Installation Instructions

Original Instructions

FLEXHA 5000 I/O System

Catalog Numbers:

- 5015-AENFTXT
- 5015-A2AXT, 5015-A4IOXT
- 5015-BEBLXT, 5015-BEBRXT
- 5015-BECCOMXT, 5015-BECPWRXT
- 5015-BIMXT
- 5015-BPGNDXT
- 5015-ECRXT
- 5015-MLTRXT
- 5015-MP300XT, 5015-MP700XT, 5015-MP900XT, 5015-MP1250XT
- 5015-RTBPWPXT, 5015-RTBPXT, 5015-RTBRPXT, 5015-RTBSAJXT, 5015-STBPXT
- 5015-N2IOXT, 5015-N2RTBXT, 5015-N2SAXT
- 5015-PB100FTXT
- 5015-U8IHFTXT

This publication describes how to install a FLEXHA 5000™ I/O system.

System Overview

A FLEXHA 5000 I/O system is a fault-tolerant I/O system. An EtherNet/IP™ adapter pair and I/O modules in a Duplex configuration provide High Availability (HA) for communications and I/O portions of the system. A Simplex configuration of the I/O modules, where only one module obtains the field signal, maintains HA for the communications but does not provide HA in the I/O signal.

The HA concept uses device and network duplication to establish redundancy in the system and maintain control if an HA device fails. A faulted redundant system component can be serviced while the control application continues to operate. For more information on Duplex and Simplex configurations, see page 20.

At initial release, a FLEXHA 5000 I/O system operates with redundant ControlLogix 5580 controllers that have redundancy enabled and 1756-EN4TR EtherNet/IP communication modules that use concurrent communication in Studio 5000 Logix Designer® application, respectively.

Figure 1 - FLEXHA 5000 I/O System

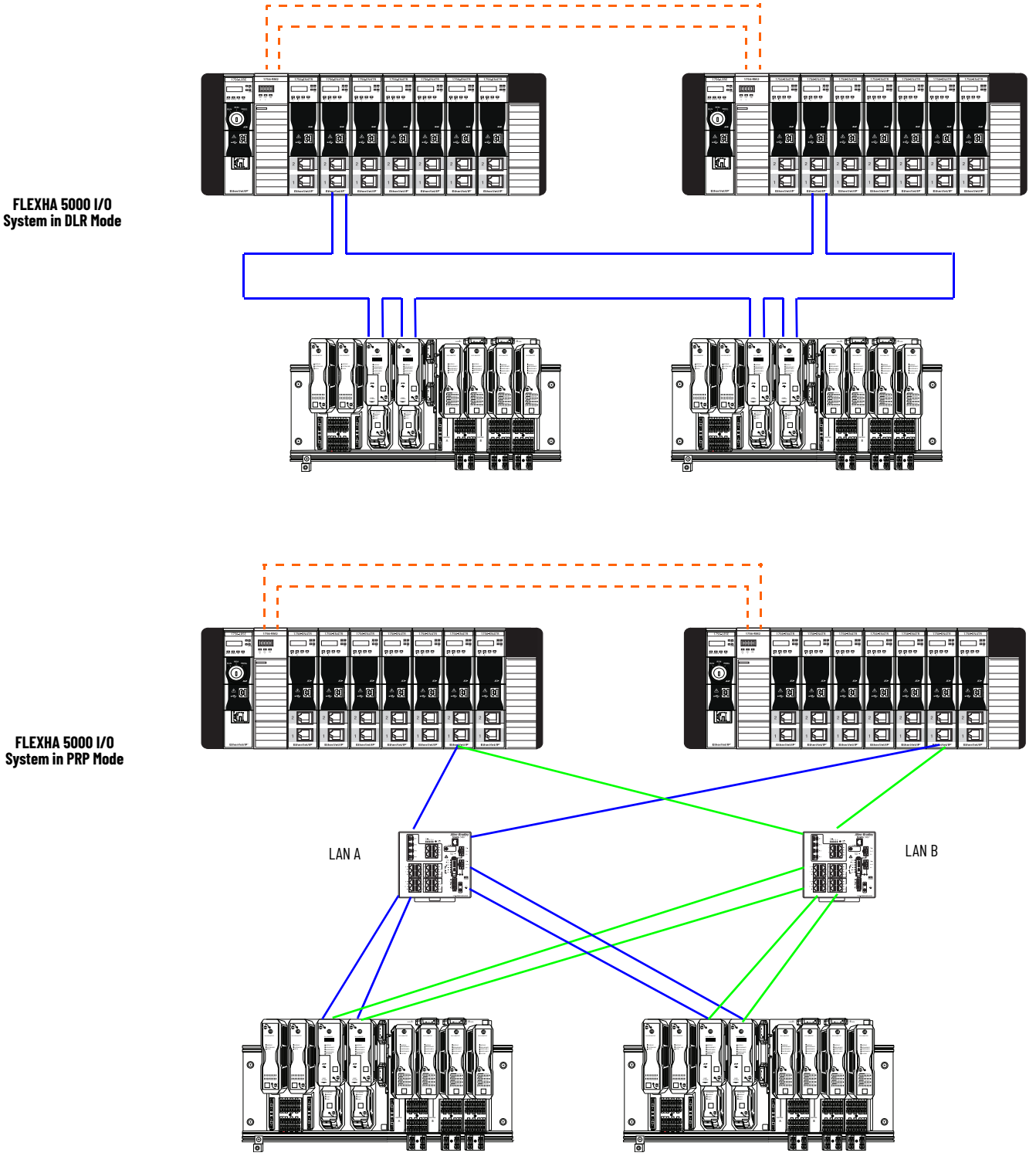
For more information on how the FLEXHA 5000 I/O system fits in an HA architecture, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

Figure 2 shows examples of a FLEXHA 5000 I/O systems in the following modes:

- Device Level Ring (DLR) - DLR provides a means to detect, manage, and recover from single faults in a ring-based network.
  For more information on DLR, see the EtherNet/IP Device Level Ring Application Technology, publication ENET-AT007.
- Parallel Redundancy Protocol (PRP) - PRP provides high availability in Ethernet networks. To create seamless redundancy, PRP technology sends duplicate frames to two independent network infrastructures that are known as LAN A and LAN B.
  For more information on PRP, see the EtherNet/IP Parallel Redundancy Protocol Application Technology, publication ENET-AT006.

Figure 2 shows examples of ways to use FLEXHA 5000 I/O systems in control systems. For more examples, to see how the FLEXHA 5000 I/O system fits in an HA architecture, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

Figure 2 - Example FLEXHA 5000 I/O System in High Availability System



Before You Begin

Before you begin system installation, be aware of the following:

- FLEXHA 5000 I/O System Components
- Mechanical Keying
- Difference Between a Base and a Bank
- Difference Between Bank Expansion Base Types

IMPORTANT We strongly recommend that you install your FLEXHA 5000 I/O system in a secured cabinet. A physically secured cabinet reduces accessibility to the system by unauthorized personnel and reduces the risk of compromise.

FLEXHA 5000 I/O System Components

Table 1 lists the components that you use to install a FLEXHA 5000 I/O system. You can order the components individually or as part of a kit. Kits are listed in Table 2 on page 8.

Table 1 - FLEXHA 5000 I/O Components

Catalog Number	Component	Description	
5015-AENFTXT	EtherNet/IP Adapter	Facilitates communication between the FLEXHA 5000 I/O system and other devices, such as, ControlLogix® 1756-EN4TR communication modules, across an EtherNet/IP network. Two EtherNet/IP adapters reside in the Adapter Base, catalog number 5015-A2AXT.	
5015-A2AXT	Adapter Base	Base that can house the following: • Two Power Conditioners, catalog number 5015-PB100FTXT • Two EtherNet/IP Adapters, catalog number 5015-AENFTXT • Two Media Landing Cards (MLCs), catalog number 5015-MLTRXT • Two Backplane Interface Modules (BIMs), catalog number 5015-BIMXT • Removable Terminal Block (RTB), Push-in, Simplex or Diagnostic, catalog number 5015-RTBPXT[1], to connect to 16 Diagnostic Inputs • Two RTBs for MOD Power/SA Power, Push-in RTBs, catalog number 5015-RTBPWPXT[2]	
5015-A4IOXT	I/O Base	Base that can house the following: • Four Universal I/O modules, catalog number 5015-U8IHFTXT • Two BIMs • Two SA power RTBs - In this case, the second RTB is used if you jump SA power manually between bases • Sensor actuator (SA) power jumper, catalog number 5015-RTBSAJXT • Any combination of the following: – Four Simplex RTBs – Two Removable Terminal Blocks, Push-in, Duplex, catalog number 5015-RTBRPXT – Two Simplex RTBs and one Duplex RTB	
5015-BEBLXT	Bank Expansion Base, Left	Uses backplane power extension and backplane communication extension cables to connect the system backplane from one bank to another. You can install this module on an Adapter Base or an I/O Base.	

Table 1 - FLEXHA 5000 I/O Components

Catalog Number	Component	Description	
5015-BEBRXT	Bank Expansion Base, Right	Use of backplane power extension and backplane communication extension cables to connect the system backplane from one bank to another. You can only install this module on an I/O Base.	
5015-BECCOMXT	Backplane CommunicationExtension Cable	Connects from a Bank Expansion Base, Left, to a Bank Expansion Base, Right, to extend backplane communication from one bank to another. The cable is 2 m (6.56 ft). When you install Backplane Communication Extension Cables, make sure the **connectors** at each end are strain relieved, tie-wrapped, or alternately **supported**. For adequate reliability, **do not** let the connectors to bear the weight of the cables themselves.	
5015-BECPWRXT	Backplane Power Extension Cable	Connects from a Bank Expansion Base, Left, to a Bank Expansion Base, Right, to extend backplane power from one bank to another. The cable is 2 m (6.56 ft).	
5015-BIMXT	Backplane Interface Module	Facilitates, and participates in, backplane communication and slot addressing. There are two BIMs in every base. The BIMs operate on separate backplanes, that is, Backplane A and Backplane B.	
5015-BPGNDXT	Back Plate Grounding Lug	Facilitates connection of the mounting plate to installation ground.	
5015-ECRXT	End Cap	Covers the last base-to-base connector of an I/O bank to protect the connector.	
5015-MLTRXT	Media Landing Cards	Connects the EtherNet/IP adapter to up to two EtherNet/IP networks via twisted-pair cabling. Supports two Ethernet RJ45 connections.	

Table 1 - FLEXHA 5000 I/O Components

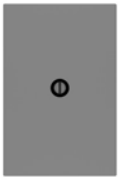
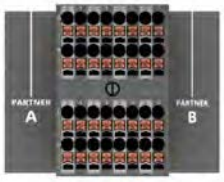
Catalog Number	Component	Description	
5015-MP300XT	Mounting Plates[3]	Length = 192 x 300 x 15 mm (7.56 x 11.81 x 0.59 in.) Supports a variety different component configurations. For example, you can use the following with this mounting plate: • An Adapter Base, catalog number 5015-A2AXT, and one Bank Expansion Base, Left, catalog number 5015-BEBLXT or • One I/O Base, catalog number 5015-A4IO, and one Bank Expansion Base, Right, catalog number 5015-BEBRXT	
5015-MP700XT		Length = 192 x 700 x 15 mm (7.56 x 27.56 x 0.59 in.) Supports a variety different component configurations. For example, you can use the following with this mounting plate: • An Adapter Base with up to two I/O Bases, and one Bank Expansion Base, Left or • One Bank Expansion Base, Right, two I/O bases, and one Bank Expansion Base, Left	
5015-MP900XT		Length = 192 x 900 x 15 mm (7.56 x 35.43 x 0.59 in.) Supports a variety different component configurations. For example, you can use the following with this mounting plate: • An Adapter Base with up to three I/O Bases, and one Bank Expansion Base, Left or • One Bank Expansion Base, Right, up to four I/O bases, and one Bank Expansion Base, Left	
5015-MP1250XT		Length = 192 x 1250 x 15 mm (7.56 x 47.24 x 0.59 in.) Supports a variety different component configurations. For example, you can use the following with this mounting plate: • An Adapter Base and up to five I/O Bases or • One Bank Expansion Base, Right, up to four I/O bases, and one Bank Expansion Base, Left	
5015-N2IOXT	I/O Slot Filler	Used instead of an I/O module to protect the unused I/O connector on the I/O Base from damage.	
5015-N2RTBXT	Removable Terminal Block, Filler, Simplex	Protects an unused RTB connector on the I/O Base from damage.	
5015-N2SAXT	SA Power RTB Filler	Protects the SA power connector on an I/O Base from damage.	
5015-PB100FTXT	Power Conditioner	Converts 24V DC to backplane power. As many as 16 diagnostic inputs are received and sent to the Adapter. Two Power Conditioners reside in the Adapter Base. If one power conditioner fails, the other power conditioner continues to power the system.	

Table 1 - FLEXHA 5000 I/O Components

Catalog Number	Component	Description
5015-RTBPXT	Removable Terminal Block, Push-in, Simplex or Diagnostic Input	Used for the following purposes: • Connects diagnostic input devices to an Adapter Base. • Connect field devices to I/O modules operating in Simplex mode. 
5015-RTBPWPXT	Removable Terminal Block for MOD Power/SA Power, Push-in	RTB type that is used for the following: • Connects module (MOD) power to the Adapter Base. • Connects SA power to an I/O Base. **IMPORTANT**: Each power connection requires its own power RTB. 
5015-RTBRPXT	Removable Terminal Block, Push-in, Duplex	Connects field devices to I/O modules operating in Duplex mode. 
5015-RTBSAJXT	Removable Terminal Block, Jumper for SA Power	Connects SA power between I/O Bases when I/O Bases are not powered individually. 
5015-STBPXT	Shield Terminal Block, Push-in	Provides termination for I/O cable shields. You install an STB at the bottom of the mounting plate under the I/O module Simplex and Duplex RTBs. 
5015-U8IHFTXT	Universal I/O Module	Fault-tolerant I/O Module, 8 Isolated Channels, configurable as Digital Input, Digital Output, Analog Input, Analog Output with or without HART 

(1) Referred to as a diagnostic RTB or Simplex RTB based on usage in the system in the rest of the document.

(2) Referred to as the MOD Power RTB or SA Power RTB based on usage in the system in the rest of the document.

(3) You can also install a grounding lug and shield terminal block (STB) on the mounting plate with any of the configurations that are listed.

Table 2 lists the kits that are available and what components are included in each kit.

Table 2 - FLEXHA 5000 I/O Kits

Kit		Includes the Following Components		
Catalog Number	**Name**	**Catalog Number**	**Component**	**Number in Kit**
5015-A2AKITXT	Adapter Base Kit[1]	5015-AENFTXT	EtherNet/IP Adapters	2
		5015-A2AXT	Adapter Base	1
		5015-BIMXT	Backplane Interface Modules	2
		5015-BPGNDXT	Back Plate Grounding Lug	1
		5015-ECRXT	End Cap	1
		5015-N2SAXT	SA Power RTB Filler	1
		5015-PB100FTXT	Power Conditioners	2
		5015-RTBPWPXT	MOD Power RTB	2
		5015-RTBPXT	Diagnostic RTB	1
5015-A4IOKITXT	I/O Base Kit[2]	5015-A4IOXT	I/O Base	1
		5015-BIMXT	Backplane Interface Modules	2
5015-BEKITXT	Bank Expansion Kit	5015-BEBLXT	Bank Expansion Base, Left	1
		5015-BEBRXT	Bank Expansion Base, Right	1
		5015-BECCOMXT	Backplane Communication Extension Cables	2
		5015-BECPWRXT	Backplane Power Extension Cables	2
		5015-BPGNDXT	Back Plate Grounding Lug	1
		5015-N2SAXT	SA Power RTB Filler	1

(1) MLCs are sold separately.

(2) I/O modules and RTBs are sold separately.

Table 3 lists the recommended power supplies to use with a FLEXHA 5000 I/O system.

Table 3 - FLEXHA 5000 I/O System - Recommended Power Supplies

Power Type Use	Catalog Number	Purpose	More Information
MOD Power[1]	1606-XLE240ECRZ	External power supply that connects to a power RTB, catalog number 5015-RTBPWPXT, that is installed on the Adapter Base to provide MOD power to a Power Conditioner. To maintain a redundant MOD power source, you must install and connect two of these external power supplies to separate power RTBs. For HA, we recommend that you feed each external supply from a separate mains source. The MOD power is converted to backplane power that is used throughout the system.	1606-XLE240ERZ and 1606-XLE240ECRZ Power Supply Installation Instructions, publication 1606-IN041
SA Power[2]	1606-XLE480ECRZ	Two external power supplies are connected through field power redundancy devices (FPRD), redundant terminal blocks, and fuses to supply SA power.	1606-XLE480ERZ and 1606-XLE480ECRZ Power Supply Installation Instructions, publication 1606-IN049
	1606-XLERED20Y	FPRD that is equipped with an automated load sharing feature, which can compensate a small voltage imbalance between the power supplies connected to the inputs to achieve an even current share. The FPRD also monitors the function of the redundancy circuitry and provides a signal if there is a failure or an imbalance between inputs that can help prevent redundancy if one power supply fails. In a FLEXHA 5000 I/O system, two 1606-XLE480ECRZ power supplies are fed into two parallel/redundant FPRD that is then connected to the power RTB on an I/O Base to provide SA power to a system.	1606-XLERED20Y Power Supply Installation Instructions, publication 1606-IN072

(1) For more information on MOD Power, see page 24.

(2) For more information on SA Power, see page 24.

Mechanical Keying

FLEXHA 5000 I/O systems support mechanical keying. Mechanical keying reduces the risk of installing the wrong replacement component in a system. A transferable key is installed in the following components:

- Power Conditioners
- EtherNet/IP adapters
- I/O modules

The mechanical keying system consists of a two-position socket and a two-position base plug for each keyed component. It is inserted into the system bases. Transferable keys are mounted in the components and are transferred to the base during the initial installation.

Each keyed component uses two keys. One key uses an alpha position indicator--positions A...E. The other key uses a numeric position indicator--positions 1...5. Table 4 lists the key positions for each component out of the box.

Table 4 - Key Positions

Component	Key Position
5015-PB100FTXT	A1
5015-AENFTXT	A1
5015-U8IHFTXT	A1

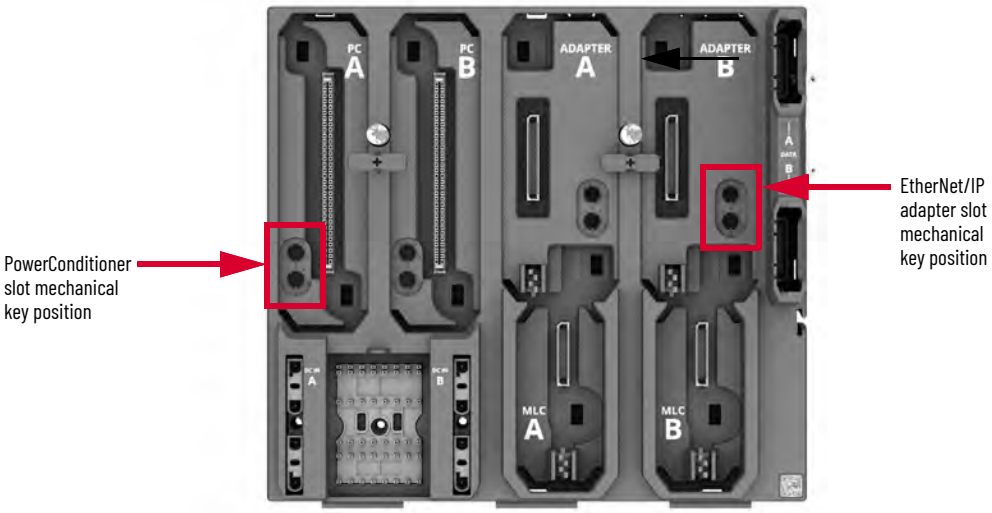
The first time that you install the component in a base, the plug part of the key transfers into the base and remains in that position when you pull the component out of the system. As a result, the slot only accepts components of the same catalog type - as defined by the alpha and numeric key.

IMPORTANT If you install a component that's already been used in a new base, there won't be keys to transfer from the component to the base. In this scenario, if you want to use mechanical keying, get the keys from the last place that the component was used or order new keys. Then install the keys in the component before installing it in the base.

Power Conditioners and EtherNet/IP Adapters

The Power Conditioner and EtherNet/IP adapter are keyed to the system via their position in the Adapter Base.

Adapter Base

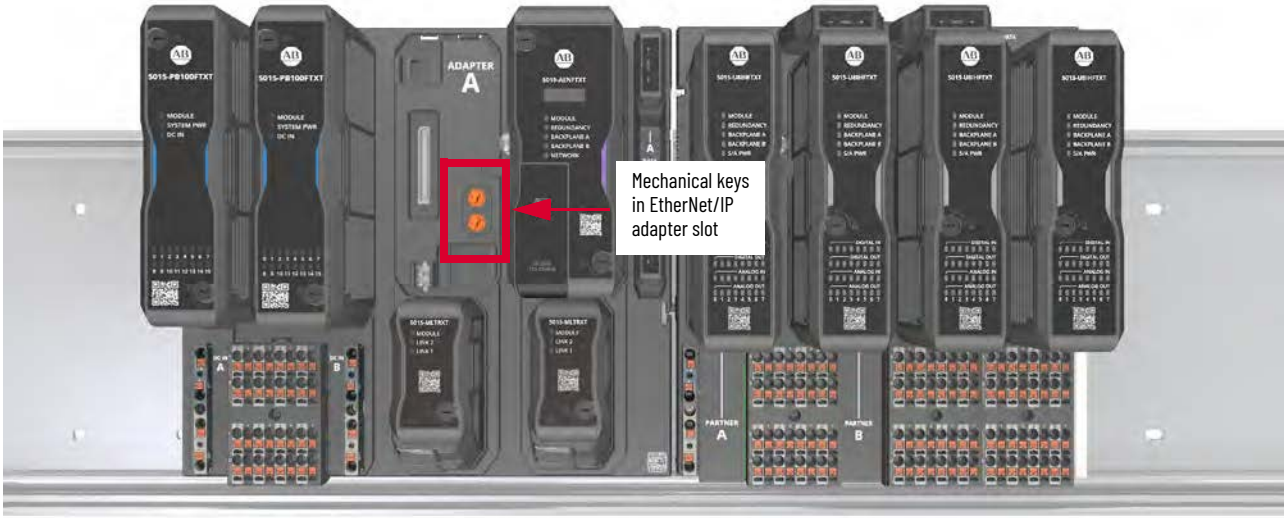


Out of the box, the mechanical keys are in the back on the Power Conditioners and EtherNet/IP adapters.

Power Conditioner

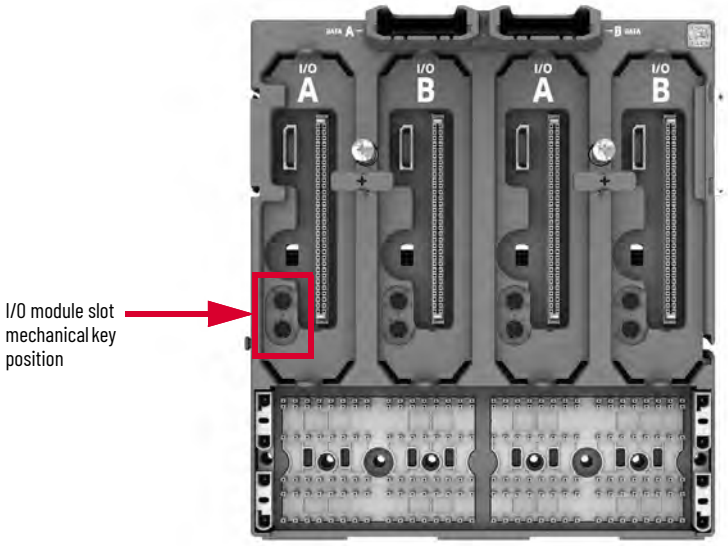
EtherNet/IP Adapter

When you remove a component, the key stays in the Adapter Base.



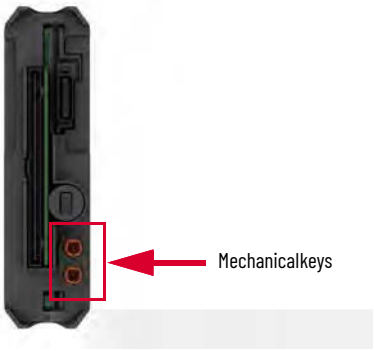
The I/O module is keyed to the system via its position in the I/O Base.

I/O Base

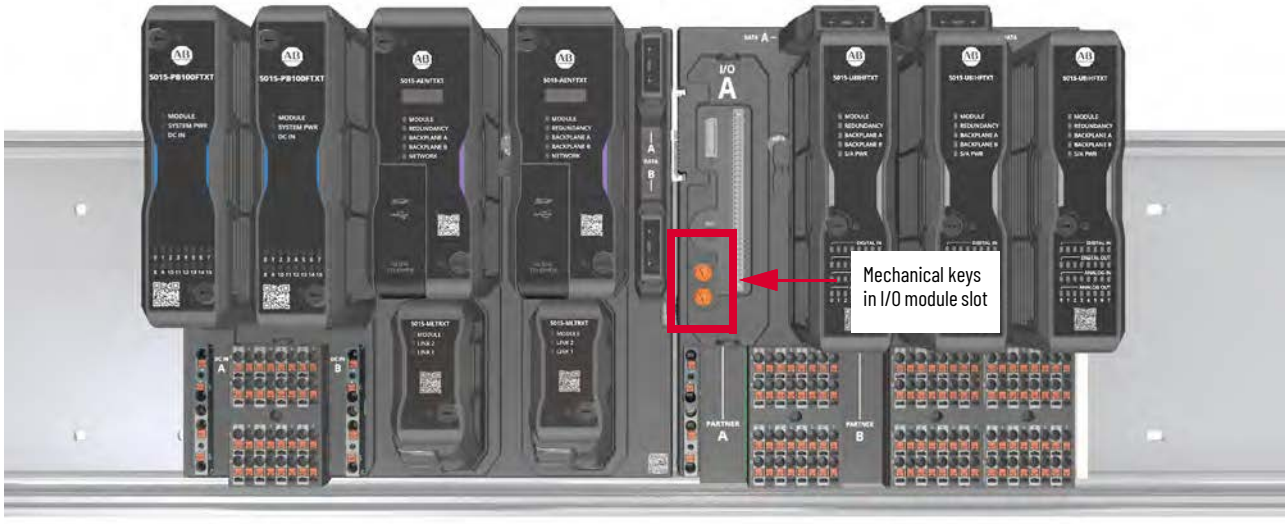


Out of the box, the mechanical keys are in the back of the I/O module.

I/O Module



When you remove an I/O module, the key stays in the I/O Base.



SD Card

The EtherNet/IP adapter supports the use of a Secure Digital (SD) card to store all configuration data that is stored in nonvolatile memory, for example, the IP address or network communication rate for each port.

An SD card slot is on the front of the EtherNet/IP adapter behind the door.

To open the door, slide the door down slightly and swing it up.

The SD card slot is behind the door--not shown here--on the front of the adapter.

For more information on how to use the SD card, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

USB Port

The EtherNet/IP adapter has a USB port behind the door on the front of the adapter. Use the USB port to complete tasks that only require a temporary connection to the EtherNet/IP adapter, for example, when you update the firmware revision.

To open the door, slide the door down slightly and swing it up.

The USB port is behind the door--not shown here--on the front of the adapter.

Difference Between a Base and a Bank

There is a difference between bases and banks in a FLEXHA 5000 I/O system. A base is a component upon which you install other components. A bank is a collection of connected bases.

FLEXHA 5000 I/O System Bases

Bases are installed on mounting plates. You can connect bases directly next to each other or across banks that are connected by expansion kits. The following base types are available:

- **Adapter Base** - There is only one Adapter Base in a FLEXHA 5000 I/O system. It is required.

  The Adapter Base supports components that provide system power, EtherNet/IP network connections, and power diagnostics. As noted on page 4, you install the following on the Adapter Base:
  - Power conditioners
  - EtherNet/IP adapters
  - MLCs
  - BIMs
  - MOD Power RTBs
  - Diagnostic RTB
  - RTB Slot Filler (optional; used in place of Diagnostic RTB)
  - Bank Expansion Base, Left (optional; used to connect to an I/O bank)
- **I/O Base** - A maximum of six I/O bases are allowed in a FLEXHA 5000 I/O system. At least one I/O Base is required.

  As noted on page 4, you install the following on the I/O Base:
  - I/O modules
  - BIMs
  - Wiring RTBs - Duplex or Simplex RTBs
  - SA Power RTB
  - SA Power RTB Filler
  - SA Power Jumper - Optional; used to continue SA power from one I/O Base to the next
  - I/O Slot Filler - Optional; used in place of an I/O module.
  - RTB Slot Filler - Optional; used with I/O Slot Filler.
  - Bank Expansion Base, Right, and Bank Expansion Base, Left, on an I/O Base - Optional; used to connect to an Adapter Bank or I/O Bank.
  - End cap - Optional; used to protect the backplane connector on the last I/O Base in the system.

FLEXHA 5000 I/O Banks

A bank in a FLEXHA 5000 I/O system is a collection of bases and the components that are installed on them. A maximum of three banks are allowed in a FLEXHA 5000 I/O system. You use Bank Expansion Bases, Left and Right, with Backplane Communication Extension cables and Backplane Power Extension cables to connect banks.

The following bank types are available:

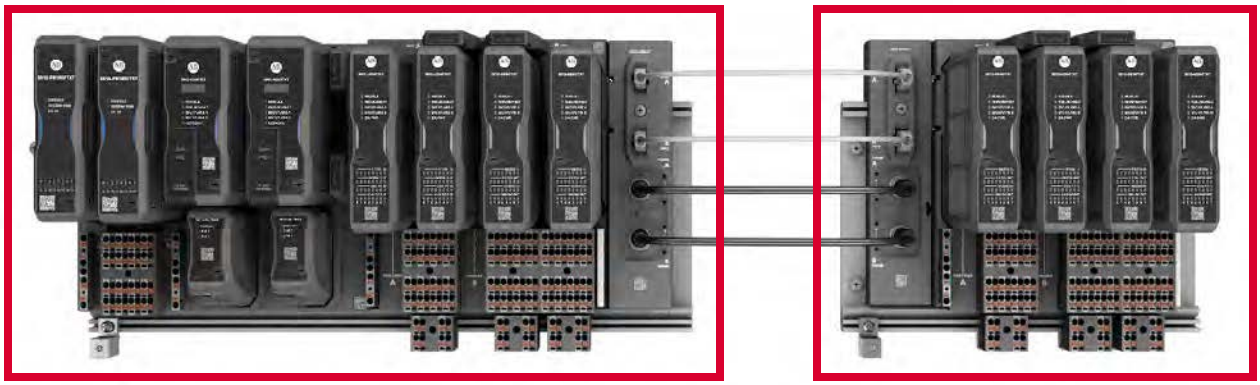
- **Adapter Bank** - There is only one Adapter Bank in a FLEXHA 5000 I/O system. It is required.
  You must use an Adapter Base in an Adapter Bank. You are not required to use I/O Bases in an Adapter Bank. but you can install a maximum of six I/O Bases on an Adapter Bank.

IMPORTANT	An Adapter Bank with seven bases--one Adapter Base and six I/O Bases--requires multiple mounting plates to be installed directly next to each other. For more information about how to install mounting plates, see Install Mounting Plates on page 26

Adapter Bank

- **I/O Bank** - You can include a maximum of two I/O Banks in a FLEXHA 5000 I/O system. An Adapter Bank is required, but I/O Banks are optional.
  I/O Banks support from one to six I/O Bases.

Adapter Bank **I/O Bank**



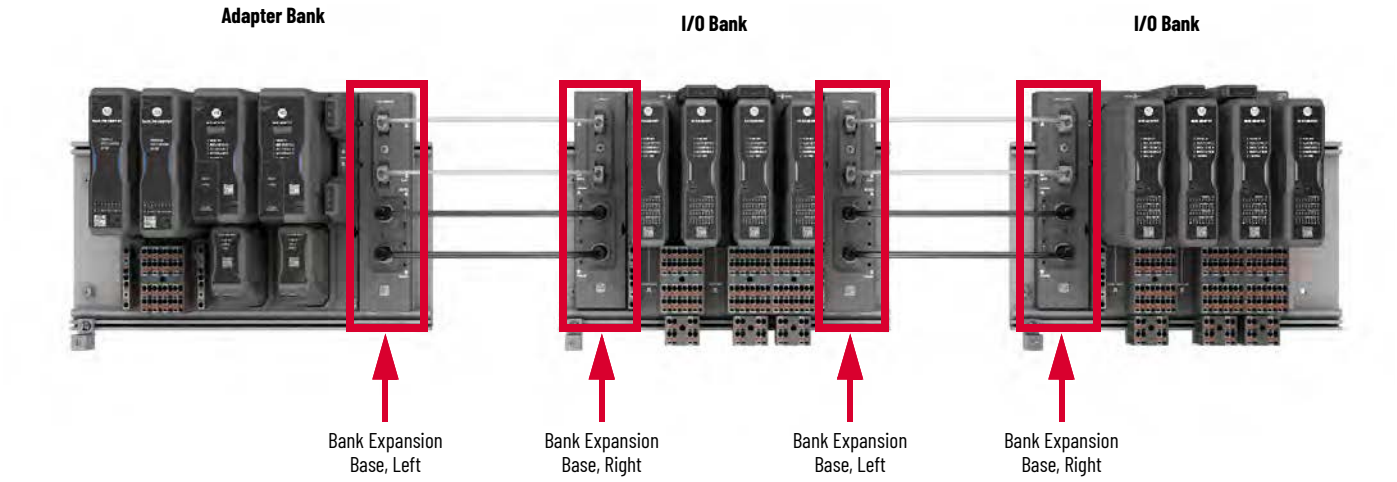
Difference Between Bank Expansion Base Types

If the FLEXHA 5000 I/O system includes multiple banks, you must use the following Bank Expansion Bases to connect them:

- Bank Expansion Base, Left
- Bank Expansion Base, Right

Bank Expansion Bases are installed on the ends of banks. Install the Bank Expansion Base, Left, on the right side of a bank. Then install the Bank Expansion Base, Right, on the left side of a bank.

Figure 3 - FLEXHA 5000 I/O System Banks



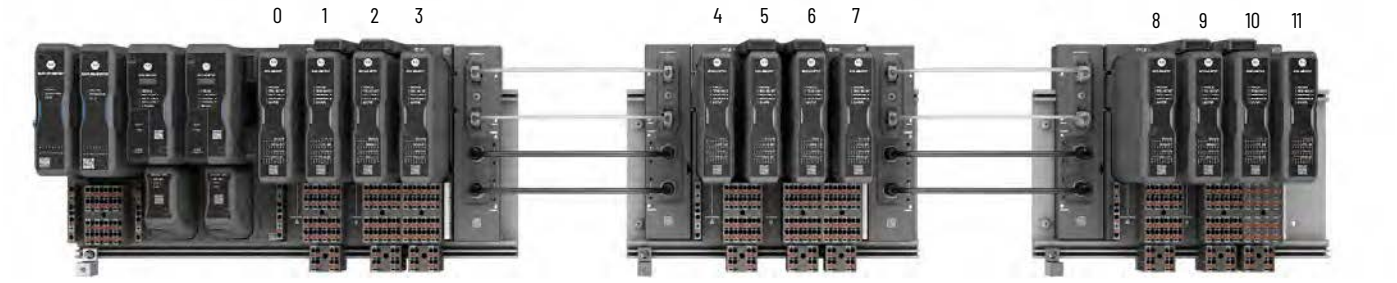
I/O Slot Addressing

A FLEXHA 5000 I/O system uses I/O slot addressing to identify the location in which I/O modules reside in the system. I/O slots start at 0 and increment up to 23. The slot in which an I/O module is installed determines its slot address. For example, the first I/O module on the left side of the first I/O Base is assigned slot number 0. As I/O modules are added to successive slots, they are assigned the address for that specific slot.

If a slot is left open, for example, the second slot in the first I/O Base, that slot still uses address 1. An I/O module that is installed in the next slot is assigned slot address 3.

Slot addresses continue to increment as I/O banks are added to the system.

Figure 4 - FLEXHA 5000 I/O System Banks - Slot Addressing



Plan the System

Use the following sections when you plan your FLEXHA 5000 I/O module system:

- Lay Out the System
- Spacing
- Ground Considerations
- System Power Considerations

Lay Out the System

Consider the following when you lay out your FLEXHA 5000 I/O system:

- In the portions of the control loop that require HA, you must assemble the system with I/O modules in Duplex pairs so there is not one point of failure.
- In the portions of the control loop that do not require HA, you can assemble the system with I/O modules in Simplex mode.
- You must mount the Adapter Base horizontally. See Figure 6 on page 21 for examples.
- You can mount I/O Bases horizontally or vertically. See Figure 6 on page 21 for examples.

IMPORTANT	The maximum ambient temperature range differs by orientation. Remember, you can mount an Adapter Base in a horizontal orientation only. You can mount an I/O Base either horizontally or vertically. • When you mount an Adapter Base or I/O Base horizontally, the maximum ambient temperature range is -40 °C ≤ Ta ≤ +70 °C (-40 °F ≤ Ta ≤ +158 °F). • If you mount an I/O Base vertically, the maximum ambient temperature range is -40 °C ≤ Ta ≤ +60 °C (-40 °F ≤ Ta ≤ +140 °F).

Maximum Number of I/O Modules

The FLEXHA 5000 I/O system supports a maximum of 24 I/O modules. You can install them in one to three banks, that is, an adapter bank and, if needed, a maximum of two I/O banks.

You are not required to distribute the number of I/O modules evenly across the number of banks. For example, you can install 16 I/O modules on the adapter bank and extend the system to an I/O bank that supports eight modules.

RTB Current Ratings

In a FLEXHA 5000 I/O system, two external power supplies and two pairs of wires provide redundant SA Power to the system. SA Power wiring examples are shown in section Connect SA Power to an I/O Base beginning on page 80.

When SA Power is wired as described in Connect SA Power to an I/O Base, SA Power connections are rated at up to 20 A at maximum operating temperature of 40 °C (104 °F). Current is shared on the SA Power RTB or SA Power Jumper.

- On the SA Power RTB, two wires carry a maximum of 10 A each, for a total of 20 A.
- On the SA Power Jumper, two internal shorting bars carry a maximum of 9.5 A each, for a total of 19 A.

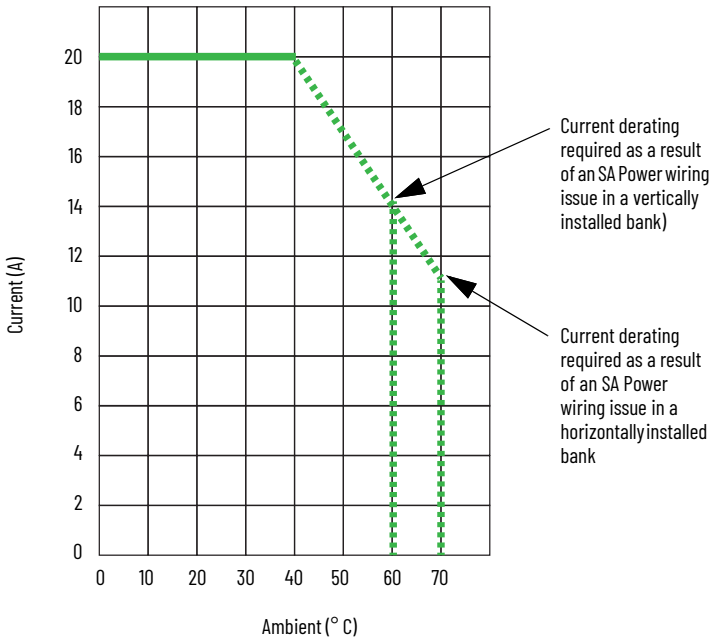
Current derating isn't required on the SA Power RTB or the SA Power Jumper, specifically, if your cabinet is temperature-controlled to be below the following limits:

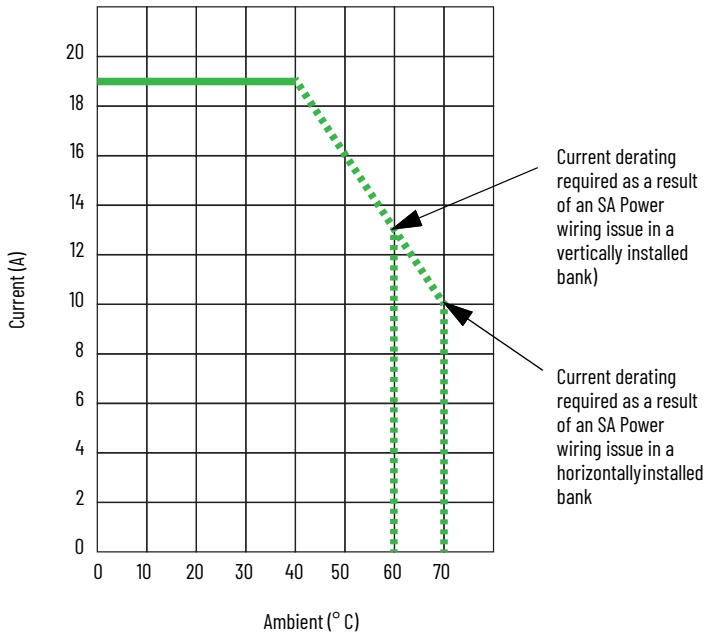
- SA Power RTB: 40 °C (104 °F)
- SA Power Jumper (when used): 40 °C (104 °F)

If your cabinet is not temperature controlled, in the event an issue occurs with one of the two conductors, for example, a wire is disconnected from the SA Power RTB, temperature-based current derating is required to maintain availability because current is no longer shared. One conductor carries all SA Power current. The temperature derating is required if the enclosure ambient temperature exceeds the limits that are shown above.

On the SA Power RTB, current derating starts above 40 °C (104 °F), as shown below. On the SA Power Jumper, current derating starts above 40 °C (104 °F), as shown on page 18. As temperature increases, the SA Power RTB and SA Power Jumper current derating continues.

To perform temperature-based current derating, limit the total SA power current draw to the value shown on the derating chart for the expected ambient temperature.

Catalog Number	Description	Current Rating	Derating Chart
5015-RTBPWPXT	Removable Terminal Block for MOD Power/SA Power, Push-in	Current derating required • 20 A/terminal up to 40° C (104° F) • 14 A/terminal at 60° C (140° F) (maximum ambient temperature for a vertically-installed bank) • 11 A/terminal at 70° C (158° F) (maximum ambient temperature for a horizontally-installed bank) Possible wiring issue examples are a break in a connection to an RTB terminal or when only one pair of + and — terminals is used.	

Catalog Number	Description	Current Rating	Derating Chart
5015-RTBSAJXT	Removable Terminal Block, Jumper for SA Power	Current derating required • 19 A/terminal up to 40 °C (104 °F) • 13 A/terminal at 60 °C (140 °F) (maximum ambient temperature for a vertically-installed bank) • 10 A/terminal at 70 °C (158 °F) (maximum ambient temperature for a horizontally installed bank) A possible wiring issue is when the jumper is not functioning as intended, for example, one of the internal shorting bars can't pass current between bases for some reason.	
5015-N2RTBXT	Removable Terminal Block, Filler, Simplex	–	–
5015-N2SAXT	SA Power RTB Filler	–	–
5015-RTBPXT	Removable Terminal Block, Push-in, Simplex or Diagnostic Input	2 A/terminal	–
5015-RTBRPXT	Removable Terminal Block, Push-in, Duplex	2 A/terminal	–
5015-STBPXT	Shield Terminal Block, Push-in	2 A/terminal	–

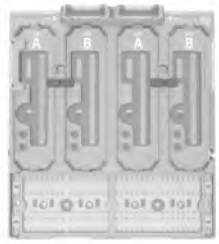
Dust Covers

Dust covers help prevent conductive materials, for example, metal shavings from drilling, from entering openings in the component housing.

The following components **ship with dust covers on them**. You install these components with the dust covers on and remove the dust covers as part of the full system installation

- Adapter Base

- I/O Base



- Bank Expansion Bases, Left and Right

The following components use dust covers. However, the **dust covers do not ship with the components**. The dust covers ship with the Base in which the component is installed.

- Power Conditioner - Dust cover ships with the Adapter Base.
- EtherNet/IP adapter - Dust cover ships with the Adapter Base.
- Media Landing Card - Dust cover ships with the Adapter Base.
- I/O module - Dust cover ships with the I/O Base.

You install the dust covers on these components after the components are installed. Then you remove all dust covers before you power up the system. The following shows a system with the dust covers on the components before they are removed and the system is powered up.

Duplex Configuration Versus Simplex Configuration

Duplex

- Fault tolerant - The system survives one fault if one channel or power source fails. As such, there is no single point of failure.
- Duplex pair of I/O modules - Two of the same modules that use the same configuration next to each other on the I/O Base.

  Configuration is performed once and applies to both modules. Also, you must install the first module in a Duplex pair in an even-numbered slot. For example, you can install I/O modules that are used as a Duplex pair in slots 0 and 1 or 2 and 3, and so forth.

  The module in the even-numbered slot is referenced as Module A. I/O connections are open to both I/O modules in a redundant pair. Connections are made to each I/O module individually. So, if a connection can't be established with one of the modules, the other still provides control.
- Each adapter sends duplicate data packets to I/O modules.
- One Duplex RTB is shared between both I/O modules in the pair.

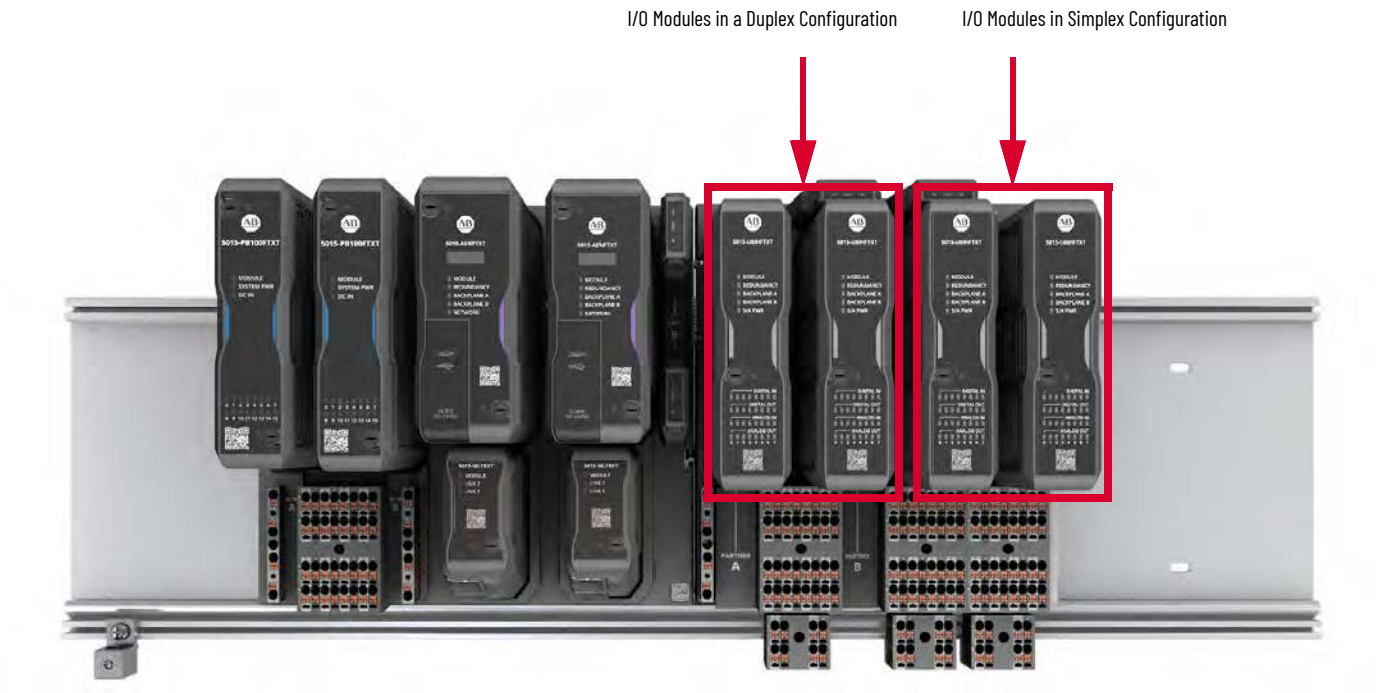
  If a wiring fault occurs, it affects both I/O modules.

Simplex

- Traditional I/O module operation
- Only one I/O module needed
- Single point of failure
- Simplex RTB is used with each I/O module

Figure 5 shows a system that includes modules that are wired for Simplex configuration and modules that are wired for Duplex configuration.

Figure 5 - Example FLEXHA 5000 I/O System with Modules in Simplex Configuration and in Duplex Configuration



System Orientation

FLEXHA 5000 I/O systems support the following installation orientations:

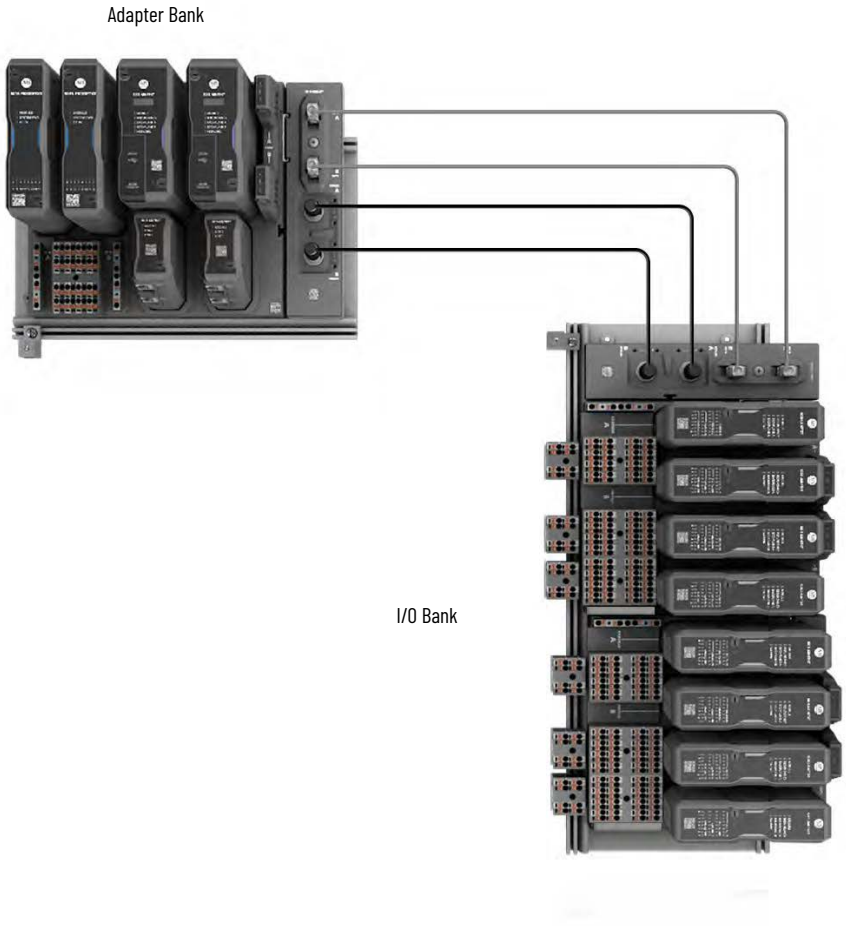
- You must mount the Adapter Base horizontally.
- You can mount I/O Bases horizontally or vertically.

IMPORTANT	The maximum ambient temperature range differs by orientation. Remember, you can mount an Adapter Base in a horizontal orientation only. You can mount an I/O Base either horizontally or vertically. • When you mount an Adapter Base or I/O Base horizontally, the maximum ambient temperature range is -40 °C ≤ Ta ≤ +70 °C (-40 °F ≤ Ta ≤ +158 °F). • If you mount an I/O Base vertically, the maximum ambient temperature range is -40 °C ≤ Ta ≤ +60 °C (-40 °F ≤ Ta ≤ +140 °F).

Figure 6 - FLEXHA 5000 I/O System Orientation

Horizontal Mounting

Horizontal and Vertical Mounting



Spacing

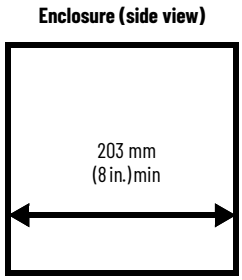
This section provides minimum distances of the enclosure and between the FLEXHA 5000 I/O system. Before you install a FLEXHA 5000 I/O system in a cabinet, make sure you use a cabinet that is sized correctly. To do so, you must calculate an enclosure size that is based on the power dissipation of the system and the ambient temperature.

The following requirements are used to maintain spacing in the FLEXHA 5000 I/O system.

- Minimum enclosure depth
- Minimum distance from I/O system banks to enclosure walls, wireways, and adjacent equipment.
- Minimum distance between I/O system banks in a multi-bank system.

FLEXHA 5000 I/O System Spacing - Recommended Enclosure Depth

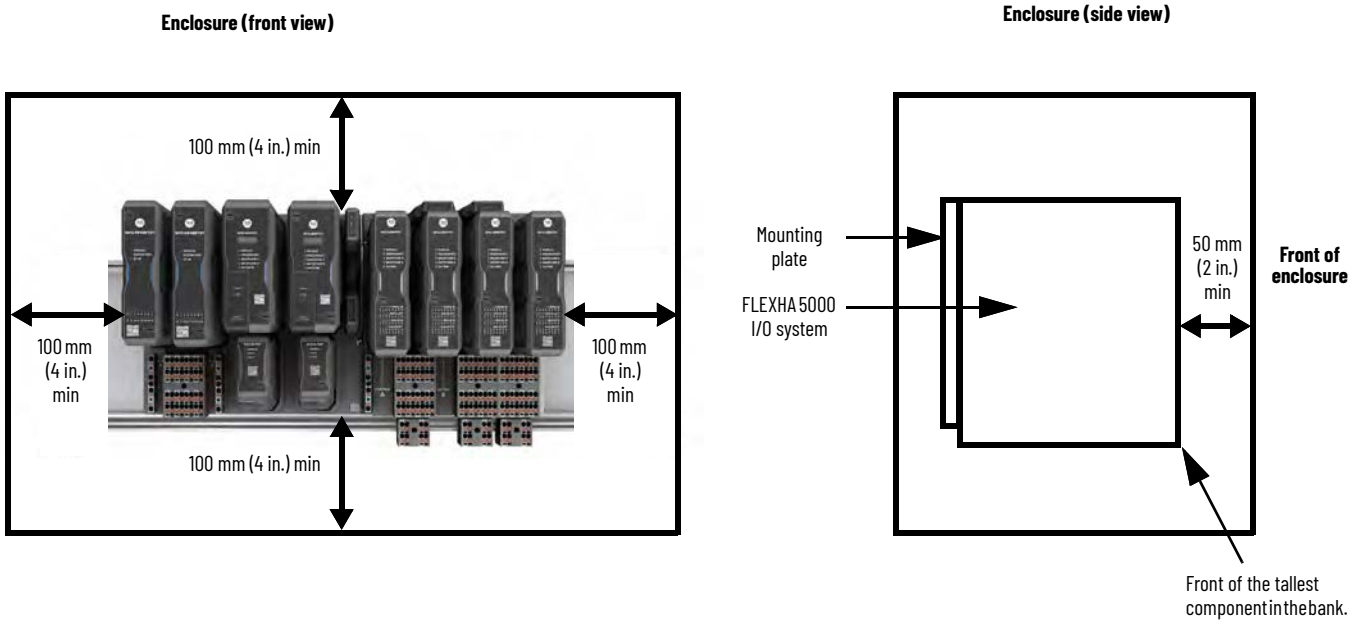
The enclosure must be a minimum of 203 mm (8 in.) deep.



FLEXHA 5000 Spacing - Single Bank

The sides of a system bank must be at least 100 mm (4 in.) from enclosure walls, wireways, and adjacent equipment. The left, right, top and bottom distance is measured from the Adapter Base and I/O Base edges, not the mounting plate, or system components, such as the I/O modules.

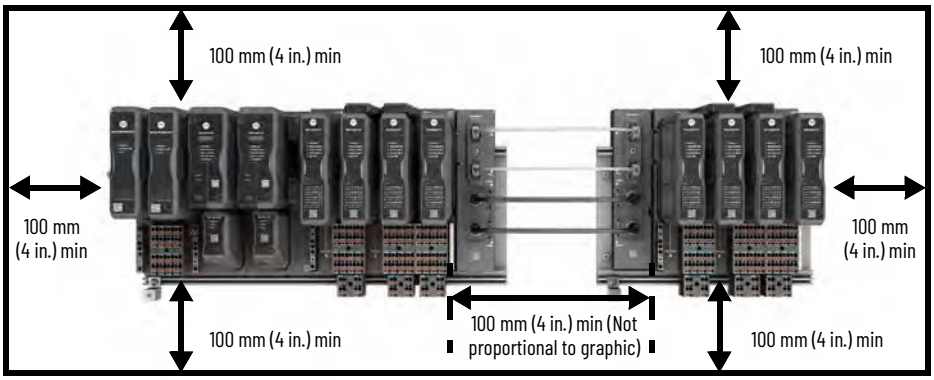
The front of a system bank must be at least 50 mm (2 in.) from the front of the enclosure. The distance is from the front of the bank components to the enclosure.



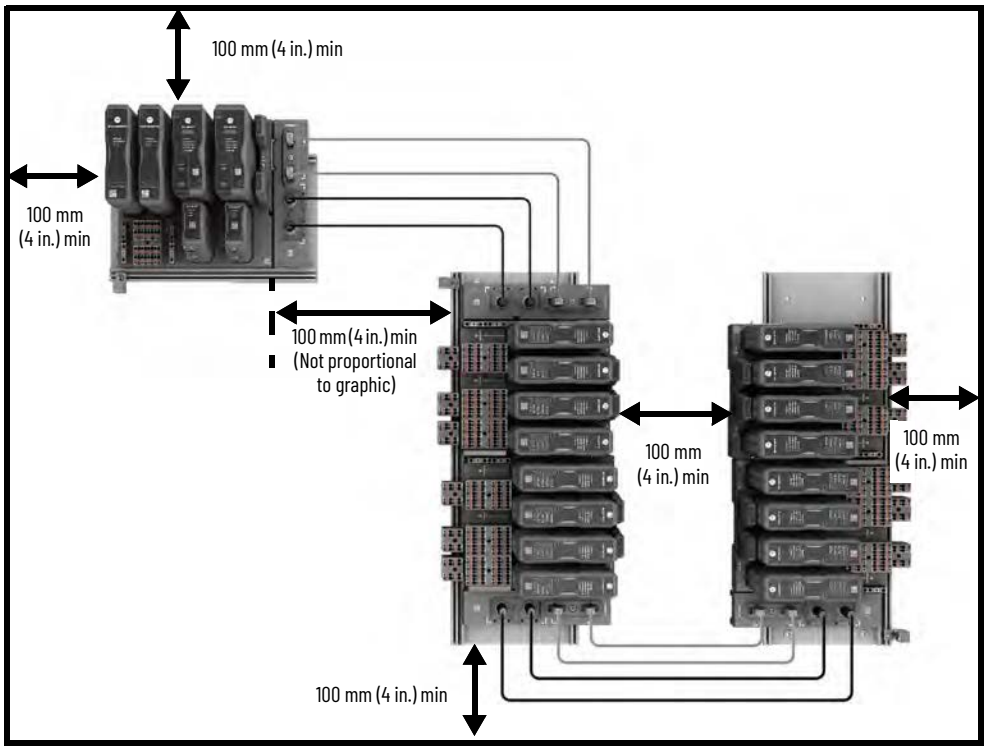
FLEXHA 5000 Spacing - Multiple Banks

When you install multiple banks, not only must you maintain a minimum distance of 100 mm (4 in.) from enclosure walls, wireways, and adjacent equipment. You must maintain a minimum of 100 mm (4 in.) between banks, as shown in the examples. The distance is measured from the Adapter Base and I/O Base edges, not the mounting plate or system components, such as the I/O modules.

Enclosure (front view)



Enclosure (front view)



Ground Considerations

Remember the following forms of grounding when you assemble your FLEXHA 5000 I/O system:

- System grounding - It is mandatory and is done via a grounding lug that is installed on the mounting plate and is connected to the cabinet ground point.
  For more information, see Install a Ground Lug on a Mounting Plate on page 28.
- I/O shield cable grounding - It is mandatory. We recommend that you ground I/O shield cables via an STB that is installed on the mounting plate. If you do not use the STB, directly ground the cable shield to earth at one point.
  For more information, see Install the Shield Terminal Block on page 73.

System Power Considerations

A FLEXHA 5000 I/O system uses the following types of power:

- MOD power
- SA power

IMPORTANT SELV/PELV power supplies are required for both MOD power and SA power.

MOD Power

MOD power is required in a FLEXHA 5000 I/O system. It powers the system operations.

Separate power supplies provide redundant power to the Power Conditioners. Connect one power supply to the MOD power RTB A and the other to MOD power RTB B. We recommend that you use the 1606-XLE240ECRZ power supply for MOD power. Feed each power supply with a separate AC source to maintain redundancy. For more information on the power supply, see the 1606-XLE240ERZ and 1606-XLE240ECRZ Power Supply Installation Instructions, publication 1606-IN041.

Power conditioners are installed on the Adapter Base. Each power conditioner derives a conditioned backplane power bus from one of the MOD power connections, to maintain HA if one failure occurs. The backplane bus is also known as system power.

One MOD power connection should be capable of supplying 5.8 A at 20.8...28.8V DC SELV/PELV for a fully populated system. Fault voltage must be limited to 32V DC. Thus, either MOD power connection can provide enough power in the event the other MOD power connection fails, and the system can continue to operate as expected.

For more information on how to connect MOD power, see Connect MOD Power to the Power Conditioners on page 76.

SA Power

SA power is field-side power that is connected to I/O Bases. It powers devices that are connected to the I/O modules.

You use the following to connect SA power to an I/O Base:

- External power supplies - We recommend that you use the 1606-XLE480ECRZ power supplies. Feed each power supply with a separate source of AC power. Do not use the external supplies for anything else in your application. Dedicate these power supplies for SA Power.
  For more information on the power supply, see the 1606-XLE480ERZ and 1606-XLE480ECRZ Power Supply Installation Instructions, publication 1606-IN049.
- Field Power Redundancy Devices (FPRD) - We recommend that you use the 1606-XLERED20Y FPRDs.
  FPRDs are redundancy modules that you use to build redundant power supply systems. In a FLEXHA 5000 I/O system, two external power supplies are connected to each FPRD. You connect each FPRD to a dedicated fuse that supplies current to the SA power RTB on the left side of an I/O Base.
  For more information on the power supply, see the 1606-XLERED20Y Power Supply Installation Instructions, publication 1606-IN072.
- Two terminal blocks - We recommend that you use RA 1492 products.
  For more information, see https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/terminal-blocks.html.
- Fuses - Your application specifics, such as, the wire gauge that is used and the size of your system dictates the fuse that you use.
  We recommend that you use RA 1492 products with fuses. For more information, see https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/terminal-blocks.html.

You must install an SA power RTB in the first available SA power slot on the I/O Base before you connect SA power. SA power starts at the power RTB and is distributed to all I/O modules that are installed on the I/O Base across an SA power bus. Each I/O module draws power as needed, and the remaining power passes along the rest of the I/O Base. For more information on how where and how to install the SA power RTB, see Install the SA Power RTB on page 68.

We recommend that you connect two FPRDs to a power RTB to provide SA power. You can extend SA power from one I/O Base to the next, and the SA power bus continues across the next I/O Base. You can also use additional dedicated power supplies, FPRDs, and fuses to establish a new SA power bus on the next I/O Base.

The total continuous current draw on an SA power bus must be no more than 20 A, max, depending on the system's operating temperature, at 20.8...28.8V DC SELV/PELV; the fault voltage must be limited to 32V DC SELV/PELV.

IMPORTANT Do not connect the SELV/PELV power that is connected to an I/O base to anything else in the FLEXHA 5000 I/O system or anything external to the FLEXHA 5000 I/O system.

For more information on how to connect SA power, see Connect SA Power to an I/O Base on page 80.

Testing Considerations

When you install a FLEXHA 5000 I/O system in a Marine application, consider the following exceptions:

1. A Salt Test is not performed on the FLEXHA 5000 I/O system because you must install the system in an enclosure. The enclosure that is used in the final installation might need to be subjected to Salt test if it is installed in the exposed area.
2. A Compass Safe Distance test is not performed on the FLEXHA 5000 I/O system. If the system is installed on the Navigation Bridge of a Marine Vessel, it must be placed outside the 5 m radius from the Compass.
3. An Acoustic Noise test is not performed on the FLEXHA 5000 I/O system because it does not to produce noise or alarms that can interfere with Marine Vessel safety signals.

For more information, see the certificate details available at https://www.rockwellautomation.com/en-us/support/documentation/literature-library.html.

Assemble the System Components

To install a FLEXHA 5000 I/O system, complete the following steps:

1. Install mounting plates and ground lugs
2. Install Adapter Base

   If you are connecting from the Adapter Base to an I/O Bank, skip to step 4.
3. Install I/O Bases

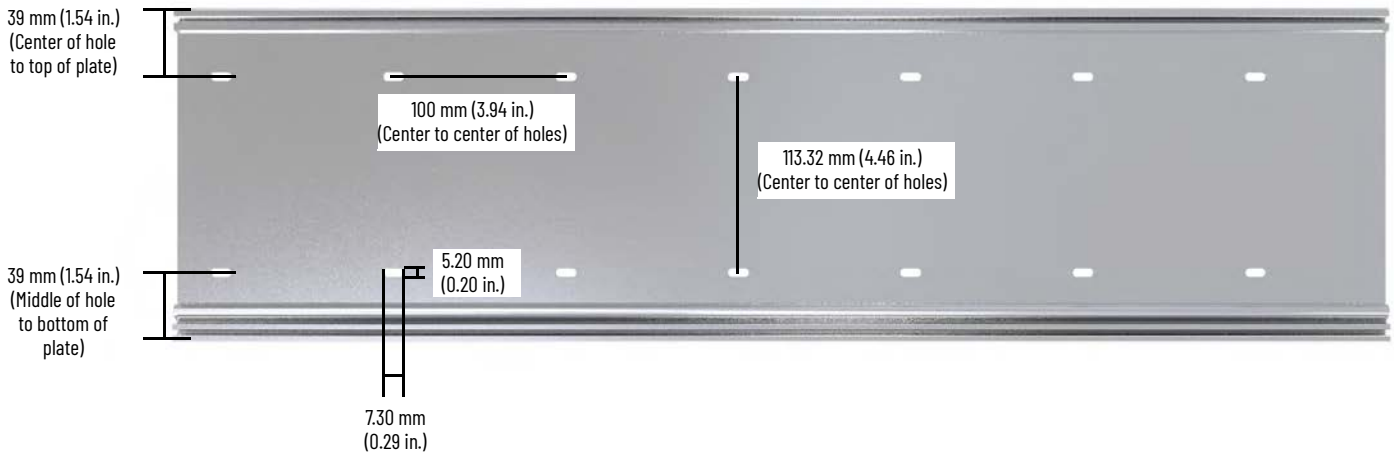
   You can install I/O Bases directly next to the Adapter Base or on an I/O Bank that is connected to the Adapter Bank via Backplane Communication and Power Extension cables. This publication shows both.
4. Install Adapter Base components, including the following:
   - Two power conditioners
   - MOD Power RTBs
   - Diagnostic RTB (optional)
   - Two EtherNet/IP adapters
   - Two MLCs
   - Two BIMs
   - Bank Expansion Base, Left (optional)
   - Backplane Communication Extension cables (optional)
   - Backplane Power Extension cables (optional)
5. Install I/O Base components, including the following:
   - Bank Expansion Base, Right (optional)
   - BIMs - Two for each I/O Base
   - I/O modules
   - I/O Slot Fillers (optional)
   - Duplex or Simplex RTBs, as dictated by system configuration
   - SA Power RTB
   - SA Power jumper, if multiple I/O Bases are used, or Power RTB Slot Filler
   - Simplex RTB and SA Power RTB covers (optional)
   - STB
   - Bank Expansion Base, Left (optional)
   - Backplane Power Extension cables (optional)
   - Backplane Communication Extension cables (optional)
   - End cap (On last I/O Base)
6. Connect power to the system.

Install Mounting Plates

Mounting plates hold and ground the FLEXHA 5000 I/O system. You install mounting plates in a cabinet. The following mounting plates are available:

- 5015-MP300XT
- 5015-MP700XT
- 5015-MP900XT
- 5015-MP1250XT

Figure 7 - Mounting Plate Dimensions



Consider the following before you install mounting plates:

- Consider future I/O system extension. We recommend that, if possible, you install one mounting plate that is long enough to support all bases in the system. If you extend your I/O system later, you can install a mounting plate next to, and touching, an existing mounting plate.
- Each mounting plate requires a ground lug.
- You must install the mounting plate on which the Adapter Base is installed in a horizontal orientation.
- You can install mounting plates with only I/O Bases installed on them in a horizontal or vertical orientation.

The maximum ambient temperature range differs by orientation.

- When you mount an Adapter Base or I/O Base horizontally, the maximum ambient temperature range is -40 °C ≤ Ta ≤ +70 °C (-40 °F ≤ Ta ≤ +158 °F).
- If you mount an I/O Base vertically, the maximum ambient temperature range is -40 °C ≤ Ta ≤ +60 °C (-40 °F ≤ Ta ≤ +140 °F).

To install a mounting plate, complete the following steps.

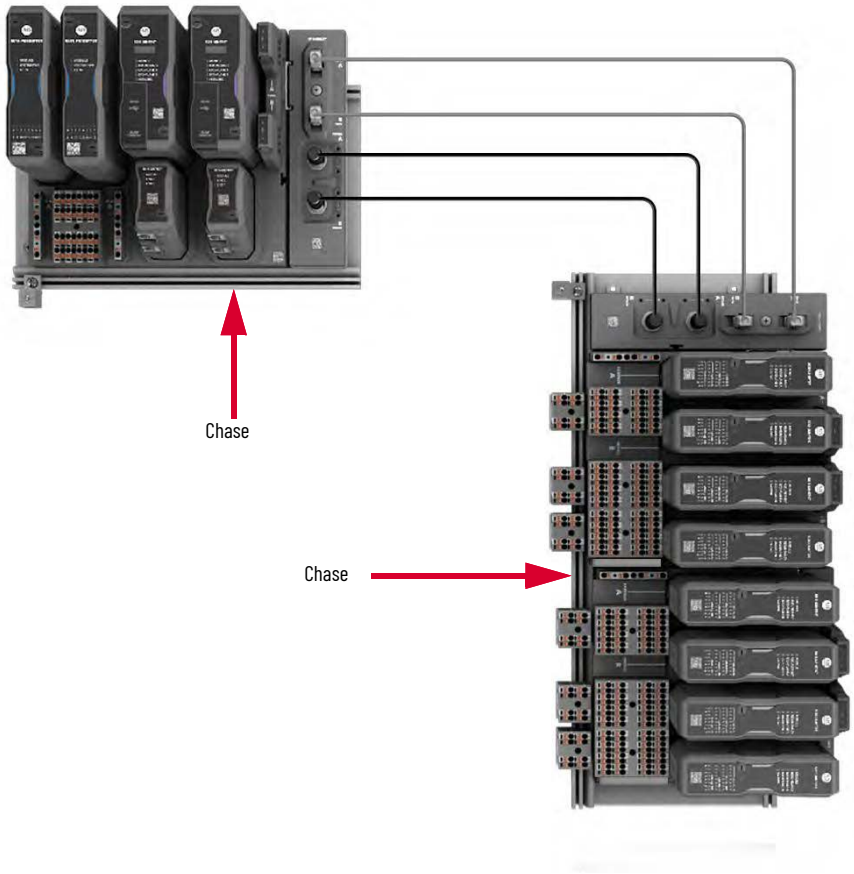
1. Drill and tap holes.
   Table 5 lists the mounting plate hardware specifications.

Table 5 - Mounting Plate Hardware Specifications

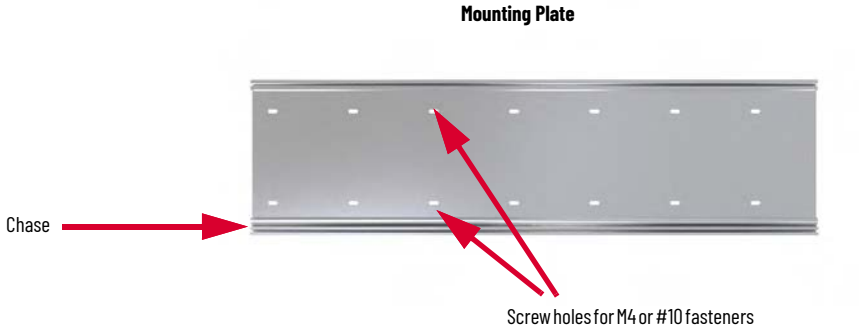
	Component	Specification
Imperial	#10 pan Hd	ASME B18.6.3
	Lock washer, split	ASME B18.21.1
	Lock washer, star int	
	Flat washer	
Metric	M4 Pan Hd	DIN 7985
	Lock washer, split	DIN 127 B
	Lock washer, star int	DIN 6797
	Flat washer	DIN 125

IMPORTANT When you install a mounting plate for the Adapter Base, make sure that the chase is on the bottom. The chase has a hook upon which the Adapter Base and I/O Bases are installed.

If you install mounting plates in a vertical orientation, be aware of where the bottom of the mounting plate is. When I/O banks are installed, the first component is a Bank Expansion Base, Right. You connect that to a Bank Expansion Base, Left, via Backplane Extension cables. To install the Bank Expansion Base, Right, at the top of the I/O bank, install the mounting plate so that the chase is on the left side, as shown.



2. Push M4 or #10 fasteners through the holes on mounting plate, and turn the screws until they are connected to the cabinet.
   The maximum screw head height is 6.5 mm (0.26 in.).



3. Repeat step 2 with all holes in the mounting plate.
4. If necessary, repeat the steps to install additional mounting plates.

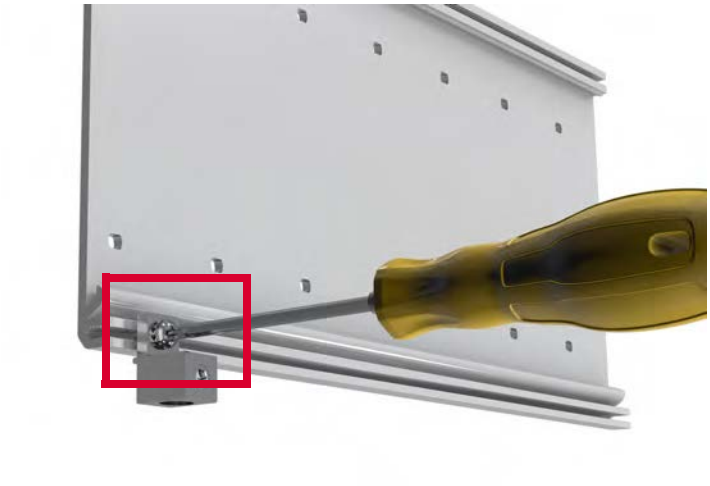
Install a Ground Lug on a Mounting Plate

The mounting plate functions as the bonding point to Protective Earth (PE) for a FLEXHA 5000 I/O system. Once the mounting plate is installed in the cabinet, install a ground lug on the mounting plate. The ground lug is then connected to the installation PE point.

To install the ground lug, complete the following steps.

1. Position the ground lug with set screw facing towards you.
2. Position the ground lug installation hole directly over the bottom chase of the mounting plate.
3. Install a lock washer between the head of the fastener and the ground lug.
4. Install the ST4.8 metric fastener into the hole on the ground lug.

5. Use a #2 Phillips screwdriver to turn the provided ST4.8 fastener until it is secure against the chase at the bottom of the mounting plate.
   The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).

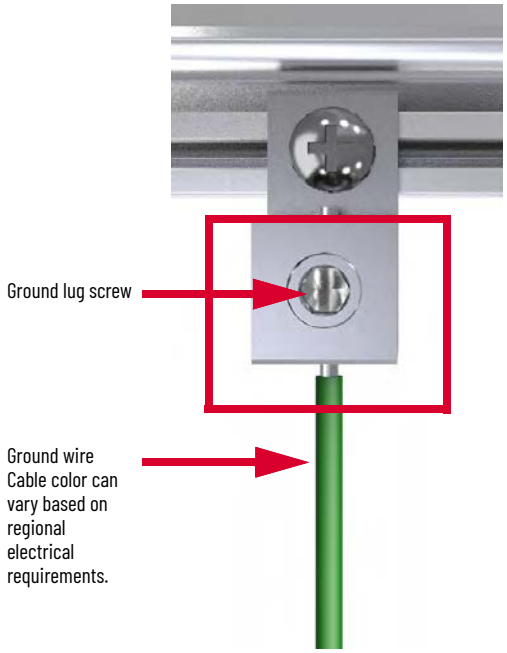


6. Strip 15.5 mm (0.61 in) insulation from the cable, and insert it inside the ground lug and tighten the ground lug screw to secure the wire in place.
   The ground lug connects to grounding wires size 2.25…21.15 mm^2 (14…4 AWG) stranded wire.

Table 6 - Ground Lug Torque Specifications

Conductor Size	Attachment Methods Bare Wire/Terminal/Lug/Ferrule
14 AWG…10 AWG	4.0 Nm (35 in•lb)
8 AWG (recommended)	4.5 Nm (40 in•lb)
6 AWG…4 AWG	5.6 Nm (50 in•lb)

7. Use a 3/16″ hex key to secure the wire.



8. Connect the other end of the cable to the installation Protective Earthing point.

IMPORTANT We recommend that you use a separate ground lug and corresponding cable that is connected to the installation PE point for each mounting plate that you install in the cabinet.
If necessary, you can bond the first mounting plate to the cabinets PE point and then daisy chain the connection to the other mounting plates.

If you must remove or replace the ground lug while the system is running, we strongly recommend that you install a parallel grounding run before removal or according to local regulations. Use a #2 Phillips screwdriver to unscrew the original ground lug from the chase.

Install the Bases

Install the Adapter Base first and then install the I/O Bases. Bases are installed on the mounting plate from left to right.

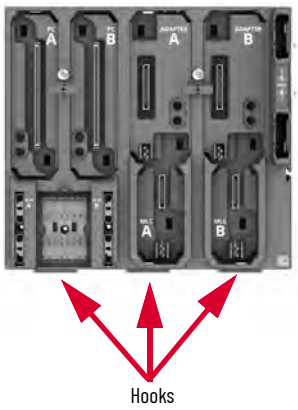
Install I/O Bases on the same bank as the Adapter Base or additional banks. For more information on bases and banks, see page 13.

Use the following to install an Adapter or I/O Base on the mounting plate:

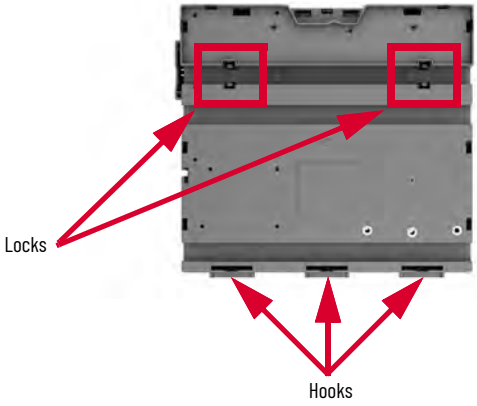
- Hook at the bottom of the mounting plate.
- Ridge at the top of the mounting plate.
- Hooks on the bottom of the base.
- Locks on the back of the base.

Mounting Plate

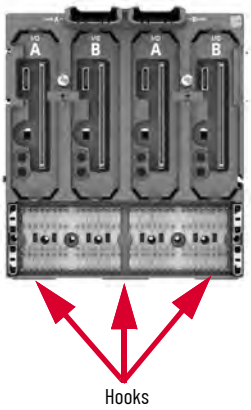
Adapter Base



Back of Base



I/O Base



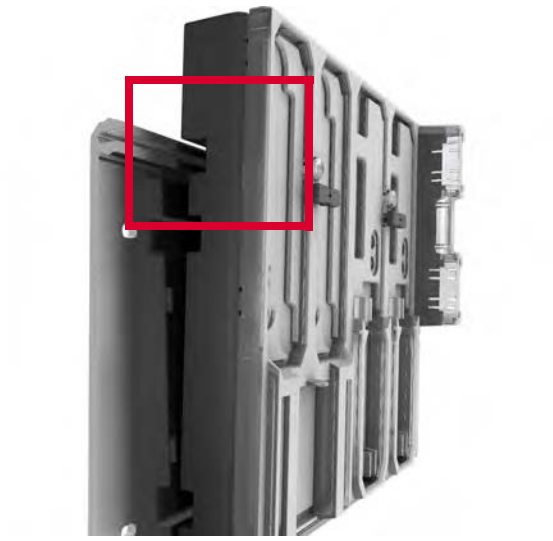
Install the Adapter Base

To install the Adapter Base, complete the following steps.

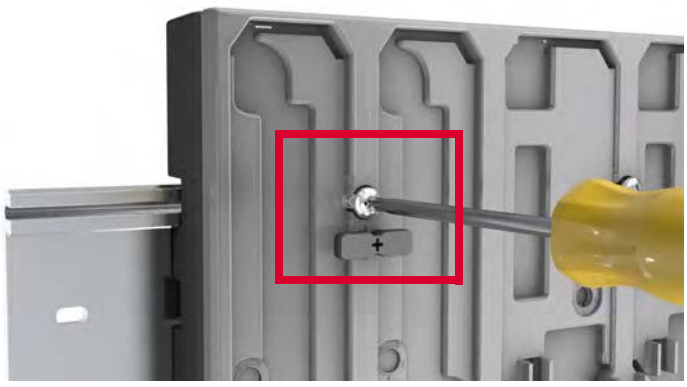
IMPORTANT You cannot install an Adapter Base in a horizontal flat position, that is, facing the sky orientation.

1. Seat the bottom of the Adapter Base in the hooked portion of the mounting plate.

2. Push the top of the base toward the mounting plate until it snaps into place.



   A click indicates when the base is installed on the mounting plate.
3. Use a #2 Phillips screwdriver to turn the provided ST4.8 metric fastener to secure the base to the mounting plate. The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).



4. Repeat as necessary for each screw.

Install an I/O Base

After you install the Adapter Base, you can install I/O Bases in any of the following configurations:

- Installed next to the Adapter Base on the Adapter bank.
- Installed on an I/O bank that is connected to the Adapter bank via Bank Expansion Bases, left and right, and Backplane Extension cables.
- Installed on an I/O bank that is connected to an I/O bank via Bank Expansion Bases, left and right, and Backplane Extension cables.

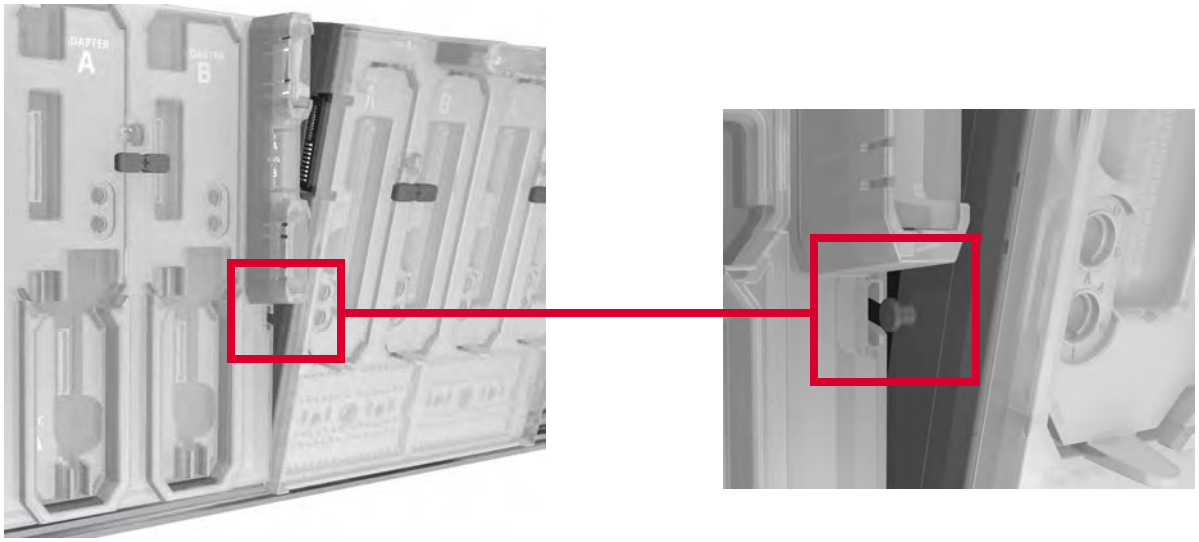
Install an I/O Base on the Adapter Bank

When you install the first I/O Base on the Adapter bank, the I/O Base is connected to the Adapter Base.

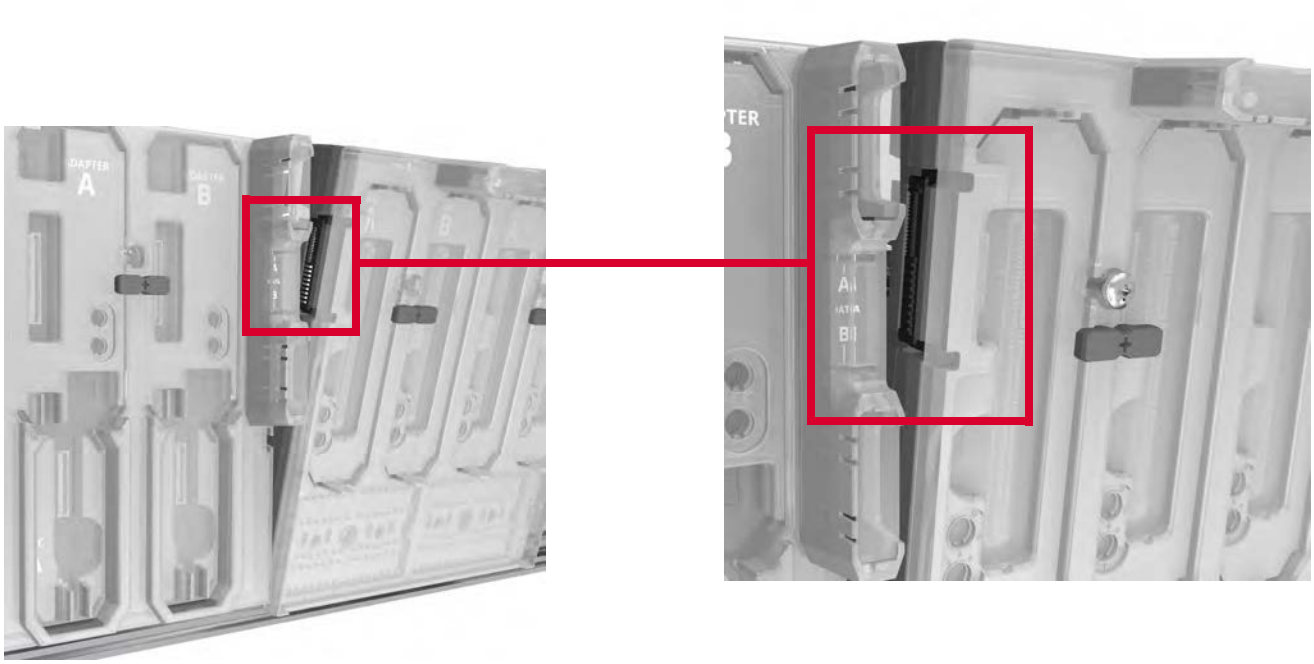
To install the I/O Base, complete the following steps.

1. Seat the bottom of the I/O Base in the hooked portion of the mounting plate and directly next to the Adapter Base.

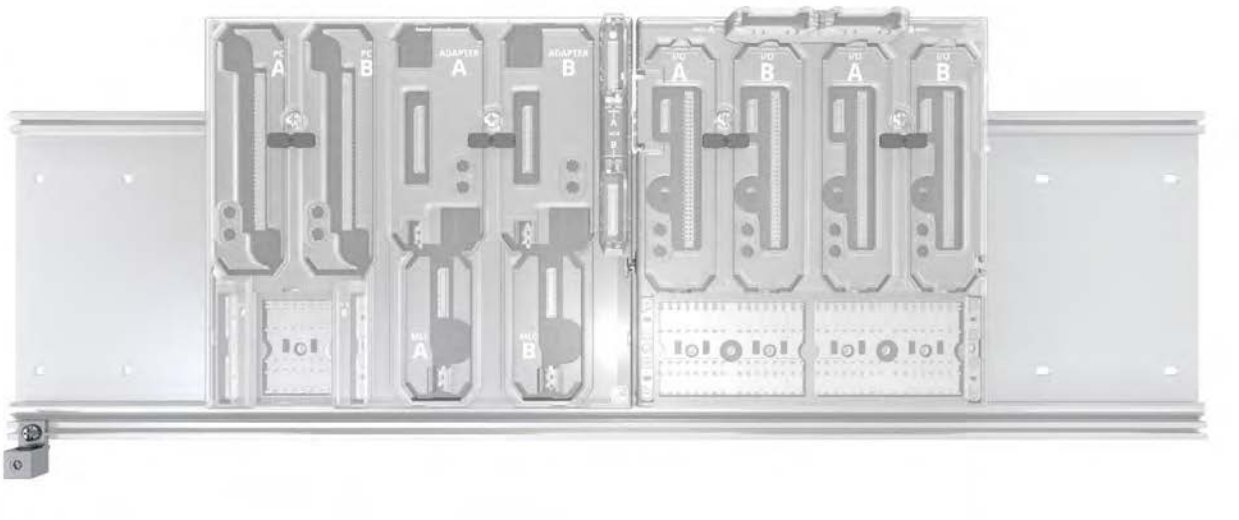
2. Push the top of the I/O Base toward the mounting plate.
   When the I/O Base is moving toward the mounting plate, a tab on the left side of the I/O Base enters an opening on the right side of the Adapter Base.



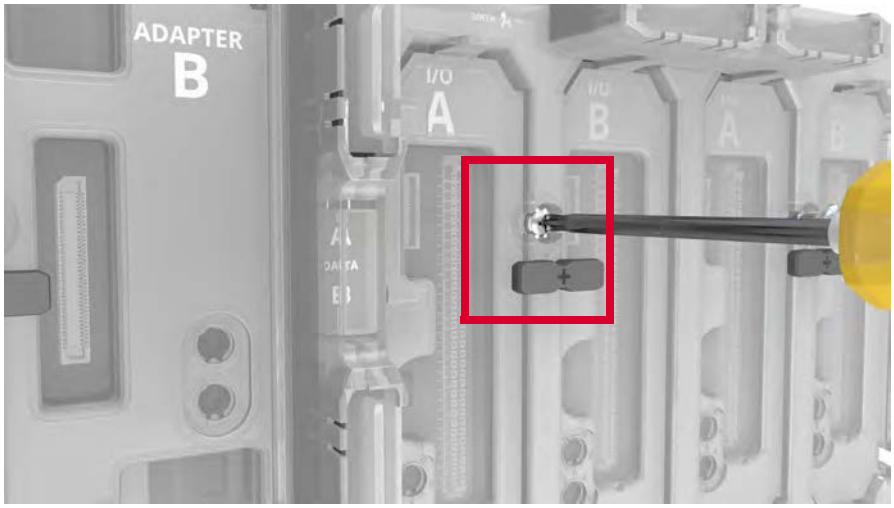
As the rotation toward the mounting plate continues, a rectangular slot on the left side of the I/O Base engages a tab on the right side of the Adapter Base.



3. Continue to push the I/O Base toward the top of the mounting plate until it snaps into place.
   When the I/O Base is fully installed next to the Adapter Base, it appears as follows.



4. Use a #2 Phillips screwdriver to turn the provided ST4.8 metric fastener to secure the base to the mounting plate.
   The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).



5. If you are not going to install any more I/O Bases in the system, make sure that an End Cap is installed on the last I/O Base.
6. To install additional I/O Bases on the I/O bank, if the End Cap is installed on the most recently installed I/O Base, pull the End Cap off.
7. To install subsequent I/O Bases, repeat the steps that begin with step 1 on page 32 as necessary.

Install an End Cap on an I/O Base

When all I/O Bases are installed, push an End Cap on the last I/O Base in the Adapter Bank or I/O Bank.

Install I/O Bases in I/O Banks Via Bank Expansion Bases and Backplane Extension Cables

IMPORTANT If you are only using an Adapter bank that includes I/O bases and I/O modules, and are not installing I/O Banks, skip this section and proceed to Assemble the I/O Base Components on page 64.

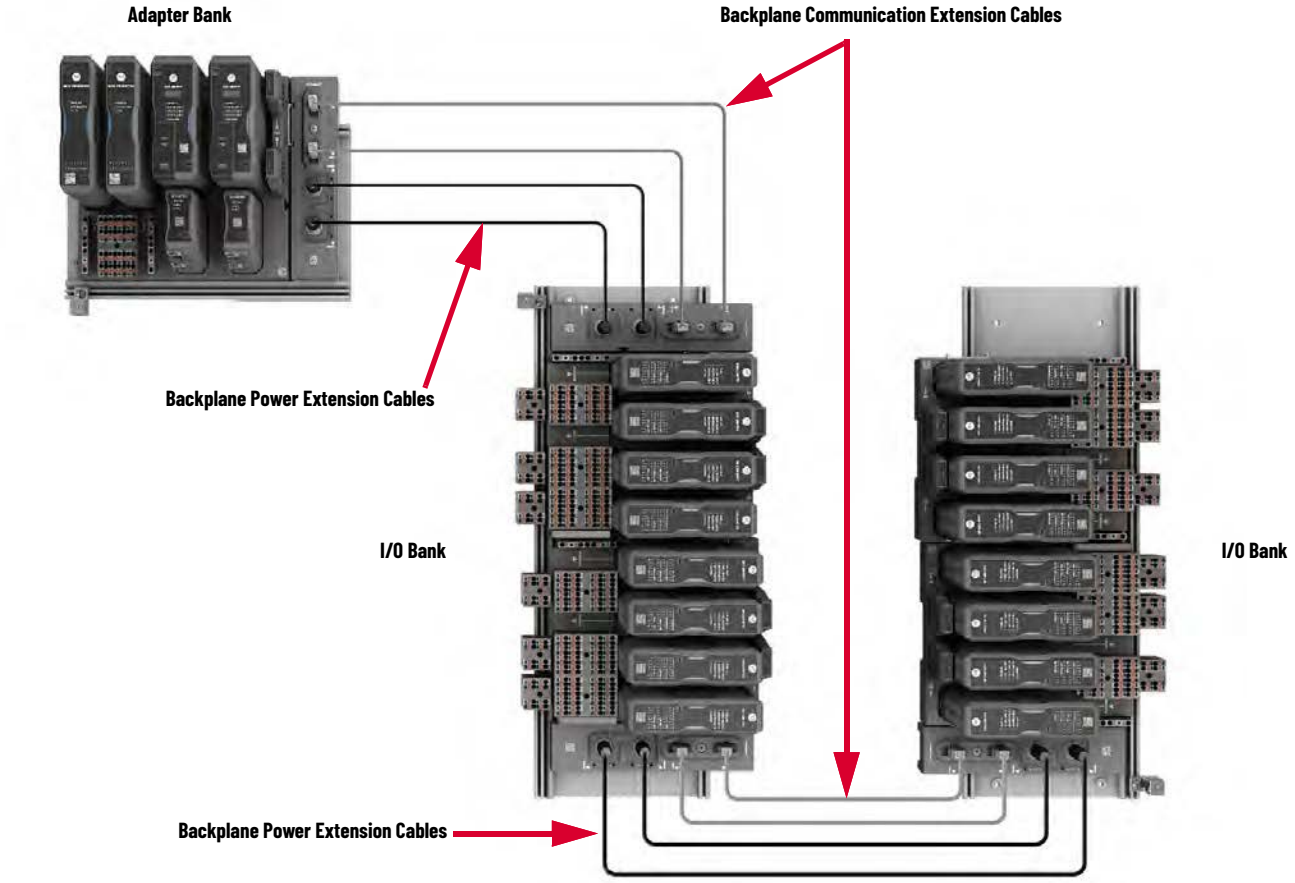
In a FLEXHA 5000 I/O system, you can have up to three banks--an Adapter bank (required) and up to two I/O banks. To connect the banks, use the following:

You can order the components separately or as part of kits. For more information, see Table 1 on page 4 and Table 2 on page 8, respectively.

- Bank Expansion Bases, left
- Bank Expansion Bases, right
- Backplane Communication Extension Cables - You must install two of these cables between bank expansion bases.

  When you install Backplane Communication Extension cables, make sure the **connectors** at each end are strain relieved, tie-wrapped, or alternately supported. For adequate reliability, **do not** let the connectors to bear the weight of the cables themselves.
- Backplane Power Extension Cables - You must install two of these cables between bank expansion bases.

You must have at least one I/O bank when you use the components that are previously listed.

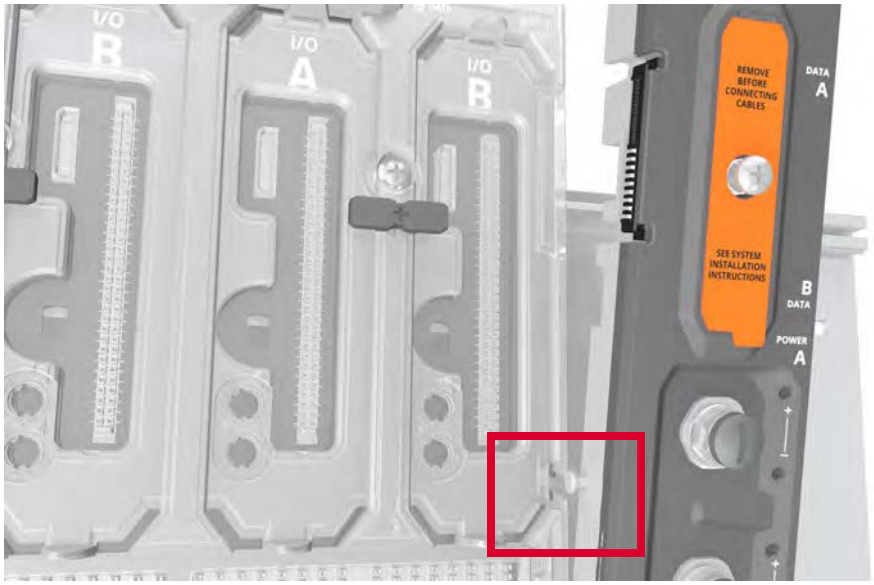


Bank Expansion Bases, Left and Right, ship with a dust cover, that is, a label, on them. You can install them with the dust cover on and remove it afterward.

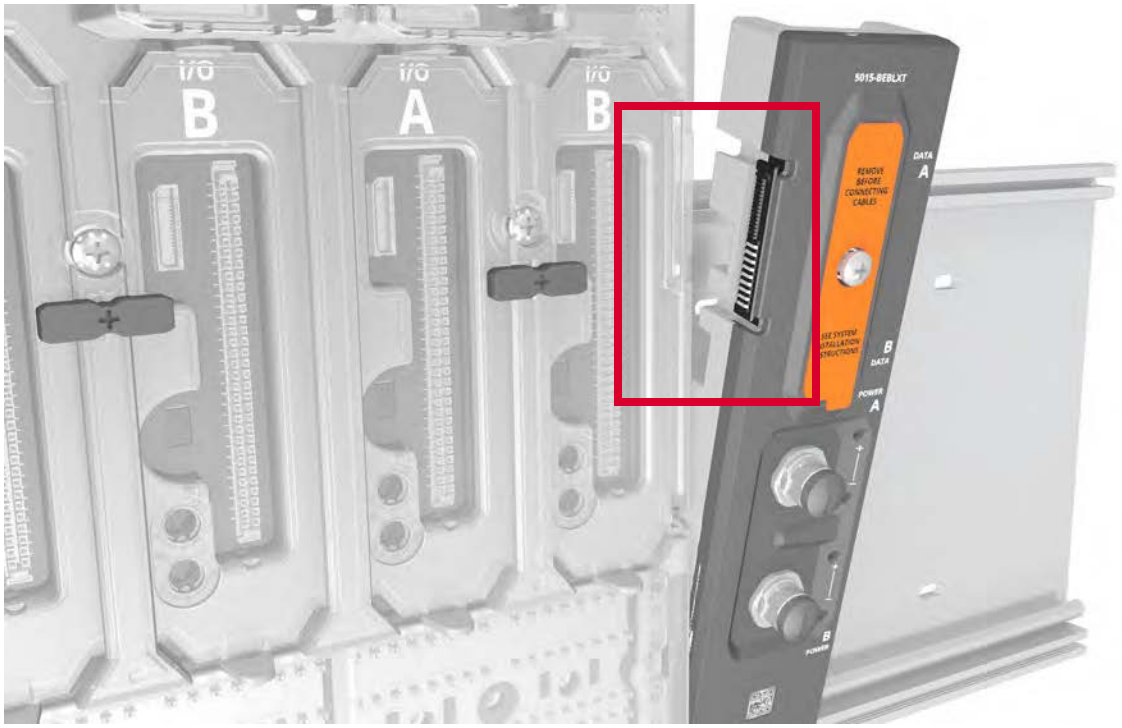
To install the Bank Expansion Base, Left, complete the following steps.

1. Install the Adapter Base and, if necessary, I/O Bases, on the Adapter bank. as described beginning on page 30.
2. If an End Cap is installed on the base to which you are connecting the Bank Expansion Base, Left, remove it.
3. Seat the bottom of the Bank Expansion Base, Left, in the hooked portion of the mounting plate and against the last base in the Bank.
   In this example, the last base is an I/O Base.

4. Push the top of the Bank Expansion Base, Left, toward the mounting plate.
   When the Bank Expansion Base, Left, is moving toward the I/O Base, a tab on the left side of the Bank Expansion Base, Left, enters a slot on the right side of the I/O Base.



As the rotation toward the mounting plate continues, a rectangular slot on the left side of the Bank Expansion Base, Left, engages a tab on the right side of the I/O Base.



5. Continue to push the Bank Expansion Base, Left, toward the top of the mounting plate until it snaps into place.
   When the Bank Expansion Base, Left, is fully installed, it appears as follows.

6. Use a #2 Phillips screwdriver to turn the provided ST4.8 metric fastener to secure the Bank Expansion Base, Left, to the mounting plate. The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).

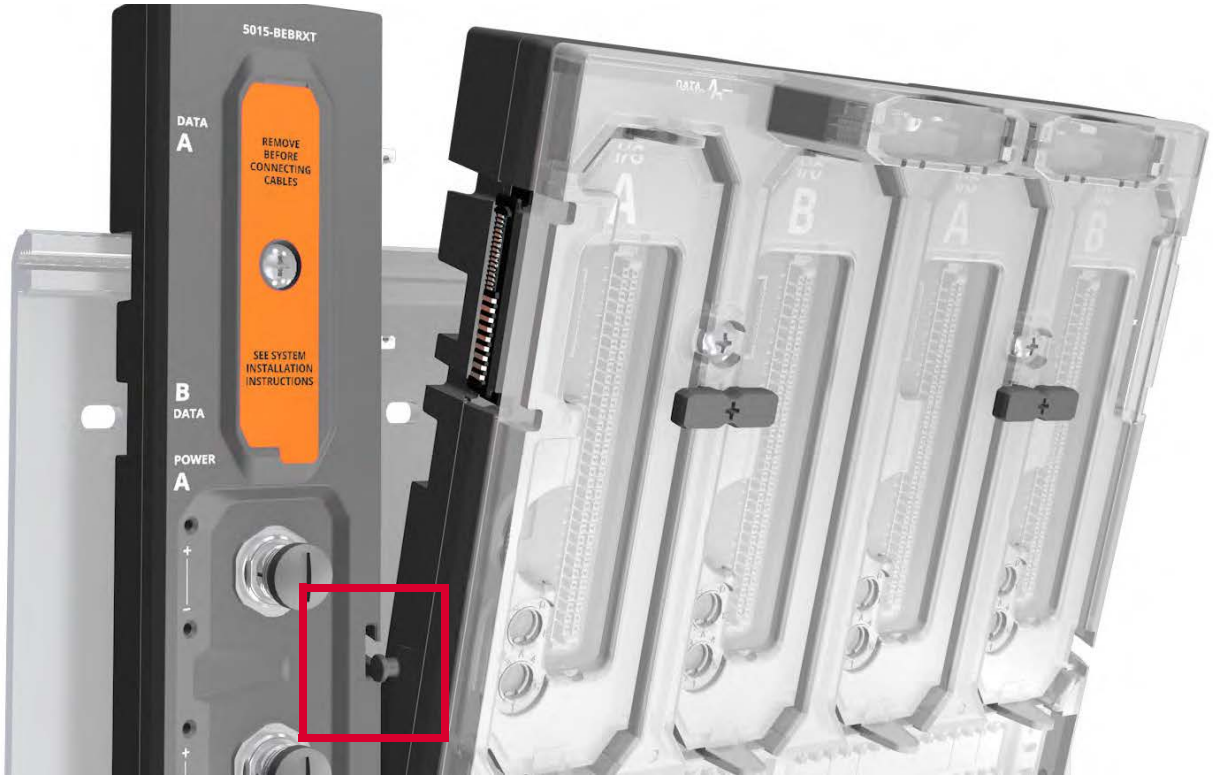
7. Peel the label off the Bank Expansion Base, Left.
8. Install a new mounting plate as described in Install Mounting Plates on page 26.
9. Install a ground lug on the next mounting plate as described in Install a Ground Lug on a Mounting Plate on page 28.
10. On another mounting plate, seat the bottom of the Bank Expansion Base, Right, in the hooked portion of the mounting plate.

11. Push the top of the Bank Expansion Base, Right, toward the mounting plate until it snaps into place.

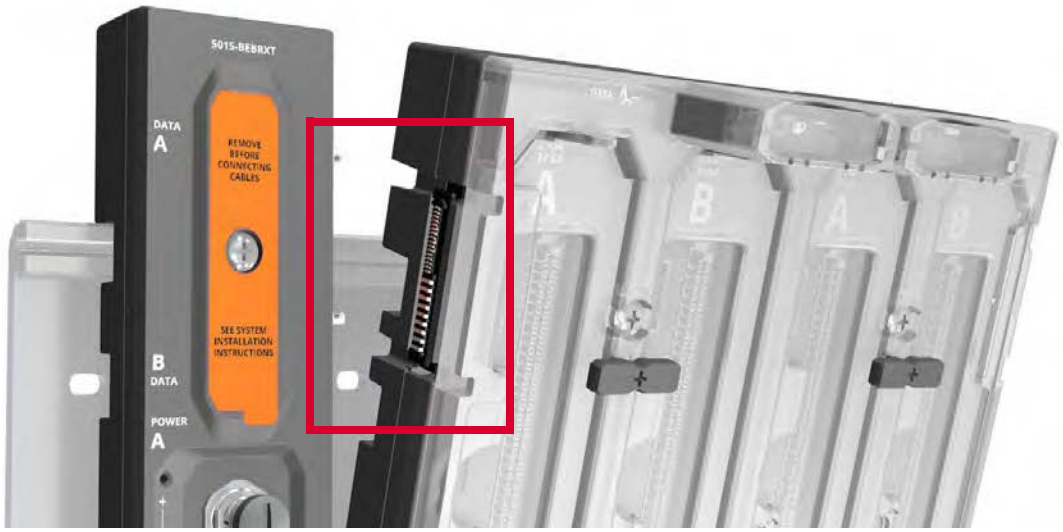
12. Use a #2 Phillips screwdriver to turn the ST4.8 metric fastener to secure the Bank Expansion Base, Right, to the mounting plate. The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).

13. Seat the bottom of the I/O Base in the hooked portion of the mounting plate.

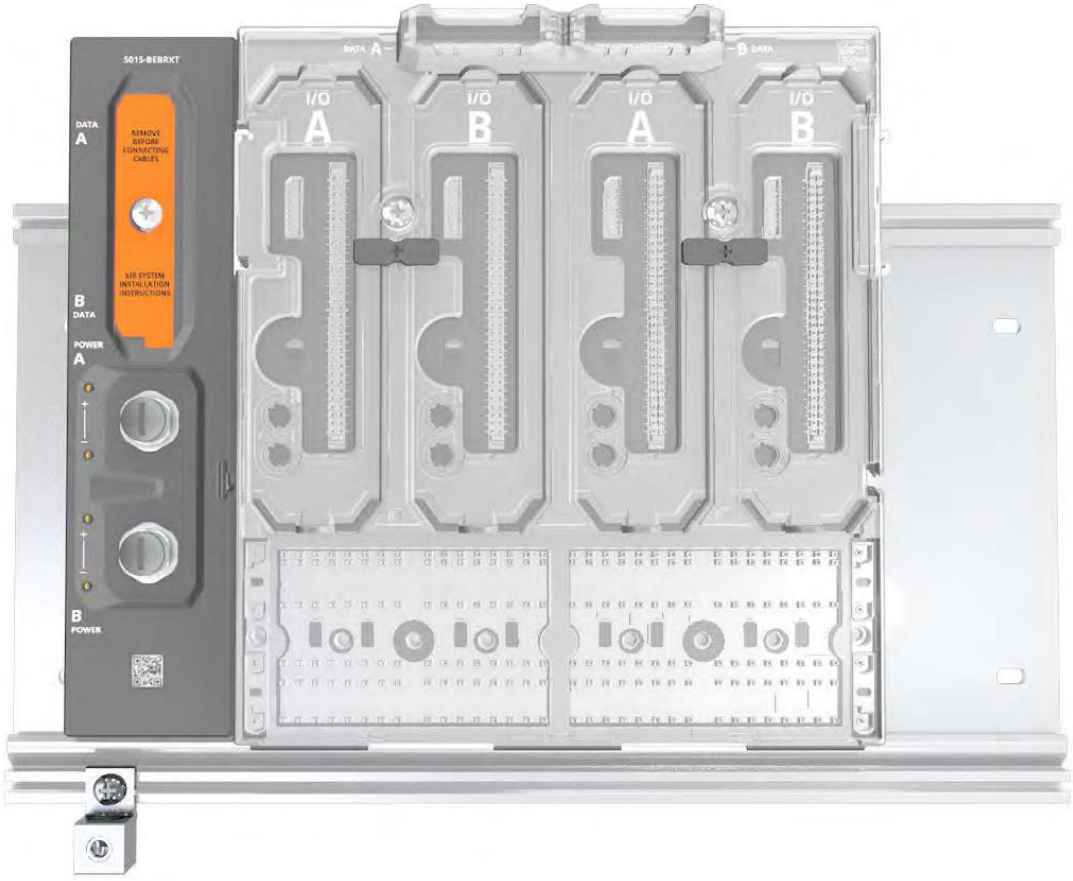
14. Push the top of the I/O Base toward the mounting plate.
When the I/O Base is moving toward the mounting plate, a tab on the left side of the I/O Base enters an opening on the right side of the Bank Expansion Base, Right.



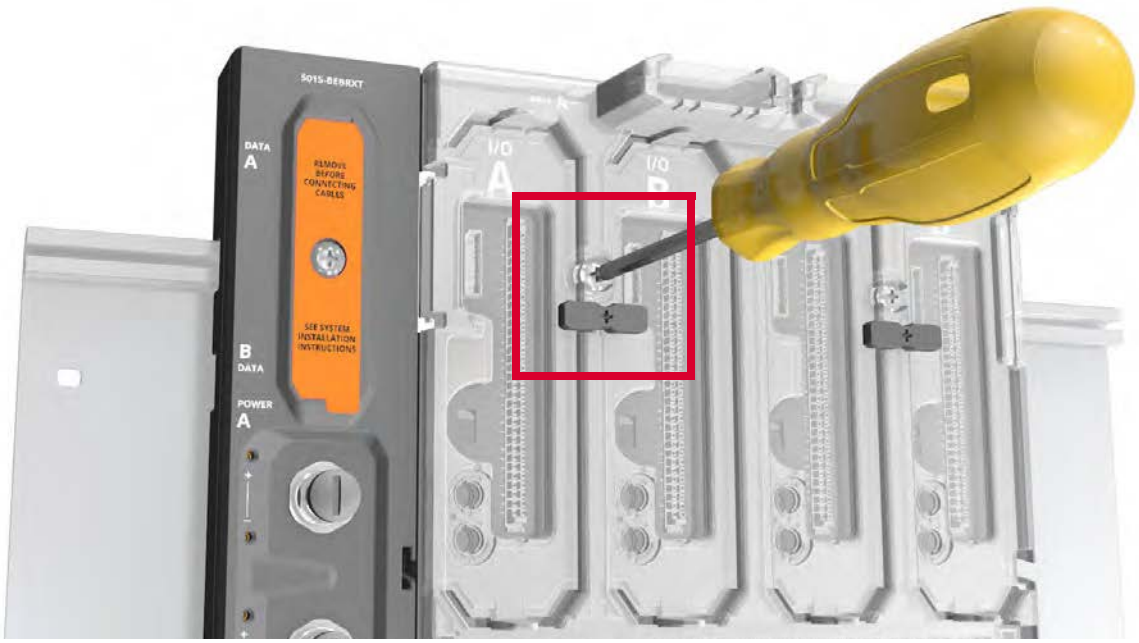
As the rotation toward the mounting plate continues, a rectangular slot on the left side of the I/O Base engages a tab on the right side of the Bank Expansion Base, Right.



15. Continue to push the I/O Base toward the top of the mounting plate until it snaps into place.
When the I/O Base is fully installed next to the Bank Expansion Base, Right, it appears as follows.



16. Use a #2 Phillips screwdriver to turn the provided ST4.8 metric fastener to secure the I/O Base to the mounting plate.
    The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).



17. Peel the label off the Bank Expansion Base, Right.
18. If you are using multiple I/O Bases on the I/O Bank, repeat the tasks that are described in step 13 on page 40 through step 16 on page 42 to install the next I/O Base.
19. Complete one of the following tasks.
    a. If you are not using another I/O Bank, install an End Cap on the last I/O Base in the first I/O Bank and skip to Connect the Adapter and I/O Banks Via Extension Cables on page 43.
    b. If you are using a second I/O Bank, repeat the tasks that are described in step 2 on page 36 through step 18.

    In step 13, the I/O Base connects to a Bank Expansion Base, Right. Additional I/O Bases on the bank connect to I/O Bases.

20. Install an End Cap on the last I/O Base in the last I/O Bank.

Remember, you can only install up to three banks in a FLEXHA 5000 I/O system--one Adapter bank and two I/O banks.

Connect the Adapter and I/O Banks Via Extension Cables

After you install the I/O Bases across multiple banks, you use Backplane Communication Extension cables and Backplane Power Extension cables between the Bank Expansion Bases to connect the banks.

IMPORTANT

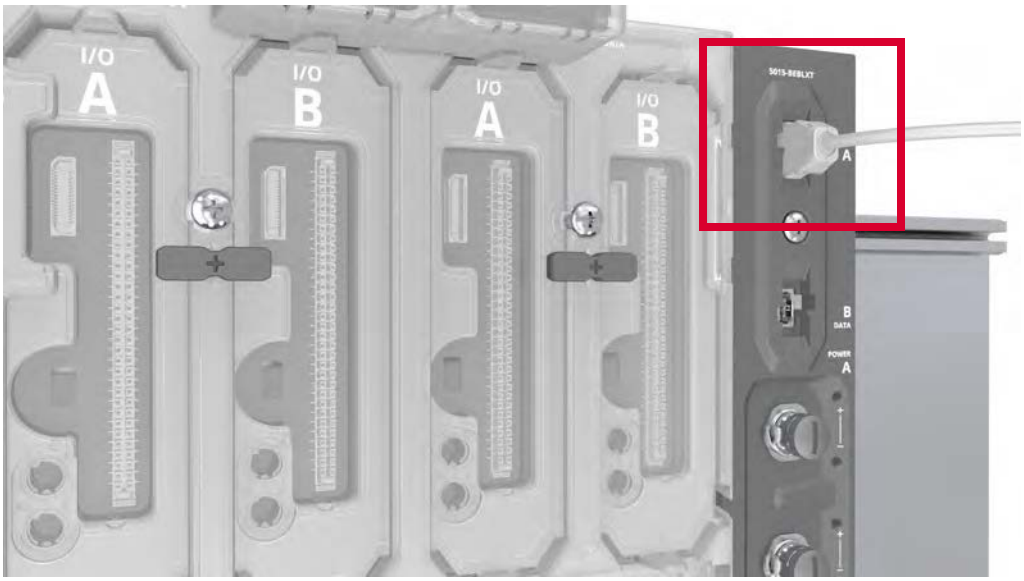
- When you use Backplane Communication and Power Extension cables, you must consider factors such as applying proper bend radius, applying strain relief, and separating cables from high-voltage cables.
  - The Backplane Communication Extension cables' minimum bend radius is 42 mm (1.65 in.).

    When you install Backplane Communication Extension cables, make sure the **connectors** at each end are **supported**. For adequate reliability, **do not** let the connectors to bear the weight of the cables themselves.
  - The Backplane Power Extension cables' minimum bend radius is 35 mm (1.38 in.).
- Make sure that you connect cables to correct ports on the other Bank Expansion Module. For example, if you connect a cable to the bottom port on the Bank Expansion Module, left, you must connect the other end of that cable to the bottom port on the Bank Expansion Module, right.

To connect the Backplane Communication Extension cables, complete the following steps.

1. Remove the dust cover from the Bank Expansion Base, Left.
2. On the Bank Expansion Base, Left, that is installed on the Adapter bank, plug the end of a Backplane Communication Extension cable that is **marked with an A** into port **Data A**.

   - Backplane Communication Extension cables are polarized and marked with an A on one end and a B on the other. You can only connect specific ends of the cables to specific ports on a Bank Expansion Base, Left, and the other ends of the cables to specific ports on the Bank Expansion Base, Right.
   - The A on the cable does not always correspond to Data A ports on the Bank Expansion Base. For example, the top data port on both Bank Expansion Bases is labeled Data A. So on the top, the A end of the cable plugs into a Data A port. The other end of the cable, marked B, plugs in a Data A port.
   - Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.



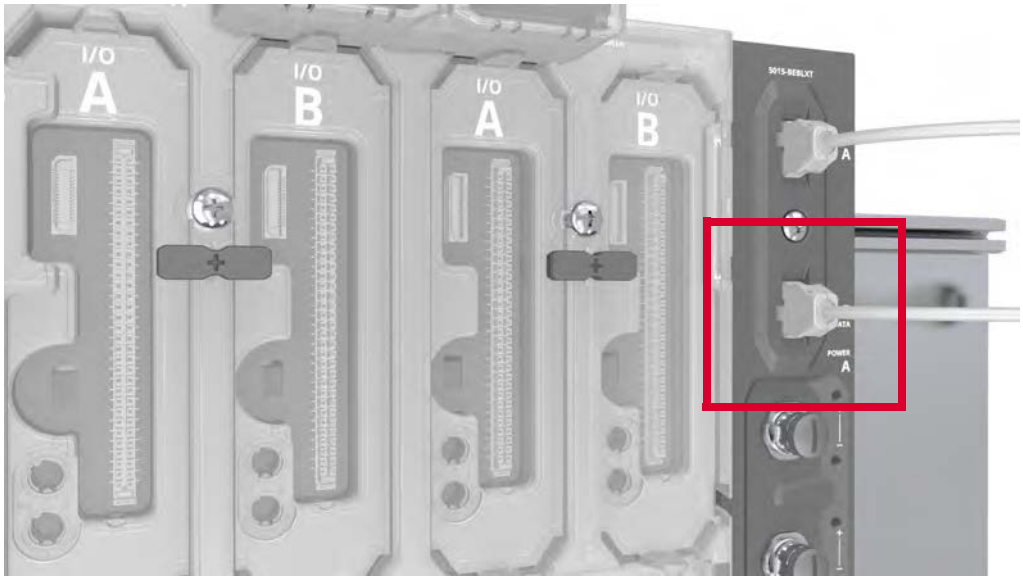
3. Remove the dust cover from the Bank Expansion Base, Right.

4. Plug the end of the Backplane Communication Extension cable that is **marked with a B** into port **Data A** on the Bank Expansion Base, Right, that is installed on the first I/O bank.

Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.

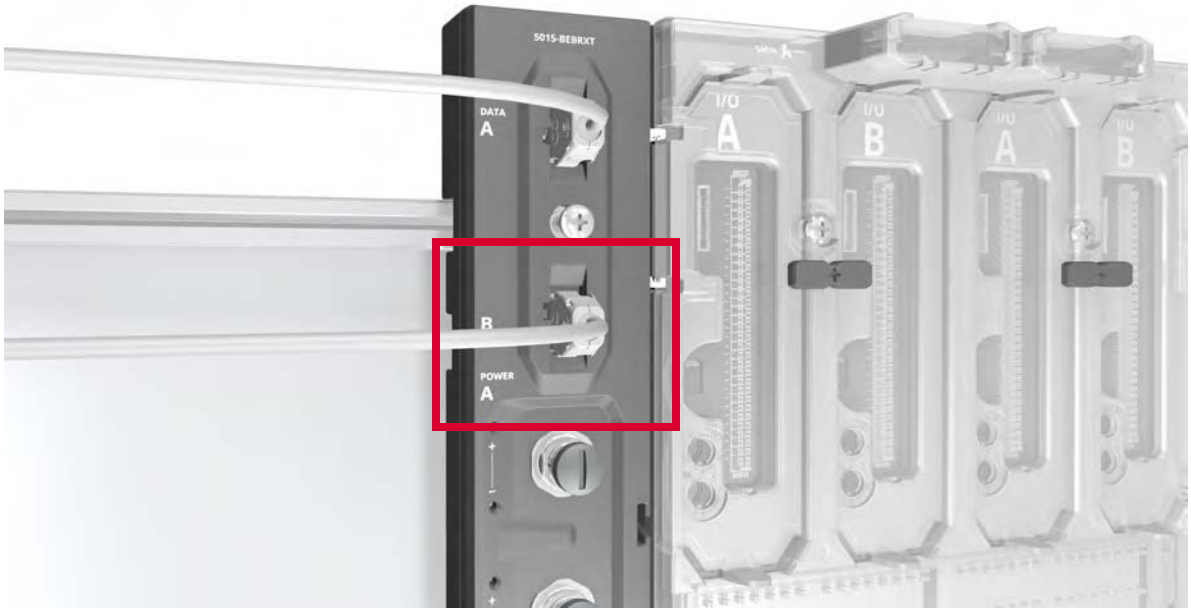
5. Plug the end of a Backplane Communication Extension cable that is **marked with a B** into port **Data B** on the Bank Expansion Base, Left, that is installed on the Adapter bank.

Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.



6. Plug the end of the Backplane Communication Extension cable that is **marked with an A** into bottom port **Data B** on the Bank Expansion Base, Right, that is installed on the first I/O bank.

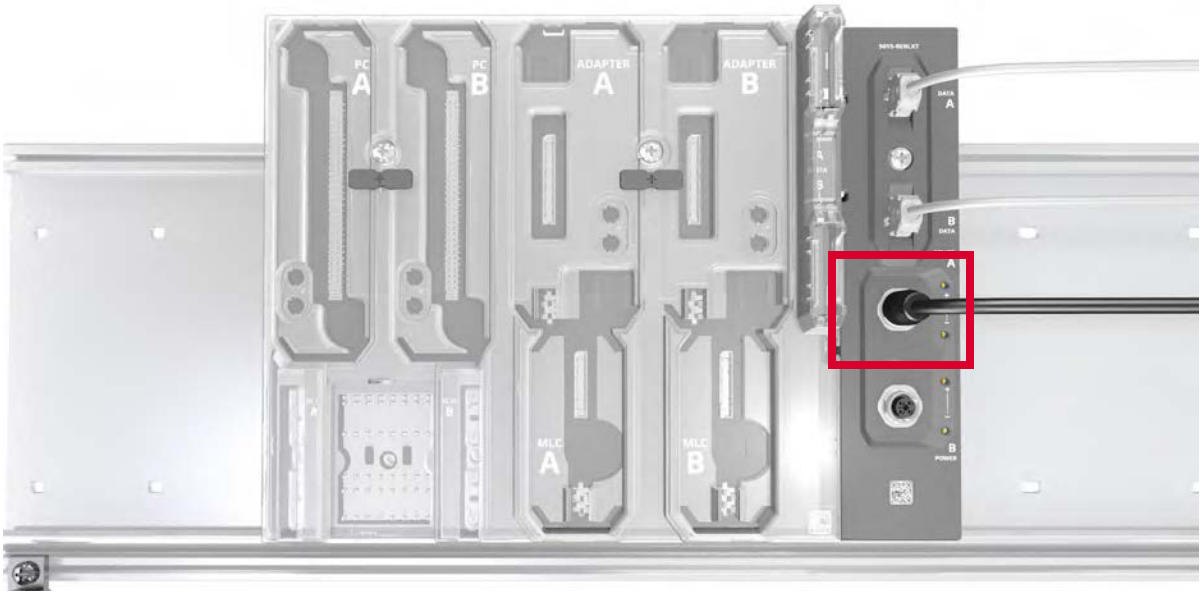
Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.



To connect the Backplane Power Extension cables, complete the following steps.

1. Remove the dust covers from the power ports on the Bank Expansion Bases, Left and Right.
2. Plug the first Backplane Power Extension cable into the **Power A** port on the Bank Expansion Base, Left, that is installed on the Adapter bank and **begin to tighten** the cable in place.

- Backplane Power Extension cables are polarized. You can only connect specific ends of the cables to specific ports on a Bank Expansion Base, Left, and the other ends of the cables to specific ports on the Bank Expansion Base, Right. If the cable does not easily fit in the port, try the other end of the cable. Connect the cables into the same port positions. If you connect one end of a cable in the top power port, connect the other end of the cable in the top power on the other Bank Expansion Base.
- Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.
- The power connectors are keyed to make sure that the correct female pins mate with the correct male pings. Check that the keying lines up before connecting the cable.

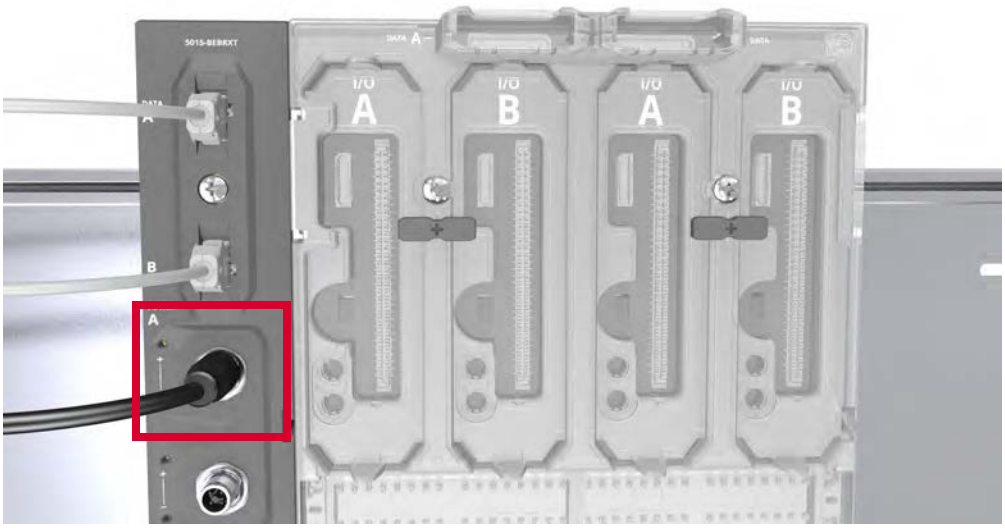


3. Use a torque wrench to **finish tightening** the cable in place. The recommended torque is 0.6 Nm (5.3 in•lb).
4. Plug the other end of the Backplane Power Extension cable into the **Power A** port on the Bank Expansion Base, Right, that is installed on the first I/O Bank, and **begin to tighten** the cable in place.

   The other end of the Backplane Power Extension cable uses receptacles and power ports on the Bank Expansion Base, Right, have pins.

For proper operation, you must connect the Backplane Power Extension cables to the same port positions. That is, if you connect a Backplane Power Extension cable to the top power port on a Bank Expansion Base, Left, connect the other end of the cable to the top power port on the Bank Expansion Base, Right.

Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.



5. Use a torque wrench to finish tightening the cable in place.

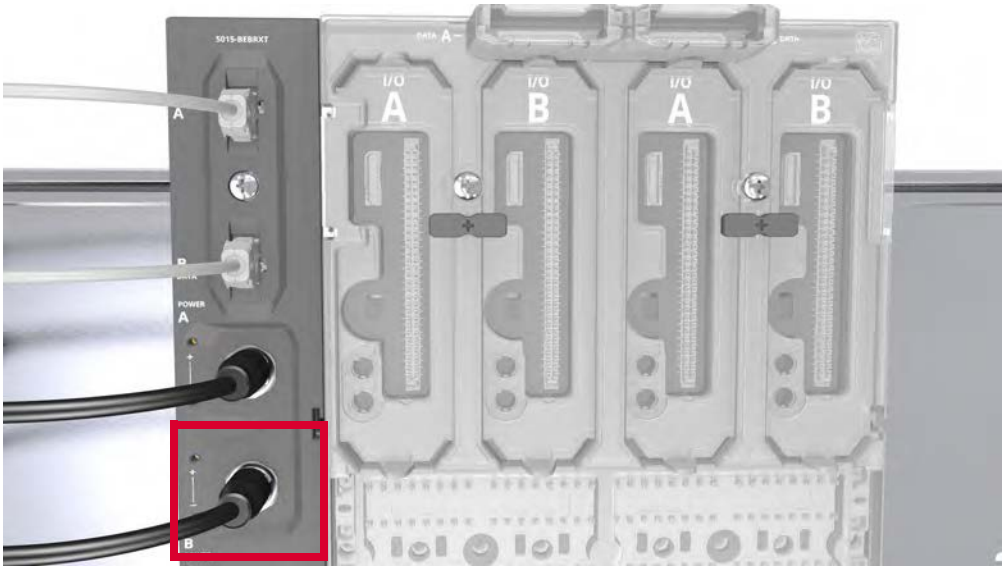
   The recommended torque is 0.6 Nm (5.3 in•lb).
6. Plug a second Backplane Power Extension cable into the **Power B** port on the Bank Expansion Base, Left, that is installed on the Adapter Bank and **begin to tighten** the cable in place.

- Backplane Power Extension cables are polarized. You can only connect specific ends of the cables to specific ports on a Bank Expansion Base, Left, and the other ends of the cables to specific ports on the Bank Expansion Base, Right. If the cable does not easily fit in the port, try the other end of the cable.
- Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.

7. Use a torque wrench to **finish tightening** the cable in place.
   The recommended torque is 0.6 Nm (5.3 in•lb).
8. Plug the other end of the Backplane Power Extension cable into the **Power B** port on the Bank Expansion Base, Right, that is installed on the first I/O Bank, and **begin to tighten** the cable in place.

For proper operation, you must connect the Backplane Power Extension cables to the same port positions. That is, if you connect a Backplane Power Extension cable to the top power port on a Bank Expansion Base. Left, connect the other end of the cable to the top power port on the Bank Expansion Base, Right.

Make sure that you hold the connector housing, and not the cable, when you push the cable into the port.



9. Use a torque wrench to finish tightening the cable in place.
   The recommended torque is 0.6 Nm (5.3 in•lb).
10. If you are using two I/O Banks, repeat step 2 on page 43 through step 9 on page 47 to connect the Backplane Communication Extension and Backplane Power Extension cables between the first I/O bank and the second I/O bank.

Assemble the Adapter Base Components

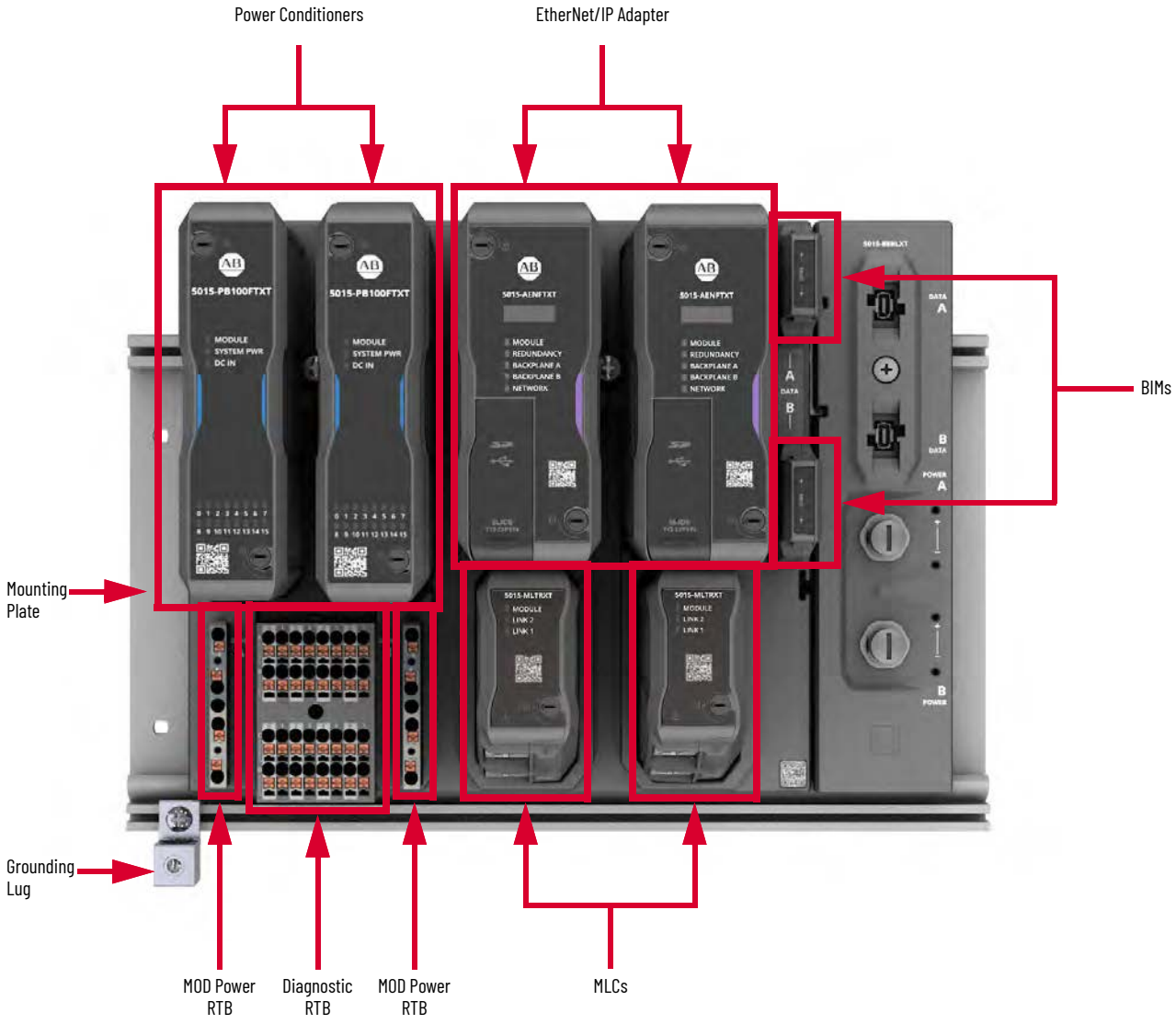
The Adapter Base is the first base that you install in the system. The following components are installed as part of this process:

- Two Power Conditioners
- Two MOD Power RTBs
- Diagnostic RTB or RTB Slot Filler
- Two EtherNet/IP Adapters
- Two MLCs
- Two BIMs

IMPORTANT When you install a Power Conditioner or EtherNet/IP adapter, make sure the orange keys at the back of the component seat into the correct position on the Adapter Base.

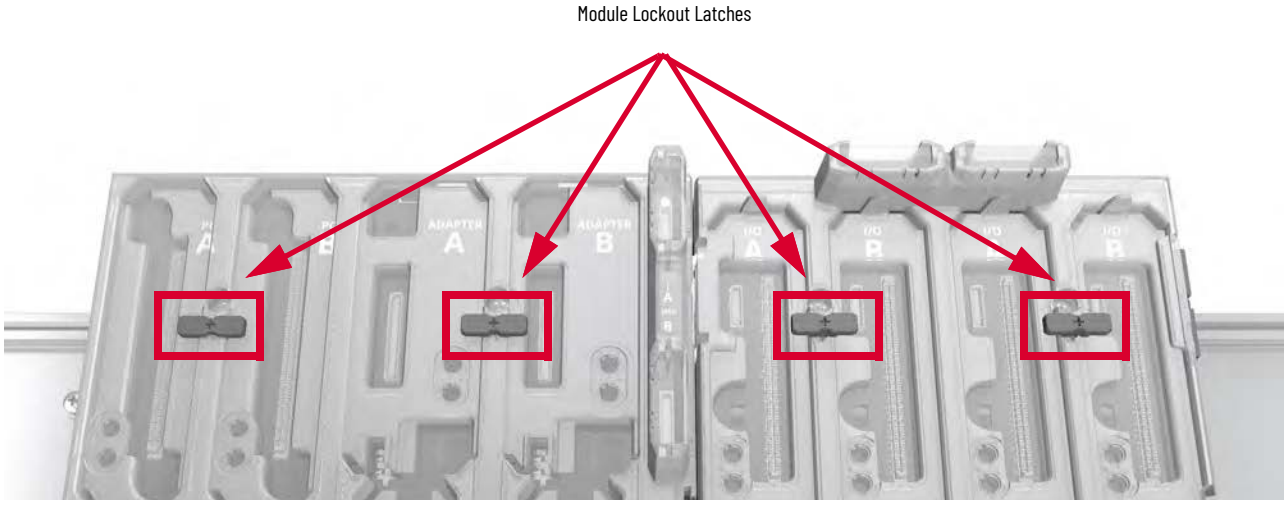
Figure 8 shows all components on an Adapter Base after the base assembly is complete.

Figure 8 - FLEXHA 5000 Adapter Base



Remove the Dust Covers from the Adapter Base and I/O Bases

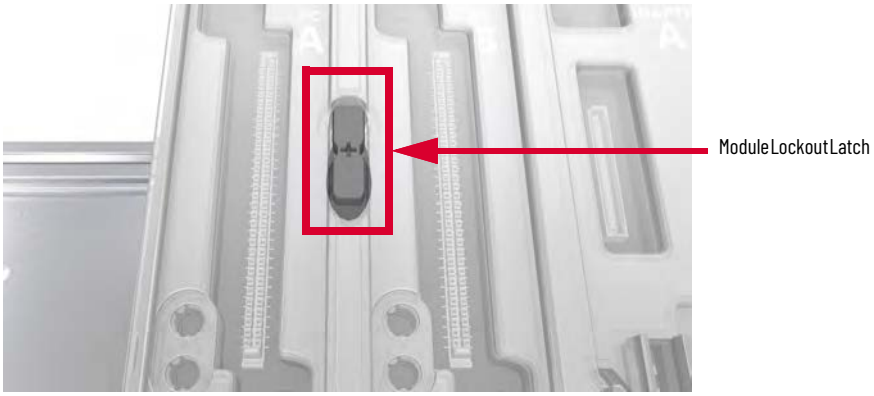
Before you can install any components on the Adapter Base or I/O Bases, you must remove the dust covers from the bases. Module lockout latches in a horizontal orientation hold the dust covers in place.



To remove the dust covers, complete the following steps.

1. Confirm that the mounting screws are properly torqued into place.
2. Turn the module lockout latches to a vertical position.

IMPORTANT	You can't install the Power Conditioners or EtherNet/IP adapters if the module lockout latches are not in the vertical position. You can't turn the module lockout latches to the vertical position unless the base mounting screws are securely tightened.

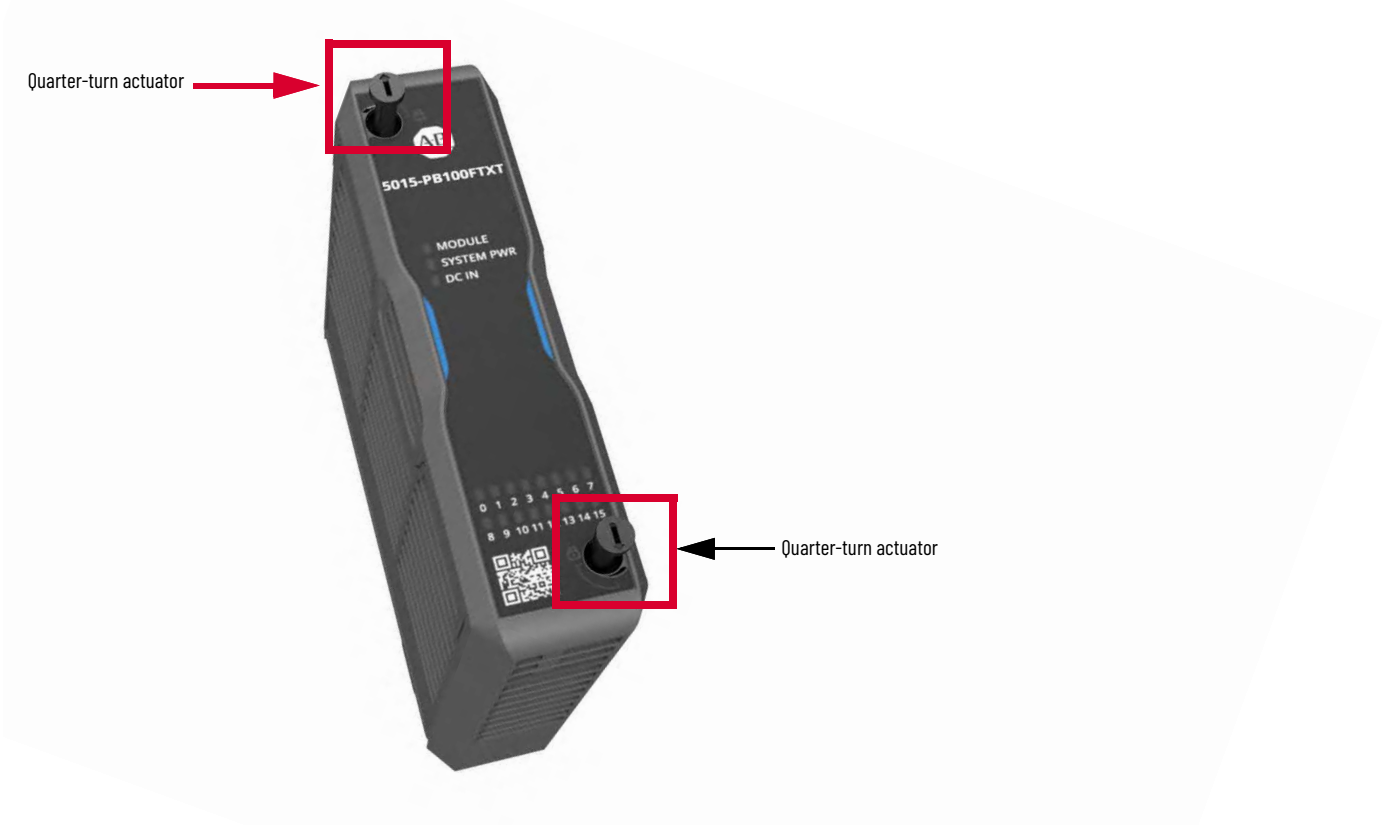


3. Pull the dust cover off the base.
4. To remove the dust covers from all installed bases, repeat the steps.

Install the Power Conditioners

Power conditioners provide module power to the FLEXHA 5000 I/O system. The Power Conditioners have two QTAs that lock them onto the Adapter Base. Out of the box, the actuators are in the up and unlocked position.

At the back of the Power Conditioner, the other ends of the QTAs install into the Adapter Base.

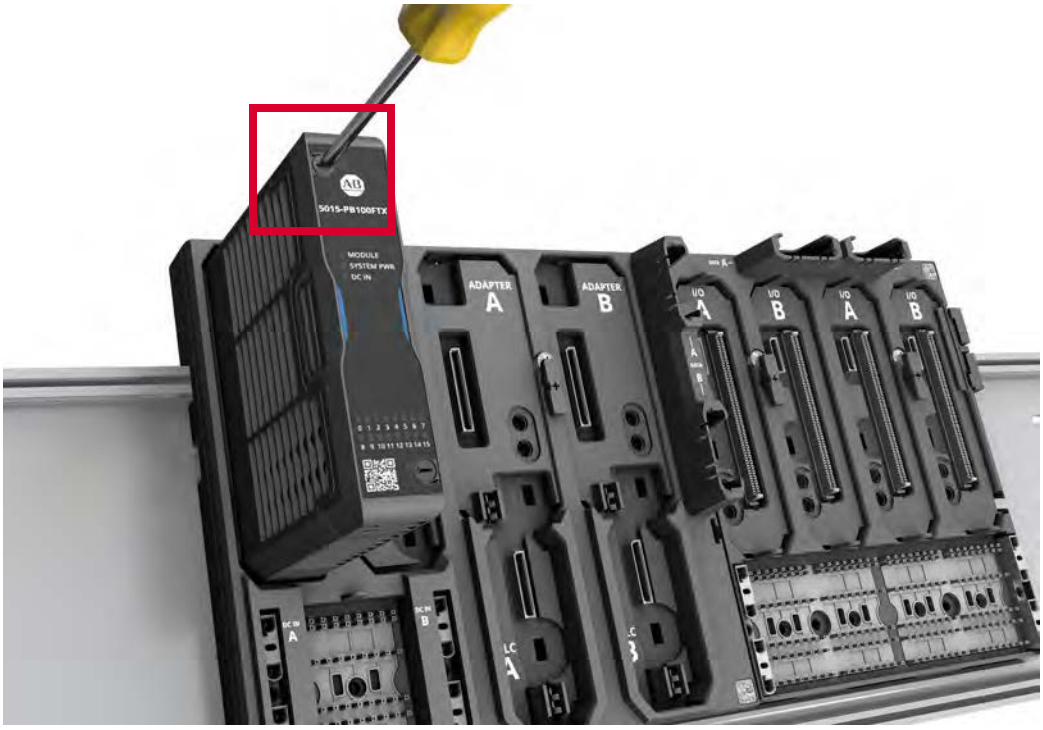


Complete the following steps.

1. Push the first Power Conditioner into the left slot on the Adapter Base.
   Orange keys on the back of the Power Conditioner seat into position on the Adapter Base.

2. To lock the Power Conditioner in place, use an RA 1492-N90 or equivalent-sized screwdriver to push in each QTA to or below the face of the Power Conditioner and then turn it 90° clockwise.

IMPORTANT	If you turn the QTA more than 90° clockwise, you can damage the actuator. Also, if you do not push in the actuator to or below the face of the power conditioner before you turn it, you can damage the actuator.



3. To install the second Power Conditioner to the right on the Adapter Base, repeat the steps.
4. If desired, slide the dust cover over the Power Conditioners.
   To show what each component looks like more clearly, the images in the rest of this publication show them without dust covers installed.

Quarter-turn Actuators on a Power Conditioner

You must lock the QTAs for a Power Conditioner to turn on. When both actuators are locked, the Power Conditioner is locked mechanically and electrically and enabled for use.

IMPORTANT	A QTA that is positioned in between the locked and unlocked positions can fail to pop out. In this case, the Power Conditoner is unlocked. Be sure that both of the QTAs are turned to the fully locked position.

During normal operation, the following occurs:

- The system monitors the position of the QTAs via a QTA diagnostic. The monitoring is important because:
  - If one QTA becomes unlocked because it was turned, the Power Conditioner continues to operate. If power is cycled before the QTA is relocked, the Power Conditioner does not turn back on. If you relock the QTA, the Power Conditioner turns back on.
  - If both of the QTAs become unlocked, the Power Conditioner is disabled and no longer provides power to the associated backplane. For example, if Power Conditioner A turns off, backplane A no longer has power. The application alerts you that such a state via the EtherNet/IP adapter's status tag *S.PowerConditionerx.MissingFault*.

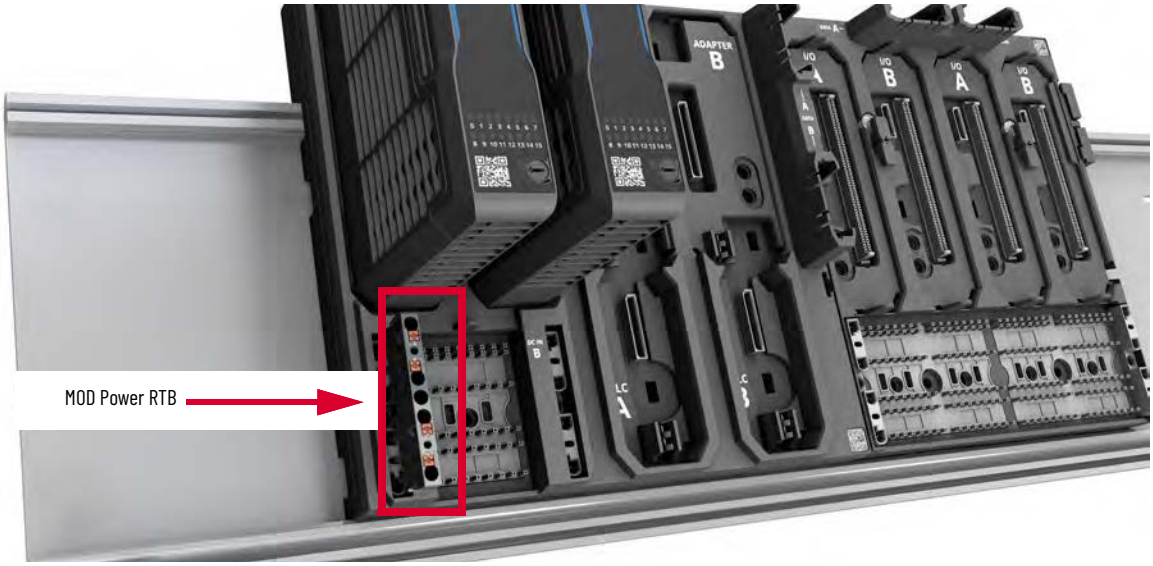
    Because only one Power Conditioner provides backplane power at this point, fault tolerance is compromised and failure on the other Power Conditioner would result in total loss of backplane power in the system. Fault tolerance resumes when both Power Conditioners are functioning properly again.
- The Power Conditioner periodically runs QTA diagnostics. If either diagnostic fails for any reason, the application alerts you to such a condition via the EtherNet/IP adapter's status tag *S.PowerConditionerx.InternalFault*. The next time power is cycled, the Power Conditioner might not turn on. If it doesn't, replace the Power Conditioner.

Install the MOD Power RTB

You install a MOD Power RTB for each Power Conditioner. The MOD Power RTB has + and - terminals on the top and bottom, respectively. The MOD Power RTB is also polarized so that you can only install it in the correct orientation.

To install a MOD Power RTB, complete the following steps.

1. Plug the first MOD Power RTB under the left Power Conditioner on the Adapter Base.



2. Use a screwdriver to turn the screw in the middle of the RTB and secure it to the Adapter Base.
   The torque is 0.7 +/- 0.11 Nm (6 +/-1 in•lb).

3. To install the MOD Power RTB under the right Power Conditioner on the Adapter Base, repeat the steps.

Install the Diagnostic Removable Terminal Block

The diagnostic RTB provides a simple digital interface to indicate some common fault conditions. The diagnostic RTB also supports input from some external devices that can indicate other conditions, such as cabinet entry warnings. You install a diagnostic RTB between the power RTBs. For more information on power diagnostics, see Wiring Diagnostic Inputs on page 92.

To install the diagnostic RTB, complete the following steps.

1. Plug the diagnostic RTB into position between the power RTBs on the Adapter Base.

   The diagnostic RTB is polarized so that you can only install it in one orientation. If you try to plug the RTB in and meet significant resistance, you have the RTB upside down.

   Rows (A...D) and columns (0...7) printed on the RTB indicate the correct orientation.

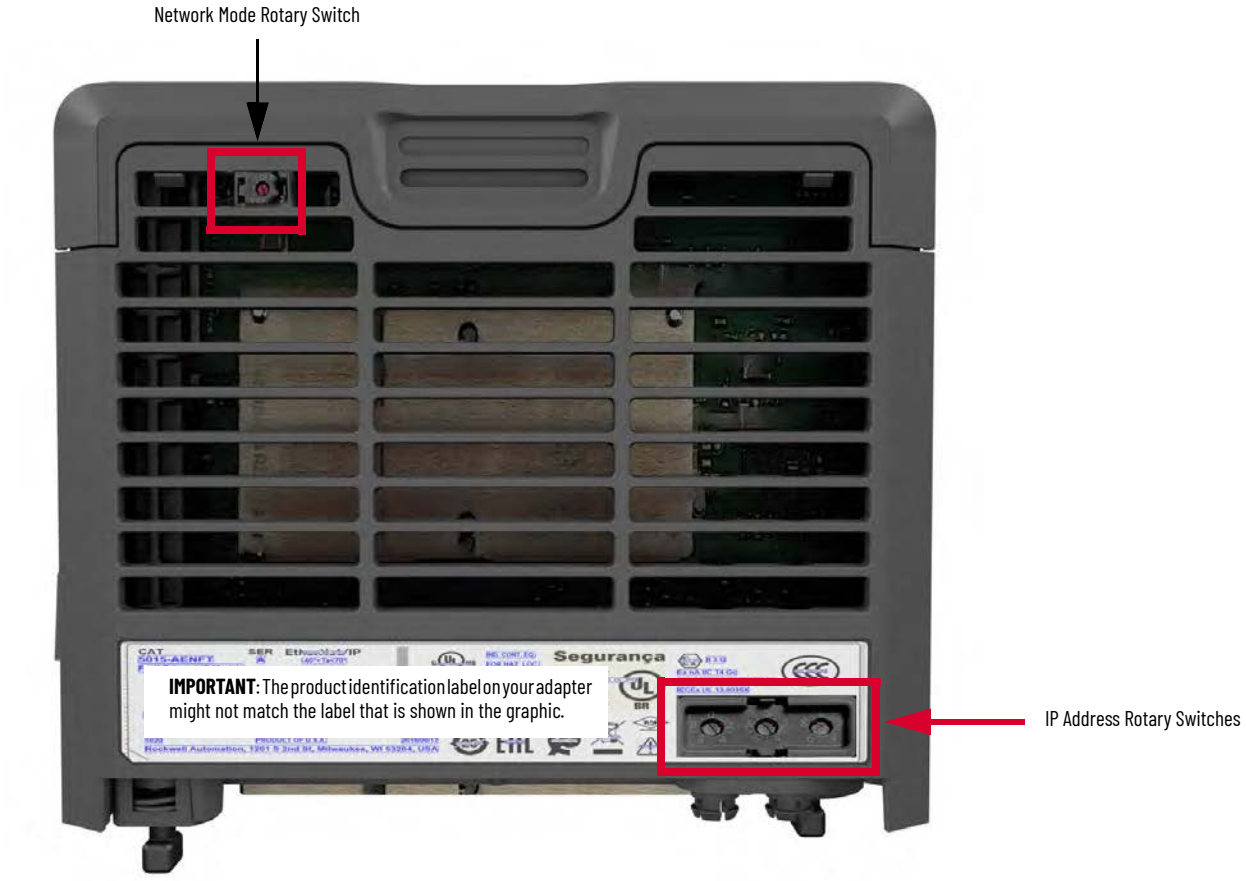
2. Use a screwdriver to turn the screw in the middle of the RTB and secure it to the Adapter Base.
   The torque is 0.7 +/-0.11 Nm (6 +/-1 in•lb).

If you are not using the diagnostic RTB, install an RTB Slot Filler in its place. To install the RTB Slot Filler, complete the previous steps.

Set the Adapter IP Address and Network Mode

FLEXHA 5000 EtherNet/IP adapters require an IP address to communicate on the EtherNet/IP network. You must also set the network mode on the adapter. You use rotary switches on the left side of the adapter to set the IP address and network mode.

Figure 9 - 5015-AENFTXT Adapter Rotary Switches



IMPORTANT	To change the rotary switch positions, first make sure that there is no dust cover on it. Otherwise, leave the dust cover on until the system is fully installed but remove before power is turned on.

Set the IP Address

You must set the IP address for both adapters. You can do so via rotary switches or software applications.

IMPORTANT	Set the IP address for the adapter A and then use an IP address that is incremented by one for adapter B. For example, if adapter A uses address 192.168.1.10, adapter B must use 192.168.1.11. If you change an EtherNet/IP adapter's IP address to a new value, be sure to change the other EtherNet/IP adapter's IP address to a value that is different by one. Repeat the steps in this section to update the IP address on the redundant EtherNet/IP adapter.

FLEXHA 5000 EtherNet/IP adapters ship DHCP-enabled and with their IP address rotary switches set to 999.

If the network uses 192.168.1.x, we recommend that you use the rotary switches to set the last octet of network IP address. Valid numbers range from 002...254.

To use the rotary switches to set the IP address, use an RA 1492-N90 or equivalent-sized screwdriver to turn the switches to the appropriate numbers before you install the adapter. The leftmost switch represents the first digit in the octet, the middle switch represents the second digit, and the right-most switch represents the third digit.

Figure 10 - 5015-AENFTXT Adapter IP Address Switches

At power-up, the adapter reads the rotary switches to determine if they are set to a valid number for the last octet of the IP address. If the settings are a valid number, these conditions result:

- IP address = 192.168.1.xxx (where xxx represents the switch settings)
- Subnet mask = 255.255.255.0
- Gateway address = 0.0.0.0
- The adapter does not have an assigned host name, nor does it use any Domain Name System

If you use the rotary switches to set the IP address, the IP address remains the same whenever power is cycled, as long as the switch settings are not changed.

If the network does not use 192.168.1.x, leave the switches in their factory default position, that is, 999. After you install and power up the adapter, you can use the following to set the network IP address:

- EtherNet/IP Address Commissioning Tool
- FactoryTalk® Linx Network Browser software
- BOOTP/DHCP tool
- DHCP server

For more information on how to use software to set the IP address, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

Reset the IP Address to the Factory Default Value

IMPORTANT	The adapter pair must use IP addresses that are different by one. For example, if adapter A uses address 192.168.1.10, adapter B must use 192.168.1.11. If you change an EtherNet/IP adapter's IP address to a new value, be sure to change the other EtherNet/IP adapter's IP address to a value that is different by one. To update the IP address on the redundant EtherNet/IP adapter, repeat the steps in this section.

After EtherNet/IP adapter operation begins, you can reset the IP address to its factory default value. To reset the IP address, complete the following steps.

1. Remove the EtherNet/IP adapter from the system.
2. Change the rotary switches to 888.
3. Reinstall the EtherNet/IP adapter into the system.
4. Wait for the power-up sequence to complete and the following message to scroll across the four-character display:
   Reset complete change switch settings.
5. Remove the EtherNet/IP adapter from the system.
6. Change the rotary switches to the desired settings.

To use one of the software applications listed previously, set the switches to 999. To use the 192.168.1.xxx convention described previously, set the switches to the appropriate value.

7. Reinstall the EtherNet/IP adapter into the system.

Set the Network Mode

You must set the network mode rotary switch on the EtherNet/IP adapter before you install it. You set the network mode based on the type of network on which the EtherNet/IP adapter operates. The following network mode switch positions are available:

- Device Level Ring (DLR)
- Parallel Redundancy Protocol (PRP)

Out-of-the-box, the switch is not set to either DLR or PRP.

IMPORTANT It is of **critical importance** that you **do not** install an EtherNet/IP adapter set for DLR network mode in a PRP network topology. For more information on network topologies, see Figure 2 on page 3.

If you install an EtherNet/IP adapter with the DLR network mode setting in a system that uses PRP, there can be significant consequences. The EtherNet/IP adapters do not open I/O nor status connections. Also, an EtherNet/IP adapter that is set to DLR mode can send data packets that are not EtherNet/IP addressed to the adapter in the PRP network.

Use an RA 1492-N90 or equivalent-sized screwdriver to turn the rotary switch to the desired value before installation.

IMPORTANT You must set the same network mode switch position for both adapters.

If the switch positions do not match, the following occurs at power-up:

- The adapters do not pair.
- One of the adapters takes control and can bridge I/O traffic. The Redundancy status indicator is green. Finally, the message *Able to Control, Partner is Not Able to Control* scrolls across the 4-character display on the front of the adapter.
- The other adapter does not take control and cannot bridge I/O traffic. The Redundancy status indicator flashes red. Finally, the message *Not Able to Control* scrolls across the 4-character display on the front of the adapter.

In this scenario, complete the following steps.

1. Remove the adapter with the wrong network node setting.
2. Set the network mode rotary switch to the correct position.
3. Reinstall the adapter.

Once the newly inserted adapter powers up and the adapters pair with each other, they both enter the *Both Able to Control* state, and their respective Redundancy status indicators are steady green.

Change the Network Mode

After EtherNet/IP adapter operation begins, you can change the network mode. To change the network mode, complete the following steps.

1. Remove the EtherNet/IP adapter from the system.
2. Change the rotary switch to the desired network mode.
3. Reinstall the EtherNet/IP adapter into the system.

IMPORTANT If you change the network mode on one EtherNet/IP adapter, you must change the network mode on the other EtherNet/IP adapter. To change the network mode on the other EtherNet/IP adapter, repeat the steps in this section.

Install the EtherNet/IP Adapters

EtherNet/IP adapters connect the FLEXHA 5000 I/O system to an EtherNet/IP network. The adapters facilitate network communication between devices in the I/O system and other devices on the network. EtherNet/IP adapters have two QTAs that lock them onto the Adapter Base.

Out of the box, the QTAs are in the up position. At the back of the adapter, the other ends of the QTAs install into the Adapter Base.

After you set the IP address and network mode, complete the following steps to install the EtherNet/IP adapter.

1. Push the first EtherNet/IP adapter into the left slot on the Adapter Base.

2. To lock the EtherNet/IP adapter in place, use an RA 1492-N90 or equivalent-sized screwdriver to push in each QTA to or below the face of the Adapter and then turn it 90° clockwise.

IMPORTANT	If you turn the QTA more than 90° clockwise, you can damage the actuator. Also, if you do not push in the actuator to or below the face of the module before you turn it, you can damage the actuator.

3. Repeat the steps for the second adapter.
4. If desired, slide the dust cover over the adapters.
   To show what each component looks like more clearly, the images in the rest of this publication show them without dust covers installed.

Quarter-turn Actuators Operation on an EtherNet/IP Adapter

You must lock the QTAs for the adapter to turn on. When both actuators are locked, the adapter is locked mechanically and electrically and enabled for use.

IMPORTANT	A QTA that is positioned in between the locked and unlocked positions can fail to pop out. In this case, the adapter is unlocked. Be sure that both QTAs are turned to the fully locked position.

At power-up, if both of the QTAs are locked, the adapter runs QTA diagnostics.

- If both of the diagnostics pass, the adapter turns on and begins normal operation.
- If either of the diagnostics fail, the adapter doesn't turn on. The adapter MODULE status indicator might not turn on or might be red. If the MODULE status indicator remains off or red for an extended period of time after full system power-up, replace the adapter.

During normal operation, the following occurs:

- The system monitors the position of the QTAs via QTA diagnostics. This monitoring is important because:
  - If one QTA becomes unlocked because the QTA was turned, the adapter continues to operate. If power is cycled before the QTA is relocked, the adapter doesn't turn back on. The MODULE status indicator does not turn on.
  - If both of the QTAs become unlocked because the QTA was turned, the adapter is disabled. When an adapter is disabled, the other EtherNet/IP adapter maintains network communication. The application alerts you that such a state via the EtherNet/IP adapter's status tag *S.Modx.MissingFault*.

    Fault tolerance is compromised until the disabled EtherNet/IP adapter resumes normal operations. If power is cycled before both of the QTAs are relocked, the adapters do not turn back on. The MODULE status indicators might not turn on or might be red.

  If you relock the unlocked QTAs during normal operation, the adapter returns to normal operation.
- The adapter periodically runs the QTA diagnostics. If either diagnostic fails for any reason, the application alerts you to the condition via an Unrecoverable minor fault on the Device Information dialog box, and the adapter continues to operate. The next time power is cycled, however, the adapter might not turn on, and the MODULE status indicator does not turn. The adapter might turn on but the MODULE status indicator is red. Replace the adapter.

Install the Media Landing Cards

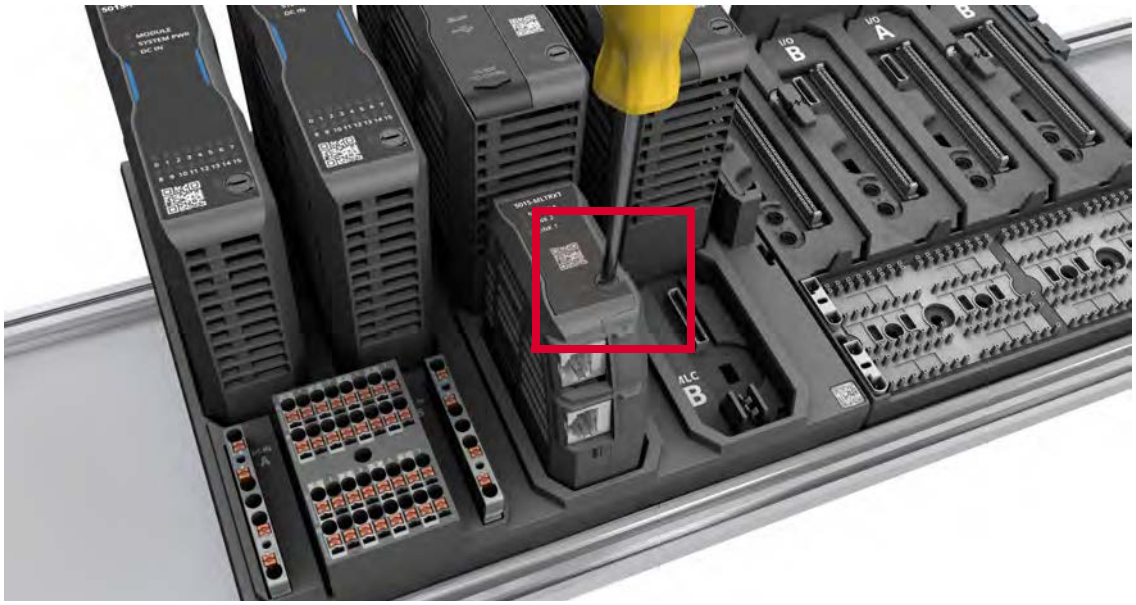
MLCs provide Ethernet ports that let the FLEXHA 5000 I/O system connect to an EtherNet/IP network. The MLCs operate concurrently with, and independent of, each other. The 5015-MLTRXT MLC has two RJ45 ports.

MLCs have one QTA. Out of the box, the QTA on the front of the MLC is in the up position. The other end of the QTA installs in the Adapter Base. The MLC has a lock symbol for the locked position but no unlocked symbol for the unlocked position.

1. Push the MLC into position under the left EtherNet/IP adapter on the Adapter Base.

2. To lock the MLC in place, use an RA 1492-N90 or equivalent-sized screwdriver to push in the QTA to or below the face of the MLC and then turn it 90° clockwise.

IMPORTANT	If you turn the QTA more than 90° clockwise, you can damage the actuator. Also, if you do not push in the actuator to or below the face of the module before you turn it, you can damage the actuator.



3. Repeat the steps for the second MLC.
4. If desired, slide the dust cover over the MLCs.
   To show what each component looks like more clearly, the images in the rest of this publication show them without dust covers installed.

Quarter-turn Actuator Operation on an MLC

You must lock the QTA for the MLC to turn on. When the QTA is locked, the MLC is locked mechanically and electrically and enabled for use.

IMPORTANT	A QTA that is positioned in between the locked and unlocked positions can fail to pop out. In this case, the MLC is unlocked. Be sure that the QTA is turned to the fully locked position.

At power-up, if the QTA is locked, the MLC runs a QTA diagnostic.

- If the diagnostic passes, the MLC turns on and begins normal operation.
- If the diagnostic fails, the MLC doesn't turn on. The MODULE status indicator might not turn on or might be red. If the MODULE status indicator stays off or red for an extended period of time after full system power-up, replace the MLC.

During normal operation, the following occurs:

- The system monitors the position of the QTA via a QTA diagnostic. This monitoring is important because if the QTA becomes unlocked because it was turned, the MLC turns off and the EtherNet/IP adapter that is associated with it can't communicate with devices in the system.

  When the affected EtherNet/IP adapter can't communicate with devices in the system, then the other adapter maintains network communication. The application alerts you that such a state via the EtherNet/IP adapter's status tag *S.Modx.MissingFault*.Whenever either EtherNet/IP adapter can't communicate on the network, fault tolerance is compromised until both MLCs are locked again and functioning properly. At that point, both adapters resume normal operation.
- The MLC periodically runs the QTA diagnostic. If the diagnostic fails for any reason, the application alerts you to the condition via the EtherNet/IP adapter status tag *MediaCardx.MissingFault*. EtherNet/IP network communication is unaffected. The next time power is cycled, however, the MLC doesn't turn on. If the MODULE status indicator stays off or red for an extended period of time after full system power-up, replace the MLC.

Install the Backplane Interface Modules into the Adapter Base

The BIMs facilitate and participate in backplane communication and slot addressing. In an Adapter Base, the redundant BIMs are installed on the right side of the base.

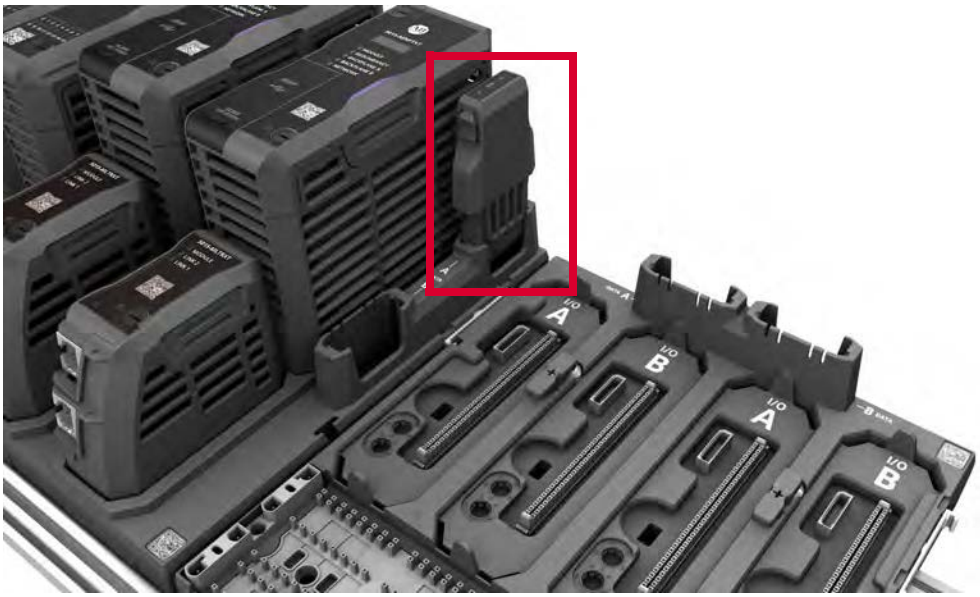
To install a BIM, complete the following steps.

1. In the top slot on the right side of the Adapter Base, hold the BIM so the aluminum heatsink portion of the BIM faces to the right.

   The location for the top BIM is marked with an A.
2. Push the BIM into the slot until it the latches on the sides of the BIM click into place.

   Do not force the BIM into place. The BIM is expected to click into place with relatively minimal force. If it doesn't click almost immediately, pull it out and make sure it is in the right position to push in. To remove the BIM, press in the plastic buttons on the sides of the BIM and pull it out.

   Once the latches click, the BIM is locked in place.



3. To install the second BIM in the lower slot, repeat these steps. The location for the lower BIM is marked with a B.

Latch Operation on a BIM

The latches on the BIM must lock it in place before power-up or the BIM does not turn on. When the latches are locked, the BIM is locked mechanically and electrically and enabled for use.

At power-up, if the latches are locked, the BIM runs a diagnostic.

- If the diagnostic passes, the BIM turns on and begins normal operation.
- If the diagnostic fails, the BIM does not function. The BIM's MOD status indicator is red. If the MOD status indicator remains red for more than 15 second after full system power-up, replace the BIM.

During normal operation, the following occurs:

- The system monitors the position of the BIM latches via a diagnostic. This monitoring is important because:
  - If either of the latches becomes unlocked, the BIM continues to operate and the MOD status indicator remains green. The application alerts you to this fact via a minor fault. If power is cycled before the latch is relocked, the BIM doesn't turn back on, and the status indicators remain off after the system power-up.
  - If both of the latches become unlocked, the BIM turns off and communication across that BIM's backplane communication ceases. For example, if BIM A turns off, communication across backplane A ceases.

    Whenever communication on either backplane stops, fault tolerance is compromised until both BIMs are locked again and functioning properly. At that point, communication occurs on both backplanes.
- The BIM periodically runs the diagnostic. If the diagnostic fails for any reason, the application alerts you to the condition via the EtherNet/IP adapter status tag S.*Basex.InterfacexInterfaceFault*. Backplane communication is unaffected. The next time power is cycled, the BIM might not turn on.
  - If the BIM does turn on, the diagnostic might fail again, the MOD status indicator turns to red, and the BIM doesn't function.
  - If the latches are locked and the BIM doesn't turn on, the BIM's MOD status indicator might stay off or might be red. If the MOD status indicator stays off or red for more than 15 seconds after full system power-up, replace the BIM.

Assemble the I/O Base Components

You use I/O Bases to install I/O modules in the FLEXHA 5000 I/O system. The following components are installed as part of this process:

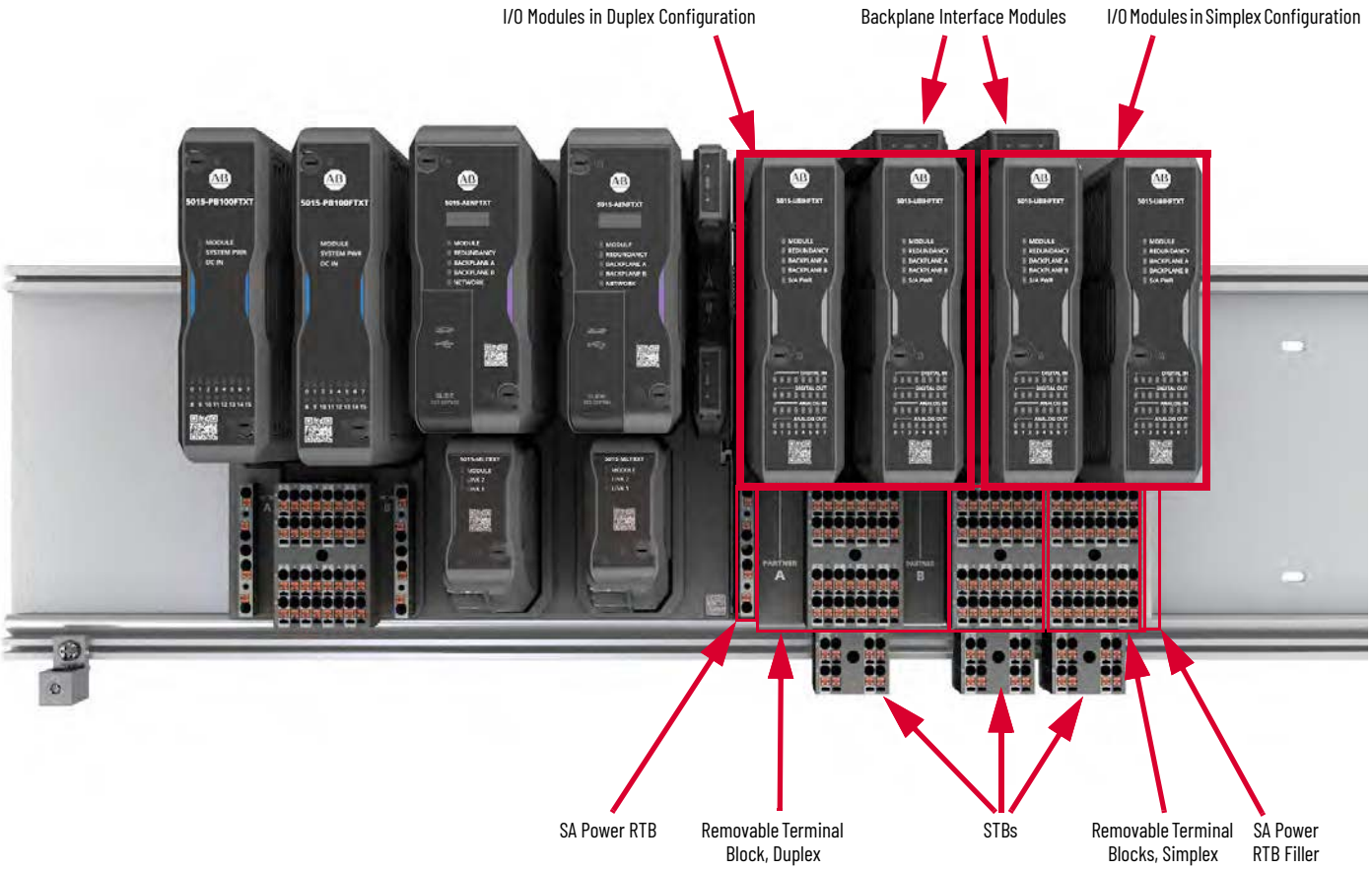
- Two BIMs
- I/O Modules
- I/O Module RTBs
- SA Power RTB
- One of the following components on the right side of the I/O Base:
  - Power RTB Slot Filler - If you do not pass SA power from one I/O Base to another.
  - SA Power Jumper - If you pass SA power from one I/O Base to another after it is installed.
    You can also install an SA Power RTB on the right side of the I/O Base to jumper SA power from one base to another.
- I/O Slot Filler - If you do not populate a slot with an I/O module.
- RTB Slot Filler - If you use an I/O Slot Filler.
- STB
- End cap - At the end of the last I/O Base.

IMPORTANT Keep in mind that when you install an I/O module, orange keys at the back of the module seat into position into the I/O Base.

Before you can install I/O modules, you must install an I/O Base, as described beginning on page 32.

Figure 11 shows all components on an I/O Base after the bases are assembled. This example system only uses one Bank, so the I/O Base is installed next to an Adapter Base.

Figure 11 - FLEXHA 5000 I/O Base



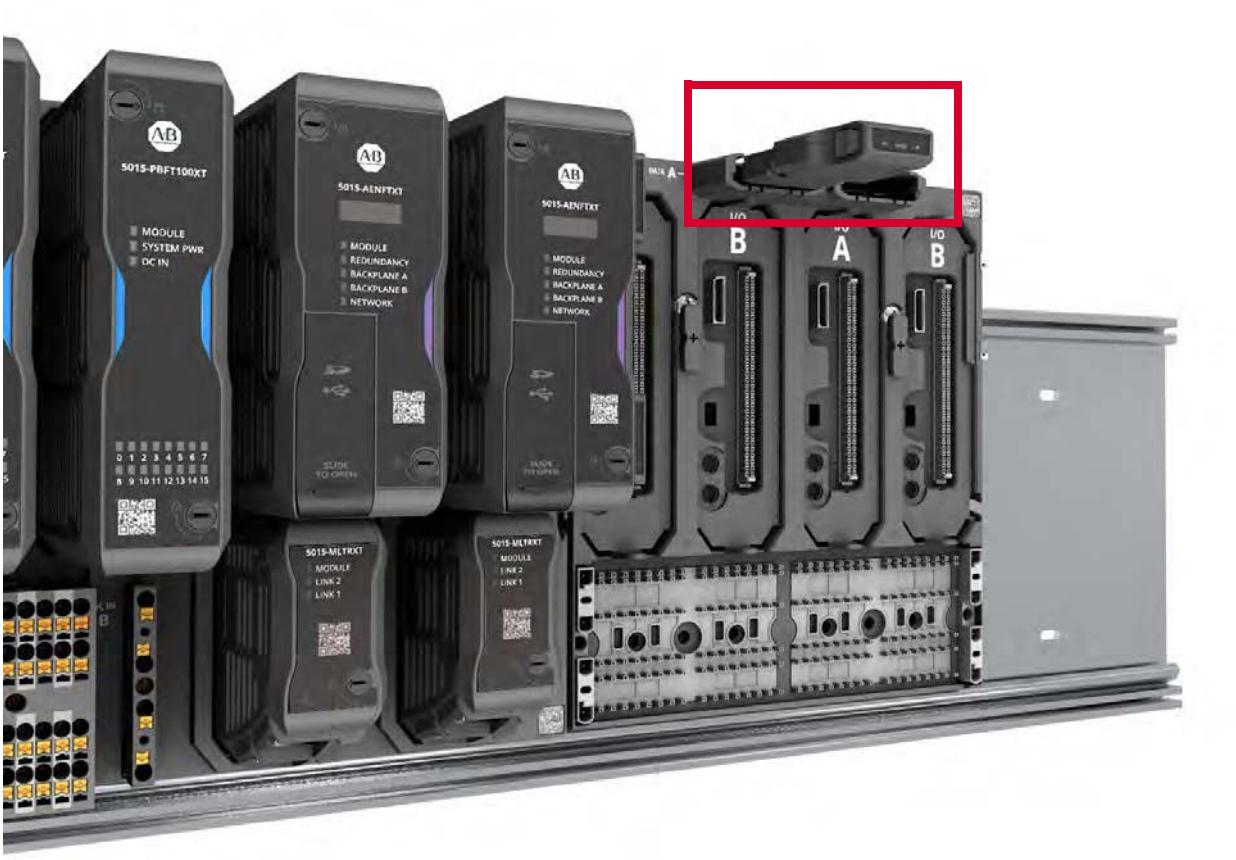
Install the Backplane Interface Modules into an I/O Base

The BIMs facilitate and participate in backplane communication and slot addressing. In an I/O Base, the BIMs are installed at the top of the base.

To install a BIM on an I/O Base, complete the following steps.

1. In the left slot on the top of the I/O Base, hold the BIM so the aluminum heatsink faces up.
   The location for the left-side BIM is marked with an A.
2. Push the BIM into the slot until it clicks into place.
   Once it clicks, the BIM is locked into place.

The BIM is expected click into place with relatively minimal force. If it doesn't click almost immediately, pull it out and make sure it is in the right orientation. Do not force the BIM into place.



3. To install the BIM on the right side at the top of the I/O Base, repeat the steps. The location for the top BIM is marked with a B.

Install the I/O Modules

The I/O modules have a QTA that locks the modules onto the I/O Base. Out of the box, the QTA is in the up position. At the back of the I/O modules, the other end of the QTA installs into the I/O Base.

In one FLEXHA 5000 I/O system, you can install a maximum of 24 I/O modules across six I/O bases.

1. Push the first I/O module into the leftmost slot position on the I/O Base.

2. To lock the I/O module in place, use an RA 1492-N90 or equivalent-sized screwdriver to push in the QTA to or below the face of the I/O module and then turn it 90° clockwise.

IMPORTANT	If you turn the QTA more than 90° clockwise, you can damage the actuator. Also, if you do not push in the actuator to or below the face of the module before you turn it, you can damage the actuator.

3. To install the remaining I/O modules in the I/O Base, repeat the steps.
4. If desired, slide the dust cover over the I/O modules.
   To show what each component looks like more clearly, the images in the rest of this publication show them without dust covers installed.

Quarter-turn Actuator Operation on a Universal I/O Module

You must lock the QTA for the I/O module to turn on. When the QTA is locked, the I/O module is locked mechanically and electrically and enabled for use.

IMPORTANT-	The QTA that is positioned in between the locked and unlocked positions can fail to pop out. In this case, the I/O module is unlocked. Be sure that it is turned all the way to the locked position.

At power-up, if the QTA is locked, the I/O module runs a QTA diagnostic.

- If the diagnostic passes, the I/O module turns on and begins normal operation.
- If the diagnostic fails, the I/O module doesn't turn on, and the status indicators stay off. Replace the I/O module.

During normal operation, the system monitors the position of the QTA via a QTA diagnostic.

- If the I/O module becomes unlocked because the QTA was turned, the I/O module turns off. If necessary, you can remove it. You can also relock the QTA to resume normal operation.
- If the QTA diagnostic fails while the QTA is in the locked position, the application alerts you to the condition.
  The I/O module continues to operate. However, it doesn't turn on the next time power is cycled. For more information on what to do if the diagnostic fails during normal operation, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

If there are not enough I/O modules to fill all open slots in the I/O Base, you must fill the slot with an I/O Slot Filler. Install an I/O Slot Filler in the same manner that you install an I/O module.

Install the SA Power RTB

You install an SA Power RTB on the left side of the first I/O Base. The SA Power RTB has + and - terminals on the top and bottom, respectively. The SA Power RTB is also polarized so that you can only install it in the correct orientation.

To install an SA Power RTB, complete the following steps.

1. Plug the SA Power RTB under the leftmost I/O module on the I/O Base.

2. Use a screwdriver to turn the screw in the middle of the SA Power RTB and secure it to the I/O Base.
   The torque is 0.7 +/-0.11 Nm (6 +/-1 in•lb).

Install the I/O Removable Terminal Blocks

You use RTBs to connect devices to the I/O modules. The following RTB types are available and used according to module configuration:

- Duplex RTB
- Simplex RTB
- RTB Slot Filler

For information on terminal designations, see Wire the I/O Modules on page 93.

Install a Duplex RTB

IMPORTANT You must use one Duplex RTB with a pair of I/O modules that are configured for Duplex mode. If you use two Simplex RTBs with a pair of I/O modules that are configured for Duplex mode, you can have issues with your application.

To install a Duplex RTB, complete the following steps.

1. Plug the RTB into the I/O Base centered beneath the Duplex pair of I/O modules.

   The RTB uses a polarized design so that you can only install it in one orientation. If you try to plug the RTB in and meet significant resistance, you likely have the RTB upside down.

   Rows (A...D) and columns (0...7) printed on the RTB indicate the correct orientation.

2. Use a screwdriver to turn the screw in the middle of the RTB and secure it to the I/O Base.
   The torque is 0.7 +/-0.11 Nm (6 +/1- in•lb).

Install a Simplex RTB

You use a Simplex RTB for each I/O module that is used in Simplex configuration.

IMPORTANT

- You must use two Simplex RTBs with a pair of I/O modules that are configured for Simplex mode. If you use one Duplex RTB with a pair of I/O modules that are each configured for Simplex mode, you can have issues with your application.
- You can use a Simplex RTB Filler instead of a Simplex RTB when you are not using an I/O module and instead have an I/O Module Slot Filler in that slot. The same installation steps apply for the Simplex RTB filler.

IMPORTANT

To install a Simplex RTB, complete the following steps.

1. Plug the Simplex RTB into the I/O Base under the I/O module.

   The RTB has a polarized design so that you can only install it in one orientation. If you try to plug the RTB in and meet significant resistance, you likely have the RTB upside down.

   Rows (A...D) and columns (0...7) that are printed on the RTB indicate the correct orientation.

2. Use a screwdriver to turn the screw in the middle of the RTB and secure it to the I/O Base.
   The torque is 0.7 +/-0.11 Nm (6 +/-1 in•lb).

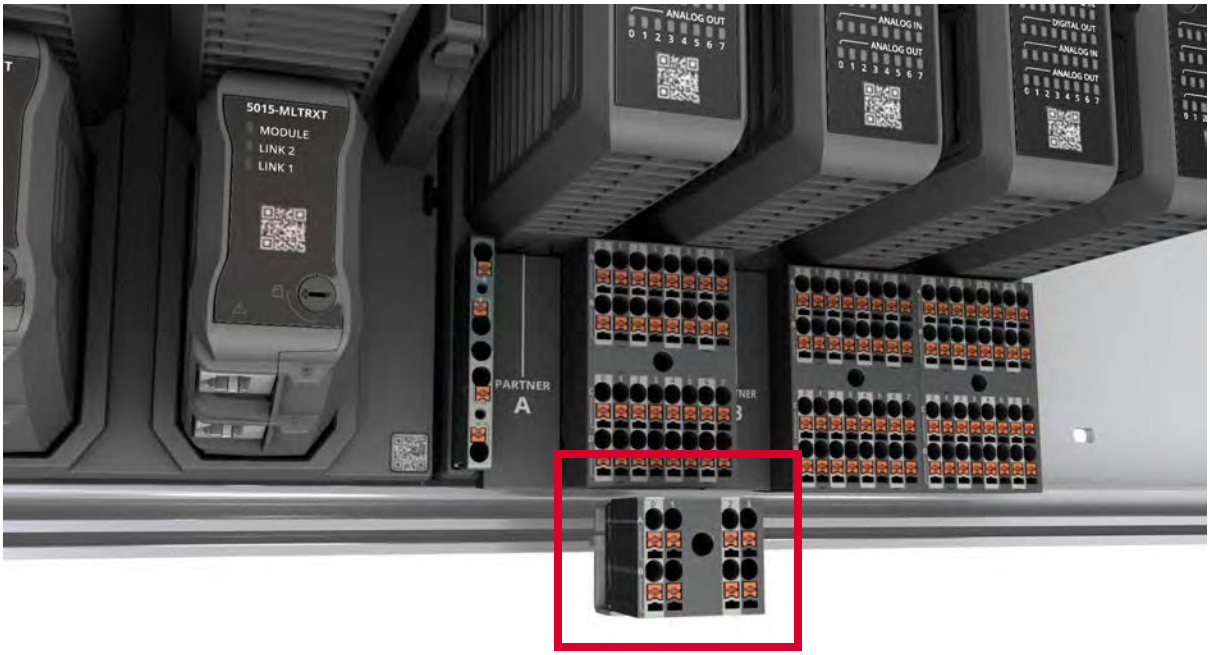
Install the Shield Terminal Block

You must install an STB to connect I/O cable shields. You install the STB in the chase at the bottom of the mounting plate on which the FLEXHA 5000 I/O system is installed.

The STB has eight terminals that serve as shield termination points for as many I/O channels on a Simplex or Duplex RTB. Install the STB directly below the I/O module. You must use shielded wires with Universal I/O modules.

To install the STB, complete the following steps.

1. Position the STB so that the ST4.8 metric fastener is positioned over the chase at the bottom of the mounting plate.

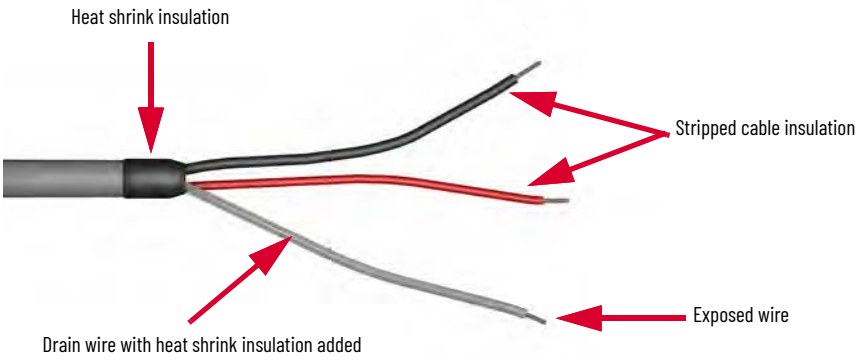


2. Use a screwdriver to turn the screw until it is secure against the chase at the bottom of the mounting plate.
   The torque is 2 +/-0.11 Nm (18 +/-1 in•lb).

Wire the STB

The following example shows how you prepare wiring when a 2-wire device is connected to a module channel. One wire is used with the STB, and the other two wires are used with the I/O channel terminals on the I/O RTB.

1. Strip the cable's outer jacket and the outer shield to expose the wires inside it.
   Make sure that you expose wire lengths that are long enough to reach the STB and the I/O RTB, respectively.
2. Add heat shrink insulation to the drain wire that connects to the STB.
   Only leave enough exposed wire to make a connection to the terminal.
   The heat shrink insulation in this graphic is clear.
3. Strip cable insulation from the channel wires that connect to the I/O RTB.
   Only leave enough exposed wire to make connections to the RTB terminal.
4. Add heat shrink insulation to the end of the stripped cable insulation.
   The heat shrink insulation in this graphic is black.



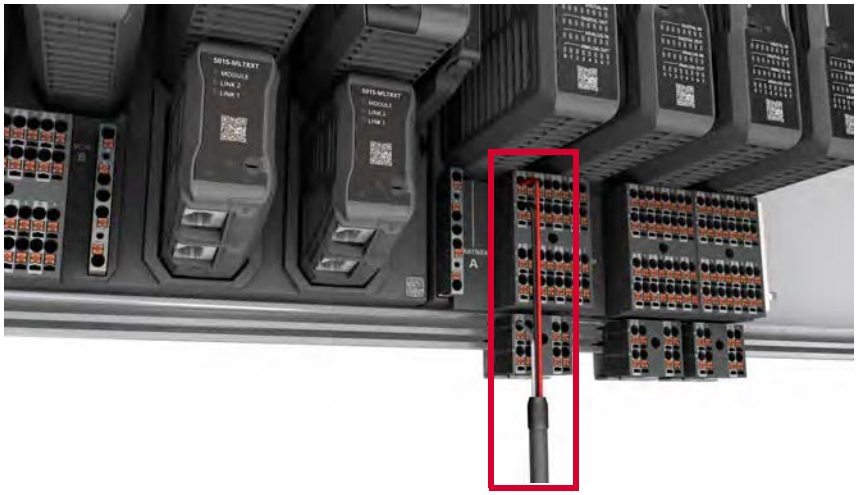
5. Insert the drain wire into the STB until you feel the terminal close on the wire. The STB terminals are the push-in type.
   The wire size must be one of the following:
   - 0.34...4 mm^2 (22...12 AWG) solid copper wire
   - 0.14...2.5 mm^2 (26...14 AWG) stranded copper wire, with ferrule

IMPORTANT	The following apply when you connect the shield wire to the STB: • Ferrule according to DIN 46 228/1. • You can use ferrules with or without plastic sleeves.

- 0.34...2.5 mm^2 (22...14 AWG) stranded copper wire, without ferrule

IMPORTANT	If you use a ferruled or solid wire, you can push the wire into the terminal. If the wire is non-ferruled and stranded, you must use a small screwdriver to push and hold in the orange tab before you insert the wire. In this case, make sure that the wire is fully inserted before you remove the screwdriver. When the orange tab comes out, the wire is locked in the terminal.

6. Insert the channel wires at the appropriate terminals on the Duplex or Simplex RTB.
   This following graphic shows wires that are connected to a Duplex RTB and the STB.



   For example wiring diagrams to use with the module channels, see Wiring Diagrams on page 94.
7. To install and wire the STBs that are under the Simplex RTBs, repeat the steps.

Connect Power

Before you connect power to the system, complete the following tasks:

- Read System Power Considerations on page 24.
- Confirm that the external power supplies that supply MOD and SA power have an adequate power rating.
- Verify that the external power supplies are turned off.
- Confirm that the wire length from external power supplies to MOD power RTBs and SA power RTBs is no greater than 10 m (32.81 ft).

WARNING: You can use FLEXHA 5000 I/O systems in environments with explosion risks, for example, mining applications. You must consider additional factors with respect to power connections in these situations, specifically when you can remove the system from a cabinet.
If your application requires the Power Conditioner to deplete residual energy to 0.2 mJ the following steps are required in order to be compliant with the IEC/EN 60079-0 standard:

- Connect at least one diagnostic input to a normally closed contact as shown in the FLEXHA 5000 I/O System User Manual, publication 5015-UM001, FLEXHA 5000 I/O System Specification Technical Data, publication 5015-TD001, or manually wire at least one diagnostic input terminal to the return terminal on the diagnostic RTB.
- Label the enclosure with: WARNING - AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.
- Wait at least 5 minutes after removal of power before opening the enclosure to access the FLEXHA 5000 I/O system.

There is no visual indication of when the 5 minutes have expired. **You must track that time period.**

- For mining applications, the entire FLEXHA 5000 I/O system must deplete residual energy before you can open an explosion-proof cabinet.

Some applications require that the installed controller to deplete its residual stored energy to specific levels before transporting it into or out of your application. This requirement can include other devices that also require a wait time before removing them. See the documentation of those products for more information.

Connect MOD Power to the Power Conditioners

You use the following components to connect external 24V DC power supplies to the Power Conditioners via MOD Power RTBs on the Adapter Base.

- Two 24V DC power supplies - We recommend that you use 1606-XLE240ECRZ redundancy power supplies.
  For more information on the power supplies, see 1606-XLE240ERZ and 1606-XLE240ECRZ Power Supply Installation Instructions, publication 1606-IN041.
- Two terminal blocks - We recommend that you use 1492 terminal blocks.
  For more information, see https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/terminal-blocks.html.
- Fuses - Your application requirements, such as, the wire gauge that is used and the size of your system dictate the fuse that you use.

You can only connect one wire to each terminal on the SA Power RTB on the I/O Base. The wire size must be one of the following:

- 4 mm^2 (12 AWG) solid copper wire
- 4 mm^2 (12 AWG) stranded copper wire, without ferrule
- 2.5 mm^2 (14 AWG) stranded copper wire, with ferrule

IMPORTANT The following apply when you use wire with a ferrule:

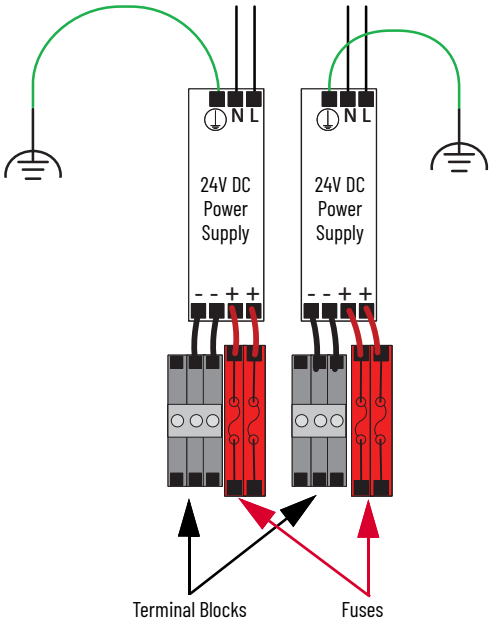
- You must use a 2.5 mm^2, max, ferrule.
- Ferrule according to DIN 46 228/1.
- You can use ferrules with or without plastic sleeves.
- Ferrule stripping length, max is 8 mm...10 mm (0.31...0.4 in.)

- 2.5 mm^2 (14 AWG) stranded copper wire, without ferrule

Use a wire size that meets local codes, for example required insulation per temperature, and your application needs. 14 AWG wires support up to 15 A of current. 12 AWG wires support up to 20 A of current.

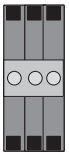
Complete the following steps to connect MOD power to the power conditioners.

1. Connect the 24V DC external power supplies to the terminal blocks and fuses.



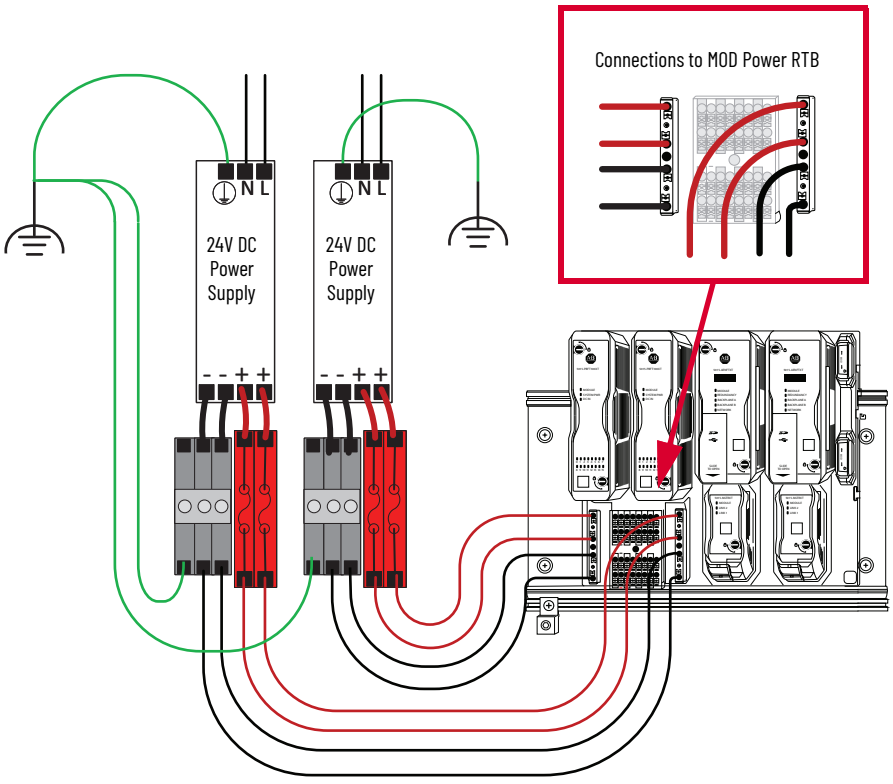
2. Complete the following:
   a. Connect the terminal blocks to the earth ground and the MOD Power RTBs, respectively.
   b. Make sure that the external power supplies and terminal blocks are connected to earth ground.
   c. Connect the fuses to the MOD Power RTBs.

Terminal Block



Fuse

IMPORTANT: The terminal block has a shorting bar for grounding purposes.



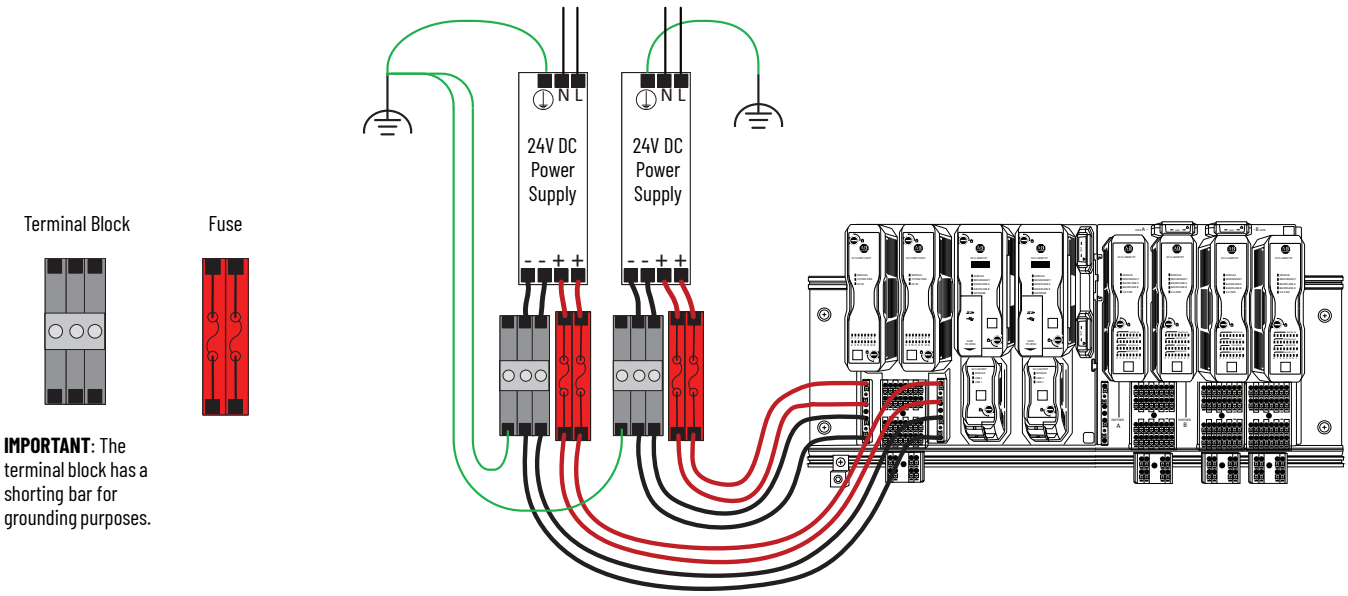
The MOD Power RTBs are the push-in type.

IMPORTANT	If you use a ferruled or solid wire, you can push the wire into the terminal. If the wire is non-ferruled and stranded wire, you must use a small screwdriver to push and hold in the orange tab before you insert the wire. In this case, make sure that the wire is fully inserted before you remove the screwdriver. When the orange tab comes out, the wire is locked in the terminal.

Backplane Power in a Single Bank

Figure 12 shows backplane power in a FLEXHA 5000 I/O system that only uses an Adapter bank.

Figure 12 - MOD Power in the Adapter Bank

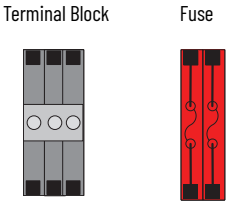


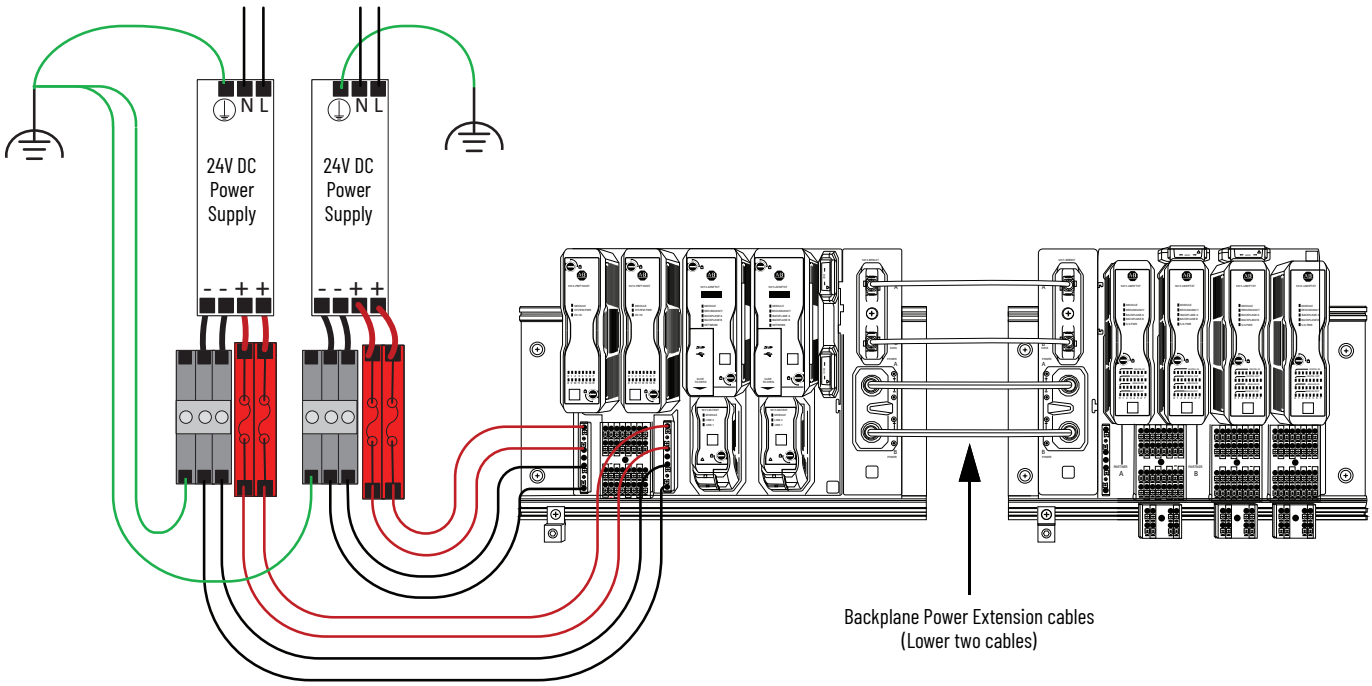
Extend Backplane Power Across the System

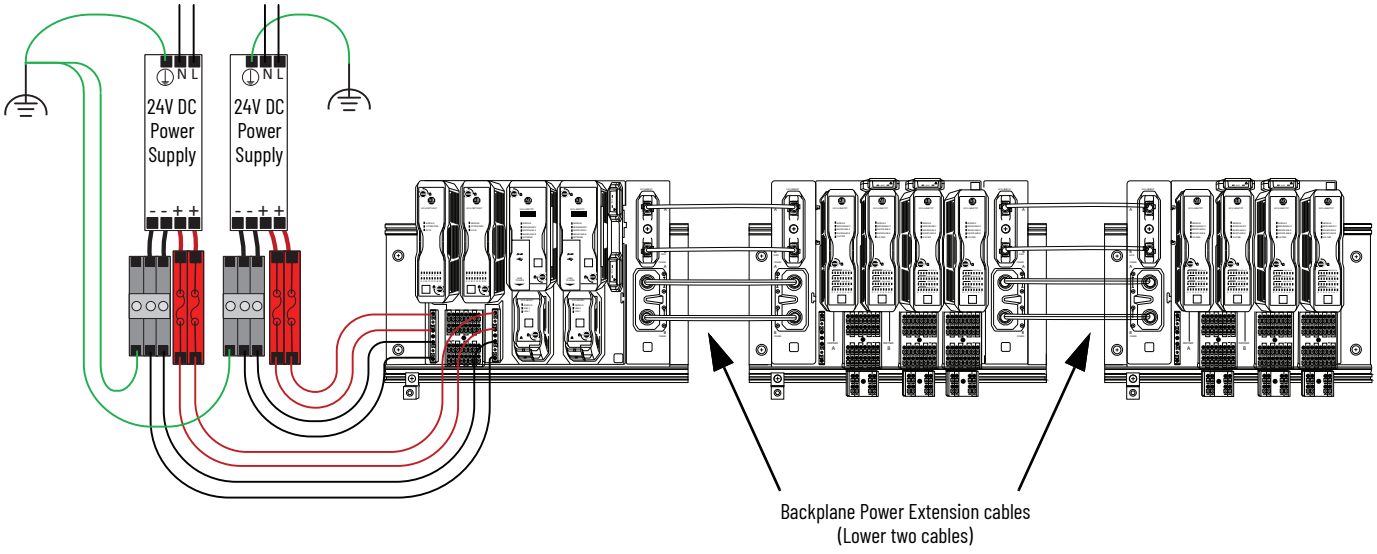
MOD power starts at the Power Conditioners where it is converted to backplane power. This passage of backplane power is not limited to the Adapter bank. When you add I/O banks to a FLEXHA 5000 I/O system, as part of the process, you must connect Backplane Power Extension cables from bank to bank.

The backplane power passes to additional banks via the Backplane Power Extension cables and no other action is needed.

IMPORTANT: The terminal block has a shorting bar for grounding purposes.







Connect SA Power to an I/O Base

You use the following to connect SA power to an I/O Base via SA Power RTBs:

- Two 24V DC power supplies - We recommend that you use 1606-XLE480ECRZ power supplies. Feed each power supply with separate sources of AC power.
- Field Power Redundancy Devices (FPRDs) - We recommend that you use two 1606-XLERED20Y FPRDs in parallel redundant configuration.
- Terminal blocks - We recommend that you use RA 1492 products.

  For more information, see https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/terminal-blocks.html.
- Fuses - Your application specifics, such as, the wire gauge that is used and the size of your system dictate the fuse that you use.

  We recommend that you use RA 1492 products with fuses. For more information, see https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/terminal-blocks.html.

You can only connect one wire to each terminal on the SA Power RTB. The wire size must be one of the following:

- 4 mm^2 (12 AWG) solid copper wire
- 4 mm^2 (12 AWG) stranded copper wire, without ferrule
- 2.5 mm^2 (14 AWG) stranded copper wire, with ferrule

IMPORTANT The following apply when you use wire with a ferrule:

- You must use a 2.5 mm^2, max, ferrule.
- Ferrule according to DIN 46 228/1.
- You can use ferrules with or without plastic sleeves.
- Ferrule stripping length, max is 8 mm...10 mm (0.31...0.4 in.)

- 2.5 mm^2 (14 AWG) stranded copper wire, without ferrule

Use a wire size that meets local codes, for example required insulation per temperature, and your application needs. 14 AWG wires support up to 15 A of current. 12 AWG wires support up to 20 A of current.

However, depending on the system's operating temperature, the level of current that the SA Power RTB can transmit is limited. You must consider RTB current rating in your application when you connect SA Power. For more information, see RTB Current Ratings on page 17.

Remember the following:

- If you use a ferruled or solid wire, you can push the wire into the terminal.

  If the wire is non-ferruled and stranded, you must use a small screwdriver to push and hold in the orange tab before you insert the wire. In this case, make sure that the wire is fully inserted before you remove the screwdriver. When the orange tab comes out, the wire is locked in the terminal.
- The power supplies and FPRDs that provide SA power to I/O Bases must be dedicated for use with those bases. **Do not** connect the power supplies nor the FPRD to anything else.
- You can only connect one set of power supplies and FPRDs to the SA Power RTB on an I/O Base.
- You can connect multiple sets of power supplies and FPRDs to one bank of I/O modules. This is because a bank of I/O modules can include multiple I/O Bases, and you can connect SA power to each I/O Base.
- SA power starts at the power RTB and is distributed to all I/O modules that are installed on the I/O Base across an SA power bus. Each I/O module draws power as needed, and the remaining power passes along the rest of the I/O Base. For example, if the first I/O module draws 1 A of current from the SA Power bus, 19 A of current is available for the remaining I/O modules that are connected to the SA Power bus.

  If a new I/O Base is installed next to the first one, you can extend the SA Power bus to the new I/O Base. The available current on the new I/O Base depends on how much was drawn on the first I/O Base. For example, if the I/O modules on the first base collectively draw 9 A from the SA Power bus, 11 A are available to the I/O modules on the next I/O Base.
- Consider the total SA Power current draw of all I/O modules on an SA Power bus before you design and connect SA power. If the current draw on the first SA Power bus exceeds the available current, you must create more than one SA Power bus.

  For example, consider a FLEXHA 5000 I/O system operating under normal operating conditions, that has three I/O Bases, all connected to each other in a single bank. The
  I/O modules in the first I/O Base collectively draw 8 A of SA Power, the I/O modules in the second I/O Base collectively draw 8 A of SA Power, and the 7 A of SA Power. The total SA Power current draw is 23 A. So you must use two SA Power buses--one for the first two I/O Bases and one for the third I/O Base or one for the first I/O Base and one for the second and third I/O Bases.
- You can extend an SA Power bus via either of the following:
  - SA Power Jumper between I/O Bases
  - A pair of SA Power RTBs that are installed directly next to each other in separate I/O Bases and wired together. In this case, one SA Power RTB is installed at the right side of an I/O Base and the second is installed on the left side of the next I/O Base.
- If your cabinet is not temperature-controlled, we recommend that you consider the possibility that an SA Power wiring issue can occur and RTB derating must be considered in system design. In this case, the component with the lowest current derating value is the driving factor in your design calculations.

EXAMPLE For example, in a horizontally-oriented system, if a wiring issue occurs, the SA Power RTB is derated to 11 A/terminal at 70° C (158° F). However, the SA Power Jumper is derated to 10 A/terminal at 70° C (158° F). If an SA Power Jumper extends the SA Power bus and the ambient temperature inside the cabinet might reach 70° C (158° F), limit the amount of your SA Power current to 10 A.

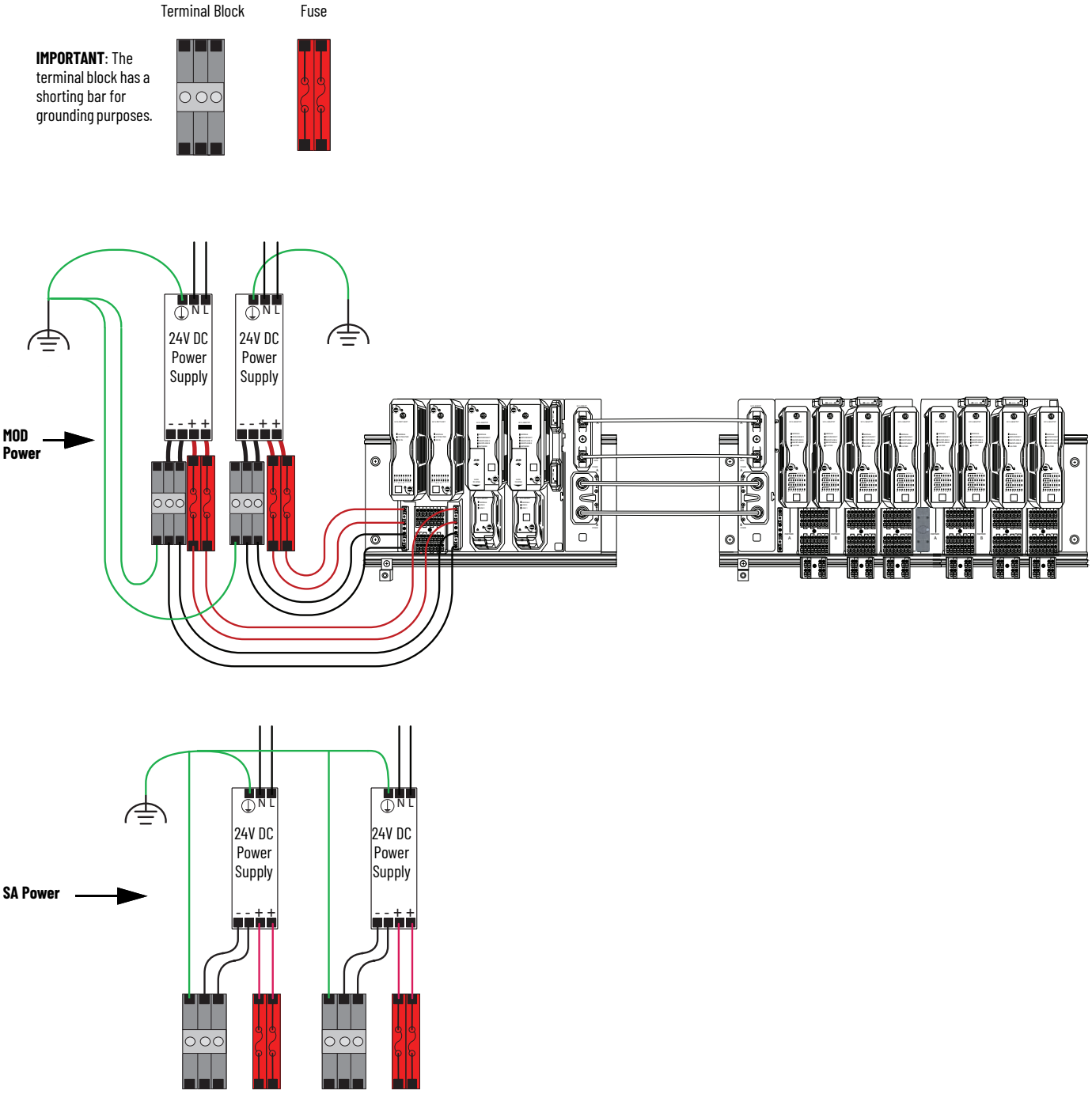
For more information on derating values per ambient temperatures, see RTB Current Ratings.

Wire SA Power in System That Extends the SA Bus via an SA Power Jumper

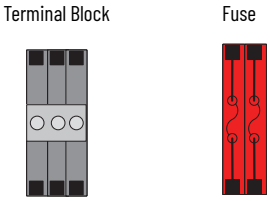
This example shows how to wire SA power to an I/O bank in which the SA Power bus is extended from one I/O Base to the next by using an SA Power Jumper.

Complete the following steps.

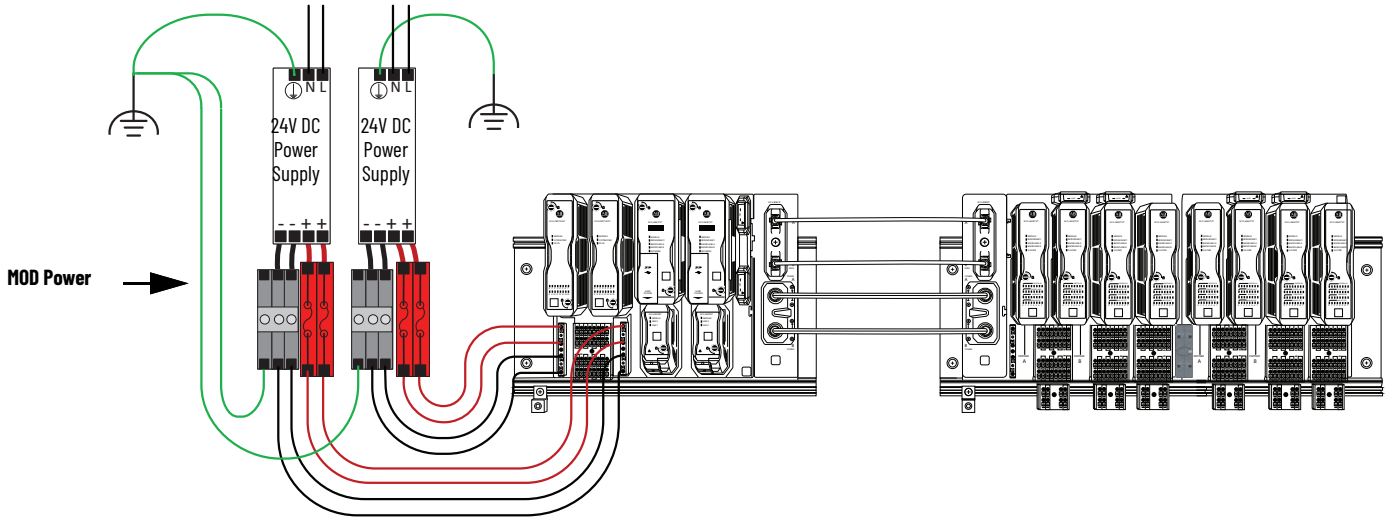
1. Connect the 24V DC external power supplies to the fuses and terminal blocks.

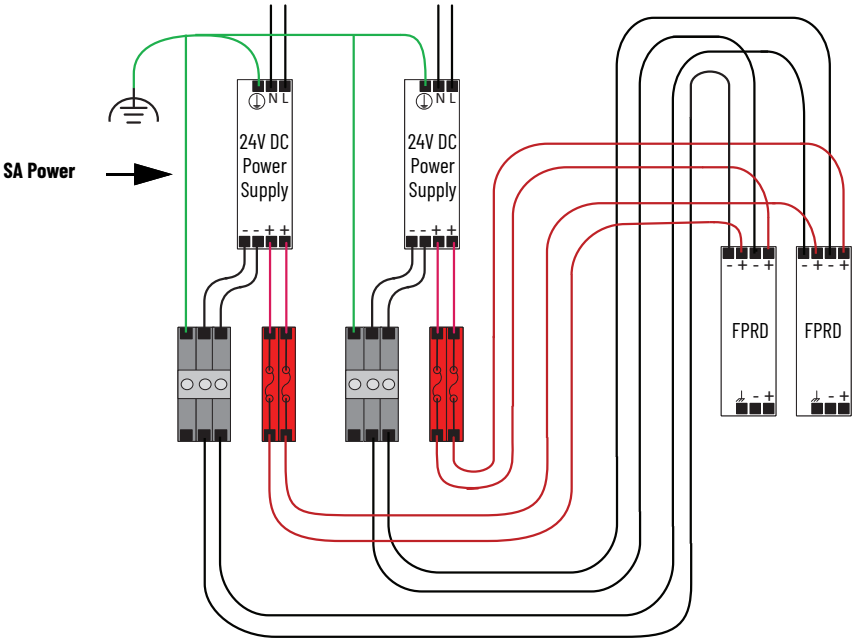


2. Connect the fuses and terminal blocks to the FPRDs.

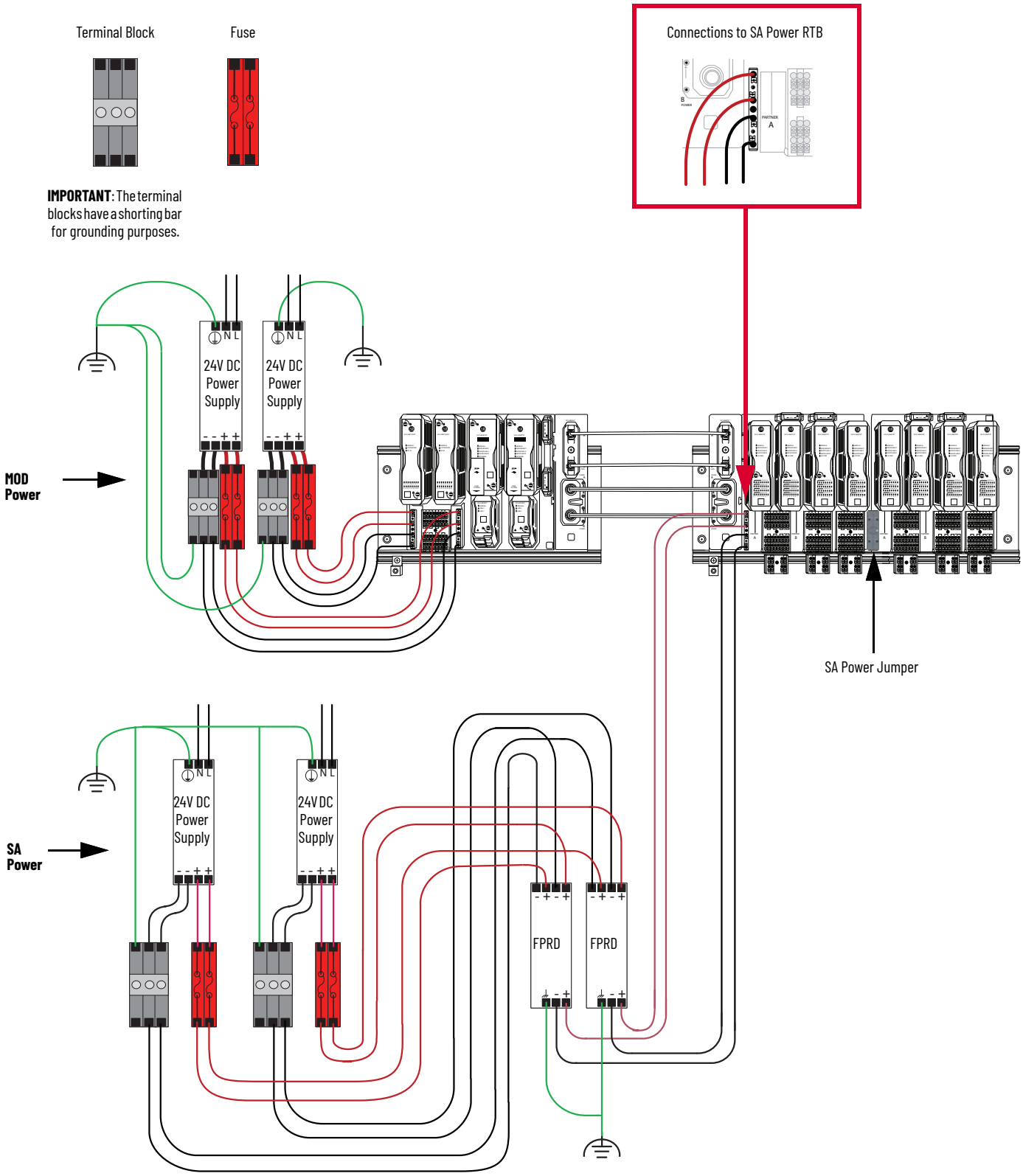


IMPORTANT: The terminal blocks have a shorting bar for grounding purposes.





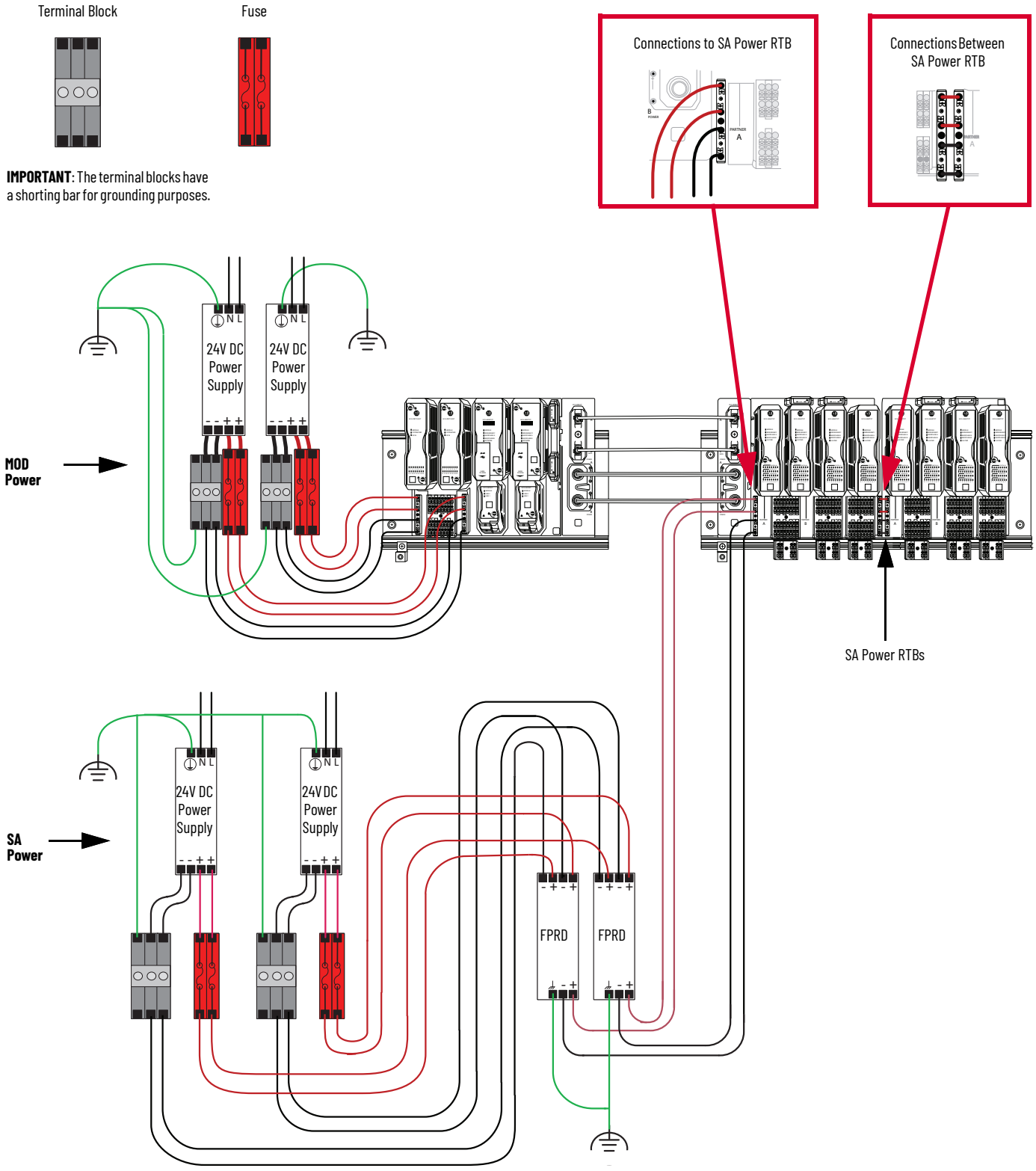
3. Complete the following.
   a. Connect the FPRDs to the SA Power RTB.
   b. Make sure that the redundant FPRDs, external power supplies, and terminal blocks are connected to earth ground.
   c. Install an SA Power Jumper between the I/O Bases.



Wire SA Power in System That Extends the SA Bus via Adjacent SA Power RTBs

This example shows how to wire SA power to an I/O bank in which the SA Power bus is extended from one I/O Base to the next by using two adjoining SA Power RTBs. One SA Power RTB is installed on the right side of the first I/O Base. Another SA Power RTB is installed on the left side of the second I/O Base. Complete the following steps.

1. Connect the 24V DC external power supplies to the fuses and terminal blocks.
2. Connect the fuses and terminal blocks to the FPRDs.
3. Connect the FPRDs to the SA Power RTB.
4. Make sure that the redundant FPRDs and external power supplies are connected to earth ground.
5. Connect the + and — terminals on the SA Power RTBs.

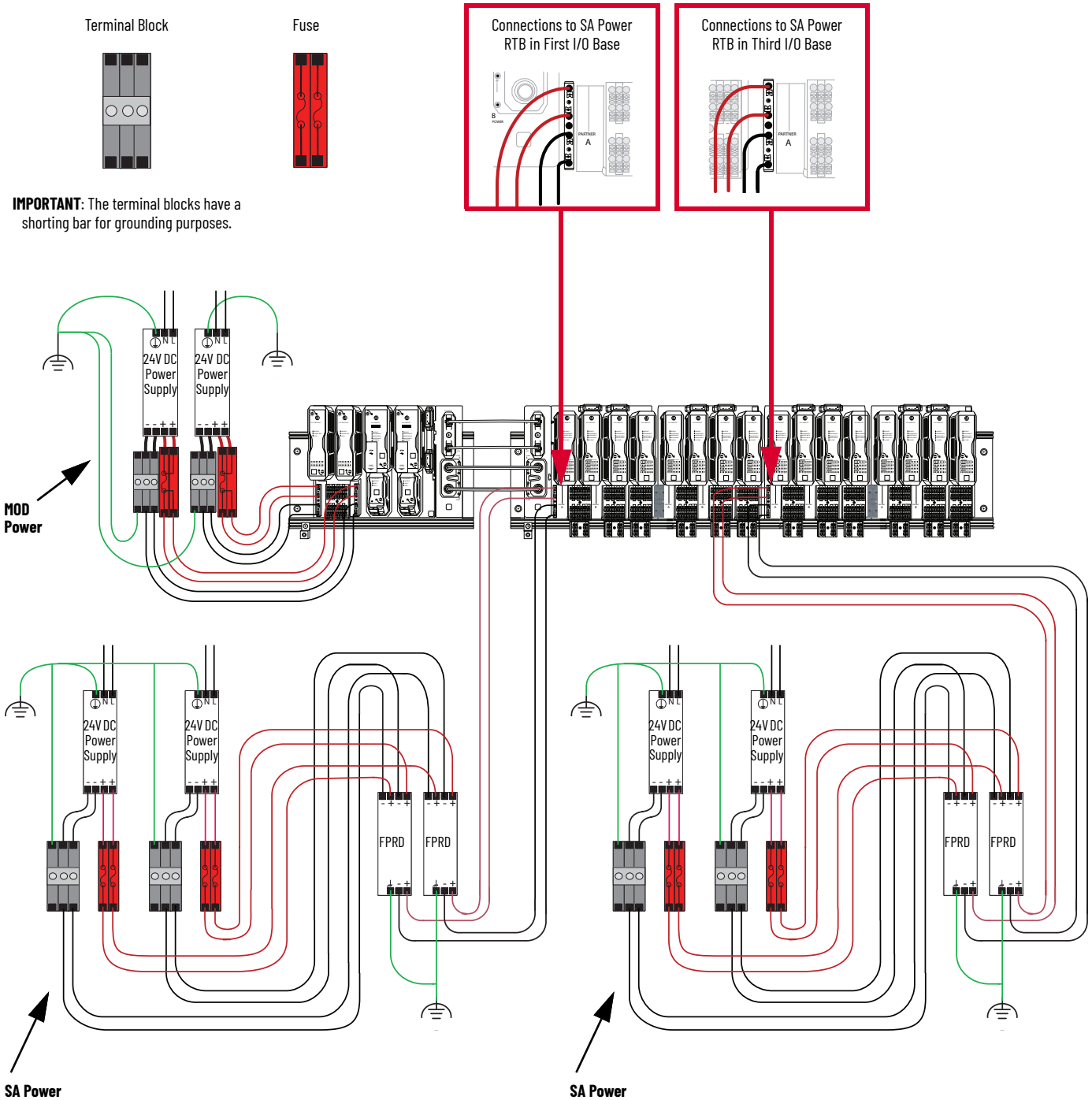


Wire Multiple SA Power Banks

This example shows how to wire SA power on separate banks. The system has individually fused SA buses. The example requires two pairs of redundant power supplies and FPRDs to make sure there is no current overdraw on either SA Power bus.

For each pair of redundant power supplies and FPRDs, complete the following steps.

1. Connect the 24V DC external power supplies to the fuses and terminal blocks.
2. Connect the fuses and terminal blocks to the FPRDs.
3. Connect the FPRDs to the SA Power RTB.
4. Make sure that the redundant FPRDs and external power supplies are connected to earth ground.



Connect Power to the Next I/O Base

Unlike MOD power that is only connected to the Adapter Base, SA power is initially confined to the I/O Base to which it is connected.

You provide SA power to the next I/O Base in a bank, you can do so in the following ways:

- Establish a new SA power bus in the next I/O bank.
- Jumper SA power from the first I/O Base to the next I/O Base in the bank.

Establish a New SA Power Bus

An SA Power RTB must be installed on the left side of an I/O Base to establish a new SA Power bus in a FLEXHA 5000 I/O system. The advantage to this option is that the level of current available to I/O modules in the I/O Base is 20 A, max, depending on the system's operating temperature. The disadvantage is that you must install a new set of external power supplies and an FPRD and connect them to the power RTB on the next I/O Base.

If you install an I/O Base and an SA Power RTB is not installed on the left side of the base, install an SA Power RTB. The power RTB has + and - terminals on the top and bottom, respectively. The power RTB is polarized so that you can only install the RTB in the I/O Base in the correct orientation.

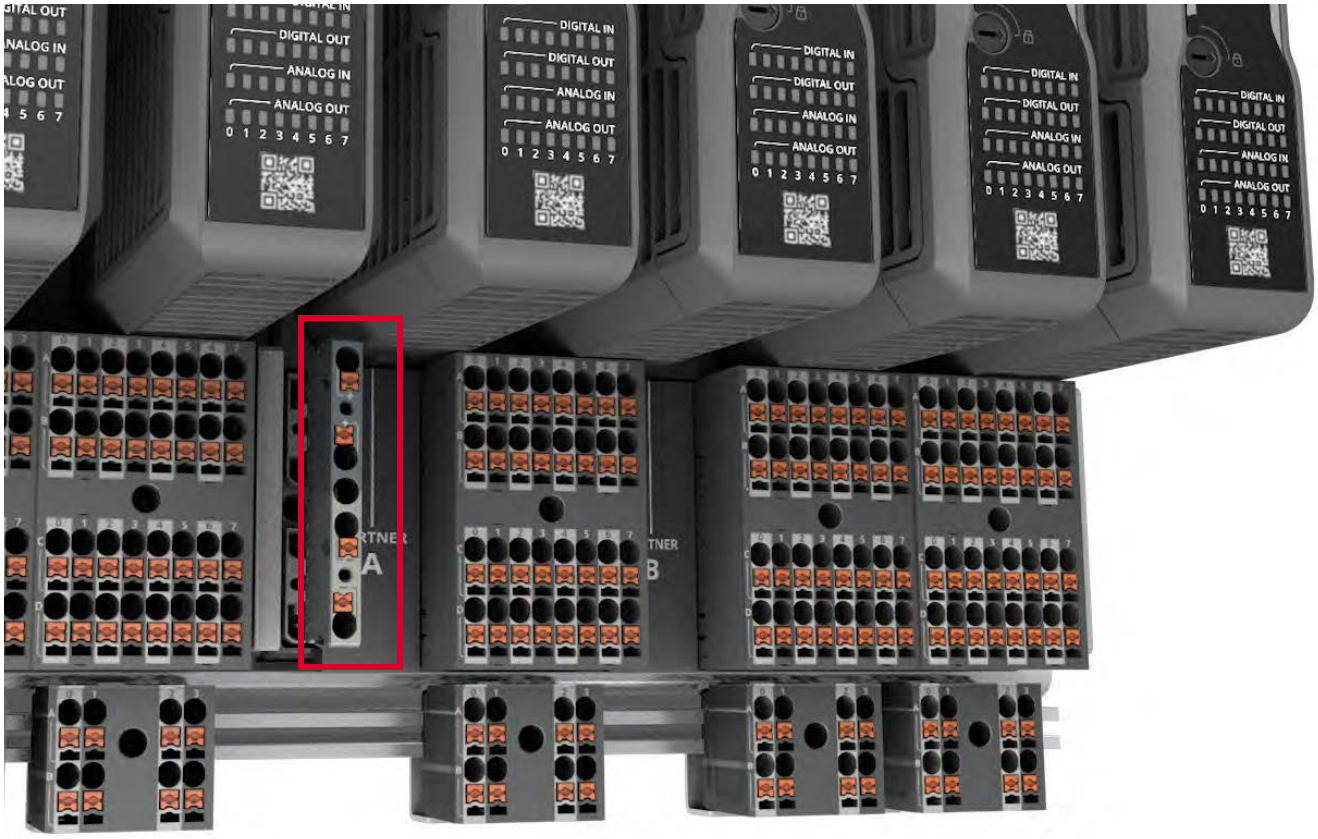
IMPORTANT If you do not use an SA Power RTB on the right side of an I/O Base, use one of the following:

- SA Power RTB Filler - Plugged into the RTB slot and snaps in place. There is no need to screw it in to secure it.
- SA Power Jumper - Used to jumper SA power to the next I/O Base. For more information on how to install an SA Power Jumper, see page 87.

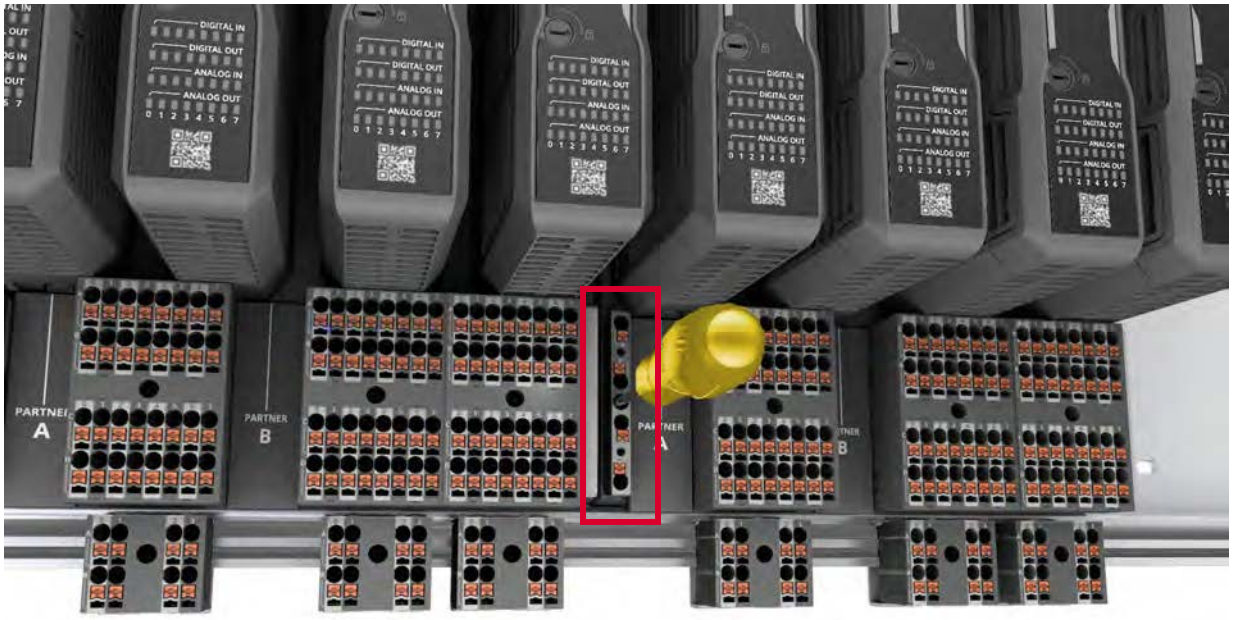
To install an SA Power RTB, complete the following steps.

1. Plug the SA Power RTB under the leftmost I/O module on the I/O Base.

   The RTB is installed on the far left side of the I/O Base. An SA Power RTB Filler is on the far right side of the first I/O Base and to the left of the SA Power RTB that is being installed.



2. Use a screwdriver to turn the screw in the middle of the SA Power RTB and secure it to the I/O Base.
   The torque is 0.7 +/-0.11 Nm (6 +/-1 in•lb).



To connect power to a new SA power bus, repeat the steps that are described in Connect SA Power to an I/O Base on page 80.

Jumper SA Power

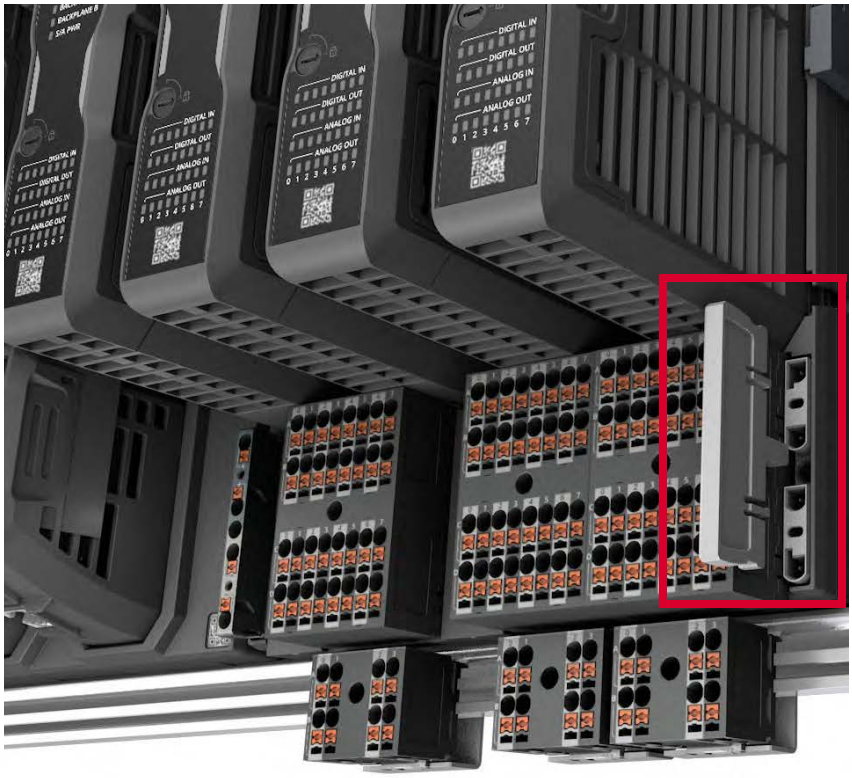
To jumper SA power across I/O Bases, use one of the following:

- SA Power RTBs that are installed directly next to each on adjoining I/O Bases and wire the + terminals and — terminals to each other.
- SA Power Jumper that plugs into the right side of the first I/O Base and the left side of the second I/O Base

The advantage to this option is that you do not have to install another set of external power supplies and an FPRD and connect them to the I/O Base. The disadvantage is that current that is available to I/O modules in the next I/O Base is less than 20 A, max. That is, the available current is whatever current remains after the I/O modules in the previous I/O Base draw from the SA power bus.

To jumper SA power from one base to the next, complete the following steps.

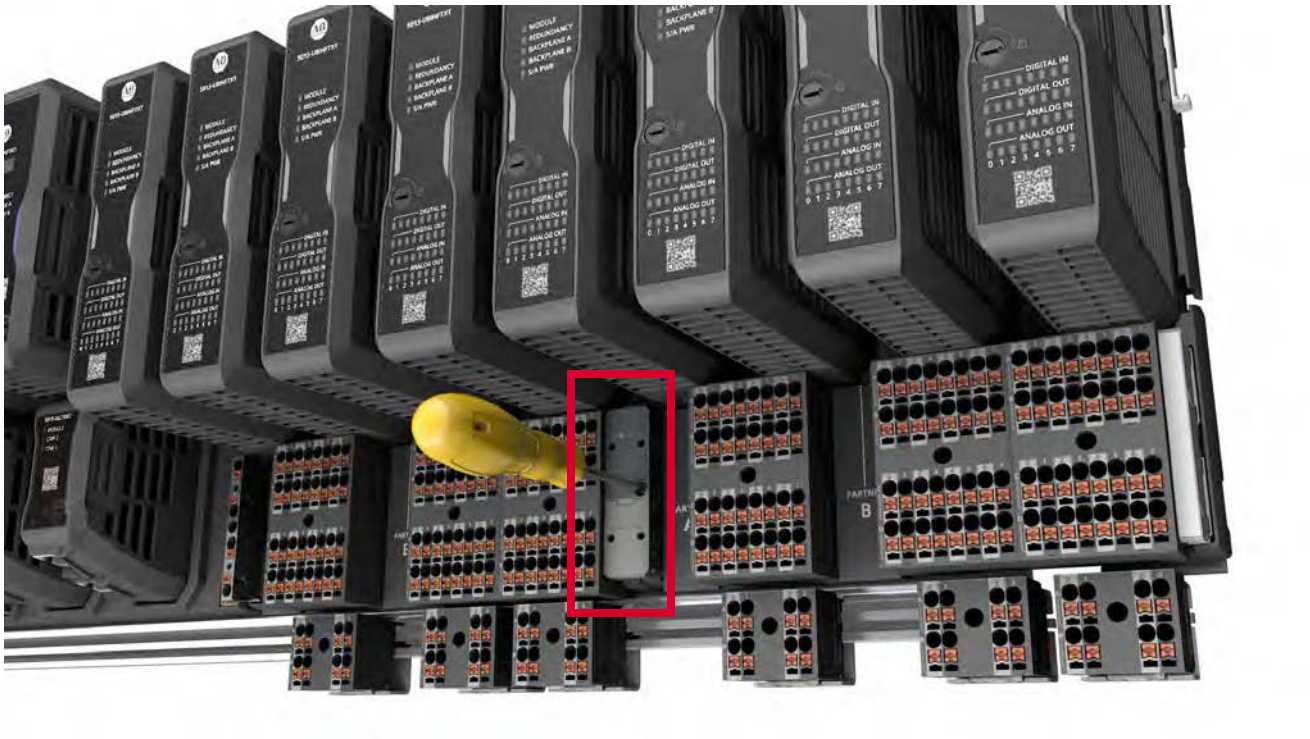
1. One of the following:
   a. If there is not an SA Power RTB Filler that is installed on the **right side of the I/O Base**, skip to step 2.
   b. If there is an SA Power RTB Filler that is installed on the right side of the I/O Base, pull the SA Power RTB Filler off the I/O Base.



2. One of the following:
   a. If there is not an SA Power RTB installed on the **left side of the next I/O Base**, skip to step 4.
   b. If there is an SA Power RTB installed on the left side of the next I/O Base, unscrew it.
3. Pull the SA Power RTB on the left side of the next I/O Base off.
4. Plug the SA power jumper into the I/O Bases so that it spans from the right side of the first I/O Base to the left side of the next I/O Base.

If you feel significant resistance when you plug the SA power jumper into the I/O Bases, it can be the result of a slight gap between the I/O Bases. In that case, slightly spread the terminals at the back of the SA power jumper and then plug it into place.

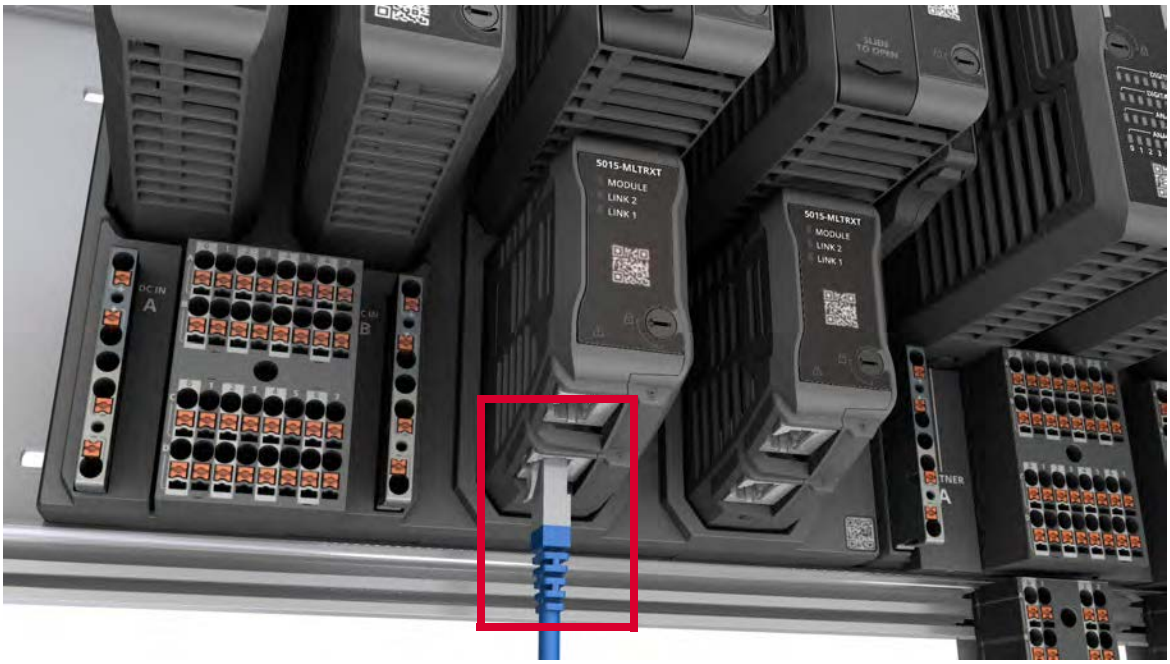
5. Use a screwdriver to turn the screw in the middle of the SA power jumper and secure it to the I/O Bases.
   The torque is 0.7 +/-0.11 Nm (6 +/-1 in•lb).



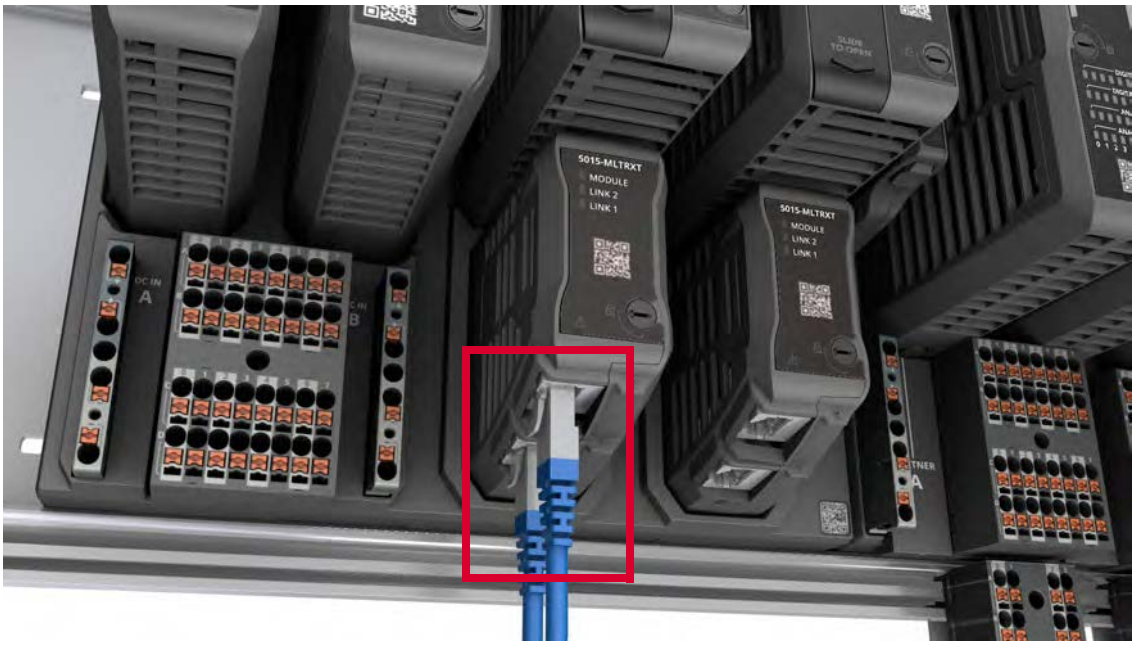
Connect Media Landing Cards to the EtherNet/IP Network

You connect the FLEXHA 5000 I/O system to an EtherNet/IP network via the MLCs that are installed below the EtherNet/IP adapters. You connect MLCs via an RJ45 connection. To connect the MLCs to an EtherNet/IP network, complete the following steps.

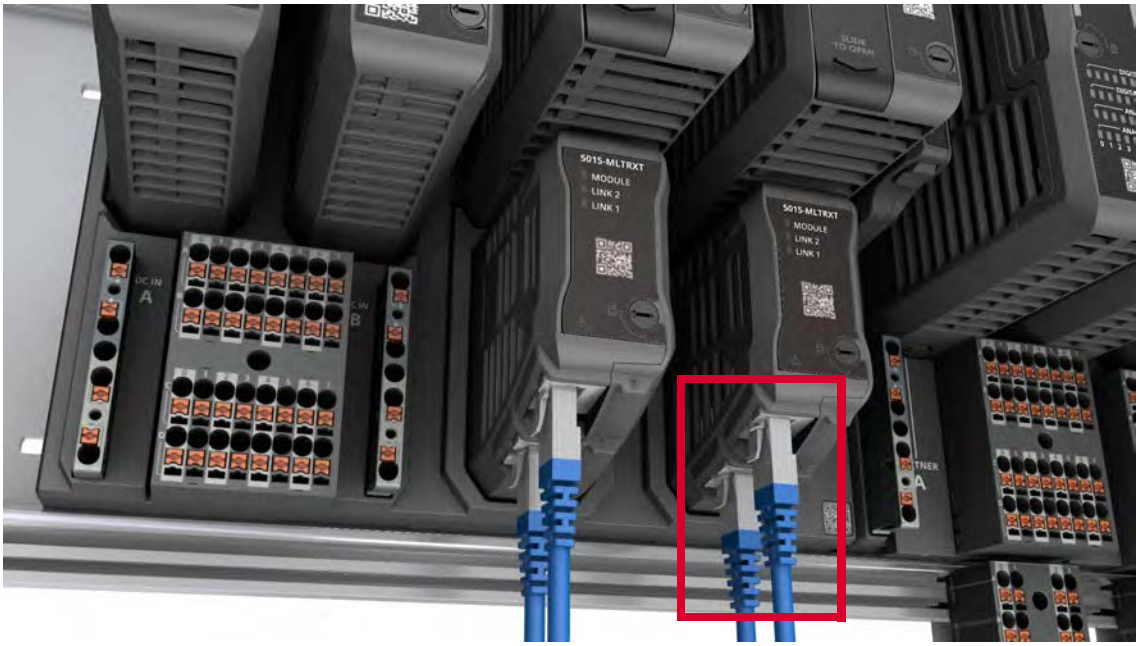
1. Push the RJ45 connector into port 1 of the first MLC as shown.
   Port 1 is the lower port of the MLC.



2. Push the RJ45 connector into port 2 of the first MLC as shown.
   Port 2 is the upper portion of the MLC.



3. To connect the second MLC to the EtherNet/IP network, as shown, repeat the steps.



Wiring Diagnostic Inputs

The Power Conditioners monitor power conditions in the system. You can install a 5015-RTBPXT beneath the power conditioner and wire 2-wire dry contact devices to the diagnostic inputs that monitor power conditions. Figure 13 shows 2-wire contacts. Consider the following:

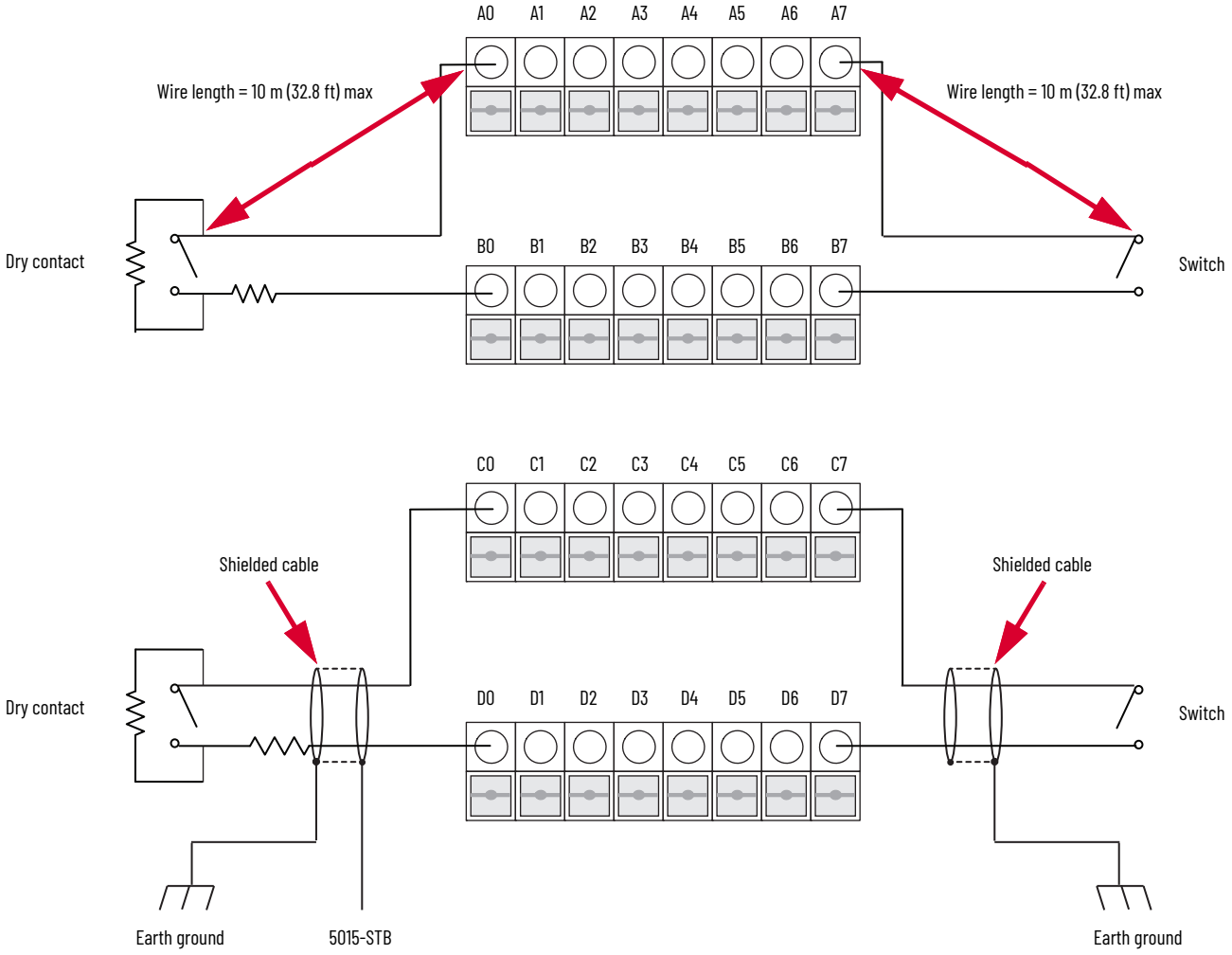
- The maximum wire length from a two-wire device to an RTB terminal is 10 m (32.8 ft).
- Shielded cable is optional. In this example, the devices that are connected to the A and B terminals do not use shielded cable. The devices that are connected to the C and D terminals do use shielded cable.
- If shielded cable is used, you must complete one of the following:
  - Connect the device side of the cable to an earth ground and the module side of the cable to the STB as shown in the Dry contact example.
  - Connect the device side of the cable to an earth ground and do not connect the module side of the cable to anything as shown in the Switch example.
    In this case, apply a crimp eyelet to the drain wire to allow connection to the mounting plate with ST4.8 screw that is torqued to 0.7 +/-0.11 Nm (6 +/-1 in•lb).

  IMPORTANT: You cannot connect both ends of the shielded cable to earth ground.

Figure 13 - 2-wire Devices Connected to a 5015-RTBPXT

You are not required to use resistors with the Power Conditioner. If you use resistors, we recommend that you use the following.

Recommended Line-Load Resistors Size 1/4W, 5%	
Series Resistor	Parallel Resistor
1.5k	6.2k



View Power Conditioner Diagnostics

When Power Conditioner faults occur, they are reported in the programming software. Table 7 describes the internal diagnostics that are provided in the Power Conditioner. You can access more information about these internal diagnostics and the externally wired Power Conditioner Diagnostic inputs in your Logix Designer application project.

Table 7 - Power Conditioner Internal Diagnostics

Condition	Description
Power Conditioner Overload	Power conditioner loading is exceeding the rated capacity.
Combined Overload	The combined loading of the Power Conditioners exceeds the capacity rating of one Power Conditioner. If a Power Conditioner fault occurs, the redundant Power Conditioner cannot maintain the system load.
Internal Over Temperature	The internal ambient temperature level is above the warning level.
Internal Temperature Critical	The internal ambient temperature level exceeds the limit.
Power Conditioner-to-Power Conditioner Communication Failure	Power conditioner A has lost communication with Power Conditioner B.
Power Conditioner Backplane Voltage Health	The backplane voltage of Power Conditioner A and/or Power Conditioner B is outside the acceptable voltage range.
MOD Power Status	The input voltage to a Power Conditioner is outside the allowable range. The input voltage can be under voltage (UV) or over voltage (OV).

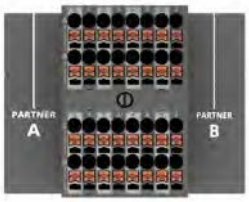
For more information on how to manage fault conditions, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

Wire the I/O Modules

Simplex and Duplex push-in RTBs are used to connect devices to the I/O modules. The RTBs offer 32 terminals.

Simplex RTB
(5015-RTBPXT)

Duplex RTB
(5015-RTBRPXT)



The Simplex and Duplex RTBs support one wire at each termination point. The following single-wire sizes are supported:

- 0.34...4mm^2 (22...12 AWG) solid copper wire
- 0.14...2.5 mm^2 (26...14 AWG) stranded copper wire, with ferrule

IMPORTANT The following apply when you connect a wire with a ferrule:

- Ferrule according to DIN 46 228/1.
- You can use ferrules with or without plastic sleeves.
- Ferrule stripping length, max is 8 mm...10 mm (0.31...0.4 in.)

- 0.34...2.5 mm^2 (22...14 AWG) stranded copper wire, without ferrule

Insert the wire into a terminal until you feel the terminal close on the wire. The RTBs are the push-in type.

IMPORTANT If you use a ferruled or a larger gauge solid wire, you can push the wire into the terminal.

If the wire is non-ferruled and stranded, or smaller gauge solid wire, you must use a small screwdriver to push and hold in the orange tab before you insert the wire. In this case, make sure that the wire is fully inserted before you remove the screwdriver. When the orange tab comes out, the wire is locked in the terminal.

Table 8 lists the terminal designations.

Table 8 - I/O Module RTB Terminals for 8-channel Modules

	Column 0	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Row A	A0	A1	A2	A3	A4	A5	A6	A7
Row B	B0	B1	B2	B3	B4	B5	B6	B7
Row C	C0	C1	C2	C3	C4	C5	C6	C7
Row D	D0	D1	D2	D3	D4	D5	D6	D7

Wiring Diagrams

This section provides the following example diagrams:

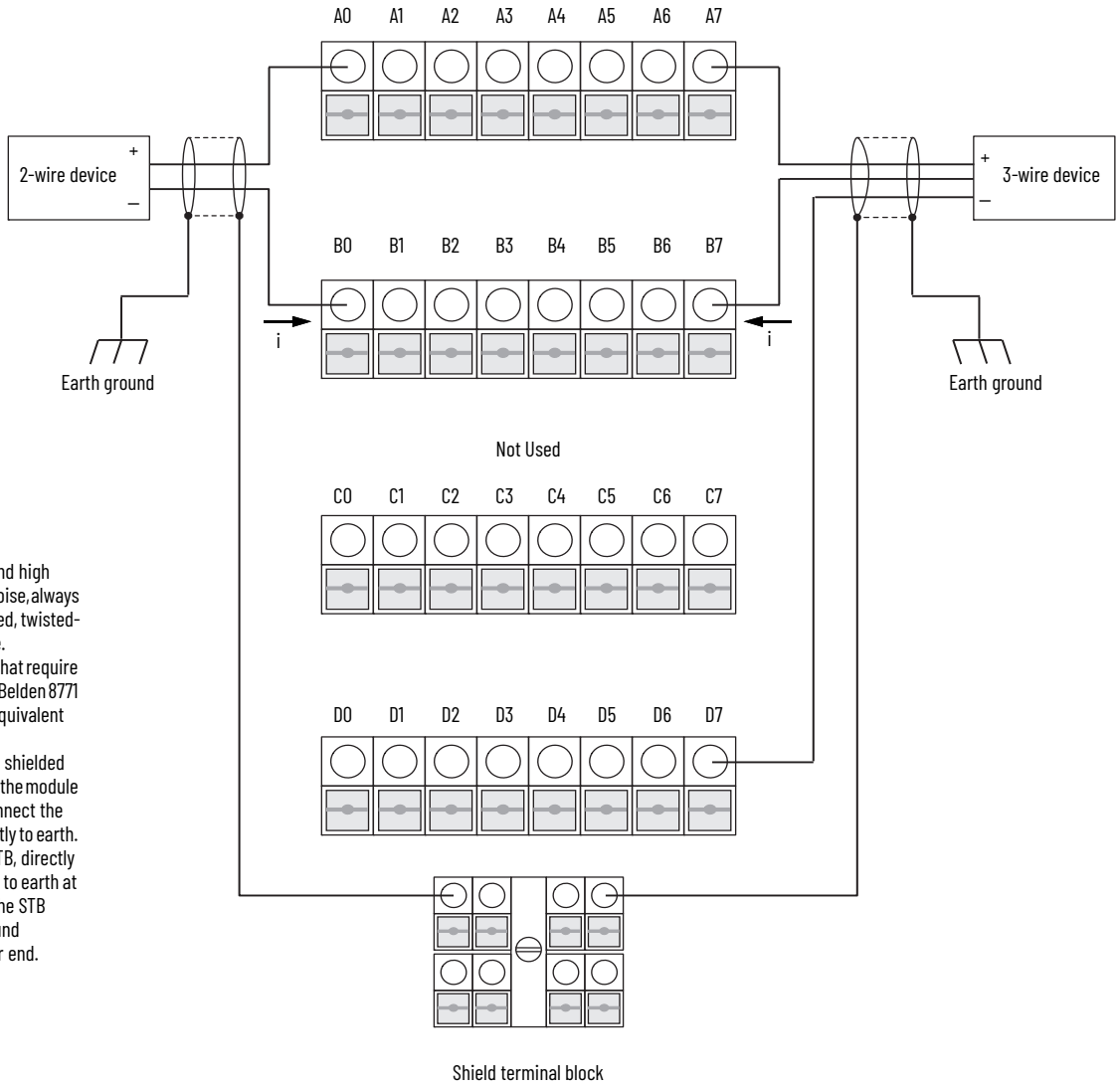
- Analog Input Wiring Diagrams
- Analog Output Wiring Diagrams
- Digital Input Wiring Diagrams
- Digital Output Wiring Diagrams

IMPORTANT

- Rows A...D are part of the I/O RTB. The STB, catalog number 5015-STBPXT, at the bottom of each diagram is the shield terminal block that is installed on the mounting plate chase below the I/O modules.
- The FLEXHA 5000 I/O system uses shielding constructs identical to EtherNet/IP systems, for example, as used with DLR ports. The STB has eight individually isolated resistor-capacitor (RC) terminations that provide EMI noise mitigation. The STB introduces an embedded RC filter that improves shielding performance through termination at multiple points without introducing the risk of ground loops. The RC terminations **do not** earth the shield and you **cannot** use them to claim conformance to any safety agencies.
  For some installations, for example, Ex installations, more restrictive grounding can be required and the cable shields can be connected directly to the mounting plate screw chase. To connect the shields directly to the mounting screw chase, use an ST 4.8 screw and an appropriately sized wire crimp eyelet.
  We recommend that all shielded cables be connected on the module side to the STB and connect the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground termination at the other end.

Analog Input Wiring Diagrams

Figure 14 - Analog Inputs 2-wire and 3-wire Current Mode with Internal Loop Power

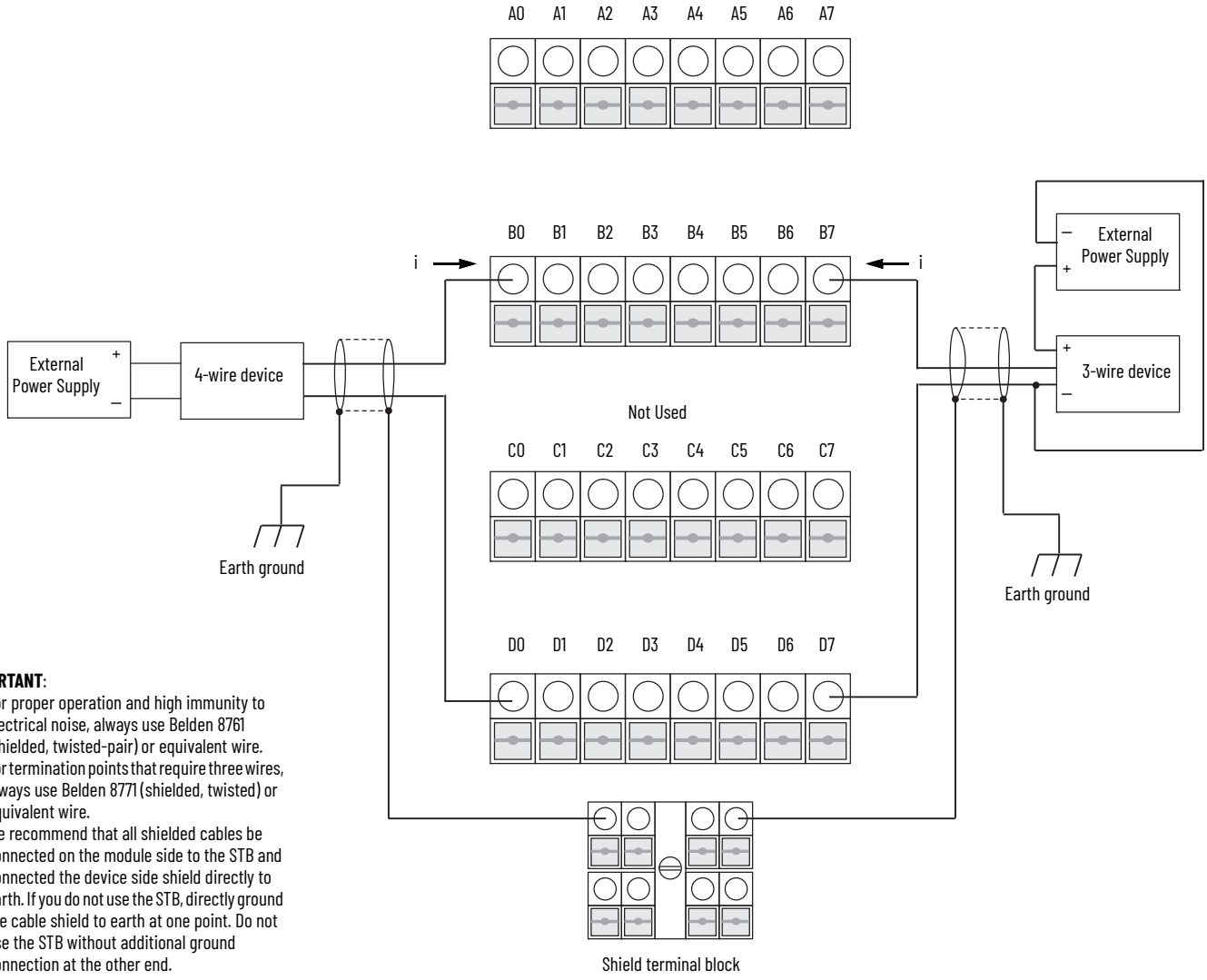


IMPORTANT:

- For proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire.
  For termination points that require three wires, always use Belden 8771 (shielded, twisted) or equivalent wire.
- We recommend that all shielded cables be connected on the module side to the STB and connect the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground connection at the other end.

Figure 15 - Analog Inputs 3-wire and 4-wire Current Mode with External Power Loop

In this example, an external power supply provides power to the transmitter. You can also source power for the transmitter from the FLEXHA 5000 I/O system as described in Figure 14.

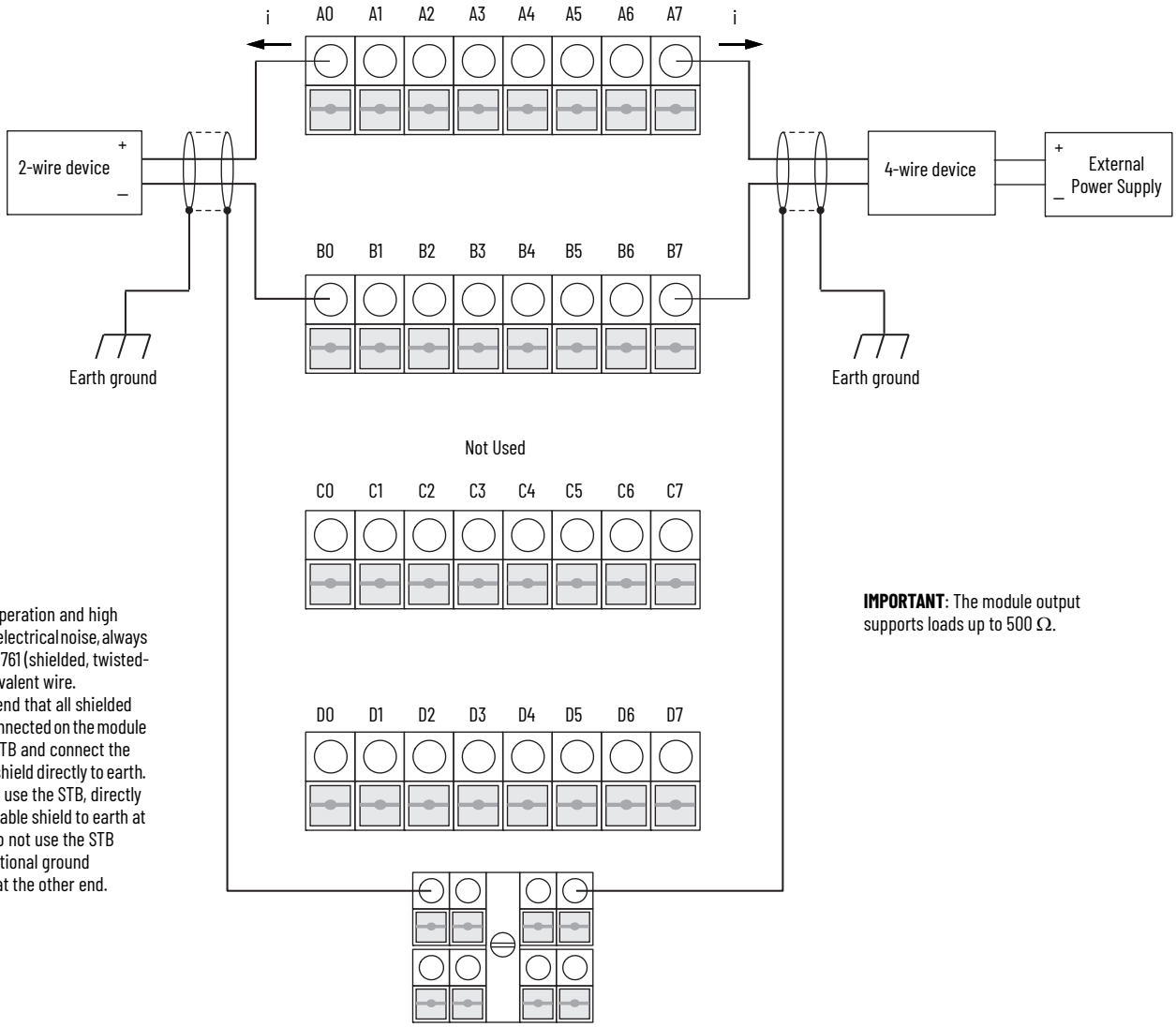


IMPORTANT:

- For proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire. For termination points that require three wires, always use Belden 8771 (shielded, twisted) or equivalent wire.
- We recommend that all shielded cables be connected on the module side to the STB and connected the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground connection at the other end.

Analog Output Wiring Diagrams

Figure 16 - Analog Outputs 2-wire and 4-wire Load

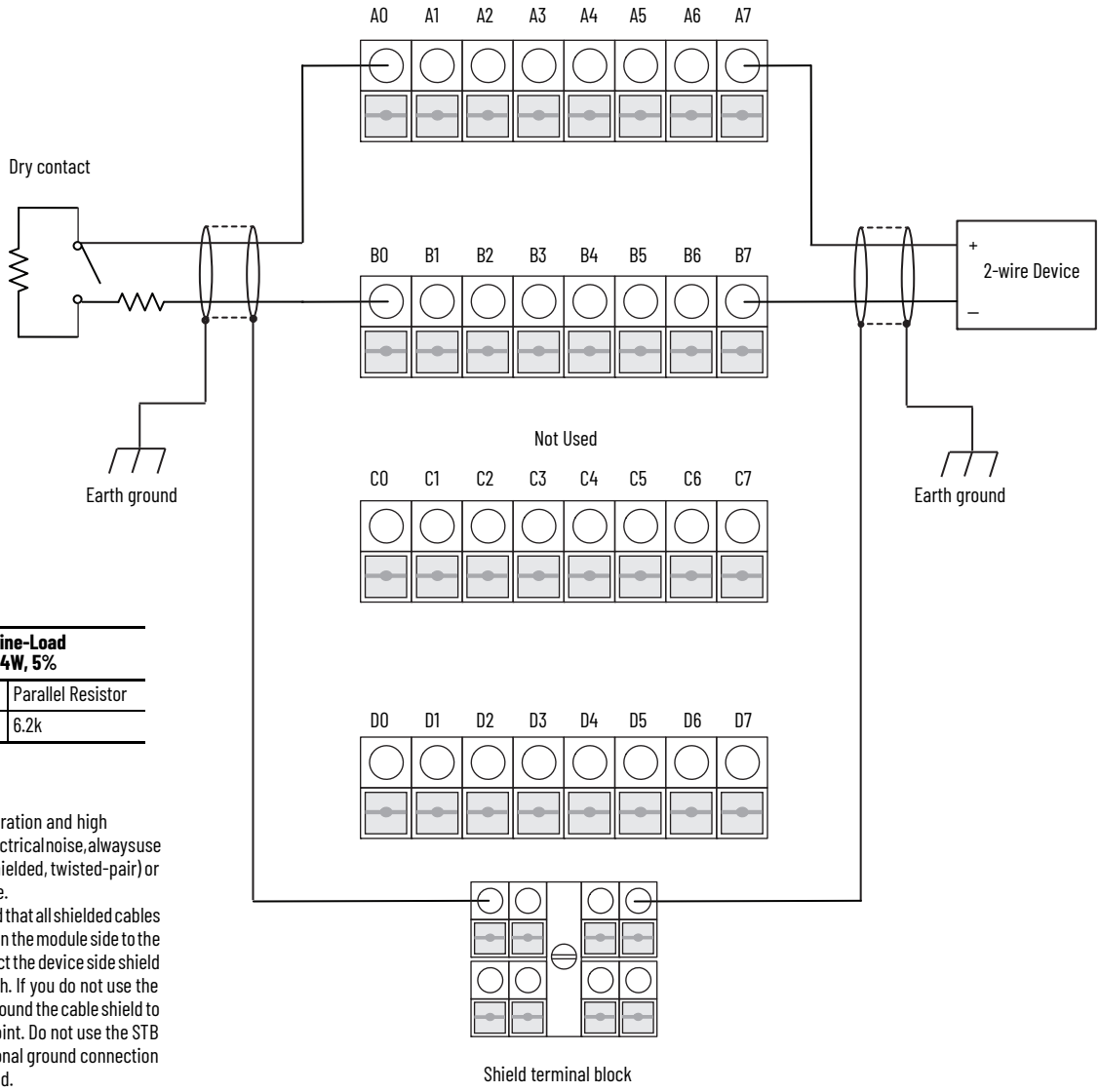


IMPORTANT:
- For proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire.
- We recommend that all shielded cables be connected on the module side to the STB and connect the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground connection at the other end.

IMPORTANT: The module output supports loads up to 500 Ω.

Digital Input Wiring Diagrams

Figure 17 - Digital Inputs 2-wire Devices



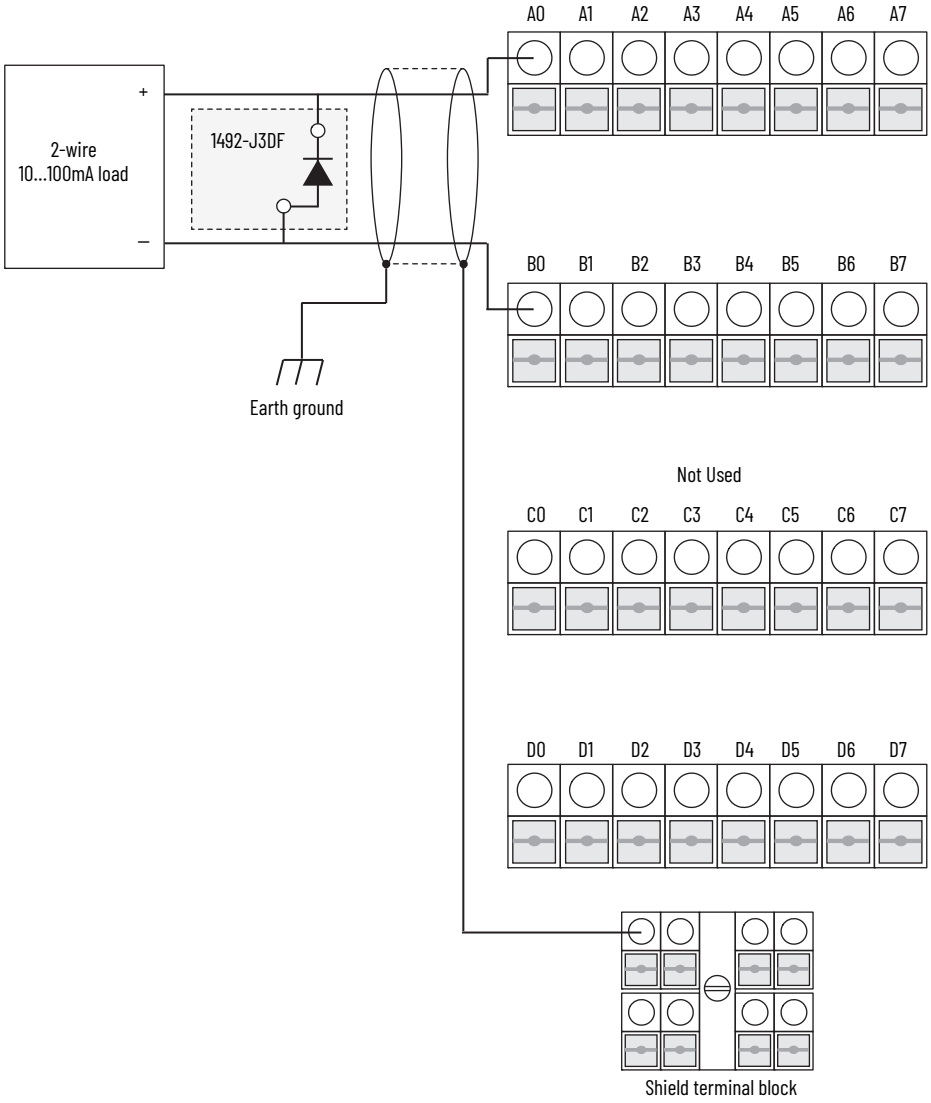
Recommended Line-Load Resistors Size 1/4W, 5%	
Series Resistor	Parallel Resistor
1.5k	6.2k

IMPORTANT:

- For proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire.
- We recommend that all shielded cables be connected on the module side to the STB and connect the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground connection at the other end.

Digital Output Wiring Diagrams

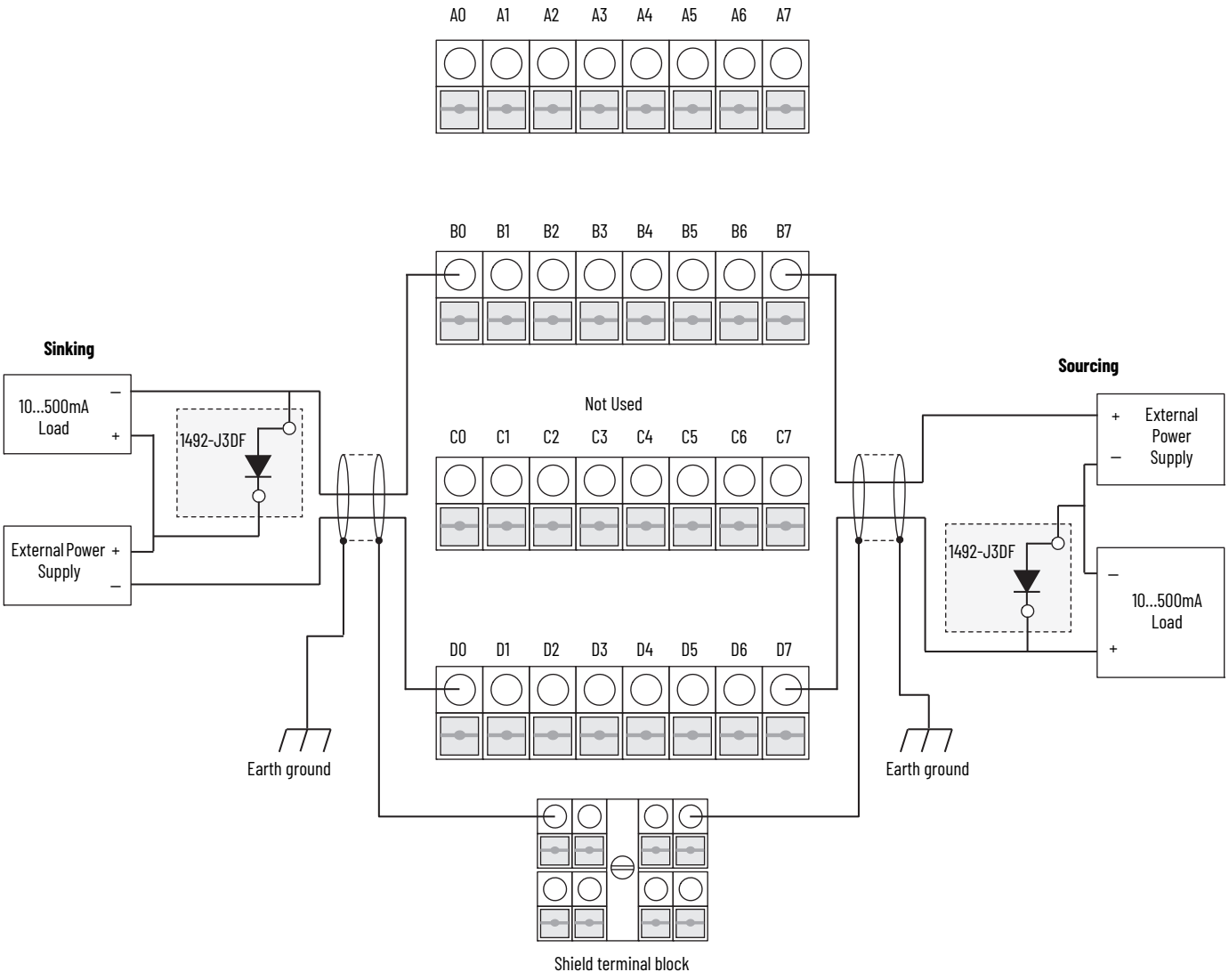
Figure 18 - Digital Outputs 2-wire Devices



IMPORTANT:

- When the module is configured for digital output mode in a Duplex Pair, the minimum load current that is required is 20 mA.
- For proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire.
- We recommend that all shielded cables be connected on the module side to the STB and connect the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground termination at the other end.
- The 5015-U8IHFTXT module has built-in surge suppression to reduce the effects of high-voltage transients. However, this suppression device is not designed to tolerate the effects of voltage transients that interrupting current to an inductive device causes. You need an additional, external suppression device if an output controls inductive devices, such as relays, motor starters, solenoids, or motors. Add the suppression device directly across the coil of an inductive device. Pilot Duty certification testing was performed with Rockwell Automation catalog number 1492-J3DF.
  IMPORTANT: System certification is the customer's responsibility.
  The 5015-U8IHFTXT channels can tolerate 32V on the channel terminals without damage. Make sure that terminal voltage never exceeds these levels, including during operation or any failure of the field device.
- Additional suppression is especially important if your inductive device is in series with or parallel to hard contacts, such as push buttons or selector switches. Add a suppression device directly across the coil of an inductive device. The suppression device reduces the effects of voltage transients that are caused by interrupting the current to that device and to prolong the life of the switch contacts.

Figure 19 - Digital Outputs - External Power Source Mode



IMPORTANT:

- When the module is configured for digital output mode in a Duplex Pair, the minimum load current that is required is 20 mA.
- For proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire.
- For termination points that require three wires, always use Belden 8771 (shielded, twisted) or equivalent wire.
- We recommend that all shielded cables be connected on the module side to the STB and connect the device side shield directly to earth. If you do not use the STB, directly ground the cable shield to earth at one point. Do not use the STB without additional ground termination at the other end.
- The 5015-U8IHFTXT module has built-in surge suppression to reduce the effects of high-voltage transients. However, this suppression device is not designed to tolerate the effects of voltage transients that interrupting current to an inductive device causes. You need an additional, external suppression device if an output controls inductive devices, such as relays, motor starters, solenoids, or motors. Add the suppression device directly across the coil of an inductive device. Pilot Duty certification testing was performed with Rockwell Automation catalog number 1492-J3DF. **IMPORTANT**: System certification is the customer's responsibility.
  The 5015-U8IHFTXT channels can tolerate 32V on the channel terminals without damage. Make sure that terminal voltage never exceeds these levels, including during operation or any failure of the field device.
- Additional suppression is especially important if your inductive device is in series with or parallel to hard contacts, such as push buttons or selector switches. Add a suppression device directly across the coil of an inductive device. The suppression device reduces the effects of voltage transients that are caused by interrupting the current to that device and to prolong the life of the switch contacts.

Remove Dust Covers

IMPORTANT Confirm that the power is not on.

Remove the dust cover from any of the components that are still covered.

Use Fillers

You can use filler components instead of some of the components in a FLEXHA 5000 I/O system. For example, if your system only needs three of the four available I/O module slots in an I/O Base, we recommend that you install an I/O Slot Filler in the remaining slot. By installing the I/O Slot Filler, the circuits in the module slot are not exposed during system operation.

Each Slot Filler is installed the same way as its corresponding component. For example, the I/O Slot Filler is pushed onto an I/O Base the same way that an I/O module is. The following Slot Fillers are available:

- I/O Slot Filler - The I/O Slot Filler is installed the same way as the I/O module. For more information, see page 66.
- RTB Slot Filler - The RTB Slot Filler is installed the same way as a Simplex RTB. For more information, see page 69.
- SA Power RTB Filler - The SA Power RTB Filler is installed in a similar way to the SA Power RTB. For more information, see page 86.

Turn Power On

Once the FLEXHA 5000 I/O system is installed and connected to an EtherNet/IP network, turn on input power to the external power supplies that provide MOD power to the system and SA power to individual I/O Bases.

Diagnostics During Duplex Pair Normal Operation

Diagnostics run on Duplex Pairs during normal operations. The diagnostics make sure that if one of the modules in the pair faults, the other module can take control. Some hardware faults can't be detected in certain conditions.

Table 9 - Methods to Check for Faults

Channel mode	Condition	Methods to Check for Faults
Analog output	Module is in Program Mode.	Some diagnostics require current to be flowing. An analog output channel has no current flowing in Program Mode. You must wait for the analog output channel to resume normal operation for diagnostics to resume.
Digital output	Channel is off.	We recommend that you occasionally pulse test the load device that is connected to the channel.
Digital input	Channel is off.	Some diagnostics require current to be flowing. A digital input channel with no line load resistors that is off has no current flowing. We recommend that you use line/load resistors as shown in Figure 17 on page 97.

Status Indicators

Some of the components in a FLEXHA 5000 I/O system have status indicators that let you monitor system operation and troubleshoot any issues that arise. For information on how to use status indicators in a FLEXHA 5000 I/O system, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001.

Replace Keyed Components

Adapters, power conditioners, and I/O modules use mechanical keys to prevent the inadvertent installation of the wrong component, as described on page 9.

Replace an EtherNet/IP Adapter

To replace an adapter, complete the following steps:

1. Unlock the QTAs on the adapter to turn it off. When the adapter is turned off, the status indicators turn off.

IMPORTANT	When an adapter is turned off, the partner adapter maintains network communication. Fault tolerance is compromised until the replacement adapter is installed, turned on and resumes normal operations.

2. Pull the adapter out of the Adapter Base.
3. If the replacement adapter is new and still has mechanical keys in the back of it, pull them out.
4. Install the replacement adapter in the Adapter Base.
5. Use the QTAs to lock the adapter in place and turn on power to it.

Replace a Power Conditioner

To replace a Power Conditioner, complete the following steps:

1. Unlock the QTAs on the Power Conditioner to turn it off. When the Power Conditioner is turned off, the status indicators turn off.

IMPORTANT	When a Power Conditioner is turned off, only the partner Power Conditioner provides power to the system. Fault tolerance is compromised until the replacement Power Conditioners is installed, turned on and resumes normal operations.

2. Pull the Power Conditioner out of the Adapter Base.
3. If the replacement Power Conditioner is new and still has mechanical keys in the back of it, pull out the mechanical keys from the back of it.
4. Install the replacement Power Conditioner in the Adapter Base.
5. Use the QTAs to lock the Power Conditioner in place and turn on power to it.

Replace an I/O Module

To replace an I/O module, complete the steps that described in the table.

IMPORTANT In the tasks described for each replacement scenario, you remove the existing I/O module from the system.
When you turn off an I/O module that is part of a Duplex pair, the partner
I/O module assumes control. Fault tolerance is compromised and a fault on the functioning I/O module results in a loss of control until the replacement I/O module is installed and resumes normal operation with the partner I/O module.
When you remove a Simplex I/O module, control is lost for the channels on the module until a replacement I/O module is installed and resumes normal operation.

Table 10 - Replace I/O Module - Keying

Replacement Scenario	Tasks
Replace an I/O module with a new I/O module of the same type.	1. Unlock the QTA on the I/O module to turn it off. When the I/O module is turned off, the status indicators turn off.(1) 2. Pull the I/O module out of the I/O Base. 3. Pull the mechanical keys from the back of the replacement I/O module. 4. Install the replacement I/O module in the I/O Base. 5. Use the I/O module's QTA to lock it in place and turn on power to it.
Replace an I/O module with an I/O module of the same type that has already been used.	1. Unlock the QTA on the I/O module to turn it off. When the I/O module is turned off, the status indicators turn off.(1) 2. Pull the I/O module out of the I/O Base. 3. Install the replacement I/O module in the I/O Base. 4. Use the I/O module's QTA to lock it in place and turn on power to it.
Replace an I/O module with a new I/O module of a different type.	1. Unlock the QTA on the I/O module to turn it off. When the I/O module is turned off, the status indicators turn off.(1) 2. Pull the I/O module out of the I/O Base. 3. Record the mechanical key positions in the back of the replacement I/O module. 4. Pull the mechanical keys from the back of the replacement I/O module. 5. Turn the keys in the I/O Base to the correct position so that it matches the positions for the new module type. You can turn the keys by hand. 6. Install the replacement I/O module in the I/O Base. 7. Use the I/O module's QTA to lock it in place and turn on power to it.
Replace an I/O module with an I/O module of a different type that has already been used.	1. Unlock the QTA on the I/O module to turn it off. When the I/O module is turned off, the status indicators turn off.(1) 2. Pull the I/O module out of the I/O Base. 3. Turn the keys in the I/O Base to the correct position so that it matches the positions for the new module type. You can turn the keys by hand. 4. Install the replacement I/O module in the I/O Base. 5. Use the I/O module's QTA to lock it in place and turn on power to it.

(1) In the unlikely event that you unlock the I/O module's QTAs and it does not turn off, you must use the Logix Designer application with the QTAs to turn it off. For more information, see the FLEXHA 5000 I/O System User Manual, publication 5015-UM001..

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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