GE PDIO Discrete I/O Module

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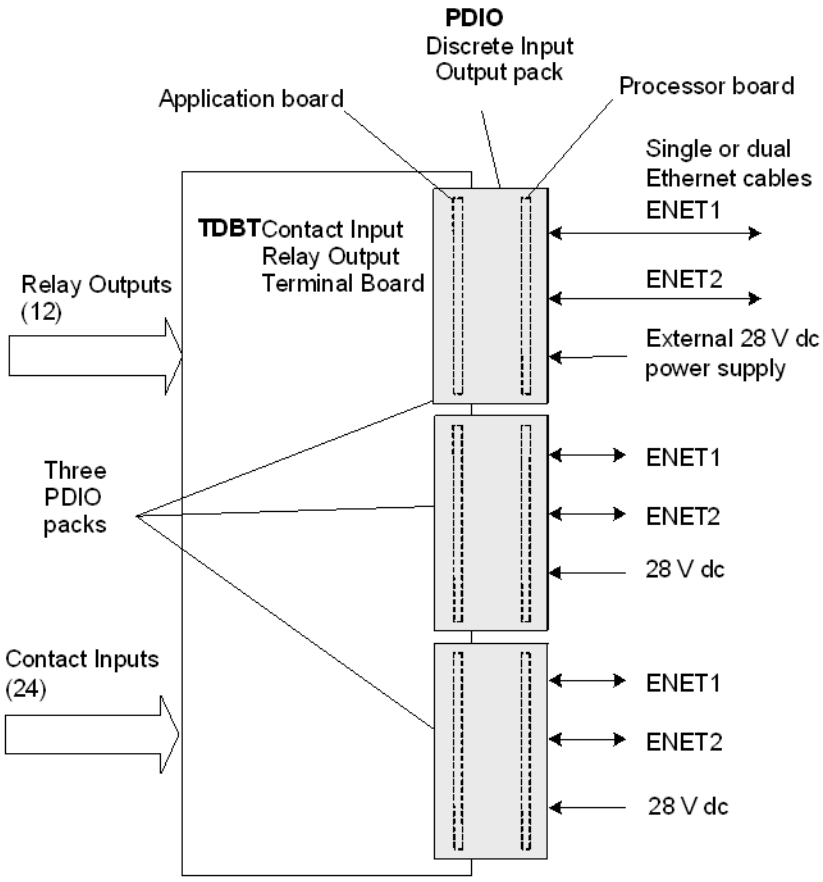
8.1 PDIO Discrete I/O Pack

The Discrete I/O pack (PDIO) provides the electrical interface between one or two I/O Ethernet networks and a discrete input/output terminal board. The PDIO contains a BPPx processor board and an acquisition board specific to the discrete input/output function. The I/O pack accepts up to 24 contact inputs, controls up to 12 relay outputs, and receives terminal board specific feedback signals. The associated terminal board determines voltage capability of the PDIO. System input to the I/O pack is through dual RJ-45 Ethernet connectors and a three-pin power input. Discrete signal input/output is through a DC-62 connector that connects directly with the associated terminal board connector. Visual diagnostics are provided through indicator LEDs.

The PDIO is the functional equivalent of a PDIA and a PDOA I/O pack combined into a single assembly. For simplex applications, it is mounted to a TDBS terminal board, which is the equivalent of a SRLY relay terminal board combined with a STCI contact input terminal board. For TMR applications, it is mounted to a TDBT terminal board, and can include a WROB option board for fused and sensed power distribution to the first six relay outputs and dedicated power to the last relay output. The following figure displays the signals for three PDIO I/O packs mounted on a TDBT terminal board.



8.1.1 Compatibility

The PDIO I/O pack includes one of the following compatible BPPx processor boards:

- The PDIOH1A contains a BPPB processor board.
- The PDIOH1B contains a functionally compatible BPPC processor board that is supported in ControlST* software suite V04.04 and later.

Redundancy refers to the number of I/O packs used in a signal path. The following are valid for PDIO.

- Simplex uses one I/O pack with one or two network connections.
- TMR uses three I/O packs with one network connection on each.

The PDIO I/O pack is compatible the following terminal and option boards.

Terminal Board	Contact Input Voltage	Redundancy	Option Boards
TDBSH2A	24 V dc	Simplex	WROB, WROF, WROG
TDBSH4A	48 V dc	Simplex	WROB, WROF, WROG
TDBSH6A	125 V dc	Simplex	WROB, WROF, WROG
TDBSH8A[1]	24 V dc	Simplex	
TDBTH2A	24 V dc	TMR	WROB
TDBTH4A	48 V dc	TMR	WROB
TDBTH6A	125 V dc	TMR	WROB
TDBTH8A[1]	24 V dc	TMR	

[1] These terminal boards are specifically designed for use in hazardous locations.

8.1.2 Installation

Warning

TDBSH8 or TDBTH8 terminal boards should not be used with intrinsic safety barriers.

Caution

When the solenoids are connected to the relay outputs, make sure that the solenoid coil rating does not exceed the voltage, current rating of the relay contacts given in the TDBS and TDBT specifications.

Caution

Discrete output option boards (such as WROB,WROF, and WROG) are not HazLoc certified, and shall not be used with TDBS or TDBT terminal boards in hazardous (classified) locations.

➢ **To install the PDIO I/O pack**

1. Securely mount the desired terminal board.
2. Directly plug the PDIO I/O pack into the terminal board connectors.
3. Mechanically secure the I/O pack(s) using the threaded studs adjacent to the Ethernet ports. The studs slide into a mounting bracket specific to the terminal board type. The bracket location should be adjusted such that there is no right-angle force applied to the DC-62 pin connector between the I/O pack and the terminal board. The adjustment should only be required once in the service life of the product.

Note The PDIO mounts directly onto the terminal board. Simplex terminal boards have a single DC-62 pin connector that receives the PDIO. TMR-capable terminal boards have three DC-62 pin connectors, one used for simplex operation, two for dual operation, and three for TMR operation. PDIO directly supports all of these connections.

4. Plug in one or two Ethernet cables depending on the system configuration. The pack will operate over either port. If dual connections are used, the standard practice is to connect ENET1 to the network associated with the R controller.
5. Apply power to the pack by plugging in the connector on the side of the pack. It is not necessary to remove power from the cable before plugging it in because the I/O pack has inherent soft-start capability that controls current inrush on power application.
6. Use the ToolboxST* application to configure the I/O pack as necessary. From the Component Editor, press F1 for help.

8.1.2.1 Connectors

The I/O pack contains the following connectors:

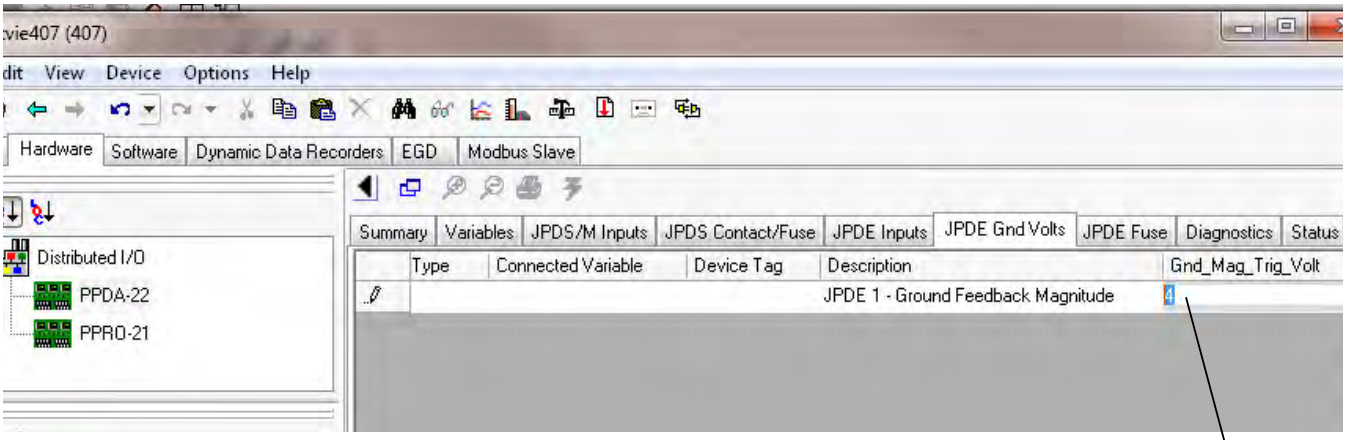
- A DC-62 pin connector on the underside of the PDIO I/O pack connects directly to the discrete input terminal board. The connector contains the 24 input signals, ID signal, relay coil power, and feedback multiplex command.
- An RJ-45 Ethernet connector named ENET1 on the side of the pack is the primary system interface.
- A second RJ-45 Ethernet connector named ENET2 on the side of the I/O pack is the redundant or secondary system interface.
- A 3-pin power connector on the side of the pack is for 28 V dc power for the I/O pack and terminal board.

8.1.2.2 Ground Fault Detection

If using TDBSH8A or TDBTH8A terminal boards, set the PPDA I/O pack, JPDE Gnd Volts, Ground Fault Threshold Feedback Magnitude (GND_Mag_Trig_Volt) limit at 4 V dc. Ground faults are annunciated when an excitation voltage output is grounded. The current limiting resistor in series with each excitation voltage output requires a lower threshold for ground fault detection.

➢ **To set the ground fault threshold**

1. From the ToolboxST application, Component Editor, Hardware Tab, Tree View, select the PPDA I/O pack that is attached to the JPDE power distribution board.
2. From the Summary View, select the **JPDE Gnd Volts** tab.



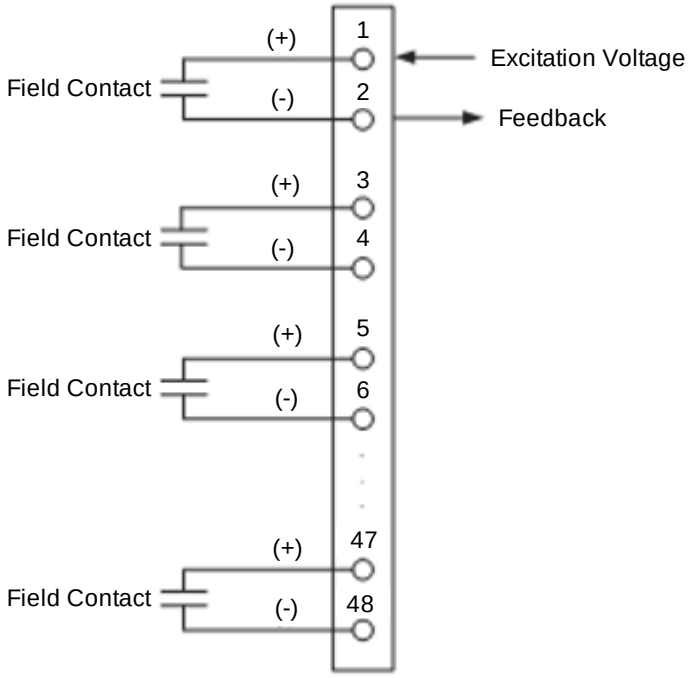
Change the value to 4.

8.1.2.3 Excitation Channels

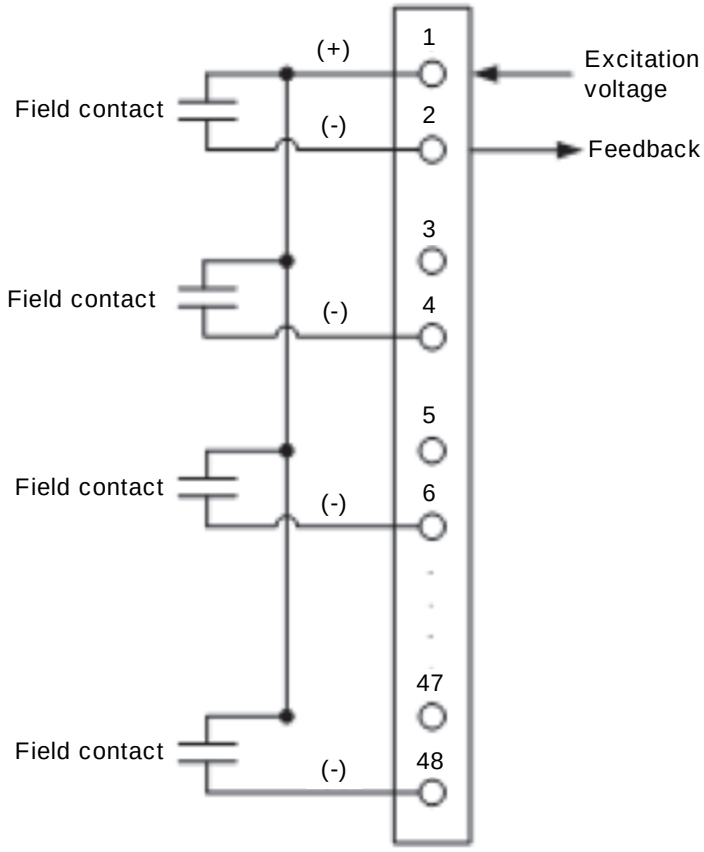
Warning

For TDBSH8A and TDBTH8A, each excitation voltage output can connect to only one field contact. In the application world, this is known as *home run* wiring. Branching one excitation voltage output to multiple contacts will cause misoperation and is not allowed. Grounding multiple excitation voltage outputs is not allowed as this will result in self-test failures or diagnostic alarms, as well as overheating of the terminal board.

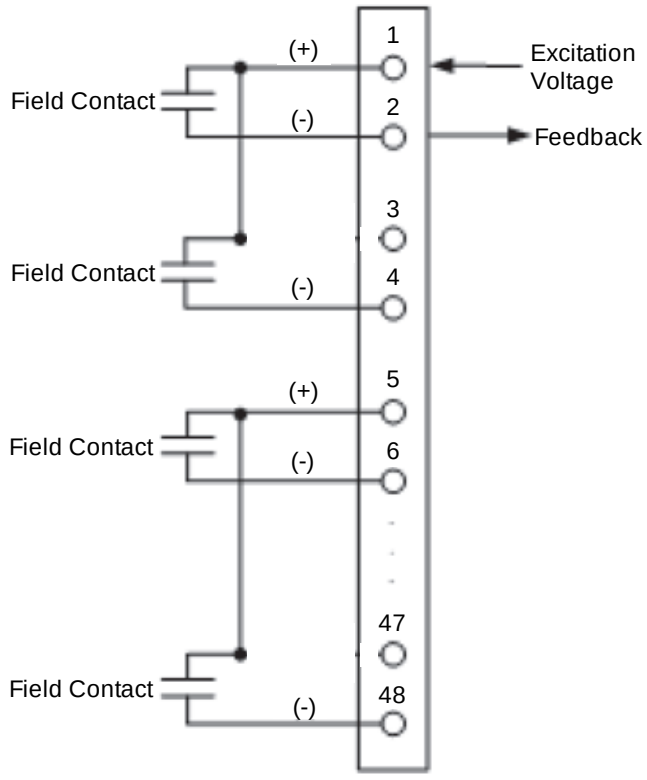
The following figures display correct configuration of excitation voltage channels based on compatible terminal board.



Correct Excitation Voltage Channels with TDBSH8A and TDBTH8A



One Excitation Voltage Channel for Multiple Field Contacts with TDBSH2A and TDBTH2A



Mixed Excitation Voltage of Different Channels with TDBSH2A and TDBTH2A

8.1.3 Operation

The following features are common to the distributed I/O modules:

- *BPPx Processor*
- *Processor LEDs*
- *Power Management*
- *ID Line*
- *I/O Module Common Diagnostic Alarms*

8.1.3.1 Connectors

The I/O pack contains the following connectors:

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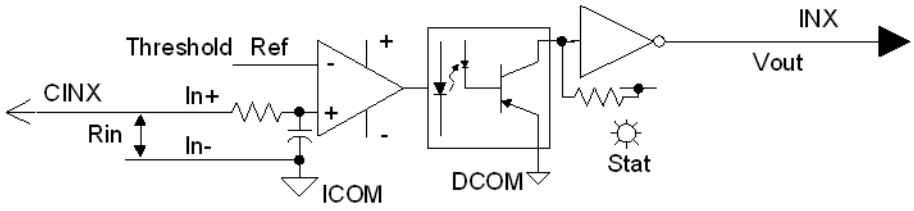
- An RJ-45 Ethernet connector named ENET1 on the side of the pack is the primary system interface.
- A second RJ-45 Ethernet connector named ENET2 on the side of the I/O pack is the redundant or secondary system interface.
- A 3-pin power connector on the side of the pack is for 28 V dc power for the I/O pack and terminal board.

8.1.3.2 Contact Input Signals

The discrete input/output acquisition board provides the second stage of signal conditioning and level shifting to interface the terminal board inputs to the control logic. Initial signal conditioning is provided on the terminal board. The discrete input acquisition input circuit is a comparator with a variable threshold. Each input is isolated from the control logic through an opto-coupler and an isolated power supply. The inputs are not isolated from each other. Each of the twenty-four inputs has filtering, hysteresis, and a yellow status LED, that indicates when an input is picked up. The LED will be OFF when the input is dropped-out. The LEDs are grouped at the bottom left of the PDIO I/O pack.

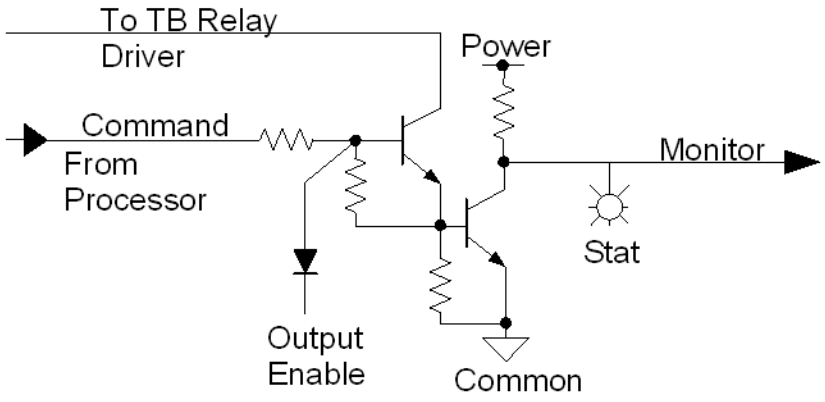


8.1.3.3 Variable Input Threshold

The input threshold is derived from the contact wetting voltage input terminal. In most applications this voltage is scaled to provide a 50% input threshold. This threshold is clamped to 13% to prevent an indeterminate state if the contact wetting voltage drops to zero. If the contact wetting voltage drops below 40% of the nominal voltage, the under-voltage detector annunciates this condition to the control. A special test mode is provided to force the inputs from the control pack. Every four seconds, the threshold is pulsed high and then low and the response of the opto-couplers is checked. Non-responding inputs are alarmed.

8.1.3.4 Relay Command Signals

The PDIO relay command signals are the first stage of signal conditioning and level shifting to interface the terminal board outputs to the control logic. Each output is an open collector transistor circuit with a current monitor to sense when the output is picked up and connected to a load. The status LEDs and monitor outputs indicate when an output is picked up and connected to the terminal board. If an output is commanded to be picked up and the correct load is not sensed, the status LED will be off and the monitor line will be false. The LEDs are grouped at the top left of the PDIO pack.



Relay Command Signals

8.1.3.5 Output Enable

All of the outputs are disabled during power application until a variety of internal self-tests are completed. An enable line reflects the status of all required conditions for operation. This function provides a path independent of the command to ensure relays stay dropped-out during power-up and initialization.

8.1.3.6 Monitor Inputs/Control

There are 15 inverting level shifting monitor input circuits. On a typical terminal board 12 of these circuits are used as relay contact feedbacks and the other three are used for fuse status. An inverting level shifting line is also provided from the control to the terminal board for status feedback multiplexing control allowing the pack to receive two sets of 15 signals from a terminal board.

8.1.3.7 Sequence Of Events (SOE)

All of the inputs and outputs may be individually configured to generate SOE records when the signal changes. It is not recommended to use output SOEs, but to instead use output feedback inputs (for example, relay feedback to log the relay SOEs). Input hardware is scanned at a 1000 Hz rate for SOE time stamping while output commands are captured when a change of command is received through Ethernet from the controller.

8.1.4 Specifications

Item	PDIO Specification
Number of Input Channels	24 DI and 12 form C contact DO
Input Isolation in Pack	Optical isolation to 1500 V on all inputs (group isolation)
Input Filter	Hardware filter, 4 ms
AC Voltage Rejection	60 V rms at 50/60 Hz at 125 V dc wetting voltage
Number of Relay Command Channels	12 relays
Relay and Coil Monitoring	12 relay/coil monitors, 3 fuse status feedbacks multiplexed to read status from 6 fuses. The selection of monitor feedbacks depends on the type of terminal board used, based on ID chip.
I/O Pack Response Time	From Ethernet command to output is typically 4 ms.
SOE Reporting	Each relay may be configured to report operation in the sequence of events (SOE) record.
Frame Rate	System dependent scan rate for control purposes 1,000 Hz scan rate for sequence of events monitoring
Fault Detection	Loss of contact input wetting voltage Non-responding contact input in test mode Incorrect terminal board Relay position feedback using contact pair separate from load contacts
Ambient Rating for Enclosure Design†	PDIOH1B is rated from -40 to 70°C (-40 to 158 °F) PDIOH1A is rated from -30 to 65°C (-22 to 149 °F)

Note † For further details, refer to the *Mark VIe and Mark VIeS Control Systems Volume I: System Guide* (GEH-6721_Vol_I), the chapter *Technical Regulations, Standards, and Environments*.

8.1.5 Diagnostics

The I/O pack performs the following self-diagnostic tests:

- A powerup self-test that includes checks of RAM, flash memory, Ethernet ports, and most of the processor board hardware.
- Continuous monitoring of the internal power supplies for correct operation.
- A powerup check of the electronic ID information from the terminal board, acquisition board, and processor board to confirm that the hardware set matches, followed by a check that the application code loaded from flash memory is correct for the hardware set.
- Monitoring for loss of contact input wetting voltage on the terminal board takes place at the selected system frame rate.
- Detecting a non-responding contact input during diagnostic test. In this test, the threshold is pulsed high and low and the response of the opto-couplers is checked. The test typically runs once every four seconds, and can be observed as a very brief period when all twenty-four contact input lights turn on.
- A frame rate comparison is made between the commanded state of each relay drive and the feedback from the command output circuit.
- Relay board specific feedback is read by the pack and processed every frame. The information varies depending on the relay board type. Refer to relay terminal board documentation for feedback specifics.

8.1.6 Configuration

Note The following information is extracted from the ToolboxST application and represents a sample of the configuration information for this board. Refer to the actual configuration file within the ToolboxST application for specific information.

Parameter	Description	Choices
Input Point Parameters	Terminal board connected to PDIO	Connected, not connected
Input	Selection will enable Contact Inputs or Relay feedback inputs	Used, Unused
SignalInvert	Inversion makes signal true if contact is open	Normal, Invert
SeqOfEvents	Record contact transitions in sequence of events	Enable, Disable
DiagVoteEnab	Enable voting disagreement diagnostic, only present on TDBT.	Enable, Disable
SignalFilter	Contact input digital filter in milliseconds (in addition to 4 ms hardware filter)	Zero, Ten, Twenty, Fifty, Hundred
Output Point Parameters		
RelayOutput	Selection will enable use of the relay	Used, Unused
SignalInvert	Inversion makes relay closed if signal is false	Normal, Invert
SeqOfEvents	Record relay command transitions in sequence of events	Enable, Disable
FuseDiag	Enable fuse diagnostic - Will appear as configuration item for use with Fuse daughterboard	Enable, Disable
Output_State	Select the state of the Relay condition based on I/O pack going offline with controller	PwrDownMode, HoldLastValue, Output_Value