845AR

High Impedence Voltmeter Null Detector

Instruction Manual

P/N 294181
April 1968

FLUKE®

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX 43210, MOUNTLAKE TERRACE, WASHINGTON 98043, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, Washington 98043

Rev. 4/80

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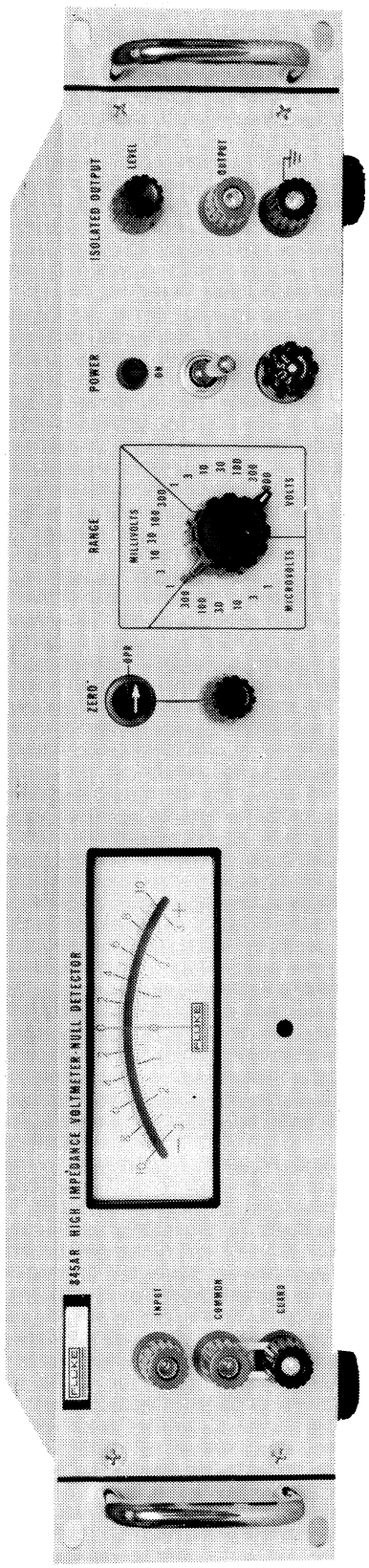
LIST OF ILLUSTRATIONS



MODEL 845AR HIGH IMPEDANCE VOLTMETER-NULL DETECTOR

SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. The Fluke Model 845AR High Impedance Voltmeter-Null Detector allows measurement of dc voltages from one microvolt to 1000 volts dc in 19 ranges. When used as a null detector on the 100 millivolt range and below, the input impedance is an excellent 1 megohms. A linear recorder output allows the instrument to be used for production testing, and also as a dc amplifier with a maximum gain of 120 db.

1-3. The instrument may be wired to operate from a line power source of 115 volts ac or 230 volts ac, as desired. The instrument is designed to be mounted directly in a standard EIA 19 inch relay rack. Resilient feet are also provided for bench top use.

1-4. ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE RANGE
1 microvolt to 1000 volts dc end scale in nineteen ranges, using X1 and X3 progression.

INPUT RESISTANCE
100 megohms on 300 millivolt range and above; 10 megohms on 100 millivolt range and below, $1 M\Omega \leq 1 mV R$

ACCURACY
±(3% end scale + 0.1 microvolt).

MAXIMUM NOISE (input shorted)

Range	Noise (peak-peak)
1 microvolt	0.20 microvolt
3 microvolt	0.25 microvolt
10 microvolt - 1000 volt	0.30 microvolt

METER RESPONSE TIME (to 90% of reading)

Range	Time
1 microvolt	5 seconds
3 microvolt	3 seconds
10 microvolt - 1000 volt	1-1/2 seconds

INPUT ISOLATION
Better than 10^{12} ohms at less than 50% relative humidity and 25° C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35° C. With driven guard, isolation improves by at least one order of magnitude up to 10^{13} ohms. Any input terminal may be floated 1100 volts off chassis ground.

DC COMMON MODE REJECTION
Better than 160 db, input short-circuited, 80% relative humidity; better than 140 db, open-circuited, 50% relative humidity; better than 120 db, open-circuited, 80% relative humidity.

AC COMMON MODE REJECTION (below 100 kHz)
100 volts rms or 120 db greater than end scale, whichever is less, will effect reading less than 2% of end scale. Input open-circuited.

AC NORMAL MODE REJECTION (60 Hz and above)
AC voltages 60 db above end scale will effect reading less than 2% of end scale. Maximum voltage not to exceed 750 volts rms.

RECORDER OUTPUT
0-1 volt, one side at chassis ground; linear to 0.5% of end scale. Source impedance, 5k to 7.5k.

STABILITY OF ZERO
Better than 0.15 microvolt/hr, better than 0.3 microvolt/day.

TEMPERATURE COEFFICIENT OF ZERO
Less than 0.1 microvolt/° C from 15° C to 35° C. Less than 0.2 microvolt/° C from 0° C to 50° C.

ZERO CONTROL RANGE
±5 microvolt minimum.

OVERLOAD PROTECTION
Up to 1100 volts dc may be applied on any range. Typical recovery time is 4 seconds.

INPUT POWER
115/230 volts ac ±10%, 50 to 440 Hz, approximately 3 watts.

1-5. ENVIRONMENTAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE
Within all specifications from 15° C to 35° C.

Within all specifications from 0° to 50° C except:
Derate by a factor of two —
Maximum Noise and Meter Response Time.
DC Common Mode Rejection —
Derate by 20 db.

STORAGE TEMPERATURE RANGE
-40° C to +70° C.

RELATIVE HUMIDITY RANGE
0 to 80%.

SHOCK
Meets hammer blow requirements of MIL-T-945A and MIL-S-901B.

VIBRATION
Meets 10 Hz to 55 Hz tests of MIL-T-945A.

1-6. MECHANICAL SPECIFICATIONS

MOUNTING
Standard EIA relay rack. Resilient feet provided for bench use.

WEIGHT
9 pounds.

SIZE
3.47 inches high x 19 inches wide x 8.26 inches deep.

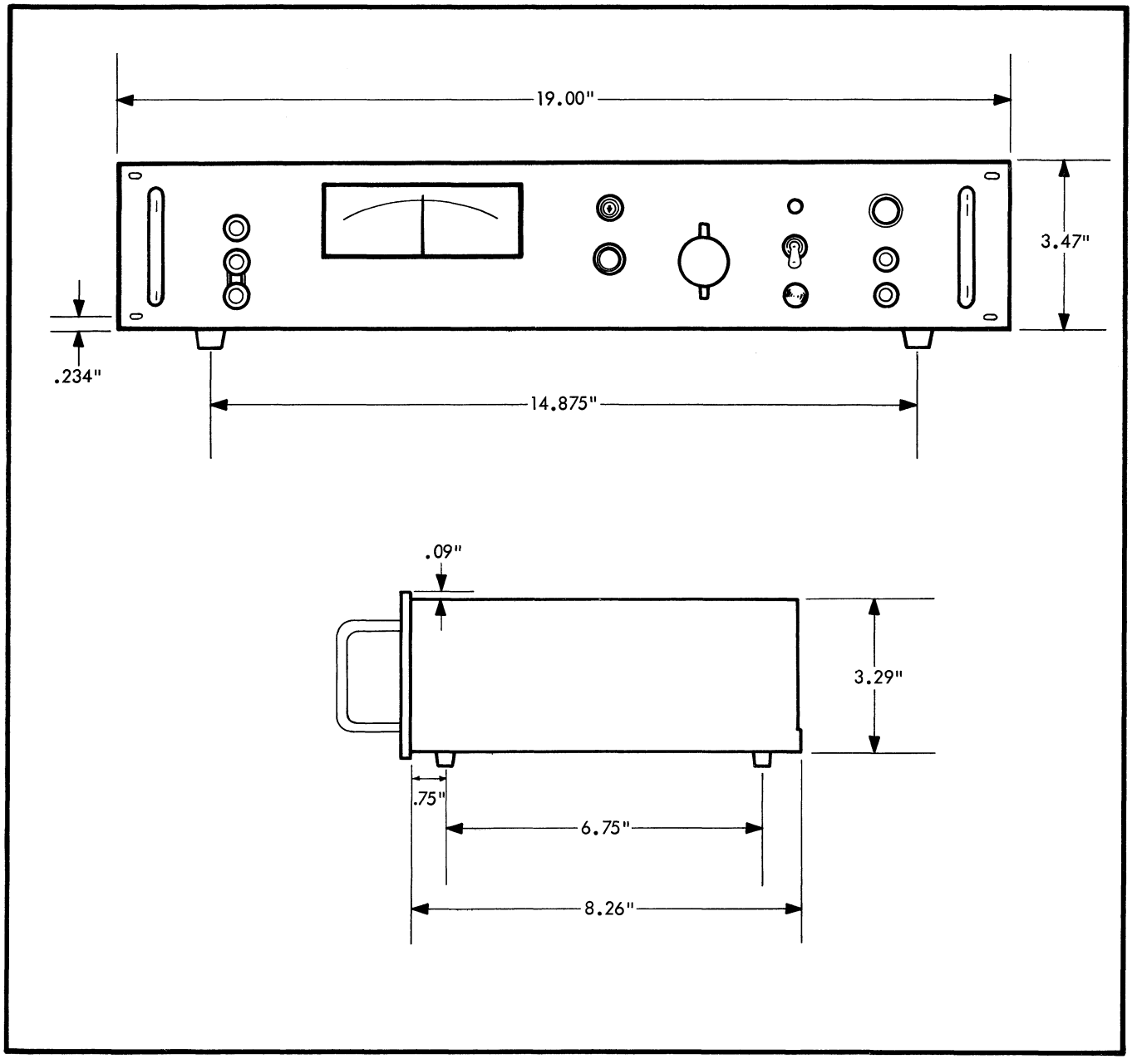
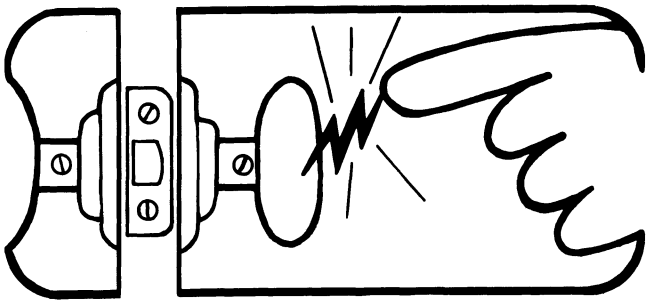


Figure 1-1. MODEL 845AR OUTLINE DRAWING

static awareness

A Message From

John Fluke Mfg. Co., Inc.

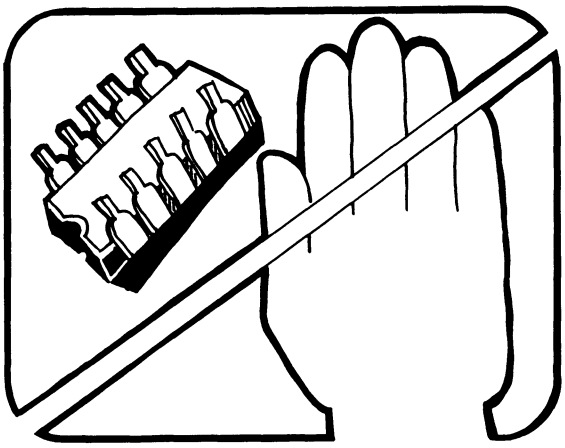


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

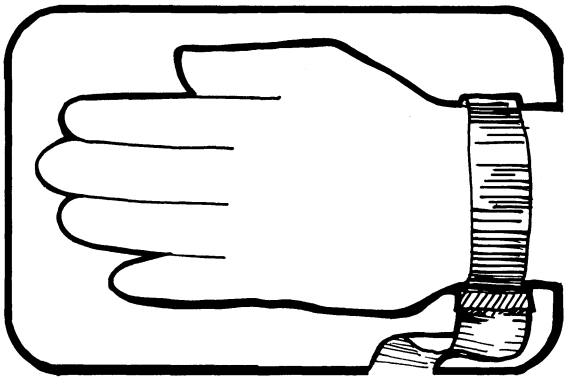
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

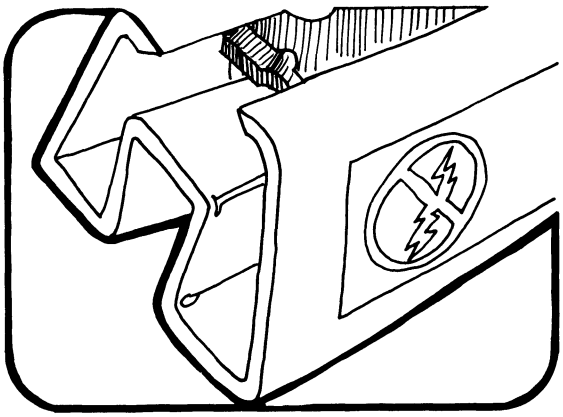
The following practices should be followed to minimize damage to S.S. devices.



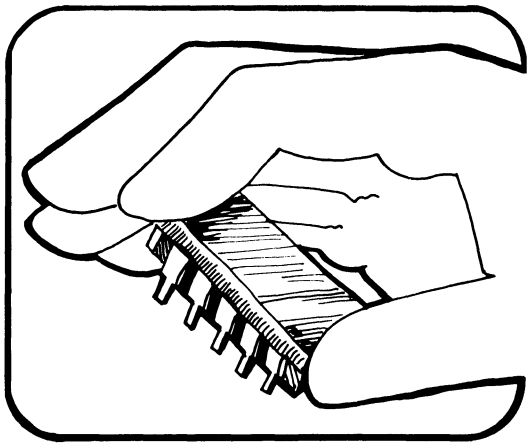
1. MINIMIZE HANDLING



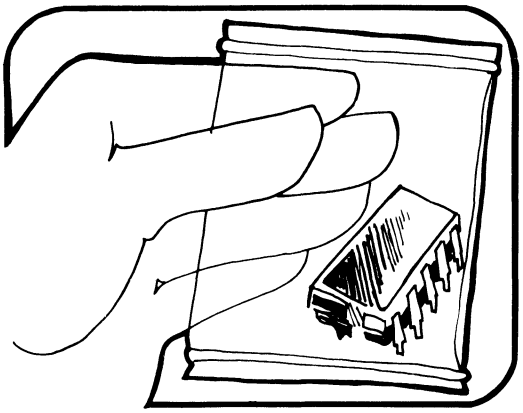
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



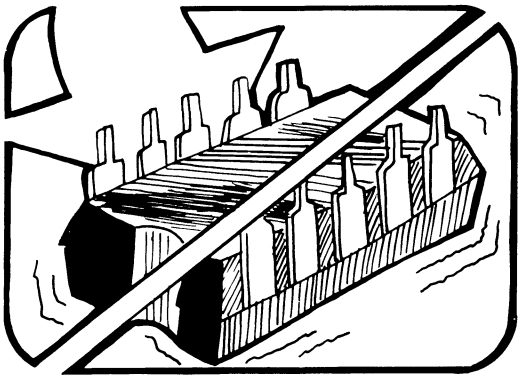
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



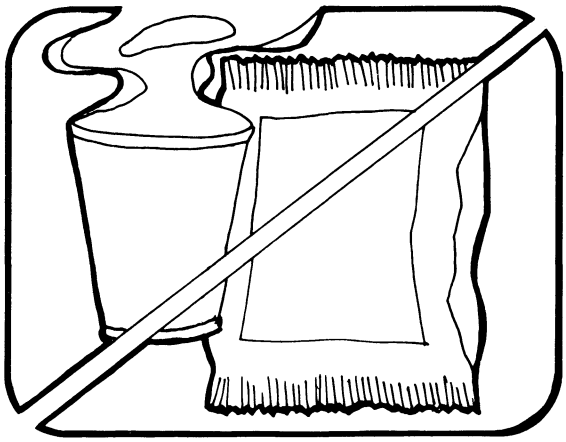
4. HANDLE S.S. DEVICES BY THE BODY



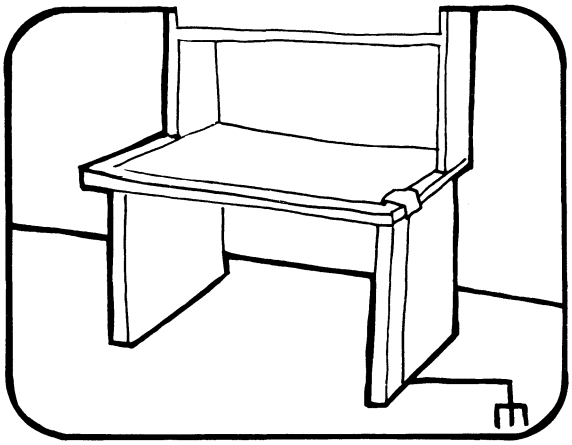
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

SECTION II

OPERATING INSTRUCTIONS

2-1. RECEIVING INSPECTION

2-2. This instrument has been thoroughly tested and inspected before being shipped from the factory. Immediately upon receiving the instrument, carefully inspect for damage which may have occurred during shipment. If any damage is noted, follow the instructions outlined in the warranty page at the back of this manual.

2-3. CONTROLS, TERMINALS, AND INDICATOR

2-4. The location and function of the front-panel controls are described in Figure 2-1. Detailed operating descriptions are given in the following paragraphs.

2-5. PRELIMINARY OPERATION

2-6. Connect the Model 845AR line plug to a 115 volt ac power outlet or to 230 volts ac if the instrument is so wired.

WARNING!

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead from the adapter to a high-quality earth ground.

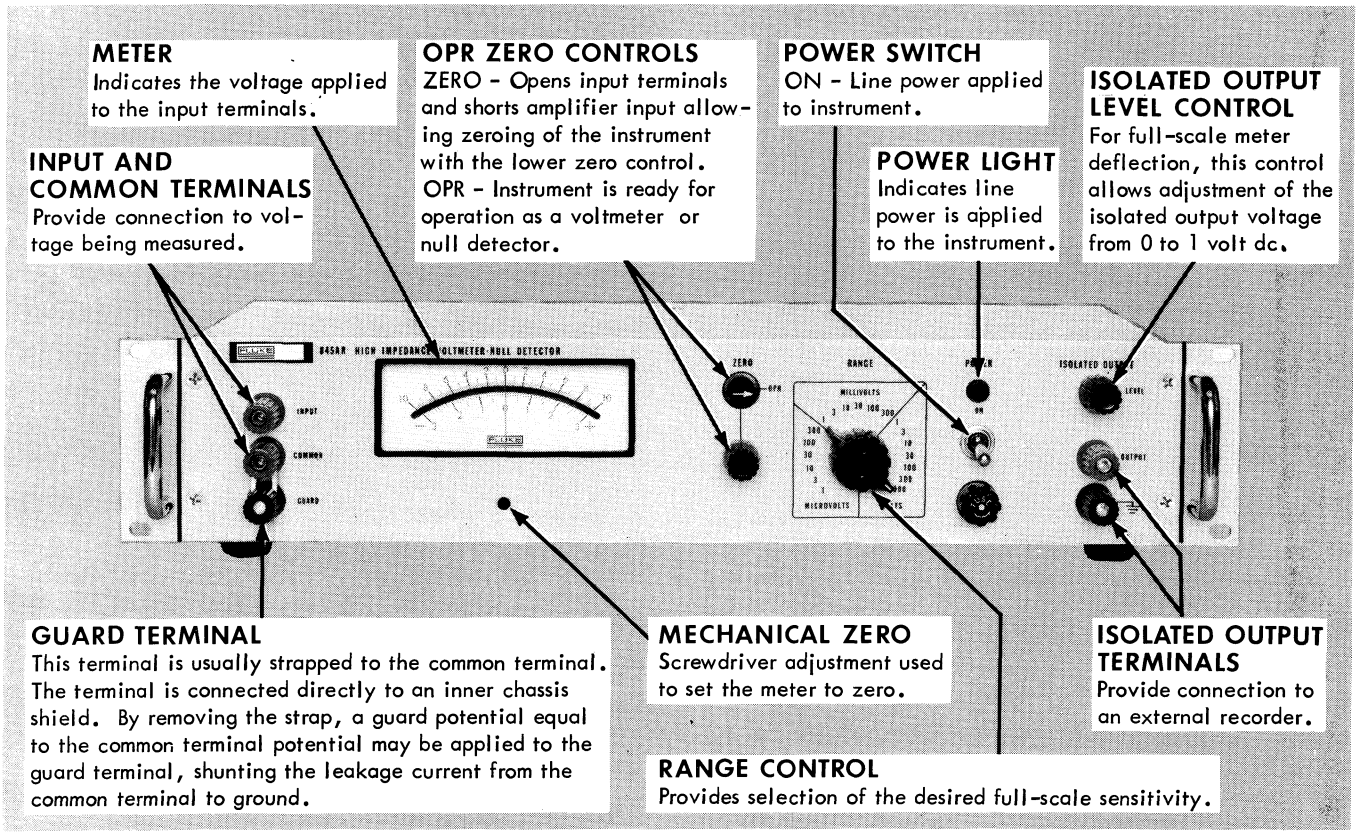


Figure 2-1. CONTROLS, TERMINALS, AND INDICATOR

a. Place the Model 845AR controls as follows:

POWER	ON
RANGE	10 MICROVOLTS
OPR/ZERO	ZERO

b. Adjust the zero control for an initial zero meter deflection. Place the RANGE switch to the 1 MICROVOLT RANGE and re-zero with the zero control.

2-7. MECHANICAL ZEROING

2-8. It may become necessary to adjust the mechanical zero control of the Model 845AR at more frequent intervals than complete calibration. To mechanically zero the instrument proceed as follows:

a. Place the RANGE switch to 1000 VOLTS and the POWER switch to ON.

b. Adjust the mechanical zero adjustment screw for zero meter deflection.

c. Place the RANGE switch to 10 MICROVOLTS and electrically zero the instrument as outlined in paragraph 2-5.

d. Repeat steps a and b.

2-9. OPERATION AS A HIGH IMPEDANCE VOLTMETER

2-10. To operate the Model 845AR as a High Impedance Voltmeter perform the preliminary operations according to paragraph 2-5 and proceed as follows:

a. Place the controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	1000 VOLTS

Note!

When measuring voltages in the microvolt ranges, use copper wire having low thermal EMF's.

b. Connect the voltage to be measured to the Model 845AR INPUT terminal and connect the common point of the voltage being measured to the COMMON terminal.

c. Deflection of the meter indicates the polarity and magnitude of the measured voltage. Increase the sensitivity of the Model 845AR for maximum on-scale deflection.

2-11. OPERATION AS A NULL DETECTOR

2-12. The Model 845AR may be used to monitor small voltage differences in bridge circuits, potentiometers, and other measuring apparatus. In most of these applications the circuits are adjusted for zero deflection or a null on the Model 845AR. Equipment connections for various types of null detector configurations are illustrated by Figure 2-2 through 2-4. To operate the Model 845AR as a Null Detector, perform the preliminary operations according to paragraph 2-5 and proceed as follows:

a. Select the desired equipment application as illustrated by Figure 2-2 through 2-4 and make the appropriate equipment connections.

b. Place the Model 845AR controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	as desired

c. Adjust the circuit being measured for zero or a null deflection on the Model 845AR meter.

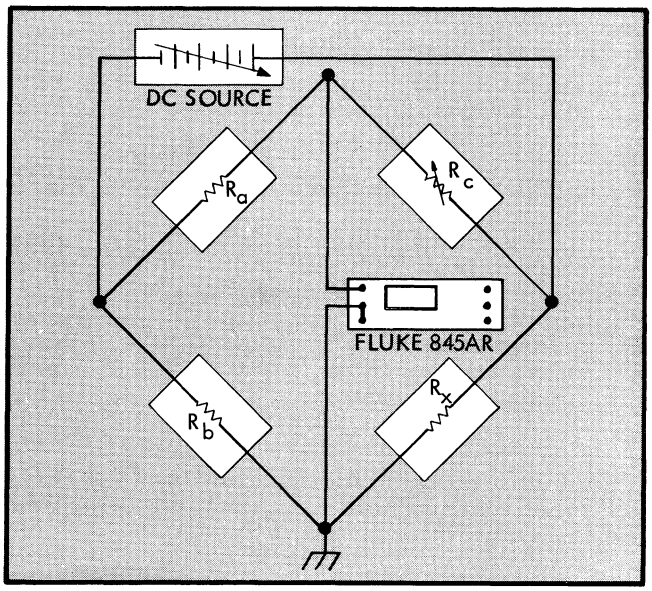


Figure 2-2. BRIDGE DETECTOR - FLOATING SUPPLY

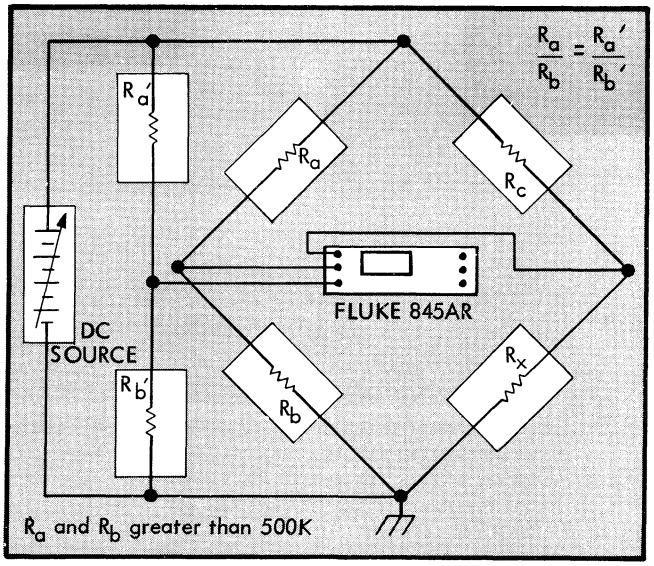


Figure 2-3. BRIDGE DETECTOR - HIGH RESISTANCE

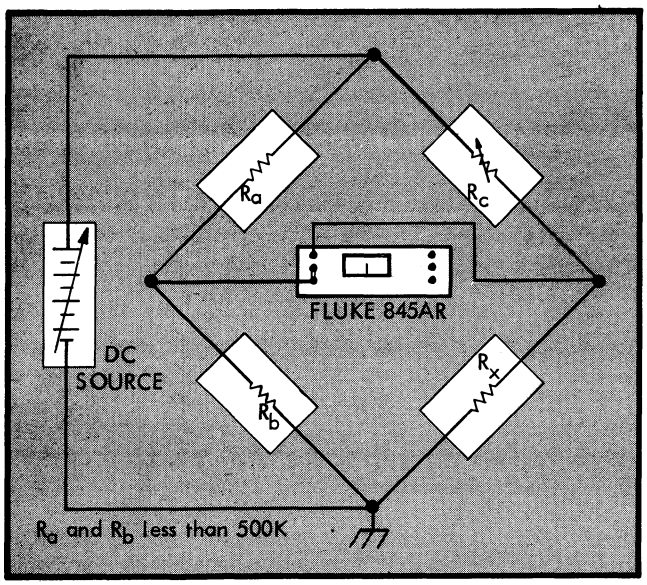


Figure 2-4. BRIDGE DETECTOR - FLOATING NULL DETECTOR

2-13. MEASURING VOLTAGES WITH A STANDARD CELL

2-14. The Model 845AR may be used with a voltage divider and a standard cell to calculate unknown voltages with a high degree of accuracy. Connect the equipment as illustrated in Figure 2-5. Perform the preliminary operation as outlined in paragraph 2-5 and proceed as follows:

a. Place the Model 845AR controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	as desired

b. Adjust the voltage divider for zero or null deflection on the Model 845AR meter while placing the RANGE switch to successively more sensitive ranges.

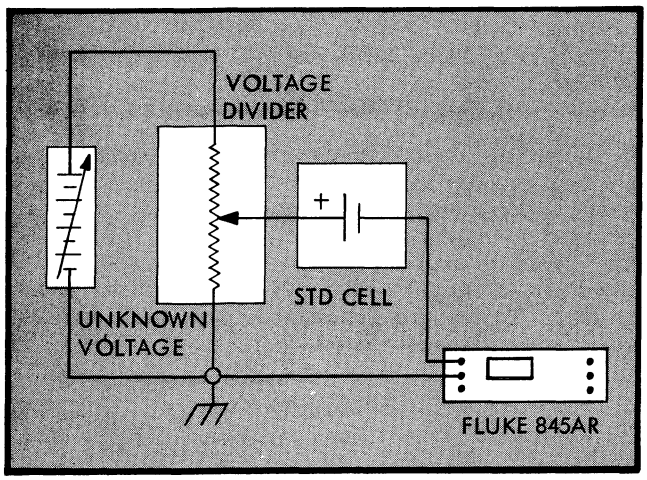


Figure 2-5. STANDARD CELL VOLTAGE MEASUREMENTS

c. Calculate the unknown voltage by dividing the standard cell voltage by the final division ratio of the divider.

2-15. USE OF ISOLATED OUTPUT

2-16. DC ISOLATION AMPLIFIER

2-17. The Model 845AR may be used as a dc isolation amplifier having a voltage gain of up to 120 db, depending on the settings of the RANGE switch and the OUTPUT LEVEL control. To compute the maximum voltage gain on any range of the Model 845AR, use the following formula:

$$\text{Voltage gain in db} = 20 \log_{10} \frac{\text{1 volt (maximum isolated output)}}{\text{Range (in volts)}}$$

2-18. RECORDER OUTPUT

2-19. The Model 845AR ISOLATED OUTPUT may be used to provide an output voltage, adjustable from zero to one volt for a full-scale meter deflection for use with a recorder. Since the output is isolated from the input, floating measurements can be made without the use of a floating recorder. To use the adjustable recorder output, proceed as follows:

a. Connect the recorder to the ISOLATED OUTPUT terminals.

Note!

The lower ISOLATED OUTPUT terminal is connected to chassis ground. If a ground reference is undesirable, remove the jumper wire above R202 on the power supply circuit board. Refer to Figure 2-6 for jumper wire location.

b. Turn the recorder on.

c. Proceed as outlined in paragraph 2-9 or 2-11, as desired.

d. Adjust the ISOLATED OUTPUT LEVEL control for the desired output to the recorder. This control has a log taper so that smooth control is possible at both high and low settings.

Note!

The ISOLATED OUTPUT current capability is 100 microamperes with a 5 kilohm source impedance.

2-20. OPERATING NOTES

2-21. SPURIOUS VOLTAGES AND CURRENTS

2-22. Voltage measurements at the microvolt level involve the persistant problems of thermoelectric effects. These effects may be compensated for by temporarily disconnecting the voltage from the circuit under measurement and noting the meter deflection of the

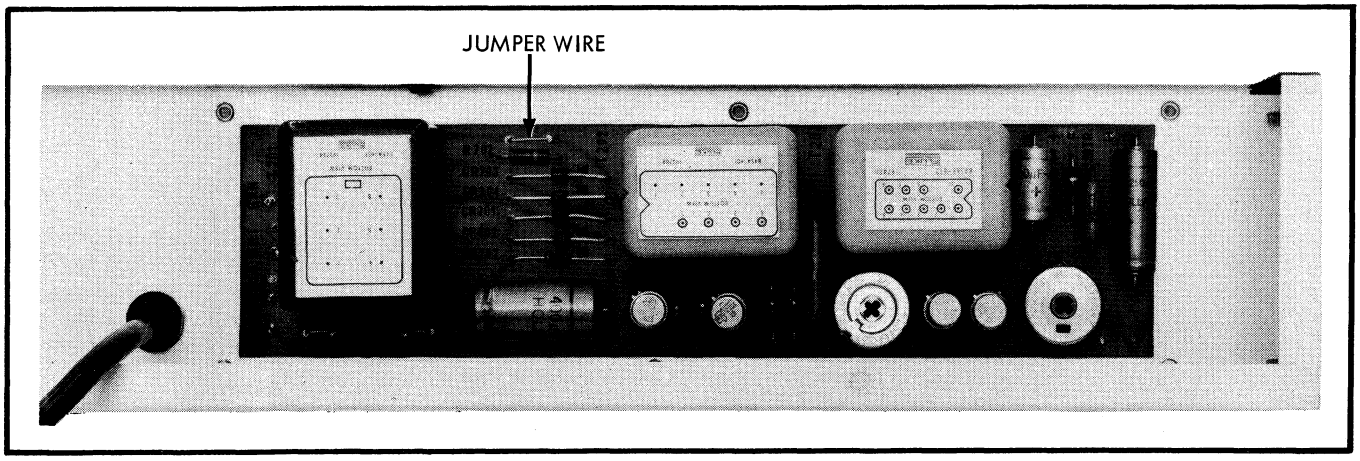


Figure 2-6. CHASSIS GROUND - JUMPER WIRE LOCATION

Model 845AR on the desired range. This reading must then be subtracted from all subsequent voltage measurements. A thorough understanding of these effects can lead to reducing or eliminating them completely.

2-23. THERMOELECTRIC VOLTAGES

2-24. If a circuit is composed of two dissimilar metals, a net voltage will result if the two dissimilar junctions are maintained at different temperatures. These thermoelectric voltages, also known as thermals, thermocouple voltages, or Seebeck voltages, can be reduced by using metals having low thermoelectric potentials, and keeping all junctions at the same temperature. The terminals of the Model 845AR are made of pure copper, gold-flashed to prevent tarnish. For lowest thermal voltages, all connections to the Model 845AR should be made with pure copper wire. Silver plated copper or solder coated copper also produce satisfactory results. Tinned copper is less satisfactory than silver plated or copper coated copper. Nickel and nickel-based alloys are not suitable for connections to the instrument. Excellent results can be obtained using ordinary TV twin lead, or even lamp cord if high insulation resistance is not required. If shielding is necessary, use a length of flat braid over the cable.

2-25. HIGH SOURCE IMPEDANCE

2-26. Due to the very high input resistance and extreme sensitivity of the Model 845AR, it is charge sensitive. Thus, a person's body potential, an electrostatic voltage, can cause charge redistribution at the input to the instrument and result in meter needle deflection as a hand approaches the input terminals. Careful shielding will eliminate this problem. Also, due to charges that may be deposited on the input terminals when the OPR-ZERO switch is set to ZERO, an appreciable transient will result when the switch is set to OPR if nothing is connected to the input terminals. Turning the switch back and forth will dissipate this charge, eliminating the problem. With a high source impedances, the response of the instrument is unavoidably slow due to the low pass filter used to suppress superimposed noise. However, the design of the low pass filter is such that common mode rejection is extremely high while the response time for the normally encountered low source impedances is very fast.

2-27. OVERLOAD VOLTAGES

2-28. The instrument is designed to withstand up to 1100 volts dc or 1100 volts peak ac continuously applied between any two of the three input terminals or between cabinet ground and any of the three input terminals regardless of the setting of the RANGE or OPR-ZERO switch. However, repeated or continuous overloads above 200 volts in the ranges below 3 millivolts will result in dissipation in protective, low-pass-filter resistor R110. This will result in thermal voltages which may take several minutes to subside after the overload is removed.

2-29. GUARDING

2-30. The instrument has an inner chassis connected to the GUARD terminal on the front panel. Ordinarily, this GUARD terminal is strapped to the COMMON terminal. When connected in this way the inner chassis serves as a shield. This greatly improves the leakage resistance to ground and the common mode rejection. However, since the inner chassis is available at the GUARD terminal, it may be driven at the same voltage as the COMMON terminal. This further increases the leakage resistance and common mode rejection by about ten times. The voltage used to drive the GUARD terminal should be obtained from a separate source or by means of a voltage divider connected directly across the source so that the leakage currents do not cause voltage drops across impedances in the circuit under measurement.

2-31. INCREASING INPUT RESISTANCE

2-32. In the 1 microvolt to 1 millivolt ranges, a 10 megohm resistor is connected directly across the input of the instrument. The input resistance may be increased on these ranges by disconnecting the 10 megohm resistor where it attaches to the RANGE switch. However, the input resistance will no longer be well defined. Typical input resistances with the 10 megohm resistor removed are as follows:

Range	Input Resistance
1 uv	300 megohms
3 uv	1,000 megohms
10 uv	3,000 megohms
30 uv to 1 mv	10,000 megohms

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. The Model 845AR High Impedance Voltmeter-Null Detector theory of operation is contained in this section of the manual. A block diagram is illustrated in Figure 3-1, and a functional schematic diagram is located at the end of Section V. The block diagram and functional schematic diagram are to be used as an aid in understanding circuit theory, and in troubleshooting.

3-3. BLOCK DIAGRAM ANALYSIS

3-4. The Model 845AR is a photo-chopper stabilized amplifier with the overall gain of the amplifier being precisely controlled by negative feedback. The instrument's main circuits are an input range divider, a photocell modulator, an ac amplifier, a synchronous demodulator, a dc amplifier, a meter, an isolation converter, a neon drive, an 84 Hz multivibrator, a supply rectifier, and a rectifier filter.

3-5. The input range divider provides a fixed input impedance to signals of less than 1 millivolt while allowing reduction of input signals above 1 millivolt. Photochoppers modulate the input signal to the ac amplifier at 84 Hz. The drive signal for the photo modulator is provided by the neon drive which is composed of neon lamps driven alternately at 84 Hz by the 84 Hz

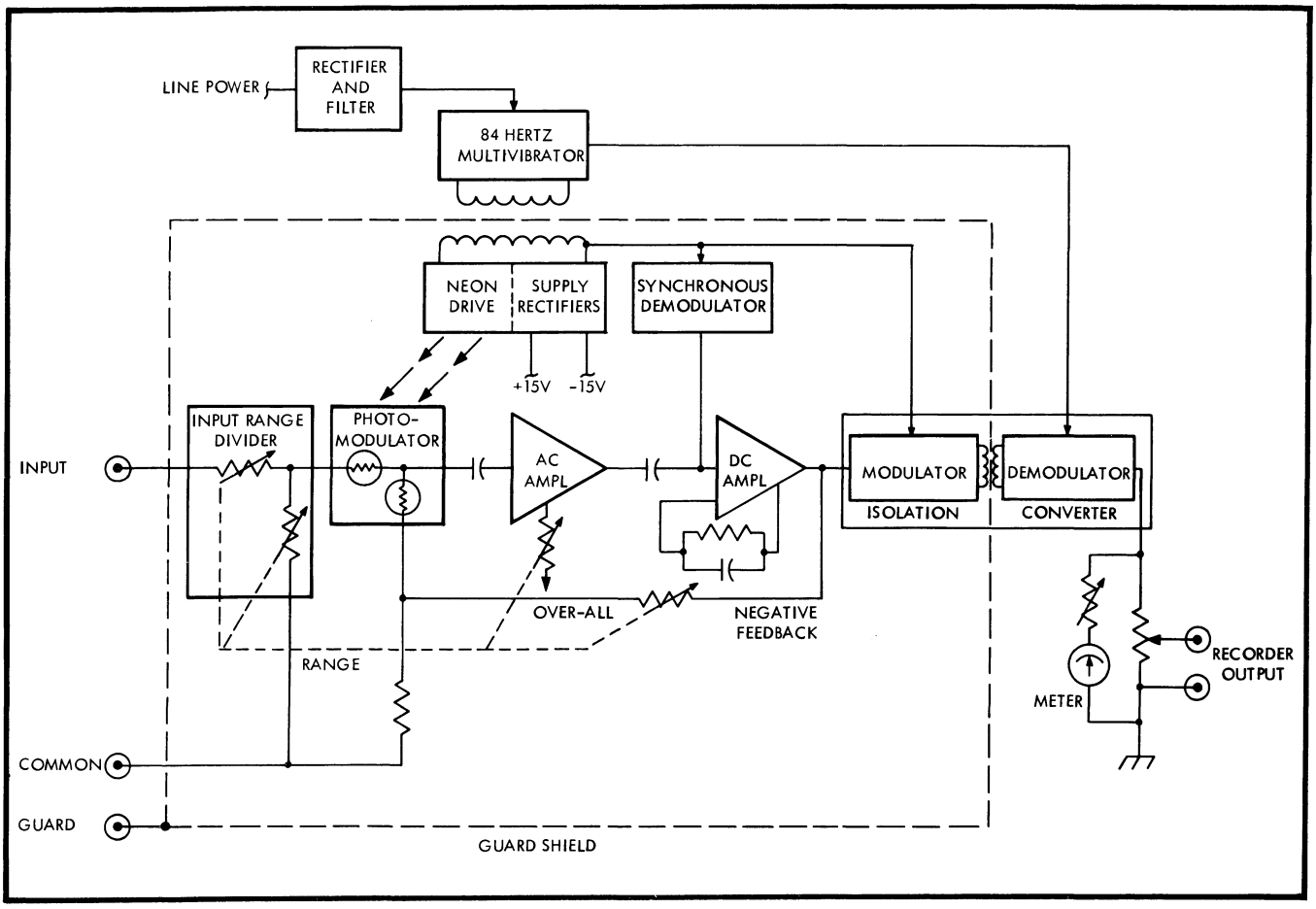


Figure 3-1. MODEL 845AR BLOCK DIAGRAM

multivibrator. Eighty four Hz is used to provide the Model 845 with an operating frequency asynchronous with the power line frequency and its harmonics. The 84 Hz multivibrator also drives the following circuits; (1) the supply rectifiers which provide operating voltages for the amplifiers, (2) the synchronous demodulator which demodulates the amplified dc signal, (3) the isolation converter which produces the meter and isolated recorder output. The entire amplifier and the secondaries of both transformers are surrounded by a guard shield which permits the use of external guard voltages.

3-6. The ac amplifier is a high impedance amplifier whose gain is controlled by the resistance selected by the RANGE control. The amplified dc signal is then detected by the synchronous demodulator.

3-7. The synchronous demodulator is driven by the 84 Hz reference signal and detects the amplified dc signal. The detected dc signal is then amplified by a dc amplifier whose gain is controlled by fixed feedback. The output signal of the dc amplifier is applied to the isolation converter which drives the isolated recorder output, and the meter which indicate the polarity and magnitude of the measured voltage. This same dc signal is also fed back to the input of the ac amplifier to control overall amplifier gain. The feedback ratio is determined by the setting of the RANGE control and allows overall amplifier gain to be precisely controlled.

3-8. CIRCUIT DESCRIPTION

3-9. POWER SUPPLY

3-10. Input power transformer T201 receives 115 volts ac, or 230 volts ac if the instrument is so wired, through the power switch, S1. The primary winding of T201 is constructed in such a manner as to utilize either 115 volts ac input, windings parallel, or 230 volts ac, windings in series. Fuse, F1, protects the Model 845AR circuitry from overloads.

3-11. The secondary voltage of T201 is rectified by bridge rectifier CR201 through CR204. The bridge rectifier output voltage is filtered by C201 and regulated by zener CR207. This regulated output voltage is used as the operating voltage for the 84 Hz multivibrator.

3-12. The 84 Hz multivibrator is used to provide synchronous drive voltages and dc operating voltages for the Model 845AR amplifier circuits free from any power line frequency variations and harmonics. The multivibrator is a transformer-coupled free running multivibrator composed of transistors Q201 and Q202, transformer T202, and frequency determining components C203 and R206 through R208. Variable resistor R206 is used to adjust the frequency of the multivibrator to 84 Hz. The voltage at the secondary of T202 is rectified by CR104 and CR105 to produce the positive and negative 15 volt dc operating voltages for the amplifier circuits. The same winding furnishes the synchronous demodulator and isolation converter drive signals and is tapped at a higher voltage level to drive the neon lamps DS101 and DS102. These neon lamps provide the drive signal for the photocell modulators V101 and V102.

3-13. INPUT DIVIDER

3-14. The basic full-scale sensitivity of the Model 845AR is limited to a maximum of 1 millivolt. Therefore, input signals above this value must be reduced. The input divider consists of R101 through R109 and RANGE switch S101A. On ranges being a multiple of 1, input voltages above 1 millivolt are divided down to 1 millivolt or less, upon selection of the proper range. On ranges being a multiple of 3, input voltages above 1 millivolt are divided down to 300 microvolts or less, upon selection of the proper range. On ranges of 1 millivolt and below, a 10 megohm resistor, R104, is connected across the input to provide a fixed value of input impedance.

3-15. AC AMPLIFIER

3-16. The input signal from the input divider is filtered by a three stage, low-pass filter composed of R110, C101, R111, C102, R112, and C103. This filter reduces any ac voltage having a frequency above 1 Hz. The filtered dc voltage is then square-wave modulated by photocell modulators V101 and V102, which are driven by DS101 and DS102. The resulting square-wave signal is coupled through C104 and amplified by Q101, Q102, and Q103 which form a three stage amplifier having a high input impedance. The gain of the ac amplifier is controlled by the common emitter resistance selected by the RANGE switch S101B. Maximum gain is used on the 1, 3, 10, and 30 microvolt ranges and is gradually reduced by the selection of R124 through R126 as the range is increased. The output of Q103 is capacitively coupled to a two stage current amplifier composed of Q104 and Q105. The current amplifiers have a constant gain controlled by fixed negative feedback through R130 and C111.

3-18. SYNCHRONOUS DEMODULATOR

3-19. The synchronous demodulator detects the magnitude and phase of the amplified signal. The 84 Hz drive signal is applied to the base of transistor Q106 which references the synchronous demodulator to the same phase as the photocell modulator. The demodulated signal is filtered by R134 and C114 before being applied to the dc amplifier.

3-20. DC AMPLIFIER

3-21. The dc amplifier amplifies the detected dc signal from the synchronous demodulator. Transistors Q107 through Q112 comprise a two-stage differential amplifier with a complementary emitter-follower output. Negative feedback through R149 and C116 is applied to the base of Q108 and controls the dc amplifier gain. The output from the common emitter of Q111 and Q112 is one volt dc for a full range input on any range, which drives the isolation converter. Overall negative feedback through the resistive network of R138 through R142 and R114 is controlled by the position of the RANGE switch S101C. This negative feedback allows precise control of the overall gain of the Model 845AR amplifiers.

3-22. ISOLATION CONVERTER

3-23. The isolation converter drives the recorder output and meter while providing isolation from the Model 845 amplifier circuitry. The output signal from the amplifier is applied to the transistors Q113 and Q114. An 84 Hz reference drive signal is applied to the bases of transistors Q113 and Q114 which causes modulation of the dc input signal to occur. The resulting modulated signal is coupled to the secondary of T203 where transistors Q203 and Q204 demodulate secondary signals occuring at their 84 Hz base signal rate. Capacitor C204 charges to the peak of the demodulated signal and discharges through the OUTPUT LEVEL control R1, R211 through R213, and the meter M1. The meter M1 indicates the polarity and magnitude of the input voltage. Capacitor C3 and resistor R2 filter the resulting dc output voltage for the recorder output.

SECTION IV

MAINTENANCE

4-1. GENERAL

4-2. The Model 845AR should be checked for calibration annually. Without extreme abuse all that should be required is periodic cleaning and calibration as specified in this section. If a problem arises, the information on corrective maintenance in this section will be extremely useful.

4-3. TEST EQUIPMENT

4-4. Figure 4-1 lists the recommended equipment with their specifications which are required for corrective maintenance and calibration.

4-5. 230 VOLT AC POWER-LINE CONVERSION

4-6. The Model 845AR may be converted for operation on 230 volt ac lines by modifying the power supply P/C board assembly wiring. Factory modified versions will have a decal on the rear panel indicating 230 volts ac input requirements.

4-7. To convert the Model 845AR to 230 volts ac operation, proceed as follows:

a. Remove the top-back dust cover.

b. Locate T201 on the power supply P/C board assembly and remove the two jumper wires labeled 115V. Refer to Figure 4-2 for location of jumper wires.

c. Place the jumpers removed in step b across the 230V labeled terminals, refer to Figure 4-2 for location, and solder the connections.

d. Replace the top-back dust cover and install a 3AG 1/32 ampere fuse in place of F1. F1 is located on the front panel.

4-8. DISASSEMBLY INSTRUCTIONS

4-9. The following procedure is to be used to gain access to the inside of the Model 845AR:

a. Remove the top-back cover by removing eight screws, six on top and two on the back. This allows access to the parts on the power supply board, and to capacitors C1 and C2 located on the front panel.

b. Remove the top cover of the guard chassis by removing six screws, three on the top of the guard and three on the back. This allows access to the dc amplifier and the last two stages of the ac amplifier. The instrument will still operate properly with the top of the guard chassis removed.

c. Remove the screws that fasten the right side panel to the front panel and other chassis panels, and remove the right side panel from the instrument.

d. Remove the two remaining screws holding the power supply P/C board. This will allow movement of the board assembly.

EQUIPMENT NOMENCLATURE	SPECIFICATIONS	RECOMMENDED EQUIPMENT
DC POWER SUPPLY	Output voltage of 0 to 1000 volts dc. Accuracy of ±0.25% or 100 microvolts.	Fluke Model 332A.
Oscilloscope	Voltage sensitivity of 200 uv/cm.	Hewlett-Packard Model 130C.
Battery	10 volt.	

Figure 4-1. TEST EQUIPMENT REQUIREMENTS

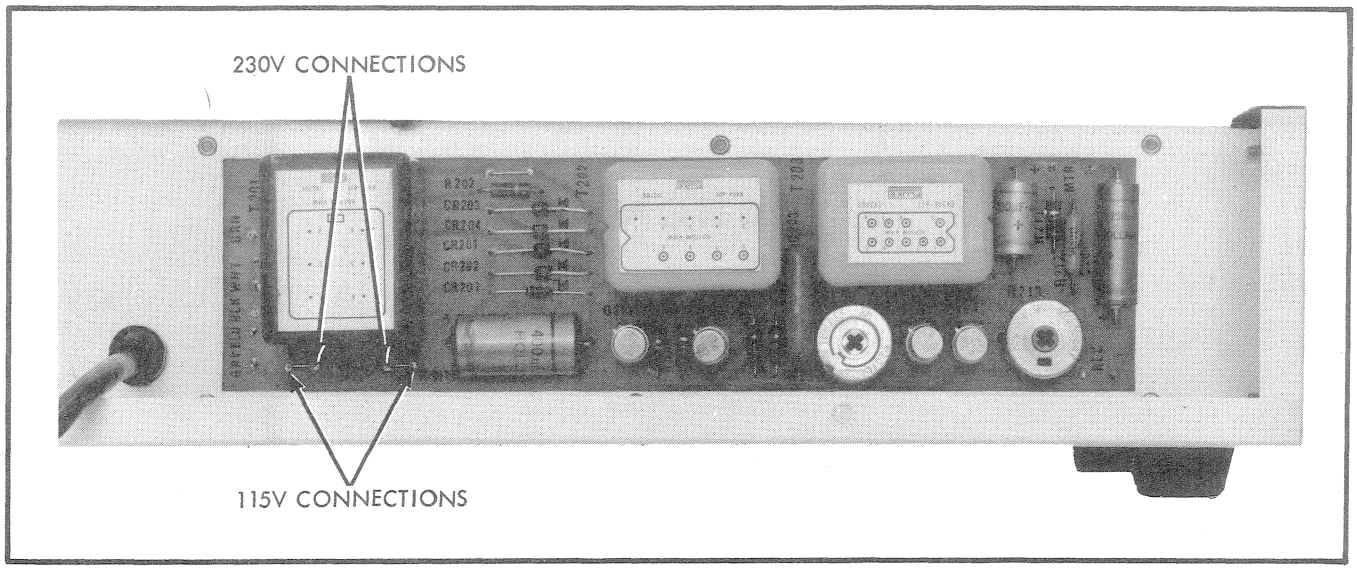


Figure 4-2. T201 115/230 VOLT AC POWER TERMINALS

e. Remove the bottom-back cover of the guard chassis by removing the three screws on the bottom of the guard chassis. This allows access to the input divider, the plus and minus 15 volts dc filter capacitors, and the isolation convertor modulator.

CAUTION!

Avoid touching the polyethelene grommets. Contamination will cause excessive electrical leakage.

4-10. CORRECTIVE MAINTENANCE

4-11. TROUBLESHOOTING

4-12. The purpose of troubleshooting is to locate and correct as quickly as possible any deficiency in operation. The causes and remedies of the more common troubles that may occur are listed in the troubleshooting chart, Figure 4-3. Waveforms useful for troubleshooting are given in Figures 4-4 through 4-9. A complete understanding of the theory of operation and familiarity with the schematic diagram is the best way to locate and correct the cause of any malfunction.

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Blows fuses.	Short circuit across secondary of T201.	Test for short circuit between pins 3 and 6.
	Shorted turn in T201.	Unsolder R202 in secondary of T201. A shorted turn will require almost as much current as normal operation.
	Defective CR201 through CR206.	Measure voltage of C201. Should be 10.5 volts. If near zero, replace CR201 through CR206, as necessary.
Photo Modulator inoperative. (Neon lights out)	Defective Q201 or Q202.	If voltage of C201 is less than 7 volts, and batteries are charged, replace Q201 and/or Q202.
	Open winding on T202, or open C203.	Waveform of TP10 should agree with Figure 4-4. If square wave is absent, T202 or C203 is defective.
	No drive to neon lamps DS101 and DS102.	A square wave of over 200 volts peak-peak should be present between pin 9 of T202 and the GUARD terminal. If not, T202 may be defective.

Figure 4-3. TROUBLESHOOTING CHART (Sheet 1 of 3)

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Meter movement inoperative.	Dead meter. Defective auxiliary supply.	Check meter with an ohmmeter. Panel meter should peg. Measure voltages at TP3 and TP4. If one voltage is near zero, check the associated diode and capacitor. If both voltages are zero, T202 is defective.
Meter pegs or wanders.	Meter mechanically stuck. Defective amplifier	Using an oscilloscope with dc coupling, measure waveforms at TP6. If waveforms agree with Figure 4-5 check Q111, Q112, Q109, Q110, Q107, and Q108 by replacement. If waveforms are not correct, then: (a) Waveform at TP6 looks more like waveform at TP7, Figure 4-6, Q106 is open. (b) No change in waveform at TP6 as ZERO control is rotated. R114 is shorted, base of Q101 is shorted, V101 or V102 is shorted. (c) Waveform at TP6 looks like a square wave. Measure waveform at TP7. If square wave disappears and waveform at TP7 is correct, C112 is shorted. If waveform is not correct, remove Q104 and measure waveform at TP2, Figure 4-7. If square wave persists, short junction of R115, C104, C105, and base of Q101 to common. If square wave disappears, remove short and transfer short to R112, C103, and V101 junction. If square wave returns, a photocell is defective, or C104 is shorted. If square wave does not return, move the short to the end of R110 that connects to RANGE switch. If signal reappears, CR101 or CR102 is defective. If square wave does not reappear, the RANGE switch is defective. (d) No signal at TP6. If there is also no signal at TP7, Q106 is probably shorted. If Q106 is satisfactory, measure waveform at TP2. If there is still no signal, C107, CR103, Q101, Q102, or Q103 is defective.
Erratic or unstable condition when measuring a voltage or zeroing instrument.	S103 Erratic Contact.	Replace or burnish contacts with crocus cloth.
Meter deflects in one direction, only.	Open winding on T203, defective Q113, Q114, Q203, or Q204.	Check and replace as necessary.
Slower response in negative direction.	Leaky C120.	Test and replace if necessary.
Measurements are low on high-sensitivity.	Shorted C116.	Test and replace if necessary.
Poor stability.	Defective CR207.	Replace if necessary.

Figure 4-3. TROUBLESHOOTING CHART (Sheet 2 of 3)

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Noise on 1, 3, and 10 uv ranges.	Dirty or defective Q101, or defective Q102. Defective chopper	Measure waveform at TP2. Figure 4-9 waveform shown is normal. Additional noise at TP2 is due to dirty Q101 or defective Q102. Remove Q111 and Q112, and apply an input of 1 mv. Observe waveform at TP1. For waveform shown in Figure 4-9: (a) Excessive noise can be caused by poor positioning of neon lamps. (b) Smaller waveform can be caused by slow response of photocells; if so, replace cells.
Unguarded leakage poor.	Dirty grommets. Leakage in T202 or T203.	Clean according to paragraph 4-15. Test and replace if necessary.
Guarded leakage poor	Leakage in T202 or T203, or pins touching circuit board. Contaminated binding posts.	Test and repair as necessary. Clean according to paragraph 4-15.
Poor overload recovery.	Defective C101, C102, C103, C120, CR101, CR102, or R110.	Test and replace as necessary.

Figure 4-3. TROUBLESHOOTING CHART (Sheet 3 of 3)

4-13. VISUAL INSPECTION

4-14. Troubles may sometimes be located by a thorough visual inspection. This may be accomplished by looking for the following symptoms:

a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in paragraph 4-15.

b. Scorched or burned parts. Damage of this type is usually caused by other defective components. Determine the cause of damage before replacing components.

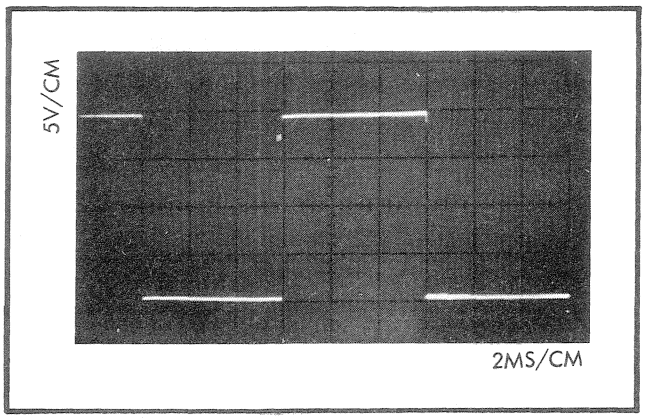


Figure 4-4. WAVEFORM AT TP10

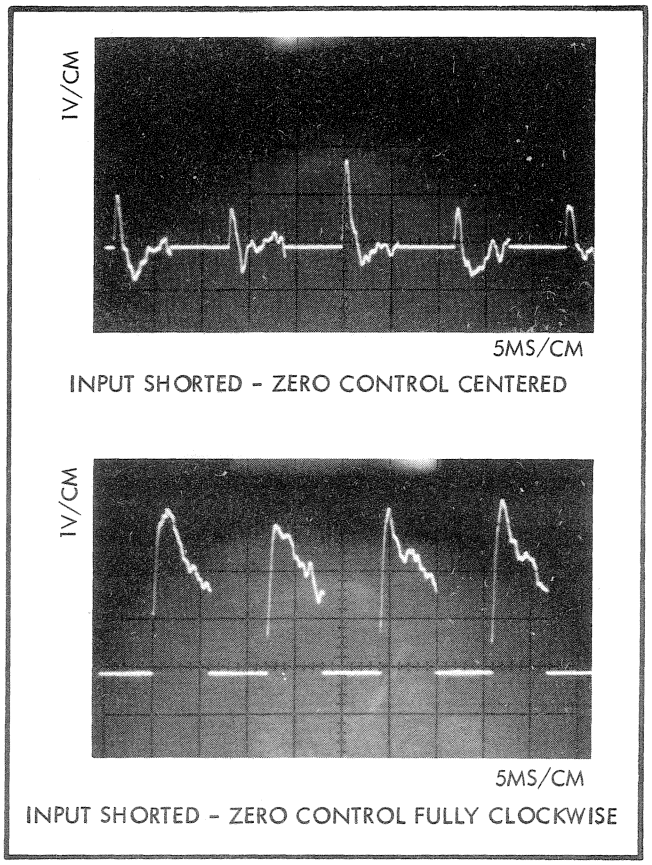


Figure 4-5. WAVEFORMS AT TP6

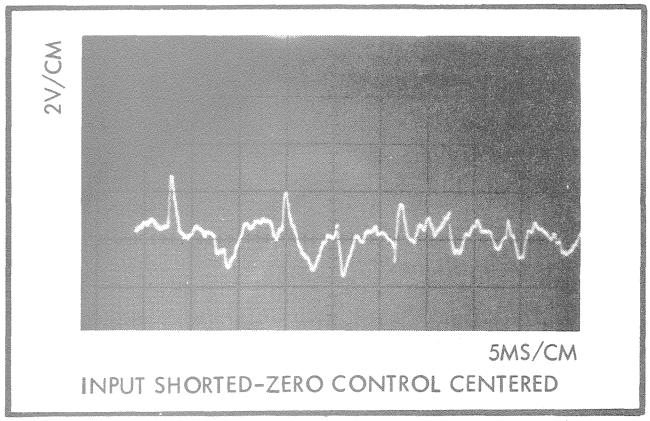


Figure 4-6. WAVEFORM AT TP7

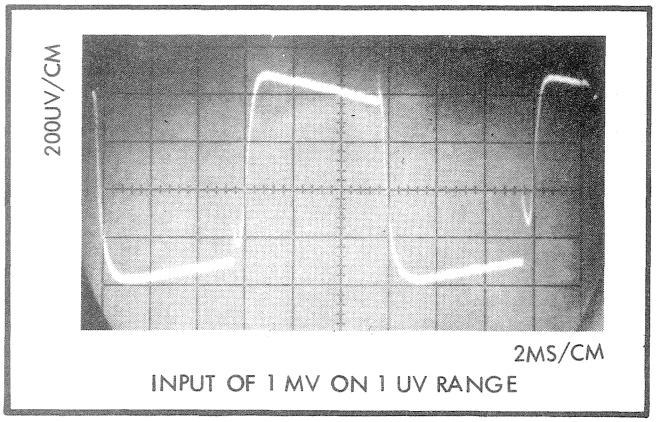


Figure 4-9. WAVEFORM AT TP1

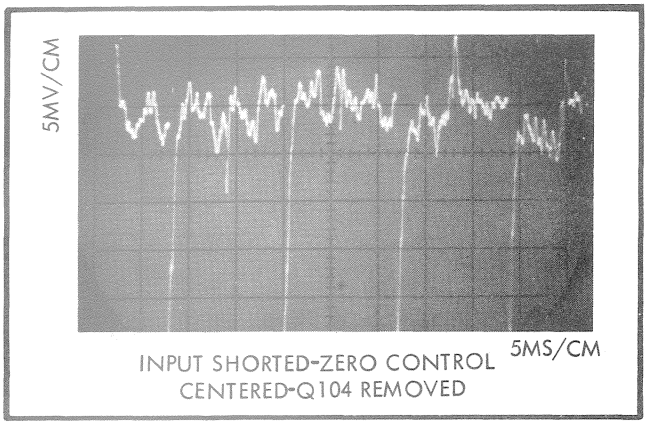


Figure 4-7. WAVEFORM AT TP2 - Q104 REMOVED

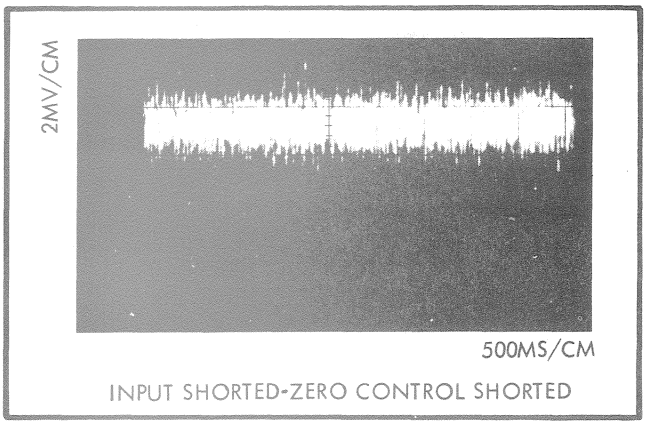


Figure 4-8. WAVEFORM AT TP2

c. Cracks, cuts, and other damage to the polyethelene grommets or to the circuit boards.

CAUTION!

Do not touch the polyethelene grommets. Contamination will cause excessive electrical leakage.

4-15. PERIODIC MAINTENANCE

4-16. Periodic maintenance consists of occasional cleaning to remove dust, grease, and other contaminations.

4-17. To clean the instrument proceed as follows:

a. Remove accumulations of dust and other foreign matter with low-pressure, clean dry air.

b. Clean binding posts and front panel with denatured alcohol, and if necessary, a clean cloth or cotton swab. Do not attempt to clean switches.

4-18. LEAKAGE RESISTANCE TEST

4-19. The following leakage test is to be used to check the leakage resistance of the Model 845. Failure of the instrument to meet the test indicates the need of cleaning or troubleshooting.

a. Connect the equipment as illustrated in Figure 4-10.

b. Place the Model 845 controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	300 MICROVOLTS

c. For a leakage resistance of 10^{12} ohms, the panel meter must not indicate more than 100 microvolts. Allow sufficient time for the meter deflection to stabilize.

4-20. CALIBRATION PROCEDURES

4-21. The Model 845 should be calibrated once every year. It is recommended that if component replacement is performed, the Model 845 should be re-calibrated. Test and alignment points are illustrated by Figure 4-11.

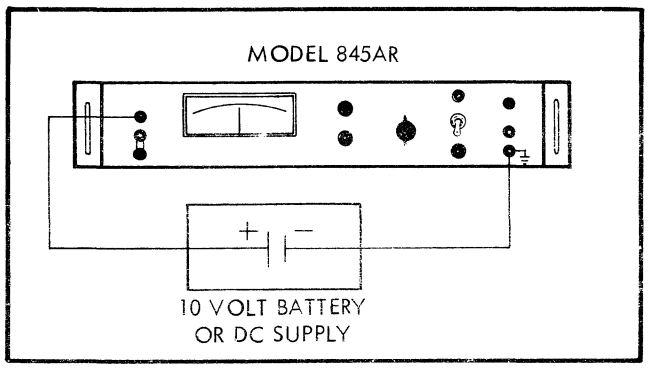


Figure 4-10. LEAKAGE RESISTANCE TEST EQUIPMENT CONNECTIONS

4-22. METER CALIBRATION

4-23. Connect the equipment as illustrated in Figure 4-12 and proceed as follows:

Note!

Allow equipment to warm up for at least 5 minutes.

a. Place the Model 845 controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	10 VOLTS

b. Adjust the Model 332 output for 10 volts dc.

c. Adjust R151 for a full-scale deflection (+10) on the Model 845 meter.

4-24. CHOPPER FREQUENCY

4-25. To adjust the 84 Hz multivibrator frequency, proceed as follows:

a. Place the Model 845 POWER switch to ON.

b. Connect an oscilloscope between TP10 and ground.

c. Adjust R206 until the oscilloscope waveform has a time period of 12 milliseconds, as illustrated in Figure 4-5.

Note!

A frequency counter may be used in lieu of the oscilloscope for adjustment of the 84 Hz multivibrator frequency.

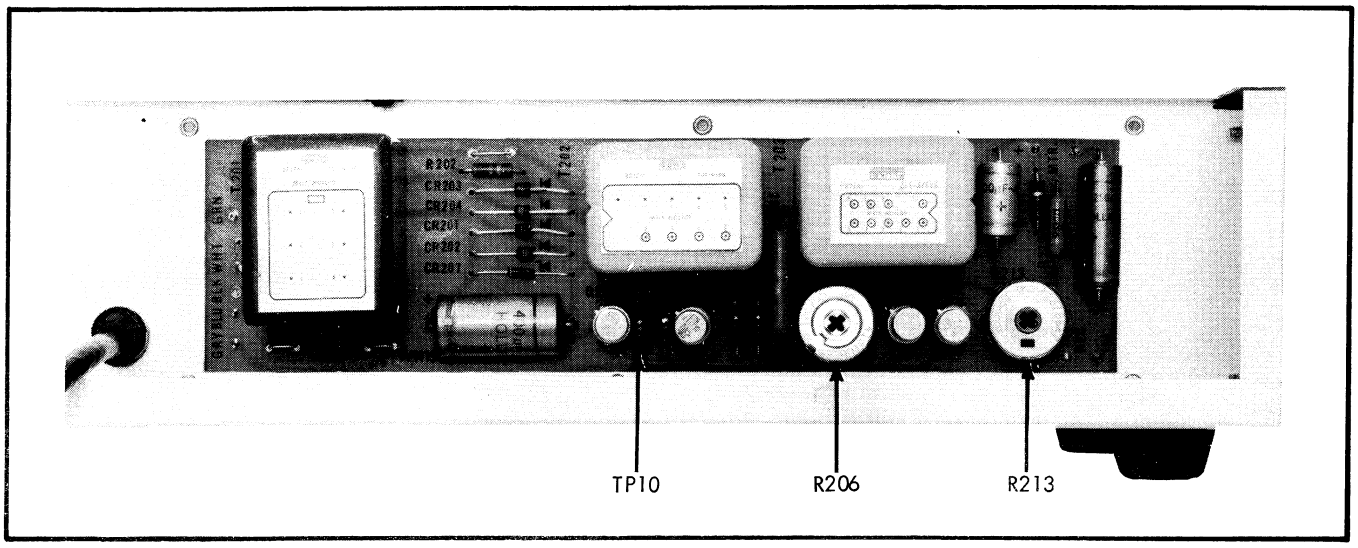


Figure 4-11. TEST AND ALIGNMENT POINTS

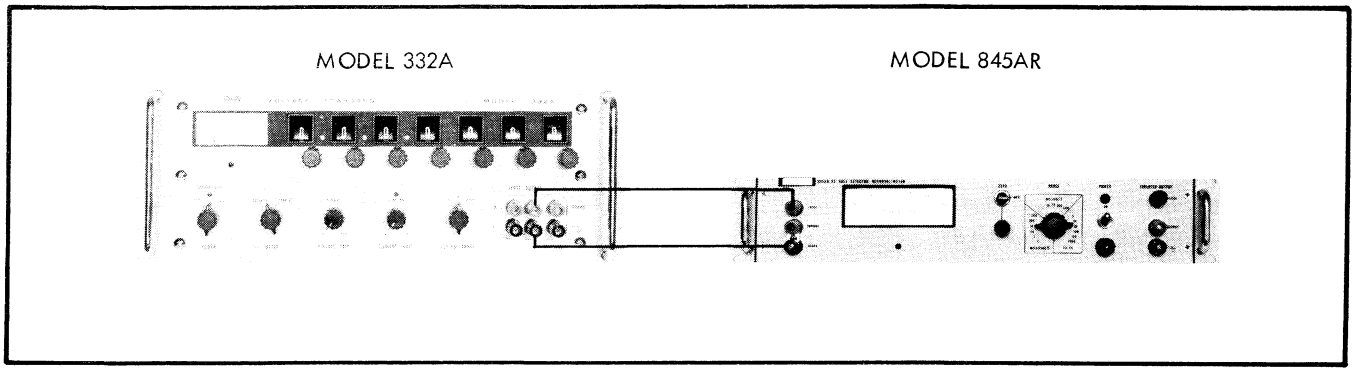


Figure 4-12. CALIBRATION EQUIPMENT CONNECTIONS

SECTION V

LIST OF REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section contains complete descriptions of those parts one might normally expect to replace during the life of the instrument. The first listing is a breakdown of all of the major assemblies in the instrument. Subsequent listings itemize the components in each assembly. Every listing where possible, is accompanied by an illustration identifying each component in the listing. Assemblies and subassemblies are identified by a reference designation beginning with the letter A, (e.g., A1, A2, A3, etc.). Components are identified by the schematic diagram reference designation (e.g. R1, C107, DS1). Flagnotes are used throughout the parts list and refer to ordering explanations. The flagnote explanations are located at the end of the parts list section in which they appear.

5-3. COLUMNAR INFORMATION

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations for the components of the subassembly may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the item description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, see paragraph 5-7.

c. The ten-digit part number by which the item is identified at the John Fluke Mfg. Co. is listed in the STOCK NO column. Use this number when ordering parts from the factory or authorized representatives.

d. The Federal Supply Code for the item manufacturer is listed in the MFR column. An abbreviated list of Federal Supply Codes is included in the Appendix.

e. The part number which uniquely identifies the item to the original manufacturer is listed in the MFR PART NO column. If a component must be ordered by description, the type number is listed.

f. The TOT QTY column lists the total quantity of the item used in the instrument. Second and subsequent listing of the same item are referenced to the first listing with the abbreviation REF. In the case of optional subassemblies, plug ins, etc. that are not always part of the instrument, the TOT QTY column lists the total quantity of the item in that particular assembly.

g. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of every part in the instrument be stocked.

h. The USE CODE column identifies certain parts which have been added, deleted or modified throughout the life of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Number Effectivity List at the end of the parts list. As Use Codes are added to the list, the TOT QTY column listings are changed to reflect the most current information. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part. In this event a parenthetical note is added in the DESCRIPTION column.

5-4. HOW TO OBTAIN PARTS

5-5. Standard components have been used wherever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co. factory or authorized representative by using the Fluke stock number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 4805-177105, Transistors, 2N3565, Q107-108 for 845AR, s/n 168.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part showing its location to other parts of the instrument is usually most helpful.

5-7. LIST OF ABBREVIATIONS

ac	alternating current
Al	Aluminum
amp	ampere
assy	assembly
cap	capacitor
car flm	carbon film
C	centigrade
cer	ceramic
comp	composition
conn	connector
db	decibel
dc	direct current
dpdt	double-pole, double-throw
dpst	double-pole, single-throw
elect	electrolytic
F	fahrenheit
Ge	germanium
gmv	guaranteed minimum value
h	henry
Hz	hertz
hf	high frequency
IC	integrated circuit
if	intermediate frequency
k	kilohm
kHz	kilohertz
kv	kilovolt
lf	low frequency
MHz	megahertz
M	megohm
met flm	metal film
ua	microampere
uf	microfarad
uh	microhenry
usec	microsecond
uv	microvolt
ma	milliampere
mh	millihenry
m	millohms
msec	millisecond
mv	millivolt
mw	milliwatt
na	nanoampere
nsec	nanosecond
nv	nanovolt
Ω	ohm
ppm	parts per million
piv	peak inverse voltage
p-p	peak to peak
pf	picofarad
plstc	plastic
p	pole
pos	position
P/C	printed circuit
rf	radio frequency
rfi	radio frequency interference
res	resistor
rms	root mean square
rtry	rotary
sec	second
sect	section
S/N	serial number
Si	silicon
scr	silcon controlled rectifier
spdt	single-pole, double-throw
spst	single-pole, single-throw
sw	switch
Ta	tantalum
tstr	transistor
tvm	transistor voltmeter
uhf	ultrahigh frequency
vtvm	vacuum tube voltmeter
var	variable
vhf	very high frequency
vlf	very low frequency
v	volt
va	voltampere
vac	volts, alternating current
vdc	volts, direct current
w	watt
ww	wire wound

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
	FINAL ASSEMBLY - Figure 5-1	845AR					
A1	Chassis Assembly (See Figure 5-2)						
A2	Front Panel Assembly (See Figure 5-3)						
A3	Amplifier P/C Assembly (See Figure 5-4)	1702-198028 (845AR-401)	89536	1702-198028	1		
A4	Power Supply P/C Assembly (See Figure 5-5)	1702-198036 (845AR-402)	89536	1702-198036	1		

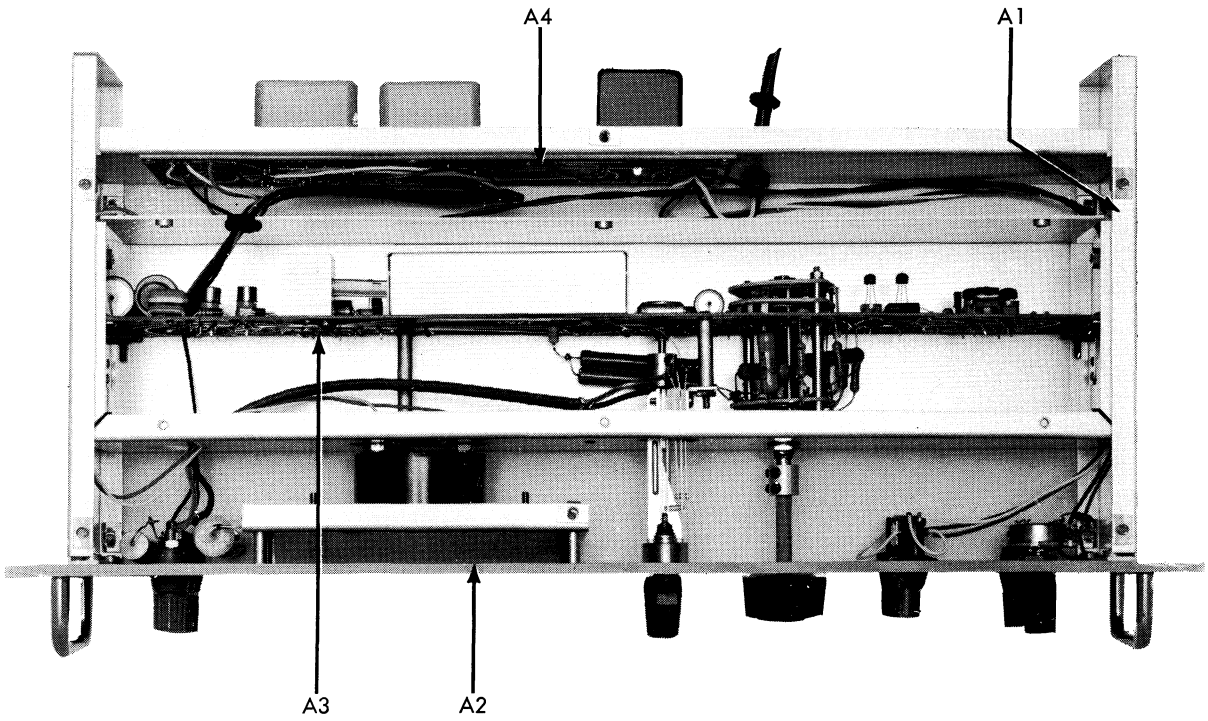


Figure 5-1. FINAL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A1	**CHASSIS ASSEMBLY - Figure 5-2**						
1	Coupler	2402-170506	80583	FC-46-S	1		
2	Coupler, 1/8" to 1/4" (not illustrated)	2402-193557	89536	2402-193557	1		
3	Cover, bottom (not illustrated)	3156-197533	89536	3156-197533	1		
4	Cover, top	3156-197525	89536	3156-197525	1		
5	Foot, rubber	2819-103309	77967	9102-W	4		
6	Line cord with plug	6005-102822	91934	019-3	1		
7	Shaft, range switch	3206-200998	89536	3206-200998	1		
8	Shaft, zero	3200-201012	89536	3200-201012	1		
9	Strain relief, 1/4"	2502-101162	28520	SR-5P-1	1		

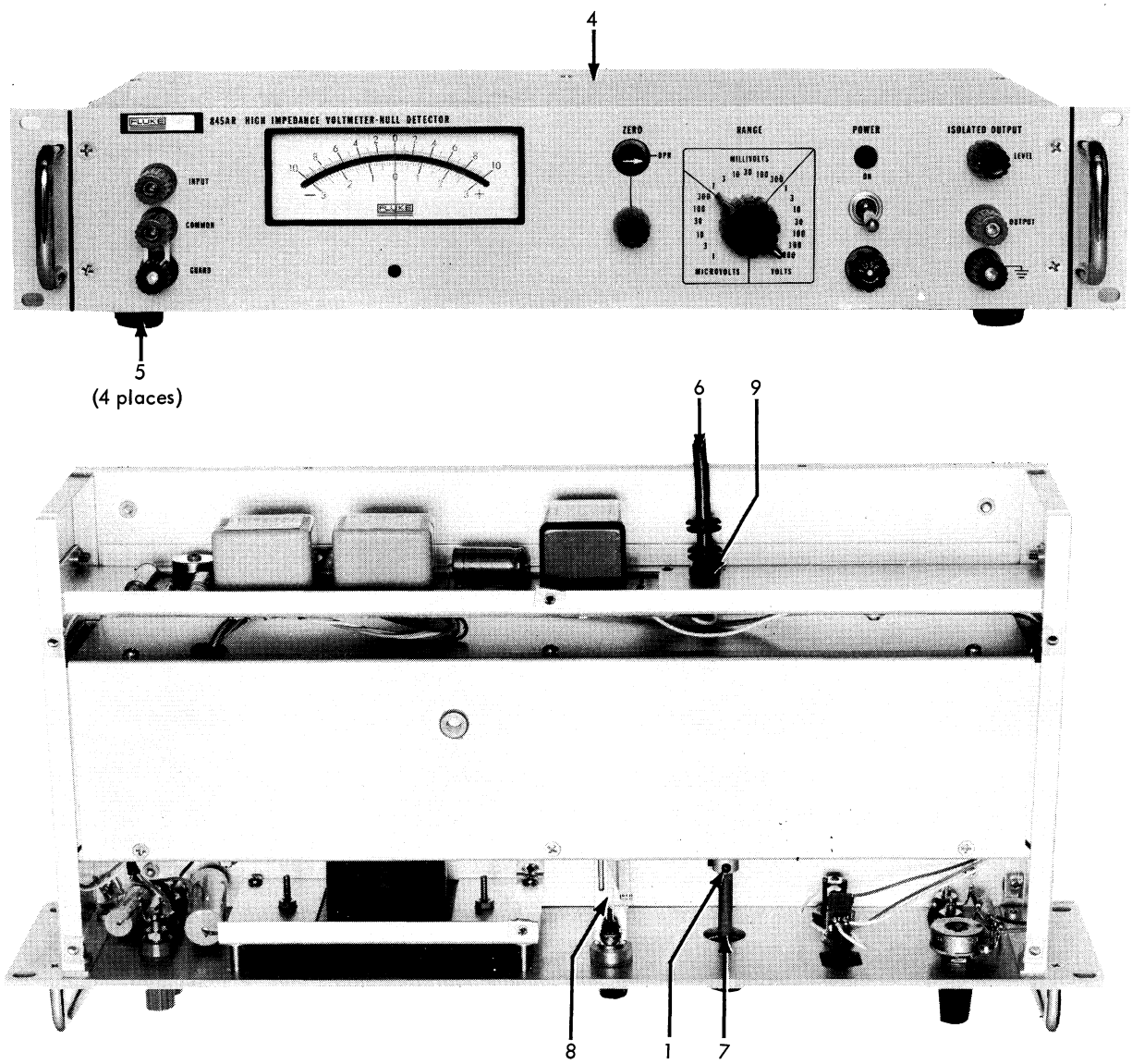


Figure 5-2. CHASSIS ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A2	**FRONT PANEL ASSEMBLY-Figure 5-3**						
C1,C2	Cap, mylar, 0.047 uf ±20%, 1200v	1507-182683	72928	343-087M	2		
C3	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	3	1	
DS1	Indicator, Neon 115v	3903-193524	08717	858-R-A/C-68K	1	1	
F1	Fuse, Type MDL, slow-blow, 1/16 amp, 250v (for 115v operation) (not illustrated)	5101-163030	71400	Type MDL	1	5	
F1	Fuse, Type MDL, slow-blow, 1/32 amp, 250v (for 230v operation) (not illustrated)	5101-163022	71400	Type MDL	1	5	
J1, J2	Binding post, red, INPUT & COMMON	2811-149856	58474	BHB-10208-G22	2		
J3	Binding post, black, GUARD	2811-142984	58474	DF31BC	2		
J4	Binding post, red, RECORDER OUTPUT	2811-142976	58474	DF31RC	1		
J5	Binding post, black, RECORDER	2811-142984	58474	DF31BC	REF		
M1	Meter, 100-0-100 ua, 750Ω	2901-192302	55026	524	1		
R1	Res, var, 10k ±30%, 1/3w	4701-192344	71450	WF-45	1		
R2	Res, comp, 4.7k ±10%, 1/2w	4704-108381	01121	EB4721	1		
S1	Switch, toggle, spst, POWER	5106-114850	04009	20994-LH	1		
XF1	Holder, Fuse	2102-160846	75915	342004	1		
10	Handle	2404-100412	05704	825	2		
11	Knob, RANGE	2405-170035	89536	2405-170035	1		
12	Knob, ZERO, LEVEL	2405-158949	89536	2405-158949	2		
13	Panel, front	1406-197475	89536	1406-197475	1		
14	Shorting link	2811-190728	24655	938LG	1		

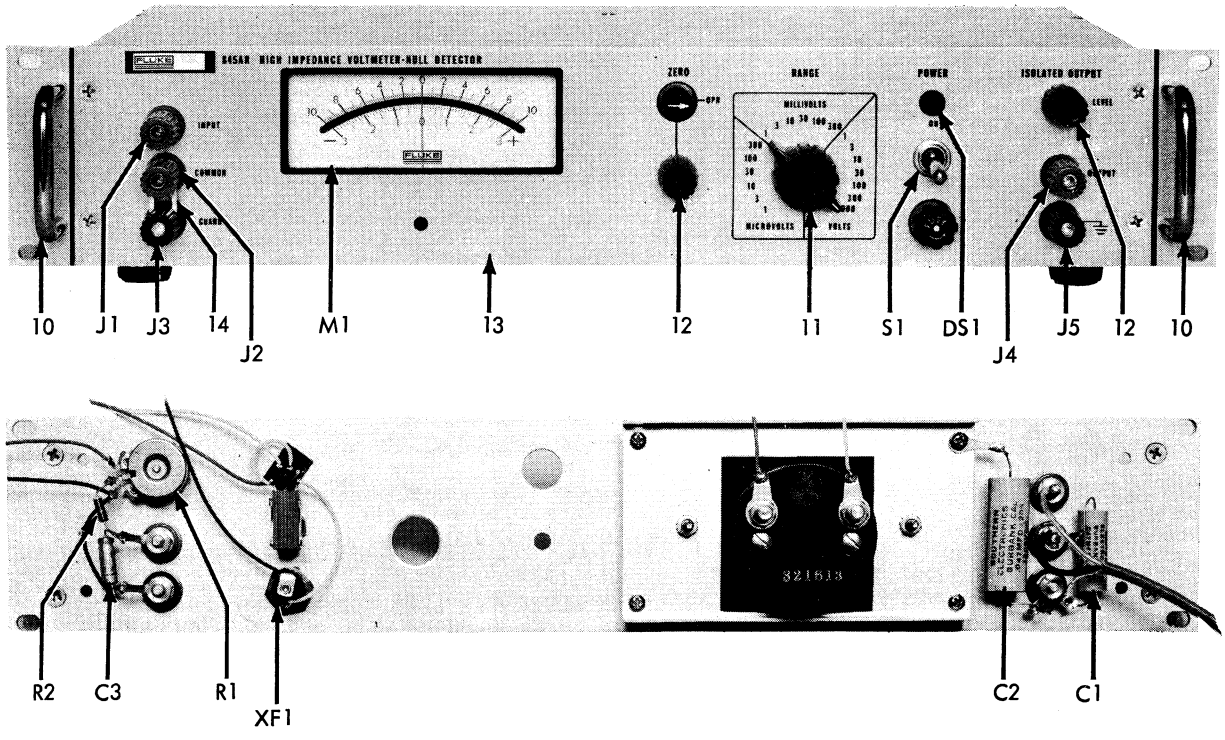


Figure 5-3. FRONT PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A3	**AMPLIFIER P/C ASSEMBLY - Figure 5-4**	1702-198028 (845AR-401)	89536	1702-198028	REF		
C101 thru C103	Cap, poly, 0.47 uf ±20%, 120v	1507-190553	84411	JF-36	3		
C104	Cap, mylar, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	3		
C105	Cap, cer, 300 pf ±10%, 500v	1501-105734	71590	BB60301KW7W	2		
C106	Cap, elect, 1250 uf +50/-10%, 4v	1502-166330	73445	C437ARB1250	1	1	
C107	Cap, elect, 250 uf +50/-10%, 16v	1502-187765	73445	C434ARE250	2	1	
C108	Cap, cer, 300 pf ±10%, 500v	1501-105734	71590	BB60301KW7W	REF		
C109	Cap, mylar, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	REF		
C110	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF	1	
C111	Cap, mylar, 0.0047 uf ±20%, 200v	1507-106054	56289	192P47202	1		
C112	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C113	Cap, elect, 400 uf +50/-10%, 4v	1502-187773	73445	C426ARB400	2	1	
C114	Cap, Ta, 10 uf ±10%, 20v	1508-160259	05397	K10C20K	1		A
C114	Cap, Ta, 6.8uf ±10%, 35v	1508-182782	05397	K6R8C35K	1		B
C115	Cap, mylar, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	REF		
C116	Cap, Ta, 22 uf ±10%, 15v	1508-182816	05397	K22C15K	1		A
	Cap, Ta, 15uf±10%, 20v	1508-153056	05397	K15C20K	1		B
C117, C118	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	3	1	
C119	Cap, mylar, 0.22 uf ±20%, 250v	1507-194803	73445	C280AE/P220K	1		
CR101, CR102	Diode, Cont. Devices Type CD12599	4802-180554	07910	CD12599	2	1	
CR103	Diode, Type 1N961A	4803-113324	07910	Type 1N961A	2	1	
CR104 thru CR107	Diode, Inter. Rect. Type 4D4	4802-180240	81483	Type 4D4	8	2	
DS101, DS102	Light, Neon, NE2U (not illustrated)	3902-162602	89730	NE2U	2	5	
L1	Ferrite bead	2503-219535	02114	56-060-85-3B	1		B
Q101	Tstr, Selected ST-1750T	4805-194456	89536	4805-194456	1	1	
Q102	Tstr, Selected Type S19254	4805-168716	07263	S19254	1	1	
Q103	Tstr, Type 2N3391	4805-168708	09213	2N3391	1	1	
Q104, Q105	Tstr, Type 2N3565	4805-177105	07263	2N3565	4	1	
Q106	Tstr, T.I. Type GA3938	4805-182709	01295	GA3938	2	1	
Q107, Q108	Tstr, Type 2N3565	4805-177105	07263	2N3565	REF		
Q109, Q110	Tstr, Cont. Device Type CS-30011	4805-169375	07910	CS-30011	2	1	
Q111	Tstr, Type 2N1304	4805-117127	01295	2N1304	1	1	
Q112	Tstr, Type 2N1305	4805-190298	01295	2N1305	1	1	
Q113	Tstr, T.I. Type GA3938	4805-182709	01295	GA3938	REF		
Q114	Tstr, T.I. Type GA3937	4805-182691	01295	GA3937	3	1	
R101	Res, car flm, matched set	1					
R102	Res, car flm, 900k ±1/2%, 1/2w	4703-107391	19701	DC1/2A	1		
R103	Res, car flm, matched set	1					
R104	Res, car flm, ~~1~~ meg ~~±1/2%~~ ±1%, 1w	~~4703-107748~~ 177156	~~19701~~ 91637	~~DC1~~ MFF1100A1/1	1		
R105 thru R109	Res, car flm, matched set	1					
R110	Res, car flm, 300k ±1%, 2w	4703-107425	12400	Type C30	2		

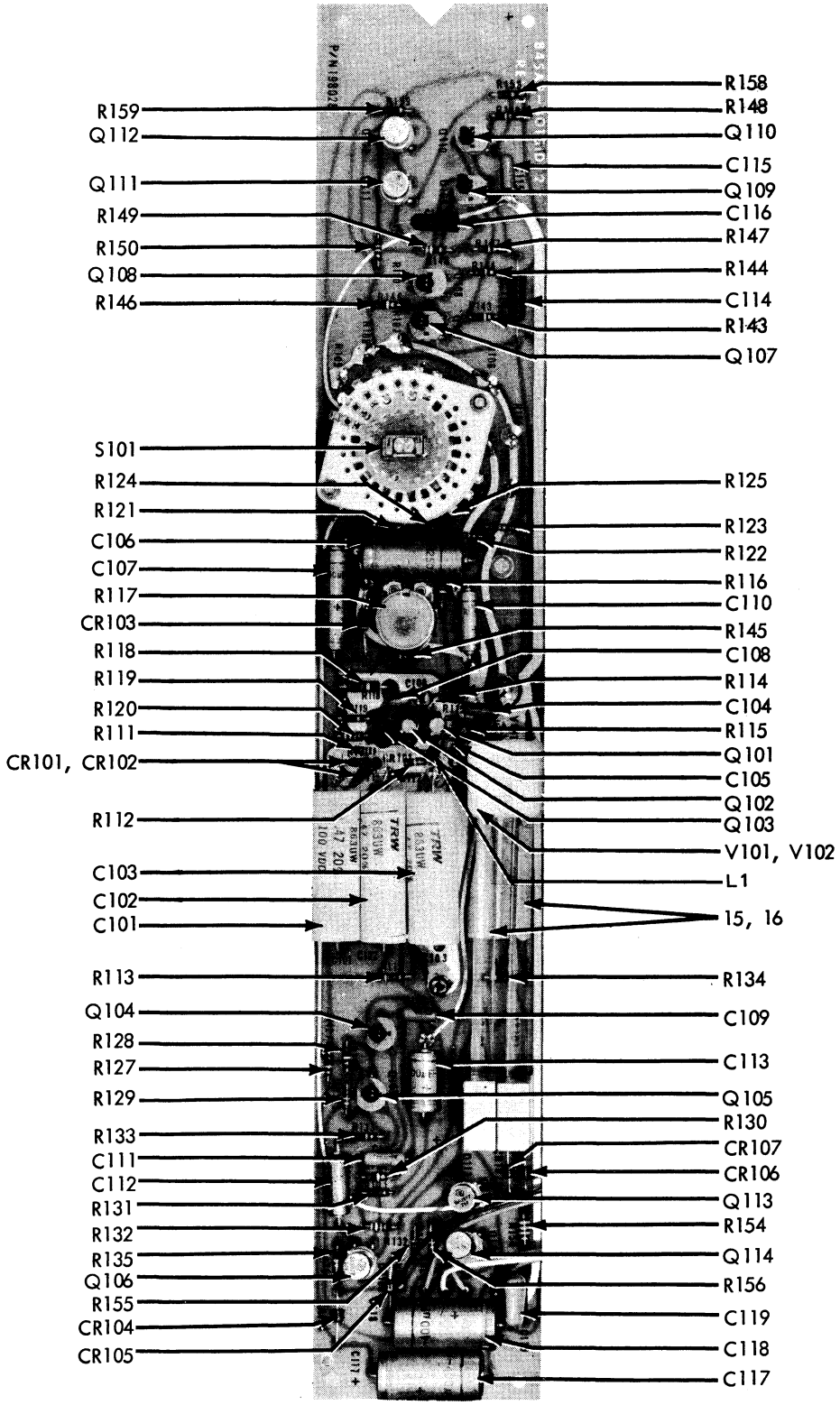
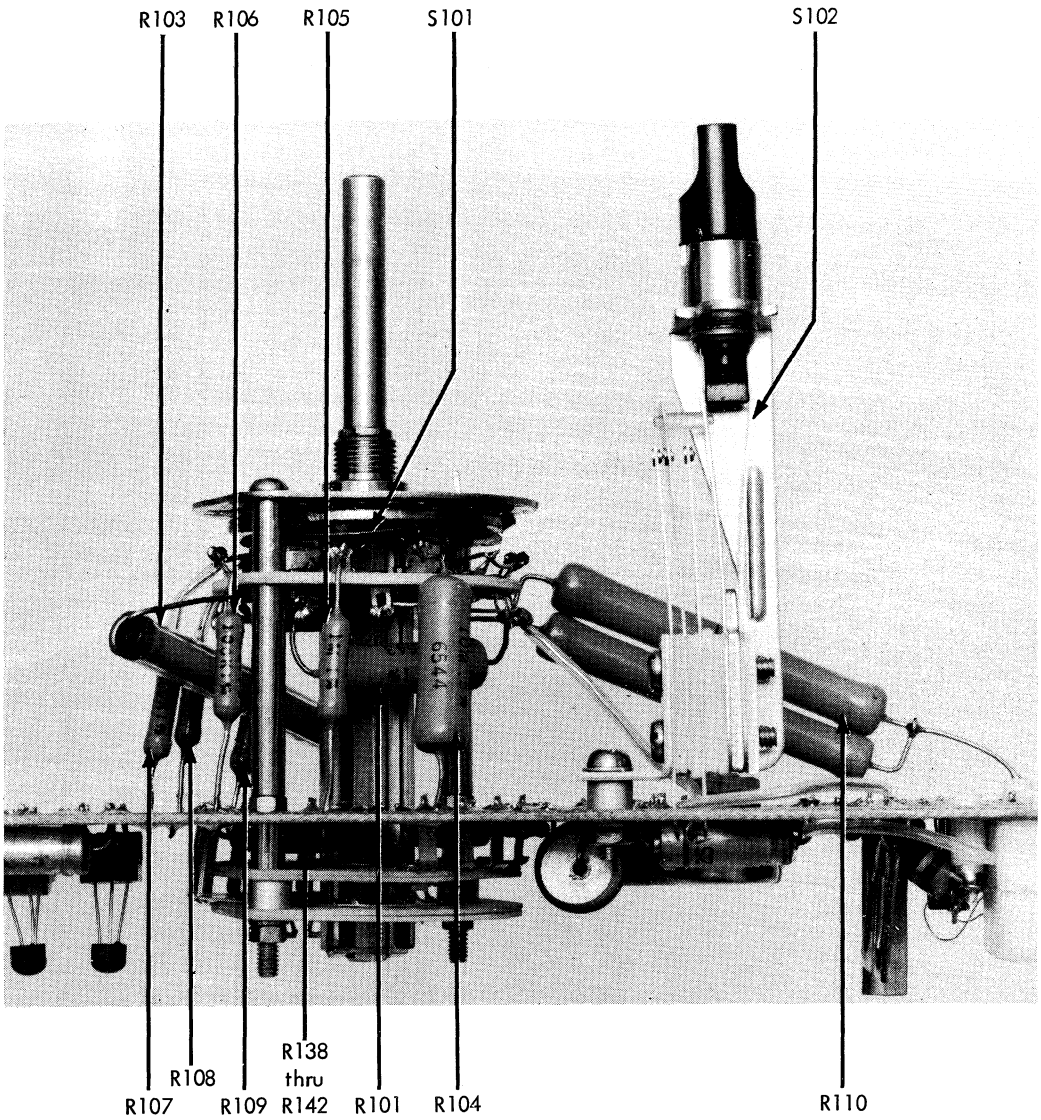


Figure 5-4. AMPLIFIER P/C ASSEMBLY (Sheet 1 of 2)



SIDE VIEW

Figure 5-4. AMPLIFIER P/C ASSEMBLY (Sheet 2 of 2)

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R111	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	2		
R112	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	4		
R113	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	1		
R114	Res, ww, 10Ω ±1%, 1/2w	4707-193946	89536	4707-193946	1		
R115	Res, comp, 1.2 meg ±10%, 1/2w	4704-108407	01121	EB1251	1		
R116	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	1		
R117	Res, var, 5 meg ±30%, 0.2w	4701-193086	71450	U-70	1		
R118	Res, comp, 10 meg ±10%, 1/2w	4704-108142	01121	EB1061	1		
R119	Res, comp, 2.2 meg ±5%, 1/4w	4704-198390	01121	CB2255	1		
R120	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R121	Res, comp, 10Ω ±5%, 1/4w (not illustrated)	4704-147868	01121	CB1005	1		
R122	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	2		
R123	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	1		
R124	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R125	Res, comp, 68Ω ±5%, 1/4w	4704-147918	01121	CB6805	1		
R126	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R127	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	2		
R128	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R129	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	5		
R130	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R131	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	1		
R132	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	1		
R133	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R134	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	2		
R135	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R136	Res, met flm, 1.07k ±1%, 1/2w (not illustrated)	4705-187930	12400	Type CEC-TO	1		
R137	Res, met flm, 3.16k ±1%, 1/2w (not illustrated)	4705-187781	12400	Type CEC-TO	1		
R138 thru R142	Res, met flm, matched set	2					
R143 thru R145	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	3		
R146	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R147	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R148	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R149	Res, comp, 3.9 meg ±5%, 1/4w	4704-188417	01121	CB3955	1		
R150	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	REF		
R154	Res, comp, 33k ±5%, 1/2w	4704-108761	01121	EB3331	1		
R155, R156	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R158, R159	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	2		
S101	Switch, rotary, RANGE	5105-194589	89536	5105-194589	1		
S102	Switch, twist, spdt, ZERO-OPERATE	5105-194936	89536	5105-194936	1		
V101, V102	Photo cell assembly	3700-194449	89536	3700-194449	1		
15, 16	Rod, optical	3800-168047	89536	3800-168047	2		

1 These resistors are factory matched. If any replacement is required, an entire set, part number 4710-227132, must be replaced.

2 These resistors are factory matched. If any replacement is required, an entire set, part number 4710-194423, must be replaced.

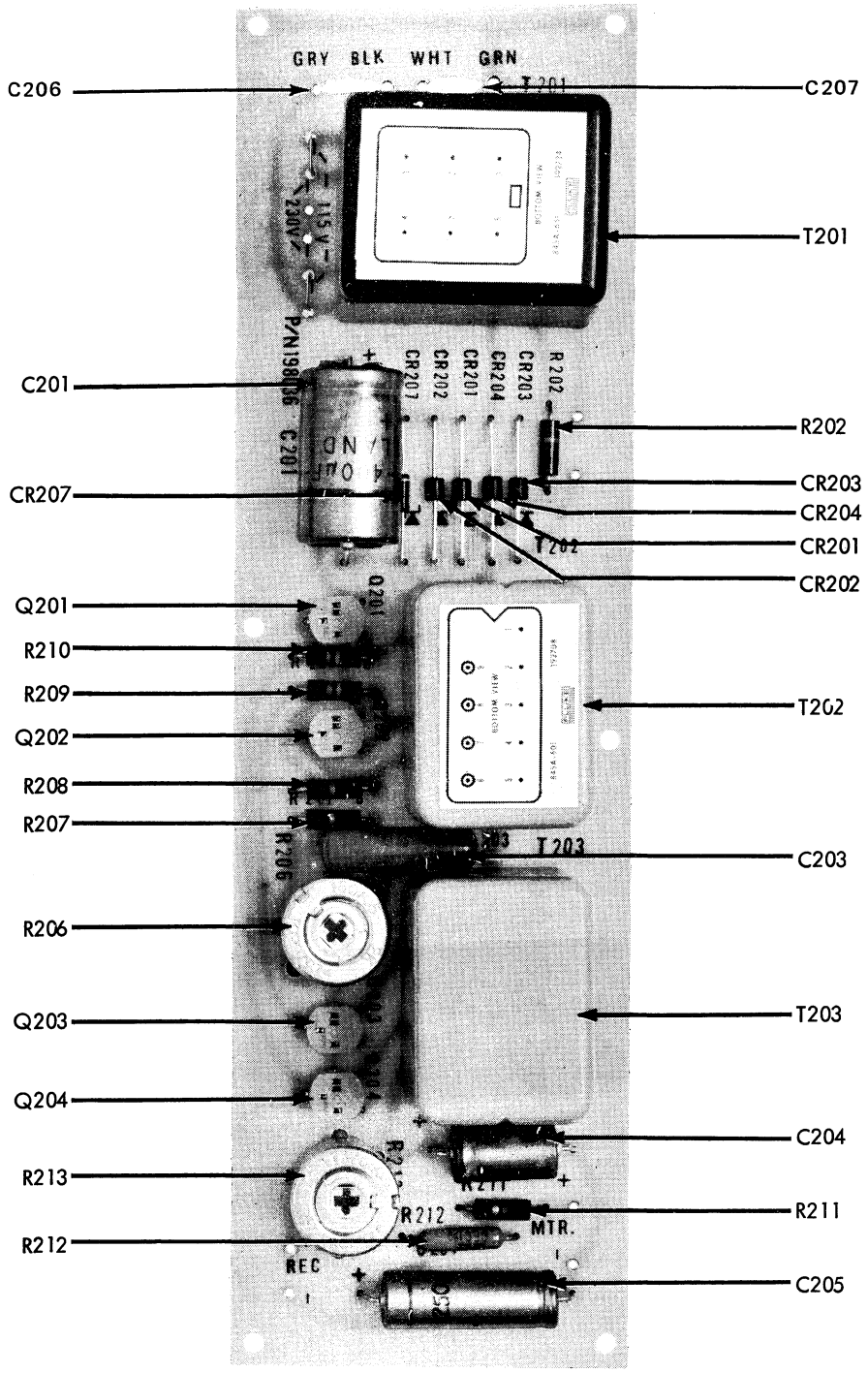


Figure 5-5. POWER SUPPLY P/C ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A4	**POWER SUPPLY P/C ASSEMBLY** **Figure 5-5**	1702-198036 (845AR-402)	89536	1702-198036	REF		
C201	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
C203	Cap, mylar, 1.0 uf ±20%, 250v	1507-190330	73445	C280AE/P1M	1		
C204	Cap, elect, 400 uf +50/-10%, 4v	1502-187773	73445	C426ARB400	REF		
C205	Cap, elect, 250 uf +50/-10%, 16v	1502-187765	73445	C437ARE250	REF		
C206, C207	Cap, mica, 0.001uf ±5%, 500v	1504-148387	14655	CD19F102J	2		B
CR201 thru CR204	Diode, Inter. Rect. Type 4D4	4802-180240	81483	4D4	REF		
CR207	Diode, Type 1N961A	4803-113324	07910	1N961A	1		
Q201, Q202	Tstr, T.I. Type GA2817	4805-182600	01295	GA2817	2	1	
Q203, Q204	Tstr, T.I. Type GA3937	4805-182691	01295	GA3937	REF		
R202	Res, comp, 150Ω ±5%, 1/2w	4704-186056	01121	EB1515	1		
R206	Res, var, ww, 2k ±5%, 1-1/4w	4702-160705	71450	Type 110	1		
R207, R208	Res, comp, 5.1k ±5%, 1/2w	4704-109108	01121	EB5125	2		
R209, R210	Res, comp, 22k ±10%, 1/2w	4704-108209	01121	EB2231	2		
R211	Res, comp, 1k ±10%, 1/2w	4704-108563	01121	EB1021	1		
R212	Res, met flm, 9.53k ±1%, 1/2w	4705-159442	12400	Type CEC-TO	1		
R213	Res, var, ww, 3k ±20%, 2w	4702-153429	71450	Type 115	1		
T201	Transformer, power	5600-192724	89536	5600-192724	1		
T202	Transformer, drive	5600-192708	89536	5600-192708	1		
T203	Transformer, isolation	5600-197400	89536	5600-197400	1		

5-8. SERIAL NUMBER EFFECTIVITY

5-9. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 845AR. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123. New codes will be added as required by instrument changes.

USE CODE	EFFECTIVITY
None	Model 845AR serial number 123 and on
A	Model 845AR serial number 123 thru 276 on.
B	Model 845AR serial number 277 and on.

Section 7
General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations
Federal Supply Codes for Manufacturers
Fluke Technical Service Centers — U.S. and Canada
Sales and Service Locations — International
Sales Representatives — U.S. and Canada

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers (Continued)

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

Federal Supply Codes for Manufacturers (Continued)

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

Federal Supply Codes for Manufacturers (Continued)

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

Federal Supply Codes for Manufacturers (Concluded)

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

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Allan Crawford Assoc. Ltd.
Fluke Technical Center
1330 Marie Victorin Blvd. E.
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B-1040 Brussels, Belgium
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Tel. 66121

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ZAC de BUC
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Lisbon 1, Portugal
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*Hispano Electronica S.A.
Poligono Industrial Urtinsa
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*Teleinstrument AB
P.O. Box 490
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SWITZERLAND
*Traco Electronic AG
Jenatschstrasse 1
8002 Zurich, Switzerland
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*Erkman Electronik Aletler
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Karakoy/Istanbul
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*Fluke International Corp.
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*R.D.T. Electronics
Engineering Ltd.
46, Sokolov Street
Ramat Hasharon 47235, Israel
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Trading & Agricultural
Development Co.
P.O. Box 567
Amman, Jordan
Tel. 23052

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P.O. Box Safat 20506
Kuwait, Arabian Gulf
Tel. 436100

LEBANON
Mabek
P.O. Box 11-3823
Beirut, Lebanon
Tel. 252631

MOROCCO
Mainvest
Residence Moulay Ismail
Bat.C Boulevard
Moulay Slimane, Rabat, Morocco
Tel. 276-64

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Marketing Est.
P.O. Box 3750
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Tel. 32700

SYRIA
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C/O Messers G. Ghazzi
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Change/Errata Information

Issue No: 2 2/79

This change/errata contains information necessary to ensure the accuracy of the following manual. Enter the corrections in the manual if either one of the following conditions exist:

1. The instrument's PCB revision letter is lower than that which is indicated at the beginning of the change/errata.

2. No revision letter is indicated at the beginning of the change/errata.

MANUAL

Title: 845AR HIGH IMPEDANCE VOLTMETER–NULL DETECTOR

Print Date: APRIL 1968

Rev and Date:

C/E PAGE EFFECTIVITY

Page No.	Print Date
1	2/79
2	2/79

CHANGE #1–6282

On page 1-1, make the following changes:

Paragraph 1-2:

FROM: below, the input impedance is an excellent 10 megohms.
TO: below, the input impedance is an excellent 1 megohm,

Paragraph 1-4:

FROM: 100 megohms on 300 millivolt range and above; 10 megohms on 100 millivolt range and below.
TO: 100 Megohms on the 300 millivolt range and above 10 Megohms on the 3 millivolt through the 100 millivolt range. 1 Megohm on the 1 millivolt range and below.

On page 2-4, make the following changes:

Paragraph 2-32:

Change all 10 Megohm references to 1 Megohm.

On page 5-6, make the following changes:

FROM: R104/C3-M2/Res, car, flm, 10M ± ½%, 1W/4703-107748/DC1/1
TO: R104/C3-M2/Res, met flm, 1M ±1%, 1W/177188/91637/MFF11004F/1

On the Functional Schematic make the following changes:

FROM: R104, 10M
TO: R104, 1M

CHANGE #2–9296

On page 5-5, make the following changes:

FROM: 12/Knob ZERO, LEVEL/2405-158949/89536/2405-158949/2
TO: 12/Knob, ZERO LEVEL/ 341396/89536/341396/2

FROM: 11/Knob, RANGE/2405-170035/89536/2405-170035/1
TO: 11/Knob, RANGE/434183/89536/434183/1

CHANGE #3–10330

On page 5-11, make the following changes:

FROM: C203/Cap, mylar, 1.0 μF ±20%, 250V/1507-190330/73445/C280AE-P1M/1
TO: C203/Cap, mylar, 1.0 μF ±20%, 200V/106450/84411/X663UW-10502/1

CHANGE #4–10873

On page 5-11, make the following changes:

FROM: R206/Res, var, ww, 2k ±5%, 1¼W/4702-160705/71450/Type 110/1
TO: R206/Res, var, ww, 3k ±5%, 1¼W/112458/89536/112458/1

ERRATA #1

On page 4-6, make the following changes:

Paragraph 4-12, step c:

FROM: Adjust R151 for a full-scale deflection (+10) on the . . .
TO: Adjust R213 for a full-scale deflection (+10) on the . . .

On the Functional Schematic make the following changes:

FROM: R211 TO: R213
FROM: R213 TO: R211

CHANGE #5–11551

On page 5-6, make the following changes:

FROM: Q106/Tstr, T.I. Type GA3938/4805-182709/01295/GA3938/2/1
TO: Q106/Tstr, T.I. /321398/89536/321398/2/1

FROM: Q111/Tstr, Type 2N1304/4805-117127/01295/2N1304/1/1
TO: Q111/Tstr/218081/01295/MPS6520/1/1

FROM: Q112/Tstr, Type 2N1305/4805-190298/01295/2N1305/1/1
TO: Q112/Tstr/229898/95303/MPS6522/1/1

FROM: Q113/Tstr, T.I. Type GA3938/4805-182709/01295/GA3938/Ref
TO: Q113/Tstr, T.I./454843/89536/454843/1

FROM: Q114/Tstr, T.I. Type GA3937/4805-182691/01295/GA3937/3/1
TO: Q114/Tstr, T.I./321398/89536/321398/3/1

FROM: A3/Amplifier P/C Assembly/1702-198028/89536/1702-198028/Ref
TO: A3/Amplifier P/C Assembly/359828/89536/359828/Ref

On page 5-11, make the following changes:

FROM: Q202/Tstr, T.I. Type GA2817/4805-182600/01295/GA2817/2/1
TO: Q202/Tstr, T.I. Selected/380394/89536/380394/1

FROM: Q203/Tstr, T.I. Type GA3937/4805-182691/01295/GA3937/Ref
TO: Q203/Tstr, Si/454843/89536/454843/1

FROM: Q204/Tstr, T.I. Type GA3937/4805-182691/01295/GA3937/Ref
TO: Q204/Tstr, Si /454843/89536/454843/Ref

ERRATA #2

On page 3-2, change all reference of: "The amplified dc signal . . ." TO: "The amplified ac signal . . ."

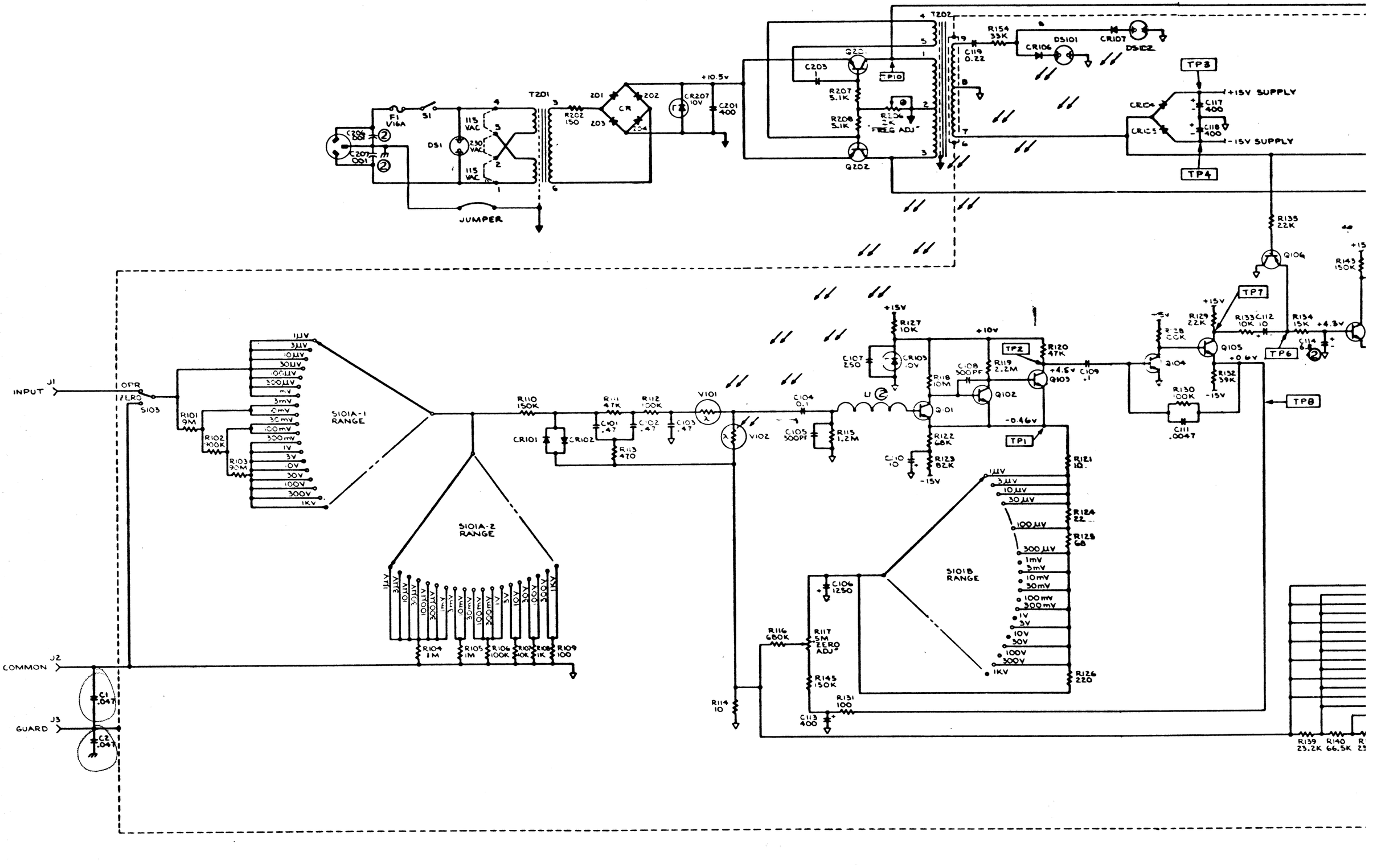
CHANGE #6–11750

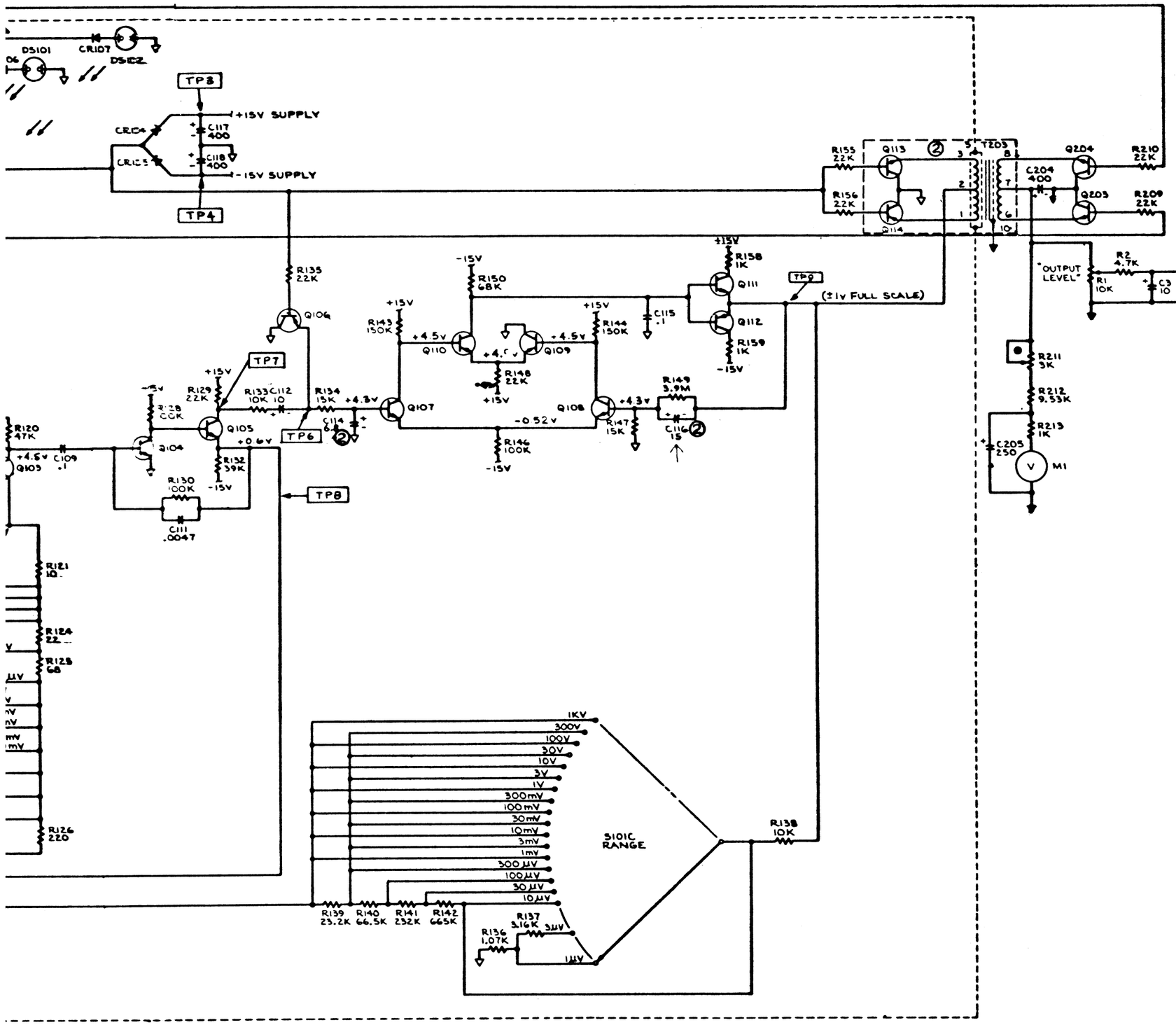
On page 5-6, make the following changes:

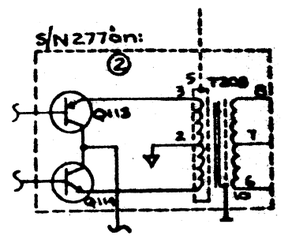
ADD: CR108/Diode, multi-pellet /375477/09214/MPD200/1

On the Functional Schematic make the following changes:

ADD: CR108 () between R150 and the collector of Q110.


INPUT J1
COMMON J2
GUARD J3
OPR/ZERO
S103
R101 9M
R102 900K
R103 90M
1µV
3µV
10µV
30µV
100µV
300µV
1mV
3mV
10mV
30mV
100mV
300mV
1V
3V
10V
30V
100V
300V
1KV
S101A-1 RANGE
S101A-2 RANGE
R104 1M
R105 1M
R106 100K
R107 40K
R108 1K
R109 100
C1 .047
C2 .047
R110 150K
R111 47K
R112 100K
C101 .47
C102 .47
C103 .47
R113 470
CR101
CR102
V101
V102
C104 0.1
C105 500PF
R115 1.2M
R114 10
C106 1250
R116 680K
R117 5MA ZERO ADJ
R145 150K
R131 100
C113 400
S101B RANGE
R121 10
R124 22
R125 68
R126 220
+15V
R127 10K
CR103 10V
C107 250
U1
+10V
R118 10M
C108 500PF
Q101
R119 2.2M
TP2
R120 47K
+4.5V
Q103
C109 .1
Q102
-0.46V
TP1
R122 68K
R123 82K
-15V
C110 10
R129 22K
R133 10K
C112 10
R134 15K
+4.8V
C114 6
TP7
TP6
Q105
+0.6V
R128 CCK
Q104
R130 100K
C111 .0047
R132 39K
TP8
R135 22K
Q106
R143 150K
+15
R139 23.2K
R140 66.5K
T202
R154 33K
DS101
CR106
CR107
DS102
C119 0.22
C205
Q201
TP10
R207 5.1K
R208 5.1K
R206 2K FREQ ADJ
Q202
TP3
+15V SUPPLY
CR104
CR105
C117 400
C118 400
-15V SUPPLY
TP4
T201
F1 V16A
S1
C206 .001
C207 .001
115 VAC
DS1
230 VAC
115 VAC
JUMPER
R202 150
CR
Z01
Z02
Z03
Z04
CR207 10V
+10.5V
C201 400





REFERENCE DESIGNATIONS:

C1-3, 101-119, 201, 203-207
CR101-107, 201-204, 207
DS1, 101, 102
F1
J1-5
M1
P1
Q101-114, 201-204
R1-2, 101-150, 154-158, 158, 159, 202, 206-218
S1, 101, 102
T201-203
V101-102

NOTES:

ALL FLAG NOTES WITH THE SAME NUMBER ARE CONNECTED

INDICATES NULL DETECTOR COMMON

INDICATES POWER SUPPLY COMMON

INDICATES CHASSIS GROUND

INDICATES INTERNAL ADJUSTMENT

UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE IN MICROFARADS.

CHANGES:

① FOR SER. NOS. 123 THRU 433:
PREVIOUS TITLE WAS "NULL DETECTOR/ MICROVOLTMETER"

② FOR SER NOS 123 THRU 126:
C206, C207 NOT INSTALLED
C114 WAS 10 uf
C116 WAS 22uf
L1 NOT INSTALLED
Q113 WAS NPN
Q114 WAS PNP