Digital Input Modules

This section describes the Digital Input Modules available for use with Tricon v9–v10 systems, which include TMR and Single (non-triplicated) modules. For installation instructions, see Replacing I/O Modules on page 223.

Table 23 Digital Input Modules

Model	Voltage/Type	Points	Description
3501E/T	115 VAC/VDC	32	TMR, isolated, non-commoned
3502E	48 VAC/VDC	32	TMR, commoned in groups of 8, with a circuit stuck-On self-test feature.
3503E	24 VAC/VDC	32	TMR, commoned in groups of 8, with a circuit stuck-On self-test feature.
3504E	24/48 VDC	64	TMR, commoned, high density, DC-coupled, with a circuit stuck-On or stuck-Off self-test feature. Configured in TriStation as 24 or 48 VDC.
3505E	24 VDC	32	TMR, commoned, low threshold, with a circuit stuck-On or stuck-Off self-test feature.
3564	24 VDC	64	Single, commoned

Each Digital Input Module has three independent channels which process all data input to the module. On each channel, a microprocessor scans each input point, compiles data, and transmits it to the Main Processors upon demand. Then input data is voted at the Main Processors before processing to ensure the highest integrity.

All Digital Input Modules sustain complete, ongoing diagnostics for each channel. Failure of any diagnostic on any channel activates the Fault indicator which in turn activates the chassis alarm signal. The 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.

Digital Input Modules include the hot-spare feature which allows online replacement of a faulty module. Like all I/O modules, Digital Input Modules require a cable interface to a remotely located external termination panel. Each module is mechanically keyed to prevent improper installation in a configured chassis.

Self-Test Feature

The Self-Test feature continuously verifies the ability of the Tricon controller to detect the transition of a circuit. This feature is available in two versions:

1) Models 3502E, 3503E, and 3505E include a circuit stuck-On self-test feature that verifies the ability to detect transitions from a normally energized circuit to the Off state.

2) Models 3504E and 3564 include a circuit stuck-On or stuck-Off self-test feature that verifies the ability of a Tricon controller to detect transitions to the opposite state—either from On to Off or from Off to On.

Single Digital Input Module

Model 3564 is a Single Digital Input Module, which is optimized for safety-critical applications where low cost is more important than maximum availability. On Single modules, only those portions of the signal path that are required to ensure safe operation are triplicated. Self-test circuitry detects all stuck-On and stuck-Off fault conditions within the non-triplicated signal conditioners in less than 500 milliseconds. This is a mandatory feature of a fail-safe system, which must detect all faults in a timely manner and upon detection of a fault, force the measured input value to the safe state. Because the Tricon controller is optimized for de-energize-to-trip applications, detection of a fault in the input circuitry forces to Off (the de-energized state) the value reported to the Main Processors by each channel. Although this module is fail-safe, it does not offer the same level of availability and reliability as a TMR module.

115 VAC/VDC Digital Input Modules

This figure is a simplified schematic for models 3501E and 3501T, which are 16-point TMR Digital Input Modules without a self-test feature.

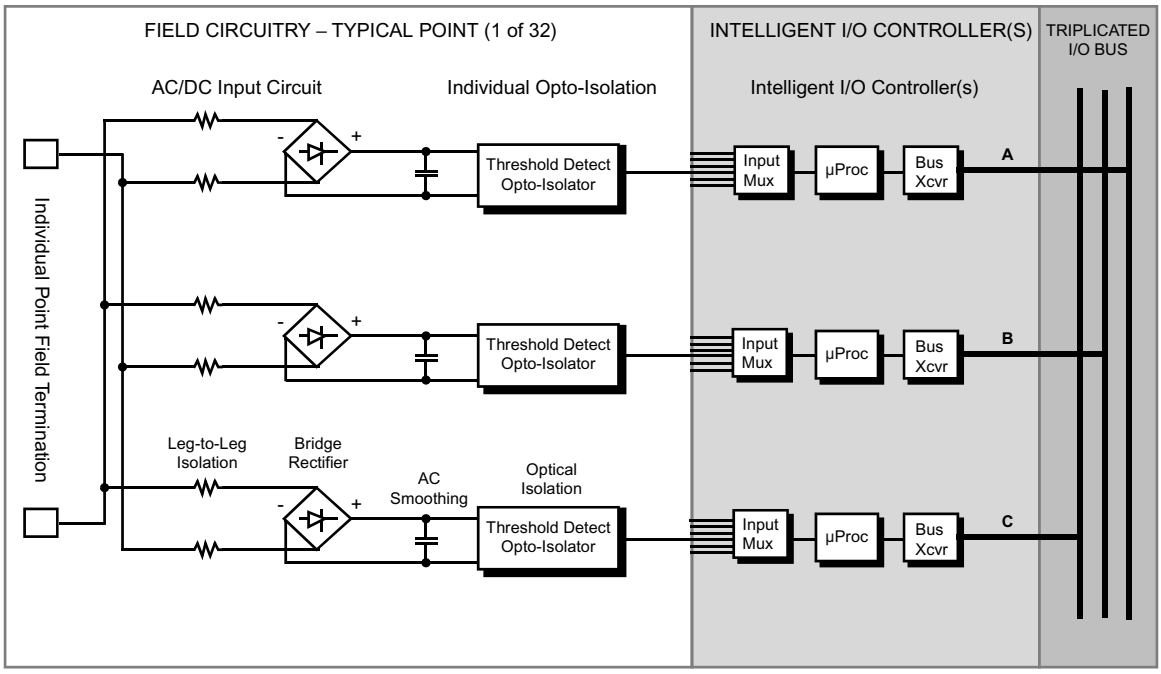

Figure 28 3501E and 3501T Simplified Schematic

This figure shows the front panels of models 3501E and 3501T.

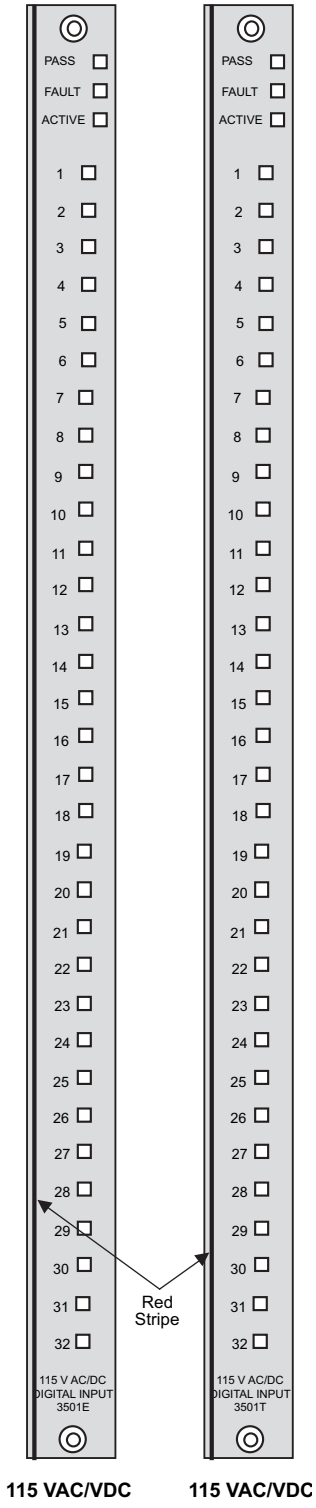

Figure 29 3501E and 3501T Front Panels

3501E and 3501T Specifications

This table lists the specifications for models 3501E and 3501T, which are 16-point TMR Digital Input Modules with a nominal input voltage of 115 VAC/VDC. Model 3501T has a higher point isolation minimum than model 3501E.

Table 24 3501E and 3501T Digital Input Specifications

Feature	Specification
Color code	Red
Number of input points	32, non-commoned, isolated
Input frequency range	DC or 47-63 Hz
Recommended input range	90–155 VAC/VDC
Maximum voltage	155 VAC/VDC
Switching level: Off to On	69 VAC/VDC typical, 86 VAC/VDC worst-case
Switching level: On to Off	36 VAC/VDC typical, 28 VAC/VDC worst-case
Typical hysteresis	32 VAC/VDC
Nominal turn-on	6 mA to 9 mA
Input impedance	> 8.5 kΩ nominal
Input delay: Off to On	< 8 ms
Input delay: On to Off	< 15 ms
Point isolation, opto-isolated: 3501E	1000 VAC minimum, 1500 VDC minimum
Point isolation, opto-isolated: 3501T	1780 VAC minimum, 2500 VDC minimum
Status indicator: On or Off state	1 per point
Status indicator: Module status	Pass, Fault, Active
Logic power	< 10 watts
Nominal field power load	1.5 watts per On point, 2.9 watts @ maximum field voltage
Leakage current to chassis @ 60 Hz	1 mA maximum per On point
Input diagnostic fault coverage:[1]	
Maximum input toggle rate	Every 100 ms
Minimum input toggle rate	Every 3 months (manually toggled by the user)
Diagnostic glitch duration	Not applicable

1. The maximum input toggle rate enables proper operation of I/O diagnostics and detection of all normally detectable faults. The minimum toggle rate provides fault coverage of normally undetectable faults within 10% of the calculated mean-time-between-faults (MTBF) for the module.

24 to 48 VAC/VDC Digital Input Modules

This figure is a simplified schematic for models 3502E, 3503E, and 3505E, which are 24 to 48 VAC/VDC, 32-point TMR Digital Input Modules with a self-test feature. The self-test feature continuously verifies the ability of a Tricon controller to detect the transition of a normally energized circuit to the Off state.

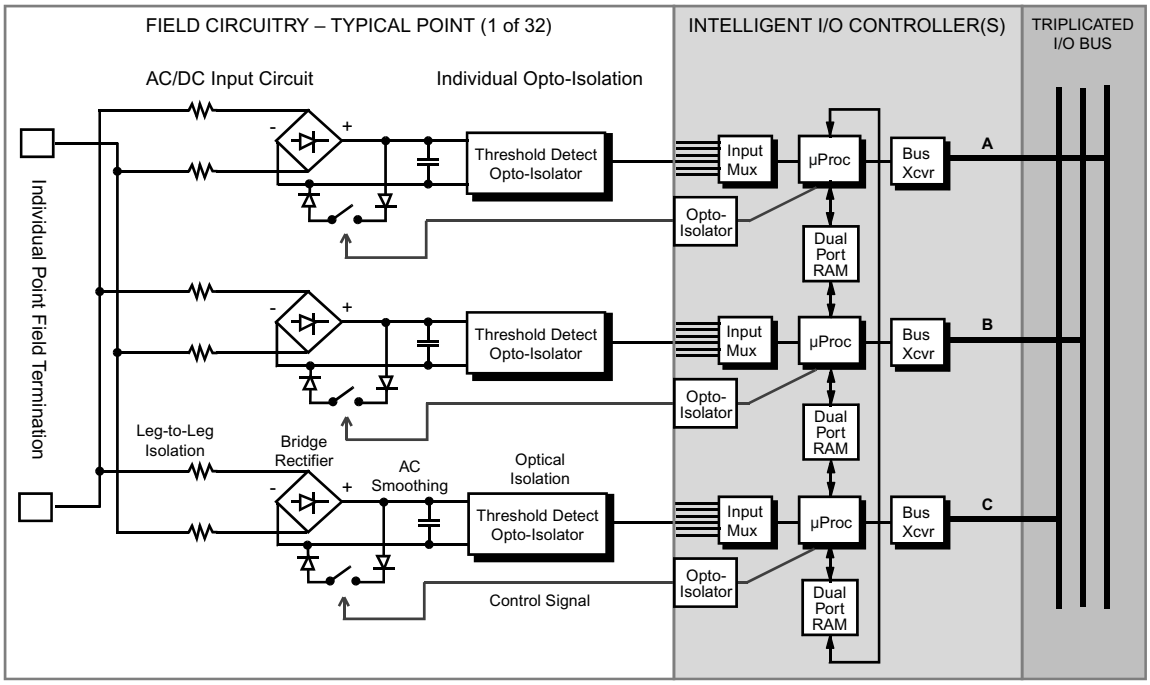

Figure 30 3502E, 3503E, and 3505E Simplified Schematic

This figure shows the front panels of models 3502E, 3503E, and 3505E.

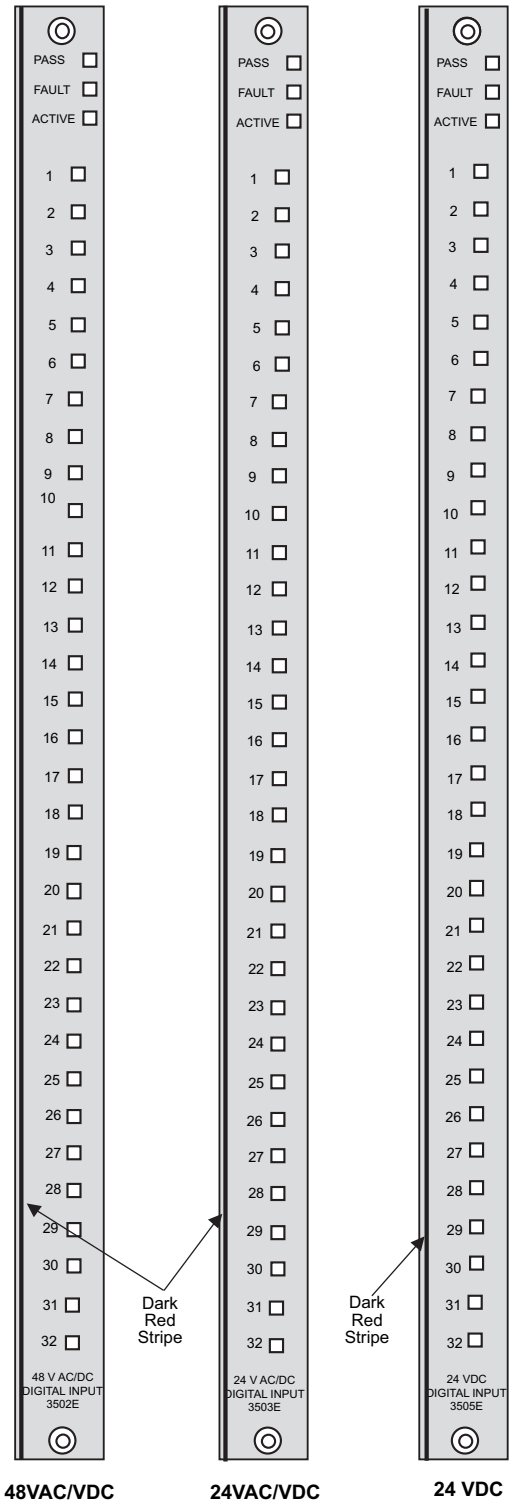

Figure 31 3502E, 3503E, and 3505E Front Panels

3502E Specifications

This table lists the specifications for model 3502E, which is a TMR Digital Input Module with a nominal input voltage of 48 VAC/VDC and a self-test feature.

Table 25 3502E Digital Input Specifications

Feature	Specification
Color code	Dark red
Number of input points	32, commoned in groups of 8
Input frequency range	DC or 47-63 Hz
Recommended input range	35–95 VAC/VDC
Maximum voltage	95 VAC/VDC
Switching level: Off to On	27 VAC/VDC typical, 32 VAC/VDC worst-case
Switching level: On to Off	14 VAC/VDC typical, 11 VAC/VDC worst-case
Typical hysteresis	7 VAC/VDC
Nominal turn-on	6 mA to 9 mA
Input impedance	> 2.9 kΩ nominal
Input delay: Off to On	< 8 ms
Input delay: On to Off	< 15 ms
Point isolation, opto-isolated	1000 VAC minimum, 1500 VDC minimum
Status indicator: On or Off state	1 per point
Status indicator: Module status	Pass, Fault, Active
Logic power	< 10 watts
Nominal field power load	1.0 watts per On point, 3.2 watts @ maximum field voltage
Leakage current to chassis @ 60 Hz	0.5 mA maximum per On point
Input diagnostic fault coverage[1]: Maximum input toggle rate	Every 100 ms
Input diagnostic fault coverage[1]:	
Minimum input toggle rate, On state	Not required
Minimum input toggle rate, Off state	Every 3 months (manually toggled by the user)
Diagnostic glitch duration[2]	20 ms typical
Output voltage	< $1/2V_{IN}$
Output impedance	< 4.22 kΩ

1. The maximum input toggle rate enables proper operation of I/O diagnostics and detection of all normally detectable faults. The minimum toggle rate provides fault coverage of normally undetectable faults within 10% of the calculated mean-time-between-faults (MTBF) for the module.
2. V_{IN} is the voltage applied to an energized point. Output voltage is noticeable on an adjacent de-energized point for the duration of the diagnostic glitch. Be advised that the glitch output may falsely energize the paralleled input of another piece of equipment.

3503E Specifications

This table lists the specifications for model 3503E, which is a TMR Digital Input Module with a nominal input voltage of 24 VAC/VDC and a self-test feature.

CAUTION This model is not recommended for use with shunt-diode intrinsic safety barriers. For these applications, Triconex recommends the model 3505E.

Table 26 3503E Digital Input Specifications

Feature	Specification
Color code	Dark red
Number of input points	32, commoned in groups of 8
Input frequency range	DC or 47-63 Hz
Recommended input range	20–42.5 VDC
Maximum voltage	42.5 VAC/VDC
Switching level: Off to On	15 VAC/VDC typical, 18 VAC/VDC worst-case
Switching level: On to Off	8 VAC/VDC typical, 6 VAC/VDC worst-case
Typical hysteresis	4 VAC/VDC
Nominal turn-on	6 mA to 9 mA
Input impedance	> 1.25 kΩ nominal
Input delay: Off to On	< 8 ms
Input delay: On to Off	< 15 ms
Point isolation, opto-isolated	1000 VAC minimum, 1500 VDC minimum
Status indicator: On or Off State	1 per point
Status indicator: Module status	Pass, Fault, Active
Logic power	< 10 watts
Nominal field power load	0.5 watts per On point[1] 1.5 watts @ maximum field voltage
Leakage current to chassis @ 60 Hz	0.25 mA maximum per On point
Input diagnostic fault coverage[2]:	
Maximum input toggle rate	Every 100 ms
Minimum input toggle rate, On state	Not required
Minimum input toggle rate, Off state	Every 3 months (manually toggled by the user)
Diagnostic glitch duration[3]	20 ms typical
Output voltage	< 1/2 V_{IN}
Output impedance	< 1.87 kΩ

1. When used with a typical shunt-diode intrinsic safety barrier, the nominal field power per On point is approximately 350 milliwatts @ 24 VDC.