



DIVISION OF CONOLOG CORP.

PDR-2000

DIGITAL TELEPROTECTION TERMINAL



MAJOR FEATURES

- All Pilot Schemes
- 8 Relay inputs
- 2 Digital Communication Ports
- On board or Remote Programming
- Sequence of events recording
- RS-422, G.703, or Fiber Optic Communication
- Unit ID
- Packet Forwarding
- Mean Trip Time < 4msec
- 16-Bit Error Detection
- Password Protection
- 12 YEAR WARRANTY

DESCRIPTION

The PDR-2000 is an eight channel digital protective relaying terminal used for high speed tripping in protective schemes for electric power transmission and generation. The PDR-2000 communicates using either a serial digital communications link or a fiber optic connection.

The PDR-2000 is standard with two communication ports that allows the unit to simultaneously operate over two digital communication lines. To increase security, each digital packet includes a Unit identification (ID) number. Packet Forwarding allows a PDR-2000 to communicate with units that are not directly connected as in a string or loop configuration. As with all INIVEN products, the PDR-2000 comes with a 12 Year Warranty.

APPLICATIONS

The PDR-2000 is used for all types of pilot protection schemes that use 56/64 Kbps, G.703 or fiber optic digital communications.

PROGRAMMABILITY

On-board and remote programming with password protection is standard on each unit. The Keypad and Display has easy to follow menu driven selections, allowing the user to program all the options and logic of the unit. A PC may be interfaced with either RS-232 port (remote, DTE and local, DCE), to program the unit using the PDR-2000 GUI, a Windows® based program.

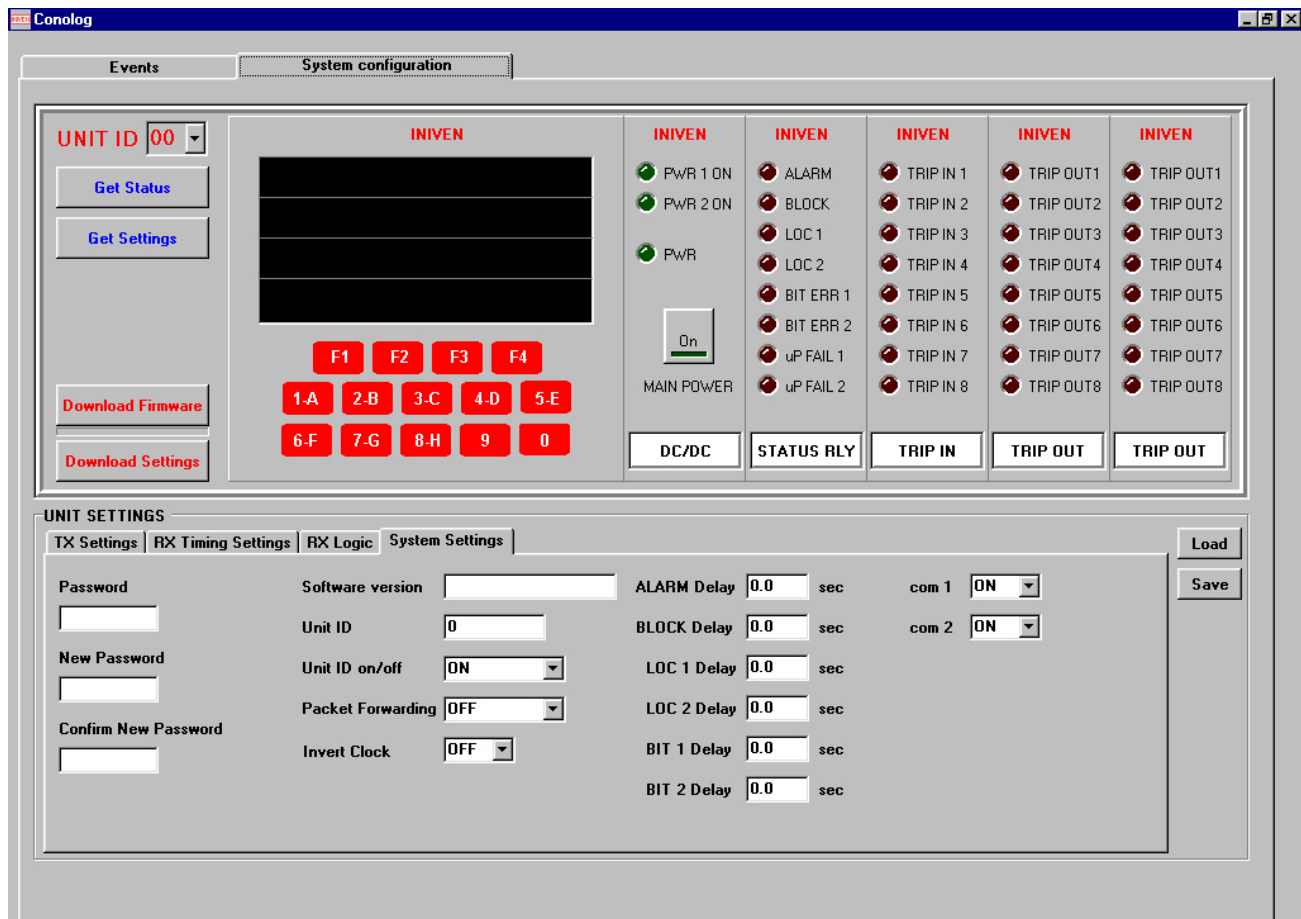


Figure 1. GUI System Settings Screen

Programmable options include:

- Unit ID number
- Trip Output Logic Schemes
- Trip hold timer
- Input Trip debounce timer
- Synchronous clocking inversion
- Packet Forwarding
- Pre-Trip timer
- Guard before Trip
- Com port activation
- Alarm relay delays

DISPLAY

The Display module consists of a VFD (vacuum florescent display) and Keypad which serve a variety of functions on the PDR-2000. This module may be used to program the PDR-2000. The Display module is also used to initiate Ping tests and manual Trips. In its default mode, the VFD displays the the status of the eight transmit and receive channels, the time being used by the event recorder, and the Unit ID number.

The VFD's brightness in combination with the standard anti-glare screen make it readable in almost any type of lighting.

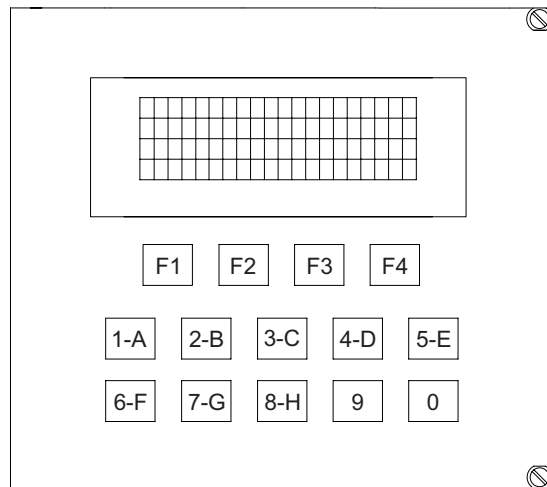


Figure 2. Keypad and Display Module

UNIT IDENTIFICATION

Each PDR-2000 should be assigned a unique Unit ID number. The Unit ID is continuously transmitted as part of every packet. This allows only units programmed to receive information, do, and data with incorrect Unit ID numbers are ignored. This increases security without effecting dependability. False Trips due to any type of digital crosstalk are eliminated.

PACKET FORWARDING

Because every packet has the Unit ID number of its source, packets may be passed from unit to unit allowing two units not directly connected to communicate with each other. Each PDR-2000 has two communication ports so that it may be directly linked to two other units. With the Packet Forwarding feature turned on, any packet received in one port is re-transmitted through the other port. Information that can be forwarded include:

- Trip
- Software settings
- Status
- Guard
- Sequence of Events
- Ping test

Any directly or indirectly connected units can share this information. Packet Forwarding is especially effective for three terminal applications and small loops or strings. This feature can also be used for redundant communications without the cost of additional equipment.

DIAGNOSTICS AND TESTING

The PDR-2000 has advanced diagnostics using a fully featured event recorder. The event recorder can hold up to 40,000 events, after which the events are overwritten. Events are timed stamped by the internal clock which can be updated using an IRIG-B signal from a GPS clock and stored in Flash memory.

The same Windows® based GUI that is used to program the unit's settings also accesses events. The GUI allows the user to download up to 1,000 events and sort the events by event type, date and time.

The Keypad and Display can also access events by starting with the most recent event and scrolling back chronologically. The types of events are listed in Figure 3.

| GUI EVENT | UNIT DISPLAY EVENT | EVENT DESCRIPTION |
|--|--------------------|---|
| Power On | POWER ON | Unit was powered On |
| Password | PASSWORD | Unit was accessed with password |
| Wrong Password | WRONG PASSWORD | Wrong password was entered |
| Trip Output # | otp # val (1/0) | Trip Output On/Off on # (number of output circuit), 1 = On, 0 = Off |
| Trip Input # | inp # val (1/0) | Trip Input On/Off on # (number of input circuit), 1 = On, 0 = Off |
| TIME OUT FROM ID # | Time Out ID # | A packet has not been received from a unit whose number is programmed in receive logic. |
| TIME OUT OFF ID # | Time Out Off ID # | TIME OUT FROM ID # event has ended, a packet has been received with the matching Unit ID number. |
| ALARM ON/OFF | ALARM ON/OFF | Alarm status relay was turned On or Off |
| Blocked On/Off | BLOCKED ON/OFF | Block status relay was turned On or Off |
| Loss of communications channel 1 | LOSS COM 1 | LOC 1 status relay was turned On |
| Loss of communications OFF channel 1 | LOSS COM 1 OFF | LOC 1 status relay was turned Off |
| Loss of communications channel 2 | LOSS COM 2 | LOC 2 status relay was turned On |
| Loss of communications OFF channel 2 | LOSS COM 2 OFF | LOC 2 status relay was turned Off |
| Bit Error channel 1 | BIT ERROR 1 | BIT ERR 1 status relay was turned On |
| Bit Error OFF channel 1 | BIT ERROR 1 OFF | BIT ERR 1 status relay was turned Off |
| Bit Error channel 2 | BIT ERROR 2 | BIT ERR 2 status relay was turned On |
| Bit Error OFF channel 2 | BIT ERROR 2 OFF | BIT ERR 2 status relay was turned Off |
| Primary CPU Power out of Range 2.5 V | PRIM 2.5 fail | Primary uP module 2.5 V is out of range |
| Primary CPU Power out of Range OFF 2.5 V | PRIM 2.5 fail OFF | Primary uP module 2.5 V has returned to within range |
| Secondary CPU Power out of Range 2.5 V | SEC 2.5 fail | Redundant uP module 2.5 V is out of range |
| Secondary CPU Power out of Range OFF 2.5 V | SEC 2.5 fail OFF | Redundant uP module 2.5 V has returned to within range |
| Primary CPU Power out of Range 3.3 V | PRIM 3.3 fail | Primary uP module 3.3 V is out of range |
| Primary CPU Power out of Range OFF 3.3 V | PRIM 3.3 fail OFF | Primary uP module 3.3 V has returned to within range |
| Secondary CPU Power out of Range 3.3 V | SEC 3.3 fail | Redundant uP module 3.3 V is out of range |
| Secondary CPU Power out of Range OFF 3.3 V | SEC 3.3 fail OFF | Redundant uP module 3.3 V has returned to within range |
| Primary Power fail 5 V | PRIM 5 fail | Primary DC/DC converter has failed |
| Secondary Power fail 5 V | SEC 5 V fail | Redundant DC/DC converter has failed |
| Primary Power fail OFF 5 V | PRIM 5 fail OFF | Primary DC/DC converter returned to within 5 V limits |
| Secondary Power fail OFF 5 V | SEC 5 fail OFF | Redundant DC/DC converter returned to within 5 V limits |
| Invalid ID | INVALID ID | A Packet was received with a Unit ID number that does not match the receive logic. Only when Packet Forwarding is Off and Unit ID is On |
| Cut-out ON/OFF | CUT-OUT ON/OFF | Cut-Out switch changed from the On to Off position |
| Ping test start | PING TEST SEND | Ping test initiated from keypad |
| Ping test received | PING TEST REC | Ping test received by remote unit |
| Ping test failed | PING TEST FAIL | Ping test did not return to initiating unit |
| Ping test passed | PING TEST DONE | Ping test successfully returned to initiating unit |
| Ping test returned | PING TEST ANSWER | Ping test transmitted from remote to initiating unit |

Figure 3. Events

Packet Forwarding allows the GUI to upload the events of not just the local unit, but any remote unit communicating in a string or loop. This is also true of a unit's Settings and Status. Retrieving Settings with the GUI displays the entire software configuration including the unit's Firmware version. Uploading the Status shows exactly the state of the LED's and Display are at the time of the request. These are displayed on a graphical representation of the PDR-2000 in Figure 1.

Channel and timing tests may be performed using the Ping test. Initiated as a single end test, it is directed through a communication port to a selected unit. A pass/fail report and the round trip time of the test are displayed.

Password protected manual trip commands may be activated on the Keypad and Display. From one to eight channels may be tripped for a designated period of time.

DIGITAL ELECTRICAL COMMUNICATIONS

Two types of electrical synchronous digital communications are available, a 56/64 Kbps RS-422 through a RS-449 port, or a 64 Kbps G.703 co-directional serial interface. Two communication ports per chassis are standard. Two ports allows one unit to communicate over two different channels to two other units, even in different locations.

Packet size ranges from 40 to 255 bits depending on the type of communication and the message purpose. All packets contain the transmitting unit's ID number and either a 16 or 32 bit CRC (Cyclic Redundancy Check) for added security. Trip and Guard commands use 40 bit packets and always have priority to ensure minimum Trip times.

DIGITAL FIBER OPTIC COMMUNICATIONS

The PDR-2000 is available with several optional fiber optic interfaces. The Fiber Optic module can house up to two transmit and two receive heads. The optional heads are listed in Figure 4.

| Emitter Type | Wavelength (nm) | Fiber Mode | Connector |
|--------------|-----------------|------------|-----------|
| Laser | 1550 | Single | FC |
| Laser | 1550 | Single | ST |
| LED | 1550 | Single | FC |
| LED | 1550 | Single | ST |
| Laser | 1300 | Single | FC |
| Laser | 1300 | Single | ST |
| LED | 1300 | Single | FC |
| LED | 1300 | Single | ST |
| LED | 1300 | Multimode | FC |
| LED | 1300 | Multimode | ST |
| LED | 850 | Multimode | ST |
| LED | 850 | Multimode | ST |

Figure 4. Fiber Optic Interfaces

For short haul fiber applications meeting ANSI C37.94, an optional 850 nm multimode fiber module is available.

TRIP TIMES

The PDR-2000 is a high speed digital communications terminal. Trip times average 3 ms. Due to the size of the PDR-2000 communication packets, times vary. For those units equipped with optional 3 amp dry contact Trip relays add approximately 3 ms to the Trip time, and approximately 1 ms for 30 amp dry contact Trip relays. In-service Trip times can be determined by using the Ping Test. Channel speed is measured with back-to-back terminals and does not include delays resulting from equipment or media outside the PDR-2000.

REDUNDANCY

The PDR-2000 is available with several optional redundant modules to increase the reliability and flexibility of the unit.

LOGIC: In the event of a failure by the primary Microprocessor module, the redundant module will operate the PDR-2000. The Status Relay module and the event recorder on the redundant module will indicate primary module failure. To simplify setup, the primary and redundant Microprocessor modules are programmed simultaneously. Likewise, the redundant Microprocessor module contains an event recorder which mirrors the primary's.

POWER SUPPLY: The PDR-2000 power supply is made up of two modules, both of which can be redundant. A DC converter module on the rear of the chassis converts the input voltage (24, 48, 125 or 250 VDC) to 5V. The DC/DC module contains a power filter, fuses, over/under voltage protection and a power fail relay. When the redundant power supply is ordered, a second DC converter module and a redundant circuits on the DC/DC module are supplied. When operating normally, each power supply carries half of the load required by the unit. In case either power supply fails, the remaining supply powers the unit, a relay and LED indicate the failure.

TRIP OUT: The Trip Out module contains eight solid state relays rated for 1A @ 300VDC. A second redundant Trip Out module can be added to the PDR-2000 to mirror the logic of the primary module's outputs. The solid state relays on the primary Trip Out module may be used as redundant outputs of the optional dry contact Trip out relays.

RELAY I/O

SOLID STATE: The PDR-2000 has eight optically isolated solid state Trip outputs on each Trip Out module with a maximum of two modules per chassis. Eight optically isolated Trip inputs are located on the Trip In module.

UNIVERSAL RELAY: The optional Universal Relay module holds four dry contact output relays. Each relay is rated for 3A @ 150VDC and may be configured as Form A or Form B. The PDR-2000 can hold up to two Universal Relay modules per chassis.

HEAVY DUTY RELAY: The optional Heavy Duty Relay module holds four Form A or B dry contact relays. Each is rated for 30A @ 150VDC. The PDR-2000 can hold up to two Heavy Duty Relay Modules per chassis.

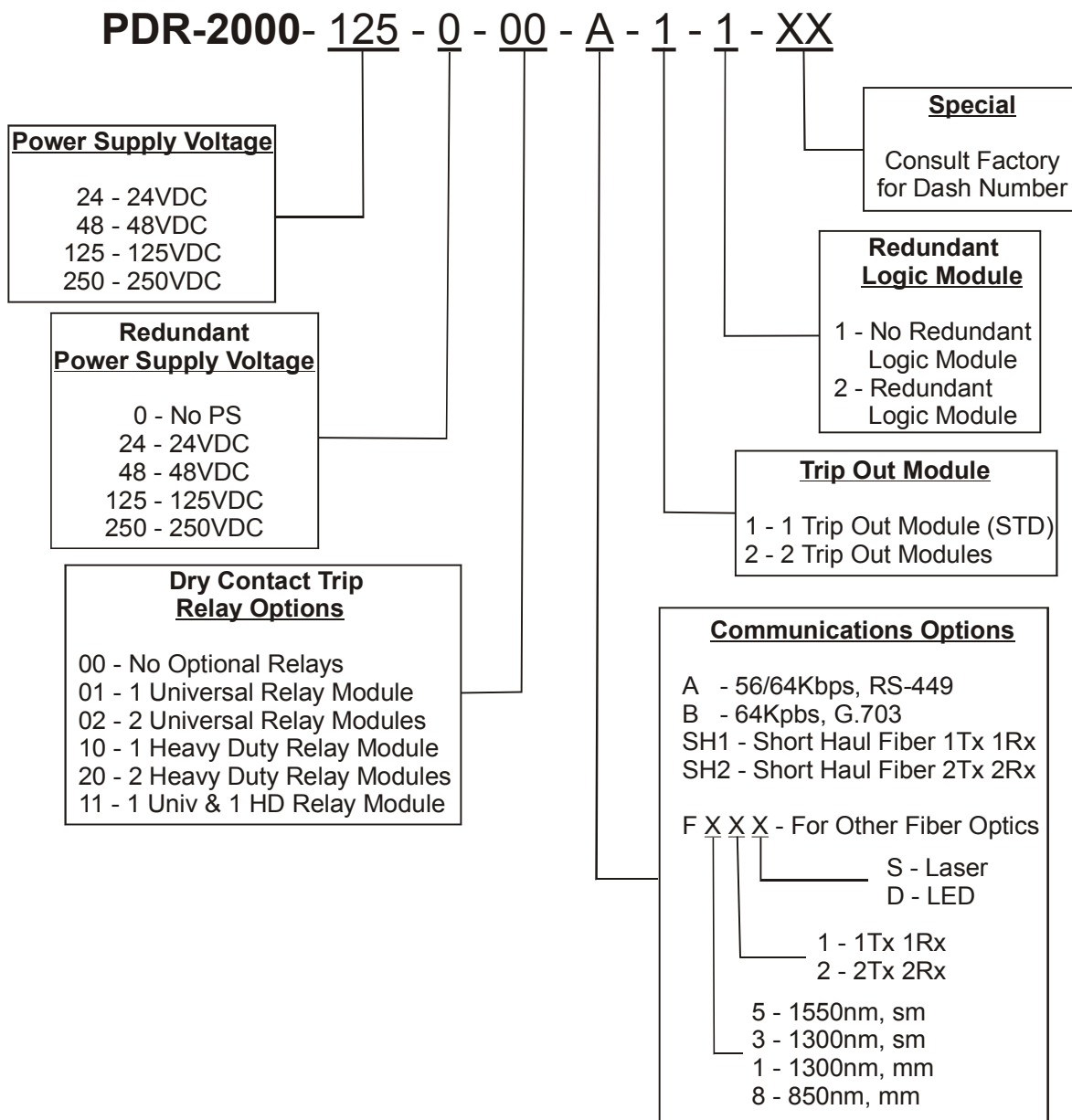
STATUS RELAYS

The Status Relay module contains eight relays: (1-Alarm, 1-Block, 2-LOC (loss of communications), 2 Bit Error, and 2-uP Fail (microprocessor fail). There is one loss of communication and one bit error rate relay for each of the two Com ports. The second uP fail relay is for the redundant uP module. All but the uP fail relays on the Status Relay module are programmable for delay. There is a power fail status relay located on the DC/DC module, two when the redundant module is supplied. The status relays drive external equipment when a change in system status is detected.

WARRANTY

As with all INIVEN products, the PDR-2000 is covered by a 12 year warranty from date of delivery.

PART NUMBER GENERATOR



SPECIFICATIONS

GENERAL

PHYSICAL:

Dimension:
Height: 5.25 in. (13.3 cm)
Width: 19 in. (48 cm)
Depth: 12.20 in. (31 cm)

Weight: 20 lb (9.1 kg) max.

OPERATING TEMPERATURE:

-30°C to +70°C (-22°F to +158°F)

RELATIVE HUMIDITY:

95% maximum @ +42°C (+108°F)
non-condensing

INTERFACE DIALECTRIC STRENGTH:

All connections including inputs, outputs and connectors meet the following specifications:

ANSI C37.90-1989
ANSI C37.90.1-1989
IEC 255-5
IEC 255-22-1
IEC 255-22-2
IEC 255-22-4

EXTERNAL CONNECTIONS:

Screw type terminal blocks, 6-32, will accept lugged wires from 12 AWG to 20 AWG.

IRIG-B connector, BNC
RS-232, 9 pin, DTE (rear)

Communication port modules:

RS-449, two 37 pin D-Sub
G.703, two 15 pin D-Sub
Fiber optic, FC or ST, multi or single mode, 2 TX & 2 RX heads:
850 nm
1300 nm
1550 nm

RFI SUSCEPTIBILITY:

ANSI C37.90.2 (35V / M)
IEC 255-22-3

STANDARD MODULES

MICROPROCESSOR MODULE:

Programmable for:
TX trip hold time, 0-40 ms
RX trip hold time, 0-40 ms
Pre-trip timer, 0-40 ms
Guard before Trip, 0-1000 ms
Status relay delay, 1-30 sec
Trip output logic
Unit ID
Packet Forwarding
Synchronous clocking
Com port activation
Event Recorder:
40,000 events before rewriting
Non-volatile memory
Diagnostics:
Ping Test
Manual Trip generation
2 per chassis max, 2nd for redundancy

DISPLAY

4 X 20 Vacuum Florescent Display (VFD)

COM MODULE:

RS-422 (64 Kbps)
Fiber optic, long haul
Fiber optic, short haul
G.703 (56/64 Kbps)

RS-232 MODULE:

IRIG-B signal input
Impedance, 3.7 Kohm
Isolation transformer, 5 KV
Signal levels:
1 = 3 V (+1, -.5 V)
0 = 1 V (+.2, -1 V)
DCE, 9 pin connector

DC MODULE:

Single or Dual (redundant) version
2 input fuses per DC input
1 output fuse per DC input
2 relays, power fail

DC CONVERTER MODULE(S):

Input Voltages:
24 VDC, 48 VDC, 125 VDC,
250 VDC
2 per chassis max with Dual DC Module

STATUS RELAY MODULE:

- 1 Alarm, programmable for delay
- 1 Block, programmable for delay
- 2 Loss of Communications, programmable for delay
- 2 Bit Error Rate, programmable for delay
- 2 Microprocessor Fail
- Max contact voltage, 300 VDC
- Max contact rating, 10 A
- Max break rating, 0.5 A @ 125 VDC

TRIP IN MODULE:

- 8 Trip inputs, optically isolated
- Current draw: 10 ma @125 VDC

TRIP OUT MODULE:

- 8 solid state Trip outputs, optically isolated
- Max voltage, 300 VDC
- Contact rating, 1 A
 - 2 A for 1 min
- 2 per chassis max

OPTION MODULES

UNIVERSAL RELAY MODULE:

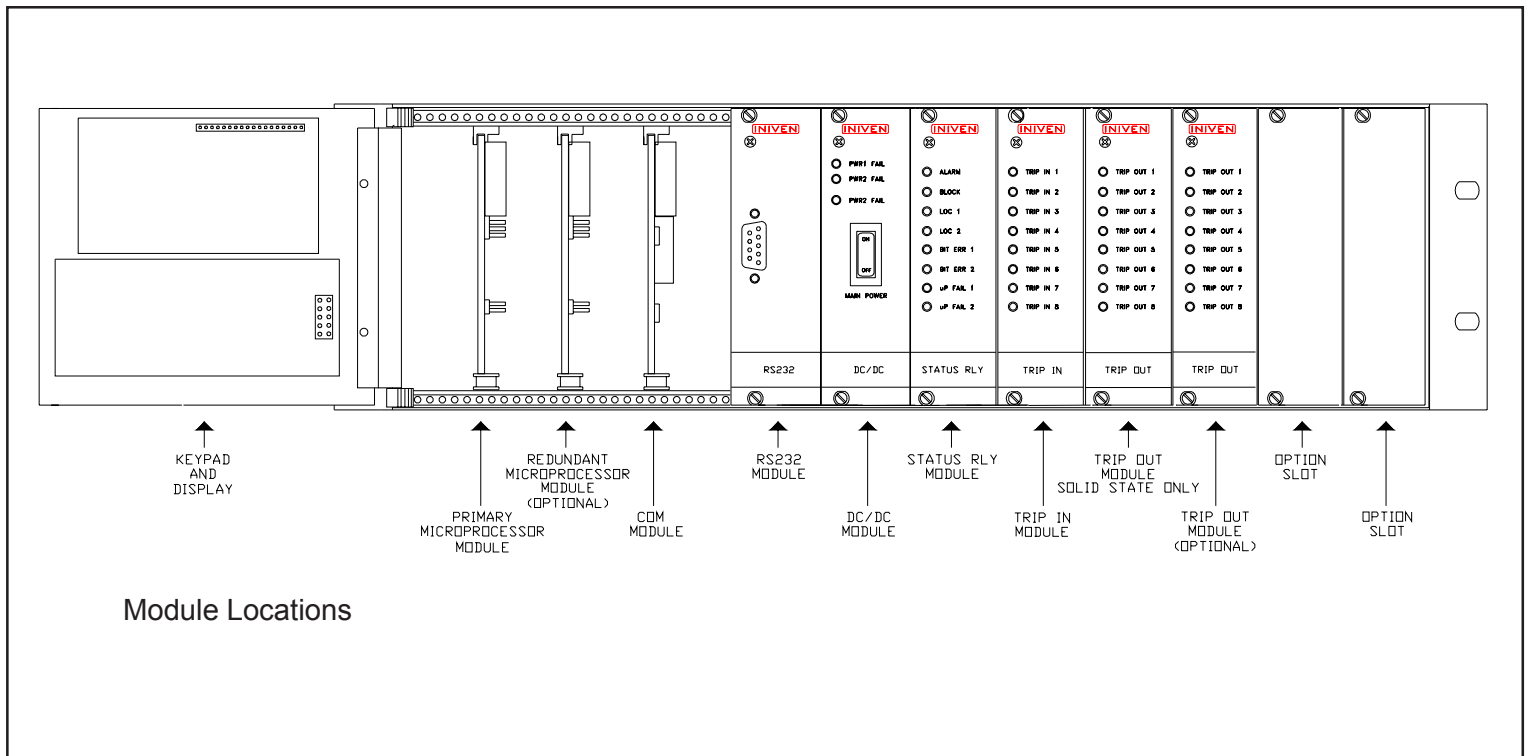
- 4 Form A / B relays
- Max voltage, 300 VDC
- Max contact rating, 10 A
- Max break rating, 3 A @ 150 VDC
- 2 per chassis max

HEAVY DUTY RELAY MODULE:

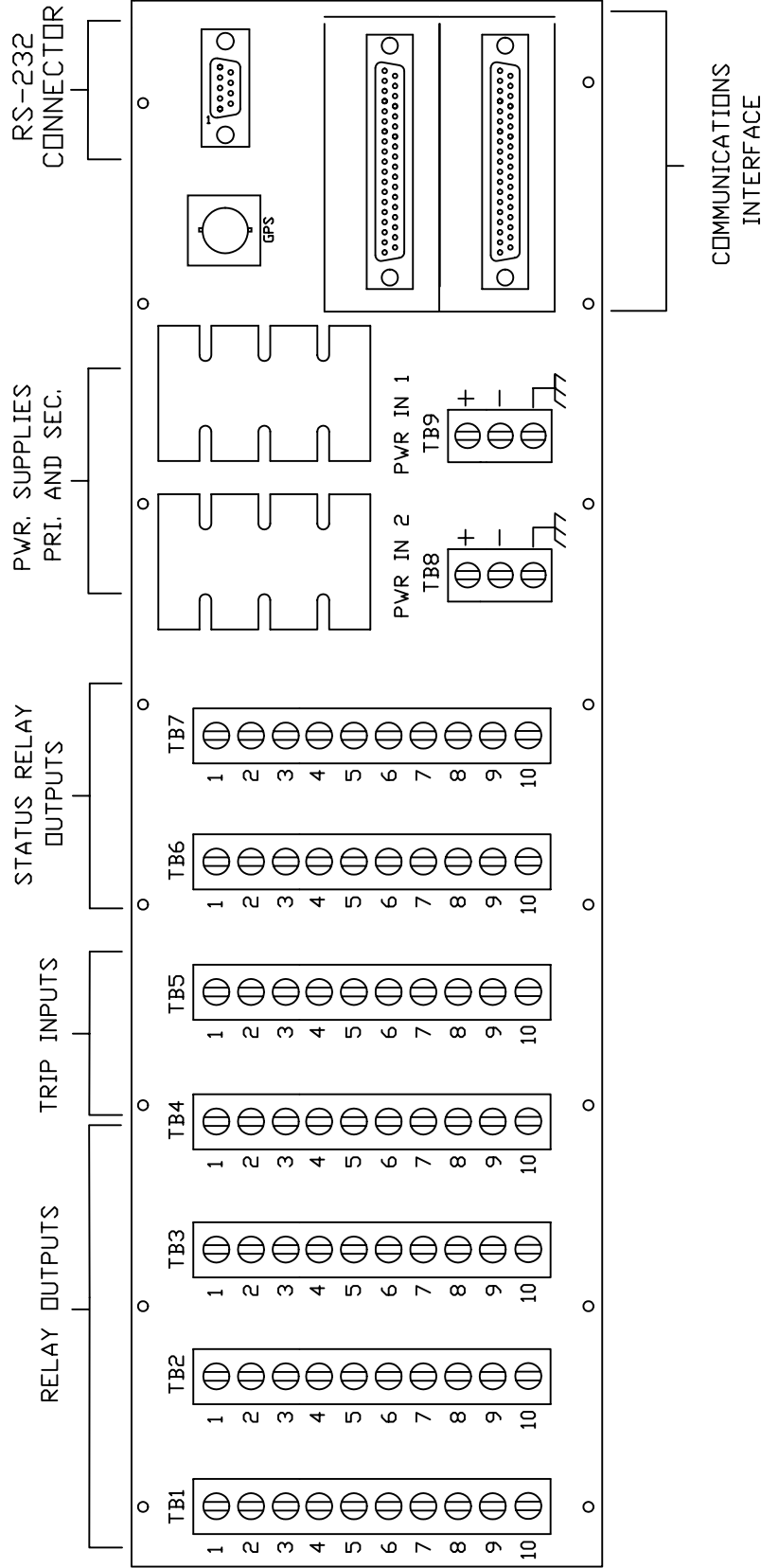
- 4 Form A / B relays
- Max voltage, 250 VDC
- Max contact rating, 30 A
- Max break rating, 10 A @ 250 VDC
- 2 per chassis max

CUT-OUT SWITCH MODULE

- Air gap switch for:
 - All Trip outputs
 - Trip In module circuit
 - uP module Trip In shutoff command



| REV. NO. | | REVISIONS | |
|----------|------|-------------|------|
| BY | DATE | DESCRIPTION | DATE |
| | | | |



| | | | |
|--|---------|---------------------|---------|
| DATE | 1/12/01 | DESIGNED BY | F. J.B. |
| CHECKED BY | | DATE | |
| UNLESS SPECIFIED OTHERWISE | | | |
| DIMENSIONS ARE IN INCHES | | | |
| DIMENSIONS ARE TO CENTER UNLESS NOTED OTHERWISE | | | |
| MATERIALS ARE TO BE AS SHOWN ON DRAWING UNLESS NOTED OTHERWISE | | | |
| SCALE | 1" = 1" | SCALE | 1" = 1" |
| NO. OF SHEETS | 1 | TOTAL NO. OF SHEETS | 1 |

| | | |
|--|----------------|---------------------|
| INVEN TM | WIRING DIAGRAM | REV. |
| SOMERVILLE, N.J. 08876 | PDR2000 | A |
| DATE | 1/12/01 | SCALE |
| BY | F. J.B. | SCALE |
| CHECKED BY | | SCALE |
| DATE | | SCALE |
| UNLESS SPECIFIED OTHERWISE | | |
| DIMENSIONS ARE IN INCHES | | |
| DIMENSIONS ARE TO CENTER UNLESS NOTED OTHERWISE | | |
| MATERIALS ARE TO BE AS SHOWN ON DRAWING UNLESS NOTED OTHERWISE | | |
| SCALE | 1" = 1" | SCALE |
| NO. OF SHEETS | 1 | TOTAL NO. OF SHEETS |

WARRANTY AGREEMENT

We hereby certify that the INIVEN product line carries a warranty for any part which fails during normal operation or service for 12 years. A defective part should be returned to the factory after receiving a return material authorization number (RMA), shipping charges prepaid, for repair f.o.b. Somerville, New Jersey. In case INIVEN cannot promptly return the unit to you it will endeavor to provide a loaner until the repair or replacement is returned to you. Any unauthorized repairs or modifications will void the warranty. In the case of parts not being commercially available, INIVEN reserves the right to replace the unit with a functionally equivalent unit.



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