MOORE INDUSTRIES

INSTRUCTION MANUAL

FDT

Frequency-to-DC Transmitter

Form 165-710-00 F

May 2016

Description

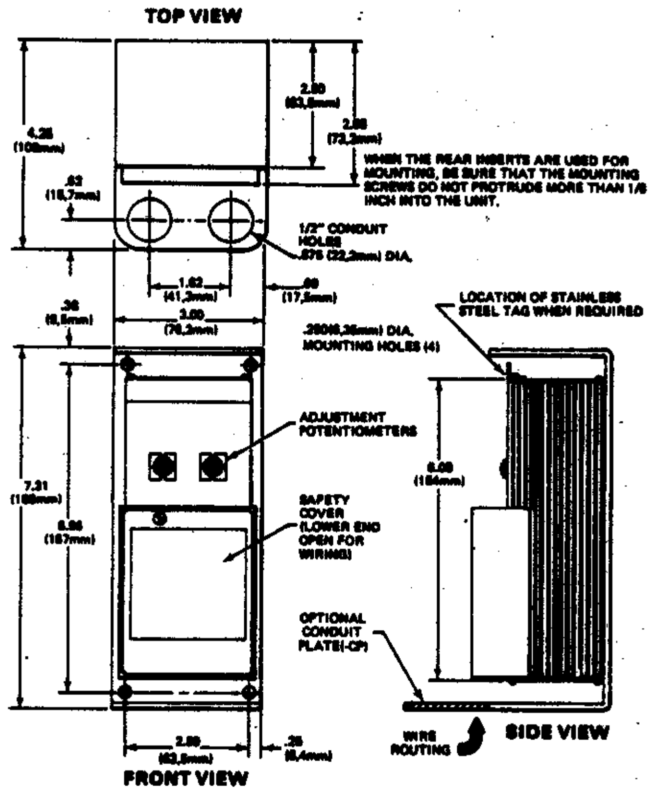
Introduction

The FDT Frequency-to-DC Transmitter is used in process control systems to measure flow rate by accepting a frequency signal input and yielding a proportional 4-20 MA or 1-5 Vdc signal output. The transmitter squares the applied AC input signal to obtain pulses which are filtered and amplified to produce a DC output voltage or current that is directly proportional to the frequency of the input signal. The FDT accepts pulse rate inputs from turbine meters and positive displacement meter pickoffs, as well as contact closures, magnetic shaft speed pickoffs, and other frequency generating flow measurement devices. Output is proportional to flow rate in all standard process current or voltage signal outputs. A unique quartz crystal time-base design also enables the FDT to maintain exceptional stability under adverse field conditions.

General Description

The standard (STD) FDT transmitter construction consists of two printed-circuit boards mounted on a main PC board. One of the small boards (PC2) contains the voltage regulators while the other small board (PC3) contains a crystal oscillator and the digital logic circuitry necessary to determine the duration of the pulse circuit. The main board (PC1) houses the remaining circuits. The three PC boards are enclosed in a protective housing and the entire assembly may be installed in a number of different ways. The standard FDT transmitter is shown in Figure 1.

An optional construction for the FDT unit is the Plug-In (PC) transmitter (shown in Figure 2) which is electrically similar to the standard STD-type unit with the exception that it only contains two printed circuit boards. One is the main board (PC1) on which the power supply and most of the components are mounted. The other is a small piggy-back board (PC2) which holds the crystal oscillator and digital logic circuitry that determine the one-shot pulse width. The main PC board in this unit is also keyed at one end to help identify the unit and to help 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 of the unit. A removable plastic safety cover protects the printed circuit boards and the other internal components of the unit from normal environmental hazards. When the plug-in unit is purchased alone, without a mounting option,



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 1. Standard Unit, Outline and Dimensions

the user must provide a 15 pin connector, such as a Viking part No. ZVK155/1-2 or equivalent, for connection purposes. Moore Industries offers the following two mounting options for the plug-in unit:

Surface Mounted (SMR) Card Rack: These rack enclosures are designed to accommodate from five to fifteen modules. Mounting flanges are located at 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 card racks (described in the following paragraph). The only difference is that the terminal strips for external connections on the SMR card racks are front-accessed for wiring convenience whenever the rack is mounted in a NEMA box or against a wall.

Important Note: This document is complete as of the printing date; however, subsequent product changes may be reflected in companion documents.

Specifications

Characteristics: FDT

Front Panel Adjustments Adjustable with multiturn potentiometer
Span: Output is fully adjustable over a preselected input range to 100% of selected output span.
Zero: With minimum input, adjusts output to 0% ± 10% of selected output span.

Calibration Capability ±0.05% of span (linearity and repeatability)

Ambient Temperature Range -18°C to 74°C (0°F to +165°F)

Performance **Ambient Temperature Effect:** ±0.005% / °F over above specified range
Isolation: Input, output, and power intput are transformer isolated with no dc connections between them. Both ac and dc powered units have this as standard. Common mode rejection exceeds 120dB at 60 Hz with a limit of 500 volts rms.

Certification CSA

Weight Approximately 2 lbs. (908 grams)

Ordering Specifications

Input Floating-transformaer coupled
Input Impedance: Greater than 5K ohms.
Input Amplitude: 300 MV P/P to 20 V P/P (for higher voltages, see -AT option). Signal may be biased to a maximum of ±5 Vdc.

Input Spans: Ranges listed here are the minimum inputs required to produce full scale output.

Jumper Selectable:
A1 0 to 2.5 thru 50Hz
(Requires -LF and -NI option)
LFA 1.56-3.12 Hz F.S.
LFB 3.12-6.25 Hz F.S.
LFC 6.25-12.5 Hz F.S.
LFD 12.5-25 Hz F.S.
LFE 25-50 Hz F.S.
A 0 to 50 thru 100 Hz
B 0 to 100 thru 200 Hz
C 0 to 200 thru 400 Hz
D 0 to 400 thru 800 Hz
E 0 to 800 thru 1600 Hz
F 0 to 1600 thru 3200 Hz
G 0 to 3200 thru 6400 Hz
H 0 to 6400 thru 12800 5Hz

Output Operational amplifier feedback current source; output limited to 150% of maximum output range value
Current:
1-5 MA into 0-4800Ω load
4-20 MA into 0-1200Ω load
10-50 MA into 0-480Ω load
Voltage:
1-5 Vdc into 20KΩ minimum
0-5 Vdc into 20KΩ minimum
0-10 Vdc into 40KΩ minimum
(for lower impedances, see -HI option)
Ripple: Less than 10MV P/P at maximum span and maximum load resistance
Load Effect: ±0.01% of span from 0 to maximum load resistance (current output)

Power 24 Vdc, 45 Vdc, ±10%
117Vac, 220Vac, 240Vac, 50/60 Hz ± 10%
5 watts nominal
Line Voltage Effect: Ac or dc: ±0.005% / 1% line change

Options
-AT Input attenuation for high voltage input
-CC Contact closure input
-HI High current output provides 20MA drive capability for 1-5V output
-LF Frequencies from 1.56 to 50 Hz (eliminates input isolation)
-NI Non-isolated input (isolation transfer deleted). Input amplitude 5V to 20V P/P.
-PTC Pressure and temperature compensation modification for FDT. Includes 1000Ω resistance bulb and provides for voltage input of 0-5V (into 1KΩ) representing pressure. Output, error, not including the pressure transducer, is less than 0.25%
-PRC Pressure compensation only--provides for voltage input of 0-5V representing pressure. Transducer not included.
-PX Excitation for 3-wire turbine meter pre-amps (+12V at 15MA maximum). (Isolation transformer deleted).
-PXI Excitation for 2-wire turbine meter pre-amps (+12V at 15MA maximum). To be used with Moore Industries Model FFX or other 2-wire pre-amplifiers. (Isolation transformer deleted).
-RF Patented filter assembly for RFI / EMI protection
-TC Temperature compensation only--includes 1000Ω resistance bulb but not head and well.

Housing
STD Standard enclosure
AB Angle bracket mounting
CP Conduit plate for use with standard units
D2 Division 2--Meets Class I, Groups C & D, Div. II requirements
EX Explosion-proof enclosure, Single Unit-Div. 1
GP General purpose enclosure, Single Unit-- NEMA 1
OT Oil-tight enclosure, Single Unit--NEMA 12
PC Plug-in card
PM Panel mount enclosure
WT Water-tight enclosure, Single Unit--NEMA 4

Model number description: Unit / Input / Output / Power / Options (Housing)

Rack Mounted (RMR) Card Rack. These rack enclosures are designed to be flush-mounted in either the standard 19-inch or 24-inch relay racks. Eleven and fifteen position RMR racks are available. Each enclosure is provided with standard EIA hole patterns and each is pre-wired from the module PC connector to the screw-type barrier strip. Both the PC connector and the screw-type barrier strip are rear-accessed for rack wiring convenience. All power connections from the PC connectors are bussed together to a separate three-terminal barrier strip for external power input. DC power supplies are available. Refer to the Electrical Connections portion of the Installation section for a more detailed description of electrical connections to the card rack. Individual modules are front loaded and a dust cover is provided to minimize the effects of environmental hazards. As mentioned previously, module connectors are keyed to assure that the units are plugged into the proper position. Key positions may be altered in the field, however, if the system configuration changes. In addition, filler cards are available for positions not used by any modules.

Installation

Introduction

This section provides information for mechanical installation, electrical connections, and power connections for the FDT Frequency-to-DC Transmitter. The standard FDT transmitter unit outline dimensions are shown in Figure 1 and outline dimensions for the plug-in units and card rack assemblies are shown in Figures 2, 3 and 4. Observe applicable notes and cautions given with the illustrations and text. Although the FDT 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 any material that can serve as a heat sink. For a plug-in unit mounted in a rack, make sure that the rack has adequate ventilation. In addition, input and output values for each unit should be checked on-site before the unit is placed into service (see Calibration section).

Electrical Connections

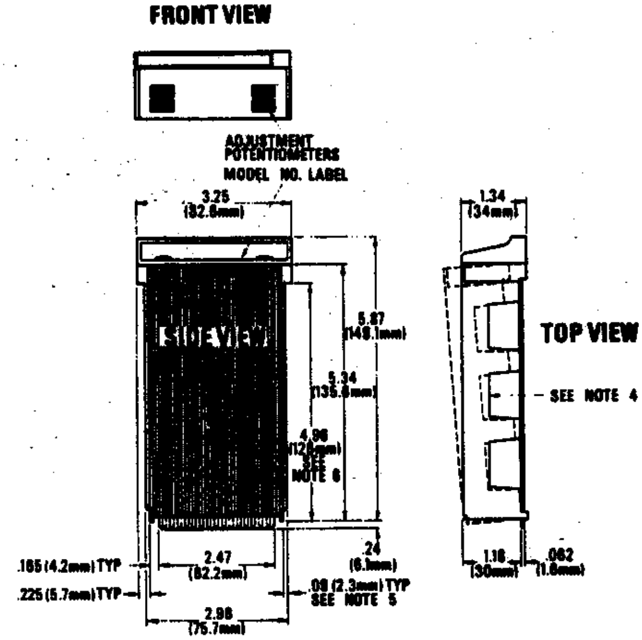
Terminals used for electrical connections for both standard and optional units are listed in Table 1. All electrical connections to standard transmitter units are made to the terminal block on each particular unit as noted. For plug-in units, electrical connections are made to the terminals on the mating connector of the unit. No special wire or cable is required for signal connections. To avoid transients and stray pickups, it is recommended that twisted conductors be used where the signal wires run close to other services (i.e., power wiring).

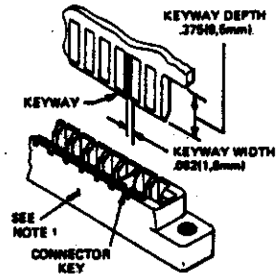
Three major categories of electrical connections to the FDT transmitter units are described in the remainder of this section as follows:

Wiring Information for All Standard Units With Terminal Strips or Blocks. Standard units with terminal strips or terminal blocks have terminals supplied with 6-32 screws that are long enough to easily accommodate three separate 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 and run it through this opening. Spade-lug connectors are recommended for all wire terminations.

Figure 5 illustrates the terminal strip locations and the respective identification labels for the standard units as well as for the explosion-proof and PST configurations. Table 1 presents the terminal labeling nomenclature for standard FDT units and for units with any available electrical options. Terminal labeling appears next to the terminal it identifies on standard units. For PST 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 1. General Purpose (GP) enclosures have conduit knockouts for various sizes of conduits from 1/2-inch to 1-inch. Oil tight (OT) and Water Tight (WT) enclosures do not have conduit holes, fittings or knockouts. Conduit access for these configurations must be provided by fittings such as Myer Scru-Tite or equivalent fittings. Fiber Glass (FG) enclosures require special attention with regard to the electrical ground connections. Since the FG-type enclosure material is polyester resin, conduit cutouts may be cut with either a hole punch or a hole saw. Ground continuity may be obtained in one of two different ways: (1) if a metal mounting plate is used, the ground connection can be made between the metal conduit locknut and the mounting plate at the point of enclosure entry and exit; or (2) if no metal mounting plate is used, a jumper connected between the conduit entry and exit is necessary to maintain ground continuity. As appropriate, remove the snapoff plastic cover to gain access to the terminal strips during the wiring procedure.

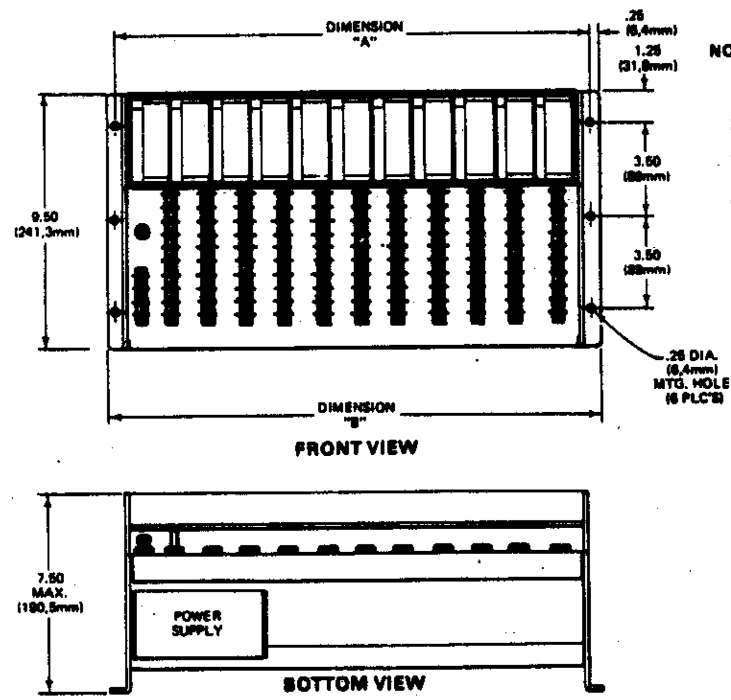




NOTES:

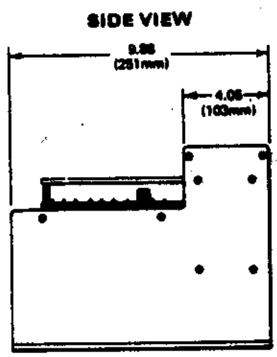
1. Connectors used must have contacts on .156 (3.96mm) centers, with contacts for both surfaces of board (recommended type: Viking part no. 2VK156/1-2).
2. Maximum card insertion depth in connector is .350 (8.89mm).
3. Minimum width of connector insertion slot is 2.470 (62.70mm).
4. Removable plastic 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 2. Plug-In Unit, Outline and Dimensions



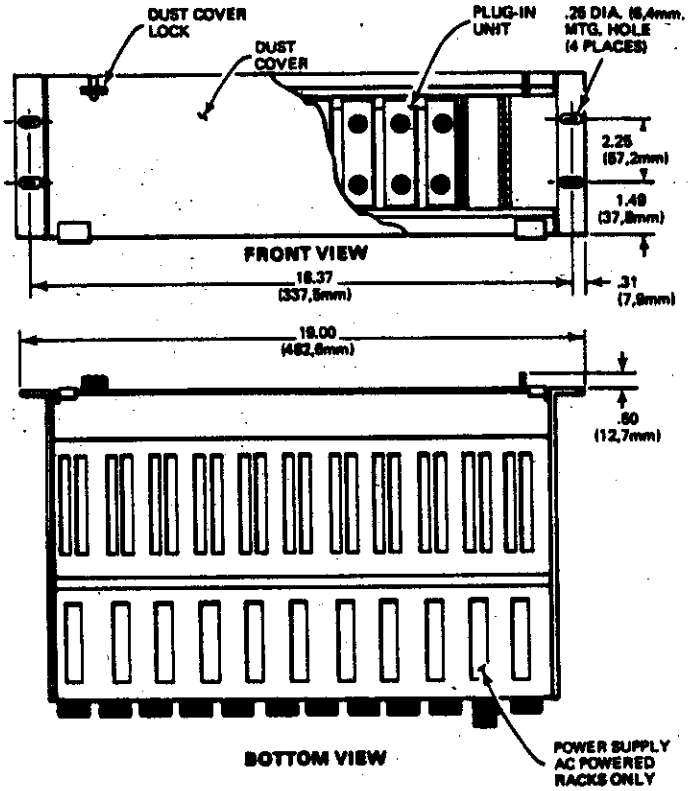
NOTES:

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 ±10%, 50/60 Hz, approximately 40 watts.



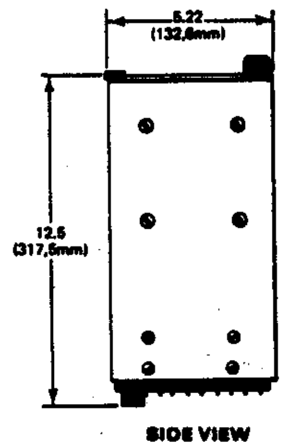
NUMBER OF POSITIONS	DIMENSION			
	A	mm	B	mm
5	9.19	233,4	9.69	246,1
6	10.62	269,7	11.12	282,4
7	12.06	306,3	12.56	319
8	13.50	342,9	14.00	355,6
9	14.94	379,5	15.44	392,2
10	16.38	416	16.88	428,8
11	17.81	452,4	18.31	465
12	19.25	489	19.75	501,7
13	20.69	525,6	21.19	538,2
14	22.12	561,8	22.62	574,5
15	23.56	598,4	24.06	611,1

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

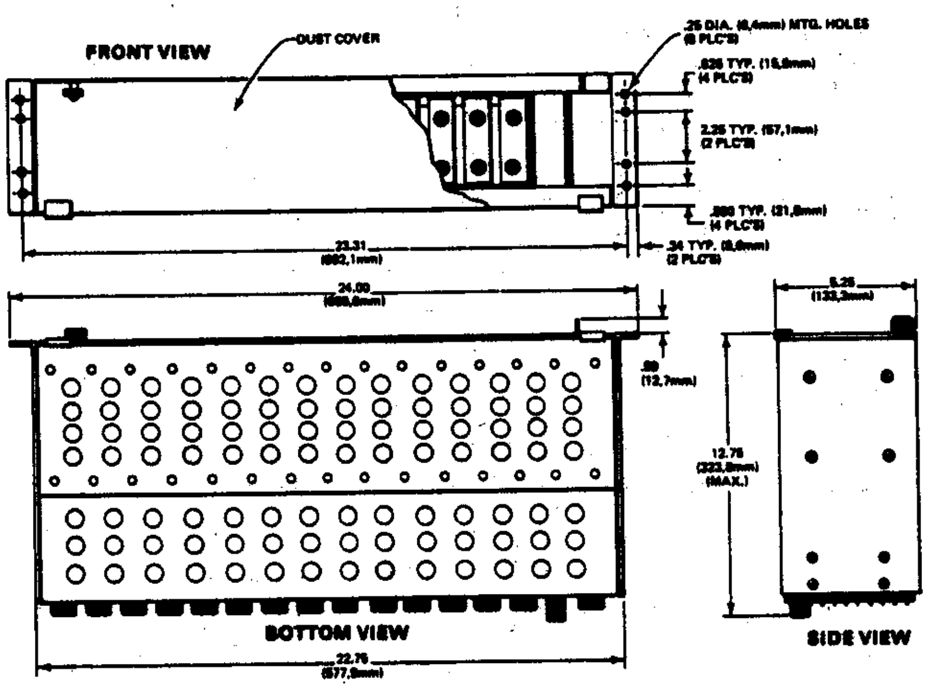


NOTES:

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 ±10% 50/60 Hz approximately 40 watts.

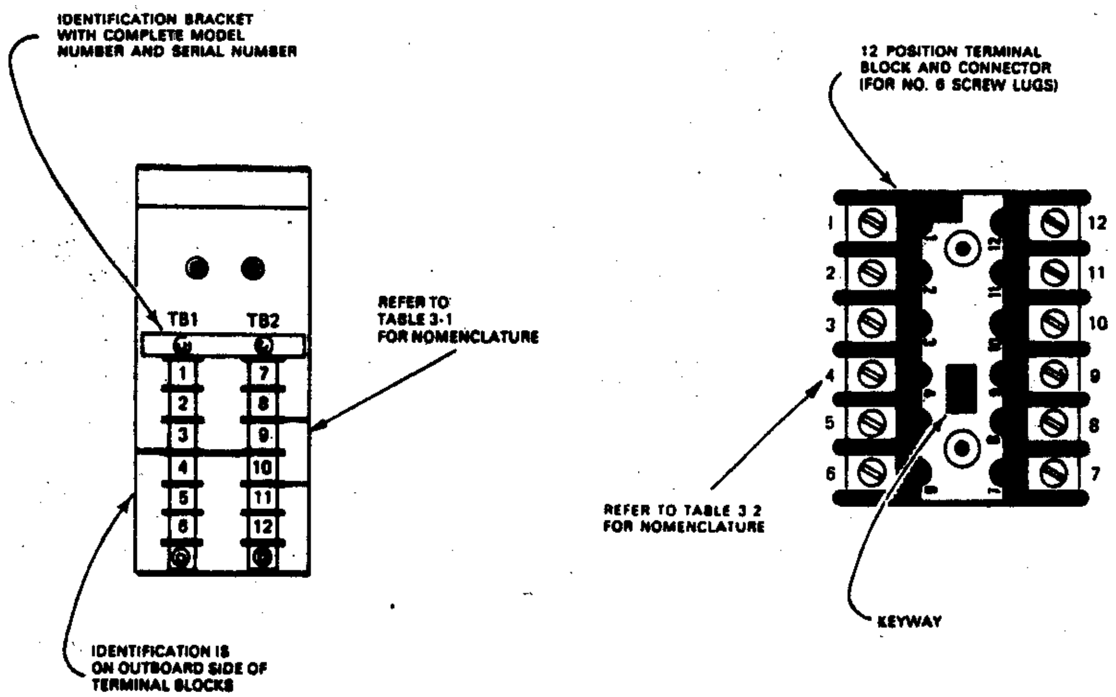


a. Eleven-Position Card Rack



b. Fifteen-Position Card Rack

Figure 4. Rack-Mounted Card Racks (RMR) Enclosure, Outline and Dimensions



a. Standard Units ***b. Units with EX or PST Configuration***

Figure 5. Terminal Strips and Terminal Blocks Identification

Table 1. Terminal Nomenclature

Options (Note 1)	Terminal Positions (See Figure 5)											
	1	2	3	4	5	6	7	8	9	10	11	12
None	SH			DCC	DC	GND			+IN	-IN	+OUT	-OUT
AC	SH			ACC	AC	GND			+IN	-IN	+OUT	-OUT
SC (Output)		SC	SC									
TC		+T	-T									
PTC		+T	-T				+P	-P				
CC (Note 2)												
PX							PX					

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, nut nomenclature will remain as shown.
2. Terminal nomenclature is not affected by this option. CC connections are made across the +IN and -IN terminals.

Legend:

AC	AC Power Input	CC	Contact Closure	+IN	Signal Input
ACC	AC Power Return	SC	Selectable Current Resistor	+OUT	Signal Output
DC	+DC Power Input	SH	Shield	±T	Temperature Sensor Input
DCC	-DC Power Input	PX	+12V Excitation	±P	Pressure Transducer Signal Input

Wiring Information for Plug-In Units and Card Rack Assemblies. Electrical connections for plug-in units and card rack configurations are made either to the terminals on the mating connector for the individual unit or to the card rack terminal strips. Figure 6 illustrates the terminal strip connections and the numerical reference designators. In addition, Table 2 provides the complete terminal nomenclature for both plug-in and card rack assemblies.

Power Connections

Input Power Connections

FDT transmitter units are designed to operate either from a DC (24 Vdc or 45 Vdc) or an AC (117 Vac, 220 Vac, or 240 Vac) power input source. The model number of the particular unit, which is usually stamped on either a tag attached to the housing case or on the inside of the housing case itself, specifies the appropriate power input source that is to be used with the respective instrument. When the proper power input source is determined, perform the appropriate connection procedure described as follows:

For DC-Powered Units, connect the DC terminal of the transmitter to the positive (+) side of the power input source and connect the DCC terminal to the negative (-) side. The DC power source should be regulated to within ± 10% of the nominal voltage and should be capable of delivering 5 watts.

For AC-Powered Units, connect the AC terminal of the tranmitter to the ungrounded or "hot" side of the power input source (if possible) and connect the ACC terminal to the common or neutral side. Connect the GND terminal on the transmitter directly to the housing case. These units require either 117 Vac ± 10%, 50/60 Hz at 5VA of nominal power or 220/240 Vac optionally.

For Rack Power Connections, connect the power input source wires to the appropriately labeled terminals of the 3-terminal connector strip located on the card rack assembly. The third terminal on the connector strip is for chassis ground.

Electrical Connections on Units with the Selectable Current (SC) Option. For FDT transmitter units with the selectable current (SC) option, connect the output selectable current resistor either to the terminals on the transmitter marked SC or to those terminals specified in Table 1. The current range is marked on the body of each resistor. For plug-in type transmitter units, mount the selectable current resistors externally. Either connect the resistors to the terminal block of the card rack or solder them to the appropriate terminals on the PC connector. Refer to Table 2 for appropriate connections.

Calibration

Introduction

This section provides information necessary to adjust and calibrate the unit. Each unit is adjusted and checked at the factory for proper performance before shipping.

General Information

After the FDT transmitter unit is unpacked, general operation-level checks of the individual unit are recommended. Generally these checks, which are specified in the Calibration portion of this section, require little or no adjustments. If the transmitter unit is ordered with the factory calibration (FC) option specified, this means that an exact calibration is performed at the factory and that red caps will be placed on the controls to guard against accidental adjustment. The red caps should never be removed from the controls. Also, field adjustments should not be made on these units unless a new range of input or output signal levels is desired.

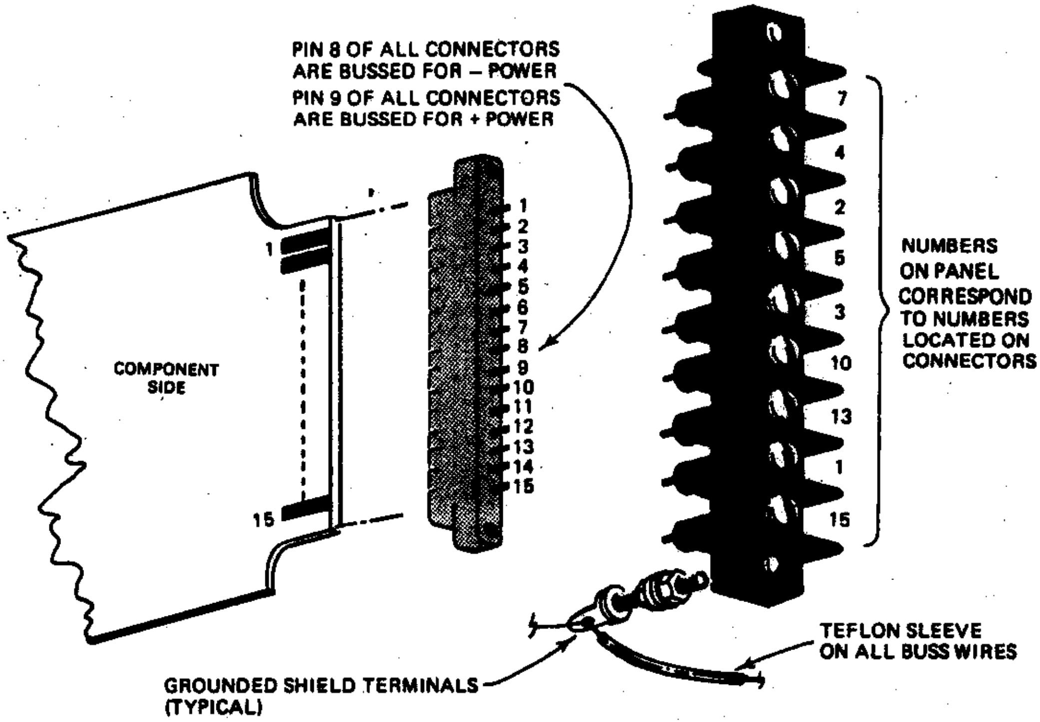
Control Description and Location

The FDT transmitter has ZERO and SPAN controls located on the front panel of the unit. Each of these controls has a multiturn potentiometer that is adjustable with a blade screwdriver.

Caution

The screwdriver blade should not be more than 0.1 inches (2.54 mm) wide. A wider blade may cause permanent damage to the potentiometer mounting.

The type of potentiometer used with these controls 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 each end to prevent damage if the control is turned beyond the wiper stop. Usually a slight change can be felt when the clutch is at the end of a range (i.e., it is slipping). However, if this change is not felt, either end can be reached by turning the shaft 20 turns in the desired direction. Turning either control clockwise makes the CAL (calibration) period longer, and turning either control counterclockwise makes the CAL period shorter.



KEYWAY PLACEMENT: BETWEEN PINS 11 & 12 AND 10 & 11.

Figure 6. Connectors and Terminal Strips Wiring and Identification for Plug-In Units

Table 2. Connector Pins and Terminal Assignments for Plug-In Units and Card Racks

Options	Terminal Position (See Figure 6)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
None	SH	SH	+IN	+OUT			-OUT	DCC	DC	-IN					
SC (Output)	SC														SC
TC	-T				+T										
PTC	-T				+T									-P	+P
PX															PX

Keyways

Legend:

DC	+DC Power Input	±IN	Signal Input
DCC	-DC Power Input	±OUT	Signal Output
SC	SC Resistor	±P	Pressure Transducer Signal Input
SH	Shield	±T	Temperature Sensor Input

Calibration Equipment and Tools Required

Test equipment and tools required to calibrate the FDT transmitter are listed in table 3. Test equipment and tools are not supplied with the unit and must be provided by the user.

Calibration Setup

Off-line calibration for all FDT units requires the same test equipment setups regardless of the physical configurations or types of options used. Hookup requirements and physical preparations may vary for some specific units however. To setup a particular unit for calibration, refer to the appropriate test equipment setup procedure as presented in this section as follows:

General Setup. Test equipment setup for transmitter calibration is the same for all units with the exception of connection identification. Figure 7 illustrates the general test equipment setup configuration. The connection nomenclature called out in the figure refers to the specific terminal markings on the standard units with CP, AB, RAA/RAT, PM and NEMA box housing options.

Plug-In Unit Setup. The equipment test setup for a plug-in unit is the same as that shown in Figure 7 with the exception that the printed circuit board connections for the plug-in unit are identified by the numbers in parentheses rather than by the standard nomenclature. Corresponding connection identification numbers are etched into the component side of the PC board of the plug-in unit. Plug-in units that are installed in card rack assemblies (i.e., rack-mounted and surface-mounted assemblies) also use the test equipment setup configuration shown in Figure 7 and the card rack terminal connections are also identified by the numbers shown in parentheses in the figure.

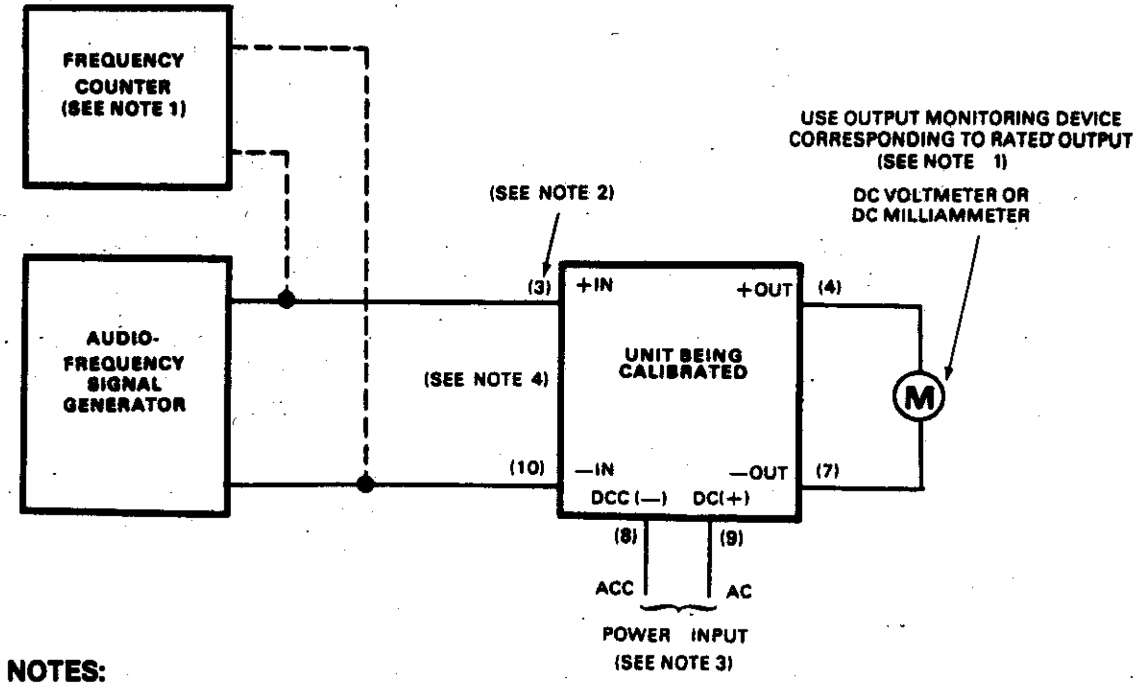
Explosion-Proof and PST-Option Unit Setup. Figure 8 illustrates the general test setup configuration for an explosion-proof enclosure or for a unit with a PST-type option. Note that in the explosion-proof configuration the protective housing must be opened up and the unit must be removed enough to expose the connection block. Similarly, units with the PST-option configuration must be unplugged from the connection block first in order to gain full access to the connections. When referring to Figure 8, also note that the numbers in parentheses refer to terminal block numbers.

Calibration

FDT transmitter 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, 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.

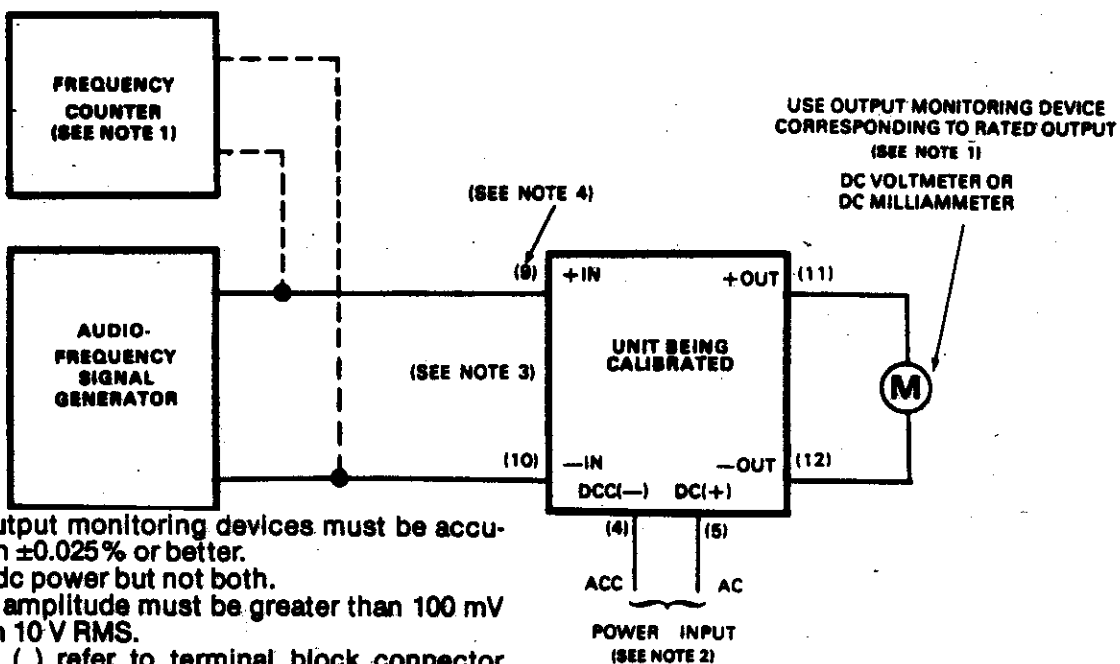
Table 3. Test Equipment and Tools Required

Equipment or Tool	Characteristic	Purpose
Screwdriver (blade)	Blade not wider than 0.1 inch (2.54 mm)	Front panel control adjustment
Audio Frequency Signal Generator	Must be capable of producing signal ranges defined by INPUT level requirements of purchased unit (see Specifications)	Simulate input signal levels
DC Voltmeter	Must be accurate to within ±0.025% or better	Output signal monitoring (voltage outputs only)
DC Milliammeter	Must be accurate to within ±0.025% or better	Output signal monitoring (current outputs only)
Frequency Counter	Must be accurate to within ±0.05% or better	Input signal monitoring
RTD or Resistance Box		Simulate temperature input for PTC or TC options
Precision Voltage Source (0-5V)		Simulate pressure input for PTC option



NOTES:
1. Input and output monitoring devices must be accurate to within ±0.025% or better.
2. Numbers in ( ) apply to plug-in units only.
3. Either ac or dc power is supplied, but not both.
4. Input signal amplitude must be greater than 100 mV but less than 10 V RMS.

Figure 7. General Test Equipment Setup for Calibration of FDT Unit



NOTES:
1. Input and output monitoring devices must be accurate to within ±0.025% or better.
2. Either ac or dc power but not both.
3. Input signal amplitude must be greater than 100 mV but less than 10 V RMS.
4. Numbers in ( ) refer to terminal block connector positions (see Figure 3-11).

Figure 8. Test Equipment Setup for Calibration of Explosion-Proof and PST Units

Note

Adjustments should *not* be made in the field to units that are calibrated to values specified on 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.

To calibrate an FDT transmitter unit, perform the appropriate procedure that is presented in this section. To perform the calibration procedure, the following testing devices are required: (1) an audio-frequency signal generator with a range covering the frequencies with which the unit will be used, (2) an output monitoring device (current or voltage) with an accuracy to within ±0.025% or better, and (3) a frequency counter to determine the frequency of the applied signal to the required accuracy.

For All FDT Units Except Those With the PRC, PTC, TC, or PX Options

1 Connect the unit and test equipment as shown in Figure 7 or 8, as appropriate. Then temporarily disconnect the signal generator and short circuit the input terminals of the unit.

2 Apply input power to the unit.

3 With the input terminals of the unit shorted, adjust the ZERO potentiometer to obtain 0% output from the unit (i.e., 1 MA, 4 MA, 10 MA, 1 Vdc, etc.)

4 Remove the short circuit from the input terminals of the unit and then connect the signal generator to these terminals. Adjust the signal generator to the maximum frequency that will be applied to the unit when it is installed. Adjust the output of the signal generator to a value greater than 100 millivolts RMS, but not more than 10 volts RMS.

5 Adjust the SPAN potentiometer to obtain 100% output (i.e., 20 mA, 50 mA, 5 Vdc, etc.)

6 Repeat steps 3 through 5 until no further adjustment of either the ZERO or SPAN potentiometer is required.

7 Apply 25%, 50%, and 75% of the frequency that was applied in step 4, and then check that the output is linearly proportional to the applied frequency (to within ±0.05% of the ouput span).

8 After step 7 is completed, remove the input signal and turn off the power input to the unit.

For FDT Units With the PRC, PTC, or TC Option

Note

The FDT transmitter has been factory calibrated to the specifications listed with the order. Refer to the procedure presented in this sub-section if any further calibration is required.

1 Connect the unit and test equipment as shown in Figure 9, 10, or 11, as appropriate. If the PRC option is being used, note that the FDT transmitter accepts an additional input for a pressure compensating signal as shown in Figure 9. This 0-5 Vdc linear pressure signal must be provided by the user.

2 Set the input frequency to the maximum input (in Hz).

3 Set the temperature RTD or resistance box for standard temperature (ohms or °F).

4 Set the pressure transducer or volts box to the maximum value (volts or psig).

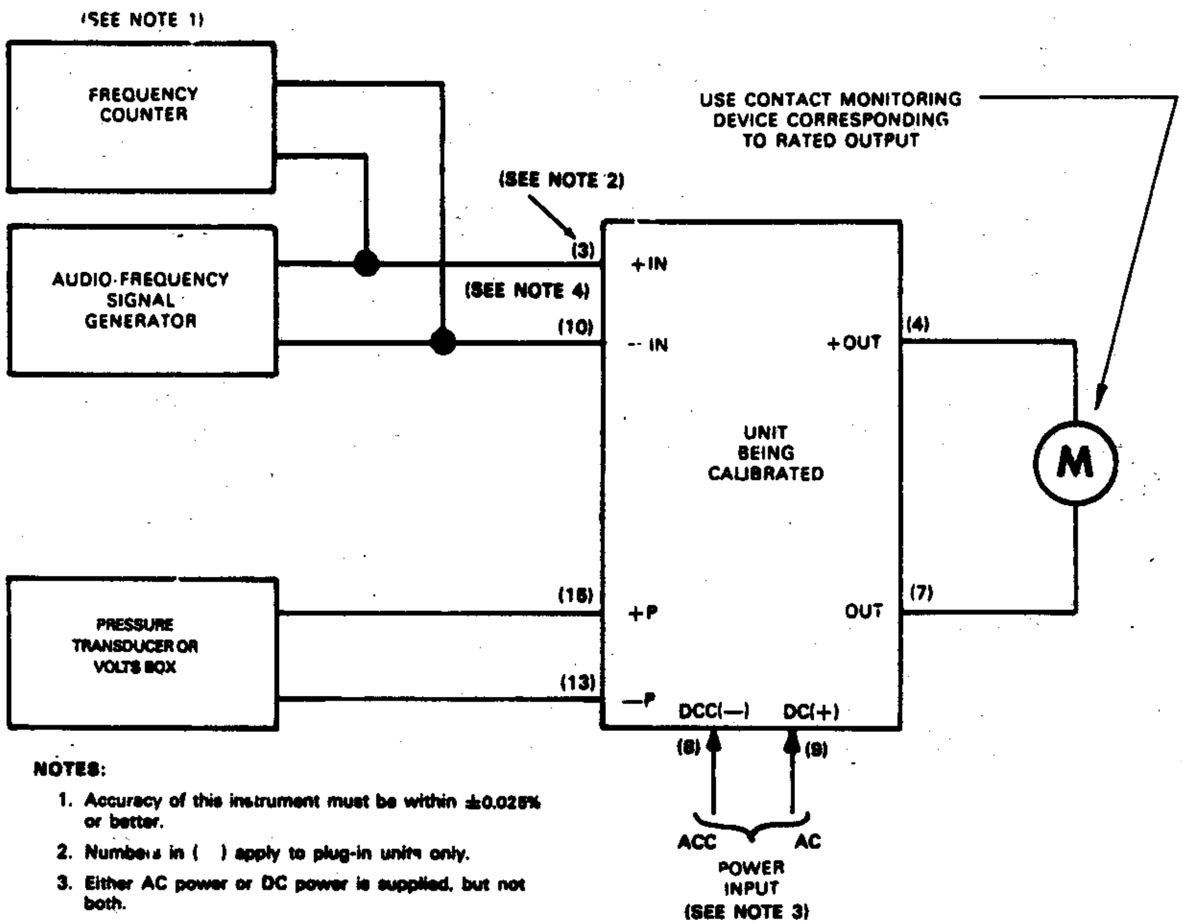
5 Adjust the SPAN potentiometer for the desired output.

6 Set the input frequency to the minimum value and then adjust the ZERO potentiometer for the desired output.

7 Repeat this procedure until no further adjustments are necessary.

For FDT Units With the PX Option

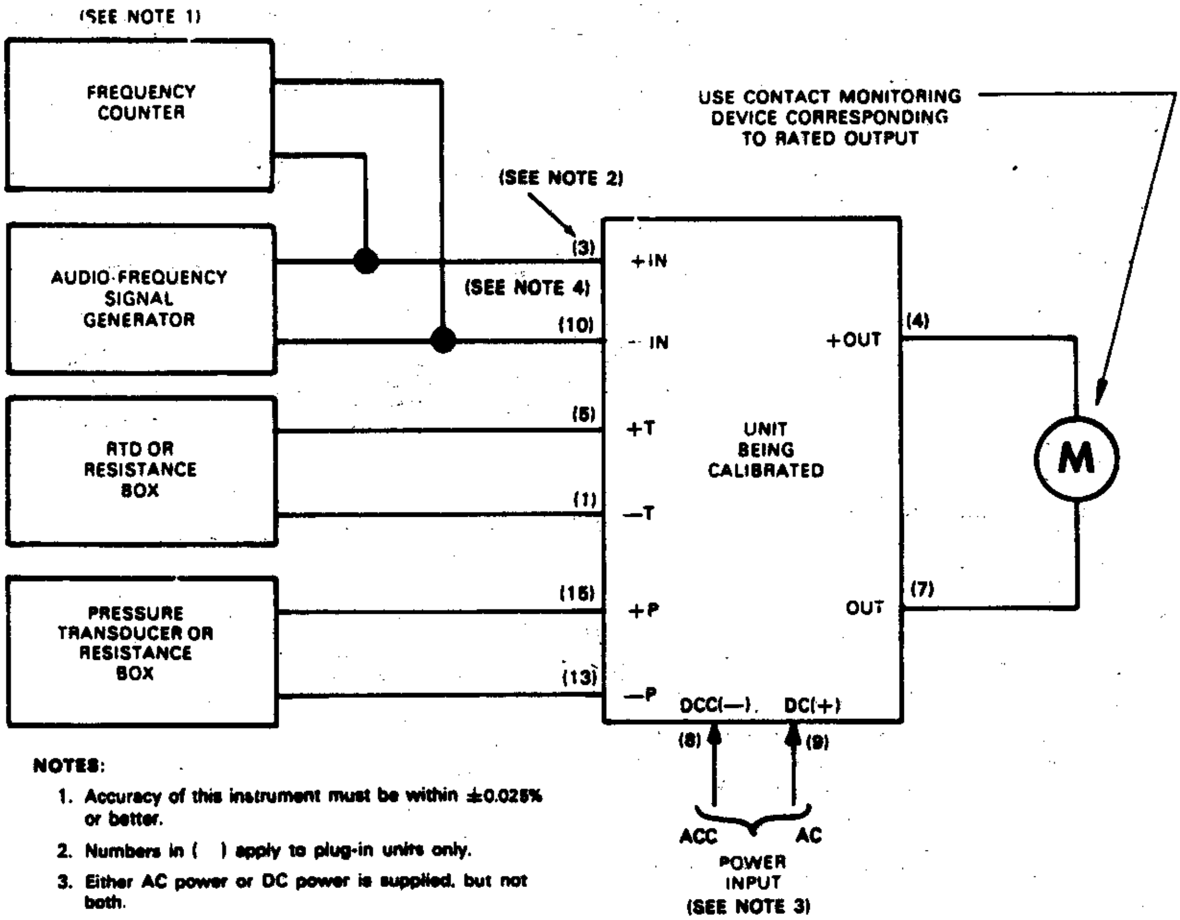
The FDT transmitter unit can be supplied with a PX-type option that provides a positive (+) 12 Vdc signal (at 15 MA, Max) for turbine meter excitation. Note that the addition of the PX-option means that the input is no longer isolated and that input sensitivity increases to 5-25 V P/P. To calibrate an FDT transmitter with the PX option, connect the additional test equipment required as shown in Figure 12 and perform the appropriate procedure as described in the previous sub-sections. Refer to Figures 7 through 11 as necessary to perform the calibration procedure.



NOTES:

1. Accuracy of this instrument must be within ±0.025% or better.
2. Numbers in ( ) apply to plug-in units only.
3. Either AC power or DC power is supplied, but not both.
4. Input signal amplitude must be greater than 100 mV but less than 10 V RMS.

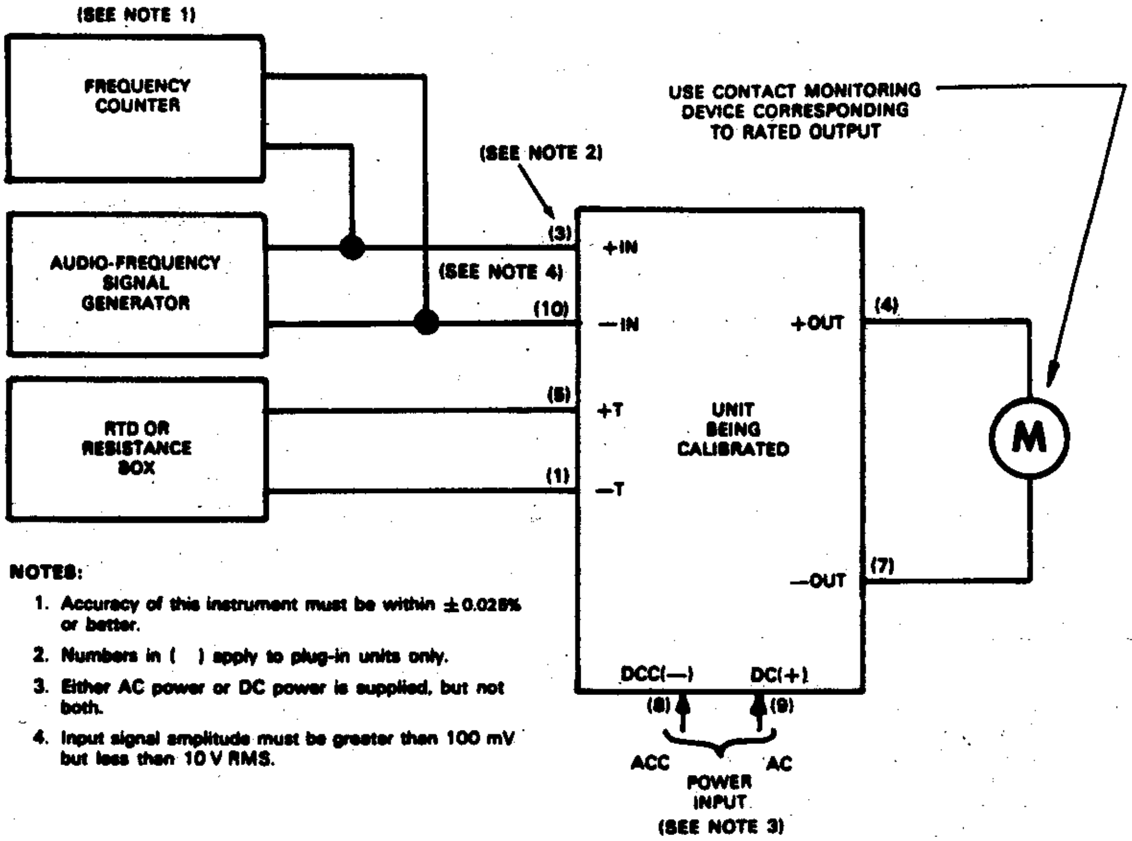
Figure 9. Test Equipment Setup for Calibration of Unit with PRC Option



NOTES:

1. Accuracy of this instrument must be within ±0.025% or better.
2. Numbers in ( ) apply to plug-in units only.
3. Either AC power or DC power is supplied, but not both.
4. Input signal amplitude must be greater than 100 mV but less than 10 V RMS.

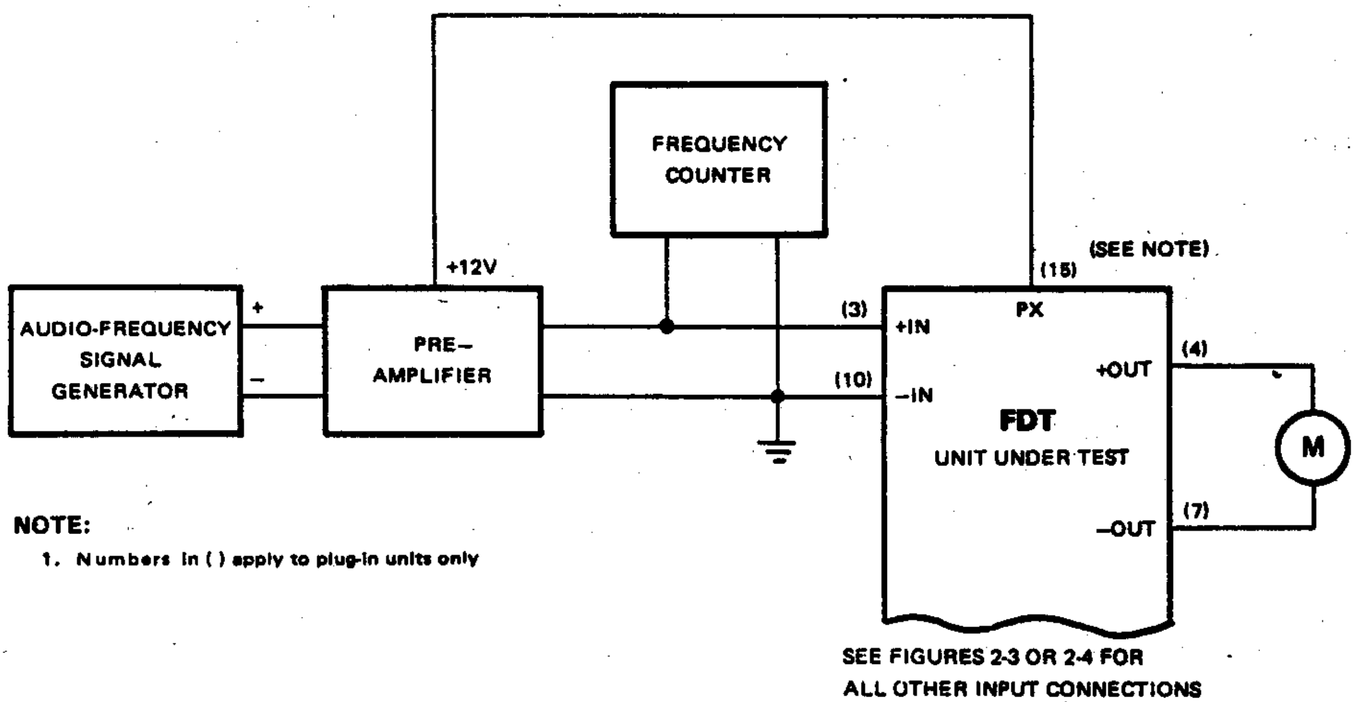
Figure 10. Test Equipment Setup for Calibration of Unit with PTC Option



NOTES:

1. Accuracy of this instrument must be within ±0.025% or better.
2. Numbers in ( ) apply to plug-in units only.
3. Either AC power or DC power is supplied, but not both.
4. Input signal amplitude must be greater than 100 mV but less than 10 V RMS.

Figure 11. Test Equipment Setup for Calibration of Unit with TC Option



NOTE:

1. Numbers in ( ) apply to plug-in units only

Figure 12. Test Equipment Setup for Calibration of Unit with PX Option

Changing the Input Range

The standard FDT transmitter unit is capable of accepting a frequency input from 50-100 Hz to 6400-12800 Hz in 8 different ranges. FDT units equipped with the Low Frequency Input (LF) option accept input signals from 25-50 Hz to 1.5625-3.125 Hz in 5 ranges. Changing from one input range to another requires moving only one internal jumper wire. Refer to Tables 4 through 7 as appropriate to detemine the proper jumper selection for each specific transmitter configuration and range. Refer to Figure 16 for jumper positions (J301-J311) for standard units and to Figure 19 for jumper positions (J201-J211) for plug-in units.

Note

Units with the LF option cannot be changed to non-LF or vice versa by the following tables.

Table 4. *Jumper Selection for Standard FDT Transmitter Without LF Option*

Input	Range	Jumper
A	0-50 thru 100 Hz	J311
B	0-100 thru 200 Hz	J310
C	0-200 thru 400 Hz	J306
D	0-400 thru 800 Hz	J304
E	0-800 thru 1600 Hz	J305
F	0-1600 thru 3200 Hz	J307
G	0-3200 thru 6400 Hz	J308
H	0-6400 thru 12800 Hz	J309

Table 5. *Jumper Selection for Standard FDT Transmitter With LF Option*

Input	Range	Jumper
LFA	0-1.5625 thru 3.125 Hz	J305
LFB	0-3.125 thru 6.25 Hz	J304
LFC	0-6.25 thru 12.5 Hz	J303
LFD	0-12.5 thru 25 Hz	J301
LFE	0-25 thru 50 Hz	J302

Table 6. *Jumper Selection for Plug-In Transmitter Without LF Option*

Input	Range	Jumper
A	0-50 thru 100 Hz	J211
B	0-100 thru 200 Hz	J210
C	0-200 thru 400 Hz	J204
D	0-400 thru 800 Hz	J202
E	0-800 thru 1600 Hz	J203
F	0-1600 thru 3200 Hz	J205
G	0-3200 thru 6400 Hz	J206
H	0-6400 thru 12800 Hz	J207

Table 7. *Jumper Selection for Plug-In Transmitter With LF Option*

Input	Range	Jumper
LFA	0-1.5625 thru 3.125 Hz	J203
LFB	0-3.125 thru 6.25 Hz	J202
LFC	0-6.25 thru 12.5 Hz	J201
LFD	0-12.5 thru 25 Hz	J208
LFE	0-25 thru 50 Hz	J209

Theory of Operation

Introduction

This section briefly describes how the FDT transmitter operates. A simplified block diagram is presented in Figure 13 to help in understanding the circuit descriptions. In addition, detailed schematic and assembly drawings are presented in Figures 14 through 19 which are located at the back of this manual.

Operation

The FDT transmitter is a flow measurement instrument that accepts a pulse-rate input and yields a proportional 4-20 MA or 1-5 Vdc signal output. The FDT consists of the functional elements shown in the block diagram in Figure 13. Note that although the figure shows both an AC operated power supply and a DC operated power inverter, the unit will have either the power supply or the inverter but not both components. The incoming AC signal is transformer-coupled and channeled into a buffer element which produces a trigger level that is compatible with a one-shot generator. The logic circuits of the one-shot generator develop a signal with a repetition rate that is equal to the frequency of the AC input signal. A switching stage then inverts these pulses to provide a positive reference point for the output stages. An active low-pass filter, which consists of two operational amplifiers, produces a DC output signal that is proportional to the frequency of the applied AC input. The unit output power is generated by a power amplifier stage.

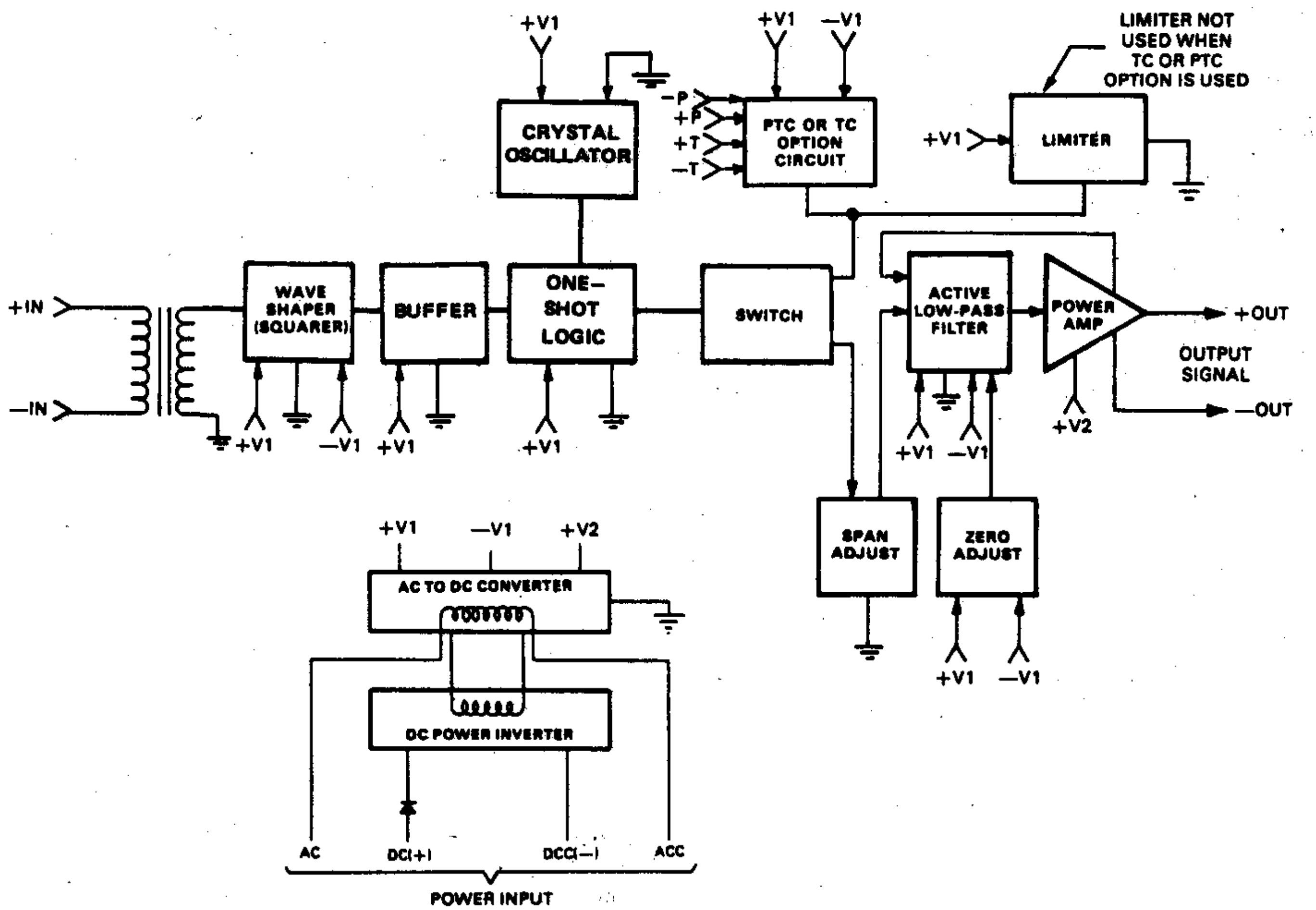


Figure 13. FDT Block Diagram

The following sub-sections present detailed descriptions of individual circuit operation grouped according to the major circuit blocks of the FDT transmitter system as follows: input stage; output stage; and power supply.

Input Stage

Input Circuit and Wave Shaper Circuit. The input signal (which may be floating or not floating) is coupled by the transformer to the buffer comparator. The ouput from the comparator produces a signal that has a shape and amplitude suitable for driving the one-shot generator. This additional stage is necessary to improve the noise immunity and thus assure constant output pulses even in the presence of noise on the input signal. Additional shaping also provides a signal with sharp transitions so that the one-shot generator will be uniformly and reliably triggered regardless of the input waveform, thereby ensuring constant accuracy of the unit. The comparator operates from the +12V and -12V supplies.

One-Shot Generator Logic Circuits. The one-shot generator logic circuits consist of a clock generator, a binary counter, and two flip-flops. These circuits develop a signal with a repetition rate that is equal to the frequency of the AC input signal.

Switch Circuit. The switch, which includes a limiter as shown in Figure 13, provides accurate near-ground and positive amplitude references for the pulses that are ultimately integrated to produce the DC output. The negative-going pulses from the one-shot generator are applied to the switch, which produces positive-going pulses of constant positive voltage above ground to drive the next stage in the required manner. A variable voltage divider applies a portion of the switch output to the following stage which effectively establishes the span of the unit. The switch (including the limiter) operates from the +12V power supply.

Output Stage

Active Low-Pass Filter Circuit. The active low-pass filter consists of two operational amplifier stages with feedback and an inverter to produce a DC output signal that is proportional to the frequency of the applied input signal. The second operational amplifier stage has associated with it a zero adjust circuit. This circuit adds an adjustable voltage of the proper polarity to the basic input signal for this stage. With zero signal applied to the unit, the zero adjust circuit is adjusted so the voltage added to the input of the second operational amplifier results in the required minimum output signal. The resulting signal from the output of the second operational amplifier is then applied to the power amplifier. Both stages in the active low-pass filter and the zero adjust circuit operate from the +12 V and -12 V power supplies.

Power Amplifier Circuit. The power amplifier is a DC-coupled stage that uses two PNP transistor stages. Feedback from the output is applied to the second operational amplifier in the active low-pass filter. This feedback results in high overall stability and a nearly ideal output impedance for the type of output used (i.e., either current or voltage).

PTC and TC Option Circuit. When a unit is ordered with either the PTC or TC (pressure-temperature or temperature compensation) option, the positive amplitude of the output from the switch is designed to be variable by the limiter instead of being constant. This variation in amplitude is accomplished by an additional circuit (i.e., PTC or TC option circuit) that replaces the limiter shown in Figure 13. This circuit produces a signal that causes the positive output from the switch to vary in proportion to P/T or 1/T, where P is an analog voltage that represents pressure and T is the output of RB that represents absolute temperature. Therefore the resulting signal that the switch applies to the subsequent stage consists of a group of pulses that have a frequency equal to that of the signal applied to the input of the unit. The pulses also have an amplitude proportional to P/T or 1/T depending on whether the PTC or TC option is used.

Power Supply

Power Inverter Circuit. The power inverter is a transformer-coupled multivibrator that oscillates at approximately a 3 KHz rate. Because the core of the transformer is saturated, a square wave of reasonably constant amplitude is generated.

AC Power Supply Circuit (Standard Units Only). When AC power is applied, the power supply produces AC voltages of different amplitude (with respect to ground). These voltages are applied to the rectifier and regulator circuit which develops regulated and unregulated DC as operating voltages for the unit.

Rectifier and Regulator Circuit. The rectifier accepts the outputs from either the AC power supply or the power inverter and produces unregulated positive and negative voltages (of equal value with respect to ground). The regulator reduces these voltages to the required operating values and regulates them against changes with load or line-voltage changes. A second rectifier produces a higher regulated output as operating voltage for the power amplifier. On all standard units, the components of the ± 12V regulator circuits are mounted on a printed circuit board (PC2) attached to the main board (PC1). The +30V rectifiers and regulators for the +30V power supply are mounted on the main board.

Maintenance

Introduction

This section contains maintenance and troubleshooting information together with unit documentation.

Troubleshooting

In general, to troubleshoot the unit, trace the signal with an oscilliscope and refer to the schematic diagrams presented in Figures 14 and 17 to determine what component or devices are causing the abnormal indication. The schematic diagrams include flagged numbers (or letters) at various points in the circuit and Table 8 indicates the appropriate voltages and waveforms at these points for specified input signal conditions. The circuit board assembly drawings presented in Figures 15, 16, 18, and 19 illustrate the physical locations of each individual component on each respective circuit board.

If the initial symptom is a complete failure of the unit to operate, the most logical components to suspect are those associated with the power supply inside the unit (including any voltage regulators). If the unit is producing an incorrect (but not zero) output, check the outputs from the voltage regulator and, if these are normal, apply a standard input signal to trace the resulting signal through the unit until the misfunctioning component is discovered.

When working on or near a circuit board during troubleshooting procedures, keep in mind that each board is protected with a moisture-resistant coating. Because of this coating, it may be necessary to use a needle-point probe while exerting a fair amount of pressure to break through the coating to observe a particular signal or voltage at a specified point. When connecting a probe to a component on the circuit board, always excercise care to make sure that the probe does not short-circuit to an adjacent component.

Table 8. Waveforms and Voltages

TEST POINT	WAVEFORM OR VOLTAGE LEVEL
1	 +12 / −12V
2	 +12V / 0
	 +12V / 0 (100 KHz)
4	 +12V / 0
	 6.5V / 0
6	0 — 0 to −0.8V (See Note 2)
7	0.2 to 1V (See Note 2) Voltage Out — 0 (Current out is −0.2 to −1V)

NOTES:

1. Operating frequency is equal to the input frequency.
2. Low value of amplitude corresponds to calibrated zero of input and high value corresponds to calibrated full scale input.

   Example: Waveform #6; input range is calibrated to 100 Hz. Therefore, A = 0V for zero input and —0.8V for 100 Hz input.

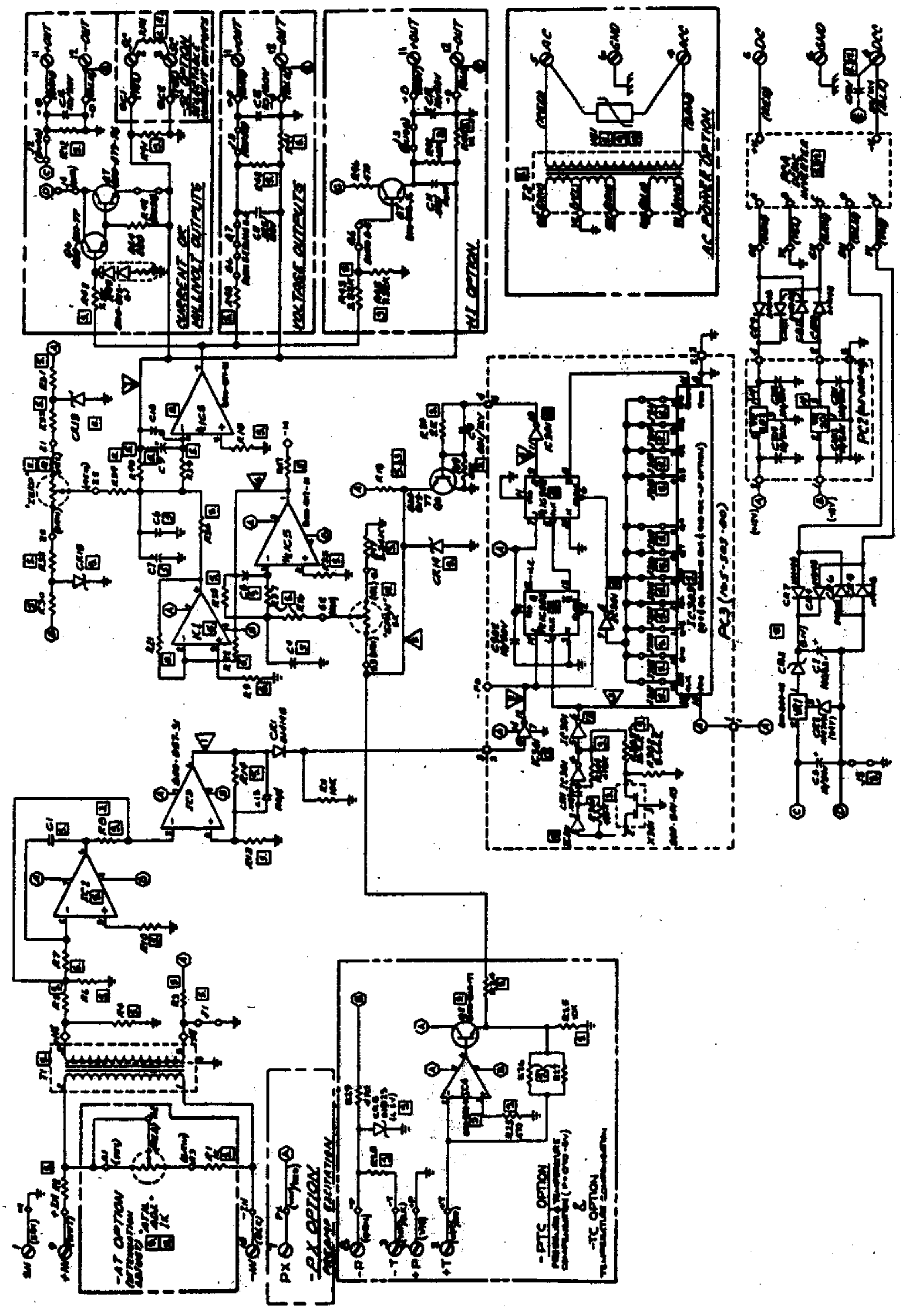
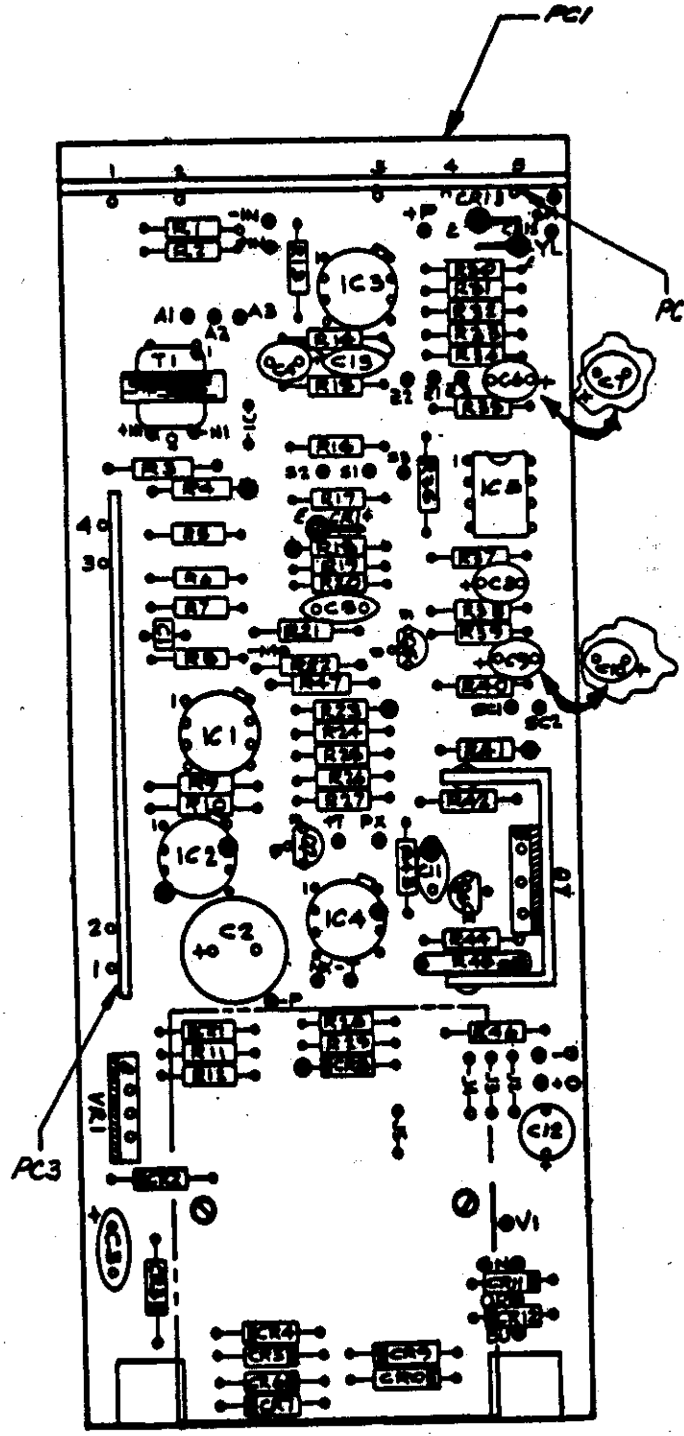
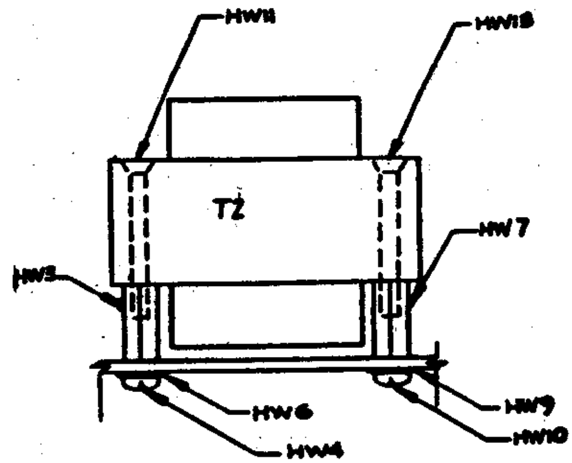
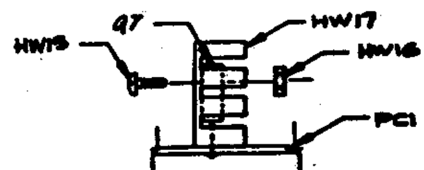


Figure 14. Schematic Diagram for Standard FDT Transmitter

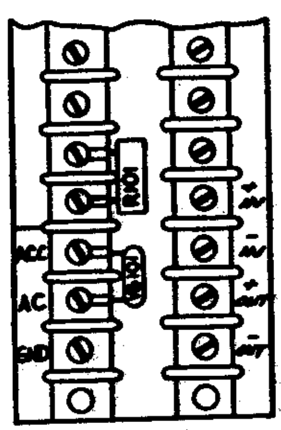




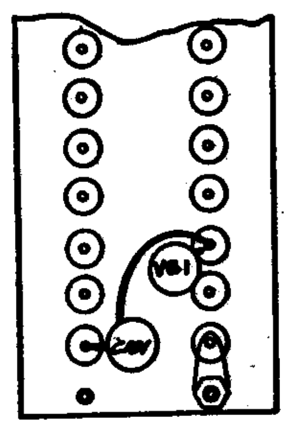
MTG. DETAIL FOR T2



MTG. DETAIL FOR Q7
(SIDE VIEW)



VS101 & R101



C101 & VS1

Figure 15. Printed Circuit Board (PC1) Assembly for Standard FDT Transmitter

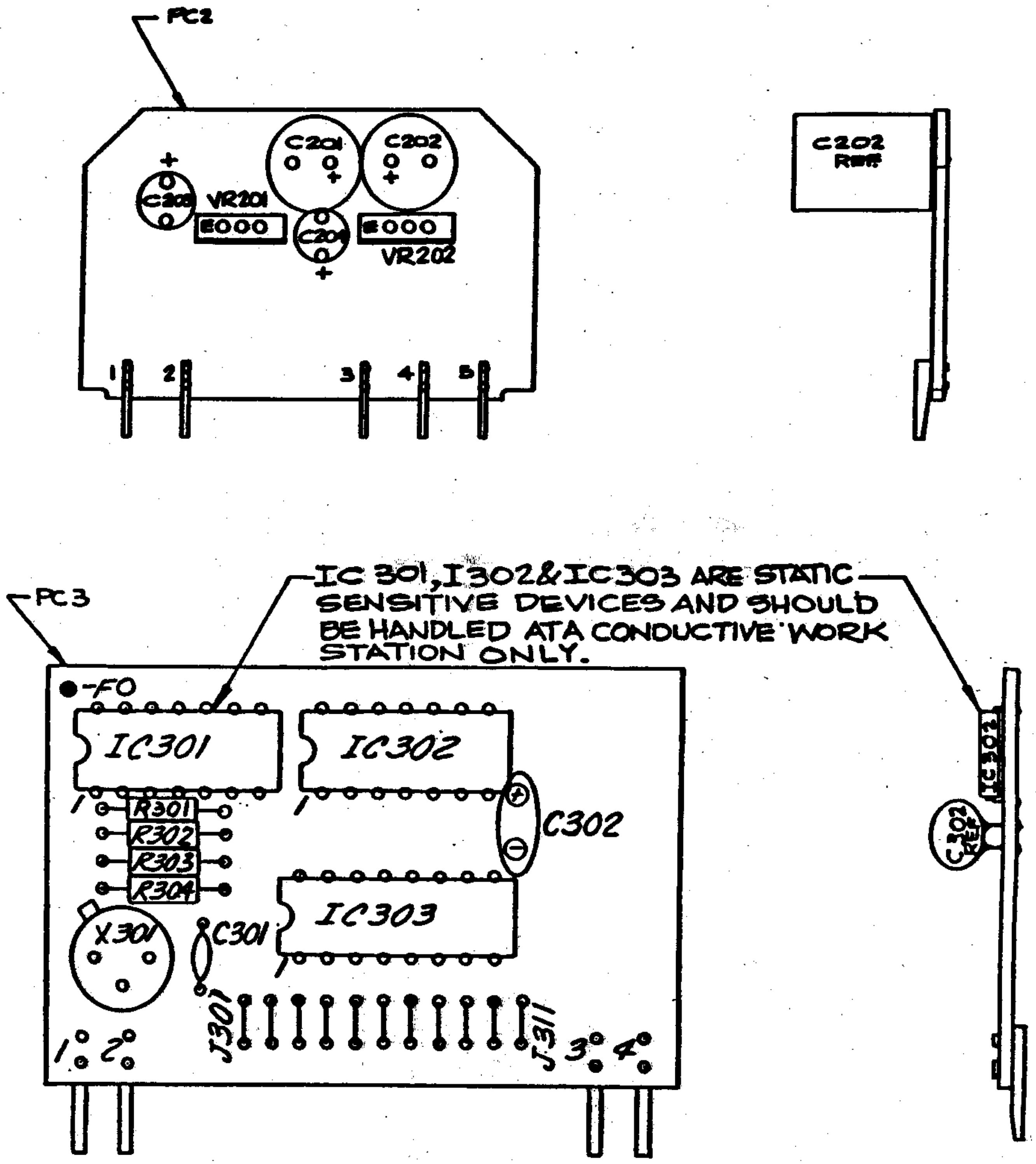


Figure 16. Printed Circuit Boards (PC2 & PC3) for Standard FDT Transmitter

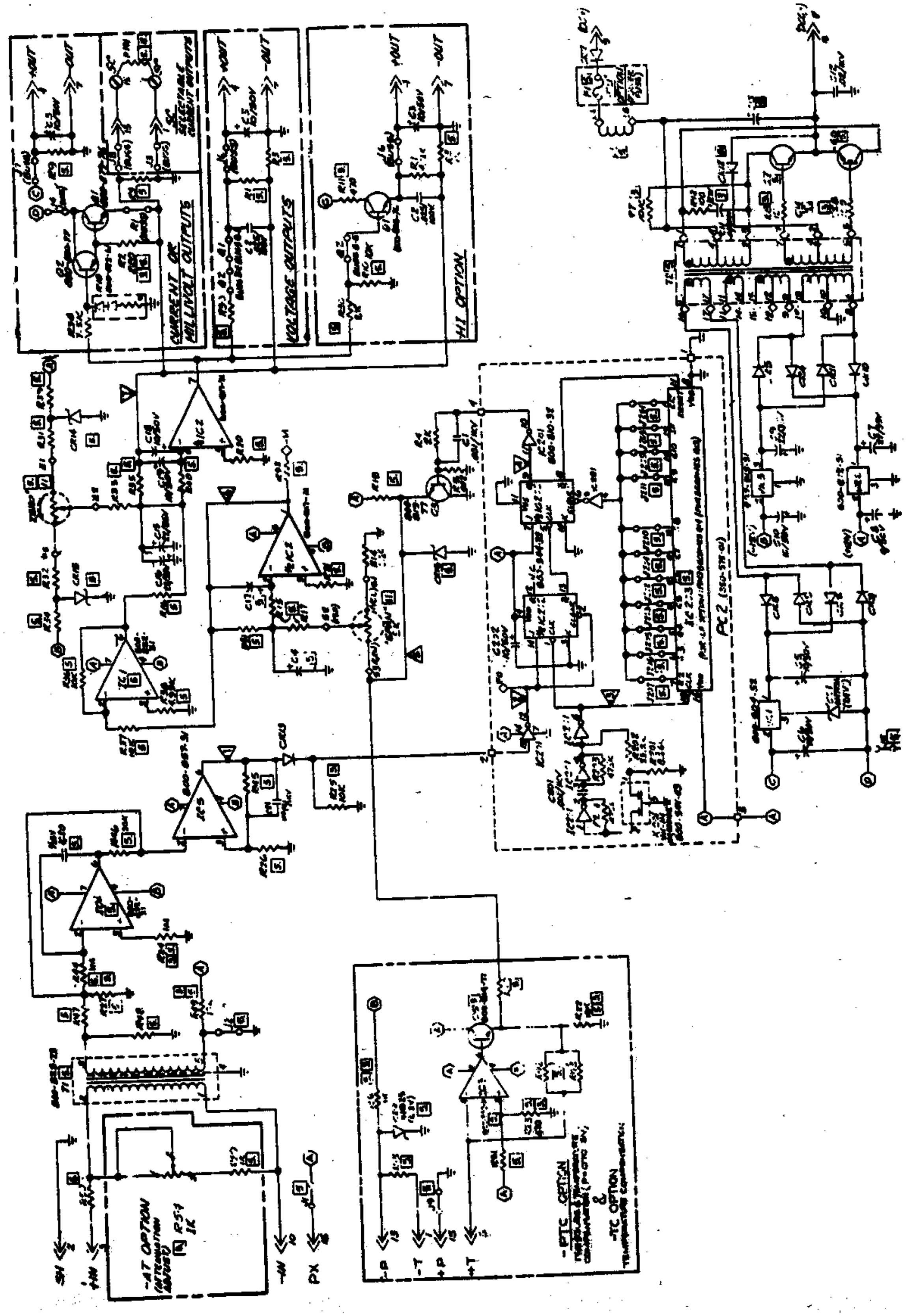


Figure 17. Schematic Diagram for Plug-In FDT Transmitter

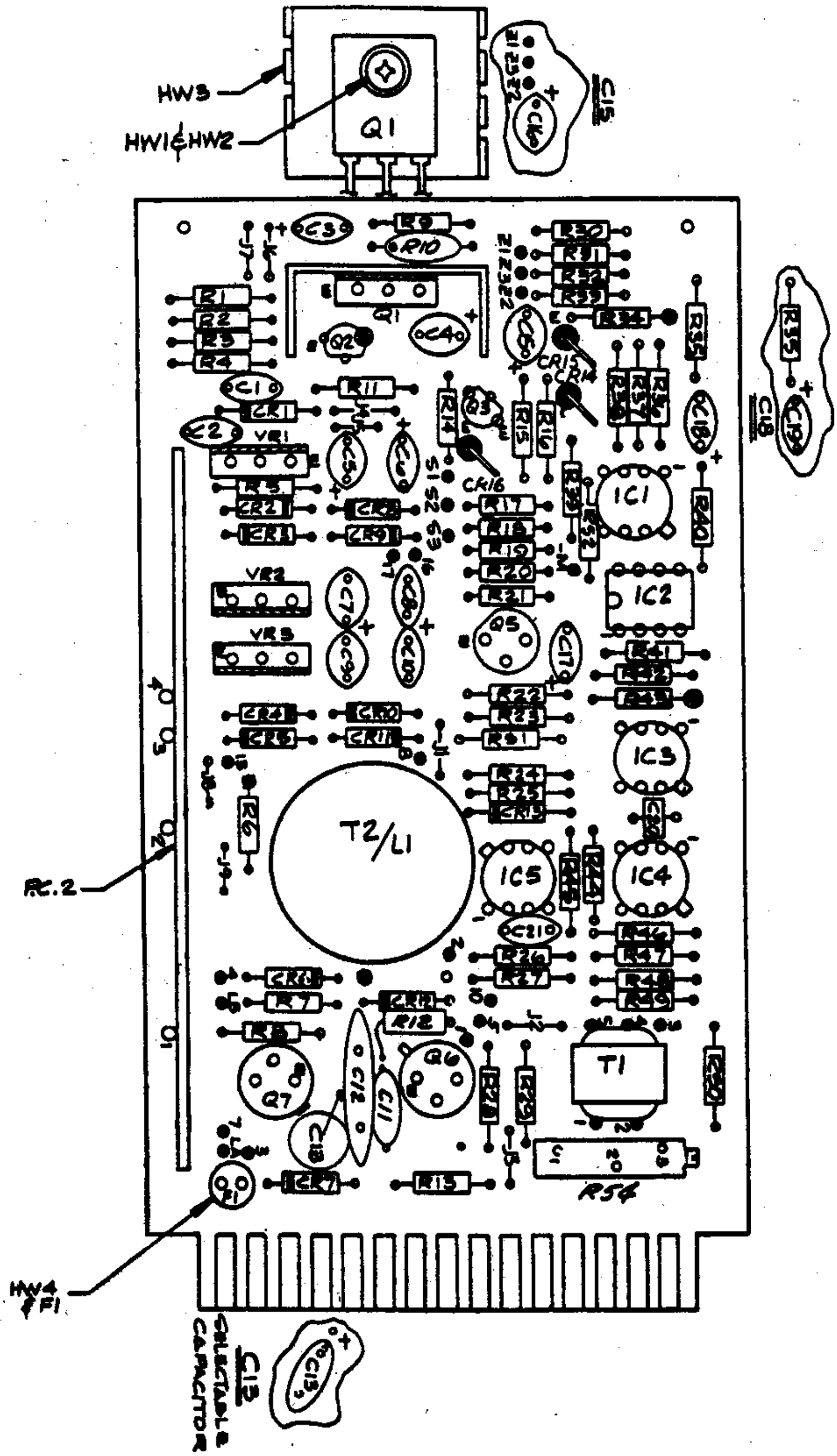


Figure 18. Printed Circuit Board (PC1) Assembly for Plug-In FDT Transmitter

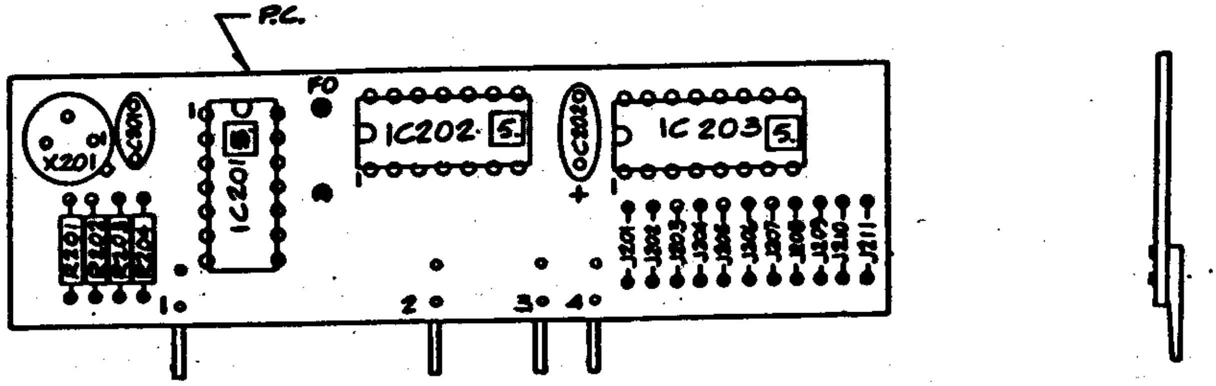


Figure 19. Printed Circuit Board (PC2) Assembly for Plug-In FDT Transmitter

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.

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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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