INIVEN

DIVISION OF CONOLOG CORP.

PDR-2000

DIGITAL TELEPROTECTION TERMINAL

INSTRUCTION MANUAL

09.28.07

This Manual is Written to Reflect the

Following SoftwareVersions:

Audio ver. 01.2crc- 05/11/2007

GUI Version: _____

PTG-NB-002SCLF SEP 27 2007

Firmware Version:_____

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.

INIVEN DIVISION OF CONOLOG CORP. **5 Columbia Road, Somerville, NJ 08876**

SAFETY

Standard safety precautions must be followed at all times when installing, operating, servicing and repairing this equipment. INIVEN assumes no liability for failure to observe safety requirements or to operate this equipment for purposes other than intended.

GROUNDING

A suitable ground is required to reduce the hazard of shock. Refer to the enclosed module, chassis, and/or cabinet wiring diagram for ground connection locations.

ENVIRONMENT

Operation of any electrical equipment in area containing gases or moisture is a potential safety hazard. Necessary precautions should be taken.

MANUAL

Operators and maintenance personnel should read this manual before installing the equipment and placing it in service. Only properly trained personnel with proper tools and equipment should operate, maintain, repair or service this equipment.

SHOCK

Potentially dangerous electrical shock can occur when working on this product. Protective measures and safety procedures should be observed at all times.

Table of Contents

Section 1 GENERAL
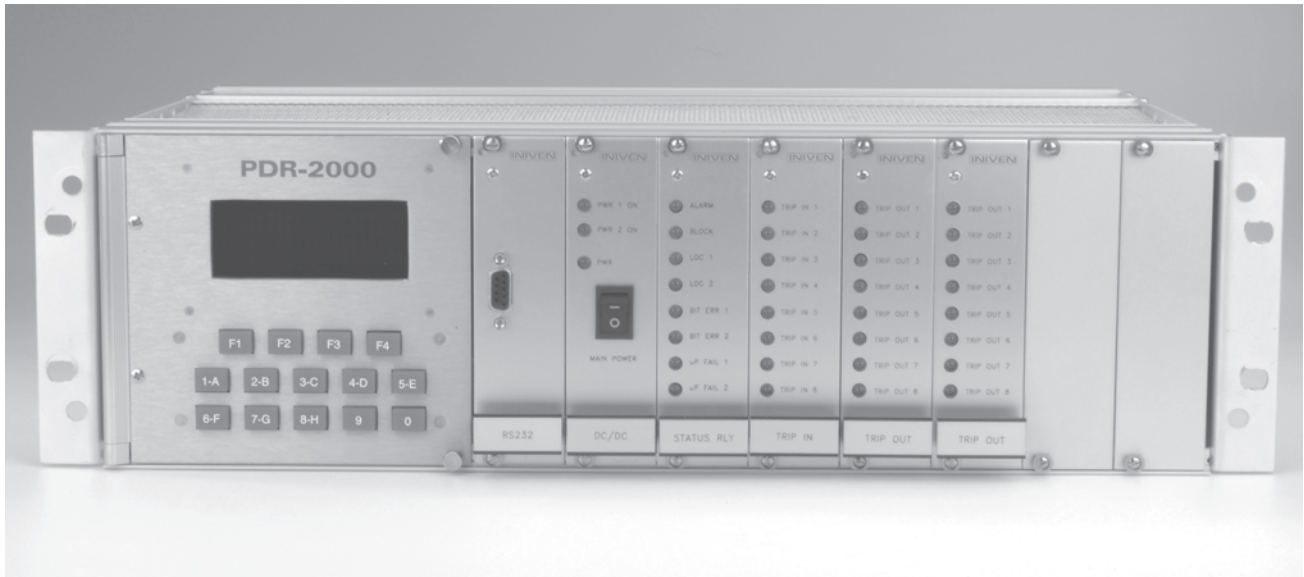

Figure 1-1. PDR-2000

DESCRIPTION

The PDR-2000 is a digital communications system used for the protection of electrical power generation and distribution equipment. A protection system consists of two or more PDR-2000 terminals communicating with each other via a digital channel (i.e., 56/64 Kbps RS449, fiber optics or 64 Kbps G.703). The PDR-2000 can also be used over a voice grade audio channel when equipped with an Audio Communications module. Up to eight Trip commands can be inputted to the unit and up to sixteen Trip outputs may be provided from a terminal.

FEATURES

DESIGN: The PDR-2000 has been designed for ease of setup, use and field modification. The units modularity allows for quick diagnostics, module replacement and addition of optional modules by the user. Multiple communication ports, up to eight Trip inputs and up to sixteen Trip outputs make the PDR-2000 extremely efficient.

PROGRAMMABILITY: The settings of the PDR-2000 are completely programmable both on-board and remotely via local or remote RS-232 ports. Firmware changes can be loaded using the GUI (Graphical User Interface) allowing software upgrades to be made easily in the field.

UNIT ID: Unit ID is a software selectable feature that requires the receive logic to confirm the Unit ID number that is transmitted on every packet to increase security and prevent accidental tripping. The Unit ID permits the terminal to upload the status and settings of a remote unit and retrieve data from it's Event Recorder. Unit ID in combination with two communication ports allows the unit to offer a feature called Packet Forwarding.

PACKET FORWARDING: A PDR-2000 uses Packet Forwarding to communicate beyond a unit it is directly connected to via the digital communications channel. Since the PDR-2000 has two communications ports and is capable of transmitting information to two units simultaneously, with the use of Packet Forwarding, multiple units may be arranged in a string or a loop. Packet Forwarding may

be used for Trip commands by turning the feature On in the software settings. Other information such as events, unit status and settings use Packet Forwarding automatically. Packet Forwarding is not used for audio applications.

EVENT RECORDING: The PDR-2000 has a built in sequence of events recorder. This Event Recorder time stamps all activity that takes place in the unit. Events include all Trip and Guard inputs and outputs, status relay activation, password access, and initial power on, see Section 7, Event Recording, for a complete list.

Up to 40,000 events are stored in nonvolatile memory before the process of overwriting the events begins. Events may be viewed one at a time on the front panel or up to 1000 events may be downloaded and sorted using the PDR-2000's Windows® based GUI.

COMMUNICATIONS: The PDR-2000 is equipped with two communication ports regardless of which type is supplied (RS-449, Fiber Optic, G.703, or Audio). Two communication ports makes the PDR-2000 extremely flexible. They may be used independently, allowing the unit to communicate with two units (or more with Packet Forwarding) simultaneously or they can both be used to communicate to one unit creating a redundant path for added security.

SPEED: The PDR-2000 is a high speed communications terminal. Trip times average approximately 3 ms for digital interfaces and 14 ms for the audio interface. Due to the size of the PDR-2000 communication packets and the delays inherent to multiplexed digital communications, times vary, see Section 2, Digital Communications, for more information on packets. For those units equipped with optional dry contact Trip relays, add approximately 3 ms to the Trip time for 10 amp relays and approximately 1 ms for 30 amp relays. In-service Trip times can be determined by using the Ping Test, which is initiated on the front panel or GUI, see Section 6, System Tests, for more details.
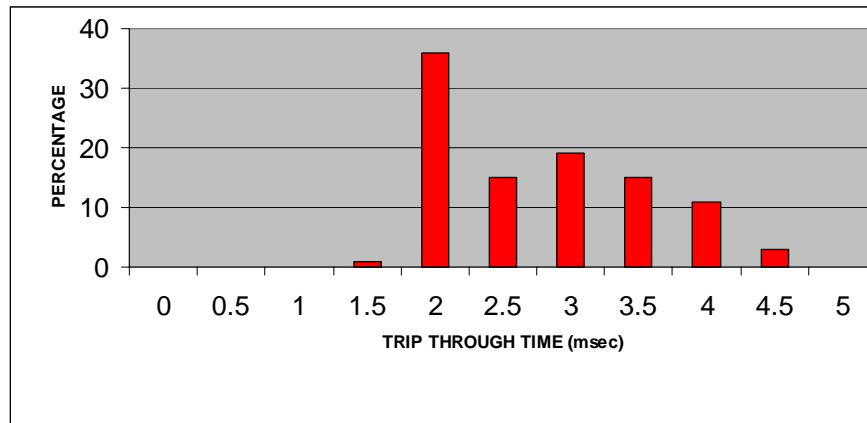

Figure 1-2. Digital Trip Times

Channel speed is measured with two back-to-back terminals and does not include channel delays.

SYSTEM SUMMARY

The following is a brief description of the standard modules that comprise a typical terminal. For detailed descriptions, schematics and parts lists, refer to the individual module's section in this manual, Sections 9 through 17.

MICROPROCESSOR MODULE: This module, located behind the Display module, controls all of the functions of the PDR-2000. The Microprocessor module (uP module) monitors and controls all Trip inputs and outputs and system status. All event recording, communications and programming are also controlled by the uP module. The Display module is directly connected to the uP module. A proprietary soft-core processor residing in an Altera FPGA and FLASH memory are the main components that run the module. A real time clock with battery backup is also on this module. The PDR-2000 requires one uP module, but an optional second module can be installed for redundancy.

DISPLAY MODULE: The Display module is made up of a 4 X 20 character Vacuum Florescent Display (VFD) and a fourteen key keypad. The keypad has four function keys and ten alphanumeric keys. The VFD is used to display Channel status, time and in conjunction with the keypad can be used to program the unit, perform tests and view events. The VFD and keypad are connected directly to the uP module via ribbon cables. This module is hinged on the left and swings out of the way to access the uP module(s) and the Communications module.

COMMUNICATIONS MODULE: Located behind the Display module and to the right of the uP module(s), this card converts the communications coming from the uP module to the format used in the system, i.e. RS-422, G.703, fiber optic or audio. The COM module (Communications module) differs depending on the type of communications supplied with the unit.

RS-232 MODULE (Data module): The RS-232 module contains two main circuits. The first contains the RS-232 circuits for the front (DCE) and rear (DTE) RS-232 communication ports and electrically isolates them from the uP module. The second contains the IRIG-B circuitry that coverts the GPS clock input for the uP module. This module may be replaced for optional protocols.

DC/DC MODULE: The standard redundant DC module converts, handles, and monitors the power in the PDR-2000. External power coming into the unit is fused and passed into the DC convertors located on the board and is fused again coming out of the DC convertors. Power is then distributed throughout the rest of the unit. The power is also monitored and is clamped if it goes high and then reset. The module is capable of handling up to two DC inputs that can be the same or different voltages. The DC module has two status relays whose contacts close in case of power failure.

STATUS RELAY MODULE: This module contains eight form A/B relays and LED indicators on the front panel. Conditions that will result in an alarm include: a uP module failure, loss of communications, master alarm, unit identification disabled, or communication block. Two outputs may also be programmed to indicate one of seven events, Trip In, Trip Out, invalid Unit ID received, loss of communication of indirectly connected units, bit errors on either Com port, or a Ping test failure that can indicate excessive propagation delay.

TRIP IN MODULE: Up to eight trips can be input into the PDR-2000, these are handled by the Trip In module. This module contains optical isolators and communicates detected trips with the uP module.

TRIP OUT MODULE: The Trip Out module has eight optically isolated solid state Trip output circuits. Trip outputs can be programmed by the uP module. The Trip Out module can also be used to drive up to 8 optional dry contact relays. A redundant Trip Out module is available that increases the total Trip out circuits to sixteen.

Figure 1-3. PDR-2000 System Block Diagram

PDR-2000 BLOCK DIAGRAM

COM MODULE

COM PORT J2
COM PORT J1
RS-449

RS-232/IRIGB

REAR RS-232
FRONT RS-232
IRIG B

STATUS RELAY

uP FAIL 2
uP FAIL 1
PROG 2
PROG 1
LOC 2
LOC 1
BLOCK
ALARM

+5V

KEYBOARD/SCREEN

MICROPROCESSOR MODULE 1

MICROPROCESSOR MODULE 2

+5V

TRIP OUT

TRIP IN

DC/DC MODULE PWR1

DC CONVERTER PS1

DC/DC MODULE PWR2

DC CONVERTER PS2

+5V

TRIP OUT 8
TRIP OUT 7
TRIP OUT 6
TRIP OUT 5
TRIP OUT 4
TRIP OUT 3
TRIP OUT 2
TRIP OUT 1

TRIP IN 8
TRIP IN 7
TRIP IN 6
TRIP IN 5
TRIP IN 4
TRIP IN 3
TRIP IN 2
TRIP IN 1

VERSIONS

HARDWARE: The PDR-2000 may be configured with different hardware arrangements. Items that differ are battery voltages, the number and type of Trip out circuits, redundant circuits and modules, and methods of communication. The part numbering system for the PDR-2000 is explained in Table 1-1. The part number covers all standard configurations. Any option module not listed is assigned a number that is placed in the last field (Special).
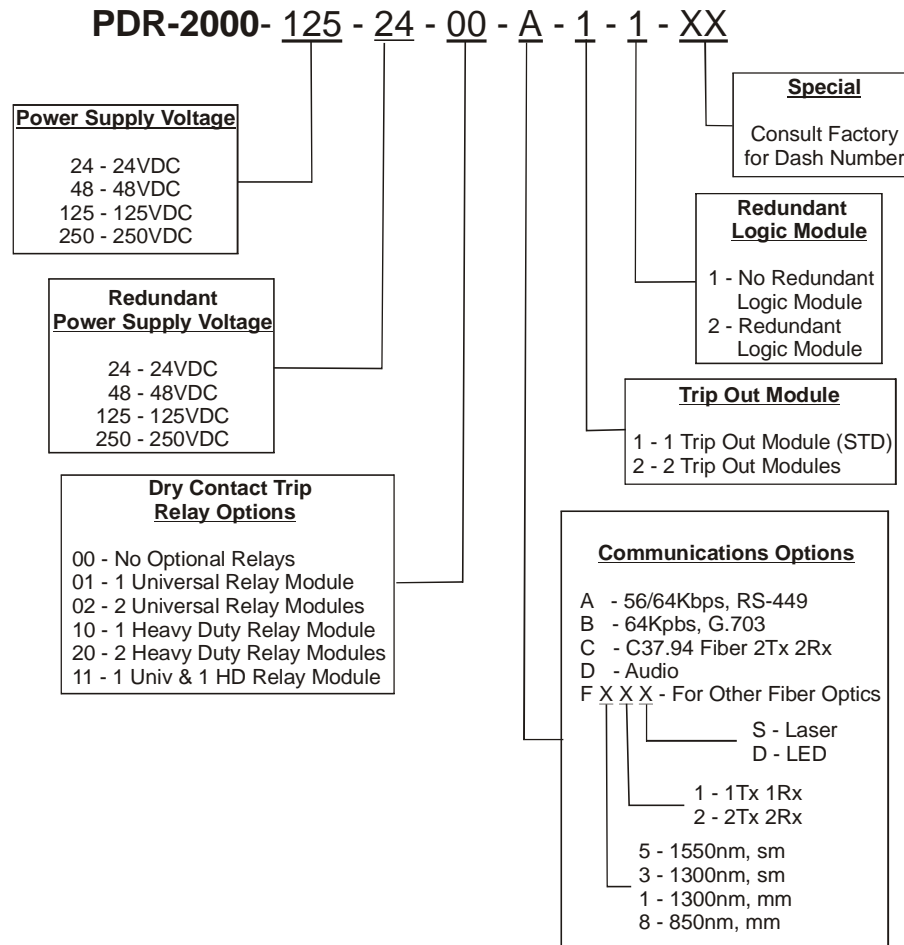
PDR-2000- 125 - 24 - 00 - A - 1 - 1 - XX

Power Supply Voltage

24 - 24VDC
48 - 48VDC
125 - 125VDC
250 - 250VDC

Redundant Power Supply Voltage

24 - 24VDC
48 - 48VDC
125 - 125VDC
250 - 250VDC

Dry Contact Trip Relay Options

00 - No Optional Relays
01 - 1 Universal Relay Module
02 - 2 Universal Relay Modules
10 - 1 Heavy Duty Relay Module
20 - 2 Heavy Duty Relay Modules
11 - 1 Univ & 1 HD Relay Module

Special

Consult Factory for Dash Number

Redundant Logic Module

1 - No Redundant Logic Module
2 - Redundant Logic Module

Trip Out Module

1 - 1 Trip Out Module (STD)
2 - 2 Trip Out Modules

Communications Options

A - 56/64Kbps, RS-449
B - 64Kpbs, G.703
C - C37.94 Fiber 2Tx 2Rx
D - Audio
F X X X - For Other Fiber Optics

S - Laser
D - LED

1 - 1Tx 1Rx
2 - 2Tx 2Rx

5 - 1550nm, sm
3 - 1300nm, sm
1 - 1300nm, mm
8 - 850nm, mm

Table 1-1. PDR-2000 Configuration Menu

Any revision made to an individual module changes the dash number of the modules "CC" part number.

EXAMPLE: The Trip Out module's part number is CC2245-00. If a change were made to the module it would be assigned the number CC2245-01.

Changes to a CC number are made only when modifications have been made to the hardware of the module. Typically, a new dash number will replace the old version and when ordering a PDR-2000 dash numbers do not need to be specified.

SOFTWARE: There are two types of software that relate to the PDR-2000. The GUI is run on a PC and does not directly affect the operational parameters. The GUI is used to change settings, review the status of a unit, view events, and download firmware. Firmware is the software that performs all the functionality of uP module and resides in the microprocessor module. Both types of software are independent of each other and maintain their own version numbers.

The GUI version number is PDR2000 GUI 1.1. The number at the end (1.1) is the version number. The version number is part of the name of the GUI that is located on the Desktop or in the INIVEN folder as part of the Start menu. The date the software was created may be found on the lower right hand side of the System Configuration Screen.

The Firmware version number is found one of two ways. Using the Keypad and Display and going to the Diagnostics menu or by using the Get Settings feature in the GUI. See Section 3, On-Board Programming and Section 4, Remote Programming for more details on using the Keypad and Display, and the GUI. A sample Firmware version number is: **PTG-0025 10/10/03.** The date at the end of the number is when the version was created and can be used along with the prefix to keep track of revisions.

The features of the GUI and Firmware described in this manual are written for the version numbers indicated on the first page of this manual.

Section 2 DIGITAL COMMUNICATIONS

The PDR-2000 uses two types of digital communications. The first is the main unit to unit communications that passes through the Com ports on the back of the chassis. The Com ports may be 64 Kbps RS-422 (using a RS-449 connector), point to point fiber optic, short haul fiber optic (ANSI C37.94), or G.703. The type of unit to unit communications is determined by the type of Com module installed. The second type of communications is the asynchronous communications from the two 9 pin RS-232 ports located on the front and rear panels. If a protocol other then RS-232 is supplied with the unit, its function is described in Section 17, Option Modules.

COMMUNICATION PORTS

The unit to unit communications involves three modules; the microprocessor module (uP module), the communications module (Com module), and the communication port module (Com port module).

COM PORT MODULE

The Com port module is a physical interface that allows for different types of connectors to be used with the PDR-2000. Two screws attach this module to the rear of the chassis. It mates to a connector located on the Interface board, see Section 16, Chassis for more information. The Com Port module comes with two complete interfaces of whichever type is supplied with the unit. For fiber optic interfaces this includes two transmit and two receive heads. This allows the PDR-2000 to communicate over two different paths to two units simultaneously. The two Com ports transmit the same packets but receive independently. Programming the receive logic allows a unit to discriminate which Trip commands to respond to (see Section 5, Installation or Section 4, Remote Programming for more details on setting receive logic and programming Com ports).

The available connectors are: RS-449 D-sub, single mode fiber (1550 and 1300 nm), multimode fiber (1300 and 850 nm), G.703 D-sub, and voice grade audio terminal blocks. The Com port module is field changeable, but requires the matching Com module to handle the different types of digital communication protocols. Electrical connectors are isolated to at least 5000 V.

COM MODULE

The Com module is located in the third slot from the left behind the keypad and display. This module takes the digital communications packet from the uP module and converts it to the appropriate protocol for the type of communications being used: 64 Kbps (RS-449), point to point fiber optic, short haul fiber optic (C37.94), G.703, or Audio. This module matches the Com port module's connector type on the rear of the chassis.

uP MODULE

The uP module creates the communications packets that are converted by the Com module to a particular protocol, i.e. RS-422. The uP module is capable of synchronous and asynchronous communications. Synchronous communications are used by all unit to unit communications. Asynchronous communications are used by the RS-232 ports or other protocol used for unit to PC communications.

The uP module also controls the output of the Com ports. The Com ports can be turned On or Off individually in the settings software.

DIGITAL PACKETS

The communications packet created by the uP module varies in length depending on the information being transmitted. The minimum packet length is 40 bits (for Trip and Guard communications) and the maximum length is 152 bits (for communicating settings).

The PDR-2000 is capable, as listed previously, of communicating more then just Trip and Guard inputs. By using the PDR-2000 GUI (Graphical User Interface), a local unit can be used to get the status, get the settings, get the events, send new settings, and send an erase events command to a remote unit.

Packets can travel from unit to unit, PC to unit, and unit to PC. Trip/Guard commands are sent from unit to unit. Sending information regarding status, current settings, and events are sent from a unit to a PC. A request for information (including status, settings and events), an erase events command, and a download of settings or firmware originate from the PC and are sent to a unit. All information can be forwarded, other than firmware. Firmware must only be downloaded from a PC directly to a unit.

DIGITAL PACKET STRUCTURES

There are several types of packets that are used by the PDR-2000.

TYPE A

Trip/Guard Commands

Byte 1	Sync word
Byte 2	Unit ID number
Byte 3	Trip input status (Guard - 0, Trip - 1)
Bytes 4 and 5	CRC code

Type A packets always have priority over all other packet types. Other packet types are sent when the Trip inputs are not changing state. Type A packets are transmitted between the packets of another type when they are in a string, even if there is not a change of state for the Trip inputs. Type A packets can only be generated and received by a PDR-2000. The packet size is always 40 bits.

TYPE B

Ping Tests

Byte 1	Sync word
Byte 2	Second sync word
Byte 3	Packet size
Byte 4	Unit ID to
Byte 5	Command
Byte 6	Unit ID from
Bytes 7 and 8	CRC code

Type B packets are used only when executing a Ping test, see Section 6 for more information on Ping tests. All types of Ping tests (manual, automatic, GUI generated, and keypad generated) use similar packet structures.

TYPE C

Get Status, Get Settings, Get Events, Get Inputs, Erase Events

Byte 1	Sync word
Byte 2	Second sync word
Byte 3	Packet size
Byte 4	Unit ID to
Byte 5	Command
Byte 6	Sub-command
Bytes 7 and 8	CRC code
Bytes 9 and 10	Footer

Type C packets are all generated from the a PC using the GUI. All of these packets are requests for the unit to perform a function, whether it is to return data to the PC or to erase events in the Flash memory. These packets can be forwarded along the Com link connecting units until the PDR-2000 addressed by the GUI is reached.

TYPE D AND E

Type D packets are used for a unit to send responses to the PC in reply for a request for information. Uploading settings, status and events are three types of information sent. Type D packets are also used to download settings and firmware to the unit from the PC. Type D packets vary in length but never exceed 152 bits in length. These longer packets are required to accommodate the amount of information that needs to be sent. All type D packets use similar structures to type C packets but vary in construction as the steps of transferring data take place. After a type D packet has been sent, the sender, whether the unit or GUI, requires a type E packet as a response before it will send another type D packet.

A type E packet is a simple 7 byte packet that tells the sending unit that the previous packet was received successfully or not. If the sending unit receives a type E packet that indicates the previous packet was received successfully, it sends the next type D packet. If the sending unit receives a type E packet that indicates the previous packet was not received successfully, it re-sends the previous packet, at which time it waits for the next response in the form of a type E packet and will repeat the message again if necessary. This process is to ensure that all data is received accurately and to prevent the unit or GUI from locking up do to faulty communications. Firmware must be downloaded from a PC directly to the unit being updated. All other information can be forwarded automatically to indirectly connected units.

CRC

The packets are checked using the CRC code (Cyclic Redundancy Check). The PDR-2000 uses the CRC-CCITT polynomial for the CRC with the formula: $x^{16} + x^{12} + x^5 + 1$. If a packet fails the CRC, the data in the packet is disregarded. The unit starts counting the next 999 packets and writes to the event recorder the percentage of bad packets received over the 1000 packets. This process is not initiated again until a packet with a CRC error is received. If the Status Relay module is programmed for a bit error alarm, the LED and relay will be activated for the duration programmed, see Section 3 (On-Board Programming) or Section 4 (Remote Programming), for instructions on programming Status Alarm relays. 100ms of bit errors will cause a loss of communications alarm on the Com port(s) with the bit errors. One error free packet is required to reset the communications channel.

The uP module also checks for communications failure. If no recognizable communications are sensed on the input of the Com port, a communications failure alarm will close and a time stamped event will be logged for the Com port from which the communications failed.

The different types of packets are prioritized. A Trip/Guard packet always has priority over other packets. When data packets other then Trip/Guard packets are sent, they are interlaced with Trip/Guard packets in order to maintain the fastest Trip times possible. When the state of the Trip inputs and outputs is stable, the other packet types are again transmitted.

UNIT ID

A Unit ID number is included in every packet. This is the number assigned to each unit to differentiate it from other units on the same communications system (see Section 3, On-Board Programming, to program Unit ID). The Unit ID number is used in two ways. First, the Unit ID number allows the GUI to program locally or remotely a unit, get the status, events and settings. This is stored in the unit and is used to respond to queries addressed, with the Unit ID number, for that unit. The other use of the Unit ID number is for acceptance of Trip commands. When a packet is received, if the receiving unit has the Unit ID feature turned On, the Unit ID number in the packet must agree with the receive logic in order to accept the Trip command, increasing security.

The PDR-2000 continually updates the status of the Trip outputs based on the packets being received. The status of an output (Trip/Guard) is maintained until a new packet is received with different (Trip/Guard) commands.

The PDR-2000 does not use the Unit ID number to address to a particular unit. It is used as an address from a unit. The receive logic determines if the Unit ID number as well as the Trip/Guard data contained in the received packet have the requirements to output a Trip. This allows the unit to be more flexible and does not require direct connections between units to allow tripping.

If communications were to cease, the Unit ID number allows the unit to block individual Trip outputs. In cases where one of the two Com ports is still operating, the PDR-2000 blocks the outputs that are programmed with the Unit ID numbers that are no longer being received. Depending on how the unit is programmed, the output will block in 500 ms or less, see Section 3 (On-Board Programming) or Section 4 (Remote Programming) for alarm programming.

Unit ID should always be used for increased security, but can be turned Off for loop back testing or other applications. Unit ID must be On when using Packet Forwarding or any other application that requires both Com ports.

PACKET FORWARDING

Packet Forwarding is used by the Trip commands and the GUI communications. When the unit is programmed with the Packet Forwarding feature turned On, all Type A packets are retransmitted. When a packet is retransmitted, it is received on one Com port and transmitted on the other port. Packets are not forwarded on the same Com port they are received on.

EXAMPLE: If Unit 10 has Packet Forwarding On and receives a Type A Trip/Guard packet on Com port 1, Unit 10 will look at the data for its own operation and retransmit the entire packet out of Com port 2.

A packet with a CRC error will not be retransmitted. The packet will no longer be forwarded when it reaches the packet's originating unit, a unit with only one active Com port, or a unit with Packet Forwarding turned Off.

Packet Forwarding is also used to transmit data and requests for data such as settings or events. Data packets (all packets other then Type A packets) are forwarded automatically. These packets forward until the addressed unit or PC are located regardless of whether Packet Forwarding is on or off. Packets that forward automatically are stopped when they reach their destination, the originating unit, or a unit with only one active Com port.

EXAMPLE: If a PC is connected to Unit 10 and the Get Status button (see Section 4, Remote Programming for instructions to operate the GUI) is clicked for Unit 30, Unit 10 will forward the query out of all active Com ports. If unit 20 receives the query from Unit 10, it will forward the query out the other Com port (if the other Com port is On) and this process will continue until Unit 30 is found. The process will reverse itself with Unit 30's response until it makes it back to Unit 10 and to the PC.

There are two types of schemes that Packet Forwarding can be used, a string or a loop. When used in a string, trip speeds are not severely impacted because they are moving in one direction. The PDR-2000 determines automatically that it is in a loop configuration when all the units have Packet Forwarding On. It realizes that a loop exists when packets containing it's own Unit ID number are being received on both Com ports. When the unit is in a loop, the spacing between packets is increased to allow for the additional data that is required on the same bandwidth. Change of state of the Trip inputs causes the associated packet to be accelerated and not wait for the longer space between packets. In general trip times will be slower then for units not in a loop.

When requesting data from remote units or changing settings using the GUI when the system is in a loop, whether or not Packet Forwarding is On, or is being queried by two computers simultaneously, the unit can only respond to one request at a time. Once the first request for information or attempt to download settings appears on a Com port, all other requests or downloads are rejected by the unit until the first process is finished or if the first process is interrupted for one second. If a request is made to a "busy" unit, a message is posted that stating that there is no communications with the unit. If this happens, wait a few seconds and try again.

It is recommended that no more then four consecutive units in a string or loop have Packet Forwarding On. When excessive packets exist on a system, some are discarded when timing and bandwidth do not allow for all packets to be transmitted. This may slow trip times.

AUDIO PACKETS

When equipped with an Audio Communications module, the PDR-2000 sends the digital information over a voice grade audio circuit, 300 to 3380 Hz. The audio module uses a unique set of data when compared to the digital I/O modules.

The Audio Communications module generates 22 tightly spaced sub-channels with a bandwidth of approximately 140 Hz each. Twenty of the sub-channels carry digital data, two of the sub-channels are pilot channels that synchronize both ends of the PDR-2000 communication channel. Of the 20 data sub-channels, each sub-channel transmits 2 bits for a total of 40 bits. The 40 data bits are made up of the following:

> 2 bits for Unit ID and determining packet type
> 8 bits contain the data (trip/guard) or (settings, status, etc...)
> 10 bits for CRC error detection
> 20 bits are a Reed-Solomon bit error correction code

Using a large bit error correction code increases dependability by correcting the most common bit errors caused by noise. The CRC will reject almost all uncorrectable errors avoiding false trips. Only packets that can not be corrected are flagged by the event recorder as a bit error.

When Type B, C, D, or E packets need to be sent using the Audio Communications module, they are sent in their entirety. The packets are broken into 8 bit bytes and transmitted in the 8 bit data field as described above. Trip/guard packets are alternated with these packets as to not adversely delay trip functionality. The result is slow transmission of Type B, C, D, or E packets when compared to fully digital systems.

PACKET FORWARDING

Packet Forwarding must be turned Off when using the Audio Communications module. The delays and bandwidth restrictions associated with audio communications make Packet Forwarding slow and impractical.

UNIT ID

The Unit ID numbers available when using the Audio Communications module are limited due to the bandwidth restrictions of an audio line. Only Unit ID numbers 1, 2, or 3 may be used. Do not use any other Unit ID numbers as they will not be recognized by the communication module. Since Packet Forwarding does not work with the Audio Communications module, more then 3 Unit ID numbers are not required.

PING TESTS

When Ping tests are used with the Audio Communication module, the results of the throughput time will not be accurate. This is due to the parceling of the Ping Test packet as described above. Use of the Ping test Fail alarm will have to be adjusted to accommodate the length of the test, see Section 6, System Tests for more details on Ping tests and see Section 13, Status Relay module for more details on the Ping Test alarm

RS-232 COMMUNICATIONS

The RS-232 ports use asynchronous communications to communicate from a PC (using the GUI) to a PDR-2000. The purpose of this communication is for programming and retrieving information.

HARDWARE

The PDR-2000 comes with two RS-232 ports. A 9 pin DCE port is located in the front of the chassis and a 9 pin DTE port is located on the rear of the chassis.

The DCE is designed to be directly connected to a serial port of a PC via a straight (not a null modem) M/F extension cable. The rate on this port is 115200 baud.

The DTE port on the rear of the chassis is designed for remote access via a modem or similar device. The PDR-2000 GUI provides for connection options including modem driver software, see Section 4 Remote Programming for instructions.

These ports are run from the RS-232 module located next to the keypad and display and has the DCE port located on its front panel. This module also contains the circuitry for the IRIG-B input. The RS-232 module provides an isolation of 5000 V between the connector and the unit. This module converts the asynchronous signal from the uP module to the RS-232 electrical standard.

The GUI is capable of downloading settings, downloading firmware, erasing events, getting events, getting status, getting settings from the unit it is directly communicating with, and can do all of the above, except download firmware, using Packet Forwarding.

IRIG-B

The PDR-2000 has the ability to update the internal clock (used for sequence of events recording) using a standard modulated IRIG-B input from a GPS clock. The standard modulated signal does not include the year so it must be entered manually (see Section 7, Event Recording for programming instructions). The uP module uses crystal oscillator to maintain the internal clock. The internal clock is updated using the IRIG-B signal to maintain a 1 ms accuracy. The internal clock maintains the time when there is no IRIG-B signal. If power is lost, a battery located on the uP module powers the internal clock. The internal clock automatically tries to update from the IRIG-B signal at Power On. The battery is only used for maintaining the internal clock when the power is turned off. If the battery dies or is removed, the clock must be set manually or by the IRIG-B input every time the power is turned on.

Section 3 ON-BOARD PROGRAMMING

This section describes all the processes available to program the PDR-2000 without the use of any external equipment (see Section 5, Installation for step by step installation instructions). There are up to four ways to program the unit; the Display module on the front panel, a PC using the RS-232 port on the front panel, a computer using a RS-232 port (or other communication port depending on unit configuration) on the rear terminal block board, or a computer connected to another PDR-2000. Programming using the Display Module is described in this section. Chart 3-1, located at the end of this section, is a flow chart for all the screens available through the Display module.

Downloading new settings does not take the PDR-2000 out of service. When programming using the Display Module, settings are changed instantaneously when the OK is pressed (as described later in this section). Unlike using the Graphical User Interface (GUI), On-board programming is done step by step. It may be recommended in some circumstances to take the PDR-2000 off-line before making significant changes to the settings using the Display Module.

PASSWORD: No matter which method is used, programming the unit requires it's password. The PDR-2000 comes with the default password, 1234, and may be changed to any four digit number. Iniven retains a manufacturer's password in case a unit's password is changed and/or forgotten.

PRIORITY: If a user is programming a PDR-2000 using the Display module, other programming methods are disabled. As long as the display module is not being used to program the unit, the other three methods have no priority and will not conflict since all programming information is downloaded all at once with the click of a mouse. The last changes downloaded are the ones that will be retained and used by the unit.

TRIP IN/OUT & CHANNELS: Since the Trip outputs can be programmed to operate with different channels, to avoid confusion, when programming the PDR-2000 Trip Inputs and Trip Outputs are referred to as 1 through 8. The eight communication sub-channels are referred to as A through H.
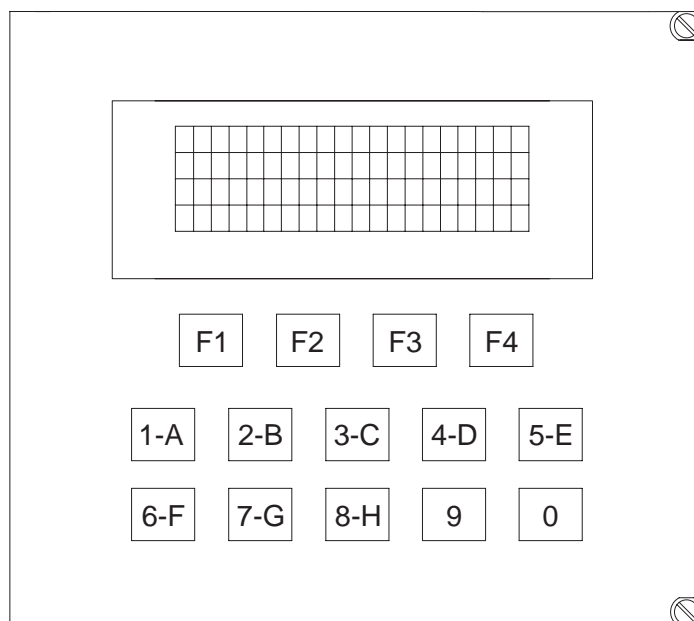
DISPLAY MODULE

Figure3-1. Display Module

The display module uses a Vacuum Florescent Display (VFD) and a keypad to program the PDR-2000. All the program settings can be made and reviewed by using the Display module. The Display module is menu driven and controlled by a combination of function keys and alphanumeric entries.

The VFD has 4 lines of 20 characters each. With the exception of the default screen, where the time is also shown, the bottom line is only used as function key commands. The top three lines are used as menu selection and information display.

Note: If left untouched for approximately two minutes, no matter what screen is presently on the VFD, the Display module will abort the screen and return to the default display. If a task is left uncompleted, the system will not be updated. When not in use the display dims to extend it's longevity.

DEFAULT DISPLAY: During normal operation and while not being queried or programmed the Display module has the following screen:

```
0  1    A    B    C    D    E    F    G    H

T  X    G    G    G    G    G    G    G    G

R  X    G    G    G    G    G    G    G    G

S  E  T  U  P        D  I  A  G    1  2  :  4  9  P  M
```
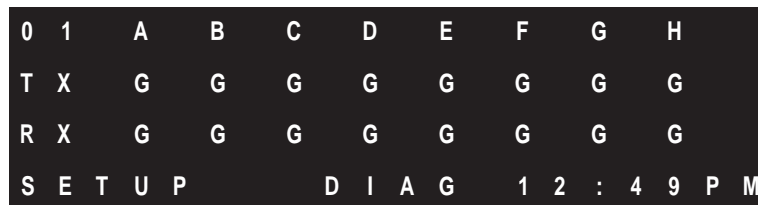
Figure 3-2. Default Display

The A through H on the first line of the display are the eight communication channels of the unit. To the left, is a two digit number. This is the Unit ID number assigned to this unit. The next line is the status of the eight communication channels that are being transmitted. The display will show a G for Guard, or T for Trip. The third line of the display is the state of the eight receive channels, again using G, T or B for Block. The bottom line has the commands for the function keys (F keys) and the time being used by the Event Recorder.

FUNCTION KEYS: There are four function keys F1 through F4. These keys perform the function described directly above it on the bottom line of the display.

PROGRAMMING

To program the PDR-2000 press the F1 key to enter the SETUP menu. The next screen will ask you for the unit's four digit password. You must enter the correct password before any settings can be changed. The password when the unit leaves the factory is 1234.

```
      E  N  T  E  R     P  A  S  S  W  O  R  D



                      _  _  _  _
O  K                          C  L  R          E  X  I  T
```

Figure 3-3. Password Screen

Use the alphanumeric keys to enter the password and press F1 for OK if correct. Press F3 to clear the entry and F4 to return to the default display.

If the password is entered incorrectly the following screen will allow you to return to the password screen or exit back to the default display.

There are three options in the general programming menu.

```
1    R X      S  E  T  U  P

2    T X      S  E  T  U  P

3    S Y  S T E M    S  E  T  U  P

O K                                           E  X  I  T
```
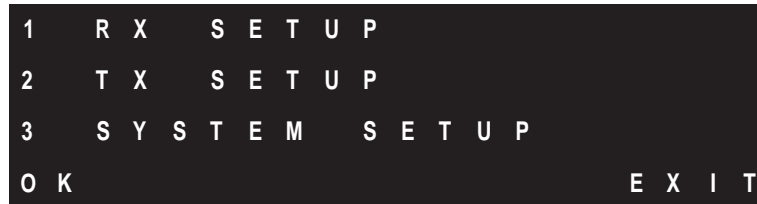
Figure 3-4. General Programming Menu

RX SETUP contains all the logic settings for receive channels and Trip outputs.

TX SETUP is used to program a transmit logic for the transmit channels.

SYSTEM SETUP controls the operating parameters of the rest of the unit including manual tripping.

Press the number of the section you want to program, until the number blinks then press F1 for OK.

System Setup: The PDR-2000 system parameters are programmed with the System Setup menus. Since many of these settings affect the way the rest of the unit is programmed, it is advised that the System Setup be programmed first.

There are nine choices spread over three menus in System Setup. Press the F2 and F3 screens to toggle between the three menus.

```
1   U N I T    I D E N T I T Y

2   P A S S W O R D

3   S E N D    T R I P    M A N U A L L Y

O K                     N E X T      E X I T
```

Figure 3-5. System Setup Menu A

```
4   P A C K E T    F O R W A R D

5   D A T E / T I M E    S E T

6   A L A R M    S E T U P

O K         P R E V    N E X T      E X I T
```

Figure 3-6. System Setup Menu B

```
7   C O M    S E T T I N G S

8   A U T O    P I N G    T E S T

9   A U D I O    S E T U P

O K         P R E V              E X I T
```

Figure 3-7. System Setup Menu C

UNIT IDENTITY is used to program the PDR-2000 Unit ID and to turn the Unit ID feature on/off. Unit ID increases security by requiring receiving units to be programmed to receive Trips on a particular channel and only from a unit with the proper ID number.

PASSWORD allows the unit's password to be changed.

SEND TRIP MANUALLY is a feature that can be used to initiate Trips on any or all channels for a specified period of time. **WARNING: this feature can result in a Trip being output on the receiving end of the channel(s) depending on receive logic.**

PACKET FORWARDING is a feature that when turned on instructs the PDR-2000 to retransmit any packets containing Trip and/or Guard commands. Packet Forwarding allows PDR-2000s to be strung together and can also be used as redundant communication paths in a loop configuration.

DATE/TIME SET is the manual internal clock setup for the sequence of events recorder. This is used to enter the year when first powering on the unit when an IRIG-B input is used. When an IRIG-B input is not used, this is used to set the internal clock for time and date.

ALARM SETUP is used to set the programmable status relays and change the default time delays on the Alarm, Block, LOC1, and LOC2 Relays. This section is also used to change the different available optional Trip Cut Out switches. These options are either a separate Cut Out Switch module or an integrated switch on the Trip Out module. Both these options have different functionality.

COM SETTINGS allows the user to turn On or Off the Com ports. Using two Com ports allows for the use of Packet Forwarding and schemes using strings, loops, and three terminal applications. This section also includes the settings for the synchronous clock source.

AUTO PING TEST is used to set up the automatic testing to another unit. The test confirms proper communications and channel delay between two units. See Section 6, System Tests, for more information about Ping test options and other testing methods. Programming a status relay for Ping test fail is performed in ALARM SETUP.

AUDIO SETUP is used to control the transmit output level of the optional Audio Communications module.

1. UNIT IDENTITY: This menu offers two options, turning the Unit ID feature on or off, and setting the Unit ID number of the unit that will be transmitted with every string.

```
        U  N  I  T      I  D  E  N  T  I  T  Y
1    O  N / O  F  F *

2    C  H  A  N  G  E    U  N  I  T     I  D

O K                                          E  X  I  T
```

Figure 3-8. Unit ID Main Menu

The asterisk indicates whether the Unit ID feature has been turned On or Off for the received channels.

Press 1 and F1 to proceed to the ID Activation menu.

```
        U  N  I  T      I  D  E  N  T  I  T  Y
1    O  N

2    O  F  F *

O K                                          E  X  I  T
```

Figure 3-9. Unit ID Activation Menu

NOTE: If OK is not pressed and either EXIT is pressed or if the unit times out from being left idle for too long, the changes will not be made.

The Unit ID Activation menu turns this feature on/off. The PDR-2000 transmits its Unit ID number in each string, this can not be turned off. When Unit ID is Off, a PDR-2000 only requires that another PDR-2000 sends an appropriate signal for the outputs to operate and ignores the Unit ID number in the receive logic. When Unit ID is turned On, the PDR-2000 receive logic requires not just the proper channel to be present, but also the ID number must agree with the Trip output's programming (See RX SETUP later in this section).

EXAMPLE: If PDR-2000 with Unit ID 1 is communicating to another unit with Unit ID 2 and Unit 1 sends a Trip indication on Channel A, Unit 2's Trip output must be programmed to receive Trips on Channel A and from Unit 1 in order to actually Trip. If another Unit ID number is present instead of 1, the Trip will not be output.

The default setting is Unit ID Off and unless otherwise programmed the communication channels are directly tied to the Trip outputs (A to 1, B to 2 and so on) as described in RX SETUP later in this section. When Unit ID is turned On, these default settings must be programmed to avoid misoperation.

Turning Unit ID On increases the security of received Trips and is always recommended. Leaving it Off can be used for local loop back tests without reprogramming the receive logic. A status alarm will turn on if the Unit ID feature is turned Off.

Packet Forwarding and use of both Com ports, features described later in this section, require the Unit ID feature to be On.

To enter this unit's ID number that will be transmitted with every string, press 2 and F1 on the Unit ID Main menu.

3-6

```
        U N I T      I D E N T I T Y
           E N T E R      N U M B E R
                          0  0
O K                       C L R        E X I T
```
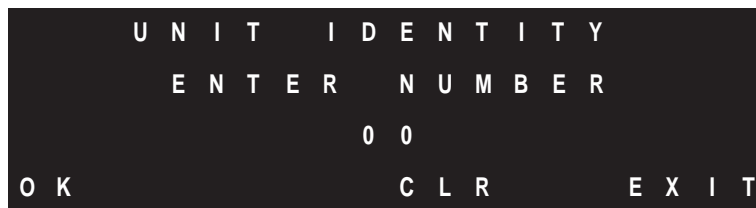
Figure 3-10. Unit ID Entry Menu

The default Unit ID number is 01. Any number from 01 to 99 can be used as the ID number for digital applications. For audio applications only Unit ID numbers 01, 02, or 03 are valid. Use the numbers on the keypad to enter the number and press F1 to enter or F3 to clear the selection without leaving the screen.

If the Unit ID feature is not being used, it is still important that a unique Unit ID number be assigned to the unit for use with the GUI, see Section 4, Remote Programming.

NOTE: It is recommended that every PDR-2000 being used in the same communications system whether they are interacting directly or indirectly be assigned different numbers when possible.

To learn more about how Unit ID works, see Section 2, Digital Communications.

2. PASSWORD: The default password for the PDR-2000 is 1234. It is recommended that the password be changed to limit access to the vital parts of the software. All features that do not affect the operation of the unit are accessible without the need of the password.

INIVEN maintains a manufacturer's password to all units in case the customer's password is changed and/or forgotten. Have your company representative call the factory in case of such an event at 800-526-3984 or 908-722-3770.
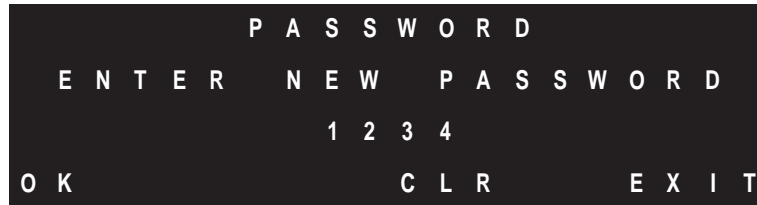
```
                         P A S S W O R D
      E N T E R     N E W     P A S S W O R D

                         1  2  3  4
  O K                       C L R         E  X  I  T
```

Figure 3-11. Password Change Menu

Enter the new password and press F1 to enter or F3 to clear the selection without leaving the menu.

By pressing OK, the unit asks to confirm the new password.

```
                         P A S S W O R D
  C O N F I R M     N E W     P A S S W O R D

                         1  2  3  4
  O K                       C L R         E  X  I  T
```

Figure 3-12. Password Change Confirmation Menu

Re-enter the new password and press F1 to permanently change the password. It is only at this point that the new password becomes effective and the old password is erased.

3. SEND TRIP MANUALLY: The PDR-2000 can transmit a Trip on any or all channels manually, without the need of a Trip input.

```
            E N T E R     P A S S W O R D



                    _   _   _   _

    O K                    C L R        E X I T
```

Figure 3-13. Manual Trip Password Confirmation

The first menu asks to confirm the unit's password. Enter the four digit number and press F1.

WARNING: The Send Trip Manually feature of this unit will transmit a Trip signal and unless the receiving unit is taken out of service, can output the appropriate Trip.

The password confirmation is used to make sure only authorized personnel have access to the following menus.

```
            M A N U A L     T R I P     O U T
    t o     c h a n g e     p r e s s     1 - 8
        -  1  -  2  -  3  -  4  -  5  -  6  -  7  -  8
    O K                                E X I T
```

Figure 3-14. Manual Trip Channel Selection Menu

The Manual Trip Channel Selection menu is used to select which Trip inputs will be activated resulting in transmitted Trips. Press the number of the input that is to be activated. The minus (inactive) sign in front of the input will change to a plus (active) sign. Do not press F1 until all the inputs have been added. To remove an incorrect input's number, press that number again and the plus sign will be changed back to a minus sign.

Once all the desired input numbers have been added, press F1.

```
            M A N U A L     T R I P     O U T
        +  1  -  2  -  3  -  4  +  5  -  6  -  7  -  8
    T I M E                 0  .  0  s e c
    O K        U P        D O W N        E X I T
```
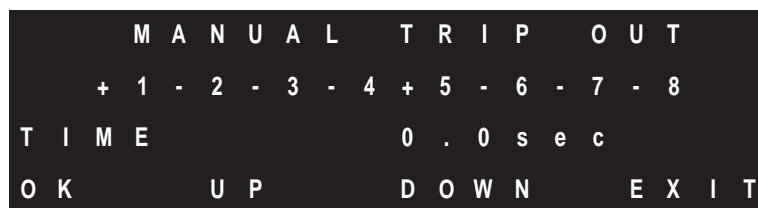
Figure 3-15. Manual Trip Duration Menu

The duration of the Trip is selected on the above screen. Press the F2 and F3 buttons to set the time in one second intervals. The unit will transmit the Trip(s) only for the entered period of time and then return to normal operation.

When the proper time has been entered press F1.

NOTE: Normal operation by the PDR-2000 is suspended during the duration of the Manual Trip.

```
        M A N U A L     T R I P     O U T
    + 1 - 2 - 3 - 4 + 5 - 6 - 7 - 8
        A R E     Y O U     S U R E ?
Y E S                                    N O
```
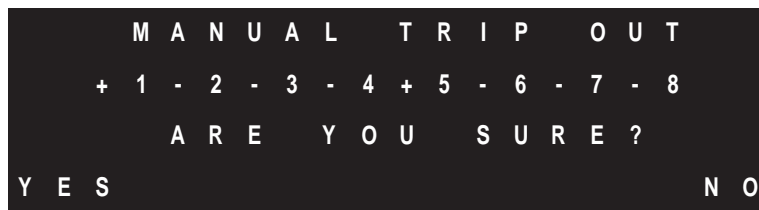
Figure 3-16. Manual Trip Final Confirmation Menu

The final menu confirms that the Trip(s) are to be sent. **This is the last menu, pressing F1 will commence the Trip(s).**

When F1 is pressed, the corresponding Channels of the Trip input circuits transmit the trip signals. The display will count down the time set in the Manual Trip Duration menu and then the unit will return to normal operation and the screen will return to the default display.

The Manual Trip Out instructions are repeated in Section 6, System Tests.

4. PACKET FORWARDING: By turning this feature on, the PDR-2000 can be used to communicate with multiple units whether they are connected directly or indirectly.

NOTE: Do not use Packet Forwarding when the Audio Communications module is installed.

Packet Forwarding works in conjunction with Unit ID and the two standard Com ports (see COM SETTINGS later in this section) to pass on Trip/Guard commands to other PDR-2000's that are not directly connected.
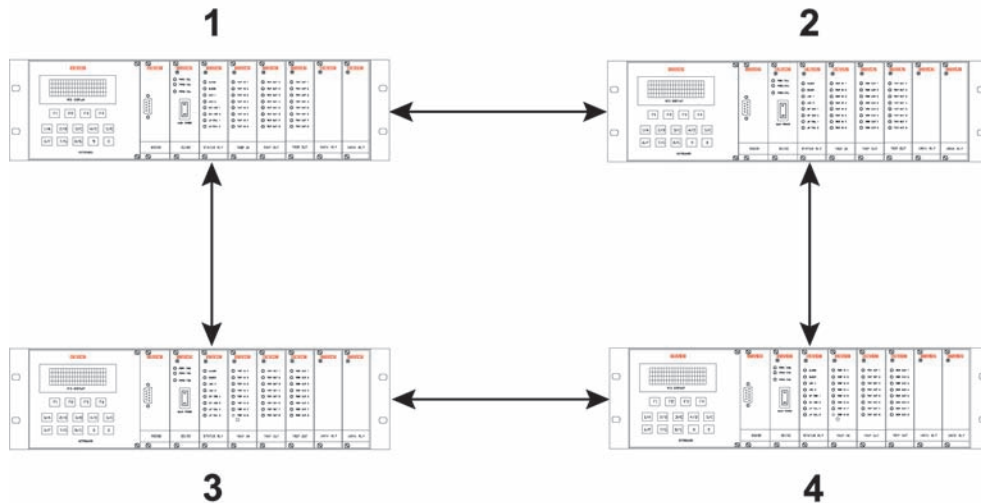

Figure 3-17. Ring Configuration

EXAMPLE: Figure 3-17 shows a ring of four PDR-2000s with bi-directional communications between units. With Packet Forwarding On, Unit 1 can send a Trip to Unit 4. For the purposes of this example, Unit 4 is programmed to Trip when it receives a Trip from Unit 1 on channel B. Unit 1 communicates over two different communication paths (using Com port 1 and Com Port 2) to Units 2 and 3. Units 2 and 3 do not output a Trip because they are not programmed to receive a Trip from Unit 1 on channel B. Unit 2 passes the Trip instruction to Unit 4, and Unit 3 passes the Trip instruction to Unit 4 through their other Com ports. When Unit 4 receives the Trip, the appropriate Trip output is activated. It does not matter that Unit 3 receives the Trip twice.

This "forwarding" works in both directions and is used only for Trip and Guard commands. Other information is controlled by the GUI and is forwarded automatically.

When Packet Forwarding is turned On using the Keypad and Display, Unit ID is automatically turned On and both Com ports need to be turned On. Both are required in order for Packet Forwarding to work properly.

NOTE: When used in a loop, trip times will be slower with Packet Forwarding On.

Packet Forwarding may also be used as a redundancy feature, so that although a Trip is intended to be direct, the indirect path can be used as a backup in case the primary path should fail.

For more information on Packet Forwarding, see Section 2, Digital Communications

```
              PACKET   FORWARD
1    ON *

2    OFF

O K                              E X I T
```

Figure 3-18. Packet Forwarding Menu

The asterisk on the Packet Forwarding menu indicates the present setting. The default setting is Off.

To turn Packet Forwarding On, press 1 and F1.

Once Packet Forwarding is On, all Trip/Guard packets (Type A packets) received by one Com port will be retransmitted out of the other Com port. The packet is forwarded until the initiating unit receives its own packet at which point the packet is no longer transmitted.

Programming the PDR-2000 with Packet Forwarding On is the same as with only Unit ID On but more care needs to be taken when programming the Receive Logic of units on a larger scale network to avoid incorrect Trip outputs.

5. DATE / TIME STAMP: There are two ways to enter the date and time for the sequence of events recorder. An IRIG-B modulated input connected to the BNC connector on the rear of the chassis will automatically update the event timing. If this is not available, the time and date may be entered manually. If the IRIG-B input is connected after the time and date have been entered, the GPS time will automatically be used. If the GPS clock is disconnected or if the signal is lost, the internal clock will automatically maintain the time and date from the last input.

```
        D A T E / T I M E    S E T

            1 0 / 1 0 / 2 0 0 2

            1 8 : 5 4 : 0 9

O K             < <          > >      E X I T
```

Figure 3-19. Date/Time Set Menu

The date set is displayed as Month/Day/Year. The time is set using military time (24 hour clock) as Hour: Minute: Second. In this format 1:00 PM is entered as 13:00, 2:00 PM as 14:00 and so on. Either re-enter all the information using the keypad starting with the month or use F2 and F3 to skip to the field that is to be changed. Press F1 to have the unit accept the new date/time setting.

The Default Display, Figure 3-2, will show the time in a 12 hour clock format with AM or PM.

A Lithium Ion battery on the uP module maintains the clock, if the unit is turned off or loses power. This battery should be replaced every 10 years. See Section 18, Maintenance for battery replacement instructions.

6. ALARM SETUP: These menus are used to program status alarms and optional Trip cut out switches.

ALARMS: The PDR-2000 has ten Status relays: Alarm, Block, LOC 1, LOC 2, PROG 1, PROG 2, Unit ID Off, uP Fail, PWR 1 Fail, and PWR 2 Fail. The first four of these alarms are programmable for delay. PROG 1 and 2 are programmable relays that can be assigned one of seven different types of events and have latching timers. The Unit ID Off, microprocessor fail and power fail alarms are instantaneous and not programmable. All alarms other then the power fail relays are located on the Status Relay module.

The Alarm and Block programmable delays also prevent the Event Recorder from writing the Alarm or Block event until the actual alarms are triggered (after the delay). The LOC (Loss of Communication) delays do not delay the recording of the event, but do delay the activation of the relay and front panel LED indication.

The programmable alarms can be set to one of seven events in the event recorder, BIT Error 1, Bit Error 2, Invalid ID, Timeout ID, Trip In, Ping Test Fail, or Trip Out. Because theses alarms are driven by the event recorder, the alarms are instantaneous and have no duration. To trigger the Status relay for any period of time, a latching timer can be programmed in 3 second intervals. The Ping Test Fail and Timeout ID can be programmed for delays for up to 20 ms. In other words, If a Ping test does not complete the test in less then the time programmed, the test fails. The other five programmable events do not have a delay setting.

For more information about Status relays and their function, see Section 13, Status Relay Module.

Two of the next three menus allow the user to choose which Status relay they would like to program. Pressing F3 displays the next screen and the other options.

```
1    A L A R M
2    B L O C K
3    L O C   1
O K                    N E X T      E X I T
```

Figure 3-20. Alarm Setup Menu A

```
4    L O C   2
5    P R O G   1
6    P R O G   2
O K         P R E V    N E X T    E X I T
```

Figure 3-21. Alarm Setup Menu B

```
7    C U T   O U T   S W I T C H


O K                   P R E V      E X I T
```

Figure 3-22. Alarm Setup Menu C

Choose the Status relay using the keypad and press F1.

```
        S E T   D E L A Y   T I M E
            0 . 0   s e c


O K       U P         D O W N   E X I T
```

Figure 3-23. Alarm Delay Time Set Menu

If one of the first four choices are made, the Alarm Delay Time menu appears. Set the delay in 1.0 second increments using the F2 and F3 keys. Press F1 to accept the entry and exit. Repeat this procedure for the remaining Status relays that need to be changed.

If one of the two programmable alarms are to be programmed, the following menu will appear.

```
        P R O G   A L A R M   1
P I N G   T E S T   F A I L
        1 5 . 0   m s e c
O K       U P         D O W N   E X I T
```

Figure 3-24. Programmable Alarm Menu

To select which event to assign to the programmable Status relay, press the 1 key repeatedly until the type of event is displayed. If Ping Test Fail or Timeout ID is selected the delay timer appears on the third line of the display. If one of the other five events is selected, line three is blank.

To program the delay time, press the F2 and F3 keys.

Press the F1 when finished.

```
        P i n g   T e s t   F a i l
D E L A Y   1 5 . 0   m s e c
L A T C H   T I M E R   9 . 0   s e c
O K       U P         D O W N   E X I T
```

Figure 3-25. Programmable Alarm Latch Timer Menu

It is important to program some latching time to the alarm or the relay will not produce an output. The programmable alarm relays will only be activated for the duration of the latching time.

To program the latch timer, press the F2 and F3 keys.

Press the F1 when finished.

Repeat the process for the other programmable alarm.

TRIP CUT OUT SWITCH: The PDR-2000 is available with an optional Cut Out Switch. There are two versions of this option that can be supplied. The Cut Out Switch (CC2256-00) is a module designed to occupy the two slots on the furthest right hand side of the chassis normally occupied by the optional dry contact relay trip modules. This module uses a large air gap switch to cut the trip outputs and the power to the trip inputs. There is also a logic block to the trip inputs as a failsafe. This switch provides a connection on the terminal blocks for an external annunciator for the switch position and a software logic block for the trip inputs.

The second option is the Trip Out module with optional Cut Out Switch (CC2245-01). This version is integrated into the Trip Output module and contains a switch that disables the solid state trip output relays. When the switch is in the cut out (Test) position, the Alarm relay is activated and the Alarm LED is lit. The trip inputs are not disabled with this version of the switch.

For the microprocessor module to work properly with different types of cut out switches, the proper selection must be made

The next menu allows the user to select the type of cut out switch is installed in the unit.

To program the type of cut out switch, press the F3 key on the Alarm Setup Menu A and F3 key again on the Alarm Setup Menu B. The third screen will contain option 7, Cut Out Switch.

Press the 7 key.

```
1    N O N E

2    T R I P     O U T     S W I T C H

3    C U T     O U T     M O D U L E

O K                       P R E V       E X I T
```
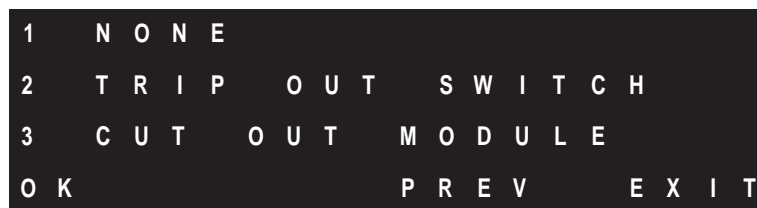
Figure 3-26. Cut Out Switch Selection Menu

Choose which type of cut out switch is installed in the unit or press 1 for None.

Press the F1key.

If a cut out switch is not installed and None is not selected, the unit will not misoperate.

7. COM SETTINGS: There are two Com ports on the rear panel of the PDR-2000. It does not matter whether the system is using fiber optic or electrical connectors. These Com ports are the main communication paths for system protection.

Com 1 is the default connector. If Unit ID is Off and the system is not set up for a loop back test, only one Com port should be used.

By using two Com ports the PDR-2000 can communicate over two different paths (i.e. T1 channels) to two different units. Both Com ports must be active in order to use Packet Forwarding (see Packet Forwarding earlier in this section).

 It is necessary to restart the unit after turning Com ports On or Off.

When using a synchronous channel that requires clocking from the communications system like a RS-422, the communications system may use the rising or falling edge of the clocking signal. The PDR-2000 defaults on the rising edge of the signal. If it is to be used with a system that uses the falling edge the PDR-2000 needs to invert the clock. **The Audio Communications module uses falling edge timer and the Invert Clock setting must be turned on for the the unit to operate correctly.** This setting is for both Com ports.

```
1    C O M     O N

2    C O M     O F F

3    I N V E R T    C L O C K     O F F

O K      c h a n g e    1 - 3      E X I T
```
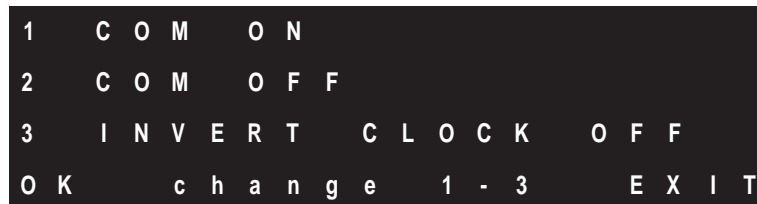
Figure 3-27. Com Port Menu

To change the state of a Com port from On to Off or vice versa, press 1 and/or 2 on the keypad. The change is made instantly in the unit and the display will change to reflect the new state of the Com port.

NOTE: Confirm that the connections on the back of the chassis correspond with the software settings or the unit may not work properly.

For more information on the Com ports and Packet Forwarding, see Section 2, Digital Communications.

To invert the clock, press 3 on the keypad. The change is made instantly in the unit and the display will change to reflect the new state of the synchronous timing signal.

8. AUTO PING TEST: The Ping test performs a complete system test of the digital communications and the receive and transmit capabilities of the PDR-2000. The Ping test also shows the results of the round trip time required to perform the test and the communication delays involved. Because the Ping test is sent to a particular unit by only one port, the communication delay can be determined over different paths to the same unit if a loop arrangement is being used.

There are two ways to initiate a Ping test. The first is by manually initiating a one time test using the diagnostics menu, see Section 6, System Testing. The second is to start an automatic repetitive test, the auto Ping test.

```
        A U T O    P I N G    T E S T
I N T E R V A L      1 0 0 S E C


O K       U P           D O W N      E X I T
```

Figure 3-28. Auto Ping Test Time Menu

The first menu sets the amount of time between tests. Press the F2 button to increase and F3 to decrease the interval and then Press F1.

NOTE: It is not recommended to make the interval too small as it may increase Trip times. For channel delay alarms use the Timeout ID status relay option described later in this section and Section 13, Status Relay Module.

```
        A U T O    P I N G    T E S T
I N T E R V A L      1 0 0 S E C
T O    U N I T    I D    0 2
O K                 C L R       E X I T
```

Figure 3-29. Auto Ping Test Unit ID Menu

The next menu determines which unit will be pinged. Use the keypad to enter the ID number of the unit on the other side of the test and press F1 to continue. Use the F3 key to clear a mistaken entry.

```
        A U T O    P I N G    T E S T
P O R T  1


O N      P O R T 1    P O R T 2      O F F
```

Figure 3-30. Auto Ping Test Port Menu

The final menu determines which port will be used for the test. By selecting the port, the path being used for the test is more strictly defined.   Use the F2 (Port 1) and F3 (Port 2) keys to choose the port and press F1 to start the automatic Ping test and press F4 if the programming is completed but the test is not to be initiated at this time. The Ping test will write the result of the test to the event recorder which includes the round trip delay.   A status relay may be assigned a Ping test fail indication which will activate a LED and a contact on the Status Relay module. For more information about Status relays, see Section 13, Status Relay Module.

9. AUDIO SETUP: The Audio Communications Module requires additional settings not required by other communication modules. The output level of the transmitter must be set in accordance to the 4W audio line being used. The standard setting is -8dBm. This may be adjusted based on the quality of the line and local practice.

This setting is only available using on-board programming.

```
1    P O W E R




O K                                              E  X  I  T
```

Figure 3-31. Audio Setup Menu

Press 1 to view or change the transmitter output level.

```
              P O W E R    - 8 d B m



O K          U P        D O W N      E  X  I  T
```

Figure 3-32. Transmitter Output Level Menu

Press F2 to increase the output level and F3 to decrease the level.

Press F1 to accept the new setting or F4 to exit.

Receive Setup: Receive logic parameters are made by programming the outputs. There are eight Trip outputs (1 through 8). These outputs can be programmed to correspond with any of the eight channels (A through H) or eight local Trip input (1 through 8) with or without the use of logic gates.

To program an output, choose the output using F2 and F3 to move the cursor to the desired output number.

```
          C H O O S E    T R I P    R X
                O U T P U T
        1    2    3    4    5    6    7    8
O K            < <                > >        E X I T
```

Figure 3-33. Receive Output Selection Menu

After choosing an output to program, press F1 to proceed.

The next two menus allow the user to choose which parameters they would like to program. Pressing F2 displays the next screen and the fourth and fifth option.

```
1    T R I P    R X    L O G I C
2    P R E T R I P    T I M E R
3    G U A R D    B E F O R E    T R I P
O K        N E X T                E X I T
```

Figure 3-34. Receive Output Programming Menu A

```
4    T R I P    R X    H O L D
5    L A T C H I N G    T I M E R

O K                    B A C K    E X I T
```

Figure 3-35. Receive Output Programming Menu B

Use F3 to switch back to the previous menu.

There are five parameters that can be programmed for the Trip output.

TRIP RX LOGIC is used to program which output will correspond to which Communication Channel. Outputs can be triggered by received Trips, received Guards, or local inputs. Additional logic can be programmed for more complex schemes using AND, OR, and XOR gates.

PRETRIP TIMER allows the uP module to delay a Trip output after it has received the Trip for the programmed period of time.

GUARD BEFORE TRIP is an option that can be turned on or off. It requires a period of Guard to be present before a Trip will be allowed to be output.

TRIP RX HOLD allows the uP module to output a Trip for a minimum period of time even if the Trip is not present for the entire period of time.

LATCHING TIMER allows the uP module to output a Trip for an additional period of time after the Trip is no longer present.

1. TRIP RX LOGIC: This menu gives the user the ability to program the logic for each Trip output.

NOTE: The default setting for the PDR-2000 is Unit ID off. In this case, unless otherwise programmed, Trip output 1 is set for Communication Channel A, Trip output 2 is set for Communication Channel B and so on. If Unit ID is turned on in the SYSTEM SETUP menu (see System Setup earlier in this section), the Unit ID numbers used in the logic must be updated or improper Trip schemes may be established.

Programming the logic is more intuitive using the GUI, but it may be done using the Trip receive logic menu.

Figure 3-36. GUI Logic Diagram

The logic flows from left to right. Inputs may be received Trip or Guard signals, local Trip inputs, and may be turned permanently On or Off. The Unit ID needs to be assigned for received channels when Unit ID is turned On. Each of the inputs may be inverted before reaching the gates. AND, OR, and XOR gates are layered as illustrated above.

The display converts this graphic representation in the following way:

Figure 3-37. Trip Receive Logic Menu

The first line indicates if the inputs on the second line are inverted or not. A _ indicates the input is inverted. A blank indicates that the input is not inverted. The symbol is located directly over the input it refers to.

The second line is the type of input and the gates. The parentheses show the logic statement. The first input A shown on the top in Figure 3-36, is on the left of Figure 3-37, and continues in order to the right. A capital letter, A through H, represent received inputs. A small case a through h represent received Guard signals. A number, 1 through 8, represents a local Trip input. The letter O is used with the letter below.

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it to show that the input is in a permanent position, either On or Off. The gates are shown as **&** for AND, **|** for OR, and **X** for XOR. The parentheses follow standard mathematical priority. The first logic gate is then gated with the second logic gate and the combined logic is gated with the third logic gate, as shown in Figure 3-36.

The third line is used to program Unit ID numbers and turn static inputs On or Off. Only received channels need Unit ID numbers. The static inputs are represented as ON for a logic 1 or OF for a logic 0. Local Trip inputs do not have any additional information associated with them.

Figure 3-38. Logic Conversion, GUI to Display

To program the Receive Logic menu, use the F3 and F4 keys to move right and left. When the cursor reaches the end of the right side of a line it will move down to the next line and when it reaches the left side of the line it will move up a line. On the first line, press the 1 key to toggle between inverted and non-inverted. On the second line, press the 1 key to toggle between the three types of gates. Use the 1 key to toggle between all types of inputs (A-H, a-h, 1-8, and On/Off). On the third line use the 1 key to enter Unit ID numbers below channel letters.

Press the F1 key when the programming is complete.

NOTE: All changes to the logic are instantaneous before the F1 key is pressed. It is strongly advised to take the unit offline when programming the logic using the keypad to avoid unwanted tripping.

Repeat the above procedure to program the eight outputs. If Unit ID is On, the Unit ID of the transmitting (remote) PDR-2000 needs to be entered when the Communications Channel is added.

If all inputs are set to Off the output relay is turned off.

NOTE: It is important to remember to program all eight channels whether they are used are not so that existing programming does not result in false Trips.

NOTE: The Unit ID number corresponds with the unit communicating with the unit being programmed. Unit ID's are confirmed only on the receive side of the Communications Channel.

If the unit is communicating with more than one other PDR-2000, either because both Com ports are in use, Packet Forwarding is being used, or both, more than one Unit ID may be used for the multiple receive channels.

Trip outputs can be programmed with the same logic Trip outputs, if redundant outputs are desired.

EXAMPLE: Trip Out 1 of Unit 1 can be programmed to Trip only when Channel A of Unit ID 2 and Channel B of Unit ID 3 are both present (see System Setup earlier in this section for Unit ID programming instructions or Section 2, Digital Communications to learn more about how Unit ID works).

Figure 3-39. Three Terminal Application Configuration

2. PRETRIP TIMER: This menu is used to increase the security by holding a received Trip for the programmed period of time before the Trip output is activated.

```
          P R E T R I P    T I M E R
                1 . 5 m s e c
                      0 0
  O K        U P        D O W N        E X I T
```

Figure 3-40. Pretrip Timer Menu

The Pretrip Timer is programmed for the output so that once all conditions for a Trip output are met, those conditions must be maintained for the time programmed, before the output will be tripped.

Use the F2 and F3 keys to increase or decrease the time (in 0.5 millisecond intervals) and press F1 for OK.

The default setting for the Pretrip Timer is 0.0 ms.

NOTE: The Pretrip Timer while being time based, requires updated packet data which may require more than a millisecond. If the Pretrip timer is set to any value higher then 0.0 ms, the minimum time is the time required to receive 2 packets. It is therefore possible for the Pretrip Timer to be extended slightly longer then the time programmed.

3. GUARD BEFORE TRIP: This menu programs the Trip output to require a Guard to be present for a period of time before a Trip will be allowed to be output.

```
 G U A R D    B E F O R E    T R I P
               0 . 0    m s e c
               O F F
O K          U P         D O W N      E X I T
```

Figure 3-41. Guard Before Trip Main Menu

When Guard before Trip is Off, a Trip will be output regardless of the state of the channel before the Trip was received. The unit does not discriminate whether the channel was previously in Guard or Block and for how long. When Guard before Trip is turned On, Guard must be present on the channel for at least the programmed amount of time or the Trip will not be output.

The time indicates the current setting for the Guard before Trip timer. The On or Off indicates whether Guard before Trip is On or Off. The default setting is Off.

Use the F2 and F3 keys to increase or decrease the time (in 50 millisecond intervals).   If the time is set to 0.0 ms and Guard before Trip is On, at least 1 packet must be received with a Guard indication for that channel before a Trip will be output. Any other time setting requires at least that amount of Guard to be present before a Trip will be output. Press F1 for OK to accept the setting and go to the next screen.

```
 G U A R D    B E F O R E    T R I P
               0 . 0    m s e c


O K          O N          O F F      E X I T
```

Figure 3-42. Guard Before Trip On/Off Menu

Press the F2 (On) or F3 (Off) button to turn Guard before Trip On or Off. Press F1 for OK to accept the setting.

4 . TRIP RX HOLD: This menu sets the minimum amount of time a Trip will be output.

EXAMPLE: If the Trip Rx Hold is set for 10 ms, any received Trip that lasts for less then 10 ms will be output for 10 ms

Trips that last longer then the Trip Rx Hold time are unaffected by this setting.

```
          TRIP   RX   HOLD
             1 . 5 m s e c


OK        UP         DOWN      EXIT
```

Figure 3-43. Trip Receive Hold Menu

Use the F2 and F3 keys to increase or decrease the time (in 5 millisecond intervals) and press F1 for OK.

The default setting for Trip receive hold is 0.0 ms.

5 . LATCHING TIMER: This menu sets an added amount of time to a Trip output.

EXAMPLE: If the Latching Timer is set for 100 ms, any received Trip will be extended for 100 ms after the Trip is no longer present.

The Latching timer is added to the output after all other logic in the system. In other words, The Pretrip Timer, Receive Logic, and Guard before Trip logic must be satisfied before the Trip can be extended.

```
          L A T C H I N G     T I M E R
              1 0 0 m s e c



O K        U P         D O W N      E X I T
```

Figure 3-44. Latching Timer Menu

Use the F2 and F3 keys to increase or decrease the time (in 10 millisecond intervals) and press F1 for OK.

The default setting for the Latching Timer is 0.0 ms.

TX SETUP

Transmit Setup: There are two timers that can be programmed as part of the transmit logic, Trip TX Hold and B Contact Keying.

Transmit logic automatically ties Input 1 to Channel A, Input 2 to Channel B, and so on. To program a transmit channel press F2 and F3 to choose a channel and then press F1.

```
     C H O O S E    T R I P    T X
              C H A N N E L
     A    B    C    D    E    F    G    H
O K         < <              > >        E X I T
```

Figure 3-45. Tx Channel Menu

Press 1 and F1 to continue.

The next menu allows the user to choose which parameters they would like to program.

```
1    T R I P    T X    H O L D

2    B    C O N T A C T    K E Y


O K                              E X I T
```

Figure 3-46. Tx Setup Menu

Press 1 for the Trip Tx Hold timer or 2 for the B Contact Keying timer and activation.

TRIP TX HOLD allows the eight transmit channels(A through H) to be programmed to transmit a Trip for a minimum amount of time. This type of timer is sometimes referred to as a de-bounce timer.

EXAMPLE: If the Trip Tx Hold is set for 10 ms, and a Trip input lasts for less than 10 ms, the trip will continue to be transmitted over the channel for 10 ms.

Trip inputs that last longer than the Trip Tx Hold time are unaffected by this setting.

B CONTACT KEYING is used to limit the length of the Trip transmit time.

1. TRIP TX HOLD: This menu is used to maintain the transmission of a Trip for a minimum period of time. If a Trip is input, the timer starts, and will maintain the Trip for the duration of the timer even if the trip input should drop out. Once the programmed time has past, the Trip will not be transmitted if the input should drop out.

```
            T R I P     T X     H O L D

                 1 . 5 m s e c



 O K         U P           D O W N        E X I T
```

Figure 3-47. Trip Tx Hold Menu

Use the F2 and F3 keys to increase or decrease the time (in 5.0 millisecond intervals up to 50 millisecond) and press F1 for OK.

The default setting for the Trip Tx Hold is 0.0 ms.

NOTE: Unlike the Receive Hold Timer, the Transmit Hold Timer's effect on the receive timing is not as exact, due to the various communication delays of a communications system.

2. B CONTACT KEYING: This menu is used to ensure a Trip does not last longer than the time programmed. Once the Trip time has expired the channel will transmit a Guard signal until the input has returned to Guard and then back to Trip at which point the entire process starts again.

```
        B   C O N T A C T   K E Y

1    O N *

2    O F F

O K                                    E X I T
```

Figure 3-48. B Contact Keying On/Off Menu

To turn B Contact Keying On or Off, press 1 or 2 and then the F1 button. The default is Off. If the timer is set but B Contact Keying is not turned On, the timer will be ignored. In order for it to work properly, B Contact Keying must be turned On and a time above 0 must be set.

```
        B   C O N T A C T   K E Y

           1 0 0 m s e c



O K        U P        D O W N      E X I T
```

Figure 3-49. B Contact Keying Timer Menu

Use the F2 and F3 keys to set the time and press F1 to accept the setting. The B Contact Keying timer can be set in 20 ms increments.

The default setting for the B Contact Keying timer is 0.0 ms.

ABCDEFGH
TX   GGGGGTTG
RX   TGGGGTTG
SETUP DIAG 12:43PM

DIAG (F2)

SETUP (F1)

1 PING TEST
2 VERSION
3 READ EVENTS/MEMO
OK   NEXT EXIT

4 RESET ALARM 1
5 RESET ALARM 2
OK   PREV EXIT

ENTER PASSWORD
* * * *
OK   CLR EXIT

UNIT BLOCKED
SERIAL INPUT
TIMEOUT

PING TEST
1 PORT 1
2 PORT 2
OK   EXIT

READ EVENTS
1 READ EVENTS
2 READ MEMO
OK   EXIT

SOFTWARE VERSION
PTG-0025 10/10/02
BACK   EXIT

1 RX SETUP
2 TX SETUP
3 SYSTEM SETUP
OK   EXIT

PING TEST PORT 1
TO UNIT ID
OK   ___ CLR EXIT

MEMO
LINE 1 OF 22
SUBSTATION 104 POTT
OK PREV NEXT EXIT

Date 12/12/2002
Time 13:45:12.003
EVENT: LOSS COM 1
OK PREV NEXT EXIT

CHOOSE TRIP TX
CHANNEL
A B C D E F G H
OK << >> EXIT

CHOOSE TRIP RX
OUTPUT
1 2 3 4 5 6 7 8
OK << >> EXIT

1 UNIT IDENTITY
2 PASSWORD
3 SEND TRIP MANUALLY
OK   NEXT EXIT

4 PACKET FORWARD
5 DATE/TIME SET
6 ALARM SETUP
OK BACK NEXT EXIT

7 COM SETTINGS
8 AUTO PING TEST
9 AUDIO SETUP
OK PREV   EXIT

PING TEST PORT 1
TO UNIT ID 1
TEST TIME 6 msec

1 TRIP TX HOLD
2 B CONTACT KEYING
OK   EXIT

4 TRIP RX HOLD
5 LATCHING TIMER
OK   BACK EXIT

1 TRIP RX LOGIC
2 PRETRIP TIMER
3 GUARD BEFORE TRIP
OK   NEXT EXIT

UNIT IDENTITY
1 ON / OFF*
2 CHANGE UNIT ID
OK   EXIT

PASSWORD
ENTER NEW PASSWORD
0000
OK   CLR EXIT

ENTER PASSWORD
___
OK   CLR EXIT

PACKET FORWARDING
1 ON
2 OFF*
OK   EXIT

DATE/ TIME SET
12/12/201
12:12:00
OK << >> EXIT

1 ALARM DELAY
2 BLOCK
3 LOC 1
OK   NEXT EXIT

4 LOC 2
5 PROG 1
6 PROG 2
OK PREV NEXT EXIT

7 CUT OUT MENU
OK   PREV EXIT

1 COM 1 ON
2 COM 2 OFF
3 INVERT CLOCK OFF
OK   change 1-3 EXIT

AUTO PING TEST
INTERVAL 1 SEC
OK UP DOWN EXIT

1 POWER
OK   EXIT

B CONTACT KEYING
100 msec
ON
OK UP DOWN EXIT

TRIP TX HOLD
0.0 msec
OK UP DOWN EXIT

LATCHING TIMER
10 msec
OK UP DOWN EXIT

TRIP RX HOLD
1.5 msec
OK UP DOWN EXIT

((A & B))(C&D))&(O F)
00 01 01 03 N 12
OK < > EXIT

PRETRIP TIMER
1.5 msec
OK UP DOWN EXIT

GUARD BEFORE TRIP
0.0 msec
OFF
OK UP DOWN EXIT

UNIT IDENTITY
1 ON
2 OFF*
OK   EXIT

UNIT IDENTITY
ENTER NUMBER
0
OK   CLR EXIT

PASSWORD
CONFIRM NEW PASSWORD
* * * *
OK   EXIT

MANUAL TRIP OUT
to change press 1-8
-1-2-3-4-5-6-7-8
OK   EXIT

ALARM DELAY
2.5 sec
OK UP DOWN EXIT

PROG ALARM 1
PING TEST FAIL
OK UP DOWN EXIT

1 NONE
2 TRIP OUT SWITCH
3 CUT OUT MODULE
OK   PREV EXIT

AUTO PING TEST
INTERVAL 1 SEC
TO UNIT ID 00
OK   EXIT

POWER -8dBm
OK UP DOWN EXIT

B CONTACT KEYING
100 msec
ON
OK ON OFF EXIT

GUARD BEFORE TRIP
1.5 msec
OK ON OFF EXIT

MANUAL TRIP OUT
+1-2-3-4-5-6-7-8
TIME   10 sec
OK UP DOWN BACK

Ping Test Fail
DELAY 15.0 msec
LATCH TIMER 9.0 sec
OK UP DOWN EXIT

AUTO PING TEST
PORT 1
ON PORT1 PORT2 OFF

MANUAL TRIP OUT
+1-2-3-4-5-6-7-8
ARE YOU SURE?
YES   NO

Chart 3-1. Display Module Menus Flow Chart Version 1.3

Section 4 REMOTE PROGRAMMING (GUI)

This section describes all the processes available to program the PDR-2000 settings using an external computer (see Section 5, Installation for step by step installation instructions). There are up to four ways to program the unit; the Display module on the front panel, a PC using the RS-232 port on the front panel, a computer using a RS-232 port (or other communication port depending on unit configuration) on the rear terminal block board, or a computer connected to another PDR-2000.

Downloading new settings does not take the PDR-2000 out of service. When programming using a computer, settings are changed instantaneously when the DOWNLOAD SETTINGS is pressed (as described later in this section) on the Graphical User Interface (GUI). Unlike using the Keypad and Display, the GUI programs the logic off line and downloads the new settings all at once.

The PDR-2000 GUI may be programmed locally or remotely. All PDR-2000's come with a RS-232 port located on the front panel of the unit. Depending on the communication protocol, either a RS-232 or another type of port will be located on the rear of the chassis for remote access to the Event Recorder and/or programming.

NOTE: This section will address the standard RS-232 ports. If a different protocol is supplied, the operation of the port is described in Section 17, Option Modules.

The GUI also allows a user to program the settings, review the status of and download the events of any PDR-2000 that the unit is communicating with either directly or indirectly. The GUI is also used to download new firmware to the unit and initiate Ping tests.

NOTE: For instruction on the operation of the Event Recorder, see Section 7, Event Recording. For instructions on the operation of the Ping test, see Section 6, System Tests.

PORTS

The nine pin RS-232 located on the front panel is a DCE port. A male/female nine pin cable is required to connect a standard PC's nine pin serial port to the PDR-2000 (a null modem cable is not required). The male nine pin RS-232 located on the back of the chassis is a DTE port designed to be connected to a modem or other communication device. The RS-232 cable can be connected with the unit ON or OFF and the software can be started before or after the cable has been connected. The GUI will not operate properly if communications are attempted to a unit unless connected to a unit. The GUI can be used without a unit if used to set programming that is to downloaded at a later time.

Figure 4-1. Front RS-232 Port

GUI

The PDR-2000 GUI will run on any standard Windows® operating system. It is recommended that the GUI be run on a computer with a screen resolution of at least 1024 x 768. All programming is performed on the System configuration tab at the top of the screen. There are six tabs at the bottom of the screen. Four of the tabs, TX Settings, RX Timing Settings, RX Logic and System Settings, provide all the programming options for the unit. The fifth tab, Memo, is used to add notes into the unit's memory. The sixth tab, inputs_com, is used to view received packet information and output logic based on received packet information. Use the audio version for units equipped with the Audio Communications module for full functionality. Retrieval of remote events will not work with the standard GUI.

Figure 4-2. System Configuration Screen

RETRIEVING DATA

The settings of a unit and it's status can be retrieved at any time. Select the Unit ID number of the PDR-2000 from which the information is being requested. The GUI will retrieve information from the PDR-2000 directly connected to the computer or a remote unit communicating with the local unit via the Com port, using Packet Forwarding.

NOTE: The Unit ID number of the unit from which the information is being sent must be correct or the GUI will not communicate properly. It does not matter if Unit ID is On or Off. **The Unit ID number is indicated on the upper left corner of the Default Display.**

To retrieve the status of the unit, what is currently displayed on the front panel indicators, press the Get Status button on the upper left hand side of the screen. The "virtual PDR" on the GUI will mimic the

actual front panel status of the unit. The LED's will light and the Display will match that of the real unit. The last two slots of the PDR-2000 are not shown on the virtual PDR since there are no indicators for those slots. The green power LED indicators will not illuminate.

To retrieve the settings of a unit (how the unit is programmed), press the Get Settings button. To view the Settings after they are uploaded, use the mouse to click on the four programming tabs in the middle of the screen in the UNIT SETTINGS box. The Get Settings command also uploads any notes in the Memo section of the memory. Click on the Memo tab to see the notes. Always upload the settings before making changes to a units logic or memo.

These settings can be saved to a disk, for future programming, by clicking on the Save button on the right hand side of the UNIT SETTINGS box. Choose the destination, name the file, and click on the Save button. To send a copy of the settings to a printer, click on the Print button on the right hand side of the screen for a report, see Figure 4-10.

PROGRAMMING

All of the programming selections for the PDR-2000 are on the four programming tabs under the UNIT SETTINGS header. The fifth tab, Memo, is used as a notepad within the units nonvolatile memory. The sixth tab, inputs_com, is used as a debugging tool. There are three ways to start programming the settings. First, a unit can be programmed from the default settings when the GUI program is first started. Most settings are set to 0 and the Trip outputs are turned Off. Second, the settings can be uploaded from a unit, as described above, and modified. Third, saved settings on a disk can be loaded to the GUI and then modified or directly downloaded to the unit. In such a case, click on the Load button and choose the drive and file name. No matter which method is used to load the settings, modifying them uses the same method.

TX Settings: This tab controls the Trip input settings for the transmitter. The eight Trip inputs are directly tied to the eight transmit channels (A through H) so that Trip In 1 is communicated over Channel A, Trip In 2 is communicated over Channel B, and so on. The eight transmit channels can be programmed to transmit a Trip for a minimum amount of time or to limit the transmission time of a Trip signal.

Trip Hold timer: this setting is used to maintain a Trip input signal for a minimum period of time after the initial Trip input is received by the PDR-2000.

EXAMPLE: If the Trip Tx Hold time Channel A is set for 10 ms, and a Trip input on Trip In 1 lasts for less than 10 ms, the Trip will continue to be transmitted over Channel A for 10 ms If Trip input 1 is keyed for 300 ms, the Trip signal will be transmitted for 300 ms.

To program the transmit hold time, click the mouse on the channel to be changed and delete the existing number and type in the new value. Trip TX Hold can be programmed in 5 ms increments from 0 to 50 ms. Repeat for all the channels whose value needs to be changed.

Transmit hold time is also commonly known as input contact de-bounce time.

B Contact Keying: this is used to limit the total duration of a trip signal being transmitted regardless of how long the Trip input is keyed. If the Trip input is keyed for less time then the B Contact Keying timer is programmed for, the Trip will be transmitted for the actual length of the input.

EXAMPLE: If Trip input 1 is keyed for 10 seconds and the B Contact Keying timer is set for 100 ms, Channel A will transmit a Trip signal for 100 ms and then transmit a Guard signal. The system will not allow a Trip signal to be sent until the Trip input returns to Guard and then keyed with a Trip again.

To program the B Contact Keying timer, click on the On/Off box for the corresponding channel. A check mark should appear and the Off should change to On. Then click in the timer field to the right and enter the time. The time represents the maximum amount of Trip signal that will be transmitted. If the On/Off box is Off and a time is entered, the B Contact Keying logic will be ignored. The time may be entered in 20 ms increments from 0 to 1260 ms. Repeat for all the channels whose value needs to be changed.

Figure 4-3. TX Settings Screen

RX Timing Settings: This tab contains the settings for the receiver's Pre-Trip Timer, Guard before Trip logic, Guard before Trip timing, RX hold timing, and RX latching timing.

Pre-trip Timer: This setting is the amount of time that must pass after a Trip signal has been received before the Trip out circuit(s) will be energized. This is controlled by the uP module and all the conditions of the receive logic (see RX Logic later in this section) must be met before the timer starts and must be maintained during the period of the timer's setting. The Pre-Trip timer settings are assigned to the Trip out circuits, not the receive channels. The Pre-Trip timer adds security by lengthening the Trip time beyond the PDR-2000's standard security settings.

To program the Pre-Trip time, click the mouse on the Trip out to be changed type in the new value. Repeat for all the Trip outs whose value needs to be changed. The time may be set in 0.5 ms increments from 0 to 10 ms.

NOTE: The Pretrip Timer while being time based, requires updated packet data which may require more than a millisecond. If the Pretrip timer is set to any value higher than 0.0 ms, the minimum time is the time required to receive 2 packets. It is therefore possible for the Pretrip Timer to be extended slightly longer then the time programmed.

Figure 4-4. RX Timing Settings Screen

Guard Before Trip: This is a feature that changes the logic of the Trip out circuit. When Guard before Trip is Off, a Trip is output regardless of the state of the channel before the Trip was received. The unit does not discriminate whether the channel was previously in Guard or Block and for how long. When Guard before Trip is turned On, Guard must be received for at least the programmed amount of time before a Trip command will be output. If the programmed time for Guard is not met, the Trip will be

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ignored and the Trip Out circuit will not be activated until another Trip was received after the appropriate period of Guard.

If the time is set to 0.0 ms and Guard before Trip is On, at least 1 complete packet must be received with a Guard indication for that channel before a Trip will be output. Any other time setting requires at least that amount time programmed, of Guard, to be present before a Trip will be output.

The Guard before Trip logic may be turned On/Off per Trip output. Guard before Trip logic takes place after the receive logic (see RX Logic later in this section), so the receive logic must be satisfied before the Guard before Trip timer. Use the mouse to click the On/Off once to toggle between the choices, a checkmark indicates Guard before Trip is On and the selection is also indicated by the words ON or OFF. To program the Guard before Trip time, click the mouse on the Trip Out number to be changed and delete the existing number and type in the new value. The time can be entered in 50 ms increments from 0 to 1000 ms. Repeat for all the Trip Outs whose value needs to be changed. If a value is entered and Guard before Trip is Off, the time setting will be ignored.

Receive Hold Time: This is very similar to Transmit Hold Time. The difference is that the Trip is programmed to the output and not the channel and the logic is performed on the receive side of the communications.

EXAMPLE: If the Rx Hold time for Trip Out 1 is set for 10 ms, and a Trip on Channel A (the channel programmed for Trip Out 1 for this example) lasts for less than 10 ms, the trip will continue to be output on Trip out 1 for a total of 10 ms. If the Trip lasts for more then 10 ms, the timer does not extend the duration of the Trip.

To program the Receive Hold Time, click the mouse on the Trip Out to be changed and delete the existing number and type in the new value. The time may be programmed in 5 ms increments from 0 to 100 ms. Repeat for all the Trip Outs whose values needs to be changed.

Receive Latching Timer: This timer extends the duration of a Trip output by whatever time is entered. If the duration of a Trip is X, the Latching timer will make the Trip output X+Latching Timer. The Latching timer is the last piece of the receive logic in the microprocessor before outputting the Trip to an output relay.

To program the Latching timer, click on the box for the Trip Out to be programmed and enter the amount of time the output is to be latched. The time may be programmed in 10 ms increments from 0 to 5000 ms. Repeat for all the Trip Outs whose values needs to be changed.

RX Logic: This menu gives the user the ability to program the logic for each Trip output.

NOTE: It is important to understand that when programming the PDR-2000, the Trip Outputs, not the channels are being programmed.

Trip Outs (1 through 8) are listed on the tabs on the top of the logic diagram. Each Trip Out circuit has it's own logic diagram. There are six inputs to the logic, each with an inverter, three initial gates and three additional gates. The inputs may be selected by using the pull down menu. Possible inputs are received Trip channels (A through H), received Guard channels (a through h), local Trip inputs (1 through 8), a permanently On state, or a permanently Off state.

WARNING: Never use Unit ID number 00 in any logic configuration. 00 is a default number and will not operate properly in real tripping schemes. The use of Unit ID 00 may result in false trips and other communication errors.

To program the Trip outs, choose the desired input from the pull down menu. Trips are designated CH A-T for channel A, CH B-T for channel B and so on. Guards are designated CH a-G for channel A, CH b-G for channel B and so on. If the input is to be inverted click on the arrow to the right of the input and a circle is added to the tip of the arrow to indicate the input is inverted. This means that a logic 1 becomes a logic 0 or vice versa. If a receive Trip or Guard channel is selected a Unit ID field will appear. Enter the Unit ID number of the remote unit whose channel the Trip is being received from.

NOTE: It is always recommended that the Unit ID feature be turned On for added security. Unless the Unit ID feature is not desired for the scheme, make sure the Unit ID feature is turned On on the Systems Settings tab (see System Settings later in this section). With two Com ports and Packet Forwarding, it is possible for a unit to receive Trip commands from more than one source.

         Figure 4-5. RX Logic Screen

The logic works on the premise that a Trip in a Trip state, Guard in a Guard state, a local input being energized or ON is a positive input. When the condition of the gate has been met (i.e. two positive inputs to an And gate) a positive output will result. A positive Trip Out is used to activate the Trip output relay after it has met the additional time logic of the RX timing settings, described earlier in this section.

NOTE: This manual often refers to outputs as Trip outputs. The "Trip outputs" may be used as a Guard output, a blocking scheme instead of a tripping scheme, or any other type of logical output. "Trip outputs" is used to differentiate these outputs from alarms or communication outputs.

The first two inputs have a gate. Program the gate by clicking on the symbol. Each time the symbol is clicked, it will change from AND, OR, then XOR (see Figure 4-6 for symbol description). Inputs 3 and 4 have their own gate as does inputs 5 and 6. The result of the Inputs 1 and 2's gate is then gated with

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inputs 3 and 4's gate output. The result of this gate is then gated with inputs 5 and 6's gate output. All the gates are programmed in the same way. The end result of all this logic is the Trip output which then passes through the receive timer logic (described earlier in this section). To turn the Trip Out Off, turn Off all six of the inputs.

Figure 4-6. RX Logic Description

System Settings: The System Settings are some of the most critical to the overall operation of the system. These settings will determine the construct in which the settings described previously will operate.

Unit ID: This is the number of the PDR-2000 that is being programmed. Every time a packet is transmitted from a unit, the Unit ID number is included. The default number is 01. **Each PDR-2000 that is on the same system should be assigned a unique number, whether the Unit ID feature is On or Off**. This allows the GUI to download the Settings, Status, and Events of not only the local PDR-2000 that it is connected to, but also any other unit that it is communicating with. If multiple units that are communicating with each other have the same Unit ID number, the GUI will not be able to correctly determine which unit the data is originating from and will not operate correctly.

The Unit ID field displays the Unit ID number when Get Settings is used. To change the Unit ID number of a unit, the Keypad and Display must be used, see Section 3, On-Board Programming.

Figure 4-7. System Settings Screen

WARNING: It is advised that a PDR-2000 not be assigned the unit Unit ID number 01. The use of Unit ID 01 may result in false trips and other communication errors if a field is mistakenly left unchanged when programming or operating the GUI. Use numbers 02 to 99 for digital schemes and 01 to 03 when using the Audio Communications module.

Unit ID On/Off: This setting turns the Unit ID feature for Receive Logic On or Off. When Unit ID is Off, the Trip Out need only be programmed for the Channel on which the Trip command is coming. When Unit ID is On, the Trip Out must be programmed for both the channel and the Unit ID number for it to operate correctly. The Unit ID number is in every packet, regardless of the Unit ID feature setting. It is

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always recommended that the Unit ID feature be turned On for added security. Turning Off the Unit ID feature will result in a status alarm and is only recommended for loop back and other tests.

Password: This field contains the user access password of the unit. The 4 digit password must be entered in this field correctly or the Download Settings, Download Firmware and Erase Events commands will not be accepted. The Password must be for the unit whose Settings or Firmware are being downloaded. This is not necessarily the local unit connected to the computer.

The default password for the PDR-2000 is 1234. It is recommended that the password be changed to limit access to the Settings. To change the Password, enter the existing password in the Password field and the new Password in the New Password field and the Confirm New Password field. Confirm all the Settings and the Unit ID number are correct and click the Download Settings button.

NOTE: If the Settings are not correct and the Download Settings button is used to change the Password, the Settings will update improperly. It is recommended that the Get Settings button be used to upload the Settings before changing the Password.

INIVEN maintains a manufacturer's password to all units in case the customer's password is changed and/or forgotten. Have your company's representative call the factory in case of such an event, at 800-526-3984 or 908-722-3770.

Packet Forwarding: By turning this feature On, the PDR-2000 can be used to communicate Trip and Guard commands with multiple units whether they are connected directly or indirectly.

Packet Forwarding works in conjunction with Unit ID and the two standard Com ports (see COM SETTINGS later in this section) to send or retrieve information including Trips to and from PDR-2000's not directly communicating with the local unit.

Figure 4-8. Ring Configuration

EXAMPLE: Figure 4-8 shows a ring of four PDR-2000's with bi-directional communications between units. With Packet Forwarding On, Unit 1 can send a Trip to Unit 4. For the purposes of this example, Unit 4 is programmed to Trip when it receives a Trip from Unit 1 on channel B. Unit 1 communicates over two different communication paths (using Com port 1 and Com port 2) to Units 2 and 3. Units 2 and 3 receive the packets, determine if there is valid tripping data for their logic, and retransmit the packet out of the Com port the packet was not received on.   Whether or not there is a Trip for Unit 2, it passes on the packet to Unit 4. Unit 3 performs the same routine with the packet and passes it to

Unit 4. When Unit 4 receives the packet from units 2 or 3, the appropriate Trip output is activated and it in turn passes the packet on. When the packet reaches the originating unit, in this case Unit 1, the packet is no longer forwarded.

Other then Trip/Guard packets all other information is forwarded automatically without Packet Forwarding turned On. This allows the user to program the settings, get the status, get the existing settings, retrieve stored events, erase stored events, and generate a Ping test to any PDR-2000 communicating with the originating unit directly (Unit 1 to Unit 2 in the example) or indirectly (Unit 1 to Unit 3 in the example).

NOTE: It is critical that both Com ports are turned On (see Com Ports later in this section) and Unit Id is also On. Only units in the "loop" or "string" with Packet Forwarding On will forward data. The forwarding stops when a unit is reached that has Packet Forwarding turned Off, only one of the two Com Ports On, or is the originating unit of the packet. When used in a loop, trip times will be slower with Packet Forwarding On. **Packet Forwarding must be off when using the Audio Communications module**

Packet Forwarding may also be used as a redundancy feature so that although a Trip is intended to be direct, the indirect path can be used as a backup in case the primary path should fail.

NOTE: It is important to remember to choose the correct Unit ID number on the GUI before initiating any communications with a remote unit.

For more information on how Packet Forwarding works, see Section 2, Digital Communications

Status Alarms: Four of the Status Alarms are programmable for their delay. Alarm, Block, LOC 1, and LOC 2 can be programmed for the amount of time required for the alarm must be present before their dry contact relays are activated. Alarm and Block timers are also used to delay writing the Alarm and Block events to the Event Recorder.

There are two programmable alarms. The programmable alarms are selected from the pull down menu and contain seven choices: Bit Error 1, Bit Error 2, Invalid ID, Time Out ID, Trip In, Trip Out, and Ping Test Fail. All of these events have a latch timer that determines the length of time the relays will be activated. The programmable alarms are sourced from the event recorder as a single event and therefore have no duration of their own, requiring the latching timer to be set. The latching timer includes a manual reset setting that holds the relay On until the alarms are reset in the Diagnostics menu on the keypad and display.

To reset a manual reset alarm, press F1 (DIAG) from the default display. Press the F2 (NEXT) for the next menu. Press 4 and/or 5 to reset the desired alarm(s). If the condition that caused the alarm is still present, i.e. a steady Trip input for a Trip input alarm, when an operator resets the alarm, the relay and LED will alarm again until the condition is cleared.

Two of the programmable alarm options require additional timers, Timeout ID and Ping Test Fail. If either of these are selected, an additional field appears. Timeout ID can be used when the Unit ID feature is On. It determines if one of the Trip outputs has a Unit ID number programmed that has not received a packet from that ID number for the amount of time programmed in the timer field. The timer field is programmable in 1 ms increments and goes up to 1 second. If the Timeout ID is not used and programmed for the status alarm, the default time used by the event recorder is 500 ms. **Do not use both programmable alarms for Ping Test Fail or Timeout ID.**

Ping Test Fail is used to determine communication integrity and propagation delays in the system. The

timer field for Ping Test Fail is used to limit the acceptable amount of time required for the round trip test. If the Ping Test exceeds the time programmed, the test is considered a failure and the relay will be activated. This alarm will work with the manual or automatic Ping Test. Since Trip/Guard packets have priority, round trip ping times may exceed the actual propagation delay and therefore should be considered when choosing the amount of time before triggering the status alarm.

The Unit ID Off, microprocessor fail and power fail alarms are instantaneous and not programmable for delay or latching.

Bit Error 1 and 2 alarms indicate that Bit Error has been detected on the matching Com port, 1 or 2.

Invalid ID is only used in a system with Unit ID On and Packet Forwarding Off. When a unit receives a packet with an ID number that is not programmed in the receive logic, the alarm is activated. This indicates that a unit is programmed incorrectly or that some type of problem exists in the communication system that is allowing data from the wrong unit to reach the alarmed unit.

Trip In indicates that a Trip In was received on one of the eight Trip inputs.

Trip Out indicates that one of the eight Trip outputs was activated.

See Section 13, Status Relay Module for more details on status relays.

Com Ports: The Com 1 and Com 2 On/Off settings are used to activate the Com ports on the rear of the chassis. It does not matter what type of communication is being used; RS-449, fiber optics, etc. The Com Ports 1 and 2 are labeled on the rear of the chassis.

When both Com ports are On, it is not necessary to program the communication channels for each port. The packets being transmitted by both ports are identical. The programming of the receive logic filters the relevant Trip/Guard commands based on Channel and Unit ID settings.

If both Com Ports are On, Unit ID must also be On unless a loop back or other test is being performed. It is recommended that unused Com ports are always turned Off. If using Packet Forwarding both ports must be On. **It is necessary to restart the unit after turning Com ports On or Off.**

Invert Clock: For RS-422/RS-449 synchronous communication applications and for all other applications where the PDR-2000 receives its timing signal from the communication device, not G.703 or C37.94. The standard setting for this clocking is on the rising edge of the signal. If this needs to be changed to the falling edge, set Invert Clock to the On position. **The Audio communication module requires the Invert Clock setting to be ON to operate correctly.**

Software Version: This field displays the version number of the Firmware in the uP module when the Get Settings command is used.

Auto Ping Test: An automatic Ping test may be performed by the unit at a programmed interval to a desired remote unit over a specific path. Enter the Unit ID number of the remote unit to be pinged in the To Unit ID field. Next enter the port the Ping test will be sent on using the pull down menu next to the Port # label. This will determine the path of the test by limiting which port the ping is transmitted on. To turn the auto test On, enter a time on the pull down menu next to the Repeat Every label. If the time selected is Off, Auto Ping Test is Off. If any time other then Off is entered, Auto Ping Test will start after the settings are downloaded. For more information on Ping Tests, see Section 6, System Tests.

NOTE: Every time a Ping test is performed, whether automatically or manually, at leas two events are written to the Event Recorder. Keep this in mind when choosing a Ping test interval.

MEMO

The fifth tab in the UNIT SETTINGS field is Memo. This section is used to view and add notes to the nonvolatile memory of the PDR-2000 uP module.   The Memo section may be used for maintenance logs, programming notes or anything else. Up to 4000 characters can be held in memory. Notes in the Memo section are treated as any other setting in the UNIT SETTINGS section. They are saved, loaded and password protected with the other settings.

To see the notes in a unit, use the Get Settings command.

To add notes to the Memo section, click the mouse in the field and the cursor will appear. Use the keyboard to type notes as if using any Word type application. When finished, download the notes to the unit.

To erase information, use the Backspace or Delete keys to erase the notes and download the changes to the unit.

To download the notes into the units memory, use the DOWNLOAD SETTINGS command as described under Downloading Software in the next part of this section. **The Memo notes are downloaded with the rest of the Software Settings so it is important to confirm that the Settings are correct before downloading.** It is recommended that the Get Settings command is used before making changes in the Memo section.

Figure 4-9. Memo Screen

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DOWNLOADING SOFTWARE

Settings: When the changes to the settings have been completed, the DOWNLOAD SETTINGS button will update the unit. Make sure the cable is attached and the PDR-2000's power is on. **Most importantly, the Unit ID number must match the unit whose settings are being updated.** If the wrong Unit ID number is used, another PDR-2000 in the system may have its settings changed. The Password under the System Settings tab must match the Password of the unit being programmed. **It is therefore suggested that different passwords are used for each unit.**

When the DOWNLOAD SETTINGS button is clicked, a blue progress bar directly over the button moves from left to right, showing the download is in progress. The words "Download Settings" will change within the button to indicate the specific operation taking place. The new settings will take effect immediately. When finished, a box will appear on the screen indicating that the download is complete.

Downloading new settings does not take the PDR-2000 out of service. The settings are changed off-line in the GUI and are only recognized by the unit when the DOWNLOAD SETTINGS button is pressed. The PDR-2000 will continue to operate under existing settings until they are instantaneously changed when the download of new settings is complete.

Firmware: Select the Unit ID number of the unit receiving the new firmware. It is recommended that only local units be programmed with firmware. To change the firmware, click on the DOWNLOAD FIRMWARE button. The GUI will ask for the source of the Firmware. Choose the drive and file name and click OPEN. This will initiate the download of the Firmware to the unit. All firmware files have a .bin suffix. **When a GUI is loaded on a computer a copy of Firmware is added to the Program folder. The GUI defaults to the Iniven folder when the Download Firmware button is pressed. Confirm that the firmware version is correct or change the directory to locate the proper file.** The Password under the System Settings tab must match the Password of the unit being programmed. The blue progress bar below the DOWNLOAD FIRMWARE button will show the status of the download. A Download Complete message will indicate the process is finished. **It is necessary to turn the main power switch on the front of the PDR-2000 Off and On for the new Firmware to be installed.** A message will appear on the display of the unit that the new firmware is loading. When the new firmware is finished loading the unit must be restarted again. If the unit fails to update the new firmware at any point during the process, the old firmware will be maintained.

Altera Code: The PDR-2000 uses an Altera PLD (programmable logic device) that contains hard coded logic. Updates may require the Altera settings to be changed. If it is required to change the Altera code (as instructed by Iniven), use the DOWNLOAD FIRMWARE button. The password of the unit must be entered along with the Unit ID number. It is recommended that only local units be programmed with new Altera code. After pressing the DOWNLOAD FIRMWARE button, use the down select arrow to select .pof files instead of .bin files. Select the source of the file and press Enter. Altera code files have a .pof suffix. Follow the prompts on the computer and PDR-2000 displays. The unit will have to be turned off and on.

If new versions of firmware or Altera code is supplied, any additional instructions provided by Iniven take precedence over this write-up.

SAVING SETTINGS

Settings from a unit or from the GUI can be saved and loaded later from a disk drive.

Saving: If Settings are to be saved on a disk, they must first be loaded onto the GUI. With the GUI communicating with a unit via a RS-232 port, select the proper Unit ID number from the pull down menu on the top left corner of the System Configuration screen, then click the Get Settings button. The settings are now loaded on the GUI. If the Settings were created on the GUI and are being saved, follow the same procedure.

Click on the Save button. Choose the Directory of the disk drive the file is to be saved on by clicking the down arrow next to the "Save in:" field. Next name the file. To save the file as an Iniven Unit settings file, the file name needs to end with the .ust. If the file name does not end with .ust, it may be more difficult to find the file when it comes time to load it. Click the Save button to save the settings to disk.

Loading: To load a saved Settings file from disk click, choose the Unit ID number of the unit to be programmed and press the Load button. Choose the disk drive and directory using the down arrow next to the "Look in" field. If the file was saved with the .ust suffix (Iniven Unit settings), then use the "Files of type:" Iniven Unit settings files (*.ust). If the Settings file is save as any other type, use the down arrow next to "Files of type:" to select All files (*.*). Select the file and click Open. The settings will be loaded into the GUI, replacing any Settings that were there previously.

Once the Settings are loaded to the GUI, they may be manipulated and downloaded to a PDR-2000.

NOTE: The Unit ID number is saved along with the settings and are attached to the Memo notes. If a Unit ID number is used other then the number that was used to configure the settings, the Memo notes will not be loaded from the saved file with the settings. The Memo notes will only load when the Unit ID number of the unit matches the Unit ID number of the unit that created the notes. The rest of the settings can be cross loaded.

PRINT SETTINGS

The settings in the GUI may be printed in a one page report. Settings from a disk or unit need to be uploaded to the GUI before they can be printed. To print the settings list, click on the Print button on the right side of the System configuration screen. Follow the prompts to send the report to the desired printer.

```
Settings for Unit #00

Date: 9/19/03  Time: 10:03:21 AM

Firmware Version
_____

System Settings:

Unit ID                OFF              Alarms Timing Settings:        Auto Ping Test:

Invert Clock           OFF              Alarm Delay  0.0  (sec)          To Unit ID   00

Packed Forwarding      OFF              Block Delay  0.0  (sec)          Port #       1

                                        LOC1 Delay   0.0  (sec)          Interval     01 hour

Communication Ports Settings:           LOC2 Delay   0.0  (sec)

COM 1  :               ON               Bit Error 1  0.0  (sec)   Latching Timer OFF

COM 2  :               ON               Bit Error 2  0.0  (sec)   Latching Timer OFF
_____

TX Settings:  Hold Time    B-Keying

Channel A :   0   (sec)    0   (sec) OFF

Channel B :   0   (sec)    0   (sec) OFF

Channel C :   0   (sec)    0   (sec) OFF

Channel D :   0   (sec)    0   (sec) OFF

Channel E :   0   (sec)    0   (sec) OFF

Channel F :   0   (sec)    0   (sec) OFF

Channel G :   0   (sec)    0   (sec) OFF

Channel H :   0   (sec)    0   (sec) OFF
_____

RX Settings:

                  PreTrip Timer GBT on/off    GBT time     Hold time     Latching time

Trip Out 1        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 2        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 3        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 4        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 5        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 6        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 7        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)

Trip Out 8        0   (msec)    OFF           0   (msec)   0   (msec)   0   (msec)
_____

RX Logic:


Out 1: ((NOT  CH A  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 2: ((NOT  CH B  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 3: ((NOT  CH C  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 4: ((NOT  CH D  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 5: ((NOT  CH E  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 6: ((NOT  CH F  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 7: ((NOT  CH G  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )

Out 8: ((NOT  CH H  [0]  OR NOT   OFF ) OR (NOT  OFF   OR NOT   OFF )) OR (NOT  OFF   OR NOT   OFF )
```

Figure 4-10. Sample System Settings Printout

The receive logic on the print report is in the same format that is used for on board programming. See Section 2, On Board Programming, for a description of the logic statement.

MODEM SETTINGS

The GUI may be used to connect a computer via a modem to the PDR-2000. The unit is designed to connect a modem to the rear RS-232 port. Once the modem connection is established, program the unit normally. Keep in mind that communications response will be slower.

To connect to a PDR-2000 via a modem, click on the Set Connection button on the System Configuration screen at the top left hand corner, just below the Unit ID pull down menu.

Figure 4-11. Connection Settings Screen

The Connection Settings screen will appear. Select the computer's Comm port that the modem is connected to, using the pull down menu. Click on the SET COMM PORT button. Next, choose the connection speed between the computer and the modem. The default setting of 115200 baud should work for most systems. The initialization string is automatically set for a V.92 modem. If the modem uses a different initilization string, enter next to INIT STRING. The initilization string is found in the modem's user manual. The dial prefix is set for a standard touch tone system with a dial tone. If a different system is used, enter the prefix in the field next to DIAL PREFIX. The dial prefix is found in the modem's user manual. Enter the phone number of the modem attached to the PDR-2000 (no dashes) and click CONNECT VIA MODEM to dial out. The PHONE # field may contain items such as 9 for an outside line. A **,** will cause a pause in dialing. Click OK after the modem has connected.

Use the GUI as if connected locally to the unit. When finished, click Disconnect Modem on the System Configuration screen.

Next to the PHONE # field is an AND button. When this button is clicked, the number in the field will be added to the GUI's memory and can be retrieved using the pull down arrow.

The Comm port of the computer is defaulted to Comm port 1 when connecting a PC directly to a PDR-2000. If that is not the serial port being used, change the Comm port on the Connection Settings screen and click SET COMM PORT. If changing from a modem to the serial port for direct connection, it may be necessary to change the Comm port back to the serial port on this screen.

TRIP/GUARD PACKET AND OUTPUT STATUS

The sixth tab is inputs_com. This tab allows the user to see two things in the unit. The first is the current status of the 8 receive channels, A through H, from all 99 unit ID numbers. The second is to see the status of the 6 inputs for each of the Trip outputs.

To see the status on the local unit or any unit, the local unit is directly or indirectly communicating with, select the Unit ID number of the unit to be queried on the upper left hand corner of the System Configuration screen and press the Get Inputs button. Both sections will fill with 0's, 1's, and 2's.

Channel Status: All 99 unit ID numbers will fill the Unit ID column. These are the potential Unit ID numbers the unit could be receiving packets from. The columns to the right indicate the status of the 8 channels for each Unit ID number. A 0 indicates the channel is in Guard. A 1 indicates the channel is in Trip. A 2 indicates the channel is blocked. If the unit is not receiving any data from a particular unit ID number the channels should all indicate 2.

If Unit ID is Off, all Unit ID numbers will display 2 in the channel fields and Unit ID 100 will indicate the status of the channels for all received packets since the Unit ID numbers are ignored by the logic.

This can be used as a diagnostic tool during setup or to confirm proper communications.

Figure 4-12. inputs_com Screen

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Output Logic Status: This section on the right of the screen is used to determine the 6 inputs' status for each of the 8 Trip outputs. The 6 inputs are located on the RX Logic tab. In1 is the top most input, In2 is the input directly below and so on.

The 6 logic inputs will have a 0, 1, or 2 in the field. Unlike the Channel Status, the numbers indicate the logic position and not a Trip, Guard, or Block. A 0 represents a logic 0 or Off state. A 1 represents a logic 1 or On state. A 2 indicates that the input is being blocked.

If a input is set to a Guard setting, CH a-G, and the unit is receiving a guard signal, the indication would be a 1. If the unit were receiving a Trip signal, the indication would be a 0. If the unit stopped receiving packets from the Unit ID number assigned to CH a-G, the indication would be a 2.

The inputs_com tab is for information only and does not change any settings in the unit and does not require a password.

Section 5 INSTALLATION

This section of the manual covers installation, unpacking, mounting and interconnect wiring instructions.

UNPACKING

The PDR-2000 may be supplied as an individual chassis, stacked interconnected chassis, or mounted in a rack or cabinet. Follow the procedure for the type of system supplied.

INDIVIDUAL CHASSIS

An individual chassis will be packed in its own shipping carton. Inspect the carton for possible damage in transit. Open each carton carefully and remove the chassis. Inspect the equipment for possible damage. Verify all items of value have been removed from the carton prior to discarding the packing material.

NOTE: It is suggested the carton be retained for possible onward shipment.

INTERCONNECTED CHASSIS

An interconnected chassis or equipment mounted in racks or cabinets will be shipped either in special boxes (wood crates or via air-ride van without any case). Inspect the crate or other packaging for possible damage in transit. Carefully remove the equipment from the container and inspect it for damage. Verify all items of value have been removed from the crate prior to discarding any packaging material and refer to above note.

Should transit damage be found, please notify INIVEN immediately.

MOUNTING

INDIVIDUAL CHASSIS

Two screws are required per mounting bracket (four total per chassis) and are not supplied with the unit. Install the chassis in the desired location and securely tighten all four screws. Spacing of the mounting holes is compliant with EIA and DIN standards.

SYSTEMS

Systems provided in a rack or cabinet from the factory must be secured to the floor or wall as required. Mounting hardware is not supplied due to the various surfaces and mounting methods.

CAUTION: EQUIPMENT MOUNTED IN SWING RACK TYPE CABINETS MUST BE SECURED TO THE MOUNTING SURFACE PRIOR TO OPENING THE SWING RACK TO PREVENT THE CABINET FROM FALLING.

INTERCONNECTED CHASSIS

Interconnected chassis or equipment mounted on shipping rails will be mounted similarly to a single chassis. When shipping rails are provided, the equipment is to be placed near the desired location. Remove the screws holding the shipping rails. Slide the equipment into the rack or cabinet and secure it with the proper screws for mating hardware being used. Tighten all screws.

NOTE: Adequate ventilation is required for reliable operation of electronic equipment. Temperatures within the equipment room should be kept within specifications to assure reliable operation.

ELECTRICAL CONNECTIONS

User connections are made on the rear of the chassis (except for the RS-232 port on the front of the chassis) through barrier and screw terminal blocks, communication ports (either electrical or fiber optic) and the IRIG-B BNC connector. Refer to the end of this section or to the drawings that come with the unit for specific wiring details.

References made to terminal blocks are via terminal block numbers. Terminal block TB-1 terminal 1 is referred to as TB1-1. Terminal block TB-1 terminal 2 is referred to as TB1-2 and so on.

CAUTION: FOR SAFETY REASONS, ELECTRICAL POWER ON THE LEADS BEING CONNECTED TO THE UNIT SHOULD BE DE-ENERGIZED DURING INSTALLATION.

Various methods of making the connections to the terminal blocks may be used and are based on local practice. Lugs or bare wire may be used. Make sure to tighten all connections and insure exposed wires and/or lugs do not touch each other or the chassis.

To reduce the possibility of induced currents on the Trip input leads, it is recommended that shielded twisted pair wires are used with the shield grounded at the PDR-2000 end only. The Trip input leads and the communication cables should be bundled separately from each other and the other leads. It is recommended that the mounting rack be grounded.

TRIP INPUT

The Trip input current is limited to 10 ma. A resistor in series with the optical isolator on each of the Trip inputs is used to limit the current. To produce a Trip, the battery voltage must be within 50% of the input battery voltage.

NOTE: The term Trip input is used to indicate the command input circuits. The inputs may be used for Guard inputs, blocking schemes, or any other type of input.

TRIP OUTPUT

The Trip outputs can be used singularly or in parallel. If optional dry contact relays are included, jumpers are on the modules to convert them from form A to form B. See Section 17 Options for details.

NOTE: The term Trip output is used to indicate the output circuits used by the receive logic. The outputs may be used for Guard indications, blocking schemes, or any other type of output.

STATUS RELAYS

There are ten status relay alarms each with a single set of SPST jumper selectable form A or form B contacts. All of the status relays are energized during normal operation. See Section 13 Status Relay Module or Section 12 DC/DC Module for details.

ELECTRICAL CONNECTORS

If the unit was supplied with an electrical 64 Kbps connector (RS-449 or G.703), make sure the cable's connector is properly seated and screwed down tightly. If only one Com port is being used, make note of the port number for programming purposes and turn off the unused port.

The DTE RS-232 is located on the rear panel and the pin locations are shown in Figure 5-1. Make sure the cable's connector is properly seated and screwed down tightly.

The IRIG-B connector is a male BNC. The internal clock will accept standard modulated IRIG-B signals.
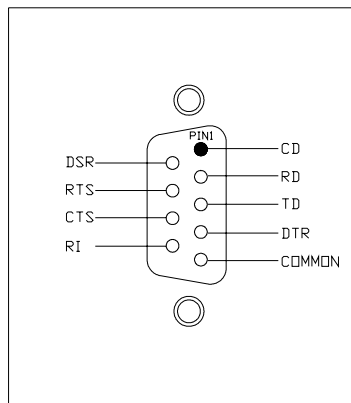

Figure 5-1. DTE RS-232 Pin Drawing

GROUNDING THE EQUIPMENT IS IMPORTANT FOR BOTH SAFETY REASONS AND RELIABLE OPERATION. Connect a 16 AWG or larger wire between chassis ground and earth ground utilizing the shortest path to keep resistance and inductance to a minimum. It is also recommended that the rack be grounded.

uP MODULE

The microprocessor module has two ribbon cables connected to the front panel Figure 5-2 shows the proper connections to the keypad and display. If a redundant uP module is being used, program the redundant module first using a PC with the redundant module in the primary slot(the first position on the left side of the chassis behind the front panel). After programming, a jumper must be placed across pins 1 and 3 on the keypad plug of the redundant microprocessor. Place the redundant module in the redundant slot(the second position from the left behind the front panel). The ribbon cables only attach to the primary uP module. The ribbon cables are keyed and latching and should only attach one way. Insert the primary microprocessor module and program normally. The two microprocessors may be programmed differently.
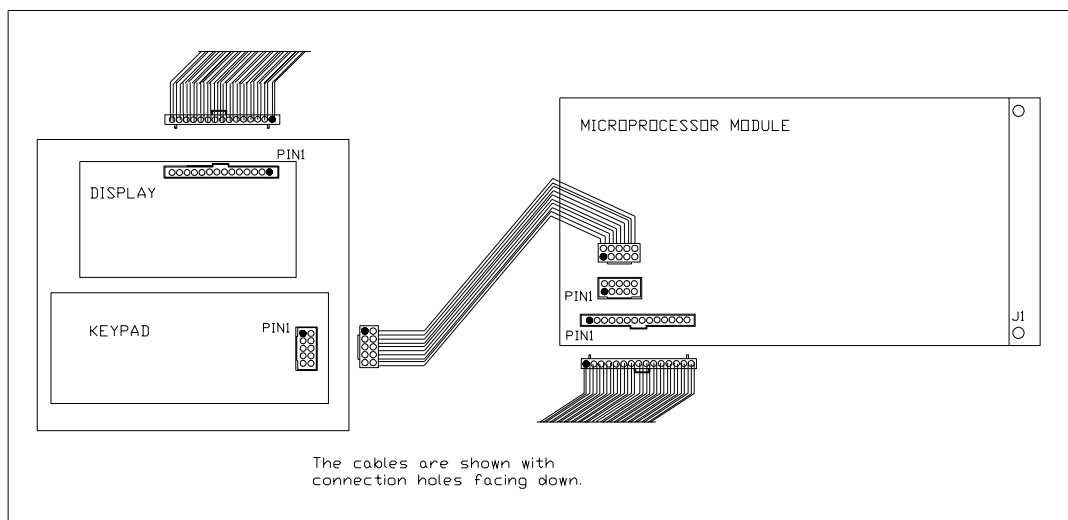

Figure 5-2. Microprocessor/Front Panel Ribbon Cable Connections

DC CONNECTIONS

The PDR-2000 comes equipped with two DC-DC converters of the same or different values. Verify the battery voltage matches the voltage of the individual DC-DC converters. The converters are found on the DC-DC module.

WARNING: Double check all connections for tightness and correctness, including polarity as applicable. Replace all protective covers supplied.

INITIAL START-UP

Each unit is checked and burned in at the factory. Verify the electrical connections as described earlier in this section. The following procedure will set the unit for proper operation.

 A flat bade screwdriver with a 1/4 inch wide tip may be required. For programming, a PC compatible computer with a 9 pin serial port running the PDR-2000 GUI (Graphical User Interface software) and straight extension type cable is recommended for ease of programming.

PROGRAMMING

The PDR-2000 can be programmed using a PC or the front keypad and display. It is important to remember that the Trip logic is assigned to the Trip out circuits and not the channels. A single channel may be used by several different Trip out circuits with the same or different logic schemes.

Installing the GUI

1. Load the Iniven GUI disc into the computer's CD drive. Confirm the disk date corresponds with the GUI version being used at your utility.

2. The Iniven CD may not be an Autorun application.   If it is click on PDR-2000 Software and skip to step 6. If the application does not start on it's own Double click on My Computer.

3. Locate the CD drive and double click. The CD should be labeled Iniven.

4. Double click on the Setup.exe file.

5. Click Next at the welcome screen.

6. Enter your name and company name and click Next.

7. The GUI will automatically create an Iniven folder in your Program Files. You may choose a different location. Click Next to install.

8. The GUI will show your settings. Click Next to install.

9. Click Finish. A Iniven icon should have been added to the desktop. Double click the Iniven icon to open the GUI.

Using the GUI

This is a step by step instruction for using the GUI to program a PDR-2000. For details on using the GUI and the function of the different operations, see Section 4 Remote Programming.

1. If not already On, turn the Main Power switch On.

2. Boot the computer being used to program the computer and load the PDR-2000 GUI.

3. Using the 9 pin M/F extension cable, connect the RS-232 port on the front panel to the serial port on the PC.

4. Select the Unit ID number of the unit being programmed and confirm the computer is communicating with the PDR-2000 by clicking on the Get Status button. The simulated display should replicate the display on the front of the PDR-2000. If the Get Status failed see Section 20 Trouble Shooting.

5. If the settings currently in the unit are to be modified or if the unit is being programmed from scratch, go to Step 6. If a saved copy of settings are to be used, skip to Step 7.

6. Upload the current settings in the unit; select the proper Unit ID number of the PDR-2000 whose settings are to be loaded. If the Unit ID number is not correct, a remote PDR-2000 communicating with the local PDR-2000 could be mistakenly programmed. The Unit ID number is the two digit number on the Default Display in the upper left corner. To change the Unit ID number use the keypad and display, follow Steps A through F. Once the Unit ID number is selected, press the Get Settings button. After a few seconds the settings on the GUI will be updated to match those in the unit.

      A. Press F1 (Setup) on the keypad.

      B. Enter the four digit password and press F1 (OK). C. Press 3 (System Setup) then F1 (OK).

      D. Press 1 (Unit Identity) then F1 (OK).

      E. Press 2 (Change Unit ID) then F1 (OK).

      F. To change the Unit ID number, enter the new Unit ID number (01 - 99 for digital applications and 01 - 03 for audio applications) and press F1 (OK) to accept. Note the new Unit ID number. The Unit ID number can not be changed using the GUI. Press F3 (Exit) repeatedly until the display is on the main menu. This is important because the unit will not program from the GUI with the display beyond the password screen. **No PDR-2000 should be assigned Unit ID number 00 due to possible conflicts with programming.**

NOTE: If programming a remote PDR-2000, using a PC connected to a local unit, you will need to know the Unit ID number of the remote PDR-2000.

Skip to Step 8

7. To load a saved copy of settings from a disk drive, click the Load button on the lower right hand side of the System Configuration screen. The settings on the GUI will change to reflect the settings from the saved file.

8. Click on the System Settings tab if it is not already selected.

9. Confirm the Unit ID number matches that of the unit to be programmed.

10. Turn the Unit ID on/off field On unless special programming or loop back testing is to be performed.

11. Enter the password. To change the Password refer to Step 6.

12. If Packet Forwarding is to be used, turn it On, otherwise confirm that it is Off. Both Com ports must be turned On in order for Packet Forwarding to work properly. Unit ID will be turned On automatically if not already On when Packet Forwarding is turned On. **Do not turn Packet Forwarding On if the Audio Communications module is used.**

13. Confirm which Com port(s) is being used and set it(them) to On. Confirm both Com ports are On if Packet Forwarding is On. **It is necessary to restart the unit after turning Com ports On or Off. Restart the unit after the settings have been downloaded.**

14. If using a RS-449 interface is being used the Invert Clock On/Off will need to be set. If the rising (or leading) edge is used, set Invert Clock to Off. If the falling (or trailing) edge is used, set Invert Clock to On. This feature is not used if the Com port protocol does not require timing, i.e. point to point fiber optics, C3794 or G.703.

15. Program the Status Relay delays for Alarm, Block, LOC 1, and LOC 2 in 1.0 second intervals. See Section 4 Remote Programming or Section 13 Status Relay Module for more details on the delay's function

16. Select the programmable alarms. Each alarm can be programmed for BIT error Com port 1, BIT error Com port 2, Timeout ID, Invalid ID, Trip In, Ping Test Fail, and Trip Out. These alarms have a latch timer that determines the duration of the relay output when one of these events occurs. Choose the type of alarm the relay is to be set for and the latching time from the pull down menu. Ping Test Fail and Timeout ID require a timer. The timer field will appear if either of those alarms are chosen. Program the timer in 1 ms intervals. See Section 13 Status Relay Module for more details on the function of these status relays.

17. Next, program the Receive Logic. Click on the RX Logic Tab. All programming for the receiver is assigned to the Trip output relays.

18. To program the Trip outs, choose the desired input from the pull down menu. If the input is to be inverted click on the arrow to the right of the input and a circle is added to the tip of the arrow to indicate the input is inverted. If a Trip or Guard is selected a Unit ID field will appear. Enter the Unit ID number of the remote unit whose channel the Trip is being received from. The inputs are gated. Program the gates by clicking on the symbol. Each time the symbol is clicked it will change from AND, OR, then XOR (see Figure 5-4 for symbol description). All the gates are programmed in the same way. The Trip output then passes through the receive timer logic (described later in this section). To turn the Trip Out Off, turn Off all six of the inputs.
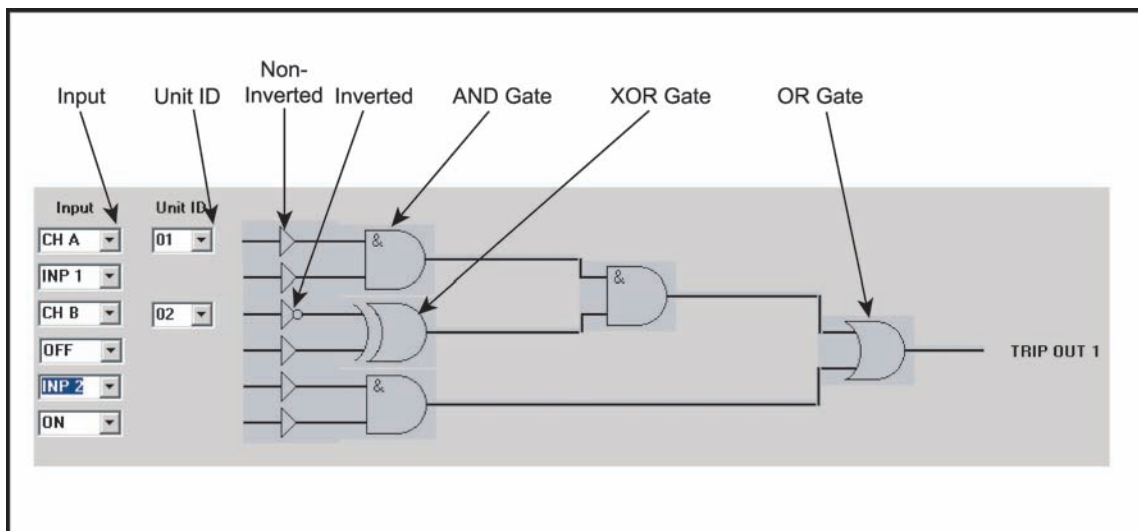
Figure 5-4. RX Logic Description

Different Trip outputs can be programmed with the same Channel from the same Unit ID number for redundant Trip outputs.

Repeat procedure for all eight Trip output circuits.

19. Click on the RX Timing Settings tab. As with the Receive Logic, the Receive Timing programs the Trip outputs and not the Channels.

20. Click on any of the Trip Outputs that require a Pre-Trip timer to be added to the Trip Time. Enter the new time value in 0.5 ms intervals. Make sure all eight Trip Outs are programmed correctly.

21. If Guard before Trip logic is required on any of the Trip Outs, click on the box next to the appropriate Trip Out number to add a check mark and change the indication from Off to On.

22. Enter the duration of time that Guard must be received before a Trip will be output in the box next to the check mark. The time may be entered in 50 ms intervals up to 1 sec. If the time is left at 0 and Guard before Trip is On, the Guard before Trip logic is active and will require a minimum of 1 packet to include a Guard for that Trip Out before it will allow a Trip. Make sure all Trip Outs are programmed correctly for Guard before Trip On/Off as well as time.

23. Click on any of the Trip Outs that require a Receive Hold timer for a minimum duration of Trips. Enter the new time value in 5 ms intervals. Make sure all eight Trip Outs are programmed correctly.

24. Click on any of the Trip Outs that require a Receive Latching timer for an additional duration of Trips. Enter the new time value in 10 ms intervals. Make sure all eight Trip Outs are programmed correctly.

25. Click on the TX Settings tab. Unlike the Receive Logic, the Transmit Logic ties the eight Trip inputs directly to the channels, Trip In 1 to Channel A, Trip In 2 to channel B and so on.

26. Click on any of the Channels that require a Transmit Hold timer. Enter the new time value in 5 ms intervals. Make sure the other Channels are programmed correctly.

27. If B Contact Keying logic is required on any of the Trip Inputs, click on the box next to the appropriate Channel letter to add a check mark and change the indication from Off to On.

28. Enter the B Contact keying duration in the box next to the check mark. The time may be entered in 20 ms intervals. If the time is entered but the On/Off box is left Off, B Contact Keying logic will be Off. Make sure the other Channels are programmed correctly.

29. If Auto Ping test is to be used, return to the System settings Tab.

       A. In the box marked AUTO Ping Test, enter the Unit ID number of the unit to be pinged in the To Unit ID field.

       B. In the Port # field, enter which Com port the ping is to transmitted over. This will determine the path of the test.

       C. Use the pull down menu next to" Repeat every" to determine how often the test will be generated. Choose Off to turn off the Auto Ping Test.

Every time a Ping test is generated, the results are written to the Event Recorder. Setting the Auto Ping Test to repeat frequently will result in a large number of event records being written.

If the Audio Communications module is being used, be advised that the Ping Test is not an accurate time of a round trip trip/guard signal due to the bandwidth restrictions. If Auto Ping Test is used with this communication module it is advised that the test is set to repeat infrequently as it will also increase trip times.

For more information on Ping tests, see Section 6 System Tests.

30. If notes are to be added to the Memo section, click on the Memo tab. Click in the field and start typing. If notes already exist, click next to the last note to add more information. To erase notes delete them from the field.

31. If the Audio Communications module is used in the chassis, the transmit output level must be set, see step 5.H of the On Board Programming later in this section

32. The settings should now be complete and can be downloaded to the unit. Confirm the Unit ID number selected on the top left of the screen matches the unit to be programmed. **If the Unit ID number is changed at this point in the process the settings will change back to default settings on the new Unit ID number. To avoid losing the settings, save them to a disk and reload them with the new Unit ID number already entered.** Once the Unit ID number has been verified, confirm that the correct Password (the default password is 1234) has been entered into the field on the System Settings tab and click the Download Settings button. To change the Password, enter the new Password in the New Password field and repeat the new Password in the Confirm New Password field. A blue progress bar will rapidly fill the space between the Download Settings and Download Firmware buttons. A message will confirm the download is complete.

33. If an entry in one of the fields is not acceptable by the unit a message will indicate the incorrect settings were changed to an acceptable value. Check the timing settings if this message appears.

34. To confirm the settings have been accepted by the unit, press the Get Settings button and see if the settings remain the same.

To confirm the Date/Time settings refer to step 5-D in the Using the Keypad and Display.
All other settings are programmed in Flash and will not be erased if the power is turned off.

Using the Keypad and Display

The following instructions give the step by step procedure for programming the PDR-2000 using the Keypad and Display.   The GUI is required to download any saved settings from disk. This method will also only allow the PDR-2000 being accessed to be programmed.

NOTE: For a description of the function of the settings controlled by the keypad and display see Section 3, On Board Programming. Refer to Chart 3-1, Display Module Menus Flow Chart when programming using the Keypad and Display.

1. If not already On, turn the Main Power switch On.

2. Press F1 (Setup).

3. Enter the 4 number Password (the default password is 1234) and press F1 (OK).

4. Press 3, then F1 (OK) to enter System Setup).

5. SYSTEM SETUP

      A. UNIT ID NUMBER

            I. Every PDR-2000 is assigned a Unit ID number whether or not the Unit ID feature is used. The current Unit ID number assigned to the unit can be found in the top left corner of the Default display. It is important that no unit be assigned number 00. The unit will not operate correctly with a Unit ID number 00.

            II. To enter a new Unit ID number, enter a two digit number from 01 to 99 (01 to 03 for units equipped with an Audio Communications module) and press F1 (OK). To exit without changing the number, press F4 (Exit).

            III. To turn the Unit ID feature On/Off press 1 then F1 (OK) to enter the Unit ID menu again. The * will show if the Unit ID is currently On or Off. To change this setting press 1 then F1 (OK). The next menu offers the On/Off choice. Again the * shows the current setting. Press 1 for On and 2 for Off then press F1 (OK).

NOTE: Unit ID must be On if Packet Forwarding or if both Com ports are on unless a local loop back or other test is being performed. If turning the Unit ID feature On, do so before programming Receive Logic. It is always recommended that the Unit ID feature be turned On for additional security.

            IV. Press F4 (Exit) to return to the System Settings menu.

      B. PASSWORD

            I. Press 2 and F1 (OK) to enter the Password menu.

            II. The current password is displayed. Enter a new 4 digit number (do not use Function keys) for the password and press F1 (OK) to change the password. Repeat the number to confirm and press F1 (OK). Press F3 (Clr) to erase an entry on the display. Press F4 (Exit) to exit without making a change to the password.

C. PACKET FORWARDING

I. To turn On/Off Packet Forwarding, press F3 (Next) from the System Settings menu, then press 4, and then press F1 (OK).

II. The * indicates the current setting for Packet Forwarding. To change the setting press either 1 or 2. The next menu offers the choice between On or Off. Press 1 for On or 2 for Off and press F1 (OK) or F4 (Exit) to exit without making a change. Unit ID must be On and both Com ports need to be On for Packet Forwarding to work properly. Packet Forwarding must be Off if the Audio Communications module is installed.

Do not turn Packet Forwarding On if the Audio Communications module is used.

D. DATE/TIME SET

I. From the second System Settings menu press 5 and then press F1 (OK) to enter the date and time manually. Use the keypad to enter the date and then the time. Use the F2 (<<) and F3 (>>) keys to skip over any sections. It is recommended that even if an IRIG-B signal is used for clocking. The date should be entered manually to insure the year is correct. Once entered, a battery maintains the clock.

II. Press F1 (OK) to change the date/time or F3 (Exit) to exit without change.

E. ALARM SETUP

Four of the ten Status Relays are programmable for delay; Alarm, Block, LOC 1, and LOC 2. Their are two programmable alarms. Each alarm can be programmed for BIT error Com port 1, BIT error Com port 2, Timeout ID, Invalid ID, Trip In, Ping Test Fail, and Trip Out. These alarms have a latch timer. The latching timer includes a manual reset setting. The Ping Test Fail and Timeout ID alarms also have a timer setting for determining a failure. See Section 13, Status Relay Module, for more information on alarm functions.

I. To Program any delays required for the first four alarms, Alarm, Block, LOC 1, LOC 2, press 1, 2, 3 or F3 (Next) and 4, to choose the relay and press F1 (OK). Use the F2 (Up) and F3 (Down) keys to change the delay for that relay. Repeat procedure for all four relays as necessary.

II. Choose the programmable alarms (5 or 6) from the second Alarm Setup menu. If Ping Test Fail or Timout ID is selected a third line will appear with a timer,   otherwise the third line will be blank. Press the 1 key to change the type of event that will trigger the alarm. Press one repeatedly to scroll through the event types. When the event type has been chosen and it is Ping Test Fail of Timeout ID, press the F2 (Up) and F3 (Down) keys to set the timer and press F1 (OK) when done, otherwise press F1 (OK). Set the latch timer for the Status alarm relay by pressing the F2 (Up) and F3 (Down) keys and press F1 (OK). Repeat for the other programmable Status alarm. Do not choose both alarms to be Ping Test Fail or Timeout ID. There may be one of each, but not two of each.

III. If the unit is equiped with an optional Trip Cut Out Switch located either on the Trip Out module or in the 2 right end slots, the setting for these should be confirmed. Choose Cut Out Switch (7) from the third Alarm Setup menu. If the switch is located on the Trip Out module then it is the Trip Out Switch and select it (2) from the menu. If the switch

is located in the right 2 end slots then it is the Cut Out Module and it (3) should be selected. If there is no test switch supplied in the unit select None (1). Press OK (F1).

F. COM SETTINGS

I. Press 7 and then F1 (OK) to turn On/Off the two main Com ports and select the type of timing signal for RS-449 applications.

II. The present status of the Com ports is listed on items 1 and 2. To turn a Com ports On or Off, press 1 or 2 once. Confirm which port(s) is being used and set it(them) to On. Confirm both Com ports are being used if Packet Forwarding is being used. **It is necessary to restart the unit after turning Com ports On or Off.**

III. Choose Invert Clock On/Off if a RS-449 interface is being used. If the rising (or leading) edge is used, set Invert Clock to Off. If the falling (or trailing) edge is used, set Invert Clock to On. This feature does not perform a function if the RS-449 interface is not being used, i.e. fiber optics or G.703. Press 3 once to change Invert Clock to On or Off instantly.

IV. Press F4 (Exit) after changes have been made to the Com ports and communication clocking to return to the System Settings menu.

Unit ID must be On if both Com ports are active in order for the unit to work properly.

G. AUTO PING TEST

I. Press 8 and then F1 (OK) to turn On/Off the Auto Ping test and set the interval of testing.

II. Use the F2 (Up) and F3 (Down) keys to set the interval of the test. To turn Auto Ping test Off, press the Up key until Off appears. Press the F1 (OK) key to continue.

III. The next screen sets the remote unit to be Pinged. Use the keypad to enter the remote unit's Unit ID number and press F1 (OK).

IV. To select the Com port that the Ping test will be generated through, press F2 (Port1) or F3 (Port2). To activate the Auto Ping test, press F1 (On). To turn Off Auto Ping test, press F4 (Off).

If the Audio Communications module is being used, be advised that the Ping Test is not an accurate time of a round trip trip/guard signal due to the bandwidth restrictions. If Auto Ping Test is used with this communication module it is advised that the test is set to repeat infrequently as it will also increase trip times.

H. AUDIO SETUP

I. Press 9 and then F1 (OK). To change the transmit output level press F2 or F3. The recommended setting is -8 dBm. This will be different depending on the type of line, noise and local practice. Press F1 (OK).

6. RECEIVE SETUP - Turn Unit ID On/Off before programming the Receive Logic

    A. Return to the General Programming menu by pressing F4 (Exit) on the System Settings menu or by entering from the Default menu (Setup - Password). Press 1 and then F1 (OK) to enter Receive Setup.

NOTE: It is important to understand that all receive logic is assigned to the Trip Out relays and not the channels.

    B. Choose a Trip Out relay using the F2 (<<) and F3 (>>) keys. Only one Trip Out circuit can be programmed at a time. Press F1 (OK).

NOTE: It is important to check all Trip Outs for errant programming.

    C. TRIP RECEIVE LOGIC

        I. Program the main logic of the Trip Out by pressing 1 and then F1 (OK).

        II. To program the Receive Logic menu, use the F3 (<) and F4 (>)keys to move right and left. When the cursor reaches the end of the right side of a line it will move down to the next line and when it reaches the left side of the line it will move up a line. On the first line, press the 1 key to toggle between inverted and non-inverted. On the second line, press the 1 key to toggle between the three types of gates. Use the 1 key to toggle between all types of inputs (A-H, a-h, 1-8,   and On/Off). On the third line use the 1 key to enter Unit ID numbers below channel letters.   Press the F1 (OK) key when the programming is complete.
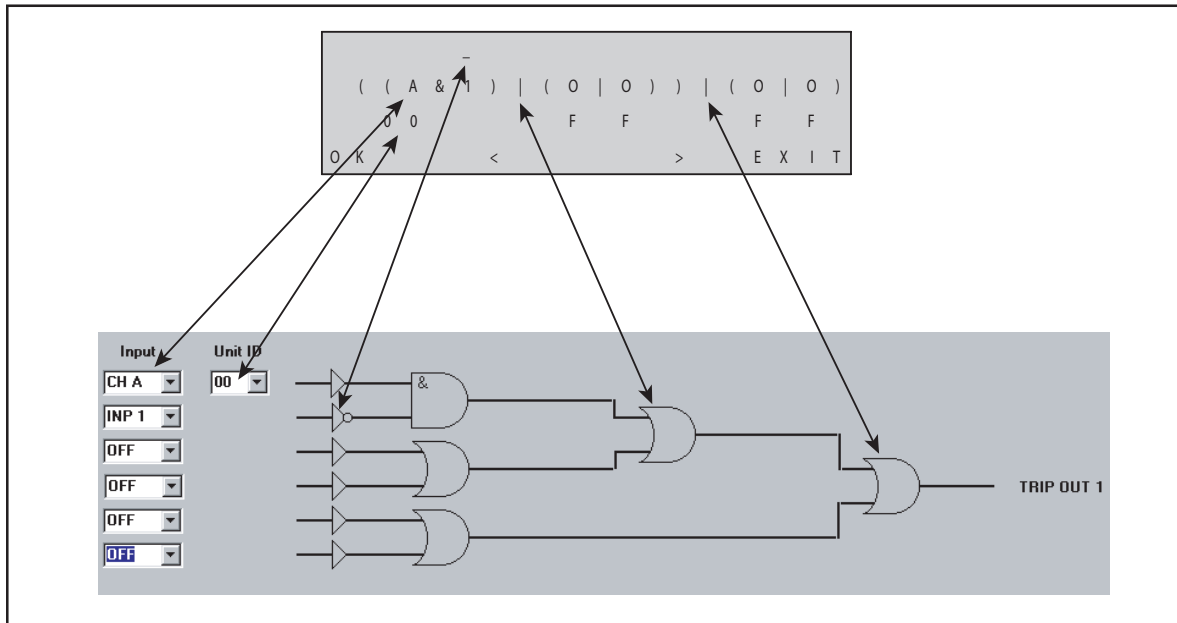

Figure 5-5. Logic Conversion, GUI to Display

    D. PRETRIP TIMER

        I. When the Trip receive Logic is programmed, press 2 (Pretrip Timer) and then F1 (OK) on the Receive Logic menu.

II. Program the Pre-Trip timer for this Trip Out circuit by using the F2 (Up) and F3 (Down) keys. Press F1 (OK) to accept the change or F4 (Exit) to exit without change.

E. GUARD BEFORE TRIP

I. Press 3 and then F1 (OK) to program the Guard before Trip logic on this Trip Out Circuit.

II. Press 1 and then F1 (OK) to turn Guard before trip On/Off.
Press 1 to turn Guard before Trip On or 2 to turn it Off then press F1 (OK). Press 2 then F1 (OK) to set the Guard before Trip time. Use the F2 (Up) and F3 (Down) to program the time and then press F1 (OK) to enter time.

F. The Receive Logic menu should be on the display. Press F3 (Next) to view the receive setup screen.

G. TRIP RECEIVE HOLD

I. To program Trip Hold Time, press 4 then F1 (OK). Use the F2 (Up) and F3 (Down) to program the time and then press F1 (OK) to enter time.

H. LATCHING TIMER

I. To program the Latching Timer, press 5 then F1 (OK). Use the F2 (Up) and F3 (Down) to program the time and then press F1 (OK) to enter time.

I. Exit to the Trip Out Selection menu and repeat programming for all eight Trip Out Circuits.

7. TRANSMIT SETUP

A. Return to the General Programming menu by pressing F4 (Exit) on the System Settings menu or by entering from the Default menu (Setup - Password). Press 2 (TX Setup) and then F1 (OK) to enter Transmit Setup.

B. Select the Channel to be programmed using the F2 (<<) and F3 (>>) keys. Press F1 (OK) to enter selection.

C. TRANSMIT HOLD TIME

I. Press 1 (Trip TX Hold) and F1 (OK) to program the Trip Transmit Hold for this Channel.

II. Use the F2 (Up) and F3 (Down) to program the time and then press F1 (OK) to enter time. Press F4 (Exit) to return to the Channel Selection menu. Repeat procedure for all desired channels.

D. B CONTACT KEYING

I. Press 2 (B Contact Keying) and F1 (OK) to program the B Contact Keying timer and to turn it On/Off.

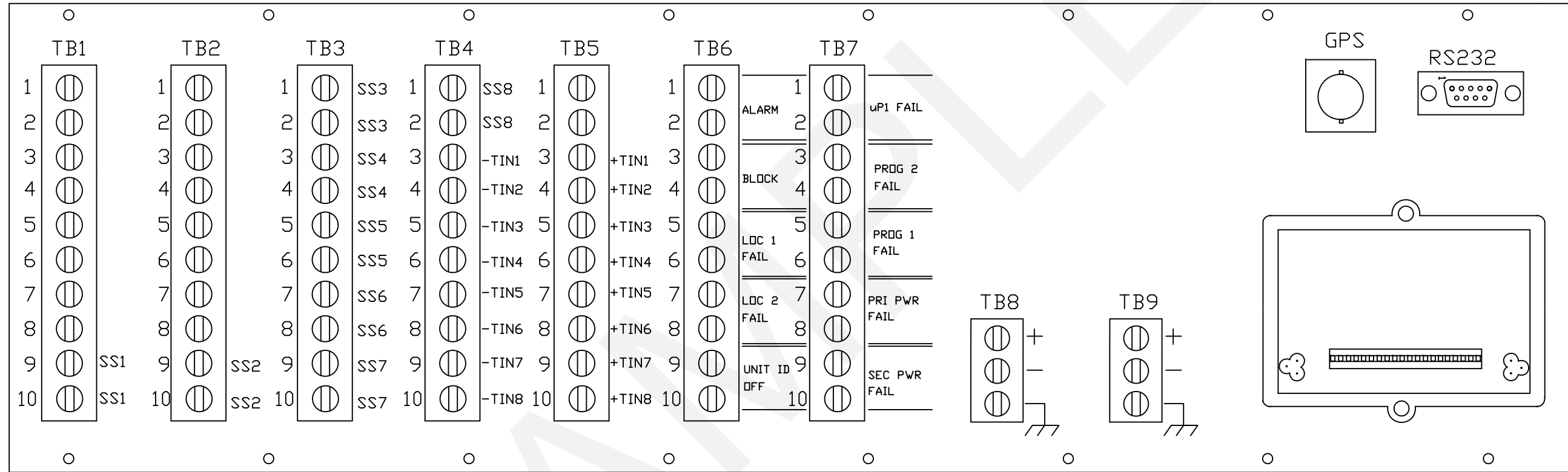II. Use the F2 (Up) and F3 (Down) to program the time and then press F1 (OK) to enter time.

III. On the next screen, Press F2 (On) or F3 (Off) to turn B Contact Keying On or Off for that channel.

If the above procedure was successfully completed, the terminal is now working properly. If the procedure could not be completed or if a malfunction is suspected, refer to Section 20, Troubleshooting, Section 3, On Board Programming, and Section 4, Remote Programming. If these sections do not resolve the problem, contact your local representative or INIVEN directly at 800-526-3984 or 908-722-3770. Once the issue is resolved, repeat the initial start-up procedure to assure that the unit is functioning properly.

TRIP OUTPUT   STATUS RLY

TB1 1–10 SS1 SS1
TB2 1–10 SS2 SS2
TB3 1–10 SS3 SS3 SS4 SS4 SS5 SS5 SS6 SS6 SS7
TB4 1–10 SS8 SS8 −TIN1 −TIN2 −TIN3 −TIN4 −TIN5 −TIN6 −TIN7 −TIN8
TB5 1–10 +TIN1 +TIN2 +TIN3 +TIN4 +TIN5 +TIN6 +TIN7 +TIN8
TB6 1–10 ALARM BLOCK LOC 1 FAIL LOC 2 FAIL UNIT ID OFF
TB7 1–10 uP1 FAIL PROG 2 FAIL PROG 1 FAIL PRI PWR FAIL SEC PWR FAIL

GPS

RS232

TB8 + −
TB9 + −

COMMUNICATIONS INTERFACE

#1   #2

TRIP INPUT   POWER IN

24VDC   24VDC   24VDC

48VDC   48VDC   48VDC

125VDC   125VDC   125VDC

REF. 2000−OLBCH01

TRIP OUTPUT

STATUS RLY

TB1
1 SS5
2 SS5
3 SS6
4 SS6
5 SS7
6 SS7
7 SS8
8 SS8
9 SS1
10 SS1

TB2
1 SS1
2 SS1
3 SS2
4 SS2
5 SS3
6 SS3
7 SS4
8 SS4
9 SS2
10 SS2

TB3
1 SS3
2 SS3
3 SS4
4 SS4
5 SS5
6 SS5
7 SS6
8 SS6
9 SS7
10 SS7

TB4
1 SS8
2 SS8
3 -TIN1
4 -TIN2
5 -TIN3
6 -TIN4
7 -TIN5
8 -TIN6
9 -TIN7
10 -TIN8

TB5
1
2
3 +TIN1
4 +TIN2
5 +TIN3
6 +TIN4
7 +TIN5
8 +TIN6
9 +TIN7
10 +TIN8

TB6
1 ALARM
2
3 BLOCK
4
5 LOC 1 FAIL
6
7 LOC 2 FAIL
8
9 UNIT ID OFF
10

TB7
1 uP FAIL
2
3 PROG 2 FAIL
4
5 PROG 1 FAIL
6
7 PRI PWR FAIL
8
9 SEC PWR FAIL
10

GPS

RS232

COMMUNICATIONS INTERFACE

TRIP INPUT

24VDC
48VDC
125VDC

#1 #2

POWER IN

24VDC   24VDC
48VDC   48VDC
125VDC 125VDC

REF: 2000-DLBCH02

TRIP OUTPUT

STATUS RLY

TB1
1
2
3
4
5
6
7
8
9 SS1
10 SS1

TB2
1 RLY1
2 RLY1
3 RLY2
4 RLY2
5 RLY3
6 RLY3
7 RLY4
8 RLY4
9 SS2
10 SS2

TB3
1 SS3
2 SS3
3 SS4
4 SS4
5 SS5
6 SS5
7 SS6
8 SS6
9 SS7
10 SS7

TB4
1 SS8
2 SS8
3 -TIN1
4 -TIN2
5 -TIN3
6 -TIN4
7 -TIN5
8 -TIN6
9 -TIN7
10 -TIN8

TB5
1 +TIN1
2 +TIN2
3 +TIN3
4 +TIN4
5 +TIN5
6 +TIN6
7 +TIN7
8 +TIN8

TB6
1
2
3
4
5
6
7
8
9
10

ALARM
BLOCK
LOC 1 FAIL
LOC 2 FAIL
UNIT ID OFF

TB7
1
2 uP FAIL
3
4 PROG 2 FAIL
5
6 PROG 1 FAIL
7 PRI PWR FAIL
8
9
10 SEC PWR FAIL

GPS

RS232

TB8
+
−

TB9
+
−

COMMUNICATIONS INTERFACE

#1 #2

TRIP INPUT

24VDC
48VDC
125VDC

POWER IN

24VDC   24VDC
48VDC   48VDC
125VDC   125VDC

REF: 2000-OLBCH03

TRIP OUTPUT   STATUS RLY

TB1   TB2   TB3   TB4   TB5   TB6   TB7   GPS   RS232

TB1
1
2
3
4
5
6
7
8
9
10

TB2
1 RLY1
2 RLY1
3 RLY2
4 RLY2
5 RLY3
6 RLY3
7 RLY4
8 RLY4
9
10

TB3
1
2
3
4
5
6
7
8
9
10

TB4
1
2
3 −TIN1
4 −TIN2
5 −TIN3
6 −TIN4
7 −TIN5
8 −TIN6
9 −TIN7
10 −TIN8

TB5
1
2
3 +TIN1
4 +TIN2
5 +TIN3
6 +TIN4
7 +TIN5
8 +TIN6
9 +TIN7
10 +TIN8

TB6
1
2
3 ALARM
4
5 BLOCK
6
7 LOC 1 FAIL
8 LOC 2 FAIL
9
10 UNIT ID OFF

TB7
1
2 uP FAIL
3
4 PROG 2 FAIL
5
6 PROG 1 FAIL
7 PRI PWR FAIL
8
9
10 SEC PWR FAIL

TB8
+
−
⏚

TB9
+
−
⏚

#1   #2

TRIP INPUT   POWER IN

24VDC   24VDC   24VDC

48VDC   48VDC   48VDC

125VDC   125VDC   125VDC

COMMUNICATIONS
INTERFACE

REF: 2000-DLBCH04

TRIP OUTPUT

STATUS RLY

GPS

RS232

TB1
1	RLY5
2	RLY5
3	RLY6
4	RLY6
5	RLY7
6	RLY7
7	RLY8
8	RLY8
9	
10	

TB2
1	RLY1
2	RLY1
3	RLY2
4	RLY2
5	RLY3
6	RLY3
7	RLY4
8	RLY4
9	
10	

TB3
| 1 |
| 2 |
| 3 |
| 4 |
| 5 |
| 6 |
| 7 |
| 8 |
| 9 |
| 10 |

TB4
1	
2	
3	-TIN1
4	-TIN2
5	-TIN3
6	-TIN4
7	-TIN5
8	-TIN6
9	-TIN7
10	-TIN8

TB5
1	
2	
3	+TIN1
4	+TIN2
5	+TIN3
6	+TIN4
7	+TIN5
8	+TIN6
9	+TIN7
10	+TIN8

TB6
1	
2	ALARM
3	
4	BLOCK
5	LOC 1 FAIL
6	
7	LOC 2 FAIL
8	
9	UNIT ID OFF
10	

TB7
1	
2	uP1 FAIL
3	
4	PROG 2 FAIL
5	
6	PROG 1 FAIL
7	PRI PWR FAIL
8	
9	SEC PWR FAIL
10	

TB8
+
−

TB9
+
−

COMMUNICATIONS INTERFACE

#1   #2

TRIP INPUT

24VDC

48VDC

125VDC

POWER IN

24VDC   24VDC

48VDC   48VDC

125VDC   125VDC

REF. 2000-OLBCH05

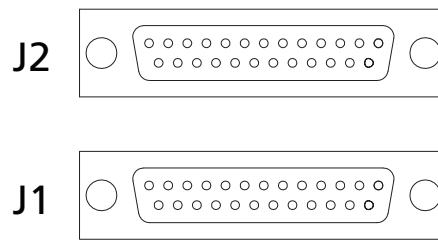TRIP OUTPUT

STATUS RLY

TB1

1		RLY5
2		RLY5
3		RLY6
4		RLY6
5		RLY7
6		RLY7
7		RLY8
8		RLY8
9		SS1
10		SS1

TB2

1		RLY1
2		RLY1
3		RLY2
4		RLY2
5		RLY3
6		RLY3
7		RLY4
8		RLY4
9		SS2
10		SS2

TB3

1		SS3
2		SS3
3		SS4
4		SS4
5		SS5
6		SS5
7		SS6
8		SS6
9		SS7
10		SS7

TB4

1		SS8
2		SS8
3		-TIN1
4		-TIN2
5		-TIN3
6		-TIN4
7		-TIN5
8		-TIN6
9		-TIN7
10		-TIN8

TB5

1		+TIN1
2		+TIN2
3		+TIN3
4		+TIN4
5		+TIN5
6		+TIN6
7		+TIN7
8		+TIN8

TB6

1		ALARM
2		
3		BLOCK
4		
5		LOC 1 FAIL
6		
7		LOC 2 FAIL
8		
9		UNIT ID OFF
10		

TB7

1		uP FAIL
2		
3		PROG 2 FAIL
4		
5		PROG 1 FAIL
6		
7		PRI PWR FAIL
8		
9		SEC PWR FAIL
10		

GPS

RS232

#1   #2

POWER IN

TRIP INPUT

	POWER IN	
24VDC	24VDC	24VDC
48VDC	48VDC	48VDC
125VDC	125VDC	125VDC

COMMUNICATIONS INTERFACE

REF: 2000-DLBCH06

COMMUNICATION INTERFACE MODULES

DUAL RS-422

J2

J1

DUAL G.703

J2

J1

DUAL V.35

J2

J1

DUAL AUDIO

TX1
TX1
RX1
RX1

TX2
TX2
RX2
RX2

DUAL C37.94

XMT1   RCV1   XMT2   RCV2

FIBER OPTIC INTERFACE 1

FIBER OPTIC INTERFACE 2

DUAL F/O

XMT1   RCV1   XMT2   RCV2

FIBER OPTIC
INTERFACE 1

FIBER OPTIC
INTERFACE 2

Section 6 SYSTEM TESTS

This section describes remote and local system tests that can be performed manually or automatically. Logic and communications diagnostics are also described in this section.

SYSTEM TESTS

The PDR-2000 contains two types of system tests, a Ping test and manual Trip initiation. Both types of tests can be initiated or setup using the keypad and display. The GUI can be used to program and initiate Ping tests only.

The first is the Ping test. The Ping test initiates a round trip test packet to a remote unit. The remote unit automatically returns it to the originating unit, which determines if the cycle was completed and the time required to complete the test. The unit is also capable of initiating Trip inputs manually. Ping tests performed when using the Audio Communications module result in lengthy incorrect round trip times due to the communication method used to transmit the packet This must be taken into account before using Ping tests for audio systems, see Section 2, Digital Communications for more information.

ON BOARD TESTS

PING TEST: The Ping test initiates a round trip test packet to a remote unit that responds to the originating unit. There are two types of Ping tests, manually generated and automatically generated. No matter which type of Ping test is used the method and results are the same. For a Ping test to be sent the unit needs to know which unit it is going to ping, this is entered in the form of the remote units Unit ID number. The system then needs to know which port to send the test packet through, Port 1 or 2. If both ports are in use and the system is set up as a loop, the port can determine which part of the loop the test will take. The remote unit being pinged will use the same path for the return packet. A test will pass if the return packet is received within 500 ms. The actions required of the two units will be time stamped on the event recorder. These are Ping Test Start, Ping Test Received, Ping Test Returned, and Ping Test Done or Failed. These events can be used to determine channel delay time. When performing a manual on-board test, the round trip time of the test will appear on the screen as soon as the test is completed. The test will fail if the wrong Unit ID number is pinged, communications with the pinged unit fails, or if the test takes too long. The default is 500 ms but that number can be changed if one of the programmable Status Alarm relays is programmed as Ping Test Fail. If so, a new time may be entered, see Section 4, Remote Programming for details on programming these alarms.

MANUAL PING TEST: The manual Ping test can be initiated using the keypad and display. This is a one time test. It is located on the Diagnostics menu On the Display. The Ping test can be sent to any PDR-2000 communicating either directly or indirectly to the initiating unit. The Ping test performs a complete system test of the digital communications and the receive and transmit capabilities of the PDR-2000. The Ping test also shows the results of the round trip time required to perform the test and the communication delays involved. Because the Ping test is sent to a particular unit by only one port, the communication delay can be determined over different paths to the same unit if a loop arrangement is being used.

0 1		A	B	C	D	E	F	G	H
T X		G	G	G	G	G	G	G	G
R X		G	G	G	G	G	G	G	G
S E T U P				D I A G			1 2 : 4 9 P M		

Figure 6-1. Default Display

To initiate a manual Ping test, Press F2 on the Default display to go to the Diagnostics menu. The items on the Diagnostics menu are not password protected and do not affect programming or performance.

```
1   P I N G   T E S T

2   V E R S I O N

3   R E A D   E V E N T S / M E M O

O K                         N E X T   E X I T
```

Figure 6-2. Diagnostics Menu

Press 1 and then F1 (OK).

```
          P I N G   T E S T

1   P O R T   1

2   P O R T   2

O K                               E X I T
```

Figure 6-3. Ping Test Com Port Menu

Select the Com port that the Ping test is to be sent through. The Ping test will only be communicated over the selected port. The response can be received by either Com port.

```
     P I N G   T E S T   P O R T   1

          T O   U N I T   I D

               _ _

O K                    C L R       E X I T
```

Figure 6-4. Ping Test Destination Menu

Enter the Unit ID number of the unit that the Ping test is to be sent using the keypad. Press F1 (OK) to initiate the test or F3 to clear the selection. Press F4 to exit the menu without initiating a test.

```
     P I N G   T E S T   P O R T   1

     T O   U N I T   I D   1

     T E S T   T I M E   5   m s e c

O K
```

Figure 6-5. Ping Test Result Menu

The manual Ping test has two possible results. A successful test will present a Ping test Result menu similar to Figure 6-5. A test time will be displayed. This is the total time required to send the test packet and have it return from the Unit ID number specified on the Ping test Destination menu. The result is also time stamped on the event recorder. If the test packet is not returned immediately, the Ping test Result menu's display will read "WAIT..." instead of the test time. If the test fails completely, "TEST FAIL" will be displayed.

NOTE: If the Ping test fails, confirm the Com port and Unit ID number and try the test again. The Ping test failing could also be the result of a programmable Status alarm being programmed for Ping Test Fail with a test time smaller then the time required to perform the test. The unit may also be busy performing other requested tasks. See Section 4, Remote Programming for more details on programmable Status alarms.

AUTOMATIC PING TEST: The Auto Ping test is the same as the manual Ping test but instead of being a one time test it automatically repeats as programmed. The Auto Ping test writes to the event recorder and will activate the Ping Test Fail Status alarm (if used) but does not report the duration of the test to the display. This test in conjunction with the programmable Status relay may be used to warn of a slow communications channel.

To setup the Auto Ping test using the keypad and display, the unit's password is required. Start by pressing F1 (Setup) on the Default display.

```
        E N T E R    P A S S W O R D



                  _  _  _  _
O K                      C L R        E X I T
```

Figure 6-6. Manual Trip Password Confirmation

Enter the four digit password using the keypad and press F1 (OK). Press 3 then F1 (OK) to enter System Setup. Press F3 (Next) to go to the second screen and then and then F3 (Next) again to go to the third System Setup menu. Press 8 then F1 (OK) to set up the Auto Ping Test.

```
        A U T O    P I N G    T E S T
    I N T E R V A L :    1 0    m i n


O K       U P          D O W N     E X I T
```
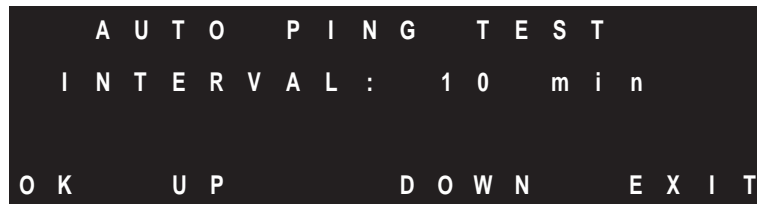
Figure 6-7. Auto Ping Test Main Menu

Next, use F2 (Up) and F3 (Down) to select the time interval between Ping Tests. The intervals selections are not linear. Press F1 (OK).

```
        A U T O    P I N G    T E S T
    I N T E R V A L :    1 0    m i n
T O    U N I T    I D :    1 5
O K       U P          D O W N     E X I T
```
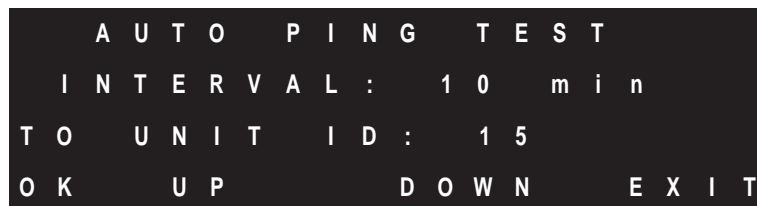
Figure 6-8. Auto Ping Test Unit ID Selection Menu

The next menu adds the Unit ID number of the remote unit to be pinged. Use the F2 (Up) and F3 (Down) keys to choose the Unit ID number.

```
         A U T O    P I N G    T E S T
              P O R T    1


O N        P o r t 1   P o r t 2       O F F
```

Figure 6-9. Auto Ping Test Port Selection Menu

The final menu selects the Com port the test packet will be sent through and adds the Unit ID number of the remote unit to be pinged. Use the F2 (Up) and F3 (Down) keys to choose the Unit ID number. To start the Auto Ping test press F1 (On). To turn Off the Auto Ping test press F4 (Off).

MANUAL TRIP OUTPUT: The PDR-2000 can transmit a Trip on any or all channels manually, without the need of an external Trip input.

To initiate the manual Trip, press F1 (Setup) from the Default display. Enter the four digit password using the keypad and press F1 (OK). Press 3 then F1 (OK) to enter System Setup. Press 3 and then F1 (OK) to start the process of generating a manual Trip(s).

The Manual Trip Password menu requires the confirmation of the unit's password. Enter the four digit number and press F1.

```
         M A N U A L    T R I P    O U T
    t o    c h a n g e    p r e s s    1 - 8
       - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8
O K                                E X I T
```

Figure 6-10. Manual Trip Channel Selection Menu

 WARNING: The Send Trip Manually feature of this unit will transmit a Trip signal, unless the receiving unit(s) is taken out of service, a Trip output can occur.

The Manual Trip Channel Selection menu is used to select which Trip inputs will be activated resulting in transmitted Trips. Press the number of the input that is to be activated. The minus sign in front of the input will change to a plus sign. Do not press F1 until all the inputs have been added. To remove an incorrect input's number, press that number again and the plus sign will be changed back to a minus sign.

Once all the desired input numbers have been added, press F1.

```
         M A N U A L    T R I P    O U T
    + 1 - 2 - 3 - 4 + 5 - 6 - 7 - 8
T I M E                0 . 0 s e c
O K        U P      D O W N      E X I T
```
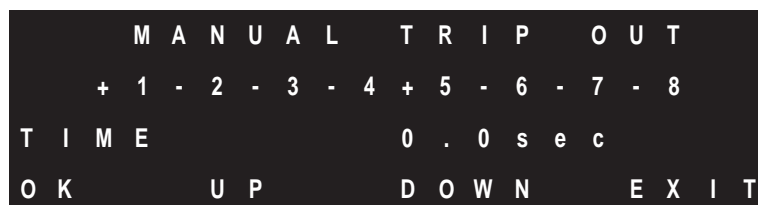
Figure 6-11. Manual Trip Duration Menu

The duration of the Trip is selected on the Manual Trip Duration menu. Press the F2 and F3 buttons to

set the time in one second intervals. The unit will transmit the Trip(s) only for the entered period of time and then return to normal operation and the Default display.

When the proper time has been entered press F1.

NOTE: Normal protection by the PDR-2000 is suspended during the duration of the Manual Trip.

```
          M A N U A L     T R I P     O U T
        + 1 - 2 - 3 - 4 + 5 - 6 - 7 - 8
            A R E     Y O U     S U R E ?
  Y E S                                         N O
```

Figure 6-12. Manual Trip Final Confirmation Menu

The final menu confirms that the Trip(s) are to be sent. **This is the last menu, pressing F1 will commence the Trip(s).**

When F1 is pressed, the corresponding Channels of the Trip input circuits transmit the trip signals. The display will count down the time set in the Manual Trip Duration menu and then the unit will return to normal operation.

REMOTE TESTS (GUI)

PING TEST: The Ping test initiates a round trip test packet to a remote unit that responds to the originating unit. There are two types of Ping tests, manually generated and automatically generated. No matter which type of Ping test is used the method and results are the same. For a Ping test to be sent the unit needs to know which unit it is going to ping, this is entered in the form of the remote units Unit ID number. The system then needs to know which port to send the test packet through, Port 1 or 2. If both ports are in use and the system is set up as a loop, the port can determine which part of the loop the test will take. The remote unit being pinged will use the same path for the return packet. A test will pass if the return packet is received within 500 ms. The actions required of the two units will be time stamped on the event recorder. These are Ping Test Start, Ping Test Received, Ping Test Returned, and Ping Test Done or Failed. These events can be used to determine channel delay time. The test will fail if the wrong Unit ID number is pinged, communications with the pinged unit fails, or if the test takes too long. The default is 500 ms but that number can be changed if one of the programmable Status Alarm relays is programmed as Ping Test Fail. If so, a new time may be entered, see Section 3, On-Board Programming or Section 4, Remote Programming for details on programming these alarms.

The Ping test when used with the Audio Communications module is inaccurate due to bandwidth and the different methodogies employed, times will be much longer then the actual channel delay.

MANUAL PING TEST: The manual Ping test can be initiated using the GUI. This is a one time test. It is located on the System Settings tab of the System Configuration Screen. The Ping test can be sent to any PDR-2000 communicating either directly or indirectly to the initiating unit. The computer running the GUI must be connected to the initiating unit. The Ping test performs a complete system test of the digital communications and the receive and transmit capabilities of the PDR-2000. The Ping test also shows the results of the round trip time required to perform the test and the communication delays involved. Because the Ping test is sent to a particular unit by only one port, the communication delay can be determined over different paths to the same unit if a loop arrangement is being used.

To initiate the manual Ping test using the GUI, start by loading the GUI and connecting the computer to the PDR-2000 that will initiate the test. The computer may be connected directly using the front RS-232 port or remotely using the rear port. The Ping data is entered in the box with the blue text below the Auto Ping Test box. Enter the Unit ID number of the Unit to be Pinged (in the field next to Initiate to ID) and the port in which the test packet will be sent from (using the pull down menu). By selecting different ports, the differing communication delays can be determined in a loop configuration.

After the information has been entered correctly click the blue letters, as the box is the button. This initiates the Ping test. To look at the results, retrieve the data from the event recorder, see Section 7, Event Recording for more details. Subtract the time between Ping Test Start and Ping Test Done to determine the round trip time of the test. Remember that the most recent event is listed first.

NOTE: If the event recorder indicates that the Ping test failed, confirm the Com port and Unit ID and try the test again. The Ping test failing could also be the result of a programmable Status alarm being programmed for Ping Test Fail with a test time smaller then the time required to perform the test. See Section 3, On-Board Programming or Section 4, Remote Programming for more details on programmable Status alarms.

AUTOMATIC PING TEST: The Auto Ping test is the same as the manual Ping test but instead of being a one time test it automatically repeats as programmed. The Auto Ping test writes to the event recorder and will activate the Ping Test Fail Status alarm (if used) but does not report the duration of the test to the display. This test in conjunction with the programmable Status relay may be used to warn of a slow communications channel.
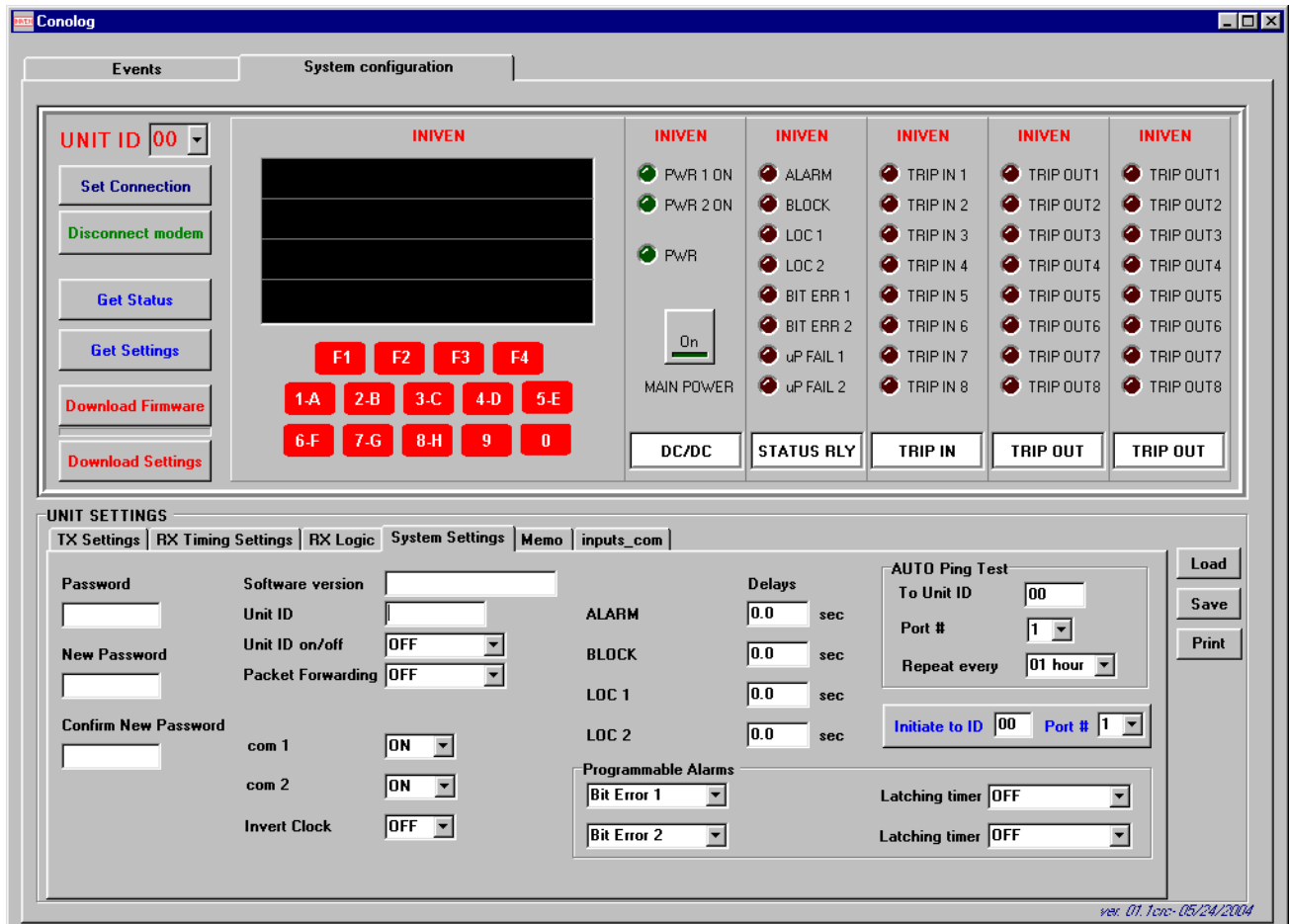

Figure 6-13. System Settings Screen

To set up the Auto Ping test, enter the Ping information in the Auto Ping Test box on the System Settings screen. Click on the To Unit ID field and enter the Unit ID number of the remote unit to be pinged. Enter the port number and the time interval of the tests using the pull down menus. The time interval (Repeat Every) choices are not linear.

NOTE: The Auto Ping Test instructions are downloaded using the Download Settings Command. It is strongly recommended that the settings be uploaded from the unit before the Auto Ping test commands are modified to prevent accidentally erasing settings or memo notes.

Enter the password and click on Download Settings, see Note above. The automatic testing will start and repeat at the interval selected until the test is turned off by reprogramming the Auto Ping test with the time interval set to the Off position.

COMMUNICATION AND LOGIC DIAGNOSTICS

The sixth tab on the System Configuration screen is inputs_com. This tab allows the user to see two things in the unit. The first is the current status of the 8 receive channels, A through H, from all 99 unit ID numbers. The second is to see the status of the 6 inputs for each of the Trip outputs.

To see the status on the local unit or any unit the local unit is directly or indirectly communicating with, select the Unit ID number of the unit to be queried on the upper left hand corner of the System Configuration screen and press the Get Inputs button. Both sections will fill with 0's, 1's, and 2's.

Channel Status: All 99 unit ID numbers will fill the Unit ID column. These are the potential Unit ID numbers the unit could be receiving packets from. The columns to the right indicate the status of the 8 channels for each Unit ID number. A 0 indicates the channel is in Guard. A 1 indicates the channel is in Trip. A 2 indicates the channel is b locked. If the unit is not receiving any data from a particular unit ID number the channels should all indicate 2.

If Unit ID is Off, all Unit ID numbers will display 2 in the channel fields and Unit ID 100 will indicate the status of the channels for all received packets since the Unit ID numbers are ignored by the logic.

This can be used as a diagnostic tool during setup or to confirm proper communications.

Figure 6-14. inputs_com Screen

Output Logic Status: This section on the right of the screen is used to determine the 6 inputs' status for each of the 8 Trip outputs. The 6 inputs are located on the RX Logic tab. In1 is the top most input, In2 is the input directly below and so on.

The 6 logic inputs will have a 0, 1, or 2 in the field. Unlike the Channel Status, the numbers indicate the logic position and not a Trip, Guard, or Block. A 0 represents a logic 0 or Off state. A 1 represents a logic 1 or On state. A 2 indicates that the input is being blocked.

If a input is set to a Guard setting, CH a-G, and the unit is receiving a guard signal, the indication would be a 1. If the unit were receiving a Trip signal, the indication would be a 0. If the unit stopped receiving packets from the Unit ID number assigned to CH a-G, the indication would be a 2.

The inputs_com tab is for information only and does not change any settings in the unit and does not require a password.

Section 7 EVENT RECORDING

The PDR-2000 has an Event Recorder built in to the uP module. The Event Recorder time stamps all activity that takes place in the unit. Events include all Trip and Guard inputs and outputs, status relay activation, password access, and initial power on. Events are time stamped by the internal clock with battery backup that receives its timing from either a manual input or a standard modulated IRIG-B input from a GPS clock. Events may be retrieved using the keypad and display or the GUI.

EVENTS

The standard events that are recorded are listed in Table 7-1.

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 ERR 1 X%	A bit error was detected on Com port 1 and since it was detected X% of the following 1000 packets failed the CRC
Bit Error channel 2 %	BIT ERR 2 X%	A bit error was detected on Com port 2 and since it was detected X% of the following 1000 packets failed the CRC
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 Fowarding 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

Table 7-1. Event Descriptions

All events with a duration are recorded with their start and stop time. Events are stored in Flash and will not be erased if power is lost or the clock's battery dies. The Flash will store approximately 40,000 events before it starts rewriting over existing events.

EVENTS WRITTEN ONCE

The following are one time events and are written once as the activity occurs and there is no follow up event to indicate the situation has changed from On to Off :

Power On	Ping Test Start	Ping Test Passed
Password	Ping Test Received	Ping Test Returned
Wrong Password	Ping Test Failed	

ON/OFF EVENTS

The following events are written once for the On event and once for the Off event. Trip Outputs and Trip Inputs write the same event, but indicate a change of status on the far right column of the event recorder under the "prev" and "now" columns. A 1 indicates On and a 0 indicates Off. A 0 in the prev column with a 1 in the now column indicates the Trip Input or Output is turning On. The rest of the listed events below have an On (or no indication) or Off indication.

Trip Output #	Secondary CPU Power Out of Range 2.5V
Trip Input #	Secondary CPU Power Out of Range Off 2.5V
Alarm ON	Primary CPU Power Out of Range 3.3V
Alarm OFF	Primary CPU Power Out of Range Off 3.3V
Blocked ON	Secondary CPU Power Out of Range 3.3V
Blocked OFF	Secondary CPU Power Out of Range Off 3.3V
Loss of Communication Channel 1	Primary Power Fail 5V
Loss of Communication Off Channel 1	Primary Power Fail Off 5V
Loss of Communication Channel 2	Secondary Power Fail 5V
Loss of Communication Off Channel 2	Secondary Power Fail Off 5V
Primary CPU Power Out of Range 2.5V	Cut-out On
Primary CPU Power Out of Range Off 2.5V	Cut-out Off

TIMEOUT ID

A Time Out From ID # event is written when a remote unit's ID number is in the Receive Logic and packets have stopped being received from that unit. If a packet has not been received with the Unit ID number required by the RX Logic for 500 ms (default), the event is written. If this event is chosen as a Programmable alarm on the Status Relay module, this time can be changed as part of the alarm settings, see Section 13 Status Relay Module for more details on the programming and function of programmable alarms.

Once the timeout event has been written for a particular Unit ID number, it will not be rewritten until it is reset. A valid packet from the remote unit is required to reset the timeout alarm. A Time Out Off ID # will be written when the valid packet is received. Each ID number used in the RX Logic is capable of generating this alarm. A timeout from one ID does not prevent another unit ID number from also timing out.

BIT ERROR DETECTION

Bit error detection is handled differently then all other events. When a packet is received and a bit error is present and detected by the CRC, the unit starts counting packets. When 1000 packets have been received, the unit determines how many packets were found to have bit errors and writes this as an event. Bit Error Channel 1 12 with the last number being the percentage of bad packets received in the last 1000. The time recorded with the event is from the last of the 1000 packets. The PDR-2000 will not start counting again until at least 1 bad packet due to bit error is received.

INVALID ID

Only when a unit's System Settings have Unit ID On and Packet Forwarding Off is it possible to receive an Invalid ID event. If a packet is received that has a Unit ID number that does not reside in the Receive Logic the Invalid ID event is triggered. This event is written every time a invalid packet is received. To limit the number of events written, as to not write the same event every few milliseconds, the event recorder will only write the Invalid ID event up to 20 times. This event will not reset until the invalid packets cease even though the event recorder has stopped writing the event. Once the invalid packets stop being received, any new invalid packets will trigger the alarm again.

DELAYED EVENTS

Four of the Status alarms may be programmed for the delay of the output relay. Two of those alarms, Alarm and Block, also delay their being logged in the Event Recorder. The same delays programmed for these alarms are used for both the dry contact and the Event Recorder. The advantage of the delay is to avoid excessive amounts of events being written due to bit errors. Since a bit error causes a CRC fail and thus can block the communications, a Block and Alarm event could be written if no delay is programmed. The delay determines a minimum amount of alarm must be present before the contact closes and the event is logged.

The other two Status Alarms programmable for delay (LOC 1 and LOC 2) are delayed only for the dry contact output. Both LOC (loss of communication) alarms are logged immediately.

PROGRAMMABLE ALARMS

Two Status alarms are programmable for different types of events. The choices are Bit Error 1, Bit Error 2, Invalid ID, Timeout ID, Trip In, Ping Test Fail, and Trip Out. These alarms are activated from the Event Recorder. Two of the events are time based, Timeout ID and Ping Test Fail. The normal amount of time allowed by these events before a fail condition is recognized is 500 ms. For Timeout ID, if a packet from a remote unit whose ID is in the receive logic of the local unit for 500 ms, the associated Trip output relay is blocked and the event is written. For Ping Test Fail, if the ping is not returned form the remote unit in 500 ms, the test fails and the event is written. If the programmable Status alarm is assigned to one of these two events, the default time of 500 ms may be changed to a smaller amount of time to determine a failure. The event recorder and the alarm will operate using the new time.

See Section 13 Status Relay Module for more details on the programming and function of programmable alarms.

DELAYED EVENTS

Four of the Status alarms may be programmed for the delay of the output relay. Two of those alarms, Alarm and Block, also delay their being logged in the Event Recorder. The same delays programmed for these alarms are used for both the dry contact and the Event Recorder. The advantage of the delay is to avoid excessive amounts of events being written due to bit errors. Since a bit error causes a CRC fail and thus can block the communications, a Block and Alarm event could be written if no delay is programmed. The delay determines a minimum amount of alarm must be present before the contact closes and the event is logged.

The other two Status Alarms programmable for delay (LOC 1 and LOC 2) are delayed only for the dry contact output. Both LOC (loss of communication) alarms are logged immediately.

RETRIEVING EVENTS

DISPLAY

The display can be used to view events one at a time starting with the most recent event. In the Default display, press F2 to view events by entering the Diagnostics menu.

```
          A    B    C    D    E    F    G    H

  T X     G    G    G    G    G    G    G    G

  R X     G    G    G    G    G    G    G    G

  S E T U P          D I A G      1 2 : 4 9 P M
```

Figure 7-1. Default Display

In the Diagnostics menu press 3 and F1 to READ EVENTS.

```
  1    P I N G    T E S T

  2    V E R S I O N

  3    R E A D    E V E N T S / M E M O

  O K                    N E X T    E X I T
```

Figure 7-2. Diagnostics Menu

The events are displayed one at a time starting with the most recent. The event will have a code for its type of event (see Table 7-1 for descriptions) and the time of the event. Press the F3 key to see the next event and F2 to go back to the previous event.

```
  D A T E          8 / 1 2 / 2 0 0 2

  T I M E      1 7 : 1 4 : 3 8 . 4 2 6 7

  E V E N T :    P A S S W O R D

  O K      P R E V      N E X T      E X I T
```

Figure 7-3. Sample Event Display

Press the F4 key to exit to the Default Display.

GUI

The PDR-2000 GUI will run on any standard Windows operating system. The nine pin RS-232 located on the front panel is a DCE port. A male/female nine pin cable is required to connect a standard PC's nine pin serial port to the PDR-2000 (a null modem cable is not required). The nine pin RS-232 located on the back of the chassis is a DTE port designed to be connected to a modem or other communication device. The RS-232 cable can be connected with the unit ON or OFF and the software can be started before or after the cable has been connected. The GUI will not operate properly unless connected to the unit.

With the GUI running on your computer, click on the EVENTS tab on the top left hand side of the screen.

Figure 7-4. GUI Event Recording Tab

Upload Events: To upload the events from the Flash on the uP module, start by selecting the proper Unit ID number from the pull down menu of the unit whose events are to be uploaded. The unit can be the PDR-2000 that is connected to the computer or a unit communicating directly or indirectly with that PDR-2000. Next, use the pull down menu for the COMMAND field and select the number of events to be uploaded. Click on the Send button. The events will appear on the list in chronological order.

NOTE: The PDR-2000 is capable of holding up to 40,000 events in Flash before overwriting the previous events. The Event Recorder software in the GUI only allows up to 1000 events to be uploaded. If more then 1000 events need to be uploaded, please have your company representative contact INIVEN for a version of the GUI designed for that purpose.

Figure 7-5. Example of Events

The more events that are to be uploaded the longer the process takes. If the events are being uploaded from a remote unit the process will be longer and if the events are being forwarded through other units the process will be longer still. The blue progress bar below the send button will continue to move during the upload process. The progress bar may move across its length several times.

Each event shows the Event number starting with 1 (the most recent event), time of the event, the type of event and for Trip Inputs and Outputs, whether their status is changing from On to Off or Off to On. "Prev" indicates the status of the Input/Output before the event and "Now" shows its status after the event has occurred. 1 indicates On and 0 indicates Off.

NOTE: Packet Forwarding does not need to be On for the GUI to upload events or erase Flash from a PDR-2000 indirectly. That type of Packet Forwarding is always On. Therefore, it is always important to confirm the Unit ID before communicating with a unit.

When events are uploaded from the unit, they are always uploaded in order from most recent on. Any sorting that is performed is done after the events are loaded onto the computer.

Sort Events: Once the events are listed, they may be sorted by event type and/or date and time. Use the pull down menu under Event Type and select the Event to be sorted. If the event is also to be sorted by time and date, click on the box next to Select events From/To so that a check mark appears to activate the calendar. Use the calendar selector to sort by date. The left and right arrows on the calendar choose the month and the year, clicking on the day changes the day. To change the time of the sort, use the clock field below the calendar and click on the Hour, Minute, or Second fields.

Change the time using the up and down arrows or type in the number using the PC's keypad. "To" is the most recent time and "From" is the starting point of the sort. Use the pull down menus under To/From to pick the day. Click on the clock's hour, minute, second or AM/PM and use the up and down arrows to adjust the setting. Click the Select button to sort. Only events meeting the sort's criteria will be listed.

Print Events: Use the Print button to send the list to a printer. Select the printer from the pull down menu and click OK.

Save Events: Use the Save button to save the list to a disk. When saving to disk, click the Save button, then select the drive and assign a file name, then click Save.

To view the list from the saved file, use a text program, Microsoft Notepad and Microsoft Word are recommended. The events will not reload to the GUI once saved.

Erase Events: To Erase all the events stored in the Flash, click the ERASE EVENTS FLASH button. A blue bar will show the progress of the process. The password is required on the System Configuration tab in order to erase the events in the flash.

NOTE: Using the ERASE EVENTS FLASH will erase all the events held in the PDR-2000's memory not just those listed on the GUI.

To clear the screen without erasing the memory in the unit, select Clear List from the Event Type pull down menu and click the Select button.

TIME STAMPING

Each event stored in the Event Recorder is stamped with a time of when the event took place. An internal clock with a battery backup is used to stamp these events. The internal clock's time is set one of two ways, either the time can be manually entered via the keypad and display or the clock receives a continuously updated GPS signal from a modulated IRIG-B input. Either way the time should be entered manually when the unit is initially installed or when the battery is replaced since the standard IRIG-B format used by the PDR-2000 does not supply a year. The clock will automatically use the IRIG-B signal if it is detected by the microprocessor module.

MANUALLY ENTERED TIME

The keypad and display of the PDR-2000 allows for the time to be entered manually. It is also the only way for the unit to receive the proper year input. To enter the time manually, follow the sequence below.

	A	B	C	D	E	F	G	H
T X	G	G	G	G	G	G	G	G
R X	G	G	G	G	G	G	G	G
S E T U P			D I A G		1 2 : 4 9 P M			

Figure 7-6. Default Display

Press F1 to enter Setup.

```
          E N T E R    P A S S W O R D



                      _  _  _  _
O K                        C L R          E X I T
```

Figure 7-7. Password Screen

Enter the Password and press F1.

```
1   R X    S E T U P

2   T X    S E T U P

3   S Y S T E M    S E T U P

O K                                       E X I T
```

Figure 7-8. General Programming Menu

Press 3 then F1 to go to System Setup

```
1   U N I T    I D E N T I T Y

2   P A S S W O R D

3   S E N D    T R I P    M A N U A L L Y

O K                        N E X T      E X I T
```

Figure 7-9. System Setup Menu A

Press F3 to go to System Setup Menu B

```
4   P A C K E T    F O R W A R D

5   D A T E / T I M E    S E T

6   A L A R M    S E T U P

O K        P R E V    N E X T        E X I T
```

Figure 7-10. System Setup Menu B

Press 5 then F1.

```
  D A T E   /   T I M E    S E T

          0 8 / 0 7 / 2 0 0 2

          1 7 : 1 8 : 2 6

O K       < <           > >        E X I T
```

Figure 7-11. Date/Time Set Menu

The cursor is flashing on the first digit of the month. Using the keypad enter the month, day, year, hour (in military time/24 hour clock), minute and second. Use F2 and F3 to navigate back and forth if necessary. Press F1 to enter the new date/time or press F4 to exit without changing the clock.

7-8

The clock will continue to keep it's own time unless a new time is entered or if an IRIG-B signal is input in which case it will automatically update using the IRIG-B signal.

IRIG-B

The PDR-2000 comes equipped with a BNC connector to receive a standard modulated IRIG-B input from a GPS clock. It is necessary to enter the year manually when first installing the unit or when replacing the clock's battery. The battery powers the clock when the main system power is turned off or lost.

The internal clock automatically tries to update from the IRIG-B signal at Power On. If the signal should cease, the internal clock will maintain the time until a new time is entered manually or the GPS signal resumes, in which case it will automatically update.

Section 8 SPECIFICATIONS

This section describes the physical and electrical specifications of the individual modules and the unit as a whole.

Figure 8-1 depicts the typical module locations and Table 8-1 describes the modules and indicates the section where the complete module write up can be found in this manual.
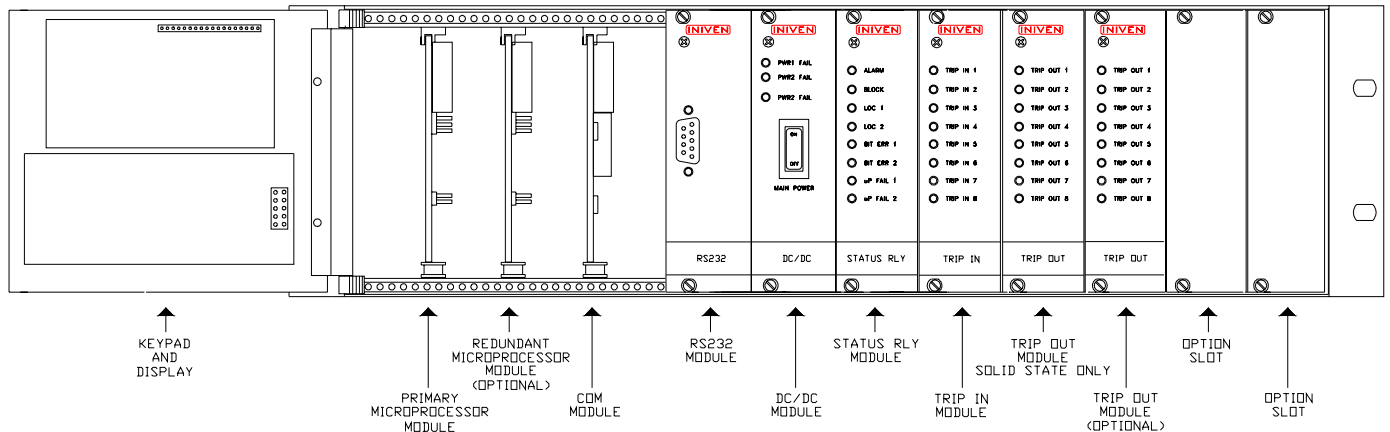

Figure 8-1. Module Locations (shown with Display module door open)

Location	Section	Description
Keypad and Display	3 and 16	Used to program and test the unit, also displays Trip, Guard, Block, Unit ID number, and time
Primary uP Module	9	Controls all functions and stores events
Redundant uP Module	9	Backs up all functions of primary uP module other then run Keypad and Display
Com Module	10	Has protocols for and interfaces with Com ports
RS-232	11	Has protocols for and interfaces with RS-232 ports and IRIG-B
DC/DC Module	12	DC power supply, interfaces with DC converters, has fuses and relays
Status Relay Module	13	Eight status relays, six programmable for delay
Trip In Module	14	Eight optically isolated Trip input circuits
Trip Out Module SS only	15	Eight Optically isolated solid state Trip outputs
Trip Out Module	15	Eight Optically isolated Trip outputs that can be used as solid state or to drive dry contact relays
Option Slots	17	Used to house optional output modules

Table 8-1. Module Location Descriptions

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 DIELECTRIC 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
>>Audio, one or two 4 wire 600 ohm
>>>Terminal blocks

RFI SUSCEPTIBILITY:
>ANSI C37.90.2 (35V / M)
>IEC 255-22-3

STANDARD MODULES

MICROPROCESSOR MODULE:
>Programmable for:
>>TX trip hold time, 0-50 ms
>>B Contact Key time, 0-1260 ms
>>RX trip hold time, 0-100 ms
>>Pre-trip timer, 0-10 ms
>>Guard before Trip, 0-1000 ms
>>Latching time, 0-5000 ms
>>Status relay delay, 1-30 sec
>>Prog relay latch, 0-42 sec
>>Auto Ping/Timeout delay 500 ms
>>Trip output logic
>>Unit ID
>>Packet Forwarding
>>Synchronous clocking
>>Com port activation
>Event Recorder:
>>40,000 events before rewriting
>>Nonvolatile memory
>Diagnostics:
>>Ping Test
>>Auto Ping Test
>>Programmable Status relays
>>Manual Trip generation
>Memo:
>>4KB
>>Nonvolatile memory
>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 (C37.94)
>G.703 (56/64 Kbps)
>Audio (0-4000 Hz)

RS-232 MODULE:
>IRIG-B modulated 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 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 Programmable alarms
1 Microprocessor Fail
1 Unit ID Off
Max contact rating, 10 A
Max break rating, 0.5 A @ 125 VDC
Max contact voltage, 300 VDC

TRIP IN MODULE:
8 inputs, optically isolated
Current draw: 10 ma @125 VDC

TRIP OUT MODULE:
8 solid state outputs,
optically isolated
Max voltage, 300 VDC
Contact rating:
1 A, 2 A for 1 min
2 per chassis max

DC MODULE:
Dual version
2 input fuses per DC input
1 output fuse per DC input
2 relays, power fail

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
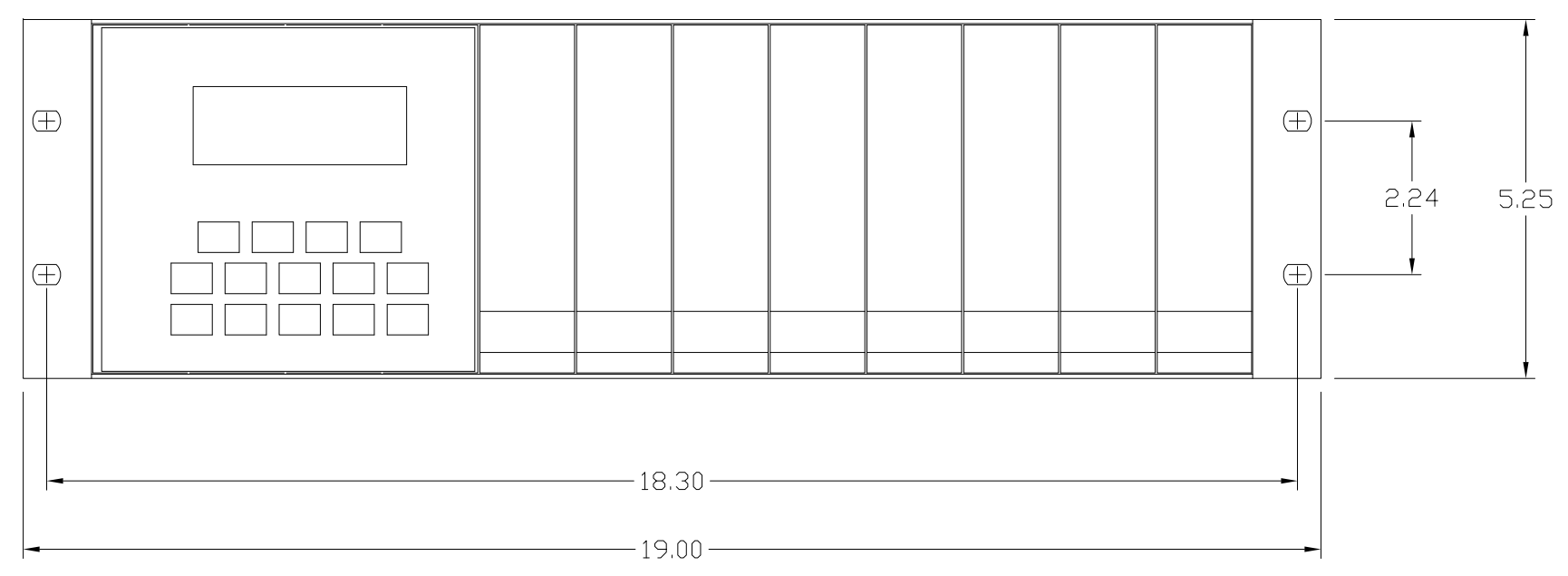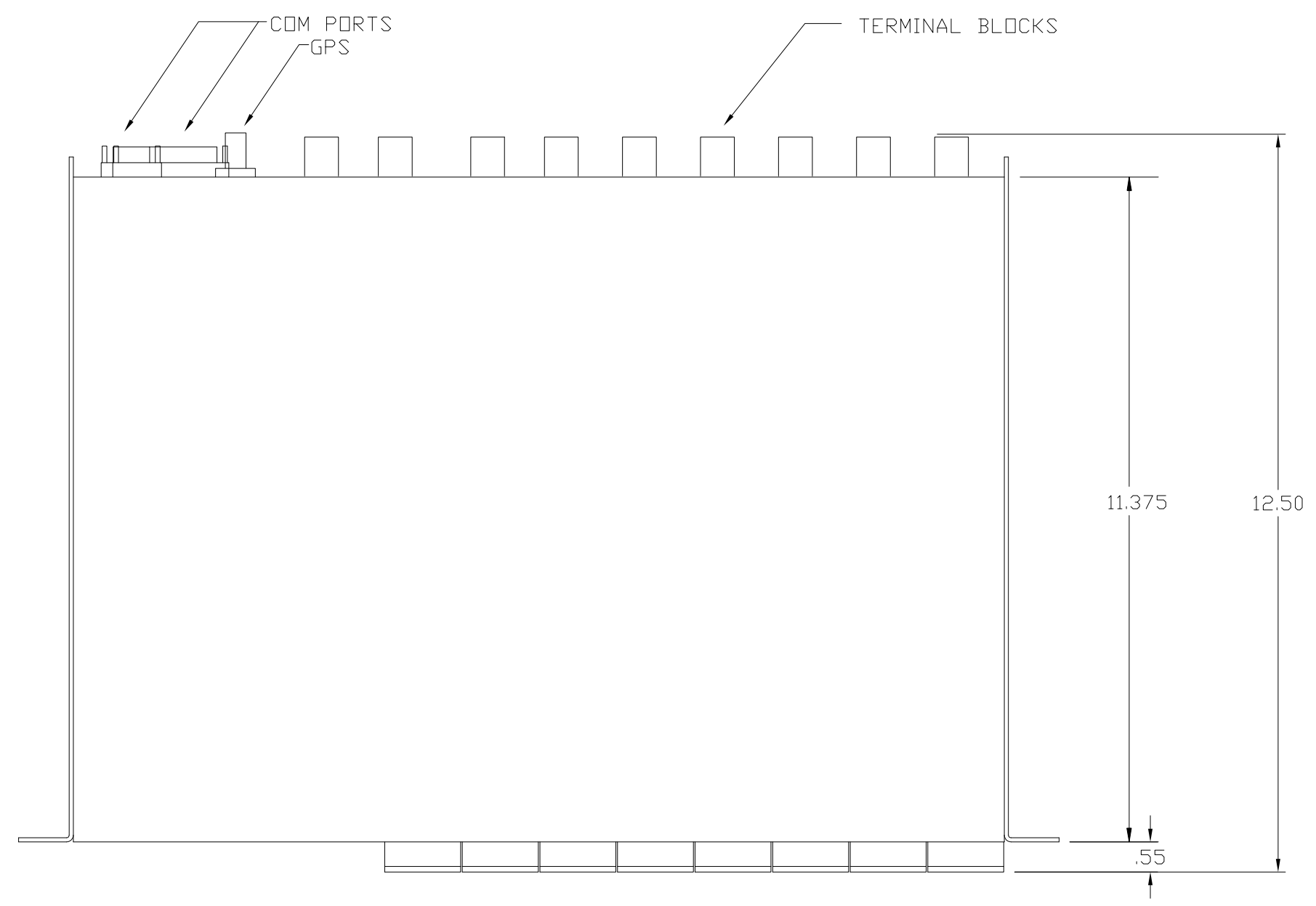Max break rating, 10 A @ 250 VDC
2 per chassis max

CUT-OUT SWITCH MODULE
Air gap switch for:
All Trip outputs
Trip In module circuit
uP module Trip In shutoff
command

COM PORTS
GPS
TERMINAL BLOCKS

11.375
12.50
.55

2.24
5.25

18.30
19.00

JP3 ——

JP4

Figure 9-1. Controls and Indicators, uP Module

Circuit Symbol	Description Marking	Functional Description
JP3	Connector	Connects to Keypad via ribbon cable
JP4	Connector	Connects to Display via ribbon cable

Table 9-1. Controls and Indicators Description, uP Module

DESCRIPTION

The Microprocessor module (uP module) controls all the functions of the PDR-2000. The module has the interfaces and controllers for the Keypad and Display. It runs the software for the Firmware and settings that control the operations of the entire chassis. The event recorder and Flash memory reside on this module as well. The uP module also generates and receives all digital communications, synchronous and asynchronous.

The PDR-2000 is capable of running a primary uP module, or primary and redundant uP modules simultaneously. The primary is connected to the keypad and display. If the primary uP should fail, it is detected by the redundant module and protection is continued uninterrupted. The display will turn off but the unit continues to function. The Status Relay module contains the uP module failure relay.

The uP module(s) are located behind the keypad and display in the first two slots on the left, the primary on the left and the redundant on the right.

THEORY OF OPERATION

HARDWARE

The system contains a soft-core processor running at 100 Mhz. The processor resides internally within the FPGA. The main system components are:

    1) Flash Memory
    2) SDRAM
    3) Altera FPGA
    4) Real-Time Clock
    5) Ethernet

FLASH MEMORY

The flash memory is used to store both the system executable code, as well as, settings and event storage. The system code occupy the first 40 blocks of the flash memory and can be reprogrammed while in system. The following blocks store the events and are constantly updated while the system is running. The flash memory is mapped into the processor address space at 0x400000.

SDRAM

The SDRAM is used as temporary storage for the system variables. At boot-up the code is loaded from the flash into the SDRAM to enhance execution performance.

ALTERA FPGA

The Altera FPGA is used to communicate with all other external peripherals including:

    1) Trip Inputs
    2) Trip Outputs
    3) IRIG-B
    4) Synchronous Ports
    5) Asynchronous Ports
    6) Display
    7) Keypad
    8) Redundancy Checking

The FPGA is loaded via a serial EPROM (EPCS1) which contains the Altera Firmware.

TRIP INPUTS

The Trip inputs are fed to the Altera via the rear connector. The processor can read the state of the input Trips via a predefined register.

TRIP OUTPUTS

The Altera asserts the appropriate Trip outputs when the Trip output register is written to by the processor.

SYNCHRONOUS AND ASYNCHRONOUS PORTS

The Altera contains 4 USARTS which can be configured by the processor for the appropriate mode of operation and baud rate. Each USART contains a 128 byte transmit and a 128 byte receive buffer.

KEYPAD

The keypad is a matrix type keypad with 4 drive lines and 6 scan lines. The Altera is responsible for controlling the drive lines and reading the scan lines. The processor then in turn queries the Altera and decodes the appropriate key.

REDUNDANCY CHECKING

The system configured to be the slave system monitors the ALIVE signal to ensure that the master(or primary) is running. During this mode of operation the Altera prevents all outputs and only the inputs are monitored. If the ALIVE signal is no longer received the Altera switches to master mode and notifies the processor via a register. The ALIVE signal is not generated if the primary microprocessor module should lose power or if the watchdog timer built into the FPGA discovers any of the internal processes have ceased.

ETHERNET

Optional for further expansion.

SOFTWARE

The system uses Real Time Operating System (RTOS) to support a number of processes which control various aspects of the system. The RTOS supports task prioritizing in order to ensure timely responses to outside data. In the event of a memory corruption, the Operating System can detect and restart the unit.

The following is a list of the system Tasks:

1. Keypad and Display I/O
2. Bi-directional communication of RS-232 and Com ports (4 total)
3. Check incoming packet from Com Port 1 and place in receive buffer
4. Check incoming packet from Com Port 2 and place in receive buffer
5. Check incoming packet from DCE RS-232 port and place in receive buffer
6. Check incoming packet from DTE RS-232 port and place in receive buffer
7. Read Com Port 1 receive buffer and initiate action
8. Read Com Port 2 receive buffer and initiate action
9. Read DCE RS-232 port receive buffer and initiate action
10. Read DTE RS-232 port receive buffer and initiate action
11. Check Alarm times
12. Turn Alarm On/Off
13. Record events in Flash
14. Rewrite settings to Flash (if commanded)
15. Update clock using IRIG-B input signal
16. Transmit packet types other then Type A (Trip/Guard) packets

CONNECTIONS

The uP module connects to the Keypad and Display via ribbon cables. The devices receive power and instructions from the uP module. The primary uP module is connected to the Keypad and Display as shown in figure 9-2. The ribbon cables are keyed and latch into position. The latch must be firmly pressed to release the ribbon cable.
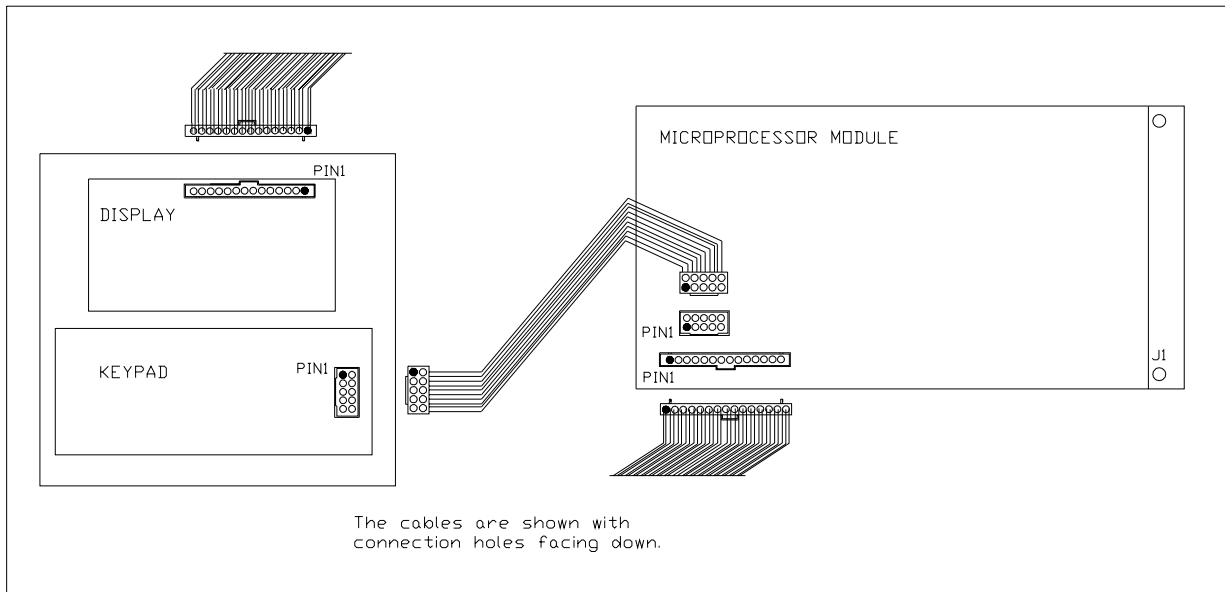

Figure 9-2. Microprocessor/Front Panel Ribbon Cable Connections

REDUNDANT uP MODULE

As an option, the PDR-2000 can be equipped with a redundant uP module. The redundant uP module is to the right of the primary module in the chassis. The two modules are identical boards. If a redundant uP module is used it must be programmed and installed separately.

When programming a PDR-2000 with two uP modules, both modules need to be programmed individually from the primary slot. It is not necessary to attach the ribbon cable to program the uP module using the GUI. Program the redundant module. Turn off the power. Remove the redundant module. Insert a jumper on pins 1 and 3 of the keypad connector of the redundant microprocessor. Insert the primary and redundant uP module. Turn the power on and program the second module with the same or different settings. Power off the unit and insert both modules. Be sure to place the primary module on the left slot and connect the ribbon cables. When the unit is on and both modules are operational, the primary uP module performs all functions but both modules record all events. In the case of a uP module failure, the Status relay (uP Fail) will close and the remaining module will stamp the event and continue operating the unit without interruption. If the primary uP module should fail, the Keypad and Display will stop functioning.

WATCH DOG TIMER

The uP modules contain a Watch Dog Timer that monitors all the processes that take place in the FPGA. If any of the processes should stop for any reason, the Watch Dog Timer will reinitialize the uP module. If a redundant uP module is used, the primary uP module will attempt to reinitialize while the redundant uP module assumes the microprocessing duties.

Table 9-2. Replaceable Parts, uP Module (CC2264)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1-7, 9-14, 16-18, 21, 23-26, 29-39, 43-48, 51, 56, 57, 60-62, 68, 69	Capacitor, ceramic .1uF, 16V, +/-20%	CCS-X7R-D-104-M
C8, 19, 22	Capacitor, tantalum, 100uF, 16V, +/-20%	EPCOS16V107M
C15	Capacitor, ceramic 100pF, 16V, +/-20%	CCS-X7R-D-101-M
C20	Capacitor, tantalum 10uF, 16V, +/-20%	EPC0S16V106M
C27, 28, 40-42, 53	Capacitor, ceramic 1uF, 16V, +/-20%	CCS-X7R-D-105-M
C49, 70	Capacitor, ceramic .01uF, 16V, +/-20%	CCS-X7R-D-103-M
C50, 52, 54, 55, 58, 59, 65-67	Capacitor, ceramic .001uF, 16V, +/-20%	CCS-X7R-D-102-M
C63, 64	Capacitor, ceramic 33pF, 16V, +/-20%	CCS-X7R-D-330-M
RESISTORS:		
R1	Resistor, 18K, 1/8W, +/-1%	SMF-0805-05-1802F
R2	Resistor, 100K, 1/8W, +/-1%	SMF-0805-05-1003F
R3, 4	Resistor, 2.2K, 1/8W, +/-1%	SMF-0805-05-2201F
R5	Resistor, 180ohm, 1/8W, +/-1%	SMF-0805-05-1800F
R6	Resistor, 27K, 1/8W, +/-1%	SMF-0805-05-2702F
R7, 8, 15, 16	Resistor, 24.9ohm, 1/8W, +/-1%	SMF-0805-05-24R9F
R9	Resistor, 11K, 1/8W, +/-1%	SMF-0805-05-1102F
R10, 13	Resistor, 49.9ohm, 1/8W, +/-1%	SMF-0805-05-49R9F
R11, 12	Resistor, 10K, 1/8W, +/-1%	SMF-0805-05-1002F
R14	Resistor, 330ohm, 1/8W, +/-1%	SMF-0805-05-3300F
R17	Resistor, 2.21K, 1/8W, +/-1%	SMF-0805-05-2211F
RP1, 2	Resistor, pack, 10K, 5%	SRP-750-101-R103J
RP3	Resistor, pack, 180ohm, 5%	SRP-750-101-R181J
RP7-9	Resistor, pack, 33ohm, 5%	SRP-750-101-R330J
SEMICONDUCTORS:		
D1	Diode	BAS70-05
D2-4	LED	SML-LXT0805GW-TR
D6	Diode	1N4001SM
L1	Filter, digital noise	P9878CT-ND
Q1	Transistor	2N7002CT
U1	SD RAM	MT48LC4M32B2TG-7
U2	Regulator	MIC29512BT

Table 9-2. Replaceable Parts, uP Module (CC2264), Continued

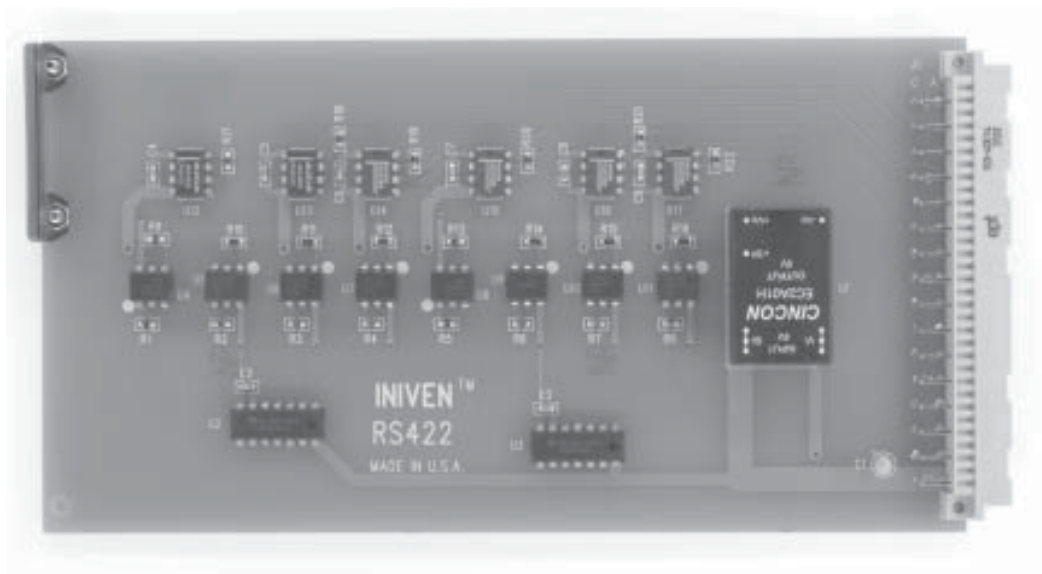| Circuit Symbol	Description	INIVEN Part Number
SEMICONDUCTORS :		
U3	Serial Flash	M25P40-VMN6
U4	3.3V Regulator	MIC29510-3.3BT
U5	Clock	DS1337
U6	Programmable Logic Device	EP1C12F324C6
U9	Flash	AM29LV320D
U11, 12	3.3V to 5V converter	PI5C3384
MISCELLANEOUS COMPONENTS:		
BT1	Battery, 3.6V	BR1225-1HC
Y1	Crystal, 32.768KHz	CA-30132.7680M-C

Figure 10-1. Com Module - RS-422

DESCRIPTION

The Com module controls the interface between the two Com ports located on the rear of the chassis and the uP module. The Com module must match the Com ports. This instruction sheet describes the RS-422 Com module that communicates through a pair of RS-449 ports. This module is designed to interface with one or two 64 Kbps slots of a DS0 channel. The transceiver chips are rated to withstand 15 KV of ESD. The optoisolators provide 5 KV isolation from input to output.

THEORY OF OPERATION

Each Com circuit consists of 1 transmit, 1 receive, 1 transmit timing and 1 receive timing circuit. The transmit circuit performs the following function: data is input to a U2A, a Schmidt trigger, it is then inverted and fed through a resistor to U4, an optoisolator. The signal is then input to U12, an RS-422 transceiver, and converted to RS-422 levels. The receive, transmit timing and receive timing circuits all perform the same function but in the reverse direction.
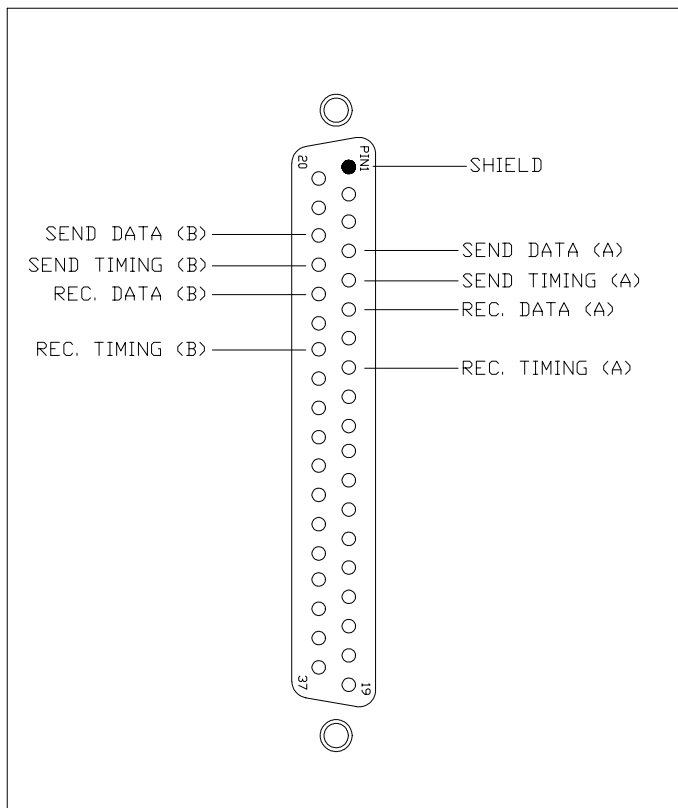
Figure 10-2. RS-449 Pin Drawing

Table 10-1. Replaceable Parts, Communications Module, RS-422 (CC2250)

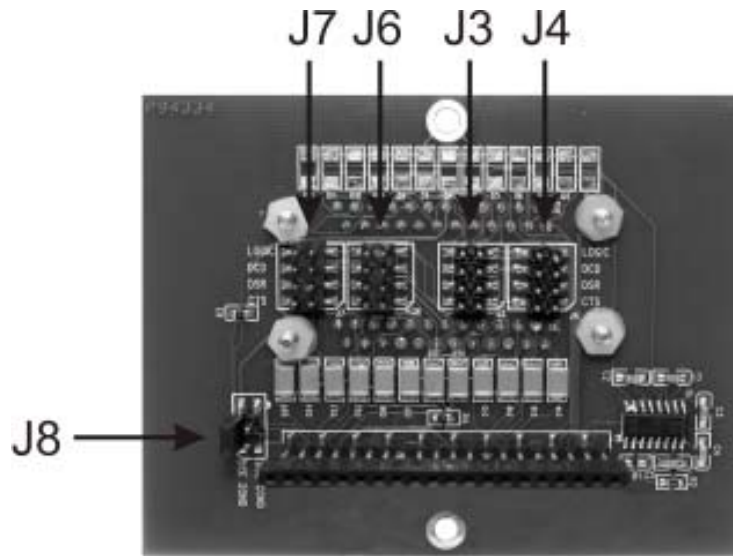| Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1	Capacitor, tantalum, 4.7 uF, 35V, +-/10%	DT35V475K
RESISTORS:		
R1, 5	Resistor, carbon, 560ohm , 1/8W, +/-5%	SCF-1206-05-561J
R2,3, 4, 6, 7, 8	Resistor, metal, 2K, 1/10W, +/-1%	SMF-0805-03-2001F
R9, 13	Resistor, carbon, 5.6K, 1/10W, +/-5%	SCF-0805-03-562J
R10, 11, 12, 14, 15, 16	Resistor, carbon, 430ohm, 1/8W, +/-5%	SCF-1206-05-431J
R17-22	Resistor, metal, 120ohm, 1/8W, +/-1%	SMF-0805-05-1200F
SEMICONDUCTORS:		
U1	DC to DC Converter	EC2A01H
U2, 3	Hex Inverter	MM74HC04N
U4-11	Opto-Isolator	H11N2
U12-17	Transceiver	MAX488ECPA

Section 10.1 COMMUNICATIONS I/O MODULE - V.35/RS-530

Figure 10.1-1. V.35/RS-530 Module

Circuit Symbol	Description Marking	Functional Description
J3	Jumper	Selects DTR Control for Com Port 1
J4	Jumper	Selects RTS Control for Com Port 1
J6	Jumper	Selects DTR Control for Com Port 2
J7	Jumper	Selects RTS Control for Com Port 2
J8	Jumper	Selects Ground

Table 10.1-1. V.35/RS-530 Module Controls and Indicators

DESCRIPTION

The Communication I/O module is the physical connection on the back of the chassis. The Communications I/O module acts as the interface between external wiring and the Communications module. The dual V.35/RS-530 contains interface has two 25 pin D-sub RS-530 Interface connectors with associated circuitry. This module is used in conjunction with the RS-422 Com module. An optional external interface cable can provide the conversion between RS-530 and V.35. These two standards share the identical data, timing and control signals. The performance and voltage isolation specifications for the RS-422 Com module apply to this interface.

To operate the RS-422 Com module with a V.35 or RS-530 protocol the V.35/ RS-530 Communication I/O module must be used. Depending on the requirements of the DCE equipment being used there are several jumper settings on the I/O module that may be changed. Each communication port may be set differently. To access the jumpers the Com I/O module needs to be removed from the chassis. For instructions on how to remove the Com I/O module, see Section 16, Chassis.

The jumpers, J3, J4, J6, and J7 are used to set the control signals from the DCE for each Com port. Each jumper can be set to Logic, DSR, CTS, or DCD. When set to Logic, the port outputs a constant logic 1 (on), on the DTR or RTS output. When the jumper is set to DSR, CTS, or DCD, the DTR or RTS outputs will mimic the input from the selected pin. See Table 10.1.1 for Jumper selection.

Jumper 8 is used to select the ground of the DCE. When the shunt is placed across the CGND pins, connector ground is selected. When SGND is selected, signal ground is used.

Figure 10.1-2. RS-530 Pin Drawing

THEORY OF OPERATION

The Com I/O module on the back of the chassis passes the data and timing signals between the Com board (RS-422) and the RS-530 connectors, but develops the DTE control signals locally. The DCE provides three control signals to the DTE: DSR (Data Set Ready), CTS (Clear To Send) and DCD (Data Carrier Detect). The Com I/O module can use any one of these or a locally developed logic "1' as a source to drive the DTE signals RTS (Request to Send) and DTR (Data Terminal Ready). The sources of the two signals for each of the two com ports are independently chosen using the four jumpers on four headers on the board. An additional jumper on the board is used to select whether local signal ground is connected to either the DCE signal ground or the RS530 shield ground.

JP3

JP1

Figure 10-1. G.703/C37.94 Module

Circuit Symbol	Description Marking	Functional Description
JP1	Jumper	Selects G.703 or C37.94 Protocol
JP3	Jumper	Selects G.703, C37.94, and Point to Point or Multiplexed Communications

Table 10-1. G.703/C37.94 Module Controls and Indicators

DESCRIPTION

The Com module controls the interface between the two Com ports located on the rear of the chassis and the uP module. The Com module's protocol setting must match the Com ports. This instruction sheet describes the G.703/C37.94/Fiber Optic Com module that communicates through a pair of 25 pin D-sub ports for G.703 or fiber optic interfaces for C37.94 or point to point fiber optic communications. One of the three protocols are selected using jumpers on JP1 and JP3.

To operate using the G.703 protocol, the six jumpers on JP1 should be inserted between the center pins and the row of pins indicated by the marking "G.703". A jumper on JP3 should be inserted in the first position on the left strapping the dual row connector indicated by the "G.703" marking. In normal operation (communications through another device, i.e a multiplexer) the second jumper is inserted in the "SHORT" position. If two PDR-2000's are wired directly together using the G.703 protocol, one unit must be set in the "LONG" position and the other unit is strapped in the "SHORT" position. If units are in a string, a "LONG" unit talks to a "SHORT" unit which in turn talks to a "LONG" unit.

For operation using the C.37.94 protocol, the six jumpers on JP1 strap the center row of pins and the row indicated by the "C37.94" marking. JP3 requires two jumpers. One should strap the two rows in the second position from the left, indicated by the marking "C37.94". A second jumper needs to strap

the two rows in the third position from the left on JP3 indicated by the "SHORT" marking.
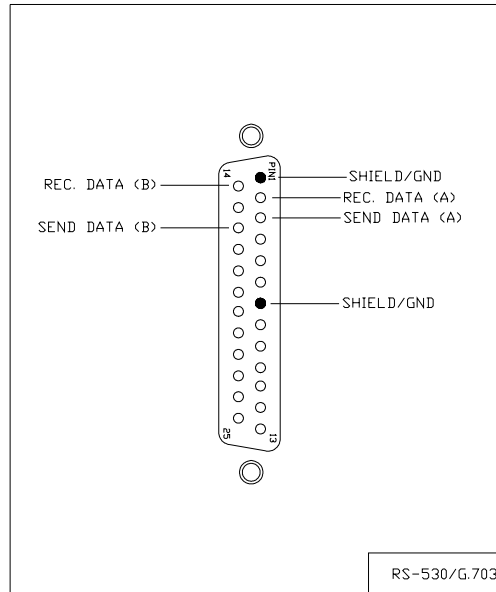

Figure 10-2. G.703 Pin Drawing

For point to point fiber optic operation set the JP1 jumpers the same as C37.94. JP3 requires two jumpers. The first should strap the two rows in the second position from the left, indicated by the marking "C37.94". On one unit the second jumper must be set in the "LONG" position and the remote unit is strapped in the "SHORT" position. If units are in a string, a "LONG" unit talks to a "SHORT" unit which in turn talks to a "LONG" unit.

THEORY OF OPERATION

G.703

In G.703 mode, the board provides two 64 Kb interface channels between the processor board and two electrical 25 pin D-sub connectors on the rear of the chassis. Each channel consists of a conversion from the microprocessor output to G.703 protocol and from G.703 to the microprocessor input. Both communication channels operate independently and have seperate microprocessor I/O's.

Output signals from the microprocessor module are clocked into the Com module and converted to the self-synchronized format of G.703 inside the Altera FPGA. There are two FPGA outputs for each channel, one for positive pulses and one for negative pulses. These are transistor amplified and applied to opposite ends of a transformer primary in order to provide an isolated, balanced G.703 output.

Input signals from each G.703 interface are transformer coupled to generate two single ended data streams: one for positive pulses and one for negative pulses. These are rectified and amplified to LVTTL levels and sent to the FPGA where they are decoded into a LVTTL pulse stream. The outputs are sent to the microprocessor module at 64 Kbps.

C37.94

In C37.94 mode, the board provides two 64 Kb(n x 1) interface channels between the processor board and four 850 nm multimode fiber heads(2 transmit and 2 receive) on the rear of the chassis. Each channel consists of a conversion from the microprocessor output to C37.94 protocol and from C37.94
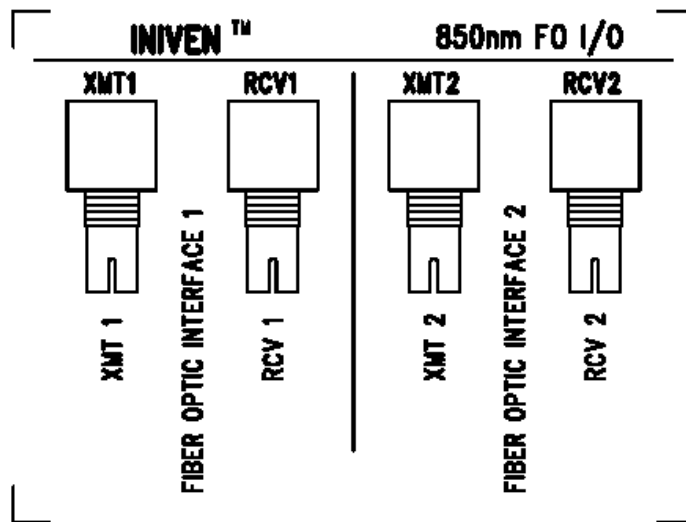
Figure 10-3. C37.94 Fiber Interface Drawing

to the microprocessor input. Both communication channels operate independently and have seperate microprocessor I/O's.

Output signals from the microprocessor module are clocked into the Com module and converted to the self-synchronized C37.94 format inside the Altera FPGA. The resulting signal is sent to the fiber optic interface module on the rear panel of the PDR-2000 where the electrical signal to optical conversion takes place.

Input signals from each fiberoptic interface are sampled by the FPGA on the Com module and converted to a bit stream. The result is output to the microprocessor module at 64 Kbps.

POINT TO POINT FIBER OPTICS

The PDR-2000 uses a modified version of the C37.94 protocol that does not require synchronization from a multiplexer. By employing the same method as the C37.94 protocol but using the crystal oscillator located on the Com module, two PDR-2000's can be connected directly.

Any type of fiber optic heads may be used with this protocol: 850 multimode, 1310 multimode, 1310 singlemode, or 1550 singlemode. Both LED and laser transmitters are available and supplied according to the customer's requirements.

Whether using G.703 or C37.94, data is sent to both Com ports simultaniously and "broadcast". Received data is treated independently. The failure of one Com port or the communication line connected to that port is diagnosed seperately from the other and does not effect the operation of the other.

Both G.703 and point to point fiber formats provide their own timing signals, allowing for a loop back test. Either a fiber optic loop back cable or a G.703 loop back test header(available from Iniven) should be used to perform a true loop back test.

When performing a loop back test, the Unit ID feature must be turned Off in order for the unit to be able to Trip itself. By turning the Unit ID Off, the receive logic ignores the Unit ID number assigned to each input and will follow the rest of the programmed logic allowing the unit to Trip itself. It is important to remember to turn Unit ID On before putting the unit back into service. The Unit ID Off alarm on the Status Relay module will be activated when Unit ID is turned Off.

Table 10-1. Replaceable Parts, Communications Module, G.703/Fiber (CC2272)

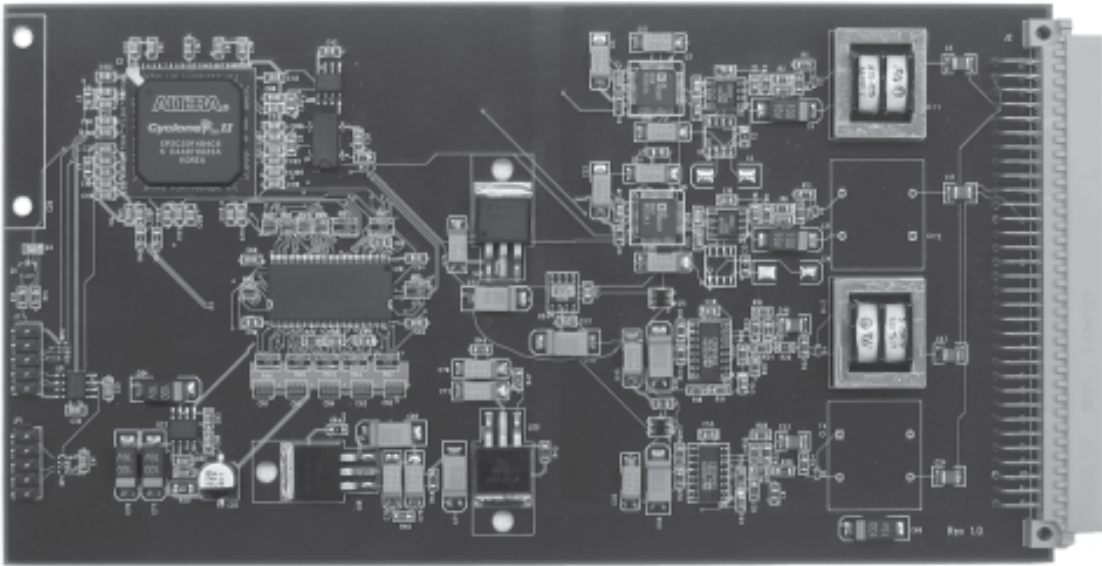| Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1, 4, 7, 10-26, 28	Capacitor, ceramic .1uF, 16V, +/-20%	CCS-X7R-D-104-M
C2, 3, 8, 29, 30	Capacitor, tantalum, 100uF, 16V, +/-20%	EPCOS16V107M
C5, 9	Capacitor, tantalum, 22uF, 16V, +/-20%	EPCOS16V226M
C6	Capacitor, ceramic 1uF, 16V, +/-20%	CCS-X7R-D-105-M
C27	Capacitor, tantalum 10uF, 16V, +/-20%	EPC0S16V106M
C31	Capacitor, ceramic 100pF, 16V, +/-20%	CCS-X7R-D-101-M
RESISTORS:		
R1, 4, 5, 7, 13, 16, 17, 19	Resistor, 10K, 1/8W, +/-1%	SMF-0805-05-1002F
R2, 14	Resistor, 270ohm, 1/8W, +/-1%	SMF-0805-05-2700F
R3, 10, 15, 22	Resistor, 1K, 1/8W, +/-1%	SMF-0805-05-1001F
R6, 8, 18, 20	Resistor, 39K, 1/8W, +/-1%	SMF-0805-05-3902F
R9, 12, 21, 24, 31-38	Resistor, 2.7K, 1/8W, +/-1%	SMF-0805-05-2701F
R11, 23, 27	Resistor, 180ohm, 1/8W, +/-1%	SMF-0805-05-1800F
R28	Resistor, 27K, 1/8W, +/-1%	SMF-0805-05-2702F
R29	Resistor, 18K, 1/8W, +/-1%	SMF-0805-05-1802F
R30	Resistor, 100K, 1/8W, +/-1%	SMF-0805-05-1003F
RP1, 2	Resistor, pack, 10K, 5%	SRP-750-101-R103J
SEMICONDUCTORS:		
D1-4	Diode	MMBD914LT1
D5	LED	SML-LXT0805GW-TR
L1, 2	Filter, digital noise	P9878CT-ND
U1, 2	Op Amp	AD8032AR
U4	Crystal oscillator, 20MHz	SG-636PCE
U5	Programmable Logic Device	EP1C3T144
U6	Serial Flash	M25P40-VMN6
U7	3.3V Regulator	MIC29510-3.3BT
U8	Regulator	MIC29512BT
MISCELLANEOUS COMPONENTS:		
T1, 3	Transformer	CC2269-00
T2, 4	Transformer	CC2270-00

Figure 10-1. Analog Modem Module

DESCRIPTION

The Com module controls the interface between the Com Interface module located on the rear of the chassis and the uP module. The Com module's protocol setting must match the Com Interface module. This instruction sheet describes the Audio Communications module that communicates through terminal blocks to a 4 wire audio line with 600 ohm impedance. This module is used where traditionally a FSK (Frequency Shift Keyed) system would have been employed. The standard frequency range of the Analog Modem module is 300 to 3240 Hz.

The Audio Communications module uses an OFDM protocol at 6.6 Kbaud to transmit the PDR-2000's digital signal over any 4 wire voice grade audio circuit. The module uses multiple streams of data at different frequencies to assure proper transmission of data even in the presence of noise. The use of error correcting codes further enhances the modules ability to operate in the presence of noise.

By using a digital signal instead of a traditional FSK signal, the PDR-2000 can take advantage of the full 8 channel tripping capacity and increase security well beyond the ability of FSK terminals. Typical trip times are 14 ms.

THEORY OF OPERATION

The Modem uses OFDM to transmit digital data over an analog line. Each OFDM channel utilizes a coherently demodulated PSK signal. The use of OFDM techniques minimizes on both Inter symbol interference as well as nonlinearities in the signal path. Pilot tones within the OFDM structure are used to synchronize the receiver to the transmitter for both symbol and carrier frequency offset.

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Figure 10-2. Security and Dependability Charts

Modulator

The modulator receives 32 bits of data from the input channel. The 8 bit header used by the PDR-2000 with digital interfaces is not required since the syncronosation is performed by the analog signal. The data is then scrambled and an additional 8 bit error correcting code is appended. This data is then used to create a single OFDM frame, utilizing an FFT algorithm. The output of the FFT is then recreated using a transformer coupled Digital to Analog Converter. The output level can be configured using settings controlled on the front display panel and keyboard.

Demodulator

The input signal is first digitized using a 16bit transformer coupled Analog to Digital converter. This minimizes any requirements for manual gain adjustments.

The demodulator synchronizes on the input data stream and checks for the validity of the pilot tones. If the pilot tone is of proper power and the receiver is synchronized, the demodulator performs an inverse FFT on the input OFDM symbol and demaps the data into a digital bit-stream.

Security and Dependability

The Analog Communications module uses a technique that allows the data stream to pass a large amount of data over an analog phone line quickly with the highest levels of security, by utilizing the entire bandwidth of the line to send data. The normal operating range is 300 to 3280 Hz. The bandwidth is broken down into 22 sub-channels of approximately 140Hz bandwidth each. 20 of the sub-channels transmit 2 bits each and 2 sub-channels are pilot tones. Because the data is sent in such small sub-channels, line rolloff has minimal effect on the data and therefore a wider bandwidth can be used. Rolloff in excess of 12 dB can be tolerated in the operating range. Of the 40 bits transmitted, 10 bits are data, 10 are CRC code and 20 are Reed-Soloman error correction code. The use of Reed-Soloman error correction code to correct any flipped or lost bits due to noise provides dependability similar to a FSK system, and when combined with the CRC code offers security far greater.

Settings

There is one additional setting for the Audio Communications module compared to the digital communications modules. There are several settings that must be turned off, modified, or used with care when using this module.

The only additional setting when using this module is the transmit ouput level. This setting can only be changed using the front display panel, located in the System Settings section, see Section 3, On Board programming for details. The transmitter level can be set from -1 to -20 dBm. The receive input level does not need to be adjusted.

Several settings are used differently for this module. Packet Forwarding should not be used at all when using an audio channel. Due to the slower channel speeds there is not sufficient bandwidth to support the extra data required of Packet Forwarding and therefore it must be turned Off. The Unit ID is still used but due to bandwidth restrictions only Unit ID number 01, 02, and 03 are available. Since Packet Forwarding is not available, more then 3 Unit ID numbers is not required. It is important not to use a Unit ID number other then 1 to 3 because the system will not recognize the numbers and therefore not operate properly.

Point to point communications of data other then trip and guard information is available but is considerably slower then that of the digital communication interfaces. This is due to the way these packets are transmitted, see Section 2, Digital Communications for more details. Therefore, Ping Tests are not an accurate measure of the channel speed and will double the trip times on the channel to 20 to 24 ms. Auto Ping Test settings will have to be considered when programming an unit with an Audio Communications module. Using Auto Ping Test too often will slow the trip channel and is not advised. If the Ping Test Fail alarm is used, the alarm time will have to be programmed with the additional delays in mind. All other settings are the same.

Figure 11-1. Controls and Indicators, RS-232 Module

Circuit Symbol	Description Marking	Functional Description
J2	DB9 connector	9 pin DCE RS-232 port

Table 11-1. Controls and Indicators Description, RS-232 Module

DESCRIPTION

The RS-232 module consists of three sections:

1. Handles the conversion of asynchronous communication packets of the uP module to the electrical RS-232 standards of the DCE port located on the front panel of the module and vice versa.

2. Handles the conversion of asynchronous communication packets of the uP module to the electrical RS-232 standards of the DTE port located on the rear of the chassis and vice versa.

3. Converts the IRIG-B signal input from the BNC connector on the rear of the chassis to a digital format before passing the signal on to the uP module.

All three sections of the RS-232 module are independently isolated for 5000 V.

THEORY OF OPERATION

DCE PORT

The TD circuit (Transmit Data) takes the digital data input on J1 pin 18A and inverted by U2C and drives optoisolator U4. The output of U4 drives U7, which converts the signal to RS-232 voltage levels. The RS-232 signal is output at the DB9 DCE port located on the front of the module. The RD circuit (Receive Data) reverses the process of the TD circuit, taking the RS-232 voltage levels from the DB9 connector and converts them to 0-5 V that are fed to the uP module. The supply voltage and I/O's in this section of the RS-232 module are isolated for SWC and ESD protection.

Figure 11-2. DCE Pin location

DTE PORT

The TD and RD circuits in this section of the RS-232 module are identical to the DCE circuits other then the pin location and the DB9 connecter that interfaces with this circuit is located on the rear of the chassis and is male. The DTE pin configuration can be found on Figure 11-3. The supply voltage and I/O's in this section of the RS-232 module are isolated for SWC and ESD protection.

IRIG-B

The IRIG-B circuit of the RS-232 module receives a signal from the BNC connector located on the rear of the chassis and inputs it to a one to one isolation transformer. The signal is then rectified and fed through a 3 pole Bessel low pass filter to reduce ripple. The output of the filter equals 0 for voltages less than 1 V or 1 for voltages greater than 3 V. The IRIG-B circuit is also protected for SWC and ESD.

Figure 11-3. DTE Pin Location

Table 11-2. Replaceable Parts, RS-232 Module (CC2251)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1	Capacitor, tantalum, 4.7 uF, 35V, +-/10%	DT35V475K
C2-7, 11-28	Capacitor, ceramic, .1uF, 50V, +/-10%	CCS-X7R-D-104-K
C8, 9	Capacitor, ceramic, 1800pF, 50V, +/-10%	CCS-X7R-D-182-K
C10	Capacitor, ceramic, 3300pF, 50V, +/-10%	CCS-X7R-D-332-K
RESISTORS:		
R1, 17, 19, 21, 22, 23	Resistor, metal, 2K, 1/10W, +/-1%	SMF-0805-03-2001F
R2, 16, 18, 20	Resistor, carbon, 560ohm, 1/8W, +/-5%	SCF-1206-05-561J
R5, 25, 27, 29, 30, 31	Resistor, carbon, 430ohm, 1/8W, +/-5%	SCF-1206-05-431J
R6, 24, 26, 28	Resistor, metal, 4.99K, 1/8W, +/-1%	SMF-0805-05-4991F
R7	Resistor, metal, 3.09K, 1/8W, +/-1%	SMF-0805-03-3091F
R8	Resistor, metal, 2.49K, 1/10W, +/-1%	SMF-0805-03-2491F
R9	Resistor, metal, 86.6K, 1/10W, +/-1%	SMF-0805-03-8662F
R10	Resistor, metal, 768K, 1/10W, +/-1%	SMF-0805-03-7684F
R11	Resistor, metal, 49.9K, 1/10W, +/-1%	SMF-0805-03-4992F
R12-14	Resistor, metal, 75K, 1/10W, +/-1%	SMF-0805-03-7502F
R15	Resistor, metal, 121K, 1/10W, +/-1%	SMF-0805-03-1214F
SEMICONDUCTORS:		
D1-4	Diode, switching	MMBD914LT1
U1, 8	DC to DC Converter	EC2A01H
U2, 6, 7	Hex inverting Schmitt-trigger	MM74HC14N
U3, 4, 9-16	Opto-Isolator	H11N2
U5, 17, 18, 19	Dual driver / receiver	LT1781CN
U20	Dual op-amp	OPA2241PA
MISCELLANEOUS COMPONENTS:		
T1	Transformer, modem	ATS-075

Section 12 DC/DC MODULE

Figure 12-1. Controls and Indicators, DC/DC Module

Circuit Symbol	Description Marking	Functional Description
F1	Input fuses	Input current protection, primary DC input
F3	Output fuse	Output current protection, primary DC converter
F4	Output fuse	Output current protection. redundant DC converter
F6	Input fuses	Input current protection, redundant DC input
SW1	Main power switch	Switch battery voltage into terminal
DS1	Power 1 On	Green LED indicates primary power supply is On
DS2	Power 2 On	Green LED indicates redundant power supply is On
DS3	Power	Green LED indicates main system power is On
PS1	Power Supply 1	Battery voltage to 5V DC-DC converter, primary
PS2	Power Supply 2	Battery voltage to 5V DC-DC converter, redundant

Table 12-1. Controls and Indicators Description, DC/DC Module

DESCRIPTION

The DC/DC module contains the redundant power supplies, fuses, DC power conditioning, and voltage protection for the PDR-2000. The station battery voltage(s) are input to the DC/DC module and converted by the corresponding DC converter (power supply) located on the board and then distributes the 5 V from the DC converter to the rest of the PDR-2000. The DC/DC module provides DC power conditioning from the station battery input and from the DC converter input. Both inputs are also fused on the module.

The DC/DC converter is normally equipped as a dual supply. Dual versions are capable of the same or different voltage inputs. Since the DC converters convert the station battery voltage, the voltage rating on the DC converters must match the station battery voltage.

The main power switch of the PDR-2000 is located on the front of the module.

THEORY OF OPERATION

DC POWER INPUT CONDITIONING

The station battery voltage is applied to the POWER IN terminal block on the rear of the chassis. The primary voltage is wired to POWER IN 1. The dual DC/DC module's redundant input is wired to POWER IN 2. Power is passed through the input fuse F1 (F6 for the redundant input). One or both fuses will blow if there is excess current draw within the unit. Diode D1 (D4 for redundant circuit) conducts if the polarity is reversed, blowing one or both fuses. Varistor VR1 (VR2 for redundant circuit) absorbs input surges. Switch SW1 serves as the main power switch to the entire unit. Common Mode transformers L1 and L4 and capacitors C1 and C2 (C7 and C8 for redundant circuit) filter transients.

Once the station battery voltage is conditioned, it is passed to DC converter PS1 (PS2 for redundant circuit).

DC POWER OUTPUT CONDITIONING

The DC converter converts the station battery voltage (24, 48, 125, or 250 VDC) to +5 V. It is then passed through F3 (F4 for the redundant circuit) and is filtered by inductor L2 (L5 for the redundant circuit) and capacitors C3, C4, and C11 (C5, C6, and C12 for the redundant circuit), then distributed to all the modules in the PDR-2000.

OVER VOLTAGE AND UNDER VOLTAGE DETECTION

The dual DC/DC module over voltage and under voltage detectors disable the faulty supply while providing notification to the processor board, deactivating the corresponding power fail status relay (K1 or K2), and turning off the LED (DS1 or DS2) of the disabled supply. Under voltage disables the circuits on the Trip Out module and Status Relay module. An under voltage condition causes the DC/DC module to turn off the DC converter until the voltage is back above 4.2 V. The DC converter will shut down if it senses its output is above 5.5 V.

Table 12-2. Replaceable Parts, DC/DC Module, Redundant (CC2242-01)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1, 8	Capacitor, metalized mylar, .1uF, 500 V, +-/5%	MPED2H104J
C2, 7	Capacitor, electrolytic, 22uF, 250V, -10+100%	ER250V226M
C3-6, 11, 12	Capacitor, ceramic, .1uF, 50V, +/-20%	CM-Z5U-D-104-M
RESISTORS:		
R1, 2	Resistor, carbon, 560ohm, 1/8W, +/-5%	SCF-1206-05-561J
R3, 5, 13, 14	Resistor, carbon, 1K 1/8W, +/-5%	SCF-1206-05-102J
R7, 9	Resistor, metal, 47K, 1/8W, +/-1%	SMF-0805-03-4702F
R8, 10	Resistor, metal, 464K, 1/8W, +/-1%	SMF-0805-05-4643F
R11, 12	Resistor, metal, 24.3K, 1/8W, +/-1%	SMF-0805-05-2432F
R15, 16	Resistor, metal, 1.5K, 1/8W, +/-1%	SMF-0805-05-1501F
R17, 18, 20, 21, 23	Resistor, carbon, 430ohm, 1/8W, +/-5%	SCF-1206-05-431J
R19, 22	Resistor, metal, 3.3K, 1/8W, +/-1%	SMF-0805-05-3301F
SEMICONDUCTORS:		
D1, 4	Diode	1N5404
D2, 3, 9, 10	Diode	1N4004
D7, 8	Diode, Schottky	95-SQ-015
DS1-3	LED, green	550-1306
U1, 2	Voltage protector, over/under, dual	ICL7665ACPA
U3, 4	Optomosfet	AQV210EH
Q1-4	Transistor, PNP	PZT2907ATI
MISCELLANEOUS COMPONENTS:		
F1, 6	Fuse, 3A	2AG3A
F3, 4	Fuse, 8A	2AG8A
K1, 2	Relay	JW1FENDC5V
L1, 4	Inductor	E3495A
L2, 5	Inductor, power	D03340P-103
L3, 6	Inductor, shielded	S1812-474K
VR1-2	Varistor, 130VAC	V130LA20B

Table 12-3. Replaceable Parts, DC Converter (CC2260)

Description	INIVEN Part Number
24 Volt DC to 5 Volt DC Converter with heatsink	CC2260-01
48 Volt DC to 5 Volt DC Converter with heatsink	CC2260-02
125 Volt DC to 5 Volt DC Converter with heatsink	CC2260-03
250 Volt DC to 5 Volt DC Converter with heatsink	CC2260-04

Figure 13-1. Controls and Indicators, Status Relay Module

Circuit Symbol	Description Marking	Functional Description
DS1	Indicator, Alarm	Lights when Alarm relay is activated
DS2	Indicator, Block	Lights when communications is blocked
DS3	Indicator, LOC 1	Lights when Com port 1 has lost communications
DS4	Indicator, LOC 2	Lights when Com port 2 has lost communications
DS5	Indicator, PROG 1	Lights when a programmable event has occured
DS6	Indicator, PROG 2	Lights when a programmable event has occured
DS7	Indicator, uP Fail	Lights when one of two uP modules fail
DS8	Indicator, Unit ID	Lights when Unit ID is turned Off
JP1 - JP8	Jumper	Changes Status Relay output from form A to form B

Table 13-1. Controls and Indicators Description, Status Relay Module

DESCRIPTION

The Status Relay module contains eight relays (Alarm, Block, 2 Loss of Communications, 2 programmable, Microprocessor Fail, and Unit ID Off) and eight relay driver circuits. The status relays drives external equipment when a change in system operation status is detected. Six of the relays are programmable for delay using the GUI or the keypad and display. All eight relays have jumpers to change the contact wiring from form A to form B.

RELAYS

ALARM: This relay is a general alarm. If any condition exists that would activate the other Status relays (other then the Unit ID Off alarm, Power Fail, or the Programmable alarms), the Alarm relay is energized. The Alarm relay is programmable for delay in 1.0 second intervals, see Section 5, Installation for programming details. The programmable delay for Alarm also delays the Event Recorder logging the alarm event by the same amount of time, see Section 7, Event Recording for more information.

BLOCK: When a condition occurs that causes a loss of data, the Block relay is energized. A loss of data occurs when expected packets have ceased or there are any blocks on an output logic setting. The Block alarm will not work properly for this function if Unit ID is turned Off. The Block alarm can also be triggered by an extended stream of bit errors (greater then 160 ms of bad packets), or internal power being out of range. Minor blocks, such as partial communications fail or timeout ID that will cause a B to appear on the front screen will also cause a Block alarm. It is possible to have a loss of communications on one port and not receive a Block alarm if redundant paths are used and all applicable packets for the programmed logic are still being received by the alternate path. In such a case the LOC relay would be activated. The Block relay is programmable for delay in 1.0 second intervals, see Section 5, Installation for programming details. The programmable delay for Block also delays the Event Recorder logging the Block alarm by the same amount of time, see Section 7, Event Recording for more information.

LOSS OF COMMUNICATIONS 1 and 2 (LOC 1, LOC 2): If no digital signal is received on Com port 1 (LOC 1) or Com port 2 (LOC 2), or BIT error is detected on one of the Com ports for more then 160 ms, the LOC relay is energized. Turning off the Com port using the GUI or keypad and display deactivates the corresponding relay. The LOC relays are programmable for delay in 0.5 sec intervals, see Section 5, Installation for programming details concerning relay delays and Com port On/Off.

PROGRAMMABLE ALARM 1 and 2 (Prog 1, Prog 2): These two alarms are independently programmed to activate when one of seven events is written by the Event Recorder. These events are BIT Error 1 and 2, Timeout ID, Invalid ID, Trip In, Ping Test Fail, and Trip Out. Since the relay is triggered by an event, it is a single pulse command that has no duration unless extended using the alarms' latching timers. Whatever duration the latch is set for will be the amount of time the relay and LED are activated for, regardless the duration of the event. When using the manual reset setting for the latching timer, if the condition that caused the alarm is still present (i.e. a steady Trip input for a Trip input alarm) when an operator resets the alarm, the relay and LED will alarm again until the condition is cleared.

> BIT Error: This event is written when one packet is detected to have an error BIT. After 1000 packets has been counted by the uP, the event is written and the relay is activated. Bit Error 1 corrisponds with Com port 1 and Bit Error 2 corrisponds with Com port 2.

> Timeout ID: If the receive logic for any of the Trip outputs is programmed with an Unit ID number whose packet is not received in the programmed period of time, the relay is activated. If the alarm is not programmed, the default time for the Event Recorder is 500 ms. Once a timeout has been detected for a particular unit ID number, it will not alarm again until the packets have been received from the timed out unit and then timed out again.

> Invalid ID: When the Unit ID feature is turned On and Packet Forwarding is turned Off, the relay is activated when a packet is received with an Unit ID number that does not match any of the Unit ID numbers programmed in the receive logic. The Invalid ID alarm will not reset until packets with the invalid unit ID number stops being received.

> Trip In: If any of the Trip input circuits are activated, the relay is activated.

Ping Test Fail: If a Ping test is generated either automatically or manually, and if it is not received by the originating unit in less time then the time programmed, the test is considered a failure and the relay is activated. The programmed time must allow for a round trip of the Ping test. Ping tests take longer then normal protection communication because of the lower priority Ping test packets have compared to Trip/Guard packets.

Trip Out: If any of the Trip output circuits are activated, the relay is activated.

MICROPROCESSOR FAIL (uP Fail): When a PDR-2000 is equipped with two uP modules, the uP Fail alarm indicates when one of the modules has stopped functioning. If the unit is only equipped with one uP module and it fails, all the relays will drop out. Typically a microprocessor failure with a single uP module will cause a flashing of all the alarms as the unit attempts to reinitialize itself. If all the relays stay on, the uP module will not reinitialize. The uP Fail relay is not programmable for delay.

UNIT ID OFF (Unit ID): When the Unit ID feature is turned Off, the alarm is activated. When Unit ID is turned On, the alarm is deactivated.

THEORY OF OPERATION

All eight relays are form C. The jumpers (JP1-JP8) allow the corresponding relays (RL1-RL8) to act as a normally open form A (jumper in the A-B position) or normally closed form B (jumper in the B-C position).

For normal system operation, all status relays are energized (pulled in). If a fault is detected, the uP module will command one or more of the relays to become de-energized (drop out). The status relays can not be pulled in unless the +5 V is within tolerance. If microprocessing ceases or a complete loss of power occurs, all the relays drop out.

The status relays are controlled by the uP module (Section 9, uP Module). Signals are fed to the input gates U1 - U4. When these input lines are pulled low, the gate output goes high, dropping out the relay it is controlling. An input of each gate is tied to a common bus. When this bus is pulled low, all status relays will drop out. When a status relay drops out, the corresponding front panel indicator (LED) illuminates, indicating the condition.

The circuit associated with Alarm relay K1 will be used as an example. Logic low on the Alarm input line would force the output of gate U1A high. This will place a high on both sides of K1's coil, causing it to drop out. When the relay drops out, the output of inverter U5A will go low, lighting Alarm indicator DS1.

Table 13-2. Replaceable Parts, Status Relay Module (CC2243)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1-4	Capacitor, ceramic, .1uF, 50V, +/-20%	CM-Z5U-D-104-M
C5	Capacitor, tantalum, 1uF, 35V, +/-10%	DT35V105K
RESISTORS:		
R1-8	Resistor, carbon, 560ohm, 1/4W, +/-5%	RCF07J561
SEMICONDUCTORS:		
D1-8	Diode	1N4004
DS1-8	LED, red	550-1106-RED
U1-4	Dual peripheral driver	DS75452N
U5, 6	Hex inverter	MM74HC04N
MISCELLANEOUS COMPONENTS:		
JP1-8	Jumper	ML-100T
RL1-8	Relay	JW1FENDC5V

Section 14 TRIP IN MODULE

Figure 14-1. Controls and Indicators, Trip In Module

Circuit Symbol	Description Marking	Functional Description
DS1 - DS8	Indicator, Trip In 1 - 8	Lights when Trip 1 - 8 is Input
JP1	Jumper	Enables Cut-Out Switch to disable uP

Table 14-1. Controls and Indicators Description, TRIP IN Module

DESCRIPTION

The Trip In module contains eight optically isolated Trip input circuits.

NOTE: One of the eight Trip In circuits is described below. The description applies to all eight, individually.

THEORY OF OPERATION

TRIP INPUT CIRCUIT

Trip Inputs are passed through series resistor R1, which limits the input current applied to optical isolator U1. Zener diode D1 protects the input of U1 against excess or inverted voltages. The R1 value must be selected to correspond to the Trip In voltage. When shorted, JP1 enables U1 to output a Trip input signal to the microprocessor module. When a Trip is received, phototransistor U1 conducts. The output of U1 goes low creating the Trip input signal for the microprocessor module. When a Trip input command is received, indicator DS# (the # depends on which Trip In circuit is energized) on the front panel will illuminate.

When the optional Cut-Out Switch module (CC2256) is supplied, JP1 is in the open position, allowing the air-gap switch to prevent U1 to output a Trip input signal to the microprocessor.

Table 14-2. Replaceable Parts, Trip Input Module (CC2244)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1	Capacitor, tantalum, 4.7 uF, 35V, +-/10%	DT35V475K
C2-3	Capacitor, ceramic molded, 0.1uF, 50V, +/-10%	CM-Z5U-D-104-K
RESISTORS:		
R1, 6, 11, 16, 21, 26, 31, 36	Resistor, wire wound, 20K, 3W, +/-5%	WWR3J203
R2, 7, 12, 17, 22, 27, 32, 37	Resistor, carbon, 2.4K, 1/4W, +/-5%	RCF07J242SM
R3, 8, 13, 18, 23, 28, 33, 38	Resistor, carbon, 430ohm, 1/4W, +/-5%	RCF07J431SM
R4, 9, 14, 19, 24, 29, 34, 39	Resistor, carbon, 10K, 1/4W, +/-5%	RCF07J103SM
R5, 10, 15, 20, 25, 30, 35, 40	Resistor, carbon, 390ohm, 1/4W, +/-5%	RCF07J391SM
SEMICONDUCTORS:		
D1-8	Diode	1N4749A
DS1-8	LED	551-0407
U1-8	Optoisolator	MOC5008
U9-10	Inverter, hex schmitt-trigger	MM74HC14N

Figure 15-1. Controls and Indicators, Trip Out Module

Circuit Symbol	Description Marking	Functional Description
DS1 - DS8	Indicator, Trip Out1 - 8	Lights when Trip 1 - 8 is Output

Table 15-1. Controls and Indicators Description, Trip Out Module

DESCRIPTION

The Trip Out module contains eight solid state relays for driving Trip output circuits (devices) external to the unit or optional dry contact relays in the unit. Up to two Trip Out modules can be installed in a chassis.

NOTE: One of the eight Trip Out circuits is described below. The description applies to all eight, individually.

THEORY OF OPERATION

Trip output instructions from the uP module are applied to the input of U9A pin 2. If supply voltages are within limits, +5 V are applied to U9A pin 1. U9A will pass the Trip output instruction to U1, an optical isolator, which drives transistor Q1. Q1 drives diode bridge CR1 which directs the current for Q1. Varistor VR1 protects against high voltage transients. Front panel LED DS1 will light when a Trip output instruction from the uP module is present. The LED's on the front panel of the Trip Out module only indicates the Trip output. It is possible to receive a Trip and not have it output if the logic scheme prevents it in the uP module, i.e. Guard before Trip.

There are two Trip Out module slots available in the PDR-2000 as shown on Figure 8-1. The outputs of the Primary Trip Out slot are connected directly to terminal blocks TB1-TB4 on the rear of

the chassis, see the Wiring Diagram located in Section 5, Installation for the exact terminal locations. The outputs of a Trip Out module in the Secondary Trip Out slot are sent to the Option slots. If a dry contact relay module is in an Option slot, the outputs of the Trip out module drive the relay coils. If the solid state outputs of the Secondary Trip Out module are to be passed to terminal blocks TB1 and TB2, a module needs to be inserted in the option slots to route the outputs. If the unit is supplied with dry contact relay modules or a Secondary Trip Out module, see Section 17, Options for more details.

Table 15-2. Replaceable Parts, Trip Out Module (CC2245)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1	Capacitor, tantalum, 4.7 uF, 35V, +-/10%	DT35V475K
C2-5	Capacitor, ceramic, .1uF, 50V, +/-20%	CM-Z5U-D-104-M
RESISTORS:		
R1, 5, 9, 13, 17, 21, 25, 29	Resistor, carbon, 51K, 1/4W, +/-5%	RCF07J513
R2, 6, 10, 14, 18, 22, 26, 30	Resistor, carbon, 390ohm, 1/4W, +/-5%	RCF07J391
R3, 7, 11, 15, 19, 23, 27, 31	Resistor, carbon, 560ohm, 1/4W, +/-5%	RCF07J561
R4, 8, 12, 16, 20, 24, 28, 32	Resistor, carbon, 1K, 1/4W, +/-5%	RCF07J102
SEMICONDUCTORS:		
CR1-8	Rectifier, single phase, full wave	3N256
DS1-8	LED, red	550-1106-RED
Q1-8	Transistor, bi-polar	MJE-5742
U1-8	Optomosfet	AQV210EH
U9-12	Dual driver / peripheral	DS75452N
MISCELLANEOUS COMPONENTS:		
VR1-8	Varistor	V130LA20B

Section 16 CHASSIS

The chassis is the 19 inch rack that houses the individual modules, and the three boards on the back of the unit . The circuit modules are inserted into the chassis in a bookshelf arrangement. The modules interface directly with the MOTHER BOARD. The MOTHER BOARD is connected to the INTERFACE BOARD which in turn is connected to the TERMINAL BLOCK BOARD. The three back boards use a series of connectors and screws to install to the rack and are not designed to be disassembled by the user. Please contact INIVEN if any assistance is required regarding these boards.

The chassis complies with EIA dimensional standards and occupies three rack units (5.25 inches) of vertical space in a 19 inch rack or cabinet. Its overall dimensions are as follows:

Height: 5.25 inches (13.3 cm)   Width: 19 inches (48.3 cm)   Depth: 12.20 inches (31 cm)

Figure 8-2 shows all dimensions. Schematics for the MOTHER BOARD, INTERFACE BOARD, and TERMINAL BLOCK BOARD are found at the end of this section. For installation and wiring diagrams see Section 5, Installation.

MOTHER BOARD

The Mother board interconnects power, control bus, and logic to all modules. The physical interface for all modules inserted from the front of the chassis are on this board.

INTERFACE BOARD

The Interface board interconnects the Terminal Block board to the Mother board. The Com ports located on the rear of the chassis connect directly, through an opening on the Terminal Block board, to a connector on the Interface board.

There are two versions of the Interface board. The CC2252-01 is the standard Interface board. The CC2252-02 is used only for applications that require the Cut-Out Switch (CC2256) option module. A PDR-2000 supplied with CC2252-02 will not operate correctly without the Cut-Out Switch module installed in the two option slots, see Section 8, Figure 8-1 for module locations. The standard Interface board (CC2252-01) will work with any or no option modules but will not work with the Cut-Out Switch module.

TERMINAL BLOCK BOARD

The Terminal Block board has all the user connections located on the rear of the chassis. The terminal blocks are used to wire all Trip/Guard and Status relay inputs and outputs, see Section 5, Installation for a Wiring Diagram. A BNC for the GPS clock signal and the 9 pin DTE RS-232 port are located above the Com Port module on the Terminal Block board. The Com Port module connects to the Interface board but mounts to the Terminal Block board.
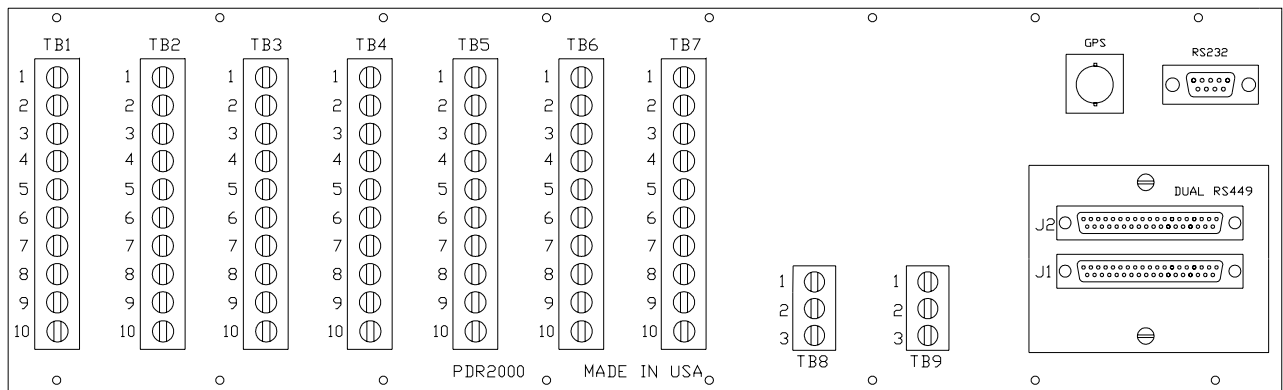
Figure 16-1. Terminal Block Board

CHANGING MODULES

Every part of the PDR-2000, with the exception of the back boards, has been designed to be easily replaced or modified by the user in the field.

CAUTION: Care should always be taken when handling individual modules to avoid electrical shock and static discharge. Always turn off the Power switch on the DC/DC module before removing any components.

REPLACING MODULES

DC Converter(s): If the a DC converter should need to be replace due to failure, turn off the power first. It is also recommended that the power also be disconnected from the station battery. Remove the DC module by unscrewing the captive screws on the faceplate and pull the module straight out of the chassis by its handle. Confirm which converter is to be replaced and match the number with the marking on the DC module. Completely remove the two screws that hold the DC converter to the standoffs. Carefully pull the converter out of the sockets mounted on the Terminal Block board.

To replace the DC converter, snap the pins into the sockets mounted on the DC module and use the screws to fasten the module to the standoffs. The sockets will not hold the DC converter without the screws. Insert the DC module completely and screw in the captive screws. Reconnect and turn on the power.

Com Ports: A Com port may be easily replaced or changed to another type of port. On the Terminal Block board, unscrew the two screws holding the board the Communication connectors in place. Pull the board straight out.

To replace the Com port board, carefully line up the connector with the connector on the Interface board and insert as straight as possible. Fasten the two screws into the standoffs. If a different type of Com port board was replaced, make sure the Com module matches the type of port (64 Kbps, G.703, fiber optic, etc.).

Front Panel Modules: To replace a module that has an attached faceplate (all modules other then uP modules and Com modules), unscrew the top and bottom captive screws on the faceplate and pull the module straight out of the chassis by its handle.

To replace the module, line the board up with the grooves of the card guides and slide the module until it is firmly seated and the faceplate is flush with the front of the chassis. Screw down both captive

16-2

screws completely. These are grounding screws and must be screwed in. If option modules are being added, refer to the literature that is supplied with the option modules for instructions.

To replace one of the modules behind the Keypad and Display, unscrew both captive screws of the faceplate and swing the panel to the left. To pull the module out, pull on the board's handle while pressing down on the red board retainer. After the board has started to come out, the retainer may be let go.

If the primary uP module is being removed, unplug the ribbon cables from the module after it has been removed.

When reinstalling the primary uP module, attach the ribbon cables before inserting it into the chassis, see Section 5, Installation for pin alignment. If a redundant uP module is being installed or replaced, remove the primary uP module and insert the redundant uP module in the primary slot. Program the redundant uP module using the GUI. Turn off the power, remove the redundant uP module, insert a jumper across pins 1 and 3 of the keypad connector on the redundant uP module and install in the redundant slot. See Section 9, uP module for more details. If a different type of Com module is being installed, make sure the Com port board on the rear of the chassis matches the new Com module.

To install a uP or Com module, hold down the red board retainer, line the board up with the grooves of the card guides and slide the module until it is firmly seated and the retainer snaps up in front of the board. Close the door holding the Keypad and Display, being careful of the ribbon cables, and fasten both captive screws for grounding.

Keypad and Display: If a keypad or Display needs to be replaced, replace just the component and not the whole assembly. Each component has four nuts that hold it to the panel. Remove the ribbon cable and then unscrew the component. The Display has an antiglare screen that is not attached to the Display. After the module has been replaced connect the ribbon cable, carefully close the panel, and fasten the two thumb screws completely, see Section 5, Installation for pin alignment.

INIVEN

INIVEN

INIVEN
PWR1 FAIL
PWR2 FAIL
PWR2 FAIL

ON
OFF
MAIN POWER

INIVEN
ALARM
BLOCK
LOC 1
LOC 2
PROG 1
PROG 2
uP FAIL
UNIT ID OFF

INIVEN
TRIP IN 1
TRIP IN 2
TRIP IN 3
TRIP IN 4
TRIP IN 5
TRIP IN 6
TRIP IN 7
TRIP IN 8

INIVEN
TRIP OUT 1
TRIP OUT 2
TRIP OUT 3
TRIP OUT 4
TRIP OUT 5
TRIP OUT 6
TRIP OUT 7
TRIP OUT 8

F1 F2 F3 F4

1/A 2/B 3/C 4/D 5/E

6/F 7/G 8/G 9 0

RS232   DC/DC   STATUS RLY   TRIP IN   TRIP OUT

REF: 2000-WDBCH01

MATERIAL	DRAWN BY	DATE	**INIVEN**™			
	FB	12/13/02	SOMERVILLE, N.J. 08876			
	CHECKED BY	DATE	CHASSIS OUTLINE			
FINISH			PDR2000			
	UNLESS OTHERWISE SPECIFIED: DIMENSIIONS ARE IN INCHES TOLERANCES ARE: .XX = ±.02 .XXX = ±.01 HOLE DIA. = ±.002 ANGLE = ±.5°		SIZE	FSCM NO.	DRAWING NO.	REV.
			D	32840	2000-OLBCH01	
DO NOT SCALE DRAWING			SCALE: N.T.S.		SHEET 1 OF 1	

INIVEN

F1 F2 F3 F4

1/A 2/B 3/C 4/D 5/E
6/F 7/G 8/G 9 0

INIVEN

RS232

INIVEN

○ PWR1 FAIL
○ PWR2 FAIL
○ PWR2 FAIL

ON
OFF
MAIN POWER

DC/DC

INIVEN

○ ALARM
○ BLOCK
○ LOC 1
○ LOC 2
○ PROG 1
○ PROG 2
○ uP FAIL
○ UNIT ID OFF

STATUS RLY

INIVEN

○ TRIP IN 1
○ TRIP IN 2
○ TRIP IN 3
○ TRIP IN 4
○ TRIP IN 5
○ TRIP IN 6
○ TRIP IN 7
○ TRIP IN 8

TRIP IN

INIVEN

○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

TRIP OUT

INIVEN

○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

TRIP OUT

REF: 2000-WDBCH02

MATERIAL	DRAWN BY	DATE	
	FB	12/13/02	**INIVEN™**
	CHECKED BY	DATE	SOMERVILLE, N.J. 08876
FINISH			CHASSIS OUTLINE PDR2000

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
.XX = ±.02 .XXX = ±.01
HOLE DIA. = ±.002
ANGLE = ±.5°

SIZE	FSCM NO.	DRAWING NO.	REV.
D	32840	2000-OLBCH02	

SCALE: N.T.S. SHEET 1 OF 1

DO NOT SCALE DRAWING

(INIVEN)

(INIVEN) (INIVEN) (INIVEN) (INIVEN) (INIVEN) (INIVEN)

F1 F2 F3 F4

1/A 2/B 3/C 4/D 5/E

6/F 7/G 8/G 9 0

○ PWR1 FAIL
○ PWR2 FAIL
○ PWR2 FAIL

ON
OFF
MAIN POWER

○ ALARM
○ BLOCK
○ LOC 1
○ LOC 2
○ PROG 1
○ PROG 2
○ uP FAIL
○ UNIT ID OFF

○ TRIP IN 1
○ TRIP IN 2
○ TRIP IN 3
○ TRIP IN 4
○ TRIP IN 5
○ TRIP IN 6
○ TRIP IN 7
○ TRIP IN 8

○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

RS232   DC/DC   STATUS RLY   TRIP IN   TRIP OUT   TRIP OUT   UNIV RLY

REF: 2000-WDBCH03

INIVEN

INIVEN

INIVEN
- PWR1 FAIL
- PWR2 FAIL
- PWR2 FAIL

ON
OFF

MAIN POWER

INIVEN
- ALARM
- BLOCK
- LOC 1
- LOC 2
- PROG 1
- PROG 2
- uP FAIL
- UNIT ID OFF

INIVEN
- TRIP IN 1
- TRIP IN 2
- TRIP IN 3
- TRIP IN 4
- TRIP IN 5
- TRIP IN 6
- TRIP IN 7
- TRIP IN 8

INIVEN
- TRIP OUT 1
- TRIP OUT 2
- TRIP OUT 3
- TRIP OUT 4
- TRIP OUT 5
- TRIP OUT 6
- TRIP OUT 7
- TRIP OUT 8

| F1 | F2 | F3 | F4 |

| 1/A | 2/B | 3/C | 4/D | 5/E |
| 6/F | 7/G | 8/G | 9 | 0 |

RS232   DC/DC   STATUS RLY   TRIP IN   TRIP OUT   UNIV RLY

REF: PDR2000-WDBCH04

MATERIAL	DRAWN BY	DATE	INIVEN™
	FB	03/07/05	SOMERVILLE, N.J. 08876
	CHECKED BY	DATE	CHASSIS OUTLINE
FINISH			PDR2000

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
.XX = ±.02 .XXX = ±.01
HOLE DIA. = ±.002
ANGLE = ±.5?

SIZE	FSCM NO.	DRAWING NO.	REV.
D	32840	2000-OLBCH04	

SCALE: N.T.S.   SHEET 1 OF 1

DO NOT SCALE DRAWING

INIVEN

INIVEN

INIVEN
○ PWR1 FAIL
○ PWR2 FAIL
○ PWR2 FAIL

○ ON
OFF

MAIN POWER

INIVEN
○ ALARM
○ BLOCK
○ LOC 1
○ LOC 2
○ PROG 1
○ PROG 2
○ uP FAIL
○ UNIT ID OFF

INIVEN
○ TRIP IN 1
○ TRIP IN 2
○ TRIP IN 3
○ TRIP IN 4
○ TRIP IN 5
○ TRIP IN 6
○ TRIP IN 7
○ TRIP IN 8

INIVEN
○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

| F1 | F2 | F3 | F4 |

| 1/A | 2/B | 3/C | 4/D | 5/E |
| 6/F | 7/G | 8/G | 9 | 0 |

RS232   DC/DC   STATUS RLY   TRIP IN   TRIP OUT   UNIV RLY   UNIV RLY

REF: PDR2000-WDBCH05

MATERIAL	DRAWN BY	DATE		
	FB	05/13/03	**INIVEN™**	
	CHECKED BY	DATE	SOMERVILLE, N.J. 08876	
FINISH			CHASSIS OUTLINE PDR2000	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
.XX = ±.02 .XXX = ±.01
HOLE DIA. = ±.002
ANGLE = ±.5°

SIZE	FSCM NO.	DRAWING NO.	REV.
D	32840	2000-OLBCH05	

SCALE: N.T.S.   SHEET 1 OF 1

DO NOT SCALE DRAWING

SAMPLE

INIVEN

F1 F2 F3 F4

1/A 2/B 3/C 4/D 5/E

6/F 7/G 8/G 9 0

INIVEN

RS232

INIVEN

○ PWR1 FAIL
○ PWR2 FAIL
○ PWR2 FAIL

ON
OFF

MAIN POWER

DC/DC

INIVEN

○ ALARM
○ BLOCK
○ LOC 1
○ LOC 2
○ PROG 1
○ PROG 2
○ uP FAIL
○ UNIT ID OFF

STATUS RLY

INIVEN

○ TRIP IN 1
○ TRIP IN 2
○ TRIP IN 3
○ TRIP IN 4
○ TRIP IN 5
○ TRIP IN 6
○ TRIP IN 7
○ TRIP IN 8

TRIP IN

INIVEN

○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

TRIP OUT

INIVEN

○ TRIP OUT 1
○ TRIP OUT 2
○ TRIP OUT 3
○ TRIP OUT 4
○ TRIP OUT 5
○ TRIP OUT 6
○ TRIP OUT 7
○ TRIP OUT 8

TRIP OUT

UNIV RLY

UNIV RLY

REF: 2000-WDBCH06

MATERIAL	DRAWN BY	DATE	INIVEN™
	FB	12/13/02	SOMERVILLE, N.J. 08876
	CHECKED BY	DATE	CHASSIS OUTLINE
FINISH			PDR2000

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
.XX = ±.02 .XXX = ±.01
HOLE DIA. = ±.002
ANGLE = ±.5°

SIZE D FSCM NO. 32840 DRAWING NO. 2000-OLBCH06 REV.

SCALE: N.T.S. SHEET 1 OF 1

DO NOT SCALE DRAWING

Section 17 OPTION MODULES

This section contains instruction inserts for any option modules that are included with the PDR-2000 that accompanied this manual. Option modules may change the operation of the unit. It is important to read this section to determine the affects of the options.
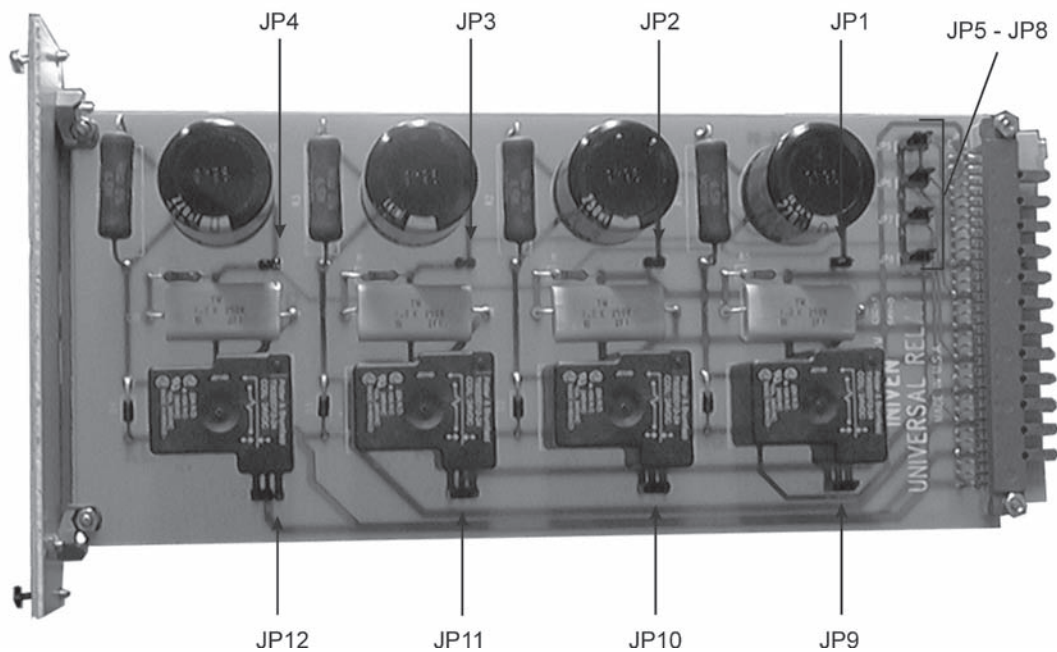
UNIVERSAL RELAY MODULE (OPTION)

Figure 1. Control and Indicators, Universal Relay Module

Circuit Symbol	Description Marking	Functional Description
JP1-4	Jumper	Enable Dry Contact or Solid State output
JP5-8	Jumper	Enable Dry Contact or Solid State output
JP9-12	Jumper	Set Dry Contact Relay as Form A or Form B

DESCRIPTION

The Universal Relay Module is an option for the PDR-2000. Each module contains four dry contact relays that can be used for Trip outputs.   Each relay is a form C relay that can be used as a form A or form B relay depending on jumper position. The relays have a contact rating of 10A at 24VDC or 3A at 125VDC (see Wiring Diagram at the end of Section 5, Installation for connections). The Universal Relay Module may also be supplied without relays. In this form it is reffered to as the Solid State Pass Through Module. If a Trip out module is placed in the optional slot (see Figure. 8.1) and the solid state relays are not being used to drive the dry contacts then the pass through module allows the solid states to be wired to the terminal blocks.

THEORY OF OPERATION

Each relay is fed from the connector directly or in parallel via the Interconnect board should multiple relays be required for a particular application.

Note: The following description refers to Relay 1 (RL1) and is applicable to all four relays if equipped.

The station battery or the voltage controlling the relay coil is connected to J1-1A and J1-1C. The negative side is connected to one side of each of the relay coils. The solid state output of the Multi-Trip module connects the positive voltage from J1-4C to J1-4A and to the other side of the relay coil via C1 and R1. The station battery will be applied to the RL1's coil through C1 which shortens the relay pull in time. After a few milliseconds, C1 charges and current is limited by resistor R1, placing the correct holding voltage across the relay coil.

Note: The Universal Relay module is designed to work at 24VDC, 48VDC, 125VDC or 250VDC and is marked on the top of the faceplate handle with the correct voltage. Please consult the factory for changing the rated voltage in the field.

JUMPERS

JP1-4
Jumpers JP1-4 are used when the module is being used as a pass through module. If the relay is not supplied or if the intention is to by-pass the relay and use the solid state output from the optional Trip out module, the jumper must be strapped. If the relay is to be used, the jumper must be open. Jumper 1 is for relay 1 which is driven by optional Trip out 1.

JP5-8
Jumpers JP5-8 are also used to bypass the dry contact relay. The jumper in the A B position is used to activate the dry contact relay. Position B C is used to bypass the relay for a solid state output. Jumper 5 controls relay 1 and the rest of the jumpers follow in order.

JP9-12
Jumpers JP9-12 are used only for the dry contact relays. The A B position of the jumper creates a NO form A circuit and the B C position creates a NC form B circuit. Jumper JP9 controls relay 1 and the rest of the jumpers follow in order.
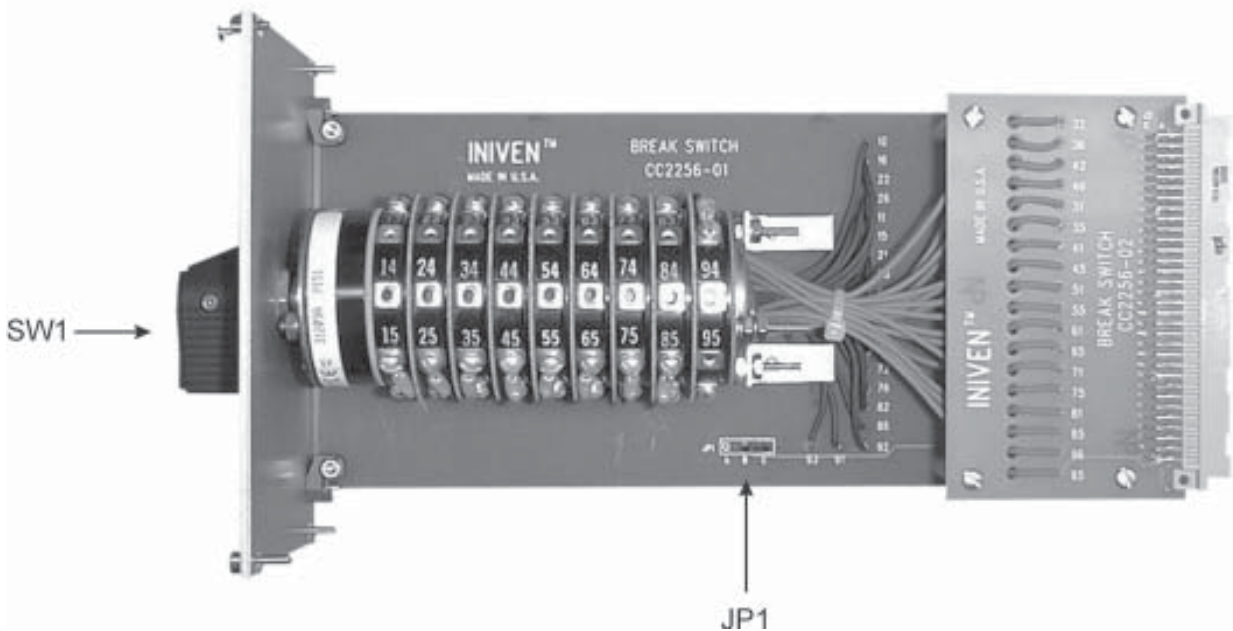
CUT-OUT SWITCH MODULE (Option)

Figure 17-1. Controls and Indicators, Cut-Out Switch Module

Circuit Symbol	Description Marking	Functional Description
SW1	Switch, Air Gap	Changes Trip I/O's from normal to isolated
JP1	Jumper	Changes Status Relay output from form A to form B

Table 17-1. Controls and Indicators Description, Cut-Out Switch Module

DESCRIPTION

The Cut-Out Switch module is used to provide an air gap isolation between the Trip inputs and outputs and the terminal blocks on the back of the chassis. When the switch is changed from normal operation to the cut-out position, the uP module receives an indication of the event and records it. A contact on the switch also acts as a status relay and may be configured as normally open or normally closed.

THEORY OF OPERATION

The Cut-Out Switch module consists of an air gap switch (SW1) that passes all Trip output circuits from the Trip Out module to the terminal blocks on the rear of the chassis. When the switch position is moved from IN (service) to OUT (of service), an air gap prevents any Trips that are received by the unit from being output. The 5 V power used by the Trip In module also passes through the switch. When the switch is in the OUT position the power is cut to the Trip input circuits preventing the unit from transmitting any Trip inputs received. As a extra measure of security, the Cut-Out Switch also sends an indication to the uP module that it is in the OUT position and the unit's Firmware prevents Trip inputs and Trip outputs from being acted upon. If a Trip is received from another unit while the switch is in the OUT position, the display will show the channels that are being tripped but the uP module will not instruct the Trip Out module to Trip. The Trip In module must have jumper JP1 in the open position

for the Cut-Out Switch module to function properly.

The Cut-Out Switch module also has two outputs for the status of the switch position. The uP input used to block the Trip I/O's is also used to record the change of the switch's position in the event recorder. A separate contact on the switch is used to indicate whether it is in the IN or OUT position. When JP1 is in the A-B position the contact is normally closed and in the B-C position, it is normally open. The contact closure is connected to Terminal Block 5 positions 1 and 2, see Section 5 for the wiring diagram.
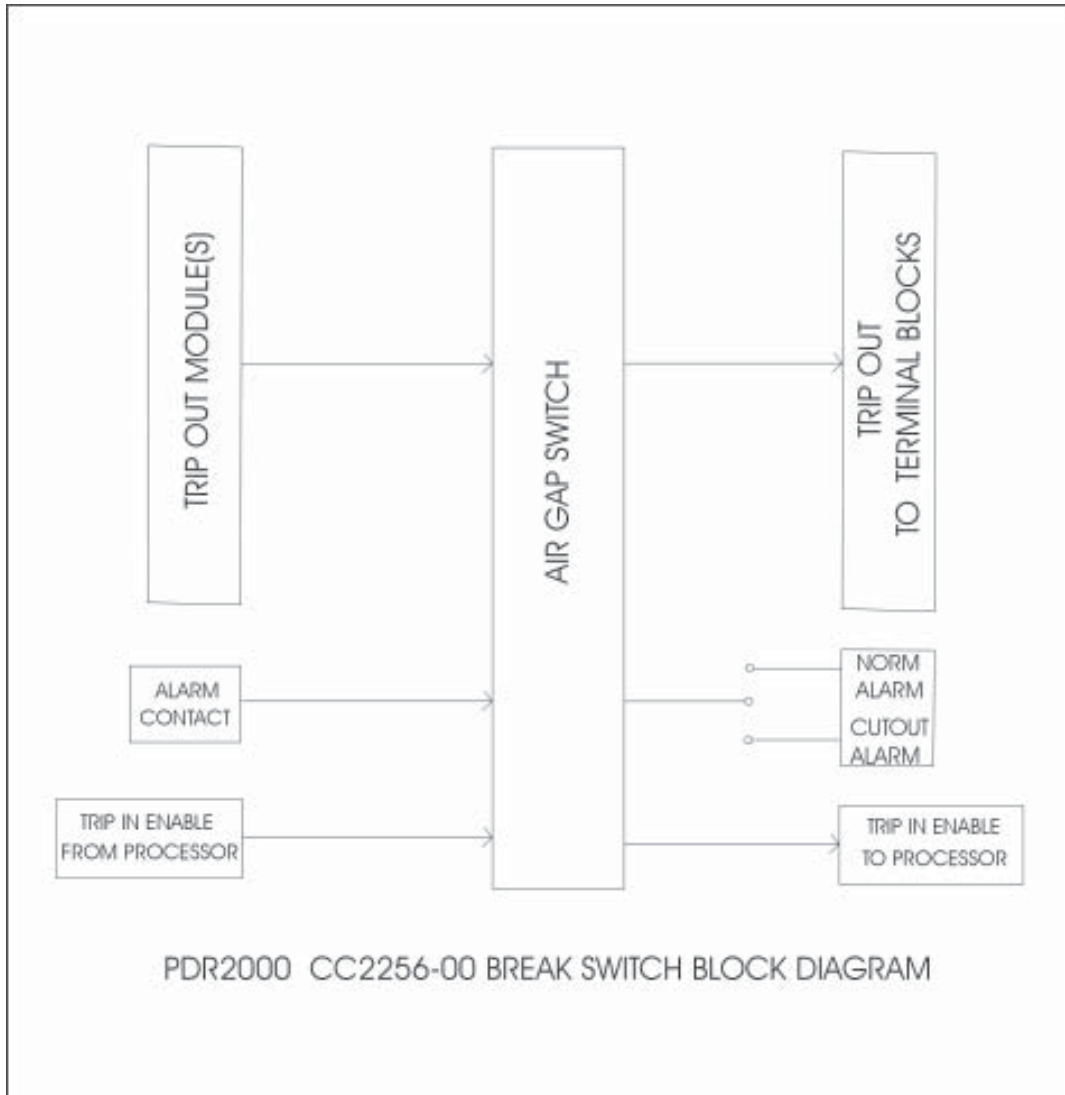

Figure 17-2. Block Diagram, Cut-Out Switch Module

Section 18 MAINTENANCE

ALL SAFETY PROCEDURES ARE TO BE STRICTLY ADHERED TO AND ONLY QUALIFIED MAINTENANCE, OPERATORS, OR SERVICE PERSONNEL ARE TO PERFORM WORK ON THIS EQUIPMENT. LIFE THREATENING VOLTAGES AND CURRENTS ARE PRESENT WITHIN THIS EQUIPMENT. OBTAIN ALL REQUIRED APPROVALS TO PLACE THIS EQUIPMENT IN OR OUT OF SERVICE.

PREVENTIVE MAINTENANCE

The PDR-2000 is designed for trouble free service. It is not necessary to perform preventive maintenance. This statement is not intended to replace preventive maintenance procedures in place within any particular organization.

BATTERY REPLACEMENT

The uP module contains a battery used to maintain the internal clock in case of power failure. The clock is only used for time/date stamping of events and the PDR-2000 will work normally even with a dead battery but will need to have the clock reset if the power is turned off. All other information is stored in Flash. When the main power is on the battery is not in use. The battery should be replaced every ten years for a unit that is in service (a unit that is powered ON for the majority of the ten years). If the battery is left in a unit that is not in service the battery should be replaced every five years.

Always turn off the main power switch on the front of the DC/DC module before removing any modules.

To replace the battery, turn off the unit, remove the uP module (see Section 16 for module removal instructions), and use a screwdriver to remove the battery from it's holder. Carefully replace the battery with another 3 V coin type lithium battery (Eveready part number, CR2032). Replace the uP module and power the unit back on. Remember to set the time and date, see Section 3, On-Board Programming.

FUSE REPLACEMENT

If the PDR-2000 has power being applied to the terminal blocks and the power switch on the front of the DC module is in the On or **I** position yet there are no green LED's lit on the front of the DC/DC Module, then a fuse may be blown.

When replacing a faulty fuse, turn the power switch on the front of the DC/DC module to the Off or **O** position. Remove the DC module (see Section 16 for module removal instructions). Use a flat blade screwdriver or fuse puller to remove the faulty fuse from the clips. Be careful not to shatter the glass. Eye protection should be worn. Replace the fuse with one of the same physical and electrical characteristics, see Section 12 for fuse location and replacement part number. Replace the DC/DC module, see Section 16 for replacement procedure, and turn the power switch on. If the green main power LED is illuminated then the problem has been corrected. If the LED does not light or if the fuse blows again, further troubleshooting is required and INIVEN should be contacted at 800-526-3984 or 908-722-3770 for assistance, repair or replacement of the faulty module.

Redundant power supplies each have their own green power LED and status relay. If the green main power LED is illuminated but the LED corresponding with the fuse does not illuminate (PWR 1 ON or

PWR 2 ON) or if the fuse blows again, further troubleshooting is required and INIVEN should be contacted at 800-526-3984 or 908-722-3770 for assistance, repair or replacement of the faulty module.

FIRMWARE CHANGE

If a change of the PDR-2000's firmware is required, a new **flash.bin** file will be used. This file can be received one of two ways. Either a new GUI will be used that has the flash.bin file incorporated into it or the flash.bin file will be a separate file. Instructions for installing the file will be included with the firmware file and may differ slightly from the procedure described below.

If a new GUI is being used, load the GUI onto the PC normally. When the GUI is created on the PC, a folder called INIVEN will be created including the flash.bin file. Attach the unit to be upgraded to the PC and open the GUI. **The unit must be offline during a firmware upgrade.**

1. Enter the password.

2. Click Download Firmware. The default for the flash.bin Open command is the INIVEN folder.

3. Select the flash.bin file and click OK. The files's properties can be used to determine the date of the firmware file.

4. Follow the instructions of PDR-2000's display screen. Depending on the version of the firmware the unit will have to be turned Off and On once or twice. When the default screen returns the unit has successfully loaded the new firmware. Check the settings to confirm no changes have occurred due to the firmware upgrade.

If the file is used separately and not part of the GUI, select the location of the file instead of the INIVEN folder from step 3 above and click on the flash.bin file and click OK.

PLD CODE CHANGE

If a change of the PDR-2000's Programmable Logic Device (PLD) is required, a new **standard.pof** file will be used. This file can be received one of two ways. Either a new GUI will be used that has the standard.pof file incorporated into it or the standard.pof file will be a separate file. Instructions for installing the file will be included with the PLD file and may differ slightly from the procedure described below.

1. Enter the password.

2. Click Download Firmware. The default for the standard.pof Open command is the INIVEN folder.

3. Use the down arrow for file type to select .pof. Select the standard.pof file and click OK. The files's properties can be used to determine the date of the PLD file.

4. Follow the instructions of PDR-2000's display screen. Depending on the version of the PLD file the unit will have to be turned Off and On once or twice. When the default screen returns the unit has successfully loaded the new PLD code. Check the settings to confirm no changes have occurred due to the PLD upgrade.

If the file is used separately and not part of the GUI, select the location of the file instead of the INIVEN folder from step 3 above and click on the standard.pof file and click OK.

Section 19 GLOSSARY

ALARM
A status alarm that indicates a communications or equipment failure.

AND
A logic statement where both inputs to the gate must both be present or "On" for the output of the logic to be present or "On"

BIT
The digital communications used by the PDR-2000 are made up of bits. A bit is either a 1 or 0. A group of bits with a beginning and an ending make a packet.

BLOCK
This is a state that can affect a single channel or multiple receive channels. A Block occurs when communication or electrical requirements are out of tolerance. This causes the Block alarm to energize and a **B** to appear on the display for the effected channels.

CHANNEL
This is a sub-channel within a single packet. The channels are referred to as A through H. These are represented as 1's and 0's in the digital packet. The channel is the form a Trip input takes while it is being communicated.

COM PORT
A connector located on the chassis' back panel is used to communicate Trip and Guard (along with other information) over the protection communication path.

COMMAND
An instruction given to or from the PDR-2000. A command usually refers to Trip/Guard instructions to/from a relay.

COMMUNICATION
This refers to the path used by the PDR-2000 for the digital packets. The packets are passed over a synchronous or asynchronous path to their destination, another unit or a PC, as opposed to the electrical inputs used by the Trip, alarm and power circuits.

CRC
An abbreviation for Cyclic Redundancy Check. This is a mathematical calculation performed on a block of data to confirm the accuracy of the data. The CRC is used by the PDR-2000 to detect the presence of error bits and to determine that a packet was received completely and correctly. The longer the CRC code the more accurate the mathematical calculation.

DCE
An abbreviation for Data Communications Equipment

DEPENDABILITY
The ability of teleprotection equipment to Trip out a valid Trip in the presence of communication interference.

DTE
An abbreviation for Data Terminal Equipment

EVENT
Any activity that occurs within a PDR-2000 that is recorded in memory.

FLASH
Nonvolatile memory.

FIRMWARE	Software that operates the PDR-2000. Firmware is not programmable by the user.
FPGA	An abbreviation for Field Programmable Gate Array.
GATE	A logic device that has two inputs and a single output depending on the status of the inputs. The PDR-2000 uses AND, OR, and XOR gates.
GUARD	Refers to the status of a Trip input and Trip output when the system is functioning normally, no Trips or Blocks. A Guard signal is a 0 in a digital packet.
GUI	An abbreviation for Graphical User Interface. The PDR-2000 GUI is a Windows® based software program used to program and retrieve data from a unit.
I/O	An abbreviation for Input/Output
IRIG-B	An abbreviation for Inter Range Instrumentation Group - Format B. This is a standard time code used by GPS clocks.
KBPS	An abbreviation for Kilo Bits Per Second
PACKET	A series of bits with a beginning and ending that contain instructions and data. The PDR-2000 uses several types of packets of differing lengths.
PING TEST	A test that measures communications delay by sending a test packet to a remote unit and receiving a response packet
PRE-TRIP TIMER	The amount of time required for a channel to be in Trip before the Trip out circuit is energized
OR	A logic statement where either or both inputs to the gate must be present or "On" for the output of the logic to be present or "On"
SECURITY	The ability of teleprotection equipment to prevent false Trips in the presence of communication interference
SETTINGS	The user programmable section of the PDR-2000 software
STATUS	The current condition of the indicators on the front panel of a PDR-2000
TRIP	A signal generated to communicate a keyed Trip In circuit. The action of keying a Trip in circuit, closing a Trip out contact, or communicating the keyed state. A Trip is communicated as a 1 in a digital packet.
TRIP IN	A keying input to the PDR-2000 from a protective relay initiating a Trip. Can be used for a blocking scheme, Guard input, or other type of input.
TRIP HOLD (TX)	A Trip is continually transmitted for a minimum period of time even if the Trip in circuit is not energized for the duration of the time allotted.
TRIP HOLD (RX)	A Trip out circuit is energized for a minimum period of time even if the Trip signal is not received for the duration of the time allotted.

TRIP OUT   A closed contact used to key a protective relay during a Trip. Can be used for a
                  blocking scheme, Guard output, or other type of output.

uP   An abbreviation for Microprocessor

XOR   A logic statement where either but not both inputs to the gate must be present or
                  "On" for the output of the logic to be present or "On"

Section 20 TROUBLESHOOTING

This section is designed to help users solve common issues they may encounter while using the PDR-2000.

GUI

ISSUE: The GUI has locked up and does not respond to user input.

POSSIBLE CAUSES:
1. The cable is not connected from the PC to the PDR-2000.
2. The wrong Unit ID number was entered when downloading settings or firmware.
3. If a Unit ID number was selected other then the local unit, the communications may have been lost. To Confirm the communications link is working, perform a Ping test as described in Section 6, System Tests.

SOLUTION: Confirm that the GUI is not performing a task such as downloading new settings. To do this, look at the space between the Download Firmware and Download Settings buttons on the GUI and check if the blue progress bar is moving.

Allow the GUI one minute to clear itself and issue a pop-up message. If this is not the case and the GUI seems unresponsive in all other ways, press the CTRL, ALT and DELETE keys simultaneously and end the task when prompted. Restart the GUI.

ISSUE: New settings were downloaded and a confirmation was received but the unit did not make the changes to the settings:

POSSIBLE CAUSE: The password was entered into the Display module locking out changes made by a PC.

SOLUTION: Make sure the Display is on the default screen and try downloading the settings again.

ISSUE: The PC is connected to the unit, but there does not seem to be any communications between the two.

POSSIBLE CAUSE: The serial comm port on the computer is not comm 1 (the default) or the comm port was set to another comm port for a modem connection.

SOLUTION: Go to the Set Connection button on the GUI and change the comm port to the proper port on the computer and click the SET COMM PORT button. Close the window and try again.

POSSIBLE CAUSE: A null modem cable was used to connect the front RS-232 port.

SOLUTION: Use the supplied serial cable or use an extension cable (i.e. keyboard/mouse extension cable) not a null modem cable.

DISPLAY

ISSUE: A setting has been changed but the unit does not seem to accept it.

POSSIBLE CAUSE: The F1 (or OK) button was not pressed when the change was made.

SOLUTION: Go back to same menu and confirm that the setting change has been made. If the setting is still in it's original state, make the change again and press the F1 button for OK.

COMMUNICATIONS

ISSUE: The units seem to be working properly but one of the LOC lights is on.

POSSIBLE CAUSE: Both Com Ports are active but only one is being used for communications.

SOLUTION: Turn off the unused Com Port using either the GUI or the Display module.

ISSUE: One of the remote units does not seem to be able to Trip the local unit.

POSSIBLE CAUSES:
   1. Both Com Ports are being used for communication but the Unit ID feature is not turned on.
   2. The Unit ID numbers in the Receive logic table were not filled in properly.
   3. The remote unit is communicating through another unit but one of the units in the string or loop does not have Packet Forwarding turned on.
   4. The communications line is plugged into the wrong Com Port.

SOLUTION: Reverse the cause of the problem.

ISSUE: A RS-449 interface is being used and all connections seem to be correct but the unit has intermittent communications and is receiving large amounts of bit errors.

POSSIBLE CAUSE: The timing signal on the RS-449 input is for the rising edge or falling edge and the unit is set the opposite way.

SOLUTION: Change the Invert Clock setting using the GUI or front panel.

ISSUE: An Audio Communications module is being used and all connections seem to be correct but the unit has intermittent communications and is receiving large amounts of bit errors.

POSSIBLE CAUSE: The Invert Clock stting is not On and must be so for this interface module.

SOLUTION: Turn the Invert Clock setting using the GUI or front panel to On or Invert Clock.

ISSUE: The unit logs a bit error event when I am requesting information from a remote unit.

POSSIBLE CAUSE: The Ping Test is active and the communications priority gives Ping Tests a higher value then data transfer (but not Trip/Guard packets). This may cause a data packet to be cut off in order to accelerate the Ping Test packet. When a data packet is cut off, the receiving unit requests the transmitting unit to send the packet again.

SOLUTION: No action need be taken. The Ping Test and data transfer will be completed. The bit error event is indicating that one of the data packets came in incomplete and needed to be resent.

ISSUE: When using a Audio Communications module the trip times are much longer then expected.

POSSIBLE CAUSE:
      1. Packet Forwarding is turned On.
      2. Auto Ping Test is turned On and set for a high repeat rate.
      3. The transmit output level is set too high.
      4. A noisy line.

SOLUTION:
      1. Turn off Packet Forwarding.
      2. Turn off Auto Ping Test or increase repeat rates to greater then 1 hour.
      3. Lower the transmit output level.
      4. Check the event recorder for bit errors. If none or few are found this is not the problem. If noise is the issue, try increasing the transmitter output level.