System Build Manual

Original Instructions

Allen-Bradley

AADvance Eurocard Controller

Catalog Numbers T9120 T9531 T9501 T9842 T9551 T9581

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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Throughout this manual, when necessary, we use notes to make you aware of safety and other considerations.

	**WARNING:** Identifies information about practices or circumstances which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	**CAUTION:** Identifies information about practices or circumstances that can cause property damage or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
NOTE	Provides key information about the product or service.
TIP	Tips give helpful information about using or setting up the equipment.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Issue Record

This manual contains new and updated information as indicated in the following table.

Issue	Date	Comments
01	April 2010	First Issue
02	Jan 2012	Updated for changes to wiring looms and additional information added on architectures.
03	Sept 2012	Peer review comments incorporated; Update for Release software 1.3.
04	Jan 2014	Issue for Release 1.32
05	Dec 2014	Updates for Exida review, PCB profiles, internal review comments
F	May 2018	Update for Exida review and document reformat to Rockwell template.
G	Dec 2023	Updates for the AADvance Eurocard 1.41 system release

Summary of changes in this Document Issue

Topic	Page
Changed *workstation* to *computer*, where applicable.	Throughout
Changed *workbench* to *software*, where applicable.	Throughout
Changed *controller* to *Eurocard controller,* where applicable, for clarity.	Throughout
Updated release number AADvance Eurocard *1.32* to AADvance Eurocard *1.41*.	Throughout
Removed references to hazardous environments as the Eurocard Controller is not certified for them.	Throughout
Updated references to the AADvance Eurocard PFH and PFD_{avg} Data publication (ICSTT-RM457) as it is replaced by the AADvance Controller and AADvance Eurocard Controller PFH and PFD_{avg} Data publication (IICSTT-RM449).	Throughout
Updated *Euro* to *Eurocard*.	Throughout
Updated software listed in the AADvance Release section.	8
Updated URLs for the Product Compatibility and Download Center.	8
Updated the Eurocard Controller Certification section for current certification actity.	15
Updated the Controller Subsea Certification section with current standards.	15
Updated values in the Environmental Specification table in the Environmental Specification AADvance Euroacard Controller section.	15
Updated the AADvance Eurocard Controller – Overview section: increased the initial number of processor modules for Eurocard configuration from one to two.	16
Provided clarifications regarding module wiring harnesses and backplanes.	16
Updated the 9551 Eurocard Digital Output Module description with *commoned*.	17
Updated Eurocard Controller System Components sections: Removed Software: Workbench. Added the AAdvance Software Development Environment, Operating Systems, Importing and Exporting Data, Software Licenses Certified Module Revision List.	19
Clarified that 1001, 1002D and 2003 are fail safe in addition to fault tolerant topologies.	23
Updated the Eurocard Controller Features section with Black Channel I/O bus information.	23
Updated the Eurocard Controller Features section with IEC 61508 certification.	23
Updated the Eurocard Process Safety Time section.	23
Updated the Fault Tolerance in Eurocard Controllers section with SIL 2 and SIL3 safety system processor requirements.	24

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Updated *1001D* to *1001* in the Internal Diagnostics and Fault Reporting section.	24
Added how to clear latched diagnostic faults in the Internal Diagnostics and Fault Reporting section.	24
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Removed the title Shock Hazard that was mistakenly in the document above the T9501 Input Module Specifications (did not remove adjacent content).	38
Updated T9501 Digital Input Module Specifications table values including addition of a footnote for Input Measurement Voltage Accuracy.	38
Updated the Mechanical Specification Dimensions (width) in the Eurocard Analogue Output Module Specifications.	41
Corrected reference from 2 channels to 8 channels for the T9551 digital output module in the Eurocard Digital Output Module Technical Overview section.	43
Provided channel isolation clarification in the Eurocard Digital Output Module Technical Overview section.	43
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Updated the Run/AMBER status resolution in the Eurocard I/O Module Status Indications table in the Eurocard Processor Status Indications section.	50
Removed duplicate information from Chapter 2 - Eurocard Controller System Architectures and referenced the current information in the AADvance Eurocard Controller Safety Manual.	51
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Updated a Field Loop Power Heat Dissipation value in the Field Loop Power Heat Dissipation table in the System Design Considerations for Heat Dissipation and Cooling section.	58
Updated all wiring diagrams.	Throughout Chapter 4, 92
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All trademarks are acknowledged.

DISCLAIMER

It is not intended that the information in this publication covers every possible detail about the construction, operation, or maintenance of a control system installation. You should also refer to your own local (or supplied) system safety manual, installation and operator/maintenance manuals.

REVISION AND UPDATING POLICY

This document is based on information available at the time of its publication. The document contents are subject to change from time to time. The latest versions of the manuals are available at the Rockwell Automation Literature Library under "Product Information" information "Critical Process Control & Safety Systems".

ROCKWELL AUTOMATION SUPPORT

Any required support can be accessed through the Rockwell Automation Support Website at:
http://www.rockwellautomation.com/global/support/overview.page

Registration for Automatic Product Safety Advisories and Product Notices from Rockwell Automation, which are available by email, is obtained by using the Technical Support Center link (available on the above web-page) and signing in with either a Tech Connect Account or free Rockwell Automation Member Account. Account holders can subscribe to important product updates, including Product Safety Advisories and Product Notices.

All repair actions for AADvance products are tracked against a SAP ticket number and customers can request a Root Cause Fault Analysis (RCFA) report.

DOWNLOADS

The product compatibility and download center is:

https://compatibility.rockwellautomation.com/Pages/home.aspx#/scenarios

Select the Find Downloads option under Download

In the Product Search field enter "AADvance" and the AADvance option is displayed.

Double click on the AADvance option and the latest version is shown.

Select the latest version and download the latest version.

AADVANCE RELEASE

This technical manual applies to AADvance Eurocard system release 1.41 and these software:

- AADvance® Workbench software version 1.40
- AADvance Workbench software version 2.1
- AADvance®-Trusted® SIS Workstation software version 1.02

NOTE AADvance Eurocard system release 1.41 identifies the product family release. Each hardware, firmware and software component has its own version within this family release and the details of those versions can be found in the AADvance Eurocard System Requirements for version 1.41 in the PCDC Release Notes, which can be accessed from the Product Compatibility and Download Center at rok.auto/pcdc.

LATEST PRODUCT INFORMATION

For the latest information about this product review the Product Notifications and Technical Notes issued by technical support. Product Notifications and product support are available at the Rockwell Automation Support Center at

http://rockwellautomation.custhelp.com

At the Search Knowledgebase tab select the option "By Product" then scroll down and select the ICS Triplex product AADvance.

Some of the Answer ID's in the Knowledge Base require a TechConnect Support Contract. For more information about TechConnect Support Contract Access Level and Features please click on the following link:

https://rockwellautomation.custhelp.com/app/answers/detail/a_id/898272

This will get you to the login page where you must enter your login details.

IMPORTANT A login is required to access the link. If you do not have an account then you can create one using the "Sign Up" link at the top right of the web page.

Environmental compliance

Rockwell Automation maintains current product environmental information on its website at:

http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page

Chapter 1

Product Overview

Chapter 2

Eurocard Controller System Architectures

Chapter 3

Before You Begin

Chapter 4

Wiring Loom Data for the AADvance Eurocard Controller

Chapter 5

System Start-Up

Chapter 6

Functional Acceptance Testing

Chapter 7

Additional Resources

Product Overview

This chapter introduces the System Build Manual, providing an overview of the AADvance Eurocard controller and briefly describing its major components.

Eurocard Controller Certification

The AADvance Eurocard Safety Manual was reviewed as part of the assessment.

Controller Subsea Certification

Subsea Qualification: The Eurocard Modules have been tested to the Q1 requirement specified in Section 9.2.3.2 of API 17F, Edition 4 (Errata 1 & 2).

Environmental Specification AADvance Eurocard Controller

The following environmental specification applies to all AADvance Eurocard Controller modules.

Table 1 - Environmental Specification

Attribute	Value
Temperature	
Operating	–25 °C to 70 °C (–13 °F to 158 °F) all Modules.
Storage and Transport	–40 °C to 70 °C (–40 °F to 158 °F) all Modules.
Humidity	
Operating	10 % to 95 % RH, non-condensing
Storage and Transport	10 % to 95 % RH, non-condensing
Vibration	
IEC 60068-2-64 (Test Fh, Operating)	20 to 80 Hz, increasing @ +3 dB/Octave, 80 to 350 Hz @ 0.04 g^2/Hz, 350 to 2000 Hz @ -3 dB/Octave. 6 g rms overall. 10 minutes single axis delivered as one continuous test
Altitude	
Operating	2000 m or less (6562 ft or less)

Attribute	Value
Storage and Transport	0 to 3000 m (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: IEC 61326-3-1:2017; IEC 61131-2:2017
Sub Sea Qualification	Tested to Q1 Extended Design levels of API 17F, Fourth Edition (December 2019), with Errata 1 and 2.

AADvance Eurocard Controller - Overview

The AADvance Eurocard system is specifically designed for functional safety and critical control applications, it supplies a flexible, scalable and distributed solution for these applications. The system can be used for safety implemented functions and process control applications that are non-safety but critical to a business.

The controller is a logic solver that has processor modules, I/O modules and field termination assemblies, a system can be configured specifically to a user's process control requirements. It runs project applications developed and deployed from the AADvance® Workbench software or AADvance®-Trusted® SIS Workstation software.

A system is assembled from one or more controllers, a combination of I/O modules, power sources, communications networks and user computers. It can operate as an independently functioning system or as a distributed node of a larger system.

A Eurocard configuration starts with two processor modules and I/O modules, and can be expanded to a maximum of three processor modules and 18 I/O modules. The modules are standard Eurocard PCBs that are coated for protection. This design allows a user to choose a different container as an alternative to a standard rack installation. It enables a controller to be used in diverse and more unusual operational environments.

AADvance Eurocard modules are designed to allow the use of custom wiring harnesses or a custom-designed backplane. The wiring loom design will be based on the system configuration of processors and I/O modules that make up the controller. Details about building a wiring loom and connecting the modules using it are given in the topic "Wiring Loom Requirements".

Eurocard Controller System Components

An AADvance Eurocard controller can be assembled from the following modules and assemblies:

- A 9120 Eurocard Processor Module is built from a Eurocard Processor CPU PCB and a Eurocard Processor Interface PCB: The Processor performs all the processing functions and application logic solving, internal and external communications with the redundant I/O control network and external networks, I/O scanning, and it initiates the built-in diagnostic testing processes.

- 9531 Eurocard Analogue Input Module, 8 Ch. Isolated: Analogue input modules are simplex modules. Redundancy is created by the wiring harness connecting two input modules together and to the dual analogue input termination assembly.
- 9501 Eurocard Digital Input Module, 24 V dc, 8 Ch. Isolated: Digital input modules are simplex modules. Redundancy is created by the wiring harness connecting two input modules together with the same field connections to each module.
- 9842 Eurocard Analogue Input Termination Assembly (TA), 8 Ch. Simplex: The TA supplies the field connections for the analogue input signals and interfaces with the 9531 Eurocard Analogue Input Module through a high reliability hypertac connector. Also supplies a higher load termination resistance and is useful for underwater applications.
- 9551 Eurocard Digital Output Module, 8Ch, Isolated, commoned: This supplies signals applicable for directly interfacing to the output field devices. A simplex output module is always two output switches in series, fault tolerance occurs when two modules operate in parallel. These modules supply the voltage and current for each channel, the values given when configured in a redundant configuration are the sum (or combined) value for the two modules operating in parallel.
- 9581Eurocard Analogue Output Module: This supplies signals for directly interfacing to the analogue field devices. Analog Output modules are simplex, but have a fail safe disconnect switch.

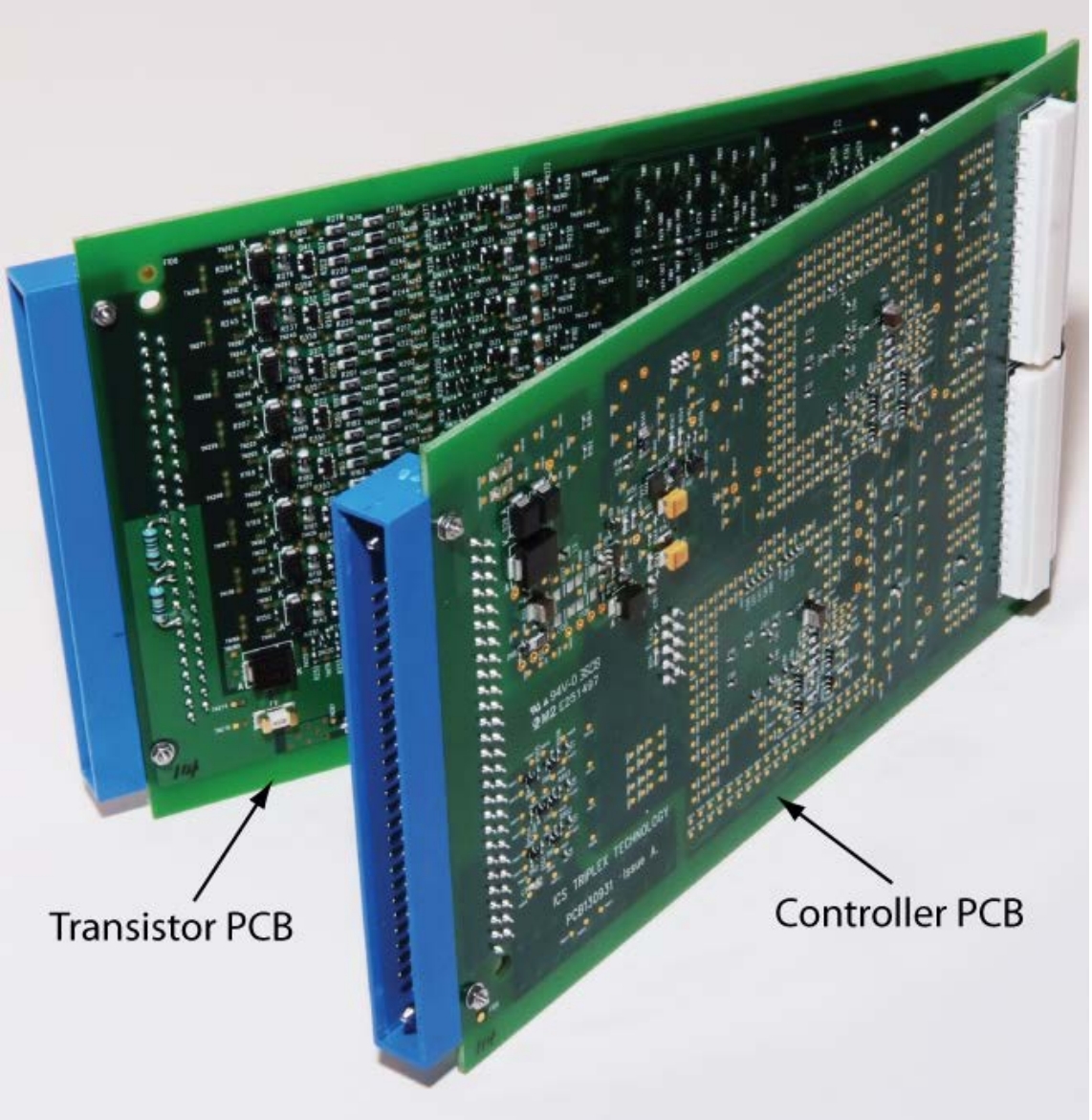
NOTE Eurocard Analogue Output modules are designed and developed using the same methods as all other Eurocard modules, but at this time they cannot be used in a redundant group arrangement and are not approved for use in a safety related application. They can be considered as non-interfering when used as part of a safety system.

All Eurocard modules have comprehensive built-in diagnostics, in the event a fault, a redundant configuration with diagnostics maximizes system availability.

Typical Eurocard Module Hardware

The following illustration shows the typical Eurocard module variant:

Figure 1 - Eurocard Module (Digital Output)



Communications Interfaces

The configuration, programming, and maintenance interface to this controller is through the 10/100 Base T Ethernet ports located on the processor modules.

The Ethernet and serial ports can be configured to use a number of different communication protocols in simplex and redundant configurations for connection to other AADvance Eurocard controllers or third party

equipment. Communications between the processors and I/O modules uses a proprietary communications protocol over a custom wired harness.

A safety network control protocol (SNCP), developed by Rockwell Automation for the AADvance system, permits distributed control and safety using new or existing network infrastructure while making sure the data is secure and has integrity. 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 distributed system can be administered from one or more computers placed at convenient locations.

AADvance Software Development Environment

The AADvance Workbench software or AADvance-Trusted SIS Workstation software lets you design one complete control strategy, and then target parts of the strategy to individual controllers. Interaction between the resources is automatic, significantly reducing the complexity of configuration in a multiresource system. Programs can be simulated and tested on the computer running the software before downloading to the controller.

The AADvance Workbench software and AADvance-Trusted SIS Workstation software are compliant with the IEC-61131 industrial standard and have several powerful features:

- the regulation of the flow of control decisions for an interacting distributed control system
- providing for the consistency of data
- providing a means for synchronous operation between devices
- eliminating the need to have separate synchronous schemes
- easing the development and maintenance of robust systems

The AADvance Workbench software and AADvance-Trusted SIS Workstation software are software development environments for a controller. Use the AADvance Workbench software or AADvance-Trusted SIS Workstation software to create local and distributed control applications using the languages of IEC 61131-3. Engineers can use one language or a combination that best suits their knowledge and programming style and the type of application.

The AADvance Workbench software or AADvance-Trusted SIS Workstation software is a secure development environment. There is also a Program Enable key that must be plugged into the processor base unit to allow the user to modify and download the application or access the AADvance Discover tool to set or change the controller IP address. The Program Enable Key when it is removed protects the application from unauthorized access.

The development environment includes:

- tools for program development
- program documentation

- function block library management
- application archiving
- import/export utilities
- on-line monitoring
- off-line simulation and controlled on-line changes
- Programs can be simulated and tested on the computer beforedownloading to the controller hardware.

Operating Systems

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

IMPORTANT	AADvance Workbench software version 1.4 supports the Instruction List (IL) language. AADvance Workbench software version 2.x and AADvanceTrusted SIS Workstation software do not support the IL language.

ATTENTION:	The AADvance Workbench software and AADvance-Trusted SIS Workstation software do not support the Sequential Function Chart (SFC) language for safety-related applications.

Importing and Exporting Data

The AADvance Workbench software and AADvance-Trusted SIS Workstation software can import and export variables data in standard file formats such as Microsoft Excel spreadsheet and comma-separated values (CSV).

Software Licenses

Refer to the applicable publication for information on software licenses:

- AADvance Controller Configuration Guide Workbench 1.x, publication ICSTT - RM405
- AADvance Controller Configuration Guide Workbench 2.x, publication ICSTT - RM458
- AADvance-Trusted SIS Workstation Software User Guide, publication ICSTT-UM002

Certified Module Revision List

Latest list of hardware and firmware configurations, as approved by the certifying body, is available in the Literature Library as Eurocard AADvance Controller - Safety certificate. The document number is ICSTT-CT007 . A list of compatible module configurations is available in the Release Notes on the Product Compatibility and Download Center (PCDC).

AADvanceDiscover

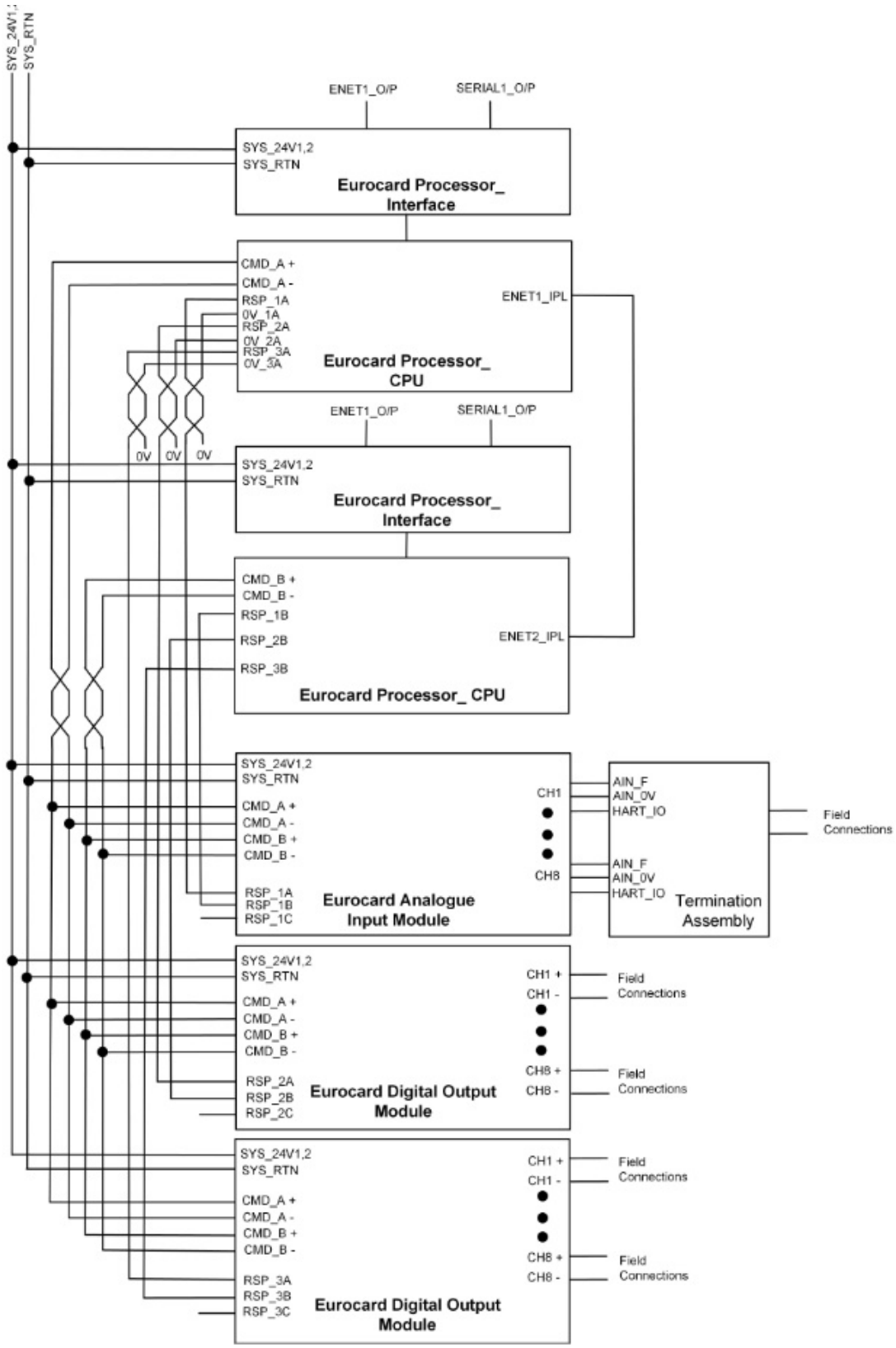
The AADvanceDiscover utility uses a Discovery and Configuration Protocol (proprietary to Rockwell Automation) to find and identify AADvance devices connected to the control network, and to configure the controller identifiers, and network IP addresses of those devices. For the AADvance Workbench software, refer to the AADvance Configuration Guide (Doc. ICSTT-RM405) for information about using the AADvance Discover utility. For the AADvance-Trusted SIS Workstation Software, refer to the online Help or the User Guide, (Doc. ICSTT-UM002).

Example Eurocard Controller

A typical Eurocard Controller is illustrated below and consists of the following:

- Dual 9120 Eurocard Processor modules comprising Eurocard Processor CPU and Eurocard Processor Interface PCBs.
- 9531 Eurocard Analogue Input Module, 8 Ch. Isolated.
- 9842 Eurocard Analogue Input TA, 8 Ch., Simplex.
- 9551 x 2 Eurocard Digital Output Module, 8 Ch., Isolated comprising a digital output controller PCB and a digital output transistor PCB.

- A bespoke wire loom with high reliability Hypertac connectors connecting all modules together.



Eurocard Controller Features

An AADvance Eurocard system controls complex and frequently critical processes in real time executing programs that accept external sensor signals, find a solution for logic equations, do calculations for continuous process control and generating control signals.

The AADvance Eurocard system key features are as follows:

- Fail safe or fault tolerant topologies — 1oo1, 1oo2D and 2oo3.
- Flexible construction using modules to assemble a bespoke system.
- Operates independently as a functional system or as part of a larger distributed network.
- Can be used for a fault tolerant safety related system.
- The Black Channel I/O bus facilitates the interconnection of mixed architectures consisting of both AADvance and AADvance Eurocard Technologies.
- Scalable I/O module expansion without system interruption.
- Provides a secure SIL 3 rated 'Black Channel' external communication network over Ethernet.
- IEC 61508 certified
- Supports industry standard protocols such as HART.
- Supports OPC when using an OPC Portal.

Eurocard Process Safety Time

The generally accepted understanding of process safety time is the period dangerous condition can exist in the process before a hazardous event occurs without a safeguard. This process safety time is used to determine the response time for the SIF implemented in the SIS.

Use the Process Safety Time configuration parameter in AADvance® Workbench software or AADvance®-Trusted® SIS Workstation software to:

- Enforce the safe state when a dangerous failure is detected.
- Verify that the Process PST is not exceeded.

This configuration parameter only applies to the logic solver portion of the process safety time, so its value must be configured taking into account both the sensor and final element response times.

Fault Tolerance in Eurocard Controllers

For safety applications you must define how the control system will react when there are faults. As faults multiply, this becomes the system's state of degraded operation or fault tolerance level.

AADvance Eurocard Systems can be configured as either fail safe, fault tolerant or as a combined fail safe/fault tolerant architecture. Dual or triple processors are required for a SIL 2 or SIL 3 safety system.

Fail Safe architectures are where single AADvance Eurocard system modules are used. For this architecture, when a fault is identified in a module, the faulty module (or part of a module) will go to its safe state (e.g. off, or de-energized).

Fault tolerant architectures are where redundant modules are configured. When a fault occurs in a module, although the faulty module (or part of a module) will go to its safe state, the redundant partner module will continue its usual operation and the data processing is not interrupted.

Combined architectures are where combinations of single and redundant modules are used where applicable for the safety functions being put in place.

Internal Diagnostics and Fault Reporting

Internal diagnostics are necessary for fault tolerance. The AADvance Eurocard controller has sophisticated internal diagnostic systems to identify faults that occur during operation and raise applicable alarm and status indications. The diagnostic systems run automatically and test for system faults related to the controller (processor and I/O modules), and field faults related to field I/O circuits.

The internal diagnostics detect and report safe and dangerous failures. A dual module arrangement, for example, diagnostics can address dangerous failures and help redress the balance between failure to react and spurious responses. Thus a dual system could be 1oo2D reverting to 1oo1 on the first identified fault and reverting to fail-safe when the two modules have a fault.

The comprehensive internal diagnostics that find and show covert and overt failures and report a serious problem immediately, but filter unimportant safe failures to prevent spurious alarms. The diagnostic systems monitor these less important items regularly and do not report them as a problem unless there have been many occurrences of a possible fault. These diagnostics will tell users that there are faults so that users can repair the system in the MTTR (used for the PFD calculations) and maintain the system's fault tolerance and integrity level.

To clear latched diagnostic faults after the initiating cause is resolved, use the remote fault reset feature..

NOTE The remote fault reset feature clears any latched fault condition. If the initiating cause is not resolved, faults will be re-annunciated, but this may be seconds-to-hours after the reset, depending on the fault type or fault class.

WARNING: Safety wiring principles must be employed for field loops if it is necessary for the user to guard against short circuit faults between I/O channels. The AADvance Eurocard controller internal diagnostics do not identify external short circuits between channels.

NOTE Refer to the AADvance Configuration Guide Doc No: ICSTT-RM405 for the SIS Workstation Online help for instructions on how to configure the Remote Reset feature.

Calculations of Probability of Failure upon Demand

For information regarding the calculation, and for PFD/PFH numbers allocated for the AADvance system, refer to the PFD calculation document (Doc No: ICSTT-RM449 AADvance Controller and AADvance Eurocard Controller PFH and PFD_{avg} Data) listed in the approved Revision List.

Failure Rates

For the purposes of Failure Rate calculation, AADvance products have a useful lifetime of 20 years. Refer to ICSTT-RM449 for AADvance Controller and AADvance Eurocard Controller PFH and PFD_{avg} Data.

Eurocard Related Documents

The following documents are related to the safety requirements applicable to the AADvance Eurocard controller and its applications.

Table 2 - Reference Documents

Document	Title
IEC 61508:2010 Part 1-7	Functional safety of electrical/electronic programmable safety-related systems
EN 61131-2:2017	Programmable controllers – Part 2: Equipment requirements and test
IEC 61326-3-1	Electrical equipment for measurement, control and laboratory use - EMC

NOTE Users must apply any National, Regional and Industrial standards when building and operating a system.

Eurocard Processor Module

The 9120 Eurocard Processor Module consists of two 160 x 100mm Eurocards.

- Eurocard CPU PCB
- Eurocard Interface PCB

It has a set of LEDs on the front edge of the Eurocard Processor CPU PCB that report the health and status of the module. The module can be mounted in a container, a rack, connected directly to a wiring harness or plugged into a back plane.

Features

- User configurable system
- Standard Eurocard PCB dimensions
- Rated for applications up to SIL 3
- IEC 61508 Compliant
- Executes IEC 1131-3 languages
- Two Ethernet and two Serial ports per processor module
- Qualified to API 17F, Fourth Edition (December 2019), with Errata 1 and 2

Eurocard Processor - Technical Overview

The Eurocard processor has two PCBS connected by internal busses and external links for the external communication network. The internal controller communication is provided by the wiring harness created for the system.

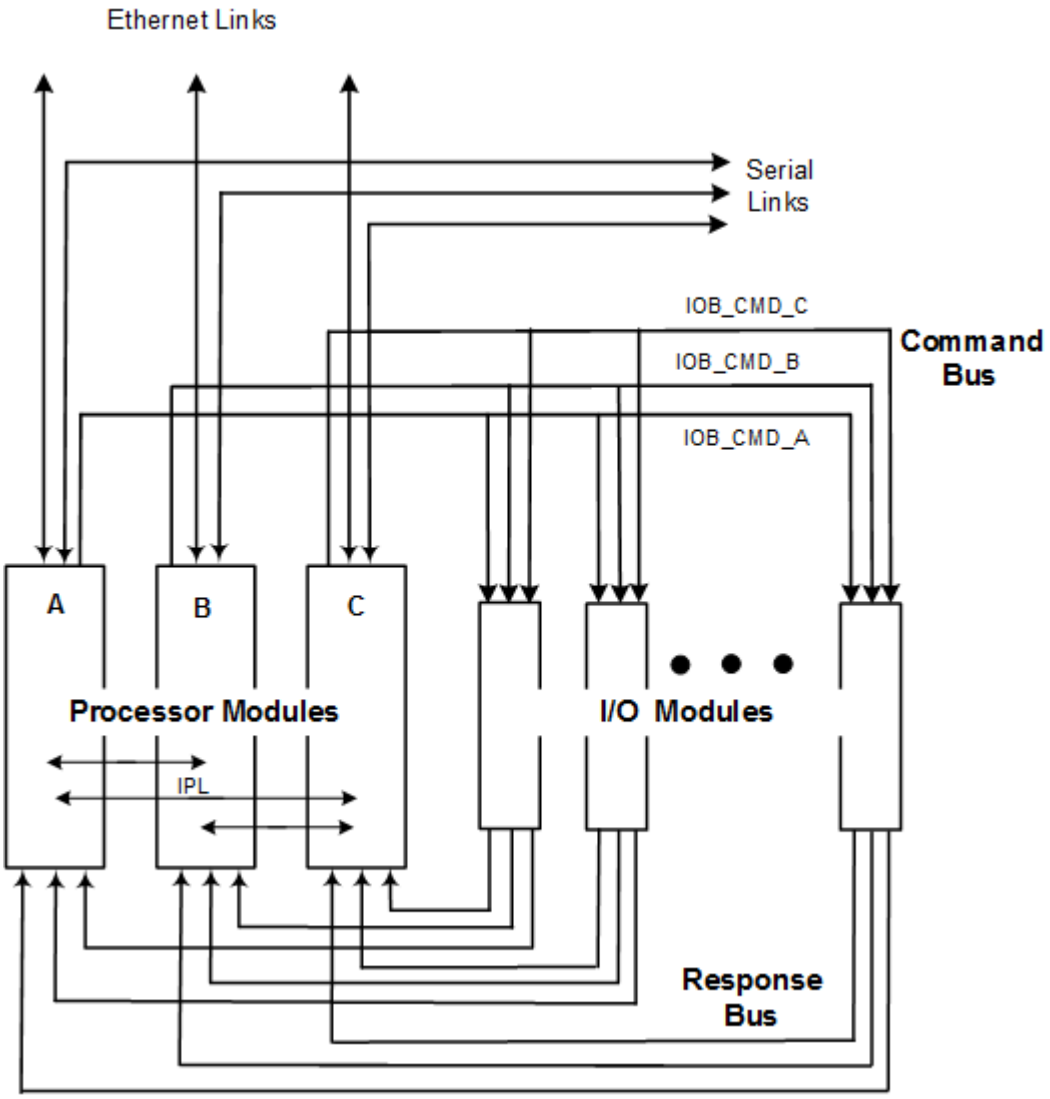
Processor to I/O Bus Structure

Internal communication between the processor modules and I/O modules is supported by command and response bus connections. A processor sends commands to every I/O module across a command line on a multi-drop arrangement, each processor has its own dedicated command line to each I/O module.

An I/O module has a dedicated response line back to each the processor. The maximum number of I/O modules is 18, this means each processor module has one command line and up to 18 response line connections to/from the I/O modules. The unique response line for each I/O module provides an unambiguous identification of the source of the I/O data and assists with fault containment.

An inter-processor Ethernet link (IPL) provides the communication links between the processor modules. This bus structure is illustrated below:

Figure 2 - Eurocard Processor to I/O Buss Structure



Eurocard Processor Interface PCB

The Eurocard Processor Interface PCB has the following functionality:

- Dual redundant 24 Vdc system input power supplies and System RTN.
- Two Ethernet 10/100 BaseT ports.
- Two RS485 serial data ports.
- Ribbon cable connector between the Eurocard Processor Interface and CPU.
- Processor containing the MAC and IP Address data.
- Slot Identification links

Two Ethernet ports are independent and are isolated to ensure that there are no common mode failures when used as redundant pairs. Each port has a configurable IP address and supports services such as MODBUS RTU, Open MODBUS/TCP protocols.

Two serial communications ports are electrically and functionally isolated from each other and are typically used for MODBUS RTU Master/Slave communications. The ports support, RS 485 (4 wire) and RS 485 (2 wire) and can be configured to support asynchronous data rates of between 1200 and 115200 baud. Included on the processor PCB are serial communication termination circuits that can be brought into use by links across the connector and a high and low bias circuit that provides bias voltages to support serial communications.

Eurocard Processor CPU PCB

The Eurocard Processor CPU PCB provides the following:

- Processing of I/O data
- I/O scanning
- Diagnostic testing
- Controls up to 18 I/O modules
- Redundant Ethernet connections for Inter-processor CPU communications
- CPU Synchronization
- Battery Holder for coin battery

It contains an application processor that incorporates a communications co-processor and a maths co-processor. They provide the processing power for logic solving and the message encapsulation and verification for secure channel communication to other nodes. The Eurocard Processor CPU is galvanic isolated from external power supplies and data links so that any faults developed in the field do not cause a Processor Module failure.

The CPU module will continue to operate in the event of failure of one of its dual redundant 24 Vdc power supplies. Under- and over-voltage protection is provided for the internal power supplies and the power availability is monitored by a diagnostics microprocessor. A battery holder provides an option to install a 3V coin battery that can support the internal clock and memory when the system power is switched off.

In dual redundant configurations, Eurocard Processor CPU PCBs are automatically synchronized to each other. An Ethernet inter-processor communication link is provided through the 53-way connectors.

The processor periodically initiates internal diagnostic tests which, together with a watchdog circuit, monitor the processor performance. Should a fault be detected the relevant Eurocard Processor CPU PCB or Eurocard Processor Interface PCB the Eurocard Processor is shut down.

All the communication between the processors and the I/O modules (IOMs) is clock-less serial data, encapsulated in a CRC error detection packet structure.

Eurocard Processor Specification

Attribute	Value
Functional Characteristics	
Degradation	1oo1D, 1oo2D and 2oo3D[(1)]
Processor clock	400 MHz
Memory	
Boot flash	512 kB
SRAM	512 kB
Bulk flash	64 MB
SDRAM	32 MB
Performance Characteristics	
Safety Integrity Level (SIL)	1 processor: non-safety applications 2 Processors: up to SIL3 safety applications 3 Processors: up to SIL3 fault tolerant and TMR safety applications.
Sequence of events (for internal variables)	
Event resolution	1 ms
Time-stamp accuracy	Application Scan
Self-test Interval	< 5.5 hours
I/O Modules supported	18
Electrical Characteristics	
Module supply voltage	Redundant + 24 V dc nominal; 18 V dc to 32 V dc range
Module supply power dissipation	8 W (27.3 BTu/h)
Mechanical Specification	
Dimensions (height × width × depth)	100 mm x 160 mm x 18mm (4 in x 6.3 in x 0.7 in) The PCBs occupy typically 100 mm x 175 mm x 40 mm including connectors
Weight	266 g (10 oz.)
Casing	None
Environmental Specification	
Temperature:	
Operating	– 25 °C to + 70 °C (-13 °F to 158 °F)
Storage and Transport	– 25 °C to + 70 °C (-13 °F to 158 °F)
Vibration	
IEC 60068-2-64 (Test Fh, Operating)	20 to 80 Hz, increasing @ +3 dB/Octave, 80 to 350 Hz @ 0.04 g^2/Hz, 350 to 2000 Hz @ -3 dB/Octave. 6 g rms overall. 10 minutes single axis delivered as one continuous test

Attribute	Value
Shock	30g peak, 11 ms duration, 4 +/- shocks per axes (18 total)
EMI	Tested to the following standards: EN 61131-2:2017; EN 61326-3-1:2017
Sub Sea Standard	Tested to Q1 Extended Design levels of API 17F, Fourth Edition (December 2019), with Errata 1 and 2.

(1) When a controller's processor modules have degraded to 1oo1D, the system must be restored to at least 1oo2D by replacing the faulty processor module(s) within the MTTR assumed in the PFD calculations; also, unless compensating measures are defined in the Safety Requirements Specification (SRS) and documented in operating procedures, the application program must be designed to shut down safety instrumented functions if a module failure due to dangerous fault has not been replaced within the MTTR.

Eurocard Analogue Input Module

A 9531 Eurocard Analogue Input Module consists of a single 160 x 100 mm Eurocard PCB. It has a set of LEDs mounted on the front edge of the PCB. It can be mounted in a container, a rack, connected directly to a wiring harness or plugged into a back plane. The LEDs report the health of the module, the status of each input channel and any potential field faults.

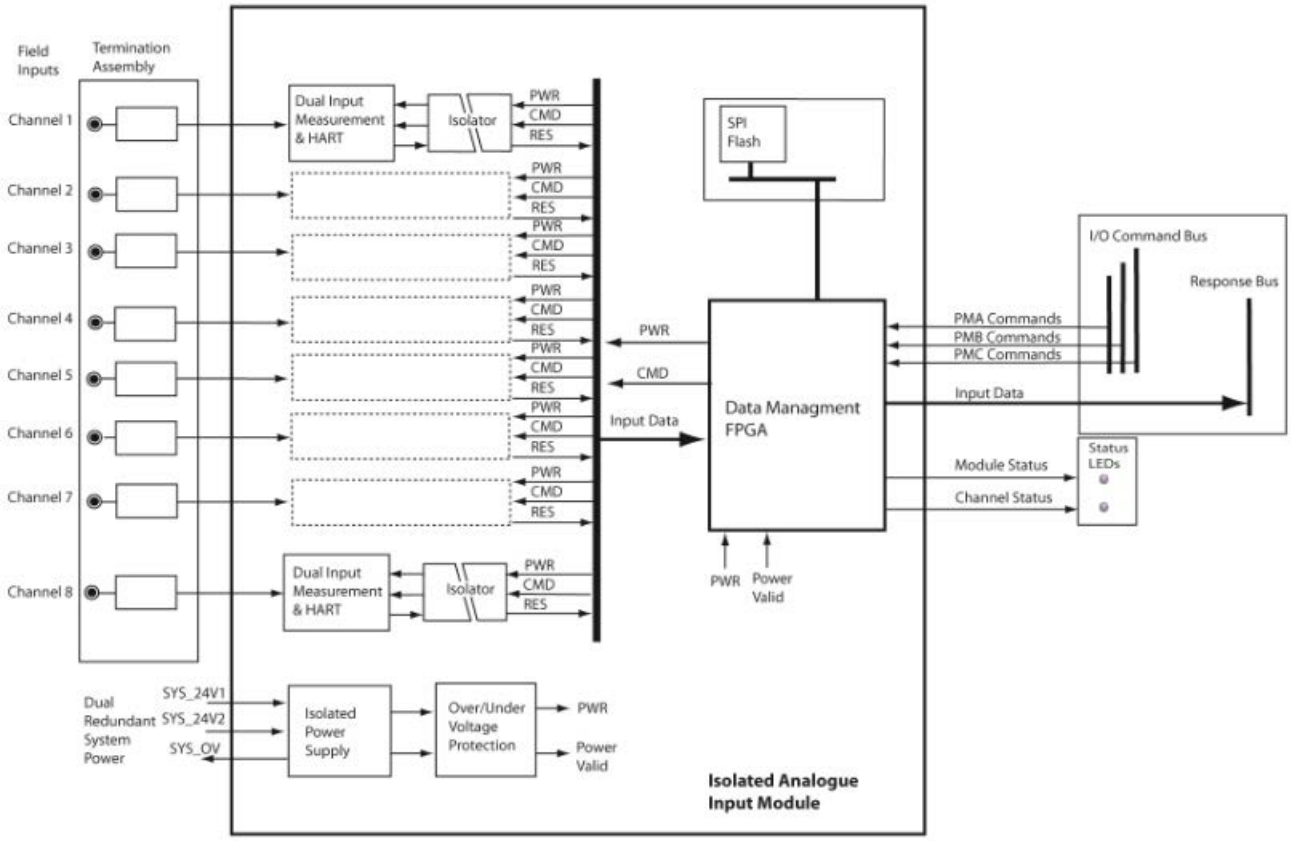
This module is supported by a 9842 termination assembly that connects the field devices to the input channels.

Features

- 8 field channel connection capability
- Rated for applications up to SIL3
- Suitable for simplex, dual redundant configurations and fault tolerant applications
- Independent galvanic isolated input channels
- Built-in diagnostic testing and independent watchdog facility
- When fitted in dual configurations, modules can be replaced on-line without interruption of the signal inputs.
- Provides line monitoring and both field wiring and device diagnostics capability

Eurocard Analogue Input Module - Technical Overview

The Eurocard Analogue Input Module circuit is illustrated below:



This module detects analogue inputs in the range 0 – 24 mA and pass input data values to the FPGA for the processor module. The system routes each input signal through a termination assembly to two input measurement devices. These devices check the input status and channel condition and generate the input data for the data management FPGA. Each channel provides both digital and analogue voltage data to the processor module for information about the field device state, line monitoring and field fault detection circuits.

On receipt of processor commands the FPGA converts the channel input data into secure data packets. It then transfers a serial data stream across the response bus to the processor module. Signal and power isolation circuits separate each input channel from the rest of the system and thus protect the system components from field faults.

An isolated power supply (supplied by the system power inputs) provides power to the module and includes over-voltage and under-voltage protection. The internal isolated power supply provides power to the FPGA. The FPGA provides power to each input circuit through power and signal isolators. Supply voltage monitoring initiates a warning signal and power-off protection mode when a power failure is detected.

Internal diagnostics, controlled by the 9120 Eurocard Processor, test the I/O module at routine intervals. An independent watchdog arrangement also monitors the module operation and provides additional fault containment by activating a shutdown mechanism should a fault be detected. The analogue input module is configured and set up through the AADvance Workbench software and AADvance-Trusted SIS Workstation.

Line Monitoring

Monitoring levels for each analogue input channel are configurable at the module and the channel level. The default thresholds ranges are:

- Fault: 0 mA to 3.8 mA
- Normal: 3.8 mA to 22.0 mA
- Fault: > 22 mA

Each input has five configurable voltage bands (there are eight distinct switching thresholds to allow hysteresis), each of which can be adjusted to provide line monitoring and field device diagnostics.

Eurocard Analogue Input Module Specifications

Attribute	Value
Functional Characteristics	
Number of Input Channels:	8
Performance Characteristics	
Safety Integrity Level	IEC 61508 SIL3
Safety level degradation	1oo1D, 1oo2D and 2oo3D
Safety accuracy limit	200 µA
Self-test interval	< 1 hour; system dependent
Sample update interval	6 ms
Value of least significant bit	0.98 µA
Error at 25°C ± 2°C	
After 1 year at 40°C	0.21 % + 10 µA
After 2 years at 40°C	0.22 % + 10 µA
After 5 years at 40°C	0.23 % + 10 µA
Temperature drift	(0.01 % + 0.3 µA) per °C
Electrical Specification	
Supply Voltage	Redundant +24 V dc nominal; 18 V dc to 32 Vdc range
Module supply power consumption	3.3 W (11.3 BTU/hr)
Input Current	
Nominal	4 to 20 mA dc
Maximum range	0 to 24 mA dc

Attribute	Value
Channel spike when removing a module	<12 mA for 2 ms
Resolution	0.98 µA, 15-bit
Measurement calibrated accuracy at 25°C	± 0.05 mA
Input channel load	see Termination Assembly
Field loop Power Consumption	see Termination Assembly
Channel Isolation - Maximum Withstanding	± 1.2k Vdc for 1 minute
Mechanical Specification	
Dimensions (H x L x D)	100 mm x 160 mm x 18 mm 4 in x 6.3 in x 0.7 in The PCBs for the Eurocard Controller occupy typically 100 mm x 175 mm x 40 mm depending on how tightly the ribbon cable bends (4 in x 6 7/8 in x 1 9/16 in)
Weight	133 g 5 oz
Casing	None
Environmental Specification	
Temperature:	
Operating	– 25 °C to + 70 °C (-13 °F to 158 °F)
Storage	– 25 °C to + 70 °C (-13 °F to 158 °F)
Vibration	
IEC 60068-2-64 (Test Fh, Operating)	20 to 80 Hz, increasing @ +3 dB/Octave, 80 to 350 Hz @ 0.04 g^2/Hz, 350 to 2000 Hz @ -3 dB/Octave. 6 g rms overall. 10 minutes single axis delivered as one continuous test
Shock	30g peak, 11 ms duration, 4 +/- shocks per axes (18 total)
EMI	Tested to the following standards: EN 61131-2:2017; EN 61326-3-1:2017
Sub Sea Qualification	Tested to Q1 Extended Design levels of API 17F, Fourth Edition (December 2019), with Errata 1 and 2

Eurocard Analogue Input Termination Assembly

The AADvance Eurocard Controller has an input termination assembly for the analogue input.

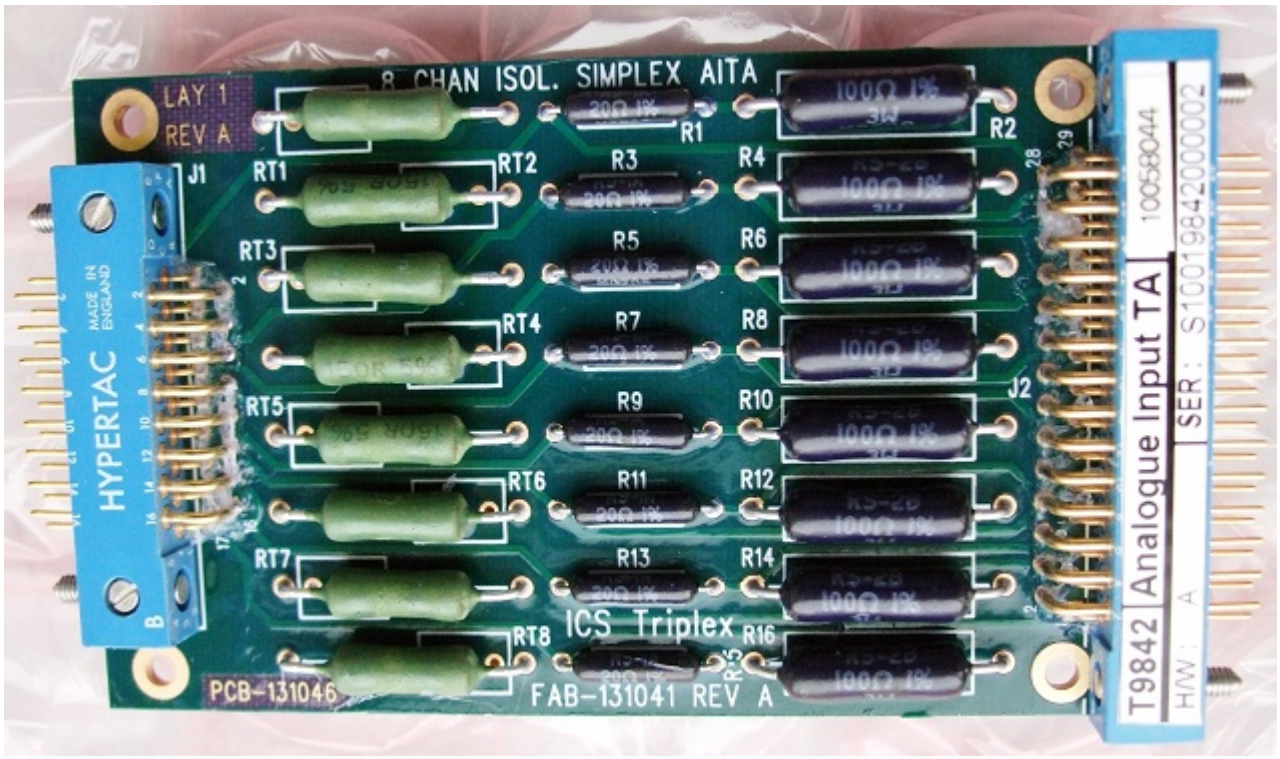
9842 Analogue Input Termination Assembly - Simplex

The termination assembly connects the 8 analogue input signals to the module inputs. It routes each analogue input channel through a 100 ohm and 20 ohm high reliability termination resistors in series plus a 150 ohm high wattage resistor (9842 only). The input current signal is fed to the module's input circuits via the mating connectors.

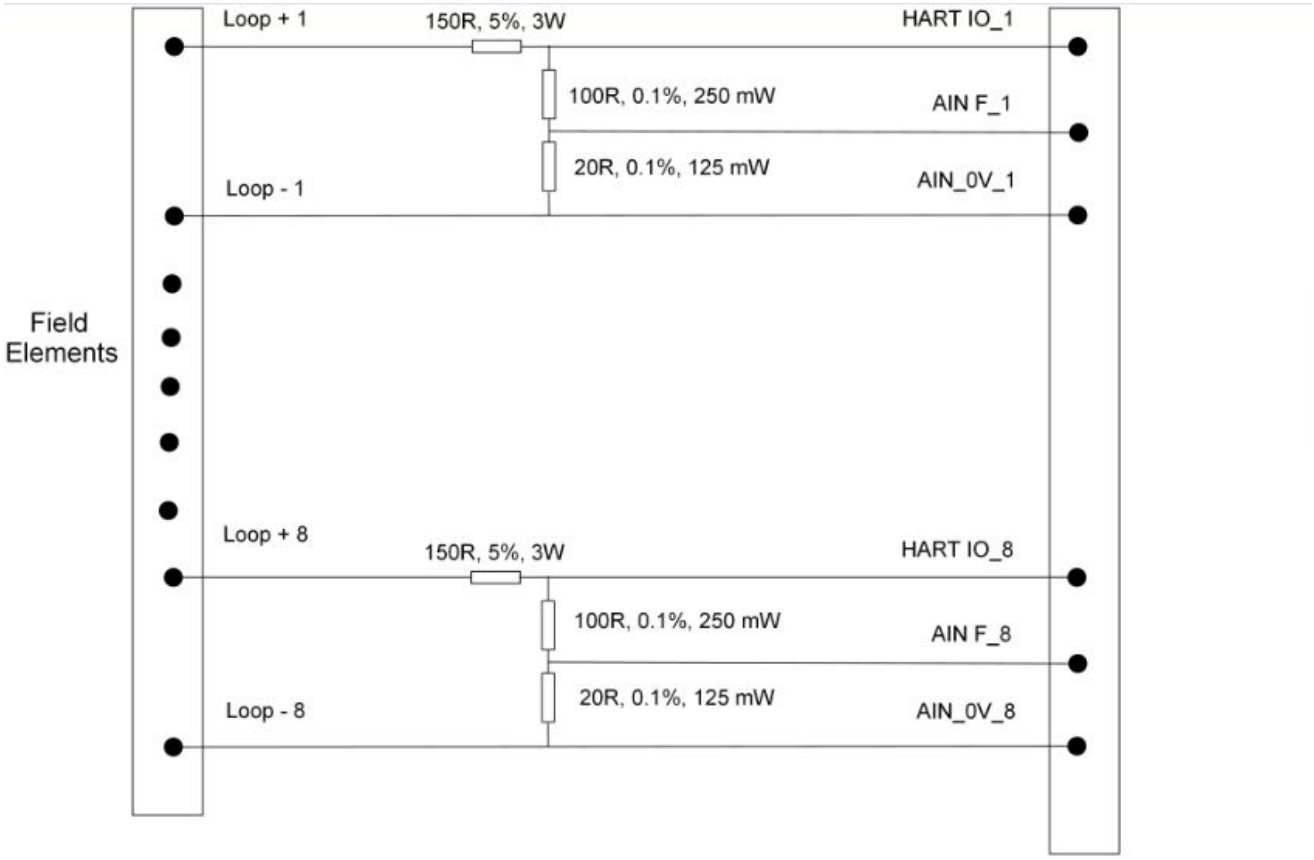
The termination assembly provides passive signal load termination for each channel and is made from robust material to cope with the effects of a short circuit on an input channel.

CAUTION: FIELD LOOP HEAT DISSIPATION

These termination resistors should be considered as part of the field loop circuit. The termination assembly has no fuses, therefore a short circuit across a field loop circuit can cause the heat dissipation at the termination assembly to rise to a much higher figure (approximately 3.8W per channel) than the normal field loop heat dissipation.



The recommended circuit for the 9842 simplex termination assembly is illustrated below:



Eurocard Analogue Input Termination Assembly Specification

Attribute	Value
Functional Characteristics	
Number of Field Connections	8
Electrical Specification	
Input channel Load	100 Ω ± 0.1 % + 20 Ω ± 0.1 % + 150 Ω ± 5 % (9842 only)
Channel Isolation - Maximum Withstanding	± 1.2k Vdc for 1 minute
Field Loop Power Consumption	0.08 W for field loop (0.27BTU/Hr)
Mechanical Specification	
Dimensions (H x W x D)	91 mm x 53 mm x 18 mm 3 9/16 in x 2 3/32 in x 0.7 in
Weight	Approximately 100 g (4 oz)
Casing	None
Environmental Specification	
Temperature:	

Attribute	Value
Operating	–25 °C to 70 °C (–4 °F to 158 °F)
Storage and Transport	–25 °C to 70 °C (–4 °F to 158 °F)
Vibration	
IEC 60068-2-64 (Test Fh, Operating)	20 to 80 Hz, increasing @ +3 dB/Octave, 80 to 350 Hz @ 0.04 g^2/Hz, 350 to 2000 Hz @ -3 dB/Octave. 6 g rms overall. 10 minutes single axis delivered as one continuous test
Shock	30g peak, 11 ms duration, 4 +/- shocks per axes (18 total)
EMI	Tested to the following standards: EN 61131-2:2017; EN 61326-3-1:2017
Sub Sea Qualification	Tested to Q1 Extended Design levels of API 17F, Fourth Edition (December 2019), with Errata 1 and 2.

Eurocard Digital Input Module

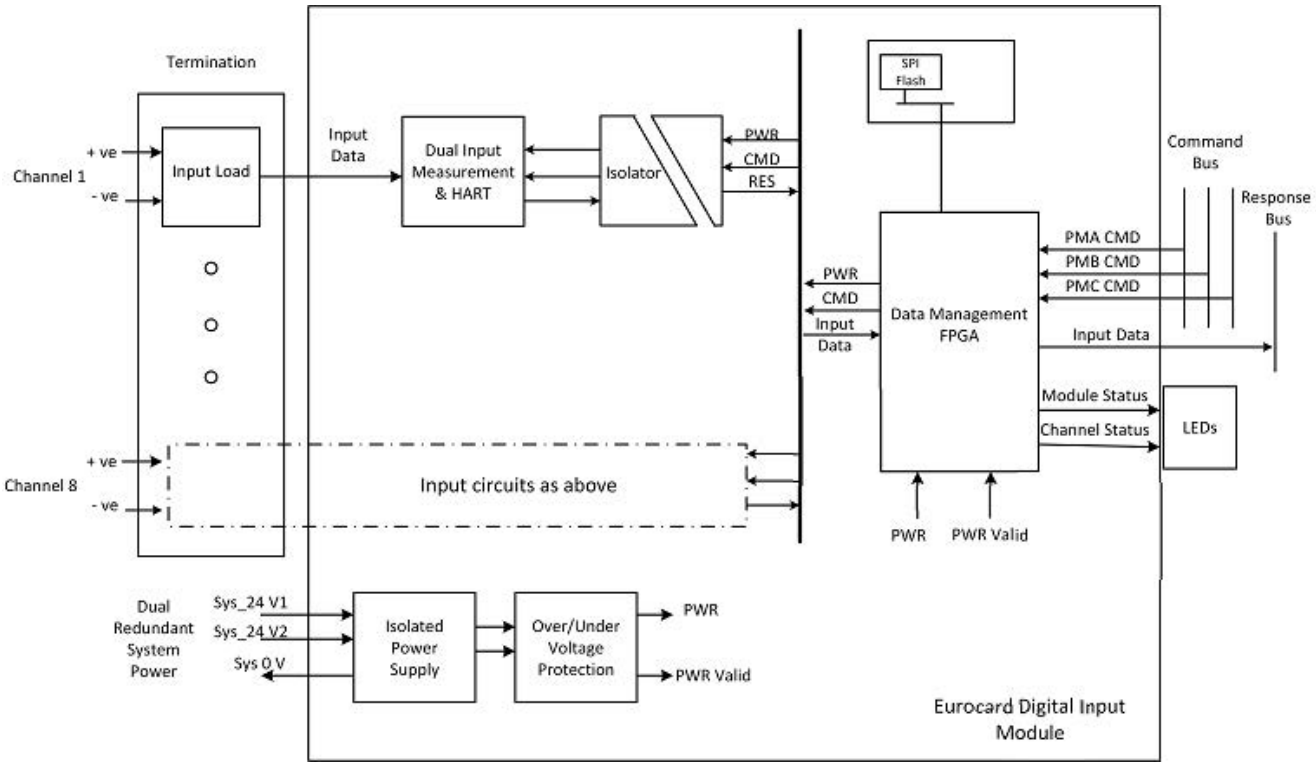
A 9501 Eurocard Digital Input Module consists of a single 160 x 100mm Eurocard PCB. It has a set of LEDs mounted on the front edge of the PCB. It can be mounted in a container, a rack, connected directly to a wiring harness or plugged into a back plane. The LEDs report the health of the module, the status of each input channel and any potential field faults.

Features

- 8 field channels per module
- Rated for applications up to SIL 3
- Suitable for simplex, dual redundant configurations and fault tolerant applications
- Independent galvanic isolated input channels
- Built-in diagnostic testing and independent watchdog facility
- When fitted in dual configurations, modules can be replaced on-line without interruption of the signal inputs.
- Provides line monitoring and both field wiring and device diagnostics capability

Digital Input Module - Technical Overview

The T9501 digital input module monitors eight or sixteen isolated digital input channels and measures input voltages in the range 0V to 32V dc. Each channel provides both digital module state and voltage data to the processor module for field device state, line monitoring and field fault detection.



Input modules provide module and individual channel status indications through the front panel LEDs. These status indications are also connected to application variables and viewed at the software. Comprehensive diagnostics at both system and module levels generate clear fault indications which help rapid maintenance and repair.

On receipt of processor commands the FPGA converts the channel input data into secure data packets. It then transfers a serial data stream across the response bus to the processor module. Signal and power isolation circuits separate each input channel from the rest of the system and thus protect the system components from field faults.

An isolated power supply (supplied by the system power inputs) provides power to the module and includes over-voltage and under-voltage protection. The internal isolated power supply provides power to the FPGA. The FPGA provides power to each input circuit through power and signal isolators. Supply voltage monitoring initiates a warning signal and power-off protection mode when a power failure is detected.

Internal diagnostics, controlled by the 9120 Eurocard Processor, test the I/O module at routine intervals. An independent watchdog arrangement also monitors the module operation and provides additional fault containment by

activating a shutdown mechanism should a fault be detected. The analogue input module is configured and set up through the AADvance Workbench.

Signal and power isolation circuits separate each input channel from the rest of the system, protecting the controller from field faults. An independent watchdog arrangement monitors the module operation and provides additional fault containment by a shutdown mechanism should a fault occur.

T9501 Digital Input Module Specification

Attribute	Value
Functional Characteristics	
Number of Input Channels:	8
Performance Characteristics	
Safety Integrity Level	IEC 61508 SIL3
Safety Level Degradation	1oo1D, 1oo2D and 2oo3D
Safety Accuracy Limit	1.0 V dc
Self-test interval	<1 hour, system dependent
Sample update interval	6 ms
Electrical Specification	
Supply Voltage	Redundant +24 V dc nominal; 18 V dc to 32 V dc range
Module supply power consumption	3.3 W (11.3 BTU/hr)
Input Data Voltage range	0 V to 32 V dc
Input Measurement voltage accuracy	± 0.5 V(1)
Input measurement voltage resolution	5 mV 13-bit
Input channel load	Recommended 5.125 KΩ ± 0.2 %
Field loop Power Consumption	Not applicable
Channel Isolation - Maximum Withstanding	± 1.2k Vdc for 1 minute
Mechanical Specification	
Dimensions (H x L x D)	100 mm x 160 mm x 18 mm 4 in x 6.3 in x 0.7 in The PCBs for the Eurocard Controller occupy typically 100 mm x 175 mm x 40 mm depending on how tightly the ribbon cable bends (4 in x 6 7/8 in x 1 9/16 in)
Weight	133 g 5 oz
Casing	None
Environmental Specification	
Temperature:	
Operating	– 25 °C to + 70 °C (-13 °F to 158 °F)
Storage	– 25 °C to + 70 °C (-13 °F to 158 °F)
Vibration	

Attribute	Value
IEC 60068-2-64 (Test Fh, Operating)	20 to 80 Hz, increasing @ +3 dB/Octave, 80 to 350 Hz @ 0.04 g^2/Hz, 350 to 2000 Hz @ -3 dB/Octave. 6 g rms overall. 10 minutes single axis delivered as one continuous test
Shock	30g peak, 11 ms duration, 4 +/- shocks per axes (18 total)
EMI	Tested to the following standards: EN 61131-2:2017; EN 61326-3-1:2017
Sub Sea Qualification	Tested to Q1 Extended Design levels of API 17F, Fourth Edition (December 2019), with Errata 1 and 2

(1) Dependent on correct termination resistor specifications. Seepage 96.

Eurocard Analogue Output Module

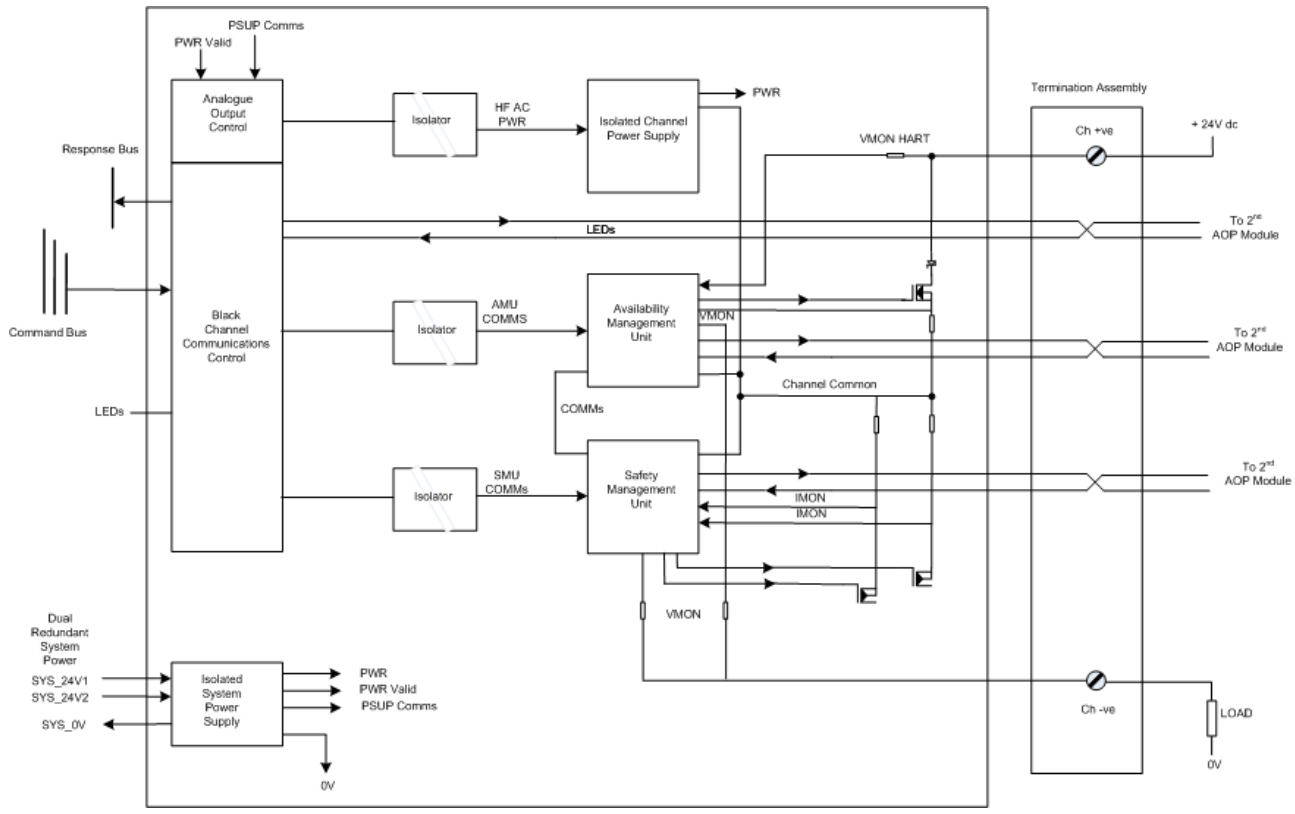
The 9581 Eurocard Analogue Output Module is a current regulating module that has a flexible and fail-safe design, it can only be configured in a simplex arrangement and does not support dual redundant configurations. The Eurocard analogue output module cannot be used for a safety related path. It can be used in a safety related system and regarded as a non-interfering module to the safety path.

Features

- Two isolated 4 to 20 mA output channels per module.
- Fail-safe design and operation (**not rated** for applications up to SIL 3).
- Suitable for simplex configurations only.

Eurocard Analogue Output Module Technical Overview

A block diagram of the module circuit is shown below:



Each channel is a current regulating circuit that provides 4 – 20mA output current for field devices, each channel regulates the full commanded output current. For channel protection each channel also features output load voltage and current monitoring, reverse current protection and short and open circuit line monitoring. The module is designed to always be able to switch off an output when demanded.

The analogue output module receives indicator settings, command output values from the processor. It reports back field current values, module status information and diagnostic test results. All channel and module status information is displayed on front panel indicators and can be routed to the software application program.

Eurocard Analogue Output Module Specification

Attribute	Value
Functional Characteristics	
Output channels	T9581: 2
Performance Characteristics	
Integrity level	Not certified for SIL 3
Degradation	1oo1D, 1oo2D
Accuracy	200 µA
Self-test Interval	<1 hour, system dependent
Value of least significant bit (control)	0.98 µA
Value of least significant bit (monitor)	3.9 µA
Error at 25°C ± 2°C	
After 1 year at 40°C	0.30 % + 10 µA
After 2 years at 40°C	0.35 % + 10 µA
After 5 years at 40°C	0.44 % + 10 µA
Temperature drift	(0.01 % + 0.1 µA) for each °C
Electrical Characteristics	
Module supply voltage:	
Voltage	Redundant +24V dc nominal; 18 V dc to 32V dc range
Module supply power dissipation	3.6 W (12.3 BTU/hr)
Output voltage:	
Maximum voltage without damage	± 60 V dc
Operating field supply voltage	18 - 32 V dc
Output current	
Nominal	4 - 20 mA
Maximum range	0.1 - 24 mA
Calibrated accuracy at 25°C	10 µA
Output current control resolution	0.98 µA, 15-bit
Output current control accuracy at 25°C	± 10 µA
Output current monitoring resolution	3.9 µA, 13-bit
Compliance voltage	3 V to 32 V dc
Load impedance	
Maximum range	0 Ω - 750 Ω limited by compliance voltage
Typical	250 Ω
Maximum field loop power dissipation	0.77 W for each field loop (2.63BTU/hr)
Mechanical Specification	
Dimensions (height × width × depth)	166 mm × 13 mm × 118 mm (6-½ in. × 1-21/32 in. × 4-21/32 in.)
Weight	290 g (10.5oz.)

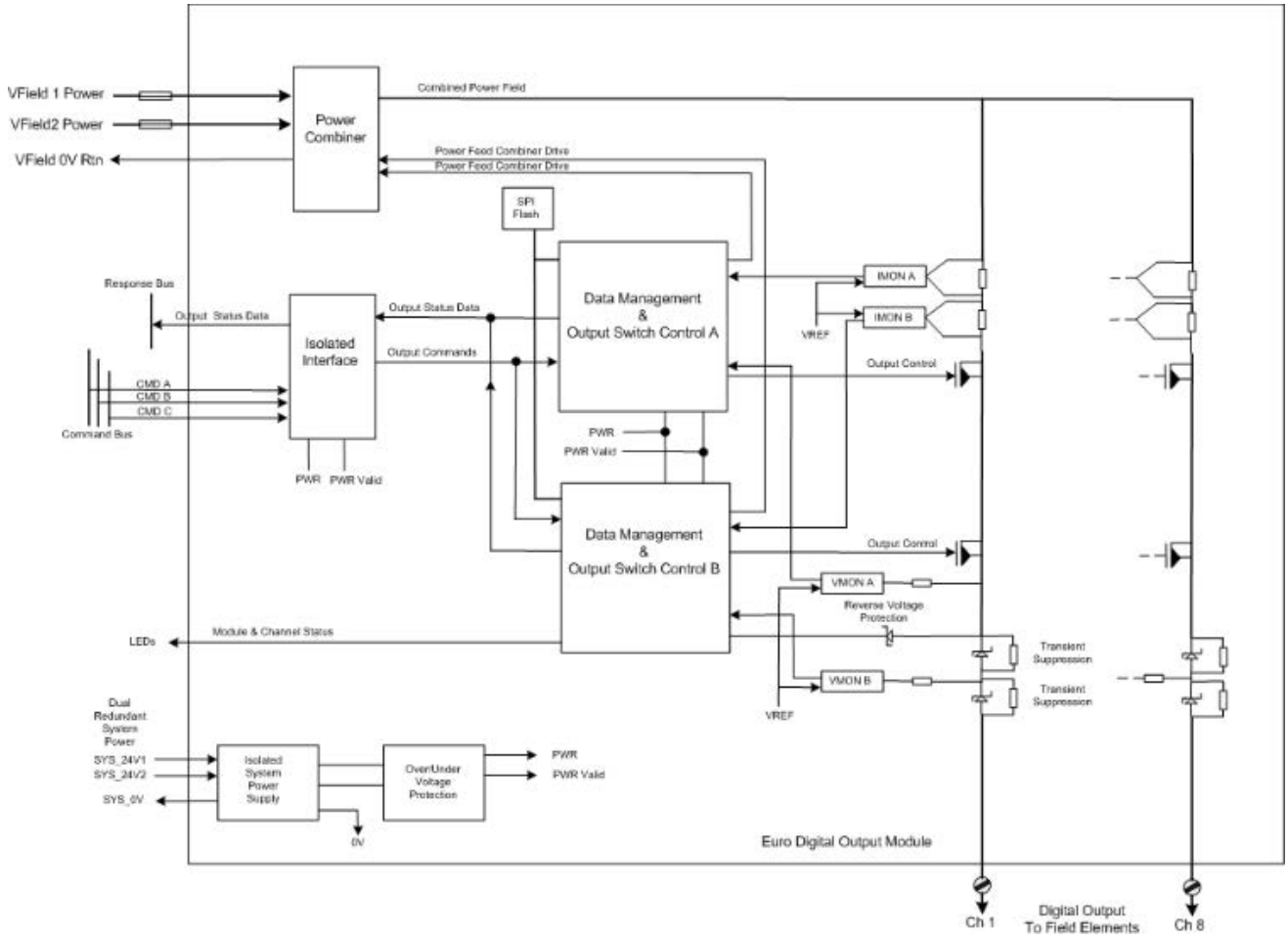
Eurocard Digital Output Module

The 9551 Eurocard Digital Output Module consist of two 160 x 100mm Eurocard PCBs. It has a set of LEDs mounted on the front edge of the Controller PCB. This module can be connected directly to a wiring harness or plugged into a back plane. The LEDs report the health of the module, the status of each input channel and any potential field faults.

Features

- 8 channels per module isolated from the system circuits
- Rated for applications up to SIL 3
- Suitable for simplex and dual redundant connections for fault tolerant applications
- Independent galvanic isolated system input commands and response signals
- Dual series output switches with overload protection in each channel
- Short circuit and open circuit line fault detection for on and off channels
- When fitted in dual configuration, modules can be replaced on-line without interruption of the signal outputs.
- Diagnostic testing of output channels

Eurocard Digital Output Module Technical Overview



The T9551 digital output module has 8 channels for a maximum of 2 field elements and can switch 1 A at 32 V dc for each device. It features voltage and load current monitoring on each channel, reverse current protection and short and open circuit line monitoring. It is designed to always be able to switch off an output when demanded. No single failure in the module can cause a stuck-on failure. The module supports dual redundant power feeds for field devices without the need for external diodes.

An output channel protection activates when the channel load exceeds a safe limit. And, a reverse voltage protection circuit in each output channel ensures that externally applied voltages do not supply current flow into the module outputs. Channels are isolated from the system supply, but share a common 0v return for all 8 channels.

The module has self-checking functionality. Short circuit and open circuit line monitoring is supplied on all outputs. Internal diagnostics do ongoing functionality checks ensuring that the output channel command data is correctly transferred to the output. The processor module initiates a test sequence on each output channel, checking for 'stuck-on' and 'stuck-off' conditions on the output switch pairs. Front panel LEDs give module, channel

and field connection status indications. These status indications can also be connected to application variables and viewed at the software.

When a controller uses a pair of digital output modules in a dual configuration, the two fail-safe output switches on each channel are combined in a parallel arrangement so that they automatically form a fault-tolerant output configuration.

The AADvance Workbench software and AADvance-Trusted SIS Workstation have settings for individual digital output channels:

- You can specify a shutdown state for an output channel that defines how the output will behave when the module is in a shutdown mode.

Eurocard Digital Output Module Specification

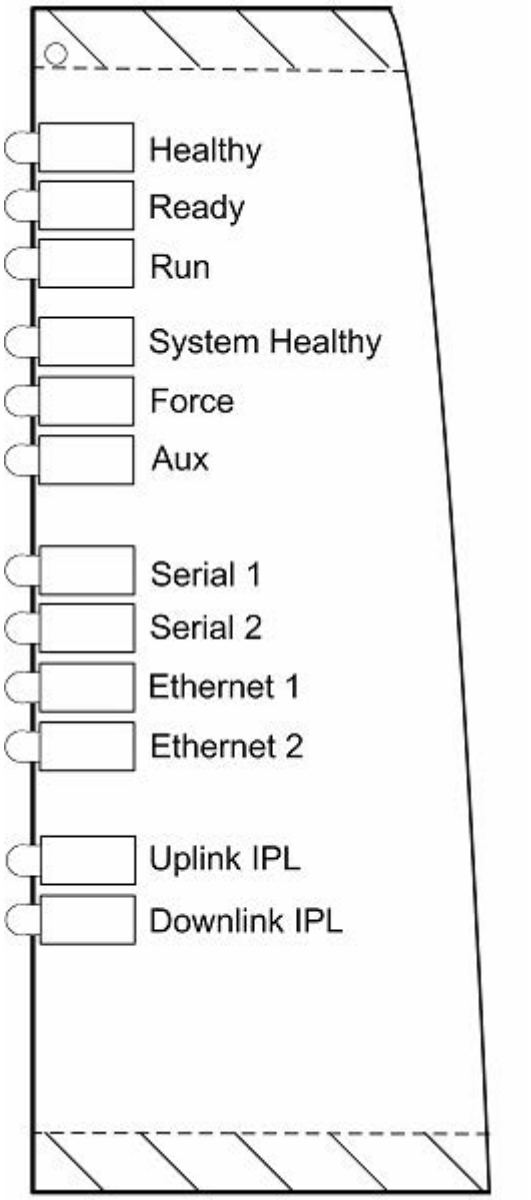
Attribute	Value
Functional Characteristics	
Output channels	8
Performance Characteristics	
Safety integrity level	IEC 61508 SIL3
Safety level degradation	1oo1D, 1oo2D
Self-test interval	<30 mins (30 s per module)
Electrical Characteristics	
Module supply voltage:	
Voltage	Redundant +24 V dc nominal; 18 V dc to 32 V dc range
Module supply power dissipation	3.0 W (10.2BTU/hr)
Output Voltage:	
Maximum voltage without damage	–1 V to +60 V dc
Operating field supply voltage	18 - 32 V dc
Output current:	1 A continuous per channel
Minimum current required for line monitoring	10 mA per module (20mA for dual pair)
Maximum voltage drop	1 V dc
Maximum current at de-rated temperature	8 A all channels @ 60°C
De-rated current at maximum temperature	6 A all channels @ 70°C
Output off resistance (effective leakage)	50 KΩ
Voltage monitoring accuracy	± 0.5 V
Current monitoring accuracy	± 10 mA
Output overload protection	
Surge	2 A for up to 50ms

Attribute	Value
Continuous	1.5 A
Maximum field loop power dissipation	0.57 W per field loop (1.94BTU/hr)
Mechanical Specification	
Dimensions (height × width × depth)	100 mm x 160mm x 18mm 4 in x 6.3 in x 0.7 in The PCBs for the Eurocard Processor occupy typically 100 mm x 175 mm x 40 mm depending on how tightly the ribbon cable bends (4 in x 6 7/8 in x 1 9/16 in)
Weight	266 g (10oz)
Casing	none
Environmental Specification	
Temperature:	
Operating	– 25 °C to + 70 °C (-13 °F to 158 °F)
Storage and Transport	– 25 °C to + 85 °C (-13 °F to 185 °F)
Vibration	
IEC 60068-2-64 (Test Fh, Operating)	20 to 80 Hz, increasing @ +3 dB/Octave, 80 to 350 Hz @ 0.04 g^2/Hz, 350 to 2000 Hz @ -3 dB/Octave. 6 g rms overall. 10 minutes single axis delivered as one continuous test
Shock	30g peak, 11 ms duration, 4 +/- shocks per axes (18 total)
EMI	Tested to the following standards: EN 61131-2:2017; EN 61326-3-1:2017
Sub Sea Qualification	Tested to Q1 Extended Design levels of API 17F, Fourth Edition (December 2019), with Errata 1 and 2

Eurocard Processor Status Indications

The PCB LED indicators are shown below:

Figure 3 - Processor Status LEDs



The status indications provide the following information:

Table 3 - Eurocard Processor Module Status Indications

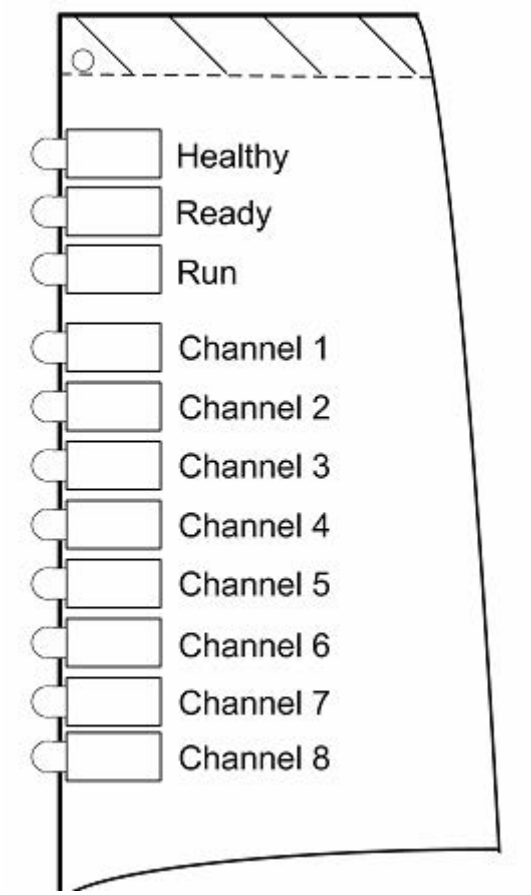
Indicator	Status	Description
Healthy		Provides an indication of the module's fault status and power-on/ operational status
	OFF	No power
	RED	• Module has a fault • Flashes RED briefly after being installed as the module is booting up or reset is in progress • controller is off-line
	GREEN	As the module is installed and receives power it flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds). When the module has booted up and is operational the LED stays GREEN and indicates that the module has no hardware faults. When in the recovery Mode and no faults are present the LED is GREEN **Note:** 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 ICSTT-RM406 Chap 3).
Ready		Provides an indication of the module's education and synchronization status
	OFF	No power
	RED	Module is booting up (10 to 20 seconds) or not educated or synchronized with partners
	GREEN	Module is educated and synchronized with partners
	Flashing GREEN	Education or synchronization 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 synchronized processors
	OFF	No power and stays off while the module is booting up (10 to 20 seconds)
	RED	Module is not educated/synchronized; 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.

Indicator	Status	Description
Force		Provides an indication that variables are being locked/forced by the application. The same indication will show for all educated and synchronized processors
	OFF	No power and stays off while the module is booting up (10 to 20 seconds)
	GREEN	No variables are being locked/forced
	AMBER	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 color except when the processor is in the Recovery Mode and the application is stopped
	OFF	No power and stays off while the module is booting up (10 to 20 seconds), or under application control
	GREEN	Under application control
	AMBER	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
Uplink IPL		Indicates the status of the inter-processor link associated with Ethernet 1 (Port B)
	OFF	No Power
	GREEN	Ethernet link present
	AMBER	Tx or Rx activity
Downlink IPL		Indicates the status of the inter-processor link associated with Ethernet 2 (Port A)
	OFF	No Power
	GREEN	Ethernet link present
	AMBER	Tx or Rx activity

Eurocard I/O Module Status Indications

The I/O module LED indicators are as shown below:

Figure 4 - I/O Module Status LEDs



The status indications provide the following information:

Table 4 - Eurocard I/O Module Status Indications

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. The Healthy indicator may turn red immediately upon application of power to the module, before then turning green
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

Indicator	Status	Description
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. Use the remote fault join feature which commands the processor 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-energized 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 energized state
	AMBER	Field fault
	RED	Channel fault

Eurocard Controller System Architectures

Eurocard Controller Configuration

A controller can be configured to manage the following requirements:

- safety applications
- low demand or high demand fault tolerant applications
- SIL 2 low demand and high demand applications
- SIL 3 safety related system application

IMPORTANT **ANALOGUE OUTPUT MODULES**

The Eurocard Analogue Output Module has not been verified or certified for use in a Safety System. It cannot be used as part of a safety path and it cannot be used in a dual redundant configuration. It will not, however, interfere with the other modules used in a Safety System.

For information about the different system architectures that can be configured for an AADvance Eurocard Controller, refer to the AADvance Eurocard Controller Safety Manual, publication ICSTT-RM456 (Chapter 3 - Eurocard Controller System Architectures).

Before You Begin

This chapter lists important information that should be read before starting to build the system. It covers preparatory information that you should read tasks you should complete for a successful installation.

System Installation Environment

An AADvance system can be installed in a non-hazardous environment. The installation environment can be a common source of failure so it is necessary that the installation assessment not only covers the environmental specification for the AADvance system but also includes the following:

- the prevailing climatic conditions.
- type of area, e.g.; is it a non-hazardous area.
- location of power sources.
- earthing and EMC conditions.

In some customer installations parts of the system can be installed in differing locations; in these cases the assessment must include each location.

In a non-hazardous environment a system does not have to be installed in an enclosure; however, the area where it is installed must not be more than a Pollution Degree 2 environment in accordance with IEC 60664-1:2007.

Pollution Degree Definition

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.

Power Sources and Heat Dissipation Calculations

It is highly recommended that module supply power and field loop power consumption calculations are done to find out the heat dissipation before designing the enclosure and making a decision about the installation environment.

Physical Installation

The installation process is a potential source of common cause failure, therefore it must be in line with the following:

WARNING: You must use the installation guidelines given in this AADvance System Build Manual and installation and any commissioning procedures that comply with applicable international or local codes and standards.

System Power Requirements

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

WARNING: A controller system must be installed with a power network that is designed to meet over voltage Category II (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 is no larger than 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.

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

Controller Power Supply Requirements

A controller requires the following power supply sources:

- A dual redundant power supply of + 24 V dc with an operating range of 18 V dc to 32 V dc. The AADvance Eurocard 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 cause the system to lose power. Consequently, the power sources must be able to supply the peak current to open any over current protection devices (such as fuses) without failing.

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

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

WARNING: The power supplies must satisfy the electrical requirements and tests specified in IEC 61131 Part 2 EN 61010-1 and EN 60950 and must be big enough for the system requirements.

Power Arrangements for Field Devices

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

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

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

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

Power Distribution Protection

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

Digital Output Field Power

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

Estimate AADvance Eurocard Controller Power Consumption

Use these tables to estimate the power consumption of an AADvance Eurocard Controller. These figures are based on a maximum voltage of 32V dc to give worst case power consumption figures. All power consumption is dissipated as heat.

Table 5 - Estimating Module Power Consumption

Item	Number of Modules	Power Allowance	Subtotal (W)
9120 Eurocard Processor		× 8.0W (27.3BTU/hr)	=
9531 Eurocard Analogue input, 8 channel		× 3.3W (11.3BTU/hr)	=
9501 Eurocard Digital Input Module, 8 channel		× 3.3W (11.3BTU/hr)	=
9551 Eurocard Digital Output, 24V dc, 8 channel		× 3.0W (10.2BTU/h)	=
9581 Eurocard Analogue output, 24V dc, 2 channel		× 3.6W (12.3BTU/hr)	=
		Total estimated controller power (watts):	

Field Power Consumption

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

System Design Considerations for Heat Dissipation and Cooling

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

Module Orientation

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

Maximum Air Temperature

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

Estimate Heat Dissipation

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

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

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

Table 6 - Module Supply Power Heat Dissipation

Item	Number of Modules	Power Allowance	Subtotal (W/BTU/hr)
9120 Eurocard Processor		× 8.0W (27.3BTU/hr)	=
9531 Eurocard Analogue input, 8 channel		× 3.3W (11.3BTU/hr)	=
9501 Eurocard Digital Input Module, 8 channel		× 3.3W (11.3BTU/hr)	=
9551 Eurocard Digital Output, 24V dc, 8 channel		× 3.0W (10.2BTU/h)	=
9581 Eurocard Analogue output, 24V dc, 2 channel		× 1.54W (5.26BTU/Hr)	=

Total estimated controller power (watts):	

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

Table 7 - Field Loop Power Heat Dissipation

Item	Number of Field loops	Field Loop Power Heat Dissipation	Subtotal (W x 3.412 BTU/hr)
Analogue Inputs		× Input current (A) x 135	=
Digital Outputs		x Output current (A) x 0.57	=
Digital Inputs		*x Input Voltage (V)/5125	=

Item	Number of Field loops	Field Loop Power Heat Dissipation	Subtotal (W x 3.412 BTU/hr)
Analogue Outputs		x (Field voltage(V) x Output Current (A) - load Resistance (OHM) x Output current (A)**	=
		Total:	

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

Specifying a Eurocard Enclosure

When the system is installed in an enclosure it must meet the environmental specification, hold the modules securely, provide mechanical protection and should not interfere with other system components.

The enclosure must also be able to handle the heat dissipated by the modules and other components included in the cabinet.

Maximum Enclosure Air temperature for Reliable Operation

CAUTION: HEAT DISSIPATION AND ENCLOSURE POSITION

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

ATTENTION: DISSIPATION THERMIQUE ET EMPLACEMENT DE L'ENCEINTE

La température ambiante nominale maximum dans une enceinte où un processeur AADvance et des modules d'E/S standard sont installés pour assurer une fiabilité prévisible, est de 70 ºC (159 °F) pour un environnement non dangereux. La consommation électrique du système et du terrain par les modules et les ensembles de raccordement est dissipée sous forme de chaleur. Vous devez tenir compte de l'effet de la dissipation thermique lors de conception et de disposition de votre enceinte, par exemple, des enceintes continuellement exposées à la lumière solaire auront une température interne plus élévée qui pourrait accroître la température de fonctionnement des modules. La fiabilité des modules fonctionnant aux limites extrêmes de la plage de température pendant une période prolongée peut être réduite.

Enclosure Requirements for a Non-hazardous Environment

An AADvance system can be installed in a non-hazardous location up to a maximum of a Pollution degree 2 Environment.

CAUTION: An AADvance system must be installed in an IP54 standard enclosure if the environment is designated a Pollution Degree 2 in accordance with IEC 60664-1: 2007.

ATTENTION: Un système AADvance doit être installé dans une enceinte normalisée IP 54 si l'environnement est classé en degré de pollution 2 conformément à la norme CEI 60664-1: 2007

Pollution Degree Definition

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.

Eurocard Module Dimensions and Mounting Requirements

Eurocards can be mounted vertically on a rack or on a customer designed support so long as the environmental conditions are maintained and the heat dissipation is considered as part of the enclosure design.

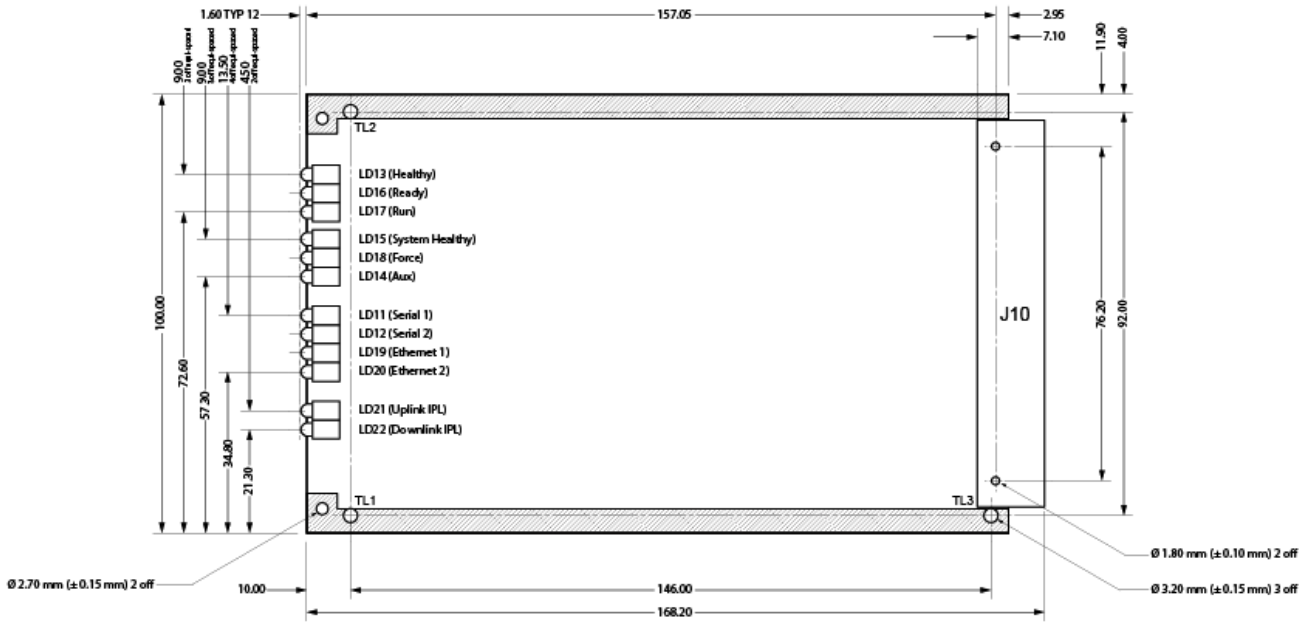
To help design the enclosure the following PCB profiles give the dimensions of the Eurocard modules.

9120 Eurocard Processor Module - PCB Profiles

The Eurocard Processor module consists of two PCBs:

- Eurocard Processor CPU
- Eurocard Processor Interface

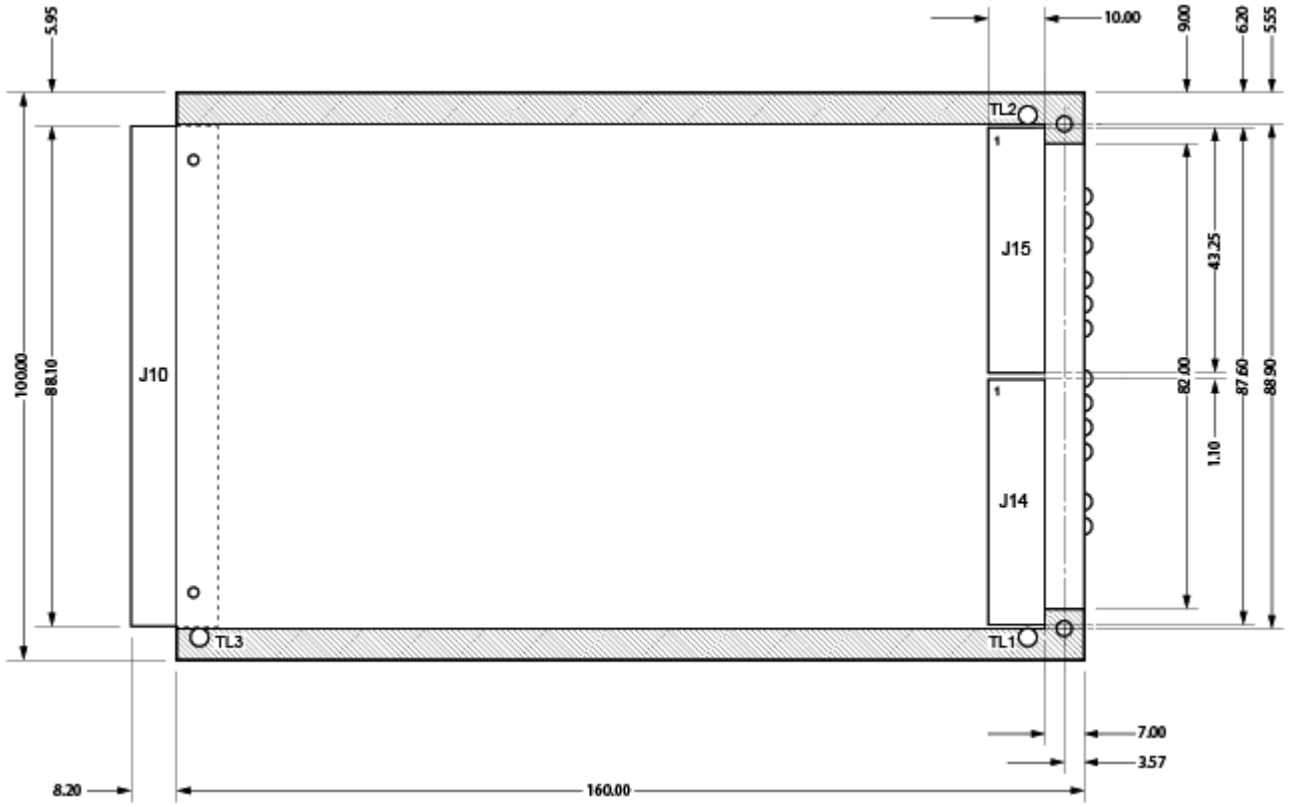
Table 8 - Eurocard Processor CPU PCB Profile



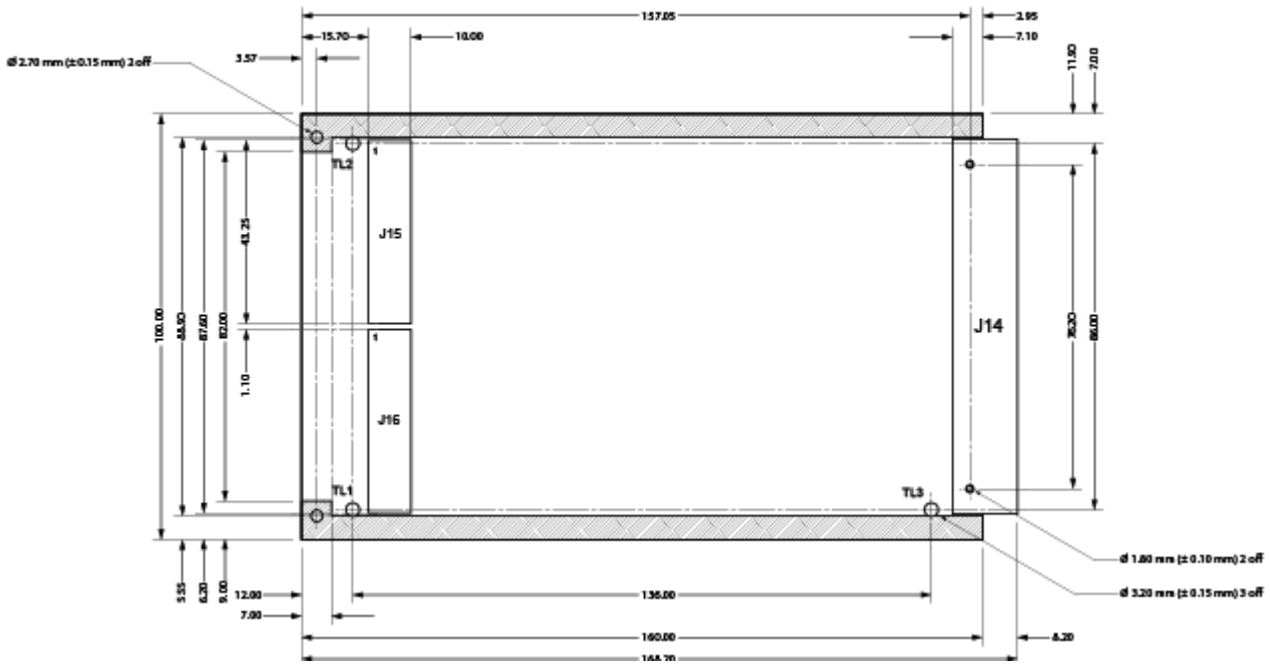
NOTE

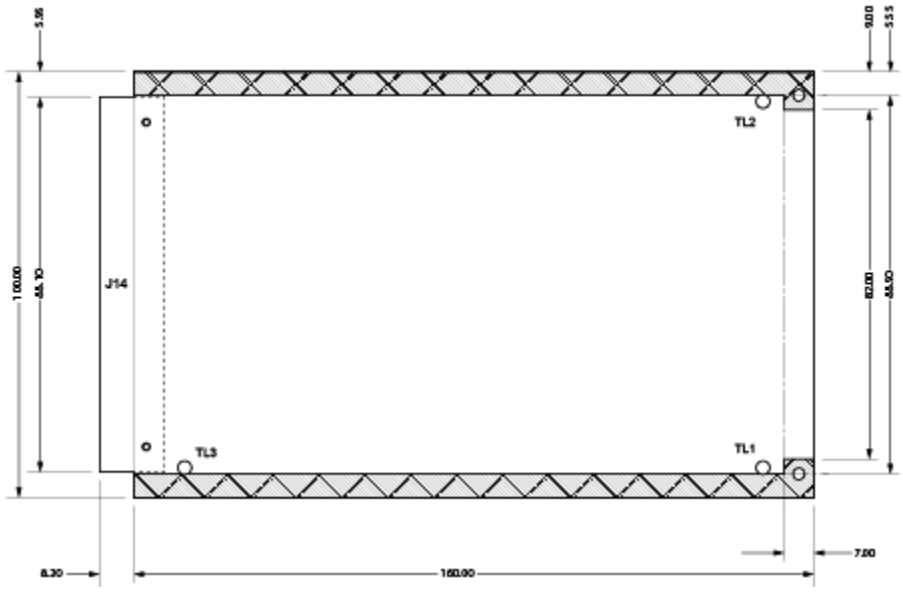
- Nominal PCB thickness 1.6 mm.
- Maximum component height is 12.4 mm on top side.
- Maximum component height is 4 mm on the bottom side of the PCB.
- Hatched areas to be free of components - provision for guide rails.
- Dimensions include provision for inter-PCB ribbon cables.

These dimensions apply to ALL Eurocard PCBs.

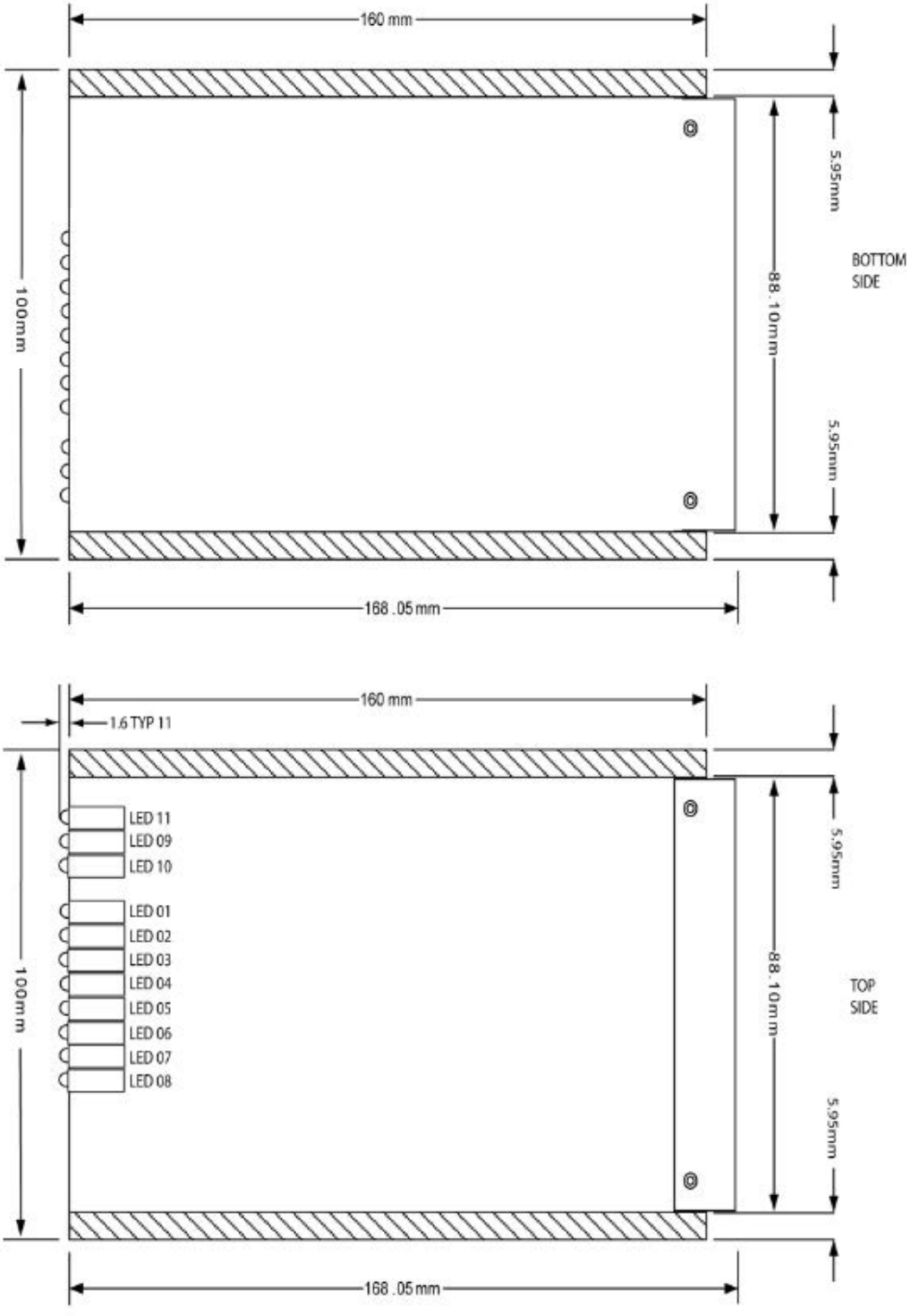


Eurocard Processor Interface PCB Profile




5.95
9.00
13.5
TL2
J14
100.00
82.00
88.50
TL3
TL1
8.30
160.00
7.00

9531 Eurocard Digital/Analogue Input Module - PCB Profile



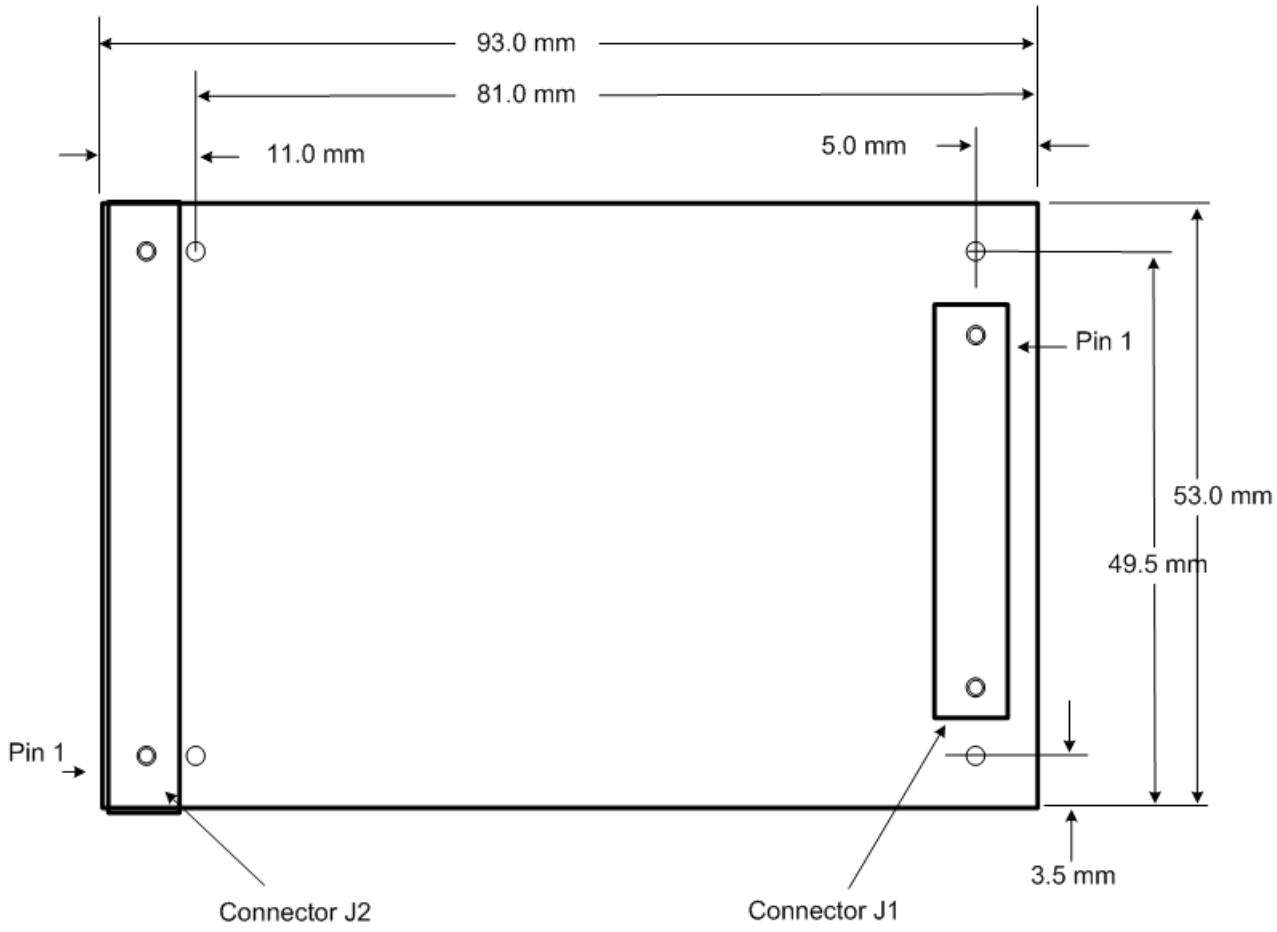
Not to scale

NOTES

1. HATCHED AREAS DENOTE COMPONENT KEEP OUT AREAS.
2. TOP SIDE COMPONENT HEIGHT RESTRICTED TO 12.4mm.
3. BOTTOM SIDE COMPONENT HEIGHT RESTRICTED TO 4.0mm.

9842 Eurocard Analogue Input TA, 8 Ch, Simplex - PCB Profile

9842 TA, 8 Ch, Simplex

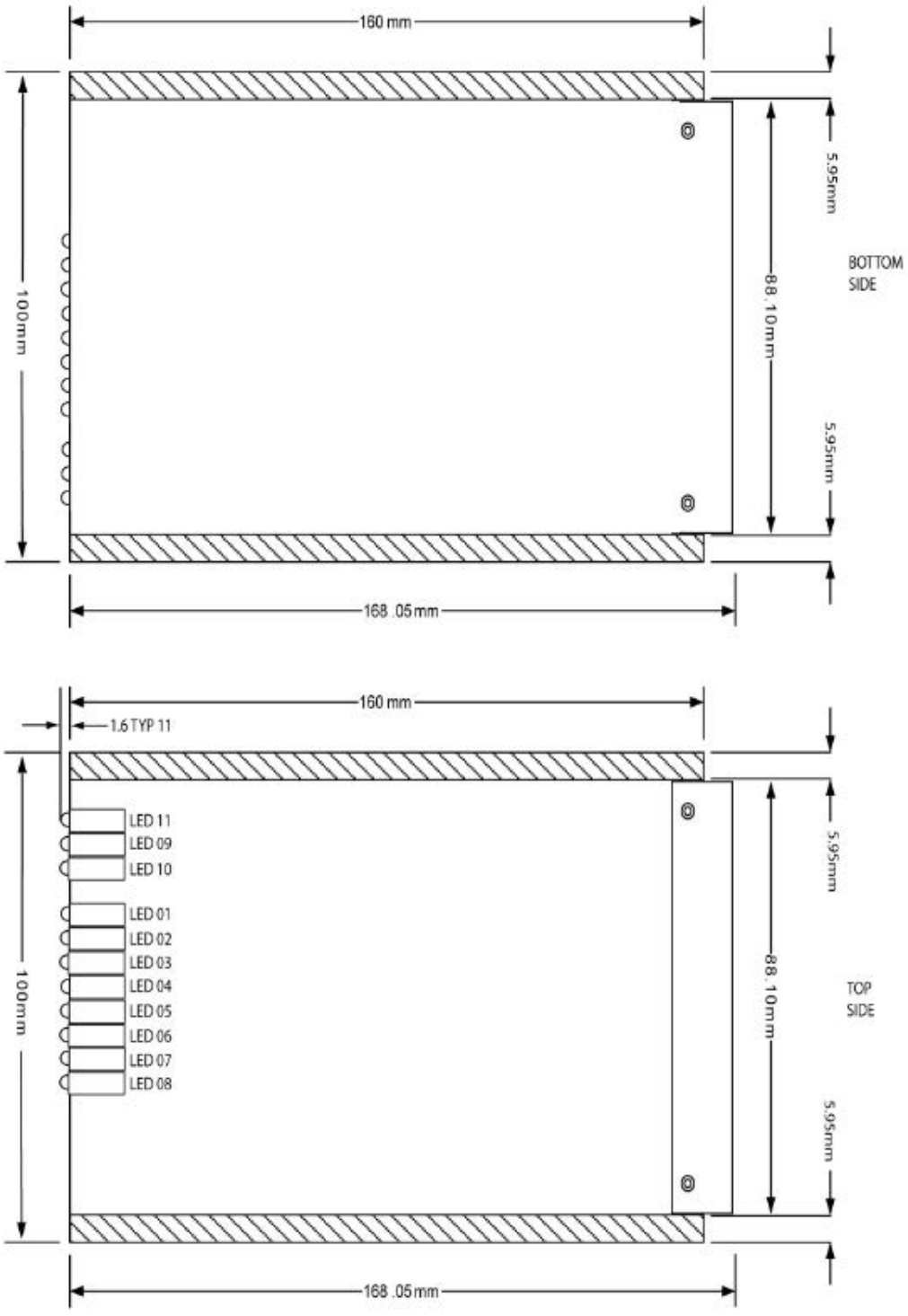


9551 Eurocard Digital Output - PCB Profiles

The Eurocard Digital Output module consists of two PCBs:

- Eurocard Digital Output controller PCB
- Eurocard Digital Output controller Interface PCB

Eurocard Controller PCB

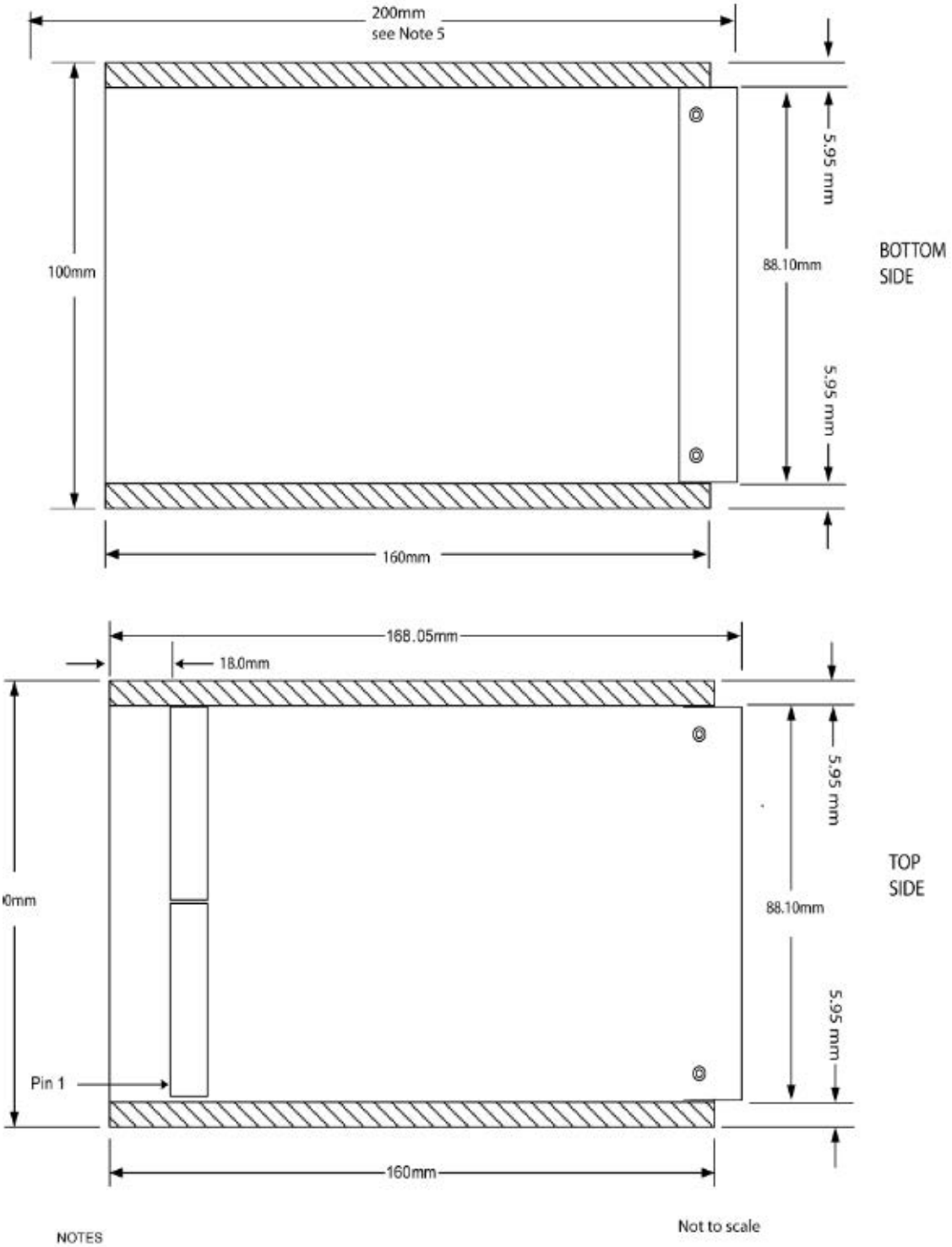


NOTES

Not to scale

1. HATCHED AREAS DENOTE COMPONENT KEEP OUT AREAS.
2. TOP SIDE COMPONENT HEIGHT RESTRICTED TO 12.4mm.
3. BOTTOM SIDE COMPONENT HEIGHT RESTRICTED TO 4.0mm.

Interface PCB

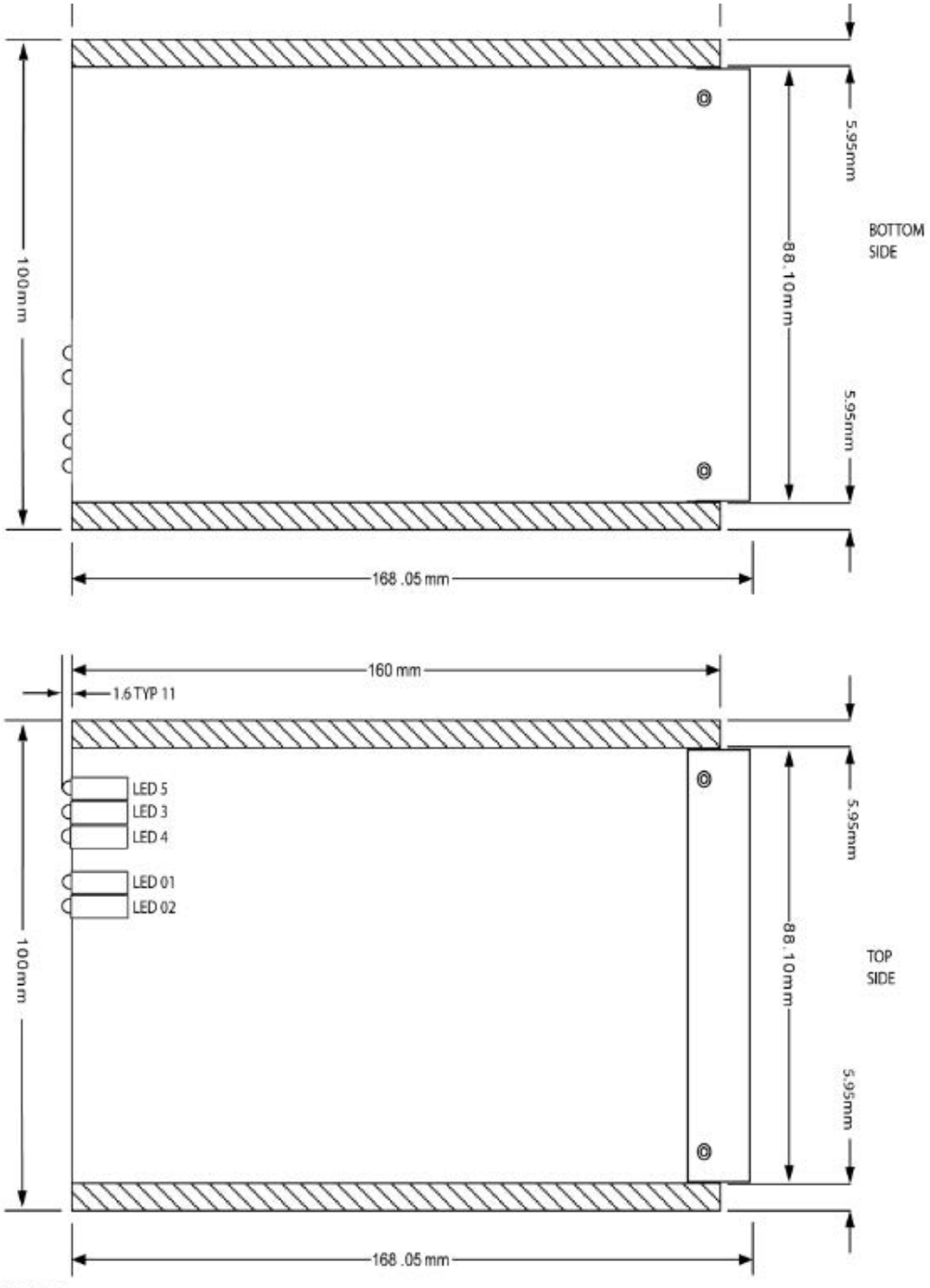


NOTES

1. NOMINAL PCB THICKNESS 1.6mm
2. MAXIMUM COMPONENT HEIGHT **12.4** ON TOP SIDE OF THE PCB
3. MAXIMUM COMPONENT HEIGHT **4mm** ON THE BOTTOM SIDE OF THE PCB
4. HATCHED AREAS TO BE FREE OF COMPONENTS – PROVISION FOR GUIDE RAILS
5. DIMENSION INCLUDES CLEARANCE FOR INTER-PCB RIBBON CABLE

9581 Eurocard Analogue Output - PCB Profiles

The Eurocard Analogue Output Module consists of one PCB with the following profile:



NOTES

1. HATCHED AREAS DENOTE COMPONENT KEEP OUT AREAS.
2. TOP SIDE COMPONENT HEIGHT RESTRICTED TO 12.4mm.
3. BOTTOM SIDE COMPONENT HEIGHT RESTRICTED TO 4.0mm.

Estimate AADvance Eurocard Controller Weight

Use this table to estimate the weight of a Eurocard controller.

Table 9 - Estimating Weight

Item	Number of Modules	Weight Allowance g (oz.)	Subtotal
9120 Eurocard Processor		× 266g (10 oz.)	=
9531 Eurocard Analogue input, 8 channel		× 133g (5 oz.)	=
9501 Eurocard Digital Input Module, 8 channel		x 133g (5oz.)	=
9582 Eurocard Analogue Output PCB, 2 channel		× 133g (5 oz.)	=
9551 Eurocard Digital Output Module, 24V dc, 8 channel		× 266g (10 oz.)	=
9842 Eurocard Termination Assemblies (average weight)		× 175g (6 oz.)	
		Total estimated controller weight	

AADvance Eurocard Controller Earth Grounding

All applications of an AADvance Eurocard controller require two separate ground (earth) systems:

- An AC safety ground (sometimes called the 'dirty ground') to protect people in the event of a fault.
- 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.

A single ground combining these functions can be used as long as there is only a single connection point from the systems is used. This single point connection is necessary to prevent ground loops from occurring.

The AC safety ground and the instrument ground will usually be made available through busbars. Busbars must 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 analogue input signals and communications signals, may need shielded (screened) cable. The shield ground may be separate or combined with either the AC safety or instrument ground or to the common point described above.

If the field signals require an intrinsic safety interface either galvanic isolated or shunt barrier types can be used.

If shunt type barriers are used it is typical to have a separate intrinsic safety ground as well. When intrinsic safety barriers are used the manufacturer's instructions must be used.

Unpack and Check the Equipment

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

- If any cartons are damaged, make a record of the damage on the carrier's shipping document before signing it. Save 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 to 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.

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 computer running the AADvance Workbench software and AADvance-Trusted SIS Workstation programming software will be needed for communicating with the system, downloading the application software and for monitoring system variables and application logic.

Required Tools (AADvance Eurocard Controller)

The installation and maintenance of the AADvance Eurocard Controller requires the following tools:

Standard Tools

1. Hypertrac crimp tool: Astro Tool 615717 8-step Crimp Tool (M22520/2-01) manufactured by the Astro Tool Corp. This tool also requires a Positioner inserted into the bayonet. Use the HPD309 Positioner manufactured by Hypertac.
2. Gaging the crimp tool requires M22520/3-01 Gage Pin Assembly Astro part no 615716.
3. Hypertac pin extractor: Astro Tool 2074, USA Gauge 58164 Removal Tool AT manufactured by the Astro Tool Corp.

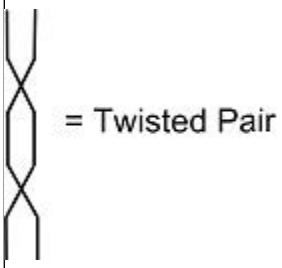
Wiring Loom Data for the AADvance Eurocard Controller

This chapter gives the wiring loom details required to build an AADvance Eurocard Controller.

AADvance Eurocard Controller Wiring Loom Requirements

The AADvance Eurocard Controller wiring loom is custom built to suit a controller module configuration; the pin connections and wiring loom details for each module are given in this chapter.

The Hypertac Connectors and wiring sizes required for the wiring loom are as follows:

Signal	Wire Requirements
System 24V supply and RTN connections	22AWG (7/0.25) cable
Inter-PCB wiring: • Processor commands signals • I/O response signals (twisted pair with a 0V) • 3V3 and 0V supply lines	26AWG(7/0.15) multi-core cable with twisted pairs. Illustrated in the wiring diagrams as follows: 
Ethernet wiring	CAT5 Cable
Serial Port wiring	26AWG (7/0.15) multi-core cable
Termination Assemblies PCB 1. Connector to the Input Termination Assembly from the field elements: 17-Way female Hypertac Connector HYPERTAC HPD017UFBNH 2. Connector to the Termination Assembly and the wiring loom: Termination Assembly connector: HYPERTAC HPD029UFBNH	Use special crimps for 22/24/26 AWG wire connections. Only one wire per crimp is recommended with heat shrink sleeves applied to the connection for strain relief - ensuring that the sleeves do not interfere with the proper connection between the wiring and the connector crimp barrel. (See details of the Crimping tool in the topic "Required Tools")
Field wiring direct to the PCB	22AWG (7/0.25) multi-core cable
Identity links	26AWG (7/0.15)
Processor and the I/O PCBs connectors from the Wiring Loom to the PCB: • Hypertac Connector HPP053UFBK0020	Use special crimps for 22/24/26 AWG wire connections. Only one wire per crimp is recommended with heat shrink sleeves applied to the connection for strain relief - ensuring that the sleeves do not interfere with the proper connection between the wiring and the connector crimp barrel.

9120 Eurocard Processor Pin Connections

Table 10 - Interface PCB

Description	Pin	Pin	Description
FLT_COM (Not available)*	2	1	FLT_NO (Not Available)*
Not Used	4	3	FLT_NC (Not Available)*
SRL2_BIAS_LO	6	5	SRL2_BIAS_HI
ENET1_TXP	8	7	ENET1_RXP
ENET1_TXM	10	9	ENET1_RXM
ENET1_COM	12	11	CHASSIS_GROUND
SRL1_BIAS_LO	14	13	SRL1_BIAS_HI
ENET2_TXP	16	15	ENET2_RXP
ENET2_TXM	18	17	ENET2_RXM
ENET2_COM	20	19	CHASSIS_GROUND
232 GND	22	21	CHASSIS_GROUND
232 RXB	24	23	232 TXB
SRL1_LINKB	26	25	SRL1_LINKA
SRL1_TRX_A	28	27	SRL1_TRX_B
SRL1_TX_A	30	29	SRL1_TX_B
SRL1_0V	32	31	SRL1_0V
SRL2_LINKA	34	33	SRL2_LINKB
SRL2_TRX_A	36	35	SRL2_TRX_B
SRL2_TX_A	38	37	SRL2_TX_B
SRL2_0V	40	39	SRL2_0V
SLOT_ID_0	42	41	0V
SLOT_ID_1	44	43	0V
SLOT_ID_2	46	45	0V
SYS_RTN	48	47	Not Used
Not Used	50	49	SYS_24V_1
SYS_24V_2	52	51	Not Used
		53	SYS_RTN

* signals no longer available because the fault relay is not fitted.

CPU PCB

Table 11 - CPU PCB Pin Connections

Description	Pin	Pin	Description
IPL_ENET2_TXM	2	1	IPL_ENET1_TXM
IPL_ENET2_TXP	4	3	IPL_ENET1_TXP
IPL_ENET2_RXP	6	5	IPL_ENET1_RXP

Description	Pin	Pin	Description
IPL_ENET2_RXM	8	7	IPL_ENET1_RXM
IPL_ENET2_COM	10	9	IPL_ENET1_COM
IOM_CMD -	12	11	IOM_CMD+
0V	14	13	0V
IOM_RSP_1	16	15	CHASSIS_GROUND
0V	18	17	IOM_RSP_2
IOM_RSP_3	20	19	0V
0V	22	21	IOM_RSP_4
IOM_RSP_5	24	23	0V
0V	26	25	IOM_RSP_6
IOM_RSP_7	28	27	0V
0V	30	29	IOM_RSP_8
IOM_RSP_9	32	31	0V
0V	34	33	IOM_RSP_10
IOM_RSP_11	36	35	0V
0V	38	37	IOM_RSP_12
IOM_RSP_13	40	39	0V
0V	42	41	IOM_RSP_14
IOM_RSP_15	44	43	0V
0V	46	45	IOM_RSP_16
IOM_RSP_17	48	47	0V
0V	50	49	IOM_RSP_18
EXT_3V_BAT_POS	52	51	0V
		53	BP_3V3

TIP For a backup voltage pin 52 - Ext_3V_BAT_pos is available to connect a backup voltage from a supply of your choice.

IOM_RSP Signal Wiring

The IOM_RSP signals are the response lines from each I/O module. The first response signal is from the first I/O module fitted and on each CPU PCB there is capacity for 18 response signals and therefore 18 I/O modules. You

should wire each response signal and 0V wire as a twisted pair from each I/O module to the each processors module as follows:

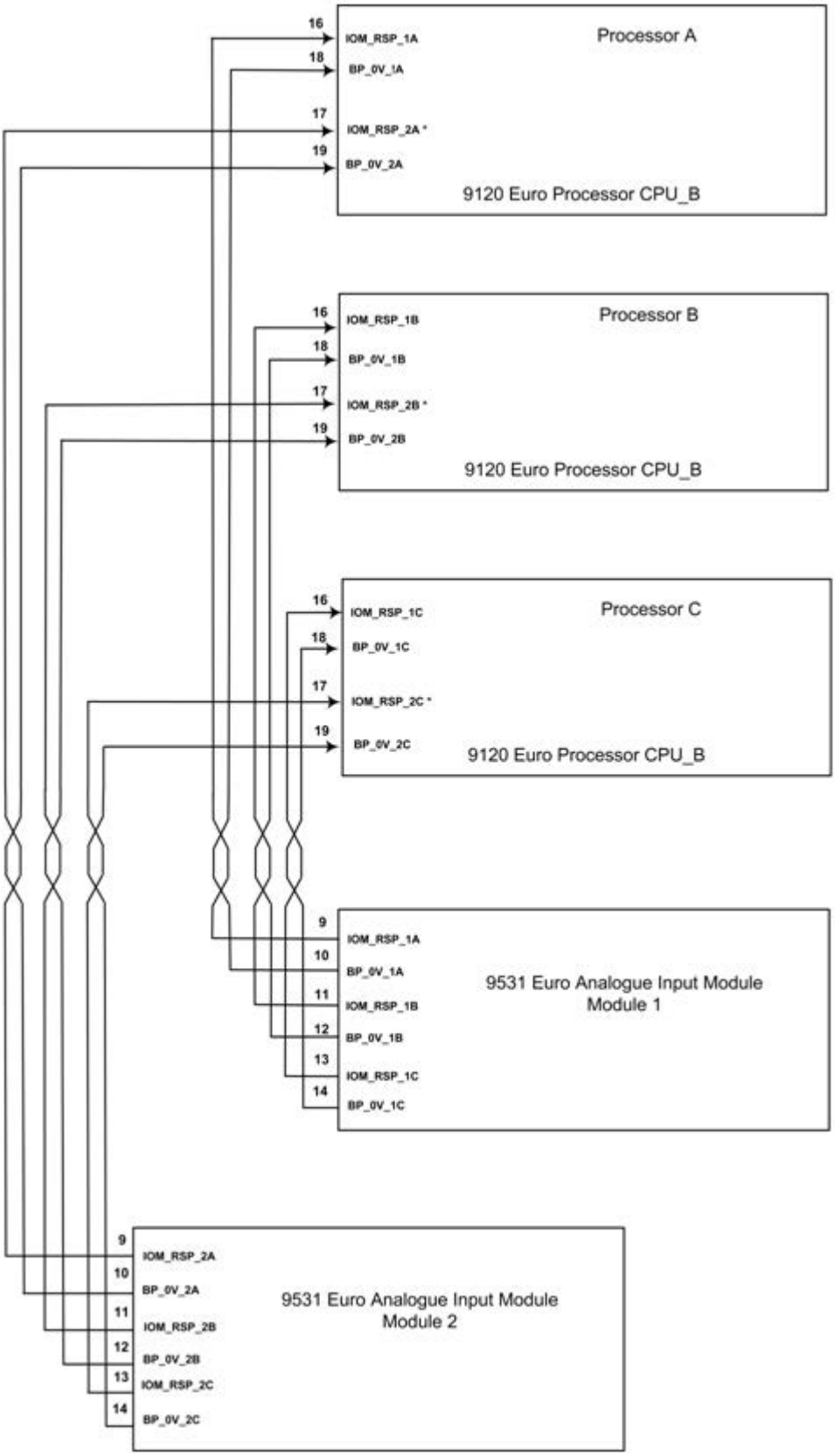
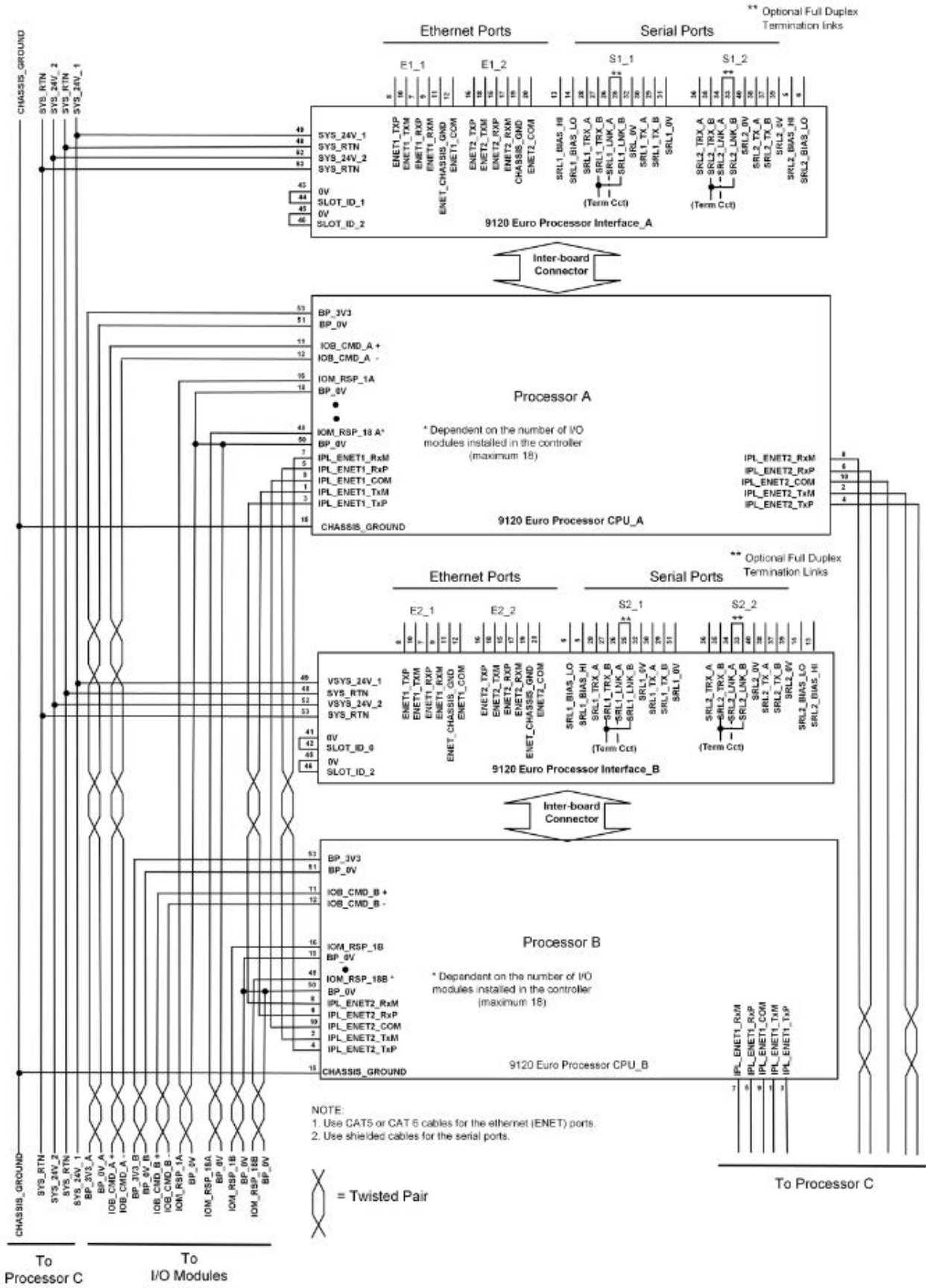
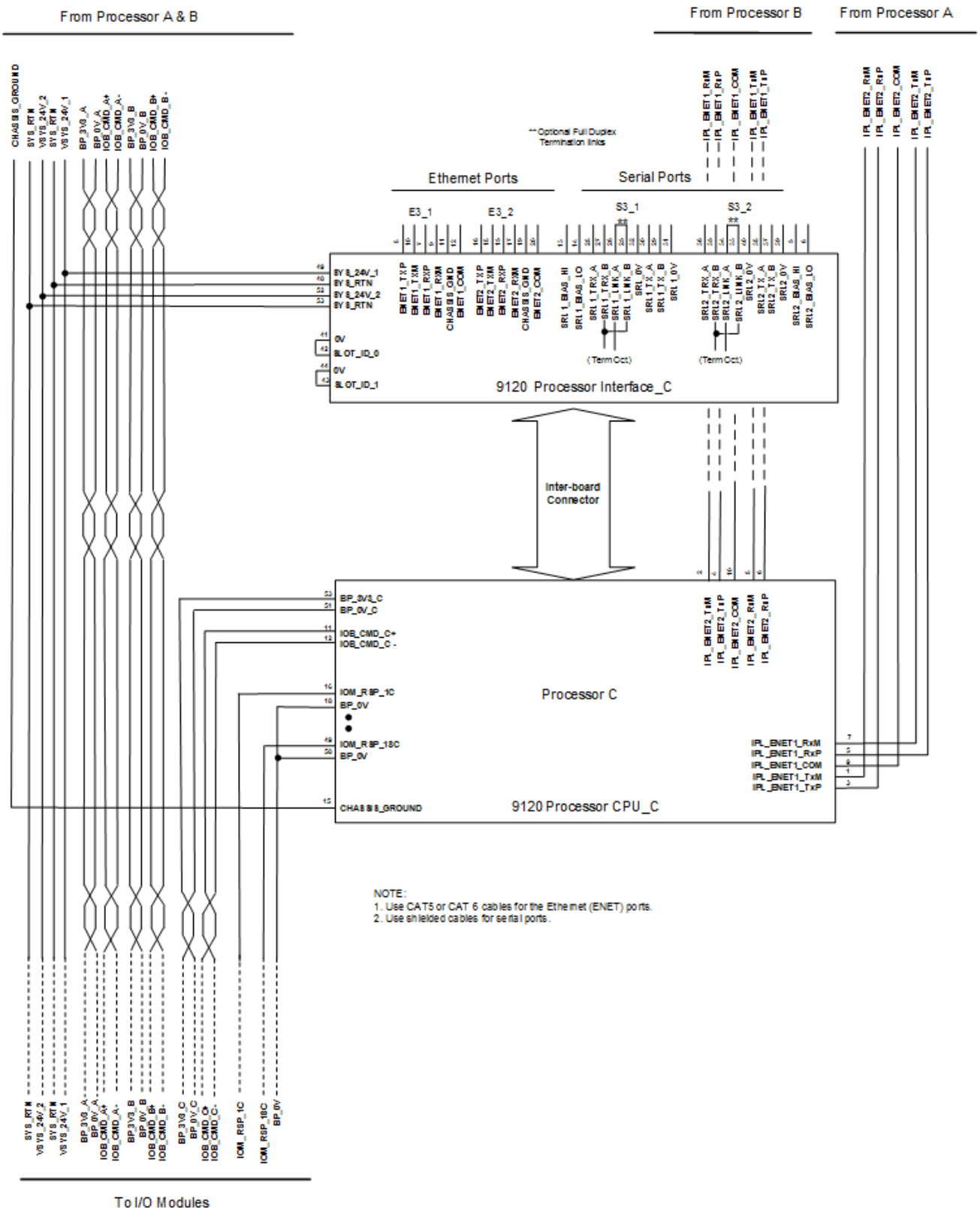


Figure 5 - Eurocard Processor Response Bus Pin Connections



Wiring Loom 9120 Eurocard Third Processor Configuration



Processor Serial Communication - Full and Half Duplex Connections

A single processor system has two serial ports, a dual processor system has four ports and a triple processor system has six ports for serial communications. You can connect the serial communications cabling to the connector ports S1-1 and S1-2 on the Processor Interface PCB.

- Make sure the length of the cable does not exceed 1,200m (3,900ft).

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	Isolated serial port 0V	Serial port 0V
TX_B	Transmit data B (non-inverting)	not used
TX_A	Transmit data A (inverting)	not used

Serial Link Termination

RS485 is a differential twisted pair interface. A key feature of RS485 over RS422 is its ability to support configurations where multiple line-drivers share a common twisted pair. In an AADvance module (standard or Eurocard) the TRX connections operate as either a Transmit or Receive end

To reduce the effect of reflections and signal noise you should terminate the serial links at the receive ends. However, if you are not at the end of the link then you do not need to terminate the connection. At the Eurocard module Serial ports you can use “one” of the two termination options - DC termination or AC termination. Both options are illustrated in the duplex diagrams.

The AC termination option is created by inserting a wire link across two pins. This will provide a termination of 120R and 100n 50V across the receive input.

For the DC termination option, you can use the Bias voltages available on the serial port pins. The bias voltages decrease the standard bias impedance and therefore increase the drive capability of the RS485 Serial port. The DC Bias circuit creates an effective termination resistance of 120R.

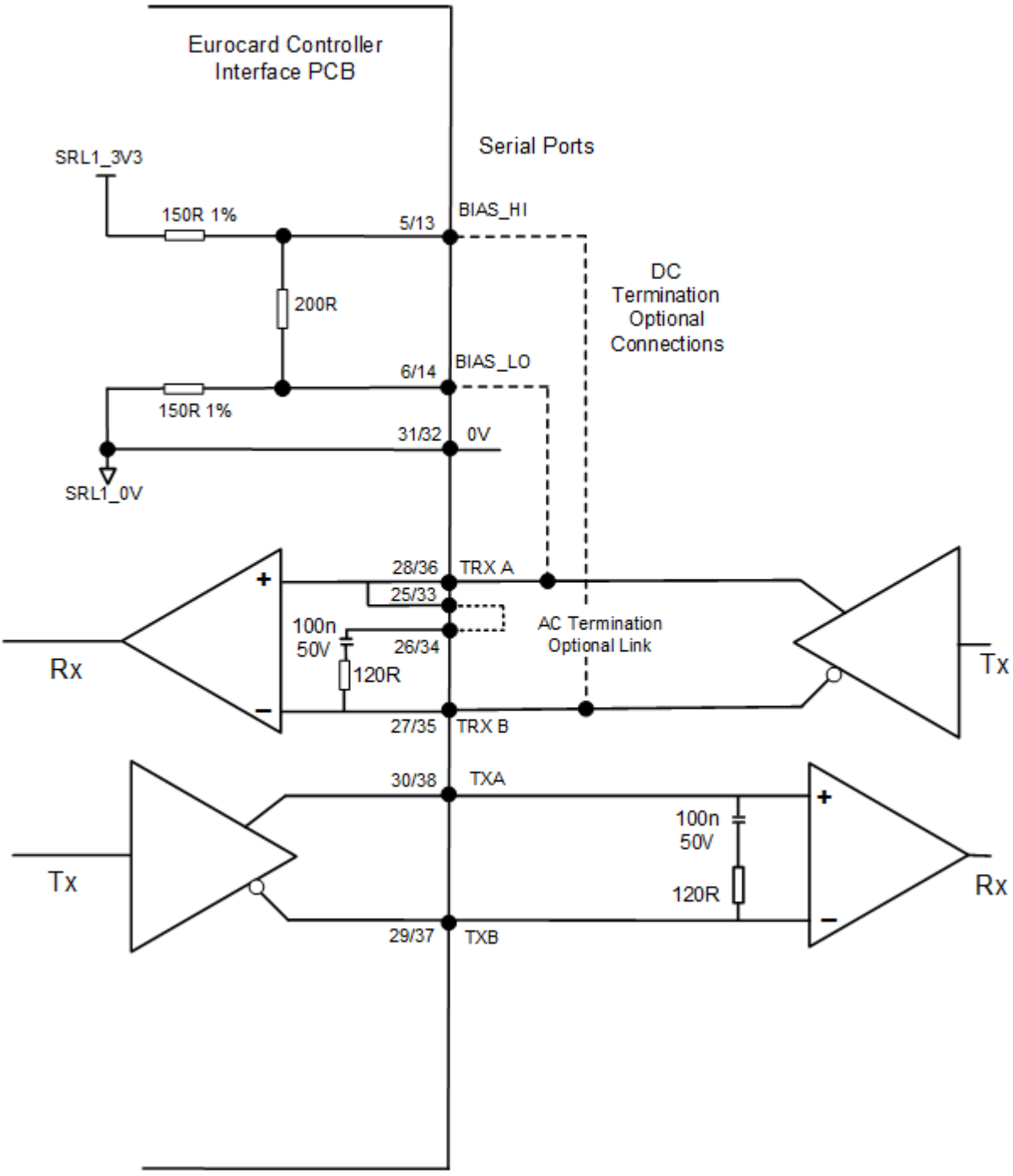
Bias Voltages

- SRL_BIAS_HI = 2310mV ± 10% w.r.t SRL_0V
- SRL_BIAS_LO = 990mV ± 10% w.r.t SRL_0V

RS485 Serial Port - Single Full Duplex

A single Full Duplex arrangement is a 4-wire point to point connection. In this configuration the TX connections are transmit outputs while the TRX connections also operate as the Rx connections (and will only operate as RX connections in a full duplex configuration). You should terminate the receive end using one of the two options.

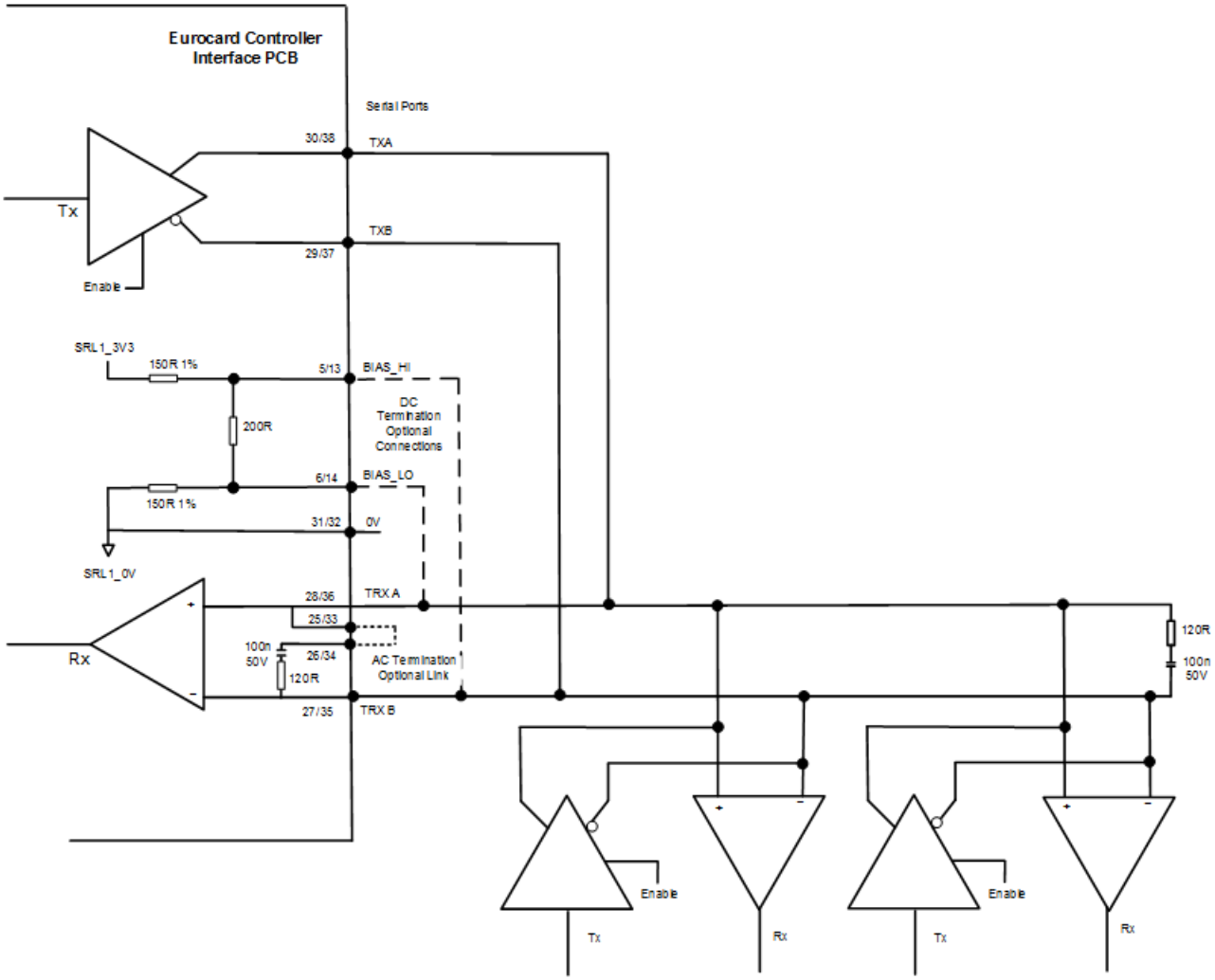
Figure 6 - Single Full Duplex Serial Link Optional Termination



RS485 Half Duplex

This is a 2 wire point to point connection with multiple transmitters on the same circuit, it is recommended that there should be terminations at both RX ends. In this configuration the Eurocard TRX connections operate as Tx and Rx ends and are switched internally.

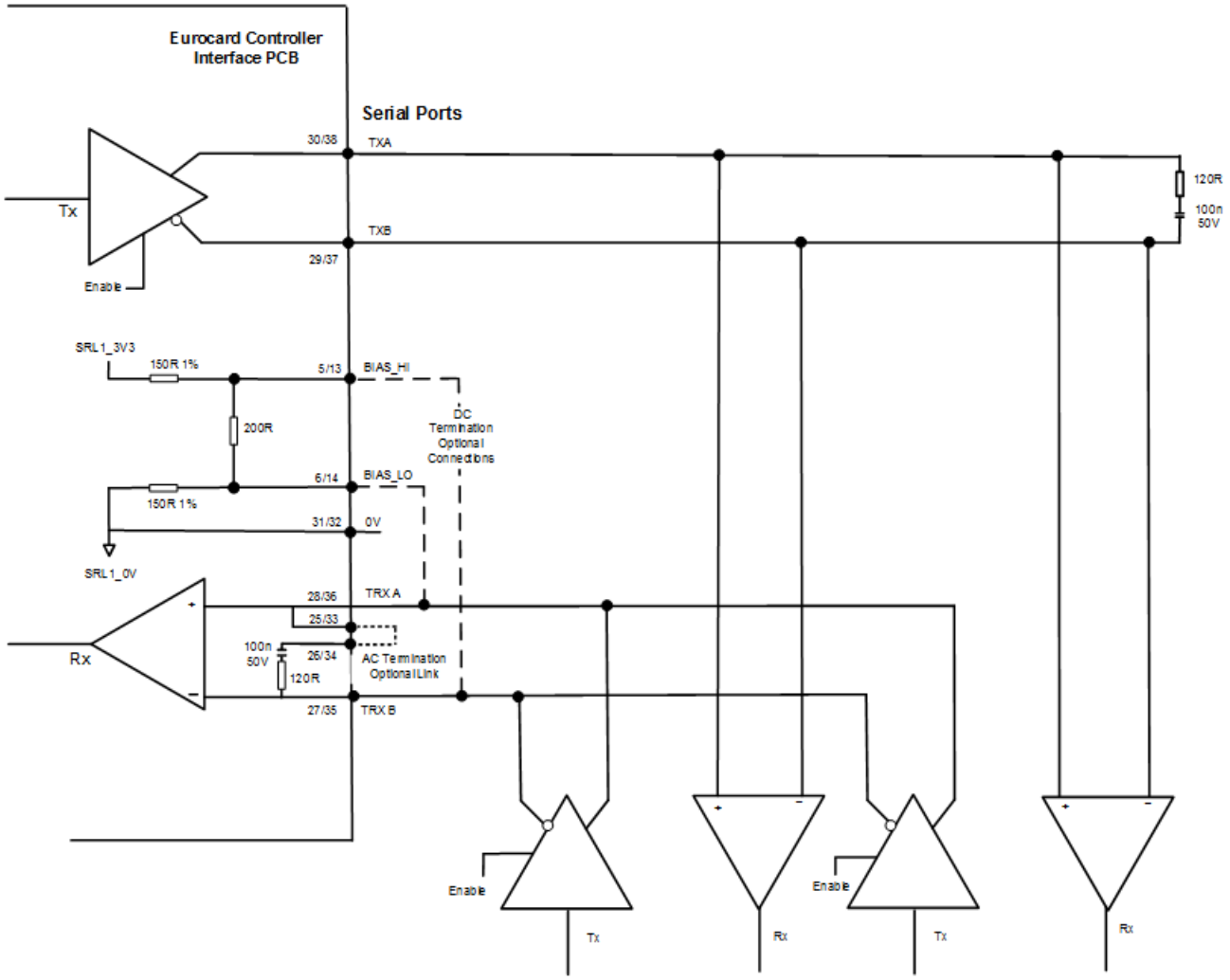
Figure 7 - Half Duplex Serial Link Optional Termination



RS485 Full Duplex Multiplexed

This is a 4-wire multi-drop connection. Circuits with multiple transmitters should be terminated at the RX end within the Eurocard module by inserting the optional link or using the bias connections. On circuits with one transmitter the line should be terminated at the far end (usually the last receiver in the chain).

Figure 8 - Full Duplex Multiplexed



9501/9531 Eurocard Digital/Analogue Input Module Pin Connections

Description	Pin	Pin	Description
IOB_CMD_B+	2	1	IOB_CMD_A+
IOB_CMD_B–	4	3	IOB_CMD_A–
IOB_CMD_C+	6	5	BP_0V
IOB_CMD_C–	8	7	BP_0V
BP_3V3_A	10	9	IOM_RSP_A
BP_3V3_B	12	11	IOM_RSP_B
BP_3V3_C	14	13	IOM_RSP_C
BP_0V	16	15	BASE UNIT_ID0
BP_0V	18	17	BASE UNIT_ID1
BP_0V	20	19	BASE UNIT_ID2
BP_0V	22	21	BASE UNIT_ID3

Description	Pin	Pin	Description
AIN_F_1	24	23	AIN_F_2
AIN_0V_1	26	25	AIN_0V_2
HART_IO_1	28	27	HART_IO_2
AIN_F_3	30	29	AIN_F_4
AIN_0V_3	32	31	AIN_0V_4
HART_IO_3	34	33	HART_IO_4
AIN_0V_5	36	35	AIN_F_6
AIN_0V_5	38	37	AIN_0V_6
HART_IO_5	40	39	HART_IO_6
AIN_F_7	42	41	AIN_F_8
AIN_0V_7	44	43	AIN_0V_8
HART_IO_7	46	45	HART_IO_8
SYS_RTN	48	47	Not Used
Not Used	50	49	SYS_24v_1
SYS_24V_2	52	51	Not Used
		53	SYS_RTN

The 9501/9531 Digital/Analogue Input Module can be used as a single or dual input configuration.

In the illustration below all three response signals IOM_RSP_A, B, C are shown as being wired. These will go to each of the three processor modules A, B and C when three processors are fitted.

Figure 9 - 9501 Digital Input Module - Simplex

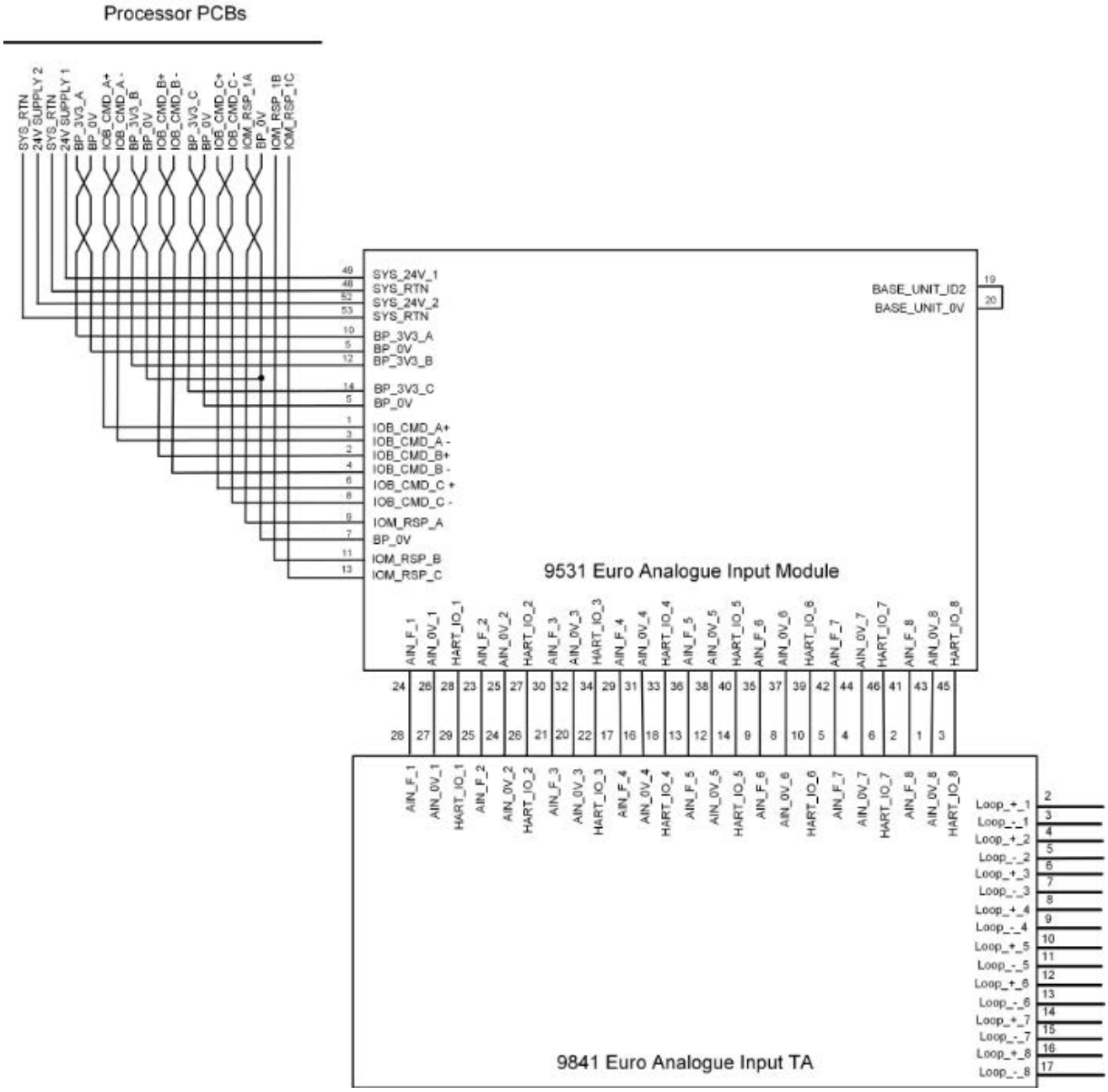
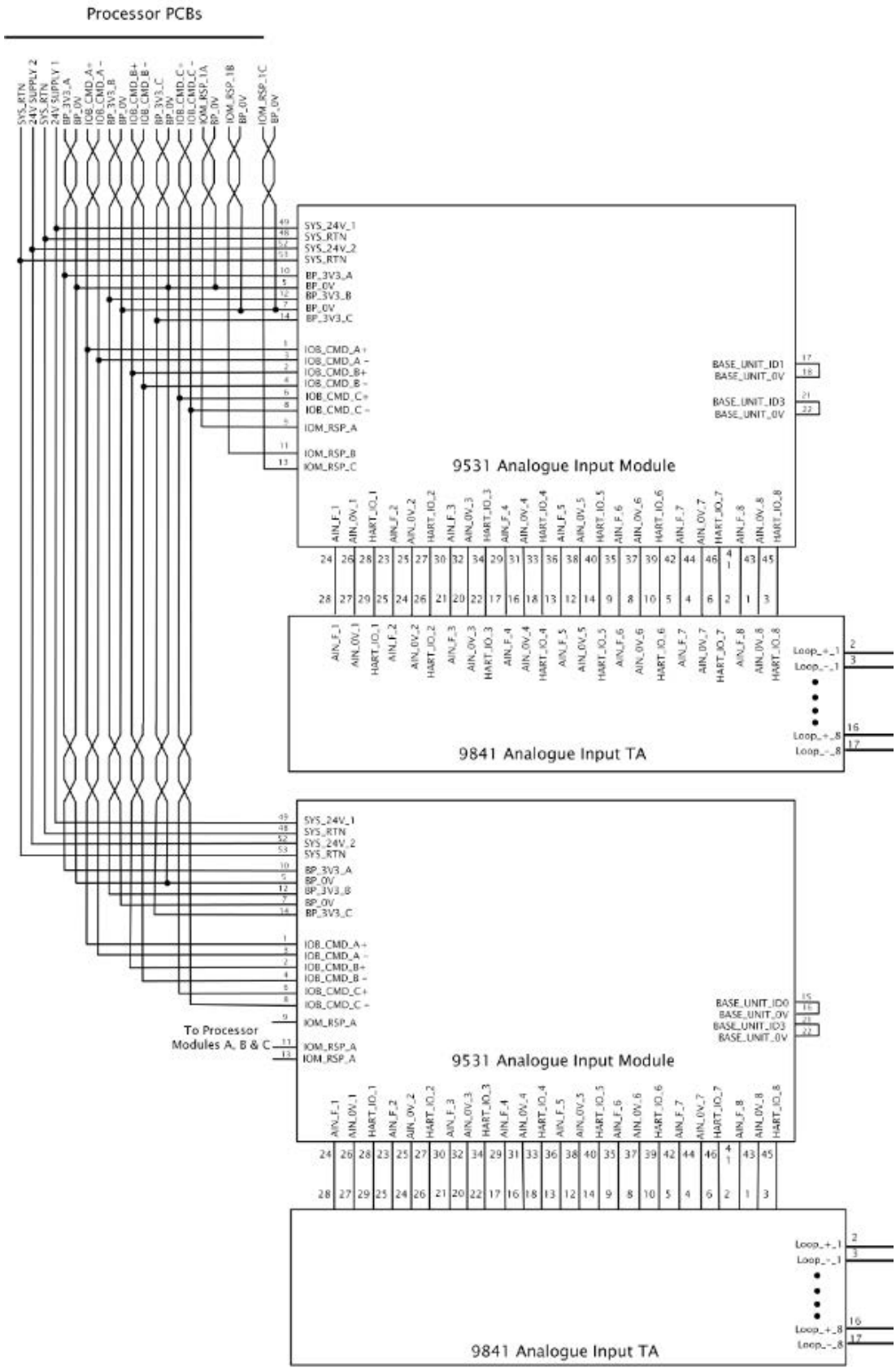


Figure 10 - 9531 Analogue Input Module - Dual



9842 Eurocard Analogue Input TA Pin Connections

Connector J1 Pin Connections (Field Connector)

Connector Type: Hypertac HPD017UMBNH020

Pin	Description
1	
2	Loop + 1
3	Loop – 1
4	Loop + 2
5	Loop – 2
6	Loop + 3
7	Loop – 3
8	Loop + 4
9	Loop – 4
10	Loop + 5
11	Loop – 5
12	Loop + 6
13	Loop – 6
14	Loop + 7
15	Loop – 7
16	Loop + 8
17	Loop – 8

Connector J2

Connector Type: Hypertac HPD029UMBNH020

Pin	Description	Pin	Description
1	AIN 0V 8	2	AIN F1 8
3	HART IO 8	4	AIN 0V 7
5	AIN F1 7	6	HART IO 7
7	Not Used	8	AIN 0V 6
9	AIN F1 6	10	HART IO 6
11	Not Used	12	AIN 0V 5
13	AIN F 5	14	HART IO 5
15	Not used	16	AIN 0V 4
17	AIN F 4	18	HART IO 4
19	Not Used	20	AIN 0V 3
21	AIN F 3	22	HART IO 3
23	Not Used	24	AIN 0V 2

Pin	Description	Pin	Description
25	AIN F 2	26	HART IO 2
27	AIN 0V 1	28	AIN F 1
29	HART IO 1		

9551 Eurocard Digital Output Module Pin Connections

Controller PCB

Description	Pin	Pin	Description
IOB_CMD_B+	2	1	IOB_CMD_A+
IOB_CMD_B–	4	3	IOB_CMD_A–
IOB_CMD_C+	6	5	BP_0V
IOB_CMD_C–	8	7	BP_0V
BP_3V3_A	10	9	IOM_RSP_A
BP_3V3_B	12	11	IOM_RSP_B
BP_3V3_C	14	13	IOM_RSP_C
BP_0V	16	15	BASE UNIT_ID0
BP_0V	18	17	BASE UNIT_ID1
BP_0V	20	19	BASE UNIT_ID2
BP_0V	22	21	BASE UNIT_ID3
BP_0V	24	23	BASE UNIT_ID4
BP_0V	26	25	BASE UNIT_ID5
BP_0V	28	27	BASE UNIT_ID6
BP_0V	30	29	BASE UNIT_ID7
Not Used	32	31	0V
Not Used	34	33	0V
Not Used	36	35	0V
Not Used	38	37	Not Used
Not Used	40	39	Not Used
Not Used	42	41	Not Used
Not Used	44	43	Not Used
Not Used	46	45	Not Used
SYS_24V_0V	48	47	Not Used
Not Used	50	49	SYS_24V1
SYS_24V2	52	51	Not Used
		53	SYS_24V_0V

Transistor PCB

Description	Pin	Pin	Description
Not Used	2	1	Not Used
Not Used	4	3	Not Used
Not Used	6	5	Not Used
Not Used	8	7	Not Used
Not Used	10	9	Not Used
Not Used	12	11	Not Used
Not Used	14	13	Not Used
VF_RTN	16	15	VF_RTN
VFIELD_2	18	17	VFIELD_2
VFIELD_2	20	19	VFIELD_2
VFIELD_2	22	21	VFIELD_2
VFIELD_1	24	23	VF_RTN
VFIELD_1	26	25	VFIELD_1
VFIELD_1	28	27	VFIELD_1
VF_RTN	30	29	VFIELD_1
LOAD1	32	31	LOAD1
LOAD2	34	33	LOAD2
LOAD3	36	35	LOAD3
LOAD4	38	37	LOAD4
LOAD5	40	39	LOAD5
LOAD6	42	41	LOAD6
LOAD7	44	43	LOAD7
LOAD8	46	45	LOAD8
Not Used	48	47	VF_RTN
Not Used	50	49	Not Used
Not Used	52	51	Not Used
		53	Not Used

The 9551 Eurocard Digital Output module can be used as a single or dual digital output configuration.

Figure 11 - 9551 Eurocard Digital Output Module - Single

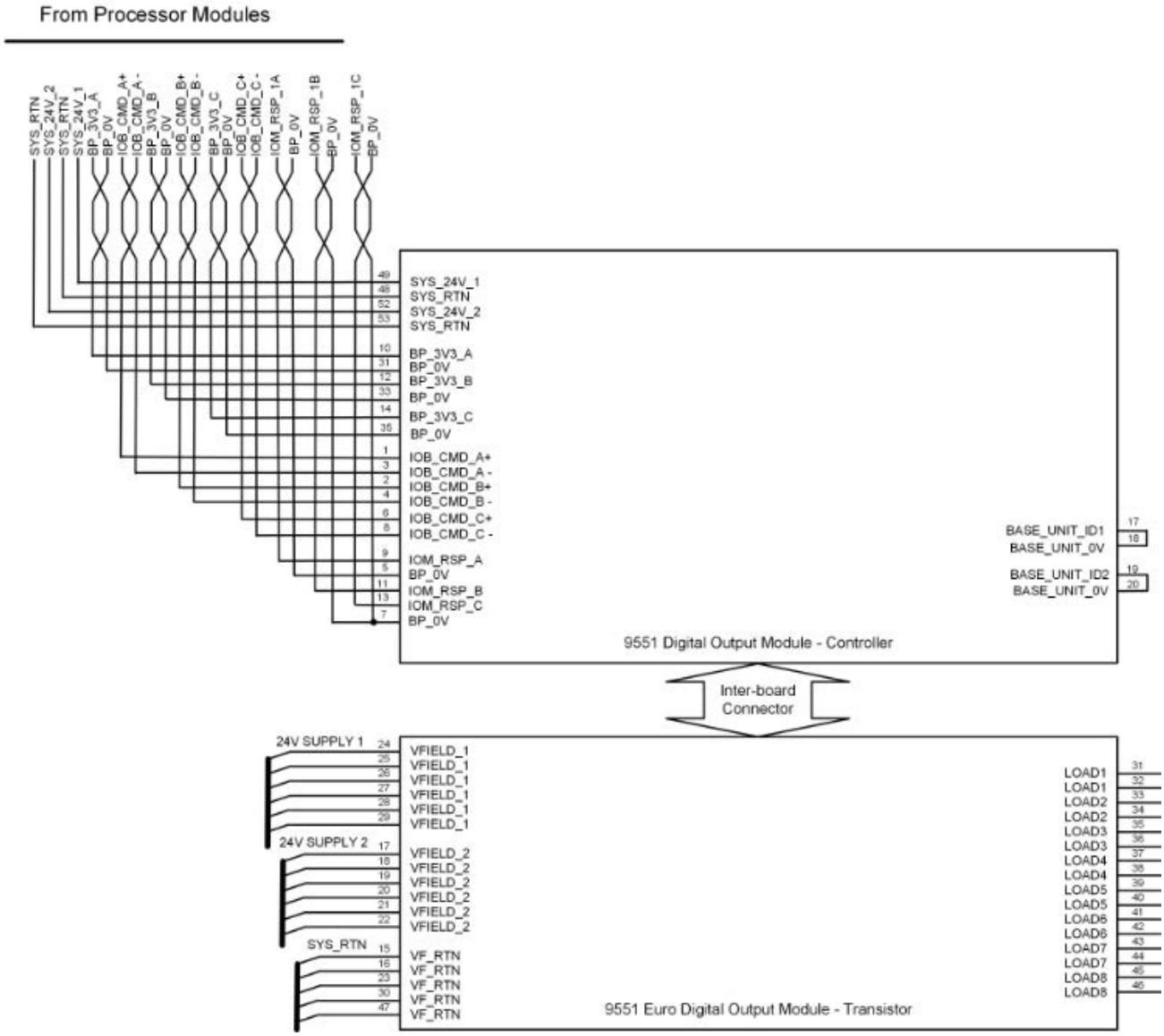
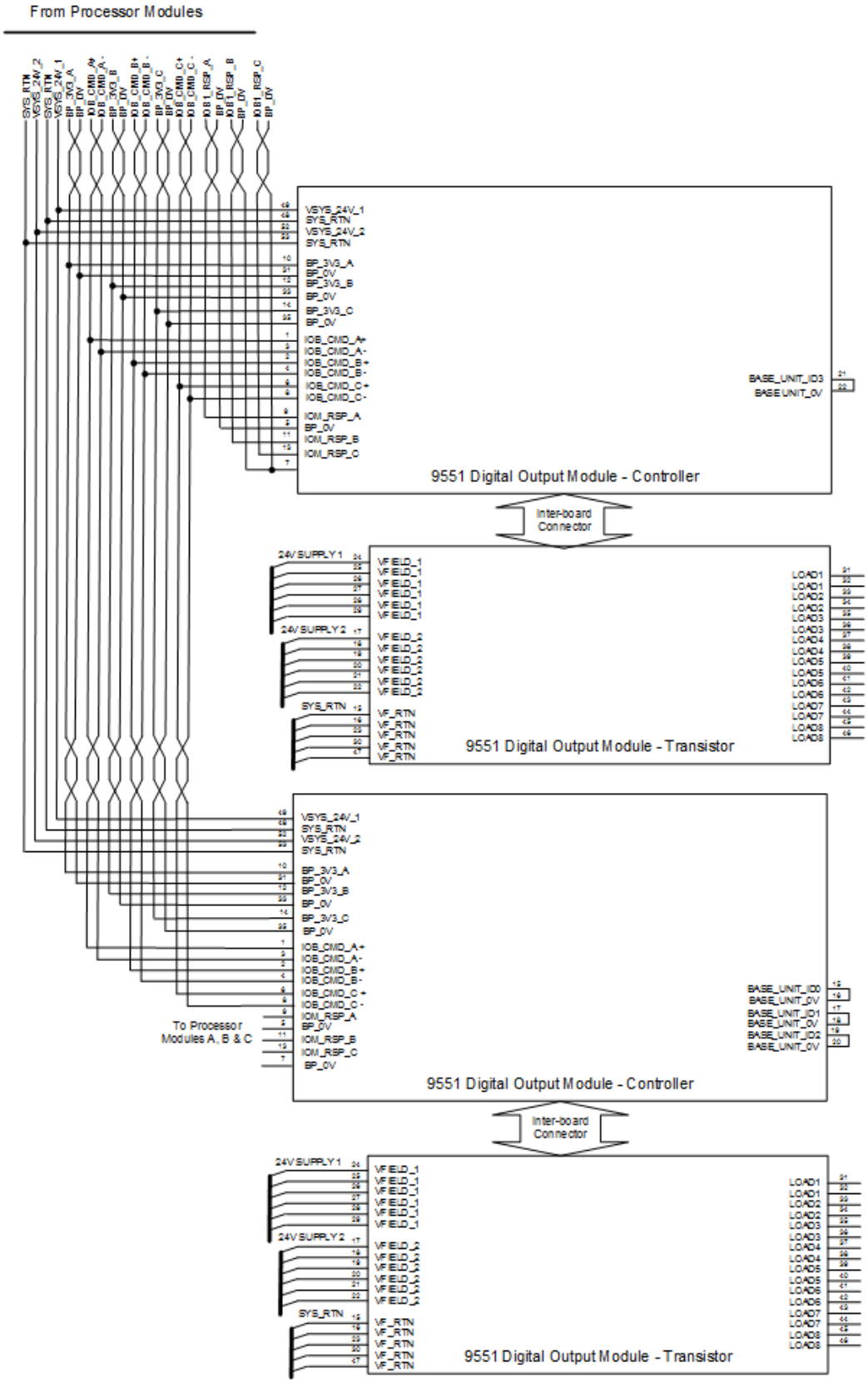


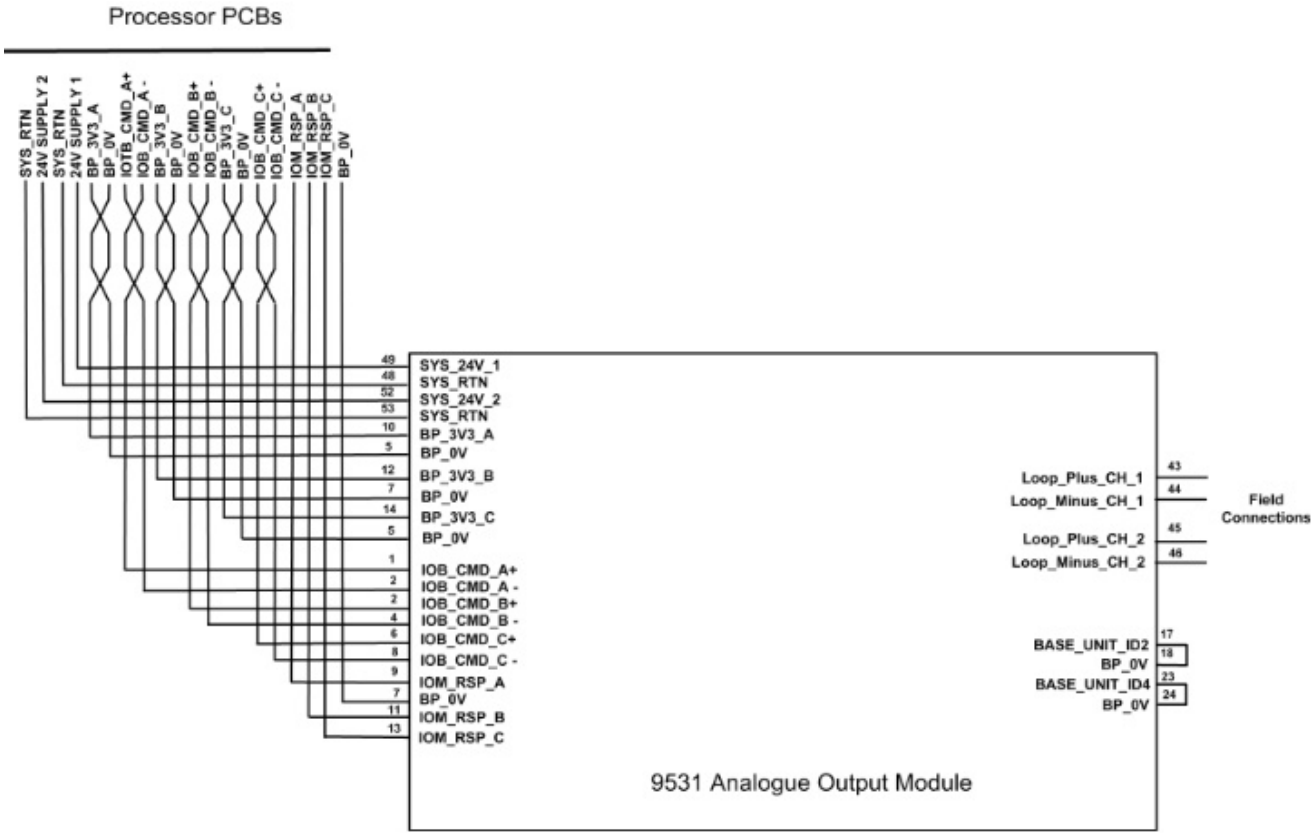
Figure 12 - 9551 Eurocard Digital Output Module - Dual



9581 Eurocard Analogue Output Pin Connections

Description	Pin	Pin	Description
IOB_CMD_B+	2	1	IOB_CMD_A+
IOB_CMD_B –	4	3	IOB_CMD_A–
IOB_CMD_C+	6	5	0V
IOB_CMD_C –	8	7	0V
BP_3V3_A	10	9	IOM_RSP_A
BP_3V3_B	12	11	IOM_RSP_B
BP_3V3_C	14	13	IOM_RSP_C
BP_0V	16	15	BASE_UNIT_ID0
BP_0V	18	17	BASE_UNIT_ID1
BP_0V	20	19	BASE_UNIT_ID2
BP_0V	22	21	BASE_UNIT_ID3
0V	24	23	BASE_UNIT_ID4
ISL_RSP	26	25	ISL_CMD
PART_AOM_RDY_CH_1	28	27	AOM_RDY_CH_1
IMON_IN_2_CH_1	30	29	IMON_IN___CH_1
IMON_OUT_2_CH_1	32	31	IMON_OUT_1_CH_1
AOM_RDY_CH2	34	33	COMMON_CH_1
IMON_IN_1_CH2	36	35	PART_AOM_RDY_CH_2
IMON_OUT_1_CH2	38	37	IMON_IN_12_CH_2
COMMON_CH_2	40	39	IMON_OUT_2CH_2
(not used)	42	41	(not used)
LOOP_MINUS_CH_1	44	43	LOOP_PLUS_CH_1
LOOP_MINUS_CH_2	46	45	LOOP_PLUS_CH_2
SYS_24v_0V	48	47	(not used)
(not used)	50	49	SYS_24V_1
SYS_24V_2	52	51	(not used)
		53	SYS_24V_0V

Figure 13 - 9581 Analogue Output Module - Single



Eurocard Module Polarization and Identity Links

Eurocard PCBs male hypertac connectors mate with the female Hypertac connectors on a wiring loom. The Hypertac connectors used are as follows:

Module Connectors

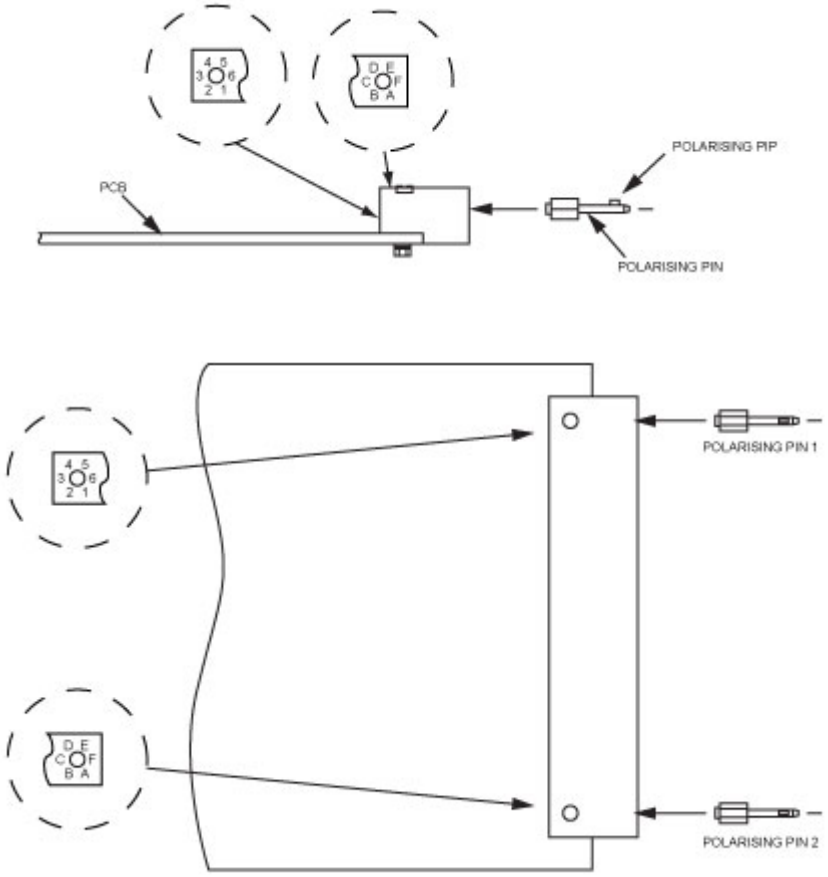
- Eurocard PCB 53-way connector: HPP053UMBKO020 (Wiring loom connector HPP053UFBKO020)

Input Module Termination Assembly Hypertac Connectors:

- 17-way male connector for the field element wiring: HPD017UMBNH (Wiring loom connector HPD17UFBNH)
- 29-way male connector for the wiring loom connection to the Input PCB: HPD029UMBNH (Wiring loom connector HPD029UFBNH)

The wiring loom connectors must have polarization keying set to match the polarization on the Eurocard PCB connectors. Each Eurocard PCB connector has polarizing positions printed on the PCB side of the connector; one polarizing pip will align with a number and the other with a letter.

Figure 14 - Eurocard Module Polarization and Identity Linking



Polarization Keys for Eurocard Modules

The polarization keys are as follows:

Module	Key
Eurocard Processor Module	
CPU PCB	B3
Interface PCB	B4
Eurocard Digital Input Module	F2
Eurocard Analogue Input module	F3
Eurocard Analogue Input TA	Not Applicable
Eurocard Analogue Output Module	F4
Eurocard Digital Output Module	
Controller PCB	F5
Transistor PCB	F6

Base Unit Address - PCB Identity Links

The following pins on the wiring loom Hypertac female connector should be linked to provide the Base_ID for the modules.

Module	Connector linked Pins
9120 Eurocard Processor Module	
Processor A	43 & 44; 45 & 46
Processor B	41 & 42; 45 & 46
Processor C	41 & 42; 43 & 44
9501 Eurocard Digital Input Module	
Simplex	15 & 16; 19 & 20
Dual	
1st Module	19 & 20; 21 & 22
2nd module	15 & 16; 17 & 18; 21 & 22
9531 Eurocard Analogue Input Module	
Simplex	19 & 20
Dual	
1st Module	17 & 18; 21 & 22
2nd module	15 & 16; 21 & 22
9551 Eurocard Digital Output Module	
Simplex	17 & 18; 19 & 20
Dual	
1st Module	21 & 22
2nd Module	15 & 16; 17 & 18; 19 & 20
9581 Eurocard Analogue Output Module	
Simplex	17 & 18; 23 & 24
Dual	
1st Module	15 & 16; 23 & 24
2nd Module	23 & 24

About AADvance Eurocard Controller Field Loop Wiring

The AADvance range of modules including the Eurocard input/output modules are designed to monitor field loops for alarm and field cable fault states. In this section recommended field loop wiring is presented.

Eurocard Analogue Input Module Field Loops

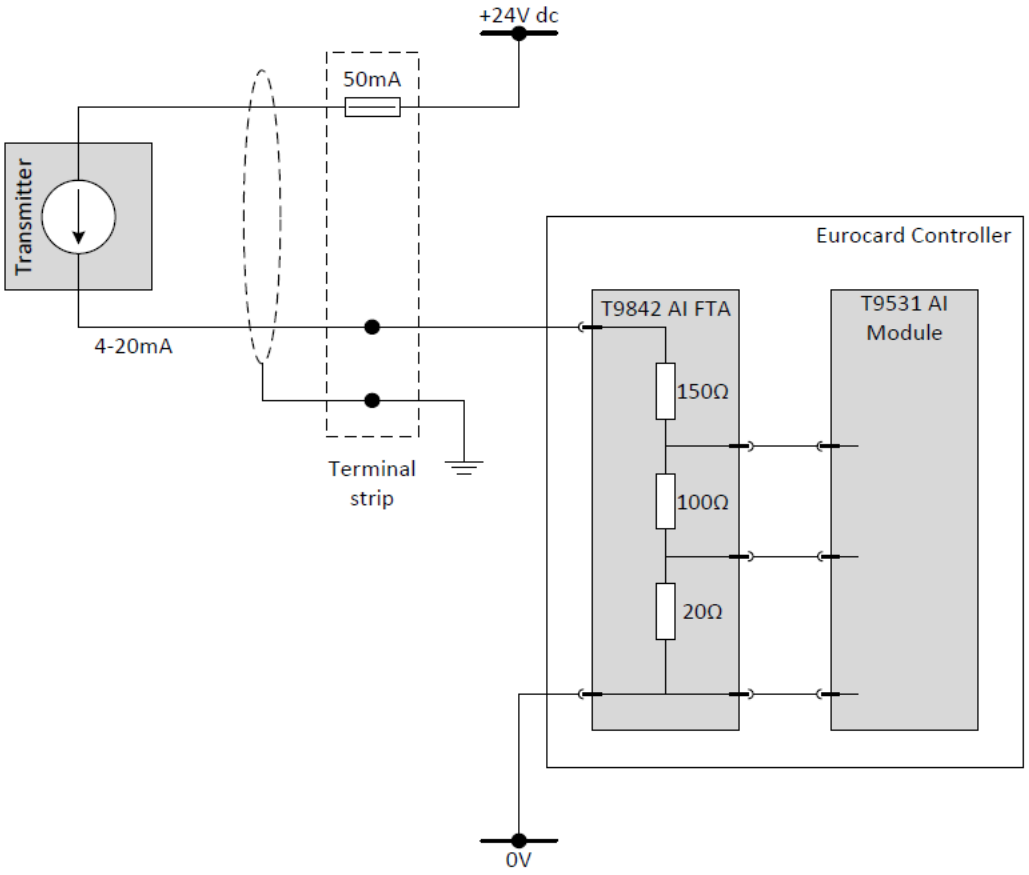
For analogue input field loops use 22 AWG multi core cabling and connect to the termination assembly connector. For a SELV system power environment The 24 Vdc input voltage must be fused and the recommended fuse rating is 50 mA.

2- Wire Analogue Input Field Loop Circuit

This field loop connection method is used for 2-wire field devices.

IMPORTANT The 150 Ω * is resistor is rated to tolerate sustained operation and limits the maximum current through the circuit when the transmitter loop is short circuited.

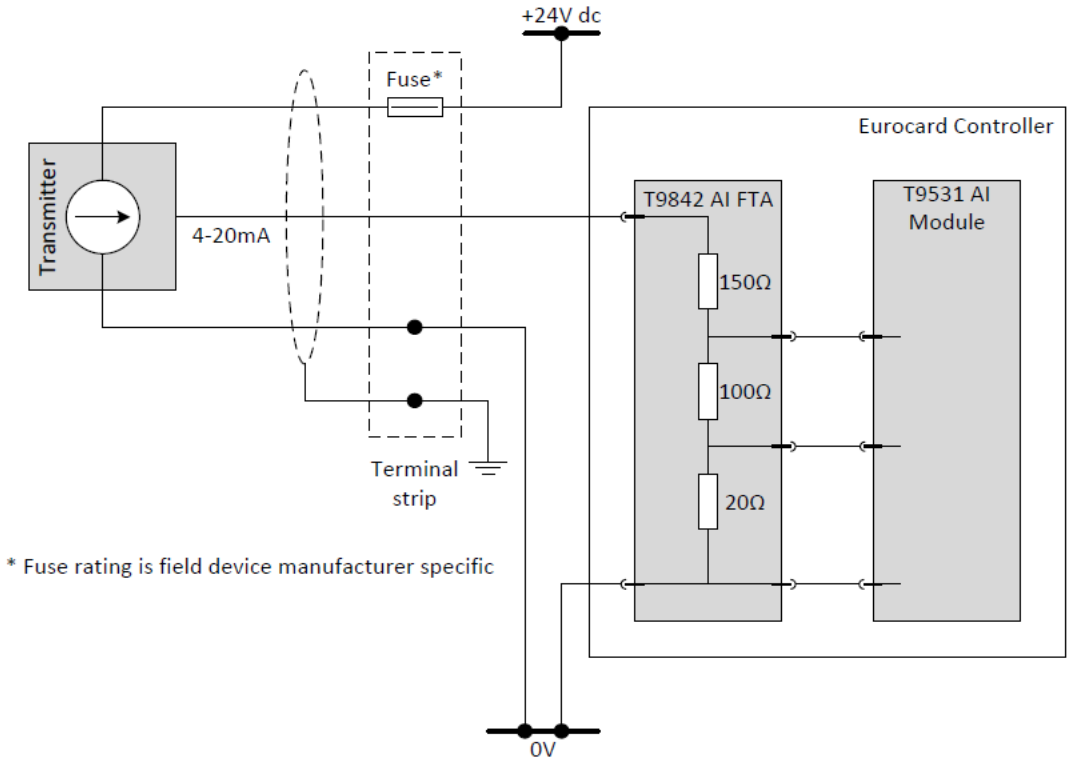
Figure 15 - Analogue Input 2-Wire Field Element Wiring



3-Wire Analogue Input Field Circuit

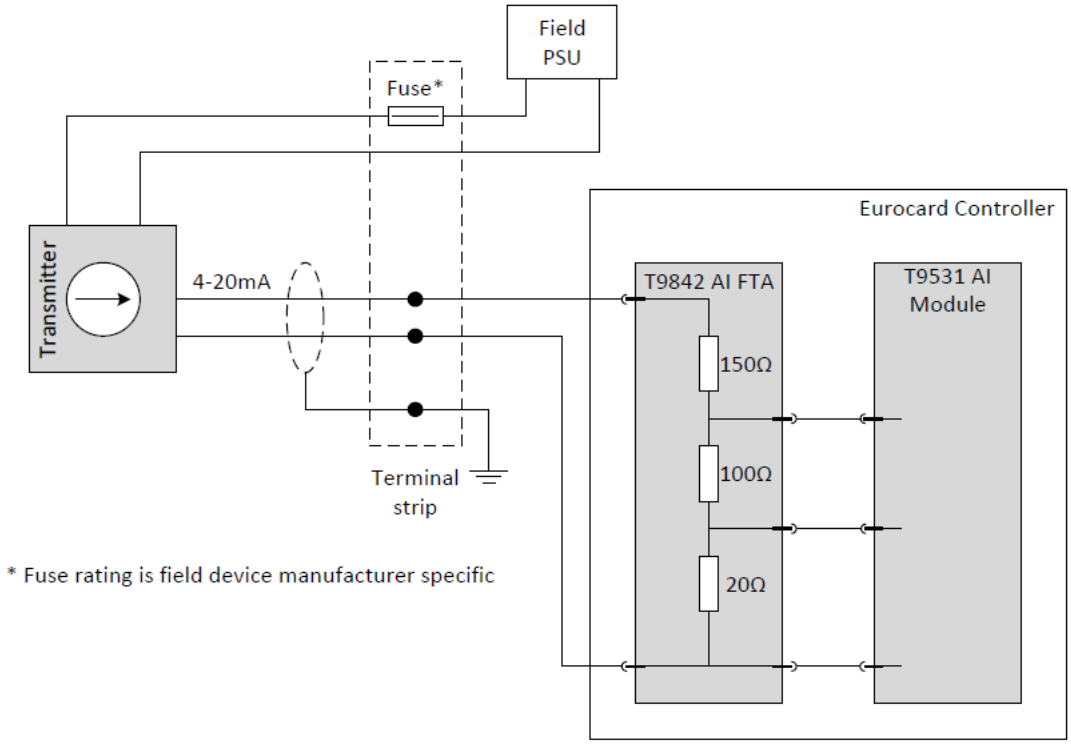
This field loop connection method is used for 3-wire analogue field devices.

Figure 16 - Analogue Input 3-wire Field Element Wiring



4-Wire Analogue Input Field Loop Circuit

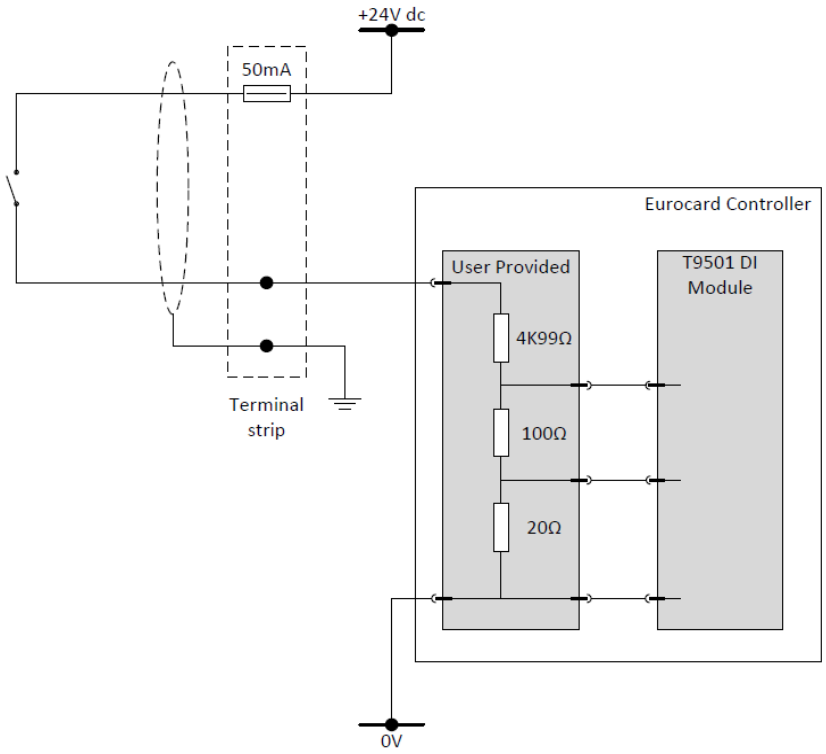
This field loop circuit is method is used for 4-wire analogue field devices.



Eurocard Digital Input Field Loops

You can set up the field loops for digital input with or without line monitoring.

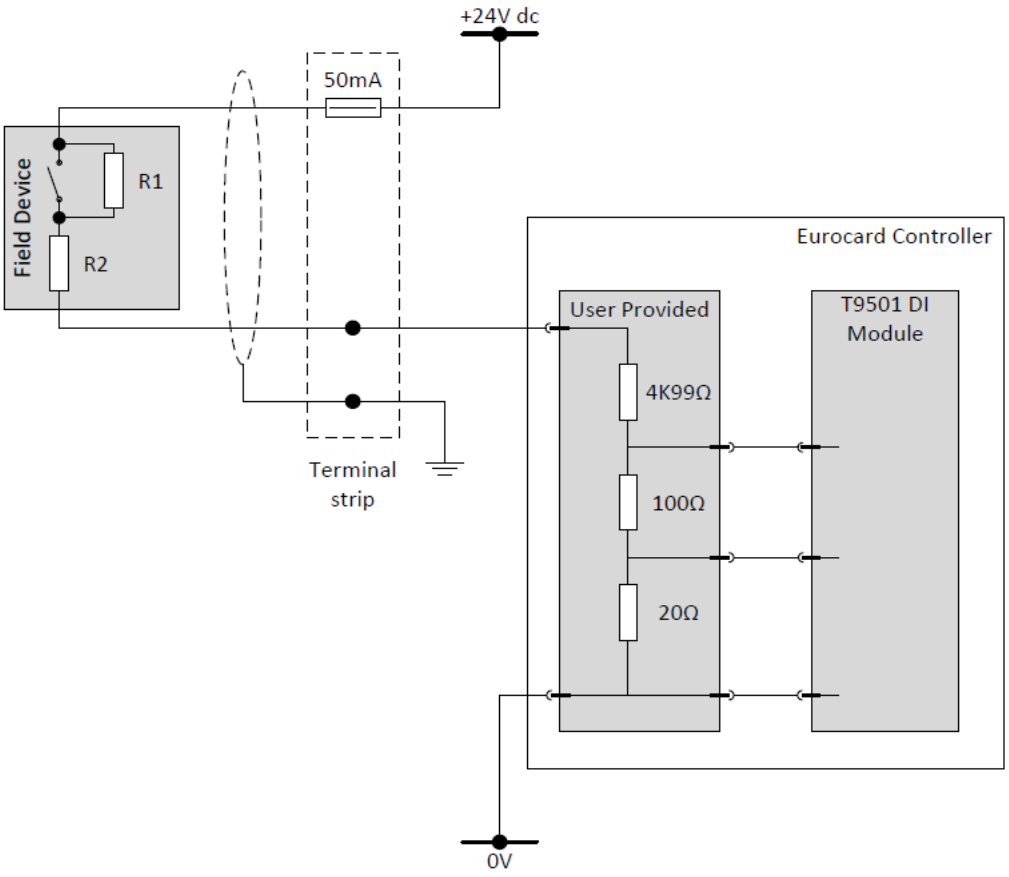
Standard Field Loop



User-Provided Termination Resistor Specification		
Resistance	**Tolerance**	**Power**
4K99Ω	5%	1W
100Ω	0.1%	1W
20Ω	0.1%	1W

Line Monitoring Field Loop for ESD

Figure 17 - Line Monitoring for ESD



The recommended values for R1 and R2 are as follows:

- R1 = 15 KΩ 1 %, 1 W (maximum power dissipated is 47 mW at 26.4 V)
- R2 = 3K9Ω 1%, 1 W (maximum power dissipated is 182 mW at 26.4 V)

Recommended threshold values for ESD line monitoring:

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

Threshold ID		Value mV
Threshold 2	=	3500
Threshold 1	=	3000
		OPEN CIRCUIT

Assumptions

- Loop supply voltage = 24V ± 10%
- Maximum field cable line resistance: < 100 Ω this means 50Ω + 50 Ω for the two cables.
- Minimum isolation between the field loop connectors is 0.75 MΩ.
- These values will let the input find more accurately different voltage levels that represent OPEN CIRCUIT - OFF - ON - SHORT CIRCUIT and will also identify Over Voltage and input which is not ON or OFF. The values make sure that a line fault will be declared before it becomes possible for a false declaration of ON and OFF states because of a combination of resistor value drift and loop voltage variation.

Eurocard Analogue Output Module Field Loops

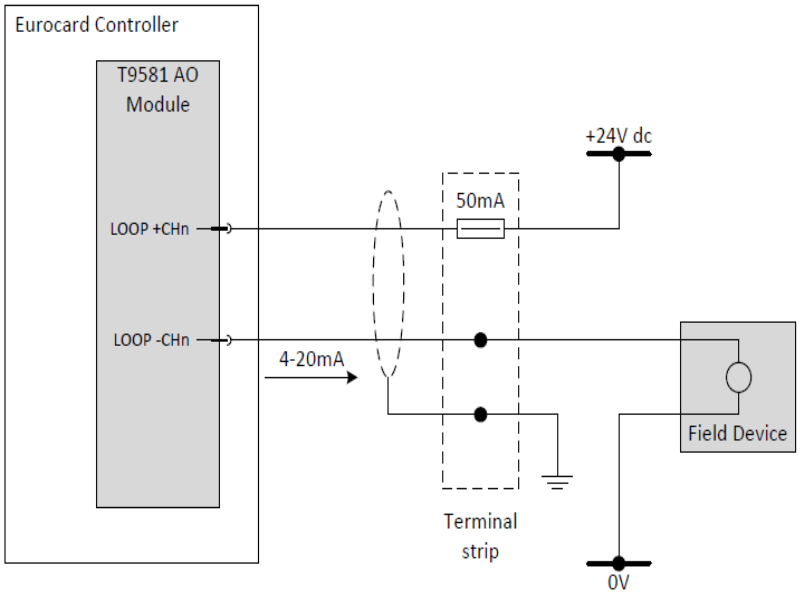
The analogue output module is a current regulator and the current to flow is into the loop plus terminal and out of the loop minus terminal. Connect the field wiring to the hypertac connectors using 22 AWG multi core cabling.

There are two recommended field loop circuits for analogue output modules as follows:

System Power Field Loop Circuit

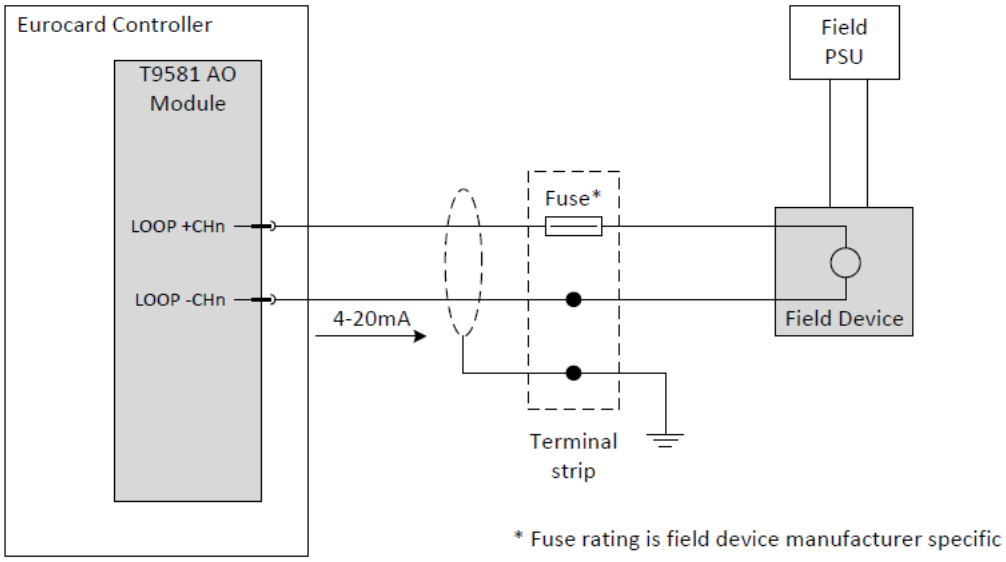
This circuit is applicable for field devices powered by the system. The channel will pass a requested current between 0mA and 24 mA. The field device can be connected as shown or alternatively between the + 24 Vdc supply and the loop plus terminal.

Figure 18 - Analogue Output Field Circuit with System Power



Field Power Circuit

This circuit is applicable for field devices that are powered locally and expect a current-controlled signal loop.

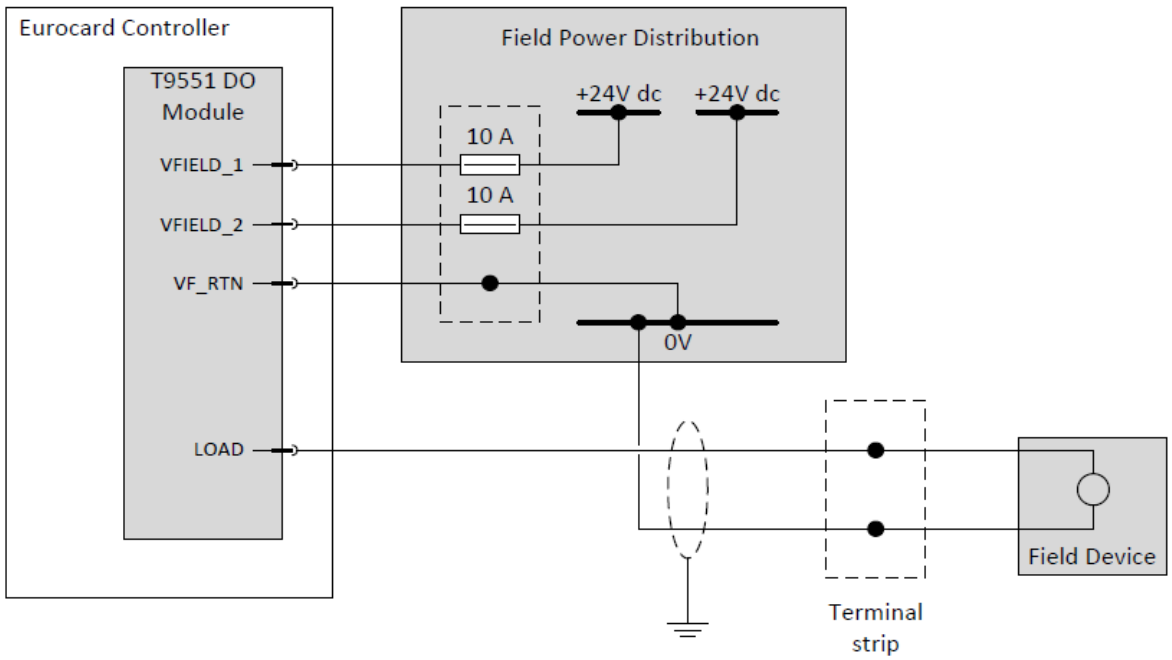


Eurocard Digital Output Field Loops

It is recommended that digital output field supplies are routed through 10 A fuses before they are connected to the module. On an AADvance Eurocard controller, these fuses must be attached externally to the module. Connect the field wiring to the hypertac connectors using 22 AWG multi core cabling.

- The field power must be supplied with an isolating source.
- The minimum current required for line monitoring is 10 mA per module, 20 mA for a dual pair.

Figure 19 - Digital Output Field Loops



ATTENTION: For inductive loads, a back EMF protection diode must be fitted at the load.

System Start-Up

This chapter describes a structured approach to the startup of a controller system.

When the checks, module installation and start up is completed successfully the system is ready for configuration. The system is configured using the AADvance Workbench software and AADvance-Trusted SIS Workstation. See AADvance Controller Configuration Guide ICSTT-RM405 for set up and configuration procedures. Then carry out Functional Acceptance Testing.

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 24 V 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 Check Ground Bonding

SHOCK HAZARD: Connect the AC safety busbar to the building earth (ground) before doing electrical testing or applying power to the system. Failure to follow these instructions can cause injury to persons.

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

Base Unit Services Processor (BUSP)

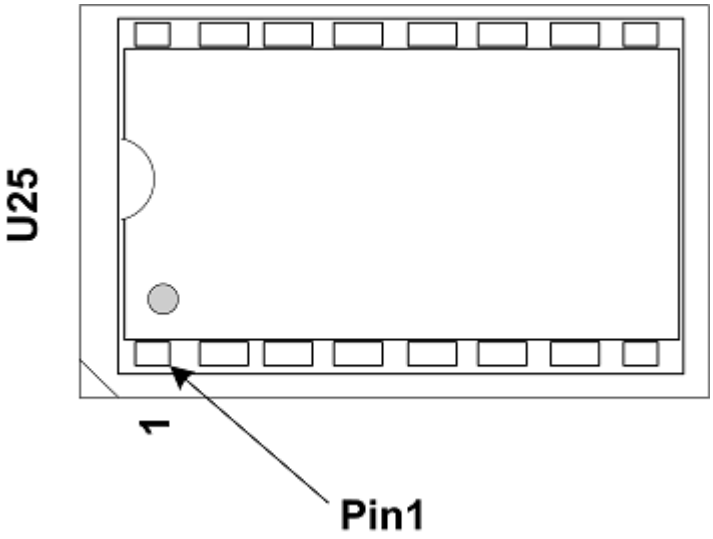
Each processor module must have a BUSP chip installed on the PCB. This BUSP stores the following information:

- Ethernet MAC configuration data - The MAC address is required when setting the processor module IP addresses using the AADvance Discover tool.
- Resource configuration and network IP address data

NOTE The BUSP chip is not installed from the factory.

It is installed manually by inserting the BUSP into the receptacle located on the PCB. The BUSP must be inserted with care so as not to damage the contact pins and ensure it is not installed backwards. The small spot on the top identifies pin1 location on the component and the PCB silk screen has "1" shown where it should be inserted.

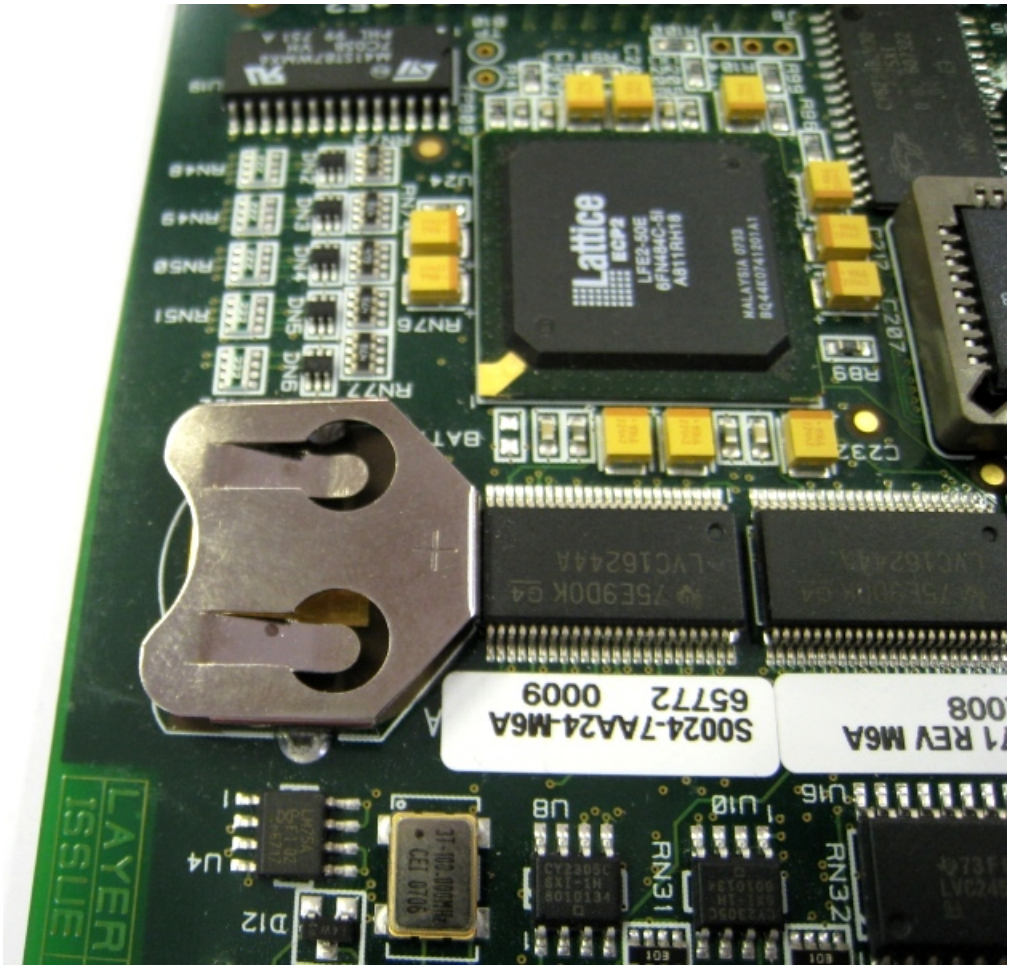
Figure 20 - BUSP Orientation for PCB Installation



Install a Battery (Optional)

If required a battery can be installed on the processor CPU PCB to support the processors' internal clock and memory when it is powered off. It should be inserted into the holder shown below with the positive side uppermost.

Figure 21 - Battery Holder



Part No: T9905 _ Poly-carbonmonofluride Lithium Coin Battery, BR2032, 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.

The battery condition is monitored by the module diagnostics on power up and every 12 hours. If the battery voltage is low a report is placed in the system log.

NOTE For applications where a battery is not fitted, the battery failure alarm signal can be set to disabled.

Set the Programmer Real Time Clock Manually

If the system has only one controller and does not have a different time server, you have to set the processor real time clock manually using RTC variables. The following procedure will help you set the clock:

Set up the following variables in the Dictionary:

RTC Control Rack Variables (all BOOLEAN Outputs)

- RTC Control: RTC_Read
- RTC Control: RTC_Write
- RTC Control: Year
- RTC Control: Month
- RTC Control: Day of Month
- RTC Control: Hours
- RTC Control: Minutes
- RTC Control: Seconds
- RTC Control: Milliseconds

RTC Status Variables (All Word Inputs)

- RTC Status: Year
- RTC Status: Month
- RTC Status: Day of Month
- RTC Status: Hours
- RTC Status: Minutes
- RTC Status: Seconds
- RTC Status: Milliseconds

RTC Program Rack Variables

- RTC Program: Year
- RTC Program: Month
- RTC Program: Day of Month
- RTC Program: Hours
- RTC Program: Minutes
- RTC Program: Seconds
- RTC Program: Milliseconds

Procedure to Check the Current Date and Time

1. Wire the processor variables; refer to the topic "Wire Processor Variables".
2. Build the program and download it or do an on-line update.
3. Check the current date and time settings:
   - Enter Debug mode
   - Request IXL Restricted Access
   - Force the RTC Read Boolean and all the time fields in the RTC Control Rack Variables to TRUE

IMPORTANT Do not force the RTC Write Boolean at this point.

- The RTC Status Variables will show the current date and time in the processor.

Procedure to Set the Date and Time

1. Unlock the RTC Read variable so it turns FALSE.
2. Select each RTC Program Rack variable and enter the date and time values.
3. Toggle the RTC Write variable TRUE then FALSE to write the new date and time setting to the processor.
4. Lock and force the RTC Read variable to TRUE.
5. The RTC Status rack now displays the new date and time of the processor.
6. Unlock all the RTC Control variables.

AADvance Eurocard Controller Start Up

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. Do the following:

1. Switch off power to the controller — both field power and controller power sources.
2. Make a record of the module serial numbers for future reference.
3. Reinstate the power.
4. Install the modules in the sequence given below:
   - Install the first Processor module (see start up procedure).
   - Install the second or the third processor module (if required).
   - Install the I/O modules.
5. Configure the controller (refer to the Doc No. ICSTT-RM405 - Configuration Guide for system configuration settings and procedures.)
6. Download the application.
7. Check system status indications show the system is on-line and operating as expected.

Eurocard Processor Start Up

IMPORTANT When installing 2nd and 3rd processor modules you must install modules with exactly the same firmware version. Check the firmware version on the label - the Issue Number must be the same for all processor modules.

Start Up Procedure

To install a single processor module follow the procedure given in the table below.

Table 12 - First Processor Installation Procedure

Step	Task	
1.	Install the processor into a processor connector A.	
2.	All LEDs are off and after applying power the processor will display the following status indications:	
	Healthy (LED 13)	Flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds)
	Ready (LED 16)	Will remain OFF as the module boots up (10 - 20 seconds) then goes RED
	Run (LED 17)	Will remain OFF as the Module boots up (10 to 20 seconds) then goes RED
	System Healthy (LED 15)	Will remain OFF as the Module boots up (10 to 20 seconds) then goes GREEN
	Force (LED 18)	Will remain OFF as the Module boots up (10 to 20 seconds) then stays OFF until the module has educated.
	Aux (LED 14)	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection.
	Serial 1 (LED 11)	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
	Serial 2 (LED 12)	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
	Ethernet 1 (LED 19)	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
	Ethernet 2 (LED 20)	Will remain OFF as the Module boots up (10 to 20 seconds) then is dependent upon data connection
You have to set up the processor IP Address so that the computer 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: ICSTT-RM405.	
4.	Download a valid application and initiate a remote fault reset. When the application is downloaded and valid the module will display the following indications:	
		Valid Application Downloaded
	Healthy	GREEN
	Ready	GREEN
	Run	RED to GREEN (Flashes GREEN as the module educates)
	System Healthy	GREEN
	Force	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

Dual or Triple Processor Start Up

To install a second or third processor module follow this procedure:

IMPORTANT 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 AADvance Configuration Guide ICSTT-RM405. 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, follow the ControlFlash procedures in the AADvance Configuration Guide ICSTT-RM405.

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.

Figure 22 - Procedure for Installation of a 2nd and 3rd Processor

Step	Task	
1.	Install the processor module into connector B on the wiring loom connectors and push the module home until the connectors are fully mated. 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:	
	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
When the Run indicator goes AMBER perform a remote fault join. The processor then displays the following indications:		
2.	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

Step	Task	
	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 next processor connector.	

Eurocard I/O Module Start Up

IMPORTANT This procedure assumes that the processor modules are installed and running.

To install a Eurocard I/O module follow the procedures below:

Table 13 - Single Module Start Up or First Module of a Group

Step	Task	
1.	This procedure applies to a single module installed or the first module of a redundant group.	
2.	Install the Output Module.	
3.	The input module will initially have the following status indications:	
	LED 11 (Healthy)	GREEN
	LED 10 (Ready)	RED
	LED 9 (Run)	RED
	LED 1 – 8 (Channel 1 – 8)	Off
4.	The input module will enter its startup sequence during which the module will educate, this lasts for approximately 3 seconds.	
5.	The module will now provide the following status indications:	
	LED 11 (Healthy)	GREEN
	LED 10 (Ready)	GREEN
	LED 9 (Run)	AMBER
	LED 1 – 8 (Channel 1 – 8)	Off
6.	Initiate a Fault Reset from the software, LED 9 (Run) indication goes GREEN.	
7.	The module will now be on-line with the following status indications:	
	LED 11 (Healthy)	GREEN
	LED 10 (Ready)	GREEN
	LED 9 (Run)	GREEN
	LED 1- 8 (Channel 1 – 8)	Dependent on channel status

Table 14 - Second or third Module of a Group Installation Procedure

Step	Task	
1.	This procedure applies to a second or third module installed of a redundant group or a replacement module to a live system.	
2	Install the Input/Output Module.	
3.	The initial module indications when power is applied:	

Step	Task	
	LED 11 (Healthy)	GREEN
	LED 10 (Ready)	RED
	LED 9 (Run)	RED
	LED 1 - 8 (Channel 1 – 8)	Off
4.	The module will immediately begin the startup sequence during which the module will educate. Wait for approximately 3 seconds. The module will now educate and complete the start-up automatically.	
5.	The module will now be on-line with the following status indications:	
	LED 11 (Healthy)	GREEN
	LED 10 (Ready)	GREEN
	LED 9 (Run)	GREEN
	LED 1 - 8 (Channel 1 – 8)	Dependent on channel status

Troubleshooting

Troubleshooting – About Fault Indications

Faults are reported by LEDs and by fault codes stored in the System Event Log. They can also be reported via the user application, sourced from system variables or I/O connection points.

Faults are classified as follows.

System Faults

A system fault is reported when a fault is detected on any module (including the processor) or any channel. When this type of fault occurs in the system, the SYSTEM HEALTHY LED (LD15) on the processor will turn RED and the System Health flag changes to TRUE. If redundant processors are fitted, all processors will report the System Health condition.

Module Faults

A module fault is indicated when a detected fault is isolated to the hardware of a specific module. Both the Healthy LED turns RED and the Module Health flag changes to TRUE on the faulty module. The System Healthy LED (LD15) on the processor CPU PCB also turns RED, along with the System Health flag changing to TRUE.

Channel Faults

A channel fault is indicated when a detected faulty channel is isolated to a hardware fault on a specific channel of an I/O module. All channel faults are also reported as a module fault. This means that the Channel LED will go RED, the I/O module Healthy LED will go RED and the System Healthy LED (LD15) on the Processor CPU PCB will also show RED. Where LED status changes to indicate a fault, there is also one or more corresponding status flags that will change state for remote monitoring.

User Application Fault Indications and Logging

The user application can read system variables and obtain the status of input connection points to indicate fault status. The information available includes:

- Module Status (i.e. Off-line or On-Line)
- Module Health (i.e. Healthy of Fault)
- Module Power Status
- Real Time clocks

The above fault indications available will depend on the application program.

Functional Acceptance Testing

Functional acceptance testing, also known as factory acceptance testing or integration testing, tests the controller and its application software to make sure that it satisfies the requirements specified in the requirements for the integrated system. If the controller is applied to a safety related application then the safety requirements are also tested.

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 design 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.

AADvance Eurocard Controller System Security

Serial networks are closed and local and have limited protocol functionality, therefore, they are immune to internal attack except local deliberate sabotage. The system, however, with its computers and DCS interfaces, uses Ethernet networks which can 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 computer security should be considered, for example:
  - Eurocard controller should not be on a network with open unsecured access to the Internet.

    TIP Firewalls have been known to affect the operation of the Discovery tool.

- The computer should be password protected. If using a laptop, it should be kept locked when not in use.
- If the software uses a hardware license USB dongle it should be kept secure, without it the software 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.

Additional Resources

Associated AADvance Publications

For more information about the AADvance Eurocard system refer to the associated Rockwell Automation technical manuals shown in table below.

Resource	Document Number
Safety Manual	ICSTT-RM456
System Build Manual	ICSTT-RM455
Configuration Guide	ICSTT - RM405
OPC Portal Server User Manual	ICSTT - RM407
PFH and PFD_{avg} Data Manual	IICSTT-RM449
Solutions Handbook	ICSTT - RM447
Troubleshooting and Maintenance Manual	ICSTT - RM406

Publication	Purpose and Scope
Safety Manual	This technical manual defines how to safely apply AADvance Eurocard controllers for a Safety Instrumented Function. It sets out standards (which are mandatory) and makes recommendations to make sure that installations satisfy and maintain their required safety integrity level.
Solutions Handbook	This technical manual describes the features, performance and functionality of the AADvance Eurocard controller and systems. It gives guidance on how to design a system to satisfy your application requirements.
System Build Manual	This technical manual describes how to assemble a system, switch on and validate the operation of your system.
Configuration Guide	This software technical manual defines how to configure an AADvance Eurocard controller using the AADvance Workbench software and AADvance-Trusted SIS Workstation to satisfy your system operation and application requirements.
Troubleshooting and Maintenance Manual	This technical manual describes how to maintain, troubleshoot and repair an AADvance Eurocard Controller.
OPC Portal Server User Manual	This manual describes how to install, configure and use the OPC Server for an AADvance Eurocard Controller.
PFH and PFDavg Data	This document contains the PFH and PFD_{avg} Data for the AADvance Eurocard Controller. It includes examples on how to calculate the final figures for different controller configurations.

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

bindings Bindings describe a "relationship" between variables in different AADvance Eurocard 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.

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.

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 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 Eurocard controller. AADvance Eurocard 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.

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 software and AADvance-Trusted SIS Workstation, ensures a high degree of confidence that there are no errors introduced by the software or the compiler during the compilation of the application.

configuration A grouping of all the application software and settings for a particular AADvance Eurocard controller. The grouping must have a 'target', but for an AADvance Eurocard 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 Where the Safety Instrumented Function in the Safety System is continually maintaining the process in a safe state.

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 computers.

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 software and AADvance-Trusted SIS Workstation 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 Eurocard 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.

energize 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.

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 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 Safety Instrumented Function in the Safety System only performs its designed function on a demand, and the frequency of demands is greater than one per year.

hot swap See live insertion.

I

I/O module A collation of interfaces for field sensors (inputs) or final elements (outputs).

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 (variable) A value passed from an I/O module to the processor module.

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.

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 Safety Instrumented Function only performs its designed function on demand, and the frequency of demands is no greater than one per year.

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 software and AADvance-Trusted SIS Workstation. The settings include communication settings and messages.

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 (variable) A value passed from the processor module to an I/O module.

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 module The application execution engine of the AADvance Eurocard controller.

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

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

proof test A periodic test performed to detect dangerous hidden faults in a safety instrumented system (SIS) so that, if necessary, a repair can restore the system to an 'as new' condition or as close as practical to this condition. Proof tests are designed to reveal both Systematic and Random failures. Proof tests may be required depending on how the technology has been implemented. AADvance product data is given for a Useful Life of 20 years. For a Mission Time of up to 20 Years, proof testing is not required. For Mission Times greater than 20 years, any products that are still in service once that time is reached should be replaced.

protocol A set of rules that is used by devices (such as AADvance Eurocard controllers, serial devices and engineering computers) 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. The process safety time for the equipment under control (denoted PSTEUC) is the period a dangerous condition can exist before a hazardous event occurs without a safety system as a protection.

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 Eurocard 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 a 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 Eurocard 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 Eurocard 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 (1-¾ 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.

Rockwell Automation Support

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Publication ICSTT-RM455G-EN-P - February 2024

Supersedes Publication ICSTT-RM455F-EN-P - May 2018