

MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

TRICONEX

3502EN2

NUCLEAR DIGITAL INPUT MODULE

Used with the applicable Triconex safety system configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: Tricon Technical Product Guide

Tricon v10.x Equipment Certified for Use in Nuclear 1E Applications

Invensys has qualified specific Tricon version 10 products for use in 1E (safety-related) applications in nuclear power plants in accordance with EPRI Report TR-107330, “Generic Requirements Specification for Qualifying Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants.” EMC testing was performed in accordance with USNRC Regulatory Guide 1.180, Revision 1, “Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems.”

All of the information (specifications, simplified schematics, installation guidelines, and so on) for standard equipment also applies to nuclear equipment. The following table lists the model numbers of Tricon v10.x equipment certified for use in Nuclear 1E applications and identifies the standard model to see for information about the equipment.

Model Number	Description	See This Standard Model
Modules^a		
8110N2	Main Chassis	8110
8111N	Expansion Chassis	8111
8112N	Remote Expansion Chassis	8112
8310N2	High-Density Power Module, 120 V	8310
8311N2	High-Density Power Module, 24 VDC	8331
8312N2	High-Density Power Module, 230 VAC	8312
3008N	Enhanced Main Processor III, 16 Mb	3008
4200N	Remote Extender Module	4200
4200-3N	Remote Extender Module (Set)	4200-3
4201N	Remote Extender Module	4201
4201-3N	Remote Extender Module (Set)	4201-3
4352AN	Tricon Communication Module (TCM)	4352A
4352BN	Tricon Communication Module (TCM)	4352B
3701N2	0–10 VDC, Differential DC Coupled, TMR	3701
3703EN	0–5 VDC or 0–10 VDC, Differential, Isolated, TMR	3703E
3721N	0–5 VDC or –5 to +5 VDC, Differential, DC Coupled, TMR	3721
3805HN	4–20 mA, Current Loop, DC Coupled, TMR	3805H
3501TN2	115 VAC, Opto-isolated, Non-commoned, TMR	3501T
3502EN2	48 VAC/VDC, Commoned in Groups of 8, Self-Test, TMR	3502E
3503EN2	24 VAC/VDC, Commoned in Groups of 8, Self-Test, TMR	3503E
3601TN	115 VAC, Opto-isolated, Non-commoned, TMR	3601T
3603TN	120 VDC, Opto-isolated, Commoned, TMR	3603T
3607EN	48 VDC, Opto-isolated, Non-commoned, TMR	3607
3623TN	120 VDC, Opto-isolated, Commoned, Supervised, TMR	3623T
3625N	24 VDC, Supervised/Non-supervised, Commoned, TMR	3625
3511N	Pulse Input, Differential, AC Coupled, TMR	3511
3708EN	Thermocouple, Differential, Isolated, TMR	3708
3636TN	Relay Output, Normally Open, Non-triplicated	3636T
8105N	Blank Module Panel	8105

TMR Digital Input Modules

Each TMR Digital Input (DI) module has three isolated input channels which independently process all data input to the module. A microprocessor on each channel scans each input point, compiles data, and transmits it to the Main Processors upon demand. Then input data is voted at the Main Processors just prior to processing to ensure the highest integrity. All critical signal paths are 100 percent triplicated for guaranteed safety and maximum availability. Each channel conditions signals independently and provides optical isolation between the field and the Tricon controller.

All TMR Digital Input Modules sustain complete, ongoing diagnostics for each channel. Failure of any diagnostic on any channel activates the module Fault indicator, which in turn activates the chassis alarm signal. The module Fault indicator points to a channel fault, *not* a module failure. The module is guaranteed to operate properly in the presence of a single fault and may continue to operate properly with certain kinds of multiple faults.

Models 3502E, 3503E, and 3505E can self-test to detect stuck-On conditions where the circuitry cannot tell whether a point has gone to the Off state. Since most safety systems are set up with a

de-energize-to-trip capability, the ability to detect Off points is an important feature. To test for stuck-On inputs, a switch within the input circuitry is closed to allow a zero input (Off) to be read by the optical isolation circuitry. The last data reading is frozen in the I/O communication processor while the test is running.

All TMR Digital Input Modules support hot-spare capability, and require a separate external termination panel (ETP) with a cable interface to the Tricon controller backplane. Each module is mechanically keyed to prevent improper installation in a configured chassis.

32-Point Digital Input Module Specifications

Model Number	3501E/3501T	3502E	3503E	3505E
Type	TMR	TMR with Self-Test	TMR with Self-Test	TMR, Low Threshold
Voltage	115 VAC/VDC	48 VAC/VDC	24 VAC/VDC	24 VDC
Points	32, non-commoned, isolated	32, commoned in groups of 8	32, commoned in groups of 8	32, commoned in groups of 8
AC Range/DC Range	90-155 VAC/VDC	35-95 VAC/VDC	20-42.5 VAC/VDC	20-42.5 VDC
Frequency Range	DC or 47-63 Hz	DC or 47-63 Hz	DC or 47-63 Hz	n/a
Maximum Voltage	155 VAC/VDC	95 VAC/VDC	42.5 VAC/VDC	42.5 VDC
Switching Level				
Off to On ^a	< 86 VAC/VDC	< 32 VAC/VDC	< 18 VAC/VDC	< 12 VDC
On to Off ^b	> 28 VAC/VDC	> 11 VAC/VDC	> 6 VAC/VDC	> 4 VDC
Nominal Turn-On	6-9 mA	6-9 mA	6-9 mA	3 mA to 5 mA
Typical Hysteresis	32 VAC/VDC	7 VAC/VDC	4 VAC/VDC	2 VDC
Input Delay				
OFF to ON/ON to OFF	< 8 ms/< 15 ms	< 8 ms/< 15 ms	< 8 ms/< 15 ms	< 8 ms/< 15 ms
Point Isolation	1,500 VDC/ 2500 VDC ^c	1,500 VDC	1,500 VDC	1,500 VDC
Nominal Input Impedance	> 8.5 K Ω	> 2.9 K Ω	> 1.25 K Ω	> 1.25 K Ω
Nominal Field Power Load				
Per On point	1.5 watts	1.0 watts	0.5 watts	0.5 watts
@ max. field voltage	2.9 watts	3.2 watts	1.5 watts	1.5 watts
Diagnostic Indicators				
Input Status	1 per point	1 per point	1 per point	1 per point
Module Status	PASS, FAULT, ACTIVE	PASS, FAULT, ACTIVE	PASS, FAULT, ACTIVE	PASS, FAULT, ACTIVE
Stuck Test	n/a	On	On	On
Color Code	Red	Dark Red	Dark Red	Dark Red

a. Off to On transition is guaranteed at or above this level but it might occur at a lower voltage, depending on the module's hysteresis.

b. On to Off transition is guaranteed at or below this level but it might occur at a higher voltage, depending on the module's hysteresis.

c. For 3501T.

General Environmental and EMC Specifications

Other than the optional conformal coating of all PCB assemblies, the Tricon controller is not explicitly protected against dust or falling debris. Atmospheric and airborne-particle protection must be provided by housing the Tricon controller in an appropriate NEMA-rated enclosure.

Operating Temperature	32° to 140° F (0° to 60° C), ambient, as measured at the bottom of the chassis, per IEC 60068-2-1 Test Nb
Storage Temperature	-40° to 167° F (-40° to 75° C), per IEC 60068-2-14, Test Na
Relative Humidity	5% to 95%, non-condensing, per IEC 60068-2-2, Test Bb, and IEC 60068-2-3 test Db
Corrosive Environment	Class G3 Level as defined in ISA Standard S71.04, based on exposure testing according to EIA Standard 364-65A, Class IIIA
Sinusoidal Vibrations per Axis	2 G @ 10 to 150 Hz, per IEC 60068-2-6, Test Fc
Shock	15 G for 6-11 ms in each axis, per IEC 60068-2-27
Electrostatic Discharge	IEC 61000-4-2, 8 kV air, 4 kV contact
Conducted Susceptibility	IEC 61000-4-4, Fast Transient/Burst, 2 kV power, 1 kV signal lines and IEC 61000-4-5, Surge Withstand, 2 kV CM AC power lines, etc. IEC 61000-4-6, RFI, 0.15-80 MHz, 10V
Radiated Susceptibility	IEC 61000-4-3, 26-1000 MHz, 10 V/m and IEC 61000-4-8, 50-60 Hz, 30 A/m
Conducted Emissions	CISPR 16, Class A, 0.15-30 MHz, 73-79 db when installed per the guidelines of the <i>P&I Guide</i>
Radiated Emissions	CISPR 11, Class A, 30-1000 MHz @ 10 m, 4-47 db when installed per the guidelines of the <i>P&I Guide</i>
Cable Flame Test Rating ^a	Interface cables (connect external termination panels to I/O modules): FT4 Vertical Flame Test-Cables in Cable Trays per C.S.A. C22.2 No. 0.3-92 Para 4.11.4 ^b I/O bus cables (connect chassis): FT6 Horizontal Flame & Smoke Test-per C.S.A. C22.2 No. 0.3-92 Appendix B ^c

a. Applies to cables shipped after April 1, 2009.

b. Cables will be marked with FT4 or CMG rating, but they all actually meet the more stringent FT4 rating.

c. Cables will be marked with FT6 or CMR rating, but they all actually meet the more stringent FT6 rating.