MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

ICS TRIPLEX

T8480

FORTY-CHANNEL ANALOG OUTPUT MODULE

Used with the applicable Trusted TMR configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: ICS Triplex T8480



Trusted TMR Analog Output Module – 40 Channel

PD-T8480 Issue16

Rockwell Automation Publication ICSTT-RM284P-EN-P - May 2022
Supersedes Publication ICSTT-RM284O-EN-P - January 2019

Rockwell Automation

Product Description Original Instructions

Summary of Changes

This manual includes new and updated information. Use these reference tables to locate changed information.

Grammatical and editorial style changes are not included in this summary.

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
Updated branding	Marketing product change
Changed *Output Field Termination Unit (OFTU)* to *Field Termination Unit (FTU)*	Technical improvement
Changed *Analogue Output Field Interface Unit (AOFIU)* to *Field Interface Unit (FIU)*	Technical improvement
Changed *Trusted 24 Vdc Analogue Output Module* to *Trusted 4-20mA Analog Output Module*	Technical improvement

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 Name	Reason
Description on page 9	Updated Figure 2 Functional Block Diagram
Line Monitoring and Output States on page 12	Updated table and added recommendation to use a dummy load resistor
Output Driver Structure on page 14	Updated Figure 3 Output Driver Structure
Rack 7: HKEEPING on page 25	Updated table
Field Wiring Faults on page 33	Removed short-circuit
Specifications on page 37	Updated Calibration Accuracy and Overall Accuracy

About This Publication

In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment. The examples given in this manual are included solely for illustrative purposes. Because of the many variables and requirements related to any particular installation, Rockwell Automation does not assume responsibility or reliability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, with respect to use of information, circuits, equipment, or software described in this manual.

The Trusted® TMR Analog 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. Voltage and current measurements onboard the Module automatically determine the output states.

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 channels 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 for non-interfering applications, refer to the safety manual T8094.
- Outputs are powered in isolated groups of eight. Each such group is a Power Group (PG).

Description

The TMR 4-20 mA Analog 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).

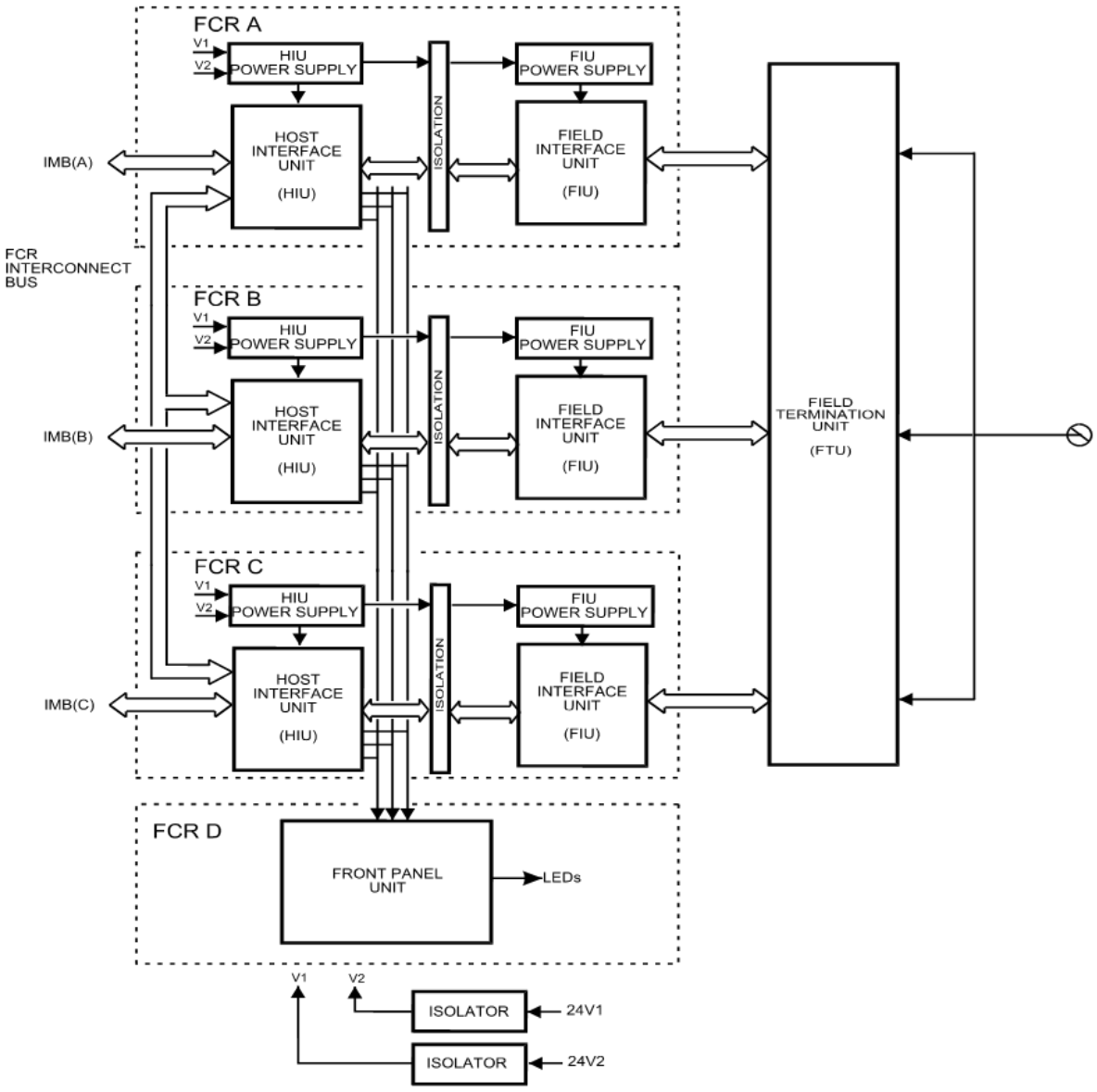


Figure 1: Module Architecture

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 4-20 mA Analog Output Module.

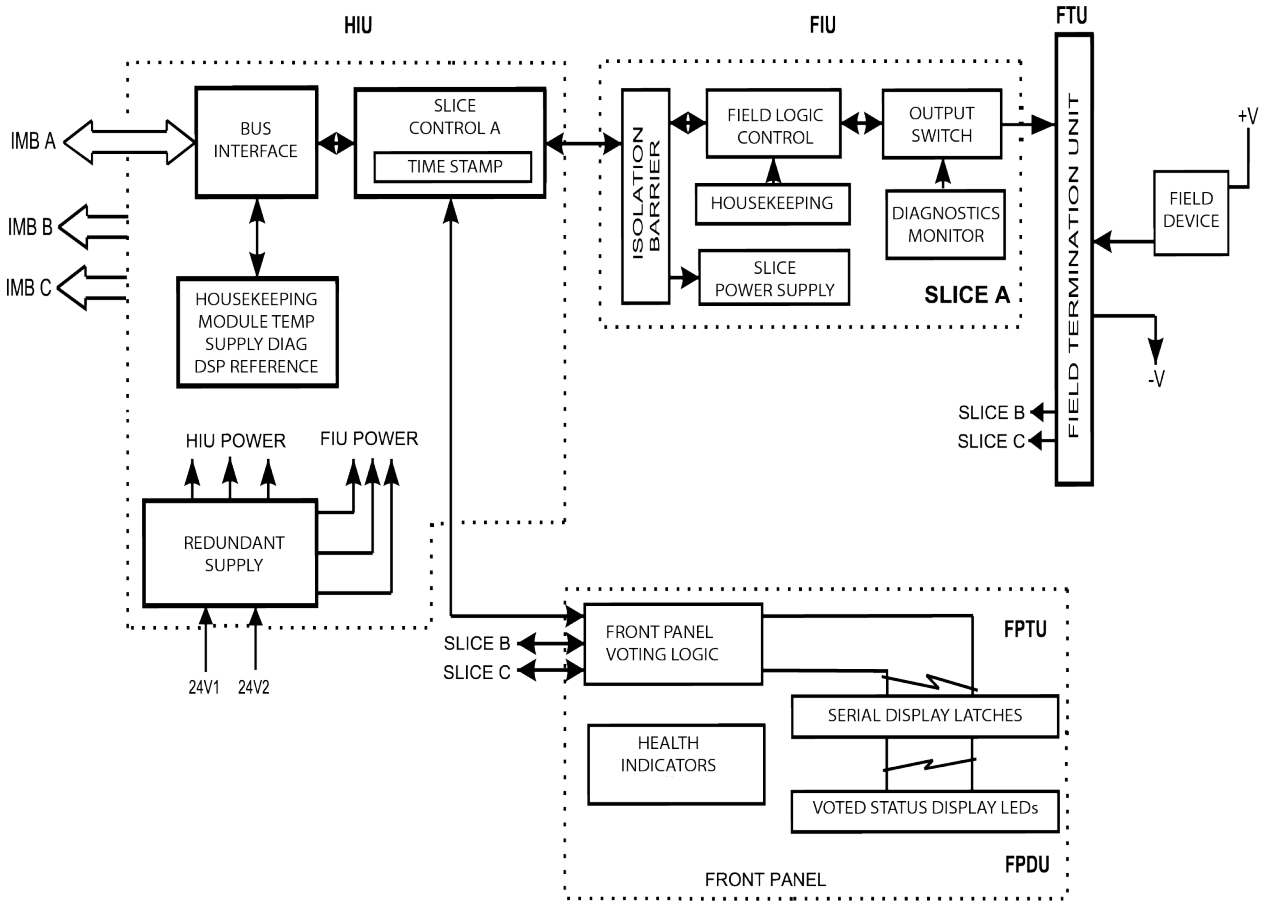


Figure 2: Functional Block Diagram

Field Termination Unit (FTU)

The Field Termination Unit (FTU) is the section of the I/O Module that connects all three Field Interface Units (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

error-detecting Random Access Memory (RAM) on each slice portion of the HIU. Received data is voted on by each slice. All data transmissions include a confirmation response from the receiver.

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 (CRCs) 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, publication ICSTT-RM243 (PD-T8013).

Output Driver Structure

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

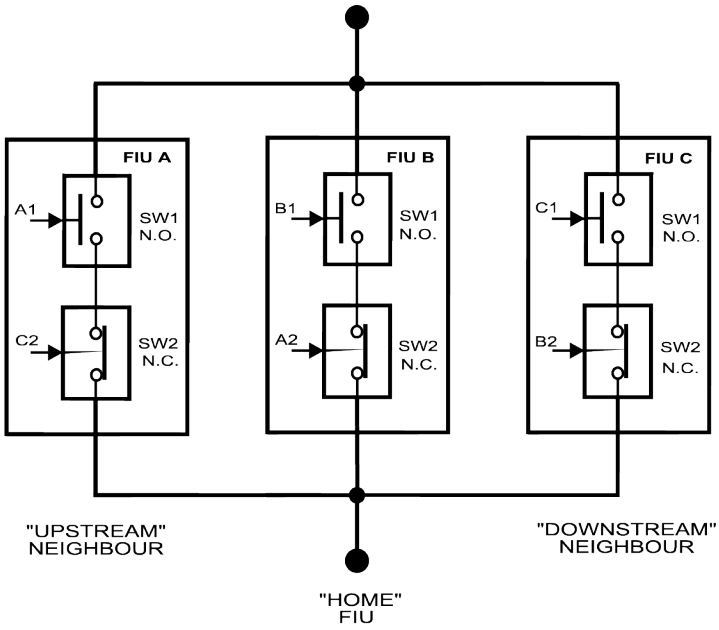


Figure 3: Output Driver Structure

The upper transistors operate in the linear mode, and are controlled by the FIU on which they are physically resident[1]. The lower switches are 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 GFSS.

[3] For an unfaulted transistor.

Specifications

Backplane (IMB) Supply	
Voltage	20V DC to 32V DC
Power	22 W
Field Supply	
Voltage	18V DC to 32V DC
Maximum Current	0.9 A
Power Dissipation	
Field Supply at maximum channel current	28 W
System Supply	22 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 (within Power Group)	None
Fusing	Not user serviceable
Number of Outputs	40
Number of Power Groups	5 Each Power Group comprises 8 channels
Output	
Off State Leakage Current @ 24V	350 µA max
Current Rating (Continuous)	1 mA to 22 mA
Recommended Output Current	4 mA to 20 mA
Calibration Accuracy @ +25 °C	±0.1% of Full Scale
Overall Accuracy 0 °C to +60 °C	±0.25% of Full Scale
Field Voltage Range	18V DC to 32V DC
Maximum Withstanding	-1V DC to +36V DC
Standby Swap Bump	±350 µA max for 7 sec max
Fault Condition Bump	±10 mA max for 50 ms max
Step Response Time	1 mA to 20 mA step change to 1% of final value <50 ms
Output Short Circuit Protection	22 mA into 0 Ω
Maximum load resistance	See graph below.[7]

[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] Maximum Load Resistance

Sequence of Events Event Resolution (LSB) Time stamp Accuracy	 1 ms ±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 Width Depth	 266 mm (10.5 in) 31 mm (1.2 in) 303 mm (12 in)
Weight	1.3 kg (2.7 lb)

