Inp_PVUncertain on PAI

raP_Dvc_AP_FFLink Configuration Considerations

Operand	Type	Description
PlantPAx control	raP_Dvc_AP_FFLink	Instance of data structure (backing tag) required for proper operation of instruction
Inp_PVData	REAL	Process variable data
Inp_PVStatusData	SINT	Process variable status data (byte)
Inp_LiveData	BOOL	Device is communicating and updating live PV and status

CS_PAI_PA Sheet



The CS_PAI_PA control strategy operates the same as the CS_PAI control strategy but relies on Profibus PA data. Substitute XT105 for XT101.

This control strategy uses the raP_Dvc_AP_PA Link instruction to integrate a Profibus PA device. For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

For more information on integrating Profibus PA devices, see Profibus PA and FOUNDATION Fieldbus Linking Devices in a PlantPAx DCS Reference Manual, publication PROCES-RM213.

raP_Dvc_AP_PALink Outputs to PAI Inputs

Output	Description
Val_PV	Process variable value
Sts_PVBad	PV Status (quality) is bad. See detail bits for additional information. Map this output to Inp_ChanFault on PAI
Sts_PVUncertain	PV Status (quality) is uncertain. See detail bits for additional information. Map this output to Inp_PVUncertain on PAI

raP_Dvc_AP_PALink Configuration Considerations

Operand	Type	Description
PlantPAx control	raP_Dvc_AP_PALink	Instance of data structure (backing tag) required for proper operation of instruction
Inp_PVData	REAL	Process variable data
Inp_PVStatusData	SINT	Process variable status data (byte)
Inp_LiveData	BOOL	Device is communicating and updating live PV and status

Process Analog Dual Sensor Input (PAID) Control Strategies

Use a PAID control strategy to provide 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 the conditions of the channels and reports configured PV quality. The PAID instruction has functions for input selection, averaging, and failure detection. Should one of the two upstream PAI signals have bad quality, the PAID continues to provide an output using the remaining good quality signal. If both upstream signals are flagged as bad, the PAID PV is also flagged as bad. Additional functions, such as filtering and alarming, are done by a downstream PAI control strategy.

The following PAID control strategies are available as routines in the process library:

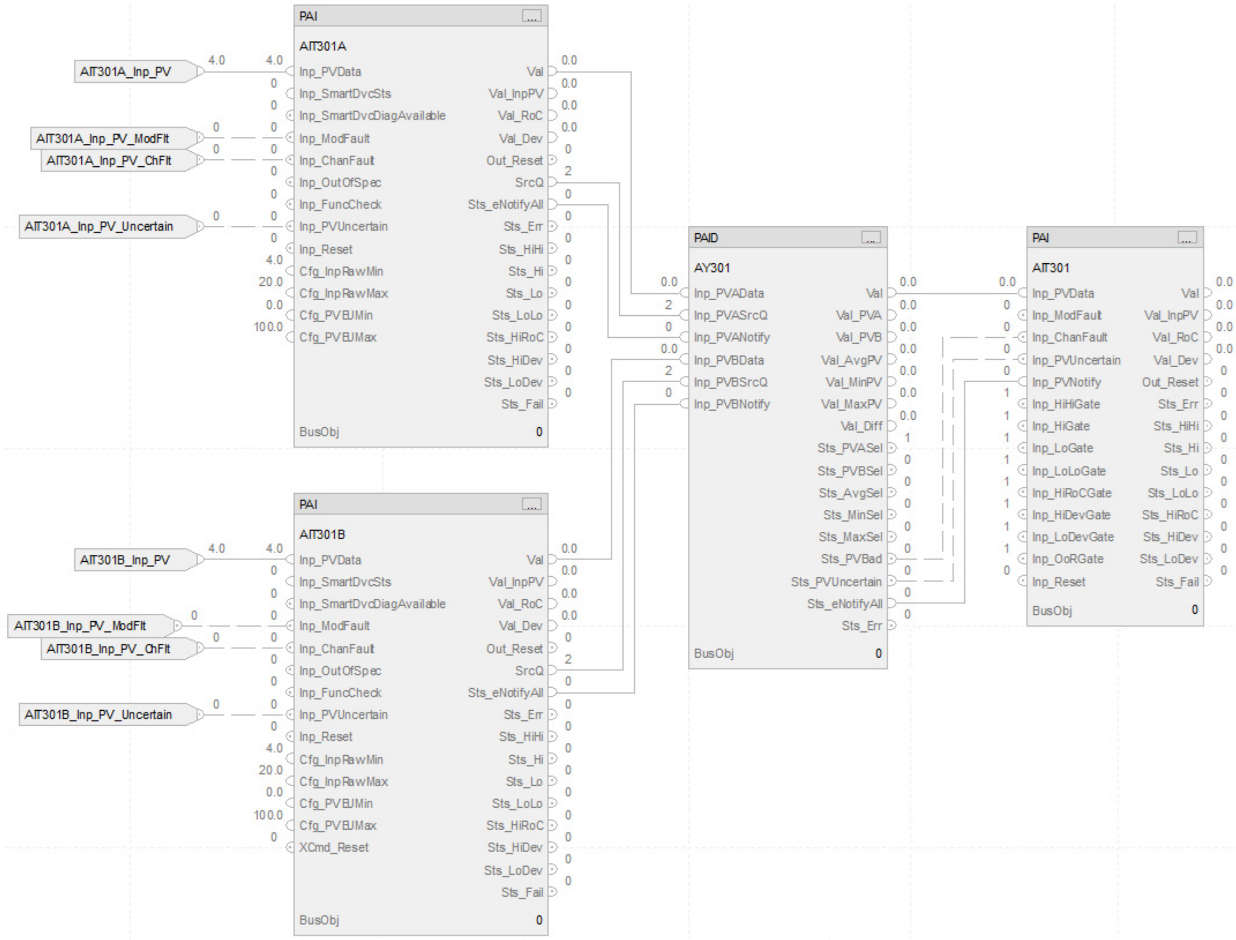
- CS_PAID
- CS_PAID_HART
- CS_PAID_EtherNetIP
- CS_PAID_EtherNetIP_NoHB
- CS_PAID_FF
- CS_PAID_PA

Import the appropriate control strategy as a **routine** in your controller project.

Each PAID control strategy contains one Function Block sheet:

Sheet	Description
CS_PAID	Process Analog Dual Sensor Input instruction
CS_PAID_HART	Process Analog Dual Sensor Input instruction with HART input
CS_PAID_EtherNetIP	Process Analog Dual Sensor Input instruction with EtherNetIP input
CS_PAID_EtherNetIP_NoHB	Process Analog Dual Sensor Input instruction with NoHB EtherNetIP input
CS_PAID_FF	Process Analog Dual Sensor Input instruction with FOUNDATION Fieldbus input
CS_PAID_PA	Process Analog Dual Sensor Input instruction with Profibus PA input

CS_PAID Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute AIT301A for the first instance of XT101
- Substitute AIT301B for the second instance of XT101

PAI Outputs to PAID Inputs

Parameter	Description
Val	Value for PV parameter Process Variable (PVEU)
SrcQ	Value for Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

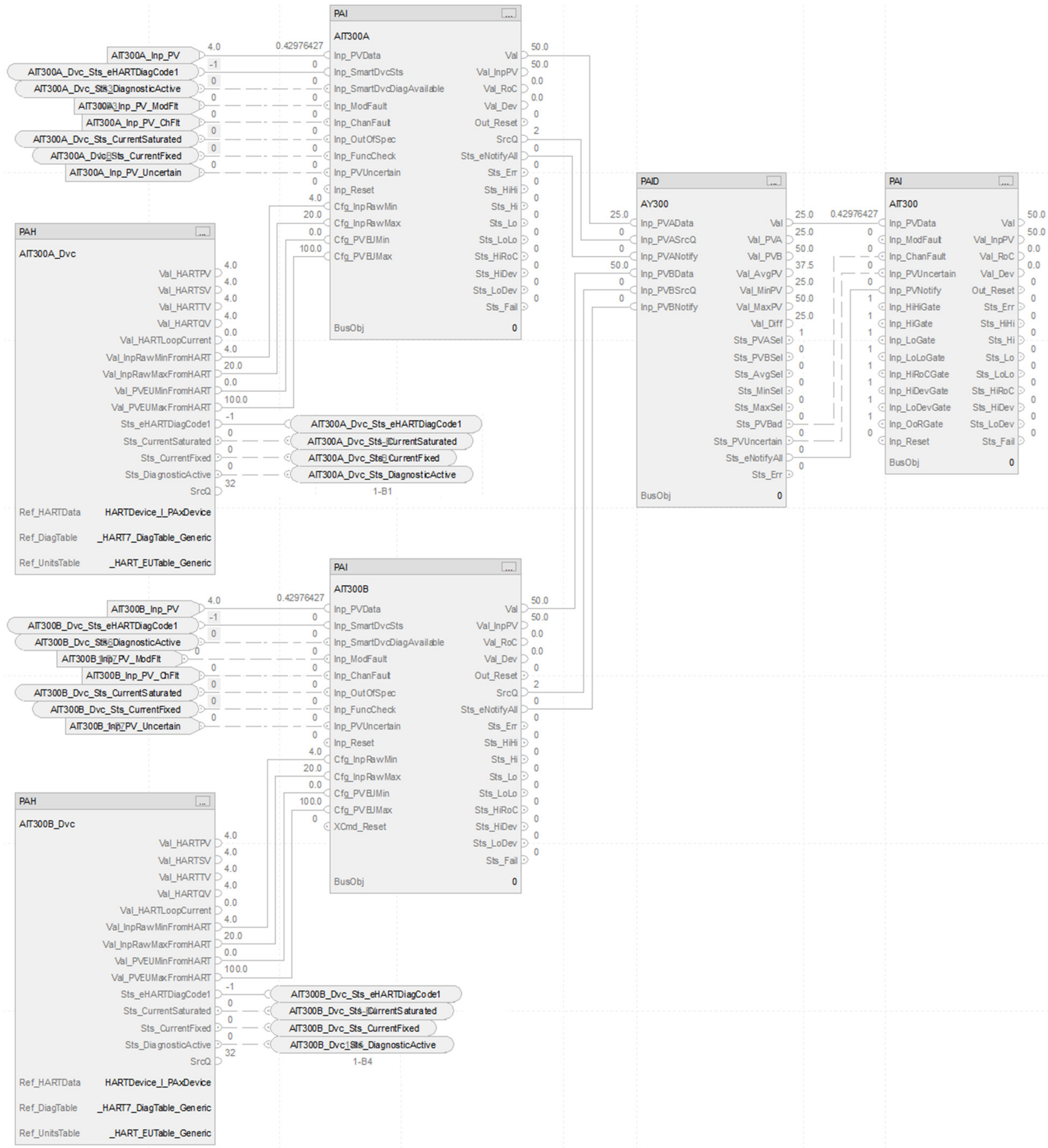
PAID Outputs to PAI Inputs

Parameter	Description
Val	Analog PV, including substitute PV, if used (PV units)
Sts_PVBad	1 = PV bad quality or out of range
Sts_PVUncertain	1 = PV value is uncertain (quality)
Sts_eNotifyAll	Alarm status

PAID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_ANALOG_INPUT_DUAL	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PAID_HART Sheet

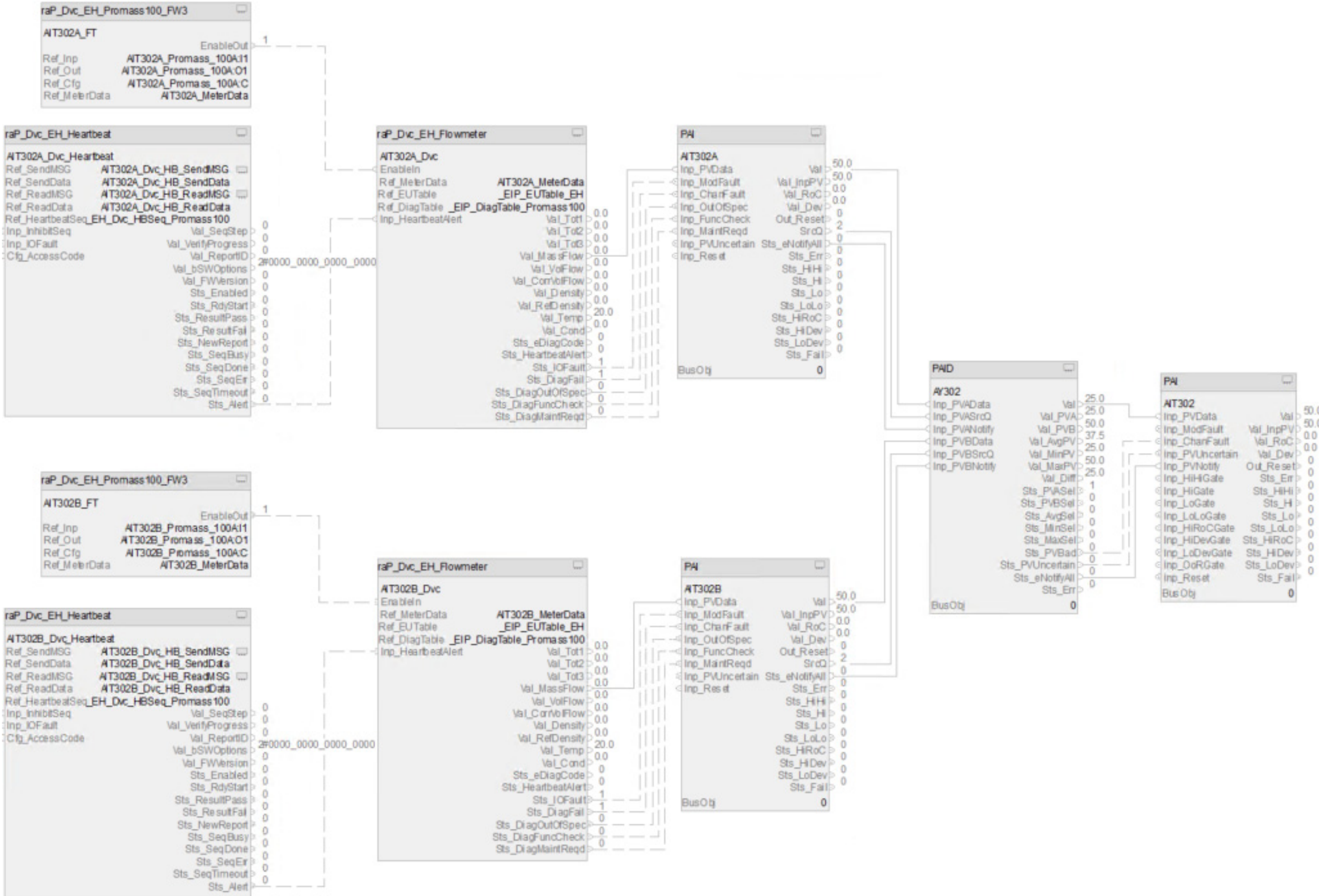


The CS_PAID_HART control strategy operates the same as the CS_PAID control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute AIT300A for the first instance of XT100
- Substitute AIT300B for the second instance of XT100

For more information, see HART Integration on page 31.

CS_PAID_EtherNetIP Sheet

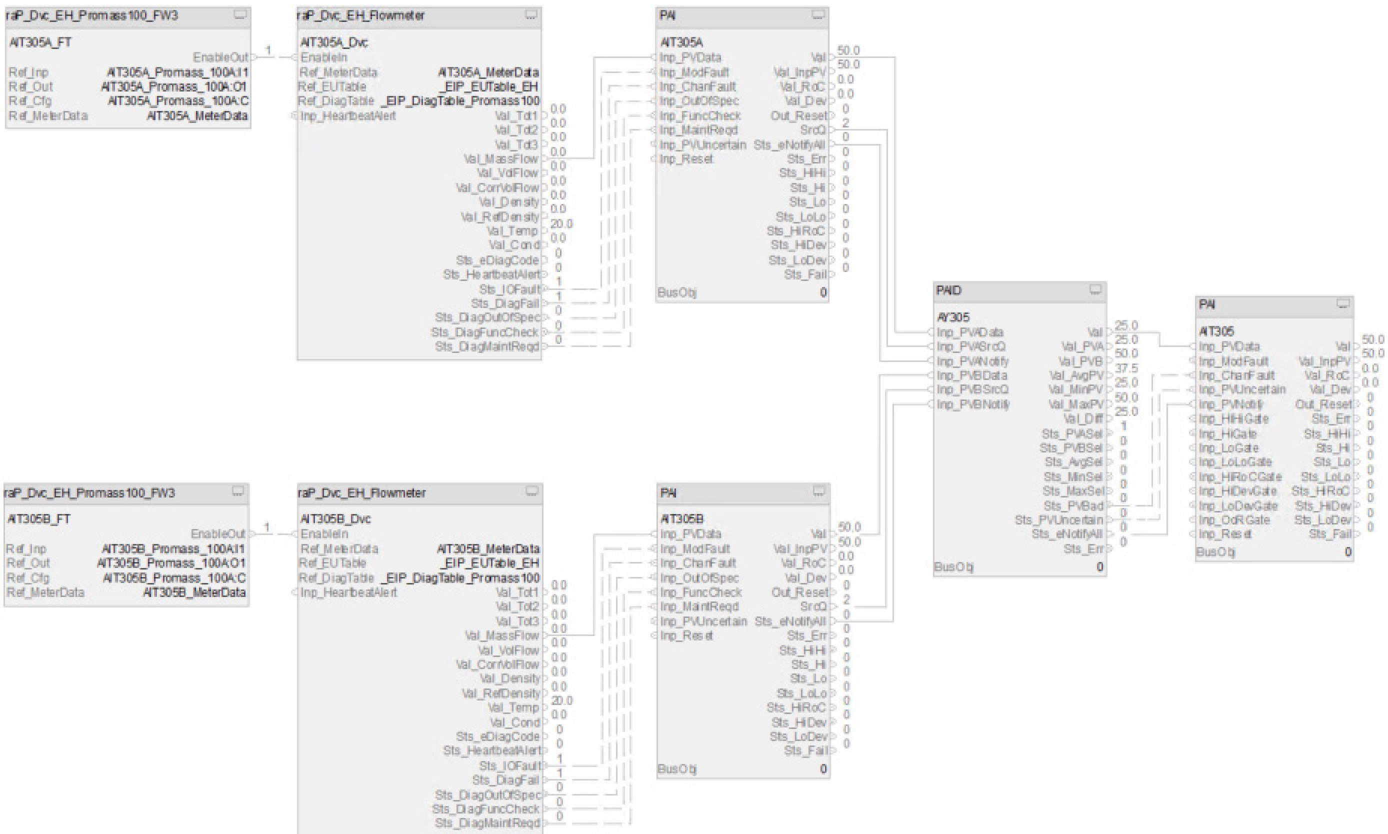


The CS_PAID_EtherNetIP control strategy operates the same as the CS_PAID control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute AIT302A for the first instance of XT100
- Substitute AIT302B for the second instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PAID_EtherNetIP_NoHB Sheet



The CS_PAID_EtherNetIP_NoHB control strategy operates the same as the CS_PAID control strategy but relies on EtherNet/IP NoHB input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute AIT305A for the first instance of XT100
- Substitute AIT305B for the second instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PAID_FF Sheet

The CS_PAID_FF control strategy operates the same as the CS_PAID control strategy but relies on Foundation Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute AIT303A for the first instance of XT100
- Substitute AIT303B for the second instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PAID_PA Sheet

The CS_PAID_PA control strategy operates the same as the CS_PAID control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute AIT304A for the first instance of XT100
- Substitute AIT304B for the second instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Chapter 11

Process Analog Input Multi Sensor (PAIM) Control Strategies

Use a PAIM control strategy to provide one analog Process Variable (PV) by using as many as eight analog input signals from sources such as sensors, transmitters, and input channels. The PAIM instruction monitors the conditions of the channels and reports configured PV quality. The PAIM instruction has functions for input selection, averaging, and failure detection. In addition, there is configuration selection for 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. Configure which PV to use if there are only two unrejected signals remaining: the lesser, the greater, or the average of the two. Additional functions, such as for filtering and alarming, are done by a downstream PAI block.

The following PAIM control strategies are available as routines in the process library:

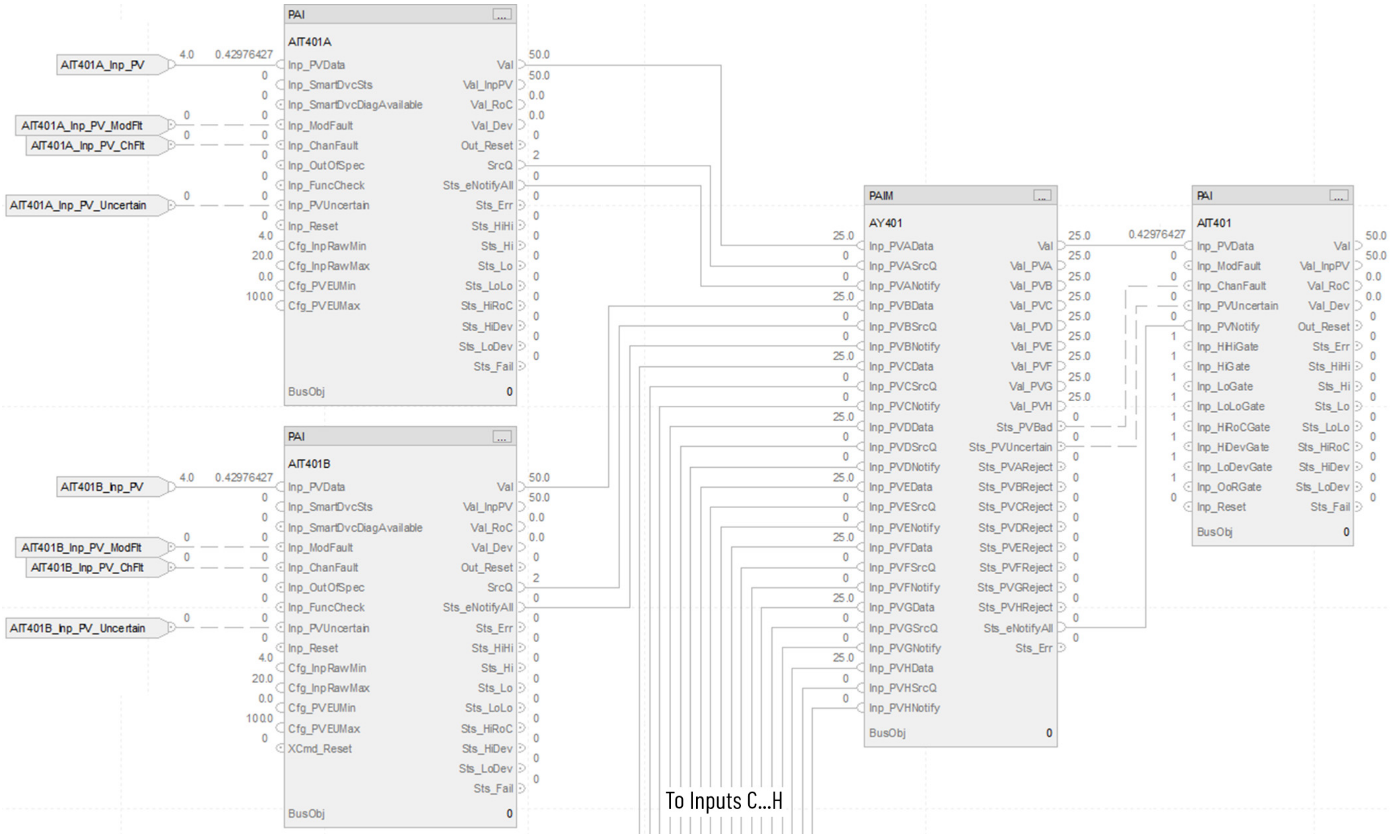
- CS_PAIM
- CS_PAIM_HART
- CS_PAIM_EtherNetIP
- CS_PAIM_EtherNetIP_NoHB
- CS_PAIM_FF
- CS_PAIM_PA

Import the appropriate control strategy as a **routine** in your controller project.

Each PAIM control strategy contains one Function Block sheet:

Sheet	Description
CS_PAIM	Process Analog Input Multi Sensor Input instruction
CS_PAIM_HART	Process Analog Input Multi Sensor Input instruction with HART input
CS_PAIM_HART_EtherNetIP	Process Analog Input Multi Sensor Input instruction with EtherNetIP input
CS_PAIM_EtherNetIP_NoHB	Process Analog Input Multi Sensor Input instruction with NoHB EtherNetIP input
CS_PAIM_FF	Process Analog Input Multi Sensor Input instruction with FOUNDATION Fieldbus input
CS_PAIM_PA	Process Analog Input Multi Sensor Input instruction with Profibus PA input

CS_PAIM Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute AIT401x for each instance of XT101

PAI Outputs to PAIM Inputs

Parameter	Description
Val	Value for PV parameter Process Variable (PVEU)
SrcQ	Value for Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

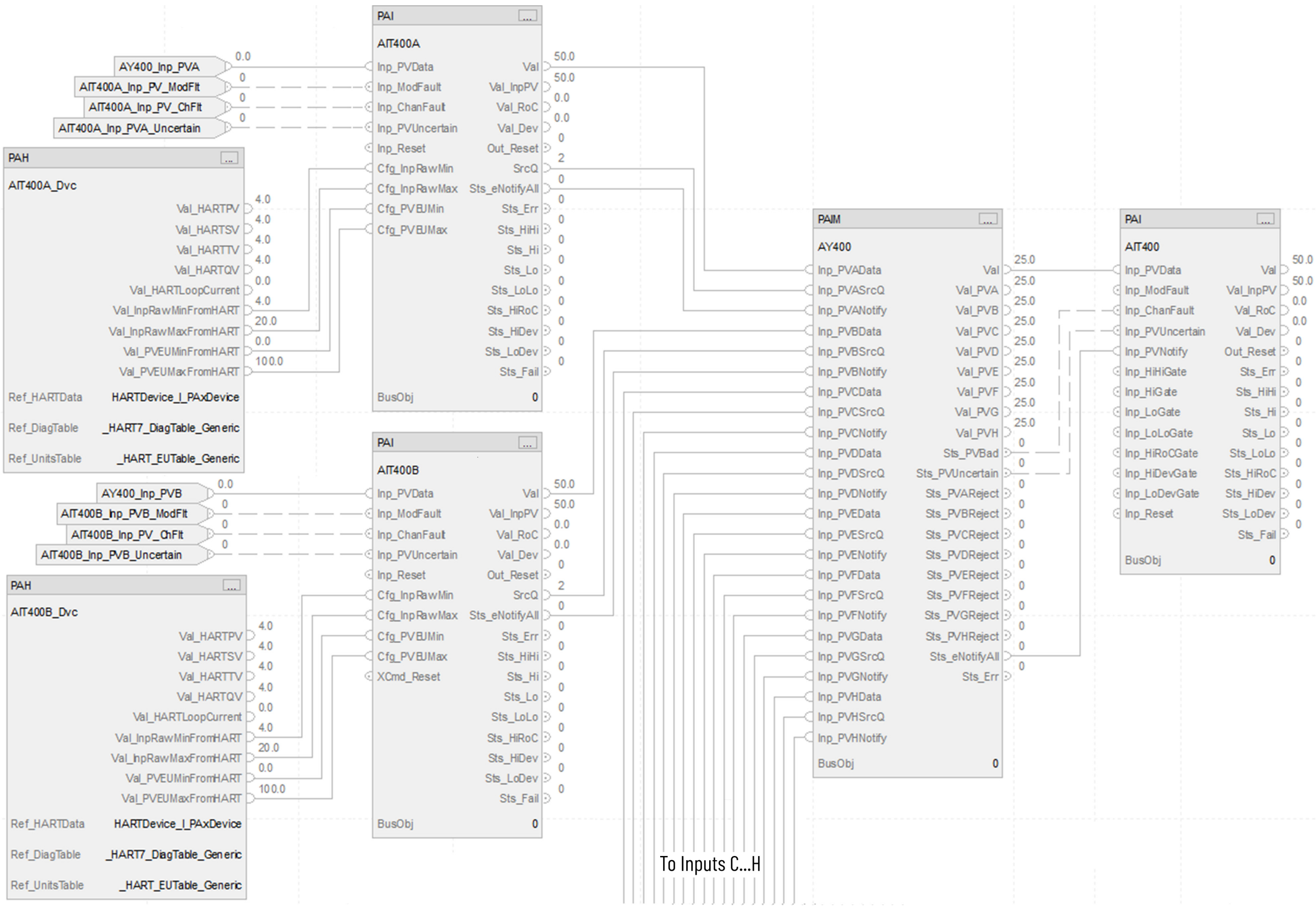
PAIM Outputs to PAI Inputs

Parameter	Description
Val	Analog PV, including substitute PV, if used (PV units)
Sts_PVBad	1 = PV bad quality or out of range
Sts_PVUncertain	1 = PV value is uncertain (quality)
Sts_eNotifyAll	Alarm status

PAIM Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_ANALOG_INPUT_MULTI	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PAIM_HART Sheet

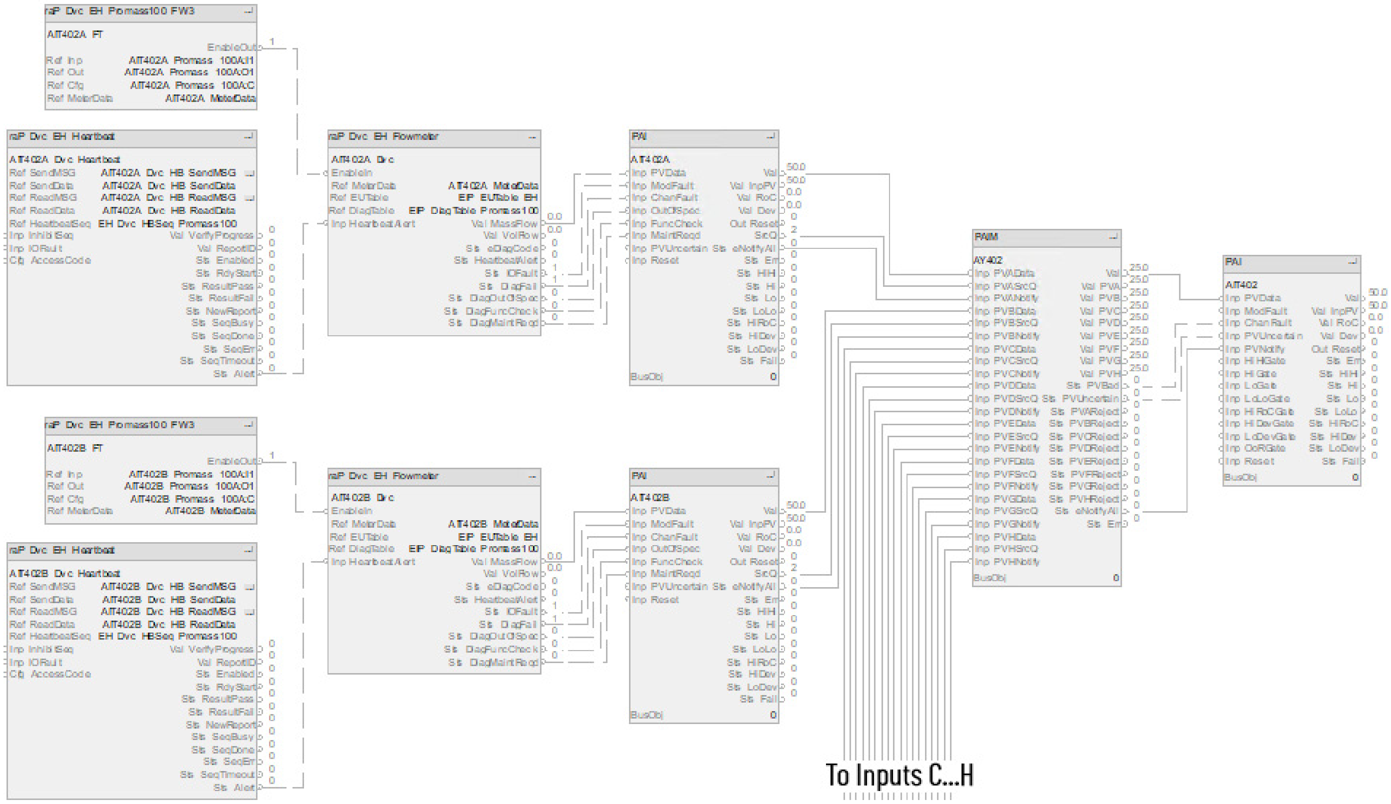


The CS_PAIM_HART control strategy operates the same as the CS_PAIM control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute AIT400x for each instance of XT100

For more information, see HART Integration on page 31.

CS_PAIM_EtherNetIP Sheet

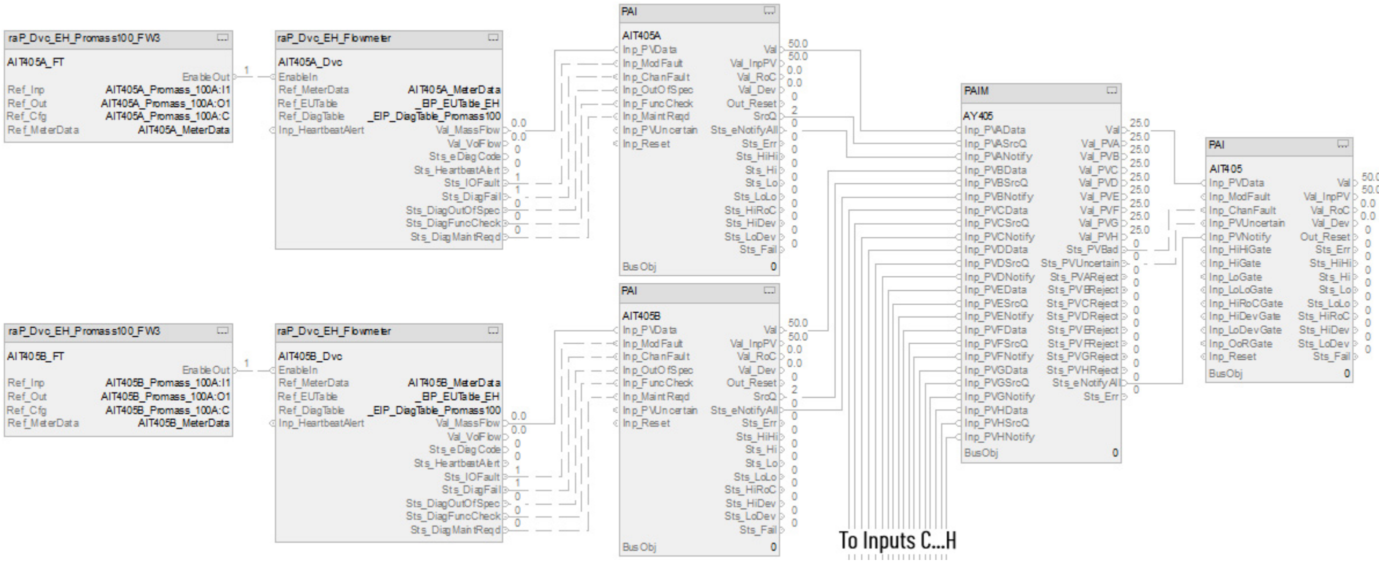


The CS_PAIM_EtherNetIP control strategy operates the same as the CS_PAIM control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute AIT402x for each instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PAIM_EtherNetIP_NoHB Sheet

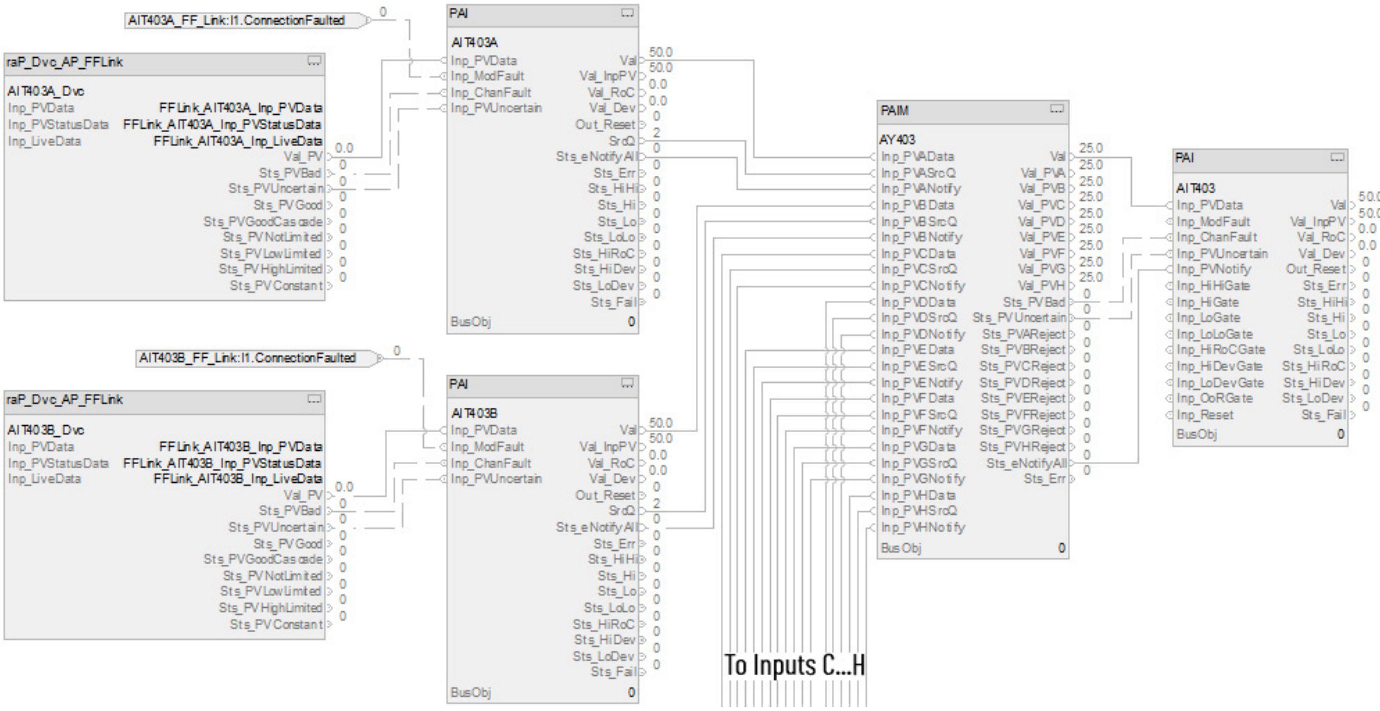


The CS_PAIM_EtherNetIP_NoHB control strategy operates the same as the CS_PAIM control strategy but relies on EtherNet/IP NoHB input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute AIT405x for each instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PAIM_FF Sheet

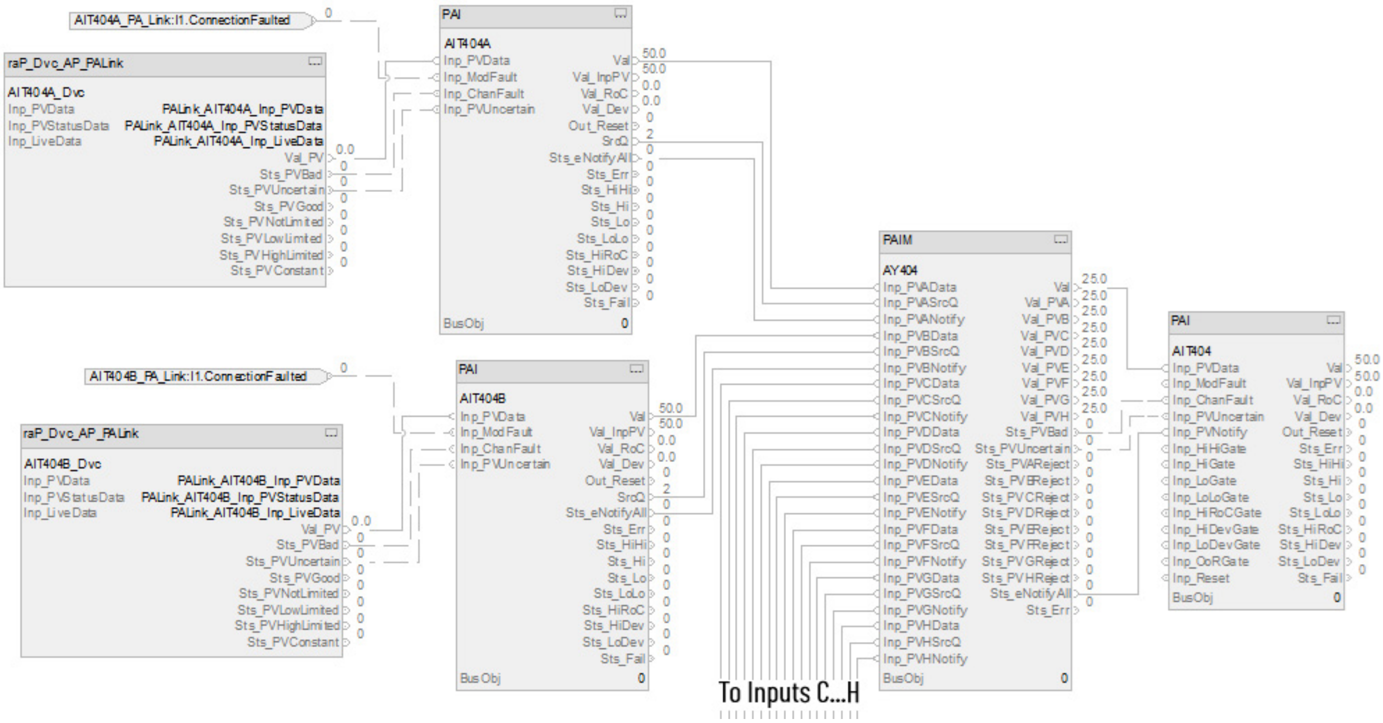


The CS_PAIM_FF control strategy operates the same as the CS_PAIM control strategy but relies on FOUNDATION Fieldbus input data.

- For information on OUNDATION Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute AIT403x for each instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PAIM_PA Sheet



The CS_PAIM_PA control strategy operates the same as the CS_PAIM control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute AIT404x for each instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Process Analog Output (PAO) Control Strategies

Use a PAO control strategy to drive an analog field device to a reference value. The reference value can be entered by operator entry at the HMI or by a program input. The control strategies use a single output to an analog output channel to drive the field device. Optional opened and closed limit indications can be configured requiring additional digital input(s).

Alternatively, use the PAO control strategies to position the field device by using two digital output pulses (one to pulse open and another to pulse close). Pulsed outputs to position the field device require two digital output channels to position the device, as well as an additional analog channel to represent the current field device position. Digital positioning also requires additional configuration in the PAO instruction for the pulse timing.

In addition to positioning a field device based on program or HMI entries, these control strategies provide the ability to position (shed) the device based on IO fault status and interlock conditions.

The following PAO control strategies are available as routines in the process library:

- CS_PAO (with interlocks)
- CS_PAO_noIntlk (without interlocks)
- CS_PAO_HART (HART input with interlocks)
- CS_PAO_HART_noIntlk (HART input with no interlocks)

Import the appropriate control strategy as a **routine** in your controller project.

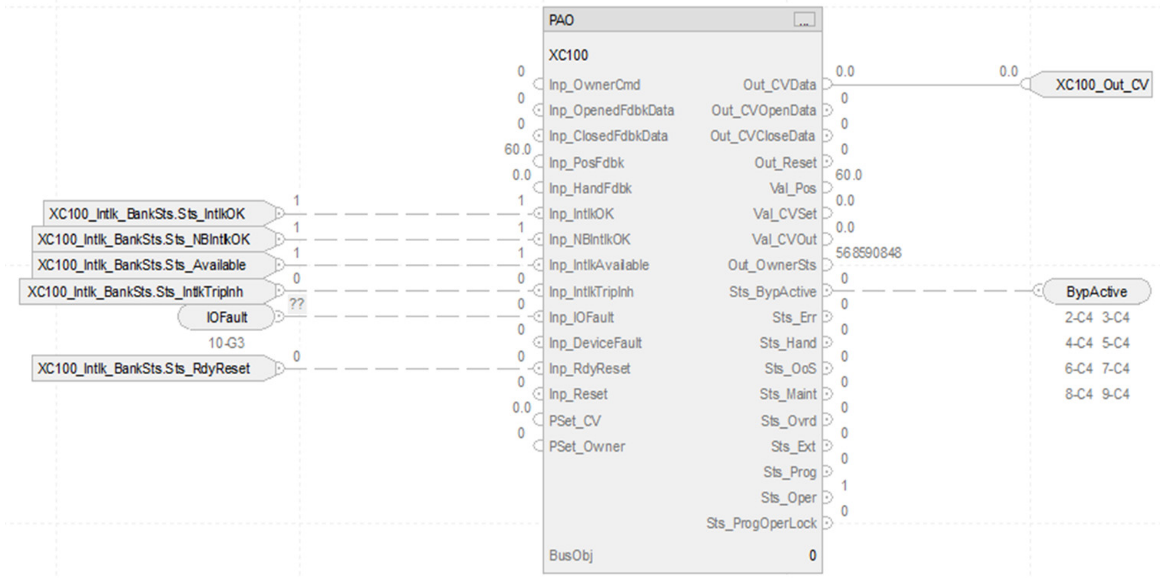
The PAO control strategies contain these Function Block sheets:

Sheet	Description
CS_PAO	Process Analog Output instruction
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	Only in CS_PAO. The PAO instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises alarm on an I/O fault.

The PAO HART control strategies contain these Function Block sheets:

Sheet	Description
CS_PAO_HART	Process Analog Output instruction with HART input
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	Only in CS_PAO. The PAO instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises alarm on an I/O fault.

CS_PAO Sheet



PAO Input References

Parameter	Description
XC100_Inp_PosFdbk	Tieback input. Feedback from actual device position PV (CV engineering units). Valid any float. Default is 0.0.
XC100_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XC100_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XC100_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XC100_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
IOFault	Input connection from IO Faults sheet
XC100_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PAO Output References

Parameter	Description
XC100_Out_CVData	Control Variable output CV output in raw (I/O Card) units. Extended properties of this member: Engineering Unit - Raw units (text) used for the analog output Destination: Analog output channel or downstream REAL tag
BypActive	Output connection to interlock bank sheet

For a HART analog output, include these outputs:

HART Parameter	Description
XC101_Val_CVOut	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 Destination: Analog output channel or downstream REAL tag
XC101_Sts_Available	1 = Analog output available for control by automation (Program)

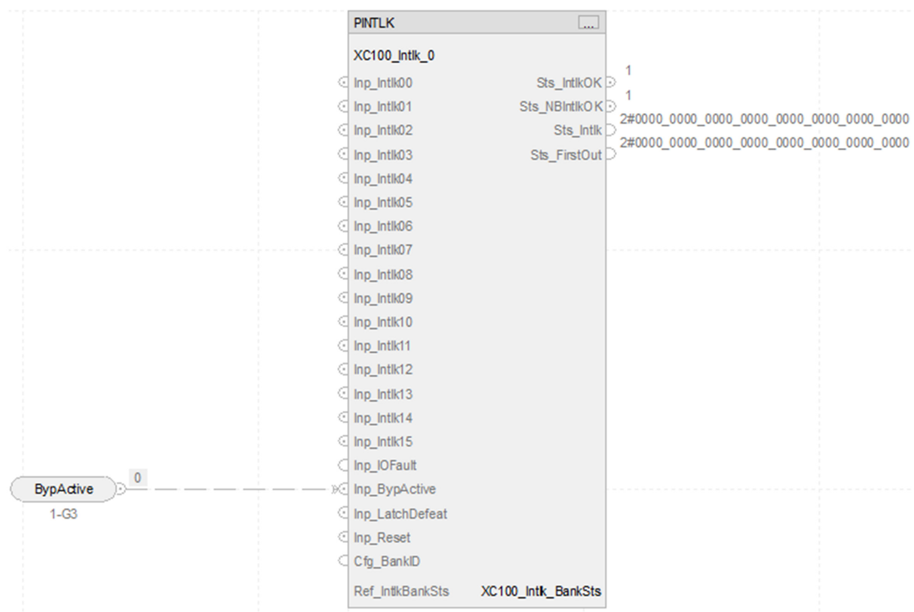
PAO Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_ANALOG_OUTPUT	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

If you use digital output pulses, configure these PAO **Parameter**:

Parameter	Description
Cfg_HasPulseOut	Enables the pulse1 = Device provides pulse output (open, close).
Cfg_HasOpenedFdbk	1 = Use device opened feedback for failure checking.
Cfg_HasCloseFdbk	1 = Device provides closed feedback signal.

Interlock Bank Sheet



Input Reference to PINTLK

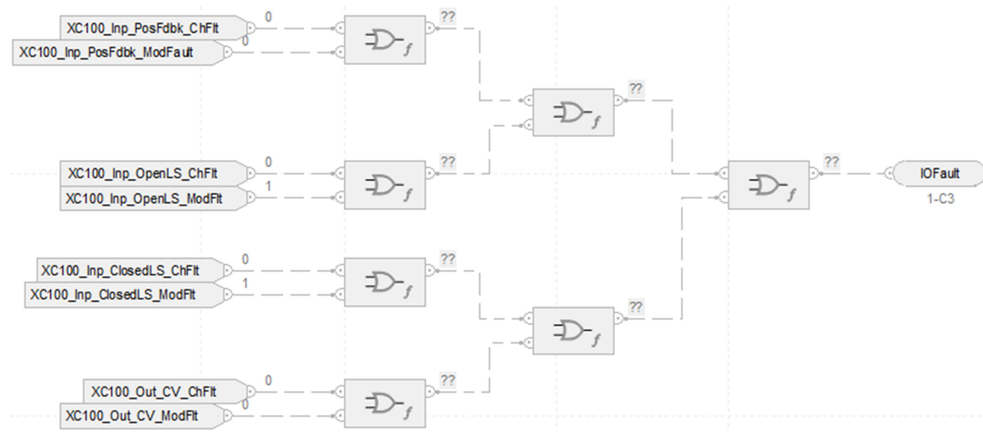
Parameter	Description
BypActive	Input connection from CS_PAO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

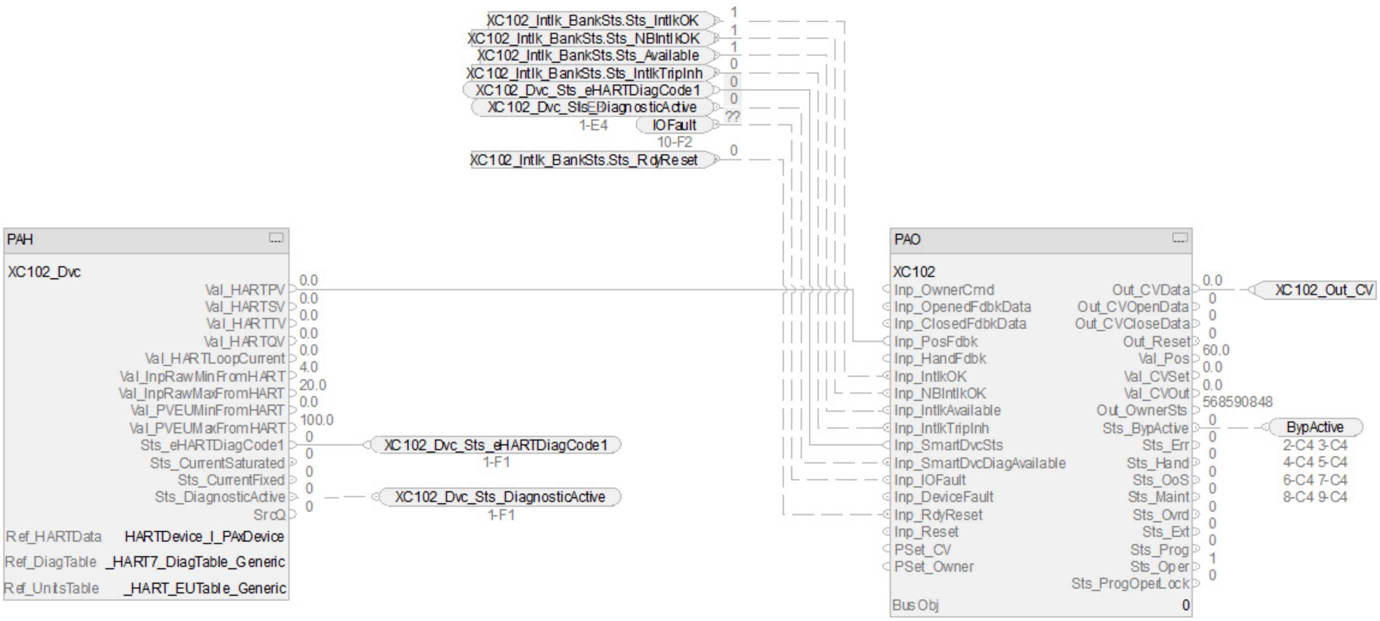
Parameter	Description
XC100_Inp_PosFdbk_ChanFault	Tieback input channel fault
XC100_Inp_PosFdbk_ModFault	Tieback input module fault
XC100_Inp_OpenLS_ChFlt	Open limit switch channel fault
XC100_Inp_OpenLS_ModFlt	Open limit switch module fault
XC100_Inp_ClosedLS_ChFlt	Closed limit switch channel fault
XC100_Inp_ClosedLS_ModFlt	Closed limit switch module fault
XC100_Out_CVData_ChanFault	Control Variable output channel fault
XC100_Out_CVData_ModFault	Control Variable output data module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PAO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

CS_PAO_HART Sheet



The CS_PAO_HART control strategy, including the Interlock and IO Fault sheets, operates the same as the CS_PAO control strategy but relies on HART input data. Substitute XC101 for XC100.

For more information, see HART Integration on page 31.

Notes:

Process Boolean Logic (PBL) Control Strategy

Use the PBL control strategy to process as many as four digital inputs by applying as many as eight gates of configurable logic. Gate types available include AND, OR, XOR (Exclusive-OR), Set/Reset, Select, and Majority. A benefit of the PBL control strategy is that assembly of the logical gates is done from the HMI, which helps to make sure that the HMI representation is accurate with respect to the underlying logic.

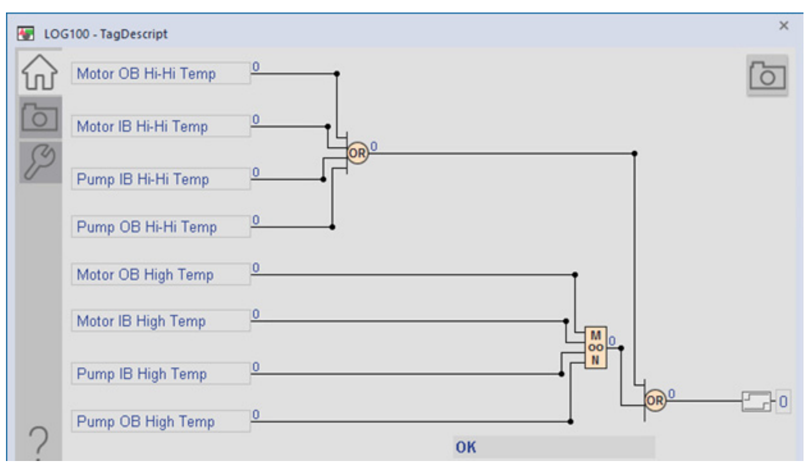
The PBL instruction can record its current state (via snapshot of current graphical representation):

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

Use the PBL instruction in these situations:

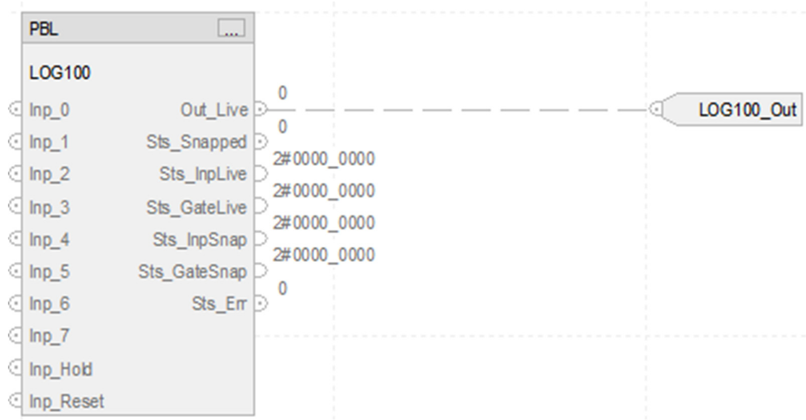
- A project requires an Interlock or Permissive condition that is more complicated than the simple OR-ing or AND-ing provided by the PINTLK (Interlocks) or PPERM (Permissives) Add-On Instructions.
- A project requires some Boolean (combination) logic that can be reconfigured from the HMI online, or which requires the snapshot capability for saving a copy of the logic state with a time stamp.
- 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 bearing over-temperature 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.

The PBL logic is typically configured from an HMI display.



The CS_PBL control strategy is available as a routine in the process library. Import the control strategy as a **routine** in your controller project. The PBL control strategy contains one CS_PBL Function Block sheet.

CS_PBL Sheet



PBL Input References

Parameter	Description
Inp_0	Logic inputs
Inp_1	
Inp_2	
Inp_3	
Inp_4	
Inp_5	
Inp_6	
Inp_7	

PBL Output Reference

Parameter	Description
LOG100_Out_Live	Condition logic output (result) after delay.

PBL Configuration Considerations

Operand	Type	Description
PBL tag	P_BOOLEAN_LOGIC	Instance of data structure (backing tag) required for proper operation of instruction

Chapter 14

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

The Process Discrete 2-, 3-, 4-state Device Add-On Instruction controls and monitors feedback (using up to four discrete outputs and up to four discrete feedbacks) from a discrete 2-state, 3-state, or 4-state device in various modes while monitoring for fault conditions. These devices include multiple-speed motors or multiple-position valves.

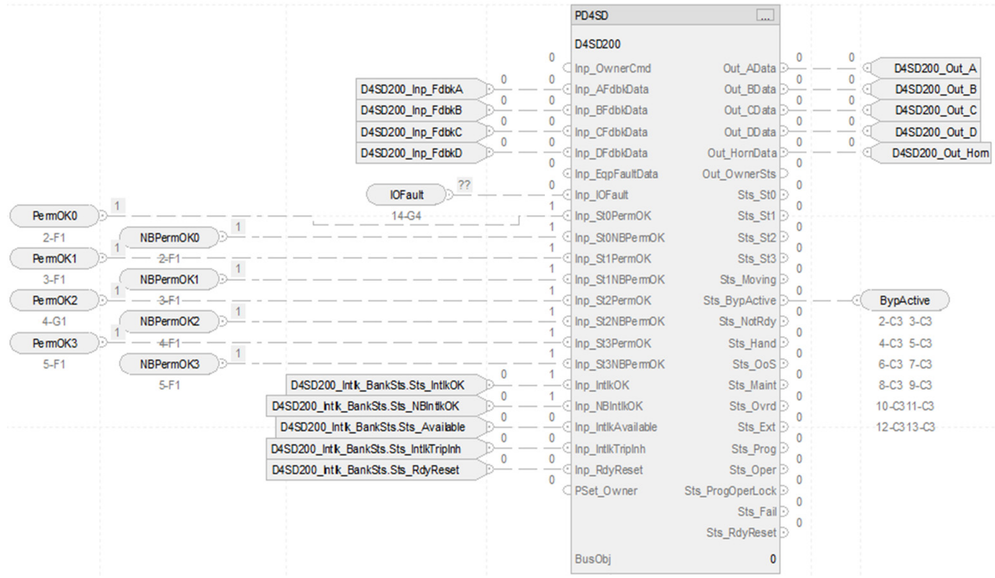
The CS_PD4SD control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The PD4SD control strategy contains these Function Block sheets:

Sheet	Description
CS_PD4SD	Discrete State Device Add-On Instruction
Permissives 0 Permissives 1 Permissives 2 Permissives 3	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Fault	The logic monitors as many as four discrete input channels and as many as five discrete output channels for I/O fault input and raises an alarm on an I/O fault.

CS_PD4SD Sheet



PD4SD Input References

Parameter	Description
D4SD200_Inp_FdbkA	Input Signal: Feedback A from device.
D4SD200_Inp_FdbkB	Input Signal: Feedback B from device.
D4SD200_Inp_FdbkC	Input Signal: Feedback C from device.
D4SD200_Inp_FdbkD	Input Signal: Feedback D from device.
IOFault	Input connection from IO Faults sheet
PermOK0	Input connection from Permissives sheet 0 (State 1) 1 = On permissives OK, device can turn On
NBPermOK0	Input connection from Permissives sheet 0 (State 1) 1 = Non-bypassable On permissives OK, device can turn On
PermOK1	Input connection from Permissives sheet 1 (State 2) 1 = On permissives OK, device can turn On
NBPermOK1	Input connection from Permissives sheet 1 (State 2) 1 = Non-bypassable On permissives OK, device can turn On
PermOK2	Input connection from Permissives sheet 2 (State 3) 1 = On permissives OK, device can turn On
NBPermOK2	Input connection from Permissives sheet 2 (State 3) 1 = Non-bypassable On permissives OK, device can turn On
PermOK3	Input connection from Permissives sheet 3 (State 4) 1 = On permissives OK, device can turn On
NBPermOK3	Input connection from Permissives sheet 3 (State 4) 1 = Non-bypassable On permissives OK, device can turn On
D4SD200_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
D4SD200_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
D4SD200_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
D4SD200_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
D4SD200_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

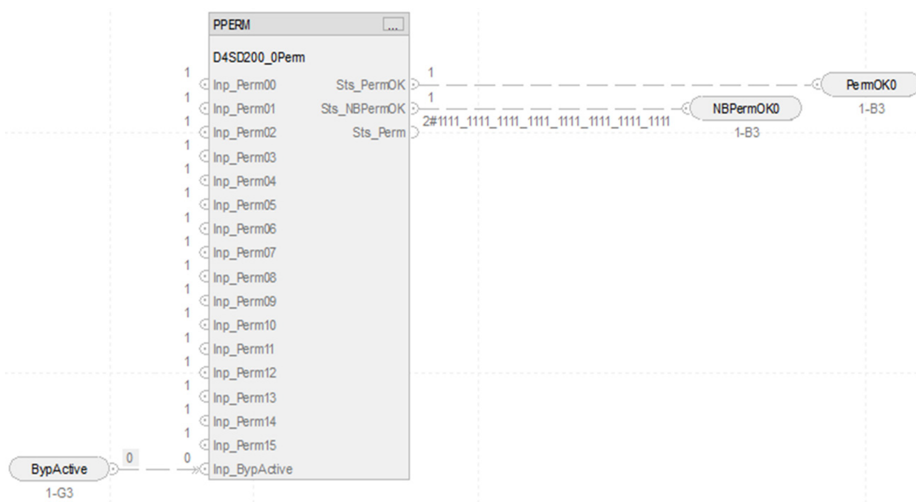
PD4SD Output References

Parameter	Description
D4SD200_Out_A	Output A to device
D4SD200_Out_B	Output B to device
D4SD200_Out_C	Output C to device
D4SD200_Out_D	Output D to device
D4SD200_Out_Horn	1 = Sound audible before commanded state change
D4SD200_Out_Reset	1 = Reset command has been received and accepted
BypActive	Output connection to permissives and interlock bank sheets

PD4SD Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DISCRETE_4STATE	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

Permissive Sheet



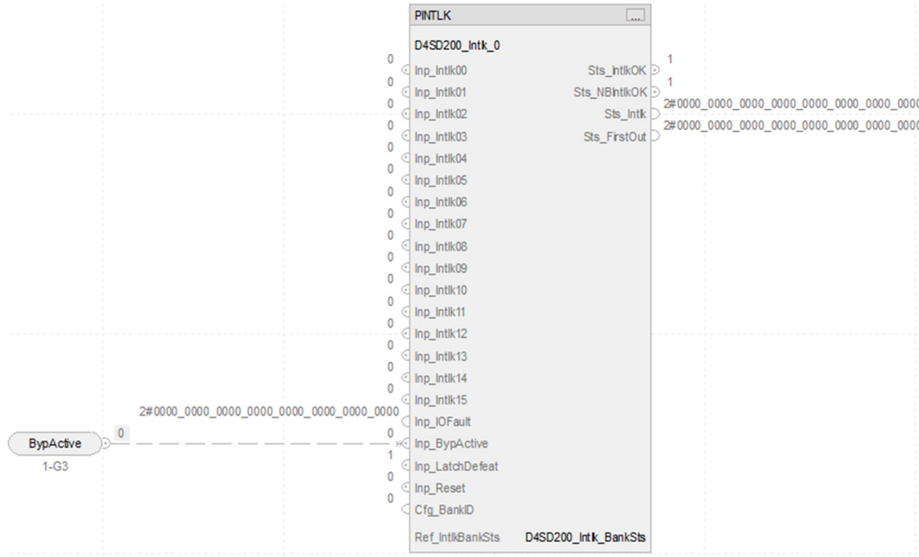
PPERM Input References

Parameter	Description
BypActive	Input connection from the CS_PD4SD sheet

PPERM Output References

Parameter	Description
PermOK0 PermOK1 PermOK2 PermOK3	Overall permissive status (1 = OK to energize)
NBPermOK0 NBPermOK1 NBPermOK2 NBPermOK3	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Interlock Bank Sheet



PINTLK Input Reference

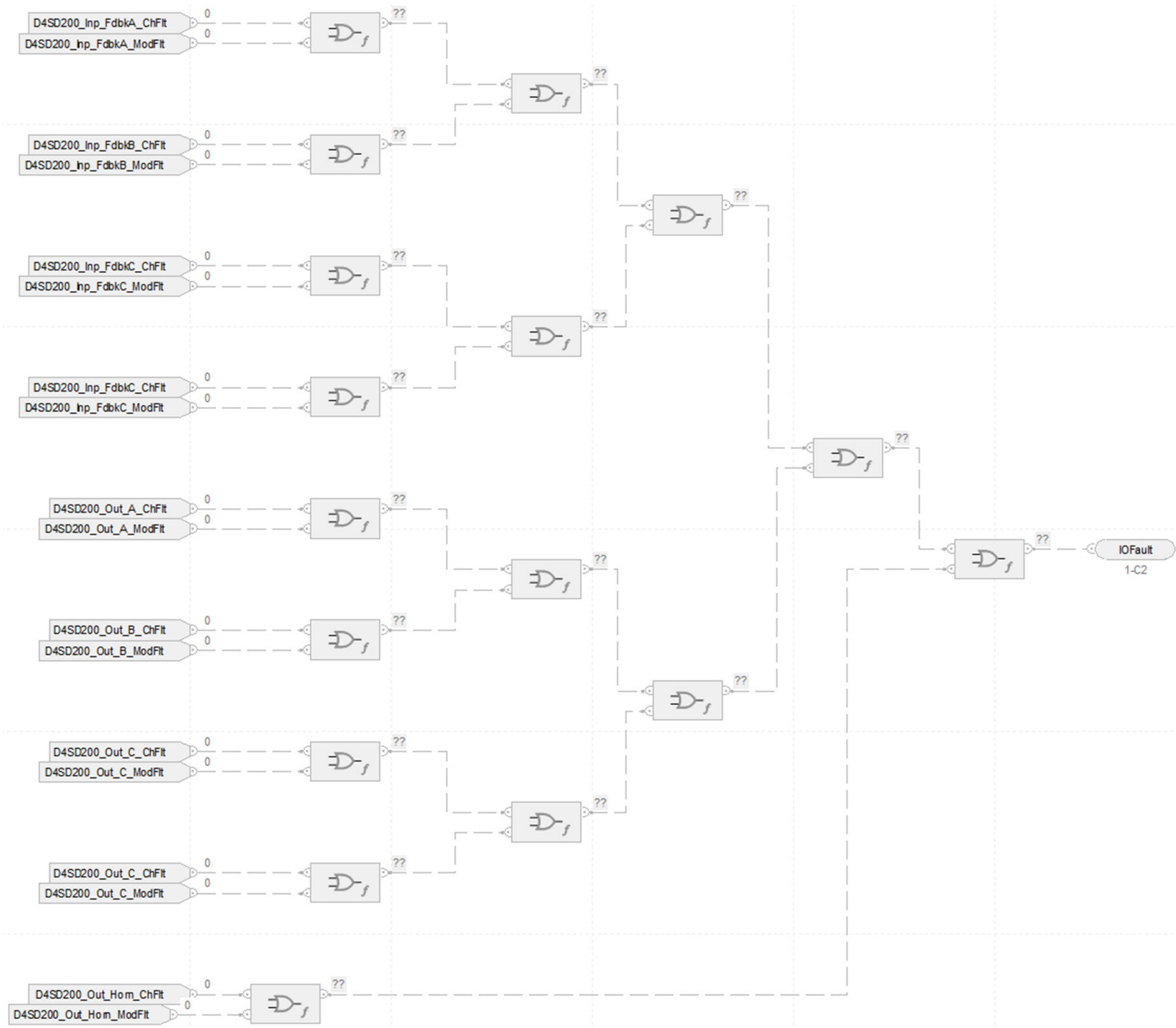
Parameter	Description
BypActive	Input connection from the CS_PD4SD sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction DS4D100 in this example corresponds to a state device
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Fault Sheet



Fault Input References

Parameter	Description
D4SD200_Inp_FdkA_ChFlt D4SD200_Inp_FdkB_ChFlt D4SD200_Inp_FdkC_ChFlt D4SD200_Inp_FdkD_ChFlt	Tieback input channel faults
D4SD200_Inp_FdkA _ModFault D4SD200_Inp_FdkB _ModFault D4SD200_Inp_FdkC _ModFault D4SD200_Inp_FdkD _ModFault	Tieback input module faults
D4SD200_Out_A_ChFlt D4SD200_Out_B_ChFlt D4SD200_Out_C_ChFlt D4SD200_Out_D_ChFlt	Output channel faults
D4SD200_Out_A_ModFlt D4SD200_Out_B_ModFlt D4SD200_Out_B_ModFlt D4SD200_Out_B_ModFlt	Output module faults
D4SD200_Out_Horn_ChFlt	Sound audible for output channel fault
D4SD200_Out_Horn_ModFlt	Sound audible for output module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PD4SD sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Deadband Controller (PDBC) Control Strategies

Use the PDBC control strategy to maintain a PV within a deadband of the SP by triggering one or two digital outputs (a raise output and a lower output).

The following PDBC control strategies are available as routines in the process library:

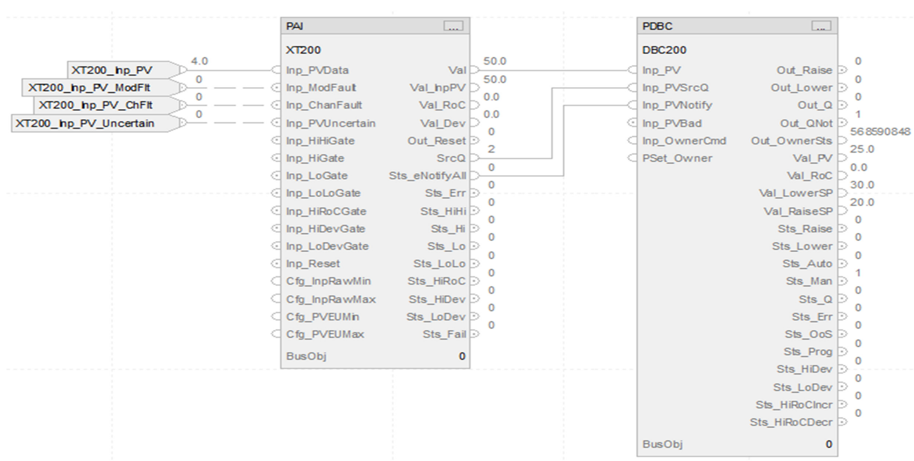
- CS_PDBC
- CS_PDBC_HART
- CS_PDBC_EtherNetIP
- CS_PDBC_FF
- CS_PDBC_PA

Import the appropriate control strategy as a **routine** in your controller project.

The PDBC control strategy contains one Function Block sheet:

Sheet	Description
CS_PDBC	Process Deadband Controller instruction
CS_PDBC_HART	Process Deadband Controller with HART input
CS_PDBC_EtherNetIP	Process Deadband Controller with EtherNetIP
CS_PDBC_FF	Process Deadband Controller with FOUNDATION Fieldbus input
CS_PDBC_PA	Process Deadband Controller with PA input

CS_PDBC Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute XT200 the instances of XT101

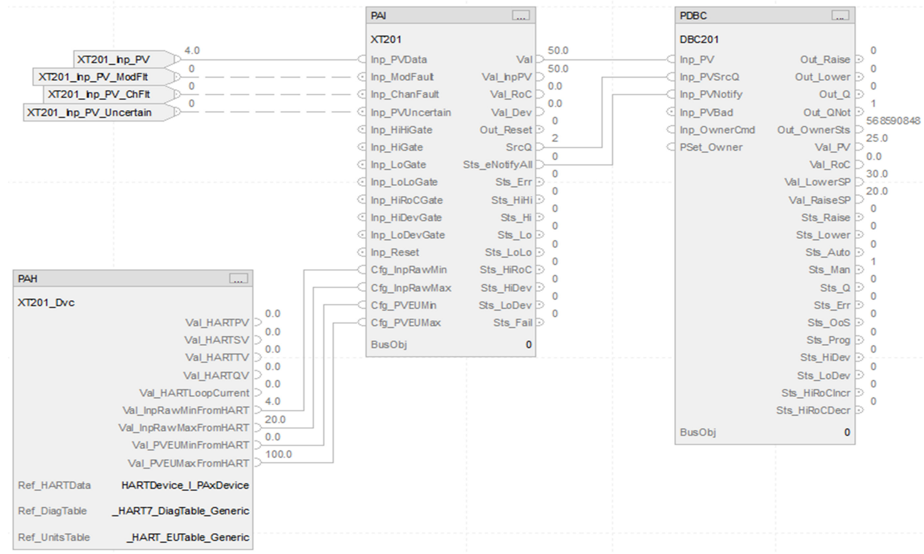
PAI Outputs to PDBC Inputs

Parameter	Description
Val	Value for PV parameter Process Variable (PVEU)
SrcQ	Value for PDBC Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PDBC Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

PDBC Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DEADBAND	Instance of data structure (backing tag) required for proper operation of instruction.
BusObj	BUS_OBJ	Bus component for organization control 0 if not using organization Bus[x].Obj when using organization. See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PDBC_HART Sheet

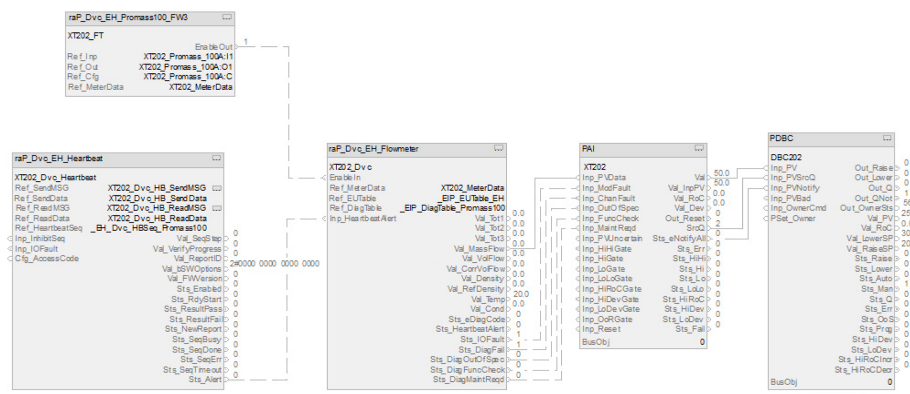


The CS_PDBC_HART control strategy operates the same as the CS_PDBC control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute DBC201 for the PV data instance of XT100
- Substitute XT201 for the remaining instances of XT100

For more information, see HART Integration on page 31.

CS_PDBC_EtherNetIP Sheet

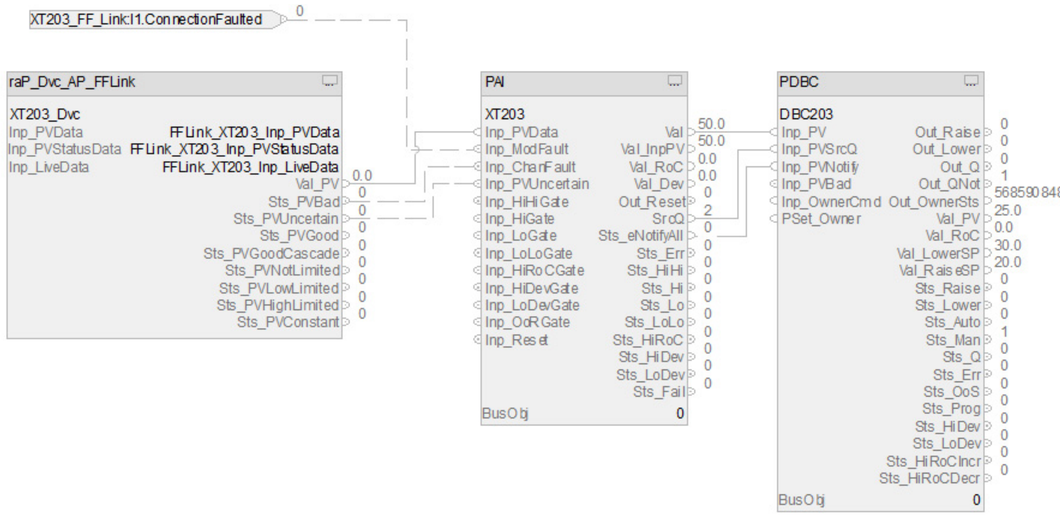


The CS_PDBC_EtherNetIP control strategy operates the same as the CS_PDBC control strategy but relies on EtherNet/IP™ input data.

- For information on the EtherNet/IP outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute DBC202 for the PV data instance of XT100
- Substitute XT202 for the remaining instances of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PDBC_FF Sheet

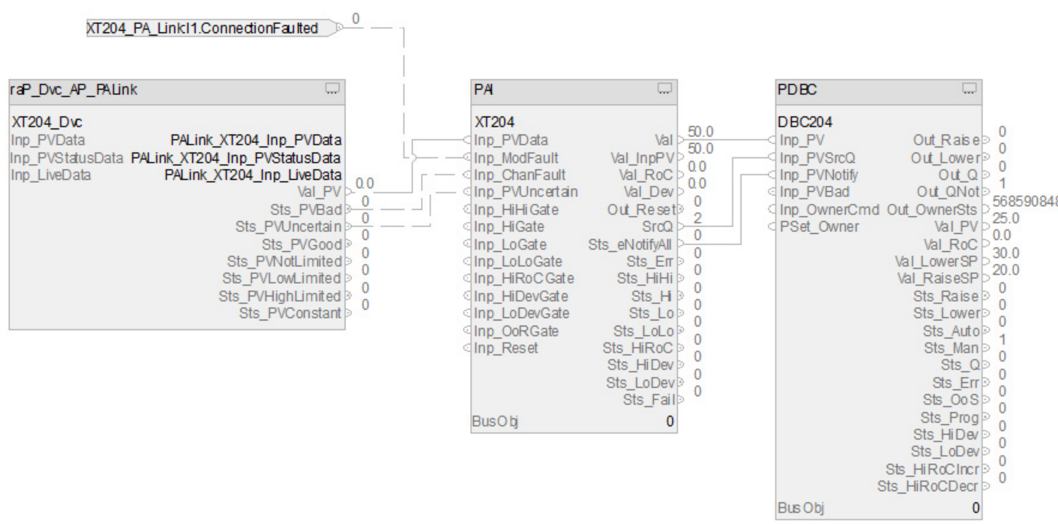


The CS_PDBC_FF control strategy operates the same as the CS_PDBC control strategy but relies on FOUNDATION Fieldbus input data.

- For information on the FOUNDATION Fieldbus outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute DBC203 for the PV data instance of XT
- Substitute XT202 for the remaining instances of XT

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PDBC_PA Sheet



The CS_PDBC_PA control strategy operates the same as the CS_PDBC control strategy but relies on PROFIBUS PA input data.

- For information on the Profibus PA outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute DBC204 for the PV data instance of XT
- Substitute XT204 for the remaining instances of XT

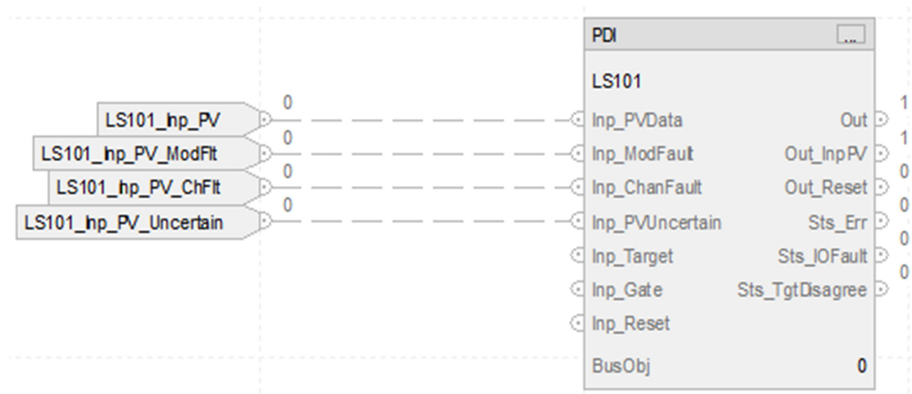
For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Process Discrete Input (PDI) Control Strategy

Use the PDI control strategy to monitor a discrete (true or false) input and check for alarm conditions. The PDI instruction processes a signal from a channel of a discrete input module. Use the PDI instruction with any discrete (BOOL) signal.

The CS_PDI control strategy is available as a routine in the process library. Import the control strategy as a **routine** in your controller project. The PDI control strategy contains one CS_PDI Function Block sheet.

CS_PDI Sheet



PDI Input References

Parameter	Description
LS101_Inp_PVData	Process variable input Source: sensor or input
LS101_Inp_PV_ModFlt	Process variable input module fault 1 = I/O module failure or module communication status bad 0 = OK
LS101_Inp_PV_ChFlt	Process variable input channel fault 1 = I/O channel fault or failure 0 = OK
LS101_Inp_PV_Uncertain	Process variable input uncertain Indicates the channel data accuracy is undetermined 1 = The channel data is uncertain This input sets Sts_PVUncertain if not in Virtual

For examples on how to map device input tags to the Inp_PVData, Inp_ModFault, Inp_ChanFault, and Inp_PVUnceratin references, see PlantPAx Control Strategies on page 19.

PDI Configuration Considerations

Operand	Type	Description
PDI tag	P_DISCRETE_INPUT	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

Notes:

Process Discrete Output (PDO) Control Strategies

Use a PDO control strategy to drive a discrete (true/false) output, monitor discrete inputs serving as feedbacks from a device driven by the discrete output, and check 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 operates in a variety of modes, and can provide steady, single pulsed, or continually pulsed output.

The following PDO control strategies are available as routines in the process library:

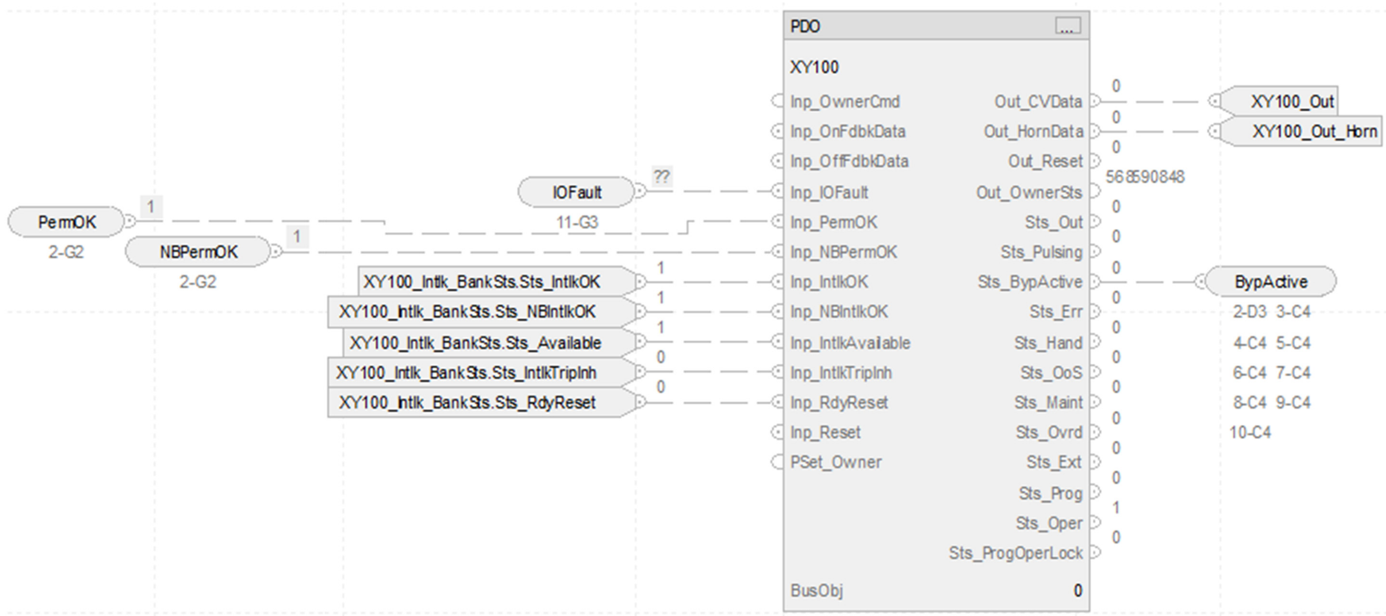
- CS_PDO (with interlocks)
- CS_PDO_noIntlk (without interlocks)

Import the appropriate control strategy as a **routine** in your controller project.

The PDO control strategies contain these Function Block sheets:

Sheet	Description
CS_PDO	Process Discrete Output instruction
Permissive	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	Only in CS_PDO The PDO instruction monitors bypassable and non-bypassable Interlocks that force the output to the configured safe state. There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors the input and output modules and channels used to interface with the device for fault conditions and raises an alarm on an I/O fault.

CS_PDO Sheet



PDO Input References

Parameter	Description
IOFault	Input connection from the IO Faults sheet
PermOK	Input connection from Permissive sheet 1 = On permissives OK, device can turn On
NBPermOK	Input connection from Permissive sheet 1 = Non-bypassable On permissives OK, device can turn On
XY100_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XY100_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XY100_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XY100_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
XY100_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PDO Output References

Parameter	Description
XY100_Out_CVData	Control Variable output CV output in raw (I/O Card) units. Extended properties of this member: Engineering Unit - Raw units (text) used for the analog output
XY100_Out_Horn	1 = Sound audible prior to commanded state change
BypActive	Output connection to permissives and interlock bank sheets

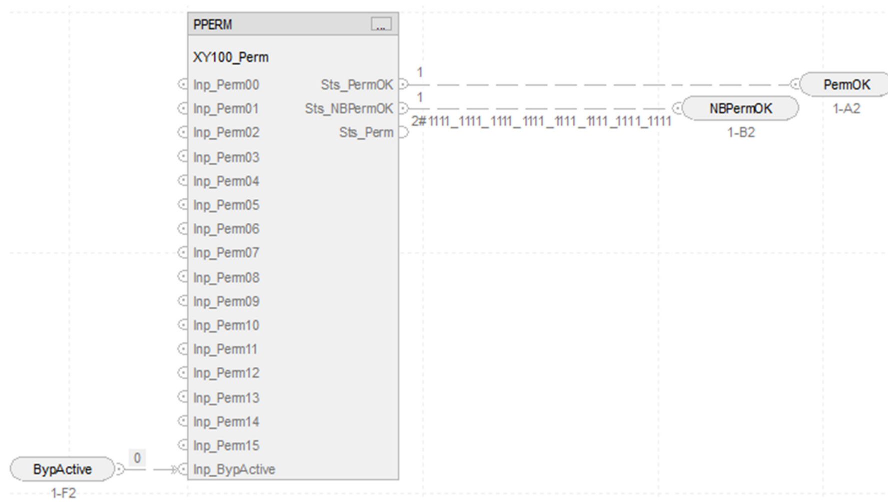
PDO Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DISCRETE_OUTPUT	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

If you use digital input pulses, configure these PDO operands:

Parameter	Description
Cfg_HasPulseOut	1 = Enable pulsing functions
Cfg_HasOnFdbk	1 = Device provides an On feedback signal
Cfg_HasOffFdbk	1 = Device provides an Off feedback signal

Permissive Sheet



PPERM Input References

Parameter	Description
BypActive	Input connection from the interlock bank sheet

PPERM Output References

Parameter	Description
PermOK	Overall permissive status (1 = OK to energize)
NBPermOK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Interlock Bank Sheet

PINTLK Input Reference

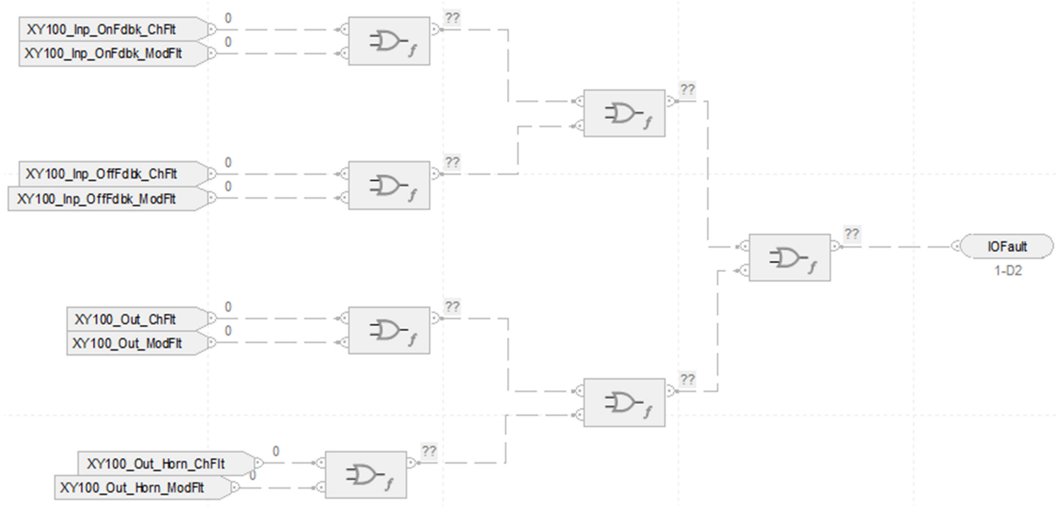
Parameter	Description
BypActive	Input connection from CS_PDO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

Parameter	Description
XY100_Inp_OnFdbk_ChFlt	On feedback channel fault
XY100_Inp_OnFdbk_ModFlt	On feedback module fault
XY100_Inp_OffFdbk_ChFlt	Off feedback channel fault
XY100_Inp_OffFdbk_ModFlt	Off feedback module fault
XY100_Out_ChFlt	Output channel fault
XY100_Out_ModFlt	Output module fault
XY100_Out_Horn_ChFlt	Output horn channel fault
XY100_Out_Horn_ModFlt	Output horn module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PDO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Notes:

Process Dosing Flow Meter (PDOSEFM) Control Strategies

Use the PDOSEFM control strategy to control 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 following PDOSEFM control strategies are available as routines in the process library:

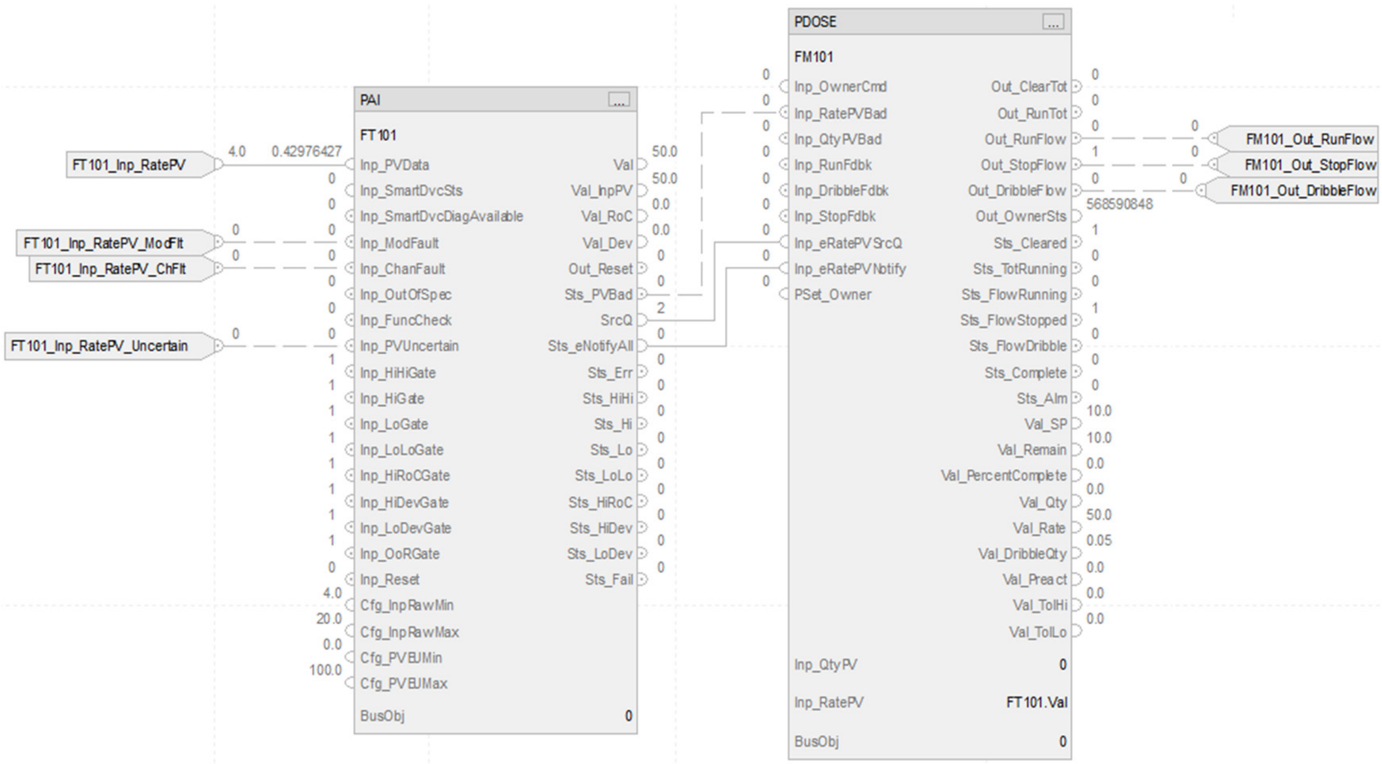
- CS_PDOSEFM
- CS_PDOSEFM_HART
- CS_PDOSEFM_EtherNetIP
- CS_PDOSEFM_EtherNetIP_NoHB
- CS_PDOSEFM_FF
- CS_PDOSEFM_PA

Import the appropriate control strategy as a **routine** in your controller project.

The PDOSEFM control strategy contains one Function Block sheet:

Sheet	Description
CS_PDOSEFM	Process Dosing Flow Meter instruction
CS_PDOSEFM_HART	Process Dosing Flow Meter instruction with HART input
CS_PDOSEFM_EtherNetIP	Process Dosing Flow Meter instruction with EtherNetIP input
CS_PDOSEFM_EtherNetIP_NoHB	Process Dosing Flow Meter instruction with No HB EtherNetIP input
CS_PDOSEFM_FF	Process Dosing Flow Meter instruction with Foundation Fieldbus input
CS_PDOSEFM_PA	Process Dosing Flow Meter instruction with PA input

CS_PDOSEFM Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute FM101 for the PV data instance of XT101
- Substitute FT101 for the remaining instances XT101

PAI Outputs to PDOSE Inputs

Parameter	Description
Sts_PVBad	Quality of PV value 1 = PV quality is flagged as Bad
SrcQ	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, 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
Sts_eNotifyAll	All alarm status enumerated values including related objects: 0 = Not in alarm, acknowledged 1 = Not in alarm, unacknowledged, or 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

PDOSE Output References

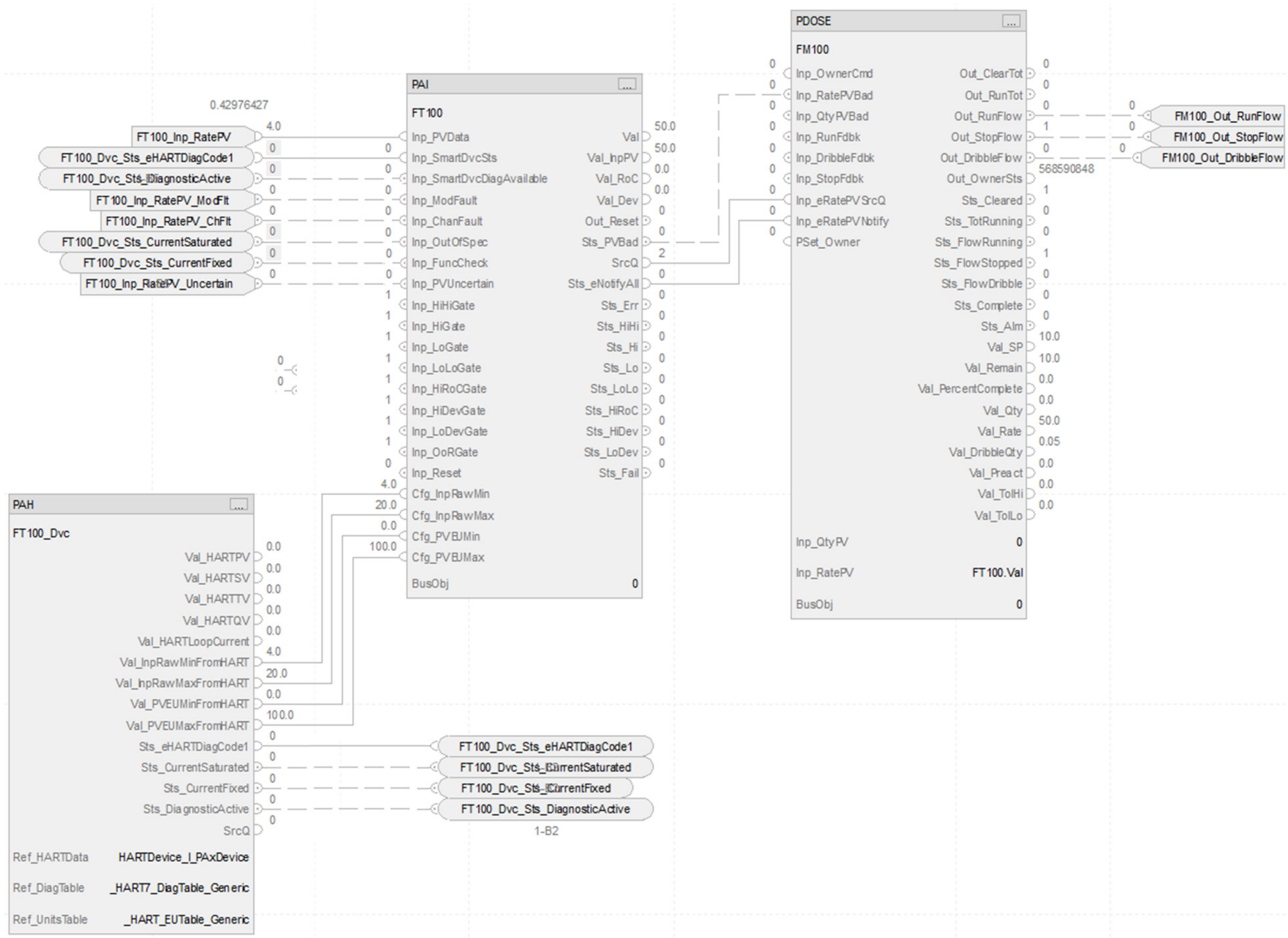
Parameter	Description
FM101_Out_RunFlow	1 = Deliver at full (fast) flow
FM101_Out_StopFlow	1 = Stop delivery equipment
FM101_Out_DribbleFlow	1 = Deliver at dribble (slow) flow

PDOSE Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DOSING	Instance of data structure (backing tag) required for proper operation of instruction
Inp_QtyPV	REAL	Quantity from flowmeter (EU or pulse count). Input is disabled if Sts_CalcQty is either of the following: • 1=integrate Inp_RatePV to get quantity • 0=use Inp_QtyPV
Inp_RatePV	REAL	Flow rate from flowmeter (EU/Time, see Cfg_RateTime). Input is disabled if Sts_CalcRate is either of the following: • 1=differentiate Inp_QtyPV to get rate • 0=use Inp_RatePV
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

For a flowmeter, you usually use the rate input. If the flowmeter provides a rate and a totalized quantity, use both the rate and quantity parameters. When both parameters are connected, the instruction uses the meter's quantity and does not need to calculate a quantity from the rate. Connect the clear totalizer output back to the meter to reset the totalizer as needed.

CS_PDOSEFM_HART Sheet

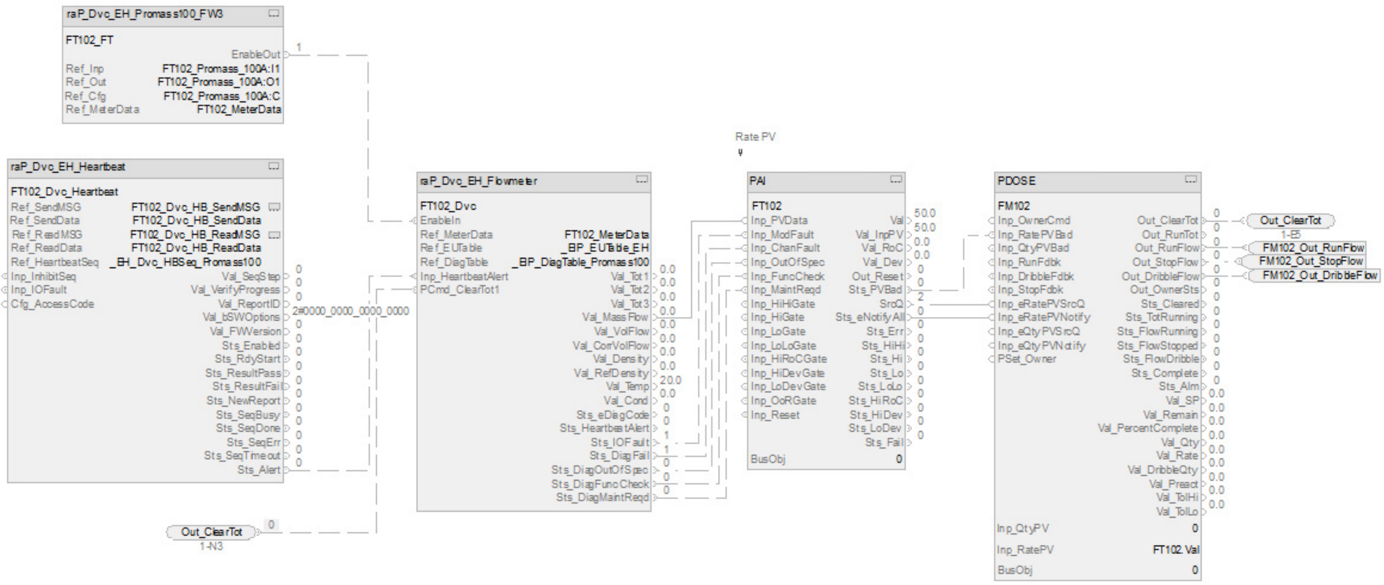


The CS_PDOSEFM_HART control strategy operates the same as the CS_PDOESFM control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute FM100 for the PV data instance of XT100
- Substitute FT100 for the remaining instances of XT100

For more information, see HART Integration on page 31.

CS_PDOSEFM_EtherNetIP Sheet

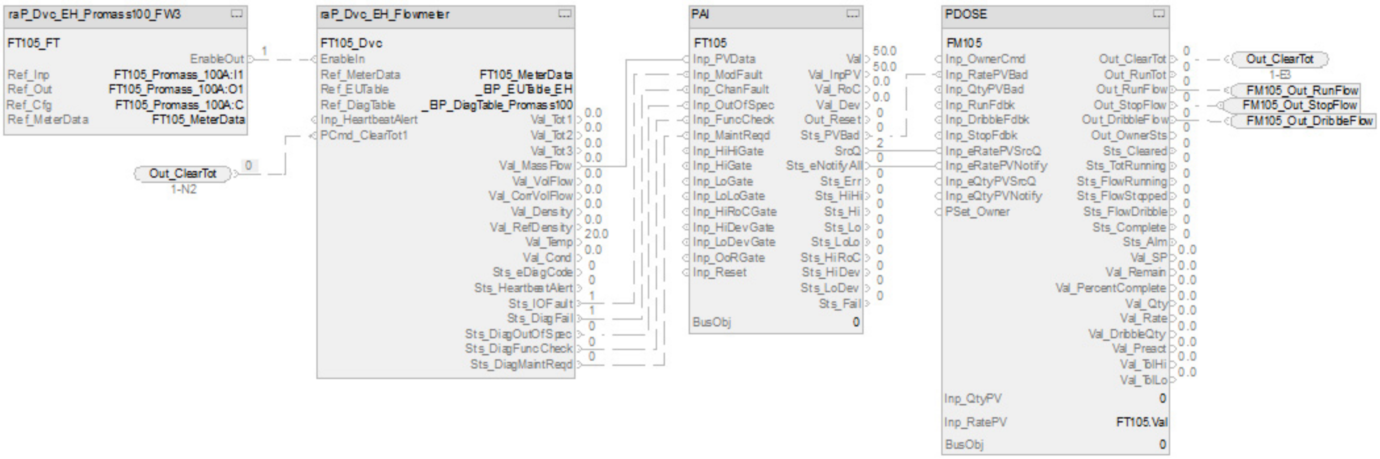


The CS_PDOSEFM_EtherNetIP control strategy operates the same as the CS_PDOESFM control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute FM102 for the PV data instance of XT100
- Substitute FT102 for the remaining instances of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PDOSEFM_EtherNetIP_NoHB Sheet

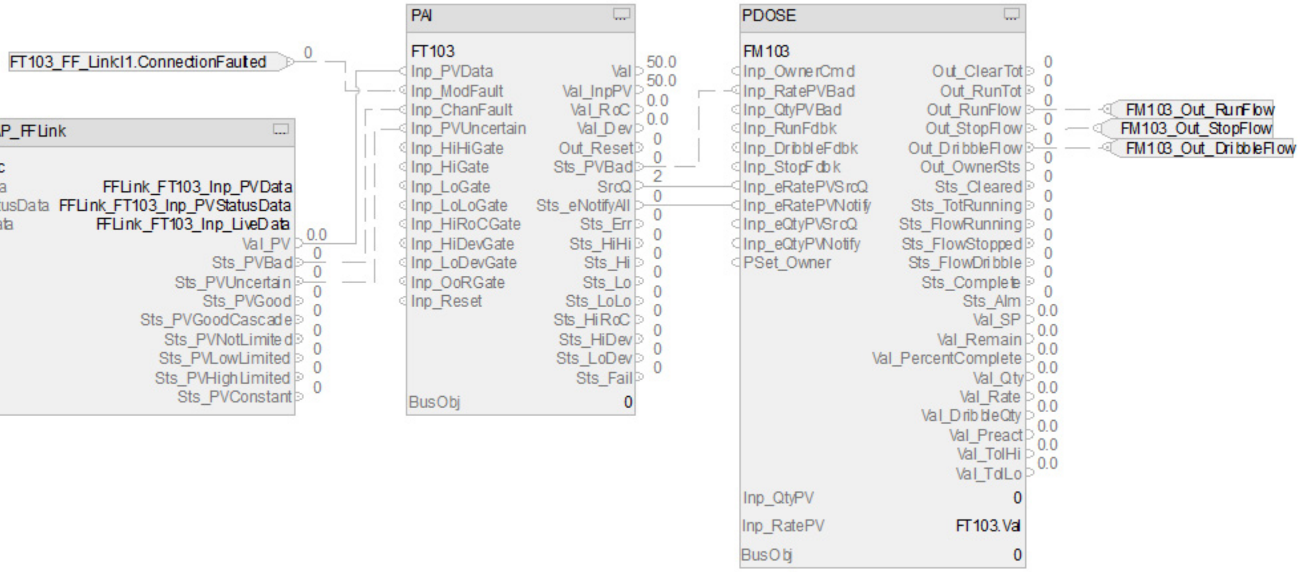


The CS_PDOSEFM_EtherNetIP_NoHB control strategy operates the same as the CS_PDOESFM control strategy but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute FM105 for the PV data instance of XT100
- Substitute FT105 for the remaining instances of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PDOSEFM_FF Sheet

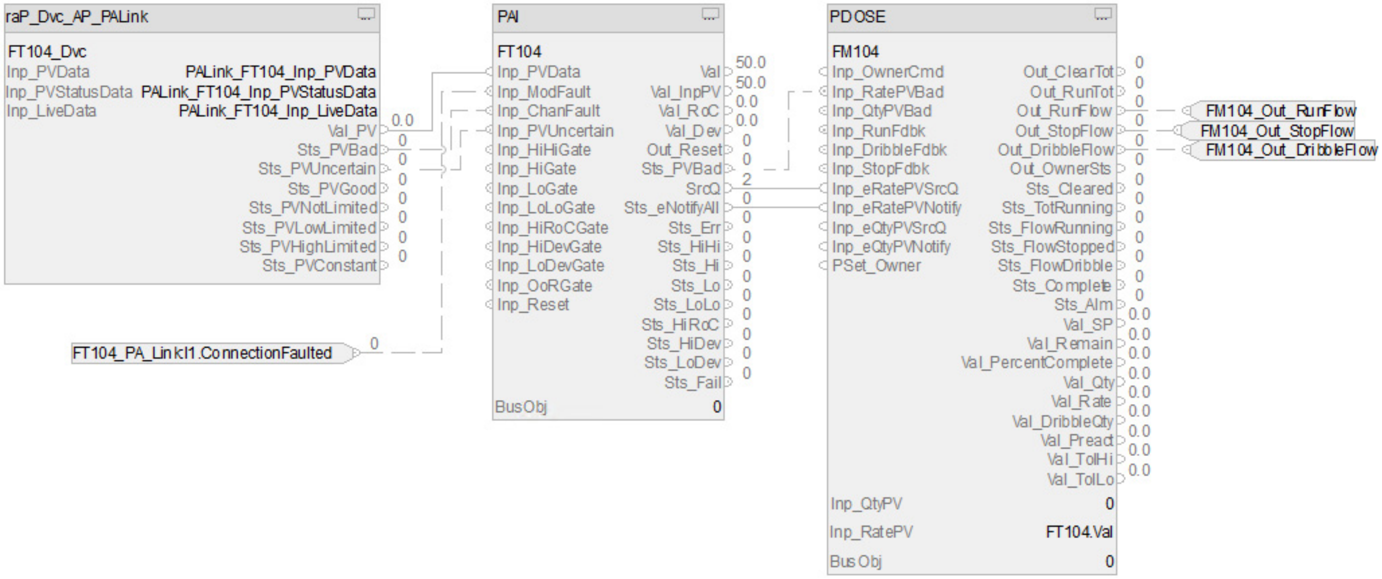


The CS_PDOSEFM_FF control strategy operates the same as the CS_PDOESFM control strategy but relies on FOUNDATION Fieldbus input data.

- For information on FOUNDATION Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute FM103 for the PV data instance of XT100
- Substitute FT103 for the remaining instances of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PDOSEFM_PA Sheet



The CS_PDOSEFM_PA control strategy operates the same as the CS_PDOESFM control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute FM104 for the PV data instance of XT100
- Substitute FT104 for the remaining instances of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Notes:

Process Dosing Weigh Scale (PDOSEWS) Control Strategy

Use the PDOSEWS control strategy to control 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 a gain in weight, or on the sourcing vessel, indicating a loss in weight. The weigh scale can be connected using an analog input, device network, or other connection.

The following PDOSEWS control strategies are available as routines in the process library:

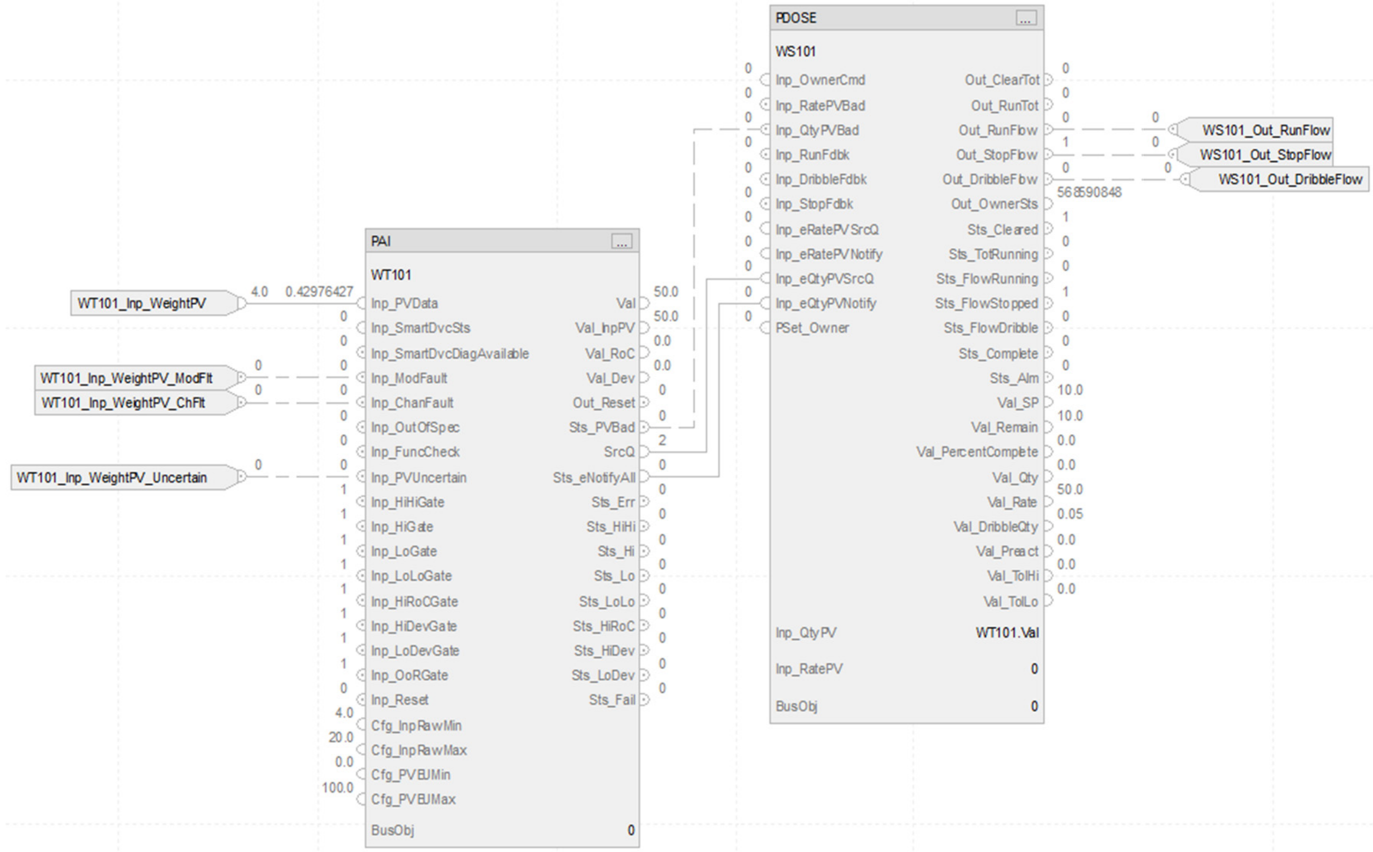
- CS_PDOSEWS
- CS_PDOSEWS_HART
- CS_PDOSEWS_EtheNetIP
- CS_PDOSEWS_EtherNetIP_NoHB
- CS_PDOSEWS_FF
- CS_PDOSEWS_PA

Import the appropriate control strategy as a **routine** in your controller project.

The PDOSEWS control strategy contains one Function Block sheet:

Sheet	Description
CS_PDOSEWS	Process Dosing Weigh Scale instruction
CS_PDOSEWS_HART	Process Dosing Weigh Scale instruction with HART input
CS_PDOSEWS_EtherNetIP	Process Dosing Weigh Scale instruction with EtherNetIP input
CS_PDOSEWS_EtherNetIP_NoHB	Process Dosing Weigh Scale instruction with No HB EtherNetIP input
CS_PDOSEWS_FF	Process Dosing Weigh Scale instruction with FOUNDATION Fieldbus input
CS_PDOSEWS_PA	Process Dosing Weigh Scale instruction with PA input

CS_PDOSEWS Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute WS101 for the PV data instance of XT101
- Substitute WT101 for the remaining instances of XT101

PAI Outputs to PDOSE Inputs

Parameter	Description	
Sts_PVBad	Quality of PV value 1 = PV quality is flagged as Bad	
SrcQ	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, 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
Sts_eNotifyAll	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

PDOSE Output References

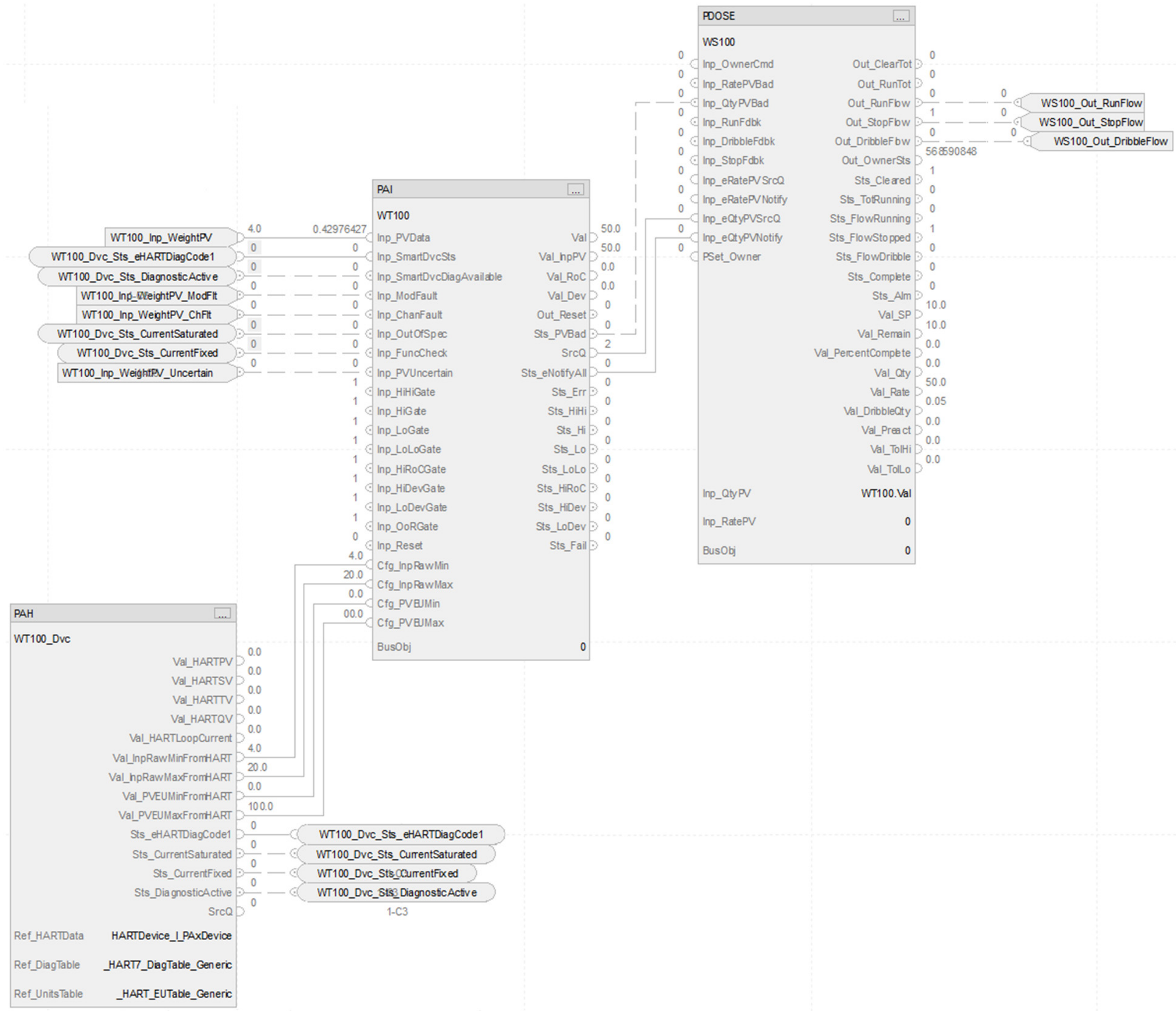
Parameter	Description
WS101_Out_RunFlow	1 = Deliver at full (fast) flow
WS101_Out_StopFlow	1 = Stop delivery equipment
WS101_Out_DribbleFlow	1 = Deliver at dribble (slow) flow

PDOSE Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DOSING	Instance of data structure (backing tag) required for proper operation of instruction
Inp_QtyPV	REAL	Quantity per time from weigh scale (EU or pulse count). Input is disabled if Sts_CalcQty is either of the following: • 1=integrate Inp_RatePV to get quantity • 0=use Inp_QtyPV
Inp_RatePV	REAL	Rate of material that is added or removed from weigh scale (EU/Time, see Cfg_RateTime). Input is disabled if Sts_CalcRate is either of the following: • 1=differentiate Inp_QtyPV to get rate • 0=use Inp_RatePV
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

A weigh scale usually only provides a quantity signal (how much material is in the device). Connect the PDOSE instruction to the quantity parameter; the instruction calculates the rate by measuring how much the quantity changes (differentiate with respect to time).

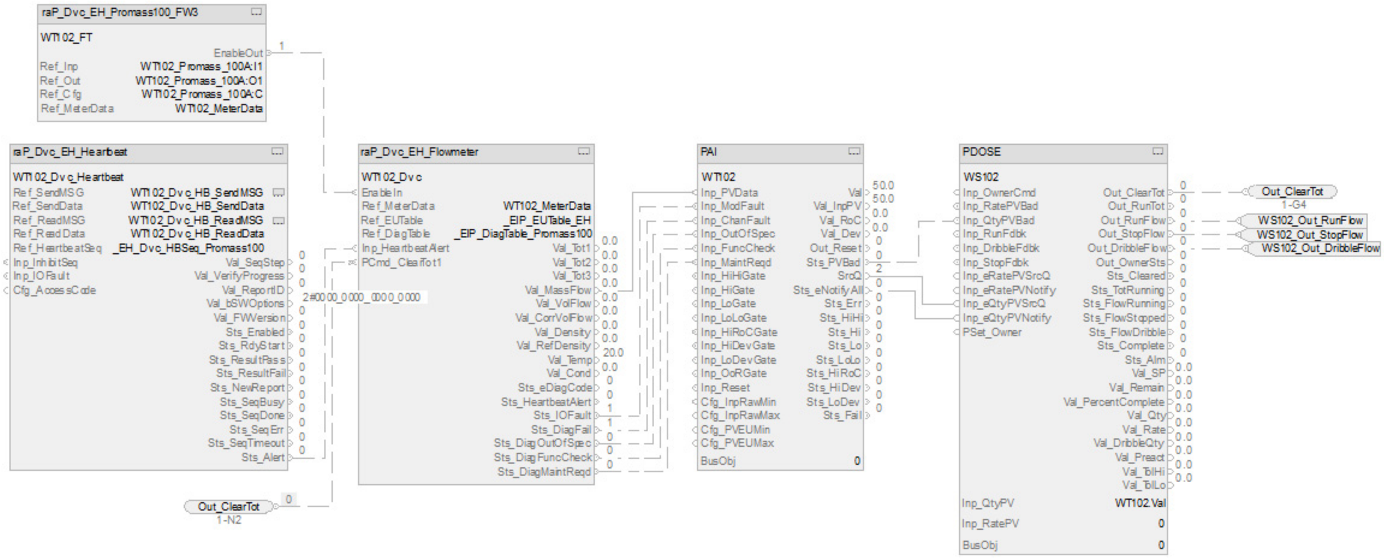
CS_PDOSEWS_HART Sheet



The CS_PDOSEWS_HART control strategy operates the same as the CS_PDOSEWS control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute for WT100 for XT100.
- For more information, see HART Integration on page 31.

CS_PDOSEWS_EtherNetIP Sheet

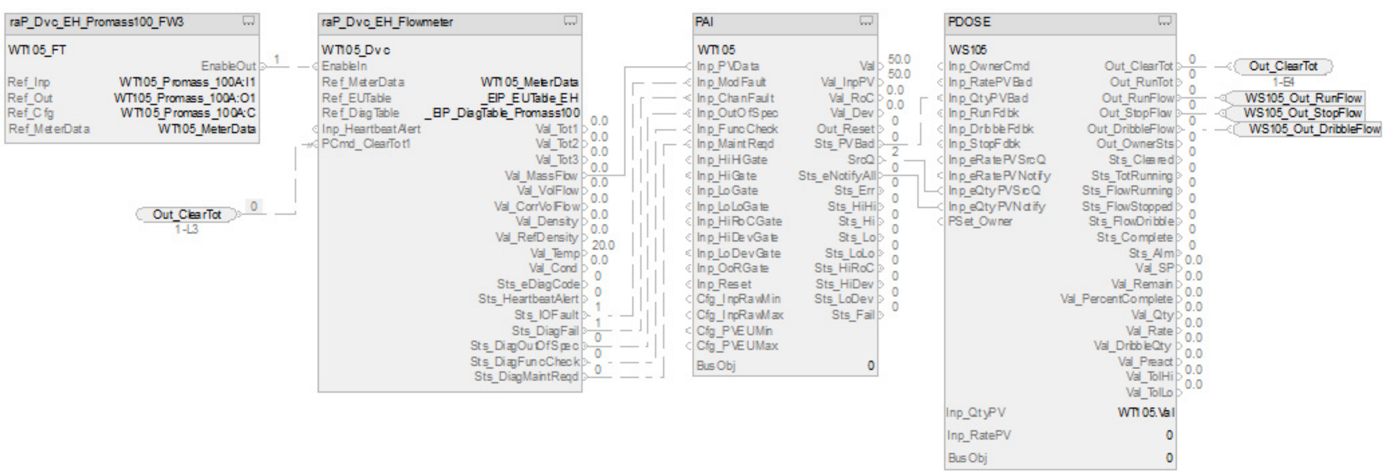


The CS_PDOSEWS_EtherNetIP control strategy operates the same as the CS_PDOSEWS control strategy but relies on EtherNet/IP™ input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute for WT102 for XT100.

For more information, see EtherNet/IP Integration on page 55.

CS_PDOSEWS_EtherNetIP_NoHB Sheet

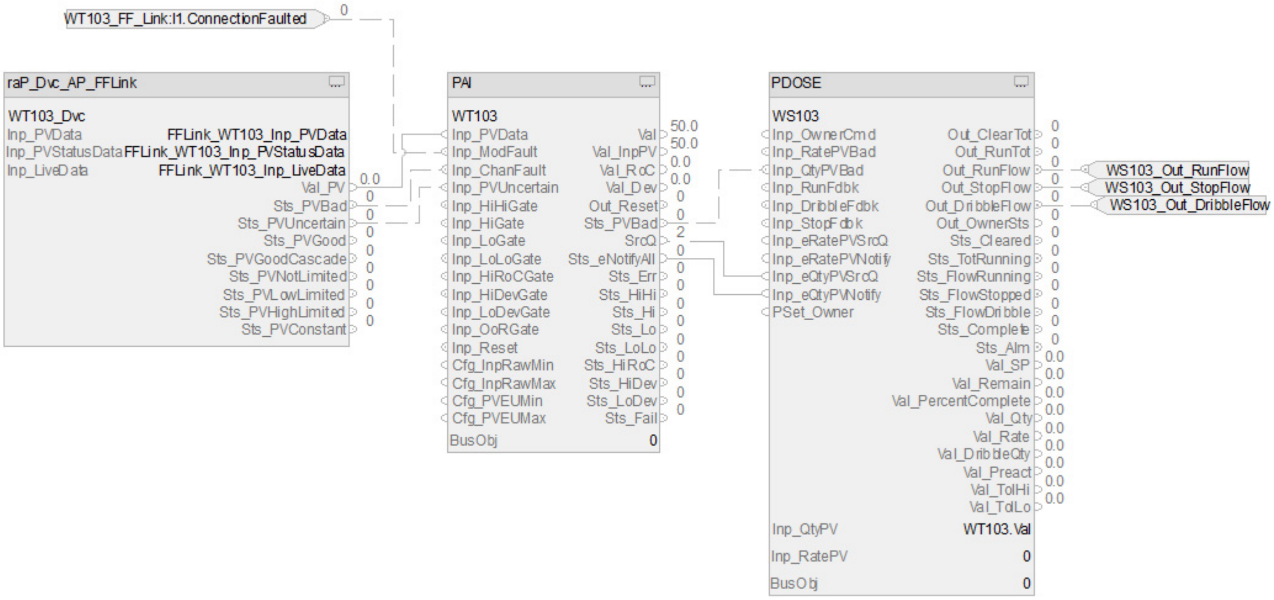


The CS_PDOSEWS_EtherNetIP_NoHB control strategy operates the same as the CS_PDOSEWS control strategy but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute for WT105 for XT100.

For more information, see EtherNet/IP Integration on page 55.

CS_PDOSEWS_FF Sheet

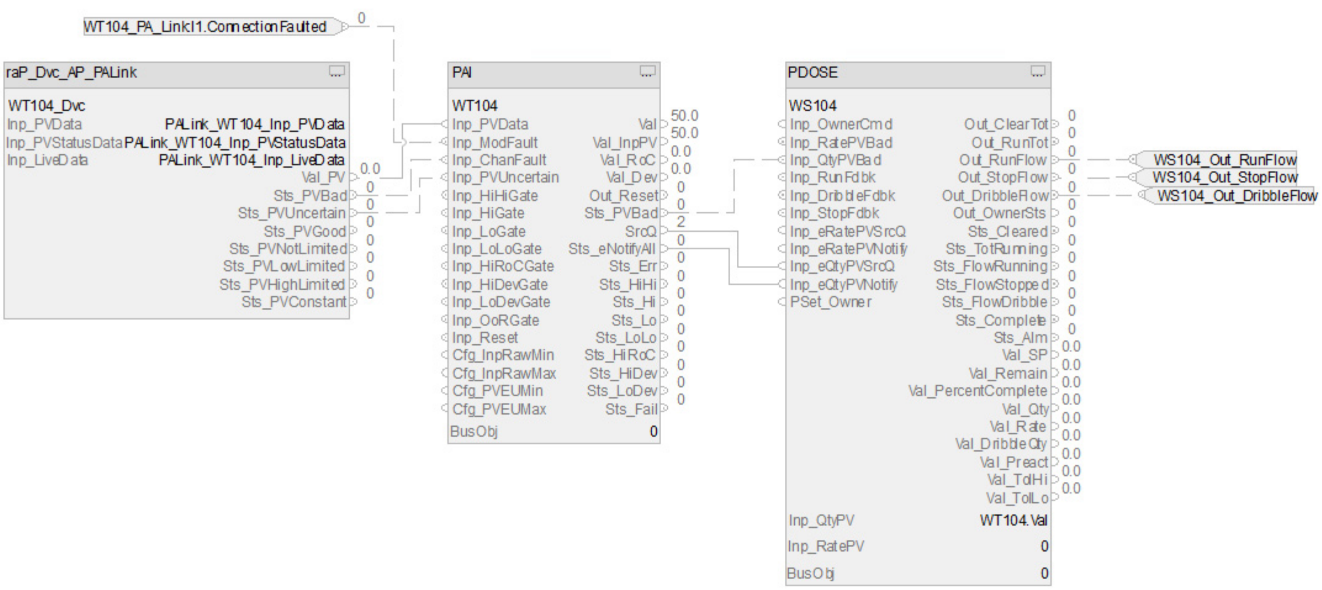


The CS_PDOSEWS_FF control strategy operates the same as the CS_PDOSEWS control strategy but relies on FOUNDATION Fieldbus input data.

- For information on FOUNDATION Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute for WT103 for XT100.

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PDOSEWS_PA Sheet



The CS_PDOSEWS_PA control strategy operates the same as the CS_PDOSEWS control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute for WT104 for XT100.

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Process Analog Fanout (PFO) Control Strategies

Use a PFO control strategy to send (fanout) one primary analog output signal to up to 8 secondary users or devices. Each secondary output has configurable gain, offset, and clamping limits.

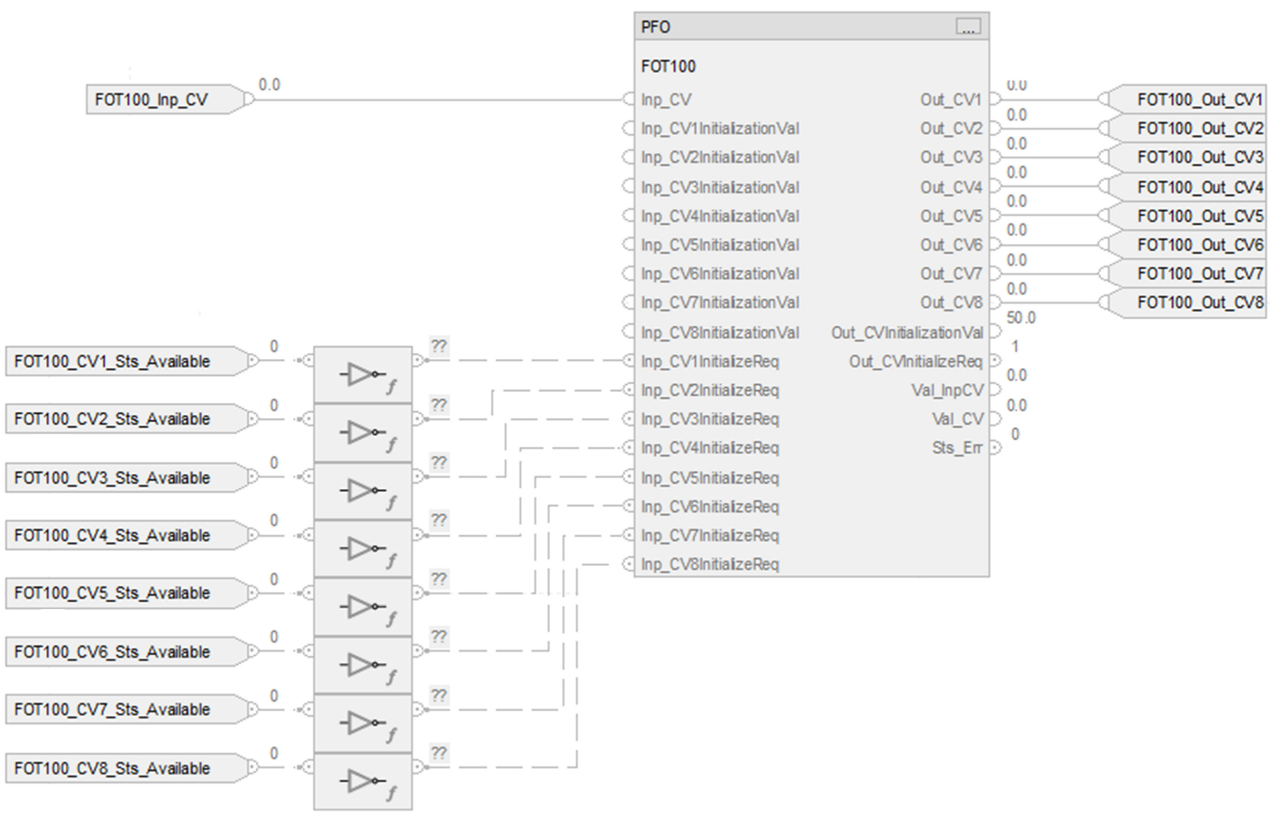
The PFO instruction receives an input CV (controlled variable) from a primary PID loop or analog output and applies rate-of-change limiting to the input signal. This control strategy is a base component of a PPID Split Range control strategy.

The following CS_PFO control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The PFO control strategy contains the CS_PFO Function Block sheet.

CS_PFO Sheet



PFO Input References

Parameter	Description
FOT100_Inp_CV	Input CV from upstream block's output (engineering units)
FOT100_CV1_Sts_Available	Initialize request from downstream block #1 1 = set Out_CV1 to Inp_CV1InitializationVal.
FOT100_CV2_Sts_Available	Initialize request from downstream block #2 1 = set Out_CV2 to Inp_CV2InitializationVal.
FOT100_CV3_Sts_Available	Initialize request from downstream block #3 1 = set Out_CV3 to Inp_CV3InitializationVal.
FOT100_CV4_Sts_Available	Initialize request from downstream block #4 1 = set Out_CV4 to Inp_CV4InitializationVal.
FOT100_CV5_Sts_Available	Initialize request from downstream block #5 1 = set Out_CV5 to Inp_CV5InitializationVal.
FOT100_CV6_Sts_Available	Initialize request from downstream block #6 1 = set Out_CV6 to Inp_CV6InitializationVal.
FOT100_CV7_Sts_Available	Initialize request from downstream block #7 1 = set Out_CV7 to Inp_CV7InitializationVal.
FOT100_CV8_Sts_Available	Initialize request from downstream block #8 1 = set Out_CV8 to Inp_CV8InitializationVal.

PFO Output References

Parameter	Description
FOT100_Out_CV1	Output to downstream block #1 (out 1 engineering unit).
FOT100_Out_CV2	Output to downstream block #2 (out 2 engineering units).
FOT100_Out_CV3	Output to downstream block #3 (out 3 engineering units).
FOT100_Out_CV4	Output to downstream block #4 (out 4 engineering units).
FOT100_Out_CV5	Output to downstream block #5 (out 5 engineering units).
FOT100_Out_CV6	Output to downstream block #6 (out 6 engineering units).
FOT100_Out_CV7	Output to downstream block #7 (out 7 engineering units).
FOT100_Out_CV8	Output to downstream block #8 (out 8 engineering units).

PFO Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_ANALOG_FANOUT	Instance of data structure (backing tag) required for proper operation of instruction

Process High or Low Selector (PHLS) Control Strategies

The PHLS control strategy is a base component of the PPID Override control strategy. Use a PHLS control strategy to select the highest or the lowest of as many as six incoming controlled variables (CVs). The instruction sends the selected CV as its output and the output(s) of the 'unselected' PPID controller(s) are kept within Kp*Error of the active PPID controller output to help ensure a quick response when another PPID's output becomes the limiting output.

For example, three PID controls feed a PHLS instruction that is configured to select the lowest of the three PID outputs as the speed reference for a drive. In normal operation, the discharge pressure PID has control, and the other PIDs track the output of the discharge pressure loop. When motor current exceeds its setpoint, or if suction pressure falls below its setpoint, the limit constrained PPID takes control to help prevent motor overcurrent or pump cavitation.

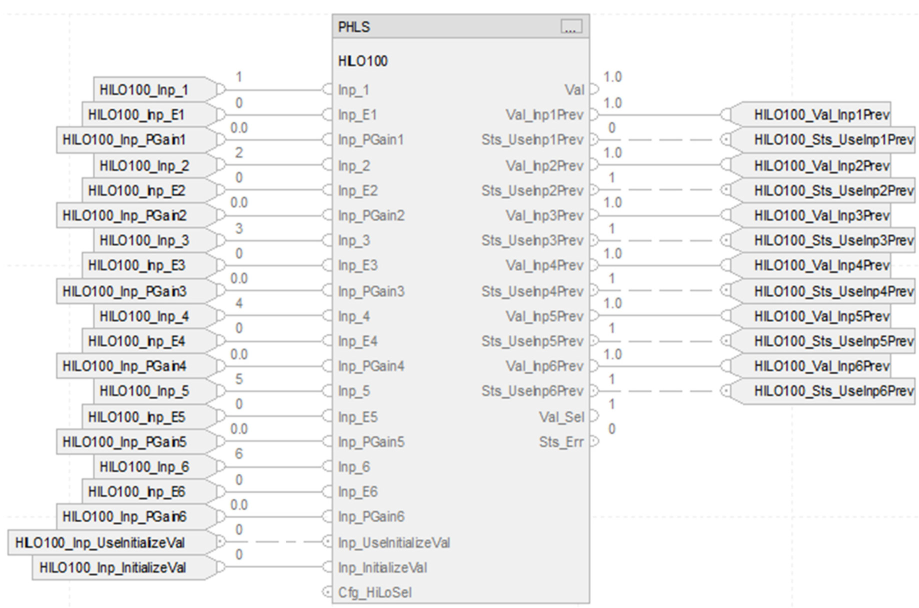
Scaling of the output of this block to CVEU can be done by a downstream PAO block. This block also supports initialization from a downstream block; the initialization is forwarded to upstream blocks.

The CS_PHLS control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The PHLS control strategy contains the CS_PHLS Function Block sheet.

CS_PHLS Sheet



PHLS Input References

Parameter	Description
HIL0100_Inp_1 HIL0100_Inp_2 HIL0100_Inp_3 HIL0100_Inp_4 HIL0100_Inp_5 HIL0100_Inp_6	Each input# is a CV value.
HIL0100_Inp_E1 HIL0100_Inp_E2 HIL0100_Inp_E3 HIL0100_Inp_E4 HIL0100_Inp_E5 HIL0100_Inp_E6	Loop error from primary input# (optional, used for offset calculation).
HIL0100_Inp_PGain1 HIL0100_Inp_PGain2 HIL0100_Inp_PGain3 HIL0100_Inp_PGain4 HIL0100_Inp_PGain5 HIL0100_Inp_PGain6	Proportional gain from primary input# (optional, used for offset calculation).
HIL0100_Inp_UseInitializeVal	Use an initialization value from a downstream block.
HIL0100_Inp_InitializeVal	Initialization value from a downstream block.

PHLS Output References

Parameter	Description
HIL0100_Val_Inp1Prev HIL0100_Val_Inp2Prev HIL0100_Val_Inp3Prev HIL0100_Val_Inp4Prev HIL0100_Val_Inp5Prev HIL0100_Val_Inp6Prev	Previous (Feedback) input value for primary input#
HIL0100_Sts_UseInp1Prev HIL0100_Sts_UseInp2Prev HIL0100_Sts_UseInp3Prev HIL0100_Sts_UseInp4Prev HIL0100_Sts_UseInp5Prev HIL0100_Sts_UseInp6Prev	Request for primary input# to use feedback Val_Inp#Prev

PHLS Configuration Considerations

Operand	Type	Description
PHLS tag	P_HIGH_LOW_SELECT	Instance of data structure (backing tag) required for proper operation of instruction

Process Lead Lag Standby (PLLS) Control Strategy

Use a PLLS control strategy to control of a parallel group of motors or drives. The number of devices to control depends on the demand on the system. The group can be configured to consist of as few as two or as many as 30 devices. The minimum demand can be set as low as 0, so that all devices are stopped at minimum demand. The maximum demand can be set as high as the number of devices in the group.

The PLLS control strategy has two options in the process library, with these routines:

Option	Routine	Description
CS_PLLS_PMTR CS_PLLS_PMTR Parameters and Local Tags MainRoutine B01_GRPMTR100_Status_Mapping B02_GRPMTR100 B03_GRPMTR100_Command_Mapping Interlocks MT400 MT401 MT402 Permissive	B01_GRPMTR100_Status_Mapping	Map motor status into the inputs of PLLS routine.
	B02_GRPMTR100	Function Block control strategy routine for motors
	B03_GRPMTR100_Command_ Mapping	Map the commands of the PLLS out to the commands of the motor
	MT400	PMTR function block for a motor
	MT401	PMTR function block for a second motor
	MT402	PMTR function block for a third motor
CS_PLLS_PVSD CS_PLLS_PVSD Parameters and Local Tags MainRoutine B01_GRPVSD100_Status_Mapping B02_GRPVSD100 B03_GRPVSD100_Command_Mapping Interlocks MT800 MT801 MT802 Permissive	B01_GRPVSD100_Status_Mapping	Map drive status into the inputs of PLLS routine
	B02_GRPVSD100	Function Block control strategy routine for motors
	B03_GPVSD100_Command_ Mapping	Map the commands of the PLLS out to the commands of the drive
	MT800	Function block for a drive
	MT801	Function block for a second drive
	MT802	Function block for a third drive

Import the PLLS as **program** in your controller project. The execution order of the routines is important for the proper operation of this control strategy.

IMPORTANT For proper operation of this control strategy:

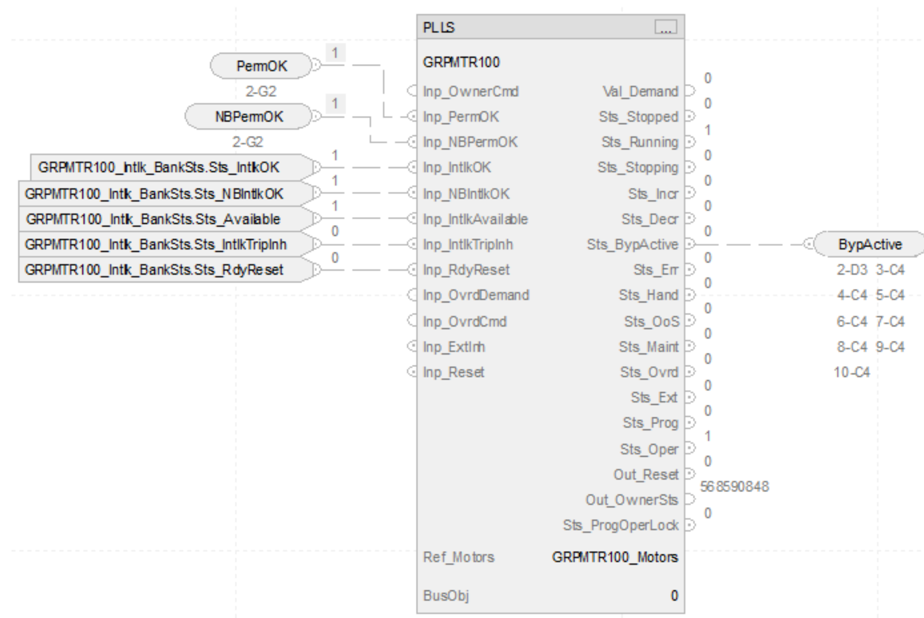
- In order for PLLS to align with the states of the motors on first scan, the motor / drive logic must be executed before this control strategy.
- The routines in this strategy must be executed in the correct order (see the MainRoutine for your PLLS option) :

1. GRPMTR100_Status_Mapping
2. GRPMTR100
3. GRPMTR100_CommandMapping.

CS_PLLS_PMTR Sheet

The B02GRPMTR100 routine contains these Function Block sheets:

Sheet	Description
CS_PLLS	Process Lead Lag Standby instruction for group drive control
Permissive	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PLLS instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.



PLLS Input References

Parameter	Description
PermOK	Input connection from permissive sheet 1 = On permissives OK, group can start
NBPermOK	Input connection from permissive sheet 1 = Non-bypassable On permissives OK, group can start
GRPMTR100_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
GRPMTR100_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
GRPMTR100_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
GRPMTR100_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops group but does not raise trip alarm
GRPMTR100_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

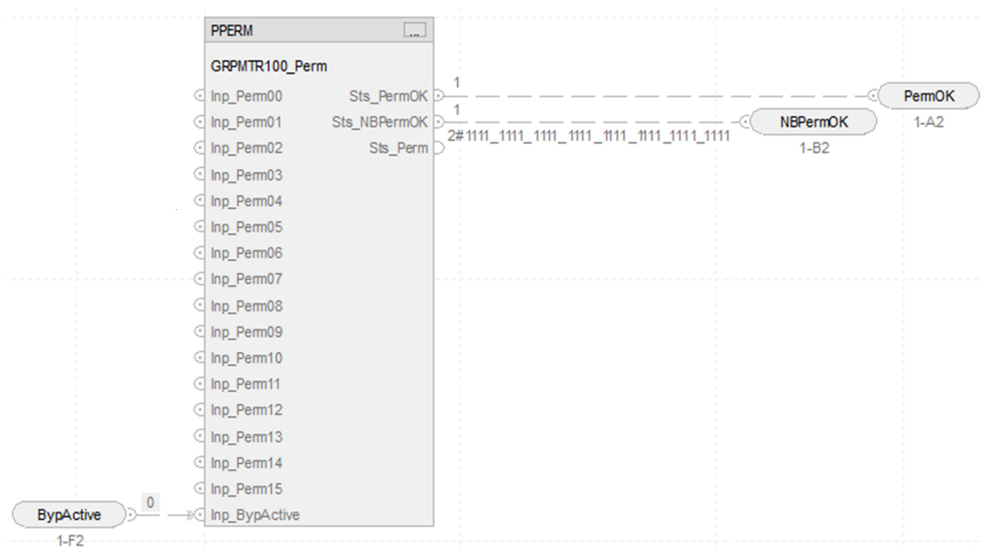
PLLS Output References

Parameter	Description
BypActive	Output connection to permissive and interlock bank sheets

PLLS Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_LEAD_LAG_STANDBY	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.
Ref_Motors	P_LEAD_LAG_STANDBY_MOTOR array	Reference to GRPMTR100_Motors array, used for motor status and motor command mapping.

Permissive Sheet



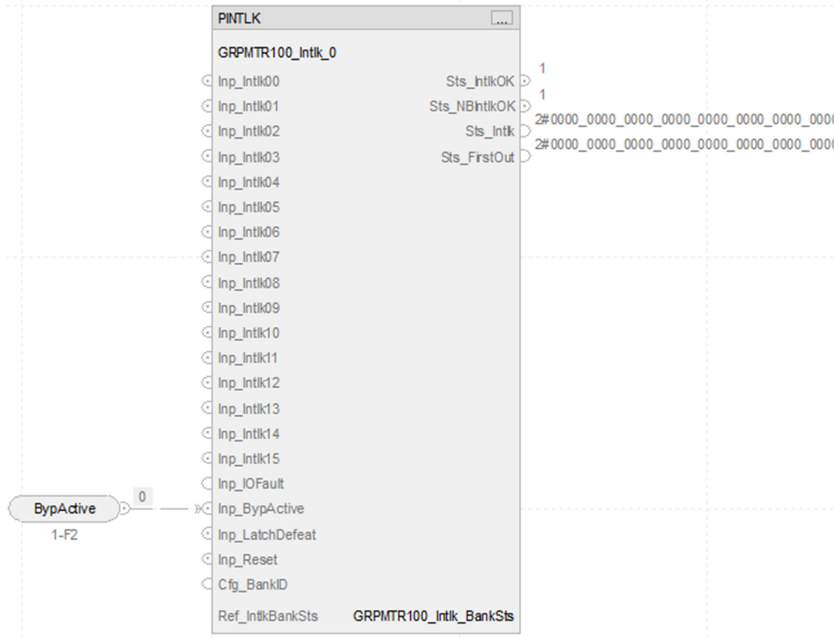
PPERM Input References

Parameter	Description
BypActive	Input connection from CS_PLLS_PMTR sheet

PPERM Output References

Parameter	Description
PermOK	Overall permissive status (1 = OK to start group)
NBPermOK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to start group)

Interlock Bank Sheet



Input Reference to PINTLK

Parameter	Description
BypActive	Input connection from CS_PLLS_PMTR sheet

PINTLK Configuration Considerations

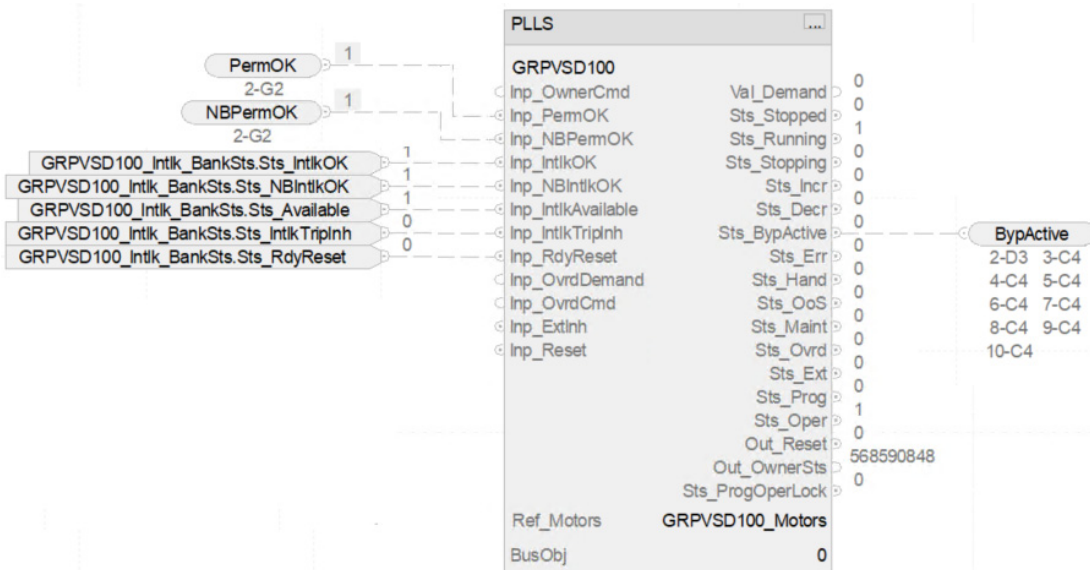
Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

CS_PLLS_PVSD Sheet

The B02GRPVSD100 routine contains these Function Block sheets:

Sheet	Description
CS_PLLS	Process Lead Lag Standby instruction for group drive control
Permissive	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PLLS instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.



PLLS Input References

Parameter	Description
PermOK	Input connection from permissive sheet 1 = On permissives OK, group can start
NBPermOK	Input connection from permissive sheet 1 = Non-bypassable On permissives OK, group can start
GRPVSD100_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
GRPVSD100_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
GRPVSD100_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
GRPVSD100_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops group but does not raise trip alarm
GRPVSD100_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

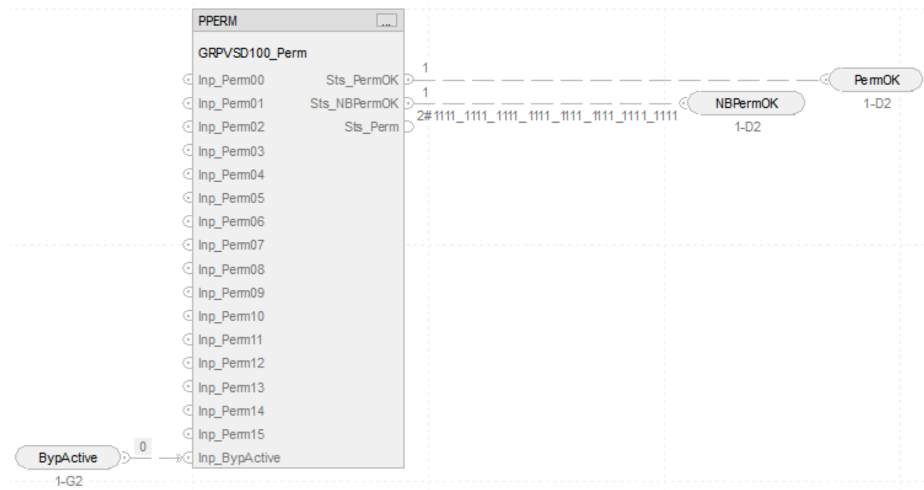
PLLS Output References

Parameter	Description
BypActive	Output connection to permissive and interlock bank sheets

PLLS Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_LEAD_LAG_STANDBY	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.
Ref_Motors	P_LEAD_LAG_STANDBY_MOTOR array	Reference to GRPVSD100_Motors array, used for motor status and motor command mapping.

Permissive Sheet



PPERM Input References

Parameter	Description
BypActive	Input connection from CS_PLLS_PVSD sheet

PPERM Output References

Parameter	Description
PermOK	Overall permissive status (1 = OK to start group)
NBPermOK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to start group)

Interlock Bank Sheet

Input Reference to PINTLK

Parameter	Description
BypActive	Input connection from CS_PLLS_PVSD sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Notes:

Chapter 23

Process Motor (PMTR) Control Strategies

Use a PMTR control strategy to monitor and control 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. The control strategy uses a Device Object to interface with the hardware motor controller.

Additional features provided in this control strategy, include a Runtime and Start Counter (to record the total run time and number of drive starts) and a Restart Inhibit (to limit the number of starts within a specified time period to protect the motor windings from overheating).

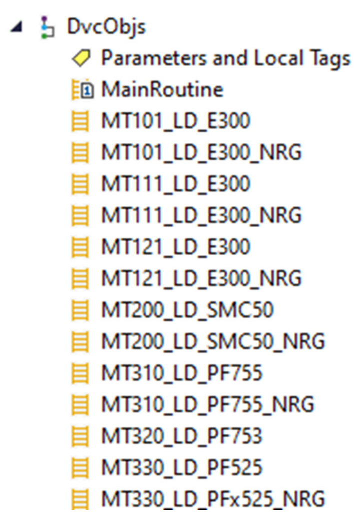
The following PMTR control strategies are available as routines in the process library:

Motor Controller Type	Control Strategy
E300™ Electronic Overload Relay	CS_PMTR_1S_E300 CS_PMTR_1S_E300_Energy CS_PMTR_2S_E300 CS_PMTR_2S_E300_Energy CS_PMTR_REV_E300 CS_PMTR_REV_E300_Energy
SMC™-50 Motor Controller	CS_PMTR_1S_SMC50 CS_PMTR_1S_SMC50_Energy
Basic	CS_PMTR_1S CS_PMTR_1S_Hand CS_PMTR_2S CS_PMTR_2S_Hand CS_PMTR_REV CS_PMTR_REV_Hand

Import the appropriate control strategy as a **routine** in your controller project.

Also, import the appropriate device object as a routine in your controller project. These objects are from the Power Device Library and must be downloaded separately from the PlantPAx® Process Library.

Each '_NRG' object uses the Energy object to group energy parameters for the device. Use this object with the corresponding, energy-related control strategy.

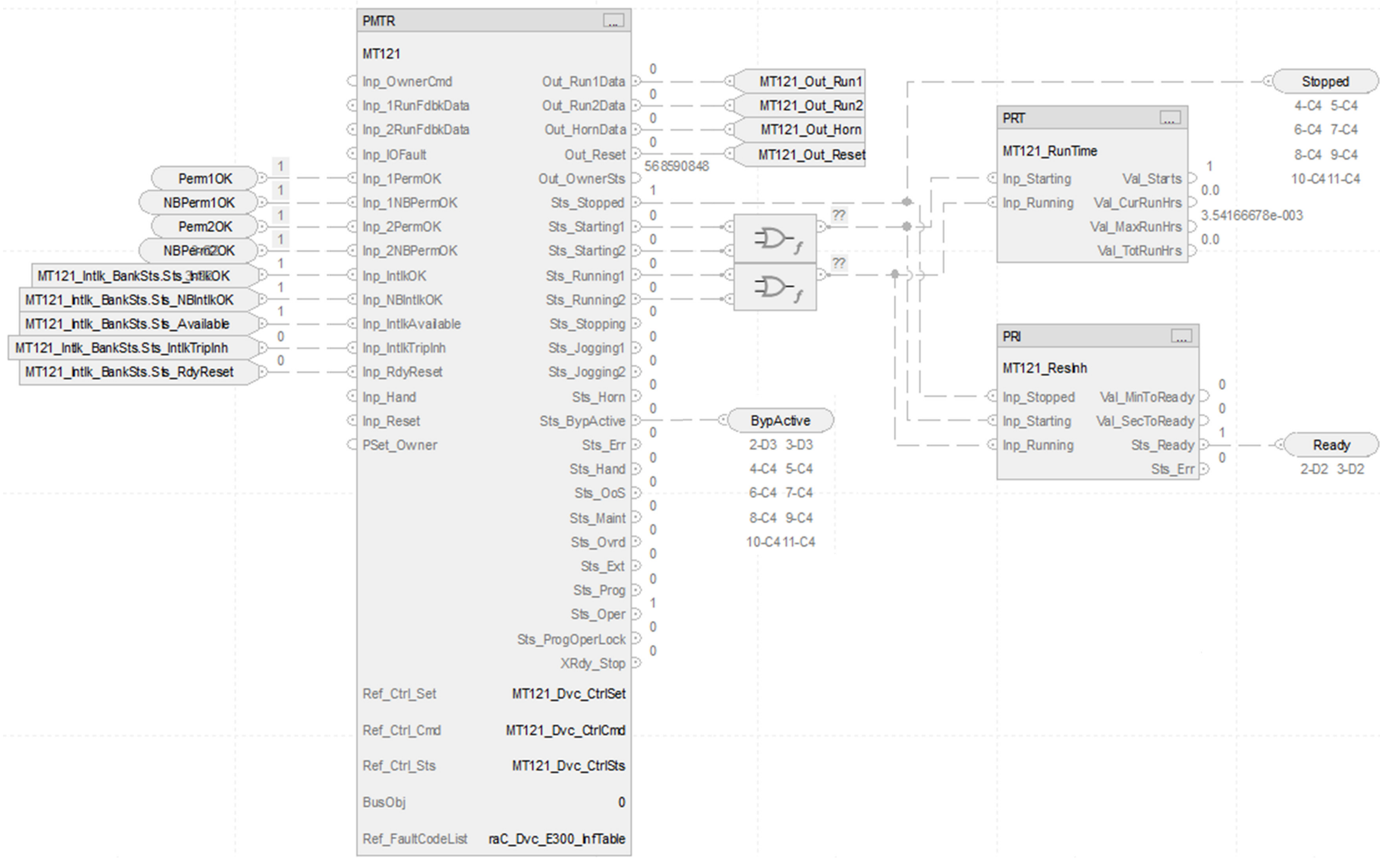


The PMTR control strategies contain these Function Block sheets:

Sheet	Description
CS_PMTR	Process Motor instruction
Permissives 1 Permissives 2	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored. The Permissives 2 sheet is only in the control strategies for two-speed and reversing motor controllers
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PMTR instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.

In the input and output reference descriptions on each sheet, [device] = PMTR instance tag.

CS_PMTR Sheet



PMTR Input References

Parameter	Description
Perm1OK	Input connection from Permissives 1 sheet (single speed) 1 = On permissives OK, device can turn On
NBPerm1OK	Input connection from Permissives 1 sheet (single speed) 1 = Non-bypassable On permissives OK, device can turn On
Perm2OK	Input connection from Permissives 2 sheet (second speed or reverse) 1 = On permissives OK, device can turn On
NBPerm2OK	Input connection from Permissives 2 sheet (second speed or reverse) 1 = Non-bypassable On permissives OK, device can turn On
[device]_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
[device]_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
[device]_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
[device]_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
[device]_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PMTR Output References

Parameter	Description
[device]_Out_Run1	Single speed 1=Start/Run Motor Reverse or Fast 0=Stop Motor (for held starter type)
[device]_Out_Run2	Second speed or reverse 1=Start/Run Motor Reverse or Fast 0=Stop Motor (for held starter type)
[device]_Out_Horn	1 = Notification before commanded state change
[device]_Out_Reset	1 = Reset command has been received and accepted
BypActive	Output connection to permissives and interlock bank sheet
Ready	Output connection to the permissive sheet
Stopped	Output connection to interlock bank sheet

The Boolean OR performs a bitwise OR based on these PMTR outputs:

- Sts_Stopped
- Sts_Starting1
- Sts_Starting2
- Sts_Running1
- Sts_Running2

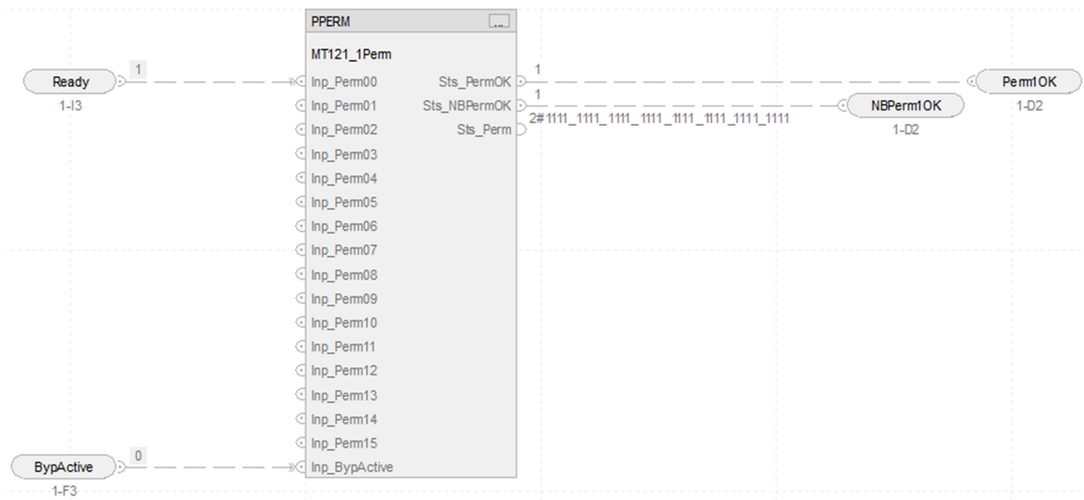
The result feeds these instructions:

Instruction	Description
Process Run Time and Start Counter (PRT)	The PRT instruction records the total run time and number of instances the drive starts.
Process Restart Inhibit (PRI)	The PRI instruction helps prevent the drive from starting repeatedly within specified time periods. Continual starts or start attempts in a short period overheat the motor windings and damage the motor.

PMTR Configuration Considerations

Operand	Type	Description
PlantPAx control	P_MOTOR_DISCRETE	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.
Ref_Ctrl_Set	RAC_ITF_DVC_PWRDISCRETE_SET	Power Discrete Automation Device Object Settings Interface Preconfigured in the device object ladder routine
Ref_Ctrl_Cmd	RAC_ITF_DVC_PWRDISCRETE_CMD	Power Discrete Automation Device Object Command Interface Preconfigured in the device object ladder routine
Ref_Ctrl_Sts	RAC_ITF_DVC_PWRDISCRETE_STS	Power Discrete Automation Device Object Status Interface Preconfigured in the device object ladder routine
Ref_FaultCodeList	RAC_CODEDESCRIPTION[400]	Fault Code to Fault Description lookup table for the motor controller Preconfigured in the device object ladder routine

Permissive Sheet



PPERM Input References

Parameter	Description
Ready	Input connection from the CS_PMTR sheet
BypActive	Input connection from the CS_PMTR sheet

PPERM Output References

Parameter	Description
Perm1OK Perm2OK	Overall permissive status (1 = OK to energize)
NBPerm1OK NBPerm2OK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Interlock Bank Sheet

PINTLK Input Reference

Parameter	Description
BypActive	Input connection from CS_PMTR sheet
Stopped	Input connection from the CS_PMTR sheet

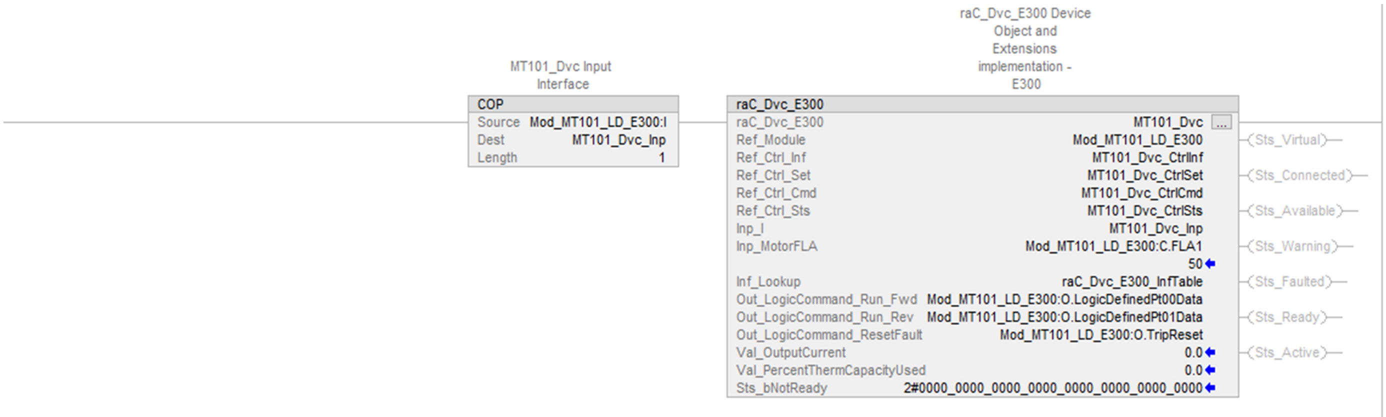
PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

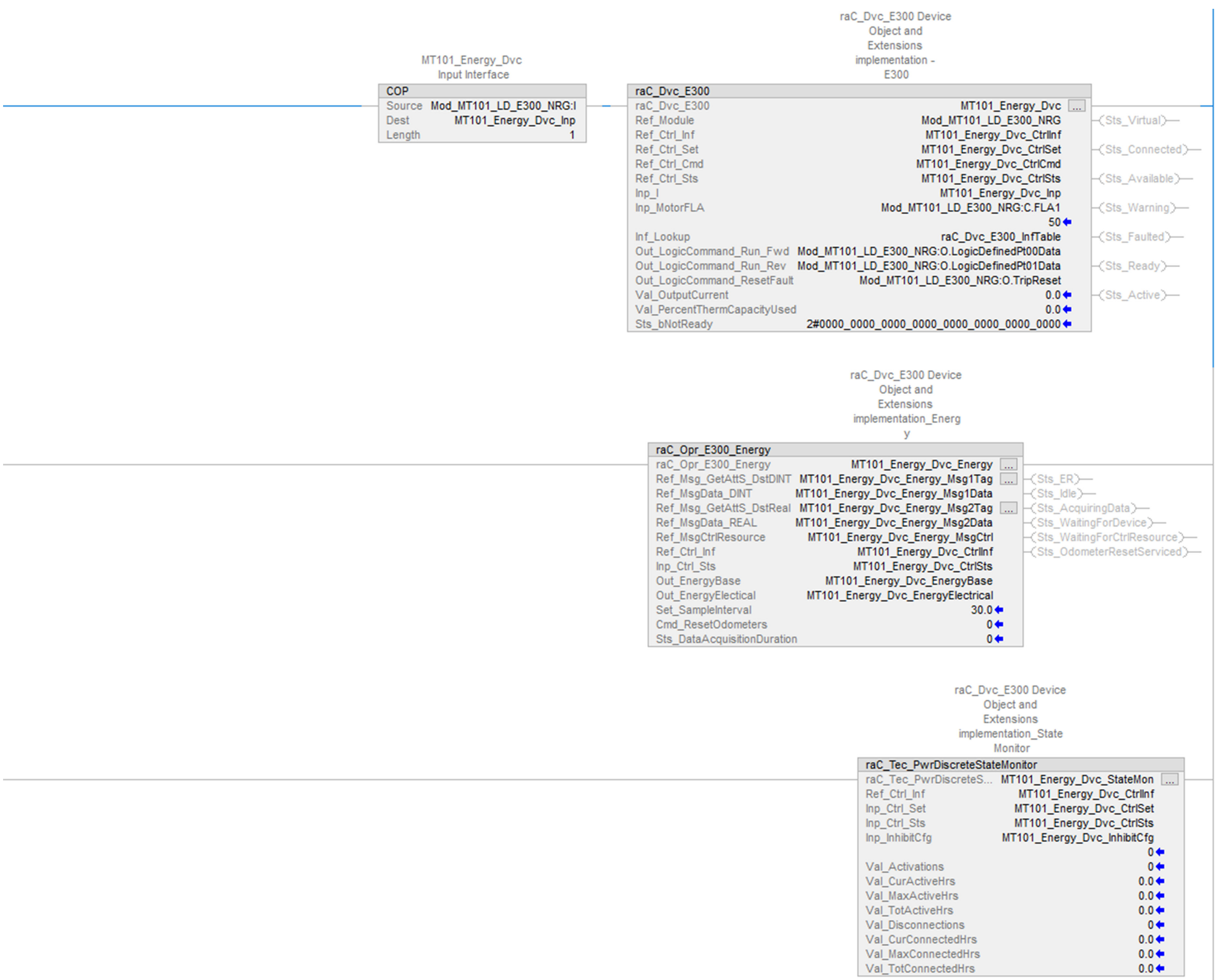
For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Motor Controller Device Objects

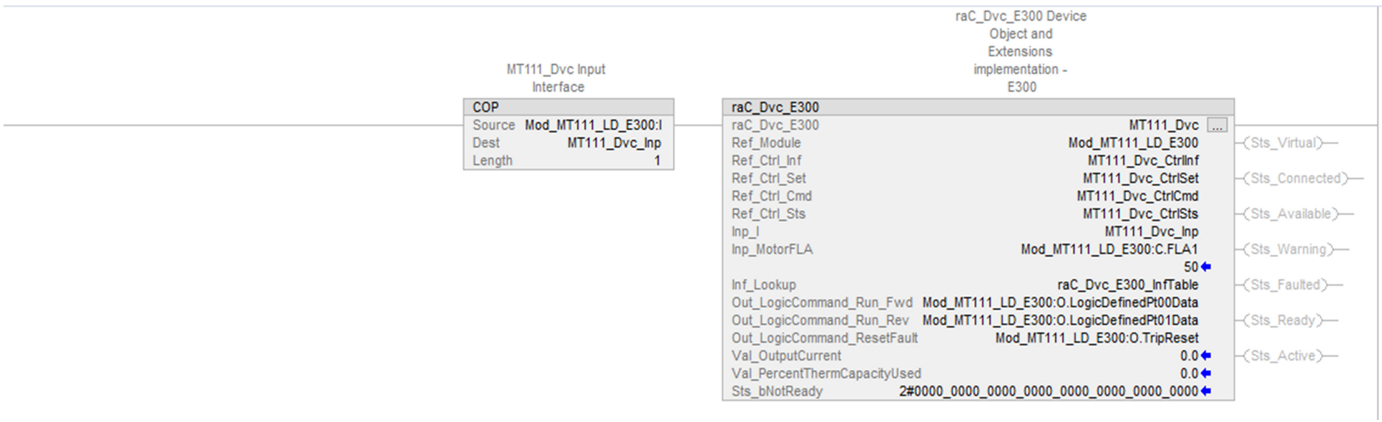
Single Speed



Single Speed with Energy Parameters

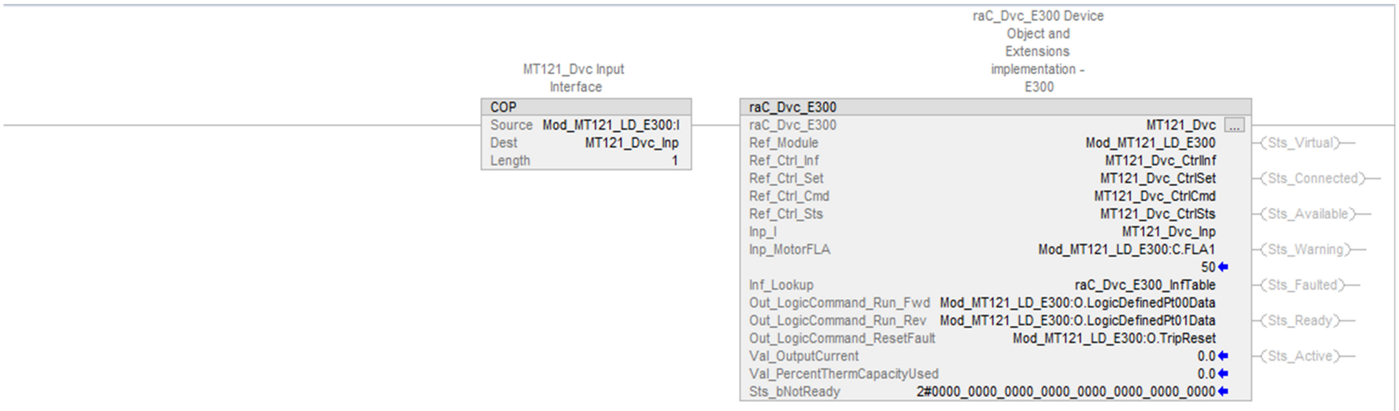


Two Speed

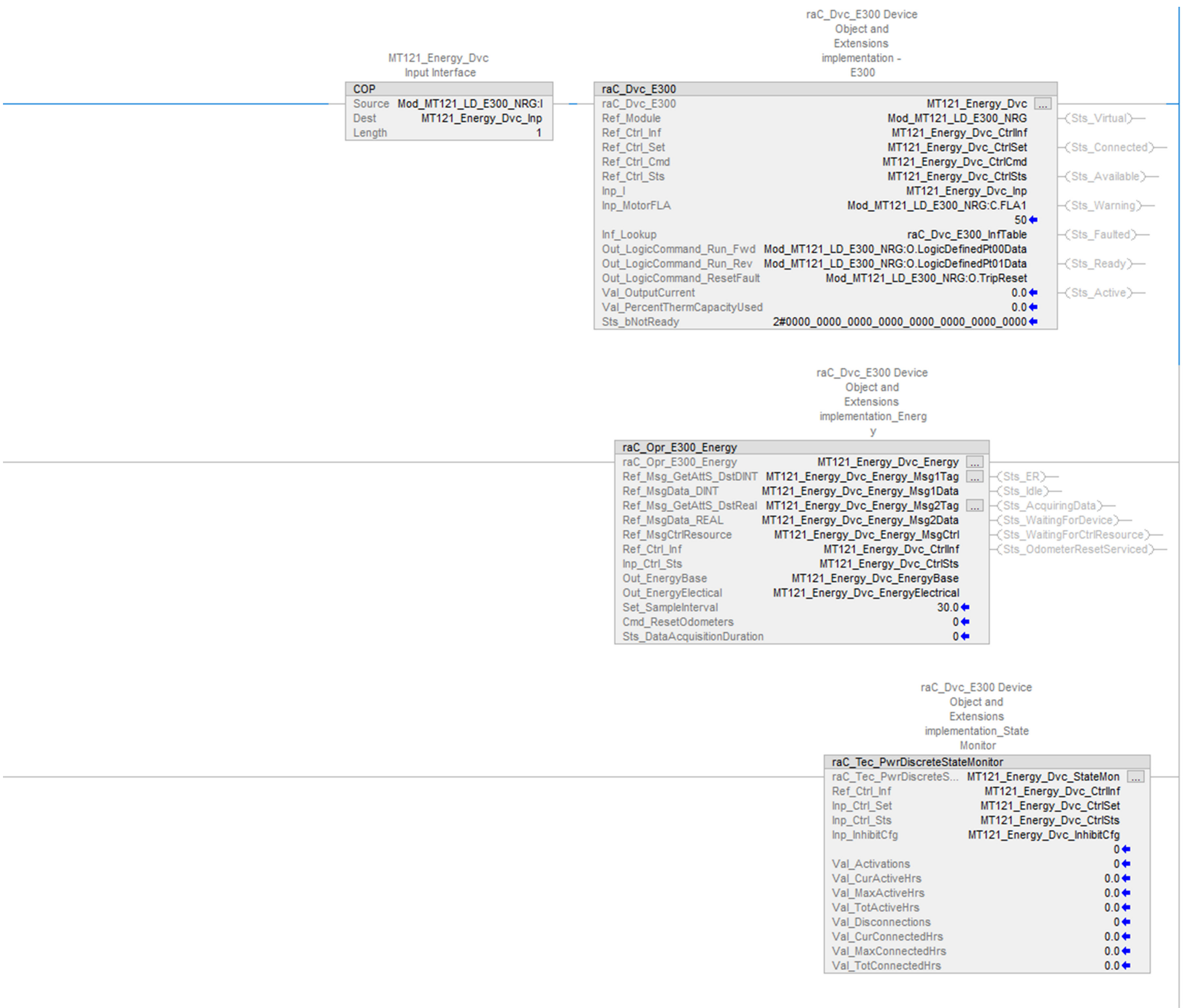


Two Speed with Energy Parameters

Reversing



Reversing with Energy Parameters



Notes:

Process n-Position (PNPOS) Control Strategy

The Process n-Position Device (PNPOS) instruction controls a circular or linear discrete device. The device can have between 2 and 30 positions. The instruction lets you select each position with associated outputs and feedbacks.

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.
- Move directly to the new position.

For circular devices, the PNPOS instruction can be configured to:

- Move only "clockwise" to increasing positions. For example, with an 8-position device, a move from position 1 to position 6 could be clockwise only (from position 1 through positions 2, 3, 4, and 5 to position 6).
- Move in whichever direction provides the shortest move. For example, with an 8-position device, it could use the shortest path (from position 1 through positions 8 and 7 to position 6).

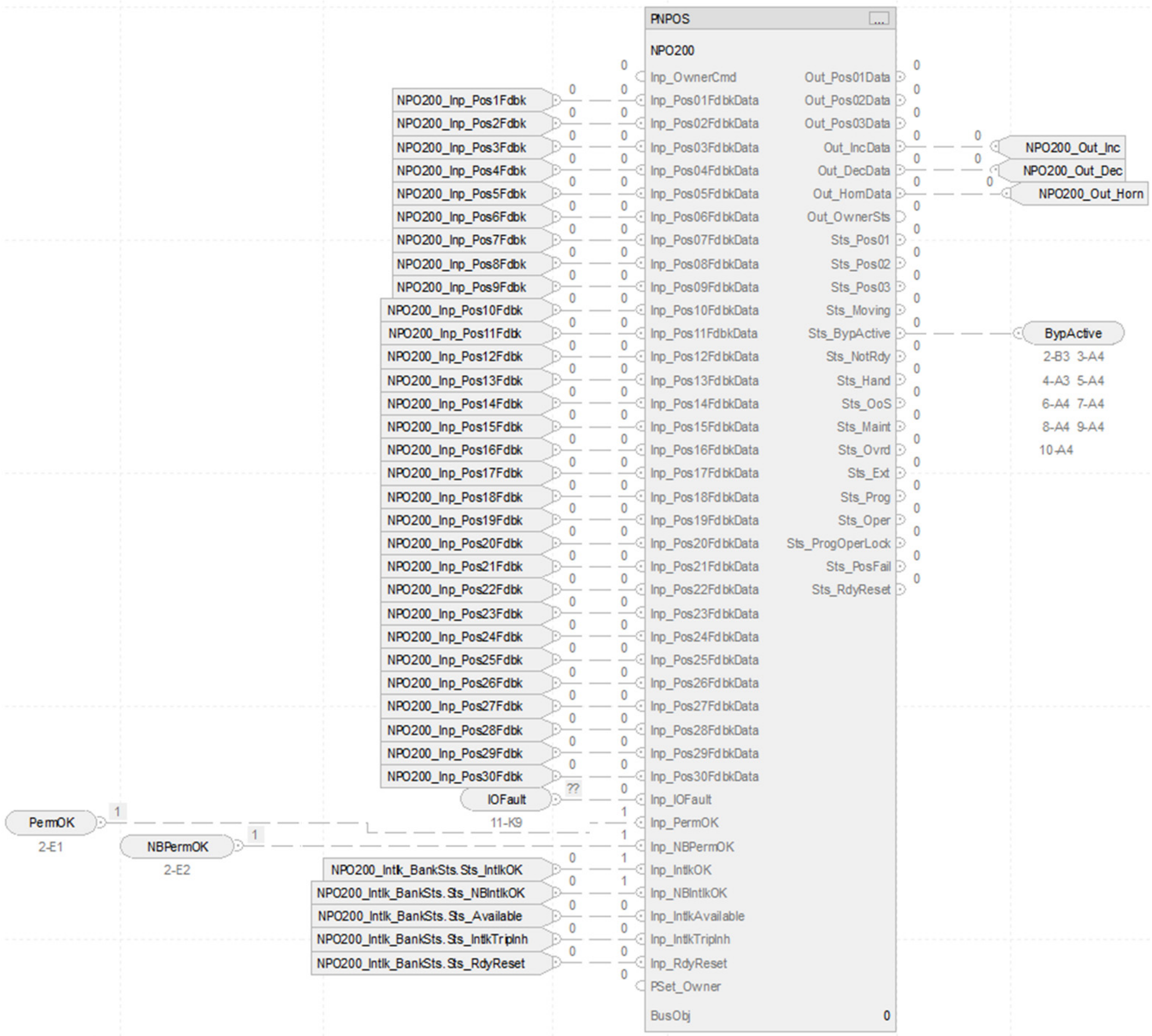
The CS_PNPOS control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The NPOS control strategy contains these Function Block sheets:

Sheet	Description
CS_PNPOS	n-Position Device Add-On Instruction
Permissives	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Fault	The logic monitors as many as 30 discrete input channels and as many as three discrete output channels for I/O fault input and raises an alarm on an I/O fault.

CS_PNPOS Sheet



PNPOS Input References

Parameter	Description
NPO200_Inp_PosxFdbk Where x=1-30	Position x feedback, 1 = Device is confirmed at Position x.
IOFault	Input connection from IO Faults sheet
PermOK	Input connection from Permissives sheet 1 = On permissives OK, device can turn On
NBPermOK	Input connection from Permissives sheet 1 = Non-bypassable On permissives OK, device can turn On
NPO200_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
NPO200_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
NPO200_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
NPO200_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
NPO200_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

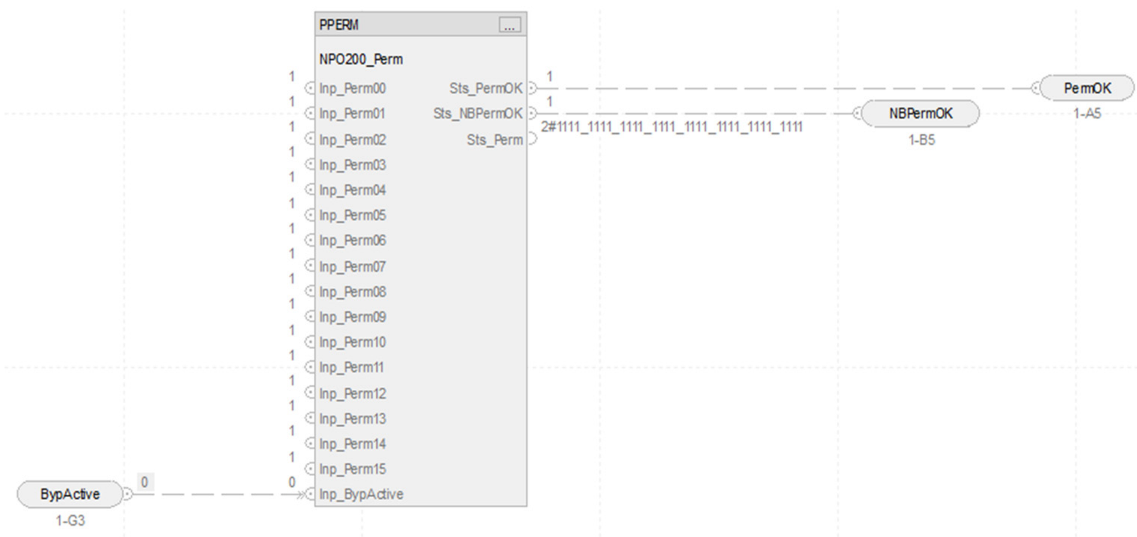
PNPOS Output References

Parameter	Description
NPO200_Out_Horn	1 = Sound audible before commanded state change
NPO200_Out_Inc	Increment output
NPO200_Out_Dec	Decrement output
BypActive	Output connection to permissives and interlock bank sheets

PNPOS Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DISCRETE_N_POSITION	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

Permissive Sheet



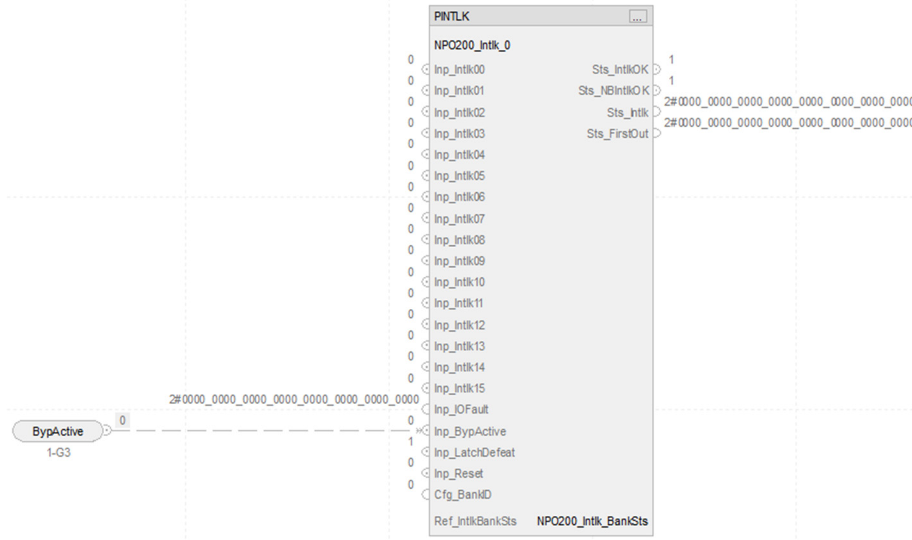
PPERM Input References

Parameter	Description
BypActive	Input connection from the CS_PNPOS sheet

PPERM Output References

Parameter	Description
PermOK	Overall permissive status, 1 = OK to energize
NBPermOK	Non-bypassable permissive status, 1 = all non-bypassable permissives OK to energize

Interlock Bank Sheet



PINTLK Input Reference

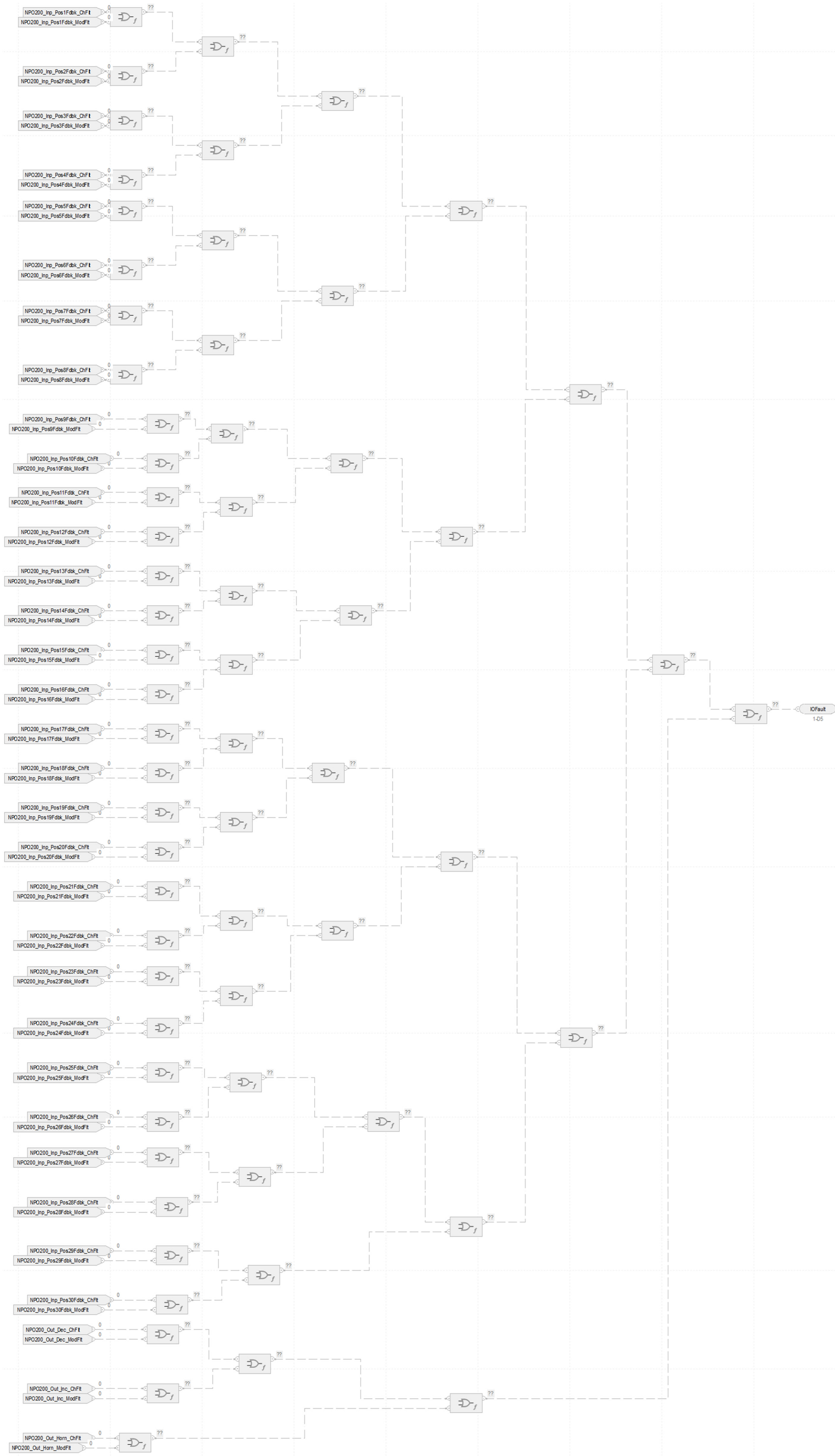
Parameter	Description
BypActive	Input connection from the CS_PNPOS sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction NPO100 in this example corresponds to a linear device
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

Parameter	Description
NP0200_Inp_PosxFdbk_ChFlt Where x=1-30	Tieback input x channel fault
NP0200_Out_Dec_ChFlt	Decrease output channel fault
NP0200_Out_Dec_ModFlt	Decrease output module fault
NP0200_Out_Inc_ChFlt	Increase output channel fault
NP0200_Out_Inc_ModFlt	Increase output module fault
D4SD100_Out_Horn_ChFlt	Sound audible for output channel fault
D4SD100_Out_Horn_ModFlt	Sound audible for output module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PNPOS sheet

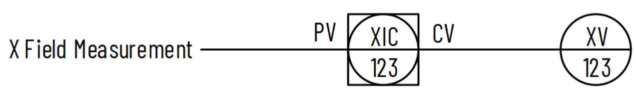
For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Proportional + Integral + Derivative (PPID) Basic Control Strategies

Use this basic PPID control strategy to manipulate one Control Variable (CV) in response to an error (the difference between the Process Variable (PV) readings and the Setpoint (SP, the target PV) settings.

To scale the CV to align with the associated IO module channel range or to accommodate a fail-open (FO) valve (or air to close) use either of the following options:

- Use a basic PPID with Analog Output control strategy
- Insert a scalar Instruction between the PPID CV and the analog output channel reference



The PPID control strategies are pre-configured to enable selectable controller actions (CV Action, SP Action, and Loop Mode Action) based on various shed conditions (Interlock trip, CV fail, PV fail, and SP fail).

The following PPID control strategies are available as routines in the process library:

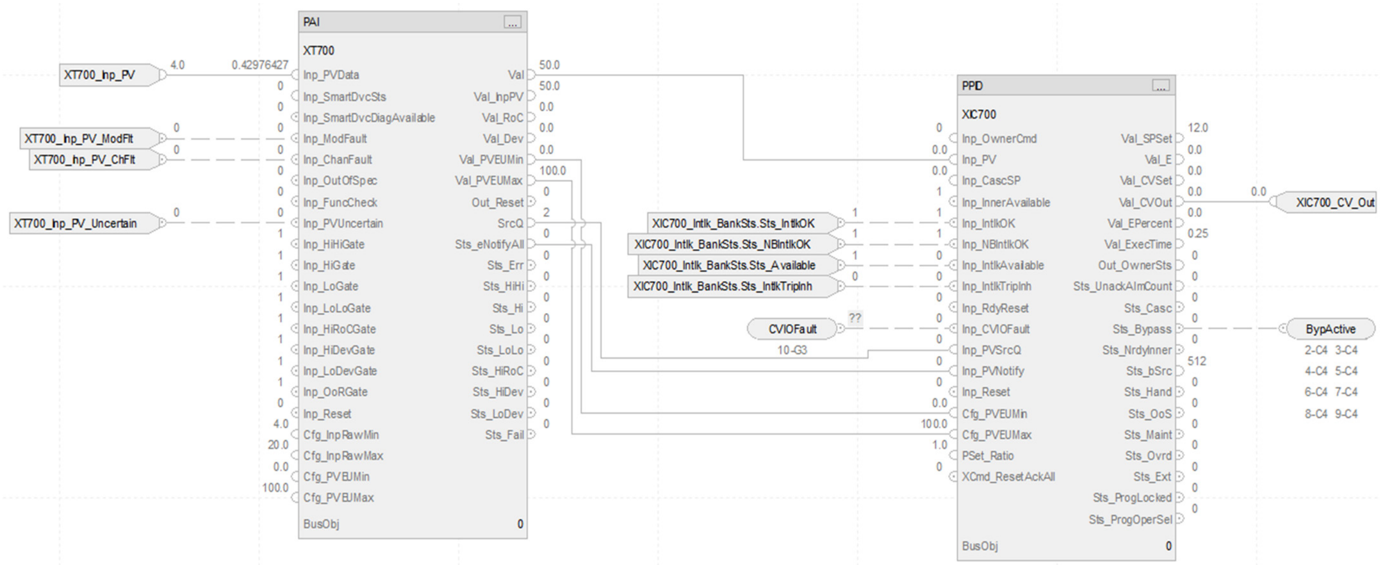
- CS_PPID
- CS_PPID_HART
- CS_PPID_EtherNetIP
- CS_PPID_EtherNetIP_NoHB
- CS_PPID_FF1
- CS_PPID_PA

Import the appropriate control strategy as a **routine** in your controller project.

Each PPID control strategy contains these sheets.

Sheet	Description
CS_PPID	PPID instruction
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PPID instruction monitors bypassablebypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The PPID instruction monitors Control Variable faults.

CS_PPID Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details. Substitute XT700 for XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

PPID Input References

Parameter	Description
XIC700_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XIC700_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XIC700_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XIC700_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection from IO Faults sheet

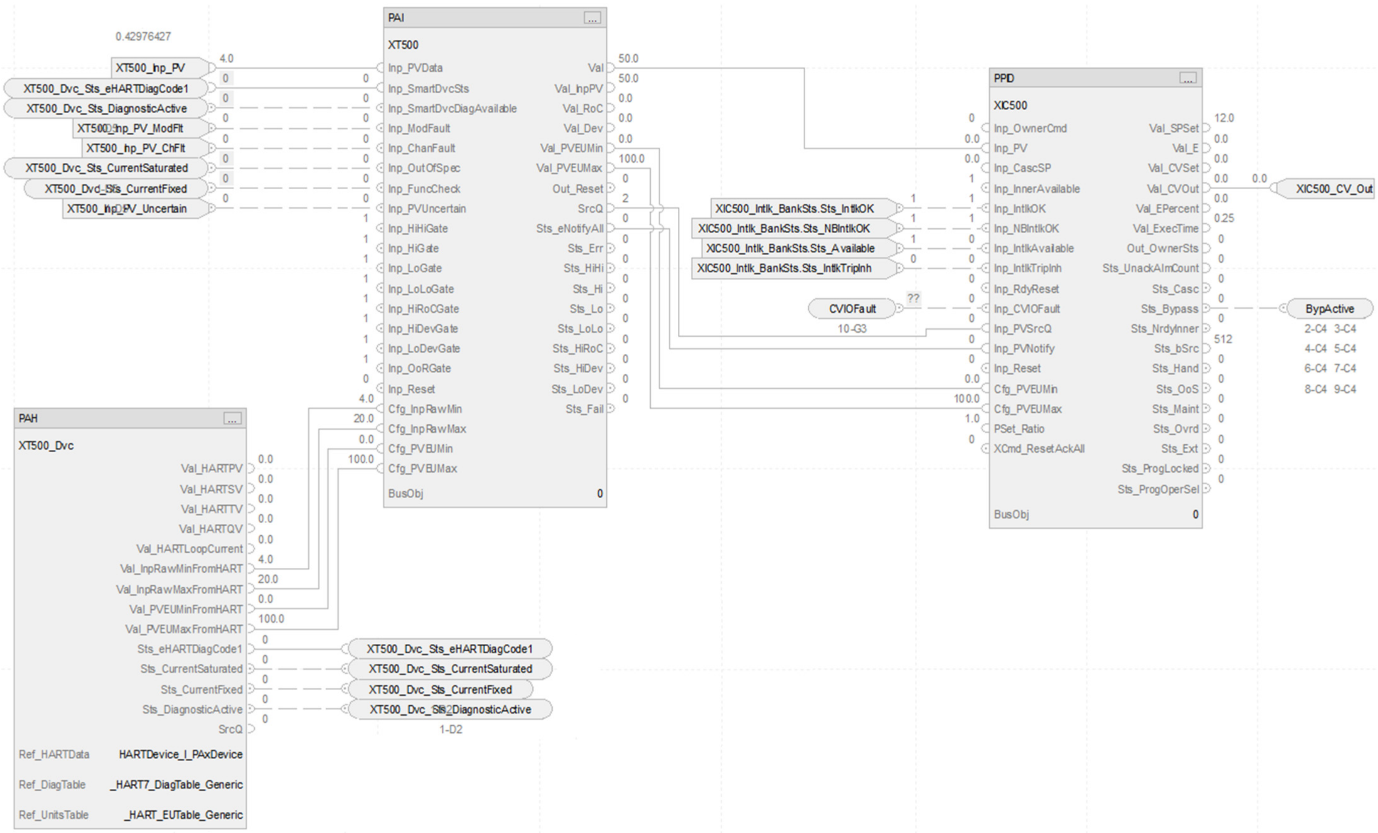
PPID Output References

Parameter	Description
XIC700_Out_CV	Control Variable output Loop CV after clamping and ramping (CVEU)
BypActive	Output connection to interlock bank sheet

PPID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID HART Sheet

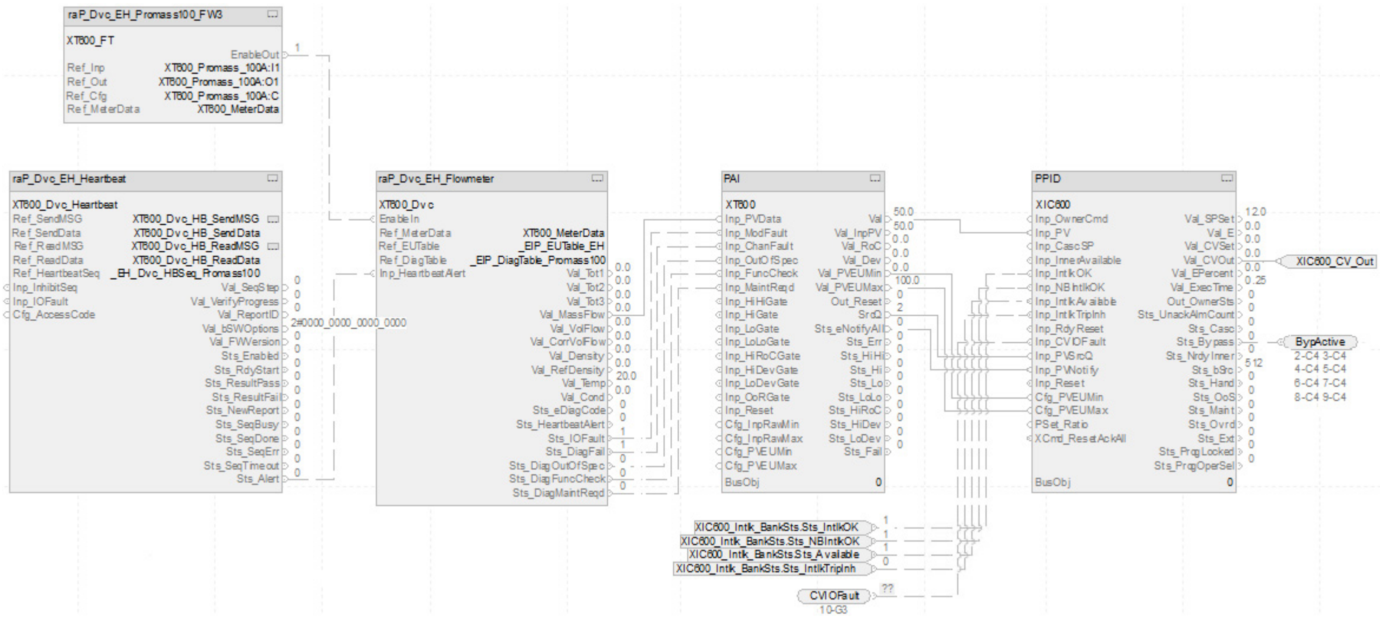


The CS_PPID HART sheet operates the same as the CS_PPID sheet but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute for XT500 for XT100

For more information, see HART Integration on page 31.

CS_PPID_EtherNetIP Sheet

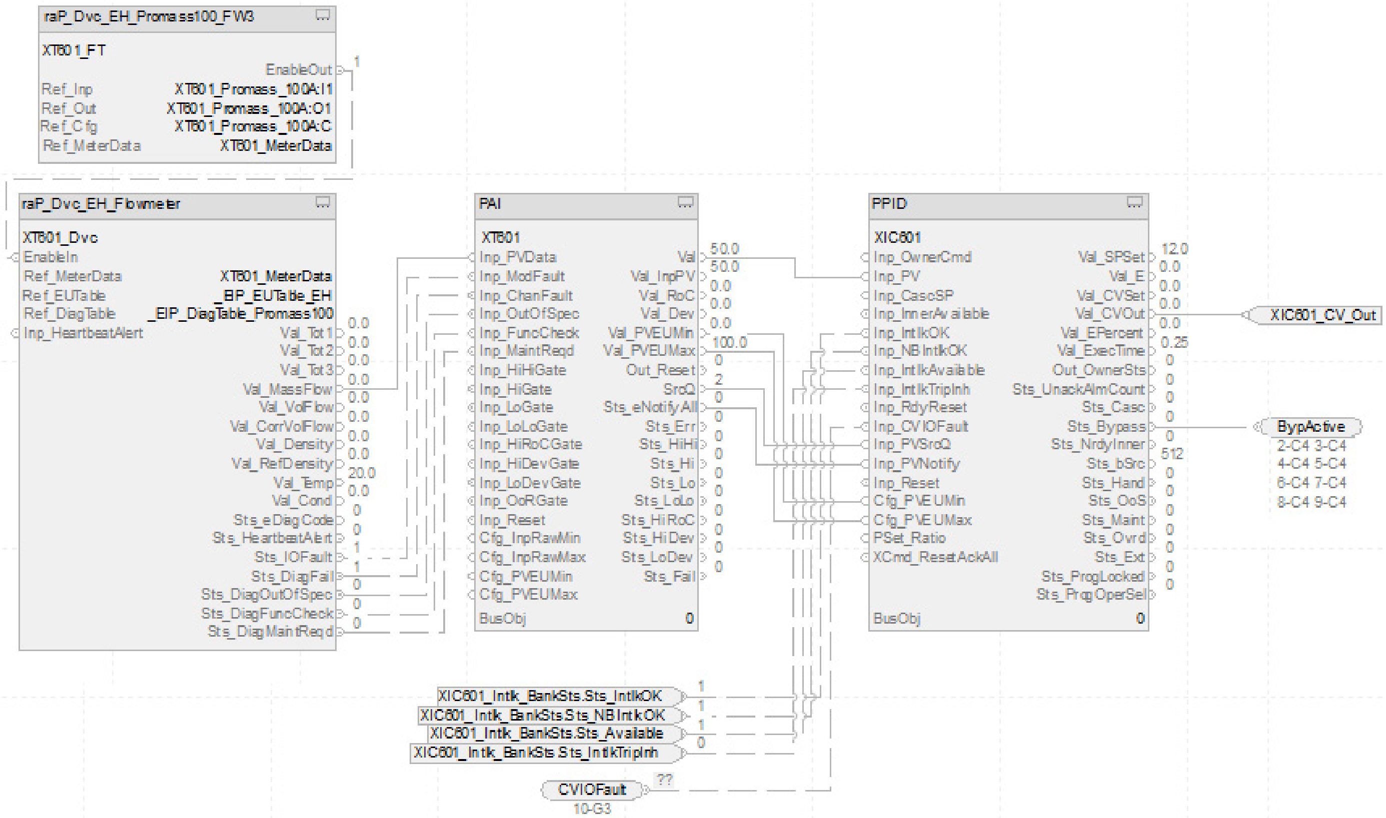


The CS_PPID EtherNet/IP™ sheet operates the same as the CS_PPID sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute for XT600 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_EtherNetIP_NoHB Sheet

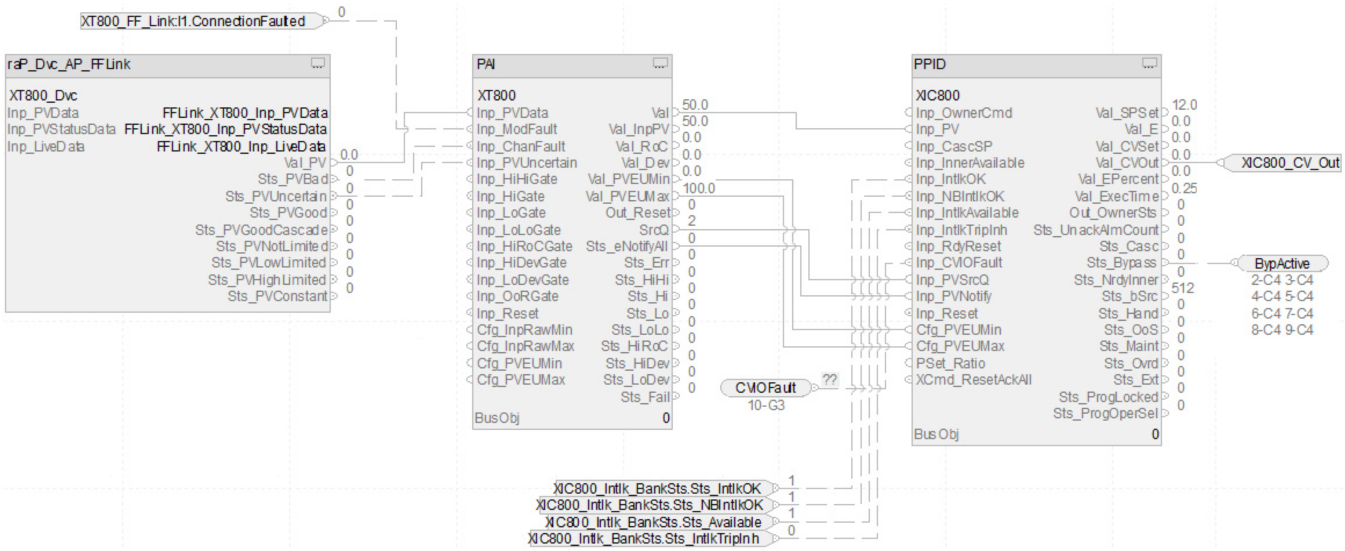


The CS_PPID EtherNet/IP NoHB sheet operates the same as the CS_PPID sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute for XT601 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_FF1 Sheet

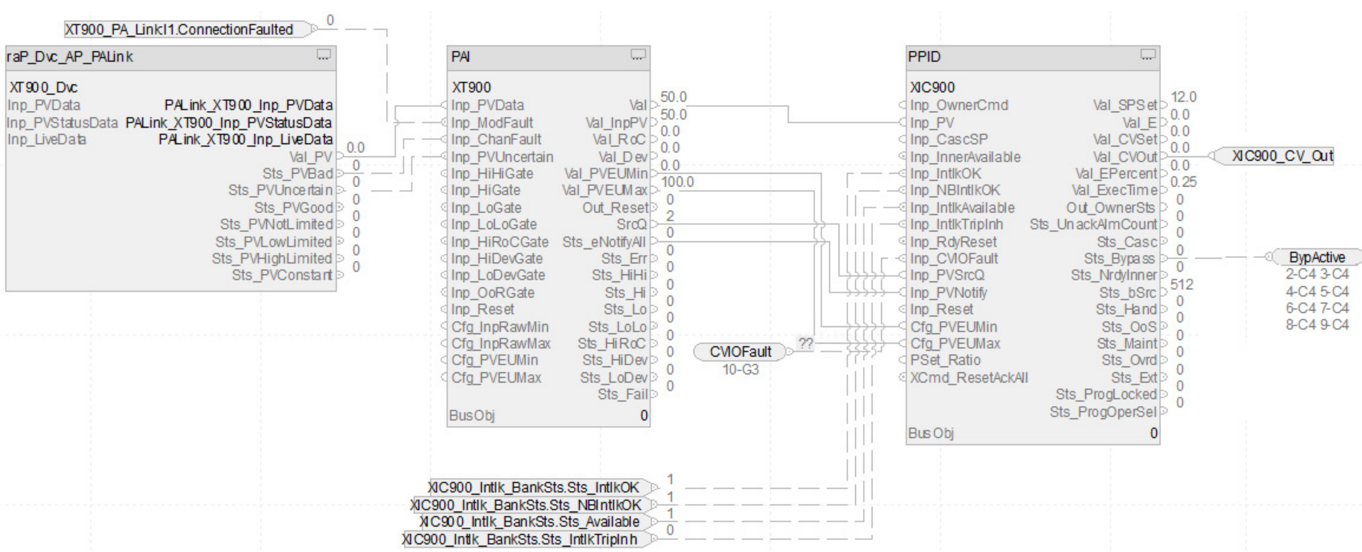


The CS_PPID_FF1 sheet operates the same as the CS_PPID sheet but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute for XT500 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_PA Sheet

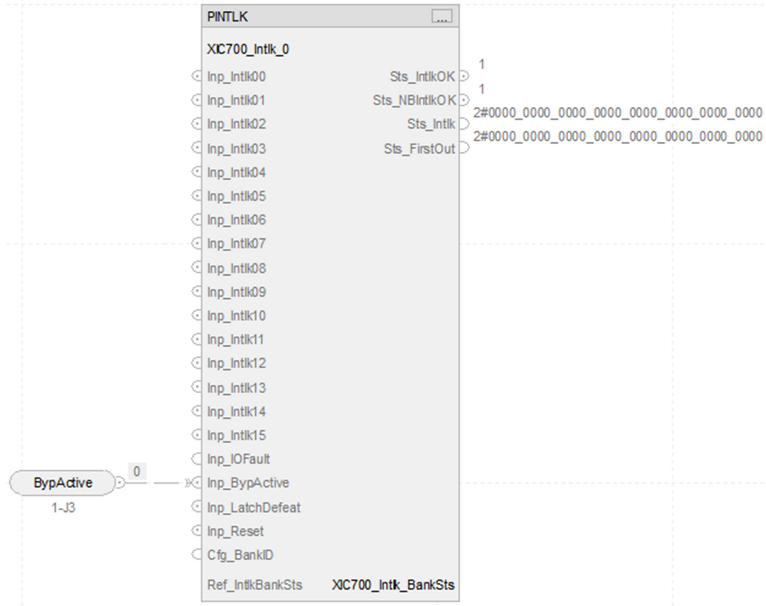


The CS_PPID PA sheet operates the same as the CS_PPID sheet but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute for XT900 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Sheet



PINTLK Input Reference

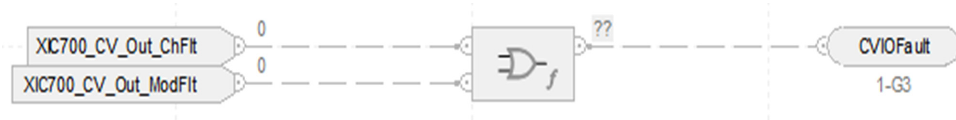
Parameter	Description
BypActive	Input connection from CS_PPID sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

Parameter	Description
XICxxx_Out_CV_ChFlt	Channel fault 1 = I/O channel fault or failure 0 = OK
XICxxx_Out_CV_ModFlt	Module fault 1 = I/O module failure or module communication status bad 0 = OK

Fault Output Reference

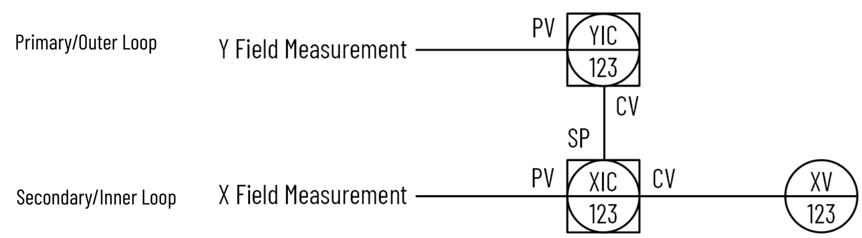
Parameter	Description
CVIOFault	Output connection to CS_PPID sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Notes:

Process Proportional + Integral + Derivative (PPID) with Cascade Control Strategies

Cascade control is defined as when an outer (primary) control loop's output (CV) is used as a setpoint (SP) to an inner (secondary) control loop. The PPID Cascade control strategy is useful when external disturbances to the inner loop process variable are frequent, which can eventually cause disturbances to the process variable of the outer control loop. Controlling the disturbance at the faster acting inner loop compensates for the resulting disturbance to the outer control loop. Also, non-linearities in the final control element can also be controlled at the faster acting Inner loop reducing potential disturbances to the outer loop.



The provided control strategies are pre-configured to provide the following features:

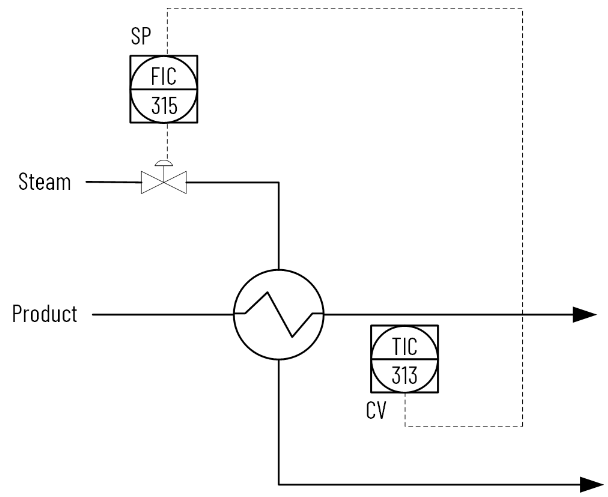
- Bumpless transfer: when the inner control loop is not available, the outer loop output (CV) tracks the inner loop setpoint.
- Anti-windup: when the inner loop hits a CV limit, the outer control loop output is prevented from winding up (increasing or decreasing) beyond that limit.

Another feature pre-configured in the control strategies is the visibility of the whole cascade control strategy status at both the outer and inner control loops. This lets you place the inner and outer PPIDs on different operator displays, while each PPID indicates the status of the whole strategy.

PPID with Cascade Control Example

In this example, the temperature of product flows through a heat exchanger where the exiting product temperature is ultimately maintained at setpoint by modulating the flow of steam to the heat exchanger.

A cascade loop provides better control by opening the steam valve when the steam flow drops before the product temperature drops. To implement a cascade 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 (outer loop) uses the product temperature as a process variable and sends its CV output into the setpoint of the inner loop. In this manner, the outer temperature loop modulates the steam flow setpoint of the inner loop. The steam flow loop is then responsible for providing the amount of steam that is requested by the temperature loop to maintain a constant product temperature.



An external disturbance to the outer loop (such as an increase in product flow) results in a reduction in temperature. In this scenario, the outer loop increases its output to increase the steam flow setpoint to bring the product temperature back to setpoint.

If an upstream disturbance reduces the steam pressure, the steam flow controller (inner loop) reacts by opening the steam valve to maintain steam flow that mitigates any resulting disturbance to the product temperature (outer loop).

The following PPID Cascade control strategies (consisting of multiple routines) are available in the process library:

Control Strategy	Routines
CS_PPID_CASC	CS_PPID_CASC Parameters and Local Tags MainRoutine XIC760 XIC770
CS_PPID_CASC_HART	CS_PPID_CASC_HART Parameters and Local Tags MainRoutine XIC560 XIC570
CS_PPID_CASC_EtherNetIP	CS_PPID_CASC_EtherNetIP Parameters and Local Tags MainRoutine Interlocks XIC660 XIC670
CS_PPID_CASC_EtherNetIP_NoHB	CS_PPID_CASC_EtherNetIP_NoHB Parameters and Local Tags MainRoutine Interlocks XIC661 XIC671
CS_PPID_CASC_FF	CS_PPID_CASC_FF Parameters and Local Tags MainRoutine FFLinkMap Interlocks XIC860 XIC870
CS_PPID_CASC_PA	CS_PPID_CASC_PA Parameters and Local Tags MainRoutine Interlocks PALinkMap XIC960 XIC970

Import the **routines** for the appropriate control strategy in your controller project. Each control strategy contains multiple routines; each routine contains multiple Function Block sheets.

Each PPID Cascade control strategy contains these routines:

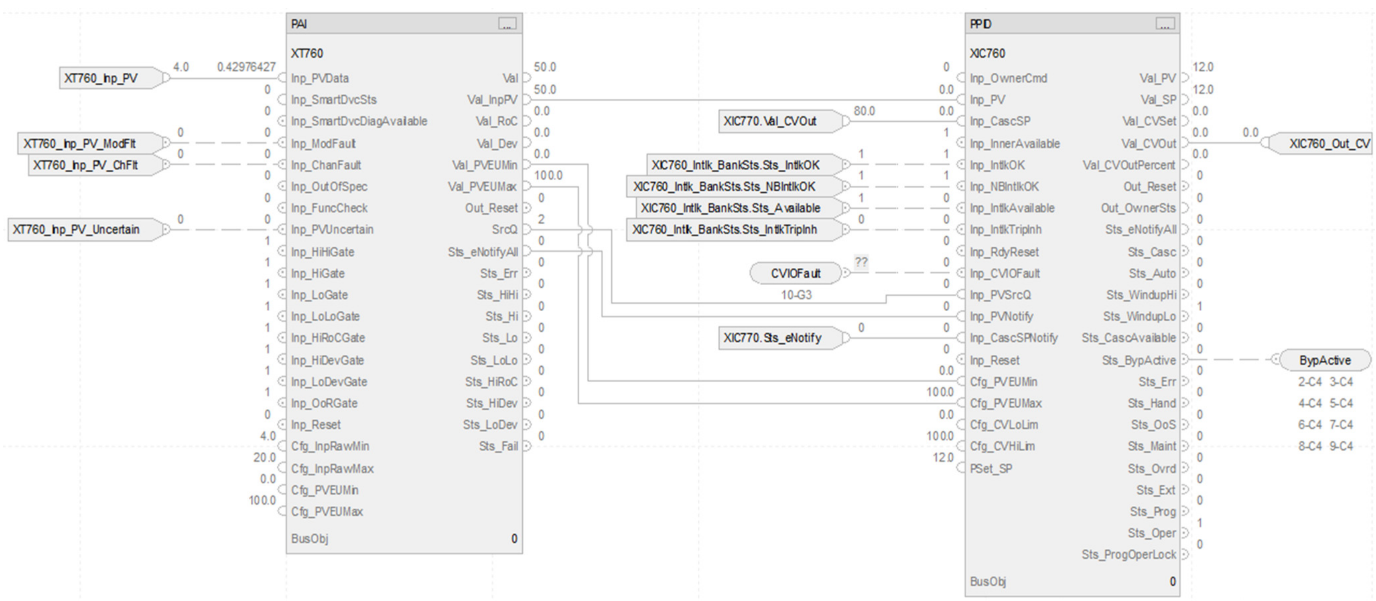
- Inner Loop
- Outer Loop

ROUTINE Inner Loop

Each routine contains these sheets

Sheet	Description
CS_PPID_CASC – Inner Loop	PPID inner loop • XIC760 analog • XIC560 HART • XC660 EtherNet/IP™ • XC661 EtherNet/IP with no heatbeat • XC860 FOUNDATION Fieldbus • XC960 Profibus PA
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PPID instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID_CASC -Inner Loop Sheet (XIC760)



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute XIC760 for the PV data instance of XT101
- Substitute XT770 for the remaining instances of XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val_InpPV	Analog input value in engineering units (actual, before Substitute PV selection)
Val_PVEUmin	Value for PPID Cfg_PVEUMin parameter PV minimum value for scaling from engineering units to %, PV at 0% (PVEU). Valid any float less than Cfg_PVEUMax.
Val_PVEUMax	Value for PPID Cfg_PVEUMax parameter PV maximum value for scaling from engineering units to %, PV at 100% (PVEU). Valid any float greater than Cfg_PVEUMin.
SrcQ	Value for PPID Inp_PVSrcQ parameter 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

PPID Input References

Parameter	Description
XIC770.Val_CVout	Outer Loop CV after clamping and ramping (CVEU).
XIC760_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XIC760_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XIC760_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XIC760_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection to IO Faults sheet
XIC770.Sts_eNotify	Alarm status from outer loop: 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.

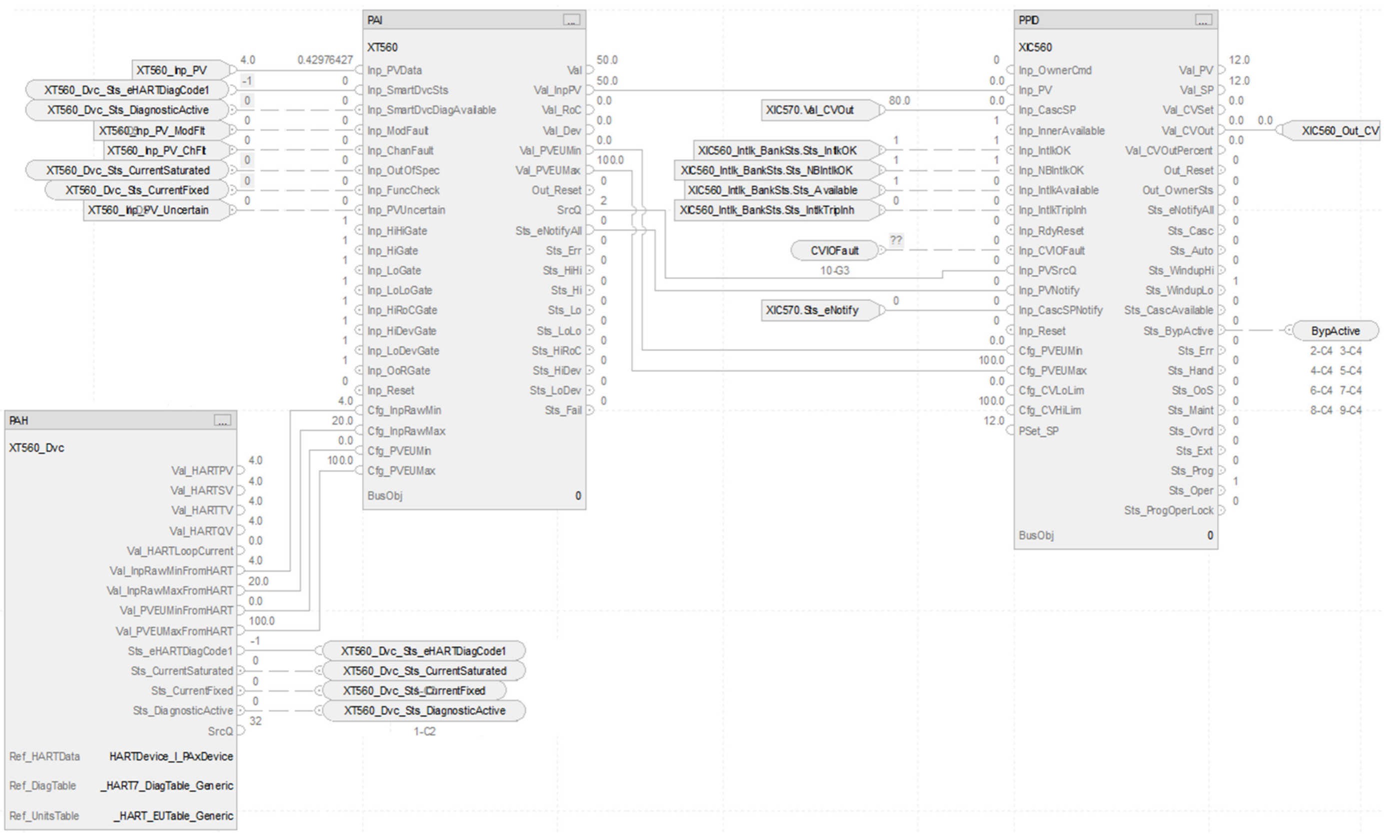
PPID Output References

Parameter	Description
XIC760_Out_CV	Control Variable output Loop CV after clamping and ramping (CVEU)
BypActive	Output connection to interlock bank sheet

PPID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID_CASC - Inner Loop HART Sheet (XIC560)

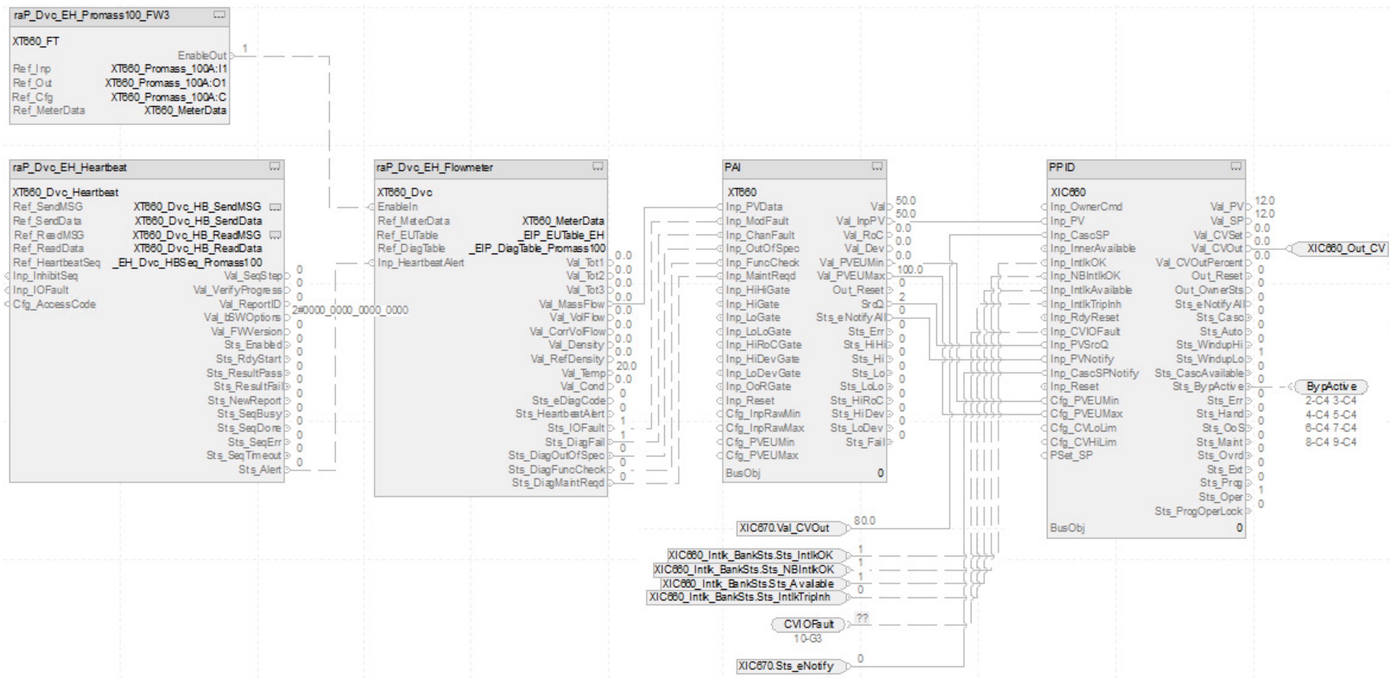


The CS_PPID_CASC -Inner Loop HART sheet operates the same as the CS_PPID_CASC - Inner Loop but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XT560 for XT100

For more information, see HART Integration on page 31.

CS_PPID_CASC - Inner Loop EtherNet/IP Sheet (XIC660)

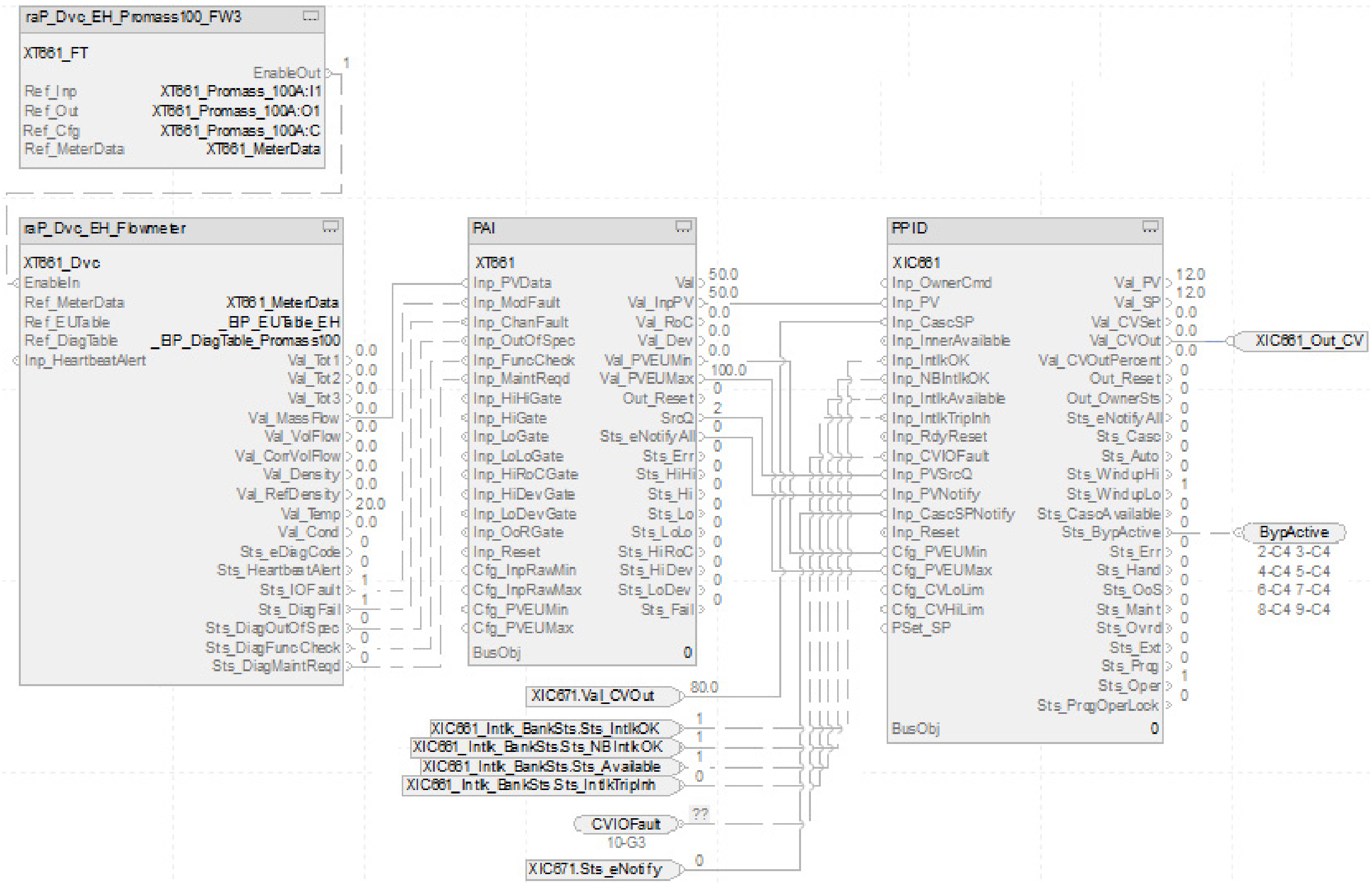


The CS_PPID_CASC -Inner Loop EtherNet/IP sheet operates the same as the CS_PPID_CASC - Inner Loop but relies on EtherNet/IP input data with no heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XT660 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_CASC - Inner Loop EtherNet/IP NoHB Sheet (XIC661)

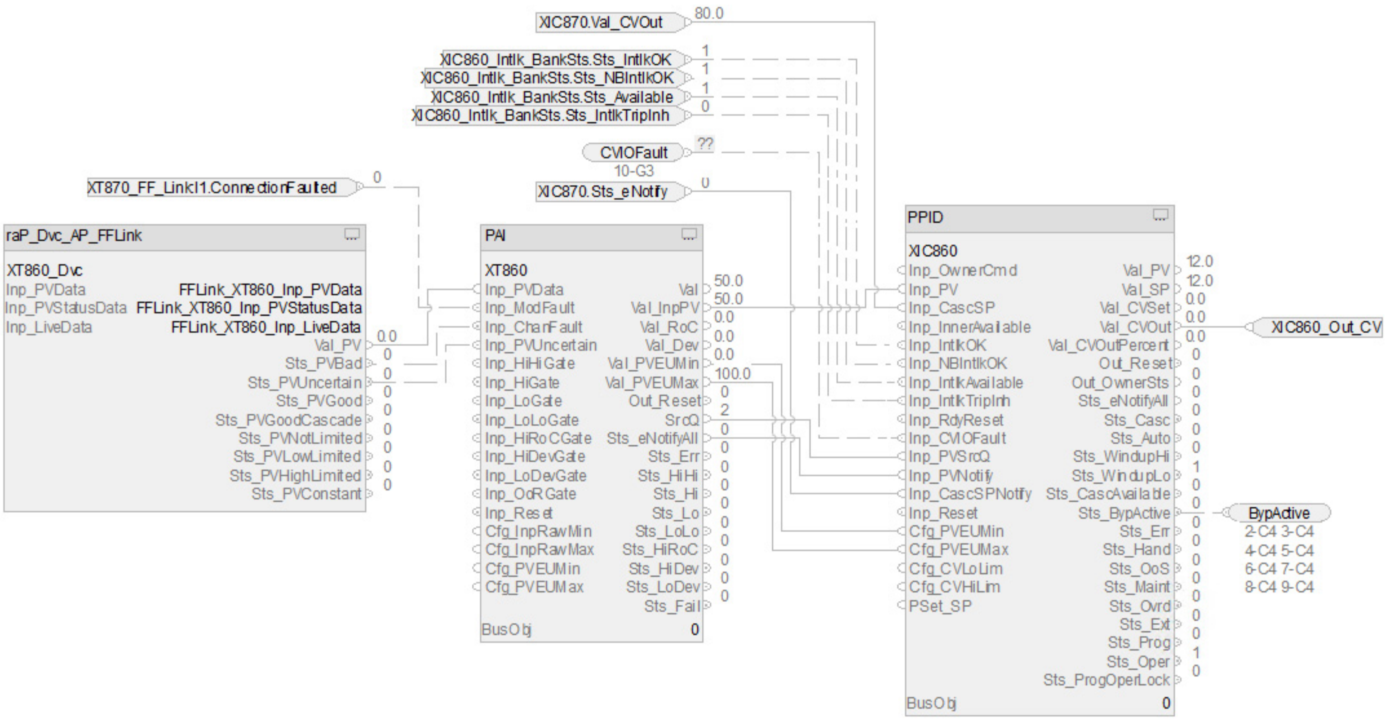


The CS_PPID_CASC -Inner Loop EtherNet/IP NoHB sheet operates the same as the CS_PPID_CASC - Inner Loop but relies on EtherNet/IP input data with no heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute XT661 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_CASC - Inner Loop FF Sheet (XIC860)

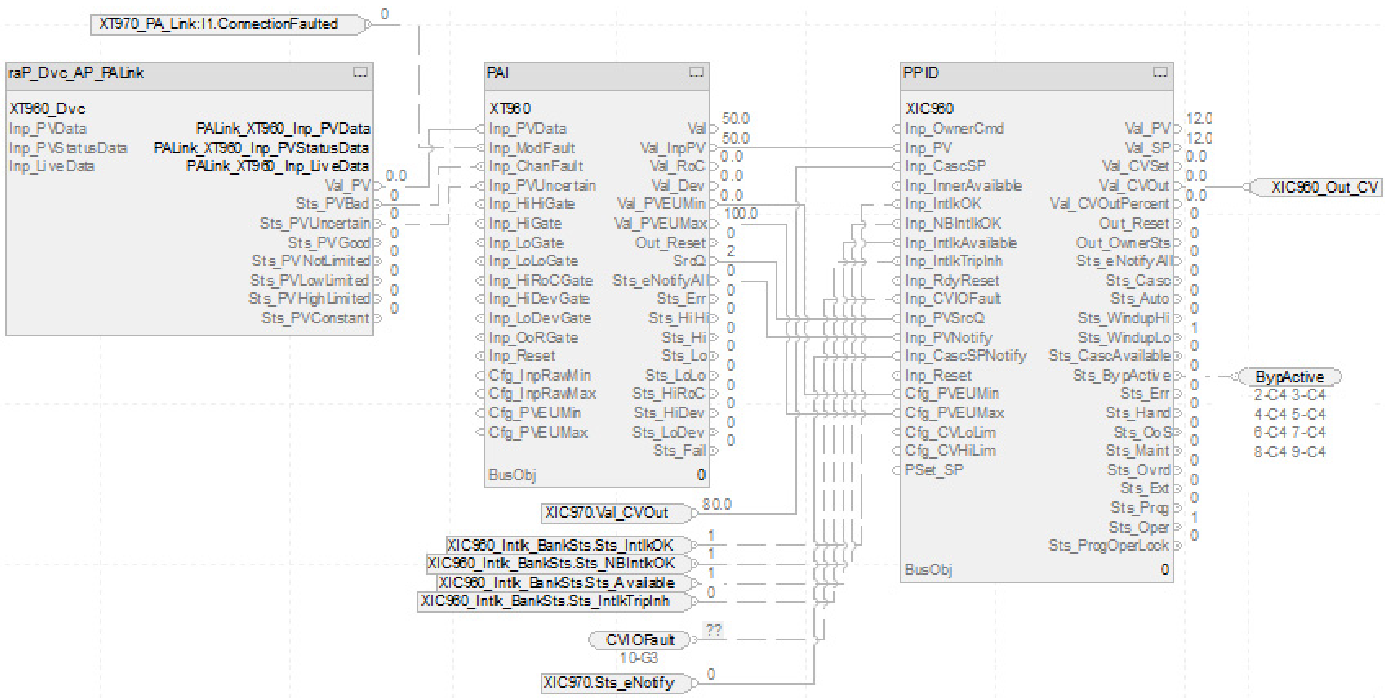


The CS_PPID_CASC -Inner Loop FF sheet operates the same as the CS_PPID_CASC - Inner Loop but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XT860 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_CASC - Inner Loop PA Sheet (XIC960)



The CS_PPID_CASC -Inner Loop PA sheet operates the same as the CS_PPID_CASC - Inner Loop but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XT960 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Inner Loop Sheet

PINTLK Input Reference

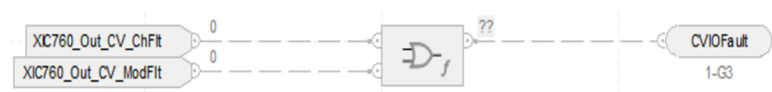
Parameter	Description
BypActive	Input connection from CS_PPID_CASC - Inner Loop sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Inner Loop Sheet



Faults Input References

Parameter	Description
XIC760_Out_CV_ChFlt	Channel fault, 1 = I/O channel fault or failure, 0 = OK
XIC760_Out_CV_ModFlt	Module fault, 1 = I/O module failure or module communication status bad, 0 = OK

Fault Output Reference

Parameter	Description
CVIOFault	Output connection to CS_PPID_CASC Inner Loop sheet

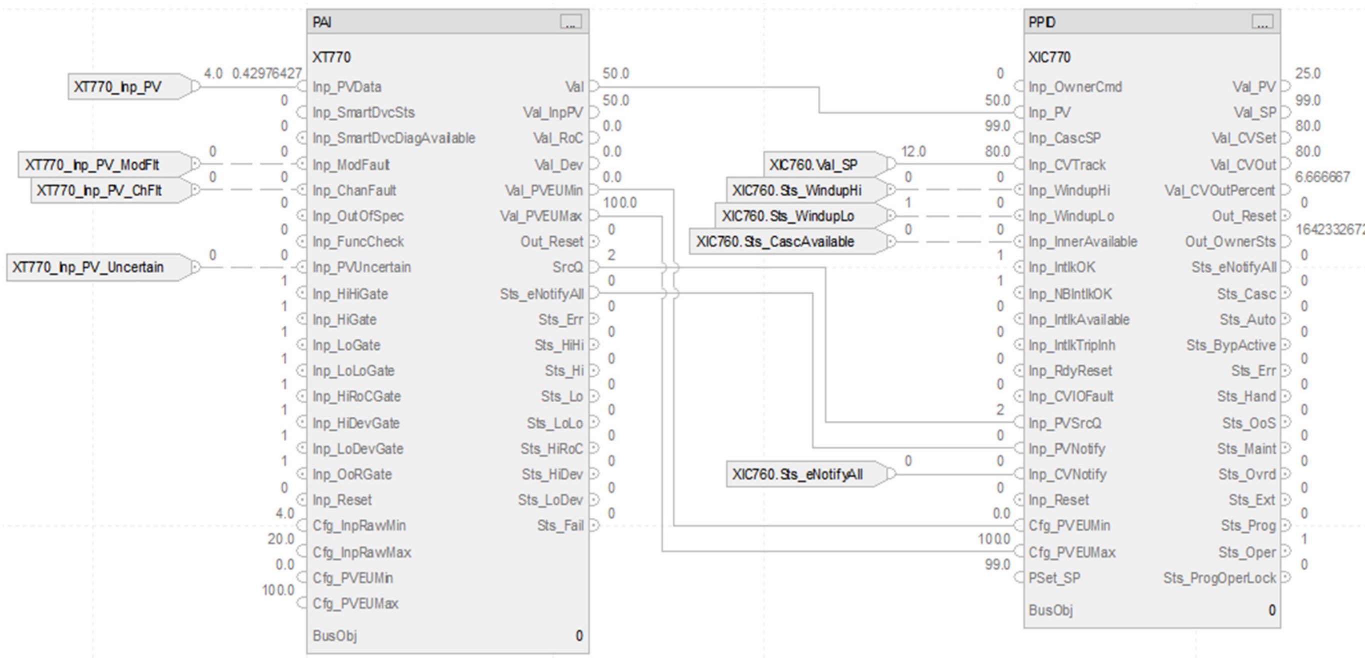
For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

ROUTINE Outer Loop

Each routine contains one sheet

Sheet	Description
CS_PPID_CASC – Outer Loop	PPID outer loop • XIC770 analog • XIC570 HART • XC670 EtherNet/IP • XC671 EtherNet/IP with no heatbeat • XC870 FOUNDATION Fieldbus • XC970 Profibus PA

CS_PPID_CASC-Outer Loop Sheet (XIC770)



PAI Input References

See CS_PAI Sheet on page 110 for details. Substitute XT770 for every instance of XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
Val_PVEUmin	Value for PPID Cfg_PVEUMin parameter PV minimum value for scaling from engineering units to %, PV at 0% (PVEU). Valid any float less than Cfg_PVEUMax.
Val_PVEUMax	Value for PPID Cfg_PVEUMax parameter PV maximum value for scaling from engineering units to %, PV at 100% (PVEU). Valid any float greater than Cfg_PVEUMin.
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

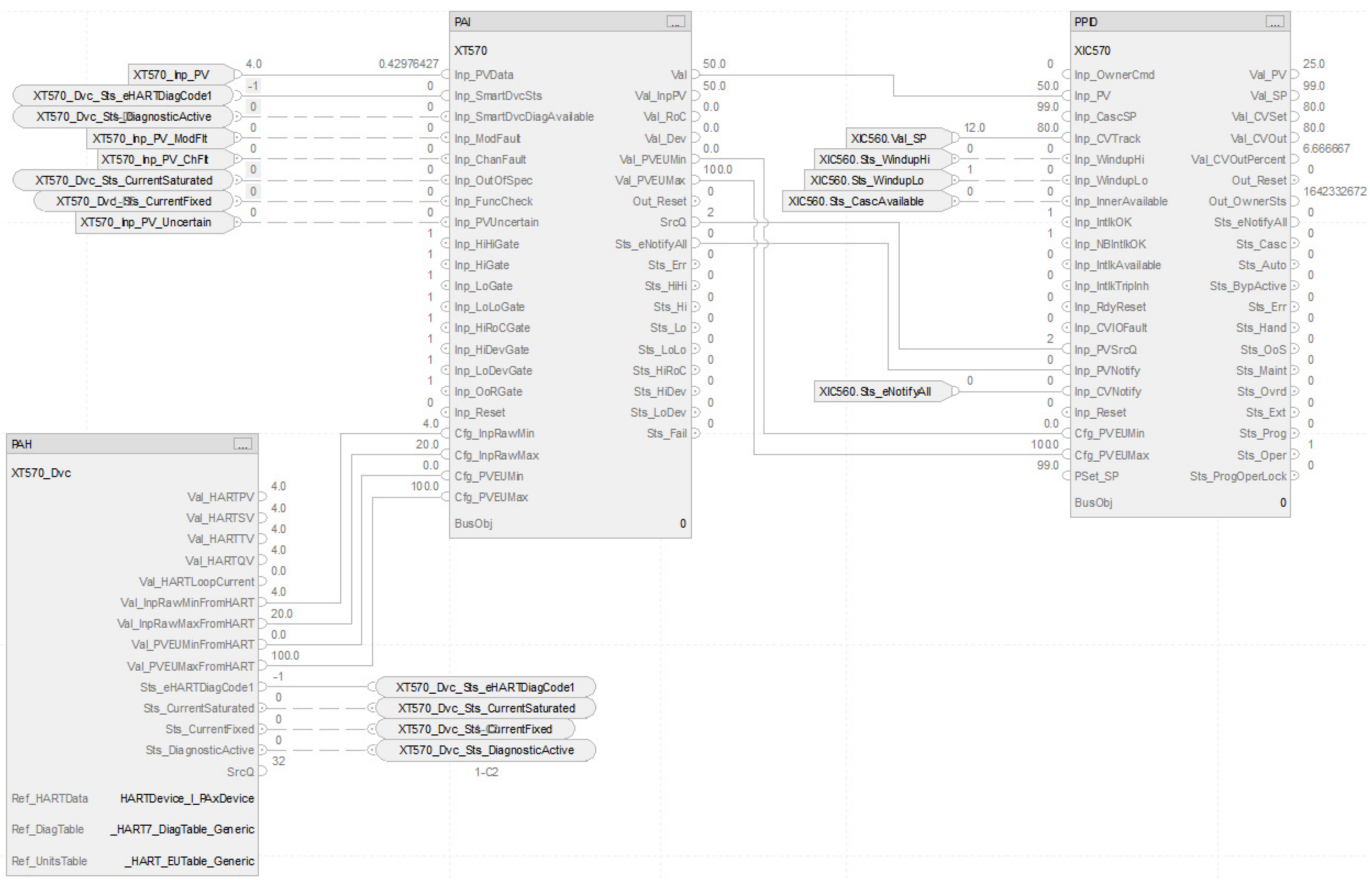
PPID Input References

Parameter	Description
XIC760.Inp_CVTrack	Inner loop CV to track if Cfg_UseCVTrack = 1 or if Inp_InnerAvailable = 0 (CVEU)
XIC760.Sts_WindupHi	1 = The inner loop winding up High, usually connects to Inp_WindupHi of outer loop
XIC760.Sts_WindupLo	1 = The inner loop winding up Low, usually connects to Inp_WindupLo of outer loop
XIC760.Sts_CascAvailable	1 = Inner loop is available. 0 = Inner loop is not available, PPID tracks Inp_CVTrack, typically inner loop SP or actuator position.
XIC760.Sts_eNotifyAll	Alarm status from inner loop: 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

PPID Configuration Considerations

Operand	Type	Description
PlantPAx control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID_CASC - Outer Loop HART Sheet (XIC570)

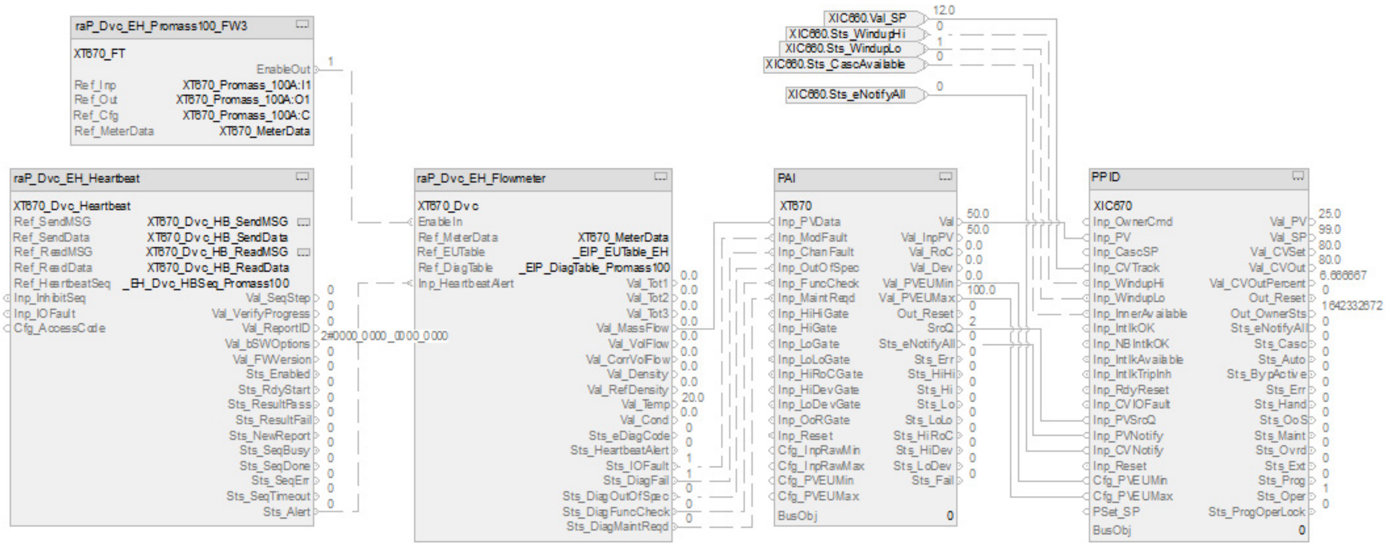


The CS_PPID_CASC - Outer Loop HART sheet operates the same as the CS_PPID_CASC - Outer Loop sheet but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XT570 for XT100

For more information, see HART Integration on page 31.

CS_PPID_CASC - Outer Loop EtherNet/IP Sheet (XIC670)

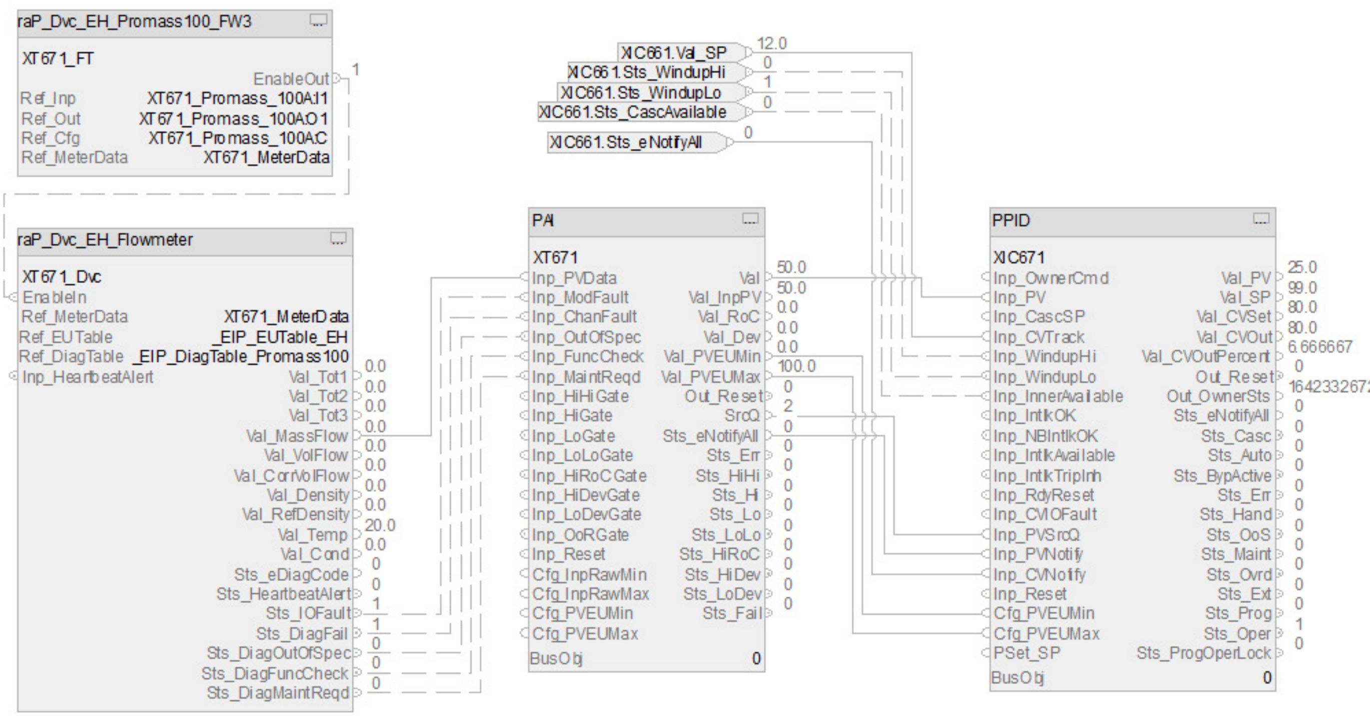


The CS_PPID_CASC - Outer Loop EtherNet/IP sheet operates the same as the CS_PPID_CASC - Outer Loop sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XT670 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_CASC - Outer Loop EtherNet/IP NoHB Sheet (XIC671)

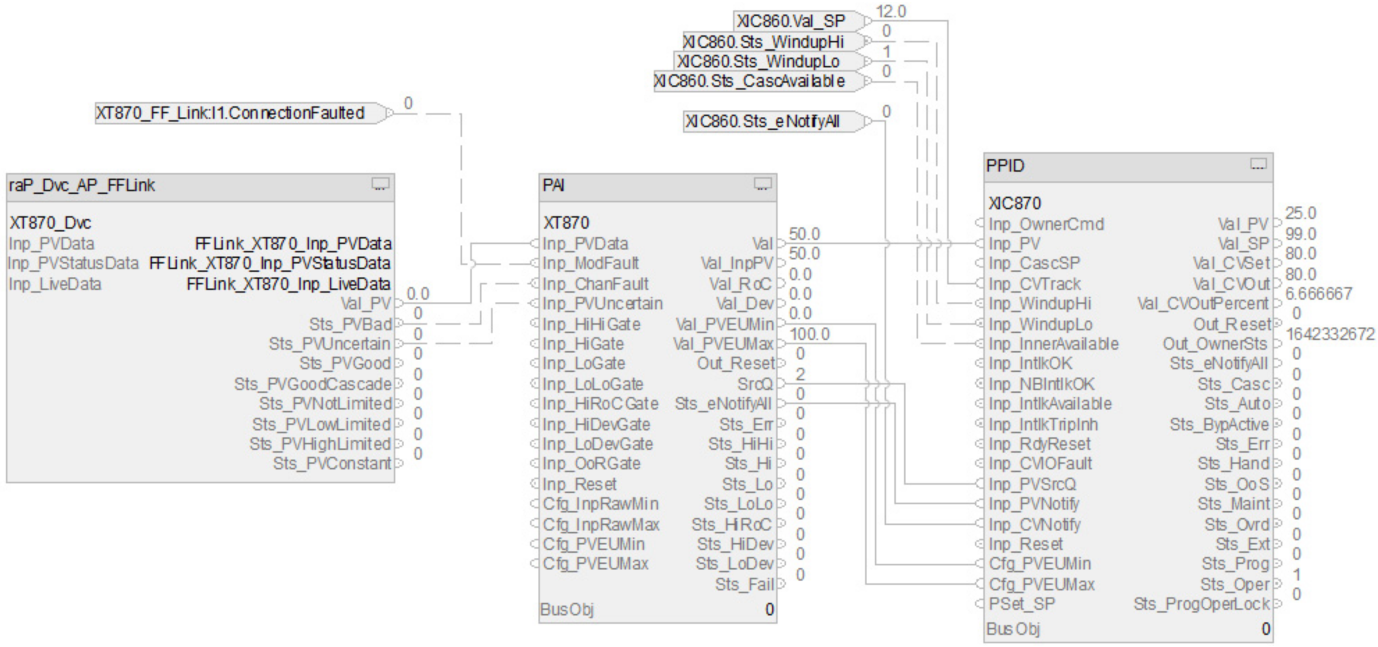


The CS_PPID_CASC - Outer Loop EtherNet/IP NoHB sheet operates the same as the CS_PPID_CASC - Outer Loop sheet but relies on EtherNet/IP input data with no heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute XT671 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_CASC - Outer Loop FF Sheet (XIC870)

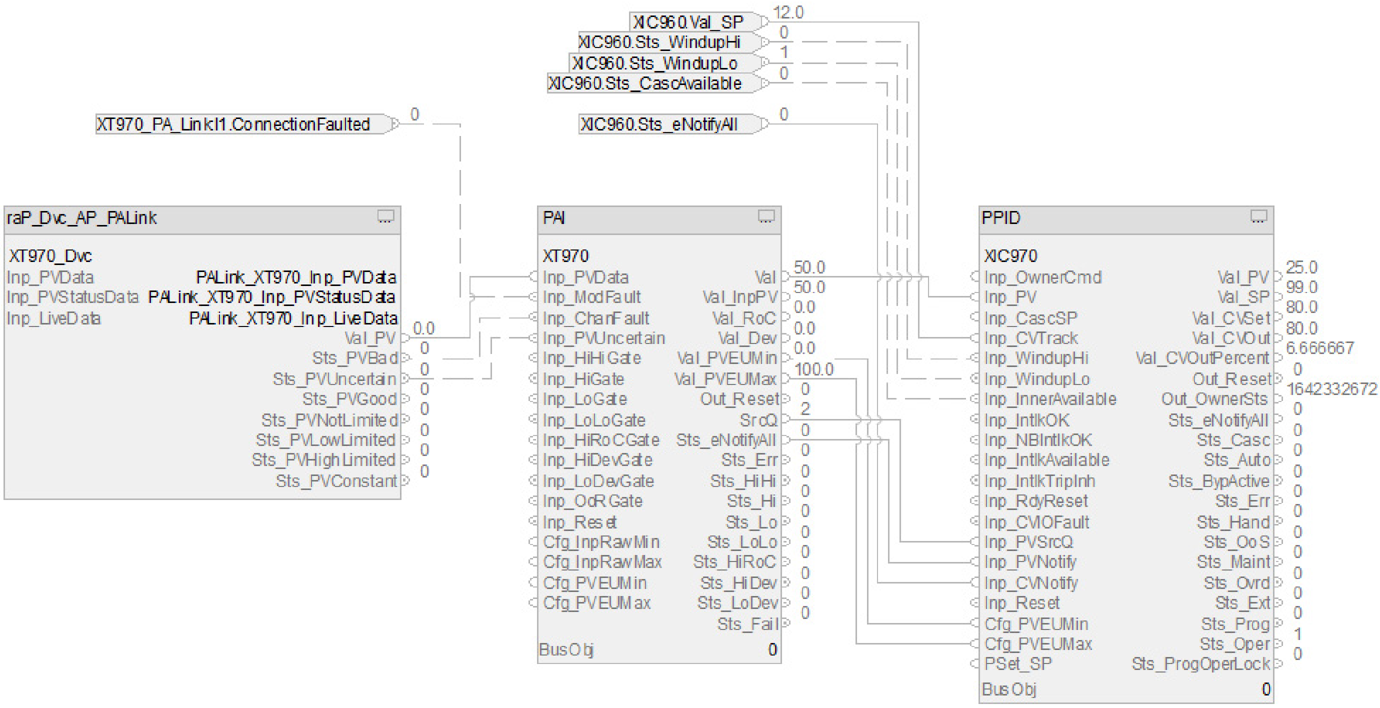


The CS_PPID_CASC - Outer Loop FF sheet operates the same as the CS_PPID_CASC - Outer Loop sheet but relies on FOUNDATION Feildbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XT870 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_CASC - Outer Loop PA Sheet (XIC970)

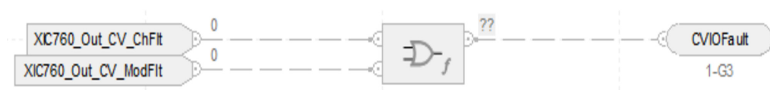


The CS_PPID_CASC - Outer Loop PA sheet operates the same as the CS_PPID_CASC - Outer Loop sheet but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XT970 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

IO Faults Outer Loop Sheet



Faults Input References

Parameter	Description
XICxxx_Out_CV_ChFlt	Channel fault, 1 = I/O channel fault or failure, 0 = OK
XICxxx_Out_CV_ModFlt	Module fault, 1 = I/O module failure or module communication status bad, 0 = OK

Fault Output Reference

Parameter	Description
CVIOFault	Output connection to CS_PPID_CASC Outer Loop sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

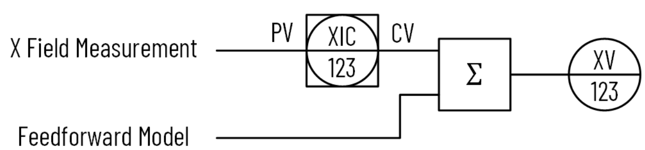
Process Proportional + Integral + Derivative (PPID) Feedforward Control Strategies

Use the PPID Feedforward control strategy when feedback control (PPID control strategy) alone is not adequate to maintain the process variable at the setpoint. 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.

To scale the CV to align with the associated IO module channel range or to accommodate a fail-open (FO) valve (or air to close) use either of the following options:

- Use a basic PPID with Analog Output control strategy
- Insert a scalar instruction between the PPID CV and the analog output channel reference

The PPID Feedforward control strategies are pre-configured to enable controller actions (CV Action, SP Action and Loop Mode Action) based on various shed conditions (Interlock trip, CV fail, PV fail, and SP fail).

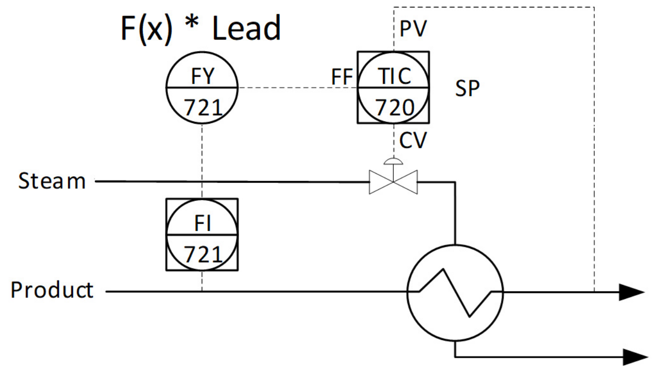


PPID Feedforward Example

Consider a control system that manipulates steam flow to a heat exchanger to maintain the discharge temperature of the product at a constant setpoint value. The outlet temperature suffers temporary deviations from setpoint if load conditions change. The feedback control system can eventually bring the exiting product's temperature back to setpoint, but it cannot begin corrective action until after a load has driven the product temperature away from the setpoint. To improve control, build both feedforward action and feedback action into the design. The feedforward action lets the control system take corrective action in response to load changes before the process variable is affected.

In this example, the dominant load in the system is product flow rate. Adapting this control system to include feedforward requires installing a product flow transmitter that is characterized to provide feedforward action to the PID controller maintaining temperature. With feedforward control action in place, the steam flow rate immediately changes with product flow rate, preemptively compensating for the increased or decreased heat demand of the product.

The feedforward component of the strategy directly affects the steam valve position in response to product flow. However, the temperature response to the manipulation of the PPID output generally includes a process lag. To overcome the process lag, the feedforward model typically includes a lead function.



When the product flow rate to this heat exchanger suddenly increases, the lead function adds a surge to the feedforward signal, quickly opening the steam valve sending a surge of steam to the exchanger to help overcome the process response lag. The feedforward action is not perfect with this lead function added, but it is substantially improved.

The following PPID control strategies are available as routines in the process library:

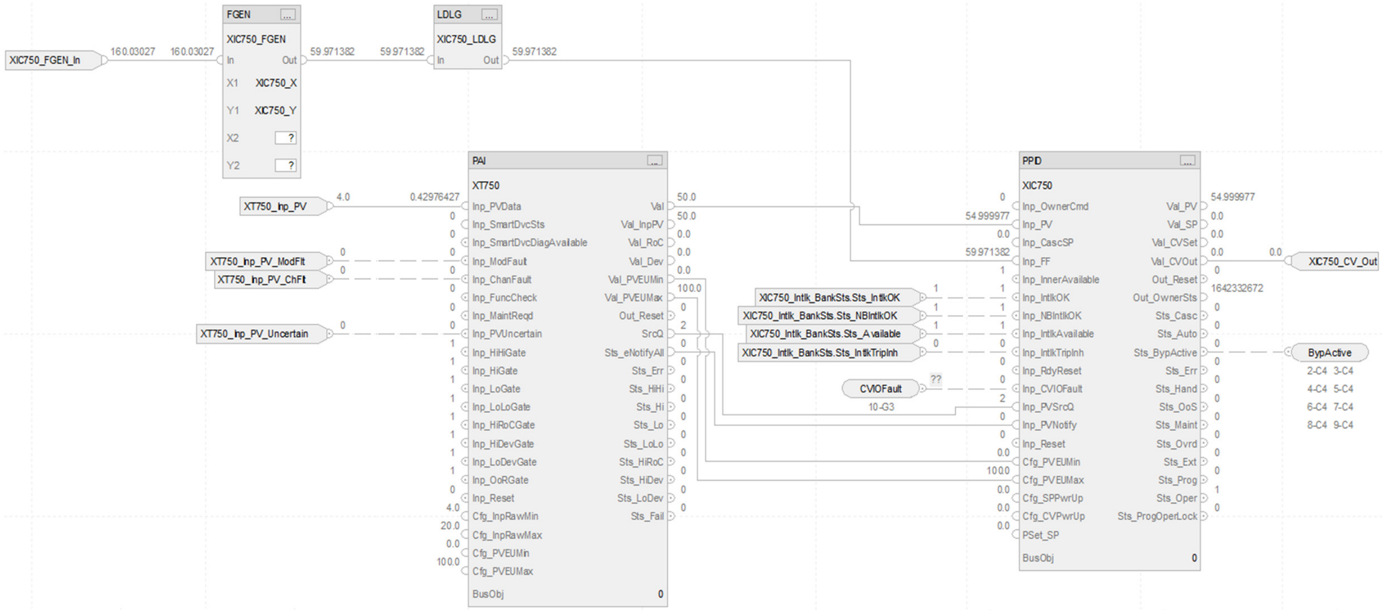
- CS_PPID_FF
- CS_PPID_FF_HART
- CS_PPID_FF_EtherNetIP
- CS_PPID_FF_EtherNetIP_NoHB
- CS_PPID_FF_FF
- CS_PPID_FF_PA

Import the appropriate control strategy as a **routine** in your controller project.

Each PPID Feedforward control strategy contains these sheets:

Sheet	Description
CS_PPID_FF	PPID instruction
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PPID instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID_FF Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute XIC750 for the PV data instance of XT101
- Substitute XT750 for the remaining instances of XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
Val_PVEUmin	Value for PPID Cfg_PVEUMin parameter PV minimum value for scaling from engineering units to %, PV at 0% (PVEU). Valid any float less than Cfg_PVEUMax.
Val_PVEUMax	Value for PPID Cfg_PVEUMax parameter PV maximum value for scaling from engineering units to %, PV at 100% (PVEU). Valid any float greater than Cfg_PVEUMin.
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

PPID Input References

Parameter	Description
XIC750_FGEN_In	FeedForward term (CVEU). Valid any float between -(Cfg_CVEUMax-Cfg_CVEUMin) and (Cfg_CVEUMax-Cfg_CVEUMin). Default is 0.0.
XIC750_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
XIC750_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status, 1 = All non-bypassable interlocks OK to run
XIC750_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
XIC750_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status, 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection from IO Faults sheet
XIC750_SPPwrUp	Loop SP on power-up (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.
XIC750_CWPwrUp	Loop CV on power-up (CVEU) used when Cfg_PwrUpLM is not 0. Value can 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.
XIC750_PSet_SP	Program setting for SP, loop mode Auto (PVEU). Valid any float. Default is 0.0.

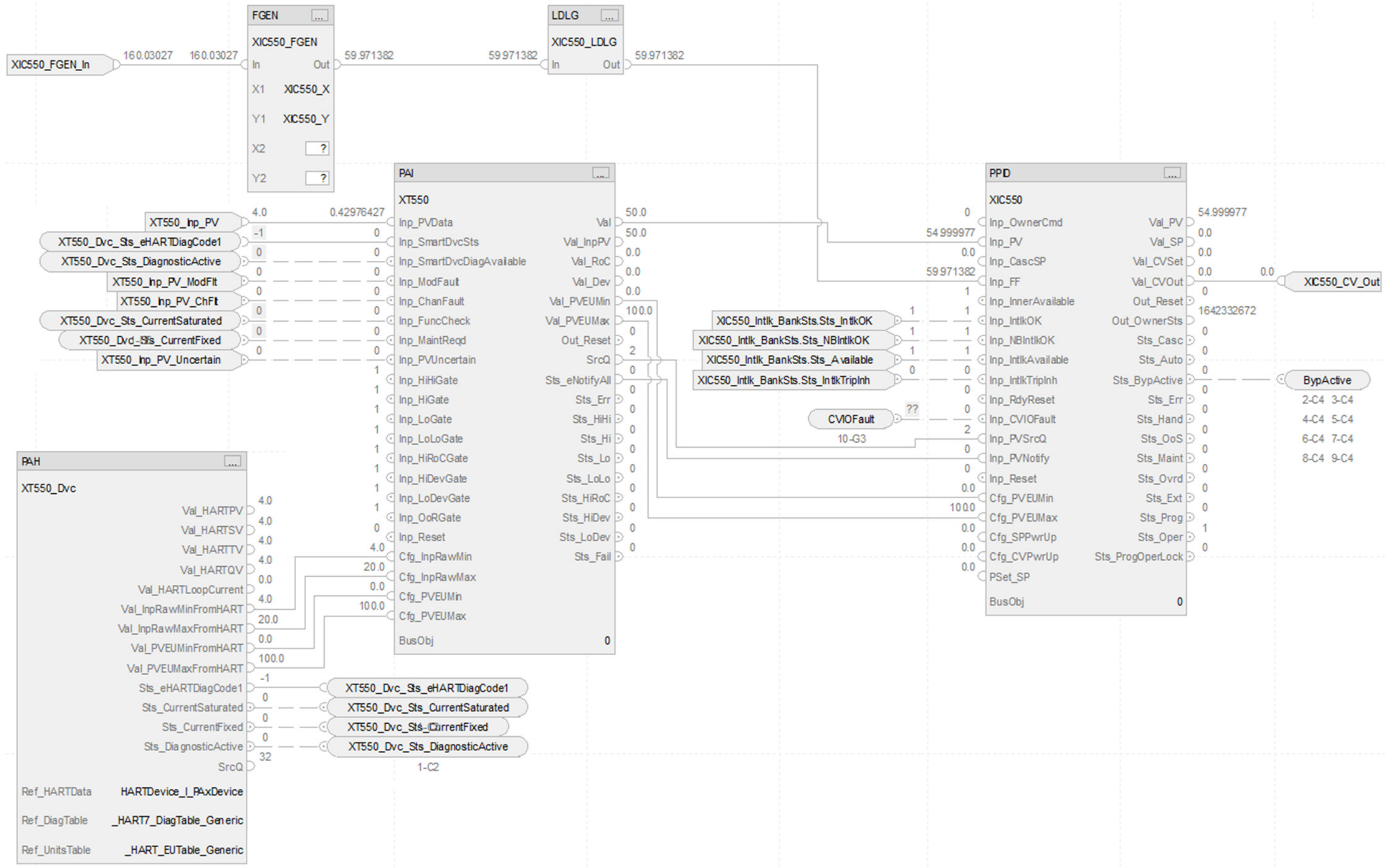
PPID Output References

Parameter	Description
XIC750_CV_Out	Control Variable output Loop CV after clamping and ramping (CVEU)
BypActive	Output connection to interlock bank sheet

PPID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID_FF HART Sheet

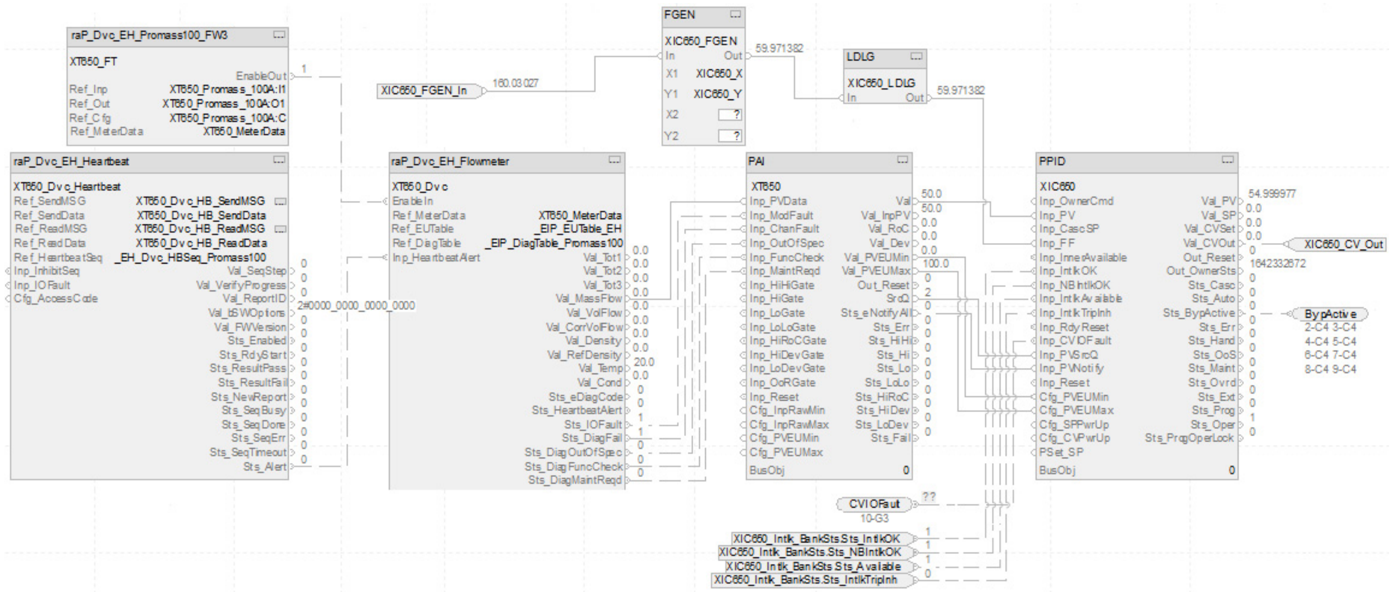


The CS_PPID_FF HART sheet operates the same as the CS_PPID_FF sheet but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XIC550 for the PV data instance of XT101
- Substitute XT550 for the remaining instances of XT101

For more information, see HART Integration on page 31.

CS_PPID_FF_EtherNetIP Sheet

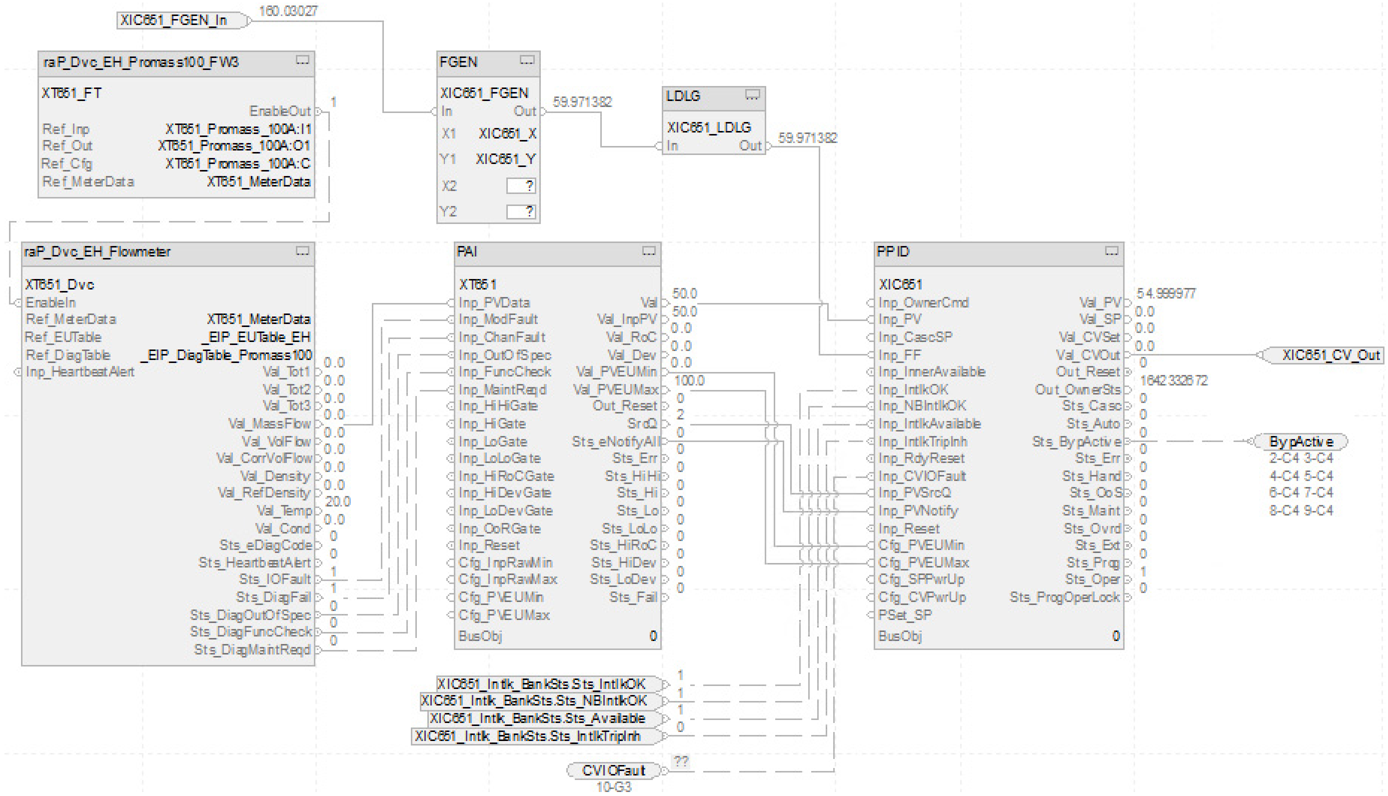


The CS_PPID_FF EtherNet/IP™ sheet operates the same as the CS_PPID_FF sheet but relies on EtherNetIP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XIC650 for the PV data instance of XT101
- Substitute XT650 for the remaining instances of XT101

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_FF_EtherNetIP_NoHB Sheet

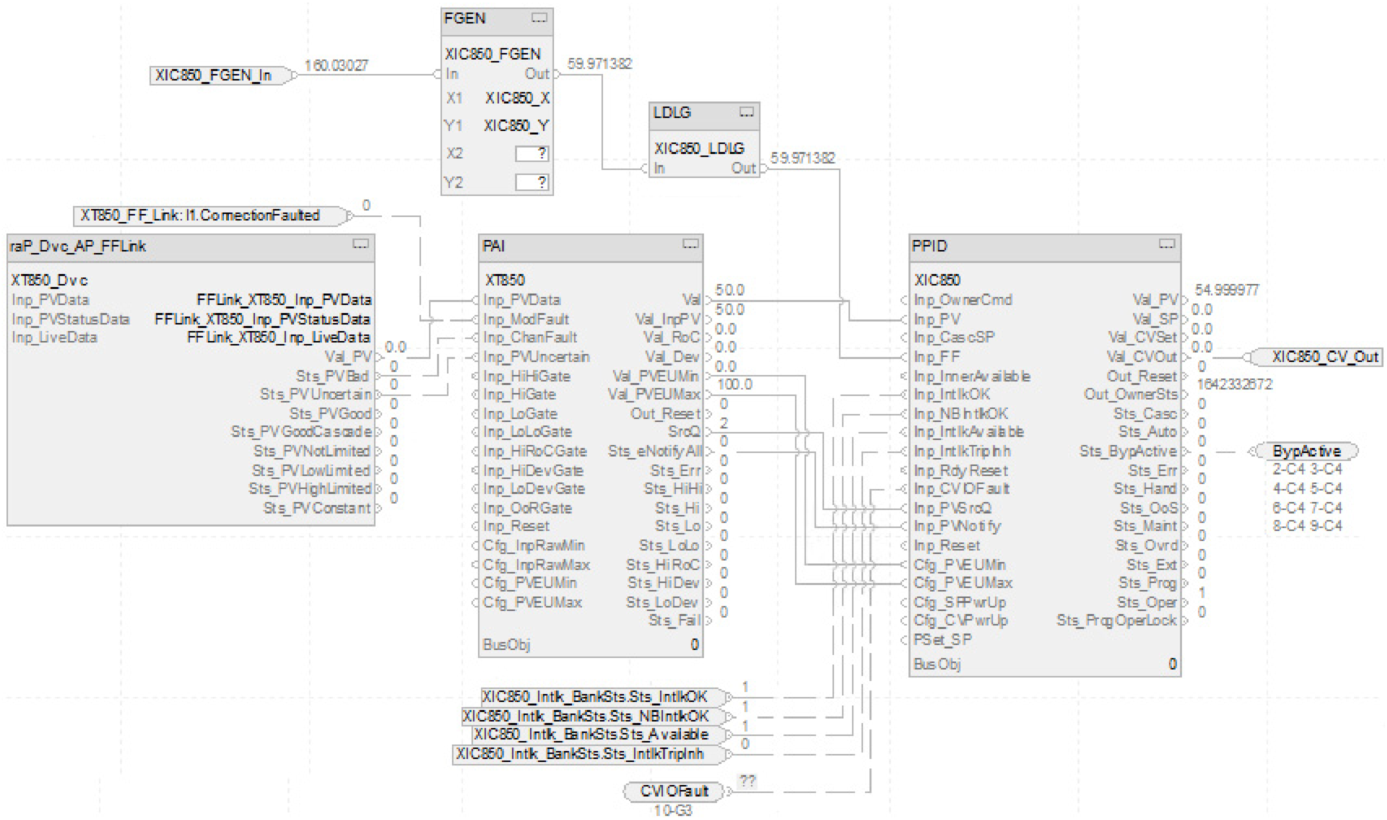


The CS_PPID_FF EtherNet/IP NoHB sheet operates the same as the CS_PPID_FF sheet but relies on EtherNet/IP input data with no heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute XIC651 for the PV data instance of XT101
- Substitute XT651 for the remaining instances of XT101

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_FF_FF

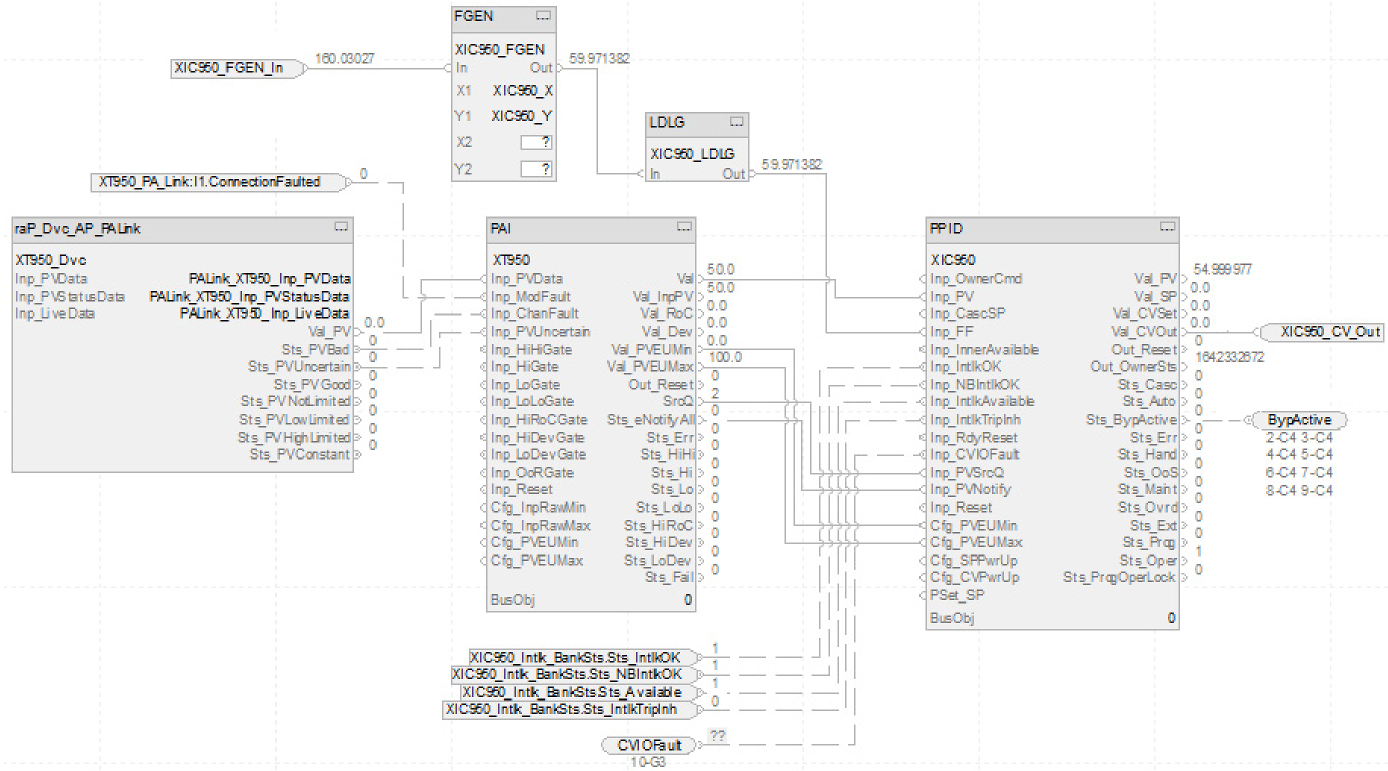


The CS_PPID_FF_FF sheet operates the same as the CS_PPID_FF sheet but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XIC850 for the PV data instance of XT101
- Substitute XT850 for the remaining instances of XT101

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_FF_PA

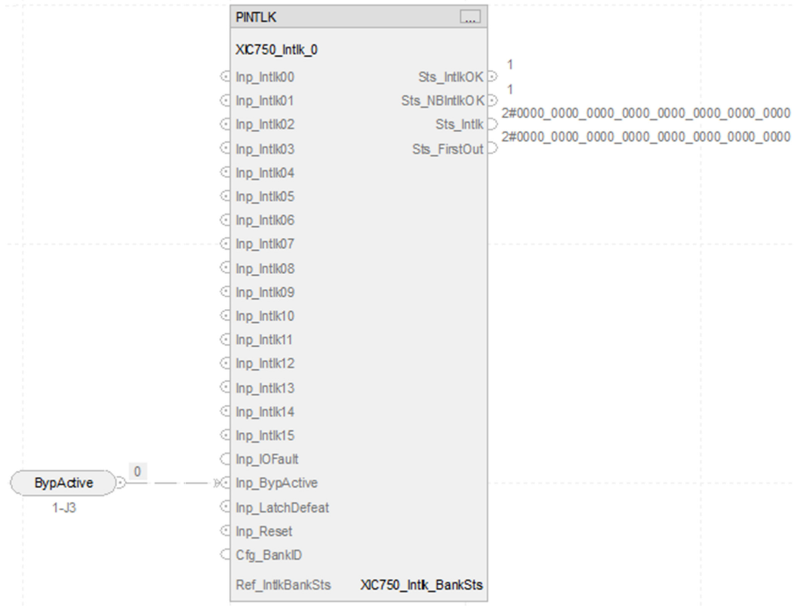


The CS_PPID_FF_PA sheet operates the same as the CS_PPID_FF sheet but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XIC950 for the PV data instance of XT101
- Substitute XT950 for the remaining instances of XT101

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Sheet



PINTLK Input Reference

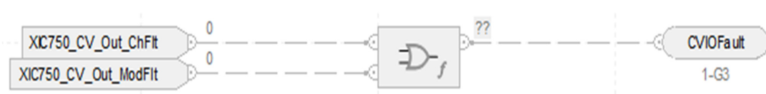
Parameter	Description
BypActive	Input connection from CS_PPID_FF sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

Parameter	Description
XICxxx_Out_CV_ChFlt	Channel fault, 1 = I/O channel fault or failure, 0 = OK Source: PAI instruction
XICxxx_Out_CV_ModFlt	Module fault, 1 = I/O module failure or module communication status bad, 0 = OK Source: PAI instruction

Fault Output Reference

Parameter	Description
CVIOFault	Output connection to CS_PPID_FF sheet

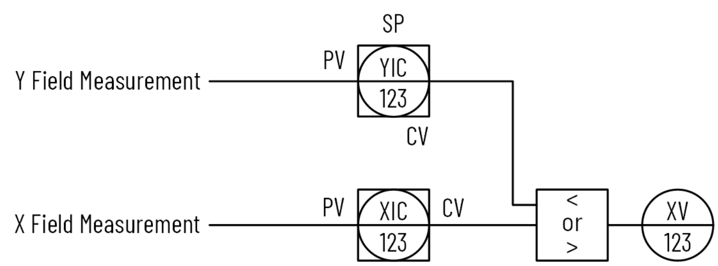
For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Proportional + Integral + Derivative (PPID) Override Control Strategies

The PPID Override control strategy selectively chooses the output of up to six PPID controllers based on configuration (High Select or Low Select) to drive an analog output device. The output(s) of the 'unselected' PPID controller(s) are kept within Kp*Error of the active PPID controller output to help ensure a quick response when another PPID's output becomes the limiting output.

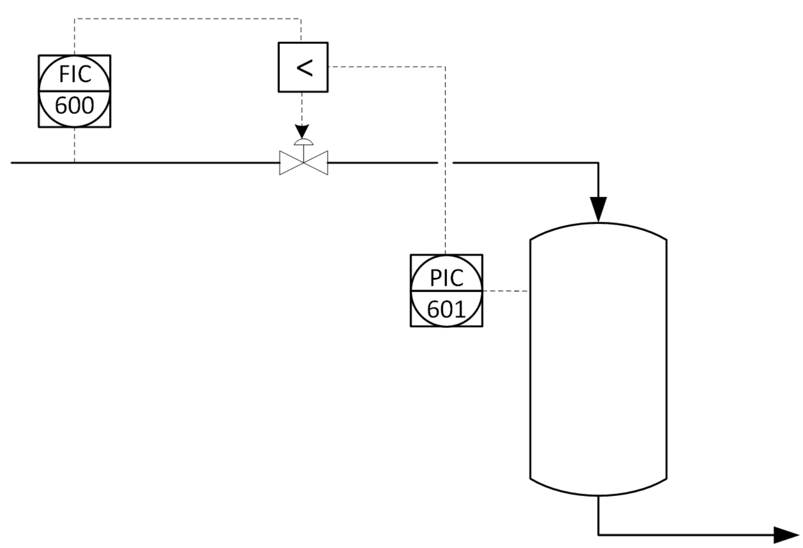
To scale the CV to align with the associated I/O module channel range or to accommodate a fail-open (FO) valve (or air to close) use either of the following options:

- Use a basic PPID with Analog Output control strategy
- Insert a scalar instruction between the PPID CV and the analog output channel reference



PPID Override Example

In this example, the primary control maintains a desired flow of product (FIC-600) into the vessel. To maintain the vessel integrity, it is desired to keep the vessel pressure below a set value. This is accomplished by using the override control strategy where the vessel pressure controller (PIC-601) restricts the valve opening if the vessel pressure exceeds the set value. The lower of the two CVs is selected to drive the final control element (FV-600).



These PPID Override control strategies (consisting of multiple routines) are available in the process library:

Control Strategy	Routines
CS_PPID_OVERRIDE	CS_PPID_OVERRIDE Parameters and Local Tags MainRoutine HILO790 XC790 XIC790 XIC800
CS_PPID_OVERRIDE_HART	CS_PPID_OVERRIDE_HART Parameters and Local Tags MainRoutine HILO590 XC590 XIC590 XIC600
CS_PPID_OVERRIDE_EtherNetIP	CS_PPID_OVERRIDE_EtherNetIP Parameters and Local Tags MainRoutine HILO690 Interlocks XC690 XIC1690 XIC690
CS_PPID_OVERRIDE_EtherNetIP_NoHB	CS_PPID_OVERRIDE_EtherNetIP_NoHB Parameters and Local Tags MainRoutine HILO691 Interlocks XC691 XIC1691 XIC691
CS_PPID_OVERRIDE_FF	CS_PPID_OVERRIDE_FF Parameters and Local Tags MainRoutine FFLinkMap HILO890 Interlocks XC890 XIC1890 XIC890
CS_PPID_OVERRIDE_PA	CS_PPID_OVERRIDE_PA Parameters and Local Tags MainRoutine HILO990 Interlocks PALinkMap XC990 XIC1990 XIC990

Import the **routines** for the appropriate control strategy in your controller project. Each control strategy contains multiple routines; each routine contains multiple Function Block sheets.

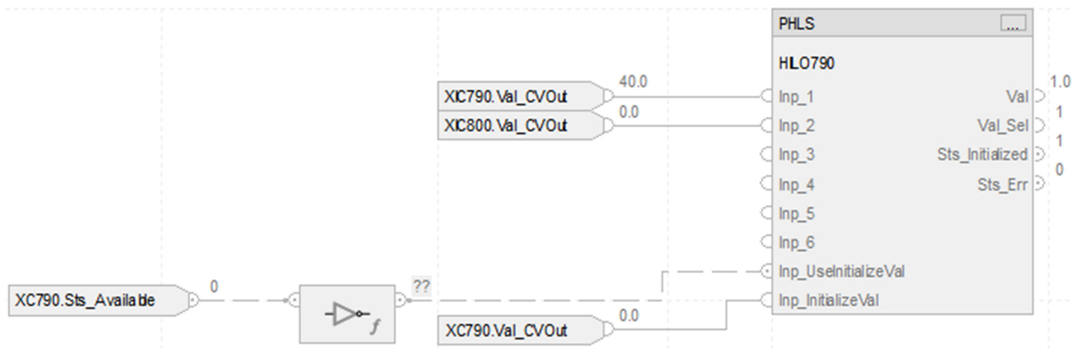
Each PPID Override control strategy contains these Routines:

- Override Low Select (the PHLS can be configured as High or Low Select)
- Process Analog Output
- Process Analog Input to Process PID (two instances)

ROUTINE Override Low Select

Sheet	Description
CS_PHLS	Process High or Low Selector instruction • HILO790 analog • HILO590 HART • HILO690 EtherNet/IP™ • HILO691 EtherNet/IP with no heartbeat • HILO890 FOUNDATION Fieldbus • HILO990 Profibus PA

CS_PHLS Sheet



The control strategy, as supplied, uses only two PID control loops. The control strategy can support up to six PID control loops by exposing additional inputs of the PHLS instruction.

Option	Inp_1	Inp_2
Analog	XIC790	XIC800
HART	XIC590	XIC600
EtherNet/IP	XIC690	XIC1690
EtherNet/IP with no heartbeat	XIC691	XIC1691
FOUNDATION Fieldbus	XIC890	XIC1890
Profibus PA	XIC990	XIC1990

The control strategy uses a subset of the PHLS control strategy. See Process High or Low Selector (PHLS) Control Strategies on page 177 for more details.

PHLS Input References

Parameter	Description
XIC790_Val_CVOut	Control Variable output 1 Source: Val_CVOut from PID loop 1 (XIC790)
XIC800_Val_CVOut	Control Variable output 2 Source: Val_CVOut from PID loop 1 (XIC800)
XC790_Sts_Available	Status available of downstream PAO, 1 = Instruction is initialized
XC790_Val_CVOut	Control Variable output as initialization value from downstream block.

PHLS Output Reference

Parameter	Description
HILO790_Val	Control Variable output (selected minimum or maximum) for downstream block Destination: PAO input (PSet_CV)

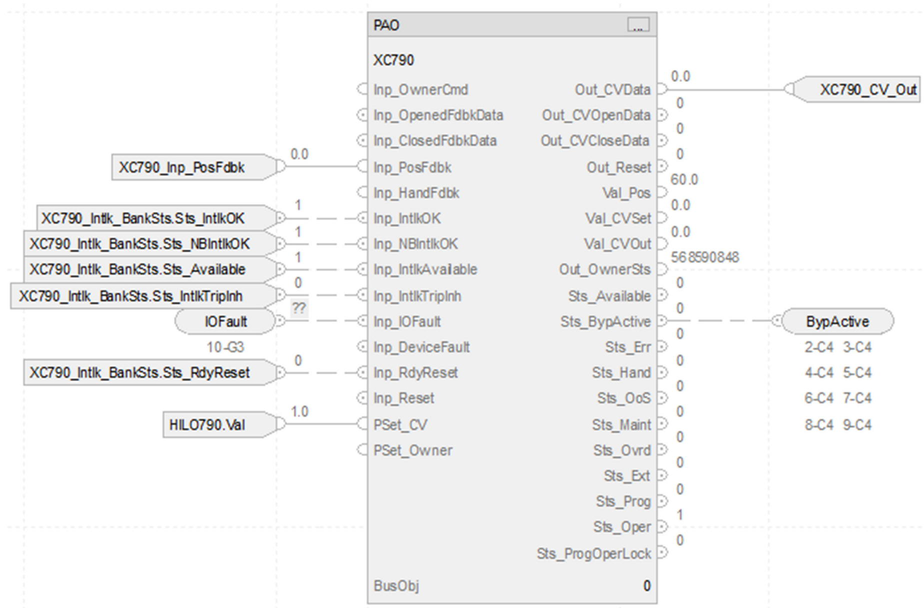
PHLS Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_HIGH_LOW_SELECT	Data structure required for proper operation of instruction

ROUTINE Process Analog Output

Sheet	Description
CS_PAO	Process High or Low Selector instruction • XC790 analog • XC590 HART • XC690 EtherNet/IP • XC691EtherNet/IP with no heartbeat • XC890 FOUNDATION Fieldbus • XC990 Profibus PA
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PAO instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises an alarm on an I/O fault.

CS_PAO Sheet



Input References to PAO and PAO Output References

For details, see the CS_PAO Sheet on page 136.

Substitute:

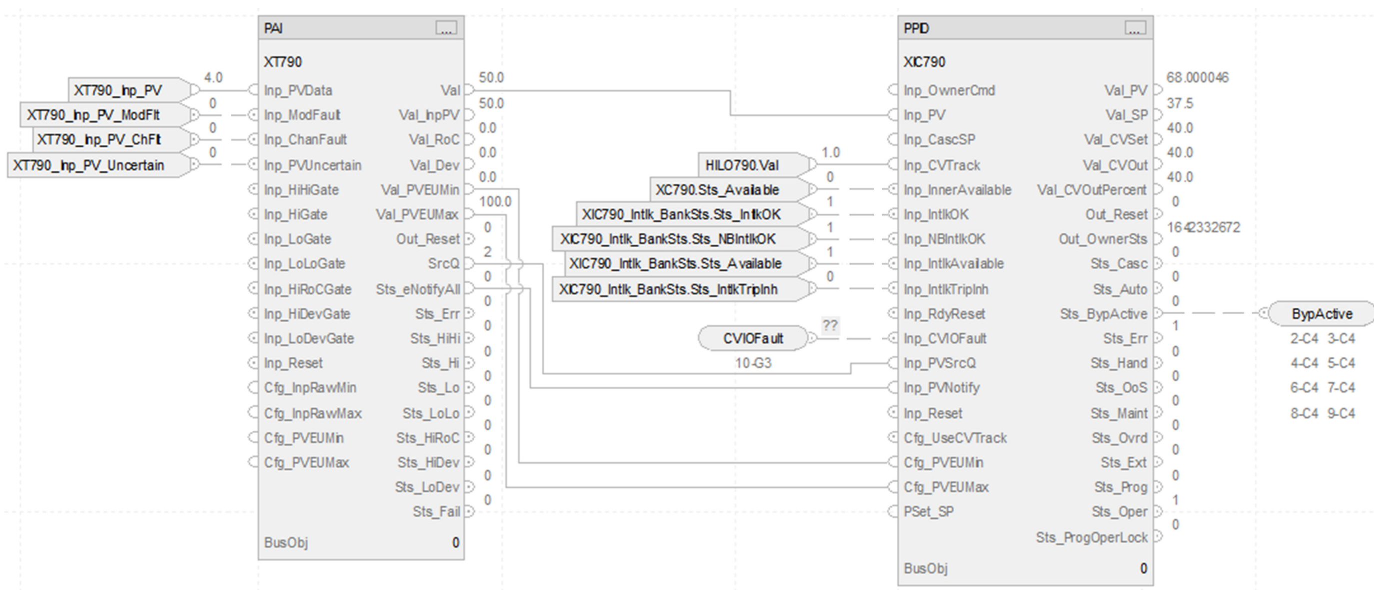
Input	XC101 =	XC100 =
Analog	XC790	HIL0790
HART	XC590	HIL0590
EtherNet/IP	XC690	HIL0690
EtherNet/IP with no heartbeat	XC691	HIL0691
FOUNDATION Fieldbus	XC890	HIL0890
Profibus PA	XC990	HIL0990

ROUTINE: Process Analog Input to Process PID

There are two routines; each routine contains these sheets.

Sheet	Description
CS_PPID	Process PID instruction with override • XIC790/XIC800 analog • XIC590/XIC600 HART • XIC690/XIC1690 EtherNet/IP • XIC690/XIC1691 EtherNet/IP with no heartbeat • XIC890/XIC1890 FOUNDATION Fieldbus • XIC990/XIC1900 Profibus PA
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PPID instruction monitors interlock conditions that 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. There are 8 interlock bank sheets; each bank exposes 16 interlocks but supports as many as 32 interlocks. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID Sheet



PAI Input References

For details, see CS_PAI Sheet on page 110.

- Substitute XIC790 for the first instance of XT101
- Substitute XIC800 for the second instance of XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
Val_PVEUmin	Value for PPID Cfg_PVEUMin parameter PV minimum value in engineering units (PVEU). Valid any float less than Cfg_PVEUMax.
Val_PVEUMax	Value for PPID Cfg_PVEUMax parameter PV maximum value in engineering units (PVEU). Valid any float greater than Cfg_PVEUMin.
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

PPID Input References

Parameter	Description
HIL0790_Val HIL0800_Val	Control Variable output CV to track if Cfg_UseCVTrack = 1 or if Inp_InnerAvailable = 0 (CVEU). Valid any float. Source: PIC control loop
XC790_Sts_Available	Status available
XC800_Sts_Available	1 = Inner loop is available 0 = Inner loop is not available
XIC790_Intlk_BankSts.Sts_IntlkOK XIC800_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XIC790_Intlk_BankSts.Sts_NBIntlkOK XIC800_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XIC790_Intlk_BankSts.Sts_Available XIC800_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XIC790_Intlk_BankSts.Sts_IntlkTripInh XIC800_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection from IO Faults sheet

PPID Output References

Parameter	Description
XIC790_Val_CVOut	Control Variable output Loop CV after clamping and ramping (CVEU) Destination: Analog output channel or downstream REAL tag
BypActive	Output connection to interlock bank sheet

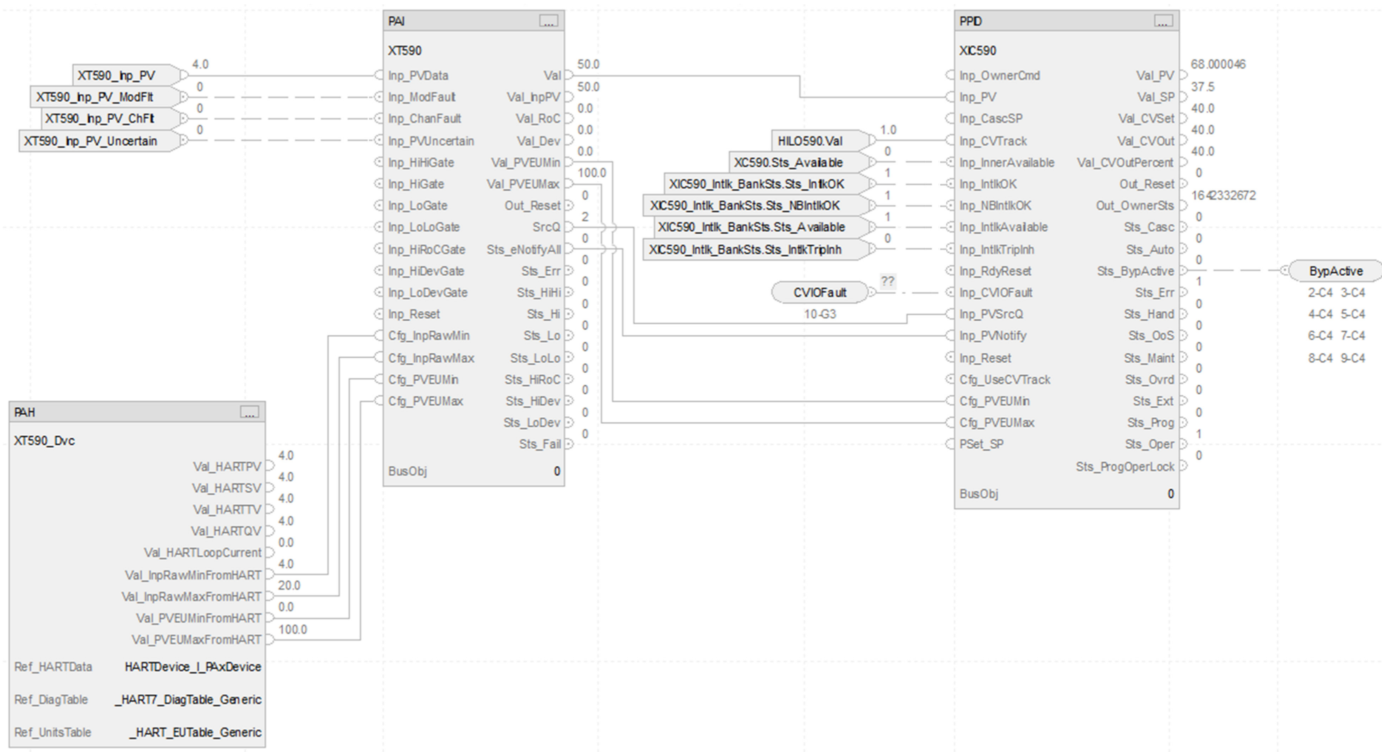
PPID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

Override requires these additional configuration operands for each PPID:

Parameter	Description
Cfg_UseCVTrack	For each PID control loop, set Cgf_UseCVTrack=1 1 = Use Inp_CVTrack reset feedback in tracking, for example, if PPID output is significantly faster than actuator or inner loop or in override select control
Cfg_CVTrackGain	For each PID control loop, set Cfg_CVTrackGain=Cfg_IGain (Tt=Ti) 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.

CS_PPID HART Sheet

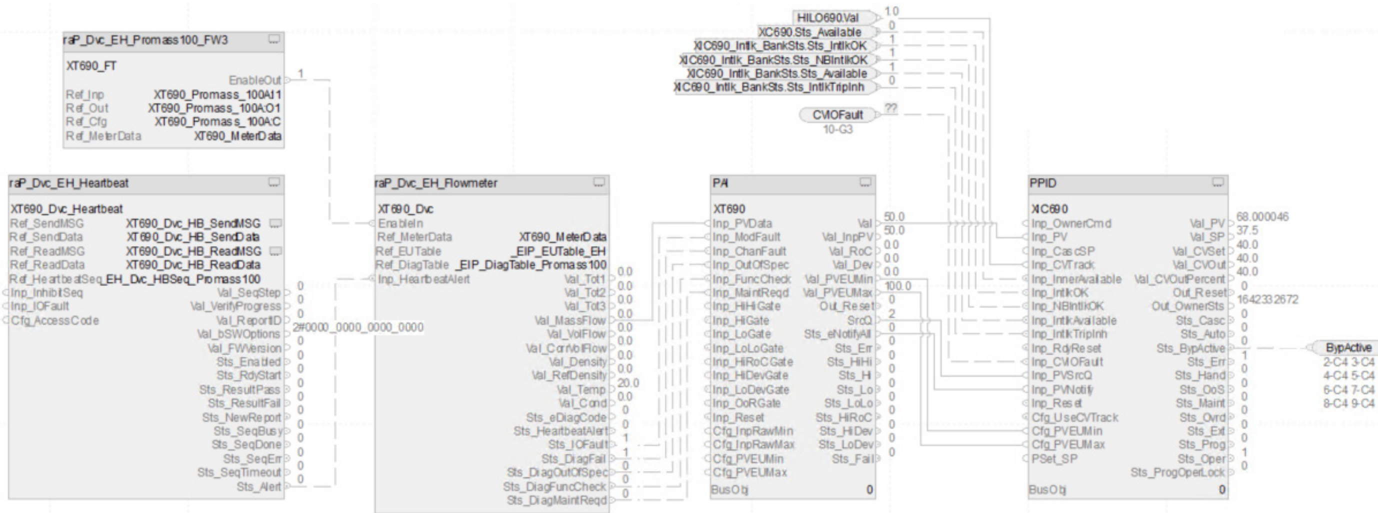


The CS_PPID HART sheet operates the same as the CS_PPID sheet but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XIC590 for the first instance of XT100
- Substitute XIC600 for the second instance of XT100

For more information, see HART Integration on page 31.

CS_PPID_EtherNetIP Sheet

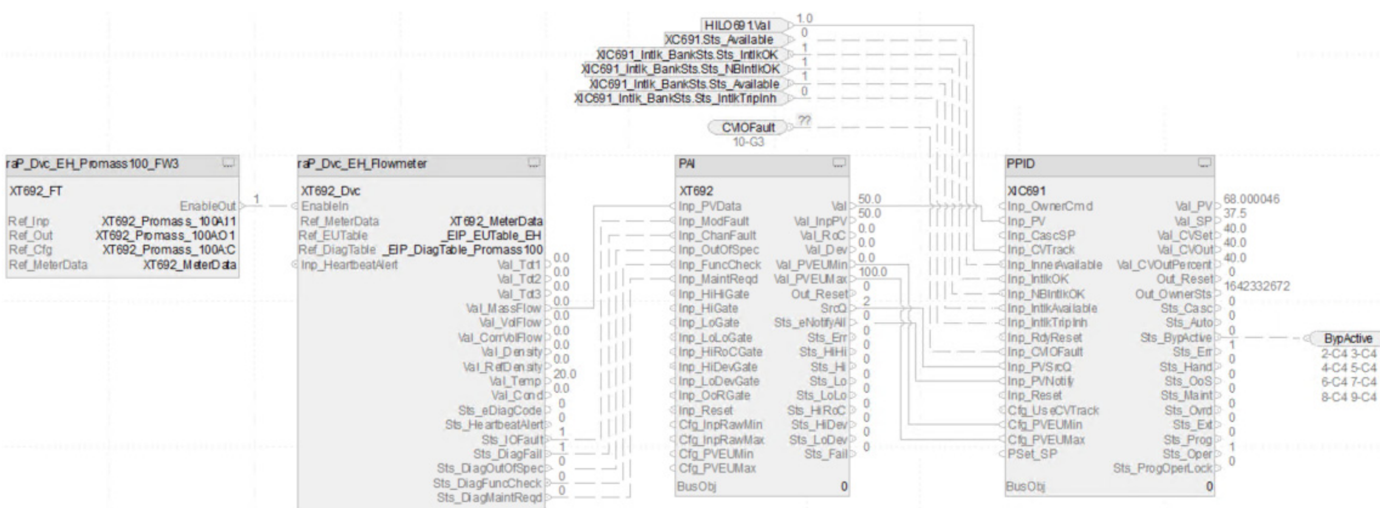


The CS_PPID EtherNet/IP sheet operates the same as the CS_PPID sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XIC690 for the first instance of XT100
- Substitute XIC1690 for the second instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_EtherNetIP_NoHB Sheet

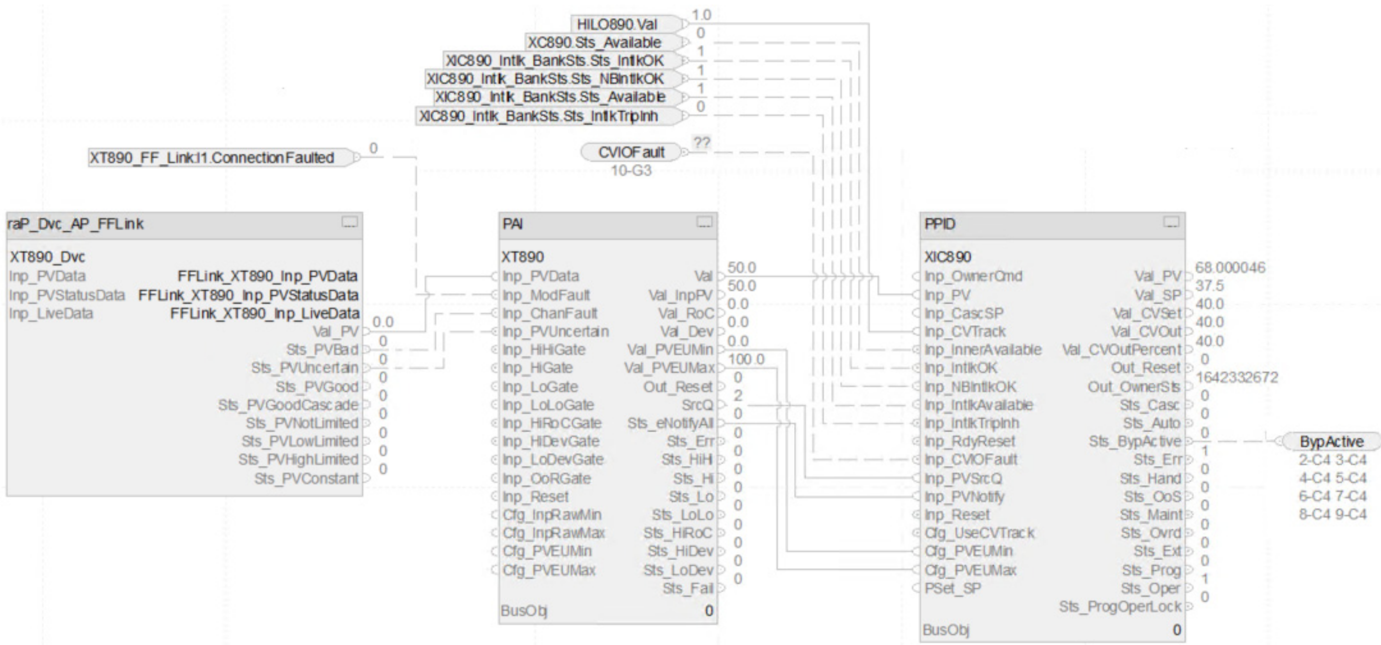


The CS_PPID EtherNetIP_NoHB sheet operates the same as the CS_PPID sheet but relies on EtherNet/IP input data with no heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute XIC691 for the first instance of XT100
- Substitute XIC1691 for the second instance of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_FF Sheet

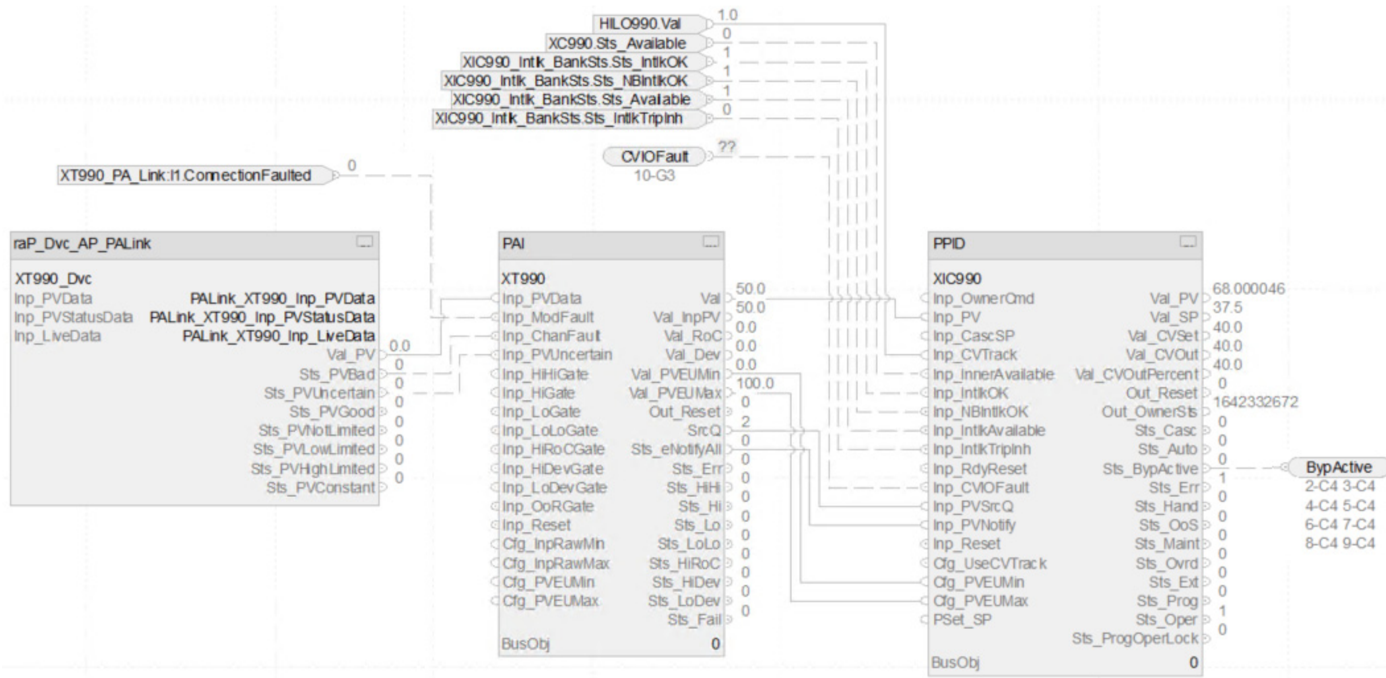


The CS_PPID_FF sheet operates the same as the CS_PPID sheet but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XIC890 for the first instance of XT100
- Substitute XIC1890 for the second instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_PA Sheet

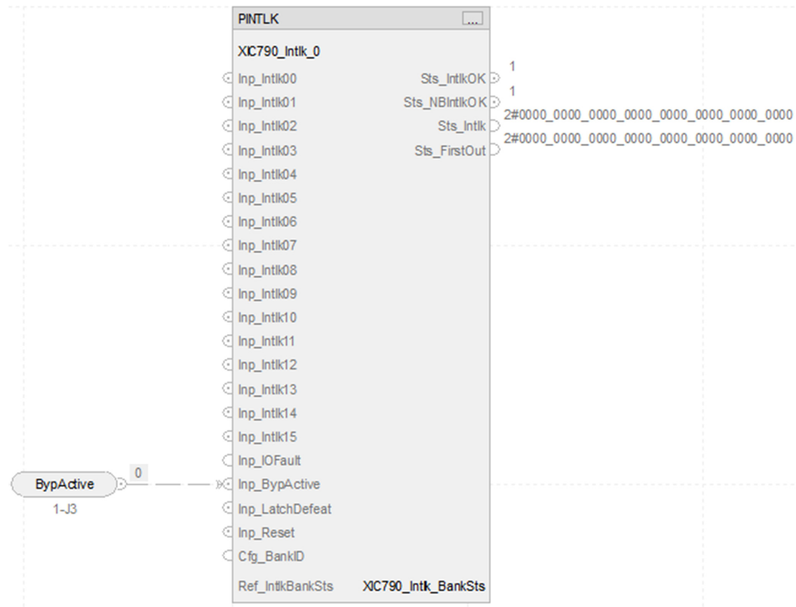


The CS_PPID_PA sheet operates the same as the CS_PPID sheet but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XIC990 for the first instance of XT100
- Substitute XIC1990 for the second instance of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Sheet



PINTLK Input Reference

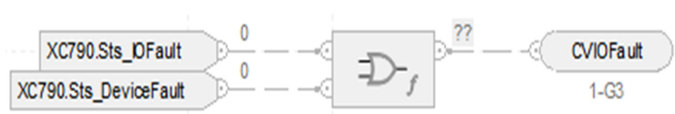
Parameter	Description
BypActive	Input connection from CS_PPID_OVERRIDE sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Faults Input References

Parameter	Description
XICxxx_Out_CV_ChanFault	Control Variable output channel fault
XICxxx_Out_CV_ModFault	Control Variable output data module fault

Fault Output Reference

Parameter	Description
CVIOFault	Output connection to CS_PPID_OVERRIDE sheet

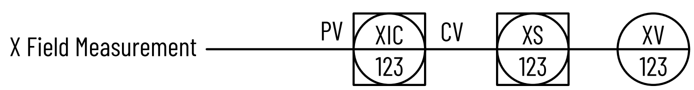
For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Proportional + Integral + Derivative (PPID) Basic PPID with Process Analog Output (PAO) Control Strategies

This control strategy differs from the Basic PPID control strategy in that a PAO instruction is inserted between the output of the PPID and the reference signal to the analog output channel.

This strategy provides the capability to pulse outputs (pulse open and pulse close) to position a valve to the reference signal provided by the PPID CV.

You can also use this control strategy instead of the Basic PPID control strategy to scale the output to accommodate fail-open (FO) valves (or air to close). Alternatively, you can use a scalar instruction in place of the PAO to accommodate fail-open valves.



PPID with PAO Control Strategies

Control Strategy	Routine
CS_PPID_PAO	CS_PPID_PAO Parameters and Local Tags MainRoutine XC730 XIC730
CS_PPID_PAO_EtherNetIP	CS_PPID_PAO_EtherNetIP Parameters and Local Tags MainRoutine Interlocks XC630 XIC630
CS_PPID_PAO_EtherNetIP_NoHB	CS_PPID_PAO_EtherNetIP_NoHB Parameters and Local Tags MainRoutine Interlocks XC631 XIC631

PPID with PAO Control Strategies

Control Strategy	Routine
CS_PPID_PAO_FF	CS_PPID_PAO_FF Parameters and Local Tags MainRoutine FFLinkMap Interlocks XC830 XIC830
CS_PPID_PAO_PA	CS_PPID_PAO_PA Parameters and Local Tags MainRoutine Interlocks PALinkMap XC930 XIC930

CS_PPID HART Options

HART Option	Description	Routine
CS_PPID_PAO_HART	HART input to PAO (XC731)	CS_PPID_PAO_HART Parameters and Local Tags MainRoutine Interlocks XC731 XIC731
CS_PPID_HART_PAO	HART input to PAI (XIC530)	CS_PPID_HART_PAO Parameters and Local Tags MainRoutine Interlocks XC530 XIC530
CS_PPID_HART_PAO_HART	HART input to PAO (XC531) and HART input to PAI (XIC531)	CS_PPID_HART_PAO_HART Parameters and Local Tags MainRoutine Interlocks XC531 XIC531

Import the **routines** for the appropriate control strategy in your controller project. Each control strategy contains multiple routines; each routine contains multiple Function Block sheets.

Each PPID with PAO control strategy contains these routines:

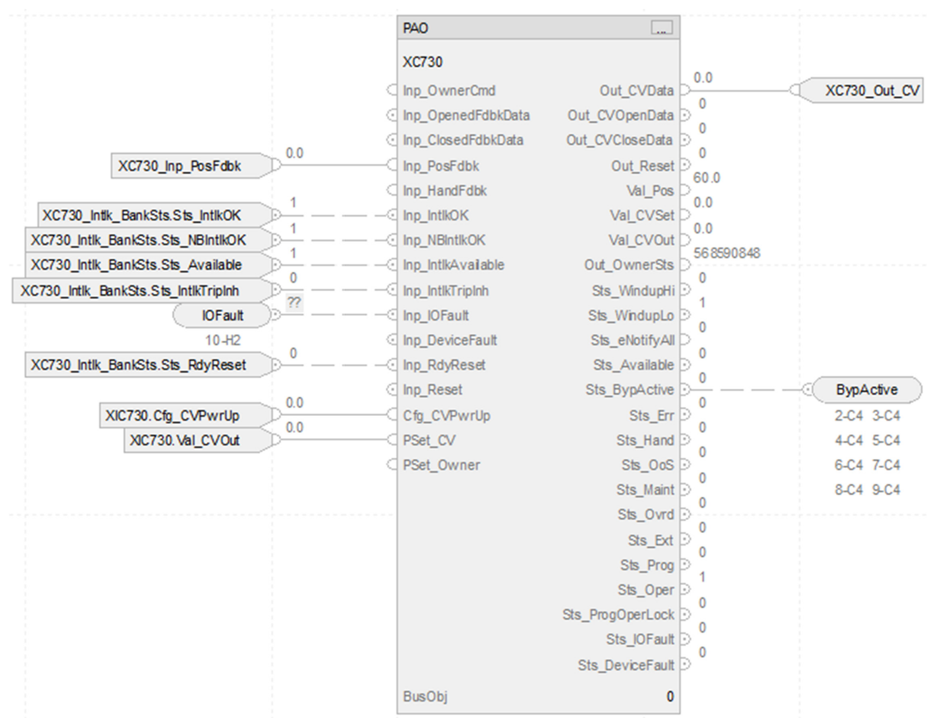
- PAO
- PPID

ROUTINE PPID_PAO

Each routine contains these sheets.

Sheet	Description
CS_PPID_PAO	Process analog output • XC730 analog • XC531 and XC731 HART • XC630 EtherNet/IP™ • XC631EtherNet/IP with no heartbeat • XC830 FOUNDATION Fieldbus • XC930 Profibus PA
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PAO instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID_PAO Sheet (XC730)



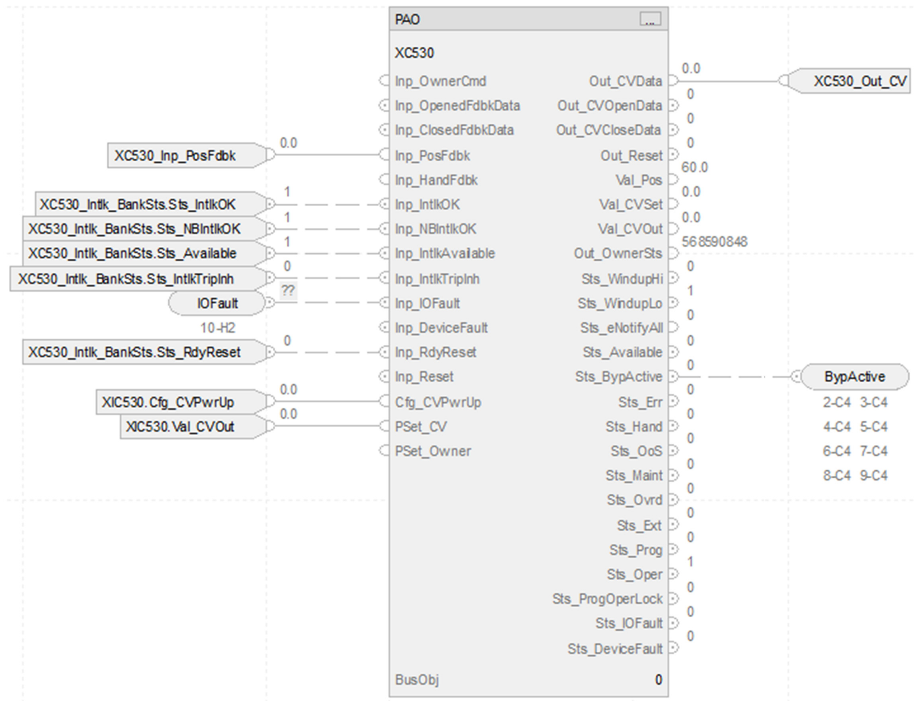
PAO Input References

For details, see the CS_PAO Sheet on page 136. Substitute XC730 for XC100.

PAO Output References

Parameter	Description
XIC730_Out_CV	Control Variable output for PPID instructions CV output in raw (I/O Card) units. Extended properties of this member: Engineering Unit - Raw units (text) used for the analog output
BypActive	Output connection to interlock bank sheet

CS_PPID_PAO HART Sheet (XC530)



The CS_PPID_PAO_HART sheet operates the same as the CS_PAO sheet but relies on HART input data.

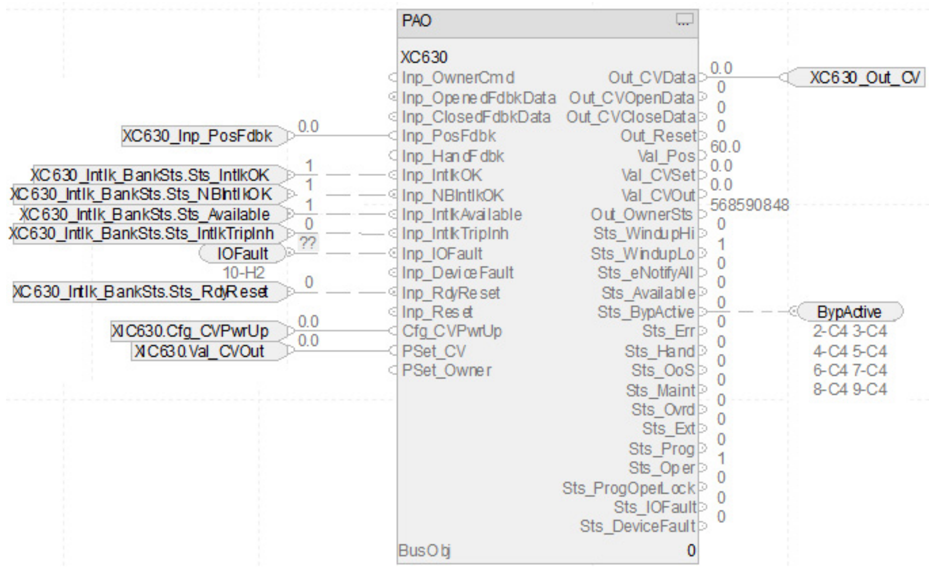
- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XC530 for XT100

For the CS_HART_PAO_HART control strategy:

- For information on PAH outputs to PAO inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XC531 for XT100

For more information, see HART Integration on page 31.

CS_PPID_PAO EtherNet/IP Sheet (XC630)

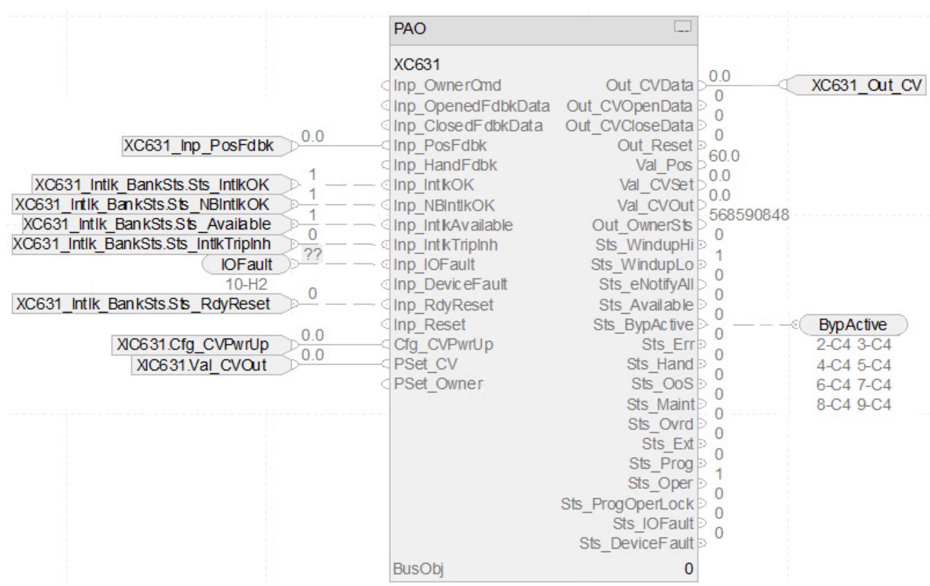


The CS_PPID_PAO EtherNet/IP sheet operates the same as the CS_PAO sheet but relies on EtherNet/IP input data.

- For information on PAO inputs, see CS_PAO Sheet on page 136.
- Substitute XC630 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_PAO EtherNet/IP NoHB Sheet (XC631)

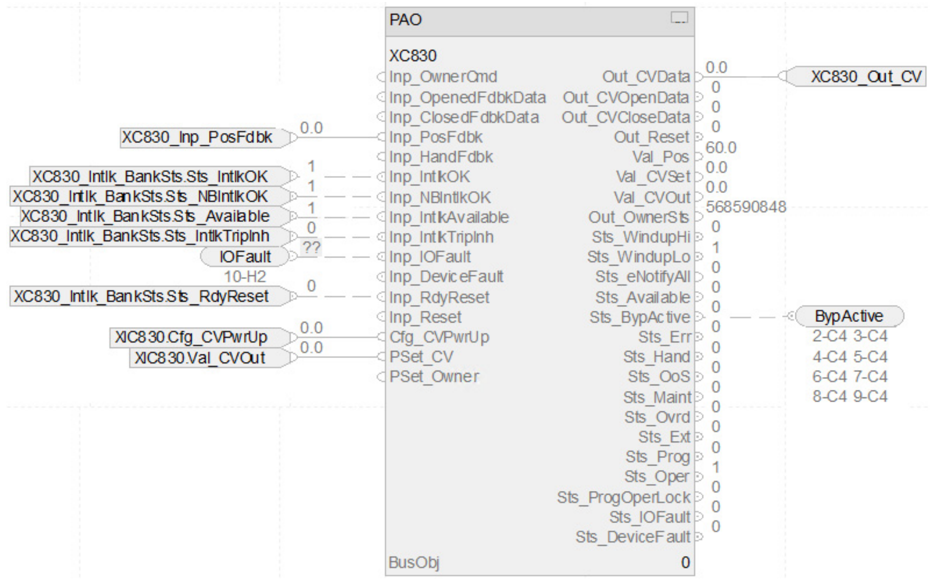


The CS_PPID_PAO EtherNet/IP NoHB sheet operates the same as the CS_PAO sheet but relies on EtherNet/IP input data with no heartbeat.

- For information on PAO inputs, see CS_PAO Sheet on page 136.
- Substitute XC631 for XC100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_PAO FF Sheet (XC830)

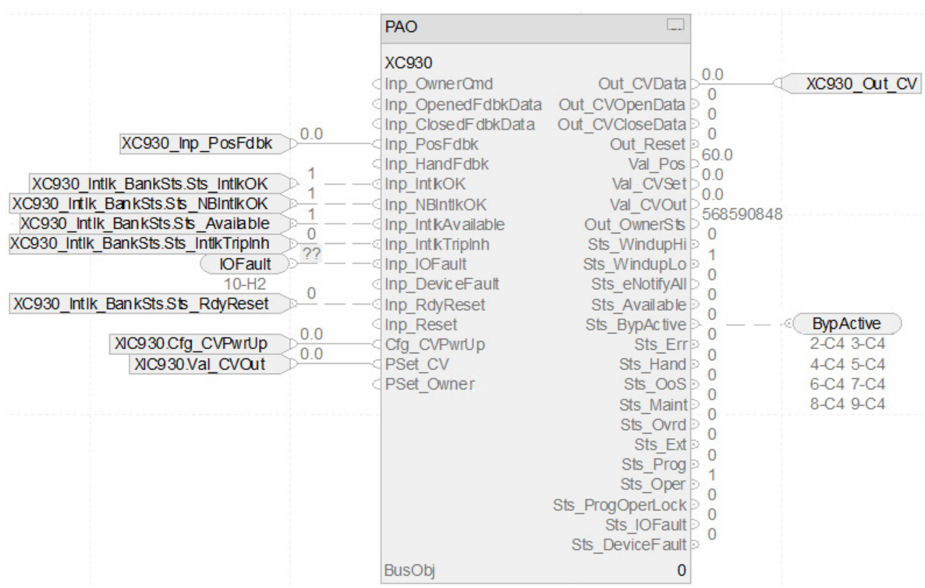


The CS_PPID_PAO FF sheet operates the same as the CS_PAO sheet but relies on FOUNDATION Fieldbus input data.

- For information on PAO inputs, see CS_PAO Sheet on page 136.
- Substitute XC830 for XC100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_PAO PA Sheet (XC930)

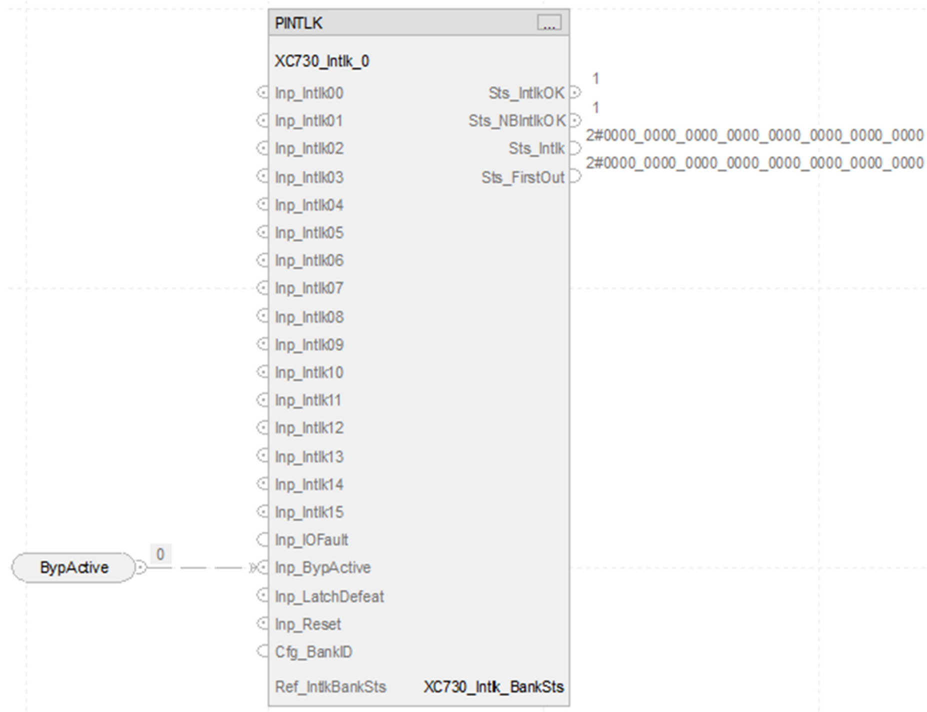


The CS_PPID_PAO PA sheet operates the same as the CS_PAO sheet but relies on Profibus PA input data.

- For information on PAO inputs, see CS_PAO Sheet on page 136.
- Substitute XC930 for XC100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Sheet



PINTLK Input Reference

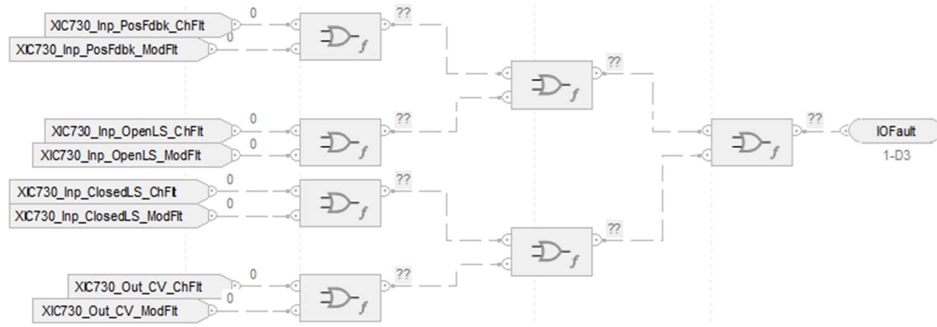
Parameter	Description
BypActive	Input connection from CS_PAO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Faults Input References

Parameter	Description
XICxxx_Inp_PosFdbk_ChFlt	Tieback Input Channel Fault Source: PAO instruction
XICxxx_Inp_PosFdbk_ModFlt	1 = This or parent I/O communication faulted (module not in Running state). Use this parameter to trigger device I/O Fault action. Source: PAO instruction
XICxxx_Inp_OpenLS_ChFlt	Opened Feedback Input Channel Fault Source: PAO instruction
XICxxx_Inp_OpenLS_ModFlt	1 = This or parent I/O communication faulted (module not in Running state). Use this parameter to trigger device I/O Fault action. Source: PAO instruction
XICxxx_Inp_ClosedLS_ChFlt	Closed Feedback Input Channel Fault Source: PAO instruction
XICxxx_Inp_ClosedLS_ModFlt	1 = This or parent I/O communication faulted (module not in Running state). Use this parameter to trigger device I/O Fault action. Source: PAO instruction
XICxxx_Out_CV_ChFlt	Control Variable Output Channel Fault 1 = I/O channel fault or failure 0 = OK Source: PAO instruction
XICxxx_Out_CV_ModFlt	1 = This or parent I/O communication faulted (module not in Running state). Use this parameter to trigger device I/O Fault action. Source: PAO instruction

Fault Output Reference

Parameter	Description
IOFault	Output connection to CS_PAO sheet

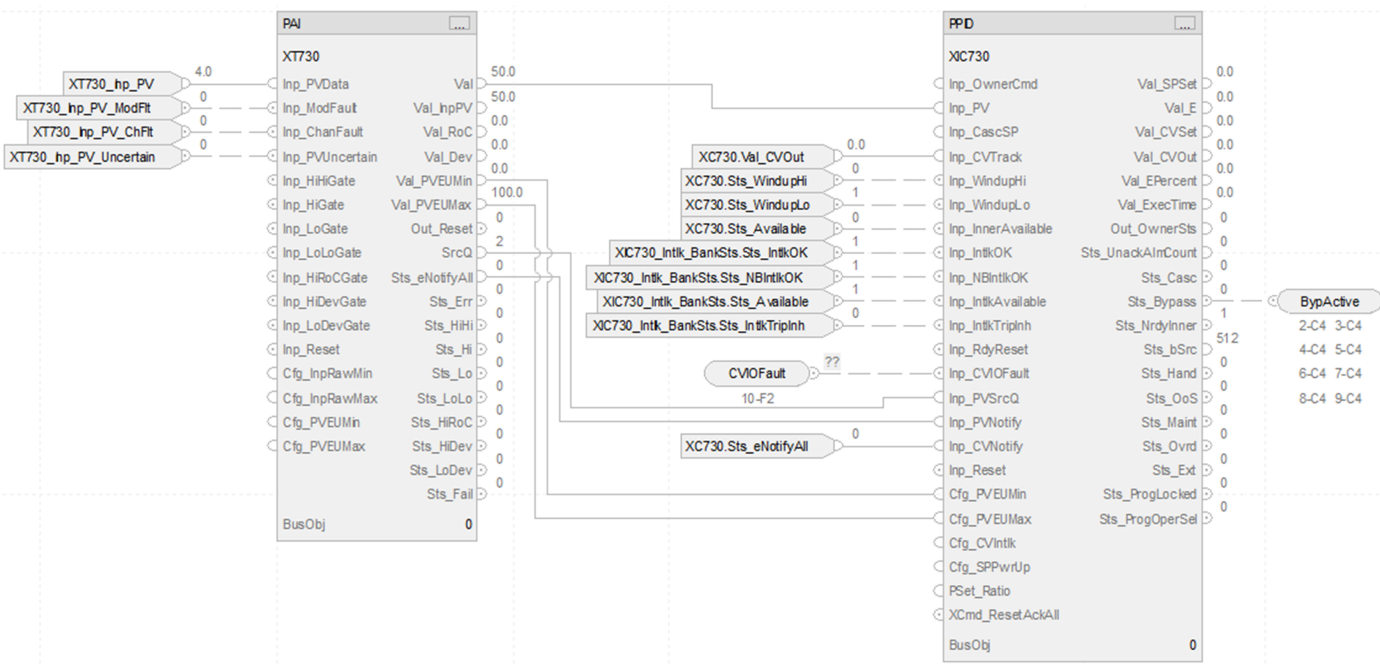
For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

ROUTINE PPID_PAO_PID

Each routine contains these sheets.

Sheet	Description
CS_PPID_PAO_PID	Process analog output • XIC730 analog • XIC530 and XIC531 HART • XIC630 EtherNet/IP • XIC631EtherNet/IP with no heartbeat • XIC830 FOUNDATION Fieldbus • XIC930 Profibus PA
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PAO instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID_PAO_PID Sheet (XIC730)



PAI Input References

For details, see CS_PAI Sheet on page 110. Substitute XT730 for XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

PPID Input References

Parameter	Description
XC730.Val_CVout	Loop CV after clamping and ramping (CVEU). Source: outer loop
XC730.Sts_WindupHi	Windup high signal. When true, the CV cannot integrate in a positive direction. The signal is typically obtained from the Windup hi output from an inner loop. Default is false.
XC730.Sts_WindupLo	Windup low signal. When true, the CV cannot integrate in a negative direction. The signal is typically obtained from the Windup low output from an inner loop. Default is false.
XC730.Sts_Available	1 = Inner loop (slave object) is available. 0 = Inner loop is not available, PPID tracks Inp_CVTrack, typically inner loop SP or actuator position. Default is true.
XIC730_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
XIC730_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status, 1 = All non-bypassable interlocks OK to run
XIC730_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
XIC730_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection from IO Faults sheet
XC730.Sts_eNotify	Alarm status from PAO: 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

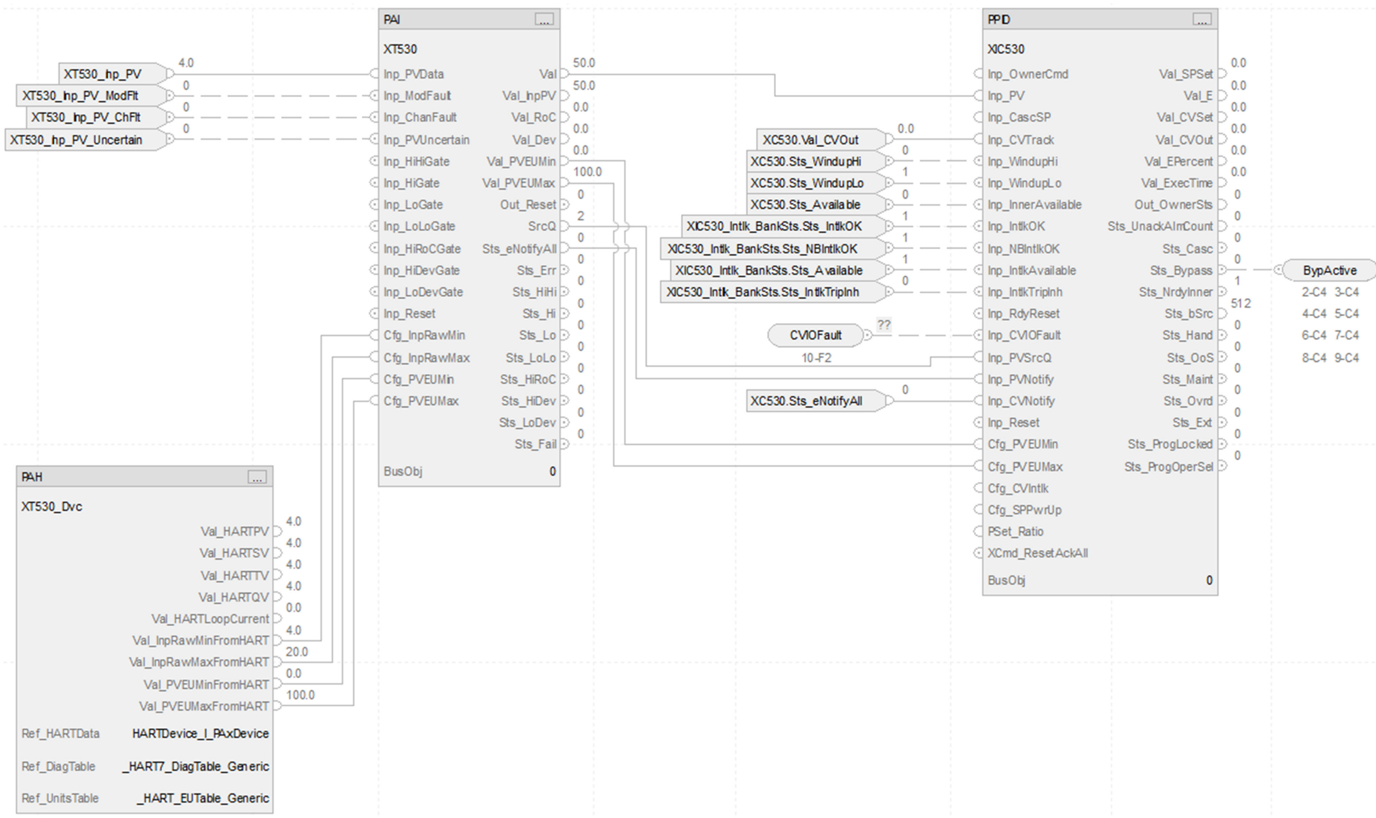
PPID Output References

Parameter	Description
BypActive	Output connection to interlock bank sheet

PPID Configuration Considerations

Operand	Type	Description
PlantPAx control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID_PAO_HART_PID HART Sheet (XIC530)



The CS_PPID_PAO_HART_PID sheet operates the same as the CS_PPID_PAO_PID sheet but relies on HART input data.

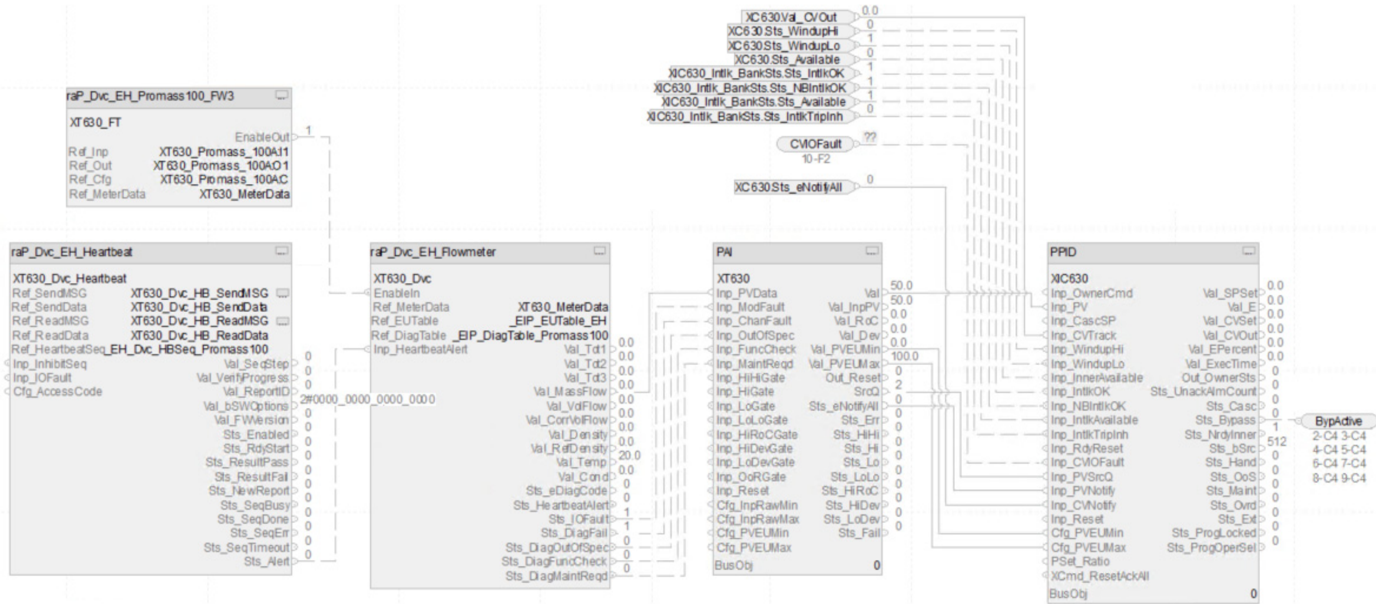
- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XT530 for XT100

If you are using the CS_HART_PAO_HART control strategy:

- Substitute XT531 for XT100

For more information, see HART Integration on page 31.

CS_PPID_PAO_PID EtherNet/IP Sheet (XIC630)

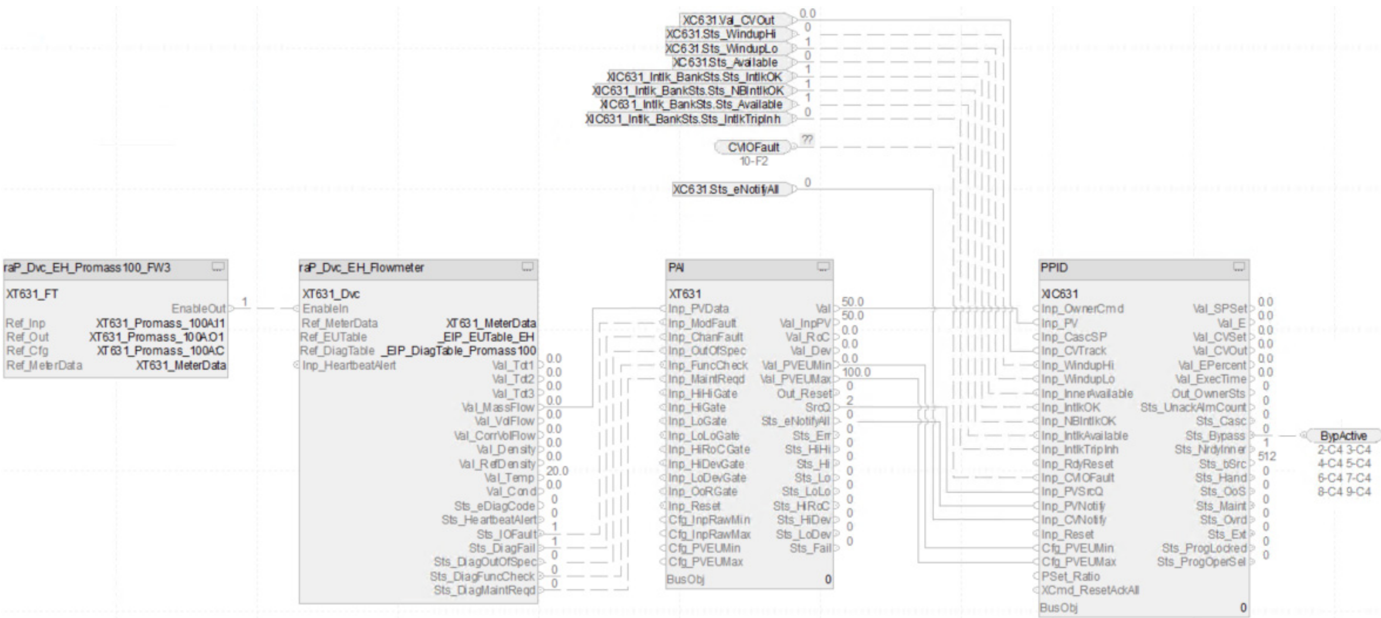


The CS_PPID_PAO_HART_PID EtherNet/IP sheet operates the same as the CS_PPID_PAO_PID sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XT630 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_PAO_PID EtherNet/IP NoHB (XIC631)

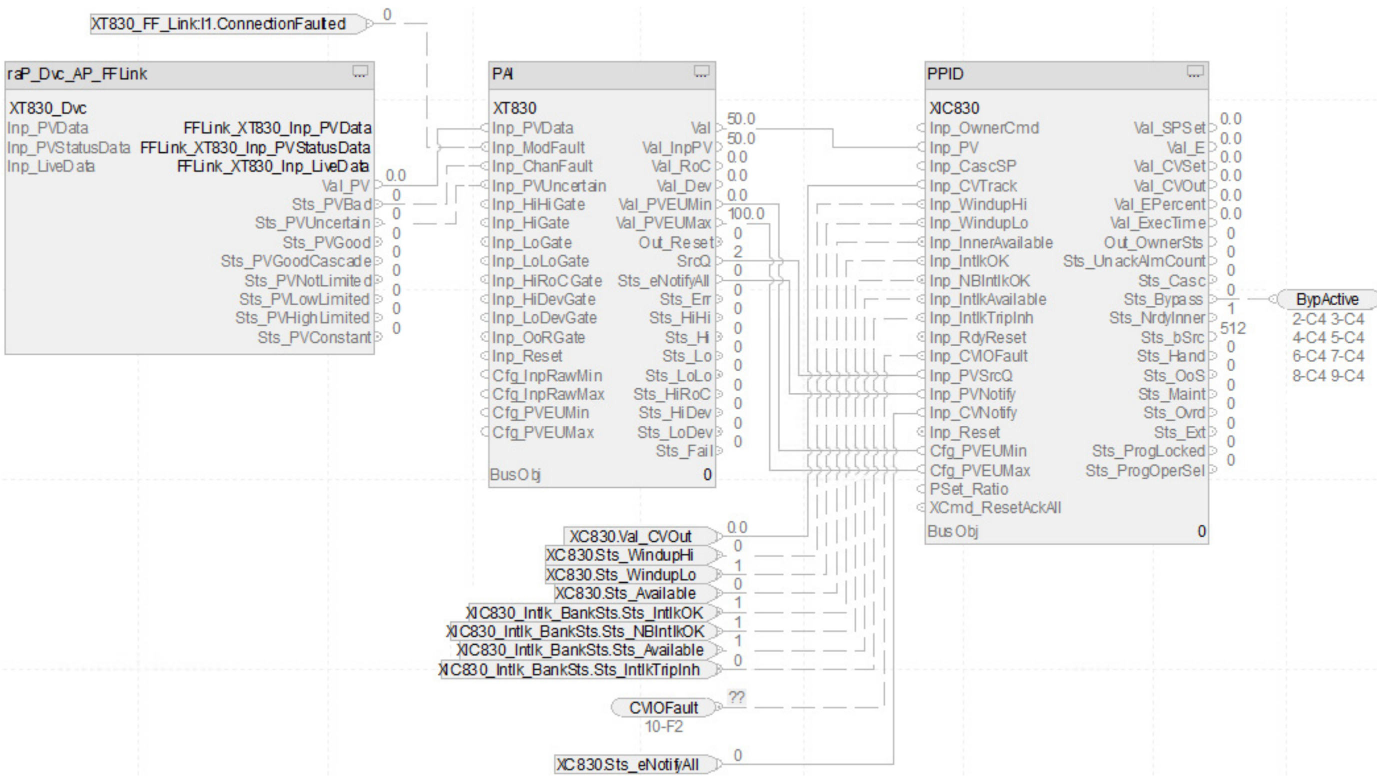


The CS_PPID_PAO_HART_PID EtherNet/IP NoHB sheet operates the same as the CS_PPID_PAO_PID sheet but relies on EtherNet/IP input data without heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute XT631 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_PAO_PID FF Sheet (XIC830)

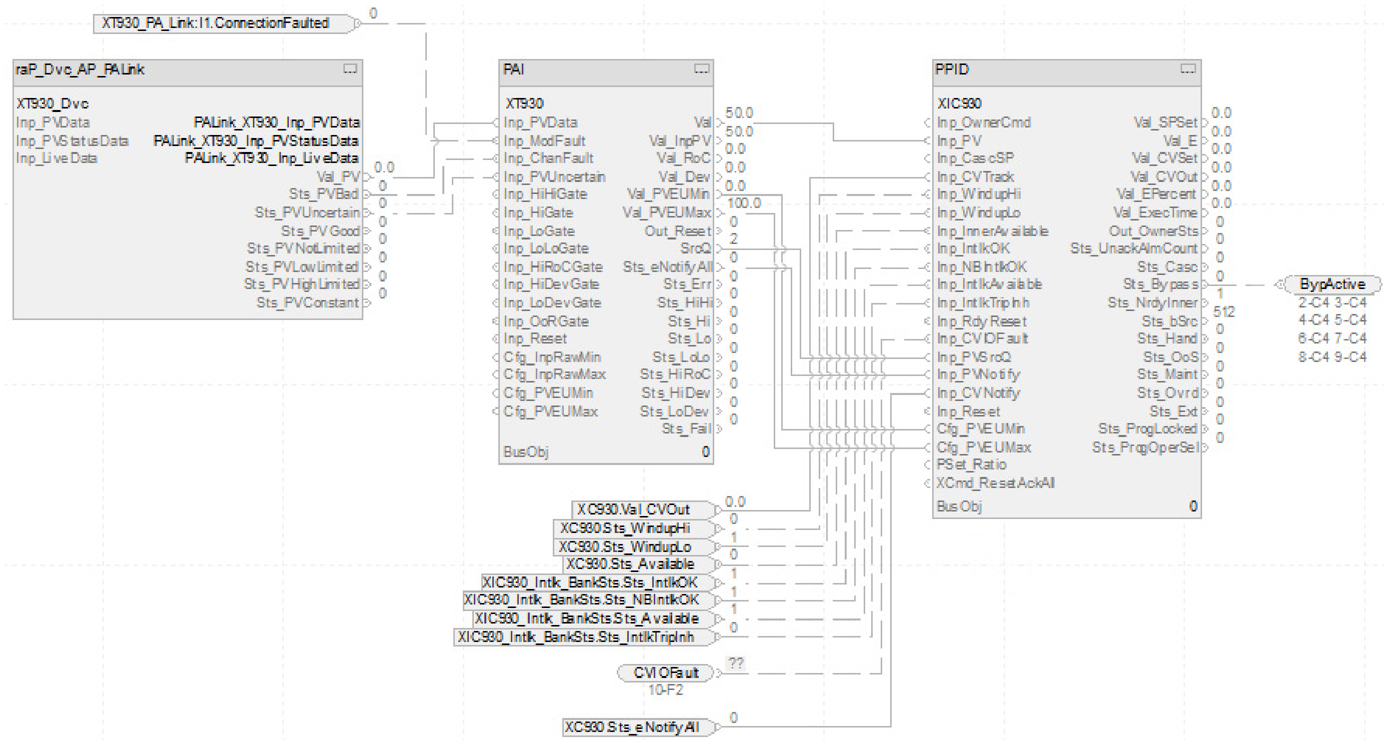


The CS_PPID_PAO_HART_PID FOUNDATION Fieldbus sheet operates the same as the CS_PPID_PAO_PID sheet but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XT830 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_PAO_PID Profibus PA Sheet (XIC930)

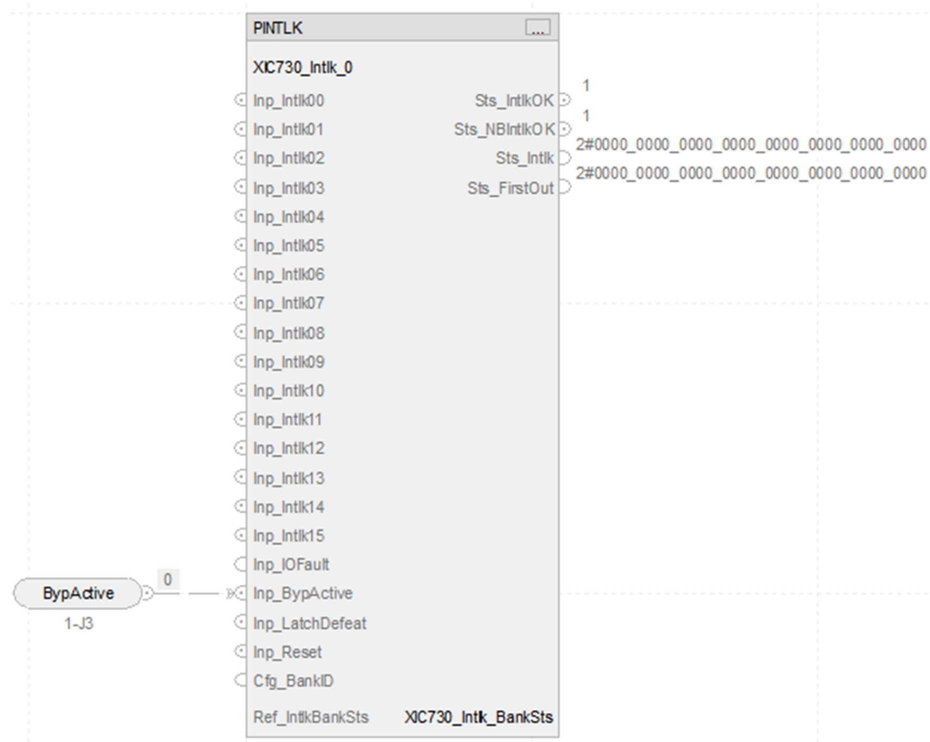


The CS_PPID_PAO_HART_PID Profibus PA sheet operates the same as the CS_PPID_PAO_PID sheet but relies on Profibus PA input data.

- For information on Profibus PA outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XT930 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Sheet



PINTLK Input Reference

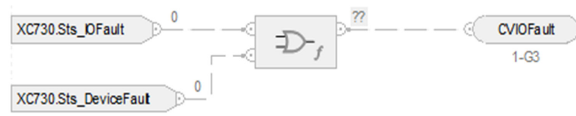
Parameter	Description
BypActive	Input connection from CS_PPID sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Faults Input References

Parameter	Description
XCxxx.Sts_IOFault	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 Source: PAO instruction
XCxxx.Sts_DeviceFault	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 Source: PAO instruction

Fault Output Reference

Parameter	Description
CVIOFault	Output connection to CS_PPID sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

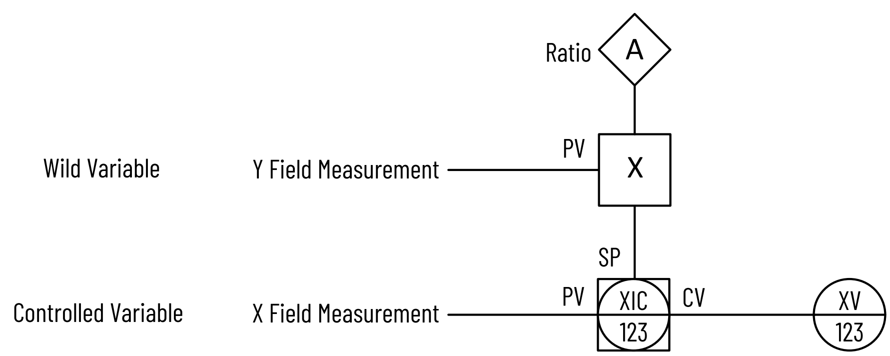
Notes:

Process Proportional + Integral + Derivative (PPID) Ratio Control Strategies

Use the PPID Ratio control strategy to add a material in a set proportion to another material.

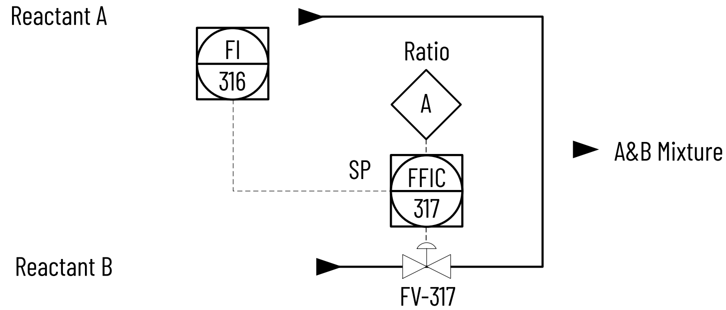
To scale the CV to align with the associated I/O module channel range or to accommodate a fail-open (FO) valve (or air to close) use either of the following options:

- Use a basic PPID with Analog Output control strategy
- Insert a scalar instruction between the PPID CV and the analog output channel reference



PPID Ratio Example

In this example, two reactants (A and B) are added to a tank in a constant ratio. The flow rate of reactant A might change over time because of some upstream process upsets. Use a PPID Ratio control strategy to automatically adjust the rate of the reactant B addition. In this example, reactant A is the uncontrolled or wild flow because it is not controlled by the PPID instruction. The flow of reactant B is 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 following PPID control strategies are available as routines in the process library:

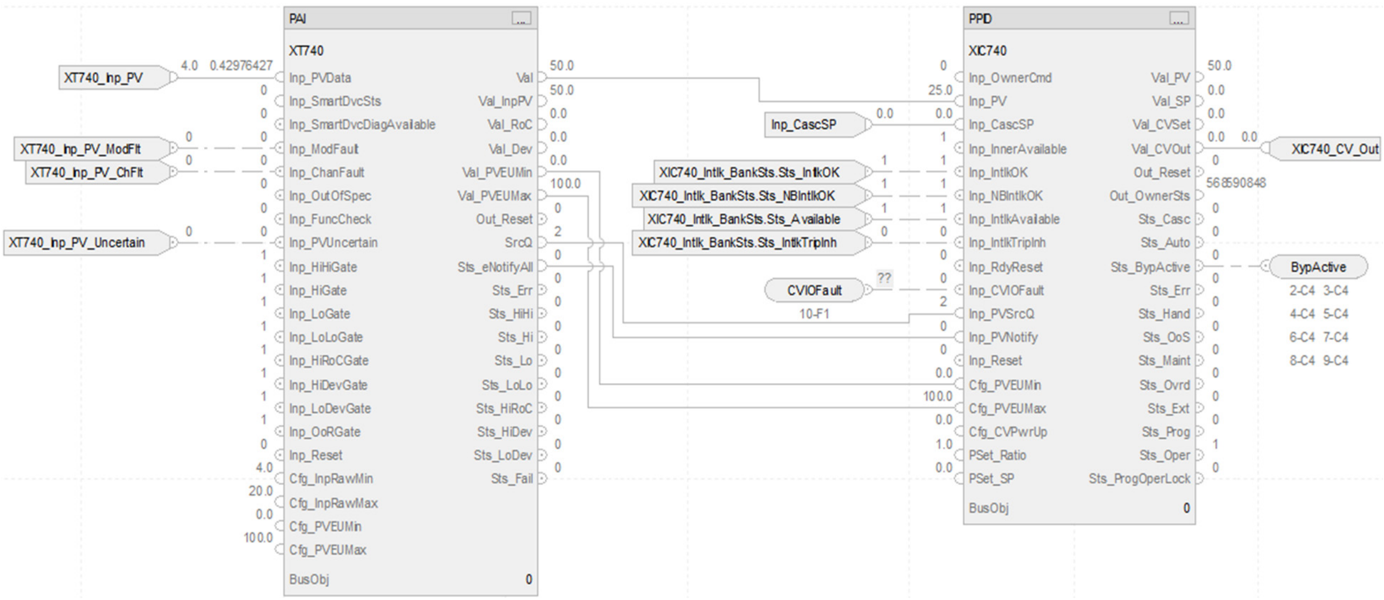
- CS_PPID_RATIO
- CS_PPID_RATIO_HART
- CS_PPID_RATIO_EtherNetIP
- CS_PPID_RATIO_EtherNetIP_NoHB
- CS_PPID_RATIO_FF
- CS_PPID_RATIO_PA

Import the appropriate control strategy as a **routine** in your controller project.

Each PPID Ratio control strategy contains these sheets:

Sheet	Description
CS_PPID_RATIO	PPID instruction
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PPID instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID_RATIO Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute XIC740 for the PV data instance of XT101
- Substitute XT740 for the remaining instances of XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
Val_PVEUmin	Value for PPID Cfg_PVEUMin parameter PV minimum value in engineering units (PVEU). Valid any float less than Cfg_PVEUMax.
Val_PVEUMax	Value for PPID Cfg_PVEUMax parameter PV maximum value in engineering units (PVEU). Valid any float greater than Cfg_PVEUMin.
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

PPID Input References

Parameter	Description
XIC740_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XIC740_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XIC740_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XIC740_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection from IO Faults sheet

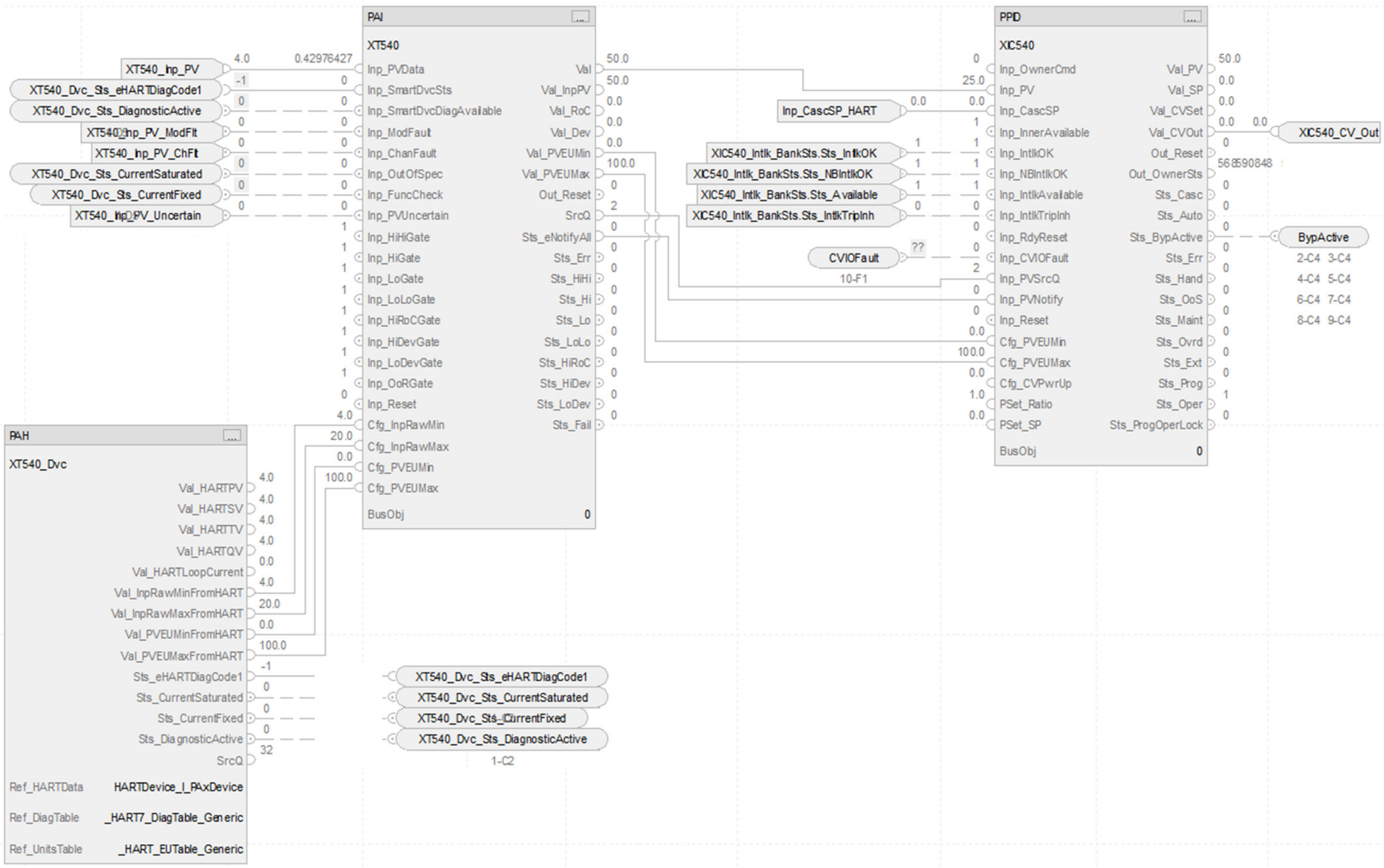
PPID Output References

Parameter	Description
XIC740_Out_CV	Control Variable output Loop CV after clamping and ramping (CVEU)
BypActive	Output connection to interlock bank sheet

PPID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID_RATIO HART Sheet

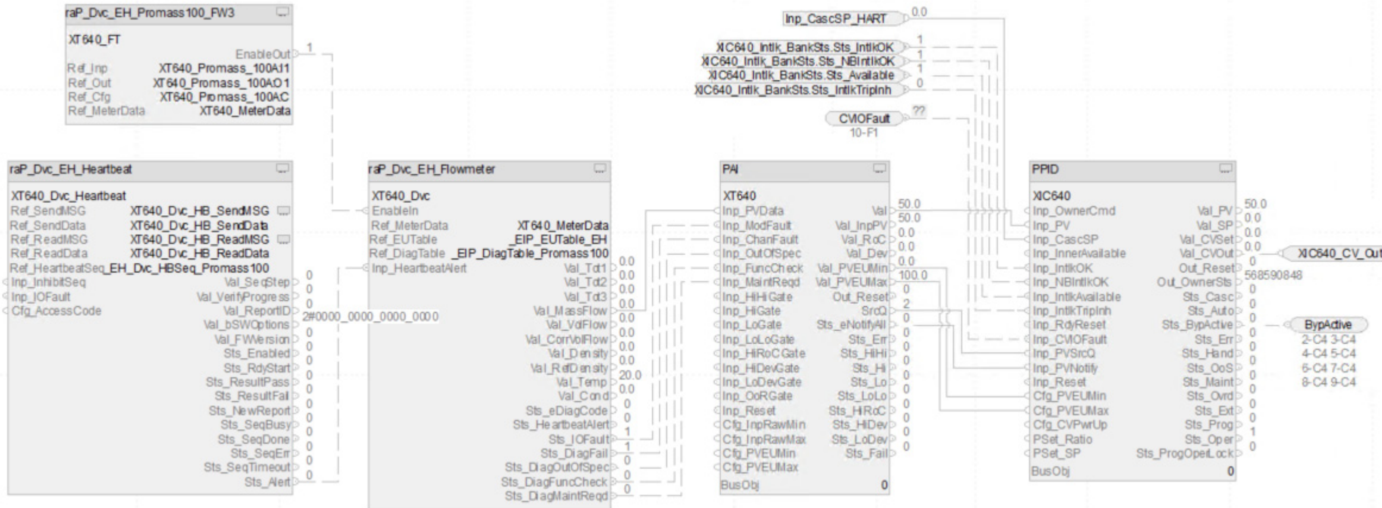


The CS_PPID_RATIO HART sheet operates the same as the CS_PPID_RATIO sheet but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XIC540 for the PV data instance of XT101
- Substitute XT540 for the remaining instances of XT100

For more information, see HART Integration on page 31.

CS_PPID_RATIO_EtherNetIP Sheet

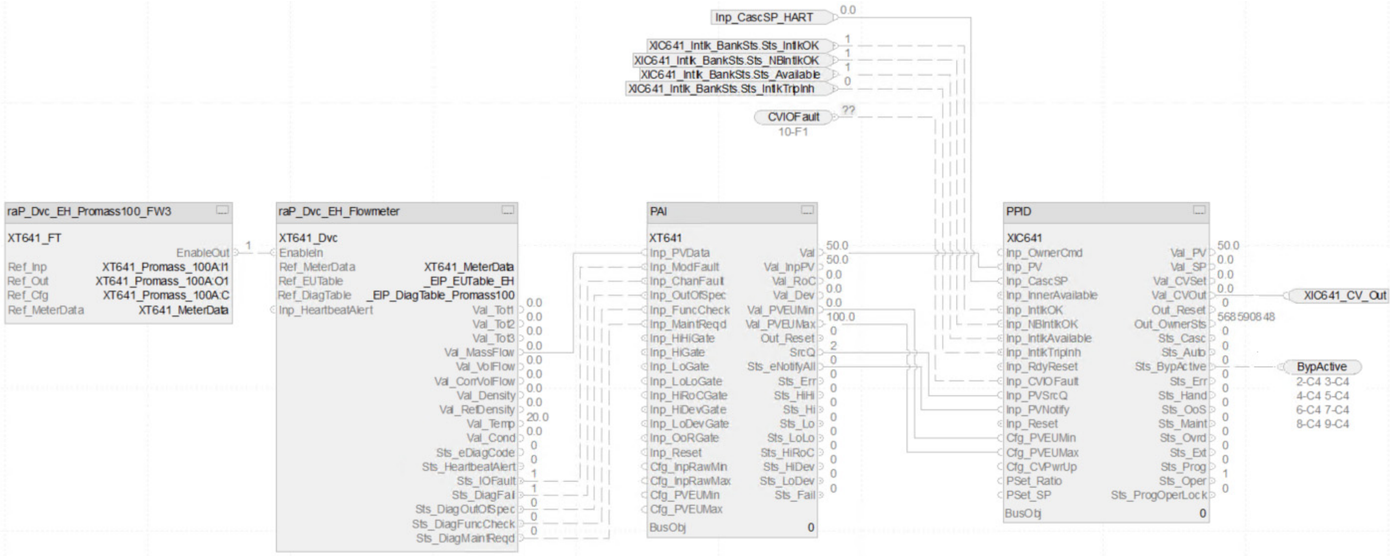


The CS_PPID_RATIO EtherNet/IP™ sheet operates the same as the CS_PPID_RATIO sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XIC640 for the PV data instance of XT101
- Substitute XT640 for the remaining instances of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_RATIO_EtherNetIP _NoHB Sheet

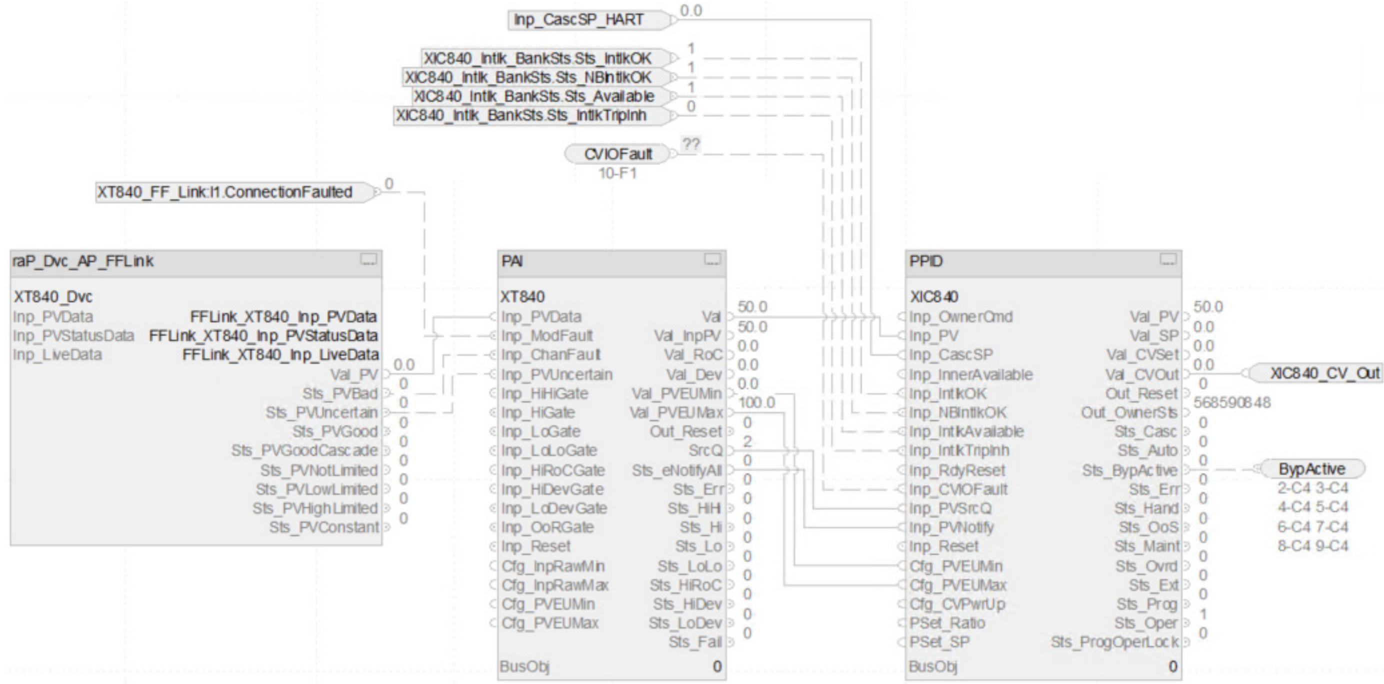


The CS_PPID_RATIO EtherNetIP NoHB sheet operates the same as the CS_PPID_RATIO sheet but relies on EtherNet/IP input data with no heartbeat.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP_NoHB Sheet on page 115.
- Substitute XIC641 for the PV data instance of XT101
- Substitute XT641 for the remaining instances of XT100

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_RATIO_FF

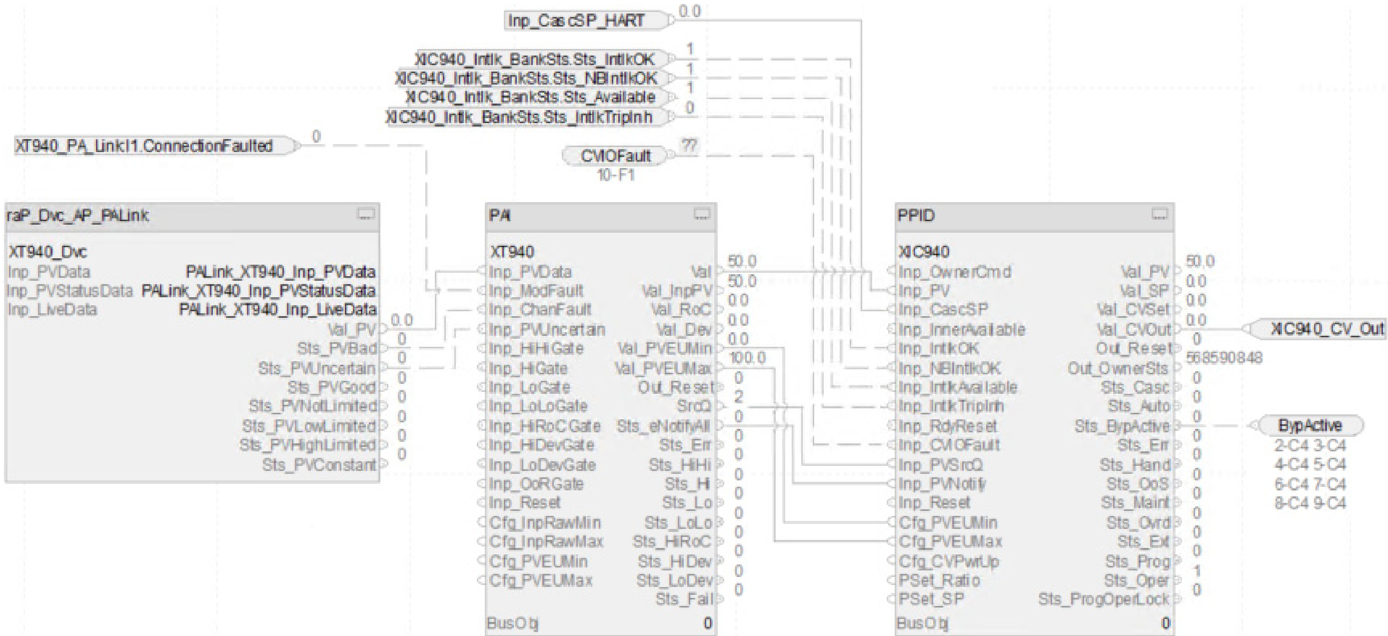


The CS_PPID_RATIO_FF sheet operates the same as the CS_PPID_RATIO sheet but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XIC840 for the PV data instance of XT101
- Substitute XT840 for the remaining instances of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_RATIO_PA

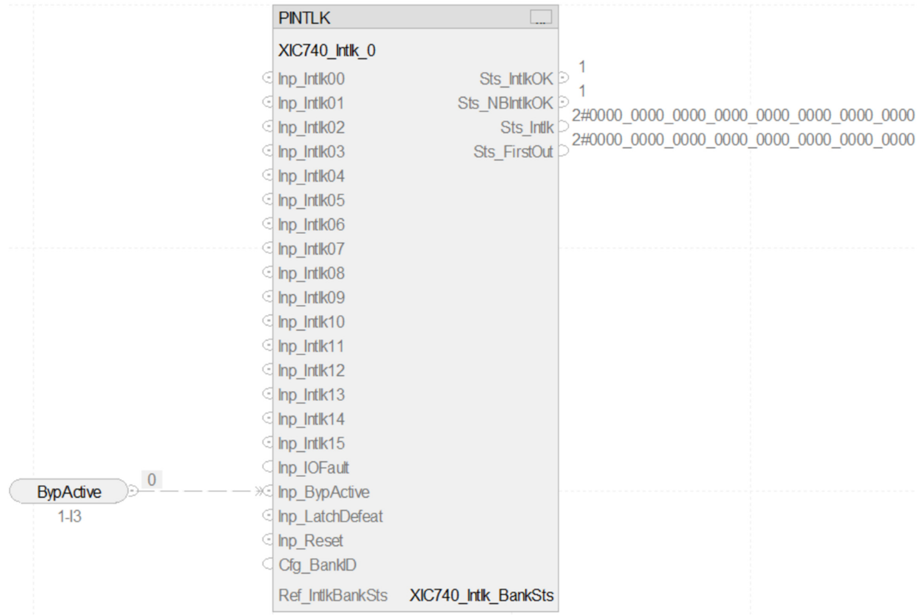


The CS_PPID_RATIO_PA sheet operates the same as the CS_PPID_RATIO sheet but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XIC940 for the PV data instance of XT101
- Substitute XT940 for the remaining instances of XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Interlock Bank Sheet



PINTLK Input Reference

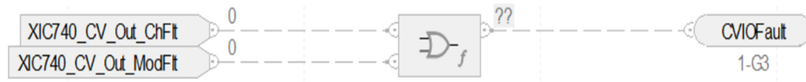
Parameter	Description
BypActive	Input connection from CS_PPID_RATIO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

Parameter	Description
XICxxx_Out_CV_ChFlt	Channel fault 1 = I/O channel fault or failure 0 = OK Source: PAI instruction
XICxxx_Out_CV_ModFlt	Module fault 1 = I/O module failure or module communication status bad 0 = OK Source: PAI instruction

Fault Output Reference

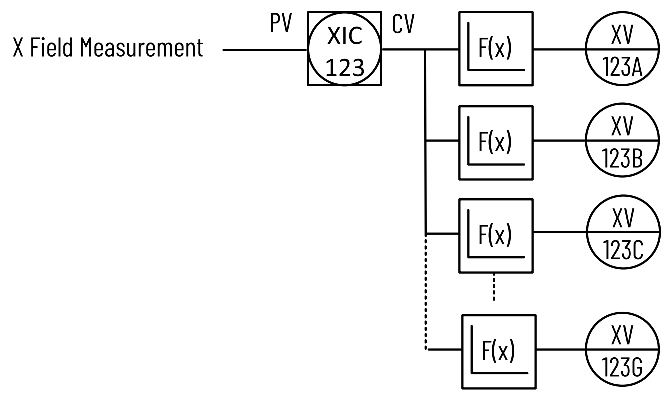
Parameter	Description
CVIOFault	Output connection to CS_PPID_RATIO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Notes:

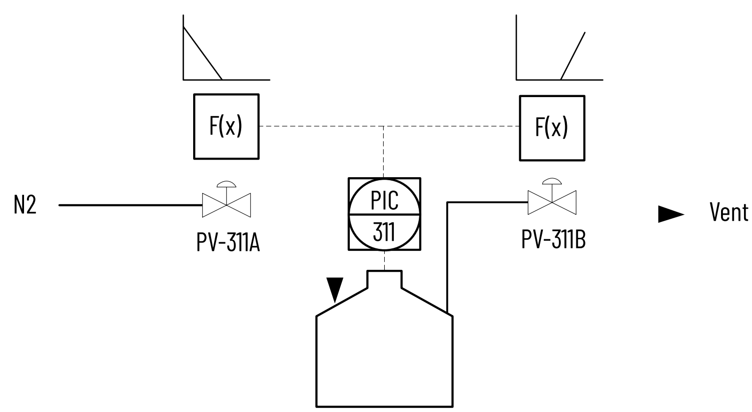
Process Proportional + Integral + Derivative (PPID) Split Range Control Strategies

This PPID Split Range control strategy as provided, manipulates two field devices to maintain one process variable (PV) at setpoint (SP). You can modify this strategy to manipulate up to eight field devices in one Split Range PPID control strategy.



A feature built into the Split Range control strategies is that the PPID instruction receives an indication whether its downstream objects can be controlled. If no downstream object is available for manipulation, the PPID tracks a configured selection (CV1 Initial Value or a fixed value).

PPID Split Range Example



Blanket gas (an inert gas) often pressurizes tanks containing combustible material to ensure no admission of air. In the example above, when PIC-311 CV = 50%, both valves are closed. When the CV is less than 50%, the pressurizing valve (PV-311A) opens, and the vent valve (PV-311B) is kept closed. When the CV is greater than 50%, the vent valve (PV-311B) opens, and the pressuring valve is kept closed.

In practice, a gap can be used in the characterization to keep the valves from continuously cycling when the CV is near 50% (such as keep both valves closed when 48% < CV < 52%).

The valves characterization (CV splitting) is done with the Process Analog Fanout (PFO) instruction. The action of the PPID is direct acting to accommodate the valves characterization. If pressure is above setpoint, the CV increases; if pressure is below setpoint, the CV decreases.

PPID Split Range Control Strategies

Control Strategy	Routines
CS_PPID_SPLITRANGE	CS_PPID_SPLITRANGE Parameters and Local Tags MainRoutine XC780A XC780B XIC780
CS_PPID_SPLITRANGE_HART	CS_PPID_SPLITRANGE_HART Parameters and Local Tags MainRoutine Interlocks XC580A XC580B XIC580
CS_PPID_SPLITRANGE_EtherNetIP	CS_PPID_SPLITRANGE_EtherNetIP Parameters and Local Tags MainRoutine Interlocks XC680A XC680B XIC680
CS_PPID_SPLITRANGE_FF	CS_PPID_SPLITRANGE_FF Parameters and Local Tags MainRoutine FFLinkMap Interlocks XC880A XC880B XIC880
CS_PPID_SPLITRANGE_PA	CS_PPID_SPLITRANGE_PA Parameters and Local Tags MainRoutine Interlocks PALinkMap XC980A XC980B XIC980

Import the **routines** for the appropriate control strategy in your controller project. Each control strategy contains multiple routines; each routine contains multiple Function Block sheets. The control strategy, as supplied, uses only two analog outputs. The control strategy can support as many as eight analog outputs by exposing additional parameters in the PFO instruction and adding PAO routines.

Each PPID Split Range control strategy Program is built from multiple Routines:

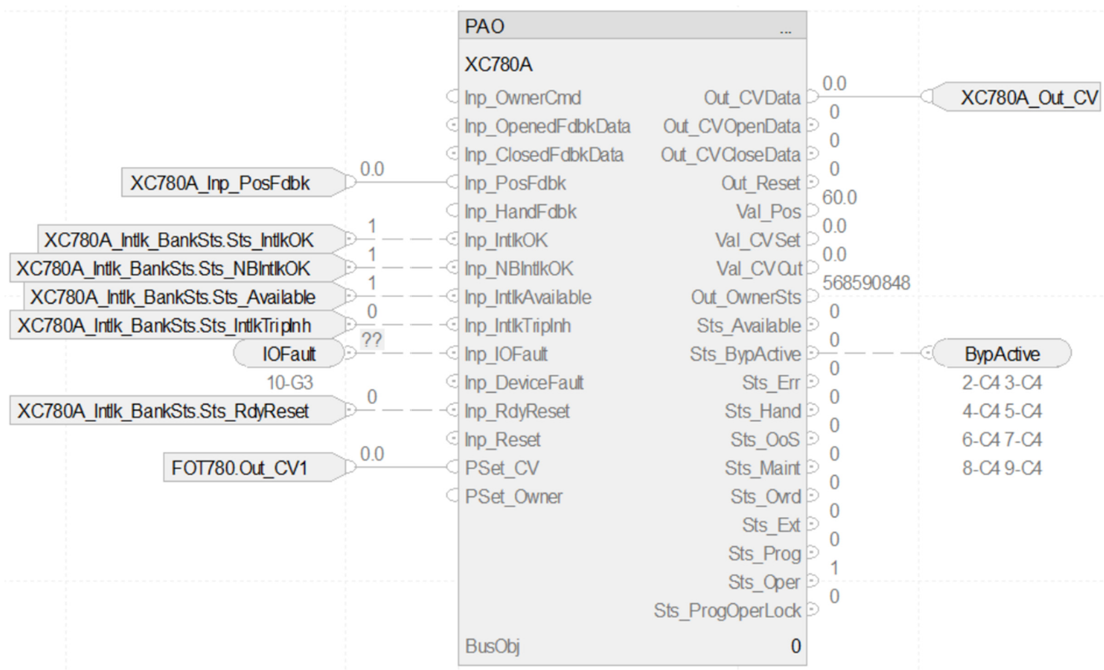
- Process Analog Output A
- Process Analog Output B
- Process Analog Input to Process PID with Fanout

ROUTINE: Process Analog Output

There are two routines; each routine contains these sheets:

Sheet	Description
CS_PAO	Process High or Low Selector instruction • XC780A and XC780B analog • XC580A and XC580B HART • XC680A and XC680B EtherNet/IP™ • XC880A and XC880B FOUNDATION Fieldbus • XC980A and XC980B Profibus PA
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PAO instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises alarm on an I/O fault.

CS_PAO Sheet



Input References to PAO

See the CS_PAO Sheet on page 136 for details.

Substitute:

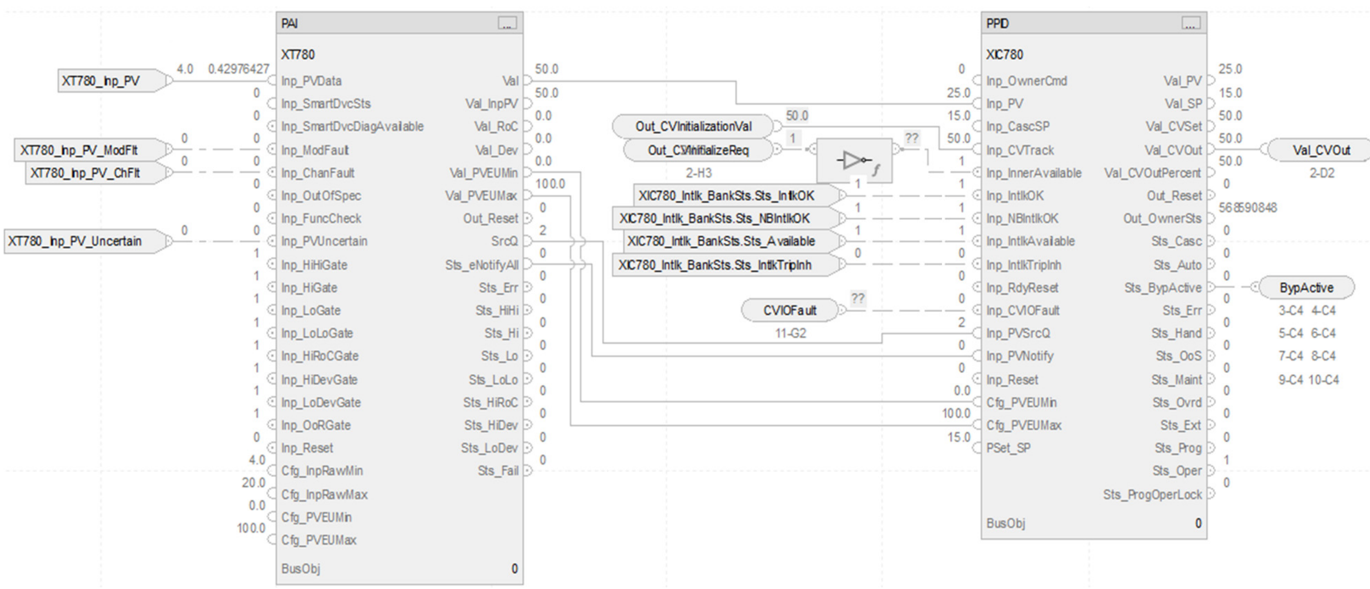
Input	First Instance of XC101 =	Second Instance of XC101 =	XC100 =
Analog	XC780A	XC780B	FOT780
HART	XC580A	XC580B	FOT580
EtherNet/IP	XC680A	XC680B	FOT680
FOUNDATION Fieldbus	XC880A	XC880B	FOT880
Profibus PA	XC980A	XC980B	FOT980

ROUTINE: Process Analog Input to Process PID with Fanout

There are two routines (One without HART and another with HART); each routine contains these sheets.

Sheet	Description
CS_PPID	Process PID instruction • XIC780 analog • XIC580 HART • XIC680 EtherNet/IP • XIC880 FOUNDATION Fieldbus • XIC980 Profibus PA
PFO	Process fan out
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PPID instruction 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. There are 8 interlock bank sheets; each bank exposes 16 interlocks but supports as many as 32 interlocks. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors Control Variable faults.

CS_PPID Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute XIC780 for the PV data instance of XT101
- Substitute XT780 for the remaining instances of XT101

PAI Outputs to PPID Inputs

Parameter	Description
Val	Value for PPID Inp_PV parameter Process Variable (PVEU)
Val_PVEUmin	Value for PPID Cfg_PVEUMin parameter PV minimum value in engineering units (PVEU). Valid any float less than Cfg_PVEUMax.
Val_PVEUMax	Value for PPID Cfg_PVEUMax parameter PV maximum value in engineering units . (PVEU). Valid any float greater than Cfg_PVEUMin.
SrcQ	Value for PPID Inp_PVSrcQ parameter 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
Sts_eNotifyAll	Value for PPID Inp_PVNotify parameter Related PV object alarm priority and acknowledgment 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

Input References to PPID

Parameter	Description
Out_CVInitializationVal	Initialization value to PPID Source: PFO instruction
Out_CVInitializeReq	Initialization request to PPID Source: PFO instruction
XIC780_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
XIC780_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status, 1 = All non-bypassable interlocks OK to run
XIC780_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
XIC780_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status, 1 = Interlock trip inhibit - stops equipment but does not trip
CVIOFault	Input connection from IO Faults sheet
XIC780_PSet_SP	Program setting for SP, loop mode Auto (PVEU). Valid any float.

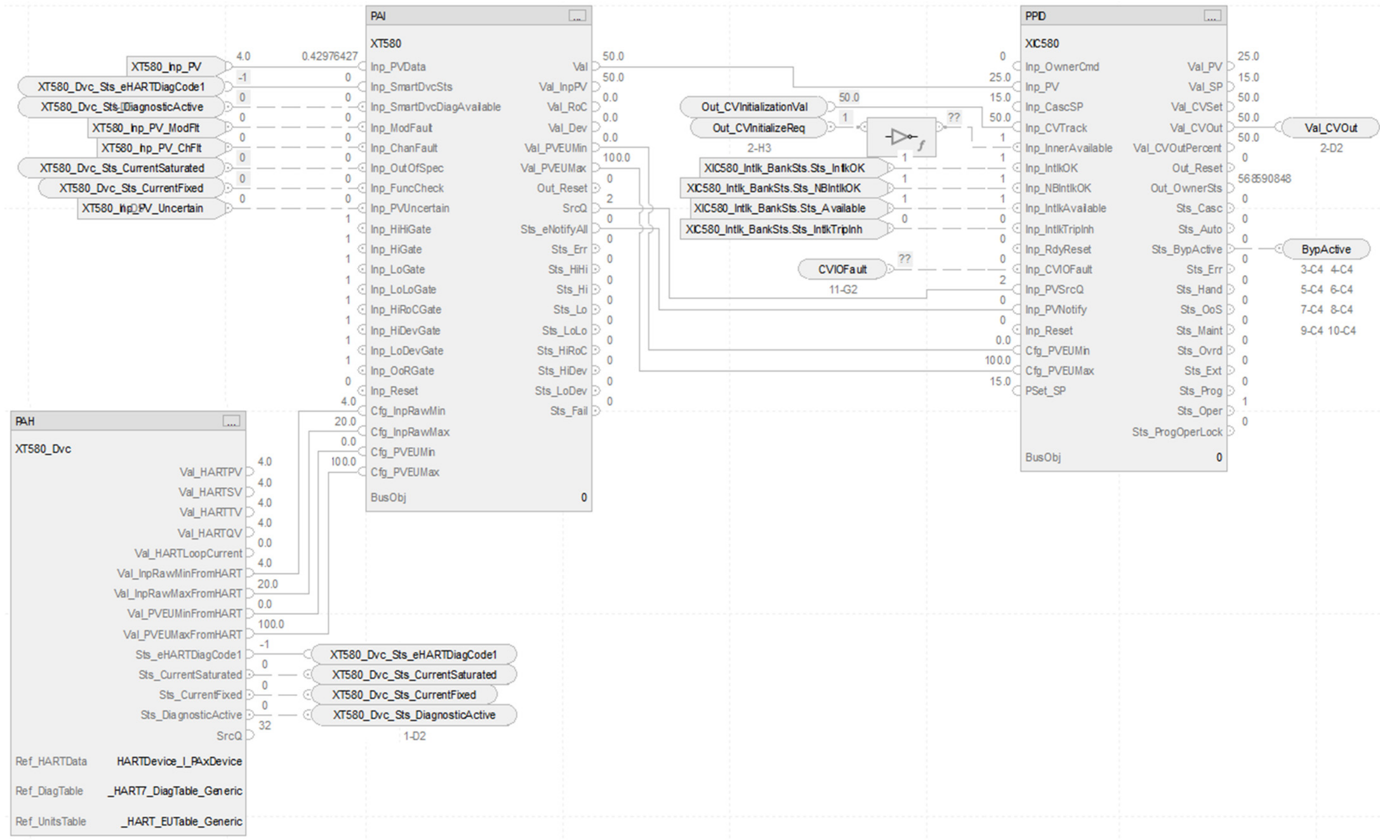
PPID Output References

Parameter	Description
Val_CVOut	Control Variable output Loop CV after clamping and ramping (CVEU) Destination: PFO instruction
BypActive	Output connection to interlock bank sheet

PPID Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PID	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

CS_PPID HART Sheet

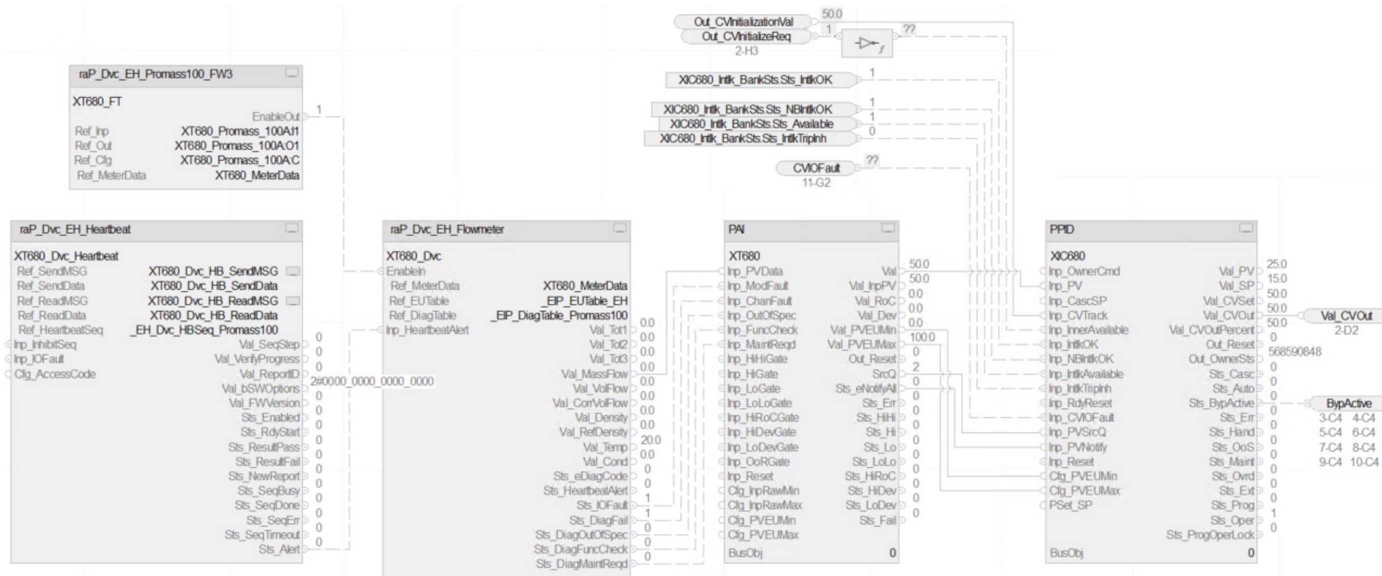


The CS_PPID HART sheet operates the same as the CS_PPID sheet but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute XIC580 for the PV data instance of XT101
- Substitute XT580 for the remaining instances of XT101

For more information, see HART Integration on page 31.

CS_PPID_EtherNetIP Sheet

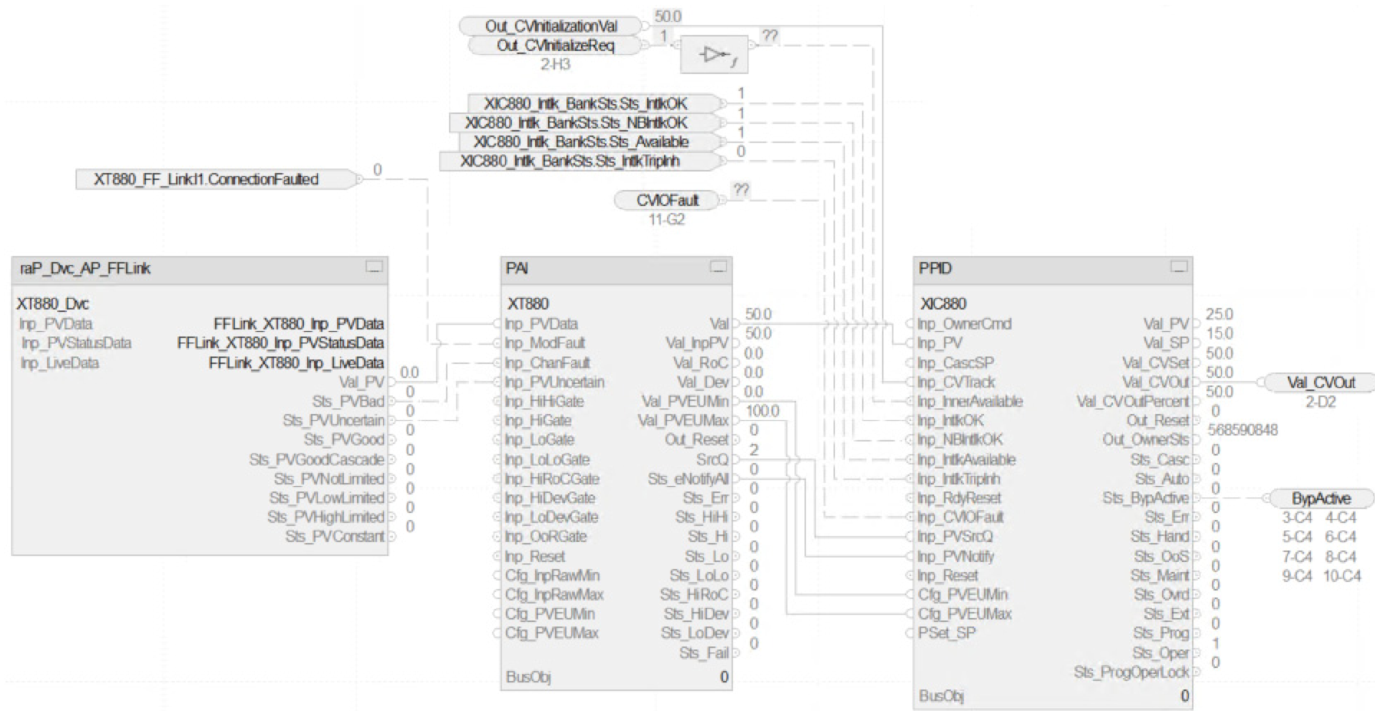


The CS_PPID_EtherNetIP sheet operates the same as the CS_PPID sheet but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute XIC680 for the PV data instance of XT101
- Substitute XT680 for the remaining instances of XT101

For more information, see EtherNet/IP Integration on page 55.

CS_PPID_FF Sheet

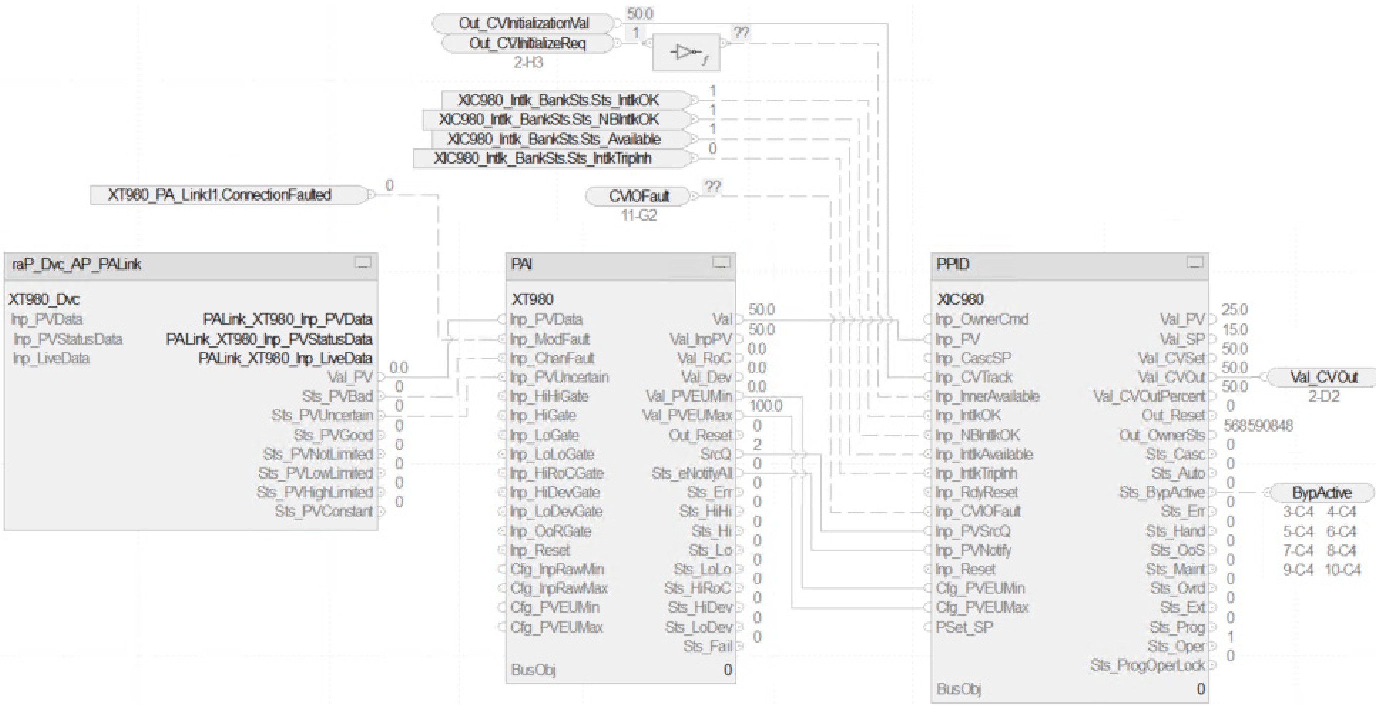


The CS_PPID_FF sheet operates the same as the CS_PPID sheet but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute XIC880 for the PV data instance of XT101
- Substitute XT880 for the remaining instances of XT101

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PPID_PA Sheet

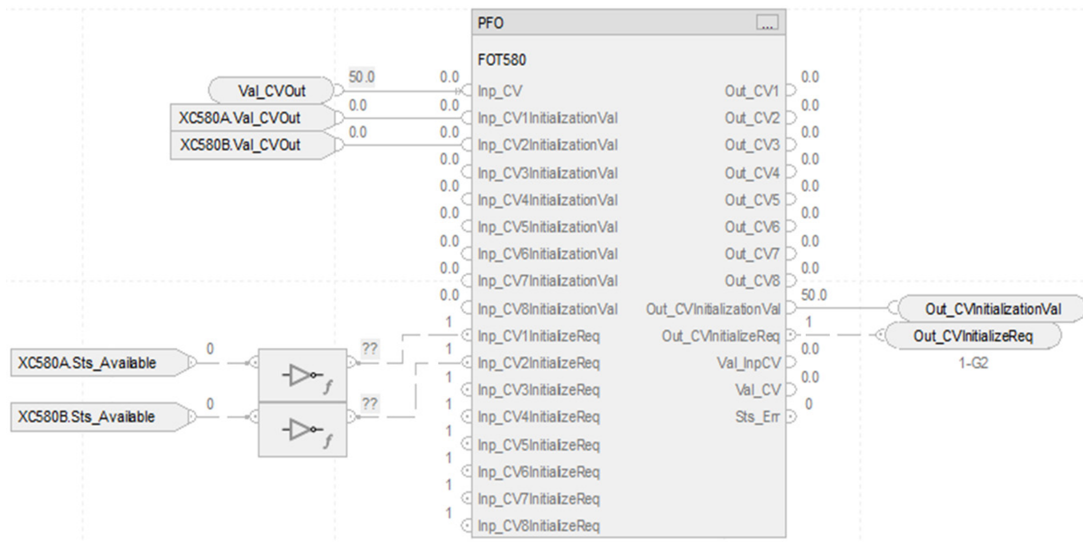


The CS_PPID_PA sheet operates the same as the CS_PPID sheet but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute XIC980 for the PV data instance of XT101
- Substitute XT980 for the remaining instances of XT101

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

PFO Sheet



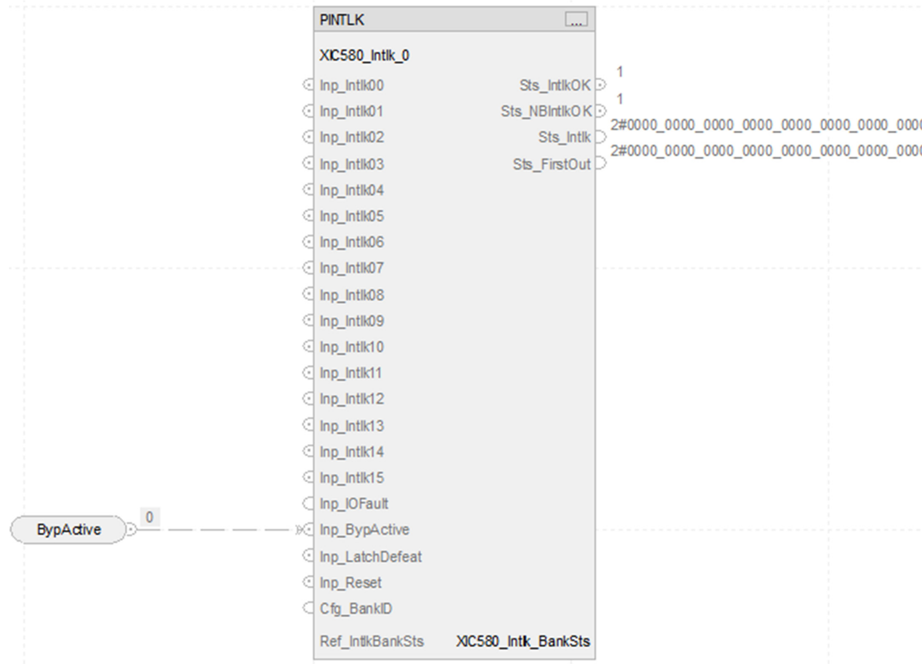
PFO Input References

Parameter	Description
Val_CVOut	Control Variable output Loop CV after clamping and ramping (CVEU)
XCxxxA.Val_CVOut XCxxxB.Val_CVOut	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. Source: PAO instructions
XCxxxA.Sts_Available XCxxxB.Sts_Available	1 = Analog output available for control by program Source: PAO instructions

PFO Output References

Parameter	Description
Out_CVInitializationVal	Initialization value for PPID
Out_CVInitializeReq	Initialization request for PPID

Interlock Bank Sheet



PINTLK Input Reference

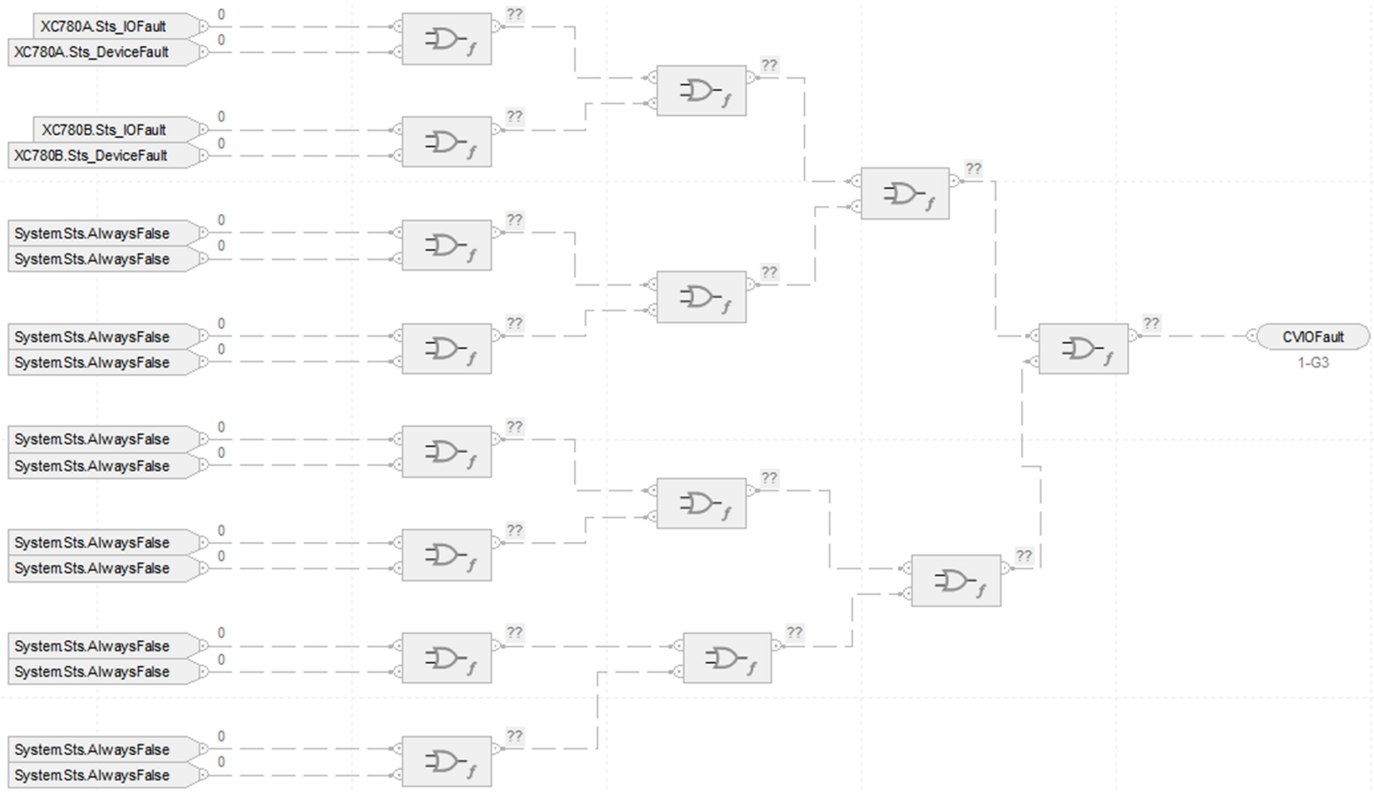
Parameter	Description
BypActive	Input connection from CS_PPID_SPLITRANGE sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27..

IO Faults Sheet



Faults Input References

Parameter	Description
XCxxxA.Sts_IOFault XCxxxB.Sts_IOFault	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
XCxxxB.Sts_DeviceFault XCxxxB.Sts_DeviceFault	1 = Device 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_DeviceFault.AlarmElement
System.Sts.AlwaysFalse	raP_UDT_Opr_ System.Sts.AlwaysFalse

Fault Output Reference

Parameter	Description
CVIOFault	Output connection to CS_PPID_SPLITRANGE sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Pressure/Temperature Compensated Flow (PPTC) Control Strategies

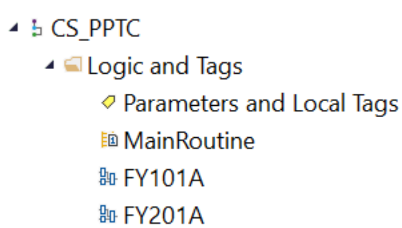
The Pressure/Temperature Compensated Flow (PPTC) instruction calculates the flow of a gas at standard / design temperature and pressure, essentially a mass flow rate, given a volumetric flow rate or differential pressure measurement. The design temperature and pressure are specific to each instrument, and since the thermodynamic conditions of the actual gas flow rarely align with the design conditions, temperature and pressure compensation is often used to compensate the actual flow measurement so that the measurement is adjusted to design conditions (essentially normalizing the gas flow to design conditions). This instruction requires measurements of the actual temperature and pressure of the flowing gas.

For the compensation to work correctly, like units for temperature and pressure must align and the final calculation is applied to absolute values. That is, Inp_Pact and Cfg_PStd must both be in the same units (Cfg_POffset is added to both values to convert to absolute pressure). Also, Inp_Tact and Cfg_TStd must both be in the same units (Cfg_TOffset is added to both values to convert to absolute temperature) _

The PPTC Add-On Instruction is intended as a calculation function only, between other blocks, and no HMI components are provided. 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.

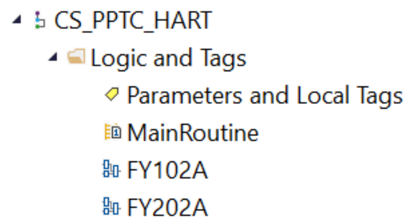
The PPTC control strategy is available as two routines in the process library:

Routine	Description
FY101A	Linear flow transmitter
FY201A	DP Transmitter



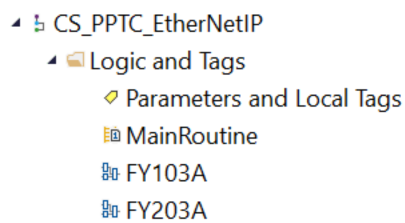
The PPTC HART control strategy is available as two routines in the process library:

Routine	Description
FY102A	HART linear flow transmitter
FY202A	HART DP Transmitter



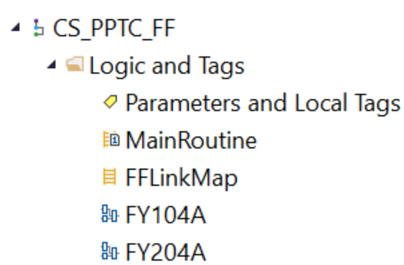
The PPTC EtherNetIP control strategy is available as two routines in the process library:

Routine	Description
FY103A	EtherNet/IP™ linear flow transmitter
FY203A	EtherNet/IP DP Transmitter



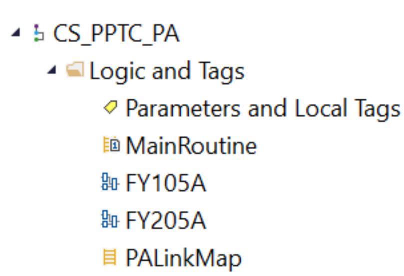
The PPTC FOUNDATION Fieldbus control strategy is available as two routines in the process library:

Routine	Description
FY105A	FOUNDATION Fieldbus linear flow transmitter
FY205A	FOUNDATION Fieldbus DP Transmitter

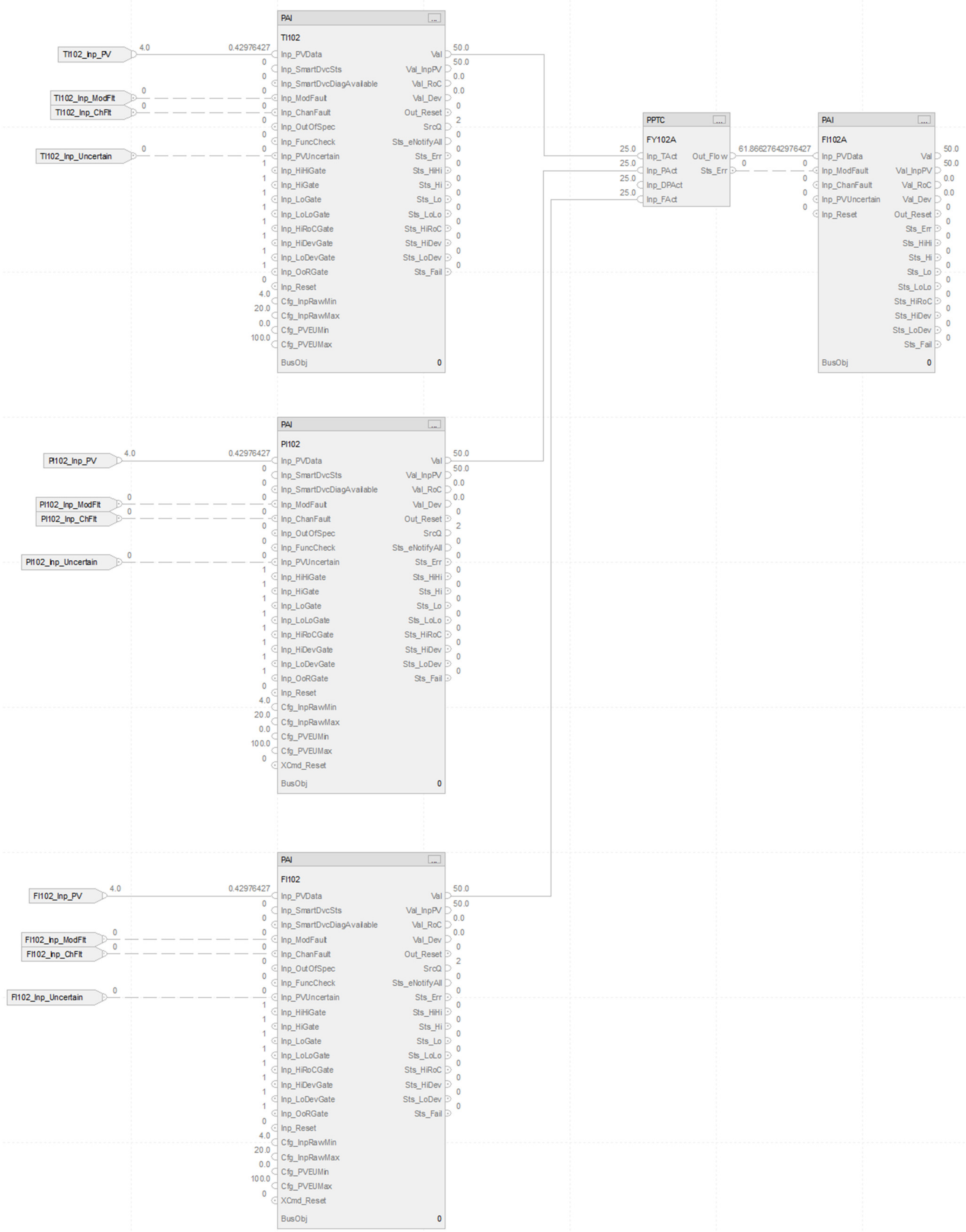


The PPTC Profibus PA control strategy is available as two routines in the process library:

Routine	Description
FY104A	Profibus PA linear flow transmitter
FY204A	Profibus PA DP Transmitter



CS_PPTC Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

PAI Instruction	Description	Substitute the Desired Instrument Name for:
PPTC Inp_TAct	Actual (measured) temperature	TI101/TI201
PPTC Inp_PAct	Actual (measured) pressure	PI101/PI201
PPTC Inp_DPAct	Actual (measured) differential pressure (square root)	PDIT101/PDIT201
PPTC Inp_FAct	Actual (measured) uncompensated flow (linear)	FI101/FI201

To configure the flow calculation method, see the Advanced properties page for the PPTC instruction. Select one of the following:

- Differential pressure (PPTC Inp_DPAct)
- Flow input (PPTC Inp_Fact)

PAI Outputs

Parameter	Description
Val for PPTC Inp_TAct	Actual (measured) temperature
Val for PPTC Inp_PAct	Actual (measured) pressure
Val for PPTC Inp_DPAct	Actual (measured) differential pressure
Val PPTC Inp_FAct	Actual (measured) uncompensated flow

PPTC Outputs

Parameter	Description
Out_Flow	Compensated flow (at standard temperature and pressure: mass flow)
Sts_Err	1 = Error in configuration: See detail bits (Sts_Errxxx) for reason

PPTC Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_PRESS_TEMP_COMPENSATED	Instance of data structure (backing tag) required for proper operation of instruction

CS_PPTC_HART Sheet

The CS_PPTC_HART control strategy operates the same as the CS_PPTC control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- For more information, see HART Integration on page 31.

PAI Instruction	Description	Substitute the Desired Instrument Name for:
PPTC Inp_TAct	Actual (measured) temperature	TI102/TI202
PPTC Inp_PAct	Actual (measured) pressure	PI102/PI202
PPTC Inp_DPAct	Actual (measured) differential pressure	PDTI102/PDIT202
PPTC Inp_FAct	Actual (measured) uncompensated flow	FI102/FI202

CS_PPTC_EtherNetIP Sheet

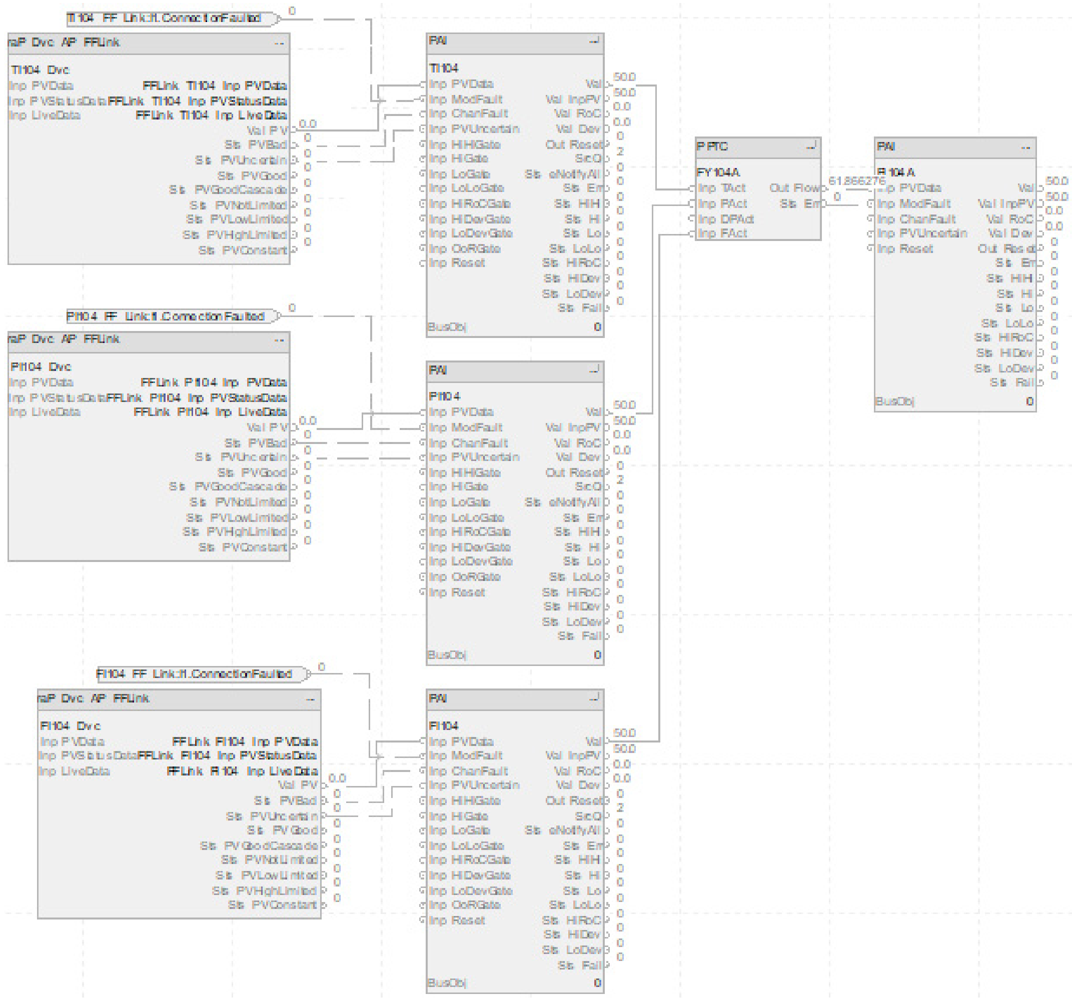
The CS_PPTC_EtherNetIP control strategy operates the same as the CS_PPTC control strategy but relies on EtherNet/IP input data.

For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.

For more information, see EtherNet/IP Integration on page 55.

PAI Instruction	Description	Substitute the Desired Instrument Name for:
PPTC Inp_TAct	Actual (measured) temperature	TI103/TI203
PPTC Inp_PAct	Actual (measured) pressure	PI103/PI203
PPTC Inp_DPAct	Actual (measured) differential pressure	PDTI103/PDIT203
PPTC Inp_FAct	Actual (measured) uncompensated flow	FI103/FI203

CS_PPTC_FF Sheet



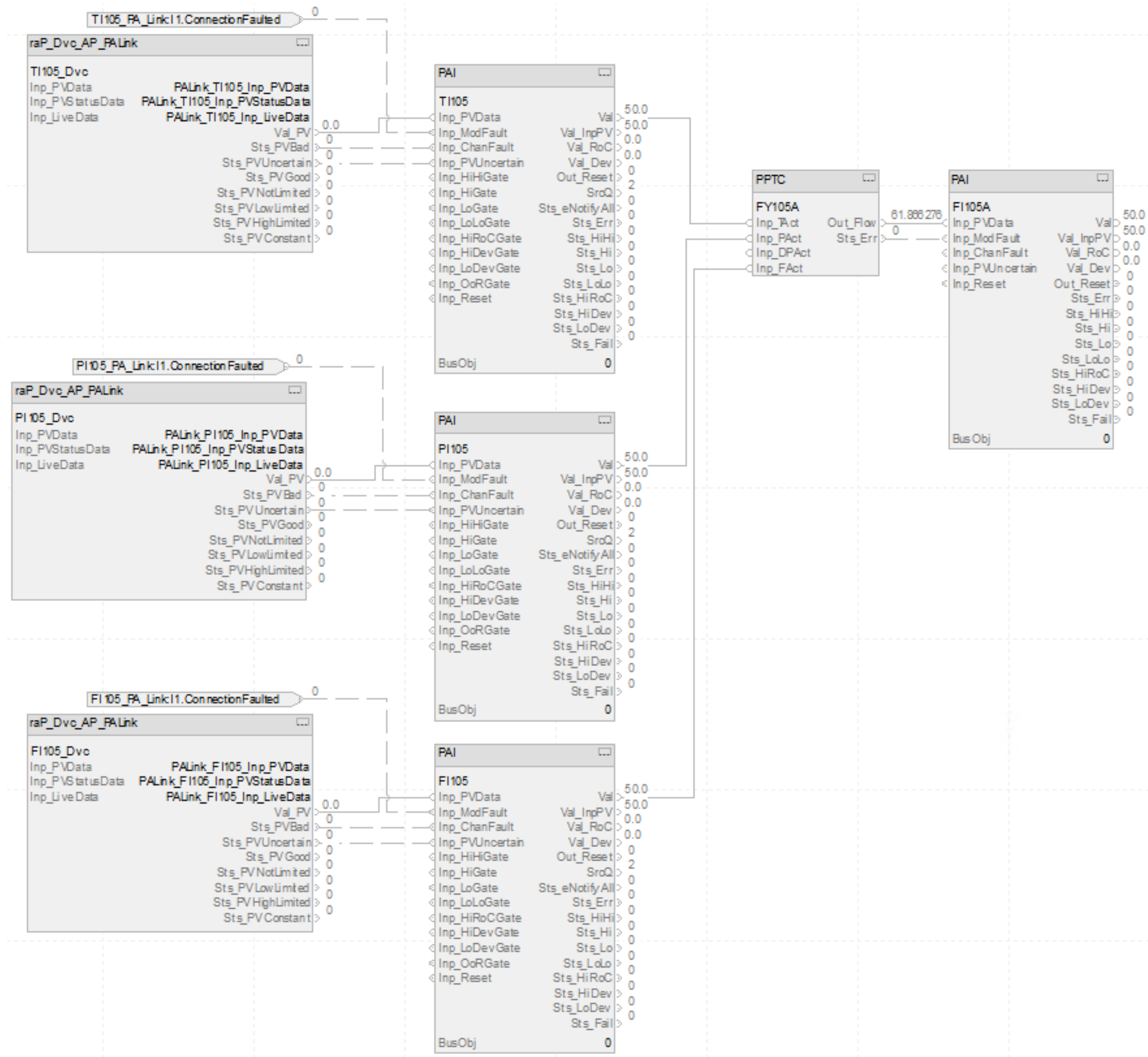
The CS_PPTC_FF control strategy operates the same as the CS_PPTC control strategy but relies on FOUNDATION Fieldbus input data.

For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

PAI Instruction	Description	Substitute the Desired Instrument Name for:
PPTC Inp_TAct	Actual (measured) temperature	TI104/TI204
PPTC Inp_PAct	Actual (measured) pressure	PI104/PI204
PPTC Inp_DPAct	Actual (measured) differential pressure	PDTI104/PDIT204
PPTC Inp_FAct	Actual (measured) uncompensated flow	FI104/FI204

CS_PPTC_PA Sheet



The CS_PPTC_PA control strategy operates the same as the CS_PPTC control strategy but relies on Profibus PA input data.

For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

PAI Instruction	Description	Substitute the Desired Instrument Name for:
PPTC Inp_TAct	Actual (measured) temperature	TI105/TI205
PPTC Inp_PAct	Actual (measured) pressure	PI105/PI205
PPTC Inp_DPAct	Actual (measured) differential pressure	PDTI105/PDIT205
PPTC Inp_FAct	Actual (measured) uncompensated flow	FI105/FI205

Process Tank Strapping Table (PTST) Control Strategies

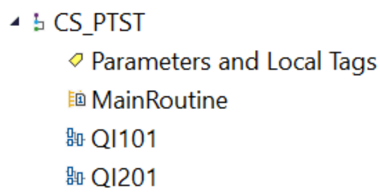
Use a PTST control strategy to calculate the volume of product in an upright cylindrical tank, given the level of the product and the tank calibration table. The instruction can compensate for:

- 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 PTST instruction is intended only as a calculation function, between other blocks, and so no HMI components are provided.

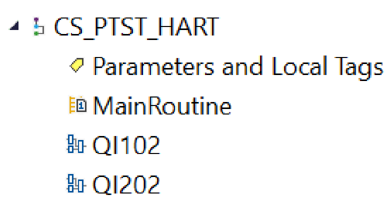
The PTST control strategy is available as two routines in the process library:

Routine	Description
QI101	Level input with no compensation
QI201	Level input with compensation inputs exposed



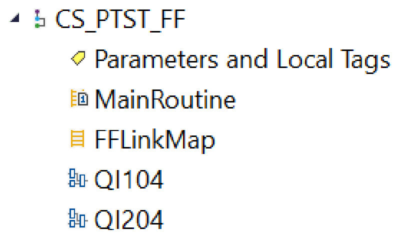
The PTST HART control strategy is available as two routines in the process library:

Routine	Description
QI102	HART level input with no compensation
QI202	HART level input with compensation inputs exposed



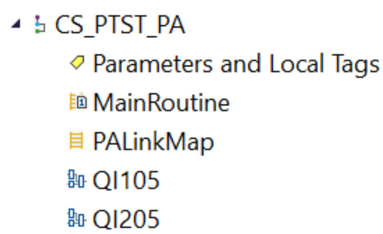
The PTST FOUNDATION Fieldbus control strategy is available as two routines in the process library:

Routine	Description
QI104	FOUNDATION Fieldbus level input with no compensation
QI204	FOUNDATION Fieldbus level input with compensation inputs exposed

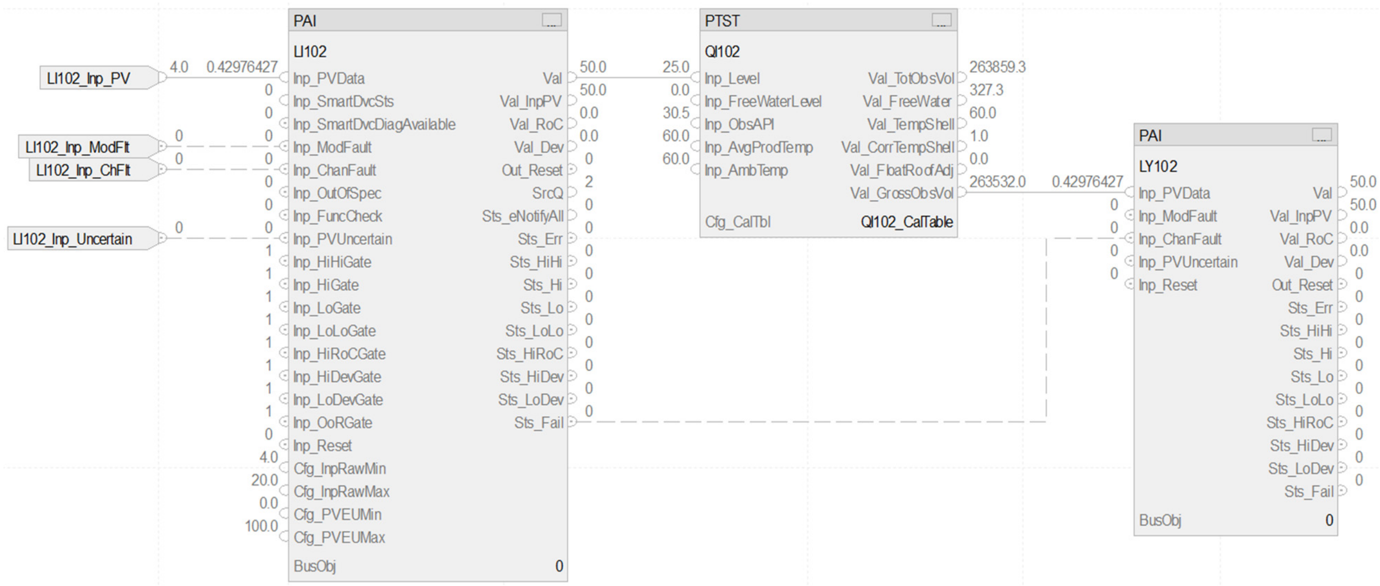


The PTST Profibus PA control strategy is available as two routines in the process library:

Routine	Description
QI105	Profibus PA level input with no compensation
QI205	Profibus PA level input with compensation inputs exposed



CS_PTST Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

- Substitute QI101/QI201 with the desired tag name
- Substitute LI101/LI201 with the desired instrument tag name
- Substitute LY101/LY201 with the desired tag name

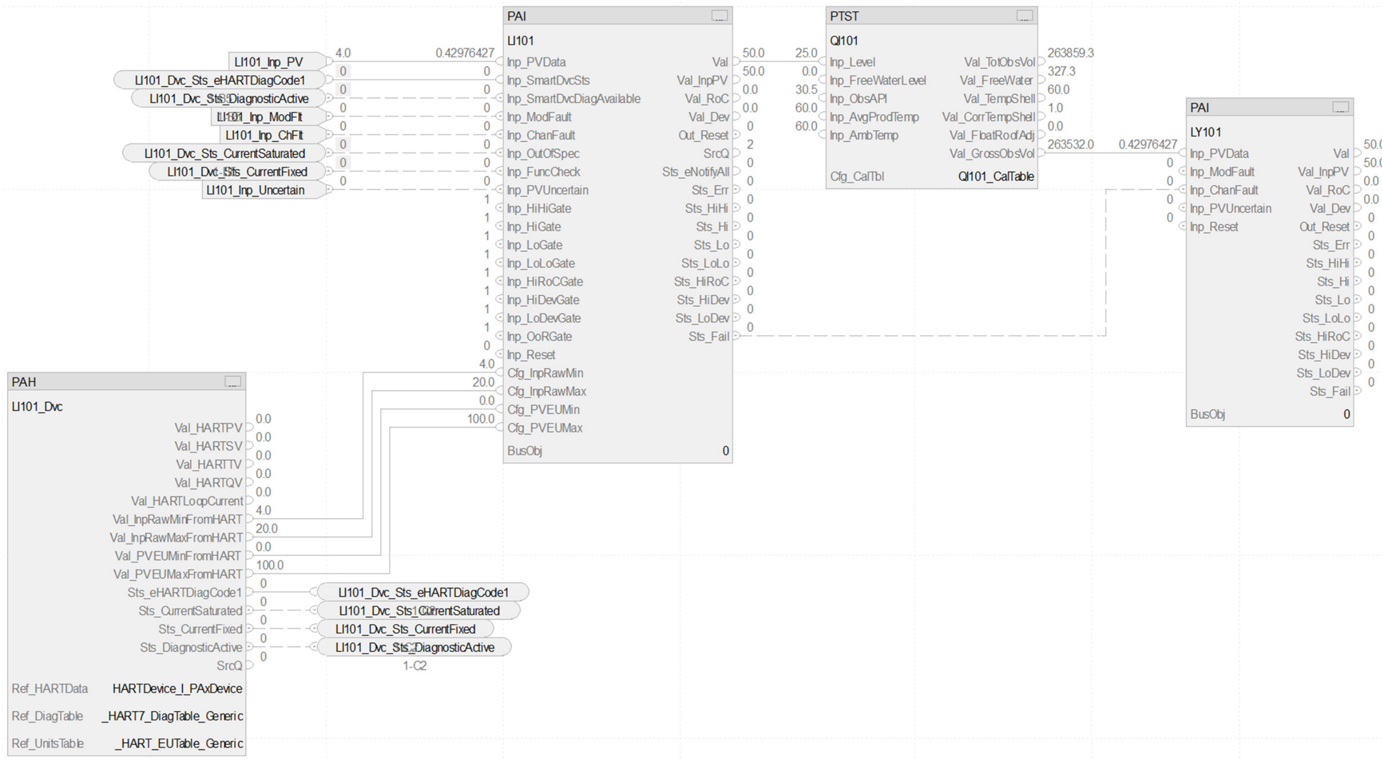
PAI Outputs

Parameter	Description
Val	Input to Inp_Level of PTST instruction Tank innage level, in feet or meters
Sts_Fail	Input to Inp_ChanFault of secondary PAI instruction 1 = I/O channel fault or failure 0 = OK

PTST Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_TANK_STRAPPING_TABLE	Instance of data structure (backing tag) required for proper operation of instruction
Cfg_CalTbl	P_STRAPPING_TABLE_ROW	Array for tank calibration table, level to volume

CS_PTST_HART Sheet

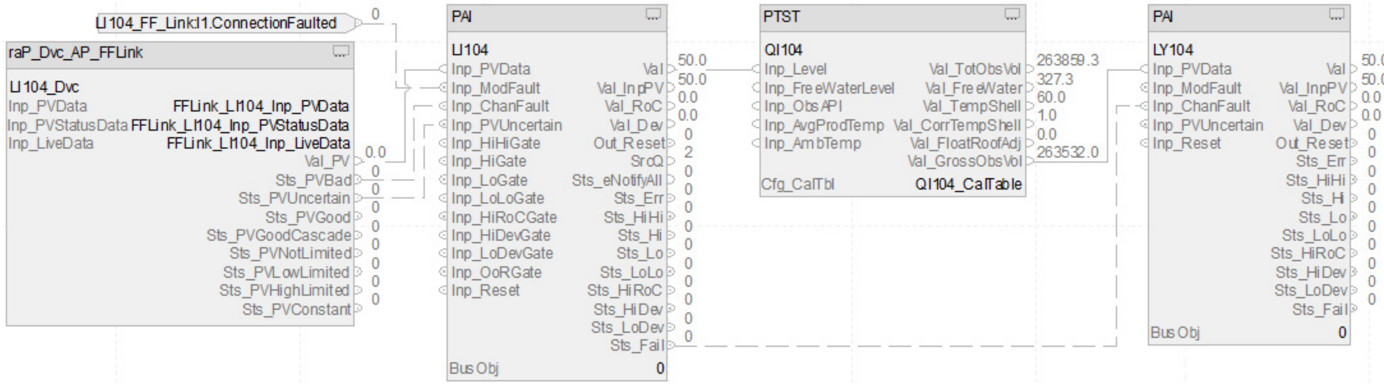


The CS_PTST_HART control strategy operates the same as the CS_PTST control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute QI102/QI202 with the desired tag name
- Substitute LI102/LI202 with the desired instrument tag name
- Substitute LY102/LY202 with the desired tag name.

For more information, see HART Integration on page 31.

CS_PTST_FF Sheet

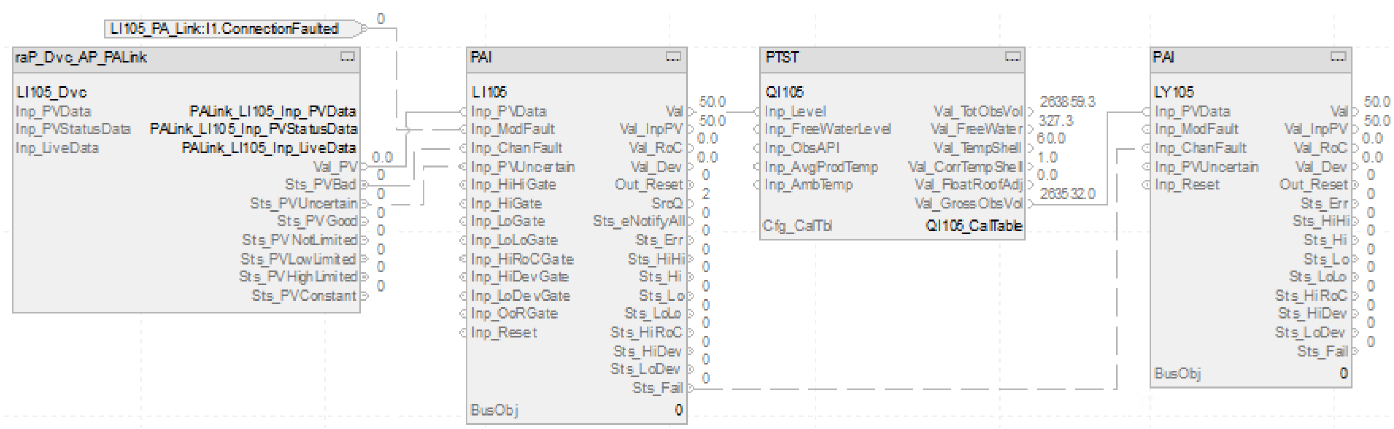


The CS_PTST_FF control strategy operates the same as the CS_PTST control strategy but relies on FOUNDATION Fieldbus input data.

- For information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute QI103/QI203 with the desired tag name
- Substitute LI103/LI203 with the desired instrument tag name
- Substitute LY103/LY203 with the desired tag name.

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_PTST_PA Sheet



The CS_PTST_PA control strategy operates the same as the CS_PTST control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute QI104/QI204 with the desired tag name
- Substitute LI104/LI204 with the desired instrument tag name
- Substitute LY104/LY204 with the desired tag name.

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Notes:

Chapter 34

Process Valve Hand Operated (PVLVHO) Control Strategy

Use the PVLVHO control strategy to monitor a hand (locally) operated valve and display its current state. The valve can have any type of actuator – handwheel, lever, motor, solenoid, pneumatic, hydraulic – but it is normally operated at the valve and only monitored by the control system via open and closed limit switches.

This PVLV control strategy does not provide operator access to control the valve, but it does provide an optional Trip output. The Trip state is generated by interlock conditions not being met and the output can be used to de-energize a valve control circuit to drive the valve to its default (fail) position. If the trip function is used, the PVLV instruction checks to make sure that the valve reaches the configured trip position (open or closed) if a trip command is executed.

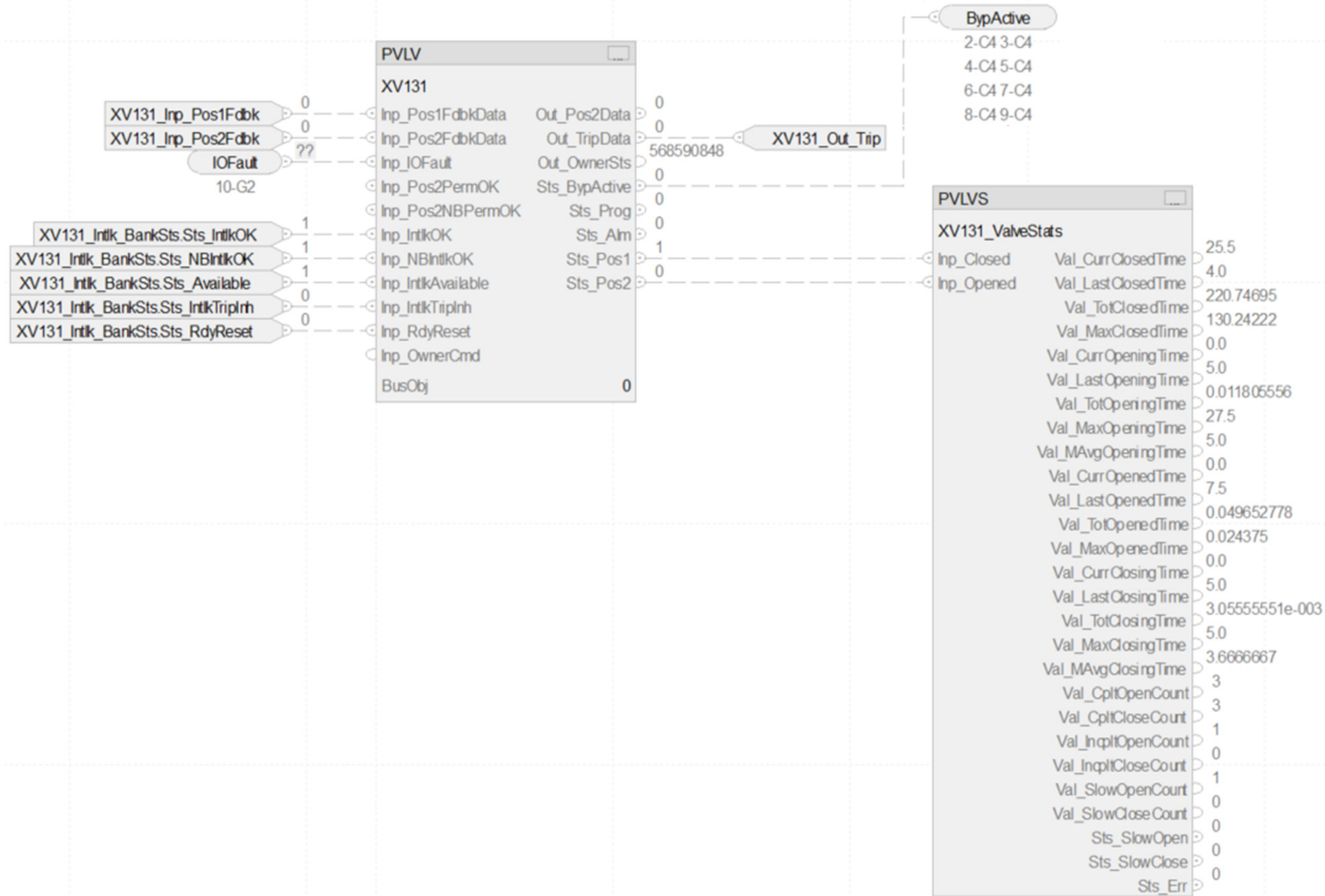
The CS_PVLVHO control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The PVLVHO control strategy contains these Function Block sheets:

Sheet	Description
CS_PVLVHO	Process Valve instruction, hand operated
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PVLV instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises an alarm on an I/O fault.

CS_PVLVHO Sheet



PVLV Input References

Parameter	Description
XV131_Inp_Pos1Fdbk	Feedback from Position 1 limit switch of the device 1 = Device confirmed Position 1
XV131_Inp_Pos2Fdbk	Feedback from Position 2 limit switch of the device 1 = Device confirmed Position 2
IOFault	Input connection from IO Faults sheet
XV131_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XV131_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XV131_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XV131_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
XV131_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PVLV Output References

Parameter	Description
XV131_Out_Trip	1 = Trip valve to safe/fail state
BypActive	Output connection to interlock bank sheet

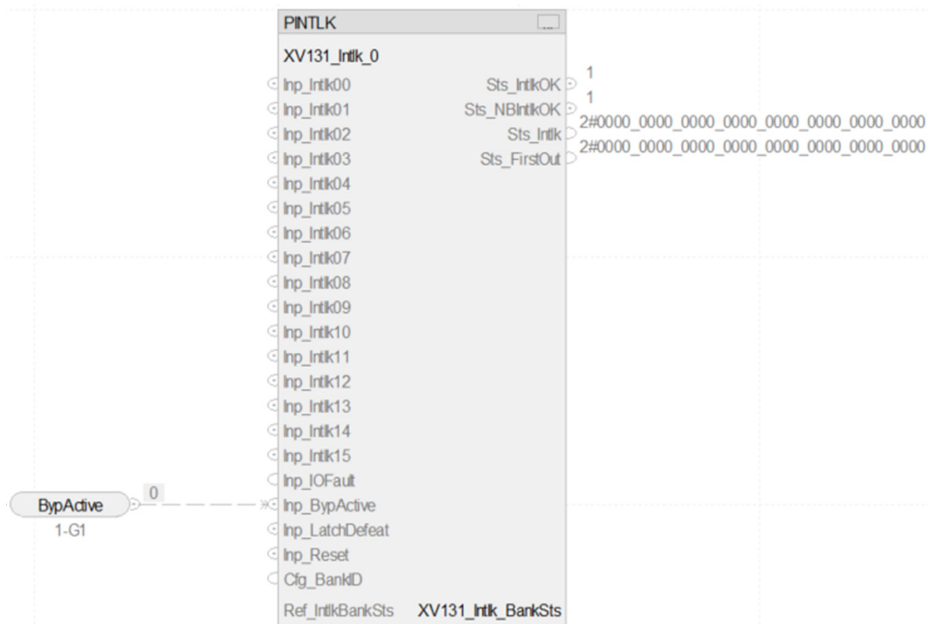
PVLV Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_VALVE_DISCRETE	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

PVLV Output References to PVLVS

Parameter	Description
Sts_Pos1	1 = Valve requested to Position 1 and is confirmed Position 1
Sts_Pos2	1 = Valve requested to Position 1 and is confirmed Position 2

Interlock Bank Sheet



PINTLK Input Reference

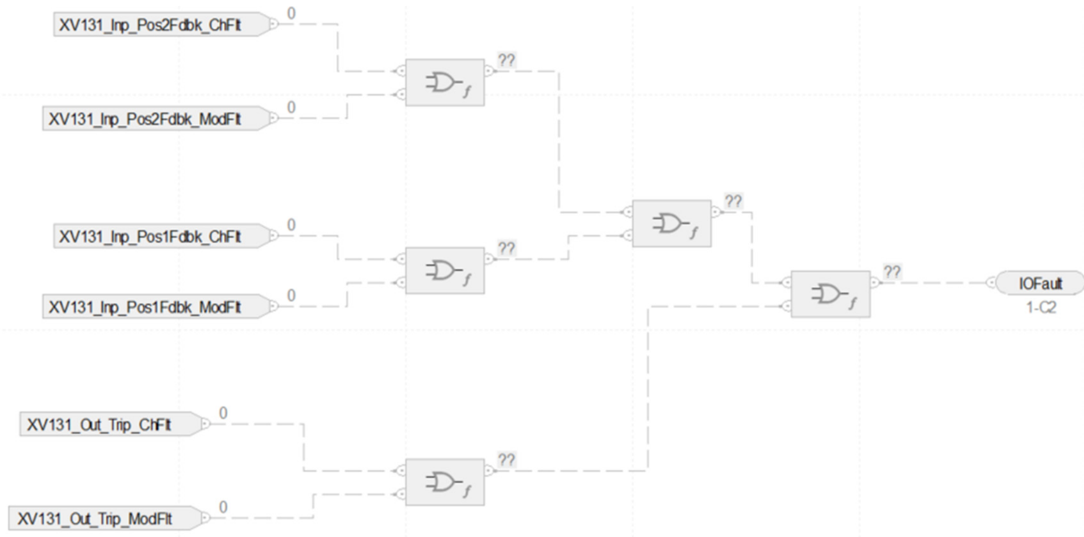
Parameter	Description
BypActive	Input connection from CS_PVLVHO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Fault Input References

Parameter	Description
XV131_Inp_Pos1Fdbk_ChFlt	Tieback input 1 channel fault
XV131_Inp_Pos1Fdbk_ModFlt	Tieback input 1 module fault
XV131_Inp_Pos2Fdbk_ChFlt	Tieback input 2 channel fault
XV131_Inp_Pos2Fdbk_ModFlt	Tieback input 2 module fault
XV131_Out_Trip_ChFlt	Output channel fault
XV131_Out_Trip_ModFlt	Output module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PVLVHO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Valve Motor Operated (PVLVMO) Control Strategy

Use the PVLVMO control strategy to operate (open and close) a motor-operated valve. Since a motor-operated valve has no spring return (to return the valve to the fail-safe state), two digital outputs are required(one to move the valve towards the open position; and another to move the valve to the closed position).

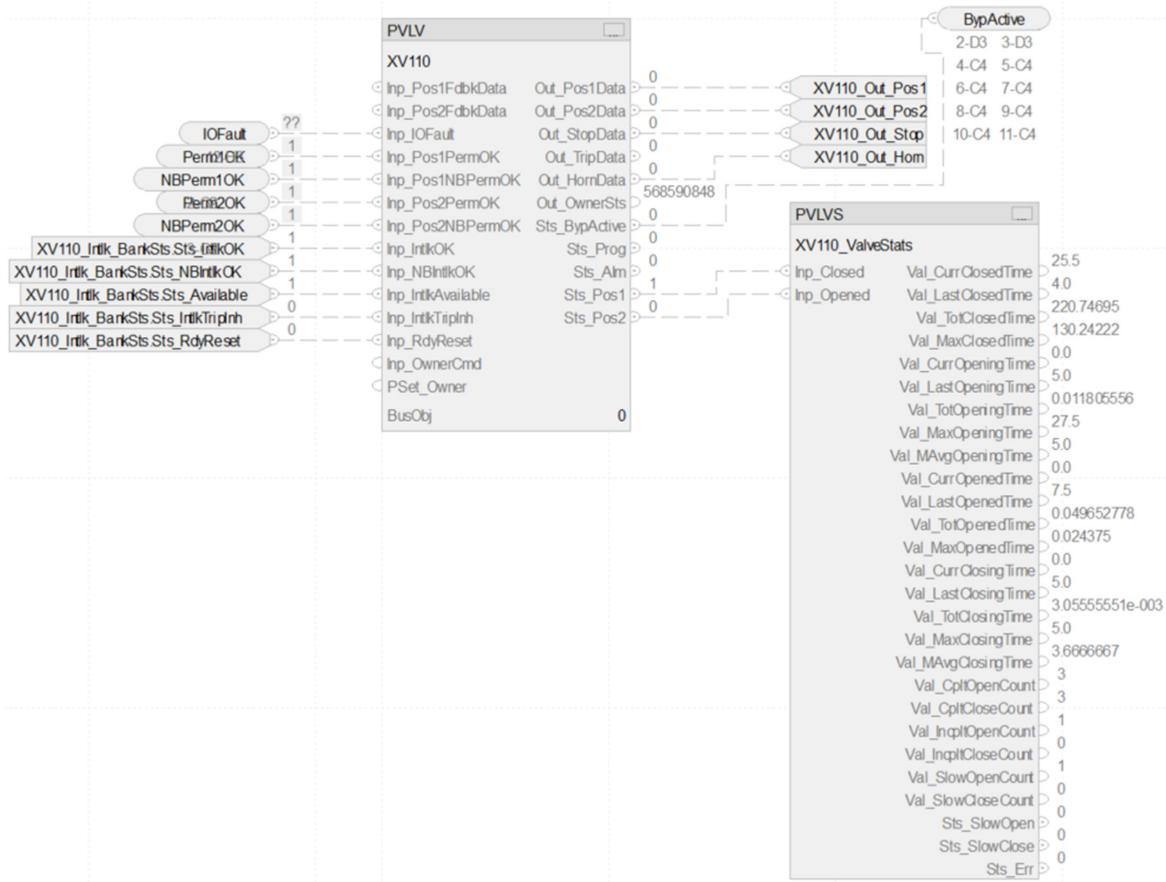
The CS_PVLVMO control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The PVLVMO control strategy contains these Function Block sheets:

Sheet	Description
CS_PVLVMO	Process Valve instruction, motor operated
Position 1 Permissives Position 2 Permissives	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. Position 1 and Position 2 permissives are applied to the commands to energize towards those positions. Permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PVLV instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises an alarm on an I/O fault.

CS_PVLVMO Sheet



PVLV Input References

Parameter	Description
IOFault	Input connection from IO Faults sheet
Perm1OK	Input connection from Position 1 Permissives sheet 1 = On permissives OK, device can turn On
NBPerm1OK	Input connection from Position 1 Permissives sheet 1 = Non-bypassable On permissives OK, device can turn On
Perm2OK	Input connection from Position 2 Permissives sheet 1 = On permissives OK, device can turn On
NBPerm2OK	Input connection from Position 2 Permissives sheet 1 = Non-bypassable On permissives OK, device can turn On
XV110_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
XV110_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status, 1 = All non-bypassable interlocks OK to run
XV110_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
XV110_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
XV131_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PVLV Output References

Parameter	Description
XV110_Out_Pos1	1 = Activate to move valve to Position 1
XV110_Out_Pos2	1 = Activate to move valve to Position 2
XV110_Out_Horn	1 = Sound audible before commanded valve start
BypActive	Output connection to permissives and interlock bank sheets

PVLV Configuration Considerations

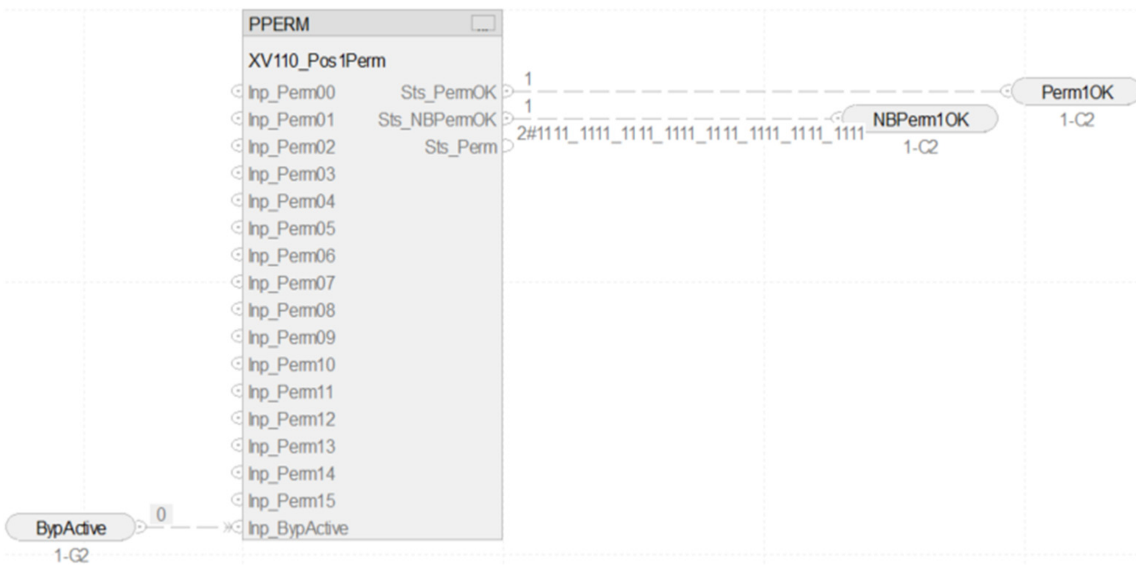
Operand	Type	Description
PlantPAx® control	P_VALVE_DISCRETE	Instance of data structure (backing tag) required for proper operation of the instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

PVLV Output References to PVLVS

Parameter	Description
Sts_Pos1	1 = Valve requested to Position 1 and is confirmed Position 1
Sts_Pos2	1 = Valve requested to Position 1 and is confirmed Position 2

Permissive Sheet

This is the sheet for Position 1, the sheet for Position 2 is similar.



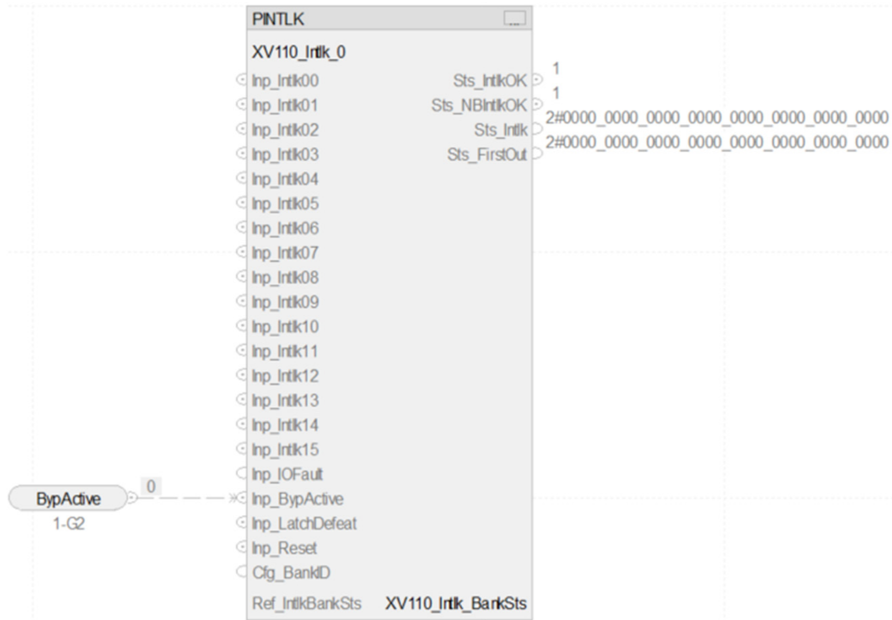
PPERM Input References

Parameter	Description
BypActive	Input connection from the CS_PVLVMO Sheet.

PPERM Output References

Parameter	Description
Perm1OK Perm2OK	Overall permissive status (1 = OK to energize)
NBPerm1OK NBPerm2OK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Interlock Bank Sheet



PINTLK Input Reference

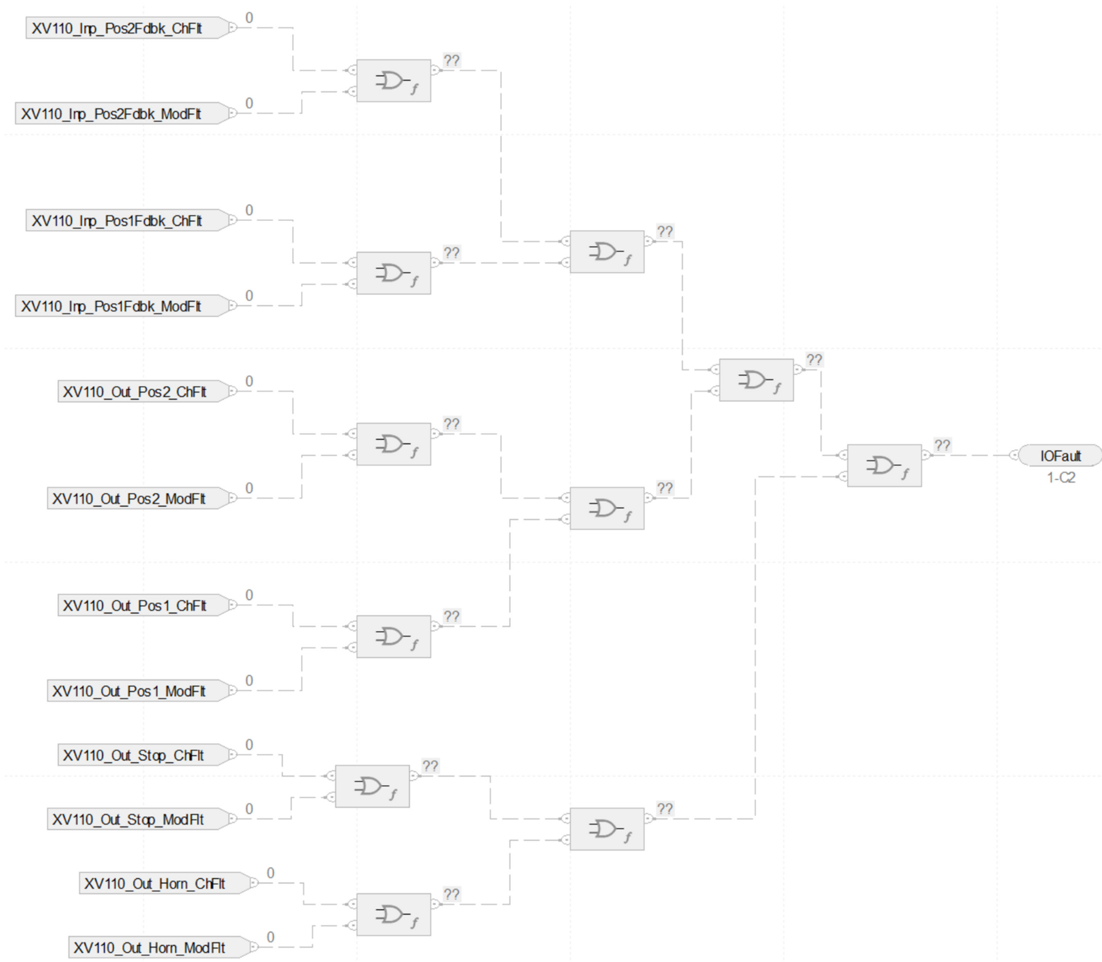
Parameter	Description
BypActive	Input connection from CS_PVLVMO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet



Faults Input References

Parameter	Description
XV110_Inp_Pos1Fdbk_ChFlt	Tieback input 1 channel fault
XV110_Inp_Pos1Fdbk_ModFlt	Tieback input 1 module fault
XV110_Inp_Pos2Fdbk_ChFlt	Tieback input 2 channel fault
XV110_Inp_Pos2Fdbk_ModFlt	Tieback input 2 module fault
XV110_Out_Pos1_ChFlt	Position 1 channel fault
XV110_Out_Pos1_ModFlt	Position 1 module fault
XV110_Out_Pos2_ChFlt	Position 2 channel fault
XV110_Out_Pos2_ModFlt	Position 2 module fault
XV110_Out_Horn_ChFlt	Sound audible for output channel fault
XV110_Out_Horn_ModFlt	Sound audible for output module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PVLVMO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Notes:

Process Mix Proof Valve (PVLVMP) Control Strategy

The Process Mix Proof Valve (PVLVMP) instruction controls and monitors feedback from a mix proof valve in various modes and states, and monitors 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 control strategy to control one mix proof valve in various modes and states, while monitoring position feedback inputs to verify that the valve reaches the commanded position. An alarm can be provided on failure to reach the commanded position.

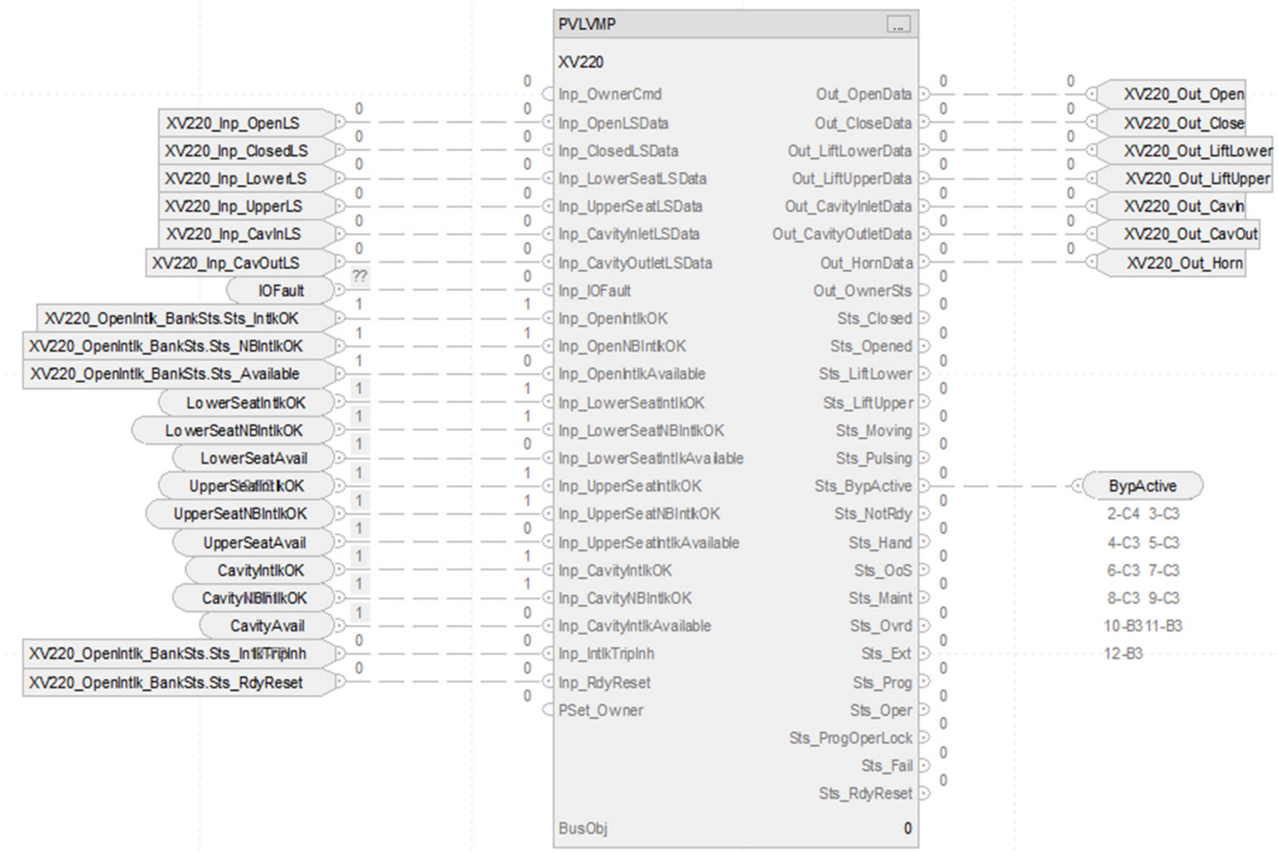
The CS_PVLVMP control strategy is available as a routine in the process library.

Import the control strategy as a **routine** in your controller project.

The PVLVMP control strategy contains these Function Block sheets:

Sheet	Description
CS_PVLVMP	Process Mix Proof Valve instruction
Permissives	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Open Interlock Cavity Interlocks Upper Seat Interlocks Lower Seat Interlocks	The PVLVMP instruction monitors bypassable and non-bypassable Interlocks that force the Output instead of 'analog output' and to the configured safe state. • Open Interlock has 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. • Cavity Interlocks, Upper Seat Interlocks, and Lower Seat Interlocks each have one interlock sheet that exposes 16 of the available 32 interlocks per bank by default. • Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors the input and output modules and channels that are used to interface with the device for fault conditions and raises an alarm on an I/O fault.

CS_PVLVMP Sheet



PVLVMP Input References

Parameter	Description
XV220_Inp_OpenLS	Valve Open Limit Switch, 1 = confirmed open
XV220_Inp_Closed_LS	Valve Closed Limit Switch, 1 = confirmed closed
XV220_Inp_LowerLS	Valve Lower Seat Lift Limit Switch, 1 = confirmed lower seat lifted
XV220_Inp_UpperLS	Valve Upper Seat Lift Limit Switch, 1 = confirmed upper seat lifted
XV220_Inp_CavInLS	Valve cavity inlet limit switch: 1 = Confirmed cavity inlet opened.
XV220_Inp_CavOutLS	Valve cavity outlet limit switch: 1 = Confirmed cavity output closed
IOFault	Input connection from I/O Faults sheet
PermOK	Input connection from Permissives sheet 1 = Permissives OK, valve can move from the closed position
NBPermOK	Input connection from Permissives sheet 1 = Non-bypassable permissives OK, valve can move from the closed position
XV220_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to move valve from the closed position, 0 = Close valve
XV220_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to move valve from the closed position 0 = Close valve
XV220_Intlk_BankSts.Sts_Available	Interlock bank status , 1 = Available
XV220_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit – closes valve but does not raise trip alarm
XV220_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

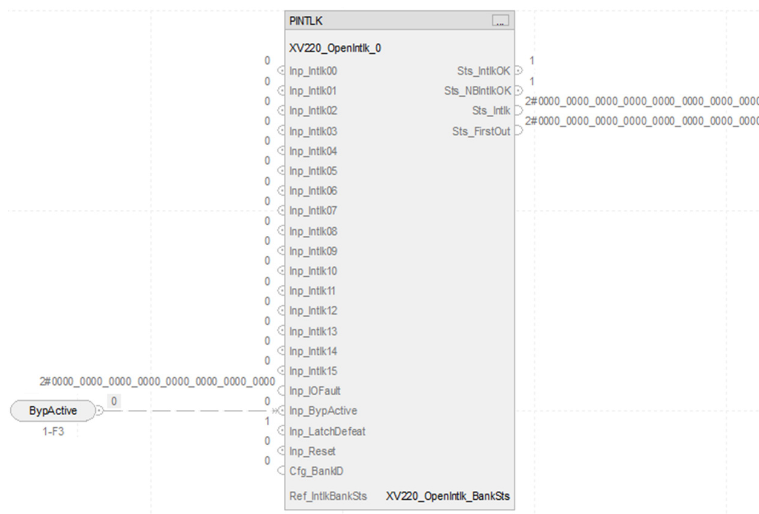
PVLVMP Output References

Parameter	Description
XV220_Out_Open	Output to Open valve, 1 = Open
XV220_Out_Closed	Output to Close valve, 1 = Close
XV220_Out_LiftLower	Output to Lift lower valve seat, 1 = Lift
XV220_Out_LiftUpper	Output to Lift upper valve seat, 1 = Lift
XV220_Out_Horn	1 = Sound audible before commanded valve action
XV220_Out_CavIn	Cavity In Output
XV220_Out_CavOut	Cavity Out Output
BypActive	Output connection to permissive and interlock bank sheets

PVLVMP Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_DISCRETE_MIX_PROOF	Instance of data structure (backing tag) required for proper operation of the instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

Open Interlock Bank Sheet



PINTLK Input References

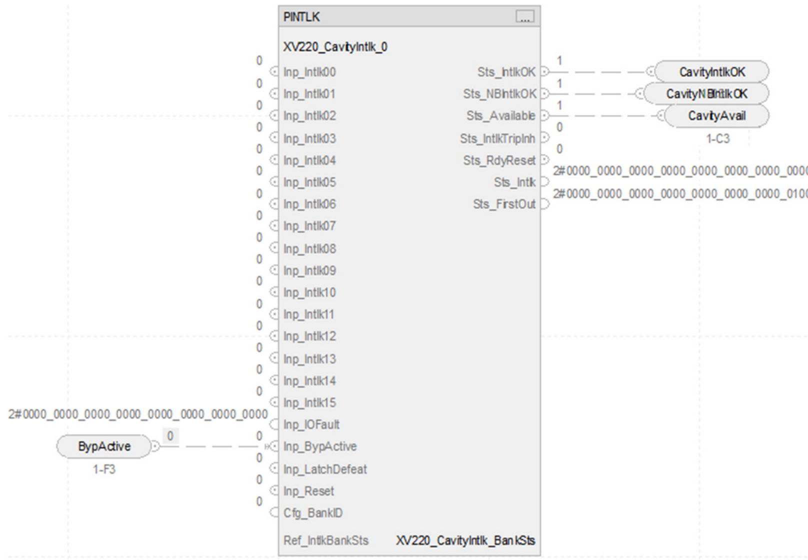
Parameter	Description
BypActive	Input connection from CS_PVLVMP sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Cavity Interlocks Bank Sheet



PINTLK Input References

Parameter	Description
BypActive	Input connection from CS_PVLVMP sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Upper Seat Interlocks Bank Sheet

PINTLK Input References

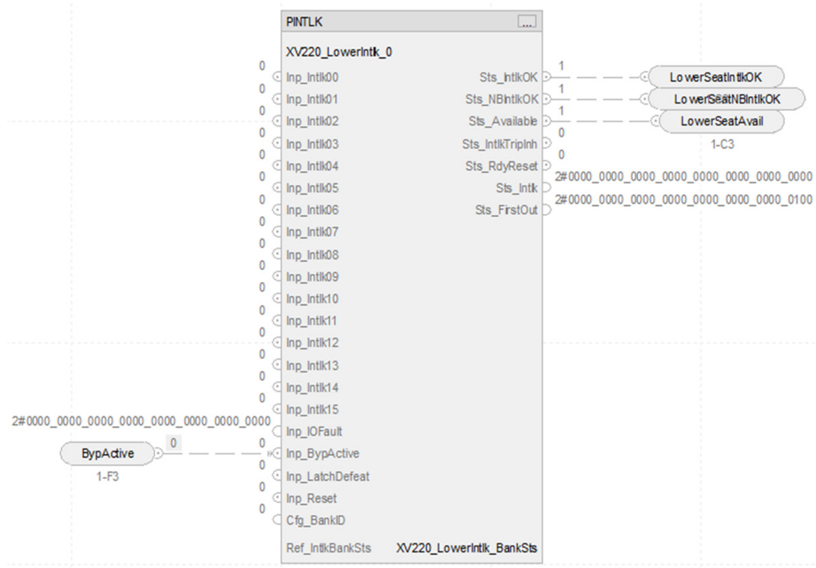
Parameter	Description
BypActive	Input connection from CS_PVLVMP sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Lower Seat Interlocks Bank Sheet



PINTLK Input References

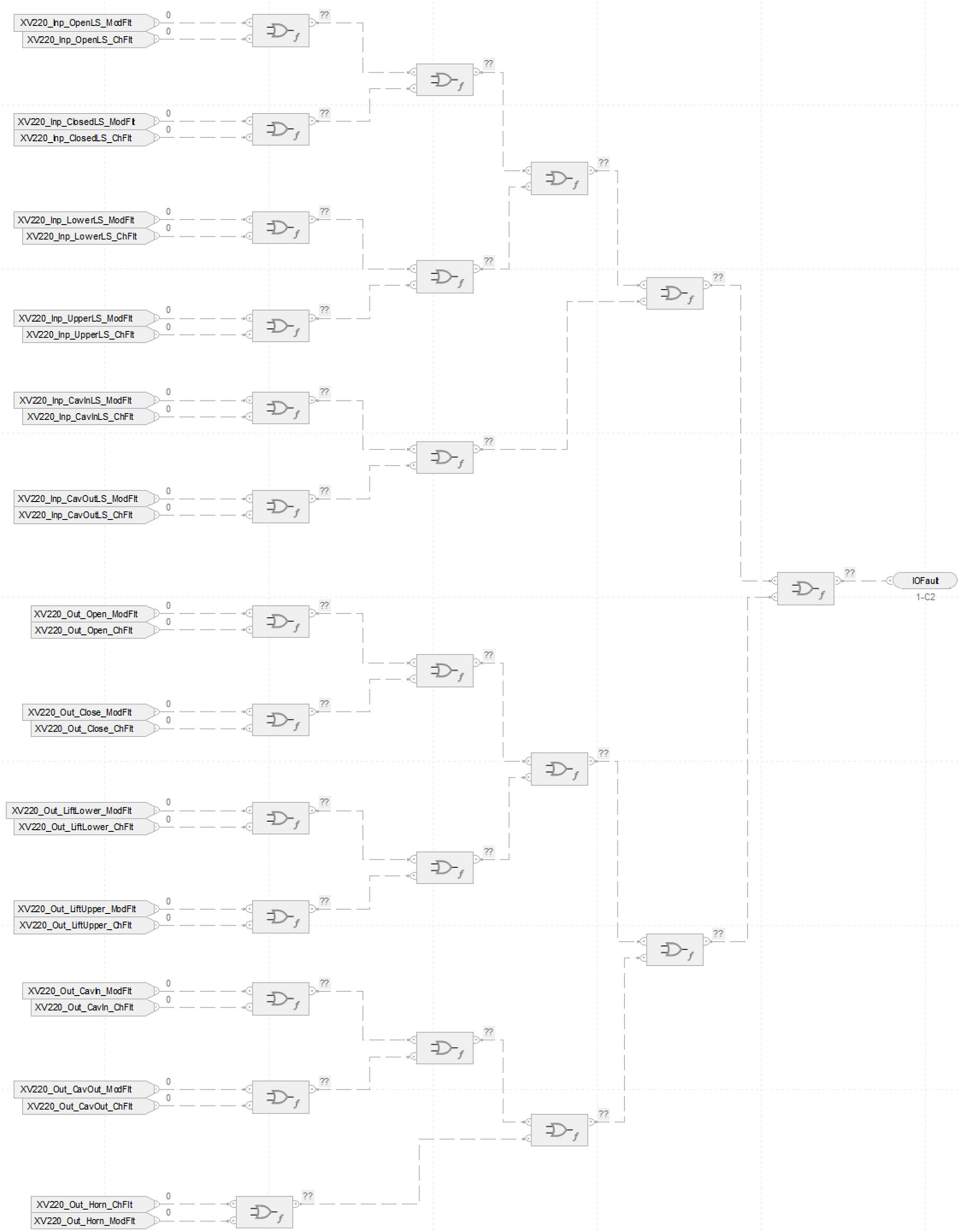
Parameter	Description
BypActive	Input connection from CS_PVLVMP sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

I/O Faults Sheet



Fault Input References

Parameter	Description
XV220_Inp_OpenLS_ModFlt	Open Feedback Input Module Fault (Any Connected I/O Module Fault)
XV220_Inp_OpenLS_ChFlt	Open Feedback Input Channel Fault
XV220_Inp_Closed_LS_ModFlt	Closed Feedback Input Module Fault (Any Connected I/O Module Fault)
XV220_Inp_Closed_LS_ChFlt	Closed Feedback Input Channel Fault
XV220_Inp_LowerLS_ModFlt	Lower Limit Switch Input Module Fault (Any Connected I/O Module Fault)
XV220_Inp_LowerLS_ChFlt	Lower Limit Switch Input Channel Fault
XV220_Inp_UpperLS_ModFlt	Upper Limit Switch Input Module Fault (Any Connected I/O Module Fault)
XV220_Inp_UpperLS_ChFlt	Upper Limit Switch Input Channel Fault
XV220_Inp_CavInLS_ModFlt	Valve cavity inlet limit switch module fault
XV220_Inp_CavInLS_ChFlt	Valve cavity inlet limit switch channel fault
XV220_Inp_CavOutLS_ModFlt	Valve cavity outlet limit switch module fault
XV220_Inp_CavOutLS_ChFlt	Valve cavity outlet limit switch channel fault
XV220_Out_Open_ModFlt	Open limit switch module fault
XV220_Out_Open_ChFlt	Open limit switch channel fault
XV220_Out_Close_ModFlt	Closed limit switch module fault
XV220_Out_Close_ChFlt	Closed limit switch channel fault
XV220_Out_LiftLower_ModFlt	Lift lower limit switch module fault
XV220_Out_LiftLower_ChFlt	Lift lower limit switch channel fault
XV220_Out_LiftUpper_ModFlt	Lift upper limit switch module fault
XV220_Out_LiftUpper_ChFlt	Lift upper limit switch channel fault
XV220_Out_CavIn_ModFlt	Cavity Inlet Output Module Fault (Any Connected I/O Module Fault)
XV220_Out_CavIn_ChFlt	Cavity Inlet Output Input Channel Fault
XV220_Out_CavOut_ModFlt	Cavity Outlet Output Module Fault (Any Connected I/O Module Fault)
XV220_Out_CavOut_ChFlt	Cavity Outlet Output Input Channel Fault
XV220_Out_Horn_ChFlt	Audible output device channel fault
XV220_Out_Horn_ModFlt	Audible output device module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PVLVMP sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Process Valve Solenoid Operated (PVLVSO) Control Strategy

Use the PVLVSO control strategy to operate (open and close) one solenoid-operated valve. Generally, a solenoid-operated valve only requires one output to energize a solenoid providing pneumatic energy to an actuator that moves the valve from its fail-safe position. When this output is de-energized, a spring forces the valve back to its fail-safe position. When using this control strategy, one must consider whether the valve is Fail Closed (FC) or Fail Open (FO). For the more common FC valve, the output XV101_Out_Pos2 must be used to drive the field device. If the valve is a FO valve, the output XV101_Out_Pos1 must be used to drive the field device.

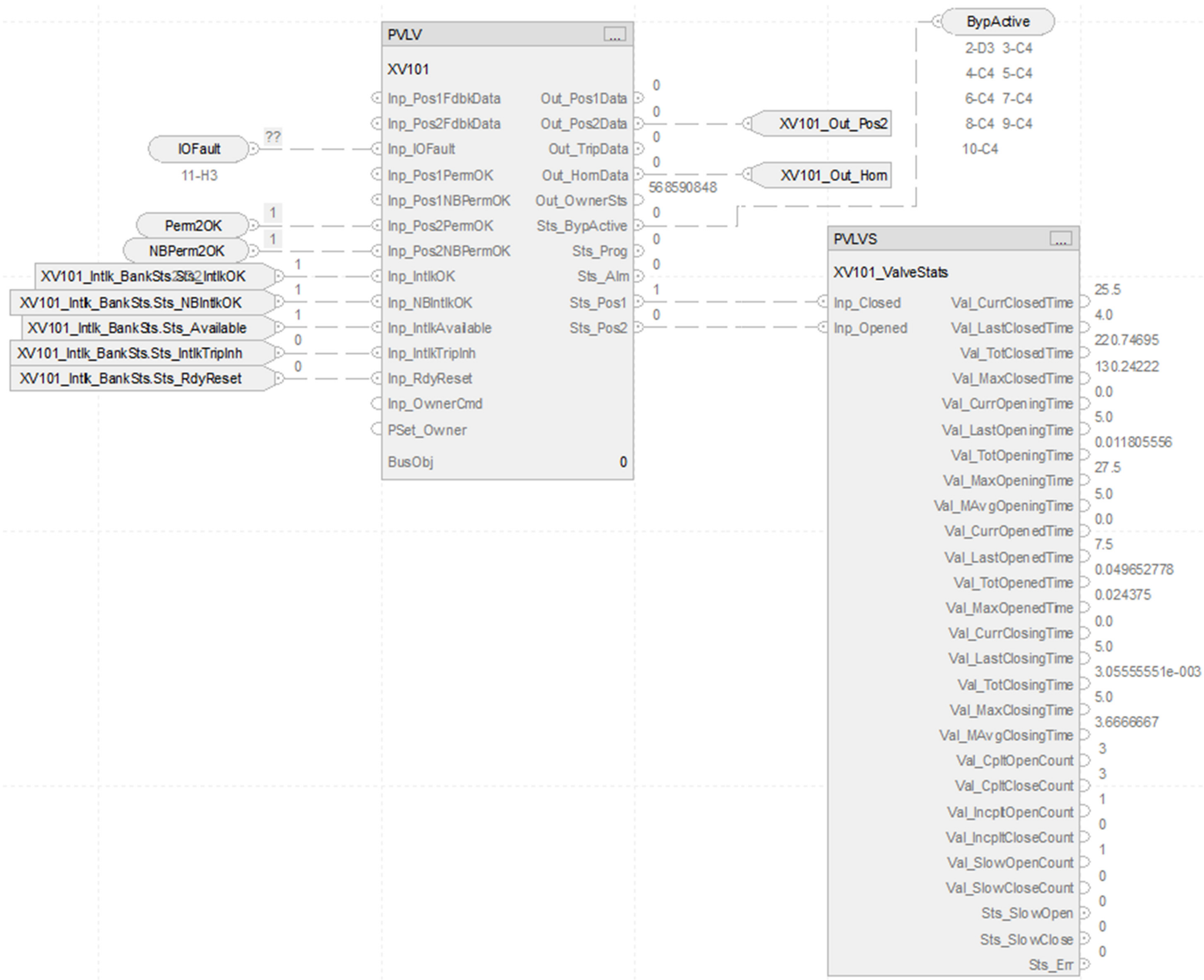
The CS_PVLVSO control strategy is available as two routines in the process library:

- One routine for fail position 1, and one routine for fail position 2. Fail position 1 and 2 could be Close/Open, Up/ Down, Left/ Right depending on the application.
- Import the control strategy as a **routine** in your controller project.

The PVLVSO control strategy contains these Function Block sheets:

Sheet	Description
CS_PVLVSO	Process Valve instruction, solenoid operated
Permissives	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PVLV instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.
IO Faults	The logic monitors one analog output channel for I/O fault input and raises an alarm on an I/O fault.

CS_PVLVSO_FailPos1 Sheet



PVLV Input References

Parameter	Description
XV101_Inp_Pos1Fdbk XV101_Inp_Pos2Fdbk	Feedback from Position limit switches of the device 1 = Device confirmed Position 1
IOFault	Input connection from IO Faults sheet
Perm2OK	Input connection from Position 2 Permissives sheet 1 = On permissives OK, device can turn On
NBPerm2OK	Input connection from Position 2 Permissives sheet 1 = Non-bypassable On permissives OK, device can turn On
XV101_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run, 0 = Stop
XV101_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XV101_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XV101_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
XV101_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PVLV Output References

Parameter	Description
XV101_Out_Pos2	1 = Activate to move valve to Position 2
XV101_Out_Pos1	1 = Activate to move valve to Position 1
XV101_Out_Horn	1 = Sound audible before commanded valve start
BypActive	Output connection to permissives and interlock bank sheets

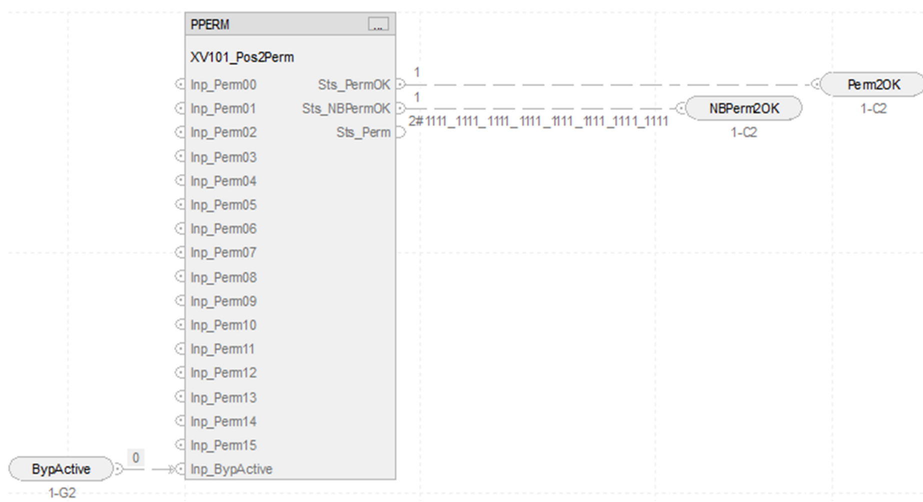
PVLV Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_VALVE_DISCRETE	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

PVLV Output References to PVLVS

Parameter	Description
Sts_Pos1	1 = Valve requested to Position 1 and is confirmed Position 1
Sts_Pos2	1 = Valve requested to Position 1 and is confirmed Position 2

Position 2 Permissive Sheet



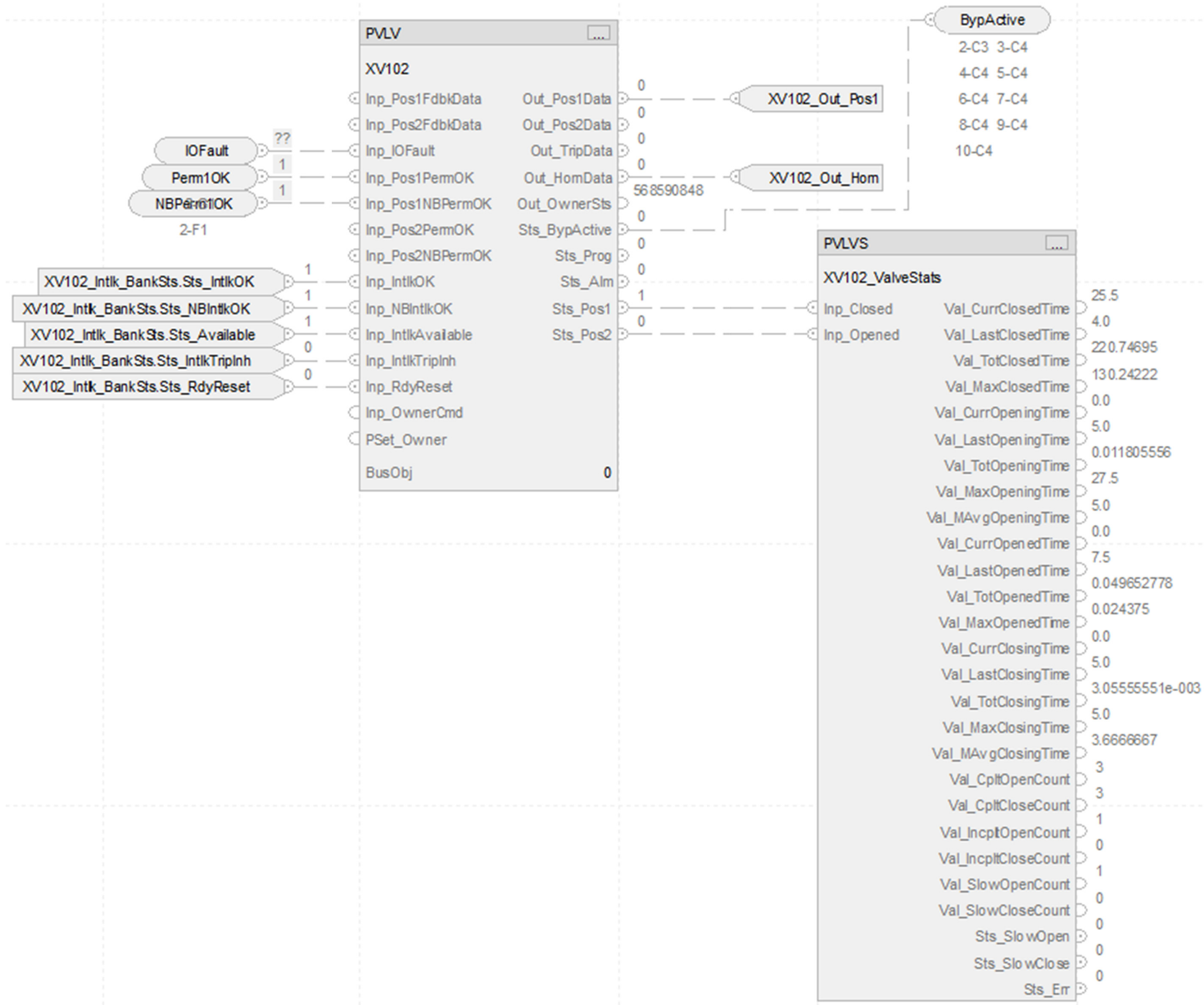
PPERM Input References

Parameter	Description
BypActive	Input connection from the interlock bank sheet

PPERM Output References

Parameter	Description
Perm2OK	Overall permissive status (1 = OK to energize)
NBPerm2OK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

CS_PVLVSO_FailPos2 Sheet



PVLV Input References

Parameter	Description
XV102_Inp_Pos1Fdbk XV102_Inp_Pos2Fdbk	Feedback from Position limit switches of the device 1 = Device confirmed Position 1
IOFault	Input connection from IO Faults sheet
Perm2OK	Input connection from Position 2 Permissives sheet 1 = On permissives OK, device can turn On
NBPerm2OK	Input connection from Position 2 Permissives sheet 1 = Non-bypassable On permissives OK, device can turn On
XV102_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
XV102_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
XV102_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
XV102_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
XV102_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset

PVLV Output References

Parameter	Description
XV102_Out_Pos2	1 = Activate to move valve to Position 2
XV102_Out_Pos1	1 = Activate to move valve to Position 1
XV102_Out_Horn	1 = Sound audible before commanded valve start
BypActive	Output connection to permissives and interlock bank sheets

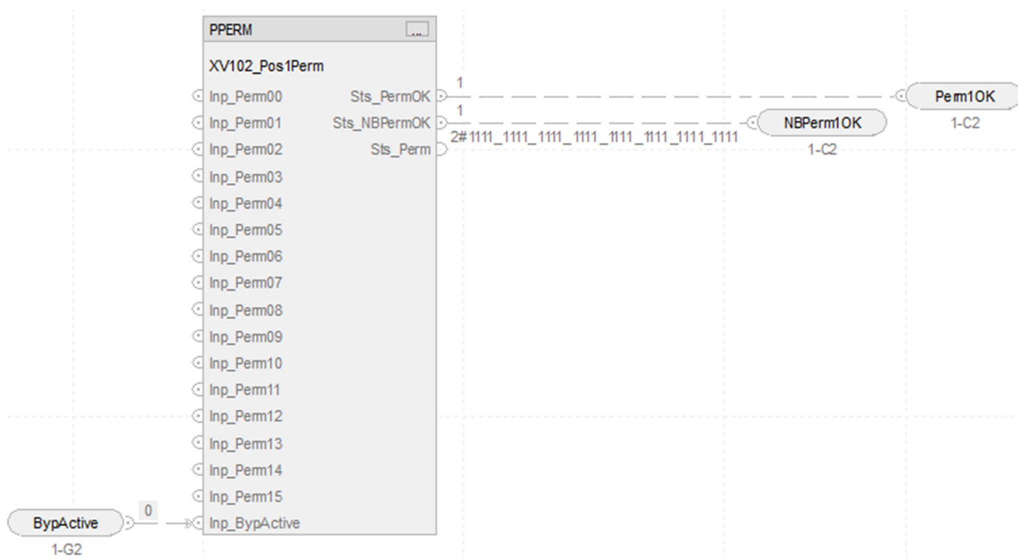
PVLV Configuration Considerations

Operand	Type	Description
PlantPAx control	P_VALVE_DISCRETE	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

PVLV Output References to PVLVS

Parameter	Description
Sts_Pos1	1 = Valve requested to Position 1 and is confirmed Position 1
Sts_Pos2	1 = Valve requested to Position 1 and is confirmed Position 2

Position 1 Permissive Sheet



PPERM Input References

Parameter	Description
BypActive	Input connection from the interlock bank sheet

PPERM Output References

Parameter	Description
Perm1OK	Overall permissive status (1 = OK to energize)
NBPerm1OK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Interlock Bank Sheet-XV101

PINTLK Input Reference

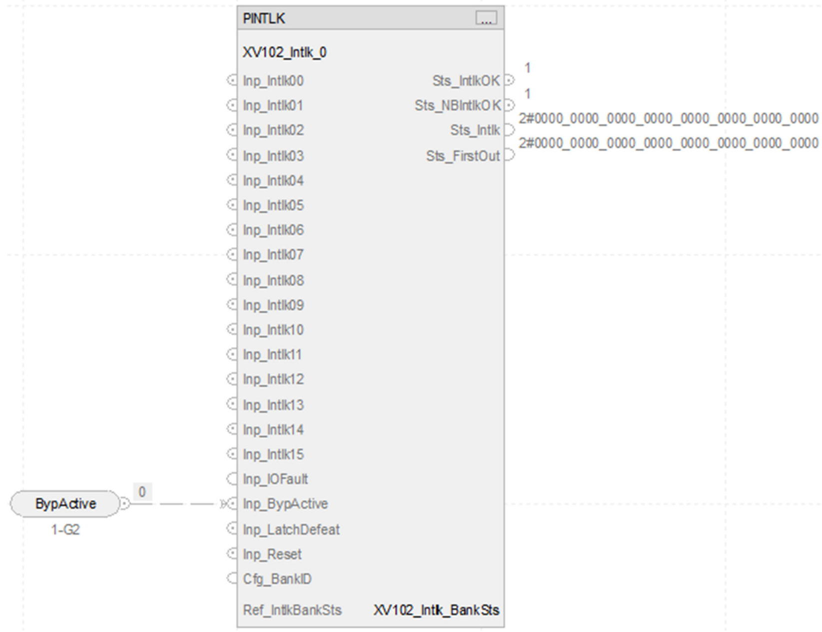
Parameter	Description
BypActive	Input connection from CS_PVLVSO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Interlock Bank Sheet-XV102



PINTLK Input Reference

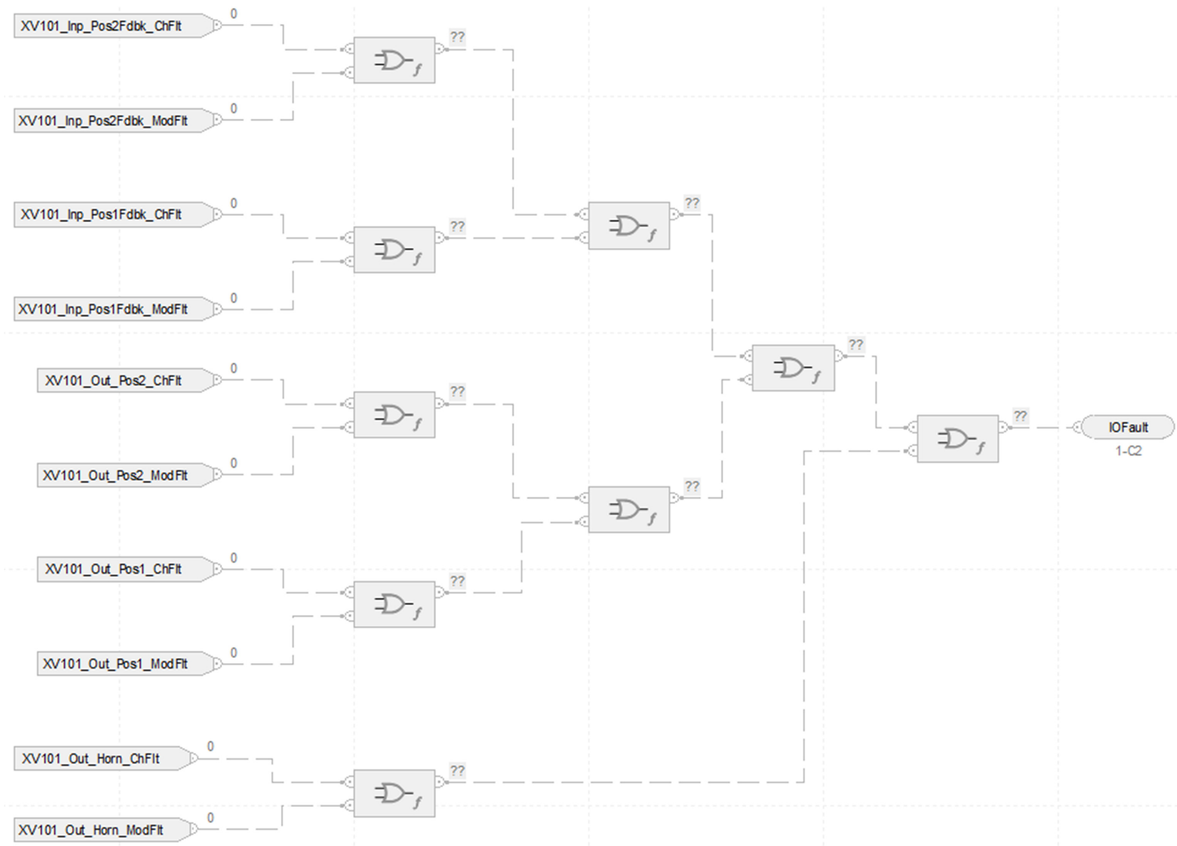
Parameter	Description
BypActive	Input connection from CS_PVLVSO sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

IO Faults Sheet-XV101



Fault Input References

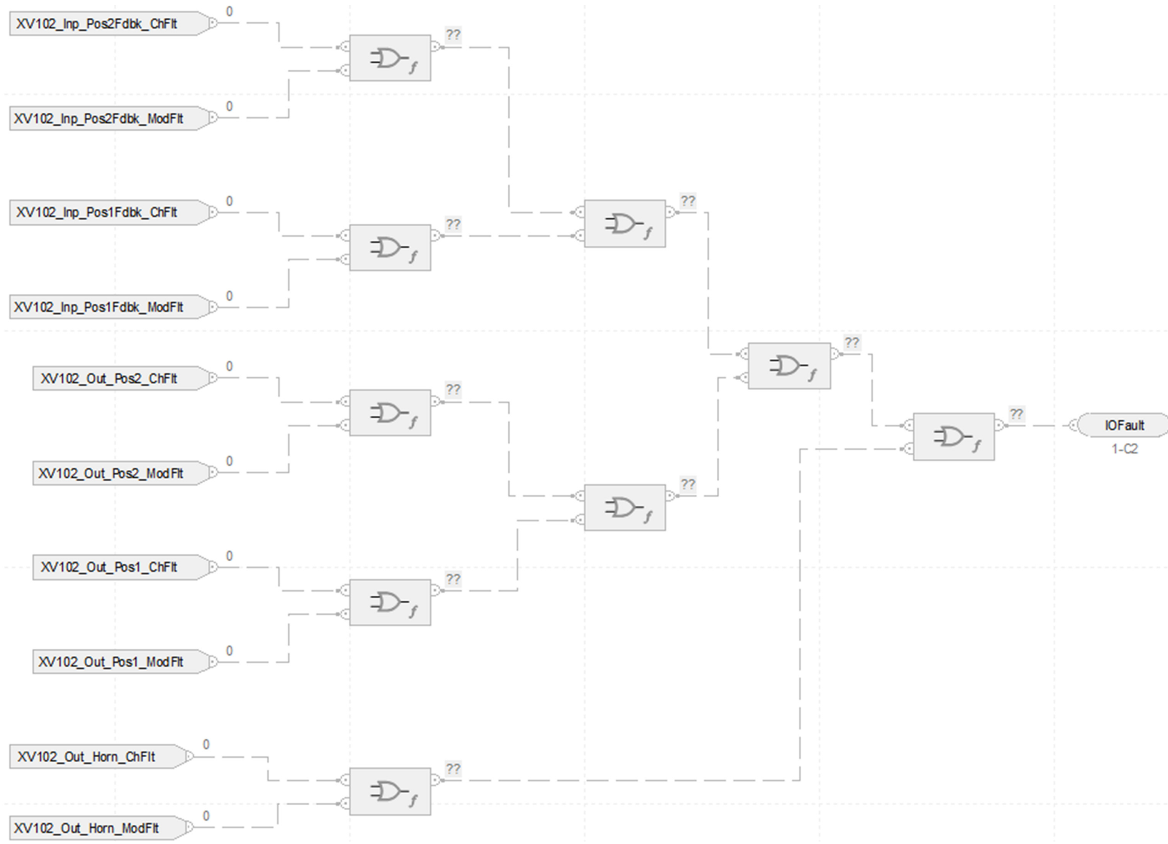
Parameter	Description
XV101_Inp_Pos2Fdbk_ChFlt	Tieback input 2 channel fault
XV101_Inp_Pos2Fdbk_ModFlt	Tieback input 2 module fault
Local:6:I.Fault.8	Discrete input fault
Local_06.Sts_IOFault	Discrete input communication faulted
Local:7:I.Fault.8	Discrete output fault
Local_07.Sts_IOFault	Discrete output communication faulted
XV101_Out_Pos1_ChFlt	Position 1 channel fault
XV101_Out_Pos1_ModFlt	Position 1 module fault
XV101_Out_Horn_ChFlt	Sound audible for output channel fault
XV101_Out_Horn_ModFlt	Sound audible for output module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PVLVSO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

IO Faults Sheet-XV102



Fault Input References

Parameter	Description
XV102_Inp_Pos2Fdbk_ChFlt	Tieback input 2 channel fault
XV102_Inp_Pos2Fdbk_ModFlt	Tieback input 2 module fault
Local:6:I.Fault.8	Discrete input fault
Local_06.Sts_IOFault	Discrete input communication faulted
Local:7:I.Fault.8	Discrete output fault
Local_07.Sts_IOFault	Discrete output communication faulted
XV102_Out_Pos1_ChFlt	Position 1 channel fault
XV102_Out_Pos1_ModFlt	Position 1 module fault
XV102_Out_Horn_ChFlt	Sound audible for output channel fault
XV102_Out_Horn_ModFlt	Sound audible for output module fault

Fault Output References

Parameter	Description
IOFault	Output connection to CS_PVLVSO sheet

For examples on how to map data to input tags, see PlantPAx Control Strategies on page 19.

Notes:

Chapter **38**

Process Variable Speed Drive (PVSD) Control Strategies

Use a PVSD control strategy to monitor and control 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.

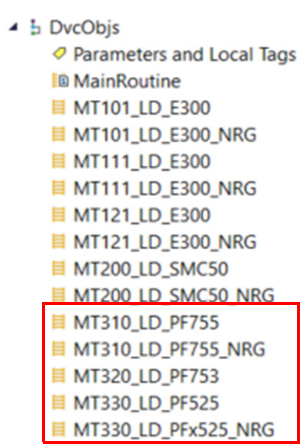
The following PVSD control strategies are available as routines in the process library:

Drive Type	Control Strategy	Description
Generic variable speed drive	CS_PVSD CS_PVSD_Hand	Basic Hand command source
PowerFlex® 525	CS_PVSD525 CS_PVSD525_Hand CS_PVSD525_Energy	Basic Hand command source Energy parameters
PowerFlex 753	CS_PVSD753 CS_PVSD753_Hand	Basic Hand command source
PowerFlex 755	CS_PVSD755 CS_PVSD755_Hand CS_PVSD755_Energy	Basic Hand command source Energy parameters
PowerFlex 755T	CS_PVSD_PF755T CS_PVSD_PF755T_Hand	Basic Hand command source
PowerFlex 6000T	CS_PVSD_PF6000T CS_PVSD_PF6000T_Hand	Basic Hand command source
PowerFlex 7000	CS_PVSD_PF7000 CS_PVSD_PF7000_Hand	Basic Hand command source

Import the appropriate control strategy as a **routine** in your controller project.

Also, import the appropriate device object as a routine in your controller project. These objects are from the Power Device Library and must be downloaded separately from the PlantPAx® Process Library.

Each '_NRG' object uses the Energy object to group energy parameters for the device. Use this object with the corresponding, energy-related control strategy.



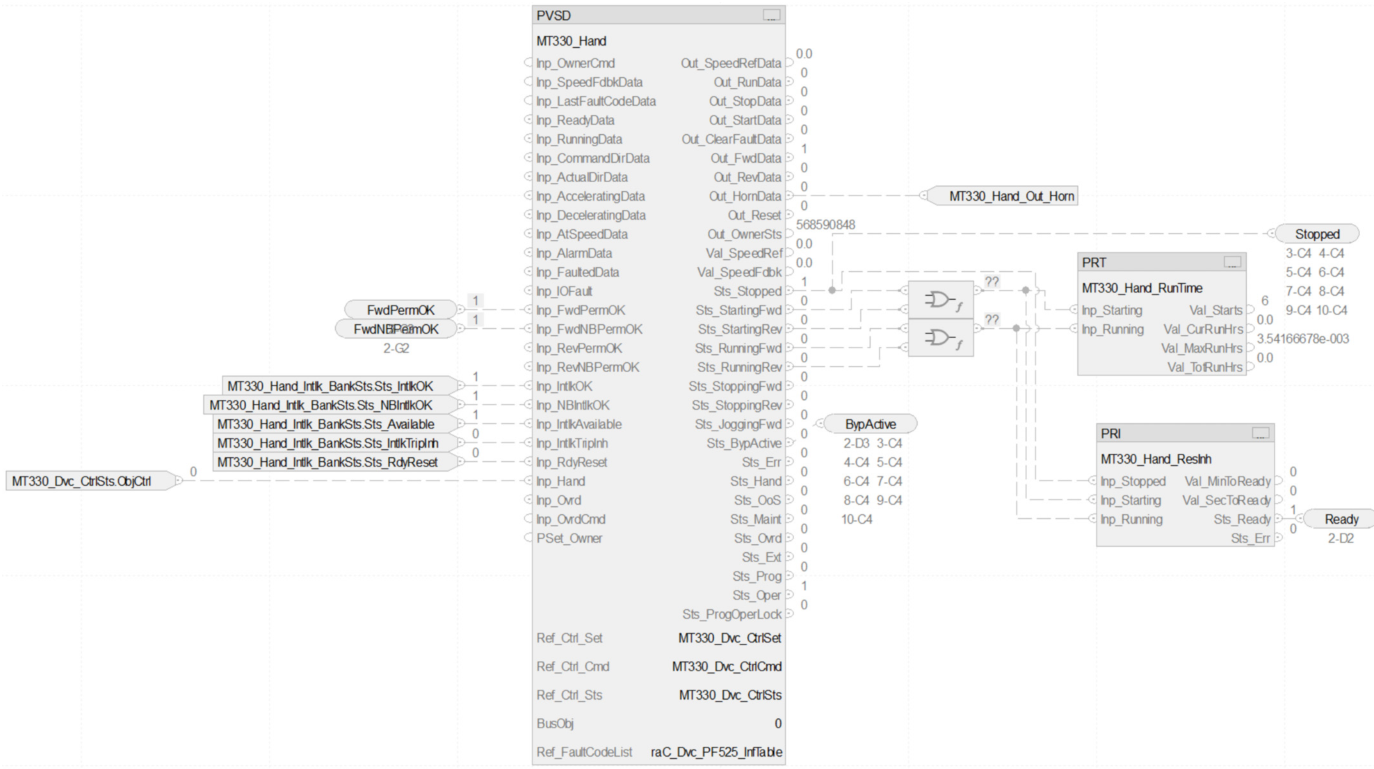
The PVSD control strategies contain these Function Block sheets:

Sheet	Description
CS_PVSD	Process Variable Speed Drive instruction
Permissive	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The PVSD instruction monitors bypassable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.

In the input and output reference descriptions on each sheet, [device] = one of the following:

Drive Type	Type
PowerFlex 525	MT330
PowerFlex 753	MT320
PowerFlex 755	MT310

CS_PVSD Sheet



PVSD Input References

Parameter	Description
FwdPermOK	Input connection from Forward Permissives sheet 1 = On permissives OK, device can turn On
FwdNBPermOK	Input connection from Forward Permissives sheet 1 = Non-bypassable On permissives OK, device can turn On
[device]_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
[device]_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
[device]_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
[device]_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
[device]_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset
[device]_Dvc_CtrlSts.ObjCtrl	Hand command source only 1 = Acquire Hand (typically hardwired local) 0 = Release Hand

PVSD Output References

Parameter	Description
[device]_Out_Horn	1 = Sound audible before commanded state change
BypActive	Output connection to permissives and interlock bank sheets
Ready	Output connection to the permissive sheet
Stopped	Output connection to interlock bank sheet

The Boolean OR performs a bitwise OR based on these PVSD outputs:

- Sts_Stopped
- Sts_StartingFwd
- Sts_StartingRev
- Sts_RunningFwd
- Sts_RunningRev

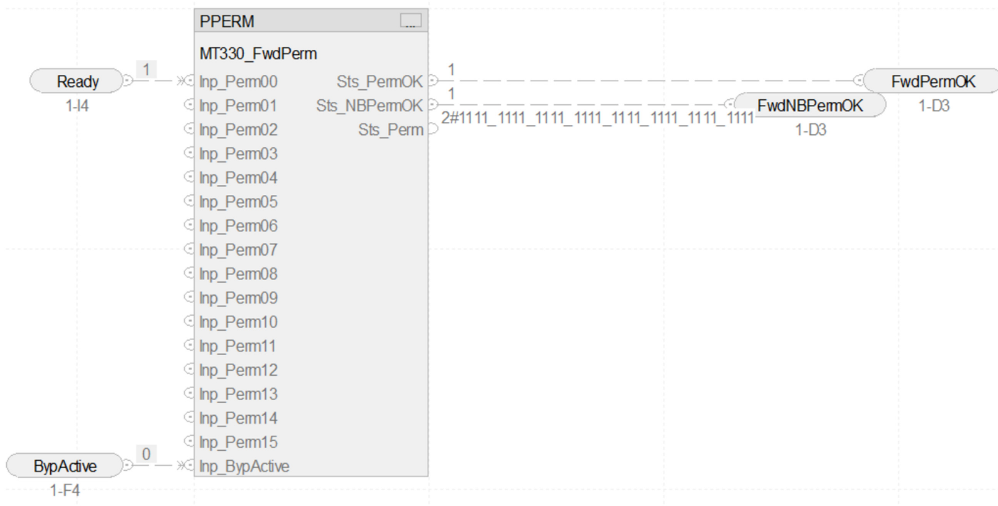
The result feeds these instructions:

Instruction	Description
Process Run Time and Start Counter (PRT)	The PRT instruction records the total run time and number of instances the drive starts.
Process Restart Inhibit (PRI)	The PRI instruction helps prevent the drive from starting repeatedly. Continual starts or start attempts in a short period overheat the motor windings and damage the motor.

PVSD Configuration Considerations

Operand	Type	Description
PlantPAx control	P_VARIABLE_SPEED_DRIVE	Instance of data structure (backing tag) required for proper operation of instruction
BusObj	BUS_OBJ	Bus component for organization control • 0 if not using organization • Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.
Ref_Ctrl_Set	RAC_ITF_DVC_PWRVELOCITY_SET	Velocity Automation Device Object Settings Interface Preconfigured in the device object ladder routine
Ref_Ctrl_Cmd	RAC_ITF_DVC_PWRVELOCITY_CMD	Velocity Automation Device Object Command Interface Preconfigured in the device object ladder routine
Ref_Ctrl_Sts	RAC_ITF_DVC_PWRVELOCITY_STS	Velocity Automation Device Object Status Interface Preconfigured in the device object ladder routine
Ref_FaultCodeList	RAC_CODEDESCRIPTION[400]	Fault Code to Fault Description lookup table for the drive Preconfigured in the device object ladder routine

Permissive Sheet



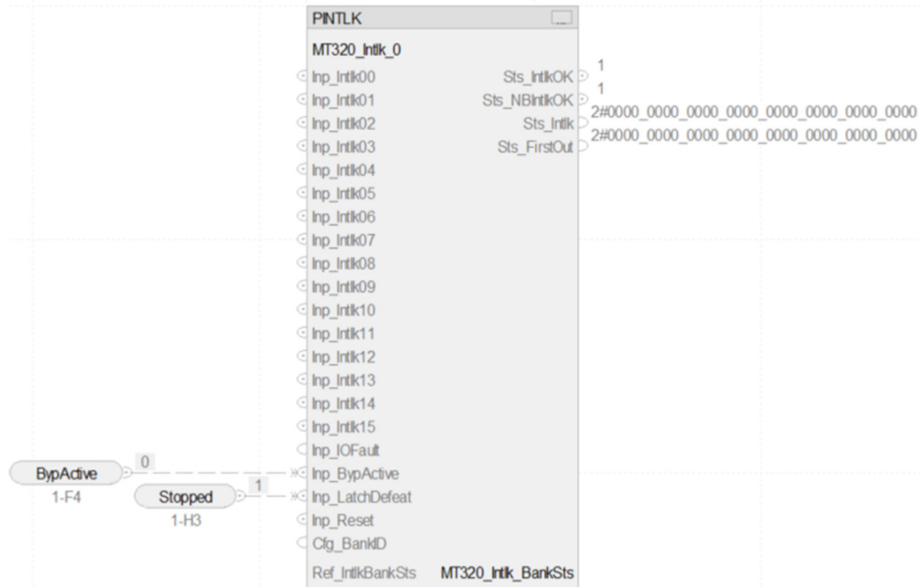
PPERM Input References

Parameter	Description
Ready	Input connection from the CS_PVSD sheet
BypActive	Input connection from the interlock bank sheet

PPERM Output References

Parameter	Description
FwdPermOK	Overall permissive status (1 = OK to energize)
FwdNBPermOK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Interlock Bank Sheet



PINTLK Input Reference

Parameter	Description
BypActive	Input connection from CS_PVSD sheet
Stopped	Input connection from the CS_PVSD sheet

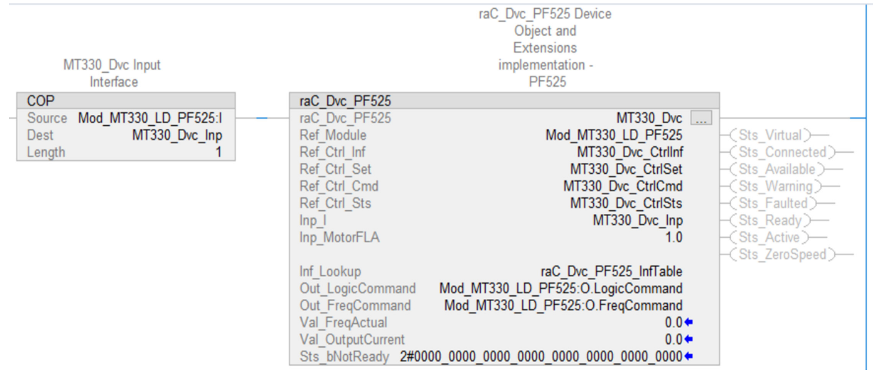
PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

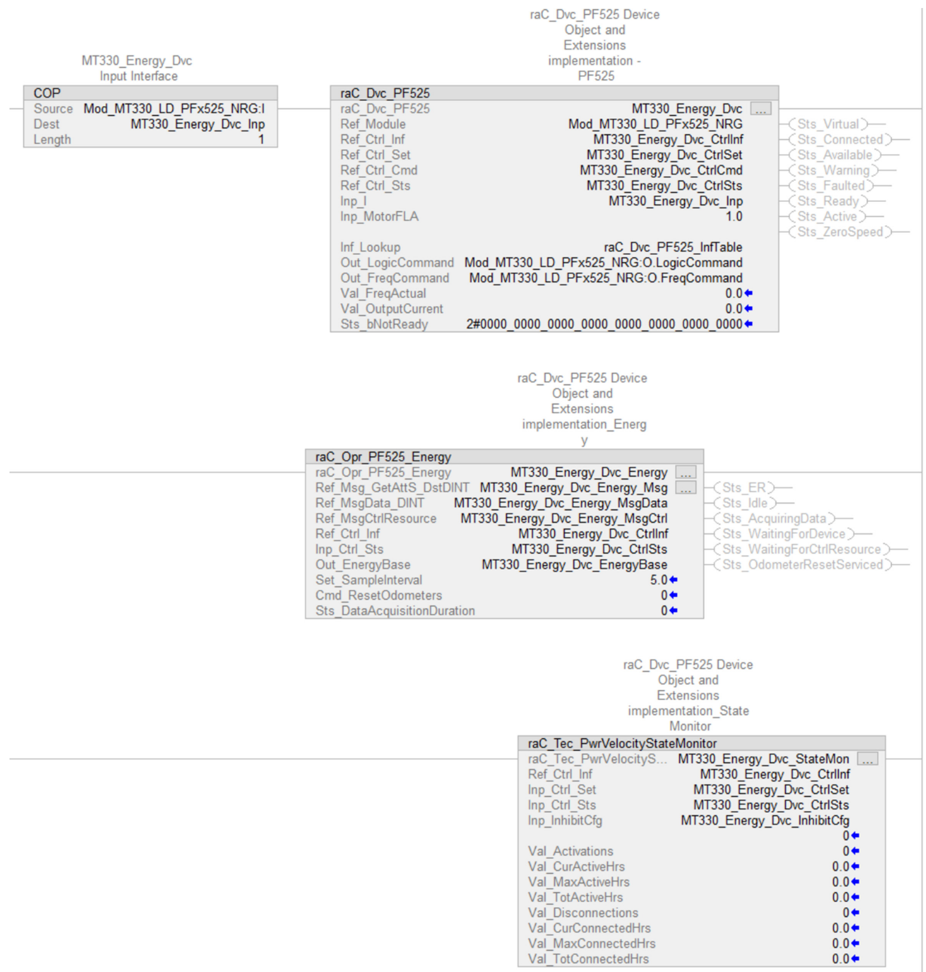
For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

Drive Device Objects

Drive



Drive with Energy Parameters



Notes:

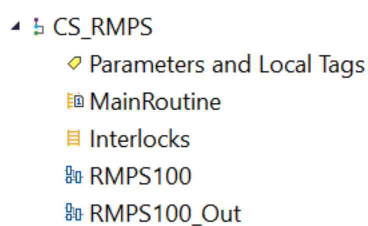
Chapter 39

Ramp/Soak (RMPS) Control Strategies

Ramp/Soak refers to the ramping of a controller setpoint to a final target at a predefined rate where it is held for a specified time. This strategy is typically used to control temperature where temperature is "ramped" (increased or decreased) at a predefined rate, and once reaching the target temperature the setpoint is "soaked" (held at temperature for a specified time). The RMPS control strategy can be used to manage multiple segments of alternating ramp and soak periods.

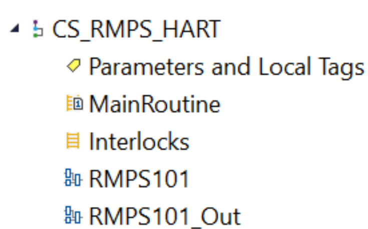
The RMPS control strategy is available as two routines in the process library:

Routine	Description
RMPS100	Ramp/Soak instruction
RMPS100_Out	Ramp/Soak instruction with analog output



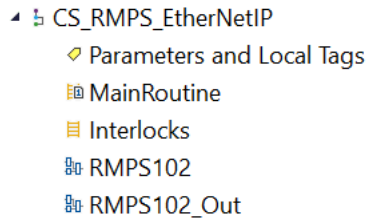
The RMPS HART control strategy is available as two routines in the process library:

Routine	Description
RMPS101	HART Ramp/Soak instruction
RMPS101_Out	HART Ramp/Soak instruction with analog output



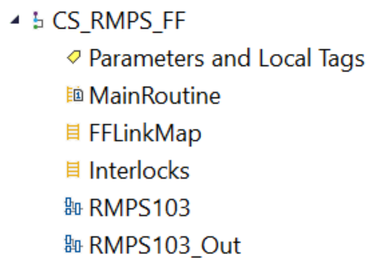
The RMPS EtherNet/IP™ control strategy is available as two routines in the process library:

Routine	Description
RMPS102	EtherNet/IP Ramp/Soak instruction
RMPS102_Out	EtherNet/IP Ramp/Soak instruction with analog output

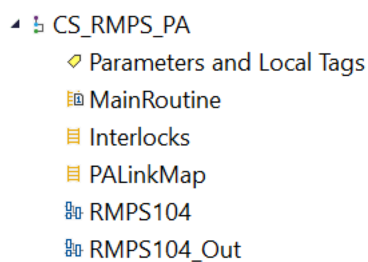


The RMPS Foundation Feildbus control strategy is available as two routines in the process library:

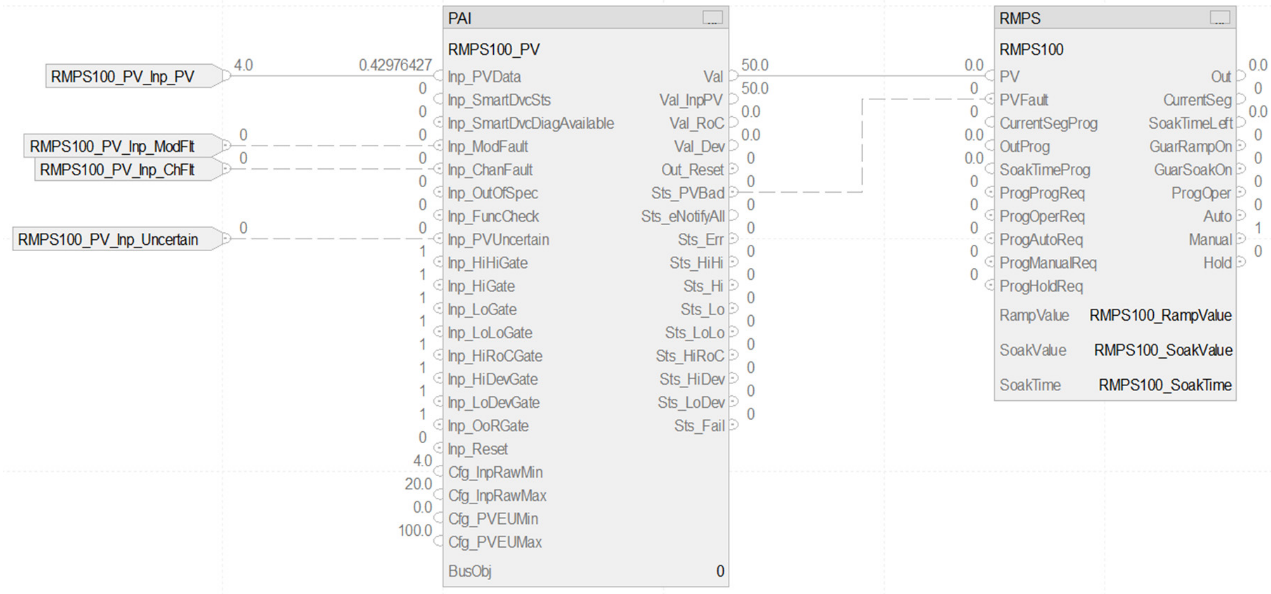
Routine	Description
RMPS103	FOUNDATION Fieldbus Ramp/Soak instruction
RMPS103_Out	FOUNDATION Fieldbus Ramp/Soak instruction with analog output



Routine	Description
RMPS104	Profibus PA Ramp/Soak instruction
RMPS104_Out	Profibus PA Ramp/Soak instruction with analog output



CS_RMPS Sheet



PAI Input References

See CS_PAI Sheet on page 110 for details.

PAI Outputs to RMPS Inputs

Parameter	Description
Val	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.
Sts_PVBad	Quality of PV value 1 = PV quality is flagged as Bad

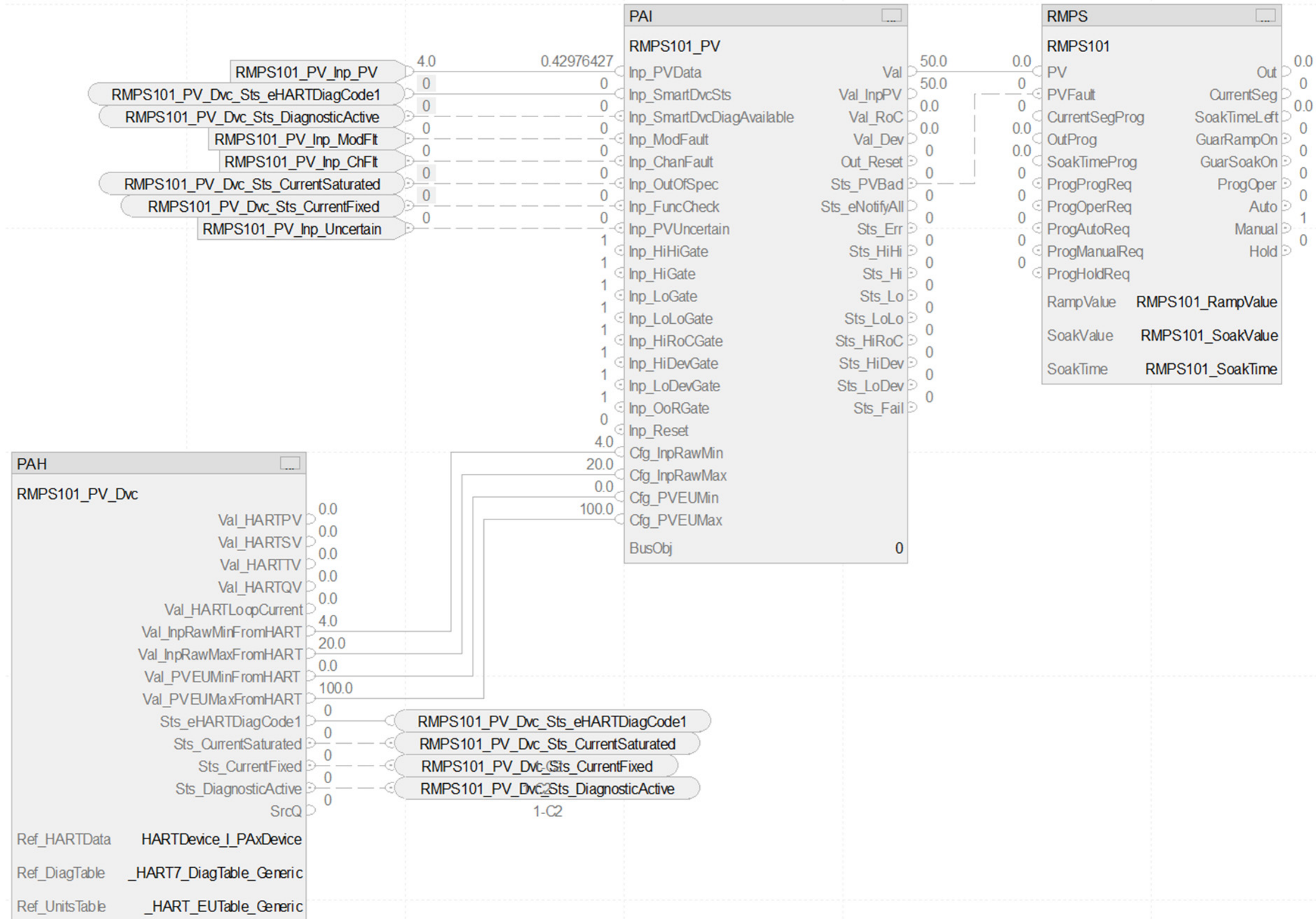
RMPS Output Reference

Parameter	Description
RMPS100_Out	The output of the ramp/soak instruction

RMPS Configuration Considerations

Operand	Type	Description
RMPS Tag	RAMP_SOAK	Instance of data structure (backing tag) required for proper operation of instruction. RMPS100 in this example corresponds to an instance of coordinating ramp/soak segments.
RampValue	REAL array	Enter a ramp value for each segment (0 to NumberOfSegs-1). Ramp values are entered as time in minutes or as a rate in units/minute. The TimeRate parameter reflects which method is used to specify the ramp. If a ramp value is invalid, the instruction sets the appropriate bit in Status and changes to Operator Manual or Program Hold mode. The array must be at least as large as NumberOfSegs. Valid = 0.0 to maximum positive float
SoakValue	REAL array	Enter a soak value for each segment (0 to NumberOfSegs-1). The array must be at least as large as NumberOfSegs. Valid = any float
SoakTime	REAL array	Enter a soak time for each segment (0 to NumberOfSegs-1). Soak times are entered in minutes. If a soak value is invalid, the instruction sets the appropriate bit in Status and changes to Operator Manual or Program Hold mode. The array must be at least as large as NumberOfSegs.

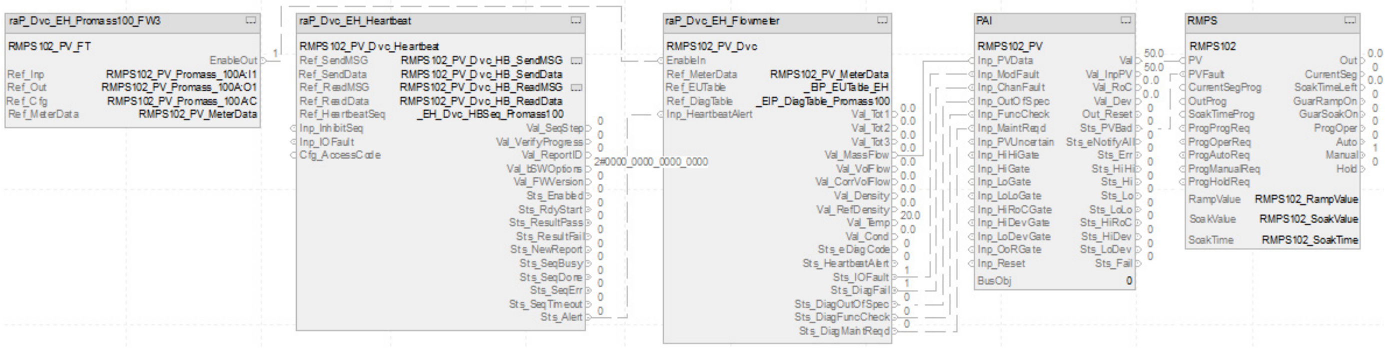
CS_RMPS_HART Sheet



The CS_RMPS_HART control strategy operates the same as the CS_RMPS control strategy but relies on HART input data.

- For information on PAH outputs to PAI inputs, see CS_PAI_HART Sheet on page 111.
- Substitute for RMPS101 for XT100
- For more information, see HART Integration on page 31.

CS_RMPS_EtherNetIP Sheet

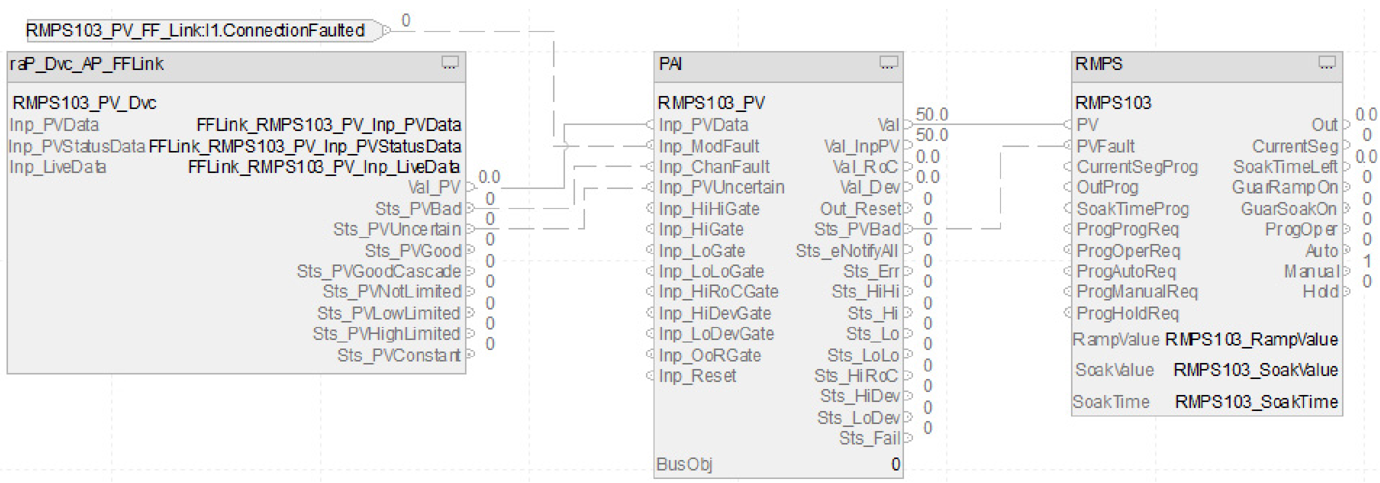


The CS_RMPS_EtherNetIP control strategy operates the same as the CS_RMPS control strategy but relies on EtherNet/IP input data.

- For information on EtherNet/IP device outputs to PAI inputs, see CS_PAI_EtherNetIP Sheet on page 113.
- Substitute for RMPS102 for XT100

For more information, see EtherNet/IP Integration on page 55.

CS_RMPS_FF Sheet

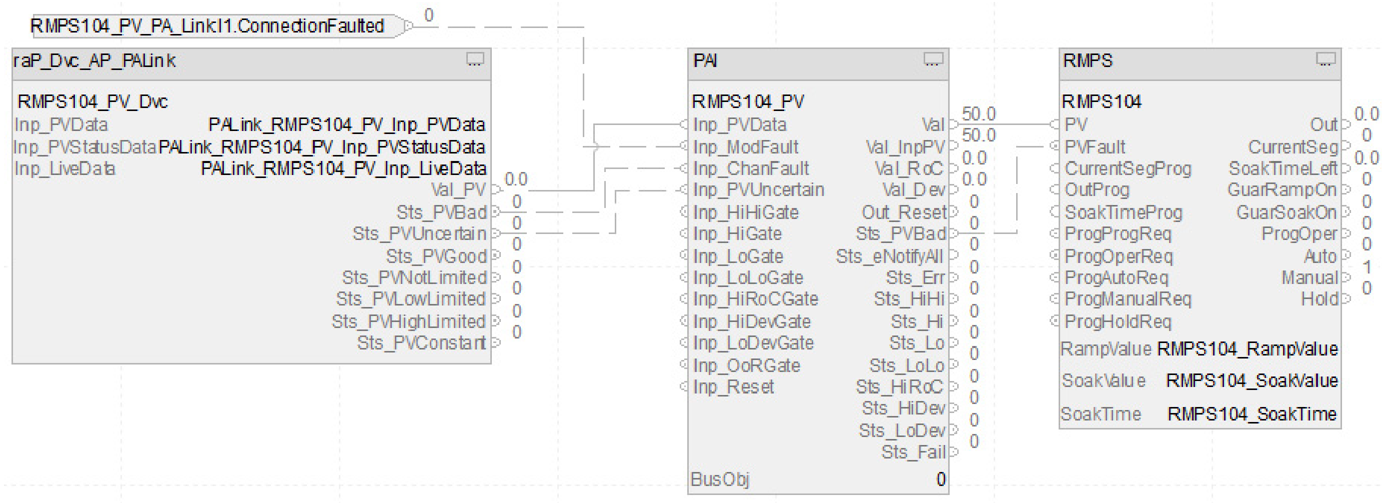


The CS_RMPS_FF control strategy operates the same as the CS_RMPS control strategy but relies on Foundation Fieldbus input data.

- FFor information on Foundation Fieldbus device outputs to PAI inputs, see CS_PAI_FF Sheet on page 117.
- Substitute for RMPS103 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

CS_RMPS_PA Sheet



The CS_RMPS_PA control strategy operates the same as the CS_RMPS control strategy but relies on Profibus PA input data.

- For information on Profibus PA device outputs to PAI inputs, see CS_PAI_PA Sheet on page 118.
- Substitute for RMPS104 for XT100

For more information, see FOUNDATION Fieldbus and Profibus PA Integration on page 69.

Chapter 40

Process Area Control Strategy

The Process Area Add-On Instruction groups Units together, aggregates status from Unit objects, and broadcasts commands to Unit objects.

You can consolidate the status from groups of equipment, and display the consolidated status on an HMI. These status items include:

- Alarm Status
- Alarm Severity
- Mode
- Configuration Errors
- Prompt Status

You can also manage any of the following functions for a group of equipment with a global set of commands:

- Mode
- Alarm Acknowledge
- Alarm Reset
- Enable/Disable Alarms

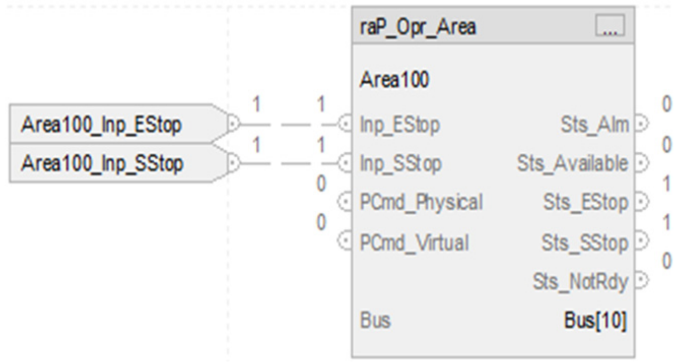
The CS_raP_Opr_Area control strategy is available as a routine in the process library. Import the appropriate control strategy as a **routine** in your controller project.

The Process Area control strategy contains these routines:

Routine	Description
Area100	Function Block control strategy routine.
ExtddAlarms	Contains instances of external alarms and trigger logic.

CS_raP_Opr_Area Sheet

The Area100 routine contains the CS_raP_Opr_Area sheet.



CS_raP_Opr_Area Input Reference

Parameter	Description
Area100_Inp_EStop	1 = Emergency stop input ok.
Area100_Inp_SStop	1 = Software stop input ok.

CS_raP_Opr_Area Configuration Considerations

Operand	Type	Description
PlantPAx® control	raP_Opr_Area	Instance of data structure (backing tag) required for proper operation of instruction
Bus	raP_UDT_Opr_Bus	Bus component for organization control 0 if not using organization Bus[x].Obj when using organization See the Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM200.

Extended Alarms Routine

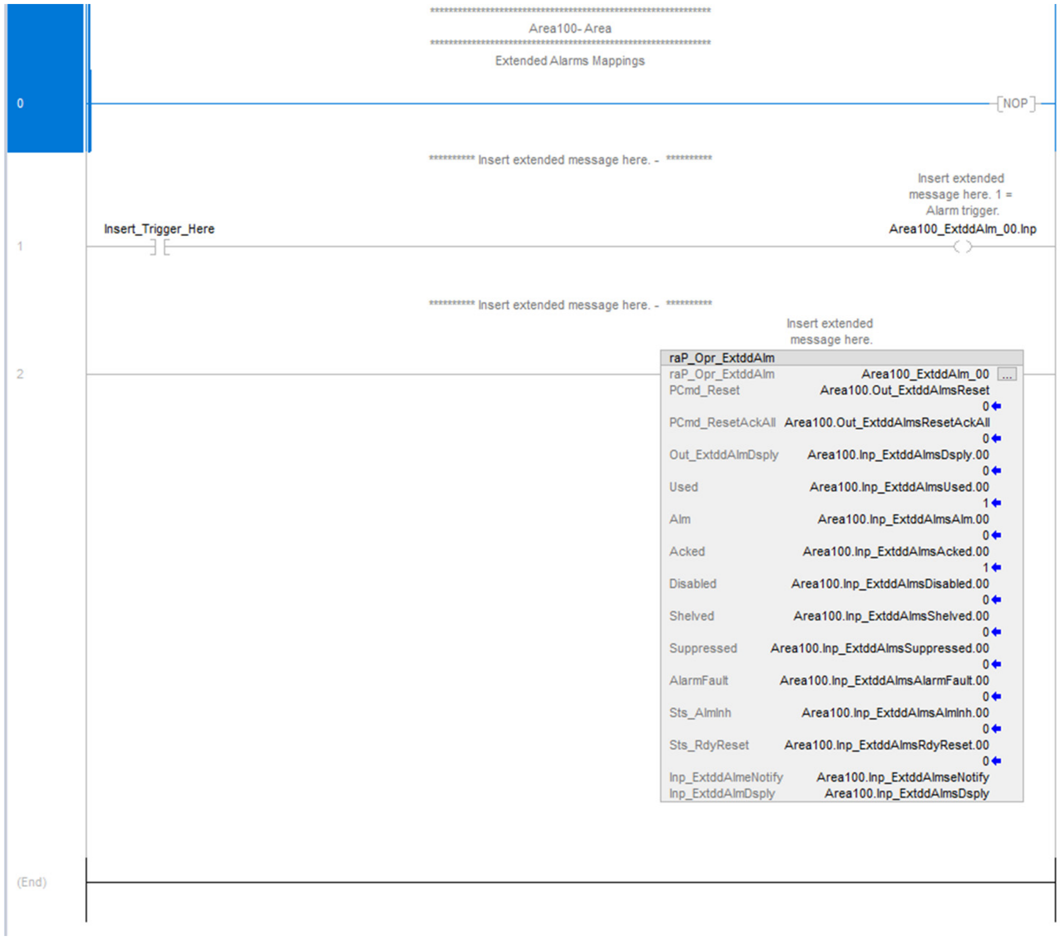
The raP_Opr_ExtddAlm (Extended Alarm Block) Add-On Instruction is used to provide notification to operators of abnormal conditions or events for up to 32 additional items external to a parent object. For more information, see the Rockwell Automation Library of Process Objects, publication PROCES-RM200.

This instruction handles these connections.

Commands from the Parent Object	Status from raP_Opr_ExtddAlm
• Acknowledge • Reset • Enabling/Disabling • Suppress/Unsuppress • UnShelve	• Used • Alarm • Acknowledged • Disabled • Suppressed • Shelved • Alarm Fault • Ready for Reset • Notify value

raP_Opr_ExtddAlm Parameters

Parameter	Description
PCmd_Reset	Program command to reset alarm request.
PCmd_ResetAckAll	Program command to reset and acknowledges all alarms. The instruction clears this operand automatically.
Out_ExtddAlmDsply	1 = Extended alarm severity value is greatest of all extended alarms active. Each bit represents an individual alarm (0…31).
Used	1 = Used.
Alm	1 = Alarm is active.
Acked	1 = In alarm acknowledged.
Disabled	1 = Alarm disabled.
Shelved	1 = Alarm shelved.
Suppressed	1 = Alarm suppressed.
AlarmFault	1 = Alarm fault.
Sts_AlmInh	1 = One or more alarms shelved, disabled, or suppressed.
Sts_Rdy_Reset	1 = A latched alarm condition is ready to be reset.
Inp_ExtddAlmeNotify	Extended alarms status enumerate values: 0 = Not in alarm 1 = Not in alarm unacknowledged or reset requires 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_ExtddAlmDsply	1 = Extended alarm severity value is greatest of all extended alarms active. Each bit represents an individual alarm (0…31).



Area100- Area
Extended Alarms Mappings
0
NOP
********** Insert extended message here. - **********
Insert extended message here. 1 = Alarm trigger.
Insert_Trigger_Here
1
Area100_ExtddAlm_00.Inp
********** Insert extended message here. - **********
Insert extended message here.
2
raP_Opr_ExtddAlm
raP_Opr_ExtddAlm Area100_ExtddAlm_00
PCmd_Reset Area100.Out_ExtddAlmsReset
0
PCmd_ResetAckAll Area100.Out_ExtddAlmsResetAckAll
0
Out_ExtddAlmDsply Area100.Inp_ExtddAlmsDsply.00
0
Used Area100.Inp_ExtddAlmsUsed.00
1
Alm Area100.Inp_ExtddAlmsAlm.00
0
Acked Area100.Inp_ExtddAlmsAcked.00
1
Disabled Area100.Inp_ExtddAlmsDisabled.00
0
Shelved Area100.Inp_ExtddAlmsShelved.00
0
Suppressed Area100.Inp_ExtddAlmsSuppressed.00
0
AlarmFault Area100.Inp_ExtddAlmsAlarmFault.00
0
Sts_AlmInh Area100.Inp_ExtddAlmsAlmInh.00
0
Sts_RdyReset Area100.Inp_ExtddAlmsRdyReset.00
0
Inp_ExtddAlmeNotify Area100.Inp_ExtddAlmseNotify
Inp_ExtddAlmDsply Area100.Inp_ExtddAlmsDsply
(End)

Generic Equipment Module (EMGEN) Control Strategy

An equipment module is a functional group of equipment that can carry out a finite number of specific minor processing activities. An equipment module is typically centered around a piece of process equipment (a weigh tank, a process heater, a scrubber, etc.). This term applies to both the physical equipment and the equipment entity.

The CS_raP_Opr_EMGen control strategy controls an Equipment Module in a variety of modes and monitors for fault conditions.

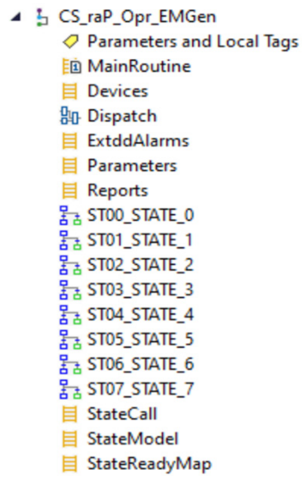
Use this control strategy when:

- You want to group equipment, and you want to apply a custom state model.
- You want to provide the following for a group of equipment:
  - Apply a mode model to the equipment group.
  - Definable Commands and states.
  - Apply interlocks and/or permissives to the group of equipment.
  - Parameters that define the behavior of the group of equipment.
  - Report resultant data from the group of equipment.
  - A faceplate that allows monitoring and control of the equipment grouping.
  - Alarm if any device fails.
  - Monitor step (description), and allow forcing of steps in maintenance mode.
  - Allow configurable alarms for certain process / equipment failure conditions.

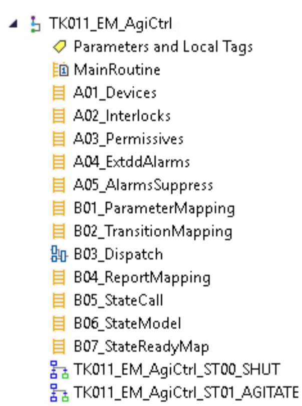
Do NOT use this control strategy when:

- You need to sequence / coordinate a device, and do not require any of the above.
- You want to apply an ISA 88.01 state model to the equipment, use the CS_raP_Opr_EPGen_PHASE control strategy instead.
- You want to apply the PackML state model.

The EMGEN control strategy is available as a program in the process library:



Import the appropriate control strategy as a **program** in your controller project.

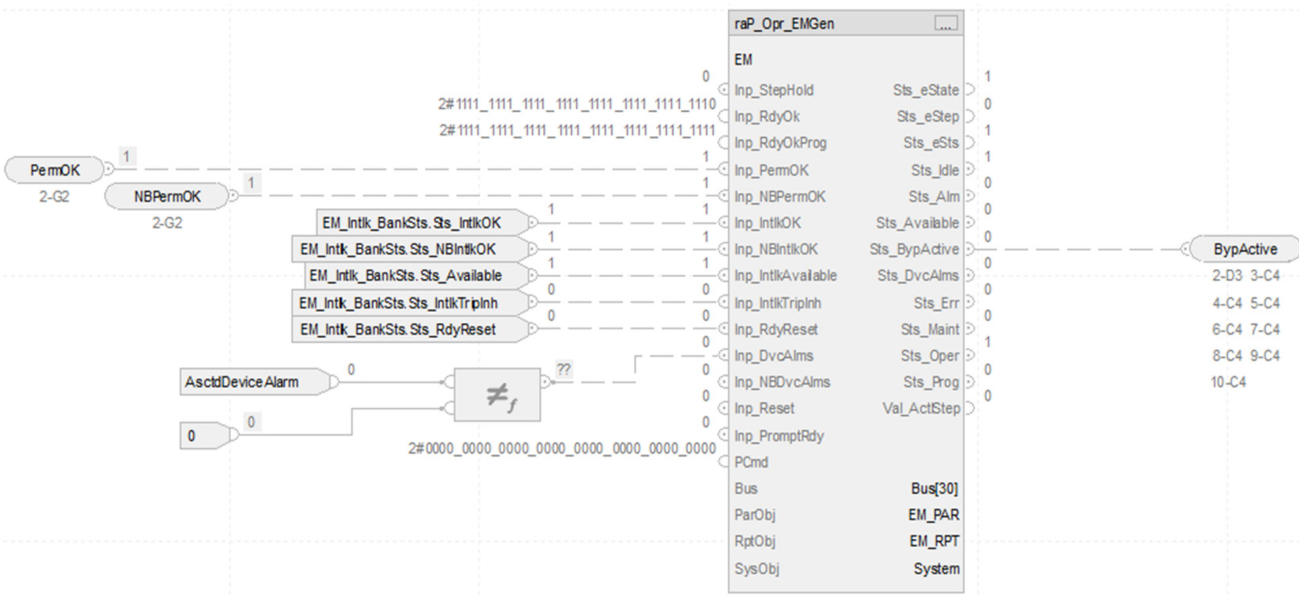
Routine	Description
Devices	Status of devices. Add logic appropriate to your application.
Dispatch	Contains raP_Opr_EMGen Add-On Instruction.
ExtddAlarms	Contains instances of external alarms and trigger logic.
Parameters	Contains raP_Opr_EMGen parameter mapping to and from Parameter blocks [_ParRpt (Enum, Integer, Real, String)] to raP_Opr_EMGen instance.
Reports	Contains raP_Opr_EMGen report mapping to and from Parameter blocks [_ParRpt (Enum, Integer, Real, String))] to raP_Opr_EMGen instance.
ST00_STATE_0…31	32 available user-defined routines that contain logic which sequences and coordinates devices (implement states as required). You can rename these routines for your project. 
StateCall	Calls the routine for the associated state when that state is active.
StateModel	Sets which state is active based upon the state request for that state and any other required conditions.
StateReadyMap	Equipment Module StateReadyMap Routine - Defines when each Equipment Module State is Available for both selection by the HMI and selection by Controller Logic. For each state number, 0 to 31: • EM.Inp_RdyOk.0 to 31 needs to be true for that state to be available to select from the HMI • EM.Inp_RdyOkProg.0 to 31 needs to be true for that state to be available to enter via Program Commands

Dispatch Routine

The Dispatch routine contains these Function Block sheets:

Sheet	Description
EMGEN100	Equipment Module Add-On Instruction
Permissives	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The instruction monitors by passable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.

Dispatch EPGEN100 Sheet



raP_Opr_EMGen Input References

Parameter	Description
PermOK	Input connection from Permissives sheet 0 (State 1) 1 = On permissives OK, device can turn On
NBPermOK	Input connection from Permissives sheet 0 (State 1) 1 = Non-bypassable On permissives OK, device can turn On
EM_Intlk_BankSts.Sts_IntlkOK	Interlock bank status 1 = OK to run 0 = Stop
EM_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status 1 = All non-bypassable interlocks OK to run
EM_Intlk_BankSts.Sts_Available	Interlock bank status 1 = Available
EM_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
EM_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset
AsctdDeviceAlarm	Associated Device Alarm Active if any Bits are Logic 1

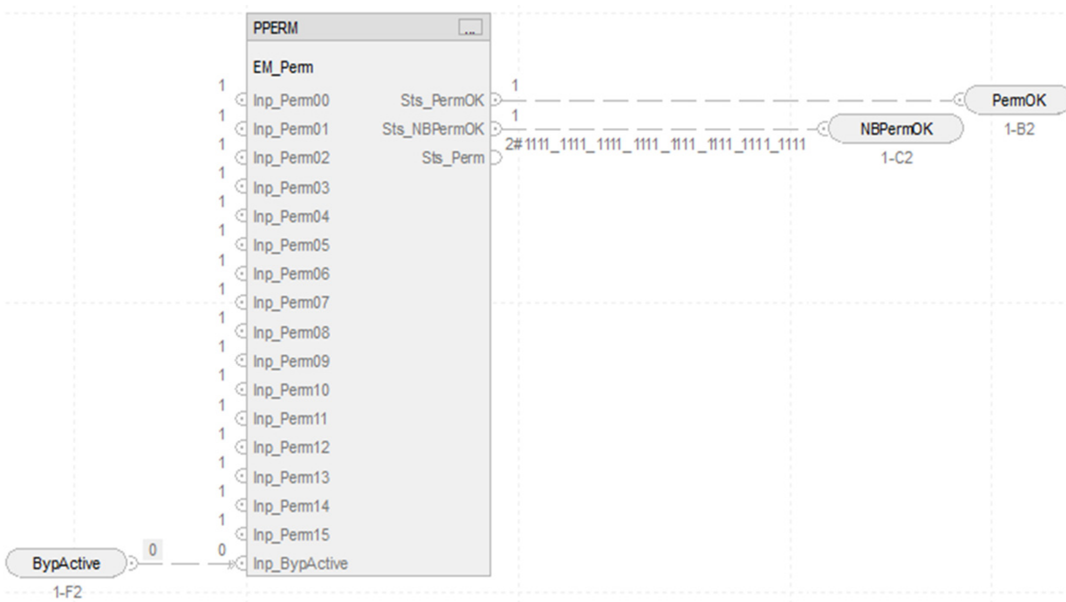
raP_Opr_EMGen Output References

Parameter	Description
BypActive	Output connection to permissives and interlock bank sheets

raP_Opr_EMGen Configuration Considerations

Operand	Type	Description
PlantPAx® control	raP_Opr_EMGen	Instance of data structure (backing tag) required for proper operation of instruction
Bus	raP_UDT_Opr_Bus	Bus component
ParObj	raP_UDT_Opr_ParRpt_Intfc	Optional parameter object interface. Link to routine
RptObj	raP_UDT_Opr_ParRpt_Intfc	Optional report object interface. Link to routine
SysObj	raP_UDT_Opr_System	System component.

Dispatch Permissive Sheet



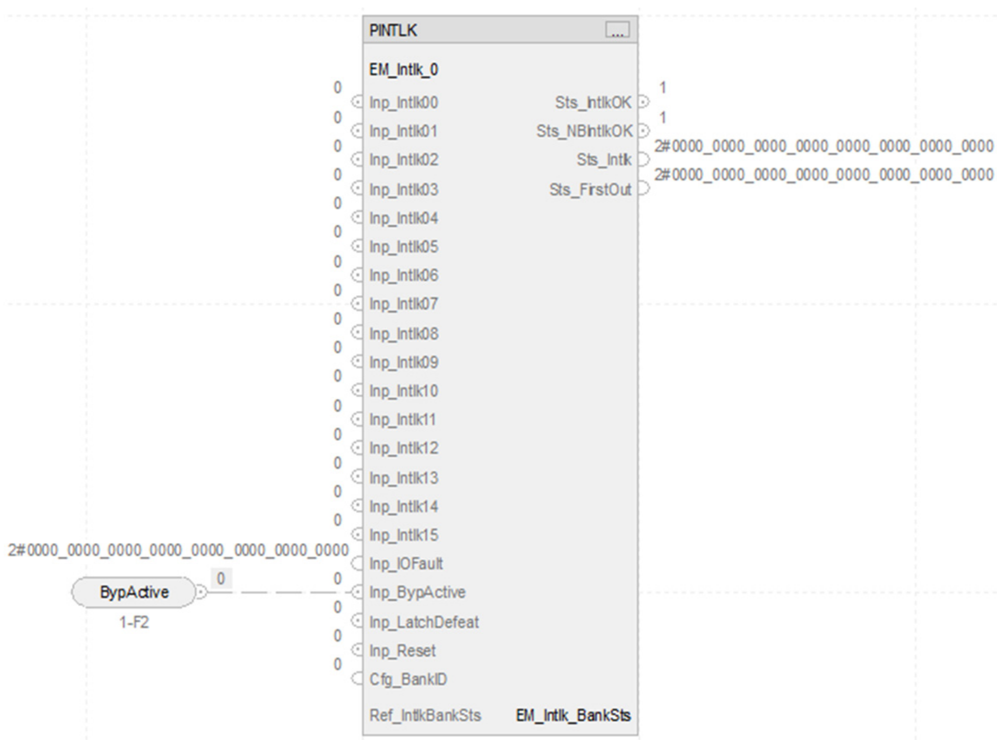
PPERM Input References

Parameter	Description
BypActive	Input connection from the EPGEN100 sheet

PPERM Output References

Parameter	Description
PermOK	Overall permissive status (1 = OK to energize)
NBPermOK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Dispatch Interlock Bank Sheet



PINTLK Input Reference

Parameter	Description
BypActive	Input connection from the CS_D4SD sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx® control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

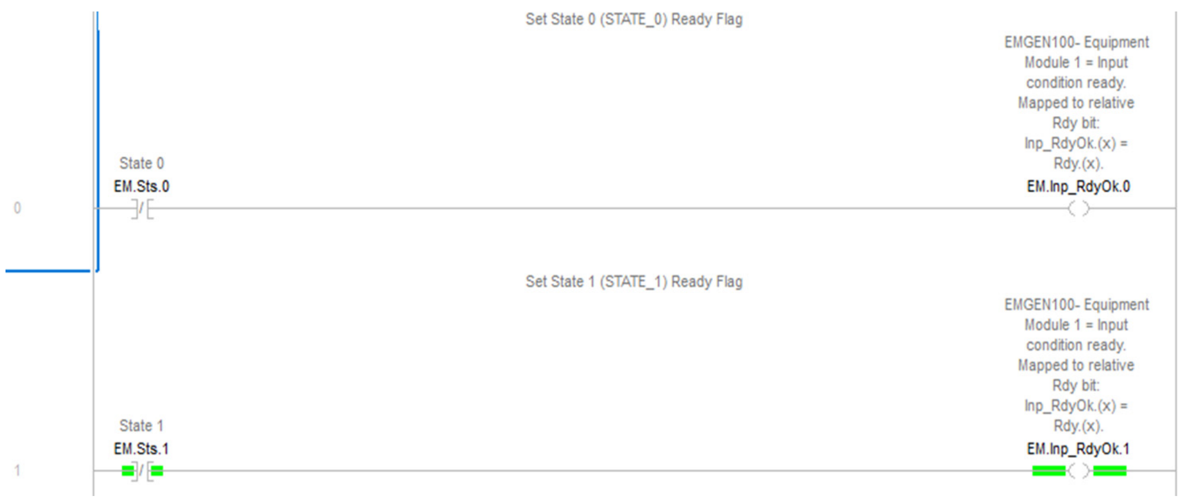
For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

State Routine Example

StateCall Routine Example

StateModel Routine Example

StateReadyMap Routine Example



Extended Alarms Routine

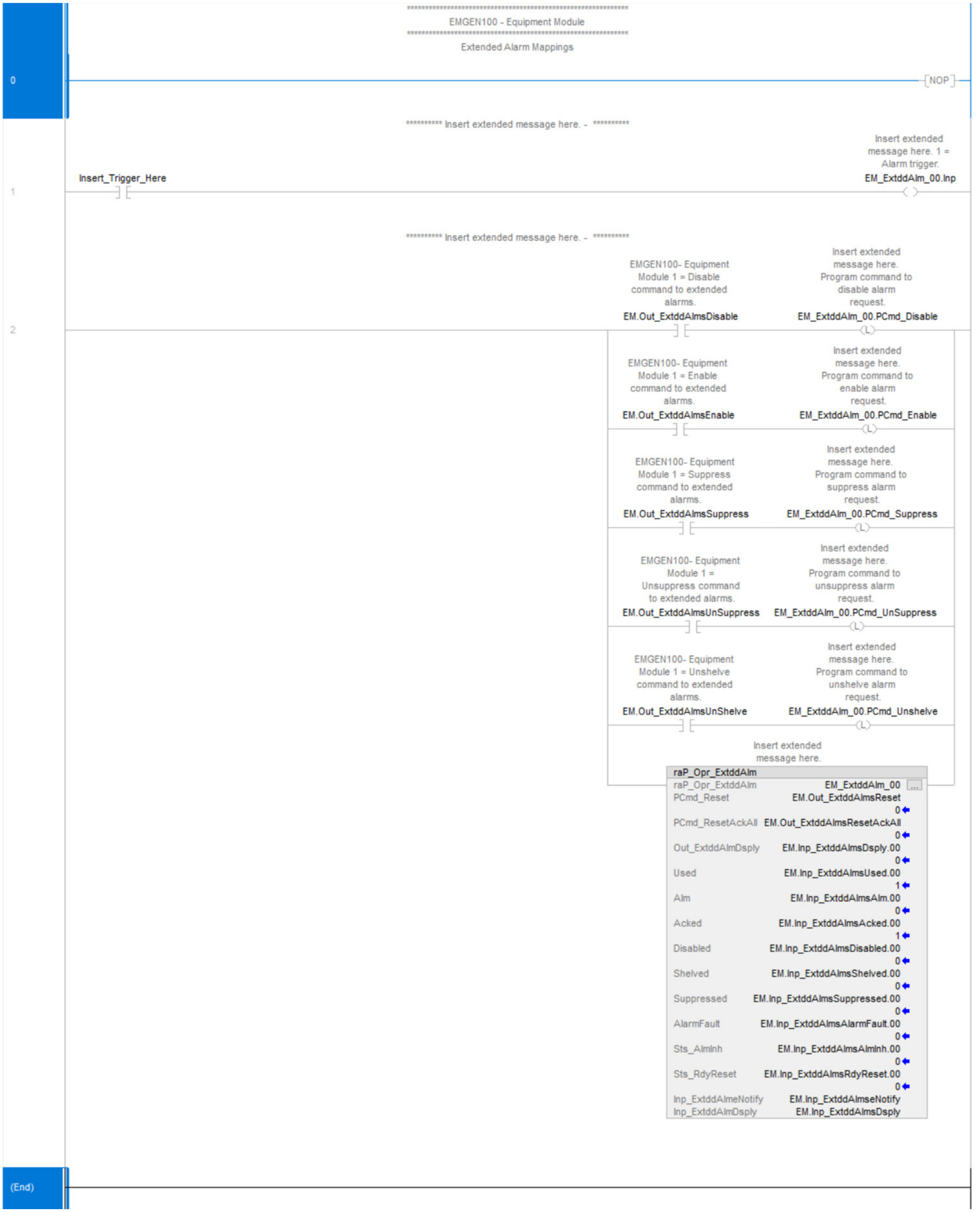
The raP_Opr_ExtddAlm (Extended Alarm Block) Add-On Instruction is used to provide notification to operators of abnormal conditions or events for up to 32 additional items external to a parent object. For more information, see the Rockwell Automation Library of Process Objects, publication PROCES-RM200.

This instruction handles these connections.

Commands from the Parent Object	Status from raP_Opr_ExtddAlm
• Acknowledge • Reset • Enabling/Disabling • Suppress/Unsuppress • UnShelve	• Used • Alarm • Acknowledged • Disabled • Suppressed • Shelved • Alarm Fault • Ready for Reset • Notify value

raP_Opr_ExtddAlm Parameters

Parameter	Description
PCmd_Reset	Program command to reset alarm request.
PCmd_ResetAckAll	Program command to reset and acknowledges all alarms. The instruction clears this operand automatically.
Out_ExtddAlmDsply	1 = Extended alarm severity value is greatest of all extended alarms active. Each bit represents an individual alarm (0…31).
Used	1 = Used.
Alm	1 = Alarm is active.
Acked	1 = In alarm acknowledged.
Disabled	1 = Alarm disabled.
Shelved	1 = Alarm shelved.
Suppressed	1 = Alarm suppressed.
AlarmFault	1 = Alarm fault.
Sts_AlmInh	1 = One or more alarms shelved, disabled, or suppressed.
Sts_Rdy_Reset	1 = A latched alarm condition is ready to be reset.
Inp_ExtddAlmeNotify	Extended alarms status enumerate values: 0 = Not in alarm 1 = Not in alarm unacknowledged or reset requires 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_ExtddAlmDsply	1 = Extended alarm severity value is greatest of all extended alarms active. Each bit represents an individual alarm (0…31).



EMGEN100 - Equipment Module
Extended Alarm Mappings
0
NOP
********** Insert extended message here. - **********
1
Insert_Trigger_Here
Insert extended message here. 1 = Alarm trigger.
EM_ExtddAlm_00.Inp
********** Insert extended message here. - **********
2
EMGEN100- Equipment Module 1 = Disable command to extended alarms.
EM.Out_ExtddAlmsDisable
Insert extended message here. Program command to disable alarm request.
EM_ExtddAlm_00.PCmd_Disable
EMGEN100- Equipment Module 1 = Enable command to extended alarms.
EM.Out_ExtddAlmsEnable
Insert extended message here. Program command to enable alarm request.
EM_ExtddAlm_00.PCmd_Enable
EMGEN100- Equipment Module 1 = Suppress command to extended alarms.
EM.Out_ExtddAlmsSuppress
Insert extended message here. Program command to suppress alarm request.
EM_ExtddAlm_00.PCmd_Suppress
EMGEN100- Equipment Module 1 = Unsuppress command to extended alarms.
EM.Out_ExtddAlmsUnSuppress
Insert extended message here. Program command to unsuppress alarm request.
EM_ExtddAlm_00.PCmd_UnSuppress
EMGEN100- Equipment Module 1 = Unshelve command to extended alarms.
EM.Out_ExtddAlmsUnShelve
Insert extended message here. Program command to unshelve alarm request.
EM_ExtddAlm_00.PCmd_Unshelve
Insert extended message here.
raP_Opr_ExtddAlm
raP_Opr_ExtddAlm EM_ExtddAlm_00
PCmd_Reset EM.Out_ExtddAlmsReset 0
PCmd_ResetAckAll EM.Out_ExtddAlmsResetAckAll 0
Out_ExtddAlmDsply EM.Inp_ExtddAlmsDsply.00 0
Used EM.Inp_ExtddAlmsUsed.00 1
Alm EM.Inp_ExtddAlmsAlm.00 0
Acked EM.Inp_ExtddAlmsAcked.00 1
Disabled EM.Inp_ExtddAlmsDisabled.00 0
Shelved EM.Inp_ExtddAlmsShelved.00 0
Suppressed EM.Inp_ExtddAlmsSuppressed.00 0
AlarmFault EM.Inp_ExtddAlmsAlarmFault.00 0
Sts_AlmInh EM.Inp_ExtddAlmsAlmInh.00 0
Sts_RdyReset EM.Inp_ExtddAlmsRdyReset.00 0
Inp_ExtddAlmeNotify EM.Inp_ExtddAlmseNotify
Inp_ExtddAlmDsply EM.Inp_ExtddAlmsDsply
(End)

Parameters and Reports Routines

The raP_Tec_ParRpt Add-On Instruction is used to implement parameter data items. Use when:

- You need the ability to view or modify a parameter from either the HMI or from logic.
- You need to arbitrate parameter input based on mode.
- You need the ability to limit the value of a parameter, from either the HMI or logic.
- You need the ability to capture an initial parameter value (based on a trigger), and provide an indication if the parameter was adjusted from the initial value.
- You need to limit the adjustment of a parameter within a deadband relative to an initial value.
- You need to apply command confirmation (i.e. Electronic Signature) to parameter entry from the HMI.
- Your parameter is read only or read/write.
- Your need a Parameter (recipe) or Report (resultant) parameter.
- Your parameter is of data type: Integer, Real, String, or is an Enumeration.

For more information, see the Rockwell Automation Library of Process Objects, publication PROCES-RM200.

raP_Tec_ParRpt References

Parameter	Description
PSet_E	Program issued setting of enumeration parameter value.
PSet_I	Program issued setting of integer parameter value.
PSet_R	Program issued setting of real parameter value.
PSet_S	Program issued setting of string parameter value.

raP_Tec_ParRpt Configuration Considerations

Operand	Type	Description
ParObj	raP_UDT_Opr_ParRpt_INTfC	Parameter object link to equipment
RptObj	raP_UDT_Opr_ParRpt_INTfC	Report object link to equipment

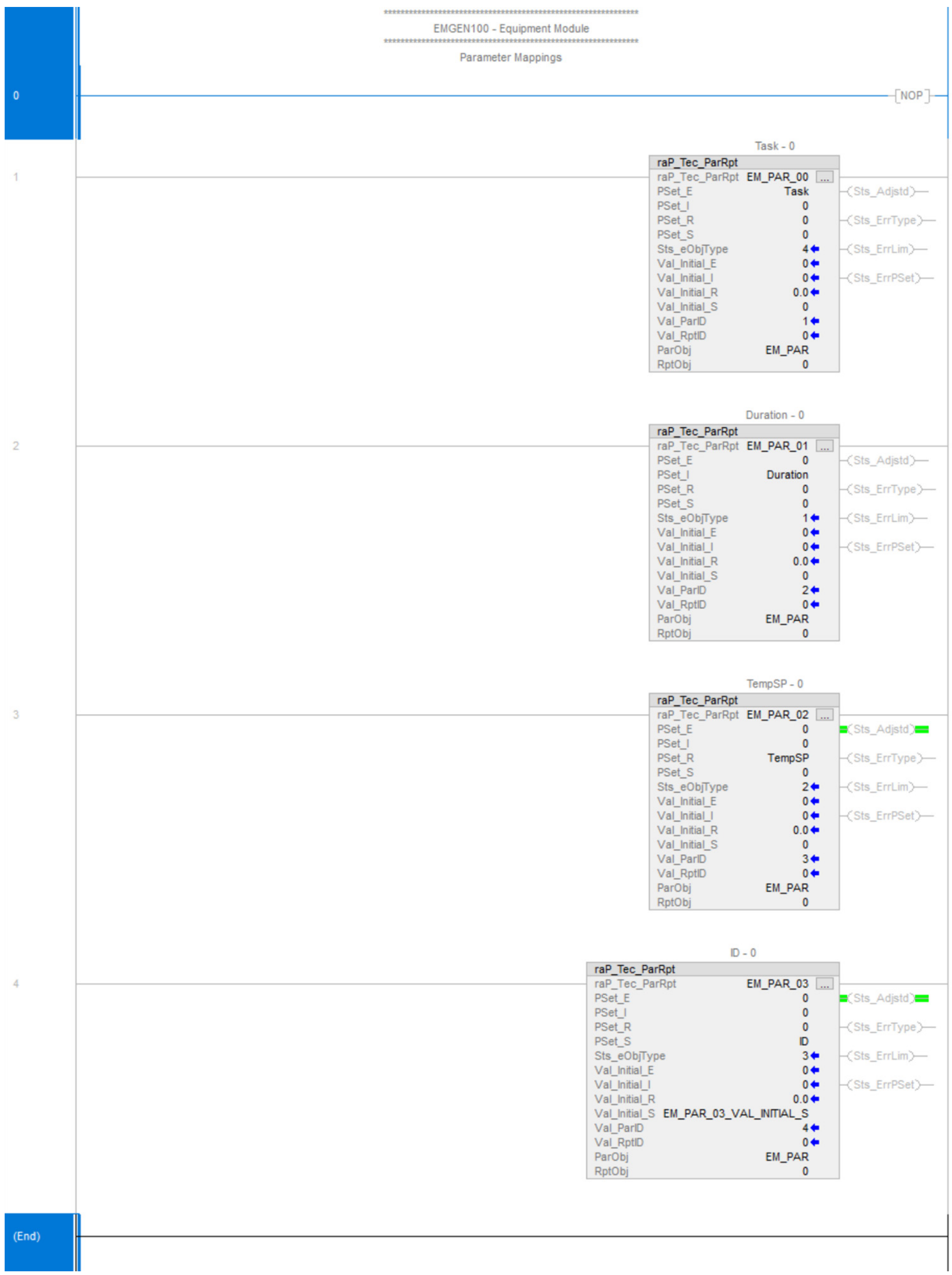
IMPORTANT You cannot set both ParObj and RptObj in the same Add-On Instruction.
- If you set ParObj, then RptObj must be zero.
- If you set RptObj, then ParObj must be zero.

CS_raP_Opr_EMGen Parameters Routine

Maps Parameters from tags (input) to the standard EM_GEN parameter structure. The steps required to create this mapping logic are as follows:

1. First determine the parameters needed for your Equipment Module, and ensure the associated tags (input) are defined within your program.
2. Open the CS_raP_Opr_EMGen Parameters Routine.
3. Starting at parameter zero (EM_Par_00), determine the type of parameter block required (Enumeration, Integer, Real, or String).
4. Modify the rest of the reports routine as needed.

Typically the PSet variable in the instruction would represent the parameter tag (as defined in the program tags). For each additional Parameter required, increment the EM_Par_## number. Up to a maximum of 48 reports can be included per EM_GEN.

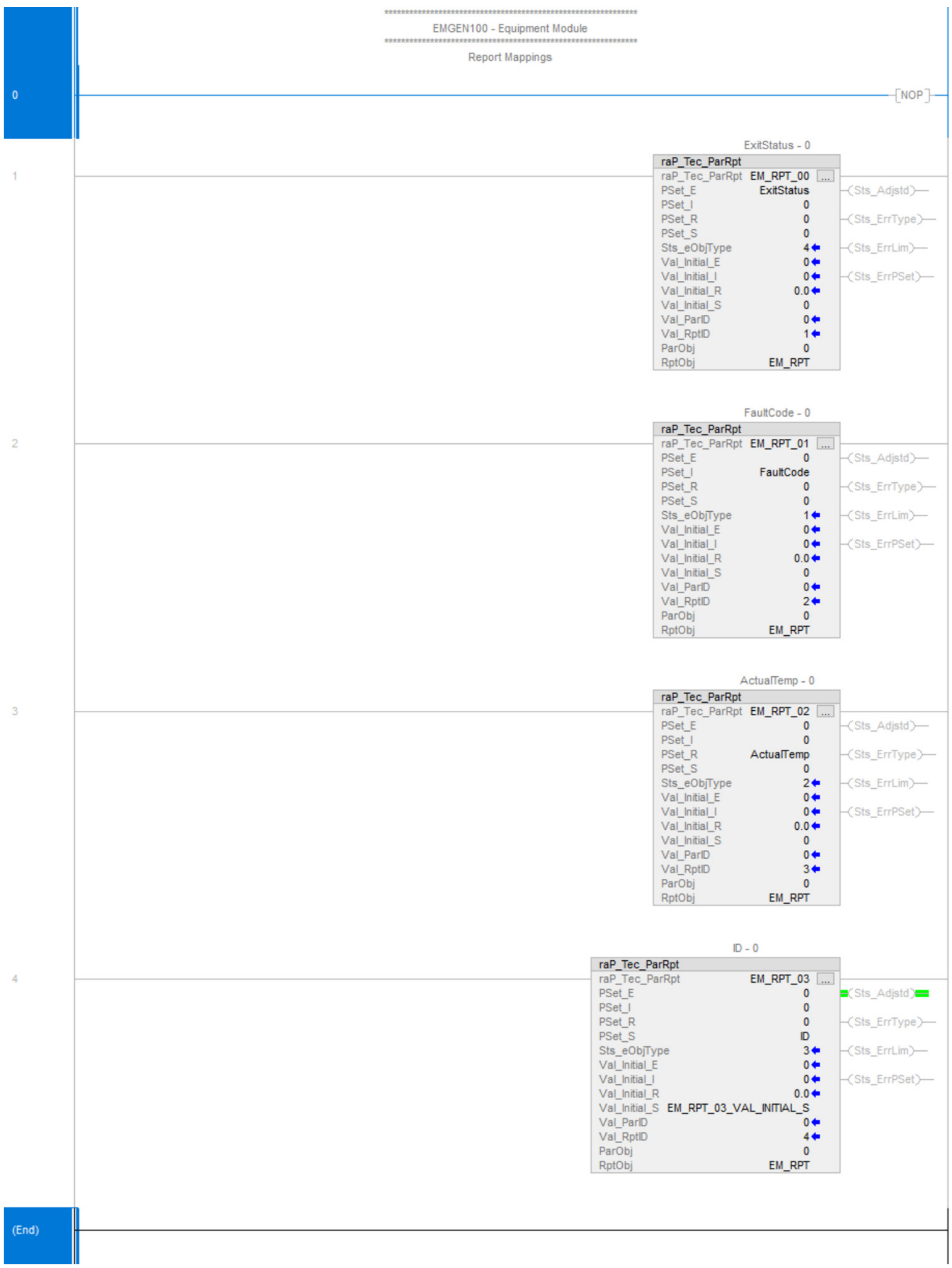


CS_raP_Opr_EMGen Reports Routine

Maps Resultant/Report data to output tags from the standard EM_GEN report structure. The steps required to create this mapping logic are as follows:

1. First determine the report data items needed for your Equipment Module, and make sure the associated tags (output) are defined within your program.
2. Open the CS_raP_Opr_EMGen Reports Routine.
3. Starting at report zero (EM_RPT_00), determine the type of parameter block required (Enumeration, Integer, Real, or String).
4. Modify the rest of the reports routine as needed.

Typically the PSet variable in the instruction would represent the parameter tag (as defined in the program tags). For each additional Parameter required increment the EM_RPT_0## number. Up to a maximum of 48 reports can be included per EM_GEN.



Notes:

Generic Equipment Phase (EPGEN) Control Strategy

An equipment phase is a functional group of equipment that can conduct a finite number of specific minor processing activities when directed by a phase (recipe).

The CS_raP_Opr_EPGen_PHASE control strategy controls an Equipment Phase in various modes and monitors for fault conditions.

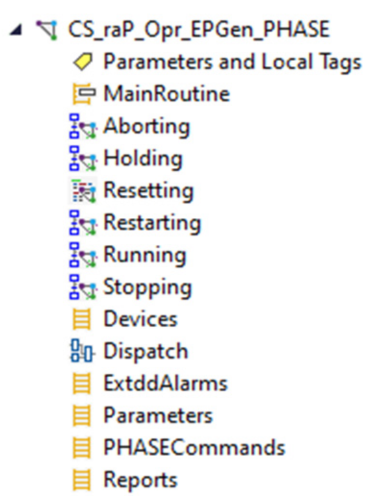
Use this control strategy when:

- You want to group equipment, and you want to apply the ISA 88.01 state model using PhaseManager™.
- You want to provide the following for a group of equipment.
  - Apply a mode model to the equipment group.
  - Apply interlocks and/or permissives to the group of equipment.
  - Parameters that define the behavior of the group of equipment.
  - Report resultant data from the group of equipment.
  - A faceplate that allows monitoring and control of the equipment grouping.
  - Monitor step (description), and allow forcing of steps in maintenance mode.
  - Allow alarms to be defined for certain process / equipment failure conditions.
  - Alarming function, including alarms based on device failure.

Do NOT use this control strategy when:

- You must sequence or coordinate a device, and do not require any of the above.
- You want to apply a custom state model to the equipment, use the CS_raP_Opr_EMGen control strategy instead.
- You want to apply the PackML state model.

The EPGEN control strategy is available as a program in the process library:



Import the appropriate control strategy as a **program** in your controller project.

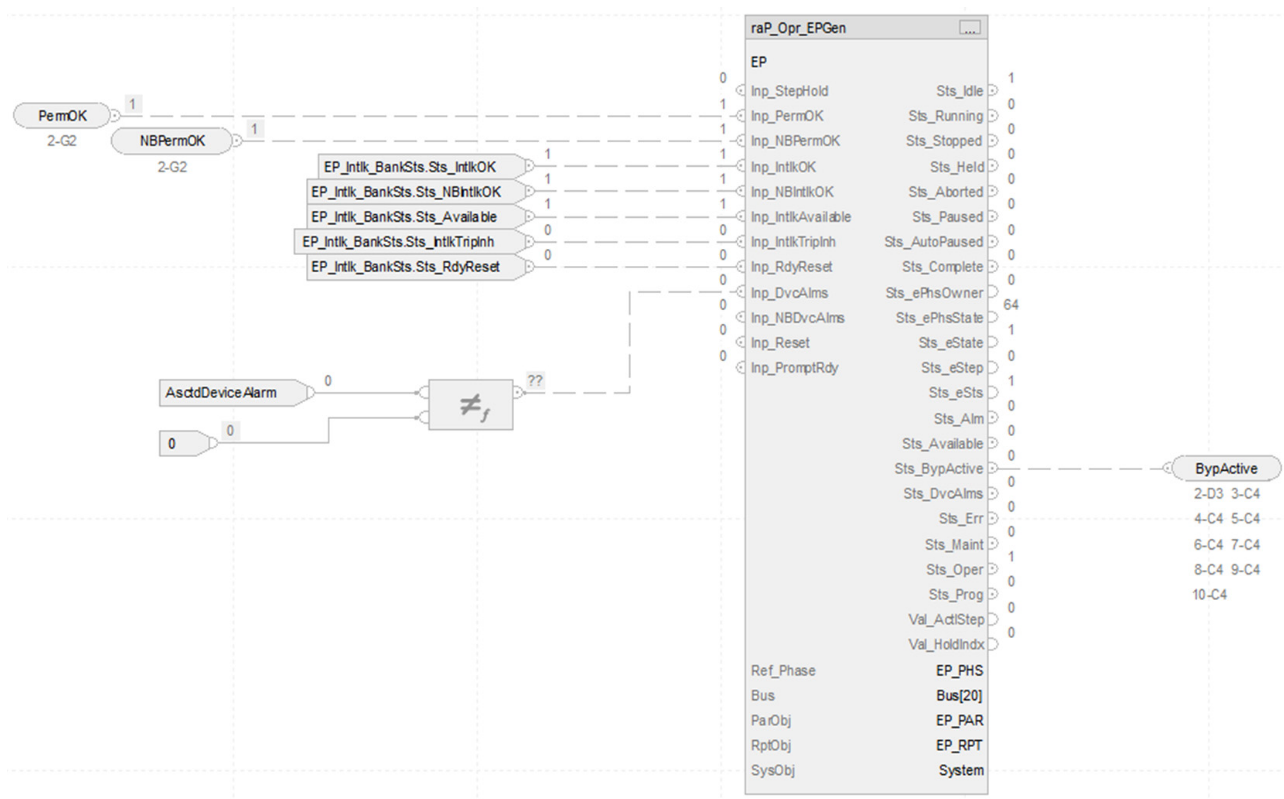
Routine	Description
Aborting	Used for shutting down equipment in an emergency situation. If you have implemented Stopping, you would at a minimum duplicate the stopping logic within Aborting. In some In some cases, the sequence in an emergency situation (Aborting) differs from the orderly shutdown of equipment (Stopping). Add logic appropriate to your application.
Holding	Used if equipment or a subset of equipment must be shut down when the phase enters the hold state. It can also be advantageous to release owned equipment if maintaining ownership while held constrains production by maintaining ownership of shared equipment. Add logic appropriate to your application.
Resetting	Used to perform "clean-up" activities such as release owned equipment. Add logic appropriate to your application.
Restarting	Generally implemented if Holding is implemented. Used to bring equipment from the state that it is in at the end of the Holding state back to the state it was in prior Holding. Add logic appropriate to your application.
Running	Use to start up equipment, and acquire ownership of equipment (if necessary). Add logic appropriate to your application.
Stopping	Use if equipment must be shut down in a given sequence.
Devices	Status of devices. Add logic appropriate to your application.
Dispatch	Contains the raP_Opr_EPGen Add-On Instruction.
ExtddAlarms	Contains instances of external alarms and trigger logic.
Parameters	Equipment Phase Parameters Routine - EP parameter mapping and logic
PHASECommands	Maps commands from EPGEN to PhaseManager commands
Report	Equipment Phase Reports Routine - EP Report mapping and logic

Dispatch Routine

The Dispatch routine contains these Function Block sheets:

Sheet	Description
EPGEN100	Equipment Phase Add-On Instruction
Permissives	Process Permissives instruction The Process Permissives (PPERM) instruction collects, or sums up, the permissive conditions that let a piece of equipment energize. In most cases, permissive conditions must be true to energize equipment. Once the equipment is energized, permissives are ignored.
Interlock Bank 0 Interlock Bank 1 Interlock Bank 2 Interlock Bank 3 Interlock Bank 4 Interlock Bank 5 Interlock Bank 6 Interlock Bank 7	The instruction monitors by passable and non-bypassable Interlocks that force the analog output to a specific configured (safe) value or to maintain the current value (configurable). There are 8 interlock bank sheets; each sheet exposes 16 of the available 32 interlocks per bank by default. Use the sheets and interlocks that you need and delete the remainder.

Dispatch EPGEN100 Sheet



raP_Opr_EPGen Input References

Parameter	Description
PermOK	Input connection from Permissives sheet 0 (State 1) 1 = On permissives OK, device can turn On
NBPermOK	Input connection from Permissives sheet 0 (State 1) 1 = Non-bypassable On permissives OK, device can turn On
EP_Intlk_BankSts.Sts_IntlkOK	Interlock bank status, 1 = OK to run, 0 = Stop
EP_Intlk_BankSts.Sts_NBIntlkOK	Interlock bank status, 1 = All non-bypassable interlocks OK to run
EP_Intlk_BankSts.Sts_Available	Interlock bank status, 1 = Available
EP_Intlk_BankSts.Sts_IntlkTripInh	Interlock bank status 1 = Interlock trip inhibit - stops equipment but does not trip
EP_Intlk_BankSts.Sts_RdyReset	Interlock bank status 1 = A latched interlock (returned to OK) is ready to be reset
AsctdDeviceAlarm	Associated Device Alarm Active if any Bits are Logic 1.

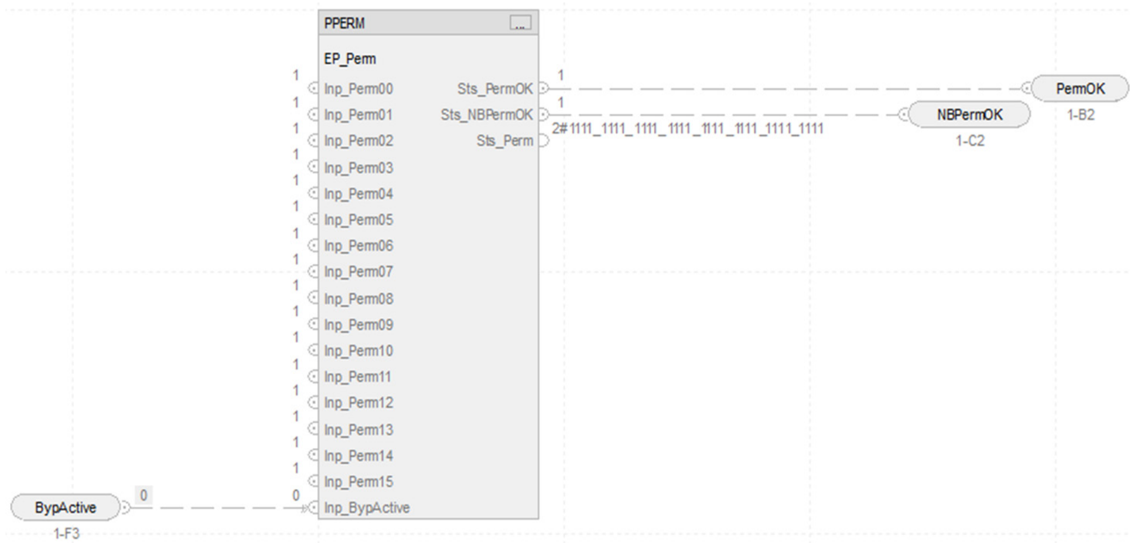
raP_Opr_EPGen Output References

Parameter	Description
BypActive	Output connection to permissives and interlock bank sheets

raP_Opr_EPGen Configuration Considerations

Operand	Type	Description
PlantPAx® control	raP_Opr_EPGen	Instance of data structure (backing tag) required for proper operation of instruction
Ref_Phase	PHASE	Referenced phase.
Bus	raP_UDT_Opr_Bus	Bus component
ParObj	raP_UDT_Opr_ParRpt_Intfc	Optional parameter object interface
RptObj	raP_UDT_Opr_ParRpt_Intfc	Optional report object interface
SysObj	raP_UDT_Opr_System	System component.

Dispatch Permissive Sheet



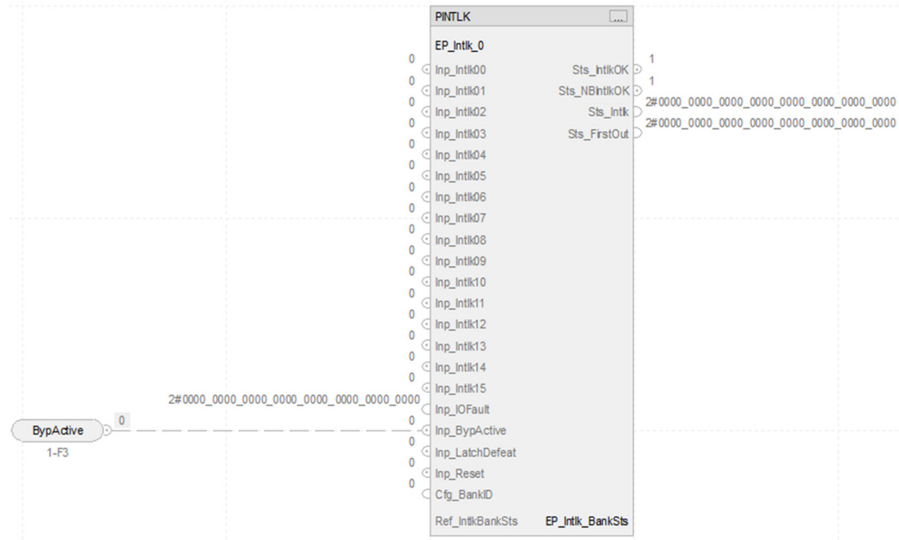
PPERM Input References

Parameter	Description
BypActive	Input connection from the EPGEN100 sheet

PPERM Output References

Parameter	Description
PermOK	Overall permissive status (1 = OK to energize)
NBPermOK	Non-bypassable permissive status (1 = all non-bypassable permissives OK to energize)

Dispatch Interlock Bank Sheet



PINTLK Input Reference

Parameter	Description
BypActive	Input connection from the CS_D4SD sheet

PINTLK Configuration Considerations

Operand	Type	Description
PlantPAx control	P_INTERLOCK	Instance of data structure (backing tag) required for proper operation of instruction
Ref_IntlkBankSts	P_INTERLOCK_BANK_STATUS	Reference interlock bank status

For more information about interlocks and how to configure multiple banks, see Interlock Options on page 27.

PHASECommands Routine

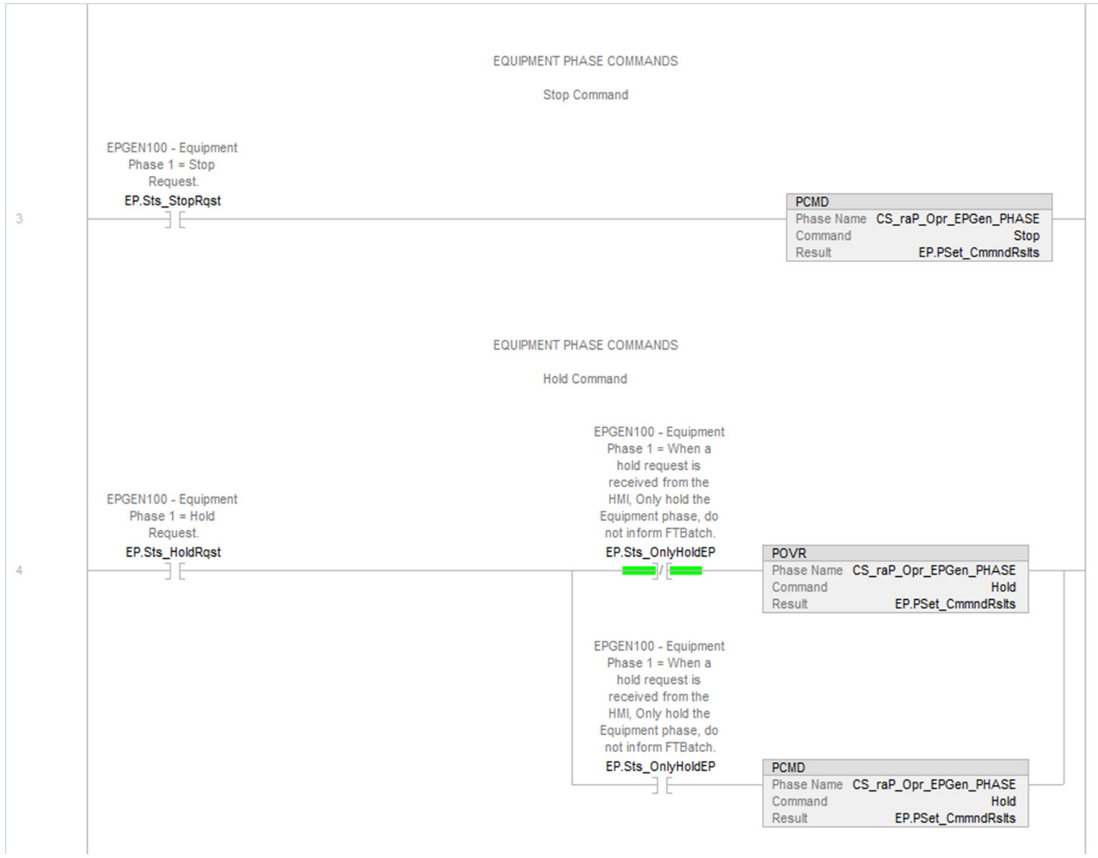
Maps commands from the EP_GEN instance to PhaseManager commands.

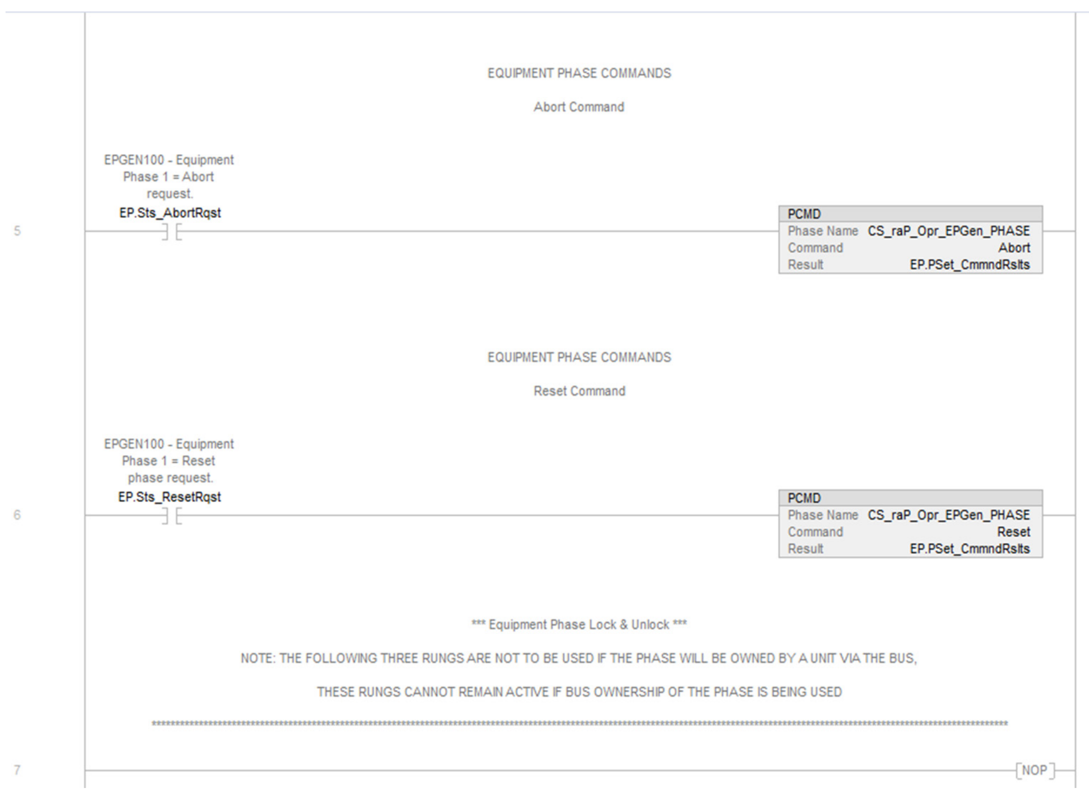
Steps required to map EP_GEN Phase Commands in Ladder:

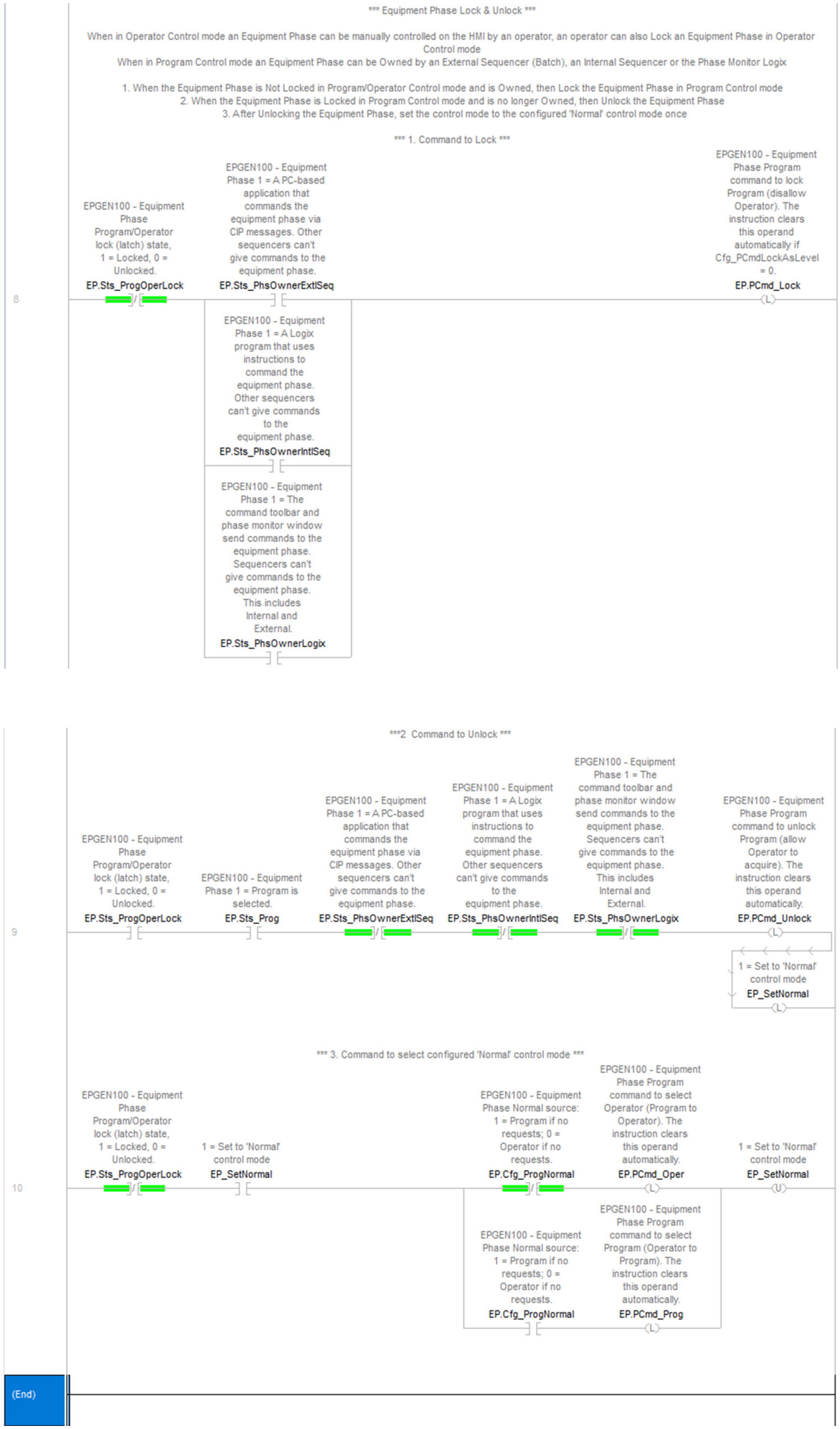
1. Open the CS_raP_Opr_EPGen PhaseCommands Routine.
2. Modify the selected phase requests as required.

   EP_GEN Phase request interface points are as follows:

   - Sts_StartRqst
   - Sts_HoldRqst
   - Sts_RestartRqst
   - Sts_StopRqst
   - Sts_AbortRqst
   - Sts_ResetRqst
   - Sts_PauseRqst
   - Sts_ResumeRqst
   - Sts_StateCmpltRqst
3. EP_GEN Request interface points are defined so that a 1 = Requested.
   - Typically a command rung would contain an XIC that represents the EP_GEN phase request (.Sts_<state>Rqst), and a PCMD or POVR instruction to issue the corresponding command to the PhaseManager Phase
   - Phase Commands (PCMD) exist for Start, ReStart, Reset, Pause, and Resume states.
   - Phase Override Commands (POVR) exist for Stop, Hold, and ABORT states.
   - A Phase Command required for each Phase State routine you have defined within your PhaseManager Phase.
4. The PCMD and POVR require definition of several reference tags:
   - Phase Name <tag>_Phase
   - Command <phase command>
   - Result <tag>_PSet_CmmndRslts


EQUIPMENT PHASE COMMANDS
Stop Command
EPGEN100 - Equipment Phase 1 = Stop Request.
EP.Sts_StopRqst
3
PCMD
Phase Name CS_raP_Opr_EPGen_PHASE
Command Stop
Result EP.PSet_CmmndRslts
EQUIPMENT PHASE COMMANDS
Hold Command
EPGEN100 - Equipment Phase 1 = Hold Request.
EP.Sts_HoldRqst
4
EPGEN100 - Equipment Phase 1 = When a hold request is received from the HMI, Only hold the Equipment phase, do not inform FTBatch.
EP.Sts_OnlyHoldEP
POVR
Phase Name CS_raP_Opr_EPGen_PHASE
Command Hold
Result EP.PSet_CmmndRslts
EPGEN100 - Equipment Phase 1 = When a hold request is received from the HMI, Only hold the Equipment phase, do not inform FTBatch.
EP.Sts_OnlyHoldEP
PCMD
Phase Name CS_raP_Opr_EPGen_PHASE
Command Hold
Result EP.PSet_CmmndRslts


EQUIPMENT PHASE COMMANDS
Abort Command
EPGEN100 - Equipment Phase 1 = Abort request.
EP.Sts_AbortRqst
5
PCMD
Phase Name CS_raP_Opr_EPGen_PHASE
Command Abort
Result EP.PSet_CmmndRslts
EQUIPMENT PHASE COMMANDS
Reset Command
EPGEN100 - Equipment Phase 1 = Reset phase request.
EP.Sts_ResetRqst
6
PCMD
Phase Name CS_raP_Opr_EPGen_PHASE
Command Reset
Result EP.PSet_CmmndRslts
*** Equipment Phase Lock & Unlock ***
NOTE: THE FOLLOWING THREE RUNGS ARE NOT TO BE USED IF THE PHASE WILL BE OWNED BY A UNIT VIA THE BUS,
THESE RUNGS CANNOT REMAIN ACTIVE IF BUS OWNERSHIP OF THE PHASE IS BEING USED
7
NOP


*** Equipment Phase Lock & Unlock ***
When in Operator Control mode an Equipment Phase can be manually controlled on the HMI by an operator, an operator can also Lock an Equipment Phase in Operator Control mode
When in Program Control mode an Equipment Phase can be Owned by an External Sequencer (Batch), an Internal Sequencer or the Phase Monitor Logix
1. When the Equipment Phase is Not Locked in Program/Operator Control mode and is Owned, then Lock the Equipment Phase in Program Control mode
2. When the Equipment Phase is Locked in Program Control mode and is no longer Owned, then Unlock the Equipment Phase
3. After Unlocking the Equipment Phase, set the control mode to the configured 'Normal' control mode once
*** 1. Command to Lock ***
8
EPGEN100 - Equipment Phase Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
EP.Sts_ProgOperLock
EPGEN100 - Equipment Phase 1 = A PC-based application that commands the equipment phase via CIP messages. Other sequencers can't give commands to the equipment phase.
EP.Sts_PhsOwnerExtlSeq
EPGEN100 - Equipment Phase 1 = A Logix program that uses instructions to command the equipment phase. Other sequencers can't give commands to the equipment phase.
EP.Sts_PhsOwnerIntlSeq
EPGEN100 - Equipment Phase 1 = The command toolbar and phase monitor window send commands to the equipment phase. Sequencers can't give commands to the equipment phase. This includes Internal and External.
EP.Sts_PhsOwnerLogix
EPGEN100 - Equipment Phase Program command to lock Program (disallow Operator). The instruction clears this operand automatically if Cfg_PCmdLockAsLevel = 0.
EP.PCmd_Lock
***2 Command to Unlock ***
9
EPGEN100 - Equipment Phase Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
EP.Sts_ProgOperLock
EPGEN100 - Equipment Phase 1 = Program is selected.
EP.Sts_Prog
EPGEN100 - Equipment Phase 1 = A PC-based application that commands the equipment phase via CIP messages. Other sequencers can't give commands to the equipment phase.
EP.Sts_PhsOwnerExtlSeq
EPGEN100 - Equipment Phase 1 = A Logix program that uses instructions to command the equipment phase. Other sequencers can't give commands to the equipment phase.
EP.Sts_PhsOwnerIntlSeq
EPGEN100 - Equipment Phase 1 = The command toolbar and phase monitor window send commands to the equipment phase. Sequencers can't give commands to the equipment phase. This includes Internal and External.
EP.Sts_PhsOwnerLogix
EPGEN100 - Equipment Phase Program command to unlock Program (allow Operator to acquire). The instruction clears this operand automatically.
EP.PCmd_Unlock
1 = Set to 'Normal' control mode
EP_SetNormal
*** 3. Command to select configured 'Normal' control mode ***
10
EPGEN100 - Equipment Phase Program/Operator lock (latch) state, 1 = Locked, 0 = Unlocked.
EP.Sts_ProgOperLock
1 = Set to 'Normal' control mode
EP_SetNormal
EPGEN100 - Equipment Phase Normal source: 1 = Program if no requests; 0 = Operator if no requests.
EP.Cfg_ProgNormal
EPGEN100 - Equipment Phase Program command to select Operator (Program to Operator). The instruction clears this operand automatically.
EP.PCmd_Oper
1 = Set to 'Normal' control mode
EP_SetNormal
EPGEN100 - Equipment Phase Normal source: 1 = Program if no requests; 0 = Operator if no requests.
EP.Cfg_ProgNormal
EPGEN100 - Equipment Phase Program command to select Program (Operator to Program). The instruction clears this operand automatically.
EP.PCmd_Prog
(End)

Extended Alarms Routine

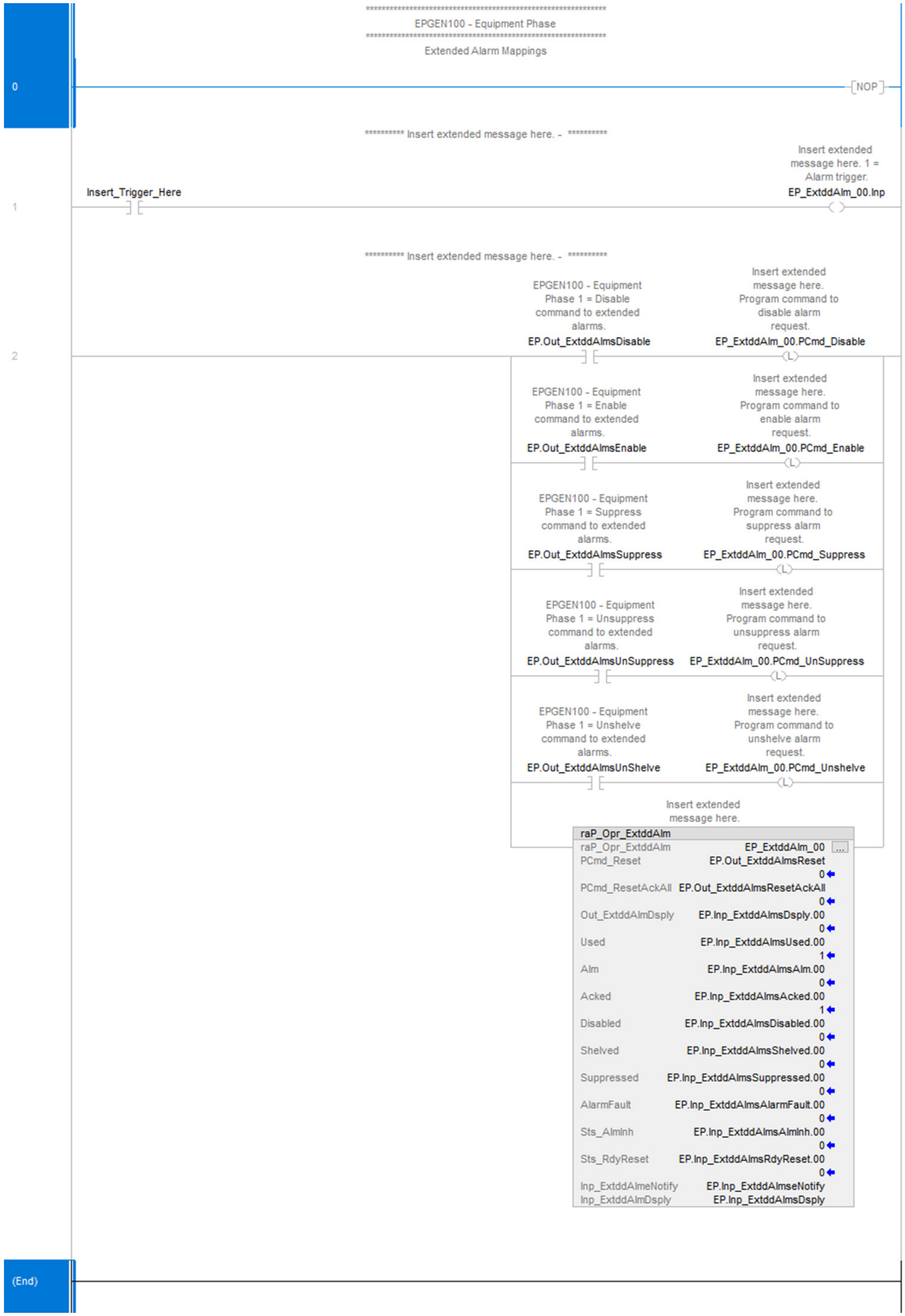
The raP_Opr_ExtddAlm (Extended Alarm Block) Add-On Instruction is used to provide notification to operators of abnormal conditions or events for up to 32 additional items external to a parent object. For more information, see the Rockwell Automation Library of Process Objects, publication PROCES-RM200.

This instruction handles these connections.

Commands from the Parent Object	Status from raP_Opr_ExtddAlm
• Acknowledge • Reset • Enabling/Disabling • Suppress/Unsuppress • UnShelve	• Used • Alarm • Acknowledged • Disabled • Suppressed • Shelved • Alarm Fault • Ready for Reset • Notify value

raP_Opr_ExtddAlm Parameters

Parameter	Description
PCmd_Reset	Program command to reset alarm request.
PCmd_ResetAckAll	Program command to reset and acknowledges all alarms. The instruction clears this operand automatically.
Out_ExtddAlmDsply	1 = Extended alarm severity value is greatest of all extended alarms active. Each bit represents an individual alarm (0…31).
Used	1 = Used.
Alm	1 = Alarm is active.
Acked	1 = In alarm acknowledged.
Disabled	1 = Alarm disabled.
Shelved	1 = Alarm shelved.
Suppressed	1 = Alarm suppressed.
AlarmFault	1 = Alarm fault.
Sts_AlmInh	1 = One or more alarms shelved, disabled, or suppressed.
Sts_Rdy_Reset	1 = A latched alarm condition is ready to be reset.
Inp_ExtddAlmeNotify	Extended alarms status enumerate values: 0 = Not in alarm 1 = Not in alarm unacknowledged or reset requires 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_ExtddAlmDsply	1 = Extended alarm severity value is greatest of all extended alarms active. Each bit represents an individual alarm (0…31).



EPGEN100 - Equipment Phase
Extended Alarm Mappings
0
NOP
********** Insert extended message here. - **********
Insert extended message here. 1 = Alarm trigger.
1
Insert_Trigger_Here
EP_ExtddAlm_00.Inp
********** Insert extended message here. - **********
2
EPGEN100 - Equipment Phase 1 = Disable command to extended alarms.
EP.Out_ExtddAlmsDisable
Insert extended message here. Program command to disable alarm request.
EP_ExtddAlm_00.PCmd_Disable
EPGEN100 - Equipment Phase 1 = Enable command to extended alarms.
EP.Out_ExtddAlmsEnable
Insert extended message here. Program command to enable alarm request.
EP_ExtddAlm_00.PCmd_Enable
EPGEN100 - Equipment Phase 1 = Suppress command to extended alarms.
EP.Out_ExtddAlmsSuppress
Insert extended message here. Program command to suppress alarm request.
EP_ExtddAlm_00.PCmd_Suppress
EPGEN100 - Equipment Phase 1 = Unsuppress command to extended alarms.
EP.Out_ExtddAlmsUnSuppress
Insert extended message here. Program command to unsuppress alarm request.
EP_ExtddAlm_00.PCmd_UnSuppress
EPGEN100 - Equipment Phase 1 = Unshelve command to extended alarms.
EP.Out_ExtddAlmsUnShelve
Insert extended message here. Program command to unshelve alarm request.
EP_ExtddAlm_00.PCmd_Unshelve
Insert extended message here.
raP_Opr_ExtddAlm
raP_Opr_ExtddAlm EP_ExtddAlm_00
PCmd_Reset EP.Out_ExtddAlmsReset 0
PCmd_ResetAckAll EP.Out_ExtddAlmsResetAckAll 0
Out_ExtddAlmDsply EP.Inp_ExtddAlmsDsply.00 0
Used EP.Inp_ExtddAlmsUsed.00 1
Alm EP.Inp_ExtddAlmsAlm.00 0
Acked EP.Inp_ExtddAlmsAcked.00 1
Disabled EP.Inp_ExtddAlmsDisabled.00 0
Shelved EP.Inp_ExtddAlmsShelved.00 0
Suppressed EP.Inp_ExtddAlmsSuppressed.00 0
AlarmFault EP.Inp_ExtddAlmsAlarmFault.00 0
Sts_AlmInh EP.Inp_ExtddAlmsAlmInh.00 0
Sts_RdyReset EP.Inp_ExtddAlmsRdyReset.00 0
Inp_ExtddAlmeNotify EP.Inp_ExtddAlmseNotify
Inp_ExtddAlmDsply EP.Inp_ExtddAlmsDsply
(End)

Parameters and Reports Routines

The raP_Tec_ParRpt Add-On Instruction is used to implement parameter data items. Use when:

- You need the ability to view or modify a parameter from either the HMI or from logic.
- You must arbitrate parameter input based on mode.
- You need the ability to limit the value of a parameter, from either the HMI or logic.
- You need the ability to capture an initial parameter value (based on a trigger), and provide an indication if the parameter was adjusted from the initial value.
- You must limit the adjustment of a parameter within a deadband relative to an initial value.
- You must apply command confirmation (that is, Electronic Signature) to parameter entry from the HMI.
- Your parameter is read-only or read/write.
- Your need a Parameter (recipe) or Report (resultant) parameter.
- Your parameter is of data type: Integer, Real, String, or is an Enumeration.

For more information, see the Rockwell Automation Library of Process Objects, publication PROCES-RM200.

raP_Tec_ParRpt References

Parameter	Description
PSet_E	Program issued setting of enumeration parameter value.
PSet_I	Program issued setting of integer parameter value.
PSet_R	Program issued setting of real parameter value.
PSet_S	Program issued setting of string parameter value.

raP_Tec_ParRpt Configuration Considerations

Operand	Type	Description
ParObj	raP_UDT_Opr_ParRpt_INTfC	Parameter object link to equipment
RptObj	raP_UDT_Opr_ParRpt_INTfC	Report object link to equipment

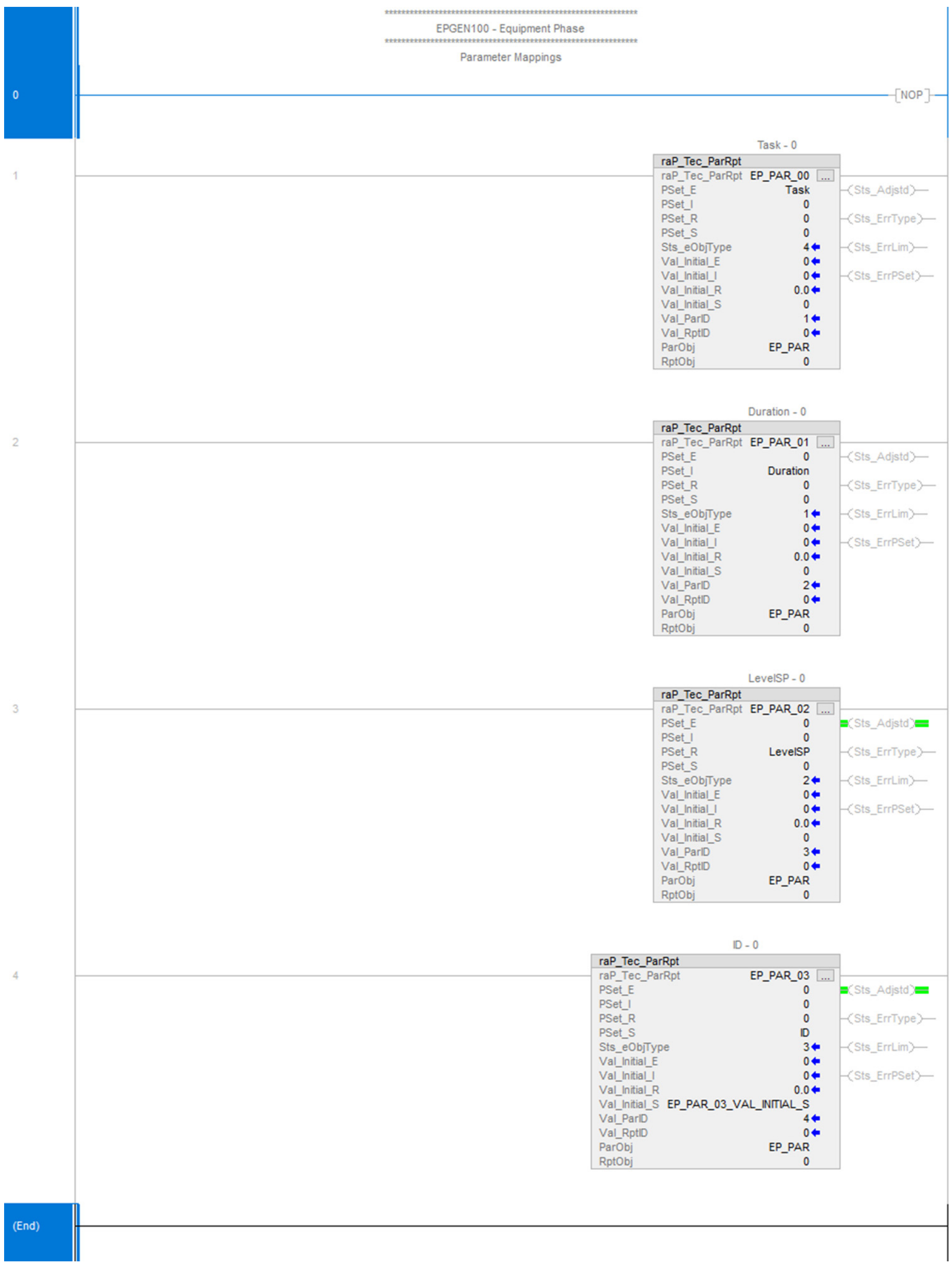
IMPORTANT You cannot set both ParObj and RptObj in the same Add-On Instruction.
- If you set ParObj, then RptObj must be zero.
- If you set RptObj, then ParObj must be zero.

CS_raP_Opr_EPGen Parameters Routine

Maps Parameters from Phase tags (input) to the standard EP_GEN parameter structure. The steps required to create this mapping logic are as follows:

1. First determine the parameters needed for your Equipment Phase, and confirm the associated tags (input) are defined within your PhaseManager program.
2. Open the CS_raP_Opr_EPGen Parameters Routine.
3. Start at parameter zero (EP_Par_00), and determine the type of parameter block required (Enumeration, Integer, Real, or String).
4. Modify the rest of the reports routine as needed.

Typically the PSet variable in the instruction would represent the parameter tag (as defined in the program tags). For each additional Parameter required, increment the EP_Par_## number. Up to a maximum of 48 reports can be included per EP_GEN.



CS_raP_Opr_EPGen Reports Routine

Maps Resultant/Report data to Phase tags (output) from the standard EP_GEN report structure. The steps required to create this mapping logic are as follows:

1. First determine the report data items needed for your Equipment Phase, and confirm the associated tags (output) are defined within your PhaseManager program.
2. Open the CS_raP_Opr_EPGen Reports Routine.
3. Start at report zero (EP_RPT_00), and determine the type of parameter block required (Enumeration, Integer, Real, or String).
4. Modify the rest of the reports routine as needed.

Typically the PSet variable in the instruction would represent the parameter tag (as defined in the program tags). For each additional Parameter required increment the EP_RPT_0## number. Up to a maximum of 48 reports can be included per EP_GEN.

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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