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INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC Certification System for Explosive Atmospheres

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Date of Issue: 2026-02-25

Applicant: **Rockwell Automation**
1201 S 2nd Street
Milwaukee, WI 53204
United States of America

Equipment: **Programmable Logic Controllers - Trusted 8000**
Programmable Logic Controller Series

Optional accessory:

Type of Protection: **Increased Safety "ec", Non-Sparking "nA"**

Marking: All models Designated with "Series B and C"

Ex ec IIC T4 Gc

0°C ≤ Ta ≤ +60°C

All models designated with "Series A"

Ex nA IIC T4 Gc

0°C ≤ Ta ≤ +60°C

Approved for issue on behalf of the IECEx
Certification Body:

Lucy Frieders

Position:

Staff Engineer

Signature:
(for printed version)

Date:
(for printed version)

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IECEx Certificate of Conformity

Annex to Certificate No.:

IECEx ULD 17.0001X

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Model	Series	Description	Supply ratings	Input / Output ratings
T8403 T8403CX	A, B, C	Digital Input TMR 40 channel	20 - 32 Vdc, 20 W	-6VDC - 36VDC
T8431 T8431CX	A, B, C	Analogue Input TMR 40 channel	20 - 32 Vdc, 20 W	0 – 6 Vdc (0 – 22mA)
T8432	A, B	Analogue Input Dual 60 channel	20 - 32 Vdc, 4-20 mA, 20W	0 – 6 Vdc (0 – 22mA)
T8433	A, B	Analogue Input TMR – 20 channel, Isolated	20 - 32 Vdc, 21 W	0 – 2.5V signal (2 - 22 mA) 4.5 – 8V supply
T8448	A, B	Zone Interface Module	20 - 32 Vdc, 27 W	18 – 32 V dc; 2A/channel; 8A / power group
T8449	A, B	Valve Monitor Module	20 - 32 Vdc, 27 W	
T8451	A, B, C	Digital Output TMR 24 Vdc 40 channel	20 - 32 Vdc, 27 W	
T8461 T8461CX	A, B, C	Digital Output TMR 48 Vdc 40 channel	20 - 32 Vdc, 27 W	18 – 58 V dc; 0.75 A / channel; 6A / power group
T8480	A, B, C	Analogue Output TMR 40 channel	20 - 32 Vdc, 20 W	18 – 32 V dc; 1 – 22 mA / channel
T8800	A, B	Digital Input FTA 40 channel fused	18 – 32 Vdc, 0 W	6.4mA / channel
T8801	A, B	Digital Input FTA 40 channel. Non Incendive	18 - 32 Vdc, 0.5 W	6.1 mA / channel
T8802	A, B	Digital Input FTA 60 channel Fused	18 - 32 Vdc, 12 W	6.4 mA / channel
T8805	A, B	Digital Input FTA 60 channel. Non Incendive	18 - 32 Vdc; 12 W	6.1 mA / channel
T8830	A, B	Analogue Input FTA 40 channel fused	18 - 32 Vdc, 5 W	0 – 22 mA / channel
T8831	A, B	Analogue Input FTA 40 channel. Non Incendive	18 - 32 Vdc; 7 W	0 – 22 mA / channel
T8832	A, B	Analogue Input FTA 60 Channel	18 - 32 Vdc	0 – 22 mA / channel
T8833	A, B	Analogue/Digital Input 20ch, Isolated	Field loop powered; 9 W	2 - 30mA / channel
T8835	A, B	Analogue Input FTA 60 channel. Non Incendive	18 - 32 Vdc	0 – 22 mA / channel
T8842	A, B	Versatile FTA	18 - 28Vdc; <9W	2.52A Max per power group



Trusted TMR 24 Vdc Analog Input Module 40 Channel

PD-T8431 Issue 19

Rockwell Automation Publication ICSTT-RM273Q-EN-P - August 2021
Supersedes PD-T8431 Issue 18 June 2018



Resource	Description
Trusted TMR Safety Manual T8094, publication ICSTT-RM459	Provides the requirements that must be met at different stages of a safety-related system to verify that the safety-related objectives of a Trusted® TMR System are achieved.
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.

You can view or download publications at <http://rok.auto/literature>.

Product overview

The Trusted® TMR 24 Vdc Analog Input module interfaces to 40 sourcing field input devices, acting as a current sink for all these devices. Comprehensive diagnostic tests are performed on each input channel. Fault tolerance is achieved through a Triple Modular Redundant (TMR) architecture within the Module for each of the 40 input channels.

Using the built-in line-monitoring feature, the Module can detect open and shorted field cables. Line monitoring functions are independently configured for each input channel.

The Module provides onboard Sequence of Events (SOE) reporting with a resolution of 1 ms. A change of state triggers an SOE entry. States are determined by voltage thresholds that can be configured on a per channel basis. When the field voltage and field return are connected to the auxiliary input channels of the Module, thresholds can be specified as a ratio of the field supply voltage.

Features

- 40 Triple Modular Redundant (TMR) input channels per Module.
- Comprehensive, automatic diagnostics and self-test.
- Selectable line monitoring per channel to detect open circuit and short circuit field wiring faults.
- 2500V impulse withstand opto/galvanic isolation barrier.
- Onboard Sequence of Events (SOE) reporting with 1 ms resolution.
- Module can be hot-replaced online using dedicated Companion (adjacent) Slot or SmartSlot (one spare slot for many modules) configurations.
- Front panel input status Light Emitting Diodes (LEDs) for each channel indicate input status and field wiring faults.
- Front panel module status LEDs indicate module health and operational mode (Active, Standby, Educated).
- TÜV Certified IEC 61508 SIL 3.

Description

The Trusted® TMR 24 Vdc Analog Input Module is a member of the Trusted range of Input/Output (I/O) modules. All Trusted I/O Modules share common functionality and form. At the most general level, all I/O Modules interface to the Inter-Module Bus (IMB) which provides power and allows communication with the Trusted TMR Processor. In addition, all Modules have a field interface that is used to connect to module-specific signals in the field. All Modules are Triple Modular Redundant (TMR).

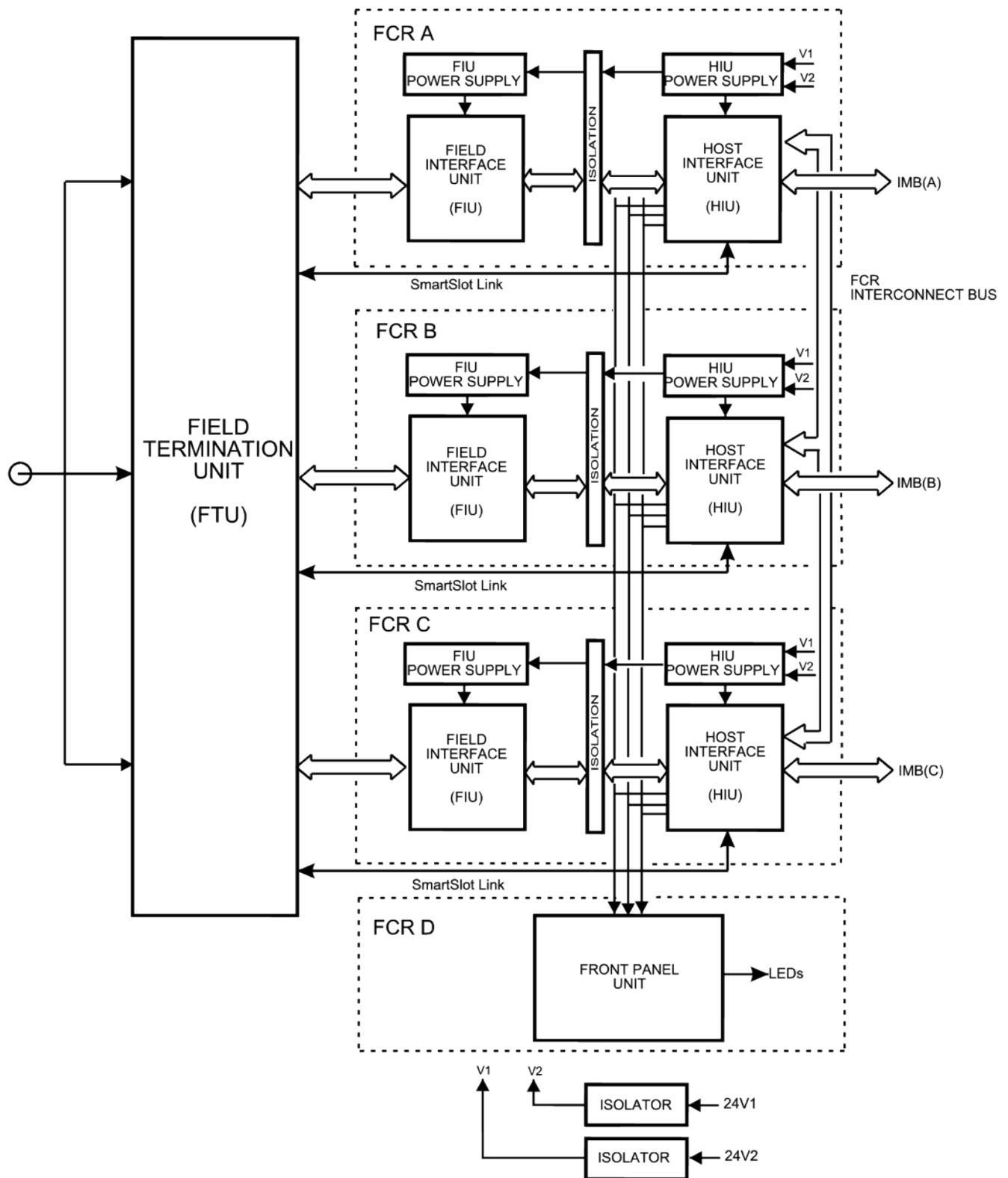


Figure 1: Module Architecture

All High Integrity I/O Modules comprise four sections: Host Interface Unit (HIU), the Field Interface Unit (FIU), the Field Termination Unit (FTU) and the Front Panel Unit (or FPU).

Figure 2 shows a simplified functional block diagram of the Trusted 24 Vdc Analog Input Module.

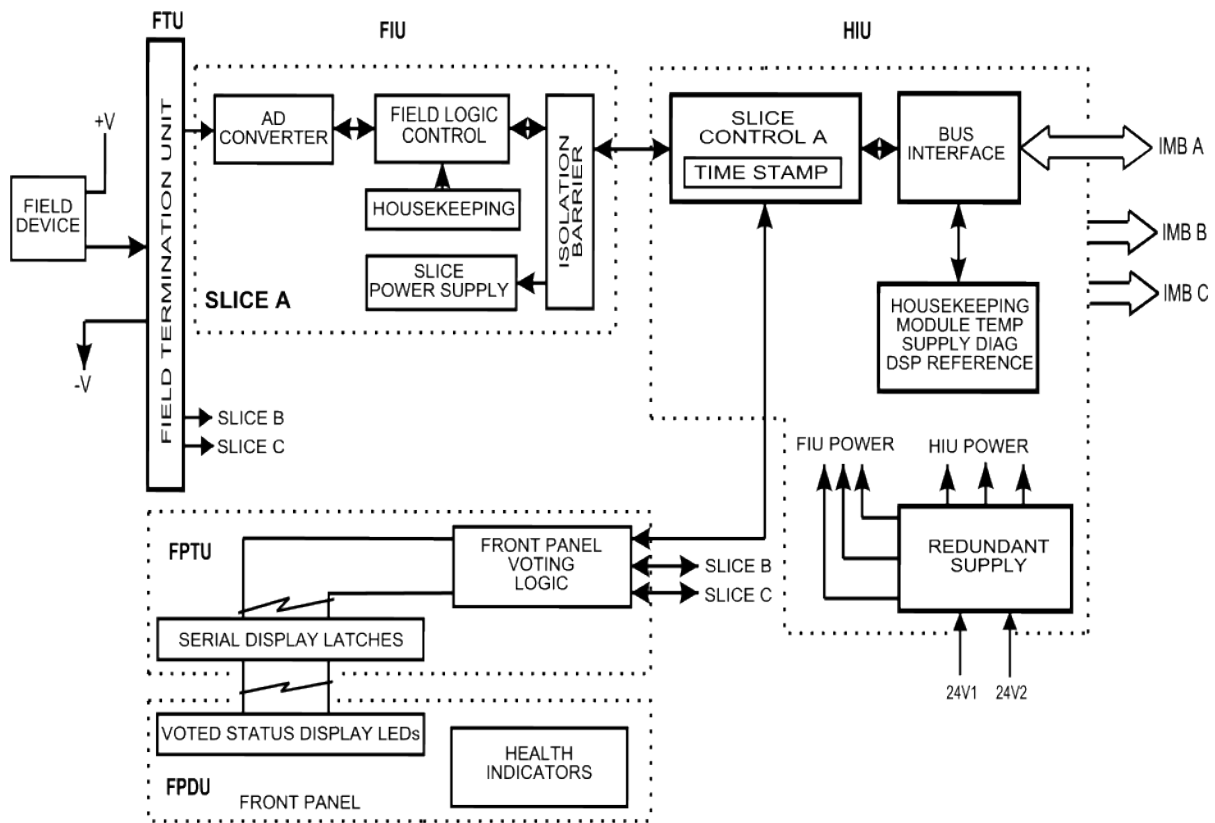


Figure 2: Functional Block Diagram

Field Termination Unit (FTU) The Field Termination Unit (FTU) is the I/O Module assembly that connects all three FIUs to a field connector. The FTU primarily contains passive components necessary for front-end signal conditioning. When installed in a Trusted Controller or Expander Chassis, the FTU field connector mates to the Field I/O Cable Assembly attached at the rear of the Chassis.

The SmartSlot link is passed from the HIU to the field connections via the FTU. These signals go directly to the I/O cable assembly and maintain isolation from the I/O signals on the FTU. The SmartSlot link is the intelligent connection between Active and Standby Modules for coordination during Module replacement.

Field Interface Unit (FIU)

The Field Interface Unit (FIU) is the section of the Module that contains the specific circuits necessary to interface to the particular types of field I/O signals. Each Module has three FIUs, one per slice. For the TMR 24 Vdc Analog Input Module, the FIU contains an analog to digital converter (ADC) for each of the 40 field inputs.

The FIU receives isolated power from the HIU for logic. The FIU provides additional power conditioning for the operational voltages required by the

FIU circuitry. An isolated 6.25 Mbit/sec serial link connects each FIU to one of the HIU slices.

The FIU also measures a range of onboard “housekeeping” signals that assist in monitoring the performance and operating conditions of the Module. These signals include power supply voltages, current consumption, onboard reference voltages and board temperature.

Host Interface Unit (HIU)

The HIU is the point of access to the Inter Module Bus (IMB) for the Module. It also provides power distribution and local programmable processing power. The HIU is the only section of the I/O Module to directly connect to the IMB Backplane. The HIU is common to most Trusted I/O Module types and has type dependent and product range common functions. Each HIU contains three independent slices, commonly referred to as A, B, and C.

All interconnections between the three slices incorporate isolation to prevent any fault interaction between the slices. Each slice is considered a Fault Containment Region (FCR), as a fault on one slice has no effect on the operation of the other slices.

The HIU provides the following services common to the Modules in the family:

- High Speed Fault Tolerant Communications with the TMR Processor via the IMB interface.
- FCR Interconnect Bus between slices to vote coming IMB data and distribute outgoing I/O Module data to the IMB.
- Optically isolated serial data interface to the FIU slices.
- Redundant power sharing of dual 24 Vdc chassis supply voltage and power regulation for logic power to HIU circuitry.
- Magnetically isolated power to the FIU slices.
- Serial data interface to the FPU for Module status LEDs.
- SmartSlot link between Active and Standby modules for coordination during Module replacement.
- Digital Signal Processing to perform local data reduction and self-diagnostics.
- Local memory resources for storing Module operation, configuration, and field I/O data.
- Onboard housekeeping, which monitors reference voltages, current consumption and board temperature.

Front Panel Unit (FPU)

The Front Panel Unit (FPU) comprises a Front Panel Termination Unit (FPTU) and a Front Panel Display Unit (FPDU). The overall FPU contains the necessary connectors, switches, logic, and LED indicators for the Front Panel. For every type of Trusted I/O Module, the FPU contains the Slice Healthy, Active/Standby and Educated indicators (LEDs), and the module removal switches. Additional bicolor LEDs provide status indication for the individual

Application

Module configuration

There is no configuration required to the physical Input Module. All configurable characteristics of the Module are performed using tools on the Engineering Workstation (EWS) and become part of the application or System.INI file that is loaded into the TMR Processor. The TMR Processor automatically configures the Input Module after applications are downloaded and during Active/Standby changeover.

The IEC 61131 TOOLSET provides the main interface to configure the Input Module. Details of the configuration tools and configuration sequence are provided in Trusted Toolset Suite Product Description, publication [ICSTT-RM249](#) (PD-T8082). There are three procedures necessary to configure the Input Module. These are:

1. Define the necessary I/O variables for the field input data and module status data using the Dictionary Editor of the IEC 61131 TOOLSET.
2. Create an I/O Module definition in the I/O Connection Editor for each I/O Module. The I/O Module definition defines physical information, e.g. Chassis and Slot location, and allows variables to be connected to the I/O channels of the Module.
3. Using the Trusted® System Configuration Manager, define custom LED indicator modes, per-channel threshold levels and noise filtering, and other Module settings.

T8431 Complex Equipment Definition

The T8431 I/O Complex Equipment Definition includes eight I/O boards, referenced numerically by Rack number:

Table 3 Complex Equipment Definition

Rack	I/O Board	Description	Data Type	Direction	No. of channels
1	THRSHIN	OEM Parameters	-	-	-
		Field Input Status	Integer	In	9
2	STATE	Field Input State	Integer	In	40
3	AI	Field Input Engineering Unit	Integer	In	40
4	THRSHOUT	Threshold data	Integer	Out	11
5	LINE_FLT	Line Fault Status	Boolean	In	40
6	DISCREP	Channel Discrepancy	Integer	In	3
7	HKEEPING	Housekeeping Registers	Integer	In	51
8	INFO	I/O Module Information	Integer	In	11

There are two OEM parameters included in the first rack (THRSHIN Board). These OEM parameters define the primary module position; declaring the Module's chassis and slot location. There is no need to define the secondary

Operation

Front panel

Status LEDs on the front of the Module provide visual indications of the module's operational status and field input status. Each LED is a tri-color LED of which for normal operation, only two colors are used; red and green. At the top and bottom of each Module is an ejector lever that is used to remove the Module from the Chassis. Limit switches detect the open/closed position of the ejector levers. The ejector levers are normally latched closed when the Module is firmly seated into the Controller or Expander Chassis.

Table 17 Module Status Indicators

LED	State	Description
Healthy	Off	No power applied to the module.
	Amber	Slice is in the startup state (momentary after installation or power-up).
	Green	Slice is healthy.
	Red - flashing	Fault present on the associated slice but the slice is still operational, or one 24V feed to the chassis has failed.
	Red (momentary)	On installation – power applied to the associated slice.
	Red	The associated slice is in the fatal state. A critical fault has been detected and the slice disabled.
Active	Off	Module is not in the Active state.
	Green	Module is in the Active (or Maintain) state.
	Red - flashing	Module is in the shutdown state if the Standby LED is off.
	Red - flashing	Module is in the fatal state if the Standby LED is also flashing.
Standby	Off	Module is not in the Standby state.
	Green	Module is in the Standby state.
	Red - flashing	Module is in the fatal state. The Active LED will also be flashing red.
Educated	Off	Module is not educated.
	Green	Module is educated.
	Green - flashing	Module is recognized by the Processor but education is not complete.
	Amber - flashing	Active/Standby changeover in progress.

I/O status LEDs

There are 40 input channel status LEDs on the Module Front Panel, one for each field input. These indicators are controlled by the FPU. The FPU receives data from each of the module slices. The FPU performs a 2003 vote on each data bit from the slices and sets the indicators accordingly.

The input status LED mode is dependent upon the voltage level of the field I/O signal. Each field input voltage is measured and compared to six threshold levels (four configurable and two fixed) which produce seven threshold bands. Each threshold band can be defined to have a particular indicator mode: off, green, red, flashing green, or flashing red.

The configurable voltage thresholds and LED modes allow users to customize the input measurement and status indications to suit individual application requirements. Without customization, the default indicator modes are suitable for analog inputs as described below:

Table 18 Default I/O Status Indicators

Channel	Description
Off	'Normal' (states 1,2,3)
Green - steady	'High alarm' (states 4,5)
Green - flashing	Over-range (state 6)
Red-flashing	Under-range (state 0) or Channel Fault (8 to 15)

Fault finding and maintenance

Fault reporting

Input Module faults are reported to the user through visual indicators (LEDs) on the Front Panel of the Module. Faults are also reported via status variables that may be automatically monitored in the application programs, and external system communications interfaces. There are generally two types of faults that must be remedied by the user; external wiring and module faults. External wiring faults require corrective action in the field to repair the fault condition. Module faults require replacement of the Input Module.

Field wiring faults

The input circuits of the Module may be used to detect field wiring faults in addition to alarm states. To achieve this, line monitoring components must be fitted to the field device.

By comparing the input signal from the field with pre-configured alarm thresholds, the Module can automatically detect field wiring faults. When a field loop develops a line fault, the input channel status LED will adopt the steady red state (default setting). The corresponding input state will be reported and the line fault status for that channel will be set to '1'. All other input channels will be unaffected, except in the case of common cause wiring faults in the field.

Once the field wiring fault has been identified and corrected, the input status and the input status LED will display the normal status of the field device and field wiring.

Module faults

Extensive diagnostics provide the automatic detection of module faults. The TMR architecture of the Input Module and the diagnostics performed ensure the validity of all critical circuits. Using the TMR architecture provides a Fault Tolerant method to withstand the first fault occurrence on the Module and continue normal input measurements without interruption in the system or process. Faults are reported to the user through the Healthy status indicators on the Front Panel of the Module and through the INFO and HKEEPING variables. Under normal operations all three Healthy Indicators are green. When a fault occurs, one of the Healthy Indicators will be flashing red. It is recommended that this condition is investigated and if the cause is within the Module, it should be replaced.

Module replacement activities depend on the type of spare module configuration chosen when the system was configured and installed. The Module may be configured with a dedicated Companion Slot or with a SmartSlot for a spare replacement module.

Specifications

This table lists the module specifications:

Item	Description
Backplane (IMB) Supply	
Voltage	20 Vdc to 32 Vdc
Power	20 W
Field Supply	N/A
Maximum Power Dissipation	20 W
Module Location	T8100, T8300 I/O Module Slot
Isolation	
Field Common	50 V Reinforced (continuous) ¹ 250 V Basic (fault) ² [Type tested at 2436 Vdc for 60 s].
Channel to Channel	None
Fusing	None
Number of Inputs	40
Input	
Impedance (FTA)	250 Ohm
Impedance (module) ³	16.967 K Ohm
Current	0 mA – 22 mA
Voltage	0 Vdc – 5.5 Vdc
Thresholds	Configurable
Resolution (LSB)	3.906 μ A
Safety Accuracy	± 200 μ A
Calibration Accuracy ⁴	± 0.15 %
Intrinsic Safety	None - External barrier required
Sequence of Events	
Event Resolution (LSB)	1 ms
Time stamp Accuracy	± 10 ms
Operating Temperature	0 °C to +60 °C (+32 °F to +140 °F)
Storage Temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Relative Humidity – Operating and Storage	10% – 95%, noncondensing
Environmental Specifications	Refer to Trusted 8000 Series International Safety and Environmental Approvals, publication ICSTI-ID003
Dimensions	
Height	266 mm (10.5 in)

¹ 50 Vrms Secondary circuit derived from Mains, OVC II up to 300V.

² 250 Vrms Mains circuit, OVC II up to 300V. Exposure to voltages at these levels shall be temporally constrained consistent with the system MTTR.

³ In the case where partner modules are fitted then the effective Module input impedance is halved.

⁴ Refer to T8094 Trusted Safety Manual for guidance on calibration maintenance.

Item	Description
Width	31 mm (1.2 in)
Depth	303 mm (12.0 in)
Weight	1.149 kg (2.5 lb)