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EXPERION PKS

Series C I/O User's Guide

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CHAPTER

1

About this guide

The procedures in this guide are intended to give you the ability to perform basic tasks with the Series C I/O such as configuring hardware devices, continuous control strategies. Respective forms are displayed to illustrate a procedure/concept only.

1.1 Revision History

Revision	Date	Description
A	November 2019	Initial release of the document.

- Intended audience
- Prerequisite Skills
- References
- Terms and acronyms

1.2 Intended audience

This guide is intended for the following users:

- Persons responsible for system planning, initial hardware installation, and control strategy configuration
- Operators who help to maintain control system operations on a day-by-day basis
- Service persons responsible for routine maintenance of control hardware, and who diagnose and repair faults.

1.3 Prerequisite Skills

It is assumed that you should have some knowledge of Experion control systems and experience of working in a Microsoft Windows environment.

1.4 References

Listed here are the documents that contain general information for planning and implementing control hardware and network communications in your Experion system:

- Control Hardware Planning Guide - Provides general information to assist you in planning and design of control hardware in an Experion system. Control hardware includes C200 Controllers, Series A Chassis I/O and FIMs, also, all I/O families, (except Series C I/O). It includes some supervisory network considerations for general reference.
- C300 Controller Guide - This guide provides information that will assist you in planning and designing activities, as well as the installation, operation, and troubleshooting of Series C300 Controllers in an Experion system.
- Series C Fieldbus Interface Module (FIM) User Guide - Provides planning and implementation guide for the Series C Fieldbus Interface Module.
- Fault Tolerant Ethernet Overview and Implementation Guide - Provides basic installation instructions and configuration requirements for a Fault Tolerant Ethernet (FTE) network and its components.
- Fault Tolerant Ethernet Installation and Service Guide - Contains instructions for installing and configuring a Fault Tolerant Ethernet (FTE) node. The guide includes troubleshooting and service information for an FTE node.
- Fault Tolerant Ethernet Bridge Implementation Guide - Provides information for implementing a Fault Tolerant Ethernet supervisory network through the FTE Bridge module. It includes module installation, configuration, operation and service data.
- Process Manager I/O Troubleshooting and Maintenance Guide - Guide features notification messages (soft fail codes and hard fail codes), service procedures and parts lists for PM I/O control hardware.

1.5 Terms and acronyms

The following table summarizes the terms and type representation conventions used in this guide.

Table 1.1 Terms and conventions

Term/conventions	Meaning	Example
Click	Click left mouse button once. (Assumes cursor is positioned on object or selection.)	Click the Browse button.
Double-click	Click left mouse button twice in quick succession. (Assumes cursor is positioned on object or selection.)	Double click the Station icon.
Drag	Press and hold left mouse button while dragging cursor to new screen location and then release the button. (Assumes cursor is positioned on object or selection to be moved.)	Drag the PID function block onto the Control Drawing.
Right-click	Click right mouse button once. (Assumes cursor is positioned on object or selection.)	Right-click the AND function block.
<F1>	Keys to be pressed are displayed in angle brackets.	Press <F1> to view the online Help.
<Ctrl>+<C>	Keys to be pressed together are displayed with a plus sign.	Press <Ctrl>+<C> to close the window.
File->New	Shows menu selection as menu name followed by menu selection	Click File->New to start new drawing.
>D:\setup.exe<	Data to be keyed in at prompt or in an entry field.	Key in this path location >D:\setup.exe<.

CHAPTER

2

SERIES C I/O PURPOSE

Series C I/O Modules, along with I/O Termination Assemblies (IOTAs), perform module diagnostics input and output scanning and processing on all field I/O data and events. To allow a more efficient use of Controller resources, I/O processing is performed separately from control processing functions so that:

- I/O sample rates are completely independent of I/O quantity, controller loading, processing, and alarming
- allows more efficient use of advanced Control Processor capability, and
- provides for future I/O expansion.

2.1 Comparing Process Manager I/O and Series C I/O

The following list compares previous features of the Process Manager I/O and the Series C I/O:

- Non-Volatile Memory:
  - In the PM, memory was maintained over a power cycle within the I/O card itself.
  - With the Series C I/O, the configuration memory information is restored from the C300 controller at power-up of the I/O Module.
- IOL - The Series C I/O link runs at twice the speed of the PMIO I/O Link. Each C300 I/O Link can be configured to provide Series-C or PMIO link speeds.
- Series C I/O fully supports HART I/O. This includes the use of Secondary HART Variables as control parameters.
- Separation of Primary from Secondary modules:
  - In the PM, the Primary and Secondary I/O Electronics modules could be separated, placed in different cabinets, and/or powered by different power systems.
  - Series C I/O does not have this capability.
- Series C permits Zone 2 mounting of the Controller and I/O
- In PMIO, the configuration memory is maintained only if a battery backup is installed.

2.2 What is Series C I/O?

The Experion Series C I/O modules are an expanding family of traditional and special function

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input/output signal interface devices. They supports local software configuration. These I/O modules share the same form factor as the C300 Controller and reside on the same type of common mounting system as other Series C components.

2.2.1 What is Series C I/O Mark II?

Series C Mark II is an enhancement to the existing Series C platform in terms of IO modules, related IOTAs, IO link, power supply, power distribution, and cabinet infrastructure, making it a more cost-effective solution than the earlier version. The design style continues to be the same.

2.2.2 Supported Series C Mark II I/O modules

ATTENTION

Series C Mark II cannot support any PM I/Os.

C300 IOLINK block parameter IOLINKTYPE is used to determine if the IOLINK supports Series C Mark II I/O.

Table 2.1 Supported Series C Mark II I/O modules

IOM model names	IOM block name	Description	No. of channels supported
CC-PAIH01	AI-HART	High Level Analog Input with HART (4) IOM	16
CC-PAOH01	AO-HART	Analog Output with HART (4) IOM	16
DC-PDIL51	DI-24	Digital Input 24V IOM w/o OWD	32
DC-PDIS51	DI-SOE	Digital Input SOE IOM	32
DC-PDOD51	DO-24B	Digital Output 24V Bussed Out IOM w/o RB	32
DC-PDIS51	DI-SOE	Digital Input SOE IOM	32
CC-PAIM51	AI-LLAI	Low Level Analog Input Mux	16
CC-PAIH51	AI-HART	AI HART IOM , R2	16
CC-PAIN01	AI-NON-HART	AI IOM NON-HART	16
CC-PAOH51	AO HART	AO HART IOM, R2	16
CC-PAON01	AO-NON-HART	AO NON-HART IOM	16

2.3 Series C Pulse Input Module (SCPIM)

The Experion Series C PIM is an interface between C300/CN100 Controller that enables high-accuracy pulse counting of pulse streams from rotating machinery such as turbines, flow meters, and densitometers. High-accuracy and repeatable measurement capability make the PIM well suited for metering and custody transfer applications.

The PIM has eight input channels. Out of the eight channels, some may be single consuming one channel or dual consuming 2 adjacent channels. The last 2 channels (channel 7 and channel 8) can also be configured as distinct Fast Cutoff using the two output channels on the module.

Each input channel has a 32-bit counter to perform pulse counting and frequency calculation. In addition, when these channels are configured as single input channels, these eight channels also have a second 32-bit timer for pulse period and pulse width measurement.

- Features of PIM
- Comparison between Series A and Series C PIM

2.3.1 Features of SCPIM

The following are some of key the features of SCPIM.

- Supports IOM redundancy.
- Supports redundant module communications with the controller via IO link.
- Supports simulation with SIM-C300/SIM-CN100 – The input value can be substituted by a program and/or UniSim using the SIMVALUE parameter.
- Supports high accuracy frequency, period, and pulse width measurement.
- Provides hardware support for Meter Suite applications.
- Provides connections to power field devices or pulse pre-amplifiers.
- Supports pulse multiplexing that enables good pulses from a dual pulse input pair to be copied to the Prover output interface.
- Supports Dual Pulse Integrity in accordance with ISO6551:1996 Level A, which is required to support interfacing of custody transfer meters with pulse outputs.
- Provides the flexibility of configuring the eight input channels as single input, dual input, or a combination of both single and dual input channels . For example you can configure the channels as;
    - 2 single input channels, 3 dual input channels or
    - 6 single input channels, 1 dual input channels.

For information on PIM specifications, refer to the Specifications document available on the Honeywell Online Support site.

2.3.2 Comparison between Series A and Series C PIM

The following table lists some of the differences between the Series A and Series C pulse input modules.

Series C PIM	Series A PIM
Shares the same form factor as the Series C I/O family.	Requires two form factors to use with C300 controller; series A for the Pulse Input and the series C form factor for the controller and other I/O modules.
Supports IOM redundancy.	Does not support IOM redundancy.
Supports Dual Pulse Integrity to support interfacing of custody transfer meters with pulse outputs.	Does not support Dual Pulse Integrity.
Supports pulse multiplexing that enables good pulses from a dual pulse input pair to be copied to the Prover output interface.	Does not support pulse multiplexing.
Supports pulse length measurement in all channels.	Does not support pulse length measurement in the last two channels.
Supports configuration of all eight channels through use of PICHANNEL block.	Needs two blocks for configuring channels: • Pulse Input Channel block for configuring the first six channels. • Pulse Input Channel with Fast Cutoff block for configuring the last two channels.
The last two channels can be configured as Pulse Input channel types or Pulse Input with Fast Cutoff channel types.	The last two channels can be configured only as Pulse Input with Fast Cutoff channel types.

2.4 What is Universal Input/Output (UIO) Module?

With R410, an Universal Input/Output (UIO) module is introduced that enables you to configure the input/output channels within a single IOM. The UIO module supports 32 channels. Each channel can independently be configured as one of the following types.

- Analog Input channel (0-20mA or 4-20mA)
- Analog Output channel (4-20mA)
- Digital Input channel (with or without broke-wire detection)
- Digital Output channel (with or without broke-wire detection)

The UIO channels and device blocks are compatible with existing Series C AI, AO, DI, and DO channels and blocks. In addition, each analog channel in the UIO module can be configured to support HART input/output functionality.

- Features of UIO
- UIO features
- Differences between UIO channels and existing Series C AI, AO, DI, and DO modules

2.4.1 Features of UIO

The following list illustrates the key features of the UIO module.

- Supports optional IOM redundancy.
- Supports simulation with SIM-C300/SIM-CN100.
- Supports HART functionality for AI and AO channel types.
- Supports multiple channel type configurations.
- Operates in an extended temperature range (-40 degree Celsius to +70 degree Celsius).
- Supports the ability to monitor the current, minimum, and maximum temperatures.
- Supports remote control when it is located within 10 kilometers from the controller.
- Supports open wire detection.
- Supports DO channel ganging from R430 onwards.
- Supports pulse counting functionality from R430 onwards.

NOTE

To use an AI HART channel in conjunction with the analog mode, it must be used on channels 13 through 20 only. If HART is used on any of the voltage inputs, it can cause an unstable analog PV value. The HART digital value will be unaffected.

NOTE

For information about UIO specification, refer to the latest Specification and Technical document available on the Honeywell Online Support site.

2.4.2 UIO features

Support for DO channel ganging

The UIO-DO channel is now enhanced to support ganging for enabling the delivery of more current output to the field (maximum current output of up to 2.0 Amperes). This is accomplished using the existing UIO hardware. DO channel ganging simply requires software configuration of up to four adjacent DO channels of the UIO module and appropriate channel wiring accordingly.

ATTENTION

- Up to four DO channels can be ganged at a time.
- UIO-channel 32 cannot be ganged with channel 1.

Support for pulse counting functionality

The UIO module DI channel is capable of providing pulse counting functionality. However, only four DI channels (channels 15, 16, 17 and 18) support pulse counting functionality.

The UIO-DI channel pulse counting supports counting up to 10 KHz of input pulse frequency.

The UIO DI channel configuration consists of simply setting the Digital Input Type parameter to “Accum” from the Configuration tab of the DI channel.

ATTENTION

Though UIO supports redundancy, it does not support pulse count synchronization. Therefore, after a switchover the counters are reset and restart at 0. If pulse count synchronization is required, you must use the Series C Pulse Input Module.

2.4.3 Differences between UIO channels and existing Series C AI, AO, DI, and DO modules

The following table lists some of the differences between the UIO and the existing Series C AI, AO, DI, and DO modules.

UIO module	Series C AI, AO, DI, and DO modules
Supports temperature range between -40 degree Celsius to +70 degree Celsius	Supports temperature range between 0 degree Celsius to +50 degree Celsius
Supports multiple channel type configuration	Supports unique channel type configuration

2.5 What is Low Level Analog Input (LLAI) Module

Starting with R430, a new Series C compliant Low Level Analog Input (LLAI) Module is introduced and designed to operate with the low voltage devices such as Thermocouples and RTDs. The AI-LLAI module supports 16 channels and accepts temperature inputs in the range of millivolts (mV).

This AI-LLAI module is identical to the existing Series C AI-LLMUX module except that the number of channels supported by the AI-LLAI module is reduced to 16 channels. Unlike the AI-LLMUX module, the field inputs can be directly connected to the AI-LLAI IOTA since it has its own IOTA. In addition, the AI-LLAI module supports a new RTD input type, that is, CU50Rtd. A new library is introduced in the standard library as "AI-LLAI."

2.5.1 Features of AI-LLAI

The following are some of the key features of AI-LLAI.

- Supports up to 16 RTDs or Thermocouple inputs.
- Operates in an extended temperature range (-40 degree Celsius to +70 degree Celsius).
- Supports a new RTD input type, CU50Rtd.
- Supports configurable Open Thermocouple Detection (OTD).
- Supports 1 second PV scanning with OTD protection.
- Supports N type thermocouple.

NOTE

AI-LLAI module does not support the following features.

- Remote cold junction capability
- User defined table

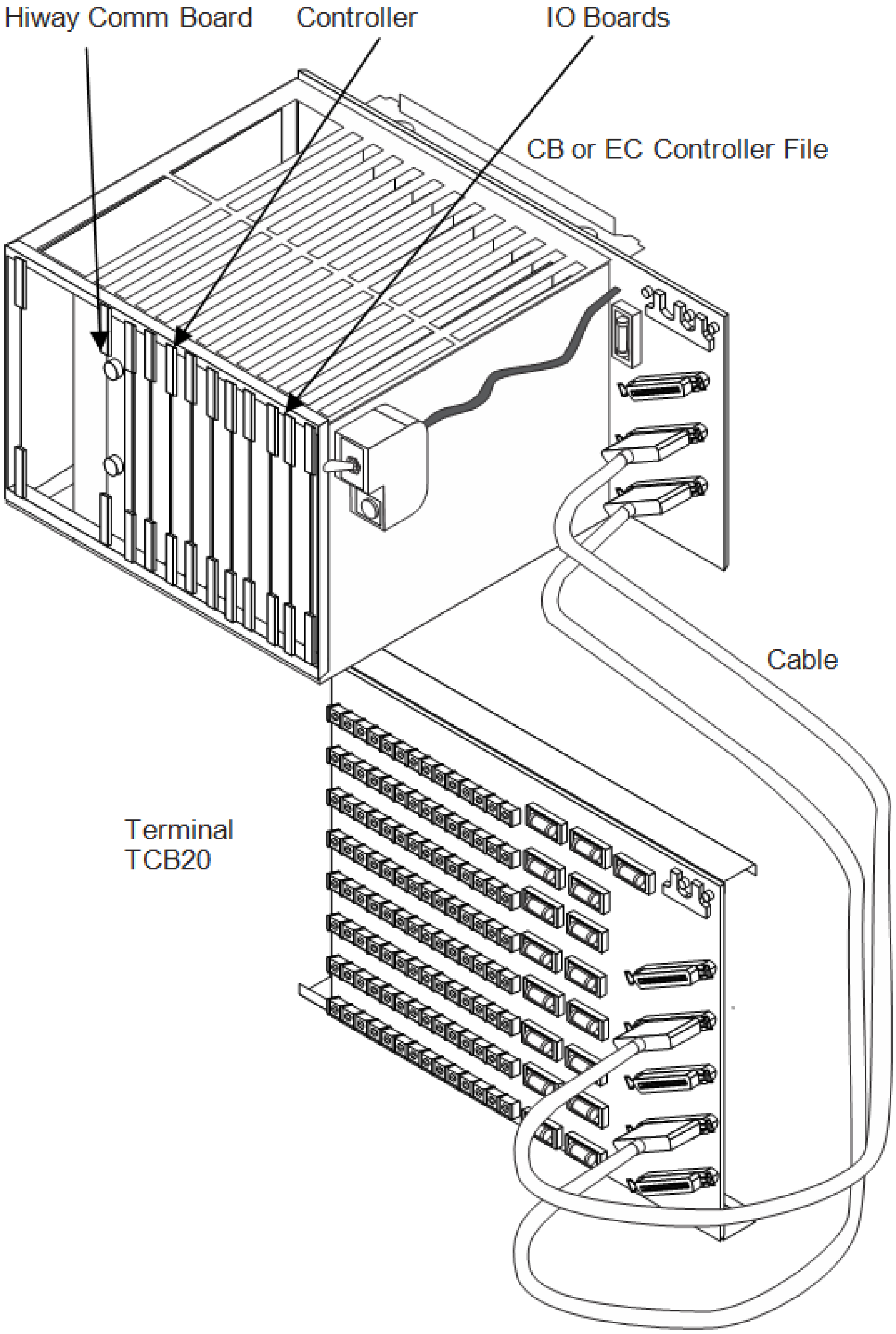
2.6 Overview of the Universal Horizontal Input/Output (UHIO)

The Universal Horizontal Input/Output (UHIO) enables the replacement of the TDC 2000 Basic Controllers (CB) and Extended Controllers (EC) with the Experion Series C controllers and Universal I/Os. To enable mounting in the existing cabinets, new IOTAs are designed for the C300 Controller, Control Firewall, and the Universal I/O module such that it can fit into the space of the CB and EC modules. However, the existing TCBxx terminal panel, and the field wiring to the TCBs are retained. Note that different IOTAs are required for the UIO and UIO-2 modules. Either IOTA will screw onto the back panel.

The introduction of the UHIO hardware allows customers to migrate their Hiway-based control system to the FTE-based Experion Series C control system.

The following figure is an example of CB/EC rack that is replaced with the Experion Series C controllers and Universal I/Os.

Figure 2.1 View of existing Basic Controller and Extended Controller



The following figures show the UHIO on the right side. The CC-HUIO11 uses UIO modules and the CC-HUIO12 uses UIO-2 modules.

Figure 2.2 Left: CC-HCN911 Right: CC-HUIO11

Figure 2.3 Left: CC-HCN911 Right: CC-HUIO12

In these figures, the following components are shown.

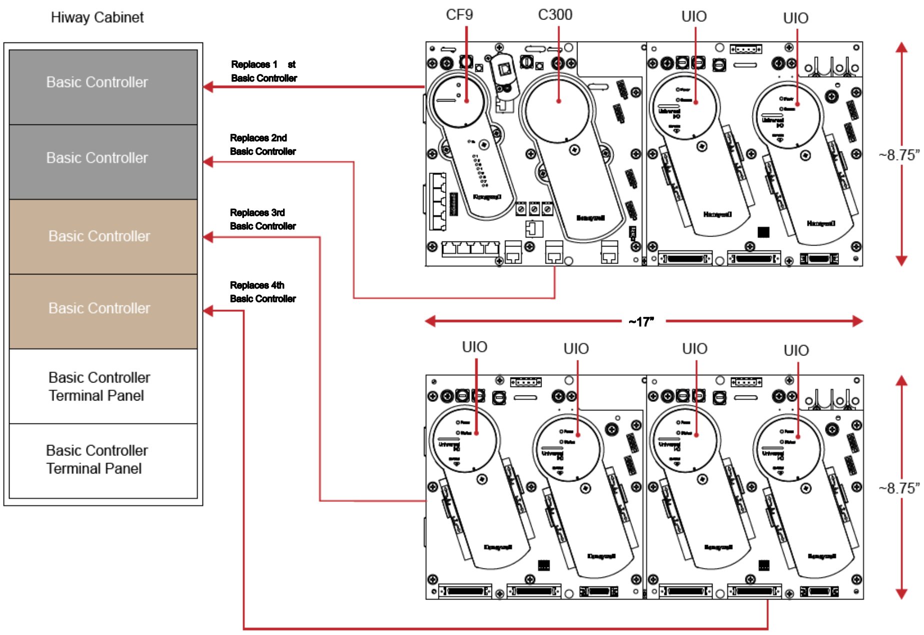
- Control Firewall
- C300 Controller
- Universal I/Os

- Mapping the CB/EC racks with UHIO components
- Features of UHIO
- UHIO hardware
- Differences between the Series C IOTA and the UHIO IOTA
- About UHIO certification

2.6.1 Mapping the CB/EC racks with UHIO components

The following figure illustrates how to map the CB/EC with the UHIO components.

Figure 2.4 Mapping the CB/EC with the UHIO components



> **ATTENTION**
>
> Note that you can increase the number of input/outputs by adding the Universal Input/Output (UIO) modules.

2.6.2 Features of UHIO

The key features of the UHIO are:

- Supports both redundant and non-redundant configuration for C300 Controller, UIO module, and CF9.
- Supports interchangeability of Series C components.
- Minimizes the effort for rewiring.

The UHIO also supports the following features.

- Provides mechanical connection to the TDC 2000 cabinet Backplane.
- Supports cabinet ground connections through the IOTA mounting screws.
- Provides electrical-mechanical connection to the IOM.
- Provides electrical-mechanical connection to the redundant IOL cable pair.
- Supports 24V fused electrical connections to the IOM(s) - Series C 24V and COM power supply.
- Supports a signal common ground.
- Supports precision resistors for measuring analog inputs.

- Supports connection for up to 24 IO channels on the existing TCBs.
- Supports connection for up to 8 additional IO channels at a location.
- Supports manual reset input(s) for restarting a stopped UIO module.
- Supports voltage or current inputs.
- Supports hot-insertion of C300, CF9, and UIO modules.

2.6.3 UHIO hardware

The UHIO uses the following Series C IO components.

- Plug-in modules such as C300, CF9, and UIO.
- FTE network communications between the controller and Experion Station.
- I/O Link between the controller and all I/O modules.
- Series C cabinet power supply.
- Experion Station and Control Builder as operator and engineering interfaces.

> ATTENTION
>
> You cannot differentiate the appearance of the UHIO components from other Series C components in the Control Builder or the Station though the UHIO components are horizontally-oriented.

2.6.4 Differences between the Series C IOTA and the UHIO IOTA

The following table lists the differences between the Series C IOTA and the UHIO IOTA.

Table 2.2 Differences between the Series C IOTA and the UHIO IOTA

Series C IOTA	UHIO IOTA
C300, CF9, and the UIO IOTA is mounted on the Series C cabinet.	New IOTA developed for C300/CF9 IOTA and UHIO cannot be mounted on the Series C CCA's. It can be mounted in a TDC 2000 basic cabinet (not a Series C cabinet) or in a PMIO cabinet using a special mounting bracket.
Series C UIO IOTA does not interface UIO module to Basic Controller Terminal Panels (TCBxx). Instead, Series C UIO IOTA is designed to directly interface with the field sensors/actuators.	UHIO IOTA is designed to interface the UIO module to the Basic Controller Terminal Panels (TCBxx).
Series C IOTA is vertically mounted on the cabinet.	UHIO IOTA is horizontally mounted on the cabinet.

> ATTENTION
>
> Series C Hazardous Certifications are not applicable to the UHIO components.

For more information about the C300/CF9/UHIO IOTA, see Series C Universal Horizontal Input/Output (UHIO) components.

2.6.5 About UHIO certification

General Purpose Certification

The UHIO's CSA General Purpose certification is applicable within Data Hiway (TDC 2000) cabinets with the Series C Power supply SPS5792-142935 (HPN 51454517-100). If any modifications have occurred since first installation, the UHIO's CSA General Purpose certification is voided and it is the responsibility of the end user to ensure they are still conforming to all applicable agency rules and regulations. The original TDC Basic Power Supplies do not support the UHIO CSA General Purpose Certification.

CE Mark certification

The UHIO's CE Mark is only applicable for installations within Data Hiway (TDC 2000) cabinets with the Series C Power supply SPS5792-142935 (HPN 51454517-100). It is assumed that the state of as shipped and as first installed has been maintained for all applicable installations. For installations that do not satisfy the previously mentioned conditions, the end user is responsible to ensure that they conform to all applicable agency rules and regulations.

CC-HUIO12

The above constraints also apply to the CC-HUIO12 IOTA. Note that the CC-HUIO12 was tested with TCB cable 51192054 only. Using the original TCB cable 30731611 with adaptor cable 51202979 may not pass CE Mark tests. For the conducted immunity test between 150kHZ and 250kHz, the AI accuracy was 4.3% instead of its normal 0.1% at room temperature.

CHAPTER

3

Series C I/O Planning and Design

This guide is intended to provide general information to assist you in planning and designing the installation of your Experion Series C I/O.

3.1 General Planning References

Refer to the following documents for planning and design details for the Experion system in general and the Fault Tolerant Ethernet supervisory network. For the sake of brevity, this Guide does not repeat the applicable general guidelines, considerations, and cautions that are covered in these other Guides.

- Control Hardware Planning Guide
- Server and Client Planning Guide
- Fault Tolerant Ethernet Overview and Implementation Guide

> TIP
>
> For complete Series C Control System Hardware Configuration planning information, refer to the Control Hardware Planning Guide.

3.1.1 Series C I/O appearance

The layout of Series C components supports enhanced heat management and provides a 30% reduction in overall size (space required to mount the hardware) versus the equivalent Process Manger set.

3.1.2 Series C I/O features

The features of Series C I/O include:

- IO Module design - tilted 18 degrees off center:
    - provides for better heat distribution
    - allows for efficient field wiring
- Combination of I/O Module and Field terminations in the same area. The I/O Module is mounted on the IOTA, which reduces cabinet space and eliminates items such as FTA connection cables.
- Redundancy is done directly on the IOTA by simply adding a second IOM to the IOTA (with the exception of the C300 controller).

For complete feature/functions for the following modules/IOTAs, refer to the Experion Series C I/O Specifications document.

Table 3.1 Series C features

I/O module/IOTA	Feature/function

Analog Input w/HART	• Extensive self-diagnostics
	• Optional redundancy
	• HART capable, multi-variable instruments
	• Fast (50ms) loop scan
	• PV protection through a broken-wire detection diagnostic
	  ◦ All channels configured for 4-20 mA inputs can detect broken field wires. A soft failure alerts the maintenance staff for corrective action.
	• Non-incendive field power
	  ◦ Non-incendive power for 4-20 mA loops is provided with no external marshalling.

Analog Input non-HART	• Extensive self-diagnostics • Optional redundancy • Fast (50ms) loop scan • Non-incendive field power

Analog Output w/HART	• Extensive self-diagnostics
	• Optional redundancy
	• HART capable, multivariable instruments
	• Safe-state (FAILOPT) behaviors
	  ◦ Each channel can be configured to HOLD, LAST, VALUE, or SHED to a SAFE VALUE.
	• Output read back checking of current delivered to the field
	• PV protection through a broken-wire detection diagnostic
	  ◦ Each channel can detect broken field wire. A soft failure alerts the maintenance staff for corrective action.
	• Non-incendive output
	  ◦ No external marshalling required to support the 4-20ma loop, and still provides for channel power protection.

Analog Output non-HART	• Extensive self-diagnostics • Optional redundancy

I/O module/IOTA	Feature/function
	• Safe-state (FAILOPT) behaviors • Each channel can be configured to HOLD, LAST, VALUE, or SHED to a SAFE VALUE. • Output read back checking of current delivered to the field • Non-incendive output

Digital Input 24VDC	• Extensive self-diagnostics
	• IOM redundancy
	• Input direct/reverse
	• Internal or external field power selections
	• Galvanic isolation
	• PV protection through a broken-wire detection diagnostic
	  • Each channel can detect broken field wire. A soft failure alerts the maintenance staff for corrective action.
	• Non-incendive output
	  • No external marshalling required to support the 4-20ma loop, and still provides for channel power protection.

Direct Input High Voltage	• Extensive self-diagnostics • Optional redundancy • Input direct/reverse • Galvanic isolation
Digital Input High Voltage PROX	• Extensive self-diagnostics • Input direct/reverse • Galvanic isolation
Direct Input - Sequence of Events DI-SOE	• Extensive self-diagnostics • Optional redundancy • 1ms Sequence of Events for Discrete Inputs • Low Latency / High Speed Scanning mode • Broken wire detection • Supplies non-incendive field power • On board excitation power (no need for marshalling power) • Direct / Reverse Input Indication Galvanic isolation
Direct Output bussed 24Vdc	• Extensive self-diagnostics • Functional redundancy • Output direct/reverse • Safe-state (FAILOPT) behaviors • Each channel can be configured to HOLD, LAST, VALUE, or SHED to a SAFE VALUE. • Fuse-less short circuit protection allows a short circuit to exist without blowing any fuses. When a particular channel is shorted, internal circuits detect this and remove power to the

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I/O module/IOTA	Feature/function
	field connection. The channel remains de-energized until the short circuit is repaired • Latched, pulsed or pulse-width modulated output • Galvanic isolation • Output read back checking to screw terminal
Digital Output - Relay IOTA	• Galvanic isolation • Counter EMF snubbing circuit • Isolated dry contact (Form A or B) • Output read back checking on system side of driver
Low Level Analog (temperature) Input - LLMUX	• TC and RTD operation • Remote cold junction capability • 1 Second PV scanning with OTD protection • Configurable OTD protection (See below) • Temperature points can be added in 16 point increments
Low Level Analog (temperature) Input - LLAI	• Thermocouple (TC) and RTD operation • 1 Second PV scanning with Open Thermocouple Detection (OTD) protection • Configurable OTD protection
Speed Protection Module - SP	• Supports 2/3 voting logic for speed and acceleration. • Supports multiple configurable trip limits for speed and acceleration.
Servo Valve Positioner Module - SVPM	• Supports PID execution and position calibration. • Computes valve position from LVDT/RVDT input signal and controls valve by signaling the Servo coil. • Provides current modulation to avoid stiction in controlled device (servo valve).
Pulse Input Module - PIM	• Highly accurate frequency/period calculations. • Supports Dual Pulse Integrity in accordance with ISO6551:1996 Level A for custody transfer applications. • Extensive self-diagnostics. • Functional redundancy. • Provides channel-to-channel and terminal block to backplane voltage isolation.
Universal Input/Output Module - UIOM	• Extensive self-diagnostics • Optional redundancy • Independently configurable I/O channels • controls DI, AI, DO, AO • HART capable, multivariable instruments • PV protection through a broken-wire detection diagnostic • Safe-state (FAILOPT) behaviors • Supports multiple channel configurations UIO-2

I/O module/IOTA	Feature/function
	In addition to all features supported by UIO, the UIO-2 supports the folowing additional features: • Provides one HART modem per I/O channel • Supports pulse counting on up to four of any of the 32 channels configured as DI • Supports DO ganging within the following eight channel number groups: 1 - 4, 5 - 8, 9 - 12, 13 - 16, 17 - 20, 21 - 24, 25 - 28, and 29 – 32. However, ganging across these groups is NOT possible Beginning with ExperionR501, the following new features are available: • Supports SOE on any channel • Supports NAMUR inputs. This function, however, will require external voltage translation for devices that do not support direct connection 24 VDC

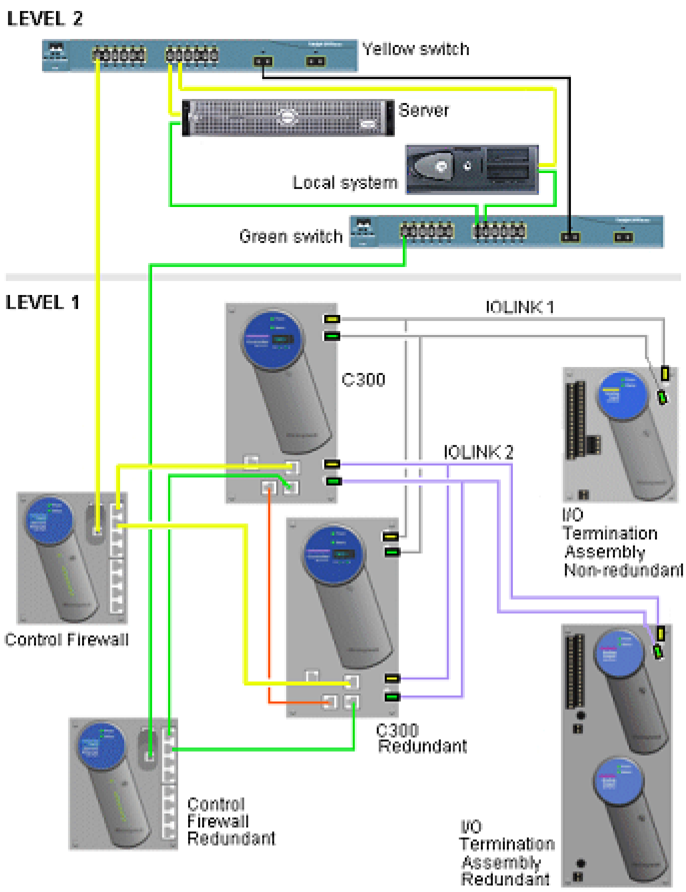
3.2 Series C I/O and C300/CN100 topology

> **ATTENTION**
>
> Topology for the Series C I/O and C300 - 20mS CEE Controller is similar to the Series C I/O and C300 - 50ms Controller, with the exception that the C300 - 20mS CEE Controller does not support the PMI/Os. CN100 supports all the Series C family of I/Os with the exception of SPM and SVPM.

Series C I/O is attached to an IOLINK that is being mastered by a C300 controller. It is important to note that:

- IOLINK - Serves as data repository for IOM function blocks in Control Builder to provide communications interface with Series C I/O.
- Series C I/O cannot reside on an IOLINK mastered by an IOLIM or xPM.

Figure 3.1 Series C I/O and C300 topology



- Examining the topology rules

3.2.1 Examining the topology rules

The following are the topology rules relating to the Series CI/O environment.

Refer to the following document for graphical representations of cabinet layouts depicting Series C, PMIO, FIM, and LLMUX hardware configurations. Control Hardware Planning Guide

Table 3.2 Topology rules

Item	Impact	Description
Redundancy	None	Redundancy capacity and performance is displayed while redundancy is present.
Switchover	Same as PM I/O	Series C I/O hardware and/or software can switchover, recover, and resume full view in a timeframe no greater than PM I/O.
Initialization	All Series C I/O per C300/CN100	Can be initialized in 60 seconds (+/- 25%) after cabinet-level loss power loss.
	I/O module	Can be initialized in 10 seconds (+/- 25%) after IOM level loss power loss.
Multiple I/O Links	2	Design allows the use of multiple Series C I/O Links in the same cabinet.

Item	Impact	Description
I/O Link performance	None	I/O Link networks perform at the current distance and IOP count specifications.
I/O Link capacity	40 max	Maximum of 40 redundant IOMs per link (for either Series C I/O or PM I/O).
IOMs / C300	64 max	Maximum of 64 redundant IOMs per C300 (for PM I/O).
	80 max	Maximum of 80 redundant IOMs per C300 (for Series C I/O).
Series C and PM I/O - combined	64	Design supports Series C and PM I/O FTAs in the same side of the cabinet. Current configuration prevents IOTA and FTAs in the same column.
I/OMs/CN100	40 Max	Maximum of 40 redundant I/OMs per CN100

3.3 Supported Series C I/O modules

The list of I/O modules below can be used on a Series C IOLINK. The IOLINK contains a function that enables programming and reprogramming the executable image (rather than substitution of a removable hardware component). The preferred method of delivery of the image is over the IOLINK.

Refer to Life Cycle changes for Series C IO modules and IOTAs section for life cycle update.

> **TIP**
>
> Series C IOLINK cannot contain any PM I/O IOPs.
>
> C300 IOLINK block parameter IOLINKTYPE is used to determine if the IOLINK supports either Series C I/O or PM I/O.

Table 3.3 Available I/O modules

IOM model names	IOM block name	Description	# of chnls	Similar to PMIO type	IOP model names
CU-PAIH01 CC-PAIH01	AI-HART	High Level Analog Input with HART (supports differential inputs on only channel 13 through channel 16) Refer to Attention	16	HLAIHART	
CC-PAIH02	AI-HART[2]	High Level Analog Input with HART ((supports differential inputs on all 16 channel)	16	HLAIHART	
CC-PAIX02	AI-HART[2]	High Level Analog Input with Differential/Single-ended non-HART (supports differential inputs on all 16 channels)	16	HLAI	
CC-PAIX01	AI-HL[1]	High Level Analog Input with Differential non-HART (supports differential inputs on only channel 13 through channel 16)	16	HLAI	

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IOM model names	IOM block name	Description	# of chnls	Similar to PMIO type	IOP model names
		Refer to Attention			
CU-PAIN01 CC-PAIN01	AI-HL[1]	High Level Analog Input with non-HART	16	HLAI	
CC-PAIH51	AI-HART[3]	1 Modem, High Level Analog Input with HART	16	HLAIHART	
CU-PAON01 CC-PAON01	AO	Analog Output with non-HART	16	AO16	
CU-PAOX01 CC-PAOX01	AO	Analog Output with non-HART Refer to Attention	16	AO16	
CU-PAIM01 CC-PAIM01	AI-LLMUX[7]	Low Level Analog Input Mux	64	LLMUX	
CC-PAIM51	AI-LLAI	Low Level Analog Input Mux	16	LLAI	
CU-PAOH01 CC-PAOH01	AO-HART	Analog Output with HART	16	AO16HART	
CC-PAOH51	AO-HART	1 Modem, Analog Output with HART	16	AO16HART	
CU-PDIH01 CC-PDIH01	DI-HV	High Voltage Digital Input (IOM supports both 120 and 240 volts AC)	32	DI	
CU-PDIL01 CC-PDIL01	DI-24	Low Voltage Digital Input (24 volts DC)	32	DI or DI24V	
CC-PDIL51	DI-24	Low Voltage, Digital Input (24 volts DC)	32	DI	
CU-PDIS01 CC-PDIS01	DI-SOE	Low Voltage Digital Input (24 volts DC)	32	DISOE	Mx-PDIS12
CU-PDOB01 CC-PDOB01	DO-24B[2]	Bussed Low Voltage Digital Output (24 volts DC)	32	DO_32	
CC-PDOD51	DO-24B[6]	Bussed Low Voltage, Digital Output (24 volts DC)	32	DO32	

IOM model names	IOM block name	Description	# of chnls	Similar to PMIO type	IOP model names
CU-PSOE01 CC-PSOE01	DI-SOE	Low Voltage Digital Input SOE (24 volts DC)	32	DISOE	
CC-PSP401	SP	Speed Protection	26		
CC-PSV201	SVP	Servo Valve Positioner	8		
CC-PPIX01	PIM	Pulse Input Module	8	PI IOP	
CC-PUIO01	UIO[8]	Universal Input/Output Module	32		
CC-PUIO31	UIO[9]	Universal Input/Output Module	32		
Series C Mark II IOM					
CC-PAIH01	AI-HART	High Level Analog Input with HART	16		
CC-PAOH01	AO-HART	Analog Output with HART	16		
DC-PDIL51	DI-24V[5]	Digital Input (24 volt DC) without Open Wire Detection	32		
DC-PDIS51	DI-SOE	Low-Voltage Digital Input SOE-Low Resolution (24 volts DC) without Open Wire Detection	32		
DC-PDOD51	DO-24B	Bussed Low Voltage Digital Output (24 volts DC) without Open Wire Detection	32		
CC-PAIH51	AI-HART	1 Modem, High Level Analog Input with HART	16	HLAIHART	
CC-PAOH51	AO-HART[4]	1 Modem, Analog Output with HART	16	AO16HART	
CC-PAIN01	AI-HL	High Level Analog Input with non-HART	16	HLAI	
CC-PAON01	AO	Analog Output with non-HART	16	AO16	

NOTES:

1. There are two models of High Level Analog Input such as, CU-PAIX01 and CU-PAIN01. The Module Hardware and the corresponding IOTAs are different and CU-PAIN01 is a new model. From the perspective of configuration and implementation, both High Level Analog Input models use the same IOM Block such as, AI-HL. It must be noted that the two models utilize the same configuration; online migration is not possible as mixed redundant pair is not possible. There are two models of Analog Output such as, CU-PAOX01 and CU-PAON01. Hence, similarly configuration, implementation, and interoperability constraints apply and CU-PAON01 is the new model.
2. Two new models of AI-HART (CC-PAIH02) and AI-HL (CC-PAIX02) modules are introduced to replace the older models of the AI-HART (CC-PAIH01) and AI-HL (CC-PAIX01) modules. The new models support both single-ended and differential inputs.
3. With R410, a new model of HART Analog Input CC-PAIH51 is introduced. The HART Analog

Input CC-PAIH51 and Cx-PAIH01 use the same IOM block, that is, AI-HART. The configuration and implementation mentioned in note 1 applies to the HART Analog Input module.

4. With R410, a new model of HART Analog Output CC-PAOH51 is introduced. The HART Analog Output CC-PAOH51 and Cx-PAOH01 use the same IOM block, that is., AO-HART. The configuration and implementation mentioned in note 1 applies to the HART Analog Output module.
5. With R410, a new model of Digital Input 24V DC CC-PDIL51 is introduced. The Digital Input 24V DC CC-PDIL51 and Cx-PDIL01 use the same IOM block, that is, DI-24. The configuration and implementation mentioned in note 1 applies to the Digital Input 24V module.
6. With R410, a new model of Digital Output 24V DC CC-PDOD51 is introduced. The Digital Output 24V DC CC-PDOD51 and Cx-PDOB01 use the same IOM block, that is, DO-24B. . The configuration and implementation mentioned in note 1 applies to the Digital Output 24V module.
7. Starting with R430, a new model of Low Level Analog Input Mux CC-PAIM51 is introduced.
8. The UIO (CC-PUIO01) has 32 configurable input or output channels. Each channel can be configured as one of the following:
    - Analog Input (0-20mA or 4-20mA active)
    - Analog Output (4-20mA active)
    - Digital Input (with or without line monitoring)
    - Digital Output (with or without line monitoring)
9. The UIO (CC-PUIO31) module is introduced with R432 and has 32 configurable input or output channels that are identical to the UIO (CC-PUIO01) module.

> **ATTENTION**
> Series C IO modules introduced in ExperionPKS R410.x release should not be used with its prior ExperionPKS releases R400.x. Do not try to downgrade the firmware of Series C IO Modules introduced in ExperionPKS R410.x release, as IOM will not work and it is difficult to recover as well.

3.3.1 Compatibility matrix between AI modules and differential AI modules

You can choose the AI modules based on your functionality requirements. The following table lists the functionalities and the respective AI modules.

If you want...	Then you must select...
AI HART/GIIS functionality	CC-PAIH02 module
Non-HART and Non-GIIS standard 2 wire transmitter (4-20mA input)	CC-PAIN01 module
Non-HART and Non-GIIS (1-5V input)	PAIX02 module

The following table lists the compatibility matrix between AI modules and differential AI modules for redundant and non-redundant configuration.

IOM	Redundant IOTA	Non-Redundant IOTA	AI 4-20ma	1-5V	0-5V	HART	No. of differential inputs
CC-PAIN01	CC-TAIN11	CC-TAIN01	X				None
CC-PAIH02	CC-TAIX11	CC-TAIX01	X	X	X	X	Channels 13 through 16
CC-PAIH02	CC-TAID11	CC-TAID01	X	X	X	X	Channels 1 through 16 (1)
CC-PAIX02	CC-TAIX11	CC-TAIX01	X	X	X		Channels 13 through 16
CC-PAIX02	CC-TAID11	CC-TAID01	X	X	X		Channels 1 through 16
CC-PAIH51	CC-TAIX61	CC-TAIX51		X			None

IOM	Redundant IOTA	Non-Redundant IOTA	IS	No. of differential inputs
CC-PAIH02	CC-GAIX11	CC-GAIX21	X	Not applicable
CC-PAIX02	CC-GAIX11	CC-GAIX21	X	Not applicable

NOTES:

1. Differential configuration does not require any custom wiring as the IOTAs (CC-TAID01 andCC-TAID11) performs it internally.

> **ATTENTION**
>
> The following module types are superseded by a new version of the module.
>
> - CC-PAIH01 superseded by CC-PAIH02
> - CC-PAIX01 superseded by CC-PAIX02
> - CC-PAOX01 superseded by CC-PAON01

3.3.2 Compatibility matrix between AO modules and differential AO modules

The following table lists the compatibility matrix between AO modules and differential AO modules for redundant and non-redundant configuration.

IOM	Redundant IOTA	Non-Redundant IOTA	AO 4-20mA	HART	IS
CC-PAOH01	CC-TAOX11	CC-TAOX01	X	X	

IOM	Redundant IOTA	Non-Redundant IOTA	AO 4-20mA	HART	IS
CC-PAOH01	CC-GAOX11	CC-GAOX21	X	X	X
CC-PAOX01	CC-TAOX11	CC-TAOX01	X		
CC-PAOX01	CC-GAOX11	CC-GAOX21	X		X
CC-PAON01	CC-TAON11	CC-TAON01	X		

3.3.3 Difference between AI-HART modules Cx-PAIH01 and Cx-PAIH51

AI-HART module Cx-PAIH01	AI-HART module Cx-PAIH51
Supports Open Wire detection.	Does not support Open Wire detection.
Supports 64-HART Communication units.	Supports 16- HART Communication units.
Supports the following sensor types. • 1-5 V • 0-5V • 0.4-2V	Supports only 1-5 V sensor type.
Supports the following input types. • Voltage • Current (2-wire or self-powered transmitters)	Supports only current (2-wire or self-powered transmitters) input type.
Supports 16 input channels (single ended or differential).	Supports all single-ended input channels.
Supports the following input range. • 0 to 5V • 1 to 5V • 0.4 to 2V • 4-20 mA (through 250 Ω)	Supports only 4-20 mA (through 200 Ω) inputs.
Supports all HART scan rates.	Supports all HART scan rates except 1 Sec Dynamic, 1 Sec Device, 2 Sec Device and Dynamic.
Supports differential voltage inputs.	Does not support differential voltage inputs.
Supports field calibration	Field calibration is not required.

3.3.4 Difference between AO-HART modules Cx-PAOH01 and Cx-PAOH51

AO-HART module Cx-PAOH01	AO-HART module Cx-PAOH51
Supports 64-HART Communication units.	Supports 16- HART Communication units.
Supports all HART scan rates.	Supports all HART scan rates except 1 Sec Dynamic, 1 Sec Device, 2 Sec Device and Dynamic.
Supports field calibration.	Field calibration is not required.

3.3.5 Difference between bussed low voltage Digital Input modules Cx-PDIL01 and Cx-PDIL51

Digital Input module Cx-PDIL01	Digital Input module Cx-PDIL51
Supports Open Wire detection.	Does not support Open Wire detection.

3.3.6 Difference between low voltage Digital Output modules Cx-PDOB01 and Cx-PDOD51

Digital Output module Cx-PDOB01	Digital Output module Cx-PDOD51
Does not support Power fail diagnostics.	Supports Power fail diagnostics at module level to diagnose the output driver power failure (fuse/4 pin terminal block failure). When the failure is detected, OPFAIL soft fail is displayed on all the channels to take care of back initialization in upstream block. The following module level soft failure is displayed. 'Field Power Failure' Check the fuse or power supply status of the 4 pin terminal block when the error message is displayed.
Supports source output type.	Supports sink (open drain) output type.
Supports load current as 500mA.	Supports load current as 100mA.

3.3.7 Difference between AI-LLMUX and CC-PAIL51 modules Cx-PAIM01 and Cx-PAIM51

AI-LLMUX module Cx-PAIM01	AI-LLAI module Cx-PAIM51
Supports 64 input channels.	Supports 16 input channels.
Supports the following RTD types. • Pt: 100 ohm DIN 4376 • Pt: 100 ohm JIS C-1604 • Ni: 120 ohm ED #7 • Cu: 10 ohm SEER	Supports a new RTD type, CU50Rtd, in addition to the RTD types supported by the AI-LLMUX.
Supports field calibration	Field calibration is not required.
Supports remote cold junction capability.	Does not support remote cold junction.
Requires an external HPM FTA to connect the field inputs to IOTA.	Field inputs can be directly connected to the IOTA.
Supports cold junction compensation	Supports cold junction compensation range, –40 to

AI-LLMUX module Cx-PAIM01	AI-LLAI module Cx-PAIM51
range, –20 to +60 degree Celsius.	+70 degree Celsius.
Supports the operating temperature between 0 to +60 degree Celsius.	Supports the operating temperature between –40 to +70 degree Celsius.

3.3.8 Identifying supported Series C I/O modules

The Series C I/O model designations follow a 'XX-YZZZNN' format.

Where:

- XX is CC or DC
- CC is for the Series C Product Line.
  The model number for every Series C product begins with a C designation for Series C.
- DC is for the Series C Mark II.
- Y is either C, E, F, G, H, K, M, P, PW, S or T
    - C = Control Processor
    - E = Enclosure
    - F = FTE
    - G = GI/IS Termination Assembly
    - H = Hazardous Interface
    - K = Cabling
    - M = Mechanical
    - P = I/O Module
    - PW = Power
    - S = Custom Interface
    - T = Termination Assembly
- ZZZ is a particular function or model.
- NN is a series of model and can be used as additional model information -
  NN +10 = Redundant complement to an IOTA.

> TIP
>
> Series C Mark II may not support all the above options.

3.3.9 Considerations for replacing or pairing Series C Analog I/O modules in a redundant configuration

In a redundant series C analog I/O module configuration, consider and complete the following before you replace or pair the modules.

Release	Hardware revisions of old modules	Hardware revisions of new modules	Considerations and actions for replacing or pairing modules
R301	• <=K for AI_HART and AI_HL • <=H for AO and AO_HART	• >=M for AI_HART and AI_HL • >=J for AO and AO_HART	You cannot pair an older hardware revision module with a latest hardware revision module. Replace your older module with a latest module.
R310 or later	• <=K for AI_HART and AI_HL • <=H for AO and AO_HART	• >=M for AI_HART and AI_HL • >=J for AO and AO_HART	You can pair an older hardware revision module with a latest hardware revision module. However, complete the following after you replace one of the older modules: 1. Migrate to the latest patch applicable for the release. 2. Migrate the applicable controllers 3. Update the firmware of the older hardware revision module. 4. Verify that the firmware versions of both the modules are indicated as “Green” in CTools.

Model number references for the affected Series C Analog I/O modules

Module model number	Module type	Hardware revisions of old modules	Hardware revisions of new modules
CC- PAIH01/02	AI_HART	<=K	>=M
CC- PAIX01/02	AI_HL	<=K	>=M
CC- PAOH01	AO_HART	<=H	>=J
CC- PAOX01	AO	<=H	>=J

3.3.10 Life Cycle changes for Series C IO modules and IOTAs

Below is the recommendation for a select number of Series C IO modules that should be utilized for new greenfield projects and for brownfield expansions. These IO modules provide the greatest value and the longest life cycle support.

IOM with lifecycle change	Spares for install base	Recommendation for Greenfield/Brownfield Expansion Projects
CC-PAIH01	No; CC-PAIH02 will be the available spare for both redundant and non-redundant CC-PAIH01 modules.	CC-PAIH02
CC-PAOX01	Yes; same module will be available for spares	CC-PAIN01
CC-PDIL51 / CC-TDIL51/ CC-TDIL61	Yes; same module will be available for spares	CC-PDIL01 / CC-TDIL01 / CC-TDIL11
CC-PDOD51/ CC-TDOD51/ CC-TDOD61	Yes; same module will be available for spares	CC-PDOB01/ CC-TDOB01/ CC-TDOB11

IOM with lifecycle change	Spares for install base	Recommendation for Greenfield/Brownfield Expansion Projects
CC-PUIO01/ CC-TUIO01/ CC-TUIO11	Yes; same module will be available for spares	CC-PUIO31/ CC-TUIO31/ CC-TUIO31 With Experion R432 and above

NOTE

For new Greenfield projects and brownfield expansions utilizing Experion revisions R431 and lower, CC-PUIO01/CC-TUIO01/CC-TUIO11 will be available.

3.4 Supported Series C I/O options

The following Series C I/O options are supported:

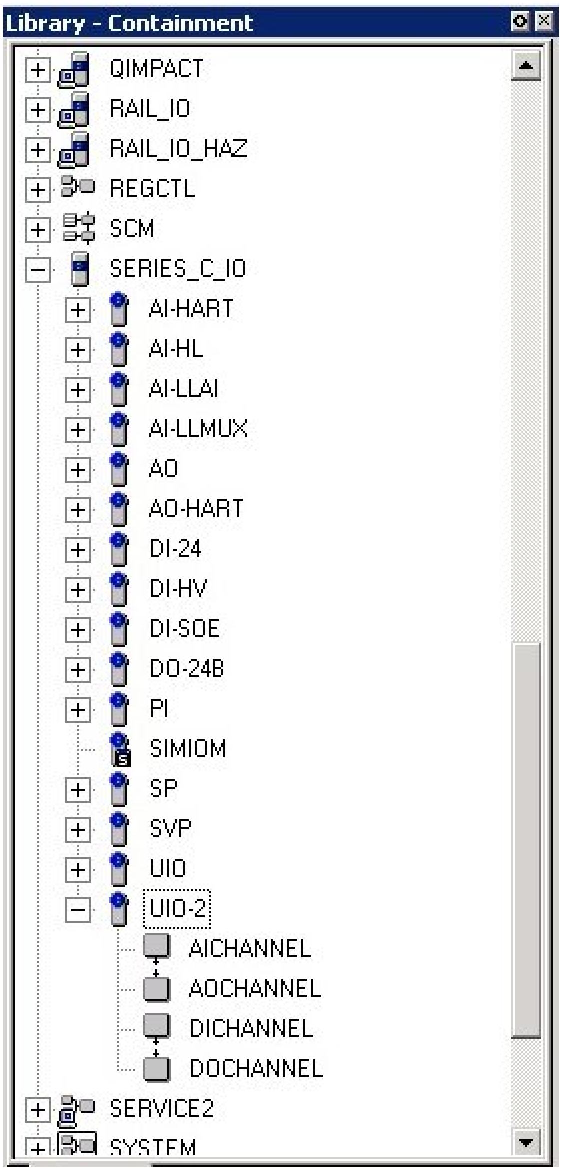
- I/O redundancy
- Power supply redundancy
- HART communications
- Galvanically Isolated/Intrinsically Safe IOTAs
- Remote I/O (using Fiber Optic I/O Extender)
- Corrosion Protection
- Harsh environment

- Inspecting the I/O library
- Inspecting IOM function blocks
- Inspecting channel function blocks
- Defining module containment
- Temperature Derating for UIO
- Internal dissipation calculation for UIO
- Temperature Derating curves for UIO
- Maximum Temperature Alarm for UIO-2
- High Temperature Limit Calculation for UIO-2

3.4.1 Inspecting the I/O library

Series C module function blocks and I/O channel blocks are housed in the Series C I/O library of Control Builder.

Figure 3.2 Series C I/O library



3.4.2 Inspecting IOM function blocks

All IOM function blocks are associated with (children of) an IOLINK function block.

The Series C I/O IOM function blocks are the following:

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-24

- DI-HV
- DISOE
- DO-24B
- SP
- SVP
- PI
- UIO
- UIO-2

3.4.3 Inspecting channel function blocks

The Series C I/O Channel function blocks are the following:

Table 3.4 Series C I/O channel function blocks

Channel block name	Associated with IOM blocks
AICHANNEL	• AI-HART • AI-HL • AI-LLMUX[1] • AI-LLAI • UIO • UIO-2
AOCHANNEL	• AO • AO-HART • UIO • UIO-2
DICHANNEL	• DI-HV • DI-24 • DI-SOE • UIO • UIO-2
DOCHANNEL	• DO-24B[2] • UIO • UIO-2
SP_AI SP_AO SP_DI SP_DO SP_SPDVOTE SP_SPEED	• SP
SVP_AI	• SVP

Channel block name	Associated with IOM blocks
SVP_AO SVP_REGCTL SVP_DI	
PICHANNEL	• PI

3.4.4 Defining module containment

An individual channel within a Series C I/O block is often abbreviated as an IOC block. While an IOC block must be 'contained in' a Control Module (CM) in Control Builder, the IOC block actually resides within the associated IOM device. This means you change the execution state (EXECSTATE) of a CM independent of the IOC's point execution state (PTEXECST).

Figure 3.3 Execution State

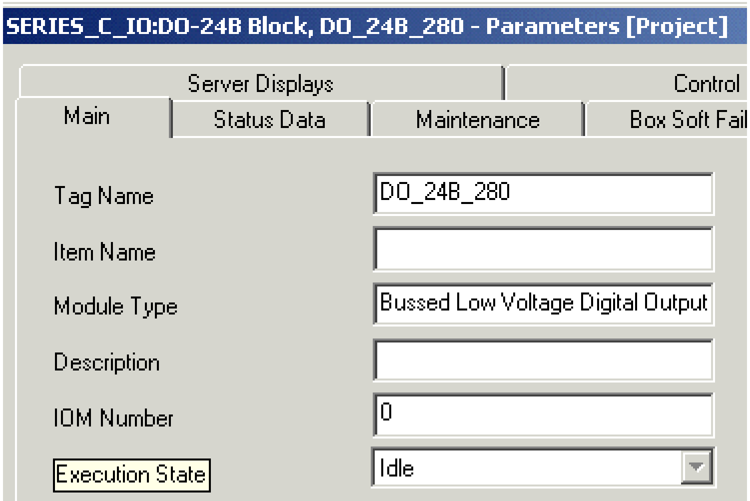
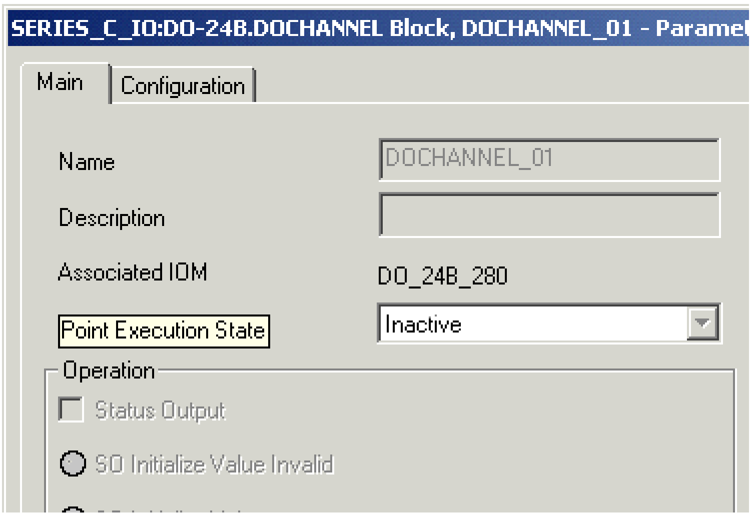


Figure 3.4 Point Execution State



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3.4.5 Temperature Derating for UIO

The maximum outside module temperature must be limited depending on the internal dissipation.

> ATTENTION
> - Airflow through the module is assumed to be natural convection.
> - Ensure that the UIO modules are installed in the correct position. A UIO module must be mounted in the upright position.

To determine the maximum acceptable outside module temperature for a typical configuration, perform the following steps.

1. Perform the **Internal Dissipation Calculation for UIO**.
   a. Determine and record the actual configuration data.
   b. Calculate the totals per dissipation contributor.
   c. Add the totals of the previous step to determine the internal dissipation.
2. Using the **Temperature Derating Curves for UIO**, determine the maximum acceptable outside module temperature.

3.4.6 Internal dissipation calculation for UIO

To calculate the maximum outside module temperature, you require the IO configuration. The maximum dissipation caused by the kernel logic of the UIO module is a fixed value. The other dissipation contributions depend on the channel configuration.

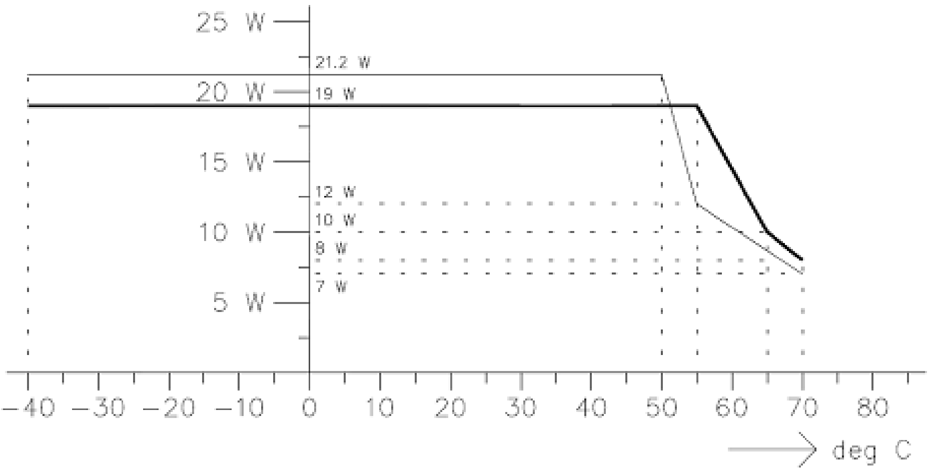
Table 3.5 Dissipation Calculation

Dissipation contributor	Max. dissipation per channel (W)	Number of configured channels	Dissipation (W)
Kernel logic			5.5
DI w/ OWD; field impedance ≥ 5 kΩ	0.01		
DI; closed contact; 3.5mA	0.085		
AI; I < 24mA; Current limited by field	0.05		
AI; I > 24mA; Current limited by UIO *	0.49		
DO; I < 0.3A	0.115		
DO; I < 0.5A	0.305		
AO; 500 Ω field impedance; I < 23mA	0.225		
AO; 250 Ω field impedance; I < 23 mA	0.335		
AO; field impedance < 250 Ω; I < 23 mA	0.47		
AO; field impedance < 250 Ω; I < 20 mA	0.42		
Total Power Dissipation (W)			
Max. outside module temperature °C			

* Analog input current above 24mA must be avoided. Field devices for the analog input must be configured to drive current below 24mA. For example, 3.5mA, for sensor fault conditions to minimize the UIO internal power dissipation. The thin-line derating curve needs to be taken when you are using current above 24mA.

3.4.7 Temperature Derating curves for UIO

The following graph displays the maximum outside module temperature versus the internal power dissipation.



Thick line: applicable for most applications having AO<=20mA and AI<=24mA

Thin line: applicable if one or more channels have AO>20mA or AI>24mA

3.4.8 Maximum Temperature Alarm for UIO-2

The alarm threshold safe operating temperature is determined based on the I/O channel configuration of the module and the anticipated module inlet air temperature.

> **ATTENTION**
> - Airflow through the module is assumed to be natural convection.
> - Ensure that the UIO modules are installed in the correct position. A UIO module must be mounted in the upright position.

To determine the maximum acceptable outside module temperature for a typical configuration, perform the following steps:

1. Perform the **High Temperature Limit Calculation for UIO-2**.
   a. Determine and record the actual configuration data and the **Estimated Ambient** inlet air temperature.
   b. Calculate the totals per dissipation contributor. For each channel type, multiply the total number of configured channels by the corresponding **Maximum Temperature Rise per**

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channel value.

c. Add the totals of the previous step to the **Estimated Ambient** temperature to determine the **High Temperature Limit Setting**. This limit value should not exceed 120 °C.

2. Enter the limit value into UIO-2 module configuration screen in Experion Control Builder.

3.4.9 High Temperature Limit Calculation for UIO-2

Table 3.6 Dissipation Calculation

Estimated Ambient [°C]		50		
Dissipation Contributor		Temperature Rise per channel [°C]	Number of channels (Total not to exceed 32)	Channel Contribution to Temperature Rise [°C]
DI	Closed contact	0.91	0	0.00
DO	<500 mA	1.06	0	0.00
AI	<20 mA	1.42	0	0.00
AO	<22 mA, 220 ohms	1.56	0	0.00
Total Number of Configured Channels			0	
High Temperature Limit Setting [°C]				50

3.5 I/O Link performance specifications

The concept of a Link Unit (LU) was introduced with PM I/O where a LU was defined as being roughly equivalent to one parameter read (or write) per second.

With the introduction of Series C I/O, the transmission rate of data on an IOLINK configured with Series C I/O is now double that of PM I/O.

ATTENTION

The Specification and Technical information is subject to change without notice and is superseded by information in applicable Experion product Specification and Technical data documents. Hence, for each Experion release, you are recommended to refer the applicable Specification and Technical data documents.

Table 3.7 Transmission rate of data on an I/O Link

I/O type	Link rate per second	Link Units per second
PM I/O	1 parameter read or write	1000
Series C I/O	1 parameter read or write	2000

> NOTE
> Refer to *Turbine Control User's Guide* for I/O link performance specification of the SPM and SVPM.

3.5.1 Reviewing Link Unit utilization

The Link Unit utilization cycle rate varies depending on the type of block being used. The following table defines the specifications for the various blocks.

Table 3.8 Link Unit utilization rates

Block names	Data processing	Link Units per cycle time	Cycle time
Every primary IOM	Event Collection	1	500 ms
Every secondary IOM	Event Collection	1	500 ms
DI-xxx IOM blocks	PV Scanning	1.75	IOM block's SCANRATE
DO-xxx IOM blocks	BACKCALC Scanning	1.25	IOM block's SCANRATE
AI-xxx IOM blocks	PV Scanning	5	IOM block's SCANRATE
AO-xxx IOM blocks	BACKCALC Scanning	5	IOM block's SCANRATE
AOCHANNEL	OP Store	1	OP connector's CM Execution Rate
status output for DOCHANNEL	SO Store	1	SO connector's CM Execution Rate
Pulse width modulation for DOCHANNEL	BACKCALC Scanning	1	IOM block's SCANRATE
Pulse width modulation for DOCHANNEL	OP Store	1	OP connector's CM Execution Rate

3.5.2 Reducing I/O Link traffic

If I/O Link overruns persist, you reduce the I/O Link traffic by:

- Increasing the value of the IOM's Scanning Rate parameter [SCANRATE] (i.e. increasing the time interval between IOM scans)
- Increase the Execution Period of Control Modules containing Output Channel blocks
- Reducing the number of IOMs configured
- Split the IOMs across multiple IOLINKS
- Check for presence of an address 'Chattering ' alarm events

Honeywell

TIP

Link IDs are only detected on their corresponding modules.

- Modules with Link ID 1 cannot detect Link ID 2.
- Modules with Link ID 2 cannot detect Link ID 1.

ATTENTION

Number of UIO-1 (CC-PUIO01) per copper I/O Link is limited to only **18 redundant modules** (not 40 redundant modules).

3.5.3 Event collection

Under normal conditions, every IOM configured on the I/O Link, whether primary or secondary, uses Link Units for event collection. This activity is periodic and can be accounted for, however; conditions in which numerous events and alarms are generated are unpredictable and may cause transient I/O Link overruns and delays in display updates. These transient overruns clear once the rush of events and alarms are collected.

3.5.4 PV and Back calculation scanning

The following I/O parameters are automatically scanned by the C300 as soon as the IOM block is loaded.

Table 3.9 I/O parameters scanned when the IOM is loaded

IOM block	Scanned parameters
AI-xxx	PV, PVSTS
AO-xxx	OP, INITREQ
DI-xxx	PVFL, BADPVFL
DO-xxx	SO, INITREQ, OP

The number of AI and DI channel blocks contained within CMs or SCMs:

- does not increase LU consumption.

The DO channel blocks contained in CMs and SCMs:

- does also not increase LU consumption for Back Calculation scanning, but LU consumption increases for each OP or SO store.

3.6 Universal Input/Output Module-2 (UIO-2)

Beginning with R432, a new Series C Universal Input/Output (UIO) module, the UIO-2, has been introduced. The UIO-2 not only supports all features and benefits offered by UIO, it also provides a few enhancements over the UIO. There are a few differences compared to the UIO too.

The UIO-2, driven by hardware miniaturization has resulted in a new design with reduced overall IOM and IOTA dimensions. Available in both redundant and non-redundant versions, the UIO-2 has a reduced footprint in the cabinet and increased density of IO point count per cabinet.

As the physical dimensions of the IOM and its IOTA are entirely different from the existing UIO, the UIO-2 is not a replacement for the UIO. The following sections provide a list of features of the UIO-2 and a list of significant differences between UIO-2 and UIO.

- New and enhanced features of UIO-2
- UIO-2 and UIO-1 compared

3.6.1 New and enhanced features of UIO-2

The UIO-2, in addition to providing all features provided by UIO, provides the following enhanced features beginning with R432:

- Is a single board module with physical dimension: 8.5 mm x 14.5 mm x 16 mm (5.5 mm dia) [4 x 4.5 dia x 14 width x 17 height]
- Dimensions of the redundant and non-redundant IOTAs are 12” and 9”, respectively
- Provides one HART modem per I/O channel
- Supports pulse counting on up to four of any of the 32 channels that are configured as DI
- Supports DO ganging within the following eight channel number groups: 1 - 4, 5 - 8, 9 - 12, 13 - 16, 17 - 20, 21 - 24, 25 - 28, and 29 – 32. However, ganging across these groups is NOT possible.

Beginning with ExperionR501, the following additional enhancements have been provided :

- Supports Sequence Of Events (SOE) functionality for digital input signals on all 32 channels
- Supports 24 V NAMUR type input signals with current (Amps) levels in accordance with IEC 60947-5-6:1999 specifications.

3.6.2 UIO-2 and UIO-1 compared

The following table describes the differences between UIO-2 and UIO-1.

Table 3.10 UIO-2 and UIO-1 comparison

Feature	UIO-2	UIO-1
Board	Single board module	Three board module
IOTA dimensions	Redundant – 12” Non-redundant – 9”	Redundant – 18” Non-redundant – 12”
HART modem count	One HART modem per channel	Only two HART modems: one modem dedicated to channels 1-16 and a second modem dedicated to channels 17-32.
Pulse counting	Supported on a maximum of 4 channels where each channel can be any of the 32 channels configured as DI. Input pulse frequency less than or equal to 15 KHz is supported.	Up to 4 channels, within channels 15 to 18 only, are supported for pulse counting. Input pulse frequency of 10 KHz is supported.
DO ganging	Supported for 2, 3, or 4 channels within the following eight channel number groups: 1 - 4, 5 - 8,	Supported for 2, 3,or 4 channels within any 4 channels. However,

Feature	UIO-2	UIO-1
	9 - 12, 13 - 16, 17 - 20, 21 - 24, 25 - 28, and 29 – 32. However, ganging across these groups is NOT possible.	channels 32 and 1 cannot be ganged.
SOE	Supported on all 32 DI channels	Not supported.
NAMUR input signals	Supported on all DI channels receiving 24 V NAMUR type input signals with current (Amps) levels in accordance with IEC 60947-5-6:1999 specifications. The DI channel can be configured to detect and report Open Wire and Short Circuit conditions. The following states are supported: • Open Wire • ON • OFF • Short Circuit **NOTE** DI channels enabled for SOE cannot be configured to support NAMUR signal inputs.	Not supported.

CHAPTER

4

SERIES C I/O INSTALLATION AND UPGRADES

The Experion release utilizes new hardware designs including those for the controllers, I/O modules, and switches. The information contained in this section defines how to establish the various hardware connections and Series C I/O firmware.

To review planning the entire Series C Control System, refer to the Control Hardware Planning Guide's Planning Your Series C Control System.

4.1 Installation Declarations

ATTENTION

This equipment shall be installed in accordance with the requirements of the National Electrical Code (NEC), ANSI/NFPA 70, or the Canadian Electrical Code (CEC), C22.1. It is supplied as 'open equipment' that is intended to be mounted on a sub-panel within an enclosure. The suitability of the enclosure and installed system shall be acceptable to the local 'authority having jurisdiction,' as defined in the NEC, or 'authorized person' as defined in the CEC.

NOTE

Electrostatic discharge can damage integrated circuits or semiconductors if you touch connector pins or tracks on a printed wiring board.

- Touch a grounded object to discharge static potential
- Wear an approved wrist-strap grounding device
- Do not touch the wire connector or connector pins
- Do not touch circuit components
- If available, use a static safe workstation
- When not in use, keep the component in its static shield box or bag

WARNING

Unless the location is known to be non-hazardous, do not:

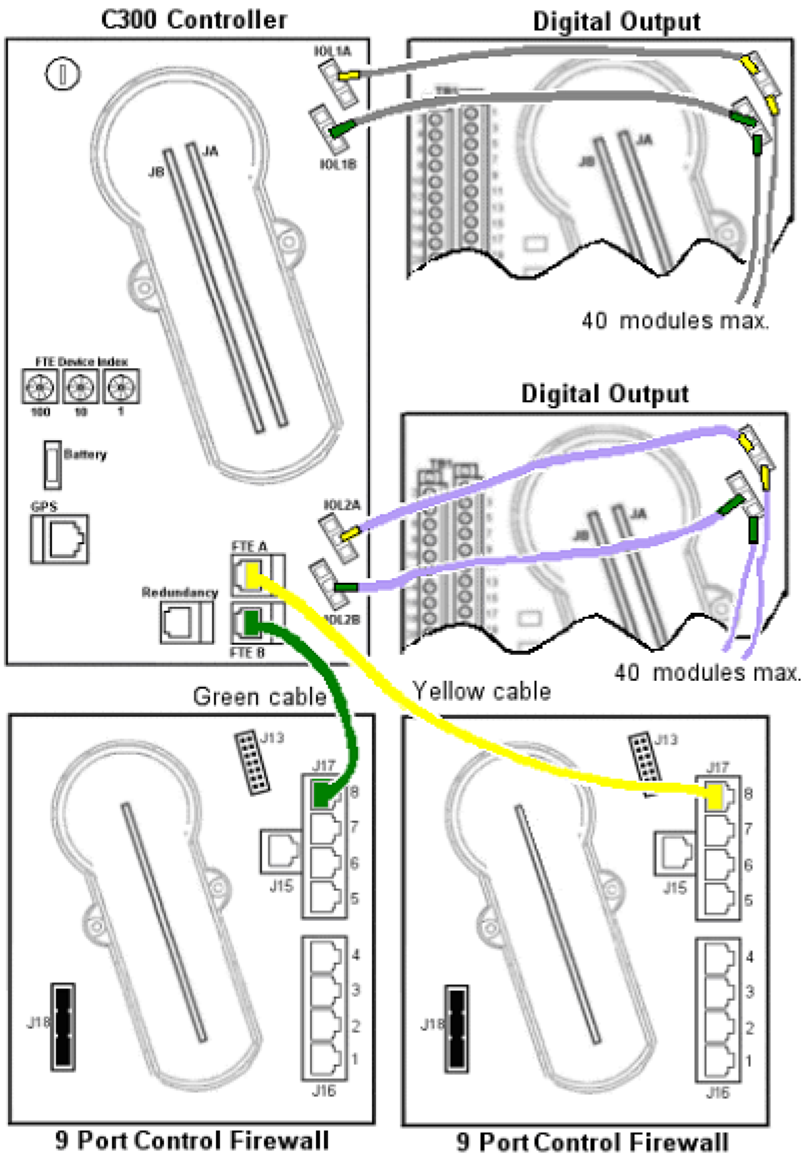
- Connect or disconnect cables
- Install or remove components
- Install or remove isolators

While the control system is powered.

4.1.1 Introduction

The following figure represents the main cabling of the Series C300 controller, Control Firewall, and I/O IOTA boards.

Figure 4.1 Series C board connections



4.1.2 I/O Link Address Jumpers

The I/O Link Address is configured using a push-on color-coded jumper with a printed number (1-40) that must be installed on each IOTA.

ATTENTION

- IO modules configured using Gray address jumpers must be connected to I/O Link 1 on the C300/CN100.
- IO modules configured using Violet address jumpers must be connected to I/O Link 2 on the C300.
- IO modules connected to the wrong I/O Link do not communicate each other.

- The IOM Number parameter (IOMNUM) specifies the address of the module on the I/O Link and must match the I/O Link address jumper on the IOTA
- Only the Honeywell provided address jumper tiles must be used. When changing address jumpers, you must ensure that:

  (1) The IOM is disconnected from the Link,

  (2) Power cycled after the address change, then

  (3) The IOM may be re-connected it back to the Link

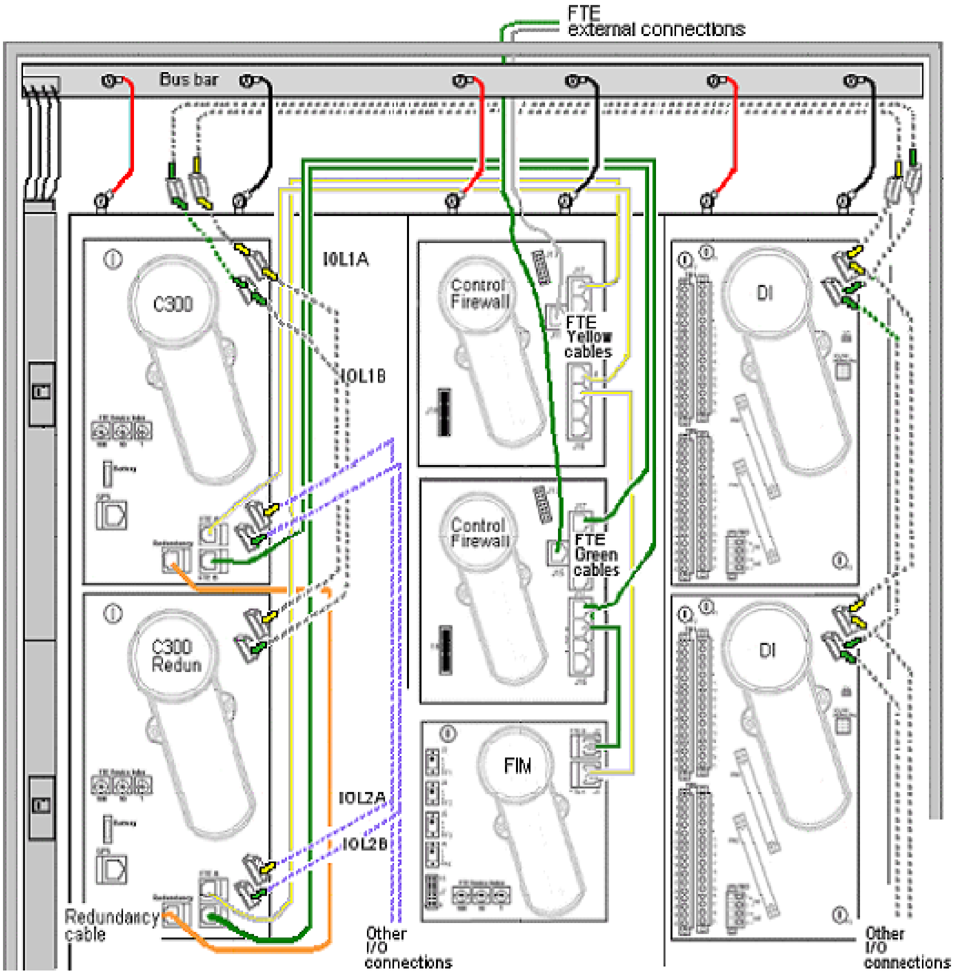
4.1.3 Cabling

The following graphic is an example of possible configuration connections with regards to the Series C I/O cabinet. Your configuration may vary based on the module layout of your cabinet. The following table defines cable type and usage in the graphic below.

Table 4.1 Series C I/O cable types

Cable	Color	Purpose
FTE -A	Yellow	Connect controller to firewall (point-to-point)
FTE - B	Green	Connect controller to firewall (point-to-point)
FTE - Redundant	Orange	Private path between primary and secondary controller (point-to-point)
IOL1A	Grey/yellow	Connect controller to I/O
IOL1B	Grey/green	Connect controller to I/O
IOL2A	Violet/yellow	Connect primary controller to secondary controller and then to I/O
IOL2B	Violet/green	Connect primary controller to secondary controller and then to I/O
24V	Red	Connect to positive terminals of power supply A and power supply B
GND	Black	Connect to negative terminals of power supply A and power supply B

Figure 4.2 Series C cabling



4.2 Installing the Series C IOTA on the carrier

- You can use a redundant IOTA to support a non-redundant Series C IOM application. Just be sure to install the non-redundant Series C IOM in the primary location on the IOTA.
- Be sure the enclosure is connected to a protective earth ground using #8 AWG solid copper wire. There should be metal to metal contact between the grounding bus bar and the enclosure as well as the carrier.

4.2.1 Prerequisites

Carrier for mounting IOTA is installed in a cabinet or desired mounting location.

- Power supply is installed.
- Control firewall is installed.
- All wiring and pre-fabricated cables are available and labeled as applicable.
- Be sure all power is turned off at the installation location.
- You have the mounting hardware supplied with the components.

4.2.2 Mounting the IOTA

Select desired mounting location on carrier and align mounting holes in IOTA with screw-hole locations on the carrier. Be sure component side of IOTA is facing up.

6 inch IOTA board 4 mounting screws

9 inch IOTA board 6 mounting screws 12 inch IOTA board

ATTENTION

When mounting the either the 9 or 12 inch IOTA board, it is recommended to secure the three mounting screws on one side (either left or right) and then secure the other side.

Securing the four corner screws and the two middle screws may cause bowing of the board and impact the alignment of the IOTA board to the carrier holes and is not recommended.

CAUTION

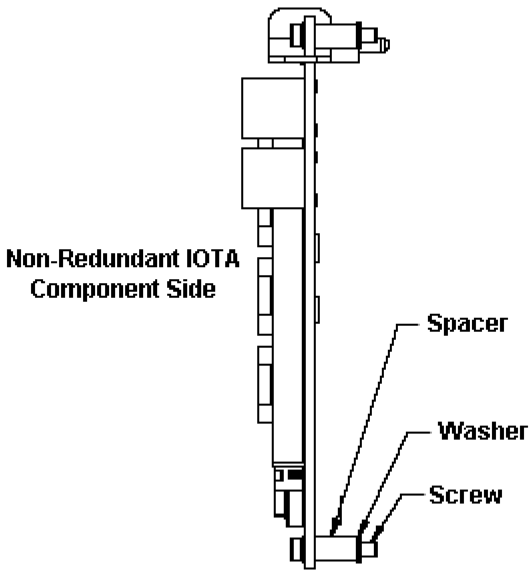
The IOTA power and ground screws can bind during installation or removal if the mounting screws are fully secured before the power/ground screws are installed.

Recommended sequence:

a. Secure the IOTA to the carrier tightening the IOTA's mounting screws only half-way. Insert the spacers and washers between bottom of IOTA and top of carrier.

b. Install the 24V (power) and ground (common) **screws fully into the bus bars**, torquing the screws to 5-inch pounds.

c. Finish installing the IOTA by **tightening the IOTA's mounting screws only full-way**, torquing the screws to 3-inch pounds



4.3 Mounting the I/O module on the IOTA

4.3.1 Prerequisites

It is recommended to attach the IOTA board to the Backplane prior to mounting the module to the IOTA. Ensure the following:

- IOTA is mounted on the Backplane.
- Power supply is installed.
- Control firewall is installed.
- All wiring and pre-fabricated cables are available and labeled as applicable.
- All power is turned off at the installation location.
- You have the mounting hardware supplied with the components.

4.3.2 Mounting the module

1. Insert the module onto the IOTA board making sure that the circuit board mates properly with the IOTA board connector.
2. Secure the module to the:
   - IOTA board - with two screws located on each side of the plastic cover.
   - Backplane - with the long gray plastic screw located on the module's face.

> CAUTION
>
> Use only a #2 Phillips screw-driver to carefully loosen or tighten the long gray plastic screw. Do not use either a #1 Phillips screw-driver or a battery-powered screw-driver to remove or install the plastic screw as this can damage the screw head.

4.4 Grounding and power considerations - IOTA boards

4.4.1 Attaching the IOTA board

The Series C cabinet allows mounted carriers that support the attachment of the IOTA boards. By making these connections, power, and chassis, grounding is provided to the IOTA board.

- Testing for power

4.4.2 Testing for power

> CAUTION

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Extreme care must be taken when testing for power at the Series C bus bars. Improper testing can result in an electrical short circuit, which will impact all modules attached to the channel carrier assembly.

Never use a test probe at an unattached IOTA's 24V screw hole. The probe can potentially touch the back channel assembly causing a short circuit.

The following locations are recommended for testing power:

Preferred location if IOTAs are attached

- Center of the screw that attaches the IOTA to the 24V bus bar.

Preferred location if IOTAs are NOT attached.

- Center of the screw of top connection terminal for power cable.

Testing for power at IOTA screw

1. Insert the test probe at the center of the screw that attaches the IOTA to the 24V power connection.
2. This concludes this procedure.

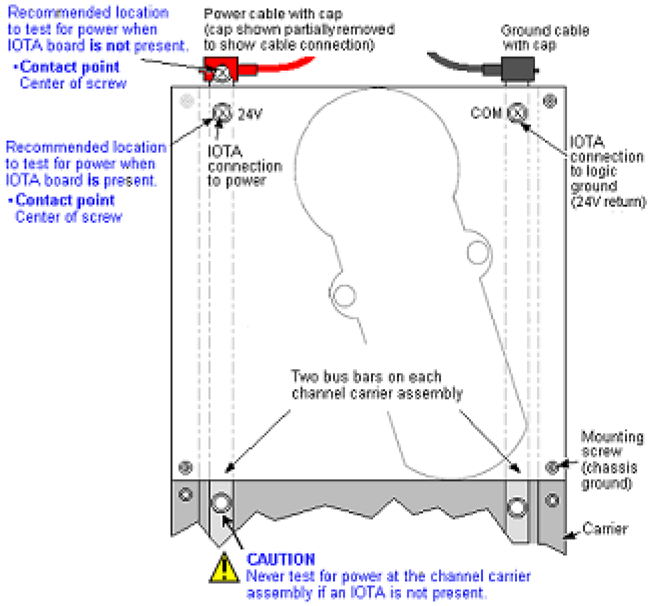
Testing for power at 24V bus bar top terminal

1. Carefully pull the red cap from the top of the terminal. It remains attached to the power cable.
   - Insert the test probe at the center of the screw to the 24V power terminal.
2. Carefully pull the black cap from the top of the terminal. It remains attached to the ground cable.

   Insert the test probe at the center of the screw to the COM ground terminal.
3. Replace the both caps.

4. This concludes this procedure.

Figure 4.3 Grounding and power connections



4.5 Connecting IOMs and field devices through I/O Termination Assemblies

All connections between IOMs and field devices are through I/O Termination Assemblies (IOTAs). IOTAs are sometimes connected to ancillary hardware that pre-conditions the signal for use in Experion.

The following table defines the relationship between IOM type and the ancillary hardware.

Table 4.2 IOM types and ancillary hardware

If IOM type is	Then the ancillary hardware
DO Digital Output	takes the output signal and drives a set of relays
AI LLMUX	can be one to four Field Termination Assemblies.

These FTA's pre-condition and package the signals before they are received by the IOTA.

To simplify system hardware selection and to minimize spare parts requirements, IOMs can be used with various types of IOTAs. The following table provides a list of IOMs, their associated IOTAs, and ancillary hardware. All IOM models listed within the same cell can be installed on any of the IOTAs listed in the adjacent cell.

ATTENTION

Connecting Series C IOM's into a Galvanically Isolated / Intrinsically Safe (GI/IS) environment requires specific GI/IS IOTAs.

Refer to the following for GI/IS IOTAs and the IOMs they support: GI/IS IOTA models

Table 4.3 IOMs, IOTAs, and ancillary cards

IOM block type	IOM model number	IOTA model number	IOTA description [7]	IOTA supported FTAs or ancillary cards
AI-HART	Cx-PAIH01 Refer to Attention	Cx-TAIX01	AI, non-redundant	None
		Cx-TAIX11	AI, redundant	None
		Cx-GAIX11	AI, GI-IS, redundant	MTL4541 MTL4575
		Cx-GAIX21	AI, GI-IS, non-redundant	MTL4544
	Cx-PAIH51	Cx-TAIX51	AI, non-redundant	None
		Cx-TAIX61	AI, redundant	None
AI-HART Differential/ Single-ended	CC-PAIH02	Cx-TAIX01	Analog Input, Non-redundant, 4 ch. differential	None
		Cx-TAIX11	Analog Input, Redundant, 4 ch. differential	None
		Cx-GAIX11	Analog Input, GI-IS, Redundant, no differential, 4-20 mA only	MTL4544
		Cx-GAIX21	Analog Input, GI-IS, Non-redundant, no differential, 4-20 mA only	MTL4541 MTL4575
		CC-TAID11	Analog Input, Redundant, 16 ch. differential	None
		CC-TAID01	Analog Input, Non-redundant, 16 ch. differential	None
AI-HL	Cx-PAIN01	Cx-TAIN01	AI, Non-redundant	None
		Cx-TAIN11	AI, Redundant	None
AI-HL	Cx-PAIX01 Refer to Attention	Cx-TAIX01	AI, Non-redundant	None
		Cx-TAIX11	AI, Redundant	None
		Cx-GAIX11	AI, GI-IS redundant	MTL-4541 MTL-4575
		Cx-GAIX21	AI, GI-IS non-redundant	MTL-4544
AI-HL Differential/ Single-ended	CC-PAIX02	CC-TAIX01	AI, non-redundant	None
		CC-TAIX11	AI, redundant	None
		Cx-GAIX11	AI, GI-IS, redundant	MTL4541 MTL4575
		Cx-GAIX21	AI, GI-IS, non-redundant	MTL4544
		CC-TAID01	AI, non-redundant	None
		CC-TAID11	AI, redundant	None
AI	CC-PAIN01	CC-	Analog Input, Non-redundant, no	None

IOM block type	IOM model number	IOTA model number	IOTA description [7]	IOTA supported FTAs or ancillary cards
		TAIN01	differential, 4-20 mA only	
		CC-TAIN11	Analog Input, Redundant, no differential, 4-20 mA only	None
AI-LLMUX	Cx-PAIM01	Cx-TAIM01[4] (note 1a)	LLMUX, non-redundant, non-coated	Mx-TAMT04 Mx-TAMR04 Mx-TAMT14
AI-LLAI	Cx-PAIM51	Cx-TAIM51	LLAI, non-redundant, non-coated	None
Cx-TAIM51	LLAI, non-redundant, non-coated			None
AO-HART	Cx-PAOH01	Cx-TAOX01	AO, non-redundant	None
		Cx-TAOX11	AO, redundant	None
		Cx-GAOX11	AO,GI-IS non-redundant	MTL4546C
		Cx-GAOX21	AO, GI-IS redundant	MTL4549C
	Cx-PAOH51	Cx-TAOX51	AO, non-redundant	None
		Cx-TAOX61	AO, redundant	None
AO	Cx-PAOX01	Cx-TAOX01	AO, Non-redundant	None
		Cx-TAOX11	AO, Redundant	None
		Cx-GAOX11	AO, GI-IS, Non-redundant	MTL4546C
		Cx-GAOX21	AO, GI-IS, Redundant	MTL4549C
AO	Cx-PAON01	Cx-TAON01	AO, Non-redundant	None
		Cx-TAON11	AO, Redundant	None
DI-HV	Cx-PDIH01	Cx-TDI110	DI, 120VAC non-redundant	None
		Cx-TDI120	DI, 120VAC redundant	None
		Cx-TDI220	DI, 240VAC non-redundant	None
		Cx-TDI230	DI, 240VAC redundant	None
DI-HV PROX	Cx-PDIH01	CC-TDI151	DI,120VAC non-redundant	None

IOM block type	IOM model number	IOTA model number	IOTA description [7]	IOTA supported FTAs or ancillary cards
DI-24	Cx-PDIL01	Cx-TDIL01	DI-24V, non-redundant	None
		Cx-TDIL11	DI-24V, redundant	None
		Cx-GDIL11	DI-24VDC, GI-IS, redundant	MTL4516 MTL4517
		Cx-GDIL21	DI-24VDC, GI-IS, non-redundant	MTL4510
		Cx-GDIL01	DI-24VDC, GI-IS, redundant (for expander)	MTL4511
		Cx-SDXX01	GI-IS expander	MTL4511
	Cx-PDIL51	Cx-TDIL51	DI-24V, non-redundant	None
		Cx-TDIL61	DI-24V, redundant	None
DI_SOE	Cx-PSOE01 (note 4)	Cx-TDIL01	DI-24V, non-redundant	None
DO-24B	Cx-PDOB01	Cx-TDOB01	DO-24V, bussed, non-redundant	None
		Cx-TDOB11	DO-24V, bussed, redundant	None
		Cx-TDOR01	DO- High Voltage Relay, non-redundant	Cx-SD0R01[2] (note 2)
		Cx-TDOR11	DO- High Voltage Relay, redundant	Cx-SD0R01[2] (note 2)
		Cx-GDOL01	DO-24VDC, GI-IS, redundant (for expander)	MTL4521
		Cx-SDXX01	GI-IS expander	MTL4521
	Cx-PDOD51	Cx-TDOD51	DO-24V, bussed, non-redundant	None
		Cx-TDOD61	DO-24V, bussed, redundant	None
SVPM	CC-PSV201	CC-TSV211	Servo Valve Positioner IOTA, Redundant, Coated	None
SPM	CC-PSP401	CC-TSP411	Speed Protection IOTA, Redundant, Coated	None
PI	CC-PPIX01	CC-TPIX11	Pulse Input w/ Fast Cutout, Redundant	None
UIO	CC-PUIO01	CC-TUIO01	UIO, Non-Redundant	None
		CC-TUIO11	UIO, Redundant	
UIO-2	CC-PUIO31	CC-TUIO31	Universal IO-2, non-redundant, coated	None
		CC-TUIO41	Universal IO-2, redundant, coated	
DI-24	DC-PDIL51	DC-TDIL01	DI 24V IOTA (Non-Redundant)	None
		DC-	DI 24V IOTA (Redundant)	

IOM block type	IOM model number	IOTA model number	IOTA description [7]	IOTA supported FTAs or ancillary cards
		TDIL11		
DI-SOE	DC-PDIS51	DC-TDIL01	DI 24V IOTA (Non-Redundant)	None
		DC-TDIL11	DI 24V IOTA (Redundant)	
DO-24B	DC-PDOD51	DC-TDOD51	DO 24V Bussed without RB IOTA (Non-Redundant)	None
		DC-TDOD61	DO 24V Bussed without RB IOTA (Redundant)	

NOTES

1. Cx-TAIM01 - This does NOT require the MU-TLPA02 Power Adapter and supports in-cabinet configuration or in a suitable enclosure up to 1,000 feet remote from the LLMUX IOTA as displayed in Figure 15.
2. Cx-TAIM21 requires the MU-TLPA02 Power Adapter and can be mounted in-cabinet and remotely.
3. One CC-KREBxx uncoated cable is used to connect the IOTA to the relay extension board.
4. One CC-KREBxx coated cable is used to connect the IOTA to the relay extension board.
5. Bussed IOM (PDOB01) is used for both bussed outputs and relay outputs, however, only relay outputs require the additional card.
6. Redundantly configured IOMs must be installed on a redundant IOTA.
7. Non-redundant IOMs can be installed on non-redundant and redundant IOTAs. However, when installed on a redundant IOTA, non-redundant IOMs must be installed in the upper IOM slot of the redundant IOTA.

> CAUTION
>
> When a module is configured as non-redundant and uses a redundant IOTA, ensure that the lower slot is kept empty or if a module is plugged into the bottom slot, make sure that the module MUST be powered off.

8. The IOTA type used for Series C IO DI-24V is used with the DI-SOE IOM also.
9. Non-redundant differential IOTA (CC-TAID01) length is 9', non-redundant IOTA (CC-TAIX01 and CC-TAIN01) length is 6', and differential redundant IOTAs (CC-TAID11, CC-TAIN11, and CC-TAIX11) length is 12'.
10. A third level of connector is available for all differential mode connections as an extension of channel 13 through 16 terminals for all 16 channels.
11. Two new models of AI-HART (CC-PAIH02) and AI-HL (CC-PAIX02) modules are introduced to replace the older models of the AI-HART (CC-PAIH01) and AI-HL (CC-PAIX01) modules. The new models support both single-ended and differential inputs.
12. With R410, new models of AI-HART (Cx-PAIH51), AO-HART (Cx-PAOH51), DI-24V (Cx-PDIL51), and DO-24B2 (Cx-PDOD51) are introduced.

4.6 Powering the Series C system

Power systems for the Series C control hardware provides:

- optional redundant power supplies with separate mains power feeds
- optional system battery backup is also available, and
- a memory RAM battery is provided to supply memory retention power for the C300 Controller

The capabilities and options available with the Series-C power system are very similar to those available with the Process Manager Power System.

Refer to the Series C Power Supply in the C300 Controller User Guide additional power system information.

4.7 Fusing - Series C IOTA boards

Series-C I/O modules are constructed to support normal field failures, wiring errors and conditions such as a shorted wire. All Series-C IOTAs contain at least one fuse that provides protection for catastrophic errors in the IOTA, IOM and other elements of the Series-C system. In normal operation as well as many abnormal operations, the fuse element should not blow.

The following attributes apply to all Series-C I/O modules:

- 24V DC power is protected by a fuse mounted on the IOTA.
- For redundant IOTAs, a fuse is provided for each IOM. If one fuse element were to blow, the partner IOM continues to operate.

> **ATTENTION**
>
> In virtually all instances of normal field failure, the I/O module will recover without any maintenance action such as replacing a component or fuse.

To access the parts information for the fuses associated with each board and module, refer to Series C recommended spares in the Recommended Spare Parts section.

CHAPTER

5

Series C IOTA Pinouts

5.1 Analog Input IOTA Models CC-TAIX01, CC-TAIX11

The Series C Analog Input IOTA board is represented by the following information and graphic.

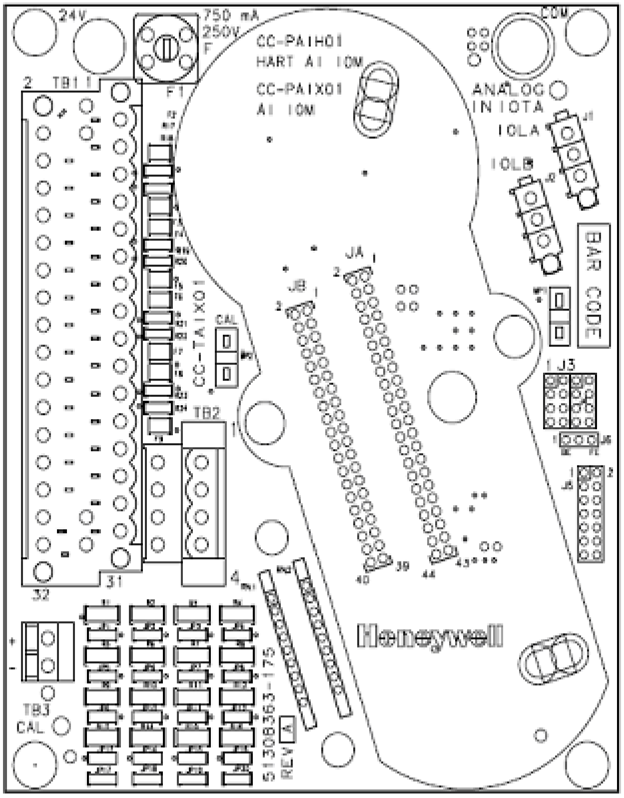
To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Analog Input in the Recommended Spare Parts section.

Series C Analog Input 6 inch, non-redundant IOTA is displayed.

Figure 5.1 Series C Analog Input 6 inch, non-redundant IOTA



NOTE

All I/O field terminations accept up to 14 gauge stranded wire.

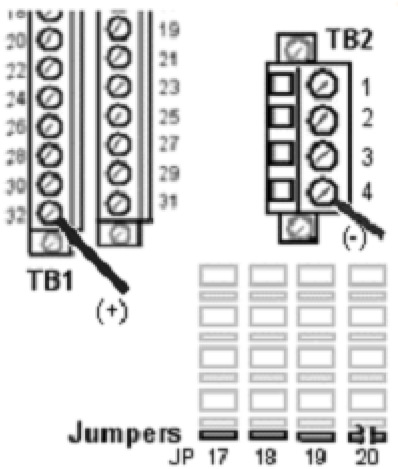
To properly wire, your module to the Series C Analog Input IOTA board with terminal block 1 (TB1) and terminal block 2 (TB2), use the following tables.

Table 5.1 AI 6 inch, non-redundant - terminal block 1

Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21

Terminal block 1		
Channel	Return screw	Power screw
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.2 AI 6 inch, non-redundant - terminal block 2

<table>
<tr><th colspan="4">Terminal block 2 - Low side of the differential inputs</th></tr>
<tr><th>If this TB2 screw is used</th><th>Then this channel is used</th><th>And this jumper is clipped</th><th></th></tr>
<tr><td>1</td><td>13</td><td>JP17</td><td rowspan="4">In the example below, cutting J20 would configure channel 16 for differential operation and pin 4 would be the low side (-) of the input signal.


Refer to Custom wiring - Analog Input module for additional power connection possibilities.</td></tr>
<tr><td>2</td><td>14</td><td>JP18</td></tr>
<tr><td>3</td><td>15</td><td>JP19</td></tr>
<tr><td>4</td><td>16</td><td>JP20</td></tr>
</table>

Jumpers are utilized to support the following conditions:

Table 5.3 Jumpers to support Analog Input connections

Channels	Signal screw
For channels 1 through 12	Each channel (1 through 12): • has a corresponding jumper. Therefore, channel 1's jumper would be JP1, and so forth. • the jumper must be cut if connected to voltage transmitters (1-5v. etc.)

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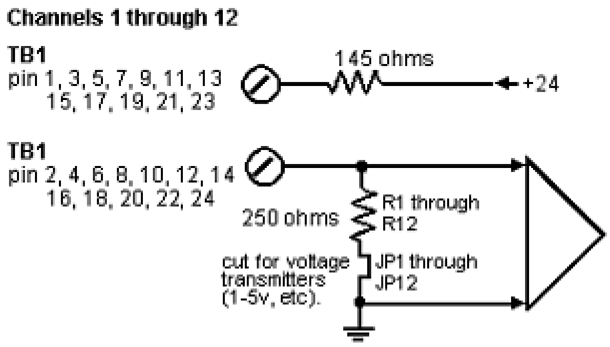
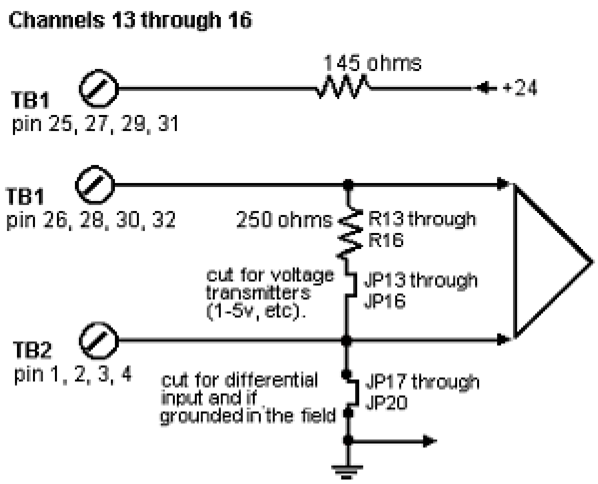
<table>
<tr><th>Channels</th><th>Signal screw</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>For channels

13 through 16</td><td>Each channel 13 through 16:
has a corresponding jumper. Therefore, channel 13's jumper would be JP13, and so forth.
the jumper must be cut if connected to voltage transmitters (1-5v. etc.)
Jumpers J17 through J20 are used with Terminal Block 2 (TB2) and are used if the device is grounded in the field.

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

- Field wiring and module protection - Analog Input module
- Two-wire transmitter wiring - Analog Input module
- Non two-wire transmitter wiring - Analog Input module
- Custom wiring - Analog Input module
- Analog Input wiring reference table
- Allowable field wiring resistance - Analog Input module
- IOTA board and connections - Analog Input module

5.1.1 Field wiring and module protection - Analog Input module

Individual field wiring is protected by an internal protection circuit permitting:

- Short circuit protection of input for field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Each signal can be shorted in the field with no damage to module or board. Other channels on the same IOM will not be affected

5.1.2 Two-wire transmitter wiring - Analog Input module

The AI IOM/IOTA is optimized for use with classic two-wire transmitters. All 16 channels can accept inputs from two-wire transmitters without any special wiring or jumper options.

The standard usage is to:

- reserve the first 12 channels of the AI IOM/IOTA for classic two-wire transmitters, and
- use the last 4 channels of the IOM/IOTA to interface any of the supported input styles (including two-wire transmitters).

Depending on the input style applied to channels 13 through 16, you may need to cut jumpers on the IOTA and apply wiring to the TB2 terminal block on the IOTA. This is discussed in detail in the following sections.

5.1.3 Non two-wire transmitter wiring - Analog Input module

The IOTA is pre-engineered (without custom wiring) to accept sources that are not two-wire transmitters, but you must use channels 13 through 16.

When sources other than two-wire transmitters are to be interfaced and you have more than 4 per IOTAs, then:

- the first four must be interfaced to channels 13 through 16, and
- the remainder may be able to interface to channels 1 through 12 (depending on input style) but you must perform some degree of custom wiring.

> NOTE
>
> There are some input styles that simply cannot be applied to channels 1 through 12 - if that applies to you then you will likely need to purchase an additional IOM/IOTA.

> CAUTION
>
> The jumpers on the IOTA are non-repairable; once cut, they stay cut. Careful planning is a must.

5.1.4 Custom wiring - Analog Input module

Custom wiring means:

- using additional wires to TB2 (beyond their intended purpose for channels 13 through 16)
- and/or using wires to another termination area in the cabinet engineered on a project-basis.

Some of the styles (other than two-wire transmitter):

- can be applied to channels 1 through 12 with the use of custom wiring.
- Other cannot be applied to channels 1 through 12 at all.

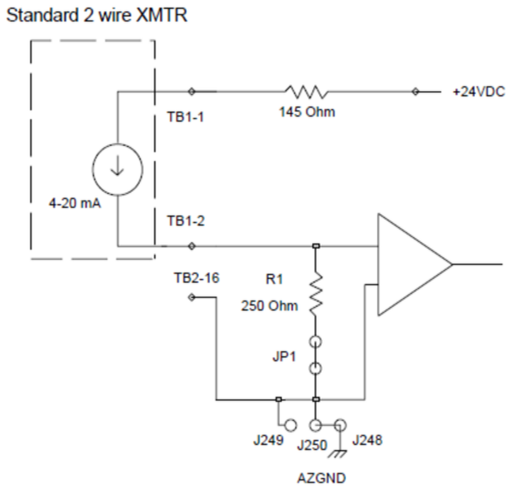
Table 5.4 Custom wiring to support Analog Input

Custom wiring scenarios

Standard and self-powered two-wire transmitter wiring

It is recommended to use channels 13 through 16, since these channels have a dedicated Series C ground screw (although it is possible to use channels 1 through 12).

Following figure illustrates an example jumper configuration for channel 1 of non-redundant 6 inch IOTA.

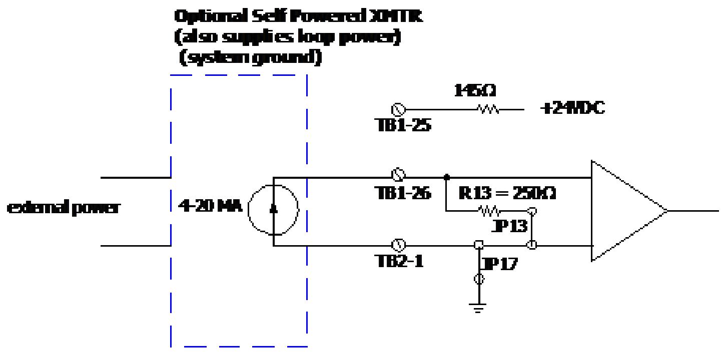


Self-powered transmitter with Experion PKS system ground

It is recommended to use channels 13 through 16, since these channels have a dedicated Series C ground screw (although it is possible to use channels 1 through 12).

For the following example:

- Channel 13 is used
- No jumpers need to be cut.
- The wire-pair is terminated to TB1-26 and TB2-1
- TB1-25 is not used.

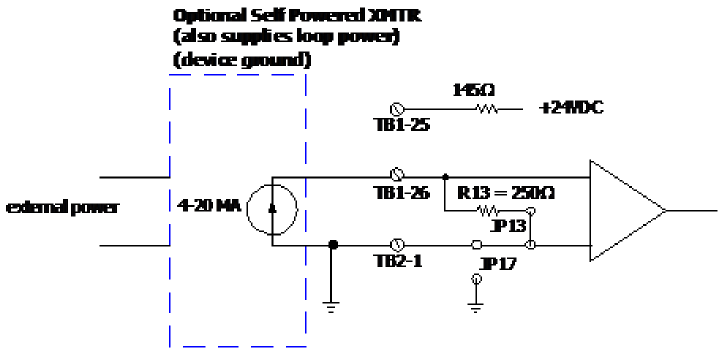


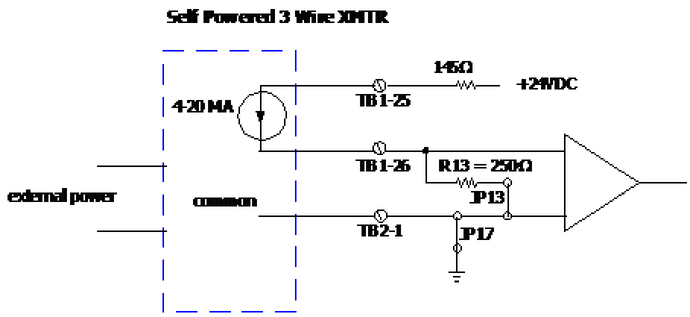
Self-powered transmitter with device grounded

This case can only be applied to channels 13 through 16 and the corresponding jumper must be cut.

For the following example:

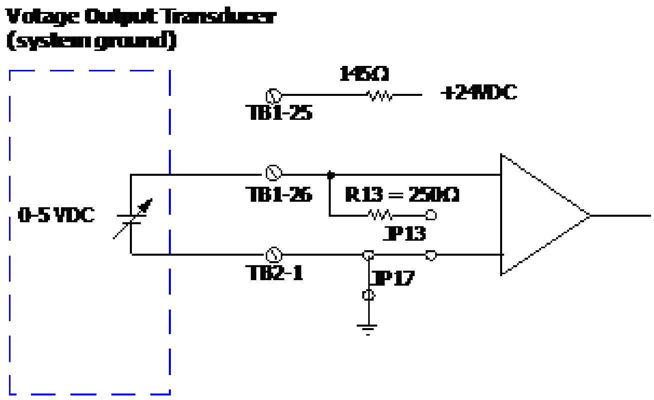
Custom wiring scenarios

• Cutting jumper JP-17 permits the transmitter's ground to be utilized
  ◦ Series C ground is then not used. Device ground must remain within the specified common-mode limits of the AI IOM.
  ◦ JP17 through JP20 are for channels 13 through 16, respectively.
• The wire-pair is terminated to TB1-26 and TB2-1.
• TB1-25 is not used.


Self-powered 3-wire transmitter (system ground) It is recommended to use channels 13 through 16, since these channels have 3 screws per channel (although it is possible to use channels 1 through 12). For the following example: • Channel 13 is used • No jumpers need to be cut • The three wires are terminated to TB1-25, TB1-26 and TB2-1 
Voltage input (system ground) It is recommended to use channels 13 through 16, since these channels have a dedicated Series C ground screw (although it is possible to use channels 1 through 12). For the following example: • Channel 13 is used. • Jumper JP13 (for the 250 ohm spool) needs to be cut. • The wire-pair is terminated to TB1-26 and TB2-1.

<table>
<tr><th>Custom wiring scenarios</th></tr>
<tr><td>

- TB1-25 is not used.



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

Slidewire

- Series C does not support Slidewire.
</td></tr>
<tr><td>

Range spool damage and wire shorting

Jumpers JP1 through JP16 are also used to overcome a damaged range spool (250 ohm dropping resistor).

A range spool can be damaged by being directly connected across a 24V for an extended period, such as, taking an even numbered terminal from TB1 to 24V. It can be removed from the circuit by clipping the corresponding jumper. You can continue to use the channel by providing a discrete (axial lead) 250 ohm resistor.

Example: using channel 5 and overcoming a damaged spool

1. One lead of the resistor connects to the even numbered screw on TB1 associated with that channel.

   (i.e. screw N = 2 times channel M, so screw 10 is for channel 5).

2. The other lead of the resistor connects to Series C ground, which can probably be found on any of the TB2 screw positions (assuming the corresponding jumper JP17-20 is still installed).

   If TB2 is already filled with wiring, 'doubling up' is permitted as long as the total wire dimension is less than the 14 AWG equivalent dimension.

3. Transmitter power is supplied in a non-incendive fashion through the odd-numbered terminals on TB1. This is done through a 145 ohm resistor inline with a Positive Temperature Coefficient (PTC) device that acts like a fuse (but never needs replacement).

   Thus, these field terminals can be permanently shorted to ground without damage. This is an improvement over Process Manager due to the inclusion of the PTC device.
</td></tr>
</table>

5.1.5 Analog Input wiring reference table

The following table summarizes the possible Analog Input wiring connections.

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Table 5.5 Summary - Analog Input wiring connections

Input style	*Connection characteristics*
Standard 2-wire transmitter	• Can use any of the 16 channels. • No custom wiring required. • No jumper cuts required.
Standard self-powered transmitter	• Can use any of the 16 channels. • No custom wiring required. • No jumper cuts required.
Self-powered transmitter with loop power (system ground)	• Can use any of the 16 channels. • Custom wiring is required for channels 1-12: you must find a screw terminal at Series C ground for one leg of the transmitter. • No jumper cuts required
Self-powered transmitter with loop power (device ground)	• Cannot use channels 1-12. • Only use channels 13-16.
Self-powered 3-wire transmitter (system ground)	• Can use any of the 16 channels. • Custom wiring is required for channels 1-12: you must find a screw terminal at Series C ground for one leg of the transmitter. • No jumper cuts required
Voltage Input (system ground)	• Can use any of the 16 channels. • Custom wiring is required for channels 1-12: you must find a screw terminal at Series C ground for one leg of the transducer. • You must cut the jumper associated with the range spool.
Voltage Input (device ground)	• Cannot use channels 1-12. • Only use channels 13-16.

> NOTE
>
> If multiple instruments need a ground reference the four positions of TB2 can serve as those ground points (assuming the JP17-JP20) jumpers are intact. If more than four grounding screws are needed then a custom wire from TB2 to a separate terminal block can allow for more grounding screw positions.

5.1.6 Allowable field wiring resistance - Analog Input module

The maximum allowable field wiring resistance between the transmitter and the IOTA connection terminal is dependent upon the voltage requirement of the transmitter. The formula for calculating the max wiring resistance for the Series C Analog Input is given by the following equation.

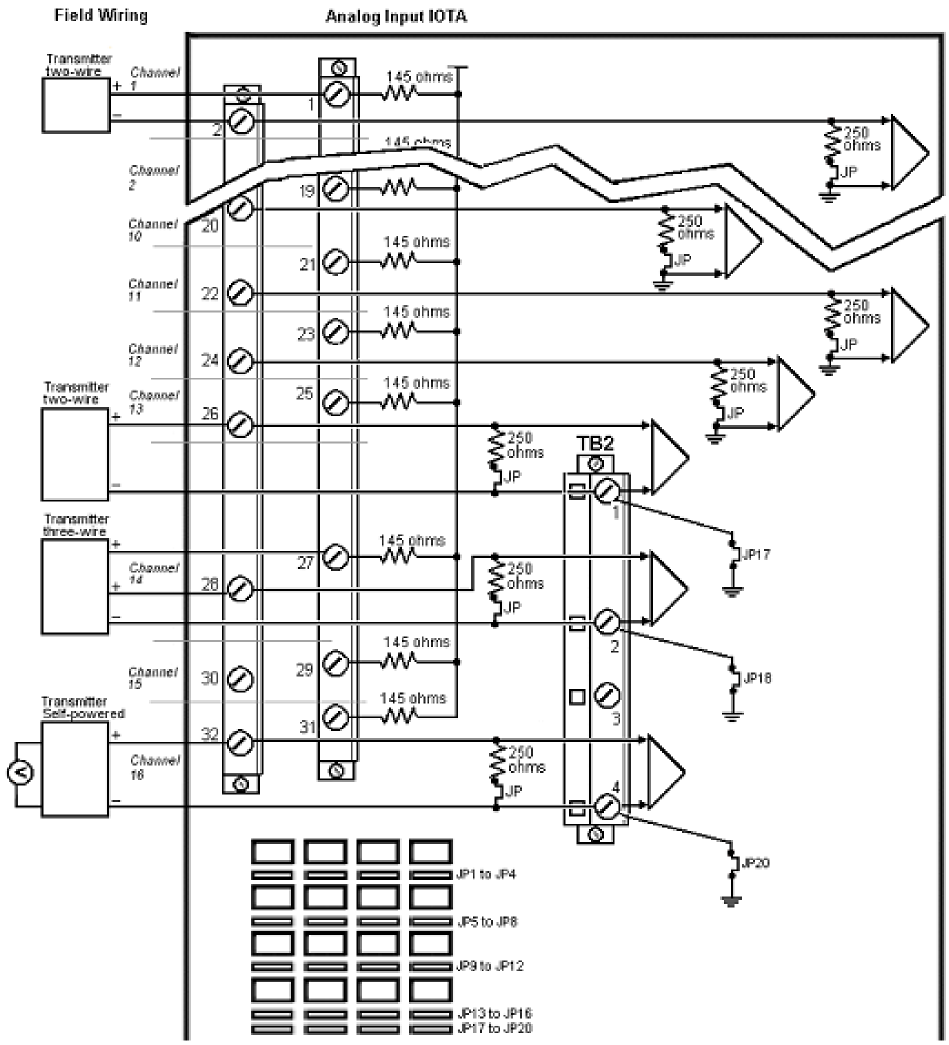
Rmax = [(13.0 - Vtx) / (0.022)]

where: Vtx = Voltage required at the transmitter terminal

5.1.7 IOTA board and connections - Analog Input module

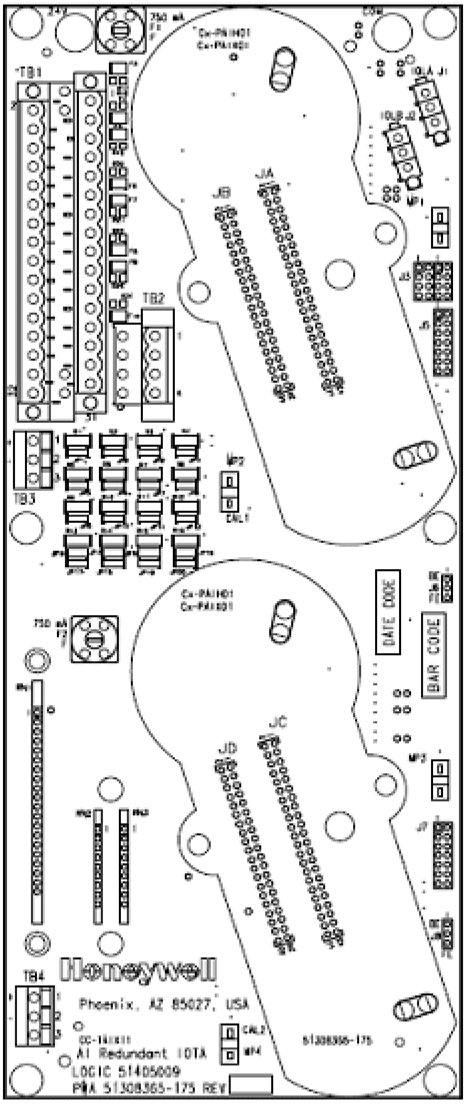
Series C Analog Input 6 inch, non-redundant IOTA and field wiring connection is displayed below:

Figure 5.2 Series C Analog Input 6 inch, non-redundant IOTA and field wiring connections



Series C Analog Input 12 inch, redundant IOTA is displayed:

Figure 5.3 Series C Analog Input 12 inch, redundant IOTA



5.2 Analog Input non-HART/HARTIOTA Models Cx-TAIX51, Cx-TAIX61

This series C Analog Input IOTA board is represented by the following information and graphic.

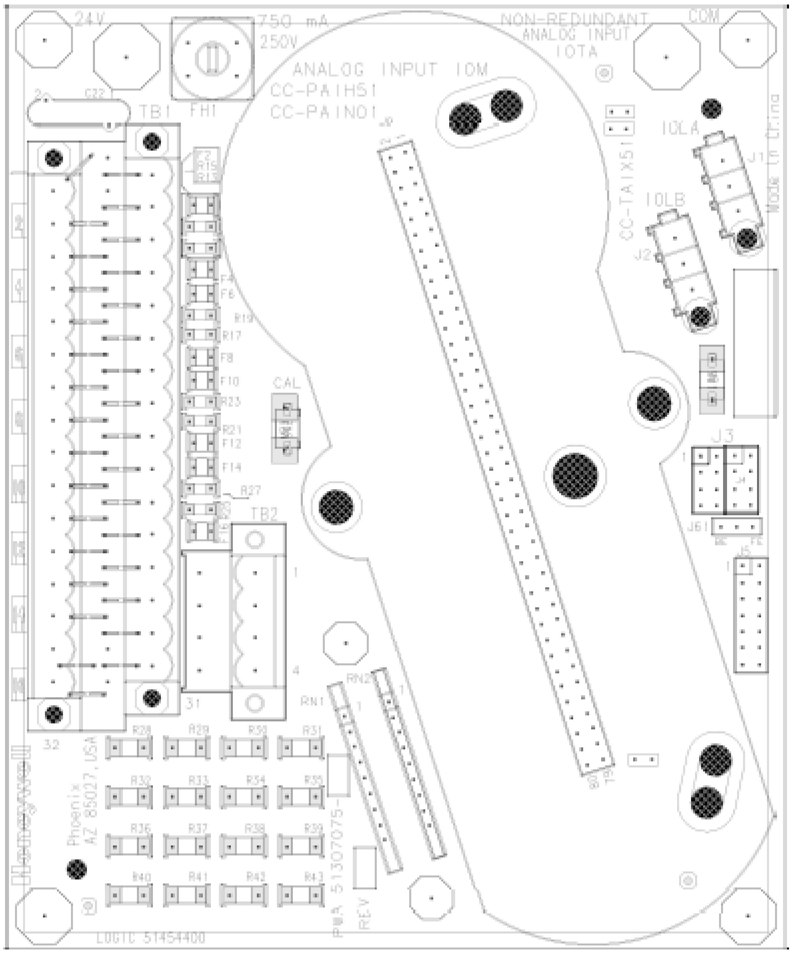
To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Analog Input in the Recommended Spare Parts section.

Series C HART/non-HART Analog Input 6 inch, non-redundant IOTA is displayed in the following figure.

Figure 5.4 Series C HART/non-HART Analog Input 6 inch, non-redundant IOTA



NOTE

All I/O field terminations accept up to 14 gauge stranded wire.

To properly wire your module to the HART/non-HART Analog Input IOTA with terminal block 1 (TB1) and terminal block 2 (TB2), use the following table.

Table 5.6 AI 6 inch HART AI, non-redundant - terminal block 1

Terminal Block 1 (TB1)		
Channel	Return Screw	Power Screw(24V)
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11

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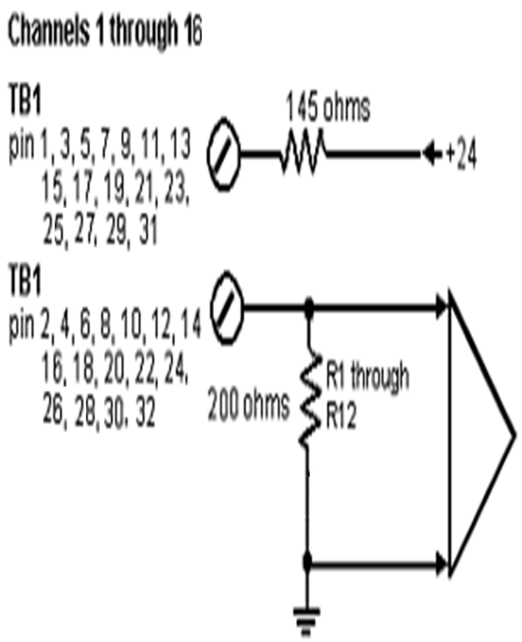
Terminal Block 1 (TB1)		
Channel	Return Screw	Power Screw(24V)
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.7 AI 6 inch, HART/non-HART AI, non-redundant terminal block 2

Channels	Signal screw
For channels 1 through 16	Channels 1 through 16 

- Field wiring and module protection - Analog Input HART module
- Two-wire transmitter wiring - Analog Input HART module
- Standard and self-powered two-wire transmitter wiring - Analog Input HART module
- Self-powered 3-wire transmitter (system ground) - Analog Input HART module
- Analog Input HART module wiring reference table
- Allowable field wiring resistance - Analog Input HART module
- IOTA board and connections - Analog Input HART module

5.2.1 Field wiring and module protection - Analog Input HART module

Individual field wiring is protected by an internal protection circuit permitting.

- Short circuit protection of input for field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Each signal can be shorted in the field with no damage to module or board. Other channels on the same IOM will not be affected.

5.2.2 Two-wire transmitter wiring - Analog Input HART module

The AI IOM/IOTA is optimized for use with classic two-wire transmitters. All 16 channels can accept inputs from two-wire transmitters without any special wiring or jumper options.

5.2.3 Standard and self-powered two-wire transmitter wiring - Analog Input HART module

The HART/non-HART AI IOM/IOTA is optimized for use with classic two-wire transmitters. All 16 channels can accept inputs from two-wire transmitters. It is recommended to use channels 13 through 16, since these channels have a dedicated ground screw (although it is possible to use channels 1 through 12).

Following figure illustrates an example jumper configuration for channel 1 of non-redundant 9 inch IOTA.

Figure 5.5 Non-redundant Analog Input 6 inch, standard 2-wire transmitter wiring

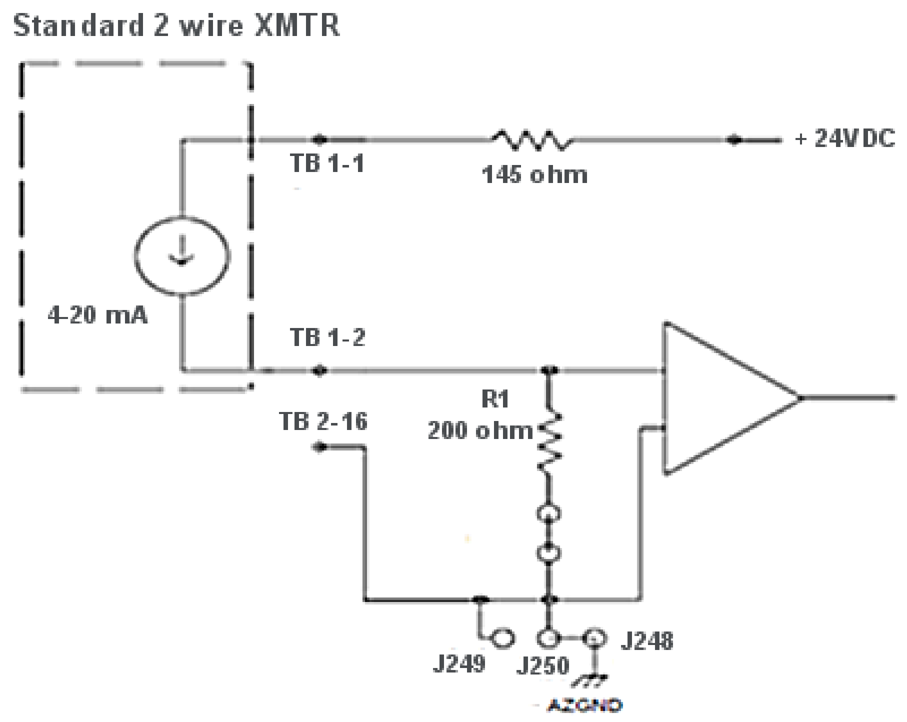


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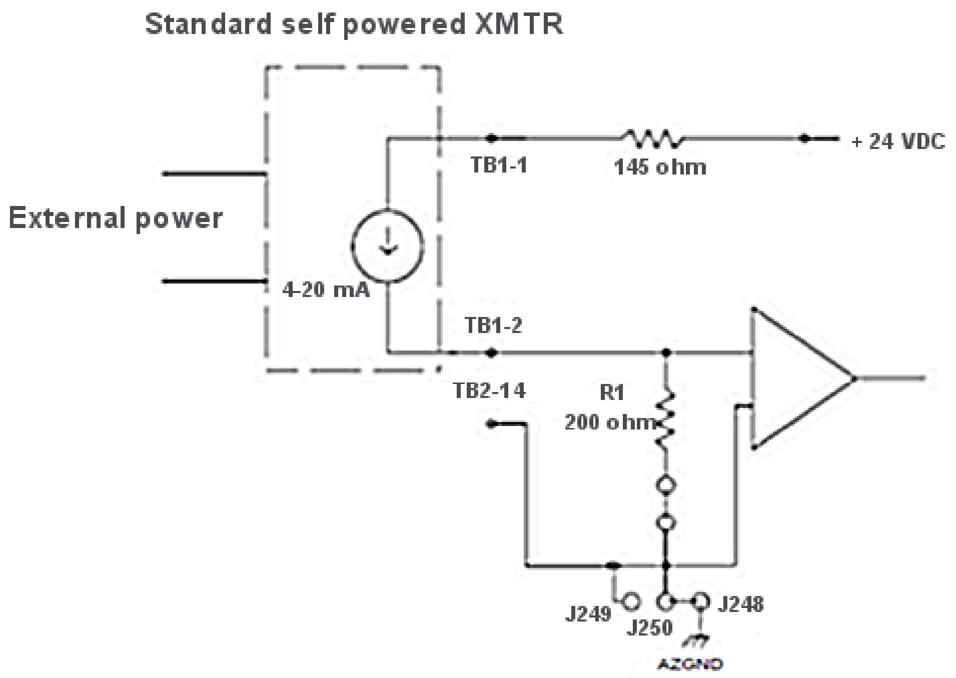
Figure 5.6 Non-redundant Analog Input 6 inch, self-powered 2-wire transmitter wiring

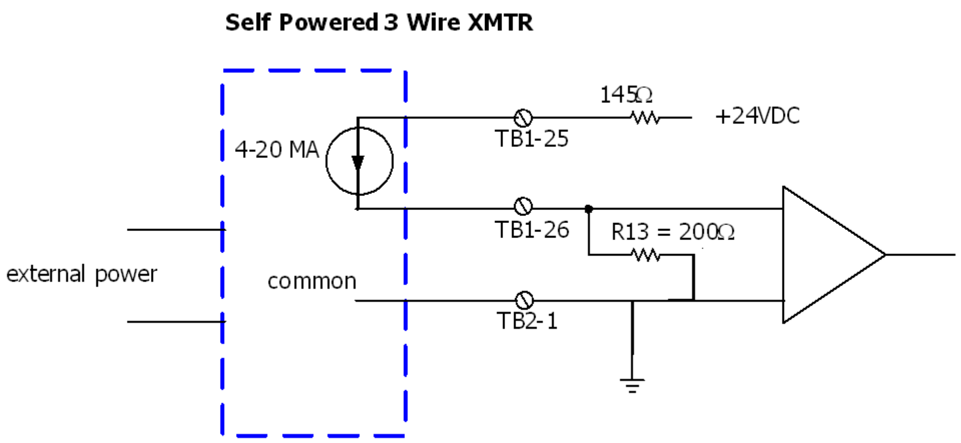


5.2.4 Self-powered 3-wire transmitter (system ground) - Analog Input HART module

It is recommended to use channels 13 through 16, since these channels have 3 screws per channel (although it is possible to use channels 1 through 12).

For the following example:

- Channel 13 is used
- The three wires are terminated to TB1-25, TB1-26 and TB2-1



NOTE

TB1: This is done through a 145 ohm resistor inline with a Positive Temperature Coefficient (PTC) device that acts like a fuse (but never needs replacement). Thus, these field terminals can be permanently shorted to ground without damage. This is an improvement over Process Manager due to the inclusion of the PTC device.

5.2.5 Analog Input HART module wiring reference table

The following table summarizes the possible Analog Input wiring connections.

Table 5.8 Summary - Analog Input wiring connections

Input style	*Connection characteristics*
Standard 2-wire transmitter	• Can use any of the 16 channels. • No custom wiring required.
Standard self-powered transmitter	• Can use any of the 16 channels. • No custom wiring required.
Self-powered transmitter with loop power(system ground)	• Can use any of the 16 channels. • Custom wiring is required for channels 1-12: you must find a screw terminal at ground for one leg of the transmitter.
Self-powered 3-wire transmitter (system ground)	• Can use any of the 16 channels. • Custom wiring is required for channels 1-12: you must find a screw terminal at ground for one leg of the transmitter.

5.2.6 Allowable field wiring resistance - Analog Input HART module

The maximum allowable field wiring resistance between the transmitter and the IOTA connection terminal is dependent upon the voltage requirement of the transmitter. The formula for calculating the max wiring resistance for the Analog Input is given by the following equation.

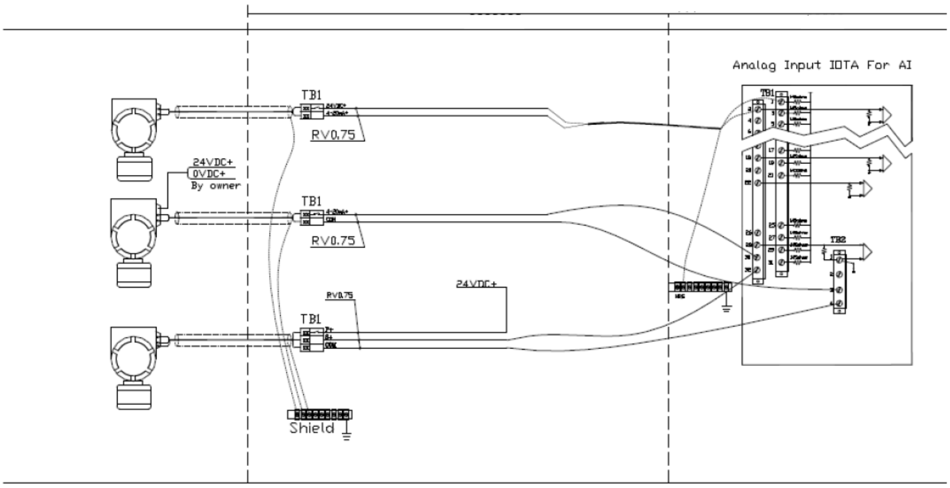
Rmax = [(13.0 - Vtx) / (0.022)]

where: Vtx = Voltage required at the transmitter terminal

5.2.7 IOTA board and connections - Analog Input HART module

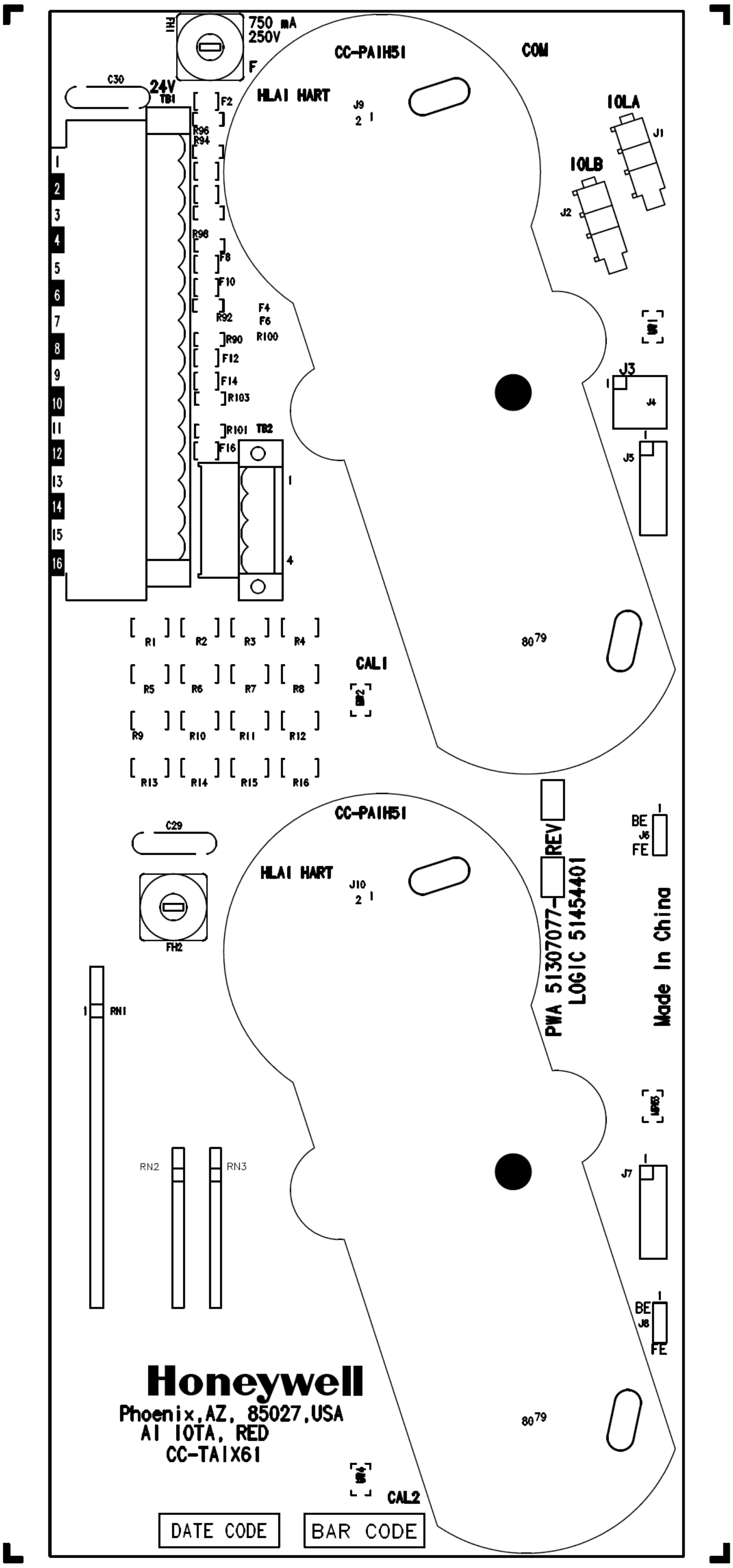
Series C Analog Input 6 inch, non-redundant IOTA and field wiring connection is displayed in the following image.

Figure 5.7 Series C Analog Input 6 inch, non-redundant IOTA and field wiring connection



The Series C Analog Input 12 inch, redundant IOTA is displayed in the following figure.

Figure 5.8 Series C HART/non-HART Analog Input 12 inch, redundant IOTA



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5.3 Non-HART Analog Input IOTA (Models CC-TAIN01, CC-TAIN11)

This Series C Analog Input IOTA board is represented by the following information and graphic.

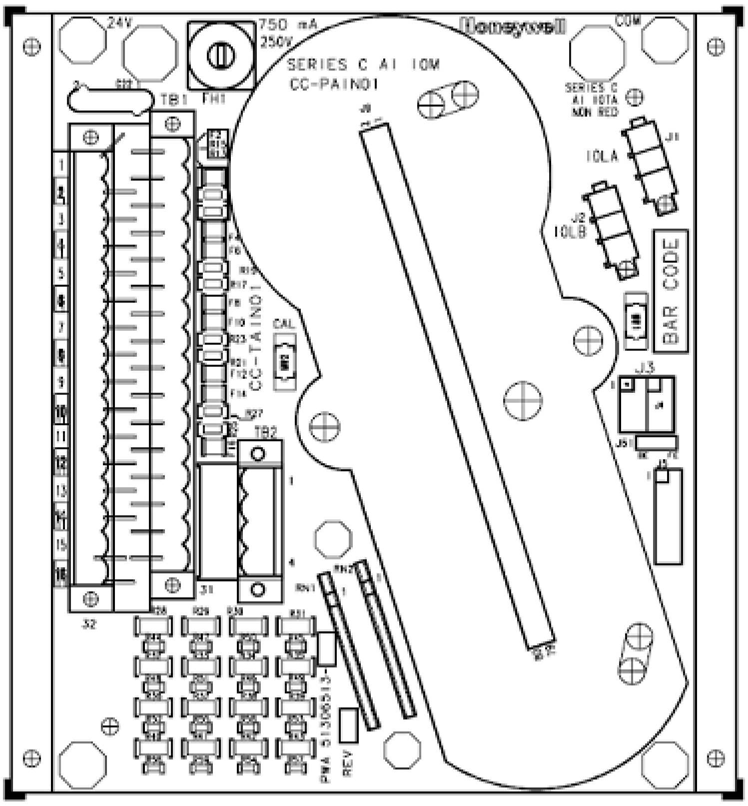
To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Analog Input in the Recommended Spare Parts section.

Series C non-HART Analog Input 6 inch, non-redundant IOTA is displayed in the following figure.

Figure 5.9 Series C non-HART Analog Input 6 inch, non-redundant IOTA



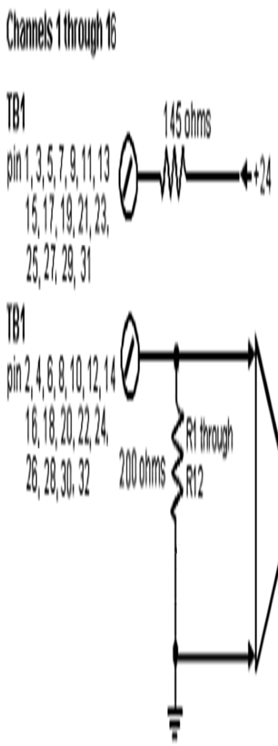
> **NOTE**
>
> All I/O field terminations accept up to 14 gauge stranded wire.

To properly wire your module to the Series C non-HART Analog Input IOTA with terminal block 1 (TB1) and terminal block 2 (TB2), use the following table.

Table 5.9 AI 6 inch, non-HART AI, non-redundant - terminal block 1

Terminal Block 1 (TB1)		
Channel	Return Screw	Power Screw(24V)
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.10 AI 6 inch, non-HART AI, non-redundant terminal block 2

<table>
<tr><th>Channels</th><th>Signal screw</th></tr>
<tr><td>For channels
1 through 16</td><td>Channels 1 through 16

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

- Field wiring and module protection - non-HART Analog Input module
- Two-wire transmitter wiring - non-HART Analog Input module

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5.3.1 Field wiring and module protection - non-HART Analog Input module

Individual field wiring is protected by an internal protection circuit permitting

- Short circuit protection of input for field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Each signal can be shorted in the field with no damage to module or board. Other channels on the same IOM will not be affected

5.3.2 Two-wire transmitter wiring - non-HART Analog Input module

The AI IOM/IOTA is optimized for use with classic two-wire transmitters. All 16 channels can accept inputs from two-wire transmitters without any special wiring or jumper options.

5.3.3 Standard and self-powered two-wire transmitter wiring - non-HART Analog Input module

The non-HART AI IOM/IOTA is optimized for use with classic two-wire transmitters. All 16 channels can accept inputs from two-wire transmitters. It is recommended to use channels 13 through 16, since these channels have a dedicated Series C ground screw (although it is possible to use channels 1 through 12).

Following figure illustrates an example jumper configuration for channel 1 of non-redundant 9 inch IOTA.

Figure 5.10 Non-redundant Analog Input 9 inch, standard 2-wire transmitter wiring

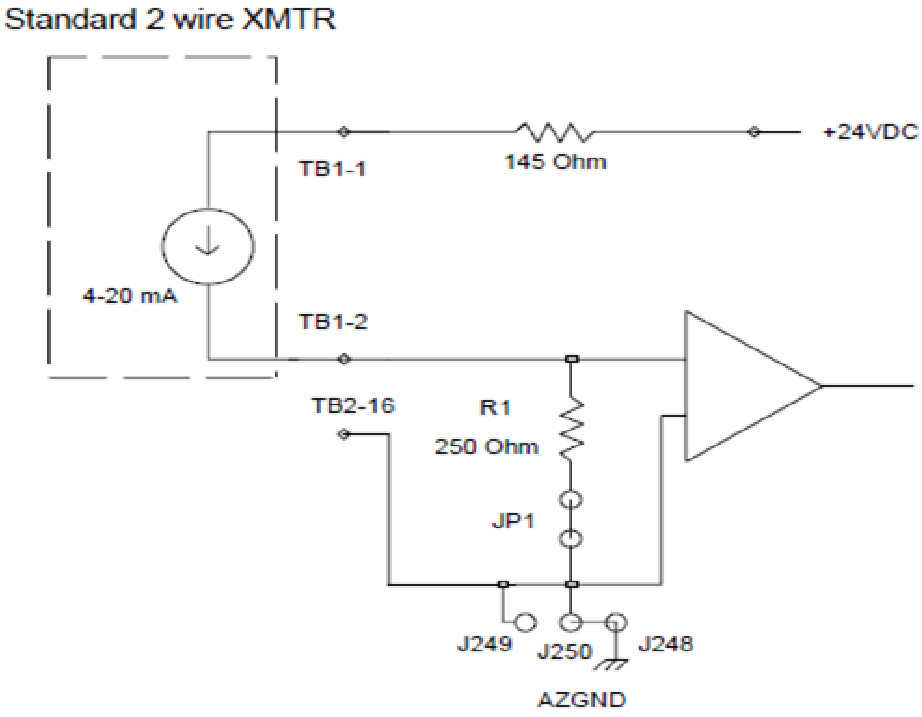
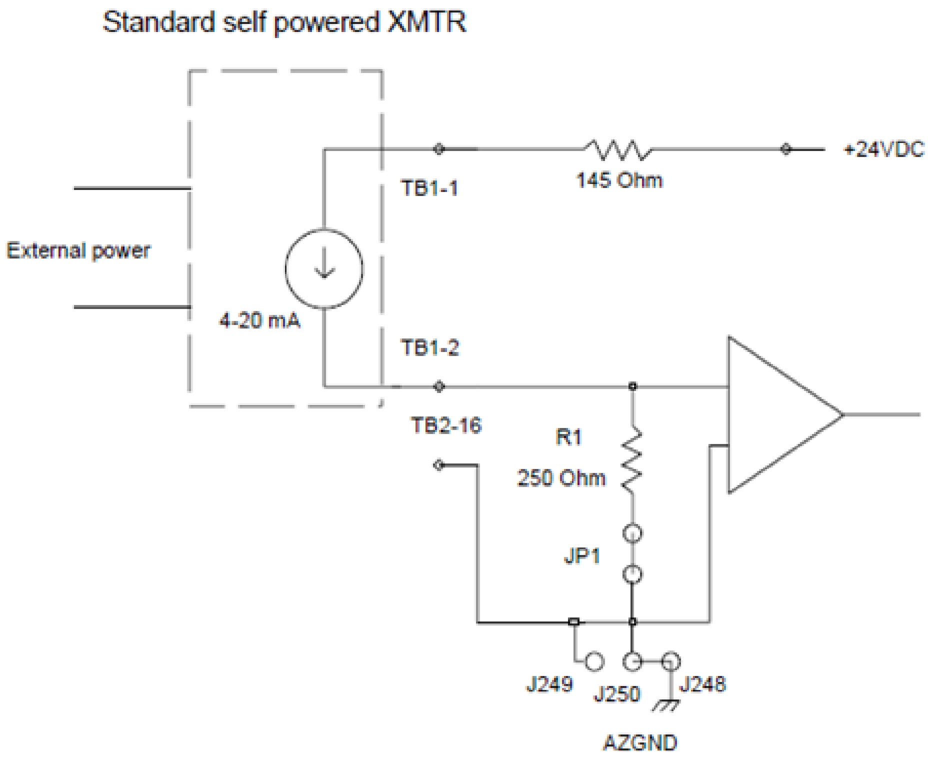


Figure 5.11 Non-redundant Analog Input 9 inch, self-powered 2-wire transmitter wiring

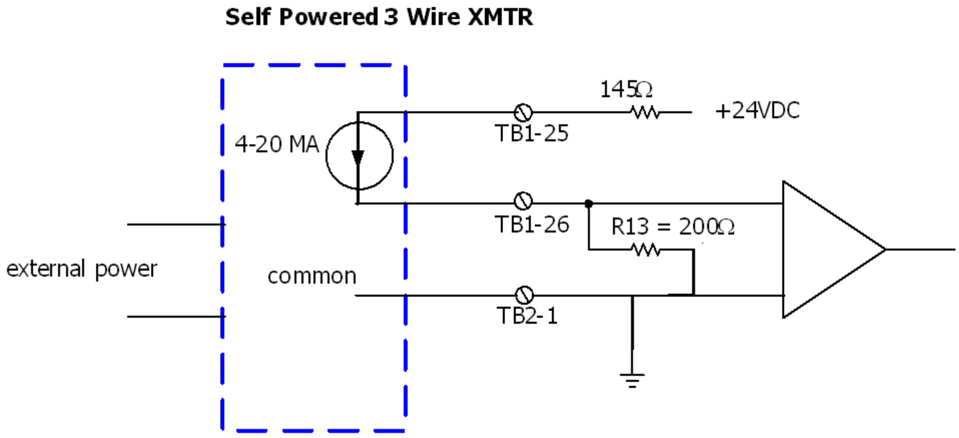


5.3.4 Self-powered 3-wire transmitter (system ground) - non-HART Analog Input module

It is recommended to use channels 13 through 16, since these channels have 3 screws per channel (although it is possible to use channels 1 through 12).

For the following example:

- Channel 13 is used
- The three wires are terminated to TB1-25, TB1-26 and TB2-1



> **NOTE**
>
> TB1: This is done through a 145 ohm resistor inline with a Positive Temperature Coefficient (PTC) device that acts like a fuse (but never needs replacement). Thus, these field terminals can be permanently shorted to ground without damage. This is an improvement over Process Manager due to the inclusion of the PTC device.

5.3.5 Non-HART Analog Input module wiring reference table

The following table summarizes the possible Analog Input wiring connections.

Table 5.11 Summary - Analog Input wiring connections

Input style	*Connection characteristics*
Standard 2-wire transmitter	• Can use any of the 16 channels. • No custom wiring required.
Standard self-powered transmitter	• Can use any of the 16 channels. • No custom wiring required.
Self-powered transmitter with loop power(system ground)	• Can use any of the 16 channels. • Custom wiring is required for channels 1-12: you must find a screw terminal at Series C ground for one leg of the transmitter.
Self-powered 3-wire	• Can use any of the 16 channels.

Input style	*Connection characteristics*
transmitter (system ground)	• Custom wiring is required for channels 1-12: you must find a screw terminal at Series C ground for one leg of the transmitter.

5.3.6 Allowable field wiring resistance - non-HART Analog Input module

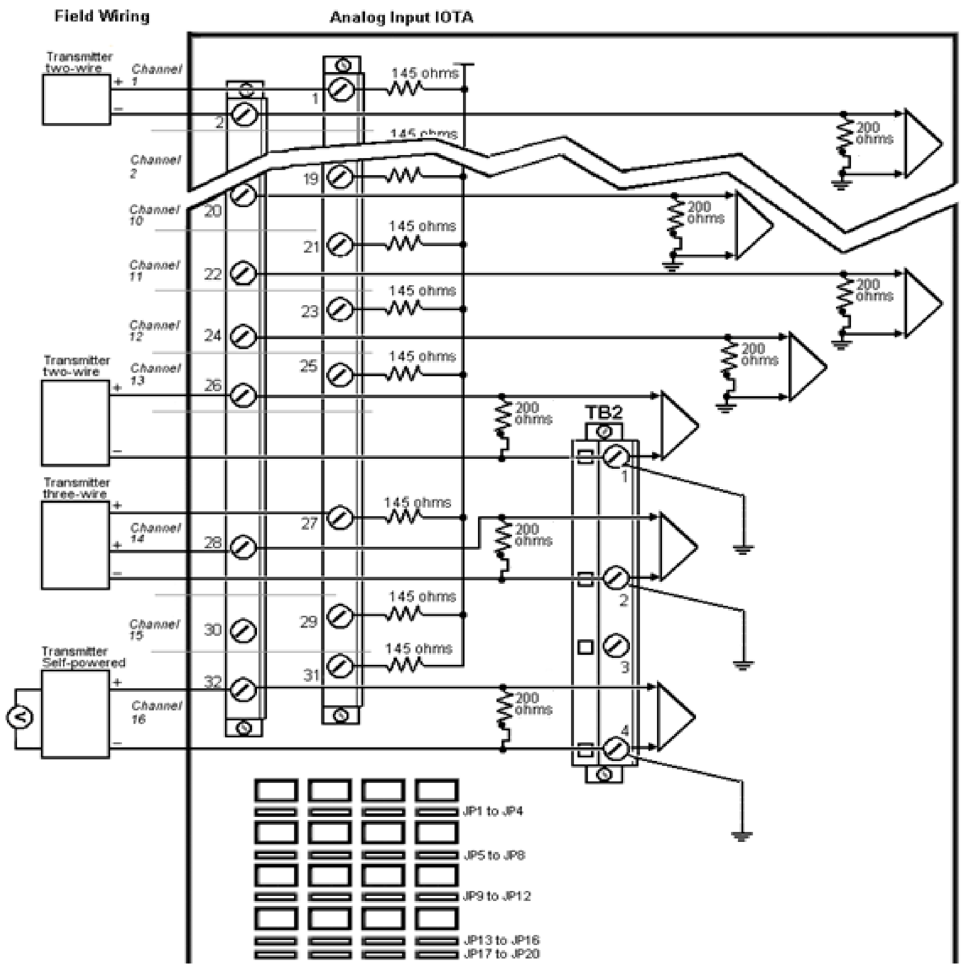
The maximum allowable field wiring resistance between the transmitter and the IOTA connection terminal is dependent upon the voltage requirement of the transmitter. The formula for calculating the max wiring resistance for the Series C Analog Input is given by the following equation.

Rmax = [(13.0 - Vtx) / (0.022)]

where: Vtx = Voltage required at the transmitter terminal

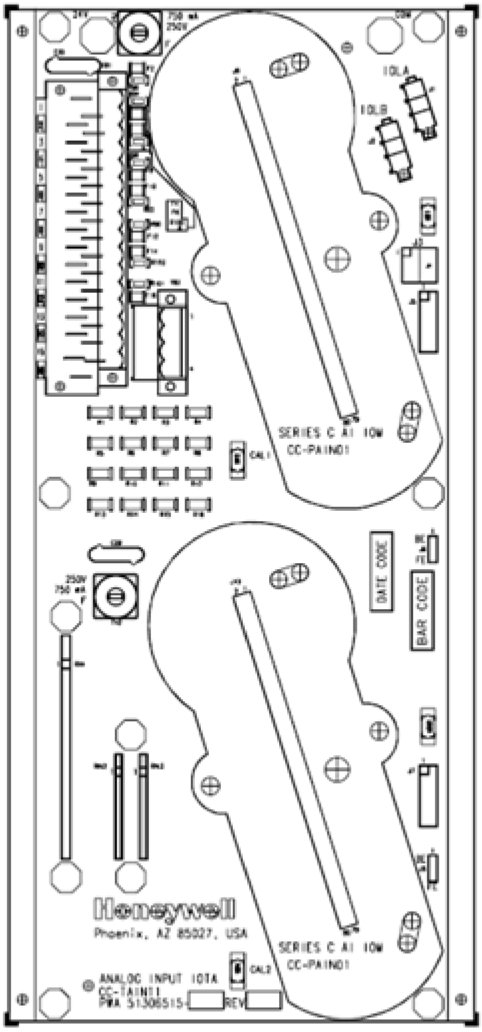
5.3.7 IOTA board and connections - non-HART Analog Input module

Series C Analog Input 6 inch, non-redundant IOTA and field wiring connection is displayed in the following image.



The Series C Analog Input 12 inch, redundant IOTA is displayed in the following figure.

Figure 5.12 Series C non-HART Analog Input 12 inch, redundant IOTA



5.4 Differential Analog input IOTA (Models CC-TAID01 and CC-TAID11)

The Series C Analog Input 6 inch, 9 inch, and 12 inch modules supports all 16 channels for differential configuration. These channels can be configured to support different inputs such as 4-20mA, 1-5V, and 0-5V. All I/O field terminations of this IOTA is designed to accept up to 14 gauge stranded wire.

NOTE

- These differential analog input modules are configured for differential configuration by default.
- The channels of these modules can be used for any configuration. that is, single-ended or differential configuration

5.4.1 Compatible IOTA models for differential analog input and output channels

IOM model number	IOM Block Name	Description	Compatible IOTA model number
CC-PAIH02	AI-HART	Differential/Single-ended Analog Input. It supports 16 channels and following inputs. • 4-20mA • 1-5V • 0-5V	CC-TAID01 - Non-redundant CC-TAID11 - Redundant CC-TAIX01 - Non-redundant CC-TAIX11 - Redundant CC-GAIX11 - GI-IS-Redundant CC-GAIX21 - GI-IS-Non-Redundant
CC-PAIX02	AI	Differential/Single-ended Analog Input without HART functionality. It supports 16 channels and following inputs. • 4-20mA • 1-5V • 0-5V	CC-TAID01 - Non-redundant CC-TAID11 - Redundant CC-TAIX01 - Non-redundant CC-TAIX11 - Redundant CC-GAIX11 - GI-IS-Redundant CC-GAIX21 - GI-IS-Non-Redundant
CC-PAIN01	AI-HL	Non-HART Analog Input module It supports 16 channels.	CC-TAIN01 (AI non-redundant; IOTA - 6') CC-TAIN11 (AI redundant; IOTA - 12')
CC-PAON01	AO	Non-HART Analog Output module It supports 16 channels.	CC-TAON01 (AO, non-redundant; IOTA - 6') CC-TAON11 (AO, redundant; IOTA - 12')

5.4.2 Standard and self-powered two-wire transmitter wiring - Differential Analog input module

The differential AI IOM/IOTA is optimized for use with classic two-wire transmitters. All 16 channels can accept inputs from two-wire transmitters. Note that, by default, the jumper settings must be changed to 'single-ended configuration' as referred in the *Series C Differential Analog Input 9 inch – terminal block 2* table and the *Series C Differential Analog Input 12 inch – terminal block 2* table.

Following figure illustrates an example jumper configuration for channel 1 of non-redundant 9 inch IOTA.

Figure 5.13 Non-redundant Analog Input 9 inch, standard 2-wire transmitter wiring

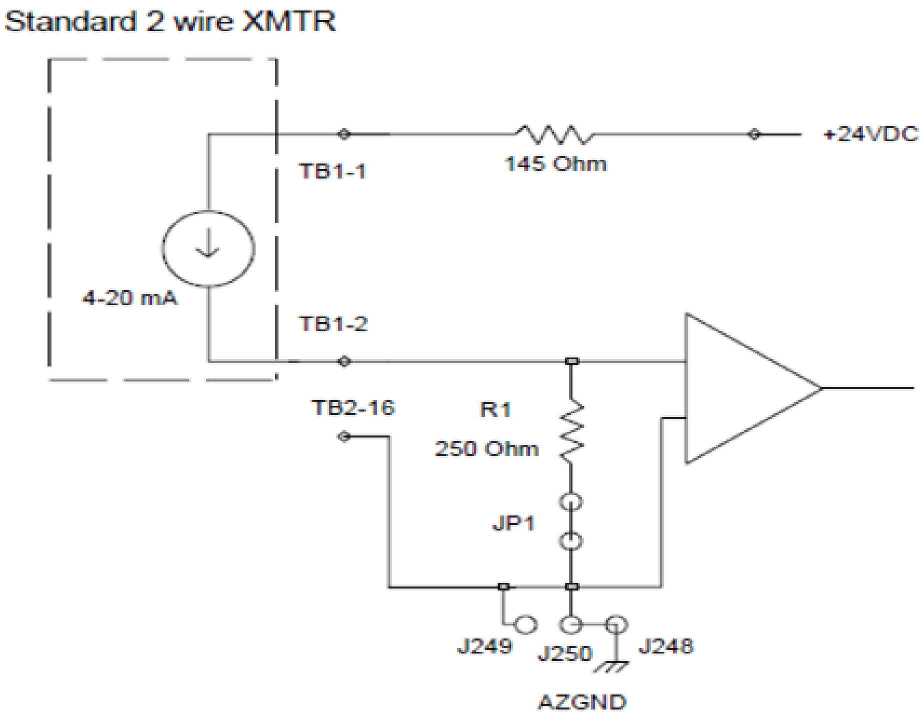
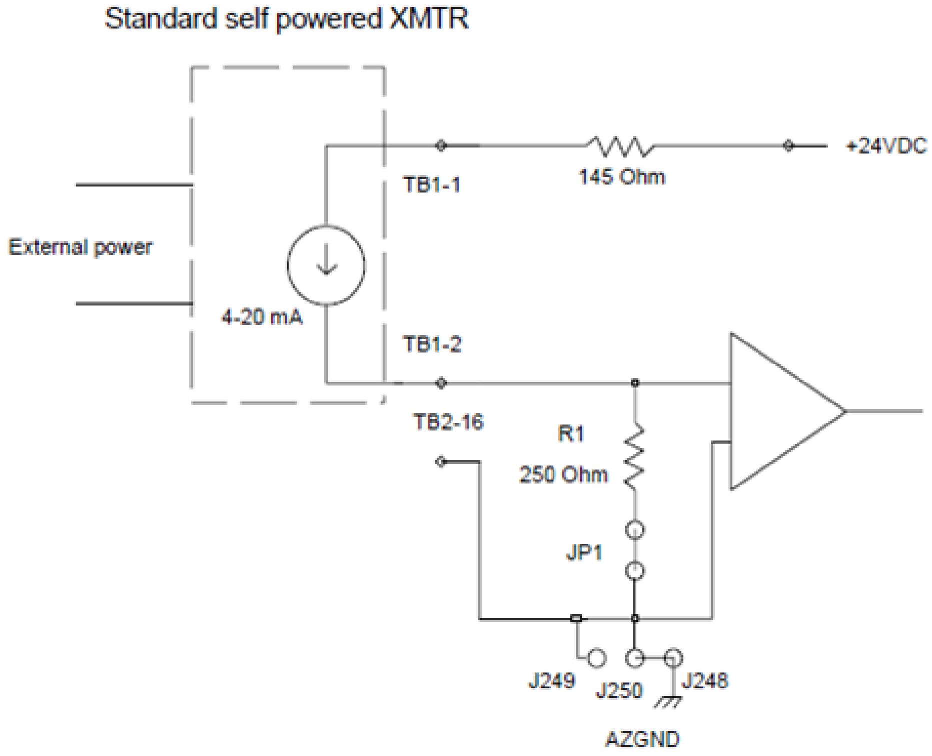


Figure 5.14 Non-redundant Analog Input 9 inch, self-powered 2-wire transmitter wiring



5.4.3 Custom wiring - Differential Analog input module

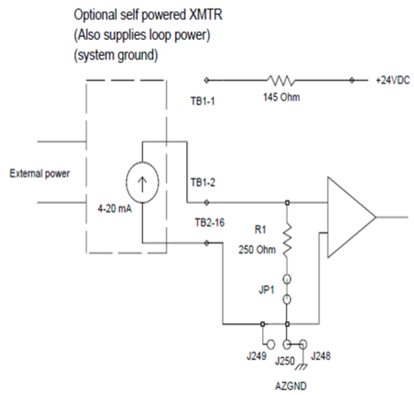
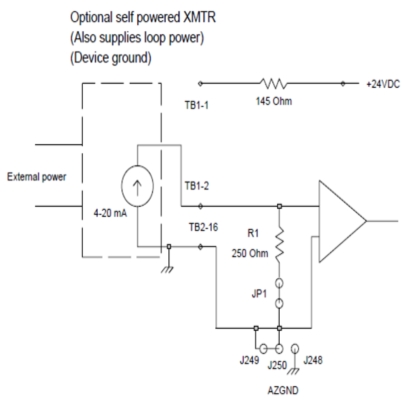
ATTENTION

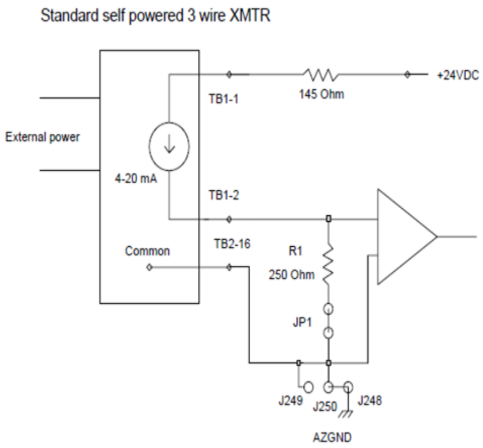
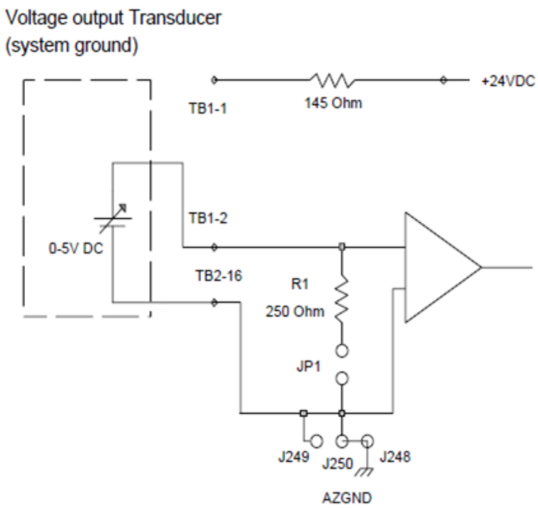
For differential HART transmitter, you can use only channel number 13 to 16. For non-HART differential transmitter, you can use all 16 channels in both differential mode and single-ended mode.

Custom wiring scenarios are explained in the following table.

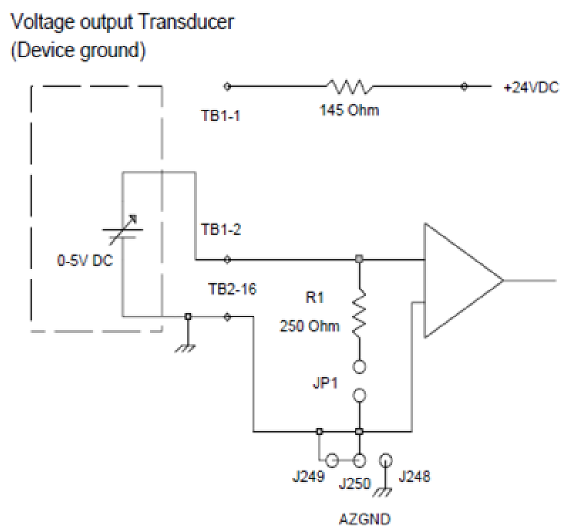
Table 5.12 Custom wiring to support differential Analog Input

Custom wiring scenarios
Self-powered transmitter with Experion PKS system ground Self-powered transmitter is connected across the TB1 - 2 and TB2 - 16 for the channel 1 of the non-redundant 9' IOTA as illustrated in the following figure. Jumper settings must be configured as single-ended according to the *Series C Differential Analog Input 9 inch – terminal block 2* table and the *Series C Differential Analog Input 12 inch – terminal block 2* table.

Custom wiring scenarios

Self-powered transmitter with device grounded Self-powered transmitter is connected across the TB1 - 2 and TB2 - 16 for the channel 1 of the non-redundant 9' IOTA as illustrated in the following figure. Jumper settings must be configured for differential configuration according to the *Series C Differential Analog Input 9 inch – terminal block 2* table and the *Series C Differential Analog Input 12 inch – terminal block 2* table. 
Self-powered 3-wire transmitter (system ground) Self-powered transmitter is connected across the TB1 - 1 and TB2 - 2 when the common terminal is terminated at TB2 - 16. Jumper settings must be configured as single-ended according to the *Series C Differential Analog Input 9 inch – terminal block 2* table and the *Series C Differential Analog Input 12 inch – terminal block 2* table.

Custom wiring scenarios

Voltage input (System ground) Voltage output transducer is connected across TB1-2 and TB2-16 as illustrated in the following figure. To use voltage output transducer, 250? spool resistor must be disconnected by cutting the jumper (example, JP1). Jumper settings must be configured as single-ended according to the *Series C Differential Analog Input 9 inch – terminal block 2* table and the *Series C Differential Analog Input 12 inch – terminal block 2* table.  **NOTE** You must plan cautiously when you cut the JP1 to JP16 jumpers as they are non-repairable. That is, once these jumpers are cut, you cannot short these jumpers.
Voltage input (Device ground) Voltage output transducer is connected across TB1-2 and TB2-16 as illustrated in the following figure. To use voltage output transducer, 250? spool resistor must be disconnected by cutting the jumper (example, JP1). Jumper settings must be configured for differential configuration according to the *Series C Differential Analog Input 9 inch – terminal block 2* table and the *Series C Differential Analog Input 12 inch – terminal block 2* table.

Custom wiring scenarios



> **NOTE**
>
> You must plan cautiously when you cut the JP1 to JP16 jumpers as they are non-repairable. That is, once these jumpers are cut, you cannot short these jumpers.

*Slide Wire:*Series C does not support Slidewire.

5.4.4 Jumper configuration for differential configuration - Differential Analog input module

Jumper configuration for the non-redundant differential AI channel is illustrated in the following figure. Each channel is associated with 250? 'range spool' or 'dropping resistor' for sources that deliver 4-20mA. In addition, one jumper and three jumper pins are provided for each channel.

Example: channel 1 consists of JP1, J248, and J249.

Figure 5.15 Series C differential non-redundant Analog Input 9 inch, jumper configuration

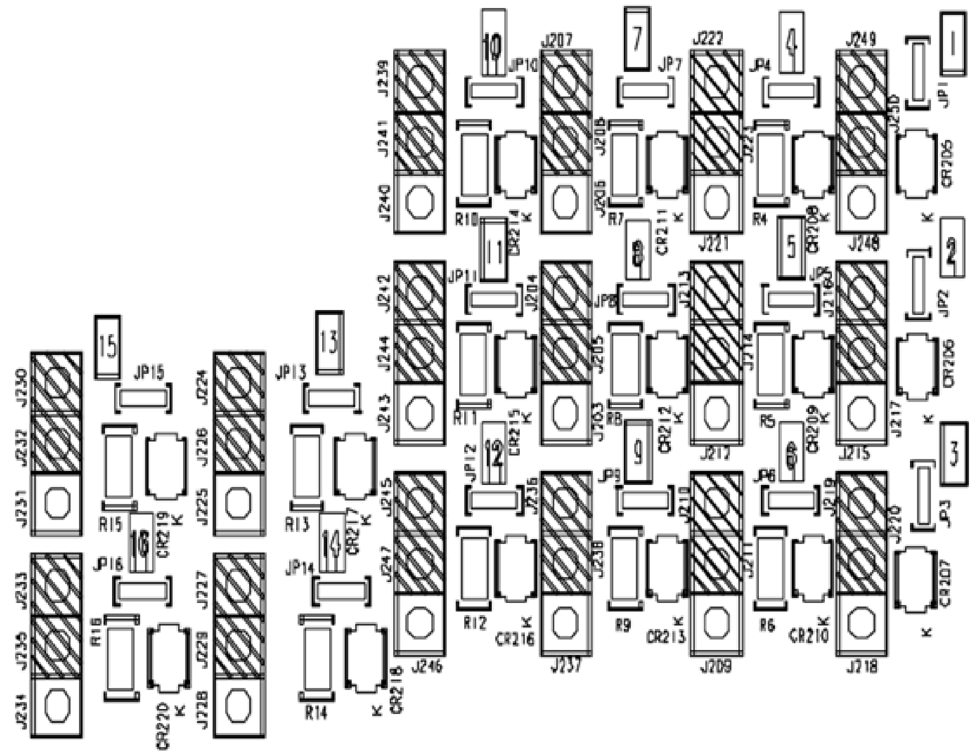
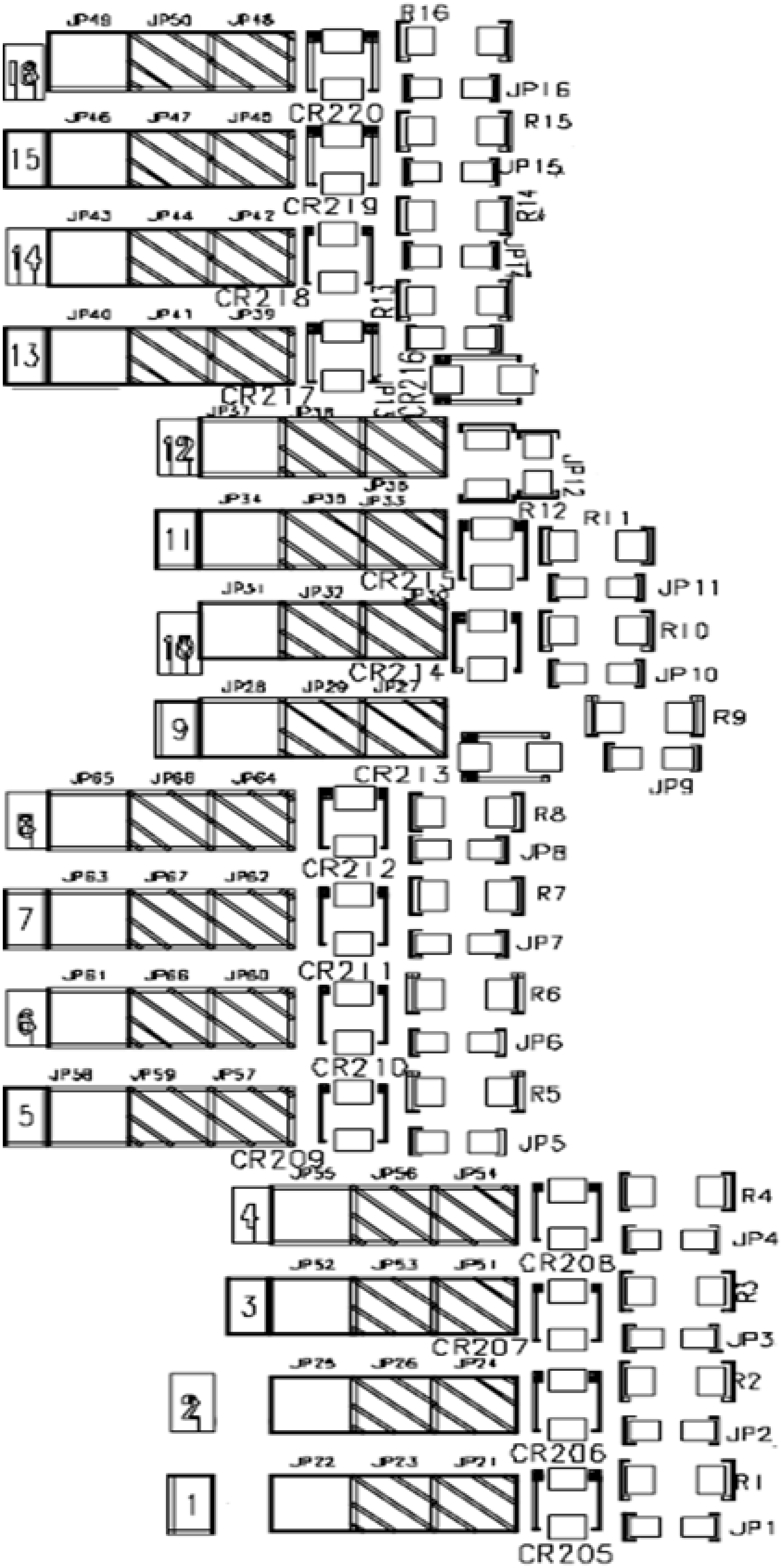


Figure 5.16 Series C differential redundant Analog Input 12 inch, jumper configuration



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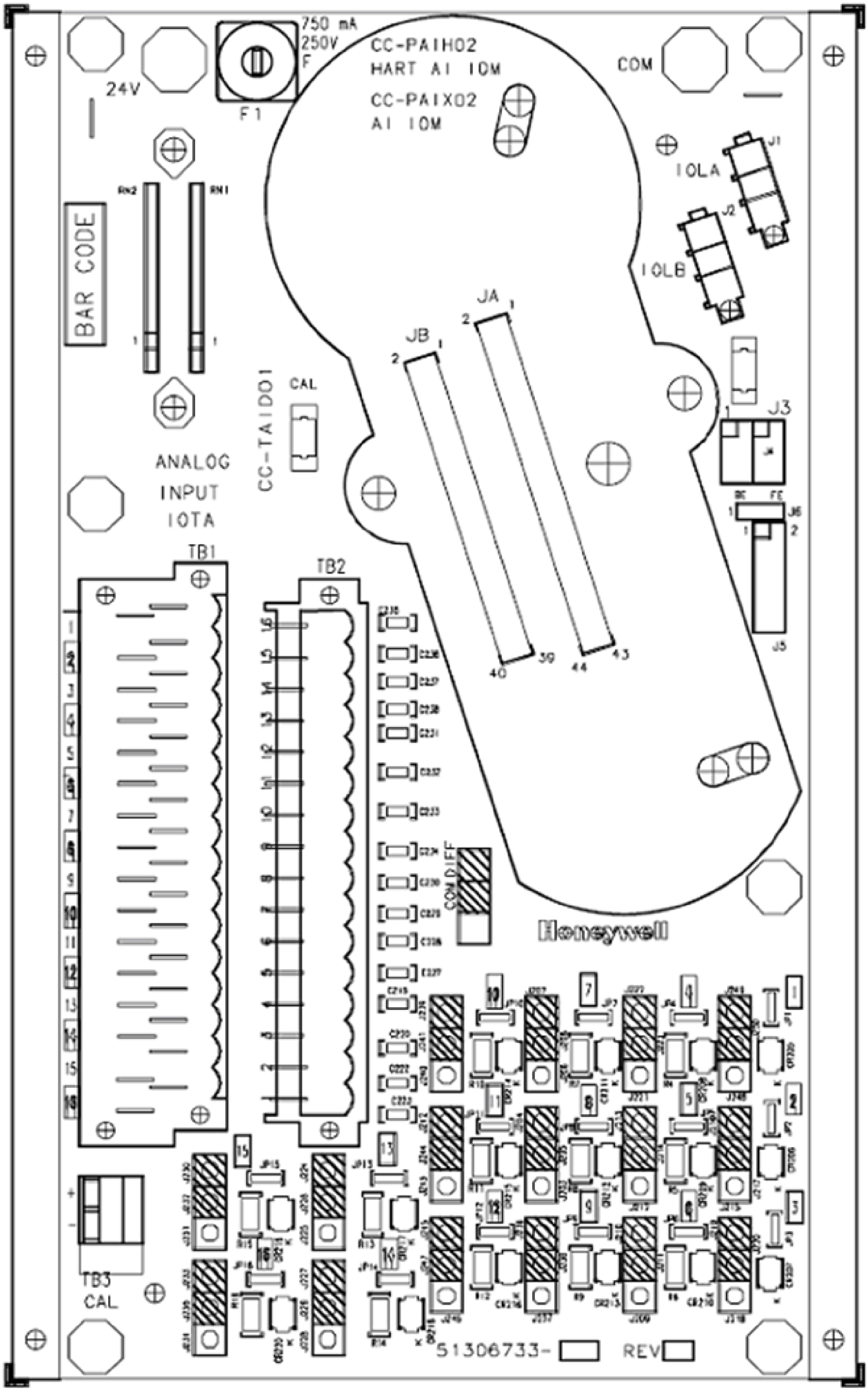
CAUTION

Jumper pins can bend or break while removing, replacing, or reinserting jumpers from/on the IOTA. Broken pins can result in loss of use of a channel on the module. Therefore, you must exercise caution while removing, replacing, or reinserting the jumpers so that the pins remain straight. Also, do not try to straighten the bent or deformed pins.

5.4.5 IOTA board and connections - Differential Analog input module

The Series C Analog Input 9 inch, non-redundant IOTA is displayed in the following figure.

Figure 5.17 Series C Differential Analog Input 9 inch, non-redundant IOTA



To properly wire your module to the Series C Analog Input IOTA for differential configuration with terminal block 1 (TB1) and terminal block 2 (TB2), use the following table.

Table 5.13 Series C Differential Analog Input 9 and 12 inch - terminal block 1

Terminal Block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

ATTENTION

- Three pin jumper labels are different for 9' and 12' IOTAs.
- All channels available in these IOTAs are configured for differential mode by default. If a shorting jumper is not present, that channel is configured in differential mode. If you want to modify the configuration from differential mode to single ended mode, refer to these to short the pair of jumpers.

Table 5.14 Series C Differential Analog Input 9 inch - terminal block 2

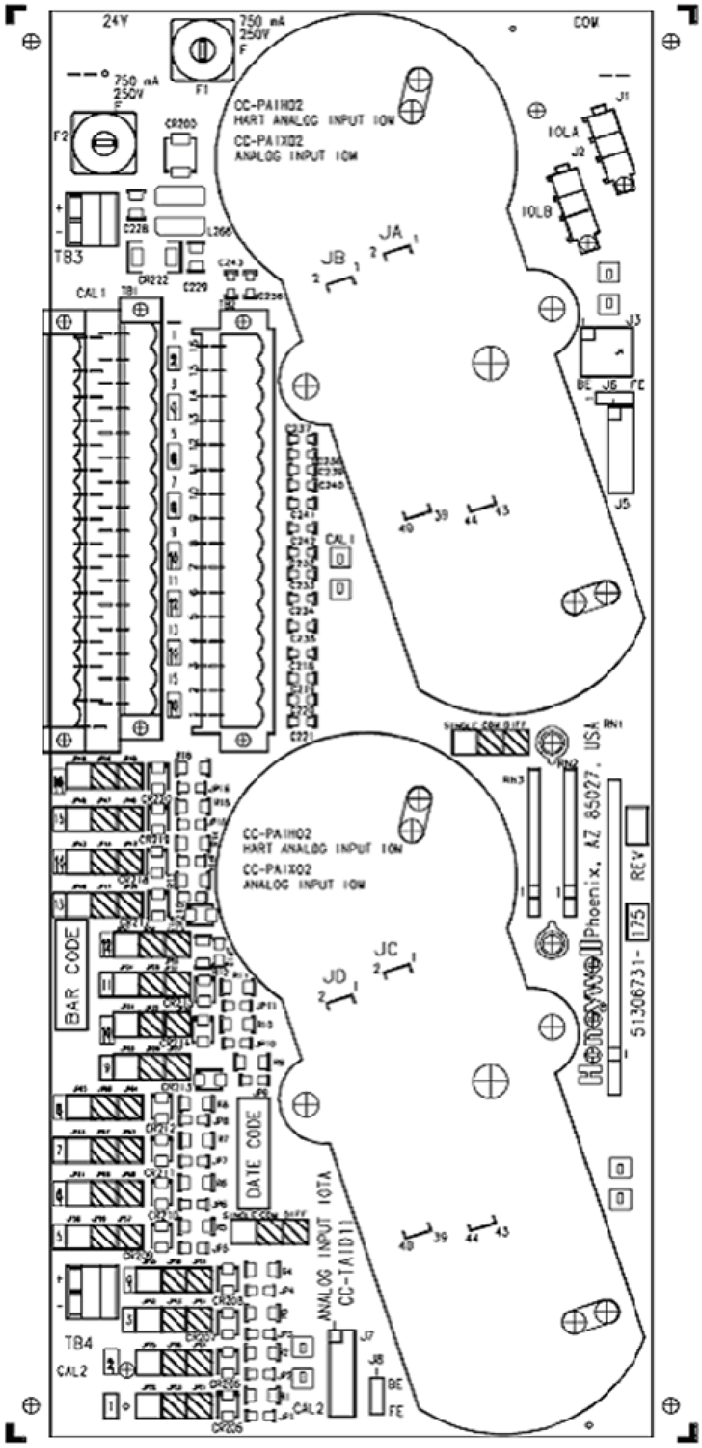
Terminal Block 2			
CC-TAID01 IOTA			
If TB2 screw is...	Then, the channel is...	And the pair of jumper to be short for differential configuration	And the pair of jumper to be short for single ended configuration
TB2-16	Ch 1	J249 - J250	J248 - J250
TB2-15	Ch 2	J216 - J217	J215 - J217
TB2-14	Ch 3	J219 - J220	J218 - J220
TB2-13	Ch 4	J222 - J223	J221 - J223
TB2-12	Ch 5	J213 - J214	J212 - J214
TB2-11	Ch 6	J210 - J211	J209 - J211
TB2-10	Ch 7	J207 - J208	J206 - J208
TB2-9	Ch 8	J204 - J205	J203 - J205
TB2-8	Ch 9	J236 - J238	J237 - J238
TB2-7	Ch 10	J239 - J241	J240 - J241
TB2-6	Ch 11	J242 - J244	J243 - J244
TB2-5	Ch 12	J245 - J247	J246 - J247

Terminal Block 2			
CC-TAID01 IOTA			
If TB2 screw is...	Then, the channel is...	And the pair of jumper to be short for differential configuration	And the pair of jumper to be short for single ended configuration
TB2-4	Ch 13	J224 - J226	J225 - J226
TB2-3	Ch 14	J227 - J229	J228 - J229
TB2-2	Ch 15	J230 - J232	J231 - J232
TB2-1	Ch 16	J233 - J235	J234 - J235

Table 5.15 Series C Differential Analog Input 12 inch - terminal block 2

Terminal Block 2			
CC-TAID11 IOTA			
If TB2 screw is...	Then, the channel is...	And the pair of jumper to be short for differential configuration	And the pair of jumper to be short for single ended configuration
TB2-16	Ch 1	JP21 - JP23	JP22 - JP23
TB2-15	Ch 2	JP24 - JP26	JP25 - JP26
TB2-14	Ch 3	JP51 - JP53	JP52 - JP53
TB2-13	Ch 4	JP54 - JP56	JP55 - JP56
TB2-12	Ch 5	JP57 - JP59	JP58 - JP59
TB2-11	Ch 6	JP60 - JP66	JP61 - JP66
TB2-10	Ch 7	JP62 - JP67	JP63 - JP67
TB2-9	Ch 8	JP64 - JP68	JP65 - JP68
TB2-8	Ch 9	JP27 - JP29	JP28 - JP29
TB2-7	Ch 10	JP30 - JP32	JP31 - JP32
TB2-6	Ch 11	JP33 - JP35	JP34 - JP35
TB2-5	Ch 12	JP36 - JP38	JP37 - JP38
TB2-4	Ch 13	JP39 - JP41	JP40 - JP41
TB2-3	Ch 14	JP42 - JP44	JP43 - JP44
TB2-2	Ch 15	JP45 - JP47	JP46 - JP47
TB2-1	Ch 16	JP48 - JP50	JP49 - JP50

The Series C Analog Input 12 inch, non-redundant IOTA is displayed in the following figure.



5.5 Analog Output IOTA Models CC-TAOX01, CC-TAOX11, CC-TAON01 and CC-TAON11

This Series C Analog Output IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Analog Ouput in the Recommended Spare Parts section.

- Field wiring and module protection - Analog Output module
- IOTA board and connections - Analog Output module
- Non-HART Analog Output IOTA (Models CC-TAON01, CC-TAON11)
- IOTA board and connections - non-HART Analog Output module

5.5.1 Field wiring and module protection - Analog Output module

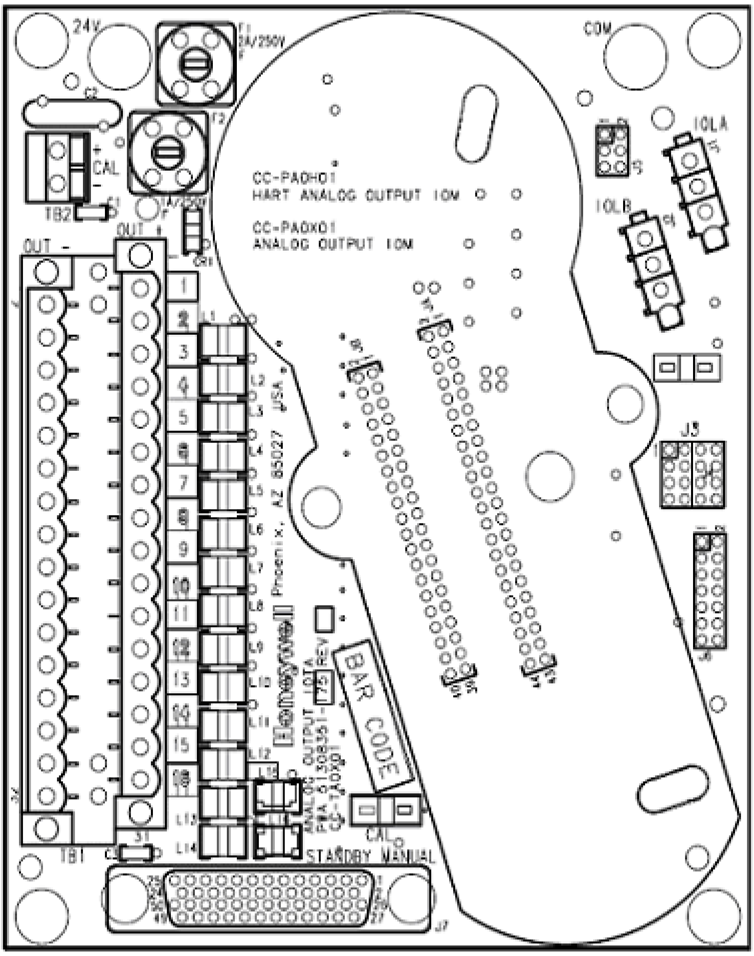
The Analog Output module provides an output current range of 0ma, and 2.9 mA through 21.1 mA based on the requested Analog Output by the Series C controller. The output current including the HART modulated signal, does not exceed 22.5mA.

- Short circuit protection of field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Each field wiring pair can be shorted together without damage to the module or IOTA. Other channels in the same module(s) will not be affected.
- A +30 Vdc source can be continuously applied across the OUT+ to OUT- terminals of the IOTA without damage to either module(s) or IOTA (i.e. with the positive lead of the source connected to OUT+ and the negative lead connected to OUT-). To prevent damage to the IOTA surge protection diodes, the current must be limited to 500 mAdc if the source is applied in the reverse polarity (i.e. with the positive lead of the source attached to OUT-, negative lead attached to OUT+). This 500 mAdc restriction does not apply in the positive polarity case.

5.5.2 IOTA board and connections - Analog Output module

Series C Analog Output 6 inch, non-redundant IOTA is displayed.

Figure 5.18 Series C Analog Output 6 inch, non-redundant IOTA



To properly wire your module to the Series C Analog Output IOTA board with terminal block 1 (TB1), uses the following table.

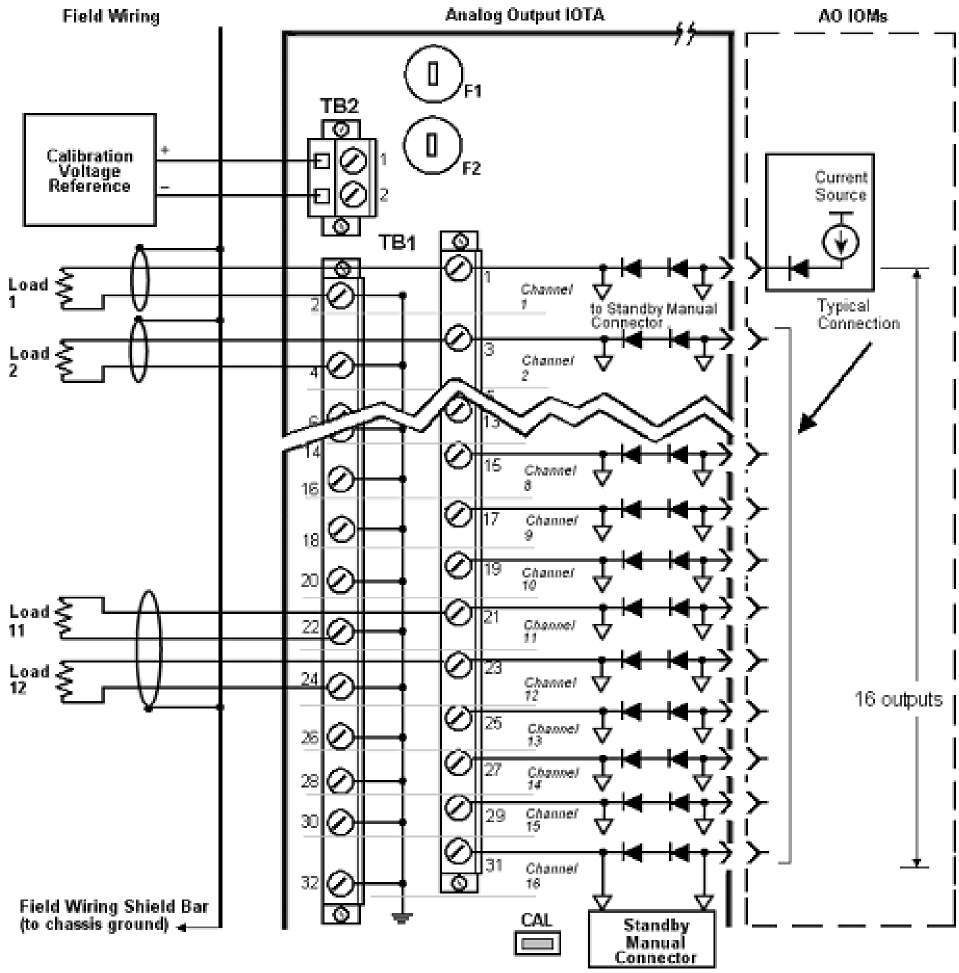
Table 5.16 AO 6 inch, non-redundant - terminal block 1

Channel	Return screw (OUT -)	Signal screw (OUT +)
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27

Channel	Return screw (OUT -)	Signal screw (OUT +)
Channel 15	30	29
Channel 16	32	31

Series C Analog Output 6 inch, non-redundant IOTA and field wiring connection

Figure 5.19 Series C Analog Output 6 inch, non-redundant IOTA and field wiring connection



Series C Analog Output 12 inch, redundant IOTA is displayed:

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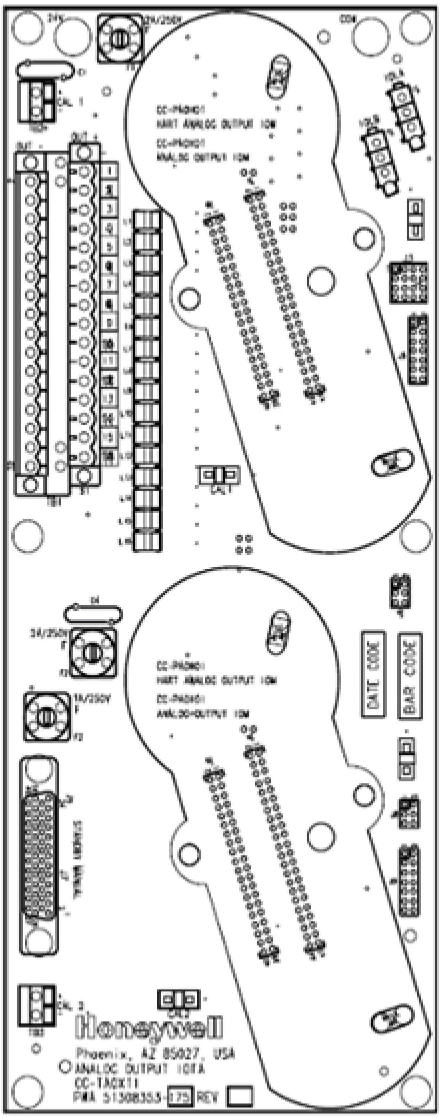
Figure 5.20 Series C Analog Output 12 inch, redundant IOTA



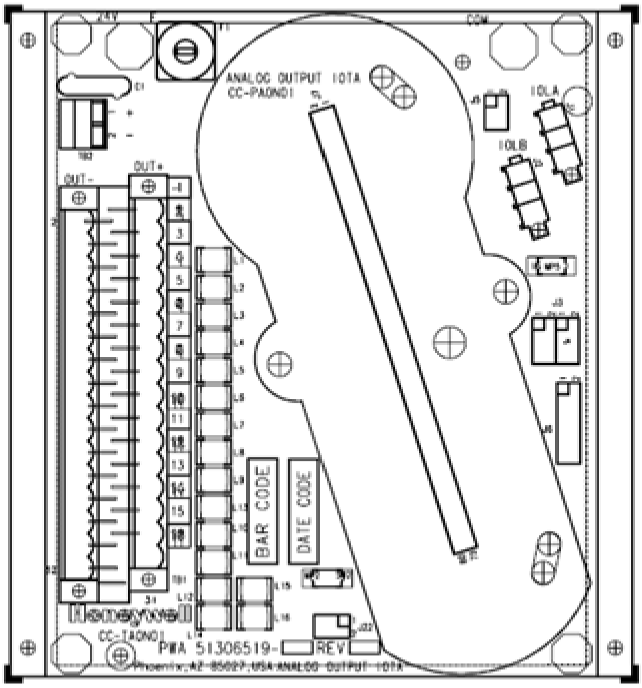
5.5.3 Non-HART Analog Output IOTA (Models CC-TAON01, CC-TAON11)

The Series C non-HART Analog Output 6 inch, non-redundant modules supports all 16 channels for single-ended configuration. All I/O field terminations of this IOTA is designed to accept up to 14 gauge stranded wire.

5.5.4 IOTA board and connections - non-HART Analog Output module

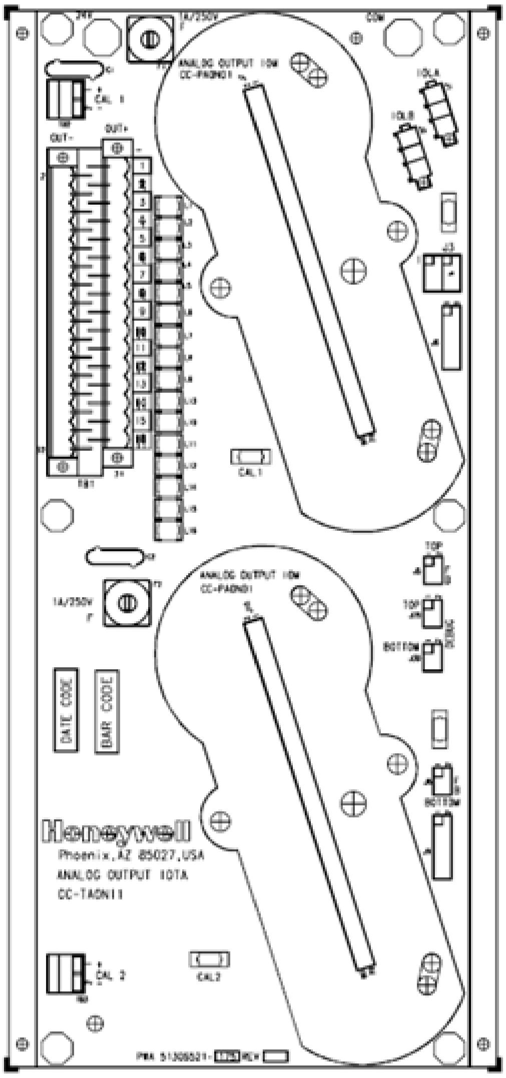
The Series C Analog Output 6 inch, non-redundant IOTA is displayed in the following figure.

Figure 5.21 Series C non-HART Analog Output 6 inch, non-redundant IOTA



The Series C Analog Output 12 inch, redundant IOTA is displayed in the following figure.

Figure 5.22 Series C non-HART Analog Input 12 inch, redundant IOTA



To properly wire your module to the Series C non-HART Analog Output IOTA with terminal block 1 (TB1) and terminal block 2 (TB2), use the following table.

Table 5.17 AO 6 inch, non-HART AO, non-redundant - terminal block 1

Terminal Block 1 (TB1)		
Channel	Return Screw (Negative)	Analog Output Screw (Positive)
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19

Terminal Block 1 (TB1)		
Channel	Return Screw (Negative)	Analog Output Screw (Positive)
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

NOTE

TB1: 32 pin connector - screw block

- 6 channels positive output terminals must be connected through upper-side of 32 pin connector.
- 16 channels negative output terminals must be connected through lower-side of 32 pin connector

The field wiring connection for Series C non-HART Analog Input 6 inch, non-redundant IOTA is identical to the Series C Analog Input 6 inch, non-redundant IOTA. For more information about the field wiring, refer to IOTA board and connections - Analog Output module.

5.6 Analog Output HART IOTA Models Cx-TAOX51, Cx-TAOX61

NOTE

Cx-TAOX51 and Cx-TAOX61 support only HART Modules.

The Analog Output IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Analog Ouput in the Recommended Spare Parts section.

- Field wiring and module protection - Analog Output HART module
- IOTA board and connections - Analog Output HART module

5.6.1 Field wiring and module protection - Analog Output HART module

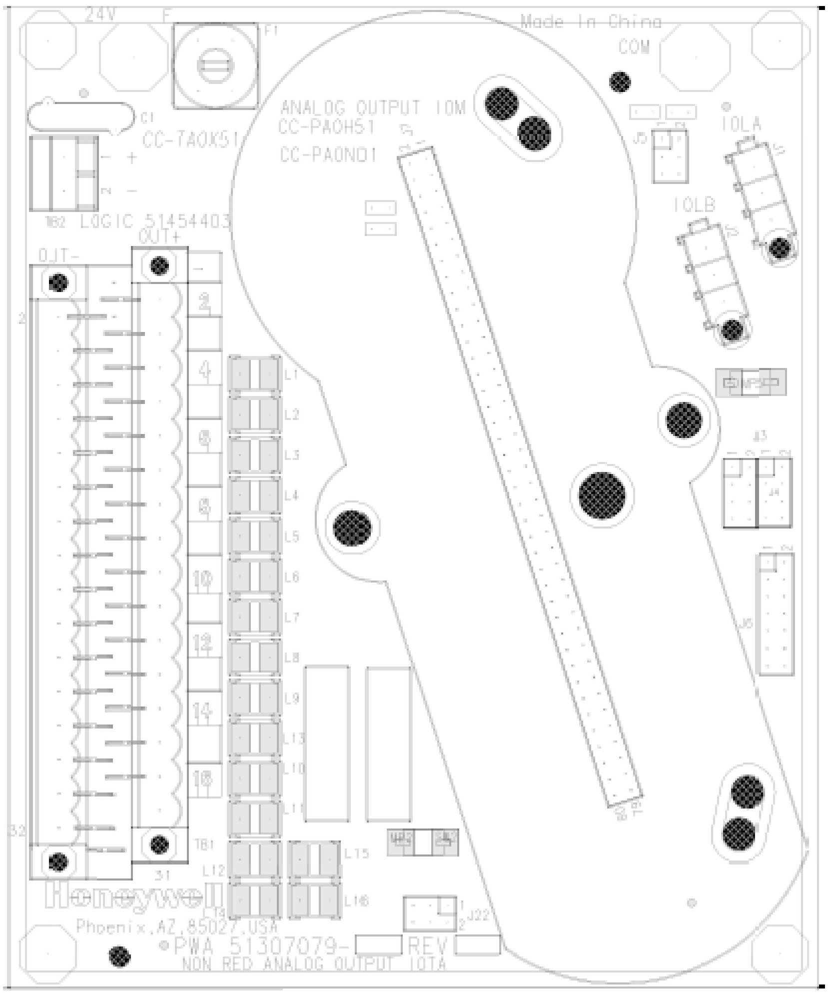
The Analog Output module provides an output current range of 0ma, and 2.9 mA through 21.1 mA based on the requested Analog Output by the Series C controller. The output current including the HART modulated signal, does not exceed 22.5mA.

- Short circuit protection of field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Each field wiring pair can be shorted together without damage to the module or IOTA. Other channels in the same module(s) will not be affected.
- A +30 Vdc source can be continuously applied across the OUT+ to OUT- terminals of the IOTA without damage to either module(s) or IOTA (i.e. with the positive lead of the source connected to OUT+ and the negative lead connected to OUT-). To prevent damage to the IOTA surge protection diodes, the current must be limited to 500 mAdc if the source is applied in the reverse polarity (i.e. with the positive lead of the source attached to OUT-, negative lead attached to OUT+). This 500 mAdc restriction does not apply in the positive polarity case.

5.6.2 IOTA board and connections - Analog Output HART module

Series C Analog Output 6 inch, non-redundant IOTA is displayed.

Figure 5.23 Series C Analog Output 6 inch, non-redundant IOTA



To wire your module to the Series C Analog Output IOTA board with terminal block 1 (TB1), use the following table.

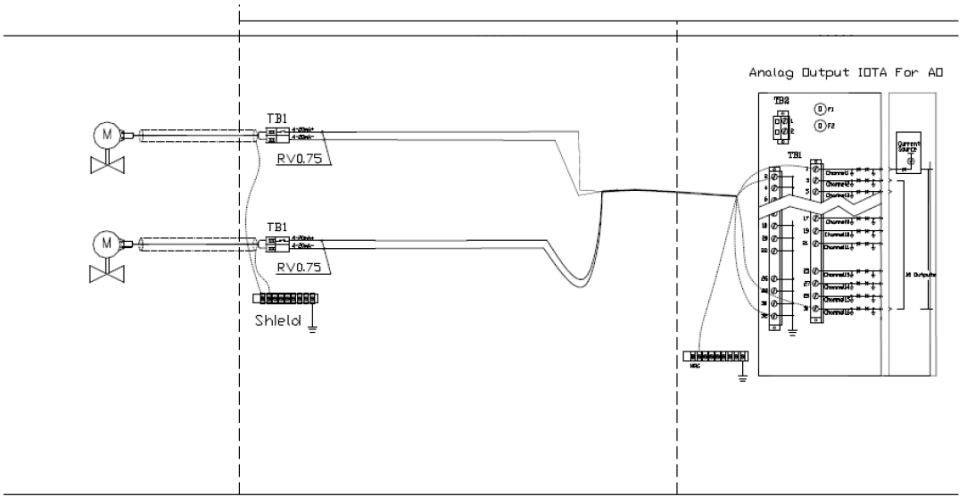
Table 5.18 AO 6 inch, non-redundant - terminal block 1

Channel	Return screw (OUT -)	Signal screw (OUT +)
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25

Channel	Return screw (OUT -)	Signal screw (OUT +)
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

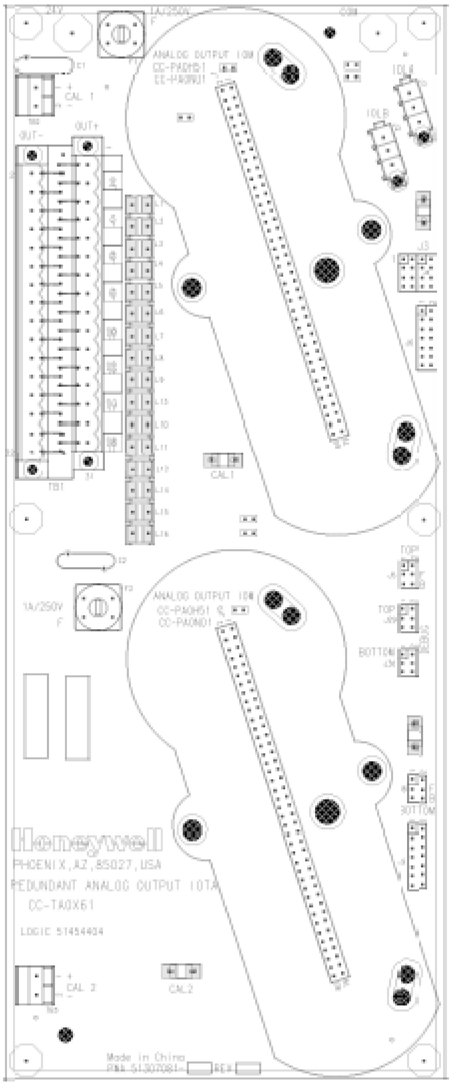
Series C Analog Output 6 inch, non-redundant IOTA and field wiring connection

Figure 5.24 Series C Analog Output 6 inch, non-redundant IOTA and field wiring connection



Series C Analog Output 12 inch, redundant IOTA is displayed:

Figure 5.25 Series C Analog Output 12 inch, redundant IOTA



5.7 Low Level Analog Input Mux (LLMUX) IOTA Models CC-TAIM01

The Series C Low Level Mux IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- connector block assembly, and
- fuses

associated with this board and module, refer to Low Level Analog Input in the Recommended Spare Parts section.

- Field wiring and module protection - Low Level Analog Input Mux (LLMUX) module

- IOTA board and connections - Low Level Analog Input Mux (LLMUX) module

5.7.1 Field wiring and module protection - Low Level Analog Input Mux (LLMUX) module

The LLMUX module provides power and communications to up to four Low Level Mux FTAs. Each FTA is protected by a specific fuse. Additionally, a main fuse protects the module's power path to all FTAs.

The following applies to fusing for LLMUX:

Fuse	Functionality	Description
F1	Power to module electronics	FUSE, 1 Amp Quick Blo, 5x20mm
F2	Switched power to all FTAs	
F3	Power to FTA 1 only	FUSE, 0.25 Amp, Quick Blo, 5x20mm
F4	Power to FTA 2 only	
F5	Power to FTA 3 only	
F6	Power to FTA 4 only	

Fuses 1 and 2

- The primary purpose of the main electronics fuse (F1) is to protect the module electronics. The primary role of the main FTA fuse (F2) is to isolate the power path from the module electronics and prevent a short circuit in the FTA power path from impacting the entire system.

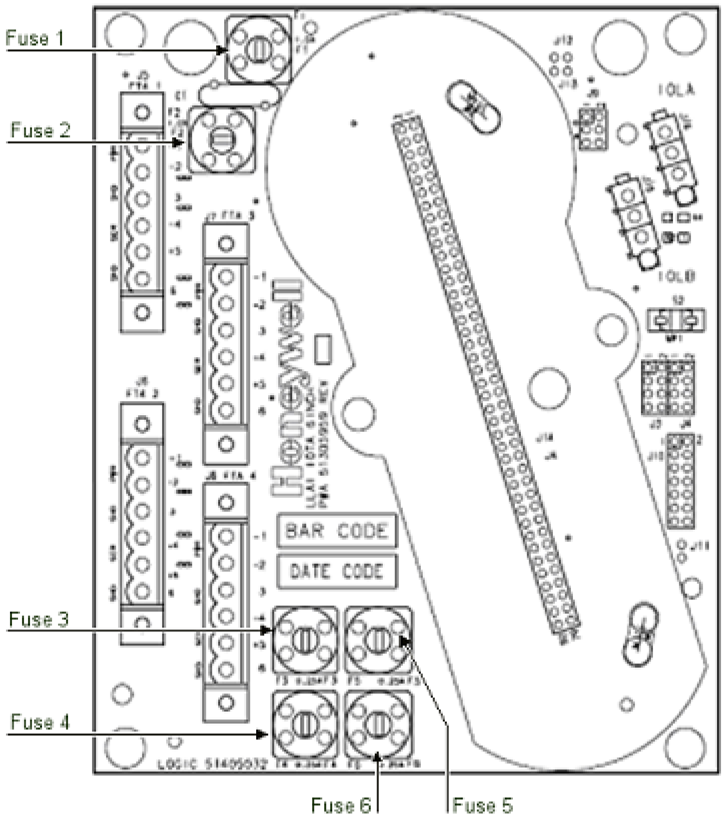
Fuses 3 through 6

- A simultaneous failure of multiple FTAs can blow the common FTA fuse.
- A short circuit on a power cable to an FTA or a short in an FTA will blow the IOTA fuse for that FTA, but not affect any of the other FTAs or their fuses.

5.7.2 IOTA board and connections - Low Level Analog Input Mux (LLMUX) module

Series C Low Level 6 inch, non-redundant IOTA is displayed.

Figure 5.26 Series C Low Level 6 inch, non-redundant IOTA



To properly wire your module to the Series C Low Level Analog Input IOTA board with Field Termination Assembly 1 (FTA1) and 2 (FTA 2), use the following graphic and table.

Figure 5.27 Series C Low Level Analog Input IOTA and field wiring connections

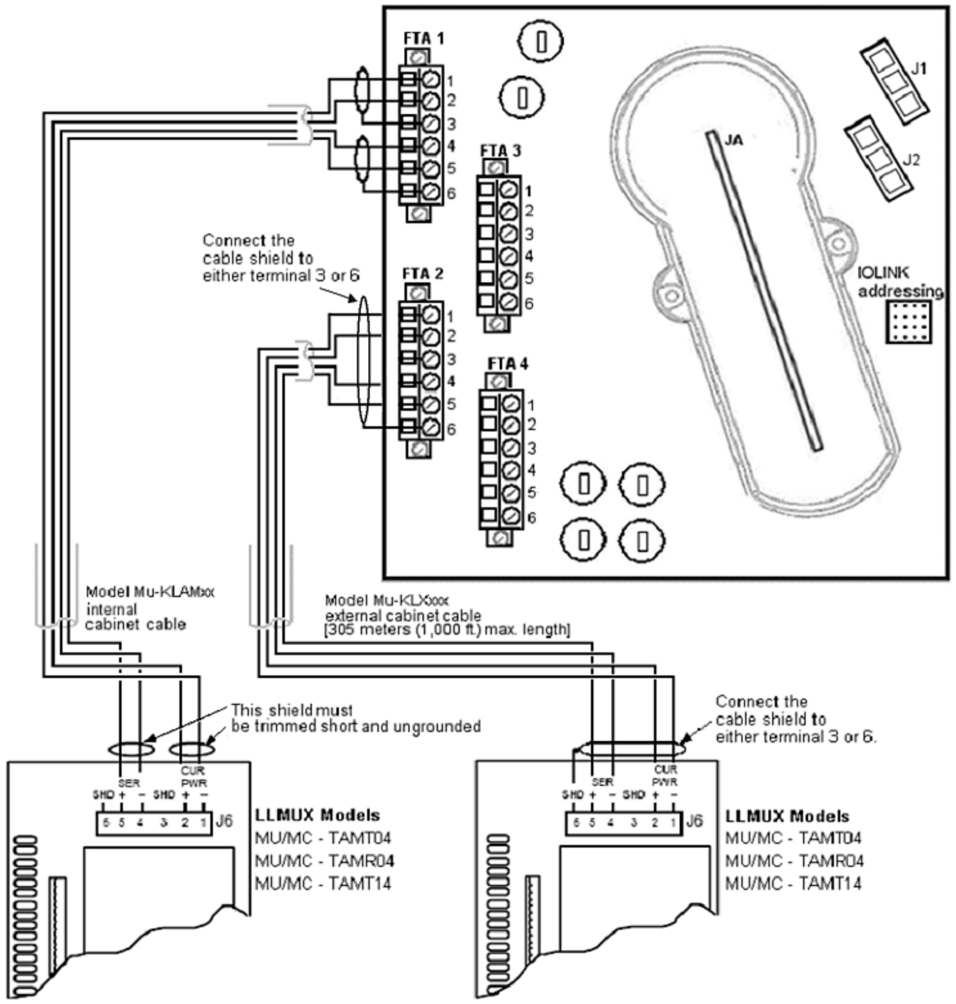


Table 5.19 LL MUX FTA connections

Field Termination Assembly (for FTA's 1, 2, 3, and 4)	
Terminal	Power screw
1 power	negative
2 power	positive
3 shield	n/a
4 serial	negative
5 serial	positive
6 shield	n/a

Table 5.20 LL MUX FTA jumper unit positions

Field Termination Assembly - jumper unit position	
FTA	Unit position
FTA 1	0

Field Termination Assembly - jumper unit position	
FTA	Unit position
FTA 2	1
FTA 3	0
FTA 4	1

5.8 Digital Input High Voltage IOTA Models CC-TDI110, CC-TDI120, CC-TDI220, CC-TDI230

The Series C Digital Input High Voltage IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Digital Input - High Voltage in the Recommended Spare Parts section.

- Field wiring and module protection - Digital Input High Voltage module
- IOTA board and connections - Digital Input High Voltage module

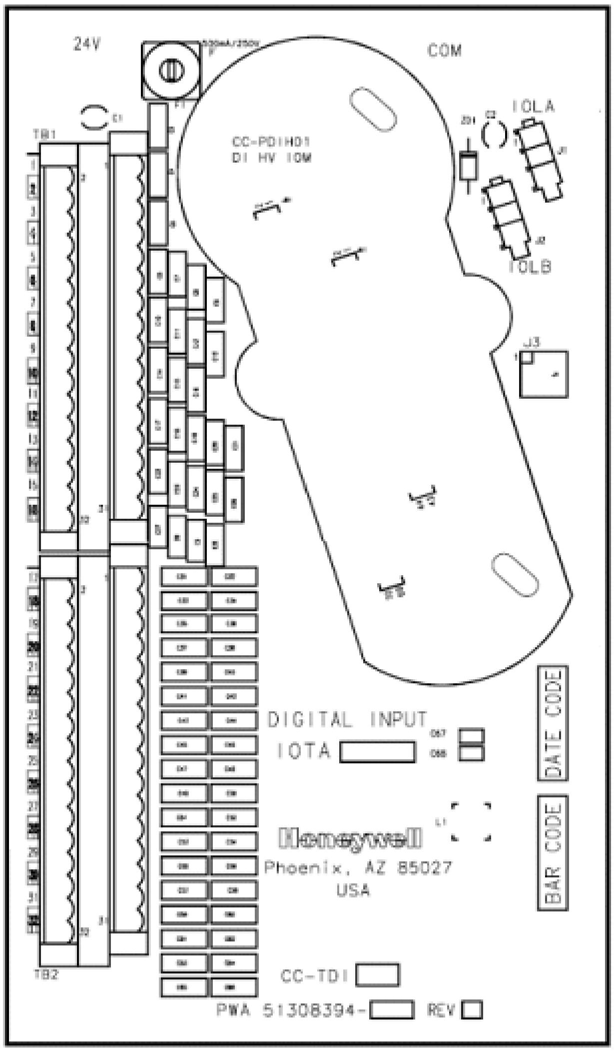
5.8.1 Field wiring and module protection - Digital Input High Voltage module

Field wiring power is provided externally, therefore, Series C protection is not required.

5.8.2 IOTA board and connections - Digital Input High Voltage module

Series C Digital Input High Voltage 9 inch, non-redundant IOTA is displayed.

Figure 5.28 Series C Digital Input High Voltage 9 inch, non-redundant IOTA



Series C Digital Input High Voltage 12 inch, redundant IOTA is displayed.

Figure 5.29 Series C Digital Input High Voltage 12 inch, redundant IOTA

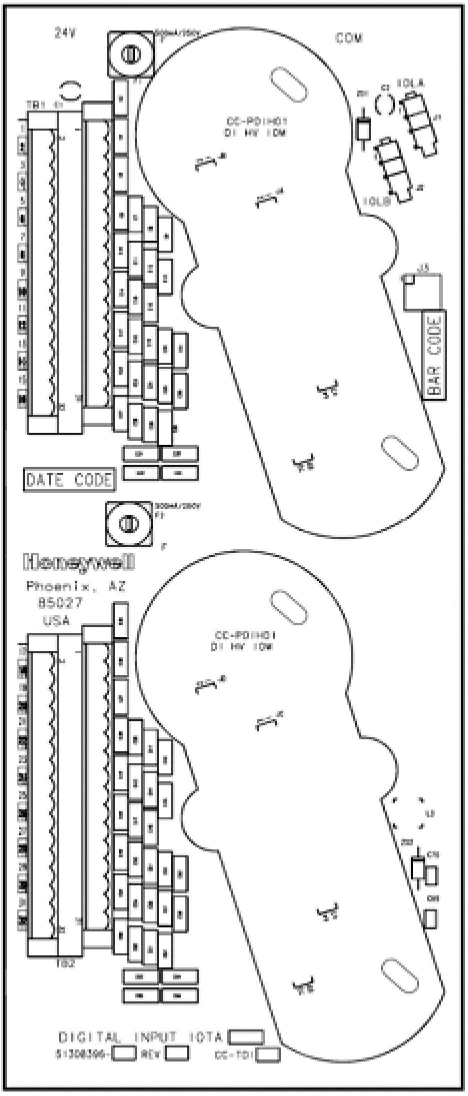


Figure 5.30 Series C Digital Input High Voltage 120 Vac and field wiring connections

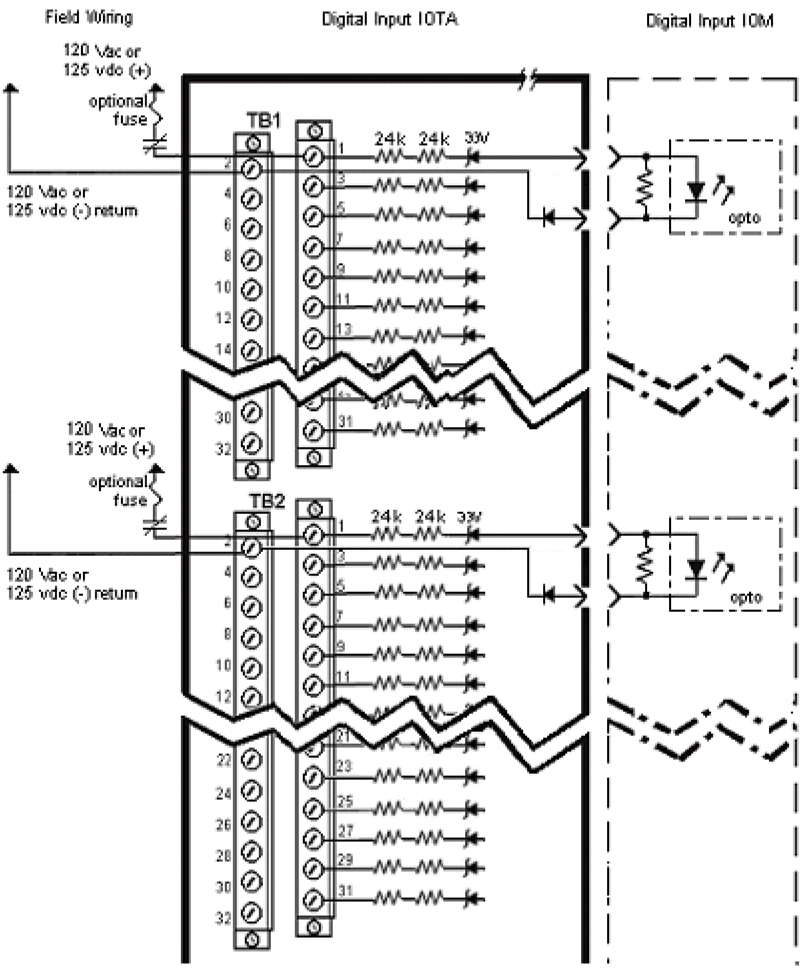
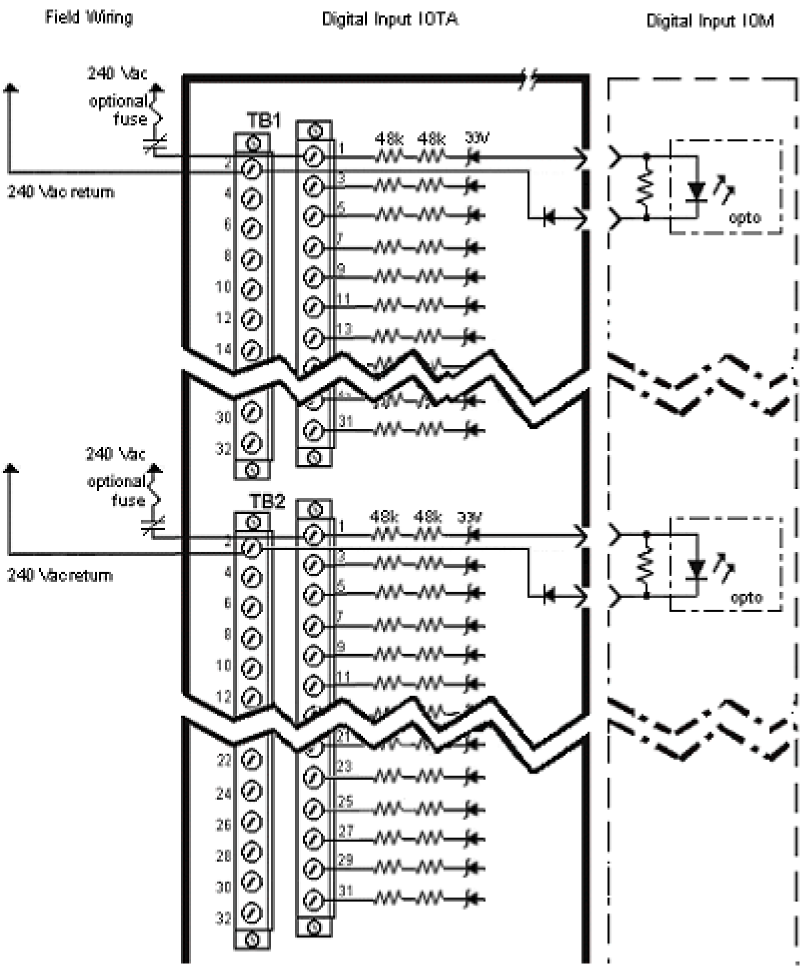


Figure 5.31 Series C Digital Input High Voltage 240 Vac and field wiring connections



To properly wire your module to the Series C Digital Input High Voltage IOTA board with terminal blocks 1 (TB1) and 2 (TB2) use the following table.

Table 5.21 DI HV 12 inch, redundant - terminal block 1

Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23

Terminal block 1		
Channel	Return screw	Power screw
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.22 DI HV 12 inch, redundant - terminal block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	30	29
Channel 32	32	31

5.9 Digital Input High Voltage PROX IOTA Model Cx-TDI151

The Series C Digital Input High Voltage PROX IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, see the "Recommended Spare Parts" table in the IOM removal and installation under power section.

- Difference between CC-TDI151 and CC-TDI110/CC-TDI120 IOTAs
- Field wiring and module protection - Digital Input High Voltage PROX IOTA (Cx - TDI151)
- IOTA board and connections - Digital Input High Voltage module

5.9.1 Difference between CC-TDI151 and CC-TDI110/CC-TDI120 IOTAs

The following table lists the differences between CC-TDI151 and CC-TDI110/CC-TDI120 IOTAs.

Table 5.23 Difference between CC-TDI151 and CC-TDI110/CC-TDI120 IOTAs

CC-TDI151	CC-TDI110/CC-TDI120
Size of non-redundant IOTA is 12 inch.	Size of non-redundant IOTA is 9 inch.
Sensor current for ON condition is 7.5 mA at 90 voltage and 10 mA at 132 voltage.	Sensor current for ON condition is 1 mA at both 90 and 120 voltages.
Sensor current for OFF condition is 2 mA.	Sensor current for OFF condition is 0.32 mA.

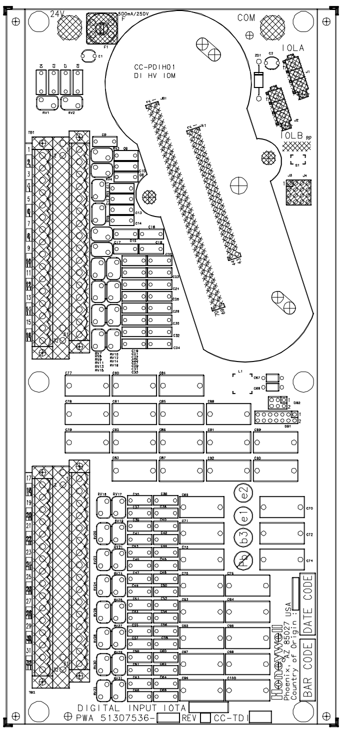
5.9.2 Field wiring and module protection - Digital Input High Voltage PROX IOTA (Cx - TDI151)

Field wiring power is provided externally, therefore, Series C protection is not required.

5.9.3 IOTA board and connections - Digital Input High Voltage module

Series C Digital Input High Voltage 12 inch, non-redundant PROX IOTA is displayed.

Figure 5.32 Series C Digital Input High Voltage 12 inch, non-redundant PROX IOTA



To properly wire your module to the Series C Digital Input High Voltage PROX IOTA board with terminal blocks 1 (TB1) and 2 (TB2) use the following table.

Table 5.24 DI HV 12 inch, non-redundant - terminal block 1

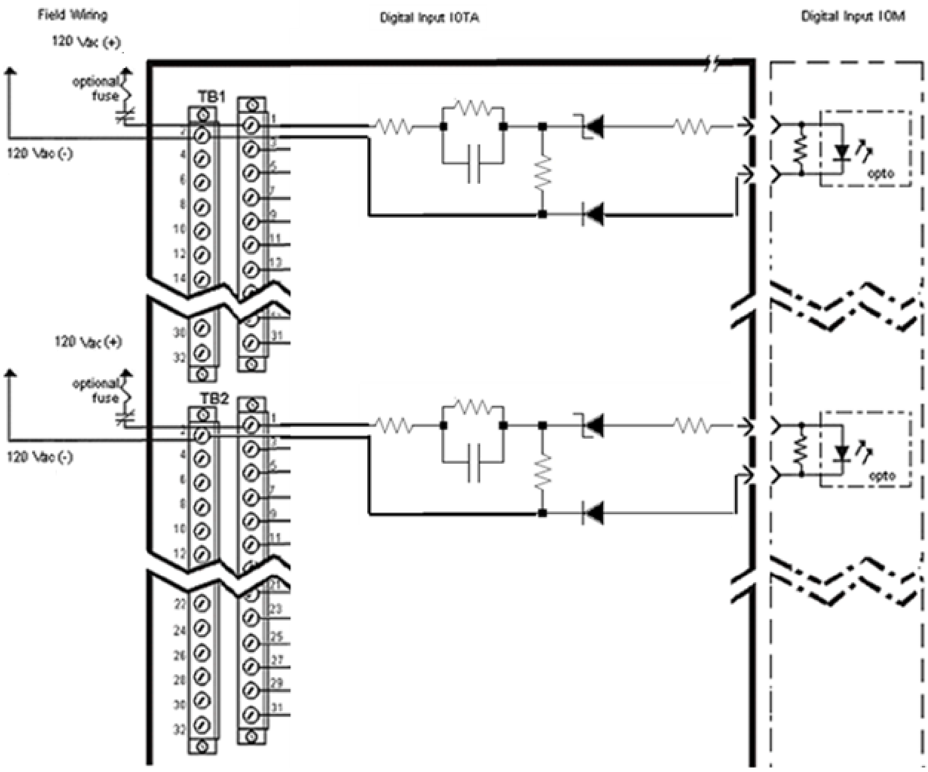
Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.25 DI HV 12 inch, non-redundant - terminal block 1

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	30	29
Channel 32	32	31

The field wiring connection of the Series C Digital Input High Voltage PROX IOTA is displayed in the following figure.

Figure 5.33 Field wiring connection of Series C Digital Input High Voltage PROX IOTA



5.10 Digital Input 24V IOTA Models CC-TDIL01, CC-TDIL11

The Series C Digital Input 24V IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Digital Input 24V in the Recommended Spare Parts section.

- Field wiring and module protection - Digital Input 24V module (CC-TDIL01, CC-TDIL11)
- Using DI 24V module (CC-TDIL01, CC-TDIL11) channels to report system alarms
- Connecting the Power System alarm cable for RAM Charger Assembly 51199932-200

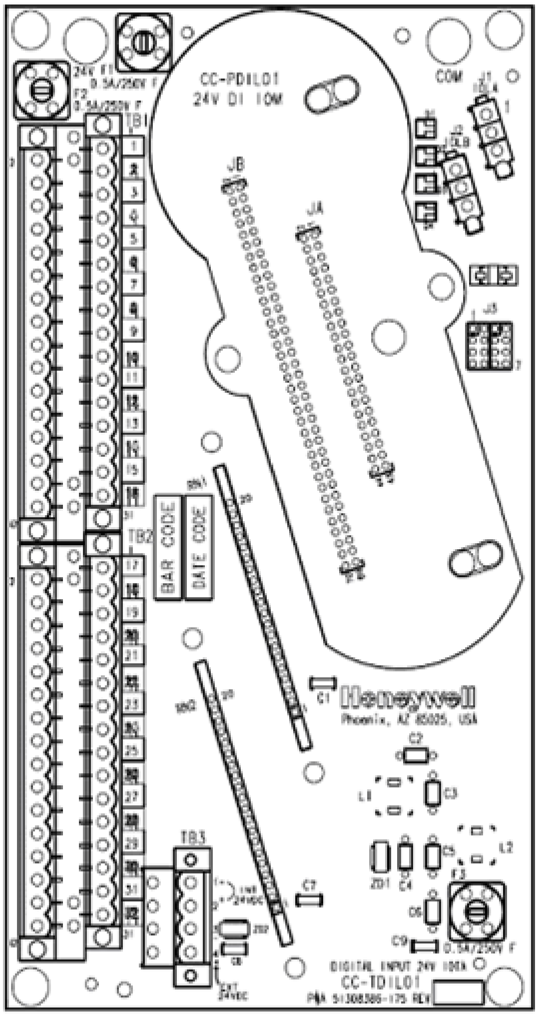
5.10.1 Field wiring and module protection - Digital Input 24V module (CC-TDIL01, CC-TDIL11)

Field wiring is protected by an internal protection circuit which:

- Allows for internal or external DI sense power (field selectable using jumper block TB3)
- Permits short circuit protection of input for field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Allows each signal to be shorted in the field with no damage to module or board. Other channels on the same IOM are not affected.
- Field drive current is limited. Short circuit of input allowed.

Series C 24V Digital Input 9 inch, non-redundant IOTA is displayed.

Figure 5.34 Series C 24V Digital Input 9 inch, non-redundant IOTA



To properly wire your module to the Series C Digital Input IOTA board with terminal blocks 1 (TB1), 2 (TB2), and 3 (TB3), use the following table.

Table 5.26 DI 9 inch, non-redundant - terminal block 1

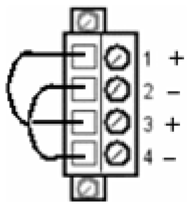
Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7

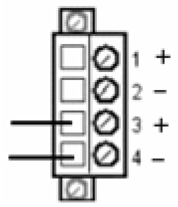
Terminal block 1		
Channel	Return screw	Power screw
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.27 DI 9 inch, non-redundant - terminal block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	30	29
Channel 32	32	31

Table 5.28 DI 9 inch, non-redundant - terminal block 3

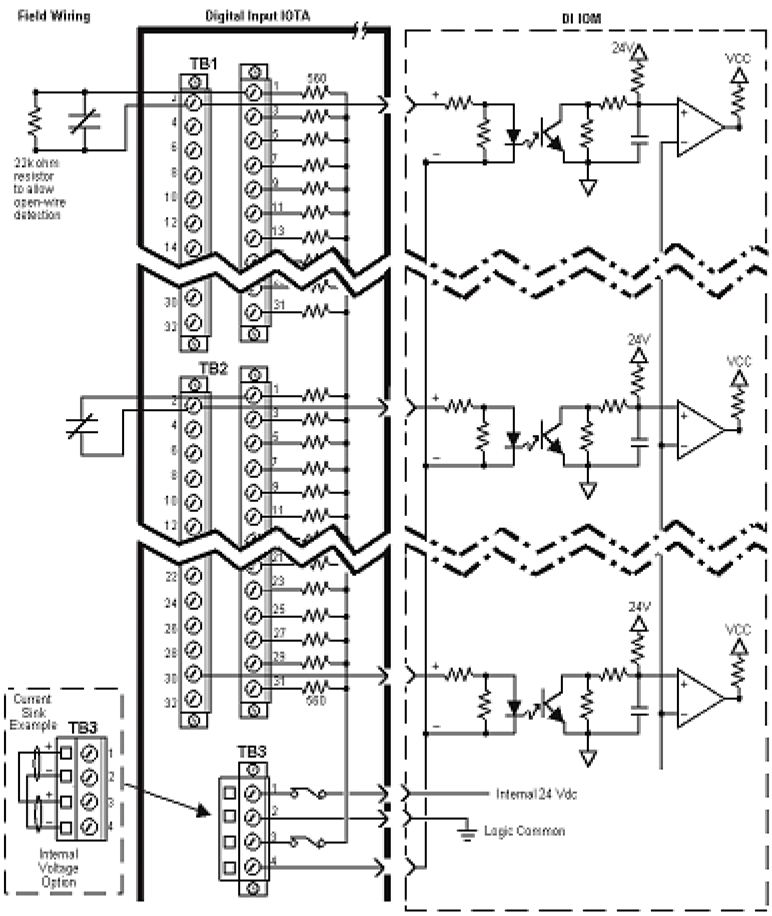
Terminal block 3	
Internal	Used with Honeywell's 24v power supply
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	
External	Used with customer's 24v power supply

Terminal block 3	
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	

Series C 24V Digital Input 9 inch, non-redundant IOTA and field wiring connection is displayed.

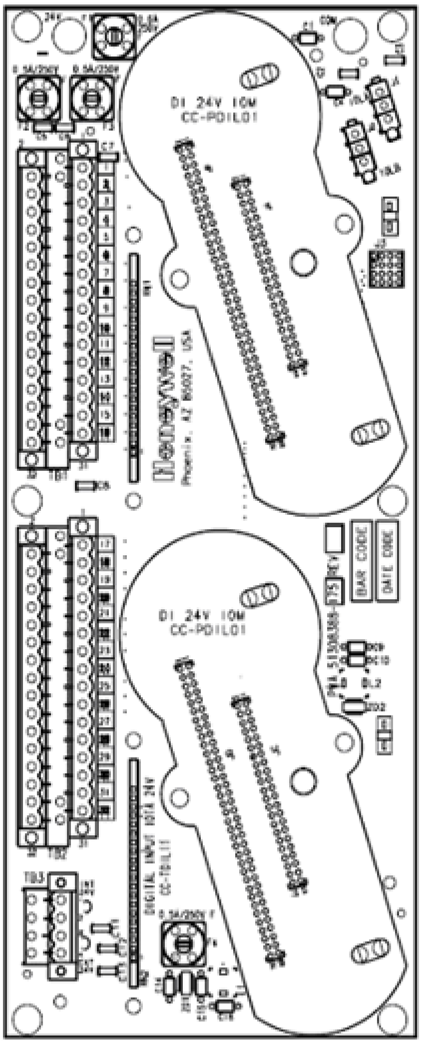
> **TIP**
>
> Optional open-wire detection can be instituted by attaching a 22k ohm resistor in the field wiring.

Figure 5.35 Series C 24V Digital Input 9 inch, non-redundant IOTA and field wiring connection



Series C 24V Digital Input 12 inch, redundant IOTA is displayed.

Figure 5.36 Series C 24V Digital Input 12 inch, redundant IOTA



5.10.2 Using DI 24V module (CC-TDIL01, CC-TDIL11) channels to report system alarms

You must include digital input channels in the control strategy to generate and report alarms based on their PVs. A typical strategy consists of a Control Module that contains the DI channel blocks where each PV (output) is connected to a PVFL input of a FLAGARRAY block configured for alarming.

The normal condition of the alarm input is ON.

Refer to the Control Building Guide for the following topics

- Creating and saving a control module
- Creating an instance of a basic function block
- Configuring alarms

Prerequisites

- You have installed and configured Series C 24V digital input I/O modules and associated IOTAs.
- You have alarm cables 51202343-001 (12-foot long) to connect power supply alarm contacts to 24V dc digital inputs on the IOM.

To connect the Power System alarm cable for RAM Charger Assembly 51199932-100

1. Plug the connection end of the alarm cable into the alarm connection on top of the power supply.
2. Connect the twisted pair wires to the terminal block 1 on the DI 24V IOTA in the following configuration. The associated alarm pins are also displayed.

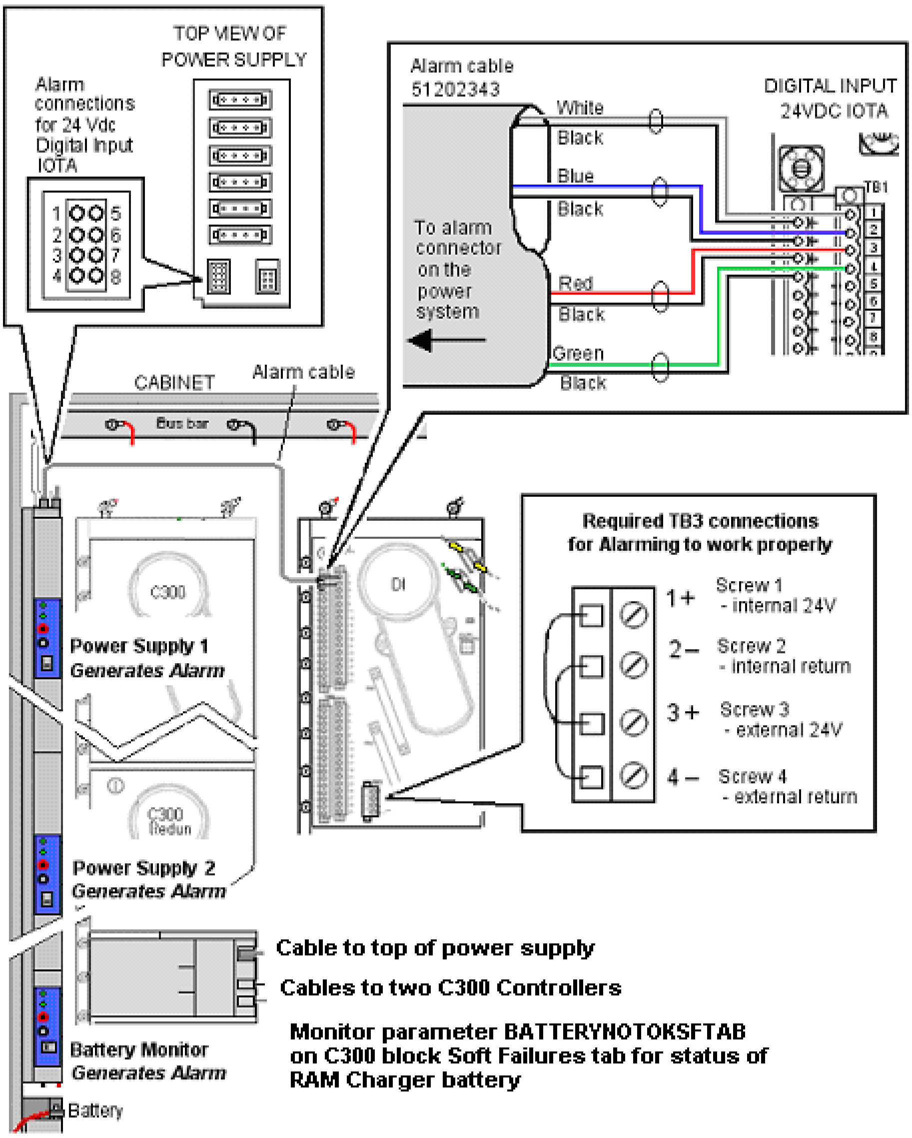
TERMINAL BLOCK 1			PWR SUPPLY ALARM CONNECTOR	
Wire color	Channel	Screw	Description	
White	1	1	Power supply 1 alarm +	(pin 8)
Black	1	2	Power supply 1 alarm -	(pin 3)
Blue	2	3	Power supply 2 alarm +	(pin 7)
Black	2	4	Power supply 2 alarm -	(pin 4)
Red	3	5	Battery alarm +	(pin 2)
Black	3	6	Battery alarm -	(pin 1)
Green	4	7	RAM charger cable alarm +	(pin 6)
Black	4	8	RAM charger cable alarm -	(pin 5)

3. Ensure terminal block 3 connections are made in the following configuration

   Screw 1 + (internal 24V) to Screw 3 + (external 24V)

   Screw 2 - (internal return) to Screw 4 - (external return)

Figure 5.37 Alarm cable connection to the power supply and 24V DI IOTA for RAM Charger Assembly 51199932-100



5.10.3 Connecting the Power System alarm cable for RAM Charger Assembly 51199932-200

1. Plug the connection end of the alarm cable into the alarm connection on top of the power supply.

2. Connect the twisted pair wires to the terminal block 1 on the DI 24V IOTA in the following configuration. The associated alarm pins are also displayed.

TERMINAL BLOCK 1			PWR SUPPLY ALARM CONNECTOR (20A power system)	
Wire color	Channel	Screw	Description	
White	1	1	Power supply 1 alarm +	(pin 8)
Black	1	2	Power supply 1 alarm -	(pin 3)
Blue	2	3	Power supply 2 alarm +	(pin 7)
Black	2	4	Power supply 2 alarm -	(pin 4)
Red	3	5	Battery alarm +	(pin 2)
Black	3	6	Battery alarm -	(pin 1)
Green	4	7	Not Used (No Cable)	
Black	4	8	Not Used (No Cable)	

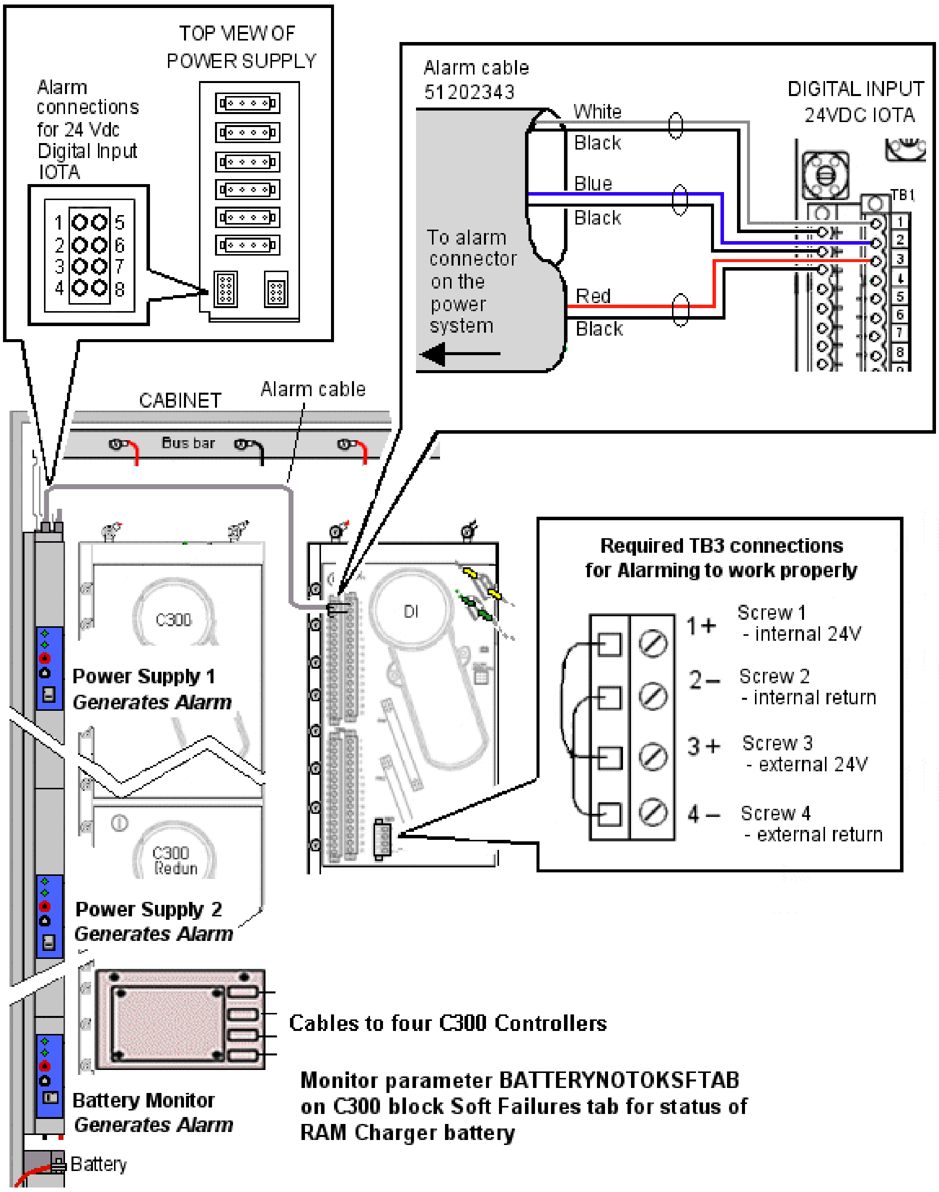
3. Ensure terminal block 3 connections are made in the following configuration

   Screw 1 + (internal 24V) to Screw 3 + (external 24V)

   Screw 2 - (internal return) to Screw 4 - (external return)

TERMINAL BLOCK 1			PWR SUPPLY ALARM CONNECTOR (40A power system)	
Wire color	Channel	Screw	Description	
White	1	1	Power supply 1 alarm +	(pin 8)
Black	1	2	Power supply 1 alarm -	(pin 3)
Blue	2	3	Power supply 2 alarm +	(pin 7)
Black	2	4	Power supply 2 alarm -	(pin 4)
Red	3	5	Power supply 3 alarm +	(pin 1)
TERMINAL BLOCK 1			**PWR SUPPLY ALARM CONNECTOR (40A power system)**	
Wire color	**Channel**	**Screw**	**Description**	
Black	3	6	Power supply 3 alarm -	(pin 2
Green	4	7	Not Used (No Cable)	
Black	4	8	Not Used (No Cable)	

Figure 5.38 Alarm cable connection to the power supply and 24V DI IOTA for RAM Charger Assembly 51199932-200



5.11 Digital Input 24V IOTA Models Cx - TDIL51, Cx - TDIL61

The Series C Digital Input 24V IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Digital Input 24V in the Recommended Spare Parts section.

- **Field wiring and module protection - Digital Input 24V module (Cx - TDIL51, Cx - TDIL61)**
- **Using DI 24V module (Cx - TDIL51, Cx - TDIL61) channels to report system alarms**

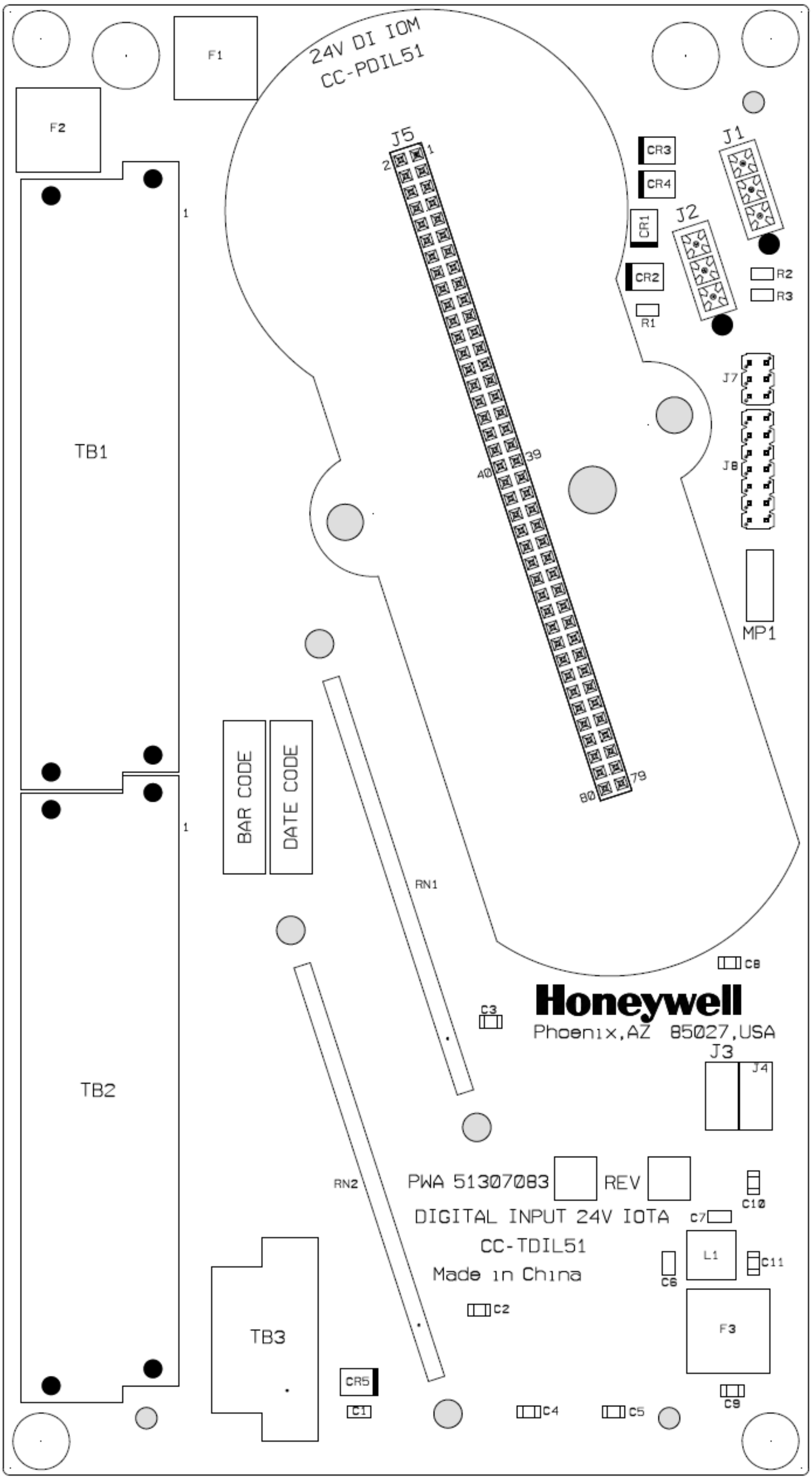
5.11.1 Field wiring and module protection - Digital Input 24V module (Cx - TDIL51, Cx - TDIL61)

Field wiring is protected by an internal protection circuit, which:

- Allows for internal or external DI sense power (field selectable using jumper block TB3)
- Permits short circuit protection of input for field short circuits. Protection suitable for Division 2 non-incendive / Zone 2 non-arcing.
- Allows each signal to be shorted in the field with no damage to module or board. Other channels on the same IOM are not affected.
- Field drive current is limited. Short circuit of input allowed.

Series C 24V Digital Input 9 inch, non-redundant IOTA is displayed.

Figure 5.39 Series C 24V Digital Input 9 inch, non-redundant IOTA


24V DI IOM
CC-PDIL51
F1
F2
J5
J1
J2
J3
J4
J7
J8
CR1
CR2
CR3
CR4
CR5
R1
R2
R3
TB1
TB2
TB3
MP1
BAR CODE
DATE CODE
RN1
RN2
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
L1
F3
Honeywell
Phoenix,AZ 85027,USA
PWA 51307083
REV
DIGITAL INPUT 24V IOTA
CC-TDIL51
Made in China

To wire your module to the Series C Digital Input IOTA board with terminal blocks 1 (TB1), 2 (TB2), and 3 (TB3), use the following table.

Table 5.29 DI 9 inch, non-redundant - terminal block 1

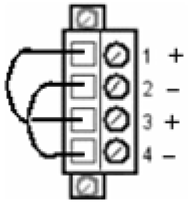
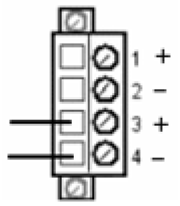
Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.30 DI 9 inch, non-redundant - terminal block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	30	29
Channel 32	32	31

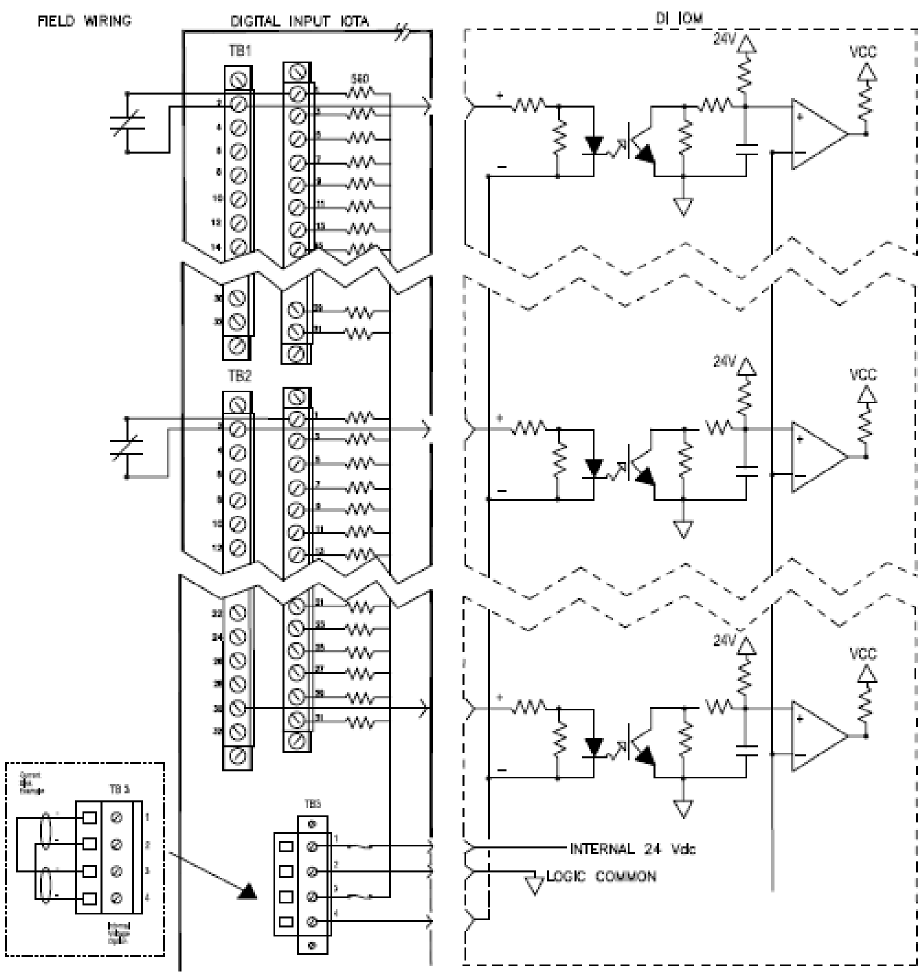
Table 5.31 DI 9 inch, non-redundant - terminal block 3

Terminal block 3	
Internal	Used with Honeywell's 24v power supply

Terminal block 3	
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	
External	Used with customer's 24v power supply
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	

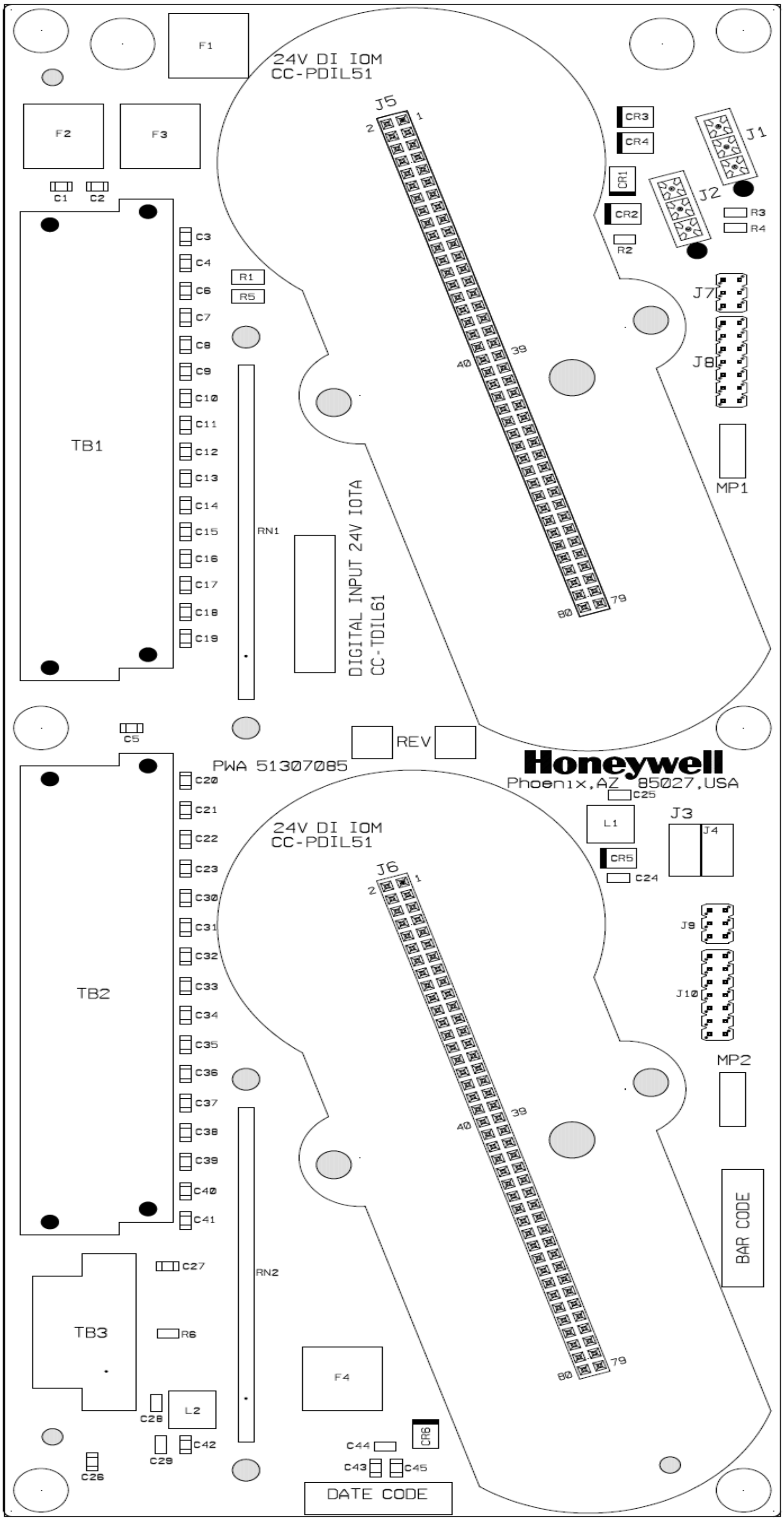
Series C 24V Digital Input 9 inch, non-redundant IOTA and field wiring connection is displayed.

Figure 5.40 Series C 24V Digital Input 9 inch, non-redundant IOTA and field wiring connection



Series C 24V Digital Input 9 inch, redundant IOTA is displayed.

Figure 5.41 Series C 24V Digital Input 9 inch, redundant IOTA



5.11.2 Using DI 24V module (Cx - TDIL51, Cx - TDIL61) channels to report system alarms

You must include digital input channels in the control strategy to generate and report alarms based on their PVs. A typical strategy consists of a Control Module that contains the DI channel blocks where each PV (output) is connected to a PVFL input of a FLAGARRAY block configured for alarming.

The normal condition of the alarm input is ON.

Refer to the Control Building Guide for the following topics

- Creating and saving a control module
- Creating an instance of a basic function block
- Configuring alarms

Prerequisites

- You have installed and configured Series C 24V digital input I/O modules and associated IOTAs.
- You have alarm cables 51202343-001 (12-foot long) to connect power supply alarm contacts to 24V dc digital inputs on the IOM.

To connect the Power System alarm cable for RAM Charger Assembly 51199932-200

1. Plug the connection end of the alarm cable into the alarm connection on top of the power supply.
2. Connect the twisted pair wires to the terminal block 1 on the DI 24V IOTA in the following configuration. The associated alarm pins are also displayed.

TERMINAL BLOCK 1			PWR SUPPLY ALARM CONNECTOR (20A power system)	
Wire color	Channel	Screw	Description	
White	1	1	Power supply 1 alarm +	(pin 8)
Black	1	2	Power supply 1 alarm -	(pin 3)
Blue	2	3	Power supply 2 alarm +	(pin 7)
Black	2	4	Power supply 2 alarm -	(pin 4)
Red	3	5	Battery alarm +	(pin 2)
Black	3	6	Battery alarm -	(pin 1)
Green	4	7	Not Used (No Cable)	
Black	4	8	Not Used (No Cable)	

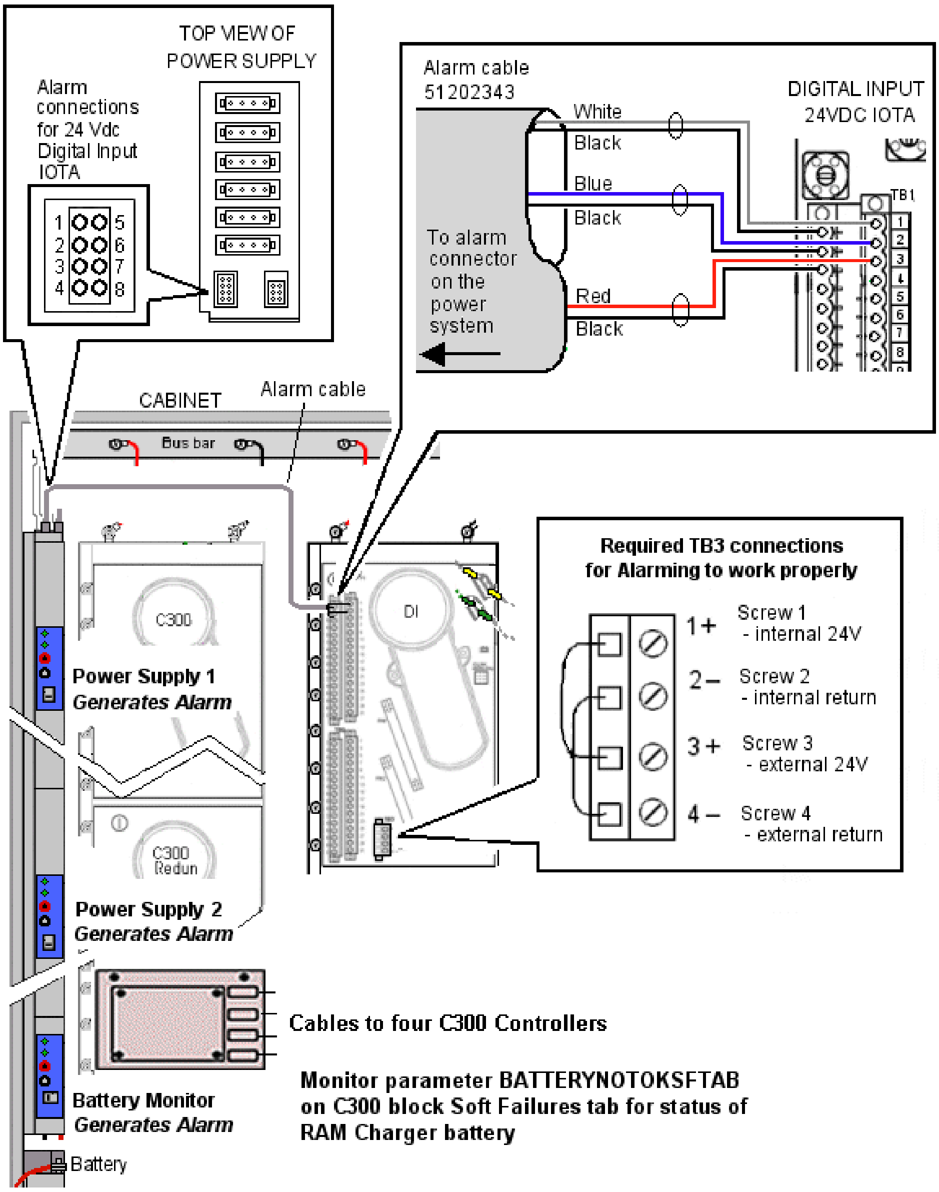
3. Ensure terminal block 3 connections are made in the following configuration

   Screw 1 + (internal 24V) to Screw 3 + (external 24V)

   Screw 2 - (internal return) to Screw 4 - (external return)

TERMINAL BLOCK 1		PWR SUPPLY ALARM CONNECTOR (40A power system)		
Wire color	Channel	Screw	Description	
White	1	1	Power supply 1 alarm +	(pin 8)
Black	1	2	Power supply 1 alarm -	(pin 3)
Blue	2	3	Power supply 2 alarm +	(pin 7)
Black	2	4	Power supply 2 alarm -	(pin 4)
Red	3	5	Power supply 3 alarm +	(pin 1)
TERMINAL BLOCK 1			**PWR SUPPLY ALARM CONNECTOR (40A power system)**	
Wire color	**Channel**	**Screw**	**Description**	
Black	3	6	Power supply 3 alarm -	(pin 2
Green	4	7	Not Used (No Cable)	
Black	4	8	Not Used (No Cable)	

Figure 5.42 Alarm cable connection to the power supply and 24V DI IOTA for RAM Charger Assembly 51199932-200



5.12 Digital Output 24V IOTA Models CC-TDOB01, CC-TDOB11

> CAUTION
>
> When wiring the Digital Output 24V ensure that the **external power is not reversed** or the IOM will be damaged.

The Series C Digital Output 24V IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Digital Output 24V in the Recommended Spare Parts section.

- Field wiring and module protection - Digital Output 24V module (CC-TDOB01, CC-TDOB11)
- IOTA board and connections - Digital Output 24V module (CC-TDOB01, CC-TDOB11)

5.12.1 Field wiring and module protection - Digital Output 24V module (CC-TDOB01, CC-TDOB11)

The Digital Output 24Volt Module provides a unique and highly functional output power protection method. When a short occurs in the field, the following occurs:

- the output circuits sense the over-current condition and shut down the output
- the shut down of the point places the mode of the point into Manual
- an Over-current Soft Failure is generated

This failure is maintained until the short circuit condition is repaired and the point is again supplying the proper current.

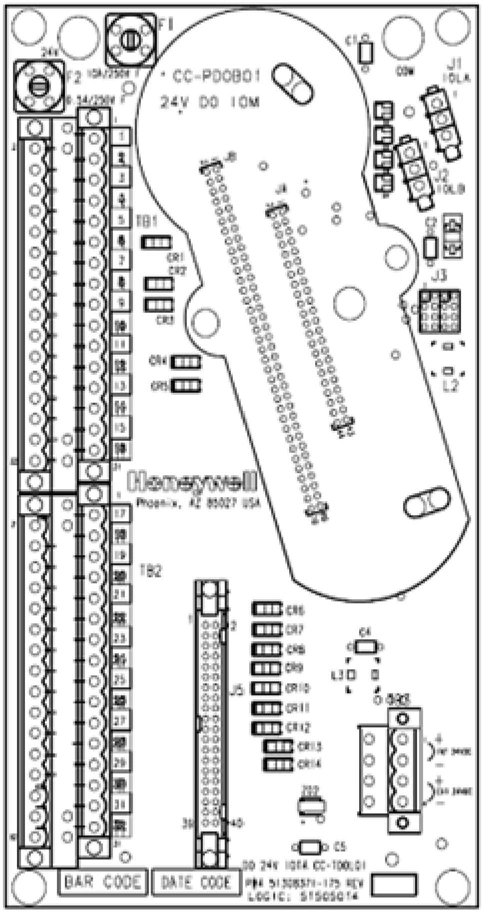
Only one channel is affected at a time. If multiple channels are affected, they are individually shut down. Any channels that do not have a short circuit condition are unaffected.

- Thermal protection alarm if short in field of > 0.5A.

5.12.2 IOTA board and connections - Digital Output 24V module (CC-TDOB01, CC-TDOB11)

Series C 24V Digital Output 9 inch, non-redundant IOTA is displayed.

Figure 5.43 Series C 24V Digital Output 9 inch, non-redundant IOTA



To properly wire your module to the Series C 24V Digital Output IOTA board with terminal blocks 1 (TB1) and 2 (TB2), use the following table.

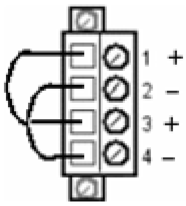
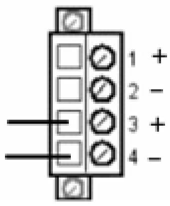
Table 5.32 24V DO 9 inch, non-redundant - terminal block 1

Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.33 24V DO 9 inch, non-redundant - terminal block 2

Terminal block 2		
Channel	**Return screw**	**Power screw**
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	29	28
Channel 32	32	31

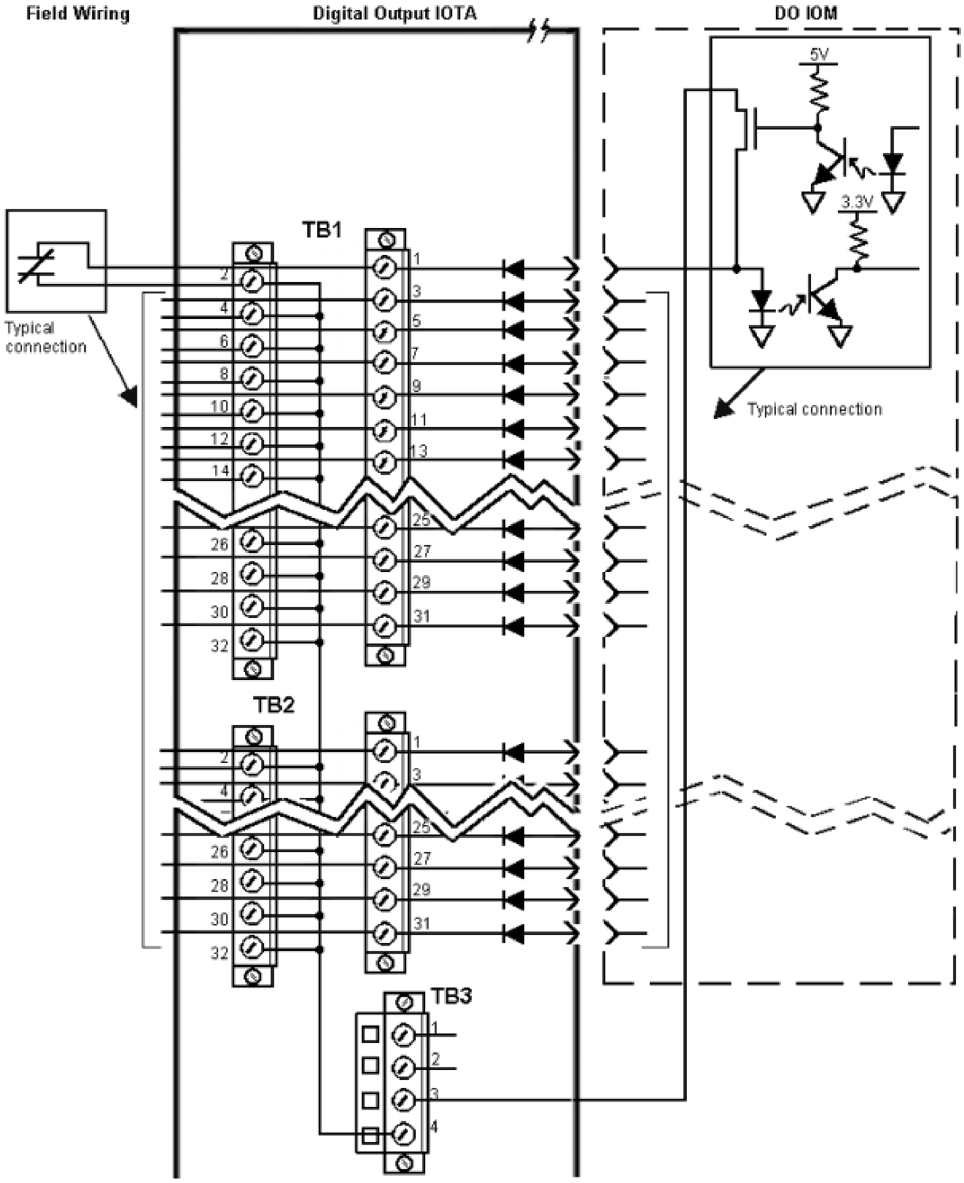
Table 5.34 24V DO 9 inch, non-redundant - terminal block 3

Terminal block 3	
Internal	Used with Honeywell's provided 24v power supply
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	
External	Used with customer's provided 24v power supply
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	

> CAUTION
>
> When wiring the Digital Output 24V ensure that the
>
> **external power is not reversed** or the IOM will be damaged.

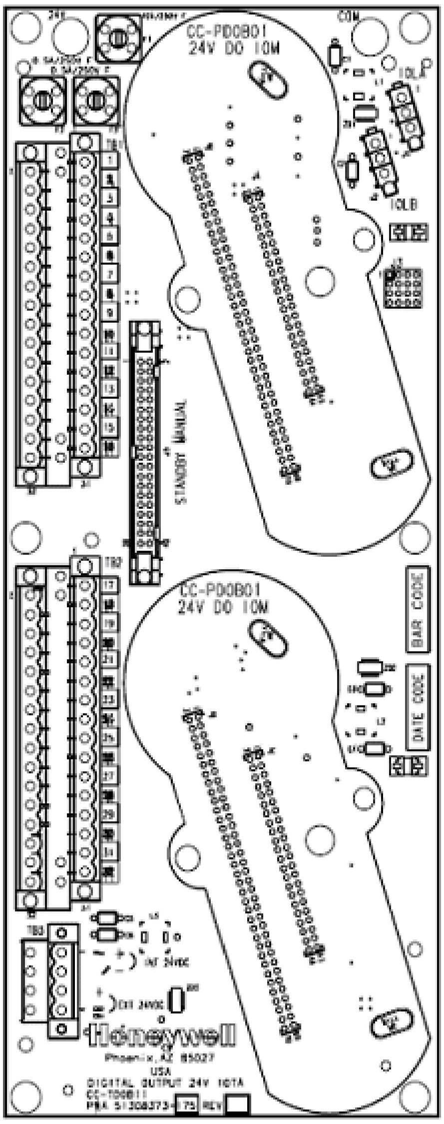
Series C 24V Digital Output 9 inch, non-redundant IOTA and field wiring connection is displayed

Figure 5.44 Series C 24V Digital Output 9 inch, non-redundant IOTA and field wiring connections



Series C 24V Digital Output 12 inch, redundant IOTA is displayed

Figure 5.45 Series C 24V Digital Output 12 inch, redundant IOTA



5.13 Digital Output 24V IOTA Models Cx-TDOD51, Cx-TDOD61

CAUTION

When wiring the Digital Output 24V ensure that the **external power is not reversed** or the IOM will be damaged.

The Series C Digital Output 24V IOTA board is represented by the following information and graphics.

To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, refer to Digital Output 24V in the Recommended Spare Parts section.

- Field wiring and module protection - Digital Output 24V (Cx-TDOD51, Cx-TDOD61)
- IOTA board and connections - Digital Output 24V (Cx-TDOD51, Cx-TDOD61)

5.13.1 Field wiring and module protection - Digital Output 24V (Cx-TDOD51, Cx-TDOD61)

The Digital Output 24Volt Module provides a unique and highly functional output power protection method. When a short occurs in the field, the following occurs.

- The output circuits sense the over-current condition and shut down the output.
- The shut down of the point places the mode of the point into Manual.
- An Over-current Soft Failure is generated.

This failure is maintained until the short circuit condition is repaired and the point is again supplying the proper current.

Only one channel is affected at a time. If multiple channels are affected, they are individually shut down. Any channels that do not have a short circuit condition are unaffected.

- Each channel in a DO module can handle a maximum load of 100mA.

5.13.2 IOTA board and connections - Digital Output 24V (Cx-TDOD51, Cx-TDOD61)

Series C 24V Digital Output 9 inch, non-redundant IOTA is displayed.

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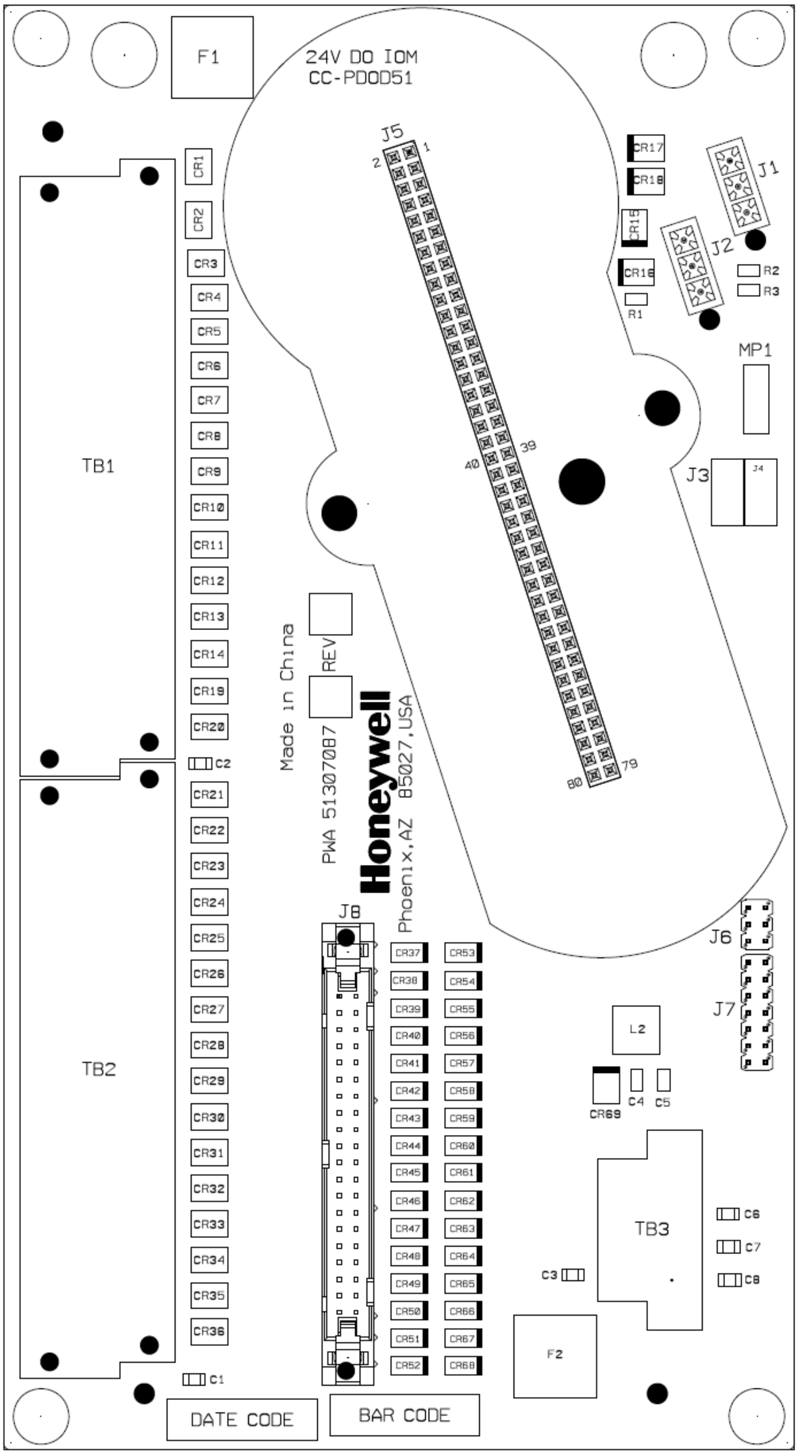
Figure 5.46 Series C 24V Digital Output 9 inch, non-redundant IOTA



To wire your module to the Series C 24V Digital Output IOTA board with terminal blocks 1 (TB1) and 2 (TB2), use the following table.

Table 5.35 24V DO 9 inch, non-redundant - terminal block 1

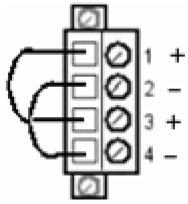
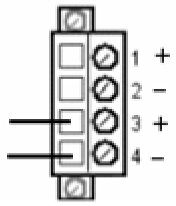
Terminal block 1		
>Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.36 24V DO 9 inch, non-redundant - terminal block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	29	28
Channel 32	32	31

Table 5.37 24V DO 9 inch, non-redundant - terminal block 3

Terminal block 3	
Internal	Used with Honeywell's provided 24v power supply

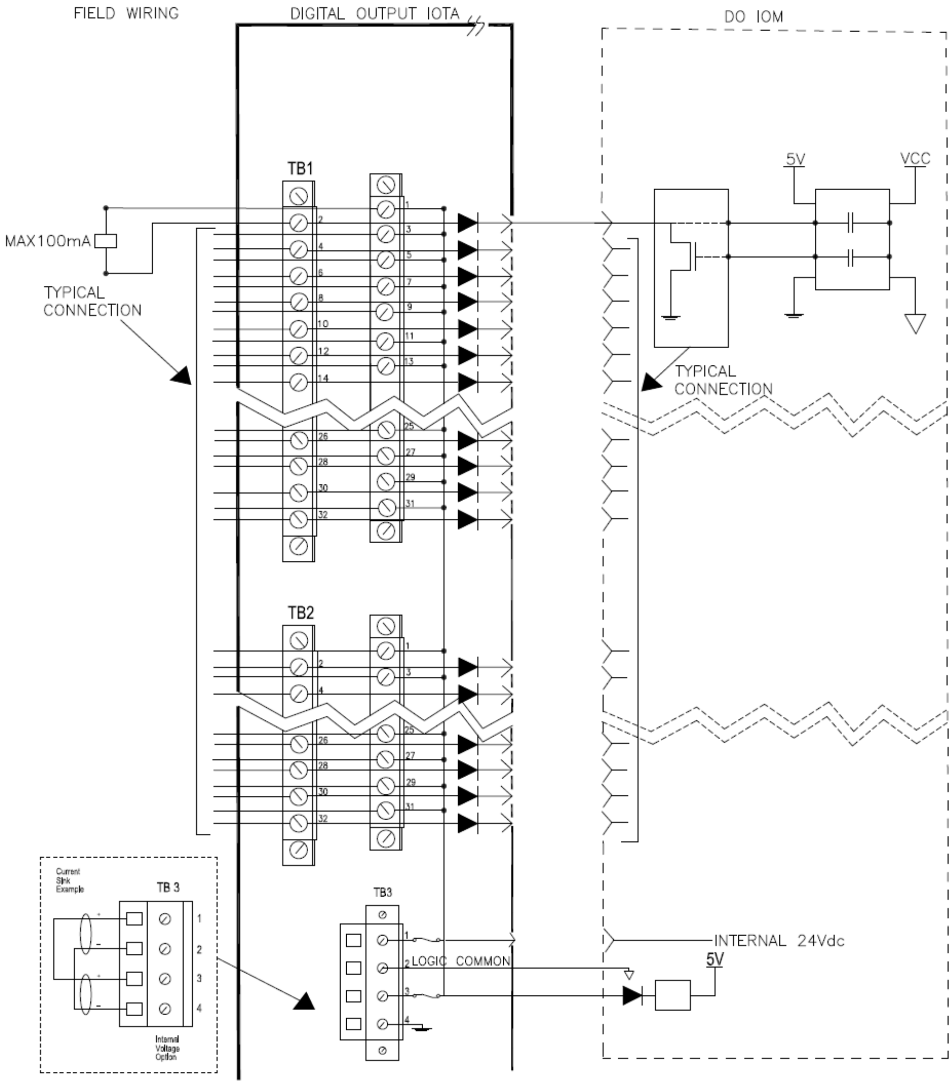
Terminal block 3	
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	
External	Used with customer's provided 24v power supply
Screw 1 - internal 24V	
Screw 2 - internal return	
Screw 3 - external 24V	
Screw 4 - external return	

CAUTION

When wiring the Digital Output 24V ensure that the **external power is not reversed** or the IOM will be damaged.

Series C 24V Digital Output 9 inch, non-redundant IOTA and field wiring connection is displayed.

Figure 5.47 Series C 24V Digital Output 9 inch, non-redundant IOTA and field wiring connections



Series C 24V Digital Output 9 inch, redundant IOTA is displayed.

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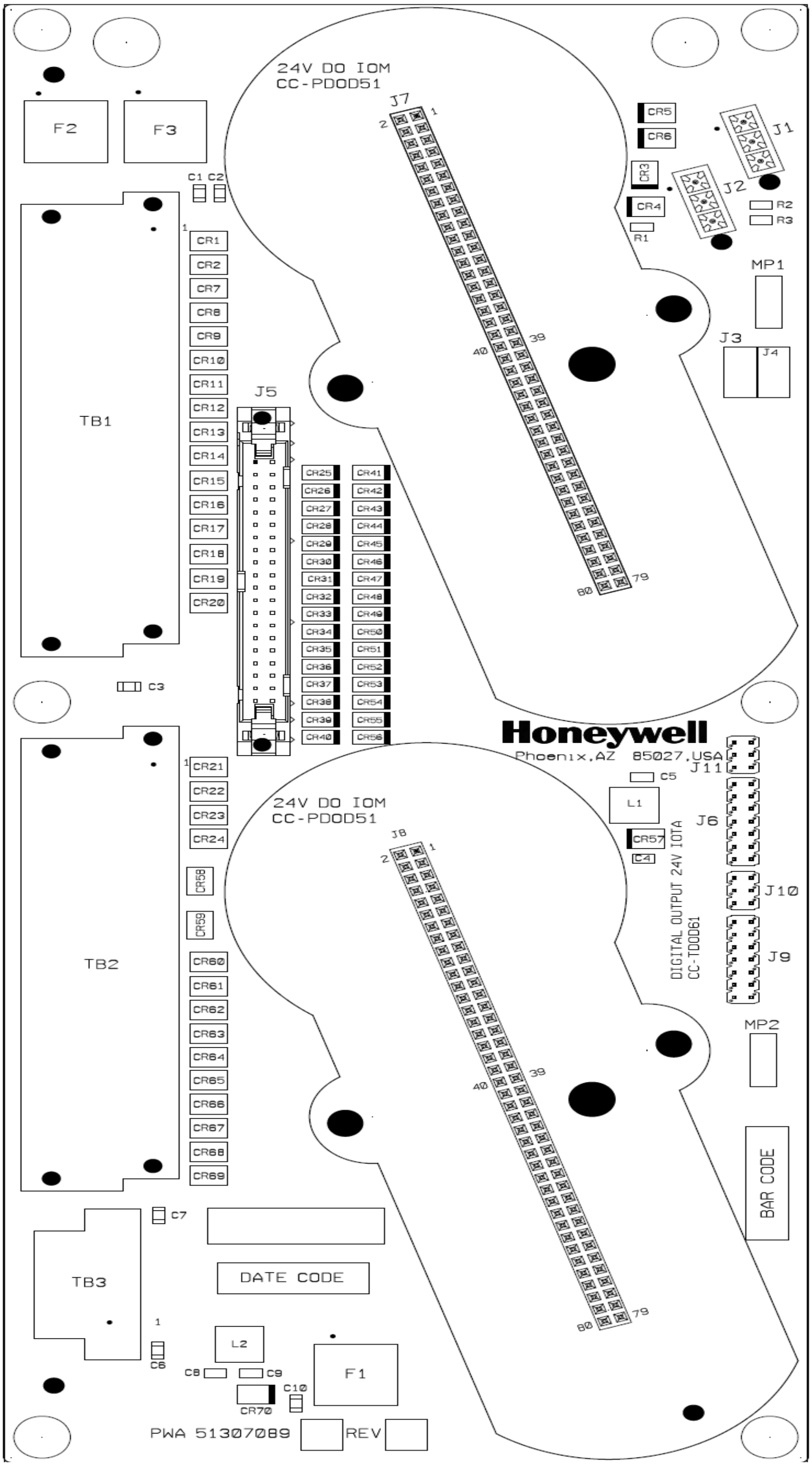
Figure 5.48 Series C 24V Digital Output 9 inch, redundant IOTA



5.14 Digital Output Relay Module IOTA Models CC-TDOR01, CC-TDOR11

The Series C Digital Output IOTA board is represented by the following information and graphics.

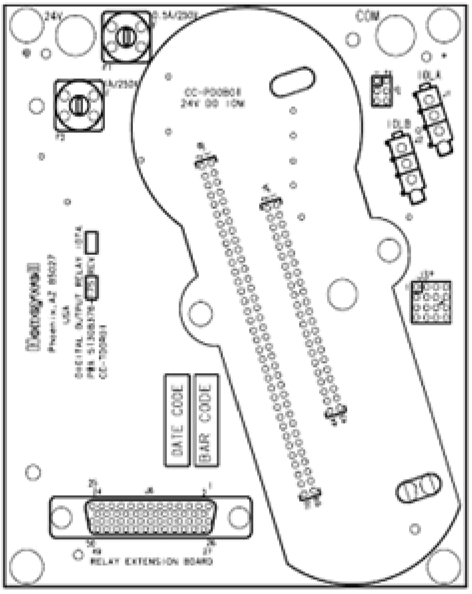
To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, jumper link, slim power relay and
- fuses

associated with this board and module, refer to Digital Output Relay in the Recommended Spare Parts section.

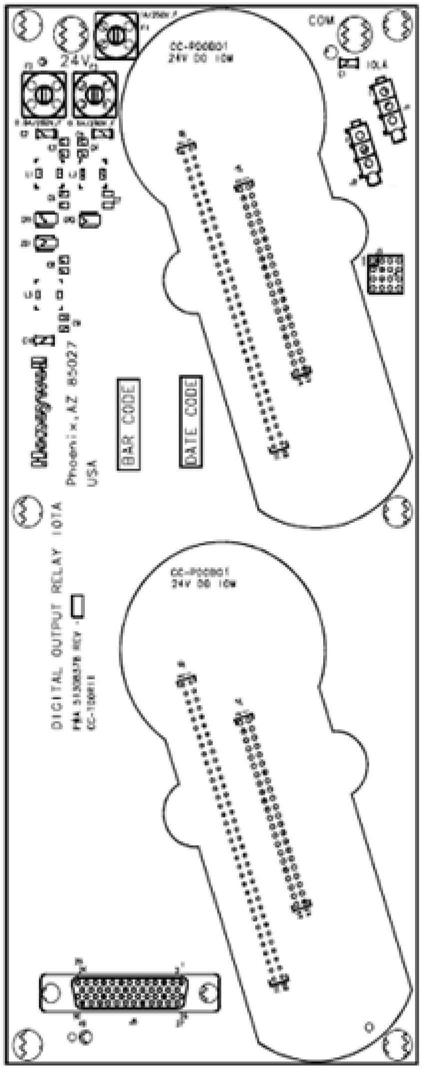
Series C Digital Output Relay non-redundant IOTA is displayed.

Figure 5.49 Series C Digital Output Relay, non-redundant IOTA



Series C Digital Output Relay redundant IOTA is displayed.

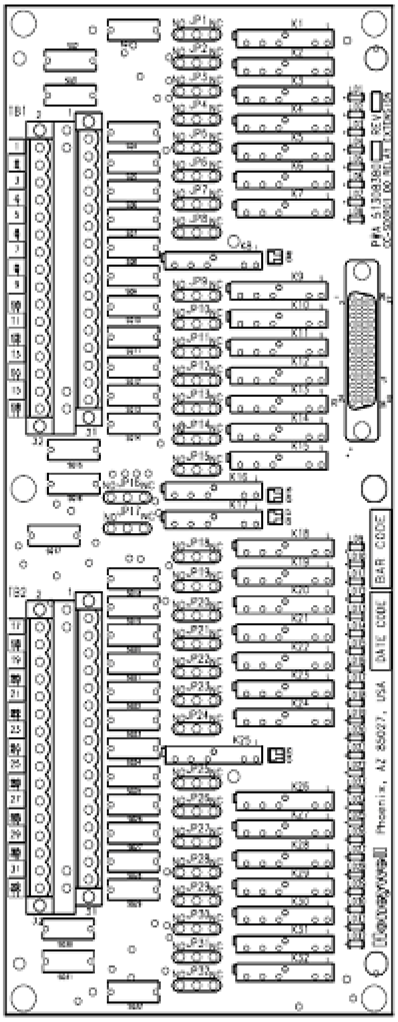
Figure 5.50 Series C Digital Output Relay, redundant IOTA



5.15 Digital Output Relay Extender board Models CC-SDOR01

Series C Digital Output Relay Extender board is displayed below.

Figure 5.51 Series C Digital Output Relay Extender board



To properly wire your module to the Series C Digital Output Relay IOTA board with terminal blocks 1 (TB1) and 2 (TB2), use the following table.

Table 5.38 DO Relay Extender board- terminal block 1

Terminal block 1		
Channel	Return screw	Power screw
Channel 1	2	1
Channel 2	4	3
Channel 3	6	5
Channel 4	8	7
Channel 5	10	9
Channel 6	12	11
Channel 7	14	13
Channel 8	16	15
Channel 9	18	17
Channel 10	20	19
Channel 11	22	21

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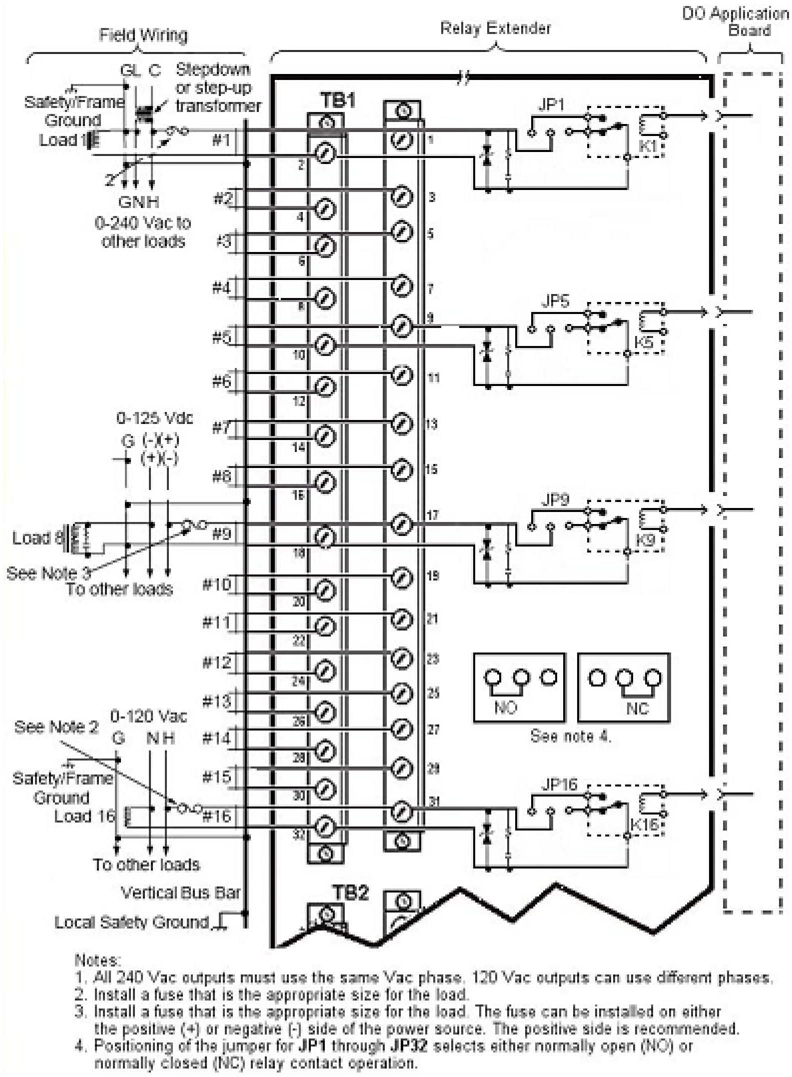
Terminal block 1		
Channel	Return screw	Power screw
Channel 12	24	23
Channel 13	26	25
Channel 14	28	27
Channel 15	30	29
Channel 16	32	31

Table 5.39 DO Relay Extender board- terminal block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	2	1
Channel 18	4	3
Channel 19	6	5
Channel 20	8	7
Channel 21	10	9
Channel 22	12	11
Channel 23	14	13
Channel 24	16	15
Channel 25	18	17
Channel 26	20	19
Channel 27	22	21
Channel 28	24	23
Channel 29	26	25
Channel 30	28	27
Channel 31	29	28
Channel 32	32	31

Series C Digital Output Relay Extender board and field wiring connection is displayed.

Figure 5.52 Series C Digital Output Relay Extender board and field wiring connections



- [DO Relay cover](#)
- [To mount the DO Relay cover](#)

5.15.1 DO Relay cover

The DO Relay Extender board being certified as high voltage (with socketed relays and jumpers) is protected by the DO Relay Cover. This complies with the hazardous location agency approvals. The cover has four captured screws; therefore, there are no loose parts.

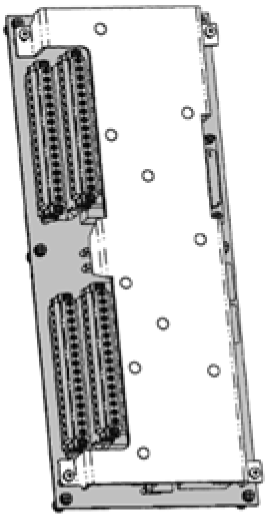
5.15.2 To mount the DO Relay cover

1. Align the four captured screws on the cover to the corresponding holes on the DO Relay Extender board.
2. Tighten the four screws securing the cover.

3. This completes this task.

> **ATTENTION**
> Before changing any jumper settings, ensure the wires on the terminal block(s) have been removed.

Figure 5.53 Series C Digital Output Relay Cover

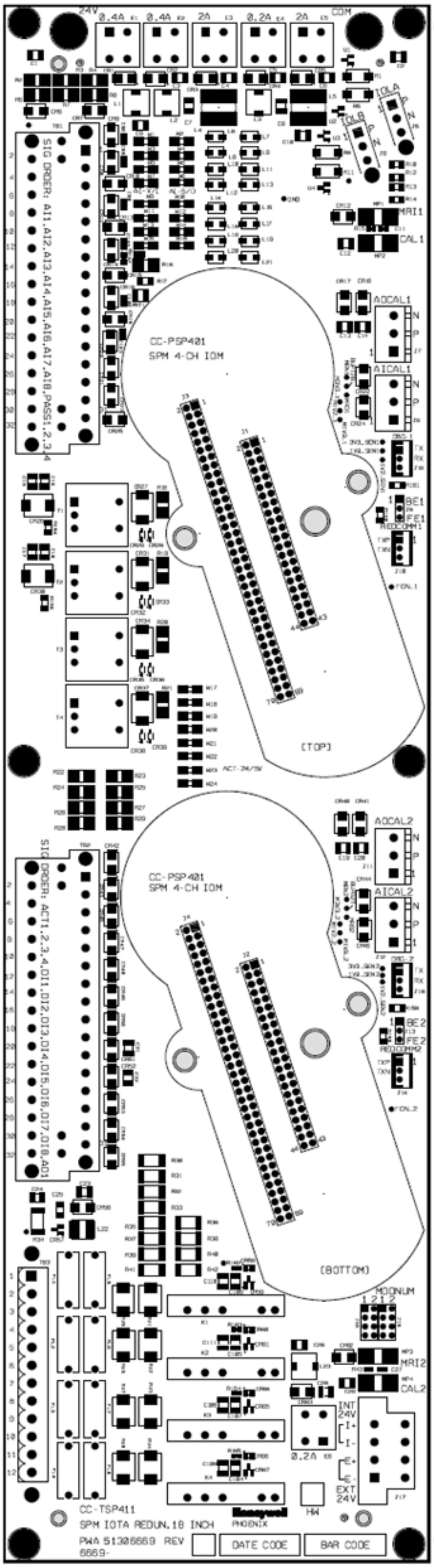


5.16 Speed Protection Module IOTA Model CC-TSP411

The Series C Speed Protection Module (SPM) IOTA board is represented by the following information and graphic.

Series C SPM 18 inch, redundant IOTA is displayed.

Figure 5.54 Series C Speed Protection Module 18 inch, redundant IOTA


CC-PSP401
SPM 4-CH IOM
[TOP]
[BOTTOM]
CC-TSP411
SPM IOTA REDUN.18 INCH
DATE CODE
BAR CODE

To properly wire your module to the Series C Speed Protection Module (SPM) IOTA board with terminal block 1 (TB1), terminal block 2 (TB2), and terminal block 3 (TB3) use the following table.

Table 5.40 SPM 18 inch, redundant - terminal block 1

Terminal Number	Signal Name	Signal Name and Description
1	AI1+	Analog Input Positive - Channel 1
2	AI1-	Analog Input Negative - Channel 1
3	AI1 24V	Analog Input 24V Supply - Channel 1
4	AI2 24V	Analog Input 24V Supply - Channel 2
5	AI2+	Analog Input Positive - Channel 2
6	AI2-	Analog Input Negative - Channel 2
7	AI3+	Analog Input Positive - Channel 3
8	AI3-	Analog Input Negative - Channel 3
9	AI3 24V	Analog Input 24V Supply - Channel 3
10	AI4 24V	Analog Input 24V Supply - Channel 4
11	AI4+	Analog Input Positive - Channel 4
12	AI4-	Analog Input Negative - Channel 4
13	AI5+	Analog Input Positive - Channel 5
14	AI5-	Analog Input Negative - Channel 5
15	AI5 24V	Analog Input 24V Supply - Channel 5
16	AI6 24V	Analog Input 24V Supply - Channel 6
17	AI6+	Analog Input Positive - Channel 6
18	AI6-	Analog Input Negative - Channel 6
19	AI7+	Analog Input Positive - Channel 7
20	AI7-	Analog Input Negative - Channel 7
21	AI7 24V	Analog Input 24V Supply - Channel 7
22	AI8 24V	Analog Input 24V Supply - Channel 8
23	AI8+	Analog Input Positive - Channel 8
24	AI8-	Analog Input Negative - Channel 8
25	PASS1+	Passive Speed Sensor Input Positive - Channel 1
26	PASS1-	Passive Speed Sensor Input Negative - Channel 1
27	PASS2+	Passive Speed Sensor Input Positive - Channel 2
28	PASS2-	Passive Speed Sensor Input Negative - Channel 2
29	PASS3+	Passive Speed Sensor Input Positive - Channel 3
30	PASS3-	Passive Speed Sensor Input Negative - Channel 3
31	PASS4+	Passive Speed Sensor Input Positive - Channel 4
32	PASS4-	Passive Speed Sensor Input Negative - Channel 4

Table 5.41 SPM 18 inch, redundant - terminal block 2

Terminal Number	Signal Name	Signal Name and Description
1	ACT1+	Active Speed Sensor 1 Positive - Channel 1
2	ACT1-	Active Speed Sensor 1 Negative - Channel 1
3	ACT1 24V	Active Speed Sensor 24V Supply - Channel 1
4	ACT2 24V	Active Speed Sensor 24V Supply - Channel 2
5	ACT2+	Active Speed Sensor 2 Positive - Channel 2
6	ACT2-	Active Speed Sensor 2 Negative - Channel 2
7	ACT3+	Active Speed Sensor 3 Positive - Channel 3

Terminal Number	Signal Name	Signal Name and Description
8	ACT3-	Active Speed Sensor 3 Negative - Channel 3
9	ACT3 24V	Active Speed Sensor 24V Supply - Channel 3
10	ACT4 24V	Active Speed Sensor 24V Supply - Channel 4
11	ACT4+	Active Speed Sensor 4 Positive - Channel 4
12	ACT4-	Active Speed Sensor 4 Negative - Channel 4
13	DI1 24V	Digital Input 1, 24V Field Supply
14	DI1	Digital Input 1 - Channel 1
15	DI2 24V	Digital Input 2, 24V Field Supply
16	DI2	Digital Input 2 - Channel 2
17	DI3 24V	Digital Input 3, 24V Field Supply
18	DI3	Digital Input 3 - Channel 3
19	DI4 24V	Digital Input 4, 24V Field Supply
20	DI4	Digital Input 4 - Channel 4
21	DI5 24V	Digital Input 5, 24V Field Supply
22	DI5	Digital Input 5 - Channel 5
23	DI6 24V	Digital Input 6, 24V Field Supply
24	DI6	Digital Input 6 - Channel 6
25	DI7 24V	Digital Input 7, 24V Field Supply
26	DI7	Digital Input 7 - Channel 7
27	DI8 24V	Digital Input 8, 24V Field Supply
28	DI8	Digital Input 8 - Channel 8
29, 30		NC
31	AO1	Analog Output 1 - Channel 1
32	GND	Analog Output 1 Return

Table 5.42 SPM 18 inch, redundant - terminal block 3

Terminal Number	Signal Name	Signal Name and Description
1	DO1_RTN	Digital Output 1 Return - Channel 1
2	DO1_NC	Digital Output 1 Normally Closed Pin - Channel 1
3	DO1_NO	Digital Output 1 Normally Open Pin - Channel 1
4	DO2_RTN	Digital Output 2 Return - Channel 2
5	DO2_NC	Digital Output 2 Normally Closed Pin - Channel 2
6	DO2_NO	Digital Output 2 Normally Open Pin - Channel 2
7	DO3_RTN	Digital Output 3 Return - Channel 3
8	DO3_NC	Digital Output 3 Normally Closed Pin - Channel 3
9	DO3_NO	Digital Output 3 Normally Open Pin - Channel 3
10	DO4_RTN	Digital Output 4 Return - Channel 4
11	DO4_NC	Digital Output 4 Normally Closed Pin - Channel 4
12	DO4_NO	Digital Output 4 Normally Open - Channel 4

- SPM Input wiring

5.16.1 SPM Input wiring

Series C SPM 18 inch, redundant IOTA and field wiring connections for different channels are displayed.

Figure 5.55 Series C SPM - AI Channel Field Wiring

Figure 5.56 Series C SPM - Passive Probe Field Wiring

Figure 5.57 Series C SPM - Active Probe Field Wiring

Figure 5.58 Series C SPM - DI Channel Field Wiring

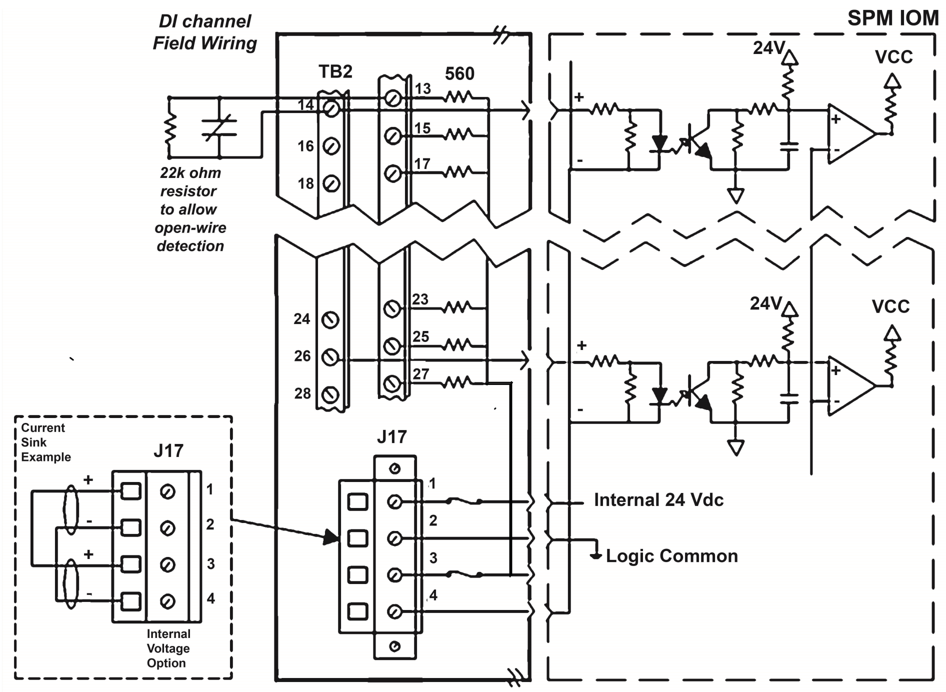


Figure 5.59 Series C SPM - AO Channel Field Wiring

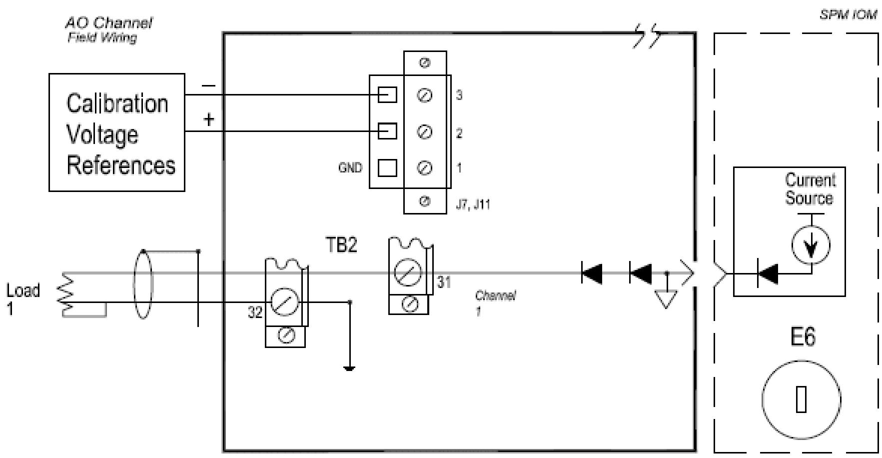


Figure 5.60 Series C SPM - DO Channel Field Wiring

SPM Fuses

Following table explains about fuses for the SPM.

Fuses	Application Circuit
E1	ACTIVE PROBE 24V
E2	AI 24V
E3	BOTTOM IOM 24V
E4	INTERNAL 24V
E5	TOP IOM 24V
E6	EXTERNAL 24V

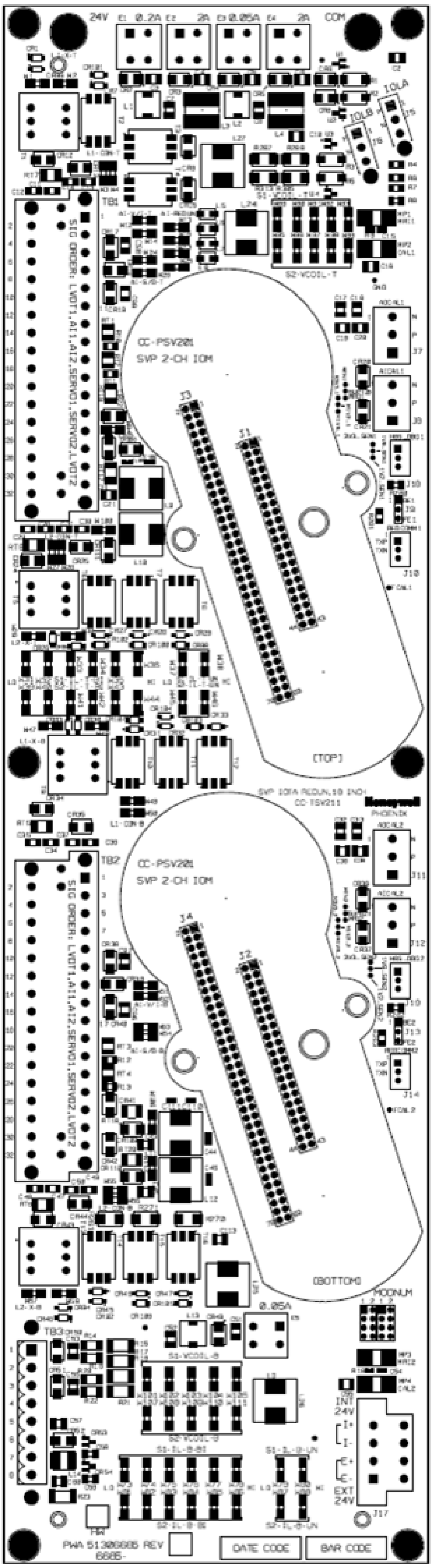
For detailed information about the jumper settings of the SPM refer to *Turbine Control User's Guide.*

5.17 Servo Valve Positioner Module IOTA Models CC-TSV211

The Series C Servo Valve Positioner Module (SVPM) IOTA board is represented by the following information and graphic.

Series C SVPM 18 inch, redundant IOTA is displayed:

Figure 5.61 Series C Servo Valve Positioner Module 18 inch, redundant IOTA


24V
0.2A
2A
0.05A
2A
COM
IOLA
IOLB
TB1
SIG ORDER: LVDT1,AI1,AI2,SERVO1,SERVO2,LVDT2
CC-PSV201
SVP 2-CH IOM
J3
J1
[TOP]
SVP IOTA REDUN,10 INCH
CC-TSV211
Honeywell
PHOENIX
TB2
SIG ORDER: LVDT1,AI1,AI2,SERVO1,SERVO2,LVDT2
CC-PSV201
SVP 2-CH IOM
J4
J2
[BOTTOM]
MODNUM
0.05A
TB3
INT
24V
EXT
24V
J17
PWA 51306885 REV
6685-
DATE CODE
BAR CODE

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To properly wire your module to the Series C Servo Valve Positioner Module (SVPM) IOTA board with terminal block 1 (TB1), terminal block 2 (TB2), and terminal block 3 (TB3) use the following tables.

Table 5.43 SVPM 18 inch, redundant - terminal block 1

Terminal Number	Signal Name	Signal Name and Description
1	L11A+	LVDT Feedback A Positive (Field Device 1) - Channel 1
2	L11A-	LVDT Feedback A Negative (Field Device 1) - Channel 1
3	L11B+	LVDT Feedback B Positive (Field Device 1) - Channel 1
4	L11B-	LVDT Feedback B Negative (Field Device 1) - Channel 1
7	L11X+	LVDT Excitation Positive (Field Device 1) - Channel 1
8	L11X-	LVDT Excitation Negative (Field Device 1) - Channel 1
11	AI11+	Analog Input Positive (Field Device 1) - Channel 1
12	AI11-	Analog Input Negative (Field Device 1) - Channel 1
13	AI11 24V	Analog Input 24V Supply (Field Device 1) - Channel 1
14	AI12 24V	Analog Input 24V Supply (Field Device 2) - Channel 2
15	AI12+	Analog Input Positive (Field Device 2) - Channel 2
16	AI12-	Analog Input Negative (Field Device 2) - Channel 2
19	SO11+	Servo Output Coil 1 (Field Device 1) Positive - Channel 1
20	SO11-	Servo Output Coil 1 (Field Device 1) Negative - Channel 1
21	SO12+	Servo Output Coil 1 (Field Device 2) Positive - Channel 2
22	SO12-	Servo Output Coil 1 (Field Device 2) Negative - Channel 2
25	L12A+	LVDT Feedback A Positive (Field Device 2) - Channel 2
26	L12A-	LVDT Feedback A Negative (Field Device 2) - Channel 2
27	L12B+	LVDT Feedback B Positive (Field Device 2) - Channel 2
28	L12B-	LVDT Feedback B Negative (Field Device 2) - Channel 2
31	L12X+	LVDT Excitation Positive (Field Device 2) - Channel 2
32	L12X-	LVDT Excitation Negative (Field Device 2) - Channel 2
5, 6, 9, 10, 17, 18, 23, 24, 29, 30		NC

Table 5.44 SVPM 18 inch, redundant - terminal block 2

Terminal Number	Signal Name	Signal Name and Description
1	L21A+	LVDT Feedback A Positive (Field Device 1) - Channel 1
2	L21A-	LVDT Feedback A Negative (Field Device 1) - Channel 1
3	L21B+	LVDT Feedback B Positive (Field Device 1) - Channel 1
4	L21B-	LVDT Feedback B Negative (Field Device 1) - Channel 1
7	L21X+	LVDT Excitation Positive (Field Device 1) - Channel 1
8	L21X-	LVDT Excitation Negative (Field Device 1) - Channel 1
11	AI21+	Analog Input Positive (Field Device 1) - Channel 1

Terminal Number	Signal Name	Signal Name and Description
12	AI21-	Analog Input Negative (Field Device 1) - Channel 1
13	AI21 24V	Analog Input 24V Supply (Field Device 1) - Channel 1
14	AI22 24V	Analog Input 24V Supply (Field Device 2) - Channel 2
15	AI22+	Analog Input Positive (Field Device 2) - Channel 2
16	AI22-	Analog Input Negative (Field Device 2) - Channel 2
19	SO21+	Servo Output Coil 2 (Field Device 1) Positive - Channel 1
20	SO21-	Servo Output Coil 2 (Field Device 1) Negative - Channel 1
21	SO22+	Servo Output Coil 2 (Field Device 2) Positive - Channel 2
22	SO22-	Servo Output Coil 2 (Field Device 2) Negative - Channel 2
25	L22A+	LVDT Feedback A Positive (Field Device 2) - Channel 2
26	L22A-	LVDT Feedback A Negative (Field Device 2) - Channel 2
27	L22B+	LVDT Feedback B Positive (Field Device 2) - Channel 2
28	L22B-	LVDT Feedback B Negative (Field Device 2) - Channel 2
31	L22X+	LVDT Excitation Positive (Field Device 2) - Channel 2
32	L22X-	LVDT Excitation Negative (Field Device 2) - Channel 2
5, 6, 9, 10, 17, 18, 23, 24, 29, 30		NC

Table 5.45 SVPM 18 inch, redundant - terminal block 3

Terminal Number	Signal Name	Signal Description
1	DI1	Digital Input 1 24V Field Supply
2	DI1 24 V	Digital Input 1 - Channel 1
3	DI2	Digital Input 2 24V Field Supply
4	DI2 24V	Digital Input 2 - Channel 2
5	AO1	Analog Output 1 - Channel 1
6	GND	Analog Output 1 Ground
7	AO2	Analog Output 2 - Channel 2
8	GND	Analog Output 2 Ground

- SVPM Input wiring

5.17.1 SVPM Input wiring

Series C SVPM 18 inch, redundant IOTA and field wiring connections for different channels are displayed.

Figure 5.62 Series C SVP - Servo, LVDT Field Wiring

Figure 5.63 Series C SVP - Servo, LVDT Redundant Field Wiring

Figure 5.64 Series C SVP - DI channel Field Wiring

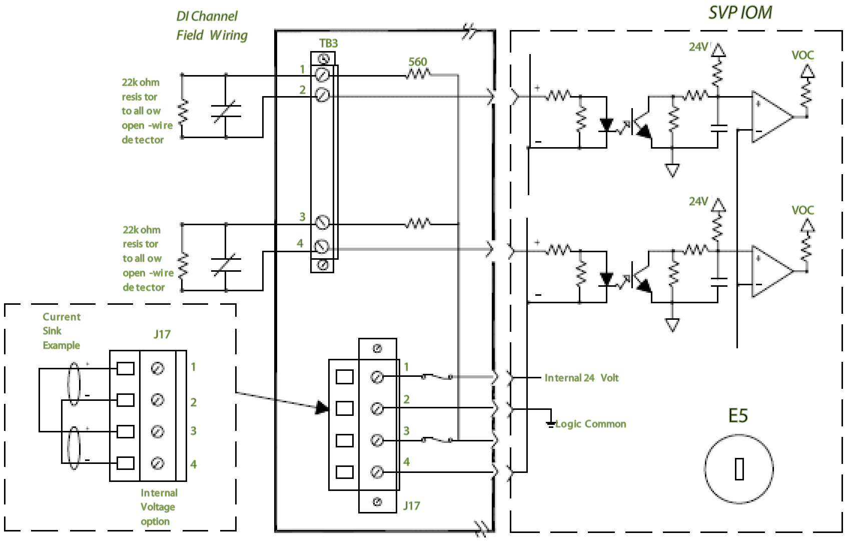
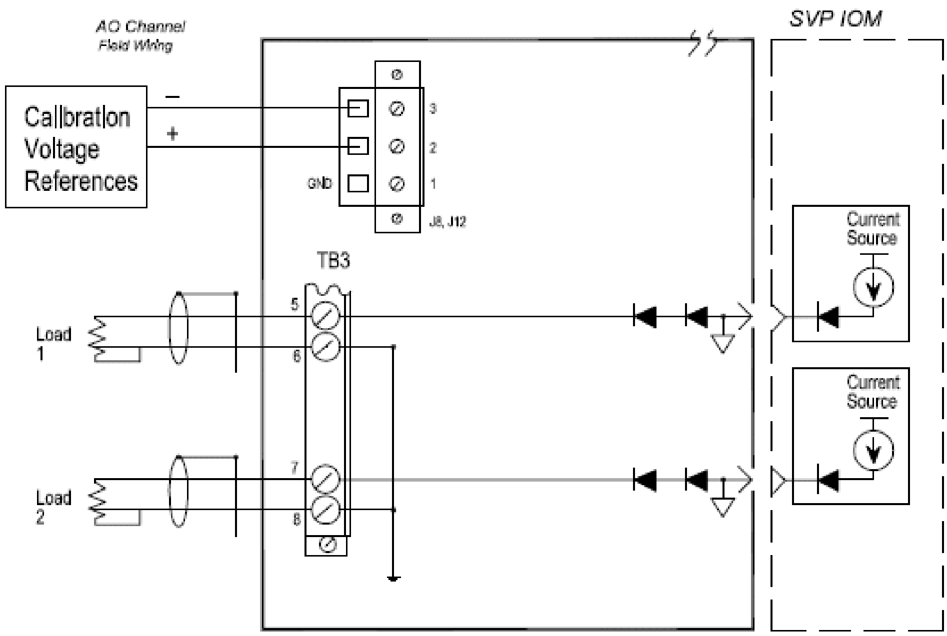


Figure 5.65 Series C SVP - AO channel Field Wiring



SVPM Fuses

Following table explains about fuses for the SVPM.

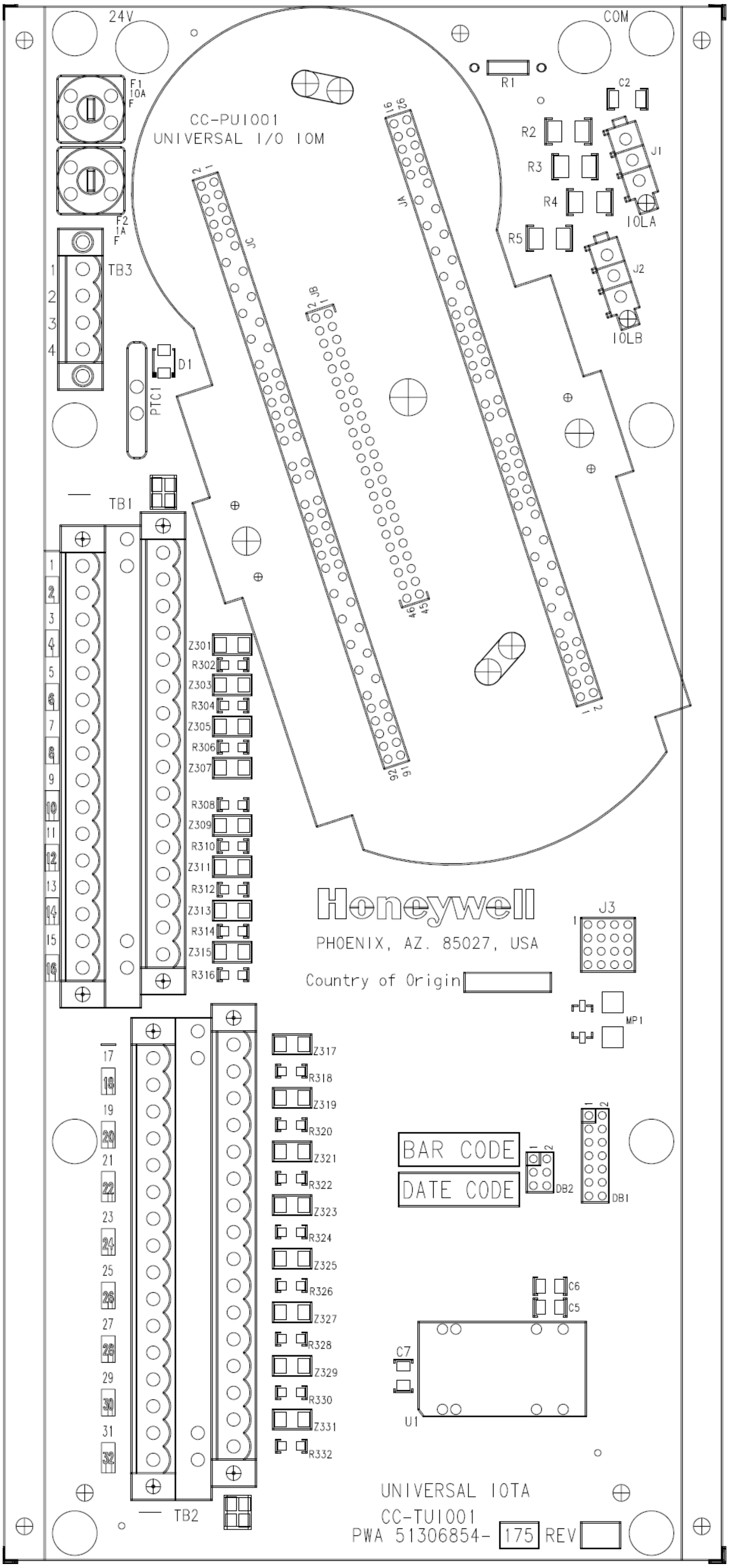
Fuses	Application Circuit
E1	AI Field Device Supply, 24V
E2	BOTTOM IOM 24V
E3	INTERNAL 24V - DI
E4	TOP IOM 24V
E5	EXTERNAL 24V - DI

For detailed information about the jumper settings of the SVPM channels, refer to *Turbine Control User's Guide*.

5.18 Universal Input/Output IOTA Models CC-TUIO01 and CC-TUIO11

Series C UIO 12 inch, non-redundant IOTA is displayed.

Figure 5.66 Universal Input/Output Module, 12 inch, non-redundant IOTA

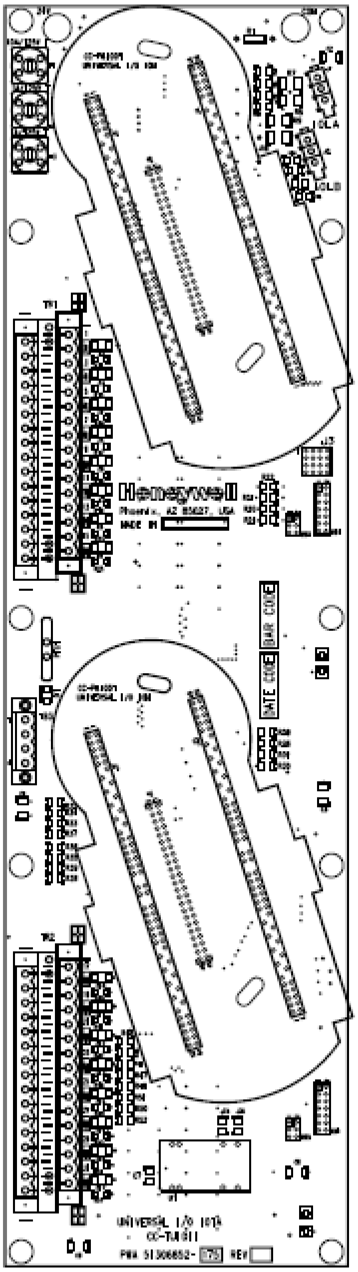

24V
COM
F1 10A F
F2 1A F
TB3
D1
PTC1
R1
C2
R2
R3
R4
R5
J1
J2
IOLA
IOLB
CC-PU1001
UNIVERSAL I/O IOM
JA
JB
JC
TB1
TB2
J3
MP1
Honeywell
PHOENIX, AZ. 85027, USA
Country of Origin
BAR CODE
DATE CODE
DB1
DB2
C5
C6
C7
U1
UNIVERSAL IOTA
CC-TUI001
PWA 51306854- 175 REV

ATTENTION

The non-redundant UIO IOTA accommodates only one UIO module.

Series C UIO 18 inch, redundant IOTA is displayed.

Figure 5.67 Universal Input/Output Module, 18 inch, redundant IOTA



To wire the module to the Series C UIO module IOTA board with terminal block 1 (TB1), terminal block 2 (TB2), and terminal block 3 (TB3), use the following tables.

Table 5.46 Terminal block 1

Terminal block 1		
Channel	Return screw	Power screw
Channel 1	-1	+1
Channel 2	-2	+2
Channel 3	-3	+3
Channel 4	-4	+4
Channel 5	-5	+5
Channel 6	-6	+6
Channel 7	-7	+7
Channel 8	-8	+8
Channel 9	-9	+9
Channel 10	-10	+10
Channel 11	-11	+11
Channel 12	-12	+12
Channel 13	-13	+13
Channel 14	-14	+14
Channel 15	-15	+15
Channel 16	-16	+16

Table 5.47 Redundant - Terminal Block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	-17	+17
Channel 18	-18	+18
Channel 19	-19	+19
Channel 20	-20	+20
Channel 21	-21	+21
Channel 22	-22	+22
Channel 23	-23	+23
Channel 24	-24	+24
Channel 25	-25	+25
Channel 26	-26	+26
Channel 27	-27	+27
Channel 28	-28	+28
Channel 29	-29	+29
Channel 30	-30	+30
Channel 31	-31	+31
Channel 32	-32	+32

Table 5.48 Redundant - Terminal Block 3

Signal	Screw Number
+24V	1
+24V	2
+24V	3
+24V	4

5.18.1 UIO channel configured as Analog Input

The UIO IOM/IOTA is optimized for use with 2-wire, 3-wire or 4-wire transmitters. All 32 channels can accept inputs from most 2-wire, 3-wire or 4-wire transmitters without any special wiring.

The following are the items that UIO AI directly supports.

- 4-20mA / 0-20mA Current Inputs
- Devices that accept Honeywell 24V power to power a 0/4-20mA current source and (optionally) the device.
- Devices that return the current to the ground terminal of the Honeywell 24V power supply.
- External devices that can moderate non-compliant devices. For example: 'moderators' = current mirrors, isolators, GI/IS barriers, mv-to-I, and so on.

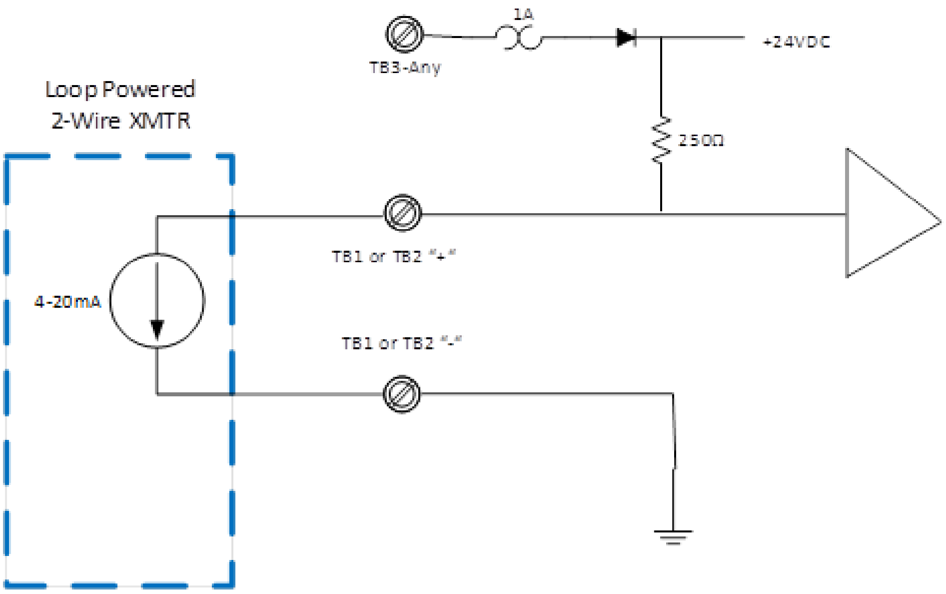
The following are the lists of items that are not directly supported by UIO AIs.

- Voltage inputs (1-5 or mv) e.g. a battery
- Thermocouples
- RTDs
- NAMUR devices

Standard 2-wire transmitter with UIO

This can be applied to any of the channels 1 through 32.

Figure 5.68 Standard 2-wire transmitter with UIO



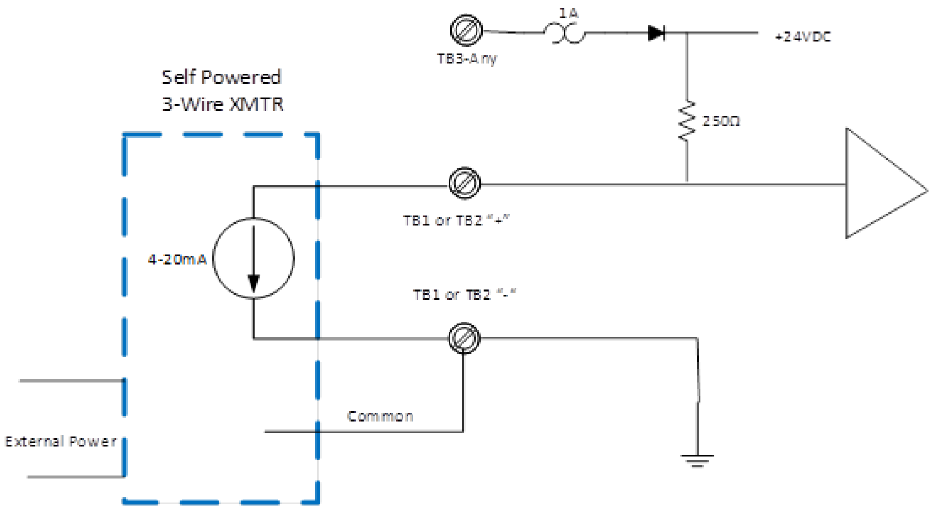
Self-powered 3-wire transmitter with system ground

This can be applied to any channels from 1 through 32.

The simplest wiring is to have the 'common' wire and the 'current source' wire under the same terminal blocks screw. If the site wiring does not permit, then you must use a separate external terminal block.

The device must reference its 'DCS-side' common to EPKS common.

Figure 5.69 Self-powered 3-wire transmitter with system ground with UIO



Self-powered 4-wire transmitter

This can be applied to any of the channels from 1 through 32.

Figure 5.70 Self-powered 4-wire transmitter with UIO

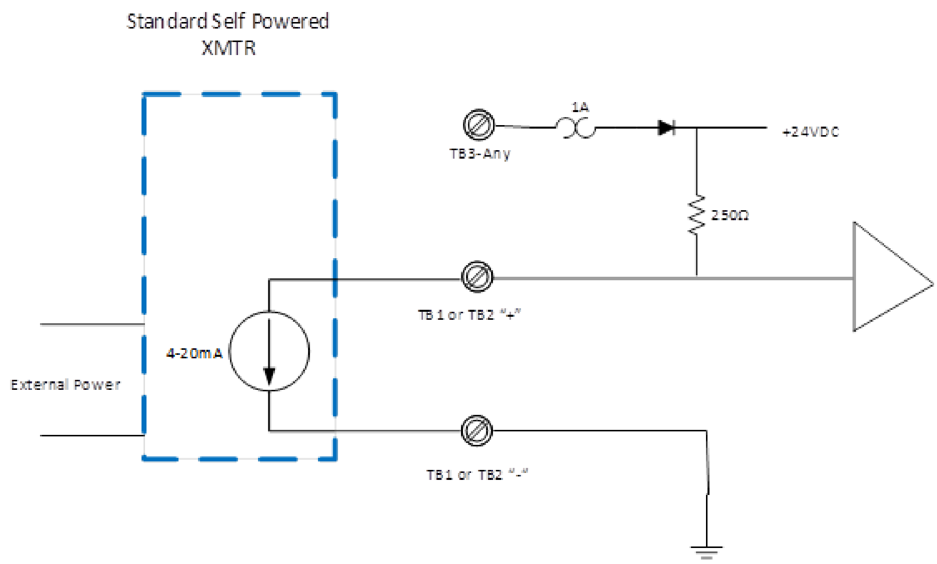
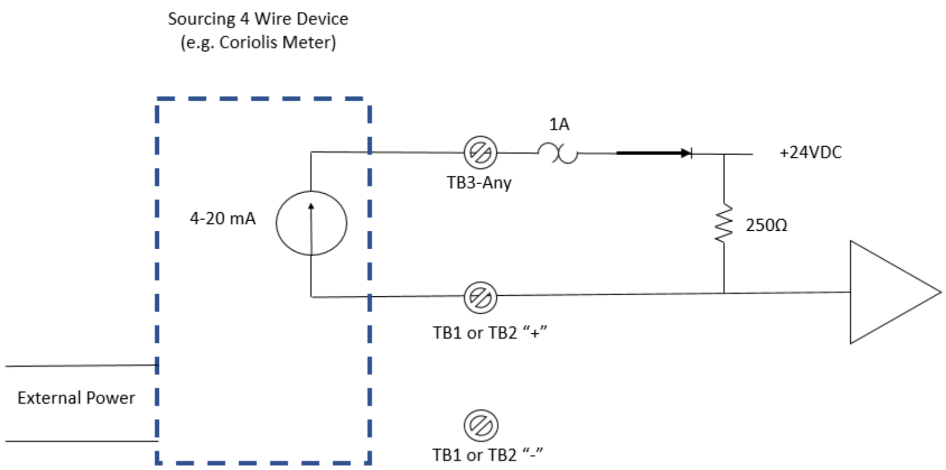


Figure 5.71 Self-powered Sourcing 4-wire Device



Series C UIO does not support the following input types:

- Voltage input: This is because Series C UIO supports only current measurements.
- Slidewire: This is because Series C UIO supports only current measurements.

5.18.2 Allowable field wiring resistance - UIO - Analog Input channel

The maximum allowable field wiring resistance between the transmitter and the IOTA connection terminal is dependent upon the voltage requirement of the transmitter. The formula for calculating the maximum wiring resistance for the Series C UIO channel used as an analog input is given by the following equation.

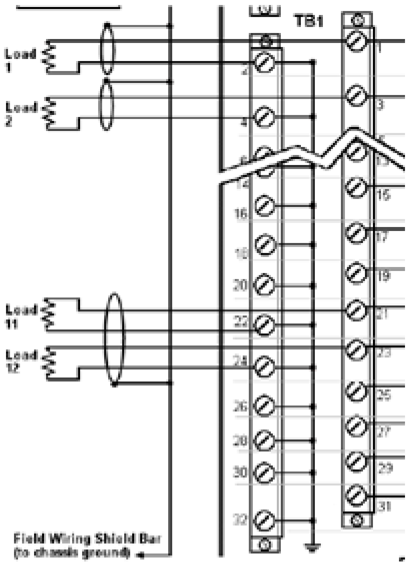
Rmax= [(19.0-Vtx) / (0.022)]

Where, Vtx=Voltage required at the transmitter terminal.

Honeywell

5.18.3 UIO channel configured as Analog Output

The UIO can drive 0, 4-20mA. The field terminal block is wired similar to Series C Analog Output 6 inch, non-redundant IOTA.

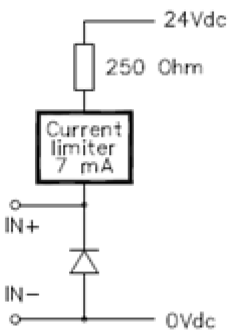


As the OP% approaches -6.9%, the current output approaches 2.896mA (based on the linear equation that correlates 0-100% with 4-20mA). However, when the OP% is set to exactly -6.9%, the output is unpowered (0mA).

5.18.4 UIO channel configured as Digital Input

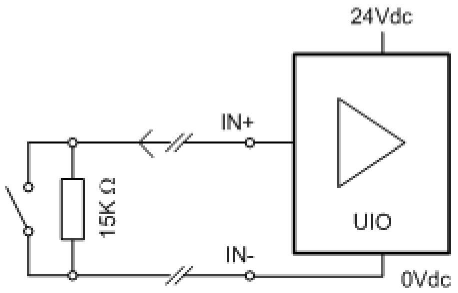
A UIO channel configured as a Digital Input consists of a 250-ohm resistor and a current limiter circuit. Refer to the following block diagram of the UIO channel configuration.

Figure 5.72 UIO_DI channel configuration



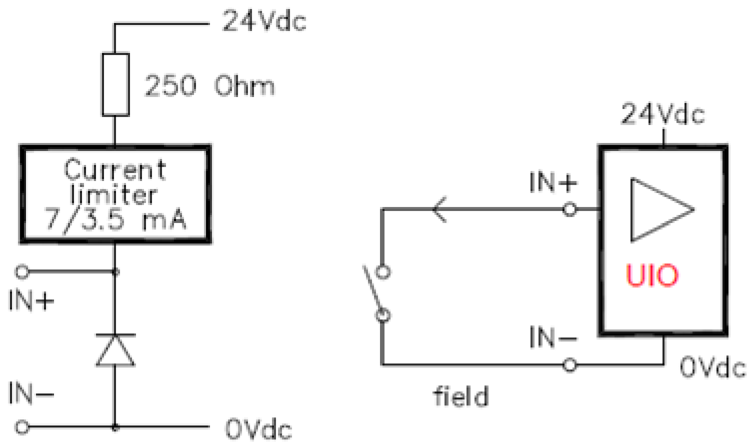
When the DI channel is configured with open wire detect (OWD), a resistor is required in the field near the switch contact as displayed in the following figure.

Figure 5.73 UIO-DI channel configured with open wire detection



A UIO channel configured as a digital input without open wire detect (OWD) consists of a 250-ohm resistance and a current limiter circuit. Refer to the following block diagram of this channel configuration, and a field-wiring example.

Figure 5.74 UIO-DI channel configured without open wire detection

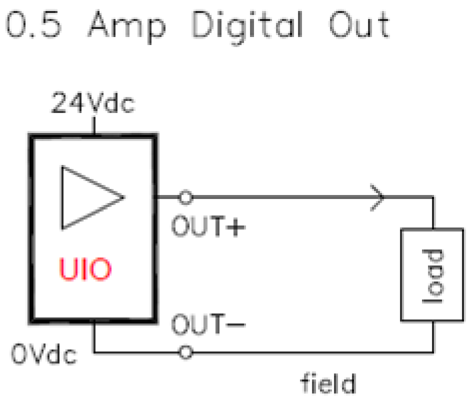


Starting with R430, four UIO-DI channels are enhanced to support pulse counting when the DITYPE parameter is configured as "Accum." For more information about pulse counting configuration, refer to the Configuring the DI channel for pulse counting.

5.18.5 UIO channel configured as Digital Output

When you configure UIO as a Digital Output, the channel can supply up to 0.5A to the field.

Figure 5.75 UIO as a Digital Output



Starting with R430, the UIO-DO channel is enhanced to support ganging. For more information about DO channel ganging configuration, refer to the Configuring the DO channel for ganging.

5.18.6 DO channel wiring configuration for ganging

You can configure a set of two, three, or four DO channels to deliver up to 1 Ampere, 1.5 Amperes, or 2 Amperes current to the field.

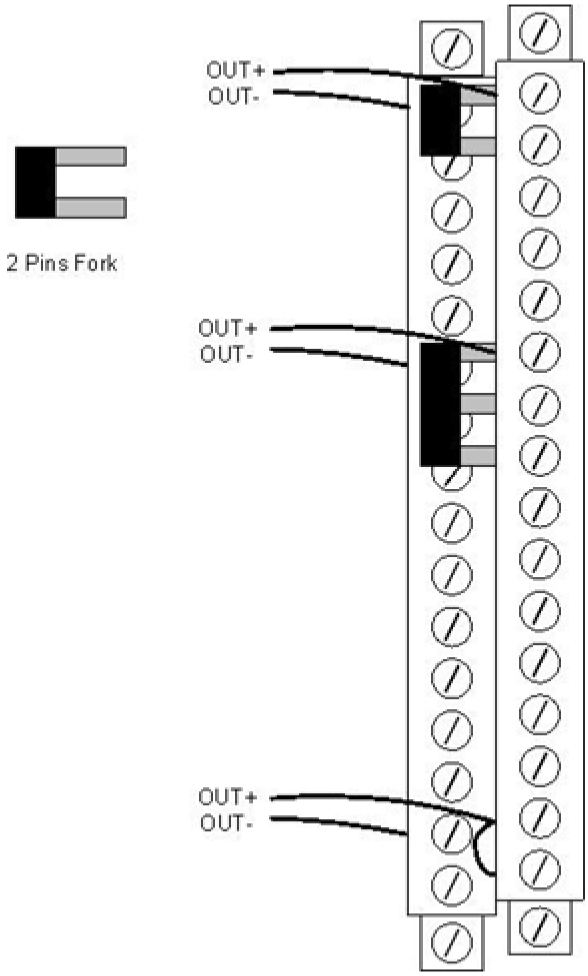
A two-pin branch with a pitch of 0.2 inches (5.08mm) can be used for interconnecting two DO channels. For example, Weidmuller part number can be used for interconnecting the DO channels. The following table lists the part number and the pins branch for interconnecting the DO channels.

Pins	Part number	No.of DO channels Two pins
Two pins branch	Weidmuller LPA QB 2	2
Three pins branch	Weidmuller LPA QB 3	3
Four pins branch	Weidmuller LPA QB 4	4

The field wire must be connected with one of the OUT pins (together with the branch). One of the OUT pins can be used for connecting the return field wire. The following figure illustrates the different ways to join the DO channels.

- Two DO channels with a two pin branch
- Three DO channels with a three pin branch

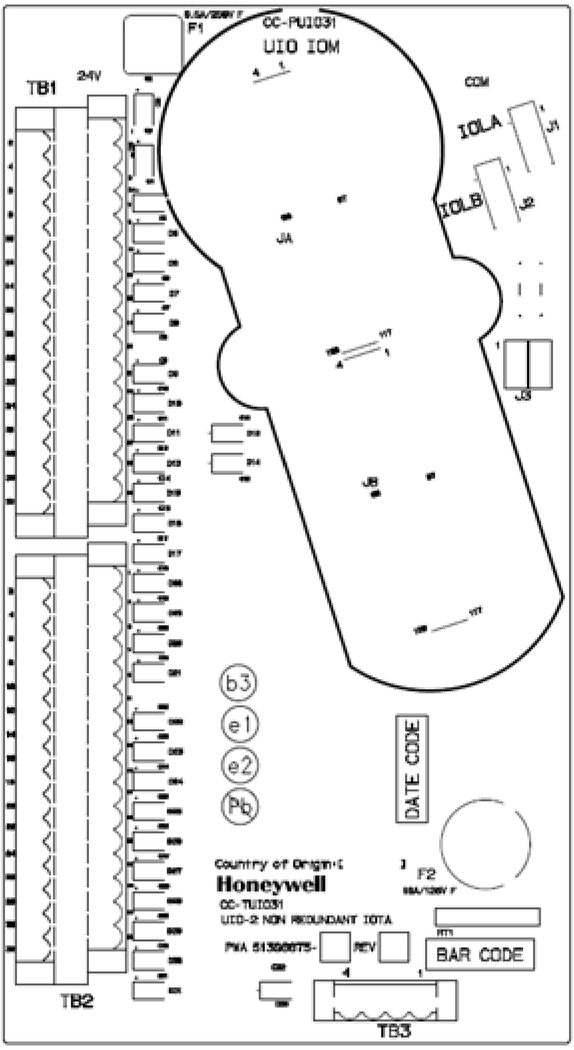
Figure 5.76 DO channel wiring for ganging



5.19 Universal Input/Output Phase 2 IOTA Models CC-TUIO31 and CC-TUIO41

Series C UIO-2 9 inch, non-redundant IOTA is displayed.

Figure 5.77 Universal Input/Output Module, 9 inch, non-redundant IOTA

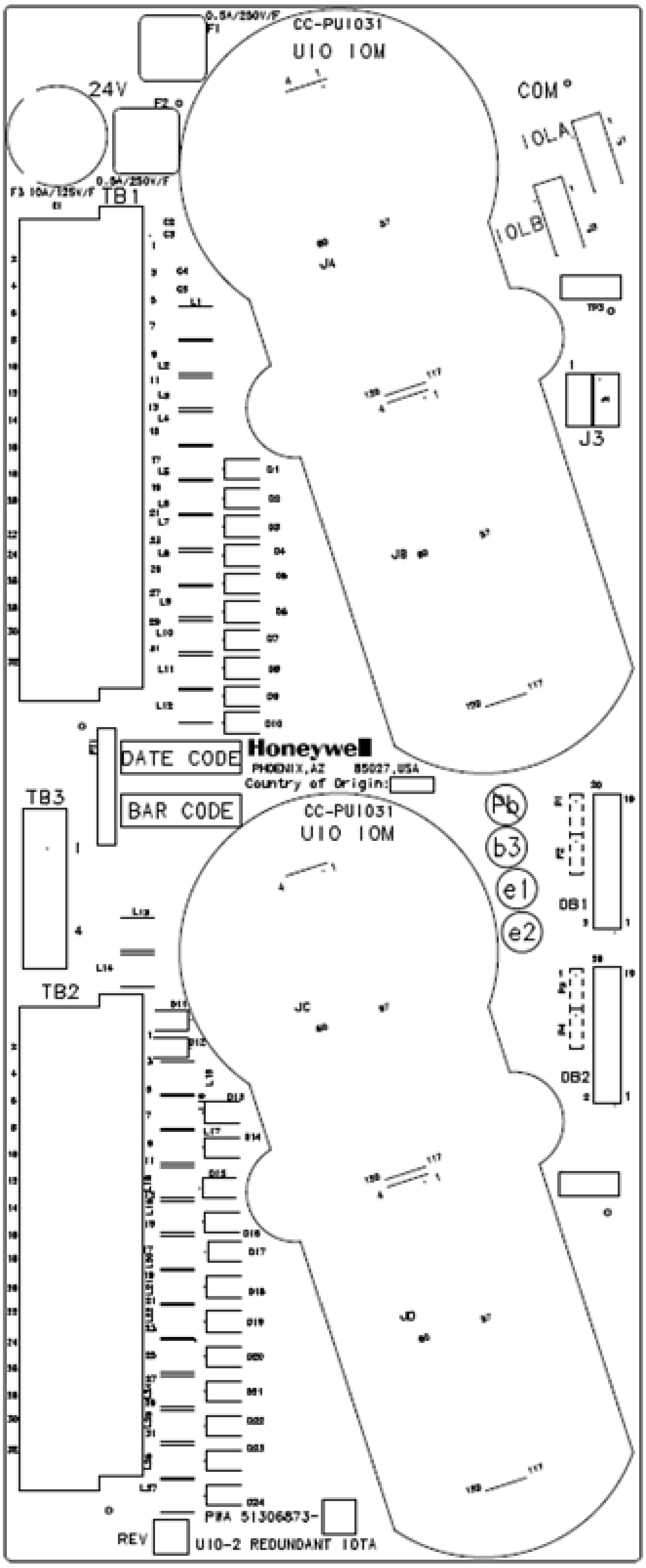


ATTENTION

The non-redundant UIO-2 IOTA accommodates only one UIO-2 module.

Series C UIO-2 12 inch, redundant IOTA is displayed.

Figure 5.78 Universal Input/Output Module, 12 inch, redundant IOTA



To wire the module to the Series C UIO module IOTA board with terminal block 1 (TB1), terminal block 2 (TB2), and terminal block 3 (TB3), use the following tables.

Table 5.49 Terminal block 1

Terminal block 1		
Channel	Return screw	Power screw
Channel 1	-1	+1
Channel 2	-2	+2
Channel 3	-3	+3
Channel 4	-4	+4
Channel 5	-5	+5
Channel 6	-6	+6
Channel 7	-7	+7
Channel 8	-8	+8
Channel 9	-9	+9
Channel 10	-10	+10
Channel 11	-11	+11
Channel 12	-12	+12
Channel 13	-13	+13
Channel 14	-14	+14
Channel 15	-15	+15
Channel 16	-16	+16

Table 5.50 Redundant - Terminal Block 2

Terminal block 2		
Channel	Return screw	Power screw
Channel 17	-17	+17
Channel 18	-18	+18
Channel 19	-19	+19
Channel 20	-20	+20
Channel 21	-21	+21
Channel 22	-22	+22
Channel 23	-23	+23
Channel 24	-24	+24
Channel 25	-25	+25
Channel 26	-26	+26
Channel 27	-27	+27
Channel 28	-28	+28
Channel 29	-29	+29
Channel 30	-30	+30
Channel 31	-31	+31
Channel 32	-32	+32

Table 5.51 Redundant - Terminal Block 3

Signal	Screw Number
+24V	1
+24V	2
+24V	3
+24V	4

5.19.1 UIO-2 channel configured as Analog Input

The UIO IOM/IOTA is optimized for use with 2-wire, 3-wire or 4-wire transmitters. All 32 channels can accept inputs from most 2-wire, 3-wire or 4-wire transmitters without any special wiring.

The following are the items that UIO AI directly supports.

- 4-20mA / 0-20mA Current Inputs
- Devices that accept Honeywell 24V power to power a 0/4-20mA current source and (optionally) the device.
- Devices that return the current to the ground terminal of the Honeywell 24V power supply.
- External devices that can moderate non-compliant devices. For example: 'moderators' = current mirrors, isolators, GI/IS barriers, mv-to-I, and so on.

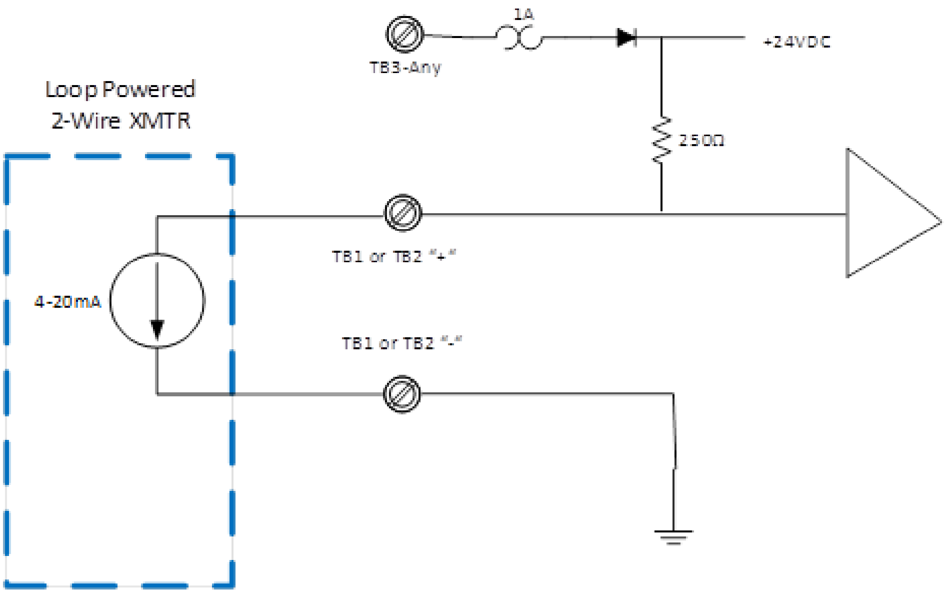
The following are the lists of items that are not directly supported by UIO AIs.

- Voltage inputs (1-5 or mv) e.g. a battery
- Thermocouples
- RTDs
- NAMUR devices

Standard 2-wire transmitter with UIO-2

This can be applied to any of the channels 1 through 32.

Figure 5.79 Standard 2-wire transmitter with UIO-2



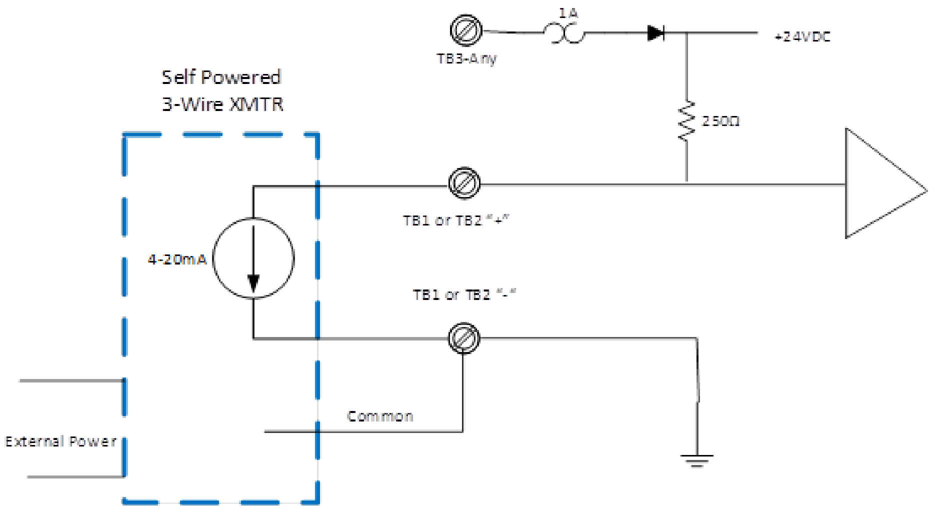
Self-powered 3-wire transmitter with system ground

This can be applied to any channels from 1 through 32.

The simplest wiring is to have the 'common' wire and the 'current source' wire under the same terminal blocks screw. If the site wiring does not permit, then you must use a separate external terminal block.

The device must reference its 'DCS-side' common to Experion PKS common.

Figure 5.80 Self-powered 3-wire transmitter with system ground with UIO-2



Self-powered 4-wire transmitter

This can be applied to any of the channels from 1 through 32.

Figure 5.81 Self-powered 4-wire Transmitter with UIO-2

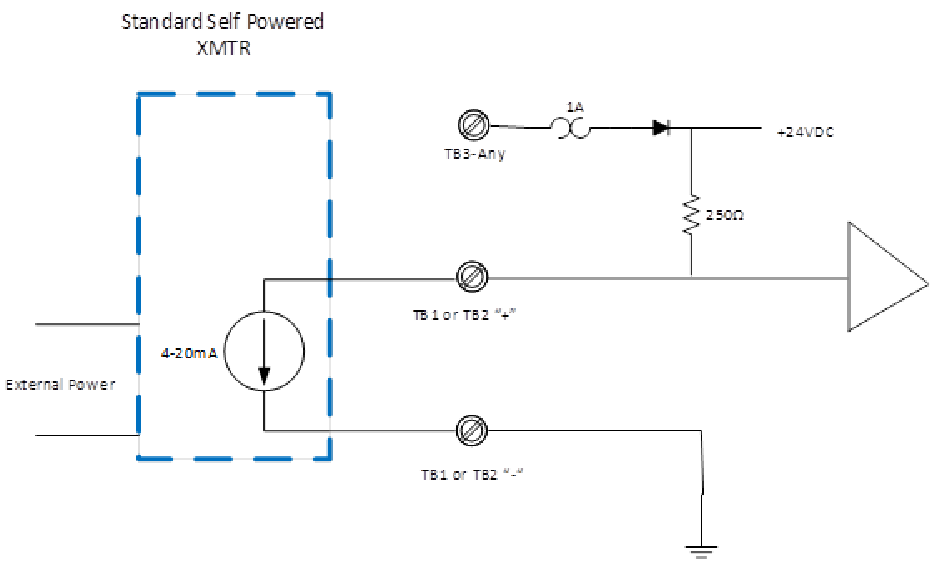
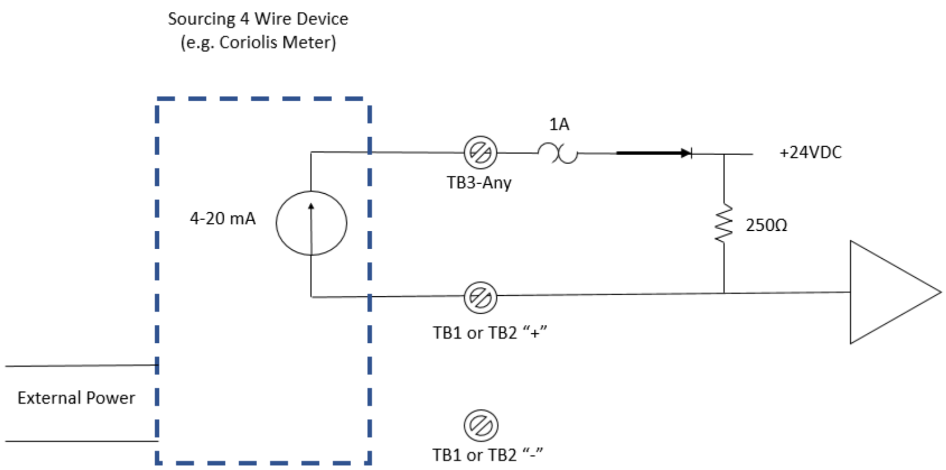


Figure 5.82 Self-powered Sourcing 4-wire Device



Series C UIO-2 does not support the following input types:

- Voltage input: This is because Series C UIO-2 supports only current measurements.
- Slidewire: This is because Series C UIO-2 supports only current measurements.

5.19.2 Allowable field wiring resistance - UIO-2 - Analog Input channel

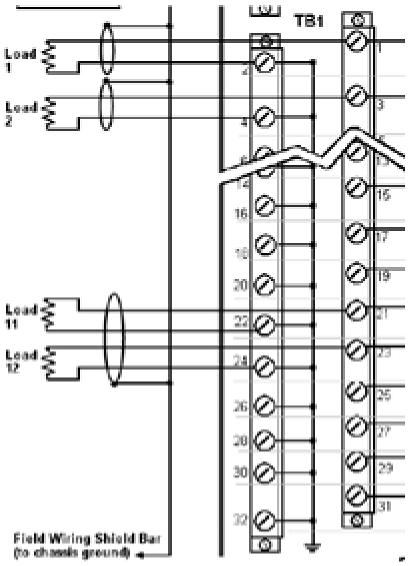
The maximum allowable field wiring resistance between the transmitter and the IOTA connection terminal is dependent upon the voltage requirement of the transmitter. The formula for calculating the maximum wiring resistance for the Series C UIO-2 channel used as an analog input is given by the following equation.

Rmax= [(19.0-Vtx) / (0.022)]

Where, Vtx=Voltage required at the transmitter terminal.

5.19.3 UIO-2 channel configured as Analog Output

The UIO-2 can drive 4-20 mA. The field terminal block is wired similar to Series C Analog Output 6 inch, non-redundant IOTA.

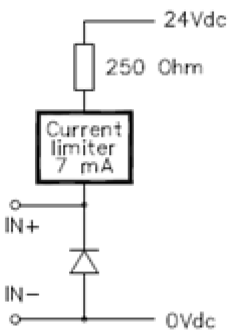


As the OP% approaches -6.9%, the current output approaches 2.896 mA (based on the linear equation that correlates 0-100% with 4-20 mA). However, when the OP% is set to exactly -6.9%, the output is unpowered (0 mA).

5.19.4 UIO-2 channel configured as Digital Input

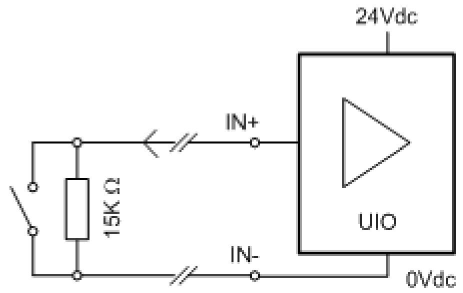
A UIO-2 channel configured as a Digital Input consists of a 250-ohm resistor and a current limiter circuit. Refer to the following block diagram of the UIO-2 channel configuration.

Figure 5.83 UIO_DI channel configuration



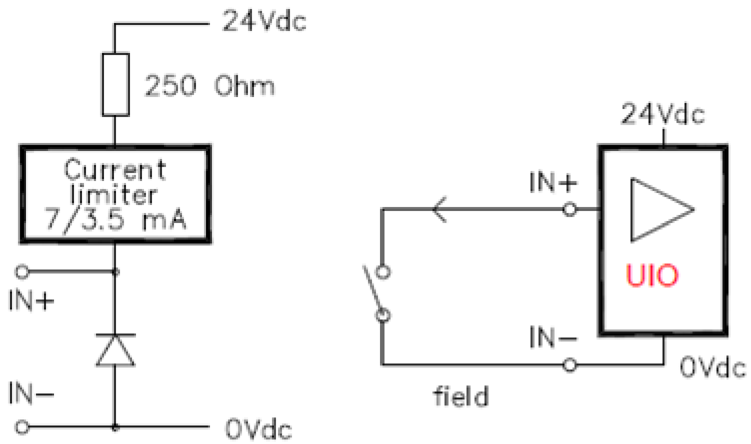
When the DI channel is configured with open wire detect (OWD), a resistor is required in the field near the switch contact as displayed in the following figure.

Figure 5.84 UIO-DI channel configured with open wire detection



A UIO-2 channel configured as a digital input without open wire detect (OWD) consists of a 250-ohm resistance and a current limiter circuit. Refer to the following block diagram of this channel configuration, and a field-wiring example.

Figure 5.85 UIO-DI channel configured without open wire detection

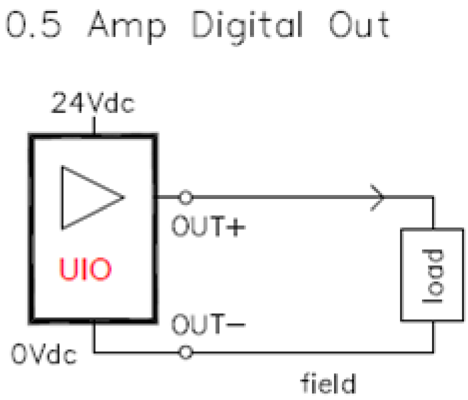


Starting with R430, four UIO-DI channels are enhanced to support pulse counting when the DITYPE parameter is configured as "Accum." For more information about pulse counting configuration, refer to the Configuring the DI channel for pulse counting.

5.19.5 UIO-2 channel configured as Digital Output

When you configure UIO-2 as a Digital Output, the channel can supply up to 0.5A to the field.

Figure 5.86 UIO-2 as a Digital Output



Starting with R430, the UIO-DO channel is enhanced to support ganging. For more information about DO channel ganging configuration, refer to the Configuring the DO channel for ganging.

5.19.6 DO channel wiring configuration for ganging

You can configure a set of two, three, or four DO channels to deliver up to 1 Ampere, 1.5 Amperes, or 2 Amperes current to the field.

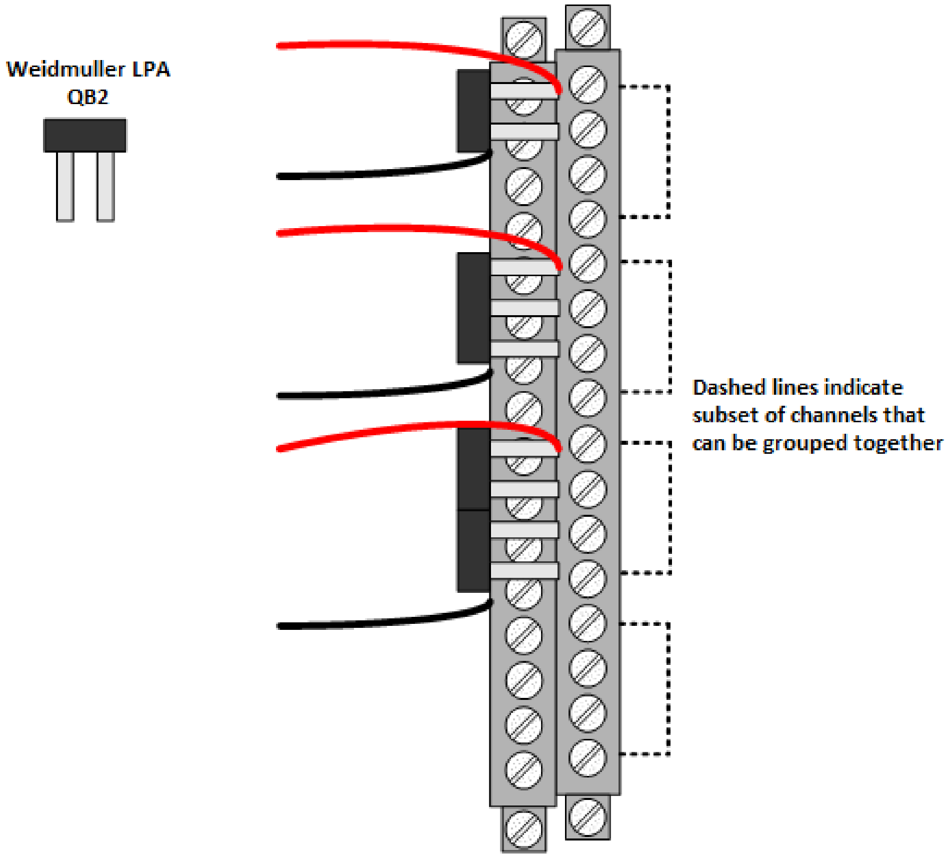
A two-pin branch with a pitch of 0.2 inches (5.08mm) can be used for interconnecting two DO channels. For example, Weidmuller part number can be used for interconnecting the DO channels. The following table lists the part number and the pins branch for interconnecting the DO channels.

Pins	Part number	No.of DO channels Two pins
Two pins branch	Weidmuller LPA QB 2	2
Three pins branch	Weidmuller LPA QB 3	3
Four pins branch	Weidmuller LPA QB 4	4

The field wire must be connected with one of the OUT pins (together with the branch). One of the OUT pins can be used for connecting the return field wire. The following figure illustrates the different ways to join the DO channels.

- Two DO channels with a two pin branch
- Three DO channels with a three pin branch

Figure 5.87 DO channel wiring for ganging



5.20 Low Level Analog Input (LLAI) Module IOTA model CC-TAIL51

This series C Low Level Analog Input (LLAI) IOTA board is represented by the following information and graphic.

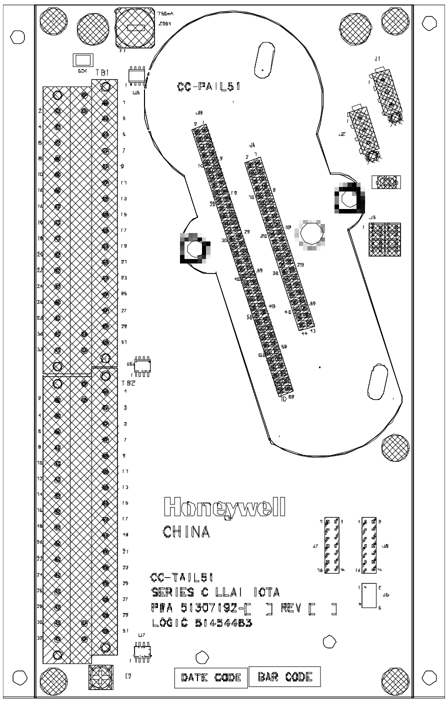
To access the parts information for the:

- module
- IOTA
- terminal plug-in assembly, and
- fuses

associated with this board and module, see Low Level Analog Input (LLAI) in the Recommended spare parts table.

Series C Low Level Analog Input (LLAI) 9 inch, non-redundant IOTA is displayed in the following figure.

Figure 5.88 Series C Low Level Analog Input (LLAI) 9 inch, non-redundant IOTA



> **NOTE**
>
> All I/O field terminations accept up to 14 gauge stranded wire.

To properly wire your module to the LLAI IOTA with terminal block 1 (TB1) and terminal block 2 (TB2), use the following table.

Table 5.52 Terminal block 1 and 2 for LLAI 0-100mV connections

Channel	Terminal Block (TB1)	
	Voltage +	Voltage -
Channel 1	1	3
Channel 2	5	7
Channel 3	9	11
Channel 4	13	15
Channel 5	17	19
Channel 6	21	23
Channel 7	25	27
Channel 8	29	31
	Terminal Block (TB2)	
Channel	**Voltage +**	**Voltage -**
Channel 9	1	3
Channel 10	5	7
Channel 11	9	11
Channel 12	13	15
Channel 13	17	19

Channel	Terminal Block (TB1)	
	Voltage +	Voltage -
Channel 14	21	23
Channel 15	25	27
Channel 16	29	31

Table 5.53 Terminal block 1 and 2 for Thermocouple connections

Channel	Terminal Block (TB1)	
	Thermocouple +	Thermocouple -
Channel 1	1	3
Channel 2	5	7
Channel 3	9	11
Channel 4	13	15
Channel 5	17	19
Channel 6	21	23
Channel 7	25	27
Channel 8	29	31
	Terminal Block (TB2)	
Channel	**Thermocouple +**	**Thermocouple -**
Channel 9	1	3
Channel 10	5	7
Channel 11	9	11
Channel 12	13	15
Channel 13	17	19
Channel 14	21	23
Channel 15	25	27
Channel 16	29	31

Table 5.54 Terminal block 1 and 2 for RTD connections

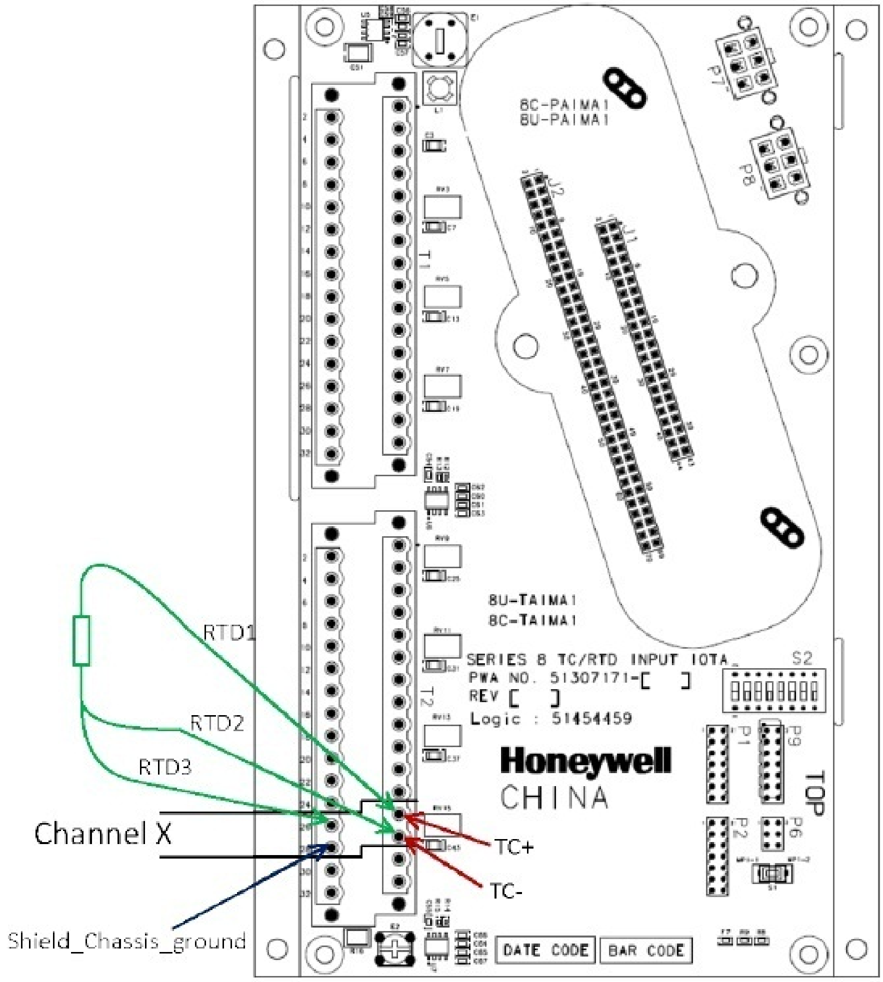
Channel	Terminal Block (TB1)	
	RTD1	RTD2
Channel 1	1	3
Channel 2	5	7
Channel 3	9	11
Channel 4	13	15
Channel 5	17	19
Channel 6	21	23
Channel 7	25	27
Channel 8	29	31
	Terminal Block (TB2)	
Channel	**RTD1**	**RTD2**
Channel 9	1	3
Channel 10	5	7
Channel 11	9	11
Channel 12	13	15
Channel 13	17	19
Channel 14	21	23

- Field wiring for thermocouple/RTD

5.20.1 Field wiring for thermocouple/RTD

The LLAI module can be configured to support either thermocouple or RTD inputs. The following figure illustrates how to connect the pins in the terminal block for thermocouple/RTD inputs.

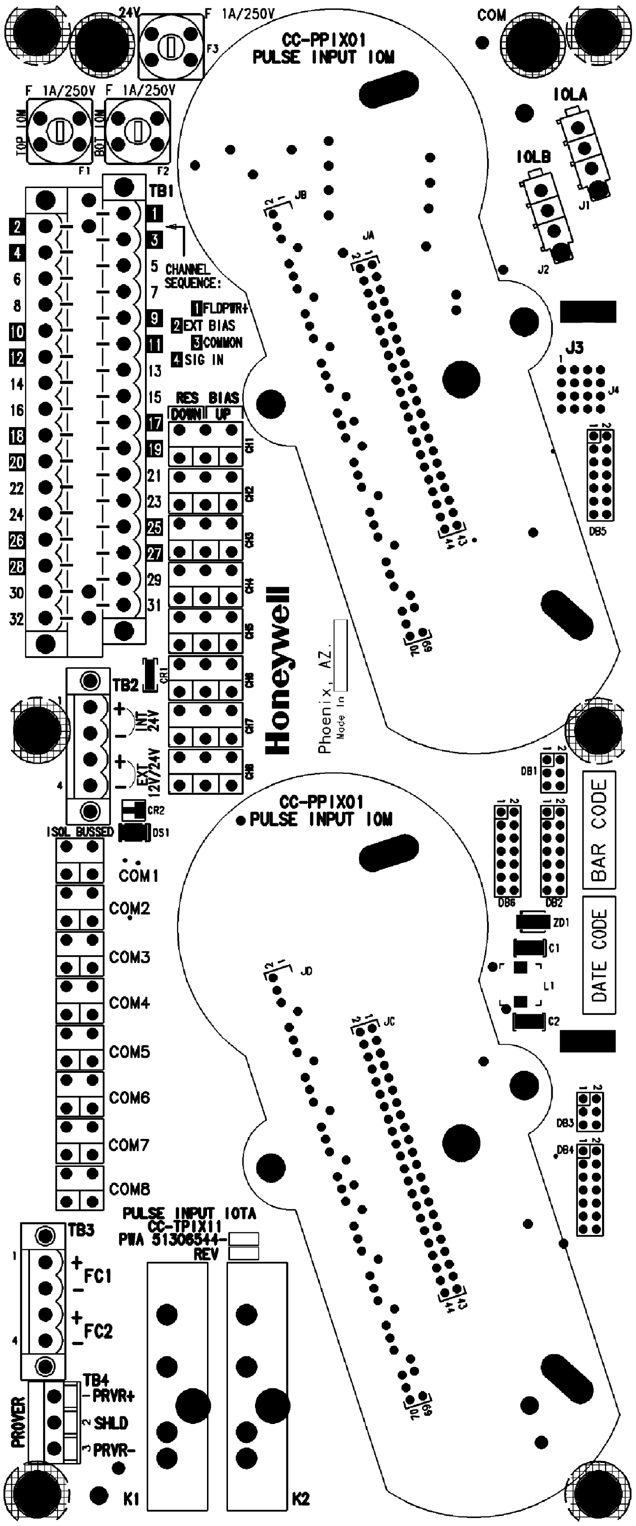
Figure 5.89 Terminal block wiring for thermocouple/RTD



5.21 Pulse Input Module IOTA Model CC-TPIX11

The Series C PIM redundant IOTA is represented by the following graphic.

Figure 5.90 Pulse Input Module redundant IOTA



The following tables provide information on pin assignments of the terminal blocks of the Pulse Input Module IOTA.

Table 5.55 Pulse Input Module IOTA – Terminal block 1* pin assignments

Terminal Block 1				
Channel	FLDPWR+ Upper connector	EXT BIAS Lower connector	COMMON Upper connector	SIG IN Lower connector
Channel 1	1	2	3	4
Channel 2	5	6	7	8
Channel 3	9	10	11	12
Channel 4	13	14	15	16
Channel 5	17	18	19	20
Channel 6	21	22	23	24
Channel 7	25	26	27	28
Channel 8	29	30	31	32

* see text on IOTA for pin numbering.

Table 5.56 Pulse Input Module IOTA – Terminal block 2 * pin assignments

Pin number	Description
1	+ INT 24V
2	– INT 24V
3	+ EXT 12V/24V
4	– EXT 12V/24V

* see text on IOTA for pin numbering.

Table 5.57 Pulse Input Module IOTA – Terminal block 3 * pin assignments

Pin number	Description
1	FC1 + (high side)
2	FC1 – (low side)
3	FC2 + (high side)
4	FC2 – (low side)

* see text on IOTA for pin numbering.

Table 5.58 Pulse Input Module IOTA – Terminal block 4 * pin assignments

Pin number	Description
1	PRVR+
2	Shield (screen)
3	PRVR–

* see text on IOTA for pin numbering.

Refer to the section Series C PIM connectivity for information on connecting PIM.

5.22 Upgrading Firmware Series C I/O components

Refer to the Upgrading firmware Series C I/O components section in the Control Hardware and I/O Module Firmware Guide.

5.23 Series Mass Termination Cables

This section describes about the cable modules, pin numbers for connectors, color codes, cable variants, and cable description.

5.23.1 Cable Module

Honeywell Model Number	Honeywell Part Number
CC-SICC-1011/LR15	51156516-101
CC-SICC-1011/L06	51156516-102
CC-SICC-1011/L10	51156516-103
CC-SICC-1011/L15	51156516-104
CC-SICC-1011/L20	51156516-105
CC-SICC-1011/L25	51156516-106
CC-SICC-1011/L30	51156516-107

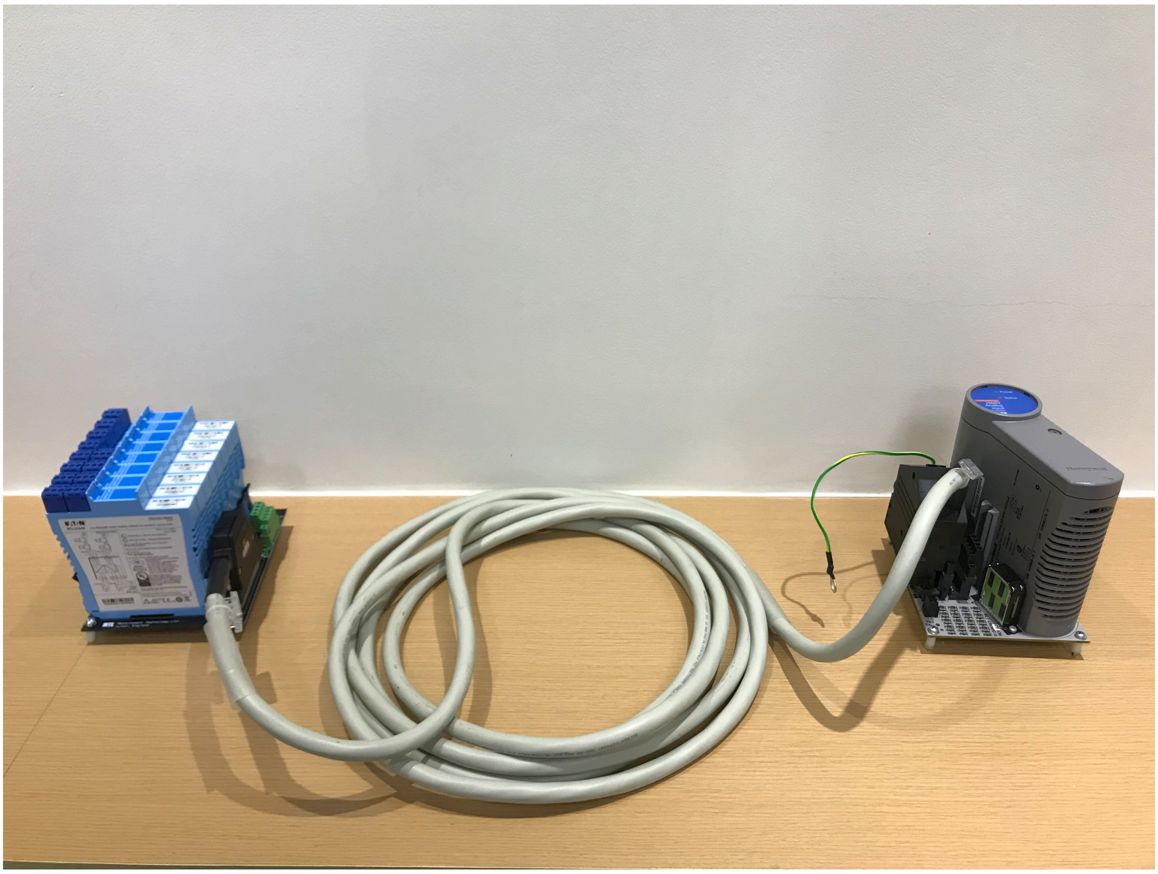
5.23.2 Pin Numbers for Connector Connections

CN1 Pin No.	CNI (TB)	CN2 Pin No.
1	TB1+	1
2	TB1-	20
3	TB2+	2
4	TB2-	21
5	TB3+	3
6	TB3-	22
7	TB4+	4
8	TB4-	23
9	TB5+	5
10	TB5-	24
11	TB6+	6
12	TB6-	25
13	TB7+	7
14	TB7-	26
15	TB8+	8
16	TB8-	27
17	TB9+	9
18	TB9-	28
19	TB10+	10
20	TB10-	29
21	TB11+	11
22	TB11-	30
23	TB12+	12
24	TB12-	31
25	TB13+	13
26	TB13-	32
27	TB14+	14

CN1 Pin No.	CNI (TB)	CN2 Pin No.
28	TB14-	33
29	TB15+	15
30	TB15-	34
31	TB16+	16
32	TB16-	35

5.23.3 Connectors

See the below pictures of connectors for actual connections.



NOTE

Colors must be unique to each channel, but are not limited to table.

NOTE

Isolation strength 500VAC between wires and 2000VAC between wires and shield.

5.23.4 Color Codes

Only required colors must be unique to each channel.

5.23.5 Cable Variants

Refer to the below table for cable variants for different lengths.

TAB	HF	SHIELDED	LENGTH L
—101	YES	YES	1500 MM
—102	YES	YES	6000 MM
—103	YES	YES	10000 MM
—104	YES	YES	15000 MM
—105	YES	YES	20000 MM
—106	YES	YES	25000 MM
—107	YES	YES	30000 MM

5.23.6 Description of Cables

Refer to the below table for length, diameter, and mating connector details of the cables.

Honeywell Model Number	Description
CC-SICC-1011/LR15	Cable Non IS 1.5 M shielded Right entry
CC-SICC-1011/L06	Cable Non IS 6 M shielded Right entry
CC-SICC-1011/L10	Cable Non IS 10 M shielded Right entry
CC-SICC-1011/L15	Cable Non IS 15M M shielded Right
CC-SICC-1011/L20	Cable Non IS 20 M shielded Right entry
CC-SICC-1011/L25	Cable Non IS 25 M shielded Right entry
CC-SICC-1011/L30	Cable Non IS 30 M shielded Right entry

5.23.7 Cable Types (If Applicable)

LiY(St)CY, 32x0.34/22AWG, FRLS, 300 V, UL AWM 2464, CE, RoHS

5.23.8 Special Considerations

Cable Specifications	300 V
Grounding Information	The grounding cable need to connect to the grounding BAR in the Series C Cabinet.

CHAPTER

6

SERIES C PIM CONNECTIVITY

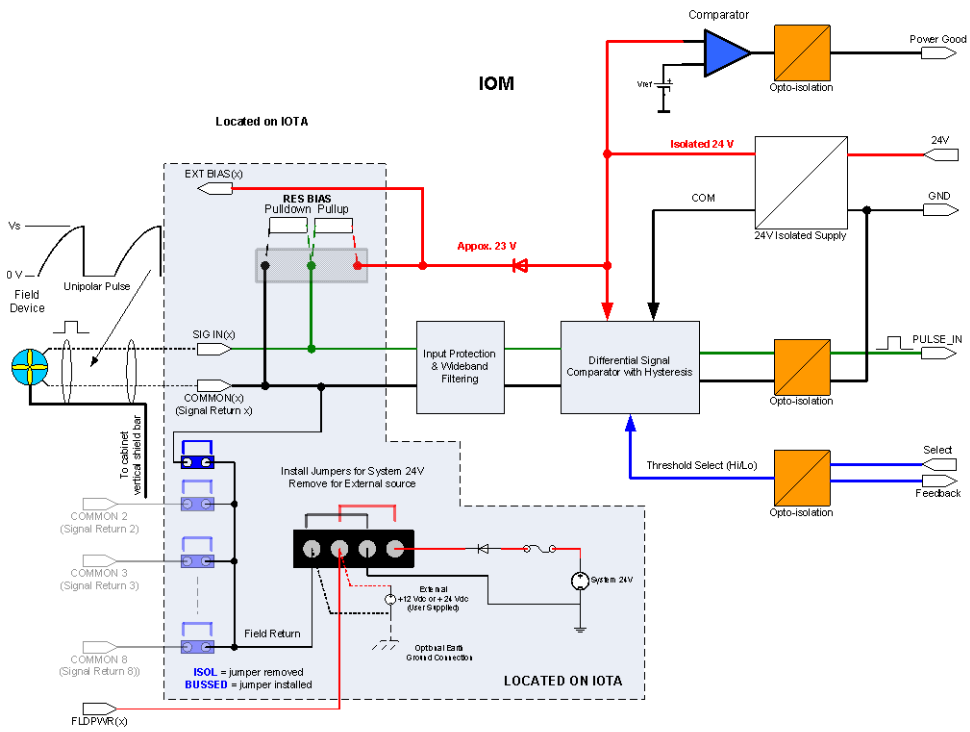
This chapter contains information related to PIM channel terminal blocks and PIM connectivity details. This chapter contains information on connecting PIM to various components such as field sensor power, fast cutoff relays, Prover Pulse Bus, ST500 dual-pulse simulation.

6.1 PIM connectivity block diagram

The following figure displays a PIM connectivity block diagram.

Honeywell

Figure 6.1 PIM connectivity block diagram



The following list summarizes the various components in the overall PIM connectivity block diagram.

- The field device connects to the IOTA screw terminals labeled SIG IN(x) and COMMON(x) where “x” denotes the channel numbers 1 through 8.
- The field sensor pulse output is conditioned by the input protection circuitry and filtered to reduce unwanted high-frequency noise. The filtered output is fed to the high-speed differential comparator which has a user-selectable threshold control. From Control Builder, you can select an appropriate low or high voltage threshold based on the sensor type and the value of the signal amplitude (V_S).
- Comparator hysteresis is also provided to further reduce false triggering especially for slow rise/fall time signals.
- Each of the eight PIM input channels are electrically isolated from one another and from system ground (cabinet ground).
- A comparator monitors the isolated +24 V channel power supply with respect to COMMON(x) and can detect a problem in the field wiring. If the output of the isolated supply falls below 22V or rises above 26V, a failure is indicated. Failures can be any of the following;
    - A short in the field wiring.
    - EXT BIAS(x) pin is shorted to COMMON(x).
    - Excessive current is being pulled from EXT BIAS(x) pin.
    - Power supply fails for some other reason.

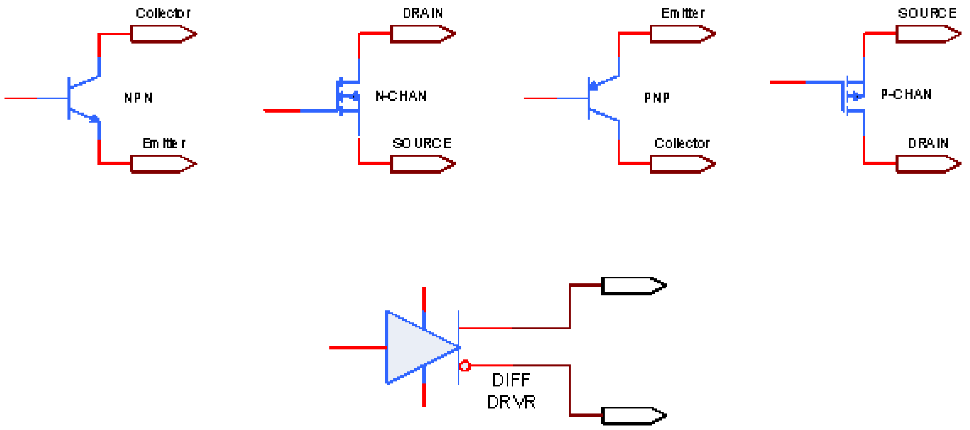
If a failure occurs, the soft failure is reported in Control Builder and Station.

> **ATTENTION**
>
> In redundant PIM modules, after a switchover, if the alarm for the reported channel still persists on the new primary, this most likely indicates a problem in the field wiring.

6.2 Field device output stage types

The output stage of most field sensors use an open collector bipolar transistor or an open drain MOSFET to produce a pulse for counting by a metering device. Open collector and open drain transistors require an externally supplied pull-up resistor and a source of dc power for transistor action to take place. Other types of sensor outputs may incorporate a push-pull, totem pole (for example TTL), or differential output stage which delivers fast rise/fall time pulses without the need of a pull-up resistor. Although not as common, some field sensors contain an open emitter or open source transistor for the output stage. This type requires an externally supplied pull-down resistor. PIM has been designed to operate with all of these types. This section provides information on the specific type and provide guidelines on the connectivity of each.

Figure 6.2 Field device output stage types



> **ATTENTION**
>
> Millivolt signals are not counted by the PIM unless a suitable preamplifier is used to boost the signal to a level that can be detected by the PIM circuitry.

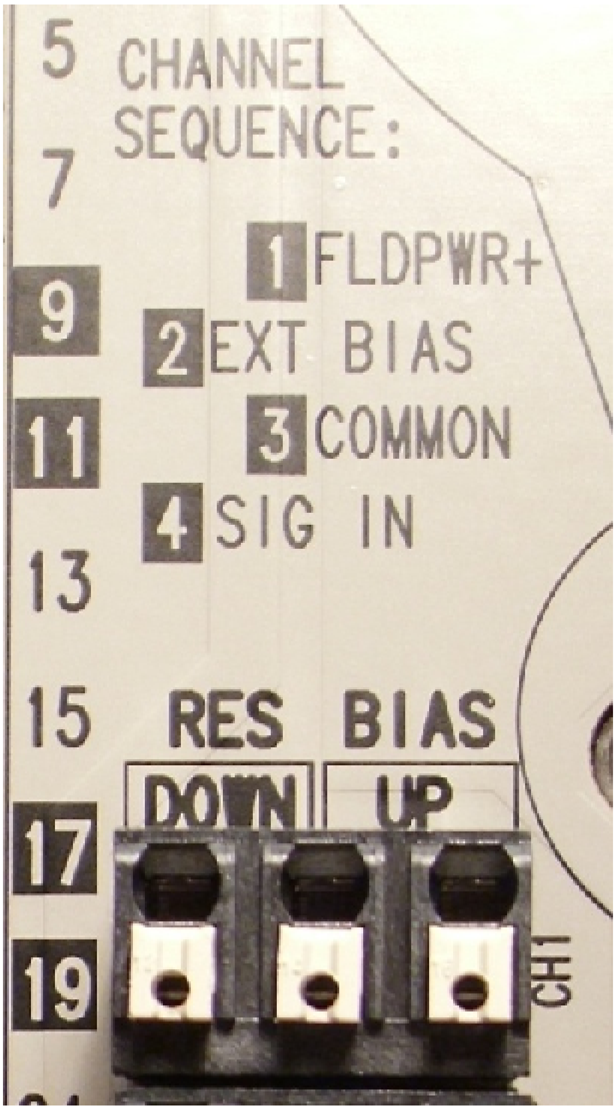
6.3 PIM resistor bias terminal blocks

The PIM IOTA provides eight terminal blocks (one for each channel) that enable the user to install the appropriate bias resistor for proper operation with the field device.

- Pull-up (open collector or open drain output stage)
- Pull-down (open emitter or open source output stage)
- No bias (Active drive - differential, Transistor-Transistor Logic (TTL), and so on)

The following figure displays the channel 1 RES BIAS terminal block.

Figure 6.3 RES BIAS Terminal Block (channel 1 shown)



An externally supplied resistor can be inserted across two pins labeled UP (for pull-up) or DOWN (for pull-down).

For No bias option, terminal block(s) are left un-connected.

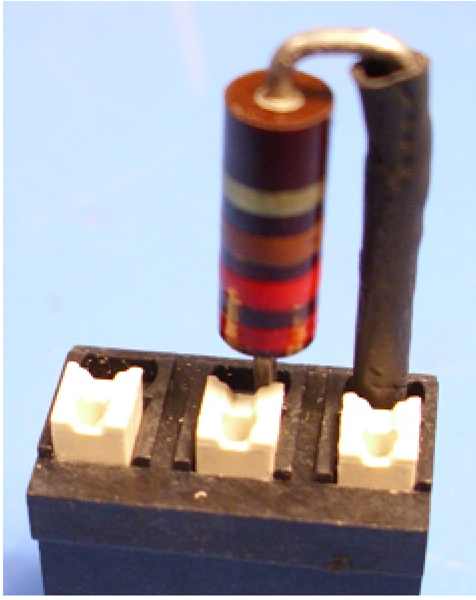
> NOTE
> - All IOTAs are shipped from the factory with all terminal blocks un-connected (No bias). The bias resistor values must be selected according to the field sensor's datasheet.
> - A resistors installed in the RES BIAS UP position is the most commonly used option.

- Inserting and removing resistors

6.3.1 Inserting and removing resistors

It is recommended that resistor leads are bent and shrink tubing is applied as displayed in the following figure.

Figure 6.4 Recommended way of insulating resistor leads and bending them



For inserting the resistor, firmly press the resistor all the way into the holes. The locking mechanism inside the terminal block locks the resistor in place automatically.

For removing the resistor, gently press the white unlocking buttons.

6.4 TB1 signal definitions

Each of the eight channels is composed of a group of four signals. The following table provides information on the signal definitions.

Table 6.1 TB1 signal definitions

Pin name	Input/output	Description
SIG IN	Input	This pin is used to connect to field sensor's pulse output positive pin.
COMMON	Input	This pin is used to connect to field sensor's pulse output negative pin. You can also use this pin for the negative return of the FIELD PWR or EXT BIAS.
EXT BIAS	Output	This pin is used with pull-up resistor supplied by the user. The open circuit voltage of this pin is approximately 23 Vdc and can source up to 25 mA. This means that the pull-up resistor value must be no lower than 920 ohms. This pin can also be a source of isolated power not to exceed the above values. You can leave the EXT BIAS pin un-connected if not required.
FLDPWR+	Output	Positive source of power from connector TB2. This pin is used to power field sensor(s) with +24 Vdc from the Series C system, or optionally from an external power source. When the source of field power is the Series C +24V system supply, the negative terminal is tied to the Series C cabinet ground. Since the sensor

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Pin name	Input/output	Description
		signal common, COMMON(x), is used for the power return, the field sensor is no longer isolated. If more than one pulse input channel uses field power, the channels are no longer isolated from one another because of the shared return at pins COMMON(x). FLDPWR+ 1 through 8 are electrically connected to each other on circuit board. This means they are bussed.

6.5 TB1 pin assignments

The following figure provides information on the pin assignments for TB1.

Figure 6.5 PIM TB1 pin assignments

TB1

Low Tier Connector

CHAN	PIN #	
1	2	EXT BIAS1
	4	SIG IN1
2	6	EXT BIAS 2
	8	SIG IN 2
3	10	EXT BIAS3
	12	SIG IN3
4	14	EXT BIAS4
	16	SIG IN4
5	18	EXT BIAS5
	20	SIG IN5
6	22	EXT BIAS6
	24	SIG IN6
7	26	EXT BIAS7
	28	SIG IN7
8	30	EXT BIAS8
	32	SIG IN8

High Tier Connector

	PIN #
FLDPWR1+ *	1
COMMON1	3
FLDPWR2+ *	5
COMMON2	7
FLDPWR3+ *	9
COMMON3	11
FLDPWR4+ *	13
COMMON4	15
FLDPWR5+ *	17
COMMON5	19
FLDPWR6+ *	21
COMMON6	23
FLDPWR7+ *	25
COMMON7	27
FLDPWR8+ *	29
COMMON8	31

* FLDPWR1+ through FLDPWR8+ are electrically connected (bussed) to each other on circuit board.

6.6 TB2 pin assignments for internal/external field sensor power

The following table provides information on the 4-pin connector TB2 pin assignments.

Table 6.2 PIM TB2 pin assignments

Pin number	Description
1	+ INT 24V
2	- INT 24V
3	+ EXT 12V/24V
4	- EXT 12V/24V

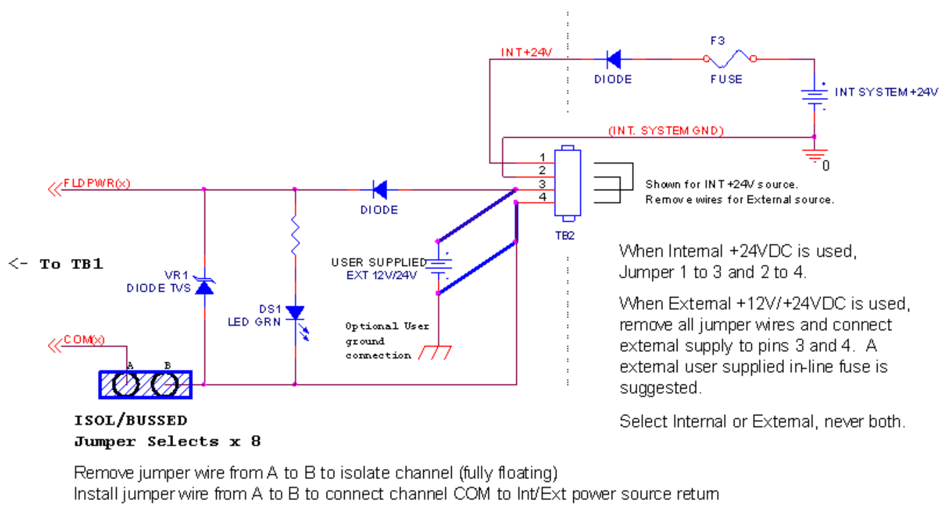
The PIM IOTA allows field sensor powering from either the Series C System +24 V internal system supply or from an external user supplied power source.

- Restrictions/limitations while using TB2
- Verifying the connection
- Examples to illustrate sensor power connections through TB2

6.6.1 Restrictions/limitations while using TB2

The following figure displays the internal/external sensor power circuit diagram.

Figure 6.6 PIM TB2 – Internal/external sensor power circuit diagram



You must be aware of the following restrictions/limitations while using TB2.

- Only a dc source with polarity indicated in the above diagram can be used because of diode steering and reverse polarity protection.
- If an external source is used, the applied dc voltage must be +30 V or less. This is because there is a 33 V transient protection diode on the IOTA circuit board which could potentially be damaged if the supply exceeds 33V. (VR1 in the above diagram).
- F3 is a fast type fuse rated for 1A/250V. When the internal system supply is selected, the maximum current must be less than this value to avoid fuse rupture.
- You must provide fusing when an external supply is utilized (fusing from external supply is not shown in the above diagram).
- The diodes are rated at 1A, do not exceed this value.

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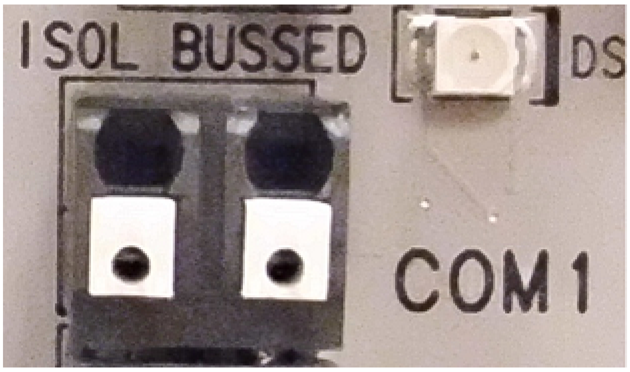
- You can choose between the internal or external source. However, both cannot be used at the same time.
- If an application does not require field sensor power through TB2, completely disconnect all wiring from TB2 including jumper wires.

You can use the following connector in conjunction with TB2. The following figure displays the terminal block for channel 1. There are similar connectors for the remaining channels.

Figure 6.7 ISOL/BUSSED terminal blocks

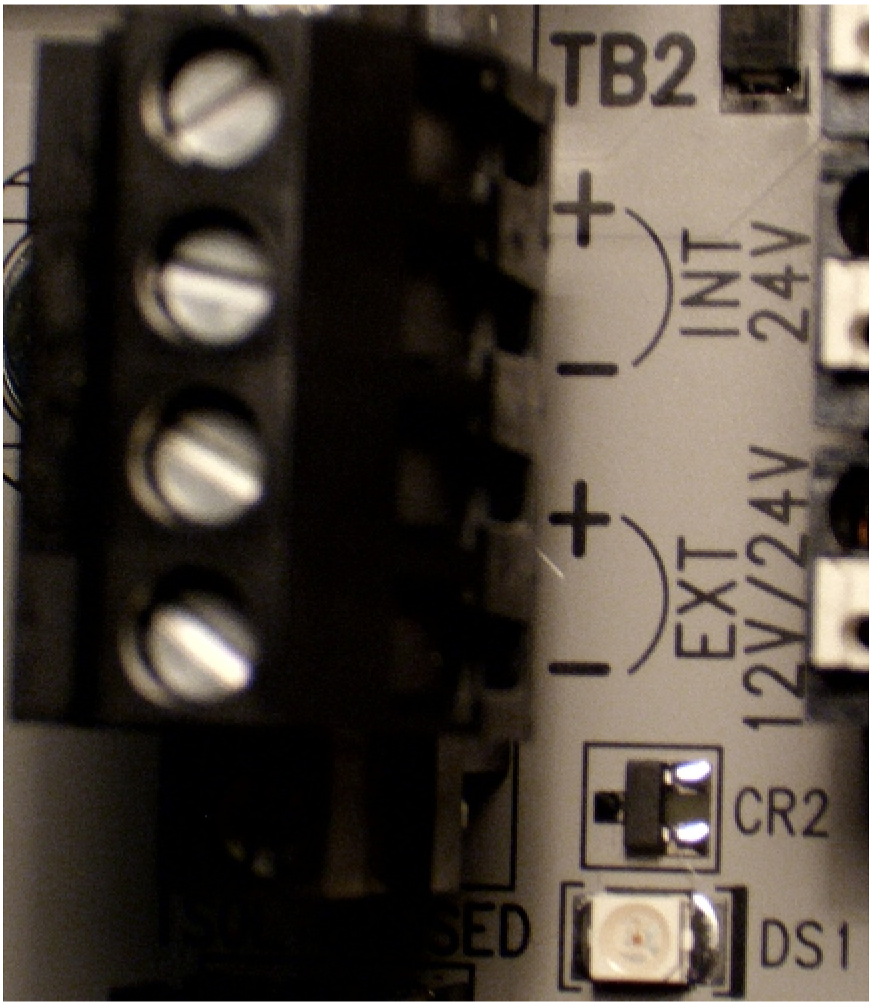


In the default configuration (as shipped from factory), the COM(x) (signal returns) for all the eight channels are electrically isolated from each other and from system power return. Based on the topology required, you can choose to connect the signal return to the system power return (TB2 pin 4) by installing a jumper across the terminal block for the required channel.

6.6.2 Verifying the connection

The following figure displays the LED DS1 on the IOTA.

Figure 6.8 PIM TB2 - DS1 LED on IOTA



The green LED, DS1, on the IOTA adjacent to terminal block TB2 illuminates if either the Series C system 24V internal system supply or an external user supplied power source is properly connected to TB2. If this LED does not illuminate, check wiring to TB2, fuse F3, or the field wiring.

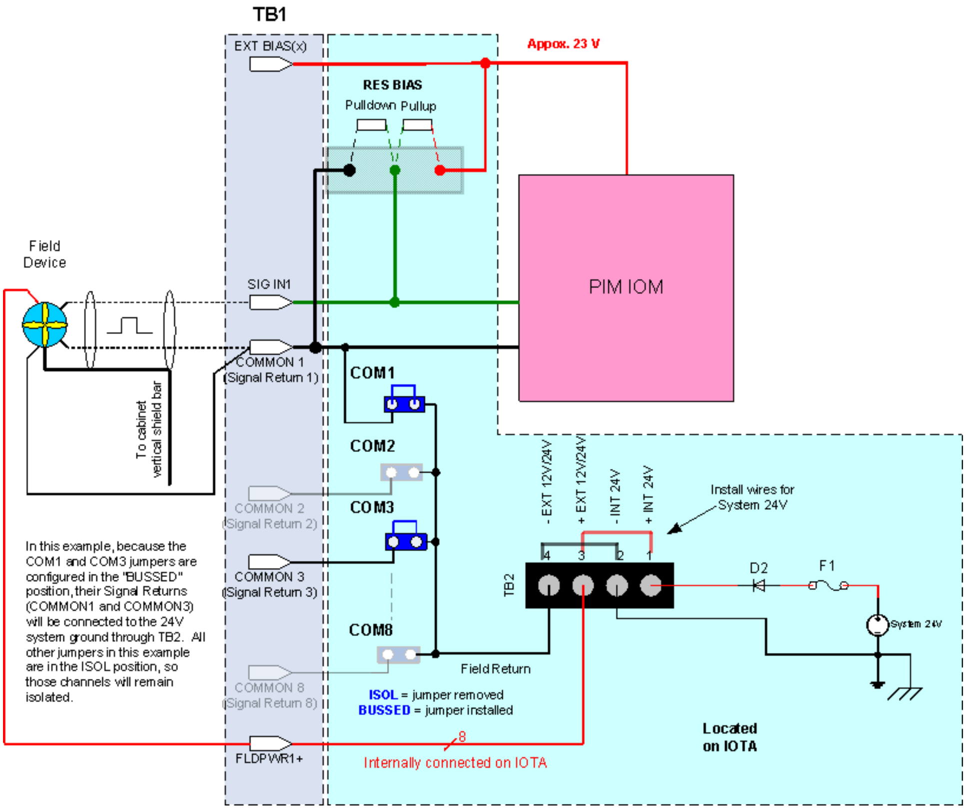
If TB2 is not used (no wires attached), then LED DS1 does not illuminate and this is normal.

6.6.3 Examples to illustrate sensor power connections through TB2

Example 1: Sensor powered from Series C System +24 V internal supply. Connections made through TB1, FLDPWR(x)+ and COMMON(x)

The following figure displays a sample diagram where the sensor is powered from Series C system +24 V internal supply and the power connections are made through TB1, FLDPWR(x)+ and COMMON(x).

Figure 6.9 Sensor powered from Series C System +24 V internal supply. Connections made through TB1, FLDPWR(x), and COM(x)



For this type of connection, you need four wires. Two wires provide power to the sensor and the other two wires connect the pulse output from the sensor to the PIM. This example shows the field sensor connected to channel 1 but the procedure applies to the remaining channels.

The internal +24 Vdc supply, TB1, and TB2 are used to supply sensor power. This is accomplished by connecting the corresponding channel's FLDPWR1+ pin and COMMON1 pin to the positive and negative power leads of the field sensor respectively. To complete the circuit, place the jumper wire across the pins of the COM1 terminal block as illustrated in the above diagram so that so field return is tied to COMMON1.

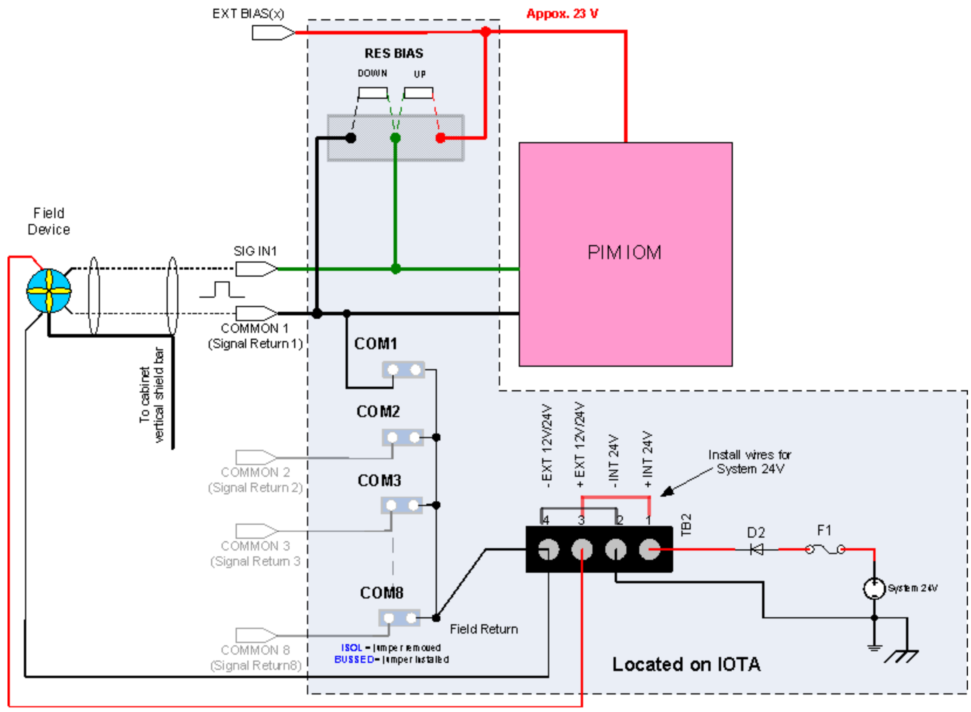
Install wires at TB2 as illustrated in the above diagram to feed all eight of the FLDPWR(x) to TB1. There is no need to add individual wires from FLDPWR(x) to the +EXT 12V/24V connector at TB2 as this is provided by internal copper tracks on the IOTA.

For clarity, the LED DS1 and other components are not shown in the above diagram. See also figure PIM TB1 pin assignments.

Example 2: Sensor powered from Series C System +24 V internal supply. Power connections directly made through TB2

The following figure displays a sample diagram where the sensor is powered from Series C system +24 V internal supply and the power connects are directly made through TB2.

Figure 6.10 System +24 V internal supply used. Power connections made through TB2



In this example, the power connections are made through TB2 only.

All COM(x) jumpers in this example are removed (ISOL). If a jumper is installed (BUSSED), the respective signal common will be connected to the 24V system ground through TB2.

6.7 TB3 pin assignment for fast cutoff relays

Two optically isolated solid state relays, K1 and K2, are provided on the PIM IOTA for connection with DC loads. The solid state relays are fast responding type capable of turning ON or OFF in less than 1 millisecond. These relays can be controlled only when channels 7 and 8 are configured for fast cutoff in Control Builder.

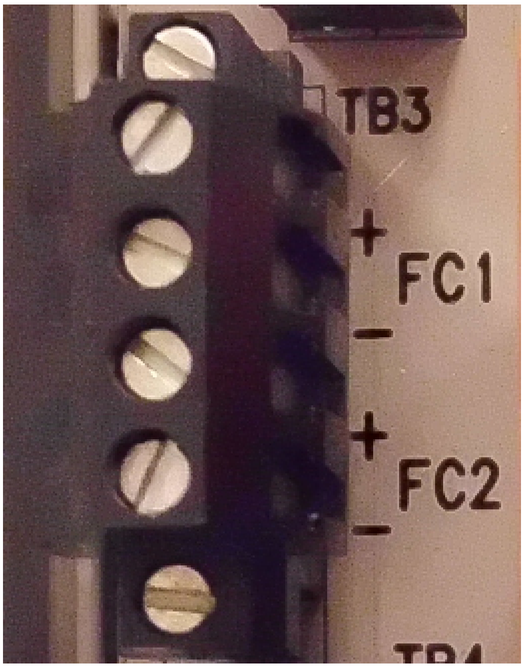
The following tables provides information on the TB3 pin assignments.

Table 6.3 TB3 pin assignment

Pin number	Description
1	FC1 + (high side)
2	FC1 - (low side)
3	FC2 + (high side)
4	FC2 - (low side)

The following figure displays the TB3 connector on the IOTA.

Figure 6.11 PIM TB3 connectors on IOTA



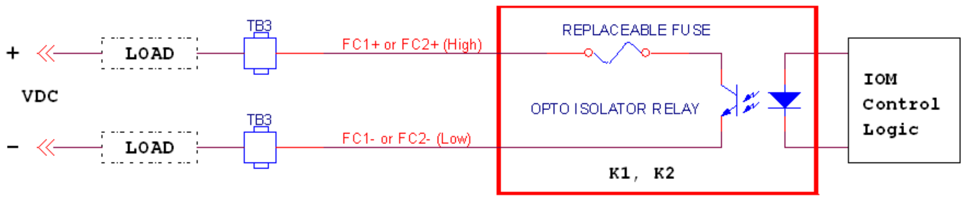
- Key points on relays

6.7.1 Key points on relays

The following list summarizes the key points on relays.

- Relay K1 (FC1) is associated with CH7 only.
- Relay K2 (FC2) is associated with CH8 only.
- User load can be connected in either leg (or both legs) of the relay path provided polarity is observed.
- Each relay contains a top mounted LED that illuminates green to indicate that the relay is in the ON state (conducting). The LED is extinguished to indicate the relay is in the OFF state (non-conducting).
- The IOTA relay connections are rated for 1.5 Adc, 60 Vdc maximum.
- The fuses in relays K1 and K2 are user replaceable (5 x 20 mm, 2.5A /250V, time lag).
- The relays K1 and K2 are electrically isolated from each other, from system power and ground and from chassis (cabinet) ground.
- Relays K1 and K2 are replaceable by ordering Honeywell part number 51190516-134.

Figure 6.12 Fast Cutoff relay wiring diagram



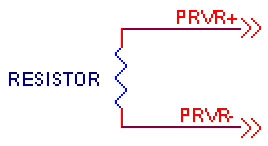
6.8 About enabling pulse proving in PIM

You must use Control Builder to select the stream to be proved (only one per PIM). This action connects the good pulses from the selected stream to the Prover Pulse Bus. For each good pulse from the selected stream, a 20 us wide positive going pulse is output on the PIM Prover Bus. The tri-state output of the Prover Pulse Bus allows for multiple Series C Prover Pulse outputs to be connected in parallel to a single ST102 (or other hardware) allowing for larger installations which have more meter streams for a single meter prover.

Only channel pairs configured in dual configuration can provide a source of good pulses for prover output.

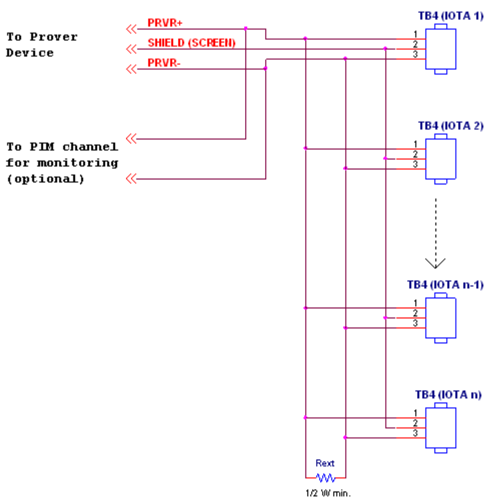
Refer to the section Enabling pulse proving in Pulse Input Module for more information.

For proper operation of the Prover Pulse Bus, a resistor must be connected to TB4 as shown in the following diagram.



If the prover pulse bus is used with more than one IOTA, only one resistor (Rext) is required. Refer to the following diagram.

Figure 6.13 Multiple IOTAs connected in parallel on the Prover Bus

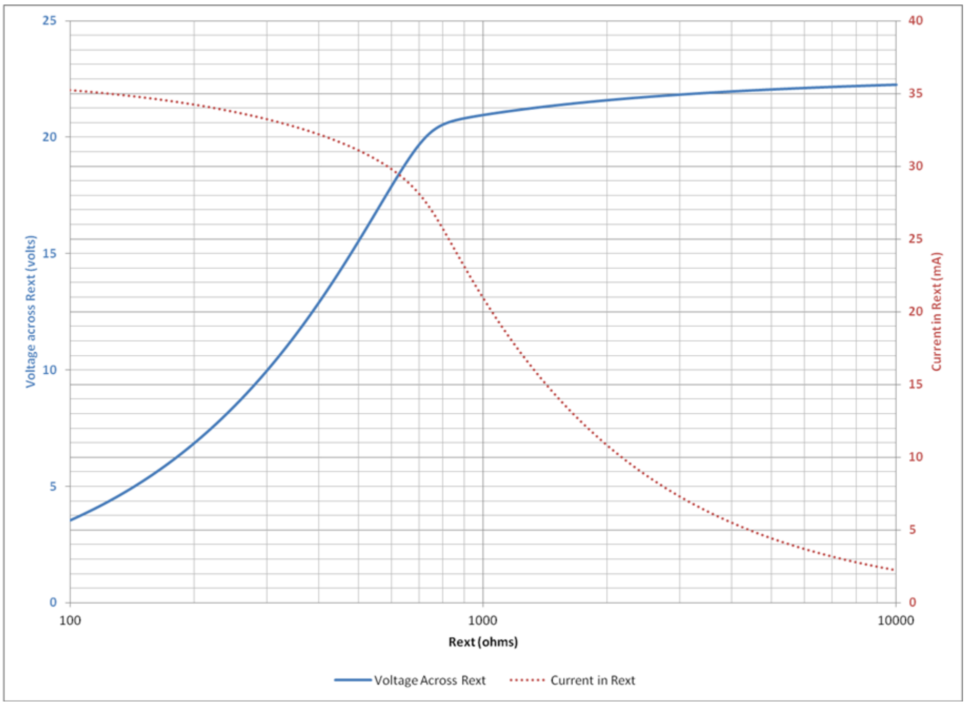


ATTENTION

The value of the resistor is dependent upon the connected meter Prover device (user load). The Prover Pulse Bus is a high compliance source driver capable of producing 0 V to 24 V pulse outputs and currents up to 35 mA. You must exercise caution while selecting an appropriate resistor as excessive current could potentially damage the meter Prover device.

The following figure displays Prover Pulse voltage and current verses Rext.

Figure 6.14 Graph of Prover Pulse voltage and current verses Rext



6.9 TB4 pin assignment for Prover Pulse Bus

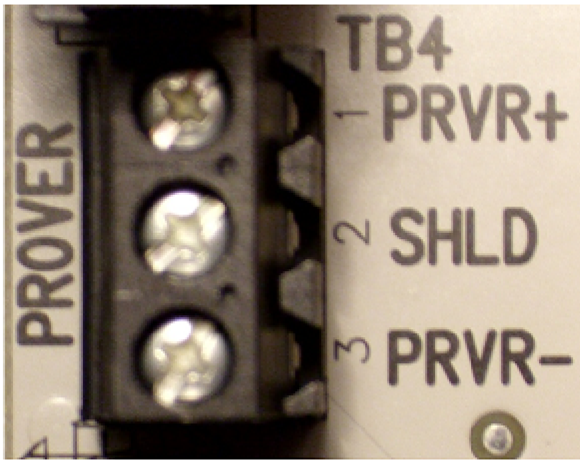
The following table provides information on the 3-pin TB4 pin assignments for Prover Pulse Bus.

Table 6.4 TB4 pin assignments for Prover Pulse Bus

Pin number	Description
1	PRVR+
2	Shield (screen)
3	PRVR-

The following figure displays the TB4 connector on the IOTA.

Figure 6.15 Prover Bus connector - TB4



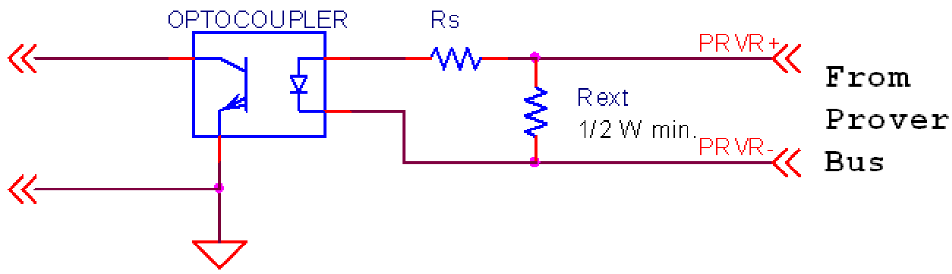
Pin 2 of TB4 is connected on the IOTA to chassis ground. If shielded wire is used, tie the shield (screen) of the cable to this pin. If the cable leaves the Series C cabinet or cabinet complex, then it is recommended that twisted pair conductors with and overall shield be used for decreased noise and transient immunity.

If required, the PRVR+ and PRVR- lines can be optionally connected to a single stream input of the PIM for monitoring purposes (refer to figure Multiple IOTAs connected in parallel on the Prover Bus). The resistor, Rext, is mandatory for proper operation. For this option, do not install any external RES BIAS "UP" or "DOWN" for the single stream pulse channel because Rext also serves this purpose.

6.10 Using Prover Pulse Bus with optocoupler

You can connect the Prover Bus to an optocoupler (such as the input stage of a ST102) as displayed in the following diagram.

Figure 6.16 Illustration of using Prover Pulse Bus with Optocoupler



Since the Prover Pulse Bus is a high compliance driver and can source 35 mA, an additional series resistor "Rs" is required to limit the current into the photo diode to a safe value. The value of "Rs" can be selected so that the manufacturing ratings are not exceeded.

The following tables provide information on the approximate values of "Rs" for selected photodiode currents with "Rext" equal to 1 k ohms and 2.2 k ohms respectively. For all of the values listed in the tables, the power rating for "Rs" is ½ watt.

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6.10.1 Conditions: Rext = 1k, photodiode V_{FWD}= 1.2 V

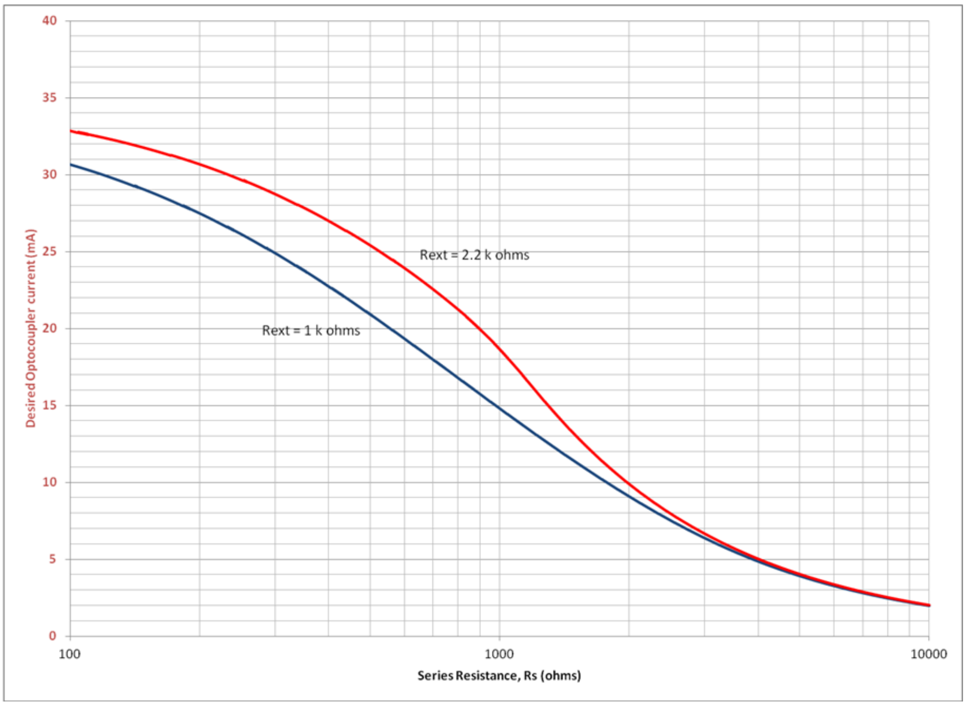
Desired photodiode current (mA)	Rext (ohms)	Voltage difference at PRVR+ minus PRVR-	Standard 5% Value of Rs (ohms)
5	1 K	20.57 V	3.9 k
10	1 K	18.95 V	1.8 k
15	1 K	15.91 V	1 k
20	1 K	12.36 V	560

6.10.2 Conditions: Rext = 2.2 k, photodiode V_{FWD} = 1.2 V

Desired photodiode current (mA)	Rext (ohms)	Voltage difference at PRVR+ minus PRVR-	Standard 5% Value of Rs (ohms)
5	2.2 K	21.35 V	3.9 k
10	2.2 K	21.05 V	2 k
15	2.2 K	20.71 V	1.3 k
20	2.2 K	19.2 V	910

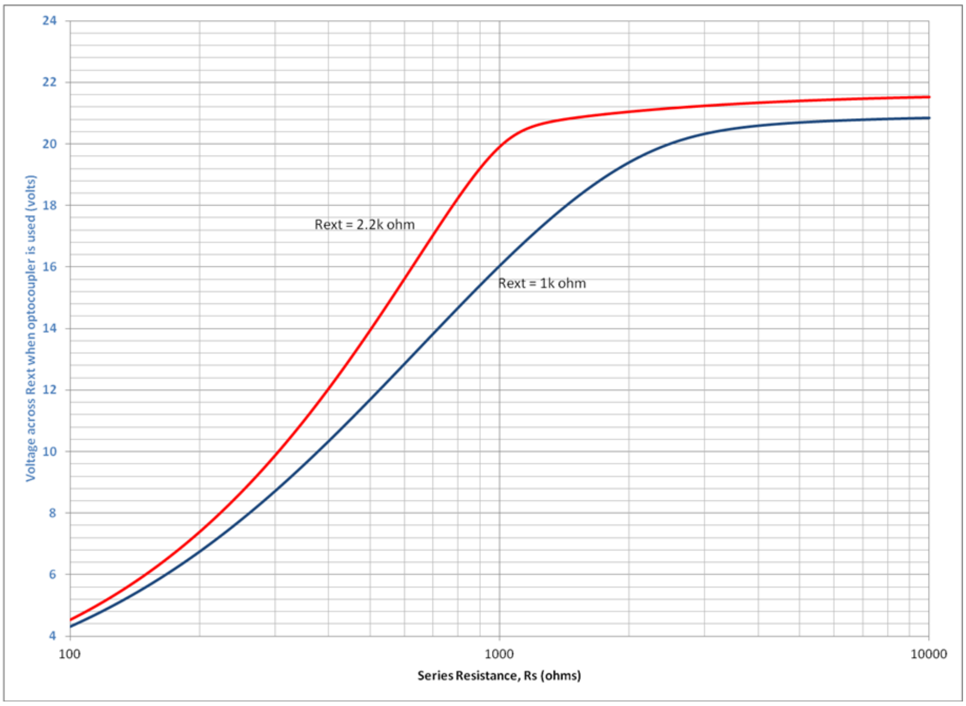
Use the following graph to determine the “Rs” values for any given photodiode current.

Figure 6.17 Graph to determine Rs values for any given photodiode current



Use the following graph to determine the a voltage values across “Rext” for any given “Rs”.

Figure 6.18 Graph to determine voltage values across Rext for given Rs



6.11 Connecting PIM with ST500 dual-pulse simulator (Swinton Technology)

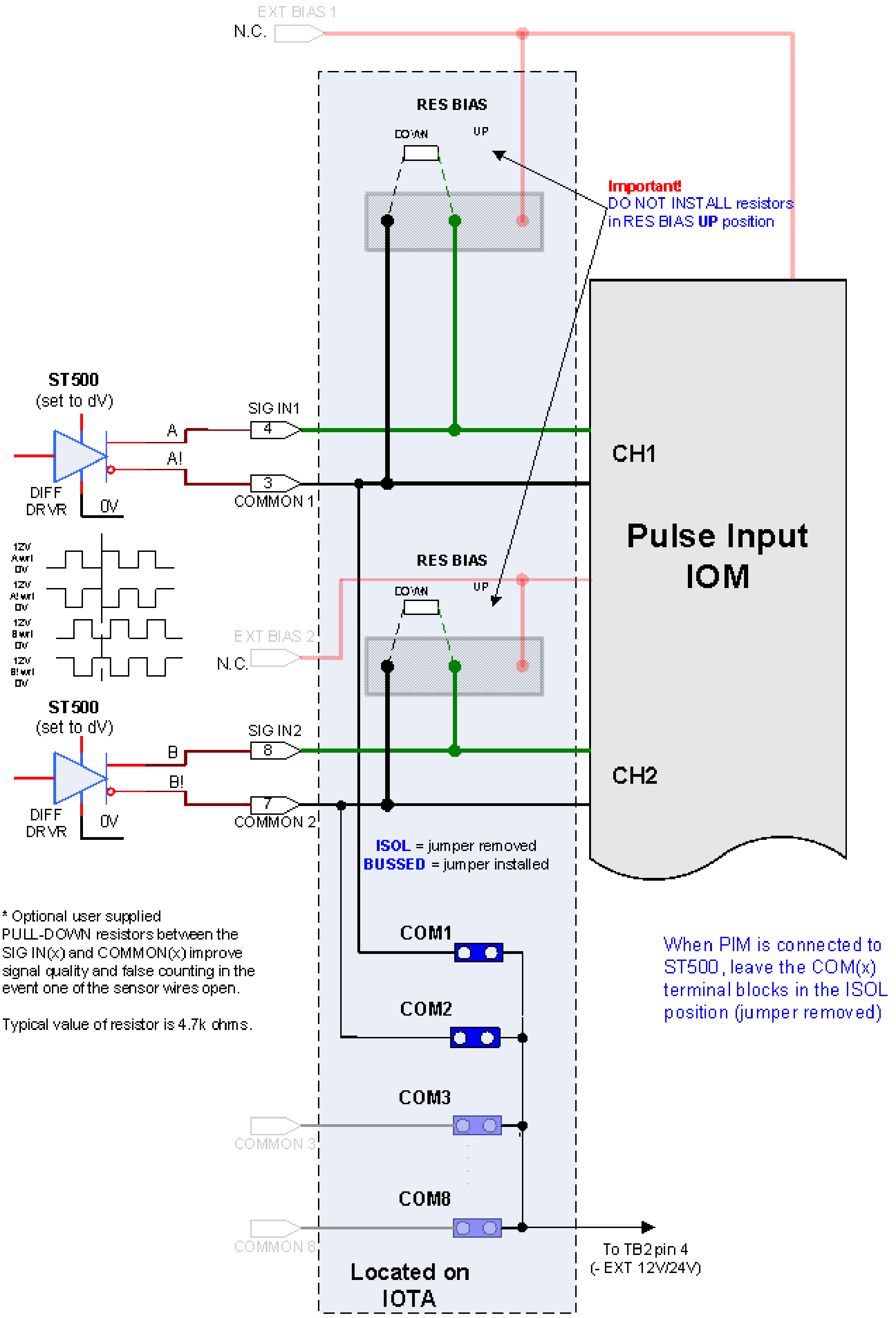
You can connect PIM with ST500 dual-pulse simulator in a differential manner as well as a single-ended manner.

- Differential manner
- Single-ended manner

6.11.1 Differential manner

The following diagram displays connecting a Swinton Technology, ST500 dual-pulse simulator, to the PIM IOTA in a differential manner.

Figure 6.19 Connecting PIM with ST500 dual-pulse simulator – differential manner

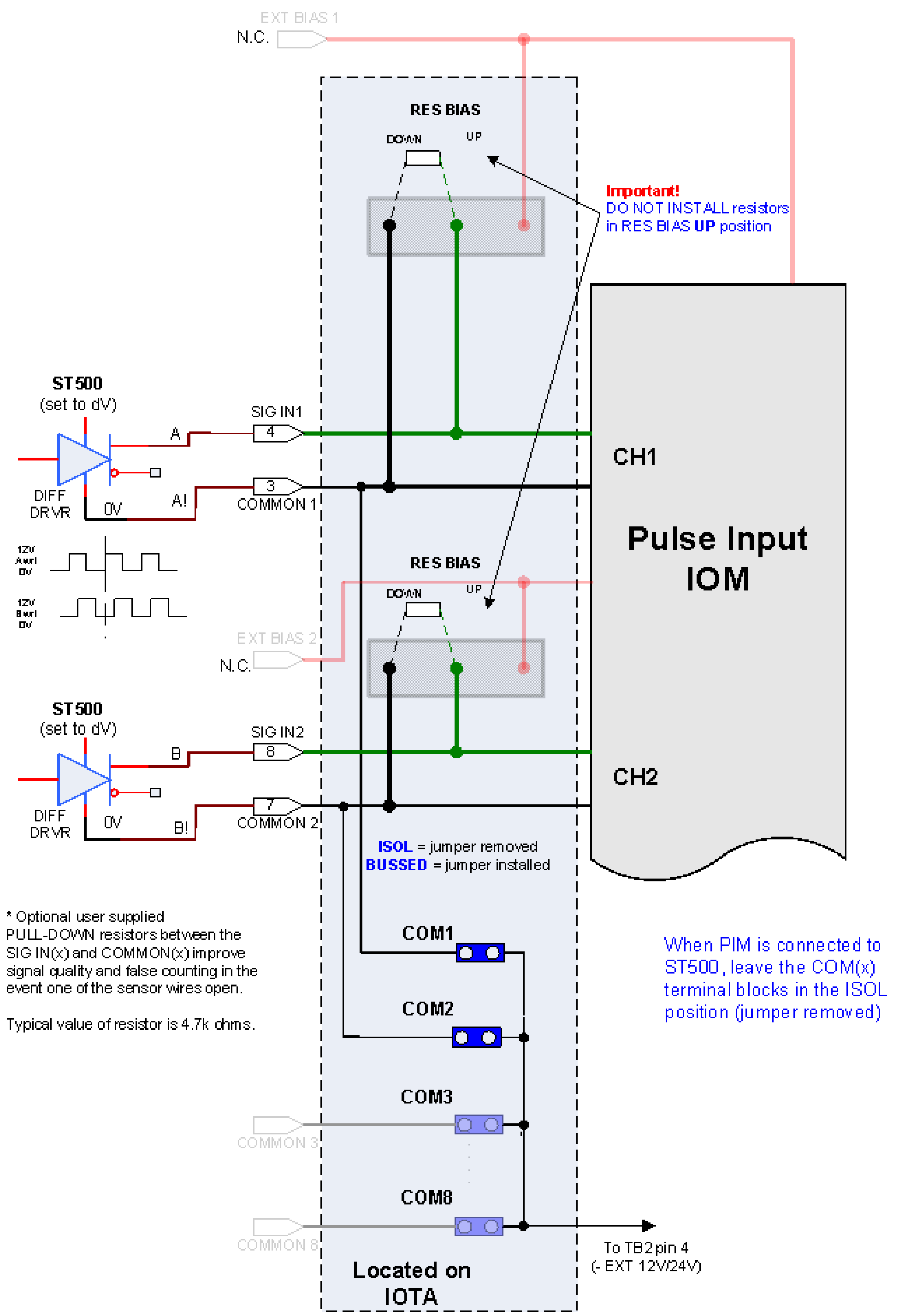


In this example, channel 1 and channel 2 are displayed. The ST500 rear panel switches need to be set to the dV (differential voltage) position. The PIM channel blocks can be configured as single stream, or dual stream. When dual stream is chosen, the PIM utilizes dual pulse error detection per ISO 6551. It is important to ensure that RES BIAS UP option is not used for the channels connected to ST500 since ST500 uses a differential driver output stage and a pull-up will interfere with the signal quality and potentially damage the ST500. Also, ensure that COM(x) terminal blocks for the channels connected to ST500 are configured for ISOL position (jumpers removed) for fully isolated operation. Otherwise, the A! will be shorted to B! and cause signal corruption.

6.11.2 Single-ended manner

The following diagram displays connecting a Swinton Technology, ST500 dual-pulse simulator, to the PIM IOTA in a single-ended manner.

Figure 6.20 Connecting PIM with ST500 dual-pulse simulator - Single-ended manner

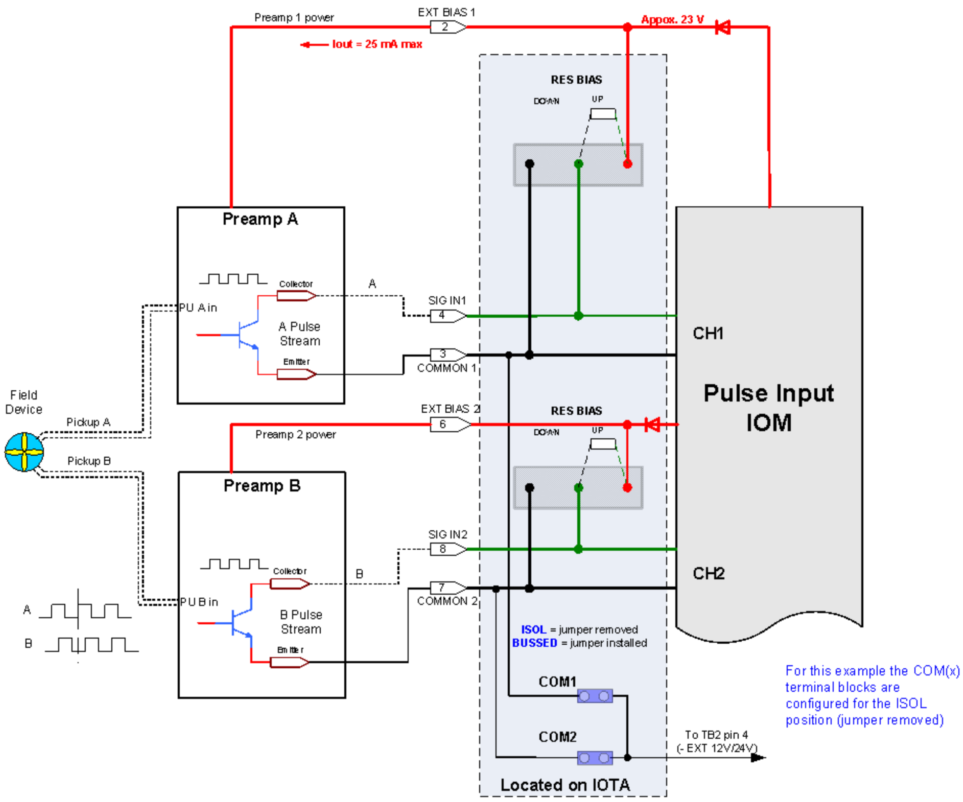


The difference between the differential and the single-ended connectivity is that the 0V pin of the ST500 driver connects to the COMMON(x) pins of the PIM IOTA. This arrangement forces the COMMON 1 and COMMON 2 to be electrically connected through the ST500. In this connection, A, A!, B, or B! can be connected to the SIG IN(x) pins of the IOTA. In the above diagram, SIG IN(x) is arbitrarily connected to A and B, which maintains the default phase 90-degree relationship.

6.12 Connecting PIM with dual stream devices

The following diagram provides information on connecting PIM with dual stream devices.

Figure 6.21 Connecting PIM with dual stream devices

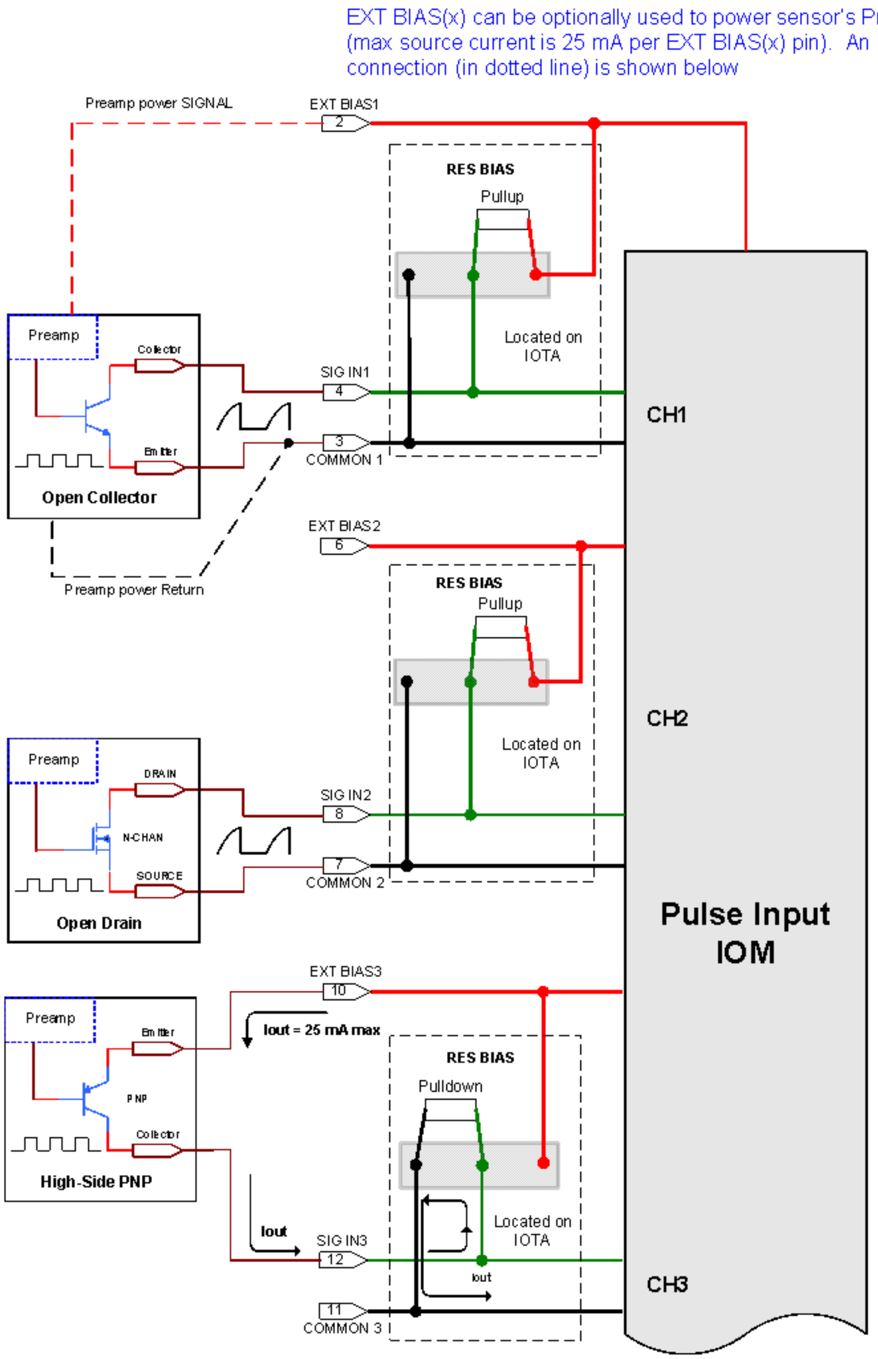


The figure “Connecting PIM with dual stream devices” is an example of dual stream field device connected to PIM through magnetic pickup preamplifiers with open collector outputs. A 3-wire connection is used. In this example, the signal output of each preamplifier is connected to SIG IN1 and SIG IN2 inputs of the PIM. The preamplifier is powered from the PIM’s EXT_BIAS1 and EXT_BIAS2 outputs. The preamplifier power return is internally connected to signal common. The maximum current that PIM can supply to the preamplifier is 25 mA. Select the preamplifier accordingly. Similar connectivity applies to the remaining dual channel pairs. Consult manufacturer’s data sheet for details on the specific preamplifier.

6.13 Connecting PIM with other sensor types

The following diagram provides information on connecting PIM with other sensor types such as open collector, open drain, and high-side PNP (not very common).

Figure 6.22 Connecting PIM with other sensor types

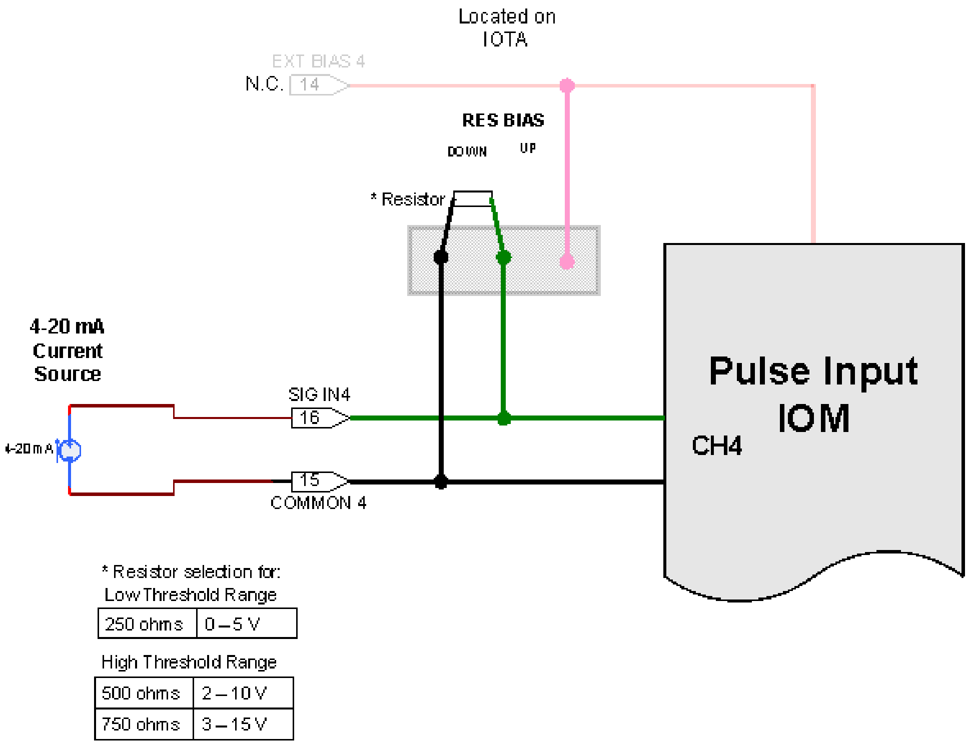


The first three PIM channels are used for illustration purposes. However, any channel can be configured for any of the sensor types.

The following diagram provides information on connecting PIM with a 4-20mA current source.

Honeywell

Figure 6.23 Connecting PIM with a 4-20mA current source



6.14 Selecting PIM input threshold

From Control Builder, you can select Low or High voltage thresholds depending upon the sensors used. Generally, if the sensor outputs a signal in the 0V to 5V range (for example, TTL), the Low threshold is the best choice. If the sensor's pulse output is an open collector or open drain type and the externally supplied Pull-up resistor is used on the IOTA, the High threshold is the best choice as the signal swings from 0V to about 23V. Other devices that are actively driven require knowledge of the output swing to determine the proper range. For example, the Swinton Technology ST500 Dual-Pulse Simulator outputs have a voltage swing of 0V to 12V with respect to the 0V terminal. Therefore, either the Low or the High threshold can be selected, but there will be slight difference in the measured Pulse Length (PL) parameter.

ATTENTION

- Millivolt signals are not counted by the PIM unless a suitable preamplifier is used to boost the signal to a level that can be detected by the PIM circuitry.
- Current Pedestal signaling is not directly supported by PIM circuitry.

The following table lists the typical thresholds for the Low and High ranges.

Table 6.5 PIM input threshold – Typical low and high ranges

Input Threshold Setting	Trip point for Rising Input (Low to High transition)	Trip Point for Falling Input (High to Low transition)	Hysteresis (typical)
Low	2.75 V	2.04 V	0.71 V
High	8.41 V	7.7 V	0.71 V

For dependable operation, the sensor signal needs to extend above and below the values mentioned in the above table to overcome noise and provide significant overdrive.

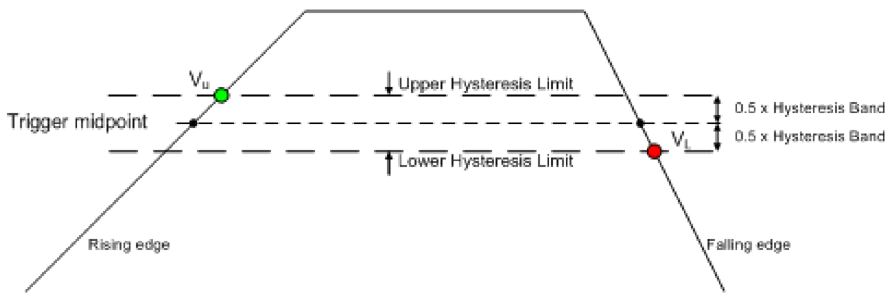
The following table lists recommended input values for dependable operation.

Table 6.6 PIM input threshold – Input values for dependable operation

Input Threshold Setting	Recommended Signal Level for Rising Input, Vu (Low to High transition)	Recommended Signal Level for Falling Input, VL (High to Low transition)
Low	3.25 V or more	1.5V or less
High	8.9 V or more	7.2 V or less

The figure below provides a pictorial representation of the upper and lower trip points and hysteresis band. For illustration, the rising and falling edges are shown asymmetrically.

Figure 6.24 Illustration of upper and lower trip points and hysteresis band



6.15 Recommended cable types

This section provides recommendations on proper types of external cabling that should be used with the PIM. Honeywell does not provide PIM interface cables. You must select cables per your requirements.

The following Belden cable types can be used with PIM.

- Blue Hose Series – 9463, 9463F, 3072F, 89463, 9463DB and so on)
- Brilliance Series (multi-conductor) – 8774

However, you can use similar cables from other manufacturers.

- Tips on cable usage

6.15.1 Tips on cable usage

Multi-conductor Cables

Multi-conductor cables may be used to allow for a single run (for example, home run cable). However, only use cables with individually shielded twisted pairs to minimize crosstalk and false counting of pulses from one channel to another within the cable bundle. At a minimum, the selected cable should have individually shielded twisted pairs with 100% foil shield coverage. Preferably, a foil plus overall braid provides more shielding effectiveness. Wire selection is critical for pulse counting performance, therefore select appropriate cables.

For fast counting, low capacitance is also desirable so that the pulse fidelity (pulse distortion) at longer cable lengths is not be compromised.

A mix of multi-conductor and individual cable runs can be used with PIM.

EMI/RFI Considerations

For best EMI/RFI performance, use cables that have a braided shield (55% or greater coverage). Some cables are double shielded with a braid over foil. This provides the best performance if the environment is EMI harsh. Proper grounding of the shields is necessary to obtain best performance.

Shield (screen) termination

The shields (screen) of the cable carrying the pulse signals from the sensor to the PIM IOTA can be grounded at either end or both ends (double termination). If low frequency ground loops are a problem in the plant, tying the shield to ground at one end may be a better choice to minimize common mode noise and interference. If the ground system/grid of the plant does not have ground loops or the run from the PIM IOTA to the sensor is short, then double termination is often preferable.

CHAPTER

7

SERIES C UNIVERSAL HORIZONTAL INPUT/OUTPUT (UHIO) COMPONENTS

The Series C UHIO is comprised of the following Series C components.

- 9-port Control Firewall CC-PCF901
- C300 Controller CC-PCNT02
- Universal Input/Output (UIO) Module CC-PUIO01 or CC_PUIO31

In addition to the existing Series C components, the UHIO contains additional components as listed below in Table 85. All of these components are packaged together in various UHIO Configurations. These configurations are defined within the section titled Components of UHIO.

The following table lists the model number of UHIO components.

Table 7.1 UHIO component's model numbers

Model Number/Part Number	Description
CC-HCAR01	Horizontal Backplane PWA, coated
CC-HCN911	Horizontal C300/CF9 IOTA PWA, coated
CC-HUIO11	Horizontal UHIO IOTA PWA, coated
CC-HUIO12	Horizontal UHIO IOTA PWA, coated
CC-HCMB02	Battery Backup Mounting Panel
51454517–100	Series C Power Supply in Basic cabinet form factor
51155572-100	Half Panel Plastic Cover
CC-PCNT02	C300 Module
CC-PCF901	C9 Module
CC-PUIO01	UIO Module
CC-PUIO31	UIO-2 Module

Table Of Symbols	
AI	Analog Input
AO	Analog Output

Table Of Symbols	
CB	TDC 2000 Basic Controller
CF9	Control Firewall (9 refers to the number of ports, 1 uplink and 8 downlink)
DI	Digital Input
DO	Digital Output
I/O	Input/Output
IOTA	Input/Output Termination Assembly
UHIO	Universal Horizontal Input/Output
UIO	Universal I/O
PE	Protective Earth Ground
COTS	Commercial Off The Shelf

Replaceable Fuses	
51190582-150	.5A, 250V, quick-acting, 5x20mm glass
51190582-310	10A, 125V, quick-acting, 5x20mm glass

Periodic Maintenance

- Non Required

Replacement Parts	
CC-PCNT02	C300 Module
CC-PCF901	C9 Module
CC-PUIO01	UIO Module
CC-PUIO31	UIO-2 module
51190582-150	.5A Fuse
51190582-310	10A Fuse

- About the Horizontal C300/CF9 IOTA
- About the Horizontal UHIO IOTA
- About the I/O connectors
- Components of UHIO
- Mounting the UHIO components
- General regulatory compliance

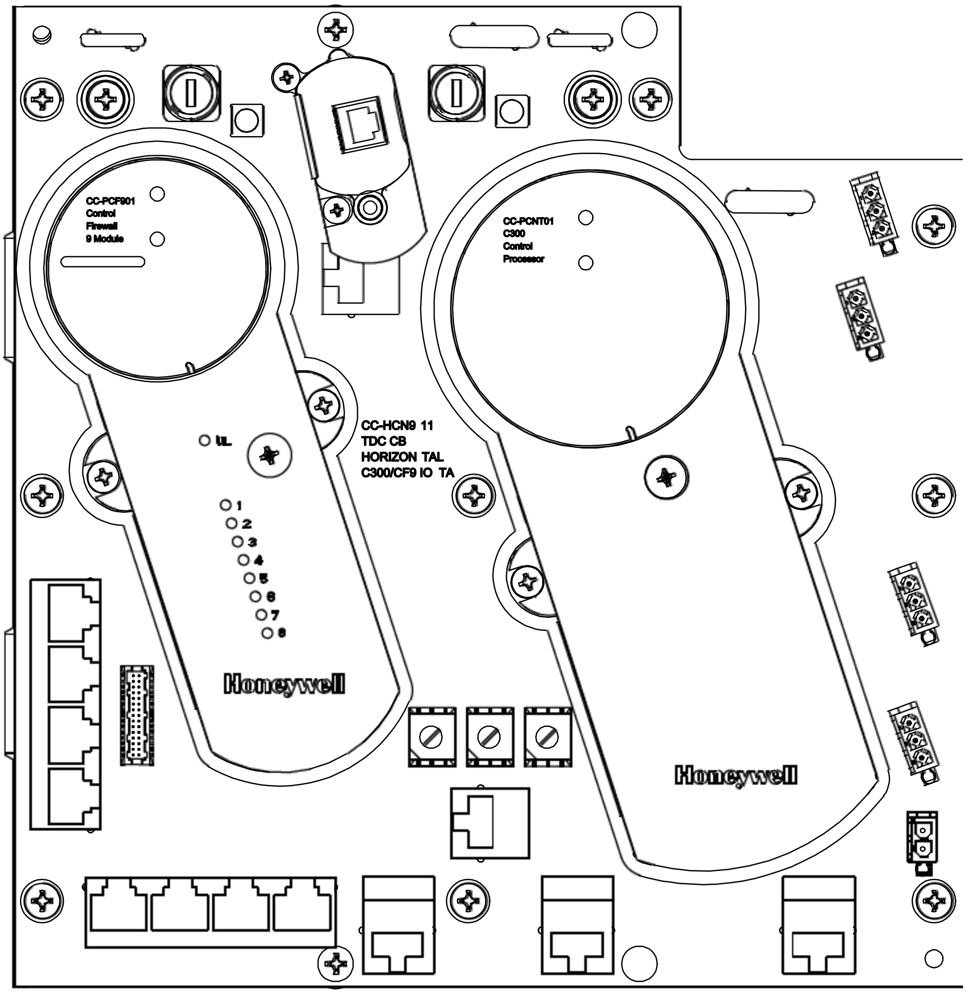
- COTS AC-DC Power supplies
- Protective Earth (Safety Ground)
- Environmental Characteristics

7.1 About the Horizontal C300/CF9 IOTA

The C300 / CF9 IOTA is a combination board that joins a Series C C300 IOTA with a Series C CF9 IOTA. The dimensions of the C300/CF9 IOTA and the UHIO IOTA are the same, 8.66X8.37 inches.

The following figure displays the engineering drawing of the C300/CF9 IOTA.

Figure 7.1 Horizontal C300/CF9 IOTA



7.2 About the Horizontal UHIO IOTA

The horizontal UHIO IOTA is designed for UIO and the dimension of the IOTA is same as that of horizontal C300/CF9 IOTA. This IOTA enables you to place the redundant UIO module side-by-side or horizontally. The placement of a UIO module differs from the placement of a Series C module, wherein you can only place the Series C modules vertically and hence it is named as "Universal Horizontal I/O." The horizontal UHIO IOTA is designed to interface the Series C UIO module with the CB/EC terminal panel – the TCBxx.

The following figures display the engineering drawings of the UHIO IOTA and the UHIO-2 IOTA.

Figure 7.2 CC-HUIO11

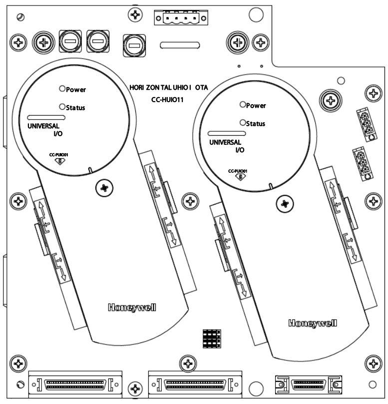
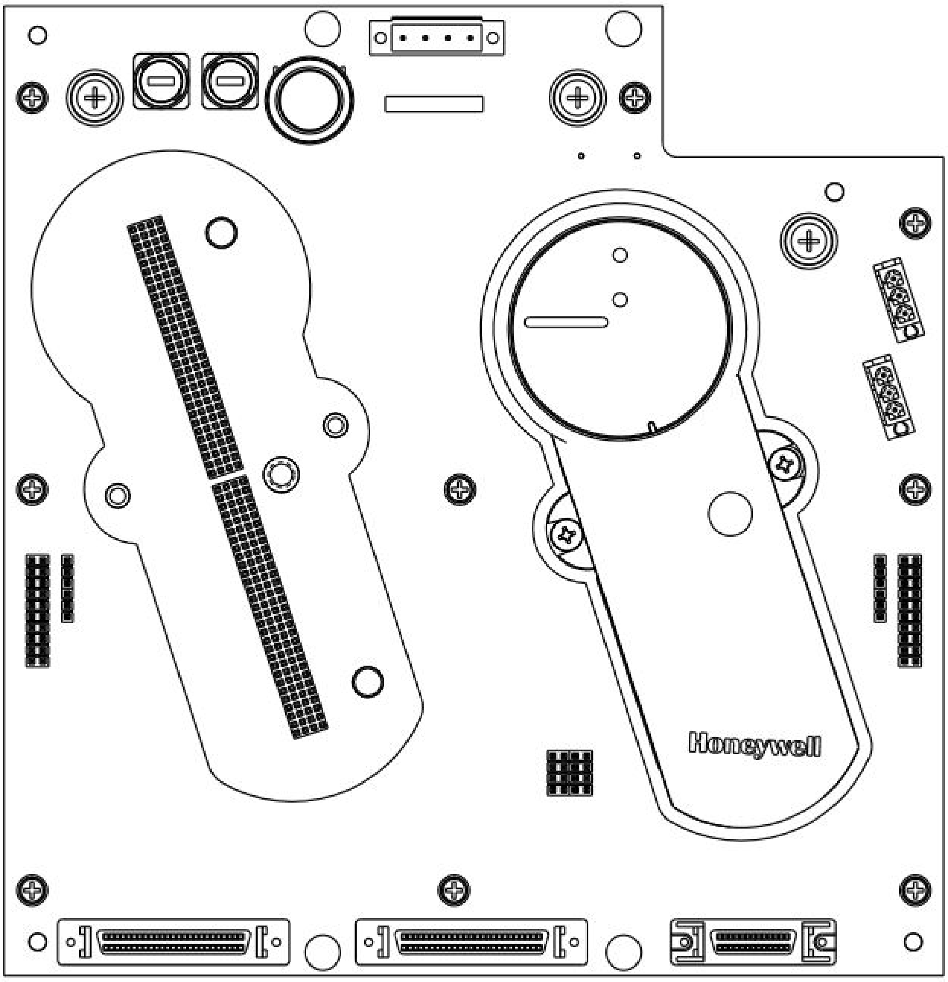


Figure 7.3 CC-HUIO12



7.2.1 Mapping the UIO channels to specific I/O types

Use of the UHIO IOTA with the UIO module pre-determines 24 of the 32 I/O channels to specific I/O types. The following table defines the mapping of UIO channels to TCBxx labeled channels.

The UHIO contains 32 UIO Channel Numbers as shown in the first column of the table below. Each of these channels can be configured as shown in the last column of the table.

> ATTENTION
>
> The channel numbers listed are identical to what is displayed on the Experion Station and Control Builder.

Table 7.2 Mapping UIO channel to specific I/O types

UIO Channel Number as displayed on Experion Station	TCBxx Channel Name	Spare Points I/O	UIO Channel Configuration Type
1	CO8	-	AO
2	CO7	-	AO
3	RV06	-	VI
4	PV06	-	VI
5	PV08	-	VI
6	RV08	-	VI
7	PV05	-	VI
8	RV05	-	VI
9	PV07	-	VI
10	RV07	-	VI
11	CO6	-	AO
12	CO5	-	AO
13	-	SP1	AI, AO, DI, DO
14	-	SP2	AI, AO, DI, DO
15	-	SP3	AI, AO, DI, DO

UIO Channel Number as displayed on Experion Station	TCBxx Channel Name	Spare Points I/O	UIO Channel Configuration Type
16	-	SP4	AI, AO, DI, DO
17	-	SP5	AI, AO, DI, DO
18	-	SP6	AI, AO, DI, DO
19	-	SP7	AI, AO, DI, DO
20	-	SP8	AI, AO, DI, DO
21	CO1	-	AO
22	CO2	-	AO
23	RV03	-	VI
24	PV03	-	VI
25	RV01	-	VI
26	PV01	-	VI
27	RV04	-	VI
28	PV04	-	VI
29	PV02	-	VI
30	RV02	-	VI
31	CO3	-	AO
32	CO4	-	AO

ATTENTION

All the AIs in the above table except for channels 13 thru 20 are 1 to 5V inputs

Examples of mapping UIO channels

The following are a few examples of mapping UIO channels to specific I/O types.

- Consider that you want to use PV08 on a TCB20. In this scenario, UIO channel 5 configured as an AI point type in Control Builder enables the monitoring of a device wired to PV08 on the terminal block.
- Consider that a valve is connected to a screw terminal CO5 on a TCB20. In this scenario to control this valve, configure channel 12 as an AO type on the appropriate UIO module in
- Consider that you want to monitor the state of a 24VDC switch (ON or OFF). In this scenario,

configure one of the spare points (such as SP3) as a DI type to monitor the switch state. Note that the corresponding UIO channel in Control Builder for SP3 is channel 15.

7.2.2 Spare point I/O configuration

UIO channels 13 through 20 are available to be configured as spare I/O points. These channels can be configured as AI, AO, DI, or DO. In other words, the configuration and use of the UHIO spare points is the same as regular channels configured and used Series C UIO.

For more information about the usage of the spare I/O points based on the configuration, see the following sections.

- UIO channel configured as analog input spare point - UIO channel configured as Analog Input.
- UIO channel configured as analog output spare point - UIO channel configured as Analog Output.
- UIO channel configured as digital input spare point - UIO channel configured as Digital Input.
- UIO channel configured as digital output spare point- UIO channel configured as Digital Output.

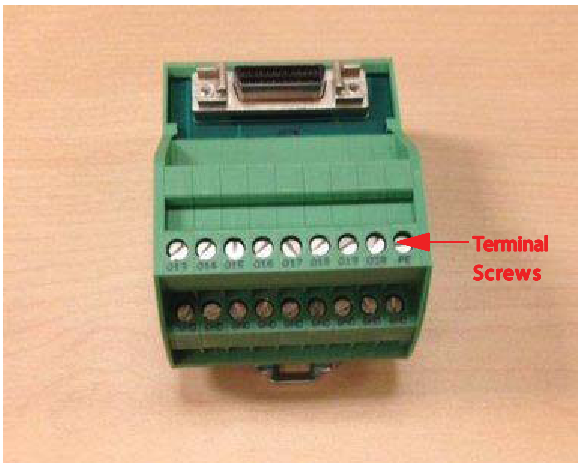
ATTENTION

There are no restrictions for configuring these eight spare I/O channels. Any combination of the four I/O types can be used for the eight spare I/O points.

Spare point panel

Honeywell recommends a solution for better configuration of the spare points. Phoenix Contact has designed a DIN rail mountable assembly for I/O of the spare points. The following figure illustrates the spare point panel.

Figure 7.4 Spare point panel



This panel contains screw terminals for attaching field wiring for eight channels. The dimensions of the panel are 1.96 inches wide x 2.56 inches high x 1.74 inches depth and can be mounted anywhere in the cabinet.

ATTENTION

For customers who want to use a spare I/O channel, one spare point panel is required per UHIO IOTA.

Phoenix Contact has assigned 2905715 as the part number to the spare point panel. Note that this part number is not assigned by Honeywell and hence, the spare points panel is not available through the Total Plant Configurator (TPC) tool.

Spare point cable

A special cable assembly is required for connecting the UHIO IOTA J7 connector with the Spare Points Panel. The cables are available in four different lengths. The spare points cables are not available through the TPC tool.

The following table lists the four cable part numbers and their lengths.

Table 7.3 Spare point cables

Honeywell Part Number	Phoenix Contact Part Number	Description
51202991-001		Spare Points Cable – 1 meter
51202991-002	51202991	Spare Points Cable – 2 meter
51202991-005		Spare Points Cable – 5 meter
51202991-010		Spare Points Cable – 10 meter

Spare points connector

For customers who want to make a customized cable and panel assembly for the spare points I/O, use the following table to connect the spare point connector on the UHIO IOTA.

Table 7.4 Spare point connector assignment on the UHIO IOTA

Spare Point Channel Number	J7 Pin Number	J7 Ground Pin Number
1	5	6
2	1	3
3	2	4
4	14	16
5	9	10
6	13	11

Spare Point Channel Number	J7 Pin Number	J7 Ground Pin Number
7	12	24
8	26	25

The following figure displays the pin numbers of the J7 connector on the UHIO IOTA.

Figure 7.5 Spare points connector

The connector selected on the UHIO IOTA board assembly is TE Connectivity. One possible mating connector is TE Connectivity part number 1-5749111-0.

About ordering the spare points panel and cable

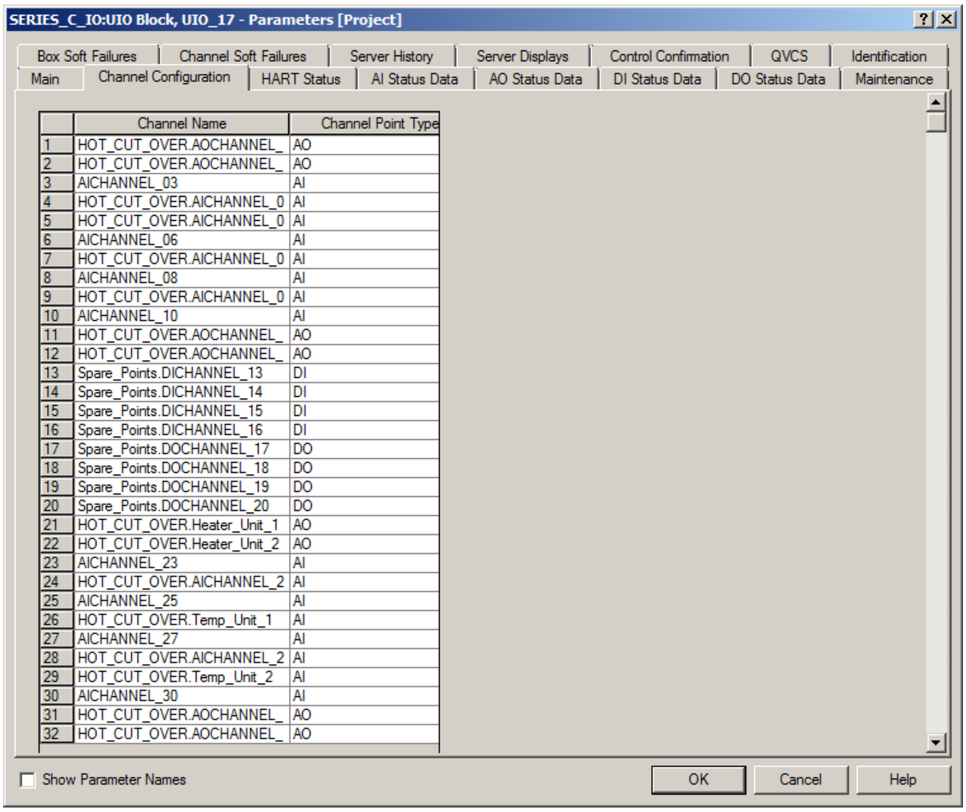
The spare points panel and cable can be ordered through Phoenix Contact's local distributors. You have to use the following Phoenix Contact web site for searching and locating a local distributor.

https://www.phoenixcontact.com

Configuring the UIO channels as spare channels

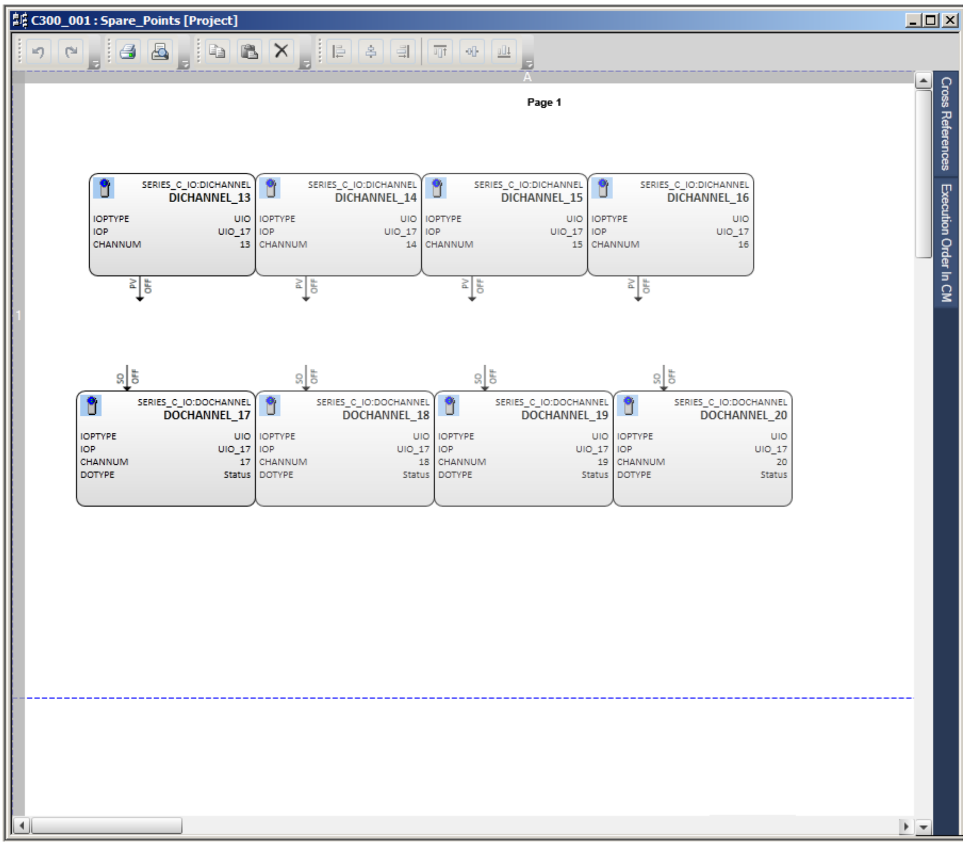
UIO channels 13 through 20 (as viewed in Control Builder) can be user configured as AI, AO, DI, or DO type. The following figure illustrates one of the possible configurations of channel 13 through 16 as DI types, and channels 17 through 20 as DO types.

Figure 7.6 UIO channel configuration in the configuration form



The following figure illustrates the configured channels used in a Control Module as DI and DO types.

Figure 7.7 Spare point channels used in a Control Module



7.2.3 Guidelines for using the HART devices with the AO channel

To connect the HART devices to any of the eight AO channels on the TCBxx panels, modify the TCBxx board assembly such that the HART functionality functions as intended.

To make the HART functionality functions, you have to remove one capacitor per AO channel from the TCBxx panel. The following table lists which capacitor must be removed from the TCBxx panel; for the AO channel used with HART.

Table 7.5 Mapping of capacitors to AO channels on TCB00, TCB20, and TCB30

TCBxx panel output	Capacitor to be removed per AO channel
CO1	C1
CO2	C2
CO3	C3
CO4	C4
CO5	C5
CO6	C6
CO7	C7
CO8	C8

7.2.4 UHIO Specifications

Specifications per I/O Type:

I/O Type	Parameters	Channel Availability
VI	1 – 5VDC	CH: 3-10, 23-30
AI	4 – 20mA	CH: 13-20
AO	4 – 20mA	CH: 1, 2, 11-22, 31, 32
DI	7mA Max	CH: 13-20
DO	1 – 500mA	CH: 13-20

Power Specification For 1 UHIO IOTA With Two UIO-2 Modules Fully Loaded

- 24 to 26VDC
- 5A

Backpanel Power Cable Specs

- 10 AWG
- 105C PVC Insulation
- 51202347-200

7.3 About the I/O connectors

The UHIO IOTA contains three I/O (J5, J6, and J7) connectors for connecting the UIO module to the field signals.

The following table provides information on the mapping of UIO channels to the I/O connectors.

Table 7.6 Mapping the UIO channels to the I/O connectors

CB Channel Name	UIO Channel Number	TCB Phone Connector	UHIO IOTA Connector	TCB Field Connector	UIO Channel Type
CO8	1	J3	J5	TB8	AO
CO7	2	J3	J5	TB7	AO
RV06	3	J3	J5	TB6	VI
PV06	4	J3	J5	TB6	VI
PV08	5	J3	J5	TB8	VI
RV08	6	J3	J5	TB8	VI
PV05	7	J3	J5	TB5	VI

CB Channel Name	UIO Channel Number	TCB Phone Connector	UHIO IOTA Connector	TCB Field Connector	UIO Channel Type
RV05	8	J3	J5	TB5	VI
PV07	9	J3	J5	TB7	VI
RV07	10	J3	J5	TB7	VI
CO6	11	J3	J5	TB6	AO
CO5	12	J3	J5	TB5	AO
SP1	13	none	J7	none	AI, AO, DI, DO
SP2	14	none	J7	none	AI, AO, DI, DO
SP3	15	none	J7	none	AI, AO, DI, DO
SP4	16	none	J7	none	AI, AO, DI, DO
SP5	17	none	J7	none	AI, AO, DI, DO
SP6	18	none	J7	none	AI, AO, DI, DO
SP7	19	none	J7	none	AI, AO, DI, DO
SP8	20	none	J7	none	AI, AO, DI, DO
CO1	21	J2	J6	TB1	AO
CO2	22	J2	J6	TB2	AO
RV03	23	J2	J6	TB3	VI
PV03	24	J2	J6	TB3	VI
RV01	25	J2	J6	TB1	VI
PV01	26	J2	J6	TB1	VI
RV04	27	J2	J6	TB4	VI
PV04	28	J2	J6	TB4	VI
PV02	29	J2	J6	TB2	VI
RV02	30	J2	J6	TB2	VI

CB Channel Name	UIO Channel Number	TCB Phone Connector	UHIO IOTA Connector	TCB Field Connector	UIO Channel Type
CO3	31	J2	J6	TB3	AO
CO4	32	J2	J6	TB4	AO

In this table, three different I/O connectors have references as J5, J6, and J7. The UIO channels OUT1 through OUT12 are connected to the I/O connector J5. The UIO channels OUT21 through OUT32 are connected to the I/O connectors J6. The Basic Controller IO points are listed in the first column and the corresponding UIO channel names are listed in the second column.

ATTENTION

- The spare channels are connected to the I/O connector J7.
- UIO channels mapped to the TCBxx terminal panel must be configured in Control Builder to the IO type as defined in the table "Mapping the UIO channels to the I/O connectors."
- The spare channels SP1 through SP8 can be configured in Control Builder as AI, AO, DI, or DO type.

7.4 Checklist for system and grounding audit of TDC 2000 system

The checklist for each components of TDC 2000 system is explained here.

7.4.1 Cabinet

1. Examine the integrity of all external cabinet sides to ensure that AC Safety Ground is maintained on all metal surfaces.
2. Verify the connectivity between the chassis ground reference point (or bar) and all metal surfaces using an ohmmeter. For a properly connected system, you can see a resistance of less than 1 ohm for all points (remember to subtract out the resistance of the meter wires).
3. Check the local master reference bar (the large copper bar at the top of the Basic cabinet) for corrosion and loose connections.
4. Inspect the vertical bus bar system (if present) and then check all three bars for corrosion.

7.4.2 Power and grounding

1. Examine the AC power cord for the power supply and then check if there is any splits or cracks in the insulation.
2. Replace power cord if needed.

> **NOTE**
> If the bulk supplies are wired directly to circuit breakers, then special permits may be required for replacing the cord.

3. (If present) Check the condition of MOV's installed for cracks and/or burn spots in the devices and then replace if needed.
4. Measure the AC input voltage and record the value.
5. (If UPS power is used) Check the quality of the AC waveform (that is, ensure that the waveform is within manufacturer's specifications).

   Distortion:

   Utility mains power normally has less than 5 % harmonic distortion.

   Transformer of proper rating adds about 1 % distortion.

   Total Harmonic Distortion (THD) of 6 % is acceptable.

   Maximum THD acceptable is 8 %.
6. Check the red and black DC power wires connected to each power supply for
   - signs of corrosion in the power wires,
   - splits or cracks in the insulation, and
   - loose connections on each end of the wires.
7. Inspect the red and black DC power wires connected between each cabinet (in a cabinet complex) for
   - signs of corrosion in the power wires connected between each cabinet,
   - splits or cracks in the insulation, and
   - connection of wires to the connector blocks.
8. Inspect the ground wire for AC Safety Ground exiting the cabinet for
   - signs of corrosion in the ground wire,
   - splits or cracks in the insulation, and
   - loose connections at each end of the wire.
9. Inspect whether a 4 AWG (5.3 mm) or larger wire is used to connect
   - AC Safety Ground in the cabinet to the AC Safety Ground collection plate, and
   - AC Safety Ground to the AC Safety Ground rod.

   Inspect how the wire from AC Safety Ground in the cabinet routed to the AC Safety Ground collection plate.
10.
    a. Inspect the ground wire for MRG.
    b. Inspect whether a 4 AWG (5.3 mm) or larger wire used to connect the local reference bar with the MRG ground rod.
    c. Check for loose connections at each end of the wire
11. Check how is the wire from the local reference bar to the MRG ground rod routed.
12. Inspect whether the wire from the local reference bar to the MRG ground rod is exposed anywhere.
13. Measure the voltage difference between MRG and AC Safety Ground for each cabinet using a

volt meter that is capable of measuring in the millivolts range.

A reading of less than 15 mv inside the cabinet indicates that MRG and AC Safety Ground are bonded together. A measurement between 15 mv and 250 mv is expected for a system that does not have MRG and AC Safety Ground bonded together.

7.4.3 Power supplies and battery backup

1. Make a note of the power supply locations.
2. Check the current loading (amperes) on each supply.
3. Measure the DC output voltage and record the value here.
4. Check whether a battery backup is used.
5. (Optional) Check the current loading (amperes) for each battery backup supply.
6. Check the age and condition of the lead acid batteries.
7. Replace the batteries as appropriate.

7.4.4 Terminal panels (TCB00, or TCB20, or TCB30)

1. Make a note of the terminal panels locations with respect to the controllers connected to them.
2. Check if the terminal panels are located in the same cabinet as the existing CB/EC or if the terminal panels are located in the same cabinet complex as the existing CB/EC.
3. Measure the difference between SC ground on the terminal panel, and SC ground near the existing CB/EC rack (associated with that terminal panel) using a volt meter.

   A measured difference of approximately 30 mV can equate to an error in an analog input reading of 1%. If a difference is 30 mV or more is measured check all screws in the cabinet for tightness (do not forget to check the connections to the large copper bus ground bus bar at the top of the cabinet(s))
4. Verify the overall condition of the terminal panels.
5. Check the fuses on the terminal panels (if present) and then replace the fuses, if required.
6. Check whether the electrical contacts on the fuses are corroded.
7. Check whether the wire link inside the fuse (if visible) indicate distortion/overstress.
8. Inspect the three screws (in the upper right-hand corner) that connect the terminal panel to the power rails and ensure that all connections are tight.

7.4.5 Terminal panel cables

1. Check whether the terminal panel are cables being replaced with new cables. If yes, skip the next two steps.
2. Check the cables connected to J2, J3, and J4 of the terminal panel for corrosion and cracked insulation.
3. Check the length of the cables connected to J2 and J3 on the terminal panel. Is the cable long enough to connect from the terminal panel to the location of the new UHIO hardware?
4. Check if the cables can be “unbundled” (that is, any tie wraps cut and cables separated) without risk to operation/control.

7.4.6 Field wiring

1. Check the field wiring for proper insulation.
2. Check for splits or cracks in the insulation.
3. Check for corrosion in the wiring.
4. Check for correct labeling.
5. If shielded cables are used, check for loose connections of each shield wire to ground (or ground bar).
6. Check for any field wiring that is connected to more than one set of terminal panel screws.

   For example, an input that is used by more than one CB/EC, or used as an input to an HLPIU. If present, this indicates that the loops in question constitute a “hardwired” Peer connection. These loops must be monitored carefully during cut-over.

7.5 Components of UHIO

The UHIO contains the following components.

- Horizontal Backplane
- Battery mounting panel
- RAM Battery Backup
- Power Supply
- Half panel plastic cover
- Cables
- Upgrade configurations

7.5.1 Horizontal Backplane

Horizontal Backplane accommodates the Horizontal C300/CF9 IOTA and the Horizontal UHIO IOTA. For more information about the Horizontal Backplane, see Horizontal Backplane.

7.5.2 Battery mounting panel and RAM Battery Back up

The battery mounting panel is a new board that enables the existing Series C memory backup assembly to be mounted inside the Basic cabinet. For more information about the Battery mounting panel and RAM Battery Backup, see Battery mounting panel and RAM Battery Backup.

7.5.3 Power Supply

A new Series C modular power supply is introduced to replace the basic power supply. For more information about the power supply, see UHIO Power Supply.

7.5.4 Half panel plastic cover

A half panel plastic cover is available for protecting the empty position on the backplane. For more information about the half panel plastic cover, see Half panel plastic cover.

7.5.5 Cables

A new cable and an adaptor for the existing cable are introduced to interface between the CB/EC rack and the TCBxx. For more information about the cables, see UHIO cables.

7.5.6 Upgrade configurations

There are seven configurations introduced for UHIO. For more information about the configurations, see UHIO Hardware Model Numbers.

- Horizontal Backplane
- Battery mounting panel and RAM Battery Backup
- UHIO Power Supply
- Half panel plastic cover
- UHIO cables
- UHIO Hardware Model Numbers
- Mounting Assembly CC-ZHMT10

7.5.7 Horizontal Backplane

A new Horizontal Backplane is introduced to power up the new form factor CF9/C300 and UHIO IOTAs and to maintain the same form factor as the TDC 2000 CB/EC card file. The size and component placement of the Series C CF9/C300, and UHIO IOTAs is modified to fit on to the Horizontal Backplane and thereby the same form factor as the TDC 2000 CB/EC card file is maintained.

The Backplane is mounted on a mechanical frame that adds rigidity and support to the whole assembly. This frame is mounted in place of the TDC 2000 CB/EC card file.

This Backplane supports the following different configuration.

- Two C300/CF9 IOTA's mounted on the Backplane
- Two UHIO IOTA's mounted on the Backplane
- One C300/CF9 IOTA and one UHIO IOTA mounted on the Backplane

The following table lists the model number and the part number of the Horizontal Backplane.

Model Number	Part Number	Description
CC-HCAR01	51454504-175	Horizontal Backplane PWA, coated

The following figure displays the front view of the Horizontal Backplane.

Figure 7.8 Horizontal Backplane

You have to fix the Horizontal Backplane on the cabinet using the four screws (as highlighted in the figure). You may also mount just one of either IOTA onto the Backplane.

> NOTE
>
> An IOTA can be mounted on the left or right side of the Backplane. In addition, a half panel plastic cover is available for covering up the empty position on the Backplane.

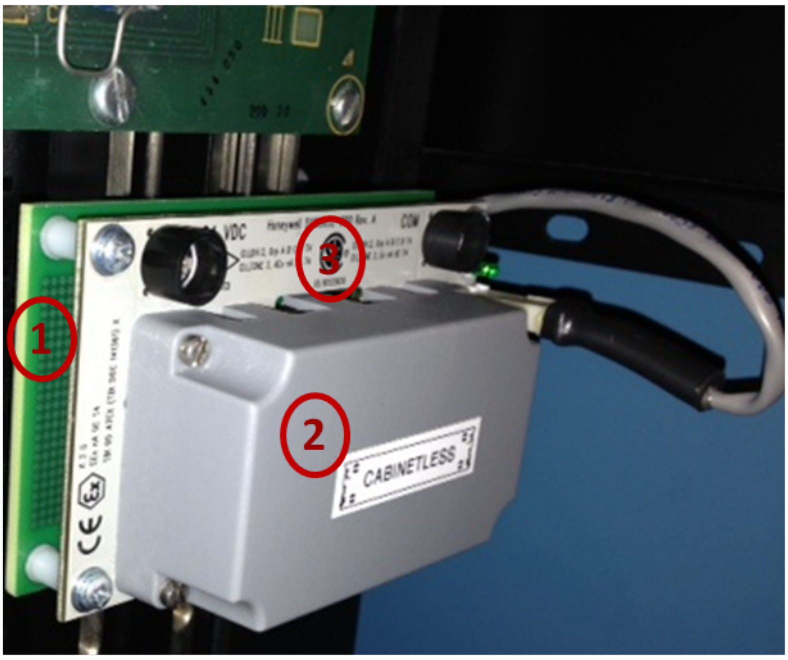
7.5.8 Battery mounting panel and RAM Battery Backup

RAM Battery Backup

A small Battery Backup assembly provides the battery power for the RAM associated with the C300 Controller. Since the existing Series C RAM needs to be mounted on the TDC Basic cabinet, a battery mounting panel is introduced for mounting the UHIO's RAM. Similar to Series C, the RAM battery backup for UHIO configurations can supply battery backup power from one to four C300s.

The following figure displays the RAM battery and the assembly.

Figure 7.9 RAM Battery Backup and Battery assembly



Numbers	Description
1	Battery mounting panel
2	RAM Battery
3	Screw for mounting the panel

Battery mounting panel

A new board is introduced for mounting the existing Series C memory backup assembly (RAM) inside the basic cabinet. The following table lists the contents of the Battery Backup assembly.

Table 7.7 Battery Backup Mounting Kit (51155581-100)

Part Number	Description	Quantity
51307261-175	Battery Backup mounting PWA	1
51108385-630	MACH SCR PAN HD CROSS REC	4
51197521-006	WASHER, LOCK	4
99000228-007	SM. M5 FL/WSHR,NICKL	4
51155586-100	Battery Backup mounting kit installation instruction sheet	1

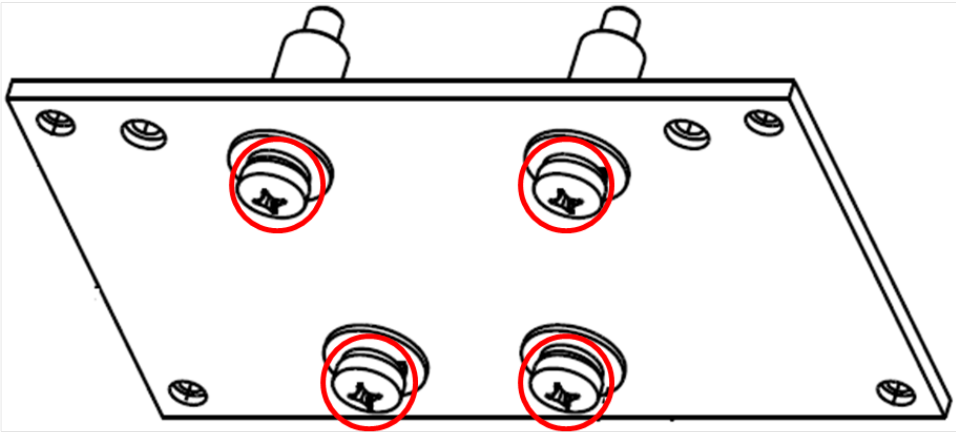
The following table lists the contents of the battery mounting kit.

Table 7.8 Battery Backup Mounting Kit (CC-HCMB02)

Part Number	Description	Quantity
CC-SCMB02	C300 Memory Backup Assembly	1
51155581-100	Battery Mounting Kit	1

The following figure displays the battery mounting panel.

Figure 7.10 Battery mounting panel



In this figure, the highlighted screws are used to mount the panel.

Alternative RAM Charger Module

RAM Charger module (TDI model number: SPS5792-2-LF) is available for providing memory backup power for C300 controller module.

Part number of RAM charger module

The following table lists the part number of RAM charger module. This part number need to be procured separately.

Table 7.9 Part numbers for RAM charger module assembly

Part Number	Description
SPS5792-2-LF	RAM charger module (HPN: 51454475-100)

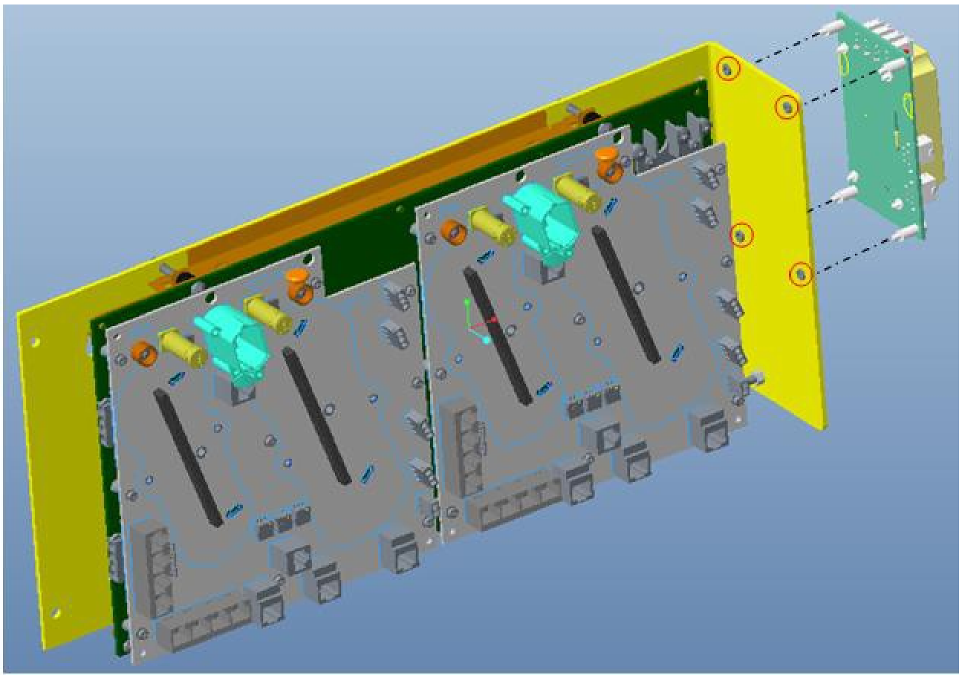
Mounting the RAM charger module

Prerequisites

The UHIO mounting plate is installed.

To install the RAM charger module on the UHIO mounting plate

1. Align the mounting holes in the RAM charger module with the screw hole locations on the right side of the UHIO mounting plate.
2. Secure the RAM charger module to the mounting plate with four screws and nuts (p/n# 30735043-302) from CCZHMT10 kit.
3. The Red circle denotes the nuts. The screws must be tightened to 3.9 Nm.



7.5.9 UHIO Power Supply

The Series C modular power supply is repackaged to fit in the same space as the Basic cabinet power supply.

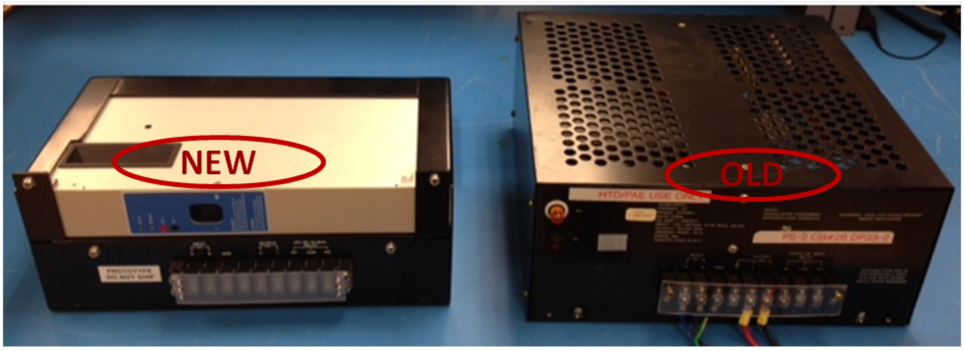
> **ATTENTION**
>
> The new power supply is not included in the seven UHIO configurations. The power supply must be ordered separately.

The following figure displays the new power supply.

Figure 7.11 UHIO Power supply

The following figure displays old and new power supplies.

Figure 7.12 Old and new power supply

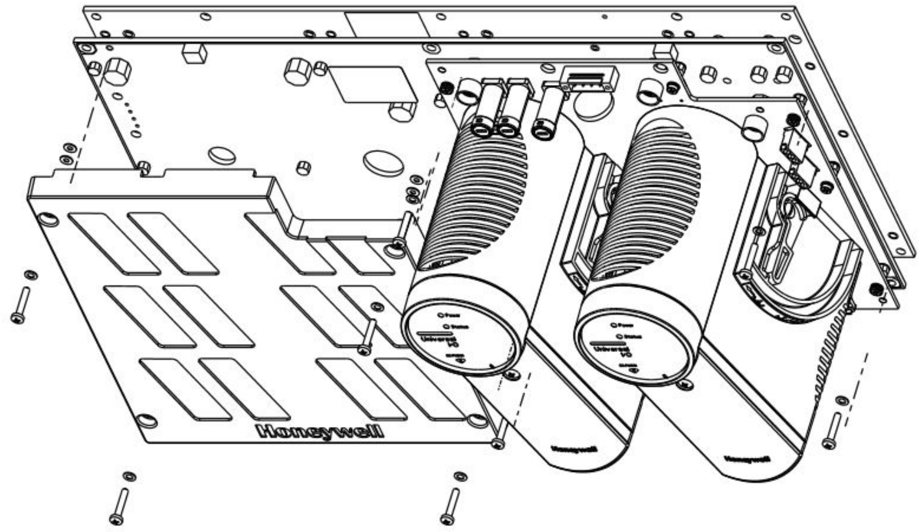


7.5.10 Half panel plastic cover

A half panel plastic cover is available for covering up the empty position on the Backplane. The half panel plastic cover can be installed on either sides of the IOTA based on the empty position.

The following figure displays the half panel cover.

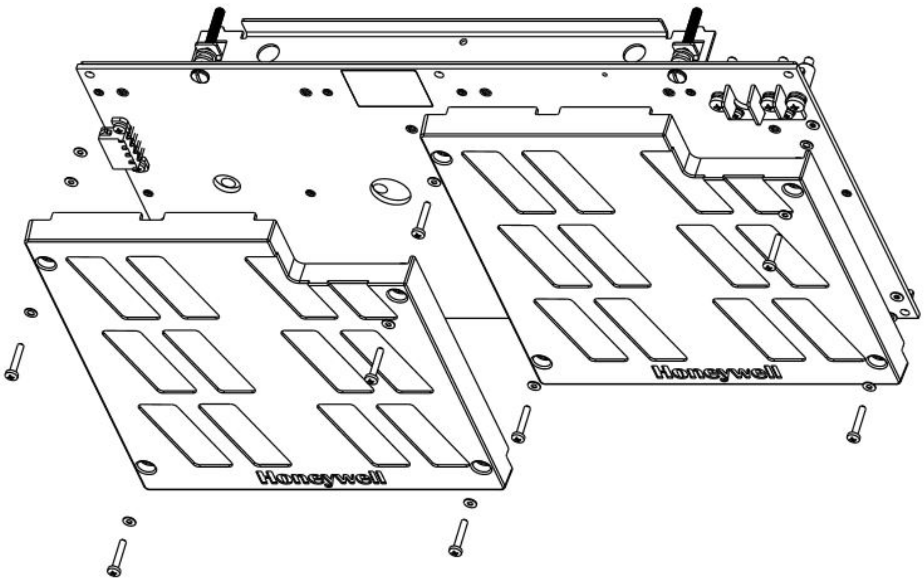
Figure 7.13 Half panel cover



In this figure, see 4 screws that are used to mount the plastic cover to the Backplane.

This panel covers half of the Backplane when only one IOTA is installed. The half panel cover can be installed on either side of the Backplane, as displayed in the following figure.

Figure 7.14 Half panel cover installed on the Backplane



7.5.11 UHIO cables

There are two options available to connect the UHIO IOTA to the TCBxx.

- Replace the existing cables with new compatible cables.
- Add a cable adapter to the existing cable to make the existing cable plug compatible with the UHIO IOTA.

ATTENTION

Due to the availability of different lengths, cables are not included in the UHIO configurations. Therefore, the cables must be ordered separately.

Replacing the existing cables

The following table lists the new cables and the respective part numbers that are introduced with UHIO.

Table 7.10 TCB cable and its part numbers

Part Number	Description
51192054-101	UHIO cable, 1 meter length
51192054-102	UHIO cable, 2 meter length
51192054-103	UHIO cable, 3 meter length
51192054-104	UHIO cable, 1.5 meter length
51192054-110	UHIO cable, 10 meter length
51192054-115	UHIO cable, 15 meter length

The following image displays the new cables connected from the UHIO IOTA to the TCBs.

Figure 7.15 New cable connected from UHIO IOTA to TCBs

In this figure, 1 denotes the UHIO end and 2 denotes the TCB end.

Adding an adapter to the existing cables

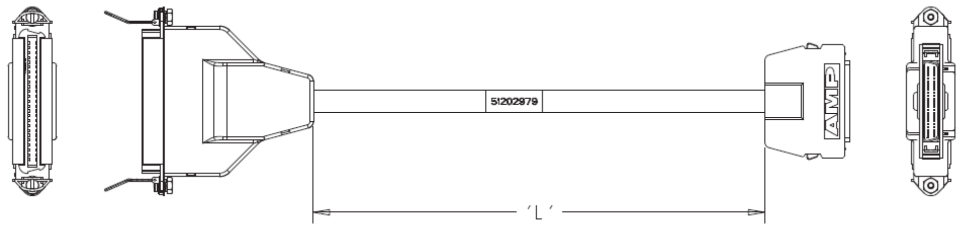
A new cable adapter is introduced to use with the existing cable there by making the existing cable plug compatible with the UHIO IOTA. This cable adapter modifies the connector style from TCB style that is used on the CB/EC to UHIO style that is used on the UHIO IOTA. The cable adapter is available in two different lengths to order. The following table lists the part numbers and the adapter.

Table 7.11 UHIO cable adapter

Part Number	Description
51202979-005	UHIO cable adapter, 0.5 meter length
51202979-010	UHIO cable adapter, 1 meter length

The following figure displays the engineering drawing of the cable adapter.

Figure 7.16 UHIO cable adapter



7.5.12 Upgrade kits

There are seven hardware upgrade kits introduced with the UHIO. These hardware kits can be used for different configuration as mentioned in the following table.

Table 7.12 Table 1. UHIO hardware upgrade kit model numbers

Model Number	Description
CC-ZHR010	UHIO CB/EC kit with C300/CF9 IOTA, redundant UIO
CC-ZHN010	UHIO CB/EC kit with C300, CF9, non-redundant UIO
CC-ZHR012	UHIO-2 CB/EC kit with C300/CF9 IOTA, redundant UIO-2
CC-ZHN012	UHIO-2 CB/EC kit with C300/CF9, non-redundant UIO-2
CC-ZHR020	UHIO CB/EC kit with 2 sets of redundant UIO
CC-ZHN020	UHIO CB/EC kit with 2 sets of non-redundant UIO
CC-ZHR021	UHIO-2 CB/EC kit with 2 sets of redundant UIO-2
CC-ZHN021	UHIO-2 CB/EC kit with 2 sets of non-redundant UIO-2
CC-ZHR030	UHIO CB/EC kit with 1 sets of redundant UIO
CC-ZHN030	UHIO CB/EC kit with 1 sets of non-redundant UIO
CC-ZHR031	UHIO-2 CB/EC kit with 1 set of redundant UIO-2
CC-ZHN031	UHIO-2 CB/EC kit with 1 set of non-redundant UIO-2
CC-ZHR040	UHIO kit with redundant C300 and redundant CF9
CC-ZHR041	UHIO-2 kit with redundant C300 and redundant CF9

ATTENTION

Due to variations allowed in cabinet layouts, the following components are not included in the kits (described in this topic), but they are necessary for completing the installation of UHIO.

- **I/O Link cables (51202329-xxx)** - Different lengths and connectors are available.
- Power supply
- FTE cables
- Terminal panel cables
- RAM Battery Backup assembly

For controller and communication redundancy, order an additional CC-ZHR010 kit or CC-ZHN010 kit.

CC-ZHR010

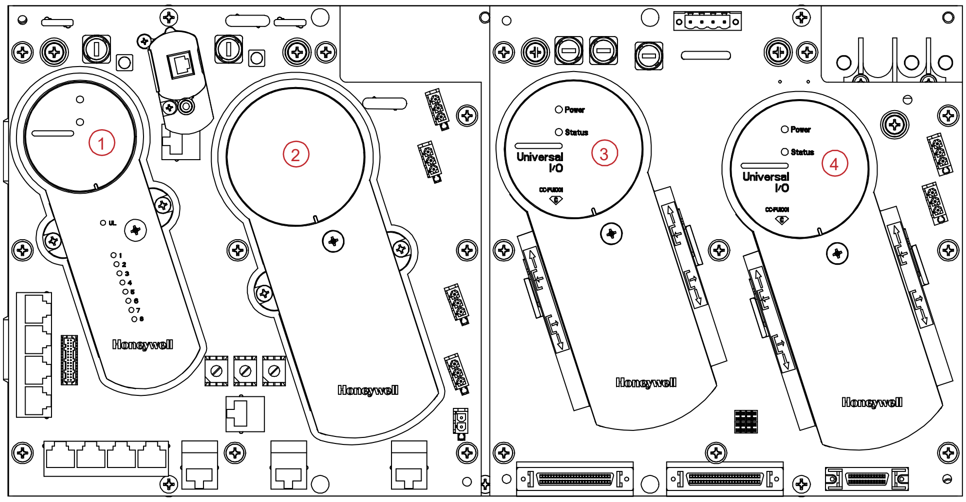
This upgrade kit contains:

- one C300 Controller
- one 9-port Control Firewall
- redundant UIO modules

This upgrade kit enables you to migrate an existing CB/EC system to a Series C system with a C300 Controller, a CF9, and a redundant UIO module.

The following figure displays the layout of CC-ZHR010 upgrade kit.

Figure 7.17 Figure 1. Layout of CC-ZHR010



Number	Description
1	Control Firewall
2	C300 Controller
3 and 4	Redundant Universal Input/Output (UIO) modules

CC-ZHR012

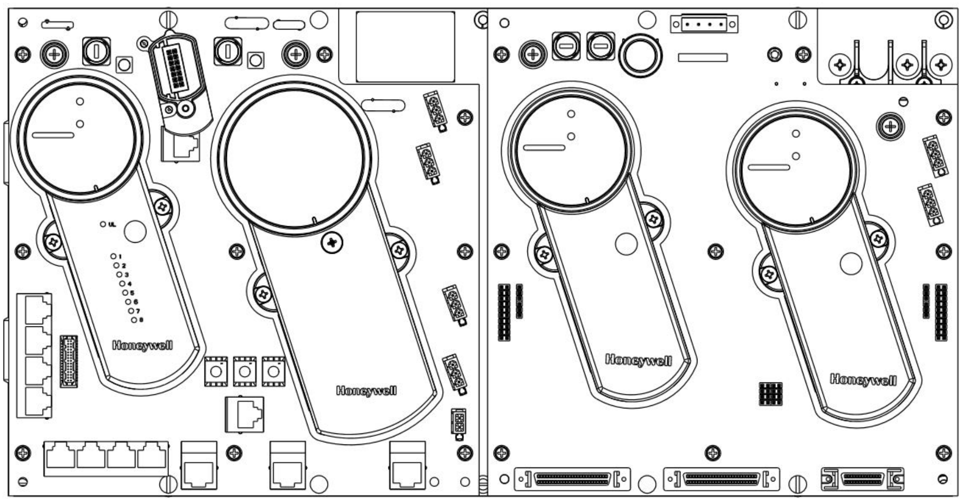
This upgrade kit contains:

- one C300 Controller
- one 9-port Control Firewall
- redundant UIO-2 modules

This upgrade kit enables you to migrate an existing CB/EC system to a Series C system with a C300 Controller, a CF9, and a redundant UIO-2 module .

The following figure displays the layout of CC-ZHR012 upgrade kit.

Figure 7.18 Figure 2. Layout of CC-ZHR012



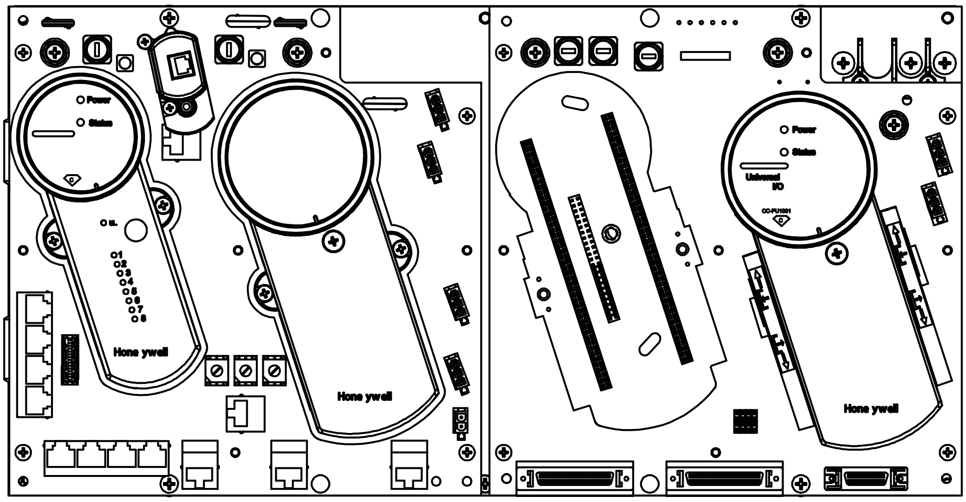
CC-ZHN010

This upgrade kit contains:

- one C300 Controller
- one 9-port Control Firewall
- a non-redundant UIO module

The following figure displays the layout of the CC-ZHN010 upgrade kit.

Figure 7.19 Figure 3. Layout of CC-ZHN010



This upgrade kit enables you to migrate an existing CB/EC system to a Series C system with a C300 Controller, a CF9, and a non-redundant UIO module.

The non-redundant UIO module must be installed on the right side of the UHIO IOTA.

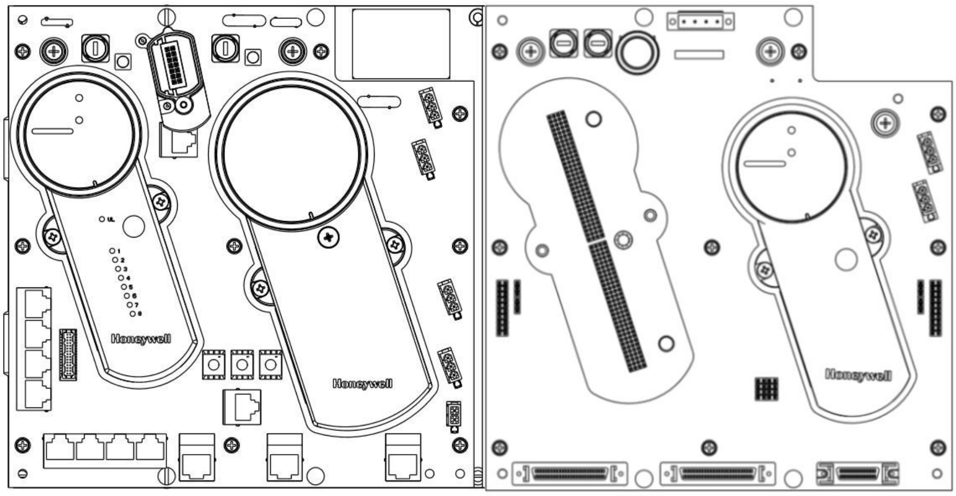
CC-ZHN012

This upgrade kit contains:

- one C300 Controller
- one 9-port Control Firewall
- a non-redundant UIO-2 module

The following figure displays the layout of the CC-ZHN012 upgrade kit.

Figure 7.20 Figure 4. Layout of CC-ZHN012



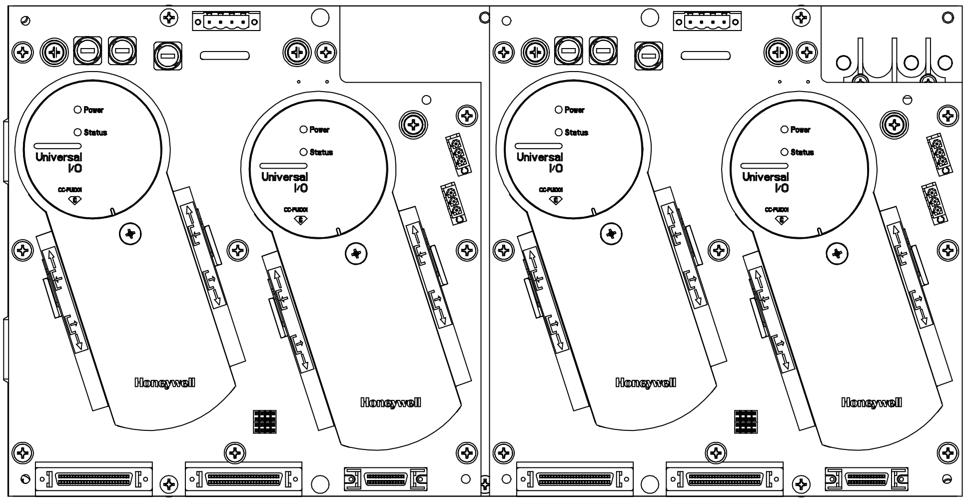
This upgrade kit enables you to migrate an existing CB/EC system to a Series C system with a C300 Controller, a CF9, and a non-redundant UIO-2 module.

The non-redundant UIO module must be installed on the right side of the UHIO—2 IOTA.

CC-ZHR020

This upgrade kit contains two sets of redundant UIO modules. This enables you to migrate an existing CB/EC system to a Series C system with two sets of redundant UIO modules. The following figure displays the layout of the CC-ZHR020 upgrade kit.

Figure 7.21 Figure 5. Layout of CC-ZHR020

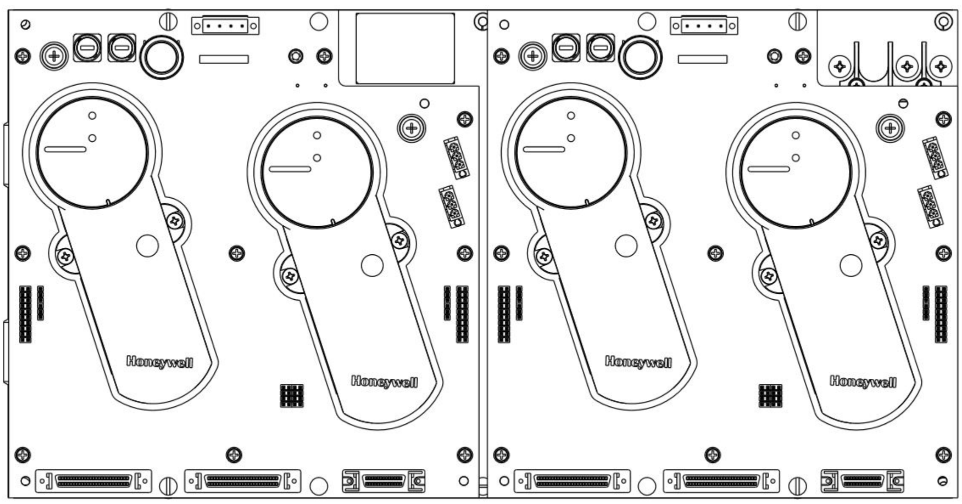


In this figure, two set of redundant UIO modules are displayed.

CC-ZHR021

This upgrade kit contains two sets of redundant UIO-2 modules. This enables you to migrate an existing CB/EC system to a Series C system with two sets of redundant UIO-2 modules. The following figure displays the layout of the CC-ZHR021 upgrade kit.

Figure 7.22 Figure 6. Layout of CC-ZHR021

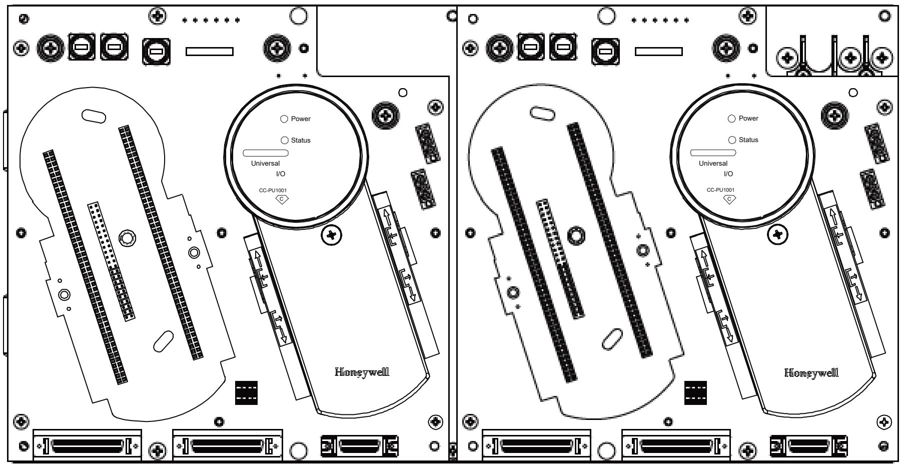


In this figure, two set of redundant UIO-2 modules are displayed.

CC-ZHN020

This upgrade kit contains two sets of non-redundant UIO modules. This enables you to migrate an existing CB/EC system to a Series C system with two sets of non-redundant UIO modules. The following figure displays the layout of the CC-ZHN020 upgrade kit.

Figure 7.23 Figure 7. Layout of CC-ZHN020

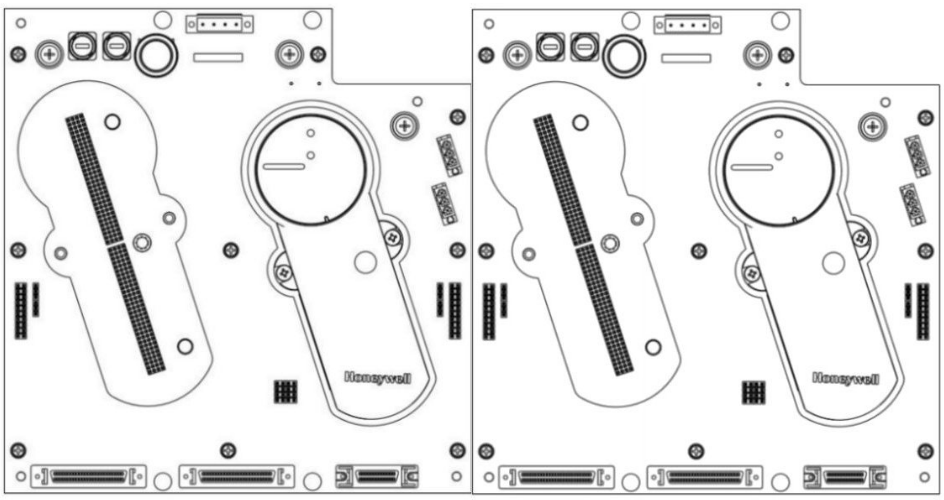


The non-redundant UIO module must be installed on the right hand side of the UHIO IOTA.

CC-ZHN021

This upgrade kit contains two sets of non-redundant UIO-2 modules. This enables you to migrate an existing CB/EC system to a Series C system with two sets of non-redundant UIO-2 modules. The following figure displays the layout of the CC-ZHN021 upgrade kit.

Figure 7.24 Figure 8. Layout of CC-ZHN021



The non-redundant UIO-2 module must be installed on the right hand side of the UHIO-2 IOTA.

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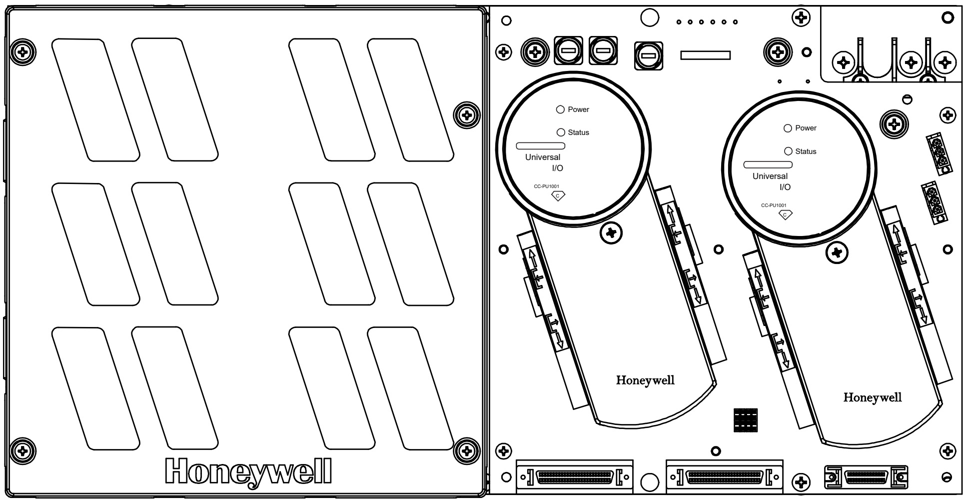
CC-ZHR030

This upgrade kit contains a single redundant UIO module. This enables you to migrate an existing CB/EC system to a Series C system with a single redundant UIO module. The following figure displays the layout of the CC-ZHR030 upgrade kit.

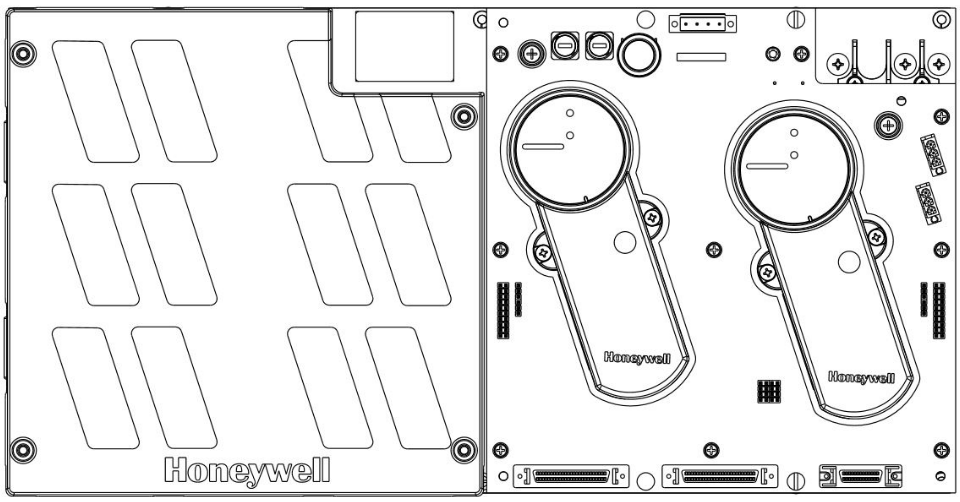
Figure 7.25 Figure 9. Layout of CC-ZHR030



CC-ZHR031

This upgrade kit contains a single redundant UIO-2 module. This enables you to migrate an existing CB/EC system to a Series C system with a single redundant UIO-2 module. The following figure displays the layout of the CC-ZHR031 upgrade kit.

Figure 7.26 Figure 10. Layout of CC-ZHR031



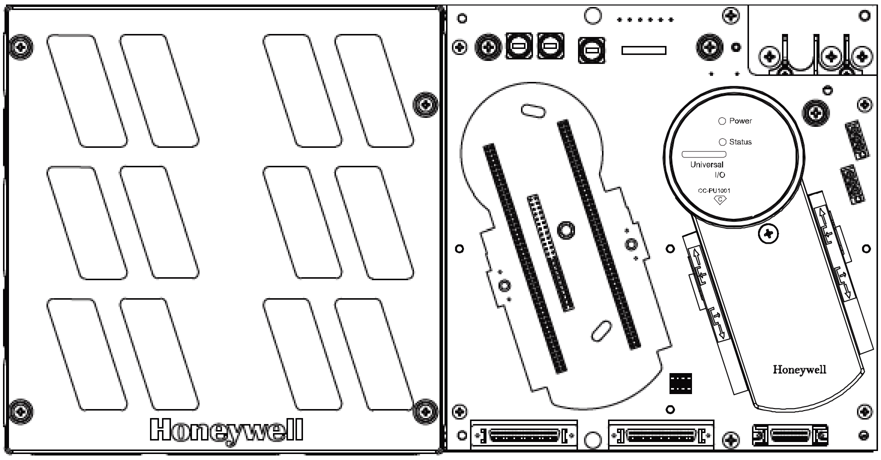
CC-ZHN030

This upgrade kit contains a single non-redundant UIO module. This enables you to migrate an existing CB/EC system to a Series C system with a single non-redundant UIO module.

The non-redundant UIO module must be installed on the right hand side of the UHIO IOTA.

The following figure displays the layout of the CC-ZHN030 upgrade kit.

Figure 7.27 Figure 11. Layout of CC-ZHN030



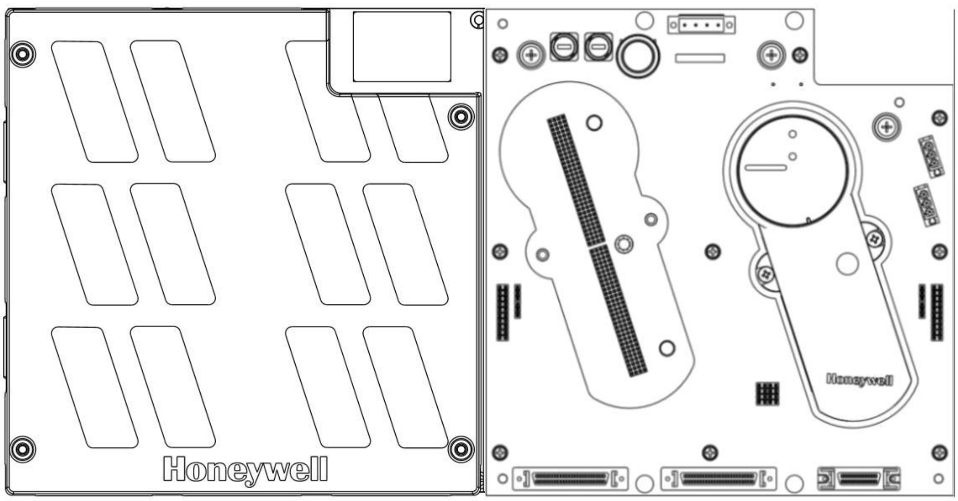
CC-ZHN031

This upgrade kit contains a single non-redundant UIO-2 module. This enables you to migrate an existing CB/EC system to a Series C system with a single non-redundant UIO-2 module.

The non-redundant UIO-2 module must be installed on the right hand side of the UHIO-2 IOTA.

The following figure displays the layout of the CC-ZHN031 upgrade kit.

Figure 7.28 Figure 12. Layout of CC-ZHN031

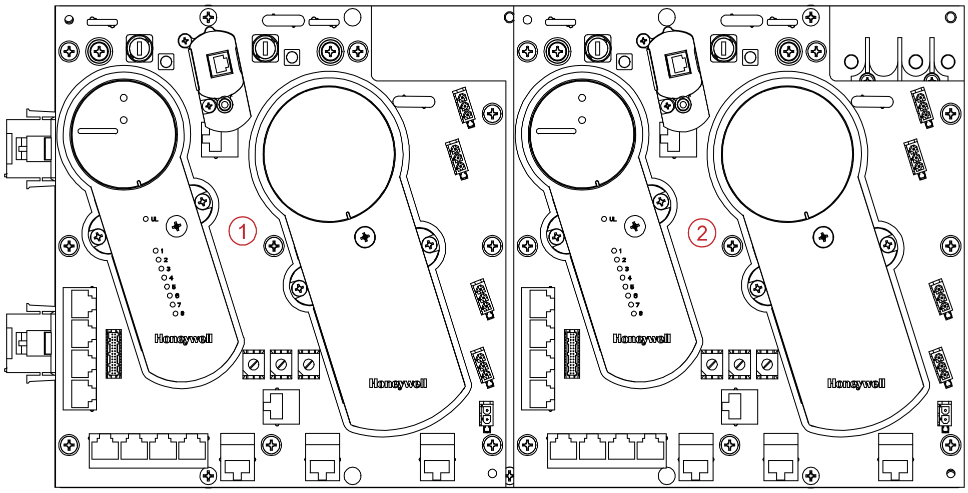


CC-ZHR040

This upgrade kit contains two sets of C300 Controller and 9-port Control Firewall.

The following figure displays the layout of the CC-ZHR040 upgrade kit.

Figure 7.29 Figure 13. Layout of CC-ZHR040



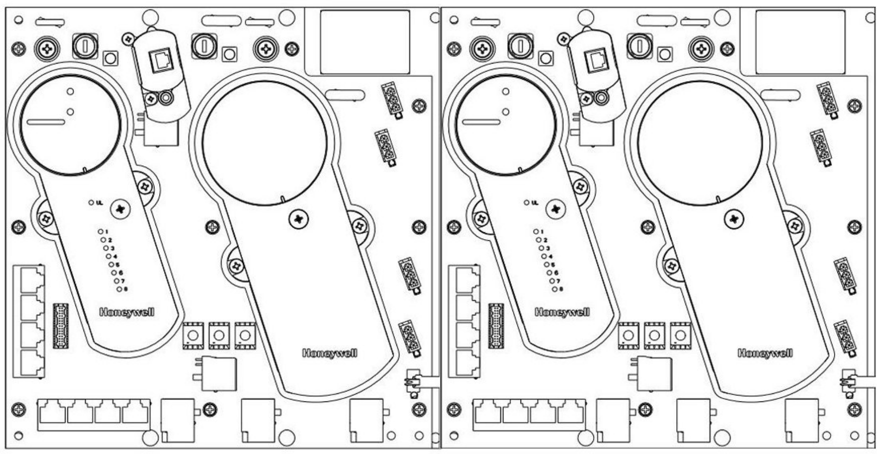
In this figure, 1 and 2 denote the two sets of C300 Controller and 9-port Control Firewall.

CC-ZHR041

This upgrade kit contains two sets of C300 Controller and 9-port Control Firewall.

The following figure displays the layout of the CC-ZHR041 upgrade kit.

Figure 7.30 Figure 14. Layout of CC-ZHR041



In this figure, 1 and 2 denote the two sets of C300 Controller and 9-port Control Firewall.

This enables you to migrate a Series C system with redundant C300 Controller and CF9.

> **ATTENTION**
>
> The UHIO's CSA General Purpose Certification for the Hardware kit CC-ZHR0404 is only applicable within Data Hiway (TDC 2000) cabinets with the Series C Power supply SPS5792-142935 (HPN 51454517-100).

7.5.13 Mounting Assembly CC-ZHMT10

Part numbers of CC-ZHMT10

The following table lists the part numbers of the CC-ZHMT10 configuration.

Table 7.13 Part numbers of CC-ZHMT10

Part Number	Description
51306877-100	Backplate, Mounting, UHIO
51202341-102	I/O link – PM to Series C I/O link cable
51202984-100	Cable for C300 Memory Backup Power
51202347-200	24V Power cable
51202948-300	24VDC Power Supply Cable
51202330-300	CABLE, BATTERY RAM CHARGER 30IN
99000222-740	Screw, Mach, Pan-Head, Slotted, M5x40L, ISO-
51195195-346	1T5ra8d0e -in instructions for upgrade configurations
51195168-616	Screw, Thread Forming, BLACK, M5x16
51108884-006	LOCK WASHER, SPLIT, M5
51108385-616	Screw, Mach, Pan-Head, Cross Rec
51108393-006	LOCK WASHER, EXT TOOTH
51108388-006	HEX NUT
30735043-302	NUT, Self Clinching, M3
51305978-805	CABLE ASSEMBLY, ETHERNET, ORANGE

Mounting the Universal Hiway Input/Output mounting plate

To mount the Universal Hiway Input/Output mounting plate (51306877-100), perform the following procedure:

1. Position the mounting plate to align the screws with the appropriate holes in the cabinet.
2. Following Figures show mounting hole alignment according to 7-slot, 10-slot and 13-slot rack locations.

Figure 7.31 Mounting holes aligned to 7-slot rack

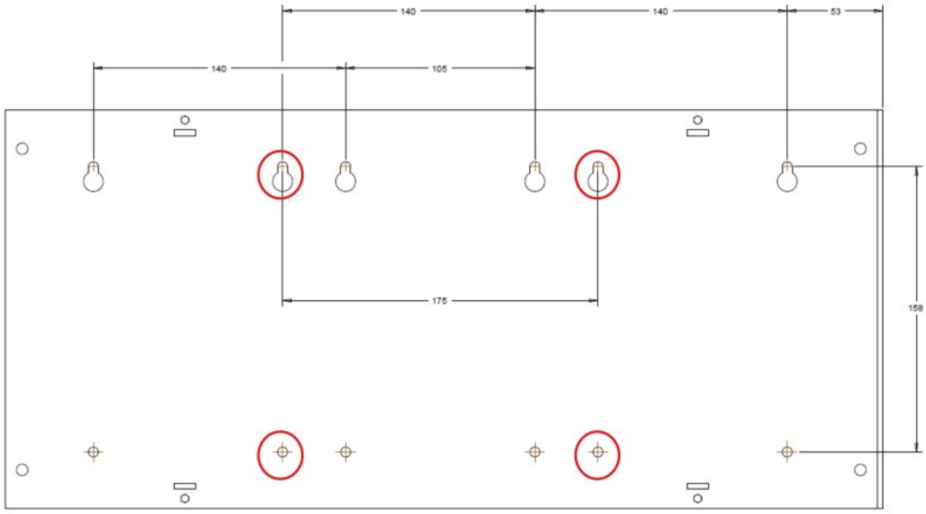


Figure 7.32 Mounting holes aligned to 10-slot rack

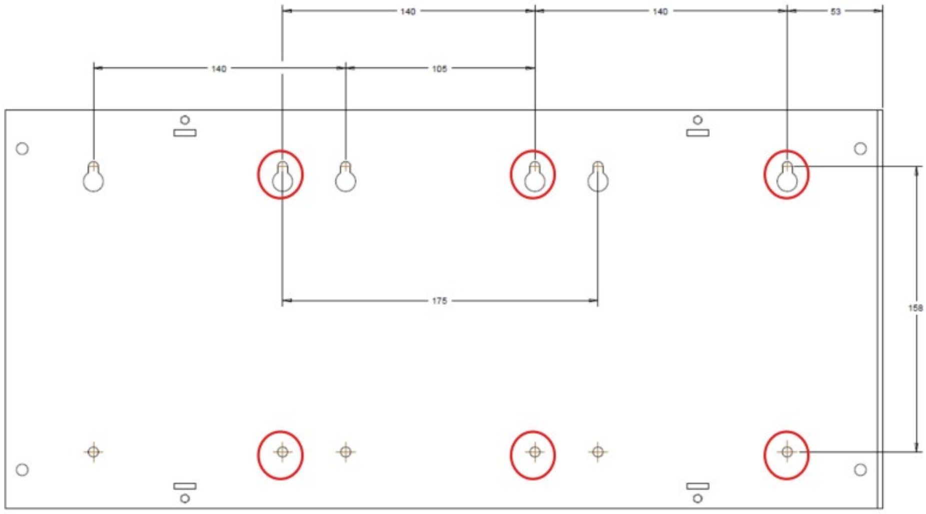
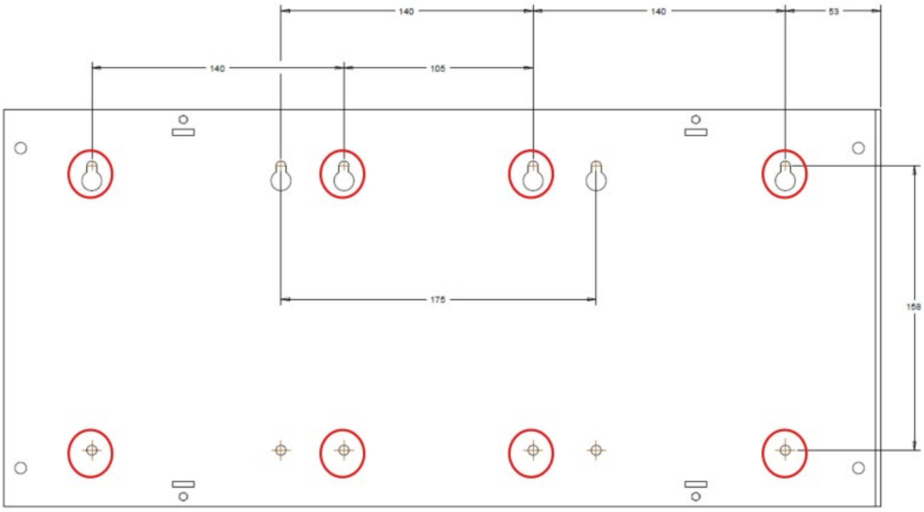


Figure 7.33 Mounting holes aligned to 13-slot rack



3. Tighten screws to 3.9 Newton-meters.

7.6 Mounting the UHIO components

You can mount the UHIO components in the following order.

1. UHIO IOTA on the Horizontal Backplane
2. C300/CF9 IOTA on the Horizontal Backplane
3. C300 Controller
4. Control Firewall
5. Universal Input/Output (UIO) module
6. UHIO Power supply
7. Battery mounting panel and RAM battery

> NOTE
>
> For ease of installation, it is permissible to mount the IOTA's onto the Backplane before mounting the Backplane and IOTA assembly into the cabinet (steps 1 and 2 above). Series C modules can be installed after mounting the Backplane assembly in the cabinet.

For more information about mounting these components, see *TDC 2000 CB and EC to UHIO Module Upgrade Kit Installation Guide*.

Any installations per this manual are subject to acceptance by the Authority Having Jurisdiction (AHJ).

7.7 General regulatory compliance

Regulatory and agency approvals, for the product described in this document, are only applicable to the product as delivered by Honeywell. Any deviation to the product and or installation instructions, as provided by Honeywell, must be evaluated with regard to all local regulatory requirements. It is the responsibility local Authority Having Jurisdiction (AHJ) to ensure the suitability of the installation of this product and to assess the impact to the installed base certification with regard to all regulatory requirements.

The product described in this document must be installed within an enclosure providing adequate protection for the intended environment and meeting all local regulatory requirements. Refer to all installation instructions provided with the product. It is the responsibility of the local Authority Having Jurisdiction (AHJ) to ensure the suitability of the enclosure and final installation with regard to all regulatory requirements.

The electromagnetic compatibility (EMC) of the product described in this document has been verified, for the intended environment, when installed in an enclosure.

The product described in this document must be installed according to Honeywell Process Solution system configuration rules and installation instructions and within an enclosure providing adequate electromagnetic interference (EMI) protection, for the intended environment. The enclosure should be made of electrically conductive material (metallic) and be enclosed on all sides, with minimal openings. The enclosure chassis must be electrically bonded to protective earth (PE) according to the installation instructions and local electrical code. Openings in the enclosure should not have a dimension larger than 5mm (maximum hole diameter or slot length). Openings in the enclosure with a dimension larger than 5mm, such as vent holes or fan grills, should be covered with wire mesh (metallic) screen and the wire mesh electrically bonded to the enclosure chassis in multiple locations around the perimeter of the opening. The wire mesh should not have openings with dimensions larger than 5mm. Refer to all installation instructions provide with the product. It is the responsibility of the system owner and the local Authority Having Jurisdiction (AHJ) to ensure the suitability of the enclosure and the EMI protection provided by the enclosure.

7.8 COTS AC-DC Power supplies

Only AC-DC power supplies are qualified for use with this product and the power supply must meet the following requirements:

- 1. Industrial EMC requirements according to IEC 61326-1, Table 2 (industrial locations).
- 2. End installation product safety ratings.
- 3. Manufacturer installation requirements
- 4. Power supply cannot be substituted for connection to a dc distribution network.
- 5. If Power Supply is installed external to the UHIO equipment cabinet the dc supply wires must be less than 3m in length.
- 6. Certified to an appropriate Industrial Safety standard.

7.9 Protective Earth (Safety Ground)

The Protective earth (PE) conductor must be connected to the identified protective conductor terminal (see the figure below) upon equipment installation. The Protective earth conductive terminal is sized to accommodate a maximum 10AWG (5.26mm^2).

Figure 7.34 UHIO showing Protective Earth symbol and PE conductive terminal

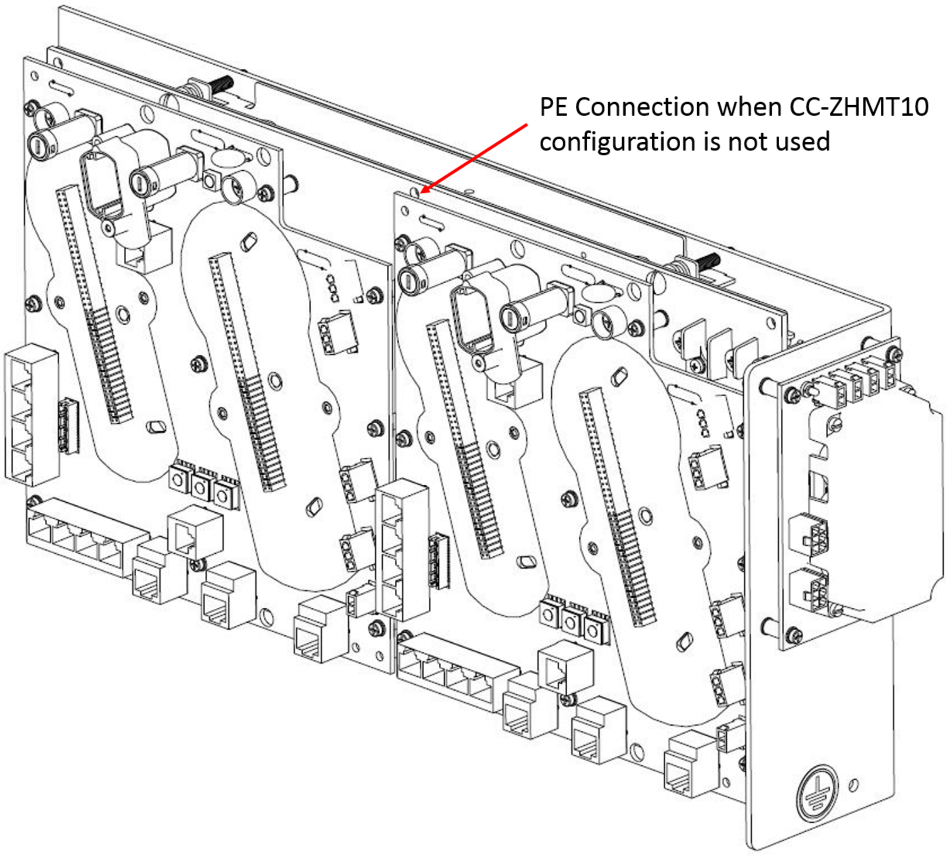
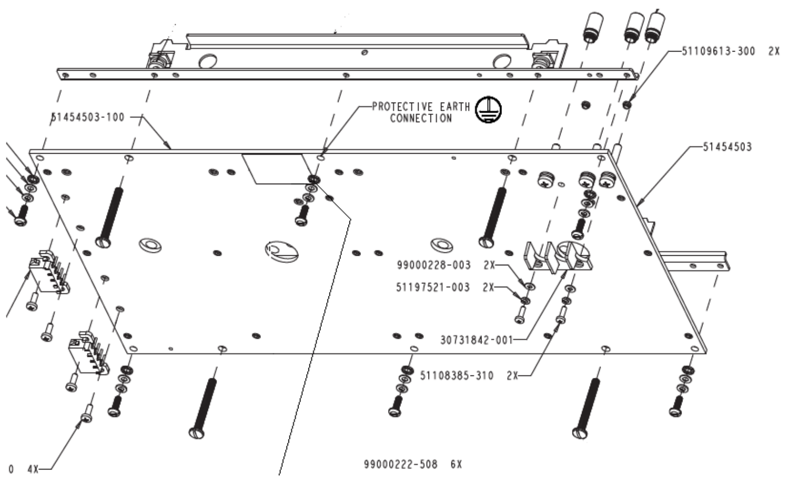


Figure 7.35 UHIO backplane showing Protective Earth connection



Use below parts from CC-ZHMT10 configuration to connect wire to the mounting plate

Part Number	Description
51108385–616	Screw, Mach, Pan-Head, Cross Rec
51108393–006	LOCK WASHER, EXT TOOTH
51108388–006	HEX NUT

The screw must be tightened to 3.9 Nm.

> NOTE
>
> When the CC-ZHMT10 configuration is not present the PE ground connection is made to the top center screw on the backpanel as shown in the above diagram. To make this connection loosen the screw at this location and place the PE ground lug between the external tooth lock washer and the flat washer. Now retorque the screw to x Nm (x in lbs).

7.10 Environmental Characteristics

The following table lists the environmental characteristics and requirements for the Series C components.

Environmental Specifications	Operating Limits	Transportation and Storage Limits
Ambient Temperature Range	0 to +60 °C	-40 to +85 °C
Temp. Rate of Change	<= 1 °C/min	<= 5 °C/min
Relative Humidity [2, 3]	5 to 95% (non-condensing)	5 to 95% (non-condensing)
Barometric Pressure Altitude	-300 to +2000 m	Any
Corrosives	G3	G3
Vibration [4, 5]		
Frequency (Hz)	0–60	0–60
Acceleration (g)	0.2	0.2
Mechanical Shock		
Acceleration (g)	5	25
Duration (ms)	30	30

Environmental Specifications	Operating Limits	Transportation and Storage Limits
Pollution degree	2	
Overvoltage category	II	

NOTE

1. Operating limits define the range of operating conditions within which the system is designed to operate. Performance characteristics are defined when operating in this state. For more information about the operating limits, see ANSA/ISA D 51.1.
    a. Transportation and storage limits define the range of conditions to which the system may be subjected without permanent damage to the equipment. Performance is not guaranteed in this state. For more information about the transportation and storage limits, see ANSA/ISA D 51.1.
2. This rating applies to the internal ambient temperature of the enclosure with the doors closed.
3. The maximum relative humidity specification applies up to 40 °C. Above 40 °C, the RH specification is de-rated to 55%, to maintain constant moisture content.
4. 10 Hz is approximate – exact crossover frequency is determined by the intersection of the displacement and acceleration.
5. Composite Transportation Test Curve--encompassing maximum Random Vibration power spectral density values associated with ground, air, and sea transportation environments.

CHAPTER 8

RAIL-MOUNTED UNIVERSAL INPUT/OUTPUT (UIO) MODULE

The Rail-Mounted Universal Input/Output module is designed to mount the Series C Universal Input/Output module vertically on a 35 mm TS-35 DIN (Deutsches Institut für Normung) rail. The entire mounting arrangement is used in non-standard Honeywell cabinets, and wall mount standalone scenarios.

> ATTENTION
> - You should not mount the rail-mounted UIO module horizontally on a DIN rail.
> - The mounting of Input/Output Termination Assembly (IOTA) and power supply for rail-mounted UIO module is identical to the mounting of IOTA and power supply for Series C I/O modules.

The rail-mounted UIO has the following categories.

- **Mechanical** – This category is used for holding the IOTAs/IOMs that can be mounted outside the standard Honeywell cabinet with provision for routing the system cables.
- **Electrical** – This category is used for providing an interface to connect ground and power from external power supply to the IOTA screw terminals in non-standard Honeywell cabinets where bus bars are not present. The interface has Printed Wiring Assembly (PWA), which also includes Reverse polarity, Electrostatic discharge (ESD) and Surge protections complying with CE standards.

8.1 Benefits

The following are the benefits of rail-mounted UIO module.

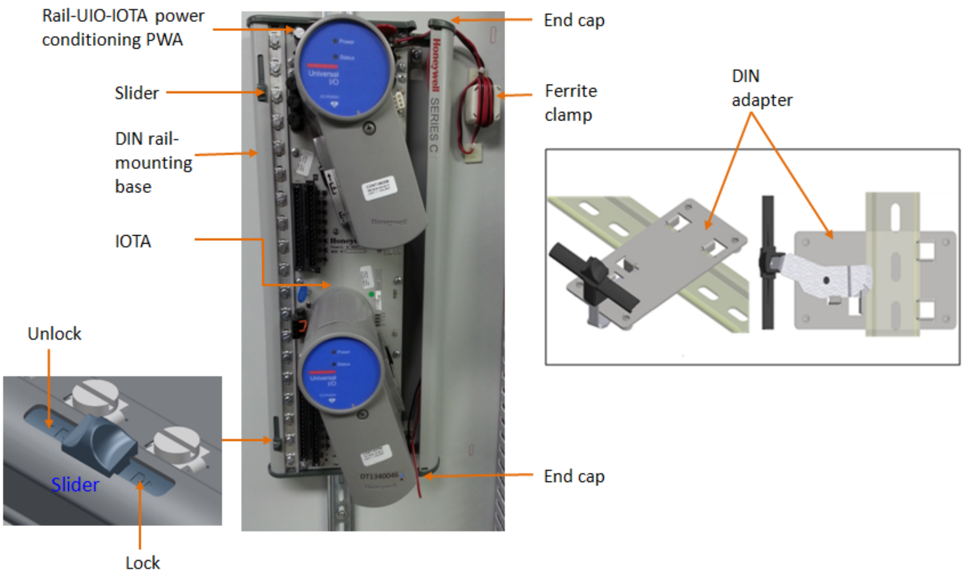
- Space consumption is less.
- Cost-effective since there is no investment required for cabinets to mount the module.
- Relocation of components is simple and easy.

- Physical description of rail-mounted UIO module assembly
- Input/output Link (IOL) management
- Single Mode FOE for rail-mounted UIO
- System wiring
- Power supply requirements
- Agency approvals
- Environmental Conditions
- Rail-mounted UIO module assembly

8.2 Physical description of rail-mounted UIO module assembly

The following figure illustrates the physical description of rail-mounted UIO module assembly.

Figure 8.1 Rail-mounted UIO module assembly



Component	Description
DIN rail-mounting base	It is designed to mount IOTA, UIO, rail-UIO-IOTA power conditioning PWA, end caps, and DIN adapter.
Rail-UIO-IOTA power conditioning PWA	It is designed to provide the interface between the external 24V DC power supply and the rail-UIO-IOTA. A conducting copper clamp is used for mounting the Printed Wiring Assembly (PWA) to the IOTA.
IOTA	It is mounted directly on the base. The power and ground connections to the IOTA are identical to the power and ground connections of the Series C IOTA and no special instructions are required for mounting.
End caps	These caps cover the open ends of the rail-mounted UIO module assembly.
Ferrite clamp	This is a device used for reducing the amount of RF (radio frequency) noise, or interference, in a wire that conducts electricity. Ferrite clamps are typically used for improving the performance of sound systems, including microphones.
Sliders	This is a plastic cap placed over the lever of the clamp, which can be used for locking or unlocking the module on the rail by moving slider towards the lock symbol and moving slider towards the unlock symbol respectively.
DIN adapter	This enables the rail-mounted UIO module assembly to be secured to a standard TS35 top hat (35mm width x 7.5 mm Height x 1.5 mm thick) DIN rail.
DIN rail stopper	This is used for preventing the rail-mounted UIO module assembly from sliding down during normal operational conditions.

The following table provides the part numbers of the selected items that would be considered infrastructure for the rail-mounted UIO module assembly.

For redundant rail-mounted UIO module:

Model Numbers	Description	Quantity	Size	Weight
CC-MDUR18	**Redundant rail-mounted UIO Module**		510 x 209 x 53 mm (L x W x H)	1.45 kg
CC_TUIO11	UIO redundant IOTA	1		
51155561-100	DIN RAIL POWER CONDITIONER WITH FERRITE CLAMP	1		
51454481-100	ASSEMBLY, RAIL MOUNT SERIES C-18 inch with stopper	1		
51202980-100	LABEL, RAIL MOUNT AGENCY APPROVAL 18“	1		

Non-redundant rail-mounted UIO Module:

Model Numbers	Description	Quantity	Size	Weight
CC-MDUN12	**Non-redundant rail-mounted UIO Module**		362 x 209 x 53 mm	1.25 kg
CC_TUIO01	UIO non-redundant IOTA	1		
51155561-100	DIN RAIL POWER CONDITIONER WITH FERRITE CLAMP with stopper	1		
51454481-101	ASSEMBLY, RAIL MOUNT SERIES C-12 inch (includes Stopper)	1		
51202980-101	LABEL, RAIL MOUNT AGENCY APPROVAL 12”	1		

> **ATTENTION**
>
> When the equipment is mounted outside, you must use a sun/rain shield protect the unit from direct sunlight.

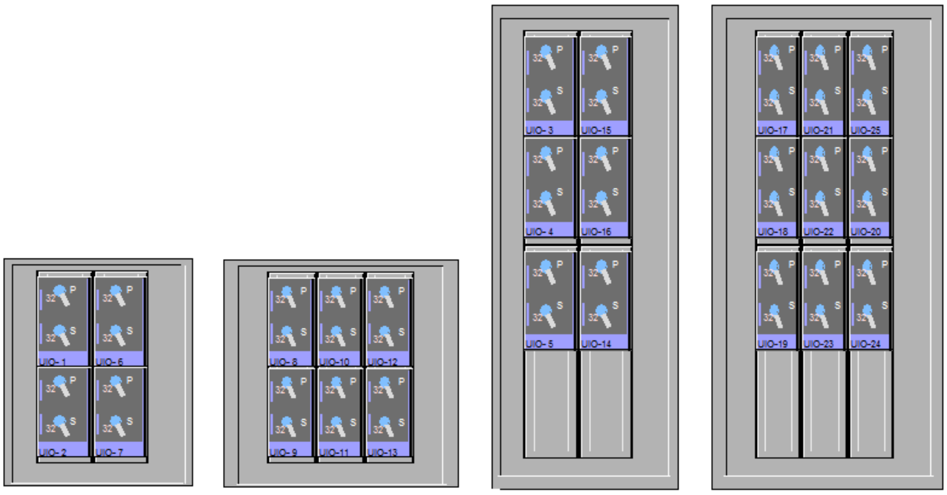
8.3 Input/output Link (IOL) management

The IOL management includes the following:

- Support for UIO IOTA versions in rail-mounted UIO assembly.
    - 18” UIO IOTA redundant
    - 12” UIO IOTA non-redundant
- DIN rail support for mounting the rail-mounted UIO assembly.

The rail-mounted UIOs can be mounted in the assembly options as in the following diagram. The following configuration is also applicable for non-redundant version.

Figure 8.2 Rail-mounted UIO layout options



Component	Description
Drop cables	• 51202329-102 – can connect up to 2 redundant UIO IOTA. (I/O link Cable Pair, 6 Drop, 6in pitch) • 51202329-402 – can connect up to 3 non-redundant UIO IOTA’s. (I/O link Cable Pair, 3 Drop, 12 pitch)
Header cables	• 51202329-606 – connecting to IOL1 - (3 drops, gray header cable pair, daisy-chained) • 51202329-616 – connecting to IOL2 - (3 drops, Violet header cable pair, daisy-chained) **ATTENTION** Each I/O link can support 40 redundant or non-redundant IOMs.
System tray	IOL needs to run in the system tray of the Rail-mounted UIO.

With the 3 drops header cable and 6 drops drop cable, the I/O link can cover 3X3 rail-mounted UIO modules as shown in this diagram.

> ATTENTION
>
> For more information about the I/O Link management, refer to the Experion Control Hardware planning Guide.

8.4 Single Mode FOE for rail-mounted UIO

The Single Mode Fiber Optic I/O Link Extender (SMFOE) is used for the Rail-mounted UIO, as this has a DIN rail-mountable option.

> ATTENTION
>
> FOE is mandatory for the installation and system wiring for Rail-mounted UIO.

FOE is placed inside the cabinet on the remote group side and also placed inside the cabinet on the control room side.

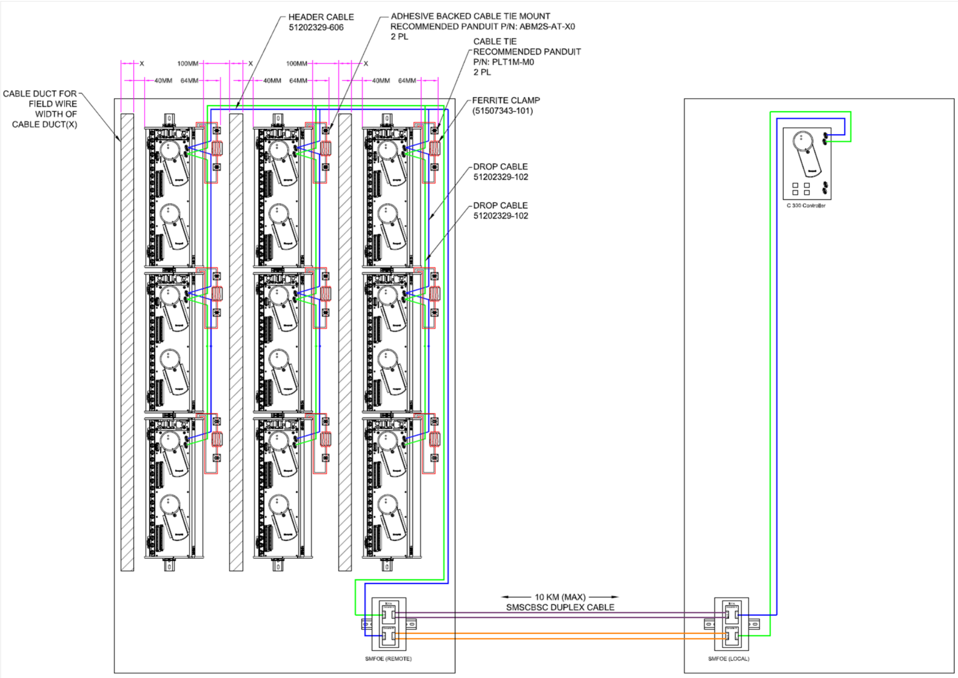
- FOE Component Options: MOXA SMFOE option consists of the following parts.
    - ICF-1150-S-SC-T, MOXA FOE Module, quantity - 2
    - 51155436-100- Install kit, IOL Extender on DIN Rail, quantity -1
- The MOXA FOEs clip to a DIN rail and they are laterally secured by end brackets. Refer*: DC power line wiring through system tray* in the section Wiring connections for illustration.
- Lower-left or right corner of the cabinet is ideal for mounting the FOE.
- One SMFOE is used for connecting to a matrix of 3X3 rail-mounted UIO network or lower. Refer to the figures in the section System wiring for illustration.
- SMFOE can extend the I/O link up to 10 KM.
- Temperature specification of MOXA SMFOE is -40 to +85 degC.
- The “leap-frog” topology is supported for the SMFOE similar that of the Multi Mode. For more information about the topology, see Defining the Fiber Optic topology.

8.5 System wiring

The Rail-mounted UIO module end to end connections in 3X3 matrix are shown in the following diagrams.

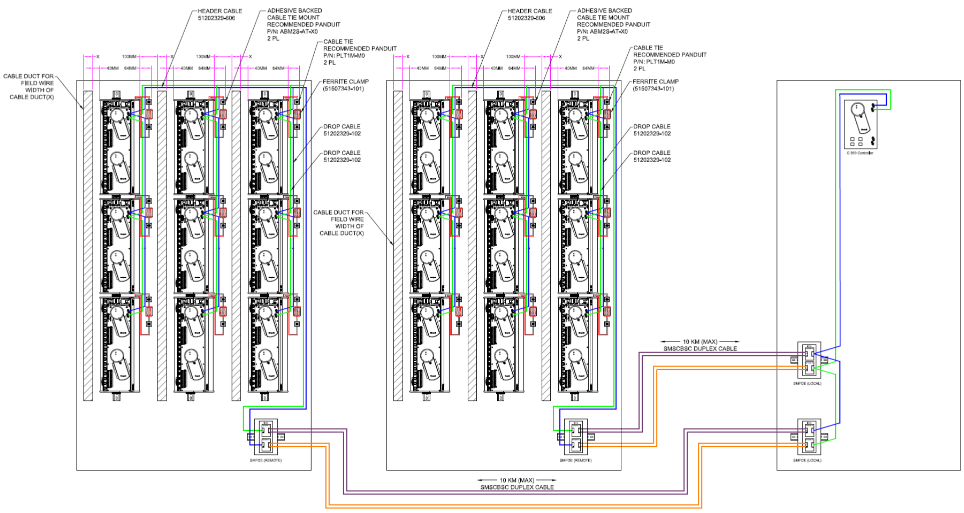
The following figure illustrates the end-to-end system wiring connections in a single cabinet.

Figure 8.3 End-to-end system wiring - Rail-UIOs in single cabinet



The following figure illustrates the end-to-end system wiring connections for the adjacent cabinets.

Figure 8.4 End-to-end system wiring - Rail-UIOs in adjacent cabinet



8.6 Power supply requirements

The rail-mounted UIO module is powered from a +24VDC remote industrial grade power supply. The DC power is supplied directly to each rail-mounted UIO assembly. Note that the customer will supply conditioned power that meets the Series C specifications. It operates reliably from a DC power source of 20VDC to 26VDC. The rail-mounted UIO module in redundant configuration consumes power at 10 Ampere from the power source.

A DC fused terminal block (TB) needs to be mounted inside the non-standard Honeywell cabinet to terminate the incoming DC power cord from the external remote DC power supply. From this terminal strip, a pair of wire with 18 AWG (0.82 mm2) terminates on the rail-mounted UIO TB. See Refer : **DC power line wiring through system tray** in the section Wiring connections to view the connections of fused TB and FOE.

The below specifications are applicable for each rail-mounted UIO module.

Output Specifications			
MUST be MET specifications for Series C system			
	Reference **Conditions** Full load @ 25° C (+/-2° C) is the base reference conditions. Additional conditions are noted below	**Operating Limits** Or **Operating Feature**	**Comments**
DC Output Voltage (VDC)		20V min 26V max	Must include combined effects of temp, line/load regulation, aging effects.
DC OUTPUT VOLTAGE STABILITY		Should be not more than +/- 0.1% for 8 hours, following a 6 hour warm-up period	
DC output Holdup Time	For all line voltage values within the normal operating band	The DC output should be maintained (with maximum load current) for at least 20 milliseconds after a (100%) dropout of the AC line input	
Low Freq - Ripple & Noise	From DC to 2x power line frequency and at the switch mode frequency	Less than 200 milli-volts peak-to-peak	For all input line and output load conditions.
Noise on the Negative Output	DC to 50MHz	Less than 3.0V peak-to-peak	Measurement to be made between System Common and Safety Ground
Output Current Limiting	Power supply should be capable of operating without damage continuously.	For power supply(ies) of 20A or less, the soft limit is 135%. For power supply(ies) between 20A to 40A, the soft limit is 120% For safety reasons, once the hard limit (200%) is reached, the power supply must shutdown the DC output (0 volts).	No component rating should be exceeded during an overcurrent condition.
24V Power down		When 24V rail falls below 19V, the output voltage shall monotonically decrease until a reapplication of the AC line input for proper system shutdown/operation	

STABILITY UNDER BROWNOUT CONDITIONS		When the Input AC line voltage is below the minimum operating limit (e.g., between 0 and 85 VAC) the power supply will not be damaged. The difference between the power-up and power- down thresholds shall be 10% of the low line operating limits	
Soft Start feature		Rise Time: > 10ms	

8.6.1 Reverse voltage protection

The Rail-UIO-IOTA power conditioning PWA (51307106-175) is mounted on the rail-mounted UIO assembly, which is provided with the reverse protection feature. This feature protects the rail-mounted UIO modules from the reverse polarity.

8.6.2 Routing of DC power lines

Each rail-mounted UIO requires a separate pair of +24V DC and GND lines from the fused Terminal Strip. The power lines are routed in the system tray of rail-mounted UIO. See **Figure: DC power line wiring through system tray** in the section Wiring connections for illustration.

- **Fused Terminal Block**
- **Circuit Breaker**

8.6.3 Fused Terminal Block

The Terminal Block is fused and the typical fuse rating for powering a single rail-mounted UIO module is as follows:

- Typical operating current: 15 Amps
- VDC: >30V
- Operating temperature: -40 to 70 degC
- Fast acting, Glass type removable fuse from the terminal block is preferred
- Meets the UL/CSA 248-14 standard
- I^2t rating > 950 Amphere^2 second
- Fuse should meet the local agency approval requirements

8.6.4 Circuit Breaker

The AC input line to the DC power system must be protected by an appropriately sized circuit breaker.

Compliance

Power wiring must conform to the local electric code like NEC and CEC or any other local electric code.

8.7 Agency approvals

The rail-mounted UIO has the following agency approvals. These agency markings are applied on the Rail-UIO product level and not on the non-standard cabinets in which Rail-UIO are mounted.

- CE and CTick: Applicable at individual component level - Power conditioner PWA and Base tray
- HAZLOC (Class 1/Div 2) - CSA, FM, ATEX, IECx: Applicable at rail-mounted UIO product level.

8.8 Environmental Conditions

Consideration	**Operating Limits (1)**	**Storage Limits (1a)**
Ambient Temp Range	-40 to +70°C	-40 to 85°C
Temp. Rate of Change	<= 1°C/min.	<=5°C/min.
Relative Humidity (2)	5 to 95% (non condensing) (3)	5 to 95%, (non condensing) (3)
Corrosives	G3 Standard (ISA S71.04) – Denoted by “CC-“ model number	G3
Ingress Protection	IP 20 NEMA 1	IP 20 NEMA 1
EMC	Emissions: EN61326–1: 2006 EN55011:2009+A1:2010 Class A Immunity: EN61326-1:2006 Harmonics: EN61000-3-2 Flicker: EN61000-3-3	N/A
EMI	10 V/M (4)	N/A
ESD	8kV 20x once/5 seconds (5)	N/A
Vibration (3 axes)	Sinusoidal (6) 10 to 60 Hz 0.5g Max acceleration 0.1 inches displacement	Random (7) 10 to 60 Hz 1g Max acceleration 0.1 inches displacement
Mechanical Shock (3 Axes)	0.5g max for a duration of 30ms max	20g max for a duration of 30ms max

ATTENTION

- (1) Operating Limits define the range of operating conditions within which the system is designed to operate. Performance characteristics are defined when operating in this state. Refer to ANSA/ISA D 51.1 for more information.
    - Transportation and Storage Limits define the range of conditions to which the system may be subjected without permanent damage to the equipment. Performance is not guaranteed in this state. Refer to ANSA/ISA D 51.1 for more information.
- (2) This rating applies to the internal ambient temperature of the enclosure with the doors closed.
- (3) The maximum relative humidity spec applies up to 40°C. Above 40°C, the RH spec is de-rated to 55% to maintain constant moisture content.
- (4) Measured with the field strength meter near the surface of the electronics with doors open.
- (5) Applied to items those are likely to be in contact with discharge sources (For example, human body) during typical maintenance actions.
- (6) 10 Hz is approximate – exact crossover frequency is determined by the intersection of the displacement and acceleration.
- (7) Composite Transportation Test Curve--encompassing maximum Random Vibration power spectral density values associated with ground, air, and sea transportation environments.

The rail-mounted UIO is not designed to meet the Marine Application requirement.

8.9 Rail-mounted UIO module assembly

8.9.1 Installation declarations

ATTENTION

This equipment shall be installed in accordance with the requirements of the National Electrical Code (NEC), ANSI/NFPA 70, or the Canadian Electrical Code (CEC), C22.1. It is supplied as "open equipment" that is intended to be mounted on a sub-panel within an enclosure. The suitability of the enclosure and installed system shall be acceptable to the local "authority having jurisdiction," as defined in the NEC, or "authorized person" as defined in the CEC.

Electrostatic discharge can damage integrated circuits or semiconductors if you touch connector pins or tracks on a printed wiring board.

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the wire connector or connector pins.
- Do not touch circuit components.
- If available, use a static safe workstation.
- When not in use, keep the component in its static shield box or bag.

ATTENTION

Unless the location is known to be non-hazardous, do not perform the following while the control system is powered.

- Connect or disconnect cables
- Install or remove components
- Install or remove isolators

- Assembling the base tray

8.9.2 Assembling the base tray

ATTENTION

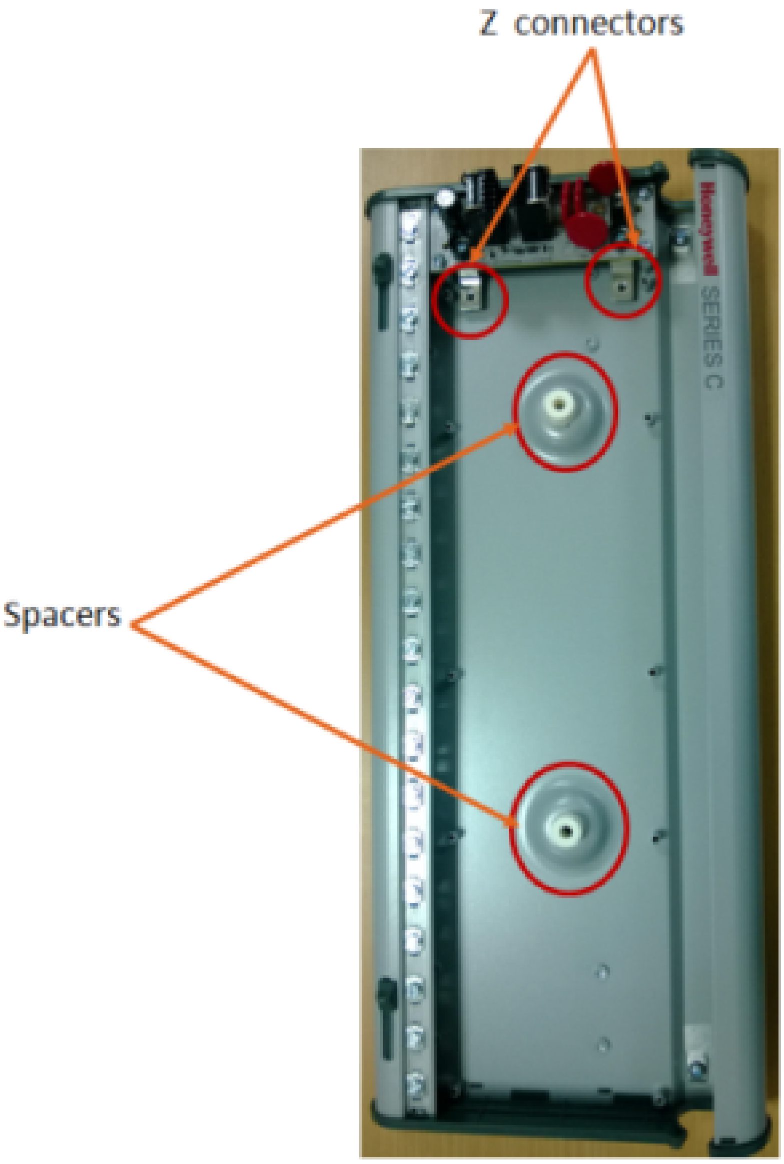
This procedure is applicable for both 12 inch and 18 inch IOTA boards.

Prerequisites

- Power supply is installed
- Control firewall is installed
- All wiring and pre-fabricated cables are available and labeled, as applicable
- Ensure all power is turned off at the installation location
- Mounting hardware is supplied with the components

To assemble the base tray

1. Locate the Spacers on the emboss cut on base tray as shown in the following figure:

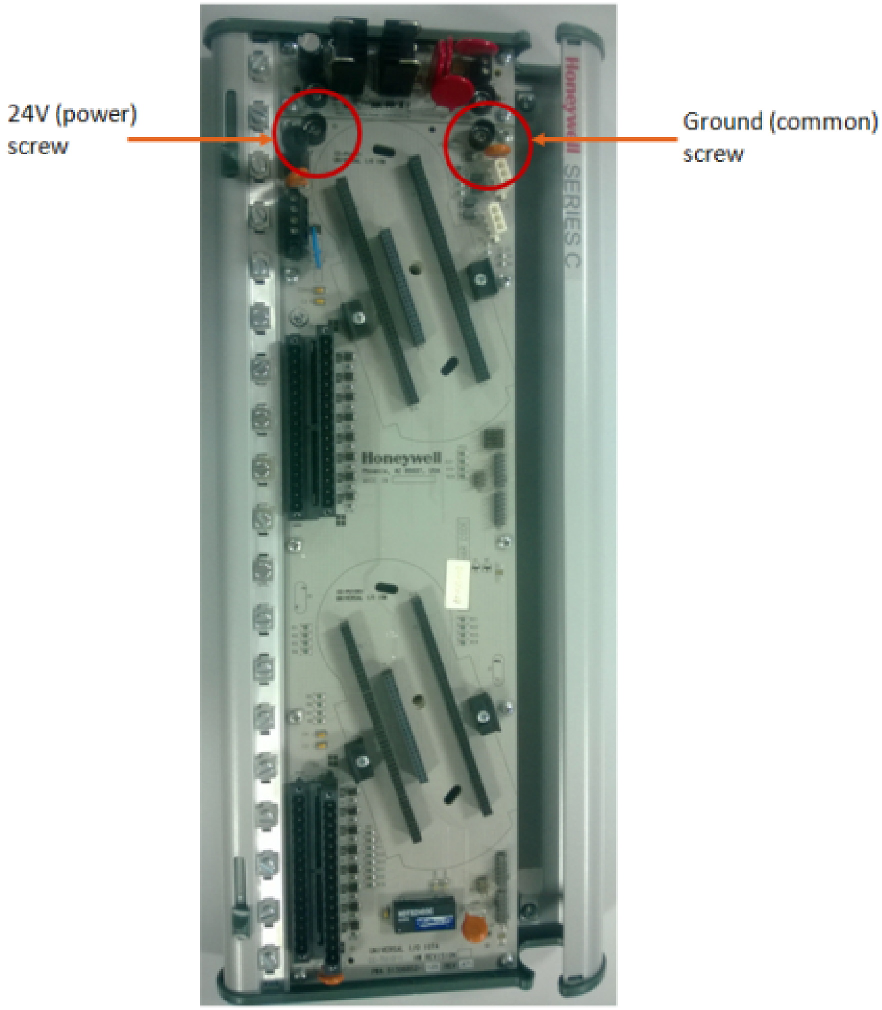


2. Assemble the IOTA Printed Circuit Board Assembly (PCBA) on the base tray using the IOTA mounting screws as follows:
   - Select the desired mounting location on the base tray and align mounting holes in IOTA with screw-hole locations on the base tray. Ensure that component side of IOTA is facing up.
     - 18 inch IOTA board - 10 mounting screws
   - While mounting 18 inch IOTA board, it is recommended to secure the three mounting screws on one side (either left or right) and then secure the other side.

ATTENTION

It is not recommended to secure the four corner screws and the two middle screws. It might cause bowing of the board and effect the alignment of the IOTA board to the base tray holes.

3. Secure the 24V (power) and Ground (common) screws on IOTA PCBA with power supply board through Z connectors.

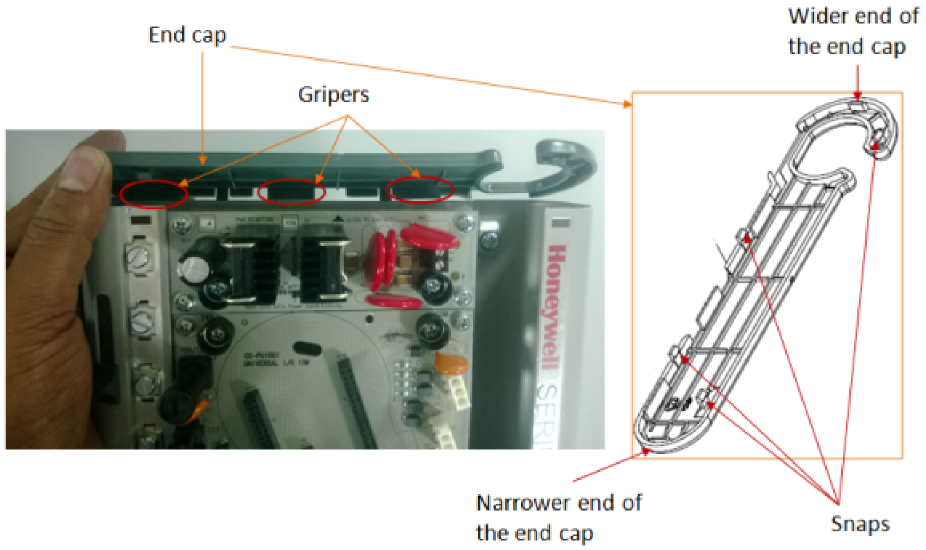


ATTENTION

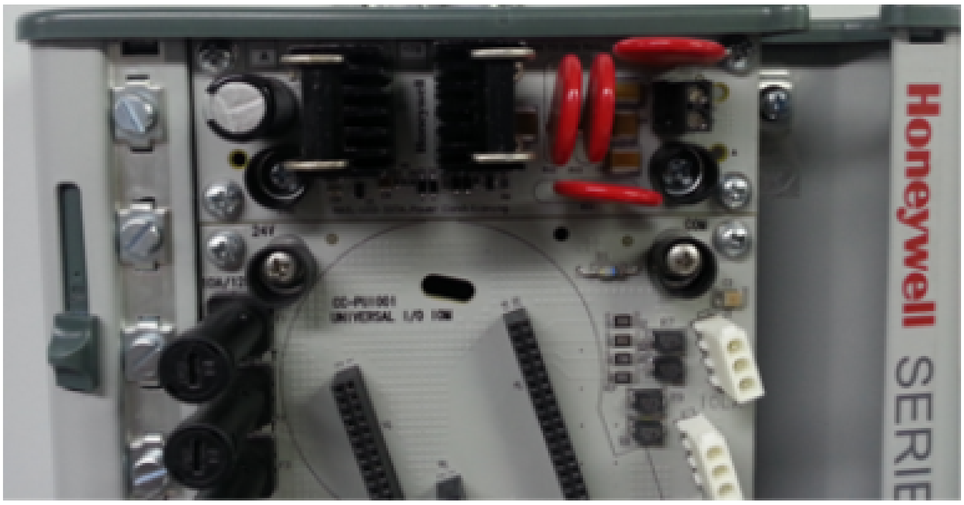
The following steps 4 to 7 are optional and you can follow those steps only if you want to replace the end caps.

Honeywell

4. [Optional] Adjust the end cap gripers to base tray such that the gripers are on top and the snaps are at bottom.



5. [Optional] Press the end cap into the base tray.
6. [Optional] Align both the narrower end and wider end of the end cap to the base tray and press. Ensure that the snap is aligned below the base tray and snap it.

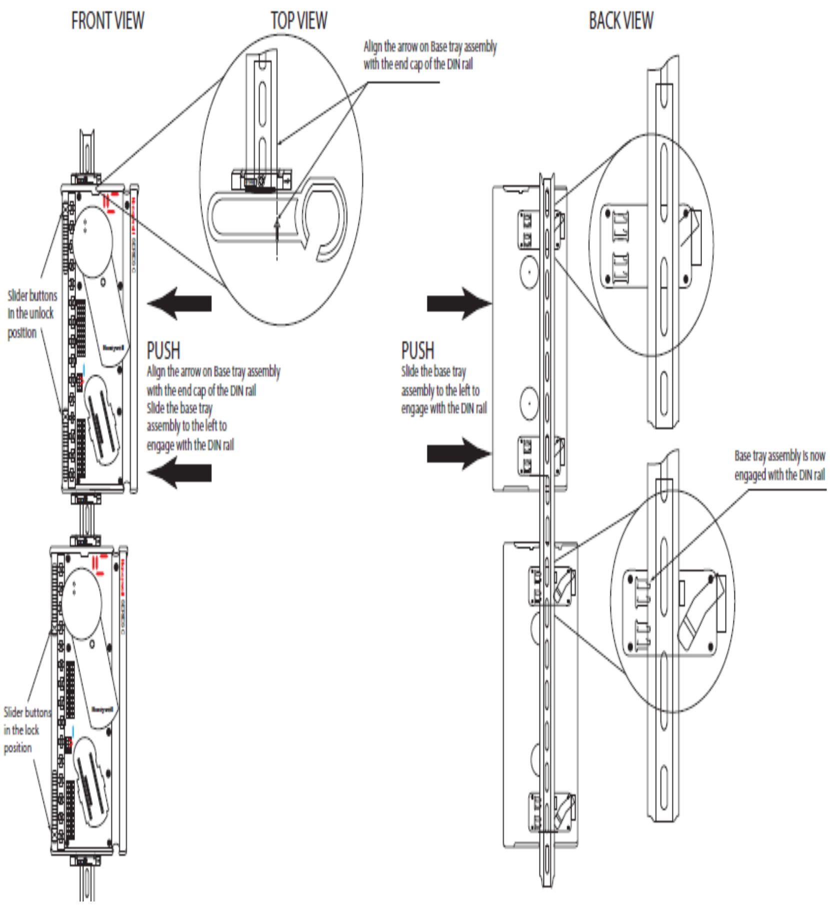


7. [Optional] Repeat the steps 4 through 6 to mount the other end cap on the other end.

8.10 Mounting base tray assembly on DIN rail

The following figure illustrates the graphical representation of mounting instructions.

Figure 8.5 Mounting instructions



For additional details on mounting instructions, refer to the HPS Support website, *http://www.honeywell.com/ps*.

> **ATTENTION**
>
> The following procedure is applicable for both 12 inch and 18 inch IOTA boards.

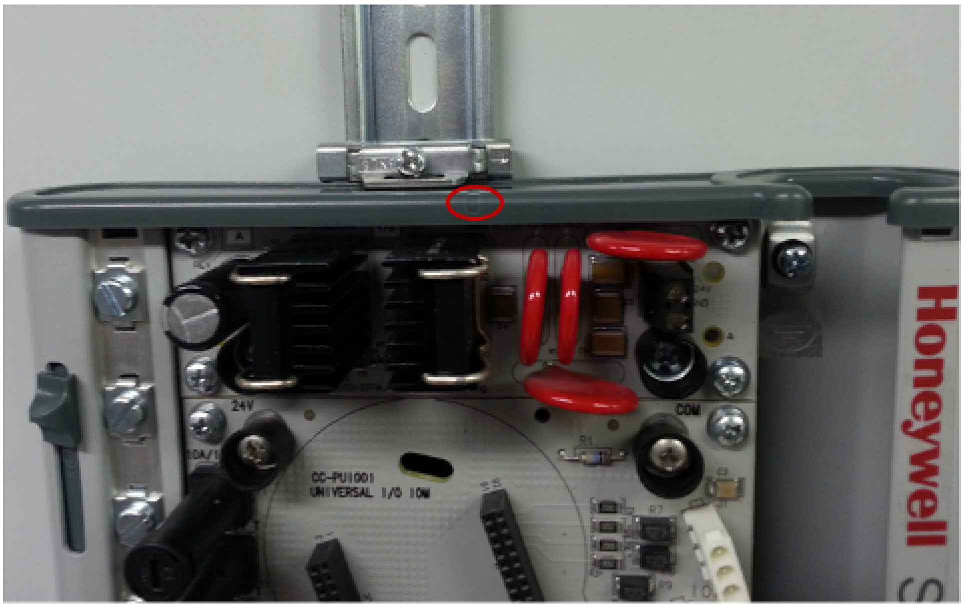
8.10.1 To mount the base tray assembly on DIN rail

1. On the DIN rail mounting base, assemble the IOTA, rail-UIO-IOTA power conditioning PWA, and end caps as per the Series C mounting method.
2. On a vertically-mounted DIN rail, mount the stopper at the bottom of the DIN rail.

> **ATTENTION**
>
> Before mounting base tray assembly on DIN rail, ensure that both the sliders are unlocked.

3. Ensure that both the slider knobs are pointed toward the upper position of the slot and then mount the base tray assembly on DIN rail.

4. Use the arrow on the end caps as a reference and align the end cap to the DIN rail as in the following figure.



5. Slide the base tray assembly toward the left to engage with the DIN rail. Push both the sliders downwards till it reaches the maximum position at the bottom to lock the base tray assembly on the DIN rail.

6. Push the base tray assembly down till it supports on the DIN rail stopper.
7. Mount another DIN rail stopper on the top of the base tray assembly to fix the base tray tightly.
8. Mount the UIO module on IOTA base tray. For more details about mounting the UIO module, refer to the section *Mounting UIO module on the IOTA*.
9. Connect the system cables (IOLINK cables, power supply cables, and the grounding wires) on the right of the rail-mounted UIO module. In addition, connect the field wire cables through cable duct on the left of the rail-mounted UIO module. For more details about wiring connections, refer to the section *Wiring connections*.

8.11 Mounting UIO module on the IOTA

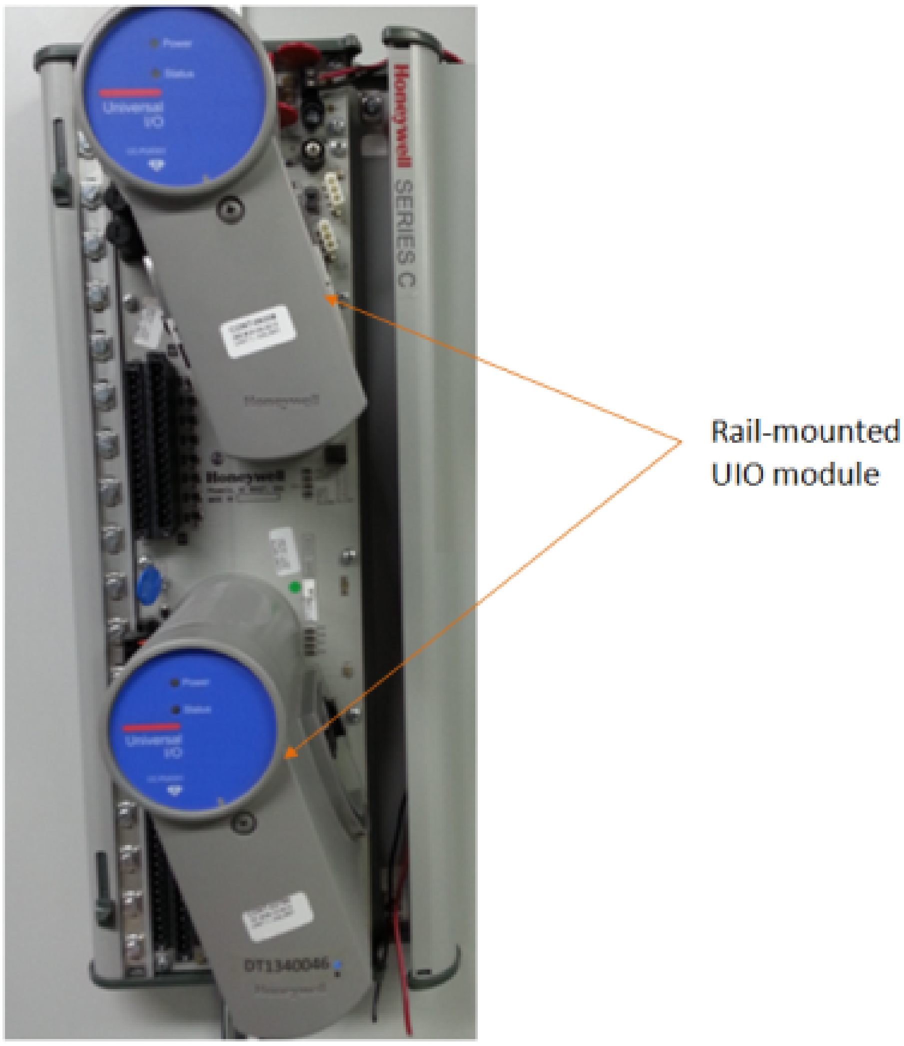
8.11.1 Prerequisites

- IOTA is mounted on the base tray
- Power supply is installed
- Control firewall is installed
- All wiring and pre-fabricated cables are available and labeled as applicable
- Ensure that power is turned off at the location of UIO installation
- Mounting hardware is supplied with the components

8.11.2 To mount UIO module on IOTA

1. Insert the UIO module into IOTA board and ensure that the circuit board matches properly with the IOTA board connector.
2. Secure the module to the:
   - IOTA board - with two screws located at each side of the plastic cover.
   - Base tray - with the long gray plastic screw located at the front of the module. This is applicable only if this provision exists.

> **ATTENTION**
> - Ensure that the lifting lever, which is available with the UIO module, should be in vertical position to ensure proper insertion of the IOM with the IOTA.
> - Only use a #2 Phillips screwdriver to carefully loosen or tighten the long gray plastic screw. Do not use either a #1 Phillips screwdriver or a battery-powered screwdriver to remove or install the plastic screw as this can damage the screw head.

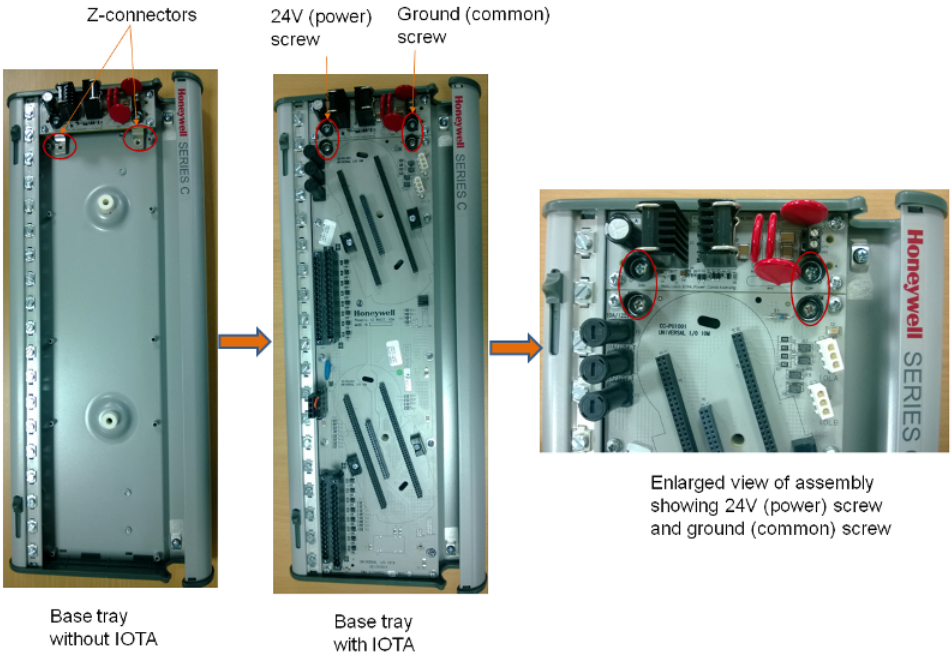


8.12 Grounding and power connections

8.12.1 Attaching the IOTA board

The non-standard Honeywell cabinet allows rail-mounted UIO assembly to support the attachment of the IOTA boards. After power and chassis connections, grounding is provided to the IOTA board. The following figure illustrates the sequence for power connections.

Figure 8.6 Power connections



The following diagram illustrates the grounding connections.

Figure 8.7 Grounding connections

> **ATTENTION**
>
> Extreme care must be taken when testing the power at the IOTA screw. Improper testing can result in an electrical short circuit, which will affect all modules attached to the base tray assembly. Never use a test probe at an unattached IOTA's 24V screw hole. The probe can potentially touch the back channel assembly causing a short circuit.

The following locations are recommended for testing power:

- Preferred location if IOTAs are attached
  - Center of the screw that attaches the IOTA to the rail-UIO-IOTA power conditioning PWA.
- Preferred location if IOTAs are NOT attached
  - Center of the screw of the top connection terminal for power cable.

Insert the test probe at the center of the screw that attaches the IOTA to the 24V power connection.

8.13 Wiring connections

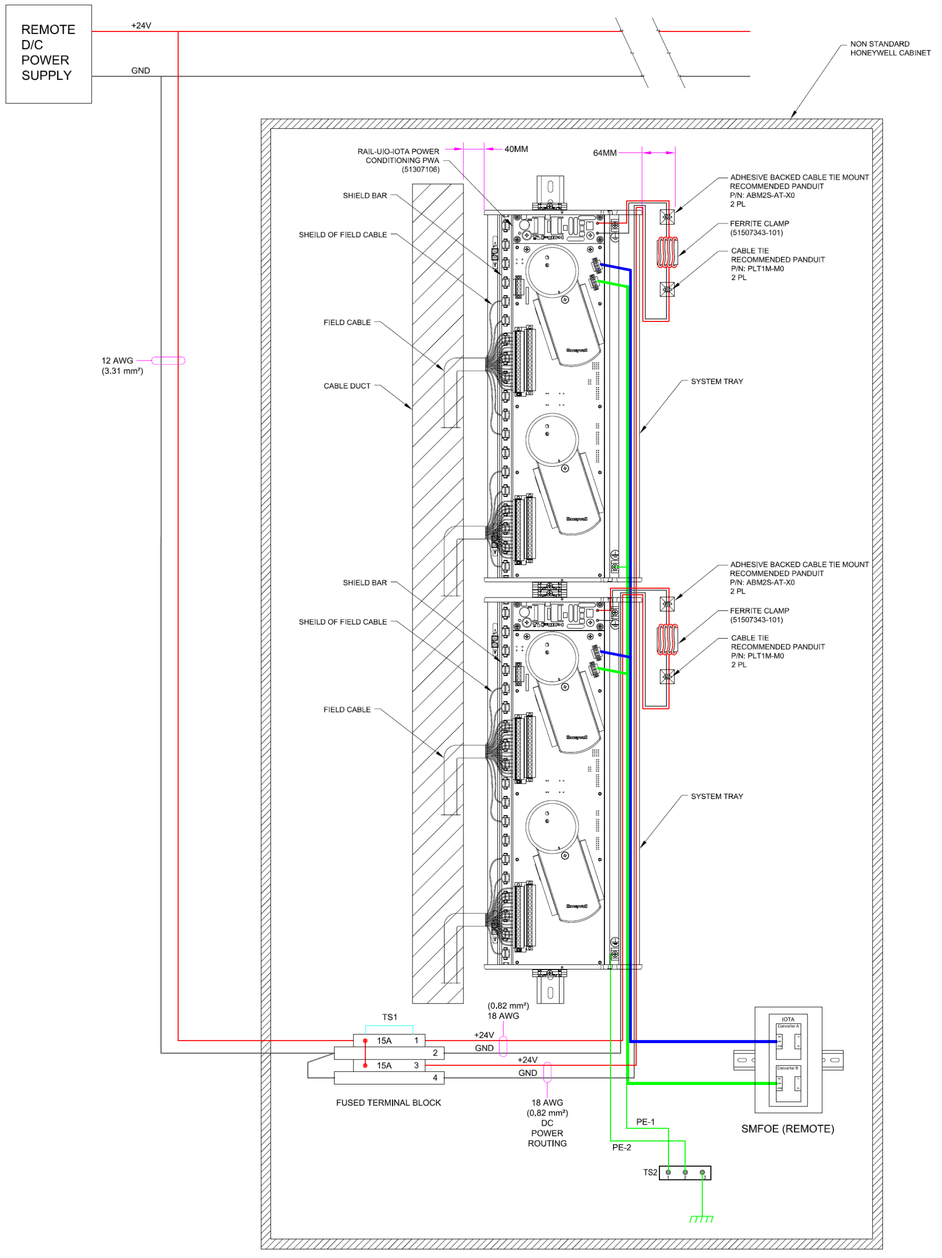
8.13.1 Wiring connection details of IOTA

The following table provides details about UIO modules, associated IOTAs, and ancillary hardware.

IOM block type	IOM model number	IOTA model number	IOTA description	IOTA supported FTAs or ancillary cards
UIO	CC-PUIO01	CC-TUIO01	UIO, Non-Redundant	None
		CC-TUIO11	UIO, Redundant	

The following figure illustrates the wiring drawing of rail-mounted UIO module assembly.

Figure 8.8 DC power line wiring through system tray power line wiring through system tray DC

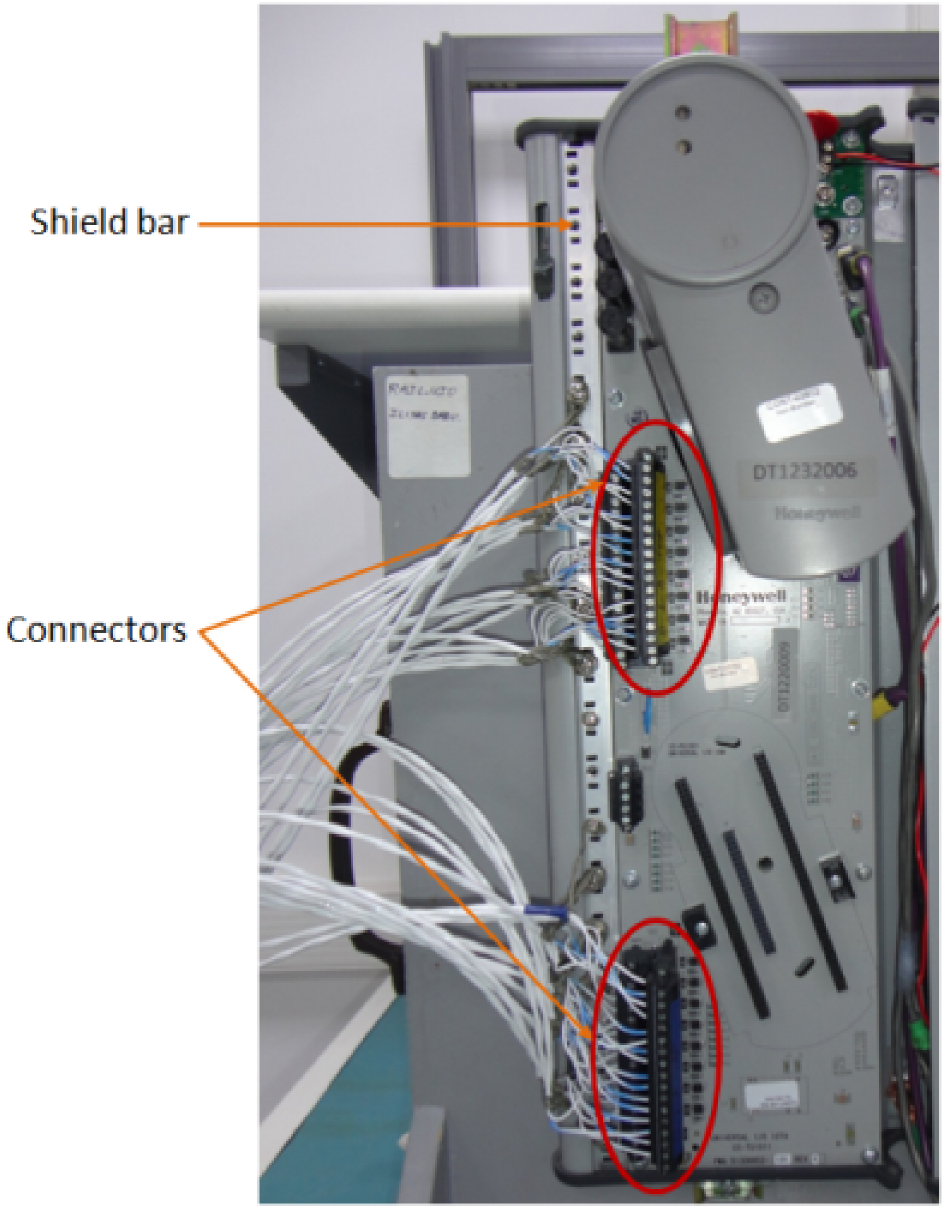


- Connecting wires and cables

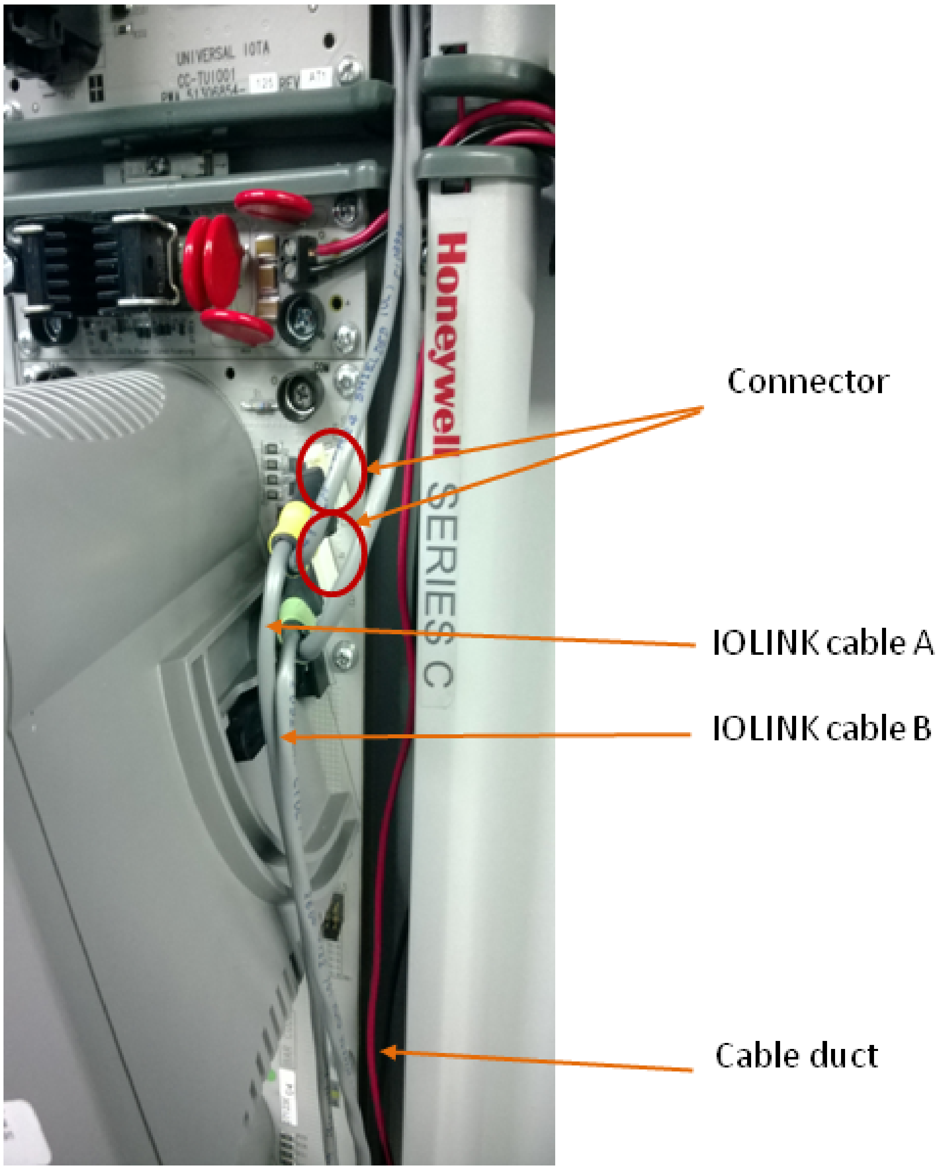
8.13.2 Connceting wires and cables

To connect wires and cables

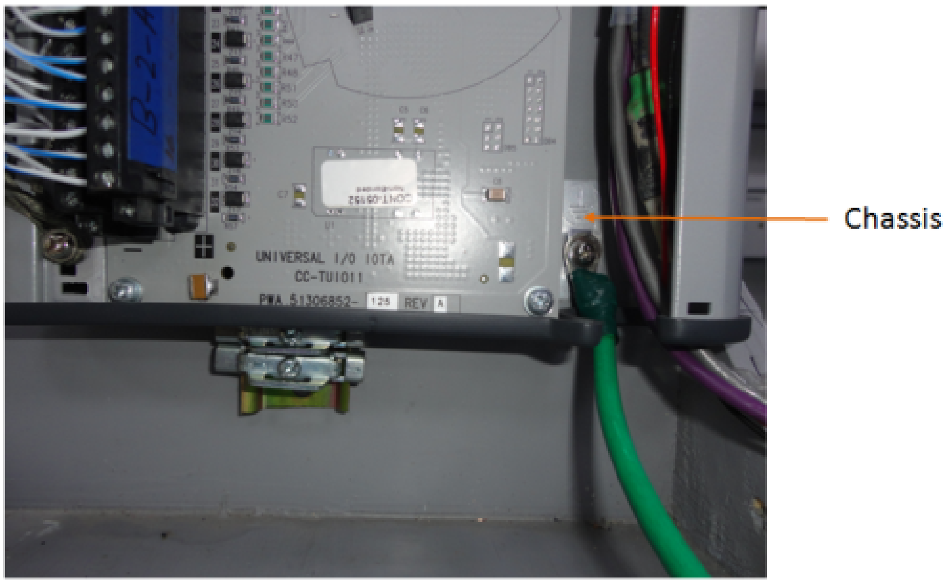
1. Shielded field cables are connected to the connector and the cable shields are connected to the shield bar of the base tray.



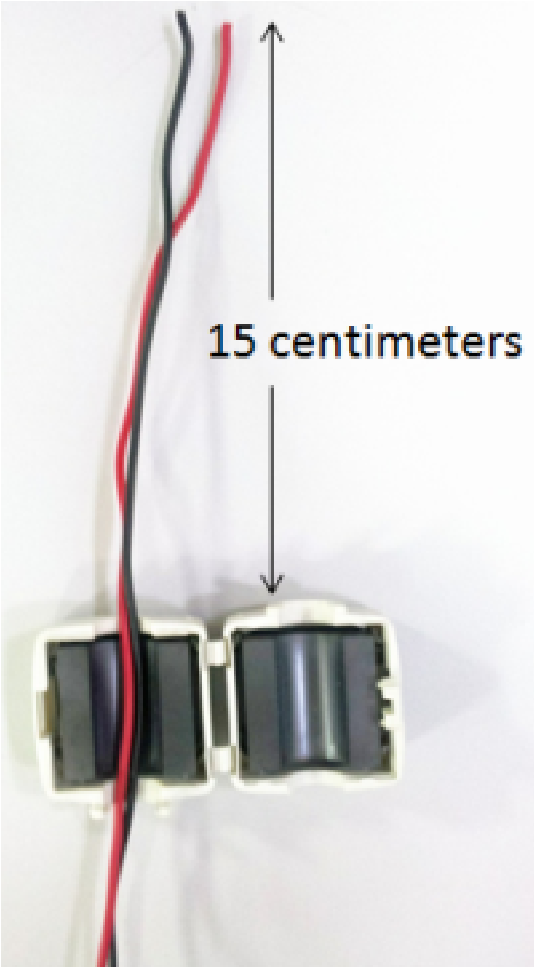
2. Connect IOLINK cable A and IOLINK cable B to the connectors respectively on the IOTA board. Ensure that all IOLINK cables and power cables are pulled through the cable duct in the base tray.



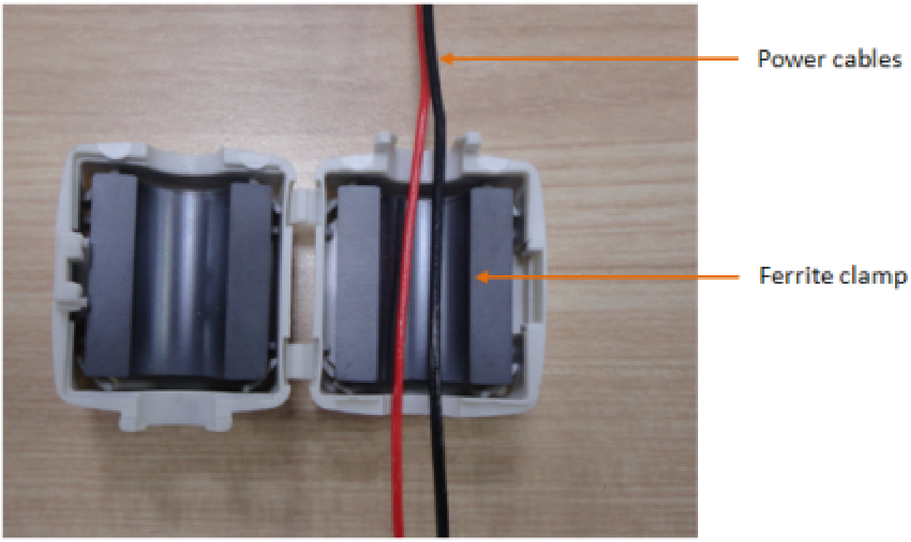
3. Connect the chassis to the protective earth through a 6 AWG (13.29 mm2) wire.



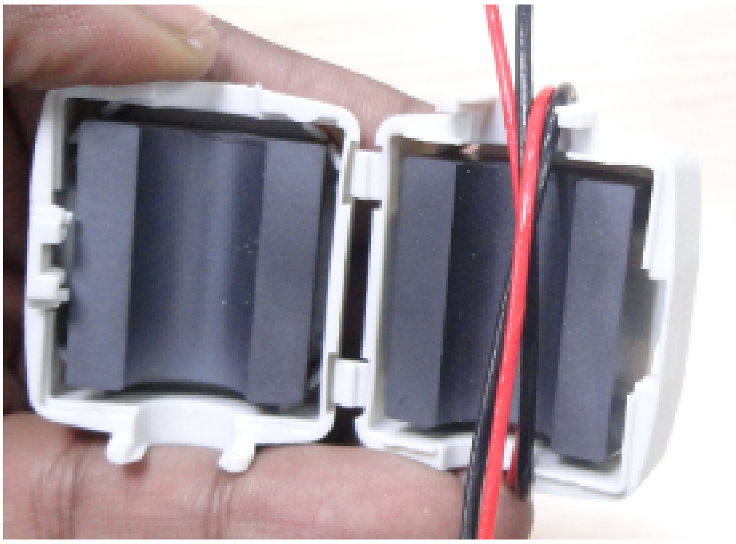
4. Before connecting the power cables from the power supply to the connector, wind the power cables as follows:
   a. Place the ferrite clamp in such a way that the distance between ferrite clamp and end of the power cables is 15 centimeters. However, end of the power cables are connected to rail-UIO-IOTA power conditioning PWA. The guage of the wire is 18 AWG (0.82 mm2), which is used for Ferrite clamp wounding.



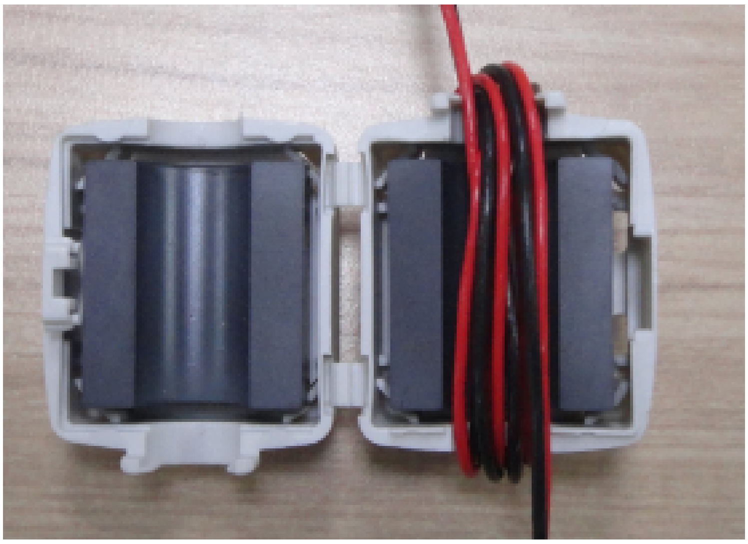
b. Place the power cables on the ferrite clamp as shown in the following figure.



c. Wind the power cables on the ferrite clamp as shown in the following figure.



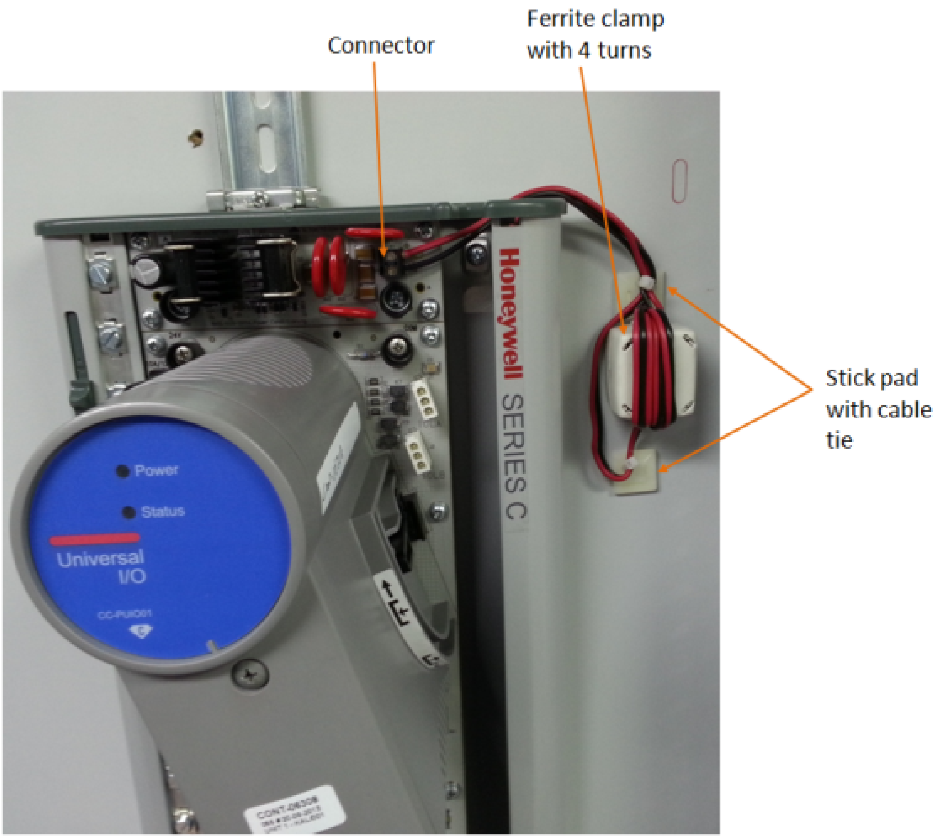
d. Wind the four turns on the ferrite clamp as shown in the following figure.



e. Lock the ferrite clamp as shown in the following figure.

f. A Ferrite clamp with 4 turns wound together as shown in the following figure.

5. Connect the power cables from the power supply to the connector on the rail-UIO-IOTA power conditioning PWA.



8.14 Removing rail-mounted UIO module

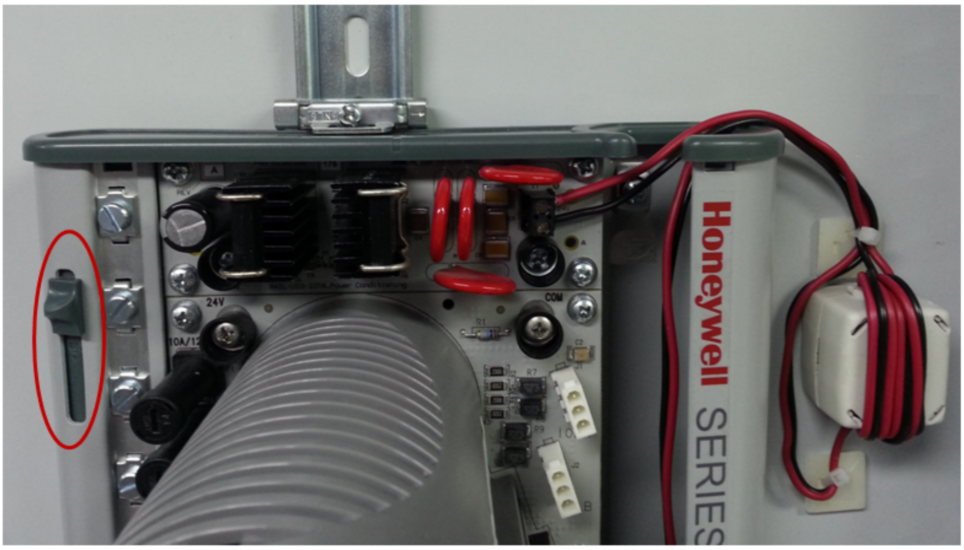
8.14.1 Prerequisites

Before removing the rail-mounted UIO module, consider the following:

- Remove all the field wire cables that are connected to the module.
- Remove ground wires.
- Remove the power supply connections from the assembly.

8.14.2 To remove rail-mounted UIO module

1. Push both the sliders upward till it reaches the maximum position to unlock the module on the DIN rail.



2. Slide the rail-mounted UIO module assembly towards the right to disengage from the DIN rail and remove it.

8.15 Replaceable spare parts

The following table lists the replaceable spare parts.

Part number	Spare part name
51307106-175	RAIL UIO-IOTA POWER INPUT-PWA
51507343-101	FERR RND CBL SNAP 8.5-10.5MM GRY
51454430-100	BASE, SERIES C MOUNTING FOR 18" IOTA
51307110-100	END CAP, BASE, TOP, SERIES C MOUNTING
51307110-101	END CAP, BASE, BOTTOM, SERIES C MOUNTING
51307156-100	ASSEMBLY, DIN ADAPTER, SERIES C MOUNTING
51454430-101	BASE, SERIES C MOUNTING FOR 12" IOTA

CHAPTER

9 SERIES C I/O CONFIGURATION FORM REFERENCE

When an IOM block is placed on the Project tab in Control Builder, its associated channel blocks are assigned to the IOM. The following applies to that IOM block:

- You assign each IOM to the IOLINK block (that represents the I/O Link network on which the IOM resides).
- All of the common configuration parameters specific to IOMs are located on the Main Tab of the IOM's configuration form.
- 'Grayed' parameters are either view-only runtime parameters or non-applicable configuration parameters
- The QVCS tab becomes visible when this option is obtained and enabled.

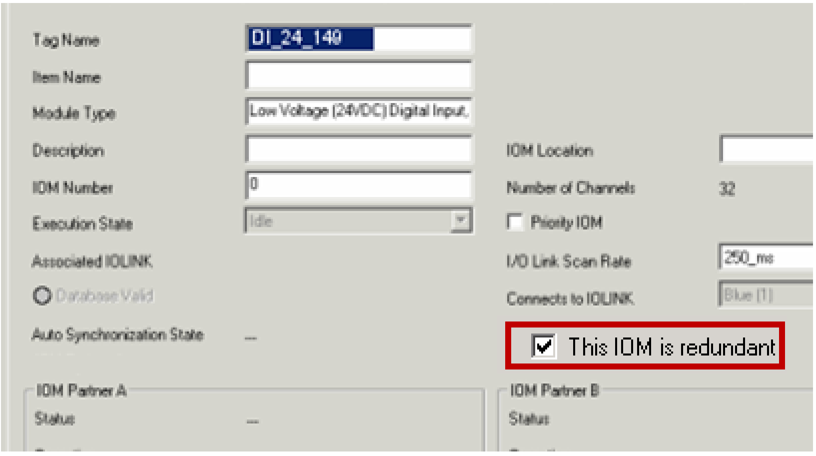
9.1 Determining Series C I/O block redundancy

The IOM blocks represent instances of the I/O Module hardware that reside on the I/O Link network. There is a specific IOM block for each I/O Module type supported in Experion.

The IOM block is used to:

- configure the network address (the IOMNUM) of the IOM device.
    - If the IOM is configured to be redundant, you enter only one IOMNUM. In either case, only one block is created which handles communication to and from both physical IOMs.
    - The hardware design uses a set of push-in IOMNUM identifiers to reduce the chance of duplicate IOMNUMs on the same link.
    - Each IOM block generates system events and alarms for soft failures, IOM synchronization, and IOM switchover.

Figure 9.1 Defining redundancy from the Main tab



9.2 Switchover and Secondary readiness

A switchover describes the process where a Secondary Series C module assumes the Primary state, and the Primary Series C module assumes the appropriate Secondary state of readiness, depending upon what triggered the switchover. A switchover can be triggered immediately upon the detection of a fault in the Primary or upon the receipt of an operator command.

The ability of a Secondary Series C module to take over the assigned control functions of the Primary depends upon which one of the following readiness states reflects its current state.

Table 9.1 Redundancy state and module readiness

If Secondary redundancy state is	Then, the Secondary module
NotSynced *Not synchronized*	Cannot assume the Primary state. This is a state of non-readiness. Switchover has not occurred. Ensure redundancy has been selected on the IOMs Main tab.
FoInProg **SwapInProg**	Cannot assume the Primary State. In this state, the Secondary module is copying database information from the Primary.

If Secondary redundancy state is	Then, the Secondary module
Synchronizing	
Syncd *Synchronized*	Can assume the Primary state upon switchover. In this state, the database in the Secondary is aligned with the database in the Primary. The Secondary closely tracks database changes to maintain its synchronization with the database of the Primary. Otherwise, the Secondary will revert to a Not Synchronized state.

9.3 Failure conditions and switchover

ATTENTION

When any failure that results in a switchover occurs in a Secondary module, the Secondary module loses synchronization.

In addition to the failure conditions, this event is reported as diagnostic notification:

- Loss of view of redundant partner on network.
- Loss of private path connection from Primary to Secondary (lonely event).

The following table identifies failure conditions that result in a switchover and those that do not.

Table 9.2 Failure conditions that result in switchover

Failure conditions that result in a switchover	Failure conditions that do not result in a switchover
Power to Primary module fails.	One or all cables fail.
An IOLINK to the Primary Series C module is lost.	One or all network conditioners fail.
Primary Series C module fails.	All supplied power to the link fails.

9.4 Configuration tools to create control strategies

The Experion Control Builder application creates control strategies that use Series C I/O data. In developing a valid control strategy, the following activities are required to be supported by Control Builder:

- create hardware blocks,
- associate blocks,
- assign modules,
- assign devices, and
- load components.

Regardless of what tool is used to configure Series C I/O, the IOM must be present during configuration load. If the IOM is not present load errors will occur and a subsequent reload or checkpoint restore will be required.

Refer to the Control Building Guide to create control strategies.

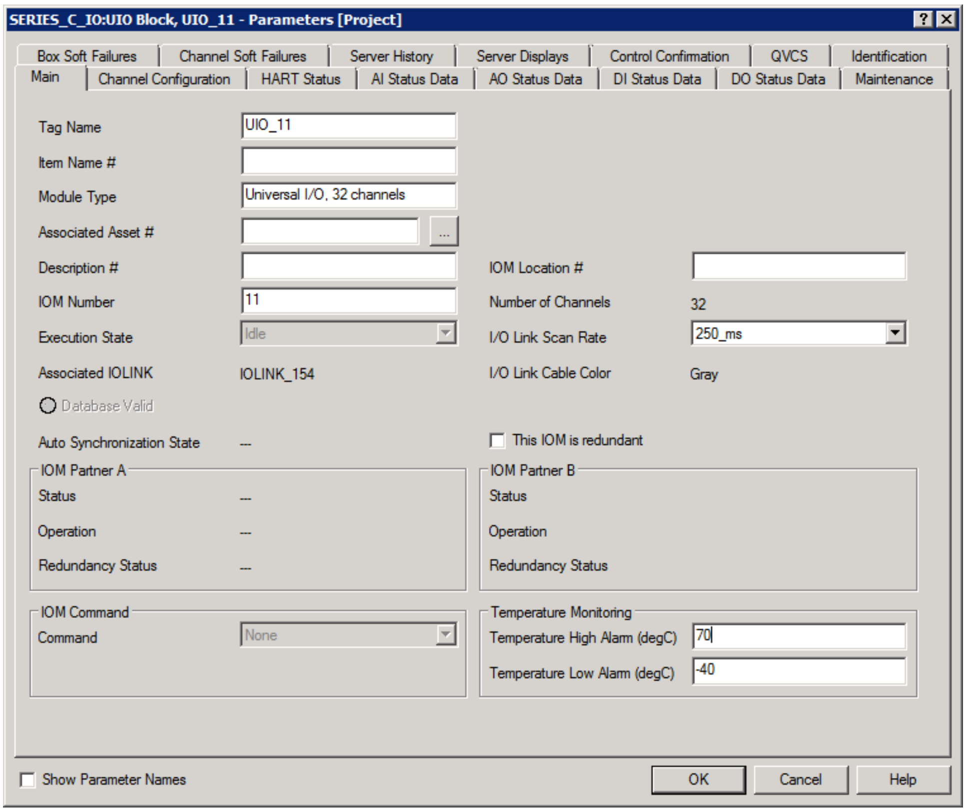
9.5 Configuring the Main tab - IOM block

The following configuration information pertains to the Main tab for all Series C module types.

- Redundancy is determined by checking the, **This IOM is redundant** check box.
- The QVCS tab becomes visible when this option is obtained and enabled.
- All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24b Block, Configuration form - Main tab.

Figure 9.2 Main tab



The parameters of the Main tab is listed in the following table.

Table 9.3 Main tab parameters

Plain text	Parameter name	User configurable	Notes
Tag Name	TAGNAME	**Project** Only	System assigned or user configured unique name. Consisting of up to 40 characters and at lease one character must be a letter (A-Z).
Item Name	ITEMNAME	**Project** Only	A non-unique name by which an entity is known within the context of the enterprise model.
Module Type	IOMTYPE	No	This non-configurable parameter is a description of the respective I/O module
Associated Asset	ASSOCASSET	Yes	Allows user to select an asset from those configured in the Enterprise Model Database to set the Scope of Responsibility (SOR) for the point.

Plain text	Parameter name	User configurable	Notes
Description	DESC	Yes	Used to specify descriptive text for the function block. Appears on both detail and group displays.
IOM Number	IOMNUM	Yes	This parameter value must be unique on a specific I/O Link, and its range must be between 1 and 40. If IOMNUM=0 and the IOP block is assigned to an I/O Link block, Control Builder automatically defaults the IOMNUM to the next available value on the I/O Link.
Execution State	IOMSTATE	No	Defines execution state
Associated IOLINK	IOLINK	No	Defines associated IOLINK
Database Valid		No	Defines if database is valid
IOM Location	IOPLOCATION	Yes	Identifies the user-entered location (within the plant) where this IOM can be found.
Number of Channels	NUMCHANS	No	The number of channels available in the IOM
I/O Link Scan Rate	SCANRATE	Yes	Defines scan rate
I/O Link Cable Color	IOLINKCOLOR	No	Defines cable color. See I/O Link Address Jumpers for color listing.
This IOM is redundant	IOREDOPT	Yes	Module is part of redundant pair.
Status	IOMSTSA	No	Defines status of IOM: Idle, OK, No Response
Operation	IOMOPER	No	Defines operation status of IOM: Primary, Secondary
Redundancy Status	REDDATA	No	Defines if redundancy is enabled
Frequency 60/50Hz (AI LLMUX only)	FREQ6050	Yes	User-configured power supply determination: 50Hz or 60Hz (AI-LLMUX, DIHV)
Command	IOMCOMMAND	No	Swap primary, reset errors, etc.
DI Mode	DIMODE	Yes	Defines the mode of the DI-24V and DI-SOE modules to be Normal, SOE, or Low Latency
Configured Prover Signal	CONFIGPROVERSIGNAL	Yes	Provides the user the ability to specify on any given Pulse Input Module the signal stream to output to the prover signal screw pair. Only dual streams can be selected.
Actual Prover Signal	ACTUALPROVERSIGNAL	No	Provides the user or a program the actual signal stream being output to the prover signal screw pair.
Maintain Selection on Fault	MAINTAINONFAULT	Yes	Provides the user the ability to specify the action to be taken by the system in case of a special condition or faults in the module or its ability to output the selected stream to the prover signal.

Plain text	Parameter name	User configurable	Notes
Temperature High Alarm	TEMPHILM	Yes	Enables the user to configure the temperature value in the range from low limit to +70.0.
Temperature Low Alarm	TEMPLOLM	Yes	Enables the user to configure the temperature value in the range from -40.0 to high limit.

9.5.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

9.5.2 To configure the Main tab

1. Enter a **Tag Name** that is more meaningful to you than its default pre-assigned number (ex. Test Strategy DI Module).
2. **Item name** is based on relationship established in Enterprise Builder
3. Enter the **Module Type**.
4. Click the  button to the right of the **Associated Asset** box.

   The **Point Selection** dialog box appears.
5. Select an asset from those configured in the Enterprise Model Database to set the Scope of Responsibility (SOR) for the point.

> NOTE
>
> No validation is done at the configuration time. If you enter an asset that does not exist in the points database, the associated asset for the point reverts to the server point. If the asset does exist but is not an area-enabled asset, then the first area-enabled asset up the tree is used for the SOR of that device. A subsequent upload of that device point to Control Builder returns the area-enabled asset and not the original non-assignable asset entered.

6. Enter an optional **Module Description** to explain the I/O Module's function
7. Enter appropriate values for **IOM Number** to match the plug-in IOM jumper number. If necessary, press F1 to access on-line help for assistance during this step.
8. If redundancy is required, check the **This IOM is redundant** check box.
9. If you have configured a Pulse Input Module, select the **Maintain On Fault** check box, if required. This parameter provides you the ability to specify the action to be taken by the system in case of a special condition or faults in the module or its ability to output the selected stream to the prover signal.

> NOTE

> You must perform the remainder of the pulse proving configuration at runtime. For more information, refer to the section Enabling pulse proving in Pulse Input Module.

10. If you have configured a Universal Input/Output Module, configure the **Temperature High Alarm** value and **Temperature Low Alarm** value in degree Celsius.

> NOTE
>
> By default, the values of **Temperature High Alarm** and **Temperature Low Alarm** are +70 and -40, respectively.

11. Proceed to the following procedures to configure parameters on the remaining tabs for the module, or click OK to accept only the changes made so far and return to the Project tree.

9.6 Configuring Server History tab - IOM block

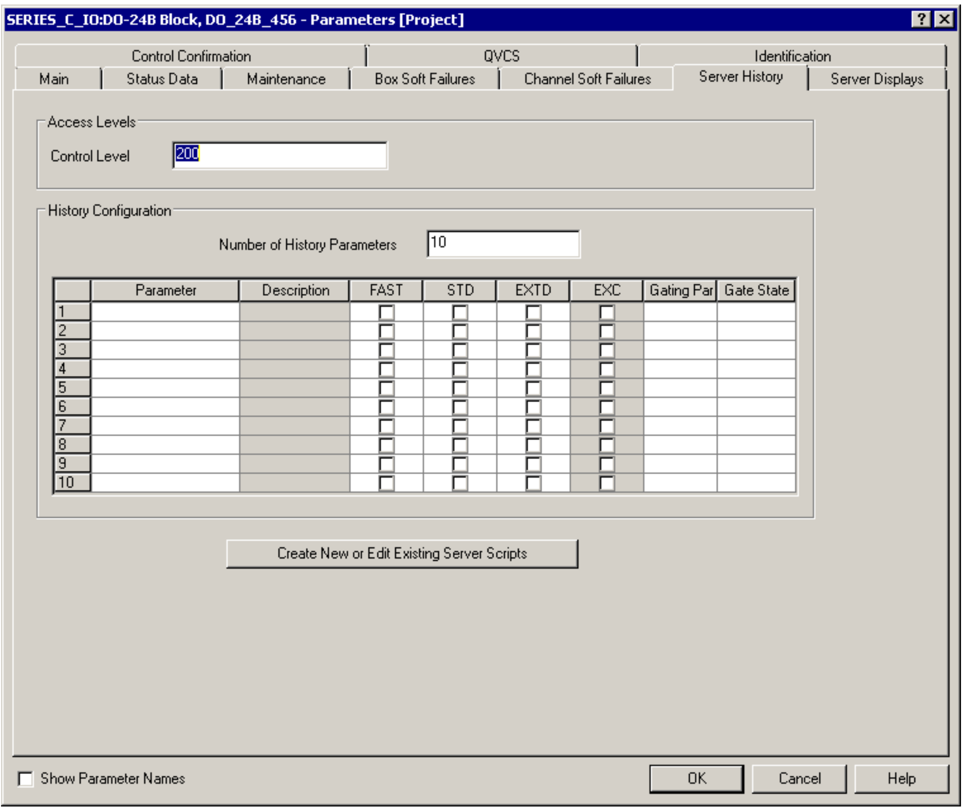
The following configuration information pertains to the Server History tab for the following modules:

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B
- SP
- SVP
- PIM
- UIO
- UIO-2

All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Server History tab.

Figure 9.3 Server History tab



The parameters of the Server History tab are listed in the following table.

Table 9.4 Server History tab parameters

Plain text	Parameter name	User configurable	Notes
Control Level	SCANCTRLLVL	Yes	Indicates Server control level to be associated with this function.
Number of History Parameters	HIST.NUMPARAMS	Yes	Defines number of history parameters to be included in History Configuration table.
Parameter	HIST.PARAM	Yes	Valid parameter name for a parameter associated with the given point that is to be collected and stored as historical data at predetermined intervals.
Description		No	Provides a brief description of the entered parameter.
FAST	HIST.FAST	Yes	Select the Fast type of history collection.
STD	HIST.STD	Yes	Select the Standard type of history collection.
EXTD	HIST.EXTD	Yes	Select the Extended type of history collection.
EXC	HIST.EXC	Yes (Station only)	Select the Exception type of history collection.
Gating Parameter		Yes	Optional gating parameter to define conditions under which data for this parameter should be collected.
Gate State		Yes	Defines gate state for configured gating

Plain text	Parameter name	User configurable	Notes
			parameter.
Create New or Edit Existing Server Scripts (Button)		N/A	Launch the Server scripting configuration utility.

9.6.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

9.6.2 To configure the Server History tab.

1. Under the **Server History** tab, enter the appropriate information for **Control Level** along with values for appropriate parameters related to history collection and archiving. If necessary, press F1 to access on-line help for assistance during this step.
2. Proceed to the following procedures to configure parameters on the remaining tabs for I/O Module, or click OK to accept only the changes made so far and return to the Project tree.

9.7 Configuring Server Displays tab - IOM block

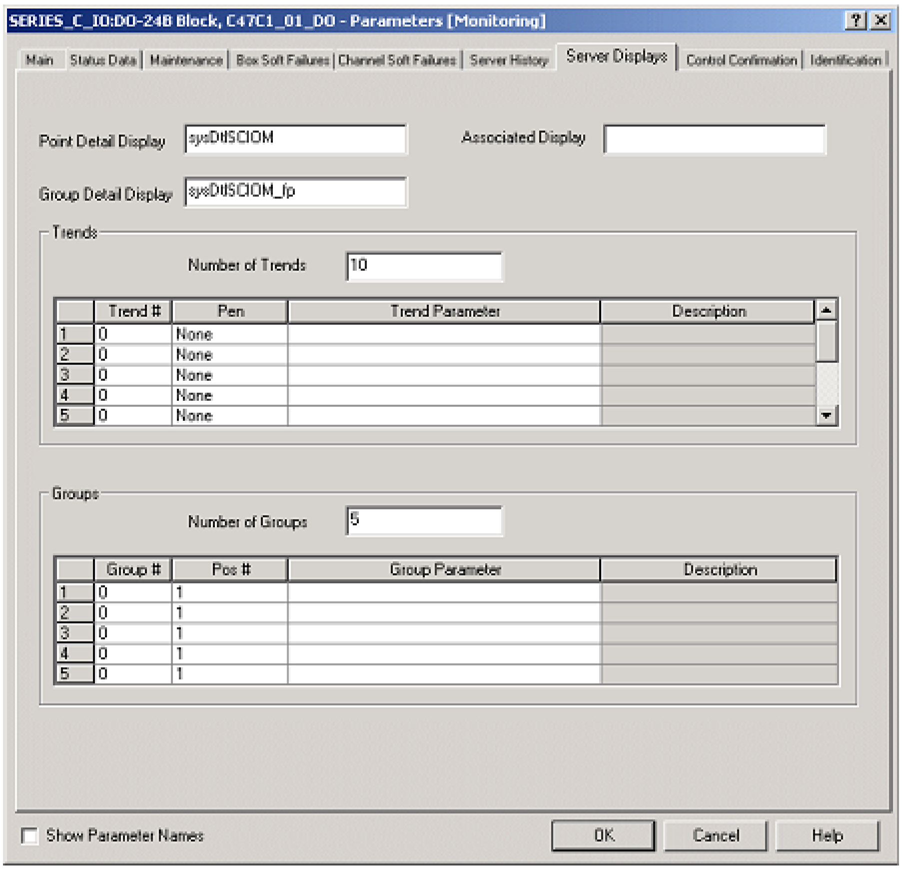
The following configuration information pertains to the Server Displays Failure tab for the following modules:

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B
- SP
- SVP
- PIM
- UIO
- UIO-2

All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Server Displays tab.

Figure 9.4 Server Display tab



The parameters of the Server Displays tab are listed in the following table.

Table 9.5 Server Display tab parameters

Plain text	Parameter name	User configurable	Notes
Point Detail Display	SCANPNTDTL	Yes	By default, a Display template is already entered into Point Detail Display box (for example, sysDtlFTEB.dsp). This template can be used for creating your own display or it can be used as is, provided that your function block name matches name built into detail display that is supplied as a template.
Group Detail Display	SCANGRPDTL	Yes	By default, a Display template is already entered into the Group Detail Display box (for example, sysGrpFTEB.dsp). This template can be used for creating your own display or it can be used as is, provided that your function block name matches name built into detail display that is supplied as a template
Associated Display	SCANASSOCDSP	Yes	Name of the Server display to be associated with this function block.
Number of Trends	TREND.NUMPARAMS	Yes	Defines the number of trend parameters to be included in the Trends Configuration table.
Trend #	-	Yes	Defines Trend number to be associated with this trend parameter
Trend Position		Yes	Defines position of the pen that will be used to

Plain text	Parameter name	User configurable	Notes
			trace assigned parameter on Station Trend display.
Trend Parameter	-	Yes	Valid parameter name for a parameter associated with given point that is configured for history collection.
Description	-	No	Provides a brief description of the entered parameter.
Number of Groups	GROUP.NUMPARAMS	Yes	Defines the number of group parameters to be included in Groups Configuration table.
Group #	-	Yes	Defines Group number to be associated with this group parameter.
Pos #	-	Yes	Defines number of position configured parameter will occupy in the Station Group display.
Group Parameter	-	Yes	Valid parameter name for a parameter associated with the given point that is configured in the system.
Description	-	No	Provides a brief description of the entered parameter.

9.7.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

9.7.2 To configure the Server Displays tab.

1. Under the **Server Displays** tab, enter the appropriate information to specify related **Point Detail Display**, **Group Detail Display**, and **Associated Display** along with values for appropriate parameters to define Trends and Groups for display. If necessary, press F1 to access on-line help for assistance during this step
2. Click OK on the configuration form to accept all configuration selections made on each configuration tab and to return to the Project tree.

9.8 Configuring Control Confirmation tab - IOM block

The Control Confirmation tab is common to all configuration forms for tagged blocks in Control Builder. If you have an optional Electronic Signature license, you can configure electronic signature information for the tagged block through this tab on the block's configuration form in Control Builder.

The Electronic Signature function aligns with the identical Electronic Signatures function that is initiated through Quick Builder and Station for Server points.

When this block is loaded to a controller,

- its control confirmation configuration (electronic signatures) is also loaded to the Server
- you can view the control confirmation configuration for this tagged object in Station and also make changes to it.
    - If you make changes through Station, you must initiate an Upload or Upload with Contents function through the Controller menu in Control Builder for the object in the Monitoring tab to synchronize changes in the Engineering Repository Database (ERDB).

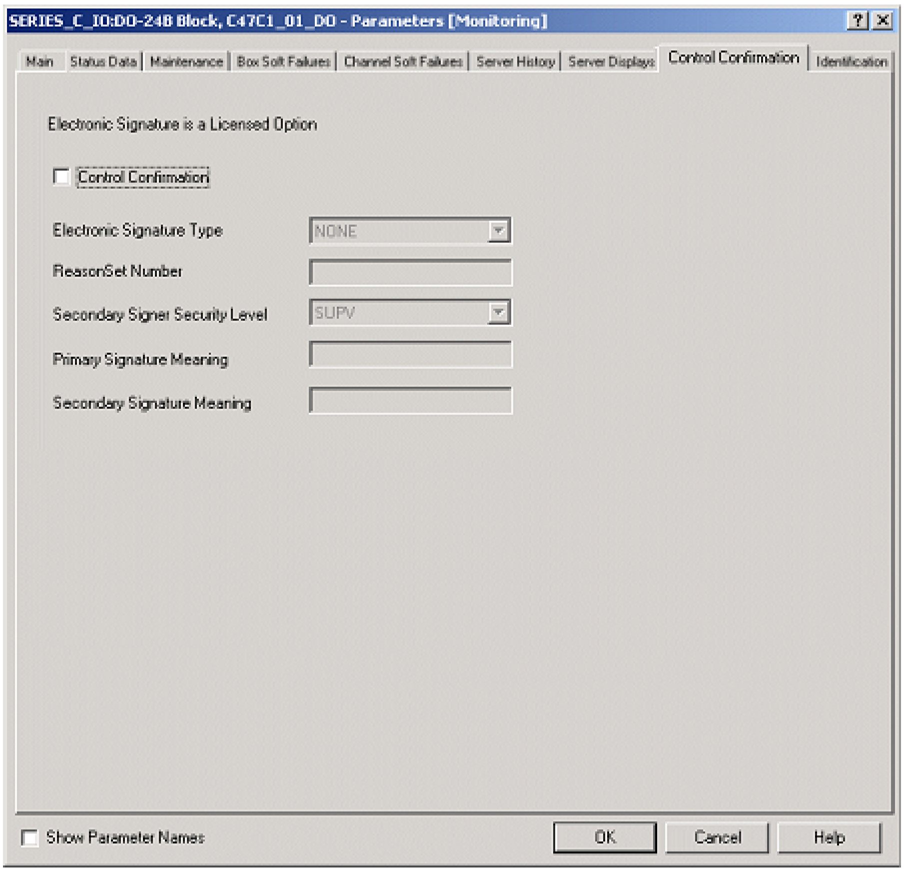
The following configuration information pertains to the Control Confirmation tab for all Series CI/O modules.

Control Confirmation is enabled by checking the Control Confirmation check box.

All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Control Confirmation tab.

Figure 9.5 Control Confirmation tab



9.8.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

9.8.2 To configure the Control Confirmation tab.

1. Under the **Control Confirmation** tab, check or clear the Control Confirmation check box. If necessary, press F1 to access on-line help for assistance during this step.
2. If the **Control Confirmation** check box is checked, the **Electronic Signature Type** drop-down list is enabled, with the options to select:
   - NONE
   - SINGLE
   - DOUBLE
3. Proceed to the following procedures to configure parameters on the remaining tabs for I/O Module, or click OK to accept only the changes made so far and return to the Project tree.

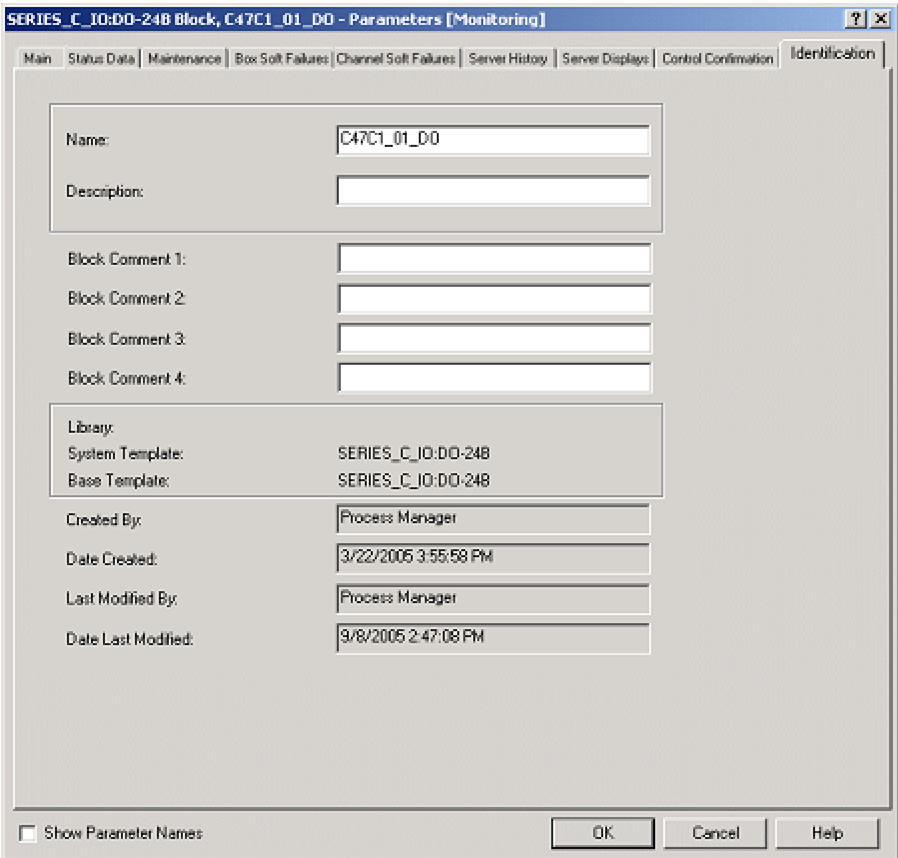
9.9 Configuring Identification tab - IOM block

The following configuration information pertains to the Identification tab for all Series C I/O modules.

All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Identification tab.

Figure 9.6 Identification tab



The parameters of the Identification tab are listed in the following table.

Honeywell

Table 9.6 Identification tab parameters

Plain text	Parameter name	User configurable	Notes
Name	NAME	Yes	Unique block name consisting of up to 40 characters to identify the block. At least one character in the name must be a letter (A-Z).
Description	DESC	Yes	Descriptive text appears on detail and group displays to uniquely describe this particular function block
Block Comment 1 Block Comment 2 Block Comment 3 Block Comment 4	BLCKCOMMENT1 BLCKCOMMENT2 BLCKCOMMENT3 BLCKCOMMENT4	Yes	Comment to be associated with this block consisting of up to 40 characters.
Library	-	No	Identifies Control Builder Library that is source of template.
System Template	-	No	Identifies System Template that is source for this block.
Base Template	-	No	Identifies Base Template that is used for this block.
Created By	CREATEDBY	No	Identifies user who created block, if operator security is implemented. Otherwise, may just show Default login.
Date Created	DATECREATED	No	Shows date and time template was created. If this block is in Version Control System, shows date and time initial version of template was created.
Last Modified By	MODIFIEDBY	No	Identifies user who made last modifications to block, if operator security is implemented. Otherwise, may just show default login. If this block is in Version Control System, modifications apply to last version of block.
Date Last Modified	VERSIONDATE	No	Shows date and time last modification was made to block's configuration. If this block is in Version Control System, modification date and time applies to last version of block.

9.9.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

9.10 Configuring QVCS tab - IOM block

Qualification and Version Control System (QVCS) provides version management for all tagged objects and a customer defined lifecycle management.

The following configuration information pertains to the QVCS tab for the following modules:

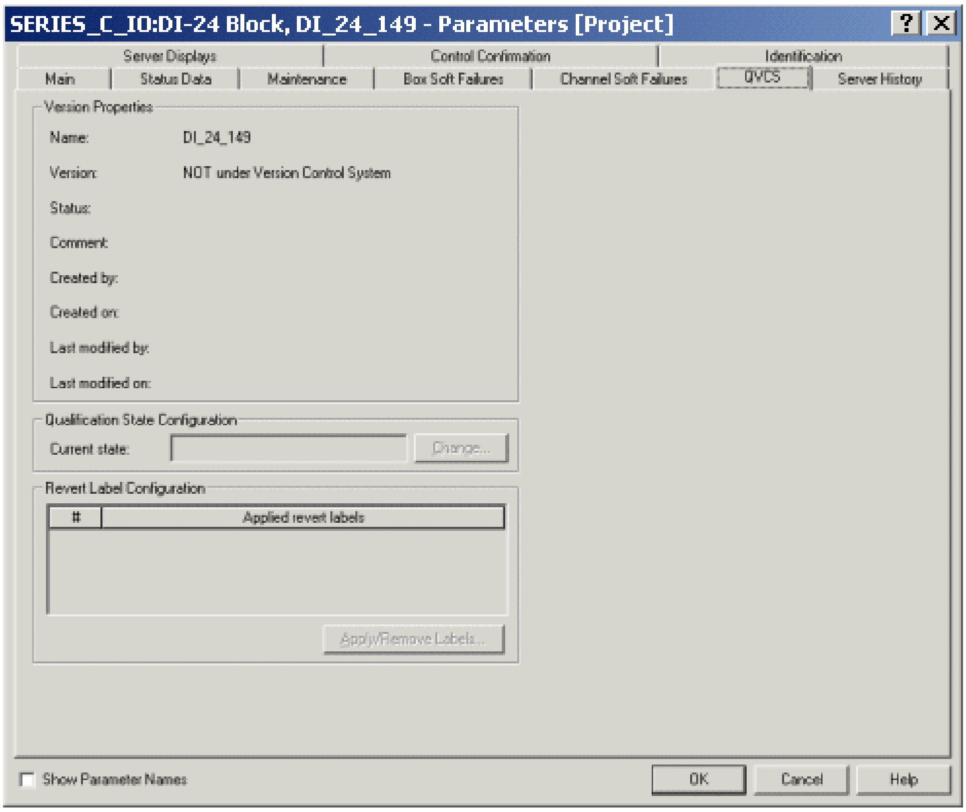
- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B
- SP
- SVP
- PIM
- UIO
- UIO-2

> NOTE
>
> No user-defined configuration setting on the QVCS tab.

All illustrations used in the procedure are for example purposes only

The following is an example of a DI-24 Block, Configuration form - QVCS tab.

Figure 9.7 QVCS tab



9.10.1 Prerequisites

- The optional QVCS license has been obtained and enabled
- Control Builder is running
- A Series C I/O control module was created

9.11 Configuring the Calibration tab - IOM block

The following configuration information pertains to the Calibration tab for the following modules:

- AI-HART
- AI-HL
- AI-LLMUX
- AO
- AO-HART
- SP
- SVP

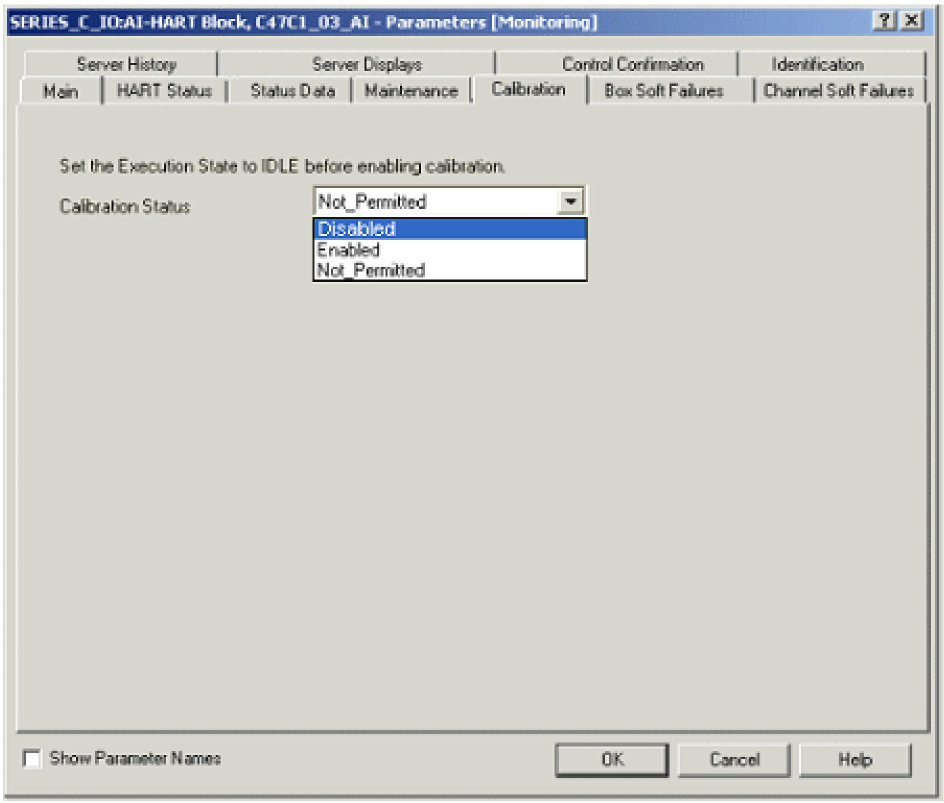
Calibration can only be done from Monitoring.

The Execution State must be set to IDLE before enabling and modifying calibration status.

All illustrations used in this procedure are for illustration purposes only

The following is an example of an AI-HART Block, Configuration form - Calibration tab.

Figure 9.8 Calibration tab



9.11.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

9.11.2 To configure the Calibration Status

1. Select either:
   - Disabled indicates disabling Calibration
   - Enabled indicates enabling Calibration

   Not Permitted indicates the Execution State of the IOM is still in the RUN state, which does not allow you to select Disable or Enable. Changing the Execution State of the IOM to IDLE allow you to modify the Calibration Status.
2. Proceed to the following procedures to configure parameters on the remaining tabs for the module, or click OK to accept only the changes made so far and return to the Project tree.

9.12 Configuring HART Status tab - IOM block

The following configuration information pertains to the HART Status tab for the following:

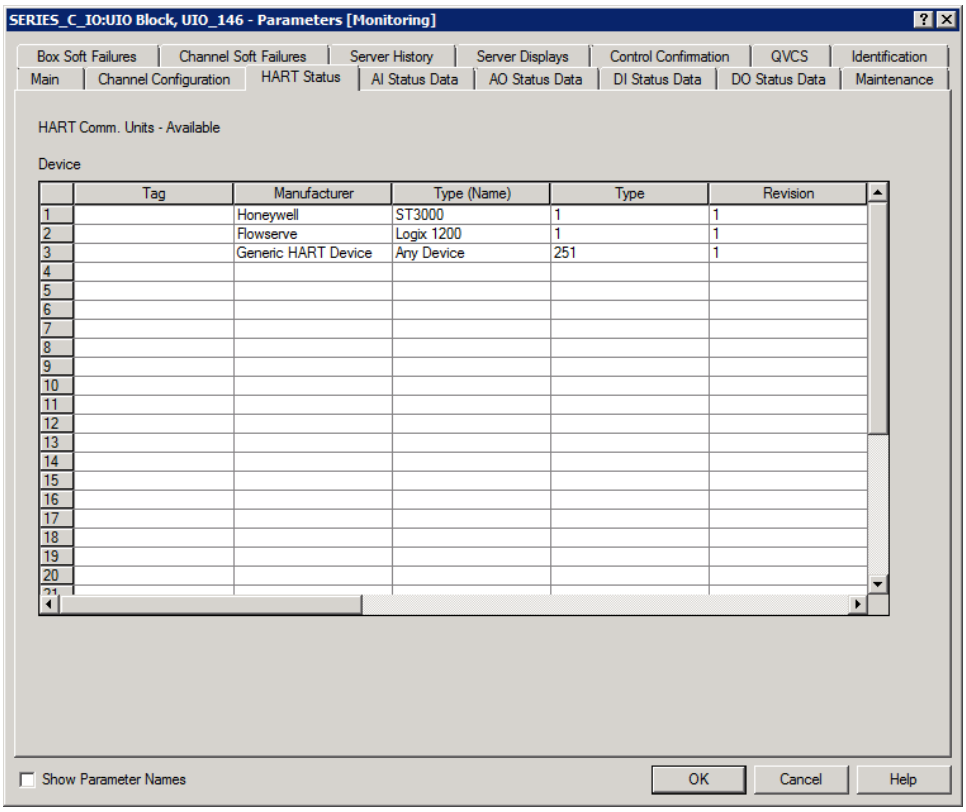
- AI-HART
- AI-HL
- AO
- AO-HART
- UIO
- UIO-2

> NOTE
>
> No user-defined configuration setting on the HART Status tab and there are no configuration items in HART status tab.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI-HART Block, Configuration form - HART Status tab.

Figure 9.9 HART Status tab



9.12.1 Prerequisites

- A Series C I/O control module is created

9.13 Configuring the Configuration tab – Channel block

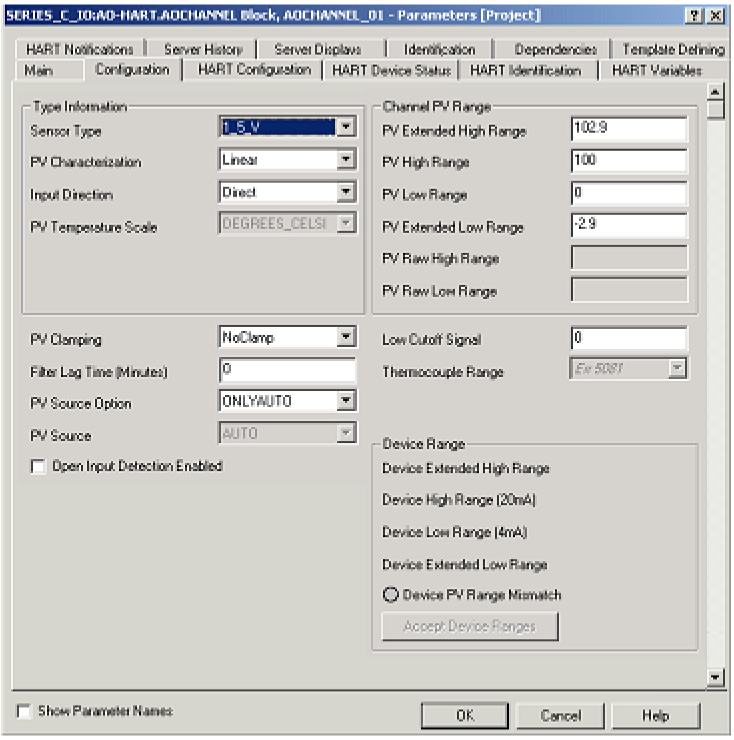
The following configuration information pertains to the Configuration tab for Series C I/O Analog

Input or Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AO Channel Block, Configuration form - Configuration tab.

Figure 9.10 Configuration tab

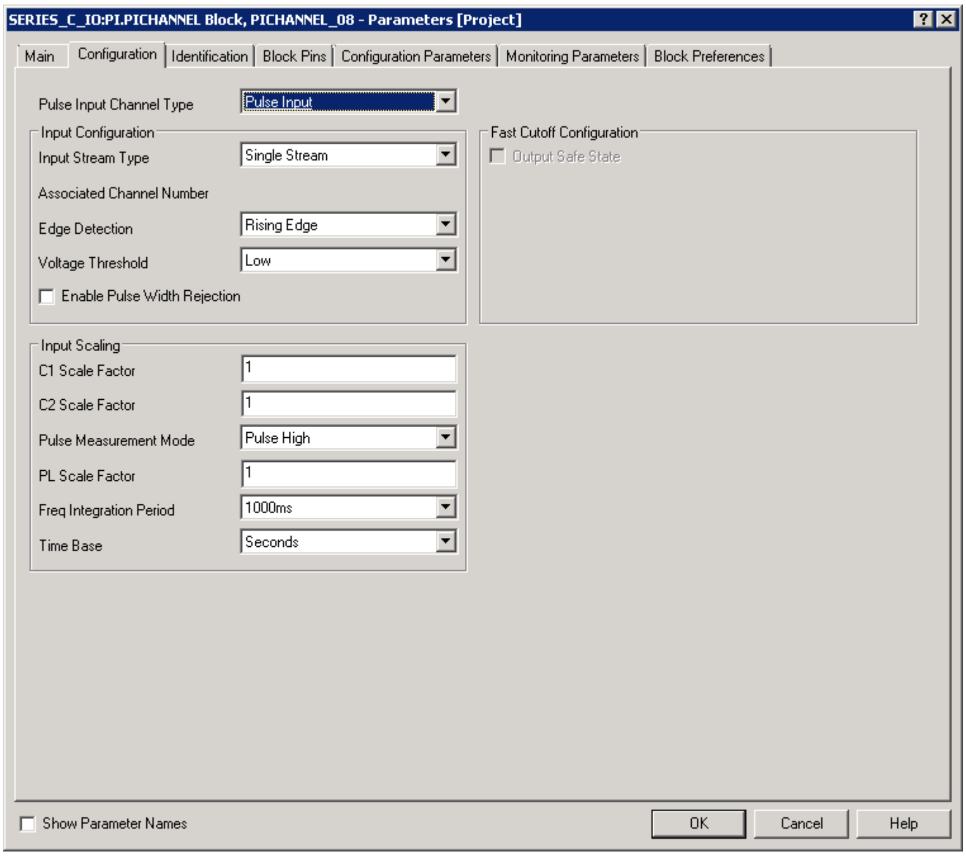


9.13.1 Prerequisites

- A Series C I/O control module is created

9.14 Configuring the Configuration tab - PI channel block

The following figure is an example of the **Configuration** tab of the PI channel block.



9.14.1 To configure the Configuration tab

1. Click the **Configuration** tab of the channel block.

   The **Configuration** tab configuration form appears. The value **Pulse Input** is selected by default in the **Pulse Input Channel Type** box.

2. Select the pulse input type in the **Pulse Input Channel Type** box. The available options are as follows:

   - **Pulse Input**- You can configure all eight channels as pulse input channel types.
   - **Pulse Input with Fast Cutoff**- You can only configure channel 7 and channel 8 for fast cutoff applications.

   The following parameters in the **Main** tab of the PI channel block are enabled after the module is loaded when the input type is **Pulse Input with Fast Cutoff**.

   - **Output Safe State (SAFEOUTPUT)**
   - **Target Value (TV)**
   - **TV Processing Run Flag (TVPROC)**
   - **Output State (SO)**
   - **Bad Output State Flag (BADSO)**
   - **SO Command OFF (SOCMDOFF)**
   - **SO Command ON (SOCMDON)**

> NOTE
> These parameters are disabled when the input type is selected as

3. Select the input stream type in the **Input Stream Type** box. You can select one of the following:
   - **Single Stream** - You can select this option for all channels.
   - **Dual Stream** - You can select this option only for odd-numbered channels.

   Whenyou configure a channel for **Dual Stream**, its associated even-numbered channel number appears in the **Associated Channel Number** box.

   For example, if you have configured channel 1 for dual stream, the channel number 2 appears in the **Associated Channel number** box.

> ATTENTION
> - When you select the pulse input channel type as **Pulse Input with Fast Cutoff** for Fast Cutoff channels (channel 7 and channel 8), **Single Stream** is selected by default and is non-editable.
> - When you select the pulse input channel type as **Pulse Input**, you can configure **Dual Stream** on the Fast Cutoff channels (channel 7 and channel 8).
> - **Dual Stream** option is not applicable for Fast Cutoff channels (channel 7 and channel 8) when the **Pulse Input Channel type** as **Pulse Input with Fast Cutoff. In this scenario,** the option **Single Stream** is selected by default and is non-editable.
> - If you select the **Input Stream Type** as **Dual Stream** for odd-numbered channels, then you cannot configure their associated even numbered channels. For example, if you have configured channel 1 as Dual Stream, you cannot configure channel 2. In addition, the associated channel does not appear in the tree view if you have configured the channel for Dual Stream.
> - If the CM already contains the even-numbered channel and you try to configure its associated odd-numbered channel as Dual Stream, an error message appears. You need to delete the associated even-numbered channel from the CM. For example, if a CM contains channel 3 and channel 4, and you try to configure channel 3 as Dual Stream, an error message appears. You need to delete channel 4 to configure channel 3 as Dual Stream.
> - When a channel is configured for Dual Stream, the **Status Data** tab of the PIM does not display any values for the associated channel in the Monitoring view. For example, if you have configured channel 3 for Dual Stream, the channel 4 row in the **Status Data** tab does not display any values.

4. Select the **Enable Pulse Width Rejection** check box if you want the pulse widths less than a specified duration to be excluded from counting.

> NOTE
> Refer to the Series C Spec and Tech data for the specific duration.

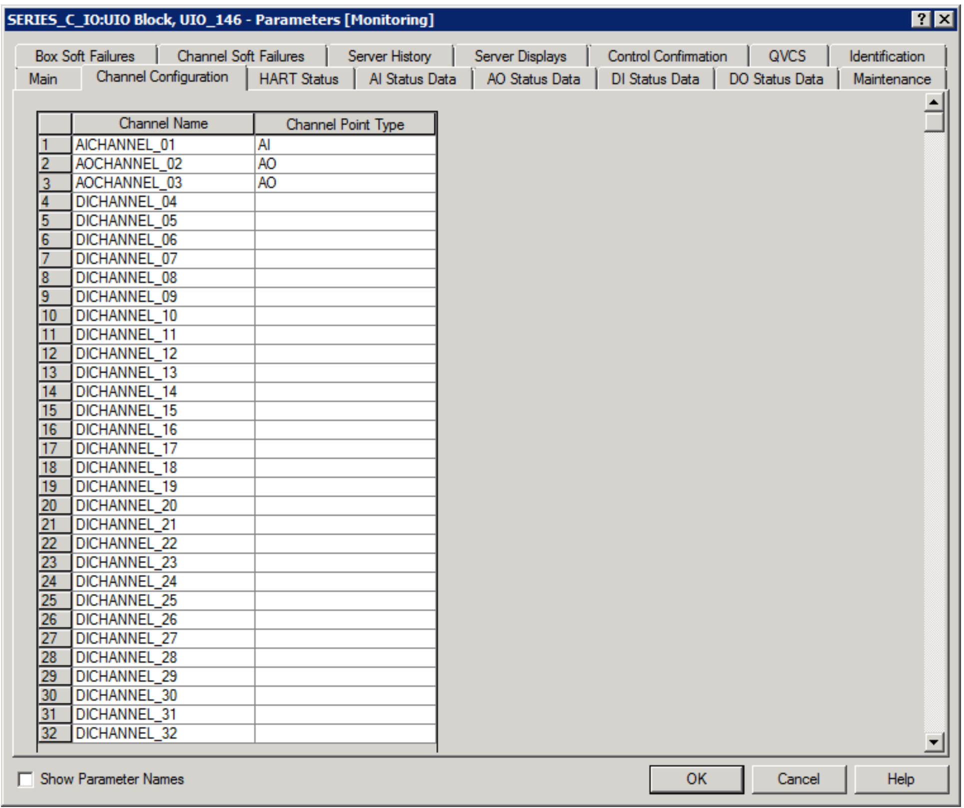
5. Refer to the *Control Builder Parameter Reference* document for more information on configuring other parameters.
6. Click **OK**.

9.15 Configuring Channel Configuration tab - UIO/UIO-2 module block

The Channel Configuration tab enables you to configure the channel types of the UIO/UIO-2 module.

The following figure is an example of the Channel Configuration tab of the UIO/UIO-2 module.

Figure 9.11 Channel Configuration tab



9.15.1 To configure the Channel Configuration tab

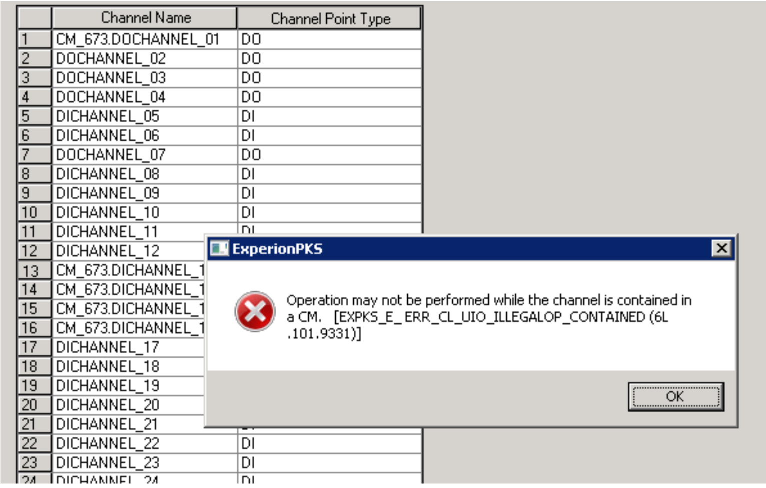
1. From the Monitoring view, right-click the UIO channel and click Block Properties.

   The UIO channel configuration form appears.

2. Click the **Channel Configuration** tab.

   The **Channel Configuration** tab configuration form appears. The point type is selected as **DI,** by default.

> ATTENTION
>
> The channel type/point type cannot be changed if the UIO channel is already configured in any Control Module.



3. Select the point type for each **Channel Name**.

   Note: When the channels are configured in the **Channel Configuration** tab, the respective status data tabs (**AI Status Data**, **AO Status Data**, **DI Status Data**, and **DO Status Data**) are updated with the channel configuration information.

> ATTENTION
>
> You can also configure the channel type from the Project view by performing the following steps.
>
> a. Right-click the channel name.
>
> b. Click **Channel Type Setting** and click channel type.
>
>   Channel Type Setting option does not appear in the Control Builder if a UIO channel is already configured in any Control Module.

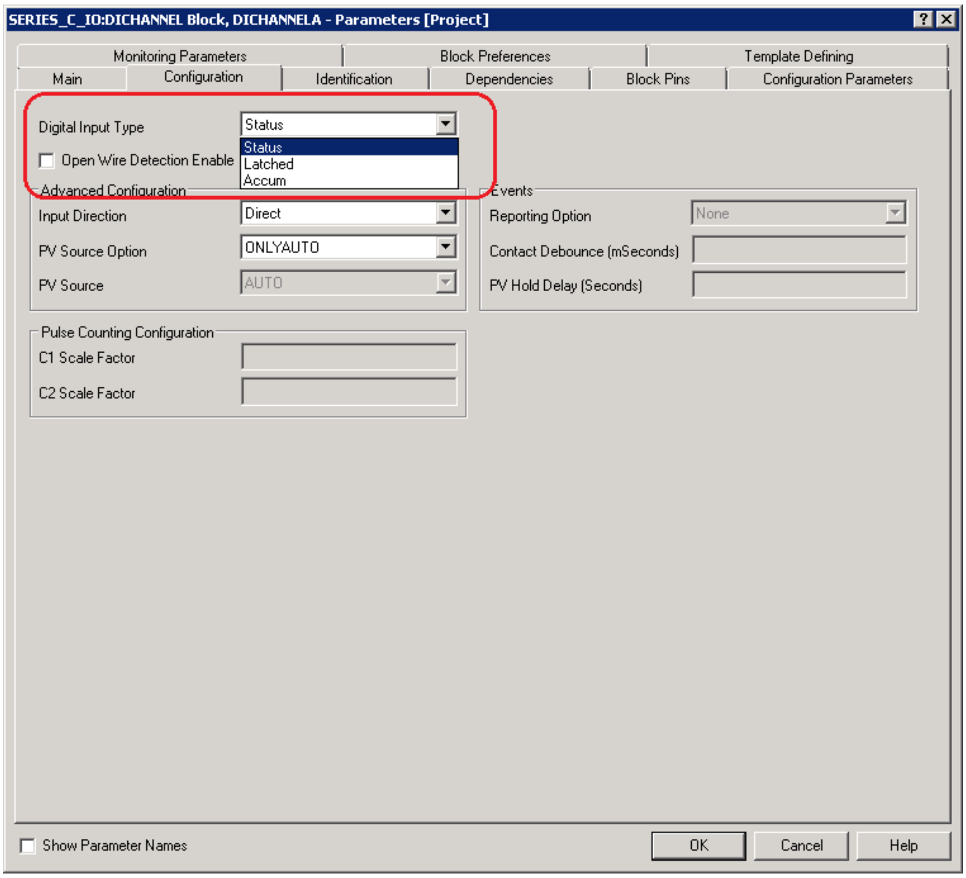
4. Click **OK**.

9.16 UIO/UIO-2 DI channel block configuration

The Configuration tab enables you to configure the DI channels for pulse counting functionality.

The following figure is an example of the Configuration tab of the UIO-DI channel.

Figure 9.12 Configuration tab - UIO-DI channel



- Configuring the DI channel for pulse counting

9.16.1 Configuring the DI channel for pulse counting

DI channel pulse counting functionality is configured for pulse counting.

Prerequisites

For UIO, you can configure up to four channels only on DI channels 15 to 18 for pulse counting.

For UIO-2, you can configure up to four of any of the available 32 channels configured as DI for pulse counting.

To configure the Configuration tab

1. From the Project view, right-click the UIO-DI channel and then click **Block Properties**.

   The UIO-DI channel configuration form appears.
2. Click the **Configuration** tab.
3. Configure the **Digital Input Type** as "Accum."
4. Click **OK**.

Results

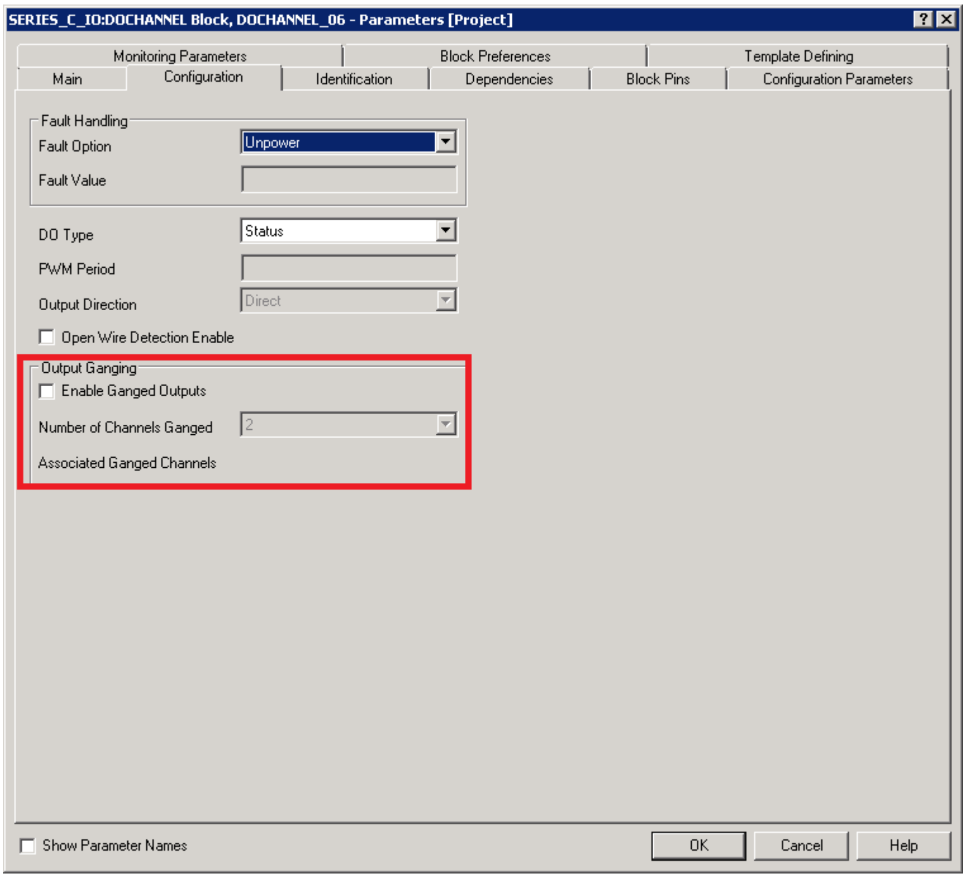
The DI channel is configured for pulse counting.

9.17 Configuring the Configuration tab - UIO/UIO-2 DO channel block

The Configuration tab enables you to configure the DO channels for ganging.

The following figure is an example of the Configuration tab of the UIO-DO channel.

Figure 9.13 Configuration tab - UIO-DO channel



- Configuring the DO channel for ganging

9.17.1 Configuring the DO channel for ganging

Prerequisites

Adjacent channel that are being ganged must be configured as DO channel types and not contained individually in other Control Modules.

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- For UIO, up to four channels (2, 3 or 4) channels can be ganged within any four adjacent channels. For example: you can gang channels 4 and 5 or 4, 5 and 6 or 4, 5, 6 and 7. However, channels 32 and 1 cannot be ganged.
- For UIO-2, DO ganging within the following eight channel number groups is possible: 1 - 4, 5 - 8, 9 - 12, 13 - 16, 17 - 20, 21 - 24, 25 - 28, and 29 – 32. However, ganging across these groups is NOT possible. For example, ganging channels 3, 4, and 5 is not possible as they do not belong to the same channel group Ch 1 to 4 or Ch 5 to 8.

To configure the Configuration tab

1. From the Project view, right-click the UIO-DO channel and click **Block Properties**.

   The UIO-DO channel configuration form appears.
2. Click the **Configuration** tab.

   The Configuration tab configuration form appears.
3. Select the **Enable Ganged Outputs** check box.

   The **Number of Channels Ganged** drop-down list is enabled for configuration.
4. Select the number of channels to be ganged from the **Number of Channels Ganged** drop-down list.
5. Click **OK**.

Results

The DO channel is configured for ganging.

9.18 Configuring HART Configuration tab - Channel block

The following configuration information pertains to the HART Configuration tab for all Series C I/O Analog Input and Analog Output modules.

The parameter HALARMENABLE is added to HART configuration tab in the channel block and:

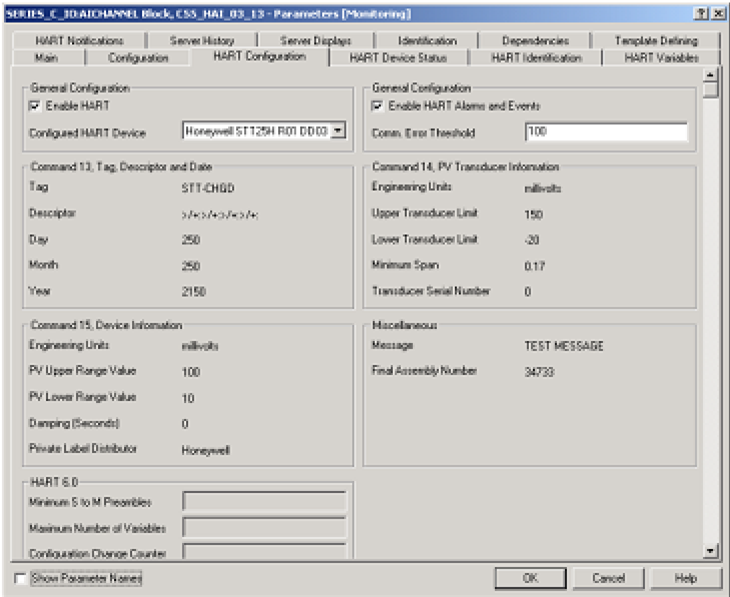
- is enabled by default
- in addition, can be changed from monitoring side, irrespective of the channel point execution state of the IOM module state.

> ATTENTION
>
> When HALARMENABLE is disabled
>
> - all the existing HART events / alarms from that channel block are disabled
> - further generation of the HART alarms / events are terminated.
>
> Note: This parameter affects only the HART alarm / event behavior. The LED device status in the HART device status tab is not impacted by the state of HALARMENABLE.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Configuration tab.

Figure 9.14 HART Configuration tab



The parameters of the HART Configuration tab are listed in the following table.

Table 9.7 HART Configuration tab parameters

Plain text	Parameter name	User configurable
General configuration		
Enable HART	HENABLE	Yes
Enable HART Alarms and Events	HALARMENABLE	Yes
Configured HART Device	HCFGDEV	Yes
Comm. Error Threshold	HCOMTHRS	Yes
Command 13, tag descriptor and date		
Tag	HTAG	No
Descriptor	HDESC	No
Day	HDAY	No
Month	HMONTH	No
Year	HYEAR	No
Command 14, tag descriptor and date		
Engineering Units	HTDEU	No
Upper Transducer Limit	HTDURL	No
Lower Transducer Limit	HTDLRL	No
Minimum Span	HTDMINSPAN	No
Transducer Serial Number	HTDSN	No

9.18.1 Prerequisites

- A Series C I/O control module is created

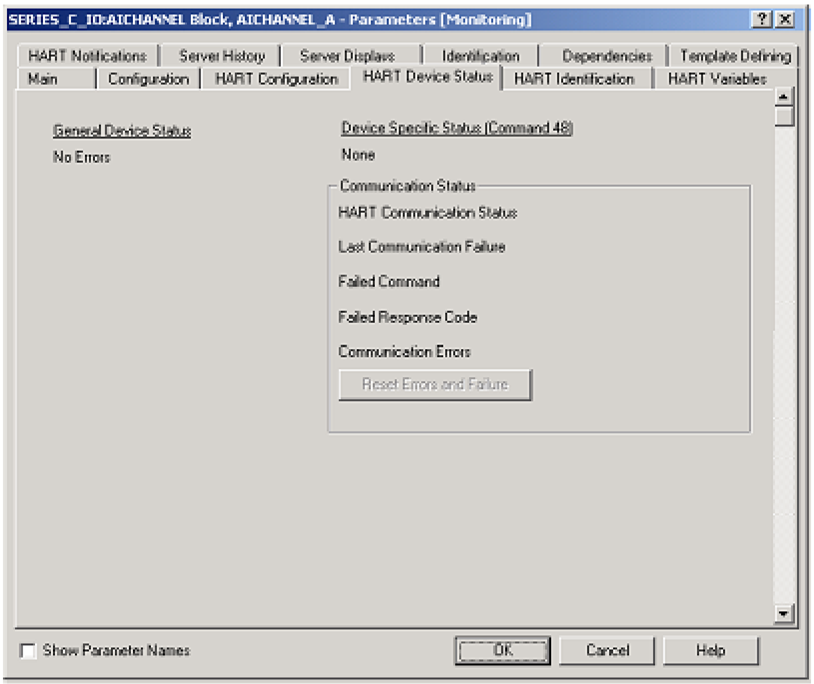
9.19 Configuring HART Device Status tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Device Status tab.

Figure 9.15 HART Device Status tab



The parameters of the HART Device Status tab are listed in the following table.

Table 9.8 HART Device Status tab parameters

Plain text	Parameter name	User configurable
Communication Status		
HART Communication Status	HCOMSTS	No
Last Communication Failure	HCOMFAIL	No
Failed Command	HCMDFAIL	No
Failed Response Code	HCMDRESP	No
Communication Errors	HNCOMERR	No

9.19.1 Prerequisites

- A Series C I/O control module was created

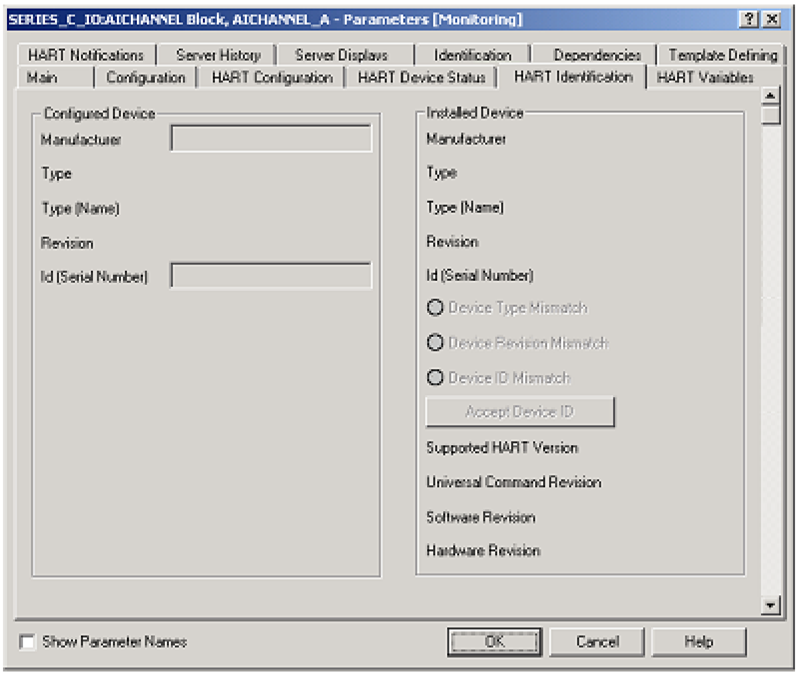
9.20 Configuring HART Identification tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O Analog Input and Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Identification tab.

Figure 9.16 HART Identification tab



The parameters of the HART Identification tab are listed in the following table.

Table 9.9 HART Identification tab

Plain text	Parameter name	User configurable
Configured device		
Manufacturer	HDVMFGCD	No
Type	HDVTYPCD	No
Type (Name)	HDVTYPCDNAME	No
Revision	HDVRREVCD	No
Id (Serial number)	HDEVIDCD	No
Installed device		
Manufacturer	HDEVMFG	No
Type	HDEVTYP	No
Type (Name)	HDEVTYPNAME	No
Revision	HDEVRREV	No
Id (Serial number)	HDVID	No
Device Type Mismatch	HDEVMISM	No
Device Revision Mismatch	HREVMISM	No
Device ID Mismatch	HDEVIDFL	No
Accept Device ID	ACCEPTDEV	No
Supported HART Version	HARTVERSION	No
Universal Command Revision	HUCMREV	No
Software Revision	HSWREV	No
Hardware Revision	HHWREV	No

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9.20.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

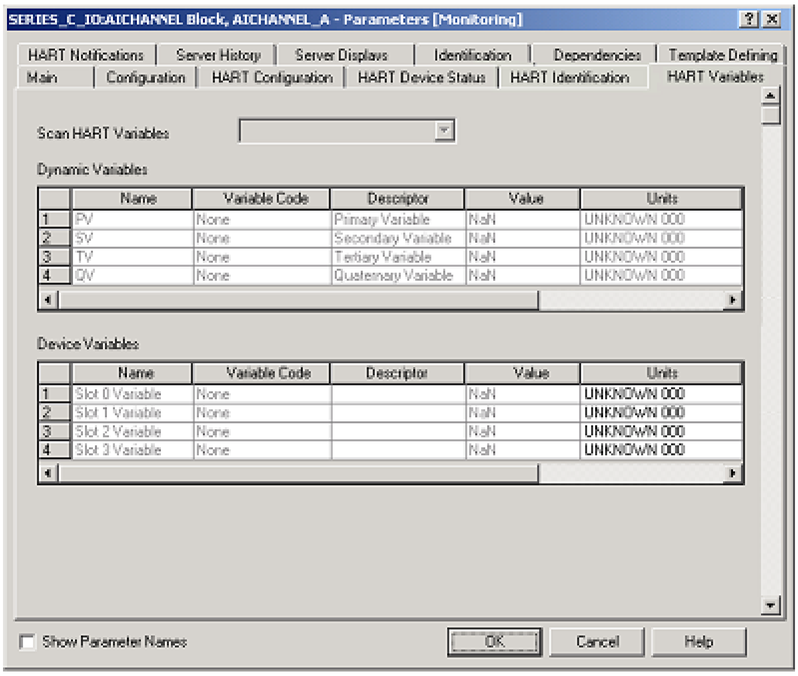
9.21 Configuring HART Variables tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O Analog Input or Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Variables tab.

Figure 9.17 HART Variables tab



The parameters of the HART Variables tab are listed in the following table.

Table 9.10 HART Variables tab parameters

Plain text	Parameter name	User configurable
Scan HART Variables	HSCANCFG	Yes
Dynamic variables		
Name	HDYNNAME	Yes
Variable Code	HDYNDVC	Yes
Descriptor	HDYNDSC	Yes
Value	HDYNVAL	Yes
Units	HDYNEU	Yes
Device variables		
Name	HSLOTNAME	No

Plain text	Parameter name	User configurable
Variable Code	HSLOTDVC	Yes
Descriptor	HSLOTDSC	Yes
Value	HSLOTVAL	No
Units	HSLOTEU	No

9.21.1 Prerequisites

- Control Builder is running
- A Series C I/O control module was created

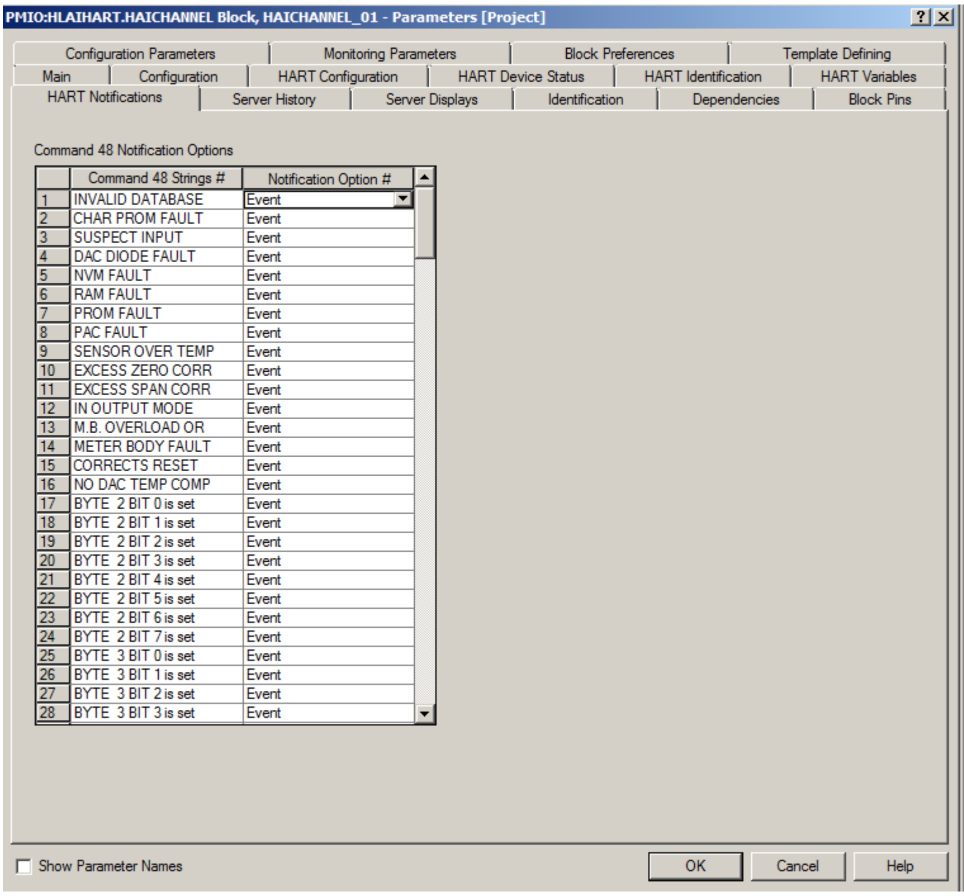
9.22 Configuring HART Notifications tab - Channel block

After importing the Device Description and assigning the device type to the channel, you can modify the Command 48 string notification types of the channel from the Project view. However, after modifying the notification types, you must user Load or Load values while Active option.

The following configuration information pertains to the Identification tab for all PM I/O Analog Input and Analog Output modules.

All illustrations used in the procedure are for example purposes only

Figure 9.18 HART Notifications tab



The parameters of the HART Notifications tab are listed in the following table.

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Table 9.11 HART Notifications tab parameters

Plain text	Parameter name	User configurable
Command 48 Strings	HCMD48STRINGS	No
Notification Option	HCMD48NOTIFY	Yes

For more information about modifying notification option, refer to HART I/O Implementation Guide.

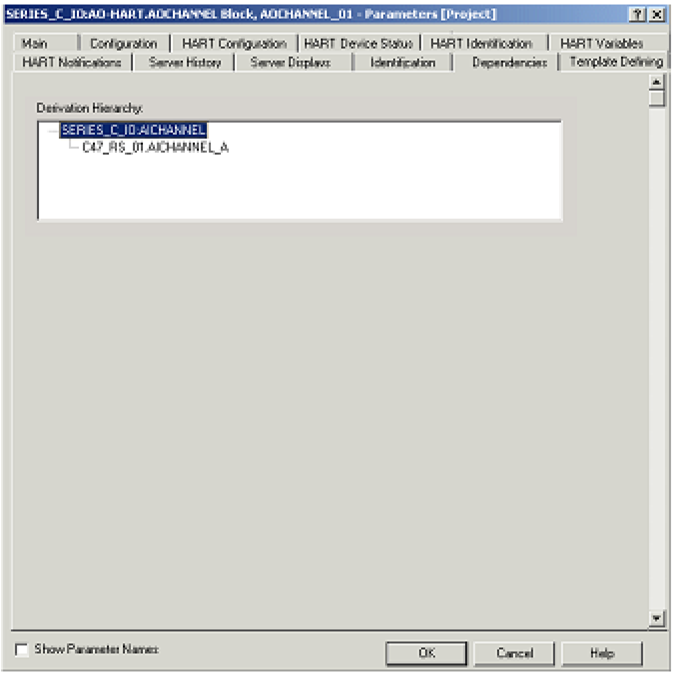
9.23 Configuring Dependencies tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O Analog Input and Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AO Channel block, Configuration form - Dependencies tab.

Figure 9.19 Dependencies tab



9.23.1 Prerequisites

- A Series C I/O control module is created

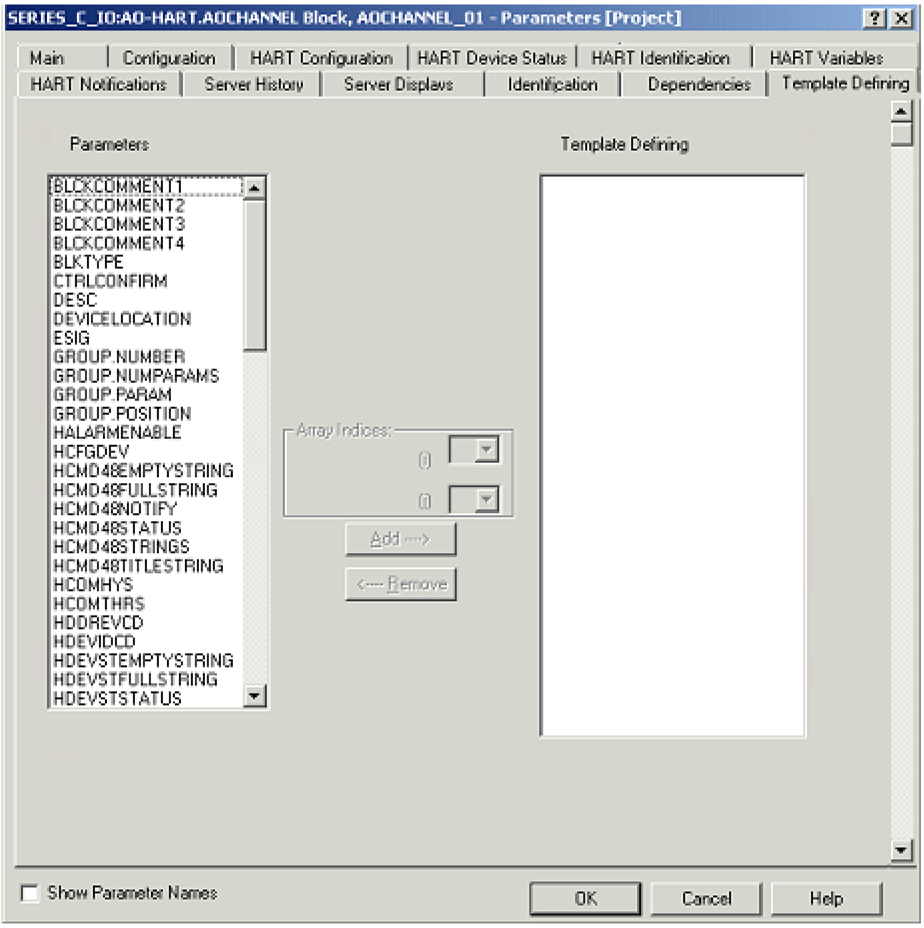
9.24 Configuring Template Defining tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O Analog Input and Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AO Channel Block, Configuration form - Template Defining tab.

Figure 9.20 Template Defining tab



9.24.1 Prerequisites

- A Series C I/O control module is created

CHAPTER

10

SERIES C I/O CONFIGURATION

10.1 Adding an IOM to Project

The following IOMs are added to the Project tab using the either the File menu method or the Drag and Drop method:

- AI-HART - High Analog Input, HART Capable, 16 channels
- AI-HL - High Level Input, 16 channels
- AI-LLMUX - Low Level Analog Input Mux, 64 channels
- AI-LLAI - Low Level Analog Input Mux, 16 channels
- AO - Analog Output, 16 channels
- AO-HART - Analog Output, HART Capable, 16 channels
- DI-24 - Low Voltage (24VDC) Digital Input, 32 channels
- DI-HV - High Voltage Digital Input, 32 channels
- DI-SOE - Digital Input - Sequence of Events, 32 channels
- DO-24B - Bussed Low Voltage Digital Output, 32 channels
- SP - Speed Protection Module, 26 channels
- SVP - Servo Valve Positioner Module, 8 channels
- PIM - Pulse Input Module
- UIO - Universal I/O, 32 channels

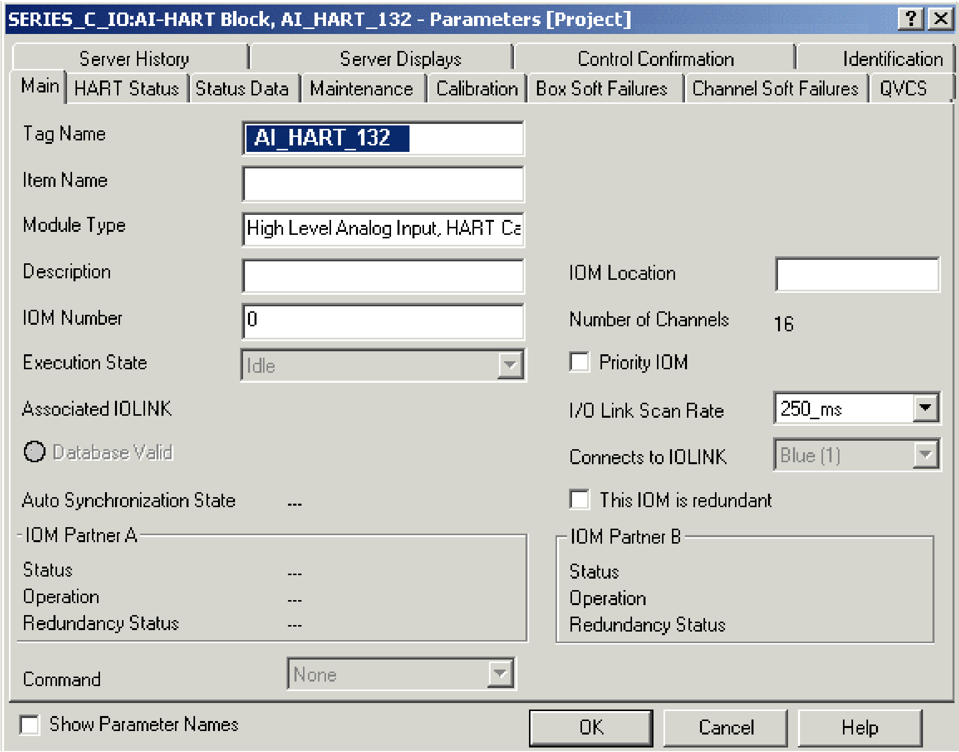
- Using the File menu method
- Using the drag and drop method

10.1.1 Using the File menu method

To add an IOM to the Project tab by the File menu method:

1. Click **File** > **New** > **I/O Modules** > **Series C I/O**.

   Result: A list of the available Series C I/O block types is displayed.
2. Select a block types from the drop down list. A Block Parameters configuration form is displayed



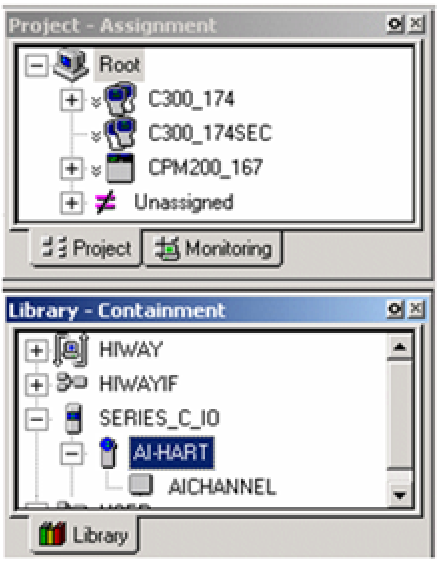
3. Type a new name in the highlighted name field.
4. Click the OK button. A new IOM instance is created in the Project tab.

> **TIP**
> IOM names can be up to 40 characters long.

10.1.2 Using the drag and drop method

To add an IOM to the Project tab by the drag and drop method:

1. Drag an IOM icon from the Library tab to an open area on the Project tab. Name New Function Block(s) dialog appears.



2. Accept or type a new tag name in the Destination column.
3. Click the Finish button. The IOM is displayed in the Project tab.

> **TIP**
> IOM names can be up to 40 characters long.

10.2 Assigning an IOM to an IOLINK

The following are the different ways to assign the IOMs to an IOLINK.

- Assigning an IOM to an IOLINK using the **Assignment** dialog box (from Unassigned items)
- Assigning an IOM to an IOLINK using the drag-and-drop mechanism (from Unassigned items)
- Assigning an IOM to an IOLINK using the drag-and-drop mechanism (from Library view)

10.2.1 Prerequisites

The IOM is created and exists under **Unassigned** in the Project view.

10.2.2 To assign an IOM to an IOLINK using Assignment dialog box

1. Choose **Edit** > **Execution Environment Assignment**, or click assignment button in the tool bar.

   The **Execution Environment Assignment** dialog box appears.

   > TIP
   >
   > You can also use "Shift key and click " or "Ctrl +A" to select multiple items in **Available Modules** and **Assigned Modules** lists.

2. Click the desired IOM to be assigned to a given IOLINK from the **Available Modules** list.

   The selected IOMs are highlighted and the configured IOLINKs appear in the **Assign To** list.
3. Accept default IOLINK selection or click desired IOLINK in the **Assign To** list.

   Ensure that you select the correct IOLINK from the list.
4. Click **Assign**.

   The assigned IOMs appear in the **Assigned Modules** list.

   > ATTENTION
   >
   > You can repeat the same procedure for the remaining IOMs.

5. Click **Close**.

   The assigned components appear under the IOLINK folder in the Project view.

10.2.3 To assign an IOM to an IOLINK using the drag-and-drop mechanism (from Unassigned items)

1. Double-click the IOLINK in the Project view.

   The IOLINK configuration form appears.
2. Configure the **I/O Family (IOLINKTYPE)** as “SERIES_C8_IO” for Series C modules.
3. Click **OK**.
4. Drag the IOMs from the Unassigned items to the IOLINK.

   You must assign the IOMs to the corresponding IOLINK.

   > ATTENTION
   >
   > If you try to assign a PM I/O to an IOLINK configured as “SERIES_C8_IO,” then an error message appears.

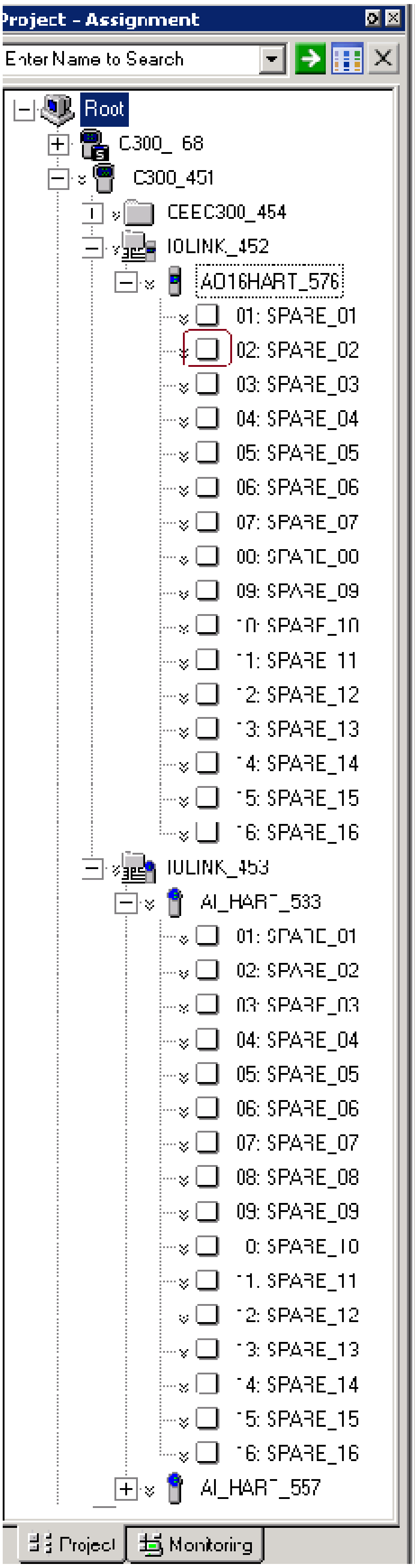
   The assigned components appear under the IOLINK folder in the Project view.

10.3 Converting the Spares to specific channel type

By default, while creating the IOMs, the I/O channels associated with the PM I/O or the Series C

IOM appear as "SPARE." A Spare represents a channel number that has not been designated as used. The Spare does not support configuration and cannot be renamed. The Spare is represented by a different icon (highlighted in the figure) in the tree view. The following figure displays the representation of the Spares and the IOMs in the Project view.

Figure 10.1 Spare representation in the Project view



You can convert the Spare to the respective supported channels by one of the following options.

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- Using the **Channel Type Setting** option
- Using the **Channel Configuration** tab of the IOM's configuration form

After a Spare has been converted to a channel, the channel may be configured and referenced by a CM or an SCM.

> ATTENTION
>
> The Spares of an Universal Input/Output (UIO) module can be converted to one of following channels.
>
> - AI
> - AO
> - DI
> - DO

> ATTENTION
>
> The channel type can be modified only if the channel is not used in any control strategies and the channel is not loaded.

The procedure explained here is common for all PM I/O, Series C I/O, and Simulation I/O channels.

10.3.1 Prerequisites

IOM is created.

10.3.2 To assign a channel by converting the Spares using the Channel Type Setting option

1. In the Project view, right-click any Spare of the PM I/O or the Series C I/O, and click **Channel Type Setting**.
2. Click the appropriate sub menu option.

   The Spare is replaced with a channel of the selected type.

   > ATTENTION
   >
   > The SIM IOM does not support the conversion of Spare to specific channel type.

10.3.3 To assign a channel by converting the Spares using the configuration form

1. In the Project view, double-click the PM I/O module or the Series C module.

   The configuration form of the IOM appears.
2. Click the **Channel Configuration** tab.
3. Select the **Channel Point Type (PNTTYPE)** for each **Channel Name (CHNLNAME)**.
4. Click **OK**.

   The Spares are converted to a specific channel type. In addition, the parameters of the specific channel type are auto-populated.

10.4 Assigning the channel to IOM by instantiation

10.4.1 Prerequisites

An empty slot is available for associating the instantiated channel.

10.4.2 To assign a channel to an IOM by instantiating the channel

1. In Library view, locate the PM I/O or Series C IOM.
2. Expand the IOM type, right-click a channel, and then click **Instantiate**.

   The channel configuration form appears.

   The IOPTYPE of the channel is set based on selected IOM type.
3. (Optional) If you know the IOPTYPE to which the instantiated channel to be assigned, then perform the following steps.
   a. Select the IOPTYPE from the **Associated IOP Type (IOPTYPE)** list.
   b. Select the **Associated IOP (IOP)** using the point picker.
   c. Click **OK**.
4. If you do not know the IOPTYPE to which the instantiated channel needs to be assigned, click **OK**.

   The instantiated channel appears in the Unassigned view.
5. Select the **Associated IOP (IOP)** using the point picker.
6. Type the **Channel Number (CHANNUM)**.
7. Click **OK**.

   The channel is assigned to the IOM.

10.5 Assigning the channel to IOM through Bulk Edit

Bulk Edit can be used to assign the PM I/O and the Series C I/O channels from one IOM to another IOM. In addition, Bulk Edit can be used to move the channels from Unassigned view to the corresponding IOMs.

ATTENTION

This procedure is identical for the PM I/O, Series C I/O, and SIM I/O channels.

10.5.1 To assign the channel to IOM through Bulk Edit

1. Choose **Tools** > **Bulk Edit Parameters** > **Create Bulk Edit List**

   The **Create Bulk Edit List** dialog box appears.
2. Select the channel blocks to be assigned or moved from the **Available Points** list.

   You can sort the channel blocks by using the column header (**Types**).
3. Click the arrow to move the selected channel blocks from the **Available Points** list to the **Selected Points** list.
4. Select the following parameters from the **Available Parameters**.
   - Channel Number (CHANNUM)
   - Associated IOP (IOP)

   ATTENTION

   If you are assigning or moving a channel to a SIM IOM, then select and edit only the Associated IOP (IOP) parameter from the configuraiton form. The selected channel is automatically assigned or moved to the SIM IOM. However, if you are moving or assigning a channel from SIM IOM to another IOM, then you must specify both the Associated IOP (IOP)and Channel Number (CHANNUM) parameters.
5. Click the arrow to move the selected parameters from the **Available Parameters** list to the **Selected Parameters** list.
6. Set the name and the path for storing the spreadsheet.
7. Click **Save**.
8. Click **Close**.
9. Open the spreadsheet, and then specify the new IOP names and the channel numbers.

   ATTENTION

   Before specifying the channel number, ensure that a spare is available in the selected IOM.
10. Save the spreadsheet, and then close it.
11. Choose **Tools** > **Bulk Edit Parameters** > **Read Bulk Edit List**

    The **Read Bulk Edit List** dialog box appears.
12. Browse to the path where you have saved the spreadsheet.
13. Click **Update Project**, and then click **Start**.

    The selected list is read and the status is displayed.

14. Click **Close**.

    The channels are assigned or moved to the specified IOMs. If there are any errors, then the errors are displayed in the errors grid and the channels are not assigned or moved.

10.6 Adding an IOC block to a Control Module using the Library tab

You can integrate IOC blocks into control strategies without assigning them to an IOM. This ability provides hardware independent control building.

IOC blocks cannot be added to Control Modules already assigned to a FIM.

The Control Module cannot be loaded until all IOC blocks have been assigned to IOM blocks.

> ATTENTION
>
> The Series C I/O channel blocks can be associated to a CM only from the Library view.

10.6.1 Prerequisites

- Control Builder is running
- Controller was created, CM was created, IOM was added and assigned to an IOLINK

10.6.2 To add an I/O channel block to a Control Module from Library view

1. Double-click the Control Module.

   The Control Module chart appears.
2. Drag the I/O channel block from the Library view to the CM.

   The I/O channel block appears on the CM chart for configuration.

> ATTENTION
>
> - The Control Module cannot be loaded until all its containing PM I/O or Series C I/O channel blocks have been assigned to IOM blocks.
> - In the CM chart view, the channel name displays the 40 characters on the faceplate of the channel block.

10.7 Assigning an IOC block to an IOM using the Function Block Assignment Dialog box

Each I/O that you have identified must be associated with an appropriate analog I/O block or digital I/O block. This association establishes a connection between the physical IOM and the control strategy.

> ATTENTION
>
> An I/O channel cannot be assigned to an IOM, if the channel is loaded.

All illustrations used in the procedure are for example purposes only.

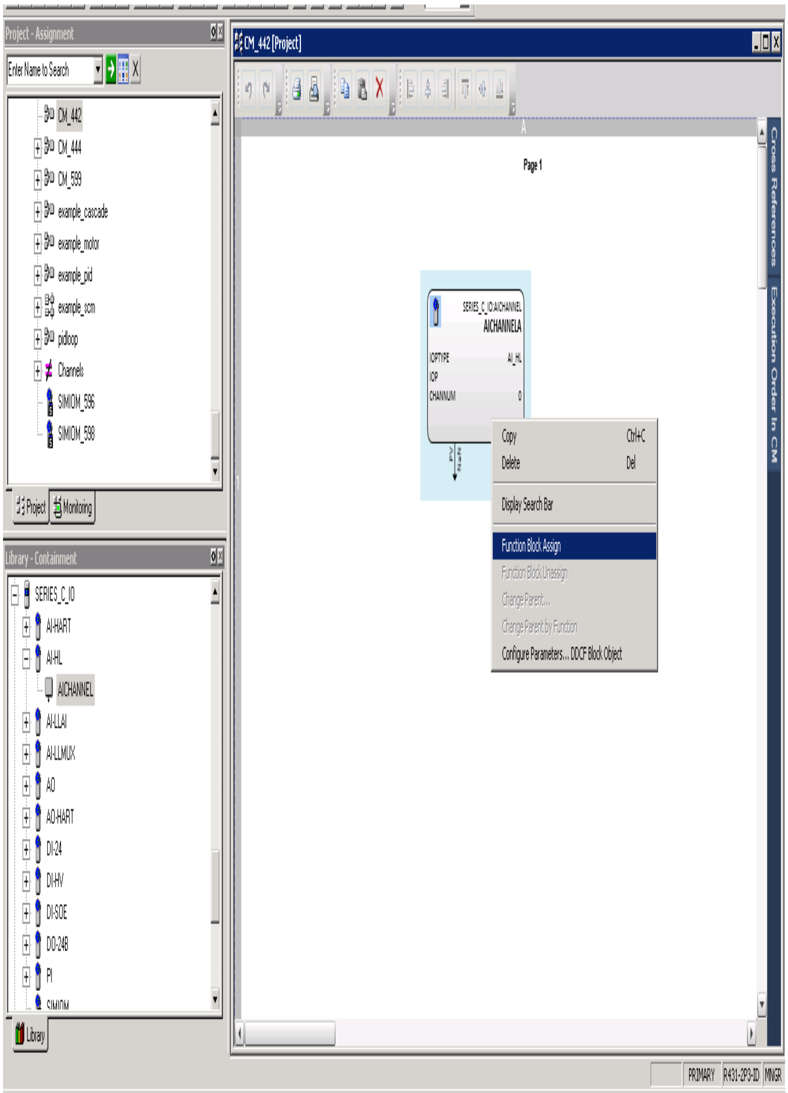
10.7.1 Prerequisites

Ensure that a channel of a respective channel type is available.

10.7.2 To assign an I/O channel block to IOM

1. Double-click the Control Module in the Project view.
2. Right-click an I/O channel block that is configured in the CM.

   The following figure displays I/O channel is contained in the CM.



3. Click **Function Block Assign**.

   The **Function Block Assignment** dialog box that lists the compatible I/O channel blocks associated with the IOM assigned to an IOLINK appears with hierarchy.

4. Select the check box for the desired channel in the IOM list.

> ATTENTION
> - You cannot assign an I/O channel to an IOM that is currently loaded to the IOLINK and appears in the Monitoring view.
> - A Control Module cannot be loaded unless all of its I/O channel blocks have been assigned to IOM blocks.

5. Click **Assign**.

   The selected I/O channel block is assigned to the selected IOM.

> ATTENTION
> For identification of unused I/O channels, see, Identification of unused I/O channels.

6. Click **Yes** on the confirmation dialog box.

   The **Function Block Assignment** dialog box closes.

7. Save and close the CM.

- Identification of unused I/O channels
- Identification of ganged DO channels

10.7.3 Identification of unused I/O channels

The identification of the I/O channel names after unassignment or deletion is explained in the following table to make the identification of unused I/O channels simpler.

Channel type and scenarios	Behavior prior to R431	Behavior in R431 and later
PMI/O or Series C I/O channels – Deletion of an assigned channel, unassignment of a channel, deletion of a CM that contains a channel	Channel name changes to its default name. For example, if “AICHANNEL_01 is renamed as “AICHANNEL_TEST” after assignment, the channel name changes to “AICHANNEL_01” in all the scenarios mentioned. However, in the Chart view, the channel name is retained as “AICHANNEL_	Deleting an unassigned channel does not impact the tree view. Deleting an assigned channel changes the channel representation in the tree view to channel name provided in the configuration. However, if the same channel name already exists in the tree view, then a number is added as a suffix to the channel name. Deleting a CM containing a channel changes the channel representation in the tree view to channel name provided in the configuration. However, if the same channel name already exists in the tree view, then a

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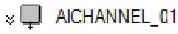
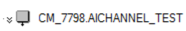
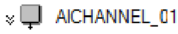
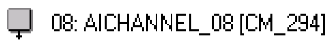
Channel type and scenarios	Behavior prior to R431	Behavior in R431 and later
	TEST." • Before channel assignment  • After assignment and renaming of a channel  After unassignment or deletion of an assigned channel or after deletion of a CM that contains a channel 	number is added as a suffix to the channel name. For example, a channel is assigned to a CM and you have deleted the channel. In this scenario, the channels are represented as follows: Assigned I/O channel contained by a CM  • Unassigned I/O channel contained by a CM 
PMI/O or Series C I/O channels – Deletion of a referenced channel, unassignment of a referenced channel, deletion of a CM that references a channel	Not applicable	Deleting an assigned channel changes the channel representation in the tree view to channel name provided in the configuration. However, if the same channel name already exists in the tree view, then a number is added as a suffix to the channel name. Deleting a CM containing a channel changes the channel representation in the tree view to channel name provided in the configuration. However, if the same channel name already exists in the tree view, then a number is added as a suffix to the channel name. For example, a channel is assigned to a CM and you have deleted the channel. In this scenario, the channels are represented as follows: • Assigned I/O channel referenced by a CM  • Unassigned I/O channel referenced by a CM 
HART-enabled I/O channels – Deletion of an assigned channel,	HART icon changes to the default icon type for the channel in all the	Deleting a HART-enabled unassigned channel does not impact the tree view.

Channel type and scenarios	Behavior prior to R431	Behavior in R431 and later
unassignment of a channel, deletion of a CM that contains a channel	scenarios mentioned. Before channel assignment HAICHANNEL_01 • After assignment and renaming of a channel TC0012_HAI • After unassignment or deletion of an assigned channel or after deletion of a CM that contains a channel HAICHANNEL_01	Deleting a HART-enabled channel changes the channel representation in the tree view to channel name provided in the configuration. However, if the same channel name already exists in the tree view, then a number is added as a suffix to the channel name. Deleting a CM containing a HART-enabled channel changes the channel representation in the tree view to channel name provided in the configuration. However, if the same channel name already exists in the tree view, then a number is added as a suffix to the channel name. For example, a HART-enabled channel is assigned to a CM and you have deleted the channel. In this scenario, the channels are represented as follows: • Assigned HART I/O channel contained by a CM 05: AICHANNELA_2 • Unassigned HART I/O channel contained by a CM 05: AICHANNELA • Assigned HART I/O channel referenced by a CM 08: AICHANNEL_08 [CM_294] • Unassigned HART I/O channel referenced by a CM 08: AICHANNEL_08

> **NOTE**
>
> In case the channel name conflicts during any of the scenarios mentioned, “_1” is suffixed with the channel name. For example, if “AICHANNEL_01” already exists in the unassigned list, the channel name is changed to “AICHANNEL_01_1.”

10.7.4 Identification of ganged DO channels

When the DO channels are ganged together, the name of the DO channel in which ganging is configured is replaced with the Control Module name in the Project view. For example, if the DO channels 7 to 10 are ganged then the name of the DO channel 10 is replaced as CMname.DOchannel7. In addition, the remaining DO channels disappear in the Project view.

Figure 10.2 Appearance of DO channels before ganging

Figure 10.3 Appearance of DO channels after ganging

10.8 Unassigning an IOC block from an IOM using the Function Block Assignment Dialog box

10.8.1 To unassign a channel block from the IOM

1. Double-click the CM in which the channel block is configured.

   The Control Module appears.
2. Right-click I/O channel block and then click **Function Block Unassign**.

   The I/O channel block is unassigned from the IOM and the associated channel number. When the channel block is unassgined, the IOP field becomes blank and the CHANNUM field value changes to 0 on the block's faceplate.
3. Save and close the Control Module.

> ATTENTION
>
> You cannot load a Control Module with an unassigned I/O channel block.

10.9 Configuring I/O channels in a control strategy using IOREFERENCES blocks

The I/O channels are configured in a control strategy using the Reference blocks.

- IOREFERENCES blocks for I/O channels
- Associating the channel to IOREFERENCES block

10.9.1 IOREFERENCES blocks for I/O channels

I/O Reference blocks are available as basic function blocks and they provide a mechanism to the CM for referencing the Input/Output channel of the supported I/O families or parameter values of any block. The references can be made to the PM I/O channels, Series C I/O channels, or parameter values of any block. The Reference blocks in strategies eliminate the dependency between the strategies and IOMs.

Types of Reference blocks

There are four types of Reference blocks listed under the IOREFERENCES library. The types of Reference blocks are:

1. AIREF (Analog Input Reference) block
2. AOREF (Analog Output Reference) block
3. DIREF (Digital Input Reference) block
4. DOREF (Digital Output Reference) block

For more information about Reference blocks and configuring the I/O channels using Reference blocks, see *Control Builder Components Theory* and *Control Builder Components Reference*.

The following parameters are used for configuring the Reference blocks.

- **Reference Type (REFTYPE):** Used for specifying the type of interface for a Reference block.
- **Reference (REF):** Used for specifying the actual reference. Based on the REFTYPE configuration, the reference can be a channel or a parameter.
- **Channel Type (CHANTYPE):** Used for setting to a specific channel type that can be referenced when REFTYPE is configured as "SERIES_C_IO" or "PMIO."

For more information about these parameters, see *Control Builder Parameter Reference*.

10.9.2 Associating the channel to IOREFERENCES block

Prerequisites

Channels are configured. They may be unassigned, assigned to a SIM IOM, or assigned to an IOM and channel number.

To associate a PM I/O or a Series C I/O channel to the IOREFERENCES block

1. Double-click the Control Module.
2. Drag the Reference block from the **IOREFERENCES** library to the CM.

   The Reference block appears in the CM for configuration.
3. Double-click the Reference block to which you want to associate the channel.

   The Reference block configuration form appears.
4. Select the **Reference Type (REFTYPE)** from the list.

   For more information about configuring the **Reference Type (REFTYPE)** parameter for each Reference block, see *Control Builder Components Theory*.
5. Click the point picker next to the **Reference (REF)** parameter, and then select the channels available from the list.

> ATTENTION
>
> Only valid selections are presented in the point picker list. When a reference is manually entered, the following errors are detected.
>
> - An invalid channel type is selected for the **Reference (REF)** parameter.
> - The referenced channel is already configured by another reference block in Project view.
> - The selected channel does not exist or the channel name is changed.
> - The selected channel is configured in another server.
> - The CM cannot be loaded unless a **Reference (REF)** parameter has been configured and the channel has been assigned to a SIM IOM or an IOM and channel number.

6. (Optional) Click the point picker next to the **Channel Type (CHANTYPE)** parameter.

   The corresponding channel type is updated.

7. Click **OK**.

   The channel is associated to the Reference block.

10.10 Field Calibration of the AI and AO modules

This section describes the field calibration procedure for the AI-HL, AI-HART, AO, and AO-HART modules.

> ATTENTION
>
> Configuration mismatch warning message appears when you configure CALIBSTS parameter and loads AO-HART module FB to AO-HART (Cx-PAOH51) module or AI-HART module FB to one modem AI-HART (Cx-PAIH51) module.

10.10.1 To perform field calibration of the AI-HL, AI-HART, AO and AO HART modules

1. From the IOM block Main tab, set the Execution State (**IOMSTATE** parameter) to IDLE.
2. From the Calibration tab, set the Calibration State (**CALIBSTS** parameter) to Enabled. Verify the IOM status LED is switched off indicating that IOM has entered calibration mode.

   > NOTE
   >
   > Both the top and bottom modules enter a calibration mode in a redundant configuration.

3. Connect the calibration voltage source to IOTA terminal block TB3 (and TB4 if redundant) and adjust the voltage to 5Vdc (4.9995 - 5.0005Vdc).

   > NOTE
   >
   > CAL terminals blocks are marked as TB2 and TB3 in the case of AO.

4. Short the two calibration pads marked as CAL1 (and CAL2 if redundant) in the IOTA.

   Result: The LED blinks two times and switches off.
5. Short the CAL pads again.

   Result: The LED blinks three times and the IOM automatically reboots within a few seconds.
6. Check that :
   - **CALIBSTS** has changed automatically back to Disabled state,
   - **IOMSTATE** is IDLE, and
   - the status LED is steady green.

   If the status LED is blinking, check for any CALBABRT softfail that indicates bad calibration.

7. Disconnect the calibration voltage-source wiring and inform the operator that the IOM field calibration is complete.

> ATTENTION
>
> UIO channels do not require the field calibration.

10.11 Defining Channel blocks

Each Series C I/O channel (IOC) block represents a single I/O point within an I/O module (which can be either input or output). There are certain attributes and parameters that are common to all I/O channel blocks. The Series C IOC block has a point execution state, similar to the PM IOC block. This allows for easy re-configuration of a single channel without disrupting the operation of the entire IOM.

> TIP
>
> In the TPS environment, a channel block is equivalent to one slot in the IO processor.

Each IOC block must have an 'assignment' block and 'containment' block in order for it to be loadable. The following table describes these blocks.

Table 10.1 I/O Channel block type

Block name	Description
Assignment	IOC is associated with a specific slot number on an IOM block
Containment	IOC exists in a Control Module

10.11.1 Common features of I/O channel blocks

There are certain attributes and parameters that are common to all I/O channel blocks. The following section identifies these common features.

10.11.2 Defining Mode and Attribute settings

The MODE parameter determines the operating mode for the channel block. These modes apply to both DO and AO channel blocks.

Operators are only permitted to change MODE if:

- MODEPERM is set to Permit, and
- REDTAG is set to Off

> NOTE
>
> Mode Permissive = Indicates if the operator can change the mode of a function block Red Tag - Allows the user to set the FB as being 'out-of-service'; this indicates that the FB or the associated control strategy needs repair, or is being repaired.

The following modes apply to the MODE parameter.

Table 10.2 Mode parameter - channel block

Operating mode	Description
Manual (Man)	Provides direct control over the output value of the channel, regardless of any continuous control strategy.
Cascade (Cas)	Data point receives its output value from a primary data point.

The MODEATTR (mode attribute) parameter determines who has authority to change certain parameters on the function block.

The following modes apply to the MODEATTR parameter.

Table 10.3 Mode Attribute parameter - channel block

Operating mode	Description
Operator	Operator supplies the output value and mode for the channel (operator access level).
Program	Program supplies the output value and mode for the channel (program access level).

10.11.3 Defining load attributes

When defining the load attributes, the channel block copies:

- the Normal Mode parameter (NMODE) into the MODE parameter, and
- the Normal Mode attribute (NMODATTR) into the MODEATTR parameter

CONSIDERATIONS:

Possible entries for the NMODE parameter:

- Man
- Cas
- None

Possible entries for the NMODATTR parameter

- Operator
- Program
- None

To define the channel block and copy the NMODE (normal mode) and NMODATTR attributes

1. Press the NORM button on the integrated keyboard (IKB).

   OR

   Press the Operator Entry Panel (OEP) at the operator station.
2. The content of the NMODE is copied into the MODE parameter and becomes the mode for the channel block.

   The content of the NMODATTR is also copied into the MODEATTR parameter and becomes the mode for the channel block.

10.11.4 Defining Fault State Handling and Fault Option settings

AO and DO channel blocks are configured so that 'if the communication between the controller and the I/O module is disrupted for 10 to 20 seconds, the upstream control strategy is assumed to have failed. The FAULTOPT parameter allows you to specify the behavior of an individual output when a fault condition exists.

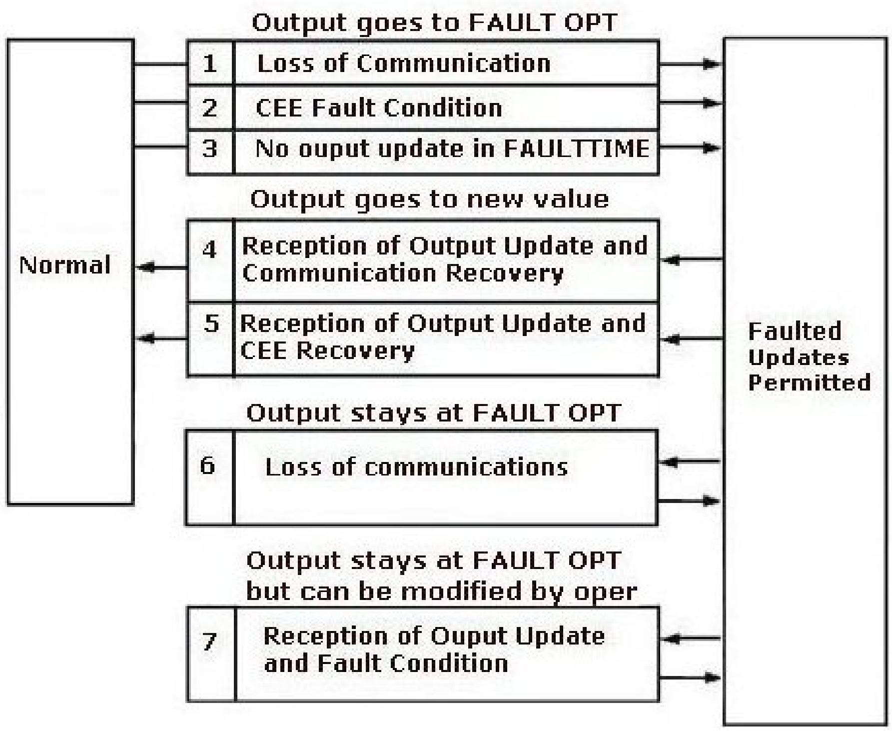
Table 10.4 Channel block fault conditions and results

Fault conditions exist when	Result
Loss of communications due to: • C300 failure • IOLEE failure • Dual IOL cable failure CEE failure, but IOLEE is up and running	All outputs on the IOM, regardless of their PTEXEST value, transition to their respective FAULTOPT states, within 8 seconds.

> **NOTE**
>
> REDTAG configuration overrides FAULTOPT configuration. Channels with REDTAG configured to ON holds the output in FAULTED state, regardless of FAULTOPT configuration.

The following figure illustrates where the output is directed to either the normal location or a Fault location.

Figure 10.4 AO and DO fault state (FAULTST) transitions



Specific fault state handling depends upon the parameter settings for MODE and MODEATTR. Refer to the tables below for AO and DO settings.

Table 10.5 AO fault handling

Source	Destination	Mode	MODEATTR	FAULTSTATE transitions
PID.OP	AO.OP	Cas	Operator or Program	1, 2, 3, 5, 7
PIDER.OP	AO.OP	Cas	Operator or Program	1, 2, 3, 5, 7
PID-PL.OP	AO.OP	Cas	Operator or Program	1, 2, 3, 5, 7
PIDFF.OP	AO.OP	Cas	Operator or Program	1, 2, 3, 5, 7
SCM	AO.OP	Man	Program	1, 2, 3, 5, 7
User	AO.OP	Man	Operator	1, 4, 6

Table 10.6 DO fault handling

Source	Destination	Mode	MODEATTR	FAULTSTATE transitions
PID.OP	DO.OP	Cas	N/A	1, 2, 3, 5, 7[1]
PIDER.OP	DO.OP	Cas	N/A	1, 2, 3, 5, 7[1]
PID-PL.OP	DO.OP	Cas	N/A	1, 2, 3, 5, 7[1]
PIDFF.OP	DO.OP	Cas	N/A	1, 2, 3, 5, 7[1]
PosProp. RAISETIME	DO.OFFPULSE	Cas	N/A	1, 2, 3, 5, 7[2]
PosProp.	DO.OFFPULSE	Cas	N/A	1, 2, 3, 5, 7[2]

Source	Destination	Mode	MODEATTR	FAULTSTATE transitions
LOWERTIME				
PosProp. RAISETIME	DO.ONPULSE	Cas	N/A	1, 2, 3, 5, 7[2]
Posprop. LOWERTIME	DO.ONPULSE	Cas	N/A	1, 2, 3, 5, 7[2]
DevCtl.PO	DO.OFFPULSE	Cas	N/A	1, 2, 3, 5, 7
DevCtl.PO	DO.ONPULSE	Cas	N/A	1, 2, 3, 5, 7
DevCtl.DO	DO.SO	Cas	N/A	1, 2, 3, 5, 7
Logic	DO.SO	Cas	N/A	1, 2, 3, 5, 7
SCM	DO.OP	Man	Program	1, 2, 3, 5, 7
SCM	DO.SO	Man	Program	1, 2, 3, 5, 7
User	DO.OP	Man	Operator	1, 4, 6
User	DO.SO	Man	Operator	1, 4, 6

The FAULTOPT parameter determines the behavior of an individual output value when a fault condition exists. The following modes apply to the FAULTOPT parameter:

Table 10.7 FAULTOPT parameter settings

Operating mode	Description	AO channels	DO channels
Hold	Holds output at last good value	Applicable to all configurations	Applicable to all configurations
Unpower	Output goes to an unpowered value	Applicable to all configurations	Applicable to all configurations
Power	Output goes to a powered value	Not applicable to AO channels	Not applicable to DO channels for PWM operation.
Use Fault Value	Output goes to the value specified by the FAULTVALUE parameter		Not applicable to DO channel configured for STATUS, ONPULSE or OFFPULSE operation.
Use Fault Value All	Output goes to the value specified by the FAULTVALUE parameter	Applicable to AO channels	Not applicable to DO channels

The FAULTOPT configuration also defines the state of the output in case of total IOM hard failure also. This feature is mainly applicable to the DO channels configured for STATUS operation.

10.11.5 FAULTED state and IOM hard failure

Total IOM hard failure means:

- dual IOM failure in the case of redundant setup
- assumes that there is no disruption 24V power to the I/O modules

The following table summarizes the state of the output for all applicable output configurations in the case of transitioning to FAULTED state or on total IOM failure.

Table 10.8 IOM hard failure and output state

	Unpower Power Hold		Fault value	
AO				
Faulted state	0mA	Not applicable	Hold last good OP value	Hold fault value without OP directions
Total IOM Failure	0mA	Not applicable	0mA	0mA
DO STATUS				
Faulted state	Drive LOW	Drive HIGH	Hold last good SO value	Not applicable
Total IOM Failure	Drive LOW	Drive HIGH	Hold last good SO value	Not applicable
DO PWM				
Faulted state	Drive LOW	Not applicable	Continues of PWM as per the last good Op value.	Continues of PWM as per the fault value.
Total IOM Failure	Drive LOW	Not applicable	Terminates the PWM and drive LOW.	Terminates the PWM and drive LOW.
DO ONPULSE/OFFPULSE				
Faulted state	Drive LOW	Drive HIGH	Proceeds to the normal completion of any on-going pulse and hold quiescent state.	Not applicable
Total IOM Failure	Drive LOW	Drive HIGH	Terminates any on-going pulse immediately and hold quiescent state.	Not applicable

10.11.6 Defining PV Source selection settings

The PVSOURCE parameter allows you to determine the source of the PV for the data channel.

Table 10.9 PV Source settings

If PVSOURCE is	
Auto • AI channel's Range Checking and Filtering circuit provides PV, or • DI channel's PVAUTO parameter provides PV	
Man • PV can be entered manually, or	
Sub • PV can come from a sequence program	

Additionally, the PVSRCOPT parameter determines if it is permissible to change the PV source to a source other than Auto.

The following modes apply to the PVSRCOPT parameter.

Table 10.10 PVSRCOPT settings

Operating mode	Description
OnlyAuto	allows the PV to be set only Automatically
All	allows the manual setting of PV

10.11.7 Defining the REDTAG settings

The REDTAG parameter allows you to set channel as being 'out of service' indicating that this channel or its associated control loops needs repair, or is being repaired. Once a channel is put in the red tag condition, its output is frozen at the last value.

REDTAG can only be set and cleared when:

- MODE = MAN
- MODATTR = Operator

Table 10.11 REDTAG settings

When channel is placed in REDTAG condition	Result
Channel output	is frozen at last value (including MODE and MODATTR) The value of OP takes precedence over the FAULTOPT settings.
Channels	• cannot be deleted • can be reloaded - the load produces errors for PNTTYPE, MODE, and MODEATTR because the parameters could not be set on the load.

10.11.8 Enabling HART in HART 6.0 and later version devices

The HART Protocol compliments traditional 4-20mA analog signaling and supports two way digital communications to intelligent process control devices. Applications include:

- remote process variable interrogation,
- cyclical access to process data, parameter setting, and
- diagnostics.

For more information, visit www.hartcomm.org.

10.11.9 Features and capabilities - HART 6.0 and later version devices

HART 6.0 and later version device features and capabilities are designed to:

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- improve support for multi-variable and valve / actuator type devices;
- enhance status and diagnostics,
- increase interoperability;
- extended commissioning / troubleshooting capabilities; and
- security measures to confirm any configuration change.

HART 6.0 and later version device functionality that is supported Series C through Control Builder includes the following:

Function	Description
Device variable classification	Provides master applications with a simple mechanism to determine the number and type of process related variables (pressure, temperature, etc.) within a device.
Extended device status	Provides additional device status alerts such as 'Device Needs Maintenance.'
Device variable status	Enables field devices to self-validate and report on the quality of the data in the command response (good, poor, bad, fixed).
Long Tag	New Long Tag with international (ISO Latin 1) characters allows consistent implementation of the longer tag names required by many industry users. The specifications currently reflect the length of this tag to be 32 characters.
Configuration change counter	Improved mechanism for master applications to determine that a field device configuration has been changed. Protects integrity of plant configuration databases.
Device Families	Establishes standard commands and status indicators for devices based on the type of process measurement. Initial Device Families include Temperature and PID Control.
Transducer Trim Commands	New Common Practice commands for performing transducer trim (calibration) operations.
Sub-Devices	Simple mechanism using Common Practice Commands to support 'HART device within a HART device' functionality. Potential uses include flow computers and multi-channel temperature devices.
Block Data Transfer	An updated mechanism to support the movement of large blocks of data, such as device configuration information, between masters and field devices.
Catch Device Variable	Simple mechanism to support the sharing of process data between field devices on the same HART network. Allows a listening field device to capture process data from another field device to be used in calculations such as tank gauging, flow computers or PID control functions.
Write Device Variable	New Command to support forcing the digital value for any Device Variable to a specific value to aid in commissioning and troubleshooting.
Lock Device	New Commands to allow a master application to lock the 'local' front panel of a field device while performing remote configuration functions.
Squawk and Find Device	New commands to support commissioning and troubleshooting of HART devices in multi-drop and multi-pair cable installations.

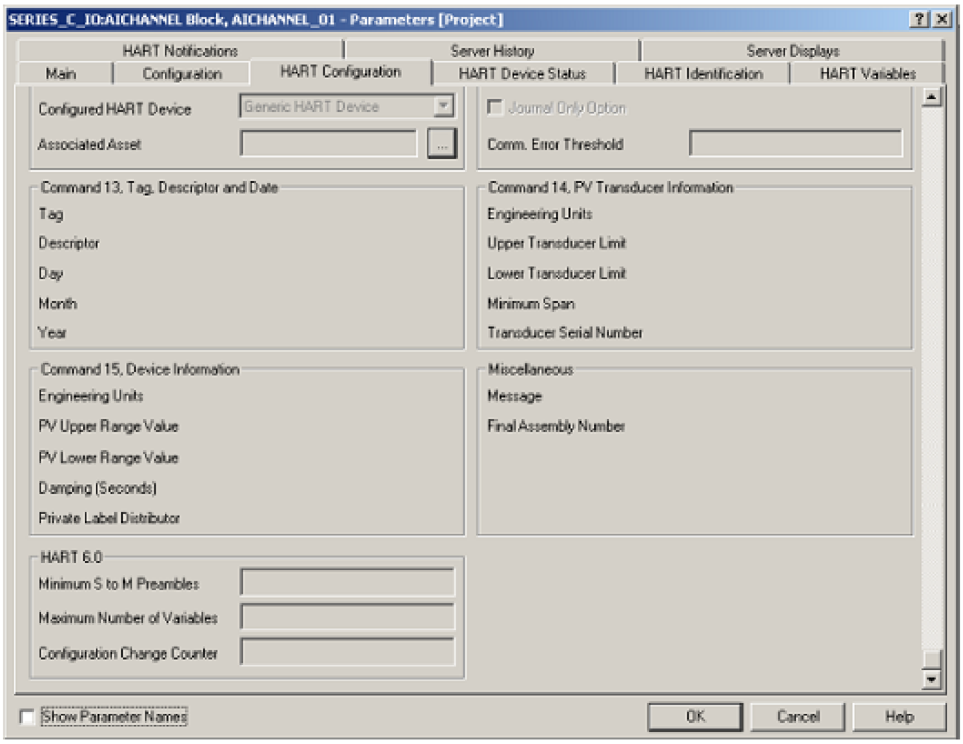
Series C I/O IOMs do not have an independent HART device block. Instead, the HART data is fully contained within an AI or AO block and:

- enabled when HENABLE parameter is set to TRUE (This is done on the AI channel block HART Configuration tab)
- becomes an Experion 'tagged' entity and can generate alarms based on its 'tagged' name in Station.

When AI and AO channel blocks are enabled, five additional HART tabs become exposed. These tabs are used exclusively for details about the attached HART device and are identical for AI and AO channels. These tabs are:

HART Configuration	HART Identification	HART Notifications
HART Device Status	HART Variables	

Figure 10.5 Series C I/O AI or AO - HART tabs



AI and AO channel blocks also have two additional tabs that appear on all tagged Experion blocks. They are the Server History and Server Displays tab. These tabs also become exposed when HART is enabled.

10.11.10 Parameters exposed after HART is enabled

For the most part, the Series CI/O HART parameters are identical to their PM I/O HART counterparts. The following table displays parameters that are only exposed when HART is enabled - all located on the Configuration tab.

Table 10.12 HART parameters

Parameter	Works the same as PMIO
ACCEPTRNG	Yes
URL,	Yes
URV	Yes
LRV	Yes
LRL	Yes
HPVMISM	Yes

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> **NOTE**
> Only 1-5V sensor type will be supported when HART is enabled.

10.11.11 Comparing parameters between Series C and PMIO

HPVCHAR, which is used in PM I/O, is not used Series C I/O. PVCHAR are used instead, and only valid enumerations (depending on the settings for HENABLE and IOM TYPE) are displayed to you.

Some HART parameters are only valid for HART Protocol Version 6. Series C IOMs support HART 6.0 and later version device features such as Extended Device Status, Configuration Change Counter, Variable Status and Classification Codes. The current release of Series C I/O supports these HART 6.0 and later version device parameters:

Parameter	Tab	Description
HMAXDEVVARS		Indicates the last device variable code supported by the device. Information can be used by the host applications.
HNCFGCHG		Configuration change counter is a counter maintained by HART 6.0 and later version device which is incremented every time configuration is changed. This is improvement over the single 'configuration changed bit' in previous HART releases
HNSMMINPRE		Minimum number of preamble bytes to be sent with the response from device to the IOM. Series C IOMs take advantage of this configuration if supported by the device to minimize the bytes sent from device in response messages.
HDYNCC	Variables	Dynamic / device variable classification code
HDYNST	Variables	Dynamic / device variable classification code
HSLOTCC	Variables	Dynamic / device variable classification code
HSLOTST	Variables	Dynamic / device variable classification code

10.11.12 Parameter values not copied during Block Copy

IOP and CHANNUM are the only configuration parameter values not copied during a Block Copy operation.

10.12 Defining AI Channel Blocks

The AI channel block represents a single analog input point on either an AI-HART or AI-LLMUX or AI-LLAI I/O Module. The type of analog input IOM needed is based on the:

- type of field sensor that is providing the input to the channel
- PV characterization options you select (as listed in the table in Determining PV Characterization):

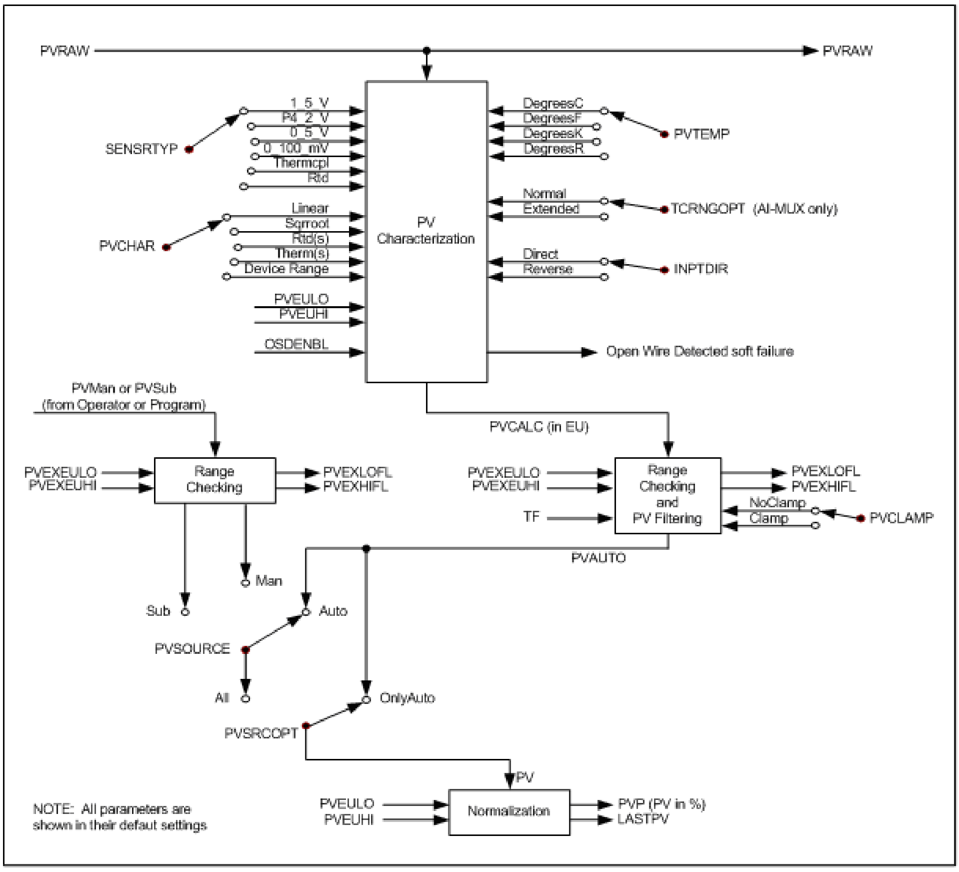
Channels contained within AI-HL and AI-HART IOM is generally used for control points. Channels located in the AI-LLMUX or AI-LLAI IOM are generally used for data acquisition points.

The analog input channel converts an analog PV signal received from a field sensor to engineering units for use by other function blocks in the C300, and by the rest of Experion.

To accomplish this function, the analog input channel, as displayed in figure below, performs:

- Analog-to digital conversion
- PV characterization
- Open Wire Detection on 4-20 mA inputs (configured as 1-5V) only
- Range Checking and PV filtering
- PV source selection

Figure 10.6 Analog Input conversion



- [Determining PV Characterization - AI Channel blocks]
- [Determining Linear Conversion - AI Channel blocks]
- [Determining Square Root Conversion - AI Channel blocks]
- [Determining Thermal Conversion - AI Channel blocks]
- [Open Wire Detection - AI Channel blocks]
- [Checking and Filtering PV Range - AI Channel blocks]
- [Comparing parameters between Series C and PMIO that support AI]

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10.12.1 Determining PV Characterization - AI Channel blocks

ATTENTION

Series C AI channels do not support the HART PV Characterization (HPVCHAR) parameter. These configuration options are selected using the PVCHAR parameter.

The PV signal received from the field is characterized based on the entries that you make for the parameters:

- SENSRTYP
- PVCHAR
- PVTEMP
- INPTDIR, and
- TCRNGOPT

The input PV signal is:

1. Converted to a raw PV signal (PVRAW) whose units can be %, ratio, millivolts, microvolts, or milli ohms depending on the entry made for the SENSRTYP parameter
2. then converted to the engineering units

The engineering unit conversions that are performed in the AI-HL, AI-HART and AI-LLMUX/AI-LLAI points are listed in the table below.

Table 10.13 AI engineering unit conversions

Sensor type (SENSRTYP)	AI Module type	PVCHAR Options	PVRAW (note 1)	PVCALC (note 2)	Bad PV detection
0-5-V (0 to 5 volts)	AI-HL[6] AI-HART (PAIH01 only)	Linear square rt.	percent	EU	Range check on PVCALC
P4_2_V (0.4 to 2 volts)	AI-HL[6] AI-HART (PAIH01 only)	Linear square rt.	percent	EU	Range check on PVCALC. Checks for open input
1_5_V (1 to 5 volts and 4 to 20 mA)[5])	AI-HL[6] AI-HART	Linear square rt. Device Range	percent	EU	Range check on PVCALC. Checks for open input
0_100_mV (0 to 100 mV)	AI-LLMUX /AI-LLAI	Linear	millivolts	EU (note 3)	Range check on PVCALC
Thermcpl (Thermocouple)	AI-LLMUX /AI-LLAI	See PVCHAR for complete list	microvolts	EU	Range check on PVCALC. Open thermocouple detection
RTD	AI-LLMUX /AI-LLAI	See PVCHAR for complete list	milliohms	EU	Range check on PVCALC

LEGEND:
EU = Engineering Units
AI-HL = High Level Analog input
AI-HART = HART capable, High Level Analog input
AI-LLMUX Low Level Analog Multiplexer
AI-LLAI = Low Level Analog input
PVCALC = Calculated PV
PVCHAR = PV Characterization
PVRAW = PV received from field and converted to digital form by the A/D converter

Notes

1. PVRAW is the voltage signal at the IOTA as a percentage of the voltage range for the sensor type. The exceptions are as follows
   a. For a thermocouple sensor type, PVRAW is in microvolts, after reference junction compensation. If an open thermocouple is detected, PVRAW is set to NaN.
   b. For an RTD sensor type, PVRAW is in milliohms, after lead-wire compensation. If an open RTD is detected, PVRAW is set to NaN.
   c. For a 0-100 millivolt sensor type, PVRAW is the IOTA voltage input for the slot.
2. If the diagnostics determine that the A/D converter has failed, PVRAW of the slot is set to NaN.
3. The normal operating range for PVRAW is configured by you (for a thermocouple 0% = PVRAWLO, 100% = PVRAWHI.
4. AI HL does not support PVCHAR of DeviceRange.
5. PVCHAR of DeviceRange, SystemRange and SystemRange And SQRT are supported when HART Enabled on AI-HART. When HART is enabled, 0_5_V and P4_2_V are not available because HART communication is 4 to 20 mA.
6. When 4-20mA signal is connected to AI-HART or AI-HL, the Sensor Type 1_5_V should be used.
7. When Cx-PAIN01 is used for AI-HL, only 4-20mA input is supported. Voltage input is not available. Sensor Type will be fixed to '1_5_V' on the configuration.
8. AI-HART (Cx-PAIH51) module supports only 1_5_V option. If you configure SENSRTYP in AICHANNEL other than 1_5_V and load to one modem AI-HART (Cx-PAIH51) module, the configuration mismatch warning message appears. After loading the module, the SENSRTYP parameter value appears as 1_5V always irrespective of configured value.

10.12.2 Determining Linear Conversion - AI Channel blocks

The PVRAW value is converted to a floating-point number. The output value of the linear conversion is PVCALC, which is calculated based on the raw input span (for 0-100 mV sensor type only), and the engineering unit span.

The state of the input direction parameter (INPTDIR) is taken into consideration during the calculation of PVCALC as follows:

For 0-100 mV sensor types, when INPTDIR is Direct:

$$PVCALC = \frac{(PVRAW - PVRAWLO)}{(PVRAWHI - PVRAWLO)} * (PVEUHI - PVEULO) + PVEULO$$

For 0-5V, 0.4-2V, and 1-5V, sensor types, when INPTDIR is Direct:

$$PVCALC = \frac{PVRAW}{100} * (PVEUHI - PVEULO) + PVEULO$$

For 0-100 mV sensor types, when INPTDIR is Reverse:

$$PVCALC = PVEUHI - \frac{(PVRAW - PVRAWLO)}{(PVRAWHI - PVRAWLO)} * (PVEUHI - PVEULO)$$

For 0-5V, 0.4-2V, and 1-5V, sensor types, when INPTDIR is Reverse:

$$PVCALC = PVEUHI - \frac{PVRAW}{100} * (PVEUHI - PVEULO)$$

10.12.3 Determining Square Root Conversion - AI Channel blocks

The square-root calculation is applied to the PVRAW input such that

100% of span = 1.0

The square-rooted value is then converted to engineering units based on the configured PV engineering-unit range values.

(For example, square root of 100% = 100%; square root of 50% = 70.71%.)

The output value of the square-root conversion is PVCALC, which is calculated based on the state of the input direction parameter (INPTDIR) as follows

If PVRAW ? 0.0 and INPTDIR is Direct:

$$PVCALC = PVEULO + \sqrt{\frac{PVRAW}{100}} * (PVEUHI - PVEULO)$$

If PVRAW < 0.0 and INPTDIR is Direct:

$$PVCALC = PVEULO - \sqrt{\frac{-PVRAW}{100}} * (PVEUHI - PVEULO)$$

If PVRAW ? 0.0 and INPTDIR is Reverse:

$$PVCALC = PVEUHI - \sqrt{\frac{PVRAW}{100}} * (PVEUHI - PVEULO)$$

If PVRAW < 0.0 and INPTDIR is Reverse:

$$PVCALC = PVEUHI + \sqrt{\frac{-PVRAW}{100}} * (PVEUHI - PVEULO)$$

10.12.4 Determining Thermal Conversion - AI Channel blocks

Thermal linearization is performed on thermocouple and RTD input types. All thermocouples (#therm) listed in the PVCHAR parameter definition, are supported by the analog input point. The range of the thermocouple type used with the AI-LLMUX/AI-LLAI channel can be increased by selecting Extended as the entry for the TCRNGOPT parameter.

The AI-LLMUX/AI-LLAI channels calculate the reference junction compensation from the measured reference junction output level. This value is stored and then later converted back to microvolts, with respect to 0 degrees C, for each thermocouple that is to be compensated. The cold-junction reference compensation (PVREFJN) parameter is expressed in microvolts for the specified thermocouple and is added to the microvolt value for PVRAW.

All RTDs (*RTD) listed in the PVCHAR parameter definition, are supported by the analog input point:

For an RTD, the AI-LLMUX/AI-LLAI channels calculate the lead-wire compensation and then subtract the value from PVRAW. The maximum allowable lead-wire resistance and intrinsic safety barrier resistance for the RTDs are listed in the table below.

Table 10.14 RTD lead wire characteristics

	Maximum allowable lead resistance - Note 1 (units are ohms)		Maximum allowable intrinsic safety barrier resistance (units are ohms)	
RTD type	Entire loop	Per leg	Entire loop	Per leg
Pt:100 DIN characterization	20	10	18	18
Pt:100 JIS characterization	20	10	18	18
Ni: 120 Edison type 7 characterization	20	10	18	18
Cu: 10 SEER Standard	20	10	0	0

RTD type	Maximum allowable lead resistance - Note 1 (units are ohms) Entire loop	Per leg	Maximum allowable intrinsic safety barrier resistance (units are ohms) Entire loop	Per leg
characterization				
Cu: 50 Ohm characterization	20	10	18	18
Note 1: Proper compensation for lead-wire resistance depends on the resistance being equal in each leg of the RTD. This includes resistance due to lead-wire resistance and intrinsic safety barriers. No provision is made to compensate for lead-wire resistance mismatch or intrinsic safety-barrier resistance mismatch. Both the lead resistance and the intrinsic-safety-barrier resistance are allowed simultaneously when connected to an RTD in a Division 1 area.				

10.12.5 Open Wire Detection - AI Channel blocks

The open wire diagnostic detects and annunciates broken field wires. In addition, a seemingly valid PV from a channel diagnosed as having a broken-wire will not be made available (thus preventing incorrect control action). Open Wire Detection is available with AI-HART module.

If open wire detection is enabled (OWDENBL = ON) and the IOM detects the broken-wire condition, then

- Soft Failure 179 'Open Wire Detected' is generated, and
- PVRAW and PVAUTO will consequently be set to NaN.

> ATTENTION
>
> Open wire detection is not supported in AI-HART (Cx-PAIH51) module. The configuration mismatch warning message appears when you select the OWDENBL option and loads AICHANNEL FB to AI-HART (Cx-PAIH51) module. After loading the module, the channel can be activated. However, the OWDENBL parameter value appears as 'FALSE.'

10.12.6 Checking and Filtering PV Range - AI Channel blocks

PV range checking ensures that the PVCALC output of PV characterization is within the limits defined by parameters PVEXEULO and PVEXEUHI. If either of the limits is violated, the output of the PVAUTO is set to NaN if clamping has not been specified. If clamping has been specified, the output of the PVAUTO is clamped to PVEXEUHI or PVEXEULO, except when PVRAW, PVCALC, and PVAUTO will consequently be set to NaN.

> ATTENTION
>
> Honeywell recommends you to configure the current for HLAI (CC-TAIX01) modules from -6.9% to +102.9% of the 4-to-20 mA range. If you configure the current above +102.9% then the PVEXEUHI goes to NaN.

If the range-checked and filtered value is less than the value specified by the user-configured LOCUTOFF parameter, the final output called PVAUTO is forced to PVEULO.

First-order filtering is performed on PVCALC, as specified by the user through parameter TF (filter lag time).

10.12.7 Comparing parameters between Series C and PMIO that support AI

The following parameters are:

- specific to AI and found on various tabs on the AI channel block, and
- work identically to the same named PM I/O counterparts.

AI supported parameters for current Series C I/O that work identically to the same named PM I/O parameters			
SENSRTYP	PVCLAMP	DECONF	PVSRCOPT
PVCHAR	LOCUTOFF	URL	PV
INPTDIR	PVTEMP	URV	PVSOURCE
PVEUHI	TF	LRV	LASTPV
PVEULO	PVRAWHI	LRL	PVCALC
PVEXEUHI	PVRAWLO	DAMPING	PVEXHIFL
PVEXEULO	TCRNGOPT	CJTACT	PVEXLOFL
			PVRAW

The following are parameters that support Series C AI and work differently than the same named PM I/O counterparts.

AI supported parameters for current Series C I/O that work differently than the same named PM I/O parameters	
PVCHAR	PVSTS

10.13 Defining AO Channel Blocks

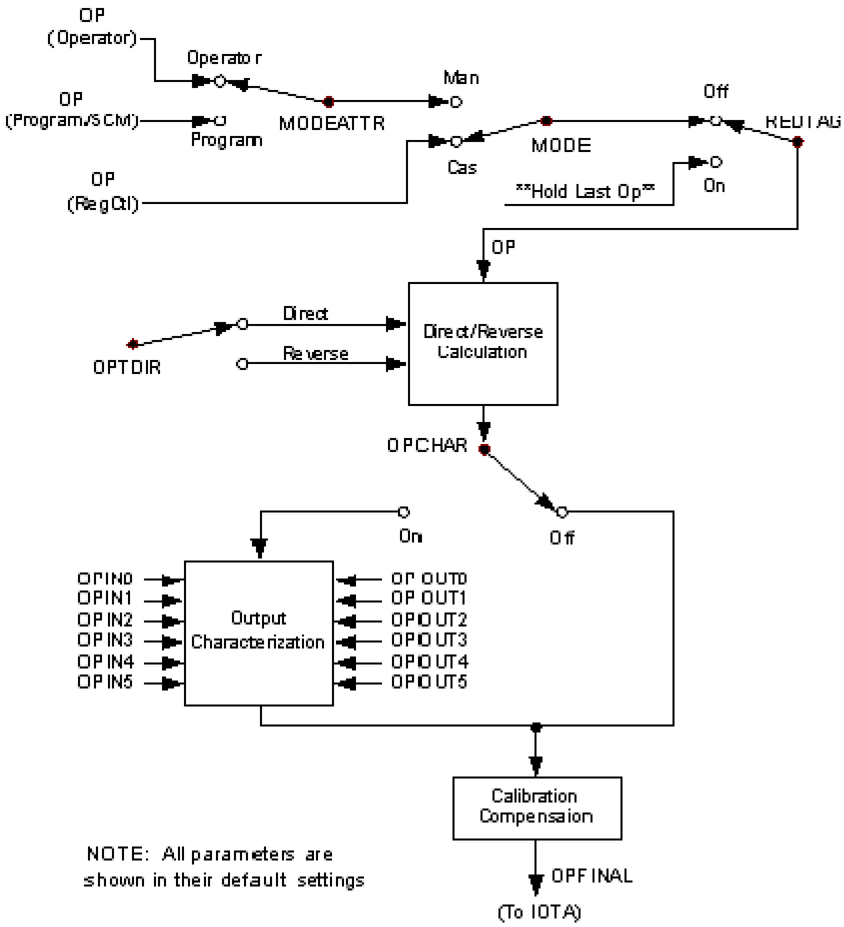
The AO channel block represents a single analog output point on the AO-HART Modules. The AO channel block converts the output value (OP) to a 4-20 mA output signal for operating final control elements such as valves and actuators in the field. The OP parameter value can be controlled from an Experion regulatory point, the operator, or an SCM.

To convert the OP value to a 4-20 mA signal, the AO channel performs:

- Direct/Reverse Output Function
- Nonlinear Output Characterization

The following is a functional diagram of the analog output channel block.

Figure 10.7 Analog Output conversion



- Determining Direct/Reverse Output - AO Channel blocks
- Determining Output Characterization - AO Channel blocks
- Determining Calibration Compensation - AO Channel blocks
- Determining Modes - AO Channel blocks
- Determining Output Verification - AO Channel blocks
- Comparing parameters between Series C and PMIO that support AO

10.13.1 Determining Direct/Reverse Output - AO Channel blocks

The OPTDIR parameter allows you to specify whether the output of the data point is:

- direct acting (where 4 mA = 0%, and 20 mA = 100%), or
- reverse acting (where 4 mA = 100%, and 20 mA = 0%).

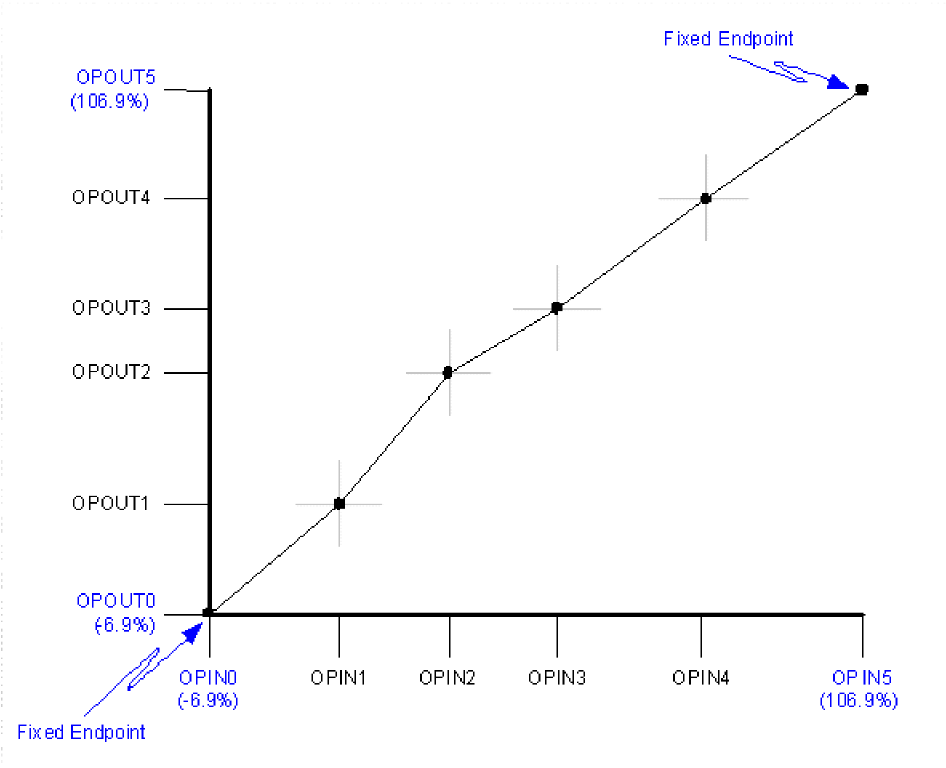
The default mode is direct acting.

10.13.2 Determining Output Characterization - AO Channel blocks

Output characterization is an optional function that can be implemented by setting parameter OPCHAR to ON. When OPCHAR is set to ON, the analog output point interpolates linearly between the two nearest values. The interpolated value becomes the output value OPFINAL.

Further, output characterization allows you to specify an output transfer function, using configurable X-Y coordinates that provide five linear segments as displayed below. The length of each segment is variable according to the coordinates OPOUT0-5 and OPIN0-5. The end points of the curve are fixed at coordinates OPOUT0, OPIN0 (at -6.9%) and OPOUT5, OPIN5 (at 106.9%). These coordinates are fixed at these values to ensure that neither the characterization function nor its inverse can provide output values, which are outside the -6.9% to 106.9% range. You enter the values for OPOUT1-4 and OPIN1-4 to achieve the desired curve.

Figure 10.8 Determining fixed endpoint



10.13.3 Determining Calibration Compensation - AO Channel blocks

The final stage of output processing in the analog output point is calibration compensation. This is accomplished in the data point using internal offset and scale constants. The output value OPFINAL is then routed to the field through the IOTA.

10.13.4 Determining Modes - AO Channel blocks

The MODE parameter determines the operating mode for the channel block. The following operating modes are applicable to the both AO and DO channel blocks:

- Manual (Man) - provides the operator or the program with direct control over the output value of the channel, regardless of any continuous control strategy.
- Cascade (Cas) - data point receives its output value from a primary data point.

10.13.5 Determining Output Verification - AO Channel blocks

Outputs are verified by periodically reading back the value on the output screw and comparing the read back value with the database value. This includes an independent A-to-D conversion for the read back value.

10.13.6 Comparing parameters between Series C and PMIO that support AO

The following parameters are:

- specific to AO and found on various tabs on the AO channel block, and
- work identically to the same named PM I/O counterparts.

AO supported parameters for current Series C I/O that work identically to the same named PM I/O parameters	
OPTDIR	INITVAL
OPCHAR	OPFINAL
OPOUT1, OPOUT2, OPOUT3, OPOUT4	COMMFAILFL
OPIN1, OPIN2, OPIN3, OPIN4	OPIN0, OPOUT0
OP	OPIN5, OPOUT5

10.14 Defining DI Channel Blocks

The DI channel block represents a single digital input point on one of the following I/O Modules: DI-24, DI-HV, and DI-SOE. This digital input channel converts a digital PVRAW signal received from the field to a PV that can be used by other data points in the Experion system.

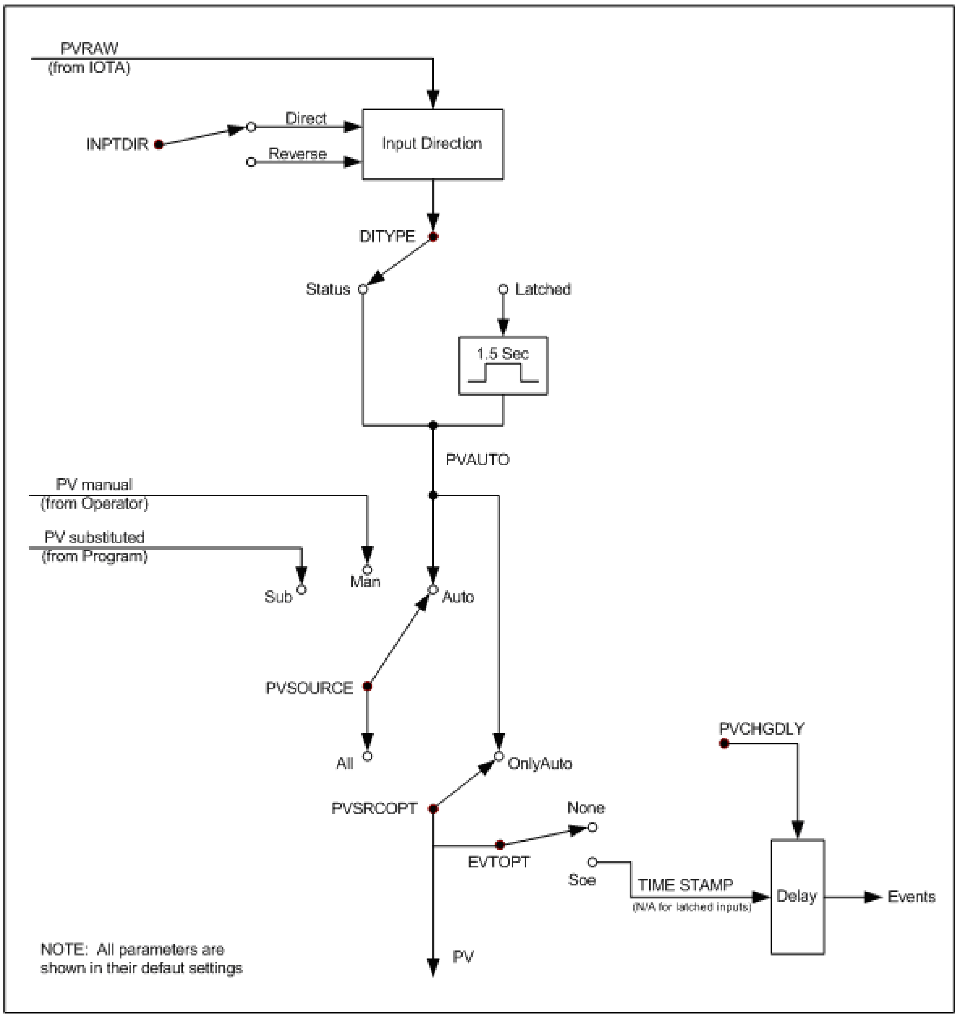
Bad PV Flag-Control strategies can test for a bad Digital Input PV. Parameter BADPVFL is set ON when:

- The PV source has been switched to Substituted, and the channel is Inactive or the module is Idle.
- The PV source is Auto and the PV is not being updated, because the channel is Inactive or the module is idle or there is a channel soft failure.

The digital input channel can also be configured as a status input or a latched input.

The following is a functional diagram of the digital input channel.

Figure 10.9 Digital input conversion



- Determining Status Digital Input channel - DI Channel blocks
- Determining Latched Digital Input channel - DI Channel blocks
- Comparing parameters between Series C and PMIO that support DI
- Open Wire Detection - DI Channel blocks

10.14.1 Determining Status Digital Input channel - DI Channel blocks

For this digital input type, the PVAUTO value represents the state of the raw input signal after the direct/reverse conversion is performed. The status digital input channel is selected by:

- entering Status for the DITYPE parameter and this block can be configured for PV source selection.

The current PV state is available as an input to logic blocks and other Experion control functions blocks.

PV Source Selection - The PV source parameter (PVSOURCE) option determines the source of the PV for a status input channel. The source can be:

- the PV input from the field (PVRAW),
- the PV state entered by the operator (PV manual), or
- it can be supplied by a user program (PV substituted).

PVSOURCE has no effect on the latched options of the digital input channel. If PVSOURCE is AUTO, PV tracks PVRAW.

10.14.2 Determining Latched Digital Input channel - DI Channel blocks

To capture the occurrence of momentary digital inputs, such as from push buttons, the digital input channel is configured as a latched input.

Configuring the channel as latched is accomplished by setting:

- DITYPE to Latched.

When configured as a latched input channel, an input pulse that is on for a minimum of 40 milliseconds is latched true for 1.5 seconds. This ensures that any control function block that needs to monitor this input executes at least once during the time that the signal is latched on.

When the DITYPE is set latch, the EVTOPT cannot be SOE and vice versa.

10.14.3 Comparing parameters between Series C and PMIO that support DI

The following parameters are:

- specific to DI and found on various tabs on the DI channel block, and
- work identically to the same named PM I/O counterparts.

DI supported parameters for current Series C I/O that work identically to the same named PM I/O parameters	
DITYPE	PVRAW
PV	BADPVFL

The following are parameters that support Series C DI and work differently than the same named PM I/O counterparts.

DI supported parameters for current Series C I/O that work differently than the same named PM I/O parameters
PVSTS

10.14.4 Open Wire Detection - DI Channel blocks

The open wire diagnostic detects and annunciates broken field wires. In addition, a seemingly valid PV from a channel diagnosed as having a broken-wire will not be made available (thus preventing incorrect control action).

The Digital Input module requires the installation of a bleed resistor (approx. 22k ohm) at the switching device between the 24VDC source and the terminal providing the switched signal. If this resistor is not installed and open wire detection is enabled (OWDENBL = ON) a false open wire alarm will be generated whenever the input device is not closed (i.e., PVRAW = OFF).

If open wire detection is enabled (OWDENBL = ON) and the IOM detects the broken-wire condition, then

- PVCALC will be NaN, in which case, PVAUTO will be NaN.
- Soft Failure 179 'Open Wire Detected' is generated, and
- PVRAW and PVAUTO will consequently be set to OFF.

Note that Open Wire Detection is supported only with the 24VDC IOTAs and not for the following:

- The high voltage DI modules
- The DI-SOE module
- The GI-IS IOTAs

If a GI-IS IOTA (CC-GDILxx) is used, open wire detection as described above may not be used.

- In these cases, OWDENBL must be set to OFF for all channels.
- As an alternative to Series C open wire detection, you may use the Line Fault Detection (LFD) feature of the MTL Switch/Proximity Detector Interfaces.

  MTL Switch/Proximity Detector Interface is the third party equipment from MTL which enables safe-area loads to be controlled by switch or proximity detectors located in a hazardous area. Two replay output are provided. Independent phase reversal control allows an alarm condition to be signaled for either state of the sensor. A selectable line fault detects (LFD) facility detects an open or short circuit in either field circuit. It is not part of any agency certification or CE certification.

  - If LFD is enabled (through a switch on the device) for any channel, two resistors must be installed: a 22k ohm resistor across the switch and a 680-ohm resistor in series with the power supply lead. This feature detects both open and short circuits. When LFD is enabled and a line fault is detected the MTL device illuminates an LED indicator and forces the channel data to OFF.
  - If a MTL4510, MTL4511, or MTL4516 device is used, there is no indication to Experion PKS.
  - If the MTL4517 is used channel 31 is energized to ON. Note that for the MTL4517 if any channel has LFD enabled channel 31 is not available for use as a general purpose input - for the other three devices channel 31 is always available.

> ATTENTION
>
> Open wire detection is not supported in DI (Cx-PDIL51) module. The configuration mismatch warning message appears when you select the OWDENBL option and loads DICHANNEL FB to AI-HART (Cx-PDIL51) module. After loading the module, the channel can be activated. However, the OWDENBL parameter value appears as 'FALSE.'

10.15 Defining DO Channel Blocks

The digital output channel provides a digital output to the field, based on the origin of the input and the configured parameters.

There are four types of digital output points:

- status output (SO) - the default type,
- pulse-width modulated (PWM) output,
- pulse-on output (PULSEON), and
- pulse-off output (OFFPULSE)

The DOTYPE parameter determines the output type. The PWM type is used in combination with RegCtl algorithms to provide true proportional control. The status and pulsing output types are for digital outputs that are connected to device control blocks.

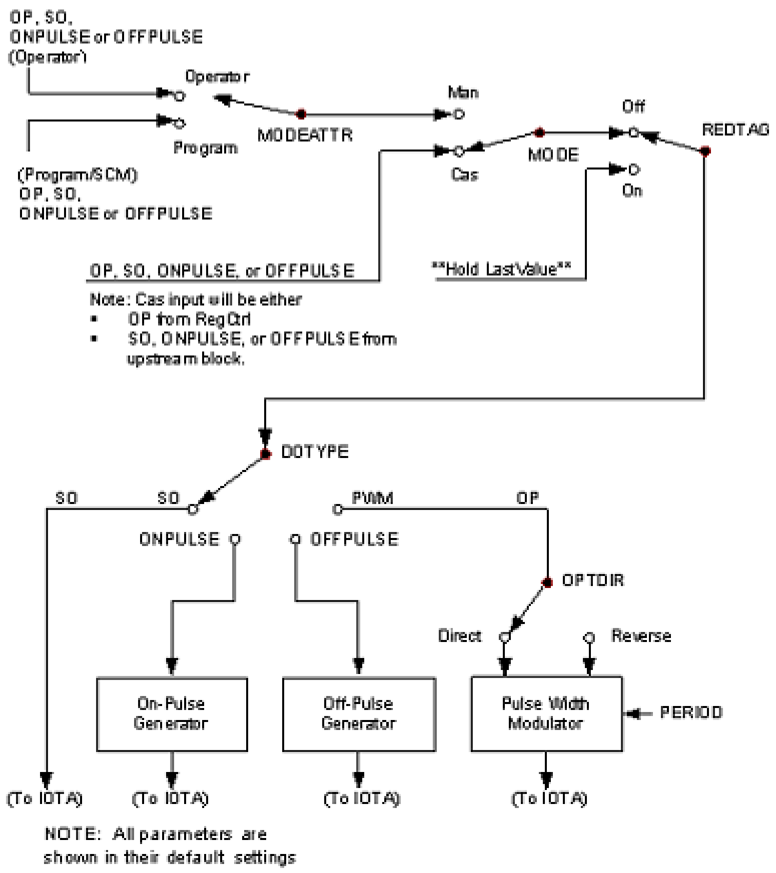
Actual output action can be:

- status,
- latched or
- momentary

It is dependant on the configuration of the device control point.

A functional diagram of the digital output channel is displayed below.

Figure 10.10 Digital output conversion



- Determining Status Output type - DO Channel blocks
- Determining Pulse Width Modulated (PWM) Output type
- Determining On-Pulse and Off-Pulse Output type - DO Channel blocks
- Determining Initialization Request Flag - DO Channel blocks
- Determining Modes - DO Channel blocks

- Determining Output Verification - DO Channel blocks
- Determining Over-current protection - DO Channel blocks
- Comparing parameters between Series C and PMIO that support DO

10.15.1 Determining Status Output type - DO Channel blocks

The status output type can be controlled from a:

- device control block output,
- logic block output, or
- RegCtl block (that has been configured for the PosProp algorithm)

as determined by the parameter connection.

10.15.2 Determining Pulse Width Modulated (PWM) Output type

The PWM output type can receive its input from an Experion regulatory block through a user-configured output connection. The length of the pulse is derived from the OP parameter provided by the regulatory block. Because OP is in percent, the percent value becomes the percent on time for the pulse whose period (1.0 to 120.0 seconds) is specified by the PERIOD parameter, as displayed below.

The output direction of the output signal can be configured to be direct or reverse acting by using the OPTDIR parameter.

The pulse on-time for direct and reverse acting outputs is calculated as follows:

For direct action:

$$PulseOnTime = \frac{OP\% * PERIOD}{100}$$

For reverse action:

$$PulseOnTime = \frac{100 - OP\% * PERIOD}{100}$$

If the value of OP is less than 0%, it is clamped to 0%; an OP with a value greater than 100% is clamped to 100%.

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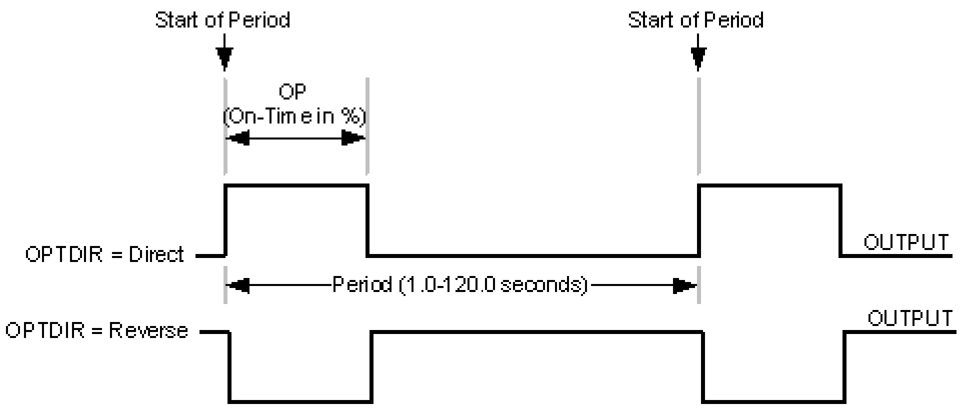
Figure 10.11 Pulse Width Modulated Output



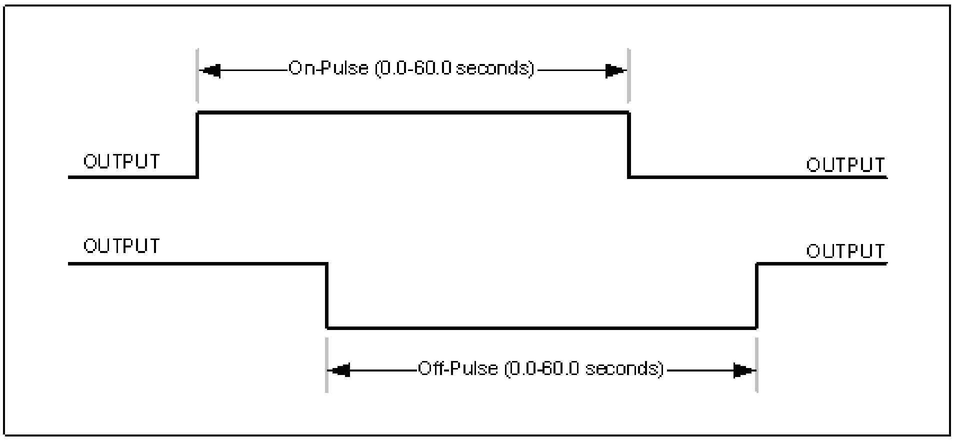
10.15.3 Determining On-Pulse and Off-Pulse Output type - DO Channel blocks

The On-Pulse and Off-Pulse output types can be controlled from:

- a device control block output,
- a RegCtl block (that has been configured for the PosProp algorithm) as determined by the parameter connection.

Pulsed operation (pulse on or pulse-off) can be obtained by linking the output connections to the ONPULSE and OFFPULSE parameters, respectively.

Figure 10.12 On-Pulse and Off-Pulse Output types



TIP

Standalone DO channels configured for On-Pulse or Off-Pulse are not supported. These blocks must have a parameter connection to an upstream block. SCM writes or other writes using Program access level are not permitted.

The Status Output (SO) setting is impacted by the ONPULSE and OFFPULSE parameters as indicated in the following table.

Table 10.15 Status Output settings

Parameter	Status Output (SO) setting	If SO is set to 0.0
ONPULSE	On - for specified duration	SO is immediately set to OFF
OFFPULSE	Off - for specified duration	SO is immediately set to ON

To provide consistent and safe behavior, the following occurs when setting DOTYPE to either ONPULSE or OFF PULSE.

Table 10.16 Setting DOTYPE to ONPULSE or OFFPULSE

If	Then
MODE is MAN	the ONPULSE and OFFPULSE parameters only accept operator writes. (Program access level writes and NOT all other writes are accepted.) operator access level writes to SO are accepted and writing SO terminates an active pulse.
PTEXECST is ACTIVE	changing MODE to CAS sets the output to the quiescent state
PTEXECST is ACTIVE	always sets the output to the quiescent state

10.15.4 Determining Initialization Request Flag - DO Channel blocks

The request to initialize a DO channel is accomplished through the INITREQ or PWMINITREQ parameters.

Table 10.17 DO channel initialization

The following is set to ON	And

INITREQ	• Control strategies in Experion cannot manipulate the output.
	• Device Control blocks and Position Proportional control algorithms are automatically forced to initialize when outputting to a Digital Output channel.
	• When one or more of the following is true:
	    • the IOMSTATE is IDLE, or
	    • PTEXECST is INACTIVE
	    • channel MODE is set to MAN, or
	    • there is a soft failure and the point is not working

	NOTE Device Control blocks and Position Proportional control algorithms are automatically forced to initialize when outputting to a Digital Output channel whose INITREQ is ON NOTE Standby manual functionality is not supported in Series C.

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10.15.5 Determining Modes - DO Channel blocks

The MODE parameter determines the operating mode for the channel block. The following operating modes are applicable to the both DO and AO channel blocks:

- Manual (Man) - provides the operator or the program with direct control over the output value of the channel, regardless of any continuous control strategy.
- Cascade (CAS) - data point receives its output value from a primary data point.

> TIP
>
> Operators are only permitted to change MODE if MODEPERM is set to Permit and REDTAG is set to off.

10.15.6 Determining Output Verification - DO Channel blocks

Outputs are verified by periodically reading back the value on the output screw and comparing the read back value with the database value. This includes an output wiggle (for the safety system) to prove they are not stuck in any one state.

10.15.7 Determining Over-current protection - DO Channel blocks

Digital outputs are protected from inadvertent over-current conditions. If a DO channel consumes more current than it should the IOM posts a soft failure and sheds to manual control. Supervisor intervention is required to return the channel to normal operation. Over-current conditions are typically the result of a shorted device or capable.

10.15.8 Comparing parameters between Series C and PMIO that support DO

The following parameters are:

- specific to DO and found on various tabs on the DO channel block.
- work identically to the same named PM I/O counterparts.

DO supported parameters for current Series C I/O that work identically to the same named PM I/O parameters		
OPTDIR	SOINITVAL	COMMFAILFL
SO	ONPULSE, OFFPULSE	PERIOD
SOREADFAIL	OP, OPINITVAL	

10.16 Electronic Short-Circuit Protection

The behavior of the Series C Digital Output - 24V with Electronic Short Circuit Protection (in the presence of wiring faults) causes a DO channel that draws more current than is permitted, to activate the IOM hardware's electronic short-circuit protection mechanism causing that channel to go unpowered. The feature applies to these specific model numbers:

- CC-PDOB01 Digital Output IO Module (IOM) (32 channels at 24V)
- CC-TDOB01 DO IOTA (32 channels at 24V)
- CC-TDOB11 DO IOTA Redundant (32 channels at 24V)

> **ATTENTION**
> Output short circuit detection is not supported if channel is configured for pulse output type

- CC-PUIO01 32 channels UIO module
- CC-PUIO31 32 channels UIO-2 module

10.16.1 Non-redundant Configuration

When the electronic short-circuit protection mechanism activates and the channel goes unpowered the non-redundant IOM:

- detects the output inconsistency and generates Soft Failure 23 - Failure in OP circuit/field wiring detected by AO/DO
- detects the over current and generates: Soft Failure 180 - Output Short Circuit Detected
- sets:
  - the output to unpowered
  - Shed Mode to Manual control.
  - Shed ModeAttr to Operator.

You should expect to see:

- Two Soft Failures
  - Soft Failure 23 - Failure in OP circuit/field wiring detected by AO/DO
  - Soft Failure 180 - Output Short Circuit Detected
- The output unpowered
- The channel in Manual mode

10.16.2 Redundant Configuration

The firmware in a Primary IOM of a redundant pair notices the output miscompare and signals the Secondary IOM to assume the role of the Primary IOM (assuming the Secondary is synced).

The most common cause for the DO over-current is a failure in the field there is a minor probability that the IOM itself might be the cause of the problem. Given this, it is a common behavior for Series C IOMs to always switchover in an attempt to localize the fault.

> TIP
>
> Note that the Primary switchover in most cases is done before actually experiencing the over current condition.

If the cause for the DO over-current is a failure in the field, then the new Primary will see the same output miscompare problem, and react like a non-redundant module would - it will:

- Detect the output miscompare generate Soft Failure 23 - Failure in OP circuit/field wiring detected by AO/DO.
- Detect the over current and generate Soft Failure 180 - Output Short Circuit Detected
- Set the output to unpowered.
- Shed Mode to Manual control.
- Shed ModeAttr to Operator.

You should expect to see:

- One Soft Failure posted from the former Primary:
- Soft Failure 23 - Failure in OP circuit/field wiring detected by AO/DO
- A IOM Failover event

  The following are likely if the fault was in the field:

  - Two Soft Failures posted by the new Primary:

    Soft Failure 23 - Failure in OP circuit/field wiring detected by AO/DO Soft Failure 180 - Output Short Circuit Detected
  - The output unpowered
  - The channel in Manual mode
  - The former Primary's output miscompare Soft Failure will Return To Normal once both modules synchronize.

10.16.3 Electronic Short-Circuit Fault Recovery

To return the channel to normal operation the shorted device or shorted wiring must be corrected.

10.16.4 To clear the short-circuit fault:

> CAUTION
>
> Immediately after the IOM detects the fault and the DO Channel is set to OFF, it should be safe to perform maintenance action.
>
> **Once the DO channel is set ON, no maintenance action can occur.**

1. Find and clear the wiring fault. This must be done prior to attempting to restore the DO channel to on-control.

> **NOTE**
>
> The fault may exist at various locations including the IOM, IOTA, external field devices and wiring connecting these devices. After attempting to clear the fault at any of these locations, Step 2 below should be followed.

2. Once the actual fault has been cleared, your appropriate plant personnel can restore the DO Channel to normal operation by setting the DO while still in Manual or setting the mode to Cascade and resuming DO writes (programmatically based on user strategy).
3. This concludes this procedure.

10.17 Defining SP-AI Channel Blocks

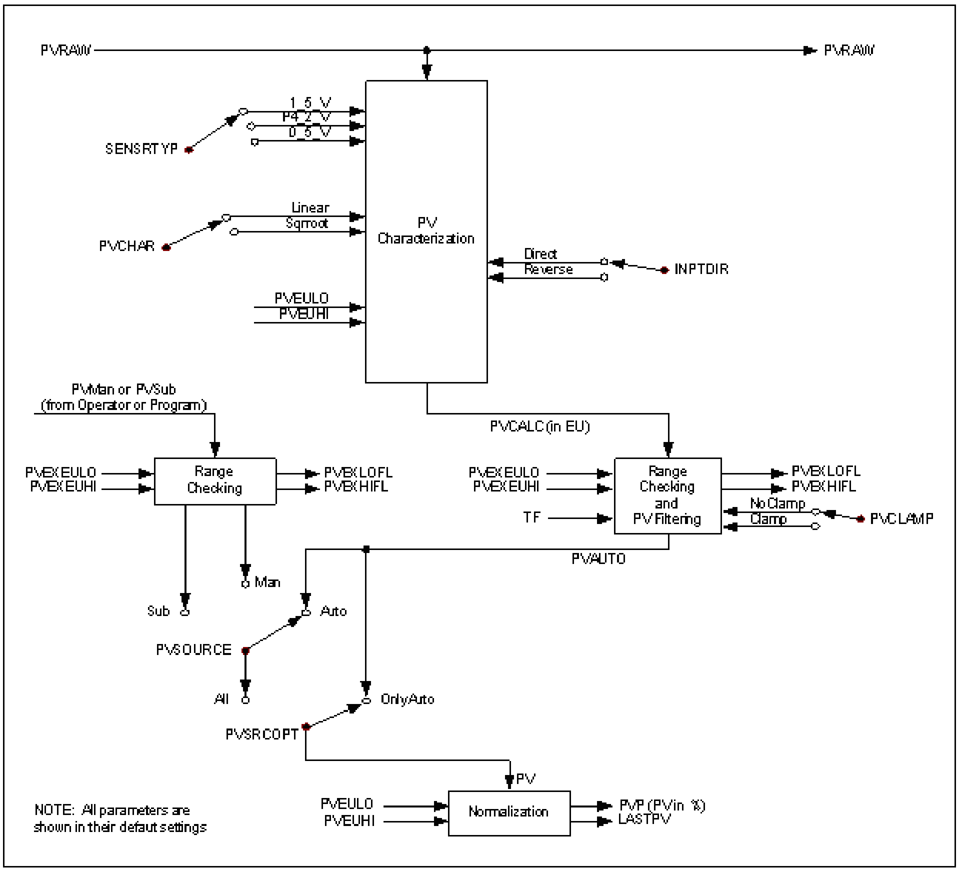
The SP - AI channel block represents a single analog point on Speed Protection (SP) module. The type of analog input IOM needed is based on the:

- type of field sensor that is providing the input to the channel
- PV characterization options you select (as listed in the table in determining PV Characterization):

The analog input channel converts an analog signal received from a field sensor to PV with appropriate engineering units for use by other function blocks in the C300 - 20mS CEE Controller, and by the rest of Experion. To accomplish this function, the analog input channel performs:

- Analog-to digital conversion
- PV characterization
- Range Checking and PV filtering
- PV source selection
- Open Wire Detection

Figure 10.13 Speed Analog Input conversion



- Determining PV Characterization - SP-AI Channel blocks
- Determining Linear Conversion - SP-AI Channel blocks
- Determining Square Root Conversion - SP-AI Channel blocks
- Open Wire Detection - SP-AI Channel blocks
- Checking and Filtering PV Range - SP-AI Channel blocks

10.17.1 Determining PV Characterization - SP-AI Channel blocks

The PV signal received from the field is characterized based on the entries that you make for the following parameters:

- SENSRTYP
- PVCHAR
- PVTEMP, and
- INPTDIR

The input PV signal is:

1. converted to a raw PV signal (PVRAW) whose units can be %, ratio, milli-volts, micro-volts, or milli-ohms depending on the entry made for the SENSRTYP parameter,
2. then converted to the engineering units.

Table 10.18 SPM - AI engineering unit conversions

Sensor type (SENSRTYP)	AI Module type	PVCHAR Options	PVRAW (note 1)	PVCALC (note 2)	Bad PV detection
0-5-V (0 to 5 volts)	SP-AI	Linear square rt.	percent	EU	Range check on PVCALC
P4_2_V (0.4 to 2 volts)	SP-AI	Linear square rt.	percent	EU	Range check on PVCALC. Checks for open input
1_5_V (1 to 5 volts)	SP-AI	Linear square rt. Device Range	percent	EU	Range check on PVCALC. Checks for open input

LEGEND:

EU = Engineering Units

SPM-AI = Speed Protection Module - Analog Input

PVCALC = Calculated PV

PVCHAR = PV Characterization

PVRAW = PV received from field and converted to digital form by the A/D converter

Notes:

1. PVRAW is the voltage signal at the IOTA as a percentage of the voltage range for the sensor type. The exceptions are as follows
2. If the diagnostics determine that the A/D converter has failed, PVRAW of the slot is set to NaN.
3. The normal operating range for PVRAW is configured by you
4. SPM-AI does not support PVCHAR of DeviceRange.
5. When 4-20mA signal is connected to SPM-AI, the Sensor Type 1_5_V must be used.

10.17.2 Determining Linear Conversion - SP-AI Channel blocks

The PVRAW value is converted to a floating-point number. The output value of the linear conversion is PVCALC, which is calculated based on the raw input span, and the engineering unit span.

The state of the input direction parameter (INPTDIR) is taken into consideration during the calculation of PVCALC as follows:

For 0-5V, 0.4-2V, and 1-5V, sensor types, when INPTDIR is Direct:

$$PVCALC = \frac{PVRAW}{100} * (PVEUHI - PVEULO) + PVEULO$$

For 0-5V, 0.4-2V, and 1-5V, sensor types, when INPTDIR is Reverse:

$$PVCALC = PVEUHI - \frac{PVRAW}{100} * (PVEUHI - PVEULO)$$

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10.17.3 Determining Square Root Conversion - SP-AI Channel blocks

The square-root calculation is applied to the PVRAW input such that

100% of span = 1.0

The square-rooted value is then converted to engineering units based on the configured PV engineering-unit range values. (For example, square root of 100% = 100%; square root of 50% = 70.71%.)

The output value of the square-root conversion is PVCALC, which is calculated based on the state of the input direction parameter (INPTDIR) as follows.

If PVRAW ? 0.0 and INPTDIR is Direct:

$$PVCALC = PVEULO + \sqrt{\frac{PVRAW}{100}} * (PVEUHI - PVEULO)$$

If PVRAW < 0.0 and INPTDIR is Direct:

$$PVCALC = PVEULO - \sqrt{\frac{-PVRAW}{100}} * (PVEUHI - PVEULO)$$

If PVRAW ? 0.0 and INPTDIR is Reverse:

$$PVCALC = PVEUHI - \sqrt{\frac{PVRAW}{100}} * (PVEUHI - PVEULO)$$

If PVRAW < 0.0 and INPTDIR is Reverse:

$$PVCALC = PVEUHI + \sqrt{\frac{-PVRAW}{100}} * (PVEUHI - PVEULO)$$

10.17.4 Open Wire Detection - SP-AI Channel blocks

Open Wire Detection is available in the SP_AI channel. The open wire diagnostic detects and annunciates broken field wires. In addition, a seemingly valid PV from a channel diagnosed as having a broken-wire is not made available (thus preventing incorrect control action).

If open wire detection is enabled (OWDENBL = ON) and the IOM detects the broken-wire condition, then

- Soft Failure 179 'Open Wire Detected' is generated, and
- PVRAW and PVAUTO are consequently set to NaN.

10.17.5 Checking and Filtering PV Range - SP-AI Channel blocks

PV range checking ensures that the PVCALC output of PV characterization is within limits defined by parameters PVEXEULO and PVEXEUHI. If either of the limits is violated and clamping is not specified, the output of PVAUTO is set to NaN. If clamping has been specified, the output of PVAUTO is clamped to PVEXEUHI or PVEXEULO, except when PVRAW, PVCALC, and PVAUTO are consequently set to NaN.

If the range-checked and filtered value is less than the value specified by the user-configured LOCUTOFF parameter, the final output PVAUTO is forced to PVEULO.

You can perform first-order filtering on PVCALC, through parameter TF (filter lag time).

10.18 Defining SP-AO Channel Blocks

The SP - AO channel block represents a single analog output point on the SP - AO Module. The SP - AO channel block converts the Output (OP) into a 4-20 mA output signal for operating final control elements such as valves and actuators in the field.

> **NOTE**
>
> The SP - AO can also function as a normal Series C AO channel.

To convert the OP value to a 4-20 mA signal, the SP - AO channel performs,

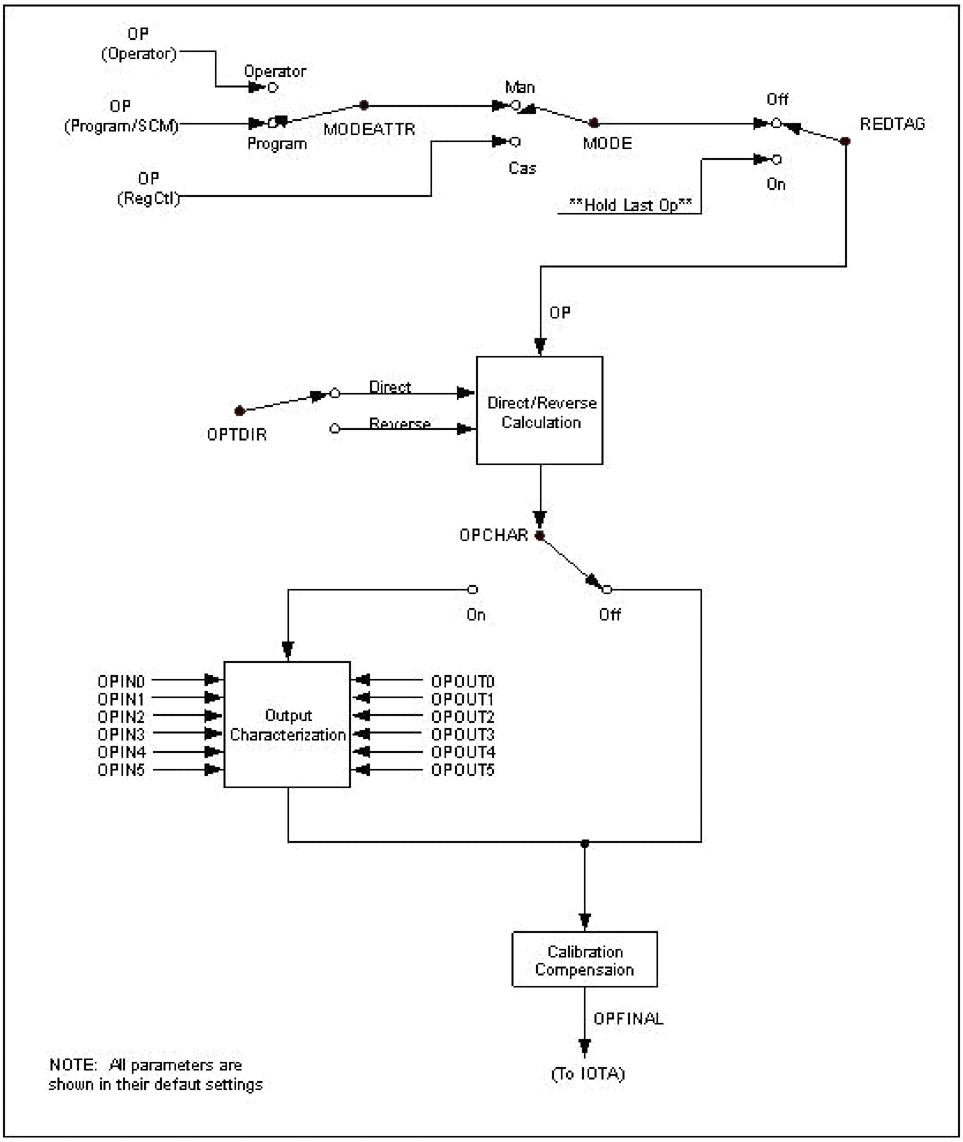
- Direct/Reverse Output Function
- Nonlinear Output Characterization

> **ATTENTION**
>
> SP_AO channel can also accept inputs from the following channels of the same SPM IOM.
>
> - PV value from SP_AI channel
> - PV value from any SP_SPEED channels
> - Voted PV1 and voted PV2 from the SP_SPDVOTE channel

The SP - AO channel block also supports the following functionalities.

1. Supports direct writes of values generated within the IOM. The OP parameter can be connected to one of the following output parameters when it is configured as a block pin.
   a. VOTPVx (x=1 or 2)
   b. PV of any speed channels, or
   c. PV of any AI channel
2. Default value for MODE is set to 'CAS' and that of MODATTR is set to 'PROGRAM.'

Figure 10.14 Speed Analog Output conversion



- Determining Direct/Reverse Output - SP-AO Channel blocks
- Determining Output Characterization - SP-AO Channel blocks
- Determining Calibration Compensation - SP-AO Channel blocks
- Determining Modes - SP-AO Channel blocks
- Determining Output Verification - SP-AO Channel blocks

10.18.1 Determining Direct/Reverse Output - SP-AO Channel blocks

The OPTDIR parameter allows you to specify whether the output of the data point is:

- direct acting (where 4 mA = 0%, and 20 mA = 100%), or
- reverse acting (where 4 mA = 100%, and 20 mA = 0%).

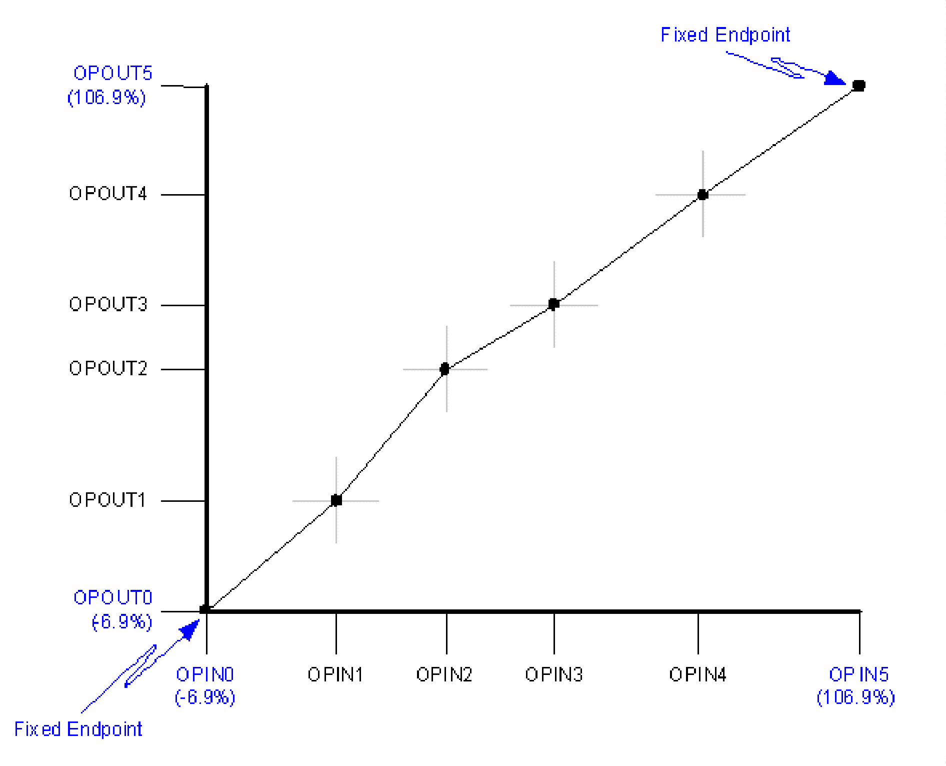
By Default, the OPTDIR parameter is set to 'Direct.'

10.18.2 Determining Output Characterization - SP-AO Channel blocks

Output characterization is an optional function that can be implemented by setting parameter OPCHAR to ON. When OPCHAR is set to ON, the analog output point interpolates linearly between the two nearest values. The interpolated value becomes the output value OPFINAL.

Further, output characterization allows you to specify an output transfer function, using configurable X-Y coordinates that provide five linear segments as displayed below. The length of each segment is variable according to the coordinates OPOUT0-5 and OPIN0-5. The end points of the curve are fixed at coordinates OPOUT0, OPIN0 (at -6.9%) and OPOUT5, OPIN5 (at 106.9%). These coordinates are fixed at these values to ensure that neither the characterization function nor its inverse can provide output values, which are outside the -6.9% to 106.9% range. You enter the values for OPOUT1-4 and OPIN1-4 to achieve the desired curve.

Figure 10.15 Determining fixed endpoint



10.18.3 Determining Calibration Compensation - SP-AO Channel blocks

The final stage of output processing in the analog output point is calibration compensation. This is accomplished in the data point using internal offset and scale constants. The output value OPFINAL is then routed to the field through the IOTA.

10.18.4 Determining Modes - SP-AO Channel blocks

The MODE parameter determines the operating mode for the channel block. The following operating modes are applicable to SPM - AO and SPM - DO channel blocks:

- Manual (Man) - provides the operator or the program with direct control over the output value of the channel, regardless of any continuous control strategy.
- Cascade (CAS) - data point receives its output value from a primary data point.
- Normal - reflects the NMODEATTR and NMODE parameter values, which was configured.

10.18.5 Determining Output Verification - SP-AO Channel blocks

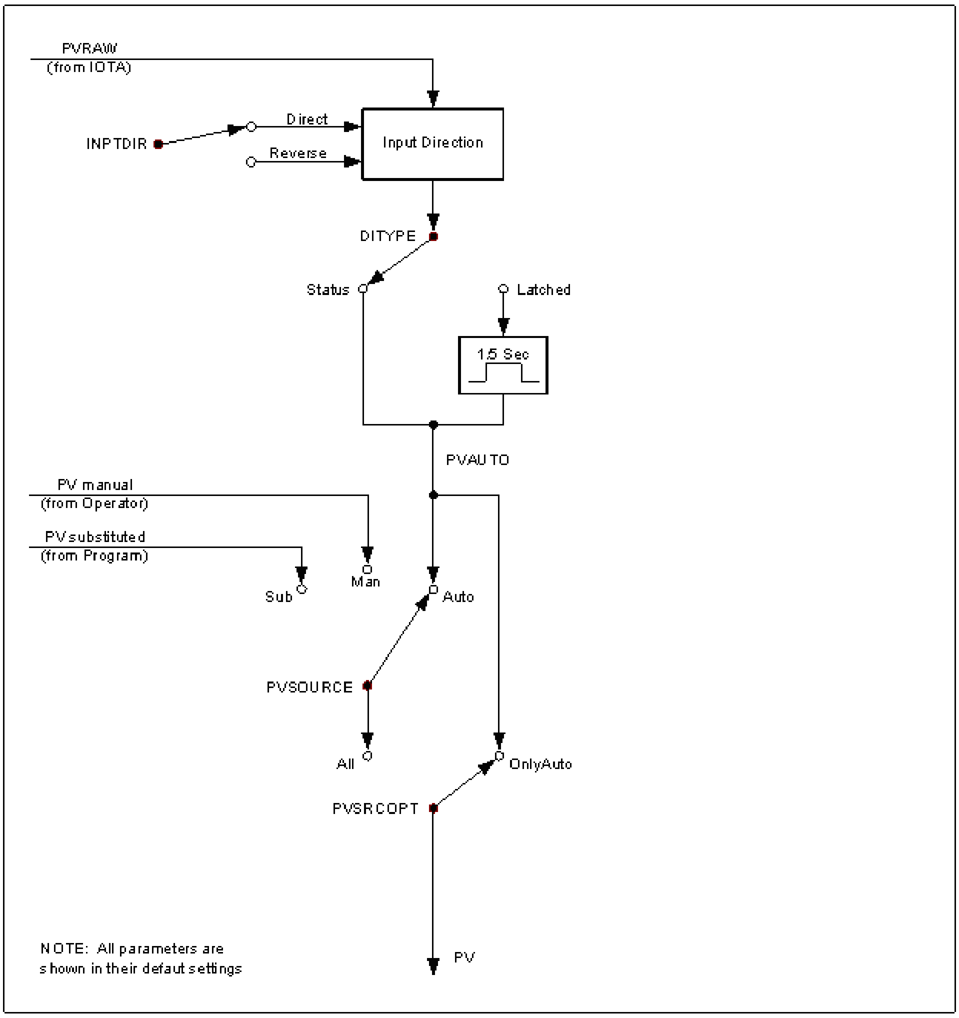
Outputs are verified by periodically reading back the value on the output screw and comparing the read back value with the database value. This includes an independent A-to-D conversion for the read back value.

10.19 Defining SP-DI Channel Blocks

The DI channel block represents a single digital input point on the SP - DI channel block. The SP - DI channel block converts a digital PVRAW signal received from the field to a PV that can be used only for Turbine Control solutions.

> **ATTENTION**
>
> The SP - DI channel block does not support DISOE and DIMODE parameter.

Figure 10.16 Speed Digital Input conversion



- Determining Status Digital Input Channel - SP-DI Channel blocks
- Determining Latched Digital Input Channel - SP-DI Channel blocks
- Open Wire Detection - SP-DI Channel blocks

10.19.1 Determining Status Digital Input Channel - SP-DI Channel blocks

For this digital input type, the PVAUTO value represents the state of the raw input signal after the direct/reverse conversion is performed. The status digital input channel is selected by setting the DITYPE parameter to 'Status,' and this block can be configured for PV source selection.

The current PV state is available as an input to logic blocks and other Experion control function blocks. It is also available for SP - DO permissive check configuration parameters.

PV Source Selection - The PV source parameter (PVSOURCE) option determines the source of the PV for a status input channel. The source can be

- PV input from the field (PVRAW),
- PV state entered by the operator (PV manual), or
- PV supplied by a user program (PV substituted).

PVSOURCE has no effect on the DITYPE of the digital input channel if PVSOURCE is AUTO, and PV tracks PVRAW.

10.19.2 Determining Latched Digital Input Channel - SP-DI Channel blocks

To capture the occurrence of momentary digital inputs, such as from push buttons, the digital input channel is configured as a latched input.

Configuring the channel as latched is accomplished by setting:

- DITYPE to 'Latched'

When the digital input channel is configured as a latched input channel, an input pulse that is ON for a minimum of 5 milliseconds is latched TRUE for 1.5 seconds. This ensures that any control function block, that needs to monitor this input, executes at least once during the time that the signal is latched.

10.19.3 Open Wire Detection - SP-DI Channel blocks

The SP - DI channel supports open wire diagnostics to detect and annunciate broken field wires. In addition, PV is displayed as 'BAD' to prevent incorrect control action.

Ensure that a bleed resistor (~ 22k ohm) resistor is installed at the switching device providing the switched signal. If this resistor is not installed and open wire detection is enabled (OWDENBL = ON), a false open wire alarm is generated whenever the input device is not closed (i.e., PVRAW = OFF).

If open wire detection is enabled and the IOM detects the broken-wire condition,

- Soft Failure 179 'Open Wire Detected' is generated, and
- PVRAW and PVAUTO is set to OFF

The DI channel supports PV flag with reset option, which can be used as an interlock option in the SPD - DO channel block.

> **NOTE**
>
> When PV is set to 'OFF,' PV.FLWRST is still set to 'ON' until you set RESETTRIP to 'ON.'

10.20 Defining SP-DO Channel Blocks

The digital output channel provides a digital output to the field, based on the origin of the input and the configured parameters.

There are two types of digital output points:

- status output (SO) - the default type, and
- on-pulse output (ONPULSE)

> **ATTENTION**
>
> Normally Open (NO), Normally Closed (NC), and RTN are provided for four relay contacts for customized configurations. You must use appropriately rated fuses in the relay output."

The DOTYPE parameter determines the output type. The status and on pulse output types are for digital outputs that are connected to device control blocks.

Actual output action can be any one of the following depending on the configuration of the device control point.

- status or
- latched

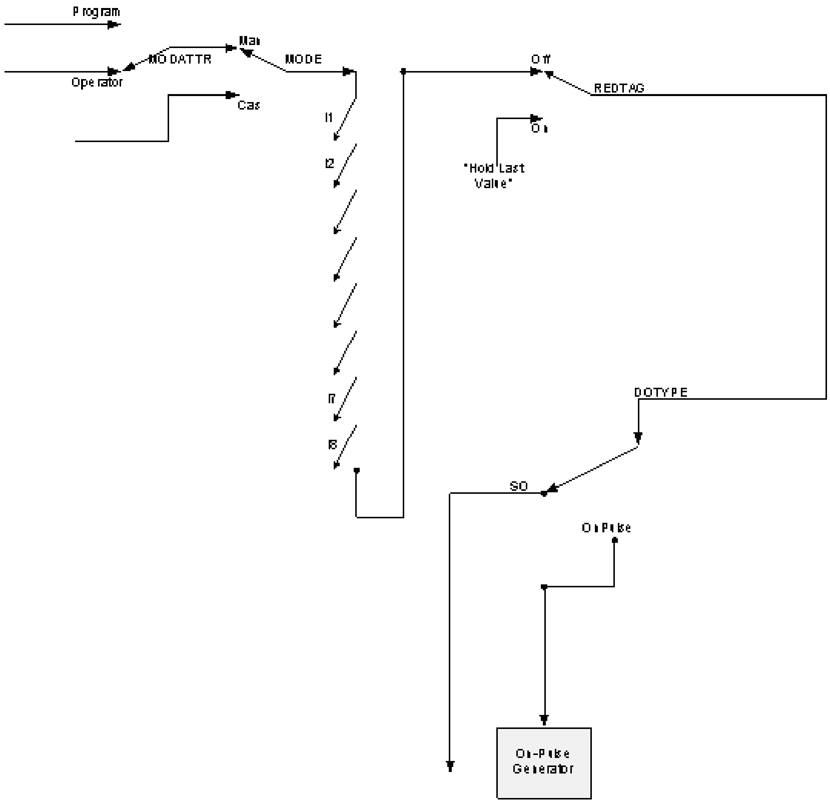
The SP - DO channel block supports multiple interlock checks prior to DO change. Eight interlock check parameters are available and are set to 'OFF' by default. The interlock check parameters can be connected with any one of the following flags.

- PV and PV.FLWRST of any DI Channel block of the same SP IOM only.
- XXXX. FL, where XXXX can be any one of - VOTPVxHIALM, VOTROCxPOSHIALM, VOTPVxHHALM or VOTROCxPOSHHALM - x=1 and 2, of local SP - SPDVOTE channel.
- XXXX. FLWRST, where XXXX can be any one of VOTPVxHHALM or VOTROCxPOSHHALM - x=1 and 2, of local SP - SPDVOTE channel.
- YYYY. FL, where YYYY can be any one of PVHIALM, ROCPOSHIALM, PVHHALM or ROCPOSHHALM of local SP - SPEED channel.
- YYYY. FLWRST, where YYYY can be any one of PVHHALM or ROCPOSHHALM of local SP - SPEED channel.

> **ATTENTION**
>
> - The interlock parameters (I1 to I8) that are not connected are not used for interlock processing.
> - The response time of the DO trip achieved using the interlock configuration is faster than that of the alarms reported using any function blocks such as FLAG or DIGACQ blocks. Hence, the TripValue displayed in the Station for the Data Acquisition Block alarms and the PV at the time when the DO was tripped may not necessarily be same.
> - LastTripReason parameter does not hold the value when the SPM power cycle happens. To retain the LastTripReason value, perform the following:
>
> 1. connect the alarm flags that are configured as interlocks to a FirstOut block
> 2. Use the same alarm flags for determining the interlock, which caused the trip in SPM.

A functional diagram of the digital output channel is displayed.

Figure 10.17 Speed Digital Output conversion



- [Determining Status Output type - SP-DO Channel blocks]
- [Determining On - Pulse Output type - SP-DO Channel blocks]
- [Determining Initialization Request Flag - SP-DO Channel blocks]
- [Determining Modes - SP-DO Channel blocks]
- [Fail-safe configuration - SP-DO Channel blocks]

10.20.1 Determining Status Output type - SP-DO Channel blocks

The status output can be controlled in two different ways.

1. The status output type can be controlled from a

- device control block output,
- logic block output, or
- RegCtl block (that has been configured for the PosProp algorithm)

if the MODE parameter is configured as 'CAS'

1. The status output can also be controlled, along with the interlock source parameters configured for this channel,

- by an operator

if the MODE parameter is configured as 'MAN' and MODATTR parameter is configured as 'OPERATOR.'

10.20.2 Determining On - Pulse Output type - SP-DO Channel blocks

The On - Pulse output type can be controlled from a:

- device control block output,
- logic block output, or
- RegCtl block (that has been configured for the PosProp algorithm) as determined by the parameter connection.

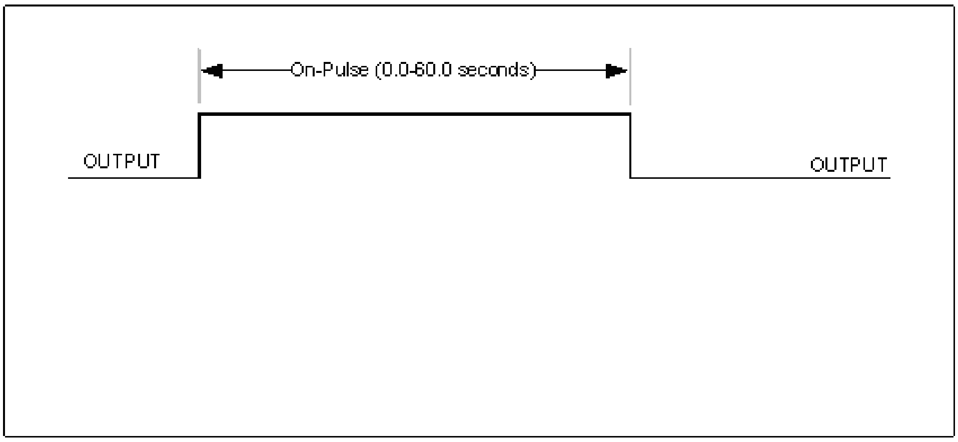
If the ONPULSE is configured as 30 seconds, Status Output (SO) is set to 'ON.' After 5 seconds, if the ONPULSE is re-configured as 20 seconds, the SO is set to 'ON' for next 20 seconds. This occurs because of the remaining 25 seconds of the previous timer count is ignored.

If the SP - DO is configured with permissive and output type as 'ONPULSE,' then

- SP - DO is set to 'ON' for the ONPULSE timer duration only if the permissive are strong state during the timer period.
- SP - DO is set to 'OFF' if the permissive go to weak state during the ONPULSE timer period, and it remains 'OFF' even the permissive become strong within initial ONPULSE period.

Pulsed operation (ONPULSE) can be obtained by linking the output connection to the ONPULSE parameter.

Figure 10.18 Speed Digital On Pulse Output



> **TIP**
>
> Standalone DO channels configured for On-Pulse or Off-Pulse are not supported. These blocks must have a parameter connection to an upstream block. SCM writes or other writes using Program access level are not permitted.

The Status Output (SO) setting is impacted by the ONPULSE parameter as indicated in the following table.

Table 10.19 Status Output settings

Parameter	Status Output (SO) setting	If ONPULSE is set to 0.0
ONPULSE	On - for specified duration (0.0 to 60.0 seconds)	SO is immediately set to OFF

To provide consistent and safe behavior, the following occurs when setting DOTYPE to ONPULSE.

Table 10.20 Setting DOTYPE to ONPULSE

If	Then
MODE is MAN	the ONPULSE parameter only accepts operator writes. (Program access level writes and NOT all other writes are accepted.) operator access level writes to SO are accepted and writing SO terminates an active pulse.
PTEXECST is ACTIVE	changing MODE to CAS sets the output to the INACTIVE state
PTEXECST is ACTIVE	always sets the output to the INACTIVE state

10.20.3 Determining Initialization Request Flag - SP-DO Channel blocks

The request to initialize a SP - DO channel is accomplished through the INITREQ or PWMINITREQ parameters.

Table 10.21 SP - DO channel initialization

If	Then

INITREQ is set to ON	• Control strategies in Experion cannot manipulate the output.
	• Device Control blocks and Position Proportional control algorithms are automatically forced to initialize when sending output to a SP - DO channel.
	• When one or more of the following is true:
	    • the IOMSTATE is IDLE, or
	    • PTEXECST is INACTIVE
	    • channel MODE is set to MAN, or
	    • there is a soft failure and the point is not working

	NOTE Device Control blocks and Position Proportional control algorithms are automatically forced to initialize when sending output to a SP - DO channel whose INITREQ is ON. NOTE Standby manual functionality is not supported in Series C.

10.20.4 Determining Modes - SP-DO Channel blocks

The MODE parameter determines the operating mode for the channel block. The following operating modes are applicable to the SP - DO and SP - AO channel blocks:

- Manual (Man) - provides the operator or the program with direct control over the output value of the channel, regardless of any continuous control strategy.
- Cascade (CAS) - data point receives its output value from a primary data point.

> TIP
>
> - The default value of MODATTR is OPERATOR.
> - The default value of MODE is MAN.

10.20.5 Fail-safe configuration - SP-DO Channel blocks

The recommended fail-safe configuration for the SP_DO channel is:

- READY flag of DO is set 'ON' for normal operation only if all the interlocks are met.
- READY flag of DO is set to 'OFF' for trip operation if there is any failure in any of the interlocks.

10.21 Defining SP-SPEED Channel Blocks

The speed channel converts pulse signal received from a field sensor to a PV value in engineering units for use by the SPM, other function blocks in the C300, and by the rest of the Experion system. In addition to speed computation, the block also computes Rate Of Change (ROC) of the PV.

The Speed Channel performs the following functions.

- PV computation and Diagnostics
- Range Checking and PV filtering
- PV source selection
- Alarm Processing
- Reverse Rotation
- Flow measurement

- PV computation for speed measurement
- Configuring the SP_SPEED channel to measure speed
- Determining PV Source Selection - SP-SPEED Channel blocks
- Detecting Speed Input Failure
- Detecting Reverse Rotation
- Measuring flow in the turbine flow meters
- Configuring the SP_SPEED channel to measure the flow

10.21.1 PV computation for speed measurement

There are two types of PV computation.

- Calculated PV (PVCALC)
- Rate Of Change (ROC) of PV (ROCPV)

The input PV signal is

1. converted to a raw signal (PVRAW), whose unit is Pulse per Second (pps)
2. then converted to a floating number, which is the value of PVCALC in RPM/min.

The PVCALC is calculated for speed measurement as follows:

$$PVCALC = ((PVRAW*60)/C1)*C2$$

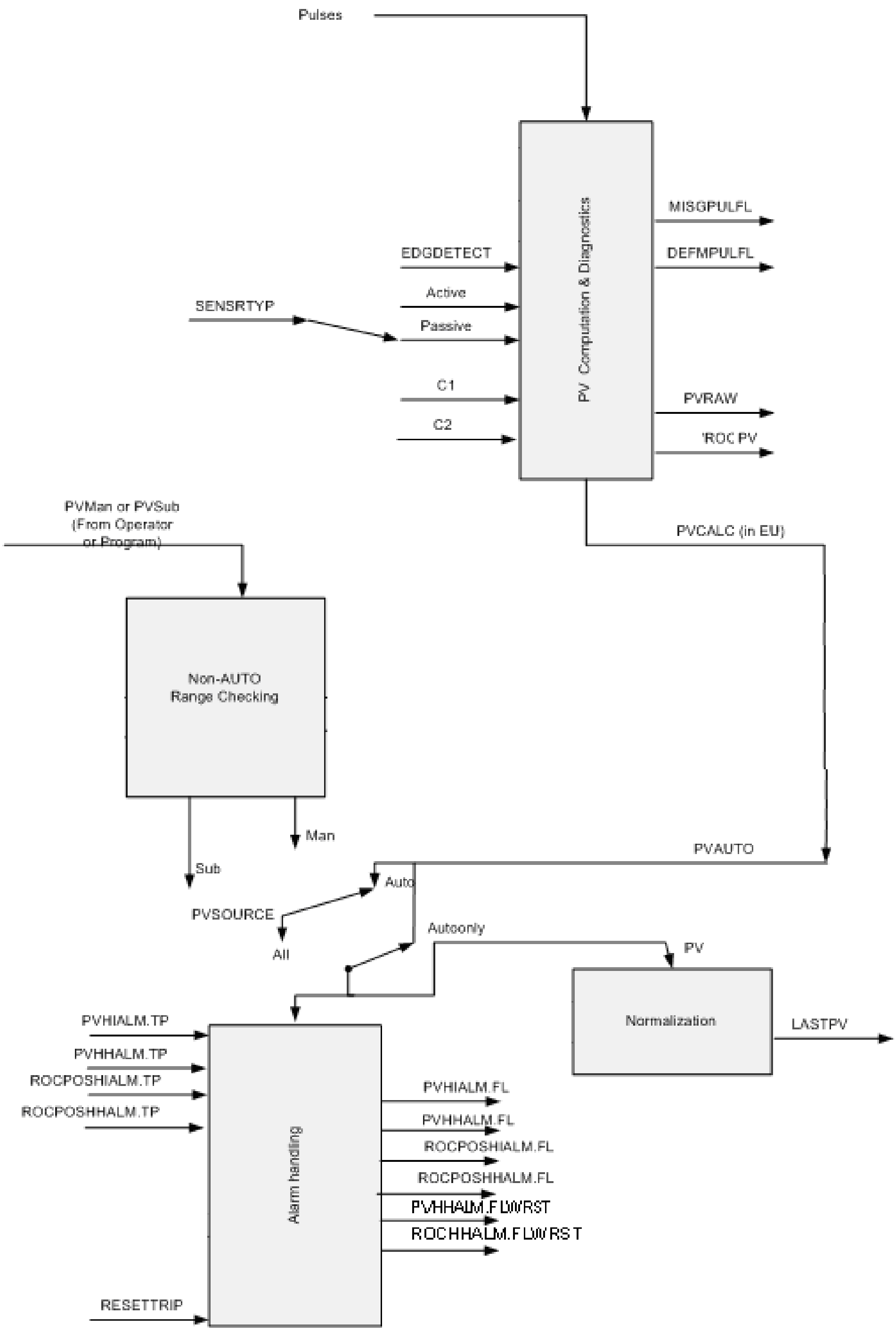
where,

- C1 is the number of teeth on the wheel (TOOTHCNT)
- C2 is gear reduction factor (GEARRATIO)

Simultaneously, ROCPV is also calculated in RPM/Min from the input signal.

The following flow diagram indicates how the pulse signal from sensor is processed to generate PVRAW and ROCPV.

Figure 10.19 Speed Channel - SPEED signal conversion



10.21.2 Configuring the SP_SPEED channel to measure speed

Perform the following steps on the **Configuration** tab of the SP_SPEED channel's configuration form to measure the speed.

- In the **Type Information** section, configure the MEASUREMENTTYPE parameter as 'Speed_ Measurement.'

  The parameters related to the speed measurement are enabled in the **Configuration** tab.

10.21.3 Determining PV Source Selection - SP-SPEED Channel blocks

PV source option parameter (PVSRCOPT) allows you to change the PV source to a source other than AUTO, as follows:

- If the PVSRCOPT parameter is set to ALL, the PVSOURCE can be manually set.
- If the PVSRCOPT parameter is set to ONLYAUTO, the PV tracks PVCALC value.

The PVSOURCE parameter allows you to select the source of the PV for the data channel, as follows:

- If the PVSOURCE parameter is set to AUTO, the PV tracks PVCALC value.
- PV can be manually entered PV (when PVSOURCE is set to 'Man') or
- PV can be directly fetched from a sequence program (when PVSOURCE is set to 'Sub').

10.21.4 Detecting Speed Input Failure

The speed channel's input may fail due to sensor failure, open wire or if the wheel moves away from sensors, and so on. In such scenarios,

- if previous speed PV is less than 200 RPM, speed channel
    - sets PV to 0, and
    - generates the 'No Pulse Input' soft failure,

and the speed channel's 'Zero Speed Detection Flag' is set to 'ON'.

- if previous speed PV is greater than 200 RPM, speed channel
    - sets PV to NaN, and
    - generates 'No Pulse Input' soft failure,

and the speed channel's 'Zero Speed Detection Flag' is not set to 'ON'.

10.21.5 Detecting Reverse Rotation

Reverse rotation is checked by monitoring the phase lag between SP_SPEED channels. Following is the pre-requisite to detect the reverse rotation during installation.

- Two SP_SPEED channels that are used for reverse rotation detection are mounted to have a 90 degree (+/-10 degree tolerance) phase difference between the pulses.

> NOTE
> If the phase difference between the pulses from SPEED channels changes substantially, reverse rotation detection may not work. In this scenario, the probe positions may need to be adjusted.

The direction of positive turbine rotation is recorded during normal turbine operation when the turbine speed exceeds 500 RPM. The reverse rotation flag is set to ON when there is a phase change observed consistently between the two speed channels for few rotations.

10.21.6 Measuring flow in the turbine flow meters

With R410, SP_SPEED channel can be configured to measure the flow in the turbine flow meters. The flow PV is computed using the following formula.

PV = (PVRAW/ KFACTOR)*TIMEBASE

where the Timebase can be configured as any one of the following:

- /Second, Timebase = 1
- /Minute, Timebase = 60
- /Hour, Timebase = 3600
- /Day, Timebase = 86400

10.21.7 Configuring the SP_SPEED channel to measure the flow

Perform the following steps on the **Configuration** tab of the SP_SPEED channel's configuration form to measure the flow in the turbine flow meters.

1. In the **Type Information** section, configure the MEASUREMENTTYPE parameter as 'Flow_ Measurement.'

   The parameters related to the flow measurement are enabled in the **Configuration** tab.
2. In the **PV Configuration** section, configure TIMEBASE parameter as any one of the following based on your requirement.
   - \Second
   - \Minute
   - \Hour
   - \Day
3. In the **Flow Information** section, ensure that the ORDEROFKFACTOR parameter is configured as '1st Order.'
4. In the **Flow Information** section, type the value of the KFACTOR as required for flow meter.

10.22 Defining SP-SPDVOTE Channel Blocks

The SP - SPDVOTE channel block accepts multiple inputs (PV1, PV2, PV3, and PV4) from the SP - SPEED block of the parent IOM to compute Voted PVs (VOTPV1 and VOTPV2) and Voted ROCs (VOTROC1 and VOTROC2). It generates alarms such as over speed/acceleration, for the Voted PV or ROC.

> ATTENTION
>
> You are recommended to use the DATAACQ block for generating alarms such as over speed, over acceleration, under speed, and under acceleration, using the SP_SPEED and SP_SPDVOTE PV parameters.

The Voted PV can be connected to

- any function blocks that are running in C300 - 20mS CEE Controller, or
- OP parameter of SP - AO channel in the same SPM.

The SP-SPDVOTE channel allows you to configure all flags for generating alarms or processing control logic.

The output pins can be connected to the interlock parameters of the parent IOM's SP - DO channel and it can be used as a trip signal.

> ATTENTION
>
> SP_SPDVOTE block pins PV1, PV2, PV3, and PV4 accept connections only from the PV pins of local SP_SPEED channel block pins. All other connections to PV1, PV2, PV3 and PV4 pins of SP_SPDVOTE logic block are blocked.

- Voting Logic Algorithm Execution

10.22.1 Voting Logic Algorithm Execution

There are two different pairs of output.

- Voted PVs (VOTPV1 and VOTPV2)
- Voted ROCs (VOTROC1 and VOTROC2)

These output are obtained by processing the inputs received from the SPEED block. The inputs are processed using the voting logic. This block supports two groups of voting logic.

- Voting Logic Group 1
- Voting Logic Group 2

A maximum of 3 channels can be configured as part of each voting group. The selection is based on GRPxVOTCHENB[1..4], where x = 1 or 2.

> **ATTENTION**
>
> If the total number of valid inputs is less than the configured inputs (GRPxMIN), the VOTPVx (x = 1, or 2) is set to NaN.

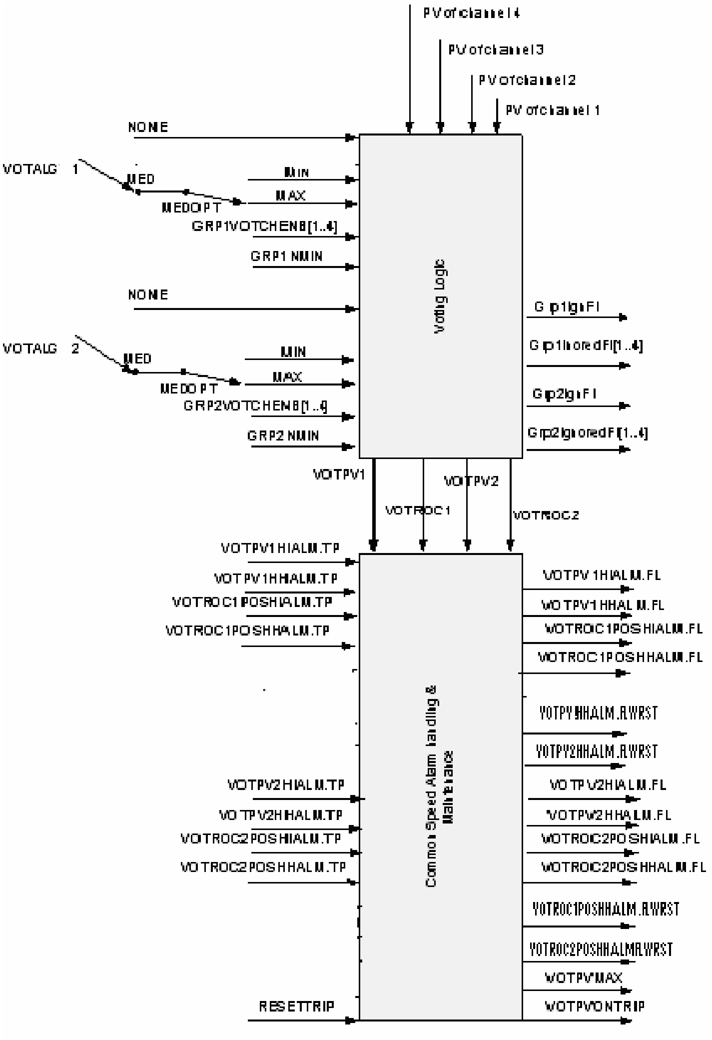
It is possible to configure the same channel to both voting groups.

The algorithm sets

- The flag - (GRPxIGNORD x=1, 2) indicating if any of the inputs is ignored by the voting logic.
- The Individual flags for each input indicating if it was ignored (GRPxIGNORDFL [1..4] x=1, 2).

The voted PV processing is explained as follows.

Figure 10.20 Voting logic algorithm execution



To configure the voting logic algorithm, perform the following steps.

1. Select Median (MED) as the voting algorithm (set VOTALGx = Med). The VOTALGx is set to 'NONE' by default. When 'NONE' is selected, the processing of voted PV, ROC and alarm processing is disabled for that particular group.
2. Select the number of channels for specific voting logic group using GRPxVOTCHENB[1..4] parameter, where x = 1 or 2.
3. Select the number of minimum valid inputs using GRPxNMIN parameter, where x=1, 2. The GRPxNMIN parameter can be 1, 2 or 3.
4. If the GRPxNMIN is set as 3, the output of the voting block (VOTPVx) is the median of the 1, 2, and 3 inputs.

> NOTE
>
> If any of the Speed channel's PV is NaN, the output of the voting block (VOTPVx) is also NaN, and VOTPVxSTS = BAD.

5. If the GRPxNMIN is set as 2, the output of the voting block (VOTPVx) is based on 'MEDOPT parameter status.' The MEDOPT parameter can be 'MIN' or 'MAX'

> NOTE
>
> If any of the Speed channel's PV is NaN, the output of the voting block (VOTPVx) is also NaN, VOTPVxSTS = BAD

> ATTENTION
>
> Same combination of channels must not be configured for voting logic groups.
>
> **Example:**
>
> If the channel 1, 2, and 3 is configured for the voting logic group 1, the same channels must not configured for the voting logic group 2.

10.23 Defining SVP-AI Channel block

The SVP - AI channel block represents a single analog point on Servo Valve Positioner (SVP) module. The type of analog input IOM needed is based on the:

- type of field sensor that is providing input to the channel
- PV characterization options you select (as listed in the table 'Determining PV Characterization'):

> ATTENTION
>
> In SVPM, position inputs in the input channels must be configured using the SENSRTYP parameter.

The analog input channel converts an analog signal received from a field sensor to PV with appropriate engineering units for use by other function blocks in the C300 - 20mS CEE Controller and by the rest of Experion. To accomplish this function, the analog input channel, performs:

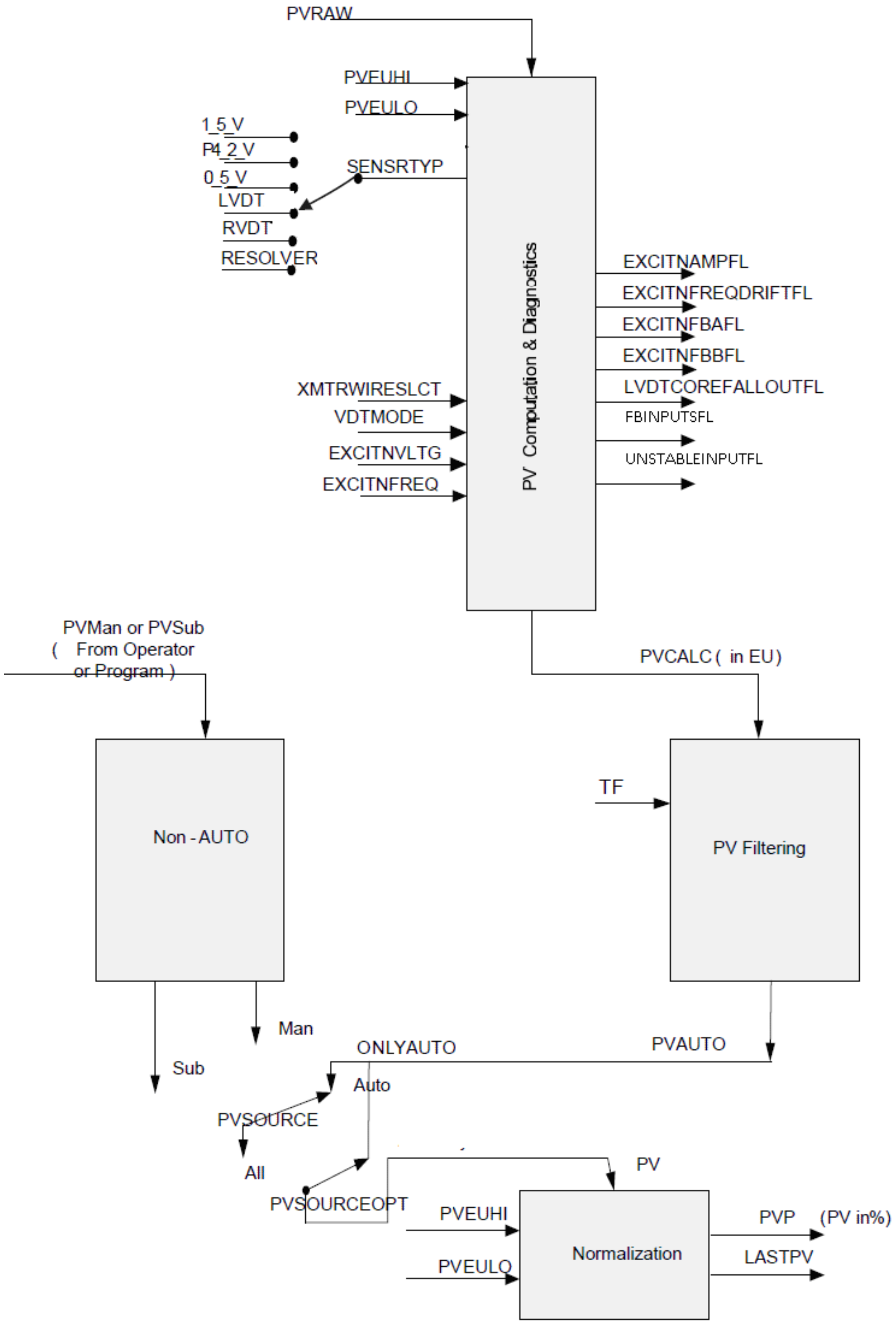
- Analog-to digital conversion
- PV characterization
- Range checking and PV filtering
- PV source selection
- Open wire detection

10.23.1 Determining PV Characterization if SENSRTYP is configured as 'LVDT' or 'RVDT' or 'Resolver'

The PV signal received from the field is characterized based on the entries that you make for the SENSRTYP parameter.

The input PV signal is converted to a raw PV signal (PVRAW) whose units can be % in case of LVDT/RVDT and degree in case of Resolver.

Figure 10.21 SVP -AI PV processing when it is configured for LVDT or RVDT or Resolver



The following parameters are enabled only when SENSRTYP is set to 'LVDT' or 'RVDT' or 'Resolver.'

- Transducer Wire Select (XMTRWIRESLCT)
- Position Mode Select (VDTMODE)
- Excitation Voltage
    - For Resolver: ranges from 1.1 vrms to 8 vrms

  - For LVDT/RVDT: ranges from 3 vrms to 8 vrms

- Excitation Frequency - ranges from 1000 Hz to 3200 Hz
- Calibration Value (CALIBVAL) - used for VDT calibration.

The VDTMODE parameter values are explained based on the XMTRWIRESLCT parameter values.

Transducer Wiring Scheme (XMTRWIRESLCT)	Supported Modes (VDTMODE)
3_WIRE	A
4_WIRE	A
5_WIRE	(A-B), (A-B)/(A+B)
6_WIRE	(A-B), (A-B)/(A+B) ARCTAN(A/B)

> **NOTE**
>
> If the SENSRTYP is configured as 'Resolver,' the VDTMODE parameter is set as 'ARCTAN(A/B)' and the XMTRWIRESLCT parameter is set as '6_WIRE.'

Table 10.22 SVP - AI engineering unit conversions

Sensor type (SENSRTYP)	AI Channel type	PVCHAR Options	PVRAW (note 1)	PVCALC (note 2)	Bad PV detection
4-20mA	SVP-AI	Linear square rt. Device Range	percent	EU	Range check on PVCALC.
LVDT	SVP-AI	Not applicable	percent	percent	Range check on PVCALC
RVDT	SVP-AI	Not applicable	percent	percent	Range check on PVCALC
Resolver	SVP-AI	Not applicable	degree	degree	Not applicable

LEGEND:

EU = Engineering Units

SVP-AI = Servo Valve Positioner Module - Analog Input

PVCALC = Calculated PV

PVCHAR = PV Characterization

PVRAW = PV received from field and converted to digital form by the A/D converter

Notes:

1. PVRAW is the voltage signal at the IOTA as a percentage of the voltage range for the sensor type.
2. If the diagnostics determine that the A/D converter has failed, PVRAW of the slot is set to NaN.

10.23.2 Determining PV Source Selection - SVP-AI Channel blocks

PV Source Selection - The PV source parameter (PVSOURCE) option determines the source of the PV for a status input channel. The source can be

Honeywell

- PV input from the field (PVRAW),
- PV state entered by the operator (PV manual), or
- PV supplied by a user program (PV substituted).

10.23.3 Determining Linear Conversion - SVP-AI Channel blocks

The PVRAW value is converted to a floating-point number. The output value of the linear conversion is PVCALC, which is calculated based on the raw input span, and the engineering unit span.

> NOTE
>
> The state of the input direction parameter (INPTDIR) is not taken into consideration during the calculation of PVCALC for all sensor types except Resolver as follows:
>
> $$PVCALC = \frac{PVRAW}{100} * (PVEUHI - PVEULO) + PVEULO$$
>
> The PVCALC is calculated for Resolver interface as follows:
>
> $$PVCALC = PVRAW + ANGLEOFFSET$$

10.23.4 Determining PV Characterization if SENSRTYP is configured other than 'LVDT' or 'RVDT' or Resolver

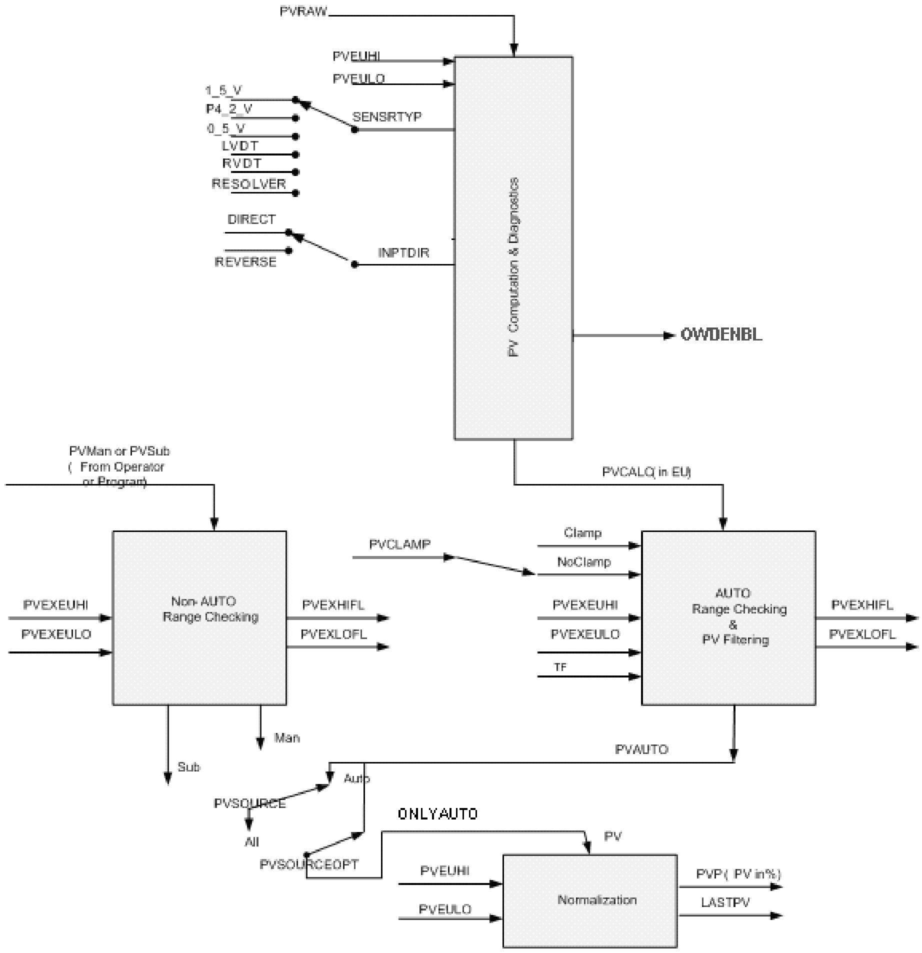
The PV signal received from the field is characterized based on the entries that you make for the parameters:

- SENSRTYP
- PVCHAR
- INPTDIR

The input PV signal is:

- converted to a raw signal (PVRAW) whose units can be %, ratio, millivolts, microvolts, or milliohms depending on the entry made for the SENSRTYP parameter,
- and, then converted to engineering units.

Figure 10.22 SVP -AI PV processing when it is configured other than LVDT/RVDT or Resolver



10.23.5 Determining Square Root Conversion - SVP-AI Channel blocks

The square-root calculation is applied to the PVRAW input such that

100% of span = 1.0

The square-rooted value is then converted to engineering units based on the configured PV engineering-unit range values.

(For example, square root of 100% = 100%; square root of 50% = 70.71%.)

The output value of the square-root conversion is PVCALC, which is calculated as follows

If PVRAW ? 0.0 and 4-20mA is selected :

$$PVCALC = PVEULO + \sqrt{\frac{PVRAW}{100}} * (PVEUHI - PVEULO)$$

For more information, refer to the following sections in Defining SP - AI Channel block section.

1. Determining PV Characterization - SP-AI Channel blocks
2. Determining Linear Conversion - SP-AI Channel blocks
3. Determining Square Root Conversion - SP-AI Channel blocks

10.23.6 Detecting Open Wire - SVP-AI Channel blocks

The open wire diagnostic detects and annunciates broken field wires. In addition, a seemingly valid PV from a channel diagnosed as having a broken-wire is not made available (thus preventing incorrect control action).

If open wire detection is enabled (OWDENBL = ON) and the IOM detects the broken-wire condition, then

- Soft Failure 179 'Open Wire Detected' is generated, and
- PVRAW and PVAUTO is consequently set to NaN.

10.23.7 Checking and Filtering PV Range - SVP-AI Channel blocks

PV range checking ensures that the PVCALC output of PV characterization is within the limits defined by parameters PVEXEULO and PVEXEUHI. If either of the limits is violated, the output of the PVAUTO is set to NaN if clamping has not been specified. If clamping has been specified, the output of the PVAUTO is clamped to PVEXEUHI or PVEXEULO, except when PVRAW, PVCALC, and PVAUTO is consequently set to NaN.

If the range-checked and filtered value is less than the value specified by the user-configured LOCUTOFF parameter, the final output called PVAUTO is forced to PVEULO.

First-order filtering is performed on PVCALC, as specified by the user through parameter TF (filter lag time).

10.23.8 Configuring the SVP_AI channel for angular measurement using Resolver

With R410, SVP_AI channel can be configured to perform angular measurement using the Resolver.

Perform the following steps in the SVP_AI channel's configuration form to measure the angle using the Resolver.

1. In the **Type Information** section of the **Configuration** tab, configure the SENSRTYP parameter as 'Resolver.'
2. On the **Position Configuration** tab, verify the following steps.
   a. Ensure that the XMTRWIRESLCT parameter is set as '6_WIRE.'
   b. Ensure that the VDTMODE parameter is set as 'ARCTAN(A/B).'

> **ATTENTION**
>
> In a redundant SVP IOM setup, even if one of the modules is faulty, you have to replace it and re-configure the actual angle to calculate the offset value. This is because, the new module does not have the angle offset value. You must configure the present PV value of the primary SVP IOM as the actual angle for calculating the offset value.

10.23.9 Configuring angle offset value

The PVRAW parameter in SVP_AI channel displays the raw value of the measured angle from the Resolver. An offset can be applied to the raw angle using the parameters ACTUALANGLE and APPLYOFFSET.

To add an offset to the raw angle and indicate the same in PV, perform the following steps.

1. In the **Resolver Angle Offset s**ection of the **Position Configuration** tab, enter the actual angular position in the **Actual Angle (ACTUALANGLE)** box.
2. Click **APPLYOFFSET**.

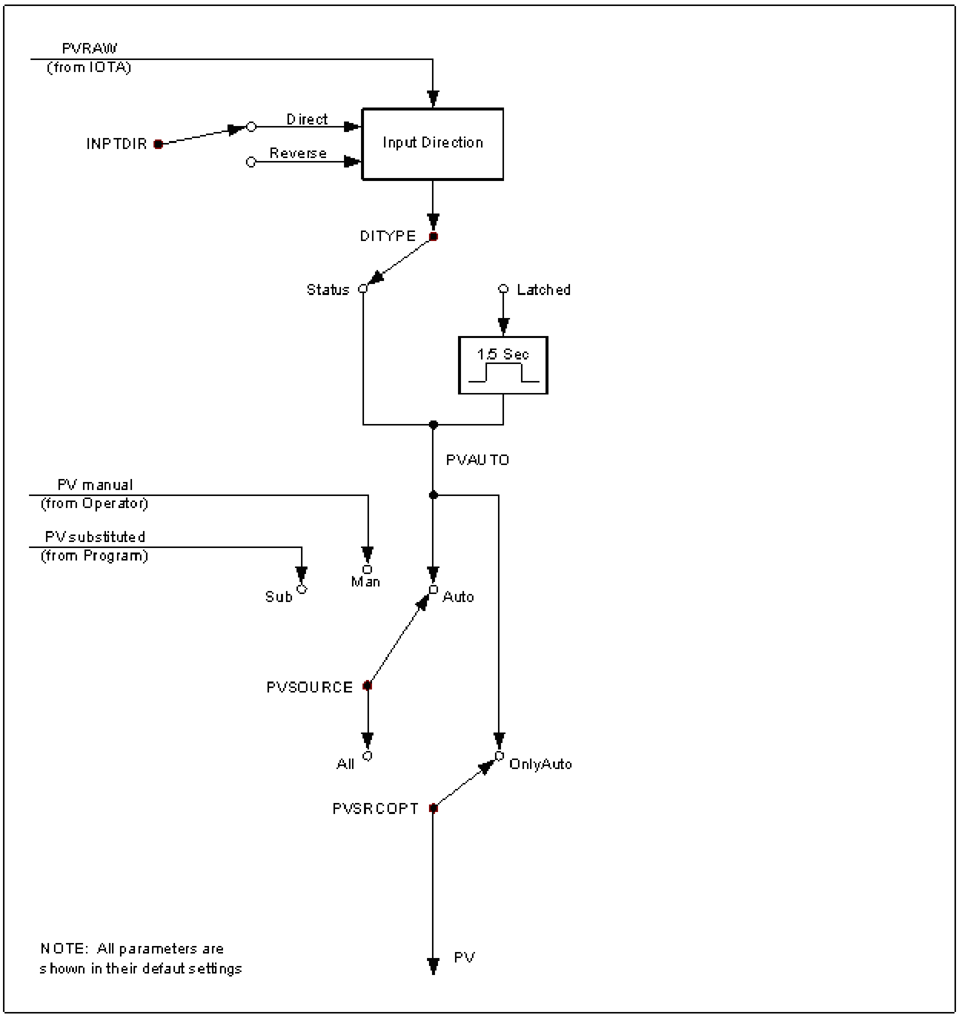
   The offset value is internally calculated and is retained even if the SVP module is powered off

   Consider that the Resolver PV displays 30 degree and you want to modify the actual angle as 75 degree. In this scenario, configure ACTUALANGLE as 75 degree and click APPLYOFFSET. As a result, the PV displays 75 degrees by internally applying a new offset to PVRAW.

10.24 Defining SVP-DI Channel Block

The DI channel block represents a single digital input point on the SVP - DI channel block. The SVP - DI channel block converts a digital PVRAW signal received from the field to a PV that can be used only for Turbine Control solutions.

Figure 10.23 SVP - Digital Input conversion



- Determining Status Digital Input Channel - SVP-DI Channel blocks
- Determining Latched Digital Input Channel - SVP-DI Channel blocks
- Low Latency Mode - SVP-DI Channel blocks
- Open Wire Detection - SVP-DI Channel blocks

10.24.1 Determining Status Digital Input Channel - SVP-DI Channel blocks

For this digital input type, the PVAUTO value represents the state of the raw input signal after the direct/reverse conversion is performed. The status digital input channel is selected by setting the DITYPE parameter to 'Status,' and this block can be configured for PV source selection.

The current PV state is available as an input to logic blocks and other Experion control function blocks.

PV Source Selection - The PV source parameter (PVSOURCE) option determines the source of the PV for a status input channel. The source can be

- the PV input from the field (PVRAW),
- the PV state entered by the operator (PV manual), or
- it can be supplied by a user program (PV substituted).

PVSOURCE has no effect on the DITYPE of the digital input channel. If PVSOURCE is AUTO, PV tracks PVRAW.

10.24.2 Determining Latched Digital Input Channel - SVP-DI Channel blocks

To capture the occurrence of momentary digital inputs, such as from push buttons, the digital input channel is configured as a latched input.

Configuring the channel as latched is accomplished by setting:

- DITYPE to 'Latched'

When configured as a latched input channel, an input pulse that is on for a minimum of 5 milliseconds is latched TRUE for 1.5 seconds. This ensures that any control function block, that needs to monitor this input, executes at least once during the time that the signal is latched.

10.24.3 Low Latency Mode - SVP-DI Channel blocks

The DIMODE parameter is not supported in SVP-IOM. The DI channel's inputs are sampled and processed every 5 msec to meet latency requirements.

10.24.4 Open Wire Detection - SVP-DI Channel blocks

The SVP - DI channel supports open wire diagnostics to detect and annunciate broken field wires. In addition, a valid PV from a channel, which is received diagnosed as having a broken-wire, is made unavailable.

Ensure that a bleed resistor (~ 22k ohm) resistor is installed at the switching device providing the switched signal. If a resistor is not installed and open wire detection is enabled (OWDENBL = ON), a false open wire alarm is generated whenever the input device is not closed (i.e., PVRAW = OFF).

If open wire detection is enabled and the IOM detects the broken-wire condition,

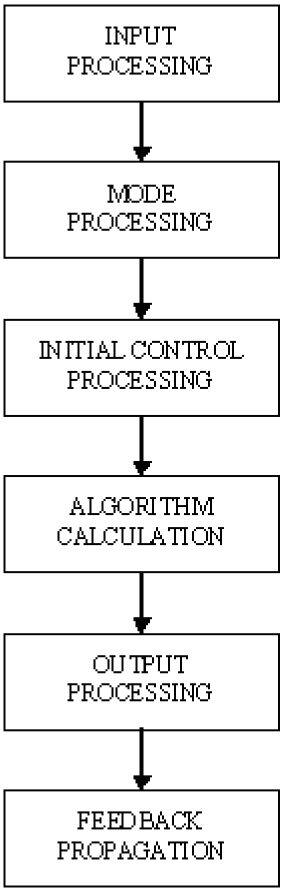
- Soft Failure 179 'Open Wire Detected' is generated, and
- PVRAW and PVAUTO is consequently set to OFF

10.25 Defining SVP-Regulatory Control Block

The SVP - REGCTL block supports the regulatory algorithm along with some of the C300 PID block features. It accepts PV as input from one of the local SVP_AI channels. It accepts Set Point (SP) from the AUXILIARY function blocks if the MODE parameter is set to 'Cascade.'

Following diagram depicts how the SVP_REGCTL block processes the input.

Figure 10.24 SVP - REGCTL block processing diagram



ATTENTION

SVP_REGCTL accepts inputs (PV1 and PV2) only from the SVP_AI channel of the same IOM/local IOM. Further, the SVP_REGCTL channel accepts the SetPoint (SP) value only from the AUXILIARY function blocks.

- PV and SP Processing
- PV handling when PVSTS is BAD
- Set Point (SP) Limit checking
- Determining and handling modes
- Initial Control Processing
- Control Initialization
- Algorithms
- Output biasing process
- Time-out monitoring
- Time-out processing
- Anti-reset windup status
- Mode shedding on timeout

- Output Processing
- Bad Control Processing
- Output Limiting
- Windup processing and handling

10.25.1 PV and SP Processing

The SVP_REGCTL block accepts the following inputs.

- Process Variables (PV1 and PV2) from the SVP_AI channel based on the PVSOURCE configuration.
- Set Point value from the AUXILIARY function blocks that reside in the C300 - 20mS CEE Controller when the MODE is set to 'Cascade.'

Process Variable (PV) Processing – fetches the input values (PV1 and PV2) from the SVP_AI channel based on the status (PV1STS and PV2STS) of the input values and gives the output PV value. The inputs PV1 and PV2 act based on the selection of preferred PV source (PREFPVSRC) parameter.

Set Point (SP) Processing – obtains the SP value from the AUXILIARY function blocks when the MODE is set to 'Cascade' and processes it to perform SP limit checking, SP value must be within the engineering unit range defined by PVEUHI and PVEULO.

10.25.2 PV handling when PVSTS is BAD

1. If the PVxSTS (x=1, 2) is set to 'BAD',
   - the PVSTSFL.BAD is set to 'ON' in the SVP_REGCTL channel,
   - MODE is set to 'MAN' in the SVP_AO channel.
   - the calculated variable (CV) is set to 'NaN' to invoke Bad Control processing.
   - the BADCTLFL is set to 'High.'

NOTE

- When the PV is 'Bad,' AO Mode change is prohibited until PVSTS returns to 'Normal' if the MODE was in 'Shed.'
- When the PV returns to 'Normal,' the channel remains in 'Manual' mode if the MODE was in 'Shed.' You must manually change the MODE to 'Normal.'

1. If the PVxSTS (x=1, 2) is set to 'Normal',
   - the PV value is normal in SVP_AI channel, and
   - the PVSTSFL.NORM is set to 'ON' in the SVP_REGCTL channel.

10.25.3 Set Point (SP) Limit checking

This ensures that the SP value does not exceed the configured limits. The limits are

Honeywell

- SPHILM - SP high limit
- SPLOLM - SP low limit

The limit values can be changed only if the status of the channel is 'InActive.' If the SP limits are changed, the network Anti-Reset Windup status (ARWNET) is recalculated.

If the SP value is beyond the range specified by SPHILM and SPLOLM limits,

- the SP is clamped to the appropriate limit, and
- the appropriate 'limit exceeded' flag (SPHIFL or SPLOFL) is set.

Following table explains about the SVP_REGCTL block behavior when the SP value exceeds the limits (SPHILM and SPLOLM) and the tolerance (SPTOL).

Table 10.23 SVP - REGCTL SetPoint processing

Scenario	Limits Exceeded	Tolerance Exceeded (SPTOL)	SVP_REGCTL Behavior
Raise or Lower keys	Yes	Yes	A warning message displays as 'SP value is clamped.'
	Yes	No	A warning message displays as 'SP value is clamped.'
	No	Yes	SP value is set to a new value without confirming the tolerance.
	No	No	SP value is set to a new value.

10.25.4 Determining and handling modes

Mode identifies the source of stores that is accepted by the inputs (SP and OP) of a SVP_REGCTL block. SVP_REGCTL block supports two modes of operation.

MODE = Manual (Man)

The OP can be stored by the operator. The SVP_REGCTL holds its last OP value instead of computing the OP value, and sets input windup status (ARWNET) to 'HiLo.'

NOTE

- The SVP_REGCTL does not initialize when its mode is changed.
- The SVP_REGCTL block does not support 'AUTO' mode, and you can store the SP value to the when the MODE is set to 'MAN.'

MODE=Cascade (CAS)

The SVP_REGCTL block obtains its input from the AUXILIARY function blocks, and calculates OP.

Mode Attribute (MODEATTR)

Lets you set the block's mode attribute. MODEATTR determines if values to the output (OP) can be stored when the block's MODE is 'MAN.' The MODEATTR can be

- OPERATOR - only operator can store the value to OP or SP as specified by MODE.
- PROGRAM - this mode is not allowed, as the SVP_REGCTL block does not accept the input from SCM.

The default selection is OPERATOR.

Permit Operator Mode Changes (MODEPERM)

Lets you specify if operators are permitted to make MODE changes or not. The default is 'Enabled' (selected). A store to MODE does not change the NORMMODE.

Normal Mode (NORMMODE) and Normal Mode Attribute (NORMMODEATTR)

NORMMODE - Lets you specify the MODE of the SVP_REGCTL block derived at runtime. You can configure the NORMMODE and NORMMODEATTR values by clicking 'NORM' in the Station Display.

The supported selections for the NORMMODE are:

- NONE
- CAScade
- MANual

The default selection is 'NONE.'

NORMMODEATTR - Lets you specify the mode attribute (MODEATTR) when the Control to Normal function is initiated through the Station display.

The supported selections for the NORMMODEATTR are:

- NONE
- OPERATOR
- PROGRAM

The default selection is 'NONE.'

10.25.5 Initial Control Processing

This function directly fetches the OP (INITVAL) value from the SVP_AO block to the SVP_REGCTL block. In the SVP_AO block, the OP value can be changed when the MODE is set to 'MAN.' Based on the OP value from the SVP_AO block, this function performs initialization and windup activities for the SVP_REGCTL block. In addition, it sets the SVP_REGCTL output range (CVEUHI and CVEULO) to the SVP_AO block output range.

10.25.6 Control Initialization

The SVP_REGCTL block brings initialization requests from its secondary through BACKCALCIN. In addition, the secondary may propagate one shot initialization requests to this block. This function requests a primary to initialize by updating the corresponding INITREQ and INITVAL parameters. Normally, the SVPREGCTL block's OP is initialized to the SVP_AO's initialization value. However, if the initialization value exceeds the OP limits, this function clamps the OP to the violated limit.

Initial Control Processing performs the following processing, based on the value of INITMAN.

- **When INITMAN changes from 'Off' to 'On':** Requests the SVP_REGCTL block's windup status to be recalculated and later propagated to the primary.
- **When INITMAN is 'ON':** Initializes the SVP_REGCTL block's output (OP).
- **When INITMAN changes from 'On' to 'Off':** Initializes the SVP_REGCTL block's output (OP), and requests its windup status to be recalculated.

This function requests the primary to initialize itself if any one of the following is true:

- SVP_REGCTL block is inactive.
- SVP_REGCTL is in initialization.
- SVP_REGCTL is not in the Cascade.
- CVEUHI or CVEULO are Bad.

10.25.7 Algorithms

> ATTENTION
>
> SAFEOP and OUTIND parameters are not supported for SVP_REGCTL channel.

The SVP_REGCTL block executes the following algorithms.

- Equation A (Eq A) algorithm - supports time-out processing and time-out monitoring.
- Equation E (Eq E) algorithm - supports both time-out processing and output biasing.

10.25.8 Output biasing process

This function enforces an output bias to the calculated Controlled Variable (CV).

The OPBIAS is the sum of the user-specified fixed bias (OPBIAS.FIX) and a calculated floating bias (OPBIAS.FLOAT). The purpose of the floating bias is to provide a bump less transfer when the function block initializes or changes mode as long as the SVP_REGCTL channel is the first initializable channel.

If the algorithm is configured as Equation E, the output bias (OPBIAS) is added to the algorithm's Calculated Value (CV) and the result is stored in CV. CV is later checked against the OP limits and then if the limits are not exceeded CV is copied to the output.

- OPBIAS is recomputed under the following conditions to avoid a bump in the output. (Note that the SVP_REGCTL channel only applies OPBIAS.FLOAT to the output for the latter two conditions, when it is the first initializable block.)
    - When the function block starts up (that is, goes Active).
    - When the function block initializes (for example, the secondary requests initialization).
    - When the mode changes to Cascade.

> ATTENTION
>
> When MODE is ' ;Manual,' OPBIAS is not used (because OP is not calculated). Consequently, when MODE changes to Manual, OPBIAS is not recomputed.

- You can store to OPBIAS only if the function block is inactive or MODE is 'Manual.' Hence, prevent a bump in OP is prevented when the bias is changed.
- When you store values to OPBIAS, the following occurs.
  - Total bias (OPBIAS) and fixed bias (OPBIAS.FIX) are both set to a new value.
- There are no limit checks applied when you store the OPBIAS. However, after the bias is added to the calculated variable (CV), the result is compared against the OP limits and clamped, if necessary.
- You can store to OPBIAS.FIX only if the function block is inactive and SVP_REGCTL is configured with the control algorithm equation as 'E.' When you store to OPBIAS.FIX, the following occurs.
  - Total bias (OPBIAS) and fixed bias (OPBIAS.FIX) are both set to a new value.

10.25.9 Time-out monitoring

If MODE is set to 'Cascade,' SVP_REGCTL channel monitors its SP input value (that is, primary input) for time-out. If a valid SP value is not received within the predefined time, the SVP_REGCTL channel invokes time-out processing. The time-out time (in seconds) is specified by TMOUTTIME.

- Enable time-out monitoring by setting TMOUTTIME to a non-zero value.
- Disable time-out monitoring by setting TMOUTTIME to zero.

10.25.10 Time-out processing

A time-out can occur for several reasons communication error, inactivation of primary block, and so on. If an input times-out, SVP_REGCTL channel performs setting a time-out flag (TMOUTFL), requesting the primary block to initialize, and shedding the SVP_REGCTL channel to a predefined mode (TMOUTMODE).

If MODE is set to 'Cascade' and the SP time-out, the SVP_REGCTL channel performs the following:

- Sets a time-out flag (TMOUTFL).
- Requests the primary to initialize.

> ATTENTION
>
> In SVP_REGCTL channel, the primary can be an ENHGENLIN block and AUXILIARY Function block from C300-20mS CEE Controller and no initialization happens to it.

The SVP_REGCTL block supports mode-shedding on time out. In such cases, SVP_REGCTL sheds the mode to 'Manual,' and the mode does not return to 'Cascade,' even if the primary block returns a valid value.

10.25.11 Anti-reset windup status

The SVP_REGCTL channel maintains anti-reset windup status for its output (ARWOP) and each of its initializable inputs (ARWNET). ARWOP indicates if OP can be raised or lowered. When ARWNET is set to 'Hilo,' stores to SP are not limited, rather this is the status propagated to the primary. The only limiting anti-reset windup status ever does is to stop integral action in one or both directions on regulatory channels.

The SVP_REGCTL channel uses ARWOP parameter to restrict integral control. When ARWOP contains a value other than 'Normal,' the SVP_REGCTL channel stops integral control in the windup direction. Integral, proportional, and derivative control continues in the other direction. However, Windup status has no impact on proportional and derivative control.

10.25.12 Mode shedding on timeout

The SVP_REGCTL block sheds the MODE to 'MAN' in case of manual intervention. Accordingly, the SVP_REGCTL does not change the MODE to 'CAS' while fetching a good value from the primary.

ATTENTION

- While disconnecting the IOLINK cables, INITREQ parameter of SVP_AO channel configured as 'Incremental' is set to 'ON' and INITMAN parameter of SVP_REGCTL channel is set to 'ON'. Hence, SP timeout does not occur and the MODE parameter of the SVP_REGCTL channel does not shed to Timeout mode, and the MODE parameter of the SVP_AO channel is set to 'MAN'.
- The shedding of MODE to 'MAN' is dependent on the SP timeout configuration. If the SP timeout is configured as 1 second, the SVP_REGCTL sheds MODE to 'MAN' on IOLINK cable removal or controller RRR during communication failure. However, if the SP timeout is configured to a value other than 1 second, SVP_REGCTL does not shed its mode during communication failure (IOLINK cable removal or RRR of controller).

10.25.13 Output Processing

Output Processing derives a control output value (OP) from the calculated variable (CV). It involves the following functions:

- OP limiting and clamping
- OP direction

ATTENTION

SVP_REGCTL channel OP value can only be connected to the OP of the SVP_AO channel when the OPACTION parameter is configured as 'Incremental.'

10.25.14 Bad Control Processing

This function helps to take a decision when the CV changed from good-to-bad or bad-to-good.

If the CV is 'Bad'

The CV can be set to 'NaN' if the SVP_REGCTL PV is bad or the CV range (CVEUHI/CVEULO) is bad.

The SVP_REGCTL block performs the following actions when the CV changes from good-to-bad.

- Sets BADCTLFL to 'ON' to indicate that a Bad Control condition exists.

> TIP
>
> - The SVP_REGCTL block performs the following when the CV is set to 'Bad.'
>
> - requests its primary to initialize if the MODE is shed to 'MAN.'
> - indicates to its primary that it is wound-up (ARWET = HiLo) and does not request the primary to initialize if the MODE is not shed to 'MAN.'
> - CV is prohibited to change its value until CV returns to good if the MODE was shed to 'MAN.'
>
> - The SVP_REGCTL block performs the following when the CV changes from 'Bad' to 'Good.'
>
> - remains at 'MAN' mode and continuously sends INITREQ to it primary if the MODE sheds to 'MAN.' You must change the SVP_REGCTL's MODE to normal.
> - clears it wind-up condition and performs a one-shot initialization if the MODE is not shed to 'MAN.' In addition, it requests the primary to perform the one-shot initialization.

If the CV is 'Good'

The SVP_REGCTL block determines if the CV is represented in terms of percentage or engineering units (EUs). If the CV is in EUs, it is converted to percentage.

10.25.15 Output Limiting

This function enforces the following limit checks to the OP value because the MODE is not 'MAN.'

- **Normal high or low limits (OPHILM and OPLOLM)** - define normal high and low levels for the OP value. If another function block or user program attempts to store an OP value that exceeds OPHILM or OPLOLM, the value is clamped to the limit. Only the operator is allowed to store an OP value that exceeds these limits. The following flags are set when the operator stores the OP value.
    - 'normal limit exceeded' flag (OPHIFL or OPLOFL)
    - 'OP Anti-Reset Windup status'
- **Extended high or low limits (OPEXHILM and OPEXLOLM)** - define the extended high and low limits for OP. If the operator attempts to store an OP value that exceeds OPEXHILM or OPEXLOLM, the value is clamped to the limit.

> ATTENTION
>
> Default OP limit values for the SVP_REGCTL channel is same as the C300-PID block even if the SVP_AO channel's OP limit values are 0% and 100% when the SVP_AO is configured as 'Incremental.'

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The SVP_REGCTL block behavior for these limits is summarized in the following table, taking the tolerance limit (OPTOL) into consideration.

Table 10.24 SVP - REGCTL OP value processing

Scenario	Limits Exceeded	Tolerance Exceeded (OPTOL)	SVP_REGCTL Behavior
Raise or Lower keys	Yes	Yes	A warning message displays as 'OP value is clamped.'
	Yes	No	A warning message displays as 'OP value is clamped.'
	No	Yes	OP value is set to a new value without confirming the tolerance.
	No	No	OP value is set to a new value.
Operator entry	Yes	Yes	An error message displays as 'Limit exceeded error (Previous value retained)'
	Yes	No	An error message displays as 'Limit exceeded error (Previous value retained)'.
	No	Yes	OP value is set to a new value along with the confirmation from the tolerance.
	No	No	OP value is set to a new value.

10.25.16 Windup processing and handling

SVP_REGCTL block maintains anti-reset windup status for its output (ARWOP) and each of its initializable inputs (ARWNET). ARWOP indicates if OP can be raised or lowered. The following table lists the possible values for ARWOP and ARWNET parameters.

Table 10.25 SVP - REGCTL ARWOP and ARWNET processing

If the ARWOP and ARWET value is ...	Then, the associated parameter is ...
Normal	free to move in either direction.
Hi	at its high limit and it may only be lowered.
Lo	at its low limit and it may only be raised.
HiLo	may not move in either direction.

- **ARWNET computation** - When ARWNET is set to 'HiLo,' stores to SP are not limited, rather this is the status propagated to the primary. The only *limiting* anti-reset windup status ever does is to stop integral action in one or both directions on regulatory channels. For any other regulatory control type block, ARWNET is not used for any kind of limiting. The ARWNET is computed as follows:

Table 10.26 SVP - REGCTL ARWNET status

If Any of the Following are True . . .	Then, ARWNET Equals . . .
This block is inactive.	**HiLo**
The ARWOP equals HiLo.	
This block is in Manual mode (MODE = Man).	
The calculated value (CV) range (CVEUHI / CVEULO) is NaN.	
The CV is NaN.	
This block is connected to a non-initializable primary.	

If Any of the Following are True . . .	Then, ARWNET Equals . . .
The ARWOP equals Hi.	**Hi**
The input from the primary is at a high limit. For example, SPHIFL = On.	
The ARWOP equals Lo. NOTE If CTLACTN is set to 'Reverse,' ARWNET tracks ARWOP, but if CTLACTN is set to 'Direct ,' ARWNET is the opposite of ARWOP.	**Lo**
The input from the primary is at a low limit. For example, SPLOFL = On.	

- **ARWOP computation** - SVP_REGCTL block uses ARWOP parameter to restrict integral control. When ARWOP contains a value other than 'Normal,' the SVP_REGCTL stops integral control in the windup direction. Integral, proportional and derivative control continues in the other direction. However, Windup status has no impact on proportional and derivative control. The SVP_REGCTL block fetches the AO's windup status through SECDATA during Control Initialization to recompute its ARWOP. The conditions within the function block, such as output being at its high limit, also affect the ARWOP. The ARWOP is computed as follows:

Table 10.27 SVP - REGCTL ARWOP status

If any of the following is true . . .	Then, ARWOP Equals . . .
This block is inactive.	**HiLo**
This block is in initialization (INITMAN = On).	
The block's output is at its high limit (OPHIFL = On).	**Hi**
The block's output is at its low limit (OPLOFL = On).	**Lo**

10.26 Defining SVP-AO Channel Block

SVP_AO channel supports unipolar and bipolar current outputs in addition to the standard 4-20mA analog output. It converts the output value (OP) to the output signal for operating the final control elements, such as valves and actuators, in the field. It accepts inputs only from ENHGENLIN block executing in the C300 - 20mS CEE Controller.

To convert the OP value to a configured signal value, the SVP_AO channel performs

- Direct/Reverse Output Function
- Nonlinear Output Characterization

> NOTE
>
> Unipolar/bipolar does not support direction function and non-linear output characterization.

ATTENTION

- SVP_AO channel accepts inputs from the AUXILIARY function blocks only if the OPACTION parameter is configured as 'FullValue.' SVP_AO channel accepts inputs from the SVP_REGCTL channel, the ENHGENLIN block, and the AUXILIARY function blocks when the OPACTION parameter is configured as 'Incremental.'
- Both SVPM channels must have the same output type. The output type can be 4–20mA outputs or coil outputs. There are no mutual dependencies in the coil outputs. The two channels can have unipolar or bipolar currents and different ranges of outputs.

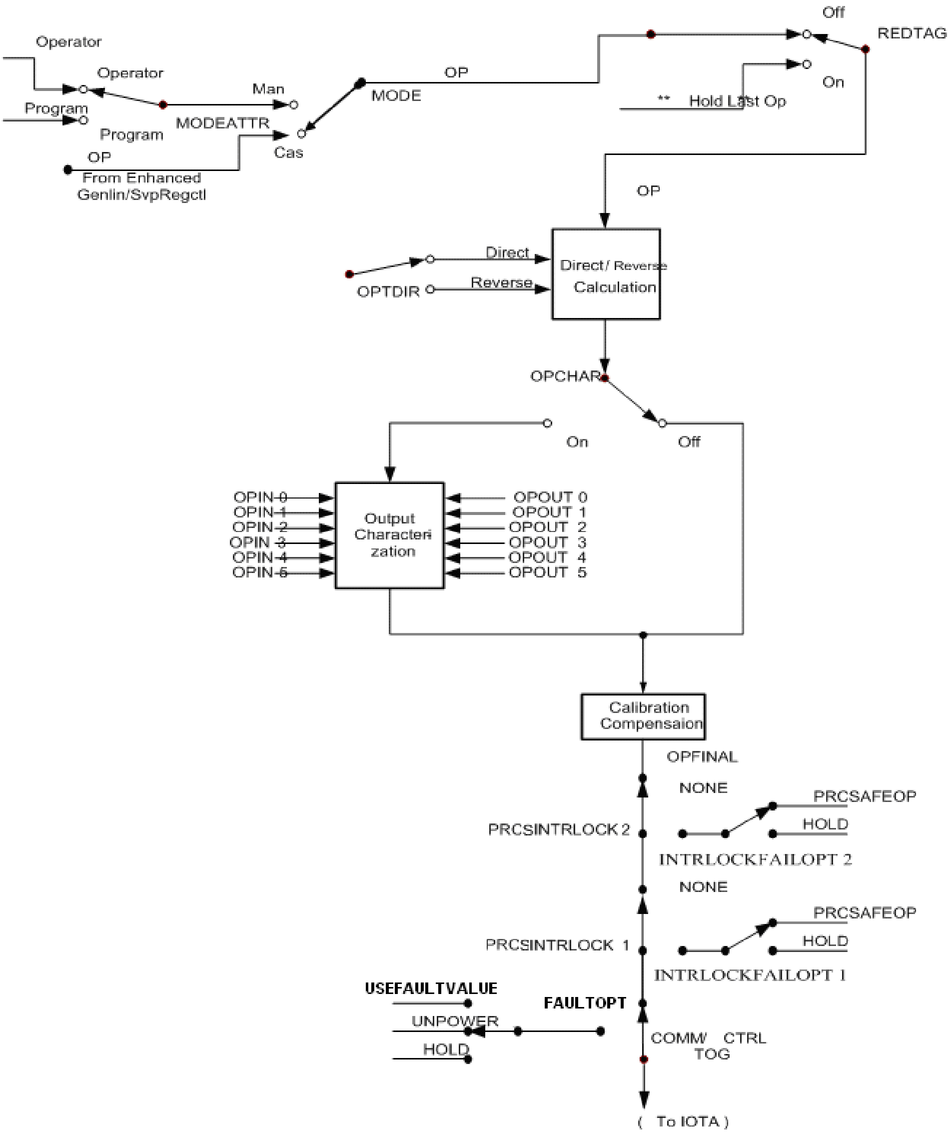
- Determining Output Characterization - SVP-AO Channel block
- Determining Direct/Reverse Output - SVP-AO Channel block
- Determining Modes - SVP-AO Channel block

10.26.1 Determining Output Characterization - SVP-AO Channel block

Output characterization can be implemented only if the OPACTION parameter is configured as 'FullValue.'

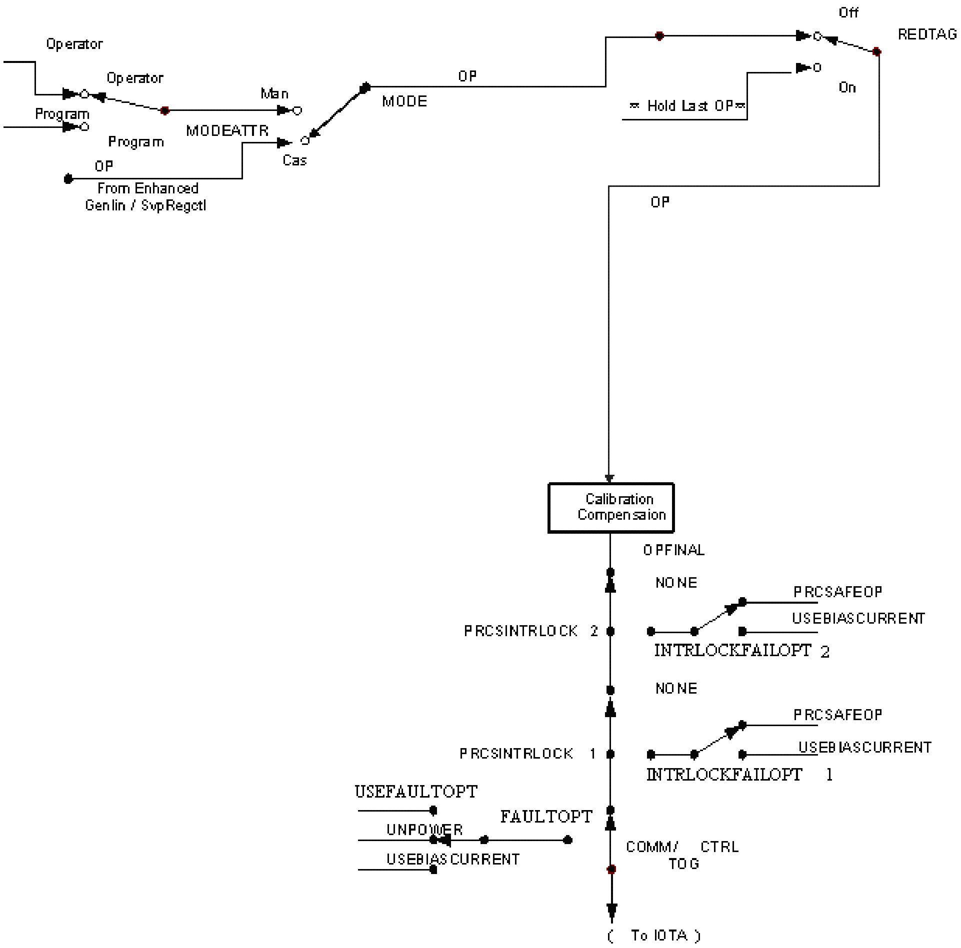
The OP value is calculated when the OPACTION parameter is configured as 'FullValue' as follows:

Figure 10.25 SVP - AO block execution diagram when OPACTION is 'FullValue'



The OP value is calculated when the OPACTION parameter is configured as 'Incremental' as follows:

Figure 10.26 SVP - AO block execution diagram when OPACTION is 'Incremental'



> **ATTENTION**
>
> When the SVP IOM is in 'IDLE' or the channel is in 'INACTIVE',
>
> - The SVP_AO channel configured as Incremental drives the output configured in the FAULTOPT parameter.
> - The SVP_AO channel is configured as FullValue, the SVP_AO channel retains the output.
>
> If any changes made to the FAULTOPT parameter when the SVP IOM is in 'IDLE' or the channel is in 'INACTIVE,' the change replicates on the SVP_AO channel screws.

10.26.2 Determining Direct/Reverse Output - SVP-AO Channel block

The OPTDIR (output direction) parameter allows you to specify whether the output of the data point is 'Direct or Reverse' when OPACTION is configured as 'FullValue.' When OPACTION is configured as 'Incremental,' the OPTDIR is grayed out and its value is 'Direct.' The following table lists the OP value mapping based on the OPTDIR value.

Table 10.28 SVP - AO OPTDIR processing

OPTDIR value	OP value mapping
Direct	OP 0% maps to OPLOCURRENT
	OP 100% maps to OPHICURRENT
Reverse	OP 0% maps to OPHICURRENT
	OP 100% maps to OPLOCURRENT

10.26.3 Determining Modes - SVP-AO Channel block

The MODE parameter determines the operating mode for the channel block. The following operating modes are applicable to the both AO and DO channel blocks:

- Manual (Man) - provides the operator or the program with direct control over the output value of the channel, regardless of any continuous control strategy.
- Cascade (CAS) - data point receives its output value from a primary data point.

However, if the OPACTION is configured as 'Incremental' and MODE is changed to 'MAN,' the AO drives OPBIASCURRENT, until the operator manually enters a new OP value.

> ATTENTION
> - MODE is set to 'SHED' if the SVPM is restarted.
> - The SVP IOM shortly loses synchronization and resynchronizes when the MODE of SVP_AO channel sheds to 'MAN.' This scenario is applicable to only when the SVP_AO channel is configured as 'Incremental.' Due to this, the soft failures are regenerated on the secondary SVP IOM.

10.27 Defining UIO Channel Blocks

The functionality of the UIO channel blocks is identical to that of the existing AI, AO, DI, and DO channel blocks. Depending on the channel configuration in the UIO module, each channel block represents one of the AI, AO, DI, and DO channel block.

For more information about each channel blocks, refer to the following sections in this document.

- AI channel block - Defining AI Channel Blocks
- AO channel block - Defining AO Channel Blocks
- DI channel block - Defining DI Channel Blocks
- DO channel block - Defining DO Channel Blocks

The functionality of UIO-2 channel blocks is identical to that of UIO channel blocks with the following exceptions:

- Supports pulse counting on up to four of any of the 32 channels that are configured as DI.
- Supports DO ganging within the following eight channel number groups: 1 - 4, 5 - 8, 9 - 12, 13 - 16, 17 - 20, 21 - 24, 25 - 28, and 29 – 32. However, ganging across these groups is NOT possible.

10.27.1 Example configuration for DO channel ganging

To configure the DO channel for ganging

1. Click **File** > **New** >**I/O Modules** > **Series_C_I_O > UIO – Universal I/O, 32 channels**.

   The UIO module appears in the Project view under the Unassigned items.
2. Assign the UIO module to an IOLINK that is configured as "SERIES_C_IO_TYPE."
3. From the Project view, right-click the UIO channel and then click **Block Properties**.

   The UIO channel configuration form appears.
4. Click the **Channel Configuration** tab.

   The **Channel Configuration** tab configuration form appears. The point type is selected as **DI**, by default.
5. Configure the **Channel Point Type** as DO for which ganging needs to be enabled.

> ATTENTION
> An error message appears if you try to change the channel type when the channel is configured in any Control Module.

6. Click **OK**.
7. Click **File** > **New** > **Control Module**.

   The Control Module chart opens.
8. Drag the DO channel from the Project view to the Control Module chart.
9. Double-click the DO channel.

   The DO channel configuration form appears.
10. Click the **Configuration** tab.

    The **Configuration** tab configuration form appears.
11. Select the **Enable Ganged Outputs** check box.

    The **Number of Channels Ganged** drop-down list is enabled for configuration.
12. Select the number of channels to be ganged from the **Number of Channels Ganged** drop-down list.

    You may encounter errors if one of the following scenarios exists.
    - Adjacent channel is not configured as DO channel.
    - DO channel, which needs to be configured for ganging, is already configured in any Control Module.
13. Click **OK**.
14. Save and close the Control Module chart.
15. Assign and load the Control Module.

Results

The channels are ganged as per configuration.

10.27.2 Example configuration for pulse counting functionality

To configure DI channel for pulse counting functionality

1. Click **File** > **New** >**I/O Modules** > **Series_C_I_O** > **UIO – Universal I/O, 32 channels**.
   The UIO module appears in the Project view under the Unassigned items.
2. Assign the UIO module to an IOLINK that is configured as "SERIES_C_IO_TYPE."
3. Click **File** > **New** > **Control Module**.
   The Control Module chart opens.
4. Go to the library and drag and drop the DI channel (15 to 18) in the CM, then assign it to the desired IOM/channel number.

> NOTE
> For UIO-2 only, you can choose from any of the available 32 channels configured as DI, a maximum of four as pulse counting channels.

5. Double-click the DI channel.
   The DI channel configuration form appears.
6. Click the **Configuration** tab.
   The **Configuration** tab configuration form appears.
7. Configure the **Digital Input Type** as "Accum."
8. Click **OK**.
9. Save and close the Control Module chart.
10. Assign and load the Control Module.

Results

The configured channels are set up for pulse counting.

CHAPTER

11 SERIES C I/O LOADING

Experion provides the ability to build control strategies offline, without being connected to the actual controller components. The process of transferring the control strategy to the actual working components in the field is called the load operation.

The load operation;

- copies configuration data from the control strategy that is stored in the Engineering Repository Database (ERDB) to the assigned controller component in the system architecture
- assures that the planned system matches the actual one
- confirms that the communication addresses and physical location assignments specified for components through Control Builder configuration match the actual addresses and locations of components in the system.

11.1 Loading an IOLINK

The C300/CN100 block must be loaded before any assigned IOM blocks. Loading the C300/CN100 block automatically loads its associated configured IOLINK function blocks.

Refer to Loading IOLINK in the C300 Controller User Guide /CN100 User Guide for information about loading the C300/CN100 block and corresponding IOLINK block.

11.1.1 Upload error conditions

The following conditions return/reload operation errors:

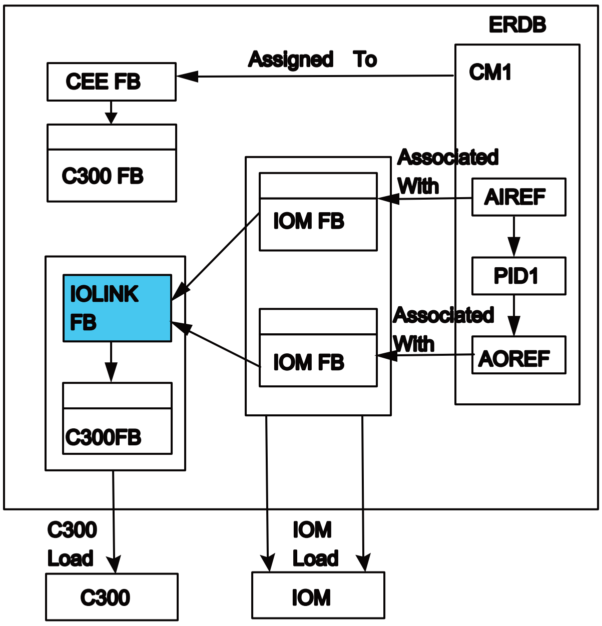
- The C300/CN100 is not present.
- The IOM is not present.
- The CM is ACTIVE.
- The IOM's Execution State is RUN and the IOC block's Point Execution State is ACTIVE.

11.2 Loading the IOM block the first time

The I/O channel blocks are loaded when the respective IOM is loaded. This operation loads all loadable configuration parameters (residing in either the C300 or the IOM device). An error message is displayed if there is any validation fails. The load returns errors if the C300 or IOM or both are not present.

The following figure displays a simplified graphical representation of what happens during the load operation.

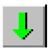
Figure 11.1 Loading the IOM block the first time



11.2.1 Prerequisites

- Ensure that I/O Modules are installed and capable of communicating with the Server.
- Ensure the parent controller is already loaded.

11.2.2 To load an IOM

1. In the Project view, click the desired IOM block icon.
2. Right-click the IOM and then click **Load**. Or, click the  load button in the tool bar.
   The **Load Operation** dialog box appears.

> ATTENTION
>
> If there is any validation failure, then the **Validation before load** dialog box appears. If you still want to continue the load, then click **Continue**. Otherwise, click **Cancel** to resolve the validation errors before loading the IOP/IOM.

3. Click **OK**.

   The IOM block load starts. The Load dialog box displays the progress and the respective information.

> **TIP**
>
> You can also check load progress through the four-LED display on the front panel of the IOM. The display changes from NODB to NOEE to OK upon a successful Load.
>
> If errors are detected, then the errors are displayed in the **Load** progress dialog box and you can continue the load or cancel, depending on the nature of the error. It is recommended that you cancel the load and identify and fix the errors. Each message includes an error code in parentheses. Note the last number in the string. For more information about the error code, see *Control Builder Error Code Reference*.

4. Once the load completes and the dialog box closes, click the Monitoring view.

   IOP/IOM icons now appear in Monitoring view. The default state for a loaded IOP/IOM is active or color code green.

> **ATTENTION**
>
> When you load the imported IOMs, ensure that all the channel type (PNTTYPE) is identical with the loaded channels. If the channel type is not identical, then the corresponding channels must be deleted from the Monitoring view before loading the imported IOM.

- Loading with the IOM block missing on the IOLINK
- Reloading the IOM block from Project or Monitoring
- Reviewing IOM re-configuration rules

11.2.3 Loading with the IOM block missing on the IOLINK

IOM blocks can be loaded without the IOM present on the link, but the following occurs:

- Errors are returned on load and the IOM icon appears red in the Monitoring Tab.

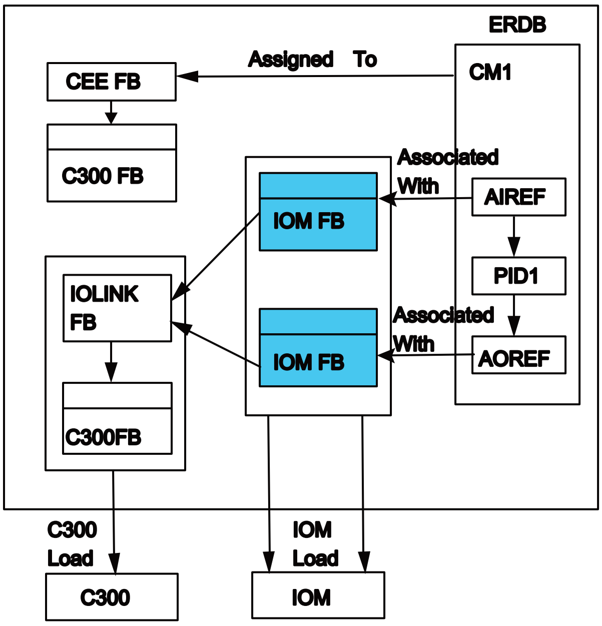
  Refer to Reviewing the Series C I/O block icons in Control Builder to view icon appearance based on current status.
- Since the IOM is responsible for error checking the loaded data, you must either reload the IOM or perform a checkpoint restore when the IOM later appears on the I/O Link.

11.2.4 Reloading the IOM block from Project or Monitoring

The behavior of the IOM when the IOM is reloaded from the Project view or the Monitoring view is explained as follows:

1. IOM block is loaded first.
2. All the channels are reloaded as dependents while loading the IOM.
3. The channel that is configured using the containment method is not reloaded while loading the IOM. However, this channel is loaded as a dependent while loading the CM.

Figure 11.2 Reloading the IOM block



11.2.5 Reviewing IOM re-configuration rules

ATTENTION

You are prohibited from altering the IOPTYPE and IOMNUM parameters while the IOM exists on the Monitoring Tab. You can only change them after the IOM is explicitly deleted from the Monitoring Tab.

The following section lists the specific IOM re-configuration rules.

Table 11.1 IOM re-configuration rules

If the IOM is in the RUN state, you:
1. Cannot delete the IOM. 2. Cannot re-configure non-redundant IOM to redundant IOM. 3. Cannot re-configure redundant IOM to a non-redundant IOM. 4. Cannot re-configure the primary IOM to a different location. 5. Cannot re-configure the secondary IOM to a different location. 6. Cannot change the IOM scan rate.
NOTE If you load the IOM and inactivate the IOM as part of the load, you are able to perform items 1 through 6

If the IOM is NOT in the RUN state, you:
1. Can delete the IOM from the Monitoring Tab (but only if all CMs containing channels of this IOM have been deleted from the Monitoring Tab).
2. Can re-configure non-redundant IOM to redundant IOM pair.
3. Can re-configure redundant pair as non-redundant.
4. Can re-configure the primary IOM to a different location.
5. Can re-configure the secondary IOM to a different location.
6. Can change the IOM scan rate.

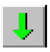
11.3 Loading the individual I/O channels

> ATTENTION
>
> Only the channels are loaded and the spares are excluded from the load. However, you cannot load a channel that is configured using the containment method.
>
> You cannot load unassigned channels.

11.3.1 Prerequisites

Ensure that the parent controller is loaded.

11.3.2 To load the individual I/O channels

1. In the Project view, right-click the desired I/O channel block and then click **Load**. Or, click the  load button in the tool bar.

   The **Load Operation** dialog box appears.

   > ATTENTION
   >
   > If there is any validation failure, then the **Validation before load** dialog box appears. Though you can continue with the load, it is always recommended that you resolve the validation errors before loading the I/O channel.

2. Click **OK**.

   The I/O channel block load starts. The Load dialog box displays the progress and the respective information.

> TIP
>
> - You can also check the load progress through the four-LED display on the front panel of the I/O Link Interface Module. The display changes from NODB to NOEE to OK upon a successful load.
> - If errors are detected, then they are displayed in the **Load** progress dialog box and you can continue the load or cancel, depending on the nature of the error. It is recommended that you cancel the load and identify and fix the errors. Each message includes an error code in parentheses. For more information about the error code, see *Control Builder Error Code Reference*.

3. Click the Monitoring view after the load is complete and the dialog box is closed.

   I/O channel block icons now appear in Monitoring view. The default state for a loaded I/O channel is active or color code green.

11.4 Behavior of IOMs and CMs under version control

11.4.1 IOM version mismatch between the Project view and Monitoring view

When you load the channel, the IOM is also loaded along with the channel. The IOM is loaded as LWA if the IOM does not have the delta flag. The LWA icon is displayed for the IOM in the **Load Operation** dialog.

From the Project view, if you load or reload a channel assigned to an IOM that is under version control, then the following channels belonging to the same IOM are also loaded as dependents:

- Unloaded channels are loaded.
- Channels having delta flag are inactivated and loaded.
- Channels with "Load While Active" changes are "Loaded While Active".

In addition, the IOM to which the channels are assigned is also selected as dependent for load. However, the LWA icon is displayed in the **Load Operation** dialog box for the IOM and for the channel which has LWA changes.

11.5 Common I/O block load activities

- Uploading the I/O block
- Update to Project
- Reviewing the Update function
- Using IOM Checkpoint

11.5.1 Uploading the I/O block

Upload of Series C I/O blocks does not differ from the upload of other Experion blocks. All loadable parameter values are read from the IOM and updated in the Monitoring database.

The upload operation uploads data for the selected objects from the controller to the Monitoring Engineering Repository Database (ERDB). Upload of data for the selected objects from the server to the ERDB also can be performed.

Usually, after performing an upload to the database, you should also update the data to Project so that both the Monitoring and the Project databases agree.

Refer to Using Upload command in the *Control Building Guide* for information about uploading.

11.5.2 Update to Project

Update to Project Series C I/O blocks does not differ from update to Project of other Experion blocks. All loadable parameter values are copied from the Monitoring tab to the Project tab.

11.5.3 Reviewing the Update function

A major part of the hierarchical building, CM/SCM containment allows the user to contain CM(s) or /SCM(s) into another CM.

If a projected CM/SCM is updated to project:

- All its projected parameters are checked to ensure that the projection chain downwards to the origin is valid, which includes the validation of both origin parameters and projected connections.
- Read only connections are not updated to project directly. Only projected connections will be updated.
- In addition, the Update operation fails for any reason, the projected parameter will remain, but the origins of the projected parameter will be emptied.

11.5.4 Using IOM Checkpoint

Checkpoint of Series C I/O blocks does not differ from checkpoint of other blocks being checkpointed.

Refer to Checkpoint Replaces Snapshot in the *Control Building Guide* to review checkpoint information.

11.6 Loading a Control Module

All illustrations used in the procedure are for example purposes only.

> ATTENTION
>
> Before attempting to load any CM or SCM components, be sure its control chart is **not** open in Control Builder.

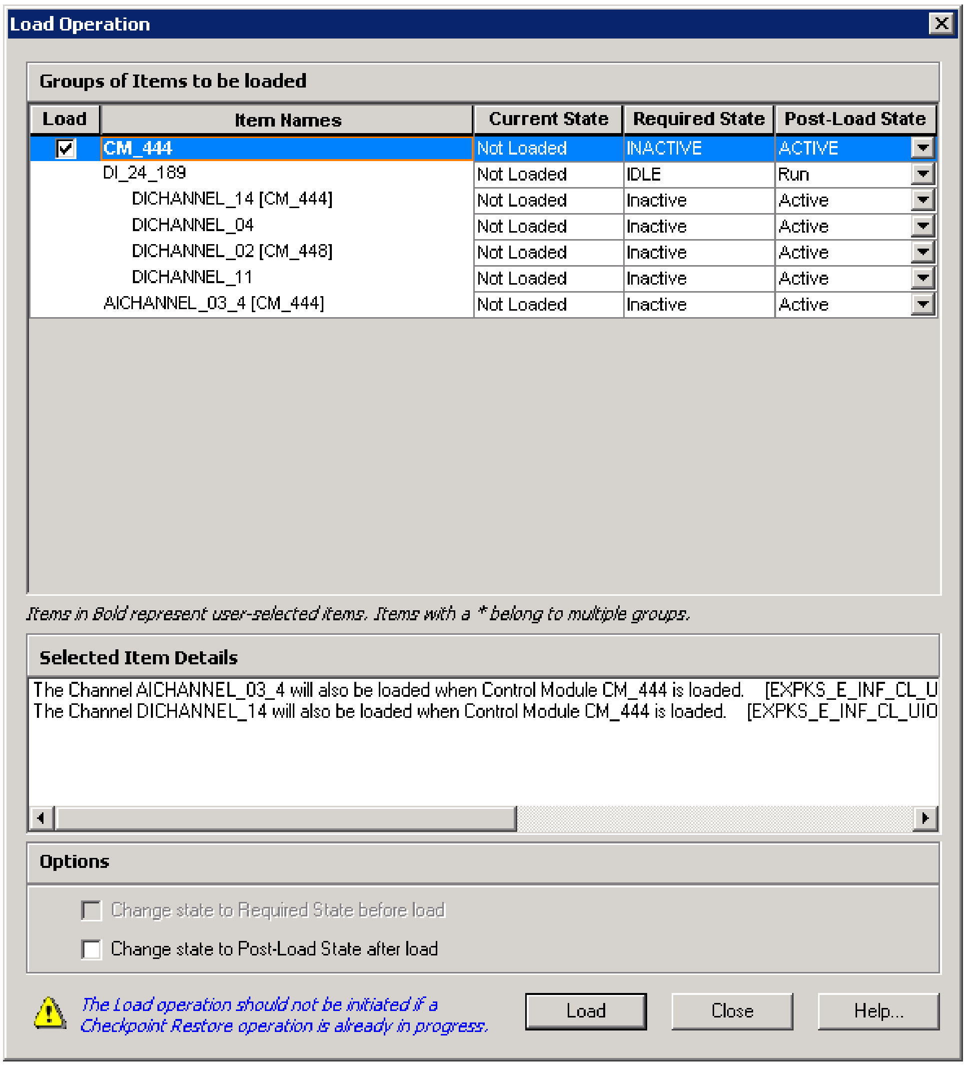
11.6.1 Prerequisites

- Control Builder is running.
- This procedure assumes that the CPM is installed and capable of communicating with the Server.

11.6.2 To load a CM

1. Right-click the CM and then click **Load**.

   The **Load Operation** dialog box appears.



   Observe that the dependent channels are automatically selected for load in the **Group of Items to be Loaded** list.

> ATTENTION
> - If you have referenced any input channels from a different controller, then an information icon is displayed in the **Info** column.
> - If you load any swapped output channels, then a warning icon is displayed in the **Info** column.

2. Click **OK**.

   The **Load** dialog box appears.

   If errors are detected during the load, then they are displayed in the **Load** dialog box. It is recommended that you cancel the load and identify and fix the errors. Each error message includes an unique error code in parentheses. For more information about the error code number, see *Control Builder Error Code Reference*.

   Once the load completes and the dialog box closes, click the Monitoring view to view the loaded CM.

> ATTENTION
>
> If you try to load the CM/SCM/RCM having non-CEE references from the Control Builder connected to the secondary server, the following error message appears. “Block Load Failed”
>
> Hence, you must always load the CM/SCM/RCM having non-CEE references from the Control Builder that is connected to the primary server. In addition, if there is any switch-over between the servers close the Control Builder and open the Control Builder that is connected to the new primary server.

3. (Optional, if the CM is loaded in inactive state) In the Monitoring view, right-click the loaded CM and then click **Activate** > **Selected Items’ (s) Content (s)**.

   The CM is activated and the CM icon color changes to "Green."

> ATTENTION
>
> If you swap the references in the CMs, then you must the load the CM. For example, consider that CM1 is configured with an AIREF1 block referencing an AICHANNEL1 and CM2 that is configured with an AIREF2 block referencing an AICHANNEL2. CM1 and CM2 are loaded. In this scenario, if you swap the references (AIREF1 references AICHANNEL2 and AIREF2 references AICHANNEL1) between the CM1 and CM2, then you must reload one of the CMs and the other CM is loaded as dependent.

- Upload error conditions
- Reloading the CM from Project or Monitoring

11.6.3 Upload error conditions

The following conditions return/reload operation errors:

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- The C300/CN100 is not present.
- The IOM is not present.
- The CM is ACTIVE.
- The IOM's Execution State is RUN and the IOC block's Point Execution State is ACTIVE.

11.6.4 Reloading the CM from Project or Monitoring

Reloading a CM from the Monitoring Tab or the Project Tab:

- reloads IOC blocks to their associated IOM devices, and
- reloads the standard Experion blocks within the CM to the assigned CEE

11.7 Setting Priority IOMs

To improve control loop latency Series C I/O Modules, there is an optional selection that supports the IO Link interface and Control Execution Environment (CEE) in the C300/CN100 Controller. The Priority IOM option is available for:

- all standard Series C IOMs supported by the C300/CN100 Controller and IO Link interface,
- except for the AI-LLMUX and AI-LLAI

A Priority IOM is designated or configured through the IOM Function Block Form using the modules I/O Link Scan Rate selection. This option applies to all the channels of the IOM. The IOM is added to a list of modules, which appear on the associated IOLINK configuration form.

A parameter (NUMPRIORITYIOM - Priority IOMs) on the IOLINK Function Block form (Main Tab) shows the number of configured IOMs with this attribute activated.

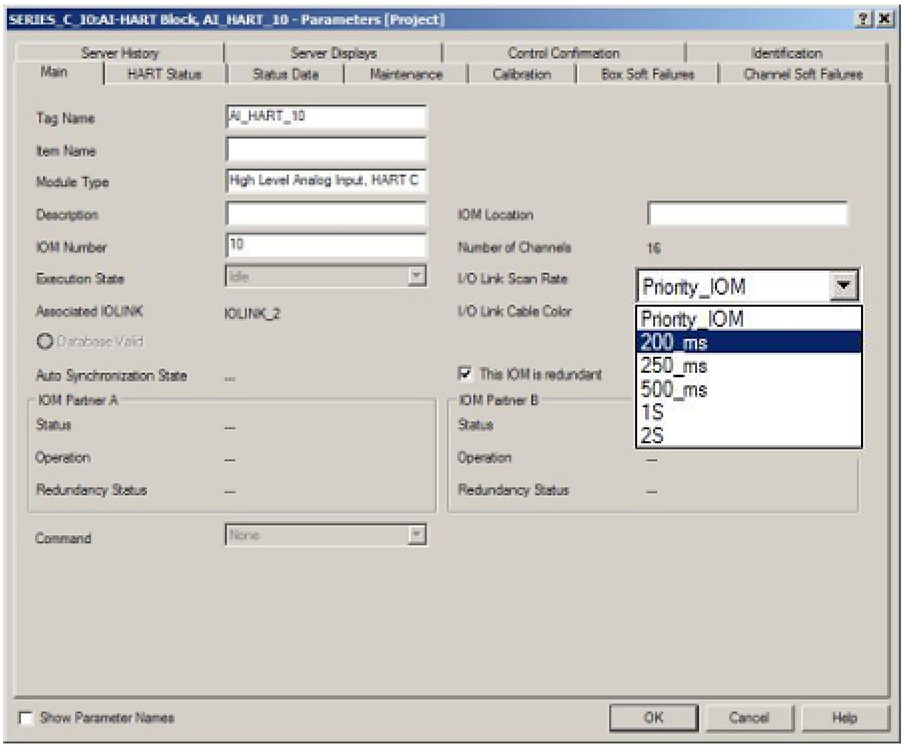
- To set the Priority IOM

11.7.1 To set the Priority IOM

1. Double-click the I/O Module in Control Builder tree view. Main tab appears.
2. From I/O Link Scan Rate, select Priority_IOM

3. This completes this task.

Figure 11.3 Setting Priority IOM



IOMs designated as Priority_IOM

- consume a relatively larger I/O Link bandwidth than other IOMs
- is given preference within the controller
- Input Process Data from these IOMs is fetched so that it is coordinated with control execution and is triggered at a point that minimizes the latency between data fetch and its use in control algorithms
- Data scanned from an output to a channel on an IOM with the Priority IOM on, is expedited in its passage through the I/O Link interface

The following I/O Link Unit table lists the amount of IO Link bandwidth used for both Priority and normal IOM configuration.

IO Modules	IOM Scan Rate (mS)	Cycles	Link Units per Module
Digital Input Modules	**Priority**	20	52
Digital Input Modules	200	5	15
Digital Input Modules	250	4	13
Digital Input Modules	500	2	8
Digital Input Modules	1000	1	5
Digital Input Modules	2000	0.5	4
Digital Output Modules	**Priority**	1	5
Digital Output Modules	All	1	5
AI-HART	**Priority**	20	100

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IO Modules	IOM Scan Rate (mS)	Cycles	Link Units per Module
AI-HART	200	5	27
AI-HART	250	4	22
AI-HART	500	2	13
AI-HART	1000	1	8
AI-HART	2000	0.5	5
AI-MUX	200	5	86
AI-MUX	250	4	69
AI-MUX	500	2	36
AI-MUX	1000	1	20
AI-MUX	2000	0.5	11
Analog Output Modules (includes BackCalc)	**Priority**	1	7
Analog Output Modules (includes BackCalc)	All	1	7
Any Secondary IOM	All	1	3
SCM Reads per second	N/A	N/A	0.7
SCM Writes per second	N/A	N/A	2
Channel connections	**CM Exec Rate (mS)**	**Cycles**	**Link Units per Module**
AO Connections (Output writes)	**50**	20	14
AO Connections (Output writes)	100	10	7
AO Connections (Output writes)	200	5	4
AO Connections (Output writes)	500	2	1
AO Connections (Output writes)	1000	1	1
AO Connections (Output writes)	2000	0.5	0
DO SO Connections	**50**	20	12
DO SO Connections	100	10	6
DO SO Connections	200	5	3
DO SO Connections	500	2	1
DO SO Connections	1000	1	1
DO SO Connections	2000	0.5	0
DO PWM Connections	**50**	20	30
DO SO Connections	200	5	3
DO SO Connections	500	2	1
DO SO Connections	1000	1	1
DO SO Connections	2000	0.5	0
DO PWM Connections	**50**	20	30
DO PWM Connections	100	10	15
DO PWM Connections	200	5	8
DO PWM Connections	500	2	3
DO PWM Connections	1000	1	2
DO PWM Connections	2000	0.5	1

CHAPTER

12

SERIES C I/O OPERATIONS

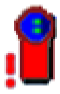
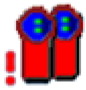
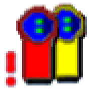
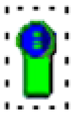
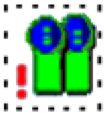
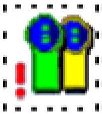
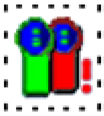
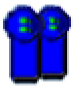
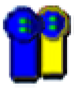
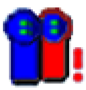
The following section describes the typical activities that you may be required to perform during normal operations while using Control Builder.

12.1 Reviewing the Series C I/O block icons in Control Builder

After loading the containing CM, the I/O channel block icon appears in the Control Builder monitoring tree. It exists under the containing CM and under the assigned IOM block. In the case of redundancy, a secondary IOM is visible in the monitoring tree.

> TIP
>
> The icon's appearance is based on the **ICONSTATE** parameter

Table 12.1 Channel block icons

If icon is . . .	Then, it represents . . .
COMM error or CONFIG mismatch error - Primary State	
 red	Non-redundant
 both red	No primary or secondary
 front red back yellow	No primary, secondary not synched
RUN - Primary State	
 green	Non-redundant.
 both green	Primary, synchronized
 front green back yellow	Primary, secondary not synched
 front green back red	Primary, no secondary
IDLE - Primary State	
 blue	Non-redundant
 both blue	Primary, synched
 front blue back yellow	Primary, secondary not synched
 front blue back red	Primary, no secondary

If icon is . . .	Then, it represents . . .
No Database and IDLE - Primary State	
yellow	Non-redundant
both yellow	Primary, secondary may or may not be synched
front yellow back red	Primary, no secondary

12.2 Reviewing the IOLINK block icons in Control Builder

The following table summarizes the various appearances that an IOLINK block icon can assume based on view and current IOLINK state. IOLINK blocks apply only to the primary or non-redundant IOM block, and do not have matching blocks for secondary IOM.

Table 12.2 IOLINK icons

If Icon is . . .	Then, it represents . . .
Project tab	
gray	IOLINK associated with configured non-redundant or primary IOM.
Monitoring tab	
gray/arrow	Control Builder / Control Data Access (CDA) server is currently establishing communication to the IOLINK
blue	IOLINK is inactive.
yellow	IOLINK is initializing.
green	IOLINK is active.
green/asterisks	IOLINK is active and uncommissioned devices exist on the H1 network.
red/black exclamation	Communication to the IOLINK is unavailable

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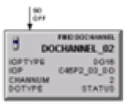
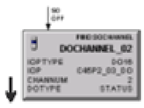
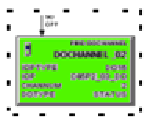
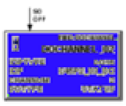
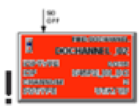
If Icon is . . .	Then, it represents . . .
 red/white exclamation	Communication to the IOLINK is available, but the IOLINK is in a failed state.

12.3 Reviewing the block icons in Control Builder

The following table summarizes the various appearances that a block icon can assume based on view and current block state. The faceplate of the block will vary to reflect the block type.

Table 12.3 Block icons

If Icon is . . .	Then, it represents . . .
Project tab	
 gray	Block added to Project.
Monitoring tab	
 gray/arrow	Control Builder / Control Data Access (CDA) server is currently establishing communication to the block.
 green	Block is active
 blue	Block is inactive
 red/exclamation	Block is offnet. Communications with the block is unavailable.

12.4 Reviewing the channel icons in Control Builder

The following table summarizes the various appearances that a channel icon can assume based on view and current block state.

Table 12.4 Channel icons

If Icon is . . .	Then ICONSTAE parameter value is . . .
yellow	Database is invalid
red	Error
blue	Block is active
green	Active
yellow/HART	Database is invalid and HART is enabled
red/HART	Error and HART is enabled
blue/HART	Inactive and HART is enabled
green/HART	Active and HART is enabled

12.5 Series C I/O LED Descriptions

The following figure and table identify and describe the LED indicators on the IOM.

Figure 12.1 Series C I/O LED indicators

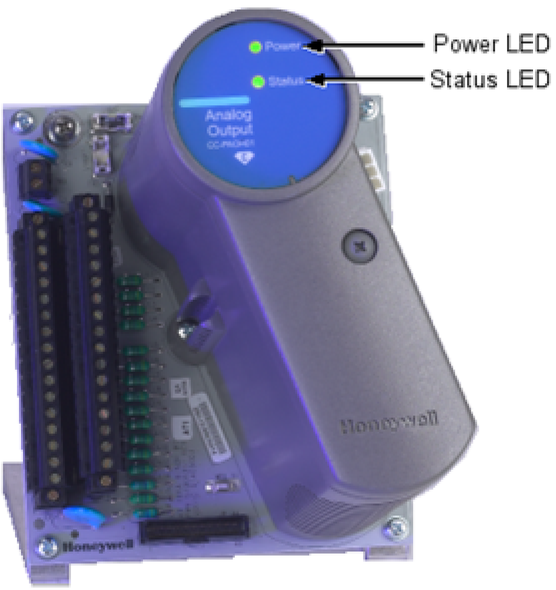


Table 12.5 I/O LED descriptions

If . . .	Is . . .	Then, it means that
Power LED	Off	IOM is not receiving power. ACTION: Check that module is properly installed or that the IOTA fuse for the module is not blown.

If . . .	Is . . .	Then, it means that
	Green	IOM is powered.
Status LED	Off	There is an IOM fault or the LED is bad. The module is in a hard failure state. In this state, the module cannot be used to gather information from or send information to attached field devices. ACTION: A user must either cycle power to the module or replace the module to correct the failure.
	Green	IOM operation is Okay. **Primary Run/Idle** The module is operating 100% correctly, and the module if commanded; will either gather inputs from the attached field devices or send outputs to the attached field devices. NOTE When used in a redundant I/O system, a module with a green LED is often referred to as the primary I/O module.
	Green - flashing (toggle once per second)	**Primary Run/Idle with Soft Failure** The module is operating, but it is operating in a diminished state as one or more soft failures have been identified.
	Amber	The module is either not configured or operating as a secondary. **Not Configured** - The module has not been configured. **Secondary** - The module is operating 100% correctly as the secondary module. This does not imply that it is synchronized with the primary IOM.
	Amber - flashing (toggle once per second)	**Not Configured with Soft Failure** - The module has not been configured and is operating with one or more active soft failures. **Secondary with Soft Failure**- The module is operating as the secondary module in a diminished state as one or more soft failures have been identified.
	Red	**Power-on -** The device is in a non-standard, transient state and not controlling any part of your plant or process. Module has just started and power-on self-test is running. During this time, there is no communication to the module.
	Red - flashing (toggle once per second)	The device is in a non-standard, transient state and not controlling any part of your plant or process. **Alive, Ready for Firmware Upgrade** - The module is ready to receive an update to its internal programming instructions.
	Red - fast flashing, (toggle one quarter (1/4) second)	The device is in a non-standard, transient state and not controlling any part of your plant or process. **Alive, Firmware Upgrade in Progress** - The module is receiving an update to its internal programming instructions. Do not remove power to the module.
	Off	**Failed** - The module has hard failed. The module is no longer communicating and must be power cycled or replaced. DO channels transition to the configured fault state. If field power is lost, all outputs go unpowered. AO channels will go unpowered.

12.5.1 Status LED behavior for the new Hardware revision of Series C AI and AO modules

The status LED behavior for the new Hardware revision of Series C Analog Input and Analog Output modules has changed due to a different power up sequence of the programmable devices used in the new hardware.

This difference in Status LED behavior after power-on is applicable to Series C AI HART (CC-PAIH01, CC-PAIH02, HW Rev F onwards), Series C AI non-HART (CC-PAIX01, CC-PAIX02, HW Rev C onwards), Series C AO HART (CC-PAOH01, HW Rev D onwards) and Series C AO non-HART (CC-PAOX01, HW Rev B onwards) modules.

A comparison between the new and old Status LED behavior for the new Hardware revision of Series C Analog Input and Analog Output modules is as described.

New behavior	Old behavior
After power on: 1. Status LED does not glow Red but it remains off (for ~ 7 seconds) 2. Then directly turns Amber (or Orange/yellow) 3. Then Green if module is configured as primary or else it stays in Amber	After power on: 1. Status LED turns Red (for ~ 7Seconds) 2. Then turns Amber (or Orange/Yellow) 3. Then turns Green if module is configured as primary or else it stays in Amber.

12.6 Powering up the IOM

Upon power up, the IOM:

- is set to IDLE state with an invalid database (DBVALID = INVALID)
- remains in this state until the IOLINK function block (C300) instructs it to change. This is due to the fact that the C300 contains all of the IOM's configuration information.

If the IOM was:

- never previously loaded, the IOM:
  - remains IDLE with an invalid database.
- previously was loaded, then
  - the C300 reloads the IOM, and restores it to the last state before power down occurred.

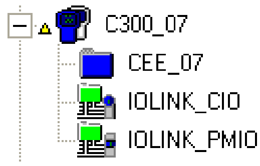
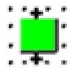
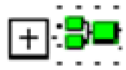
Therefore, upon powering up the IOM:

- any previously loaded channel blocks are reloaded and
- the IOM and channel blocks are set to idle, or run as they were previously set before the IOM lost power.

12.7 Activating a control strategy from the Monitoring tab

Activation of control strategy components from the Monitoring Tab should be performed in the following order to avoid possible load process data alarms.

Table 12.6 Sequence of activating components - Monitoring tab

Order	Component	Typical loaded icon in Monitoring tab	
1	CEEC300	CEEC300_1	
2	IOM	AI_HART	
3a	IOC	CM1.AICHANNEL_1	
3b	HART Enabled IOC	HAI_DEVICE_2	
4	CM or SCM	pidloop	

- Starting an IOM
- Issuing Shutdown command

12.7.1 Starting an IOM

Database security is provided to prevent you from starting an IOM that has an invalid database. As part of the IOM load:

- the IOM database is made valid. A checkpoint restore also makes the database valid.
- Once the IOM database is valid, you set the IOM Execution State (IOMSTATE) parameter to RUN.
- An IOM cannot be switched from IDLE to RUN unless its database is valid.

12.7.2 Issuing Shutdown command

The following occurs when issuing the Shutdown command (through the IOMCOMMAND parameter):

- field output terminals go unpowered for all channels.
- INITREQ is asserted on all associated Output channel blocks.
- the IOM icon in the Monitor Tab becomes RED.
- The detail display shows Alive state.

The following also occurs:

- an active 'IOP State Changed to Alive' alarm in Station System Summary.
- the **Status** LED of the IOP flashes RED.

12.8 Activating HART

The Series C I/O's fundamental AI and AO channel blocks support HART communications protocol. To enable HART, you must assign the channel to a HART IOM, and set HENABLE to TRUE. Other than this difference, the enabled channel is identical to a PM I/O HART enabled channel.

Refer to Enabling HART in HART 6.0 and later version devices to review Series C configuration form tabs and parameter availability for HART.

Refer to the HART I/O Implementation Guide for complete HART configuration instructions based on PM I/O.

- Assigning a channel to HART - Series C
- Enabling HART Alarm and Events - Series C
- Disabling HART Alarm and Events
- Migrating HART IO modules to/from non-HART IO modules
- Migrating between different Model Numbers of Modules without HART

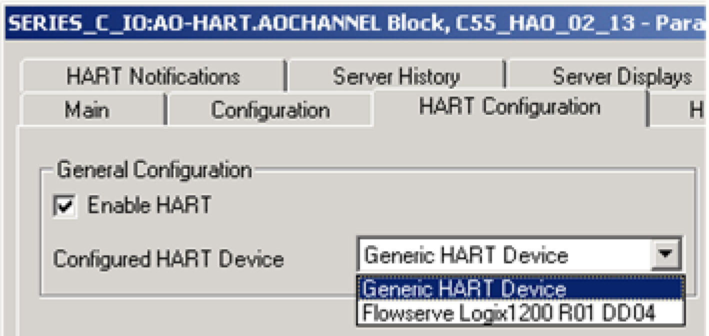
12.8.1 Assigning a channel to HART - Series C

Prerequisites

- A control module is created

To assign a channel to HART

1. Double-click the AI or AO channel block. The channel block configuration form opens.
2. Select the HART Configuration tab from the configuration form.
3. Select the ENABLE HART (HENABLE parameter).



4. To assign the channel block to a specific device, select a device from the pull-down menu.
5. Click OK to accept changes and close the configuration form.

12.8.2 Enabling HART Alarm and Events - Series C

A new selection is added to HART Configuration tab in the channel block, **Enable HART Alarm and Events** (HALARMENABLE parameter).

Refer to HART alarms/events to review the alarms that are available to be displayed on the HART Configuration tab for a channel block.

12.8.3 Disabling HART Alarm and Events

When the parameter HALARMENABLE is disabled, (Enable HART Alarm and Events deselected):

- all the existing HART events / alarms from that channel block are disabled
- further generation of the HART alarms / events are terminated

> NOTE
>
> Changing this parameter affects only the HART alarm / event behavior and the LED update of the device status in the HART device status tab happens as usual regardless of the state of HALARMENABLE.

To disable HART Alarm and Events:

1. Double-click the AI or AO channel block. The channel block configuration form opens.
2. Select the HART Configuration tab from the configuration form.
3. Deselect the Enable HART Alarm and Events (HALARMENABLE parameter).

12.8.4 Migrating HART IO modules to/from non-HART IO modules

Although AI-HART and AI-HL (Cx-PAIX01) uses the same IOTA, migration must be performed offline because the block configuration is different for both modules. The hardware change is only the module replacement. The firmware image is same for both modules.

The AO-HART and AO (Cx-PAOX01) migration is identical to the AI-HART and AI-HL migration.

Prerequisites

- Not all channels of the module are HART-enabled.
- Assume the new IOM would use the same IOM address. The difference of CC-PAIX01 and CC-PAIN01 is noted.

To migrate a non-HART module to/from HART module

1. From Control Builder, inactivate the IO Module and Channels.
2. From the Monitoring view, inactivate and delete all CMs that contain the IO channels.
3. Delete the IOM block from the Monitoring view.
4. From the Project view, note the IOM address and change it to some unused address.
5. Create the new IOM block and set the address to the one you noted.
6. For each IO channel, un-assign the existing IOM and assign the new IOM using the same channel slot.
7. Delete the old IOM from Project view.
8. Replace the hardware. That is, the IO Module /and the IOTA.
   - If the AI-HL is PAIN-01, replace the IOTA also. Set the address accordingly.
   - If the IOTA is redundant, replace the both IO Modules.
9. Load the appropriate firmware from CTools.
10. Load the IOM.
11. Load the CMs.
12. Activate the IO Module, Channels and CMs.

12.8.5 Migrating between different Model Numbers of Modules without HART

Migration between Cx-PAIX01 and Cx-PAIN01 is off-line because the IOTAs are different. It is impossible to mount the different model numbers on one IOTA. However, block configuration (IOM FB and IOC FB) is the same.

Migration between Cx-PAOX01 and Cx-PAON01 is similar.

The following is step-by-step instruction to migrate between different model numbers of modules without HART:

Prerequisites

Assume that all AI channels are 4-20mA.

To migrate between Model Numbers of Modules without HART

1. Inactivate the IOM and its channels.
2. Replace the hardware and the IOTA. The IOM address must remain the same.
3. Load the appropriate firmware using C Tools.
4. Load the IOM block.
5. Activate the IOM and its channels.

12.9 IOM configuration values not copied during Block Copy operation

The following subset of the IOM configuration parameter values are not copied during a Block Copy operation.

Uncopied IOM configuration parameters during a Block Copy			
IOLINKNAME	IOLINKNUM	IOMNUM	CHNLNAME

12.10 SOE Scenarios

The DEBOUNCE parameter specifies the minimum time input remaining at a new state, thus creating a PV change. This timer prevents the 'nuisance PV change events' by not creating the events until the input settle.

This parameter:

- may be set from 1msec intervals up to 50msec
- with zero msec indicating no debounce (all transitions logged)

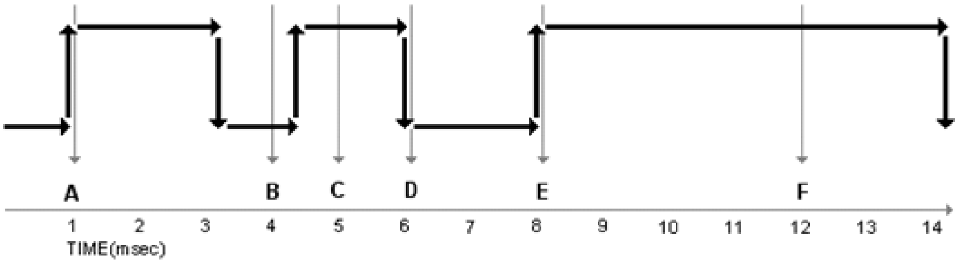
> NOTE
>
> Inputs are sampled every msec. In the figure below, points A, B, C, D, E and F are identified to illustrate the behavior of the IOM at that point of time.

- Input chatter scenario
- PVCHGDLY scenarios
- PV State Change event Regeneration

12.10.1 Input chatter scenario

- DEBOUNCE parameter is set to 4ms
- The Previous valid event was with PV = LOW.
- Input is scanned every 1msec.

Figure 12.2 SOE input chatter scenario



Point	Typical action
A	Action: State change detected at A Result: The time stamp is stored
B	Action: At B, the state change is detected before the DEBOUNCE counter reaches the target Result: The DEBOUNCE counter is set to 0
C	Action: At C, State change is detected before the DEBOUNCE counter reaches the target Result: The DEBOUNCE counter is set to 0
D	Action: At D, State change is detected before DEBOUNCE counter reaches the target Result: The DEBOUNCE counter is set to 0
E	Action: At E, State change is detected before the DEBOUNCE counter reaches the target Result: The DEBOUNCE counter is set to 0
F	Action: At F, the state is the same as it was at 4 msec back Result: DEBOUNCE counter is incremented and it is now 4. The DEBOUNCE counter is equal to the target value (= 4 msec) and the state is same as that when the time stamp was stored, an Event with time stamp stored at A will be posted

NOTE

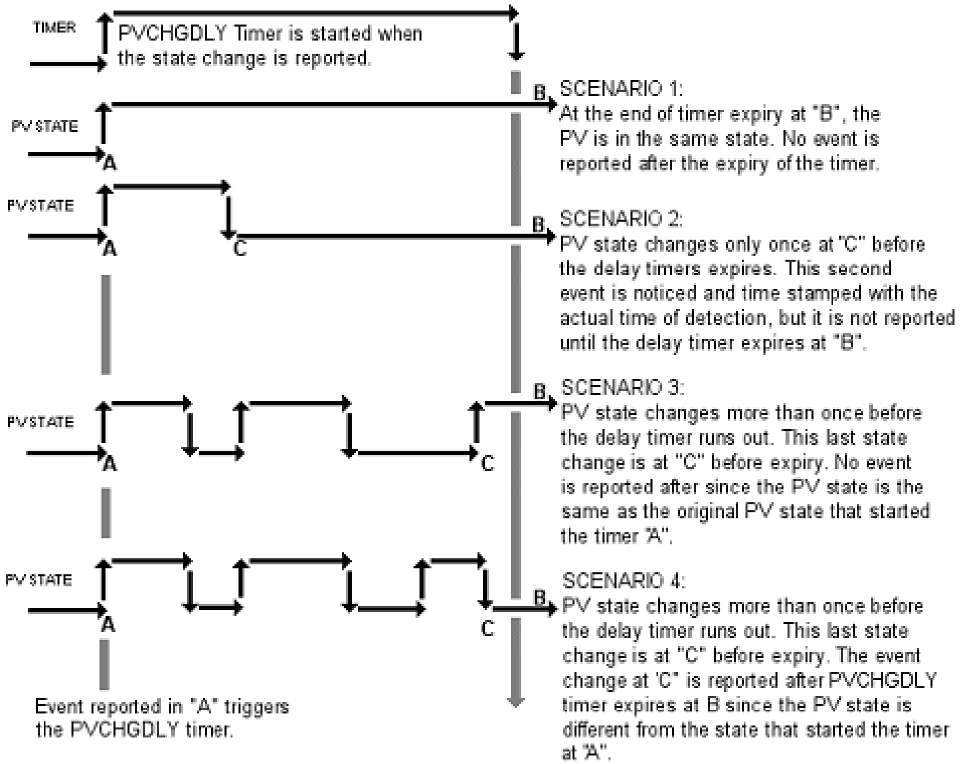
In the above scenario, if the DEBOUNCE is set to 0, SoeEvt event is reported at every state the change is detected. With reference to the above figure, state change events are reported at, 3, 5, 6 and 8 msec on the time scale given. However, with the DEBOUCE set to 4, there is only one event reported at point F.

12.10.2 PVCHGDLY scenarios

The PVCHGDLY parameter filters nuisance events by not reporting the events logged when the timer is active. It is specified in 1 second increments in the range of 0 to 60 seconds.

The below figure illustrates how PVCHGDLY filters nuisance event reporting.

Figure 12.3 SOE PV Change Delay Scenario



12.10.3 PV State Change event Regeneration

Regeneration is initiated when the:

- module goes off the link and comes back again
- redundant modules are switched over
- redundant controllers are swapped
- alarm reporting is enabled from disabled state in Station

When the regeneration is requested:

- the IOM regenerates events that are reported in the last 20 sec from the time of the ReGen request
- if there are too many events exceeding the regeneration buffer, then the number of events regenerated is limited to the capacity of the buffer. This can impact recording the events in last 20 secs.

The regenerated events have a timestamp of the actual event and therefore, you can see duplicate events after the event regeneration has occurred.

12.11 SOE Events configuration

The following table displays the EVTOPT and DIMODE dependencies:

Table 12.7 EVTOPT and DIMODE dependency

DIMODE	Configurable value of EVTOPT parameter
SOE	None, SOE
Normal	None
Low Latency	None

The following occurs to the EVPTOPT with regards to the DISOE:

If	Then
EVTOPT = None (Default Value)	the DI-SOE IOM is Normal (DI-24V mode) or the Low Latency mode
	DI channels of DI-SOE IOM operating in SOE mode do not report SOE events and vice versa
If you change the EVTOPT value to SOE when the DIMODE parameter has either Normal or Low Latency	the following error is reported: 'EVTOPT incompatible with module's DIMODE'

- SOE Events

12.11.1 SOE Events

The following table identifies the SOE event types and descriptions available:

Event type	Description
SoeEvt	When the DIMODE parameter on IOM FB is configured to SOE and EVTOPT parameter on DI channel block configured to SOE: • state changes detected by the IOM are reported as 'SoeEvt' events with 0.1ms time resolution on SOE Event Summary display • these events have msec resolution on Event Summary display however; the tool tip on the Event summary display displays time in 0.1msec resolution
SoeLost	When there is a burst of state change events, it can cause the module SOE event buffer to overflow. Under these circumstances: • IOM posts a 'SoeLost' event in the PVCL • You see a 'SoeLost' reported against the module in the SOE Event Summary page • The event informs you that there are some events lost during this time
SoeEvtNotCorr	When there is a state change event fetched from the IOM after the communication between C300 and IOM had been lost for about 60sec or more: • the 'SoeEvtNotCorr' event is reported with the latest time (current time of the time source)
SoeLostNotCorr	When there is a 'SoeLost' event fetched from the IOM after the communication between C300 and IOM had lost for about 60sec or more: • the 'SoeLostNotCorr' event is reported with the latest time stamp (current time of the time source)

12.12 DIMODE and OWDENBL related scenarios

The following are examples of the DIMODE parameter when modified in different views.

IOM	View	DIMODE	Description
DI24V, DISOE	Project	Old value: • Normal • some channels have OWDENBL = TRUE New value: • LowLatency	Throws an error: 'DIMODE cannot be configured as 'LowLatency,' if Open Wire Detection of any channel is enabled' Clear any channels with OpenWire Detection enabled. Change again and configuration changes successfully.
DI24V, DISOE	Project	Old value: • LowLatency New value: • Normal	Configuration changes successfully
DI24V	Monitoring	Old value: • LowLatency New value: • Normal	Throws an error: 'Invalid access level '
DI24V	Monitoring	Old value: • Normal New value: • LowLatency	Throws an error: 'Invalid access level '
DISOE	Monitoring	Old value: • LowLatency/Normal/ SOE New value: • LowLatency/Normal/ SOE	Throws an error: 'Invalid access level '
DISOE	Project	Old value: • SOE • some channels have EVTOPT = SOE New value: • LowLatency	Throws an error: 'DIMODE incompatible with EVTOPT on one or more channels' Reload the CMs with channel block after changing EVTOPT to NONE on the channels with option SOE. Reload the IOM. Configuration is loaded successfully
DISOE	Project	Old value: • LowLatency New value: • SOE	Configuration changes successfully.

12.12.1 Low Latency Mode

When the DIMODE parameter in DI24V and DI-SOE IOM FB is set to LowLatency, the channel's inputs are sampled and processed every 5 msec for better response times when using Discrete Loops that require low latency responses. In the case of DI-SOE, SOE event generation is not supported when DIMODE is LowLatency. This mode will also not support Open Wire Detection.

12.12.2 OWDENBL changes in Project View

The following Open Wire Detection changes occur when the initial value of DIMODE = LowLatency DIMODE and is modified:

- Changing the OWDENBL parameter value to TRUE is not allowed in LowLatency and SOE modes.
- If this is done, the following error is displayed: 'Open Wire Detection cannot be enabled if DIMODE of IO Module is configured as LowLatency or SOE.'

12.13 Enabling pulse proving in Pulse Input Module

To improve metering accuracy, turbine meters used for custody transfer purposes are often “proved” in situ using the real process fluid at the correct flow rate. When a meter is being proved, its flow is diverted such that the prover is downstream and in series with the meter. Thus the same flow passes through the meter and the prover in series.

The prover is basically a length of pipe. Inside the pipe is a sphere which is driven around the pipe by the pressure of the flow. In a bi-directional prover, the sphere can move in the forward or reverse direction as determined by the position of the 4-way valve. As the sphere moves around the pipe, it passes sphere detection switches. The swept volumes between all sphere switch combinations (that is 1 and 3, 1 and 4, 2 and 3 and 2 and 4) are determined offline and are known extremely accurately. The sphere switches are used to turn on and off a copy of the good pulses from the meter being proved. Thus a total number of pulses can be obtained versus a known swept volume and so the actual K factor of the meter being proved can be determined.

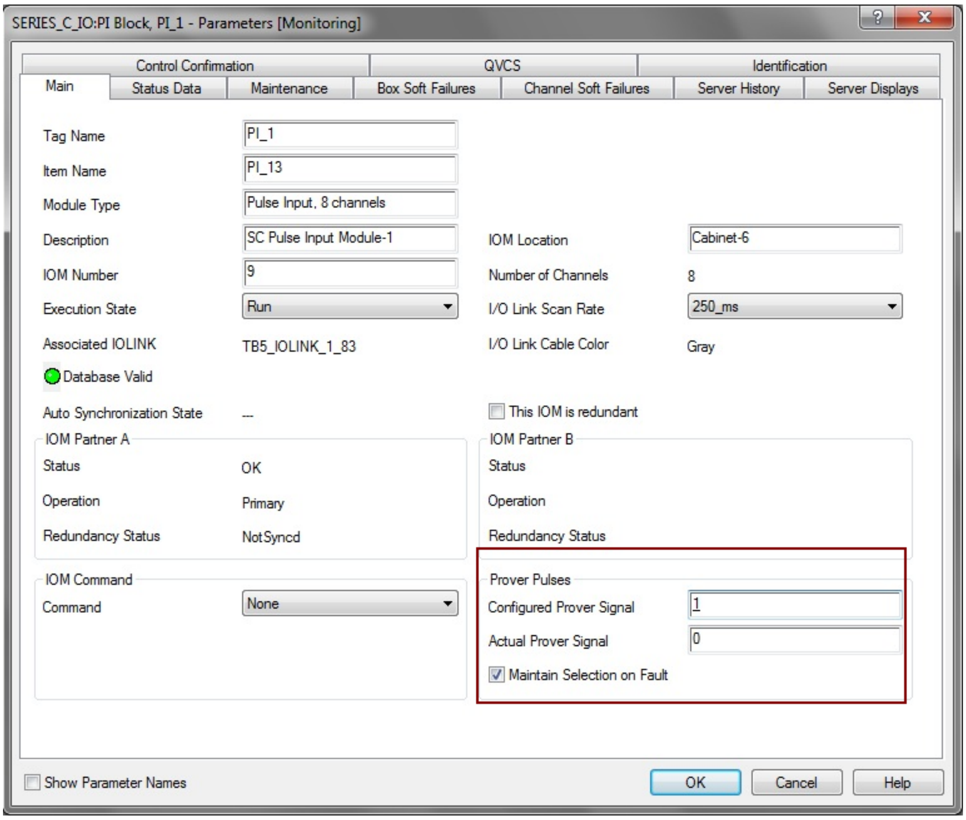
12.13.1 Prerequisites

- The PI channel is configured for Dual Stream.
- The PIM module is loaded.

12.13.2 To enable pulse proving in PIM

1. Double-click the PIM in the Monitoring view.

   The PIM module configuration form appears.



2. Enter the configured prover signal (signal stream to output to the prover signal screw pair on a given PI module) in the **Configured Prover Signal** box. The possible channel numbers that you can enter are 0, 1, 3, 5, or 7.

   The actual prover signal (the actual signal stream being output to the prover signal screw pair) appears in the **Actual Prover Signal** box. The possible channel numbers that can appear are 0, 1, 3, 5, or 7.

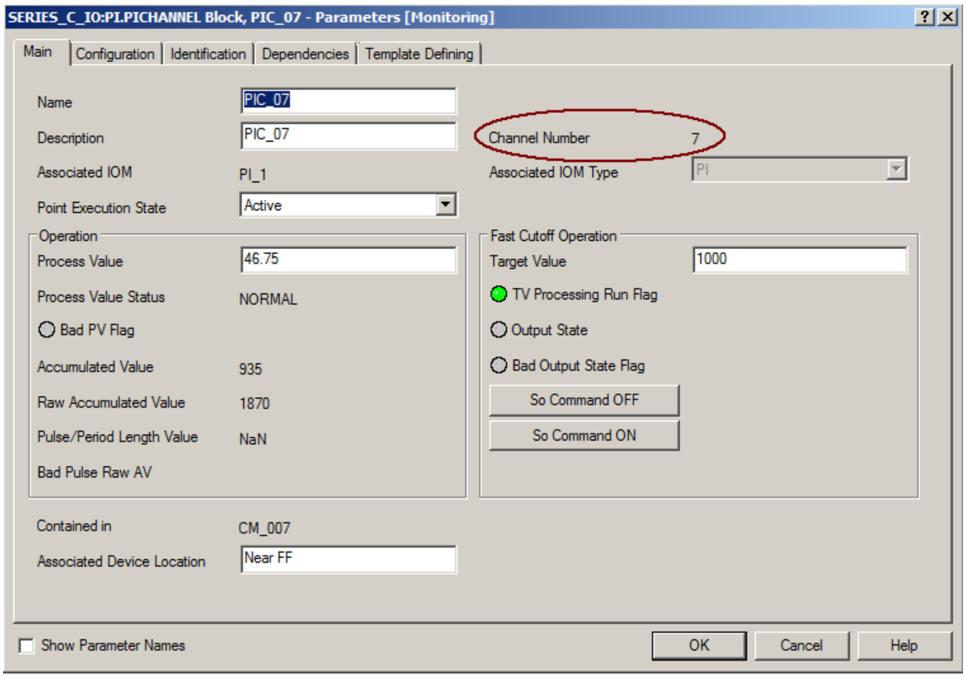
3. Click **OK**.

12.14 Enabling Fast Cutoff mechanism in PI channel block

12.14.1 Prerequisites

- Channel 7 and/or channel 8 are configured for Fast Cutoff operation.
- Pulse Input Module is loaded.

The following figure illustrates a sample PI channel block **Main** tab configuration form from the Monitoring view.



12.14.2 To enable the Fast Cutoff configuration

1. Double-click the PI channel block (channel 7 or 8) from the Monitoring view. The Configuration form appears.

> NOTE
>
> The following parameters are enabled if you have selected the pulse input type as Pulse Input with Fast Cutoff.
>
> - Output Safe State (SAFEOUTPUT)
> - Target Value (TV)
> - TV Processing Run Flag (TVPROC)
> - Output State (SO)
> - Bad Output State Flag (BADSO)
> - SO Command OFF (SOCMDOFF)
> - SO Command ON (SOCMDON)

2. Reset the accumulated value.

   You can reset the accumulated value using the RESETFL (Reset Command Flag).

3. Set the Output State value to a non-safe state value.

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4. Enter the target value in the **Target Value** box.

> NOTE
> - When you enter a target value and if the Output State is set to the non-safe state value, fast cutoff functionality is enabled. When fast cutoff functionality is enabled, TVPROC parameter is set to ON.
> - When the accumulated value reaches or exceeds the target value, the hardware sets the output to the configured safe state.

> ATTENTION
> After the target value has been stored, the fast cutoff functionality is disabled and the TVPROC is set to OFF if any of the following is true.
> - The Output State is set to the safe-state. This occurs in the following scenarios:
>   - The PIM block is inactivated.
>   - A communication fault occurs.
>   - Output State is manually set by the operator.
>   - Output State is set by another block.
> - The accumulated value is reset.
> - The accumulated value reaches the target value.

5. Refer to the *Control Builder Parameter Reference* document for more information on other parameters.
6. Click **OK**.

12.15 Monitoring I/O modules

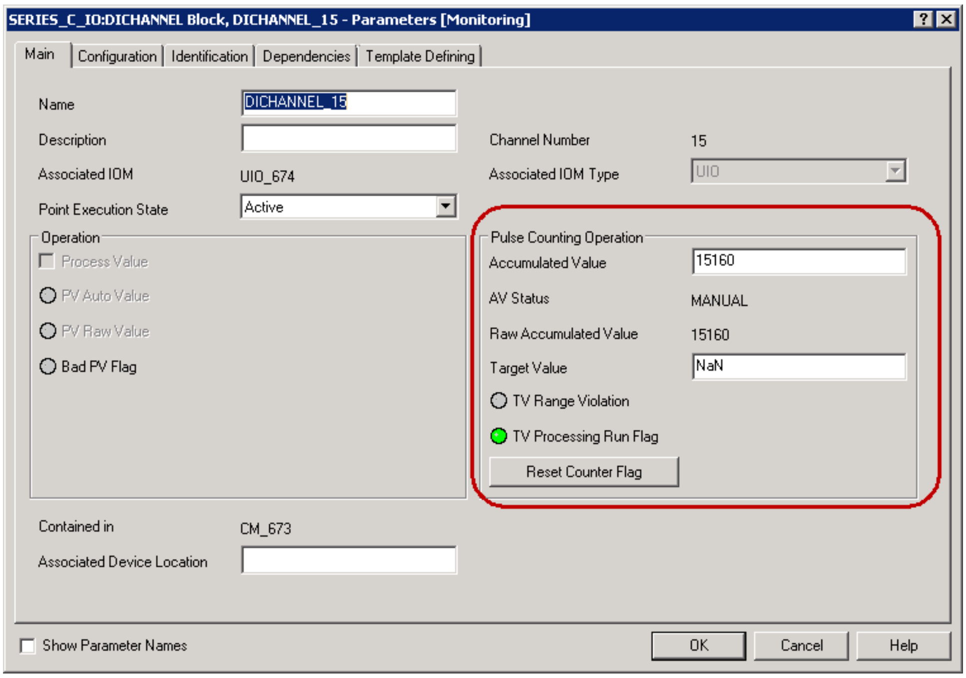
- Main tab - DI channel block
- AI Status Data tab
- AO Status Data tab
- DI Status Data tab
- DO Status Data tab
- Status Data tab
- PIM Status Data tab
- Maintenance tab
- UIO Maintenance tab
- UIO – 2 Maintenance tab
- Box Soft Failures tab
- Channel Soft Failures tab
- HART Device Status tab - Channel block
- HART Identification tab - Channel block
- HART Variables tab - Channel block

12.15.1 Main tab - DI channel block

From the Monitoring view, you can only monitor the parameters of the channels that are configured for pulse counting functionality.

The following is an example of the DI channel block configured for pulse counting functionality.

Figure 12.4 Main tab —UIO-DI channel



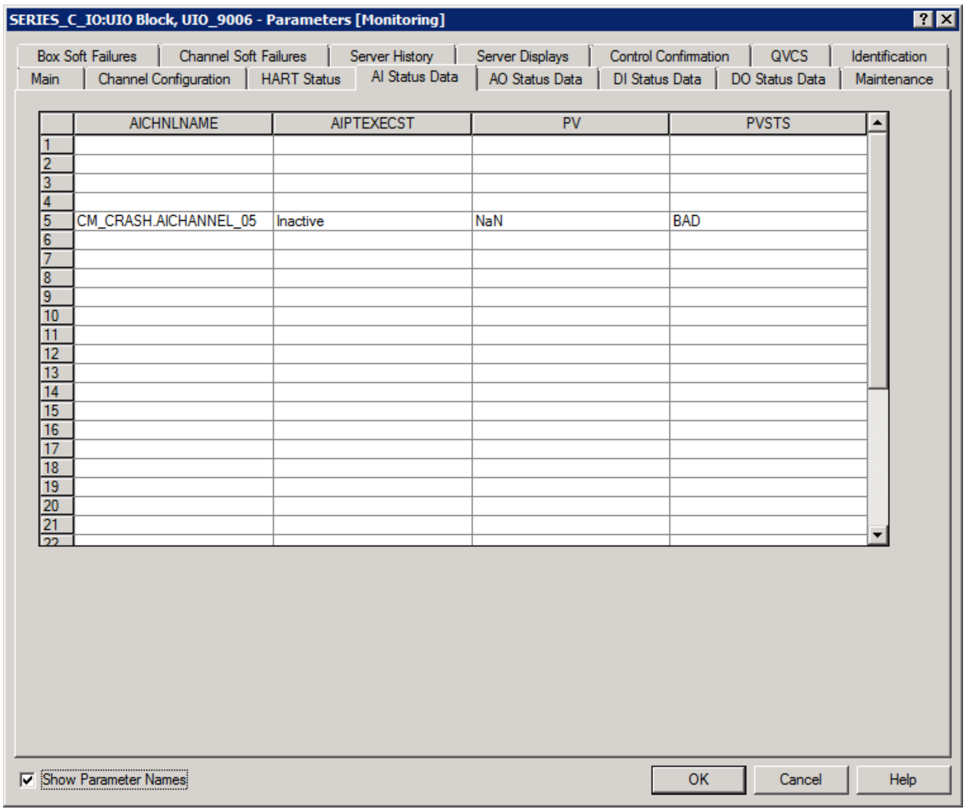
As illustrated in the figure, the parameters listed in the Pulse Counting Operation section can be monitored.

12.15.2 AI Status Data tab

You can only monitor the parameters of the channels that are configured as AI from the Channel Configuration tab.

The following is an example of the AI channel block configured in the UIO module.

Figure 12.5 AI Status Data tab



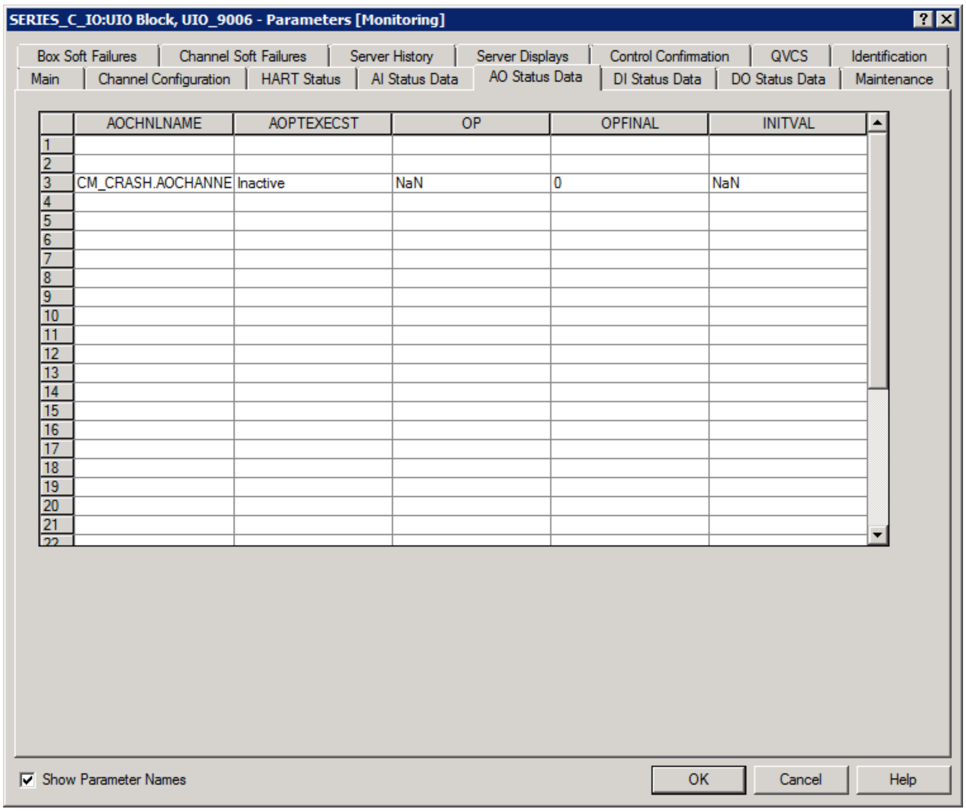
As illustrated in the figure, channel 5 is configured as AI channel in the UIO module.

12.15.3 AO Status Data tab

From the Monitoring view, you can only monitor the parameters of the channels that are configured as AO in the Channel Configuration tab.

The following is an example of the AO channel block configured in the UIO module.

Figure 12.6 AO Status Data tab



As illustrated in the figure, the channel 3 is configured as AO channel in the UIO module.

12.15.4 DI Status Data tab

From the Monitoring view, you can only monitor the parameters of the channels that are configured as DI in the Channel Configuration tab.

Starting with R430, when the DI channel type (DITYPE) is configured as "Accum," applicable parameters such as AV, are available for monitoring.

The following is an example of the DI channel block configured in the UIO module.

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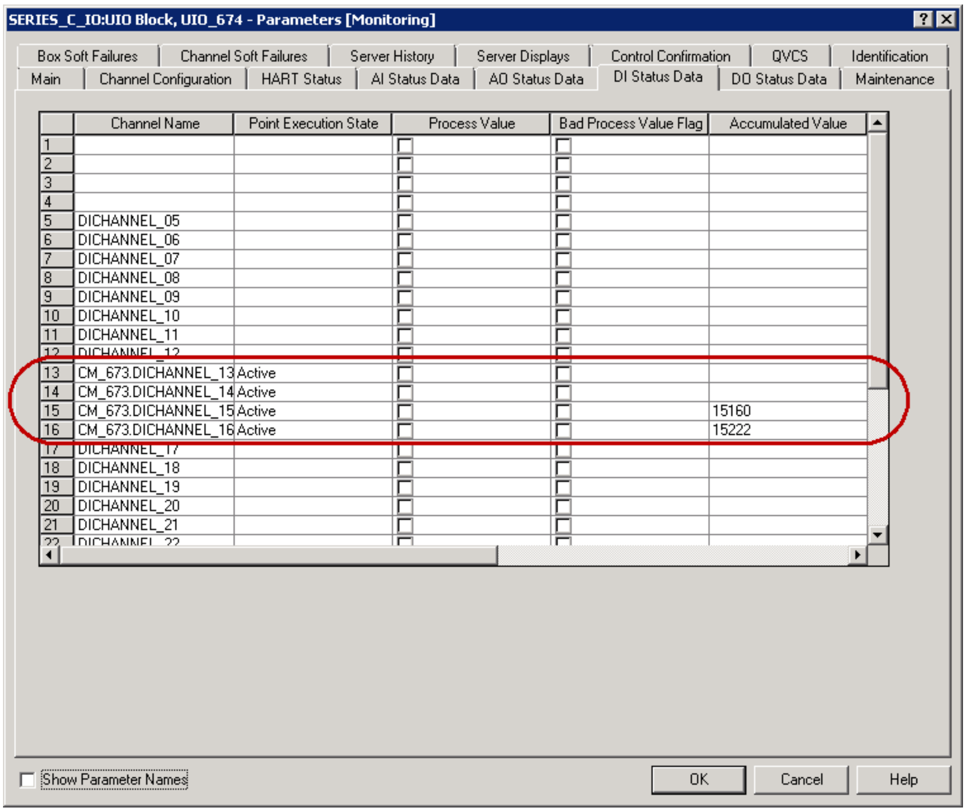
Figure 12.7 DI Status Data tab



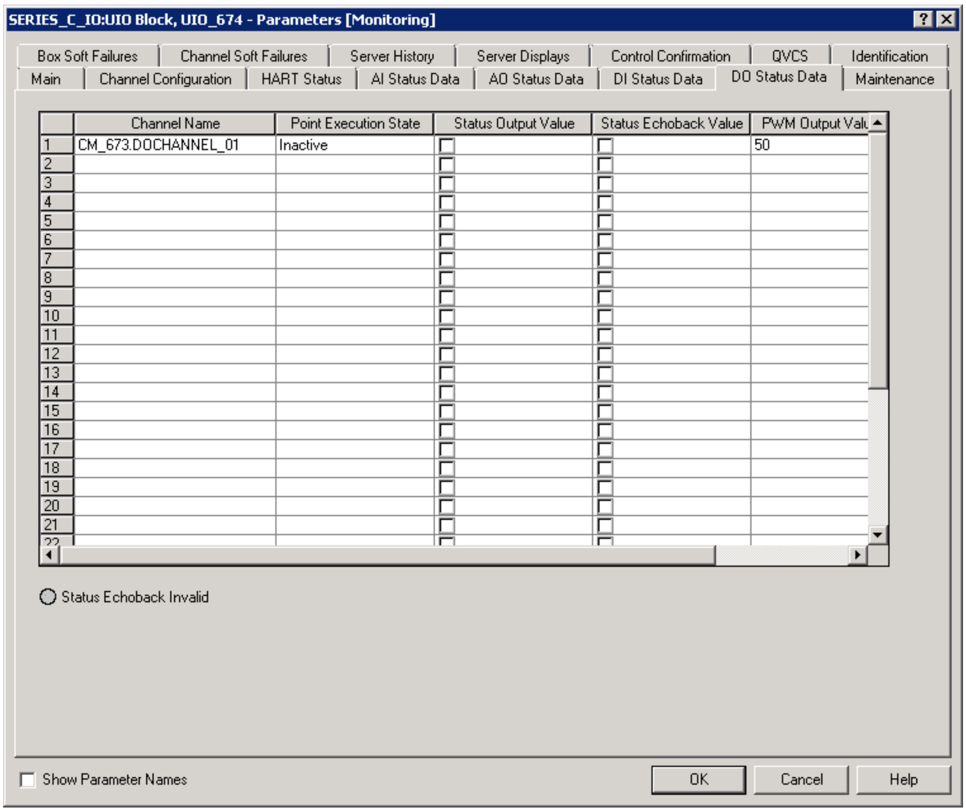
As illustrated in the figure, the accumulated value is displayed for the DI channels that are configured for pulse counting.

12.15.5 DO Status Data tab

From the Monitoring view, you can only monitor the parameters of the channels that are configured as DO in the Channel Configuration tab.

The following is an example of the DO channel block configured in the UIO module.

Figure 12.8 DO Status Data tab



As illustrated in the figure, the channel 1 is configured ganging in the UIO module.

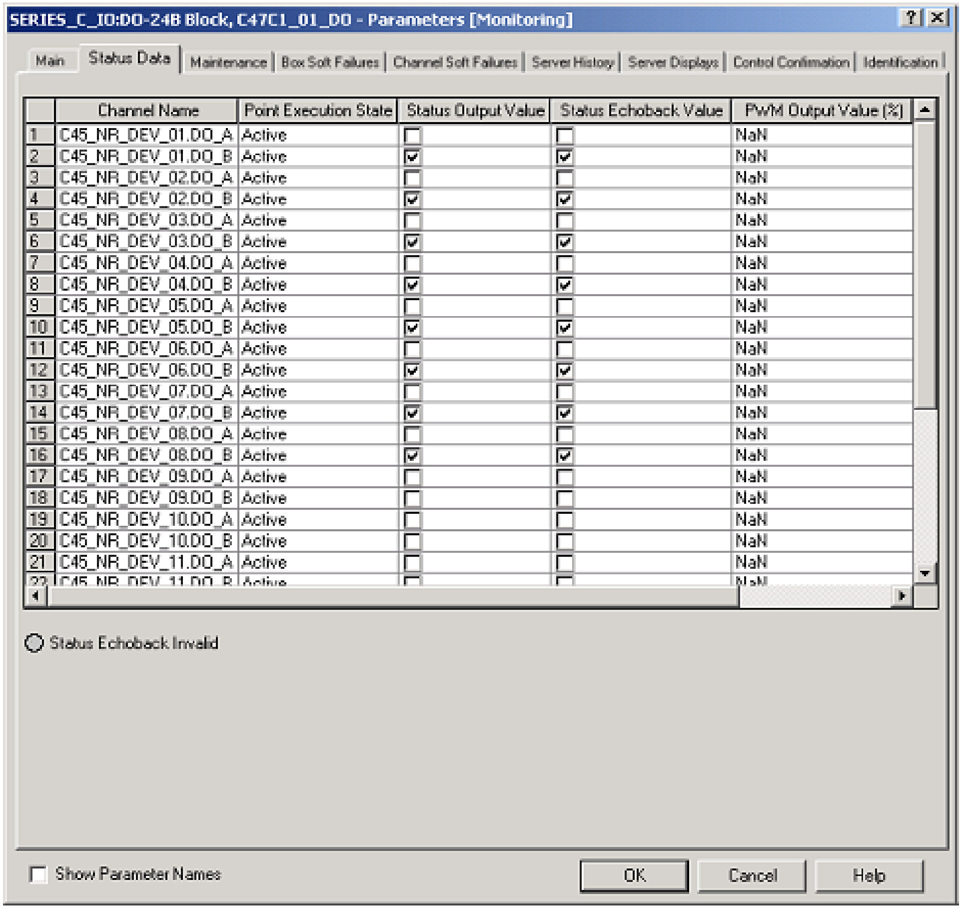
12.15.6 Status Data tab

You cannot configure any **Status Data** tab parameters from the Project view. You can only monitor the parameters from the Monitoring view. You can only monitor the status of the following I/O modules from the Monitoring view.

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B
- SP
- SVP
- PIM

The following is an example of a DO-24B Block, Configuration form - **Status Data** tab.

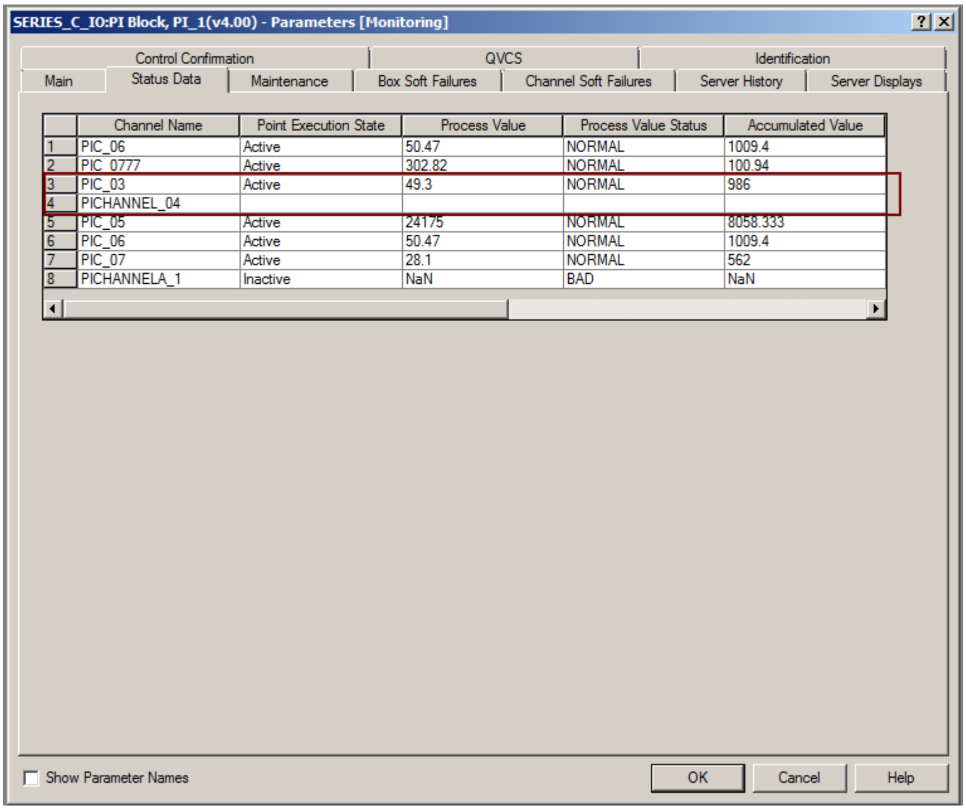
Figure 12.9 Status Data tab



12.15.7 PIM Status Data tab

The following figure displays a sample **Status Data** tab of the PIM from the Monitoring view.

Figure 12.10 Status Data tab of a PIM



As illustrated, channel 3 is configured for Dual Stream. Therefore, the row for channel 4 does not display any values.

12.15.8 Maintenance tab

The following configuration information pertains to the Maintenance tab for the following module types:

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B
- SP
- SVP
- PIM
- UIO

Maintenance can only be done from Monitoring.

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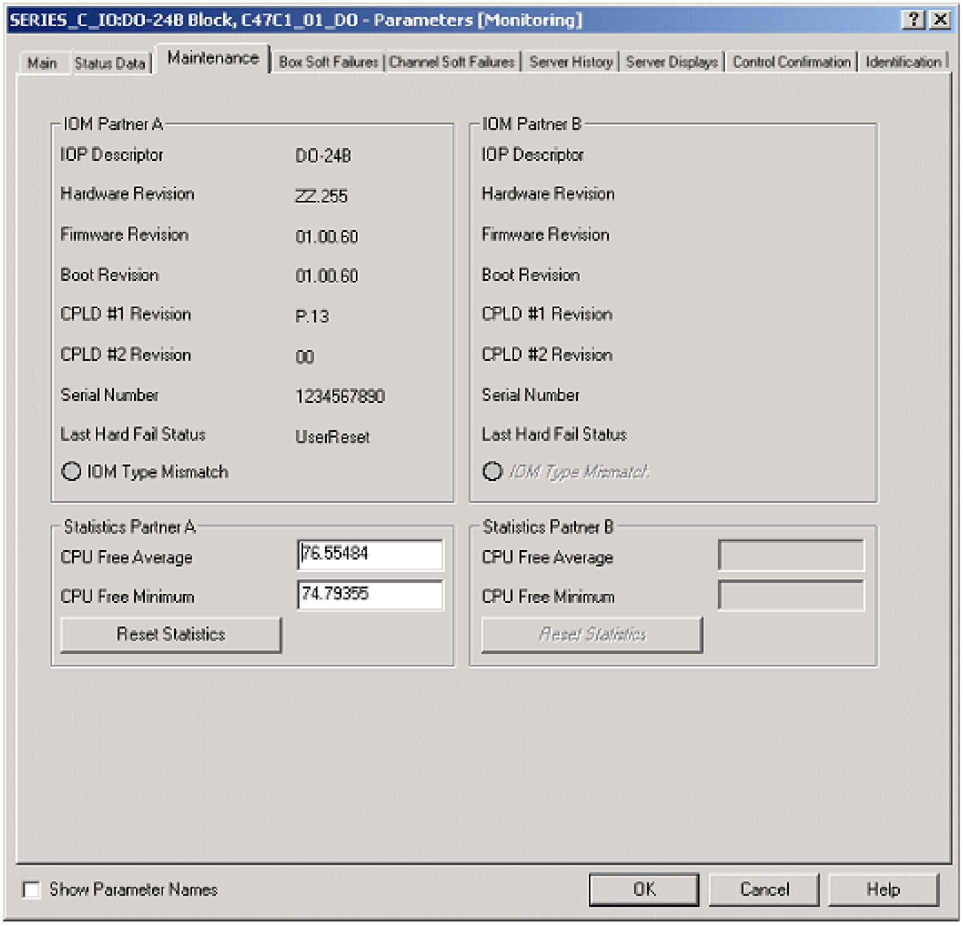
All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Maintenance tab.

Figure 12.11 Maintenance tab



Prerequisites

- A Series C I/O control module is created

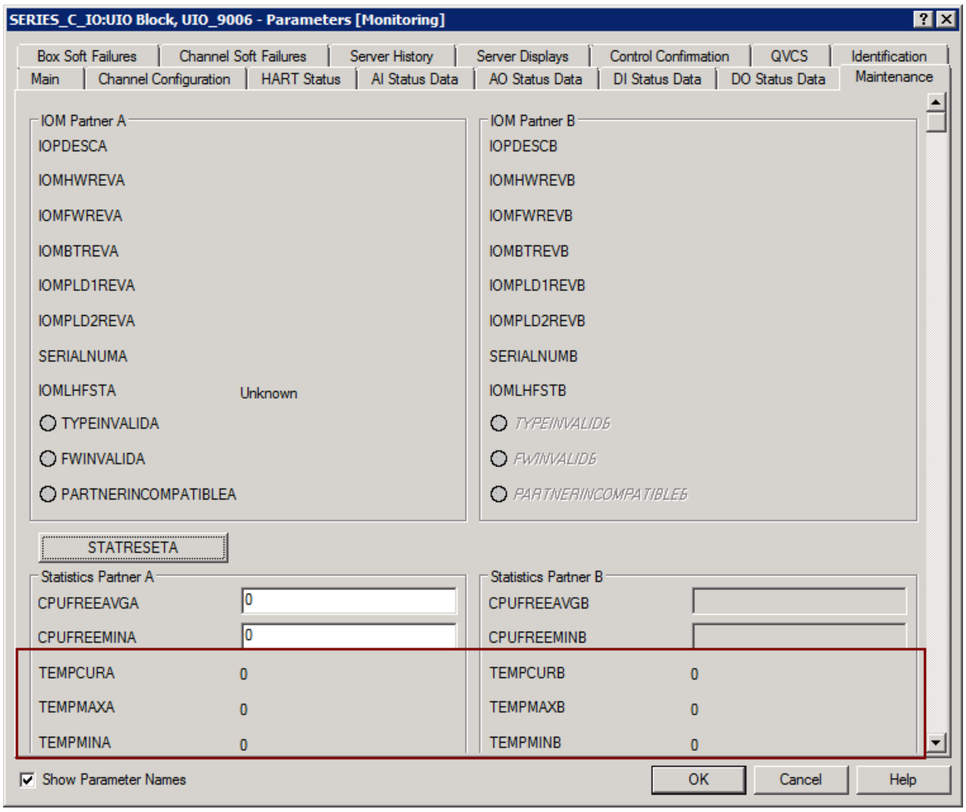
To Reset Statistics on the Maintenance tab

1. From the Statistics Partner frame, monitor the **CPU Free Average** and **CPU Free Minimum** settings. To reset statistics to their default values, proceed to the next step.
2. Click Reset Statistics to reset **CPU Free Average** and **CPU Free Minimum** to their default settings.

12.15.9 UIO Maintenance tab

The following figure displays an example Maintenance tab of the UIO from the Monitoring view.

Figure 12.12 Maintenance tab

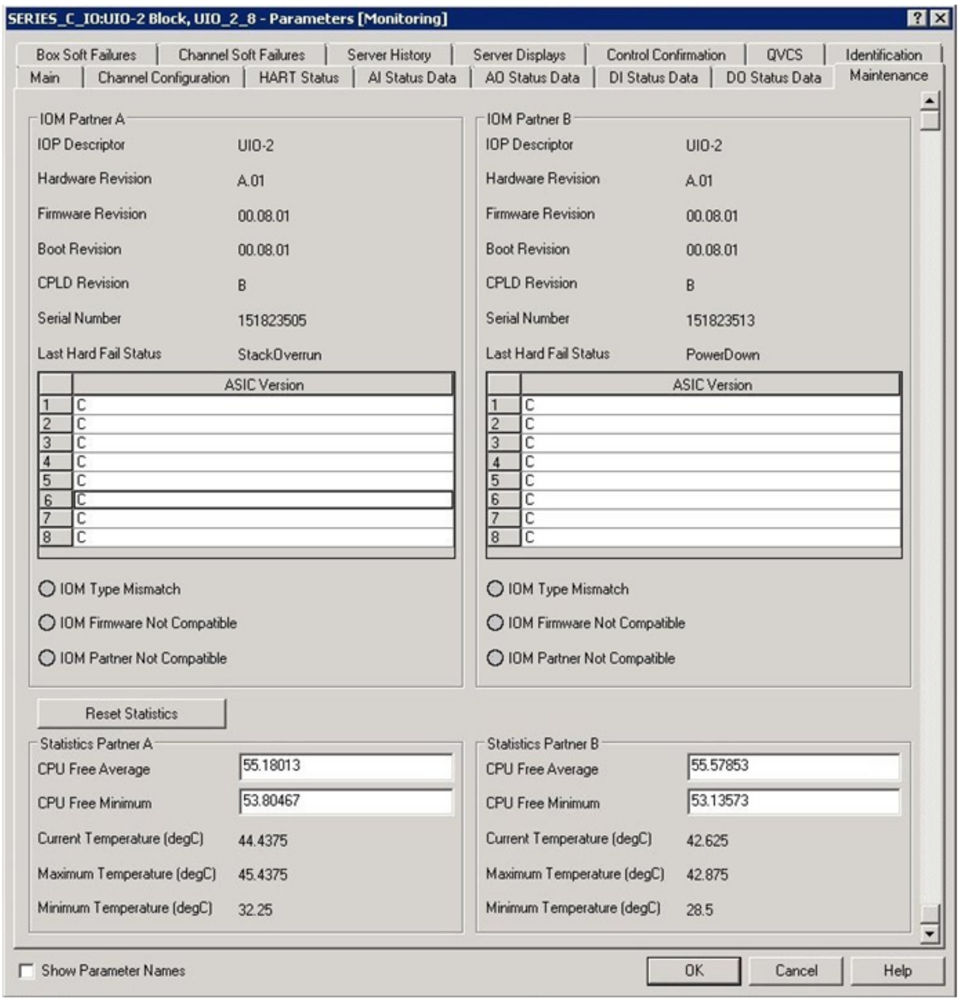


As illustrated in the figure, the temperature-related parameters of the UIO module can be monitored from the Monitoring view.

12.15.10 UIO – 2 Maintenance tab

For UIO-2, the information displayed is different from that displayed in case of UIO. Hardware information (for both redundant and non-redundant setups) is displayed.

Figure 12.13 UIO-2 Maintenance tab



12.15.11 Box Soft Failures tab

The following configuration information pertains to the Box Soft Failures tab for the following modules:

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B

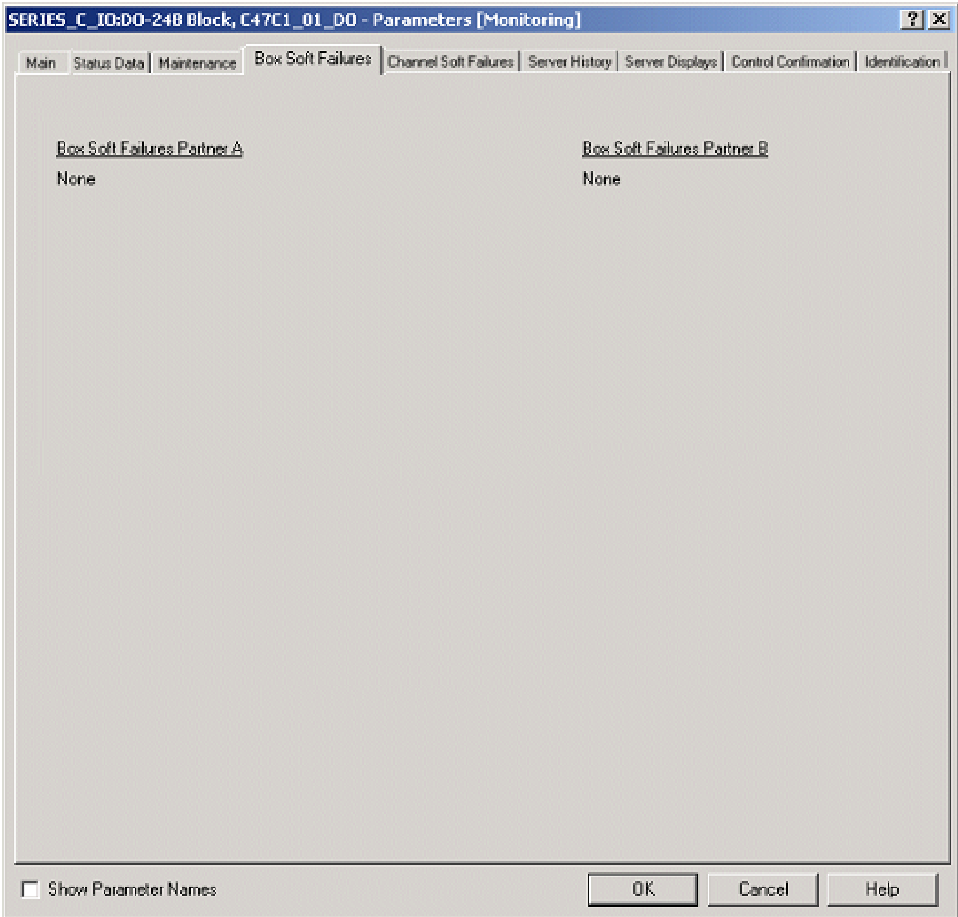
- SP
- SVP
- PIM
- UIO

> **NOTE** No user-defined configuration setting on the Box Soft Failures tab.

All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Box Soft Failures tab.

Figure 12.14 Box Soft Failures tab



Prerequisites

- A Series C I/O control module is created

12.15.12 Channel Soft Failures tab

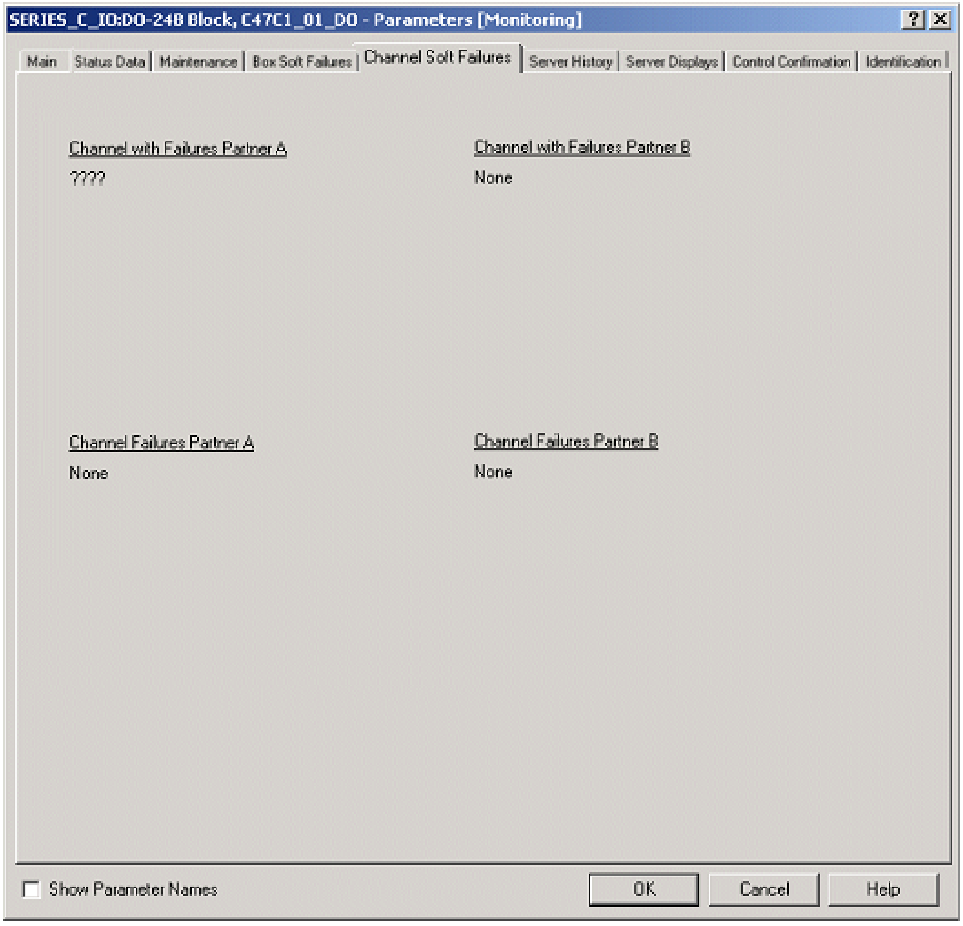
The following configuration information pertains to the Channel Soft Failures tab for the following modules:

- AI-HART
- AI-HL
- AI-LLMUX
- AI-LLAI
- AO
- AO-HART
- DI-HV
- DI-24
- DI-SOE
- DO-24B
- SP
- SVP
- PIM
- UIO

> **NOTE**
>
> No user-defined configuration setting on the Channel Soft Failures tab.
>
> - All illustrations used in the procedure are for example purposes only

The following is an example of a DO-24B Block, Configuration form - Channel Soft Failures tab.

Figure 12.15 Channel Soft Failures tab



When the DO channel is configured for ganging and a soft failure occurs in one of the ganged DO channel, the soft failure is reported with the respective DO channel number. For example, consider that the DO channel 1 to 4 are configured for ganging and a soft failure (for example, open wire is detected) occurs in the DO channel 3. In this scenario, the soft failure is reported with the DO channel 3.

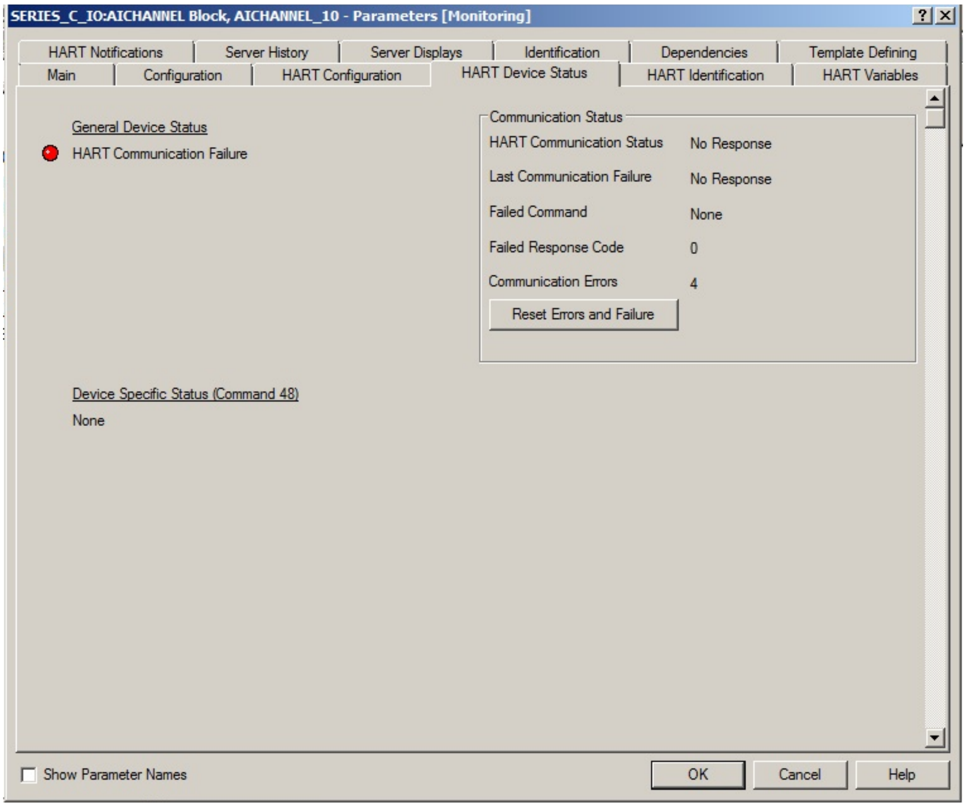
12.15.13 HART Device Status tab - Channel block

The following configuration information pertains to the HART Device Status tab.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Device Status tab.

Figure 12.16 HART Device Status tab



The parameters of the HART Device Status tab are listed in the following table.

Table 12.8 HART Device Status tab parameters

Plain text	Parameter name	User configurable
Communication Status		
HART Communication Status	HCOMSTS	No
Last Communication Failure	HCOMFAIL	No
Failed Command	HCMDFAIL	No
Failed Response Code	HCMDRESP	No
Communication Errors	HNCOMERR	No

Prerequisites

- A Series C I/O control module is created

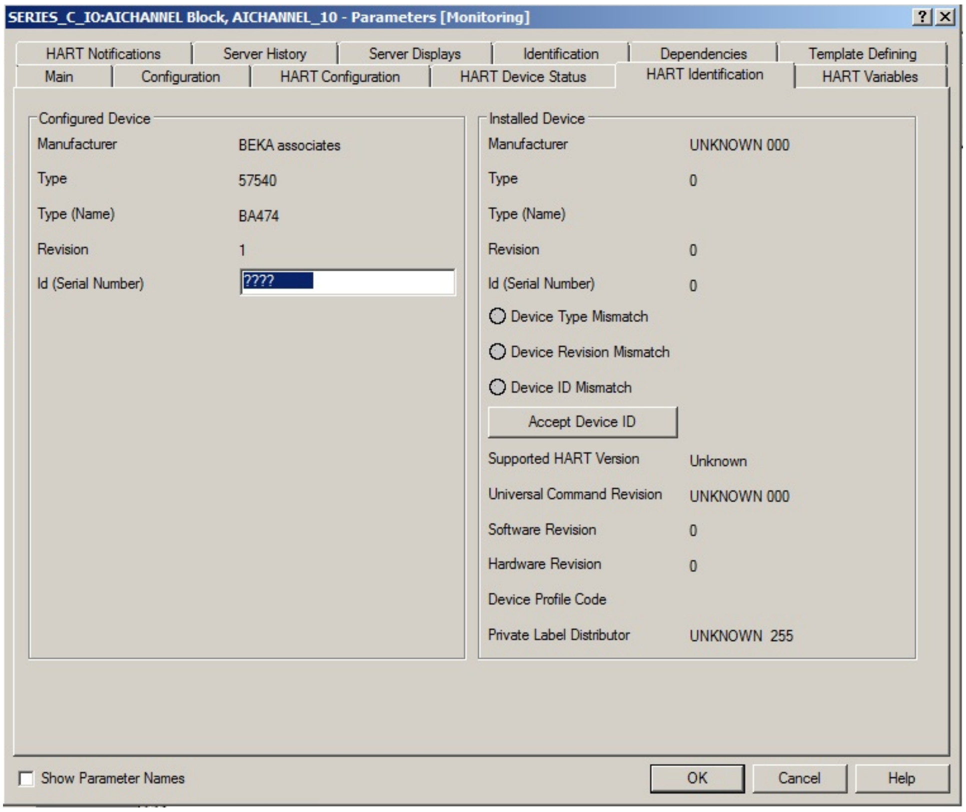
12.15.14 HART Identification tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O Analog Input and Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Identification tab.

Figure 12.17 HART Identification tab



The parameters of the HART Identification tab are listed in the following table.

Table 12.9 HART Identification tab

Plain text	Parameter Name	User Configurable
Configured device		
Manufacturer	HDVMFGCD	No
	HDVMFGCD7	No
Type	HDVTYPCD	No
	HDVTYPCD7	No
Type (Name)	HDVTYPCDNAME	No
Revision	HDVRREVCD	No
Id (Serial number)	HDEVIDCD	No
Installed device		
Manufacturer	HDEVMFG	No
Type	HDEVTYPE	No
	HDEVTYPE7	No
Type (Name)	HDEVTYPNAME	No
Revision	HDEVRREV	No
Id (Serial number)	HDVID	No
Device Type Mismatch	HDEVMISM	No
Device Revision Mismatch	HREVMISM	No
Device ID Mismatch	HDEVIDFL	No
Accept Device ID	ACCEPTDEV	No

Plain text	Parameter Name	User Configurable
Supported HART Version	HARTVERSION	No
Universal Command Revision	HUCMREV	No
Software Revision	HSWREV	No
Hardware Revision	HHWREV	No
Device Profile Code	HDEVPROFILE	No
Private Label Distributor	HPVTLDST	No

Prerequisites

- Control Builder is running
- A Series C I/O control module was created

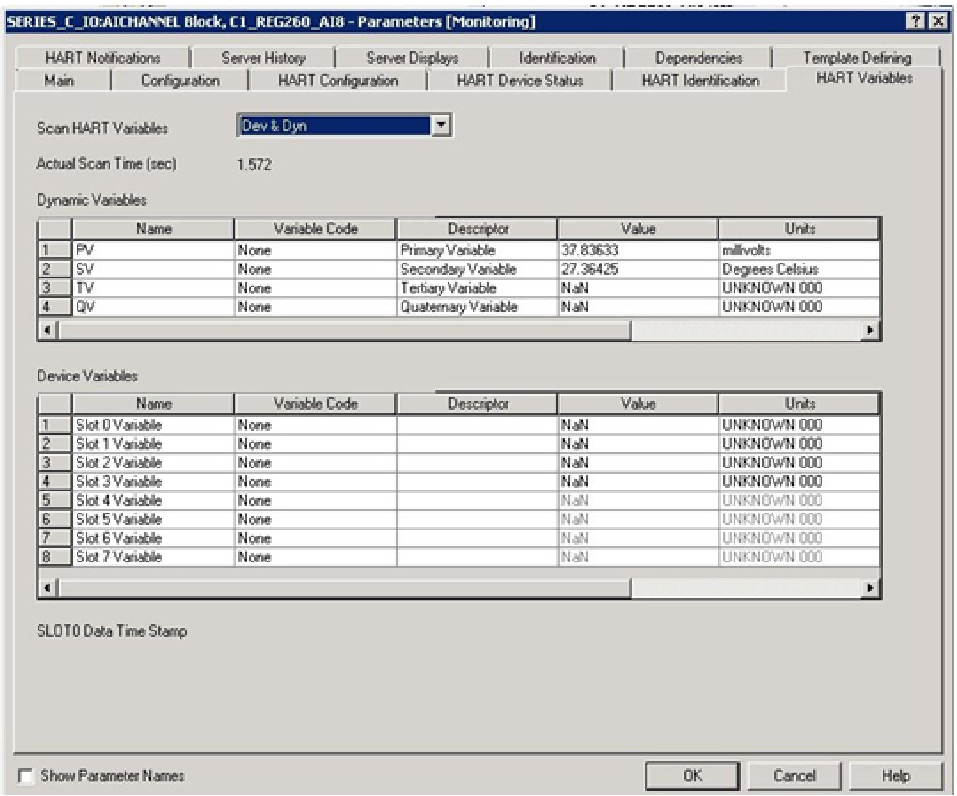
12.15.15 HART Variables tab - Channel block

The following configuration information pertains to the Identification tab for all Series C I/O Analog Input or Analog Output modules.

All illustrations used in the procedure are for example purposes only

The following is an example of an AI Channel Block, Configuration form - HART Variables tab.

Figure 12.18 HART Variables tab



The parameters of the HART Variables tab are listed in the following table.

Table 12.10 HART Variables tab parameters

Plain text	Parameter name	User configurable
Scan HART Variables	HSCANCFG	No
Only for UIO-2, the Scan HART Variables are configurable as described here. A screenshot of the same is shown at the end of this table.		
Scan HART Variables	HSCANCFG	Yes • Status Only • Device Only • Dynamic Only • Dev & Dyn
Dynamic variables		
Name	HDYNNAME	Yes
Variable Code	HDYNDVC	Yes
Descriptor	HDYNDSC	Yes
Value	HDYNVAL	Yes
Units	HDYNEU	Yes
Device variables		
Name	HSLOTNAME	Yes
Variable Code	HSLOTDVC	Yes
Descriptor	HSLOTDSC	Yes
Value	HSLOTVAL	Yes
Units	HSLOTEU	Yes
Slot0 Data Time Stamp	SLOT0TS	No

Prerequisites

- Control Builder is running
- A Series C I/O control module was created

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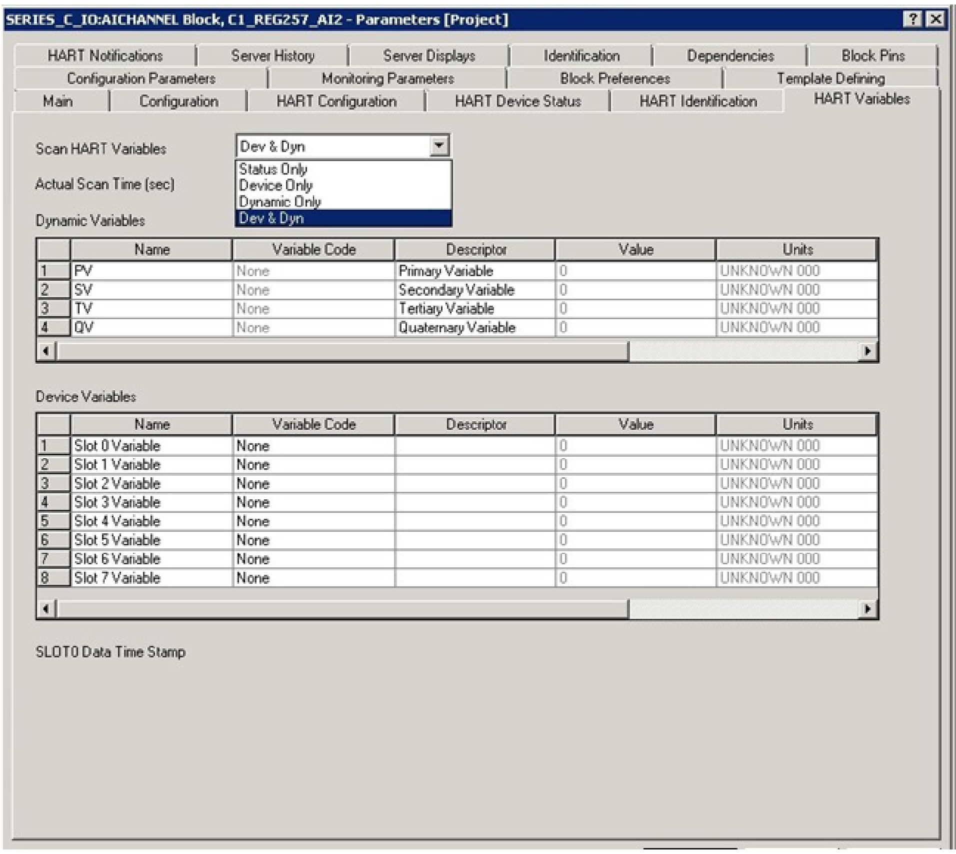
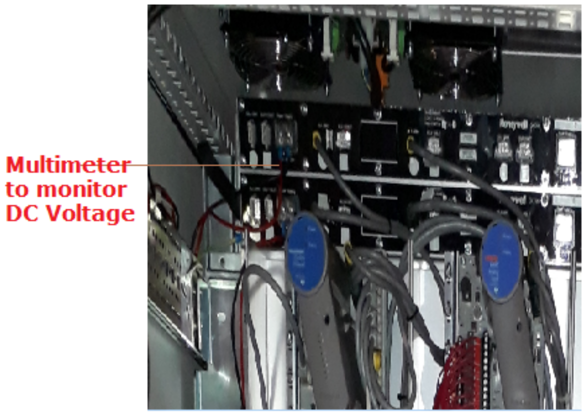
Figure 12.19 HART Variables tab — Scan HART Variables



12.16 Calibrating the DC output voltage for a Meanwell redundant system

To calibrate the DC output voltage for a Meanwell redundant system, perform the following steps.

1. After assembling the power supply and redundancy module, ensure the following:
   - Separate breakers are provided for each power supply.
   - Both the power supplies are in off state.
   - There are no loose connections.
2. Turn on the breaker of the power supply 2.



> NOTE
>
> For the power supply 2, if the LED labeled as 'DC OK' is on, then it indicates that the power supply is on.

3. Connect multi-meter to measure DC output voltage of power supply 2 at the terminal block. Refer above figure.
4. Adjust the potentiometer (labeled as' +V ADJ 'on the power supply) to set voltage at the terminal block to 25.0 volts.
5. Turn off the power supply 2 and Turn on power supply 1.
6. Repeat steps 3 to 5 for power supply.
7. Turn on power Supply 2.

> NOTE
>
> When both the power supplies are on, check the DC output voltage at the terminal block must be 25V.

12.17 Calibrating the DC output voltage for a non-redundant Meanwell system

To calibration the DC output voltage for a non-redundant Meanwell system, perform the following steps.

1. After assembling the power supply in a non-redundant power system, ensure the following:
   - Separate breaker is provided for power supply.
   - Power supply is in off state.

2. Turn on the breaker of the power supply 2.

> **NOTE** For the power supply 2, if the LED labeled as 'DC OK' is on, then it indicates that the power supply is on.

3. Connect multi-meter to measure DC output voltage of power supply 2 at the terminal block.
4. Adjust the potentiometer (labeled as' +V ADJ 'on the power supply) to set voltage at the terminal block to 25.0 volts.

12.18 Calibrating the DC output voltage for a Phoenix redundant power system

To calibrate the DC output voltage for a Phoenix redundant power system, perform the following steps.

12.18.1 To calibrate the DC output voltage for a Phoenix Contact redundant option

1. After assembling the power supply and redundancy module, perform the following:
   - Ensure separate breakers are provided for each power supply.
   - Check that both the power supplies are in off state.
   - Ensure there are no loose connections.
   - Switch on the breaker of power supply 2.

2. Observe that the LED labeled as **DC OK** of power supply 2 is on. See the following figure in which the LED is indicated as **DC OK**.

3. Connect the multimeter to measure DC output voltage of power supply 2 at the terminal block . See the following figure.

4. Adjust the potentiometer (labeled as" 18-29.5 V "on the power supply) to set voltage to 25.0 volts on terminal block.
5. Switch off the power supply 2 and then switch on the power supply 1.
6. Repeat the above steps for the power supply 1.
7. Switch on the power supply 2.
8. When both the power supplies are on, check the DC output voltage at terminal block.

   The output voltage should be 25V.

12.18.2 To calibrate the DC output voltage for a Phoenix Contact redundant option

1. After assembling the power supply and redundancy module, perform the following:
   - Ensure separate breakers are provided for each power supply.
   - Check that the power supply is in off state.
   - Ensure there are no loose connections.
2. Observe that the LED labeled as **DC OK** of power supply 2 is on. See the following figure in which the LED is indicated as **DC OK**.

3. Connect the multimeter to measure DC output voltage of power supply 2 at the terminal block . See the following figure.

4. Adjust the potentiometer (labeled as" 18-29.5 V "on the power supply) to set voltage to 25.0 volts on terminal block.
5. When the power supply is on, check the DC output voltage at terminal block.

   The output voltage should be 25V.

12.19 Power up the COTS power system

When you turn on the Series C system for the first time, you must always confirm that the DC output voltage of the power system must be within the range of 24V to 26 V.

Following are the tools required to power up the power system.

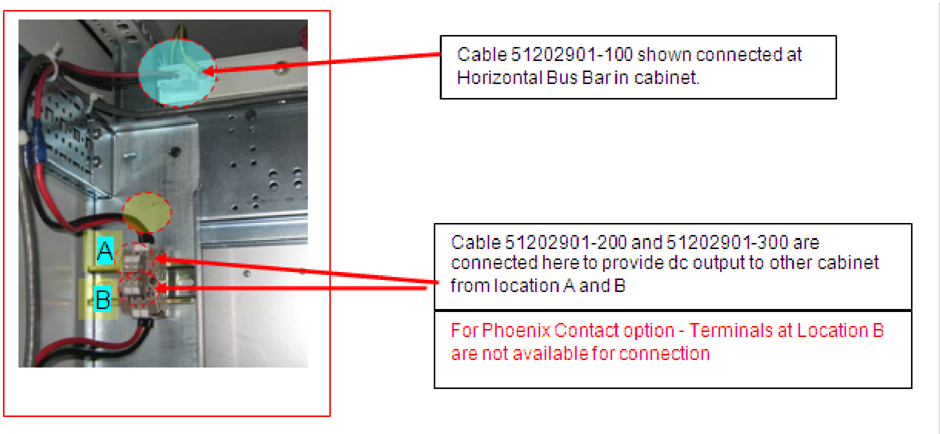
- Flat head screw driver
- Digital multi-meter

Before you turn on the COTS power system, ensure the following:

- There must be no loose connections.
- AC power is connected to an COTS power system through the circuit breaker. Circuit breaker facilitate turning On/Off of the power supply.
- Applicable local safety and agency requirements are fulfilled.
- All safety and grounding requirements applicable to series C system are complied.

12.19.1 To confirm the DC output voltage of the power system

1. Remove the connector or connectors on horizontal bus bar in cabinet.
2. Remove the cables from the horizontal bus bar, 24 volts is disconnected as shown in the following figure.



3. Turn on the power supply or power supplies using the circuit breaker.
4. Check that the LED is labeled as 'DC OK 'of the power supply is on.
5. Measure the voltage on the terminal block with help of Digital Multi-meter. The voltage must

be in the range of 24V to 26V.

6. Turn off the power system and then reconnect the connector or the connectors removed from the horizontal bus bar.
7. Initial check of the power system must be complete.

CHAPTER

13

SERIES C I/O LINK FIBER OPTIC EXTENDERS (FOE)

The Fiber Option Extender modules support the extension of the I/O link beyond the Series C Cabinet with the C300, enabling remote applications of the Series C I/O.

The following two types of FOEs are qualified to be used with Experion depending on the distance between the controller and the IO modules.

- Multi-mode FOE
- Single mode FOE

You can select the appropriate FOE based on your requirement.

13.1 Overview of multi-mode FOE

The Fiber Optic module and IOTA board are built exclusively for Honeywell by a third party company. With a Series C I/O Link Fiber Optic Extender (FOE) module, the ability exists to connect the C300 controller to remote:

- Series C I/O and
- PM I/O

The FOE has the following capabilities:

- To connect one local cabinet to two remote I/O sites.
  - If more than two remote sites exist, multiple FOE modules may be installed in the local cabinet.
- Has two fiber optic ports sets, FO1 and FO2,
  - each set having both a receive (Rx) and transmit (Tx) connector.
- An IOLINK connector for connecting to the copper IOL.

> NOTE
>
> The same FOE module cannot be used for both types Series C and PM I/O concurrently.

The following FOE connections can be made:

Fiber optic port connections	• Series C: FOE modules to FOE modules • PM I/O: FOE modules to PM I/O Link Extender
IOLINK (copper) connections	• Series C: FOE modules to copper IOLINK

- Fiber Optic Extender assembly
- FOE features
- Fiber Optic redundancy
- FOE assembly certification details

13.1.1 Fiber Optic Extender assembly

The Fiber Optic Extender assembly consists of components that include the FOE module and the FOE IOTA board, along with the FOE interface cable. This assembly is installed in a control cabinet on vertically mounted carriers, specially designed for Series C control hardware. The following figure shows the features of the FOE and its associated IOTA board.

Figure 13.1 Fiber Optic Extender assembly

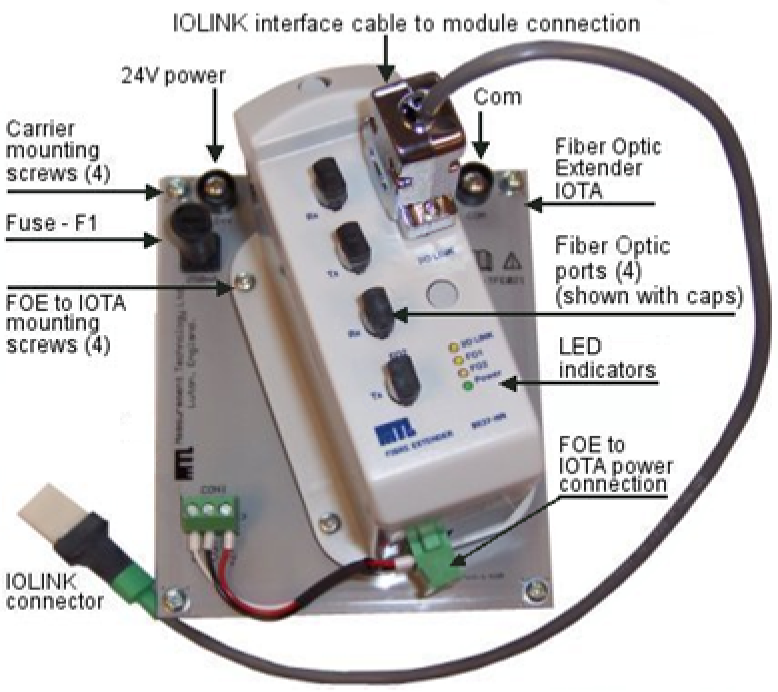


Table 13.1 FOE module and IOTA summary

Item	Description
IOTA board 6-inch	
F1	Fuse
24V power	Power connection to carrier
Com	Ground connection to carrier
FOE Power connector	Plug for FOE power cable connection

Item	Description
Fiber Optic Extender module	
IOLINK connector	IOLINK connector
Fiber optic ports (2 sets)	FO1 - Rx (receive) and Tx (transmit) connectors FO2 - Rx (receive) and Tx (transmit) connectors Either set can be used interchangeably.
LED indicators	Power and communication indicators for the module

13.1.2 FOE features

The following table lists the features available with the Fiber Optic Extender.

Feature	Description	
Supported family	Series C and PM I/O	
Topology types	Point-to-point	Two systems (nodes) connected by a single cable set.
	Daisy chain	Multiple systems connected in a serial manner. Each module acts like 'a repeater' allowing greater fiber distances.
	Star Sometimes compared to a 'chicken foot'	Topology whereby all nodes are individually connected to a central connection point. More cable is needed, but if one cable fails, the rest of the nodes remain operational.
Optical budget	8db min 15db typical	
Distance	• Between FOEs with standard cables 1.5 km with premium cable 2.0 km • Daisy chain max 8 km PM I/O 10 km Series C	
Module mounting options	• IOTA • DIN rail (with user supplied power)	
Fiber Optic ports	2	
Power options	• Series C - IOTA • External power system (DIN rail mounting option)	
Power supply options	20 to 30V at 85mA to 74mA max	
Ambient temperature	Operating: -20 to +70 degrees C Storage : -20 to +85 degrees C	
Corrosives	G3 per ISA specification S71.04-1985	
Relative humidity	0% to 90% RH	
Fiber type	Multi-mode	

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Feature	Description
	Fiber core diameter 62.5 ˚m Fiber cladding diameter 125 ˚m Connector type ST type

13.1.3 Fiber Optic redundancy

Since both Series C and PM I/O links are redundant, FOE modules are always installed in pairs . Therefore, two independent fiber cables (one for Link A and one for Link B) are required between each local and remote connection.

13.1.4 FOE assembly certification details

The individual elements of the code are explained by reference to the items below.

- Class I, Division 2, Groups A, B, C, D
- Class I, Zone 2, AEX nA IIC
- II 3G EEx nA IIC
- ATEX EEx nA IIC T4

13.2 FOE Installation

The procedures in this guide assume that you have completed all pertinent planning activities as outlined in the *Control Hardware Planning Guide*.

- Handling components - ESD
- Work practices
- Hazardous areas
- Operations
- Checking and Maintenance
- Installation

13.2.1 Handling components - ESD

Electrostatic discharge can damage integrated circuits or semiconductors if you touch the connector pins.

> NOTE
>
> Follow these guidelines when you handle a module:

- Touch a grounded object to discharge static potential,
- Wear an approved wrist-strap grounding device,
- Do not touch the connector pins,
- If available, use a static safe workstation

13.2.2 Work practices

Before installation, follow these work practices when performing general tasks:

- Ensure that all installation work is to be carried out in accordance with local standards, codes of practice and site regulations and any other special requirements stated in this manual.
- Check that all module functions are correct for the application
- Take care to avoid damaging the pins at all connector interfaces
- Ensure that AC mains supplies have been isolated.
- It is recommended that some form of mechanical assistance is used for lifting and supporting the enclosure when installing it.

13.2.3 Hazardous areas

This subsection describes the considerations that should be given to Zone 2 and Division 2 hazardous environments of the equipment prior to its installation.

Work activities in a Zone 2 and Division 2 hazardous area are restricted in order to avoid ignition of explosive gas/air mixtures.

13.2.4 Operations

The equipment must only be installed, operated and maintained by trained competent personnel.

13.2.5 Checking and Maintenance

The installation and maintenance must be carried out in accordance with all appropriate international, national and local standard codes of practice and site regulations in accordance with the instructions contained in this manual.

13.2.6 Installation

The installation must comply with the appropriate European, national and local regulations, which may include reference to the IEC code of practice IEC 60079-14. In addition, particular industries or end users may have specific requirements relating to the safety of their installations and these requirements must be met. For the majority of installations the Directive 1999/92/EC [the ATEX Directive - safety of installations] is also applicable.

13.3 Component mounting sequence

It is required that the installation be done in the following sequence:

1. Mount the FOE module onto the IOTA
2. Connect the FOE module's power cable to the module
3. Remove the IOTA F1 fuse.
4. Mount the FOE module assembly to the carrier
5. Connect the I/O link cable.
6. Re-install the IOTA F1 fuse.

- Mounting the FOE module onto the IOTA
- Connecting the FOE module's power cable to the module
- Removing the FOE IOTA F1 fuse
- Mounting the FOE module/IOTA assembly to the carrier
- Connecting the IOLINK interface cable to the FOE module
- Re-installing the FOE IOTA F1 fuse
- Connecting the fiber optic cables to the FOE module
- FOE connection rules
- LED indicators

13.3.1 Mounting the FOE module onto the IOTA

Prerequisites

It is required to attach the FOE module to the IOTA prior to its mounting to the carrier. The following also needs to be established:

All wiring and pre-fabricated cables are available and labeled as applicable.

To mount the module onto the IOTA

1. Align the FOE screws (located on the flange) with the holes on the IOTA.
2. Tighten the four screws that attach the base of the FOE module to the IOTA board (using a Phillips screw-driver).
3. This completes the procedure.

Mounting the IOTA

For installation purposes, it is assumed that the mounting channel is already fitted in a cabinet or enclosure that provides a suitable environment for the IOTA and its associated equipment.

The IOTA is normally supplied with the FOE fitted. However, the following mounting instructions can be used irrespective of whether the IOTA has the FOE fitted or not.

To mount the IOTA

1. Mount the IOTA on the channel in appropriate orientation.
2. Secure each of the fixing screw with its spacer and plastic retaining washer beneath the board.
3. Position the IOTA and then secure it using the four fixing screws.

13.3.2 Connecting the FOE module's power cable to the module

Typically, the FOE power cable does not require any adjustment or maintenance. If there is a power issue with the FOE module, a loose contact or disconnected power cable may be the cause. If the power cable is damaged the IOTA board requires replacing.

Prerequisites

Before connecting the FOE module's power cable to the module refer to the FOE connection rules.

To connect the FOE power cable to the module

1. Ensure the power cable connector is properly aligned with the plug on the module.
2. Press the plug firmly into the connector.
3. Using a small slotted screwdriver, fasten the screws on the cable connector to the FOE module.
4. This completes the procedure.

13.3.3 Removing the FOE IOTA F1 fuse

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

To remove the FOE IOTA F1 fuse

1. Using a small slotted screwdriver, place the tip into the slot on the fuse cap
2. Rotate the cap counter clockwise, a quarter-turn. Remove the cap that also holds the fuse.
   Place fuse and fuse cap aside in a safe place for reuse in a later assembly step.
3. This completes the procedure.

13.3.4 Mounting the FOE module/IOTA assembly to the carrier

Prerequisites

Before installing the FOE module/IOTA assembly in the cabinet, ensure that:

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All wiring and pre-fabricated cables are available.

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

To mount the FOE module/IOTA assembly to the carrier

1. Ensure the F1 fuse is removed.
2. Make sure each of the 4 carrier mounting screws have their spacers secured by the plastic retaining washers.
3. Select the desired mounting location on the carrier and align the mounting holes in the IOTA with the screw-hole locations on the carrier.
4. Using a #2 Phillips screwdriver, secure the FOE assembly to carrier using the 4 corner carrier mounting screws.
5. Tighten the two power screws, connecting the IOTA board to the vertical bus bars on the channel carrier assembly:
   - +24 V power screw
   - Com ground screw
6. This completes the procedure.

13.3.5 Connecting the IOLINK interface cable to the FOE module

> ATTENTION
>
> The IOLINK interface cable should be connected before powering the FOE module.

Prerequisites

Before connecting the FOE module's IOL interface cable to the module:

- Refer to FOE connection rules.

To connect the IOLINK interface cable to the FOE module

1. Ensure the IOLINK interface cable connector is properly aligned with the connector on the FOE module.
2. Press plug firmly into the connector.
3. Fasten the screws on the cable connector to the FOE module.
4. This completes the procedure.

13.3.6 Re-installing the FOE IOTA F1 fuse

> ATTENTION
>
> The fuse, **F1**, can be removed or replaced only after verifying that the location is non-hazardous.

To re-install the FOE IOTA F1 fuse

1. Using the fuse and cap from section 13.3.3, place the fuse in the fuse cap and insert it back into the fuse holder on the IOTA board.
2. Tighten the fuse cap rotating it clockwise a quarter-turn, using a small slotted screwdriver.
3. This completes the procedure.

13.3.7 Connecting the fiber optic cables to the FOE module

> ATTENTION
>
> Unused optical ports should always have protective covers on them to prevent dust and other contaminants from accumulating on the glass fiber optic interfaces.
>
> Fiber-optic ST-type connectors may be removed, or replaced, while active and in a Zone 2 or Division 2 hazardous area.
>
> Clean and inspect the fiber optic cable endfaces per IEC-61300-3-35 at time of installation or any time the fiber cables are removed and reinstalled into the FOE Tx/Rx ports. Do not skip this critical step. A 200x/400x optical fiber microscope is required for verification. Failure to meet specification may result in communication errors or undesired operation.

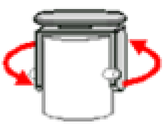
Prerequisites

Before connecting the FOE module's power cable to the module:

Refer to FOE connection rules.

To connect the FOE cables to the FOE module

1. Ensure the dust caps are removed from the ST optical ports on the FOE module. Remove the dust caps by rotating the cap counter-clockwise to disengage from the locking tab.



2. Carefully insert the ST connector of the fiber optic cable onto the proper FOE port.

   Top Port

FO1 - Rx (receive) and Tx (transmit) connectors

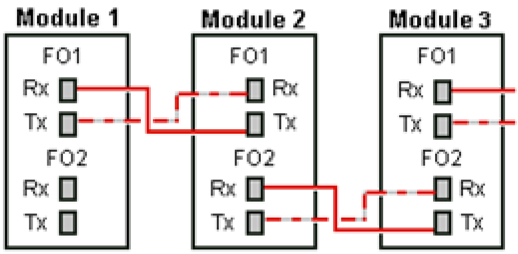
Bottom Port

FO2 - Rx (receive) and Tx (transmit) connectors

FOE Cable Guidelines

- FO1 and FO2 ports may be used interchangeably. However, the Rx and Tx connections of a given cable set must be terminated on the same port.
- The cable end attaches to Rx on one module and to the Tx on the other module.

> NOTE
>
> The figure below illustrates how to connect the fiber optic ports on the FOE modules in daisy chain.



> ATTENTION
>
> Do not connect fiber cables between FO1 and FO2 on the same fiber optic module. Improper operation will result.

13.3.8 FOE connection rules

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

The power and cable connections to the FOE are allowable under the following conditions:

Connecting and discounting	Rule
Power	Removing fuse F1 from the IOTA powers down the FOE module.
IOLINK cable under power	The IOLINK cable between the C300 and the FOE module can be removed or replaced while under power only after verifying that the location is a non-hazardous area.
Fiber optic	Fiber-optic ST-type connectors may be removed, or replaced, while active and in a

Connecting and discounting	Rule
cables under power	Zone 2 or Division 2 hazardous area.

13.3.9 LED indicators

The following table defines the LEDs located on the Fiber Optic Extender module.

Table 13.2 FOE LED descriptions

Indicator	Color	LED off	LED on
Power	Green	Power fail	Power OK
FO 1	Yellow	Communication signal not present	Communication signal present on Rx channel
FO 2	Yellow	Communication signal not present	Communication signal present on Rx channel
I/O LINK	Yellow	Communication signal not present	Communication signal present on RS485 port.

13.4 Defining the Fiber Optic topology

There are three different FOE topologies supported. These topologies are:

- Daisy chain
- Tree
- Star

> **ATTENTION**
>
> The following figure is an example how the FOE can be deployed in a variety of topologies for both the Series C and PM I/O environment. This graphic is not to depict any restrictions with regards to FOE capacity or cable length.

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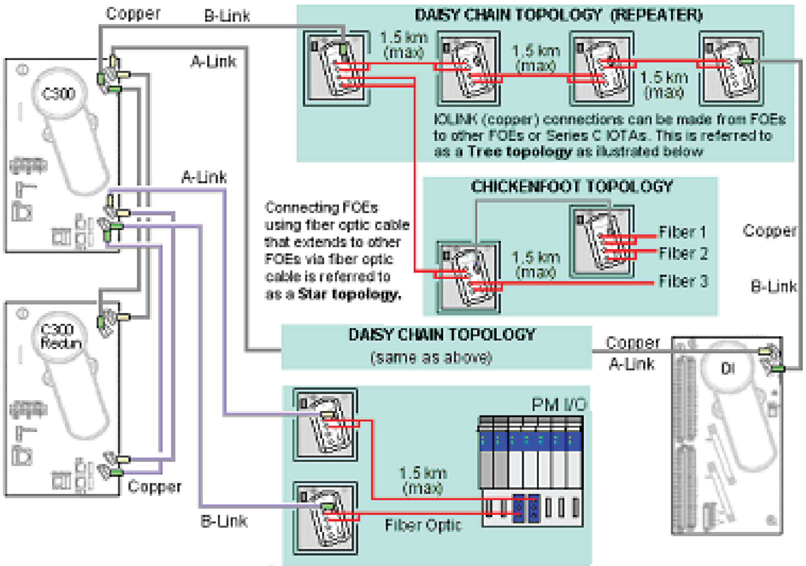
Figure 13.2 Example of possible FOE usage



FOE CONSTRAINTS - Total Cable lenght
PM I/O: 8km max
each FOE counts as .5 km

Series C: 10 km max
each FOE counts as .25 km

13.4.1 FOE capacity

The FOE can be deployed and combined in a variety of topologies. The following list can be used as a general guideline of supported environments and FOE capacities.

Environment	Hardware	Capacity
Series C I/O	Cable length	10 km max - each FOE counts as .25 km
PM I/O	Cable length	8 km max - each FOE counts as .5 km

13.4.2 Required hardware

Depending on your topology, the following Series C hardware is required to achieve remote I/O accessibility:

Component

- Fiber Optic Extender IOTA
- Fiber Optic Extender module
- Fiber optic cables

FOE interface cables - 0.5M length for both Series C & PM I/O

- Gray (pair) for IOL1
- Violet (pair) for IOL2

13.4.3 Fiber Optic Extender interface cable

The Series C interface cable has a different electrical keying than its PM I/O counterpart. Therefore, the specific cable type must be used for each I/O family.

> **ATTENTION**
>
> The proper interface cable must be used for either the Series C or the PM I/O topology. Use of the incorrect cable will result in faulty and/or corrupted IOL communications.

The fiber link is a passive subsystem and is essentially transparent to the system operation. It does not increase or decrease traffic or impact other capabilities of the I/O system. In addition, the following designations occur for these cables:

Interface	Cable color	A-link band color	B-link band color
IOL1	Gray	Yellow	Green
IOL2	Violet	Yellow	Green

13.4.4 Fiber optic cable - length factors

The maximum run of the fiber optic cables is limited by the optical power budget of 8db. Standard cables support 1.5 km while premium cable supports 2 km runs.

13.4.5 FOE topologies - Daisy chain topology

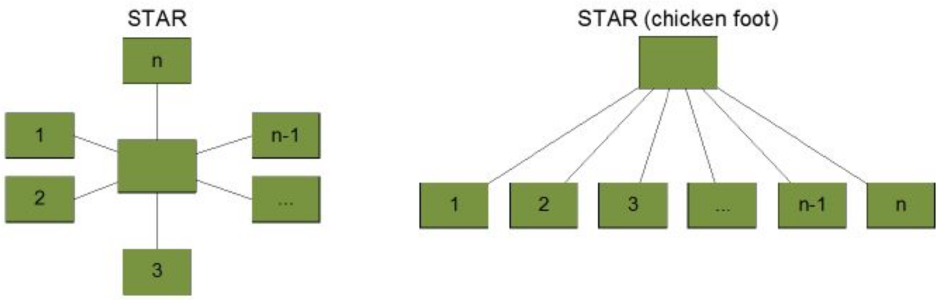
A daisy chain topology allows the remote I/O connection to be extended and can be utilized several times - if maximum flight delay times of data passing between the C300 controller and I/O are not exceeded.

When Series C daisy chaining, the electrical port requires no interface cable to be attached. This applies if: • daisy chaining Series-C link traffic, and • I/O is not present at the repeating location.
When PM I/O daisy-chaining, an interface cable must always be connected to the electrical port. This is because the cable keys the FOE for the PM mode of operation

A repeater function also extends the remote I/O similar to the daisy chain technique, but relies on the optical ports of two FOE modules to provide the interconnection.

13.4.6 FOE topologies - Star topology

The figures below illustrate the **STAR** topology whereby remote FOE nodes are individually connected to a central connection point (e.g. the C300). This topology has the advantage in that if one cable or cable set fails, the rest of the remote nodes remain operational. For this reason STAR is the most widely used configuration. The STAR is sometimes referred to as a **chicken foot** topology.



13.4.7 Maximum flight delay times

The I/O link communication protocol imposes a constraint between the C300 controller and the most distant I/O location, known as maximum flight delay time. This places a limit on the combined number of FOEs, and cumulative fiber cable length permitted in any IOL path. Note that these flight delay times constrain the distance regardless of the use of multi-mode versus single-mode fiber. In another words, the maximum distance are stated below regardless of the use of multi-mode versus single-mode fiber. This constraint varies for:

Series C - maximum cable length is 10 km
PM I/O - maximum cable length is 8 km

13.4.8 Fiber optic budget considerations

> ATTENTION
>
> Fitting terminations to fiber optic cable requires special equipment and techniques. In order to obtain the best results, a trained person should perform this operation in accordance with the manufacturer's instructions. For these reasons, the following installation instructions do not include detailed procedures for this process.
>
> Testing of the quality (loss) of the terminations should be carried out at each stage.

13.4.9 Standard I/O link extender maximum cable span calculation

The following calculation MUST be used to ensure that the number of planned splices and the cable choice supports the necessary cable span distance.

The maximum cable span calculation (in km) is as follows:	
Max Span =	(Available Optical Power - Losses in Splices)/(Max Loss per Cable Type)

The calculations or values for each of the above variables are described below.

13.4.10 Available standard I/O link extender optical power

The available optical power calculation is as follows:

Transmit Power - Minimum Receiver Sensitivity - Power Loss Over Time =	
Available Optical Power	
	where for a Standard I/O Link Extender:
	Transmit Power = - 16.0 dB Minimum Receiver Sensitivity = - 24.0 dB Power Loss Over Time = 2.5 dB
	Example calculation for a Standard I/O Link Extender using 62.5 micron cable: (- 16.0 dB) - (- 24.0 dB) - (2.5 dB) = 5.5 dB Available Optical Power

> ATTENTION
>
> Because the maximum transmitter output level is -7 dB, and the maximum receiver input level is -10 dB, the receiver may be overdriven on a short link and may require a 3 dB attenuator. Connector allowances for the transmitter and receiver are included in the above power declaration.

13.4.11 Losses in splices

The table below is used for the following **Losses in Splices** calculation.

Losses in Splices = Number of Splices x Maximum Loss per Splice

Standard Extender I/O cable type	Average Loss per type (dB)	Maximum loss per type (dB)
Fusion	0.2	0.3
Mechanical	0.3	0.5
ST-connector	0.5	0.9

Examples: Max. span calculation for cables with fusion or mechanical splices:

Variable values: Available optical power = 5.5 dB, two splices.

Two fusion splices	(5.5 dB) - (2 splices x **0.3 dB** max loss per splice) / (4 dB/km) = 1.22 km
Two mechanical splices:	(5.5 dB) - (2 splices x **0.5 dB** max loss per splice) / (4 dB/km) = 1.12 km

13.4.12 Honeywell ST-type connector cable assemblies

Honeywell can provide short fiber optic ST-type connector cable assemblies. You order by part number and cable length.

13.4.13 Link A and B cable length differences

The maximum difference in fiber optic cable length between Link A and Link B must be less than 500 meters (1640 feet) to limit the communications delay difference between Link A and Link B.

13.4.14 Allowable standard I/O Link extender cable signal loss

The Standard I/O Link Extender cable:

- Must have a total signal loss equal to or less than -5.5 dB at a wavelength of 850 nanometers.
- Fiber loss is measured at 22 degrees C ±3 degrees and is usually stated as a mean value.
- Individual fiber losses may be as much as 25% greater than the mean.

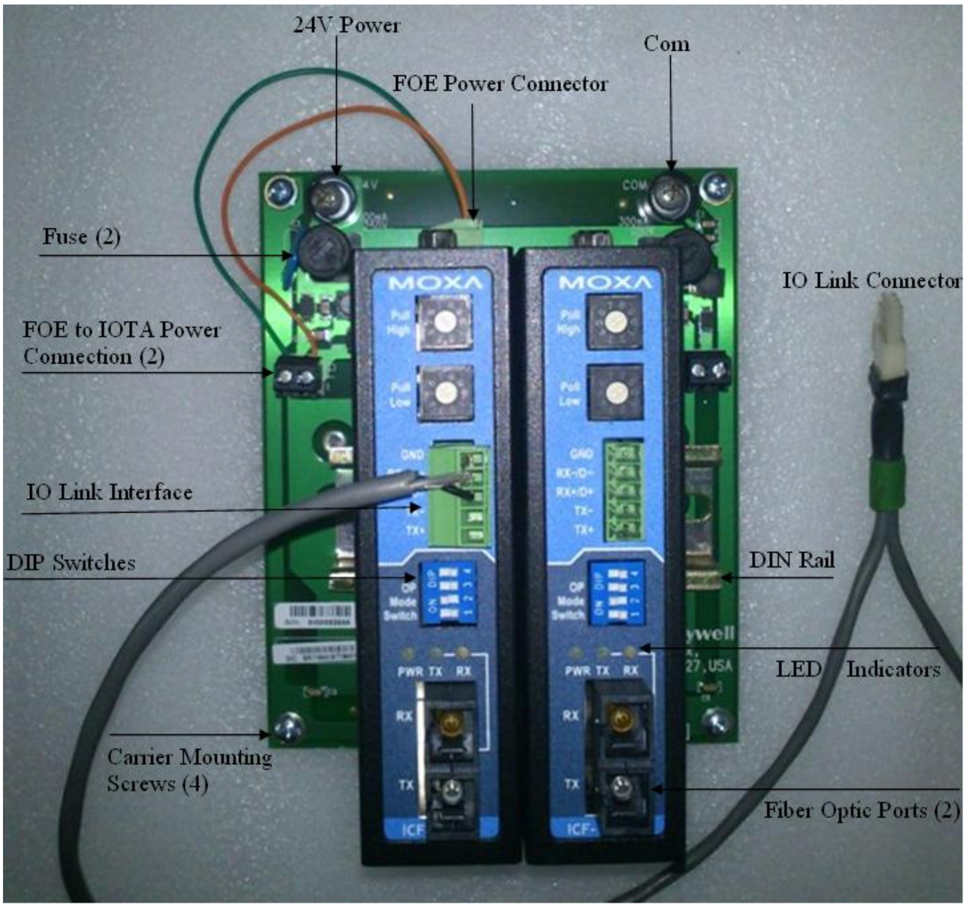
13.5 Single mode fiber optic extender

The single mode fiber optic module is built by a third-party company and the IOTA by Honeywell for use with Experion Series C I/O Family or HPM I/O Family. The single mode FOE supports the extension of the I/O Link beyond the Series C Cabinet with the C300, enabling remote applications of the Series C I/O and PM I/O.

The single mode FOE is available in two mounting options.

- IOTA - The FOE modules are mounted on the dedicated IOTA board and installed within the Series C Control Cabinet on vertically mounted carrier channel assemblies
- DIN RAIL - The FOE modules are mounted on the DIN rail within the cabinet.

The following figure displays a sample single mode FOE and its IOTA.



The single mode fiber optic extender can be used as a cabinet to cabinet repeater, supporting a network architecture similar to the following:

- Cabinet 1: Last Series C IOTA on IOLINK network in Cabinet 1===RS485===[MOXA ICF-1150]---fiber
- Cabinet 2: [MOXA ICF-1150]===RS485===[1st SC IOTA]==RS485====[last SC IOTA]===RS485===[MOXA ICF-1150]---fiber
- Cabinet 3: [MOXA ICF-1150], and so on

- Key features of single mode FOE
- Key features of single mode converter
- Single mode FOE installation
- Mounting the single mode FOE on the DIN rail
- Single mode FOE IOLINK interface cable details
- Single mode FOE IOLINK connection
- FOE fiber connections
- Power connection details for the single mode FOE on IOTA
- Connecting the power cables to the single mode FOE on DIN rail
- Using Meanwell/Phoenix Contact power supply
- Using TDI power supply
- Replacing the FOE fuse on the terminal block when FOE is mounted on DIN rail
- Removing the FOE module from the DIN rail

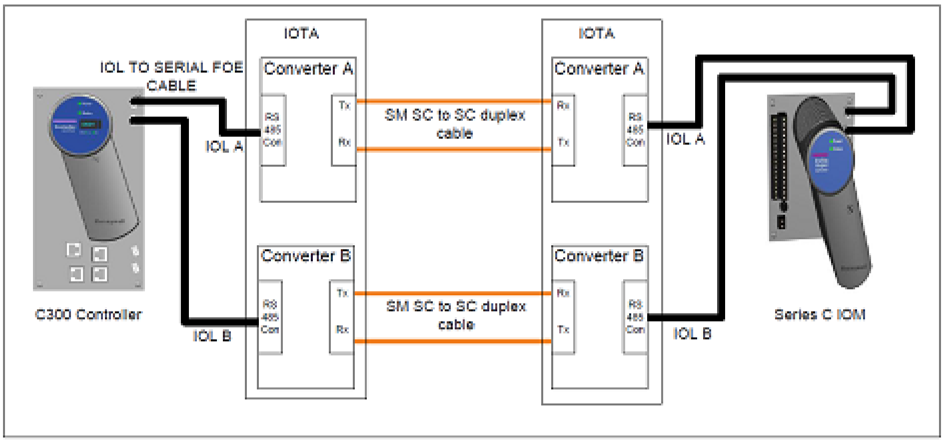
- Single mode FOE configuration
- Pull High/Low resistor setting
- DIP switch settings

13.5.1 Key features of single mode FOE

- Single mode fiber that can extend the IOLINK up to 10 km.
- Three-way communication: RS-232, fiber and RS-422/485.
- Rotary switch to change the pull high/low resistor value
- Extend RS-232/422/485 transmissions up to 440 km with single-mode. However, FOE module on IOTA supports up to 10 km only.
- Reverse power protection.
- Support baud rate up to 921.6 Kbps.
- Class I, Div. II certification.

The single mode fiber optic converter extends RS232/422/485 transmission up to 10km long with single mode fiber.

The following figure displays a sample IO link arrangement.



13.5.2 Key features of single mode converter

- Fiber optic support for Honeywell IO Link optional speed selection for 750/375 kbits/s.
- Provides fiber to copper conversion and re-transmitted fiber signals.
- The optical power emitted is less than 0.5mW.
- CE marked.

Features	Description
Supported family	Series C, Process Manager
Topology types	• Point-to-point

Features	Description
	• A single cable connecting two devices
Optical budget	15dB typical
Distance	Between FOEs with standard cables 10 km
Module mounting options	• IOTA • DIN rail (with user supplied power)
Fiber optic ports	2
Power options	Series C - IOTA External power system (DIN rail mounting option)
Power supply options	18 to 30VDC with a maximum of 127mA per terminal block
Ambient temperature	Operating: -40 to +85 degrees C Storage : -40 to +85 degrees C
Relative humidity	5% to 95% RH (non-condensing)
Fiber type	Single Mode • Fiber core diameter - 9um • Fiber cladding diameter - 125um • Connector type - SC

13.5.3 Single mode FOE installation

This equipment may be mounted in a hazardous area, in which case it must be installed, operated and maintained by competent personnel. Such personnel shall have undergone training, which included instruction on the various types of protection and installation practices, the relevant rules and regulations and on the general principles of area classification.

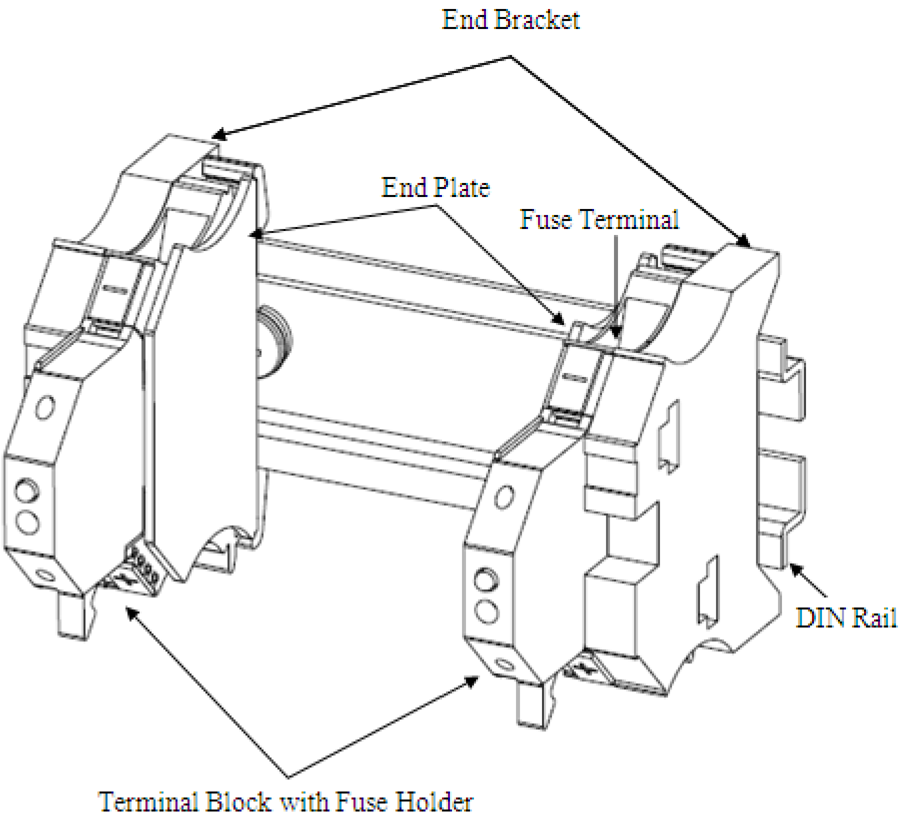
The SM FOE may be mounted in a safe area, a Zone 2 or a Class I, Division 2, Groups A-D T4 hazardous area.

13.5.4 Mounting the single mode FOE on the DIN rail

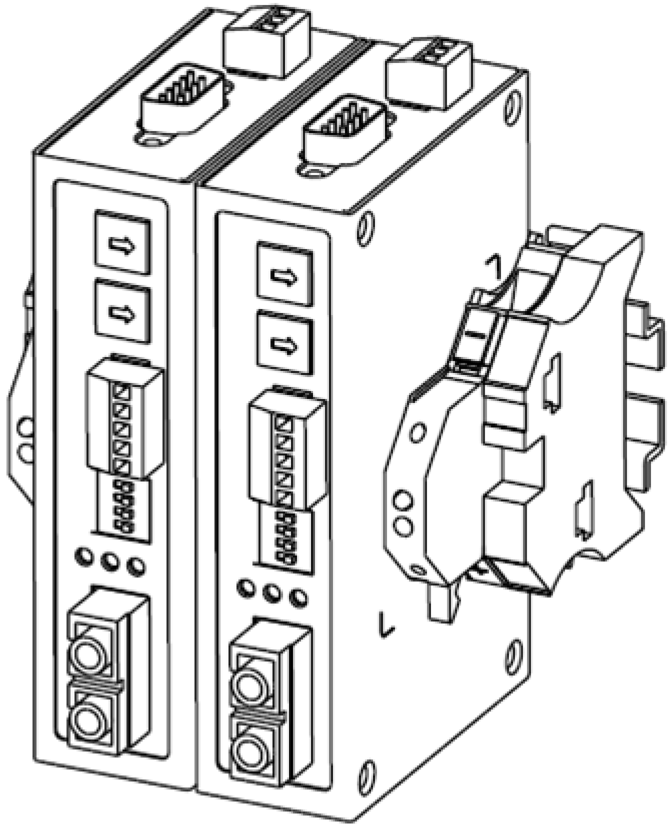
It is assumed for the purposes of these installation instructions that the mounting channel is already fitted in a cabinet or enclosure that already provides a suitable environment for the IOTAs and their associated equipment. Such an environment will be suitable for the SM FOE and its IOTA. The following mounting instructions may be used for purposes of mounting FOE / IOTA.

To mount the module on the DIN rail

1. Position the FOE module with DIN rail guide on the upper edge of DIN rail as displayed in the following figure.



2. Push it in with downward motion to fix.
3. Position the DIN rail guide on the terminal block with fuse holder next to the FOE module as displayed in the following figure and push it in to attach to the DIN rail.



4. Place the end bracket next to the terminal block on the DIN rail in the same way as the FOE module and fasten the screw in the center.

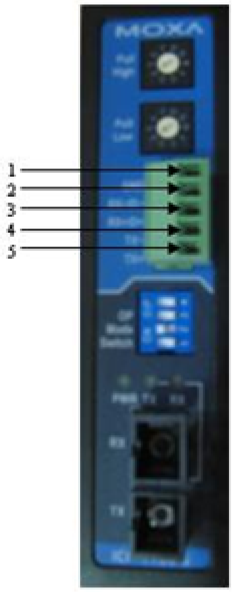
13.5.5 Single mode FOE IOLINK interface cable details

The following table provides information on the Honeywell interface cable to be used with FOE module.

I/O type	Operating speed	Honeywell cable part number
SC Series (IOTA option)	750 kbits/s	51202789-900, 51202789-901
SC Series (DIN rail option)		51202789-910, 51202789-911

13.5.6 Single mode FOE IOLINK connection

The following figure displays the 5-pin screw terminal connector located on the front view of the FOE module.

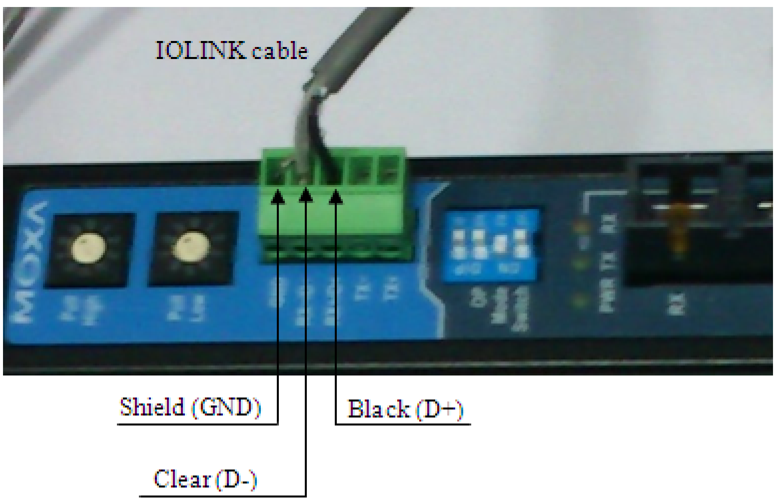


To make the connection, connect the free ends of the IO Link cable 51202789-9xx into the 5-pin screw terminal connector on the front face of the FOE module.

Refer to the following table to connect the IO link cable into the 5-pin screw terminal connector.

Pin	FOE Terminal	Description	Cable cover color
1	GND	Ground	No cover
2	D-	DATA -	Clear
3	D+	DATA +	Black
4	Not to be connected	NA	NA
5	Not to be connected	NA	NA

The following figure displays the IO link cable on the FOE interface.



13.5.7 FOE fiber connections

There is one pair of SC type fiber terminals on each FOE.

- RX (Receive) and TX (Transmit)

When not used, these SC terminals should be protected by plastic caps.

To make the fiber optic link, connect the TX of one FOE to the RX of the other FOE and vice versa. This can be done by aligning the notch on the fiber optic connector in the cable with the SC connector on the FOE module and pushing it in gently to lock.

The function of TX, RX pair is identical on both the FOE modules and either module can be used interchangeably. Ensure to insert the correct cable into the TX or RX connector.

13.5.8 Power connection details for the single mode FOE on IOTA

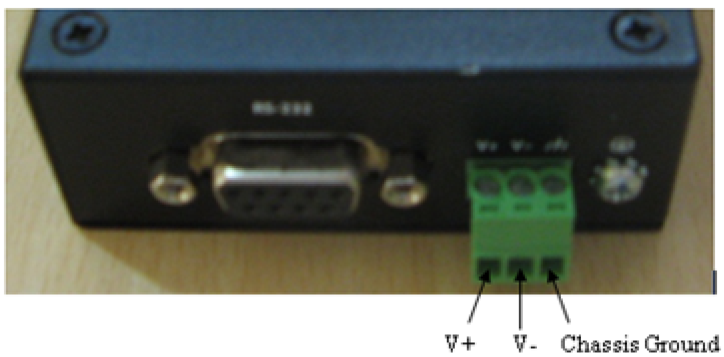
The FOE receives its input power from the IOTA through the terminal block. Two separate terminal blocks are provided on the IOTA for powering the two FOE modules.

FOE mounting option	Honeywell part number (power cable)
IOTA	51202930-100

The following table provides information on connecting the FOE Power terminal block and the IOTA screw terminal connector TB1/TB2.

Wire color	TB1 pin	TB2 pin	FOE pin	Description
Red	1	2	V+	+24V
Black	2	3	V-	COM
Yellow	3	1	⏚	Chassis / Safety Ground

The following figure displays the top view of the FOE module. It contains the DB-9 connector for RS232 communication, a 3-pin terminal block for input power and a screw for safety ground connection.



ATTENTION

The safety ground on the FOE module must be wired to the chassis ground of the system cabinet.

13.5.9 Connecting the power cables to the single mode FOE on DIN rail

The FOE modules mounted on the DIN rail can derive power from one of the following power supply options.

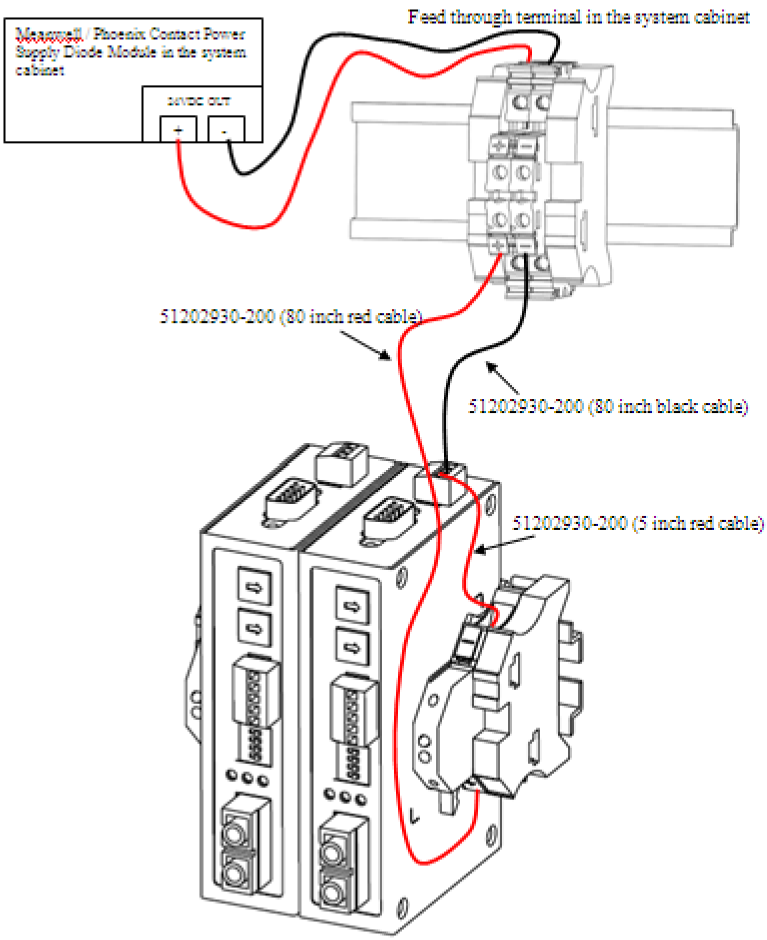
- Meanwell/Phoenix Contact
- TDI

The following table provides information on the power supply options and the appropriate Honeywell part number.

Power supply option	Honeywell part number (power cable)
Meanwell/Phoenix Contact	51202930-200
TDI	51202948-100 (Two FOE modules)
TDI	51202948-200 (One FOE module)

13.5.10 Using Meanwell/Phoenix Contact power supply

The following figure illustrates the power connections to the FOE module from Meanwell/Phoenix Contact.

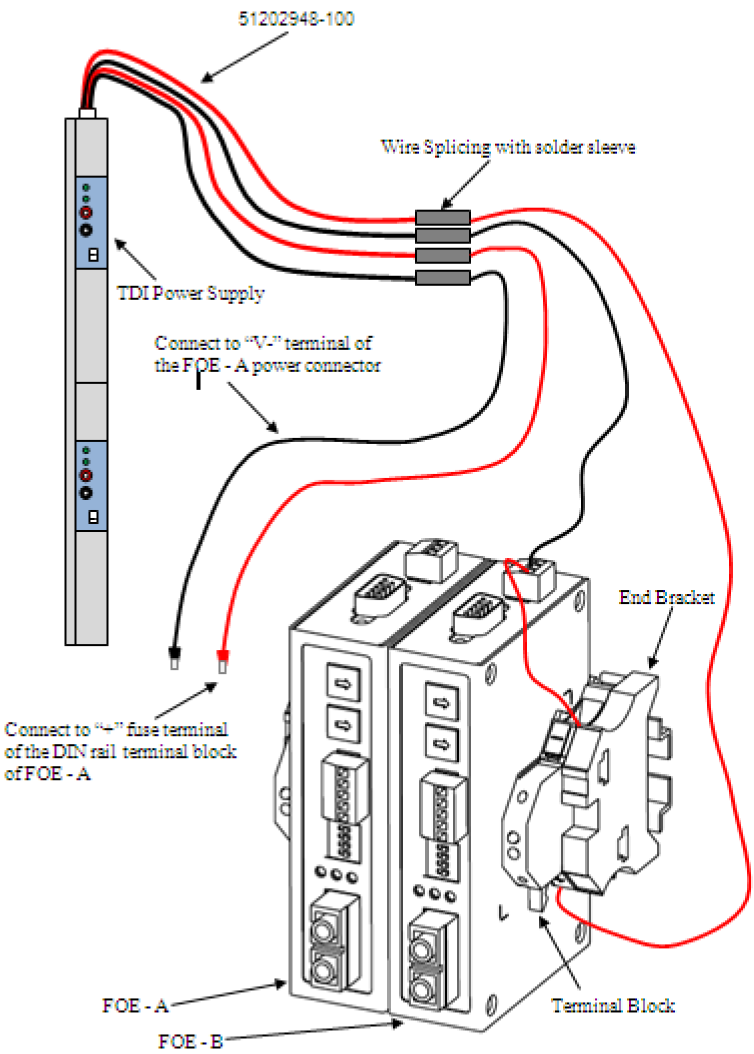


Refer to the following instructions for making power connections from Meanwell/Phoenix Contact to the FOE module on DIN rail.

1. Connect the power cable 51202930-200 (two red and one black cable) to the terminal block on DIN rail. Perform the following steps to do so:
   - Open the fuse holder using the lever provided.
   - Insert the ferrule of the cable into the fuse terminal on the side.
   - Fasten the screw inside the terminal block, below the fuse holder.
2. Connect one end of the 5-inch red cable into the fuse terminal marked '-' on the terminal block and the other end to the 'V+' terminal of the power connector on the FOE module. You can do so by inserting the ferrule inside the terminal and fastening the corresponding screw inside the terminal block.
3. Connect the 80-inch red cable from the '+' terminal of the feed through terminal block in the system cabinet to the fuse terminal marked '+' on the terminal block on DIN rail.
4. Connect the 80-inch black cable from the '-' terminal of the feed through terminal block in the system cabinet to the 'V-' terminal of the power connector on the FOE module.

13.5.11 Using TDI power supply

The following figure illustrates the power connections from TDI power supply to the FOE module.



Refer to the following instructions for making power connections to the FOE module on DIN rail from TDI power supply option.

1. Mate the power connector of the 51202948-100/51202948-200 to the free output port on top of the TDI power supply as displayed in the figure.
2. Connect the power cable 51202948-100/51202948-100 to the terminal block on DIN rail. Perform the following to do so:

Open the fuse holder using the lever provided.

Insert the ferrule of one of the two red cables into the fuse terminal marked '+'.

Fasten the corresponding screw inside the terminal block, below the fuse holder.

1. Connect one of the two black cables to the 'V-' terminal of the power connector on the FOE module.
2. Connect one of the free ends of the 5-inch red cable into the '-' fuse terminal of the terminal block on DIN rail and the other end to the 'V+' terminal of the power connector on the FOE module.
3. Repeat steps 2 through 4 to make power connections to the other FOE module.

13.5.12 Replacing the FOE fuse on the terminal block when FOE is mounted on DIN rail

To replace the FOE fuse on the terminal block when the FOE is mounted on the DIN rail

1. Using the lever provided on the terminal block, open the fuse holder.
2. Remove the fuse from the fuse holder.
3. Replace the fuse by positioning it in the fuse holder, press and fit.
4. Close the fuse holder and press the lever to lock.

13.5.13 Removing the FOE module from the DIN rail

To remove the FOE module from the DIN rail

1. Power down the FOE module by opening the fuse holder of the terminal block using the lever and removing the fuse
2. Remove all the cables before detaching the FOE modules. Perform the following steps to do so.
   a. Unscrew and remove the cable (HPN 51202930-200) running from the feed through terminal of the system cabinet to the '+' fuse terminal of the terminal block (Meanwell/Phoenix Contact power supply only).
   b. Remove the power connector of the cable (HPN 51202948-100/51202948-200) from the power supply by releasing the lock in the side and pulling it out gently (TDI power supply only).
   c. Unfasten the screw of the '-' fuse terminal of the terminal block on DIN rail and remove the cable.
   d. Unfasten the screw of the 'V+' terminal of power connector on the FOE module and remove the cable.
   e. Unfasten the screw of the '-' terminal of the feed through terminal block and remove the cable.
   f. Unfasten the screw of the 'V-' terminal of power connector on the FOE module and remove the cable.
   g. Remove the fiber optic cables from the FOE module by pulling it out gently.
   h. Unscrew and remove the I/O Link cable (HPN 51202789-910 / 51202789-911) from the FOE module or remove the I/O Link connector by pulling it out.
3. Unfasten the screw in the center of the end bracket and remove it by slightly lifting and pulling it out.
4. Push the FOE module slightly downwards and slide it out at the lower edge of DIN rail.

> **WARNING**
> Powering off both FOE modules accidently may halt the IOL communication completely and can lead to dangerous situation in plant. You must ensure to turn off the power of suspected FOE and should remove it without disturbing the functional FOE. Ensure to notify plant operators while performing this operation.

13.5.14 Single mode FOE configuration

Rotary switches are provided on the FOE module to set the Pull High/Low resistor settings. The DIP switches are provided for setting the FOE operating mode.

13.5.15 Pull High/Low resistor setting

The Pull High/Low resistors are provided on the FOE module for impedance matching which may vary with multi-drop or daisy-chain connection. The default settings are 1K for both the switches. To set a different value, turn the dial with the arrow head pointing at the required position. The following figure displays the Pull High/Low Resistors.

Figure 13.3 Pull High/Low Resistors

The following table lists the correct resistor setting against each position for the two use-case scenarios (150K and 10K). If the adapter is located such that its copper port is connected to the Controller (HPPM or C300) then position 0 (150K ohms) should be selected. If the adapter is located such that its copper port is connected only to IOPs/IOMs then position 1 (10K ohms) should be selected. Settings for "pull high" and "pull low" are always the matched (both the same).

Table 13.3 PULL High Resistor setting

PULL High Resistor										
Position	0	1	2	3	4	5	6	7	8	9
Ohm	150K	10K	4.7K	3.3K	1K	909	822	770	500	485
150K	Use this position for adapters connected in a system that contain a C300 Controller/HPPM.									
10K	Use this position for adapters connected in a system that contain I/O module only.									

Table 13.4 PULL Low Resistor setting

PULL Low Resistor										
Position	0	1	2	3	4	5	6	7	8	9
Ohm	150K	10K	4.7K	3.3K	1K	909	822	770	500	485
150K	Use this position for adapters connected in a system that contain a C300 Controller/HPPM.									
10K	Use this position for adapters connected in a system that contain I/O module only.									

13.5.16 DIP switch settings

Four DIP switches are located in the front face of the FOE. The following table provides information on the DIP switch settings. The DIP switch settings on the converter are displayed in the DIP switch column in the table. You must set the switches in the direction as indicated by the arrows.

Description	Setting	SW 1	SW 2	SW 3	SW 4	Required?	DIP switch
Communication protocol	RS-422	ON	OFF	-	-	Not Supported	
	2-wire RS-485	OFF	ON	-	-	Yes	
	4-wire RS-485	OFF	OFF	-	-	Not Supported	

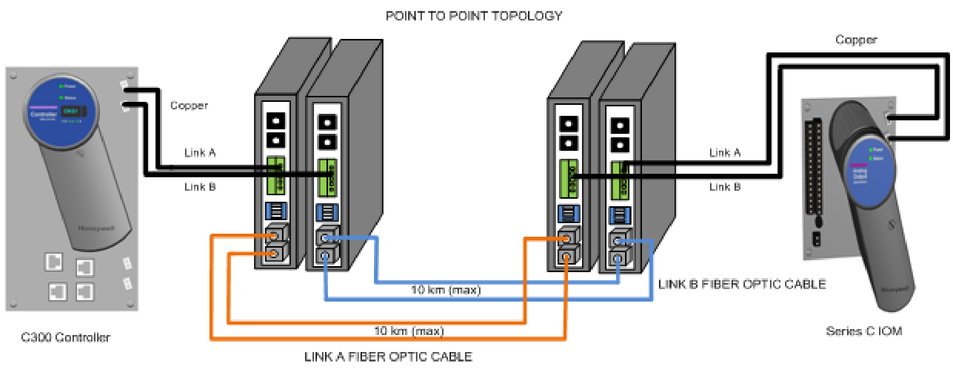
Description	Setting	SW 1	SW 2	SW 3	SW 4	Required?	DIP switch
Fiber mode	Ring	-	-	ON	-	Not Supported	
	Point to Point			OFF		Yes	
120-ohm terminator	Enable	-	-	-	ON	Not Supported	
	Disable	-	-	-	OFF	Yes	

13.6 Defining the single mode fiber optic topology

The single mode fiber optic extender supports point-to-point topology.

> **ATTENTION**
>
> The following figure is an example how the FOE can be deployed in point-to-point topology for series environment. This graphic is not to depict any restrictions with regards to FOE capacity or cable length.
>
> Daisy Chain topology is not supported.

Figure 13.4 Single mode fiber optic topology



- FOE capacity
- Required hardware
- Fiber Optic Extender interface cable
- Fiber optic cable - length factors
- Standard I/O link extender maximum cable span calculation
- Available standard I/O link extender optical power
- Losses in splices
- Link A and B cable length differences
- Allowable standard I/O Link extender cable signal loss

13.6.1 FOE capacity

The following list can be used as a general guideline of supported environments and FOE capacities.

Environment	Hardware	Capacity
Series C I/O or HPM I/O	Cable length	10 km max

13.6.2 Required hardware

Depending on the requirement, the following Series C hardware is required to achieve remote I/O accessibility:

Component

- Fiber Optic Extender IOTA
- Fiber Optic Extender module
- Fiber optic cables

FOE interface cables - 0.5M length for Series C

- Gray (pair) for IOL1
- Violet (pair) for IOL2

Refer to the Key features of single mode FOE section for more information on the compatible fiber optic cables.

13.6.3 Fiber Optic Extender interface cable

Specific cable types must be used for the fiber optic interface.

> ATTENTION
>
> The proper interface cable must be used for the Series C topology. Use of the incorrect cable results in faulty and/or corrupted IOL communications.

The fiber link is a passive subsystem and is essentially transparent to the system operation. It does not increase or decrease traffic or impact other capabilities of the I/O system. In addition, the following designations occur for these cables:

Cable	Cable color	A-link tab color	B-link tab color
IOL1	Gray	Yellow	Green
IOL2	Violet	Yellow	Green

13.6.4 Fiber optic cable - length factors

The maximum run of the fiber optic cables is limited by the optical power budget of 15dB. Standard cables support 10 km.

13.6.5 Standard I/O link extender maximum cable span calculation

The following calculation MUST be used to ensure that the number of planned splices and the cable choice supports the necessary cable span distance.

The maximum cable span calculation (in km) is as follows:	
Max Span =	(Available Optical Power - Losses in Splices)/(Max Loss per Cable Type)

13.6.6 Available standard I/O link extender optical power

The available optical power calculation is as follows:

Transmit Power - Minimum Receiver Sensitivity - Power Loss Over Time =

Available Optical Power		
	where for a Standard I/O Link Extender:	
	Transmit Power = - 35.0 dB Minimum Receiver Sensitivity = - 55.0 dB Power Loss Over Time = 5 dB	
	Example calculation for a Standard I/O Link Extender using 9 micron cable: (- 35.0 dB) - (- 55.0 dB) - (5 dB) = 15 dB Available Optical Power	

13.6.7 Losses in splices

The following table is used for the following **Losses in Splices** calculation.

Losses in Splices = Number of Splices x Maximum Loss per Splice

Standard Extender I/O cable type	Average Loss per type (dB)	Maximum loss per type (dB)
Fusion	0.2	0.3
Mechanical	0.3	0.5
ST-connector	0.3	0.9

Examples: Max. span calculation for cables with fusion or mechanical splices:

Variable values: Available optical power = 15 dB, two splices.

Two fusion splices	(15 dB) - (2 splices x 0.3 dB max loss per splice) / (0.4 dB/km) >> 10 km
Two mechanical splices:	(15 dB) - (2 splices x 0.5 dB max loss per splice) / (0.4 dB/km) >> 10 km

13.6.8 Link A and B cable length differences

The maximum difference in fiber optic cable length between Link A and Link B must be less than 500 meters (1640 feet) to limit the communications delay difference between Link A and Link B.

13.6.9 Allowable standard I/O Link extender cable signal loss

The Standard I/O Link Extender cable:

- Must have a total signal loss equal to or less than 15 dB at a wavelength of 1310 nanometers.
- Fiber loss is measured at 22 degrees C ±3 degrees and is usually stated as a mean value.
- Individual fiber losses may be as much as 25% greater than the mean.

CHAPTER

14

MIGRATING FROM PMIO TO SERIES C I/O

14.1 Determining Series C I/O vs. PMIO functionality

The Series C I/O is designed to allow integration with legacy of PM I/O family or replacement of the legacy PM I/O family. As such, many PM I/O concepts are directly carried forward into Series C I/O. Some notable concepts that are NOT directly carried forward are included in the table below.

Table 14.1 Comparing Series C and PM I/O functionality

Topic	PM I/O supported	Series C I/O supported
Experion	Yes	Yes
PlantScape	Yes	No
TPS	Yes	No
Nomenclature	IOP I/O Processor	IOM I/O Module
Physical address - how to derive	Uses file and card concept	Address derived from IO Link address jumper tile on IOTA
DISOE	'Off Normal' alarms and events supported	'Off Normal' alarms and events *NOT* supported
Enumeration sorting	By ordinal value	Alphabetically, unless otherwise stated.
FAILOPT or FAULT [*]	FAILOPT is a IOP-wide configuration, making it same to all channels in an IOP	Series C FAILOPT is replaced with the following: • FAULTOPT, and • FAULTVALUE this can be set individually for every output channel.
Firmware - remotely downloaded in Experion	No - contact TAC for support	Yes - using CTools application
HART I/O	PMIO supported four separate AI, AO, HAI and HAO channel blocks. AI and AO channel blocks could not be configured for HART operation	Series C I/O, AI and AO channel blocks can be configured for HART operation. No separate HAI and HAO channel blocks will be supported.
HART 5.0 compliant	Yes	Yes
HART 6.0 and later	Yes	Yes

Honeywell

Topic	PM I/O supported	Series C I/O supported
compliant		
IO redundancy	All IOP types supported except: • DI • DO16 • LLAI • LLMUX • RHMUX	All IOM types supported except: AI -LLMUX
IOLINK connection	Yes (see Note 1) Through C200 controller and IOLIM or C300 controller	Yes (see Note 2) C300 controller only
	PM I/O and Series C I/O cannot exist on the same IOLINK	PM I/O and Series C I/O cannot exist on the same IOLINK
IOTA slots	Any combination allowed	Upper - always IOMA Lower - always IOMB Non-redundant configurations only IOMA can be used.
LLMUX maximum channels	32	64
PNTFORM (FULL and COMPONENT points) is supported	Yes	No The most powerful FULL point features have been incorporated into Series C I/O channel blocks.
Open Wire Detection for Inputs Detect/sense open sensor (open wire)	No	Yes. The HART Analog Output IOM detects open wire by virtue of its analog read back check. DI 24V and DISOE IOM in Normal mode support Open Wire Detection.

* Specifications for the availability of HART data, including availability through an IOM switchover are tightened for Series C I/O.

Notes:

1. Physical address is a function of the 'file number' and 'card number'. The file number is determined by a user jumper configuration. Logical address is assigned by user. Both addresses must be configured in the module block and they are independent of one another. The physical address block configuration must match the physical attributes.
2. Logical address is determined by a user jumper configuration. The physical address is a function of the logical address and is not visible to the user. Only the logical address must be configured in the module block. The logical address block configuration must match the jumper configuration.

14.2 Migrating channels blocks from PMIO to Series C I/O

The high-level user-related configuration and operational differences between PM I/O channels and Series C I/O channels are best seen by examining differences between the parameters for each I/O family.

With the exception of HART based channels, PM I/O uses a single channel block with a multitude of options and tabs to represent channels defined on multiple IOPs. For example:

- PM I/O uses the same AICHANNEL block for channels contained within HLAI, LLAI, LLMUX, RHMUX and STIMV IOPs.
- Series C I/O has the ability to morph an AICHANNEL block for use with many IOMs types. Tabs of the parameter form that are not used for some IOM types are hidden.

Series C I/O HART enabled channels now can be morphed to/from a standard AI or AO channel block. The following also applies:

- On an IOP switchover,

  HART digital data could take as long as 48 seconds to be refreshed.
- For Series C IOM,

  HART digital data is refreshed within twice the module's SCANRATE time.

Table 14.2 Comparing Series C and PM I/O parameters

PM I/O IOC parameter	Series C I/O IOC parameter	Change from PM I/O channel/comment
SENSRTP	SENSRTP	A list of valid values for the particular AI channel type is always provided. You are NEVER displayed or allowed to select an invalid value for any particular AI channel type. Refer to the Control Builder Parameter Reference guide for parameter specific information.
PVCHAR	PVCHAR	
PNTTYPE	(removed)	Parameter is deleted. Some TPS 'FULL' point parameters are now part of Series C I/O channel blocks.
SLWSRCRCID	(removed)	Parameter was deleted. SLIDEWIRE sensor type is not supported Series C I/O. SLIDEWIRE sensor type was not implemented in PM I/O. However, the parameter was defined.
PVRAWHI	PVRAWHI	These parameters are valid only for AICHANNELS that exist on AI-LLMUX IOMs.
PVRAWLO	PVRAWLO	
HPVCHAR	PVCHAR	The PM I/O functionality provided by setting HPVCHAR to 'Device Range' is provided by the setting PVCHAR to 'Device Range.'
ACCEPTRNG	ACCEPTRNG	The text on this push button changed from 'Accept Device Ranges' to 'Sync. Device and PV Ranges'.
HPVMISM	HPVMISM	While HPVMISM generated an alarm in PM I/O, it is a simple Boolean flag Series C I/O.
FAILOPT	FAULTOPT FAULTVALUE FAULTST	In PM I/O, FAILOPT is a read/write parameter for IOP blocks. In addition, the FAILOPT value applies to all channels on that IOP and FAILOPT is a read only parameter for channel blocks. In Series C I/O, each channel has its own fault option and a set of 'fault' related parameters. Additionally, there are a significant number of enhancements related to handling AO and DO channel faults. When migrating from PMIO you are encouraged to obtain a thorough understanding of the AO and DO channels before migrating to Series C I/O.
(not implemented)	HDYNCC HDYNST HMAXDEVVARS	PM I/O does not support HART version 6.0. Series C I/O supports these parameters for HART version 6.0.

PM I/O IOC parameter	Series C I/O IOC parameter	Change from PM I/O channel/comment
	HNCFGCHG HNSMMINPRE HSLOTCC HSLOTST	
PIUOTDCF	OWDENBL	Made OWDENBL the consistent name for enabling Open Wire Detection Enable. In addition, OWDENBL is valid for DI channels on DI-24 IOMs and AI channels.
PVSOURCE	PVSOURCE	In PM I/O, these parameters were only on DI channels whose PNTFORM was set to FULL. Series C I/O, these parameters are now used on all DI channels regardless of PNTFORM and on all AI channels.
PVSRCOPT	PVSRCOPT	
(not used)	MODE MODEPERM NMODE NMODATTR MODEATTR REDTAG	In PM I/O, these parameters were not used. Series C I/O, they are valid for AO and DO channel blocks.

CHAPTER

15

SERIES C I/O TROUBLESHOOTING

This section offers checks that you can make to help isolate a problem. The checks are arranged in no particular order.

- Self-test diagnostics at power-up
- IOLINK - loss of communication problems
- IOLINK - re-establishing communications
- FOE Troubleshooting

15.1 Self-test diagnostics at power-up

TIP

Unlike C300, the Series C I/O modules do not have an alphanumeric display for displaying test codes.

Series C I/O modules run the following self-tests (transparent to the user) every time the module boots up following a power-on, reset, or reboot.

- After the hardware and memory initializations AI, AO, and LLMUX IOMs reload the FPGA (field-programmable gate array) image from the flash memory to the FPGA.
- All IOMs check the validity of the application image by computing the CRC (Cyclic Redundancy Check) of the flash memory where application image is stored. If the CRC comparison is valid, the module transfers to the application mode. Otherwise, the module stays in the boot mode waiting for a firmware download operation.
- In the application mode hardware and memory is re-initialized for application operation and module ID set by the address jumpers is checked.

  Modules then execute a series of self-diagnostics as listed below (any failure-detected results in hard fail of the IOM.)
  - **CPU**: Checks the CPU registers by writing and reading back specific patterns and execution of a set of logical operations.
  - **RAM contents**: Test patterns are written and read back to all RAM locations. This test ensures that each RAM bit can store and retrieve 0 and 1 without any error.
  - **Address lines**: CPU address lines are tested by walking 1's and 0's. This test ensures that each address lines can be changed independent of others.
  - **Flash contents**: CRC of the application image is checked again.
  - **Stack**: A test pattern is written to the top of the stack, which is confirmed read back. This pattern is used for the background stack diagnostics during normal operation of the module.

During the normal operation, the above self-diagnostics run as low-priority background activity.

- Application specific database objects are created and task scheduler is initialized. Watchdog circuitry and IOL are enabled and normal operation of the module begins.
- There are application specific diagnostic routines that run during the normal operation, which normally runs at a higher rate and priority. Examples of application specific diagnostics are:
    - Checking the integrity of calibration data
    - Redundancy diagnostics in redundantly configured modules
    - Reference voltage tests in analog modules
    - Open wire detection
    - Short circuit detection in DO modules

15.2 IOLINK - loss of communication problems

IOMs can experience a loss of communication with the IOLINK function block for several reasons. The two most common reasons are:

- the C300/CN100 losing power, or
- a fault in the IOLINK cable

Whenever an IOM can no longer communicate with a C300/CN100, the channels contained within the IOM use the following:

- FAULT parameters
    - FAULTOPT, and
    - FAULTVALUE
- and a separate IOM internal fail-safe timeout to ensure that the channel is in the appropriate fail-safe setting.

15.3 IOLINK - re-establishing communications

Once communication between a C300/CN100 and an IOM is re-established, the C300/CN100 determines if the databases between the C300/CN100 and IOM are identical. If they are different and the IOM's DBVALID flag is true, (indicating that the IOM configuration has been maintained through the period of loss of communication), then the C300/CN100 uploads the configuration from the IOM.

If the IOM's DBVALID is false (indicating the IOM configuration is not maintained through the period of communication) and if C300/CN100 has a copy of last valid IOM configuration, then the C300/CN100 downloads the configuration to the IOM. This warm restore mechanism replaces the warm start mechanism in PM IOPs.

15.4 FOE Troubleshooting

This section identifies some common problems with the Fiber Optic Extender and describes how you might fix them.

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

The Fiber Optic Extender does not exhibit a large number of errors that are directly attributed to the FOE. Knowledge of your system's setup is critical in determining the potential source of disruption to communication and process. Failures beyond the point of the FOE may indicate a functionality issue with the FOE.

- Loss of power
- Loss of communication

15.4.1 Loss of power

The isolator has lost power supply communications to I/O has failed.

Diagnostic check

Power to the isolators has failed. Communications to I/O has been discontinued.

- System Alarm Summary alarms displayed
- Green LED on isolator is off.

Cause

Power fuse is blown on the GI/IS IOTA.

Solution

If there is no obvious reason for the failure of the fuse on the GI/IS IOTA, then the isolator must be suspected of having a fault and must be replaced and its functionality checked in a non-hazardous area. If the isolator is known not to be the reason for the failure of the fuse, then it is permitted to replace the fuse without isolating the power to the IOTA.

Cause

C300 controller has lost power.

Solution

Refer to C300 'Loss of power' instructions.

Cause

Main power source has been disconnected or shut down either manually or temporarily by *brownout* or *blackout* condition.

Solution

Re-connect the main power source or turn it On or wait for temporary *brownout* or *blackout* condition to pass.

Cause

The 24 Vdc power supply failed or power cable has been disconnected or failed.

Solution

Replace the 24 Vdc power supply or re-connect/replace the power cable.

15.4.2 Loss of communication

The remote I/O communication is lost or behaving erratically. The Fiber Optic Extender module yellow LEDs are not on/blinking.

Diagnostic check

Remote I/O communications is lost.

- System Alarm Summary alarms displayed
- Green LED on FOE module is on.
- Yellow LED on FOE module is off
- Erratic behavior of I/O connections/communications beyond a specific FOE.

Cause

Possible loose cable connection:

Solution

Check the following cable connections:

- IOLINK CABLE
    - From C300 to FOE module IOLINK connector
- Fiber optic cable
    - From FOE module to FOE module
    - From FOE module to PM I/O Link Extender card

Cause

Power is lost to the FOE module, C300 controller or entire control cabinet.

Solution

Refer to 'Loss of power' troubleshooting information.

Cause

FOE module is malfunctioning.

Solution

Replace FOE module.

CHAPTER

16

SERIES C I/O MAINTENANCE

16.1 Series C recommended spares

The following table provides replacement parts, or parts that you may want to keep on hand for backup.

16.1.1 IOM removal and installation under power

The IOM has been designed to permit removal and installation under power (RIUP) without damaging the module or interrupting IOTA communications. Notice should be taken on how this may impact the active process.

> CAUTION
>
> We recommend that you proceed with extreme caution whenever replacing any component in a control system. Be sure the system is offline or in a safe operating mode.
>
> Component replacements may also require corresponding changes in the control strategy configuration through Control Builder, as well as downloading appropriate data to the replaced component.

Refer to Replacing an I/O module for IOM replacement and cautionary information.

Table 16.1 Recommended spare parts

Part name	Part number	Description
ANALOG INPUT		
Series C AI IOM	CC- PAIH01	Series C Analog Input Module
	CC-PAIH02	Series C HART Differential Analog Input Module
	CC-PAIX02	Series C non-HART Differential Analog Input Module
	CC-PAIN01	Series C non-HART Analog Input Module
	CC-PAIH51	Series C Analog Input Module

<table>
<tr><th>Part name</th><th>Part number</th><th colspan="3">Description</th></tr>
<tr><td colspan="5">IOTA</td></tr>
<tr><td rowspan="2">Non-Redundant. IOTA</td><td>CC- TAIX01
51308363-175</td><td colspan="3">Analog Input, non-redundant, coated</td></tr>
<tr><td>Cx-TAIX51
51306979-175</td><td colspan="3">Analog Input, non-redundant, coated</td></tr>
<tr><td>Redundant. IOTA</td><td>CC- TAIX11
51308365-175</td><td colspan="3">Analog Input, redundant, coated</td></tr>
<tr><td colspan="5">Terminal plug-in assembly</td></tr>
<tr><td>16-terminal block plug-in assembly</td><td>51506273-216</td><td colspan="3">2 per IOTA</td></tr>
<tr><td>4-terminal block plug-in assembly</td><td>51506269-204</td><td colspan="3">1 per IOTA</td></tr>
<tr><td colspan="5">Fuses</td></tr>
<tr><td>Description</td><td>Part number</td><td>Quantity</td><td>Reference designator</td><td>Function</td></tr>
<tr><td rowspan="2">Fuse 750 mA, 5x20, fast acting</td><td rowspan="2">51190582-175</td><td>1 per non-red. IOTA</td><td>F1</td><td>The fuse covers the IOM and the power feeds to the field wiring. A blown fuse interrupts power to these.</td></tr>
<tr><td>2 per red. IOTA</td><td>F1
F2</td><td>F1 covers upper IOM
F2 covers lower IOM
If one fuse is blown power is interrupted to the IOM, but field wiring continues to receive power from other fuse.</td></tr>
<tr><td colspan="5">ANALOG OUPUT</td></tr>
<tr><td rowspan="4">Series C AO IOM</td><td>CC- PAOH01</td><td colspan="3">Series C HART Analog Output Module</td></tr>
<tr><td>CC-PAOX01</td><td colspan="3">Series C non-HART Analog Output Module</td></tr>
<tr><td>CC-PAON01</td><td colspan="3">Series C non-HART Analog Output Module</td></tr>
<tr><td>CC-PAOH51</td><td colspan="3">Series C HART Analog Output Module</td></tr>
<tr><td colspan="5">IOTA</td></tr>
<tr><td rowspan="2">AO
Non-Redundant. IOTA</td><td>CC-TAOX01
51308351-175</td><td colspan="3">Analog Output, non-redundant, coated</td></tr>
<tr><td>Cx-TAOX51
51306983-175</td><td colspan="3">Analog Output, non-redundant, coated</td></tr>
<tr><td rowspan="2">AO Redundant. IOTA</td><td>CC- TAOX11
51308353-175</td><td colspan="3">Analog Output, redundant, coated</td></tr>
<tr><td>Cx-TAOX61
51306981-175</td><td colspan="3">Analog Output, redundant, coated</td></tr>
<tr><td colspan="5">Terminal plug-in assembly</td></tr>
<tr><td>16-pin terminal plug-in assembly</td><td>51506273-216</td><td colspan="3">2 per non-redundant IOTA
2 per redundant IOTA</td></tr>
<tr><td colspan="5">Fuses</td></tr>
<tr><td>Description</td><td>Part number</td><td>Quantity</td><td>Reference designator</td><td>Function</td></tr>
</table>

Part name	Part number	Description		
Fuse 2A Fast acting 5x20mm	51190582-220	1 per non-red. IOTA	F1	Module fuse
		2 per red. IOTA	F1, F2	
ANALOG INPUT LOW LEVEL				
Series C AI Low Level IOM	CC-PAIM01	Series C Low Level Module		
IOTA				
AI Low Level IOTA	CC--TAIM01 51305959-175	AI Low Level, non-redundant, coated		
Connector block assembly				
Connector Block Assembly, 6 Position	51195775-100	4 per IOTA		
Fuse				
Description	*Part number*	*Quantity*	*Reference designator*	*Function*
FUSE, 0.25 Amp, Quick Blo, 5x20mm	51190582-125	4 per IOTA	F3	Power to FTA 1 only
			F4	Power to FTA 2 only
			F5	Power to FTA 3 only
			F6	Power to FTA 4 only
FUSE, 1 Amp, Quick Blo, 5x20mm	51190582-210	2 per IOTA	F1	Power to module electronics
			F2	Switched power to all FTAs
LOW LEVEL ANALOG INPUT				
Series C Low Level AI IOM	CC-PAIL51	Series C Low Level Module		
IOTA				
Low Level AI IOTA		CC--TAIL51 51307192	Low Level AI, non-redundant, coated	
Connector block assembly				
Connector Block Assembly, 6 Position	51195775-100	4 per IOTA		
Fuse				
Description	*Part number*	*Quantity*	*Reference designator*	*Function*
FUSE, 0.25 Amp, Quick Blo, 5x20mm	51190582-125	4 per IOTA	F3	Power to FTA 1 only
			F4	Power to FTA 2 only
			F5	Power to FTA 3 only
			F6	Power to FTA 4 only
FUSE, 1 Amp, Quick Blo, 5x20mm	51190582-210	2 per IOTA	F1	Power to module electronics
			F2	Switched power to all FTAs
DIGITAL INPUT 24V				
Series C DI-24 IOM	CC- PDIL01	Series C 24V Digital Input Module		
	CC-PDIL51	Series C 24V Digital Input Module		
IOTA				

Part name	Part number	Description
DI-24V Non-Redundant. IOTA	CC- TDIL0 51308371-175	24V Digital Input, non-redundant, coated
	Cx-TDIL51 51306969-175	24V Digital Input, non-redundant, coated
DI-24V Redundant. IOTA	CC- TDIL11 51308373-175	24V Digital Input, redundant, coated
	Cx-TDIL61 51306967-175	24V Digital Input, redundant, coated
Terminal plug-in assembly		
16-terminal plug-in assembly	51506273-216	2 per non-redundant IOTA 2 per redundant IOTA
4-terminal plug-in assembly	51506269-204	1 per non-redundant IOTA 1 per redundant IOTA
Fuses		

Description	*Part number*	*Quantity*	*Reference designator*	*Function*
Fuse 0.5A Fast acting 5x20mm	51190582-150	3 per non-red. IOTA	F1	Fuse for field power if system power is connected through TB3, in series with F3
			F2	Top IOM kernel
			F3	Fuse for field power if external power is connected through TB3
		4 per red. IOTA	F1	Fuse for field power if system power is connected through TB3, in series with F4
			F2	Top IOM kernel
			F3	Bottom IOM kernel
			F4	Fuse for field power if external power is connected through TB3

Part name	Part number	Description
DIGITAL OUTPUT 24V		
Series C DO IOM	CC--PDOB01	Series C Digital Output Module
	CC-PDOD51	Series C Digital Output Module
IOTA		
24V DO Non-Redundant IOTA	CC--TDOB01 51308371-175	24V Digital Output, bussed, non-redundant
	Cx-TDOD51 51306975-175	24V Digital Output, bussed, non-redundant
24V DO Redundant IOTA	CC--TDOB11 51308373-175	24V Digital Output, bussed, redundant, coated
	Cx-TDOD61 51306973-175	24V Digital Output, bussed, redundant, coated
Terminal plug-in assemblies		
16-terminal plug-in assembly	51506273-216	2 per non-redundant IOTA 2 per redundant IOTA

Part name	Part number	Description
4-terminal plug-in assembly	51506269-204	1 per non-redundant IOTA 1 per redundant IOTA

Fuses

Description	*Part number*	*Quantity*	*Reference designator*	*Function*
Fuse 10A Fast acting 5x20mm	51190582-310	1 per non-red. IOTA	F1	Fuse for field power if system power is connected through TB3
		1 per red. IOTA	F1	
Fuse 5A Fast Acting 5x20mm	51190582-250	1 per non-red. IOTA	F2	Fuse for field power if system power is connected via TB3
		1 per red. IOTA	F1	Fuse for IOM kernel
Fuse 0.5A Fast acting 5x20mm	51190582-150	1 per non-red. IOTA	F2	
		2 per red. IOTA	F2, F3	Top IOM kernel Bottom IOM kernel

DIGITAL INPUT - HIGH VOLTAGE

Series C DI-24 IOM	CC- DIHV01	Series C Digital Input High Voltage I/O Module
IOTA		
120VAC DI Non-Redundant. IOTA	CC-TDI110 51308394-175	120VAC Digital Input, non-redundant, coated
120VAC DI Redundant. IOTA	CC-TDI120 51308396-175	120VAC Digital Input, redundant, coated
240VAC DI Non Redundant IOTA	CC-TDI220 51308394-275	240VAC Digital Input, non-redundant, coated
240VAC DI Redundant IOTA	CC-TDI230 51308396-275	240VAC Digital Input, non-redundant, coated
120VAC DI Non Redundant IOTA	CC-TDI151 51307536–176	120VAC Digital Input, non-redundant, coated
Terminal plug-in assembly		
16-terminal plug-in assembly	51506273-216	2 per non-redundant IOTA 2 per redundant IOTA

Fuse

Description	*Part number*	*Quantity*	*Reference designator*	*Function*
Fuse 0.5A Fast acting 5x20mm	51190582-150	1 per non-red. IOTA	F1	+24vdc power for IOM
		2 per red. IOTA	F1	+24vdc power for top IOM
			F2	+24vdc power for bottom IOM

DIGITAL OUTPUT HIGH VOLTAGE RELAY

Series C DO IOM	CC- PDOB01	Series C Digital Output Module
DO Relay Extender	51308380	Series C Digital Output Relay Extender
DO-HV Relay Non-Redundant. IOTA	CC- TDOR01 51308376-175	Digital Output High Voltage, relay, non-redundant, coated
DO-HV Relay Redundant. IOTA	CC- TDOR11	Digital Output High Voltage, relay, redundant, coated

Part name	Part number	Description
	51308378-175	
Miscellaneous		
Jumper Link	30731551-001	32 per DO Relay Extender
Slim Power Relay 24VDC (Tyco)	51506348-100	32 per DO Relay Extender
16-terminal plug-in assembly	51506273-216	4 per DO Relay Extender
Fuses		

Description	*Part number*	*Quantity*	*Reference designator*	*Function*
Fuse 1A Fast acting 5x20mm	51190582-210	1 per non-red. IOTA	F2	When this fuse blows, the 24V to DO IOM (Application Board) stops. It covers energizing current for 32 relay coils.
		1 per red. IOTA	F1	
Fuse 0.5A Fast acting 5x20mm	51190582-150	1 per non-red. IOTA	F1	Covers current to kernel board.
		2 per red. IOTA	F2	Top IOM kernel
			F3	Bottom IOM kernel

GENERAL		
Fuse holder	51506443-100	
UNIVERSAL IO		
Series C UIO IOM	CC-PUIO01	Series C Universal IO Module
IOTA		
Non-Redundant. IOTA	CC-TUIO01	Universal IO, non-redundant, coated
Redundant IOTA	CC-TUIO11	Universal IO, redundant, coated
Terminal plug-in assembly		
16-terminal block plug-in assembly	51506273-301 51506273-303 51506273-305 51506273-307	white on black connector - TB1 upper row white on black connector - TB2 upper row black on white connector - TB1 lower row black on white connector - TB2 lower row
4-terminal block plug-in assembly	51506269-104	1 per redundant IOTA for TB3
Fuses		

Description	*Part number*	*Quality*	*Reference designator*	*Function*
Fuse 10A, 5x20mm, time lag	51190582-310	1 per red. IOTA	F1	Fuse for field power
Fuse 1A, 5x20mm, time lag	51190582-210	2 per red. IOTA	F2 F3	Fuse for top IOM kernel Fuse for bottom IOM kernel

UNIVERSAL IO-2		
Series C UIO–2 IOM	CC-PUIO31	Series C Universal IO Module-2
IOTA		
Non-Redundant. IOTA	CC-TUIO31	Universal IO-2, non-redundant, coated
Redundant IOTA	CC-TUIO41	Universal IO-2, redundant, coated
Terminal plug-in assembly		
16-terminal block plug-	51506273-301	white on black connector - TB1 upper row

Part name	Part number	Description		
in assembly	51506273-303 51506273-305 51506273-307	white on black connector - TB2 upper row black on white connector - TB1 lower row black on white connector - TB2 lower row		
4-terminal block plug-in assembly	51506269-104	1 per redundant IOTA for TB3		
Fuses				
Description	*Part number*	*Quality*	*Reference designator*	*Function*
Fuse 10A, 5x20mm, time lag	51190582-310	1 per red. IOTA	F1	Fuse for field power
Fuse 1A, 5x20mm, time lag	51190582-210	2 per red. IOTA	F2 F3	Fuse for top IOM kernel Fuse for bottom IOM kernel
PULSE INPUT MODULE				
Series C PIM	CC-PPIX01	Series C Pulse Input Module		
IOTA				
IOTA	(CC-TPIX11)	Redundant IOTA		
Fuses				
Description	*Part number*	*Reference designator*		
Fuse 1A Fast acting 5x20mm (replaceable fuses)	51190582-210	F1, F2, F3		
Relays				
	Part number			
K1, K2 (solid state fast-cutoff replaceable relays)	51190516-134			
Plug-in connectors				
	Part number			
TB1	51506273-216			
TB2, TB3	51506269-104			

16.2 Replacing a Series C IOTA

ATTENTION

Replacing the Series C IOTA requires that the IOM be in an inactive off-process state.

Honeywell

WARNING

Replacing a GI/IS IOTA and all associated activities may only be performed when the area has been determined to be non-hazardous.

16.2.1 To replace a Series C IOTA

1. To remove the I/O module, refer to the following procedure To replace an I/O module
2. Label and disconnect all cables from the IOTA board connectors.
3. To remove the IOTA board do the following:

CAUTION

The IOTA power and ground screws can bind during installation or removal if the mounting screws are fully secured before the power/ground screws are installed.

Recommended sequence:

a. Remove the IOTA from the carrier by loosening the IOTA's mounting screws only half-way.
b. Remove the screw from the left side of the IOTA board that connects to the 24 Vdc bus bar.
c. Remove the screw from the right side of the IOTA board that connects to the GND bus bar.
d. Completely remove the IOTA's mounting screws
e. Place screws, washers and spacers in a secure place for potential reuse.

4. Mount the new I/O IOTA board on the carrier, and refer to the following procedure Mounting the IOTA.
5. Insert the I/O module onto IOTA board making sure that the I/O circuit board mates properly with the IOTA board connector.

   Refer to the following procedure, Mounting the module.
6. The I/O module boots-up into IDLE state.
7. In **Control Builder**, perform a '**Load with Contents**'.

16.3 Replacing an I/O module

CAUTION

We recommend that you proceed with extreme caution whenever replacing any component in a control system. Be sure the system is offline or in a safe operating mode.

Component replacements may also require corresponding changes in the control strategy configuration through Control Builder, as well as downloading appropriate data to the replaced component.

16.3.1 Prerequisites

You have logged onto Control Builder with sufficient security level to make control strategy changes.

- You can remove and install the Series C IOM under power.
- Be sure you take ESD hazard precautions when handling the module and IOTA.

16.3.2 To replace an I/O module

1. Loosen the screws:
   - at each side of the plastic cover that secures the I/O module to the IOTA board, and
   - the long gray plastic screw located on the module's face. It is not necessary to completely remove this screw.

   > CAUTION
   >
   > Only use a #2 Phillips screwdriver to carefully loosen or tighten the long gray plastic screw. **Do not use** either a #1 Phillips screwdriver or a battery-powered screwdriver to remove or install the plastic screw as this can damage the screw head.

2. Remove the I/O module from the IOTA board and connector.
3. Insert the new I/O module onto IOTA board making sure that the I/O circuit board mates properly with the IOTA board connector.
4. Secure the module to the:
   - IOTA board

     using the two metal screws at the plastic cover

     tightening the long gray plastic screw. See **CAUTION** in Step 1.
   - Carrier - with the long screw that is inserted into the hole on the face of the module's plastic cover.

   The new I/O module boots-up to the IDLE state.
5. Load firmware which is the same version as was running in the old controller.
6. In **Control Builder**, perform a '**Load with Contents**".

16.4 FOE recommended spares

The following table provides replacement parts, or parts that you may want to keep on hand for backup.

Table 16.2 Recommended spare parts

Part name	Part number	Description
Fiber Optic Extender module		
Fiber optic Extender module	8937-HN	Fiber Optic Extender module 2km CC-PFE221 - Honeywell model number
Fiber optic Extender	ICF-1150-S-	Fiber Optic Extender module 10 km

<table>
<tr><th>Part name</th><th>Part number</th><th colspan="3">Description</th></tr>
<tr><td>module</td><td>SC-T</td><td colspan="3"></td></tr>
<tr><td colspan="5">Fiber Optic Extender IOTA</td></tr>
<tr><td>Fiber Optic Extender IOTA</td><td>8939-HN</td><td colspan="3">6 inch FOE IOTA
CC-TFE021 - Honeywell model number</td></tr>
<tr><td colspan="5">Cables</td></tr>
<tr><td rowspan="2">SC IOL cable</td><td>CC-KFSGR5</td><td colspan="3">0.5M FOE to Series C I/O link interface cable - Gray</td></tr>
<tr><td>CC-KFSVR5</td><td colspan="3">0.5M FOE to Series C I/O link interface cable - Violet</td></tr>
<tr><td rowspan="2">PM IOL cable</td><td>CC-KFPGR5</td><td colspan="3">0.5M FOE to PM I/O link interface cable - Gray</td></tr>
<tr><td>CC-KFPVR5</td><td colspan="3">0.5M FOE to PM I/O link interface cable - Violet</td></tr>
<tr><td colspan="5">Fuses</td></tr>
<tr><td>Description</td><td>Part number</td><td>Quantity</td><td>Reference designator</td><td>Function</td></tr>
<tr><td>Fuse</td><td>Two replacement options.
• 216.250P Littelfuse
• S501-250-R Cooper Bussman</td><td>1</td><td>F1</td><td>Power to module electronics</td></tr>
</table>

16.5 FOE Maintenance

Remote I/O requires a minimum of maintenance. A regular inspection program is advised, but the frequency of inspections depends largely upon the environmental conditions in which the equipment normally operates.

The following should be periodically checked:

- all cables and wires attached to the FOE module
- evidence of any tampering or unauthorized modifications

The FOE module and IOTA cannot be repaired by the user and must be replaced with an equivalent certified product. Repairs should only be carried out by the manufacturer.

- Replacing the FOE IOTA F1 fuse
- Replacing the FOE fuse on the terminal block when FOE is mounted on DIN rail
- Replacing the FOE module on the IOTA
- Removing the FOE module from the DIN rail
- Removing the FOE assembly from the carrier
- Hazardous Area Cable Requirements
- Cable jacket Building Code Requirements
- Cable temperature variation considerations
- Spare fiber cable recommendation

16.5.1 Replacing the FOE IOTA F1 fuse

Refer to the FOE recommended spares section in this document for the proper replacement fuse to be used.

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

To replace the FOE IOTA F1 fuse

1. Using a small slotted screwdriver, place the tip into the slot on the fuse cap (The cap is the fuse holder).
2. Rotate the cap counter clockwise, a quarter-turn. Remove cap that also holds the fuse.
3. Replace the fuse in the fuse holder and insert back into the fuse container on the IOTA board.
4. Tighten the fuse cap rotating it clockwise a quarter-turn using the screwdriver.
5. This completes the procedure.

16.5.2 Replacing the FOE fuse on the terminal block when FOE is mounted on DIN rail

To replace the FOE fuse on the terminal block when the FOE is mounted on the DIN rail

1. Using the lever provided on the terminal block, open the fuse holder.
2. Remove the fuse from the fuse holder.
3. Replace the fuse by positioning it in the fuse holder, press and fit.
4. Close the fuse holder and press the lever to lock.

16.5.3 Replacing the FOE module on the IOTA

If the FOE module needs replacing or requires mounting on the IOTA, do the following.

Prerequisites

The IOTA has been previously removed or is missing from the IOTA board

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

To replace the FOE module on the IOTA

1. Align the FOE screws (located on the flange) with the holes on the IOTA.
2. Tighten the four screws that attach the base of the FOE module to the IOTA board (using a small Phillips screwdriver).
3. Connect the power cable from the IOTA board to the connector at the bottom of the module.
4. This completes the procedure.

16.5.4 Removing the FOE module from the DIN rail

To remove the FOE module from the DIN rail

1. Power down the FOE module by opening the fuse holder of the terminal block using the lever and removing the fuse
2. Remove all the cables before detaching the FOE modules. Perform the following steps to do so.
    a. Unscrew and remove the cable (HPN 51202930-200) running from the feed through terminal of the system cabinet to the '+' fuse terminal of the terminal block (Meanwell/Phoenix Contact power supply only).
    b. Remove the power connector of the cable (HPN 51202948-100/51202948-200) from the power supply by releasing the lock in the side and pulling it out gently (TDI power supply only).
    c. Unfasten the screw of the '-' fuse terminal of the terminal block on DIN rail and remove the cable.
    d. Unfasten the screw of the 'V+' terminal of power connector on the FOE module and remove the cable.
    e. Unfasten the screw of the '-' terminal of the feed through terminal block and remove the cable.
    f. Unfasten the screw of the 'V-' terminal of power connector on the FOE module and remove the cable.
    g. Remove the fiber optic cables from the FOE module by pulling it out gently.
    h. Unscrew and remove the I/O Link cable (HPN 51202789-910 / 51202789-911) from the FOE module or remove the I/O Link connector by pulling it out.
3. Unfasten the screw in the center of the end bracket and remove it by slightly lifting and pulling it out.
4. Push the FOE module slightly downwards and slide it out at the lower edge of DIN rail.

> **WARNING**
> Powering off both FOE modules accidently may halt the IOL communication completely and can lead to dangerous situation in plant. You must ensure to turn off the power of suspected FOE and should remove it without disturbing the functional FOE. Ensure to notify plant operators while performing this operation.

16.5.5 Removing the FOE assembly from the carrier

If the FOE assembly needs replacing and therefore, requires removal from the carrier, do the following.

> ATTENTION
>
> Prior to installing or servicing the FOE assembly (FOE module on the IOTA) to the carrier, the **F1** fuse needs to be removed. After mounting the FOE assembly to the carrier and securing the power and ground screws, the **F1** fuse can be re-installed.

To remove the FOE assembly from the carrier

1. Using a #2 Phillips screw-driver, loosen the two power screws, connecting the IOTA board to the vertical bus bars on the channel carrier assembly:
   - +24 V power screw
   - Com ground screw
2. Disconnect the IOLINK cable from the end that attaches to either the C300 or I/O IOTA.
3. Remove the FOE assembly from the carrier using a #2 Phillips screwdriver.
4. This completes the procedure.

16.5.6 Hazardous Area Cable Requirements

For U.S. installations, section 770-53 (d) of NEC Article 770 states that 'Cables installed in hazardous (classified) locations shall be any type indicated in Table 770-53.' This table is reproduced below.

Cable type	Permitted substitutions
OFNP	None
OFCP	OFNP
OFNR	OFNP
OFCR	OFNP, OFCP, OFNR
OFNG, OFN	OFNP, OFNR
OFCG, OFC	OFNP, OFCP, OFNR, OFNG, OFN

The cable types are described in the following table:

Cable marking	Cable type	Reference (NEC Article 770)
OFNP	Nonconductive optical fiber plenum cable	770-51(a) and 770-53(a)
OFCP	Conductive optical fiber plenum cable	770-51(a) and 770-53(a)
OFNR	Nonconductive optical fiber riser cable	770-51(b) and 770-53(b)
OFCR	Conductive optical fiber riser cable	770-51(b) and 770-53(b)
OFNG	Nonconductive optical fiber general-purpose cable	770-51(c) and 770-53(c)
OFCG	Conductive optical fiber general-purpose cable	770-51(c) and 770-53(c)
OFN	Nonconductive optical fiber general-purpose cable	770-51(d) and 770-53(c)
OFC	Conductive optical fiber general-purpose cable	770-51(d) and 770-53(c)

Nonconductive fiber optic cable is defined as cable containing no metallic members and no other electrically conductive materials.

Conductive fiber optic cable is defined as cable containing non-current-carrying

conductive members such as metallic strength members, metallic vapor barriers and metallic armor or sheath.

16.5.7 Cable jacket Building Code Requirements

Building code requirements frequently do not allow cables with polyethylene jackets. Jackets of polyvinyl chloride are frequently restricted to conduits, while fluoropolymer or other approved jacked material is required for use in cable trays and air plenums. Cable with suitable jacket material must be selected for the application.

16.5.8 Cable temperature variation considerations

Where ambient temperature variations are 20°C or greater on a daily basis, the life of the fibers can be significantly reduced. In applications where the ambient temperature is not controlled, loose buffered cable must be specified.

16.5.9 Spare fiber cable recommendation

A minimum of two cable fibers is required for each link, one for transmit and one for receive. The following characteristics apply to fiber optic cable spares:

- As insurance against future damage, such as fiber breakage, or encountering excessive loss in any one fiber, the inclusion of spare fibers is recommended. 100% cable replacement is recommended.
- Indoor 62.5 Micron Cable is used for indoor cabling. Indoor cables are available with 2, 4, or 6 fibers.
- Outdoor 62.5 Micron Cable is used for outdoor cabling. Outdoor aerial and direct burial cables are available with 4, 6, or 8 fibers.

CHAPTER

17

SERIES C POWER SUB-SYSTEM CONNECTIONS AND ALARM INDICATIONS

17.1 Series C DC Power Connections and Indicators

The following figures illustrate the typical DC power and battery backup connections made Series C cabinets with RAM Charger Assembly 51199932-100 and 51199932-200, respectively; as well as the associated LED indicators. See the To connect the Power System alarm cable for RAM Charger Assembly 51199932-100or Connecting the Power System alarm cable for RAM Charger Assembly 51199932-200section for more information about the alarm connections for 24Vdc Digital Inputs.

Figure 17.1 Typical dc power and battery backup connections Series C cabinet with RAM Charger 51199932-100

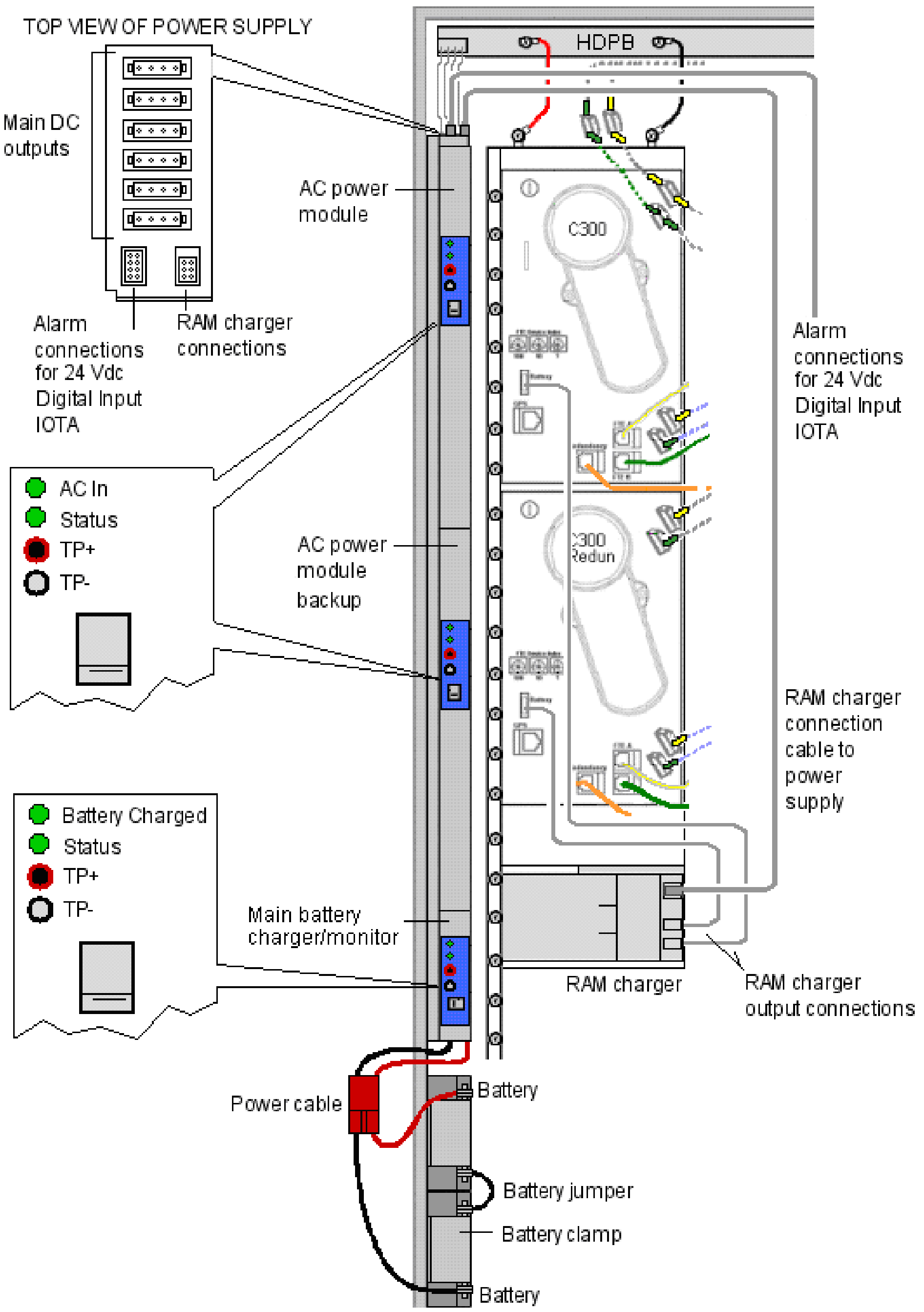
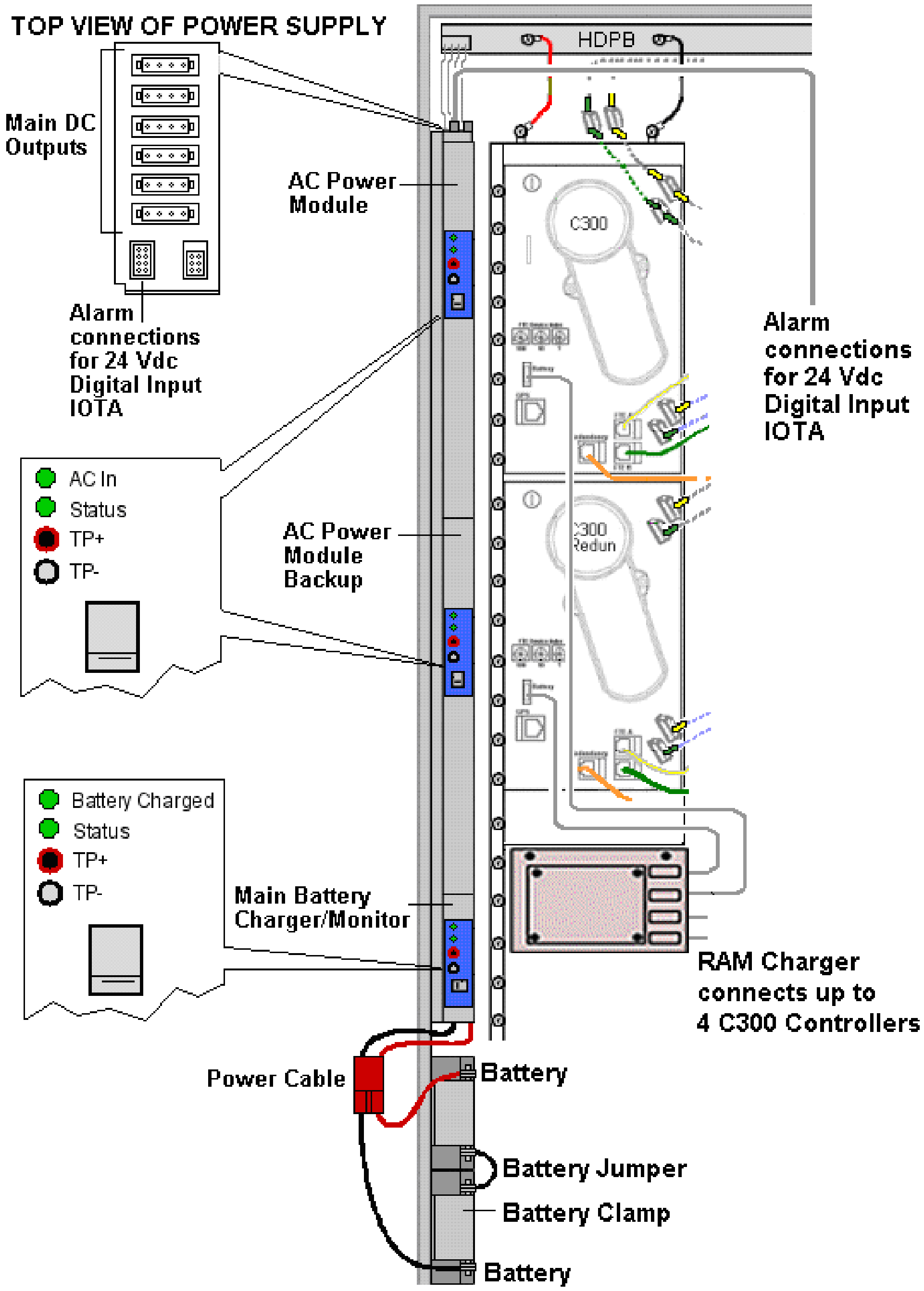


Figure 17.2 Typical dc power and battery backup connections Series C cabinet with RAM Charger 51199932-200



With R410, the COTS power system is available, which is a low cost power system used to power Series C system. The Commercial Off-the-Shelf (COTS)power system is available in the following two configurations.

- COTS power redundant system, which consists of the following:
  - Two power supply modules
  - Redundancy module
  - Terminal block
  - Mechanical hardware

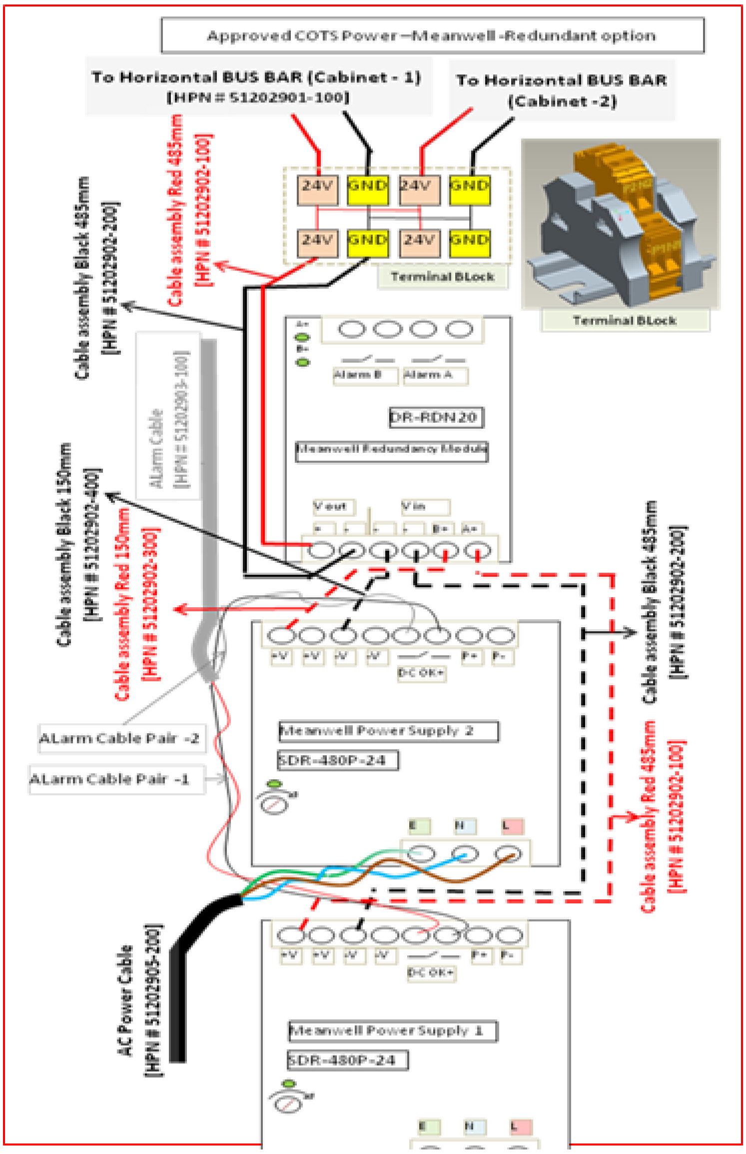
Honeywell

- Cable kit

- COTS power non-redundant system, which consists of the following:
  - Power supply module
  - Terminal block
  - Mechanical hardware
  - Cable kit

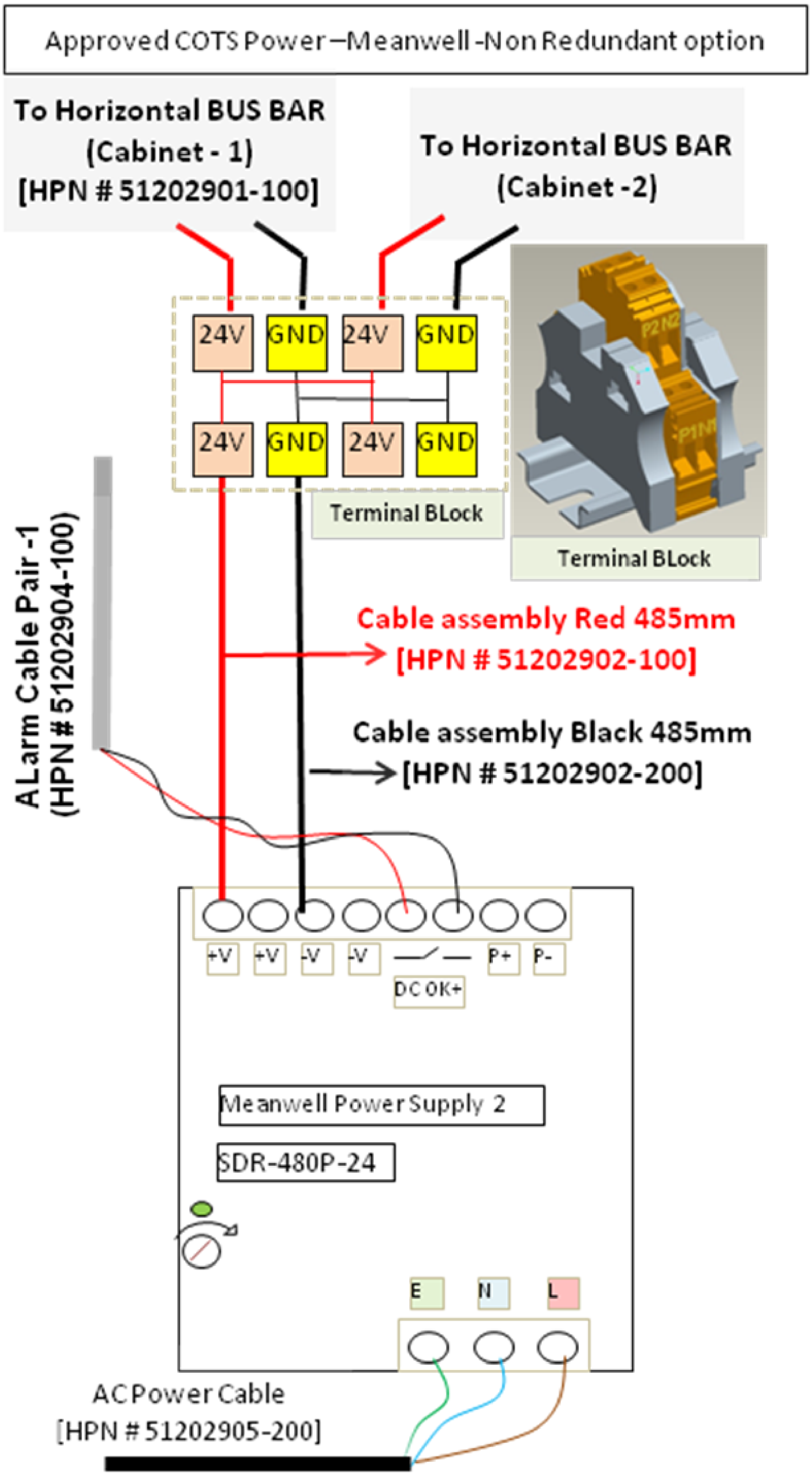
Following are the two types of COTS power system that are available.

- COTS Power- Meanwell redundant (20A) and Meanwell non-redundant (20A)
- COTS Power-Phoenix redundant (20A) and Phoenix non-redundant (20A)

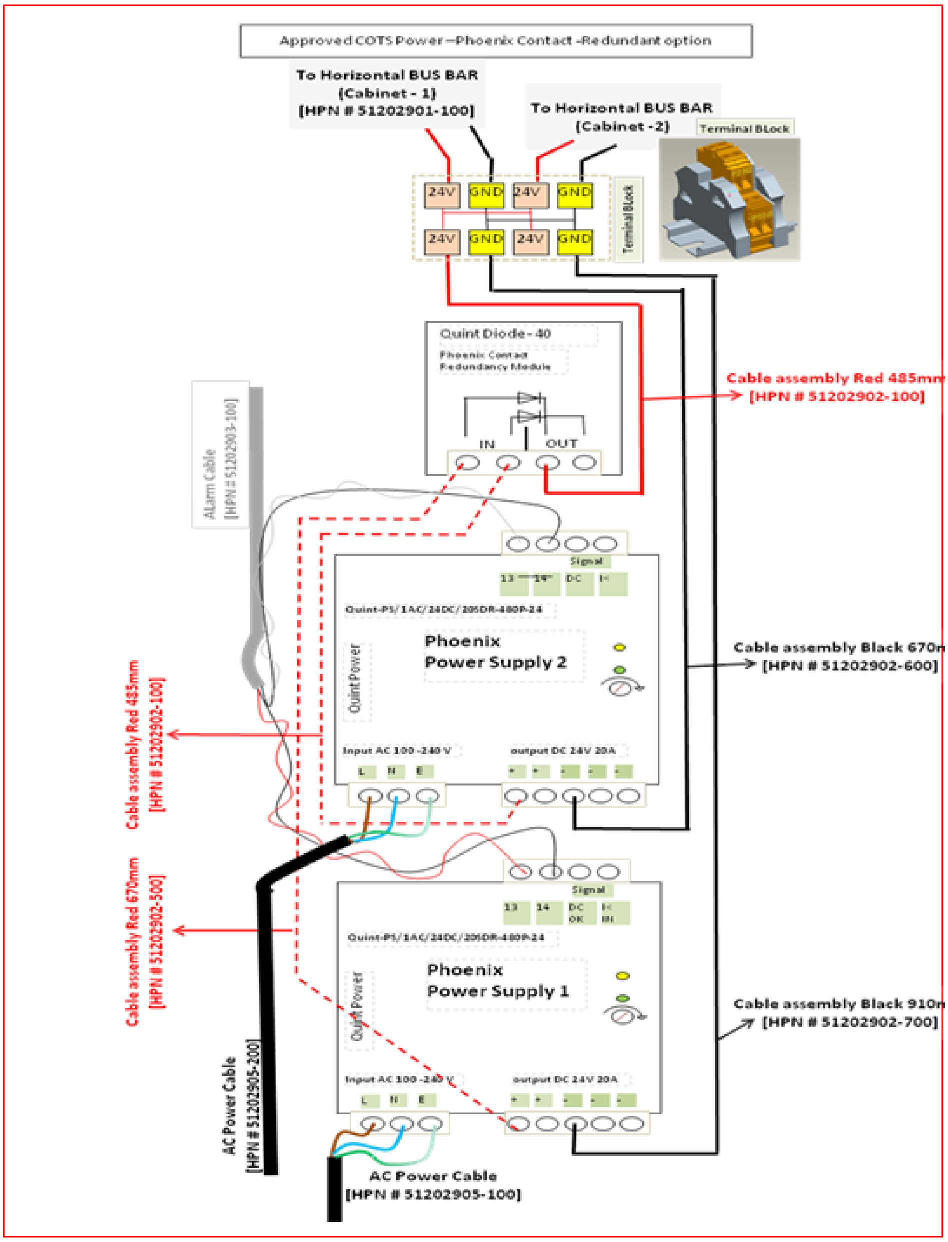


The following figure displays the connection diagram for COTS Power-Meanwell redundant system.

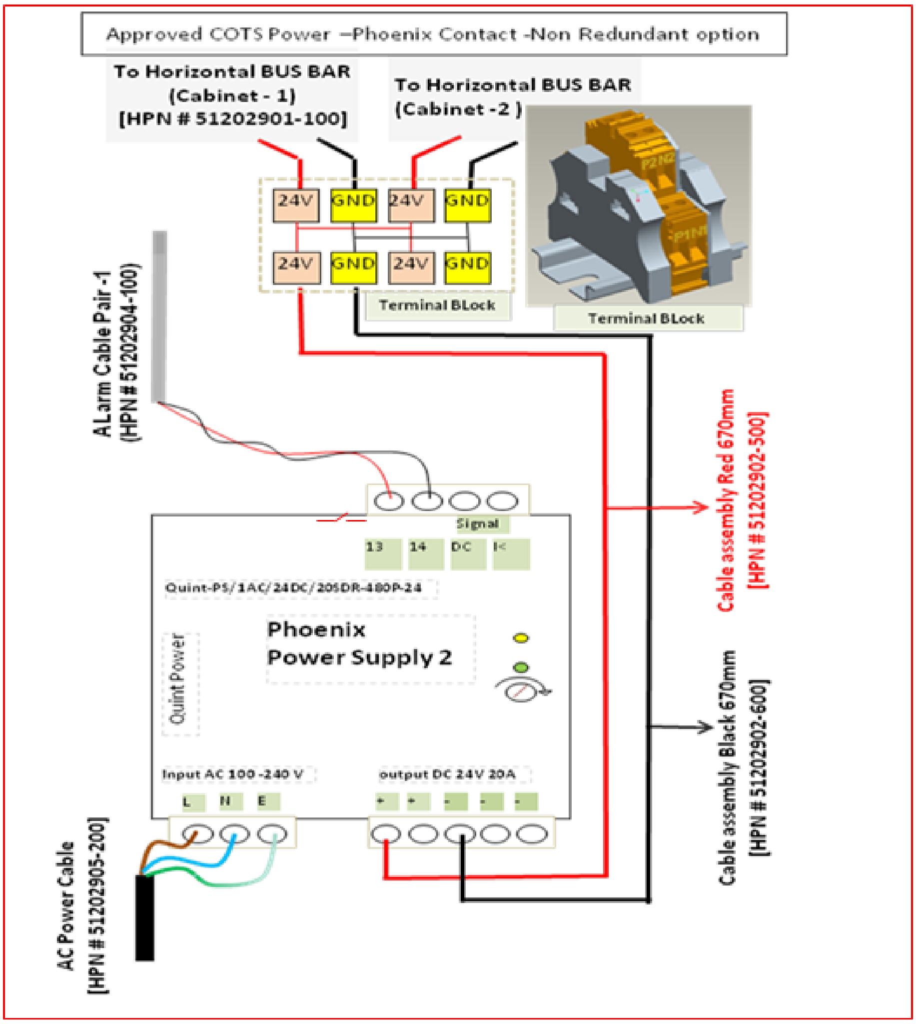
The following diagram displays the connection diagram for COTS power-Phoenix redundant system.



The following diagram displays the connection diagram for COTS Power Meanwell non-redundant system.



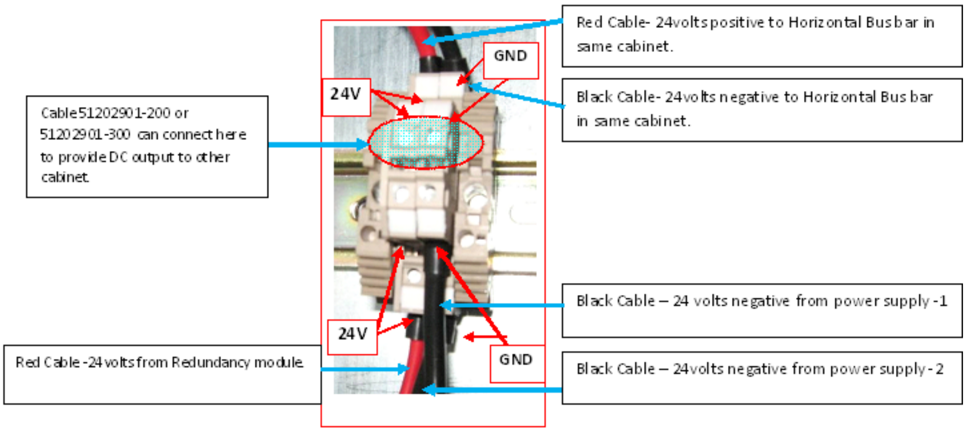
The following diagram displays connection for the COTS power-Phoenix non-redundant system.



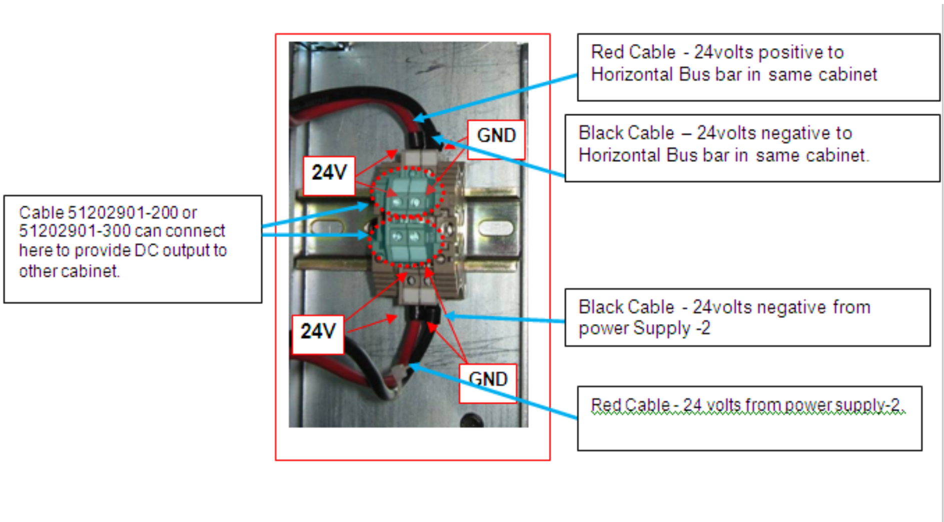
- Terminal block connections - Meanwell power system
- Terminal block connections - Phoenix power system

17.1.1 Terminal block connections - Meanwell power system

The following figure displays the terminal block wiring for COTS power Meanwell redundant system.

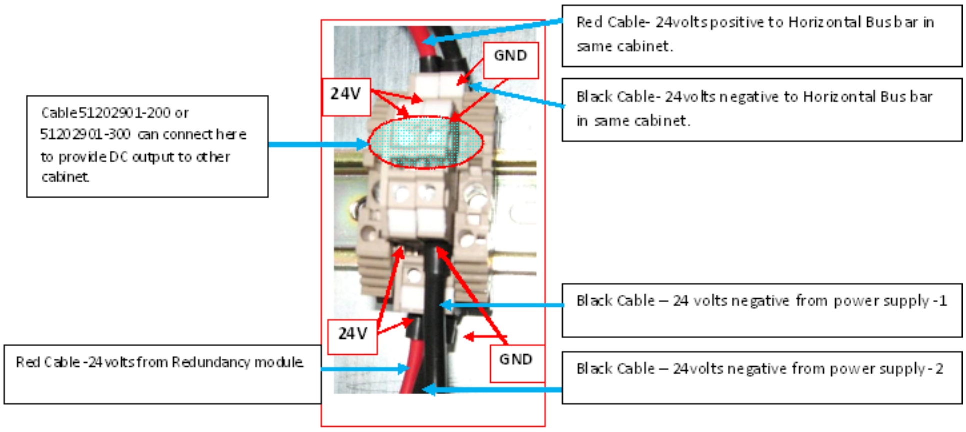


The following figure displays the terminal block wiring for COTS power Meanwell non-redundant system.

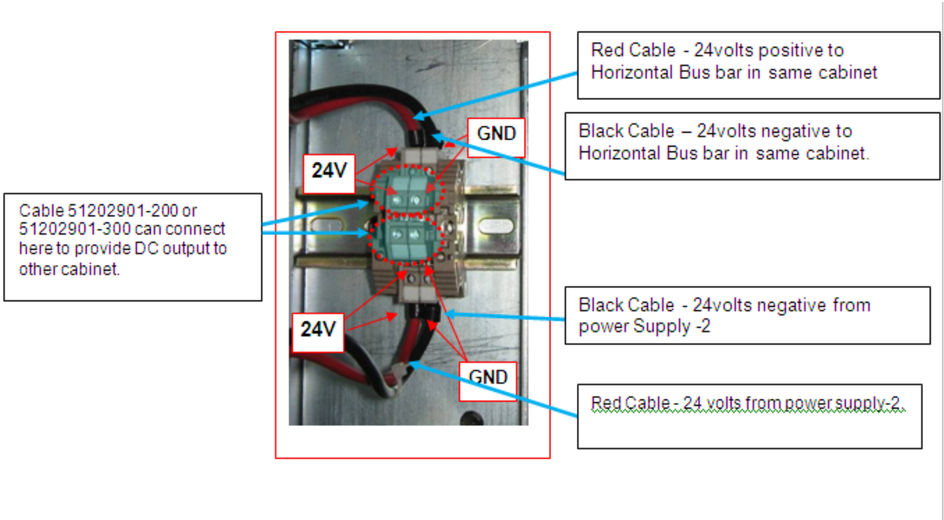


17.1.2 Terminal block connections - Phoenix power system

The following figure displays the terminal block wiring for COTS power Phoenix redundant system.



The following figure displays the terminal block wiring for COTS power Phoenix non-redundant system.



17.2 Series C Power Sub-System LED Indications

The following table summarizes the Light Emitting Diode (LED) indications provided by the various Series C power sub-system components.

LED Name - Color	LED State		
	OFF	*ON*	*Blinking*
AC Power Module Indicators (per supply)			
AC IN - Green	AC input is lost (for any reason)	AC input is within specified range	N/A
Status - Green	• DC output voltage is out of specifications (on anode side of isolating ORing diode), • A greater current than specified is being pulled from the power supply, and/or • Power supply has reached temperatures above specified limits.	Power supply output is within specified voltage, temperature, and current limits.	Fan has failed. (This indicator must also be OFF even if a failed fan in one supply is being *windmilled* by the airflow from the fan in an adjacent supply.)
Main Battery Backup Charger/Regulator/Monitor Indicators			
Status - Green	• DC input is lost (for any reason), • Battery charger senses an over-voltage on the batteries, • Battery charger senses over-current while charging the batteries, • Battery charger senses an over-temperature condition, • Batteries are not present, or • Temperature sensor is missing or not connected.	Power supply output is within the specified voltage, temperature, and current limits.	Fan has failed. (This indicator must also be OFF even if a failed fan in one supply is being *windmilled* by the airflow from the fan in an adjacent supply.)
Battery Charged - Green	• Main battery is missing or discharged, or • Battery is not at the top-off	Battery output is capable of supplying the specified output voltage and current for the specified time.	N/A

LED Name - Color	LED State		
	voltage.		
Ram Battery Backup Charger/Monitor Indicator (51199932-100 Only)			
Status - Green	• Main battery is missing, or • Battery is not charged yet	Battery output is capable of supplying the specified output voltage and current for the specified time.	N/A

Cots Power -Meanwell option

LED Name-Color	LED Located on	LED State: OFF	LED State: ON	LED State: Blinking
A+ /Green	Redundancy Module	No input DC voltage at terminal Vin-A+	DC voltage input at terminal Vin-A+ is within specified limit.	NA
B+ /Green	Redundancy Module	No input DC voltage at terminal Vin-B+.	DC voltage input at terminal Vin-B+ is within specified limit.	NA
DC OK	PowerSupply1, Powersupply2	Power supply DC output voltage is less than the 90% of specified voltage	Power supply DC output voltage is within specified voltage.	

Cots Power - Phoenix Contact option

LED Name-Color	LED Located on	LED State: OFF	LED State: ON	LED State: Blinking
DC OK / Green	PowerSupply1, Powersupply2	NA	Power supply DC output voltage is within specified voltage	Power supply DC output voltage is less than the 90% of Specified Voltage
Boost / Amber	PowerSupply1, Powersupply2	Load current is less than the specified current	Load current is greater than specified current	NA

> **NOTE**
>
> Alarm opens if :
>
> - Battery voltage is less than 3.5 volts,
> - Input voltage to the charger is less than 14 volts,
> - Battery pack has been removed, or
> - Battery is still being charged (not in the top-off state).

- Series C Power Sub-System LED indications - Meanwell power system
- Series C Power Sub-System LED indications - Phoenix power system

17.2.1 Series C Power Sub-System LED indications - Meanwell power system

LED ON	The output voltage reaches the adjusted output voltage
LED OFF	The output voltage drop below 90% of adjusted output voltage.

17.2.2 Series C Power Sub-System LED indications - Phoenix power system

DC OK LED

LED ON	The output voltage reaches the adjusted output voltage
LED Flashing	The output voltage is below 90% of adjusted output voltage.
LED OFF	NO DC output voltage

BOOST LED

LED ON	The Load current > 20Amp
LED OFF	The Load current < 20Amp

17.3 Series C Power Sub-System Alarm Contacts and LED Activation Levels

Each power supply and the main battery backup regulator/charger, and the RAM battery backup charger provide an alarm contact. The alarm contact opens if any of the LED indicators listed in the previous section are **not** in the normal (ON) state. The alarm contact is electrically isolated from all other circuitry so that it can be series connected by the user with alarms in other devices.

Use a hermetically sealed electromechanical relay. The alarm contacts are rated for 24 Volts ac or dc at 0 to 65 mA non-inductive load. An alarm condition is signaled by an open contact (1000 ohms or more); and a no alarm condition is signaled by a closed contact (10 ohms or less).

The following table provides a functional description of the activation levels for a given LED indicator.

LED Name	Functional Description
AC Power Module Indicators (per supply)	
AC IN	The LED turns ON when the AC input voltage is sufficient to start the unit. This is guaranteed to occur when the input voltage has risen to 85 Vac, but it could occur at a lower voltage, depending on output loading and unit-to-unit variations. Once the unit starts, the LED remains ON through the entire AC input voltage range. The LED will turn OFF at the point where the power supply shuts down. For a fully loaded supply, this is guaranteed not to occur until the input voltage descends below 85 Vac. This voltage can be considerably lower, if the unit is lightly loaded and depending on unit-to-unit variations. The unit does not shut down when the AC input range is exceeded unless there is a failure in the power supply.
Status	The LED turns ON when output voltage is within the operating range. The LED turns OFF when the DC voltage is increased to above 26.4 Vdc and the power supply shuts down due to an over-voltage condition. (Based on manufacturer's

LED Name	Functional Description
	tests, the actual data range for over-voltage is 26.4 to 30 Vdc.) The LED turns OFF during output overload, which is reached when the load is increased to over 26 A and results in the unit shutting down.
Main Battery Backup Charger/Regulator/Monitor Indicators	
Status	The LED turns ON when both the input and battery voltages are within operating range. The LED will remain ON until the battery reaches the Low-Voltage Drop-out point (32 Vdc) and the unit turns OFF along with the LED (output will still be regulated at 25 Vdc during battery discharge). The LED turns OFF when the battery voltage is above 45.5 Vdc. (Based on manufacturer's tests, the actual data range for over-voltage is 45.5 to 48.5 Vdc.)
Battery Charged	The LED operation is based on both battery charge voltage and battery charge current. The battery charge voltage must be above 40 Vdc and the battery charge current must be below 1 A for the LED to be ON. If both of these conditions are not met, the LED will be OFF.

CHAPTER

18

Series C I/O Alarms and Failures

18.1 Reviewing IOM alarms generated by the C300

The IOM block reports diagnostic alarms in the event of an IOM hardware failure or a change in the IOM redundancy state. The IOM alarms that the C300 presents are listed in the notification table below.

Table 18.1 IOM alarms displayed by the C300 controller

Notification type	Auxiliary descriptor text
Diagnostic alarm	• Communication error • Configuration mismatch • No response
System info event	• IOM power on • IOM switchover

18.1.1 HART alarms/events

In addition to the existing PMIO functionality, the following are added to Series C HART IOMs.

18.1.2 Field device status notifications

Field device status notifications has one more extra byte called 'extended device status notifications.' This byte is supported only by HART 6.0 and later version devices.

Currently, only the following two bits of this byte are defined.

Extended device condition/bit	Type	Definition
Maintenance required / Bit 0	Alarm	Device requires maintenance.
Device variable alert / Bit 1	Alarm	Any device variable is in alarm or warning state.

18.1.3 HALARMENABLE

A new parameter - HALARMENABLE - is added to HART configuration tab in the channel block. This parameter is by default enabled and can be changed from Monitoring side, irrespective of the channel point execution state of the IOM module state.

When HALARMENABLE is disabled, all the existing HART events / alarms from that channel block are disabled and further generation of the HART alarms / events are terminated.

This parameter affects only the HART alarm / event behavior. The LED update of the device status in the HART device status tab happens regardless of the state of HALARMENABLE.

18.2 Reviewing IOM soft failures

The IOM reports device soft failures to Experion Server and located on the Control Builder configuration forms under the Soft Failures tab.

The table below lists all IOM soft failures and identifies those that appear within Experion. Since Series C I/O is not slated for use with TPS, soft failures related to TPS are not be provided by Series C I/O modules.

The SOFTFAIL1A, SOFTFAIL1B, SOFTFAIL2A and SOFTFAIL2B parameters are used to view an IOM's soft failures. For a list of channels in failure, use the CHNLWFAILA and CHNLWFAILB parameters.

- 01 STCOVRUN
- 02 REQOFLOW
- 06 FTAMISSG
- 07 EECKSMER
- 08 EECNTERR
- 09 EEFLAGER
- 21 INPTFAIL
- 23 OUTPUTFL
- 24 STCKLIM
- 26 DIAGCTFL
- 31 FTAMSMCH
- 32 VZERO-FL
- 33 BADRJVAL
- 36 FTA1FAIL
- 37 FTA2FAIL
- 38 CALBABRT
- 39 BADCALRF
- 41 VREFFAIL
- 42 ADOUTUDF

18.2.1 01 STCOVRUN

Sample time clock overrun

Diagnostic check

Investigate a possible I/O Link problem

Cause

Sample time clock overrun

Solution

Investigate a possible I/O Link problem or excessive IOL activity. Check C300, IOL cables, IOMs and IOL budgets. Call TAC if the alarm persists or repeatedly occurs.

18.2.2 02 REQOFLOW

IOP task request overflow - excessive IOL activity

Diagnostic check

Check IOL activity

Cause

IOP task request overflow - excessive IOL activity

Solution

Call TAC for assistance.

18.2.3 06 FTAMISSG

LLMUX, power adaptor, or DO Relay IOM config. is missing relay adapter board

Diagnostic check

Check for missing items defined below.

Cause

If LLMUX, power adapter missing or if DO Relay IOM configuration is missing relay adapter board.

Solution

Install the FTA or relay adapter. If an FTA is present, replace the FTA or check the FTA cable. (Note: For the LLMux, this code refers to the Power Adapter assembly. RTD and TC FTAs are diagnosed by error Codes 50 and 51.)

18.2.4 07 EECKSMER

EEPROM checksum error - IOM probably not calibrated

Diagnostic check

EEPROM checksum error - IOM probably not calibrated

Cause

EEPROM (used to hold calibration information in Analog Input and Analog Output IOPs) checksum failure. It usually means an Analog Output IOM is not calibrated properly.

Solution

Calibrate the Analog Input or Analog Output IOM (refer to the 'IOM Calibration Procedures' section for the procedure). If the error persists, replace the IOM.

18.2.5 08 EECNTERR

EEPROM counter error-too many writes

Diagnostic check

Check EEPROM counter.

Cause

EEPROM counter error. The number of writes to EEPROM has exceeded the safe number (10,000). This could also indicate the IOM has not been calibrated because a virgin EEPROM will fail this test.

Solution

Calibrate the Analog Input or Analog Output IOM (refer to the 'IOM Calibration Procedures' section for the procedure). If the error persists, replace the IOM.

18.2.6 09 EEFLAGER

EEPROM flag error - incomplete EEPROM write resulting in uncalibrated IOM

Diagnostic check

Check EEPROM.

Cause

EEPROM flag error - incomplete EEPROM write resulting in uncalibrated IOM.

Solution

Calibrate the Analog Input or Analog Output IOM (refer to the 'IOM Calibration Procedures' section for the procedure). If the error persists, replace the IOM.

18.2.7 21 INPTFAIL

Input point failed diagnostic

Diagnostic check

Cause

Input point failed diagnostic

Solution

18.2.8 23 OUTPUTFL

Failure in output circuit / field wiring detected by AO or DO.

Diagnostic check

Check field wiring and the fuses on the IOTA.

Cause

Failure in output circuit / field wiring detected by AO or DO.

Solution

Check field wiring and the fuses on the IOTA. If it is good, try replacing the IOTA and/or the appropriate IOM card.

18.2.9 24 STCKLIM

IOM firmware stack usage is dangerously close to its limit.

Diagnostic check

Stack reaching limit.

Cause

IOM firmware stack usage is dangerously close to its limit.

Solution

Reduce activity on this IOM - inactivate control strategies. Call TAC for assistance.

18.2.10 26 DIAGCTFL

IOM diagnostic circuit failure

Diagnostic check

IOM diagnostic circuit failure.

Cause

IOM diagnostic circuit failure.

For AI IOM, 'noise' on the input may cause this error.

Solution

Reset the IOM. If reset does not clear the error, replace the appropriate IOM.

For AI IOM, check for 'noise' on the input.

18.2.11 31 FTAMSMCH

LLMUX FTA type mismatch with channel configuration.

Diagnostic check

Check channel block configuration.

Cause

LLMUX FTA type mismatch with channel configuration.

Solution

Re-configure the channel block or replace the FTA.

18.2.12 32 VZERO-FL

Zero reference voltage out of range in AI and AO IOMs

Diagnostic check

Zero reference failure.

Cause

Zero reference voltage out of range in AI and AO IOMs

Solution

Replace the IOM.

18.2.13 33 BADRJVAL

Reference junction value bad

Diagnostic check

Cause

Reference junction value bad

Solution

18.2.14 36 FTA1FAIL

LLMUX :FTA 1 has a soft failure

Diagnostic check

Check LLMUX FTA 1

Cause

LLMUX FTA 1 has a soft failure.

Solution

Check LLMUX FTA 1

18.2.15 37 FTA2FAIL

LLMUX FTA 2 has a soft failure

Diagnostic check

Check LLMUX FTA 2

Cause

LLMUX FTA 2 has a soft failure.

Solution

Check LLMUX FTA 2

18.2.16 38 CALBABRT

Calibration of a module has aborted due to a failure

Diagnostic check

Cause

Calibration of a module has aborted due to a failure

Solution

18.2.17 39 BADCALRF

Internal calibration test voltages out of range.

Diagnostic check

None - Internal calibration test voltages out of range.

Cause

Internal calibration test voltages out of range.

Solution

Replace AI or AO IOM.

18.2.18 41 VREFFAIL

Reference voltage out of range

Diagnostic check

Check reference voltage

Cause

Internal 5V reference out of range in AI or internal AA55 reference test failed in the case of DI.

Solution

Replace the AI or DI IOM.

18.2.19 42 ADOUTUDF

Analog to digital conversion on this Analog Input channel is out of range.

Diagnostic check

Check input wiring.

Cause

Analog to digital conversion on this Analog Input channel is out of range.

Solution

Check the input wiring at the IOTA; possible open contact. Otherwise, replace the IOM.

18.2.20 43 ADOUTCAL

AI or AO IOM is out of calibration.

Diagnostic check

Check AI or AO IOM calibration

Cause

AI or AO IOM is out of calibration.

Solution

Calibrate or replace the IOM (refer to the 'IOP Calibration Procedures' section).

18.2.21 44 BADFLREG

AO module failure selection register is bad

Diagnostic check

Cause

AO module failure selection register is bad

Solution

18.2.22 45 BDSNDLTC

Secondary latch failure

Diagnostic check

Cause

Secondary latch failure

Solution

18.2.23 46 BDOUTBFR

Output disable buffer failure.

Diagnostic check

Cause

Output disable buffer failure

Solution

18.2.24 47 VCALFAIL

Calibration reference voltage out of range.

Diagnostic check

Cause

Calibration reference voltage out of range

Solution

18.2.25 48 F1NOTCAL

FTA1 not calibrated.

Diagnostic check

Cause

FTA1 not calibrated

Solution

18.2.26 49 F2NOTCAL

FTA2 not calibrated.

Diagnostic check

Cause

FTA2 not calibrated

Solution

18.2.27 50 F1COM_FL

LLMUX FTA 1 communication failure.

Diagnostic check

LLMUX FTA 1 communication failure.

Cause

LLMUX FTA 1 communication failure.

Solution

Check the connection from the Power Adapter to FTA 1. If the FTA is missing, install the FTA. If the FTA is present, replace the FTA.

18.2.28 51 F2COM_FL

LLMUX FTA 2 communication failure.

Diagnostic check

LLMUX FTA 2 communication failure 2.

Cause

LLMUX FTA 2 communication failure.

Solution

Check the connection from the Power Adapter to FTA 2. If the FTA is missing, install the FTA. If the FTA is present, replace the FTA.

18.2.29 52 F1_IDERR

LLMUX FTA 1 identification failure.

Diagnostic check

LLMUX FTA 1 identification failure.

Cause

LLMUX FTA 1 identification failure.

Solution

Verify/correct the FTA pinning.

18.2.30 53 F2_IDERR

LLMUX FTA 2 identification failure.

Diagnostic check

LLMUX FTA 2 identification failure.

Cause

FTA 2 identification failure

Solution

Verify/correct the FTA pinning.

18.2.31 54 F1VREFFL

LLMUX FTA 1 reference voltage failure

Diagnostic check

LLMUX FTA 1 reference voltage failure

Cause

LLMUX FTA 1 reference voltage failure

Solution

Replace the FTA.

18.2.32 55 F2VREFFL

LLMUX FTA 2 reference voltage failure

Diagnostic check

LLMUX FTA 2 reference voltage failure

Cause

LLMUX FTA 2 reference voltage failure

Solution

Replace the FTA.

18.2.33 56 F1CAL_FL

LLMUX FTA 1 calibration failure.

Diagnostic check

LLMUX FTA 1 calibration failure.

Cause

LLMUX FTA 1 calibration failure.

Solution

Re-calibrate the FTA.

18.2.34 57 F2CAL_FL

LLMUX FTA 2 calibration failure.

Diagnostic check

LLMUX FTA 2 calibration failure.

Cause

LLMUX FTA 2 calibration failure.

Solution

Re-calibrate the FTA.

18.2.35 58 LOSTSYNC

IOP lost synchronization with its primary

Diagnostic check

Cause

IOP lost synchronization with its primary

Solution

18.2.36 59 WRITENBL

AO/DO write enable protection failure.

Diagnostic check

Cause

AO/DO write enable protection failure

Solution

18.2.37 60 MLTINPFL

Multiple input failure detected.

Diagnostic check

Cause

Multiple input failure detected

Solution

18.2.38 61 REDNDIAG

Redundancy hardware diagnostic failure.

Diagnostic check

Redundancy hardware diagnostic failure.

Cause

Redundancy hardware diagnostic failure.

Solution

Replace the IOMs one at a time following database synchronization.

18.2.39 63 WRONG_HW

IO redundancy configured on non-supportive hardware rev.

Diagnostic check

Cause

IO redundancy configured on non-supportive hardware rev

Solution

18.2.40 64 HWFIFOFL

Hardware FIFO diagnostic failed - PVs set BAD - replace IOP.

Diagnostic check

Cause

Hardware FIFO diagnostic failed - PVs set BAD - replace IOP

Solution

18.2.41 65 PRVRAMFL

Private RAM diagnostic failed - PVs set BAD - replace IOP.

Diagnostic check

Cause

Private RAM diagnostic failed - PVs set BAD - replace IOP

Solution

18.2.42 66 SOECLKFL

SOE clock failed - PVs set BAD - replace IOP

Diagnostic check

Cause

SOE clock failed - PVs set BAD - replace IOP

Solution

18.2.43 67 PVVALDFL

PV validation diagnostic failed - PVs set BAD - replace IOP.

Diagnostic check

Cause

PV validation diagnostic failed - PVs set BAD - replace IOP

Solution

18.2.44 68 SOECNTFL

SOE counter diagnostic failed - PVs set BAD - replace IOP.

Diagnostic check

Cause

SOE counter diagnostic failed - PVs set BAD - replace IOP

Solution

18.2.45 69 DTPATHFL

Data path failure.

Diagnostic check

Cause

Data path failure

Solution

18.2.46 70 DTPATHTO

Data path time out.

Diagnostic check

Cause

Data path time out

Solution

18.2.47 71 STMACHFL

State machine diagnostic failure - PVs set BAD - replace IOP.

Diagnostic check

Cause

State machine diagnostic failure - PVs set BAD - replace IOP

Solution

18.2.48 72 PIFAULTY

Bad personality image.

Diagnostic check

Cause

Bad personality image

Solution

18.2.49 161 HMODEM1

HART hardware error detected against DUART channel 1 or modem 1.

Diagnostic check

None - HART hardware error detected

Cause

HART hardware error detected against DUART channel 1 or modem 1.

Solution

Replace the IOM.

18.2.50 162 HMODEM2

HART hardware error detected against DUART channel 2 or modem 2.

Diagnostic check

None - HART hardware error detected

Cause

HART hardware error detected against DUART channel 2 or modem 2.

Solution

Replace the IOM.

18.2.51 163 HMODEM3

HART hardware error detected against DUART channel 3 or modem 3.

Diagnostic check

None - HART hardware error detected

Cause

HART hardware error detected against DUART channel 3 or modem 3.

Solution

Replace the IOM.

18.2.52 164 HMODEM4

HART hardware error detected against DUART channel 4 or modem 4.

Diagnostic check

None - HART hardware error detected

Cause

HART hardware error detected against DUART channel 4 or modem 4.

Solution

Replace the IOM.

18.2.53 165 HDIAGTO

HART processor diagnostic task under-run.

Diagnostic check

Cause

HART processor diagnostic task under-run.

Solution

18.2.54 166 HSTACKHI

HART processor program stack above 90% usage level.

Diagnostic check

Cause

HART processor program stack above 90% usage level.

Solution

18.2.55 167 FTA3FAIL

LLMUX: FTA 3 has a Soft failure.

Diagnostic check

Check FTA 3.

Cause

LLMUX: FTA 3 has a Soft failure.

Solution

Check FTA 3. This soft failure is introduced in Series C.

18.2.56 168 FTA4FAIL

LLMUX: FTA 4 has a Soft failure.

Diagnostic check

Check FTA 4.

Cause

LLMUX: FTA 4 has a Soft failure.

Solution

Check FTA 4. This soft failure is introduced in Series C.

18.2.57 169 F3NOTCAL

FTA3 not calibrated.

Diagnostic check

Cause

FTA3 not calibrated

Solution

18.2.58 170 F4NOTCAL

FTA 4 not calibrated.

Diagnostic check

Cause

FTA4 not calibrated

Solution

18.2.59 171 F3COMFL

LLMUX FTA 3 communication failure.

Diagnostic check

LLMUX FTA 3 communication failure.

Cause

LLMUX FTA 3 communication failure.

Solution

Check the connection from the Power Adapter to FTA 1. If the FTA is missing, install the FTA. If the FTA is present, replace the FTA. This soft failure is introduced in Series C.

18.2.60 172 F4COMFL

LLMUX FTA 4 communication failure.

Diagnostic check

LLMUX FTA 4 communication failure.

Cause

LLMUX FTA 4 communication failure.

Solution

Check the connection from the Power Adapter to FTA 2. If the FTA is missing, install the FTA. If the FTA is present, replace the FTA. This soft failure is introduced Series C.

18.2.61 173 F3IDERR

LLMUX FTA 3 identification failure.

Diagnostic check

Verify/correct the FTA pinning.

Cause

LLMUX FTA 3 identification failure.

Solution

Verify/correct the FTA pinning. This soft failure is introduced Series C.

18.2.62 174 F4IDERR

LLMUX FTA 4 identification failure.

Diagnostic check

Verify/correct the FTA pinning.

Cause

LLMUX FTA 4 identification failure.

Solution

Verify/correct the FTA pinning. This soft failure is introduced Series C.

18.2.63 175 F3VREFFL

LLMUX FTA 3 reference voltage failure.

Diagnostic check

None

Cause

LLMUX FTA 3 reference voltage failure.

Solution

Replace the FTA. This soft failure is introduced Series C.

18.2.64 176 F4VREFFL

LLMUX FTA 4 reference voltage failure.

Diagnostic check

None

Cause

LLMUX FTA 4 reference voltage failure.

Solution

Replace the FTA. This soft failure is introduced Series C.

18.2.65 177 F3CALFL

LLMUX FTA 3 calibration failure.

Diagnostic check

Check FTA calibration

Cause

LLMUX FTA 3 calibration failure.

Solution

Re-calibrate the FTA. This soft failure is introduced in Series C.

18.2.66 178 F4CALFL

LLMUX FTA 4 calibration failure.

Diagnostic check

Check FTA calibration

Cause

LLMUX FTA 4 calibration failure.

Solution

Re-calibrate the FTA. This soft failure is introduced in Series C.

18.2.67 179 OPENWIRE

Open wire / sensor detected.

Diagnostic check

Check the field wiring and IOTA connections.

Cause

Open wire / sensor detected.

Solution

Check the field wiring and IOTA connections.

18.2.68 180 DOVRCRNT

DO channel detected a short circuit or over current situation.

Diagnostic check

Check the field wiring and IOTA connections.

Cause

DO channel detected a short circuit or over current situation.

Solution

Check the field wiring and IOTA connections.

18.2.69 181 FTAPOWFL

LLMUX IOM is not able to power the FTAs.

Diagnostic check

LLMUX IOM is not able to power the FTAs.

Cause

LLMUX IOM is not able to power the FTAs.

Solution

Replace the IOM. This soft failure is introduced Series C.

18.2.70 182 DPADIAFAIL

IOL Address Diag Failure

Diagnostic check

IOL address diagnostic failure

Cause

IOL address diagnostic failure

Solution

Check IOM number at device index switch. Ensure correct assignment. If not correct, reset to correct device index number. Reset IOM.

18.2.71 183 RDBKRGDIAGFL

Readback Register Diagnostic Failure

Diagnostic check

Readback register diagnostic failure

Cause

Readback register diagnostic failure

Solution

Internal hardware problem. Replace the IOM.

18.2.72 184 WDTDIAGFAIL

Watch Dog Timer Diagnostic Failure

Diagnostic check

Watch Dog Timer diagnostic failure

Cause

Watch Dog Timer diagnostic failure

Solution

Replace the module.

18.2.73 185 RLYEXTBDMSSNG

Relay Extension Board Missing

Diagnostic check

Relay Extension Board missing

Cause

Relay Extension Board missing

Solution

Ensure Relay Board is properly installed.

18.2.74 186 REDHWFAIL

Redundancy hardware failure

Diagnostic check

Cause

Redundancy Hardware Failure

Solution

18.2.75 187 HARTCHANFAIL

IOM or IOTA HART channel failure.

Diagnostic check

Cause

IOM or IOTA HART Channel Failure

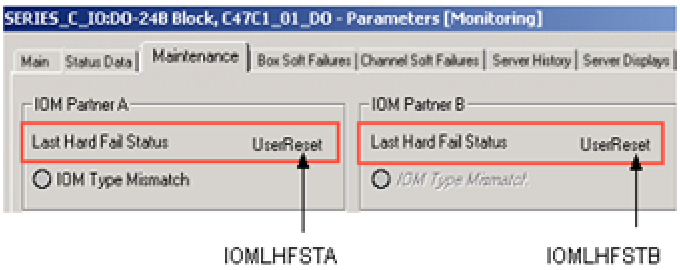
Solution

18.3 IOM hard failures

The IO module will hard fail or crash when a fatal fault is detected. A fatal fault is a malfunction (either hardware or software) that is so severe that safe and reliable control of the process is in jeopardy.

IOM reports device hard failures on the Configuration Form's Maintenance tab for the IOMLHFSTA / IOMLHFSTB parameters.

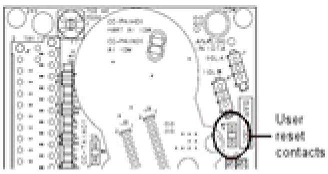
Figure 18.1 Location of hard failure message



To review the FAULTED state of AO and DO failures see, FAULTED state and IOM hard failure

18.3.1 To recover from an IO module hard failure

1. Reset the IO module using the **User Reset Contacts** located on the IOTA.



> NOTE
>
> The DO outputs with FAULTOPT set to HOLD continue to HOLD the FAULTOPT state during the user reset operation through the contacts.

2. Record the **Last Hard Fail** Status code.

   This is located on the Configuration Form's Maintenance tab for the IOMLHFSTA / IOMLHFSTB parameters.

3. Record the **IOM firmware** and **hardware revisions** located on the Configuration Form's Maintenance tab:
   - Hardware Revision of the failed IO module.
   - Firmware Revisions (Boot Image and Application Image) of the failed IO module.
   - Release number of the Experion system in which the IO module was operating.
4. Extract the **C300 Controller internal logs** using the CTool Application.
5. Extract the **IOM internal logs** (trace and crash logs) using the CTool Application.
6. Report the problem to Honeywell TAC and provide all data captured in Steps 2-5.

18.4 IOM Behavior during Hard Failures

When the IOM hard fails and switch over to the Secondary does not take place:

- For a DO module:
  - all field output terminals for channels with DOTYPE = STATUS go to the configured fault state.
  - the field output terminals for channels with other DOTYPE go unpowered.
- For an AO module, all field output terminals go unpowered
- INITREQ is asserted on all associated Output Channel Blocks
- the IOM icon in the Monitor tab becomes RED
- the Detail Display shows No Response

There also is:

- an active 'IOP State Changed to No Response' alarm in Station System Summary.
- the **Status** LED of the IOP is OFF.

The following codes can appear for the IOMLHFSTA and IOMLHFSTB parameters.

Table 18.2 IOM hard failures

Code	Name	Cause/description	AI	AO	DI	DO	LLMUX
00	UNKNOWN	Unknown failure.	X	X	X	X	X
01	POWERDOWN	IOM was powered down or a loss of 24v power to the IOM was detected	X	X	X	X	X
02	INVPRGEXEC	Invalid program execution	X	X	X	X	X
04	RAMCNTERR	RAM contents diagnostics failed	X	X	X	X	X
05	RAMADRERR	RAM address diagnostics failed	X	X	X	X	X
06	DPAERROR	IOM was changed while the IOM is powered	X	X	X	X	X
09	IOLJABBER	IOL jabber circuit fired	X	X	X	X	X
11	BADPGJMP	Illegal value case control in the IOM firmware	X	X	X	X	X
17	DMT_TMOUT	Dead man cell timer expired. IOM firmware task scheduling corrupted.	X	X	X	X	X
25	OPCNTRLHW FAIL	Output control hardware failure		X		X	
26	AOOTPTMUX FAIL	AO output control MUX failure		X			
27	ASCRCFAIL	Flash contents diagnostics failed	X	X	X	X	X
31	STCKOVRUN	IOM firmware stack overrun	X	X	X	X	X
32	WDTTIMEOUT	IOM firmware watchdog timeout	X	X	X	X	X
35	IOMUSER RESET	User triggered reset	X	X	X	X	X

18.5 Getting further assistance

The following table lists other documents and sections that contain troubleshooting information for other Experion subsystems.

All of these documents are available from Knowledge Builder. Some documents are also supplied as part of Station Help. For documents that can be accessed directly from this page, click on the link, otherwise look for the document within Knowledge Builder.

Document/Section	Comments
Experion R300 > Reference	There is a separate interface reference for each type of controller other than the Process Controller, for example, the *ASEA Interface Reference*. Most of these references contain an interface-specific troubleshooting section.
Experion R300 > Reference > TPS Integration Guide > Troubleshooting	Troubleshooting an integrated system that uses Experion 'TPS Integration' option.
Experion R300 > Reference > Control Builder Error Codes Reference	Describes error codes generated from within Control Builder.
Experion R300 > Troubleshooting and Maintenance > Control Hardware Troubleshooting and Maintenance Guide	The main repository for troubleshooting, maintenance and repair of Process Controllers.
Experion R300 > Configuration > DeviceNet Interface Implementation Guide > Troubleshooting DeviceNet Status Failures	Describes error codes generated from DeviceNet Interface Board.
Experion R300 > Configuration > Fault Tolerant Ethernet Bridge User's Guide > Service > Troubleshooting	Troubleshooting FTE bridges.
Experion R300 > Installation and Upgrades > Fault Tolerant Ethernet Installation and Service Guide > Troubleshooting FTE Nodes	Troubleshooting FTE nodes.
Experion R300 > Reference > Honeywell TDC 3000 Data Hiway Interface Reference > TDC error codes and Troubleshooting	Troubleshooting TDC 3000 Hiway problems.
Experion R300 > Configuration > Qualification and Version Control System User Guide > QVCS Troubleshooting	Troubleshooting QVCS.
Experion R300 > Configuration > SafeView User's Guide > Appendix D - SafeView Error Messages	Describes the meaning of SafeView configuration errors.
Experion R300 > Reference > Server Scripting Reference > Server scripting error messages	Describes the meaning of error messages in the server log specific to server scripting.
Experion R300 > Configuration > System Management Configuration Guide > Troubleshooting System Management	Describes the meaning of System Management Configuration errors.
Experion R300 > Configuration > System Management Configuration Guide > System Event Server > Troubleshooting SES configuration	Describes the meaning of SES Configuration errors.
Experion R300 > Configuration > System Management Configuration Guide > System Performance Server > Troubleshooting SPS configuration	Describes the meaning of SPS Configuration errors.
Experion R300 > Planning and Design > Planning, Installation, and Service for WS360	Troubleshooting workstation nodes used in Experion and TPN.

- Guidelines for requesting support

18.5.1 Guidelines for requesting support

If you cannot resolve a problem by using this guide, you can request support from your Honeywell

Solutions Support Center. When requesting support, please supply as many relevant details about the problem by referring to Gathering information for reporting problems to Honeywell to obtain the problem-related information.

CHAPTER

19

SERIES C I/O GALVANICALLY ISOLATED / INTRINSICALLY SAFE HARDWARE

The procedures in this section are intended to give you the ability to perform basic tasks with the Galvanically Isolated / Intrinsically Safe (GI/IS) module such as installing procedures and considerations.

The GI/IS assembly consists of:

- IOTA board - specific for GI/IS usage
- IOM module - Series C type
- Isolators - Allows for the interfacing of field devices in hazardous areas and/or where galvanic isolation is required. Field wiring is accomplished through plug-in style connectors.
- Terminal plugs - connectors that allow the field wiring to be installed

Figure 19.1 GI/IS board assembly

- GI/IS IOTA models

19.1 GI/IS IOTA models

The GI/IS IOTAs have with the following features:

- Non-redundancy - 6-inch IOTA
- Redundancy - 12-inch IOTA
- High density
- supporting MTL45xx galvanically isolated isolators

The following table lists the GI/IS IOTAs and their corresponding isolators.

Table 19.1 GI/IS IOTAs and Isolators

IOTA Model	Size	Redundant	High Density	Channels	Isolator	Isolator quantity
ANALOG INPUT						
CC-GAIX11	12	Yes	No	16	**MTL4541**	16
			Yes	16	**MTL4544**	8
CC-GAIX21	6	No	Yes	16	**MTL4544**	8
TEMPERATURE						
CC-GAIX11	12	Yes	No	16	**MTL4575**	16
ANALOG OUTPUT						
CC-GAOX11	12	Yes	No	16	**MTL4546C**	16
			Yes	16	**MTL4549C**	8
CC-GAOX21	6	No	Yes	16	**MTL4549C**	8
DIGITAL INPUT						
CC-GDIL01	12	Yes	No	32	**MTL4511**	16
CC-SDXX01 Expander	12	--	No	--	**MTL4511**	16
CC-GDIL11	12	Yes	No	32	**MTL4516**	16
CC-GDIL11 and Line Fault detection	12	Yes	No	30*	**MTL4517***	15*
CC-GDIL21	6	No	Yes	32	**MTL4510**	8
DIGITAL OUTPUT						
CC-GDOL11	12	Yes	No	32	**MTL4521**	16
CC-SDXX01 Expander	12	--	No	--	**MTL4521**	16
DUMMY ISOLATOR						
Terminates unused connectors. Can be used on all GI/IS IOTAs.					**MTL4599**	varies

*When using the MTL4517's only 30 DI channels are available and a MTL4599 is required in channels 31 and 32. In order to see the line fault detect indicator:

- Channel 31 is configured as a DI input for alarms
- Channel 32 is not available for use as an input.

Refer to Open Wire Detection - DI Channel blocks for GI-IS limitations and usage.

- **Line-Fault Detection (LFD) - Digital Input GI/IS only**

19.1.1 Line-Fault Detection (LFD) - Digital Input GI/IS only

In the event of an open or shorted circuit in the field wiring, the resistance sensed at the input to the Galvanic Isolation Module is a high value. This permits the readback of the **Digital Input IOMs** to detect the open or shorted field circuit and indicate a wiring problem to the user.

An open wire is defined as a resistance of 7k ohms, or greater and shorted wire is defined as less than 55-ohms resistance.

The following GI/IS isolators support line fault detection for Digital Input:

- MTL4510 has LED indicator on isolator when line fault detection occurs
- MTL4511 has LED indicator on isolator when line fault detection occurs
- MTL4516 has LED indicator on isolator when line fault detection occurs
- MTL4517 has LED indicator on isolator and reports line fault detection back to the system

IF LFD is enabled (through a switch on the device) for any channel two resistors must be installed - a 22k resistor across the switch 680 resistor in series with the power supply lead. This feature detects both open and short circuits.

CHAPTER

20

GI/IS POWER AND GROUNDING REQUIREMENTS

The power requirement for the IOTAs is a nominal +24 Vdc.

- Grounding and power considerations -GI/IS IOTA boards

20.1 Grounding and power considerations -GI/IS IOTA boards

The Series C cabinet allows mounted carriers that support the attachment of the IOTA boards. By making these connections, power and chassis grounding is provided to the IOTA board.

- Testing for power for GI/IS
- Testing for power at the GI/IS IOTA screw
- Testing for power at 24V bus bar top terminal for the GI/IS

20.1.1 Testing for power for GI/IS

CAUTION

Extreme care should be taken when testing for power at the Series C bus bars. Improper testing can result in an electrical short, which will impact all modules attached to the channel carrier assembly.

Never use a test probe at an unattached IOTA's 24V screw hole. The probe can potentially touch the back channel assembly causing a short.

The following locations are recommended for testing power:

Preferred location if IOTAs are attached

- Center of the screw that attaches the IOTA to the 24V bus bar.

Preferred location if IOTAs are NOT attached.

- Center of the screw of top connection terminal for power cable.

WARNING

Testing for power at the Series C bus bars must only be conducted when the area has been verified to be nonhazardous.

20.1.2 Testing for power at the GI/IS IOTA screw

Refer to the **Caution** above at Testing for power

1. Insert the test probe at the center of the screw that attaches the IOTA to the 24V power connection.
2. Verify that a nominal +24V dc is present.
3. This concludes this procedure.

20.1.3 Testing for power at 24V bus bar top terminal for the GI/IS

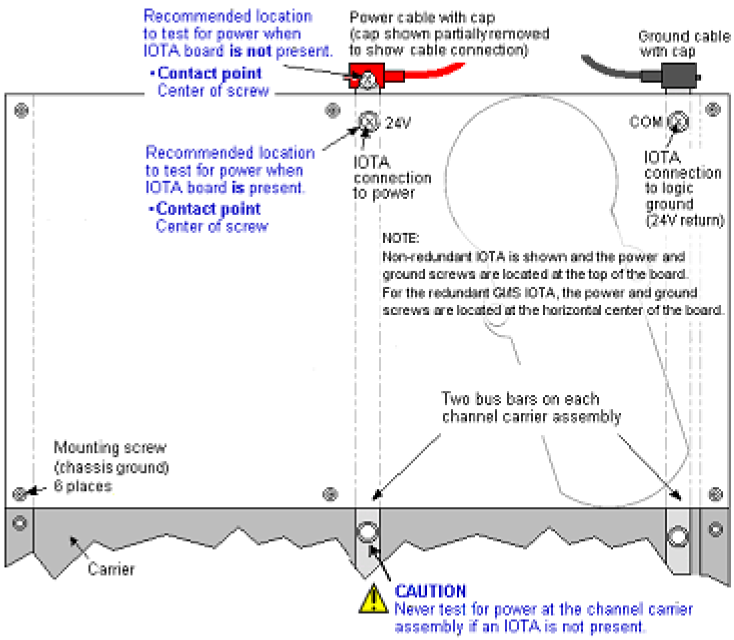
> WARNING
>
> Testing for power at the Series C bus bars must only be conducted when the area has been verified to be nonhazardous.

Refer to **Caution** above at Testing for power.

1. Carefully pull the red cap from the top of the terminal. It remains attached to the power cable.
   - Insert the test probe at the center of the screw to the 24V power terminal.
2. Carefully pull the black cap from the top of the terminal. It remains attached to the ground cable.

   Insert the test probe at the center of the screw to the COM ground terminal.
3. Replace the both caps.
4. This concludes this procedure.

Figure 20.1 GI/IS Grounding and power connections



CHAPTER

21

GI/IS INSTALLATION

21.1 GI/IS Shield Connection Options

Shielded field wiring is not required for any of the Series C GI/IS IOTAs. If shielded field wiring is used, the shield connections must follow these rules:

1. The shield must only be terminated at one end. That is, if the shield is terminated at the field device, it must not be terminated in the cabinet, and vice versa.
2. If the shield is to be terminated in the cabinet, the connection must be made to the vertical shield bar to the left of the IOTA tray.
3. Any shield bars used for GI/IS shields must be used for GI/IS wiring only, and must be connected to a dedicated IS ground system."

21.2 Installing the GI/IS IOTA onto the carrier

The mounting of the GI/IS IOTA is similar to the standard Series C IOTA with the exception that there is an additional set of mounting screws to accommodate the wider GI/IS IOTA. You select the desired mounting location on carrier and then align the mounting holes in the IOTA with screw-hole locations on the carrier.

> TIP
>
> The IOMs and isolators should be removed prior to installing the IOTA onto the carrier. This allows for easier installation of the IOTA.

- 6 inch GI/IS IOTA board 6 mounting screws
- 12 inch GI/IS IOTA board 9 mounting screws

When mounting the 12 inch IOTA board, it is recommended to:

- secure the mounting screws on one side (either left or right)
- secure the mounting screws in the middle
- and then secure the other side

> ATTENTION
>
> Securing the corner screws and then the middle screws may cause bowing of the board and impact the alignment of the IOTA board to the carrier holes and is not recommended.

Refer to the following instructions to see how the IOTA is mounted: Mounting the IOTA.

Refer to the following graphic to see how GI/IS IOTA board is mounted: Figure 1.

21.3 Installing the IOM onto the GI/IS IOTA

The mounting of the IOM on a GI/IS IOTA is similar to mounting the IOM on the standard Series C IOTA.

Refer to the following instructions to see how the IOM is mounted on the IOTA: Mounting the module.

21.4 Installing the isolator

The isolator can be installed with or without the field wiring connected to the terminals. There is no special sequence required for connecting the isolators to the IOTA board, although starting with the upper most available connector allows for ease of making the connection.

Refer to Preparing the isolator for installation

> ATTENTION
>
> Make sure the isolator is fully seated on the board by firmly pushing down on it.
>
> - The black side tabs secure the isolator mechanically to the IOTA.
> - More importantly, the gray bottom connector on the isolator needs to be fully seated on the IOTA to ensure a true electrical connection.

21.4.1 To install the isolator

1. Properly align isolator into connectors.
2. Push down firmly on the isolator allowing the connector to be securely seated. The side tabs located on the IOTA lock the isolator in place.
3. This concludes this procedure.

Figure 21.1 Mounting a module onto an IOTA

- Precautions
- Preparing the isolator for installation
- Installing the isolator

21.4.2 Precautions

Make sure that all installation work is carried out in accordance with all relevant local standards, codes of practice and site regulations.

Check that the hazardous-area equipment complies with the descriptive system document.

If in doubt, refer to the certificate/catalog for clarification of any aspects of intrinsic safety, or contact MTL or your local MTL representative for assistance.

WARNING

Replacing an isolator must only be performed when the area has been determined to be non-hazardous.

WARNING

When installing MTL4500 Series isolators it is essential to make sure that intrinsically safe and non-intrinsically safe wiring is segregated as required by a nationally accepted authority or as described in IEC 60079-14, ANSI/ISA RP12.6 or DIN VDE-165.

WARNING

When plugging isolators onto an IOTA and hazardous-area terminal plugs onto the isolators, check the identification labels to make sure the items match correctly. It is recommended that the connector is identified by the same tag number as the matching isolator.

21.4.3 Preparing the isolator for installation

Ensure proper isolator is used for the appropriate IOTA.

Refer to *GI/IS IOTAs and Isolators* table for proper Isolator and IOTA association table.

ATTENTION

MTL4575 - For thermocouple inputs requiring cold junction compensation a blue terminal plug HAZ-CJC hazardous-area (with integrated CJC sensor) is necessary.

Refer to the following: *Terminal wiring connections table*.

To prepare the isolator for installation

1. Terminate hazardous area circuits on blue connector(s).
2. Segregate intrinsically safe and non-intrinsically safe cables as required by a nationally accepted authority or as described in PD60079.14:2000 (BS5345 is now obsolescent) - ISA RP 12.6 or DIN/VDE-0165.
3. This concludes this procedure.

21.4.4 Installing the isolator

The isolator can be installed with or without the field wiring connected to the terminals. There is no special sequence required for connecting the isolators to the IOTA board, although starting with the upper most available connector allows for ease of making the connection.

Refer to Preparing the isolator for installation

ATTENTION

Make sure the isolator is fully seated on the board by firmly pushing down on it.

- The black side tabs secure the isolator mechanically to the IOTA.
- More importantly, the gray bottom connector on the isolator needs to be fully seated on the IOTA to ensure a true electrical connection.

To install the isolator

1. Properly align isolator into connectors.
2. Push down firmly on the isolator allowing the connector to be securely seated. The side tabs located on the IOTA lock the isolator in place.
3. This concludes this procedure.

Figure 21.2 Mounting a module onto an IOTA

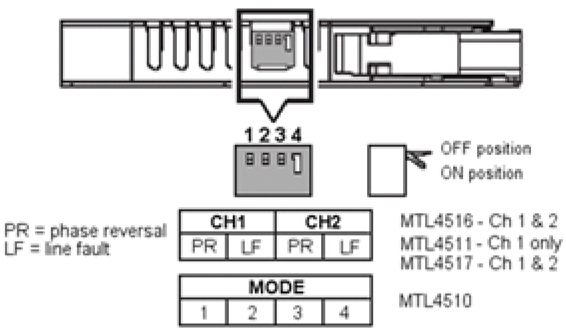
- Precautions
- Preparing the isolator for installation
- Installing the isolator

21.5 Setting Operation mode through Digital Input isolator DIP switches

Different modes of operation are available with the DI isolators and these are set using internal DIP switches, accessible through vents on the edge of the module.

> TIP
>
> Set switches to the required mode before installation.

Figure 21.3 DI module switch setting



21.5.1 To set the DIP switches

1. Toggle the appropriate switch (refer to the DIP switch setting tables) using a small slotted screw-driver.
2. This concludes this procedure.

   See the following tables that define the appropriate DIP switch settings for the various Digital Input isolators.

21.6 MTL4510

This four-channel digital isolator has solid state output switches in a safe-area that respond to input switches in a hazardous area. The way they respond depends upon the switch settings.

Table 21.1 MTL4510 isolator DIP switch settings

Mode	o/p 1	SW1-4	o/p 2	o/p 3	o/p 4	I/p type
0	0000	chA	chB	chC	chD	switch
1	0001	chA rev.	chB	chC	chD	
2	0010	chA	chB rev	chC	chD	
3	0011	chA	chB	chC rev	chD	
4	0100	chA	chB	chC	chD rev	
5	0101	chA rev	chB	chC rev	chD	
6	0110	chA	chB rev	chC	chD rev	
7	0111	chA rev	chB rev	chC rev	chD rev	
8	1000	chA	chB	chC	chD	prox detector + LFD
9	1001	chA rev	chB	chC	chD	
10	1010	chA	chB rev	chC	chD	
11	1011	chA	chB	chC rev	chD	
12	1100	chA	chB	chC	chD rev	
13	1101	chA rev	chB	chC rev	chD	
14	1110	chA	chB rev	chC	chD rev	
15	1111	chA rev	chB rev	chC rev	chD rev	

Table 21.2 Module input/output operation

Operation	Input value	Direct acting	Reverse acting	LFD	LED	Relay/ output	MTL4511/MTL4717 LFD relay
Normal	<1.2mA	On	-	On	Off	De-energized / On	De-energized
	>2.1mA	On	-	On	On	Energized / Off	De-energized
	<1.2mA	-	On	On	On	Energized / Off	De-energized
	>2.1mA	-	On	On	Off	De-energized / On	De-energized
Broken line	<50uA	On	-	On	Off	De-energized / On	Energized
	<50uA	-	On	On	Off	De-energized / On	Energized
	<50uA	On	-	Off	Off	De-energized / On	De-energized

Operation	Input value	Direct acting	Reverse acting	LFD	LED	Relay/ output	MTL4511/MTL4717 LFD relay
	<50uA	-	On	Off	On	Energized / Off	De-energized
Shorted line	6.5mA	On	-	On	Off	De-energized / On	Energized
	6.5mA	-	On	On	Off	De-energized / On	Energized
	6.5mA	On	-	Off	On	Energized / Off	De-energized
	6.5mA	-	On	Off	Off	De-energized / On	De-energized

21.7 MTL4511 / 4516 / 4517

For switch sensor inputs, with LFD selected, make sure resistors (22k ohms and 680 ohms) are fitted.

Table 21.3 MTL4511 isolator DIP switch settings

Mode		Functionality
0	0000	Phase reversal and LFD not enabled
1	1000	Phase reversal enabled
2	0100	Line Fault Detection enabled

Table 21.4 MTL4516 isolator DIP switch settings

Mode		Functionality
0	0000	Phase reversal and LFD not enabled
1	0001	Ch1 Phase reversal enabled
2	0010	Ch1 Line Fault Detection enabled
3	0100	Ch2 Phase reversal enabled
4	1000	Ch2 Line Fault Detection enabled

Table 21.5 MTL4517 isolator DIP switch settings

Mode		Functionality
0	0000	Phase reversal and LFD not enabled
1	0001	Ch1 Phase reversal enabled
2	0010	Ch1 Line Fault Detection enabled
3	0100	Ch2 Phase reversal enabled
4	1000	Ch2 Line Fault Detection enabled

21.8 Field Wiring Connections

The GI/IS IOTAs do not have field terminal connectors mounted directly on the IOTAs; instead, field wires are connected to screw-clamp terminals that mate with the connector on the individual Galvanic Isolation module.

TIP

The terminal plugs are keyed to be inserted in specific openings in the isolator. The label on the terminal plug gives an indication into which isolator openings the plug fits.

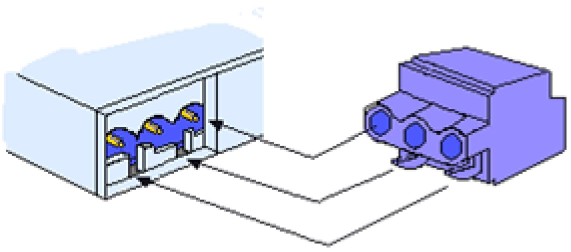
ATTENTION

When using crimp ferrules for the hazardous and non-hazardous (safe) signal connectors the metal tube length should be 12mm and the wire trim length 14mm.

21.8.1 To install the terminal plug into the isolator

1. Align the terminal plug's openings and alignment tabs to match the pins and openings on the isolator. The label on the terminal plug identifies into which isolator openings it must be inserted.
2. Firmly press the terminal plug in the isolator ensuring a snug fit.
3. This concludes this procedure.

Figure 21.4 Inserting the terminal plug into the isolator



- Isolator plug-in capability
- Isolator removal
- Screw-clamp terminals

21.8.2 Isolator plug-in capability

The isolator connector's plug-in capability allows:

- for the field wiring to be connected to the terminal plug while the terminal plug is not connected to the isolator. This allows for a possibly easier field wire-to-terminal plug process.
- replacement of the isolator and retaining the field wiring connection to the terminal plug. After the isolator is replaced, the terminal plug can be re-inserted into the new isolator.

21.8.3 Isolator removal

WARNING

> Replacing an isolator must only be performed when the area has been determined to be non-hazardous.

A failed isolator or GI/IS IOTA is replaced simply by unplugging the field wire terminal plug on the isolator, then removing and replacing the isolator/IOTA. The individual wires do not have to be disconnected from the terminal plug.

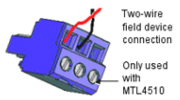
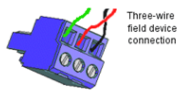
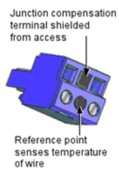
21.8.4 Screw-clamp terminals

Compression-type terminal connectors are specified for the terminal plugs.

21.9 Screw-terminal wiring

The following table defines the layout of the terminal plugs that support their corresponding isolators.

Table 21.6 Terminal wiring connections

Isolator	2 wire	3 wire	Ref. pt.	Terminal wiring
MTL4510 - four channel, multifunctional digital	X			
MTL4511 - single channel, LFD	X			
MTL4516 - two channel, LFD	X			
MTL4517 - two channel, LFD and phase reversal	X			
MTL4521 - loop-powered, IIC	X			
MTL4541 - single channel	X	X		
MTL4544 - two channel	X	X		HAZ-CJC connector
MTL4546C - single channel, HART valve positioners, LFD	X			
MTL4549C - two channel, HART valve positioners, LFD	X			
MTL4575 - single channel, temperature converter			X	
MTL4599 - dummy isolator	n/a	n/a	n/a	

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CHAPTER

22

GI/IS IOTA PINOUTS

22.1 GI/IS Analog Input IOTA Model CC-GAIX11

The model CC-GAIX11 Analog Input IOTA accommodates up to sixteen 4-20 mA input signals. This IOTA supports redundancy and allows galvanically isolated inputs from the following isolators:

- MTL4541 - single channel 4-to-20 mA isolator with HART®
- MTL4544 - dual channel 4-to-20 mA isolator with HART®
- MTL4575 - thermocouple/RTD isolating converter with 4-to-20 mA output (or something similar).
- MTL4599 - dummy, terminates unused connectors

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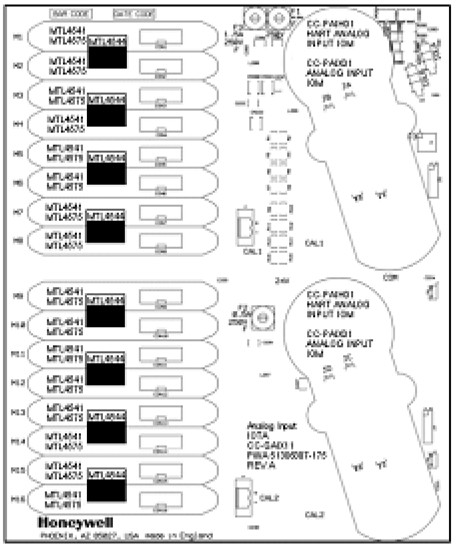
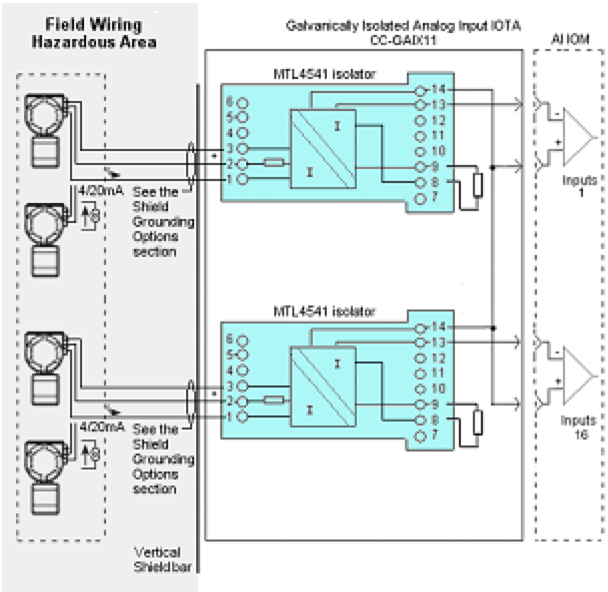
22.1.1 CC-GAIX11 Analog Input IOTA

Figure 22.1 CC-GAIX11 Analog Input IOTA



22.1.2 CC-GAIX11 Analog Input IOTA connection diagram

Figure 22.2 CC-GAIX11 Analog Input IOTA connection diagram



22.2 GI/IS Analog Input IOTA Model CC-GAIX21

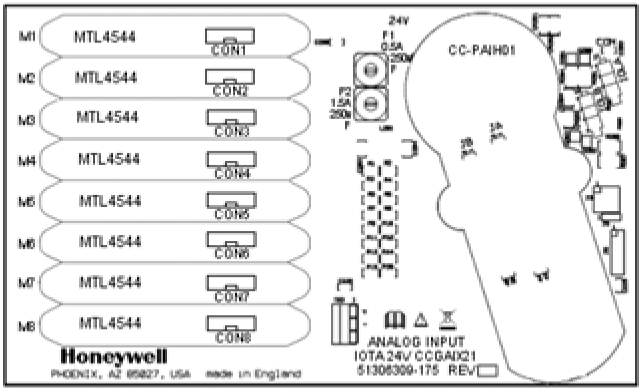
The model CC-GAIX21 Analog Input IOTA accommodates up to sixteen high level dc signals. This IOTA does not support redundancy and allows galvanically isolated inputs from the MTL4544 (two channel) isolator.

- MTL4544 - dual channel 4-to-20 mA isolator with HART®
- MTL4599 - dummy, terminates unused connectors

Refer to GI/IS IOTA models for a complete list of supported Series C IOTA and their corresponding isolators.

22.2.1 CC-GAIX21 Analog Input IOTA

Figure 22.3 CC-GAIX21 Analog Input IOTA



22.2.2 CC-GAIX21 Analog Input IOTA connection diagram

Figure 22.4 CC-GAIX21 Analog Input IOTA connection diagram

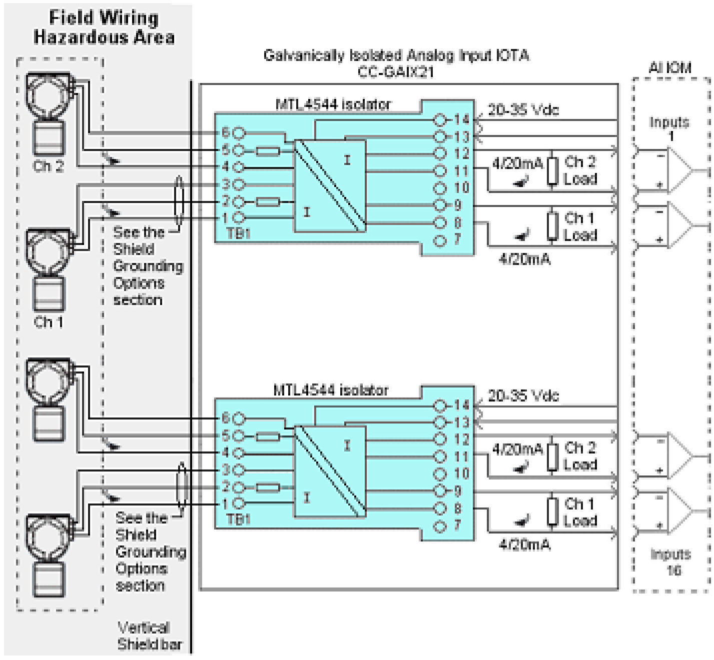
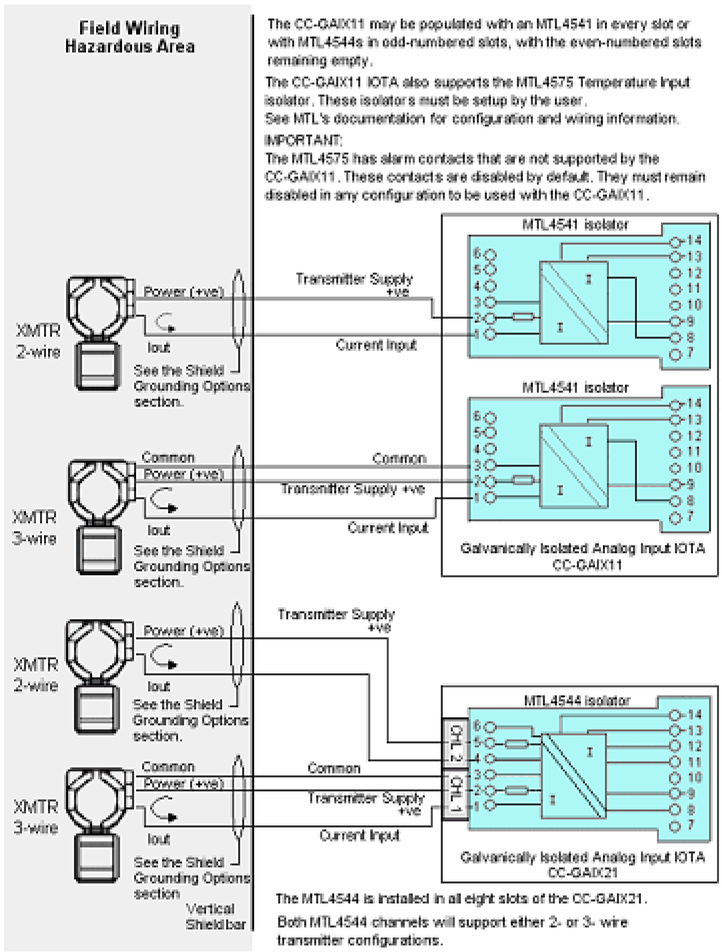


Figure 22.5 Transmitter Field Wiring to CC-GAIX11/GAIX21 IOTAs



22.2.3 Analog Input supported isolators

The following table defines important distinctions between the various isolators and the Analog Input IOTAs they support.

Table 22.1 AI IOTAs and their supporting isolators

Item	MTL4541 CC-GAIX11	MTL4544 CC-GAIX11 CC-GAIX21	MTL4575 CC-GAIX11
Maximum current consumption (with 20mA signal)	51mA at 24V	95mA at 24V	60mA at 24V 50mA at 20V 35mA at 35V
Maximum power dissipation within isolator (with 20mA signal)	0.7W at 24V	1.4W at 24V	0.7W at 24V 1.2W at 35V
Isolation	250V ac between hazardous area and safe/power supply circuits 100V ac between safe and power supply circuits	250V ac between hazardous area and safe/power supply circuits 100V ac between safe and power supply circuits	Three port isolation 250V ac between safe- and hazardous-area circuits. Input circuit's floating.
Temperature drift	<0.8μA/degrees C	<0.8μA/degrees C	**Inputs:** mV/THC: ±0.003% of input value/°C THC line resistance:600Ωmax RTD: ±7mΩ/°C Output: ±0.6μA/°C
Safety description	**Terminals 2 to 1 and 3:** Vo=28V Io=93mA Po=651mW Um = 253V rms or dc **Terminals 1 to 3:** Non-energy-storing apparatus ≤1.2V, ≤0.1A, ≤20μJ and ≤25mW;can be connected without further certification into any IS loop with an open-circuit voltage <28V	**Terminals 2 to 1 and 3, and 5 to 4 and 6:** Vo=28V Io=93mA Po=651mW Um = 253V rms or dc **Terminals 1 to 3 and 4 to 6** Non-energy-storing apparatus ≤1.2V, ≤0.1A, ≤20μJ and ≤25mW;can be connected without further certification into any IS loop with an open-circuit voltage <28V	**Terminals 5 and 6** Non-energy-storing apparatus ≤1.2V, ≤0.1A, ≤20μJ and ≤25mW.Can be connected without further certification into any IS loop with an open-circuit voltage not more than 10V. **Terminals 1 and 2** Vo=7.2V Io=8mA Po=144mW Um = 253V rms or = dc **Configuration socket** Vi=11.2V Ii=12mA Pi=280mW Vo=7.2V Io=14.5mA Po=26mW

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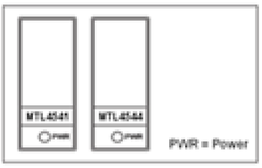
22.2.4 MTL4541 / 4544

The following isolators are available for Analog Input GI/IS IOTAs.

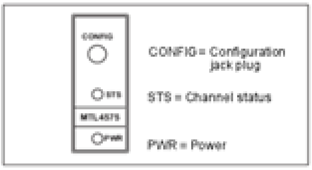
Figure 22.6 Analog Input - MTL4541 and MTL4544 isolator LED indicators



22.2.5 MTL4575

Before placing the isolator into operation, the interface unit must be configured for the particular application

Figure 22.7 Temperature - MTL4575 isolator LED indicators



22.2.6 Testing Temperature Converter- MTL4575

1. Connect a link between terminals 1 and 5.
2. Connect 2-wire transmitter between terminals 2(+ve) and 4(-ve). Both outputs will now repeat the current in the transmitter loop.

> **NOTE**
> HART data is transferred through channel 1

3. This completes this procedure.

The following table lists the isolator's LED status and description.

Table 22.2 MTL4575, power and status information

LED status	Description
ON	Unit working normally
Slow flash	Output of 1mA, module in low alarm or downscale drive
Fast flash	Output of 21mA, module in high alarm or upscale drive
Off	No power to unit

22.2.7 Default configuration

Unless ordered differently, every MTL4575 module is supplied with the following default configuration.

- Input Type K thermocouple
- Linearization enabled
- Units degrees C
- CJ Compensation enabled
- Damping value 0 seconds
- Smoothing value 0 seconds
- Output zero 0 degrees C
- Output span 250 degrees C
- Tag and description fields blank
- Open circuit alarm set high (upscale)
- Transmitter failure alarm set low (downscale)
- CJ failure alarm set low (downscale)
- Line frequency 50Hz

22.2.8 Configuration using PCS45/PCL45

The PCS45 software, used in conjunction with PCL45 serial link, is the method to configure the MTL4575 isolators. Instructions are contained within the configuration software.

Refer to the following: PCS45 Configuration Software.

22.2.9 Field Wiring Input Signals

Each Galvanic Isolation Module on the AI IOTA provides a floating dc source for energizing conventional 2-wire or 3-wire, 4-20 mA transmitters. The Galvanic Isolation Module accurately converts the input current into a 1 to 5 volt output signal to the associated IOM.

22.2.10 Field Wiring Input Signals

Each Galvanic Isolation Module on the AI IOTA provides a floating dc source for energizing conventional 2-wire or 3-wire, 4-20 mA transmitters. The Galvanic Isolation Module accurately converts the input current into a 1 to 5 volt output signal to the associated IOM.

22.3 Analog Output GI/IS IOTAs

The galvanically isolated Analog Output (AO) IOTAs isolate up to sixteen 4-20 mA signals that can drive current-to-pressure (I/P) transducers, position actuators, or any load between 90 and 800 ohms from the associated Analog Output IOM. Additionally, bi-directional HART® communications with 4-20mA field devices and HART® hand-held communicators are supported.

The GI/IS Analog Output (AO) IOTAs provide the following features:

- An Intrinsically Safe (IS) interface directly to hazardous-area processes
- Galvanic Isolation (GI) eliminating the high integrity ground required for Zener barriers
- Compact design for reduced cabinet space
- A reduced total installed cost compared to separate Zener barrier or isolator approaches
- The plug-in MTL isolators on the IOTAs, incorporate both the galvanic isolation and intrinsic safety functions and additionally provide:
    - Single loop integrity (MTL4546C)
    - Ease of maintenance
    - Simplified wiring, because hazardous field wiring can be brought directly to the isolators on the IOTAs, eliminating the need for separate IS barriers

Two models are available:

CC-GAOX11 - Redundant Analog Output IOTA

CC-GAOX21 - Non-Redundant Analog Output IOTA

22.4 GI/IS Analog Output IOTA Model CC-GAOX11

The model CC-GAOX11 Analog Output IOTA provides up to sixteen 4-20 mA output channels. This IOTA supports redundancy and accepts the following GI/IS isolators:

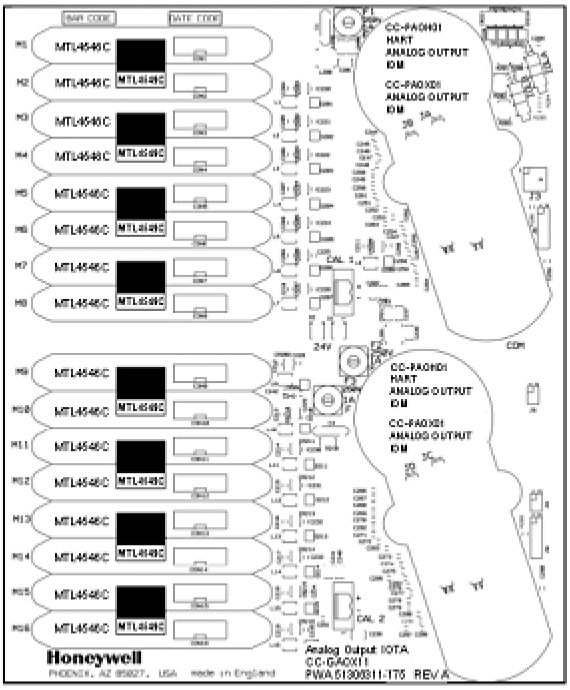
- MTL4546C - one channel HART® with open wire detection
- MTL4549C - two channel HART® with open wire detection
- MTL4599 - dummy, terminates unused connectors

Refer to GI/IS IOTA models for a complete list of supported Series C IOTA and their corresponding isolators.

- **CC-GAOX11 Analog Output IOTA**
- **CC-GAOX11 Analog Output IOTA connection diagram**

22.4.1 CC-GAOX11 Analog Output IOTA

Figure 22.8 CC-GAOX11 Analog Output IOTA



22.4.2 CC-GAOX11 Analog Output IOTA connection diagram

Figure 22.9 CC-GAOX11 Analog Output IOTA connection diagram

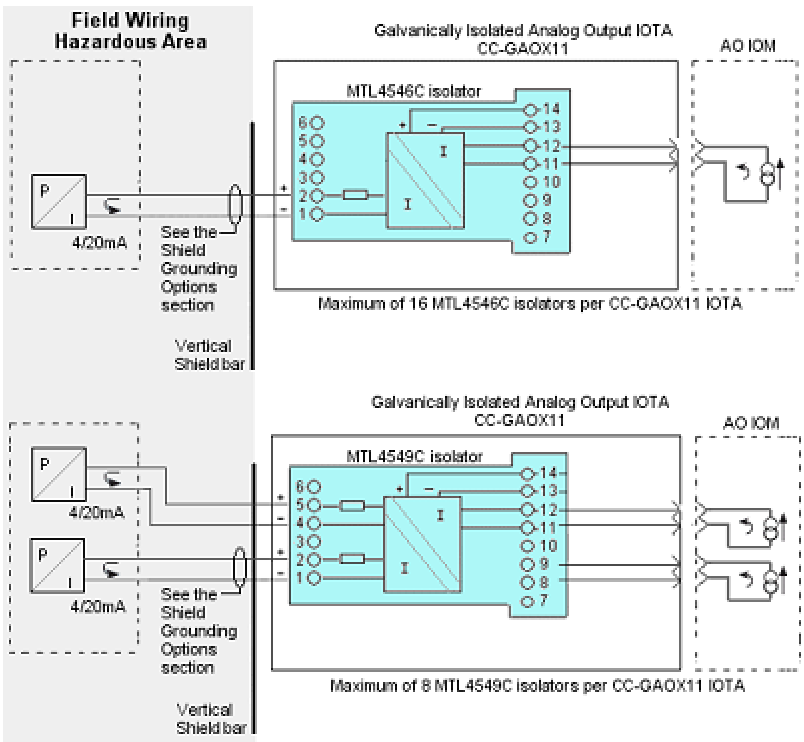
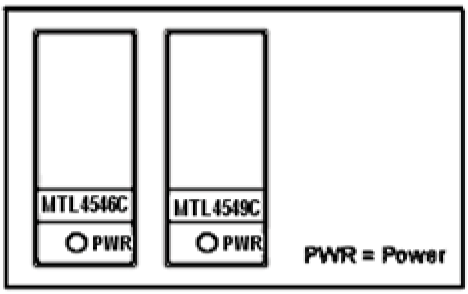


Figure 22.10 Analog Output - MTL4546C and MTL4549C LED indicators



22.5 GI/IS Analog Output IOTA Model CC-GAOX21

The model CC-GAOX21 Analog Output IOTA provides up to sixteen 4-20 mA output channels. This IOTA does not support redundancy and accepts only the dual-channel GI/IS isolator below:

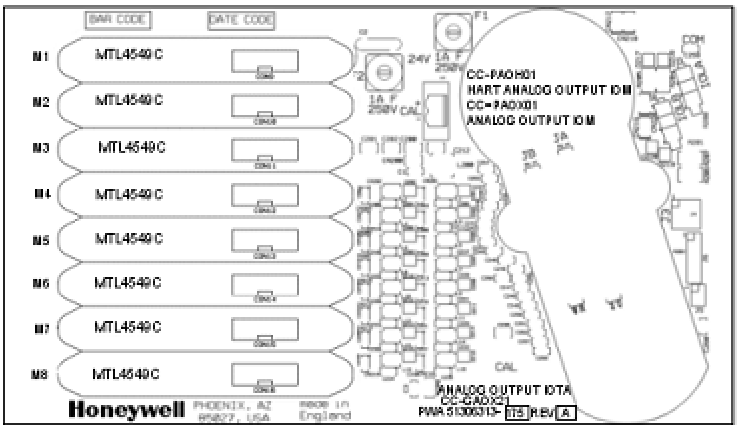
- MTL4549C - two channel HART® with open wire detection.
- MTL4599 - dummy, terminates unused connectors

Refer to GI/IS IOTA models for a complete list of supported Series C IOTA and their corresponding isolators.

- CC- GAOX21 Analog Output IOTA
- CC-GAOX21 Analog Output IOTA connection diagram
- Analog Output supported isolators

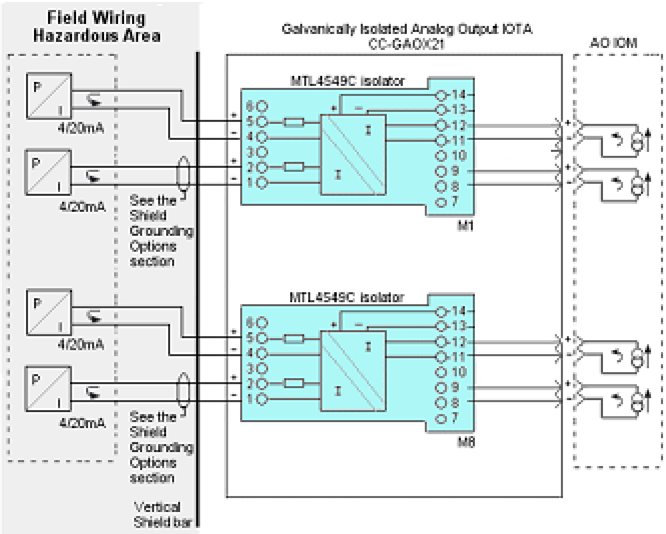
22.5.1 CC- GAOX21 Analog Output IOTA

Figure 22.11 CC-GAOX21 Analog Output IOTA



22.5.2 CC-GAOX21 Analog Output IOTA connection diagram

Figure 22.12 CC-GAOX21 Analog Output IOTA connection diagram



22.5.3 Analog Output supported isolators

The following table defines important distinctions between the various isolators and the Analog Output IOTAs they support.

Table 22.3 AO IOTAs and their supporting isolators

Item	MTL4546C CC-GAOX11	MTL4549C CC-GAOX11 CC-GAOX21
Power requirement, Vs	35mA at 24V	70mA at 24V
Maximum power dissipation within isolator (with 20mA signal)	0.8W at 24V	1.6W at 24V
Isolation	250V ac between hazardous area and safe/power supply circuits	250V ac between hazardous area and safe/power supply circuits
Temperature drift	<1.0μA/degrees C	<1.0μA/degrees C
Safety description	Vo=28V Io=93mA Po=651mW Um = 253V rms or dc	Vo=28V Io=93mA Po=651mW Um = 253V rms or dc

22.6 24 Vdc Digital Input GI/IS IOTAs

The galvanically isolated Digital Input (DI) IOTAs isolate up to thirty-two 24V signals that allows galvanically isolated inputs from-switches and proximity detectors.

- **Input signal phase and IOTA features**

22.6.1 Input signal phase and IOTA features

The phase of the input signals is selectable on the model CC-GDIL01, CC-GDIL11 and CC-GDIL21 IOTAs, allowing the alarm condition to be chosen for either state of the sensor. This is accomplished with two switches, one for each input on the top of the galvanic isolators.

22.7 GI/IS Digital Input IOTA Model CC-GDIL01

The model CC-GDIL01 Digital Input IOTA accommodates up to thirty-two 24V high level dc signals. This IOTA supports redundancy and allows galvanically isolated inputs from the following isolators:

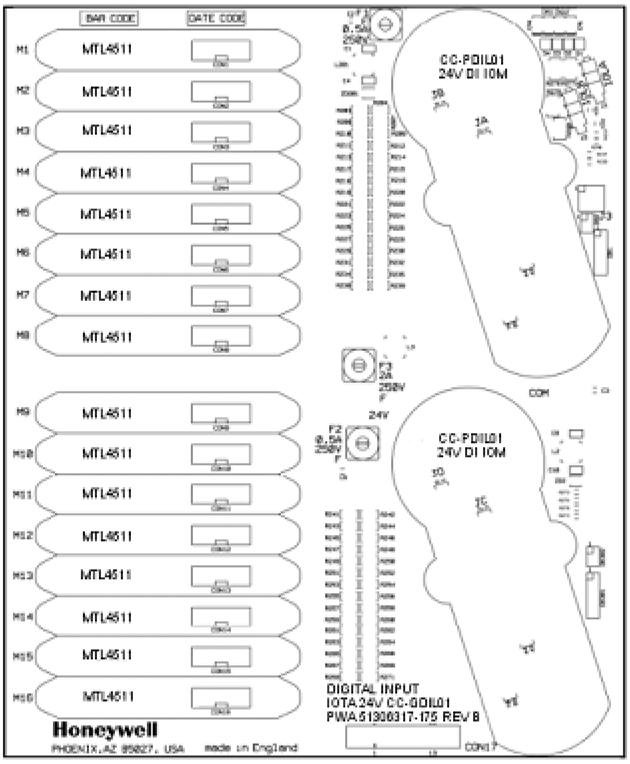
- MTL4511 - one channel with line fault detection
- MTL4599 - dummy, terminates unused connectors

Refer to GI/IS IOTA models for a complete list of supported Series C IOTA and their corresponding isolators.

- **CC-GDIL01 Digital Input IOTA**
- **CC-GDIL01 Digital Input IOTA connection diagram**

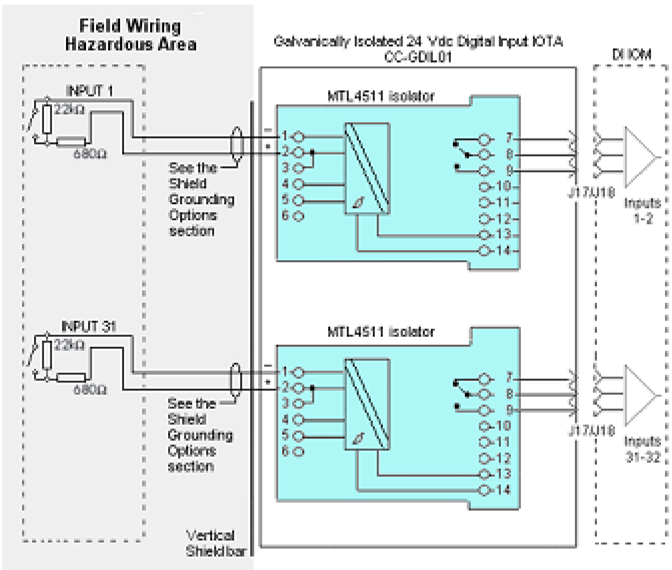
22.7.1 CC-GDIL01 Digital Input IOTA

Figure 22.13 CC-GDIL01 Analog Output IOTA



22.7.2 CC-GDIL01 Digital Input IOTA connection diagram

Figure 22.14 CC-GDIL01 Analog Output IOTA connection diagram



22.8 GI/IS Digital Input IOTA Model CC-GDIL11

The model CC-GDIL11 Digital Input IOTA accommodates up to thirty-two 24V high level dc signals.

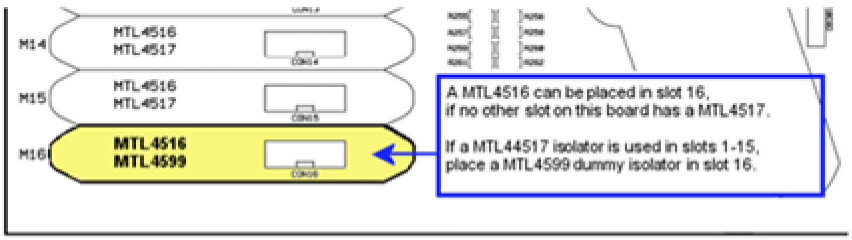
This IOTA supports redundancy and allows galvanically isolated inputs from the following isolators:

- MTL4516 - two channel with line fault detection
- MTL4517 - two channel with line fault detection and phase reversal
- MTL4599 - dummy, terminates unused connectors

Refer to GI/IS IOTA models for a complete list of supported Series C IOTA and their corresponding isolators.

The model CC-GDIL11 Digital Input (DI) IOTA accommodates up to 32 switch or proximity detector inputs from a hazardous area, isolates the signals, and presents them to the associated 24 Vdc Digital Input IOM in a safe area. The IOTA is similar to the model CC-GDIL01 IOTA, except the phase of the galvanic isolator's input to output signals are not selectable on the module, and the module's signal outputs are solid-state, instead of contacts. In addition, the IOTA has no auxiliary output connector.

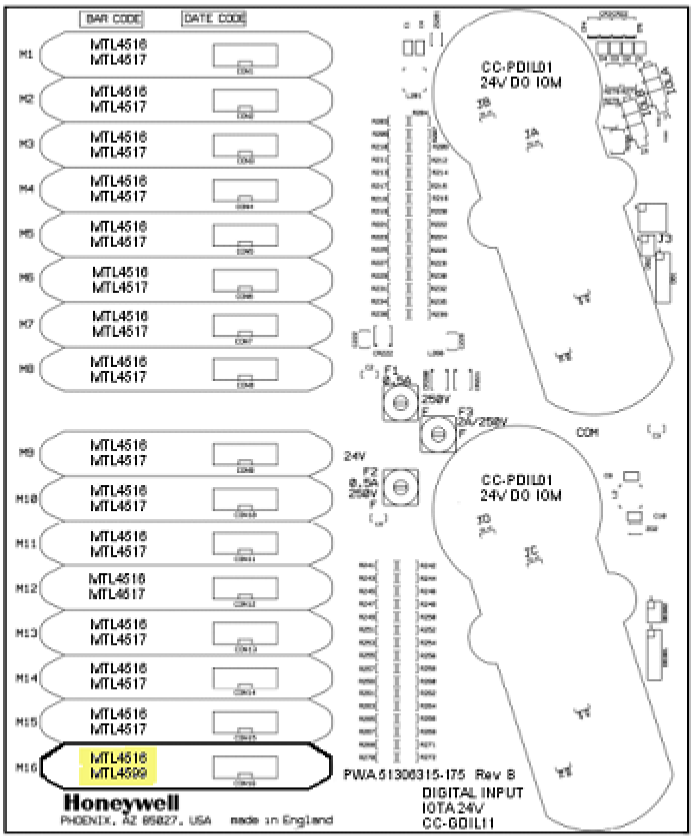
Figure 22.15 CC-GDIL11 DI and isolator usage



- CC-GDIL11 Digital Input IOTA
- CC-GDIL11 Digital Input IOTA connection diagram

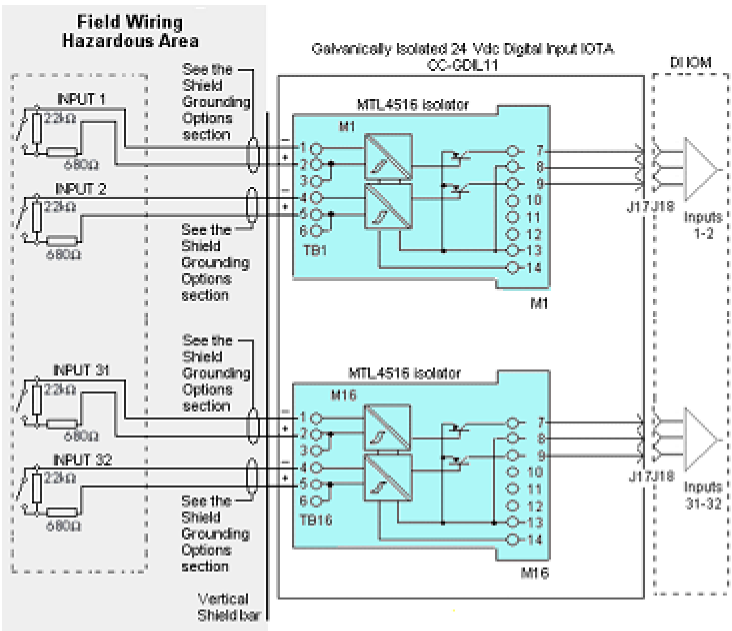
22.8.1 CC-GDIL11 Digital Input IOTA

Figure 22.16 CC-GDIL11 Digital Input IOTA



22.8.2 CC-GDIL11 Digital Input IOTA connection diagram

Figure 22.17 CC-GDIL11 Digital Input IOTA connection diagram



22.9 GI/IS Digital Input IOTA Model CC-GDIL21

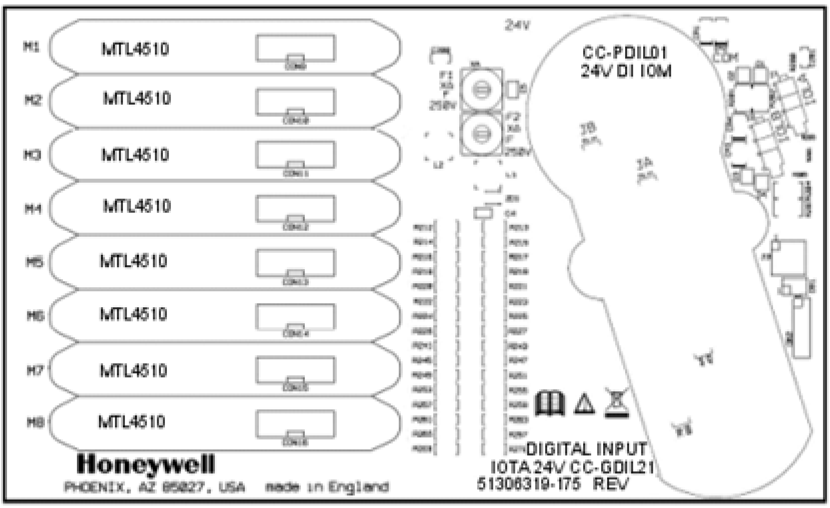
The model CC-GDIL21 Digital Input IOTA accommodates up to thirty-two 24V high level dc signals. This IOTA does not support redundancy and allows galvanically isolated inputs from the following isolators:

- MTL4510 - four channel multi-function digital input with line fault detection
- MTL4599 - dummy, terminates unused connectors

- CC-GDIL21 Digital Input IOTA
- Model CC-GDIL21 Digital Input IOTA connection diagram
- Digital Input supported isolators (MTL4510 / 4511 / 4516 / 4517)
- Digital Input isolator characteristics

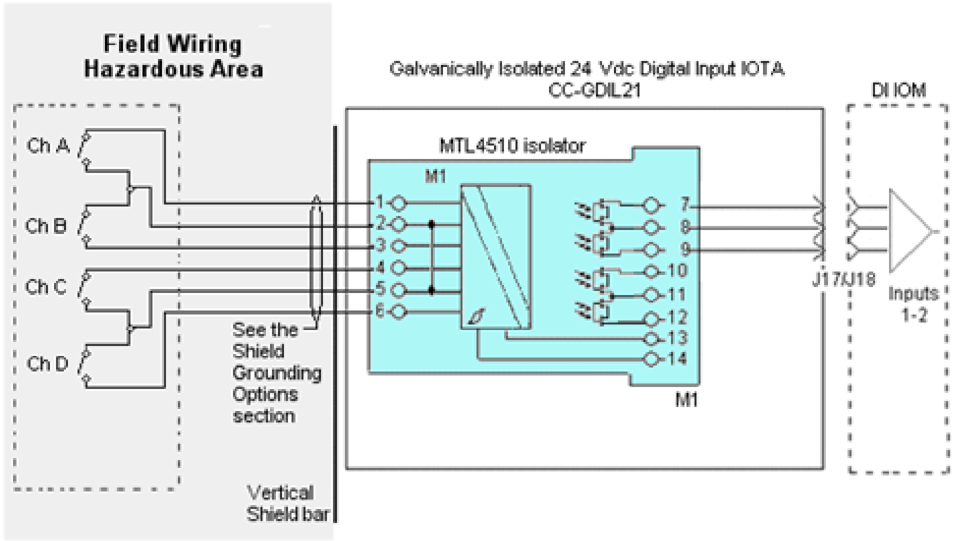
22.9.1 CC-GDIL21 Digital Input IOTA

Figure 22.18 CC-GDIL21 Digital Input IOTA



22.9.2 Model CC-GDIL21 Digital Input IOTA connection diagram

Figure 22.19 CC-GDIL21 Digital Input IOTA connection diagram

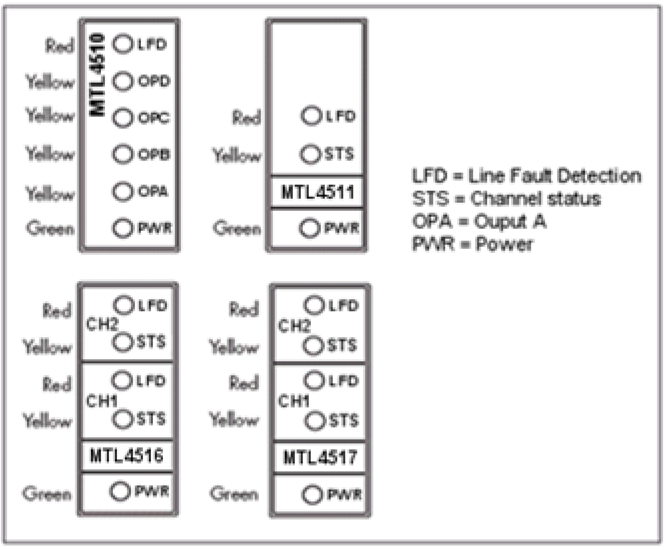


22.9.3 Digital Input supported isolators (MTL4510 / 4511 / 4516 / 4517)

If an internal fault is detected, all outputs and channel LEDs turn off and the red Fault LED turns on.

LEDs are provided to indicate the output status (STS), a line fault (LFD) and power supply status (PWR).

Figure 22.20 Digital Input - MTL451x isolator LED indicators



22.9.4 Digital Input isolator characteristics

The following table defines important distinctions between the various isolators and the Digital Input IOTAs they support.

Table 22.4 DI IOTAs and their supporting isolators

Item	MTL4510 CC-GDIL21	MTL4511 CC-GDIL01 CC-SDXX01	MTL4516 CC-GDIL11	MTL4517 CC-GDIL11
Maximum current consumption (with 20mA signal)	30mA at 24V	35mA at 20V 30mA at 24V 20mA at 35V	40mA at 20V 35mA at 24V 30mA at 35V	40mA at 20V 35mA at 24V 30mA at 35V
Maximum power dissipation within isolator (with 20mA signal)	0.88W at 24V	0.72W at 24V	0.84W at 24V	0.84W at 24V
Isolation	250V ac between power supply , hazardous-area and safe-area	250V ac or dc between power supply , hazardous-area circuits and relay outputs	250V ac or dc between power supply , hazardous-area circuits and relay outputs	250V ac between safe- and hazardous-area circuits.
Safety description	Vo = 10.5V Io = 14mA Po = 37mW Um = 253V rms or dc	Vo = 10.5V Io = 14mA Po = 37mW Um = 253V rms or dc	Vo = 10.5V Io = 14mA Po = 37mW Um = 253V rms or dc	Vo = 10.5V Io = 14mA Po = 37mW Um = 253V rms or dc

22.10 GI/IS Digital Output IOTA Model CC-GDOL11

The model CC-GDOL11 24 Vdc Digital Output (DO) IOTA can drive up to 32 channels in a hazardous area. The load can be a solenoid or an alarm, as well as a non-energy storing 'simple apparatus,' such as an LED.

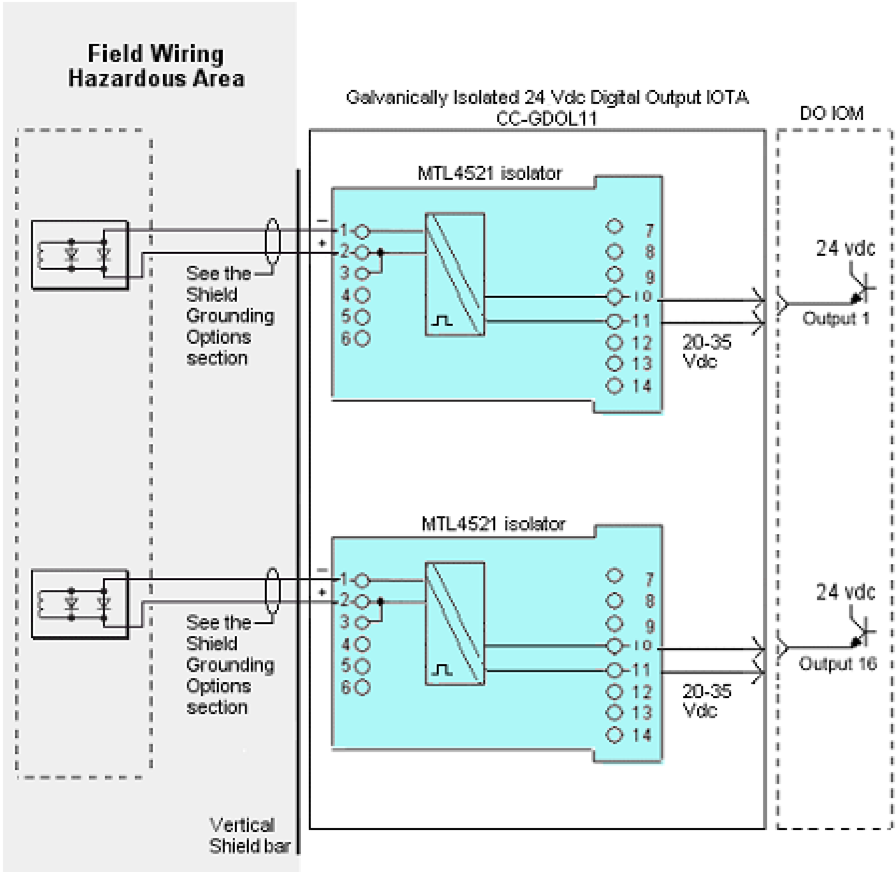
This IOTA allows galvanically isolated inputs from the following isolators:

- MTL4521 - loop-powered, IIC

- CC-GDOL11 Digital Output IOTA

22.10.1 CC-GDOL11 Digital Output IOTA

Figure 22.21 CC-GDOL11 Digital Output IOTA assembly layout



Digital Output supported isolator characteristics (MTL4521)

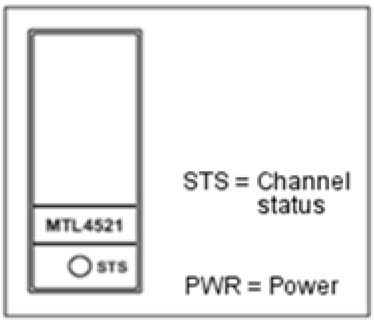
The following table defines basic features for the MTL4521 DI isolator. A 24V logic signal applied across terminals 8 and 9 allows the solenoid/alarm to be operated by the control input. If the logic signal is disconnected, the solenoid/alarm is off.

Table 22.5 DO IOTA and its supporting isolator

Item	MTL4521 CC-GDOL11
Maximum current consumption	90mA at 24V
Maximum power dissipation within isolator	1.4W at 24V
Safety description	Vo=25V Io=147mA Po=919mW Um = 253V rms or dc
LED status	On = Output state 12.8v at 48 mA

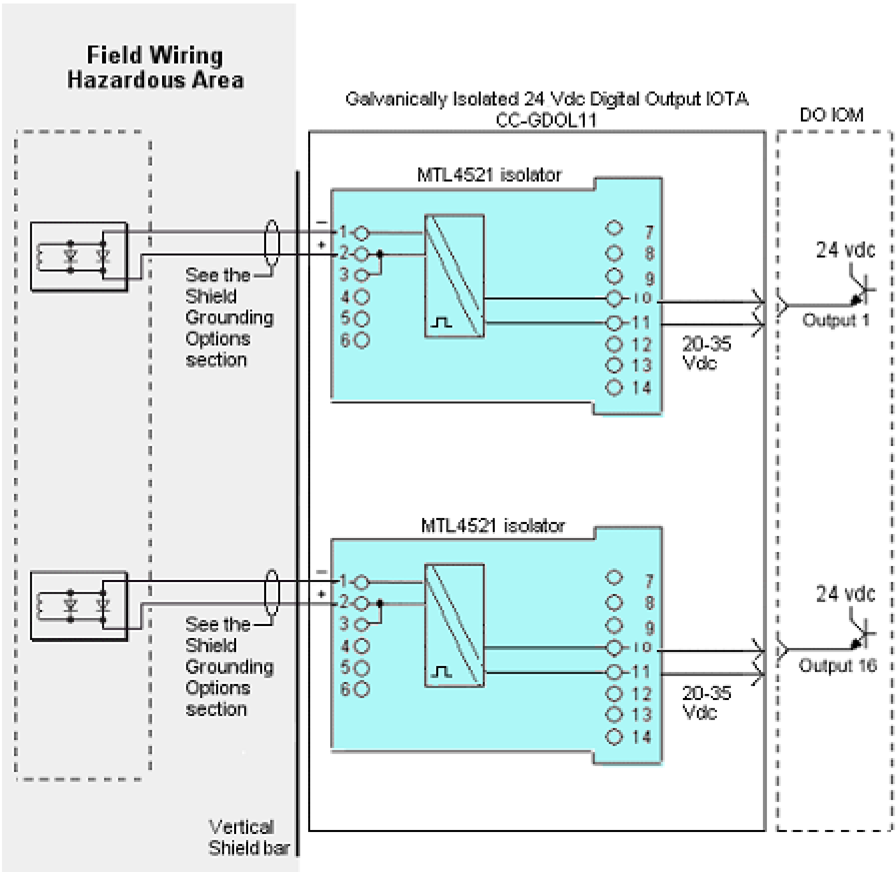
Honeywell

Figure 22.22 Digital Output - MTL4521 isolator LED indicators



22.10.2 CC-GDOL11 Digital Output IOTA

Figure 22.23 CC-GDOL11 Digital Output IOTA assembly layout



Digital Output supported isolator characteristics (MTL4521)

The following table defines basic features for the MTL4521 DI isolator. A 24V logic signal applied across terminals 8 and 9 allows the solenoid/alarm to be operated by the control input. If the logic signal is disconnected, the solenoid/alarm is off.

Table 22.6 DO IOTA and its supporting isolator

Item	MTL4521 CC-GDOL11
Maximum current consumption	90mA at 24V
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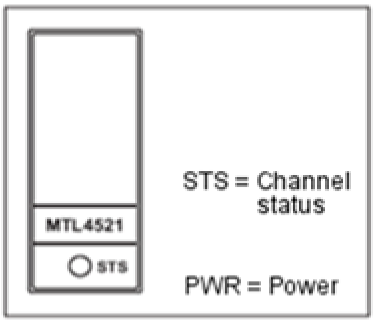
LED status	On = Output state 12.8v at 48 mA

Figure 22.24 Digital Output - MTL4521 isolator LED indicators



22.11 GI/IS Digital I/O Expander Model CC-SDXX01

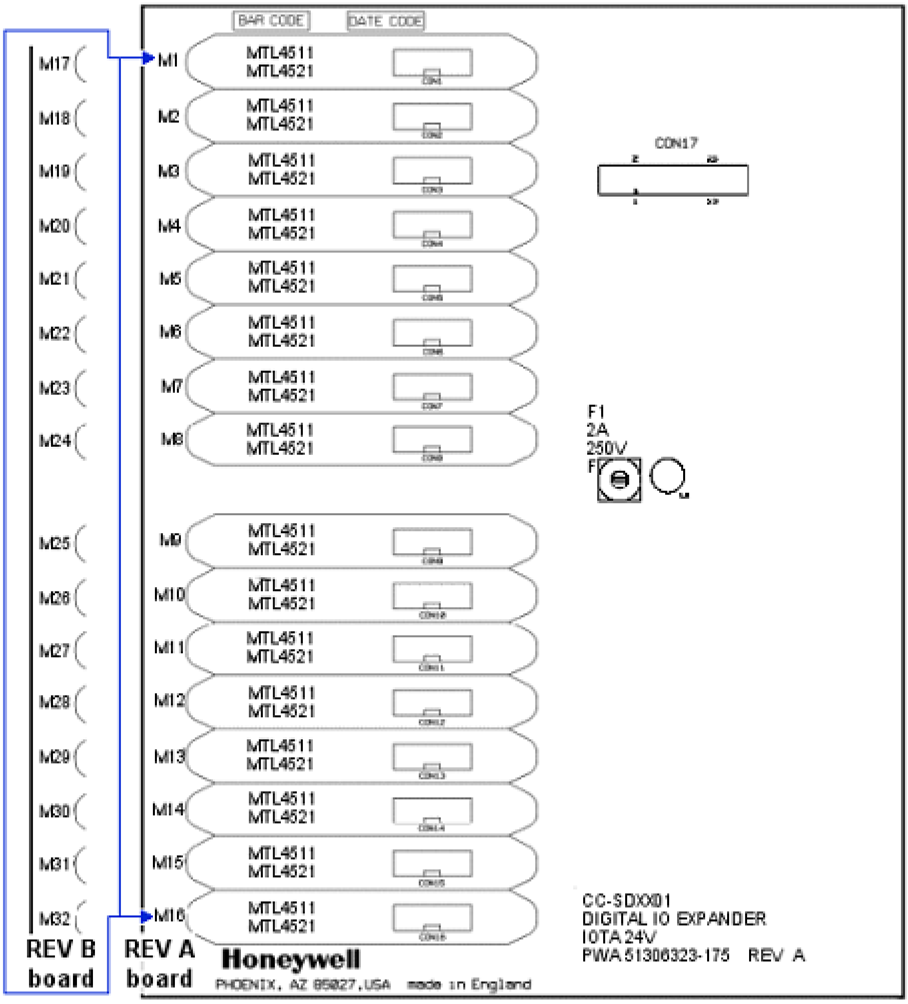
The GI/IS Digital Input/Output Expander board is displayed below. There are two versions of the CC-SDXX01 IOTA board available. The change between the two versions is solely based on changing the labels corresponding to the channels:

- Rev A board shows labels M1 through M16
- Rev B board shows labels M17 through M32

This IOTA allows galvanically isolated inputs from the following isolators:

- MTL4511 - one channel with line fault detection
- MTL4521 - loop-powered, IIC
- MTL4599 - dummy, terminates unused connectors

Figure 22.25 CC-SDXX01 Digital Output IOTA assembly layout



CHAPTER 23

PCS45 CONFIGURATION SOFTWARE

The PC-Configuration software (PCS45) allows the configuration of the MTL4575 Temperature converter isolator. Data is transmitted from the PC to the temperature converter through the PC-link PCL45 (USB).

WARNING

Not FM or CSA approved

The MTL PCL45USB pc link to the MTL4575 Temperature Converter is not approved by either FM or CSA. Therefore, the device **cannot** be used in North America (or those locations requiring FM or CSA) unless both:

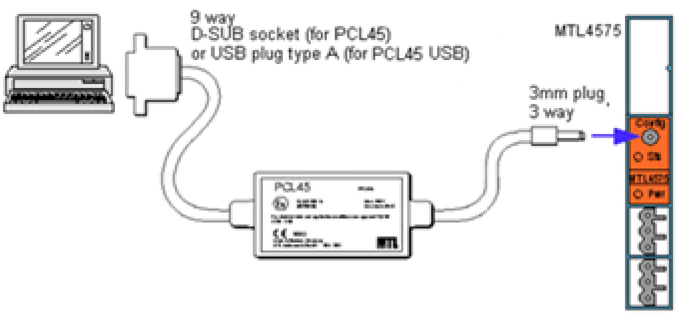
- the area where the cabinet is located (or the 4575 Converter) and
- the field devices connected to the 4575 converter are verified to be nonhazardous.

ATEX Certified

The PCL45USB is ATEX certified; however, the certification only applies to the outputs of the link that allow it to be connected to the 4575 with field wiring connections installed (and the field devices can be located in Zone 0 or Zone 1).

The ATEX certification for the link:

- does not allow the link to be located in a Zone 2 locations
- the cabinet, and or the 4575, must be within a verified nonhazardous location for the link to be connected to the 4575 Converter.



Parameters can be configured, for example sensor type, measuring range and alarm signals. These can then be saved and later used to configure other MTL4575s isolators.

For diagnostic purposes, the software allows the user to:

- look at the input and output values or
- monitor parameters over a period of time

Example: The output can be set to various currents, without affecting the input, allowing the safe area equipment to be checked or calibrated.

Operating PCS45 in Demo mode maintains all the functionality of the software but requires no connection to a temperature converter.

- PCS45 Operating Modes
- Troubleshooting the PSC45 software

23.1 PCS45 Operating Modes

The following operating modes are selectable.

Mode	Description
Offline	No connection is made between the software and the isolator. Therefore, changes in the configuration of the software will not be downloaded to the isolator.
Online	A connection is made between the software and the isolator. Any changes made to the configuration of the isolator are downloaded immediately to that isolator. The data seen in the software is identical to that in the isolator.
Demo	The 'on-line' operation and the data exchange with the transmitter are simulated. This mode can be used for training purposes.
Edit	In the 'off-line' operation, the configuration data can be edited and saved into a file on the hard drive or disk. This mode can be used in order to generate the configuration for several transmitters in the project phase.
Restricted access	The configuration details for the isolator can only be viewed or printed. Editing of the configuration settings is not allowed. Files can be loaded into the software, but when files are saved they have the filename 'DEMO.D45," this cannot be altered.
Full access	Full access is required when configuration changes to the isolator are to be made. To save the configuration file, any filename can be used. NOTE The software doesn't always indicate the operational mode it is currently in.

- Data format
- Data flow
- Temperature converter
- PC-link - PCL45 and PCL45USB
- Export and Print file
- Damping and smoothing
- Alarm signals
- Trip output value
- Menus

23.1.1 Data format

PCS45 software saves configuration data as a .D45 file extension.

23.1.2 Data flow

The PCS45 software creates and manages a copy of the transmitter's configuration data string on the computer and controls the exchange of this data between the computer/disk and the transmitter. The data flow between the copies of this data structure depends upon the operational mode.

Within the PCS45 application the following occurs:

- Various displays within the application enable the contents of these data structures to be viewed and altered.
- After a change has been made and accepted the data values are tested before the data is transferred to the data structure.
- A copy of the configuration data held in the software can be saved into or accepted from a file at any time, but the operation mode will always change to 'off-line.'

  In the 'off line' mode, no data is automatically transferred between the software and the temperature converter.
- When changes have been accepted in the 'online' operation mode, data is transmitted straight into the non-volatile memory of the temperature converter.

  If there are any errors during this data transfer the operation mode changes to 'off-line' because coherent configurations cannot be expected.
- In the demo mode, data is not transferred to the temperature converter, and any exchange is simulated.

23.1.3 Temperature converter

The temperature converter takes an mV or signal from either a thermocouple or RTD in hazardous area, and converts this to a 4/20mA signal in the safe area.

The isolator is programmable by the PCS45 software and PCL45 hardware, which configures input types, output spans, alarms, etc.

23.1.4 PC-link - PCL45 and PCL45USB

The PC-link:

- Allows data to be exchanged between the PC and the Temperature converter.
- Is ATEX certified. This allows the configuration of the MTL4575 isolator while remaining part of the hazardous area circuit.

The PCL45USB device:

- Is powered from the computer and is ready for communication immediately after the physical connection has been established.

The PCL45 device:

- Is powered from the RS232 and from the Temperature converter data lines.
- The serial port on a computer must be able to supply ± 8Vat 3mA.

TIP

A minimum connection time of 15 seconds has to be allowed before data can be exchanged between the PC and the isolator.

23.1.5 Export and Print file

The export and print file is composed of the current isolator configuration settings. The following is an example of an export and/or print file.

Converter type:	MTL5073
Manufacturer's ident.	MTL Group
Software revision	7
Hardware revision	7.000
Tag name	DEMO
Descriptor	DESCRIPTION
Date	15.12.99
Input type	E type THC
Process units	°C
Linearization	on
Cold Jm. Comp.	on
Point 4mA	10.0 °C
Point 20mA	200.0 °C
Damping time constant	0.0 s
Smoothing time constant	2 s
Filter frequency	50 Hz
Open circuit alarm level	off
Cold Jm failure alarm	off
Transmitter failure alarm	off
Created on:	21/8/00

23.1.6 Damping and smoothing

Damping and smoothing are both filter functions, which are configurable, and have different effects on the way the input signal is processed.

- Damping causes conventional single-pole, low-pass filtering that is similar to an R-C network.
- Smoothing causes a more 'intelligent' damping where small changes (noise) are heavily suppressed and large (tendency) changes are processed normally.

Although, high damping values will greatly suppress noise and make the output signal stable, it causes a slow response time. The smoothing function avoids this disadvantage by removing the filtering while there are very large signal changes on the input.

Higher damping values are recommended for slow input signals requiring high levels of stability, while fast signals require lower damping values. If in doubt, some experimentation will yield the best results.

23.1.7 Alarm signals

Alarm signals can be configured to drive analog output currents outside the working range.

- The **low** alarm changes the output current to 1.00 mA and
- The **high** alarm changes the current to 21.00mA.

There are three types of fault that trigger an alarm response:

- O/C Alarm - alarm is signaled if an open circuit in the field is detected.
- Tx Fail - alarm signaled if a fault is detected.
- Cj Fail - alarm signaled if a fault is detected with the Cj sensor.

Meanwell power system

To monitor the DC voltage, a free relay contact is provided labeled as 'DC OK.'

Relay contact close	The output voltage reaches the adjusted output voltage
Relay contact open	The output voltage below 90% of adjusted output voltage.

Relay Contact Ratings - 60V dc/0.3Amp

30V dc/1Amp

30V ac /0.5 Amp

The alarm signal can be connected to external circuit or can be connected to Series C Digital Input module.

Phoenix power system

To monitor the DC output voltage a free Relay contact is provided .It is numbered as 13, 14 with sign of relay contact.

Relay contact closed	The output voltage reaches the adjusted output voltage
Relay contact open	The output voltage drop below 90% of adjusted output voltage.

Relay Contact Ratings - 30 volts dc/1Amp

30 volts ac /1Amp

The alarm signal can be connected with external circuit or can be connected to Series C Digital Input module.

23.1.8 Trip output value

The Trip Output Value function is not supported by Honeywell IOTAs, and can cause improper operation.

- All MTL4575 isolators used with Honeywell IOTAs must have this feature set to 'Off' (identified in the PCS45 software's Configure Output Data dialog box as Trip/EBD/Off).
- The default state for this feature is 'Off' for MTL4575 isolators purchased from MTL or through Honeywell.

23.1.9 Menus

PCS45 configuration software's menu sand their default submenus are listed in the table below. The actual list may vary depending on the nature of the activity you are currently attempting.

The accesses to some of the functions are restricted and only after the correct password has been entered access can be gained.

The password is used to protect the configuration data of the Isolators. Without a password you can only view the configuration of the modules. After entering the password, you have unrestricted access to change the settings of the configuration data.

> **ATTENTION**
>
> The default password is '**MTL**' for all new installations of the PCS45 software and can be changed using Options/Change Password menu.

Menu	Submenu	Function
File	Allows access to the following submenus:	
	- New	Creates a new data record with all parameters set to defaults
	- Open	Allows loading of previously saved configurations. The configuration data can be edited and saved without being on-line.
	- Save	Saves the current configuration settings that can later be loaded back into the software and upload to other transmitters. Access is password restricted, unless in demonstration mode.
	- Save as...	When saving configuration data first time 'Save as...' allows the user to specify a filename using the file extension '*.D45'.
	- Import...	Information in text form can be imported back into the PCS45 software similar to opening a .D45 file. The three column text file requires only the information in the second column.
	- Export...	The configuration data can be saved as a text file with three columns containing the parameter name, value and units. This file can later be imported into other software packages.
	- Print...	Prints configuration settings.
	- Exit	Closes PCS45 software.
Connection	Allows access to the following submenus:	
	- Establish	A connection is established that brings the temperature converter on-line and uploads all the configuration information that is stored in the isolator. The uploaded data is tested and the device type, operating status and TAG name are displayed in the status indicator bar. Any changes made to the configuration in PCS45 will be automatically downloaded to the isolator once the changes have been saved. In demo mode, the connection is simulated. All the data is taken from default values.
	- Disconnect	Breaks the connection between the PCS45 software and the Isolator and will put PCS45 into the 'off-line' mode. The TAG name will still show in the information bar, until a new configuration file has been loaded.

Menu	Submenu	Function
Display	Allows access to the following submenus:	
	- Basic config.	The following data is displayed: • Manufacturers Ident. • Device Type. • Software revision. • Hardware revision. • Tag name. • Descriptor • Date No changes to configuration data can be carried out in this window. To make a configuration change go to the 'Device data' menu (a password is required).
	- Input config.	The following data is displayed: • Input type. • Process units. • Linearization. • Cold Junction Compensation (CJC). No changes to configuration data can be carried out in this window. To make a configuration change go to the 'Device data' menu (a password is required).
	- Output config.	The following data is displayed: • Point 4mA. • Point 20mA. • Damping time constant. • Smoothing time constant. • Filter frequency. • Open Circuit alarm level. • Cold Junction alarm level. • Transmitter alarm level. No changes to configuration data can be carried out in this window. To make a configuration change go to the 'Device data' menu (a password is required).

Menu	Submenu	Function
Diagnostics	Allows access to the following submenus:	

<table>
<tr><th>Menu</th><th>Submenu</th><th>Function</th></tr>
<tr><td></td><td>- Set output</td><td>Sets the output of the Temperature converter to a known current value for loop testing purposes.
• Current value range: between 0.000mA and 22.250mA.
• Once window is closed the output returns to the current value, dependent upon the process variable.
• Only can be activated, if the process variable is not monitored by a closed-loop control system.</td></tr>
<tr><td></td><td>- Reset</td><td>Resets the hardware in the temperature converter by clearing the internal buffer.
• If the Temperature converter was running in a temporary state, e.g. at a set current output and the PCL45 (PC-Link) was accidentally disconnected the temperature converter would remain in this mode until the Reset function is used to return the temperature converter back to its normal operation.
• Only can be activated if the process variable is not monitored by a closed-loop control system.</td></tr>
<tr><td></td><td>- Status</td><td>Shows the condition of the three alarm signals and the two status bytes, with this data being refreshed every second.
The three alarm signals show either:
• On in front of a red background for an alarm condition or
• Off with a green background if there are no faults.
In the status window:
• if the first status byte does not equal 0 there is a configuration error, and
• if the second byte does not equal $00 then there is an interface error.</td></tr>
<tr><td></td><td>- Monitor</td><td>Shows the current value of the following with a bar graph display for the Process Variable. The display is refreshed every two seconds.
• Process Value - displays the reading for the primary variable.
• Output current - display the value of the loop current.
• Cold Junction Value - displays the reading for the temperature of the Cj.
The Cold junction temperature is only displayed with a thermocouple input.</td></tr>
<tr><td></td><td>- Data-Logger</td><td>Allows the user to record either the Process Variable or Output current to a file for future viewing in a separate software package, e.g. spread sheet.
The data logger has:
• a default setting of measuring the Process Variable for 10 seconds with 100 reading points and
• a decimal point separator that can be altered by user.
The settings available are:
• Variable to measure - Process variable or Output current.
• Interval type - seconds or minutes.</td></tr>
</table>

Menu	Submenu	Function
		• Length of interval. • Number of points. • Filename • Separator type - decimal point or comma. The data is saved to the file when logging is interrupted or recording has finished. If the software is in demo mode then the filename used is DEMO.DAT.

Menu	Submenu	Function
Device data	Allows access to the following submenus:	

<table>
<tr><th>Menu</th><th>Submenu</th><th>Function</th></tr>
<tr><td></td><td>- Calibrate</td><td>Used to re-calibrate the output of the Temperature converter.

To perform this function a milli-ammeter with an accuracy of ±1mA or better needs to be connected to the output of the temperature converter.

The temperature converter does the following:
• compares the output current with the actual current seen on the meter
• calculates the adjustment needed to correct the error, and stores these values in non-volatile memory.

At first the temperature converter:
• sets its output to 4.000 mA ,and then
• the user enters the reading from the meter
• the converter then sets the output to 20.000 mA, and
• finally, the user enters the value seen on the meter

Once this procedure is complete, the temperature converter calculates the adjustment needed.

The access to this feature is unlocked when the password is entered as it interrupts the functional dependency between input and output.

This may only be activated if the process variable is not monitored by a closed-loop control system.</td></tr>
<tr><td></td><td>- Basic config.</td><td>Allows configuration of the basic parameters of the temperature converter, only appears if the password has been previously entered.

This window shows the following data:
• Manufacturers Ident (read-only)
• Device Type (read-only)
• Software revision (read-only)
• Hardware revision (read-only)
• Tag name.
• Descriptor
• Date

The Tag name and Descriptor have a maximum character length of 8 and 40 characters respectively. All lower case letters in these fields are converted to upper case automatically and illegal characters are suppressed.

The date is displayed with 2 digits for the day and month and 4 digits for the year). A calendar is also give, which is opened using the arrow at the right hand side of the text box.</td></tr>
<tr><td></td><td>- Input config</td><td>Allows configuration of input parameters of the temperature converter, only appears if a password has been entered previously.

This window shows the following data:
• Input type.
• Process units.</td></tr>
</table>

<table>
<tr><th>Menu</th><th>Submenu</th><th>Function</th></tr>
<tr><td></td><td></td><td>Linearization.
Cold Junction Compensation. When a RTD or mV input type is selected the Cold junction compensating and failure alarm (in the Output config. menu) are automatically disabled. Selecting mV disables: Cold junction compensating
Failure alarm
The selection of the Process units and automatically sets them to mV. When an RTD input is selected: Disables cold junction compensating
Disables failure alarm
and the linearization is turned off, the process units are automatically set to ohms.</td></tr>
<tr><td></td><td>- Output config.</td><td> Allows setting of output parameters for the temperature converter, only appears if the password has been entered previously. This window shows the following data: 4 mA point.
20 mA point.
Damping time constant.
Smoothing time constant.
Filter frequency - 50 or 60Hz.
Cold junction failure alarm - off, low or high.
Open circuit alarm - off, low or high.
Transmitter failure alarm - off, low or high.</td></tr>
<tr><td></td><td>- Save to device</td><td> Allows the configuration data to be transferred from the PC to the transmitter. Allows for the re-purposing of the saved temperature settings. After saving, the transfer of the configuration data happens automatically if on-line. This window is password protected. </td></tr>
<tr><td></td><td>- Compare to device</td><td> Allows a comparison of the configuration data held within the software to the data in the temperature converter. After saving, the comparison of data occurs automatically, if online. </td></tr>
</table>

<table>
<tr><th>Menu</th><th>Submenu</th><th>Function</th></tr>
<tr><td rowspan="5">Options</td><td colspan="2">Allows access to the following submenus:</td></tr>
<tr><td>- Change password</td><td>The password is used to protect the configuration data of the Isolators.

Without a password:
You can only view the configuration of the modules.
After entering the password:
You have unrestricted access to change configuration settings.
Default password for PCS45 software is MTL

To change the password:
Select Options, Change Password.
Enter the current password. You will then be asked to enter the new password and confirm this new password. Once the new password has been accepted, it is stored permanently onto the PC.
Note: The password is not case sensitive.</td></tr>
<tr><td>- Language</td><td>Enables the software to be configured for the following languages.
English
German
French</td></tr>
<tr><td>- Port selection</td><td>With the PCS45 application running, the PCL45 USB connected and this option selected the correct port is automatically scanned.

Allows you to configure the serial port, If the PCL45 PC-link is used.

To select a port:
Choose Options < Port selection
Select one of the listed ports (ex. COM1) Note: The software detects which serial ports are available, but it is up to the user to ensure the correct serial port is being used.
NOTE

Care has also to be taken to ensure the data lines can supply ± 8V @ 3mA, to the PC-link PCL45.

The application may operate in Demo mode. This mode maintains all the functionality of the software but does not require a connection to the temperature converter.</td></tr>
<tr><td>- Error indication</td><td>Allows selection of the following errors to be displayed:
Defect
Disturbed
Exception</td></tr>
</table>

Menu	Submenu	Function
Help	Allows access to the following submenus:	
	- Contents	Open embedded help file for the software
	- Online Help	Provides Online Help info
	- Information	Displays support and software version information

23.2 Troubleshooting the PSC45 software

- Interface error
- Configuration error
- Device defective or causing problems error
- Device exception status error

23.2.1 Interface error

Using the Diagnostic -> Status menu interface errors is monitored. The following is a listing of interface error messages.

Error	Description
$02	buffer overflow
$08	longitudinal parity error.
$10	framing error.
$20	overrun error.
$40	vertical parity error.
$80	interface error (always set when an error has occurred).

In case an interface error does occur, do the following checks can be carried out.

- Ensure the correct COM port has been selected.
- Check the connections at both ends of PCL45.
- Check the COM port has the capability to drive +/- 8V at 3mA.

23.2.2 Configuration error

Using the Diagnostic -> Status menu configuration errors are monitored.

The following is a listing of configuration error messages.

Error	Description
2	invalid selection
3	data value too high
4	data value too low

Error	Description
5	not enough data
14	span value too small
16	access refused
64	unknown command

> NOTE
>
> Error messages 5 or 64 indicate an interface error.

23.2.3 Device defective or causing problems error

Using the Diagnostic -> Status menu configuration errors that have occurred if the isolator is in exception or causing problems are displayed. The message is a hexadecimal value with followed types of errors (where for example value $03 means $02 + $01). The following is a listing of configuration error messages

Error	Description
$01	input signal outside of the measuring range
$02	current output 'frozen'
$08	more status data detected
$10	not enough data
$20	cold start (reset) detected
$04	current output halted
$40	configuration changed
$80	device is defective The message 'device defective' ($80) will also show up if there is a power failure while programming. Until correct configuration, the isolator will remain in the defective mode. An error is indicated on the temperature converter by a flashing green 'PWR LED'

The messages $01 to $40 do not show the defect, but only information about the reason for the exception or disturbance.

23.2.4 Device exception status error

The isolator is in exception status or disturbed.

The most frequent reason for exception status indicated by a flashing PWR LED is caused from operating the isolator with unconnected sensor (e.g. at the lab desk or during start-up). The unit periodically tests for line faults. If a fault is detected, an error alarm is released and the analogue output is set according to the alarm configuration. In this situation, either the error message should be ignored or a sensor must be attached to the isolator.

An exception (no defect, no disturbance) also occurs if the device status is requested in the following situations:

- - immediately after a cold start (reset)
- - immediately after a change of the configuration

CHAPTER

24

GI/IS MAINTENANCE

24.1 GI/IS recommended spares

The following table provides replacement parts, or parts that you may want to keep on hand for backup.

Table 24.1 GI/IS Recommended spare parts

<table>
<tr><th>Part name</th><th>Part number</th><th colspan="3">Description</th></tr>
<tr><td colspan="5">GI/IS Analog Input IOTA</td></tr>
<tr><td>AI IOTA
Redundant</td><td>CC-GAIX11</td><td colspan="3">Analog Input, redundant</td></tr>
<tr><td>AI IOTA
Non-Redundant</td><td>CC-GAIX21</td><td colspan="3">Analog Input, non-redundant</td></tr>
<tr><td colspan="5">Fuse</td></tr>
<tr><td>Description</td><td>Part number</td><td>Quality</td><td>Reference designator</td><td>Function</td></tr>
<tr><td rowspan="2">Fuse 0.5A
Fast acting
250V</td><td rowspan="2">51190582-150</td><td rowspan="2">2 per CC-GAIX11</td><td>F1</td><td>Used for
upper IOM</td></tr>
<tr><td>F2</td><td>Used for
lower IOM</td></tr>
<tr><td>1 per CC-GAIX21</td><td>F1</td><td>Used for IOM</td><td></td><td></td></tr>
<tr><td rowspan="2">Fuse 1.5A
Fast acting
250V</td><td rowspan="2">51190582-215</td><td>1 per CC-GAIX11</td><td>F3</td><td>Used for the
isolators</td></tr>
<tr><td>1 per CC-GAIX21</td><td>F2</td><td>Used for the
isolators</td></tr>
<tr><td colspan="5">GI/IS Analog Output IOTA</td></tr>
<tr><td>AO IOTA</td><td>CC-GAOX11</td><td colspan="3">Analog Output, redundant</td></tr>
</table>

Part name	Part number	Description		
Redundant				
AO IOTA Non-Redundant	CC-GAOX21	Analog Output, non-redundant		
Fuse				
Description	*Part number*	*Quality*	*Reference designator*	*Function*
Fuse 1A	51190582-210	3 per CC-GAOX11	F1	Used for upper IOM
			F2	Used for lower IOM
F3	Used for the isolators			
2 per CC-GAOX21	F1	Used for the IOM		
	F2	Used for the isolators		
GI/IS Digital Input IOTA				
DI IOTA Redundant	CC-GDIL01	Digital Input, redundant		
DI IOTA Redundant	CC-GDIL11	Digital Input, redundant		
DI IOTA Redundant	CC-GDIL21	Digital Input, non-redundant		
Fuse				
Description	*Part number*	*Quality*	*Reference designator*	*Function*
Fuse 0.5A	51190582-150	2 per CC-GDIL01	F1	Used for upper IOM
			F2	Used for lower IOM
		2 per CC-GDIL11	F1	Used for upper IOM
F2	Used for lower IOM			
1 per CC-GDIL21	F1	Used for the IOM		
Fuse 2A	51190582-220	1 per CC-GDIL01	F3	Used for the isolators
		1 per CC-GDIL11	F3	Used for the isolators
Fuse 1AF	51190582-210	1 per CC-GDIL21	F2	Used for the isolators

Part name	Part number	Description		
GI/IS Digital Output IOTA				
DO IOTA Redundant	CC-GDOL11	Digital Output, redundant		
Fuse				
Description	*Part number*	*Quality*	*Reference designator*	*Function*
Fuse 5A	51190582-250	1 per CC-GDOL21	F1	Used for the IOM
			F2	Used for the isolators
GI/IS Digital I/O Expander IOTA				
Digital I/OI Expander	CC-SDXX01	Digital Input/Output Expander		
Fuse				
Description	*Part number*	*Quality*	*Reference designator*	*Function*
Fuse 2A	51190582-220	1 per CC-SDXX01	F1	Used for the isolators
MTL GI/IS isolator				
MTL4510		Switch/ Proximity Detector Interface - four-channel, multi-function digital input		
MTL4511		Switch/ Proximity Detector Interface - single channel, with line fault detection		
MTL4516		Switch/ Proximity Detector Interface - two-channel, with line fault detection		
MTL4517		Switch/ Proximity Detector Interface - two-channel with line fault detection and phase reversal		
MTL4521		Solenoid/Alarm Driver - loop-powered, IIC		
MTL4541		Repeater Power Supply - 4/20mA, smart, for 2- or 3-wire transmitters with open wire detection		
MTL4544		Repeater Power Supply - two channel, 4/20mA, smart, for 2- or 3- wire transmitters with open wire detection		
MTL4546C		Isolating Driver - 4-20mA HART valve positioners with open wire detection		
MTL4549C		Isolating Driver - two-channel, for 4-20mA HART® valve positioners with open wire detection		
MTL4575		Temperature Converter - THC (with early burn-out detection) or RTD input		
MTL4599		Dummy isolator		

24.2 Repair

The isolator and IOTA cannot be repaired by the user and must be replaced with an equivalent certified product. Repairs should only be carried out by the manufacturer

24.3 Replacing an GI/IS IOTA

> WARNING
>
> Replacing a GI/IS IOTA and all associated activities may only be performed when the area has been determined to be non-hazardous.

> CAUTION
>
> We recommend that you proceed with extreme caution whenever replacing any component in a control system. Be sure the system is offline or in a safe operating mode.
>
> Component replacements may also require corresponding changes in the control strategy configuration through Control Builder, as well as downloading appropriate data to the replaced component.

The replacing of the GI/IS IOTA is different from the replacing the standard Series C IOTA with regards to the following areas:

- the isolators and terminal plugs must be moved to the new IOTA, and
- there is an additional set of mounting screws to accommodate the wider GI/IS IOTA.

> ATTENTION
>
> Replacing the GI/IS IOTA requires that the IOM is in an inactive off-process state.

24.3.1 To replace an GI/IS IOTA

1. Loosen the screws:
   - at each side of the plastic cover that secures the I/O module to the IOTA board, and
   - the long gray plastic screw located on the module's face. It is not necessary to completely remove this screw.

   > CAUTION
   >
   > Only use a #2 Phillips screw-driver to carefully loosen or tighten the long gray plastic screw. Do not use either a #1 Phillips screw-driver or a battery powered screw-driver to remove or install the plastic screw as this can damage the screw head.

2. Remove the I/O module from the IOTA board and connector.

3. Label and disconnect all cables from the IOTA connectors.
4. Note which terminal plugs are connected to which isolator/channel to make reconnection easier after the IOTA is replaced.

   Remove the terminal plugs (retaining the field wiring) from the isolators.

   Do not remove the isolators at this time.
5. Loosen the screws that secure the IOTA board to the carrier and remove the IOTA board.

   To remove 24 V power to the IOTA board do the following:
   - Loosen the screw from the left side of the IOTA board that connects to the **24 Vdc** bus bar.
   - Loosen the screw from the right side of the IOTA board that connects to the GND bus bar.
6. Mount new I/O IOTA board on the carrier at the same position as the old IOTA board. Secure with screws.
7. Move the isolators from the old IOTA to the new IOTA preserving the original configuration.
8. Attach the appropriate terminal plugs to the appropriate isolators.
9. Reconnect the cables (removing labels if they were utilized) to the IOTA connectors
10. To reconnect power to the IOTA board through the COM and 24 Vdc bus bars, do the following:
    - Install screw through right side of IOTA board to tap into the **GND** bus bar of carrier.
    - Install screw through left side of IOTA board to tap into the **24 V** bus bar of carrier.
11. Insert the I/O module onto IOTA board making sure that the I/O circuit board mates properly with the IOTA board connector.

    Secure the module to the:
    - IOTA board - with two screws located at each side of the plastic cover.
    - Carrier - with the long screw that is inserted into the hole on the face of the module's plastic cover.
12. The I/O module will boot-up into IDLE state.
13. In **Control Builder**, perform a '**Load with Contents**'.

    Refer to the following instructions to see how to replace a Series C IOTA: Replacing a Series C IOTA

24.4 Replacing an IOM on the GI/IS IOTA

> CAUTION
>
> We recommend that you proceed with extreme caution whenever replacing any component in a control system. Be sure the system is offline or in a safe operating mode.
>
> Component replacements may also require corresponding changes in the control strategy configuration through Control Builder, as well as downloading appropriate data to the replaced component.

The removing of the IOM on a GI/IS IOTA is similar to removing the IOM on the standard Series C IOTA.

Refer to the following instructions to see how the IOM is removed on the IOTA: Replacing an I/O module.

24.5 Replacing the isolator

> WARNING
>
> Replacing an isolator must only be performed when the area has been determined to be non-hazardous.

The isolator can be removed under the following conditions:

- keeping the terminal plug and field wiring connected to the isolator, or
- removing the terminal plug with the field wires still connected to it.

24.5.1 To remove the isolator

1. Unclip the latch nearest the CE mark on the isolator label.
2. Rotate the isolator away from this latch.
3. When the isolator is unplugged from the power connector, move the isolator clear of the other latch and remove.
4. This concludes this procedure.

Figure 24.1 Removing a module from an IOTA

24.6 Replacing fuses on a GI/IS IOTA

Refer to the GI/IS recommended spares section in this document for the proper replacement fuse.

> WARNING
>
> Replacing any GI/IS IOTA fuse must only be performed when the area has been determined to be non-hazardous.

24.6.1 To replace fuses on a GI/IS IOTA

1. Using a small slotted screw-driver, place the tip into the slot on the fuse cap.
2. Rotate the cap counter clockwise, a quarter-turn. Remove the cap that also holds the fuse.
3. Remove the fuse, ensuring an appropriate replacement is available. Properly discard the defective fuse.
4. Insert the fuse in the cap and replace the fuse holder on the IOTA board.
5. Tighten the fuse cap by rotating it clockwise a quarter-turn using the screw-driver.
6. This completes the procedure.

CHAPTER

25

GI/IS TROUBLESHOOTING

This section identifies some common problems with the GI/IS and describes how you might fix them.

CHAPTER

26

ATEX INFORMATION

26.1 General

The following information is in accordance with the Essential Health and Safety Requirements (Annex II) of the EU Directive 94/9/EC [the ATEX Directive - safety of apparatus] and is provided for those locations where the ATEX Directive is applicable.

In common with all other electrical apparatus installed in hazardous areas, the GI/IS assembly must only be installed, operated and maintained by competent personnel. Such personnel shall have undergone training, which included instruction on the various types of protection and installation practices, the relevant rules and regulations, and on the general principles of area classification. Appropriate refresher training shall be given on a regular basis. [See clause 4.2 of EN 60079-17].

This apparatus meets the requirements of associated electrical apparatus in accordance with EN 50020 and EN 50014. Additionally, the apparatus meets the Category 3 requirements of protection 'n' in accordance with EN 50021

This apparatus provides protection against all the relevant additional hazards referred to in Annex II of the Directive, such as those in clause 1.2.7.

26.1.1 Installation

The installation must comply with the appropriate European, national and local regulations, which may include reference to the IEC code of practice IEC 60079-14. In addition, particular industries or end users may have specific requirements relating to the safety of their installations and these requirements must be met. For the majority of installations the Directive 1999/92/EC [the ATEX Directive - safety of installations] is also applicable.

26.1.2 Inspection and maintenance

Inspection and maintenance should be carried out in accordance with European, national and local regulations which may refer to the IEC standard IEC 60079-17. In addition, specific industries or end users may have specific requirements, which should also be met.

26.1.3 Repair

The isolator and IOTA cannot be repaired by the user and must be replaced with an equivalent certified product. Repairs should only be carried out by the manufacturer

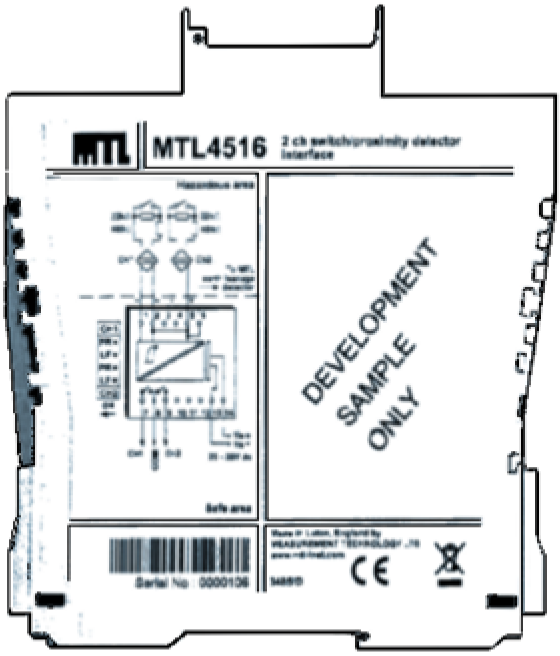
26.1.4 Marking

MTL4500 Series isolators carry approval certificate numbers.

Each device is also CE marked with the Notified Body Identification Number of 1180 and carries the following information:

- Company logo
- Company Name and Address
- Product Number and Name
- Certificate Number
- Ex Classification (where applicable)
- Schematic diagram
- Safety description parameters
- Ambient temperature range

Figure 26.1 Typical MTL45xx series isolator label



26.2 Isolators safety parameters

Table 26.1 MTL4500 safety parameters

Model	Terminals	V	mA	mW
MTL4510		10.5	14	37

Model	Terminals	V	mA	mW
MTL4511		10.5	14	37
MTL4516		10.5	14	37
MTL4517		10.5	14	37
MTL4521		25	14	37
MTL4541		28	93	651
MTL4544		28	93	651
MTL4546C		28	93	651
MTL4549C		28	93	651
MTL4599		Non-energy storing		
MTL4575	5 & 6	Non-energy storing		
	1& 2	7.2	8	144
	config	Vi = 11.2	Li = 12	Pi = 280
		Vo = 7.2	Lo = 14.5	Po= 26

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