MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

ICS TRIPLEX

T8451C

FORTY-CHANNEL DIGITAL OUTPUT MODULE

Used with the applicable Trusted TMR configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: ICS Triplex T8451C



Trusted TMR 24 Vdc Digital Output Module – 40 Channel

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Rockwell Automation

Reference Manual

Original Instructions

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Trusted release

This technical manual was updated for Trusted Release 4.0.

Latest product information

See the Trusted Release Note for the revision of this document applicable to the release at rok.auto/pcdc.

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The Trusted® TMR 24 Vdc Digital Output Module interfaces to 40 field devices. Triplicated diagnostic tests are performed throughout the Module including measurements for current, and voltage on each portion of the voted output channel. Tests are also performed for stuck on and stuck off failures. Fault tolerance is achieved through a Triple Modular Redundant (TMR) architecture within the Module for each of the 40 output channels.

Automatic line monitoring of the field device is provided. This feature enables the Module to detect both open and short circuit failures in field wiring and load devices.

The Module provides onboard Sequence of Events (SOE) reporting with a resolution of 1 ms. An output change of state triggers an SOE entry. Output states are automatically determined by voltage and current measurements onboard the Module.

This Module is not approved for direct connection to hazardous areas and should be used in conjunction with Intrinsic Safety Barrier devices.

Features

- 40 Triple Modular Redundant (TMR) output points per Module.
- Comprehensive, automatic diagnostics and self-test.
- Automatic line monitoring per point to detect open circuit and short circuit field wiring and load faults.
- 2500V impulse withstand opto/galvanic isolation barrier.
- Automatic overcurrent protection (per channel), no external fuses required.
- 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 output status light-emitting diodes (LEDs) for each point indicate output 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.
- Outputs are powered in isolated groups of eight. Each such group is a Power Group (PG).

Description

The TMR 24 Vdc Digital Output 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 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).

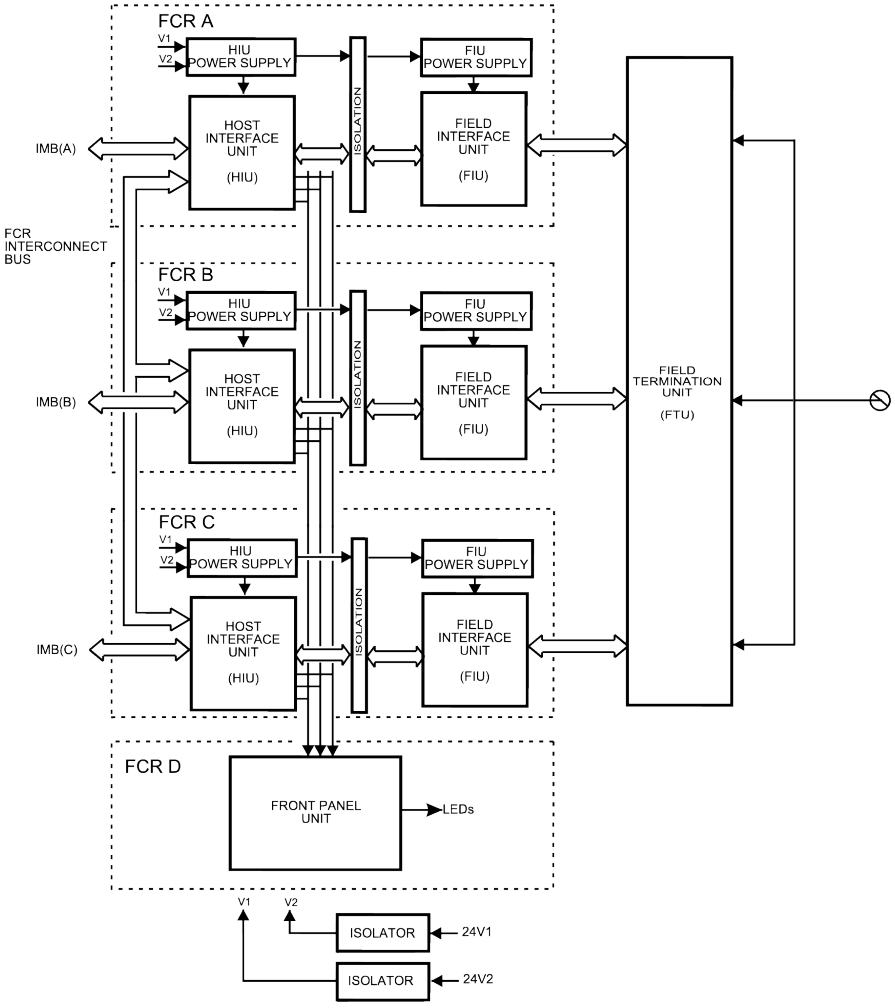


Figure 1: Module Architecture

All High Integrity I/O Modules are made up of 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 block diagram of the Trusted 24 Vdc Digital Output Module.

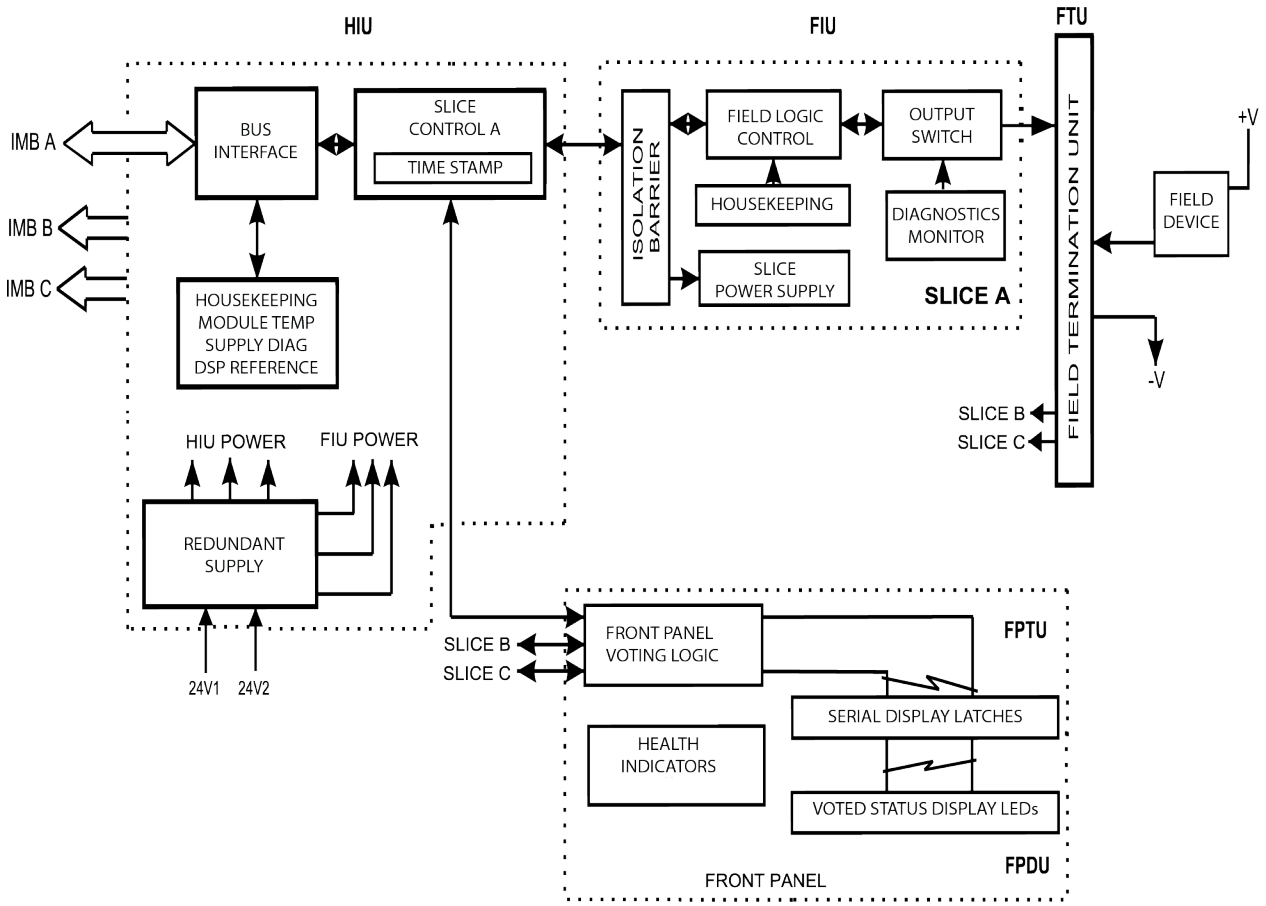


Figure 2: Functional Block Diagram

Field Termination Unit (FTU)

The Field Termination Unit (FTU) is the section of the I/O Module that connects all three FIUs to a single field interface. The FTU provides the Group Fail-Safe Switches and passive components necessary for signal conditioning, overvoltage protection, and EMI/RFI filtering. When installed in a Trusted Controller or Expander Chassis, the FTU field connector interconnects 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 field connector 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 Digital Output Module, the FIU contains one stage of the output switch structure,

Periodically, the TMR Processor commands the onboard Digital Signal Processors (DSPs) to perform a Safety Layer Test (SLT). The SLT results in the DSP verifying with the TMR Processor its ability to process data with integrity. In addition, the DSP uses Cyclical Redundancy Checks (CRC) to verify the variables and configuration stored in Flash memory.

Between the HIU and FIU are a series of galvanically isolated links for data and power. The datalink is synchronized and monitored for variance. Both FIU and HIU have onboard temperature sensors to characterize temperature-related problems.

The power supplies for both the HIU and FIU boards are redundant, fully instrumented and testable. Together these assemblies form a Power Integrity Subsystem.

Sequence of Events Characteristics

The Module automatically measures the field voltage and current to determine the state of each output channel. An event occurs when the output transitions from one state to another. When a channel changes state, the onboard timer value is recorded. When the TMR Processor next reads data from the Output Module, the channel state and real-time clock value are retrieved. The TMR Processor uses this data to log the state change into the system Sequence of Events (SOE) log. The user may configure each output to be included in the system SOE log. Full details of SOE are contained in Trusted Sequence of Events and Process Historian Package Product Description, publication ICSTT-RM243.

Output Switch Structure

The Digital Output Module provides a TMR switch topology where the load is driven by a total of three fully monitored, fail-safe (6 element) switch channels, one physically resident on each FIU in the Module. Any single switch or entire slice failure is designed to leave two of the three fail-safe switch channels operational to power the load.

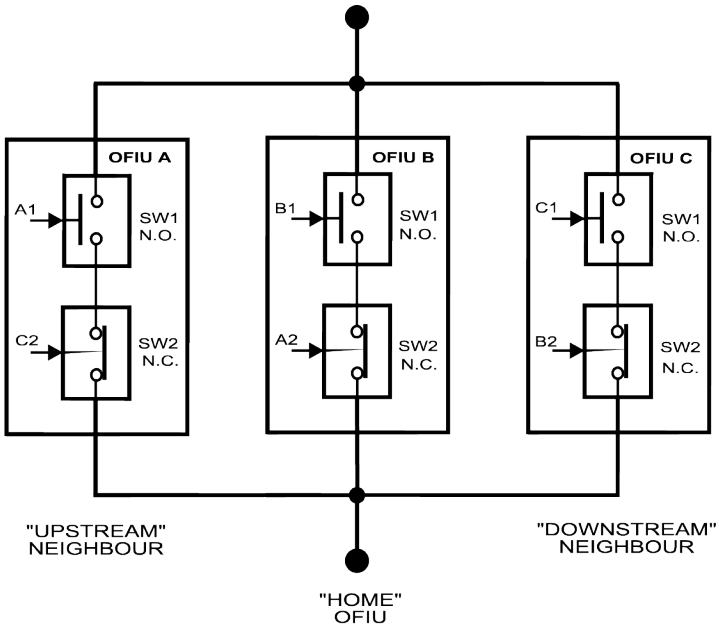


Figure 3: Output Switch Structure

The upper switches as shown in Figure 3 are denoted as N.O. (Normally Open), and are controlled by the FIU on which they are physically resident[1]. The lower switches are depicted as N.C. (Normally Closed), and are controlled by the "upstream" neighboring FIU[2].

Note: In this context, N.O. is defined as being in the off state in the absence of control signal power, and similarly, N.C. is the on state in the absence of control signal power. These switches are constructed from enhancement mode MOSFETs and are both guaranteed to be off in the absence of Module power to create gate voltage signals to bias them on[3] (unlike electromechanical relays for example).

The reason that the lower switches are specified to be on in the absence of control signal power is to allow two channels to power the load should an entire slice fail. Even if an entire slice fails, the surviving output circuits will carry the necessary control.

[1] Their “home” FIU.

[2] The home FIU, supplies an independent control signal for the “downstream” FIU FSS.

[3] For an unfaulted transistor.

Specifications

Specifications

This table lists the module specifications:

Item	Description
Backplane (IMB) Supply	
Voltage	20V DC to 32V DC
Power	27 W
Field Supply	
Voltage	18V DC to 32 V DC
Maximum Current	40 A limited to 8 A per power group (T_A = 50 °C max) 30 A limited to 6 A per power group (T_A = 60 °C max)
Power Dissipation	
Field Supply at maximum power group current.	128 W (T_A = 50 °C max) 96 W (T_A = 60 °C max)
System Supply	27 W
Module Location	T8100, T8300 I/O Module Slot
Isolation	
Power Group to Power Group	50V Reinforced (continuous)[4] [Type tested at 1411V DC for 60 s].
Field Common	50V Reinforced (continuous)[5] 250V Basic (fault)[6] [Type tested at 2436V DC for 60 s].
Channel to Channel	None
Fusing	Not user serviceable
Number of Outputs	40
Number of Power Groups	5 Each Power Group comprises 8 channels
Output	
Output On State resistance	1.6 Ω
Maximum Current Rating (Continuous)	2 A per channel
Minimum On State Load Current	50 mA
Current Measurement Range	0 A to 2.7 A ±5% / ±5 mA[7]
Voltage Measurement Range	0V DC to +30V DC ±2V DC
Maximum Withstanding	-1V DC to +40V DC
Channel to Channel Crosstalk	< 1%
Maximum Load Capacitance	3000 µF
Output Short Circuit Protection	Electronic latching

[4] 50V rms Secondary circuit derived from Mains, OVC II up to 300V.

[5] 50V rms Secondary circuit derived from Mains, OVC II up to 300V.

[6] 250V rms Mains circuit, OVC II up to 300V. Exposure to voltages at these levels shall be temporally constrained consistent with the system MTTR.

[7] Tolerance is ±5 mA up to 1.8 A, thereafter is ±5%.

Item	Description
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 Document ICSTT-TD003
Dimensions	
Height	266 mm (10.5 in)
Width	31 mm (1.2 in)
Depth	303 mm (12.0 in)
Weight	1.3 kg (2.7 lb)