T9431/2 Analogue Input Module, 8/16 Channel

The T9431/2 analogue input has eight (T9431) or sixteen (T9432) isolated analogue input channels and measures input current in the range 0 mA to 24 mA. Each channel supplies digital state and analogue data to the processor for process monitoring. Each input has five configurable voltage bands (there are eight distinct switching thresholds to allow hysteresis), each of which can be adjusted to supply line monitoring and field device diagnostics.

The input module makes local module and channel status indications through its front panel LEDs, the same indications can be connected to application variables and viewed at the Workbench. Comprehensive diagnostics at system and module levels give clear indications which help fast maintenance and repair.

The module incorporates signal and power isolation circuits, which divide each input channel from the remainder of the system, protecting the controller from field faults. An independent watchdog arrangement monitors the module operation and supplies more fault containment by a shutdown mechanism if a fault occurs.

These modules mate with the T9831/2/3 Analogue Input termination assemblies. When analogue modules are installed in a dual or TMR configuration they supply fault tolerant input functionality, enabling you to replace input modules without interrupting the channel input data flow to the processor modules.

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 module diagnostic information such as comparison and error reporting.

Analogue Input Line Monitoring

Each analogue input module is set up through the AADvance Workbench. Monitoring levels for each input channel are configurable at both the module and channel level. The default parameters are:

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

T9431/2 Analogue Input Module Specification

Table 29 - Analogue Input Module Specification

Attribute	Value
Functional Characteristics	
Input channels:	T9431: 8 T9432: 16
Degradation	1oo1D, 1oo2D and 2oo3D
Performance Characteristics	
Safety integrity level	IEC 61508 SIL 3 (1)
Safety level degradation	1oo1D, 1oo2D and 2oo3D
Safety accuracy limit	200 µA

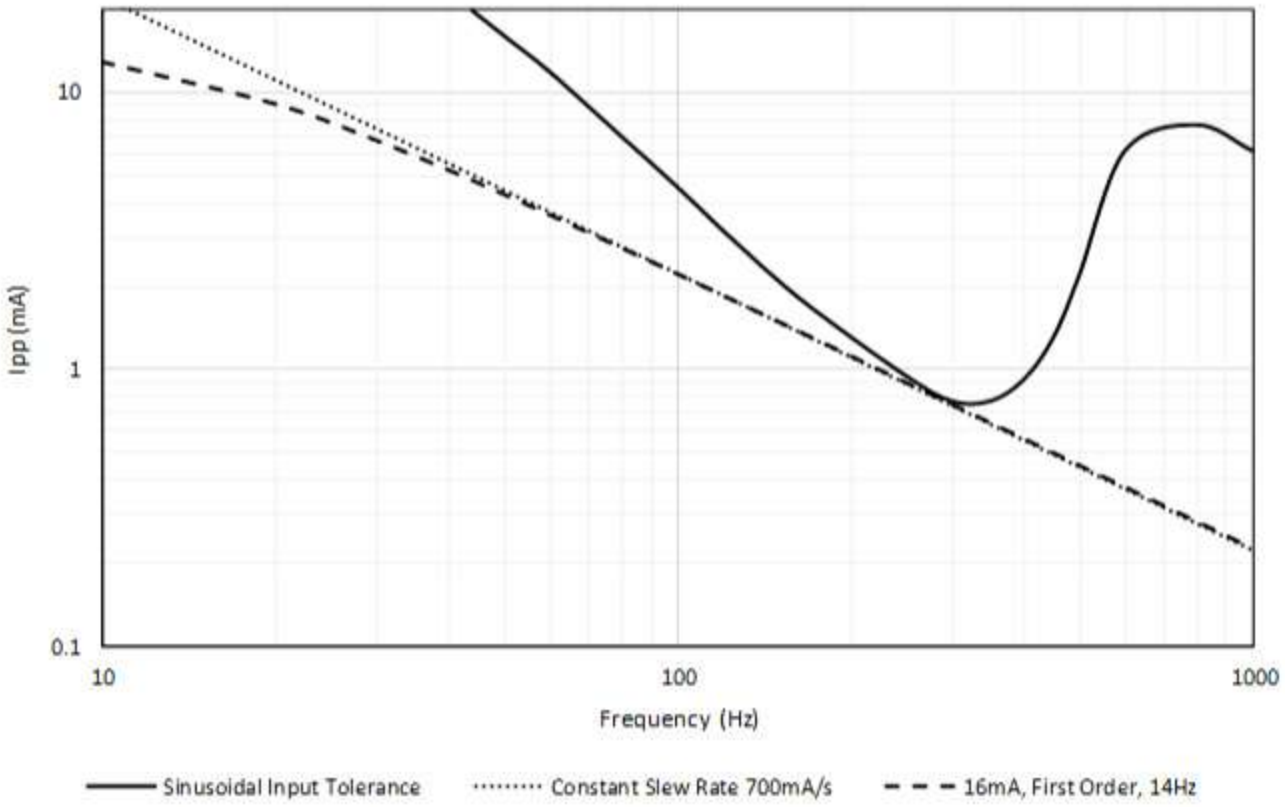
Table 29 - Analogue Input Module Specification

Attribute	Value
Self test interval	< 1 hour; system dependent
Sample update interval (no filter)	6 ms
Value of least significant bit	0.98 µA
Error at 25 °C ± 2 °C After 1 year at 40 °C After 2 years at 40 °C After 5 years at 40 °C	 0.21 % + 10 µA 0.22 % + 10 µA 0.23 % + 10 µA
Temperature drift	(0.01 % + 0.3 µA) per °C
Electrical Characteristics	
Module supply voltage:	
Voltage	Redundant + 24 Vdc nominal
Module supply power dissipation	T9431: 3.3 W (11.3 BTU/hr) T9432: 4.0 W (13.6 BTU/hr)
Input Current	
Nominal	4 mAdc to 20 mAdc
Maximum range	0 mAdc to 24 mAdc
Maximum Input Slew Rate	See Figure 32 below (2)
Input channel load	see TA Specification
Resolution	0.98 µA, 15-bit
Measurement calibrated accuracy at 25 °C	± 0.05 mA
Field loop power dissipation	see 9831/2/3 TA Specification
Channel isolation - maximum withstanding	± 1.5k Vdc for 1 minute
Mechanical Specification	
Dimensions (height × width × depth)	166 mm × 42 mm × 118 mm (6-½ in. × 1-21/32 in. × 4-21/32 in.)
Weight	T9431: 280 g (10 oz.) T9432: 340 g (12 oz.)
Casing	Plastic, non-flammable

(1) SIL 3 is the maximum achievable for a single channel. Selected CPU, input and output voting configurations could increase or decrease the correct SIL achieved.

(2) The input slew may exceed the specified levels providing the duration of the transgression is less than the process safety time of the configured module.

Figure 32 - Analogue Input Slew Tolerance



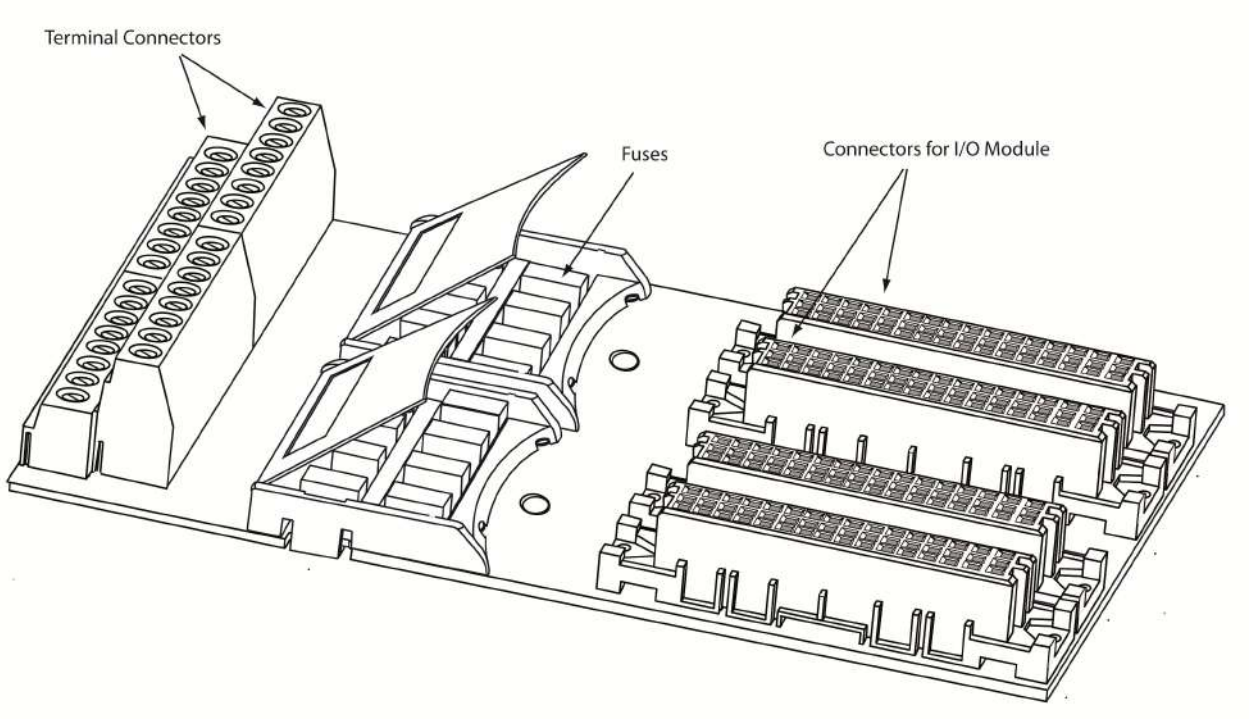
Transgression of the slew rate limits identified above may lead to channel failure resulting from diagnostics otherwise designed to verify that channels are operating within their defined safety accuracy.

T9831/2/3 Termination Assemblies for Analogue Inputs

There are three termination assemblies for use with analogue input modules for simplex, dual and triple modular redundant configurations.

A T9831 termination assembly is for a simplex application and has terminations for 16 non-isolated analogue inputs. It supports one T9431 or T9432 analogue input module. The T9832 and T9833 termination assemblies support 16 isolated analogue inputs for dual and triple modular redundant arrangements of analogue input modules. Illustrated is the T9832 termination assembly:

Figure 33 - Digital/Analogue Input Termination assembly



The termination assembly protects each sensor input signal by a 50 mA fuse. Fuses can be replaced without removing an I/O module or termination assembly.

Analogue Input Termination Assembly

A T9831 termination assembly is for a simplex configuration and has terminations for 16 non-isolated digital inputs. The T9832 and T9833 termination assemblies support 16 isolated digital inputs for dual and triple modular redundant arrangements of digital input modules.

Table 30 - T9831/2/3 Analogue Input TA Specification

Attribute	Value
Functional Characteristics	
Field connections	16; Wiring: Conductor cross section maximum 1.31mm^2 (16 AWG); Stripping length 6mm (¼ in.)
Number of input modules supported	
T9831	One
T9832	Two
T9833	Three
Electrical Characteristics	
Input channel fuses	50 mA, 125 V, Type T manufactured by Littelfuse
Channel load	(135 ± 0.2 %) Ω
Channel isolation:	

Table 30 - T9831/2/3 Analogue Input TA Specification

Attribute	Value
T9831	None
T9832/T9833	± 1.5 kVdc Maximum withstanding for 1 minute
Maximum field loop power dissipation	0.08 W for each field loop (0.27 BTU/hr)

T9451 Digital Output Module, 24Vdc, 8 channel

The T9451 digital output module has 8 channels for a maximum of 8 field elements and can switch 1 A at 32 Vdc for each device. It features voltage and load current monitoring on each channel, reverse current protection and short and open circuit line monitoring. It is designed to always be able to switch off an output when demanded. No single failure in the module can cause a stuck-on failure. The module supports dual redundant power feeds for field devices without the need for external diodes.

The output module isolates the processor module from the output channel control and data management circuits, thus protecting the processor module from possible faults in the output control circuits and field connections. An output channel protection activates when the channel load exceeds a safe limit. And, a reverse voltage protection circuit in each output channel verifies that externally applied voltages do not supply current flow into the module outputs.

The module has self-checking functionality. Short circuit and open circuit line monitoring is supplied on all outputs (see article 605753 on the Rockwell Automation Knowledgebase website). Internal diagnostics do ongoing functionality checks ensuring that the output channel command data is correctly transferred to the output. The processor module initiates a test sequence on each output channel, checking for 'stuck-on' and 'stuck-off' conditions on the output switch pairs. Front panel LEDs give module, channel and field connection status indications. These status indications can also be connected to application variables and viewed at the Workbench.

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

The AADvance Workbench has settings for individual digital output channels:

- You can specify a shutdown state for an output channel that defines how the output will behave when the module is in a shutdown mode.
- You can disable the line test feature for an output that disables detection of a no-load condition (e.g. for used output channels).

T9451 Digital Output Module Specification

Table 31 - Digital Output Module Specification

Attribute	Value
Functional Characteristics	
Output channels	8
Performance Characteristics	