With reference to Figure 11 - Flat Panel Mounting, three mounting units are illustrated above.

Drill three holes per base unit to suit M5 screws.

The screws are positioned with reference to the datum Hole A, which is shown on Figure 11 above.

- Set Dimension 'X' to suit number of base units:
- Min 157 mm for 1 base unit
- Min 283 mm for 2 base units
- Min 409 mm for 3 base units
- Add 126 mm for each additional base unit

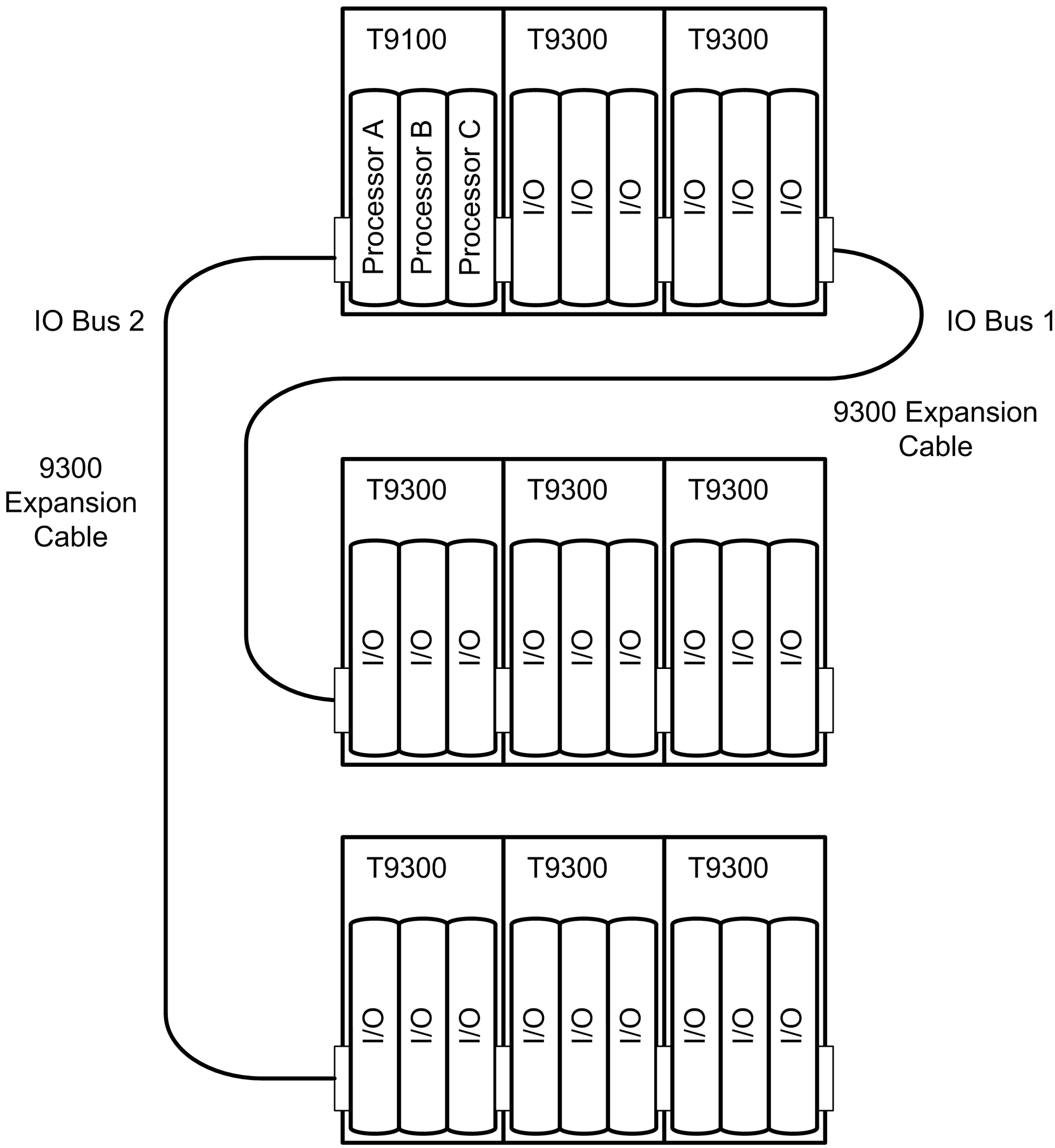
CAUTION: HEAT DISSIPATION AND ENCLOSURE POSITION
The maximum air temperature rating in an enclosure where standard AADvance processor and I/O modules are installed to support predictable reliability is 70 ºC (158 °F) for I/O modules and 60 °C (140 °F) for processor modules. System and field power consumption by modules and termination assemblies is dissipated as heat. You should consider the effect of heat dissipation on the design and positioning of your enclosure; e.g. enclosures exposed to continuous sunlight will have a higher internal temperature that could increase the operating temperature of the modules. Modules operating at the extremes of the temperature band for a continuous period can have a reduced reliability.

ATTENTION: DISSIPATION THERMIQUE ET EMPLACEMENT DE L'ENCEINTE
La température ambiante nominale maximum dans une enceinte où un processeur AADvance et des modules d'E/S standard sont installés pour assurer une fiabilité prévisible, est de 70 ºC (158 °F) pour modules d'E/S et de 60 °C (140 °F) pour processeur. La consommation électrique du système et du terrain par les modules et les ensembles de raccordement est dissipée sous forme de chaleur. Vous devez tenir compte de l'effet de la dissipation thermique lors de conception et de disposition de votre enceinte, par exemple, des enceintes continuellement exposées à la lumière solaire auront une température interne plus élevée qui pourrait accroître la température de fonctionnement des modules. La fiabilité des modules fonctionnant aux limites extrêmes de la plage de température pendant une période prolongée peut être réduite.

Base Units Rows and Expansion Cables

AADvance T9300 I/O base units connect to the right hand side of the T9100 processor base unit (I/O Bus 1) and to the right hand side of other T9300 I/O base units by a direct plug and socket connection. The I/O base units connect to the left hand side of the processor base unit by using the T9310 expansion cable (I/O Bus 2). The expansion cable also connects the right hand side of I/O base units to the left hand side of other I/O base units to install extra rows of I/O base units. Base units are secured in place by top and bottom clips that are inserted into the slots on each base unit.

Figure 12 - Connecting Base Units with Expansion Cables



The expansion bus accessed from the right hand edge of the T9100 processor base unit is designated I/O Bus 1, while the bus accessed from the left hand edge is designated I/O Bus 2. The module positions (slots) in the I/O base units are numbered from 01 to 24, the left most position being slot 01. Any individual module position within the controller can thus be uniquely identified by the combination of its bus and slot numbers, for example 1-01.

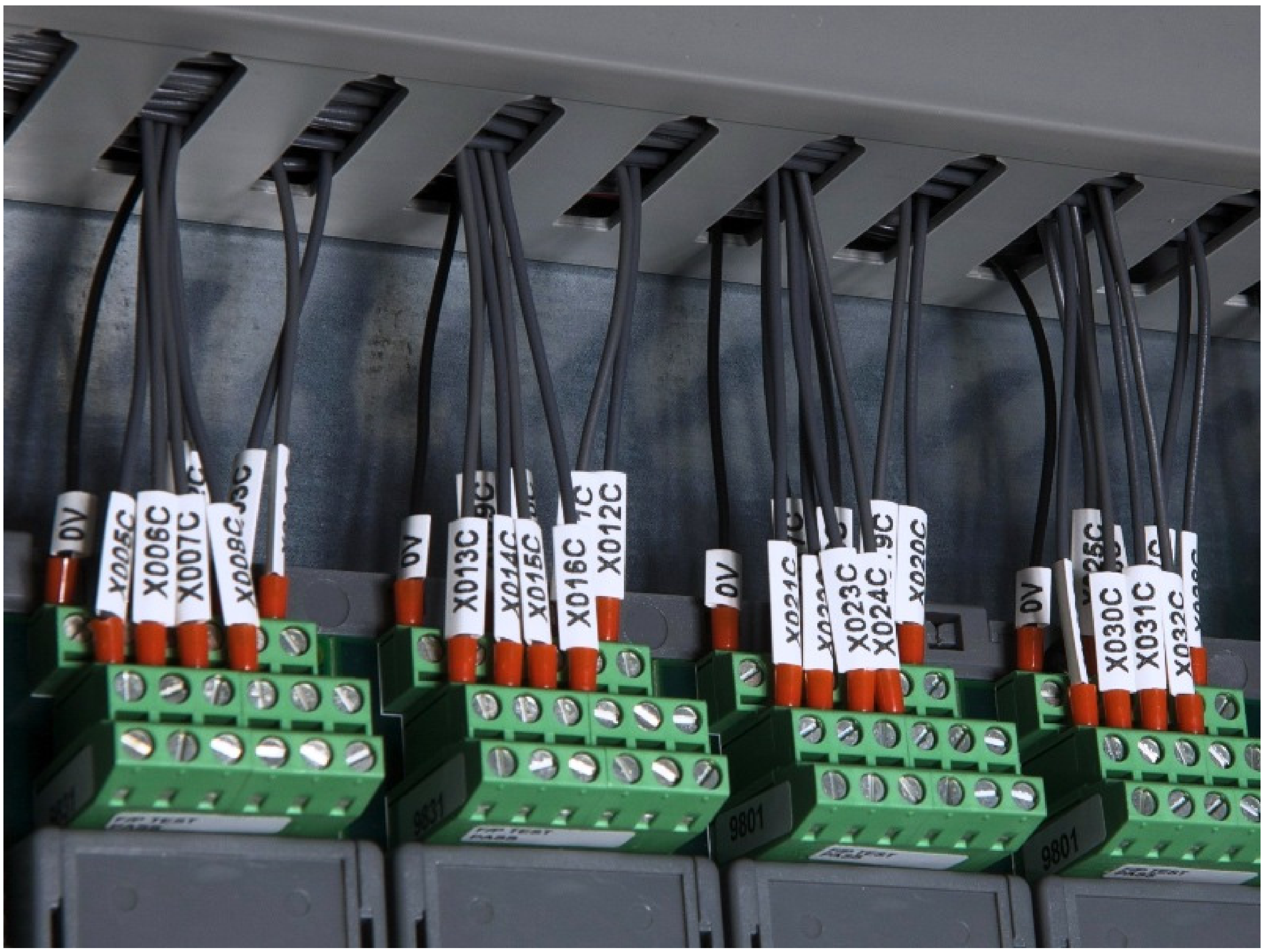
The electrical characteristics of the I/O bus interface limit the maximum possible length of either of the two I/O buses (the combination of I/O base units and expansion cables) to 8 meters (26.24 ft.).

NOTE The T9310 Expansion Cable is 2 m (6.56 ft.).

Adding Field Cable Management

The field, power and other system wiring will be connected to terminals along the top of the base units. It is recommended a length of cable trunking or the equivalent be put above each set of base units, for cable management.

Figure 13 - Field Wiring Connections



System Power Requirements

A controller's system power should be supplied from two different 24 Vdc (Nominal) power supplies with a common return path; that is, the 0 V return will be the same between the power feeds. Each controller also requires an external field power source for the field loops.

WARNING: A controller system must be installed with a power network that is designed to meet over voltage Category II

This means that a controller must be supplied with system power from a power source that complies with SELV and PELV standards.

- SELV (safety extra-low voltage) is a voltage which is no larger than 30 Vrms, 42.4 Vpeak and 60 Vdc between conductors, or between each conductor and earth in a circuit which is isolated from the line voltage by a safety transformer.
- PELV (protected extra-low voltage) is an extra low voltage circuit with a protective partition from other circuits which has a protective earth connection.

To satisfy SELV and PELV requirements the power source must have a safety transformer with a protective partition between the primary and secondary windings so that the windings are galvanic and electrically isolated.

Power Supply and Power Distribution Requirements

The power supplies and power distribution, if incorrectly designed, are a possible electrical or fire safety hazard and can contribute to common cause failure. It is therefore necessary to:

- Establish the power philosophy, specific earthing philosophy, power requirements, and the separation requirements where items of equipment are separately supplied, for example system internal supplies and field loop supplies.
- Make sure that the chosen Power Supply Units (PSUs) are compatible with the power feeds supplied. Alternatively, measures must be put in place to make sure that the power feeds stay within the specifications of the PSUs.
- Define the power distribution requirements, together with the protective philosophy for each distribution; for example, current limited at source or protective devices. Where protective devices are used, it is important to find out that sufficient current will be available to make sure their protective action and the protective device can break the maximum prospective fault current.
- Make sure that the power supplies are sufficient to meet the system load and for any foreseeable load requirements and load transients.
- Make sure that the power supplies have a minimum hold up time of 10 ms.
- Make sure that the power distribution cabling is sized to allow the maximum prospective fault currents and tolerable voltage losses. This is specifically important where floating supplies are employed and other power sources can cause high prospective fault currents if multiple earth faults occur.

Controller Power Supply Requirements

A controller requires the following power supply sources:

- A dual redundant power supply of + 24 Vdc with an operating range of 18 Vdc to 32 Vdc. The AADvance controller is designed to accept supply transient and interference according to IEC 61131 part 2.

An over current fault in the controller must not cause the system to lose power. Consequently, the power sources must be able to supply the peak current to open any over current protection devices (such as fuses) without failing.

The power supply protection of the controller is in the modules, the power distribution arrangement must have a circuit breaker on the input side of each power source. The controller is designed to be resistant to a reverse polarity connection without permanent damage.

The power sources must come from a commercially available industrial un-interruptible power supply (UPS) system. An applicable UPS must have the capacity sufficient to satisfy the entire system load (including field devices and the controller) and an applicable contingency allowance for projected future expansion.

WARNING: The power supplies must satisfy the electrical requirements and tests specified in IEC 61131 EN 61010-1 and EN 60950 and must be big enough for the system requirements.

Power Arrangements for Field Devices

Output modules use an external source of power for field devices. This may be the power source used for the controller or a separate power source.

- For digital and analogue outputs a field power supply of +24 Vdc within a range of 18-32 Vdc is required.

Recommended field circuits are given for each type of I/O module later in the section "Connecting Field Wiring".

IMPORTANT It is highly recommended that the negative side of the field supply be connected to earth (ground). This will avoid possible fail danger conditions that can be caused by some earth fault monitors used with floating power supplies.

Power Distribution Protection

The power distribution circuit for each field input and for each output module must be protected, externally to the controller. Rockwell Automation recommend that power distribution must meet national and local panel wiring protection standards.

Digital Output Field Power

Special fusing arrangements are required for Digital Output field supplies for UL, ATEX and IECEx approved installations, (see topic on field loops for Digital Output Modules).

Estimating Power Consumption

To estimate the power supply requirements (power supply sizing) you need to know the power consumption of all the modules. Use the following table to estimate the system power consumption.

Table 6 - Module Supply Power Consumption

Item	Number of Modules	Power Consumption	Subtotal
T9110 Processor Module		× 8.0 W	=
T9401 Digital Input Module 24 Vdc, 8 channel		× 3.3 W	=
T9402 Digital Input Module 24 Vdc, 16 channel		× 4.0 W	=
T9431 Analogue Input Module, 8 channel		× 3.3 W	=
T9432 Analogue Input Module, 16 channel		× 4.0 W	=
T9451 Digital Output Module, 24 Vdc, 8 channel		× 3.0 W	=
T9482 Analogue Output Module, 8 channel, isolated		× 3.6 W	=
		Total:	

IMPORTANT	The above figures are worst case values calculated from the range of operating voltages and currents. If your system is required to meet UL/CSA standards the power consumption and the corresponding electrical ratings must not exceed the maximum electrical ratings given in the table included in the topic "Backplane Electrical Ratings".

Field Power Consumption

To estimate overall controller power dissipation it is necessary to include the field power component dissipated within the controller. Refer to the table "Field Loop Power Heat Dissipation". The field power requirements should be calculated separately and is dependent on the number and type of field elements. Refer to the specifications for the Digital and Analogue output modules for details of the channel output electrical specifications.

System Design Considerations for Heat Dissipation and Cooling

The controller is designed to operate in its specified environment without forced air cooling. However, forced air cooling may be needed in individual circumstances when the controller shares its enclosure with other heat producing equipment and the internal temperature could exceed the recommended operating temperature range.

Module Orientation

Rockwell only recommend that modules are oriented vertically, if modules are mounted in any other orientation then specific temperature tests must be done to achieve reliable and predictable operation.

Maximum Air Temperature

The maximum air temperature rating in an enclosure where AADvance modules are installed to support predictable operation is 70 °C (158 ° F).

Estimate Heat Dissipation

The heat in the enclosure is generated from several sources such as the power supplies, the AADvance modules and some of the field loop power. Use the following calculation and the data given in the tables to estimate the overall heat dissipation:

- Power supply consumption (Watts x (100-efficiency) (%) + the sum of the system power consumed by the modules + part of the field power that is in the enclosure.

The following module power dissipation values are worst case values over the range of operating voltages and currents.

Table 7 - Module Supply Power Heat Dissipation

Item	Number of Modules	Module Power Heat Dissipation	Subtotal (W/BTU/hr)
T9110 Processor Module		× 8.0 W (27.3 BTU/hr.)	=
T9401 Digital Input Module 24 Vdc, 8 channel		× 3.3 W (11.3 BTU/hr.)	=
T9402 Digital Input Module 24 Vdc, 16 channel		× 4.0 W (13.6 BTU/hr.)	=
T9431 Analogue Input Module, 8 channel		× 3.3 W (11.3 BTU/hr.)	=
T9432 Analogue Input Module, 16 channel		× 4.0 W (13.6 BTU/hr.)	=
T9451 Digital Output Module, 24 Vdc, 8 channel		× 3.0 W (10.2 BTU/hr.)	=
T9482 Analogue Output Module, 8 channel, isolated		× 3.6 W (12.3 BTU/hr.)	=
		Total:	

The field loop power heat dissipation is generated from the input voltages and currents + the output currents:

Table 8 - Field Loop Power Heat Dissipation

Item	Number of Field Loops	Field Loop Power Heat Dissipation	Subtotal (W x 3.412 BTU/hr)
Digital Inputs		× Input Voltage (V)/5125	=
Analogue Inputs		× Input current (A) x 135	=
Digital Outputs		x Output current (A) x 0.57	=
Analogue outputs		x (Field voltage(V) x Output Current (A) - load Resistance (Ω) x Output current (A) [1]	=
		Total:	

[1] The maximum field loop power heat dissipation for analogue outputs should be calculated at an output current corresponding to the smaller of the Maximum Channel Output Current OR Field Voltage/(2 x Load Resistance)

Estimate AADvance Controller Weight

Use the following table to make an estimate of the weight of your controller.

Table 9 - AADvance Controller Module Weight

Item	Number Used	Weight Allowance g (oz.)	Subtotal
T9100 Processor Base Unit		× 460 g (16 oz.)	
T9110 Processor Module		× 430 g (15 oz.)	
T9401 Digital input module, 24 Vdc, 8 channel		× 280 g (10 oz.)	
T9402 Digital input module, 24 Vdc, 16 channel		× 340 g (12 oz.)	
T9431 Analogue input module, 8 channel		× 280 g (10 oz.)	
T9432 Analogue input module, 16 channel		× 340 g (12 oz.)	
T9451 Digital output module, 24 Vdc, 8 channel		× 340 g (12 oz.)	
T9482 Analogue output module, 8 channel		× 290 g (10.5 oz.)	
T9300 I/O base unit (3 way)		× 133 g (5 oz.)	
T98x1 Simplex Termination assembly		× 133 g (5 oz.)	
T98x2 Dual Termination Assembly		× 260 g (10 oz.)	
T98x3 Triple Termination Assembly		× 360 g (13 oz.)	
T9310 Expansion cable assembly and 2 m cable		× 670 g (24 oz.)	
T9841 Termination Assemblies (average weight)		× 175 g (6 oz.)	
		Total estimated controller weight	

Estimating Center of Gravity Information

If it is necessary to calculate the location of the center of gravity of an AADvance controller destined for a maritime or other shock-mounted application, it is reasonable to assume the center of gravity of each assembly of modules and their base unit is at the geometric center of the assembly.

Design Considerations for Electrical Grounding

All applications of the controller will require at least two separate ground (earth) systems:

- An AC safety ground (sometimes called the 'dirty ground') to protect people in the event of a fault. The ground stud on the T9100 processor base unit, and all exposed metalwork such as DIN rails, will be bonded to the AC safety ground.
- An instrument ground (sometimes called the 'clean ground' or the '0 Vdc ground') to provide a good stable 0 V reference for the system. Every signal return will be referenced to the instrument ground. The instrument ground will be isolated from the AC safety ground.

The AC safety ground and the instrument ground will usually be made available through bus-bars. Bus-bars must be of copper; they may be nickel plated. For a small application, you may use ground studs instead of bus-bars.

Some field wiring, such as communications cables, will need shielded (screened) cable. There may be a shield ground, in addition to the AC safety and instrument grounds, to provide a common point to terminate shields of such cables. The shield ground will usually be connected to the AC safety ground; or, more rarely, to the instrument ground. In practice, the continuity of the shield connections will be more important than the goodness of the ground connection provided.

The controller input and output modules incorporate galvanic isolation. Nevertheless, it is possible that a particular application will require the provision of barrier strips with galvanic isolation, for example to provide consistency with an existing installation. In these cases, there may be a separate intrinsic safety ground as well.

Specify software requirements

For information about supported operating systems and other software product version support, refer to product release notes from the Product Compatibility and Download Center (PCDC): rok.auto/pcdc.

Design Considerations for Maintenance Activities

Maintenance Activities

The design of the installation must allow preventive and corrective maintenance activities to take place. Corrective maintenance tasks will embrace the identification and renewal of defective modules and other assemblies and, when exhausted, renewal of the back-up battery within the T9110 processor module.

Fuses on the termination assemblies can be replaced so access to the fuses is required. There are no user-serviceable parts inside modules therefore repair is by replacement; defective modules should be returned to Rockwell Automation for investigation and repair.

WARNING: EXPLOSION HAZARD
Do not connect or disconnect equipment, while the circuit is live or unless the area is known to be free of ignitable concentrations or equivalent.

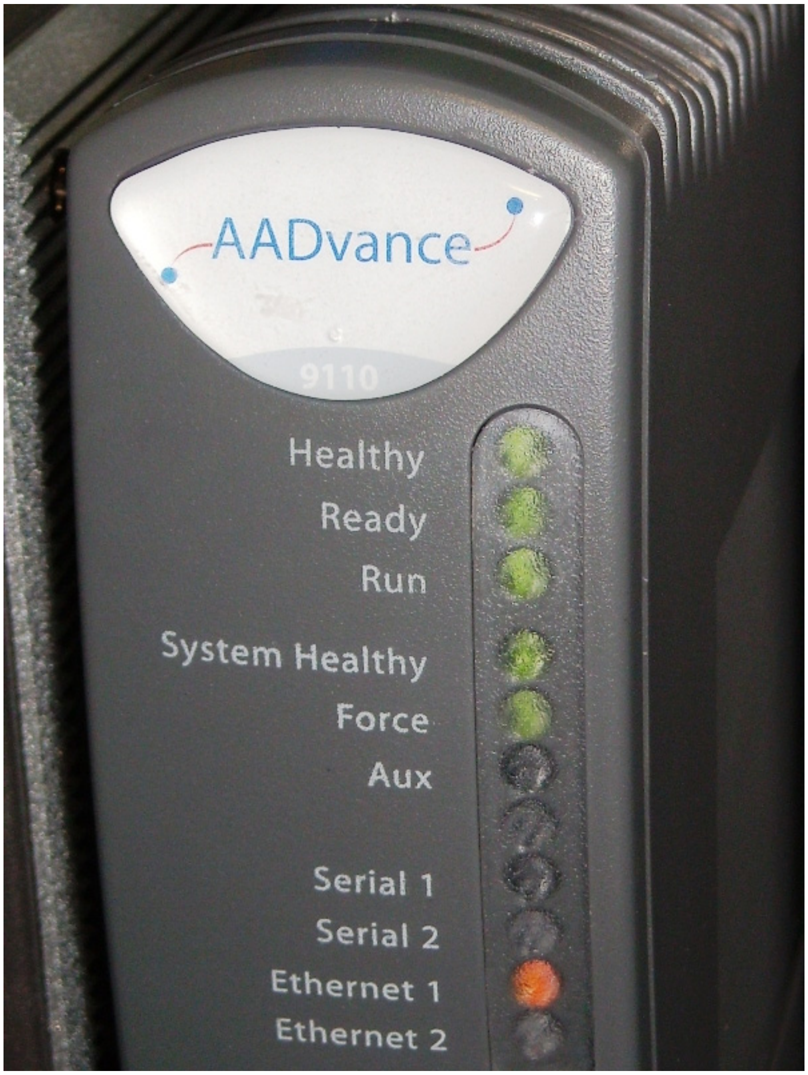
AVERTISSEMENT: RISQUE D'EXPLOSION
Ne pas connecter ou déconnecter l'équipement alors qu'il est sous tension, sauf si l'environnement est exempt de concentrations inflammables ou équivalente.

Design Provisions

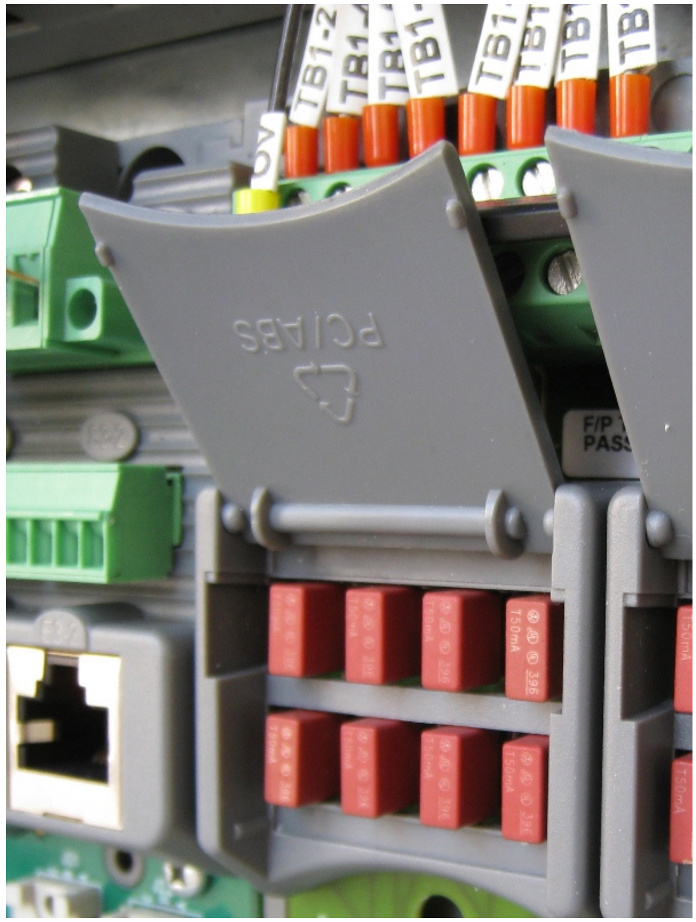
The design of the controller installation should make the following provisions:

- Clear access to remove and install modules, termination assemblies, base units and security dongle (Program Enable key). Repair of controller modules will be by module replacement.

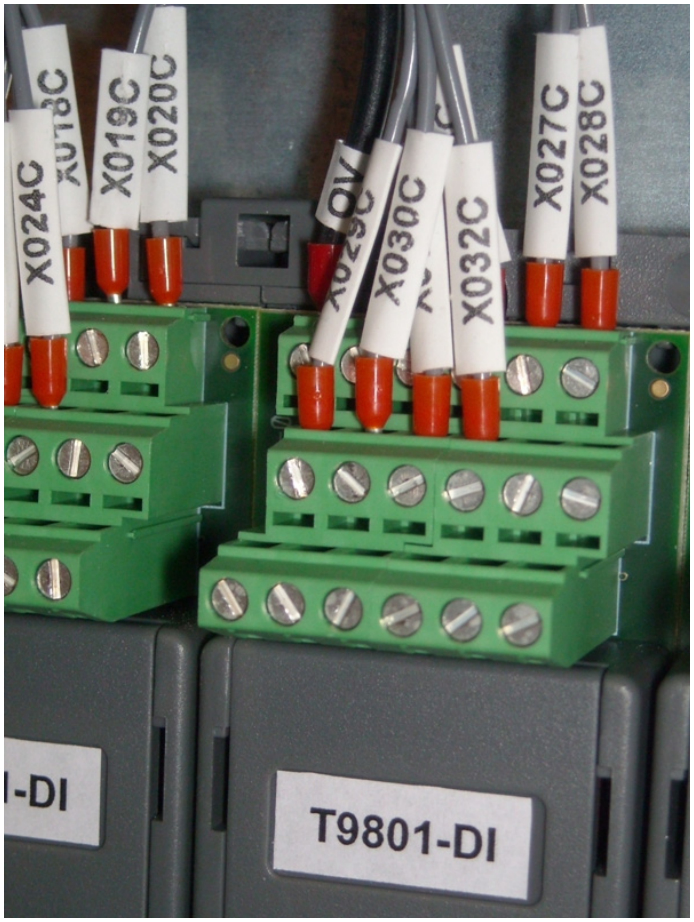
A way for plant operations personnel to inspect the status LEDs on each module. The status LEDs report faults.



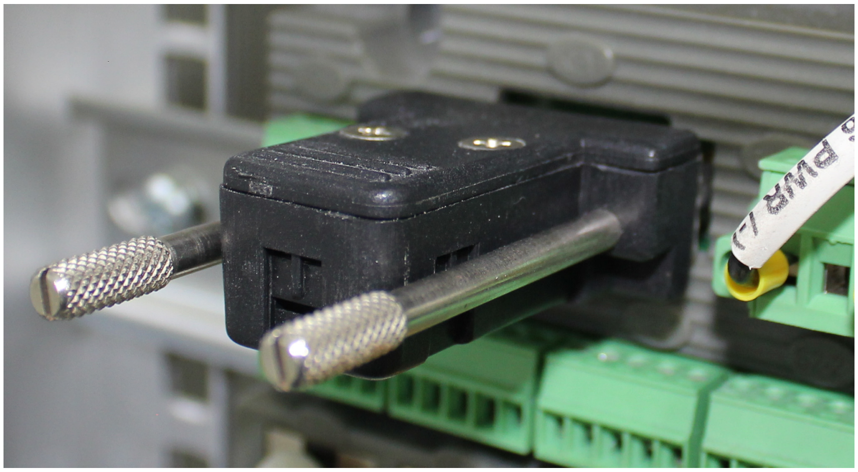
Clear access to examine, remove and install fuses located on the termination assemblies.



Clear access to terminals and connectors for field, power and network wiring, and access to the wiring itself.



Clear access to the Security Dongle (Program Enable Key)



In addition, it may be appropriate to make the following provisions:

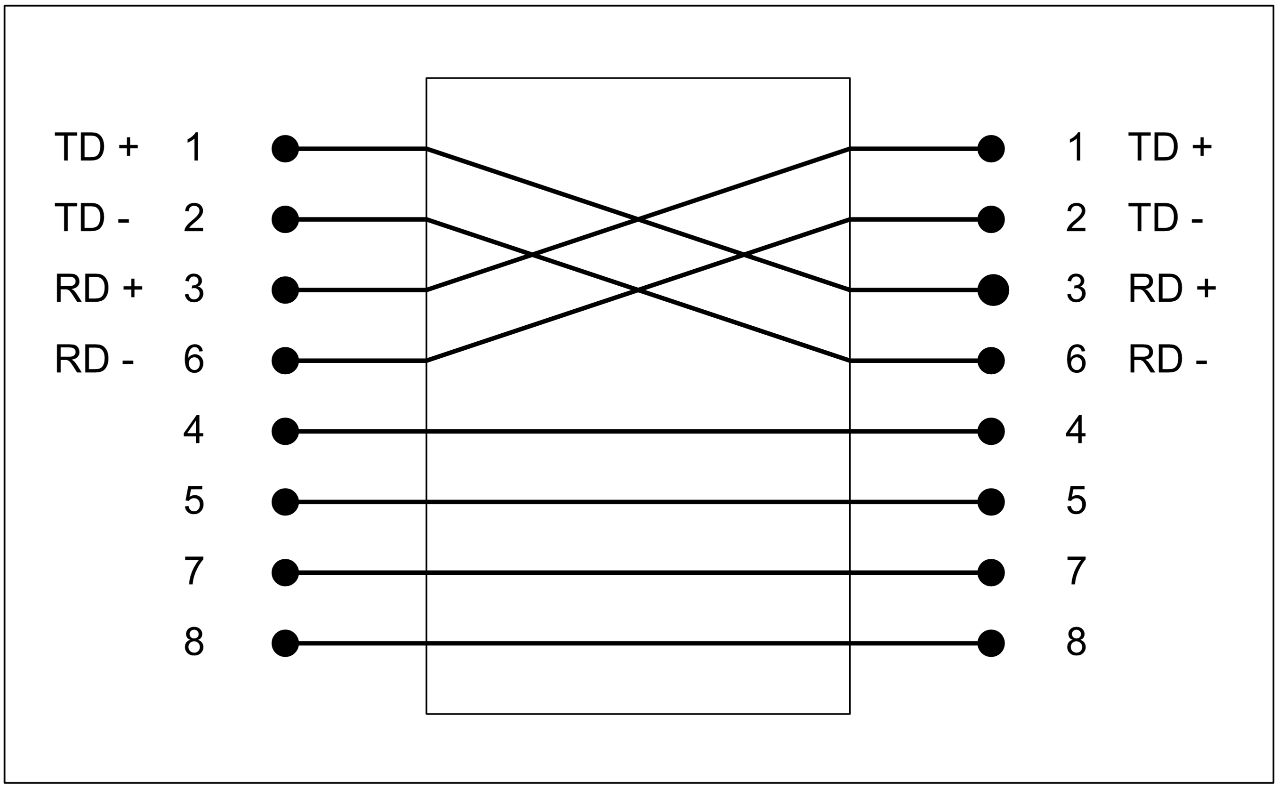
- A lock on the door of the enclosure, to deter unauthorized access and possible unofficial modifications.
- Lighting.
- Utility sockets.

Connecting the AADvance Controller to the Network

The T9100 processor base unit has six auto-sensing 10/100BASE-TX Ethernet ports which allow it to connect to a local area network through standard Rj45 Ethernet cable. These are two ports for each processor module.

If a direct connection is required from the controller to the computer (for example, during setting up) use a crossover cable. This will depend on the characteristics of the network interface in the PC.

Figure 14 - Wiring for 100BASE-TX Ethernet Crossover Cable

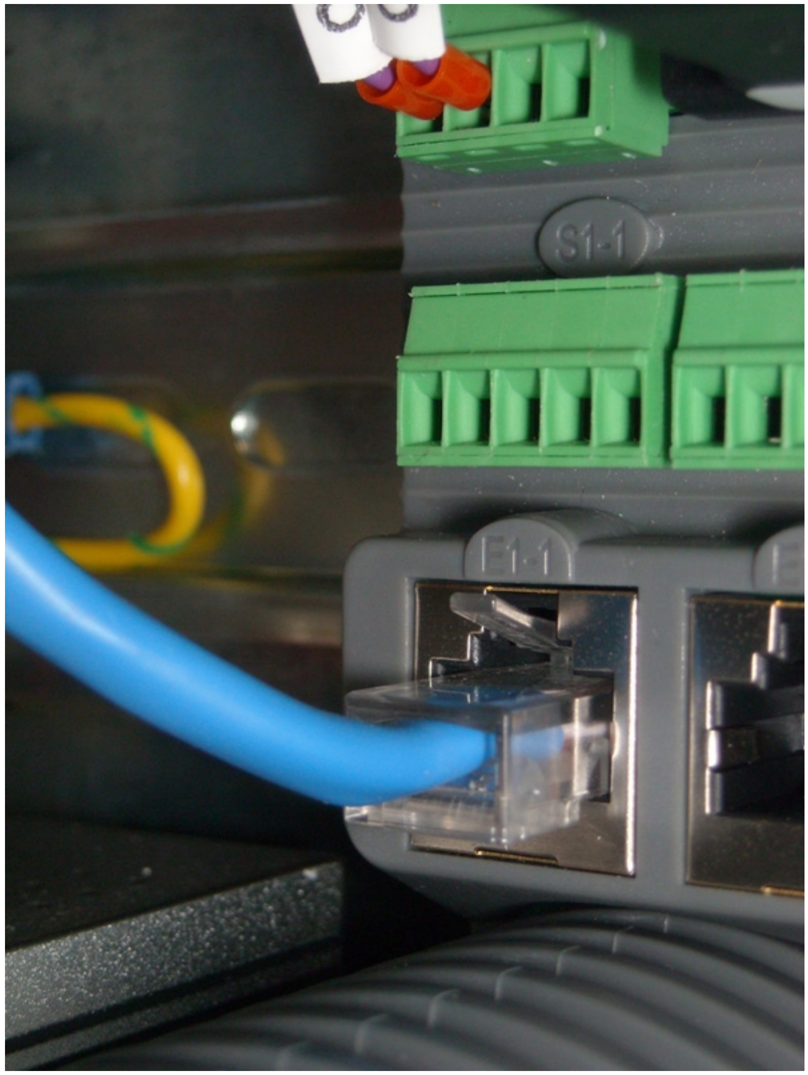


The fixed connectors on the controller are RJ45 sockets. Use Cat5e (enhanced) cables with RJ45 modular plugs for the network cabling.

Connect the network cables to the sockets on the T9100 processor base unit.

- For each network connection, insert the RJ45 modular plug on the cable into the appropriate socket.
- Make sure the length of the cable does not exceed 100m (328 ft).

Refer to the illustration for an example.


S1-1
E1-1

Notes:

Install the AADvance System

The system installation defines the steps that will verify that the system is correctly installed and ready for the on-site factory tests before the system is brought on-line. This chapter describes how to install the AADvance® system hardware into the chosen enclosure.

WARNING: In addition to the installation guidelines given in this chapter you must also use installation and commissioning procedures that obey the rules and standards of the country of installation. These standards can include for example, IEC 61511, NFPA72 and ISA 84.00.01 depending on the location.

Unpacking and Preassembly Checks

The components are packed to make sure they arrive undamaged and ready for assembly. Nevertheless, you should inspect all modules before beginning the assembly work.

On receipt, carefully inspect all the shipping cartons for damage.

- If any cartons are damaged, note the damage on the carrier's shipping document before signing it. Save any damaged cartons for inspection by the carrier.
- If any part of the delivered components has been damaged during shipping, notify the carrier and Rockwell Automation immediately.

Damaged goods must be returned Rockwell Automation for repair or replacement (see Warranty and Returns instructions with delivery documentation).

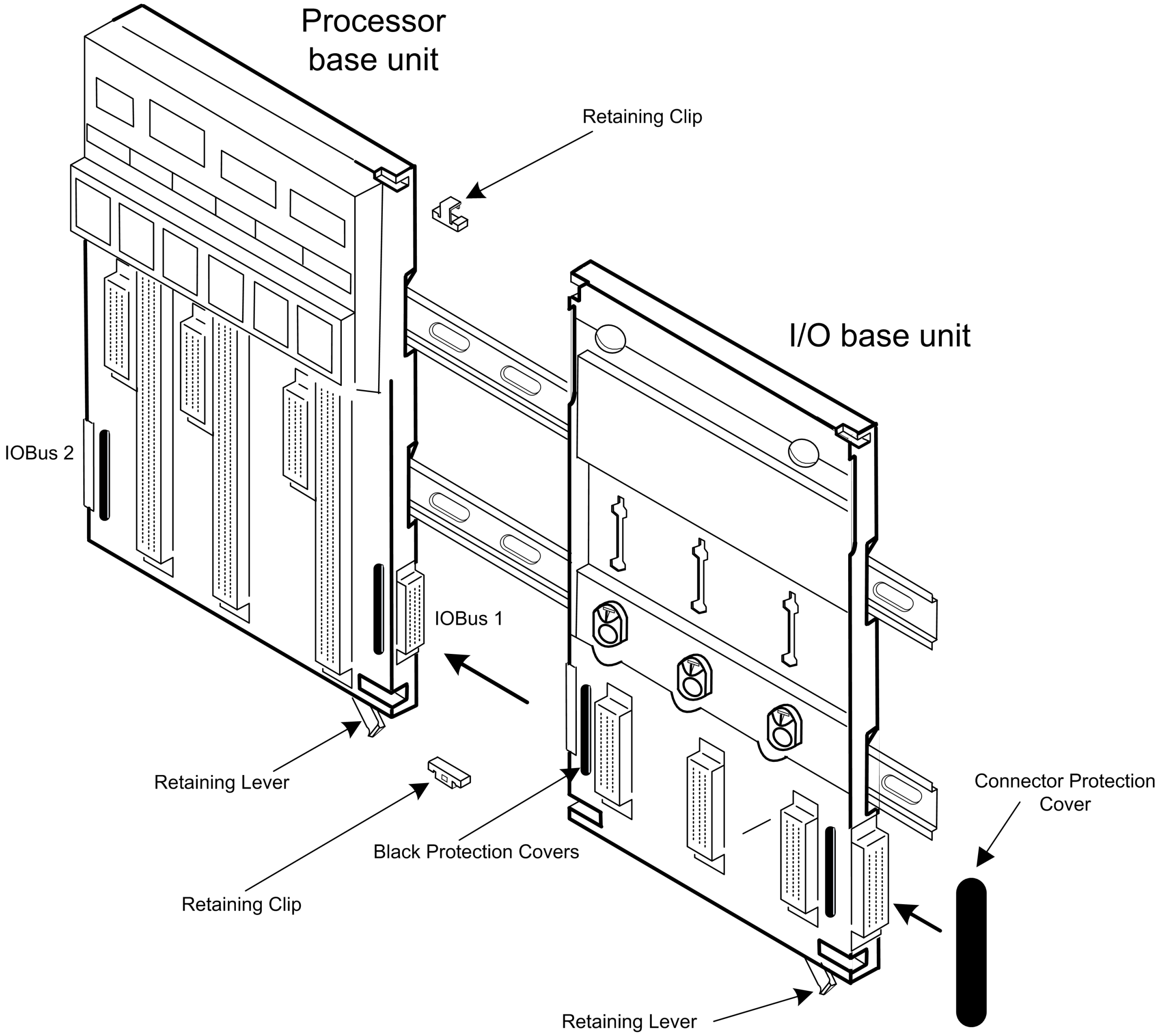
CAUTION: Handling Modules Stored at Extreme Temperatures:
It is recommended that modules removed from storage should be allowed to normalize their temperature before installation. This is particularly important when modules have been stored at very low temperatures where condensation can occur. Remove the modules and place them in an upright position and wipe away any condensation that might appear on the modules.

Failure to follow these recommendations could lead to damage to modules or incorrect operation when installed into a running system.

Install Base Units and Termination Assemblies: Enclosure DIN Rail Assembly Method

The following illustration shows how to it the backplanes on to Din rails and use the retaining clips and lever to hold them in position.

Figure 15 - Fit I/O Base Unit onto DIN Rails



IMPORTANT	Fit the rubber connector protection cover to exposed connectors that are not joined to another base unit.

For a system build that uses DIN rails do the following:

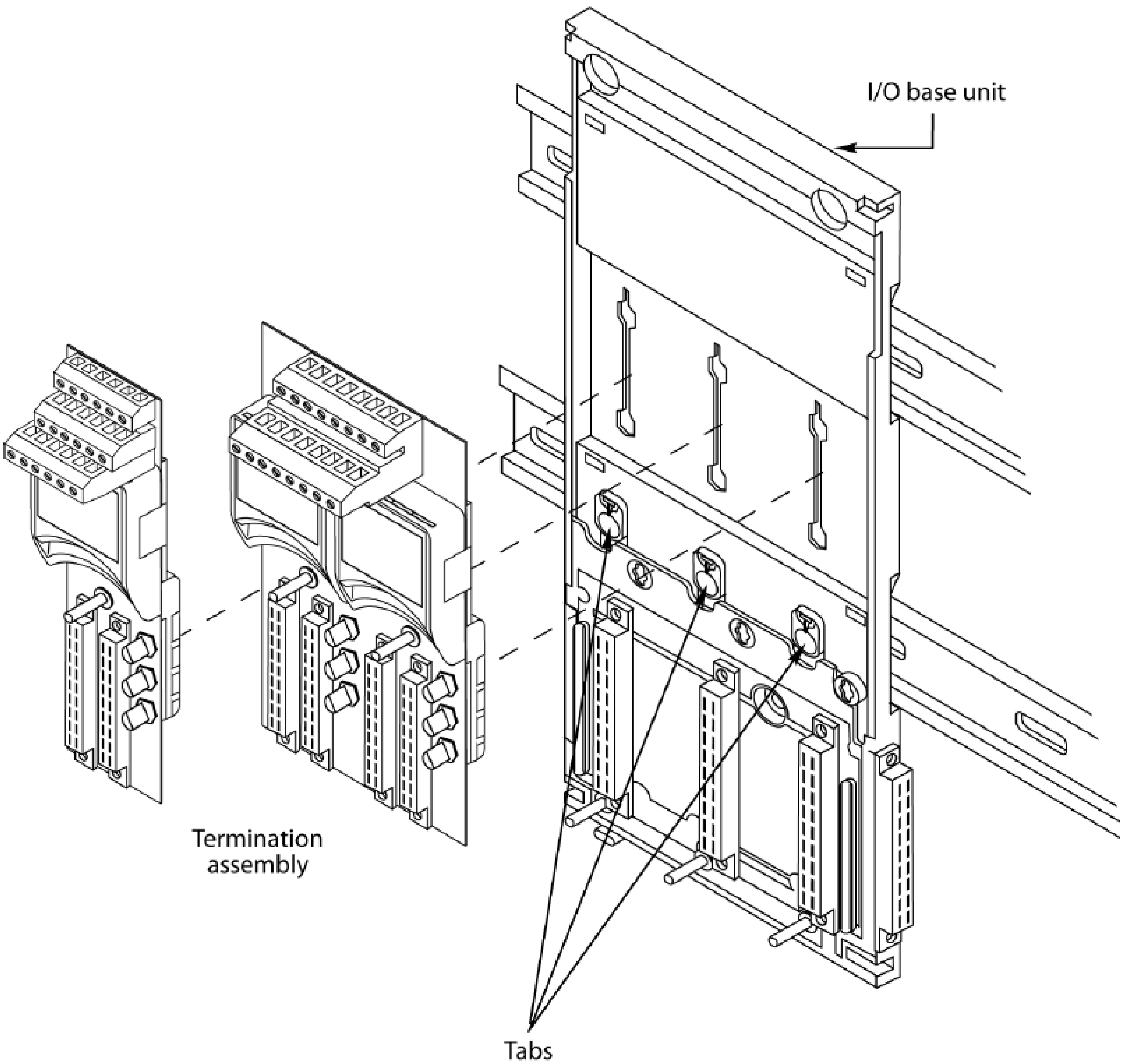
1. Install the **DIN rails**.
   - The AADvance controller will be mounted onto one or more pairs of parallel DIN rails. For each pair of rails, mount the lower rail with its center line 101.0mm below the center line of the upper rail. M5 thread rolling screws are suitable.
2. Mount the **T9100 processor base unit**
   - Place the **T9100 processor base unit** onto the **DIN rails** and position it towards the left, leaving space for the T9300 I/O base units to the right.
   - Secure the **processor base unit** onto the **DIN rails** by sliding the retaining lever (below the base unit) to the left.
3. Mount each **T9300 I/O base unit**
   - Place a **T9300 I/O base unit** onto the **DIN rails** to the right of the T9100 processor base unit.

- Slide the **I/O base unit** to the left until the joining connectors are fully mated.
- Insert the **retaining clips** at the top and bottom of the **base units**.
- Secure the **I/O base unit** onto the **DIN rails** by sliding the retaining lever (below the base unit) to the left. Then insert the **backplane clips** into the top and the bottom slots.

4. Mount **end stops** onto **DIN rails**.
   - Install two **end stops** onto the **upper DIN rail**, one at each end of the assembly.

Fitting Termination Assemblies

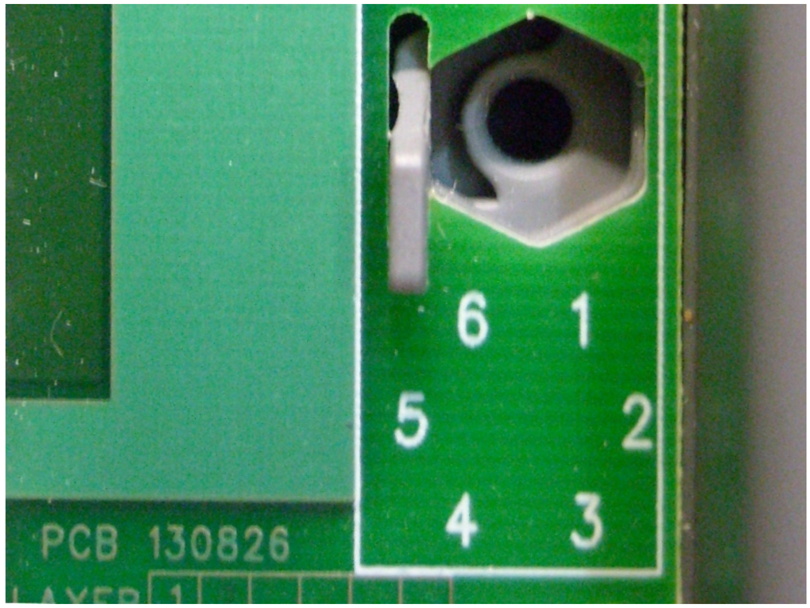
Figure 16 - How to Fit Termination Assemblies



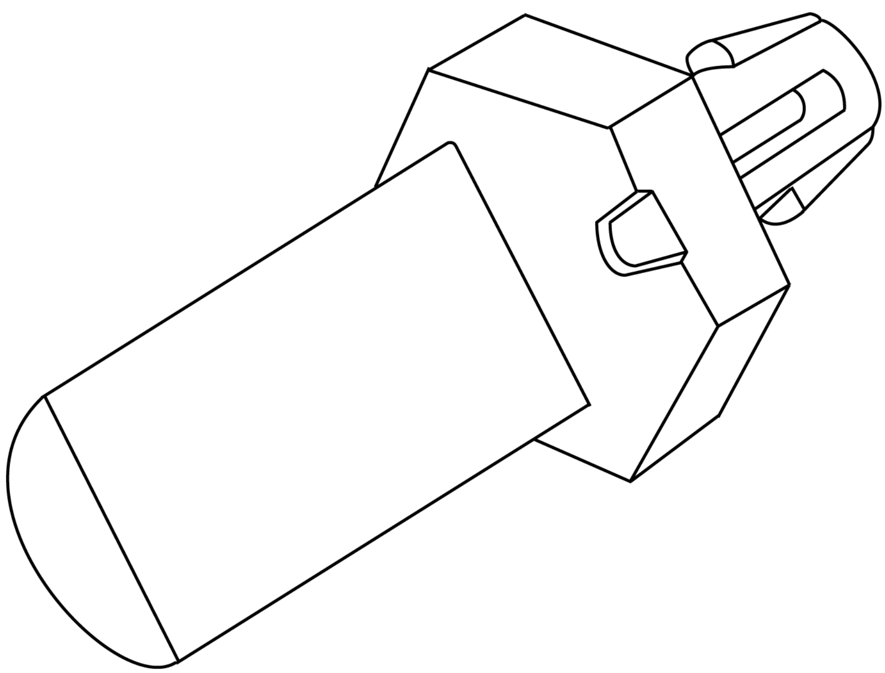
1. To fit termination assemblies do the following:

- Insert the **retaining clip** on the back of the termination assembly into the **slot** on the I/O base unit. Press the **termination assembly** onto the **base unit** and then slide the **assembly** upwards as far as it will go.
- Make sure the **retaining tab** clips over the **printed circuit board** to secure the termination assembly in position.

2. Check **coding pegs**.
   - Observe the **legend** on the T9100 processor base unit (and repeated on some termination assemblies) which defines the six possible positions for a coding peg. The positions are numbered from 1 to 6.



   - Examine a **coding peg** (fitted) and identify the index recess on the hexagonal flange.



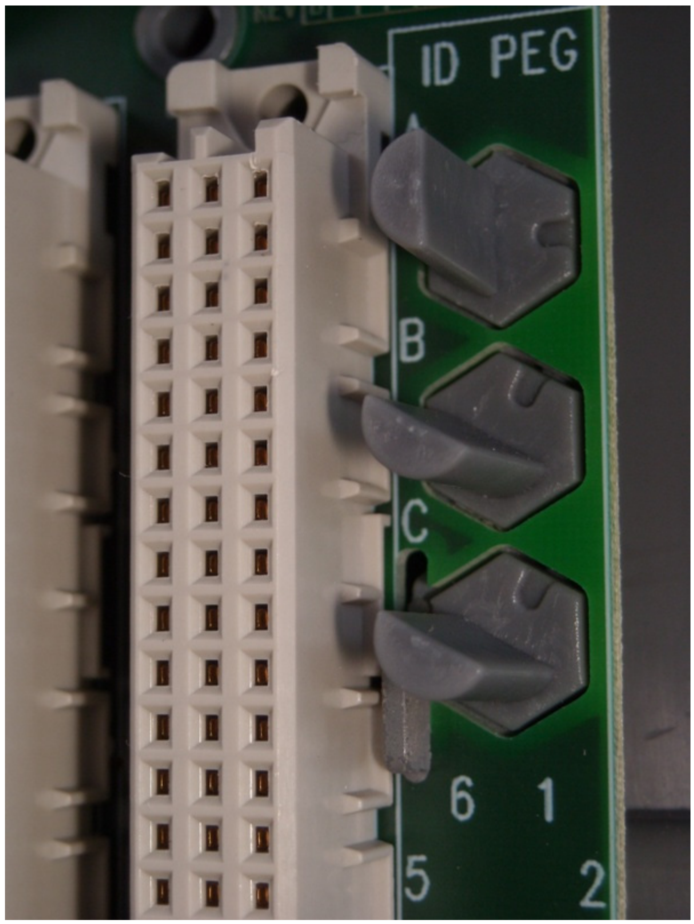
   - Refer to the **following table** and verify each **coding peg** is fitted so its index recess is adjacent to the relevant numbered position.

Allocations of Coding Pegs

Coding pegs are assigned to each module type as shown in the following table:

Application	Key A	Key B	Key C
T9100 processor base unit (for T9110 processor module)	1	1	1
T9801/2/3 digital input termination assemblies (for digital input modules)	2	1	1
T9831/2/3 analogue input termination assemblies (for analogue input modules)	2	1	3
T9851/2 digital output termination assemblies (for digital output modules)	3	1	1
T9842/1 analogue output module	3	1	2

This example shows pins set to positions 2, 1, 1 for a T9401 digital input module.



Connect the AC Safety Ground Connection

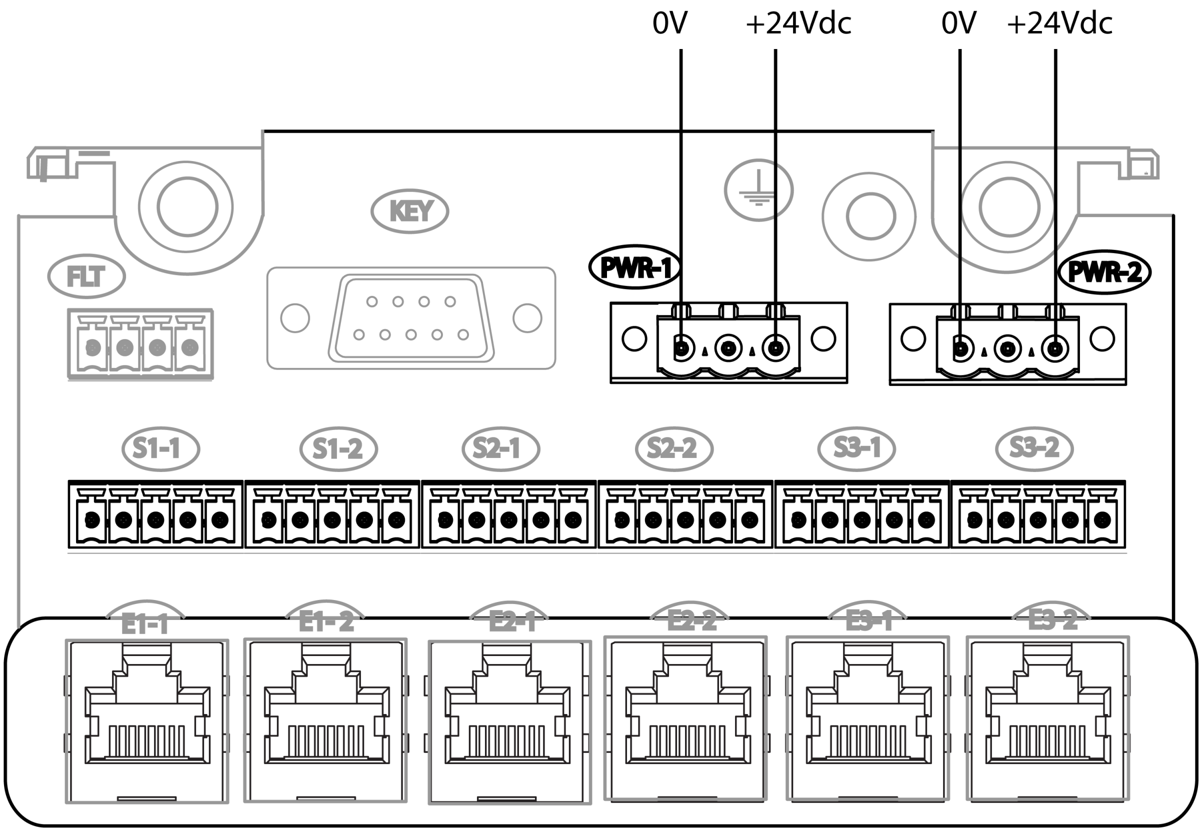
The T9100 processor base unit has a ground stud which must be connected to the AC safety ground. Connect the **ground stud** to the **AC safety ground bus-bar** of the system or panel.

- Conductor wire must be a minimum of 12 AWG (3.31 mm2) with a temperature rating of 85 °C.
- Use a **M6 lug** on the end of the ground wire.
- Place the **lug** below the second nut on the ground stud, between two washers, and use **two 10mm wrenches** to tighten the nuts to a torque of 1.2 Nm to 2 Nm (0.88 lb./ft. to 1.48 lb./ft.).

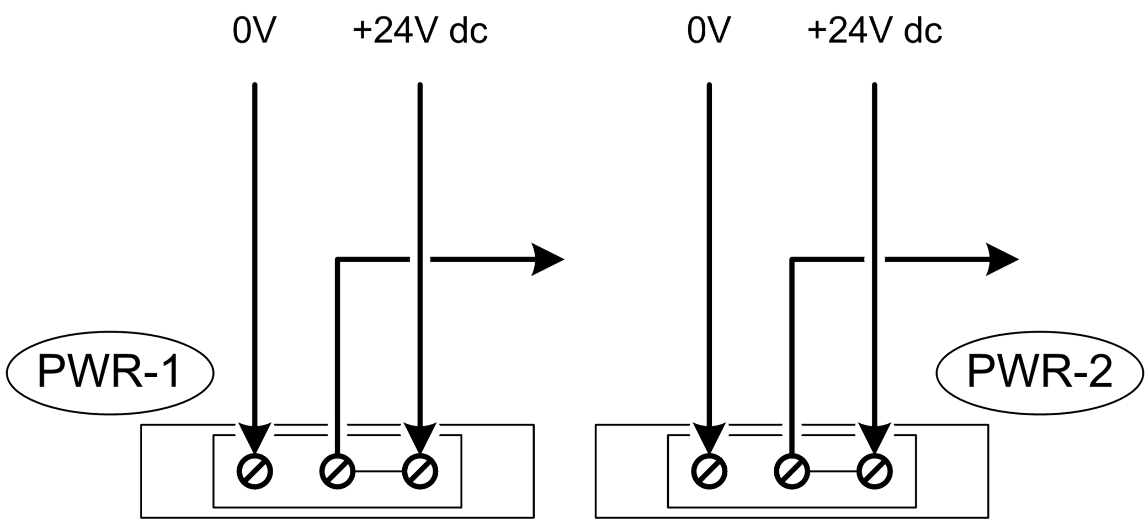
Refer to the **photograph** of the 24 Vdc Power Connectors the earth stud is shown between the two power leads.

Connect the 24 Vdc System Power to an AADvance Controller

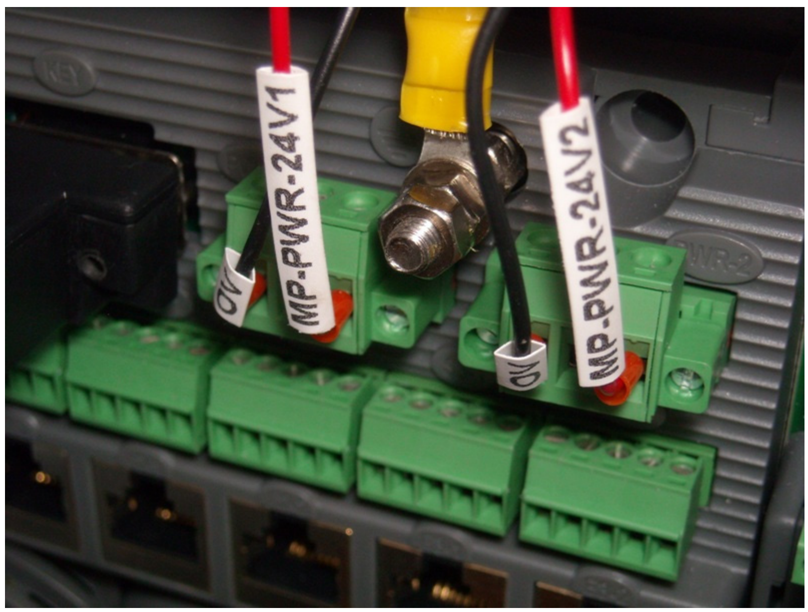
The dual redundant +24 Vdc system power, taken from the chosen power source, is connected to the controller at two plugs labeled PWR-1 and PWR-2 on the processor base unit:



The processor base unit has a link between the +24 Vdc connections to the center terminal of each connector PWR-1 and PWR-2. This link may be useful to connect the +24 Vdc supply to further devices:



24 Vdc Power Connectors



For each power supply connection, do the following:

- Connect the **negative line** from the power supply, typically labeled '0 V', to the left-hand terminal.
- Connect the **positive line** from the power supply, typically labeled '+24 V', to the right-hand terminal.
- Apply a minimum tightening torque of 0.5 Nm (0.37 ft. lb.) to the **terminal screws**.

IMPORTANT	Make sure that PWR-1 and PWR-2 are supplied from independent 24 Vdc sources.

Procedure to Connect Serial Communications Cabling

The serial ports (S1-1 and S1-2; S2-1 and S2-2; S3-1 and S3-2) support the following signal modes depending on use:

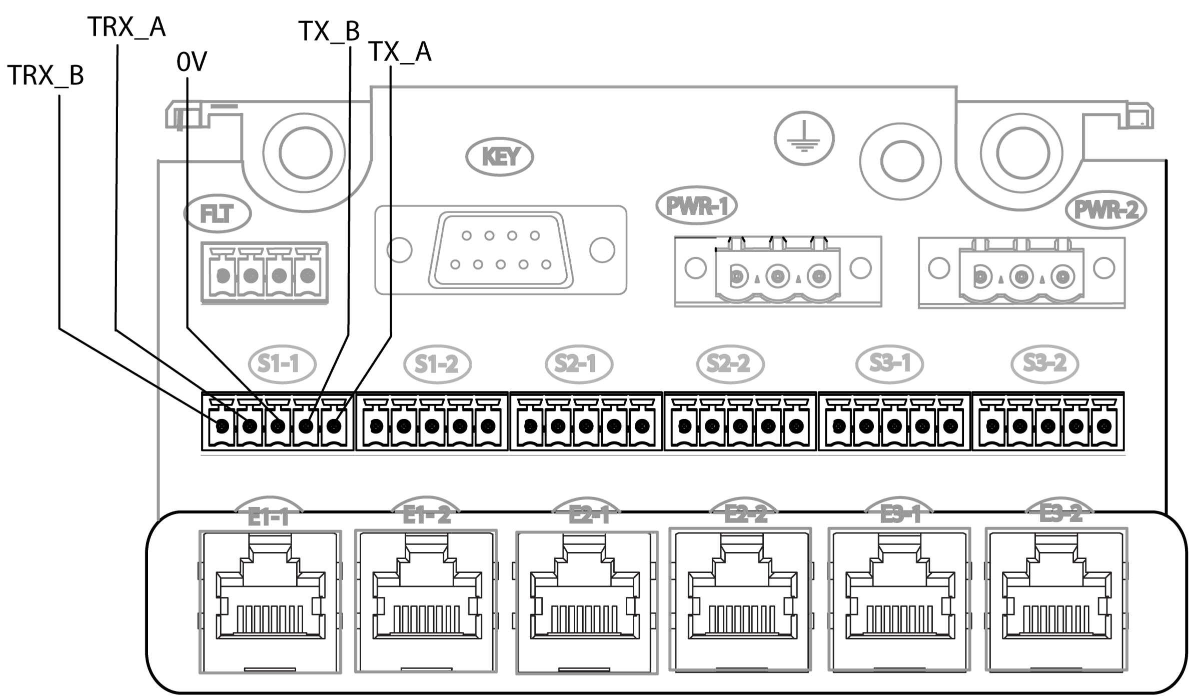
- RS485fd: A four-wire full duplex connection that features different busses for transmit and receive. This selection must also be used when the controller is acting as a MODBUS Master using the optional four-wire definition specified in Section 3.3.3 of the MODBUS-over-serial standard.
- RS485fdmux: A four-wire full-duplex connection with tri-state outputs on the transmit connections. This must be used when the controller is acting as a MODBUS Slave on a four-wire bus.
- RS485hdmux: A two-wire half duplex connection applicable for master slave or slave use. This is shown in the MODBUS-over-serial standard.

Each processor uses the two serial ports above it on the baseplate. Data is not mirrored between ports. Therefore a single processor system has two ports available, a dual processor system has four ports and a triple processor system has six ports available to it.

Connect the serial communications cabling to the six plugs labeled S1-1 through S3-2 on the T9100 processor base unit.

- For each **serial communications connection**, connect the **cabling** according to the following Serial Communications Illustration.
- Apply a minimum tightening torque of 0.22 Nm (0.16 ft. lb.) to the **terminal screws**.
- Make sure the length of the **cable** does not exceed 1,200 m (3,900 ft.).

Serial Communications Illustration



Terminal	Function Description (4-wire)(1)	Function Description (2-wire)(1)
TRX_A	Receive data A (inverting)	Transmit/receive data A (inverting)
TRX_B	Receive data B (non-inverting)	Transmit/receive data B (non-inverting)

Terminal	Function Description (4-wire)(1)	Function Description (2-wire)(1)
0V	Instrument ground (signal ground)	Instrument ground
TX_B	Transmit data B (non-inverting)	not used
TX_A	Transmit data A (inverting)	not used

(1) The line functions shown in the table ("receive" and "transmit") are with respect to the processor base unit.

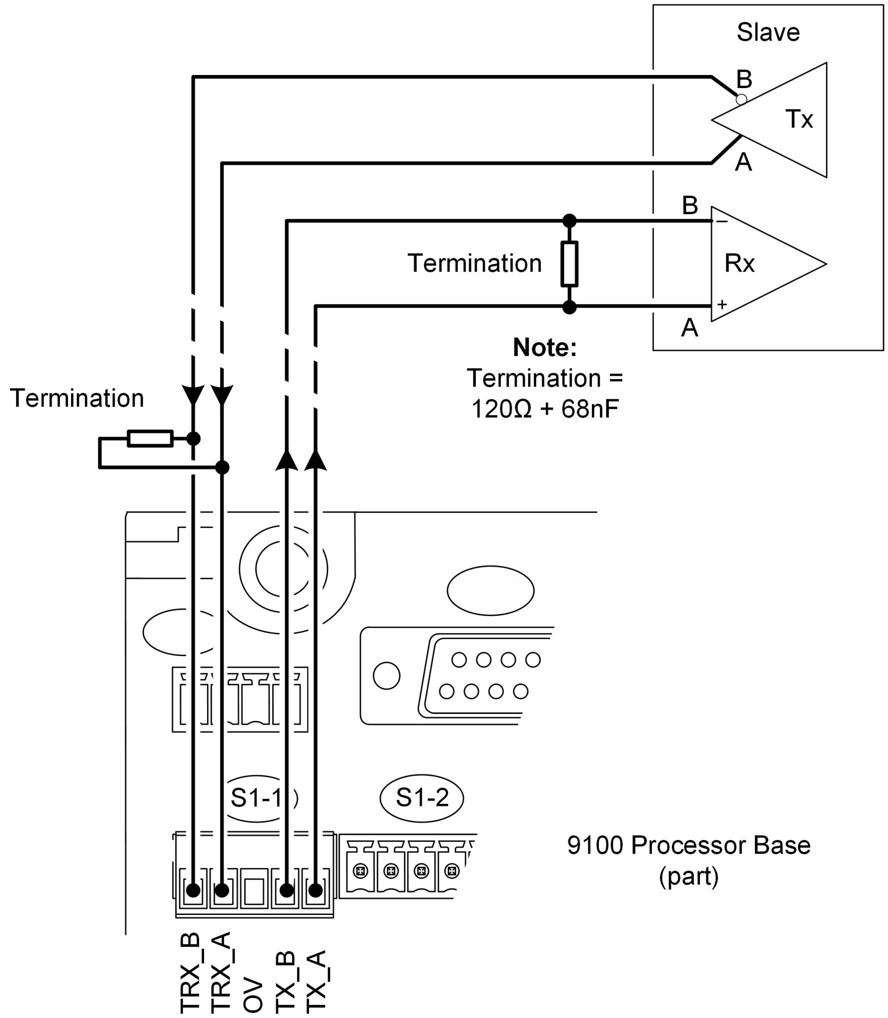
NOTE To connect to the external communication link you should terminate the receive end of the twisted pairs with a 120 Ω resistor in series with a 68nF capacitor at the receiver ends.

Connecting MODBUS Slave Devices to Serial Ports

You can use a full duplex or a half-duplex connection for a MODBUS Slave device on a serial port.

Connect a Slave Device, Full Duplex

You can use a full duplex serial connection to connect one MODBUS Slave device to the AADvance controller. To make the physical connection, do the following:



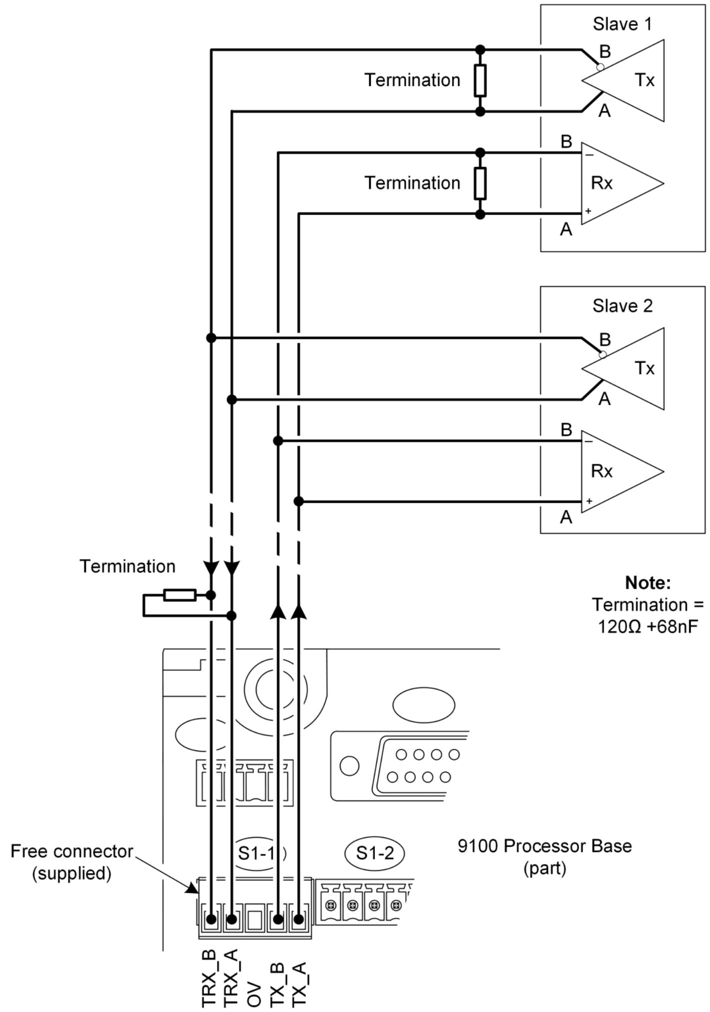
1. Select an applicable cable. We recommend 3-pair, overall shielded cable.
2. Remove the serial port connector from the T9100 processor base unit.
3. Make the connections shown in the illustration. Terminate the twisted pairs with a 120 Ω resistor in series with a 68 nF capacitor at the receiver ends.
4. Connect the signal ground (not illustrated) from the 0 V terminal to the slave device.

IMPORTANT	Do not connect the signal ground to the AC safety ground.

5. Insert the connector into the T9100 processor base unit.

Connect Multiple Slave Devices, Full Duplex

You can use a full duplex serial connection to connect multiple MODBUS Slave devices to the AADvance controller. To make the physical connection, do the following:



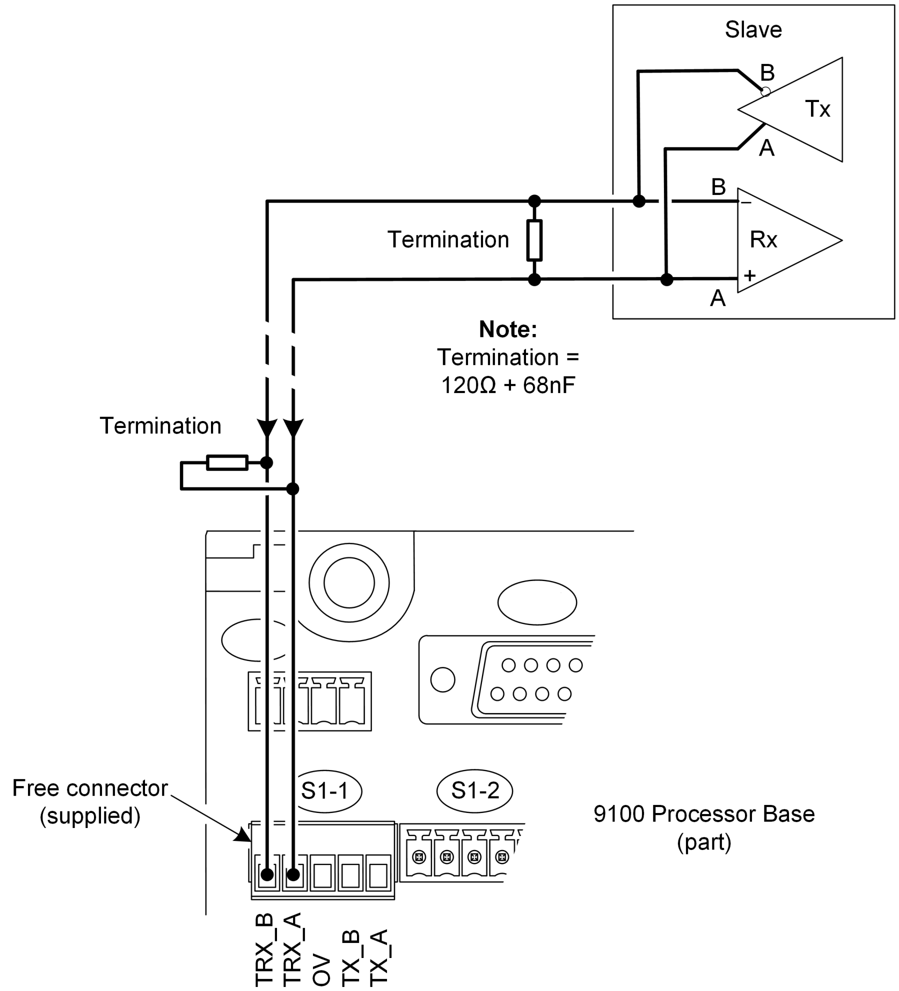
1. Select an applicable cable. We recommend 3-pair, overall shielded cable.
2. Remove the serial port connector from the T9100 processor base unit.
3. Make the connections shown in the illustration. Terminate the twisted pairs with a 120 Ω resistor in series with a 68 nF capacitor at the receiver ends.
4. Connect the signal ground (not illustrated) from the 0 V terminal to the slave device.

IMPORTANT	Do not connect the signal ground to the AC safety ground.

5. Insert the connector into the T9100 processor base unit.

Connect a Slave Device, Half Duplex

You can use a half duplex serial connection to connect a single MODBUS Slave device to the AADvance controller. To make the physical connection, do the following:



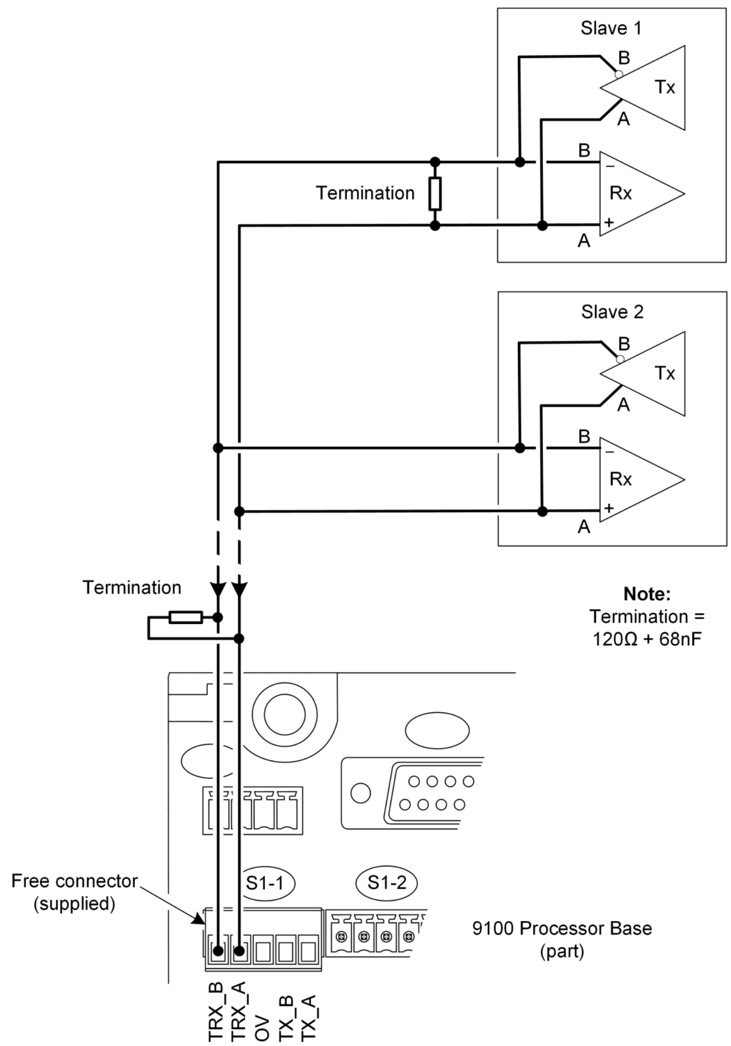
1. Select an applicable cable. We recommend 3-pair, overall shielded cable.
2. Remove the serial port connector from the T9100 processor base unit.
3. Make the connections shown in the illustration. Terminate the twisted pairs with a 120 Ω resistor in series with a 68 nF capacitor at the receiver ends.
4. Connect the signal ground (not illustrated) from the 0 V terminal to the slave device.

IMPORTANT	Do not connect the signal ground to the AC safety ground.

5. Insert the connector into the T9100 processor base unit.

Connect Multiple Slave Devices, Half Duplex

You can use a half duplex serial connection to connect multiple MODBUS Slave devices to the AADvance controller. To make the physical connection, do the following:



1. Select an applicable cable. We recommend 3-pair, overall shielded cable.
2. Remove the serial port connector from the T9100 processor base unit.
3. Make the connections shown in the illustration. Terminate the twisted pairs with a 120 Ω resistor in series with a 68 nF capacitor at the receiver ends.
4. Connect the signal ground (not illustrated) from the 0 V terminal to the slave device.

IMPORTANT	Do not connect the signal ground to the AC safety ground.

5. Insert the connector into the T9100 processor base unit.

System Security

Serial networks are closed and local and have limited protocol functionality, so they are immune to any external attack apart from local deliberate sabotage. The AADvance system, however, with its computers and DCS interfaces, uses Ethernet networks which are frequently part of a larger corporate network and can expose the system to accidental or malicious infection or attack.

These steps help prevent such issues:

- Consider network and computer security, for example:

- The AADvance system must not be on a network with open unsecured access to the Internet.
- The Firewall must be active on the computer, helping prevent access to the relevant Ethernet ports on each communication interface. Anti-virus software must be installed and be kept up-to-date.

IMPORTANT	Firewalls have been known to change the operation of the AADvance Discover tool.

- The computer must be password-protected. If using a laptop, keep the laptop locked when not in use.
- If the software uses a hardware license USB dongle, keep the USB dongle secure. The software will not run without the USB dongle.
- The application must be password-protected.
- Removable media, such as USB storage devices and CDs, must be virus checked before use in the system.

Connecting Field Wiring

Connect the field wiring to the screw terminal blocks on the termination assemblies.

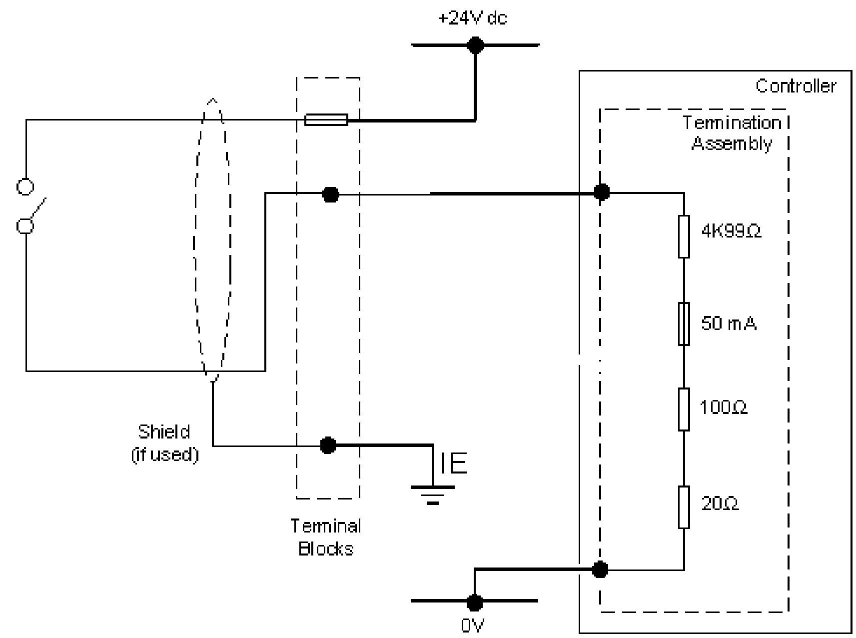
Use conductor wire with a cross section of 16 AWG. The stripping length should be 6mm (1/4 in.) and a conductor temperature rating of 85 °C. Apply a tightening torque of 0.5 Nm (0.37 ft. lb.) to the terminal screws.

Digital Input Field Loop Circuits

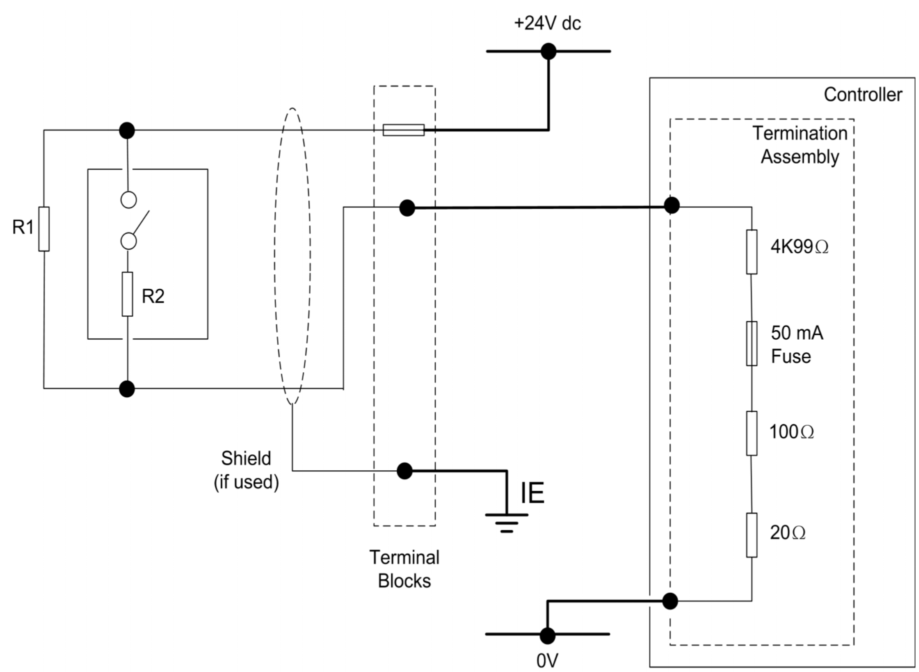
Recommended Field Loop Circuits

This section contains recommended field loop circuits for line monitoring digital inputs used in Emergency Shutdown or Fire & Gas applications.

Field Loop Circuit for Digital Input



Field Loop Circuit for Line Monitored Digital Input for Emergency Shutdown Systems (ESD)



The suggested values for R1 and R2 are as follows:

R1 = 15K Ω 1%, 1W (maximum power dissipated is 47mW at 26.4V)

R2 = 3K9 Ω 1%, 1W (maximum power dissipated is 182mW at 26.4V)

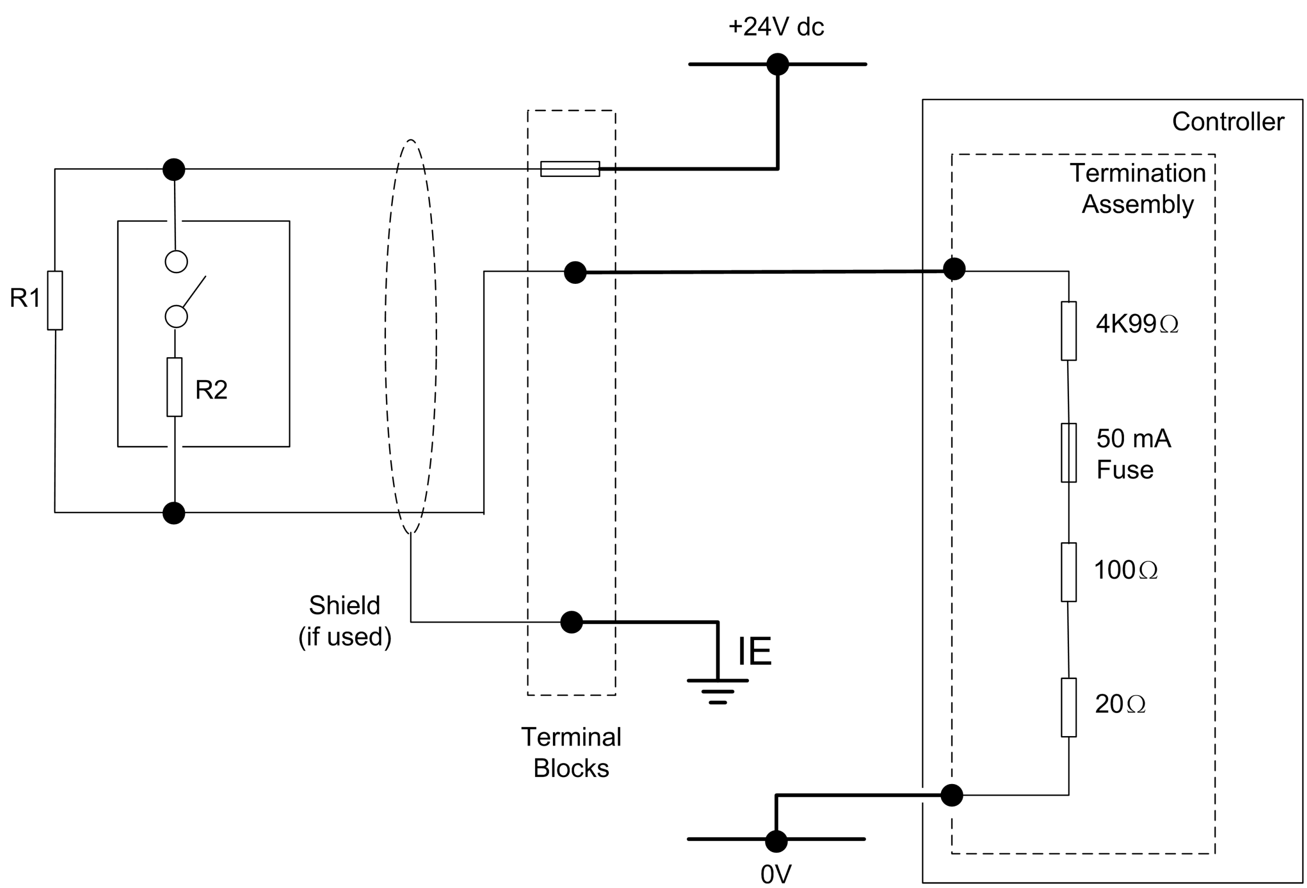
Suggested range of values for both of the above circuits are as follows:

Range		Value (mV)
Maximum Allowed	=	32000
		SHORT CIRCUIT
High	=	19000
Low	=	18500
		ON (nominal 16V)
High	=	11000
Low	=	10500
		INDETERMINATE
High	=	6500
Low	=	6000
		OFF (nominal 8V)
High	=	3500
Low	=	3000
		OPEN CIRCUIT

Assumptions:

- Loop supply voltage = 24V ± 10%
- Maximum Field Cable Line Resistance: < 100 Ω total; this means < 50 + 50 Ω for the two cables.
- Minimum Isolation is 0.75M Ω between the field loop conductors.
- These values will allow the input to detect more accurately different voltage levels that represent OPEN CCT - OFF - ON - SHORT CCT and will also detect Over Voltage and an input which is neither ON nor OFF. The values verify that a line fault will be declared before it becomes possible for a false declaration of On and Off states due to a combination of resistor value drift and loop voltage variation.

Field Loop Circuit for Line Monitored Digital Input for Fire and Gas Systems (F & G)



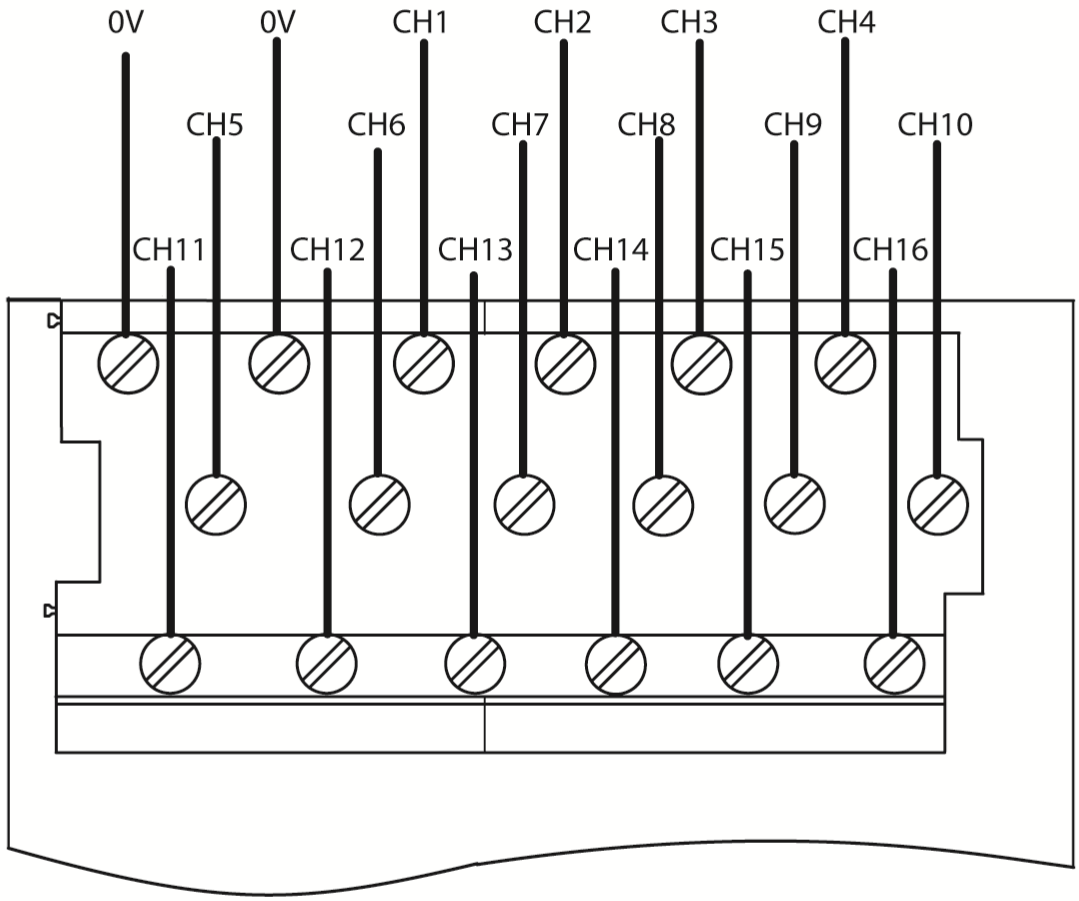
- The F&G circuit will also allow two devices to be in alarm without reporting short circuit.
- All of the input circuits are suitable for simplex, dual and TMR configurations.
- The F&G circuit assumes that the devices are volt-free contacts.
- For further information, please refer to application note AN-T90001 Field Loop Configuration, which is located in the Rockwell Automation Knowledgebase Support Center. This also includes advice for fire detectors which are not simple volt free contacts.

Digital Input Slew Tolerance

It is possible during sustained periods of abnormal input voltage slewing that channels can be declared faulted as a consequence of diagnostics otherwise designed to verify that the channels are operating within their designed safety accuracy.

To avoid spurious declaration of channel faults it is necessary to ensure that the input signal condition satisfies the maximum slew rate criteria defined in the Solutions Handbook. Accordingly it may be necessary to condition the input signal such as by filtering or by appropriate choice of process safety time.

Connections to T9801 Non-isolated Digital Input TA — 16 Channel Simplex



- Apply a minimum tightening torque of 0.5 Nm (0.37 ft. lb.) to the terminal screws.