



USER'S MANUAL

FDX

Frequency-to-DC Transmitter

January 1989

No. 165-706-00 E

ADDENDUM

If You Have Ordered A 2-Wire Transmitter in the
DIN HOUSING,

Please Note The Following Information:

1. This manual is written for the HOCKEY PUCK (HP) configuration, and is currently undergoing revision to incorporate the DIN housing. However, the information provided here does apply to the DIN configuration since both units use the same basic schematic diagram and parts layout profile.
2. If the built-in test points are used to measure the output of a DIN unit, the milliammeter used must have an internal impedance of 10 ohms or less to avoid compromising the measurements. In this case no external resistance is required.
3. For thermocouple input units, the temperature compensating resistor is embedded in the terminal block.

1.0 SCOPE OF MANUAL

This manual contains operating and maintenance information for the two-wire Frequency-to-dc Transmitter (FDX) manufactured by MOORE INDUSTRIES INCORPORATED, Sepulveda, California. The manual consists of the following sections:

Section 1. General Information, provides the physical and functional configuration for the unit. A model number explanation is also included.

Section 2. Calibration Procedures, provides information necessary for adjustment and calibration of the unit. This section contains a list of the tools necessary for adjusting the equipment. A test connection diagram is included.

Section 3. Installation and Operation, this section contains mechanical and electrical installation instructions, which include recommended wiring practices and electrical connections for the unit.

Section 4. Theory of Operation, describes the circuit operating principles based on a simplified schematic diagram.

Section 5. Maintenance and Troubleshooting, gives step-by-step procedures for maintaining and troubleshooting equipment.

The terms **NOTE**, **CAUTION**, and **WARNING** have specific meanings.

A **NOTE** provides additional information that makes it easier to perform a particular task. Failure to follow a note may result in some inconvenience or needless expense, but the unit will not be damaged, nor is the Instrument Technician likely to be injured.

A **CAUTION** stresses important details to follow when making electrical connections or cleaning PC board contacts. Failure to heed a caution may damage the unit, void the Moore Industries warranty, or cause minor physical injury to the Instrument Technician.

A **WARNING** provides vital safety information that must not be ignored. Warnings deal with proper grounding of equipment, use of solvents, etc. Ignoring warnings may damage the unit and risk personal injury or even death to the instrument technician.

1.1 DESCRIPTION

The FDX is a pulse averaging discriminator with a wide input dynamic range. It features an optional isolated input (transformer coupled). The unit first limits the applied ac input signal. It processes the limited signal, triggers a circuit that produces pulses at a repetition rate corresponding to that of the input signal, and then filters these pulses. Finally, the unit amplifies the resulting filtered pulses to produce a varying dc level.

1.2 SPECIFICATIONS

The specifications contain information on input ranges, outputs, power, options and housings, as well as front panel adjustments and performance characteristics.

1.3 MODEL NUMBER EXPLANATION AND USE

MOORE INDUSTRIES model numbers identify the instrument type, functional characteristics, operating parameters, and any options ordered. If the documentation is missing, the model number can be used to obtain technical information on the unit. See Table 1-1.

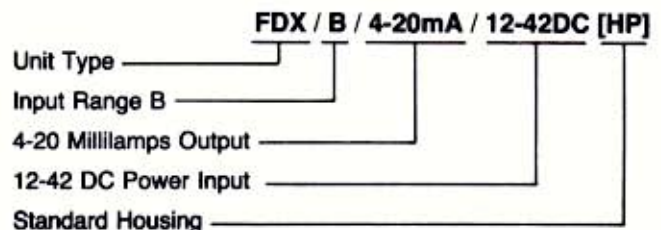


TABLE 1-1. MODEL NUMBER EXAMPLE

The model number is located on the identification label on the cover. For explosion-proof units, the model number is stamped on a stainless steel tag on top of the enclosure.

1.4 SERIAL NUMBER USE AND LOCATION

MOORE INDUSTRIES keeps a complete history on each unit sold. This historical information is keyed to the serial number. If service is required on a unit, it is necessary to provide the factory with the serial number as well as the model number. This identification is usually located with the model number as described in paragraph 1.3. Plug-in units have the serial number engraved inot the printed circuit board.

Specifications

Characteristics

Front Panel Adjustments 22-turn potentiometers
Zero: Adjustable to $\pm 10\%$ of span
Span: Output is fully adjustable to 100% of output span over a preselected input range.

Performance **Calibration Capability:** $\pm 0.1\%$ of span
Over Voltage: 60V maximum without damage
Line Voltage Effect: $\pm 0.003\%$ of span/volt change

Ambient Temperature **Range:** -29°C to $+82^{\circ}\text{C}$ (-20°F to $+180^{\circ}\text{F}$)
Effect: $\pm 0.01\%$ of span/ $^{\circ}\text{F}$ over above range.

Input Impedance 10K ohm

Input Amplitude 10mV minimum, 20V maximum P/P

CMR $> 60\text{dB}$ (Common Mode Rejection)

Weight DIN 8.5 oz.
 HP 5.5 oz.

***Power Input** 12Vdc minimum to 42Vdc maximum (limited by CSA) measured at the input terminals

Options **-RF** RFI/EMI filtered terminals
-SS Sensitivity Select. Input amplitude 400mV minimum.

Ordering Specifications

Unit FDX

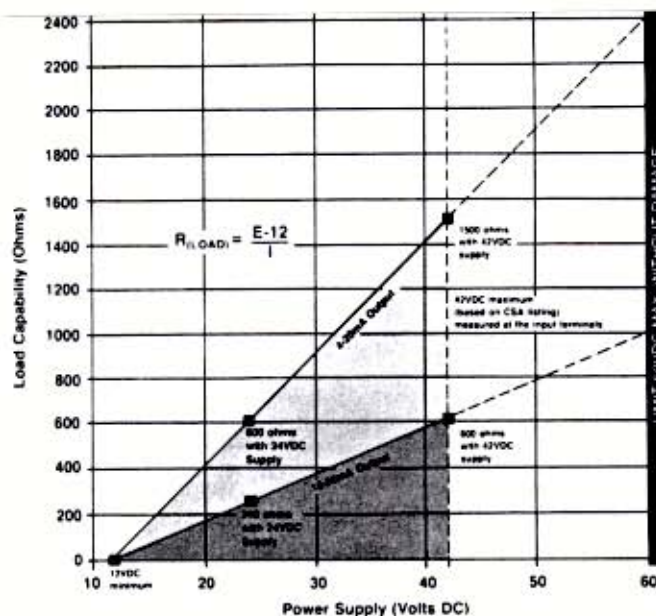
Input Ranges **A** 0 to 50 through 100 Hz
B 0 to 100 through 200 Hz
C 0 to 200 through 400 Hz
D 0 to 400 through 800 Hz
E 0 to 800 through 1600 Hz
F 0 to 1600 through 3200 Hz
G 0 to 3200 through 6400 Hz
H 0 to 6400 through 12,800 Hz

Output 4-20mA (limited at 30mA maximum)
 10-50mA (limited at 65mA maximum)

Housings **DIN** Rail-mount housing
HP Standard aluminum case with spring clips for mounting in explosion-proof enclosures
FL Aluminum case (HP) with mounting flanges for relay-track or surface mounting.
****2LS** Explosion-proof, 2-hub.
****3LS** Explosion-proof, 3-hub.
****2HG** Explosion-proof, high-glass dome, 2-hub
****3HG** Explosion-proof, high glass dome, 3-hub.

When ordering, specify: Unit/ Input Frequency Range/Output / Power Input /Options [Housing]
Model number examples: FDX/B/4-20MA/12-42DC/-RF [HP]

*Before making a final selection, refer to the Load Capability Chart (presented below) to verify that the load capability of the selected power supply is adequate for the application.
****P (suffix)** 2" pipe mounting bracket for explosion-proof enclosures.



SECTION 2

CALIBRATION PROCEDURES

2.0 CALIBRATION PROCEDURES

This section provides information necessary for unit adjustment and calibration. Each unit is adjusted and checked for proper performance at the factory before shipping. However, input and output values for each unit should be checked, on site, by the user before the equipment is placed into service.

CAUTION

SCREWDRIVER BLADE MUST NOT BE MORE THAN 0.1 INCH (2.54 MM) WIDE. USE OF A WIDE BLADE MAY PERMANENTLY DAMAGE THE POTENTIOMETER MOUNTING.

2.1 GENERAL INFORMATION

After a Frequency-to-dc Transmitter (FDX) is unpacked, general operating level checks are recommended using the calibration procedures specified in this section. If units are ordered with factory calibration (-FC option), an exact calibration is performed at the factory and red caps are put over the controls. Adjustments should not be made in the field to the units with red caps unless a new range of input or output signals is desired.

2.3 TEST EQUIPMENT AND TOOLS REQUIRED

The test equipment and tools required for calibrating the FDX are described in Table 2-1; they are not supplied and must be provided by the customer at the installation test site.

2.2 CONTROL DESCRIPTION AND LOCATION

ZERO and SPAN adjustments are located on the front panel of the Model FDX. The external controls are 22-turn potentiometers that are adjusted with a blade screwdriver.

2.4 TEST EQUIPMENT SET-UP

The test equipment set-up required to calibrate an FDX unit is shown in Figure 2-1.

NOTE

IN THE EXPLOSION-PROOF (-EX OPTION) HOUSING, THE PROTECTIVE HOUSING MUST BE OPENED AND THE UNIT REMOVED TO EXPOSE THE CONNECTION BLOCK.

Equipment or Tool	Characteristic	Purpose
Screwdriver (blade)	Blade not wider than 0.1 inch (2.54 mm)	Front panel control adjustment
AC Signal Source	Must be frequency stable to within $\pm 0.05\%$ or better	Simulates input
DC Voltmeter	Must be accurate to within $\pm 0.05\%$ or better	Output signal monitoring (across series output resistor)
DC Milliammeter	Must be accurate to within $\pm 0.05\%$	Output signal monitoring
Frequency Counter	Must be capable of measuring output of AC signal source to within 0.05% or better	Measure frequency of AC signal source

TABLE 2-1. TEST EQUIPMENT AND TOOLS REQUIRED

2.5 CALIBRATION

FDX 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 performance of the unit should be checked by the user before the module is placed in service.

Calibration consists of simulating the operative signal input and adjusting the unit to obtain the specified output.

NOTE

ADJUSTING SHOULD NOT BE MADE IN THE FIELD TO UNITS THAT ARE CALIBRATED AT THE FACTORY TO CUSTOMER'S SPECIFICATIONS. UNITS CALIBRATED IN THIS MANNER HAVE PROTECTIVE RED CAPS OVER THE SPAN AND ZERO POTENTIOMETERS.

An audio-frequency signal generator, a frequency counter, and an output monitoring device are required for calibration. The audio-frequency generator must have a range covering the frequencies with which the unit will be used. The frequency counter determines the frequency of the applied input signal to the required accuracy; the frequency of the audio-frequency signal generator cannot be read directly to the same degree of accuracy as the frequency counter. The monitoring device must have an accuracy of within 0.05% of better. Refer to Figure 2-1 for test equipment setup.

To calibrate an FDX, proceed as follows:

- a. Leaving the signal generator temporarily disconnected and short circuiting the input terminals of the unit, connect the FDX and test equipment as shown in Figure 2-1.

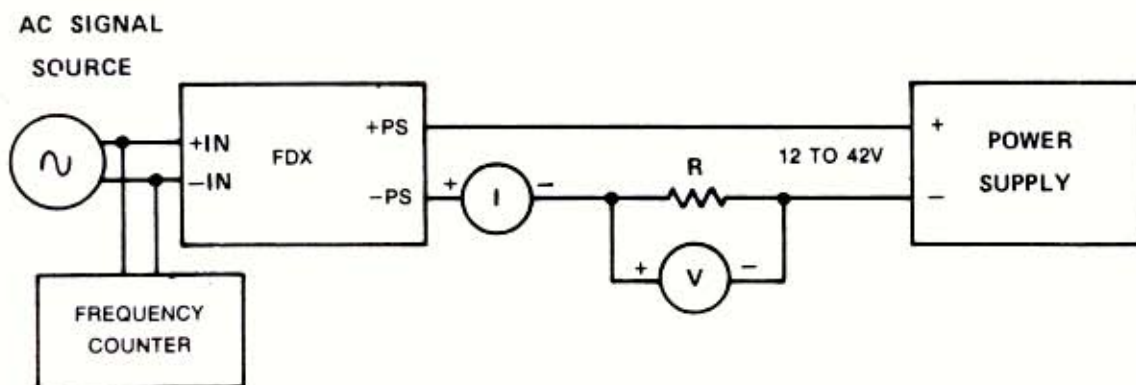


Figure 2-1. Test Equipment Setup For Calibration of Unit

- b. Apply power input to the unit.
- c. With the input terminals of the unit shorted, adjust the ZERO potentiometer to obtain 0% output from the unit (4mA or 10mA).
- d. Remove the short circuit from the input terminals of the unit and 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, and adjust the output of the signal generator to a value greater than 100 millivolts RMS but not more than 10 volts RMS.
- e. Adjust the SPAN potentiometer to obtain 100% output with the input applied as in step (d).
- f. Repeat steps (c) through (e) until no further adjustment of either the ZERO or SPAN potentiometer is required.
- g. Successively apply frequencies of 25%, 50%, 75% of the frequency used in step (d) to the unit, and check that the output is linearly proportional (within $\pm 0.1\%$ of the output span) to the applied frequency.
- h. After step (g) has been successfully completed, remove the signal input to the unit and then turn off the power input to the unit.

2.6 CHANGING INPUT RANGE

The FDX is capable of accepting frequency input from 0-100 to 0-6400 Hz in seven different ranges.

Changing from one input range to another requires selecting one current limiting diode and one internal jumper combination. See table 2-2 and refer to the schematic diagram in the back of the manual. Choice of capacitor values shown, maximizes the rejection of common-mode and normal-mode interference. To access components for input range change, refer to disassembly procedures in Section 5.

SECTION 2

CALIBRATION PROCEDURES

CAUTION

BEFORE MAKING A RANGE CHANGE, READ AND THOROUGHLY FAMILIARIZE YOURSELF WITH PROPER DISASSEMBLY AND SOLDERING PROCEDURES. SEE SECTION 5.

IMPROPER WORK BY UNQUALIFIED TECHNICIANS MAY DAMAGE THE UNIT AND WILL VOID THE MOORE INDUSTRIES WARRANTY.

2.7 APPLICATIONS

The FDX is available in either the standard (input-isolated) or non-isolated versions.

Standard (Input-isolated) Units: A standard unit is used where high sensitivity is required and the input to the unit is a high-level pulse. An input transformer isolates the input from the source, producing a low noise signal.

This configuration will fit 95% of applications. It requires 200mV peak to peak input signal at frequencies as low as 25Hz. Because the input is isolated from the output, the unit has better common mode rejection and better noise rejection.

The -SS option, with a sensitivity of 60mV, is available where a higher sensitivity is required.

NOTE

OBSERVE GOOD WIRING PRACTICES WHEN CONNECTING THE FDX.

Observe the following wiring procedures:

- The input signal should be a zero crossing signal.
- With no signal applied, the input should have a noise level less than 1 millivolt peak to peak.
- Locate the FDX transmitter no more than three feet from the signal source.
- Avoid RFI.
- Use twisted, shielded input wire and ground it at the signal source end.

- The power supply for the loop current should be good quality and low capacity to the ac power line.
- The signal-to-noise ratio should be at least 4 to 1 (12dB) at the input.
- Ground the HP case or DIN rail to a good water pipe ground.
- Ensure that the electromagnetic pick-up is not located near electromagnetic disturbance.

Refer to Figures 2-2 and 2-3 for the minimum signal necessary to activate the transmitter.

Non-isolated Unit: A non-isolated unit is used where low sensitivity is required and the input to the unit is a low-level pulse at a low frequency rate. For example, a turbine flow meter measuring a flow of a very high viscosity fluid provides such an input to the FDX.

The unit is also available in two gain configurations with -SS options of 10mV RMS and 60mV RMS.

NOTE

LOCATE THE FDX AS CLOSE AS POSSIBLE TO THE SIGNAL SOURCE. USE TWISTED, SHIELDED WIRE, GROUNDED AT THE SIGNAL SOURCE ONLY.

Exercise extreme care in input/output wire procedures to ensure a low noise input level. If the input noise level exceeds the input level, erroneous output will occur. This signal-to-noise ratio should be 10 to 1 (20dB). Follow the wiring practices described above for the standard units.

If a 10-millivolt input sensitivity is not required, then reduce the sensitivity to the minimum value required for your application. Refer to Figures 2-2 and 2-3 to determine the signal necessary to activate the transmitter. The non-isolated unit amplitudes have the same shape as the standard unit curves, but not necessarily the same characteristics.

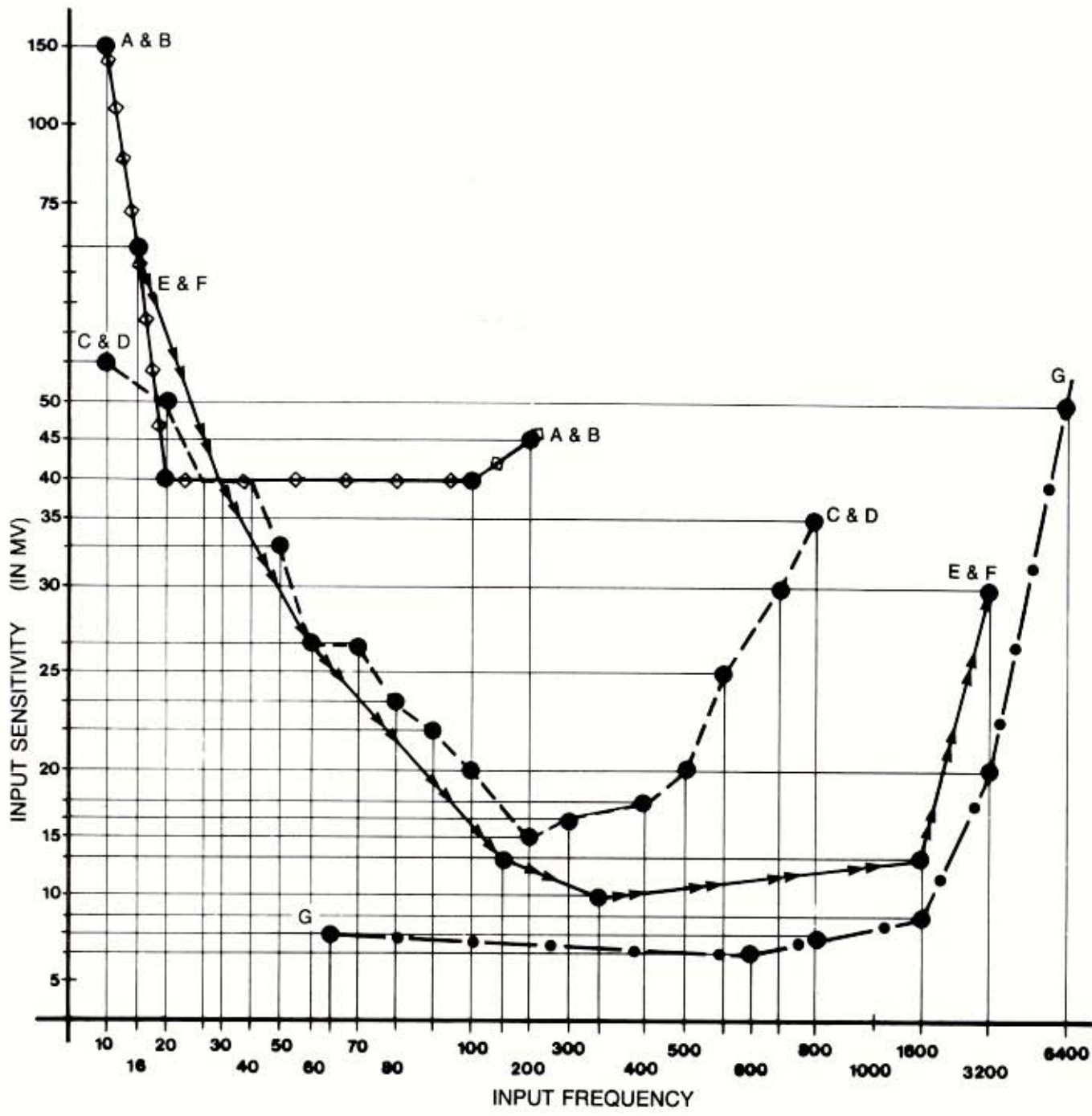


Figure 2-2. Input Sensitivity For Standard (Input-Isolated) FDX

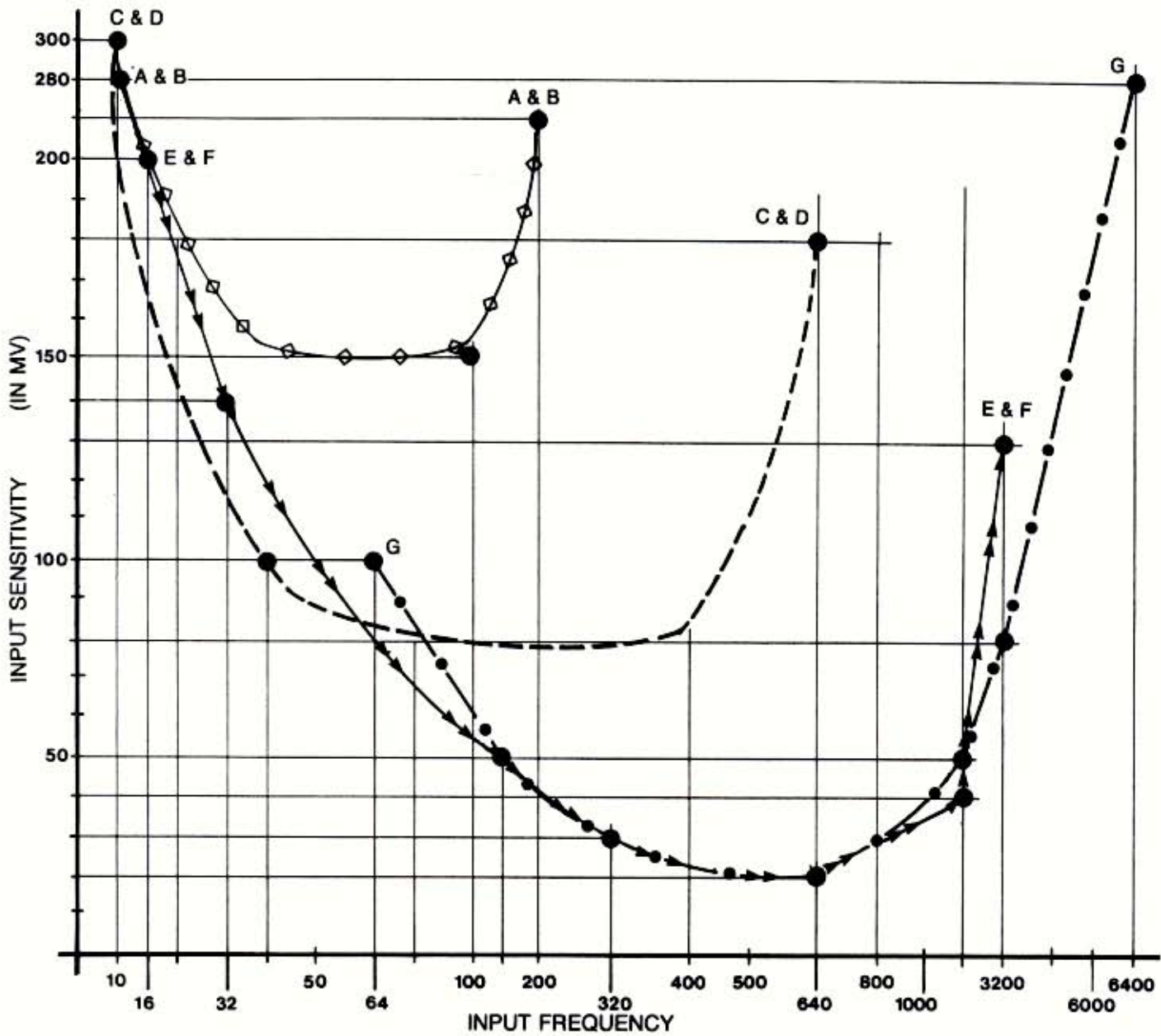


Figure 2-3. Input Sensitivity For Standard (Input-Isolated) FDX With -SS Option.

INPUT	RANGE(Hz)	JUMPER	DIODE	STANDARD C1(μ f)	UNIT C17(μ f)	SENSITIVITY C1(μ f)	SELECT C17(μ f)
A	50-100	J5	CR9	0.1	0.01	0.1	0.047
B	100-200	J4	CR12	0.1	0.01	0.1	0.047
C	200-400	J7	CR13	0.01	0.001	0.022	0.01
D	400-800	J8	CR11	0.01	0.001	0.022	0.01
E	800-1600	J3	CR10	0.01	0.001	0.01	0.001
F	1600-3200	J9	CR14	0.01	100pf	0.01	0.001
G	3200-6400	J6	CR8	0.01	100pf	0.01	470pf

TABLE 2-2. RANGE SELECTION

3.0 INSTALLATION AND OPERATION

3.1 MECHANICAL INSTALLATION

Installation of the FDX is divided into two phases: mounting and electrical connections. In most cases, it is easier to mount the FDX before completing the electrical connections. See figures 3-1 and 3-2.

Although the unit is designed for convection cooling, it is advisable to mount the unit on a surface made of material that can serve as a heat sink. The unit should be located in an area that is protected from dust, moisture and corrosive atmospheres.

3.2 ELECTRICAL CONNECTIONS

Special wire or cable is not required for signal connections to the unit. To avoid transients and stray

pick-ups, it is recommended that twisted conductors be used where they are run close to other services (such as power wiring). Electrical connections fall into two major categories: standard units with PC connectors and explosion-proof units.

Standard Units: Openings are provided under the terminal screws. Insert bare wire into hole and tighten terminal screw. Table 3-1 provides complete labeling nomenclature for the units. Terminal labeling appears next to the terminal it identifies on standard units. Units with SS option have standard unit connections.

3.2.1 POWER CONNECTIONS

Units are designed to operate directly from a dc power source.

Terminal Positions (HP)					
1	2	3	4	5	6
(+) PS	(-) IN	(-) PS	+SS		(+) IN

Terminal Positions (DIN)					
1	2	3	4	5	6
+IN	-IN		+SS	+PS	-PS

TABLE 3-1. TERMINAL NOMENCLATURE

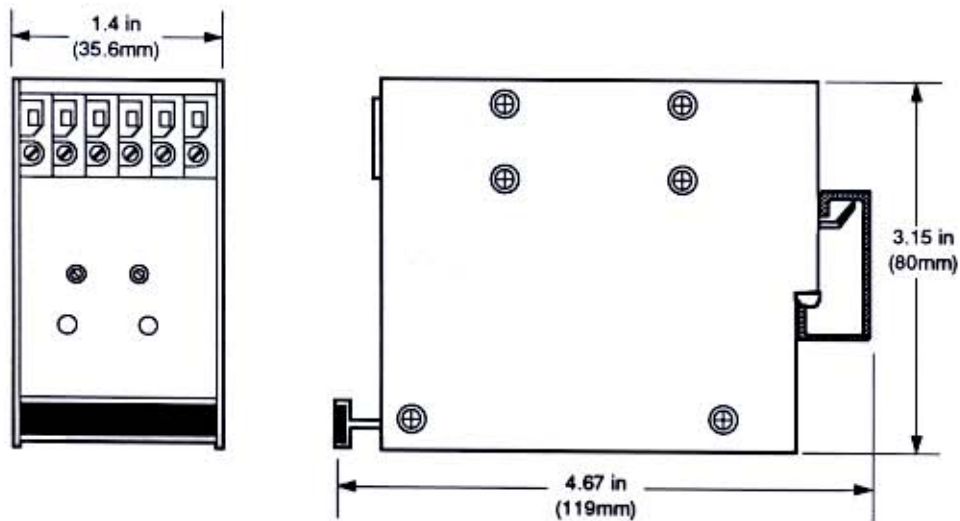


Figure 3-1. Installation Dimensions (DIN)

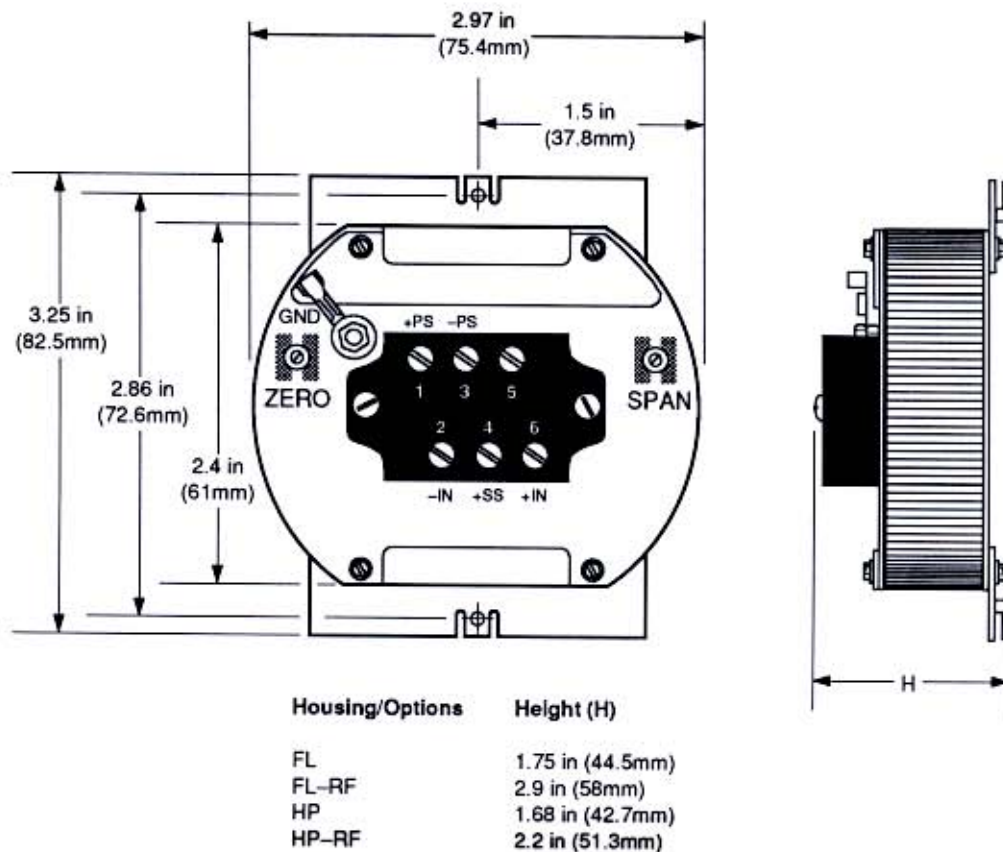


Figure 3-2. Installation Dimensions (HP)

SECTION 4

THEORY OF OPERATION

4.0 THEORY OF OPERATION

This section describes the operation of the FDX. The functional description is based on the unit block diagram, figure 4-1. A detailed schematic is located in the back of the manual.

4.1 FUNCTIONAL DESCRIPTION

The incoming signal is processed by a wave-shaper that produces a trigger for a multiple of the input frequency. This signal is converted to an average dc level by an active circuit and amplified by output drivers.

4.2 POWER SUPPLY CIRCUITS

The power supply circuits consist of a circuit protection element, a constant current generator, and a voltage limiter. The circuit protection consists of diode CR6 and varistor VS201. The diode protects the circuits against accidental hook-up to the wrong polarity voltage. The varistor prevents power transients from damaging the unit.

Transistor CR15 is used as a zener diode, maintaining constant voltage at point A, while CR7 develops constant current to power the FDX circuits.

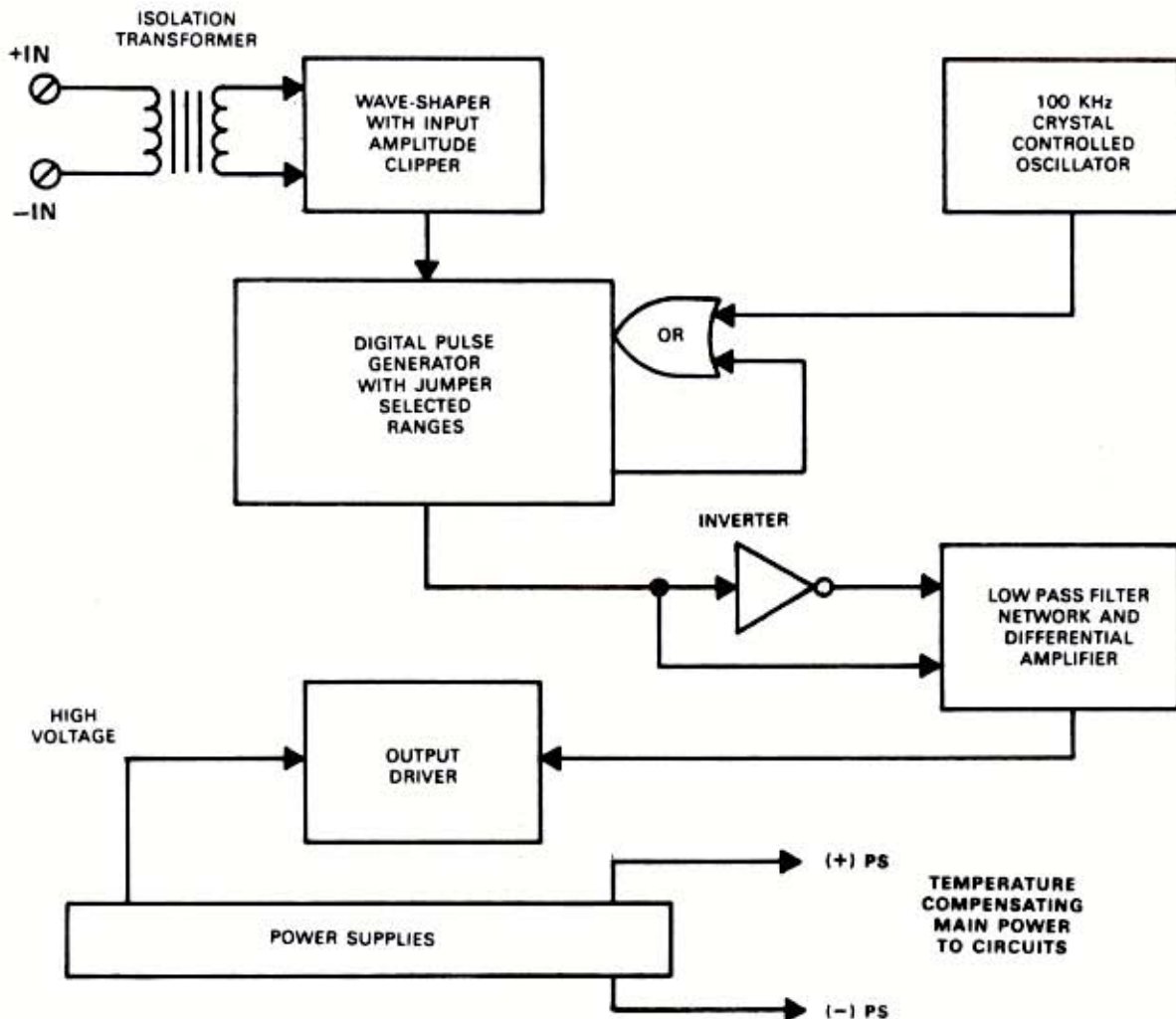


Figure 4-1. FDX Block Diagram

4.3 INPUT CIRCUITS

The input circuit consists of isolation transformer T1, preamplifier U2-7 and wave-shaper U1-1. In the standard FDX, the input frequency at the +IN and -IN is coupled into the wave-shaper circuits through T1 to ground isolate the FDX from its signal source. The wave-shaper circuits contain voltage limiting elements CR1, CR2, filtering network C1, R1, C17, preamplifier U2-7, bias network R3, R4, C2, C3, and edge detector U1-1.

When the non-isolated input (-NI) option is selected, transformer T1 is replaced by jumpers J1 and J2, and C1 is replaced by R32. These changes increase the sensitivity of the unit but remove the ground isolation, thereby reducing the unit's common-mode rejection. Resistor R32 terminates the signal source.

When the signal level at U1-3 crosses the level of U1-2, the output at U1-1 changes polarity. Resistors R2 and R29 control the input sensitivity by adding a fixed hysteresis onto the output of U2-7. The amount of the hysteresis is increased when the Selectable Sensitivity (SS) option is included. This has the effect of reducing the input sensitivity.

4.4 FREQUENCY SELECTION CIRCUITS

The frequency selection circuits consist of U1-7, counter U4, and their associated components. The output of U1-1 is differentiated by C6 and clipped by CR3 to produce a positive trigger for counter U4. Op-

erational amplifier U1-7, is used in conjunction with crystal oscillator XL1 to develop a 100KHz clock. Counter U4 is a twelve-stage binary counter. Outputs of the counter stages are selected by on limiting diode and a connecting jumper combination in accordance with the FDX operating frequency. Thus, only one of limiting CR8 through CR14 and one of jumpers J3 through J9 shown on the detailed schematic diagram in Section 6 are used in any one unit.

4.5 OUTPUT CIRCUITS

The output circuits consist of dynamic filter circuits and output drivers. Counter U4 selected output stage is connected into Q2 and Q3. These elements are discrete CMOS inverters that produce an average dc level from the pulsed counter outputs. Thus, at zero frequency, the average dc level at TP5 is equal to the A (TP2) voltage. As the frequency of the input increases, the average dc level lowers until it approximates 87% of the A voltage (TP2).

Operation amplifier U2-1 is connected as a differential amplifier. This element amplifies the difference between the A source voltage and the dc level at the output of the FETS transistors Q2 and Q3. MOSFET Q6 is the output driver. Resistors R17 and R18 limit the output to less than 150% of the input signal level. The ZERO control adjusts the output to 4mA at zero frequency. The SPAN control adjusts the output span over a 2 to 1 ratio of the input frequency to produce a 20mA output at 100%.

5.0 MAINTENANCE AND TROUBLESHOOTING

All units found to be performing below specifications should be returned to the factory for service in accordance with the instructions found on the inside back cover of this manual.

In an emergency, the user may contact the Customer Service department for verbal assistance in diagnosing and repairing a totalizer problem.

5.1 MAINTENANCE

The design of the Model FDX limits maintenance primarily to keeping the input and output terminals and conductors clean and tight while maintaining a heat conduction path to a suitable heat sink. A thorough cleaning of terminal blocks for standard units and contacts of the plug-in modules requires complete disassembly and should only be done at the factory. It is recommended that the user check the terminations every six months of service to verify that they are secure and free of oxidation.

5.2 DISASSEMBLY

When changing input range, it is first necessary to disassemble the unit.

NOTE
ALWAYS IDENTIFY WIRE—USUALLY BY TAGGING—BEFORE DISCONNECTING EXISTING CONNECTIONS.
CAUTION
DISCONNECT INPUT SIGNAL AND REMOVE POWER INPUT BEFORE DISASSEMBLING UNIT.

To disassemble, remove the unit from its installed position. After the unit has been removed from its installed position, disassemble the unit as follows to gain access to the circuit board.

- a. Disconnect plug-in connector from unit.
- b. Remove two cover-mounting hex-head screws at top of unit.
- c. Loosen Q2 heatsink mounting screw and remove screw and mica insulator.

NOTE

WHEN REPLACING PC BOARD INTO HOUSING, ADD THERMAL COMPOUND TO MICA INSULATOR BEFORE SECURING HEATSINK.

- d. Remove cover and lift out PC board.

NOTE

CONTINUE WITH THIS PROCEDURE ONLY IF ADJUSTMENT POTENTIOMETERS REQUIRE REPLACEMENT.

- e. Using solder-suckers or solder wick, remove solder from the potentiometer pin connectors.

NOTE

CONNECTOR PINS MAY BE BENT WHEN REMOVING THE POTENTIOMETER.

- f. Roll the potentiometer to the side to loosen the pins from the mounting holes and lift away from the board while clearing small board edge.

5.3 TROUBLESHOOTING

If a problem is suspected with the Model FDX review the following procedures:

1. Verify that all electrical connections are clean and tight.
2. Verify that the measuring instrument used for input voltage or current is of the proper range and accuracy.
3. Verify that the output circuit is electrically isolated from the input circuit.

If the problem still exists, the unit might be defective and should be returned to the factory for repair in accordance with the instructions found on the inside back cover of this manual.

MOORE INDUSTRIES
 8650 Schoonaert Street
 Cupertino, California 91343

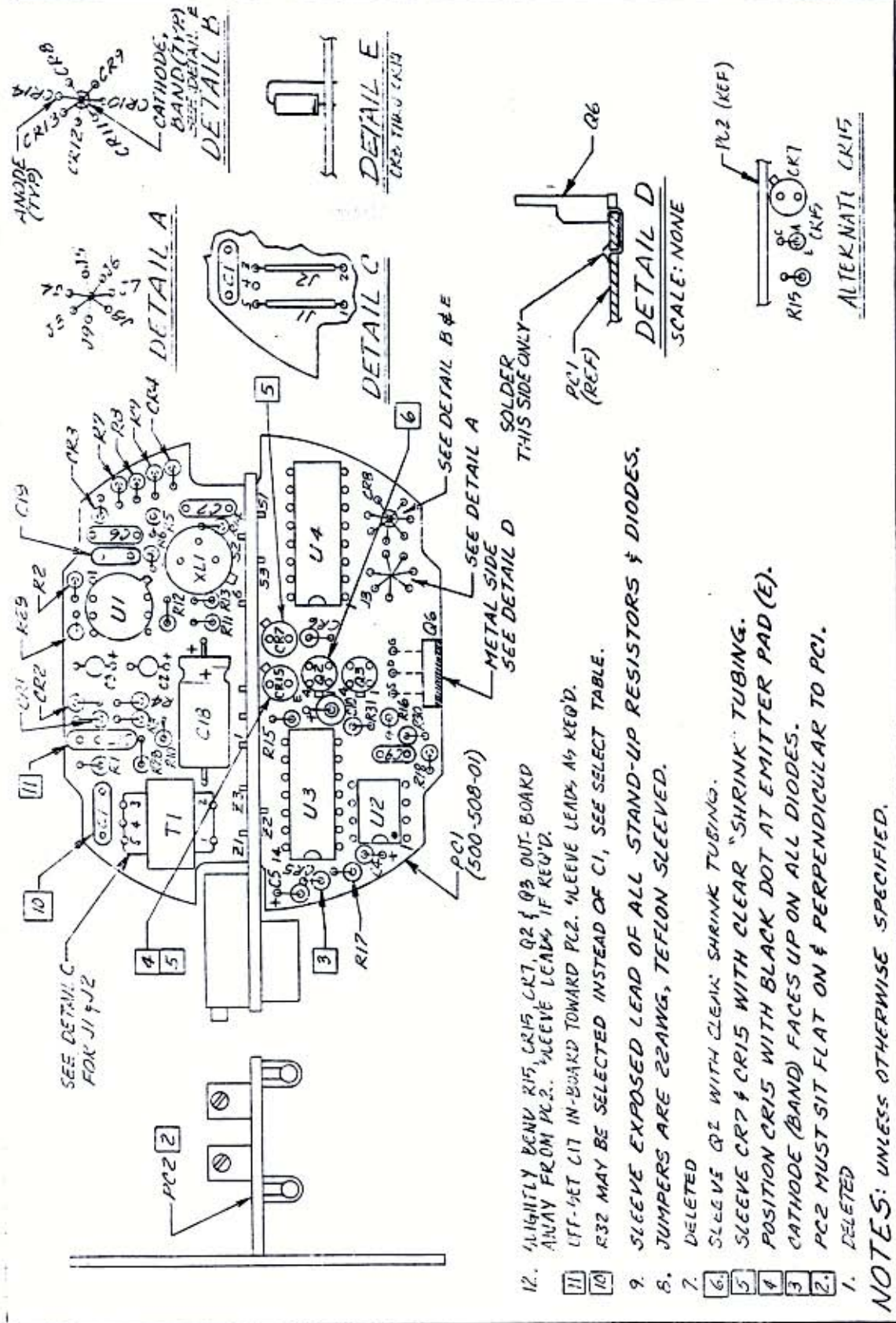
DO NOT SCALE DRAWING

TOLERANCES UNLESS NOTED
 X ± .1
 XX ± .03
 XXX ± .010
 ANGLES ± 30°

DATE: 4/83
 DRAWN BY: P. Kelley
 CHECKED BY: [Signature]
 SCALE: 2-1

FDX DIN
 PCI

Stock Code: 165-509-00
 H
 OFFICE: ASSEMBLY
 REV: 500 0550



12. LIGHTLY BEND R15, CR15, CR7, CR2 & CR3 OUT-BOARD AWAY FROM PC2. SLEEVE LEADS AS REQ'D.
11. OFF-SET C17 IN-BOARD TOWARD PC2. SLEEVE LEADS AS REQ'D.
10. R32 MAY BE SELECTED INSTEAD OF C1, SEE SELECT TABLE.
9. SLEEVE EXPOSED LEAD OF ALL STAND-UP RESISTORS & DIODES. JUMPERS ARE 22AWG, TEFLON SLEEVED.
8. DELETED
7. DELETED
6. SLEEVE CR2 WITH CLEAR SHRINK TUBING.
5. SLEEVE CR7 & CR15 WITH CLEAR "SHRINK" TUBING.
4. POSITION CR15 WITH BLACK DOT AT EMITTER PAD (E).
3. CATHODE (BAND) FACES UP ON ALL DIODES.
2. PC2 MUST SIT FLAT ON & PERPENDICULAR TO PC1.
1. DELETED

NOTES: UNLESS OTHERWISE SPECIFIED.

ALTERNATE CR15

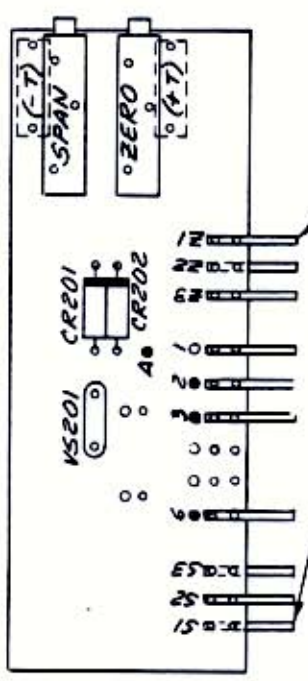
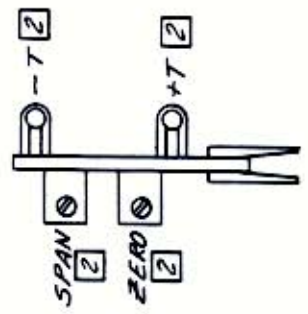
MOORE INDUSTRIES
 18880 Schoenberg Street
 Sepulveda, California 91343

DO NOT SCALE DRAWING

TOLERANCES UNLESS NOTED	DATE <i>R. Kelley 9/83</i>
X ± .1	DESIGN
XX ± .03	MATERIAL
XXX ± .010	SCALE <i>2-1</i>
ANGLES ± 30°	

FDX DIN
PC2

MOORE NUMBER	165-510-00	REV	C
DESCRIPTION	ASSEMBLY	DATE	
PRICE #	E/O 6124	BY	



HW201-HW209

NOTES:
 2 SPAN, ZERO, +T & -T MUST SIT FLAT ON BOARD
 1. ALL LEADS TO BE SOLDERED TO PADS.

MOORE INDUSTRIES
18850 Schwabhorn Street
Sepulveda, California 91343

DO NOT SCALE DRAWING

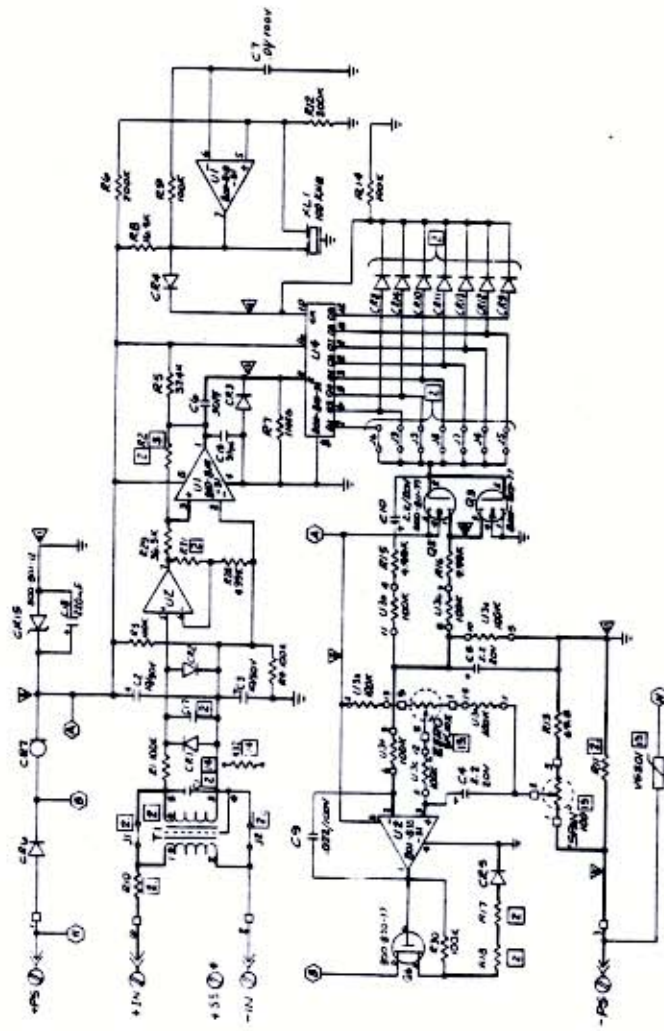
TOLERANCES
UNLESS NOTED
.X ±.1
.XX ±.03
.XXX ±.010
ANGLES ±30°

TESSERS
CIRCUIT 1012877
1/2/77
KON JONE

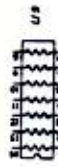
STANDARD
Z-WIRE
FDX

165-420-00
SCHEMATIC
ECC 6103, 6123

PC-1	
REFERENCE DESIGNATORS	NOT USED
C-9	C8 (2) max. Ch
C-15	C1, C6, C5
G-6	R-32
R-7	A-1
A-1	U-4



- 1. ALL RESISTORS ARE 5% TOL. UNLESS OTHERWISE SPECIFIED
 - 2. SEE LIST OF MATERIAL FOR VALUE, PART NO. AND/OR USAGE
 - 3. CARBON COMPOSITION RESISTOR 2.0K, 1/8W.
 - 4. RESISTANCE IN OHMS, CAPACITANCE IN MICROFARADS.
 - 5. POTENTIOMETER INCREASE CLOCKWISE FROM 170°.
 - 6. 100M TERMINAL CONNECTION.
 - 7. SECTION'S OF MANUAL, MAINTENANCE.
 - 8. TEST POINT, FIELDED END IS POSITIVE. REFER TO SECTION'S OF MANUAL, MAINTENANCE.
 - 9. LETTERS AND NOT ON RE-BRAND OR PAUL ABST. AND
 - 10. LETTERS ELECTRICAL COMMON (SAME LETTER)
 - 11. RES MAY BE SUBSTITUTED FOR C1. SEE SELECT TABLE FOR VALUE AND LEAD
 - 12. COMPONENTS MOUNTED BY PCZ
 - 13. ABOVE SCHEMATIC IS SCHEMATIC OF RESISTOR NETWORK U3.
 - 14. CIRCUIT COMMON GROUND
 - 15. ALL DIODES ARE 1N4148
- NOTES CONTINUED**



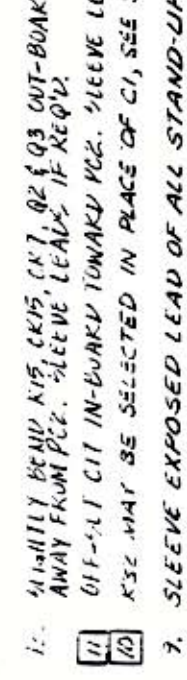
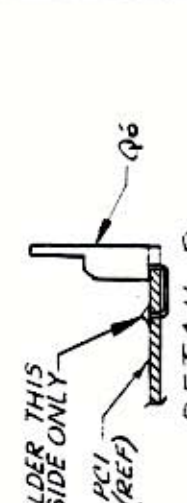
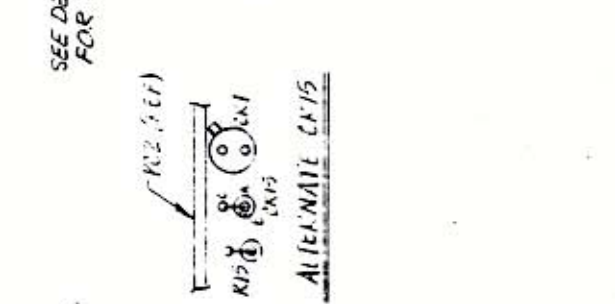
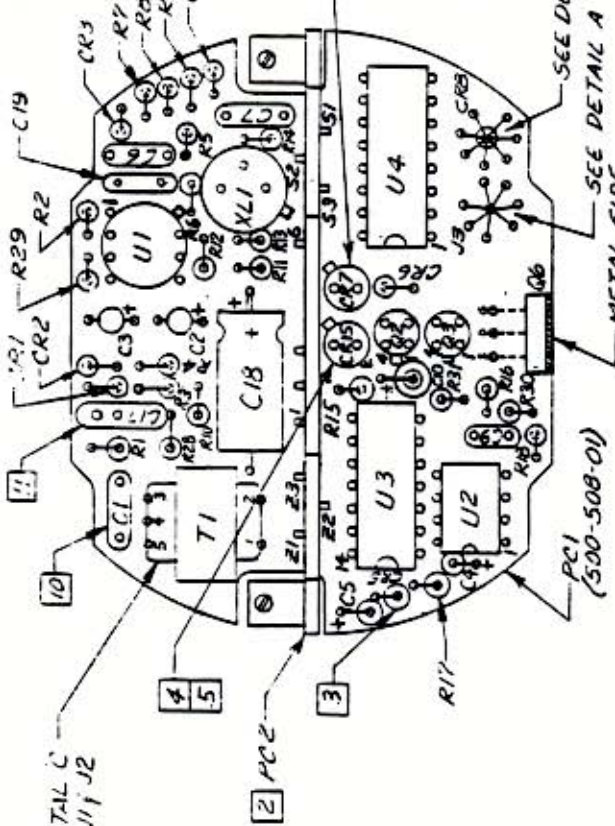
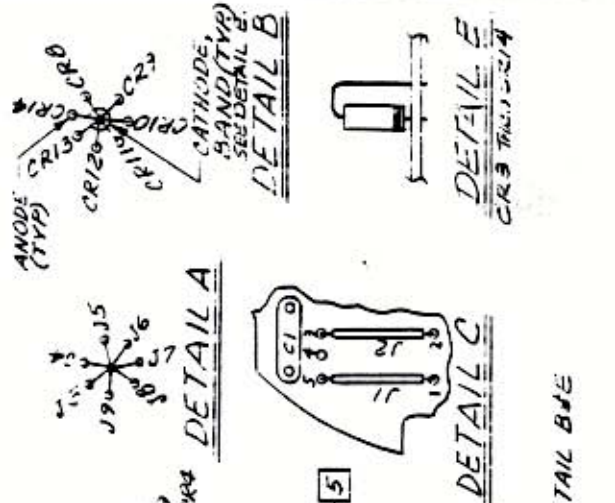
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19650 Schomberg Street
Sepulveda, California 91343

DO NOT SCALE DRAWING

TOLERANCES	DATE	BY
MM 1/16	R. Kelley	11/82
X 1/32		
XX 1/64		
XXX 1/128		
ANGLES 230	REV	
	2-1	

STANDARD
2-WIRE
FDX PCI

165-520-00 F
ASSEMBLY
3:0 0253



1. SLIGHTLY BEND K15, K15, K17, Q2 & Q3 OUT-BOARD AWAY FROM PCB. SLEEVE LEADS IF REQ'D.
2. OFF-SET CUT IN-BOARD TOWARD PCB. SLEEVE LEADS AS REQ'D.
3. K32 MAY BE SELECTED IN PLACE OF C1, SEE SELECT TABLES.
4. SLEEVE EXPOSED LEAD OF ALL STAND-UP COMPONENTS.
5. JUMPERS ARE 22AWG, TEFLON SLEEVED.
6. SLEEVE Q2 WITH SHRINK TUBING.
7. C15, C17, X11 & R15 TO BE .30 COMPONENT HEIGHT MAX.
8. SLEEVE CR7 & CR15 WITH SHRINK TUBING.
9. POSITION CR15 WITH BLACK DOT AT EMITTER PAD(E).
10. CATHODE (BAND) FACES UP ON ALL DIODES, EXCEPT DETAIL E.
11. PCB MUST SIT FLAT ON & PERPENDICULAR TO PCI.
12. ALIGN PCI AND PCB USING FIXTURE 200-213-62.

NOTES: UNLESS OTHERWISE SPECIFIED.



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DO NOT SCALE DRAWING

TOLERANCES
 UNLESS NOTED
 .X ±.1
 .XX ±.03
 .XXX ±.010
 ANGLES ±30°

DRAWN *J. Gammert* 12.2.76
 CHECKED
 ENGINEER *J. R. Gammert* 3/12/78
 SCALE 2/1

STANDARD
 2 - WIRE
 FDX
 PC2

DRAWING NUMBER

165-521-00

CATEGORY

PC ASSEMBLY

REVISED BY

ECO 6237

DATE

11/82

BY

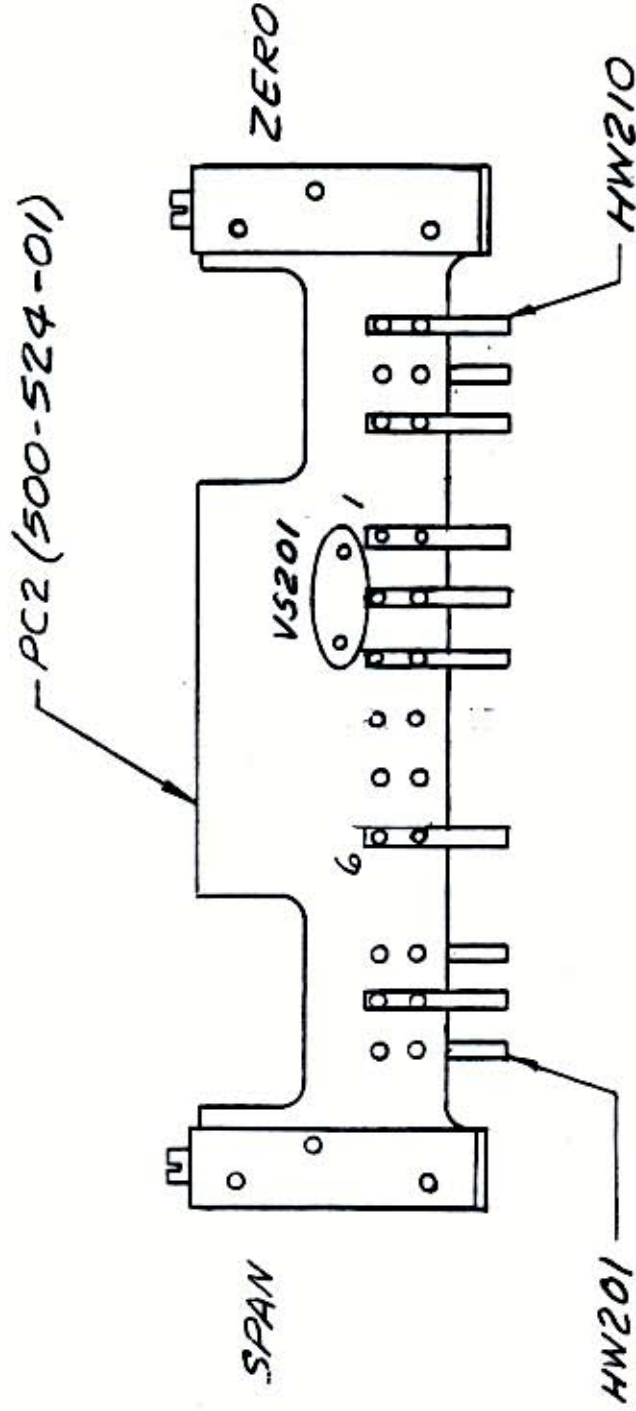
[Signature]

APPROVAL

[Signature]

REVISION

C



1. TRIM EXCESS FROM HW201 THRU HW210.

NOTES: UNLESS OTHERWISE SPECIFIED



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DO NOT SCALE DRAWING

TOLERANCES
UNLESS NOTED
X ±.1
XX ±.03
XXX ±.010
ANGLES ±30'

DRAWN J.A. DURE 1/15/71
CHECKED
ENGINEER
SCALE 2/1

STD. 2-WIRE
F.D.X
PC2, R.F. OPTION

DRAWING NUMBER

105-522-00

CATEGORY

P.G. ASSEMBLY

REVISED BY

E.C.O. 6237

DATE

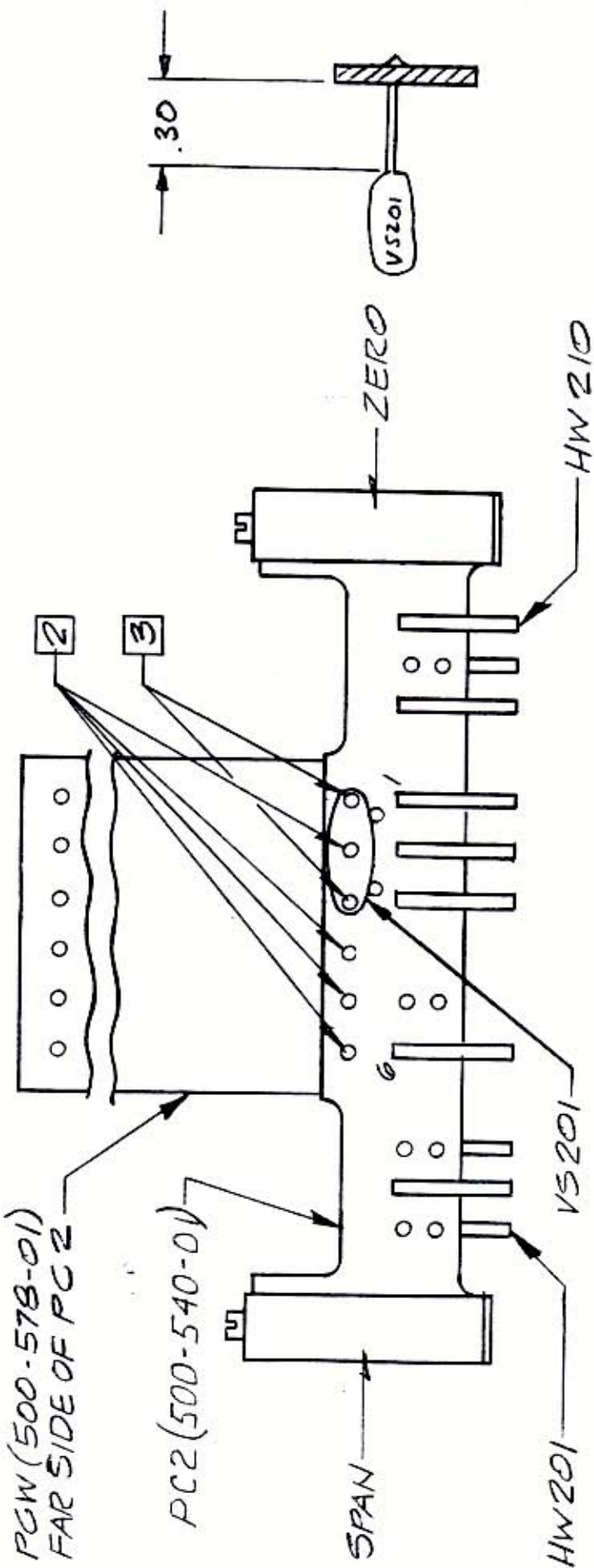
11/16/62

BY

140

APPROVAL

140



- 3. INSTALL VS201 LEADS THRU PC2 & PCW, SOLDER THIS SIDE OF PC2 & FAR SIDE OF PCW.
- 2. INSTALL 22 AWG BUSS WIRE THRU PC2 & PCW, SOLDER THIS SIDE OF PC2 & FAR SIDE OF PCW.
- 1. TRIM EXCESS FROM HW201 THRU HW.210.

NOTES: UNLESS OTHERWISE SPECIFIED

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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