Honeywell

Experion PKS

Rail I/O Series H Implementation Guide

Release 431

Honeywell

Document	Release	Issue	Date
EPDOC-X115-en-431A	431	0	February 2015

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Contents

1 About this document

Provides information about interfacing Series H Rail I/O components with your Experion system through Control Builder configuration. It includes component installation, configuration, operation, and service data.

Revision history

Revision	Date	Description
A	February 2015	Initial release of the document.

2 Introduction

The Rail Input/Output Module - Series H (RIOM-H) products are designed for use in locations with potentially explosive atmospheres. They complement the existing Experion system rack I/O components by providing a seamless integration with the ControlNet communications network through a Galvanically Isolated/Intrinsically Safe (GI/IS) Gateway and a fiber optic-coupling scheme.

This document is intended to provide information about the RIOM-H only as a supplement to the existing Experion documentation.

If this is a new Experion system installation, we recommend that you familiarize yourself with the contents of these and other Experion guides before reading this Guide:

- *Planning Guide ControlNet Installation Guide*
- *Control Hardware Installation Guide*

These Guides provide general planning details and installation considerations for the Experion system in general. For the sake of brevity, this Guide does not repeat the applicable general guidelines, considerations, cautions, etc. that are covered in these other Guides.

2.1 System block diagram

The following diagram gives a simplified graphic representation of the RIOM-H integration with the Experion system. This will give you a quick idea of how the RIOM-H components are functionally integrated with the overall operation of the Experion system.

> **Attention**
> Refer to the latest Experion Specification document for the operating system specifications.
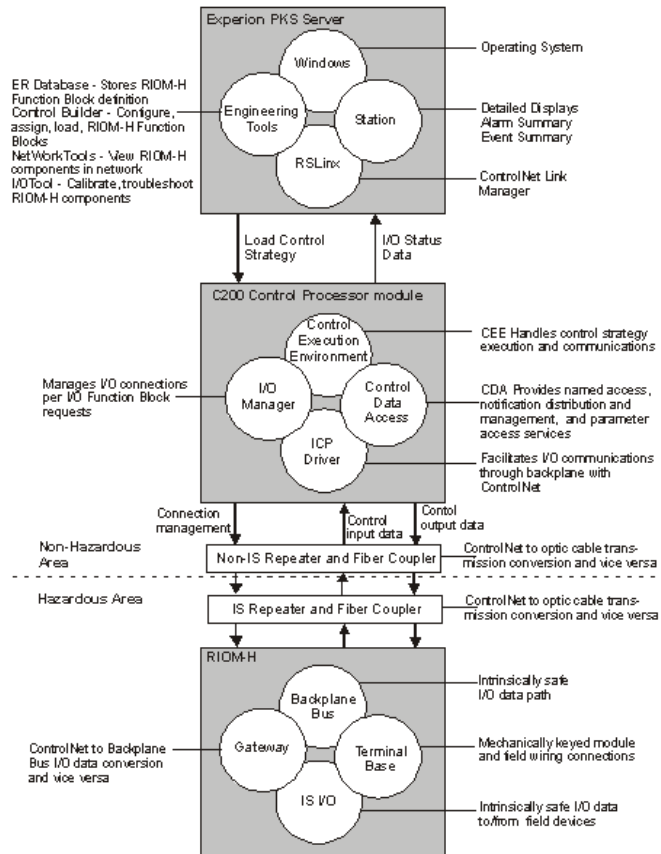
Figure 1: Block diagram of RIOM-H functional integration with the Experion System

2.2 Getting started

Related topics

2.2.1 Starting conditions and assumptions

We assume that:

- You have reviewed and/or are familiar with the information provided for planning and installing a basic Experion system consisting of an Experion Server and Hybrid Controller. This information provides general guidelines that are pertinent to overall system implementation.
- You have ordered and received your RIOM-H components.
- You have classified the potentially explosive atmosphere and defined its boundaries.

For general reference, Appendix A provides an overview of hazardous area classifications and the I/O entity values for the RIOM-H components.

2.2.2 Adhering to safety regulations

You are responsible for adhering to all applicable national codes and local ordinances for applying intrinsically safe equipment in a potentially explosive atmosphere.

2.2.3 Selecting wiring and cabling

Attention

- Honeywell offers a complete array of ControlNet cabling accessories approved for use with RIOM-H components located in potentially explosive atmospheres. See Appendix B.
- Be sure any cabling used with RIOM-H components meets all national and local codes, and carries an approved Intrinsically Safe identification marking.

You will need shielded, stranded 24 to 14 AWG wire for I/O connections, coaxial cable for ControlNet connections, and fiber optic cable type 62.5/125 micron with ST termination for fiber optic system connections.

You are responsible for selecting the wire and cable that is appropriate for your planned routing method and meets both national and local electrical and fire codes.

Since cable routes can vary from using plenum air returns to being buried underground, we suggest that you work with a cable manufacturer to select the wiring that meets your particular installation requirements. If you have access to the Internet, you can visit the Belden Wire and Cable Company web site at www.belden.com for helpful technical data on a wide variety of wire and cable types.

2.2.4 Reviewing CE Mark requirements

For this product to comply with the EMC Directive, you must adhere to the following special installation requirements:

- Mount the Gateway and its associated Terminal Bases in an enclosure with a RF seal.
- Install a ferrite core on:
    - The Power Supply output (channel) cable at the point where it enters the sealed enclosure.
    - The power input cable to the Gateway at the point where the cable connects to the power input terminals on the Gateway.
    - Each ControlNet coaxial trunk cable at the point where the cable exits the enclosure.

    Attention
    Honeywell offers a kit of assorted ferrites. See Appendix B.

- For analog I/O connections, use shielded multicore cable with a shield for each channel. The isolation for each channel must be greater than 500V.
- For digital I/O connections, use shielded multicore cable.

2.2.5 Observing good wiring practices

To promote electromagnetic compatibility, observe the following four general wiring practice guidelines.

- **Guideline 1:** Be sure all inactive metal parts have a good ground connection.
    - Connect all inactive metal parts, including their entire surface and with low impedance, to ground.
    - Use special contact plates or remove the insulated protective layers on the contact points for screw connections on varnished or anodized metal parts.
    - Avoid using aluminum parts whenever possible for grounding. Since aluminum oxidizes easily, it is not very suitable for grounding.
    - Make a central connection between ground and the protective conductor.
- **Guideline 2:** Be sure the wiring is properly run.
    - Separate the wiring according to these four categories: high current, power supply, signal line and data line.
    - Always run the high current wiring and signal/data line wiring in separate conduits or bundles.
    - Run the signal/data line wiring in metal trays or as close as possible to bus bar, metal rails, and metal enclosure areas.
- **Guideline 3:** Be sure the shielded wires are securely fastened.
    - Use shielded cable for signal and data lines.
    - Run the entire surface area of the shielded wire inside the enclosure on a shielded bus bar and fasten it with a cable clamp. Then, run the shielded signal line to the I/O module terminal connections. Remove the last 10 cm (4 in) of the shield from the signal line before connecting it to the terminal.
    - Never use "pigtails" to connect the cable shield to the protective conductor.
    - All shields should be grounded at one end only - preferably the I/O module end in the enclosure.
    - When a distribution box is used for dividing a multicore cable into separate cables, be sure the potential of the cable shields is isolated from the metal housing of the distribution box. The distribution box must be made of metal. The metal housing can be connected to a protective conductor
- **Guideline 4:** Make a uniform reference potential
    - If there are potential differences between installations, run enough dimensional potential equalizer connections.
    - Check the use of ground. It can serve as a measure of protection.

–   Avoid ground loops by connecting the installations and enclosures with central and additional devices radically to the earth ground and protective conductor.

2.2.6 Avoiding electrostatic charge

Protect the system against electrostatic charge. Post the "**Attention**" label shipped with each Gateway and each Repeater Adapter near the system or even right on the enclosure door.

2.3 Conventions used in this guide

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

Term/Type Representation	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 shown in angle brackets.	Press <F1> to view the online Help.
<Ctrl>+<C>	Keys to be pressed together are shown 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<.

2.4 Typical RIOM-H system architecture

Figure 2 is a graphic representation of the components functionally identified in the block diagram in Figure 1. A typical RIOM-H system includes:

- Non-Intrinsically Safe Repeater/Fiber Hub (two needed for redundant media)
- Intrinsically Safe Repeater/Fiber Hub (two needed for redundant media)
- ControlNet Gateway Redundant Media
- Terminal Base (up to eight per Gateway)
- Analog and/or Digital Plugin I/O Modules (mechanically keyed to Terminal Base)
- Intrinsically Safe Power Supply (not shown)

The ControlNet Gateway serves as the communication interface between the intrinsically safe I/O data on the backplane bus and the fiber optic coupled I/O data on the I/O data bus to the Experion system. The ControlNet Gateway module and Terminal Base components connect together to form an instant internal backplane bus. Each Terminal Base features a mechanical key, so it can be "keyed" to support any one of the given plugin I/O modules before making field wiring connections to the base.

> **Attention**
>
> An I/O network can have up to four downlink CNIs installed in a C200 chassis with multiple uplink CNIs and Rail Gateways physically connected to the same network. However, be sure each Rail Gateway has **configured communication paths** from only one downlink CNI. The downlink CNIs may have **configured communication paths** to multiple Rail Gateways and chassis mounted I/O modules through uplink CNIs. Each downlink CNI may have a maximum number of 24 **configured communication paths**. Each C200 can support a maximum of 64 I/O modules on the controller$s I/O network.
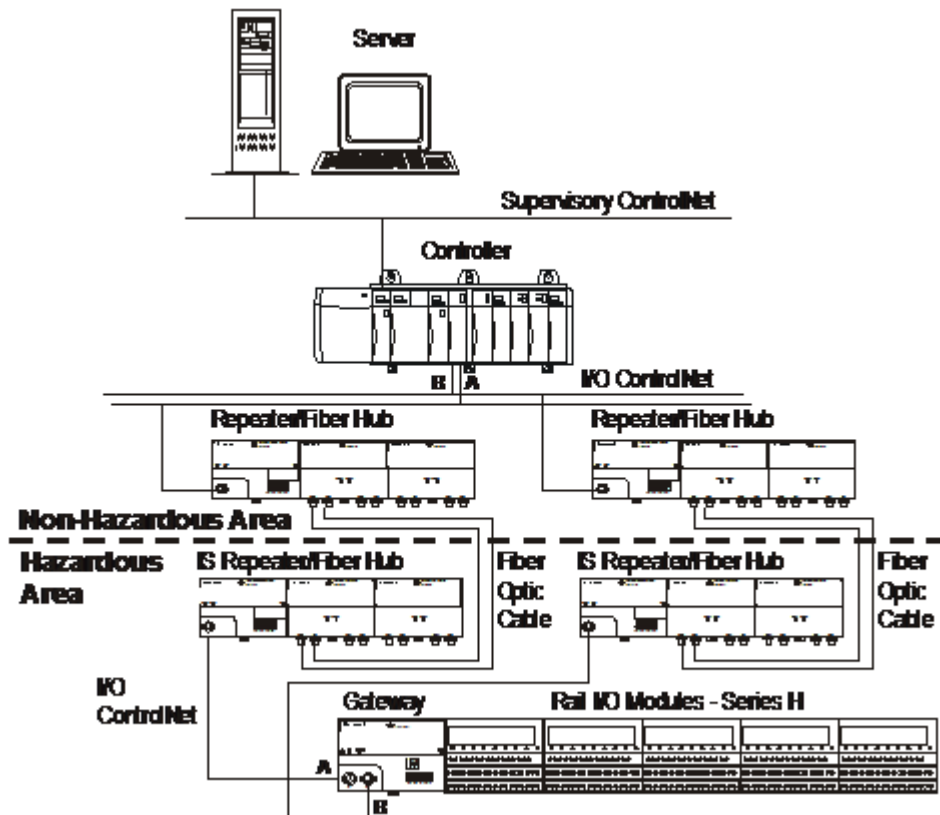
Figure 2: Typical RIOM-H system architecture integrated with the Experion system using redundant ControlNet media.

3 Installation

Related topics

3.1 Planning considerations

Related topics

3.1.1 I/O module allowance

> ❗ **Attention**
> A C200 Control Processor module (CPM) with a 5 millisecond Control Execution Environment (CEE-5ms) does not support operation with RIOM-H components. Only the 50 millisecond Control Execution Environment (CEE-50ms) is compatible with RIOM-H.

Be sure your Experion System I/O requirements do not exceed the capacities listed in the following table.

Description	Total
Maximum number of I/O modules(including local and remote rack I/O and RIOM-H) per CPM	64
Maximum number of analog I/O modules (including rack I/O and RIOM-H) per CPM	32
Maximum number of remote I/O racks and/or RIOM-H Gateways per CPM	8

3.1.2 Determining intrinsically safe power supply requirements

Each intrinsically safe power supply has four separate channels. Each power supply channel can handle one (1) Unit Load. The following table lists the power requirement in Unit Load and power dissipation in Watts for the given RIOM-H component for reference.

Component	Model Number	Power Requirement (Unit Load)	Power Dissipation (Watts)
ControlNet Gateway	TC-PGCN11	1	8.0
Analog Input Module (8 points)	TC-PIA081 TC-PIA082	0.95	5.2
Digital Input Module (16 points)	TC-PIB161	0.33	2.8
Temperature Input Module (8 points)	TC-PIL081	0.19	1.6
Analog Output Module (8 points)	TC-POA081	0.77	5.4
Digital Output Module (4 points)	TC-POB041	1	5.0
ControlNet Repeater Adapter	TC-PBFO01	1	8.0
Intrinsically Safe Power Supply	TC-PPDXX1	6.5	21

To calculate the number of intrinsically safe power supplies your system requires:

- Multiply the number of each component in the system by its power requirement (Unit Load) from the above table,
- Add the power requirements for all components to find the total power requirement for your system,

- Round the total power requirement answer to the next highest number to find the total number of power supply channels required.
- Divide the total number of channels by 4 and round the answer to the next highest number to find the number of power supplies needed.

For example, assume that your system includes these components:

- 3 Gateways = 3 x 1 = 3
- 4 Digital Output Modules = 4 x 1 = 4
- 9 Digital Input modules = 9 x 0.33 = 2.97
- 7 Temperature Input modules = 7 x 0.19 = 1.33
- 1 Repeater adapter = 1 x 1 = 1

The total power requirements equal 3 + 4 + 2.97 + 1.33 + 1 = 12.3 total.

The number of channels required is 12.3 rounded to 13 channels.

The number of power supplies required equal 13 / 4 = 3.25 rounded to 4 power supplies.

Figure 3 shows how this example system might be configured schematically.
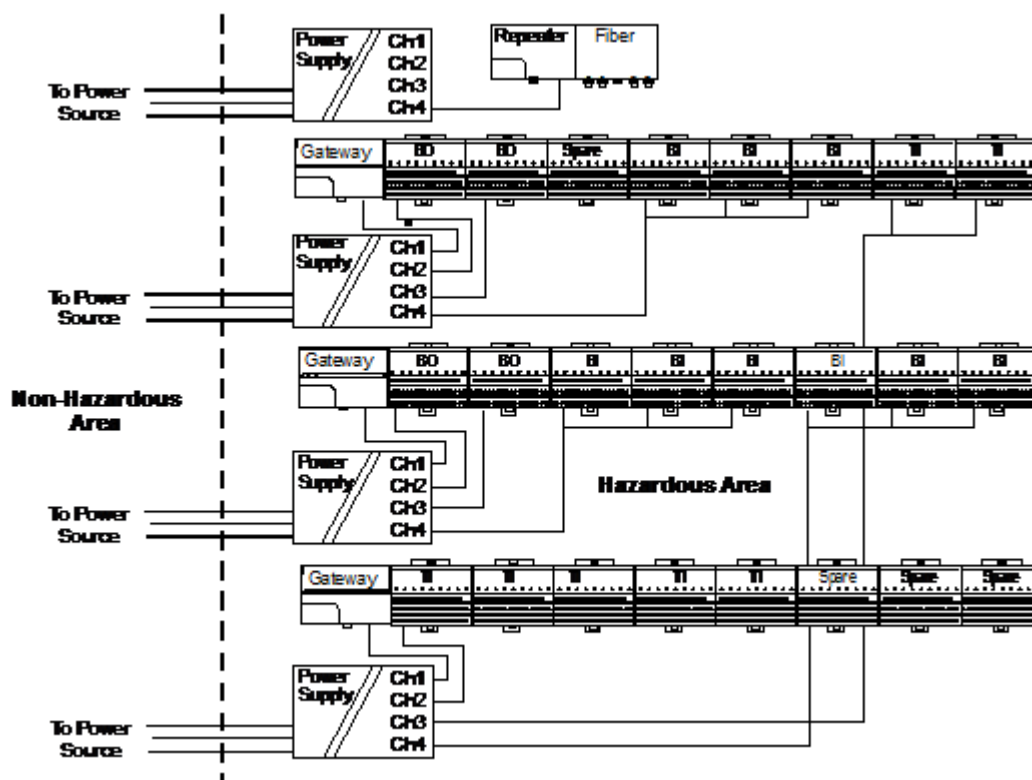
Figure 3: Example of intrinsically safe power distribution within an RIOM-H system.

3.1.3 Selecting an enclosure

Attention

With the exception of the intrinsically safe power supply; do not expose the RIOM-H components to the environment. The components are designed to meet an IP20 rating.

To meet EMC directive requirements, you must mount all components except the power supply in a shielded enclosure.

Consider the following things when selecting an enclosure for RIOM-H components:

- The number of RIOM-H components to be installed in one enclosure.
- Are power supplies to be mounted inside or outside the enclosure?
- Are all the components to be mounted in one large enclosure or several small enclosures?
- What are the thermal dynamics of the enclosure?
- Will component heat dissipation cause the interior temperature to exceed 70°C (158°F)?

Attention

We recommend that you mount the power supplies outside the enclosure to keep heat dissipation inside the enclosure to a minimum.

You can mount the RIOM-H components in either a horizontal or vertical arrangement. You must always install the ControlNet Gateway at the left end of an I/O module segment. Figures 4 and 5 show typical RIOM-H component arrangements in two different size enclosures.

For reference, the small size enclosure in Figure 4 is equivalent to a Rittal model number AE1073-600 with an EMC shielding option for CE Mark Compliance. The larger size enclosure in Figure 5 is equivalent to a Rittal model number AE1180.700 that includes EMC shielding.
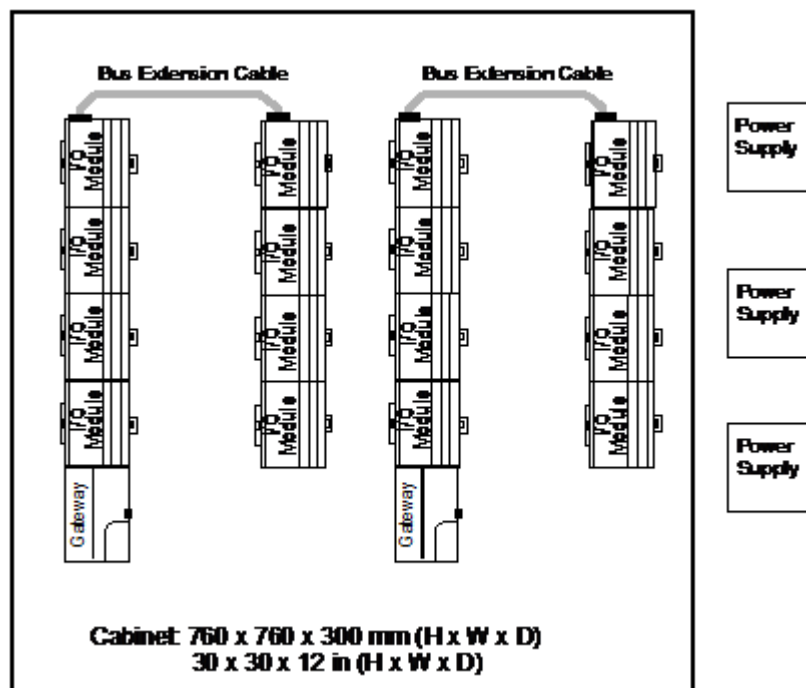
Figure 4: Figure Typical RIOM-H component layout in a 760 (H) x 760 (W) x 300 (D) mm (30 x 30 x 12 in) enclosure.
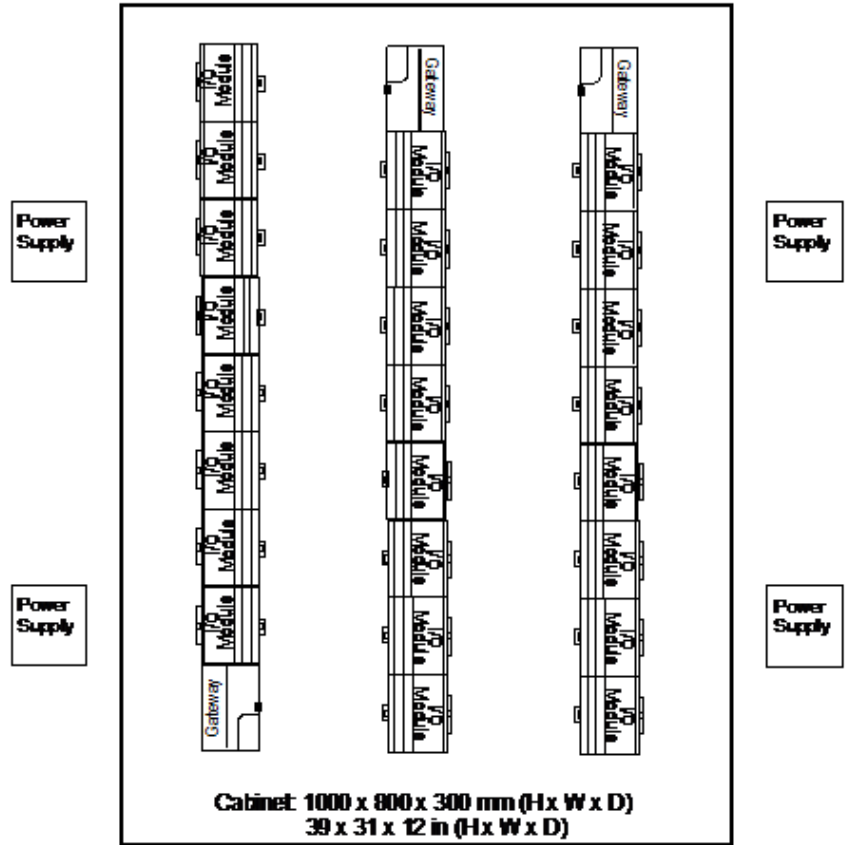
Figure 5: Figure Typical RIOM-H component layout in a 1000 (H) x 800 (W) x 300 (D) mm (39 x 31 x 12 in) enclosure.

3.1.4 Calculating maximum ambient temperature inside an enclosure

Since ambient temperature can affect the working life of components, you must calculate the maximum ambient temperature inside an enclosure based on the power dissipation of the installed components and the thermal characteristics of the enclosure. Use the following formula to calculate the maximum temperature increase that can occur inside an enclosure with respect to the outside ambient temperature.

- $deltaT_{max} = Qv \, / \, k \, A_{eff}$

Where:		
deltaTmax	=	Maximum temperature increase
Qv	=	Total power dissipation of all components in the enclosure
k	=	Heat transfer coefficient of the enclosure
Aeff	=	Effective surface of the enclosure

To calculate the total power dissipation (Q_v), simply multiply the power dissipation listed in the previous power requirement table by the corresponding number of components installed in the enclosure and sum the values.

Look in the enclosure manufacturer's technical documentation to find the heat transfer coefficient (k) of the enclosure. A typical coefficient for a sheet steel housing is 5W/m2\C (0.9 BTU)

Use the following formula to calculate the effective surface area (A_{eff}) for a wall-mounted enclosure. In this case, the back of the enclosure is mounted against the wall and the outside top, bottom, sides, and front surfaces are exposed to free air.

A_{eff} [m2] = H x (W+2 x D) +2 x W x D

Where:		
W	=	Width of the enclosure in meters
H	=	Height of the enclosure in meters
D	=	Depth of the enclosure in meters

Where an enclosure is mounted can have an impact on the effective surface area calculation. For example, an enclosure mounted in a location with plenty of surrounding free space provides better heat dissipation. You may want to refer to an Engineering Handbook to review the rules for calculating the effective surface area or review DIN 57600 Part 500 and VDE 660 Part 500 standards.

If the calculation reveals that the maximum ambient temperature inside the case will exceed the 70\C (158\F) operating limit for RIOM-H components, you must consider moving the enclosure to a location with a lower maximum ambient temperature, removing some components from the enclosure, or getting a larger enclosure.

3.1.5 Maximum ambient temperature calculation example

For example, assume that you have these components mounted inside a 1000 (H) x 800 (W) x 300 (D) mm enclosure mounted to a wall:

- 3 Gateways = 3 x 8 = 24
- 4 Digital Output Modules = 4 x 5 = 20
- 9 Digital Input modules = 9 x 2.8 = 25.2
- 7 Temperature Input modules = 7 x 1.6 = 11.2

The total power dissipation (Qv) equals 24 + 20 + 25.2 + 11.2 = 80.7 rounded to 81 W total.

The enclosure's heat transfer coefficient (k) is 5W/m2\C

The effective surface area (Aeff) of the wall-mounted enclosure is:

Aeff = 1 x (0.8 + 2 x 0.3) + 2 x 0.8 x 0.3 = 1.88 m2

Then, substituting into the formula for maximum temperature increase yields:

deltaTmax = 81 W / (m2\C / 5W)\ 1.88 m2 = 8.6\C (15.5\F)

In this example, if the ambient temperature outside the enclosure reaches a maximum of 45\C (113\F), the maximum ambient temperature inside the enclosure will be approximately 54\C (129\F).This means the maximum ambient temperature inside the case is within the 70\C (158\F) operating limit for RIOM-H components.

3.2 Installing the ControlNet Gateway

Related topics

3.2.1 Front view of the ControlNet Gateway

Figure 6: Front view of ControlNet Gateway media redundant model TC-PGCN11.

3.2.2 Mounting the ControlNet Gateway on a DIN rail

Attention

- You are responsible for obtaining and mounting the 35 x 7.5 mm metal, top hat rails (DIN EN50022) to be used for mounting RIOM-H components.
- Be sure you install the ControlNet Gateway at the left end of an I/O module segment.
- We highly recommend that you use ControlNet dual media with every RIOM-H Gateway segment.

1   Orient the Gateway so the top of the unit is over the top of the DIN rail.

2   Slightly rotate the module to slip its top mounting flange on the top of the DIN rail.

3   Press the module down flush with the DIN rail so its locking tab snaps into place, securing the module to the rail. If necessary, you can use a screwdriver to manually retract the lock while pressing the module firmly against the rail and then releasing it when in position.

4   Leave the protective covers on the connectors until you are ready to make the connections.

3.2.3 Wiring the ControlNet Gateway

⚠ **WARNING**

- Use only an intrinsically safe power supply to power the Gateway. The maximum intrinsically safe values must not be exceeded.

- Use only RIOM-H components with the Gateway, so that the intrinsically safe values of the backplane bus system are not exceeded.

- Do not use the Gateway in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

To wire the ControlNet Gateway

1   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 DIN rails.

2   For EMC compliance, install a ferrite core (supplied with the power supply) on each power supply channel cable where it enters the enclosure (if power supply is mounted outside the enclosure), and install a ferrite core (supplied with the Gateway) around the power cable wires where they connect to the Gateway. (Note that spare ferrite cores are available in Honeywell Ferrite Kit Model TC-PFEK01. The kit includes three split-ring, ferrite cores for use with power supply channel cables routed outside an enclosure. Each split-ring, ferrite core can be installed on 1 to 4 channel cables already routed from a single power supply mounted outside an enclosure and connected to Rail I/O components inside the enclosure.)

3   Observing polarity, connect the leads from the power supply channel to either pair of the V+ and V- terminals, respectively. The recommended wire size is 14 AWG stranded cable.

   (Note that the Gateway does not have a power switch, so it is powered whenever the power supply is turned on. The unused V+ and V- terminals can **not** be used to "daisy chain" power to another module because the Gateway consumes the entire Unit Load of power from one power supply channel.)

4   Do the following:

   a   Be sure to install the blue insulator rings provided on the tap and trunk cable BNC connectors before making connections.

   b   For non-redundant media, only remove the protective cover from the BNC connector marked A and connect a drop cable from an RIOM-H approved ControlNet T or Y Tap (TC-PHTPx) to it. For redundant media, also remove the protective cover from the BNC connector marked B and connect a drop cable from an RIOM-H approved ControlNet T or Y Tap (TC-PHTPx) to it as well.

   c   Refer to the Control Drawing shipped with the ControlNet Gateway for overall RIOM-H system wiring requirements.

5   For EMC compliance, install a ferrite core (supplied with the Gateway) on each approved ControlNet coaxial trunk cable at the point where it enters or exits the enclosure, as applicable. Run the coaxial trunk cable close to the enclosure wall and away from other cables. (Note that spare ferrite cores are available in Honeywell Ferrite Kit Model TC-PFEK01.)

6   Use the blue cable markers kit (TC-PCLPB1) to mark cables as Intrinsically safe, as required. Use the red and yellow cable markers supplied with taps to mark the A and B cables, respectively, in a redundant-media system.

3.2.4 Setting the ControlNet Gateway MAC ID

You must set the required Media Access Control (MAC) ID (or I/O ControlNet address) by using the switches on the front of the Gateway module. Press the -or + button to lower or raise the value of each digit. The valid address range for a Gateway on an I/O ControlNet network of the Experion system is 02 to 20. Since the Gateway can not function as a"Keeper node" on the I/O ControlNet network, it must **not** use an address of 01. It must also **not** use any address already assigned to another node on the same I/O ControlNet network.

3.3 Installing the Terminal Base

Related topics

3.3.1 Front view of the Terminal Base
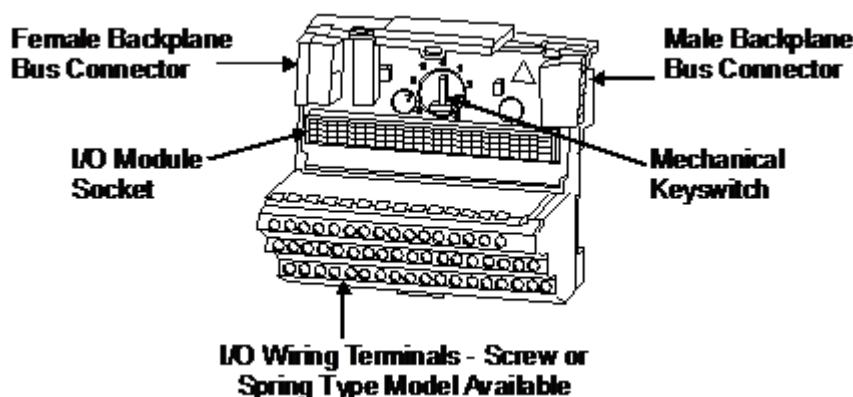
Figure 7: Front view of Terminal Base model TC-PTBC11 screw type or TC-PTBS11 spring type.

3.3.2 Mounting the Terminal Base on a DIN rail

> **Attention**
> This procedure assumes that a ControlNet Gateway or another Terminal Base is already installed and that the power supply is turned Off.

1   Remove the protective cover from the backplane bus connector on the Gateway or the male backplane bus connector on the Terminal Base.

2   Be sure the female bus connector on this Terminal Base is fully retracted into the Base module.

3   Orient the Terminal Base so the top of the unit is over the top of the DIN rail to the right of the installed Gateway or adjacent Terminal Base.

4   Slightly rotate the Terminal Base to slip its top mounting flange on the top of the DIN rail and slide the unit against the Gateway or mating Terminal Base, so its hook is aligned with the notch on the rear of the Gateway or mating Terminal Base.
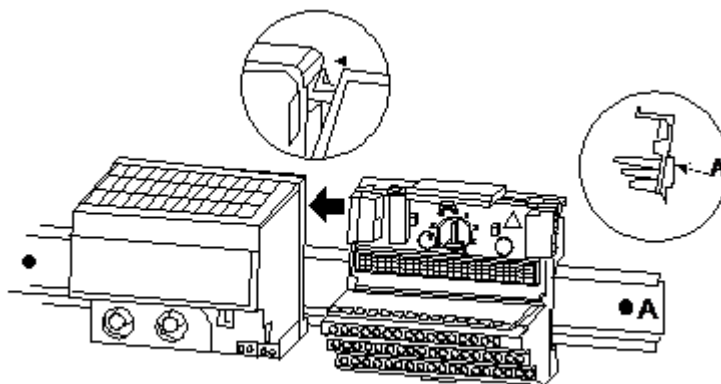
5   Press the Terminal Base down flush with the DIN rail so its locking tab snaps into place, securing the Terminal Base to the rail. If necessary, you can use a screwdriver to manually retract the lock while pressing the Base firmly against the rail and then releasing it when in position.

6   Carefully slide the female backplane bus connector to the left until it is fully seated in the mating Gateway or Terminal Base bus connector.
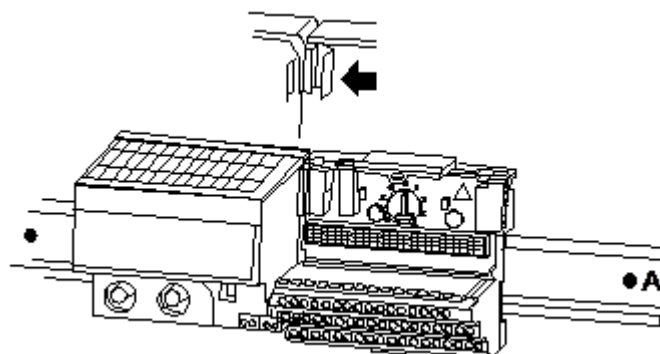
7   Leave the protective cover on the male backplane bus connector until you are ready to make the connection.

3.3.3 Wiring the Terminal Base

⚠ **WARNING**
   • Use only an intrinsically safe power supply to power the Terminal Base. The maximum intrinsically safe values must not be exceeded.
   • Use only RIOM-H components with the Terminal Base, so the intrinsically safe values of the backplane bus system are not exceeded.
   • Do not use the Terminal Base in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

1   Observing polarity, connect the leads from the power supply channel to terminals 34+ and 35- on the Terminal Base, respectively. The recommended wire size is 14 AWG stranded cable.

    (Note that the Terminal Base does not have a power switch, so it is powered whenever the power supply is turned on.)

2   Refer to the given I/O module installation section in this Guide for specific I/O wiring details.

3   If applicable, use the other power terminals 50+ and 51- to "daisy chain" power to another module, as long as the total power consumption does not exceed 1 Unit Load

3.3.4 Setting the Terminal Base keyswitch position

> ⚠ **CAUTION**
> Once you set the keyswitch position for a given I/O module and make the I/O wiring connections specific to that module, do not change the keyswitch position without rewiring the I/O connections accordingly.

The position of the keyswitch on the Terminal Base is I/O module specific as noted in the following table. This keys the Terminal Base to a given I/O module type, so a keyed module can not be accidentally replaced with another type of module.

If you use this I/O module . . .	Then, set the Keyswitch to this position . . .
Temperature Input model TC-PIL081	2
Analog Input model TC-PIA081/TC-PIA082	3
Analog Output model TC-POA081	4
Digital Input model TC-PIB161	6
Digital Output model TC-POB041	7

3.3.5 Using Bus Extension Cable Accessories

The following bus extension cables are available to connect split DIN Rail configurations together.

TC-PKTX30: 30 cm (12 in) long, two female connectors

TC-PKTX90: 90 cm (36 in) long, two female connectors

Use the TC-PKTXxx cables to join rails in a split configuration as shown in Figure 8. You can use only one bus extension cable per I/O segment. Once you plug the cable connectors into the corresponding backplane bus connectors on the Terminal Bases, secure the cable connectors to the panel with the hardware supplied.
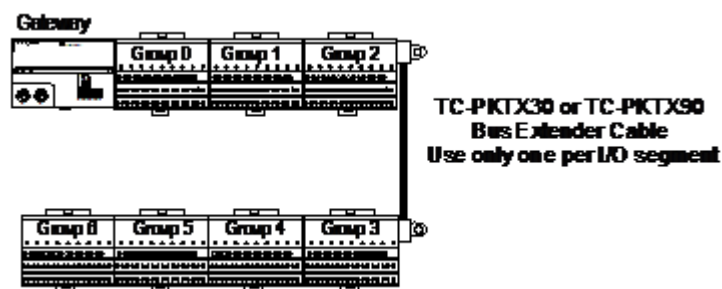
Figure 8: Using bus extension cable to connect split rail I/O segment.

3.4 Installing the Analog Input Module

Related topics

3.4.1 Front view of the Analog Input Module
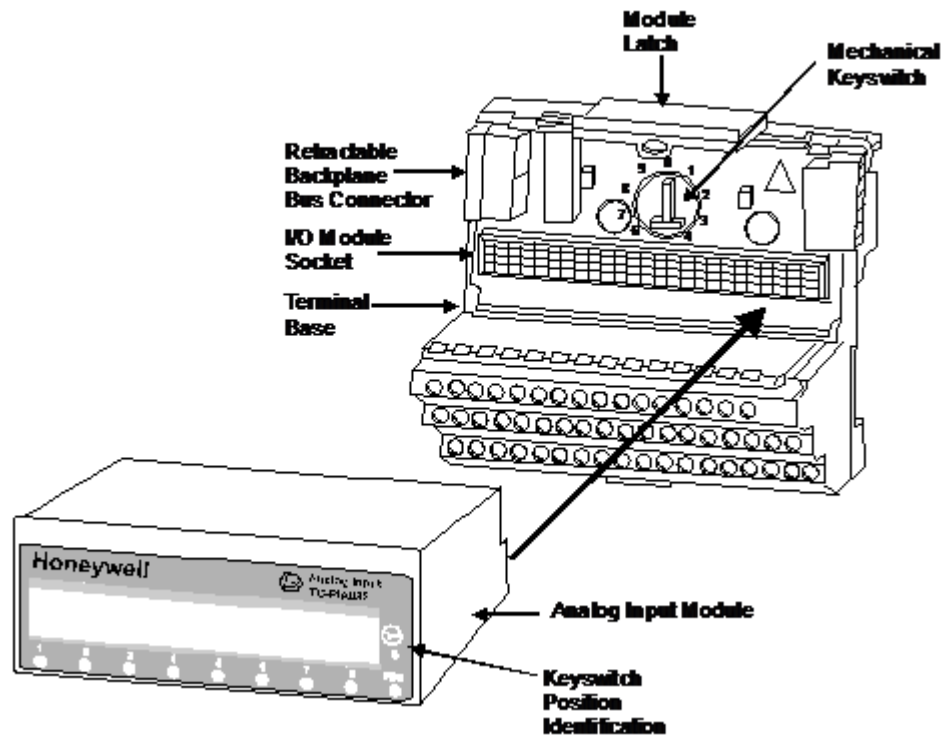
Figure 9: Analog Input Module model TC-PIA081/TC-PIA082 plugs into Terminal Base model TC-PTBC11 or TC-PTBS11.

> **Attention**
> Analog Input Module model TC-PIA082 is a direct replacement for model TC-PIA081. The TC-PIA081 module has been withdrawn from sale and is no longer available.

3.4.2 Plugging the Analog Input Module into the installed Terminal Base

> **Attention**
> This procedure assumes that the Terminal Base is already installed and connected to another Terminal Base or the Gateway, and that the power supply is turned Off.

> **CAUTION**
> Be sure that at least one other Rail I/O module of any type is present in the Gateway segment that is to include an Analog Input module. Do not construct a Gateway segment that includes only an Analog Input module.

1   Turn the keyswitch on the Terminal Base clockwise to its number 3 position.
(Note that the module's keyswitch position is identified on its front label.)

2   Be sure the retractable backplane bus connector on the Terminal Base is fully inserted into the mating module. Do **not** install an I/O module into a Terminal Base that is **not** installed.

3   Orient the Analog Input module so its connector is aligned with the I/O socket on the Terminal Base. Carefully press the module into the Terminal Base so it is fully seated in the I/O socket and the Terminal Base's module latch snaps into place.

3.4.3 Wiring the Analog Input Module

⚠ **WARNING**

- Use only an intrinsically safe power supply to power the Terminal Base and Analog Input module. The maximum intrinsically safe values must not be exceeded.
- Use only RIOM-H components with the Terminal Base and Analog input module, so the intrinsically safe values of the backplane bus system are not exceeded.
- Do not use the Terminal Base or Analog Input module in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

1   Observing polarity, connect the leads from an analog input device in the current range of 0 to 22mA to the +, Sig, and - terminals for channels 0 to 7. The connection scheme is input source to the + terminal, input signal to the Sig terminal, and input return to the - terminal. Refer to Figure 10 for typical transmitter connections.

(Note that the channels in this module are electrically connected to each other and have a common plus-line.)

2   Connect individual shields to an external ground source such as a bus bar.

3   Refer to the Terminal Base Wiring section for power supply connections.

Next steps

⚠ **CAUTION**

Do **not** use the unused terminals (3, 7, 11, 15, 20, 24, 28, 32, 37, 38, 39, 46, 47, 48) with an Analog Input module on this Terminal Base unit. Using these terminals for any purpose can result in damage to the module and/or unintended operation of your system (Figure 10).

Do **not** connect shields to the chassis ground terminals 16, 33, 40, 41, 42, 43, 44, and 45.

❗ **Attention**

When interconnecting several lines, you must consider the total accumulated power and check for intrinsic safety.
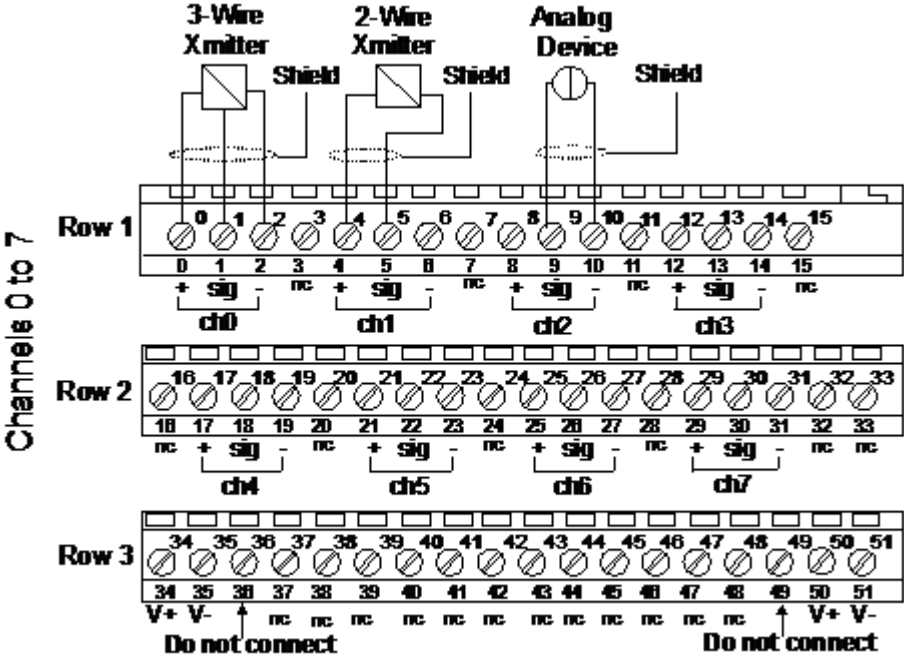
Figure 10: Typical Analog Input module connections.

3.5 Installing the Digital Input Module

Related topics

3.5.1 Front view of the Digital Input Module

Figure 11: Digital Input Module model TC-PIB161 plugs into Terminal Base model TC-PTBC11 or TC-PTBS11.

3.5.2 Checking the Digital Input Module DIP switch settings

There are four DIP switches on the bottom of the Digital Input Module. Each switch is used to activate or deactivate the circuit fault detection on one group of four channels, as shown in Figure 12. The default setting is ON for circuit fault detection activated.
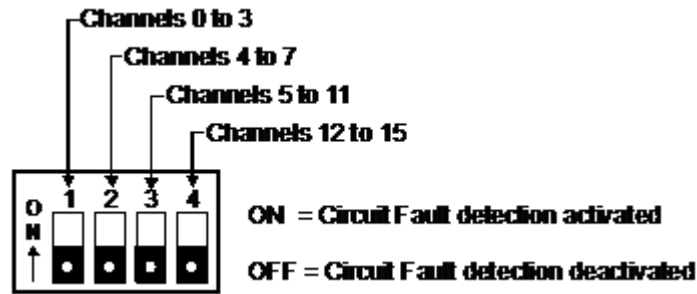
Figure 12: DIP switch settings for circuit fault detection on Digital Input module.

3.5.3 Plugging the Digital Input Module into the installed Terminal Base

> **Attention**
> This procedure assumes that the Terminal Base is already installed and connected to another Terminal Base or the Gateway, and that the power supply is turned Off.

1   Turn the keyswitch on the Terminal Base clockwise to its number 6 position.
    (Note that the module's keyswitch position is identified on its front label.)

2   Be sure the retractable backplane bus connector on the Terminal Base is fully inserted into the mating module. Do not install an I/O module into a Terminal Base that is **not** installed.

3   Orient the Digital Input module so its connector is aligned with the I/O socket on the Terminal Base. Carefully press the module into the Terminal Base so it is fully seated in the I/O socket and the Terminal Base's module latch snaps into place.

3.5.4 Wiring the Digital Input Module

> ⚠ **WARNING**
> • Use only an intrinsically safe power supply to power the Terminal Base and Digital I/O module. The maximum intrinsically safe values must not be exceeded.
> • Use only RIOM-H components with the Terminal Base and Digital I/O module, so the intrinsically safe values of the backplane bus system are not exceeded.
> • Do not use the Terminal Base nor Digital Input module in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

1   Observing polarity, connect the leads from a NAMUR sensor or mechanical contact to the + and - terminals for channels 0 to 15. The connection scheme is input source to the + terminal, input signal to the - terminal. Refer to Figure 13 for typical input connections.
    (Note that the channels in this module are electrically connected to each other and have a common plus-line.)

2   Connect individual shields to an external ground source such as a bus bar.

3   Refer to the Terminal Base Wiring section for power supply connections.

Next steps

> ⚠ **CAUTION**
> Do **not** use the unused terminals (37, 38, 39, 46, 47, 48) on this Terminal Base unit with a Digital Input module. Using these terminals for any purpose can result in damage to the module and/or unintended operation of your system. (Figure 13).
>
> Do **not** connect shields to the chassis ground terminals 16, 33, 40, 41, 42, 43, 44, and 45.

> **Attention**
> When interconnecting several lines, you must consider the total accumulated power and check for intrinsic safety.
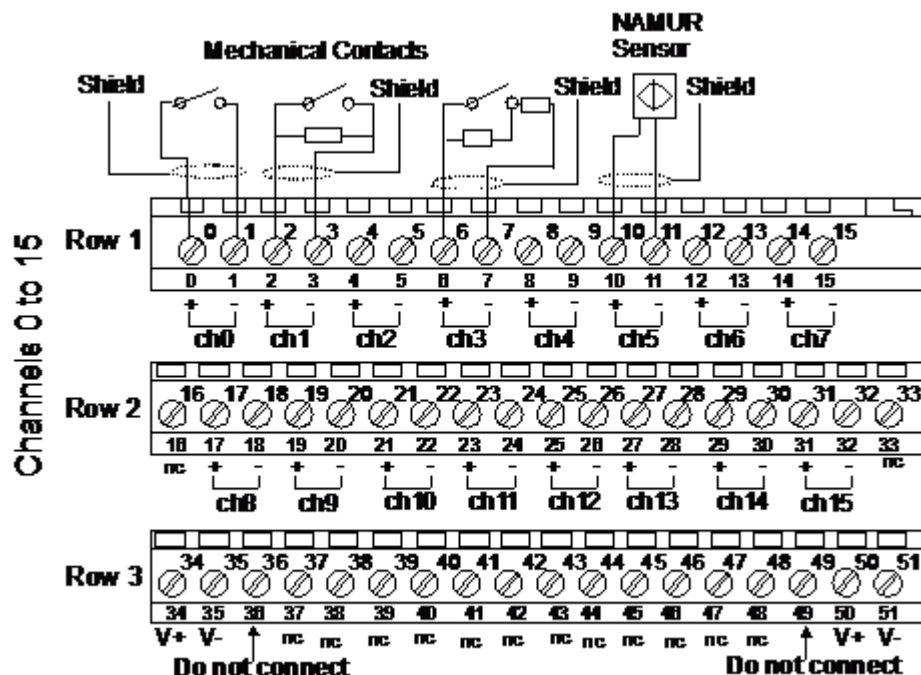
Figure 13: Typical Digital Input module connections.

3.6 Installing the Temperature Input Module

Related topics

3.6.1 Front view of the Temperature Input Module
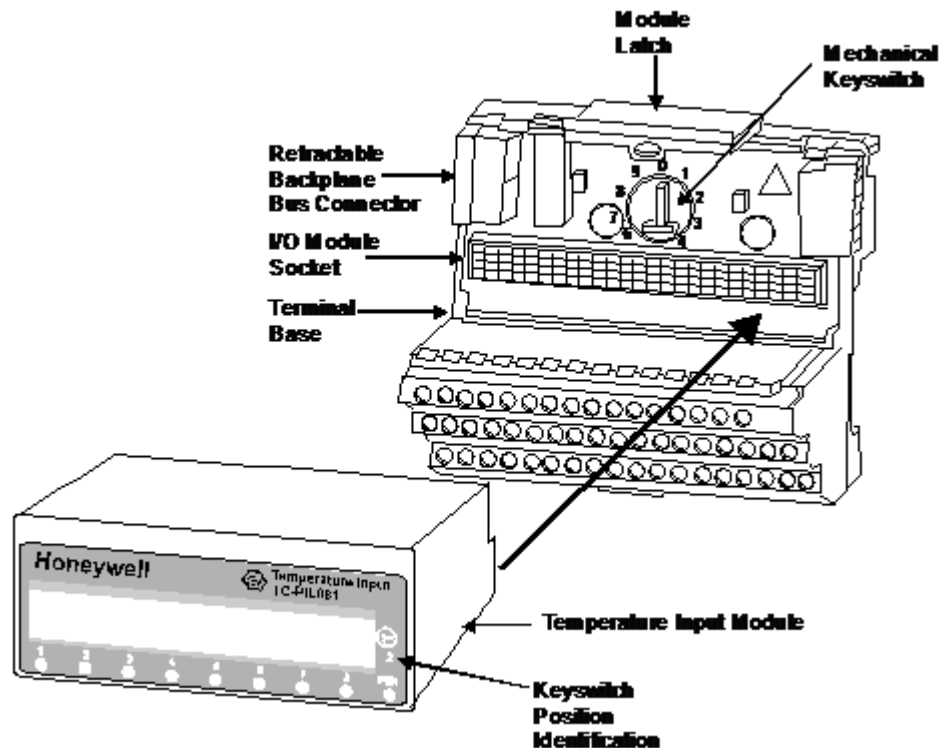
Figure 14: Temperature Input Module model TC-PIL081 plugs into Terminal Base model TC-PTBC11 or TC-PTBS11.

3.6.2 Plugging the Temperature Input Module into the installed Terminal Base

> **Attention**
> This procedure assumes that the Terminal Base is already installed and connected to another Terminal Base or the Gateway, and that the power supply is turned Off.

1   Turn the keyswitch on the Terminal Base clockwise to its number 2 position.
    (Note that the module's keyswitch position is identified on its front label.)

2   Be sure the retractable backplane bus connector on the Terminal Base is fully inserted into the mating module. Do **not** install an I/O module into a Terminal Base that is **not** installed.

3   Orient the Temperature Input module so its connector is aligned with the I/O socket on the Terminal Base. Carefully press the module into the Terminal Base so it is fully seated in the I/O socket and the Terminal Base's module latch snaps into place.

3.6.3 Wiring the Temperature Input Module

⚠️ **WARNING**

- Use only an intrinsically safe power supply to power the Terminal Base and Temperature Input module. The maximum intrinsically safe values must not be exceeded.

- Use only RIOM-H components with the Terminal Base and Temperature input module, so the intrinsically safe values of the backplane bus system are not exceeded.

- Do not use the Terminal Base nor Temperature Input module in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

To wire the Temperature Input Module

1 Do the following:

a For thermocouple input, connect sensor leads to terminals L (+) and - for channels 0 to 7.

For external Cold Junction Compensation (CJC), connect one sensor (CJC1) to terminals 37, 38, and 39 and the other sensor (CJC2) to terminals 46,47, and 49. If applicable, connect the tail of CJC1 to terminal 5 and the tail of CJC2 to terminal 12 for thermocouple inputs to channels 0 to 3; CJC1 to terminal 21 and CJC2 to terminal 29 for thermocouple inputs to channels 4 to 7, or CJC1 to terminal 5 and CJC2 to terminal 29 for thermocouple inputs to channels 0 to 7.

b For RTD inputs, connect 2-wire RTD to terminals + and -, 3-wire RTD to terminals +, L, and -, 4-wire RTD to terminals +, H, L, and - for channels 0 to 7.

c For millivolt inputs, observing polarity, connect the leads from the millivolt source in range of -40 to 100mV to the L (+) and - terminals for channels 0 to 7.

d Refer to Figure 15 for typical input connections.

(Note that the channels in this module are electrically connected to each other and have a common plus-line.)

2 Connect individual shields to an external ground source such as a bus bar.

3 Refer to the Terminal Base Wiring section for power supply connections.

⚠️ **CAUTION**

Do not use the unused terminals on this Terminal Base unit with a Temperature Input module. Using these terminals for any purpose can result in damage to the module and/or unintended operation of your system. (Figure 13).

Do not connect shields to the chassis ground terminals 16, 33, 40, 41, 42, 43, 44, and 45.

❗ Attention

When interconnecting several lines, you must consider the total accumulated power and check for intrinsic safety.

❗ Attention

The sensor type accepted as inputs to Channels 0 to 3 and Channels 4 to 7 are user configurable. This means that Channels 0 to 3 could be configured to accept RTD inputs from a selected sensor type and Channels 4 to 7 could be configured to accept Thermocouple inputs from a selected sensor type. If the Thermocouple sensor type is millivolts, you can not mix straight millivolt inputs with Thermocouple inputs within the same channel group 0-3 or 4-7. Note that Figure 15 shows a mix of Thermocouple and millivolt inputs to channel group 4-7 for general reference only. This is not a valid wiring configuration.
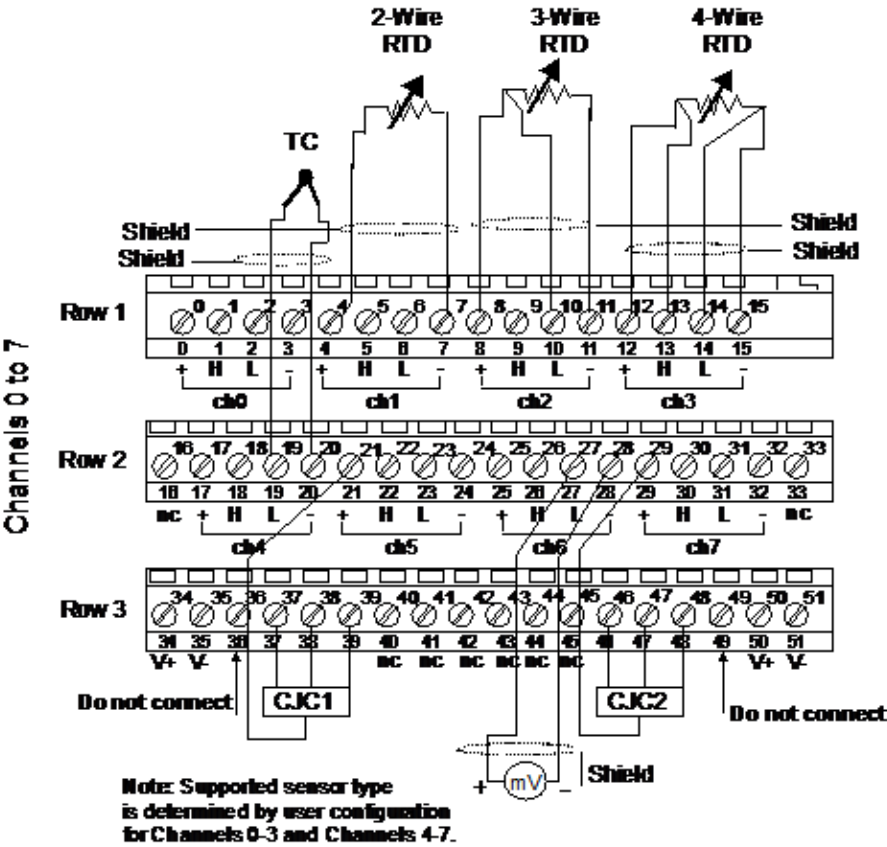
Figure 15: Typical Temperature Input module connections.

3.7 Installing the Analog Output Module

Related topics

3.7.1 Front view of the Analog Output Module
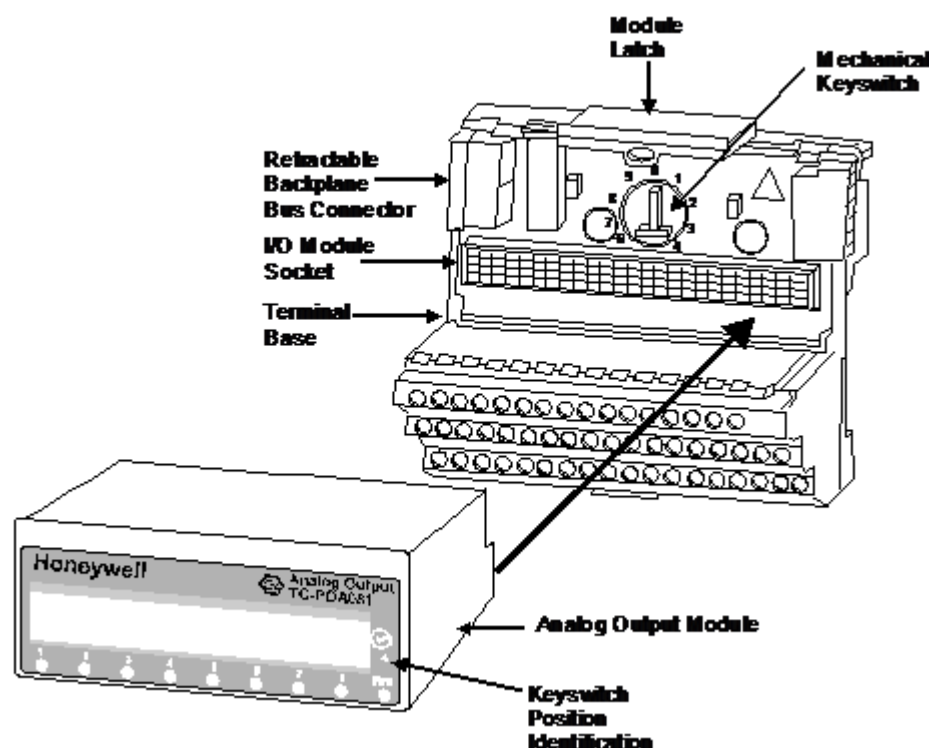
Figure 16: Analog Output Module model TC-POA081 plugs into Terminal Base model TC-PTBC11 or TC-PTBS11.

3.7.2 Plugging the Analog Output Module into the installed Terminal Base

Attention

This procedure assumes that the Terminal Base is already installed and connected to another Terminal Base or the Gateway, and that the power supply is turned Off.

1   Turn the keyswitch on the Terminal Base clockwise to its number 4 position.

   (Note that the module's keyswitch position is identified on its front label.)

2   Be sure the retractable backplane bus connector on the Terminal Base is fully inserted into the mating module. Do **not** install an I/O module into a Terminal Base that is **not** installed.

3   Orient the Analog Output module so its connector is aligned with the I/O socket on the Terminal Base. Carefully press the module into the Terminal Base so it is fully seated in the I/O socket and the Terminal Base's module latch snaps into place.

3.7.3 Wiring the Analog Output Module

> **WARNING**
> - Use only an intrinsically safe power supply to power the Terminal Base and Analog Output module. The maximum intrinsically safe values must not be exceeded.
> - Use only RIOM-H components with the Terminal Base and Analog Output module, so the intrinsically safe values of the backplane bus system are not exceeded.
> - Do not use the Terminal Base or Analog Output module in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

1 Observing polarity, connect the output leads from the + and - terminals for channels 0 to 7 to analog devices in the current range of 0 to 22mA. Refer to Figure 17 for typical analog device connections.

   (Note that the channels in this module are electrically connected to each other and have a common plus-line.)

2 Connect individual shields to an external ground source such as a bus bar.

3 Refer to the Terminal Base Wiring section for power supply connections.

Next steps

> **CAUTION**
> Do not use the unused terminals (2, 3, 6, 7, 10, 11, 14, 15, 19, 20, 23, 24, 27, 28, 31, 32, 37, 38, 39, 46, 47, 48) on this Terminal Base unit with an Analog Output module. Using these terminals for any purpose can result in damage to the module and/or unintended operation of your system (Figure 17).
>
> Do not connect shields to the chassis ground terminals 16, 33, 40, 41, 42, 43, 44, and 45.

> **Attention**
> When interconnecting several lines, you must consider the total accumulated power and check for intrinsic safety.
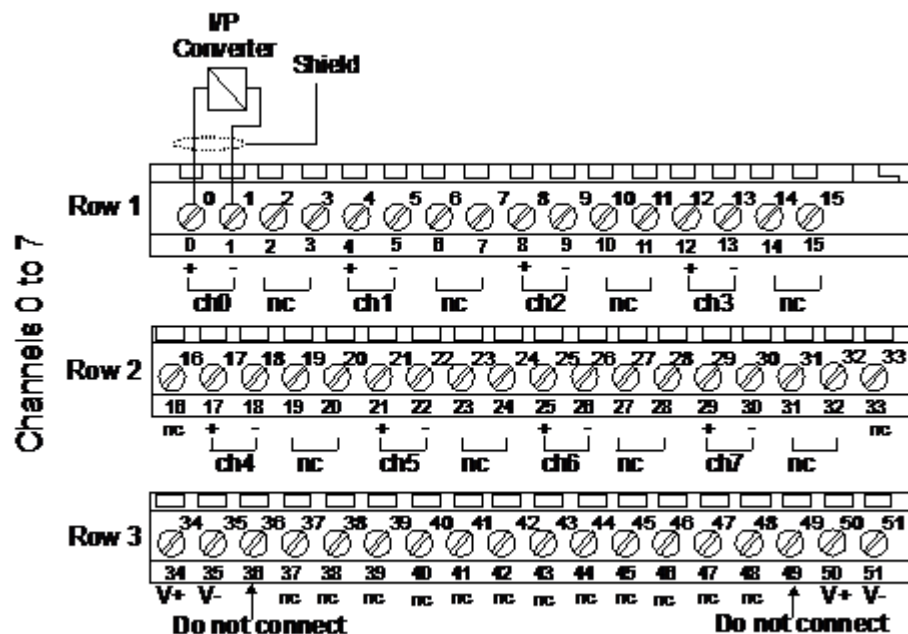

Figure 17: Typical Analog Output module connections.

3.8 Installing the Digital Output Module

Related topics

"Front view of the Digital Output Module" on page 39
"Plugging the Digital Output Module into the installed Terminal Base" on page 39
"Wiring the Digital Output Module" on page 40

3.8.1 Front view of the Digital Output Module
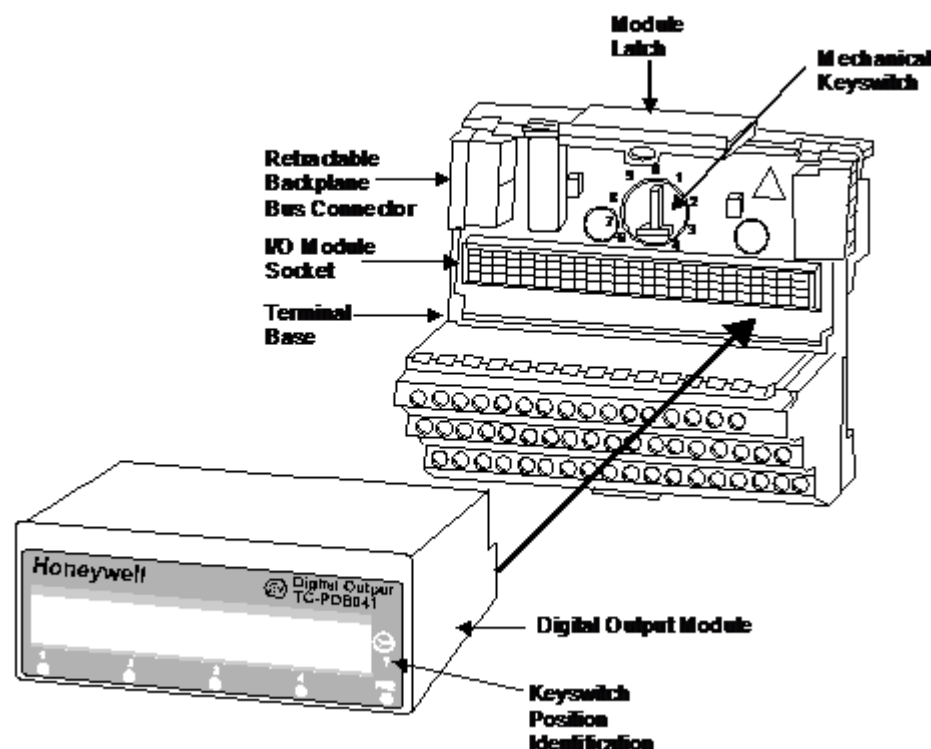
Figure 18: Digital Output Module model TC-POB041 plugs into Terminal Base model TC-PTBC11 or TC-PTBS11.

3.8.2 Plugging the Digital Output Module into the installed Terminal Base

> **Attention**
> This procedure assumes that the Terminal Base is already installed and connected to another Terminal Base or the Gateway, and that the power supply is turned Off.

1   Turn the keyswitch on the Terminal Base clockwise to its number 7 position.
    (Note that the module's keyswitch position is identified on its front label.)

2   Be sure the retractable backplane bus connector on the Terminal Base is fully inserted into the mating module. Do **not** install an I/O module into a Terminal Base that is **not** installed.

3   Orient the Digital Output module so its connector is aligned with the I/O socket on the Terminal Base. Carefully press the module into the Terminal Base so it is fully seated in the I/O socket and the Terminal Base's module latch snaps into place.

3.8.3 Wiring the Digital Output Module

⚠️ **WARNING**

- Use only an intrinsically safe power supply to power the Terminal Base and Digital Output module. The maximum intrinsically safe values must not be exceeded.

- Use only RIOM-H components with the Terminal Base and Digital Output module, so the intrinsically safe values of the backplane bus system are not exceeded.

- Do **not** use the Terminal Base or Digital Output module in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

1   Observing polarity, connect the output leads from the + and - terminals for channels 0 to 3 to valve actuators in the current range of 0 to 45mA - see the following curve. Refer to Figure 19 for typical digital device connections.
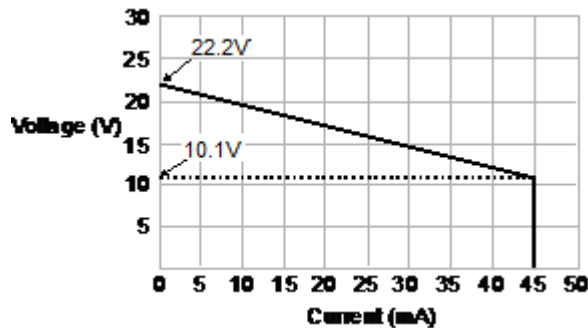
(Note that the channels in this module are electrically connected to each other and have a common plus-line.)

2   Connect individual shields to an external ground source such as a bus bar.

3   Refer to the Terminal Base Wiring section for power supply connections.

⚠️ **CAUTION**

Do not use the unused terminals (2, 3, 6, 7, 10, 11, 14, 15, 17 up to 32, 37, 38, 39, 46, 47, 48,) on this terminal base unit. Using these terminals for any purpose can result in damage to the module and/or unintended operation of your system. (Figure 19).

Do **not** connect shields to the chassis ground terminals 16, 33, 40, 41, 42, 43, 44, and 45.

❗ **Attention**

When interconnecting several lines, you must consider the total accumulated power and check for intrinsic safety.
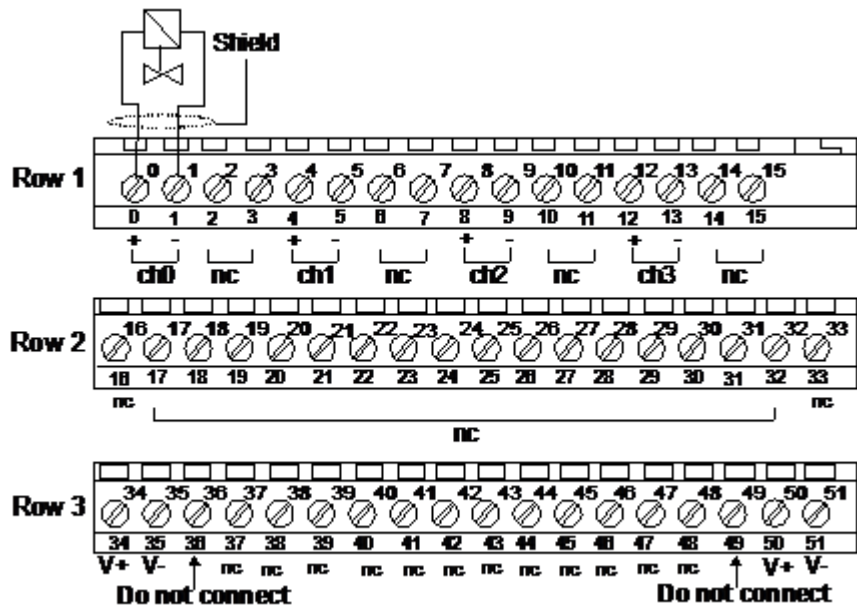
Figure 19: Typical Digital Output module connections.

3.9 Installing the ControlNet Repeater Adapter

Related topics

3.9.1 Front view of the ControlNet Repeater Adapter

Figure 20: Front view ControlNet Repeater Adapter model TC-PBFO01.

3.9.2 Mounting the ControlNet Repeater Adapter on a DIN rail

Attention

- You are responsible for obtaining and mounting the 35 x 7.5 mm metal, top hat rails (DIN EN50022) to be used for mounting RIOM-H components.
- The Repeater Adapter supports non-redundant ControlNet media communications. For redundant ControlNet media support, a second Repeater Adapter is required.
- Be sure you install the ControlNet Repeater Adapter at the left end of a Repeater Adapter and Fiber Module hub.
- We strongly recommend that you use redundant ControlNet media for the RIOM-H system.

1 Orient the Repeater Adapter so the top of the unit is over the top of the DIN rail.

2 Slightly rotate the module to slip its top mounting flange on the top of the DIN rail.

3 Press the module down flush with the DIN rail so its locking tab snaps into place, securing the module to the rail. If necessary, you can use a screwdriver to manually retract the lock while pressing the module firmly against the rail and then releasing it when in position.

4 Leave the protective covers on the connectors until you are ready to make the connections.

5 For redundant ControlNet media, repeat this procedure to mount a second Repeater Adapter on a separate DIN rail.

3.9.3 Wiring the ControlNet Repeater Adapter

⚠️ **WARNING**

• Use only an intrinsically safe power supply to power the Repeater Adapter. The maximum intrinsically safe values must not be exceeded.

• Use only RIOM-H components with the Repeater Adapter, so that the intrinsically safe values of the backplane bus system are not exceeded.

• Do not use the Repeater Adapter in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

To wire the ControlNet Repeater Adapter

1 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 DIN rails.

2 Observing polarity, connect the leads from the power supply channel to one set of the V+ and V- terminals, respectively. The recommended wire size is 14 AWG stranded cable.

(Note that the Repeater Adapter does not have a power switch, so it is powered whenever the power supply is turned on.)

3 Do the following:

a Remove the protective cover from the BNC connector and connect an RIOM-H approved ControlNet T or Y Tap (TC-PHTPx) with a drop cable to it. (Note that when a Repeater Adapter and Fiber Module pair (Hub) are used to **only** repeat a fiber link to another fiber link, there will be no coax drop cable connection to the BNC connector. **No** terminator should be applied to the BNC connector in that situation. Also, it may be desirable to cover the red "COM" LED (which will be lit to indicate no cable is connected).)

b Refer to the Control Drawing shipped with the Repeater Adapter for overall RIOM-H system wiring requirements.

4 Do the following:

a Make required approved ControlNet trunk cable and terminator connections to the Tap.

b Refer to Figure 21 for example of redundant ControlNet media cabling.

5 If applicable, use the other set of V+ and V- terminals to "daisy chain" power to another module.

6 Use the blue cable markers kit (TC-PCLPB1) to mark cables as Intrinsically safe, as required. Use the red and yellow cable markers supplied with taps to mark the A and B cables, respectively, in a redundant-media system.
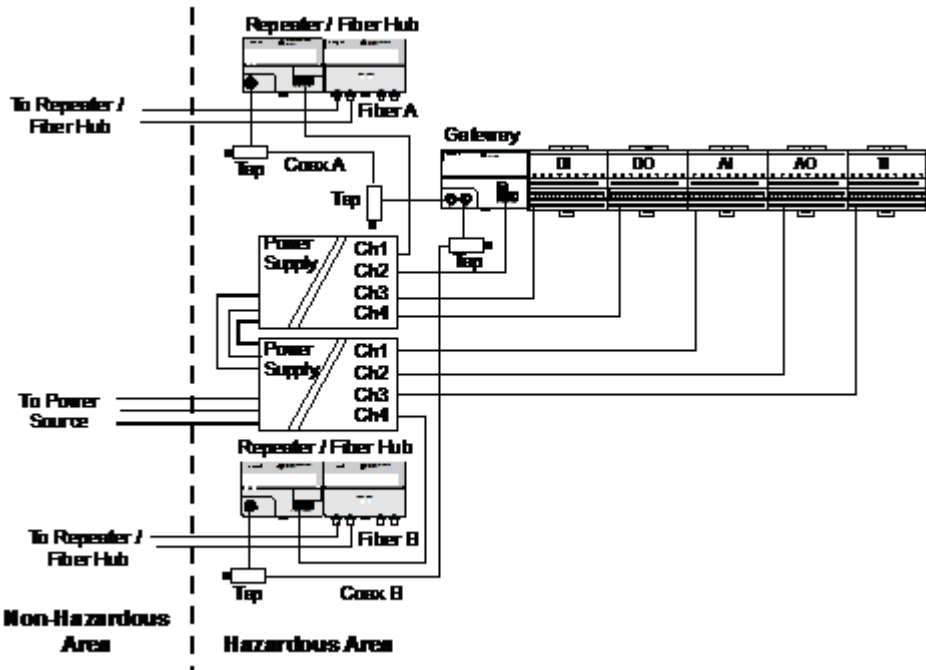
Figure 21: Example of redundant ControlNet cabling for RIOM-H segment.

3.10 Installing the ControlNet Fiber Module

Related topics

3.10.1 Front view of the ControlNet Fiber Module

Figure 22: Front view ControlNet Fiber Module model TC-PMFO01.

3.10.2 Mounting the ControlNet Fiber Module on a DIN rail

> **Attention**
>
> This procedure assumes that a ControlNet Repeater Adapter and optional ControlNet Fiber Module is already installed and that the power supply is turned Off. (Note that one or two Fiber Modules may be used with one Repeater Adapter, allowing for 1-4 fiber links to be connected to the Fiber Module(s). Also, the 4 fiber connectors shown in the figure above are not as symmetrically located on the actual Fiber Module hardware.)

1 Remove the protective cover from the backplane bus connector on the Repeater Adapter or other Fiber Module already connected to a Repeater Adapter. Remove the protective cover from the bus connector on the left side of the Fiber Module to be installed.

2 Orient the Fiber Module so the top of the unit is over the top of the DIN rail to the right of the installed Repeater Adapter or Fiber Module.

3 Slightly rotate the Terminal Base to slip its top mounting flange on the top of the DIN rail.

   • Press the Fiber Module down flush with the DIN rail so its locking tab snaps into place, securing the module to the rail. If necessary, you can use a screwdriver to manually retract the lock while pressing the module firmly against the rail and then releasing it when in position.

   • Carefully slide the module to the left until its bus connector is fully seated in the mating Repeater Adapter or Fiber Module bus connector.
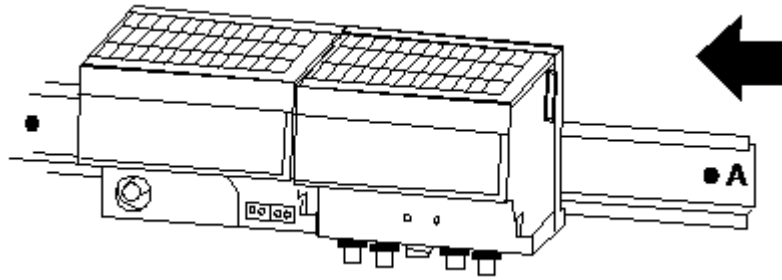
(Note that you can connect up to two Fiber Modules to one Repeater Adapter. Be sure you secure the modules together with DIN rail anchors to minimize the chance of lost communications or damage to the modules.)

4   Leave the protective cover on the backplane bus connector on the right side of the module until you are ready to make the connection.

3.10.3 Wiring the ControlNet Fiber Module

WARNING
- Use only RIOM-H components with the Fiber Module, so that the intrinsically safe values of the backplane bus system are not exceeded.
- Do **not** use the Fiber Module in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

Attention
The Fiber Module receives its power from the Repeater Adapter.

1   Complete the following:

   a   Remove the protective cover from the Recv connector for channel 1. Connect the ST connector on the end of the fiber optic cable from the Xmit connector on the Fiber Module in the non-hazardous area.

   b   Remove the protective cover from the Xmit connector for channel 1. Connect the ST connector on the end of the fiber optic cable from the Recv connector on the Fiber Module in the non-hazardous area. Be sure the Recv connector is from the same channel as the Xmit connector. Never connect the cable between channel 1 or channel 2 on the same Fiber Module or a different Fiber Module on the same Repeater/Fiber hub.

   (Note that the Fiber Module does not have a power switch, so it is powered whenever the Repeater Adapter is powered.)

2   If applicable, repeat Step 1 for a redundant ControlNet media.

3   Use the blue cable markers kit (TC-PCLPB1) to mark cables as Intrinsically safe, as required.

4   Refer to Figures 23, 24, and 25 for examples of Repeater/Fiber hub cabling.
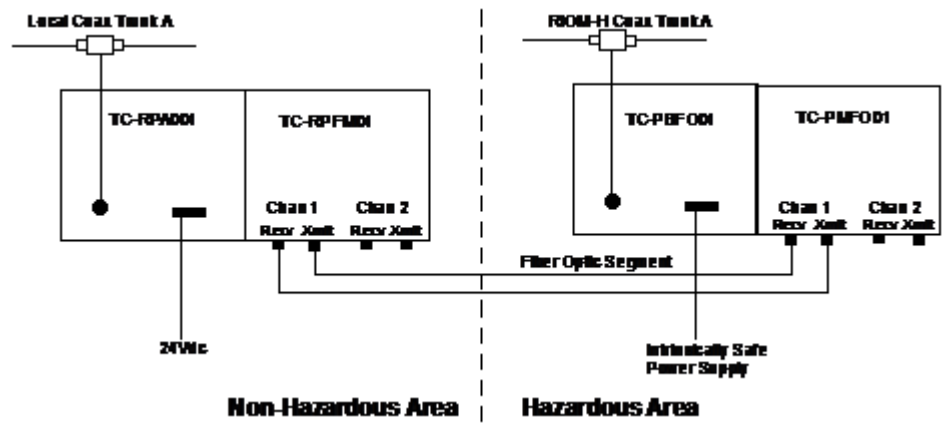
Figure 23: Typical Repeater/Fiber hub cabling for non-redundant ControlNet media.
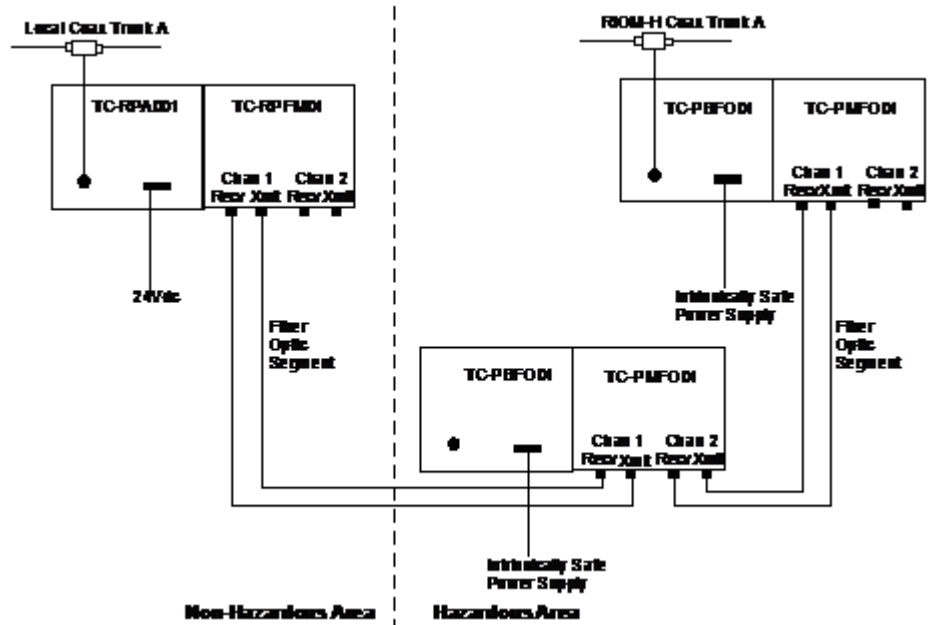
Figure 24: Typical Repeater/Fiber hub cabling for non-redundant ControlNet media using a second hub in series to extend cable distance.
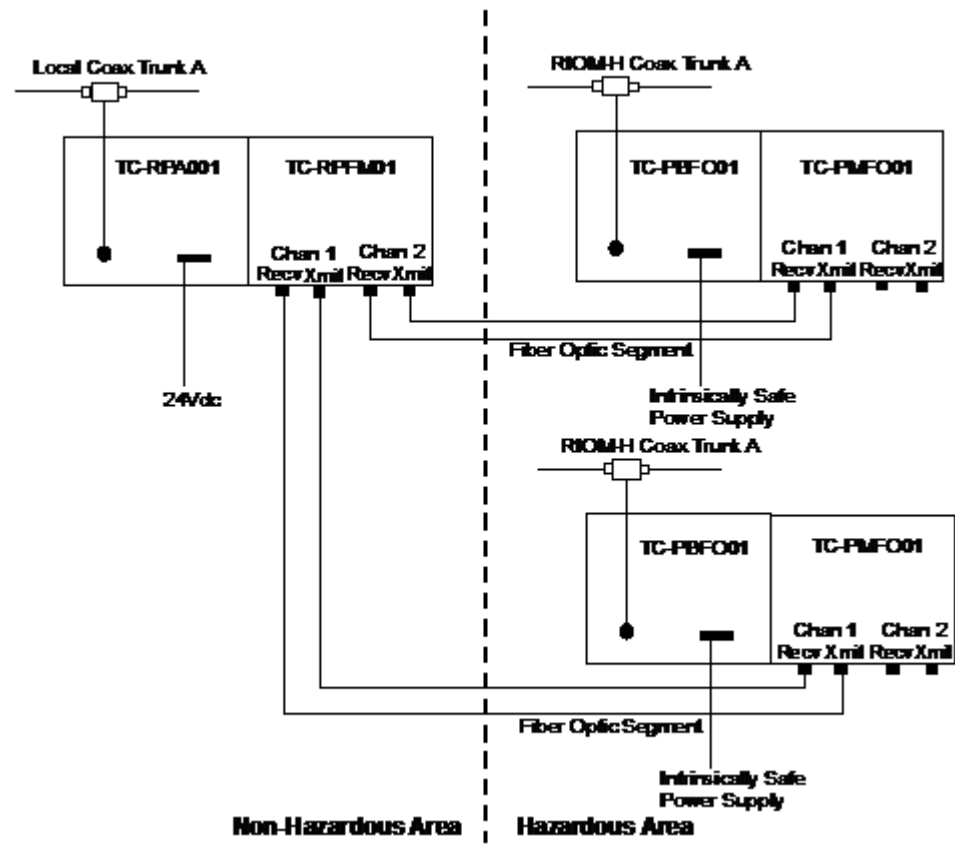
Figure 25: Typical Repeater/Fiber hub cabling for non-redundant ControlNet media in support of two RIOM-H segments.

3.11 Installing the Intrinsically Safe Power Supply

Related topics

3.11.1 Front view of the Intrinsically Safe Power Supply
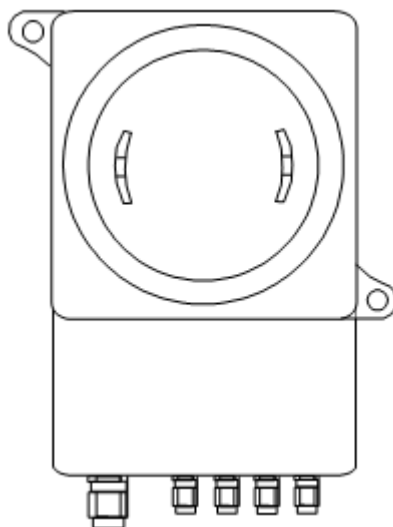
Figure 26: Four-Channel Intrinsically Safe Power Supply model TC-PPDXX1.

1 inch NPT   1 inch NPT
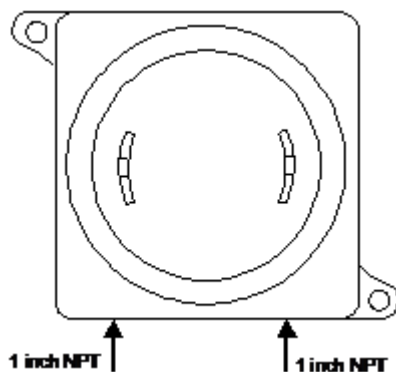
Figure 27: Four-Channel Intrinsically Safe Power Supply model TC-PPD1X1.

3.11.2 Mounting the Intrinsically Safe Power Supply on a panel

> **Attention**
> We assume that you will be installing the power supply on a panel in a non-hazardous area and then moving the panel to the hazardous area. If you mount the power supply in the hazardous area, you are responsible for ensuring the safety of both equipment and personnel.

1   Position the power supply housing at the desired location on the panel. Hold the housing in place and use a center punch to mark the location of the mounting holes on the panel. See Figure 27-A or 27-B for mounting dimension reference, depending on model.

2   Drill the required clearance holes for the mounting screws.

3   Be sure there is good metal-to-metal contact between the power supply housing and the mounting surface. Secure the housing to the panel with screws and lockwashers.

3.11.3 Dimensions of the Intrinsically Safe Power Supply
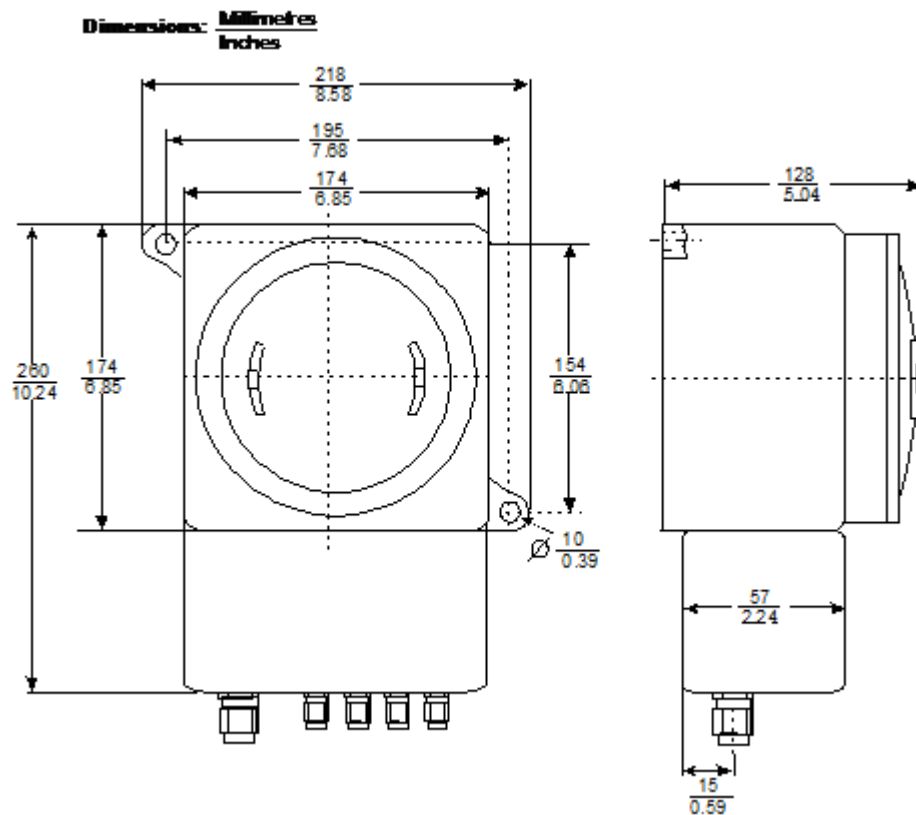
Figure 28: Mounting dimensions for intrinsically safe Power Supply model TC-PPDXX1.
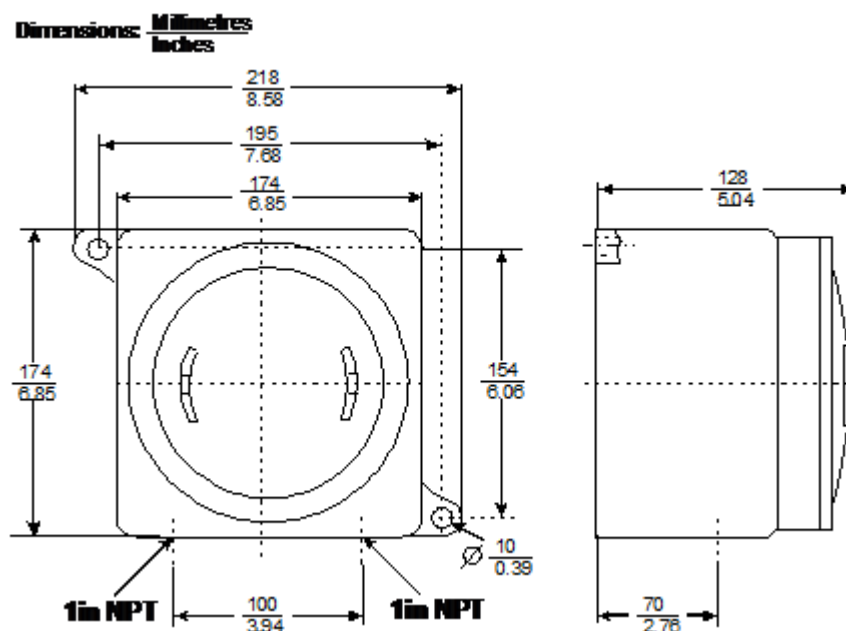
Figure 29: Mounting dimensions for intrinsically safe Power Supply model TC-PPD1X1.

3.11.4 Wiring the Intrinsically Safe Power Supply

> ⚠ **WARNING**
> - Use only RIOM-H components with the Power Supply, so that the intrinsically safe values of the backplane bus system are not exceeded.
> - Do not use the Power Supply in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

> ❗ **Attention**
> - The input and output circuits are galvanically isolated, but the output circuits are not isolated from one another.
> - Be sure to keep Intrinsically Safe wiring separated from hazardous wiring.
> - Use the compression fittings supplied to seal the wiring where it enters the power supply terminal box on model TC-PPDXX1.
> - Use the conduit screw fittings supplied to seal the wiring where it enters the power supply housing on model TC-PPD1X1.
> - Be sure all wiring is unpowered before making connections.
> - Confirm that the hazardous supply voltage is compatible with the power supply input requirements.
> - For optimum performance, keep the length of the supply voltage cable to a minimum, so the voltage measured at the power supply input terminals is as close to 24Vdc as possible.
> - Be sure the cable used for the power supply output wiring does **not** exceed these limits:
>   - Resistance = 0.085 ohms
>   - Capacitance = 800 F
>   - Inductance = 10 u ηH
> - Be sure the lengthμ of the power supply output cable does **not** exceed 11ft (3.5m).

1 Remove the cover from the power supply housing.

2 Connect chassis ground to terminal 3.

3   Feed the hazardous supply input wiring through the black compression fitting on model TC-PPDXX1, or through one conduit seal on model TC-PPD1X1. Observing polarity, connect the wiring to terminals 1 (+) and 2 (-). Tighten the compression or conduit seal fitting.

(Note that you can connect a redundant power source to terminals 4 (+) and 5 (-)).

4   Feed the intrinsically safe output wiring for channel 1 through one of the blue compression fittings on model TC-PPDXX1 or through the other conduit seal on model TC-PPD1X1. Observing polarity, connect the wiring to terminals 10 (+) and 11 (-).

5   Repeat Step 4 for the output channels 2, 3, and 4 using terminals 12 (+), 13 (-); 14 (+), 15 (-); and 16 (+), 17 (-), respectively.

6   Tighten the compression or conduit seal fitting. Be sure the wiring is appropriately marked as intrinsically safe.

7   Replace the cover.

4 Configuration and parameter reference

Related topics

"Configuring the RIOM-H in an Experion control strategy" on page 54
"RIOM-H parameter reference" on page 61

4.1 Configuring the RIOM-H in an Experion control strategy

Related topics

4.1.1 About control strategy configuration

You use the Control Builder application to configure a process Control Strategy using predefined function blocks. Since RIOM-H components have been functionally integrated with the Experion system, the Control Builder includes rail I/O module Function Blocks in its Library database tab.

This means each rail IOM block has an associated configuration form for defining its configurable attributes. These attributes include naming and identifying the component's location within the network as well as setting module and channel specific parameters, as applicable. If you have used Control Builder to configure rack IOM blocks, you will use the same process to configure rail IOM blocks.

Refer to the *Control Building User's Guide* for overall information about using Control Builder to build a Control Strategy.

> **Attention**
>
> The following information is only intended as a supplement to the Control Building Guide and does not repeat the basic functionality details for calling up, navigating, and interacting with the application. All the basic configuration tasks, such as assigning function blocks to a CEE and loading modules to a Controller, are the same for the RIOM-H function blocks as they are for any other block.

4.1.2 Adding a rail IOM block to a project

1 In the Library tab, click the + sign to the left of the RAIL_IO_HAZ icon to open the menu tree.

2 Click the IOM icon for the model number of the module you want to add and drag it to the Project tab.

TC-PIA082 for Analog Input

TC-PIB161 for Digital Input

TC-PIL081 for Temperature Input

TC-POA081 for Analog Output

TC-POB041 for Digital Output

3   Control Builder automatically assigns a sequential IOM name to the added block, such as IOM167.

4   Right-click the icon for the added block in Project to call up the block's configuration form

5   On the form's Main tab, enter:

- Desired Module Name and Description

- IOM Slot Number: This corresponds to the position of the Terminal Base containing the module. The Terminal Base connected to the ControlNet Gateway in the segment is Group 0 or Slot Number 0. The next Terminal Base in the segment is Group 1 or Slot Number 1 and so on up to Group 7 or Slot Number 7 for the maximum number of Terminal Bases allowed in a segment.

- Remote IO Chassis MAC Address: This corresponds to the address of the ControlNet Gateway for the segment containing the Terminal Base that contains this module.

- CNI Slot Number: This corresponds to the location of the downlink CNI in the rack I/O chassis or the Controller Chassis. The slot numbers are zero-based from left to right.

6   Go to the appropriate section that follows to configure the module and channel parameters for a given module.

4.1.3 Configuring module/channel data for an Analog Input module TC-PIA081/TC-PIA082

The Analog Input module is pre-configured for the following range data:

- Signal Range = 4 to 20mA

- Input Range = 2 to 22mA

- Resolution = 0.1% of 4 to 20mA

Enable or disable the communication faults alarm for the module by checking or unchecking the Alarming Enabled check box on the Module Configuration tab of the configuration form.

Note that Execution State selection on the Module Configuration tab is only active when the Analog Input module is accessed through the Monitoring tab after it has been downloaded as part of a Control Strategy to a Controller.

Configure the following parameters through the Channel Configuration tab of the configuration form for channels 0 to 3 as one group and channels 4 to 7 as another group.

> **Attention**
>
> The Digital Filter Cutoff frequency range values listed for the Analog Input module model TC-PIA081 parameters FLTRCUTOFF03 and FLTRCUTOFF47 do **not** work as intended. Refer to the given parameter description in the *RIOM-H Parameter Reference* section of this *Guide* for details. This does **not** apply to model TC-PIA082.

Parameter	Description
Enable Fault Detection	Enable or disable both local and remote fault detection by checking or unchecking the check box. When enabled, the local fault detection checks inputs for short-circuit and wire-off (open-circuit) conditions. Default is no check (disabled).
Digital Filter Cutoff	Select the cutoff frequency of the digital filtering applied to the input signal. Default is 10Hz.

Parameter	Description
Remote Fault Direction	Only active if Enable Fault Detection is enabled. Specifies the direction a remote transmitter will drive its signal when it detects an internal fault. Selections are: • LOW: Transmitter drives its signal into the underrange region. • HIGH: Transmitter drives its signal into the overrange region. • NONE: Disables remote fault detection (This means that only local fault detection is active, when the Enable Fault Detection is enabled.) Default is NONE.
Remote Fault Low Trip Point	Only active if Remote Fault Direction selection is LOW. Specify LOW trip point in range of 2.0 to 3.9mA. Default is 2.0.
Remote Fault High Trip Point	Only active if Remote Fault Direction selection is HIGH. Specify HIGH trip point in range of 20.1 to 22.0mA. Default is 22.0.

4.1.4 TC-PIA081/TC-PIA082 alarm flags

The Analog Input module can assert an internal flag for these conditions, when it is Active.

Condition	Description
Local Fault Alarm	If Fault Detection is enabled, indicates whether a 'short-circuit' or 'wire-off' condition exists
Remote Fault Alarm	If Fault Detection is enabled, indicates whether or not a remote transmitter is signaling that it is faulted.
Over-range Alarm	Indicates if the input value has exceeded the high limit of the analog-to-digital conversion capability of the module (20 mA)
Under-range Alarm	Indicates if the input value has fallen below the low limit of the analog-to-digital conversion capability of the module (2 mA)
Module Hardware Status	Indicates whether the module has detected an internal fault

4.1.5 Configuring module/channel data for Digital Input module TC-PIB161

Enable or disable the communication faults alarm for the module by checking or unchecking the Alarming Enabled check box on the Module Configuration tab of the configuration form.

The Digital Filter Time parameter is the only other configuration parameter for this module. This parameter specifies the time constant in milliseconds to be used for filtering both input data and the detection of fault conditions. The module will not recognize input pulses or fault states that do not exist for the specified time. The default selection is 0.25MSDELAY.

For Fault Detection to work, you must have the four DIP switches on the bottom of the module set to ON to allow activation of the fault status bits. Refer to *Checking DIP switch settings* in the *Installing Digital Input module* section.

Note that Execution State selection on the Module Configuration tab is only active when the Digital Input module is accessed through the Monitoring tab after it has been downloaded as part of a Control Strategy to a Controller.

4.1.6 TC-PIB161 alarm flags

When it is Active, the Digital Input module can assert an internal flag for each of the 16 discrete inputs to indicate whether a 'short-circuit' or 'wire-off' condition exists.

4.1.7 Configuring module/channel data for Temperature Input module TC-PIL081

Configure the following parameters through the Module Configuration tab of the configuration form for all module channels.

● **Attention**

The Digital Filter Cutoff frequency range values listed for the Temperature Input module (TC-PIL081) parameter FILTRCUTOFF do **not** work as intended in the initially released models. Refer to the given parameter description in the *RIOM-H Parameter Reference* section of this *Guide* for details.

Parameter	Description
Alarming Enabled	Enable or disable the communication faults alarm for the module by checking or unchecking the check box. Default is checked (enabled).
Reference Temp (Celsius)	Select temperature in Celsius to be used for the reference junction or external temperature compensation for Thermocouple inputs. Default is 0.
Digital Filter Cutoff	Select the cutoff frequency of the digital filtering applied to the input signal. Default is 10Hz.
Temperature Format	Select the data format for the process value units used for temperature measurements. Default is CELSIUS.

Note that Execution State selection on the Module Configuration tab is only active when the Temperature Input module is accessed through the Monitoring tab after it has been downloaded as part of a Control Strategy to a Controller.

Configure the following parameters through the Channel Configuration tab of the configuration form for channels 0 to 3 as one group and channels 4 to 7 as another group.

Parameter	Description
Input Type	Defines type of input to be accepted as channel input. Default is Thermocouple.
Enable Fault Detection	Enable or disable fault detection by checking or unchecking the check box. When enabled, fault detection checks inputs for wire-off (open-circuit) conditions. Default is no check (disabled).
TC Sensor Type	Only active when Input Type selection is Thermocouple. Select straight millivolt (MV) or specific Thermocouple type (B, E, J, K, L, N, R, S, or T) input for all channels in the group. Default is MV.
TC Sensor Mode	Only active when Input Type selection is Thermocouple. Select whether internal (FIXED_COMP), external (CJR_COMP), or no (NONE) temperature compensation is to be used for the inputs. Default is CJR_COMP.
RTD Sensor Type	Only active when Input Type selection is RTD. Select straight OHMS or specific RTD type (PT100, IEC 751; PT200, IEC 751; PT100, JIS; PT200, JIS; NI100, DIN 43; NI120 MINCO; or CU10 MINCO) input for all channels in the group. Default is OHMS.
RTD Sensor Mode	Only active when Input Type selection is RTD. Select whether 2-WIRE (without lead compensation), 2-WIRE_LOOP (with lead compensation), 3-WIRE, or 4-WIRE sensor is to be used for the inputs. Default is 2-WIRE.
RTD Loop Resistance Offset	Only active when RTD Sensor Mode selection is 2-WIRE_LOOP. Select lead compensation value in ohms (5, 10 or 15 ohms) or to be DETERMINED based on the internal compensation value of 2-wire calibration. Default is 5_OHMS.

4.1.8 TC-PIL081 alarm flags

The Temperature Input module can assert an internal flag for these conditions, when it is Active.

Condition	Description
Fault Alarm	If Fault Detection is enabled, indicates whether a 'short-circuit' or 'wire-off' condition exists
Overrange Alarm	Indicates if the input value has exceeded the high limit for the selected sensor type.
Underrange Alarm	Indicates if the input value has dropped below the low limit for the selected sensor type.
Cold Junction Alarm	Indicates Cold junction thermistor lead is broken or shorted. Only active if sensor type is Thermocouple and sensor mode is external temperature compensation (CJR_COMP).
Module Hardware Status	Indicates whether the module has detected an internal fault

4.1.9 Configuring module/channel data for Analog Output module TC-POA081

The Analog Output module is pre-configured for the following range data:

- Signal Range = 4 to 20mA
- Input Range = 2 to 22mA
- Resolution = 0.1% of 4 to 20mA

Enable or disable the communication faults alarm indication for the module by checking or unchecking the Alarming Enabled check box on the Module Configuration tab of the configuration form.

Note that Execution State selection on the Module Configuration tab is only active when the Analog Input module is accessed through the monitoring tab after it has been downloaded as part of a Control Strategy to a Controller.

Configure the following parameters through the Channel Configuration tab of the configuration form for channel pairs or groups as designated.

Parameter	Description
Wire-off Detection	Enable or disable the detection of an open condition in the field wiring or input device by checking or unchecking the check box for each channel pair. Default is no check (disabled).
Latch Mode Enabled	Enable or disable the latching of detected wire-off conditions by checking or unchecking the check box. When enabled, detected faults are latched. Default is no check (disabled).

4.1.10 TC-POA081 alarm flags

The Analog Output module can assert an internal flag for these conditions, when it is Active.

Condition	Description
Open Wire Fault	If Wire-off Detection is enabled, indicates whether a 'wire-off' condition exists as well as latched wire-off conditions, when Latched Mode Enabled is enabled.
Module Hardware Status	Indicates whether the module has detected an internal fault

4.1.11 Configuring module/channel data for Digital Output module TC-POB041

Configure the following parameters through the Module Configuration tab of the configuration form for all module channels.

Parameter	Description
Alarming Enabled	Enable or disable the communication faults alarm indication for the module by checking or unchecking the check box. Default is checked (Enabled).
Latch Mode Enabled	Enable or disable the latching of detected fault conditions on all channels by checking or unchecking the check box. When enabled, detected faults are latched. Default is no check (disabled).
	Note that, once a fault is latched on a given channel, you must manually reset the latch through the Fault Reset check box on the Status/Data tab on the configuration form in the CB Monitoring tab or the module's Detail Display in Station.
Fault Detection Delay Time	Only active if Latch Mode Enabled function is disabled. Select the time in milliseconds that a fault condition must exist before it is signaled. Default is 11MS.
	If Latch Mode Enabled function is enabled, the Fault Detection Delay Time is 11 milliseconds and it is not configurable.

Enable or disable the detection of wire-off and short circuit conditions by checking or unchecking the Enable Fault Detection check box for each channel on the Channel Configuration tab.

4.1.12 TC-POB041 alarm flags

The Digital Output module can assert an internal flag for these conditions, when it is Active.

Condition	Description
Short Alarm	If Enable Fault Detection is enabled, indicates whether a "short circuit" condition exists as well as latched short circuit conditions, when Latched Mode Enabled is enabled.
Wire-off Alarm	If Enable Fault Detection is enabled, indicates whether a 'wire-off' condition exists as well as latched wire-off conditions, when Latched Mode Enabled is enabled.

4.1.13 Defining Server related configuration data

The Server History and Server Displays tabs in the module configuration form let you configure parameters related to collecting history data and displaying of module data through standard and custom displays in the Station application. These tabs include pre-configured entries for links to the standard Point Detail and Group Detail displays as well as the default Control Level. Refer to the online Help for more information about the individual parameter entries.

4.1.14 About the Status/Data tab

The Status/Data tab of the module's configuration form is only functional when the module is active in the Monitoring tab of Control Builder. It provides information about the general status of the module. This same information appears on the module's Detail display in Station.

4.1.15 About the Version tab

The Version tab in the module configuration form lets you view information relavent to the Qualification and Version Control system function, if you have a Version Control System license. See the online help for more information about monitoring the data on this tab.

4.1.16 About the Identification tab

The Identification tab in the module configuration form lets you view information relavent to the Template building function, if you have a Template license. See the online help for more information about monitoring the data on this tab.

4.2 RIOM-H parameter reference

Related topics

4.2.1 Unique rail IOM parameters

The following parameters are unique to the rail IOM blocks. They are listed in alphabetical order for general reference. Refer to the *Parameter Reference* document for parameters that are common to all IOM blocks.

4.2.2 CJALARM03

Specific to Block(s)	Rail Temperature Input Modules
Description	Cold Junction Alarm
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This alarm indicates a 'Cold Junction Compensation Thermistor' fault that may consist of either a broken lead or a shorted lead to the CJ compensation thermistor.
	This alarm is only active if the device has been configured as follows:
	• Input Type = Thermocouple
	• Input Mode = External
	If a broken lead is detected, 70 C is substituted for the CJC temperature in all calculations
	If a short-circuit is detected, 0 C is substituted for the CJC temperature in all calculations
	This parameter applies to channels 0 to 3.

4.2.3 CJALARM47

Specific to Block(s)	Rail Temperature Input Modules
Description	Cold Junction Alarm
Data Type	BOOLEAN

Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This alarm indicates a 'Cold Junction Compensation Thermistor' fault that may consist of either a broken lead or a shorted lead to the CJ compensation thermistor.
	This alarm is only active if the device has been configured as follows:
	• Input Type = Thermocouple
	• Input Mode = External
	If a broken lead is detected, 70 C is substituted for the CJC temperature in all calculations
	If a short-circuit is detected, 0 C is substituted for the CJC temperature in all calculations
	This parameter applies to channels 4 to 7.

4.2.4 DIAGINFO

Specific to Block(s)	Rail Analog Input and Temperature Input Modules
Description	Module Hardware Status
Data Type	ENUM
Range	• Normal
	• >Calibration Fault (during preparation) (Bad_Cal)
	• >Configuration Fault (Bad_Config)
	• >Message Fault (during preparation) (Bad_Message)
	• >Line Breakage Detection Circuitry Fault (LBD_Failure)
	• >Major Hardware Fault (Maj_HW_Fail)
	• >EEPROM Fault (Bad_EEPROM)
	• >RAM Fault (Bad_PSD_RAM)
	• >ROM Fault (Bad_PSD_ROM)
	• >Calculation Fault (during preparation) Bad_Calc
	• >Microprocessor RAM Fault (Bad_uP_RAM)
	• >SerBus Interface ASIC RAM Fault (Bad_CRISPRAM)
Default	Normal
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	HWFAULTFL (asserted if DIAGINFO has a value other than 'Normal')
Remarks	This parameter reflects the status of a hardware self-diagnostic performed by the device itself.

Specific to Block(s)	Rail Analog Output Modules
Description	Module Hardware Status
Data Type	ENUM
Range	• Normal • >Bad Calibration (Bad_Cal) • Bad Configuration (Bad_Config) • Bad Message (Bad_Message) • Line Breakage Detection Circuit Failure (LBD_Failure) • EEPROM Fault (Bad_EEPROM) • RAM Fault (Bad_RAM) • ROM Fault (Bad ROM • Calculation Fault (Bad_Calc) • Data Range Error (DataRangeErr)
Default	Normal
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameters	HWFAULTFL (asserted if DIAGINFO has a value other than 'Normal')
Remarks	This parameter reflects the status of a hardware self-diagnostic performed by the device itself.

4.2.5 DIGFILTER

Specific to Block(s)	Rail Digital Input Modules
Description	Digital Filter Time
Data Type	ENUM
Range	• 0.25ms Delay • 0.5msDelay • 1msDelay • 2msDelay • 4msDelay • 8msDelay • 16msDelay • 32msDelay
Default	0.25msDelay
Config Load	Yes
Access Lock	App Dev Only
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This parameter sets the filter time for both input data and fault detection for all sixteen (16) channels. The module does not recognize input pulses or fault states that are shorter in duration than the specified filter time.

4.2.6 DOMSO[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	Output Value
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	PVVAL, PVSTS
Remarks	Output value written to the device

4.2.7 FAULTALARM[0...7]

Specific to Block(s)	Rail Temperature Input Modules
Description	Fault Alarm
Data Type	BOOLEAN
Range	ON/OFF
Default	ON
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB03, FAULTENB47
Remarks	This parameter is asserted if a broken or detached lead is detected on an input channel. While the size of this array is eight, the fault detection is enabled for channel group 0 to 3 (FAULTENB03) and/or channel group 4 to 7 (FAULTENB47), but fault alarm occurs on the basis of an individual channel.

4.2.8 FAULTDELAY

Specific to Block(s)	Rail Digital Output Modules
Description	Fault Detection Delay Time
Data Type	ENUM
Range	11ms
	16ms
	32ms
Default	11ms
Config Load	Yes
Access Lock	AppDevOnly

Residence	CEE
Active Connections	No
Related Parameter	LATCHENB, FAULTENB
Remarks	• This parameter sets the length of time a fault must exist before it is recognized and signaled. • Applies to all channels of the module.

4.2.9 FAULTDIR03

Specific to Block(s)	Rail Analog Input Modules
Description	Remote Fault Detection
Data Type	ENUM
Range	• NONE • HIGH • LOW
Default	NONE
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTLOTP03, REMFLTHITP03, FAULTENB03
Remarks	If Fault Detection is enabled (FAULTENB03), this parameter determines whether or not Remote Transmitter Faults will be detected and whether a signal direction higher than 20mA (REMFLTHITP03) or lower than 4mA (REMFLTLOTP03) will signal the fault. This parameter applies to channels 0 to 3 as a group.

4.2.10 FAULTDIR47

Specific to Block(s)	Rail Analog Input Modules
Description	Remote Fault Detection
Data Type	ENUM
Range	• NONE • HIGH • LOW
Default	NONE
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTLOTP47, REMFLTHITP47, FAULTENB47

Remarks	If Fault Detection is enabled (FAULTENB47), this parameter determines whether or not Remote Transmitter Faults will be detected and whether a signal direction higher than 20mA (REMFLTHITP47) or lower than 4mA (REMFLTLOTP47) will signal the fault.
	This parameter applies to channels 4 to 7 as a group.

4.2.11 FAULTENB[0...3]

Specific to Block(s)	Rail Analog Output Modules
Description	Wire-Off Detection
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	LATCHENB03, LATCHENB47, FAULTRESET, WIREOFF
Remarks	This is an arrayed parameter. Each fault is applied to two channels as a group as follows: • FAULTENB[0] for channels 0 and 1 • FAULTENB[1] for channels 2 and 3 • FAUTLENB[2] for channels 4 and 5 • FAULTENB[3] for channels 6 and 7

Specific to Block(s)	Rail Digital Output Modules
Description	Enable Fault Detection
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameters	LATCHENB, FAULTRESET
Remarks	• Enables detection of wire-off and short-circuit conditions. • Applies to individual channel. There are four channels associated with this device.

4.2.12 FAULTENABLE03

Specific to Block(s)	Rail Analog Input Modules
Description	Enable Fault Detection

Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTHITP03, REMFLTLOP03, FAULTDIR03
Remarks	• Enables both Local and Remote Fault Detection. For only local fault detection, disable remote fault detection by setting the fault direction parameter (FAULTDIR03) to NONE. • This parameter applies to channels 0 to 3 as a group.

Specific to Block(s)	Rail Temperature Input Modules
Description	Enable Fault Detection
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameters	FAULTALARM[], CJALARM03
Remarks	• Enables line-breakage and input voltage overrange detection. • This parameter applies to channels 0 to 3 as a group.

4.2.13 FAULTENABLE47

Specific to Block(s)	Rail Analog Input modules
Description	Enable Fault Detection
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTHITP47, REMFLTLOP47, FAULTDIR47
Remarks	• Enables both Local and Remote Fault Detection. For only local fault detection, disable remote fault detection by setting the fault direction parameter (FAULTDIR47) to NONE. • This parameter applies to channels 4 to 7 as a group.

Specific to Block(s)	Rail Temperature Input Modules

Description	Enable Fault Detection
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameters	FAULTALARM[], CJALARM47
Remarks	• Enables line-breakage and input voltage overrange detection. • This parameter applies to channels 4 to 7 as a group.

4.2.14 FAULTRESET

Specific to Block(s)	Rail Analog Output Modules
Description	Fault Reset
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	Engineer
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB[], LATCHENB03, LATCHENB47
Remarks	• This parameter issues a Latched Fault Reset, when selected by the user. • This parameter applies globally to all channels on the module.

4.2.15 FILTRCUTOFF

❗ Attention

The Digital Filter Cutoff frequency range values listed for the Temperature Input module (TC-PIL081) parameter FILTRCUTOFF do not work as intended in initially released models. The actual filter time constants cause the break point (-3dB) frequencies to be much lower. This limits the pass-band performance, which may be detrimental to closed loop system performance. Be sure you select the desired filter frequency based on the actual cutoff frequency and time constant listed in the following table for the given Digital Filter Cutoff frequency range value and input sensor type. We suggest that you use the default 10 Hz filter selection.

Digital Filter Cutoff Frequency Range Value (Hz)			10		4		2		1		0.5	
Sensor Type	Format	Mode	Actual (Hz)	Actual Time Const (S)	Actual (Hz)	Actual TimeConst(S)	Actual (Hz)	Actual Time Const (S)	Actual (Hz)	Actual Time Const (S)	Actual (Hz)	Actual Time Const (S)
mV	mV	-	1.384	0.115	0.554	0.288	0.277	0.575	0.138	1.150	0.069	2.300

Digital Filter Cutoff Frequency Range Value (Hz)			10		4		2		1		0.5	
T/C	F	-	1.088	0.146	0.435	0.366	0.218	0.731	0.109	1.463	0.054	2.925
T/C	C	-	0.972	0.164	0.389	0.409	0.194	0.819	0.097	1.638	0.049	3.275
Ohm	Ohm	4-wire	0.479	0.333	0.191	0.831	0.096	1.663	0.048	3.325	0.024	6.650
Ohm	Ohm	3-wire	0.395	0.403	0.158	1.006	0.079	2.013	0.040	4.025	0.020	8.050
Ohm	Ohm	2-wire	0.505	0.315	0.202	0.788	0.101	1.575	0.051	3.150	0.025	6.300
RTD PT100	C	4-wire	0.456	0.349	0.183	0.872	0.091	1.744	0.046	3.488	0.023	6.975
RTD PT100	C	3-wire	0.381	0.418	0.152	1.044	0.076	2.088	0.038	4.175	0.019	8.350
RTD PT100	F	3-wire	0.391	0.408	0.156	1.019	0.078	2.038	0.039	4.075	0.020	8.150
RTD PT100	C	2-wire	0.472	0.338	0.189	0.844	0.094	1.688	0.047	3.375	0.024	6.750

Specific to Block(s)	Rail Temperature Input Modules
Description	Digital Filter Cutoff
Data Type	ENUM
Range	10 Hz 4 Hz 2 Hz 1 Hz 0.5 Hz 0.2 Hz
Default	10Hz
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This parameter defines the cut-off frequency of the input filter applied on all channels.

4.2.16 FLTRCUTOFF03

> **Attention**
>
> The Digital Filter Cutoff frequency range values listed for the Analog Input module model TC-PIA081 parameters FLTRCUTOFF03 and FLTRCUTOFF47 do not work as intended. The actual filter time constants cause the break point (-3dB) frequencies to be much lower. This limits the pass-band performance, which may be detrimental to closed loop system performance. Be sure you select the desired filter frequency based on the actual cutoff frequency and time constant listed in the following table for the given Digital Filter Cutoff frequency range value for model TC-PIA081 only.

Digital Filter Cutoff Frequency Range Value (Hz)	Intended Time Constant (Seconds)	Actual Digital Filter Cutoff Frequency Value (Hz)	Actual Time Constant (Seconds)
10	0.0159	1.591	0.1
4	0.0398	0.637	0.25
2	0.0795	0.3183	0.5
1	0.0159	0.1591	1.0
0.5	0.3183	0.0795	2.0

Specific to Block(s)	Rail Analog Input Modules Model TC-PIA081
Description	Digital Filter Cutoff
Data Type	ENUM
Range	• 10Hz • 4Hz • 2Hz • 1Hz • 0.5Hz
Default	10Hz
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	FLTRCUTOFF47, FAULTEN03
Remarks	This parameter sets the cutoff frequency (in terms of time constant) of the input filter on channels 0 to 3 as a group.

Specific to Block(s)	Rail Analog Input Module Model TC-PIA082
Description	Digital Filter Cutoff
Data Type	ENUM
Range	• 10Hz • 4Hz • 2Hz • 1Hz • 0.5Hz
Default	10Hz
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connector	No
Related Parameters	FLTRCUTOFF47, FAULTEN03
Remarks	This parameter sets the cutoff frequency (in terms of time constant) of the input filter on channels 0 to 3 as a group.

4.2.17 FLTRCUTOFF47

> **❗ Attention**
>
> Read the Attention note above for parameter FLTRCUTOFF03 for important frequency range value information for Model TC-PIA081 only.

Specific to Block(s)	Rail Analog Input Modules Model TC-PIA081
Description	Digital Filter Cutoff
Data Type	ENUM
Range	• 10Hz • 4Hz • 2Hz • 1Hz • 0.5Hz
Default	10Hz
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	FLTRCUTOFF03, FAULTEN47
Remarks	This parameter sets the cutoff frequency (in terms of time constant) of the input filter on channels 4 to 7 as a group.

Specific to Block(s)	Rail Analog Input Module Model TC-PIA082
Description	Digital Filter Cutoff
Data Type	ENUM
Range	• 10Hz • 4Hz • 2Hz • 1Hz • 0.5Hz
Default	10Hz
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connector	No
Related Parameters	FLTRCUTOFF03, FAULTEN47
Remarks	This parameter sets the cutoff frequency (in terms of time constant) of the input filter on channels 4 to 7 as a group.

4.2.18 HWFAULTFL

Specific to Block(s)	All Rail I/O Module Function Blocks

Description	Hardware Fault Flag
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	WIRE0FF[], DIAGINFO, REMFAULT
Remarks	This parameter is set TRUE if one or more of the following faults are signaled. • A detected fault in the I/O device hardware itself. • Opened or shorted leads to the sensor. • A faulted remote transmitter.

4.2.19 HWFAULT[0...15]

Specific to Block(s)	Rail Digital Input Modules
Description	Indicates whether a wire-off or short-circuit condition exists on the channel
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	WIREOFF
Remarks	This parameter indicates a wire-off or short-circuit fault on the channel when it is ON. Failsafe value is OFF. Fault detection is disabled in the presence of a communications fault.

4.2.20 INPUTTYPE03

Specific to Block(s)	Rail Temperature Input Modules
Description	Input Type (Thermocouple versus RTD)
Data Type	ENUM
Range	• Thermocouple • RTD
Default	Thermocouple
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	TCTYPE03, TCMODE03, RTDTYPE03, RTDMODE03

Remarks	This parameter specifies whether Thermocouple or RTD sensor types are to be connected to channels 0 to 3 as a group.

4.2.21 INPUTTYPE47

Specific to Block(s)	Rail Temperature Input Modules
Description	Input Type (Thermocouple versus RTD)
Data Type	ENUM
Range	• Thermocouple • RTD
Default	Thermocouple
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	TCTYPE47, TCMODE47, RTDTYPE47, RTDMODE47
Remarks	This parameter specifies whether Thermocouple or RTD sensor types are to be connected to channels 4 to 7 as a group.

4.2.22 LATCHENB

Specific to Block(s)	Rail Digital Output Modules
Description	Latch Mode Enable
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB, FALUTRESET
Remarks	This parameter enables latching of detected faults. Only active if fault detection is enabled. This parameter applies to all channels on the module.

4.2.23 LATCHENB03

Specific to Block(s)	Rail Analog Output Modules
Description	Latch Mode Enabled
Data Type	BOOLEAN
Range	0N/OFF
Default	OFF
Config Load	Yes

Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB[], FAULTRESET, WIREOFF[]
Remarks	This parameter enables latching of detected faults in channels 0 to 3 as a group.

4.2.24 LATCHENB47

Specific to Block(s)	Rail Analog Output Modules
Description	Latch Mode Enabled
Data Type	BOOLEAN
Range	0N/OFF
Default	OFF
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB[], FAULTRESET, WIREOFF[]
Remarks	This parameter enables latching of detected faults in channels 4 to 7 as a group.

4.2.25 LROFFSET03[0...3]

Specific to Block(s)	Rail Temperature Input Module
Description	RTD Loop Resistance Offset
Data Type	ENUM
Range	• Determined (internal compensation value of 2-wire calibration) • 5 ohms • 10 ohms • 15 ohms
Default	5 ohms
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	RTDMODE03
Remarks	When RTD sensor types are used, this parameter sets a compensation value to be used to offset the lead resistance found between the module terminal and the sensor. Individual values are set for each of the four channels 0 to 3.

4.2.26 LROFFSET47[4...7]

Specific to Block(s)	Rail Temperature Input Module

Description	RTD Loop Resistance Offset
Data Type	ENUM
Range	• Determined (internal compensation value of 2-wire calibration) • 5 ohms • 10 ohms • 15 ohms
Default	5 ohms
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	RTDMODE47
Remarks	When RTD sensor types are used, this parameter sets a compensation value to be used to offset the lead resistance found between the module terminal and the sensor. Individual values are set for each of the four channels 4 to 7.

4.2.27 NOFIELDPWR

Specific to Block(s)	Rail Digital Output Modules
Description	Zero Cross Diagnostic
Data Type	BOOLEAN
Range	Always ZERO
Default	
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This parameter is not supported in this module. Provided to support DO Channel blocks.

4.2.28 NOFIELDPWR[0...15]

Specific to Block(s)	Rail Digital Input Modules
Description	Signals no field power detected on an input channel
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No Load
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	

Remarks	• This parameter is not supported in this module. It is provided for compatibility with the DI Channel block. • Always Zero.

4.2.29 NOLOAD[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	Wire-Off Alarm
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB[], FAULTRESET, LATCHENB, HWFAULTFL
Remarks	This parameter signals detection of a wire-off (open) on a channel terminal, if fault detection is enabled for that channel.

4.2.30 OFFPULSE[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	OFF Pulse Timer
Data Type	FLOAT64
Range	
Default	0.0
Config Load	• DOM (No) • OFF Pulse Channel Block (Yes)
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	ONPULSE
Remarks	This parameter is only configured when an OFF Pulse Channel block is associated with a channel of this module.

4.2.31 ONPULSE[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	ON Pulse Timer
Data Type	FLOAT64
Range	
Default	0.0

Config Load	• DOM (No) • ON Pulse Channel Block (Yes)
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	ONPULSE
Remarks	This parameter is only configured when an ON Pulse Channel block is associated with a channel of this module.

4.2.32 PVSTS[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	Echo Back Status
Data Type	BOOLEAN
Range	ON/OFF
Default	None
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	PVVAL
Remarks	Failsafe value is ON.

4.2.33 PVSTS[0...15]

Specific to Block(s)	Rail Digital Input Modules
Description	PV (Process Variable) Status
Data Type	BOOLEAN
Range	ON/OFF
Default	None
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	PVVAL
Remarks	This parameter signals whether or not a fault is associated with a channel and hence whether or not the PVVAL is good. Asserted to ONE in the presence of any fault condition (hardware or communications).

4.2.34 PVVAL[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	Echo Back Value

Data Type	BOOLEAN
Range	ON/OFF
Default	None
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	DOMSO, PVSTS
Remarks	• This parameter signals the echo back data value received from the module for each point. • Failsafe value is OFF.

4.2.35 PVVAL[0...15]

Specific to Block(s)	Rail Digital Input Modules
Description	Process Value
Data Type	BOOLEAN
Range	ON/OFF
Default	None
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	PVSTS
Remarks	• This parameter reflects the Boolean value of the actual field data. • Failsafe value is ZERO.

4.2.36 PWMPERIOD[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	PWM Period in Seconds
Data Type	FLOAT64
Range	
Default	0.0
Config Load	• DOM (No) • PWM Channel block (Yes)
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This parameter is only configured when PWM channel block is associated with a channel.

4.2.37 REFTEMP

Specific to Block(s)	Rail Temperature Input Modules
Description	Reference Temperature (Celsius)
Data Type	ENUM
Range	• 0 C • 20 C • 25 C • 30 C • 40 C • 50 C • 60 C • 70 C
Default	0 C
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE03, INPUTTYPE47, TCMODE03, TCMODE47
Remarks	This parameter specifies a fixed compensation temperature for thermocouple and external temperature compensation.

4.2.38 REMFLTHITP03

Specific to Block(s)	Rail Analog Input Modules
Description	Remote Fault High Trip Point
Data Type	FLOAT64
Range	20.1 to 22.0
Default	22.0
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTLOTP03, FAULTDIR03, FAULTENB03
Remarks	This parameter sets the high trip point for signaling a Remote Transmitter Fault, if fault detection (FAULTENB03) is enabled and the High range for fault direction (FAULTDIR03) is selected. This parameter applies to channels 0 to 3 as a group.

4.2.39 REMFLTHITP47

Specific to Block(s)	Rail Analog Input Module
Description	Remote Fault High Trip Point

Data Type	FLOAT64
Range	20.1 to 22.0
Default	22.0
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTLOTP47, FAULTDIR47, FAULTENB47
Remarks	This parameter sets the high trip point for signaling a Remote Transmitter Fault, if fault detection (FAULTENB47) is enabled and the High range for fault direction (FAULTDIR47) is selected. This parameter applies to channels 4 to 7 as a group.

4.2.40 REMFLTLOTP03

Specific to Block(s)	Rail Analog Input Modules
Description	Remote Fault Low Trip Point
Data Type	FLOAT64
Range	2.0 to 3.9
Default	2.0
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTHITP03, FAULTDIR03, FAULTENB03
Remarks	This parameter sets the low trip point for signaling a Remote Transmitter Fault, if fault detection (FAULTENB03) is enabled and the Low range for fault direction (FAULTDIR03) is selected. This parameter applies to channels 0 to 3 as a group.

4.2.41 REMFLTLOTP47

Specific to Block(s)	Rail Analog Input Modules
Description	Remote Fault Low Trip Point
Data Type	FLOAT64
Range	2.0 to 3.9
Default	2.0
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	REMFLTHITP47, FAULTDIR47, FAULTENB47

Remarks	This parameter sets the low trip point for signaling a Remote Transmitter Fault, if fault detection (FAULTENB47) is enabled and the Low range for fault direction (FAULTDIR47) is selected.
	This parameter applies to channels 4 to 7 as a group.

4.2.42 RTDMODE03

Specific to Block(s)	Rail Temperature Input Modules
Description	RTD Sensor Mode
Data Type	ENUM
Range	• 2-Wire • 2-Wire_Loop • 3-Wire • 4-Wire
Default	2-Wire
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE03, RTDTYPE03
Remarks	This parameter provides choice of the following modes for and RTD input type. • 2-Wire measurement without compensation of the lead resistance (2-Wire) • 2-Wire measurement with compensation of the lead resistance (2-Wire_Loop) • 3-Wire measurement • 4-Wire measurement The value of this parameter is applied to channels 0 to 3 as a group.

4.2.43 RTDMODE47

Specific to Block(s)	Rail Temperature Input Modules
Description	RTD Sensor Mode
Data Type	ENUM
Range	• 2-Wire • 2-Wire_Loop • 3-Wire • 4-Wire
Default	2-Wire
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE47, RTDTYPE47

Remarks	This parameter provides choice of the following modes for and RTD input type.
	• 2-Wire measurement without compensation of the lead resistance (2-Wire)
	• 2-Wire measurement with compensation of the lead resistance (2-Wire_Loop)
	• 3-Wire measurement
	• 4-Wire measurement
	The value of this parameter is applied to channels 4 to 7 as a group.

4.2.44 RTDTYPE03

Specific to Block(s)	Rail Temperature Input Modules
Description	RTD Sensor Type
Data Type	ENUM
Range	• Ohms
	• Pt100_IEC751
	• Pt200_IEC751
	• Pt100_JIS
	• Pt200_JIS
	• Ni100_DIN
	• Ni200_DIN
	• Ni120_Minco
	• Cu10_Minco
Default	Ohms
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE03, RTDMODE03
Remarks	This parameter provides for selection of the type of RTD to be connected to channels 0 to 3 as a group.

4.2.45 RTDTYPE47

Specific to Block(s)	Rail Temperature Input Module
Description	RTD Sensor Type
Data Type	ENUM
Range	• Ohms
	• Pt100_IEC751
	• Pt200_IEC751
	• Pt100_JIS
	• Pt200_JIS
	• Ni100_DIN
	• Ni200_DIN
	• Ni120_Minco
	• Cu10_Minco

Default	Ohms
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE47, RTDMODE47
Remarks	This parameter provides for selection of the type of RTD to be connected to channels 4 to 7 as a group.

4.2.46 SHORT[0...3]

Specific to Block(s)	Rail Digital Output Modules
Description	Short Alarm
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB[], FAULTRESET, LATCHENB, HWFAULTFL
Remarks	This parameter signals detection of short-circuit on channel terminal, if fault detection is enabled for that channel.

4.2.47 TCMODE03

Specific to Block(s)	Rail Temperature Input Modules
Description	Thermocouple Sensor Mode
Data Type	ENUM
Range	CJR_COMP
	FIXED_COMP
	None
Default	CJR_COMP
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE03, TCTYPE03
Remarks	This parameter selects whether thermocouple type uses internal temperature compensation (FIXED_COMP), external temperature compensation (CJR_COMP), or no temperature compensation.
	The value of this parameter is applied to channels 0 to 3 as a group.

4.2.48 TCMODE47

Specific to Block(s)	Rail Temperature Input Modules
Description	Thermocouple Sensor Mode
Data Type	ENUM
Range	CJR_COMP FIXED_COMP None
Default	CJR_COMP
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE47, TCTYPE47
Remarks	This parameter selects whether thermocouple type uses internal temperature compensation (FIXED_COMP), external temperature compensation (CJR_COMP), or no temperature compensation. The value of this parameter is applied to channels 4 to 7 as a group.

4.2.49 TCTYPE03

Specific to Block(s)	Rail Temperature Input Modules
Description	Thermocouple Sensor Type
Data Type	ENUM
Range	• MV • B • E • J • K • L • N • R • S • T
Default	MV
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE03, TCMODE03
Remarks	This parameter provides choice of thermocouple type connected to channels 0 to 3 as a group.

4.2.50 TCTYPE47

Specific to Block(s)	Rail Temperature Input Modules
Description	Thermocouple Sensor Type
Data Type	ENUM
Range	• MV • B • E • J • K • L • N • R • S • T
Default	MV
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	INPUTTYPE47, TCMODE47
Remarks	This parameter provides choice of thermocouple type connected to channels 4 to 7 as a group.

4.2.51 TEMPMODE

Specific to Block(s)	Rail Temperature Input Modules
Description	Temperature Format
Data Type	ENUM
Range	• Celsius • Fahrenheit • Kelvin
Default	Celsius
Config Load	Yes
Access Lock	AppDevOnly
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This parameter determines whether the temperature data provided by the module is scaled as Celsius, Fahrenheit, or Kelvin.

4.2.52 VERIFYLOST

Specific to Block(s)	Rail Digital Output Modules
Description	Output Verify
Data Type	BOOLEAN
Range	Always ZERO
Default	
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	
Remarks	This parameter is not supported in this module. It is provided to support DO Channel blocks.

4.2.53 WIREOFF[0...7]

Specific to Block(s)	Rail Analog Output Modules
Description	Open Wire Fault
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No
Related Parameter	FAULTENB[], FAULTRESET, LATCHENB03, LATCHENB47
Remarks	This arrayed parameter indicates whether a wire-off or open circuit condition exists on a specific channel.

4.2.54 WIREOFF[0...15]

Specific to Block(s)	Rail Digital Input Modules
Description	Indicates a wire-off condition on a specific channel
Data Type	BOOLEAN
Range	ON/OFF
Default	OFF
Config Load	No
Access Lock	View Only
Residence	CEE
Active Connections	No

Related Parameter	HWFAULT
Remarks	• The module does not support this parameter. It is provided for compatibility with the DI Channel block. • Always set to ZERO.

5 Operation

Related topics

"Monitoring and interacting with process data" on page 90

5.1 Monitoring and interacting with process data

Related topics

5.1.1 Using Station Displays

The Experion Server Station application includes pre-configured Detail displays for each rail IOM block. Once you establish communications with a ControlNet Gateway, you can begin monitoring the status of any rail IOM block that has been loaded as part of a Control Strategy to a Controller with points registered in the Experion Server. The Detail displays let you quickly view the module's current state, fault status, and pertinent configuration data.

Refer to the *Operator's Guide* for detailed information about calling up, navigating, and viewing Station displays.

5.1.2 Using the Control Builder Monitoring tab

Once you download a control strategy to a Controller, you can use the Monitoring tab to interact with the function blocks in the Control Modules, Sequential Control Modules, and IOMs assigned to the Control Execution Environment (CEE).

You simply double-click the desired IOM icon in the I/O tree menu under the CEE icon to call up the module's Configuration form. Click the Status/Data tab to view the module's current status. Both the CEE and IOM function block must be active to view on-line data.

Refer to the *Control Building User's Guide* sections in *On-Line Monitoring Using Control Builder* for detailed information.

5.1.3 Using Network Tools

You can use the Network Tools (NTOOLS) application supplied with Experion Engineering Tools to monitor and interact with the ControlNet Network. The RIOM-H system components are displayed in the same way as other Controller and rack I/O chassis components. The ControlNet Gateway always appears as the leftmost component in the RIOM-H segment graphic representation in the Detail pane of NTOOLS. Not all NTOOLS menu functions can be used with RIOM-H system components and unusable functions will appear faded or "grayed out" in the menus.

- Refer to the on-line Help provided with Network Tools for more information about the application.
- Refer to the *Process Software Installation and Upgrade Guide*, if you need to update the firmware in the ControlNet Gateway.

5.1.4 Summary of RIOM-H inactivation affects on outputs

The following table summarizes the affects on field outputs from directly or indirectly inactivating a rail output module based on various operating conditions.

If you inactivate...	Then, expect these results...
A Rail Analog Output or Digital Output module with no association to a PWM CHANNEL or ON/OFF Pulse DO CHANNEL block in a Control Module,	• Module holds the output value applied to the field terminals at the time of the inactivation. • All module parameters are set to their failsafe values. • The INIT_REQ parameter is asserted on all associated Output Channel blocks. • The module's icon turns blue in Monitoring tab. • The module's detail display shows INACTIVE state with proper failsafe values for parameters. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.
A Control Module that has IO CHANNEL blocks, but **not** a PWM CHANNEL or ON/OFF Pulse DO CHANNEL block, associated with a Rail Analog Output or Digital Output module,	• Module holds the output value applied to the field terminals at the time of the inactivation. • The INIT_REQ parameter is asserted on all associated Output Channel blocks. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.
A CEE that contains Rail Analog Output and/or Digital Output module assignments,	• Module holds the output value applied to the field terminals at the time of the inactivation. • The INIT_REQ parameter is asserted on all associated Output Channel blocks. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.
A Rail Digital Output module associated with a PWM CHANNEL block in a Control Module,	• Module terminates the generated pulse at the time of inactivation and field terminals go to UNPOWERED state. • All module parameters are set to their failsafe values. • The INIT_REQ parameter is asserted on associated PWM CHANNEL block. • The module's icon turns blue in Monitoring tab. • The module's detail display shows INACTIVE state with proper failsafe values for parameters. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.
A Control Module that has a PWM CHANNEL block associated with a Rail Digital Output module,	• Module continues pulse generation for field terminals. • The INIT_REQ parameter is asserted on associated PWM CHANNEL block. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.

If you inactivate...	Then, expect these results...
A Rail Digital Output module associated with an ON or OFF Pulse DO CHANNEL block in a Control Module,	• Module terminates the generated pulse at the time of inactivation and field terminals go to UNPOWERED state. • All module parameters are set to their failsafe values. • The INIT_REQ parameter is asserted on associated DO CHANNEL block. • The module's icon turns blue in Monitoring tab. • The module's detail display shows INACTIVE state with proper failsafe values for parameters. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.
A Control Module that has an ON or OFF Pulse DO CHANNEL block associated with a Rail Digital Output module,	• Module continues pulse generation for field terminals until the pulse width period expires. • The INIT_REQ parameter is asserted on associated DO CHANNEL block. • No fault alarms appear on the Station's Alarm Summary (communication with the module is not disrupted). • No change in the Gateway's Status LED.

5.1.5 Output interaction with redundant Controller switchover

Expect the following interaction with on-line Rail Analog Output and Digital Output modules in response to a redundant Controller switchover.

• No loss of connection to the Rail Output modules

– The Gateway status LED remains solid Green.

– No communication fault alarms are generated for the module as a result of the switchover.

The Rail Output module holds its value for the field terminal signal during the switchover of the connection. The switchover lasts no more than 400 milliseconds and typically lasts only 150 to 200 milliseconds.

6 Maintenance, checkout, and I/O calibration

Related topics

6.1 Adding, removing, and replacing RIOM-H system components

Related topics

6.1.1 About removal and insertion under power

You can remove and insert the ControlNet Gateway and Rail I/O Modules without removing power. The removal of the Gateway from a given RIOM-H segment will result in the loss of communications with every Rail I/O module in the segment. The removal of an individual Rail I/O module only breaks communications with that module.

Review the Removal and Insertion Under Power (RIUP) Function Guidelines in the *Control Hardware Installation Guide* before you RIUP any module.

> **Attention**
> The removal or failure of one or more I/O modules does not affect the function of the remaining modules.

6.1.2 General procedure

> **Attention**
> The RIOM-H components are not repairable in the field. Any attempt to repair a component will void the warranty and IS certification. If repair is necessary, return the component to the factory.

The direct replacement of an RIOM-H component of the same kind is just a matter of removing the existing component and installing a new one in its place.

If you are adding an RIOM-H component, follow the installation instructions for the component and then configure it through Control Builder to integrate it with your control strategy.

If you are removing and/or replacing an RIOM-H component, proceed with **extreme caution**. You must delete, restore, and/or create all hardware connections and the control strategy database configuration through the Control Builder.

6.2 Interpreting RIOM-H component LED indications

Related topics

6.2.1 ControlNet Gateway LEDs

The following table summarizes the meanings of typical LED indications on the ControlNet Gateway.

LED	Green		Green/Red	Red	
	Permanent	*Flashing*	*Flashing*	*Flashing*	*Permanent*
A	Communications OK	Communications faulty [1]	-	Bus wiring defective or disconnected	-
B	Communications OK	Communications faulty[1]	-	Bus wiring defective or disconnected	-
A + B	-	-	Self-test Incorrect network parameter	Same MAC ID as another ControlNet device	Major communication error
A + B and Status	-	-	-	ControlNet Lonely state	-
-	ControlNet Lonely state	-	-	-	
A + B and Status	-	-	Incorrect network parameter (UMAX < Gate-way MAC ID)	-	-
	-	Incorrect network parameter (UMAX < Gate-way MAC ID)	-	-	-
Status	At least one bus connection present	No bus connection	-	Incorrect I/O module reconnected (Cycle power to Gateway)	Device failed (Major fault detected in diagnostics)
PWR	Power applied and device operating normally	-	-	-	-

[1] If both connections are faulted, try these recovery steps:

1. Remove power from the Gateway.
2. Remove and reconnect the cables.
3. Apply power to the Gateway

6.2.2 Digital Input Module LEDs

The following table summarizes the meanings of typical LED indications on the Digital Input module.

LED	Meaning	Green	Yellow	Red	
		Permanent	Permanent	Flashing	Permanent
0	Channel 0, Input	-	Signal present	Channel fault	Power on test or module faulty
1	Channel 1, Input	-	Signal present	Channel fault	-
2	Channel 2, Input	-	Signal present	Channel fault	-
:	:	:	:	:	:
15	Channel 15, Input	-	Signal present	Channel fault	-
PWR	Power Supply	Device operating normally	-	-	-

6.2.3 Analog Input or Temperature Input Module LEDs

The following table summarizes the meanings of typical LED indications on the Analog Input or Temperature Input module.

LED	Meaning	Green	Yellow	Red	
		Permanent	Permanent	Flashing	Permanent
0	Channel 0, Input	-	-	Channel fault	Power on test or module faulty
1	Channel 1, Input	-	-	Channel fault	-
2	Channel 2, Input	-	-	Channel fault	-
:	:	:	:	:	:
7	Channel 7, Input	-	-	Channel fault	-
PWR	Power Supply	Device operating normally	-	-	-

6.2.4 Digital Output Module LEDs

The following table summarizes the meanings of typical LED indications on the Digital Output module.

LED	Meaning	Green	Yellow	Red	
		Permanent	Permanent	Flashing	Permanent
0	Channel 0, Output	-	Output active	Channel fault	Power on test or module faulty
1	Channel 1, Output	-	Output active	Channel fault	-
2	Channel 2, Output	-	Output active	Channel fault	-
3	Channel 3, Output	-	Output active	Channel fault	-

LED	Meaning	Green	Yellow	Red	
		Permanent	Permanent	Flashing	Permanent
PWR	Power Supply	Device operating normally	-	-	-

6.2.5 Analog Output Module LEDs

The following table summarizes the meanings of typical LED indications on the Analog Output module.

LED	Meaning	Green	Yellow	Red	
		Permanent	Permanent	Flashing	Permanent
0	Channel 0, Output	-	-	Channel fault	Power on test or module faulty
1	Channel 1, Output	-	-	Channel fault	-
2	Channel 2, Output	-	-	Channel fault	-
:	:	:	:	:	:
7	Channel 7, Output	-	-	Channel fault	-
PWR	Power Supply	Device operating normally	-	-	-

6.2.6 Repeater Adapter LEDs

The following table summarizes the meaning of typical LED indications on the Repeater Adapter. The COM LED shows the status of the coax connection and the MOD one shows the accumulative status of the fiber channels.

> **Attention**
> Several good fiber channels can mask faulty ones.

COM and MOD LEDs	
If both LEDs are . . .	This means . . .
Off	The Repeater is not powered. Check the power line for correct voltage.
Alternately Red/Green	The Repeater is being powered up or reset. This indication normally lasts for 5 seconds after power is applied.
Green	Normal operation
Red	There is a Repeater fault. • If a jabber condition is causing the fault, the fault indication is automatically cleared when the jabber condition is removed from the coax or fiber port. • If a jabber condition is **not** causing the fault, replace the Repeater.
If either LED is flashing. . .	This means . . .

COM and MOD LEDs	
If both LEDs are . . .	*This means . . .*
Green/Off	The system is experiencing temporary network errors. This condition normally corrects itself. If the condition persists, check your nodes and cable system. When checking the cable system, make sure: • All BNC connector pins are properly seated. • All taps are approved types. • All coax terminators are 75 ohms and installed at both ends of all coax segments. • Coax cable has not been inadvertently grounded.
Red/Off	The system is experiencing a high level of network errors. Check for broken cable or tap, and missing segment terminator. (Note that this is a **normal** indication for a system that has **no** ControlNet nodes installed or enabled, since it has **no** network activity. It is also a normal indication for a Repeater Adapter used in a Hub serving as a fiber-to-fiber repeater with no coax cable connected.)
PWR LED	
If LED is . . .	*This means . . .*
Green	Power is applied.
Off	No power is applied.

6.2.7 Fiber Module LEDs

The following table summarizes the meaning of typical LED indications on the Fiber Module. The left LED shows the status of the Channel 1 connection and the right one shows the status of the Channel 2 connection.

If LED is . . .	*This means . . .*
Off	The Fiber Module is not receiving power from the Repeater Adapter or the Fiber Module is faulted.
Flashing Green/Off	No data activity on the associated channel.
Green	Normal channel operation

6.3 Reviewing output behavior in response to communication faults and IOM deletion

Related topics

"Faulty ControlNet cable or Gateway losses power" on page 99
"Restoration of ControlNet Cable connections or Gateway power" on page 99
"Deletion of an Analog or Digital Output module" on page 100

6.3.1 Faulty ControlNet cable or Gateway losses power

If both cables in a redundant ControlNet media fail or the ControlNet Gateway losses power, the Rail I/O modules will exhibit the following behavior.

> **Attention**
> The following behavior also applies to the removal of an individual Rail IOM with the exception that only the connections to the given IOM are lost and the output of an Analog Output module will go unpowered instead of going to 2mA.

- Connections to all Rail IOMs in the Gateway segment are lost.
    - Affected Rail IOM icons in Monitoring tab turn Red, if connected and activated.
    - Affected Rail IOM Detail display in Station shows Comm Failure alarms.
    - Alarm Summary display in Station shows Communication Failure alarms for affected Rail IOMs as well as the Gateway.
- Outputs for Analog Output modules go to 2mA at the field terminals.
- Outputs for Digital Output modules go to unpowered at the field terminals.
- IOM function blocks for the Rail I/O modules on the failed Gateway segment will:
    - Stop writing data to the device as long as the connection is bad.
    - Clear all fault indications.
    - Indicate "Path Broken" and assert INITREQ on all associated Output IO CHANNEL blocks.
    - Set OPECHO to 0.0 and OPFINAL to NaN on Rail Analog Output blocks.
    - Set DOMSO to Last Value, PVVAL to 0, and PVSTS to 1 on Rail Digital Output blocks

6.3.2 Restoration of ControlNet Cable connections or Gateway power

If both cables in a redundant ControlNet media are restored or the power is restored to the Gateway, the Rail I/O modules will exhibit the following behavior.

- Connections to all Rail IOMs in the Gateway segment are restored.
    - Affected Rail IOM icons in Monitoring tab turn Blue for connected and inactive.
    - Affected Rail IOM Detail display in Station shows OK status.
    - Alarm Summary display in Station shows Communication Failure alarms for affected Rail IOMs 8220;n to normal" as well as the Gateway.
- Outputs at the field terminals continue to hold at:
    - 2mA for Analog Output devices.
    - unpowered for Digital Output devices.

These outputs are held until the Rail IOM blocks complete two successful execution cycles. After two successful cycles, the IO CHANNEL blocks will resume writing to the output device.

6.3.3 Deletion of an Analog or Digital Output module

If you delete a Rail Output module from the Monitoring tab in Control Builder, the Rail I/O modules will exhibit the following behavior.

* Outputs for Analog Output modules go to 2mA at the field terminals.
* Outputs for Digital Output modules go to unpowered at the field terminals.
* The IOM Function Block closes the connection to the Rail Output module.
* The Rail Output module holds the last values written to it.
* The icon for the Rail Output Module is removed from the Monitoring Tab.

6.4 Using the IOTOOL for calibration

Related topics

6.4.1 About IOTOOL

You can use the IO Maintenance Tool (IOTOOL) application supplied with Experion Engineering Tools to calibrate Rail I/O modules. It is included in the Programs menu under Experion Engineering Tools. The RIOM-H system components are accessed in the same way as other Controller and rack I/O chassis components. You must identify the ControlNet Gateway segment by its MAC ID and the Rail I/O module by its slot number or group position in the segment.

Refer to the on-line help for the IO Maintenance Tool for general information.

6.4.2 Input versus output calibration

To calibrate input modules, you will need a precision voltage, current, or ohms source to simulate the input signal for calibration.

To calibrate an output module, you will need an accurate measuring device, such as a digital multimeter, to measure the output signal from the module.

6.4.3 Preparing for calibration

> ⚠ **WARNING**
> - We recommend that you calibrate the RIOM-H components in a non-hazardous, controlled environment.
> - If RIOM-H components must be calibrated in the field, you are responsible for ensuring the compatibility of the test equipment used and the safety of the personnel performing the calibration in the hazardous area.

> **Attention**
> For calibration purposes, you can connect a ControlNet Gateway directly to the CNI ISA/KTC card in the Experion Server. You do not need to have a CPM present in the ControlNet network to calibrate an IOM. This makes it easier to conduct calibration in a lab setting.

- Label and disconnect all field wiring from the Terminal Base containing the module to be calibrated.
- Remove power from other Rail I/O modules in the same segment.
- Be sure you have eight-ohm resistors on hand for calibrating a Rail Analog Output module.
- Be sure you have 383 ohm and 100 ohm resistors or a decade resistance box on hand for calibrating a Rail Temperature Input module.

6.4.4 Calling up the IOTOOL and establishing communications

Use the following procedure to launch the IOTOOL application and establish communications with the Rail I/O module to be calibrated.

1   Click **Start** > **Programs** > **Experion PKS Engineering Tools** > **IOTOOL** to launch the application.

2   In the Navigator tab, click Rail I/O selection so it is checked.

- If the Gateway is connected directly to the CNI ISA/KTC card, be sure the Enable Remote ControlNet checkbox is not checked and in the appropriate Local ControlNet fields:

    Enter the Gateway's MAC ID,

    Enter the SLOT number of the module to be calibrated. Remember that slot (or group) numbers are zero based (0 to 7) starting with the first module (Slot 0) to the right of the Gateway.

- If the Gateway is connected to a downlink ControlNet Interface module (CNI) in a rack I/O or Controller chassis, be sure the Enable Remote ControlNet checkbox is checked and in the appropriate Local ControlNet and Remote ControlNet fields:

    Enter the MAC ID (Local) of the uplink CNI (connects to KTC card or Supervisory ControlNet) in the associated rack chassis,

    Enter the SLOT (Local) number of the downlink CNI (Connects to Gateway or I/O ControlNet) in the associated rack chassis,

    Enter the Gateway's MAC ID (Remote),

    Enter the MODULE # (Slot number) (Remote) of the module to be calibrated.

3   Click the Show Detail button.

4   Click the Get Module Data button and verify that the listed ControlNet Gateway and Device information are correct and that no fault is signaled. .

5   Click the Calibration tab and go to the appropriate section that follows to calibrate the module.

6.4.5 Calibrating the Rail Analog Input Module

Use the following general procedure to calibrate each channel individually by selecting one channel at a time and applying the calibration signal to the corresponding field terminals. It is possible to calibrate all input channels simultaneously by applying the calibration signal to the all the corresponding field terminals at the same time.

1   Click Channel 0 so its check box is checked.

   (To calibrate all of the channels simultaneously, click the Set All button.)

- Observing polarity, connect a precision current source to the field terminals for Channel 0.
- Set source to 0.000 mA (+/- 0.001)

2   Click the Start Calibration Mode button.

3   Click the Offset Cal button to initiate calibration.

4   A GREEN indication in the Offset box for the channel signals the successful completion of the Offset calibration.

   (Note that a RED indication means the calibration failed, recheck source connections and setting and repeat the calibration.)

5   Repeat Steps 1, 2, 4 and 5 to calibrate the remaining input channels substituting the appropriate channel number in Steps 1 and 2.

6   Click Channel 0 so its check box is checked.

   (To calibrate all of the channels simultaneously, click the Set All button.)

- Observing polarity, connect a precision current source to the field terminals for Channel 0.

- Set source to 20.000 mA (+/- 0.001)

7   Click the Gain Cal button to initiate calibration

8   A GREEN indication in the Gain box for the channel signals the successful completion of the Gain calibration.

   (Note that a RED indication means the calibration failed, recheck source connections and setting and repeat the calibration.)

9   Repeat Steps 7 to 10 to calibrate the remaining input channels substituting the appropriate channel number in Steps 7 and 8.

10   Click the Stop Calibration Mode button to exit the calibration process.

11   Exit the IOTOOL. Restore field wiring and power to other modules.

6.4.6 Calibrating the Rail Analog Output Module

Use the following general procedure to calibrate each output channel individually. It is possible to calibrate all output channels simultaneously by connecting measurement devices to all corresponding field terminals at the same time.

1   Click Channel 0 so its check box is checked.

   (To calibrate all of the channels simultaneously, click the Set All button.).

2   Connect an eight ohm resistor to the - field terminal for Channel 0. Observing polarity, connect the measurement instrument to the field terminals for Channel 0 in series with the eight-ohm resistor.

3   Click the Start Calibration Mode button.

4   Click the Min Scale Cal button to initiate calibration.

   (Note that the Min Cal Ref field in the detail pane shows the value of the signal sent to the output channel.)

5   Read the value displayed on the measurement instrument. Enter this measurement (+/- .001) in the channel's Measurement field. Click the Finish Calibration button.

6   A GREEN indication in the Min box for the channel signals the successful completion of the Min Scale calibration.

   (Note that a RED indication means the calibration failed, recheck measurement connections and repeat the calibration.)

7   Repeat Steps 1, 2, 4, 5, and 6 to calibrate the remaining output channels substituting the appropriate channel number in Steps 1 and 2.

8   Click Channel 0 so its check box is checked.

   (To calibrate all of the channels simultaneously, click the Set All button.).

9   Connect an eight ohm resistor to the - field terminal for Channel 0. Observing polarity, connect the measurement instrument to the field terminals for Channel 0 in series with the eight-ohm resistor.

10   Click the Max Scale Cal button to initiate calibration.

   (Note that the Max Cal Ref field in the detail pane shows the value of the signal sent to the output channel.)

11   Read the value displayed on the measurement instrument. Enter this measurement (+/- .001) in the channel's Measurement field. Click the Finish Calibration button.

12   A GREEN indication in the Max box for the channel signals the successful completion of the Max Scale calibration.

   (Note that a RED indication means the calibration failed, recheck measurement connections and repeat the calibration.)

13   Repeat Steps 8 to 12 to calibrate the remaining output channels substituting the appropriate channel number in Steps 8 and 9.

14   Click the Stop Calibration Mode button to exit the calibration process.

15   Exit the IOTOOL. Restore field wiring and power to other modules.

6.4.7 Calibrating the Rail Temperature Input Module

Use the following general procedure to calibrate each temperature-input channel individually and the two Cold Junction Compensation channels. It is possible to calibrate all input channels simultaneously by applying the calibration signal to all the corresponding field terminals at the same time.

> ⚠ **CAUTION**
> You must calibrate Offset and Gain first.

1 Click Channel 0 so its check box is checked.
   (To calibrate all of the channels simultaneously, click the Set All button.).

2 Observing polarity, connect a precision millivolt source to the L (+) and - field terminals for Channel 0.

3 Click the Start Calibration Mode button.

4 Click the Offset Cal button to initiate calibration.

5 Read the value displayed in the Offset Ref field in the detail pane for Gain 1(0.000) and set the mV source to this value +/- .001.

6 Click the Gain 1 button.

7 A GREEN indication in the Offset box for the channel signals the successful completion of the Gain 1 calibration.
   (Note that a RED indication means the calibration failed, recheck measurement connections and setting, and repeat the calibration.)

8 Repeat Steps 5 to 7 substituting Gain 2 (-30.000), Gain 4 (-10.000), Gain 8 (-5.000) and Gain 16 (-1.010), respectively, for Gain 1.

9 Repeat Steps 1, 2, and 4 to 8 to calibrate the remaining input channels substituting the appropriate channel number in Steps 1 and 2.

10 Click Channel 0 so its check box is checked.
   (To calibrate all of the channels simultaneously, click the Set All button.).

11 Observing polarity, connect a precision millivolt source to the L (+) and - field terminals for Channel 0.

12 Click the Gain Cal button to initiate calibration.

13 Read the value displayed in the Gain Ref field in the detail pane for Gain 1(330.000) and set the mV source to this value +/- .001.

14 Click the Gain 1 button.

15 A GREEN indication in the Gain box for the channel signals the successful completion of the Gain 1 calibration.
   (Note that a RED indication means the calibration failed, recheck measurement connections and setting, and repeat the calibration.)

16 Repeat Steps 13 to 15 substituting Gain 2 (100.000), Gain 4 (77.000), Gain 8 (48.000) and Gain 16 (21.960), respectively, for Gain 1.

17 Repeat Steps 10 to 16 to calibrate the remaining input channels substituting the appropriate channel number in Steps 10 and 11.

18 Click Channel 0 so its check box is checked.
   (To calibrate all of the channels simultaneously, click the Set All button.).

   • Connect a precision decade resistance box or 383 ohm resistor to the +, H and -, L field terminals for Channel 0 using four separate leads to simulate a four-wire connection. Connect the decade box or resistor to + and - terminals and the sense wires to L and H terminals.

   • Set the decade box to 383 ohms.

19 Click the 383 Ohm Current Cal button. This **must**be done before the 100 ohm current calibration.

20 A GREEN indication in the 383 ohm box for the channel signals the successful completion of the 383 ohm Current calibration.

(Note that a RED indication means the calibration failed, recheck measurement connections and setting, and repeat the calibration.)

21 Repeat Steps 18 to 21 to calibrate the remaining input channels substituting the appropriate channel number in Steps 18 and 19.

22 Click Channel 0 so its check box is checked.

(To calibrate all of the channels simultaneously, click the Set All button.).

- Connect a precision decade resistance box resistor to the +, H and -, L field terminals for Channel 0 using four separate leads to simulate a four-wire connection. Connect the decade box or resistor to + and - terminals and the sense wires to L and H terminals.

- Set the decade box to 100 ohms.

23 Click the 100 Ohm Current Cal button.

24 A GREEN indication in the 100 ohm box for the channel signals the successful completion of the 100 ohm Current calibration.

(Note that a RED indication means the calibration failed, recheck measurement connections and setting, and repeat the calibration.)

25 Repeat Steps 22 to 25 to calibrate the remaining input channels substituting the appropriate channel number in Steps 22 and 23.

26 Remove the thermistor from terminals 37, 38, and 39. Connect a decade resistance box set to 10K ohms or a 10K-ohm resistor to terminals 37 and 39.

27 Click Left so its check box is checked

28 Click the Cold Junction Compensation Calibration button.

29 A GREEN indication in the box for the left thermistor indicates the successful completion of the left thermistor calibration.

(Note that a RED indication means the calibration failed, recheck connections and setting, and repeat the calibration.)

30 Repeat Steps 27 to 30 for the Right thermistor using field terminals 46, 47, and 48 in Step 27. Substitute Right for Left in Steps 28 and 30.

31 Remove decade box or resistor from field terminals and reconnect the thermistors.

32 Do you plan to use Determined as the configuration choice for the RTD Loop Resistance Offset parameter?

- If the answer is **Yes**, go to Step 34

- If the answer is **No**, go to Step 39

33 Click Channel 0 so its check box is checked.

(To calibrate all of the channels simultaneously, click the Set All button.).

- Connect a precision decade resistance box to the + and - field terminals for Channel 0.

- Set the decade box to simulate the lead resistance value in ohms for the RTD to be connected to Channel 0. The default setting is zero ohms.

34 Click Loop Resistance Comp button. This is a tuning function rather than a calibration one.

35 A GREEN indication in the LRC box for Channel 0 indicates the successful completion of Loop Resistance Compensation tuning.

(Note that a RED indication means the calibration failed, recheck connections and setting, and repeat the calibration.)

36 Repeat Steps 34 to 37 to calibrate the remaining input channels substituting the appropriate channel number in Steps 34 and 35.

37 Click the Stop Calibration Mode button to exit the calibration process.

38 Exit the IOTOOL. Restore field wiring and power to other modules.

7 Appendix A - Hazardous locations reference

Related topics

"North American classification of hazardous locations" on page 108
"International Electrotechnical Commission (IEC) classification of hazardous locations" on page 112

7.1 North American classification of hazardous locations

Related topics

7.1.1 Electrical codes

Installation of electrical apparatus within hazardous (classified) locations of the United States is conducted under the provisions of the National Electrical Code (NEC), ANSI/NFPA 70, Article 500; and within Canada, under the provisions of the Canadian Electrical Code (CEC) C22.1, Part 1, Section 18.

7.1.2 Classifications

In both the United States and Canada, hazardous locations are classified into one of these three classes.

Class	Description of Hazardous Location
I	Presence of flammable gases or vapors may be present in quantities sufficient to produce explosive or ignitable mixtures.
II	Presence of combustible dusts, powders or grains.
III	Presence of easily ignitable fibers or flying.

7.1.3 Divisions

The classes listed above are further classified into one of the following divisions based upon the level of risk present.

Division	Description of Risk
1	Locations in which hazardous concentrations of flammable gases or vapors, or combustible dust in suspension are continuously, intermittently or periodically present under normal operating conditions.
2	Locations in which flammable gases or vapors are present, but normally confined within closed containers or systems from which they can escape only under abnormal or fault conditions. Combustible dusts are not normally in suspension nor likely to be thrown into suspension.

For example, A **Class III, Division 1** location is a location in which easily ignitable fibers or material processing combustible flying are handled, manufactured or used. A **Class III, Division 2** location is a location in which easily ignitable fibers are stored or handled.

7.1.4 Groups

Flammable gases, vapors and ignitable dusts, fibers and flying are classified into one of the following groups according to the energy required to ignite the most easily-ignitable mixture within air.

Class I Group	Description of Atmosphere
A	Atmospheres containing acetylene.
B	Atmospheres containing hydrogen, fuel and combustible process gases containing more than 30 percent hydrogen by volume, or gases or vapors of equivalent hazard
C	Atmospheres such as ethyl ether, ethylene, or gasses or vapors of equivalent hazard.
D	Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane or gases or vapors of equivalent hazard
Class II Group	**Description**
E	Atmospheres containing combustible metal dusts including aluminum, magnesium, and their commercial alloys, and other metals of similarly hazardous characteristics.
F	Atmospheres containing combustible carbonaceous dusts including carbon black, charcoal, coal or other dusts that have been sensitized by other materials so that they present an explosion hazard.
G	Atmospheres containing combustible dusts not included in Group E or F, including flour wood, grain, and other dusts of similarly hazardous characteristics.

7.1.5 Methods of protection

The following table summarizes available methods of protection for use in given locations.

Protection Concept	Designation	Permitted Use	Principle
Explosion-proof	XP	Division 1 & 2	Contains explosion and quenches flame.
Intrinsic Safety	IS	Division 1 & 2	Limit energy of sparks under normal and fault conditions.
Pressurized	Type X and Y	Division 1	Keeps flammable gas out.
Pressurized	Type Z	Division 2	Keeps flammable gas out.
Nonincendive	NI	Division 2	No arcs, sparks or hot surfaces under normal conditions

7.1.6 Temperature classification

Equipment intended for installation directly within the hazardous location classification must also be classified for the maximum surface temperature that can be generated under normal or fault conditions as referenced to either 40\C (104\F) or the maximum operating ambient of the equipment (whichever is greater). The maximum surface temperature must be less than the minimum autoignition temperature of the hazardous atmosphere present. The temperature shall be indicated in identification numbers as listed in the following table.

Temperature Identification Number	Maximum Temperature	
	Degrees C	Degrees F
T1	450	842
T2	300	572
T2A	280	536
T2B	260	500
T2C	230	446
T2D	215	419
T3	200	392
T3A	180	356

Temperature	Maximum Temperature	
Identification Number	Degrees C	Degrees F
T3B	165	329
T3C	160	320
T4	135	275
T4A	120	248
T5	100	212
T6	85	185

7.1.7 Apparatus parameters

The Intrinsically Safe Apparatus Parameters are defined as follows.

Parameter	Description
Vmax (Ui)	Maximum safe voltage, which can be applied to the apparatus terminals.
Imax (Ii)	Maximum safe current, which can be applied to the apparatus terminals.
CI	Unprotected capacitance in the apparatus, which can be considered present at the terminals.
LI,	Unprotected inductance in the apparatus, which can be considered present at the terminals.

The Associated Apparatus Parameters are defined as follows.

Parameter	Description
Voc (Uo)	Maximum output voltage, which can be delivered to the hazardous (classified) location. This voltage is the maximum from a single channel.
Isc (Io)	Maximum output current, which can be delivered to the hazardous (classified) location. This current is the maximum from a single channel.
*Vt	Maximum output voltage, which can be delivered to the hazardous (classified) location. This voltage is the maximum across any combination of terminals of a multiple channel configuration.
*It	Maximum output current, which can be delivered to the hazardous (classified) location. This current is the maximum through any combination of terminals of a multiple channel configuration.
Ca (Co)	Maximum capacitance, which can be connected to the apparatus.
La (Lo)	Maximum inductance, which can be connected to the apparatus.

*CSA does not recognize these parameters at this time.

7.1.8 Entity concept

A field device mounted in the hazardous area, such as a transmitter, must be certified if it is capable of storing energy. However, if it is a "simple device" or "nonvoltage producing" device that neither generates nor stores significant energy, no certification of the field device is required. A thermocouple is an example of a "simple device."

The Entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criteria for interconnection is that the voltage (V_{max}) and current (Imax), which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (Voc or Vt) and current (I_{sc} or I_t) levels which can be delivered by the associated apparatus, considering faults and applicable factors.

In addition, the maximum unprotected capacitance (C_i) and inductance (L_i) of the intrinsically safe apparatus, including interconnecting wiring, must be less than or equal to the capacitance (C_a) and inductance (L_a) which

can be safely connected to the associated apparatus. Field wiring has distributed capacitance and inductance capable of releasing energy. Because IS requirements are concerned with the amount of energy that can be released from circuits in a hazardous area, the stored energy in the distributed inductance and capacitance of the cable must be considered in determining the length of the field wiring. If these criteria are met, then the combination may be connected and remain intrinsically safe.

The following table summarizes the maximum values that are permissible for the given RIOM-H component field circuits.

I/O Module Type	Model Number	V_{oc} (V)	I_{sc} (mA)	P_{oc} (mW)	L_a EEx ia		C_a EEx ia	
					IIB	IIC	IIB	IIC
Digital Input	TC-PIB161	14.5	15	40	10mH	2mH	1µF	300nF
Analog Input	TC-PIA081/2							
2-Wire		23.7	92.5	548	10mH	2.5mH	560nF	66nF
3-Wire		23.7	93.5	555	10mH	2.5mH	560nF	66nF
Temperature Input	TC-PIL081							
RTD		9	37	83	80mH	20mH	40µF	4.8µF
CJC (Internal)		9mV	1	3	1H	1H	40µF	4.9µF
CJC(External)		9	38	86	80mH	20mH	40µF	4.9µF
Digital Output	TC-POB041	27.4	110		8mH	2mH	677nF	87nF
Analog Output	TC-POA081	21	93	520	10mH	2mH	400nF	80nF

7.2 International Electrotechnical Commission (IEC) classification of hazardous locations

Related topics

7.2.1 About IEC

The IEC has established a number of recommendations applying to the construction of explosion protected electrical apparatus identified. These recommendations are found within IEC 79-0 through 79-15 and 79-28.

For all EC countries as well as various neighboring countries (CENELEC member states), the European Standards EN 50 014 to EN 50 020 and EN 50 039 apply for the construction of explosion protected electrical apparatus. They were established on the basis of the IEC. However these recommendations are much more detailed by comparison.

7.2.2 Zones

Within IEC7-10, hazardous locations are classified into one of these three zones.

ZONE	Description of Hazardous Location
0	Explosive gas atmosphere is present continuously, or is present for long periods.
1	Explosive gas atmosphere is likely to occur in normal operation.
2	Explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, it will exist for a short period only.

7.2.3 IEC groups

Flammable gases, vapors and mists are further classified into groups according to the energy required to ignite the most easily-ignitable mixture within air. Apparatus is grouped according to the atmospheres it may b used within as follows:

Group	Description of Atmosphere
IIC	Atmospheres containing acetylene, hydrogen, fuel and combustible process gases or vapors of equivalent hazard.
IIB	Atmospheres such as ethyl ether, ethylene, or gasses or vapors of equivalent hazard.
IIA	Atmospheres such as acetone, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane or gases or vapors of equivalent hazard.

7.2.4 IEC methods of protection

The following table summarizes available methods of protection for use in given locations.

Protection Concept	Designation	Permitted Use	Principle
Flameproof	d	Zone 1 & 2	Contains explosion and quenches flame.
Intrinsic Safety	ia	Zone 0, 1 & 2	Limits energy of sparks under 2 faults.
	ib	Zone 1 & 2	Limits energy of sparks under 1 fault
Pressurized	p	Zone 1	Keeps flammable gases out.
Encapsulation	m	Zone 1 & 2	Keeps flammable gases out.
Increased Safety	e	Zone 1 & 2	No arcs, sparks or hot surface.
Powder Filled	q	Zone 1 & 2	Contains explosion and quenches flame.
Oil Immersion	o	Zone 1 & 2	Keeps flammable gases out.
Non-sparking	nA	Zone 2	No arcs, sparks or hot surfaces under normal conditions.
Enclosed Break	nC	Zone 2	Contains explosion and quenches flame.
Limited Energy	nA	Zone 2	Limits energy of sparks and surface temperature under normal conditions.
Restricted Breathing	nR	Zone 2	Keeps flammable gases out.

7.2.5 IEC temperature classification

Equipment intended for installation directly within the hazardous location must also be classified for the maximum surface temperature that can be generated under normal or fault conditions as referenced to the maximum operating ambient of the equipment. The maximum surface temperature must be less than the minimum autoignition temperature of the hazardous atmosphere present. The temperature shall be indicated in identification numbers as listed in the following table.

Temperature Identification Number	Maximum Temperature	
	Degrees C	Degrees F
T1	450	842
T2	300	572
T3	200	392
T4	135	275
T5	100	212
T6	85	185

7.2.6 Enclosure ratings

The NEMA (National Electrical Manufacturer's Association) enclosure classifications are recognized in the US. The IEC Publication 529 Enclosure Classifications are recognized throughout Europe and those parts of the world that use the IEC standards as a basis for product certifications.

7.2.7 NEMA and IEC comparison

IEC Publication 529, *Classification of Degrees of Protection Provided by Enclosures*, provides a system for specifying the enclosures of electrical equipment on the basis of the degree of protection provided by the enclosure. IEC 529 does not specify degrees of protection against mechanical damage of equipment, risk of explosion, or conditions such as moisture (produced for example by condensation), corrosive vapors, fungus, or vermin. NEMA Standards Publication 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*, does test for environmental conditions such as corrosion, rust, icing, oil, and coolants. For this reason, and because

the tests and evaluations for other characteristics are not identical, the IEC enclosure classification designations cannot be exactly equated with NEMA enclosure type numbers.

Basically, the IEC designation consists of the letters IP followed by two numerals. The first characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons and solid foreign objects entering the enclosure. The second characteristic numeral indicates the degree of protection provided by the enclosure with respect to the harmful ingress of water.

The table below provides an approximate conversion from NEMA enclosure type numbers to IEC enclosure classification designations. The NEMA types meet or exceed the test requirements for the associated IEC classifications; **for this reason the Table cannot be used to convert from IEC classifications to NEMA types.**

NEMA Enclosure Type Number	IEC Enclosure Classification Designation
1	IP 10
2	IP 11
3	IP 54
3R	IP 14
3S	IP 54
4 and 4X	IP 56
5	IP 52
6 and 6P	IP 67
12 and 12K	IP 52
13	IP 54

Attention

This comparison is based on tests specified in IEC Publication 529.

8 Appendix B

Related topics

"Cabling accessories for IS applications" on page 116

8.1 Cabling accessories for IS applications

Component	Model Number
Ferrite Kit Assortment (**qty = 8**) • 1 larger ferrite core for use with Gateway • 4 smaller ferrite cores for use with ControlNet trunk cables • 3 split-ring, ferrite cores for use with power supply output channel cables	TC-PFEK01
Bus Extender Cable, 30 cm, twisted	TC-PKTX30
Bus Extender Cable, 90 cm, twisted	TC-PKTX90
ControlNet T Tap, drop cable with right angle connector	TC-PHTPR
ControlNet T Tap, drop cable with straight connector	TC-PHTPS
ControlNet Y Tap, drop cable with right angle connector	TC-PHTPYR
ControlNet Y Tap, drop cable with straight connector	TC-PHTPYS
ControlNet Tap Dummy Loads (**qty = 5**)	TC-PHTCAP
ControlNet trunk terminators (**qty = 2**)	TC-PHXT
ControlNet (blue) cable markers (**qty = 100**)	TC-PCLPB1

9 Glossary

Acronyms and abbreviations used in this document include:

CB - Control Builder

CEE - Control Execution Environment

CM - Control Module

CNI - ControlNet Interface module

CPM - Control Processor module

GI/IS- Galvanically Isolated/Intrinsically Safe

I/O - Input/Output

IS- Intrinsically Safe

IOM - Input/Output Module

LED - Light Emitting Diode

MAC - Media Access Control

RAM - Random Access Memory

RCP - Redundant Chassis Pair

ROM - Read-Only Memory

SCM - Sequential Control Module

10 Notices

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10.2 How to report a security vulnerability

For the purpose of submission, a security vulnerability is defined as a software defect or weakness that can be exploited to reduce the operational or security capabilities of the software.

Honeywell investigates all reports of security vulnerabilities affecting Honeywell products and services.

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Submit the requested information to Honeywell using one of the following methods:

*   Send an email to security@honeywell.com.

    or

*   Contact your local Honeywell Process Solutions Customer Contact Center (CCC) or Honeywell Technical Assistance Center (TAC) listed in the "Support and other contacts" section of this document.

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For support, contact your local Honeywell Process Solutions Customer Contact Center (CCC). To find your local CCC visit the website, https://www.honeywellprocess.com/en-US/contact-us/customer-support-contacts/Pages/default.aspx.

10.4 Training classes

Honeywell holds technical training classes on Experion PKS. These classes are taught by experts in the field of process control systems. For more information about these classes, contact your Honeywell representative, or see http://www.automationcollege.com.