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Introduction

This manual contains descriptive, calibration, and maintenance information on the Eurocard Millivolt Transmitter, Model MVT-EU. The MVT-EU converts a millivolt-range signal into a current or voltage output signal of a higher level. There is complete isolation between the input and output terminals and the unit is highly stable.

Description

Typical applications of the MVT-EU include interfacing gas analyzer output, pH meter output or DC current shunts with a panel meter, recording device or computer. In the current shunt application, the input/output isolation (with over 500 volt breakdown capability) permits non-hazardous monitoring of DC motor power.

Complete input, output and power isolation, along with high input impedance (over 10 megohms) make it possible to apply almost any millivolt source, grounded or ungrounded, without interference problems.

Interference from any source is minimized in the MVT-EU. A common mode rejection of 120dB (1,000,000:1) with a limit of 500 volts rms is standard.

The MVT-EU is configured to allow for high-density installation in a plug-in Eurorack. Twelve Eurocard transmitters may be installed in a single 19-inch (483mm) Eurorack. Installation dimensions and plug-in details are presented in figure 1.

A complete set of specifications for the MVT-EU is shown in table 1. This specification contains complete information on input, output, and performance.

Model Number. Moore Industries' model numbers identify the type of instrument, functional characteristics, operating parameters, any options ordered, and housing. If all accompanying documentation of a unit is missing, the model number can be used to obtain technical information. The model number for the MVT-EU is located on the inside of the front panel.

Serial Number. A complete history is kept on every Moore Industries' 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 the serial number. This information is engraved on the printed circuit board of the unit.

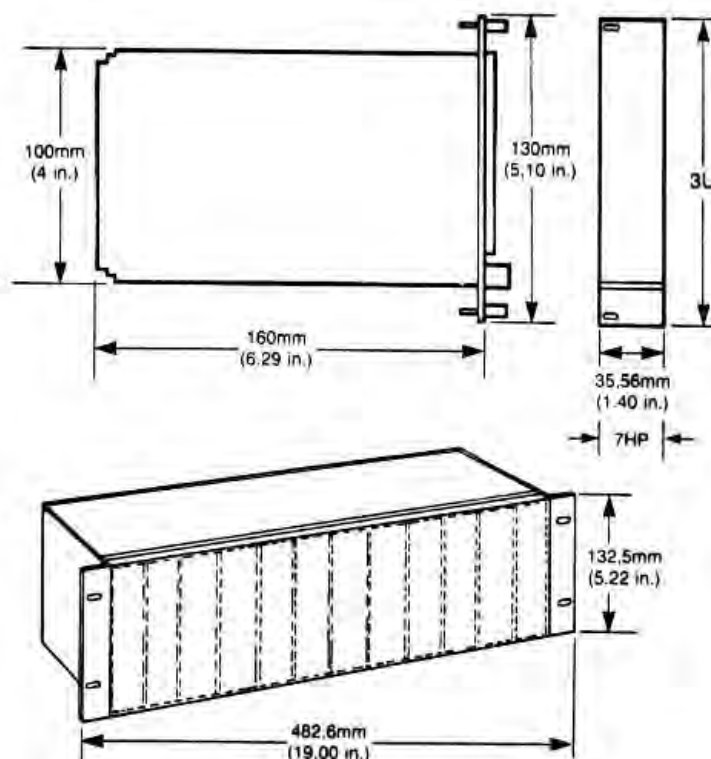


Figure 1. MVT-EU Installation Dimensions

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

MVT-EU

Specifications

Characteristics: MVT-EU		Ordering Specifications	
<p>Front Panel Adjustments Adjustable with multiturn potentiometers Span: With full scale input, adjusts output to 100% $\pm 10\%$ Zero: With minimum input, adjusts output to 0% $\pm 10\%$</p> <p>Calibration Capability Linearity and Repeatability $\pm 0.1\%$ of span $\pm 0.25\%$ of span for LSA $\pm 0.50\%$ of span for LSB</p> <p>Ambient Temperature Range -18°C to $+82^{\circ}\text{C}$ $(-4^{\circ}\text{F}$ to $+180^{\circ}\text{F})$</p> <p>Performance Ambient Temperature Effect: $\pm 0.005\%/^{\circ}\text{F}$ over above specified range Frequency Response: 5 Hz maximum at the -3dB point Isolation: Input, output, and power input are transformer isolated with no dc connections. Common mode rejection exceeds 120dB at 60 Hz with a limit of 500 volts rms.</p> <p>Weight Approximately 11ozs (300 grams)</p>	<p>Input DC millivolts. Ranges listed are the minimum and maximum inputs to produce full scale output. 0-5 through 10mV 0-5 through 15mV 0-10 through 20mV 0-20 through 40mV 0-40 through 80mV 0-80 through 160mV 0-160 through 320mV</p> <p>Output Operational amplifier feedback current source; output limited to 150% of maximum output range value Current: 0-20mA into 0-1200Ω load 1-5 MA into 0-4800Ω load 4-20 MA into 0-1200Ω load 10-50 MA into 0-480Ω load Voltage: 0-5V, 1-5Vdc standard into 20KΩ minimum Ripple: 10 MV P/P at maximum span and maximum load resistance. Load Effect: $\pm 0.01\%$ of span from 0 to maximum load resistance (current output)</p> <p>Power 24Vdc, $\pm 10\%$</p> <p>Line Voltage Effect: $\pm 0.005\%$/1% line change</p>	<p>Options -CS Coding strip -DD Downscale drive -DI Dual Input -DO Dual Output -EZ Elevated Zero -FU 400 MA power fuse -HI High current output 20 MA max 1-5V -LSA Lower span: from 2mV to 5mV -LSB Lower span: from 0.75mV to 2mV -RO Reverse output, current or voltage -UD Upscale drive</p> <p>Housings EUR Eurocard</p>	
<p>When Ordering Specify: Unit / Input / Output / Power / Options [Housing]</p> <p>Model number example: MVT-EU / 5-10MVFS / 4-20MA / 24DC / -CS [EUR]</p>			

Table 1. MVT-EU Specifications

Calibration

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.

After the MVT-EU unit is unpacked, general operation level checks of the individual unit are recommended. Generally these checks, which are specified in the Calibration Procedure portion of this section, require little or no adjustments.

Adjustments

The MVT-EU 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. The type of potentiometer used with these adjustments usually require twenty 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 adjustment 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., slipping). However, if this change is not felt, either end can be reached by turning the shaft twenty turns in the desired direction.

Calibration Equipment

Calibration equipment is listed in table 2. This equipment is not supplied with the unit and must be provided by the user.

Calibration Setup

Off-line calibration for all MVT-EU units requires the same test equipment setup regardless of the physical configurations or types of options used. Refer to the test equipment setup for unit calibration as shown in figures 2 and 3.

Calibration Procedure

Calibration consists of simulating an input signal to the MVT-EU, monitoring the output, and adjusting the controls to obtain the desired value. A precision millivolt supply and output monitoring device are required for making adjustments, as shown in table 2. These instruments must have an accuracy within $\pm 0.05\%$ or better.

Table 2. Calibration Equipment

Equipment	Description
Screwdriver (slotted)	Head width no greater than 0.1 inch (2.54mm)
Millivolt Source	Must be capable of producing signal ranges defined by input level requirements
DC Voltmeter	Must be accurate to within $\pm 0.05\%$ or better
DC Milliammeter	Must be accurate to within $\pm 0.05\%$ or better

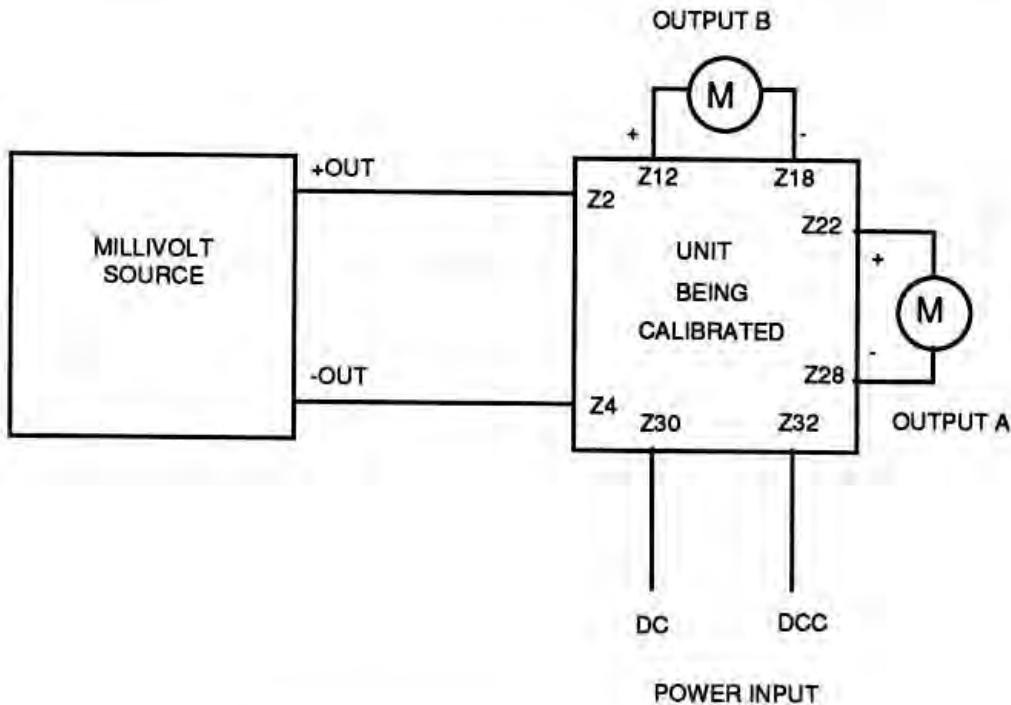


Figure 2. Calibration Setup for MVT-EU

To adjust a unit, proceed as follows:

1. Connect the unit and test equipment as shown in figure 2. Adjust the millivolt source for zero output.
2. Apply power to the unit.
3. Adjust the millivolt source to the value of the minimum input signal that will be applied to the unit.
4. Adjust the ZERO potentiometer to obtain 0% output (1mA, 4mA, etc.).
5. Adjust the millivolt source to the value of the maximum input signal that will be applied to the unit.
6. Adjust the SPAN potentiometer to obtain 100% output with the input signal applied as in step 5.
7. Repeat steps 3 through 6 until no further adjustment of either zero or span is required.
8. Apply 25%, 50% and 75% of the input span and check that the output is linearly proportional (to within $\pm 0.1\%$ of the output span).

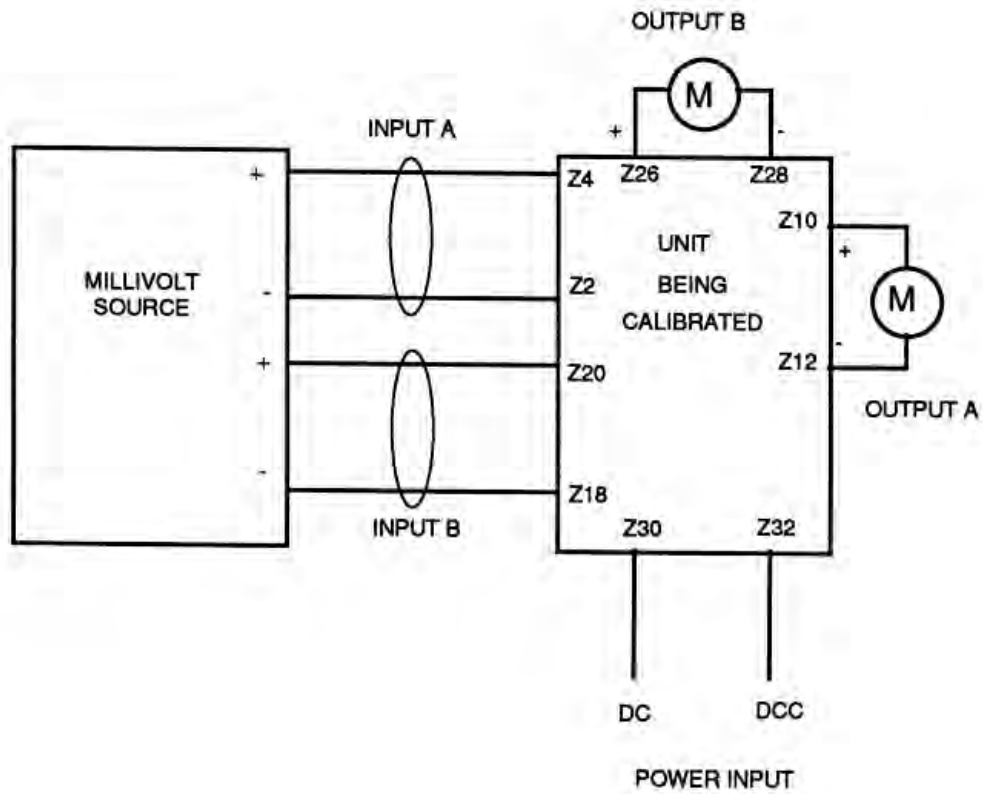


Figure 3. Calibration Setup for the MVT-EU Dual Channel

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Installation

This section provides information for mechanical installation, electrical connections, and power connections for the MVT-EU. The front panel dimensions for the unit are shown in Figure 1.

Mechanical Installation

Rack Mounted (RMR-EU) Euro-Card Rack. These rack enclosures are designed to be flush-mounted in a standard 19-inch relay rack. Twelve position RMR racks are available. Each enclosure is provided with standard EIA hole patterns and is rear-accessed for rack wiring convenience. 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 PC cards are front loaded. Edge connectors can be keyed to assure that the units are plugged into the proper position. Key positions may be altered in the

field if the system configuration changes. Filler cards are available for positions not used by any modules.

Electrical Connections

Terminals used for electrical connections for both standard and optional units are listed in table 3.

All electrical connections are made to the terminals on the mating connector of the unit, located in the rack. No special wire or cable is required for signal connections (The terminals are designed for 16AWG maximum wire size).

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). The DC power source should be regulated to within $\pm 10\%$ of the nominal voltage and should be capable of delivering 5 watts.

Table 3. Terminal Nomenclature for the MVT-EU

Terminal Positions																	
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	ROW
MVT	+IN	-IN									+OUT			-OUT	(+) DC	(-) DCC	Z
MVT DUAL OUT	+IN	-IN				+OUT B			-OUT B		+OUT A			-OUT A	(+) DC	(-) DCC	Z
MVT DUAL CHANNEL	-IN A	+IN A			+OUT A	-OUT A			-IN B	+IN B			+OUT B	-OUT B	(+) DC	(-) DCC	Z

Legend: DC +DC Power Input ±IN Signal Input
DCC -DC Power Input ±OUT Signal Output

Theory of Operation

This section describes the unit operation. The functional description is based on the block diagram in figure 4.

The MVT-EU operates by chopping the applied dc input signal into an ac signal, using ac coupling to the following stages, and then synchronously demodulating the resulting ac signal to produce a dc output proportional to the input. In this way, complete isolation is obtained between the input and the output terminals. High stability is achieved by using operational amplifiers with large amounts of feedback. A variation in the output circuit allows the unit to produce either current or voltage output.

Power Supply Circuit

Units are supplied for use with a dc power input that is applied directly to the power inverter, with diode protection to prevent damage to the power inverter if the dc power input is accidentally connected with reverse polarity.

Power Inverter Circuit

The power inverter produces a number of different ac (square wave) and dc outputs from the dc applied to its input. Four separate square-wave outputs at approximately 3KHz are developed, and are used as drive voltages for the input switches and demodulator.

Two isolated sets of regulated (+) and (-) dc outputs are also produced and used as operating voltages for the amplifiers in the input section of the unit. The inverter also produces a higher (+) dc output as the operating voltage for the power amplifier.

Input Network and Zero Adjust Circuit

The floating input signal is provided with the proper termination by the input network and combined with the voltage from the zero adjust circuit. The zero adjust circuit, which operates from \pm DC supply #1,

adds an adjustable voltage of the proper polarity to the basic input signal. With the minimum input signal applied, the zero adjust circuit is adjusted so the voltage added to the applied input signal results in the required minimum output signal. The composite input signal (applied input signal plus the voltage introduced by the zero adjust circuit) is then applied to the series input switch.

Input Switches

The input switches produce a 3KHz square-wave output with an amplitude proportional to the input signal applied to the unit. Each switch is operated by a separate 3KHz square-wave drive signal from the power inverter. During one half of the drive signals, the series switch passes the composite input signal to the input of the next stage (operational amplifier).

At the same time, the drive signal applied to the shunt switch causes this switch to act effectively as an open circuit. During the next half cycle of the drive signals, the series switch opens and the shunt switch acts as a short-circuit to the ground. In this manner, the dc input signal is chopped into a proportional 3KHz signal so ac coupling can be used from this point to the demodulator.

The use of both a series and a shunt switch for chopping virtually eliminates any loading of the composite input signal by the circuit following the switches.

Operational Amplifier Circuit

The operational amplifier following the input switches is used to provide gain and a low impedance source for driving the primary of the isolation transformer between the input and output sections. High stability is achieved through the use of feedback. In addition, the gain of the amplifier is varied by the span adjust circuit to establish the maximum output signal when the maximum specified signal is applied to the input of the unit. The transformer couples the signal from the output of the operational amplifier to the output switch and also completely isolates the input section from the output section of the unit.

MVT-EU

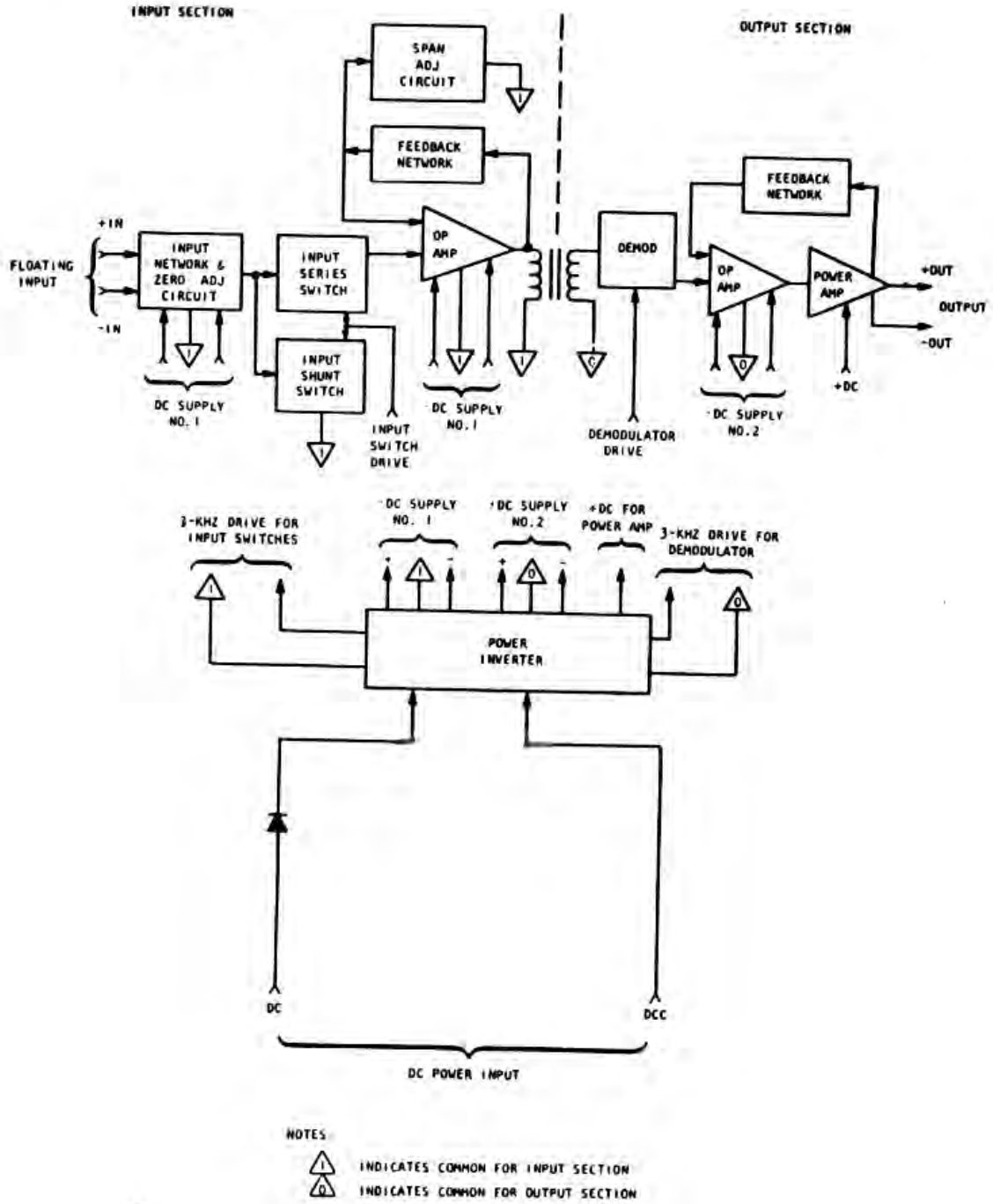


Figure 4. MVT-EU Block Diagram

Demodulator Circuit

The demodulator accepts the 3KHz signal from the secondary of the transformer and converts it back into a proportional dc level. The power converter provides a 3KHz demodulator drive signal that is out of phase with the drive signal applied to the series input switch. This phase relationship between the two drive signals satisfies the drive requirements for simultaneous (i.e., synchronous) identical switching action of solid-state devices with opposite-type channels, thereby assuring proper operation of the unit.

Output Circuit

The output circuit consists of an operational amplifier and power amplifier. Feedback is used to achieve high stability and a nearly ideal output impedance for the type of output used. The operational amplifier operates from the higher positive voltage from the power inverter.

Maintenance

In general, maintenance is limited to checking that the unit is properly seated in the rack and that the electrical connections are tight and free from corrosion. Periodically, the calibration of the unit may be checked.

Troubleshooting

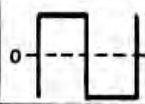
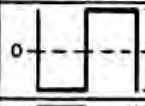
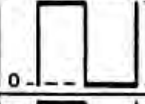
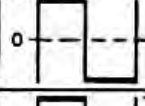
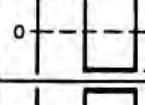
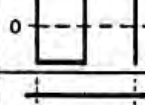
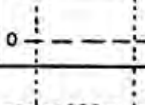
The schematic diagrams include flagged numbers at various points in the circuit. Table 4 gives the voltages and waveforms at these points for specified input signal conditions. The assembly drawings show the physical locations of the parts on the circuit board.

In general, troubleshooting is carried out by tracing the signal with an oscilloscope and referring to the schematic diagram to determine what component might be causing an observed abnormal indication. If the original symptom was a complete failure of the unit to operate, the most likely components to suspect are those associated with the power supply. 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 and trace the resulting signal through the unit.

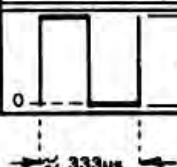
Drawings

This section consists of assembly and schematic drawings.

Table 4. Waveforms and Voltages

TEST POINT(S)	WAVEFORM AND AMPLITUDE OR VOLTAGE LEVEL
1	 37V
2	 37V
3	 (APPROXIMATELY EQUAL TO INPUT AMPLITUDE)
4	 1 to 5V**
5	 0.4 to 2V**
6	 40V
7,8	 0.2 to 1V**

~ 333µs

TEST POINT	WAVEFORM	POWER INPUT AND WAVEFORM AMPLITUDE	
		24VDC/117VAC/220VAC	45VDC
9	 A	48V	90V

~ 333µs

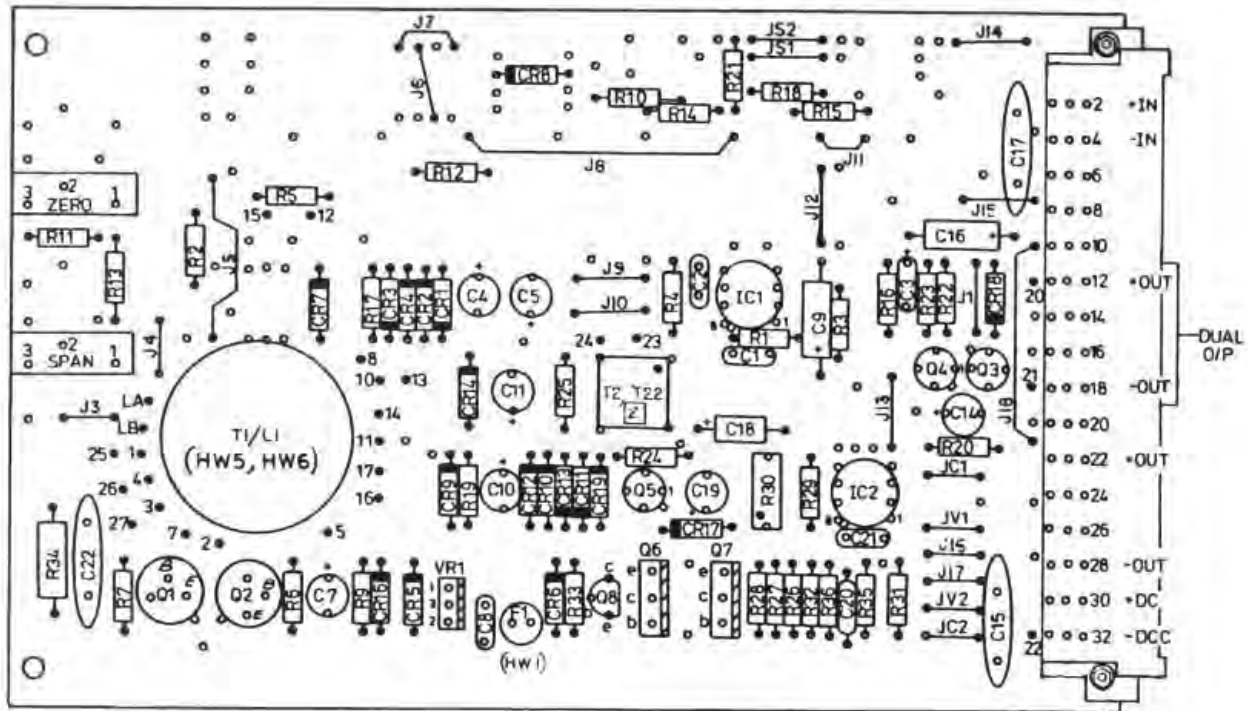
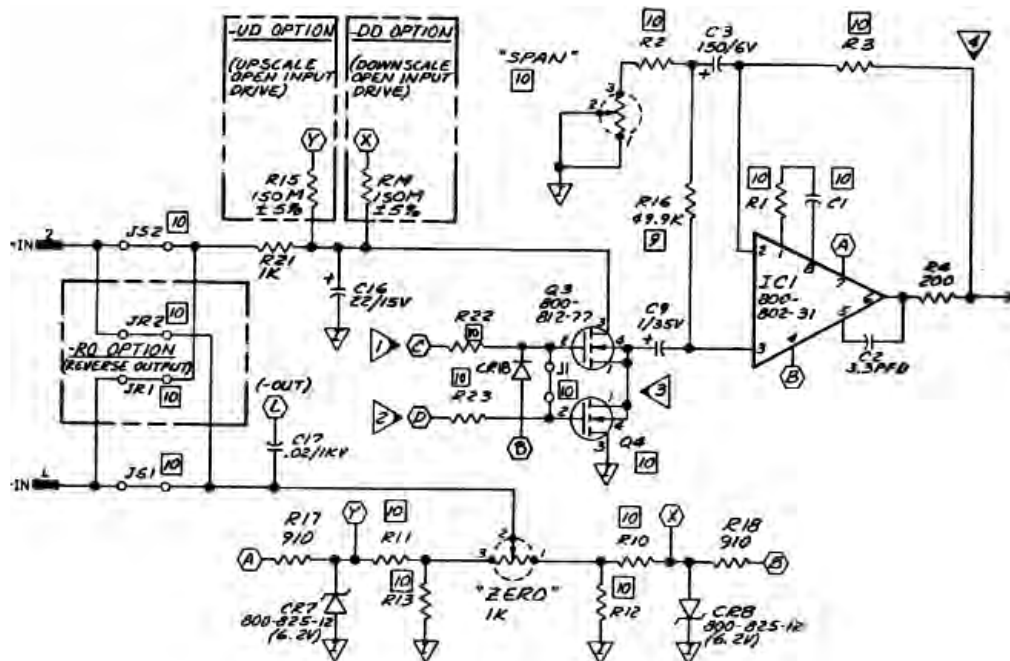


Figure 5. PC1 Assembly

MVT-EU



- 10 SEE LIST OF MATERIALS FOR VALUE, PART NO. AND/OR USAGE.
- 9 METAL FILM RESISTOR, $\pm 1\%$ TOL.
- 8 TEST POINT; FILLED END IS POINTER. REFER TO SECTION 5 OF MANUAL, "MAINTENANCE".
- 7 INPUT SECTION COMMON (GROUND).
- 6 OUTPUT SECTION COMMON (GROUND).
- 5 CONNECTOR PIN POSITION (32 PINS).
- 4 IDENTIFIED WIRING PAD ON P.C. BOARD.
- 3 ELECTRICAL COMMONS (SAME LETTERS); THESE LETTERS DO NOT APPEAR ON P.C. BOARD OR ASS'Y DWGS.
- 2 ALL POTENTIOMETERS INCREASE C.W. FROM 1 TO 3.
- 1 DIODES ARE M.I.I. P/N 800-4143-11; RESISTORS ARE $\frac{1}{4}$ W CARBON COMP., $\pm 10\%$ TOL.
- RESISTANCE VALUES ARE IN OHMS; CAPACITANCE VALUES ARE IN MICROFARADS.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 6. MVT-EU Schematic (page1 of 2)

MVT-EU

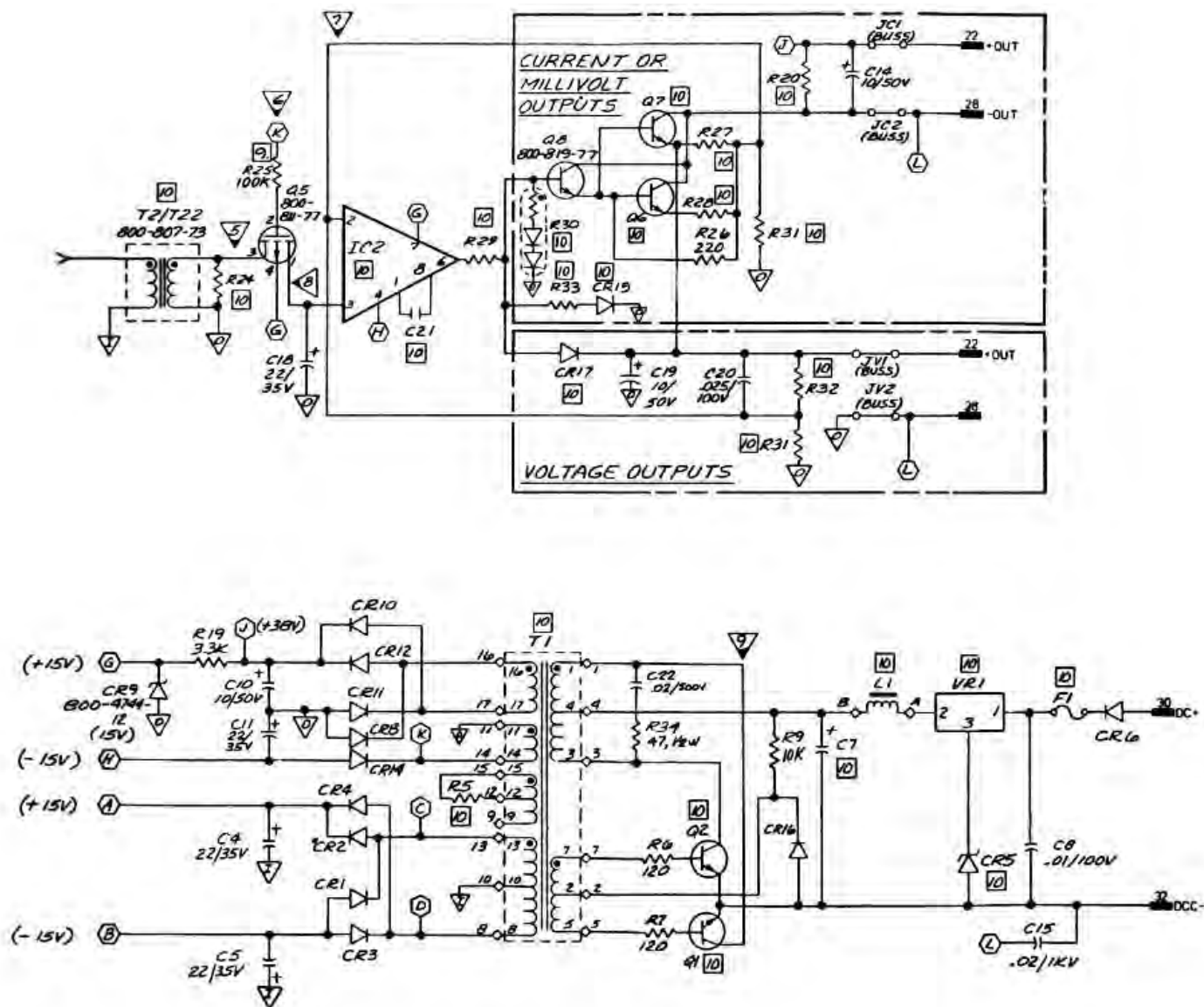


Figure 6. MVT-EU Schematic (page 2 of 2)

MVT-EU

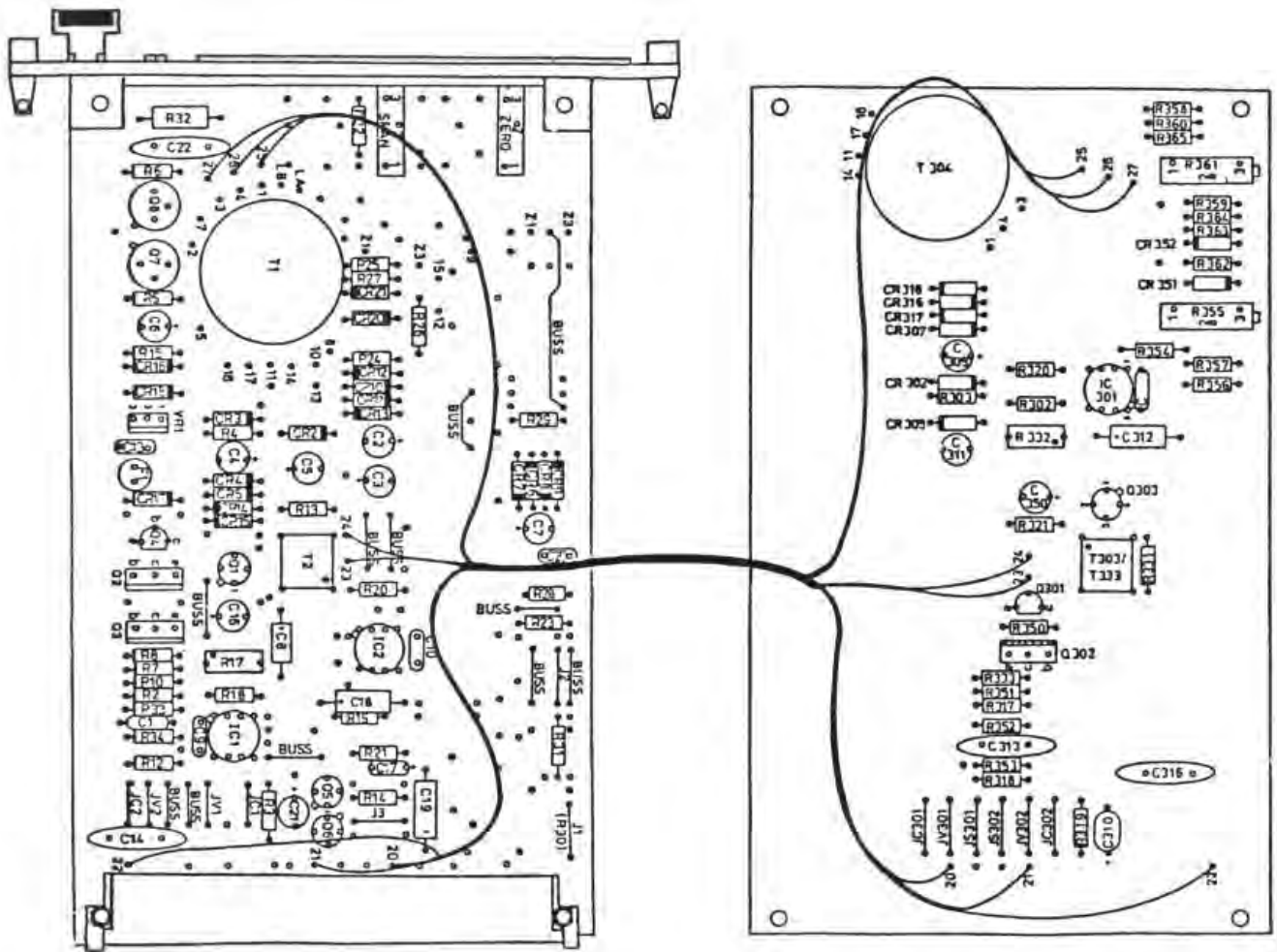


Figure 7. Dual Output Eurocard Connections

MSD 159.001

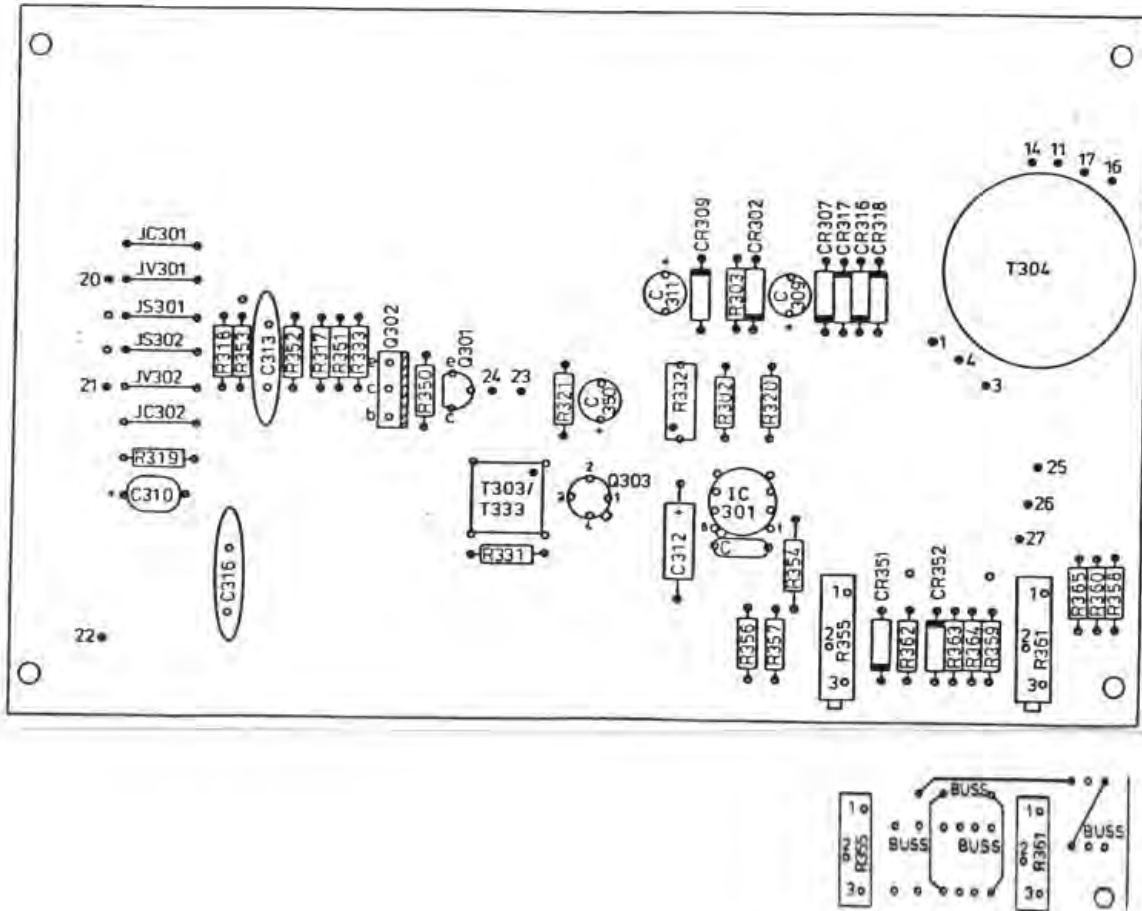
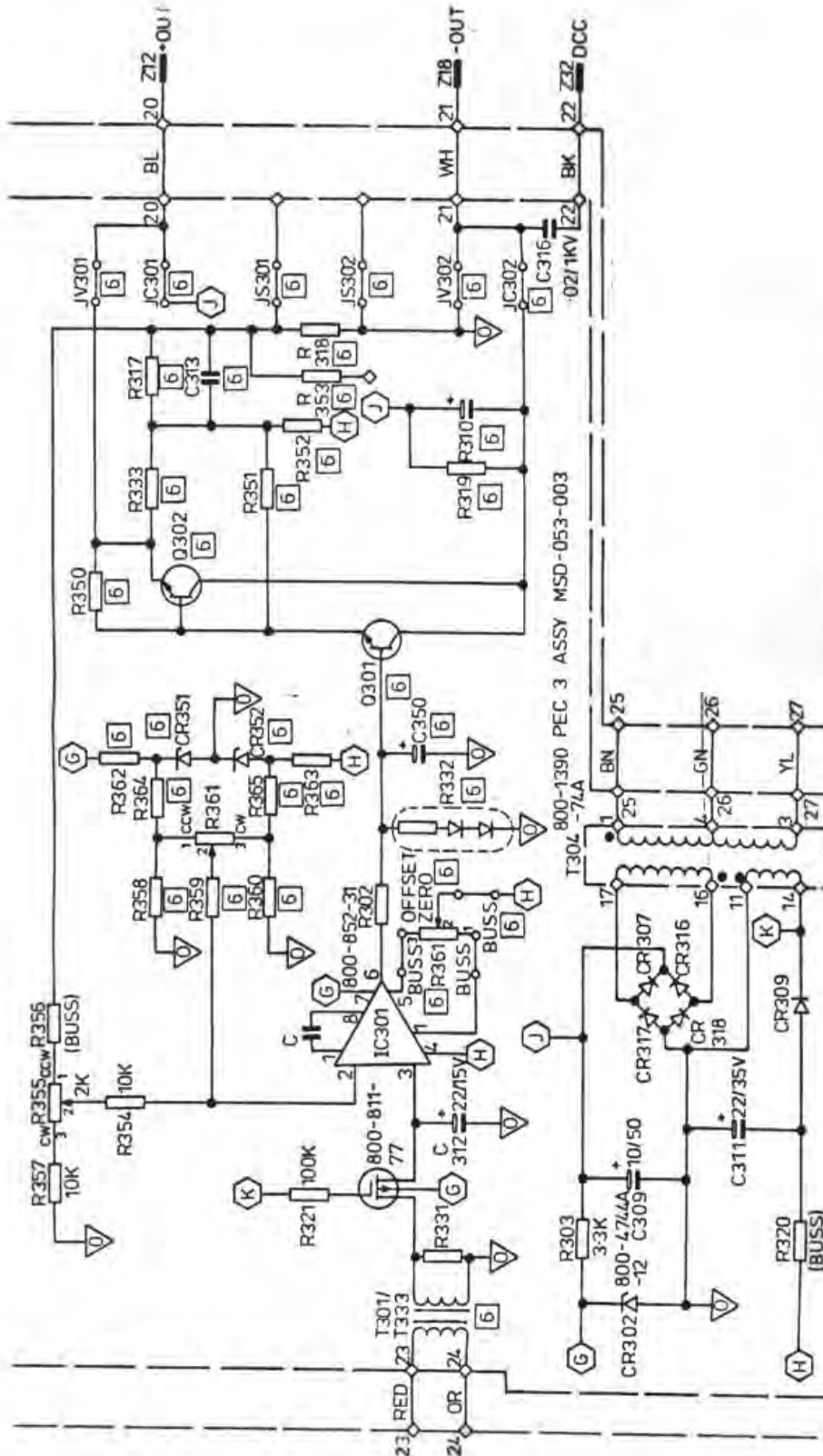


Figure 8. Dual Output Assembly



- NOTES (UNLESS OTHERWISE STATED):
- 1. RESISTANCE VALUES ARE IN OHMS; CAPACITANCE IN MICROFARADS.
 - 2. DIODES ARE IN4148; RESISTORS ARE CARBON COMP (RC07G) ±10% TOL.
 - 3. POTENTIOMETERS INCREASE CLOCKWISE FROM PIN 1 TO PIN 3.
 - 4. ○ INDICATES ELECTRICAL COMMON (SAME LETTER).
 - 5. ITEM MOUNTED EXTERNAL OF PC BOARD.
 - 6. SEE LIST OF MATERIALS FOR USAGE, VALUE AND PART N°.
 - 7. ○ INDICATES PC1/PC2 INTERCONNECT PIN.
 - 8. ▽ INDICATES OUTPUT SECTION COMMON (GROUND).
 - 9. ——— INDICATES PLUG-IN CONNECTOR POSITIONS.

Figure 9. Dual Output Schematic

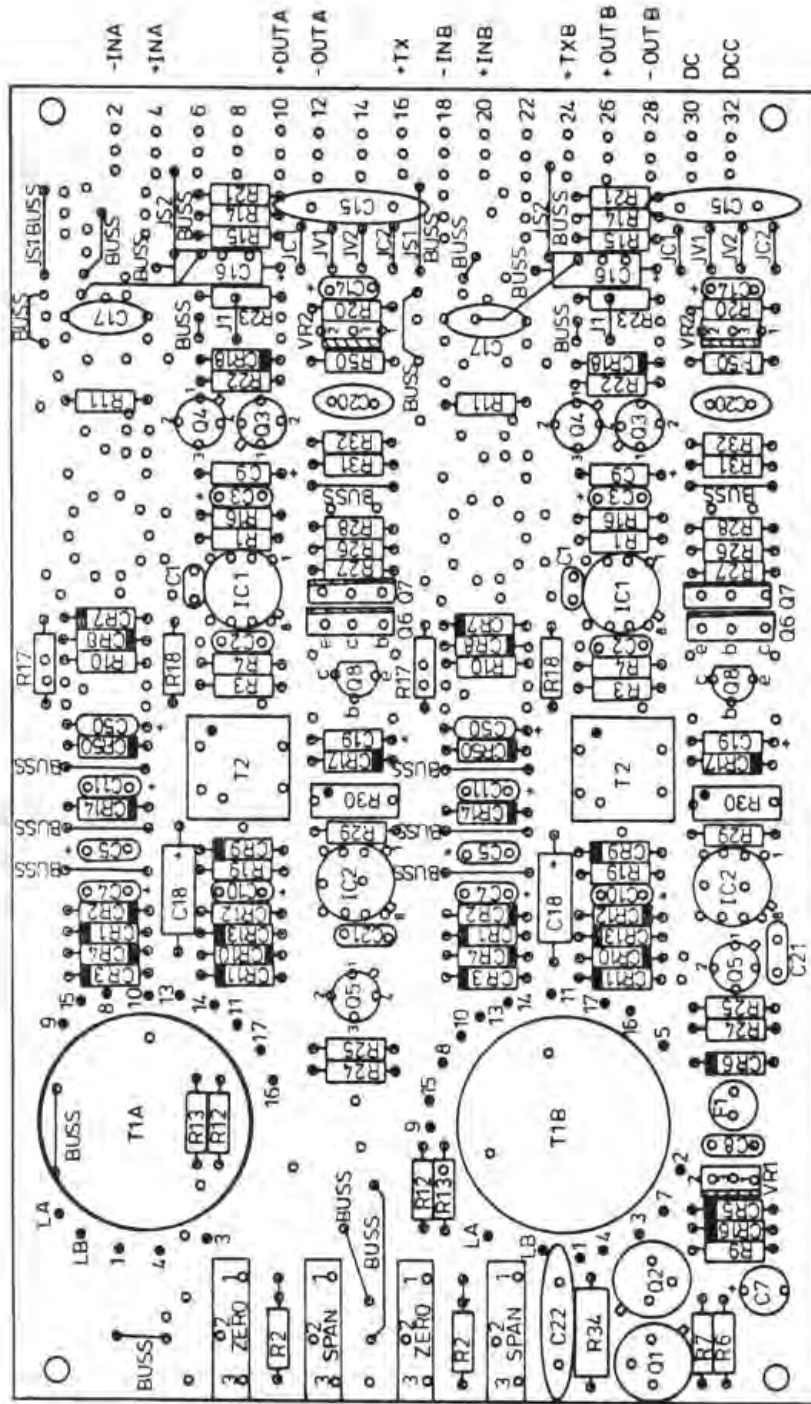
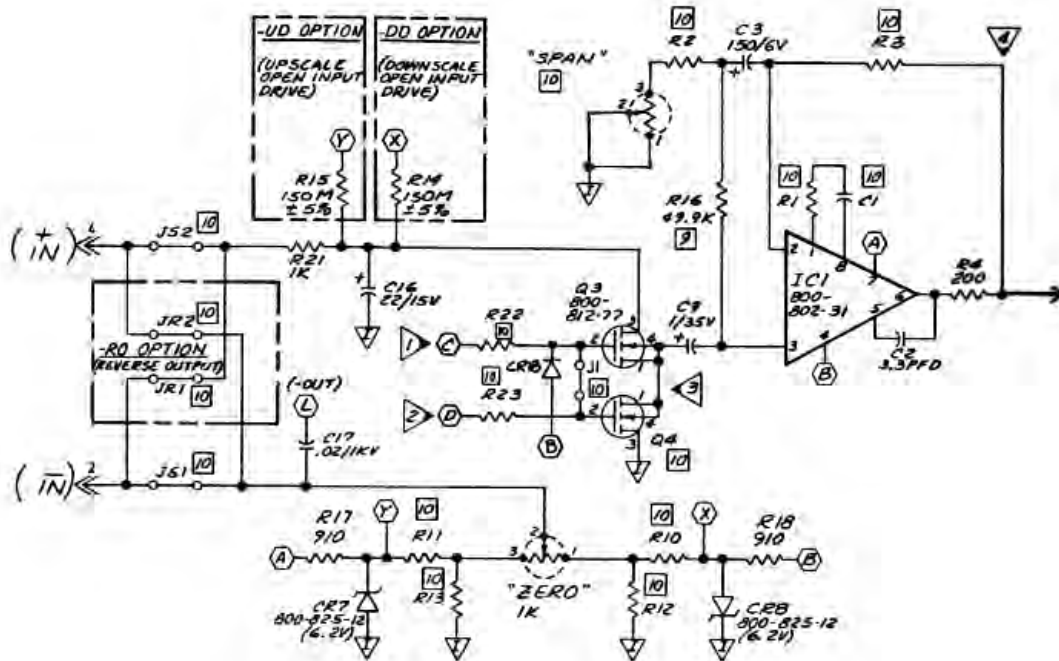


Figure 10. Dual Channel Assembly

MVT-EU



- 11. DELETED
 - 10. SEE LIST OF MATERIALS FOR VALUE, PART NO. AND/OR USAGE.
 - 2. METAL FILM RESISTOR, ±1% TOL.
 - 8. TEST POINT; FILLED END IS POINTER, REFER TO SECTION 5 OF MANUAL, "MAINTENANCE".
 - 7. INPUT SECTION COMMON (GROUND).
OUTPUT SECTION COMMON (GROUND).
 - 6. CONNECTOR PIN POSITION (32 PINS).
 - 5. IDENTIFIED WIRING PAD ON P.C. BOARD.
 - 4. ELECTRICAL COMMONS (SAME LETTERS); THESE LETTERS DO NOT APPEAR ON P.C. BOARD OR ASS'Y DWGS.
 - 3. ALL POTENTIOMETERS INCREASE C.W. FROM 1 TO 3.
 - 2. DIODES ARE M.I.I. P/N 800-814B-11; RESISTORS ARE 1/4 W CARBON COMP, ±10% TOL.
 - 1. RESISTANCE VALUES ARE IN OHMS; CAPACITANCE VALUES ARE IN MICROFARADS.
- NOTES: UNLESS OTHERWISE SPECIFIED

Figure 11. Channel A Schematic (page 1 of 2)

MVT-EU

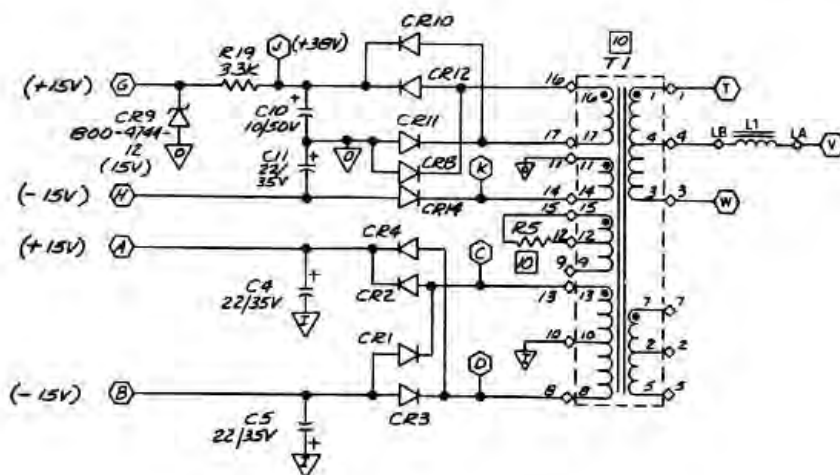
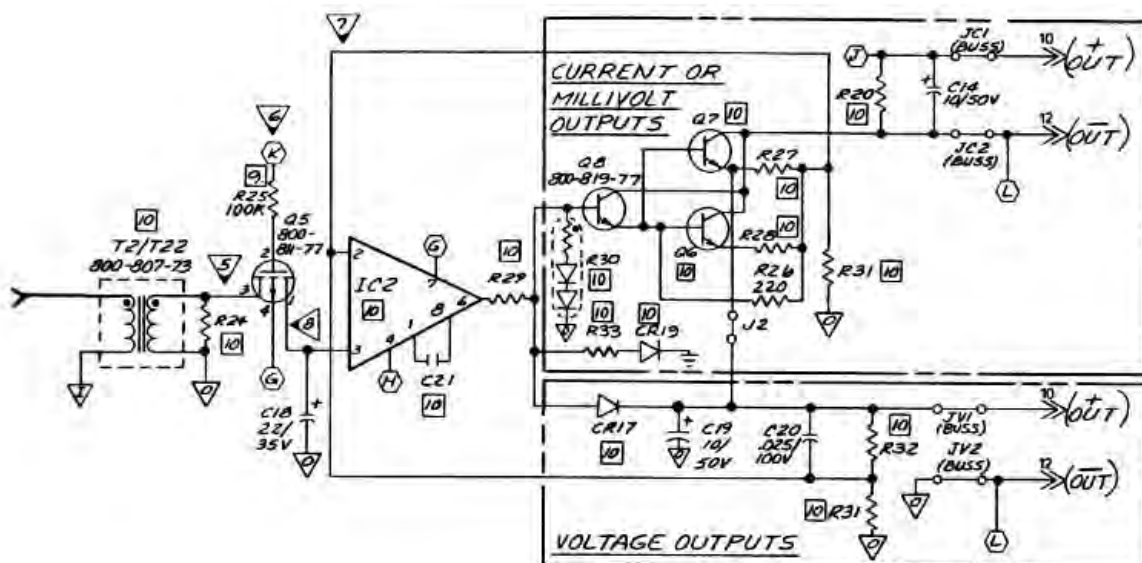
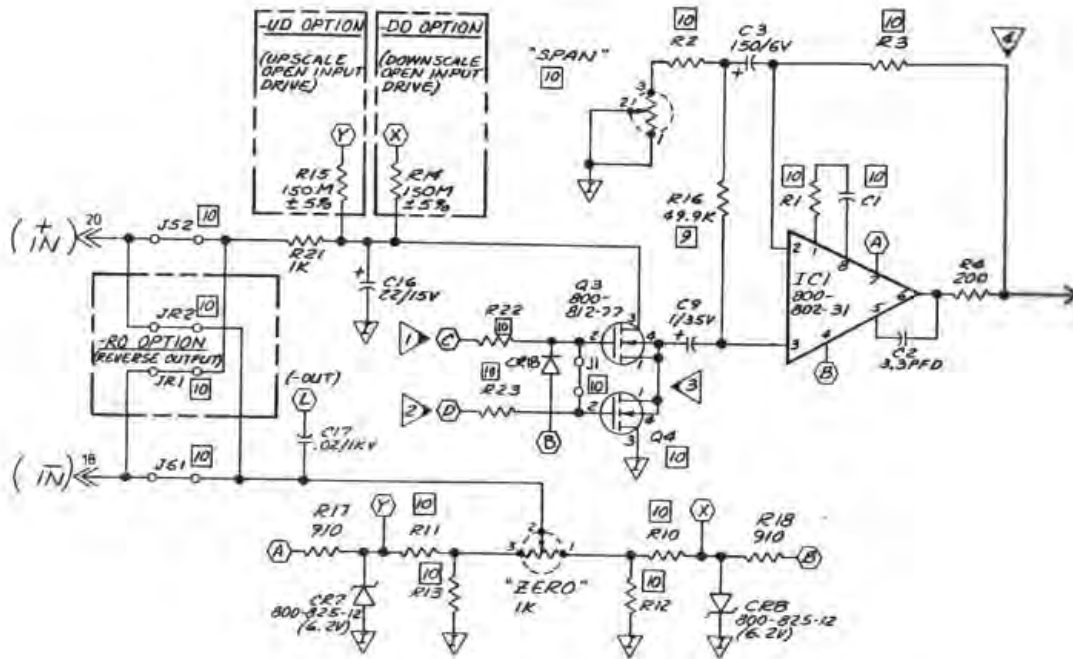


Figure 11. Channel A Schematic (page 2 of 2)

MVT-EU



- 11. DELETED
 - 10. SEE LIST OF MATERIALS FOR VALUE, PART NO. AND/OR USAGE.
 - 9. METAL FILM RESISTOR, ±1% TOL.
 - 8. TEST POINT; FILLED END IS POINTER. REFER TO SECTION 5 OF MANUAL, "MAINTENANCE".
 - 7. INPUT SECTION COMMON (GROUND).
 - 6. OUTPUT SECTION COMMON (GROUND).
 - 6. CONNECTOR PIN POSITION (15 PINS).
 - 5. IDENTIFIED WIRING PAD ON P.C. BOARD.
 - 4. ELECTRICAL COMMONS (SAME LETTERS); THESE LETTERS DO NOT APPEAR ON P.C. BOARD OR ASS'Y DWGS.
 - 3. ALL POTENTIOMETERS INCREASE C.W. FROM 1 TO 3.
 - 2. DIODES ARE M.I.I. P/N 800-4148-11; RESISTORS ARE 1/4 W CARBON COMP., ±10% TOL.
 - 1. RESISTANCE VALUES ARE IN OHMS; CAPACITANCE VALUES ARE IN MICROFARADS.
- NOTES: UNLESS OTHERWISE SPECIFIED

Figure 12. Channel B Schematic (page 1 of 2)

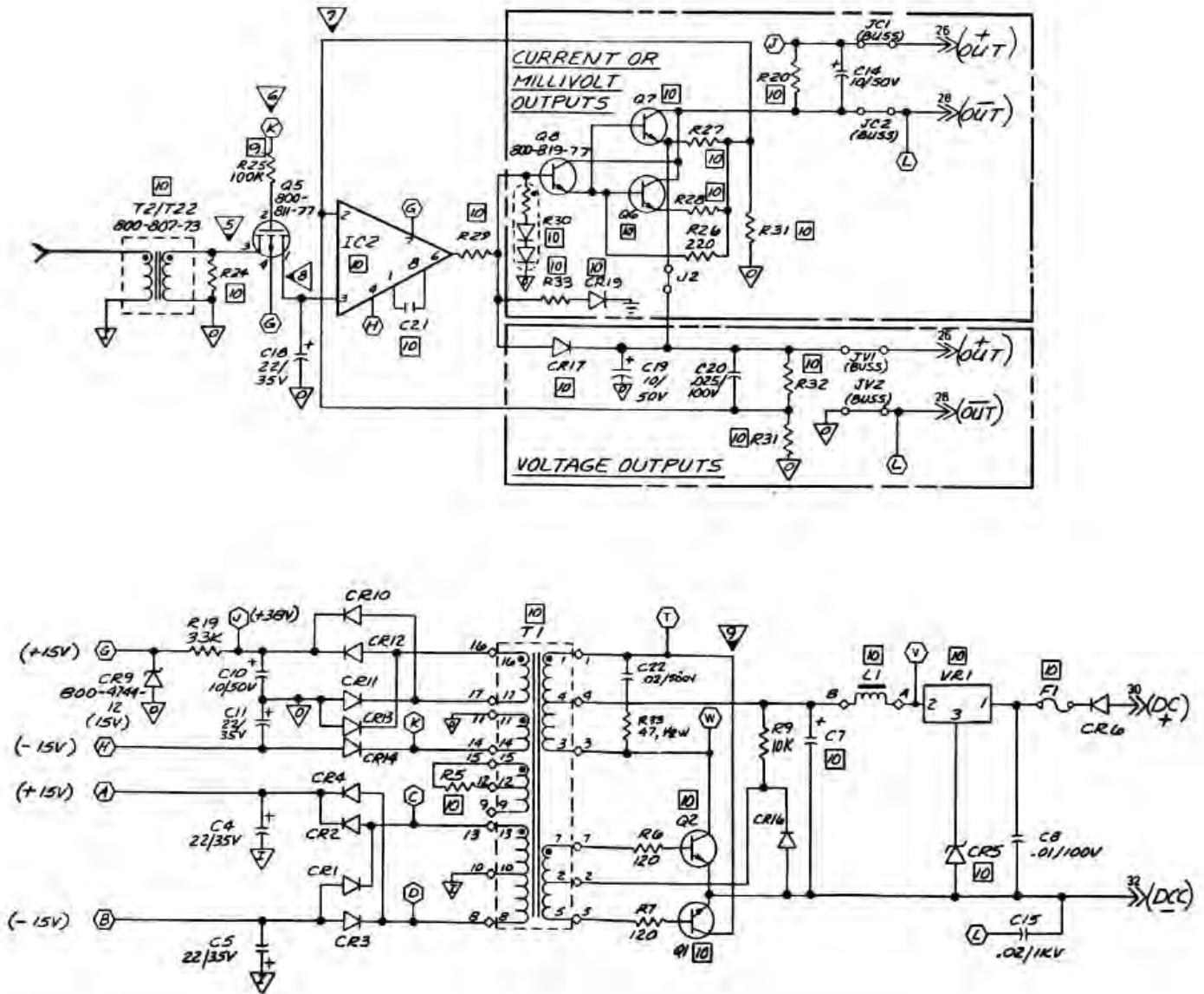


Figure 12. Channel B Schematic (page 2 of 2)

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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