ICS Regent®

PD-6011

DC Digital Input Modules

24 VDC, 48 VDC and 120 VDC
(T3401, T3402 and T3408)

Issue 1, March, 06

DC digital input modules provide input sensing for 16 field input switches. Three types of modules are available for interfacing to inputs powered from 24, 48, or 120 VDC field power supplies. Each module's triplicated I/O Safetybus interface ensures that no failure in the module can affect the operation of the Regent system or other I/O modules in the system. Extensive fault detection and annunciation of critical redundant circuits help prevent the controllers from receiving erroneous data from a faulty input module.

Features

- Sixteen input circuits, configured as two isolated groups of eight circuits each.
- Fault tolerant operation when connected in parallel with redundant modules of the same type.
- Hot-replaceable.
- Automatic self-testing of triplicated I/O Safetybus circuits and many simplex logic circuits.
- Individual front panel indicators on each module show active and fault status and logic-side input on/off status.
- 2500 volt minimum electrical isolation between field and logic circuits.
- TÜV certified, Risk Class 5.

Three DC digital input modules can be connected in parallel to obtain fault tolerant input sensing. In this triple module configuration, a failed module can be removed and replaced without interrupting the input signals.

Module Operation

A block diagram of a typical DC digital input module is shown in Figure 1.

Optical isolation between field wiring and the modules' logic circuitry provides field-to-logic isolation — protecting the modules' logic circuits from field signal over-voltages, transients, and other electrical disturbances. It also provides a safety barrier between the primary field voltages and user accessible circuits.

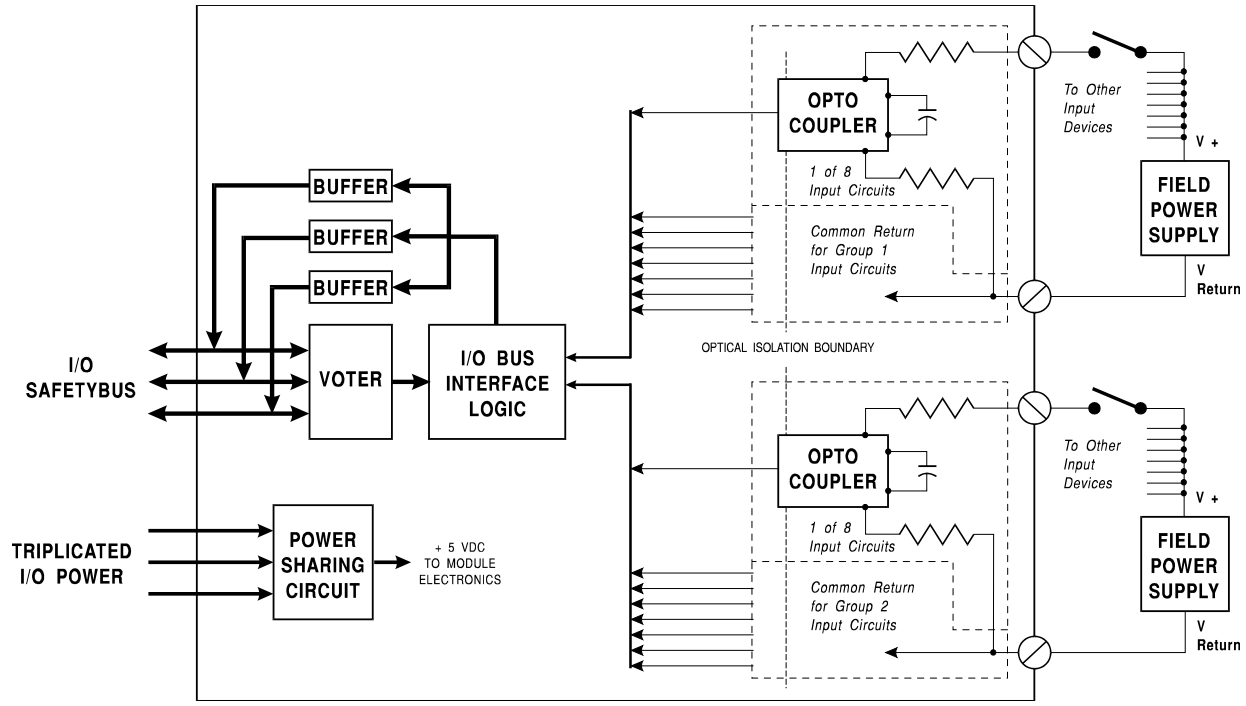

Figure 1. Block Diagram of DC Digital Input Module.

When the field switch is closed, the input to the module is on. When the field switch opens, the input to the module turns off.

Data from the logic side of the optical isolators are bused to the I/O bus interface logic.

The processor modules send triplicated read data requests to the input module over the I/O Safetybus. The processors' addressing data and data read requests are voted by the

module (preventing I/O Safetybus failures upstream from the module from affecting its ability to be read). The voted result is then passed to the I/O bus interface logic.

After receiving the voted data read request, the I/O bus interface logic sends its input data to the module's three bus drivers. Each of the three bus drivers is independently powered and controlled by the I/O transceiver modules—preventing failures in a single driver from propagating to the other two busses.

The bus drivers transmit the data across the backplane I/O Safetybus to the I/O transceivers which, in turn, transmit the data to the processors.

Testing and Diagnostics

Each module's voter circuits are periodically tested by the processor modules. Discrepant data are sent through one of three legs of the I/O Safetybus to determine whether the module's voter is able to outvote the incorrect data. A failure to return the correct majority-voted result to the processors produces an I/O module error indication at the processor modules and a module fault indication at the I/O module.

Each type of module has a unique identification code that is read by the controller. This code lets the controller know which type of module is installed in each I/O chassis slot and how to address that module and its points specifically. If a module is removed, or is replaced with a module of a different type, the processor modules will indicate I/O module errors.

Loopback logic tests periodically write data to the module and then read it back to determine whether the module's I/O bus interface logic is functioning correctly.

Front Panel Indicators

Figure 2 shows the physical features of the DC digital input modules. The front panel of each module contains active and fault status indicators and field signal status indicators for each circuit.

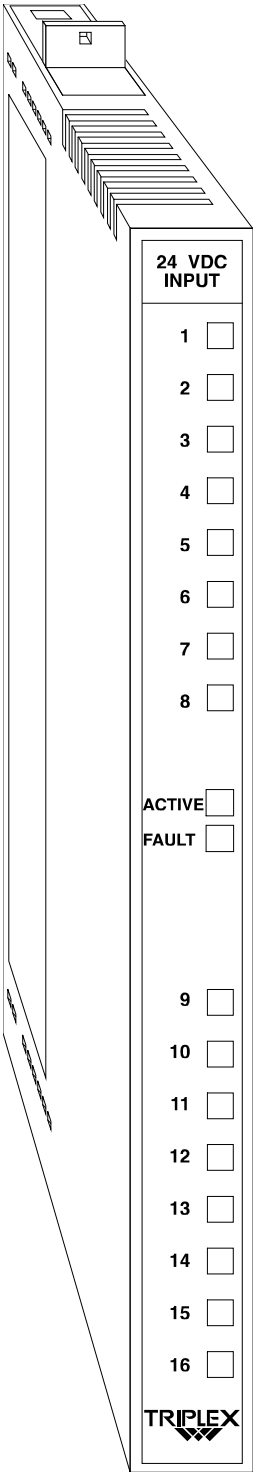

Figure 2. DC Digital Input Module.

Active and Fault Status Indicators

These green and red LEDs indicate the overall health of the module. During normal operation the green ACTIVE indicator flashes at the controller's scan rate. If a module fault is detected the red FAULT indicator turns on and the green indicator turns off.

Field Status Indicators

Input status indicators are located on the logic-side (after the signal conditioning and isolation). The field status indicators are lit when current is flowing through the input.

Application

Simplex Configuration

Digital input modules provide a suitable interface to non-critical input signals. Although many of the circuits in the digital input modules are automatically tested and annunciated, some logic circuits and all of the field-side sensing circuits are simplex and non-tested. This simplex input configuration is illustrated in Figure 3.

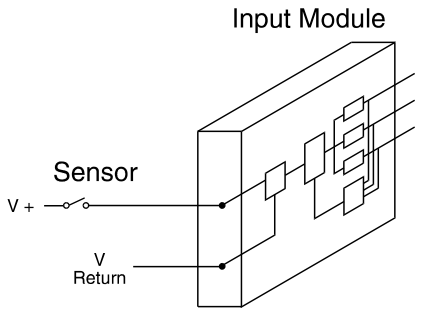

Figure 3. Simplex Digital Input Configuration.

Fault Tolerant Connection

For critical inputs, redundant input modules are used in a 2oo3 or 1oo2 fault tolerant configuration. In these configurations the redundant input modules are connected to single or multiple sensors. If redundant sensors are installed

in the field, the redundant modules are connected so that each sensor connects to one of the redundant modules. These configurations are illustrated in Figure 4, showing triple redundant input modules. Each DC digital input module is hot replaceable. In triple redundant input configurations, if a fault occurs on one module, it can be removed and replaced while the system continues to sense the inputs from the remaining two input modules.

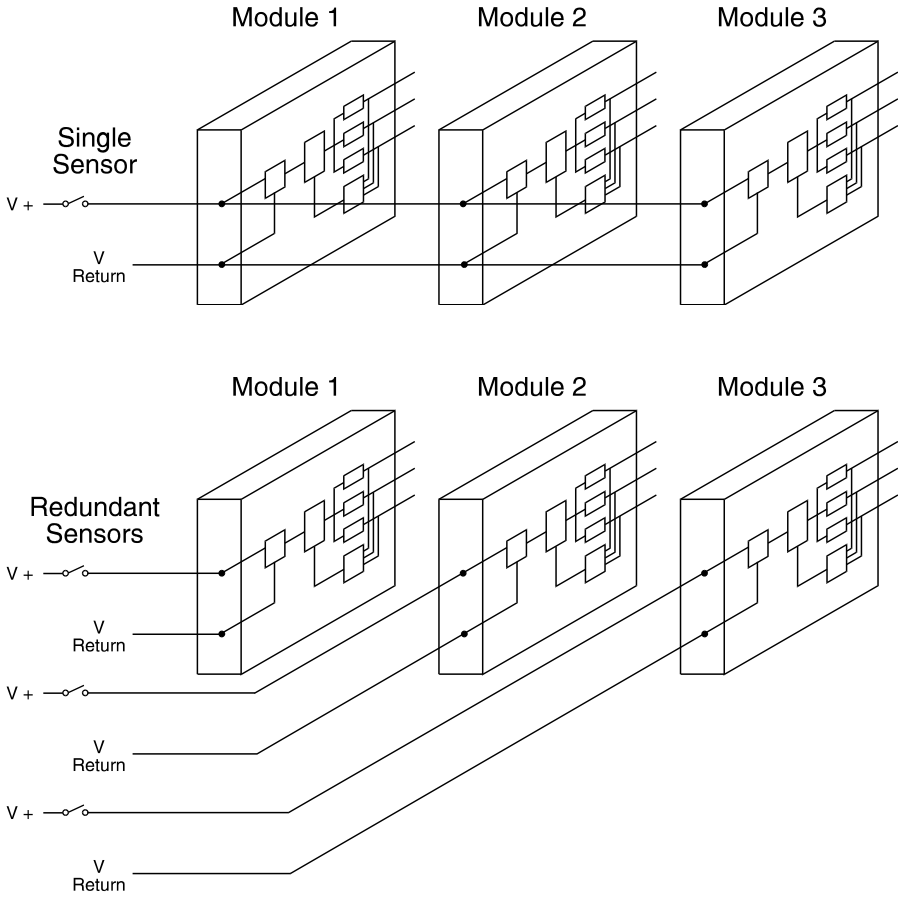

Figure 4. Fault Tolerant Digital Input Configurations.

Field Wiring

Field wiring terminal blocks on the I/O chassis are used to connect the field input signals and the common power return signals to the module. The terminal blocks are located directly above and below the slot where the module is

installed. Each terminal block consists of ten #6 wire clamp screw terminals, with each terminal capable of holding two 12 AWG wires.

The module has a separate common power return terminal for each group of inputs (group 1: channels 1-8, group 2: channels 9-16). These two groups are electrically isolated from each other (2500 volts minimum). Figure 5 shows the proper connection of input signals to the input wiring terminals.

When redundant field sensors are installed, each input module is wired as shown in Figure 5. In a fault tolerant configuration with single field sensors, the input signals are connected in parallel across all three input modules as shown in Figure 6.

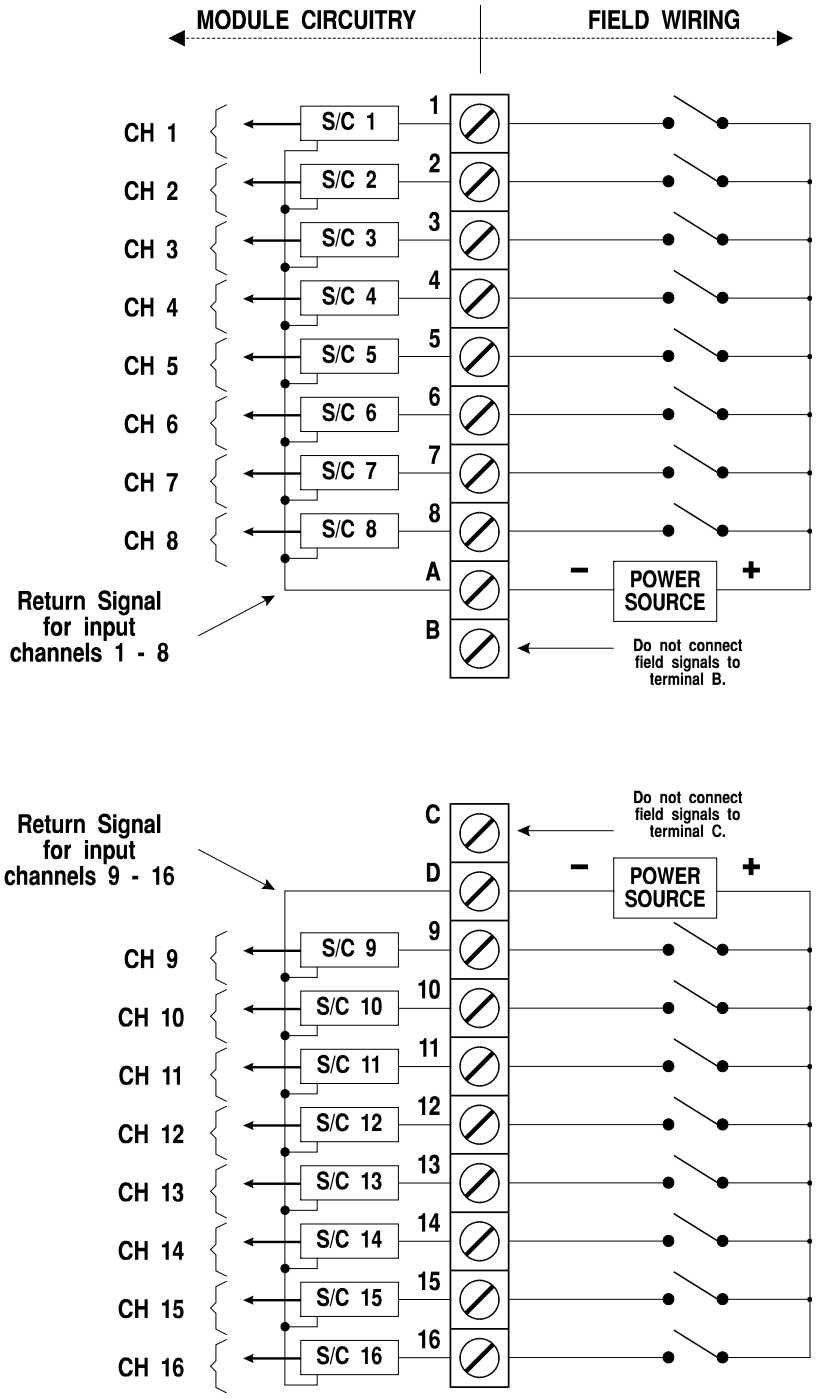

Figure 5. Module Wiring, Single Sensors to a Single Digital Input Module.

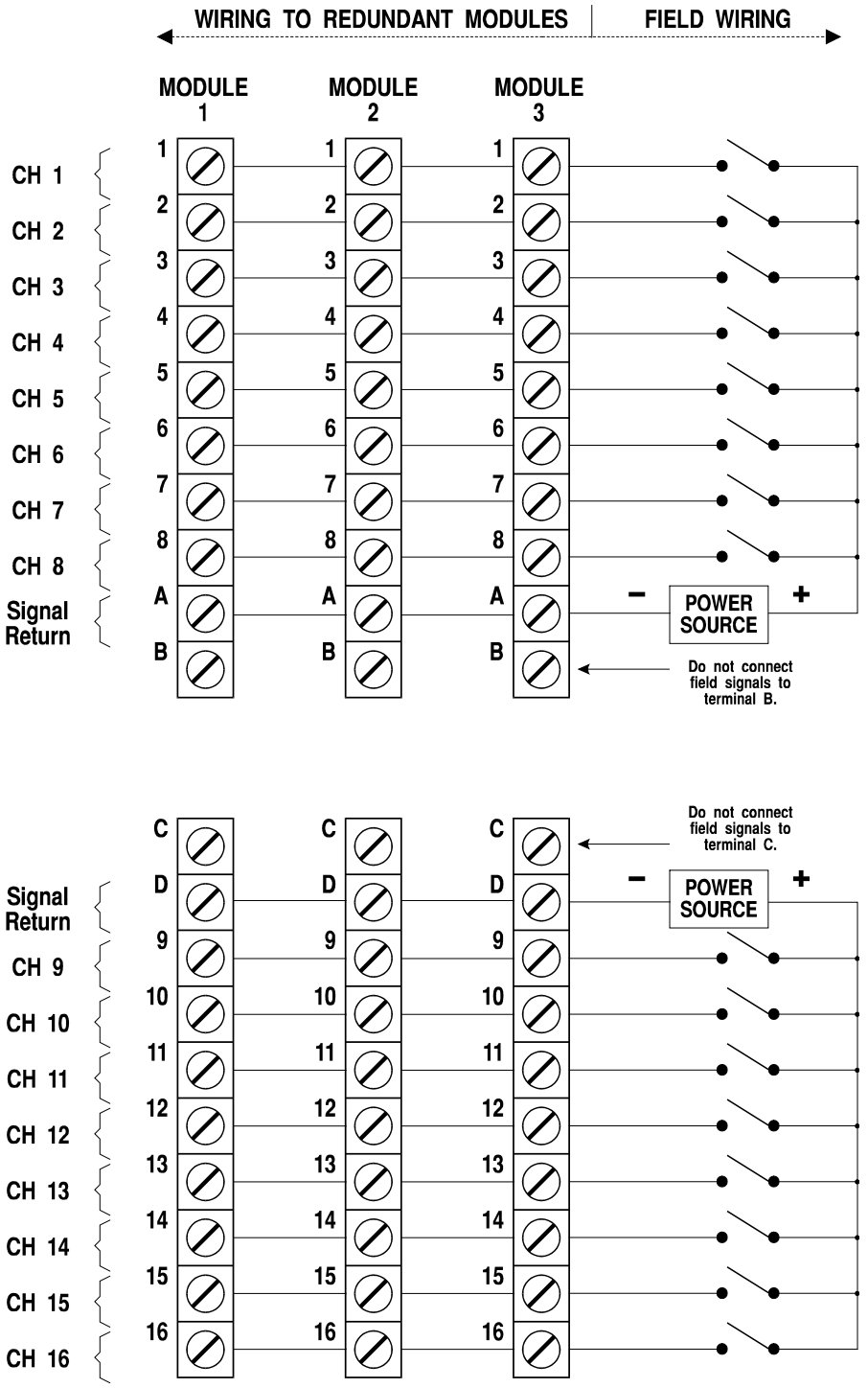

Figure 6. Module Wiring, Single Sensors to Triplicated Digital Input Modules.

Keying

The I/O chassis can be physically keyed to prevent accidental damage caused by inserting a module into a slot wired for a different module type. Figure 7 illustrates how the slot keys are installed on the I/O chassis slot field wiring connectors. The slot key positions for the DC digital input modules are listed in Table 1.

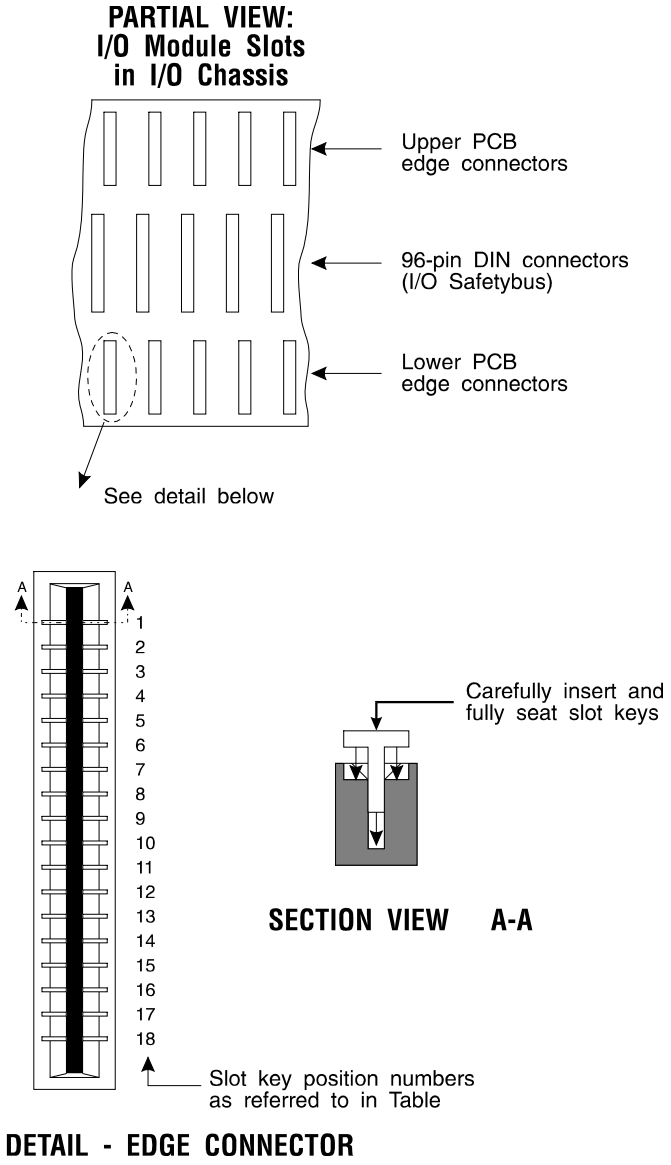

Figure 7. Installing Slot Keys.

Table 1. Slot Key Positions.

Module	Upper Connector	Lower Connector
T3401	4	15
T3402	10	15
T3408	12	15

Configuration

Each input module is configured using the WINTERPRET I/O Configuration Editor. In the editor, you will perform the three steps described below to configure the input module.

1) Set the Module Type:

   Position the cursor on the module slot you wish to define. Choose Set Module Type from the Edit Menu and select the appropriate digital input module from the list.

2) Edit the Module Definition:

   Choose Edit Module Definition from the Edit Menu. A dialog box will open where you can define the input point definitions.

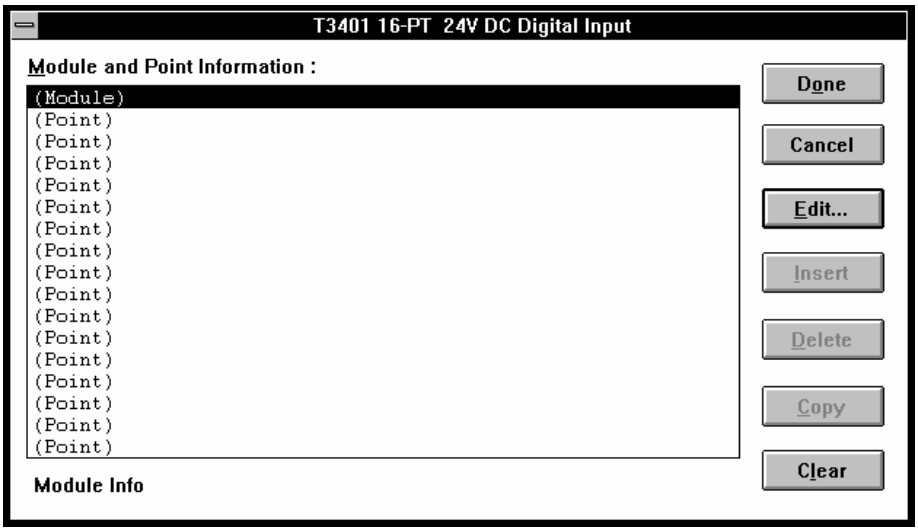

Figure 8. Digital Input Module Definition.

3) Edit each point:

Choose Edit from the Module Definition dialog box to define a name and description for each I/O point. In the Digital Input Point dialog, enter a tag name (up to 12 characters) and a description (up to 40 characters).

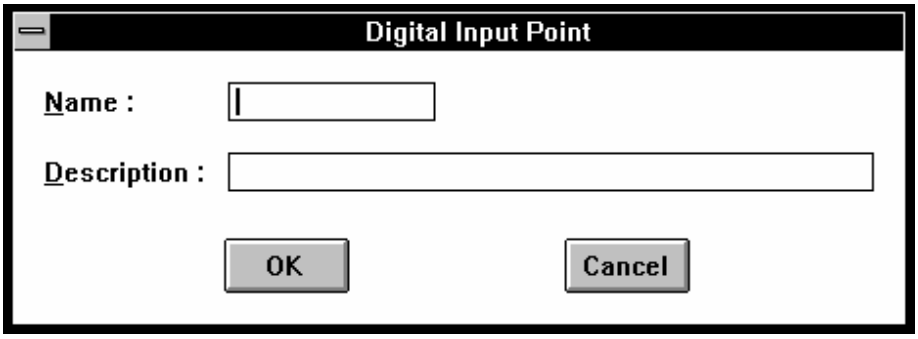

Figure 9. Defining a Digital Input Point.

The tag names are used in the application program to represent the input state. In addition, a module tag name can be entered to represent the combined state of all 16 inputs. This module tag name represents the 16 inputs as a signed, 16-bit integer. In this format, input point one is the least significant bit (LSB) and input point 16 is the most significant bit (MSB).

Programming

Inputs are referenced in the application program through the tag names defined in the I/O Configuration Editor. When current flows through the input (field switch closed) the input is said to be on, or have a value of one. In ladder logic, the on state would produce power flow in a normally open (N.O.) contact.

To program fault tolerant configurations using triplicated digital input modules, a voter element can be used as shown in Figure 10.

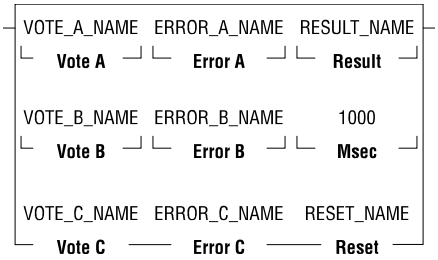

Figure 10. Programming Fault Tolerant Digital Inputs.

In this illustration, VOTE_A_NAME, VOTE_B_NAME, and VOTE_C_NAME represent the three digital inputs to be two-out-of-three voted. ERROR_A_NAME, ERROR_B_NAME and ERROR_C_NAME are the error bits for the digital inputs. RESULT_NAME is the result of the voter instruction. The field Msec is the time, in milliseconds, an input can be incorrect before signaling an error. RESET_NAME is the reset bit used to reset the latched error bits.

The voter instruction can be used to vote digital input points or entire digital input modules. When voting digital input modules, the tag names VOTE_A_NAME, VOTE_B_NAME, and VOTE_C_NAME would be the names of the digital input modules and RESULT_NAME would be a shared variable register. After voting the modules, a block move instruction should be used to move the contents of the register RESULT_NAME into individual shared variable control relays. Refer to the WINTERPRET Help files for more information about the block move instruction and shared variable definitions.

Maintenance

No periodic maintenance or calibration is required for the digital input modules. There are no user replaceable parts inside these modules. In safety critical input applications, the inputs should be dynamically transitioned at a period not greater than six months.

Safety Considerations

TÜV The DC voltage digital input modules are TÜV certified as

non-interfering and when properly configured are also certified for Risk Class 5 safety critical inputs. Safety critical configurations include 2oo3 and 1oo2 voting methods.

In safety critical input applications using a single sensor, it is important that the sensor failure modes be predictable and well understood, so there is little probability of a failed sensor not responding to a critical process condition. In such a configuration, it is important that the sensor be tested regularly, either by dynamic process conditions that are verified in the Regent, or by manual intervention testing.

Redundant sensors can be used with redundant input modules to eliminate any single points of failure and extend fault tolerance to include the sensors.

In all safety critical configurations and applications, the DC voltage digital input modules can be used for de-energized to trip inputs, only if the inputs are dynamically transitioned at a period not greater than six months.

For additional safety considerations, please refer to the Safety Considerations section of the Regent User's Guide.

Specifications

Safetybus Power	1.15 load units
Number of Inputs	16 circuits divided into two groups of eight

	T3401	T3402	T3408
Voltage Range	14 to 30 VDC	38 to 58 VDC	95 to 150 VDC
Turn-On Voltage	12 VDC, min	36 VDC, min	88 VDC, min
Turn-Off Voltage	4.7 VDC, max	11 VDC, max	28 VDC, max
Input Current	8.7 mA	4.4 mA	4.4 mA
Turn-On Delay			
minimum	0.2 msec	0.1 msec	0.05 msec
maximum	1.8 msec	1.0 msec	0.4 msec
Turn-Off Delay			
minimum	0.5 msec	0.15 msec	0.05 msec
maximum	2.6 msec	1.0 msec	0.5 msec
Over Voltage Protection			
continuous:	50 VAC	140 VAC	400 VAC
burst:	80 VAC, for 5 sec	220 VAC, for 5 sec	880 VAC, for 5 sec
Heat Dissipation	10 Watts, 34 BTUs/hour	9.5 Watts, 32 BTUs/hour	18 Watts, 60 BTUs/hour

Fusing	None, fuse external if required
Isolation	2500 volts minimum (field wiring to control logic) 2500 volts minimum (input group 1-8 to input group 9-16)
Operating Temperature	0° to 60° C (32° to 140° F)
Storage Temperature	-40° to 85° C (-40° to 185° F)

Operating Humidity	0 to 95% relative humidity, non-condensing
Vibration	
10 to 55 Hz:	±0.15mm
Shock	
Operating:	15 g, ½ sine wave, 11 msec
Electromagnetic Interference	
• IEC 801 Part 2 - Electrostatic Discharges	Level 3: Contact discharge of 6 kV
• IEC 801 Part 3 - Radiated Electromagnetic Fields	Level 3: 10 V/M, 27 MHz - 500 MHz
• ANSI/IEEE C37.90 - Surge Withstand Capability	2.5 kV damped 1 MHz sine wave 4 kV bi-directional impulse, 10 nsec rise time, fast transient (T3402, T3408 only)
Safety	Certified to DIN V VDE 0801 for Risk Class 5. Also designed to meet UL 508 and CSA 22.2, No. 142-M1981
Dimensions	
Height:	12.6" (320 mm)
Width:	1.27" (32 mm)
Depth:	10.12" (257 mm)
Weight	3.0 lbs (1.4 kg)