

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual contains operating and maintenance information on the Pulse Duration Receiver (PDR), manufactured by MOORE INDUSTRIES INC., Sepulveda, California. The manual consists of six sections, as follows:

Section 1, General Information, introduces the equipment function and describes the equipment physical appearance, the equipment specifications, and options available for the unit. The introduction also provides information on the use and description of the MOORE model numbering system.

Section 2, Calibration, provides all the information necessary to calibrate the unit before installation. This section contains a list of the tools necessary for calibrating the equipment; and illustrates the test setups essential to perform that task. The section also lists the various procedures required for calibration of the units in any configuration.

Section 3, Installation and Operation, supplies all the information needed to install and operate the equipment. The section contains figures that specify the installation requirements for the units, and text that informs the user on recommended wiring practices for the equipment as well as defines the electrical connections for each unit regardless of physical modifications. A brief outline of periodic observations required during the equipment operation is also included here.

Section 4, Theory of Operation, gives the maintenance personnel a detailed explanation of the internal function of the unit. The circuit theory is based on a block diagram that shows the functional elements of the unit. Each element operation is then described, first in relation to the other elements, then independently where its major components use and purpose are described.

Section 5, Maintenance, offers complete disassembly procedures for all unit configurations available. Troubleshooting information is also provided in this section as well as component replacement techniques to aid the technician in the repair of the equipment.

Section 6, Unit Documentation, acquaints the user with the MOORE IND. computerized parts listing and identification system. The section also provides a recommended spare parts list. All schematics and parts assembly drawings referred to by the text are located in the back of Section 6.

1.2 EQUIPMENT DESCRIPTION

The Pulse Duration Receiver (PDR) used in process control systems accepts a pulse-duration input from transmitting instruments such as the Moore PDT, Foxboro TELETAX, Honeywell DURAPULSE, or Bristol METAMETER, and converts it into a standard process output current or voltage proportional to the duration or width of the incoming pulses. The input pulse may consist of contact closures or 5V to 32V, the duration of which is pre-determined according to standard limits. The duty cycle of the input pulse does not affect the PDR operation since the output data is displayed instantaneously on the falling edge of the input pulse.

Through the use of counters, the unit determines the duration of the ON time of the incoming signal and converts this time into a digital representation. The "number" thus obtained is sent into a digital-to-analog converter, the output of which is an analog proportional to the digital input. An operational amplifier buffers this voltage, which is then amplified to produce a standard voltage or current output level. Table 1-3 in the rear of the section lists available electrical options while Section 4 gives a complete explanation of those configurations.

1.3 PHYSICAL DESCRIPTION

The unit is available in several physical configurations. In general, the standard unit consists of a main circuit board and two small boards mounted on the main board. One small board contains the clock circuit, and the other small board contains the D/A converter. The main board contains the input circuit, buffer and analog output circuits.

The boards are enclosed in a protective housing, and the entire assembly may be installed in a number of ways. Specific details about each unit is outlined in this section, while the following paragraphs outline the physical differences of each option available for the units. Electrical connections information are given in Section 3, Installation and Operation.

These brackets are used to mount the unit in applications where the standard U-bracket will not apply. The brackets are provided with two #10 screw clearance holes each, for ease of mounting.



Standard (SD) Unit



Unit with Angle Bracket (AB) Option

1.3.3 NEMA Boxes Options Description

Units equipped with angle brackets (AB) option may be enclosed in NEMA boxes to ensure protection against harsh environments that may be damaging to the unit. Four configurations are available for this purpose.

1.3.1 Conduit Plate Option (CP) Description

This option consists of an extension of the standard bracket lower mounting flange. The additional surface is cut with two mounting holes to accommodate 1/2-inch electrical conduit. This option is illustrated in the next section outline and dimension drawings.

1.3.2 Angle Bracket (AB) Option Description

This option consists of two angle brackets, one on the top and the other on the bottom of the unit.

Oil Tight (OT) NEMA Box Option. This enclosure consists of a NEMA12 box construction, with two cover-holding screw clamps, mounted opposite to the hinged side of the cover (right side). These enclosures are oil and dust tight only. Conduit holes, fittings, or knockouts are not provided on these boxes. Suggested fittings are "Myer's Scrutite." The units are mounted on a drilled and tapped mounting plate at the back of the box.

Water Tight (WT) NEMA Box Option. This enclosure consists of a NEMA4 box construction equipped with three cover-holding screw clamps, one on each of the three non-hinged sides of the box. These enclosures are watertight, in addition to oil and dust tight. Unit mounting and electrical connections are made in the same manner as the OT option enclosures.



Unit in Water Tight (WT) Enclosure



Corrosion Resistant Fiber Glass (FG) Enclosure

Fiber Glass (FG) Option Enclosures. This enclosure is molded from pigmented polyester resins, using 302 stainless steel for all exposed hardware. A one-piece neoprene jacket provides additional sealing protection against corrosive environments. Boxes are normally hinged on the long side. The cover is secured by four slot-head screws accessible at the top of the cover and located on each side of the top and bottom cover corners opposite the hinge side. Conduit holes may be cut with a hole punch, and special precautions must be taken with ground connections, since the box material is non-conductive. Refer to Section 3 for wiring information. Units are mounted into the enclosure in the same way as in the OT enclosures.

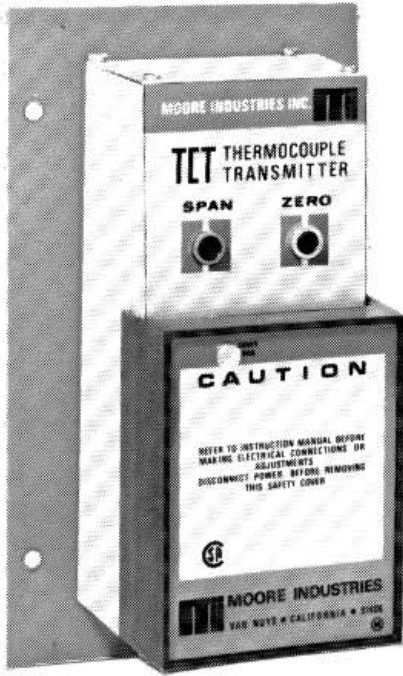
General Purpose (GP) Options Enclosures. This enclosure consists of a general purpose steel construction box with knock-outs for various size electrical conduits ($\frac{1}{2}$, $\frac{3}{4}$, or 1 inch). The cover is hinged and spring locked. Units are secured into the enclosure on four studs and four 10-32 nuts. The complete enclosure can be secured through four mounting holes provided on the box back cover.



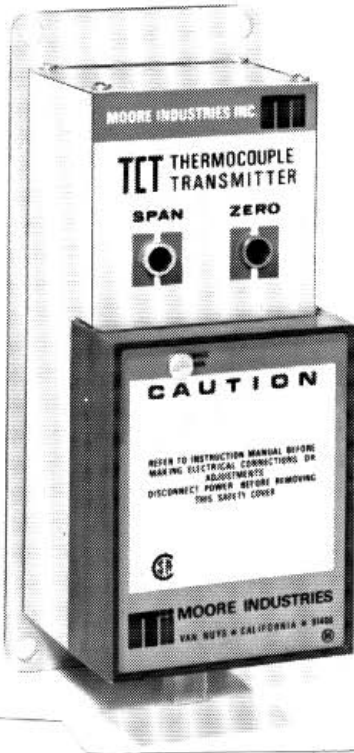
General Purpose (GP) Enclosure

1.3.4 AA and TA Options Description

These options consist of special mounting hardware attached to MOORE units to replace obsolete instrumentation of other manufacture.



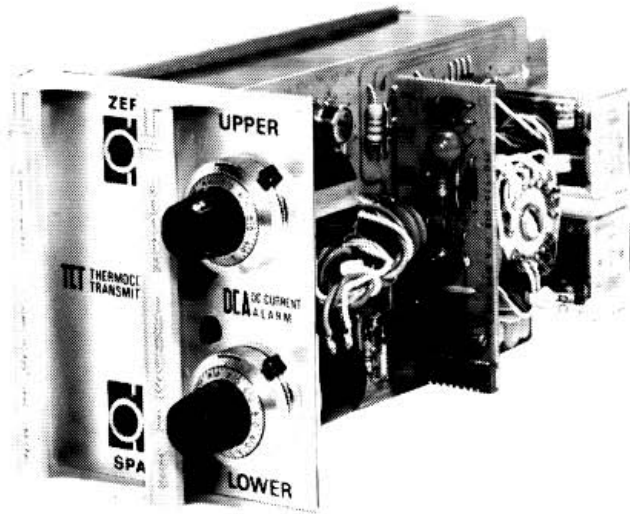
Replacement Mounting (AA Option)



Replacement Mounting (TA Option)

1.3.5 Plug-In (PC) Units Description

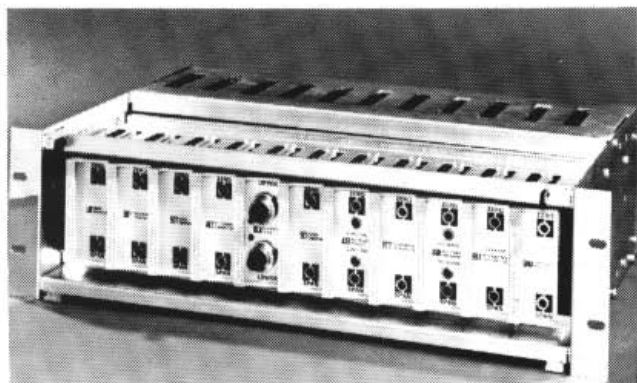
The plug-in unit is electrically similar to the standard unit. The printed circuit board is keyed to identify the unit and ensure proper connection mating. The other end of the main board is fastened to a display panel that allows external access to the various controls for the unit. A removable plastic safety cover protects the printed circuit board and components from normal environmental hazards. When the PC unit is purchased alone, the user must provide a 15 pin connector, such as Viking part No. ZVK155/1-2 or equivalent. Several mounting options are available for the plug-in unit.



Plug-In (PC) Unit

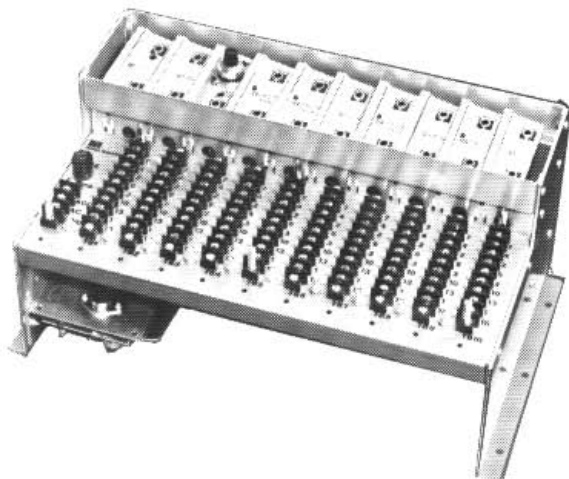
Rack Mounted (RMR) Card Racks. These enclosures are designed to flush-mount in standard 19 and 24-inch relay racks, respectively. The enclosures are provided with standard EIA hole patterns. Eleven and fifteen position RMR racks are available. These are pre-wired from the module PC connector to the screw-type barrier strip, which are rear-accessed for rack-wiring convenience. All power connections from the PC connectors are bussed together to a separate 3 terminal barrier-strip for external power input. DC power supplies are available. Electrical connections to the card rack are detailed in Section 3, Installation and Operation. Modules are front loaded and a dust cover is provided to minimize the

effects of environmental hazards. Module connectors are keyed to assure that units are plugged into their proper position; keying, however, may be altered in the field if the system configuration changes. Filler cards are available for positions not used by a module.



Card Rack Enclosure for Relay Racks (RMR)

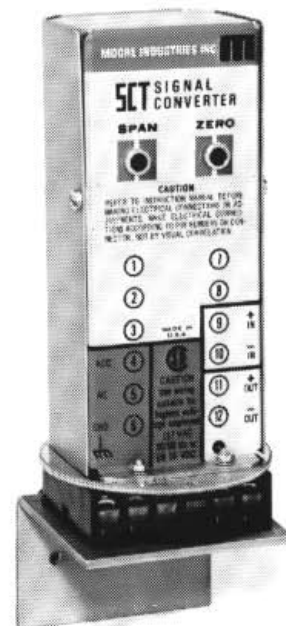
Surface Mounted (SMR) Card Rack. These rack enclosures are designed to accommodate as few as five and up to 15 modules. Mounting flanges are located in the rear of the side panel which allows for surface mounting or for NEMA box mounting. These enclosures are electrically identical in construction to the RMR racks. Terminal strips for external connections, however, are front-accessed for wiring convenience whenever the rack is mounted into a NEMA box or against a wall.



Surface Mounted Card Racks (SMR)

1.3.6 Standard Plug-In Transmitter (PB and PT) Options

The standard plug-in transmitter consists of a standard enclosure as described in paragraph 1.3 except that connections are not provided on the face of the unit. Instead, the transmitter is attached physically and electrically to a circular interconnect card with plug-in pins, keyed to eliminate errors in connections. The mating connector consists of a bracket-mounted square terminal block. External electrical connections are made to screw terminals located on the periphery of the connector block. A plug-in receptacle arrangement is located in the center of the block to accommodate the keyed interconnect card plug-in pins from the transmitter. The mounting bracket secured to the terminal block is pre-drilled with clearance holes for 10-32 screws. When the transmitter assembly is removed, the terminal block screw connections are easily accessible.



Plug-In Standard Unit (PB)

1.3.7 Explosion Proof (XC, XT, XX) Option

The explosion-proof enclosure option consists of a **PB** option unit described in paragraph 1.3.6 enclosed into a two-piece cast aluminum alloy enclosure. The two pieces consist of a screw-type

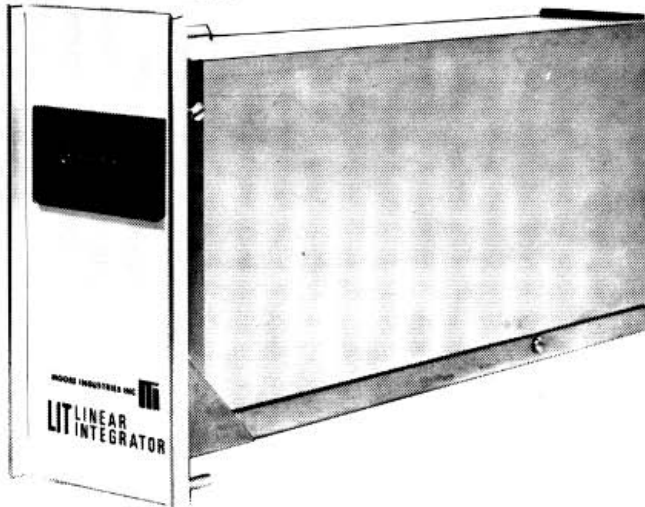
cover and a connector housing. When the cover is removed, the PB type unit is easily accessible. With the PB unit unplugged, the terminal block is clearly visible and connections are made with ease. No mounting bracket is used on the terminal block as with the PB option. Instead, the terminal block is secured flush with the bottom of the housing. Electrical conduit hubs are provided for external electrical wiring through electrical conduits. Several configurations of conduit inputs are available. Refer to Section 3 for detailed description of conduit configurations.



Explosion Proof Housing (XC Shown Only)

1.3.8 Panel Mounted Transmitter (PM) Option

This option is electrically similar to the standard unit of paragraph 1.3, except that the enclosure and terminals locations are different. Instead of the standard enclosure, the printed circuit boards are enclosed in a metal frame equipped with a blank panel. Controls and electrical connections are accessible to the rear of the enclosure by removing a cover. The bottom of the frame is provided with two holes to accommodate 1/2-inch electrical conduit.



Panel Mounted Unit (PM)

1.4 SPECIFICATIONS

The specifications for the unit are listed in Table 1-1.

1.5 MODEL NUMBER EXPLANATION AND USE

MOORE INDUSTRIES' model numbers describe an instrument's type, functional characteristics, operating parameter, and include option identification. If all accompanying documentation of a unit is missing, the model number may be used to obtain technical information on the unit by following the example of Table 1-2. The model number for standard units, and units with CP and AB options, is located at the upper end of the terminal block stamped on a stainless steel tag. Plug-in units have their model number labeled on the inside of the grip extension to the front panel. PB units have the model number on top of the transmitter case. For explosion-proof units, the model number is stamped on a stainless steel tag on top of the enclosure and on the identification label on the unit within the enclosure. PM units model numbers are stamped on a stainless steel tag, visible when the rear safety cover is removed. To expose the model number on all NEMA box enclosures, open box and remove safety cover of the unit.

1.6 SERIAL NUMBER USE AND LOCATION

A complete history is kept on every MOORE unit. This information is keyed to the serial number. Whenever service data is required on a unit, it is necessary to provide the factory with a serial number as well as a model number. This identification is usually located with the model number (see paragraph 1.5 for location on equipment) except for plug-in units and explosion proof where the serial number is engraved into the PC board or stamped on a stainless steel tag respectively, and is usually preceded by the letter E.

TABLE 1-1. UNIT SPECIFICATIONS

INPUT: 5-32 volt pulse at 5 mA, or isolated contact closure (CC option)

Input Ranges:

- 0.2-1.8 seconds duration
- 1-5 seconds duration
- 3-12 seconds duration

FRONT PANEL ADJUSTMENTS: Adjustable with multi-turn potentiometer

Span: With full scale input, adjusts output to 100% ±20% of selected output span

Zero: With minimum input, adjusts output to 0% ±10% of selected output span

OUTPUT: Operational amplifier feedback current source; output limited to 150% of maximum output range value.

Current:

- 1-5 mA into 0-4800 ohm load
- 4-20 mA into 0-1200 ohm load
- 10-50 mA into 0-480 ohm load

Voltage: 1-5 VDC standard into 20K ohms minimum

Ripple: 10 mV P/P maximum span and maximum load resistance

Load Effect: ±0.01% of span from 0 to maximum load resistance (current output)

PERFORMANCE:

Calibration Capability: ±0.1% of span

Ambient Temperature:

- Range: 0°F to +165°F (—18°C to 74°C)
- Effect: ±0.01%/°F over above range

Isolation: Voltage output units have input negative side common to output negative side. Current output models have output negative side elevated above input negative side. Mixed outputs are optionally available. Power input isolation is maintained on both AC and DC powered units.

POWER INPUT:

- 24 VDC, 45 VDC, ±10% **standard**
- 117 VAC, 240 VAC, 50/60 Hz, ±10% **optional**
- 5 watts nominal

CERTIFICATION: Canadian Standards Association

WEIGHT: Approximately 2 lbs. (908 grams)

TABLE 1-2. MODEL NUMBER EXAMPLE

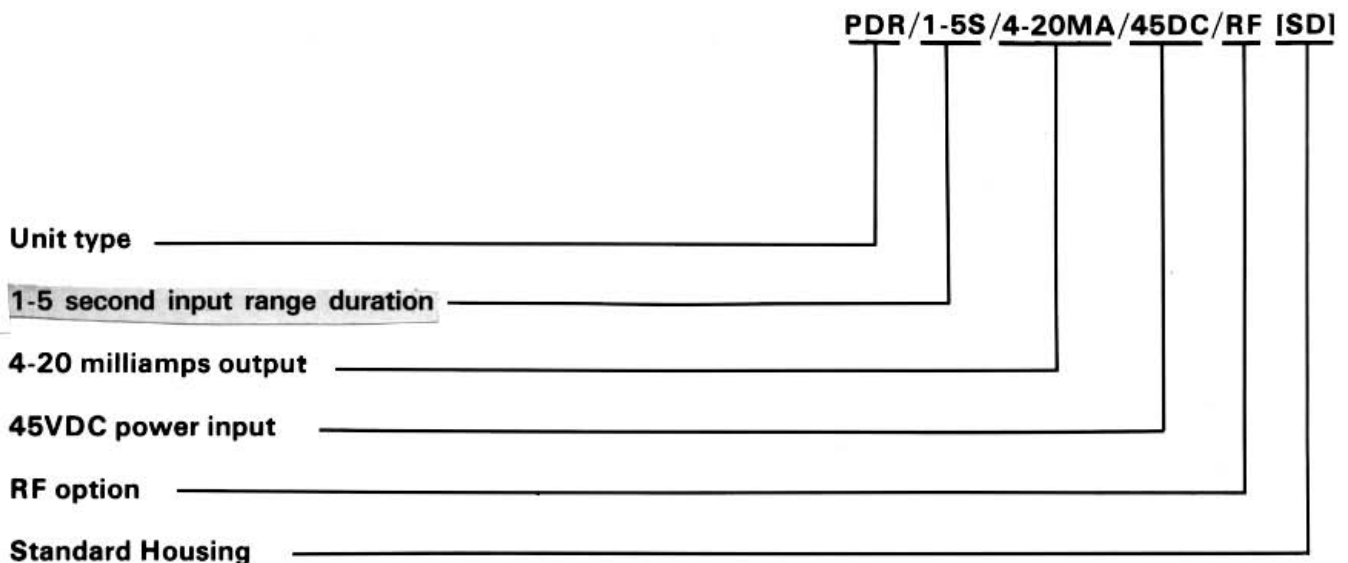


TABLE 1-3. PDR ELECTRICAL OPTIONS

OPTION DESCRIPTION	CODE
Input attenuation for signal input voltage exceeding specification — specify voltage (200V maximum)	AT
Contact Closure Input — provides capability to process relay contact closure signals	CC
Intrinsically safe protection — provides zener fuse barrier to input and/or output lines to limit energy to intrinsically safe levels. Requires a NEMA type enclosure for mechanical installation (NEMA 1, 4 or 12)	EB
Factory calibration of unit	FC
Power fuse on Plug-In Transmitter Card (PC Option), 400 mA rating	FU
High-Current/Voltage Output — (Analog units only) 1-5V output, capable of delivering 20 mA	HI
RFI Filter Terminal Assembly — (Standard Units Only) adds Moore Industries patented integral Filter Terminal Assembly which prevents radio frequency energy from entering standard aluminum case	RF
Reversed output current or voltage relationship (Analog output units only)	RO
Selected Current Output — provides external selection of different current outputs (1-5 mA, 4-20 mA, or 10-5 mA)	SC

CALIBRATION

2.1 GENERAL INFORMATION

This section provides information about unit calibration. Units with standard input and output levels are normally calibrated at the factory. After the unit is unpacked, general operating level checks of units is recommended. Usually these checks, specified in this section under calibration procedures, require little or no adjustments. If units are ordered with factory calibration option (FC), an exact calibration is performed at the factory, and red caps are placed on the controls. Adjustments should not be made in the field on these units unless a new range of input or output signal level is desired. Red caps should not be removed as a precaution against accidental adjustments.

External controls are multiturn potentiometers that are adjusted with a blade screwdriver NOT MORE THAN 0.1 INCH (2.54 mm) WIDE. USE OF A WIDER BLADE MAY PERMANENTLY DAMAGE THE POTENTIOMETER MOUNTING. This type of potentiometer usually requires 20 turns of the shaft to move the wiper from one end of its range to the other. It is equipped with a slip clutch at either end of its travel to prevent damage if it is turned beyond the wiper stop. Usually a slight change in feel will be noticed when the clutch is slipping. However, if this change is not observed, either end can be reached by turning the shaft 20 turns in the desired direction. Controls are connected, so turning the shaft clockwise increases the quantity or makes it more positive, and turning the shaft counterclockwise has the opposite effect.

2.2 CONTROLS DESCRIPTION AND LOCATION

The controls consist of ZERO and SPAN adjustments, located on the unit front panel.

2.3 TEST EQUIPMENT AND TOOLS REQUIRED

Test equipment and tools required for calibration of the unit are described in Table 2-1; they are not

TABLE 2-1. TEST EQUIPMENT AND TOOLS REQUIRED

Equipment or Tool	Characteristic	Purpose
Screwdriver (blade)	Blade not wider than 0.1 inch (2.54 mm)	Front Panel Control Adjustment
Pulse or Contact Closure Input Device	Must be capable of producing signal ranges defined by INPUT level requirements of purchased unit (see Table 1-1)	Simulate input signal levels
DC Voltmeter	Must be accurate to within $\pm 0.05\%$ or better	Output signal monitoring (voltage outputs only)
DC Milliammeter	Must be accurate to within $\pm 0.05\%$ or better	Output signal monitoring (current outputs only)

supplied and must be provided by the customer at the installation or test site.

2.4 TEST EQUIPMENT SETUPS

Off-line calibration for all units require the same test equipment setups regardless of option or physical configuration. The hookup requirements and physical preparations may vary on some units. The following paragraphs define the general test setup and identify the units that require special attention for test preparation and connections.

2.4.1 General Test Equipment Setups

The test equipment setup required for calibration of all units is identical except for connection identification. Figure 2-1 shows the general test setup configuration. Connection nomenclature refer to terminal markings on the standard units with CP, AB, AA/AT, PM, and NEMA boxes mechanical options.

2.4.2 Plug-In Units Test Equipment Setup

Plug-in units equipment test setup is the same as the one shown in Figure 2-1, except that printed circuit board connections are identified in that figure by numbers in parentheses. Connection

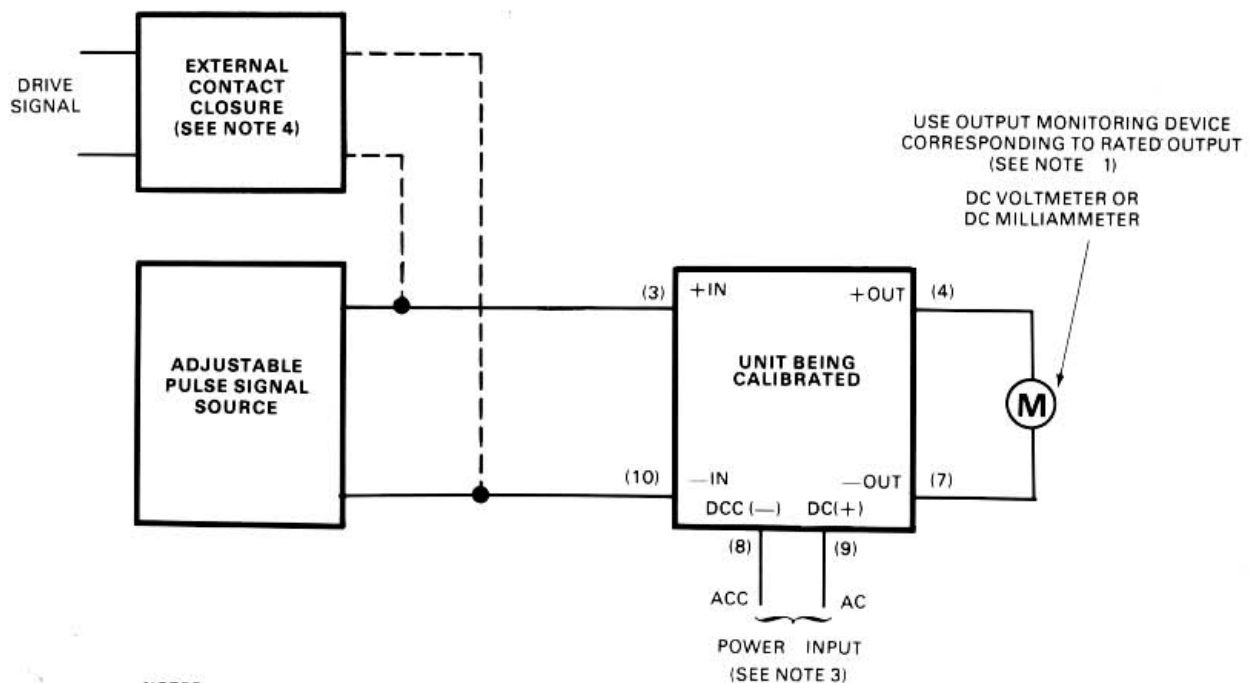
identification numbers are etched in the component side of the PC board. Plug-in units inserted in a rack also use the test setup shown in Figure 2-1 with card rack terminal connections identified by numbers in parentheses. These include either the rack mount (RMR) or the surface mounted (SMR).

2.4.3 Explosion-Proof (EX) and PB Option Test Setup

Figure 2-2 shows the general test setup configuration for an explosion-proof enclosure or a PB option. Note that in the explosion proof configuration the protective housing must be opened and the unit removed to expose the connection block. Similarly, units with the PB configuration must be unplugged from the connection block in order to access the connections more effectively. Numbers in parentheses refer to terminal block numbers.

2.5 CALIBRATION

Units are calibrated and checked for proper performance at the factory before they are shipped. However, unless calibration was requested to a specific set of input-output values, the unit performance should be checked by the user before the unit is placed in service. Calibration consists of simulating the operative signal input and adjusting the unit to obtain the specified output.



NOTES:

1. MONITORING DEVICES MUST BE ACCURATE TO WITHIN +0.05% OR BETTER
2. NUMBERS IN () APPLY TO PLUG-IN UNITS ONLY
3. EITHER AC POWER OR DC POWER IS SUPPLIED BUT NOT BOTH
4. USE ONLY IF UNIT HAS CC OPTION

Figure 2-1. Test Equipment Setup For Calibration of Unit

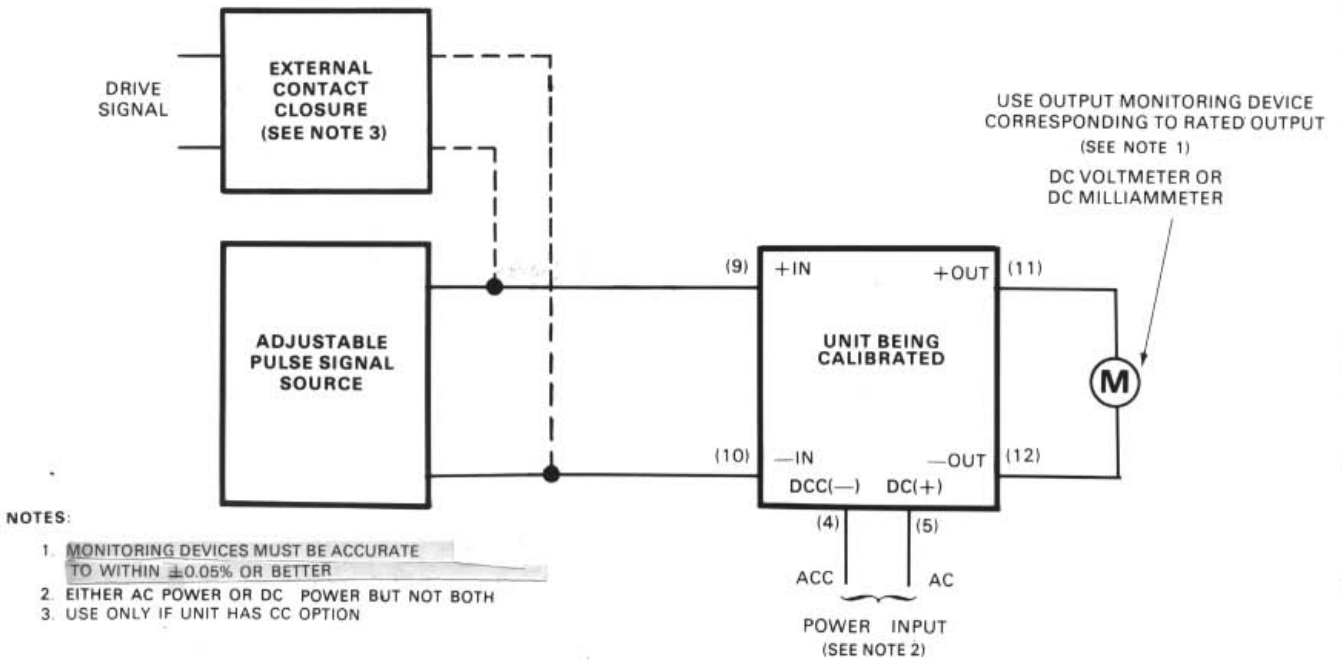


Figure 2-2. Test Equipment Setup for Calibration of Explosion Proof and PB Units

NOTE

Adjustments should *not* be made in the field on units that are calibrated to values specified in the purchase order. Units that are calibrated at the factory to customer's specifications have protective caps over the SPAN and ZERO potentiometers; do NOT remove these caps.

A pulse signal source, with an appropriate pulse repetition rate and with a pulse duration that can be varied, is required to calibrate the unit. A PDT (Pulse Duration Transmitter), driven by an analog signal that can be varied in the required manner, may be used to supply the pulse signal. Or, the signal may be supplied by a pulse generator with the required range and with an adjustable pulse width. The accuracy of the pulse duration of the input signal (in terms of percent of pulse repetition period) must be $\pm 0.01\%$ or better. If the PDR has the CC (contact closure) option, the external contacts are used instead of the signal generator. Appropriate adjustable drive must be supplied to the contact closure device (e.g., relay). An output monitoring device (current or voltage) with an accuracy within $\pm 0.05\%$ or better is also required.

NOTE

Refer to paragraph 1.5 for information on how to use the model number to obtain the specified values of minimum and maximum output.

To calibrate a unit, proceed as follows:

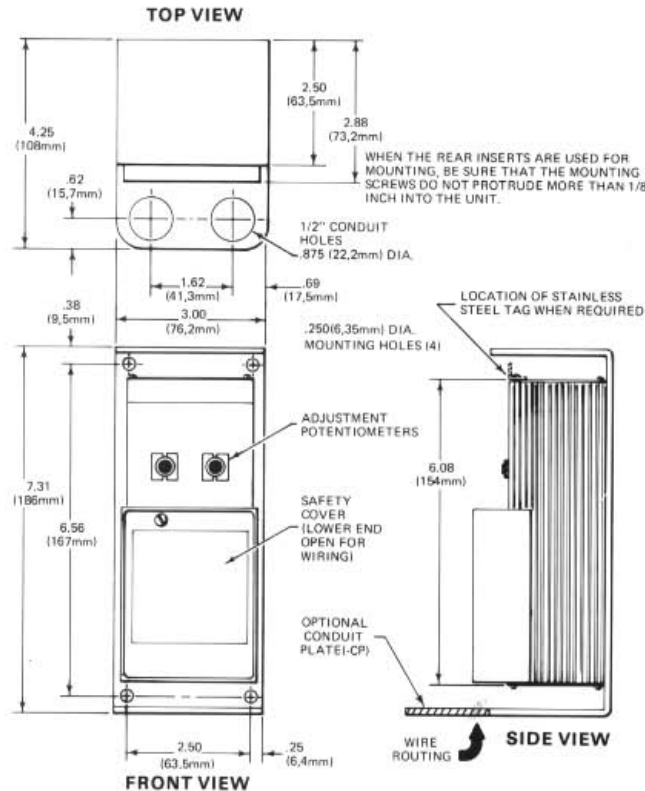
- a. Connect unit and test equipment as shown in Figure 2-1 or 2-2.
- b. Apply power input to the unit.
- c. Adjust the pulse signal source (or drive to the contact closure device) to produce a pulse period (i.e., frame time) the same as that to be applied to the unit when it is installed. (For conciseness, the pulse signal source or the contact closure device (whichever is used) will be referred to hereafter as the input signal source.) For example, if the pulses to be applied to the unit have a frame time of 15 seconds, adjust the input signal source to produce one pulse every 15 seconds.

- d. Adjust the input signal source for a pulse duration corresponding to 0% input. For example, if a pulse duration of 3 seconds represents 0% input, adjust the input signal source to produce a 3-second pulse every 15 seconds (3 seconds on and 12 seconds off).
- e. Adjust the ZERO potentiometer to obtain 0% output. For example, for an output range of 4 to 20 mA, the ZERO potentiometer would be adjusted to obtain 4 mA output.
- f. Adjust the input signal source for a pulse duration corresponding to 100% input. For example, if a pulse duration of 12 seconds represents 100% input, adjust the input signal source to produce a 12-second pulse every 15 seconds (12 seconds on and 3 seconds off).
- g. Adjust the SPAN potentiometer to obtain 100% output. For example, for an output range of 4 to 20 mA, the SPAN potentiometer would be adjusted to obtain 20 mA output.
- h. Repeat steps (d) through (g) as required to obtain the outputs specified in steps (e) and (g), until no further adjustment of either the ZERO or SPAN potentiometer is required.
- i. After step (h) has been successfully completed, remove the input signal source and turn off the power to the unit.

INSTALLATION AND OPERATION

3.1 MECHANICAL INSTALLATION

Units may be obtained in various physical configurations. Figures 3-1 through 3-10 show the outline dimensions and other installation requirements for the available configurations. Select the proper outline and dimension figure applicable to the unit purchased. Be sure to observe the applicable special procedures and precautions given with the illustration. Although the units are designed to operate in free air at quite a high ambient temperature, it is advisable, if possible, to mount the unit on a surface made of material that can serve as a heat sink. For a plug-in unit mounted in a rack, be sure that the rack has adequate ventilation.



NOTES:

1. Complete Model No. and Serial No. are permanently marked on identification plate located at upper end of terminal blocks.
2. When extra-compact mounting is required for rack or portable installation, C-shaped mounting bracket may be removed and two threaded inserts (located 4.00 inches apart) may be used for mounting, using 6-32NC machine screws.

Figure 3-1. Standard Unit and Unit with CP Option, Outline and Dimension

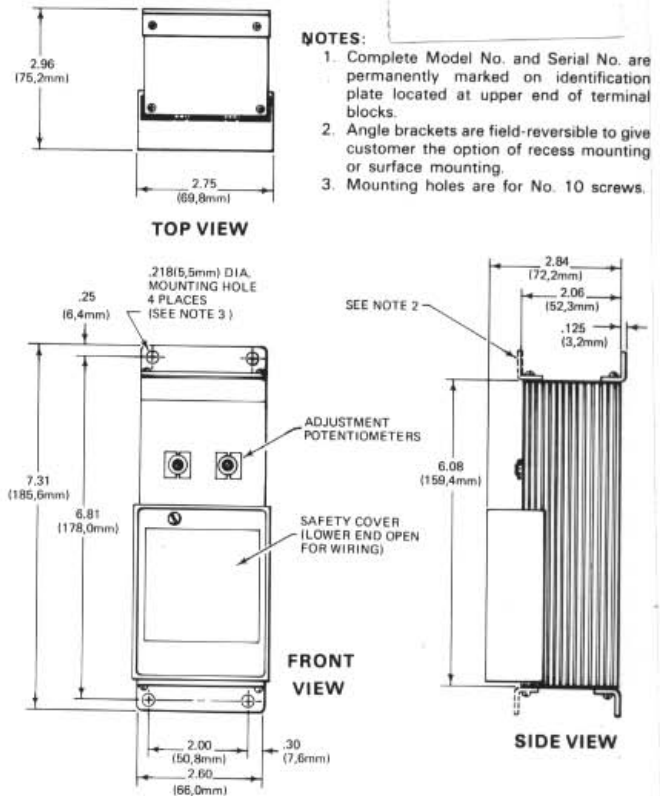


Figure 3-2. Standard Unit with Angle Brackets (AB) Option, Outline and Dimensions

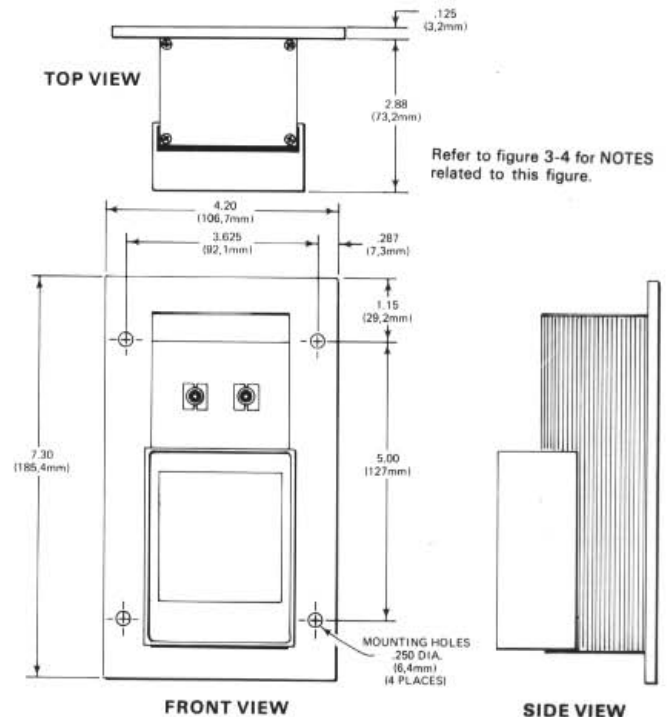
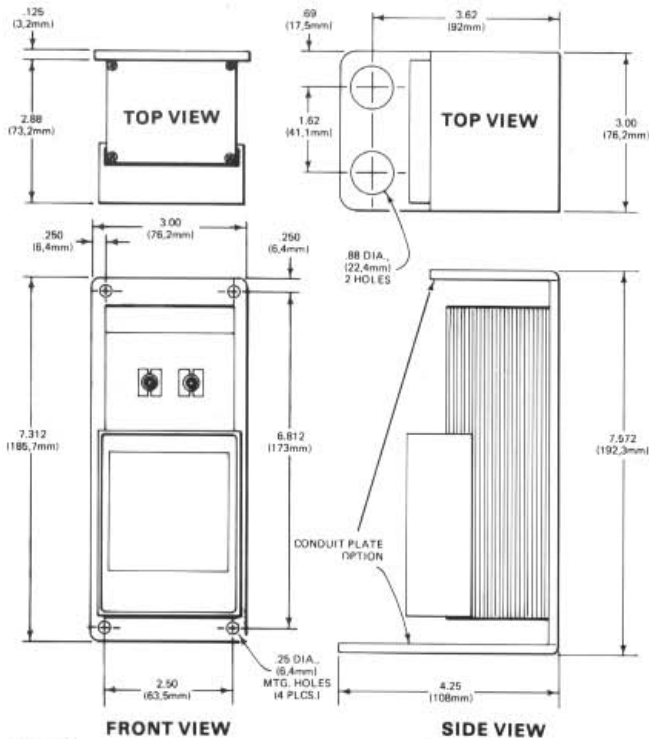


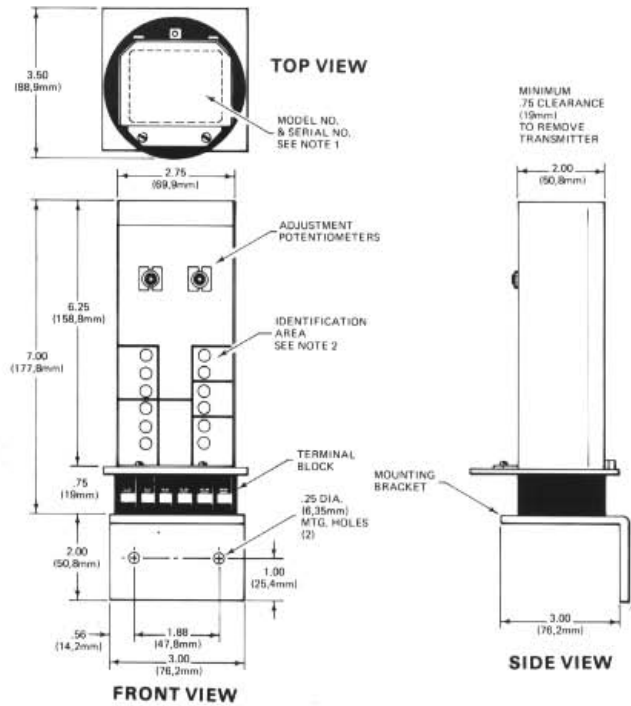
Figure 3-3. Standard Unit, With Adaptor Plate (AA) Option, Outline and Dimensions



NOTES:

1. Use two threaded inserts (located 4.00 inches apart on back of standard transmitter) for mounting adapter plate to transmitter. Use 6-32 NC machine screws.
2. Unit to adapter plate mounting screws should not protrude more than 1/8" into the unit.

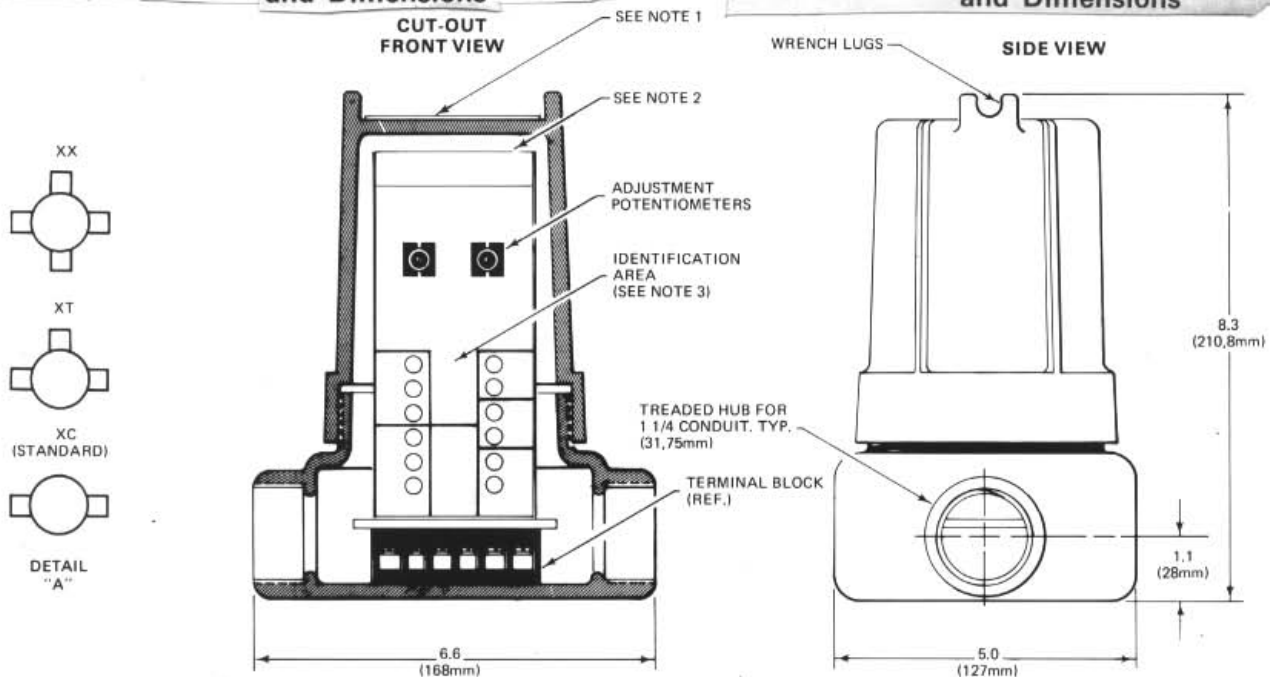
Figure 3-4. Standard Unit, With Adaptor Plate (TA) Option, Outline and Dimensions



NOTES:

1. Identification area on top of unit case carries complete model number and serial number.
2. Identification area on front of transmitter case gives electrical connection information.

Figure 3-5. Standard Unit With Plug-In STD Transmitter (PB) Option, Outline and Dimensions



NOTES:

1. Top of cover has metal label carrying unit type (e.g., TCT, MVT) and equipment number (if any).
2. Identification area on top of unit case carries complete model number and serial number.
3. Identification area on front of unit case gives electrical connection information.
4. Standard "XC" housing (two conduit hubs) is shown above. Similar housings with three or four hubs is illustrated in detail A. Housings are cast aluminum alloy and meet NEMA specifications for Class I, Groups C and D and Class II, Groups E, F, and G.

Figure 3-6. Standard Unit in Explosion-Proof Enclosure, Outline and Dimensions

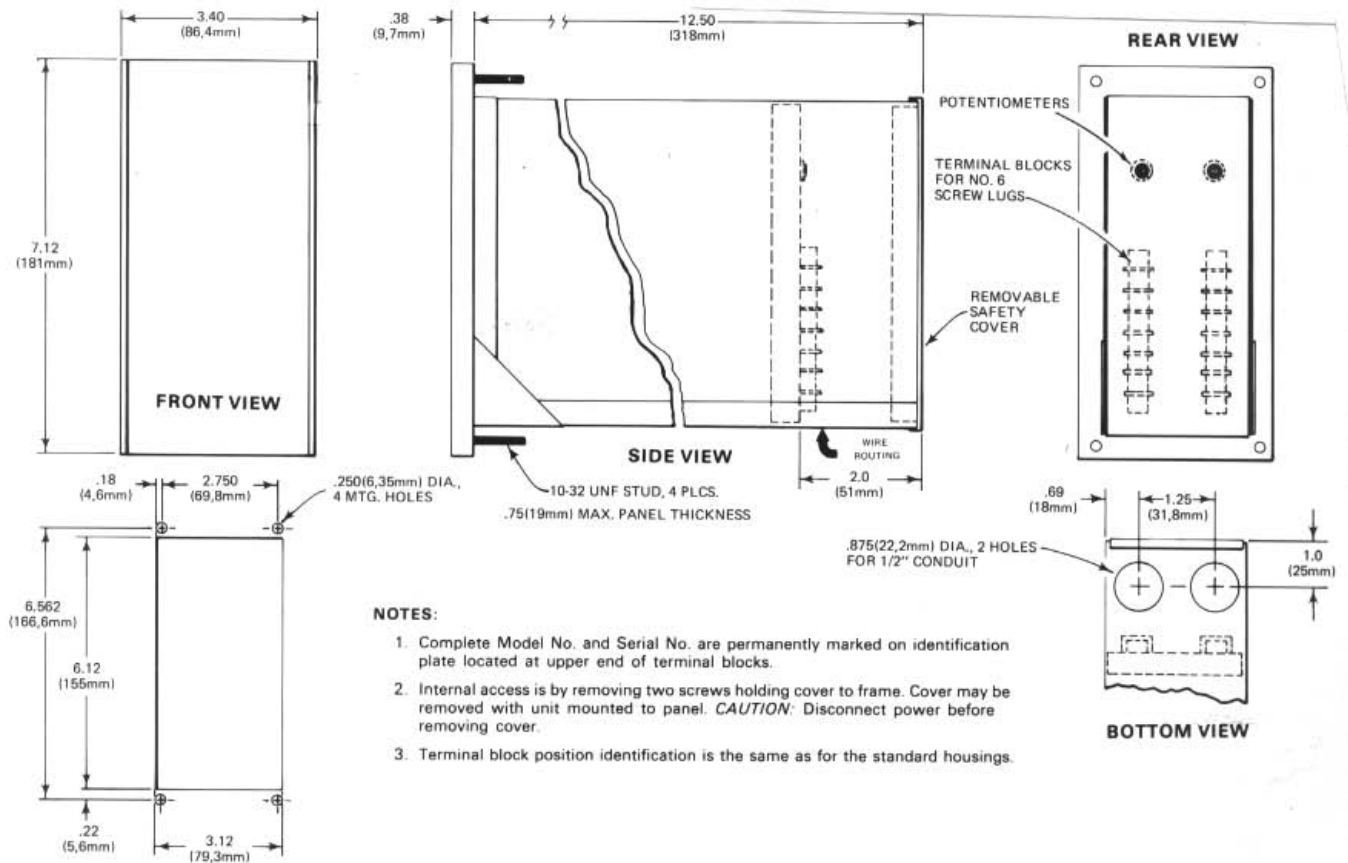


Figure 3-7. Standard Unit with Panel Mount Enclosure (PM) Option, Outline and Dimensions

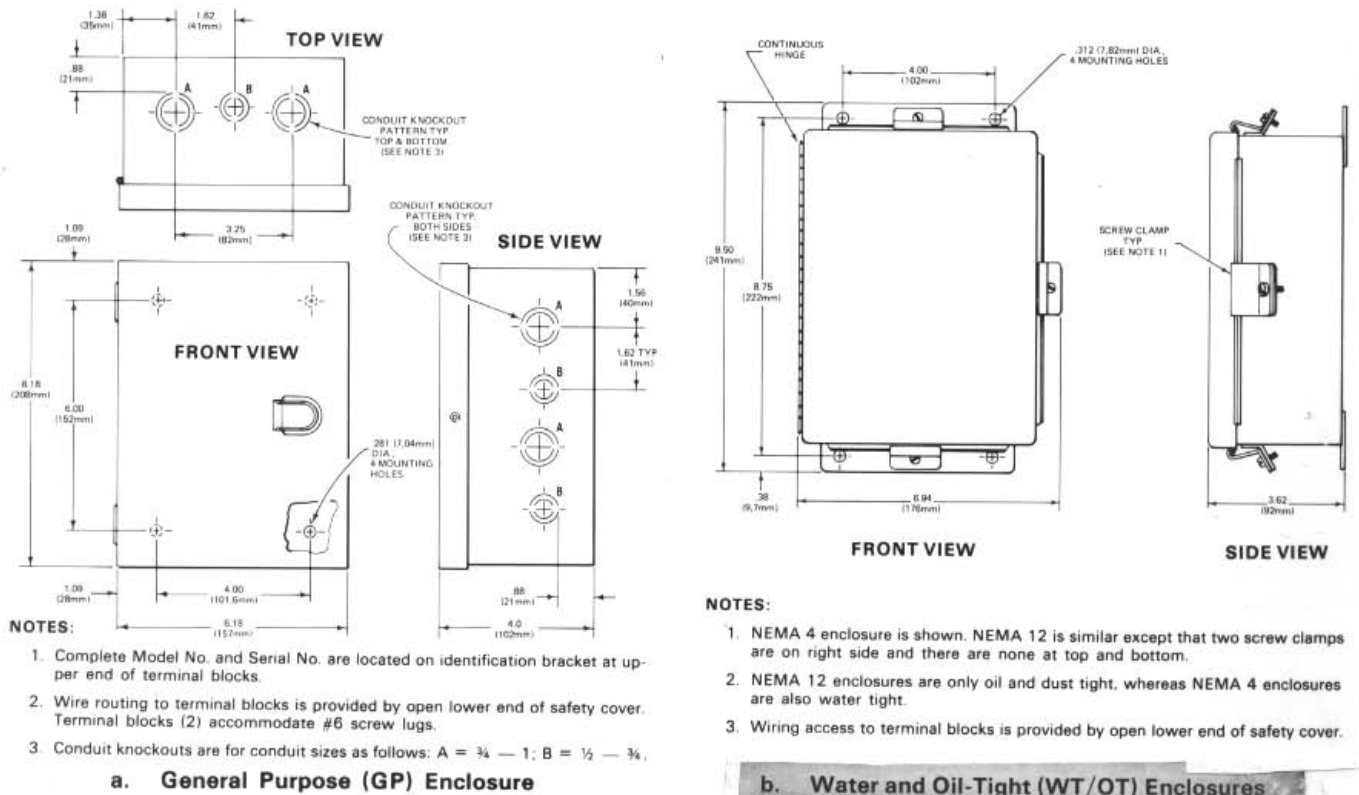
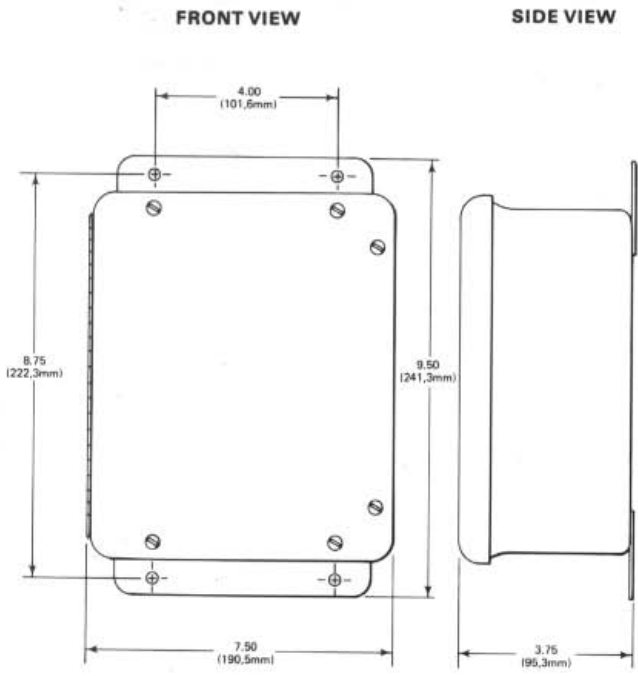


Figure 3-8. Standard Unit in NEMA Boxes, Outline and Dimensions

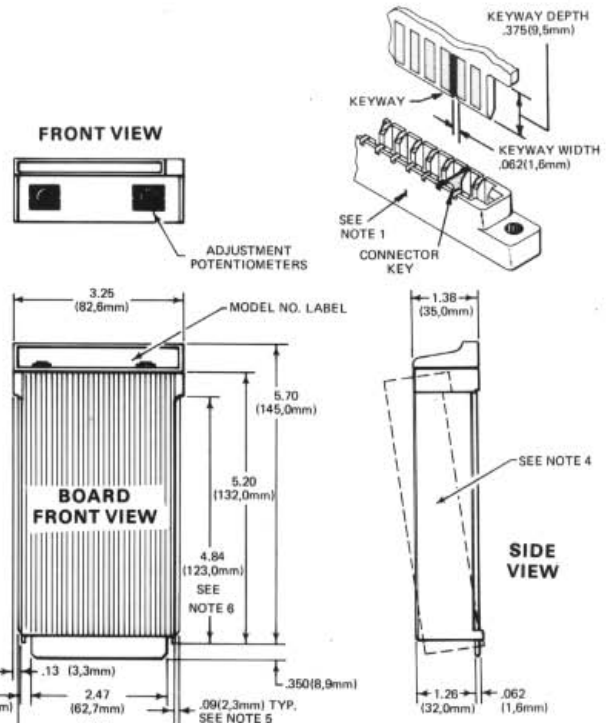


NOTES:

1. All exposed metal hardware is type 302 stainless steel. Boxes are hinged on the long side unless otherwise specified.
2. All boxes include a one piece closed cell neoprene gasket.
3. Standard color is machine tool grey. Boxes are molded from pigmented polyester resins with the color throughout the box wall for a maintenance-free installation.

c. Corrosion-Proof (FG) Enclosure

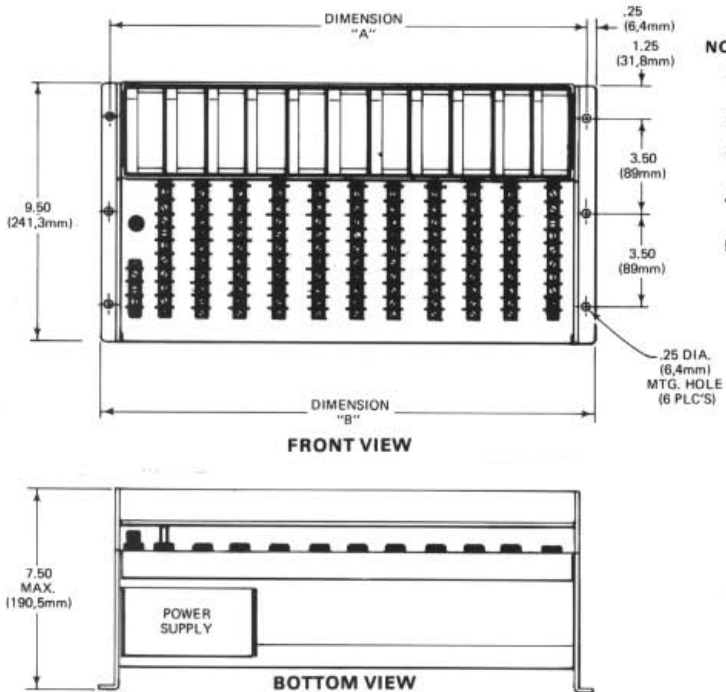
Figure 3-8. Standard Unit in NEMA Boxes, Outline and Dimensions (Cont.)



NOTES:

1. Connectors used must have contacts on .156 (3.96mm) centers, with contacts for both surfaces of board (recommended type: Viking part no. 2VK155/1-2).
2. Maximum card insertion depth in connector is .350 (8.89mm).
3. Minimum width of connector insertion slot is 2.470 (62.70mm).
4. Removable plastic safety cover, 2.800 (71.12mm) wide.
5. Maximum card edge-guide insertion depth is .09 (2.29mm). Guides must be non-conductive.
6. Card edge-guides cannot extend beyond here.
7. Card extender part no. 350-513-00 is available for testing unit while in operating position.

Figure 3-9. Plug-In Unit, Outline and Dimensions

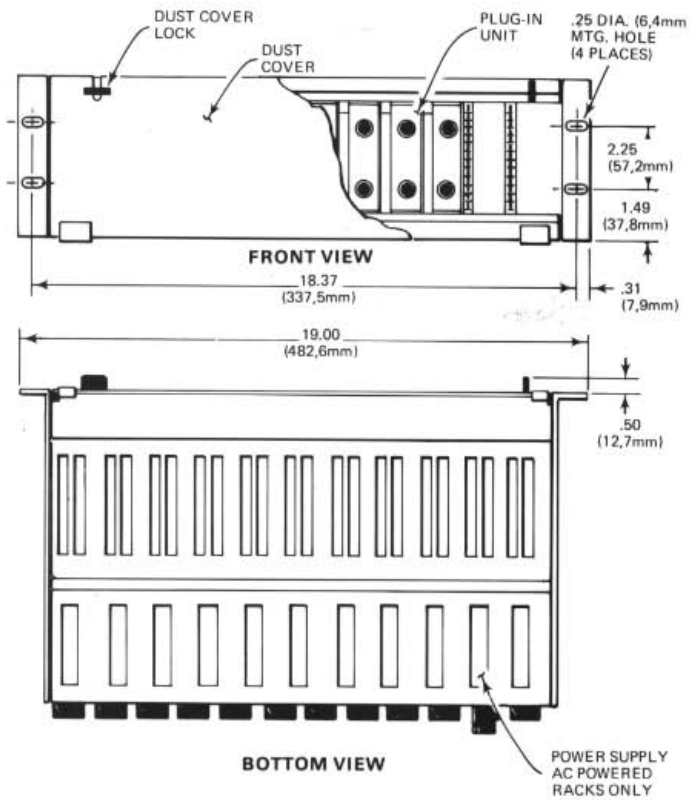


NOTES:

1. M.I.I. surface mounted card rack accommodates as few as 5, and as many as 15 plug-in units.
2. Empty positions may be closed by means of filler cards, P/N 350-213-00.
3. Connections are keyed to assure units will be plugged into proper position. Keying may be changed in the field if the system configuration changes.
4. Eleven position card rack is illustrated. Dimensions for mounting larger or smaller racks may be found in the table.
5. 24V power supply, shown, is capable of powering all models in card rack. Input specification, 117 VAC \pm 10%, 50/60 Hz, approximately 40 watts.

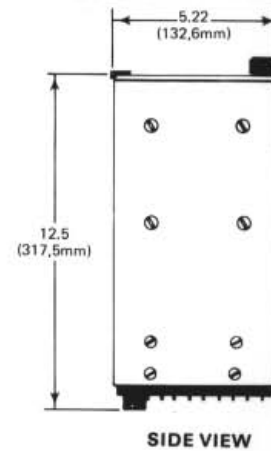
NUMBER OF POSITIONS	DIMENSION			
	A	mm	B	mm
5	9.19	233.4	9.69	246.1
6	10.62	269.7	11.12	282.4
7	12.06	306.3	12.56	319
8	13.50	342.9	14.00	355.6
9	14.94	379.5	15.44	392.2
10	16.38	416	16.88	428.8
11	17.81	452.4	18.31	465
12	19.25	489	19.75	501.7
13	20.69	525.5	21.19	538.2
14	22.12	561.8	22.62	574.5
15	23.56	598.4	24.06	611.1

Figure 3-10. Surface Mounted Card Racks (SMR), Outline and Dimensions

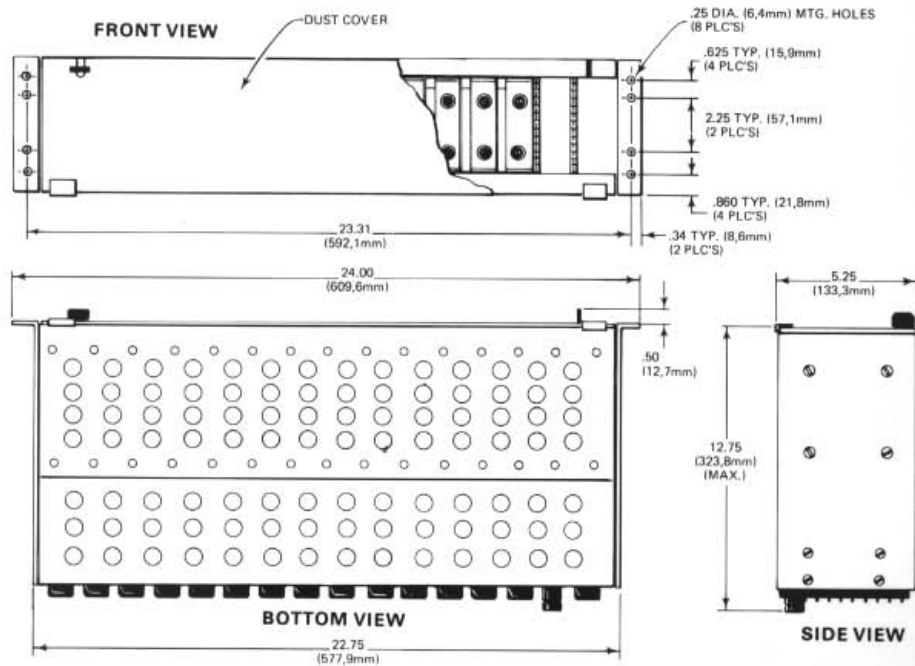


NOTES:

1. Connectors are keyed to assure units will be plugged into proper position. Keying may be changed in the field should the system configuration change.
2. This enclosure is designed to mount in a standard 19-inch rack with E.I.A. hole pattern.
3. Surface mounting card racks for use in NEMA type enclosures are also available. Contact factory for further details of card racks and card rack assemblies.
4. Barrier strip connectors are CSA approved.
5. Empty positions may be closed by means of filler cards, Part No. 350-213-00, which must be ordered individually in quantity required.
6. 24 volt power supply furnished capable of powering a typical complement of up to fifteen modules. Input specification 117 volts \pm 10% 50/60 Hz approximately 40 watts.



a. Eleven-Position Card Rack



b. Fifteen-Position Card Rack

Figure 3-11. Rack-Mounted Card Racks (RMR) Enclosure, Outline and Dimensions

3.2 ELECTRICAL CONNECTIONS

All electrical connections to standard units are made to the terminal blocks on the unit. On plug-in units, the electrical connections are made to terminals on the mating connector for the unit. Terminals used for standard units and their options are defined in the following paragraph.

3.2.1 General Wiring Information

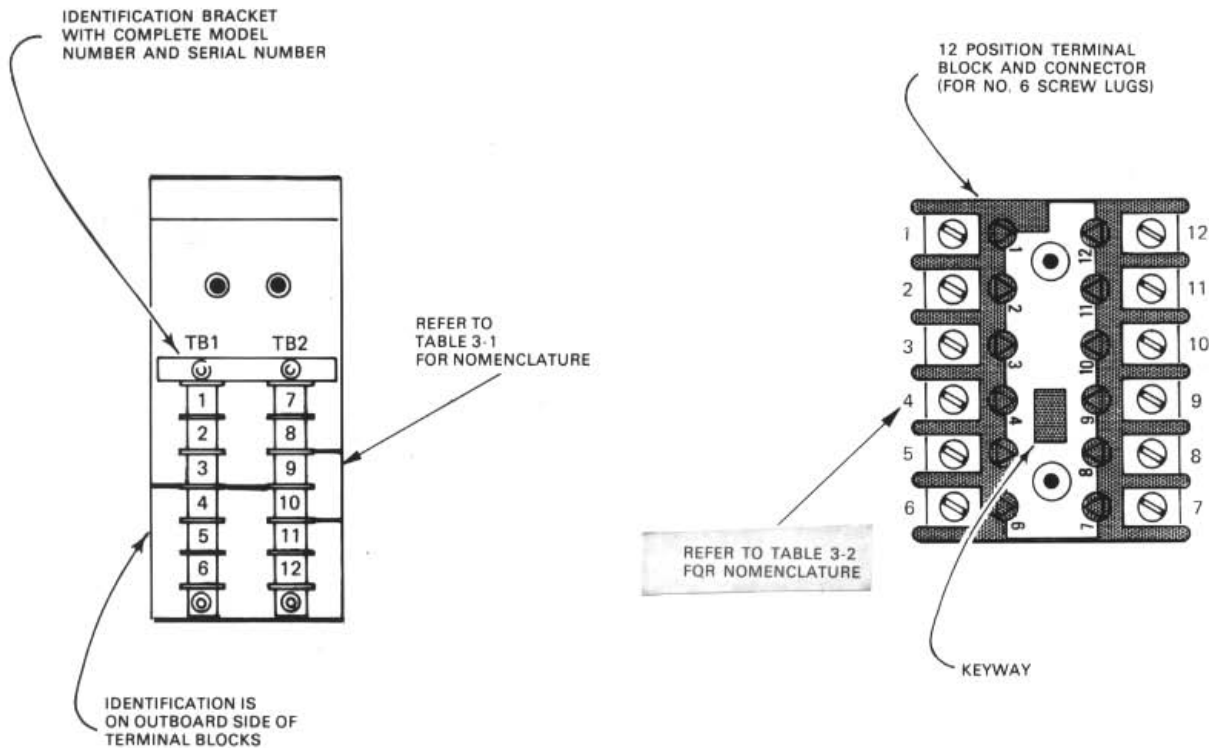
No special wire or cable is required for signal connections to the unit. To avoid transients and stray pickups, it is recommended that twisted conductors be used where they are run close to other services (such as power wiring). Electrical connections to the units fall into two major categories: connections to all standard units with terminal blocks, and connections to plug-in units and their associated enclosures.

Wiring Information for All Standard Units With Terminal Strips and Blocks. Standard units with terminal strips or terminal blocks have terminals supplied with 6-32 screws long enough to easily accommodate three spade-lug connectors. Standard units with snap-off plastic covers have an opening in the bottom of the cover. Dress all wiring to and from the terminals through this opening. Spade lug connectors are recommended for all wire terminations. Figure 3-11 illustrates the

terminal strip locations and identification for the standard units and the terminal block identifications for the explosion proof and PB configurations. Table 3-1 provides the complete labeling nomenclature for standard units and any available electrical options. Terminal labeling appears next to the terminal it identifies on standard units. For PT and explosion proof units, terminal labeling is marked on the front of the unit housing with the referenced terminals identified numerically.

Wiring Information for All Units in NEMA Boxes. Units mounted in NEMA boxes are standard units with or without the options listed in Table 3-1. NEMA boxes for OT or WT options do not have conduit holes fittings or knockouts. Conduit access must be provided by fittings such as Myer Scru-Tite or equivalent.

General Purpose (GP) enclosures have conduit knockouts for various sizes of conduits from 1-inch down to 1/2-inch. Corrosion-Proof (FG) enclosures require special attention with ground connections. Since enclosure material is polyester resin, conduit cutouts may be cut with a punch or hole saw. Ground continuity may be obtained in two different ways. If a metal panel is used, ground can be made between the metal con-



a. Standard Units

b. Units with EX or PT Configuration

Figure 3-11. Terminal Strips and Terminal Blocks Identification

TABLE 3-1. TERMINAL NOMENCLATURE

Options (Note 1)	Terminal Positions (See Figure 3-11)											
	1	2	3	4	5	6	7	8	9	10	11	12
SD				DCC	DC	GND			+IN	-IN	+OUT	-OUT
AC				ACC	AC	GND			+IN	-IN	+OUT	-OUT
SC (Output)		SC	SC									
CC (Note 2)												
RO (Note 3)												
AT (Note 3)												
HI (Note 3)												

NOTES:

1. Labeling shown here may be combined. The combination may include standard labeling and one or more options. Combinations of options may cause labeling positions to change, but nomenclature will remain as shown.
2. Terminal nomenclature not affected by this option. **CC connections made** across +IN and -IN terminals.
3. Terminal nomenclature not affected by this option.

Legend:

DC +DC Power Input
 DCC -DC Power Input
 GND Chassis Ground
 AC AC Power Input

ACC AC Power Return
 ±IN Signal Input
 ±OUT Signal Output
 SC SC Resistor

duit locknut and the panel at enclosure entry and exit. If the enclosure is used without the back panel, a jumper between the conduit entry and exit is necessary to maintain ground continuity. Remove snap-off plastic cover to access terminal strips.

Wiring Information for Plug-In Units. Plug-in units and card rack electrical connections are made to terminals on the mating connector for the unit or the card rack terminal strips. Figure 3-12 illustrates the terminal strip connections and their

numerical reference designator. Table 3-2 provides a complete terminal nomenclature for both Plug-In and Rack assemblies.

3.2.2 Power Connections

Units are designed to operate from either a DC or AC power source. Refer to paragraph 1.5 for information on how to use the model number to determine the type of power required.

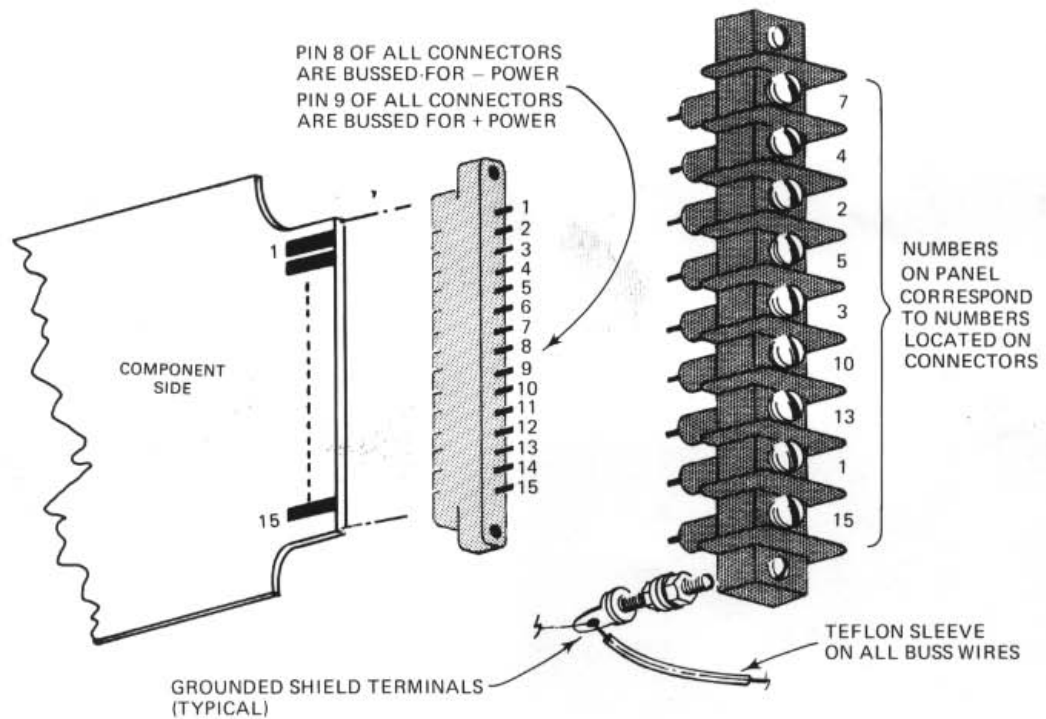


Figure 3-12. Plug-In Connectors and Terminal Strips Wiring and Identification

TABLE 3-2. CONNECTOR PINS AND TERMINAL ASSIGNMENTS FOR PLUG-IN UNIT AND CARD RACKS

Options	Terminal Position (See Figure 3-12)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NONE or CC, RO or AT Options			+IN	+OUT			-OUT	DCC	DC		-IN				
SC (Output)		SC			SC										

↑ Keyways ↑

Legend:

DC	+ DC Power Input	± IN	Signal Input
DCC	- DC Power Input	± OUT	Signal Output
GND	Chassis Ground	SC	SC Resistor

DC-powered units. On these units the DC terminal is connected to the + (positive) side of the source, and the DCC terminal is connected to the — (negative) side. The DC source should be regulated to within $\pm 10\%$ of the nominal voltage and should be capable of delivering 5 watts.

AC-Powered Units. These units require 117 volts AC $\pm 10\%$, 50/60 Hz at 5 VA of nominal power or 220/240 VAC optionally. The AC terminal should be connected to the ungrounded or "hot" side of the supply, if possible, and the ACC terminal is connected to the common or neutral. The GND terminal is the mechanical case connection.

Rack Power Connections. Connect power input wires to the appropriately labeled terminals of the 3-terminal connector strip. The third terminal on strip is chassis ground.

3.2.3 Connections On Units With SC Option

On units with the SC (selectable current) option, connect the output selectable current resistor to the terminals marked SC, or those specified in Table 3-1. The current range is marked on the body of each resistor. If provided, the selectable current resistors for a plug-in unit should be mounted externally either at the terminal block of

the card rack, or soldered to the appropriate terminals on the PC connector. See Table 3-2 for correct connections.

3.3 OPERATION AND PERIODIC OBSERVATION

Once calibrated and installed, the unit may be operated unattended. The only controls on the outside of the unit are the SPAN and ZERO potentiometers, which, after initial adjustments, need no further attention. There are no indicators on the unit. Because the circuit uses highly reliable solid-state components with no moving parts, the unit should operate virtually maintenance-free for a long period of time. However, if a malfunction should occur, refer to Section 5 for maintenance information.

A periodic check of input and output connections is recommended every six months to ensure continued dependability of operation.

A unit may become warm during operation, especially where the ambient temperature is rather high. This is perfectly normal and should not be a cause for alarm unless a malfunction is also observed.

THEORY OF OPERATION

4.1 INTRODUCTION

This section describes the theory of operation of the unit. The description of each circuit is presented in sufficient detail so troubleshooting, if required, can be carried out intelligently and rapidly.

A schematic diagram and a block diagram (Figure 4-1) of the PDR module is included in this manual. Unless otherwise directed, refer to the schematic diagram when reading the following paragraphs.

Components reference designators are listed here for both the standard and the plug-in models. The standard unit reference designator is listed first followed by the reference designator for the plug-in unit in parentheses and italics. If both reference designators are the same, only one is listed.

4.2 GENERAL FUNCTIONAL DESCRIPTION

The PDR electronics consist of a nobounce input

buffer stage, a clock and control logic circuits all mounted on a separate board (PC3); a counter, latch circuit, D to A ladder and output circuits are mounted differently between standard and plug-in units. In the standard units the counter, latch circuit and D to A ladder are all mounted on PC2, another separate board, while the output circuits are mounted on the main board with the power supply. In the plug-in units, it is the output circuits that are mounted separately from the main board. These circuits are mounted on PC2, while the counter, latch circuit and D to A ladder are all on the main board with the power supply.

As the input pulse or contact closure is received (Figure 4-1), a counter is triggered on and continues to count up at each clock time. When the input signal returns low, the control logic generates two commands. The first control signal (Latch Control) loads the state of the counter into a series of D flip-flops. The second control (reset)

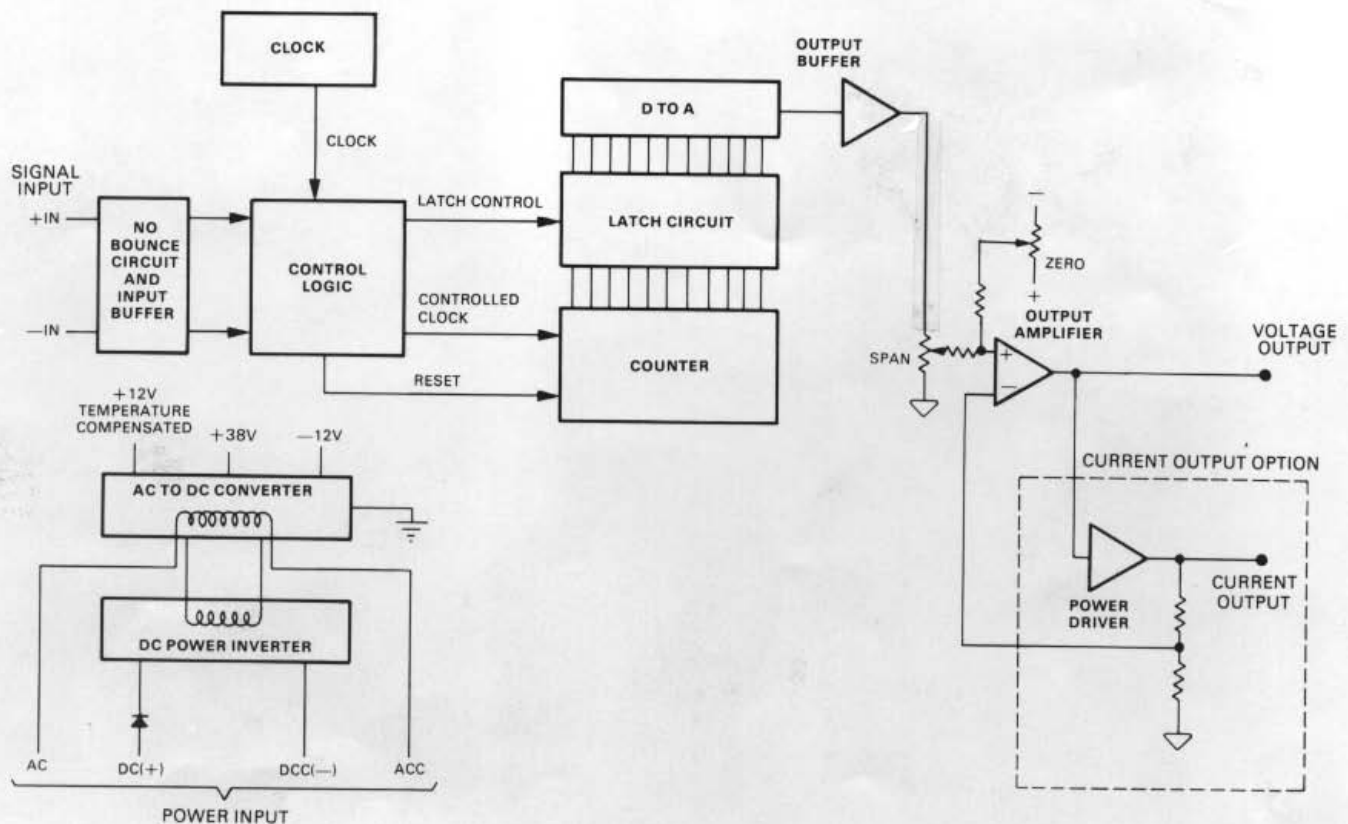


Figure 4-1. PDR Block Diagram

initializes the counter to zero in preparation for the next input pulse. A resistance ladder converts the D flip-flop's outputs into an analog signal (D to A) that is buffered and amplified for external processing.

4.3 AC POWER SUPPLY CIRCUIT (Standard Units Only)

The AC power supply circuit consists basically of a power transformer that produces two different AC outputs. Referring to the schematic diagram, VS1 is connected across the primary of power transformer T2 and suppresses transients that may be present on the power line. Each half of the center-tapped secondary of T2 develops 18 volts, and the other secondary produces 38 volts. The voltage from the center-tapped secondary is applied to a full wave bridge rectifier. The other secondary voltage is applied to a half-wave rectifier.

4.4 POWER-INVERTER CIRCUIT

When the unit is ordered for use with DC power, the power inverter is used instead of the AC source shown on the schematic diagram. The DC applied to the power inverter is converted to a square wave of approximately 3 KHz by Q2, Q3 (Q1, Q2) and the primaries of T1, functioning as a DC-to-AC inverter. Filter L1-C1 (C2) prevents the 3-KHz signal from getting back into the external DC source. CR4 provides protection against damage from inadvertent application of DC of incorrect polarity.

The square-wave output from center-tapped secondary 8-13 is applied to a full wave rectifier, and that from secondary 17-16 is applied to a half wave rectifier.

4.5 RECTIFIER AND REGULATOR CIRCUIT FOR STANDARD UNIT

Diode bridge rectifiers CR6 thru CR9 (CR6, CR5, CR9, CR10) form a full-wave bridge rectifier that produces both positive and negative DC outputs (with respect to the grounded center tap of the transformer winding). The positive DC output is filtered by C8, temperature compensated by IC2 (IC3) as well as regulated by both IC2 (IC3) and pass transistor Q1 (Q3). These circuits produce a regulated and temperature compensated +12V.

The negative DC output is filtered by C4 (C9) and zener regulated by CR5 to produce a -12V source for the operational amplifiers IC1 and IC3 (IC2). Voltage from the transformer winding that is not center-tapped is applied to a half-wave rectifier CR10 and filter C9 to produce operating voltage of approximately 38 volts for the power amplifier.

4.6 INPUT CIRCUIT

The PDR input circuit consists of an initialization circuit, a no-bounce buffer input circuit, a clock generator and control logic circuits.

4.6.1 Initialization Circuit

The initialization circuit consists of IC304 (IC302) and associated components. When power is applied to the PDR, the effect of RC network C304, R306 (C303, R303), causes IC304-4 (IC302-3) to go low for about a half second. This causes both TP7 and TP8 to go high providing a low enabling pulse at TP9 to IC303-8 (IC304-6). At the next low clock time, TP11 goes high and the counter resets. At the same time the high state of IC304-4 (IC302-3) propagates to pin 1 of the latch circuits and clears these circuits.

4.6.2 Buffer Input Circuit Description

The buffer input circuit consists of Q301, an element in IC303 (IC304) and associated components. These components form a no-bounce circuit that nullifies any contact bounce present in the input signal. The input from \pm IN terminals is divided down by R303 (R306), R304 (R305). During the quiescent state of the input signal, resistor R304 (R305) holds the base of Q301 to near ground, and Q301 is cut off. When the leading edge of an input pulse occurs, Q301 conducts and IC303-1 (IC304-1) fall to a near ground potential. The resultant voltage rise at IC303-3 (IC304-3) causes Q301 base through C303 (C304) to hold Q301 into saturation for about 10 milliseconds. This condition holds Q301 output at a steady state even if some contact bounce may exist on the input signal. If the CC option is used, the same effect occurs except that R303 (R306) is not in the circuit. Under these conditions, the contact closure input goes low, simulating a saturated Q301. With a low on IC303-1 (IC304-1), (IC303-3) (IC304-3) goes high. This state is propagated through C303 (C304) to the base of Q301 and the transistor saturates providing a no-bounce control for at least 10 milliseconds.

4.6.3 Buffer Input Circuit With Attenuation (AT) Option

With the AT option, the buffer input circuit operates exactly the same as described in paragraph 4.6.2 except that resistors R303 (R306) and R304 (R305) are selected to develop an attenuated signal compatible with the unit operating range.

4.6.4 Clock Generator Description

The clock generator produces the pulses that control the time-sequence action of the various gating circuits. It also provides the source of the pulses that are counted for a period equal to the ON time of the incoming signal.

The clock generator consists of IC301 and associated components. IC301 is a timer circuit whose frequency is controlled by resistor R301 and capacitor C301. These values vary according to the PDR input range requirement. Therefore, the PDR basic clock frequency range will vary from approximately 130 to 900 Hz.

4.6.5 Control Logic Circuits Description

The control logic circuit gates the counter clock and two control commands to the counter and latch circuits (see Figure 4-1). The basic clock frequency from the clock generator is gated to the counter circuits by IC304-10 (IC302-4) at TP6. The continuously running clock from the clock generator is controlled by the MSB of the counter to prevent any overrange while counting a pulse duration. This condition is implemented by IC303-11 (IC304-11). If the MSB from the counter is low, meaning that the counter is not full, the gate is enabled and the clock signal will be present at IC304-8 (IC302-6). When an input signal is received at +IN, IC304-11 (IC302-11) goes high gating the clock at TP6 to the clock input of counter IC201 (IC6).

As soon as the input signal returns to the quiescent state, IC304-11 (IC302-11) goes low disabling the clock gating element at TP6 and the counter stops. Similarly if the counter counts up to 2048 bits (full count), TP4 goes high disabling IC303-11 (IC304-11) and no clocks reach the clock gate at IC304-8 (IC302-6).

The two control commands issued from the control logic circuits consist of a latch control to the latch circuits and a counter reset control. These

two controls are generated by the action of two D flip-flops IC302-5 (IC303-5) and IC302-8 (IC303-8). While a pulse is present at +IN and the pulse duration is being timed, TP3 and TP7 are low and TP8 is high. When the +IN input returns to the quiescent state, TP3 goes high. At the next clock pulse TP7 also goes high, TP8 remains high for one more clock time. This condition enables IC304-3 (IC302-10). During this period, which represents the positive half of a clock-time, TP10 goes high providing a latch control to the latch circuits. While IC304-3 (IC302-10) is low, IC303-10 (IC304-4) is enabled. As the second half (negative half) of the clock time occurs, TP11 now goes high, generating a reset indicator to the counter. On the rise of the next clock TB8 goes low and removes the latch and reset commands and readies the unit for the next input pulse.

4.7 COUNTER CIRCUIT DESCRIPTION

The counter consists of a single chip IC201 (IC6). This element is a binary up counter that counts on the negative going edge clock received from the control logic. The counter will continue to count-up until the end of the input pulse at +IN. At that time a reset is generated by the logic described in paragraph 4.6.5 and the counter returns to zero. Just before this event, however, the content of the counter is read by the latch circuit as described in the paragraph below. The counter is powered by a temperature-compensated supply to improve dependability of operation.

4.8 LATCH AND D TO A CIRCUITS DESCRIPTION

The latch and D to A circuits consist of two HEX D-Flip Flop chips IC202, IC203 (IC4, IC5). The combined 12 outputs look into a resistive ladder.

Each output develops a voltage across its respective voltage dividing resistor network. Since the network outputs are connected in series, the resistances are additive. The output of the D to A converter issues from the top of the ladder which is the most significant bit side of the ladder, junctions of R201, R202 (R13, R14).

When power is applied, all latch outputs are set to zero by the action of the clear indicator as described in paragraph 4.6.1. As the input pulse returns to the quiescent state, the control logic generates a latch command as described in paragraph 4.6.5. When that command is received, the contents of the counter IC201 (IC6) is read by the combined inputs of the latch circuits. Instantly the D to A resistance ladder produces a signal level equal to the summation of all outputs of the latch circuits. This signal is provided to the output buffer IC1.

4.9 OUTPUT BUFFER CIRCUIT DESCRIPTION

The output buffer IC1 consists of a buffer amplifier with a gain of 1. The function of this buffer is to maintain the output impedance of the ladder as high as possible, preventing loading of the ladder by the output circuits. The output of IC1 at full scale input is approximately 5V. This output is divided down through SPAN potentiometer to provide a selection of output signal span.

4.10 OUTPUT AMPLIFIER CIRCUITS DESCRIPTION

The output amplifier provides the drive necessary for the unit voltage output (see paragraph 4-14) or for the drivers when current output or HI option is selected (see paragraph 4-12 or 4-15 respectively). This circuit provides the zero level and signal span adjustments. The output amplifier is a differential amplifier that consists of IC3 (IC2) and associated components. IC3 (IC2) receives the output of IC1 through the SPAN potentiometer. Normally the SPAN potentiometer output is summed with the ZERO potentiometer output at pin 3 of IC3 (IC2). The ZERO circuit develops a bias across a voltage divider network consisting of resistors and diodes between the positive and negative supply. A shift of the ZERO potentiometer wiper contact can produce a positive or a negative signal at the amplifier summing point. The resultant output of IC3 (IC2) at pin 6 is a voltage whose zero shift is directly affected by the position of the ZERO potentiometer.

4.11 REVERSE OUTPUT (RO) OPTION DESCRIPTION

The reverse output is obtained by feeding the SPAN circuit output to the inverting input, pin 2 of IC3 (IC2). An additional R22 (R203) is used to control the amplifier gain. The ZERO circuit is also modified to set the voltage divider network between the positive supply and ground. Now a shift of the ZERO potentiometer will vary the output signal zero shift between the positive supply level and ground.

4.12 CURRENT OUTPUT CIRCUIT DESCRIPTION

Output amplifier IC3 (IC2) provides drive current to power amplifiers Q4, Q5, Q6 (Q201, Q202, Q203). Transistors Q4, Q5 (Q201, Q203) are connected in a Darlington configuration. Transistor Q6 (Q202) is connected in parallel with Q5 (Q201) to generate greater drive to —OUT output terminal for the 10 to 50 mA output. A power source of approximately 38 volts is provided at +OUT. This configuration allows the unit load between the OUT terminals to be driven directly by the power amplifiers, thereby offering a very low output impedance. Capacitor C6 (C201) filters transients from the load circuit.

4.13 SELECTABLE CURRENT (SC) OUTPUT OPTION

The SC option consists of the additional selectable current resistor R101. All other current output circuits are identical to those described in paragraph 4.12. Normally current from the power source flows through the external load through Q6 and Q6 (Q202) and R16 (R201) to ground. When the SC option is selected, however, R16 (R201) is removed and replaced by R101. Load current now flows through R101 and is thereby limited to the value specified by the resistor.

4.14 VOLTAGE OUTPUT CIRCUIT DESCRIPTION

When a voltage output is selected, transistors Q4, Q5 and Q6 (Q201, Q202 and Q203) are removed and the output of IC3 (IC2), now a higher gain circuit (gain of 5), provides a high impedance output to the OUT terminals. The load now is between the amplifier output and ground and is in parallel with R16 and R17 (R201 and R209).

4.15 HIGH CURRENT, VOLTAGE OUTPUT (HI) OPTION

This option provides higher current for voltage output by adding a driver stage Q5 (Q201) directly in series between output amplifier IC3 (IC2) and the output terminals. Driver Q5 (Q201) is powered by a 38-volt source providing the drive necessary for high current capability for voltage output. Capacitor C5 (C1) is used in amplifier IC3 (IC2) to minimize the offset generated by the high gain of the amplifier.

MAINTENANCE

5.1 INTRODUCTION AND GENERAL INFORMATION

This section contains information to aid in the maintenance of the unit. This includes disassembly instructions for all mechanical options, as well as general troubleshooting. Precautions and special techniques required to replace components are also described.

5.2 DISASSEMBLY

When unit troubleshooting is required, it is first necessary to disassemble the unit. The physical configuration of the unit determines the steps to be followed in disassembly. These are described in the following paragraphs.

NOTE

Always identify wires — usually by tagging — before disconnecting existing connections.

CAUTION

DISCONNECT INPUT SIGNAL AND REMOVE POWER INPUT BEFORE DISASSEMBLING UNIT.

5.2.1 Disassembly of Standard Unit and Units With AB or CP Options

To disassemble a standard, AB, or CP unit, remove the unit from its installed position. If the mounting bracket is used, separate it from the unit by removing the two countersunk screws at the rear of the unit. After the unit has been removed from its installed position, disassemble the unit as follows to gain access to the circuit board.

- a. Remove the two front Phillips-head screws at the top of the unit.
- b. Remove the four Phillips-head screws at the bottom of the unit.
- c. Slide the front panel (with the circuit board still attached) down and free of the sides of the case. Points on the circuit board may now be reached for troubleshooting. It is

suggested that the case be used as a container for storing the removed hardware.

5.2.2 Disassembly of Unit in NEMA Boxes

Normally electrical connections are made to NEMA boxes through conduits. Units are secured on a mounting plate in the NEMA boxes. The following disassembly instructions apply to the various configurations.

Disassembly of Units in OT, WT and GP Enclosures. Use the following procedures to disassemble unit:

- a. Loosen clamps that hold hinged cover on OT and WT enclosures only, and open enclosure.
- b. Remove plastic safety cover from unit.
- c. Tag and disconnect wires from unit.
- d. Loosen four mounting screws that hold unit into box.
- e. Disassemble unit as described in paragraph 5.2.1.

Disassembly of Units in FG Enclosure. Use the following procedures to disassemble unit:

- a. Loosen four screws that secure cover on box.
- b. Open box and inspect gasket for damage. Replace if necessary.
- c. Remove plastic safety cover from unit.
- d. Tag and disconnect wires from unit.
- e. Tag and disconnect ground wire from conduit to mounting post.
- f. Remove four nuts that secure unit to mounting plate in rear of box.
- g. Disassemble unit as described in paragraph 5.2.1.

5.2.3 Disassembly of Units in PB Enclosures

Use the following procedure to disassemble unit:

- a. Remove unit from terminal block by rocking it slightly while pulling upward.
- b. Remove two nuts, screws, washers, holding front panel to bottom of PC board (two front bottom).
- c. Remove two side screws from front panel.
- d. Remove one countersunk screw from back-bottom of unit in bottom of PC board.

Terminal block and card connector are keyed to eliminate error when the unit is reinstalled.

5.2.4 Disassembly of Units in EX Enclosures

Use the following procedure to disassemble unit:

- a. Using a bar wrench, attach to wrench lugs and loosen the housing cover from the base.
- b. Unscrew protective cover to expose unit.
- c. Use procedure of paragraph 5.2.3.

5.2.5 Disassembly of PM Units

Use the following procedure to disassemble unit. Refer to Figure 5-1 for parts nomenclature.

- a. Pull out safety cover to expose wiring.
- b. Tag and disconnect wires from terminal strip. If troubleshooting requires access to reverse side of PC board, perform the procedure described in next step.
- c. Remove screws holding cover to frame and lift cover off the case assembly.

CAUTION

WIRE SERVICE LOOP IS SUFFICIENT TO ALLOW PC BOARD AND END PLATE ASSEMBLIES TO BE TURNED OVER. ANY EXCESSIVE MOVEMENT OF THIS ASSEMBLY MAY CAUSE WIRING DAMAGE.

- d. Remove two nuts and washers that secure PC board and end plate into frame and carefully lift and slide board and plate towards terminal panel, out of end holder.

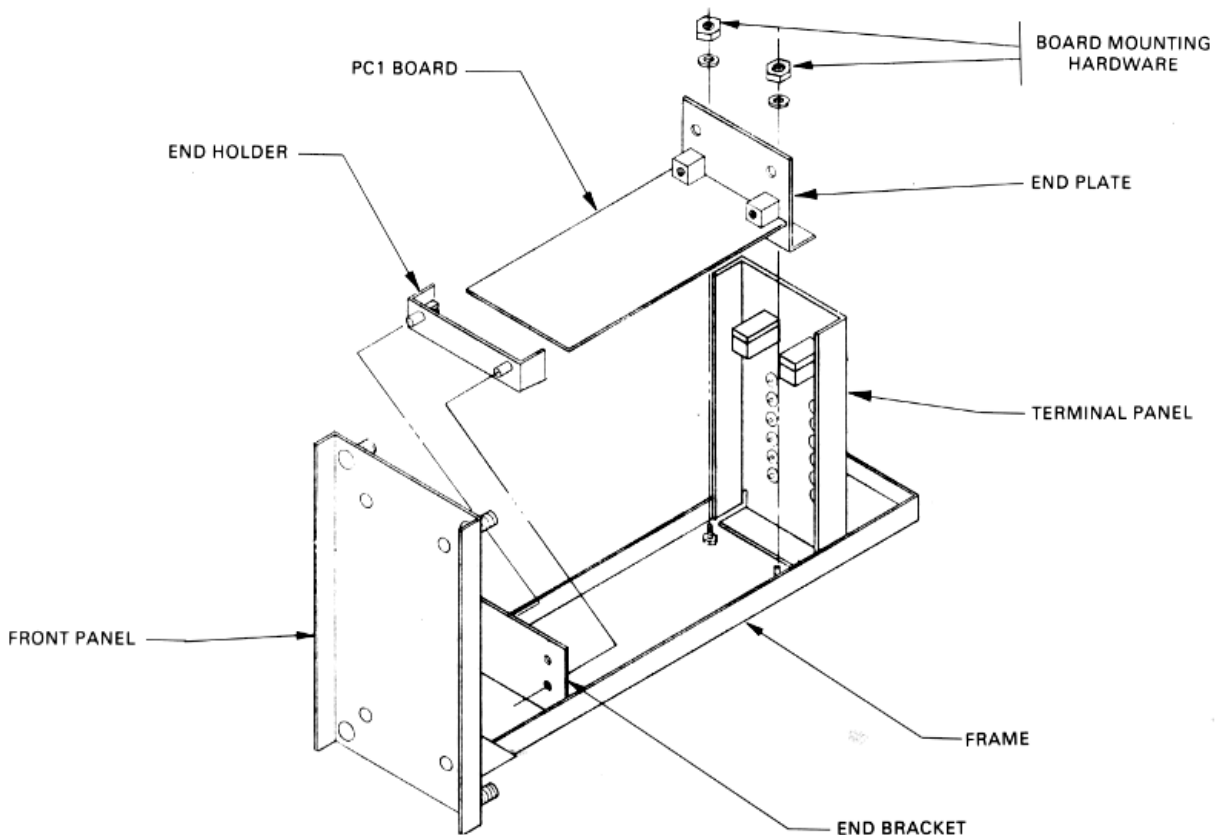


Figure 5-1. Disassembly of PM Units

5.2.6 Disassembly of a Plug-In Unit

To remove the cover of a plug-in unit, proceed as follows:

CAUTION

DO NOT LIFT FRONT OF COVER MORE THAN ¼ INCH. EXCESSIVE FORCE APPLIED TO COVER MAY BREAK REAR RETAINING CLIPS.

- a. Gently spread forward locking feet and lift front of cover.
- b. With the front of the cover raised, slide the cover to the rear to disengage it from the plug-in card.

To test a plug-in unit in the operating position, a circuit board extender card (M.I.I. Part No. 350-513-00 or equivalent) is required. The extender card brings the unit forward so components on circuit board are accessible for troubleshooting.

5.2.7 Disassembly of Plug-In Units in Card Racks

Except for SMR, access to units in racks is effected by removing dust cover over plug-in units. Surface Mounted Racks (SMR) do not have a cover over plug-in units since the whole rack may be enclosed into a NEMA box.

5.3 TROUBLESHOOTING

The schematic diagrams include flagged numbers (or letters) at various points in the circuit. Table 5-1 gives the voltages and waveforms at these points for specified input-signal conditions. The assembly drawing shows the physical locations of the parts on the circuit board. Bear in mind that the circuit board is protected with a moisture-resistant coating. Therefore, it may be necessary to use a needle-point probe and exert a fair amount of pressure to break through the coating when it is desired to observe the signal or voltage at a specific point. When connecting a probe to a component on the circuit board, exercise care to make sure the probe does not short-circuit to an adjacent component.

In general, troubleshooting is carried out by tracing the signal with an oscilloscope and referring to the schematic diagrams to determine what com-

ponent might be causing an observed abnormal indication. If the original symptom was a complete failure of the unit to operate, the most logical components to suspect are those associated with the power supply in the unit (including any voltage regulators). If the unit was producing an incorrect (but not zero) output, check the outputs from the voltage regulator and, if these are normal, apply a standard input signal and trace the resulting signal through the unit.

5.3.1 Plug-In Board Connector Cleaning

Occasionally, modules which have been in service for a long period of time may develop resistive coatings on the gold-plated contacts of the plug-in boards. This coating, if allowed to build up, can cause malfunctions by decreasing the noise margin of a circuit.

There are two types of foreign material coatings which can develop on the gold-plated contacts of a plug-in module. The first type is INORGANIC. This type of contamination results when copper "bleeds" through the gold plating and oxidizes. The second form of contamination involves ORGANIC substances, which usually are a result of careless handling, and are mainly made up of fingerprints, salts, and oils deposited when the plug-in boards are handled by the gold-plated contacts. Contamination by organic substances can be greatly reduced by careful handling of the modules.

Although rack connectors are usually of the self-cleaning type, it may become necessary to clean the module fingers to ensure reliable connection. When module contacts are in need of cleaning, the following procedures are recommended:

Removal of Inorganic Contaminants

- a. Immerse contacts of plug-in board in an ultrasonic bath of deionized water and a detergent, such as Liguinyx, for at least 30 seconds.
- b. Repeat step (a) with pure deionized water only.

CAUTION

REMOVE WATER IMMEDIATELY FROM CONTACTS. IF THIS IS NOT DONE QUICKLY, DAMAGE TO CONTACTS MAY RESULT.

- c. Remove water by immersing contacts in an ethand or methanol bath to same depth used during the ultrasonic cleaning of step (a). Never wipe or use an abrasive cleaner on the contacts. If wiping is necessary, use K-Dry towels or equivalent.

Removal of Organic Contaminants

- a. After inorganic contaminants and water have been removed, organic materials may be removed by immersion of contacts in trichloroethane for at least 30 seconds.

CAUTION

NEVER USE AN ERASER ON THE CONTACTS. THE USE OF ABRASIVE CLEANERS OR ERASERS ON PLUG-IN BOARD CONTACTS IS CONSIDERED A PHYSICAL ABUSE TO THE PLUG-IN UNIT AND MAY VOID THE UNIT WARRANTY.

- b. Let contacts air dry or wipe with a very fine, nonabrasive material such as K-Dry towels or equivalent.

5.3.2 Component Replacement General Information

Replace all defective components with identical parts. Refer to Section 6 for a list of recommended replacement parts. The last row of numbers in the parts list is the number of spares recommended to be kept on hand for that part, per unit, for up to ten units of the same type. For more than ten units, a spares complement of 10% on the indicated parts should be used.

5.3.3 Component Replacement Techniques

Most parts used in the unit are quite small and are located in a confined area. Therefore, small hand tools are a necessity when servicing the unit. The following is a summary of the general techniques and precautions that should be observed to prevent damage to components in the unit:

- a. Use a transformer-operated low-voltage soldering iron with a grounded tip and rated at not more than 50 watts. A temperature-controlled tip is desirable.
- b. Use extreme care when unsoldering the leads to any component. Do not keep the soldering iron on a point for more than a few seconds at a time. Use a suction-type solder-removing tool (solder sucker) as an

aid in unsoldering transistors and integrated circuits. The protective coating on the unit may be removed with trichlorethane or equivalent. Be sure adequate ventilation is provided when using this or any other chemical.

NOTE

Unused connections on integrated circuits are left unsoldered to aid in removal. Refer to the assembly drawing for more complete information.

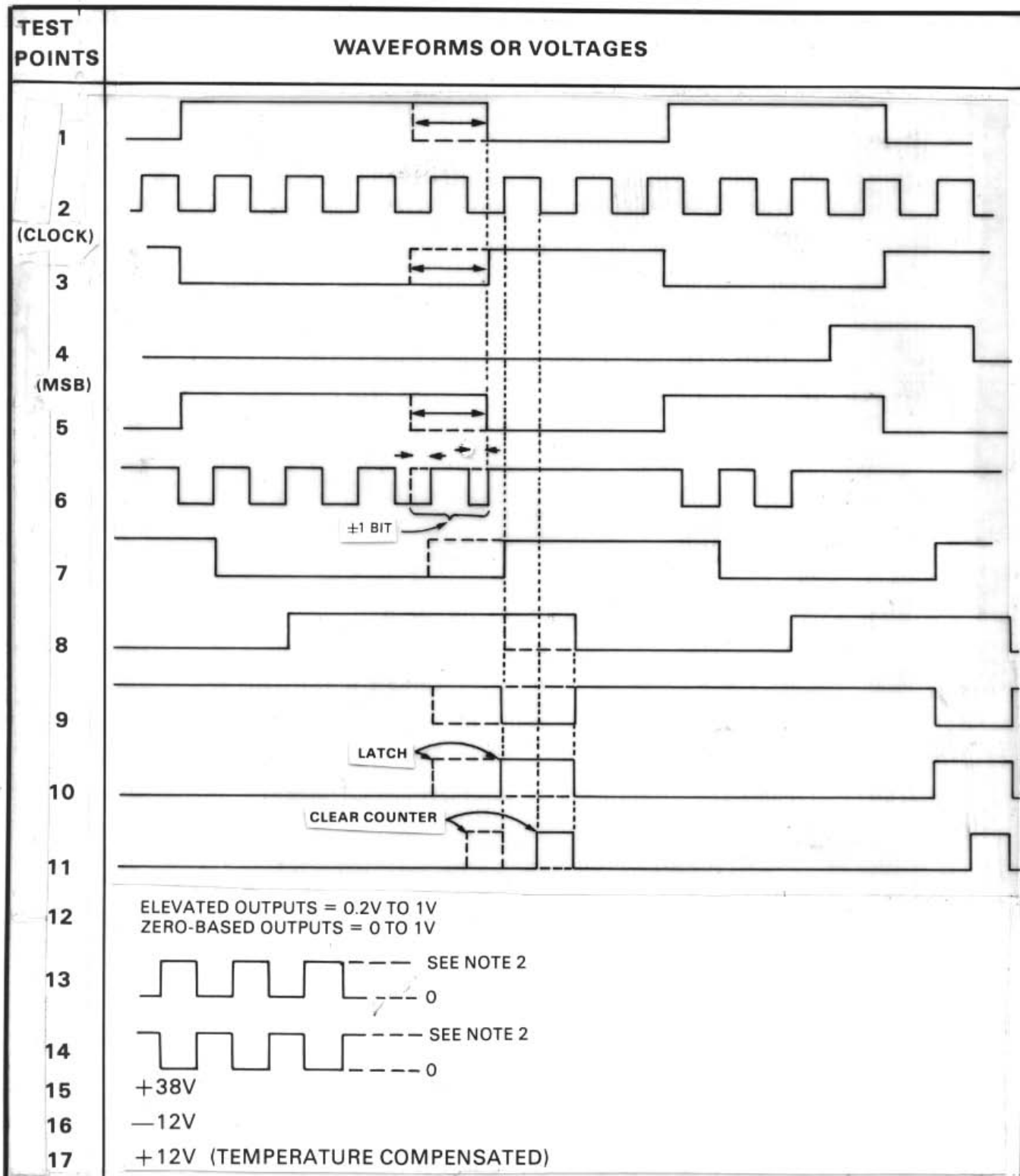
- c. Do not excessively bend or twist the leads of small components; they break easily.
- d. Before removing a component, observe the lead dress. Be sure that the lead dress of the replacement is the same as that of the original.
- e. Remove all flux from soldered joints with trichlorethane or equivalent.

NOTE

Units that were calibrated at the factory to customer's specifications have protective caps over the SPAN and ZERO potentiometers. These caps must be removed so the unit can be recalibrated. LIFT, DO NOT TWIST, the caps off, using a screwdriver tip as a prying tool. Snap the caps back in place, WITHOUT TWISTING, when recalibration has been completed.

- f. Test the unit for proper operation and, if necessary, recalibrate by the procedure given in Section 2. When the performance of the unit is known to be satisfactory, apply clear *acrylic* to reseal the unit where required. Check that all leads are clear of the board edge before reinstalling the board into its case.
- g. When reinstalling the unit onto the mounting bracket, be sure to use the same screws (or screws of the same size) as the ones removed. Longer screws will damage the unit.

TABLE 5-1. WAVEFORMS AND VOLTAGES



- NOTES**
1. Nominal input is 5V — Maximum input is 32V (without CC option)
 2. 48 VOLTS FOR 24VDC INPUT, 90 VOLTS FOR 45 VDC INPUT

PARTS LISTS

6.1 GENERAL

This section consists of a computer print-out table that provides parts identification information for the unit. Wiring lists have been provided in this section as an aid to the maintenance personnel.

Parts information is grouped according to the number of assemblies. If the unit contains two PC boards, the table will be divided into two major sections: one section will contain information related to PC1 and the other section will list PC2 components information. Each major section in the table contains a complete parts list headed LIST OF MATERIALS specifying which PC board it is describing. This list is usually found at the end of the section. The list of materials consists of the following headings:

ITEM: A reference numeral used for data processing and not used by maintenance personnel.

NAME: Gives the nomenclature of the part.

DESCRIPTION: Identifies the component by manufacturer's part number, usually followed by component's parameters or value.

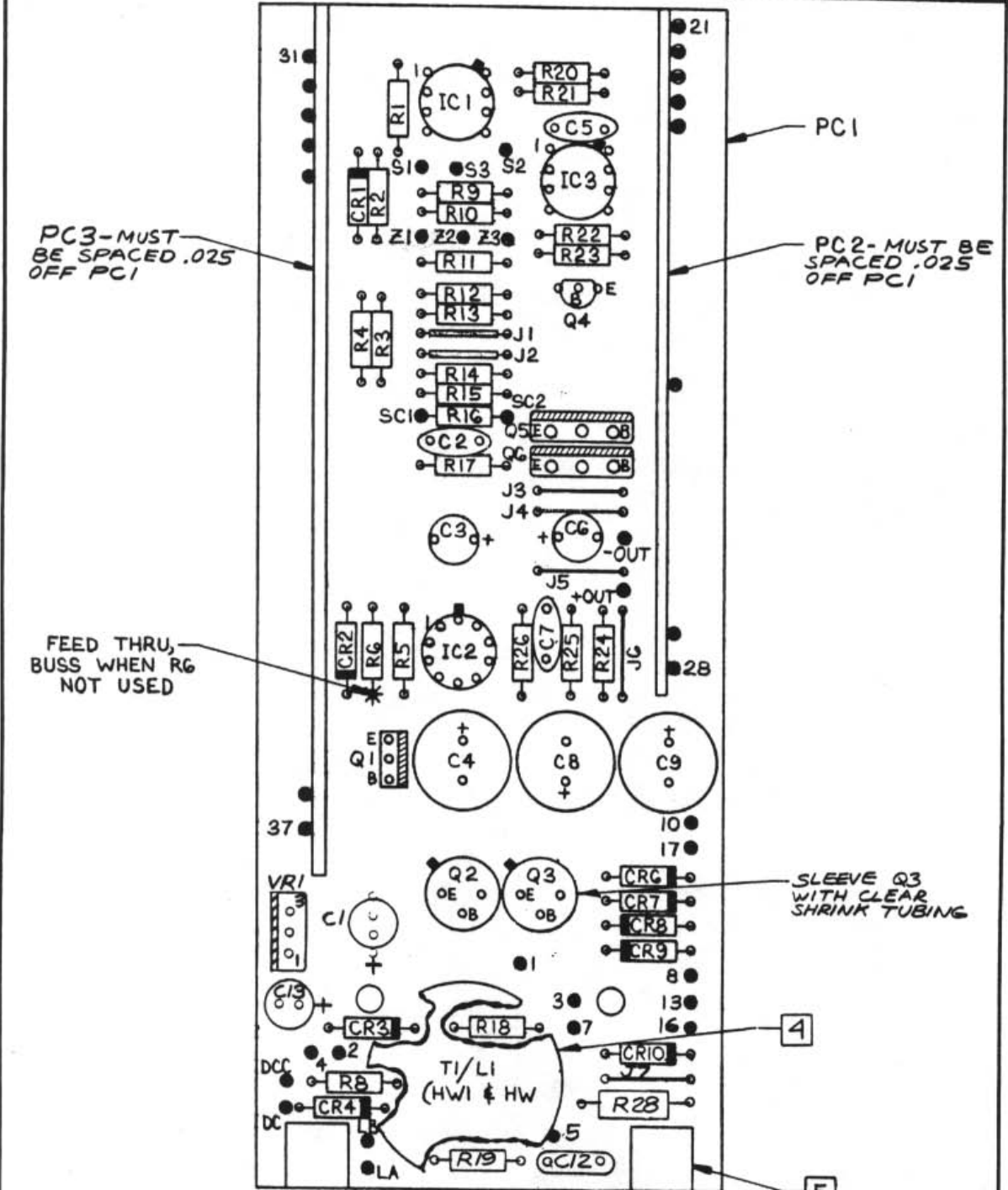
REF: Lists the reference designation for the component, referred to in Section 4, on the schematic and assembly drawings.

PART NUMBER: This column specifies the Moore Industries assigned part number. This is the part identification required when ordering parts from Moore Industries.

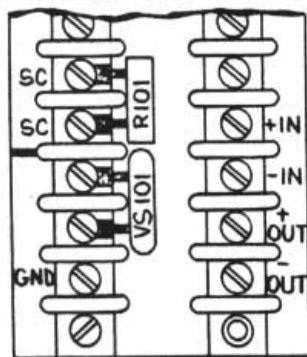
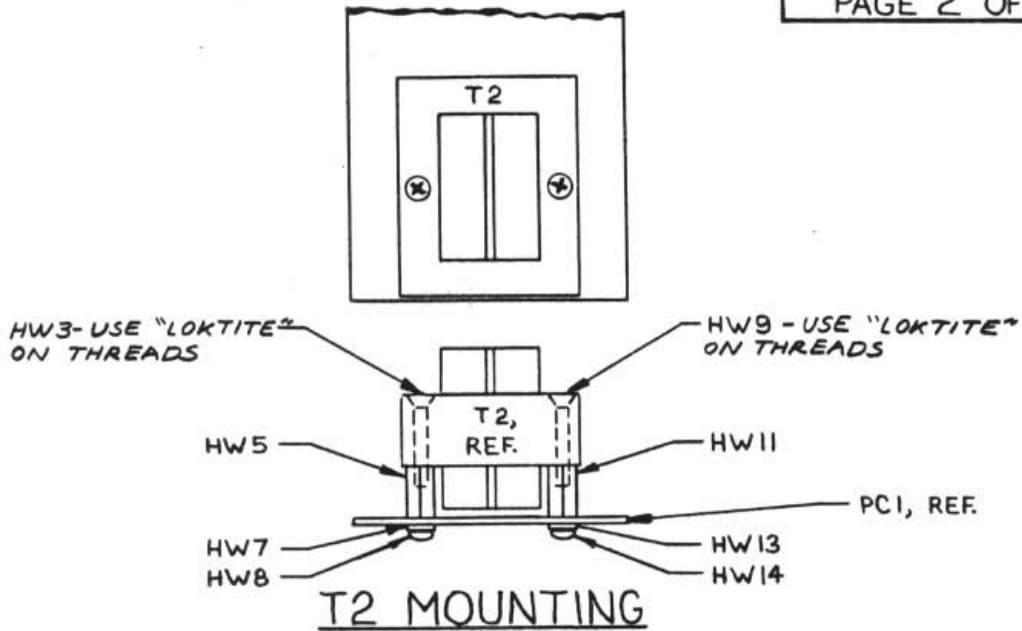
SPARE: The numeral in this column specifies the recommended number of component spares per unit type that should be kept on hand by maintenance personnel.

6.2 GLOSSARY OF ABBREVIATIONS

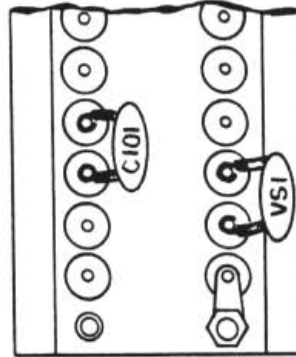
C	Capacitor	R	Resistor
CR	Diode — Zener included	T	Transformer
HW	Special hardware	IC	Integrated circuit
J	Connecting buss wire	Q	Transistor
L	Inductor	LED	Light emitting diode
LBL	Label	TB	Terminal block
PC	Printed circuit board	VS	Voltage regulating varistor



- 6. SEE PAGE 2 FOR ADDITIONAL COMPONENT LOCATIONS.
 - 5. SWAGE MOUNTING BLOCKS TO PC1 BEFORE ADDING COMPONENTS. SEE CASE ASSEMBLY FOR POSITION OF BLOCKS.
 - 4. MOUNT TI/LI PER DWG 200-237-00.
 - 3. INDICATES METAL SIDE OF Q1, Q5, Q6 & VRI.
 - 2. ALL JUMPERS ARE 22 AWG BUSS, TEFLON SLEEVED AS REQUIRED.
 - 1. ALL LEADS AND TERMINALS MUST BE SOLDERED TO PADS.
- NOTES: UNLESS OTHERWISE SPECIFIED

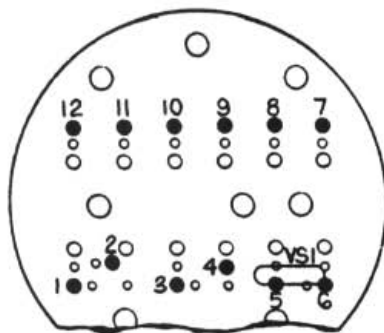


VS101 & RI01

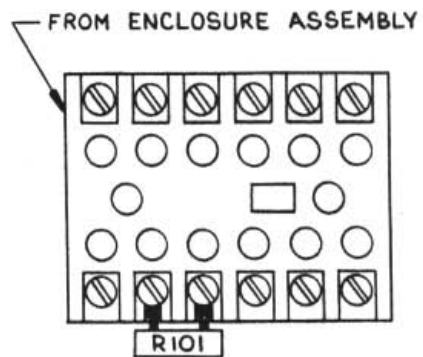


C101 & VS1

SR, PM, & VT CASES



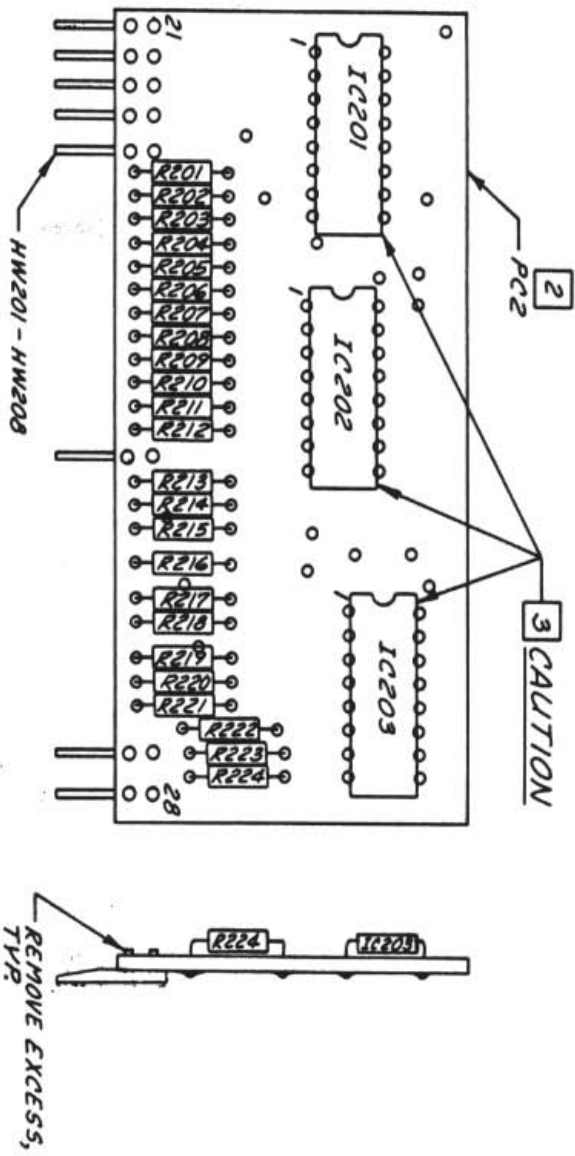
VS1



RI01

SP CASE

REV.	DESCRIPTION	DATE	BY	APPROV
B	REV'D PER RE-DESIGN		JK	AD.
C	ECO 2160	9-20-82	TW	BDL



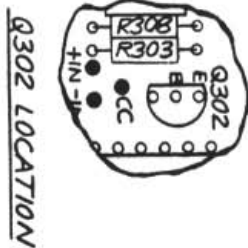
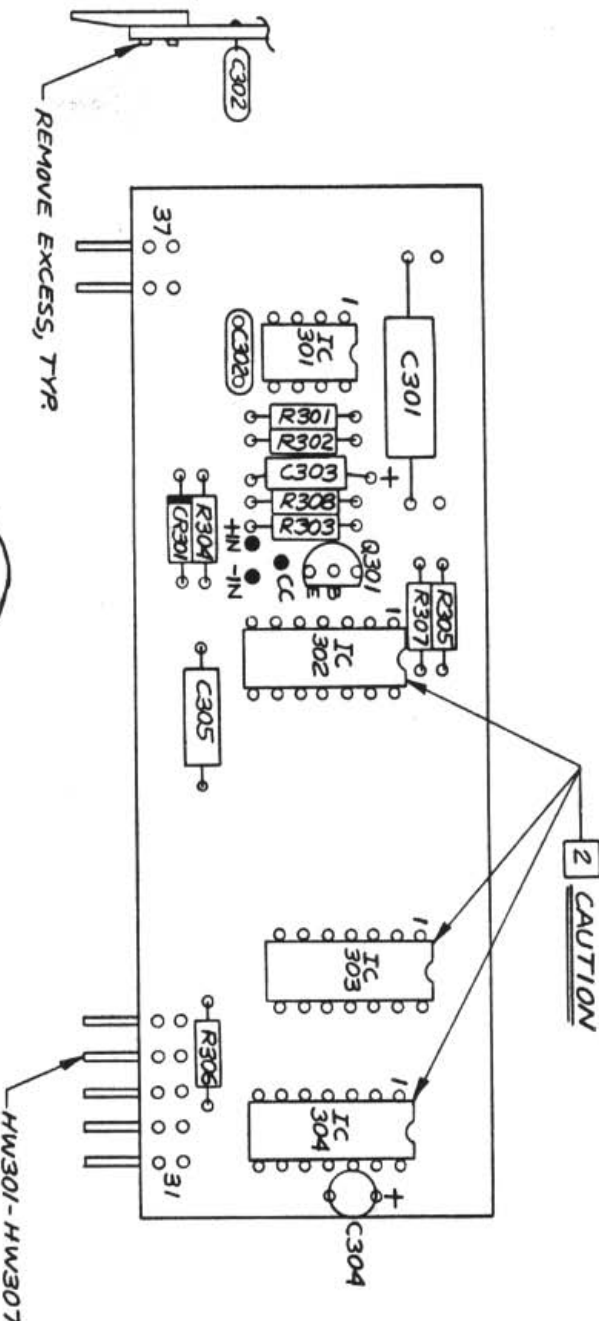
- 3 DO NOT HANDLE LEADS OF IC201, IC202 OR IC203 WITH FINGERS, SEE PRODUCTION HANDLING PROCEDURE OR INSTRUCTION MANUAL.
 - 2 THIS P.C. BOARD HAS PLATED THRU HOLES, SOLDER ON REAR SIDE ONLY.
 - 1 ALL LEADS & TERMINALS MUST BE SOLDERED TO BOARD.
- NOTES: UNLESS OTHERWISE SPECIFIED

-1		ITEM	PART NUMBER		PART NAME		MANUFACTURER		REFERENCE DESIGNATION		
NO. OF BOARDS		666-501-00		NEXT ASSEMBLY		SCALE		JOB NO.		666	
FINISH		X .5, 1 X .5, .01 X .5, .010 X .5, .015 X .5, .020 X .5, .025 X .5, .030		DRAWN		CHECKED		APPROVED		DATE	
CUST.		K. Kelly		T. HART		Abdul D.		7-23-78			
SCALE		2/1		DO NOT SCALE DRAWING		P.C. BOARD ASSEMBLY STD. DIGITAL PDR PC2		MOORE INDUSTRIES INC. VAN NUYS • CALIF.		666-502-00C	

MOORE INDUSTRIES
 1655 Schoenborn Street
 Depue, California 91343

DO NOT SCALE DRAWING
 TOLERANCES UNLESS NOTED
 X ±.1
 XX ±.03
 XXX ±.010
 ANGLES ±.30°
 SCALE 2/1

P.C. BD. ASS'Y
 STD. DIGITAL
 PDR
 (PC3)
 666-504-00
 P.C. ASS'Y
 ECO'S 4140 & 4558
 DATE: 1/81
 BY: J.A.M.

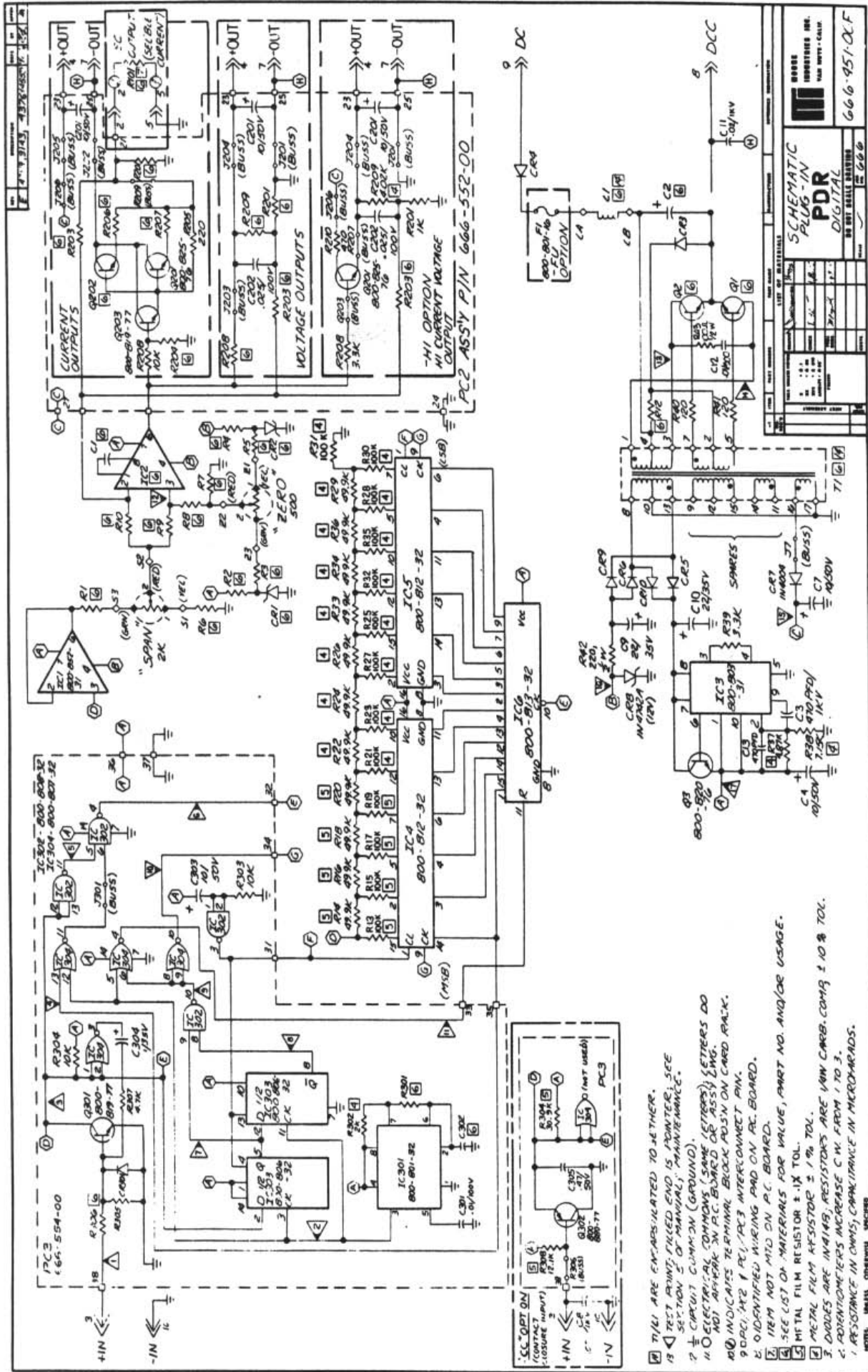


Q302 LOCATION

2 DO NOT HANDLE LEADS OF IC302, IC303 & IC304 WITH FINGERS. SEE PRODUCTION HANDLING PROCEDURE OR INSTRUCTION MANUAL.

1. ALL LEADS & TERMINALS MUST BE SOLDERED TO PADS.

NOTES-

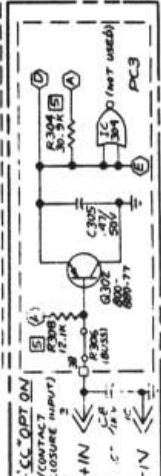


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SCHEMATIC
PLUG-IN
PDR-IN
DIGITAL

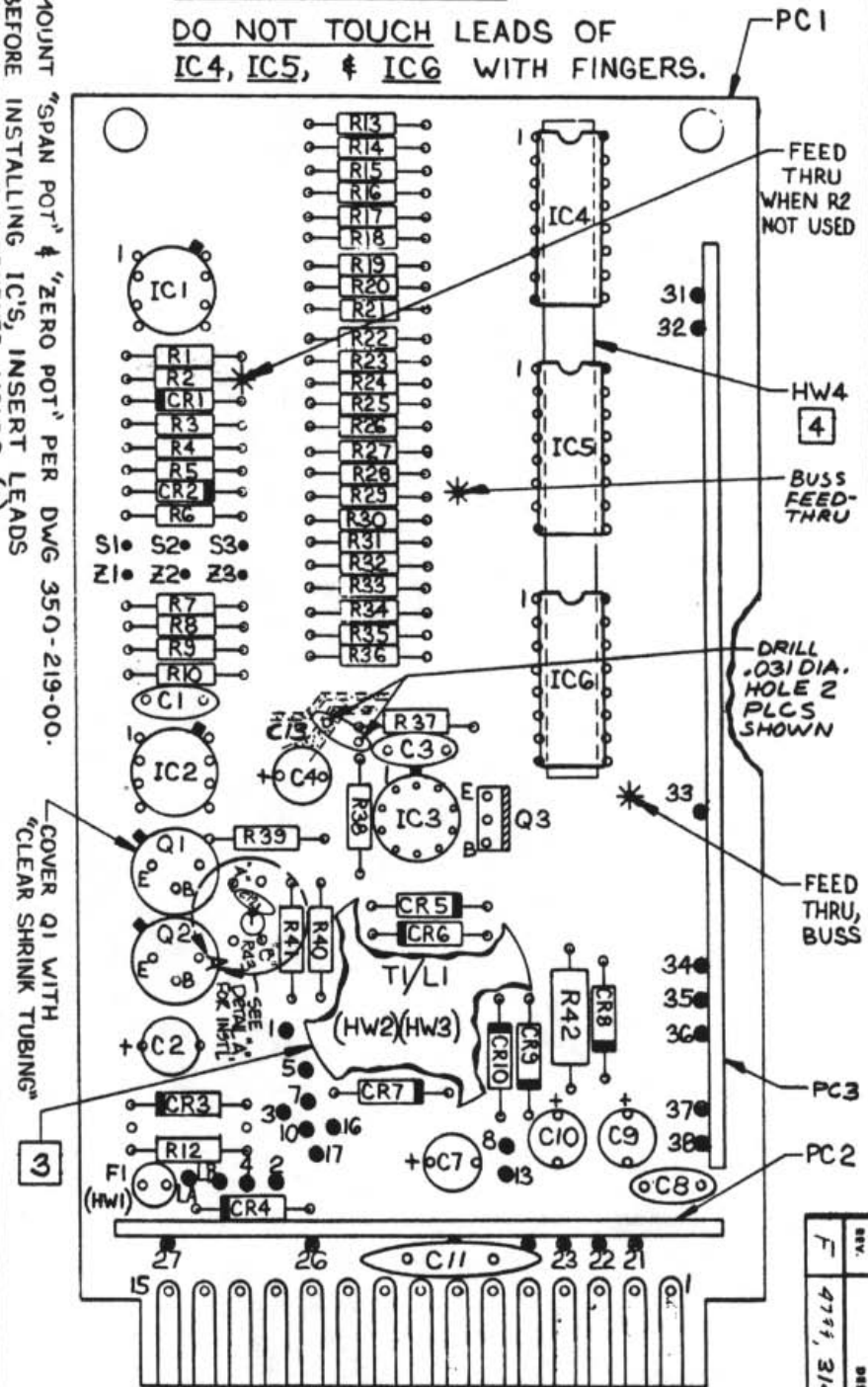
666-951-01F

- 1. ITEMS NOT MTD ON P.C. BOARD.
- 2. SEE LIST OF MATERIALS FOR VALUE, PART NO. AND/OR USAGE.
- 3. METAL FILM RESISTOR ± 1% TOL.
- 4. DIODES ARE IN114B, RESISTORS ARE 1/4W CARB-COM19 ± 10% TOL.
- 5. RESISTANCE IN OHMS; CAPACITANCE IN MICROHEADS.
- 6. IDENTIFIED WIRING PAD ON AC BOARD.
- 7. 0.01% TOL.
- 8. 0.01% TOL.
- 9. 0.01% TOL.
- 10. INDICATES TERMINAL BLOCK POSN ON CARD RACK.
- 11. NOT APPEAR IN P.C. BOARD OR ASSY LING.
- 12. ELECTRICAL COMMONS (SAME LETTERS) LETTERS DO NOT APPEAR IN P.C. BOARD OR ASSY LING.
- 13. CONTACT COMMON (GROUND).
- 14. TEST POINT; TILED END IS ADAPTER; SEE SECTION 2 OF DRAWING, MAINTENANCE.
- 15. TI/VI ARE ENCAPSULATED TOGETHER.



WARNING

DO NOT TOUCH LEADS OF IC4, IC5, & IC6 WITH FINGERS.



1. MOUNT "SPAN POT" & "ZERO POT" PER DWG 350-219-00.
2. BEFORE INSTALLING IC'S, INSERT LEADS OF HW4 INTO DARKENED HOLES (●) AND BEND BACK INSULATION ON EDGE OF HW4 WITH NON-METALLIC PROBE TO PROVIDE CLEARANCE BETWEEN INSULATOR AND IC PINS.
3. MOUNT T1/L1 PER DWG 200-237-00.
4. **XXXXXXXX** INDICATES METAL SIDE OF Q3.
5. ALL LEADS & TERMINALS MUST BE SOLDERED TO PADS.

NOTES: UNLESS OTHERWISE SPECIFIED

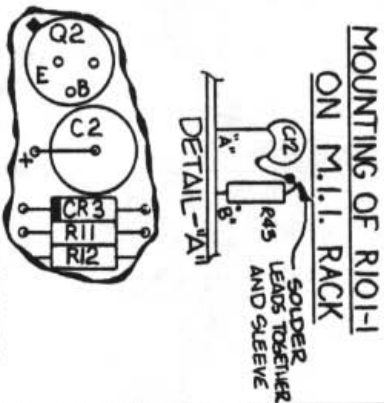
NO.	ITEM	PART NUMBER	PART NAME	MANUFACTURER	REFERENCE DESIGNATION
1	RESISTOR	R1	10K		CR1
2	RESISTOR	R2	10K		CR2
3	RESISTOR	R3	10K		CR3
4	RESISTOR	R4	10K		CR4
5	RESISTOR	R5	10K		CR5
6	RESISTOR	R6	10K		CR6
7	RESISTOR	R7	10K		CR7
8	RESISTOR	R8	10K		CR8
9	RESISTOR	R9	10K		CR9
10	RESISTOR	R10	10K		CR10
11	RESISTOR	R11	10K		CR11
12	RESISTOR	R12	10K		CR12
13	RESISTOR	R13	10K		CR13
14	RESISTOR	R14	10K		CR14
15	RESISTOR	R15	10K		CR15
16	RESISTOR	R16	10K		CR16
17	RESISTOR	R17	10K		CR17
18	RESISTOR	R18	10K		CR18
19	RESISTOR	R19	10K		CR19
20	RESISTOR	R20	10K		CR20
21	RESISTOR	R21	10K		CR21
22	RESISTOR	R22	10K		CR22
23	RESISTOR	R23	10K		CR23
24	RESISTOR	R24	10K		CR24
25	RESISTOR	R25	10K		CR25
26	RESISTOR	R26	10K		CR26
27	RESISTOR	R27	10K		CR27
28	RESISTOR	R28	10K		CR28
29	RESISTOR	R29	10K		CR29
30	RESISTOR	R30	10K		CR30
31	RESISTOR	R31	10K		CR31
32	RESISTOR	R32	10K		CR32
33	RESISTOR	R33	10K		CR33
34	RESISTOR	R34	10K		CR34
35	RESISTOR	R35	10K		CR35
36	RESISTOR	R36	10K		CR36
37	RESISTOR	R37	10K		CR37
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96	RESISTOR	R96	10K		CR96
97	RESISTOR	R97	10K		CR97
98	RESISTOR	R98	10K		CR98
99	RESISTOR	R99	10K		CR99
100	RESISTOR	R100	10K		CR100

PC BOARD ASSEMBLY
PLUG-IN, DIGITAL
PDR PC1

DO NOT SCALE DRAWING

MOORE INDUSTRIES INC.
VAN NUYS • CALIF.

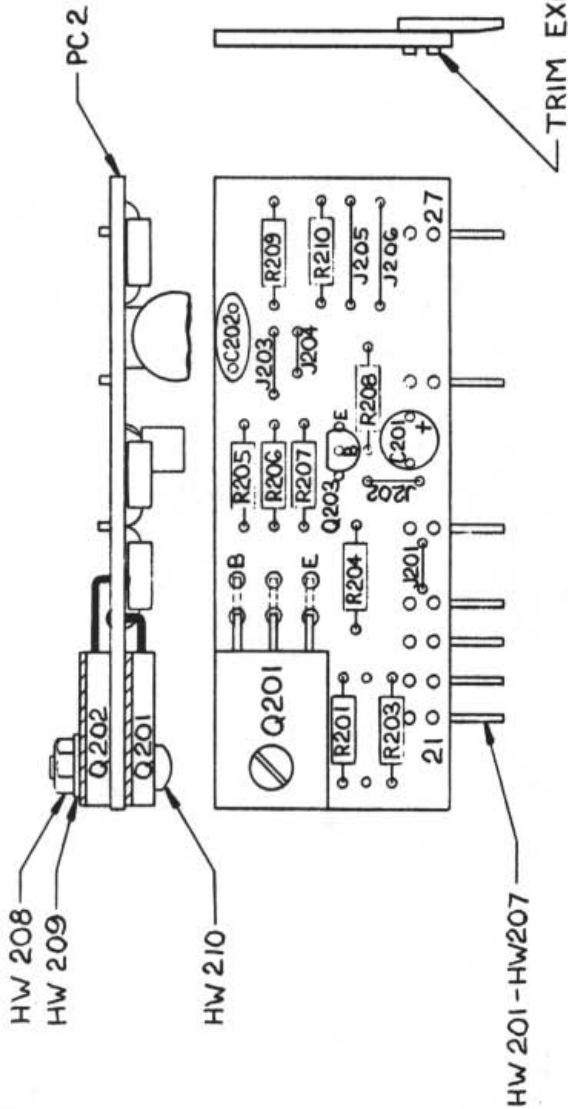
666-551-00F



REV.	DESCRIPTION	DATE	BY	APPROV.
F	4794, 3143, 4376 & 4559	1/18/75	J.C.	J.C.

666-552-00 B
P.C. BOARD PLUG-IN DIGITAL PDR (PC2)

REV.	DESCRIPTION	DATE	BY	APPROV
A	INITIAL RELEASE		T.H.	T.H.
B	PER ECO 2204	11/14/74	T.H.	gpb



3. INDICATES METALIZED SIDE OF Q201 & Q202.
 2. ALL LEADS & TERMINALS MUST BE SOLDERED TO PADS.
 1. ALL JUMPERS ARE 22 AWG BUSS WIRE, TEFLON SLEEVED AS REQUIRED.
- NOTES: UNLESS OTHERWISE SPECIFIED

ITEM NO.	PART NUMBER	PART NAME	MANUFACTURER	REFERENCE DESIGNATION
-1		PC BOARD ASSEMBLY		
NO. REQ'D		LIST OF MATERIALS		
		DRAWN T. HART		
		CHECK <i>[Signature]</i>		
		PROJ. ENGR. <i>[Signature]</i>		
		CUSTE.		
		FINISH		
		POLE, UNLESS NOTED		
		.X ± .1		
		.XX ± .03		
		.XXX ± .010		
		ANGLES: ± 30		
		SCALE 2/1		
		FOR NO. GGG		
		DO NOT SCALE DRAWING		
		MOORE INDUSTRIES INC.		
		VAN NUYS • CALIF.		
		666-552-00B		

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

Warranty Repair –

If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

Non-Warranty Repair –

If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
 - a) A note listing the symptoms that indicate the unit needs repair
 - b) Complete shipping information for return of the equipment after repair
 - c) The name and phone number of the person to contact if questions arise at the factory
3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.
4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

WARRANTY DISCLAIMER

THE COMPANY MAKES NO EXPRESS, IMPLIED OR STATUTORY WARRANTIES (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY GOODS OR SERVICES SOLD BY THE COMPANY. THE COMPANY DISCLAIMS ALL WARRANTIES ARISING FROM ANY COURSE OF DEALING OR TRADE USAGE, AND ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY ACKNOWLEDGES THAT THERE ARE NO WARRANTIES IMPLIED BY CUSTOM OR USAGE IN THE TRADE OF THE BUYER AND OF THE COMPANY, AND THAT ANY PRIOR DEALINGS OF THE BUYER WITH THE COMPANY DO NOT IMPLY THAT THE COMPANY WARRANTS THE GOODS OR SERVICES IN ANY WAY.

ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY AGREES WITH THE COMPANY THAT THE SOLE AND EXCLUSIVE REMEDIES FOR BREACH OF ANY WARRANTY CONCERNING THE GOODS OR SERVICES SHALL BE FOR THE COMPANY, AT ITS OPTION, TO REPAIR OR REPLACE THE GOODS OR SERVICES OR REFUND THE PURCHASE PRICE. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES EVEN IF THE COMPANY FAILS IN ANY ATTEMPT TO REMEDY DEFECTS IN THE GOODS OR SERVICES. BUT IN SUCH CASE THE BUYER SHALL BE ENTITLED TO NO MORE THAN A REFUND OF ALL MONIES PAID TO THE COMPANY BY THE BUYER FOR PURCHASE OF THE GOODS OR SERVICES.

ANY CAUSE OF ACTION FOR BREACH OF ANY WARRANTY BY THE COMPANY SHALL BE BARRED UNLESS THE COMPANY RECEIVES FROM THE BUYER A WRITTEN NOTICE OF THE ALLEGED DEFECT OR BREACH WITHIN TEN DAYS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH, AND NO ACTION FOR THE BREACH OF ANY WARRANTY SHALL BE COMMENCED BY THE BUYER ANY LATER THAN TWELVE MONTHS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH.

RETURN POLICY

For a period of thirty-six (36) months from the date of shipment, and under normal conditions of use and service, Moore Industries ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by The Company), to be defective in material or workmanship. This policy extends to the original Buyer only and not to Buyer's customers or the users of Buyer's products, unless Buyer is an engineering contractor in which case the policy shall extend to Buyer's immediate customer only. This policy shall not apply if the product has been subject to alteration, misuse, accident, neglect or improper application, installation, or operation. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.



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