

AADvance Controller
System Build Manual

Issue: 08

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(ICSTT-RM448_EN_P)

LISTEN.
THINK.
SOLVE.®

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This technical manual applies to **Release 1.3** of the AADvance Controller.

Issue Record

Issue	Date	Comments
01	April 2008	First Issue
02	Feb 2009	Update for Product Titles
03	Nov 2009	Update for Release 1.1
04	July 2010	Update for Release 1.1.1
05	Oct 2010	Updates for UL Certification
06	March 2011	Updated for Release 1.2
07	Aug 2011	Updated for UL Requirements
08	July 2012	Updates for release 1.3 and 1.3.1

Notes and Symbols used in this manual



This symbol calls attention to items which "must" be considered and implemented when designing and building an AADvance controller for use in a Safety Instrumented Function (SIF). It appears extensively in the AADvance Safety Manual.

Note: Notes are used extensively to provide important information about the product.

Standard Warnings and Cautions

WARNING ELECTRICAL ARCS AND EXPLOSION RISK IN HAZARDOUS AREAS



If you connect or disconnect wiring, modules or communications cabling while power is applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Do not remove wiring, fuses, modules or communications cabling while circuit is energized unless area is known to be non hazardous.

Failure to follow these instructions may result in personal injury.

WARNING MAINTENANCE



Maintenance must be carried out by people who are experienced in working on electronic equipment and in particular safety related systems. They should have knowledge and experience of local operating and safety standards. Failure to follow these recommendations may result in situations that can lead system damage and even personal injury.

CAUTION RADIO FREQUENCY INTERFERENCE



Most electronic equipment is influenced by Radio Frequency Interference. Caution should be exercised with regard to the use of portable communications equipment around such equipment. Signs should be posted in the vicinity of the equipment cautioning against the use of portable communications equipment.

CAUTION HEAT DISSIPATION AND ENCLOSURE POSITION



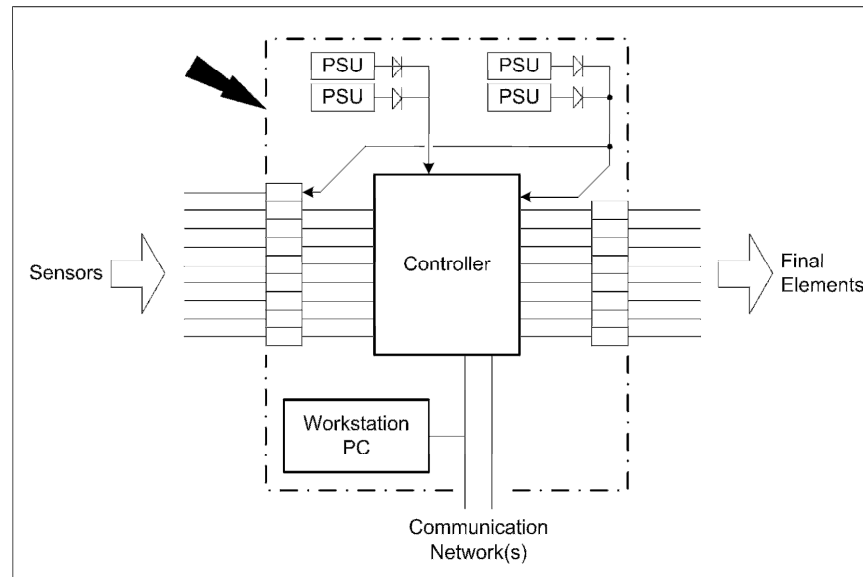
System and field power consumption by modules and termination assemblies is dissipated as heat. You should consider this heat dissipation on the design and positioning of your enclosure; e.g. enclosures exposed to continuous sunlight will have a higher internal temperature that could affect the operating temperature of the modules. Modules operating at the extremes of the temperature band for a continuous period can have a reduced reliability.

Foreword

The AADvance controller is a logic solver consisting of one or more processors and a family of I/O modules. An AADvance system can be built from one or more AADvance controllers and/or standard controllers.

This technical manual describes how to assemble a system, switch on and validate the operation of a controller.

Scope of System Build Manual



Who Should Use this Manual

This manual is intended primarily for System Integrators. The information contained in this manual is aimed at engineers experienced in building and setting up safety-related systems. It is expected that the users have been trained and have a thorough understanding of the intended application.

Note: Note: System Integrators are responsible for compliance to local, national and international standards that apply for the application that AADvance is being used for. System Integrators are responsible for resolving any conflicts between this document and the applicable project codes and standards.

If AADvance is being used for any Safety Functions the System Integrators are responsible for applying the requirements defined in the AADvance Safety Manual.

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Product Overview

This chapter provides an overview of a controller and briefly describes its major components.

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The AADvance Controller

The AADvance controller is specifically designed for functional safety and critical control applications, it provides a flexible solution for your smaller scale requirements. The system can be used for safety implement functions as well as applications that are non-safety but still critical to a business process. This controller offers you the ability to create a cost-effective system to suit any of the following applications:

- ▶ Critical process control
- ▶ Fire and gas protection systems
- ▶ Rotating machinery control systems
- ▶ Burner management
- ▶ Boiler and furnace control
- ▶ Distributed process monitoring and control

The AADvance controller is a logic solver and I/O processing device that consists of processor modules, I/O modules and field termination assemblies that can easily be assembled and configured. A system is built up from one or more controllers, a combination of I/O modules, power sources, communications networks and user workstations. How you configure the system determines the type of application it can be used for.

An AADvance controller is particularly well suited to emergency shut down and fire and gas detection protection applications by providing a system solution with integrated and distributed fault tolerance. It is designed and validated to international standards and is certified by TÜV for functional safety control installations.

A Frequency Input Module (not yet released) will provide the functionality to meet the requirements of turbomachinery governor control and overspeed protection.

The significant benefits of the AADvance controller are its performance and flexibility. Being designed to IEC 61508 it meets both SIL2 and SIL3 application requirements from the basic range of modules and mixed SIL rated applications can be covered by this range of modules.

All of the configurations are readily achieved by combining modules and assemblies without using special cables or interface units. System architectures are user configurable and can be changed without major system modifications. Processor and I/O redundancy is configurable so you can choose between fail safe and fault tolerant solutions. This scalability is user configurable, therefore, there is no change to the complexity of operations or programming if you choose to add redundant capacity to create a fault tolerant solution.

A controller is built from a range of compact plug-in modules that are straightforward to assemble into a system. They can be mounted onto DIN rails in a cabinet (see photograph) or directly mounted onto a wall in a control room. They do not require forced air cooling or special environmental control equipment. However, certain consideration to the cabinet type must be applied when used in hazardous environments.



A secure network communications protocol, developed by Rockwell Automation for the AADvance system, permits distributed control using new or existing network infrastructure while ensuring the security and integrity of the data. Individual sensors and actuators can connect to a local controller, minimizing the lengths of dedicated field cabling. There is no need for a large central equipment room; rather, the complete distributed system can be administered from one or more PC workstations placed at convenient locations.

Single input modules are designed to meet SIL3 and in the most basic simplex configuration they offer a fail-safe solution. The AADvance system has comprehensive built-in diagnostics, while maintenance activities are straight forward operations which maximize system availability.

The AADvance controller is developed and built for IEC 61131 compliance and includes support for all five programming languages. Program access is secured by a removable "Program Enable" key. Simulation software lets you prove a new application before reprogramming and downloading, again maximizing system uptime.

Controller TÜV Certification

TÜV Certification

TÜV is the safety certifying authority for an AADvance controller. The AADvance system is certified to the following standard:

 ZERTIFIKAT CERTIFICATE			
		Nr./No.: 968/EZ 388.01/10	
Prüfgegenstand Product tested	Safety Related Programmable Electronic System	Zertifikatsinhaber Licence holder	ICS Triplex PLC Hall Road Maldon, Essex CM9 4LA United Kingdom
Typbezeichnung Type designation	AADvance System 1.1	Hersteller Manufacturer	same as licence holder
Prüfgrundlagen Codes and standards forming the basis of testing	IEC 61508, Part 1-7:1998-2000 IEC 61511-1:2004 EN 61131-2:2007 EN 61326-3-1:2008 EN 61000-6-2:2005 EN 61000-6-4:2007		EN 50178:1997 EN 50156-1:2004 EN 54-2:1997, A1:2006 NFPA 72:2007 NFPA 85:2007 NFPA 86:2007
Bestimmungsgemäße Verwendung Intended application	Safety Related Programmable Electronic System for process control, Burner Management (BMS), emergency shut down, where the demand safe state is the de-energized state up to and including SIL 3. Applications like fire and gas systems, where the demand state is the de-energized or energized state up to and including SIL 3.		
Besondere Bedingungen Specific requirements	For the use of the systems the test report mentioned above, the Safety Manual, the user manuals and the official list of product documentation, hardware modules and software components released by ICS Triplex and TÜV Rheinland have to be considered.		
This certificate is valid until 2015-02-12.			
		Der Prüfbericht-Nr.: 968/EZ 388.01/10 vom 12.02.2010 ist Bestandteil dieses Zertifikates. Der Inhaber eines für den Prüfgegenstand gültigen Genehmigungs-Ausweises ist berechtigt, die mit dem Prüfgegenstand übereinstimmenden Erzeugnisse mit dem abgebildeten Prüfzeichen zu versehen. The test report-no: 968/EZ 388.01/10 dated 2010-02-12 is an integral part of this certificate. The holder of a valid licence certificate for the product tested is authorized to affix the test mark shown opposite to products, which are identical with the product tested.	
TÜV Rheinland Industrie Service GmbH Geschäftsfeld ASI Automation, Software und Informationstechnologie Am Grauen Stein, 51105 Köln Postfach 91 09 51, 51101 Köln		 Dipl.-Ing. Heinz Gall	
2010-02-12		Zertifizierungsstelle bei der TÜV Rheinland Industrie Service GmbH	

The Euro Controller is also tested to QI Extended Design levels of ISO 13628-6: 2006 Sub Sea Production Control System.

Certification for use in Hazardous Environments

The AADvance controller has been investigated and approved by UL (UL508) for use as Industrial Control Equipment in a general industrial environment and for use in hazardous locations, Class I, Division 2, Groups A, B, C and D. The UL file numbers are: E341697 and E251761.

Certificate

The AADvance controller modules have been evaluated to the requirements of EN 60079-0: 2009 and EN 60079-15: 2010 under Certificate Number: DEMKO II ATEX II 29711X.

[1]

TYPE EXAMINATION CERTIFICATE



[2]

Equipment or Protective System intended for use
in Potentially Explosive Atmospheres
Directive 94/9/EC

[3]

Type Examination Certificate Number: **DEMKO 11 ATEX 1129711X Rev. 0**

[4]

Equipment: **Programmable Logic Controllers Models 9110 Processor, 9111 Processor, 9401 Digital Input, 9402 Digital Input, 9431 Analog Input, 9432 Analog Input, 9451 Digital Output, 9481 Analog Output, 9482 Output Input, 9100 Processor Backplane, 9101 Dual Backplane, 9300 I/O Backplane, 9801 Digital Input Termination Assembly, 9802 Digital Input Termination Assembly, 9803 Digital Input Termination Assembly, 9831 Analog Input Termination Assembly, 9832 Analog Input Termination Assembly, 9833 Analog Input Termination Assembly, 9851 Digital Output Termination Assembly, 9852 Digital Output Termination Assembly, 9881 Analog Output Termination Assembly, 9882 Analog Output Termination Assembly.**

[5]

Manufacturer: **Rockwell Automation Ltd.**

[6]

Address: **Hall Road, Maldon, CM9 4LA, United Kingdom**

[7]

This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

[8]

UL International Demko A/S certifies that this equipment has been found to comply with the Essential Health and Safety Requirements that relate to the design of Category 3 equipment, which is intended for use in potentially explosive atmospheres. These Essential Health and Safety Requirements are given in Annex II to the European Union Directive 94/9/EC of 23 March 1994.

The examination and test results are recorded in confidential report no. **11CA29711**

[9]

Compliance with the Essential Health and Safety Requirements, with the exception of those listed in the schedule of this certificate, has been assessed by reference to Standards:

EN 60079-0:2009

EN 60079-15:2010

[10]

If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

[11]

This Type examination certificate relates only to the design of the specified equipment, and not to specific items of equipment subsequently manufactured.

[12]

The marking of the equipment or protective system shall include the following:



Ex nA IIC T4 Gc

Certification Manager

Jan-Erik Storgaard

This certificate may only be reproduced in its entirety and without any change, schedule included

Date of issue: 2011-09-02

Certification Body:

UL International Demko A/S, Borupvang 5A, 2750 Ballerup, Denmark,
Tel. +45 44 85 65 65, info.dk@dk.ul.com
www.ul-europe.com



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Underwriters
Laboratories

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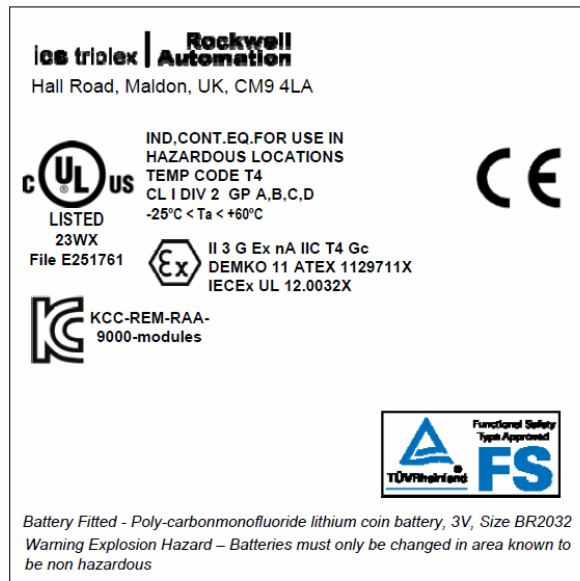
The AADvance controller has also been evaluated under certificate IECEx UL 12.0032X to the standards IEC 60079-0; (5th Edition) and IEC 60079-15 (4th Edition).

[certificate to be supplied]



For a system that is located in a Zone 2 Hazardous environment where ATEX certification is required, all modules should be installed in an ATEX and IECEx Certified, tool accessible IP54 enclosure. The enclosure is to be marked with the following: "Warning - Do not open when energized". After installation of the modules into the enclosure, access to termination compartments shall be dimensioned so that conductors can be readily connected. The modules and assemblies are for use in an area of not more than pollution degree 2 in accordance with IEC 60664-1

Module label



KCC-EMC Registration

KCC- EMC Registration

1. A급 기기 (업무용 방송통신기기): 이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
 - Translation: Class A device (Broadcasting Communication Device for Office Use): This device obtained EMC registration for office use (Class A), and may be used in places other than home. Sellers and/or users need to take note of this.

AADvanceDiscover Utility

The **AADvanceDiscover** utility is installed when you install the AADvance Workbench, and appears on the Start menu of the computer. Click on **AADvance Discover** to start the AADvanceDiscover utility.

The **AADvanceDiscover** utility displays a list of the AADvance controllers on the broadcast network, and reports a status for each one:

- ▶ Configurable
- ▶ Locked
- ▶ No response

Controller ID	Configuration Name	Type	Res Num	Status
00-A0-EC-00-0C-54	PC_VARS\CONFIG1	Series 9000		No Response
00-A0-EC-00-0C-9C	EUROAO_FTEST\CONFIG1	Series 9000	1	Locked
00-A0-EC-00-0C-E4	ALPHAXPBINDINGS\CONFIG1	Series 9000	1	Locked
00-A0-EC-00-0D-F6		Series 9000	1	Configurable
08-00-70-22-44-40	ALPHAXPBINDINGS\CONFIG1	Series 9000	1	Locked
08-00-70-22-44-50	NEWPCNAME\CONFIG1	Series 9000	1	Locked

Ready Refresh

Double-clicking on an entry in the list lets you inspect the resource and IP address settings for a controller. There is also a **Refresh** button, which makes a scan of the network and creates a new list.

A controller is configurable when the program enable key is present (this plugs into the **KEY** connector on the processor base unit) and either no application is loaded or an application is loaded but not running. The status will be locked if the controller reports that one or more of these criteria has not been met.

If the **AADvanceDiscover** utility reports a status of 'no response' for a controller, either the controller has been turned off or the communications between the computer running the utility and the controller have failed. Check the power to the controller and check the connection, and click the Refresh button.

The **AADvanceDiscover** utility also reports a status of 'in progress' and '**Pending restart**'. '**In progress**' appears while the controller accepts new settings. '**Pending restart**' means the controller is waiting for manual intervention from you; cycle the power to the controller.

The **AADvanceDiscover** utility will also allow you to save configurations that you can re-load in the future as required. It can also be used to enable the Ethernet Forwarding feature.

Physical Features

An innovative feature of the AADvance controller is the design of the hardware. Everything fits together easily without any need for inter-module wiring.

Environmental Specification

The following environmental specification defines the minimum recommended environmental conditions for an AADvance controller installation. Additional conditions apply to installations in a Hazardous environment.

Table 1: Environmental Specification

Attribute	Value
Operating Temperature Range: For use in a Hazardous Environments (see UL508 certification) Processor Modules I/O Modules and Assemblies	-25 °C to 60 °C (-13 °F to 140 °F) -25 °C to 70 °C (-13 °F to 158 °F)
For use in Non-hazardous environments (see TUV Certification) Processor Modules, I/O modules and Assemblies	-25 °C to 70 °C (-13 °F to 158 °F)
Storage and Transport Temperature	-40 °C to 85 °C (-40 °F to 185 °F)
Module Surface Temperature (during normal operation)	43° C (109 °F) ± 2 °C
Humidity	
Operating	10% to 95% RH, non-condensing
Storage and Transport	10% to 95% RH, non-condensing
Vibration	
Functional Stress	5Hz to 9Hz
Continuous	1.7mm amplitude
Occasional	3.5mm amplitude
Withstand	10Hz to 150Hz
Acceleration	0.1g in 3 axes
Endurance	10Hz to 150Hz
Acceleration	0.5g in 3 axes
Shock	15g peak, 11ms duration, ½ sine
Altitude	

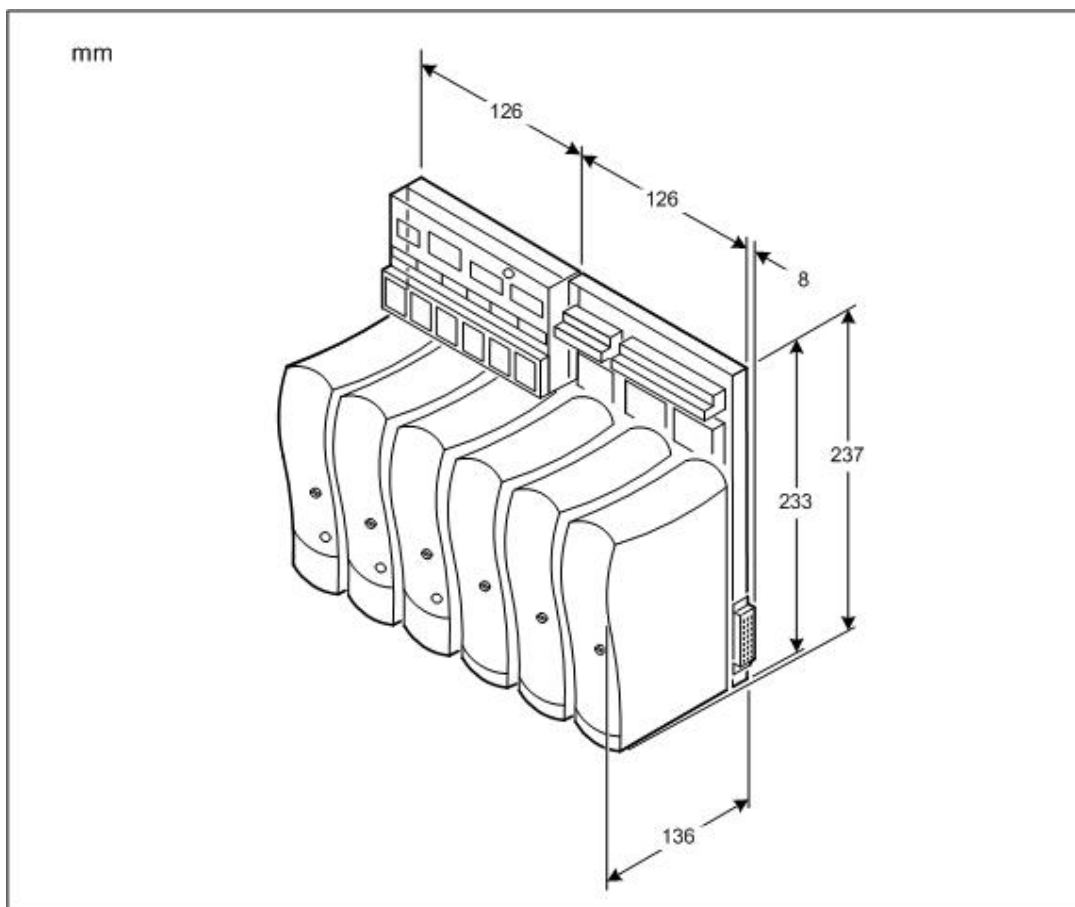
Operating	0 to 2000m (0 to 6,600 ft.)
Storage and Transport	0 to 3000m (0 to 10,000 ft.) This equipment must not be transported in unpressurized aircraft flown above 10,000 ft.
Electromagnetic Interference	Tested to the following standards: EN 61326-1:2006, Class A; EN 61326-3-1:2008, EN 54-4:1997, A1; EN 61131-2:2007; EN 62061:2005.
Hazardous Location Capability	Suitable for Class I Div 2 Groups A, B, C and D

Note:

Casing: Standard AADvance modules also have a plastic casing and are rated IP20: Protected against solid objects over 12mm (1/2in.) for example "fingers". There is no specific protection against liquids.

Product Dimensions

Overall Dimensions of Modules with Base Units



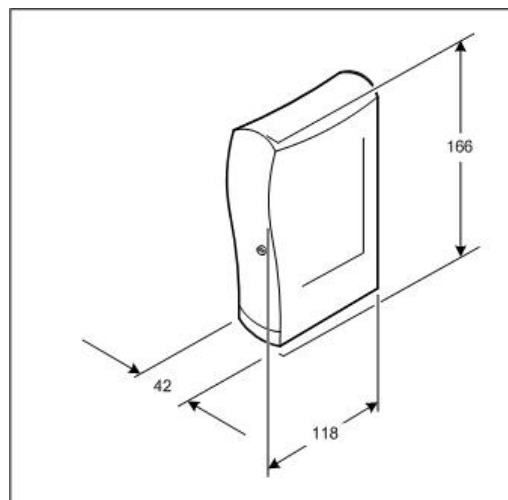
Summary of Dimensions

Attribute	Value
Base unit dimensions (H × W × D), approx.	233 × 126 × 18mm (see text) (9-¼ in × 5 × ¾ in)
Module dimensions (H × W × D), approx.	166 × 42 × 118mm (6-½ in × 1-⅝ in × 4-⅝ in)

The depth of the base unit (18mm) excludes the parts of the backplane connectors that mate inside the module connectors. Adding the depth of module (118mm) to the depth of the base unit gives the overall depth of the controller assembly, which is 136mm.

Module Dimensions

All modules have the same dimensions.



Compact Module Design

Each processor and I/O module is enclosed in a flame-retardant and impact-resistant plastic cover. The cover is designed to assist ventilation and heat dissipation. Processor and I/O modules fit onto a series of standardized base units. Base units are securely held together by specially designed plastic clips which cannot corrode or seize. Modules are retained by a locking latch accessible from the front panel, and corrective maintenance activities need only a standard screwdriver.

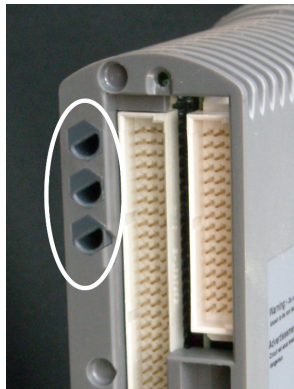


Base units are moulded from a similar material. Each base unit can be mounted onto standard DIN rails or directly onto a panel or wall. The moldings incorporate slots and clamps for DIN rail mountings, and holes for screw fixing.

Module Polarization Keying

For each I/O Module there is a matched termination assembly set. The controller incorporates module polarization keying to ensure they are matched when installed.

Modules have polarized sockets that align and mate with coding pegs located on the termination assembly. The alignment of the sockets and pegs ensure only the matched I/O module type can be fitted into each associated termination assembly and only a processor can be installed on a processor base unit.



Module Locking Mechanism



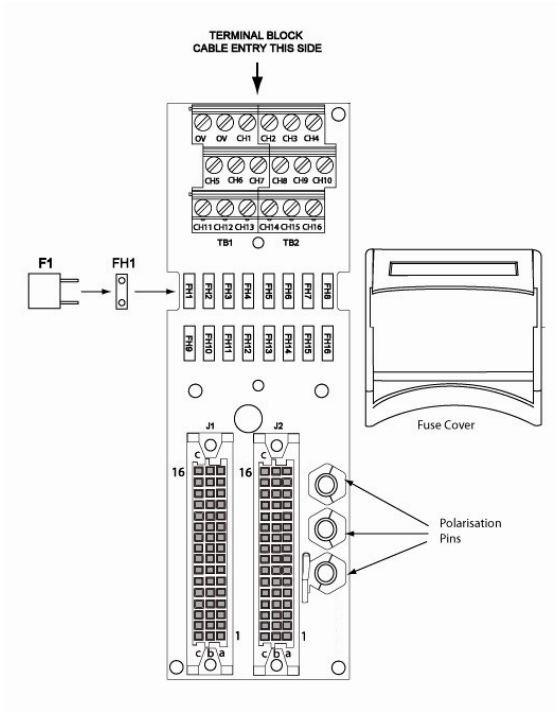
Each module carries a locking mechanism, which secures the module onto its base unit. The locking mechanism is in the form of a clamp screw, visible on the front panel of the module and engaged by a quarter turn of a flat blade screwdriver. The module senses the locking mechanism position and notifies the controller accordingly. This acts as an interlock device and prevents the module from going on-line when it is not in the locked position.

Termination Assemblies

The AADvance system provides a range of termination assemblies to connect field wiring to the I/O modules. A termination assembly is a printed circuit equipped with screw terminal blocks for the field wiring (in some cases fuses) and connectors for the plug-in I/O modules. Termination assemblies are matched to their relevant I/O modules by the coding pegs and sockets and come in three types: simplex, dual or triple. Therefore, they can accommodate one two or three I/O modules. Each assembly provides connections for up to 16 channels but can accommodate 8 or 16 channel modules.

Termination assembly design gives the controller greater flexibility for building redundant and fault tolerant systems. I/O module(s) plugged into its matched termination assembly can provide a simplex, dual or triple modular redundant configurations.

The version illustrated is a simplex termination assembly for a digital input module. The field wiring connectors are located to the left, the fuses have a cover (shown open) and the module sockets are to the right.



Part No: Digital Input Fuses T9901: No 396/TE5 50mA time lag fuse; UL 248-I4, 125 V,T Leadfree; manufactured by Littlefuse.
Part No: Digital Output Fuses T9902: SMF Omni-Block, Surface Mount Fuse Block 154 010, with a 10A, 125V Fast Acting Fuse, Littlefuse.

WARNING FUSE REMOVAL or REPLACEMENT



When the controller is installed in a Hazardous environment do not remove or replace a fuse when energized.

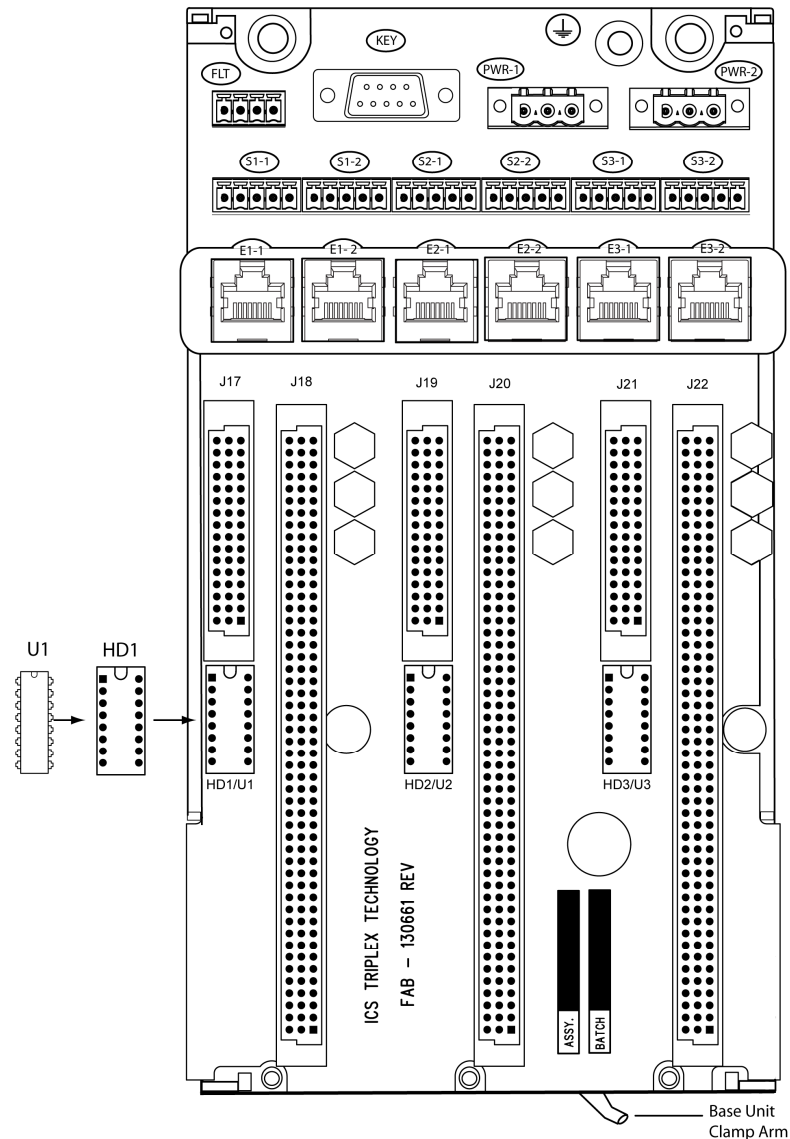
Field Wiring Connections

Field connections are made using industry-standard screw terminal blocks. Terminals are readily accessible for future wiring modifications without needing to dismantle any assemblies. This illustration shows field wiring to four simplex termination assemblies:



T9100 Processor Base Unit

Every AADvance controller has one T9100 processor base unit. A processor base unit supports one, two or three modules depending on the architecture chosen for the application.



The processor base unit provides the electrical connections between the T9110 processor modules, and the rest of the controller modules and has the following connections:

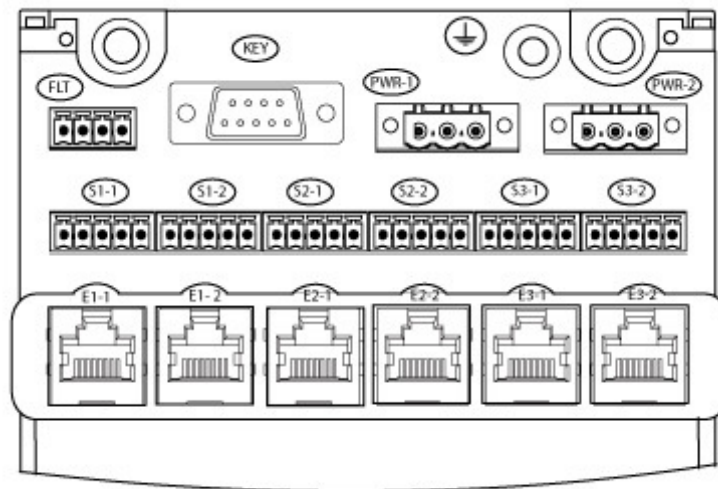
- ▶ Command and response bus connections for up to 48 I/O modules
- ▶ Inter-processor links
- ▶ Two Ethernet 100 BaseT connectors per processor
- ▶ Two serial data connections per processor
- ▶ Dual +24v System power
- ▶ Ground stud
- ▶ Program enable key

The processor base unit holds the IP address of each processor module separately in a BUSP (UI shown in above illustration) which is installed during manufacture. This means that you can remove a defective processor module and install a new one without needing to set up the IP address of the new module.

Ethernet, Serial Data and Power Connections

The external connections for Earthing, Ethernet (**E1-1 to E3-2**), serial data (**S1-1 to S3-2**) and the +24V dc Redundant powers supplies (**PWR-1 and PWR-2**) are all located on the T9100 Processor Base Unit. There are two serial data and two Ethernet connectors for each processor module. two connectors for the dual redundant power supplies, a stud for the Earth and a connector for the security device (**KEY**) also known as the Program Enable Key.

Note: The **FLT** connector is not used.



Serial Communications

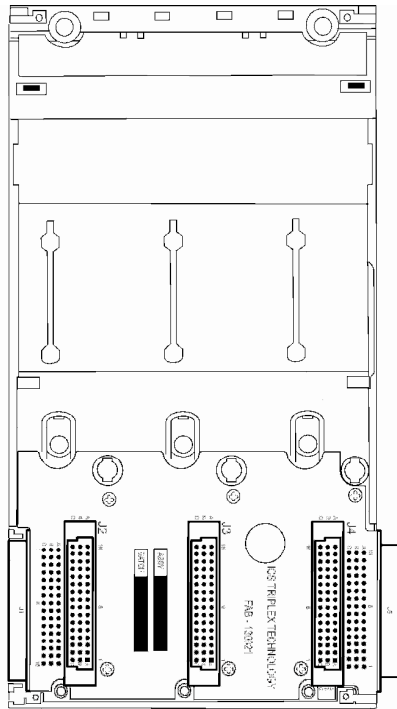
The serial ports (**S1-1 & S1-2, S2-1 & S2-2, S3-1 & S3-2**) support the following signal modes depending upon use:

- ▶ **RS485fd**: A four-wire full duplex connection that features separate busses for transmit and receive. This selection should also be used when the controller is acting as a Modbus master using the optional four-wire definition described 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 should be used when the controller is acting as a Modbus slave on a four-wire bus.
- ▶ **RS485hdmux**: A two-wire half duplex connection appropriate for or master slave or slave use. This is shown in the Modbus-over-serial standard.

T9300 I/O Base Unit (3 way)

The AADvance controller has T9300 I/O base units for the I/O modules. An I/O base unit supports up to three I/O modules (of any type), and their associated termination assemblies.

It contains a passive backplane that provides the electrical connections between the I/O modules and the T9100 processor base unit; i.e. the command and response buses and the system power.



The bus and power connections from the processor base unit enter the backplane at the left connector and are routed direct to the module connectors. The backplane provides a connector at the right for the next I/O backplane. The connection to the left of the backplane can connect to a processor base unit or another I/O base unit.

Adjacent base units clip together and are held in position by a plastic retaining clip. Alternatively rows of I/O base units can be connected together using a T9310 expansion cable assembly.

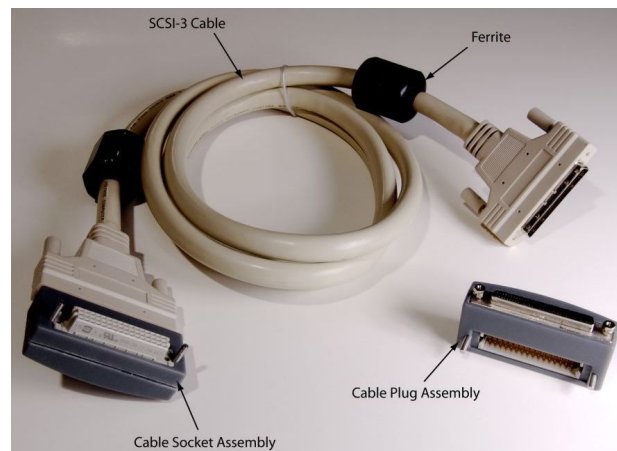
T9310 Expansion Cable Assembly

The **T9310** expansion cable assembly connects a **T9300** I/O base unit to another I/O base unit or to the **T9100** processor base unit. The assembly consists of a cable, terminated by multi-way plugs, and a pair of adaptors.

One end has a cable socket assembly and the other end a cable plug assembly that connects to the right-hand bus connector of an I/O base unit or to IO Bus2 (the left hand connector) of a processor base unit. The socket connects to the left-hand bus connector of an I/O base unit.

The expansion cable offers the following features:

- ▶ Two meter cable length
- ▶ Secured with retaining screws and screw cap screws
- ▶ Connects all command and response signals and system power
- ▶ Screened to reduce resonance emissions



Backplane Electrical Ratings

The following are the voltage and current ratings for the Process and I/O backplanes:

Module	Back-plane Electrical Ratings		Input/Output Electrical Ratings
	Voltage (Vdc)	Current (mA)	
9100	18-32	10.4A (400mA per slot)	-
9101	18-32	10.4A (400mA per slot)	-
9300	18-32	9.6A (400mA per slot)	-
9110	18-32	380	-
9111	18-32	380	-
9401	18-32	260	Input: 18-32Vdc @ 24mA
9402	18-32	260	Input: 0-32Vdc @ 6.5mA
9431	18-32	260	Input: 0-32Vdc @ 6.5mA
9432	18-32	260	Input: 18-32Vdc @ 24mA
9481	18-32	260	Output: 18-32Vdc/0-20mA
9482	18-32	260	Output: 18-32Vdc/0-20mA
9451	18-32	165	Output: 18-32Vdc@0.5A, Pilot duty 16VA, 1.5A Inrush
9801	18-32	6.5	-
9802	18-32	6.5	-
9803	18-32	6.5	-
9831	18-32	0-24	-
9832	18-32	0-24	-
9833	18-32	0-24	-
9851	18-32	500	-
9852	18-32	500	-
9881	18-32	0-24	-
9882	18-32	0-24	-

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Before You Begin

This chapter lists important information the reader should consider before starting to build the system. It includes preparatory information necessary for a successful installation.

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Required Tools Standard AADvance

The installation and maintenance of the AADvance controller requires the following tools:

Standard Tools

- ▶ Screwdriver, flat 0.8 x 9.0mm (1/25 c 3/8 inch), for the module clamp screws and blanking covers
- ▶ Screwdriver, cross head number 0, for battery cover on T9110 processor module
- ▶ screwdriver, flat 0.8 x 4.0mm (1/25 x 5/32 inch), for locking screws on extension cables
- ▶ Torque screwdriver, flat 0.6 x 3.0 mm(1/40 x 1/8 inch, for dc power wiring terminals
- ▶ Torque screwdriver, flat 0.4 x 2.0mm (1/64 x 5/64), for field wiring terminals
- ▶ 2 x wrench, open end, 10mm, for ground stud nuts
- ▶ Allen key (hex wrench), 2.5mm, for plug and sockets assemblies used with extension cables

Special Tool

- ▶ Long nosed pliers to remove the fuses on termination assemblies.

Test Equipment

The assembly of the system does not require the use of test-equipment, however, the preparation for initial switch on and start up may require the use of a multimeter.

An engineering workstation running the Workbench programming software will be needed for communicating with the system, downloading the application software and for monitoring system variables and application logic.

System Installation Environment

The installation environment is a potential source of common cause failure, therefore it is vital that compatibility of the equipment with the environment is known. The environment for these purposes includes the prevailing climatic, hazardous area, power, earthing and EMC conditions. In many cases, there will not be a single installation environment. Elements of the system may be installed in differing locations; in these cases, it is important to know the environment for each location.

Specifying an Enclosure

An enclosure for a controller must be designed for the environmental conditions where the controller is installed. It needs to support the weight of the controller modules, provide mechanical protection and remove the heat that the controller generates. The enclosure must also be able to hold the modules securely and should not interfere with any components.

Maximum Enclosure Air temperature

The maximum air temperature rating in an enclosure where standard AADvance processor and I/O modules are installed to ensure predictable reliability is 70 °C (140 °F).

CAUTION

HEAT DISSIPATION AND ENCLOSURE POSITION



System and field power consumption by modules and termination assemblies is dissipated as heat. You should consider this 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 affect the operating temperature of the modules. Modules operating at the extremes of the temperature band for a continuous period can have a reduced reliability.

Recommended Enclosure for a non-hazardous environment



An AADvance system must be installed in a suitable enclosure to maintain a Pollution Degree 2 (IEC 60664-1) environment. When used in an ATEX Zone 2 atmosphere the enclosure must provide a minimum ingress rating of IP54.

Pollution Degree

The IEC definition of the four pollution degrees are given in IEC 60664-1:2007: For the purpose of evaluating creepage distances and clearances, the following four degrees of pollution in the micro-environment are established:

- ▶ Pollution Degree 1: No pollution or only dry pollution occurs. The pollution has no influence.
- ▶ Pollution Degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.
- ▶ Pollution Degree 3: Conductive pollution occurs or dry non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.
- ▶ Pollution Degree 4: Continuous conductivity occurs due to conductive dust, rain or other wet conditions.

CAUTION **STATIC SENSITIVE COMPONENTS**



The controller contains static sensitive devices which can be damaged by incorrect handling. You should label the exterior surfaces of the enclosure to caution personnel to observe antistatic precautions when handling modules.

Enclosure Requirements for a Hazardous Environment



For a system that is located in a Zone 2 Hazardous environment where ATEX certification is required, all modules should be installed in an ATEX and IECEx Certified, tool accessible IP54 enclosure that has been evaluated to the requirements of IEC 60079-0:2009 and IEC 60079-15:2010. The enclosure is to be marked with the following: "Warning - Do not open when energized". After installation of the modules into the enclosure, the enclosure should provide sufficient access and space so that the field wiring conductors can easily be connected. It is also recommended that potted glands or equivalent are used when the cable runs into other zoned areas to prevent the propagation of explosive gasses from an external atmosphere through the cable sleeving. Modules are for use in an area of not more than pollution degree 2 in accordance with IEC 60664-1.

This equipment is not certified for use in a Zone 1 location. In a Zone 1 hazardous environment the equipment should be housed in an enclosure offering suitable additional protection. This enclosure should be certified to IEC 60079-0:2009 and IEC 60079-1:2007.

This equipment is not certified for use in a Zone 0 hazardous environment.

Free Space Around the Controller

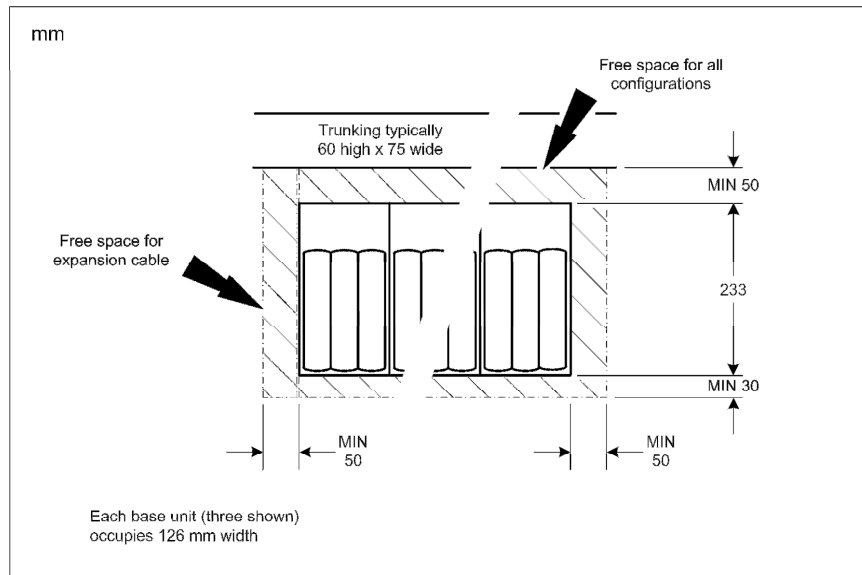
The controller requires a free space at least 140mm deep (from front to back) between the rear panel of an enclosure and the inside of an enclosure door. If you wish to mount the controller on DIN rails, increase this allowance by the additional depth of the DIN rails.

You must allow sufficient free space around the base units. Every application needs space on at least three sides, as follows:

- ▶ Space above, to manipulate and install field wiring
- ▶ Space below, to enable modules to fit and to be able to grasp a module during removal
- ▶ Space to the right, to move an I/O base unit during assembly or in the event of installing a new base unit

If an expansion cable is to connect to the left-most base unit, the controller also needs space to the left, to fit the expansion cable adapter.

This illustration shows the minimum recommended clearances for a flat panel or DIN rail mounting.

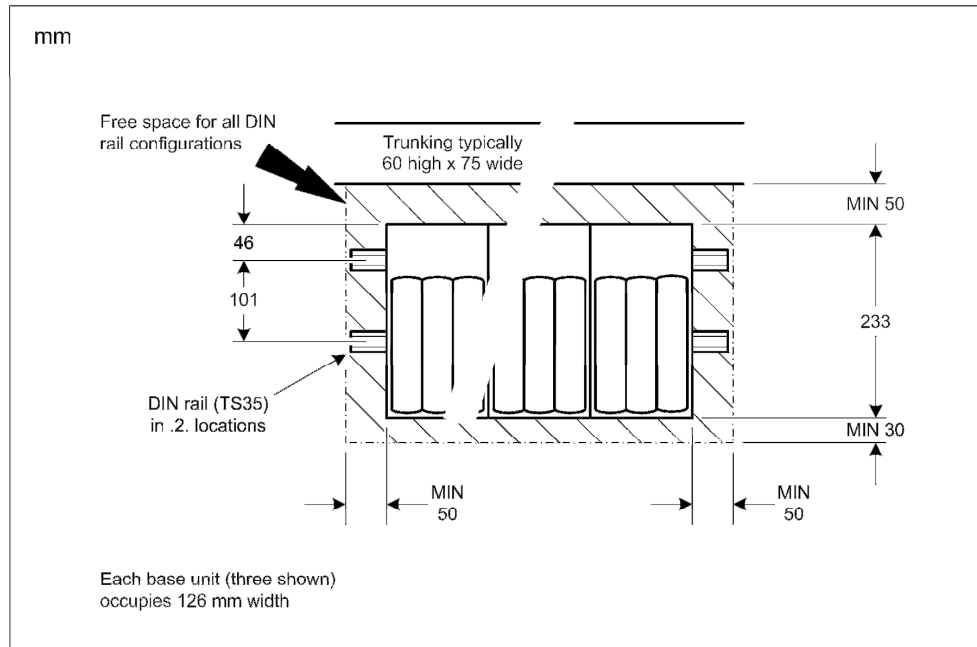


DIN Rails Fitting

You can install the AADvance controller onto a pair of parallel DIN rails. The DIN rails must be **TS35** rail, which is 35mm × 7.5mm standard symmetric rail. Alternatively, you can install the controller onto a flat panel. The fixing dimensions are given below for both methods.

A typical DIN rail arrangement is shown below:

An application using DIN rails must provide the DIN rail free space to the left to fit an end stop on the upper DIN rail.

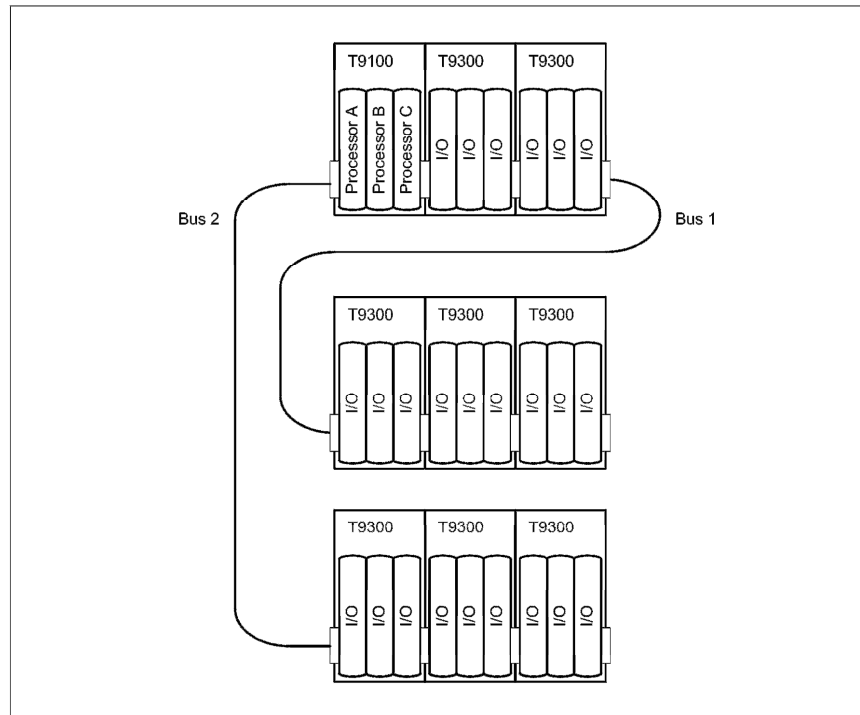


Base Units, DIN Rail installations and Expansion Cables

Base units fit together side by side. One I/O base unit can be fitted directly onto the right hand edge of the processor base unit. The second and subsequent base units connect directly to the right of this first I/O base unit. If required, termination assemblies can bridge adjacent I/O base units to save space.

Using Expansion Cables

A further eight I/O base units can be connected through an expansion cable to the left-hand edge of the processor base unit.



The expansion bus accessed from the right hand edge of the 9100 processor base unit is designated bus 1, while the bus accessed from the left hand edge is designated bus 2. The module positions (slots) within 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 I-01.

The expansion cable assemblies are two metres long. The maximum possible length of an entire bus (the combination of I/O base units and expansion cables) is 8 metres. This is limited by the electrical characteristics of the interface.

Adding 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 trunking or similar be located above each set of base units, for cable management.



Controller Design Considerations for Heat 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. The design and positioning of the enclosure should keep the controller environment within a range of 25°C to 40°C for normal operation and to maintain predictable reliability for the equipment.

Note: Component failure rate of the controller doubles with every 10°C rise in temperature.

System Power Requirements

A controller's system power (AADvance standard or Eurocard controller) should be supplied from two independent 24V dc power supplies with a common return path; that is, the 24V return shall be common between the power feeds. Each controller also requires an external field power source for the output modules.



A controller system must be installed with a power network that is designed to meet over voltage Category II (see BS EN 60664-1)

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 does not exceed 50VAC or 120 V ripple-free DC 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.

Thus to meet 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 galvanically and electrically isolated.

The power supplies and power distribution, if incorrectly designed, present a potential 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.
- ▶ Ensure that the chosen PSUs are compatible with the power feeds provided. Alternatively, measures should be implemented to ensure that the power feeds remain 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 establish that sufficient current be available to ensure their protective action and that the protective device can break the maximum prospective fault current.
- ▶ Ensure that the power supplies are sufficient to meet the system load and for any foreseeable load requirements and load transients.
- ▶ Ensure that the power supplies have a minimum hold up time of 10ms.
- ▶ Ensure that the power distribution cabling is sized to accommodate the maximum prospective fault currents and tolerable voltage losses. This is specifically important where floating supplies are employed and other power sources may result in high prospective fault currents in the event of multiple earth-fault conditions.



The power supplies used shall conform to IEC61131 Part 2, EN61010-1 and EN 60T950 and shall be of adequate capacity for the system.

IMPORTANT TIP: 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 Arrangements for Field Devices

The input circuits and the output modules of the controller require an external source of power for field devices. This may be the power source used for the controller or a separate power source, depending on the application.

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

The power distribution circuit for each field input and for each output module must be protected, externally to the controller. For a typical system, it is recommended that you provide a single breaker on the output of the field power source, followed by one or more multi-way fused distribution boards.

Estimate Module Supply Power Dissipation and Field Loop Power Dissipation

Module supply voltage and field power consumption is dissipated as heat. Use these tables to estimate the supply voltage and field power heat dissipation of your system.

Table 2: Estimating Module Supply Power Dissipation

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

Table 3: timing Field Loop Power Dissipation

Item	Number of Field loops	Maximum Field Loop Power Dissipation	Subtotal (W/BTU/hr)
T9801/2/3 Digital Input Termination Assembly (powered by the T9401/2 module)		× 0.2W (0.68BTU/hr)	=
T9831/2/3 Analogue Input Termination Assembly (powered by the T9431/2 module)		× 0.08W (0.27BTU/hr)	=
T9451 Digital Output Module, 24V dc, 8 channel (1A load)		× 0.57W (1.94 BTU/hr)	=
T9482 Analogue Output Module, 8 channel, isolated		× 0.77W (2.63BTU/hr)	=

Total:	
--------	--

Note: All figures given are worst-case estimates based upon maximum operating field current and voltages.

Estimate AADvance Controller Weight

Use the following table to estimate the weight of your system.

Table 4: AADvance Controller Module Weight

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

Total estimated controller weight	
-----------------------------------	--

Estimating Centre of Gravity Information

If it is necessary to calculate the location of the centre of gravity of an AADvance controller destined for a maritime or other shock-mounted application, it is reasonable to assume the centre of gravity of each assembly of modules and their base unit is at the geometric centre 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 '0V dc ground') to provide a good stable 0V 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 busbars. Busbars shall be of copper; they may be nickel plated. For a small application, you may use ground studs instead of busbars.

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.

Power Supply Requirements

A controller requires the following power supply sources:

- ▶ A dual redundant power supply of + 24V dc with an operating range of 18V dc to 32V dc.

Note: An AADvance controller is designed to accept supply transient and interference according to IEC 61131 part 2.n

An over current fault in the controller must not result in the whole system losing power. Consequently, the power sources must be able to deliver the peak current needed to open any over current protection devices (such as fuses) without themselves failing.

The power supply protection of the controller is within the modules, the power distribution arrangement must provide a circuit breaker on the input side of each power source.

Note: A controller is designed to withstand a reverse polarity connection without permanent damage.

The power sources should come from a commercially available industrial uninterruptible power supply (UPS) system. A suitable UPS should have capacity sufficient to meet the entire system load (including field devices as well as the controller) and a suitable contingency allowance for any projected future expansion.

Specifying the Workstation PC

The workstation PC which runs the Workbench and other software requires the following specification:

- ▶ Operating system:
- ▶ Windows XP with Service Pack 3
- ▶ Windows Vista, Windows 7 & Server 2003 in both 32-bit and 64-bit versions

Note: Windows 64-bit versions will not recognize Workbench software licenses.

CAUTION OPERATING SYSTEM



Do not use XP Professional x64 edition

- ▶ Network port (10/100 Base T Ethernet)
- ▶ Access to a CD-ROM drive, for software installation

If the application adopts the dongle licensing option for the software, the workstation PC will also require one free USB port.

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 T9I I0 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 ELECTRICAL ARCS AND EXPLOSION RISK IN HAZARDOUS AREAS



If you connect or disconnect wiring, modules or communications cabling while power is applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Do not remove wiring, fuses, modules or communications cabling while circuit is energized unless area is known to be non hazardous.

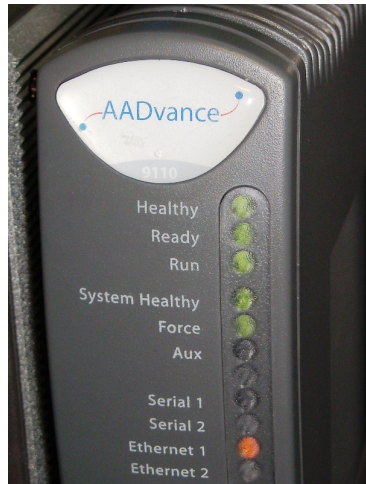
Failure to follow these instructions may result in personal injury.

Design Provisions

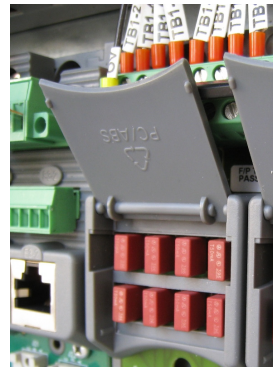
The design of the controller installation should make the following provisions:

- ▶ 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.

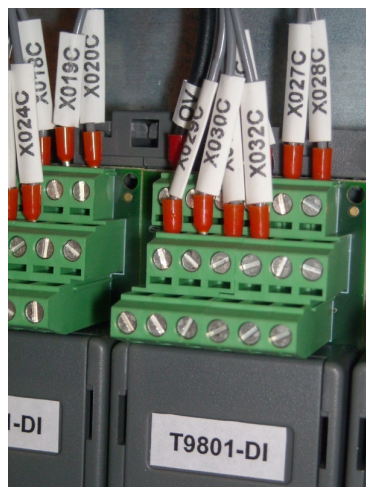
A way for plant operations personnel to inspect the status LEDs on each module. The status LEDs report faults.



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.

Install the AADvance System

The system installation defines the steps that will ensure 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.

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Unpacking and Pre-assembly 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

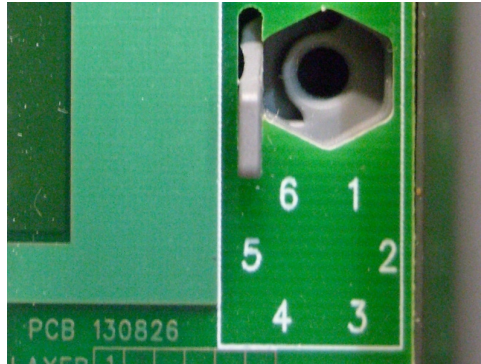
For a system build that uses DIN rails do the following:

- 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 centre line 101.0mm below the centre line of the upper rail. M5 thread rolling screws are suitable.
- 2) Mount power supply units.
 - ▶ To install the power supply units, refer to the instructions supplied with the units.
- 3) 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.
- 4) 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.
- 5) Mount end stops onto DIN rails.
 - ▶ Install two end stops onto the upper DIN rail, one at each end of the assembly.
- 6) Fit termination assemblies.

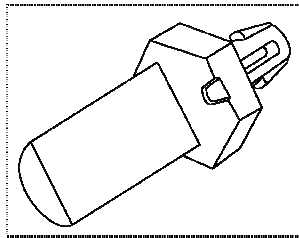
- ▶ Insert the retaining clip on the back of the termination assembly into the slot on the I/O base unit. Press the termination assembly onto the base unit and then slide the assembly upwards as far as it will go.
- ▶ Make sure the retaining tab clips over the printed circuit board to secure the termination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

7) Check coding pegs.

- ▶ Observe the legend on the 9100 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
9100 processor base unit (for 9110 processor module)	1	1	1
9801/2/3 digital input termination assemblies (for digital input modules)	2	1	1
9831/2/3 analogue input termination assemblies (for analogue input modules)	2	1	3
9851/2 digital output termination assemblies (for digital output modules)	3	1	1
9842/1 analogue output module	3	1	2

This example shows pins set to positions 2, 1, 1 for a 9401 digital input module.

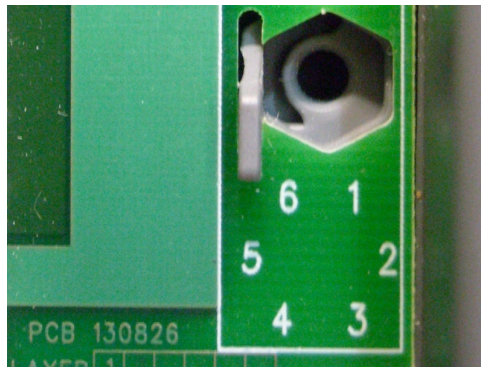


Install Base Units and Termination Assemblies: Flat Panel Assembly

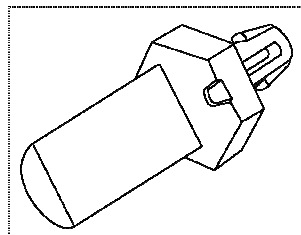
Flat panel assembly secures the AADvance controller directly onto a panel, without the use of DIN rails. Do the following:

- 1) The base units carry latches which are intended to secure the base units to DIN rails.
- 2) Assemble the base units. Place the base units on a workbench and use the backplane clips (supplied) to join adjacent base units together.

- ▶ Use only finger pressure to manipulate and engage the clips. Do not attempt to use a screwdriver or other tool as injury or equipment damage may result.
 - ▶ Use two clips for each join.
- 3) Mark off the panel to locate hole positions for three screws for each base unit. You can place the assembly of base units onto the panel and use the assembly as a template, or refer to the illustration to locate the holes.
- ▶ Mark and drill the panel and then secure the base units. M5 screws are suitable.
- 4) Mount power supply units.
- ▶ To install the power supply units, refer to the instructions supplied with the units.
- 5) Fit termination assemblies.
- ▶ 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.
- 6) Check coding pegs.
- ▶ Observe the legend on the 9100 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.



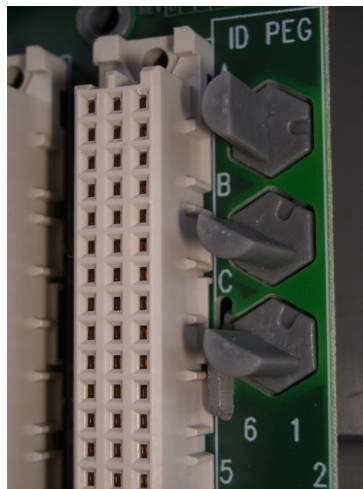
- ▶ Refer to the following table and verify each coding peg is fitted so its index recess is adjacent to the relevant numbered position.

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
9100 processor base unit (for 9110 processor module)	1	1	1
9801/2/3 digital input termination assemblies (for digital input modules)	2	1	1
9831/2/3 analogue input termination assemblies (for analogue input modules)	2	1	3
9851/2 digital output termination assemblies (for digital output modules)	3	1	1
9842/1 analogue output module	3	1	2

This example shows pins set to positions 2, 1, 1 for a 9401 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 busbar of the system or panel.

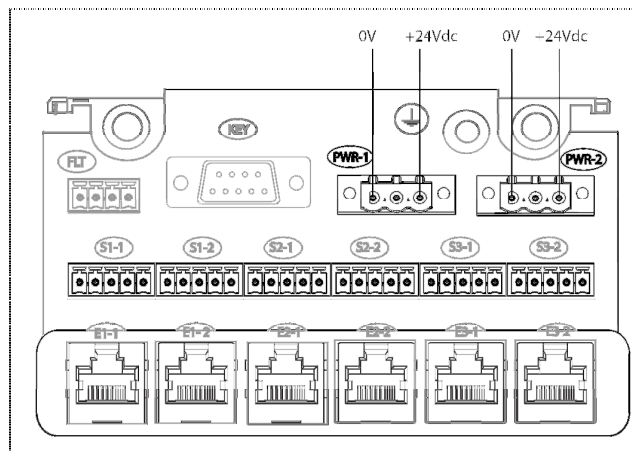
- ▶ Use conductor wire of 10AWG (4mm²) with a temperature rating of 85°C.
- ▶ Use a M6 lug on the end of the ground wire.
- ▶ Place the lug below the second nut on the ground stud, between two washers, and use two 10mm wrenches to tighten the nuts to a torque of 1.2Nm (0.74lb/ft) to 2Nm (1.48lb/ft).

Refer to the illustration for an example.

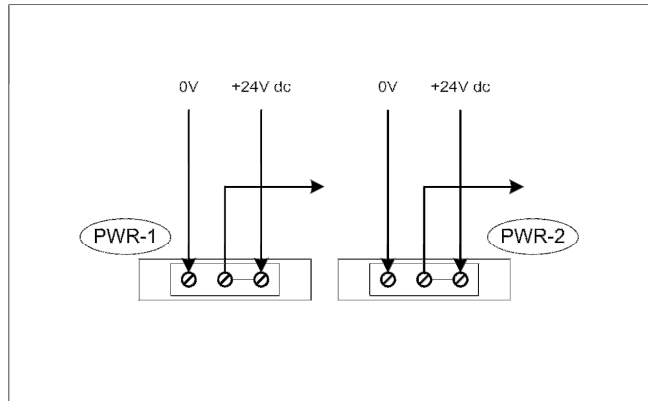


Connect the 24V dc System Power to an AADvance Controller

The dual redundant +24V dc 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 links the +24V dc connections to the center terminal of each connector PWR-1 and PWR-2. This link may be useful to connect the +24V dc supply to further devices:

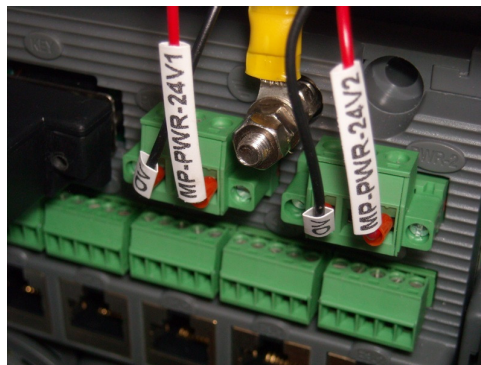


For each power supply connection, do the following:

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

Note: Make sure that PWR-1 and PWR-2 are supplied from independent 24V dc sources.

Refer to the illustration for an example.



Power and External Connector Wiring Details

External connectors for power, serial data, Ethernet data and the application security device are connected to the T9100 Processor base unit. The field connections for I/O data are connected to the Termination Assemblies.

The wiring specifications are as follows:

Table 5: External Connectors

Connector Function	Location	Designation	Summary Specifications	Remarks
Controller power in	T9100 processor base unit	PWR-1, PWR-2	Two 3-way connectors Conductor cross section maximum 3.3mm ² (12 AWG) Stripping length 7mm (9/32 in.)	Wire to screw terminals on free connectors supplied with processor base unit
Serial ports	T9100 processor base unit	S1-1, S1-2 S2-1, S2-2 S3-1, S3-2	Six 5-way connectors Conductor cross section maximum 1.31mm ² (16 AWG) Stripping length 7mm (9/32 in.)	Wire to screw terminals on free connectors supplied with processor base unit
Ethernet ports	T9100 processor base unit	E1-1, E1-2 E2-1, E2-2 E3-1, E3-2	RJ45 socket	Use network patch cords (not supplied)
Field wiring (sensors, actuators and field power sources)	I/O Termination Assemblies	None	Screw terminal blocks Conductor cross section maximum 1.31mm ² (16 AWG) Stripping length 6mm (¼ in.)	Wire to screw terminal blocks on termination assemblies
Program enable key	T9100 processor base unit	KEY	DB9 Plug with detected circuit	Removable security device that allows workbench programming, variable locking/forcing and AADvance Discover write access. Supplied with base unit

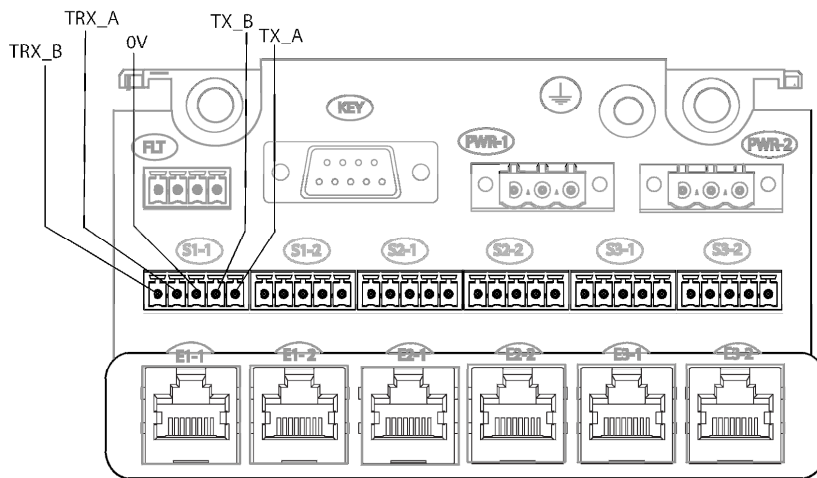
Conductor cross sections specified are for stranded and solid conductors, with and without a ferrule.

Note: The AADvance controller does not provide mechanical support to hold power or external communications. Mechanical support should be arranged in the design of the installation, for example through the provision of suitable cable trunking.

Procedure to Connect Serial Communications Cabling

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

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



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

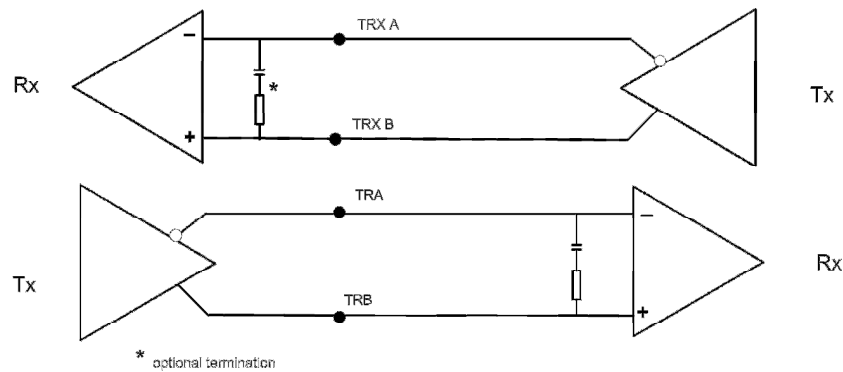
Terminal	Function Description (4-wire)	Function Description (2-wire)
TRX_A	Receive data A (inverting)	Transmit/receive data A (inverting)
TRX_B	Receive data B (non-inverting)	Transmit/receive data B (non-inverting)
0V	Instrument ground (signal ground)	Instrument ground
TX_B	Transmit data B (non-inverting)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

To connect to the external communication link you should terminate the receive end of the link.

Note: 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.

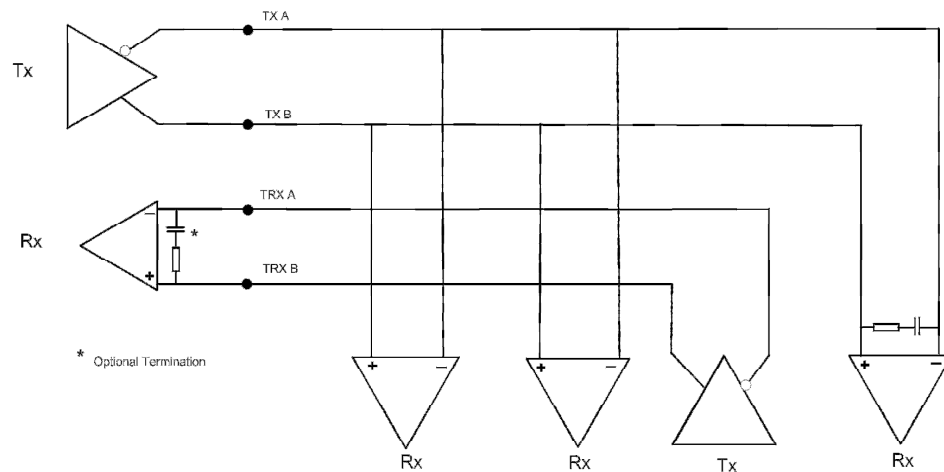
RS485 Full-Duplex

This is a 4-wire point to point connection. The receive end should always be terminated a resistor and capacitor as shown in the diagram or similar termination. The recommended values are 120R + 100nf.



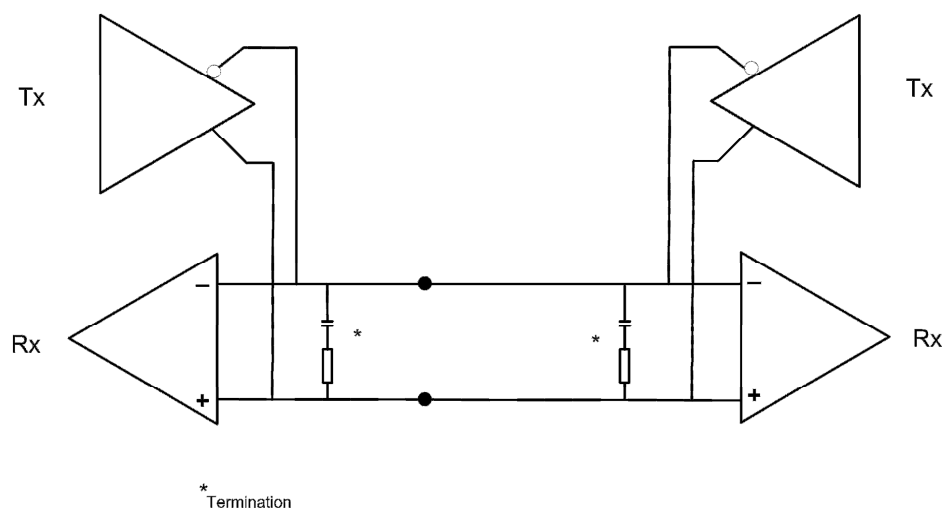
RS485 Full Duplex Multiplexed

This is a 4-wire multi-drop connection. Circuits with multiple transmitters should be terminated at both ends as shown in the diagram. On circuits with one transmitter the line should be terminated with the recommended values at the far end (usually the last receiver in the chain).



RS485 Half-Duplex

The Half -duplex connections should be terminated with the recommended values as shown:



System Security

Serial networks are closed and local and have limited protocol functionality, therefore, immune to any external attack except local deliberate sabotage. The AADvance system, however, with its workstations and DCS interfaces, uses Ethernet networks which tend to be part of a larger corporate network and can expose the system to accidental or malicious infection or attack.

There are some simple steps that can be taken to help prevent such issues:

- ▶ Network and workstation security should be considered, for example:
 - ▶ AADvance should not be on a network with open unsecured access to the Internet.
 - ▶ The Firewall must be active on the Workstation, preventing access to the relevant Ethernet ports on each communication interface. Anti-virus software must be installed and be kept up-to-date.

Note: Firewalls have been known to affect the operation of the AADvance Discovery tool

- ▶ The workstation should be password protected. If the workstation is a laptop, it should be kept locked when not in use.
 - ▶ If the workstation uses a hardware license USB dongle it should be kept secure, without it the workstation will not run.
 - ▶ The application should be password protected.
-

- ▶ Removable media, such as USB storage devices and CDs, should be virus checked before use within the system.
- ▶ The **program enable key** (shown below) should be removed from the processor base unit after application download (not applicable to a Euro Controller). This provides read only access to controllers during normal operation.



Connecting Field Wiring

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

Note: Use conductor wire with a cross section of 16AWG . 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.

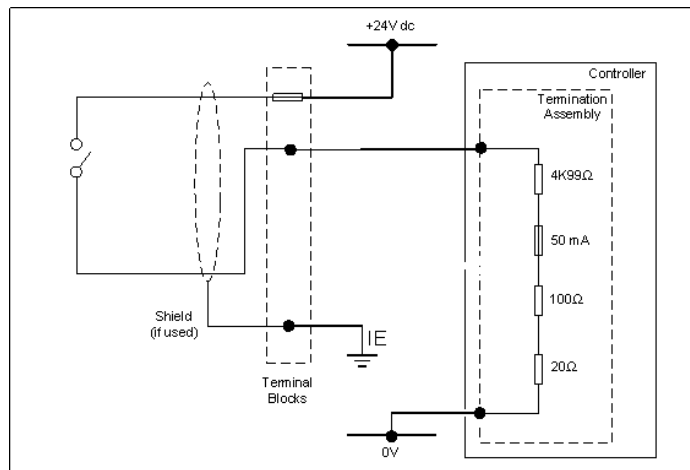


Digital Input Field Loop Circuits

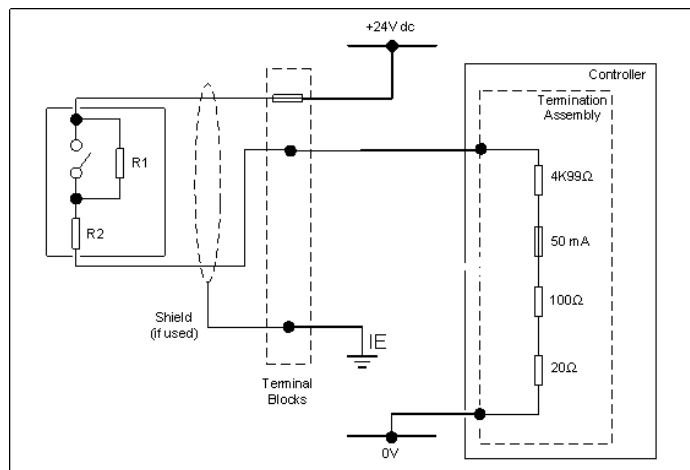
Recommended Field Loop Circuits

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)

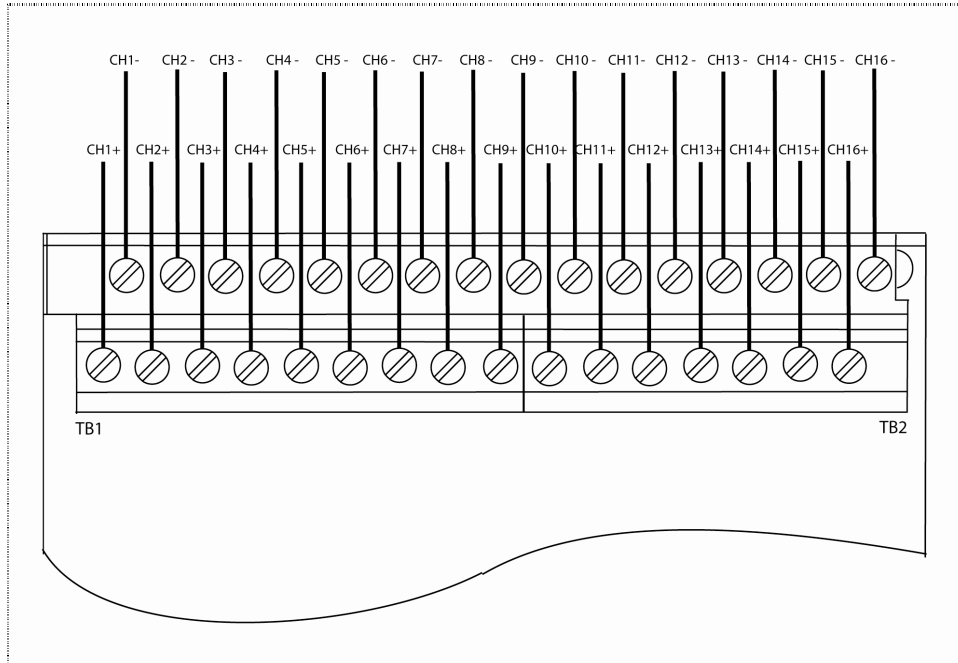
Suggested threshold values for both of the above circuits are as follows:

Threshold ID		Value (mV)
Maximum Allowed	=	32000
		SHORT CIRCUIT
Threshold 8	=	19000
Threshold 7	=	18500
		ON (nominal 16V)
Threshold 6	=	11000
Threshold 5	=	10500
		INDETERMINATE
Threshold 4	=	6500
Threshold 3	=	6000
		OFF (nominal 8V)
Threshold 2	=	3500
Threshold 1	=	3000
		OPEN CIRCUIT

Assumptions:

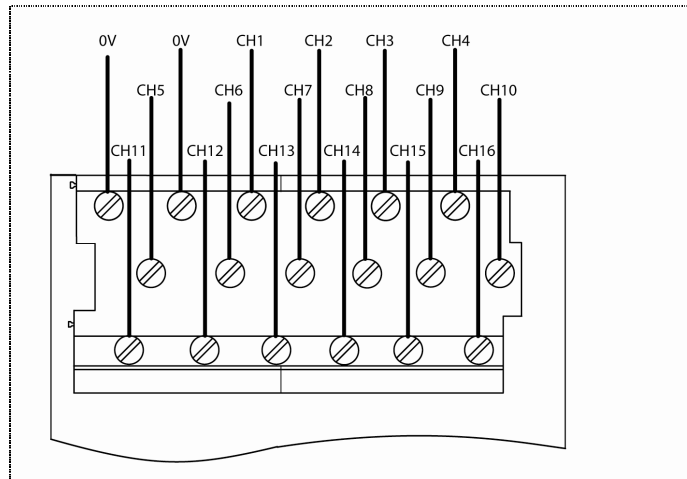
- ▶ Loop supply voltage = 24V \pm 10%
- ▶ Maximum Field Cable Line Resistance: < 100 Ω total; this means < 50 + 50 Ω for the two cables.
- ▶ Minimum Isolation is 0.75M Ω between the field loop conductors.
- ▶ These values will allow the input to detect more accurately different voltage levels that represent OPEN CCT - OFF - ON - SHORT CCT and will also detect Over Voltage and an input which is neither ON or OFF. The values ensure 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. 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. This also includes advice for fire detectors which are not simple volt free contacts.

Connections to 9802/9803 Isolated Digital Input TA – 16 Channel Dual/TMR



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

Connections to 9801 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.

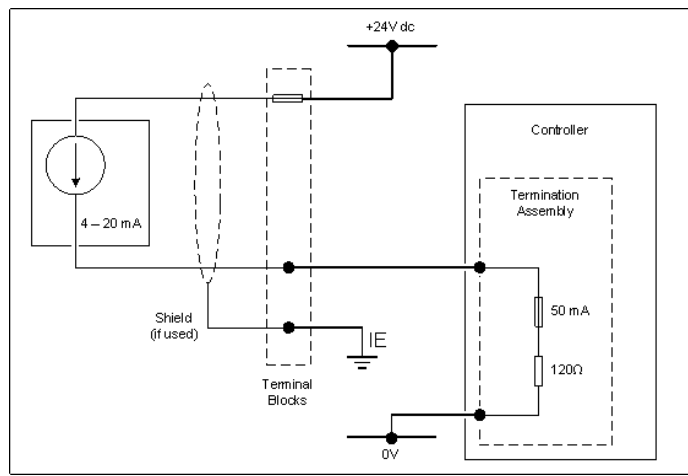
Analogue Input Field loop Circuits

These circuits can be used for simplex, dual and triple configurations of analogue input modules. Fit a fuse (as shown) in each circuit to protect the field wiring.

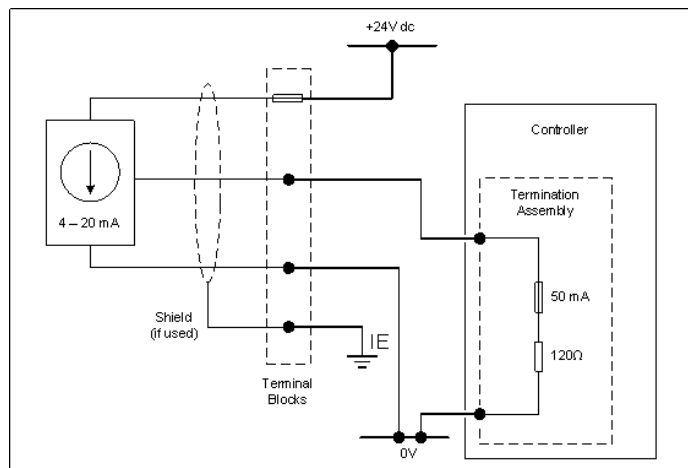
Recommended Field Loop Circuits

Note: A 150 ohm resistor is fitted only for the Euro Version of the Termination Assembly (T9842 Euro Analogue Input TA, 8 ch, Simplex)

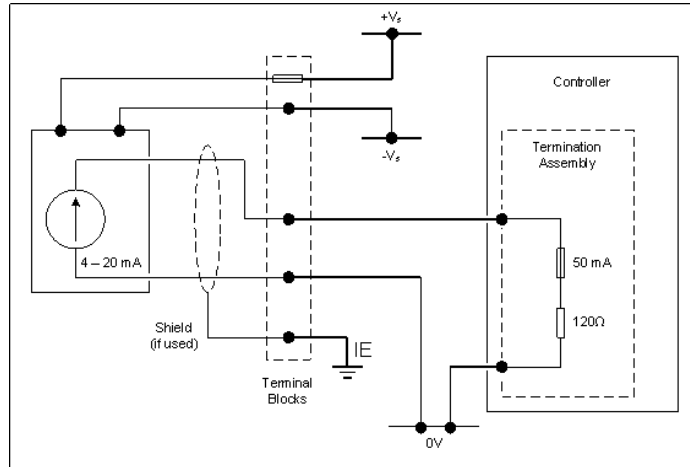
2-Wire Analogue Input



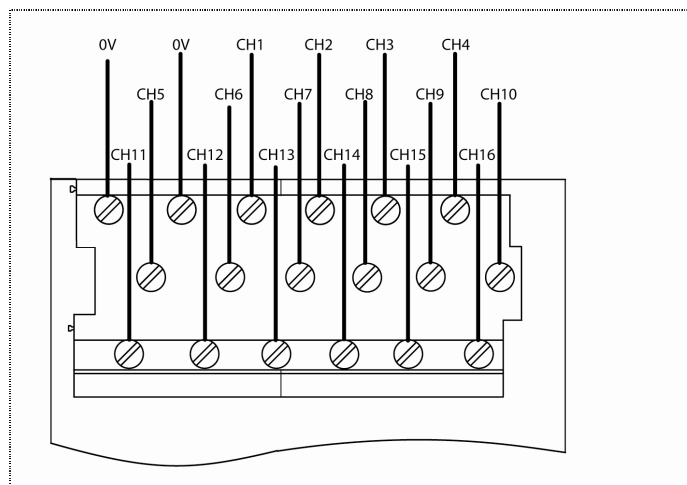
3-Wire Analogue Input



4-Wire Analogue Input

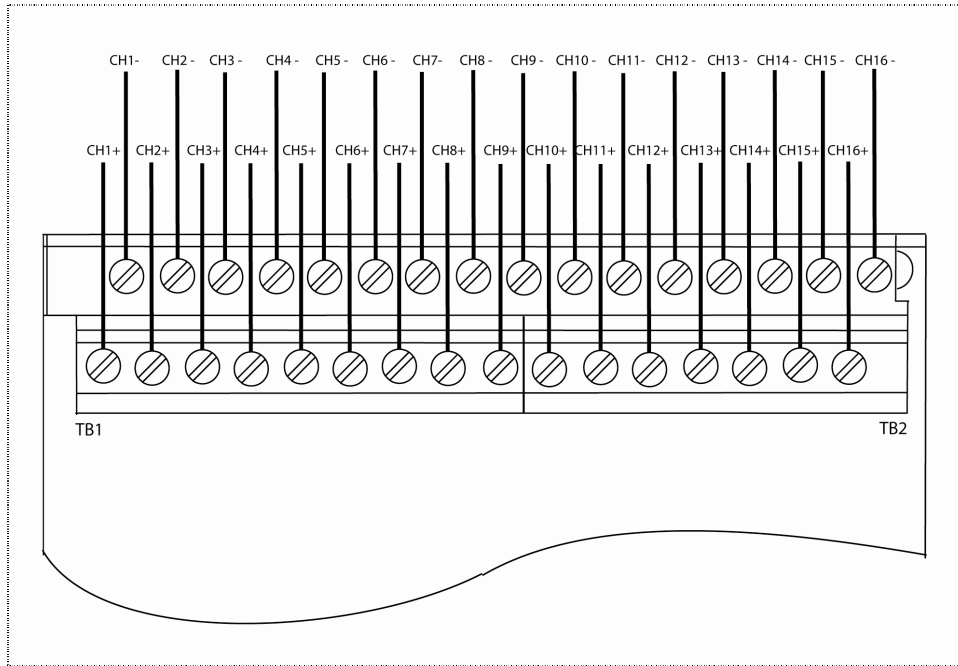


Connections to T9831 Non-isolated Analogue Input TA – 16 Channel Simplex



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

Connections to T9832/T9833 Isolated Analogue Input TA – 16 Channel TMR



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

Recommended Field Circuit for Digital Outputs

This circuit is suitable for simplex and dual configurations of digital output modules. The two 10A fuses shown are included on the termination assembly within the controller. The field power 5A fuses comply with UL508 requirements see illustration below..

The 10A fuses are fitted into the termination assembly and are:

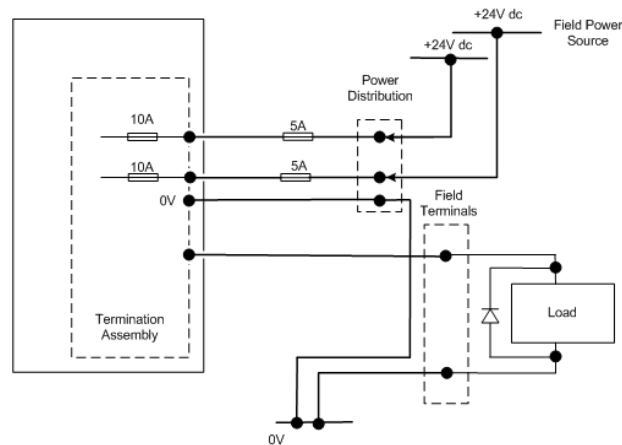
- ▶ T9902: SMF Omni-Block, Surface Mount Fuse Block I54 010, with a 10A, 125V Fast Acting Fuse, Littlefuse.

The field power input 5A fuses are:

- ▶ No 396/TE5 5A time lag fuse; UL 248-14, 125 V,T Leadfree; manufactured by Littlefuse.

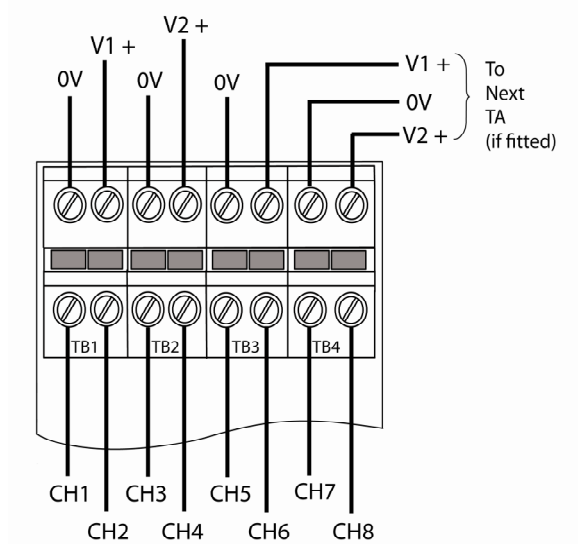
Note:

1. Alternatively instead of fitting two 5A fuses you can use Class 2 power supplies for the +24V dc field voltage. Class 2 is defined by the NEC as providing less than 100 watts (at 24V).
 2. The field power must be wired using 12 AWG wire.
 3. The field power must be supplied with an isolating source.
 4. The minimum current required for line monitoring is 10mA per module, 20mA for a dual pair.
-



For inductive loads, a back EMF protection diode shall be fitted at the load.

Connections to T9851/T9852 Digital Output TA – 8 Channel Simplex/Dual

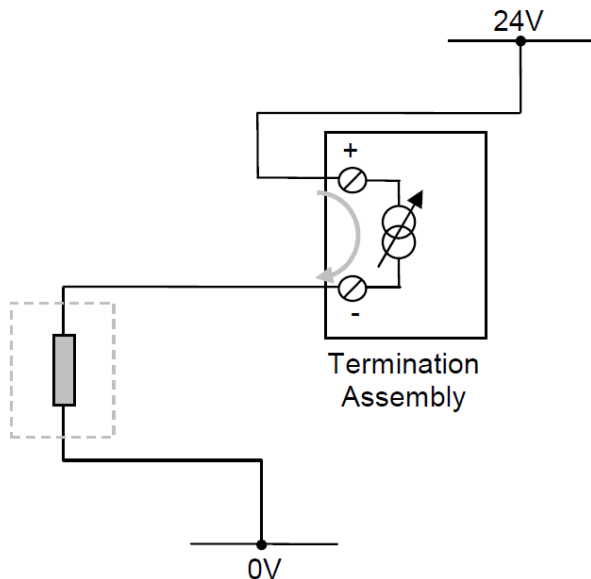


- ▶ Apply a minimum tightening torque of 0.5 Nm (0.37 ft lb) to the terminal screws.

Recommended Circuit for Analogue Outputs

These circuits are suitable for simplex and dual configurations of analogue output modules. All channels are isolated from each other but may be bridged at the '+' terminal if fed by a common system mounted supply.

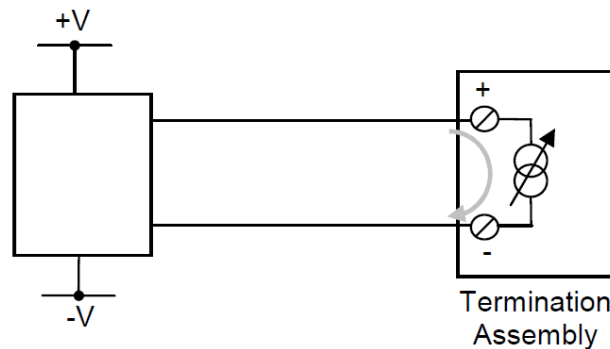
System powered devices



The above circuit is appropriate for devices that are powered by the system. The channel will pass a requested current between 0mA and 24mA. The field device could also be connected between the 24V supply and the Loop Plus terminal.

Note: that if the 24V supply is shared between channels or between modules, the field loops will not be isolated from each other.

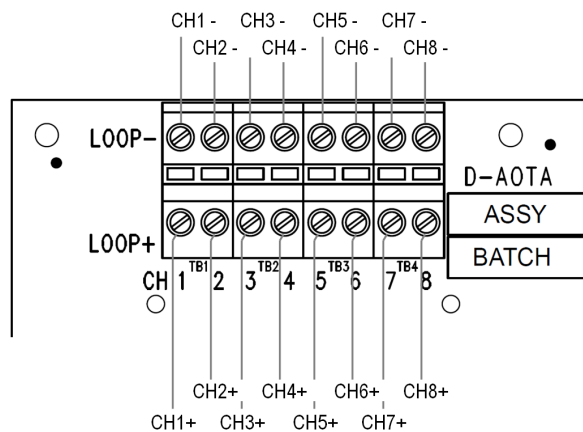
Field powered devices



The above circuit is appropriate for devices that are powered locally and expect a current-controlled signal loop. Ensure that the loop is wired to pass current to the Loop Plus terminal and return it on the Loop Minus terminal.

Connections to T9881/T9882 Analogue Output TA - 8 Channel Simplex/Dual

This diagram shows the T9882. The T9881 has the same terminal arrangement.



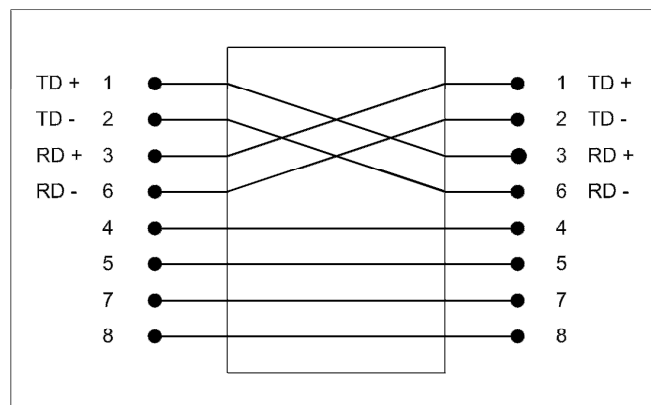
Note: Apply a minimum tightening torque of 0.5 Nm (0.37 ft lb) to the terminal screws.

Connecting the AADvance Controller to an Ethernet 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.

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

Wiring for 100BASE-TX Ethernet Crossover Cable

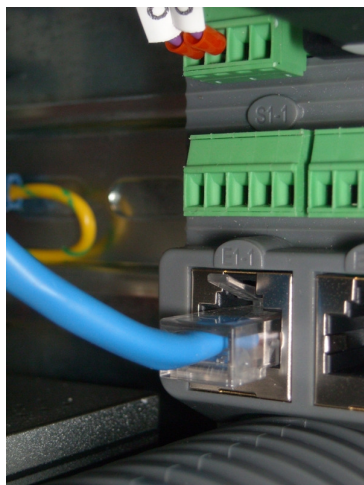


The fixed connectors on the controller are RJ45 sockets. Use Cat5e (enhanced) cables with RJ45 modular plugs for the network cabling.

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.



Install Modules

The modules of the AADvance controller mount onto the base units. The processor module(s) mount onto the T9100 processor base unit, while the various I/O modules mount onto the T9300 I/O base unit and associated termination assemblies.

The product range includes two sizes of blanking covers to conceal unused module positions. The shorter cover is for a spare position on the processor base unit, while the taller cover is for a spare position on an I/O base unit.

Install a T9110 Processor Module

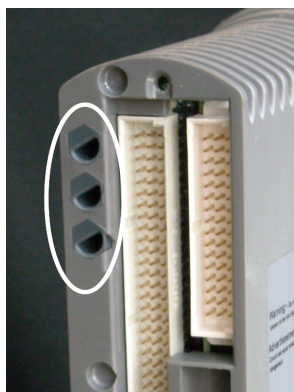
Note: All new processor modules are delivered with the latest firmware and a base level Recovery Mode firmware build. You can enter the Recovery Mode by pressing the **Fault Reset** button immediately after the module has booted up.

Inspect the module:

- ▶ Before inserting a new I/O module, inspect it for damage.
- ▶ The identification labels on the sides of the I/O module will be hidden once the module is installed. Therefore before installation record the location of the module and the details shown on the label.
- ▶ If you are installing more than one processor module make sure they all have the same firmware build.

To install each T9110 processor module, do the following:

- 1) Examine the coding pegs on the T9100 processor base unit and verify they complement the sockets on the rear of the processor module:



- 2) Place the processor module on to the dowel pins on the processor base unit. Make sure the slot on the head of the module clamp screw is vertical and then push the module home until the connectors are fully mated.

- 3) The module locking screw requires a quarter turn clockwise to lock. Use a broad (9mm) flat blade screwdriver to lock the locking screw.

Note: The locking screw acts as a power interlock device. Therefore, the locking screw must be in the locked position after the power is applied otherwise the module will not boot up.

Upgrade a Processor Module Firmware

To upgrade the firmware use the Recovery Mode and follow the procedures using the ControlFLASH utility. Refer to the configuration Guide for detailed procedures on using the ControlFLASH utility.

Note: If you need to downgrade the firmware to meet the requirements of your application and system contact Product support.

Install a Processor Back-up Battery

The T91 I0 processor module uses a battery to support its internal clock and memory when it is powered off. The battery condition is monitored by the module diagnostics every 24 hours. If the battery voltage is low, an application variable is set indicating there is a problem and the processor Healthy LED goes red.

Note: The processor back up battery is supplied separately and must be installed into each new processor.

To install a new battery, do the following:



(Part No: T9905 Poly-carbonmonofluride Lithium Coin Battery, BR2032 (recommended type) , 20mm dia; Nominal voltage 3V; Nominal capacity (mAh) 190; Continuous standard load (mA) 0.03; Operating temperature -30°C to 80°C, supplied by Panasonic. The battery will last for approximately 10 years under normal operating conditions, or approximately six months if the module is not in use.

- 1) Use a small cross head screwdriver to release the battery cover. Remove the cover.
- 2) To remove an old battery pull on the ribbon in the battery holder and pull the battery out.
- 3) To install a new battery orientate the new battery with the positive (+) terminal to the right. Trap the ribbon behind the new battery so it can be removed in the future and then push the battery into the holder.
- 4) Reinstall the battery cover.
- 5) Press the Fault Reset button on the processor module. The processor Healthy LED will go green (applies if the module is part of a running system).

If the battery is replaced when only a single processor module is installed and the processor module is not under power the processor clock will need to be reset to the current time. Correct the clock at the earliest opportunity. If it is replaced when more than one processor module is installed then the clock will be updated through synchronization.

If you have previously set up SNTP when you set up your processor module then the clock will be reset to the current time automatically. If you haven't set up SNTP it is recommended that you do so, as this will not only reset the processor clock but will also keep the time accurately during normal operation. Refer to the AADvance Configuration Guide, Chapter 4 for the SNTP set up instructions.

Alternatively use the following procedures to set the processor clock using the Processor Variables.

Set the Processor clock

To set the processor clock you can use the RTC variables:

- 1) To monitor the time wire variables to all the RTC Status points.
- 2) To configure the time to be set, wire variables to the RTC Program points:
 - ▶ Hours
 - ▶ Minutes
 - ▶ Seconds
- 3) Preset all RTC Program variables to the time that is to be programmed:
 - ▶ It is recommended that you set a time of 03:00. Do not set the time to midnight or a slow clock will always be set back 24 hours.

- 4) To control the time setting, wire variables to the RTC Control points:
 - ▶ RTC Write
 - ▶ RTC Read
- 5) Wire Variables to RTC Control:
 - ▶ Hours
 - ▶ Minutes
 - ▶ Seconds
- 6) Set RTC Read to be always True (the time will not be written unless this point is also True).
- 7) Set RTC Control elements Hours, Minutes and Seconds to be always True.
- 8) Use an external trigger to change RTC Write from False to True at the time you have preset in step 3.
 - ▶ The time will now be set into Real Time Clock

Note: On the very first setting it will be necessary to program all the time elements (Year, Month, Day etc)

Install I/O Modules

Inspect the module:

- ▶ Before inserting a new I/O module, inspect it for damage.
- ▶ The identification labels on the sides of the I/O module will be hidden once the module is installed. Therefore before installation record the location of the module and the details shown on the label.
- ▶ Examine the coding pegs on the termination assembly and verify they complement the sockets on the rear of the new I/O module.

To install each I/O module, do the following:

- 1) Examine the coding pegs on the termination assembly and verify they complement the sockets on the rear of the I/O module.
- 2) Place the I/O module on to the dowel pins on the T9300 I/O base unit. Make sure the slot on the head of the module clamp screw is vertical and then push the module home until the module connectors are fully mated with the I/O base unit and termination assembly connectors.
- 3) The locking screw requires a quarter turn clockwise to lock. Use a broad (9mm) flat blade screwdriver to lock the clamp screw.

Note: The locking screw acts as a power interlock device and must be in the locked position when power is applied otherwise the module will not power up.

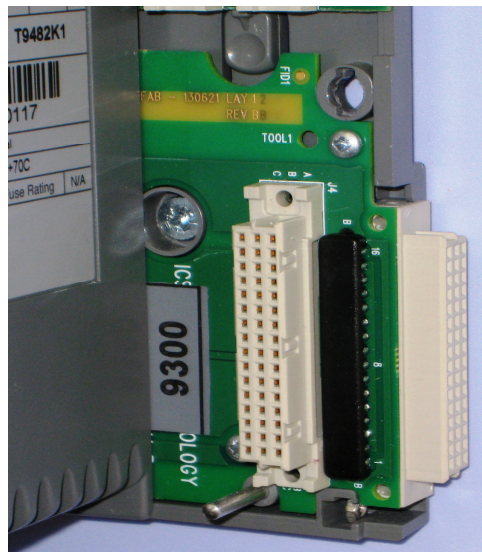
Install Blanking Covers

- ▶ Install a blanking cover to each spare position on the base units.
- ▶ Place the blanking cover on the base unit and use a broad (9mm) flat blade screwdriver to turn the clamp screw 90° to the lock position.



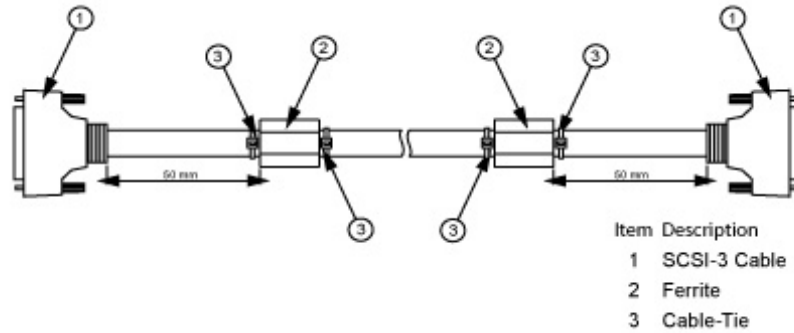
Fit EMC Static Protection Covers

For EMC static protection you should fit the black plastic protection covers (supplied with the base units) over any exposed 48 pin DIN connectors on the T9300 I/O Base unit.

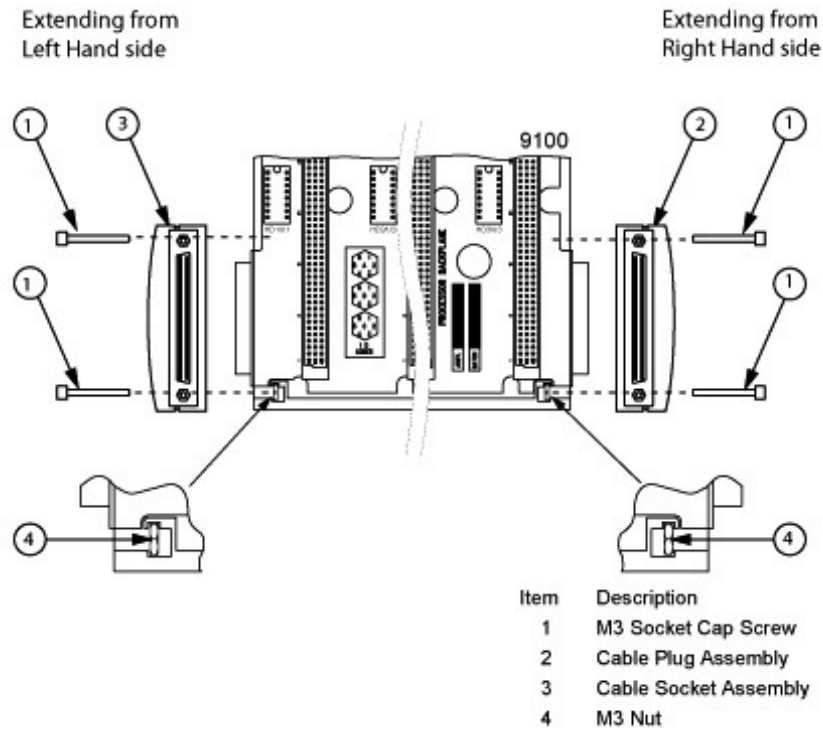


Install T9310 Expansion Cable

- 1) The expansion cable ferrites are snap on components. Fit the ferrites 50mm (1.97) from each end and secure with cable ties either side of the ferrites.



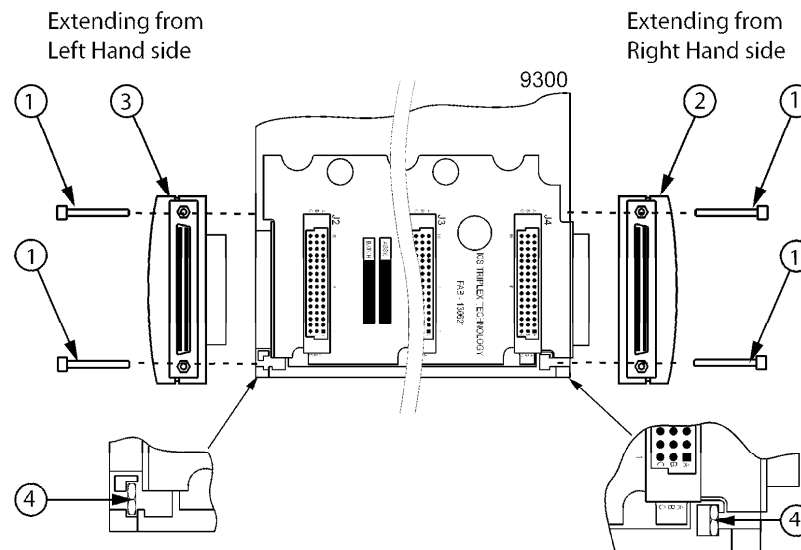
Connect Expansion Cable between T9100 Base Unit and T9300 I/O Base unit (IO Bus2)



- 1) Connect the expansion cable to a T9100 processor base unit for an IO Bus 2 connection.
- ▶ Insert a cable socket assembly into the left hand connector of the T9100 processor base unit.

- ▶ Secure the socket assembly by inserting the two M3 socket cap screws.
 - ▶ Tighten the screws with a 2.5mm Allen key.
 - ▶ Install the cable to the socket assembly and tighten the retaining screws by hand.
- 2) Insert the free end of the expansion cable into a right hand socket of a T9300 I/O base unit.
- ▶ Insert a cable plug assembly into into the right hand socket of the processor or I/O base unit.
 - ▶ Secure the plug assembly by inserting the two M3 socket cap screws.
 - ▶ Tighten the screws with a 2.5mm Allen key.
 - ▶ Install the cable to the plug assembly and tighten the retaining screws by hand.

Connect Between a T9300 I/O Base Unit and a T9300 I/O Base Unit



Item	Description
1	M3 Socket Cap Screw
2	Cable Plug Assembly
3	Cable Socket Assembly
4	M3 Nut

- 1) Connect the expansion cable between a T9100 processor base unit (or a T9300 I/O Base unit) to a T9300 I/O base unit.
- ▶ Insert a cable plug assembly into into the right hand socket of the processor or I/O base unit.
 - ▶ Secure the plug assembly by inserting the two M3 socket cap screws.

- ▶ Tighten the screws with a 2.5mm Allen key.
 - ▶ Install the cable to the plug assembly and tighten the retaining screws by hand.
- 2) Connect the free end of the expansion cable to the left hand plug of an I/O base unit using a cable socket assembly.
- ▶ Insert a cable socket assembly into the left hand connector of the T9300 processor base unit.
 - ▶ Secure the socket assembly by inserting the two M3 socket cap screws.
 - ▶ Tighten the screws with a 2.5mm Allen key.
 - ▶ Install the cable to the socket assembly and tighten the retaining screws by hand.

Fault Reporting Reference Information

Each module has a set of front panel status indicators. The purpose and meaning of these indicators relevant to each module is as follows:

Status Indicators on the T94xx Series Input and Output Module



Table 6: Status Indicators on the 94xx Series Input and Output Module

Indicator	Status	Description
Healthy		Provides an indication of the general status of the module
	OFF	No power
	GREEN	No module faults present
	RED	One or more module faults are present Note. 1. The Healthy indicator may turn RED immediately upon application of power to the module, before then turning GREEN 2. If Healthy is GREEN and the Ready and Run are RED then the module is said to be in its "shutdown state" refer to the Troubleshooting Manual - Chap 3 for more information on the shutdown state.
Ready		Provides an indication of the module's ability to report channel values to a running application
	OFF	No power or unlocked
	GREEN	Locked and ready to report channel values
	RED	Locked but not ready to report channel values
Run		Provides an indication that the module is reporting channel values to a running application
	OFF	No power or unlocked

	GREEN	Module is online and providing data to/receiving data from application
	AMBER	Module is inserted into a running system but not online. Press the Fault Reset button on any processor module to enable the module to go online
	RED	Module is ready to go online but no application is running
Channel 1 - 8		Provides an indication of the status of each input or output channel
	OFF	Input module: field switch is open Output module: output is in its de-energised state If the run indicator is not green (the module is not reporting channel values), all channel indicators will be off
	GREEN	Input module: Channel input is on Output module: Output is in its energised state
	AMBER	Field fault
	RED	Channel fault

Status Indicators on the T9110 Processor Module

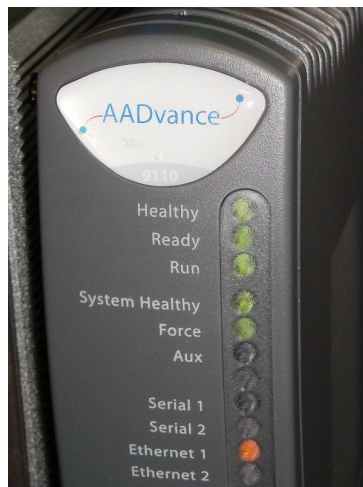


Table 7: Status Indicators on the 9110 Processor Module

Indicator	Status	Description
Healthy		Provides an indication of the module's fault status and power-on/operational status
	OFF	No power
	RED	<ul style="list-style-type: none"> ▶ Module has a fault ▶ Flashes RED briefly after being installed as the module is booting up or reset is in progress ▶ controller is off-line
	GREEN	<p>As the module is installed and receives power it flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds).</p> <p>When the module has booted up and is operational the LED stays GREEN</p>

		<p>and indicates that the module has no hardware faults.</p> <p>When in the recovery Mode and no faults are present the LED is GREEN</p> <p>Note:</p> <ol style="list-style-type: none"> 1. If Healthy is GREEN and all the other indicators are OFF then the module has failed to boot up 2. If Healthy is GREEN and the Ready and Run are RED then the module is said to be in its shutdown state (See topic - Module Shutdown State and Possible Causes in the Troubleshooting Manual Chap 3).
Ready		Provides an indication of the module's education and synchronisation status
	OFF	No power
	RED	Module is booting up (10 to 20 seconds) or not educated or synchronised with partners
	GREEN	Module is educated and synchronised with partners
	Flashing GREEN	Education or synchronisation is in progress (may be a very short period of flashing then Green)
Amber	Module is in the Recovery Mode	
Run		Provides an indication of the module's application status. Should be the same for all educated and synchronised processors
	OFF	No power and stays off while the module is booting up (10 to 20 seconds)
	RED	Module is not educated/synchronised; No application loaded; The processor module is in the Recovery Mode and the base level firmware is running
	GREEN	The application is present and running
	AMBER	Module is in the Recovery Mode or The application is present but not running, press Fault Reset to start it running.
System Healthy		Provides an indication of the global health of the system, including all processors and I/O modules. Must be the same indication for all educated and synchronized processors
	OFF	No power and stays off while the module is booting up (10 to 20 seconds)
	RED	System or module faults present or the application has stopped running because the module has entered the Recovery Mode.
	GREEN	No system or module faults present during normal operation and when in the recovery Mode.

Force		Provides an indication that variables are being locked/forced by the application. The same indication will show for all educated and synchronised processors
	OFF GREEN AMBER	No power and stays off while the module is booting up (10 to 20 seconds) No variables are being locked/forced Module is in the Recovery Mode. or an operating controller has at least one variable being locked/forced
Aux		This LED is controlled by the application. The application can turn it on/off and any colour except when the processor is in the Recovery Mode and the application is stopped
	OFF GREEN AMBER	No power and stays off while the module is booting up (10 to 20 seconds), or under application control Under application control Module is in the Recovery Mode or under application control
Serial 1 and 2		Provides an indication of serial port activity
	OFF	No power and stays off while the module is booting up (10 to 20 seconds)
	RED	Pulse stretched Tx
	GREEN	Pulse stretched Rx
	AMBER	Tx and Rx activity in close proximity
Ethernet 1 and 2		Provides an indication of Ethernet port activity
	OFF	No power and stays off while the module is booting up (10 to 20 seconds)
	GREEN	Ethernet link present
	AMBER	Tx or Rx activity

Note: When inserting more than one processor module they **MUST** be inserted one at a time and the module allowed to educate (in the case of a 2nd and 3rd processor).

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System Start-Up

This chapter describes a structured approach to the start up of a controller system. When the checks and module installation and start up is completed successfully, the system is ready for a Functional Acceptance Test.

In This Chapter

Recommendations to Manage Test Documentation.....	4-1
System Physical Design Check.....	4-2
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Procedure to Conduct the Mechanical Inspection.....	4-2
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Recommendations to Manage Test Documentation

It is important that the system is documented when it is installed and this documentation is maintained throughout the testing process system.

- 1) Obtain these items of documentation:
 - ▶ I/O wiring database with checklist
 - ▶ Complete set of drawings
 - ▶ Bill of materials
- 2) Ensure that each item of documentation is the latest issue.
 - ▶ Mark each item as 'Test Copy'.
- 3) Create a system activity log book and ensure the log book accompanies the system into test.
 - ▶ Allocate an entry number for each test and record each test against its number in the log book.
 - ▶ If, during functional tests, the system does not behave as expected, record the problem in the log book. Allocate a new entry and fault number for each problem.

System Physical Design Check

Assess the physical design of the system to determine whether it is ready to be tested. Do the following:

- ▶ Verify there is physical segregation of any mains supply circuits from the 24V dc controller circuits.
- ▶ Review the arrangements of terminals and the provision of cable entries for field wiring.
- ▶ Evaluate the ease of access for maintenance activities.

Procedure to Verify Build State

Assess the build state of the system against the test documentation. Do the following:

- ▶ Compare the arrangement of the system with the General Arrangement drawings to make sure the system has been manufactured and assembled correctly.
- ▶ Verify that every item shown in the bill of materials on the General Arrangement drawings is either in place or is available to be installed.
- ▶ Check that any special features, configurations or options called for on the drawings are present and correct.
- ▶ Check nameplates and identification labels against the drawings.

Identify any non-conformance found between the system and the drawings. If appropriate, correct the drawing. Record each non-conformance in the log book.

Procedure to Conduct the Mechanical Inspection

Carry out a mechanical inspection to verify that an acceptable standard of workmanship has been achieved in the assembly and wiring and that the test arrangements are correct. Do the following:

- ▶ Visually inspect the controller and verify that base units, modules and terminals are free of damage.
- ▶ Review the termination of system cabling against the drawings.

Procedure to Check Ground Bonding

WARNING AC SAFETY GROUND



Secure the AC safety ground busbar to the local factory earth point before proceeding with any electrical testing or applying power to the system.

Failure to follow these instructions may result in personal injury.

-
- ▶ Check that the ground continuity does not exceed 0.2 Ω .
 - ▶ Check that the isolation between grounds is 10M Ω .
-

Procedure to check Power Distribution Integrity

Note: Before you begin this task, you must have checked the ground bonding.

Check the integrity of the power distribution system to verify that each power distribution sub-section is wired in accordance with the drawings and that the subsections are isolated from each other. Do the following:

- 1) Make sure all power sources are isolated.
- 2) Switch off all circuit breakers and open distribution fuses.
- 3) Remove all modules from the controller.
- 4) Check that the circuit breakers and fuses of the correct capacity and rating are installed in the correct locations.
- 5) Check that all subsections are isolated from each other.

Power Distribution and First Power Up

Note: Before you begin this task, you must have checked the power distribution integrity.

The power distribution and first power up verifies that the power distribution circuits function as designed and as detailed in the drawings. It shows the correct voltages are appearing, and only in the correct places. It also provides an opportunity to verify correct operation of any power indicators outside the controller itself.

Do the following:

- 1) Make sure all modules are removed.
- 2) Trip all circuit breakers and disengage all power distribution fuses and field fuses.
- 3) Apply power to the incoming power terminals.
- 4) It is good practice to switch on power supplies to field devices before supplies to the controller. Devise a formal sequence in which to switch on individual circuits.
 - ▶ In sequence, check each circuit breaker or fuse for zero volts on the destination side, and then close the circuit breaker or fuse and verify that the appropriate voltage appears.
 - ▶ Check that any associated power indicator is lit.
 - ▶ As each circuit breaker is tested, leave the breaker in the 'on' position so that any unwanted connection between different power circuits can be detected.
- 5) Trip and re-instate each circuit breaker in turn and verify the correct circuits are isolated and restored. Similarly disengage and replace each fuse and verify the associated circuits.
- 6) At the same time verify correct operation of any power indicators supplied with the system.

Start Up Process

Once the procedures for power distribution tests have been successfully completed, the controller is ready for installation of its modules and its second power up. The installation process should be completed in the following order:

- 1) Switch off power to the controller — both field power and controller power sources.
- 2) Make a record of the module and base unit serial numbers for future reference.
- 3) Reinstate the power.
- 4) Install the modules in the following sequence.
- 5) Install the **program enable key** to the connector labeled **KEY** on the processor base unit.
- 6) Install the first Processor module.
 - Refer to the Processor Module start-up process.
- 7) Install the second or the third processor module (if required).
 - Refer to the Processor Module start-up process.
- 8) Install the I/O modules.
 - Refer to the I/O Module start up process.
- 9) Check system status indications show the system is on-line and operating as expected.

Processor Module Start Up Process

Note: When inserting more than one processor module they **MUST** be inserted one at a time and the module be allowed to educate (in the case of a 2nd and 3rd processor).

Table 8: Single Processor Module Installation Procedure (New Processor Module)

Step	Task								
1.	Install the processor into a processor base unit slot.								
2.	<p>All LEDs are off and after applying power the processor will display the following status indications:</p> <table border="0"> <tr> <td style="vertical-align: top;">Healthy</td> <td>Flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds)</td> </tr> <tr> <td style="vertical-align: top;">Ready</td> <td>Will remain OFF as the module boots up (10 - 20 seconds) then goes RED</td> </tr> <tr> <td style="vertical-align: top;">Run</td> <td>Will remain OFF as the Module boots up (10 to 20 seconds) then goes RED</td> </tr> <tr> <td style="vertical-align: top;">System Healthy</td> <td>Will remain OFF as the Module boots up (10 to 20 seconds) then goes GREEN</td> </tr> </table>	Healthy	Flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds)	Ready	Will remain OFF as the module boots up (10 - 20 seconds) then goes RED	Run	Will remain OFF as the Module boots up (10 to 20 seconds) then goes RED	System Healthy	Will remain OFF as the Module boots up (10 to 20 seconds) then goes GREEN
Healthy	Flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds)								
Ready	Will remain OFF as the module boots up (10 - 20 seconds) then goes RED								
Run	Will remain OFF as the Module boots up (10 to 20 seconds) then goes RED								
System Healthy	Will remain OFF as the Module boots up (10 to 20 seconds) then goes GREEN								

Step	Task
	<p>Force Will remain OFF as the Module boots up (10 to 20 seconds) then stays OFF until the module has educated.</p> <p>Aux Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection.</p> <p>Serial 1 Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection</p> <p>Serial 2 Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection</p> <p>Ethernet 1 Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection</p> <p>Ethernet 2 Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection</p>

You have to set up the processor IP Address so that the workstation can communicate with the processor module and download the latest firmware build and configure the processor variables.

3.	Set the Controller IP Address for all the processor modules using the "AADvance Discover Utility". (Refer to the Configuration Guide for detailed instructions on using the AADvance Discover Utility Doc. No: 553633).
4.	<p>Install a Program Enable Key. Download a valid application and press the FAULT RESET button. When the application is downloaded and valid the module will display the following indications:</p> <p style="padding-left: 40px;">Valid Application Downloaded</p> <p>Healthy GREEN</p> <p>Ready GREEN</p> <p>Run RED to GREEN (Flashes GREEN as the module educates)</p> <p>System Healthy GREEN</p> <p>Force GREEN</p> <p>Aux Off (Application Dependent)</p> <p>Serial 1 Dependent on data connection</p> <p>Serial 2 Dependent on data connection</p> <p>Ethernet 1 Dependent on data connection</p> <p>Ethernet 2 Dependent on data connection</p>

Table 9: Procedure for Installation of a 2nd and 3rd Processor

Note: The second and third processor modules must be programmed with the same firmware as the first processor. Check the firmware revision on the labels and if required use the procedure in the Configuration Guide. If the firmware revision is different to the first processor module you can download the latest firmware build to all the processor modules using the ControlFLASH utility.

When inserting a second and third processor module they **MUST** be inserted one at a time and allowed to educate before inserting the next one.

Step	Task
I.	<p>Place the processor module on slot B on the Processor Base Unit connectors and push the module home until the connectors are fully mated. Turn the locking screw with a flat bladed screwdriver to lock the module in position.</p> <p>All the Module LEDs are OFF until the module is installed. As soon as the module receives power it will boot up then educate and display the following indications:</p>
Healthy	Flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds)
Ready	Will remain OFF as the module boots up (10 - 20 seconds) then goes RED for 10 secs then flashes GREEN as it educates and finally it goes to steady GREEN
Run	Will remain OFF as the module boots up (10 - 20 seconds) then goes RED until educated and then it goes AMBER
System Healthy	Will remain OFF as the Module boots up (10 to 20 seconds) then goes GREEN
Force	Will remain OFF as the Module boots up (10 to 20 seconds) then stays OFF until the module has educated and the application is running
Aux	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
Serial 1	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
Serial 2	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
Ethernet 1	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
Ethernet 2	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection

Step	Task																				
When the Run indicator goes AMBER press the Fault Reset button and the processor will display the following indications:																					
2.	<table border="0"> <tr> <td>Healthy</td> <td>Green</td> </tr> <tr> <td>Ready</td> <td>GREEN (can flash for a short time as the module educates)</td> </tr> <tr> <td>Run</td> <td>AMBER to GREEN (AMBER as the module educates)</td> </tr> <tr> <td>System Healthy</td> <td>GREEN</td> </tr> <tr> <td>Force</td> <td>Off to GREEN</td> </tr> <tr> <td>Aux</td> <td>Off (application dependent)</td> </tr> <tr> <td>Serial 1</td> <td>Dependent on Data Connection</td> </tr> <tr> <td>Serial 2</td> <td>Dependent on Data Connection</td> </tr> <tr> <td>Ethernet 1</td> <td>Dependent on Data Connection</td> </tr> <tr> <td>Ethernet 2</td> <td>Dependent on Data Connection</td> </tr> </table>	Healthy	Green	Ready	GREEN (can flash for a short time as the module educates)	Run	AMBER to GREEN (AMBER as the module educates)	System Healthy	GREEN	Force	Off to GREEN	Aux	Off (application dependent)	Serial 1	Dependent on Data Connection	Serial 2	Dependent on Data Connection	Ethernet 1	Dependent on Data Connection	Ethernet 2	Dependent on Data Connection
Healthy	Green																				
Ready	GREEN (can flash for a short time as the module educates)																				
Run	AMBER to GREEN (AMBER as the module educates)																				
System Healthy	GREEN																				
Force	Off to GREEN																				
Aux	Off (application dependent)																				
Serial 1	Dependent on Data Connection																				
Serial 2	Dependent on Data Connection																				
Ethernet 1	Dependent on Data Connection																				
Ethernet 2	Dependent on Data Connection																				
3.	To insert a 3rd processor module repeat step 1 and insert in Slot C.																				

I/O Module Start Up Process

To start up an Input/Output Module follow this procedure:

Note: The start up sequence is different when a module is installed into an on-line system that is running compared to installing the module into a system that is off-line and has processor modules but no I/O modules installed. The first part of this procedure covers the initial start up of an off-line system, the second part covers a system that is on line and you are adding I/O modules.

Table 10: Single Module or First Module of a group Installation Procedure

Step	Task								
1.	This procedure applies to a single module installed or the first module of a redundant group.								
2.	Install the Input/Output Module and turn the locking screw to the lock position.								
3.	The input module will provide the following status indications:								
	<table border="0"> <tr> <td>Healthy</td> <td>GREEN</td> </tr> <tr> <td>Ready</td> <td>RED</td> </tr> <tr> <td>Run</td> <td>RED</td> </tr> <tr> <td>Channel 1 – 8</td> <td>Off</td> </tr> </table>	Healthy	GREEN	Ready	RED	Run	RED	Channel 1 – 8	Off
Healthy	GREEN								
Ready	RED								
Run	RED								
Channel 1 – 8	Off								
4.	The input module will enter its start up sequence during which the module will educate. Wait for approximately 3 seconds.								
5.	The module will now provide the following status indications:								
	<table border="0"> <tr> <td>Healthy</td> <td>GREEN</td> </tr> </table>	Healthy	GREEN						
Healthy	GREEN								

	Ready	GREEN
	Run	AMBER
	Channel 1 – 8	Off
6.	Press the Fault Reset button on the processor module and the Run indication goes GREEN.	
7.	The module will now be on-line with the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	GREEN
	Channel 1 – 8)	Dependent on channel status
8.	If the module fails to educate and go on-line replace the module.	


Table 11: Second or third Module of a Group Installation Procedure

Step	Task	
1.	This procedure applies to a second or third module of a redundant group.	
2.	Install the Input/Output Module and turn the locking screw to the lock position.	
3.	The input module will provide the following status indications:	
	Healthy	GREEN
	Ready	RED
	Run	RED
	Channel 1 – 8	Off
4.	The input module will enter its start up sequence during which the module will educate. Wait for approximately 3 seconds.	
5.	The module will now provide the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	AMBER
	Channel 1 – 8	Off
6.	Press the Fault Reset button on the processor module and the Run indication goes GREEN.	
7.	The module will now be on-line with the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	GREEN
	Channel 1 – 8)	Dependent on channel status

8.	If the module fails to educate and go on-line replace the module.
----	---

ControlFLASH Firmware Upgrades

The AADvance controller supports upgrades of processor module firmware by using the ControlFLASH utility (I/O module upgrades using ControlFLASH are not currently supported in this release.)

	<p>WARNING FIRMWARE UPGRADE DANGER TO A RUNNING SYSTEM</p> <p>Do not attempt to upgrade firmware on a running system. Control FLASH will not warn you that a system is running and you will lose control of the application when the system reboots.</p>
---	--

Upgrading the processors is a two stage process:

- ▶ **Stage 1:** Run the latest version of 350720_xxx_ControlFLASH.msi program to install the ControlFLASH firmware upgrade kit for the Recovery Mode on your PC. Then run the ControlFLASH utility to upgrade your processor module and install the Recovery Mode. If your module is delivered with the Recovery Mode installed then this stage is not necessary.

Note: Stage 1 must be done individually on each processor; it does not matter if you download the Recovery Mode one at a time in a specific slot or in their own slots.

- ▶ **Stage 2:** Reboot the processor and enter the Recovery Mode. then run the latest version of 354400_xxxx_ControlFLASH.msi program to install the ControlFLASH to upgrade your processor's OS, FPGA, LSP and BUSP.

Note: When Stage 1 is completed ControlFLASH can be used to upgrade three processor modules in the same processor base unit all at the same time.

What You need

You will need the ControlFLASH firmware upgrade kit.

- ▶ Firmware for the processors being upgraded.
- ▶ ControlFLASH programming tool, along with its required support drivers and on line HELP.
- ▶ Quick Start and RSLinx Classic Lite software or better.

To install and configure the ControlFLASH utility refer to the Rockwell Automation ControlFLASH Upgrade Kit documentation, Publication No: 1756-UM105C-EN-E March 2012 available from the Rockwell Automation Literature Library.

RSLinx Software

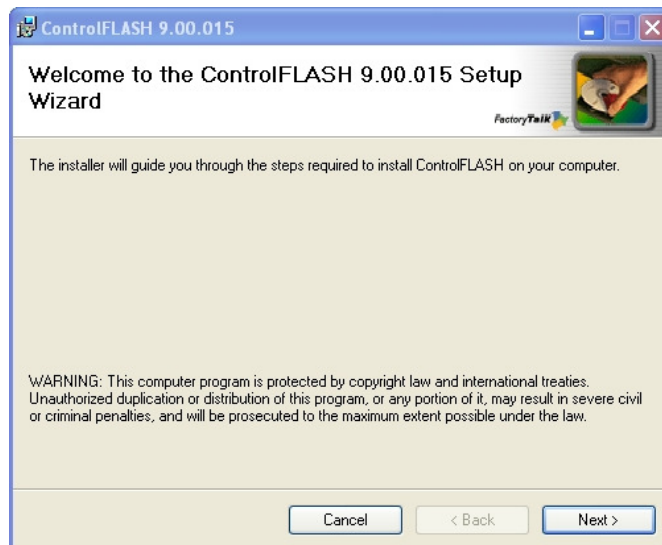
The RSLinx Classic Lite software must be installed before you can install the ControlFLASH software. RSLinx software is a communications software package that you can use with a wide variety of rockwell automation applications and hardware. The ControlFLASH software uses the RSLinx Classic Lite software to communicate over Data highway Plus, DFI, DH485, ControlNet, DeviceNet and Ethernet networks.

Before installing the ControlFLASH Firmware Kit, RSLinx must be configured with the IP address of the controller you wish to upgrade. Ensure that when you run the RSLinx software from the "**Communications**" menu click "**Configure Drivers**". Select a driver of type "**Ethernet Devices**" and add the required IP address to the list.

Stage 1: Installing the ControlFLASH Firmware

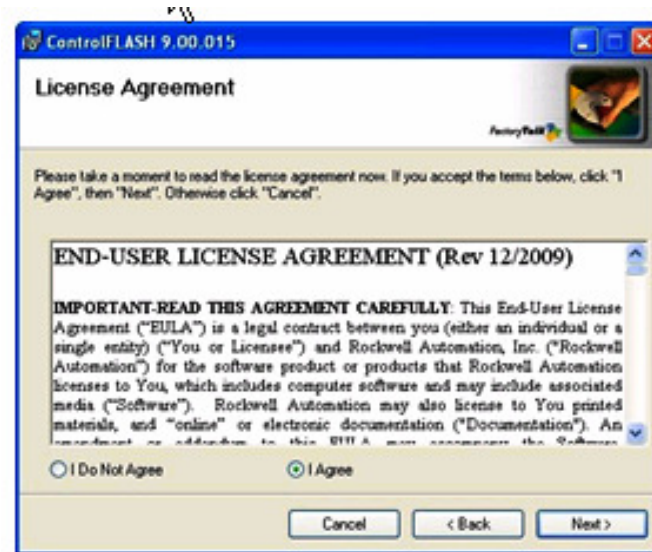
This procedure will install Recovery Mode and Secondary Boot firmware.

- 1) Run the '350720_102_ControlFLASH.msi file.

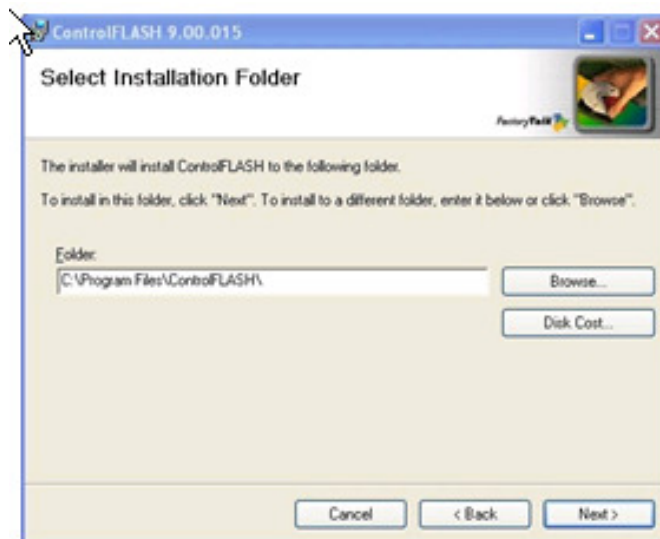


- 2) Click **Next**

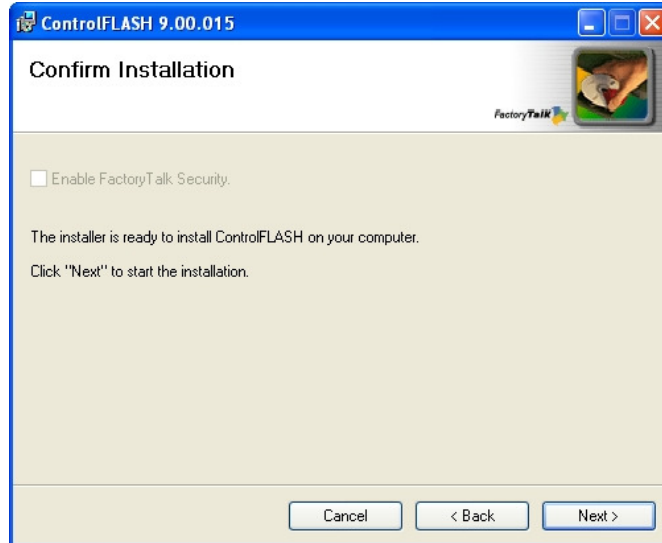
- 3) Read and agree to the license and click **Next**



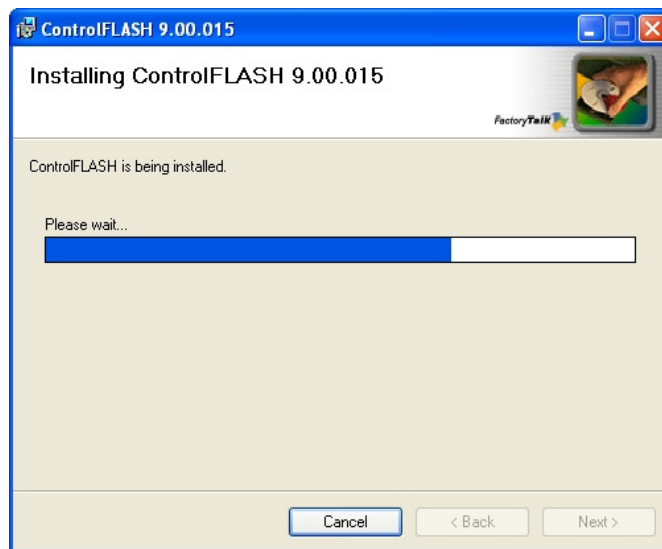
- 4) Click **Browse** to select the location of the installation or Next to select the default location.



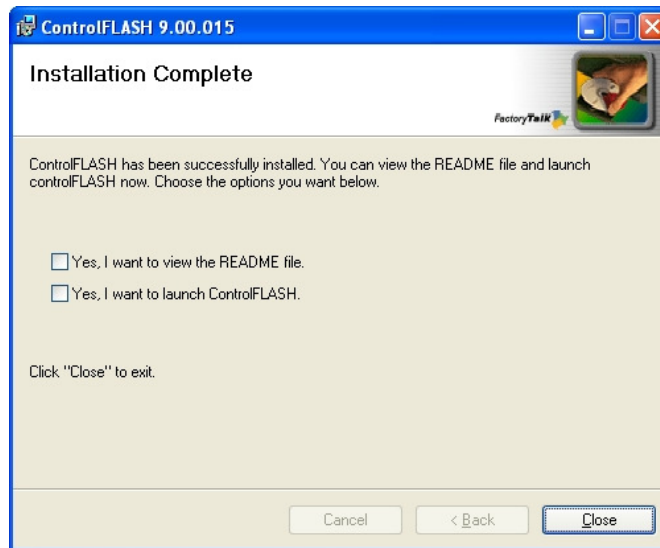
- 5) Click **Next** to start the installation.



▶ **ControlFLASH** installs.



- 6) To launch ControlFLASH select the **Yes I want to launch controlFLASH** option, then click **Close**.




- ▶ ControlFLASH will launch and you can now upgrade the Processor Module firmware.

Upgrade the Processor Module Recovery Mode Firmware

This is the recommended procedure to upgrade the processor module firmware using the **ControlFLASH** Utility.

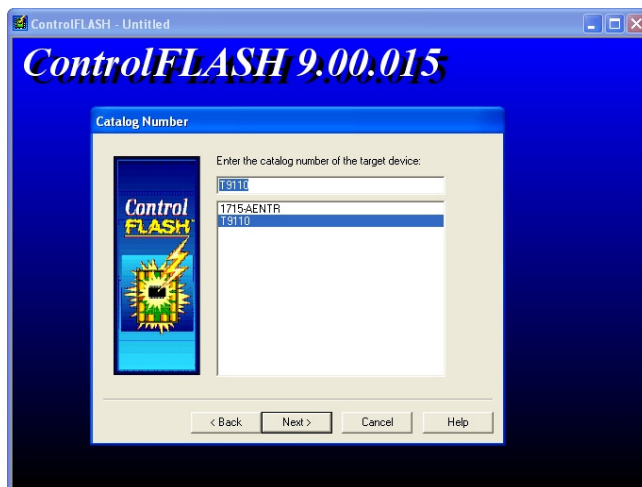
Note: ControlFLASH can upgrade 3 processor modules at once when installed into a 9100 base unit and they are in the Recovery Mode. To do this press and hold the **Fault Reset** button on all three processors when they are being powered up during a power on/off cycle until the AUX LED goes Amber.

	<p>WARNING FIRMWARE UPGRADE DANGER TO A RUNNING SYSTEM</p> <p>Do not attempt to upgrade firmware on a running system. Control FLASH will not warn you that a system is running and you will lose control of the application when the system reboots.</p>
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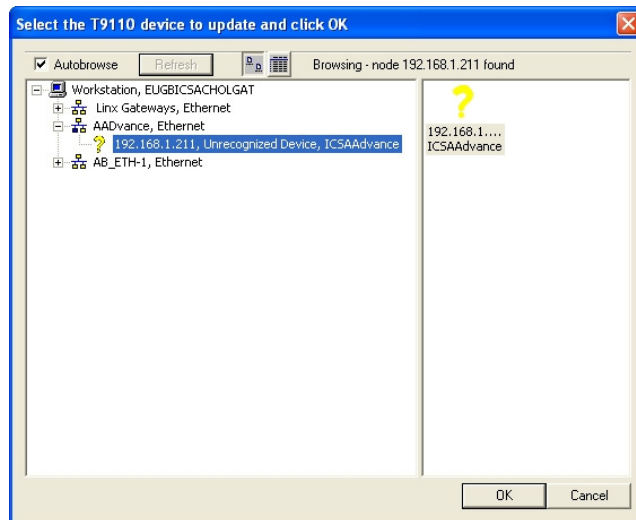
- 1) Run the **ControlFLASH** software by either:
 - ▶ Launching from the installation
 - ▶ Double clicking the desktop icon
 - ▶ Launching from the **Start** button



- 2) Click **Next**.
- 3) Select T9110 from the list.



- 4) Browse to the device in the **RSLinx** window



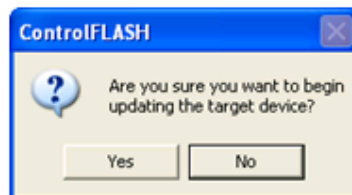
- 5) Select the firmware revision for the latest Release.



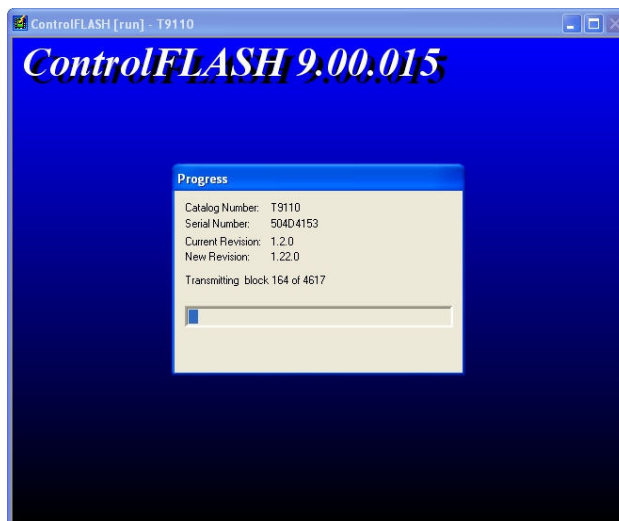
- 6) Check the summary details, click **Finish**



The continue message is displayed:



- 7) Click **Yes** to continue with the update
 - ▶ A progress bar is displayed

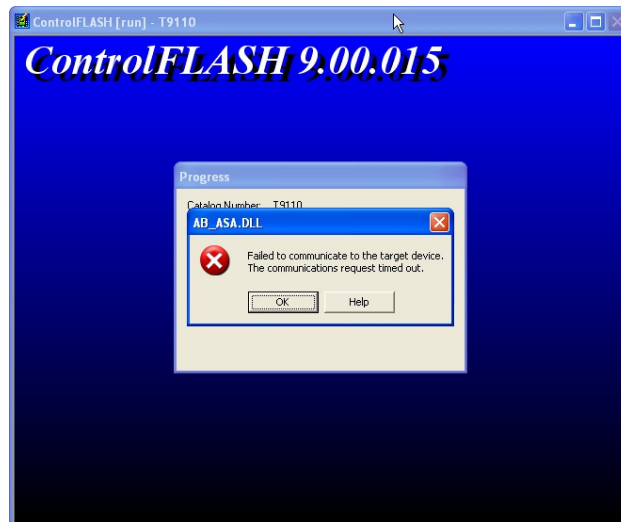


- ▶ When the progress bar reaches the end, it may take several minutes for the next screen to appear.

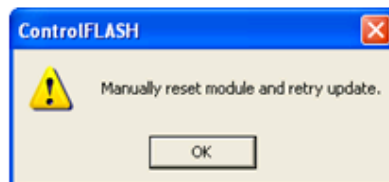
Note:

It has not locked up! Wait until the next message box appears !

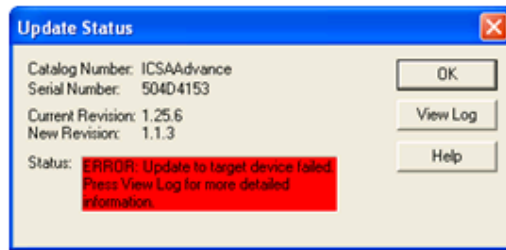
You may get a "Comms error message" as AADvance processors do not automatically reboot as **ControlFLASH** expects them to but the firmware download should have completed correctly.



- 8) Click **OK**.
 - ▶ Wait another couple of minutes and the same message will appear again.
- 9) Click **OK**.
 - ▶ The following message now appears.



10) Click OK and another error message is displayed.



11) Click **OK** then **Cancel** to Exit ControlFLASH.

12) Reboot the processor module by switching the power OFF then ON and hold in the **Fault Reset** button as the module reboots until the Aux LED goes amber.

The processor module(s) will reboot into the Recovery Mode indicated by the following LED states on the processor module.

Healthy	Green (dependent on Module health)
Ready	Amber
Run	Amber
System Health	Green (dependent on system health)
Force	Amber
Aux	Amber

Stage 2: Installing the ControlFLASH Firmware Kit for OS, FPGA, LSP and BUSP

This procedure describes how to upgrade the Processor Firmware for OS, FPGA, LSP and BUSP.


The procedure that follows is basically the same as for stage 1.

- 1) Run the 354400_102_ControlFLASH.msi file.
- 2) Click **NEXT**.
- 3) Read and agree the License.
- 4) Click **Browse** to select the location of the installation or **Next** to choose the default location.
- 5) Click **Next** to confirm the installation.
 - ▶ ControlFLASH installs and shows the progress bar.
- 6) Click **Yes I want to launch ControlFLASH**, then click **Close**.

Upgrade Processor OS, FPGAFPGA, LSP and BUSP Firmware

This procedure describes how to upgrade the processor module firmware using ControlFLASH.

Note: ControlFLASH can upgrade 3 processor modules at once when installed into a 9100 base unit.

	<p>WARNING FIRMWARE UPGRADE DANGER TO A RUNNING SYSTEM</p> <p>Do not attempt to upgrade firmware on a running system. Control FLASH will not warn you that a system is running and you will lose control of the application when the system reboots.</p>
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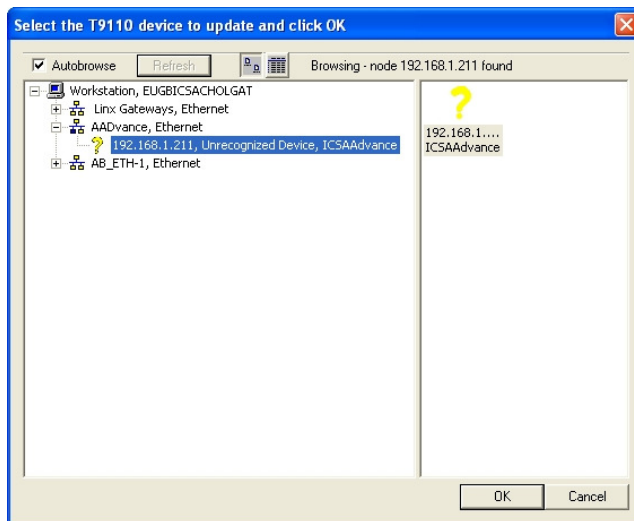
- 1) Run the **ControlFLASH** software by either:
 - ▶ Launching from the installation
 - ▶ Double clicking the desktop icon
 - ▶ Launching from the **Start** button



- 2) Click **Next**.
- 3) Select T9110 from the list.



4) Browse to the device in the **RSLinx** window



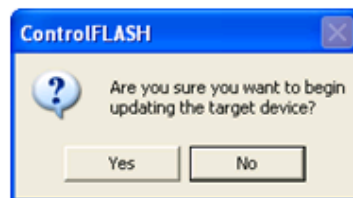
5) Select the firmware revision for the latest Release.



6) Check the summary details, click **Finish**

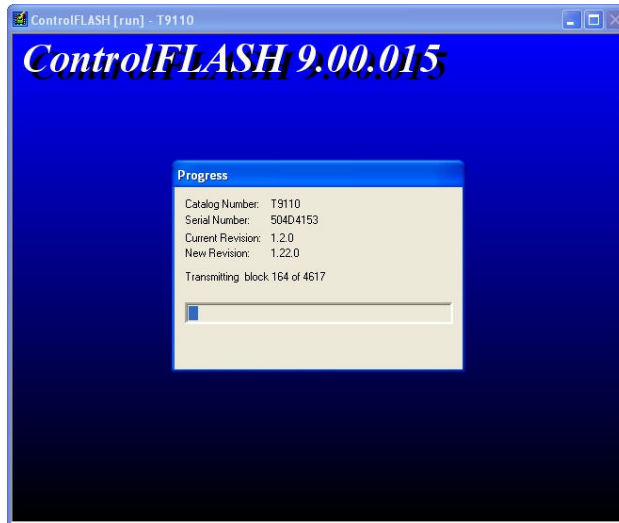


The continue message is displayed:



7) Click **Yes** to continue with the update

- ▶ A progress bar is displayed

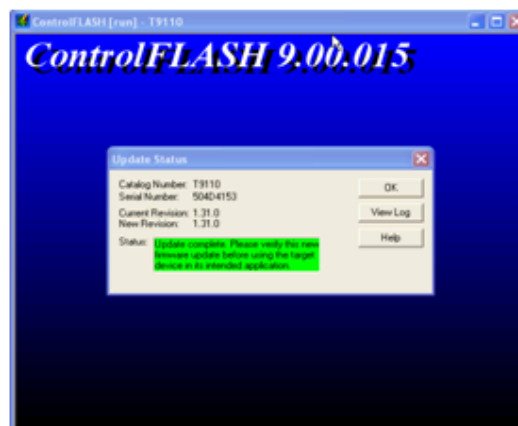


Note: if the processor is not in the Recovery Mode the following error is displayed.



Follow the procedure in Stage I to download the recovery Mode.

- ▶ After the progress bar reaches the end, it may take several minutes for the next screen to appear.



- ▶ Use the View Module Firmware Versions procedure to verify that the upgrade has worked.

Setting Up the Controller IP Address for AADvance Workbench Communications

The AADvance controller stores a resource number and IP address information. These details have to match those defined in the AADvance Workbench for the application. After you have configured these details the AADvance Workbench can communicate with the controller. You use the **AADvanceDiscover** utility to set up the controller for AADvance Workbench communications.

Controller IP Address Setting

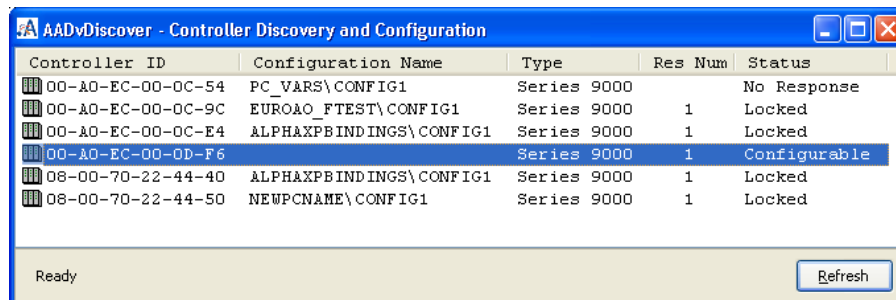
The **AADvanceDiscover** Utility uses a discovery and configuration protocol (proprietary to Rockwell Automation) to set the controller IP address within the AADvance Workbench and to scan the broadcast domain for other AADvance controllers. The utility locates each controller by its unique **MAC Address**. Having located a particular controller to be configured, the utility lets you configure the resource number and **IP Address** to be stored in the controller; after you have done this, the AADvance Workbench can communicate with the other controller.

AADvanceDiscover Utility

The **AADvanceDiscover** utility is installed when you install the AADvance Workbench, and appears on the Start menu of the computer. Click on **AADvance Discover** to start the AADvanceDiscover utility.

The **AADvanceDiscover** utility displays a list of the AADvance controllers on the broadcast network, and reports a status for each one:

- ▶ Configurable
- ▶ Locked
- ▶ No response



Controller ID	Configuration Name	Type	Res Num	Status
00-A0-EC-00-0C-54	PC_VARS\CONFIG1	Series 9000		No Response
00-A0-EC-00-0C-9C	EUROAO_FTEST\CONFIG1	Series 9000	1	Locked
00-A0-EC-00-0C-E4	ALPHAXPBINDINGS\CONFIG1	Series 9000	1	Locked
00-A0-EC-00-0D-F6		Series 9000	1	Configurable
08-00-70-22-44-40	ALPHAXPBINDINGS\CONFIG1	Series 9000	1	Locked
08-00-70-22-44-50	NEWPCNAME\CONFIG1	Series 9000	1	Locked

Ready Refresh

Double-clicking on an entry in the list lets you inspect the resource and IP address settings for a controller. There is also a **Refresh** button, which makes a scan of the network and creates a new list.

A controller is configurable when the program enable key is present (this plugs into the **KEY** connector on the processor base unit) and either no application is loaded or an application is loaded but not running. The status will be locked if the controller reports that one or more of these criteria has not been met.

If the **AADvanceDiscover** utility reports a status of 'no response' for a controller, either the controller has been turned off or the communications between the computer running the utility and the controller have failed. Check the power to the controller and check the connection, and click the Refresh button.

The **AADvanceDiscover** utility also reports a status of 'in progress' and '**Pending restart**'. '**In progress**' appears while the controller accepts new settings. '**Pending restart**' means the controller is waiting for manual intervention from you; cycle the power to the controller.

The **AADvanceDiscover** utility will also allow you to save configurations that you can re-load in the future as required. It can also be used to enable the Ethernet Forwarding feature.

About Discover Communications

AADvanceDiscover uses DCP (Discovery & Configuration Protocol), not TCP. This is a general purpose protocol which allows AADvance controllers without an IP address to be configured on a network without having to set switches, or connect a serial cable to preset an IP address.

DCP communications may be blocked or mis-routed by Windows or by other network devices. You may find that systems known to be on the network do not appear in the list, or appear only randomly. There is no point in attempting any 'ping' commands - if a system is not yet programmed it will not respond, and if it is already programmed, you will just prove it is programmed.

Note: DCP messaging will not work across network bridges and routers.

Discover Communications Fault-Finding

This procedure describes how to activate communications using the Discover tool. After completing the steps, refresh the Discover tool's list of modules to test for communications.

- 1) Ensure that the Ethernet cable is plugged into a socket above a fitted AADvance controller – communications will not 'pass through' unused slots.
- 2) Ensure that the controller is activated by turning the locking bar. Wait for the Ready LED to go green before refreshing the Discover tool. (The communications tasks are not active until it is 'Ready').

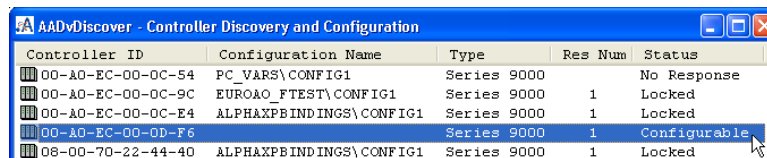
- 3) Do not use an office network. Use an isolated hub or switch between the computer and AADvance controller. Check that the hub/switch has LEDs lit for the ports to both computer and controller, showing that the ports are working.
- 4) Open the Network Connections window. Open the Properties of the computer's network adapter (as used for configuring AADvance). Un-tick all protocol "items" which are not immediately necessary, especially "Check Point SecuRemote" and "iPass Protocol" (if present). You will need to leave "Internet Protocol" (or) "IPv4" and "IPv6", "Client for Microsoft Networks", "File and Printer Sharing" and "Network Monitor Driver" (if present) for normal Windows operation.
- 5) Disable the Windows Firewall, or any third-party firewalls and shields.
- 6) If you are using a laptop, disable Wireless. If you have more than one network connection, disable the one you are not using. The Discover tool installed with AADvance Workbench release 1.2 (1.20.109) will not discover with more than one network connection available.

Configure the Controller Resource Number

When you build a new AADvance controller, or install a new 9100 processor base unit, you have to configure the resource number stored in the controller. This is a kind of device address, and it must also be configured in the application.

The procedure to configure the resource number uses the **AADvanceDiscover** utility. To set the resource number do the following:

- 1) Make a note of the controller's **MAC address (Controller ID)**; this is shown on a label on the processor base unit. Install at least one 9110 processor module into the processor base unit.
- 2) Make sure the program enable key is inserted in the **KEY** connector on the processor base unit.
- 3) Start the AADvDiscover tool from the Start menu:
 - ▶ **Start** → **All Programs** → **AADvance** → **AADvance Discover**.
 - ▶ The **AADvanceDiscover** utility scans the network for controllers, and creates a list.



Controller ID	Configuration Name	Type	Res Num	Status
00-A0-EC-00-0C-54	PC_VARS\CONFIG1	Series 9000		No Response
00-A0-EC-00-0C-9C	EUROAO_FTEST\CONFIG1	Series 9000	1	Locked
00-A0-EC-00-0C-E4	ALPHAXPBINDINGS\CONFIG1	Series 9000	1	Locked
00-A0-EC-00-0D-F6		Series 9000	1	Configurable
08-00-70-22-44-40	ALPHAXPBINDINGS\CONFIG1	Series 9000	1	Locked

- 4) Locate the controller in the list and make sure that the status of the controller is **Configurable**.
- 5) Double-click on the **MAC address** in the **Controller ID** field.

- ▶ The resource and **IP Address** dialog box opens.

- 6) Enter the resource value into the **Resource Number** field, click **Apply**.
 - ▶ Returning to the main window of the utility, the controller status will show **Pending Restart**.
- 7) To complete the update, cycle the power to the controller.
- 8) Refresh the screen to confirm that the new resource number is displayed in the resource field and the controller status is configurable.

The **Resource Number** must also be configured in the application, in the **Resource Properties**.

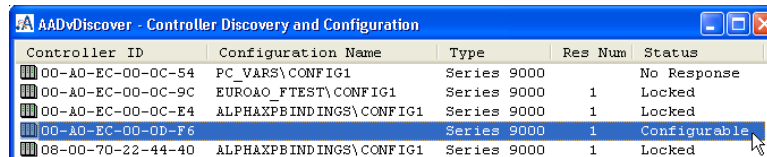
Configure the IP Address in the Controller

When you build a new AADvance controller, or install a new 9100 processor base unit, you have to configure the **IP Address** stored in the controller.

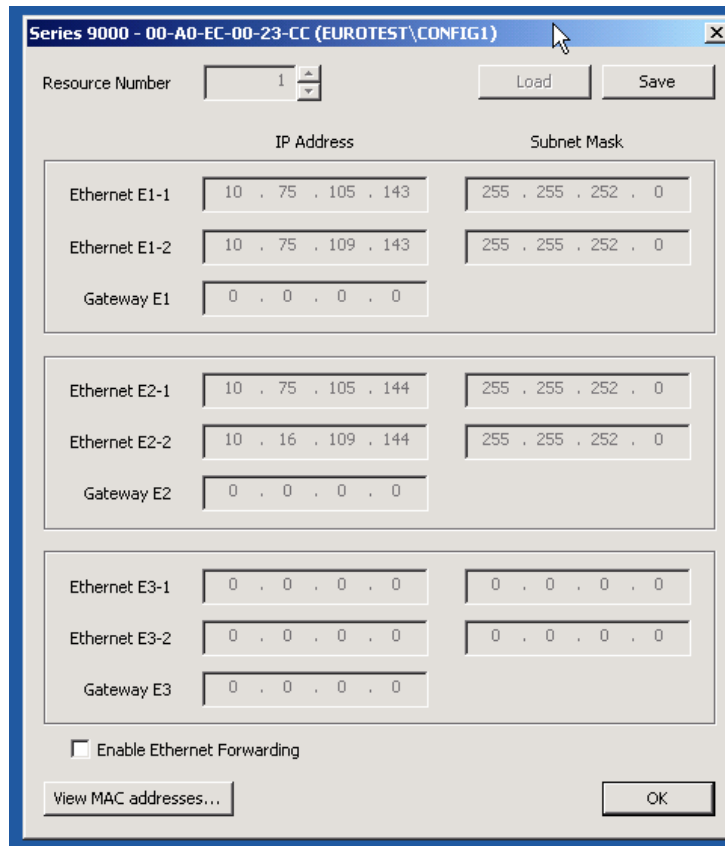
The procedure to configure the **IP Address** uses the **AADvanceDiscover** utility. Changes take effect immediately and you do not have to restart the controller. To set the **IP Address** do the following:

- 1) Make a note of the controller's MAC address (**Controller ID**); this is shown on a label on the processor base unit. Install at least one 9110 processor module into the processor base unit.

- 2) Make sure the program enable key is inserted in the **KEY** connector on the processor base unit.
- 3) Start the **AADvanceDiscover** tool from the Start menu:
 - ▶ **Start** → **All Programs** → **AADvance** → **AADvance Discover**.
 - ▶ The **AADvanceDiscover** utility scans the network for controllers, and creates a list.



- 4) Locate the controller in the list and make sure that the status of the controller is **Configurable**.
- 5) Double-click on the **MAC address** in the **Controller ID** field.
 - ▶ The resource and IP address dialog box opens.



- 6) Enter the **IP Address** and **Subnet Mask** into the fields for each Ethernet port.
- 7) Enter the **Gateway** values for each processor module, click **Apply**.

- ▶ Returning to the main window of the utility, the controller status will show **In Progress** and then **Configurable**.
- ▶ The controller uses the new settings.

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Functional Acceptance Testing

Functional acceptance testing, also known as factory acceptance testing or integration testing, will test the controller and its associated application software to make sure it satisfies the requirements defined in the requirements specification for an integrated system. When its applied to a safety related application then the safety requirements are also tested.

In This Chapter

Recommendations for Functional Acceptance 5-1

Recommendations for Functional Acceptance

Types of Tests to be Carried Out

The tests performed during functional acceptance testing should include:

- ▶ Performance tests, including timing, reliability and availability, integrity, safety requirements and constraints.
- ▶ Interface testing.

In some cases additional tests such as those listed below may be carried out. These however are not essential as the product sdesign has been tested to the limits in the module specifications for the categories below.

- ▶ Environmental tests, including electromagnetic compatibility, life- and stress-testing.
- ▶ Testing in degraded modes, fault modes and exception testing.

If technical manuals have been prepared for the maintenance and operation of the final safety instrumented system, the content of these manuals should be reviewed as well.

Test Cases, Descriptions, Data and Acceptance Criteria

- ▶ Decide the pass / fail criteria.
- ▶ Define who will be responsible for carrying out the test and who (for example, the customer or their representative) will witness the test.
- ▶ For tests that cannot be physically demonstrated, devise a written analysis to show how the equipment achieves the requirement.

Note: Make sure the test cases allow for any associated systems or interfaces with which the system needs to communicate with.

Test Environment and Tools

The testing should take place in a factory environment, before installing and commissioning at the plant.

Controller Configuration

Testing should take place on a defined version of the controller. Record the type, serial number and physical location of module for shipping and later re-installation in their original locations.

Dismantling the AADvance System

In This Chapter

About Dismantling a System	6-1
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About Dismantling a System

Dismantling

Dismantling is a reverse of the system assembly process.

Disposal

It will be necessary to arrange for the collection, treatment, recovery and environmentally sound disposal of the equipment at the end of its life. Contact Rockwell Automation to discuss the most appropriate way to do this.

Re-use

Before disposing of serviceable items, contact Rockwell Automation. It may be possible to return unwanted items to Rockwell Automation for possible future reconditioning.

Parts List

Bases	
Part No.	Part Description
T9100	Processor base unit
T9300	I/O base unit (3 way)
Modules	
Part No.	Part Description
T9110	Processor module
T9401	Digital input module, 24Vdc, 8 channel, isolated
T9402	Digital input module, 24Vdc, 16 channel, isolated
T9451	Digital output module, 24Vdc, 8 channel, isolated, commoned
T9431	Analogue input module, 8 channel, isolated
T9432	Analogue input module, 16 channel, isolated
T9481	Analogue output module, 3 channel, isolated
T9482	Analogue output module, 8 channel, isolated
Special Application Modules	
Part No.	Part Description
T9441	Frequency Input Module (Product not yet released. Contact Sales for more information)
Termination Assemblies	
Part No.	Part Description
T9801	Digital input TA, 16 channel, simplex, commoned
T9802	Digital input TA, 16 channel, dual
T9803	Digital input TA, 16 channel, TMR

T9831	Analogue input TA, 16 channel, simplex, commoned
T9832	Analogue input TA, 16 channel, dual
T9833	Analogue input TA, 16 channel, TMR
T9851	Digital output TA, 24Vdc, 8 channel, simplex, commoned
T9852	Digital output TA, 24Vdc, 8 channel, dual
T9881	Analogue output TA, 8 channel, simplex commoned
T9882	Analogue output TA, 8 channel, dual
T9844	Frequency Input Module TA, Simplex, Active (not yet released)
T9845	Frequency Input Module TA, Dual, Active (not yet released)
T9846	Frequency Input Module TA, TMR, Active (not yet released)
T9847	Frequency Input Module TA, Simplex, Passive (not yet released)
T9848	Frequency Input Module TA, Dual, Passive (not yet released)
T9849	Frequency Input Module TA, TMR, Passive (not yet released)

Expansion Cable Assembly

Expansion cable assembly, comprising expansion cable and two adaptors

Part No.	Part Description
T9310-02	Backplane expansion cable, 2 metre

Blanking Covers

Part No.	Part Description
T9191	Blanking cover (tall) for I/O positions with no TA fitted
T9193	Blanking cover (short) for I/O positions with TA or a Processor

Spares & Tools

Part No.	Part Description
T9901	Replacement input fuse 50mA (pack of 20)* see notes (for T9801/2/3 and T9831/2/3)
T9902	Replacement output fuse 10A (pack of 20) * see notes (for T9851/2)

T9903	Replacement coding pegs (pack of 20)
T9904	Replacement backplane clips (pack of 20)
T9905	Replacement processor 3V lithium cell (pack of 20) *see notes
T9906	Replacement program enable key
T9907	Installation tool kit
T9908	Fuse Extractor Tool

Software

Part No.	Part Description
T9082U	IEC 61131 Workbench, USB key, single user, single controller
T9082D	IEC 61131 Workbench, hard disk key, single user, single controller
Part No.	Part Description
T9083U	IEC 61131 Workbench, USB key, multiple controllers
T9083D	IEC 61131 Workbench, hard disk key, multiple controllers
Part No.	Part Description
T9084U	IEC 61131 Workbench, 5 user USB key, multiple controllers
T9085	5 additional user licenses, for use with T9084U
Part No.	Part Description
T9030	OPC portal server
T9033	AADvance DTM (for use with HART Passthru feature)

Demonstration Unit

Part No.	Part Description
T9141	AADvance Demonstration Unit (Including HMI)

Micellaneous Items

Part No.	Part Description
T9020	Euro BUSP Kit

Notes:

T9901: No 396/TE5 50mA time lag fuse; UL 248-14, 125 V,T Leadfree; manufactured by Littlefuse.

T9902: SMF Omni-Block, Surface Mount Fuse Block 154 010, with a 10A, 125V Fast Acting Fuse, Littelfuse.

T9905: Poly-carbonmonofluoride Lithium Coin Battery, BR3032, 20mm dia; Nominal voltage 3V; Nominal capacity (mAh) 190; Continuous standard load (mA) 0.03; Operating temperature 30°C to 80°C, supplied by Panasonic

Glossary of Terms

A

accuracy

The degree of conformity of a measure to a standard or a true value. See also 'resolution'.

achievable safe state

A safe state that is achievable.

Note: Sometimes, a safe state cannot be achieved. An example is a non-recoverable fault such as a voting element with a shorted switch and no means to bypass the effect of the short.

actuator

A device which cause an electrical, mechanical or pneumatic action to occur when required within a plant component. Examples are valves and pumps.

AITA

Analogue input termination assembly.

alarms and events (AE)

An OPC data type that provides time stamped alarm and event notifications.

allotted process safety time

The portion of the total process safety time allotted to a sub function of that process.

application software

Software specific to the user application, typically using logic sequences, limits and expressions to read inputs, make decisions and control outputs to suit the requirements of the system for functional safety.

architecture

Organizational structure of a computing system which describes the functional relationship between board level, device level and system level components.

asynchronous

A data communications term describing a serial transmission protocol. A start signal is sent before each byte or character and a stop signal is sent after each byte or character. An example is ASCII over RS-232-C. See also 'RS-232-C, RS-422, RS-485'.

availability

The probability that a system will be able to carry out its designated function when required for use — normally expressed as a percentage.

B

backplane clip

A sprung, plastic device to hold together two adjacent AADvance base units. Part number 9904. Used in pairs.

base unit

One of two designs which form the supporting parts of an AADvance controller. See 'I/O base unit' and 'processor base unit'.

bindings

Bindings describe a "relationship" between variables in different AADvance controllers. Once a variable is "bound" to another variable, a unique and strong relationships is created between the two variables and the SIL 3 Certified SNCP protocol is used to ensure that the consuming variable is updated with the data from the producing variable.

black channel

A communication path whose layer (i.e. cabling, connections, media converters, routers/switches and associated firmware/software, etc.) has no requirement to maintain the integrity of safety critical data transferred over it. Measures to detect and compensate for any errors introduced into the black channel must be implemented by the safety critical sender and receiver (by software and/or hardware means) to make sure the data retains its integrity.

blanking cover

A plastic moulding to hide an unused slot in an AADvance base unit.

boolean

A type of variable that can accept only the values 'true' and 'false'.

BPCS

Basic process control system. A system which responds to input signals and generates output signals causing a process and associated equipment to operate in a desired manner, but which does not perform any safety instrumented functions with a claimed safety integrity level of 1 or higher.

Refer to IEC 61511 or to ANSI/ISA—84.00.01—2004 Part 1 (IEC 61511-1 Mod) for a formal definition.

Equivalent to the Process Control System (PCS) defined by IEC 61508.

breakdown voltage

The maximum voltage (AC or DC) that can be continuously applied between isolated circuits without a breakdown occurring.

BS EN 54

A standard for fire detection and fire alarm systems.

BS EN 60204

A standard for the electrical equipment of machines, which promotes the safety of persons and property, consistency of control response and ease of maintenance.

bus

A group of conductors which carry related data. Typically allocated to address, data and control functions in a microprocessor-based system.

bus arbitration

A mechanism for deciding which device has control of a bus.

C

CIP

Common Industrial Protocol. A communications protocol, formally known as 'CIP over Ethernet/IP', created by Rockwell Automation for the Logix controller family, and which is also supported by the AADvance controller. AADvance controllers use the protocol to exchange data with Logix controllers. The data exchange uses a consumer/producer model.

clearance

The shortest distance in air between two conductive parts.

coding peg

A polarization key, fitted to the 9100 processor base unit and to each termination assembly, which ensures only a module of the correct type may be fitted in a particular slot. Part number 9903.

coil

In IEC 61131-3, a graphical component of a Ladder Diagram program, which represents the assignment of an output variable. In Modbus language, a discrete output value.

Compiler Verification Tool (CVT)

The Compiler Verification Tool (CVT) is an automatic software utility that validates the output of the application compilation process. This process, in conjunction with the validated execution code produced by the AADvance Workbench, ensures a high degree of confidence that there are no errors introduced by the Workbench or the compiler during the compilation of the application.

configuration

A grouping of all the application software and settings for a particular AADvance controller. The grouping must have a 'target', but for an AADvance controller it can have only one 'resource'.

consumer

The consuming controller requests the tag from the producing controller.

contact

A graphical component of a Ladder Diagram program, which represents the status of an input variable.

continuous mode

See high demand mode.

controller

A logic solver; the combination of application execution engine and I/O hardware.

controller system

One or more controllers, their power sources, communications networks and workstations.

coverage

The percentage of faults that will be detected by automated diagnostics. See also 'SFF'.

creepage distance

The shortest distance along the surface of an insulating material between two conductive parts.

cross reference

Information calculated by the AADvance Workbench relating to the dictionary of variables and where those variables are used in a project.

D

data access (DA)

An OPC data type that provides real-time data from AADvance controllers to OPC clients.

de-energize to action

A safety instrumented function circuit where the devices are energized under normal operation. Removal of power de-activates the field devices.

dictionary

The set of internal input and output variables and defined words used in a program.

discrepancy

A condition that exists if one or more of the elements disagree.

DITA

Digital input termination assembly.

DOTA

Digital output termination assembly.

E

element

A set of input conditioning, application processing and output conditioning.

energise to action

A safety instrumented function circuit where the outputs and devices are de-energized under normal operation. Application of power activates the field device.

EUC

Equipment Under Control. The machinery, apparatus or plant used for manufacturing, process, transportation, medical or other activities.

expansion cable assembly

A flexible interconnection carrying bus signals and power supplies between AADvance base units, available in a variety of lengths. Used in conjunction with a cable socket assembly (at the left hand side of a base unit) and a cable plug assembly (at the right hand side of a base unit).

F

fail operational state

A state in which the fault has been masked. See 'fault tolerant'.

fail safe

The capability to go to a pre-determined safe state in the event of a specific malfunction.

fault reset button

The momentary action push switch located on the front panel of the 9110 processor module.

fault tolerance

Built-in capability of a system to provide continued correct execution of its assigned function in the presence of a limited number of hardware and software faults.

fault tolerant

The capability to accept the effect of a single arbitrary fault and continue correct operation.

fault warning receiving station

A centre from which the necessary corrective measures can be initiated.

fault warning routing equipment

Intermediate equipment which routes a fault warning signal from the control and indicating equipment to a fault warning receiving station.

field device

Item of equipment connected to the field side of the I/O terminals. Such equipment includes field wiring, sensors, final control elements and those operator interface devices hard-wired to I/O terminals.

fire alarm device

A component of a fire alarm system, not incorporated in the control and indicating equipment which is used to give a warning of fire — for example a sounder or visual indicator.

fire alarm receiving station

A centre from which the necessary fire protection or fire fighting measures can be initiated at any time.

fire alarm routing equipment

Intermediate equipment which routes an alarm signal from control and indicating equipment to a fire alarm receiving station.

function block diagram

An IEC 61131 language that describes a function between input variables and output variables. Input and output variables are connected to blocks by connection lines. See 'limited variability language'.

functional safety

The ability of a system to carry out the actions necessary to achieve or to maintain a safe state for the process and its associated equipment.

G

group

A collection of two or three input modules (or two output modules), arranged together to provide enhanced availability for their respective input or output channels.

H

hand-held equipment

Equipment which is intended to be held in one hand while being operated with the other hand.

HART

HART (Highway Addressable Remote Transducer) is an open protocol for process control instrumentation. It combines digital signals with analogue signals to provide field device control and status information. The HART protocol also provides diagnostic data. (For more details of HART devices refer to the HART Application Guide, created by the HART Communication Foundation, and their detailed HART specifications. You can download documents from www.hartcomm.org.)

high demand mode

Where the frequency of demands for operation made on a safety-related system is greater than once per year or greater than twice the proof test interval. Applies to safety-related systems that implement continuous control to maintain functional safety. Sometimes known as 'continuous mode'.

hot swap

See live insertion.

I**I/O base unit**

A backplane assembly which holds up to three I/O modules and their associated termination assembly or assemblies in an AADvance controller. Part number 9300. See 'I/O module' and 'termination assembly'.

I/O module

A collation of interfaces for field sensors (inputs) or final elements (outputs), arranged in a self-contained and standardized physical form factor.

IEC 61000

A series of international standards giving test and measurement techniques for electromagnetic compatibility.

IEC 61131

An international standard defining programming languages, electrical parameters and environmental conditions for programmable logic controllers. Part 3, which is entitled 'Programming Languages', defines several limited variability languages.

IEC 61508

An international standard for functional safety, encompassing electrical, electronic and programmable electronic systems; hardware and software aspects.

IEC 61511

An international standard for functional safety and safety instrumented systems (SIS) for the process industry, encompassing electrical, electronic and programmable electronic systems, hardware and software aspects.

indicator

A device which can change its state to give information.

input (Workbench variable)

In the context of an AADvance Workbench variable, this term describes a quantity passed to the Workbench from a controller.

instruction list

An IEC 61131 language, similar to the simple textual language of PLCs. See 'limited variability language'.

integer

A variable type defined by the IEC 61131 standard.

IXL

IXL stands for ISaGRAF eXchange Layer. This is the communication protocol between ISaGRAF based components.

K**key connector**

The receptacle on the AADvance controller for the program enable key. A 9-way 'D' type socket, located on the 9100 processor base unit.

L**ladder diagram**

An IEC 61131 language composed of contact symbols representing logical equations and simple actions. The main function is to control outputs based on input conditions. See 'limited variability language'.

LAN

Local area network. A computer network covering a small physical area, characterised by a limited geographic range and lack of a need for leased telecommunication lines.

live insertion

The removal and then reinsertion of an electronic module into a system while the system remains powered. The assumption is that removal of the module and reinsertion will cause no electrical harm to the system. Also referred to as 'hot swap'.

low demand mode

Where the frequency of demands for operation made on a safety-related system is no greater than one per year and no greater than twice the proof-test frequency.

M

manual call point

A component of a fire detection and fire alarm system which is used for the manual initiation of an alarm.

Modbus

An industry standard communications protocol developed by Modicon. Used to communicate with external devices such as distributed control systems or operator interfaces.

Modbus object

A representation of the configuration settings for a Modbus master or for its associated slave links, within the AADvance Workbench. The settings include communication settings and messages.

module locking screw

The AADvance latch mechanism seen on the front panel of each module and operated by a broad, flat-blade screwdriver. Uses a cam action to lock to the processor base unit or I/O base unit.

N

NFPA 85

The Boiler and Combustion Systems Hazards Code. Applies to certain boilers, stokers, fuel systems, and steam generators. The purpose of this code is to contribute to operating safety and to prevent uncontrolled fires, explosions and implosions.

NFPA 86

A standard for Ovens and Furnaces. Provides the requirements for the prevention of fire and explosion hazards in associated with heat processing of materials in ovens, furnaces and related equipment.

O

on-line

The state of a controller that is executing the application software.

OPC

A series of standards specifications which support open connectivity in industrial automation.

output (Workbench variable)

In the context of an AADvance Workbench variable, this term describes a quantity passed from the Workbench to a controller.

P

peer to peer

A Peer to Peer network consists of one or more Ethernet networks connecting together a series of AADvance and/or Trusted controllers to enable application data to be passed between them.

pinging

In Modbus communications, sending the diagnostic Query Data command over a link and by receiving a reply ensuring that the link is healthy and the controller is able to communicate with the master. No process data is transferred or modified. In the case of slave devices that will not support pinging then the Standby command will default to Inactive state, but no error will be returned.

portable equipment

Enclosed equipment that is moved while in operation or which can easily be moved from one place to another while connected to the supply. Examples are programming and debugging tools and test equipment.

process safety time (PST)

For equipment under control this represents the period of time a dangerous condition can exist without the protection of a safety instrumented system before a hazardous event occurs.

processor base unit

A backplane assembly which holds all of the processor modules in an AADvance controller. Part number 9100. See also 'processor module'.

processor module

The application execution engine of the AADvance controller, housed in a self-contained and standardized physical form factor.

producer

A controller producing a tag to one or more consumers, at the request of the consumers.

program enable key

A security device that protects the application from unauthorized access and change, in the form factor of a 9-way 'D' type plug. Part number 9906. Supplied with the processor base unit. See also 'key connector'.

project

A collection of configurations and the definition of the linking between them. See 'configuration'.

protocol

A set of rules that is used by devices (such as AADvance controllers, serial devices and engineering workstations) to communicate with each other. The rules encompass electrical parameters, data representation, signalling, authentication, and error detection. Examples include Modbus, TCP and IP.

PST

Process Safety Time

R**real**

A class of analogue variable stored in a floating, single-precision 32-bit format.

redundancy

The use of two or more devices, each carrying out the same function, to improve reliability or availability.

resolution

The smallest interval measurable by an instrument; the level of detail which may be represented. For example, 12 bits can distinguish between 4096 values.

RS-232-C, RS-422, RS-485

Standard interfaces introduced by the Electronic Industries Alliance covering the electrical connection between data communication equipment. RS-232-C is the most commonly used interface; RS-422 and RS-485 allow for higher transmission rates over increased distances.

RTC

Real-time clock.

RTU

Remote terminal unit. The Modbus protocol supported by the AADvance controller for Modbus communications over serial links, with the ability to multi-drop to multiple slave devices.

S**safe state**

A state which enables the execution of a process demand. Usually entered after the detection of a fault condition; it makes sure the effect of the fault is to enable rather than disable a process demand.

safety accuracy

The accuracy of an analogue signal within which the signal is guaranteed to be free of dangerous faults. If the signal drifts outside of this range, it is declared faulty.

safety-critical state

A faulted state which prevents the execution of a process demand.

sensor

A device or combination of devices that measure a process condition. Examples are transmitters, transducers, process switches and position switches.

sequential function chart

An IEC 61131 language that divides the process cycle into a number of well-defined steps separated by transitions. See 'limited variability language'.

SFF

Safe Failure Fraction. Given by (the sum of the rate of safe failures plus the rate of detected dangerous failures) divided by (the sum of the rate of safe failures plus the rate of detected and undetected dangerous failures).

SIF

Safety Instrumented Function. A form of process control that performs specified functions to achieve or maintain a safe state of a process when unacceptable or dangerous process conditions are detected.

SIL

Safety Integrity Level. One of four possible discrete levels, defined in IEC 61508 and IEC 61511, for specifying the safety integrity requirements of the safety functions to be allocated to a safety-related system. SIL4 has the highest level of safety integrity; SIL1 has the lowest.

The whole of an installation (of which the AADvance system forms a part) must meet these requirements in order to achieve an overall SIL rating.

SNCP

SNCP (Safety Network Control Protocol) is the Safety Protocol that allows elements of an AADvance System to exchange data. SNCP is a SIL 3 certified protocol which provides a safety layer for the Ethernet network making it a "Black Channel".

SNTP

Simple Network Time Protocol. Used for synchronizing the clocks of computer systems over packet-switched, variable-latency data networks.

structured text

A high level IEC 61131-3 language with syntax similar to Pascal. Used mainly to implement complex procedures that cannot be expressed easily with graphical languages.

synchronous

A data communications term describing a serial transmission protocol. A pre-arranged number of bits is expected to be sent across a line per second. To synchronise the sending and receiving machines, a clocking signal is sent by the transmitting computer. There are no start or stop bits.

T

TA

See 'termination assembly'.

target

An attribute of a 'configuration' which describes characteristics of the AADvance controller on which the configuration will run. Includes characteristics such as the memory model and the sizes of variable types for the controller.

TCP

Transmission control protocol. One of the core protocols of the Internet Protocol suite. It provides reliable, ordered delivery of a stream of bytes from a program on one computer to another program on another computer. Common applications include the World Wide Web, e-mail and file transfer and, for an AADvance controller, Modbus communications over Ethernet.

termination assembly

A printed circuit board which connects field wiring to an input or output module. The circuit includes fuses for field circuits. The board carries screw terminals to connect field wiring to the controller, and the whole assembly clips onto the 9300 I/O base unit.

TMR

Triple modular redundant. A fault tolerant arrangement in which three systems carry out a process and their result is processed by a voting system to produce a single output.

TÜV certification

Independent third party certification against a defined range of international standards including IEC 61508.

U

U

Rack unit. A unit of measure used to describe the height of equipment intended for mounting in a standard rack. Equivalent to 44.45mm (1-3/4 inches).

V

validation

In quality assurance, confirmation that the product does what the user requires.

verification

In quality assurance, confirmation that the product conforms to the specifications.

voting system

A redundant system (m out of n) which requires at least m of the n channels to be in agreement before the system can take action.

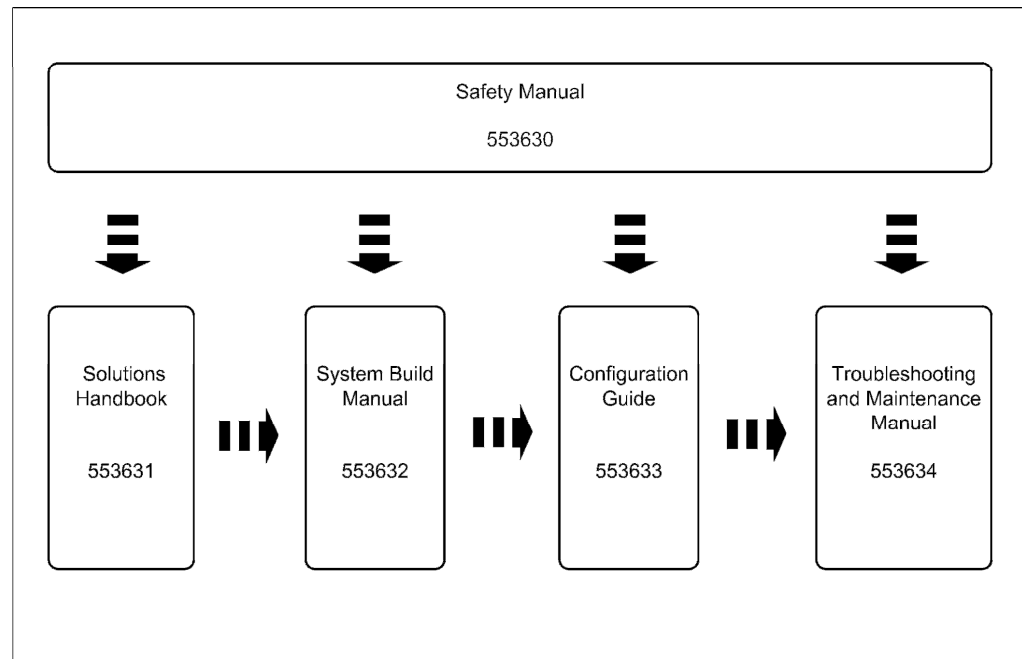
W

withstand voltage

The maximum voltage level that can be applied between circuits or components without causing a breakdown.

Additional Resources

For more information about the AADvance system refer to the associated Rockwell Automation technical manuals shown in this document map.



Publication	Purpose and Scope
Safety Manual	This technical manual defines how to safely apply AADvance controllers for a Safety Instrumented Function. It sets out standards (which are mandatory) and makes recommendations to ensure that installations meet their required safety integrity level.
Solutions Handbook	This technical manual describes the features, performance and functionality of the AADvance controller and systems. It sets out some guidelines on how to specify a system to meet your application requirements.
System Build Manual	This technical manual describes how to assemble a system, switch on and validate the operation of a your system.
Configuration Guide	This manual defines how to configure an AADvance controller using the AADvance Workbench to meet your system and application requirements.
Troubleshooting and Maintenance Manual	This technical manual describes how to maintain, troubleshoot and repair an AADvance Controller.
OPC Portal Server User Manual	This manual describes how to install, configure and use the OPC Server for an AADvance Controller.

PFH avg and PFDavg Data	This document contains the PFH _{avg} and PFD _{avg} Data for the AADvance Controller. It includes examples on how to calculate the final figures for different controller configurations. The data supports the recommendations in the AADvance Safety Manual Doc No: 553630.
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Regional Offices

Rockwell Automation Oil and Gas Resources are available in Regional Offices worldwide.

Rockwell Automation 4325 West Sam Houston Parkway North, Suite 100 Houston Texas 77043-1219 USA	Rockwell Automation Hall Road Maldon Essex CM9 4LA England, UK	Rockwell Automation Millenium House Campus I Aberdeen Science & Tech Park Balgownie Road, Bridge of Don Scotland, UK
Tel: +1 713 353 2400 Fax: +1 713 353 2401	Tel: +44 1621 854444 Fax: +44 1621 851531	+44-1224-227-780

Rockwell Automation. No. 2 Corporation Road #04-01 to 03 Corporation Place Singapore 618494	Abu Dhabi: 903, Bin Hamoodah Building 9th Floor Khalifa Street Abu Dhabi, UAE	Dubai: Silvertech Middle East FZCO PO Box 17910 Jebel Ali Free Zone Dubai, UAE
Tel: +65 6622-4888 Fax: +65 6622-4884	971-2-627-6763	+9714 883 7070

Internet: <http://www.rockwellautomation.com/icstriplex>

Technical support: icstsupport@ra.rockwell.com

Sales enquiries: sales@icstriplex.com