



WARNING: For Continuous Mode applications the measures specified in this section for High Demand applications must be applied.

Table 8 - Modules for SIL 2 Fault Tolerant High demand Architecture

Position	Module Type
I/P A & B	2 × T9401/2 Digital Input Module, 24 Vdc, 8/16 Channel + T9802 Digital Input TA, 16 Channel, Dual or 2 × T9431/2 Analogue Input Module, 8/16 channel + T9832 Analogue Input TA, 16 Channel, Dual 1 × T9300 I/O Base unit
CPU A & CPU B	2 × T9110 Processor, T9100 Processor Base Unit
O/P A & B	2 × T9451 Digital Output Module, 24 Vdc, 8 Channel + T9852 Digital Output TA, 24 Vdc, 8 channel, T9300 Base Unit or 2 × T9481/T9842 Analogue Output Module, 3/8 Ch, Isolated + T9882 Analogue Output TA, 8 Ch, Dual and T9300 Base Unit

SIL 3 Architectures

SIL 3 architectures have at least two or three processor modules and are applicable for use with:

- SIL 3 de-energize to trip applications.
- SIL 3 energize to action applications when fitted with dual digital output modules.
- SIL 3 high demand applications where the required safe state is more than 4 mA, when fitted with dual analogue output modules (A 'safe state' is an output configured to go to a specific value, or configured to hold last state).

Faulted input modules in a SIL 3 arrangement can be replaced without a time limit; faulted output modules must be replaced within the MTTR assumed in the PFD calculations.

In all SIL 3 architectures, when the processor modules have degraded to 1001D on the first detected fault, the system must be restored to at least 1002D by replacing the faulty processor module within the MTTR assumed in the PFD calculations or all SIL 3 safety instrumented function and high demand safety instrumented functions must be shut down.

SIL 3 Fail-safe I/O, Fault Tolerant Processor

A SIL 3, fail-safe I/O with a fault tolerant processor architecture has a simplex input and output arrangement with dual or triple processor modules. The dual processor modules operate in 1002D under no fault conditions and degrade to 1001D on detection of the first fault in either module. When there are faults on both modules the configuration fails-safe.

Table 10 - Modules for SIL 3 Fault Tolerant Architectures

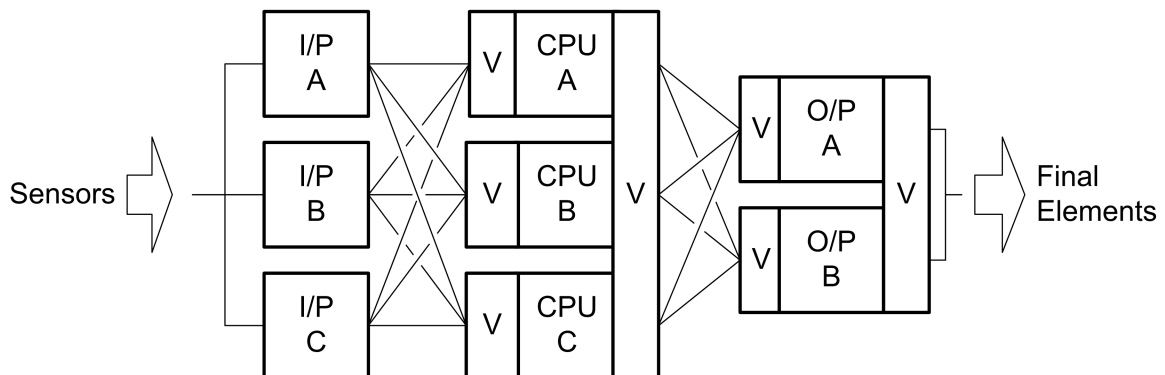
Position	Module Type
I/P A and I/P B	2 x T9401/2 Digital Input Module, 24 Vdc, 8/16 Channel + T9802 Digital Input TA, 16 Channel, Dual or 2 x T9431/2 Analogue Input Module, 8/16 Channel + T9832 Analogue Input TA, 16 Channel, Dual 2 x T9300 I/O Base Unit
CPU A & CPU B	2 x T9110 Processor Module, 9100 Processor Base Unit
O/P A and O/P B	1 x T9451 Digital Output Module, 24 Vdc, 8 Channel + T9851 Single Digital Output TA, 24 Vdc, 8 Channel for de-energize to action T9300 Base unit 2 x T9451 Digital Output Module, 24 Vdc, 8 Channel + T9852 Dual Digital Output TA for energize to action T9300 Base Unit Or 2 x T9481/T9842 Analogue Output Module, 3/8 Ch, Isolated + T9882 Analogue Output TA, 8 Ch, Dual T9300 Base Unit

SIL 3 TMR Input and Processor, Fault Tolerant Output

A SIL 3 TMR architecture offers the highest level of fault tolerance for an AADvance controller and consists of triple input modules, triple processors and dual output modules.

- The input and processor modules operate in a 2003D under no fault conditions, degrade to 1002D on detection of the first fault in any module, and degrade to 1001 on the detection of faults in any two modules and will fail-safe when there are faults on all three modules.

In the event of a failure in any element of a channel, the channel processor will still produce a valid output which could be voted on because of the coupling between the channels. This is why the triple modular redundant implementation supplies a configuration that is inherently better than a typical 2003 voting system.



Digital Output Modules

A digital output module fault must be repaired within the MTTR which was used in the PFD calculation. This rule applies to simplex digital output modules in de-energize to trip applications and to dual digital output modules in energize to action applications.

Analogue Output Modules

An analogue output module fault must be repaired within the MTTR which was used in the PFD calculation. This rule applies to simplex analogue output modules where the safe state is less than or equal to 4 mA and to dual analogue output modules where the safe state is more than 4 mA. (A 'safe state' is an output configured to go to a specific value, or configured to hold last state).

Table 11 - Modules for TMR Input and Processor, Fault Tolerant Output

Position	Module Type
I/P A	3 × T9401/2 Digital Input Module, 24 Vdc, 8/16 Channel + T9803 Digital Input TA, 16 Channel, TMR or 3 × T9431/2 Analogue Input Module, 8/16 Channel + T9833 Analogue Input TA, 16 Channel, TMR 2 × T9300 I/O Base Unit
CPU A & CPU B	3 × T9110 Processor Module, T9100 Processor Base Unit
O/P A	2 × T9451 Digital Output Module, 24 Vdc, 8 Channel + 9852 Digital Output TA, 24 Vdc 8 Channel, Dual; 1 × T9300 Base Unit Or 2 × T9481/T9842 Analogue Output Module, 3/8 Ch, Isolated + T9882 Analogue Output TA, 8 Ch, Dual; 1 × T9300 Base Unit

NOTE All configurations that use dual or triplicate processor modules are applicable for SIL 3 architectures with de-energize to trip outputs. Dual outputs are always required for SIL 3 energize to action outputs.

Certified Configurations

Revisions of modules are subject to change. A list of the released versions can be obtained from Rockwell Automation.

Table 12 - Central Modules

Modules	Certified Configuration	Conditions
Processor Module T9110	1oo2D, 2oo3D	Safety-related and can be used for safety-critical applications in SIL 2 with 2 modules fitted and SIL 3 applications with 2 or 3 modules fitted. Note: For both Low and High Demand applications you must use a minimum of two processors.

Input Modules

Table 13 - Input Modules

Modules	Certified Configuration	Conditions
Digital Inputs T9401/2, 24 Vdc, 8/16 Channel, isolated. + T9801/2/3 Digital Input TA, 16 channel, Simplex/Dual/TMR	1oo1D, 1oo2D, 2oo3D	De-energized to action (normally energized): SIL 3 with 1, 2 or 3 modules fitted. Energize to action (normally de-energized): with 1, 2 or 3 modules fitted Note: When the integrity level is at 1oo1D then the faulty module must be replaced to restore the integrity level back to 1oo2D.
Analogue Inputs T9431/2, 8/16 Channel, isolated + T9831/2/3 Analogue Input TA, 16 Channel, Simplex/Dual/TMR	1oo1D, 1oo2D, 2oo3D	Within the manufactures specified safety accuracy limits of 1 %. The safety state of the analogue input has to be set to a safe value which is a calculated value based on a count value of 0 mA. (refer to the AADvance Configuration Guide Doc Nos: ICSTT-RM405 and ICSTT-RM458 for more details) SIL 3 with 1, 2 or 3 modules fitted. Note: When the integrity level is at 1oo1D then the faulty module must be replaced within the MTTR assumed for the PFD calculations to restore the integrity level back to 1oo2D.

Table 14 - Output Modules

Modules	Certified Configuration	Conditions
Digital Outputs T8451, 24 Vdc, 8 channel + T9851/2 TA, 24 Vdc, 8 Channel, Simplex/Dual	1oo1, 1oo2 or 1oo2D	De-energize to action (normally energized): SIL 3 with 1 or 2 modules fitted. (1oo2D with dual output modules fitted). Energize to action (normally de-energized): SIL 2 with 1 module fitted and SIL 3 with 2 modules fitted. A faulty digital output module must be repaired or replaced within the MTTR which was used in the PFD calculation. This rule applies to all simplex digital output modules and to dual digital output modules in energize to action applications.
Analogue Outputs T9481/T9842 Analogue Output Module, 3/8 Ch, Isolated + T9881/T9882, TA, 8Ch, Simplex/Dual	1oo1, 1oo2 or 1oo2D	SIL 3 with 1 or 2 modules fitted where the safe state is less than or equal to 4 mA SIL 3 with 2 modules fitted where the safe state is more than 4 mA (1oo2D with dual output modules fitted). A faulty analogue output module must be repaired or replaced within the MTTR which was used in the PFD calculation. This rule applies to all simplex analogue output modules and to dual analogue output modules where the safe state is > 4 mA

Table 15 - Auxiliary Modules

Modules	Conditions
Processor Base T9100	Safety-related and can be used for safety critical applications in SIL 2 applications with 2 modules fitted or SIL 3 applications with 2 or 3 modules fitted
I/O Base T9300 (3-way)	Safety-related and can be used for safety critical applications in SIL 3.

Specify I/O Base Units

The T9300 I/O base unit (3 way) is a single, standardized design which suits all termination assemblies and I/O modules. The base unit can have one triple modular redundant assembly, one dual assembly and one simplex assembly or up to three to simplex assemblies. The dual and triple modular redundant assemblies can bridge adjacent base units, so two base units can (for example) hold three dual assemblies.

Choosing Termination Assemblies

The use of termination assemblies gives the AADvance system flexibility for creating different architectures and expanding the system. Each termination assembly is a very simple circuit that is matched to a type of I/O module and to a specified module configuration. This table shows a summary of the termination assemblies which are available and the related I/O module configurations.

Table 17 - Choosing a Termination Assembly

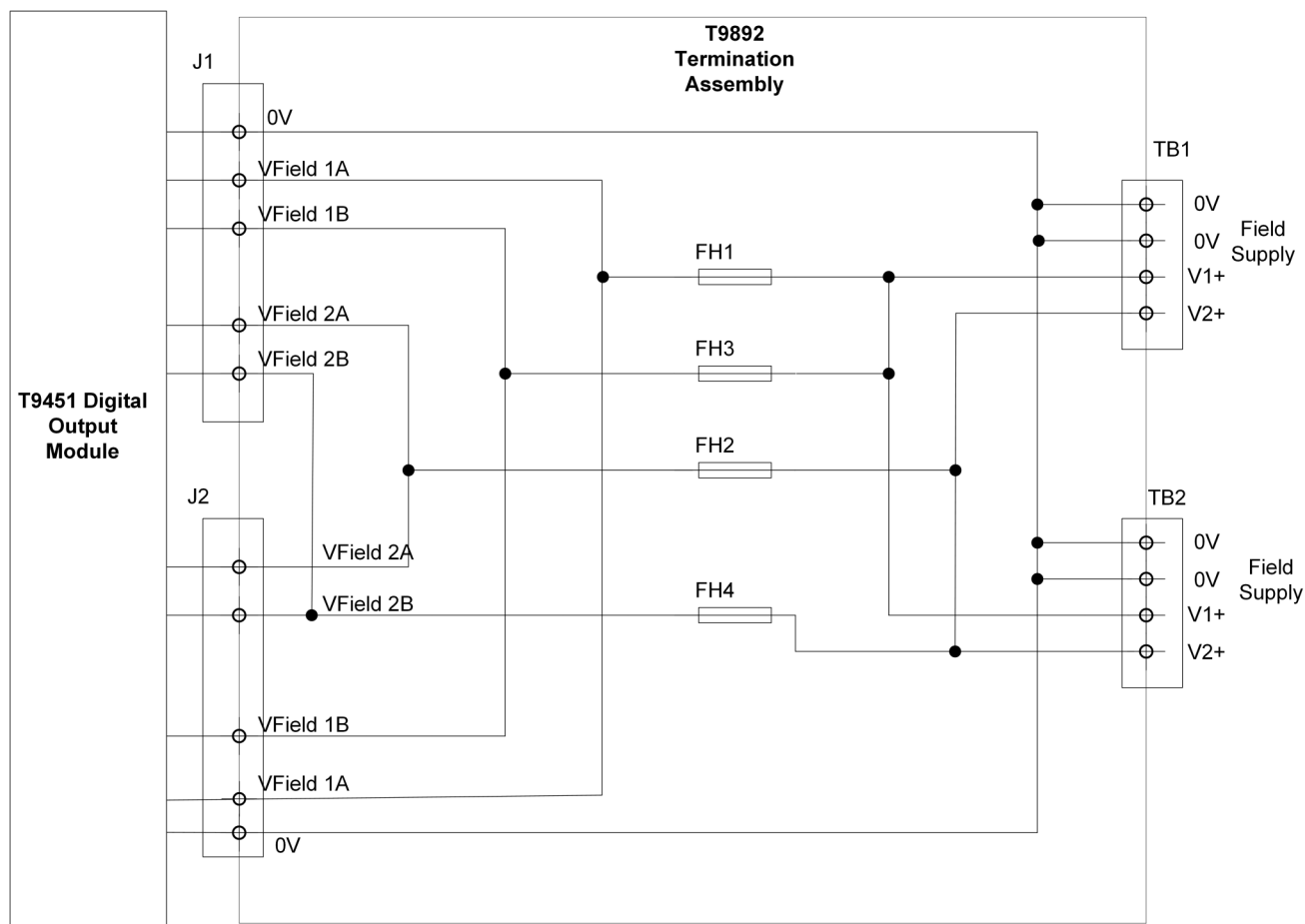
	Simplex I/O Module Configuration	Dual I/O Module Configuration	Triple I/O Module Configuration
Digital input	T9801, Digital Input TA, 16 channel, Simplex Commoned (non-isolated)	T9802, Digital Input TA, 16 channel, Dual	T9803, Digital Input TA, 16 channel, Triple
Analogue input	T9831, Analogue Input TA, 16 channel, Simplex, commoned (non-isolated)	T9832, Analogue Input TA, 16 channel, Dual	T9833, Analogue Input TA, 16 channel, Triple
Digital output	T9851, Digital Output TA, 8 channel, Simplex, commoned (non-isolated)	T9852, Digital Output TA, 8 channel, Dual (non-isolated)	Not applicable
Analogue Output	T9881, Analogue Output TA, 8 Channel, Simplex, commoned	T9882, Analogue Output TA, 8 channel, Dual	Not applicable

IMPORTANT The termination assemblies for inputs have 8-channel I/O modules and 16-channel I/O modules. A dual or triple arrangement can be made of 8- or 16-channel modules, but not a mixture of the two.

You need one termination assembly for each group of related modules. For example:

- Four T9401 digital input modules used in two, dual redundant configurations need two T9802 termination assemblies — one for each pair of modules
- Four T9401 digital input modules used for simplex inputs need four T9801 termination assemblies — one for each module

Figure 34 - Schematic T9882



T9481/2 Analogue Output Module

The T9481 and 9482 analogue output modules deliver 4 mA to 20 mA output current for field devices. Each channel is a current sink device and in simplex mode a channel drops the full demanded current. In dual module operation each channel drops half the output current.

The module features voltage and load current channel monitoring, reverse current protection and short and open circuit line monitoring. It is designed to always be able to switch off an output when demanded.

Internal diagnostics do continuous functionality checks. All module, channel and status information is displayed on front panel indicators and status data is routed to the AADvance where it can be viewed and checked. The module has a user configurable failure mode that can be set outputs to hold last state, fail safe, or a user specified output state. In dual mode the two modules communicate with each other by an inter-module link to maintain fault tolerant operation'.

This module supports HART commands #03 to collect data from the field device. The application can be configured to use HART information to monitor and respond to device conditions. It may also be used to supply diagnostic information such as comparison and error reporting.

T9881/2 Analogue Output Termination Assembly Specification

Table 34 - Analogue Output Module TA Specification

Attribute	Value
Functional Characteristics	
Field connections	8; Wiring: Conductor cross section maximum 1.31 mm ² (16 AWG); Stripping length 6mm (¼ in.)
Modules supported	T9881: One T9882: Two
Electrical Characteristics	
Channel isolation	± 1.5 kVdc maximum withstand for 1 minute
Mechanical Specification	
Dimensions (height x width)	
T9881	132 mm × 42 mm (5-¼ in. × 1-21/32 in.)
T9882	132 mm × 84 mm (5-¼ in. × 3-5/16 in.)
Weight	
T9881	133 g (5 oz.)
T9882	260 g (10 oz.)

Part No.	Part Description
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
T9907	Installation tool kit
T9908	Fuse Extractor Tool

(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
T9084U	IEC 61131 Workbench, 5 user USB key, multiple controllers
T9085	5 additional user licences, for use with T9084U