

AADvance Controller

Catalog Numbers T9110, T9300, T9310, T9401/2, T9431/2, T9451, T9481/2

Allen-Bradley
by ROCKWELL AUTOMATION

Troubleshooting and Maintenance Manual Original Instructions

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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The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, 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.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

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).

About This Publication

This technical manual describes how to maintain, troubleshoot, and repair an AADvance® controller.

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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 rok.auto/support.

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 TechConnect℠ 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 rok.auto/pcdc.

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 system release 1.40.

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 rok.auto/knowledgebase.

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, click this link: Knowledgebase Document ID: IP622 - TechConnect Support Contract - Access Level & Features.

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.

Purpose Of This Manual

This manual specifies the maintenance requirements and describes the procedures to assist troubleshooting and maintenance of an AADvance system.

Who Should Use Manual

This manual is for plant maintenance personnel who are experienced in the operation and maintenance of electronic equipment and are trained to work with safety systems.

Environmental Compliance

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

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Global changes

This table identifies changes that apply to all information about a subject in the manual and the reason for the change. For example, the addition of new supported hardware, a software design change, or additional reference material would result in changes to all of the topics that deal with that subject.

Subject	Reason
Changed *workstation* to *computer*	Technical improvement
Changed *LED* to status *indicator*	Technical improvement
Added AADvance®-Trusted® SIS Workstation software information where applicable	Enhancement
Changed *Workbench* to *software* where applicable	Technical improvement
Applied latest publication template	Marketing product change

New or enhanced features

This table contains a list of topics changed in this version, the reason for the change, and a link to the topic that contains the changed information.

Topic	Page	Reason
Rockwell Automation Support	3	Added section.
AAdvance Release	4	Updated AADvance system release information.
Return a Module	12	Updated procedure.
View Module Firmware Versions	23	Added steps for AADvance Workbench software version 2.x and AADvance-Trusted SIS Workstation software.
Upgrade the processor module firmware	25	Updated procedures.
Latching and Non-Latching Faults	33	Added information for AADvance Workbench software version 2.x and AADvance-Trusted SIS Workstation software.
I/O Module Channel Degradation and Shutdown	38	Updated information.
Fault Finding Process - System Level	41	Changed *Workbench variable* to *status variable*.
Rectify a Critical Processor Firmware/Hardware Failure	42	Updated information.
Troubleshooting Remote Fault Reset/Join	49	Updated information.
Set the Real Time Clock Manually	49	Removed Rack from list headings.
Understanding the State Variable (<variablename>.STA)	51	Changed *<tagname>.STA* to *<variablename>.STA*.
Correlation of Status Indicators with State Variable for a Digital Output	54	Updated Knowledgebase Document ID.
Examine the State Variable	63	Changed *tagname* to *name*. Added steps for AADvance Workbench software version 2.x and AADvance-Trusted SIS Workstation software.
Software	78	Added AADvance-Trusted SIS Workstation software AADvance license.
Glossary	83	Updated several entries.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
AADvance Controller Safety Manual, ICSTT-RM446	This technical manual defines how to safely apply AADvance controllers for a Safety Instrumented Function. It sets out standards (which are mandatory) and makes recommendations to make sure that installations satisfy and maintain their required safety integrity level.
AADvance Controller System Build Manual, ICSTT-RM448	This technical manual describes how to assemble a system, switch on and validate the operation of your system.
AADvance Controller Configuration Guide Workbench 1.x, ICSTT-RM405	This software technical manual defines how to configure an AADvance controller using the AADvance Workbench software version 1.x to satisfy your system operation and application requirements.
AADvance Controller Configuration Guide Workbench 2.x, ICSTT-RM458	This software technical manual defines how to configure an AADvance controller using the AADvance Workbench software version 2.x to satisfy your system operation and application requirements.
AADvance-Trusted SIS Workstation Software User Guide, ICSTT-UM002	This publication provides how-to instructions for AADvance-Trusted SIS Workstation software configuration and use.
AADvance Controller OPC Portal Server User Manual, ICSTT-RM407	This manual describes how to install, configure and use the OPC Server for an AADvance Controller.
AADvance Controller PFH and PFDavg Data, ICSTT-RM449	This document contains the PFH and PFD_{avg} Data for the AADvance Controller. It includes examples on how to calculate the final figures for different controller configurations.
AADvance Controller Solutions Handbook, ICSTT-RM447	This technical manual describes the features, performance and functionality of the AADvance controller and systems. It gives guidance on how to design a system to satisfy your application requirements.
AADvance Controller Troubleshooting and Maintenance Manual, ICSTT-RM406	This technical manual describes how to maintain, troubleshoot and repair an AADvance Controller.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

Chapter 5

Troubleshooting and Rectifying Module Faults

Chapter 6

Troubleshooting and Rectifying Channel/Field Faults

Chapter 7

Parts List

Introduction to Maintenance Activities

Corrective and preventative maintenance activities for the AADvance® controller include troubleshooting activities and repair procedures to correct the problem and return the controller back to full operation. Preventative maintenance and testing procedures are needed to keep the system available and healthy.

Making Repairs Promptly

A fault indication does not necessarily mean an important part of the controller is not operational. Some faults have no immediate effect — for example, a fault in one of the diagnostic systems. Nevertheless, the problem must be rectified in a timely manner.

System repair must be done promptly, to make sure that faults do not build up. This principle applies as much to a redundant arrangement, which needs to make sure that fault-tolerant operation continues, as it does to a simplex controller. Multiple failures can cause a plant shutdown.

WARNING: Never permit an AADvance controller used for a safety-critical function to operate for an extended time with a failed module. Replace the module in less than the MTTR assumed for PFD calculations to preserve the SIL level for the system.

Resolving Multiple Faults

The fault diagnosis procedures in this manual will find a solution for a single fault. If you follow one of the processes to its conclusion but if a fault indication persists, then other faults are present. Quarantine faulty components you have removed during your first investigation, then repeat the fault finding procedure.

Required Tools Standard AADvance

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

Standard Tools

- Screwdriver, flat 0.8.mm x 9.0 mm (1/25 inch x 3/8 inch), for the module clamp screws and blanking covers
- Screwdriver, flat 0.6 mm x 3.0 mm (1/40 inch x 1/8 inch), or a similar that will open fuse covers on termination assemblies.
- Screwdriver, cross head number 0, for battery cover on 9110 processor module
- Screwdriver, flat 0.8 mm x 4.0 mm (1/25 inch x 5/32 inch), for screws on extension cables

- Torque screwdriver, flat 0.6 mm x 3.0 mm (1/40 inch x 1/8 inch), for dc power wiring terminals
- Torque screwdriver, flat 0.4 mm x 2.0 mm (1/64 inch x 5/64 inch), for field wiring terminals
- 2 x wrench, open end, 10 mm, for ground stud nuts
- Allen key (hex wrench), 2.5 mm, for plug and sockets assemblies used with extension cables

Special Tools

- Long nosed pliers to remove the fuses on termination assemblies.
- Digital voltmeter, for troubleshooting activities
- Resistor 1k8, for troubleshooting analogue input modules
- Resistor 1k 1W, for troubleshooting digital output modules
- Resistor 250R 1W, for troubleshooting analogue output modules

Required Test Equipment

The maintenance of the AADvance controller requires the following test equipment.

IMPORTANT All test equipment must be calibrated and regularly tested for accuracy

1. Digital voltmeter
   - DC voltage range 0 V to 32 Vdc or better.
   - Resistance resolution 0.01 W or better.
2. Current simulation instrument
   - Output range 4 mA to 20 mA with an accuracy better than 0.05 mA.
3. Bench power supply
   - Output range 0 V to 32 Vdc.

Return a Module

Before returning a module, contact your local Rockwell Automation technical support representative or send an email to returns@ra.rockwell.com to get a Return Material Authorization (RMA) number.

For more information, see rok.auto/support.

To get an RMA number by using email

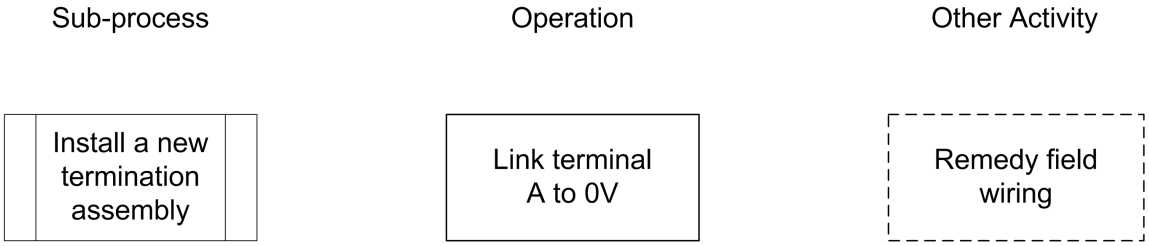
1. Send an email to returns@ra.rockwell.com with the subject *RMA request*. Leave the message empty.

   An email message with instructions returns.
2. Follow the instructions in the email message.

Conventions Used in Flow Charts

This technical manual includes flow charts. The charts use solid and broken lines to show different kinds of activities.

Figure 1 - Flowchart Conventions



Refer to detailed instructions which follow the chart

Boxes with solid borders show tasks which are self-explanatory and activities which are automated

Boxes with broken borders show activities which depend on the system. Refer to system documentation and procedures

Notes:

Preventive Maintenance

Safety systems are designed to run continuously without manual intervention. However, some manual preventive maintenance must be done to make sure the system stays available and healthy.

This chapter describes the preventive maintenance activities for an AADvance® controller.

ARC FLASH HAZARD: ARCS AND EXPLOSION RISK IN HAZARDOUS AREAS
If you connect or disconnect wiring, modules or communications cabling while power is applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. **Do not remove wiring, fuses, modules or communications cabling while circuit is energized unless area is known to be non-hazardous.**
Failure to follow these instructions may cause personal injury.

Preventive Maintenance Schedule

The preventative maintenance tasks must be done at the following intervals:

Table 1 - Recommended Schedule for Preventive Maintenance

Preventive Maintenance Task	Interval
Review **status indicators**	Daily
Examine **fuses**	3 months
Examine **wiring terminals**	3 months
Examine **seating of plug-in components**	3 months
Look for **contamination**, examine **general condition** and make sure **there is sufficient environmental protection**	3 months
Measure **resistance of the ground connection**	3 months
Measure **analogue input module calibration values**	2 years
Measure **analogue output module calibration values**	2 years
Measure **digital input module calibration values**	3 years
Measure **digital output module calibration values**	3 years
Do a **manual test**	Manual Test Interval

NOTE All modules are returned to Rockwell Automation® for calibration. To return a module see Return a Module on page 12.

IMPORTANT Testing of the logic solver and its related field devices must be carried out according to the applicable plant or process safety analysis and the safety integrity validation. The manual test interval is used by the Probability of Failure on Demand (PFD) data analysis as part of the certification process.

Status Indicators on the 9110 Processor Module

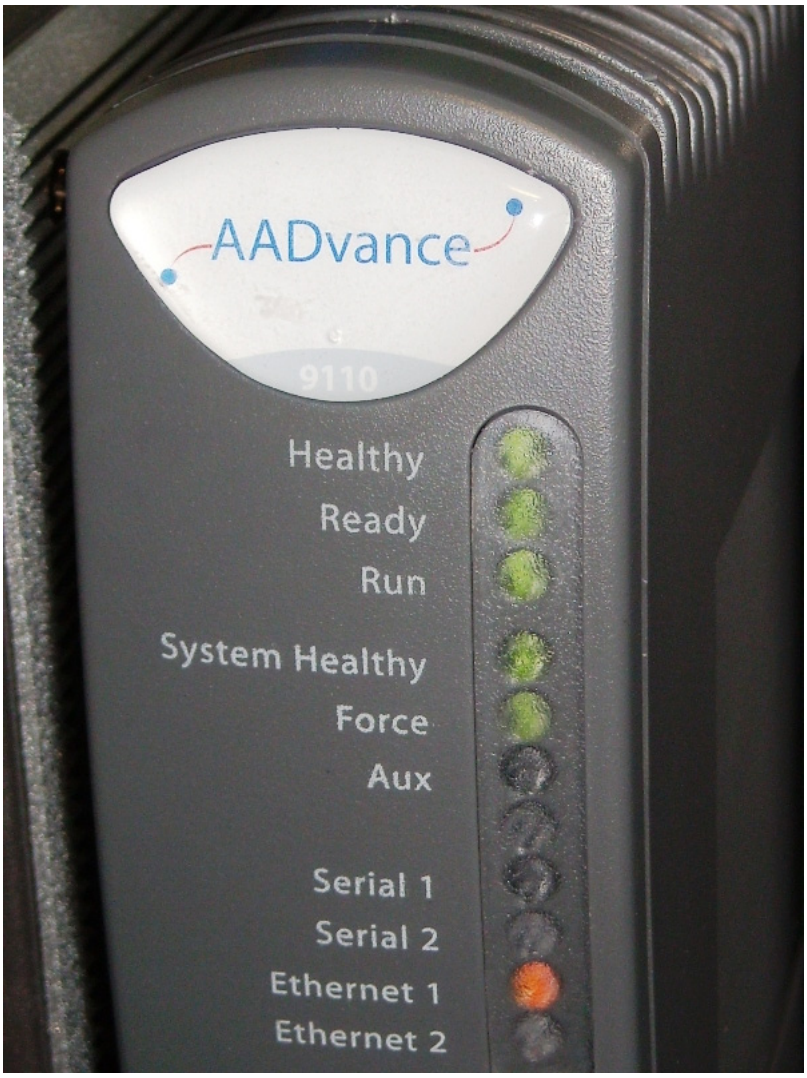


Table 2 - Status Indicators on the T9110 Processor Module

Indicator	Status	Description
Healthy	OFF	No power.
	RED	• Flashes RED briefly after being installed as the module is booting up • Continuous RED means a Module has a fault.
	GREEN	As the module boots up it goes GREEN, this lasts for 10 to 20 seconds. When the module is operational the status indicator stays GREEN. When in the recovery mode and no faults are present the status indicator is GREEN. Fault Indications: • If Healthy is GREEN and all the other indicators on the module are OFF then the module has failed to boot up. • If Healthy is GREEN and Ready and Run are RED then the module is in its shutdown state.
Ready	OFF	No power.
	RED	• Module is booting up (10 to 20 seconds) or not educated or synchronized with partners. • Module is in the shutdown state.
	Flashing GREEN	The module is being educated or synchronized.
	GREEN	Module is educated and synchronized with partners.
	AMBER	Module is in Recovery Mode.

Table 2 - Status Indicators on the T9110 Processor Module

Indicator	Status	Description
Run	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. • Module is in the shutdown state.
	GREEN	The module contains an application and it is running.
	AMBER	Module is in Recovery Mode. or The module contains the application but the application has stopped. Press Fault Reset to start the application.
System Healthy	OFF	No power and stays off while the module is booting up (10 to 20 seconds).
	RED	There is a fault on one or more modules. or The application has stopped because the module has entered Recovery Mode.
	GREEN	No system or module faults present or The system is in Recovery Mode.
Force	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	OFF	No power and stays off while the module is booting up (10 to 20 seconds), or under application control.
	GREEN	The module is under application control.
	AMBER	Module is under application control. or The module is in the Recovery Mode.
Serial 1 and 2	OFF	No power and stays off while the module is booting up (10 to 20 seconds).
	RED	Serial port pulse stretched Tx.
	GREEN	Serial port pulse stretched Rx.
	AMBER	Quickly alternating Tx and Rx activity.
Ethernet 1 and 2	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 on Ethernet Port

Status Indicators on the 94xx Series Input and Output Module

Table 3 - Status Indicators on the 94xx Series Input and Output Module

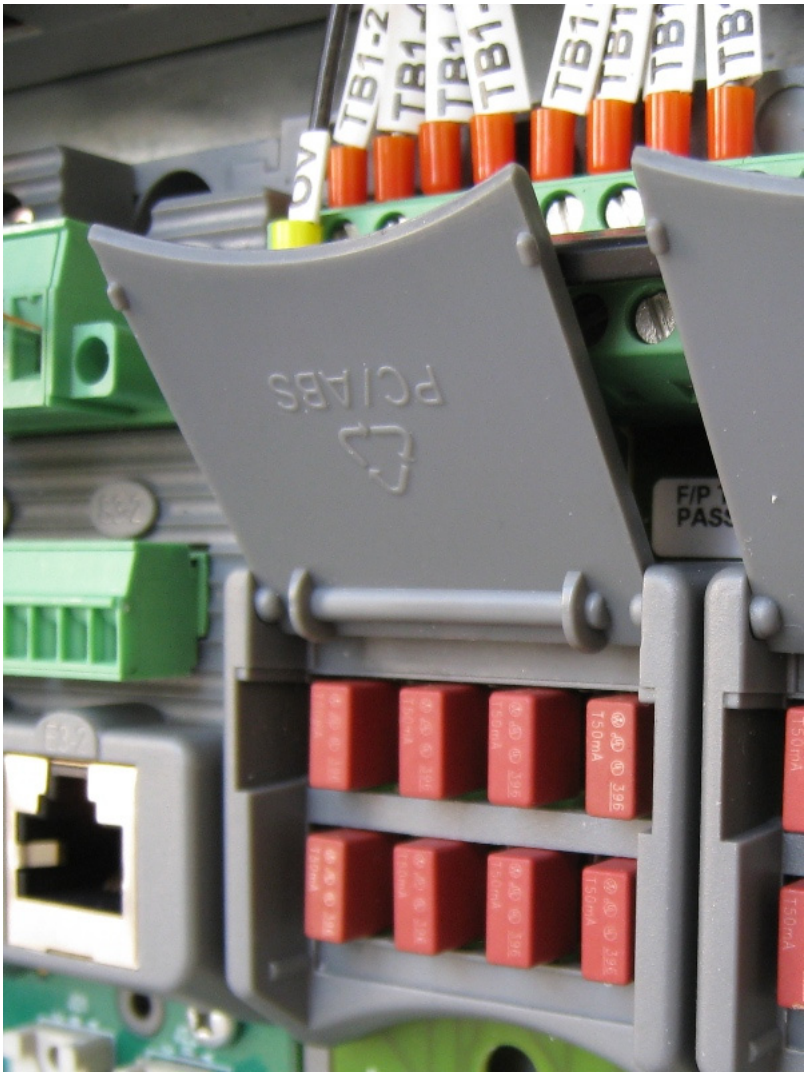
Indicator	Status	Description
Healthy	OFF	No power.
	GREEN	No module faults present.
	RED	The module has one or more faults. • The Healthy indicator can turn RED immediately after power is applied to the module, before then turning GREEN • If Healthy is GREEN and the Ready and Run are RED then the module is said to be in its "shutdown state" refer to the Troubleshooting Manual - Chapter 3 for more information on the shutdown state.
Ready	OFF	No power or module is unlocked.
	GREEN	Locked and prepared to report channel values.
	RED	Locked but not prepared to report channel values.
Run	OFF	No power or module is unlocked.
	GREEN	Module is on-line and supplying data to/receiving data from application
	AMBER	Module is inserted into a running system but not on-line. Push the Fault Reset button on any processor module to set the module to go on-line.
	RED	Module is prepared to go on-line but no application is running.

Table 3 - Status Indicators on the 94xx Series Input and Output Module

Indicator	Status	Description
Channel 1 - 8	OFF	Input module: field switch is open. Output module: output is in its de-energized condition. **Note:** If the run indicator is not green (the module is not reporting channel values), all channel indicators will be off.
	GREEN	Input module: input is on. Output module: output is in its energized condition.
	AMBER	Field fault.
	RED	Channel fault.

Check Fuses

1. Open the **fuse cover** on each termination assembly and examine the **fuses**.
2. Look for **signs of overheated, damaged, or incorrectly seated fuses**.



Check Wiring Terminals

IMPORTANT For controller power and field wiring terminals. When installed a minimum tightening torque of 0.5 Nm (0.37 ft. lb.) has to be used.

For serial connections a minimum tightening torque of 0.22 Nm (0.16 ft. lb.) has to be used.

To examine the wiring terminals do the following:

- Examine the **field, power and network wiring** and look for any **signs of physical stress** such as chafing.
- Tighten any **loose terminal screws** to help prevent open circuits causing trips, see **torque values** in note above.

Check Seating of Plug-in Components

To examine the seating of plug-in components, do the following:

- Examine the **AADvance controller** and make sure all **plug-in items cable assemblies and base unit bus connectors, are correctly seated**.

Check Physical Condition and Environmental Conditions

To examine the physical condition of the controller and the environmental conditions, do the following:

- Examine the **AADvance controller assemblies** for contamination, corrosion, dampness and dust.
- Look for **unauthorized modifications**.
- Look for **exposed parts** (where covers are missing), **bare wires** and **damaged insulation**.
- Make sure that l**ocal ventilation and air conditioning systems are operating correctly**.

Check Ground Connection

To measure the controller ground connection, do the following:

- Measure the **resistance of the connection to the ground stud** on the 9100 processor base unit, it must be less than 0.2 ?. If it is above this figure then **check the ground stud connection**.

Check Analogue Input Module Calibration Values

The AADvance controller detects possible calibration drift by continually checking its measured input values. The controller uses diverse hardware to compare two measurements. It is recommended that you do this **calibration drift check every two years**. You can make sure that an analogue input is within the stated accuracy (±0.05mA) without taking a module out of service using the following procedure:

1. Use the **AADvance® Workbench software or AADvance®-Trusted® SIS Workstation software to lock the input channel**.
   - The input value freezes, allowing the procedure to continue operating.
2. Disconnect the **field device at the termination assembly** and connect a **calibrated current simulation instrument** in its place.
3. Set the **current simulation instrument** to supply 4 mA, make sure that the **input value is in the range 3.95 mA to 4.05 mA**.
4. Set the **current simulation instrument to supply 12 mA**, make sure that the **input value is in the range 11.95 mA to 12.05 mA**.

5. Set the **current simulation instrument to supply 20 mA**, make sure that the **input value is in the range 19.95 mA to 20.05 mA**.
6. Disconnect the **current simulation instrument** and connect the **field device**.
7. Apply a **minimum tightening torque of 0.5 Nm (0.37 ft. lb.) to the terminal screws**.
8. Make sure that the **field device is showing a satisfactory value**.
9. Unlock the **input channel**.
   - The input is in service again.

If desired, you can include this calibration test in the proof test for the loop instead. To do this, put a calibrated current meter into the circuit in series with the field device in step 2; use the field device to drive the input.

Check Digital Input Module Calibration Values

The AADvance controller detects possible calibration drift by continually checking its measured input values. The controller uses diverse hardware to compare two measurements. It is recommended that you do this **calibration drift test every two years**. You can make sure that a digital input is in the stated accuracy (0.5 V) without taking a module out of service.

To test the digital input module calibration, do the following:

1. Use the **AADvance Workbench software or AADvance-Trusted SIS Workstation software** to lock the **input channel**.
   - The field input value freezes, allowing the procedure to continue operating.
2. Disconnect the **field device** at the termination assembly and connect a **bench power supply** and a **calibrated digital voltmeter** in its place.
3. Set the **bench power supply to give 2 V**, make sure that the **input value is in the range 1.5 V to 2.5 V**.
4. Set the **bench power supply to give 16 V**, make sure that the **input value is in the range 15.5 V to 16.5 V**.
5. Set the **bench power supply to give 30 V**, make sure that the **input value is in the range 29.5 V to 30.5 V**.
6. Disconnect the **test equipment** and connect the **field device**.
7. Apply a **minimum tightening torque of 0.5 Nm (0.37 ft. lb.)** to the **terminal screws**.
8. Make sure that the **field device** is showing a satisfactory value.
9. Unlock the **input channel**.
   - The input is in service again.

Perform the Manual Test

The manual test checks for hidden failures of components which the AADvance controller alarms cannot indicate. Do the following:

- Transition each **digital input** to its **opposite state** and then back to its **current state**. Subject each **analogue input** to its **full range (minimum to maximum)** and **examine accuracy**.
- At the same time, make sure that **each output operates as expected**. Use the application software to force the **outputs which do not seem to operate**.
- Carry out a **manual examination** to **test each input and output**.

Notes:

Upgrading Controller Firmware

Rockwell Automation issues firmware upgrades for processor modules from time to time. This chapter provides an overview of the firmware upgrade process and the instructions for using the ControlFLASH™ software.

WARNING: Do not attempt to upgrade firmware on a running system. ControlFLASH will not warn you that a system is running and you will lose control of the application when the system reboots.

View Module Firmware Versions

Using the AADvance Workbench software versions 1.1, 1.2, 1.3, and 1.4, you can view the module firmware data on screen and save this data with your project.

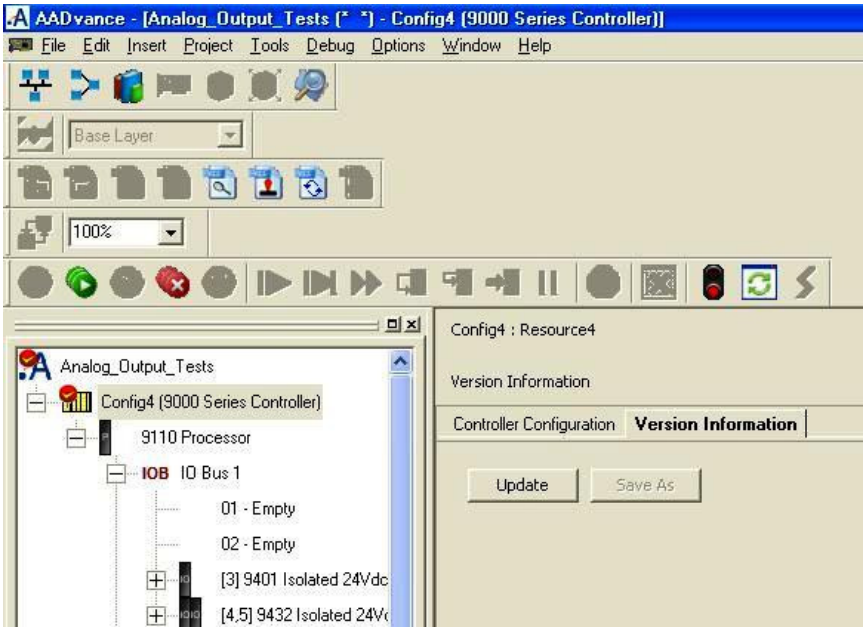
IMPORTANT To view the firmware version numbers of the modules you must be connected using Debug to a running controller.

IMPORTANT If using the AADvance Workbench software version 2.x or AADvance-Trusted SIS Workstation software, perform these steps:

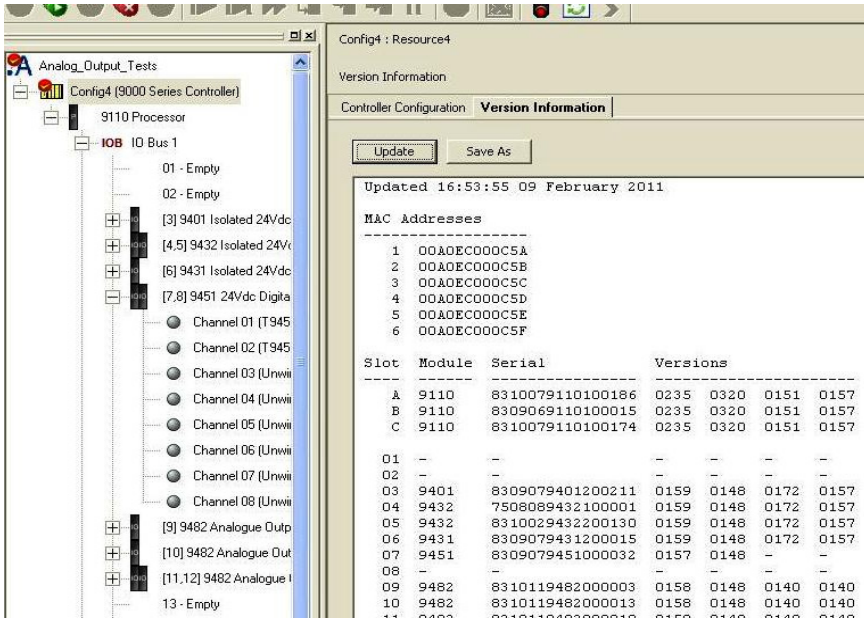
1) Obtain the serial number of your module by using the AADvance 1715 Trusted Collection Tool, which can be downloaded from Product Compatibility and Download Center (PCDC), rok.auto/pcdc.

2) Contact Technical Support for assistance on how to get the firmware version.

1. Select the **Equipment View tab**.
2. Select the **desired configuration node**. This is Config4 (9000 Series Controller) in the example shown below.
3. Select the **Version Information tab**.
   - The version information window appears. If the version data has previously been requested and saved (applied) then it will be displayed in this window.



4. Click **Update**.
   - The window now shows your controller's current firmware version information.



The data displayed is as follows:

- MAC Addresses - MAC addresses for the controllers. The first two addresses are allocated to the controller. The other four addresses are not used.

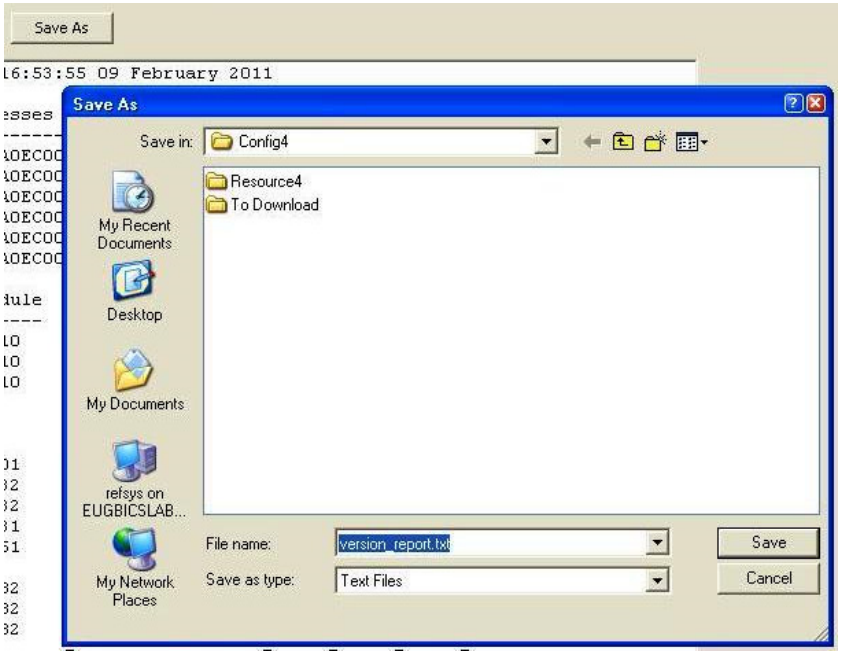
The module data is as follows:

- Slot - the slot the module has been allocated
- Module - the module identity
- Serial - the module hardware serial number
- Versions - The firmware versions in the module

5. Click **Apply**

- The data is saved with the project so that next time the project is opened you can view it.

6. To save data to a text file click **Save As**.
7. A window opens with a default text file name Version_Report.txt; Enter your **own file name** and click **Save**.



Upgrade the processor module firmware

Upgrade the processor module Recovery Mode firmware and then upgrade the processor module firmware.

The processor module firmware upgrade process can be summarized as follows:

1. Download software and firmware.
2. Install software.
3. Configure RSLinx Classic software.
4. Use ControlFLASH to upgrade firmware.

Download software and firmware

Download these items from the PCDC, rok.auto/pcdc:

- RSLinx Classic or RSLinx Classic Lite software, version 4.20.00 or later

  Used by the ControlFLASH to communicate with the AADvance controller over an Ethernet network.
- ControlFLASH Firmware Tools version 15.03.00 or later

  Firmware update tool used for electronically updating firmware.
- T9110 Processor Module firmware files
  - Firmware for T9110 Processor Module v1.040 (T9110_1.040.dmk)
  - Firmware for T9110 Recovery Mode Processor Module version 1.001 (T9110_Recovery_Mode_1.001.103.dmk)

Search for **Firmware for T9110 Processor Module v1.040** in PCDC and follow the links.

Install software

Install the RSLinx Classic and ControlFLASH software. For information, see these publications:

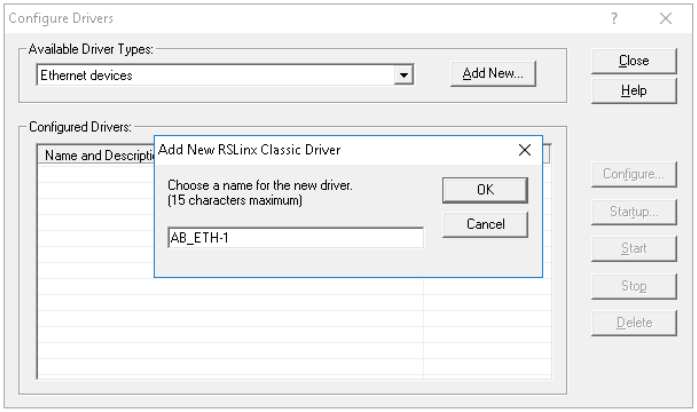
- RSLinx Classic Getting Results Guide, publication LINX-GR001
- ControlFLASH User Manual, publication 1756-UM105

Configure RSLinx Classic software

Configure the RSLinx Classic software to communicate with the AADvance controller.

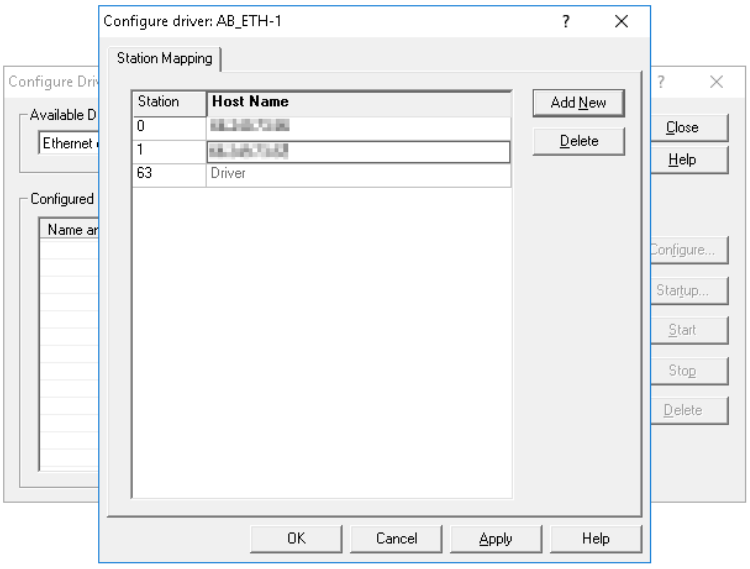
To configure the RSLinx Classic software:

1. Open the RSLinx Classic software.
2. Select **Communications** > **Configure** to open the **Configure Drivers** dialog box.
3. In **Available Driver Types**, select **Ethernet Devices** or **EtherNet/IP Driver**.
4. Select **Add New**, and type a name for the driver or accept the default name.



5. Perform the step that corresponds to the selected driver type:
   - **Ethernet devices**

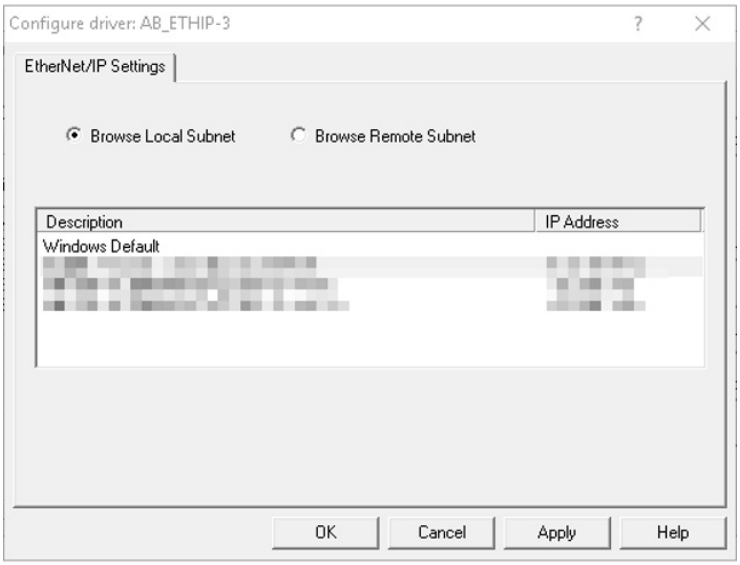
     Select **OK**, then for each device, enter the IP address (or Host Name if DNS is supported) under **Host Name**. Select **Add New** as necessary.



- **EtherNet/IP Driver**

Select **OK** then select **Browse Local Subnet**.

To view devices on a different subnet or VLAN from the workstation running RSLinx software, select **Browse Remote Subnet**.



6. Select **OK**, then **Close** when finished.
7. Close the RSLinx Classic Lite software.

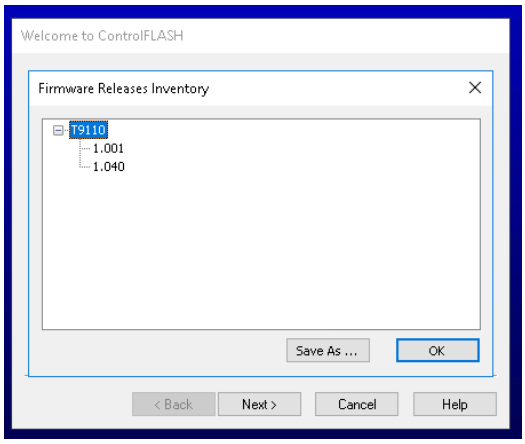
Use ControlFLASH to upgrade firmware

Use ControlFLASH to simultaneously upgrade the firmware of up to three processor modules that are installed in the same processor base unit.

WARNING: FIRMWARE UPGRADE DANGER TO A RUNNING SYSTEM
Do not attempt to upgrade firmware on a running system. ControlFLASH will not warn you that a system is running and you will lose control of the application when the system reboots.

To upgrade the processor module firmware:

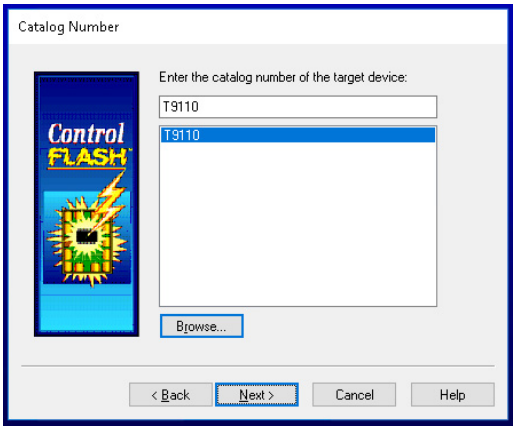
1. Open the ControlFLASH software and select **View Inventory** to display the **Firmware Releases Inventory**.



2. If Firmware Releases Inventory displays T9110 versions 1.001 and 1.040, select **OK** then **Next**.

   If T9110 versions 1.001 and 1.040 are not listed:

   a. Select **OK** then **Next**.
   b. Select **Browse** to view **Firmware Kit Locations**.
   c. Copy the **T9110_1.040.dmk** and **T9110_Recovery_Mode_1.001.103.dmk** files to one of the monitored folders.
   d. Select **OK**.



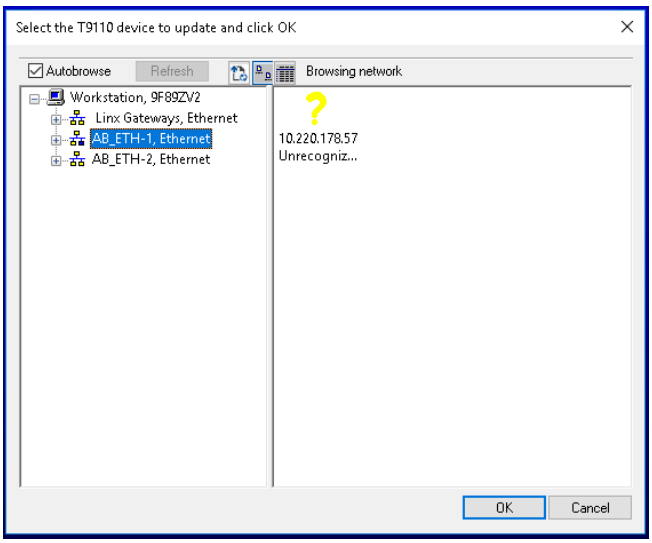
3. Power off the system, and then power on while holding the **Fault Reset** button of each processor module until the **Aux** status indicator becomes amber.

   The **Aux** status indicator becomes amber to indicate that the module is loading Recovery Mode.

   When the module is ready, the **Ready**, **Run**, **Force**, and **Aux** status indicators become amber.

Firmware cannot be upgraded when the system is operational. The T9110 processor must be in Recovery Mode to accept firmware. There is no application running in Recovery Mode and outputs will de-energize.

4. In **Catalog Number**, select **T9110** then Next to display RSWho.



5. Wait until the device to be upgraded appears with a yellow question mark and without a red X.

   Select the T9110 device to upgrade and select **OK**.

6. In **Firmware Revision**, select **1.001** then **Next**.
7. In **Summary**, select **Finish** and follow the instructions until the **Update Status** dialog box prompts that the update is completed.

   The Recovery Mode firmware set is loaded to the processor module.

8. Repeat steps 1 to 5.
9. In **Firmware Revision**, select **1.040** then **Next**.
10. In **Summary**, select **Finish** and follow the instructions until the **Update Status** dialog box prompts that the update is completed.

    The processor module operational firmware is updated.

11. View the module firmware version to verify that the upgrade is successful.

    For more information, see View Module Firmware Versions on page 23.

Notes:

About Troubleshooting

Troubleshooting covers system faults, module and channel faults, termination assemblies and field faults. Troubleshooting and maintenance is based on internal diagnostic systems, fault warnings shown by the module status indicators and/or reported to the application through the AADvance Workbench software or AADvance-Trusted SIS Workstation software. Except for fuses, all failed modules must be returned for repair and replaced in the system with a new or serviceable module.

WARNING: For a safety implemented system in a redundant I/O configuration **remove only one module at a time** unless a system shutdown is planned.

Prerequisites for Troubleshooting

The troubleshooting procedures identified in this manual assumes that the System Healthy alarm is connected to a variable in the AADvance Workbench software or AADvance-Trusted SIS Workstation software and the alarm can be used as a starting point for activities or, the processor module has defaulted to the Recovery Mode because of a critical firmware failure.

The fault finding procedures make the following assumptions:

- The controller was fully operational before the fault arose.
- A serviceable spare module is available.
- There is a working network connection between the computer and the AADvance controller.

IMPORTANT You must fit the **Program Enable Key** (supplied with the T9100 processor base unit) before you download the application onto the controller.

Internal Diagnostics and Fault Reset

The AADvance controller contains comprehensive internal diagnostic systems to identify faults that occur during operation and trigger warnings and status indications. The diagnostic systems run automatically and test the system for faults related to the controller, and field faults related to field I/O circuits. The diagnostic systems monitor such items at regular times, and need a number of occurrences of a possible fault before reporting it as a problem.

The diagnostic systems use LED status indicators to report a problem. The status indicators identify the module and can also identify the channel where the fault has occurred. There is also a summary system healthy indication for all of the controller. The application uses its variable structures to report a fault problem; these variables give status reports and are configured using the

AADvance Workbench software or AADvance-Trusted SIS Workstation software.

Faults in the processor modules are non-latching. The controller will recover automatically and the fault indication will clear once the fault condition has been removed. Faults in the I/O modules are latched. To clear them a fault reset signal is sent from the processor module by pressing the Fault Reset button on the processor module front panel. Field faults are not latched and will clear as soon as the field fault is repaired.

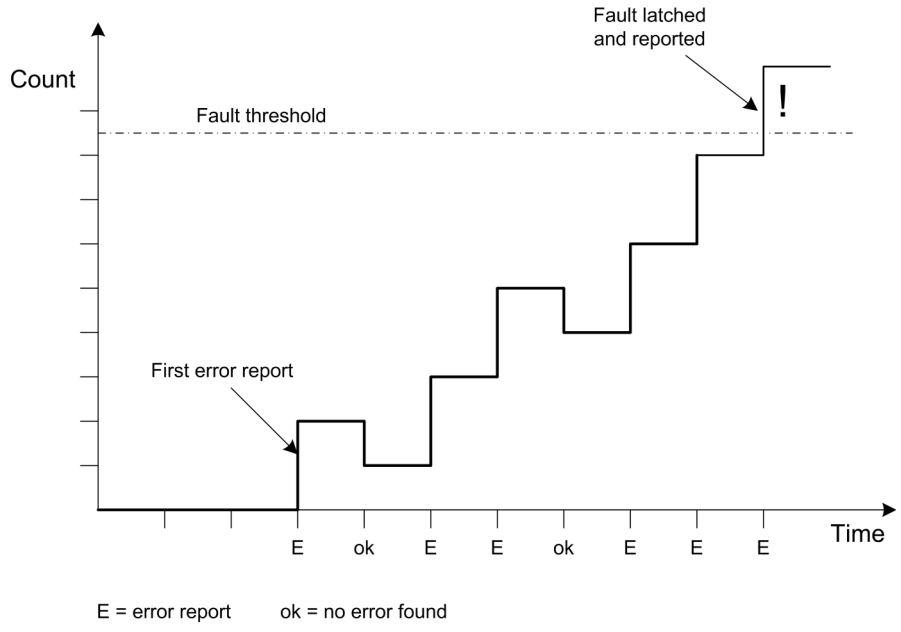
When the Fault Reset button on each processor module is pressed it attempts to clear a fault indication immediately, however, the diagnostic systems will report a serious problem again so quickly there will be no visible change in the fault status indications.

Actions of the Diagnostic Systems

The diagnostic systems filter possible but not critical fault conditions by sampling at periodic intervals and requiring a number of matching error reports before reporting a problem. Typically the diagnostic systems maintain a counter for a fault. If an error is found, the counter increments. If an error is not found, the counter decrements, but by a smaller value. Once the counter reaches a threshold, the diagnostic systems latch the counter and raise alarm and status indications to report the fault.

As an example, a non-critical item might be monitored every three hours and reported after 24 hours like this.

Figure 2 - Diagnostic Threshold



Pushing the Fault Reset button resets every counter which has reached the fault threshold.

Latching and Non-Latching Faults

Faults occurring in the T9110 processor module are non-latching. The controller will get back to usual operation automatically, and the fault indication will clear, after the fault condition has been repaired.

Faults occurring in the I/O subsystem are latched. In order to clear them, you must repair the faulty component (usually by replacing a module) and then push the Fault Reset button on the processor module. During the reset operation, the application continues to run at its normal scan rate and there is no change in system performance and no increased vulnerability to faults.

Depending on your software, set up a Fault Reset[(a)] or Remote Fault Reset[(b)] variable to mimic pressing the **Fault Reset** button on the front panel. This feature is provided for systems located in inaccessible locations. Refer to the applicable publication for instructions on how to set up the variable:

- 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

Indications of field faults (which are shown by an Amber channel status indicator) are non-latching and some short term problems are not always seen (*). The fault indication clears as soon you repair the source of the field fault.

(*) An exception to this rule occurs during short-circuit protection where an output commanded on will remain de-energized until either its commanded state transitions through an off state or the Fault Reset button is pressed.

Module Shutdown State and Possible Causes

Processor Module

When the module is operational without a valid application, the module is in the shutdown state. The module can also go into the shutdown state when the application stops running, this is not a fault but a normal state of operation. The processor shutdown also occurs when the module is in the Recovery Mode.

Recovery Mode uses a base level firmware. It is entered automatically when a critical firmware failure occurs or it can be entered manually by pressing the processor Fault Reset button immediately after the module has booted up.

As an alternative firmware version it permits the following maintenance activities:

- Update the **firmware** using the **ControlFLASH** utility.
- Program the **processor IP Address** with the **AADvance Discover utility**.
- Extract **diagnostic data**.

(a) For AADvance Workbench software version 1.x.

(b) For AADvance Workbench software version 2.1 and AADvance-Trusted SIS Workstation software. AADvance Workbench software version 2.0 does not support this feature.

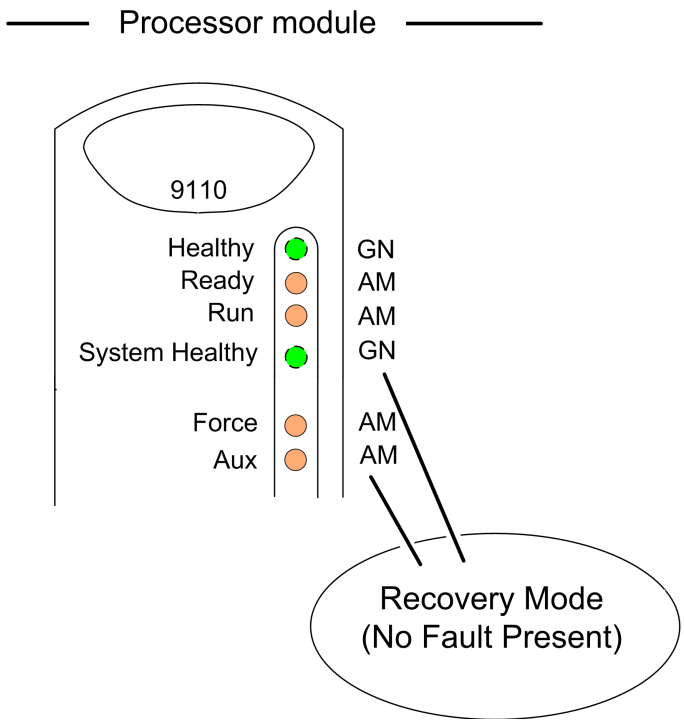
WARNING: When the controller enters Recovery Mode the I/O communications are disabled and the application stops.

Recovery Mode Indications

When the processor enters Recovery Mode and the module contains a valid application the indications that follow are displayed on the processor module:

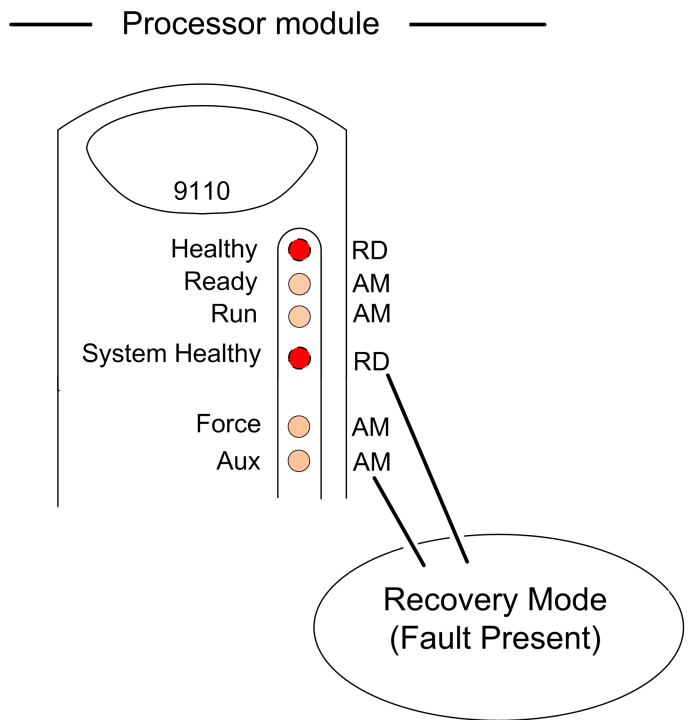
Recovery Mode with No Fault Present

When a valid application is running and the module is re-booted and the Fault Reset button pushed the module enters Recovery Mode.



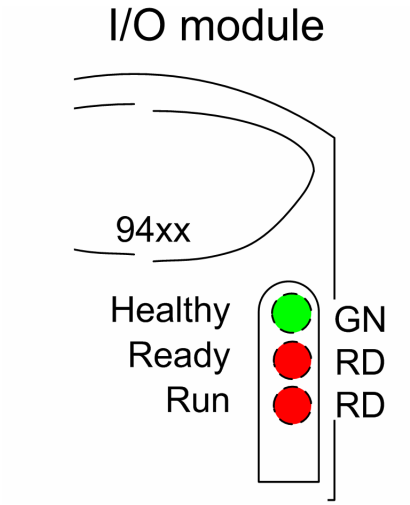
Recovery Mode with Fault Present

After a critical application failure the Healthy and System Healthy status indicators stay Green for a number of seconds then go Red.



I/O Module

An I/O module is in a shutdown state shown by the following indications:



- Healthy: GREEN
- Ready: RED
- Run: RED

Possible causes to be investigated

However, other faults or problems such as the following can cause a module to go into this state:

- The module is not in the processor's application control; i.e. the processor has not started the module and it stays in the shutdown state.
- Check: the application program to see if the I/O module is installed in the equipment and if so if it is installed into the correct I/O Bus and Slot.

- Check: the module PST value is it set to the correct value or if it has been left at zero.
- Check: the communication link between the processor module and the I/O module (possible I/O base unit fault or loose bus cable)

Fault Indications

The diagnostic systems detects these classes of fault:

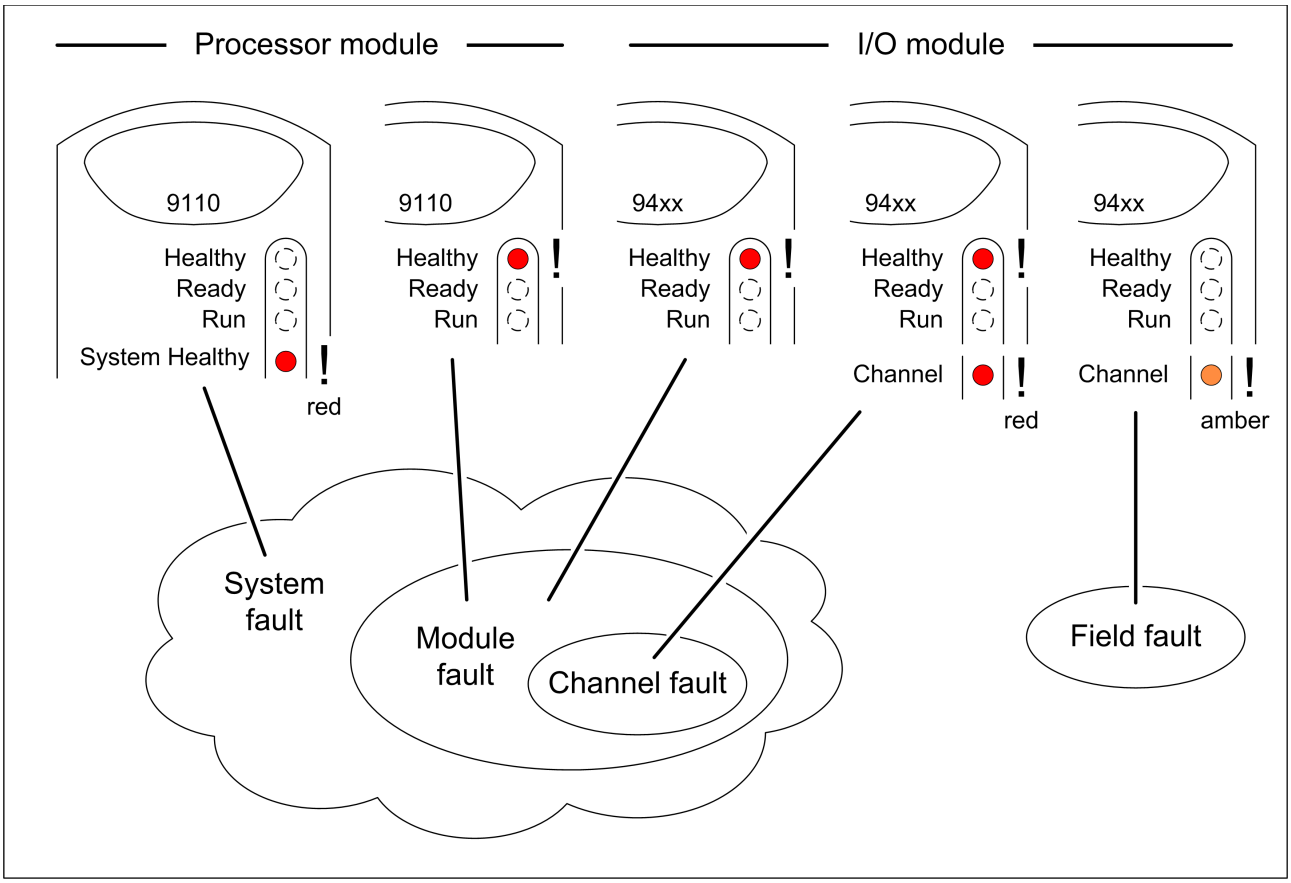
- System fault: a faulty AADvance system.
- Module fault: a faulty single module.
- Channel fault: faulty circuits inside an I/O module or in a TA serving a channel.
- Field fault: faulty field loop wiring outside the I/O module and TA serving a channel.

The diagnostic systems uses the module status indicators to show the presence of a fault. The indicators show the location and where possible the type of fault, and give the information you need to find the problem. The following groups of status indicators can show faults:

- The System Healthy status indicator on each processor module
- The Healthy status indicator on each processor and I/O module
- The Channel status indicator on each I/O module
- A channel fault produces a module fault indication and a system fault indication, similarly a module fault will also produce a system fault.

The relationships between the classes of faults and the status indicators are shown in the illustration.

Figure 3 - Class of Fault and Status Indications



System Fault

The controller indicates a system fault when it detects an internal fault rather than and external field fault. The controller can detect and report as a system fault the following kinds of faults:

A module fault

A fault the controller cannot isolate to an individual module. For example, the absence of every I/O module in a termination assembly group.

The System Healthy status indicator on each processor module will show red to indicate a system fault.

Module Fault

The controller indicates a module fault when it detects a fault and can isolate it to one of its module (processor or I/O module). The Healthy status indicator on the faulty module will show red and the System Healthy status indicator on each processor module will also show red.

Channel Fault

The controller indicates a channel fault when it detects a fault and can isolate it to a fault on a channel of an I/O module. The controller always reports a

channel fault and a module fault. This means that the Channel status indicator will show red, the Healthy status indicator of the I/O module will show red and the System Healthy status indicator on each processor module will also show red.

It is possible during sustained periods of abnormal field voltage and/or current slewing for channels to be declared faulted as a consequence of diagnostics otherwise designed to verify that the channels are operating within their designed safety accuracy. For details of slew rate limitations, refer to the AADvance Controller Solutions Handbook, publication ICSTT-RM447.

Field Fault

The controller indicates a field fault when it detects a fault and can isolate it to a field condition or a field device. Examples are an open circuit field connection or an out-of-range signal. The Channel status indicator on the applicable I/O module will go Amber.

I/O Module Channel Degradation and Shutdown

Input Module Non-degraded Status

Degradation for input modules is on a channel-by-channel basis. A channel is considered not degraded when all the modules in a group are on-line and none of them are reporting a fault for the specified channel. For each I/O module channel, the AADvance Workbench software or AADvance-Trusted SIS Workstation software reports the module status variable **Discrepancy** as FALSE.

- A simplex module configuration that has not degraded reports the channel values to the application.
- A dual module configuration that has not degraded reports the channel values to the application.
- A triple module configuration that has not degraded reports the values from any of the three channels in the group.

Input Module Degraded Status

A channel is considered fully degraded when no modules in a group are reporting values for that channel, or there is a fault reported on that channel for all modules in the group, and either condition exists for longer than the PST. For each I/O module channel, the AADvance Workbench software or AADvance-Trusted SIS Workstation software reports the module status variable **Discrepancy** as TRUE and the module reports 'safe' values back to the application for the faulty channel.

Degraded Channel Reporting Values

When a fault exists on a channel, the module will report safe values for that channel and the Discrepancy status variable reports TRUE.

Simplex Module Configuration

When a simplex module channel fault exists for longer than the module PST the channel shows a fault condition and the module reports the following status values:

- Channel State = 7
- Channel Input State = FALSE
- Line fault = TRUE
- Discrepancy = TRUE
- Channel fault = TRUE
- Channel reports a voltage value = 0

Dual Module Configuration

When the reported values between two input modules in dual configurations diverge by more than two times the safety margin specification for the time it takes for two application scans as follows:

- Digital input modules diverge by more than 2.0 Vdc.
- Analogue input modules diverge by 0.4 mA.

The lower of the two values will be reported and a discrepancy flag is set and the configuration degrades to a simplex operation.

Triple Module Configuration

When the reported values between modules in digital/analogue triple configuration diverge by more than two times the safety margin specification for the time it takes for two application scans, that is by the following values:

- Digital input module by more than 2.0 Vdc.
- Analogue input module by 0.4 mA.

The lower of the two values will be reported and a discrepancy flag is set and the configuration degrades to a dual operation.

Output Channel Shutdown

When an output channel is in shutdown mode the output module drives its outputs to their configured shutdown settings; for example, de-energized or hold last state. The shutdown mode and channel drive states stay in place until new command states are received from a running application, or until the module loses power.

On power up or module insertion, an output module de-energizes all channels and they stay de-energized until command states are received from a running application.

Dual Output Module Shutdown

As long as one module in a group continues to receive updated command state values from a running application in the PST, each channel is driven according to its commanded state. This covers the situation when only one module out of

a pair goes into shutdown mode with some channels energized (from a hold last state setting). This makes sure that these channels do not get stuck energized, and that the remaining module can energize or de-energize these channels according to the commanded state received from a running application.

Troubleshooting and Rectifying Module Faults

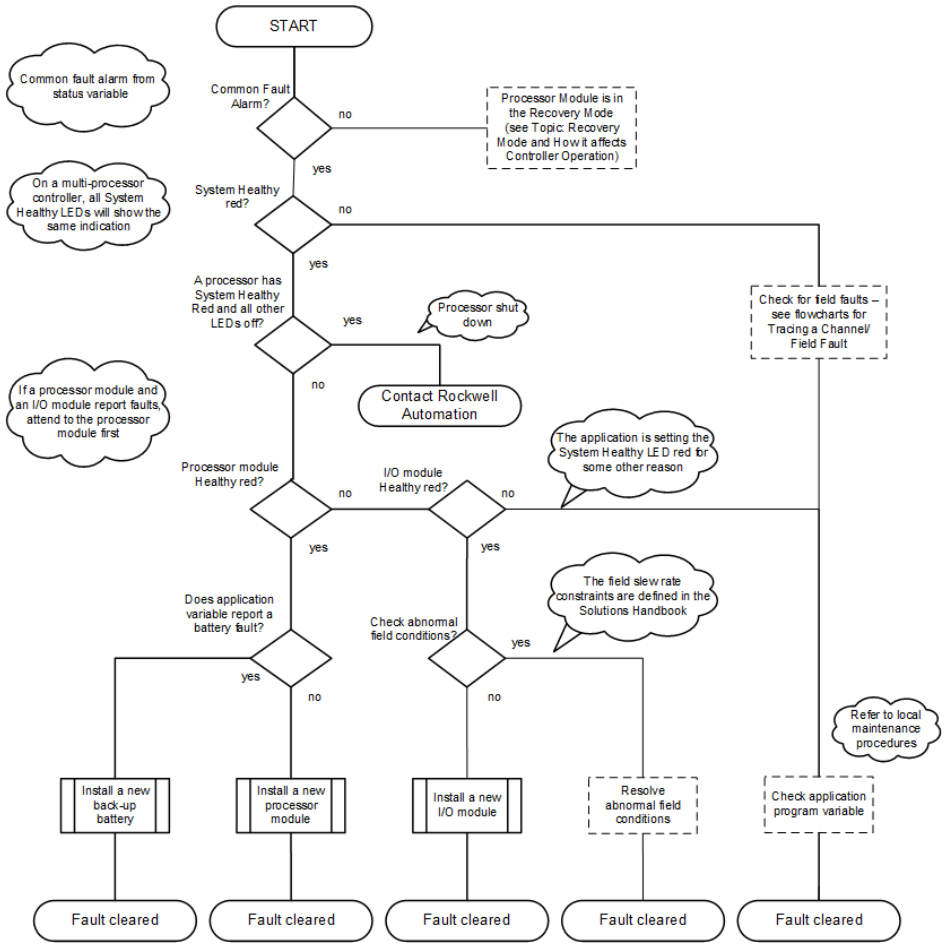
This chapter explains how to find faults and adjust a system and module fault.

ARC FLASH HAZARD: If you connect or disconnect wiring, modules, or communications cabling while power is applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Do not remove wiring, fuses, modules, or communications cabling while circuit is energized unless the location is known to be non-hazardous. Failure to follow these instructions can cause injury.

Troubleshooting Module Faults

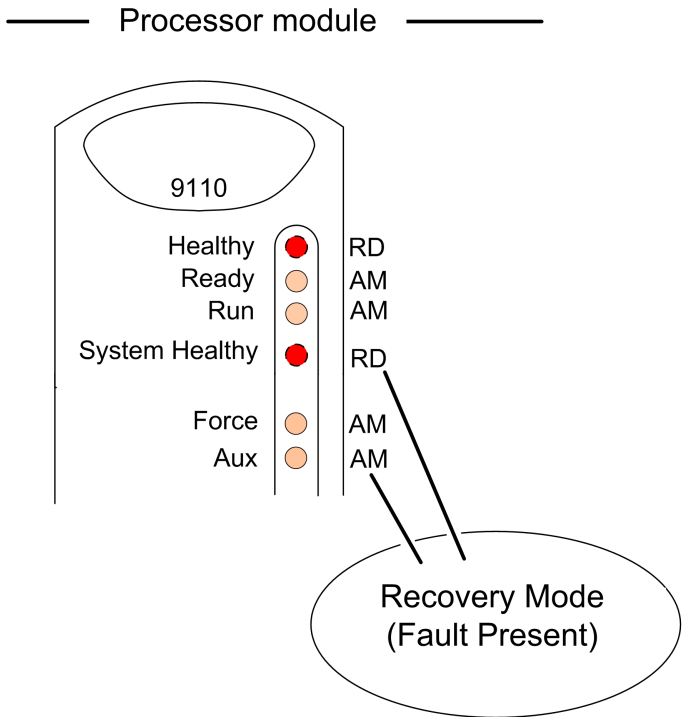
Use this flow chart to start a new fault investigation.

Figure 4 - Fault Finding Process - System Level



Rectify a Critical Processor Firmware/Hardware Failure

When a critical firmware failure occurs, such as a software watchdog failure, or a self-test detects a hardware failure, the processor module will automatically reboot into Recovery Mode. In Recovery mode the application is stopped and the following status indications occur:



- Collect the **logs from the processor** and send them to **Rockwell Automation** (http://rockwellautomation.custhelp.com) for analysis by technical support.

  alternatively,

- Install a **new processor module** and get an **RMA number** to return the **faulty module**. See Return a Module on page 12 for more information.

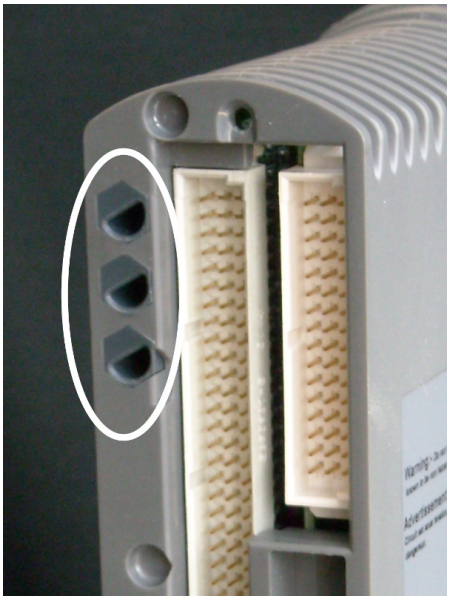
Install a 9110 Processor Module

Do the following:

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

Installation

1. Examine the coding pegs on the 9100 processor base unit and **make sure they fit the sockets on the rear of the processor module**:



2. Place the **processor module on to the coding pegs**. Make sure the **slot on the head of the module locking screw is vertical** and then **push the module home until the connectors are fully mated**.
3. Using a broad (9mm) flat blade screwdriver **turn the module locking screw clockwise to lock**.

NOTE The locking screw acts as a power interlock device and **must be locked** or the module will not boot up.

Processor Module Start Up Process

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

Table 4 - Single Processor Module Installation Procedure (New Processor Module)

Step	Task
1.	With the power switched on **place the processor module into slot A** on the Base Unit connectors and **push the module home until the connectors are fully mated**. **Turn the locking screw** and **lock the module in position**.

Table 4 - Single Processor Module Installation Procedure (New Processor Module)

Step	Task	
2.	All status indicators are off and after applying power the processor will show the following status indications:	
	Healthy	Flashes RED for a second then goes GREEN as the module boots up (10-20 seconds)
	Ready	Will stay OFF as the module boots up (10 to 20 seconds) then goes RED
	Run	Will stay OFF as the Module boots up (10 to 20 seconds) then goes RED
	System Healthy	Will stay OFF as the Module boots up (10 to 20 seconds) then goes GREEN
	Force	Will stay OFF as the Module boots up (10 to 20 seconds) then stays OFF until the module has educated.
	Aux	Will stay OFF as the Module boots up (10 to 20 seconds) then depends on data connection.
	Serial 1	Will stay OFF as the Module boots up (10 to 20 seconds) then depends on data connection
	Serial 2	Will stay OFF as the Module boots up (10 to 20 seconds) then depends on data connection
	Ethernet 1	Will stay OFF as the Module boots up (10 to 20 seconds) then depends on data connection
	Ethernet 2	Will stay OFF as the Module boots up (10 to 20 seconds) then depends on data connection
3.	Install a **Program Enable Key**. Download a **correct application** and push the **FAULT RESET button**. When a valid application is downloaded the module shows 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 (Depends on application)
	Serial 1	Depends on data connection
	Serial 2	Depends on data connection
	Ethernet 1	Depends on data connection
	Ethernet 2	Depends on data connection

Procedure for Installation of a Second and Third Processor

The second and third processor modules **must have the same firmware version as the first processor**. If the firmware revision is different **upgrade the firmware using the ControlFLASH™**.

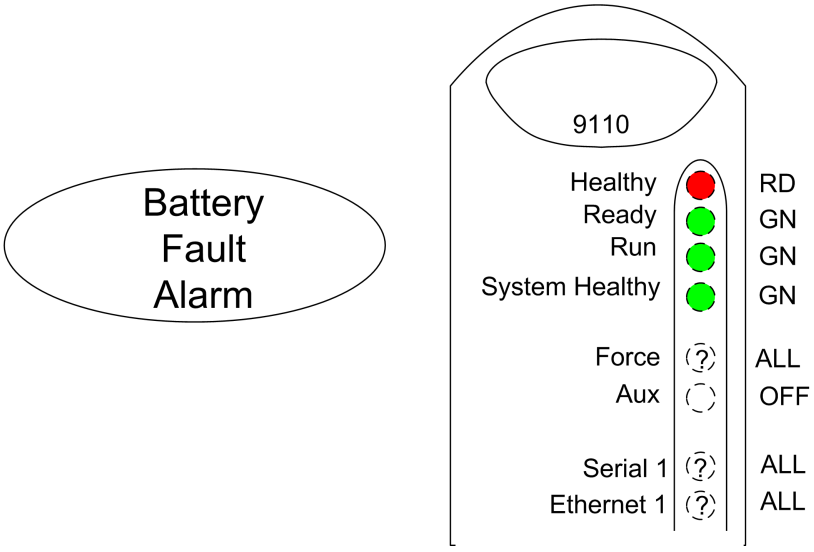
IMPORTANT	When inserting a second and third processor module they MUST be inserted one at a time and allowed to educate before inserting the next one.

Table 5 - Procedure for Installation of a Second and Third Processor

Step	Task	
1.	Place the processor module on slot B on the Processor Base Unit connectors and push the module home until the connectors are fully mated. Turn the locking screw with a flat bladed screwdriver and lock the module in position. All the Module status indicators are OFF until the module is installed. As soon as the module receives power it will boot up then educate and show the following indications:	
	Healthy	Flashes RED for a second then goes GREEN as the module boots up (10 to 20 seconds)
	Ready	Will stay OFF as the module boots up (10 to -20 seconds) then goes RED for 10 seconds then flashes GREEN as it educates and lastly it goes to steady GREEN
	Run	Will stay OFF as the module boots up (10 to 20 seconds) then goes RED until educated and then it goes AMBER
	System Healthy	Will stay OFF as the Module boots up (10 to 20 seconds) then goes GREEN
	Force	Will stay 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 stay OFF as the Module boots up (10 to 20 seconds) then is depends on data connection
	Serial 1	Will stay OFF as the Module boots up (10 to 20 seconds) then is depends on data connection
	Serial 2	Will stay OFF as the Module boots up (10 to 20 seconds) then is depends on data connection
	Ethernet 1	Will stay OFF as the Module boots up (10 to 20 seconds) then is depends on data connection
	Ethernet 2	Will stay OFF as the Module boots up (10 to 20 seconds) then is depends on data connection
When the Run indicator goes AMBER push the Fault Reset button and the processor will show the following indications:		
2.	Healthy	GREEN
	Ready	GREEN (will 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	Depends on application
	Serial 1	Depends on data Connection
	Serial 2	Depends on data Connection
	Ethernet 1	Depends on data Connection
3.	To insert a 3rd processor module repeat step 1 and insert in slot C.	

Faulty Processor Back-up Battery

The battery condition is monitored by the module diagnostics every 24 hours. If the battery voltage is low or the battery is missing, a variable and the processor module Healthy status indicator goes red indicating a faulty battery, which needs replacing.



The following variables report a faulty battery:

- Processor Module A NVRAM Battery Health
- Processor Module B NVRAM Battery Health
- Processor Module C NVRAM Battery Health

The variable details are:

- Direction: input to application from controller
- Type: BOOLEAN
- Values:
  - TRUE = the back-up battery in the 9110 processor module in the given slot is present and its voltage is within acceptable limits.

NOTE For a new processor the backup battery is supplied separately and **must be installed into each new processor module**.

Replace a Faulty Processor Back-up Battery

Use the following **official Rockwell Automation battery** or one of an equivalent specification.

Part No and Description

T9905: Polycarbon monofluoride Lithium Coin Battery, BR2032 (recommended type), 20 mm dia; Nominal voltage 3 V; Nominal capacity (mAh.) 190; Continuous standard load (mA.) 0.03; Operating temperature -30 °C to +80°C, supplied by Panasonic.

Battery design life is based on operating at a constant 25 ° C and low humidity (high humidity, temperature and frequent power cycles are all factors that will shorten the batteries operational life).

The battery has a design life of 10 years when the processor module is continually powered; for processor modules that are un-powered, the design life is up to 6 months.

CAUTION: The battery may explode if mistreated. **Do not attempt to recharge, disassemble or dispose of in a fire.**

ATTENTION: La pile peut exploser si elle est maltraitée. Ne tentez pas de la recharger, désassembler ou de la brûler.

WARNING: Batteries must only be changed in an area known to be non-hazardous.

AVERTISSEMENT: Les piles ne doivent être remplacées que dans une zone réputée non dangereuse.

Procedure

To replace a faulty battery, do the following:

1. Use a **small cross head screwdriver** to release and remove the **battery cover**.

2. Remove the **battery** by pulling on the blue ribbon.

3. Insert a **new battery**, orientate it the **positive (+) terminal to the right**. Trap the **ribbon behind the new battery** so it can be removed in the future and then push the **battery into the holder**.
4. Put the **cover back** and secure it with the cross head screw.
5. Push the **Fault Reset button** on the processor module. The processor Healthy status indicator will go green (applies if the module is part of a running system).

If the battery is replaced when more than one processor module is installed then the processor clock will be updated automatically through synchronization.

If you have previously set up SNTP when you set up your processor module then the clock will be reset to the current time automatically. If you have not set up SNTP it is recommended that you do so, as this will not only reset the processor clock but will also keep the time accurately during operation. Refer to the applicable publication for SNTP setup instructions:

- 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

The following applies:

- If the battery is replaced when only one processor module is installed and the processor module is not powered up and SNTP has not been set up, you must set the **clock** to the **current time** as soon as practicable.
- The battery does not do any function while the processor module is powered and the application is running. The Processor's Real Time Clock provides Date and Time data for SOE functions and also for the Processor diagnostic log entries.

The specific functions that the battery maintains on complete loss of power are the following:

- Real Time Clock – The battery provides power to the RTC chip itself.

- Retained Variables – Data for retained variables is stored at the end of each application scan in a portion of RAM, backed by the battery. On restoration of power, the retained data is loaded back into the variables assigned as retained variables for use by the application scan.
- Diagnostic logs – The processors diagnostic logs are stored in the portion of RAM backed by the battery.

Remote fault reset/Join

Troubleshooting Remote Fault Reset/Join

The remote fault reset/join is enabled and configured as part of the application, then triggered by a remote client writing to configured MODBUS variables. If it does not work as expected, then check the configuration and client as described below.

Trouble shooting the application

- Ensure that the **Remote Fault Reset/Join has been enabled** by configuring the enabler key to a non-zero hexadecimal value.
- Ensure the required MODBUS variables have been defined and connected to the correct outputs on the processor I/O board as follows:
  - A BOOL output, configured as a MODBUS coil, connected to the "Perform Remote Fault Reset" output.
  - A BOOL output, configured as a MODBUS coil, connected to the "Perform Remote Fault Join" output.
  - A WORD output, configured as a MODBUS holding register, connection to "Allow Remote Fault Reset MSB".
  - A WORD output, configured as a MODBUS holding register, connection to "Allow Remote Fault Reset LSB".
- Ensure "Allow MODBUS Write" is enabled for the four MODBUS variables.

Trouble shooting the remote client

- Ensure that the **client is writing the correct values** to the variables connected to "**Allow Remote Fault Reset MSB**" and "**Allow Remote Fault Reset LSB**" before triggering the reset/join. The **combined values** must match the **enabler key**.
- Ensure that the **client is writing to the correct BOOL trigger variable**, "**Perform Remote Fault Reset**" or "**Perform Remote Fault Join**", depending on the function required.
- To trigger the reset/join, the BOOL trigger variable must transition from FALSE to TRUE.

Set the 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 assists in setting the clock:

Set up the following variables in the Dictionary

RTC Control 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 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 and download the **program** or perform 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 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 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 now displays the new date and time of the processor.
6. Unlock all the **RTC Control variables**.

Troubleshooting and Rectifying Channel/Field Faults

This chapter provides recommended approaches to find and repair channel/field faults. It must be read in conjunction with the local operation and maintenance manual or equivalent documentation for your system.

ARC FLASH HAZARD: : If you connect or disconnect wiring, modules, or communications cabling while power is applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Do not remove wiring, fuses, modules, or communications cabling while circuit is energized unless the location is known to be non-hazardous. Failure to follow these instructions can cause injury.

Understanding the State Variable (<variablename>.STA)

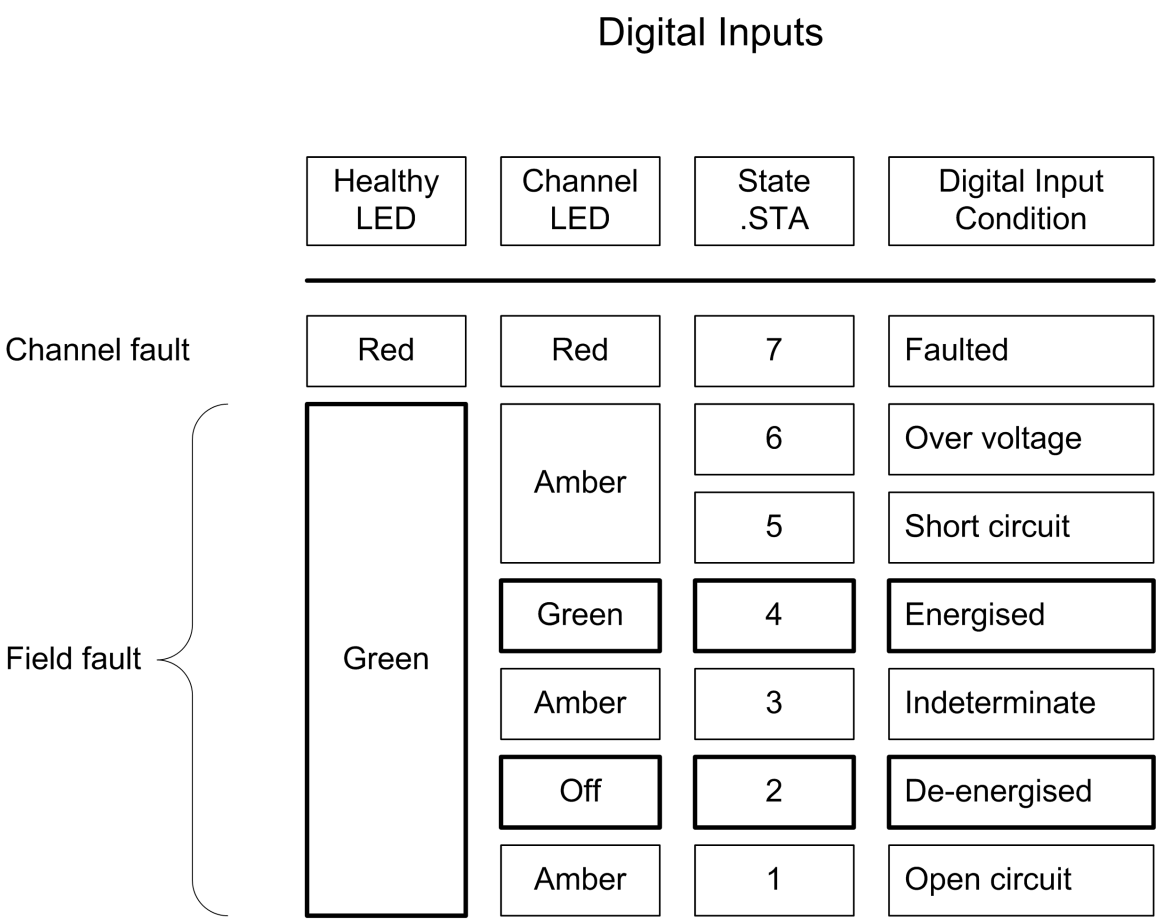
The state variable (<variablename>.STA) is one attribute of the full structure for input and output channels. The variable reports a numeric value which reflects the current state of the channel.

There are seven possible values (states) for the state variable from 1 to 7. States 2 and 4 show normal operation for digital inputs and outputs; state 3 represents normal operation for an analogue input. The other states show a fault.

The state variable updates in real time. The fault diagnosis procedures for field faults use the value of the state variable.

Correlation of Status Indicators with State Variable for a Digital Input

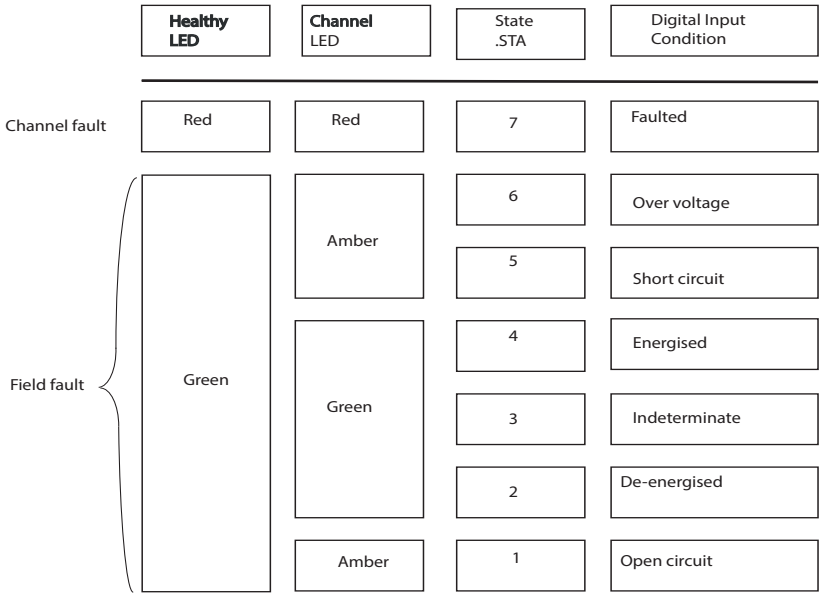
A digital input channel without line monitoring can find and report states 2, 3, 4, 6 and 7, but cannot find an open circuit or short circuit. A line monitored input can find and report every state, including an open circuit or short circuit.



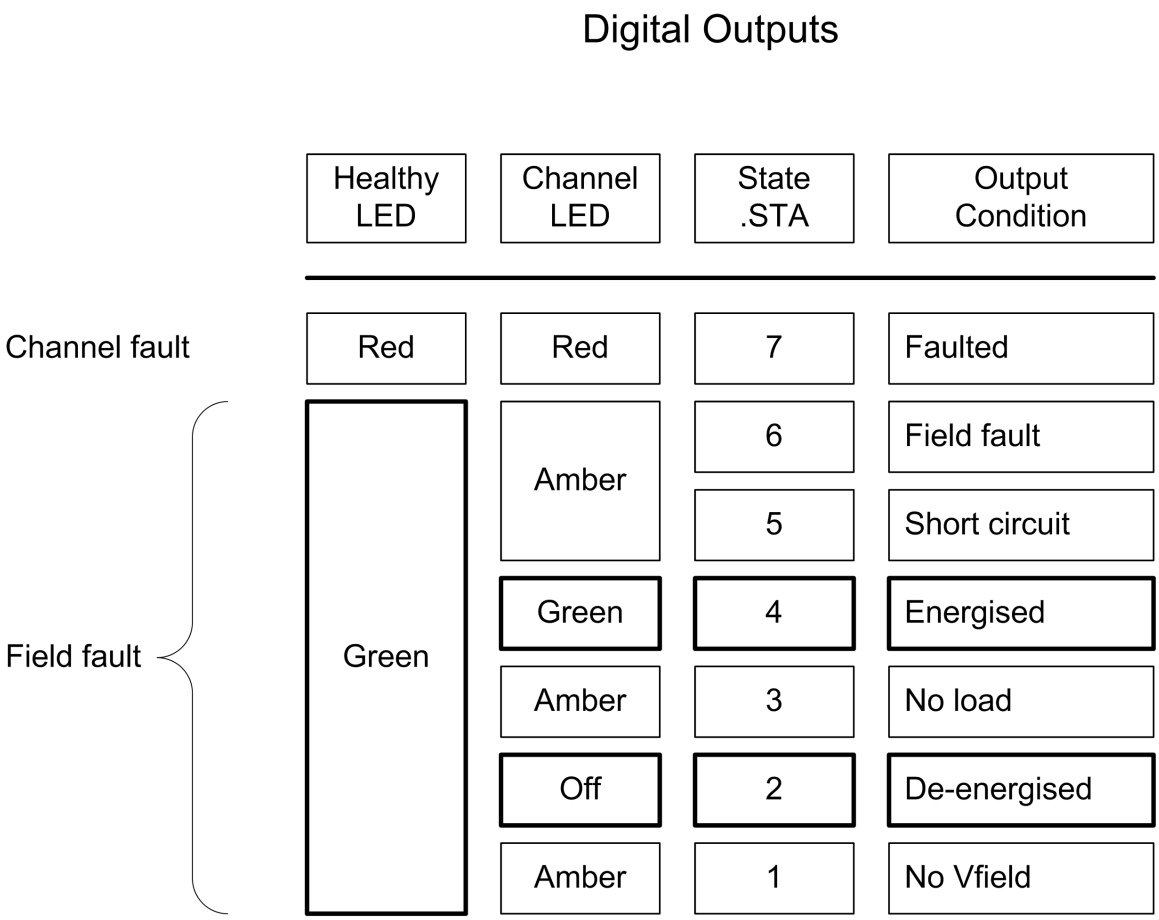
Correlation of Status Indicators with State Variable for an Analogue Input

Analogue input channels are always line monitored. An analogue input channel can detect and report every state from 1 to 7.

Analogue Inputs



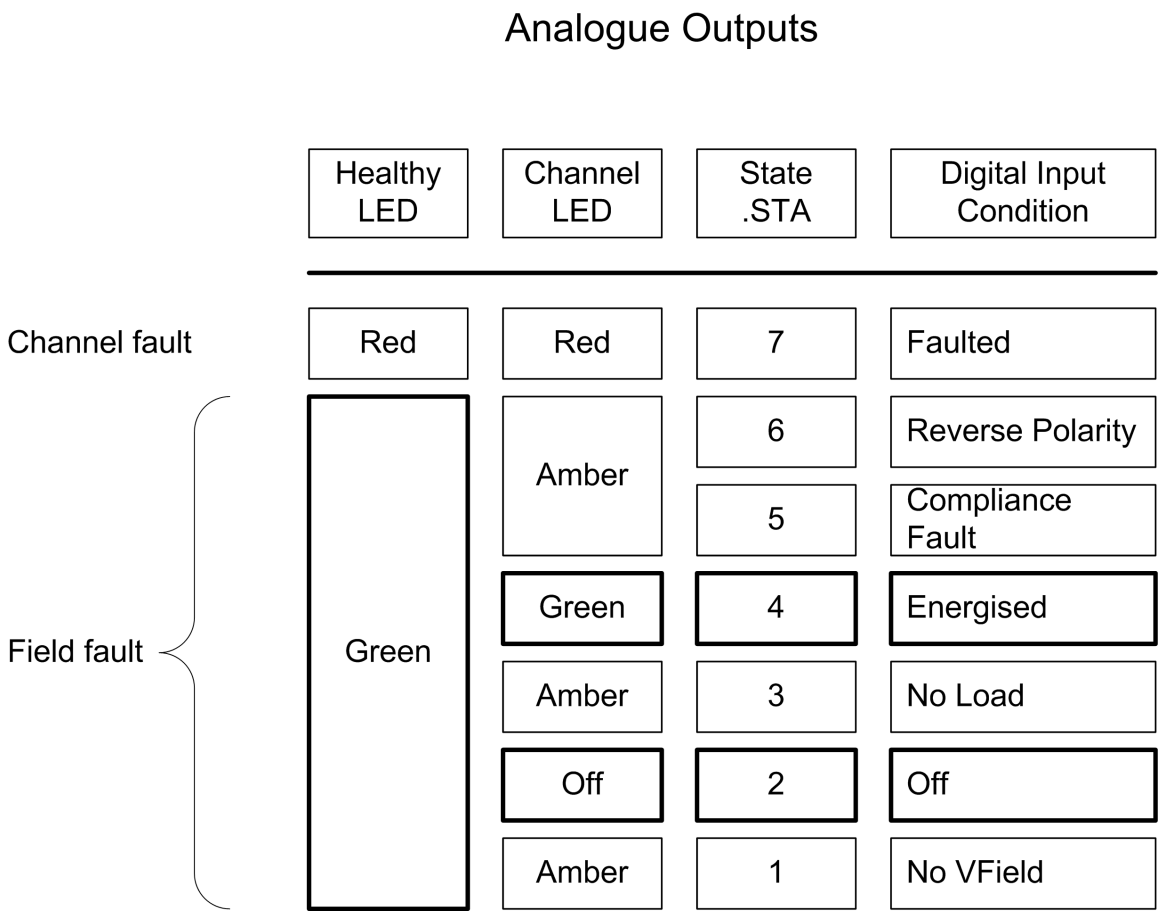
Correlation of Status Indicators with State Variable for a Digital Output



For details on how the AADvance digital output module detects field faults, see Knowledgebase Document ID: QA23147 AADvance/bulletin 1715: Digital output channel diagnostic test.

Sign in to your Rockwell Automation account to view Knowledgebase articles.

Correlation of Status Indicators with State Variable for an Analogue Output



Start Troubleshooting Channel/Field Faults

An investigation into a channel/field fault begins with a channel indication on an I/O module showing amber. Do the following:

- For digital input modules use **chart 'A'**.
- For analogue input modules use **chart 'B'**.
- For digital output modules use **chart 'C'**.
- For analogue output modules use **chart 'D'**.

Use this **circuit diagram** in conjunction with **chart 'A'**.

Figure 5 - Digital Input Circuit

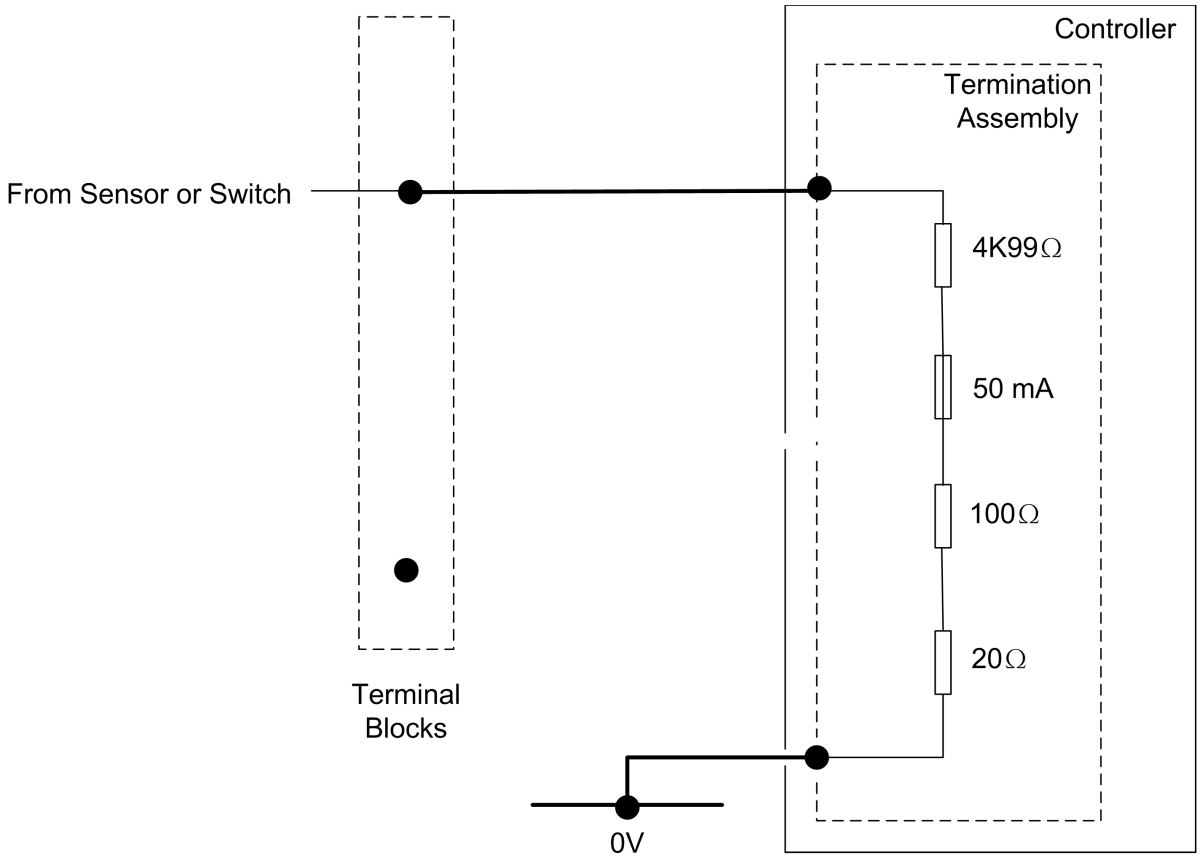
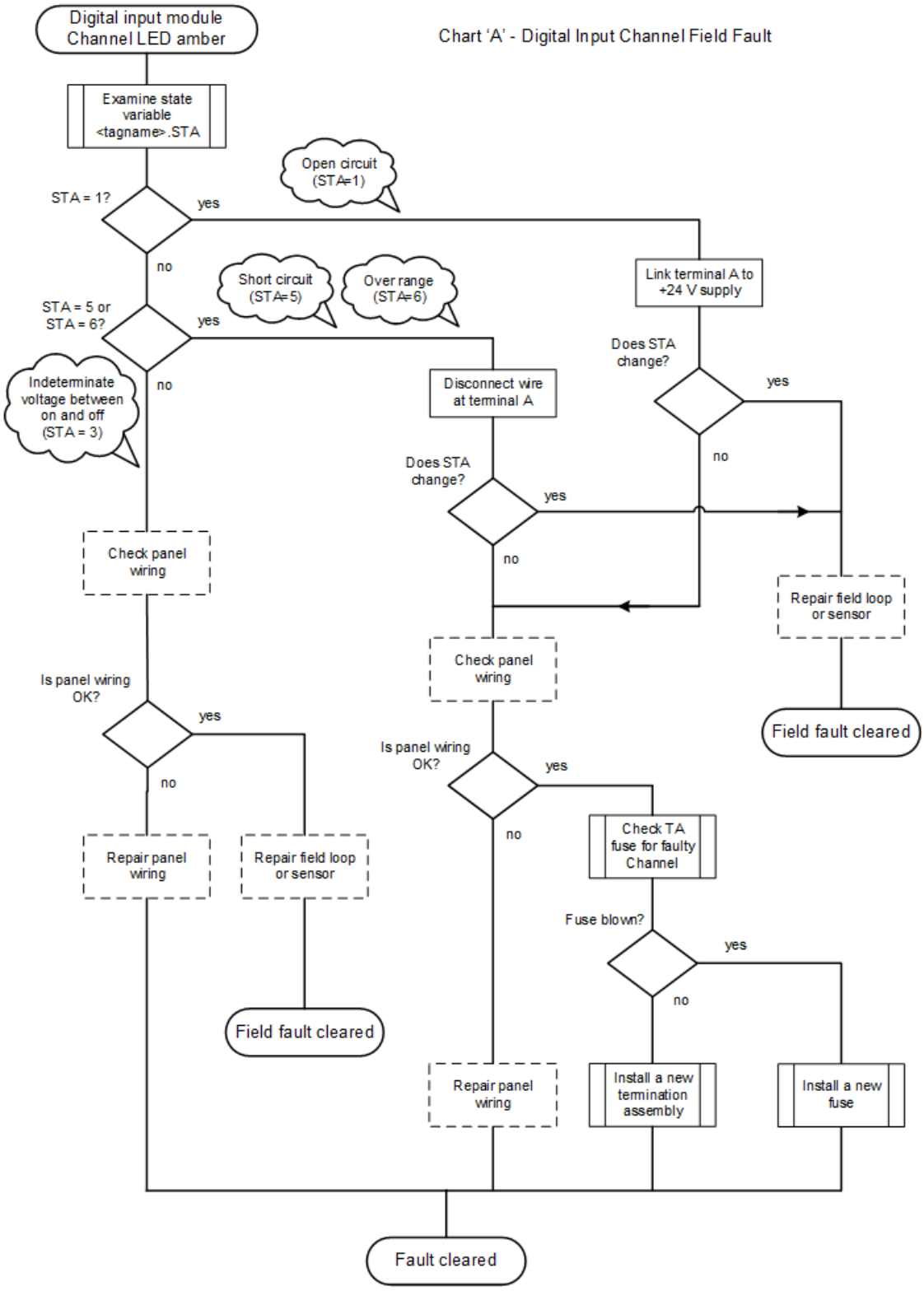


Figure 6 - Chart A: Fault finding Process Digital Input



Use this **circuit diagram** in conjunction with **chart 'B'**.

Figure 7 - Analogue Input Circuit

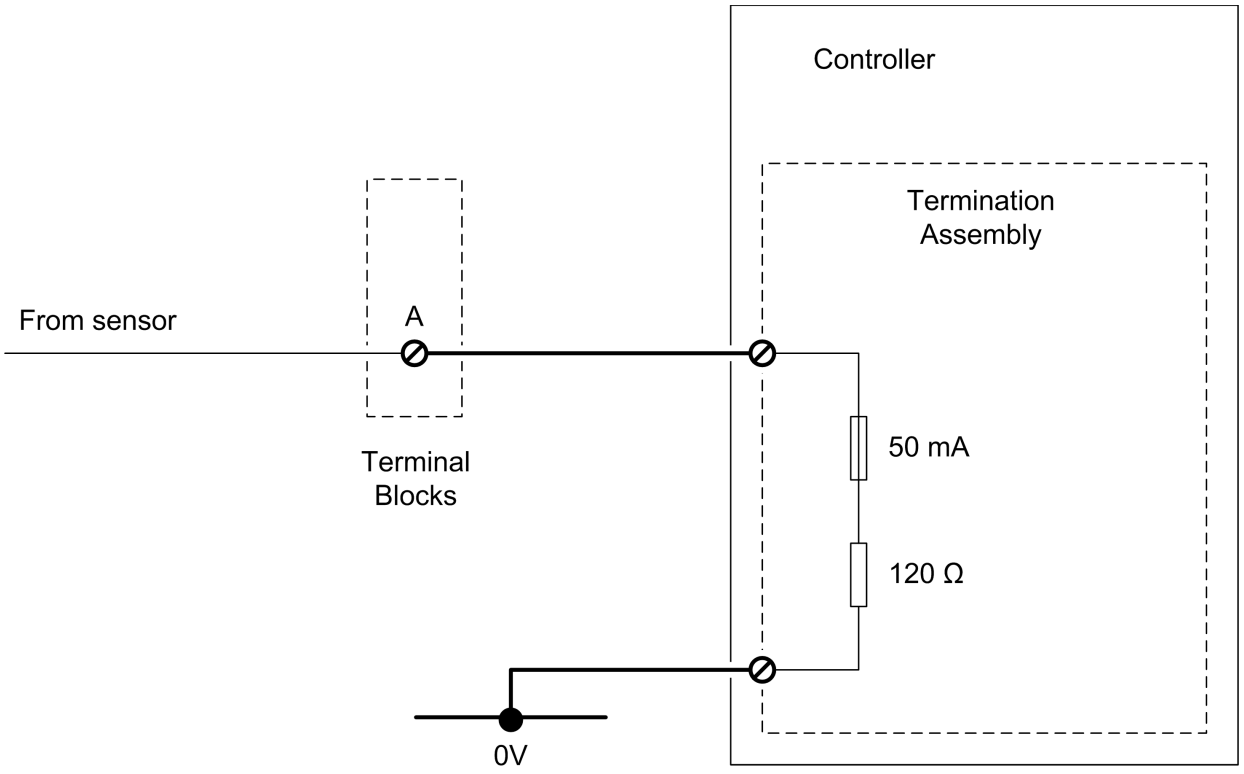
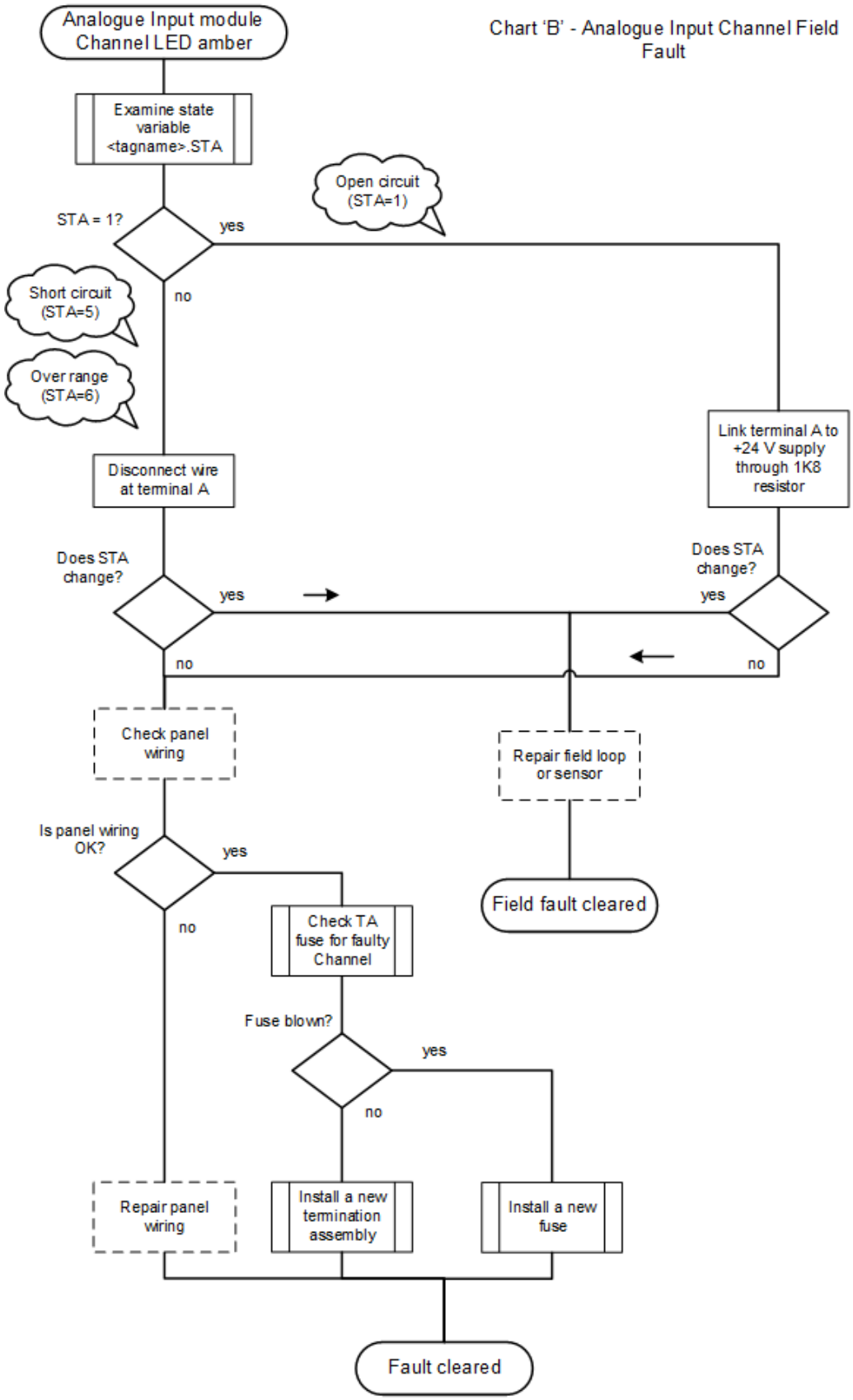


Figure 8 - Chart B: Fault Finding Process Analogue Input



Use this **circuit diagram** in conjunction with **chart 'C'**

Figure 9 - Digital Output Circuit

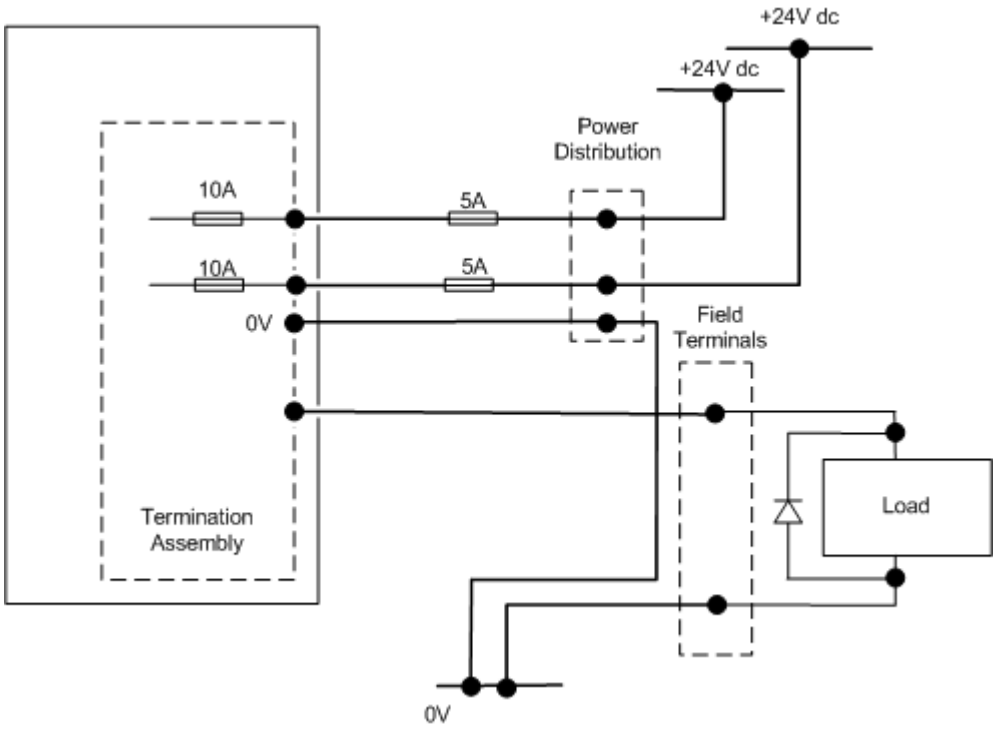
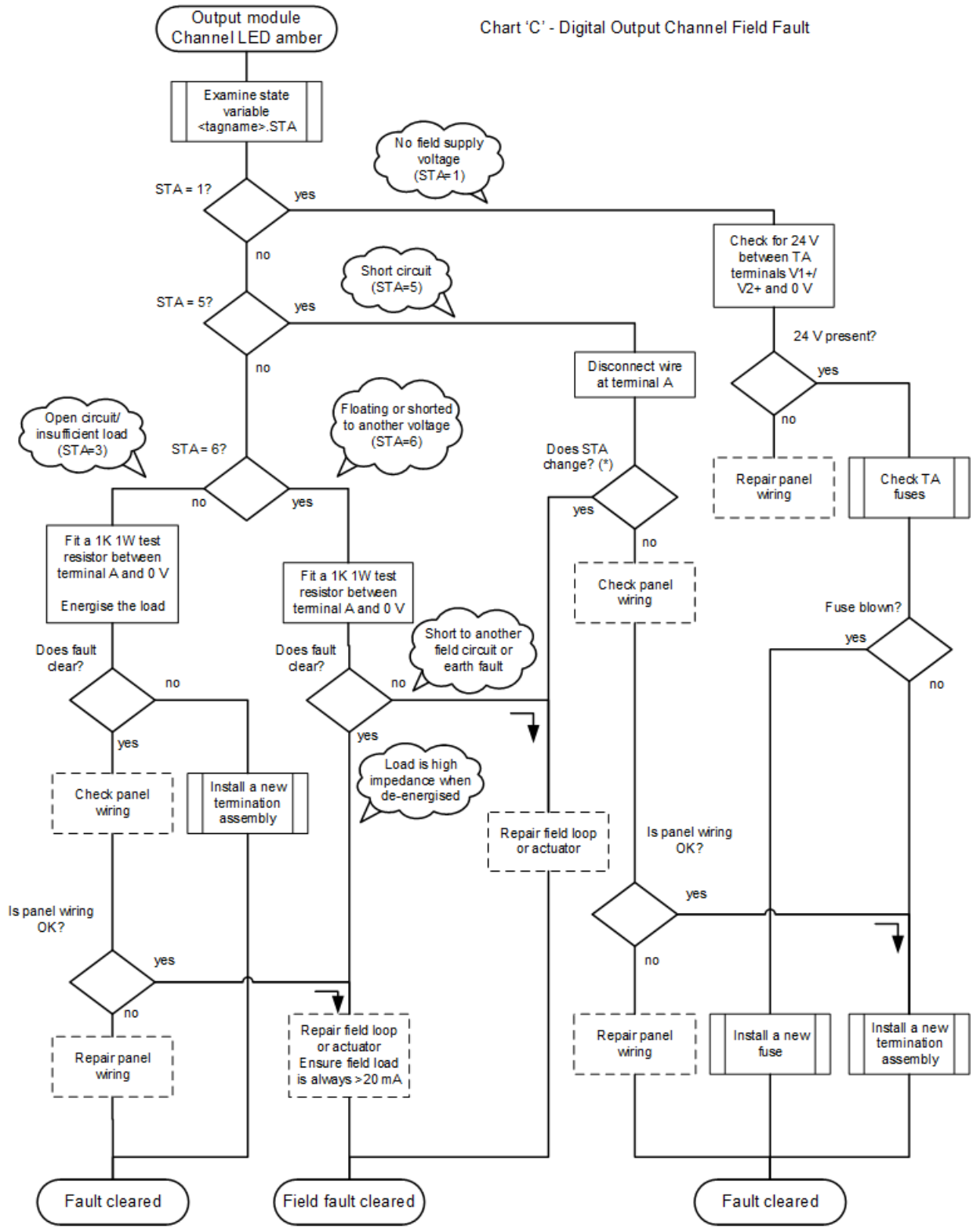


Figure 10 - Chart C: Fault finding Process Digital Output



(*) For energised outputs it will be necessary to press Fault Reset button before checking this status.

Use this **circuit diagram** in conjunction with **chart 'D'**.

Figure 11 - Analogue output Circuit

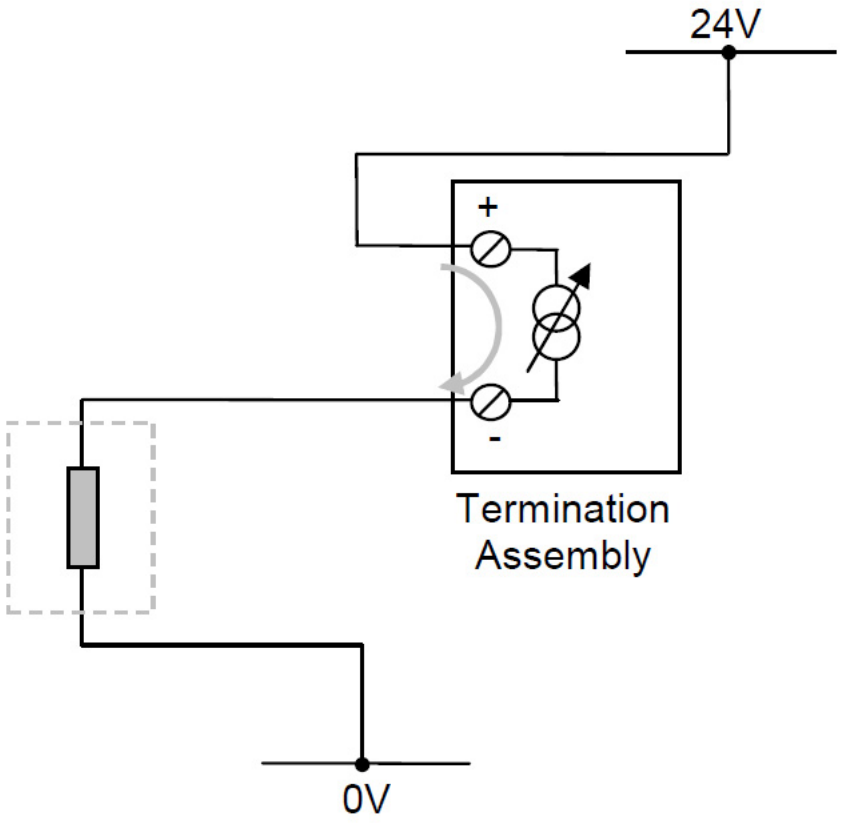
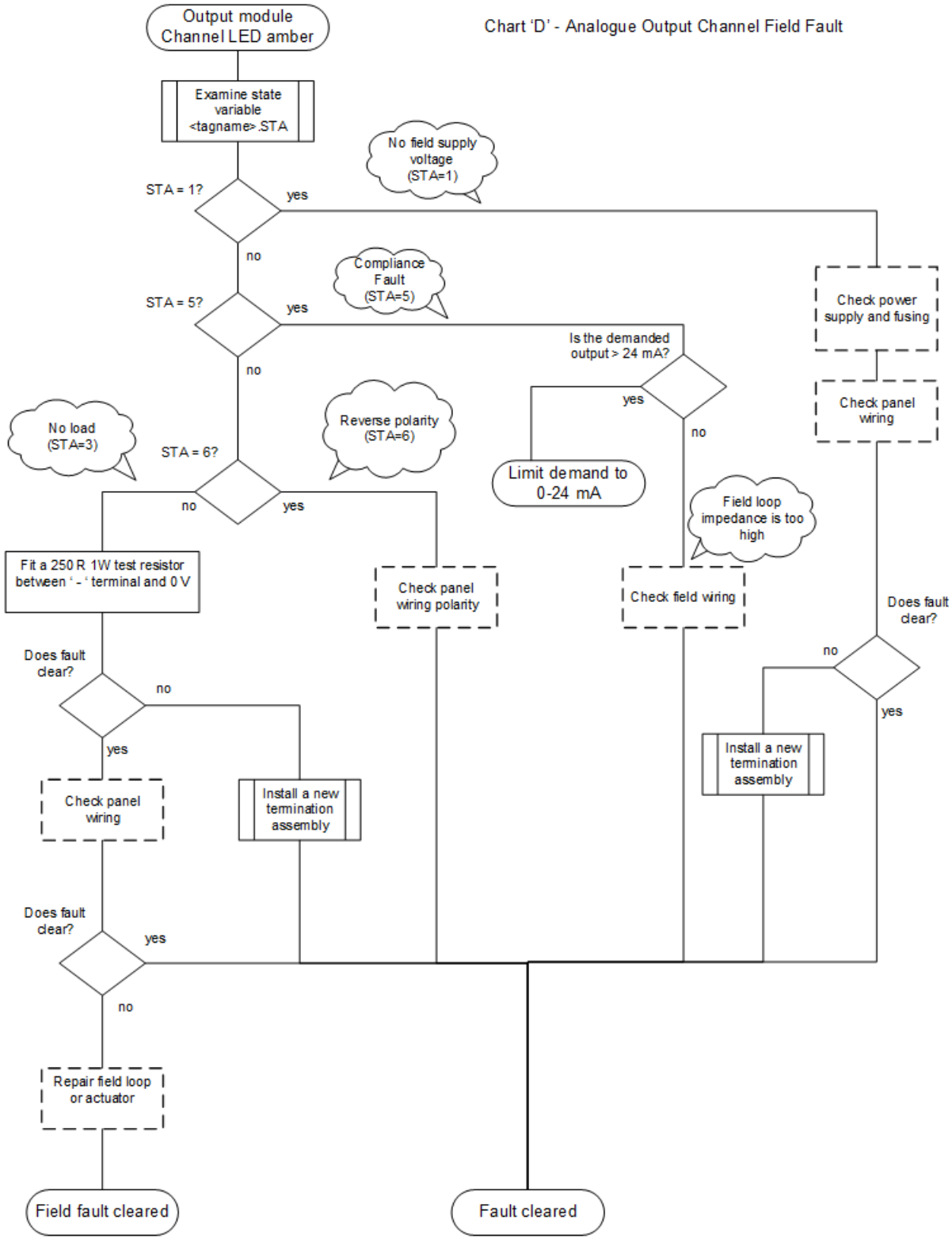


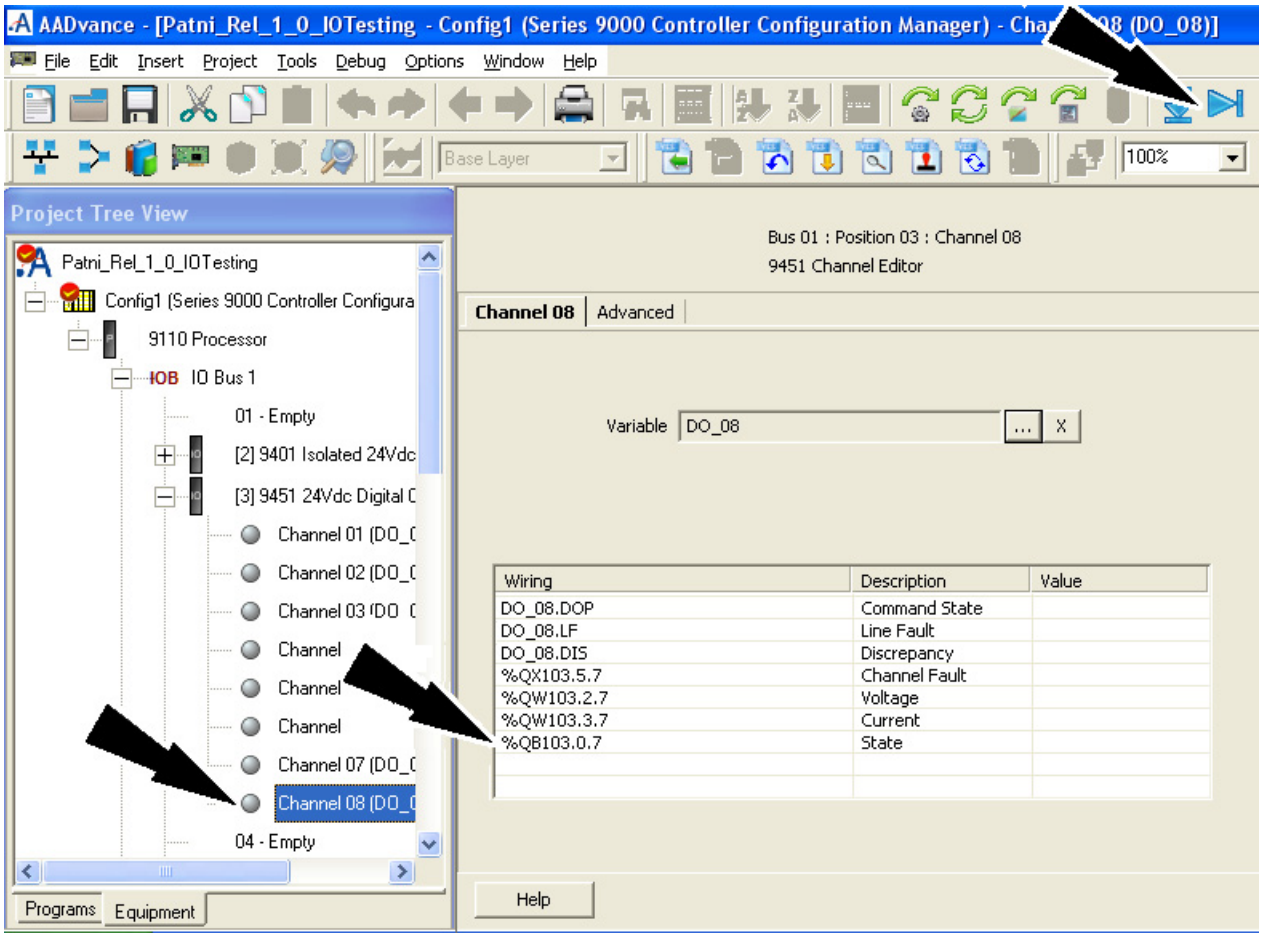
Figure 12 - Chart D: Fault finding Process Analogue Output



Examine the State Variable

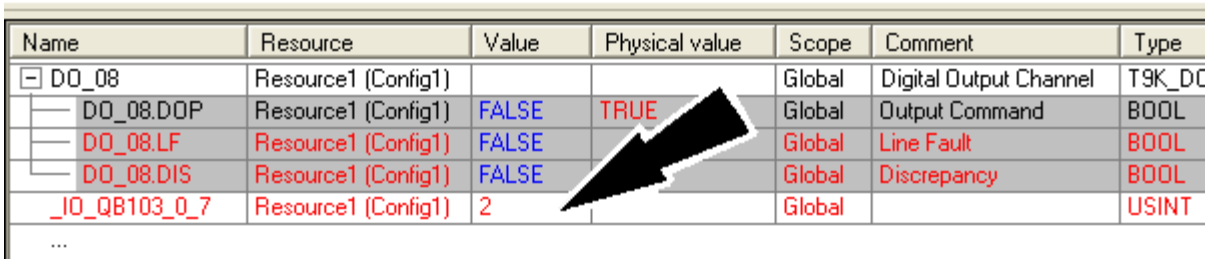
Use the State variable (**<variablename>.STA**) to find field faults. To do this, you have to identify the **Name** of the variable, and then add the variable to the Spy List:

To examine the State variable in AADvance Workbench software version 1.x:



1. Select the **Equipment tab** to use the Project Tree View to find the **channel you wish to examine**.
2. Identify the **reference for the State variable**. This will be of one of two forms:
   - %IBnnn.0.7 for an input module
   - %QBnnn.0.7 for an output module (illustrated)

   From Release 1.2, live data is available in the view shown above. For releases before Release 1.2, use the **Spy List** as identified below.
3. Select **Debug Target** and then open the **Spy List**.



4. Double-click on the **Name field**.
5. Select the **Name** for the state variable from the **drop down list**.
   - The State variable is added to the Spy list.

- The value of the State variable ('2' in this example) will update in real time to reflect the state of the I/O channel.

If the Spy List is empty, double-click on the **ellipsis** (**...**) to create the entry.

To examine the State variable in AADvance Workbench software version 2.x or AADvance-Trusted SIS Workstation software:

1. From the **Equipment View**, expand the module, and then double-click the channel to examine.
2. From the **Equipment** property page, identify the State variable.
   - Input modules: %IBnnn.0.n
   - Output modules: %QBnnn.0.n
3. Connect to the controller to see updates in real time.

   For information, refer to the online help or user manual for the product.

   The value of the State variable updates in real time to reflect the state of the
   I/O channel.

Replacing Channel Fuses

Use the following fuses for the I/O modules:

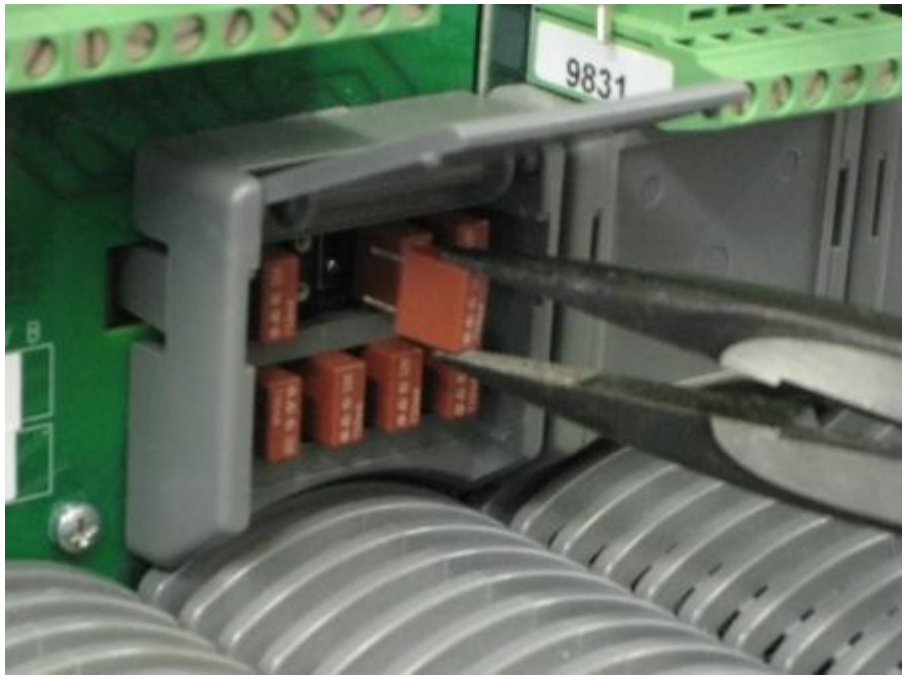
- **Digital/ Analogue Input Fuses T9901:**
  No 396/TE5 50 mA time lag fuse; UL 248-14, 125 V, Leadfree; manufactured by Littelfuse.
- **Digital Output Fuses T9902:**
  SMF Omni-Block, Surface Mount Fuse Block 154 010, with a 10 A, 125 V Fast Acting Fuse, Littelfuse.

ARC FLASH HAZARD: : In a hazardous location, make sure a circuit is de-energized before you remove or replace a fuse. If the circuit is energized it is possible to make an electrical arc and cause an explosion. Failure to follow these instructions can cause injury to persons.

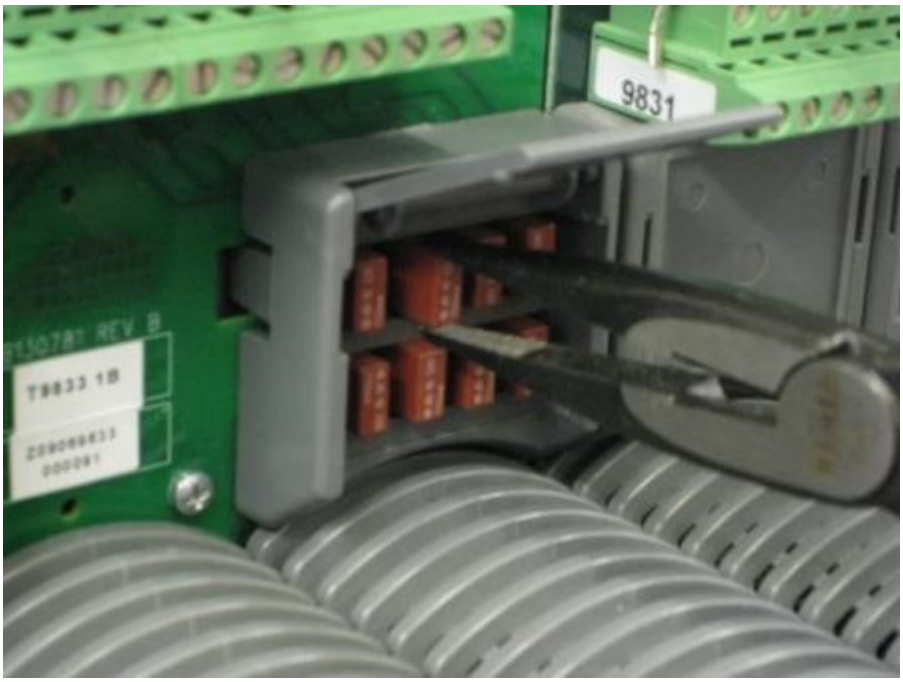
Replace an Input Channel Fuse

1. Open the **fuse cover**.

2. Find the **blown fuse** and remove it.



3. Insert the **new fuse**.



4. Close the **fuse cover**

Replacing Digital Output Fuses

To replace a fuse in a Digital Output Termination Assembly do the following:

1. Use a **small screwdriver** to open the **fuse cover**.

2. Remove the **blown fuse** with **long nosed pliers**.

3. Insert a **new fuse** using the same **long nosed pliers**.

4. Close the **fuse cover**.

Install I/O Modules

Do the following:

- Before inserting a **new I/O module**, **examine it for damage**.
- The identification labels on the sides of the I/O module will be hidden when the module is installed. Therefore before installation **write down the location of the module and the details shown on the label**.

Installation

1. Examine the **coding pegs** on the termination assembly and make sure that they **fit the sockets** on the rear of the new I/O module.
2. Place the **I/O module on to the dowel pins** on the T9300 I/O base unit. Make sure the **slot on the head of the module clamp screw is vertical** and then **push the module home** until the module connectors are fully mated with the I/O base unit and termination assembly connectors.
3. The **locking screw** requires a quarter turn clockwise to lock. Use a **broad (9mm) flat blade screwdriver** to **lock the clamp screw**. The locking screw acts as a power interlock device and must be in the locked position when power is applied otherwise the module will not be configured.

I/O Module Start-up Process

The start-up sequence is different when a module is installed into an on-line system that is running compared to installing the module into a system that is off-line and has processor modules but no I/O modules installed.

Table 6 - Single Module or First Module of a group Installation Procedure

Step	Task	
1.	This procedure applies to a single module installation or the first module of a redundant group installation.	
2	Install the I/O module and turn the locking screw to the lock position.	
3.	The input module will show the following status indications:	
	Healthy	GREEN
	Ready	RED
	Run	RED
	Channel 1 – 8	Off
4.	The input module will follow its start-up sequence and the module will educate.	
5.	After approximately 3 seconds the module will now show the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	AMBER
	Channel 1 – 8	Off
6.	Push the Fault Reset button on the processor module and the Run indication goes GREEN.	
7.	The module will now be on-line with the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	GREEN
	Channel 1 – 8	Dependent on channel status
8.	If the module fails to educate (and go on-line) replace the module.	

Table 7 - Second or third Module of a Group Installation Procedure

Step	Task	
1.	This procedure applies to a second or third module of a redundant group installation.	
2	Install the Input/Output Module and turn the locking screw to the lock position.	
3.	The module will provide the following status indications:	
	Healthy	GREEN
	Ready	RED
	Run	RED
	Channel 1 – 8	Off
4.	The input module will follow its start-up sequence and the module will educate.	

Table 7 - Second or third Module of a Group Installation Procedure

Step	Task	
5.	After approximately 3 seconds the module will now make the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	AMBER
	Channel 1 – 8	Off
6.	Push the Fault Reset button on the processor module and the Run indication goes GREEN.	
7.	The module will now be on-line with the following status indications:	
	Healthy	GREEN
	Ready	GREEN
	Run	GREEN
	Channel 1 – 8	Dependent on channel status
8.	If the module fails to educate and go on-line replace the module.	

Install a New Termination Assembly

To install a new termination assembly, do the following.

Remove the I/O Module(s)

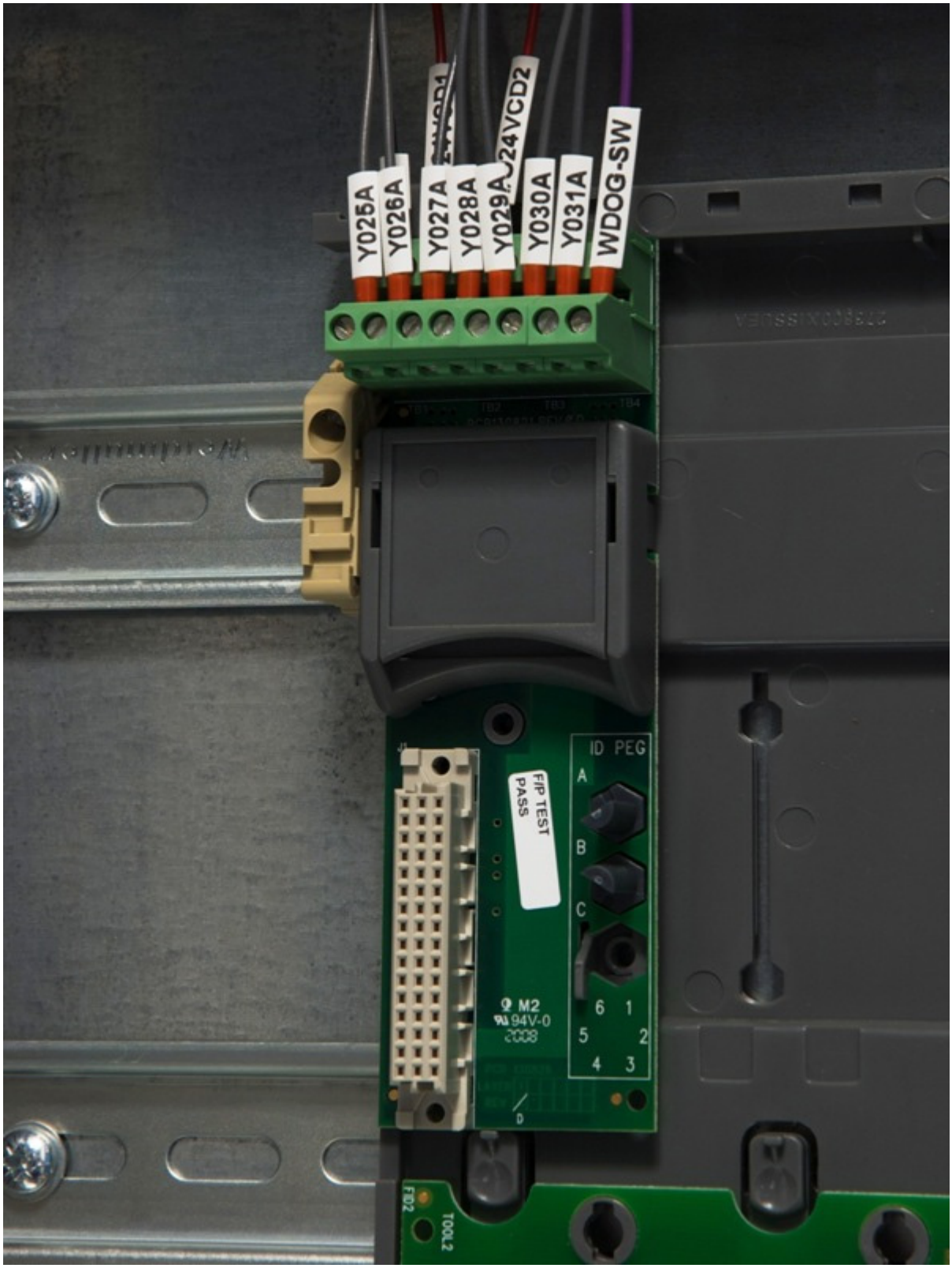
Remove each I/O module that uses the termination assembly:

1. Locate the head of the locking screw on the front of the module. Use a **broad (9 mm) flat blade screwdriver** to **turn the screw counterclockwise a quarter turn** so the slot is vertical.
2. Grasp the **module at the top and bottom** and pull it away from the **controller**.

Disconnect and Remove the Existing Termination Assembly

1. Record the identity and location of **each wire at the TA terminal block**, then **disconnect each wire**.
2. Depress the **retaining tab below the termination assembly** (multiple tabs for dual and triple modular redundant versions) and then **pull the termination assembly downwards**.
3. Lift out the **termination assembly**.

Figure 13 - Termination Assembly



Fit and Wire the New Termination Assembly

1. Insert the **retaining clip** on the back of the termination assembly into the slot on the **I/O base unit**.
   - Press the **termination assembly** onto the **base unit** and then slide the **assembly** up as far as it will go.

- Make sure each **retaining tab** clips over the **printed circuit board** to set the **termination assembly** in position.

2. Connect the **wiring** to the **screw terminal blocks**. Apply a minimum tightening torque of 0.5 Nm (0.37 ft. lb.) to the **terminal screws**.
3. Insert the **I/O modules** (refer to the I/O module installation procedure).

Operation and Maintenance Plan

An Operation and Maintenance Plan helps to make sure that functional safety can be maintained after the commissioning of the system. The in-service operation and maintenance is normally outside the responsibility of the system integrator, but the system integrator can give guidance and use procedures to make sure that the persons or organizations accountable for operation and maintenance can keep the system operating to the specified safety levels.

The Operating and Maintenance Plan must include the following items:

- Clear definitions of power up and power down sequences. These definitions must make sure that the sequences never cause resulting periods when the system cannot operate safely when a hazard is present.
- The procedures for re calibrating sensors and actuators. The recommended calibration periods must be included.
- The procedures for frequently testing the system at regular intervals, together with definitions of the maximum intervals between testing.
- Definitions of the overrides to be applied to be able to do maintenance to the sensors and actuators.
- The procedures for maintaining system security.

Input Module Calibration

The Operation and Maintenance Plan must include recommendations to measure the calibration of controller input modules.

The calibration of each analogue input module must be measured every two years; the calibration of each digital input module must be measured every five years.

Planned Maintenance

In most system configurations there will be some elements that are not tested by the system's internal diagnostics — for example, the final passive elements in I/O modules, the sensors and actuators themselves, and the field wiring.

A regime of planned maintenance testing must be specified to make sure that any faults, which could ultimately cause the system's inability to fulfill its safety functions, do not build up. The maximum interval between these tests must be specified before installation. It is highly recommended the test interval be less than the Proof Test Interval used to calculate the PFD values.

Field Device Maintenance

The Operation and Maintenance Plan must include field maintenance activities, such as re-calibration, testing and replacement of field devices.

In general, sufficient provision for these measures will be specified by the client. As long as the necessary maintenance overrides and other facilities are implemented, no other safety requirements will be necessary.

It is highly recommended the I/O forcing is NOT used during field device maintenance.

Handling Module Faults

When the AADvance controller uses modules in a dual or triple redundant configuration, the controller can continue to operate if a fault occurs on one of its modules. However, when a module does have a fault it must be replaced as recommended in the Safety Manual (all modules permit live removal and replacement in redundant configurations) to make sure that faults do not accumulate and that multiple failure conditions do not cause a plant shutdown.

On-site repair is not supported apart from for the replacement of fuses in some termination assemblies. All failed modules must be returned for repair or fault diagnosis in accordance with the warranty and return policy documentation delivered with your system.

Keeping Maintenance Records

To make sure that the safety objectives are met through the lifetime of the system it is important to keep records of all faults, failures and anomalies as they occur. This requires the maintenance of records by the end-user and the System Integrator. It is highly recommended the following data is included:

- Description of the fault, failure or anomaly
- Details of the equipment involved, together with module types and serial numbers where applicable
- When the fault was experienced and the circumstances leading to why it happened
- Any temporary measures implemented to correct or work around the problem
- Description of the resolution of the problem, remedial action plans and impact analysis

You must define the procedure for field returns, and repair and defect handling. The information requirements placed on the end user because of this procedure must be clearly documented and given to the end user. The defect handling procedure must include:

- Method of detecting product related defects and the reporting of these to the original designers
- Methods for detecting systematic failure that could affect other elements of the system or other systems, and links to the satisfactory resolution of the issues
- Procedures for tracking all reported anomalies, their temporary solutions and resultant corrective action where applicable
- The information requirements placed on the end users by this procedure must be clearly documented and given to the end user

Preserving Functional Safety

Design changes will inevitably occur during the system life-cycle; to make sure that the system safety is preserved, such changes must be carefully managed. Procedures defining the measures for updating the plant or system must be specified and documented. These procedures are the responsibility of the end user, but the system integrator must supply sufficient guidance so that the procedures keep the required level of functional safety during and after the changes.

Product Level Module and Firmware Updates

Special consideration must be given to procedures for product level module and firmware updates.

Updates to the system must include the modification adaptation for application changes and firmware changes.

The procedures must include the need to do an impact analysis of any such changes, and the measures to change the system and its application as an outcome of the adaptation requirements.

The other requirements specified here must be applied, as well as the requirements specified for the following items:

- Scope definition
- Hazard and risk analysis
- System Functional and Safety Requirements
- System engineering
- Application programming
- System production
- System integration
- Installation and commissioning

The definition of these procedures must include the examination and authorization process to be adopted for system changes.

Modification Records and Change Management

Modification records shall be created to give traceability of each requested or required change. The change management procedure must consider the impact of each such change before authorizing the change. The implementation of the change must repeat the safety lifecycle phases which are altered by the change. The test of the resultant changes must include non-regression testing as well as test of the change itself. All test results must be recorded.

Decommissioning

The procedure for decommissioning the system must be specified. This procedure must include the requirements for the safe decommissioning of the system and, where applicable, the safe removal or return of materials.

As with commissioning, it is likely the decommissioning will be performed in a phased manner. The decommissioning procedure must make sure that a plan be developed that maintains the functional safety while the corresponding hazards are present. Similarly, the physical environment of the control equipment must be maintained while the equipment is required to function.

The procedure for decommissioning must address the following items:

- The sequence in which the hazards are to be removed.
- Methods which permit the removal of interactions between safety functions while maintaining functional safety for the remaining possible hazards and without initiating safety responses. This must include the interaction between systems.
- A definition of the modules and materials which are to be returned to Rockwell Automation for ethical disposal following decommissioning.

Notes:

Parts List

Base Units

Part No.	Part Description
T9100	Processor base unit
T9300	I/O base unit (3 way)

Modules

Part No.	Part Description
T9110	Processor module
T9401	Digital input module, 24 Vdc, 8 channel, isolated
T9402	Digital input module, 24 Vdc, 16 channel, isolated
T9451	Digital output module, 24 Vdc, 8 channel, isolated, commoned
T9431	Analogue input module, 8 channel, isolated
T9432	Analogue input module, 16 channel, isolated
T9481	Analogue output module, 3 channel, isolated
T9482	Analogue output module, 8 channel, isolated

Special Modules

Part No.	Part Description
T9441	Frequency Input Module (Product not yet released. Contact Sales for more information)

Termination Assemblies

Part No.	Part Description
T9801	Digital input TA, 16 channel, simplex, commoned
T9802	Digital input TA, 16 channel, dual
T9803	Digital input TA, 16 channel, TMR
T9831	Analogue input TA, 16 channel, simplex, commoned
T9832	Analogue input TA, 16 channel, dual
T9833	Analogue input TA, 16 channel, TMR

Part No.	Part Description
T9851	Digital output TA, 24Vdc, 8 channel, simplex, commoned
T9852	Digital output TA, 24Vdc, 8 channel, dual
T9881	Analogue output TA, 8 channel, simplex commoned
T9882	Analogue output TA, 8 channel, dual
T9844	Frequency Input Module TA, Simplex, Active (not yet released)
T9845	Frequency Input Module TA, Dual, Active (not yet released)
T9846	Frequency Input Module TA, TMR, Active (not yet released)
T9847	Frequency Input Module TA, Simplex, Passive (not yet released)
T9848	Frequency Input Module TA, Dual, Passive (not yet released)
T9849	Frequency Input Module TA, TMR, Passive (not yet released)

Expansion Cable Assembly

Expansion cable assembly, comprising expansion cable and two adapters

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

Blanking Covers

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

Spares and Tools

Part No.	Part Description
T9901	Replacement input fuse 50 mA for T9801/2/3 and T9831/2/3, pack of 20 (1)
T9902	Replacement output fuse 10A for T9851/2, pack of 20 (2)
T9903	Replacement coding pegs (pack of 20)
T9904	Replacement backplane clips (pack of 20)
T9905	Replacement processor 3 V lithium cell, pack of 20 (3)
T9906	Replacement program enable key

(1) T9901: No 396/TE5 50 mA time lag fuse; UL 248-14, 125 V, Leadfree; manufactured by Littelfuse.

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

(3) T9905: Polycarbon monofluoride Lithium Coin Battery, BR2032, 20 mm dia; Nominal voltage 3 V; Nominal capacity (mAh) 190; Continuous standard load (mA) 0.03; Operating temperature -30 °C to +80 °C, supplied by Panasonic.

Software

Part No.	Part Description
T9082U	IEC 61131 Workbench, USB key, single user, single controller
T9082D	IEC 61131 Workbench, hard disk key, single user, single controller
T9083U	IEC 61131 Workbench, USB key, multiple controllers
T9083D	IEC 61131 Workbench, hard disk key, multiple controllers

Part No.	Part Description
T9084U	IEC 61131 Workbench, 5 user USB key, multiple controllers
T9087	IEC 61131 AADvance Workbench 2.x
T9090	AADvance®-Trusted® SIS Workstation software AADvance® license
T9030	OPC portal server

Demonstration Unit

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

Miscellaneous Items

Part No.	Part Description

Notes:

History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

ICSTT-RM406J-EN-P, February 2021

Change
Updated for AADvance system release 1.40 TÜV Rheinland certification
Technical improvements.
Added AADvance-Trusted SIS Workstation software information where applicable
Updated publication template.
Return a Module: Updated procedure.
View Module Firmware Versions: Added steps for AADvance Workbench software version 2.x and AADvance-Trusted SIS Workstation software.
Upgrade the processor module firmware: Updated procedures.
Latching and Non-Latching Faults: Added information for AADvance Workbench software version 2.x and AADvance-Trusted SIS Workstation software.
I/O Module Channel Degradation and Shutdown: Updated information.
Fault Finding Process - System Level: Changed *Workbench variable* to *status variable*.
Rectify a Critical Processor Firmware/Hardware Failure: Updated information.
Trouble shooting Remote Fault Reset/Join: Updated information.
Set the Real Time Clock Manually: Removed Rack from list headings.
Understanding the State Variable (<variablename>.STA): Changed *<tagname>.STA* to *<variablename>.STA*.
Correlation of Status Indicators with State Variable for a Digital Output: Updated Knowledgebase Document ID.
Examine the State Variable: Changed *tagname* to *name*. Added steps for AADvance Workbench software version 2.x and AADvance-Trusted SIS Workstation software.
Software: Added AADvance-Trusted SIS Workstation software AADvance® license. Glossary: Updated several entries.
Software: Added AADvance-Trusted SIS Workstation software AADvance® license.
Glossary: Updated several entries.

ICSTT-RM406I-EN-P, July 2019

Change
Updated for Release 1.34 IEC 61508 Edition 2.0 certification
Updated Preface release number to 1.34
Legal requirements
Updated trademarks
Removed print location

ICSTT-RM406H-EN-P, April 2018

Change
Reformat to Rockwell Automation Template

Issue 11, June 2015

Change
Correct Issue Record

Issue 10, March 2015

Change
Updates for Release 1.34

Issue 09, November 2013

Change
Release 1.33

Issue 08, June 2013

Change
Update for Release 1.3 & 1.31

Issue 07, April 2012

Change
Update Release 1.2 to add Analogue Output Module information

Issue 06, August 2011

Change
Update Release 1.2 version for TUV review comments

Issue 05, March 2011

Change
Release 1.2

Issue 04, November 2010

Change
Add fuse replacement

Issue 03, April 2009

Change
Change title and add calibration procedures

Issue 02, February 2009

Change
Update with official product titles

Issue 01, December 2008

Change
First issue

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

A

AADvance Workbench software A design, configuration, and maintenance software environment that enables the design of a multi-controller safety strategy as a single project, and then targets parts of the strategy for each controller.

AADvance-Trusted SIS Workstation software A software suite for building process control projects for use with Trusted® Series 8000 controllers or AADvance® Series 9000 controllers.

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 The output binaries produced by the compiler included in the AADvance Workbench software and AADvance-Trusted SIS Workstation software. Once compiled, download the application to the controller.

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

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

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

B

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

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

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

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

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

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

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

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

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

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

BS EN 54 A standard for fire detection and fire alarm systems.

BS EN 60204 A standard for the electrical equipment of machines, which promotes the safety of persons and property, consistency of control response and ease of maintenance.

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

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

C

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

clearance The shortest distance in air between two conductive parts.

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

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

Compiler Verification Tool (CVT) An automatic software utility that validates the output of the application compilation process.

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 or AADvance-Trusted SIS Workstation software relating to the dictionary of variables and where those variables are used in a project.

D

data access (DA) An OPC data type that provides real-time data from AADvance controllers to OPC clients.

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

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

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

DITA Digital input termination assembly.

DOTA Digital output termination assembly.

E

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

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.

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

F

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

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

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

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

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

fault warning receiving station A centre from which the necessary corrective measures can be initiated.

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

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

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

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

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

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

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

G

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

H

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

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

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

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

IEC 61000 A series of international standards giving test and measurement techniques for electromagnetic compatibility.

IEC 61131 An international standard defining programming languages, electrical parameters and environmental conditions for programmable logic controllers. Part 3, which is entitled 'Programming Languages', defines several limited variability languages.

IEC 61508 An international standard for functional safety, encompassing electrical, electronic and programmable electronic systems; hardware and software aspects.

IEC 61511 An international standard for functional safety and safety instrumented systems (SIS) for the process industry, encompassing electrical, electronic and programmable electronic systems, hardware and software aspects.

indicator A device which can change its state to give information.

input (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.

K

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

L

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

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

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

low demand mode Where the 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 Represents the configuration settings for a MODBUS Master or for its associated slave links in the AADvance Workbench software or AADvance-Trusted SIS Workstation software. The settings include communication settings and messages.

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

N

NFPA 85 The Boiler and Combustion Systems Hazards Code. Applies to certain boilers, stokers, fuel systems, and steam generators. The purpose of this code is to contribute to operating safety and to help prevent uncontrolled fires, explosions and implosions.

NFPA 86 A standard for Ovens and Furnaces. Provides the requirements for the prevention of fire and explosion hazards in associated with heat processing of materials in ovens, furnaces and related equipment.

O

on-line The state of a controller that is executing the application.

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

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

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

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

project Contains the source of the applications compiled by the AADvance Workbench software or AADvance-Trusted SIS Workstation software.

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 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 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 'project' that describes characteristics of the AADvance controller on which the project will run. Includes characteristics such as the memory model and the sizes of variable types for the controller.

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

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

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

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

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.

Notes:

Rockwell Automation Support

Use these resources to access support information.

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

Documentation Feedback

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

Waste Electrical and Electronic Equipment (WEEE)

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

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

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