**JOHN FLUKE MFG. CO., INC.**
P.O. Box 7428 Seattle, Washington 98133



# MODEL 845A & 845AB
## HIGH IMPEDANCE VOLTMETER
## NULL DETECTOR

845A serial no._____ and above.

# warranty

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. Notify the John Fluke Mfg. Co., Inc., 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 forewarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

**SHIPPING**

All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. 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**

The instrument should be thoroughly inspected immediately upon receipt. 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 fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc. will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P.O. BOX 7428, SEATTLE, WASHINGTON 98133.

# TABLE OF CONTENTS

# LIST OF ILLUSTRATIONS


MODEL 845AB HIGH IMPEDANCE VOLTMETER-NULL DETECTOR

# SECTION I

# INTRODUCTION AND SPECIFICATIONS

## 1-1. INTRODUCTION

1-2. The Fluke Model 845 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 10 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 consists of the line powered Model 845A, and the line-battery-powered Model 845AB. The instruments are half-rack in size, and are equipped with resilient feet and a tilt-up bail for field or bench use. A single instrument may be mounted in a standard 19 inch rack by means of metal handle rack adapter kit 881A-102. Two instruments may be mounted side-by-side in a standard 19 inch rack by means of metal handle rack adapter kit 881A-103.

## 1-4. ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE RANGE
1 microvolt to 1000 volt 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.

ACCURACY
±(2% end scale + 0.1 microvolt).

MAXIMUM METER NOISE (Input Shorted)

| RANGE | NOISE (peak-to-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 ac 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. Response time is approximately half that of the meter, therefore noise may exceed meter noise by 6 db.

STABILITY OF ZERO
Better than 0.15 microvolt/hour.
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
Model 845A
115/230 volts ac ±10%, 50 to 440 Hz, approximately 3 watts.
Model 845AB
Rechargeable battery or 115/230 volts ac ±10%, 50 to 440 Hz, approximately 6 watts during recharge (40 hours operation on full charge, batteries trickle-charged while instrument operates from line power).

## 1-5. ENVIRONMENTAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE
Within all specifications from 15°C to 35°C.
Within all specifications from 0°C to 50°C except:
Maximum noise and meter response time - derated by a factor of two.
DC Common Mode Rejection - derated by 20 db.

STORAGE TEMPERATURE RANGE
Model 845A -40°C to +70°C.
Model 845AB -40°C to +60°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
Resilient feet provide for bench and portable use. For side-by-side EIA rack mounting of two units, add Adapter Kit 881A-103 (includes handle-brackets and key plate). For EIA rack mounting of a single unit, add Adapter Kit 881A-102.

WEIGHT
Model 845A 9 pounds.
Model 845AB 10-1/4 pounds.

SIZE
8 inches high by 8-1/2 inches wide by 9 inches deep.

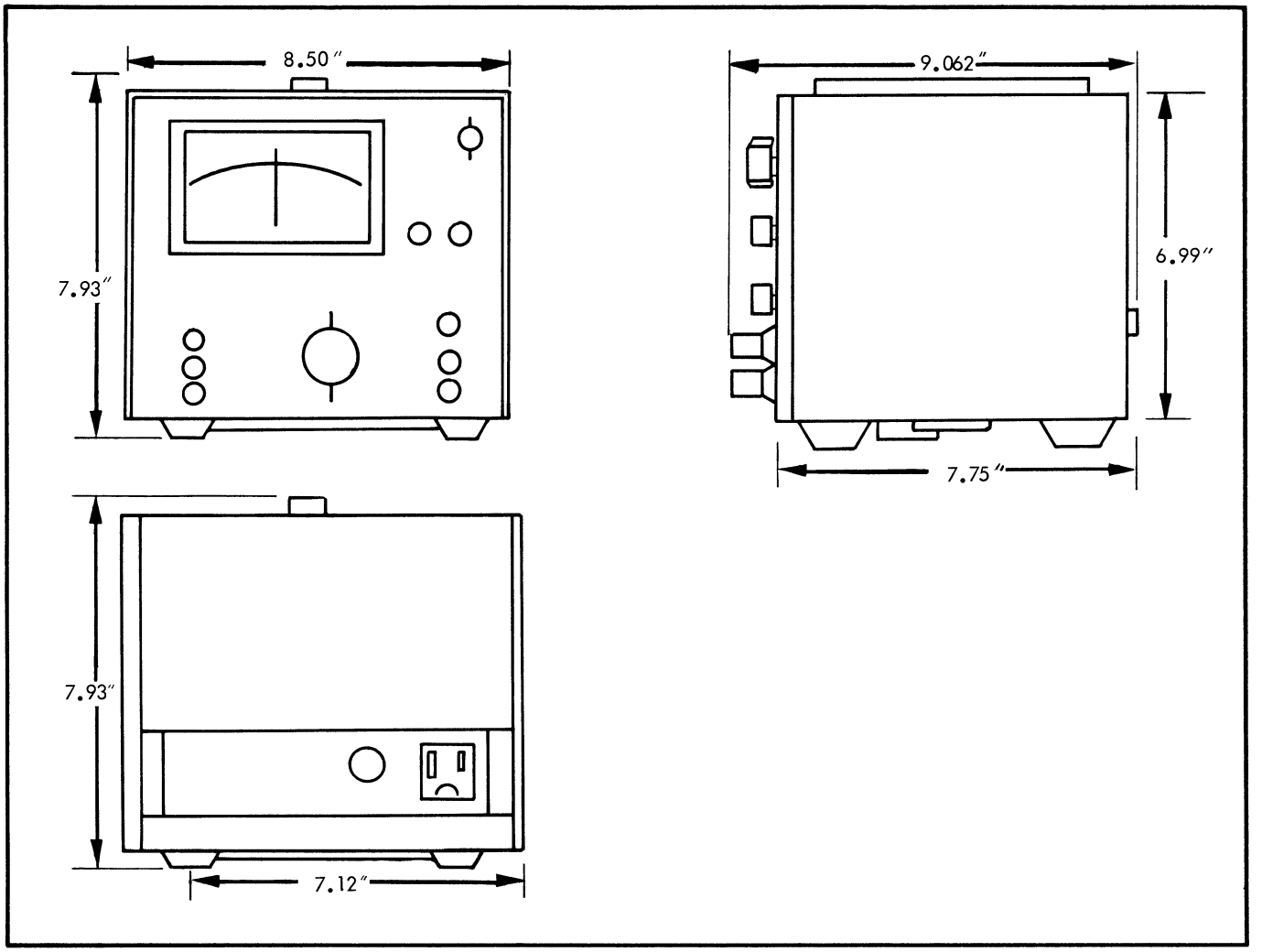


Figure 1-1. MODEL 845 OUTLINE DRAWING

# SECTION II

# OPERATING INSTRUCTIONS

## 2-1. INTRODUCTION

2-2. This section of the manual contains information necessary to operate the Model 845 High Impedance Voltmeter-Null Detector. Should any difficulties be encountered during operation of your instrument, feel free to contact your nearest John Fluke Sales Representative or write directly to the John Fluke Mfg. Co. Inc.

## 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 845 line plug to a 115 volt ac power outlet or to 230 volts ac, if the instrument is so wired. If your instrument is a Model 845A, proceed with steps a and b. If your instrument is a Model 845AB, check the batteries as outlined in paragraph 2-7. Upon completion of a satisfactory battery check, proceed with steps c and d.

**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.

a. Place the Model 845A controls as follows:

| | |
|---|---|
| POWER | ON |
| RANGE | 10 MICROVOLTS |
| OPR | 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.

c. Place the Model 845AB controls as follows:

| | |
|---|---|
| POWER | LINE OPR or BAT OPR |
| RANGE | 10 MICROVOLTS |
| OPR | ZERO |

d. 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. MODEL 845AB BATTERY CHECK

2-8. The Model 845AB batteries must be in the proper charge state for the instrument to operate properly in the BAT OPR mode. To check the batteries proceed as follows:

a. Place the POWER switch to BAT CHK position.

b. The Model 845AB meter needle should deflect within the BATTERY OK region. If the meter needle does not stay within the BATTERY OK region for at least 10 seconds, charge the batteries as indicated in paragraph 2-9. If the batteries are adequately charged, refer to paragraph 2-5.

## 2-9. MODEL 845AB BATTERY CHARGING

2-10. If the Model 845AB is left in the BAT OPR mode for an extended period of time, the batteries will become discharged. If the batteries are fully discharged, the instrument will not operate properly in the LINE OPR mode until the battery voltage can be brought up to 3/4 of full voltage. This will require about 15 minutes of charging. To charge the Model 845AB batteries proceed as follows:

a. Connect the line plug to a 115 volt ac power outlet or to 230 volts ac, if the instrument is so wired.

b. Place the POWER switch to BAT-CHG LINE OPR. After 16 hours the batteries will be fully charged and capable of operating the instrument for at least 40 hours.

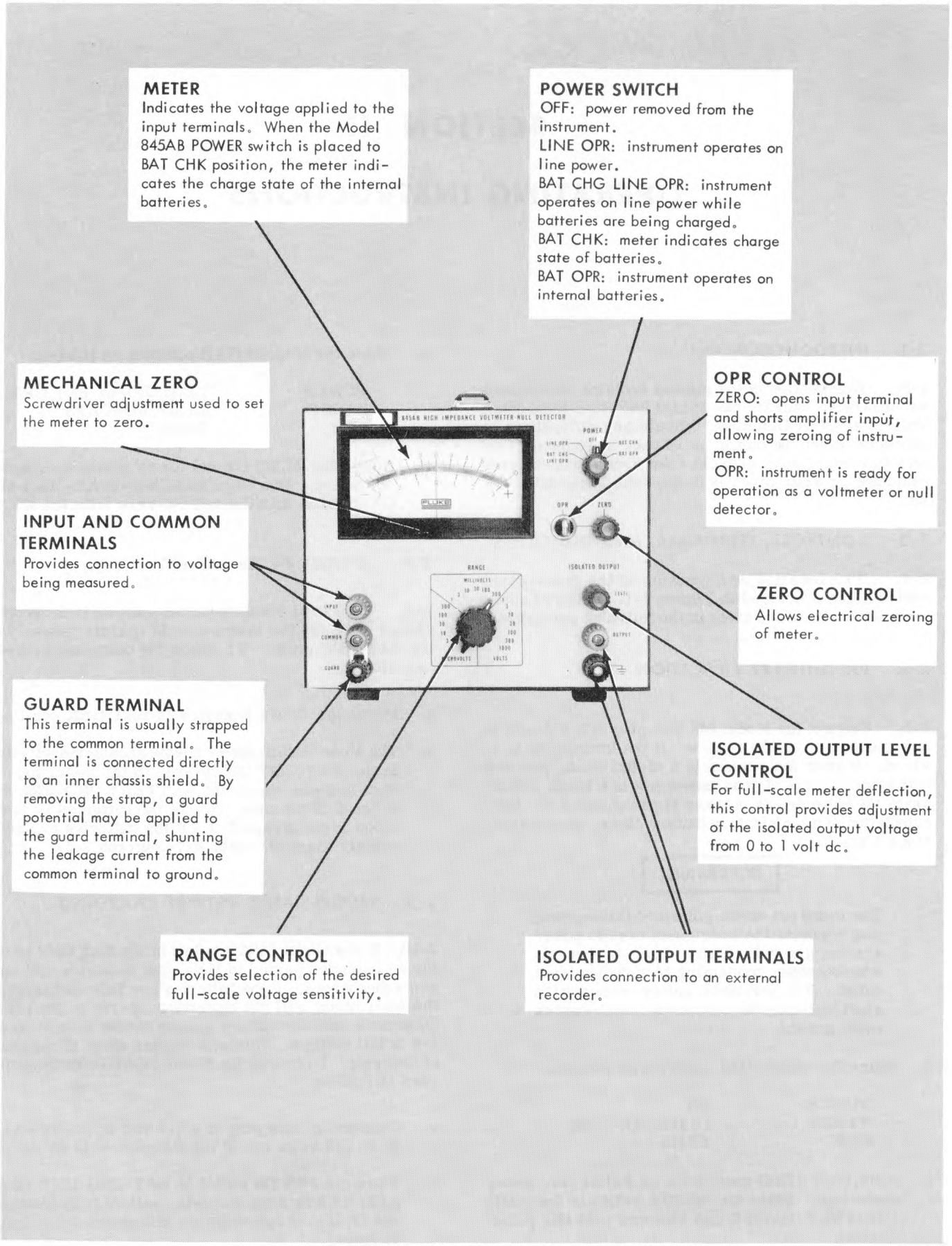


Figure 2-1. CONTROLS, TERMINALS, AND INDICATORS

## 2-11. MECHANICAL ZEROING

2-12. It may be necessary to adjust the mechanical zero control of the Model 845 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 or to LINE OPR.

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 through c until the meter is mechanically and electrically zeroed.

## 2-13. OPERATION AS A HIGH IMPEDANCE VOLTMETER

2-14. To operate the Model 845 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/LINE OPR or BAT OPR |
| OPR | 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 845 INPUT terminal and connect the common point of the voltage being measured to the Model 845 COMMON terminal.

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

## 2-15 OPERATION AS A NULL DETECTOR

2-16. The Model 845 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 845. Equipment connections for various types of null detector configurations are illustrated by Figure 2-2 through 2-4. To operate the Model 845 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 845 controls as follows:

| | |
|---|---|
| POWER | ON/LINE OPR or BAT OPR |
| OPR | OPR |
| RANGE | as desired |

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

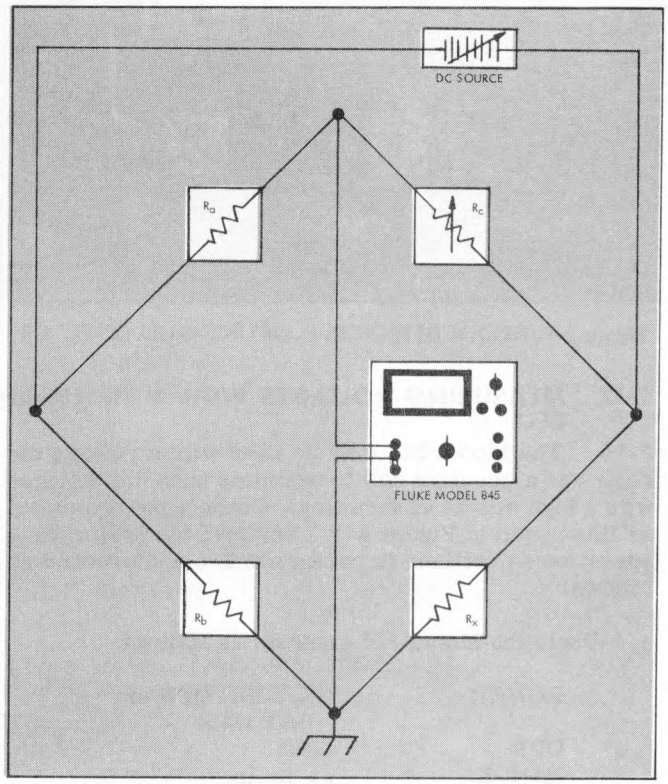


Figure 2-2. BRIDGE DETECTOR-FLOATING SUPPLY

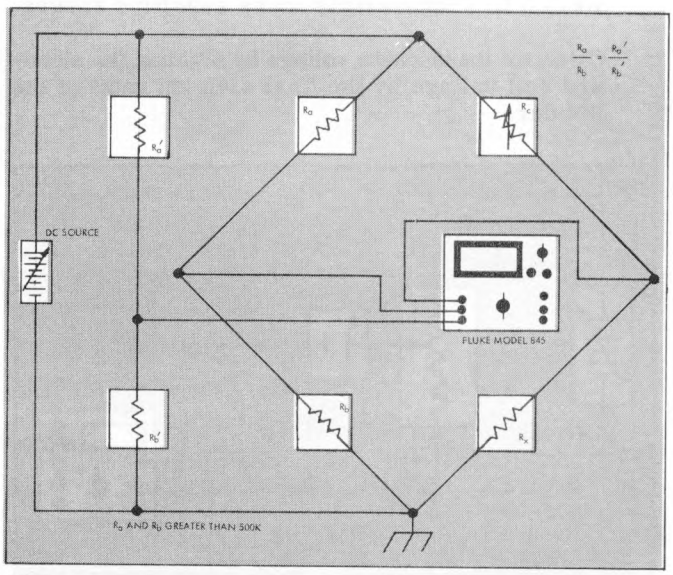


Figure 2-3. BRIDGE DETECTOR-HIGH RESISTANCE

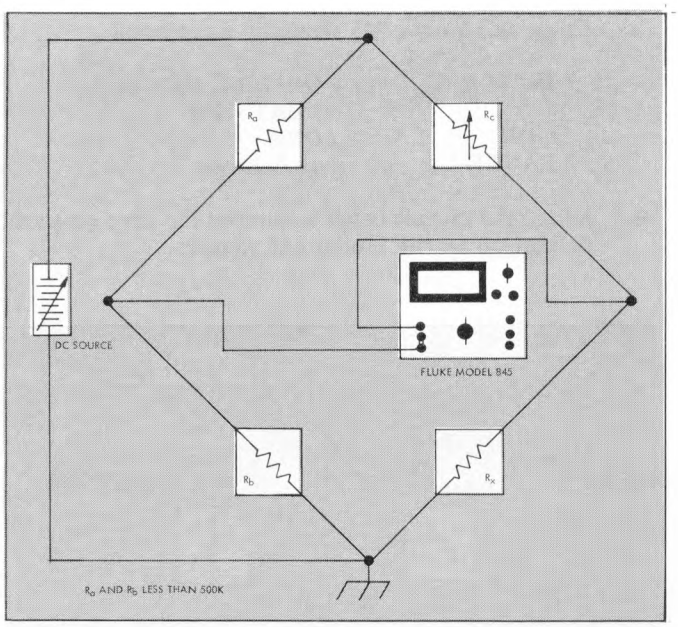


Figure 2-4. BRIDGE DETECTOR-FLOATING NULL DETECTOR

## 2-17. MEASURING VOLTAGES WITH A STANDARD CELL

2-18. The Model 845 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 845 controls as follows:

| | |
|---|---|
| POWER | ON/LINE OPR or BAT OPR |
| OPR | OPR |
| RANGE | as desired |

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

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

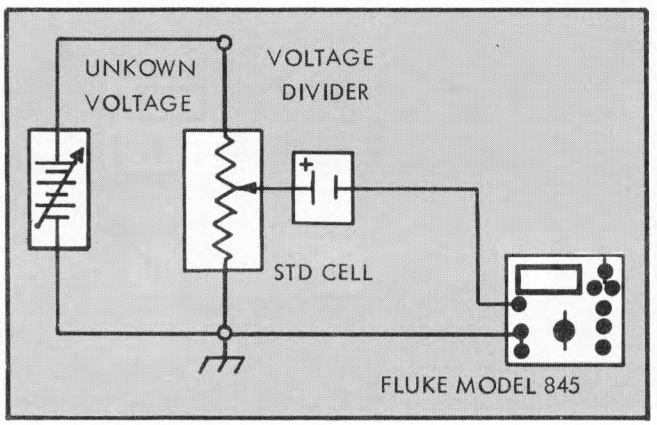


Figure 2-5. STANDARD CELL VOLTAGE MEASUREMENTS

## 2-19. USE OF ISOLATED OUTPUT

### 2-20. DC ISOLATION AMPLIFIER

2-21. The Model 845 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 845, use the following formula:

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

### 2-22. RECORDER OUTPUT

2-23. The Model 845 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 measurments 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, disconnect the green wire between the power supply circuit board and the grounding pin on the ac line plug. Refer to Figure 2-6 for wire location.

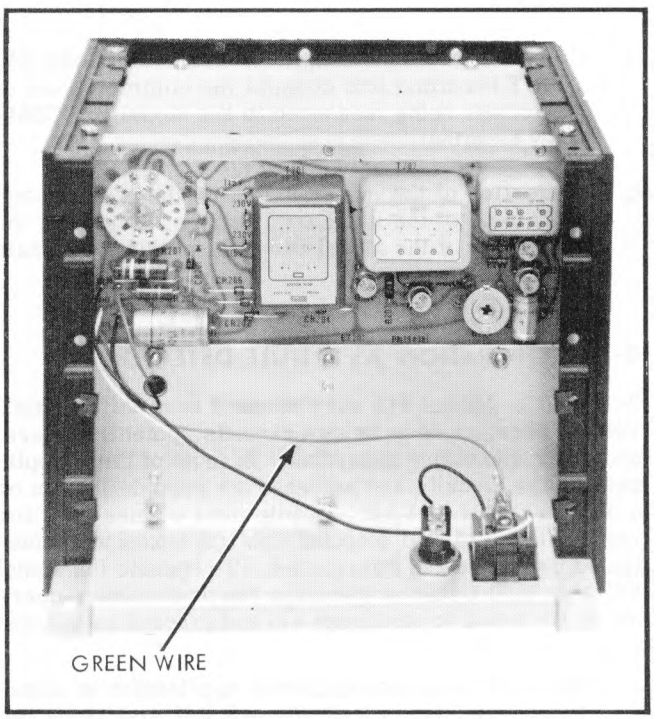


Figure 2-6. CHASSIS GROUND-WIRE LOCATION

b. Turn the recorder on.

c. Proceed as outlined in paragraph 2-13 or 2-15, 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.

## 2-24. OPERATING NOTES

### 2-25. SPURIOUS VOLTAGES AND CURRENTS

2-26. 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 Model 845 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.

### 2-27. THERMOELECTRIC VOLTAGES

2-28. 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 845 are made of pure copper, gold-flashed to prevent tarnish. For lowest thermal voltages, all connections to the Model 845 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 solder 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.

### 2-29. HIGH SOURCE IMPEDANCE

2-30. Due to the very high input resistance and extreme sensitivity of the Model 845, 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 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 impedance, 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.

### 2-31. OVERLOAD VOLTAGES

2-32. 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 switch. However, repeated or continuous overloads above 200 volts in the ranges below 3 millivolts will result in excessive dissipation in the protective, low-pass-filter resistor R110. This will result in thermal voltages which may take several minutes to subside after the overload is removed.

### 2-33. GUARDING

2-34. 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.

### 2-35. INCREASING INPUT RESISTANCE

2-36. 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 microvolt | 300 megohms |
| 3 microvolt | 1000 megohms |
| 10 microvolt | 3000 megohms |
| 30 microvolt to 1 millivolt | 10,000 megohms |

# SECTION III

# THEORY OF OPERATION

## 3-1. INTRODUCTION

3-2. The Model 845 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 845 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 and allows reduction of input signals above 1 millivolt. Photo-choppers 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 multivibrator. The 84 Hz signal provides the Model 845 with an operating frequency asynchronous with the power line frequency and power line harmonics. The 84 Hz multivibrator also drives the following circuits; (1) the supply rectifiers which provide operating voltages for the amplifiers, (2) the isolation converter which provides the isolated recorder output, (3) the synchronous demodulator which demodulates the amplified dc signal. 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. Demodulation of the output signal of the ac amplifier is accomplished by a synchronous demodulator. 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 drives the meter which indicates the polarity and magnitude of the measured voltage, and the isolation converter which drives the isolated recorder output. 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.

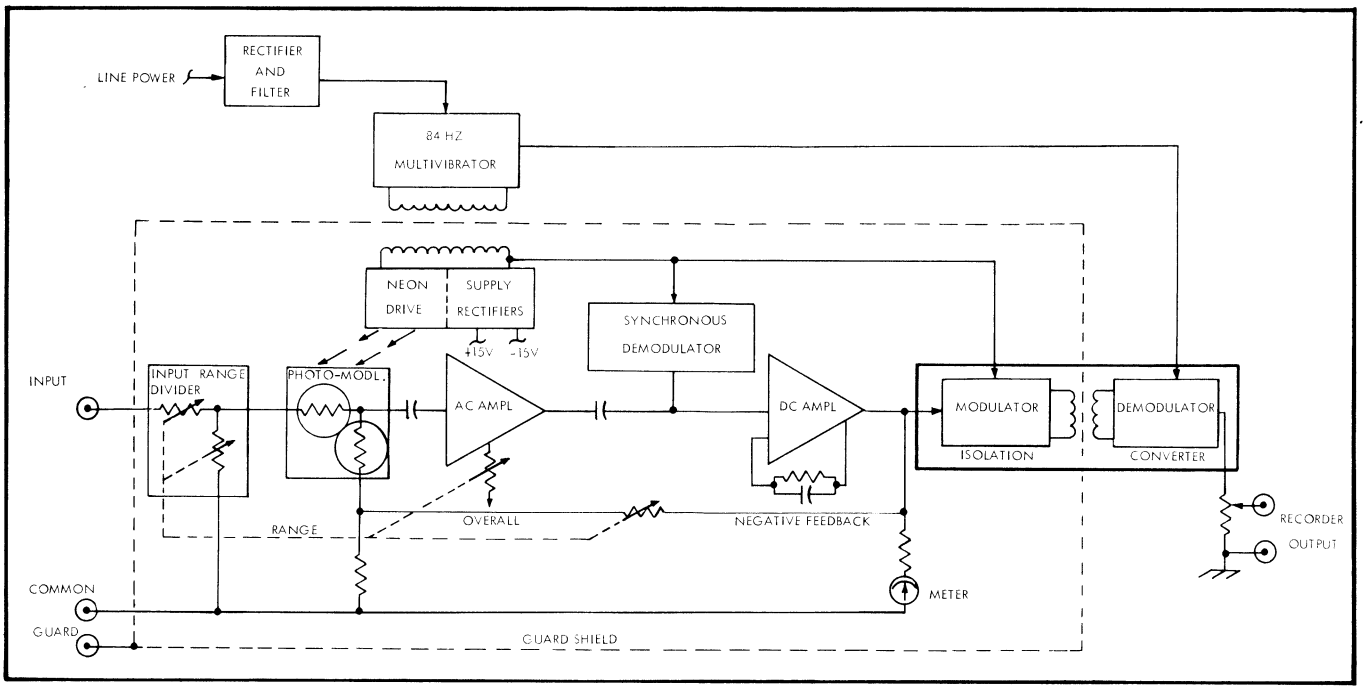


Figure 3-1. MODEL 845 BLOCK DIAGRAM

## 3-8. CIRCUIT DESCRPTION

### 3-9. THE 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, S201. 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 845 circuitry from overloads.

3-11. The secondary voltage of T201 is rectified by bridge rectifier CR201 through CR204. An additional bridge leg composed of CR205 and CR206, is used on the Model 845AB for charging of the batteries. This additional leg allows charging of the batteries while using the instrument on line power and also references the bridge rectifier to the battery voltage, providing regulation of the dc output voltage. When the POWER switch S201 is placed to the BAT CHK position, meter multiplier resistor R205, and meter shunt resistor R157, are selected. The output dc voltage of the batteries under an actual load condition is then indicated by the meter of the Model 845AB. The Model 845A bridge rectifier output voltage is regulated by zener CR207. Capacitor C201 filters the output dc voltage on both Model 845 instruments. This regulated output 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 845 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 determing 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. The neon lamps provide the drive signals for the photocell modulators V101 and V102.

### 3-13. THE INPUT DIVIDER

3-14. The basic full-scale sensitivity of the Model 845 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. THE 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 photochoppers V101 and V102, which are driven by DS101 and DS102. The resulting square-wave signal is coupled through C104 and the Ferrite Bead FL1 and amplified by Q101, Q102, and Q103 which form a three stage ac 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.

### 3-17. THE SYNCHRONOUS DEMODULATOR

3-18. 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 photo modulator. The demodulated signal is filtered by R134 and C114 before being applied to the dc amplifier.

### 3-19. THE DC AMPLIFIER

3-20. 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 1 volt dc for a full range input on any range, which drives the meter and 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 845 amplifiers.

### 3-21. THE ISOLATION CONVERTER

3-22. The isolation converter drives the recorder output and provides isolation from the Model 845 amplifier circuitry. The output signal from the dc 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. C3 and R2 filter the resulting dc output voltage for the recorder output.

# SECTION IV

# MAINTENANCE

## 4-1 INTRODUCTION

4-2. The Model 845A and 845AB instruments 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, refer to the information on corrective maintenance in this section.

## 4-3. TEST EQUIPMENT

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

## 4-5. BATTERY REPLACEMENT

4-6. Batteries in the Model 845AB need to be replaced when 16 hours of charging will no longer bring the meter to the minimum BATTERY OK region.

4-7. To replace the batteries proceed as follows:

a. Remove upper and lower dust covers of the Model 845AB.

b. Locate the battery pack which is mounted below the power supply printed circuit assembly and unsolder the black and red leads that electrically connect the battery pack to the power supply printed circuit assembly.

c. Remove the six nuts and screws that attach the battery pack to the power supply printed circuit assembly.

d. Remove the battery pack from the Model 845AB and replace the defective batteries observing the connections and polarities as illustrated in Figure 4-2.

e. Replace the battery pack in the Model 845AB, securing it to the power supply printed circuit assembly and chassis assembly with the six screws and nuts removed in step c.

f. Replace the battery pack black and red leads removed in step b, and replace the upper and lower dust covers.

g. Check the batteries as outlined in paragraph 2-7. If the batteries show a discharge, recharge them as outlined in paragraph 2-9.

## 4-8 230 VOLT AC POWER-LINE CONVERSION

4-9. All versions of the Model 845 may be converted for operation on 230 volt ac line power by modifying the power supply printed circuit assembly wiring. Factory modified versions will have a decal on the rear panel indicating a 230 volt ac input requirement.

4-10. To convert the Model 845 to 230 volt ac operation proceed as follows:

a. Remove the top-back dust cover.

b. Locate T201 on the power supply printed circuit assembly and remove the two jumper wires labeled 115V. Refer to Figure 4-3, for location.

| EQUIPMENT NOMENCLATURE | SPECIFICATIONS | RECOMMENDED INSTRUMENT |
|---|---|---|
| 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. Sweep speed of 2 ms/cm. | Hewlett-Packard Model 130C |
| Battery | 10 volt | |

Figure 4-1. TEST EQUIPMENT REQUIREMENTS

c. Place the jumpers removed in step b across the 230V labeled terminals, refer to Figure 4-3 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.

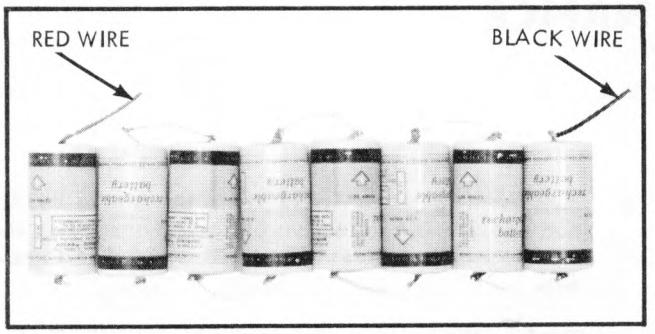


Figure 4-2. BATTERY POLARITY CONNECTIONS

## 4-11. DISASSEMBLY INSTRUCTION

4-12. The following procedure can be used to gain access to the inside of the Model 845:

a. Remove the top-back cover by removing four screws that fasten it to side castings. This allows access to the parts on the power supply board (parts with 200 series reference designations.)

b. Remove the bottom cover by removing two screws that fasten it to side castings. This allows access to capacitors C1 and C2 on the front panel.

c. Remove the large side cover on both sides of instrument by removing two screws that fasten each of them to side castings.

d. Remove the top cover of the guard chassis by removing four screws; two screws on the top of the guard and two on the back. This allows access to the dc amplifier Q107 through Q112, and the last two stages of the ac amplifier, Q104 through Q106. The instrument will still operate properly with the top of guard chassis removed. When the instrument is turned on, a red neon glow from the two lucite rods on the amplifier board is an indication that the photo-modulator drive circuit is working.

e. Remove the bottom-back cover of guard chassis by removing two screws on bottom. This allows access to; the input divider R101 to R110, the +15 and -15 volt dc supply filter capacitors C117 and C118, and the recorder output modulator Q113 and Q114. The instrument will still operate but will have a meter offset, especially with high source impedances.

f. Remove the screw that fastens the right side casting to the front panel at the top of the instrument.

g. Remove the small right side cover by removing the two screws that attach it to the chassis.

h. Loosen the four screws located below the removed small right side cover, by two turns only.

***CAUTION!***

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

i. Remove the top and bottom screws that fasten the right side casting to the power supply board bracket.

j. Loosen the top and bottom screws that fasten the left side casting to the power supply board bracket by two turns.

k. Take off the power plug bracket at the rear of the instrument by removing two screws that fasten it to the side castings.

l. Pull the rear of the right side casting out far enough to swing the power supply board bracket out from the back of the instrument. This will allow access to the entire component side of the amplifier board.

m. Remove the input shield located at the end of the Lucite rods by removing the two attaching screws. This will allow access to the first three amplifier stages Q101 to Q103, and the chopper drive photocells V101 and V102.

n. If it is necessary to gain access to the land side of amplifier board, proceed as follows:

(1) Place the RANGE control to 1 MICROVOLTS and loosen the RANGE switch set screw that points toward the bottom of the instrument.

(2) Place the RANGE switch to 1000 VOLTS and loosen the other set screw that now points down, and take off the RANGE knob.

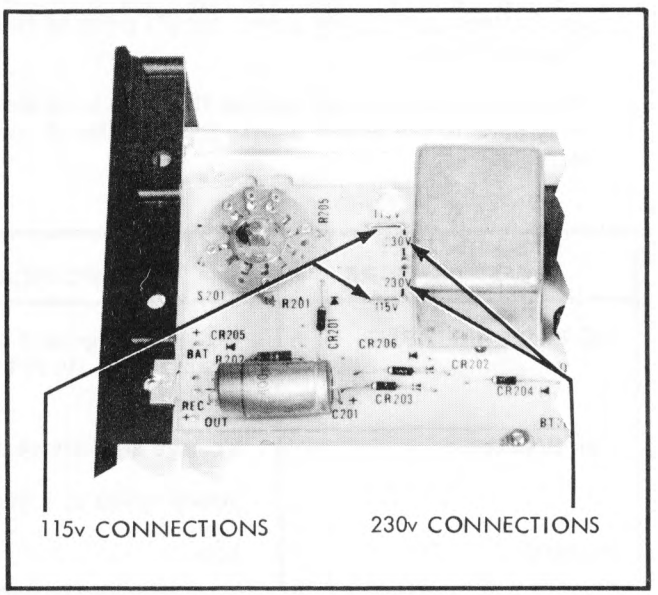


Figure 4-3. T201 115/230 VOLT AC POWER TERMINALS

(3) Loosen the set screw on the ZERO control shaft coupler where it connects to the potentiometer.

(4) Using a 1/2" socket wrench, remove the nut that holds the range switch to the guard chassis.

(5) Remove the four screws that hold the amplifier board to the guard chassis.

(6) Slide the amplifier board toward the rear of the instrument. This will allow access to the land side of the amplifier board.

## 4-13. CORRECTIVE MAINTENANCE

4-14. TROUBLESHOOTING

4-15. The purpose of troubleshooting is to locate and replace as quickly as possible any malfunctioning component or components that are causing improper operation. The causes and remedies of the more common troubles that may occur are listed in the troubleshooting chart, Figure 4-4. Waveforms useful for troubleshooting are given in Figures 4-5 through 4-10. 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.

4-16. VISUAL INSPECTION

4-17. 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 4-18.

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

| 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 thru CR206, as necessary. |
| Photo Modulator inoperative (Neon lights out) | Low battery voltage | Charge batteries. |
| | 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 on TP10 should agree with Figure 4-5. 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-to-peak should be present between pin 9 of T202 and the GUARD terminal. If not, T202 may be defective. |
| Meter movement inoperative | Dead meter | Check meter with an ohmmeter. Panel meter should peg. (Model 845AB in LINE OPR, line cord disconnected). |
| | Defective auxiliary supply | Test points 3 and 4 voltage is near zero, check the associated diode and capacitor. If both voltages are zero, T202 is defective. |

Figure 4-4. TROUBLESHOOTING CHART (Sheet 1 of 2)

| SYMPTOM | PROBABLE CAUSE | FAULT ISOLATION PROCEDURE |
|---|---|---|
| Meter pegs or wanders | Meter mechanically stuck<br><br>Defective amplifier | Using an oscilloscope with dc coupling, measure waveforms at TP6. If waveforms agree with Figure 4-6 check Q111, Q112, Q109, Q110, Q107, and Q108 by replacement. If waveforms are not correct, then:<br>(a) Waveform at TP6 looks more like waveform at TP7, Figure 4-7, Q106 is open.<br>(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.<br>(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 4-8. 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 square reappears, CR101 or CR102 is defective. If square wave does not reappear, the RANGE switch is defective.<br>(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. |
| ISOLATED OUTPUT operates on one polarity 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 ranges | Shorted C116 | Test and replace if necessary. |
| Poor stability | Defective CR207<br><br>Batteries not charged | Replace if necessary.<br><br>Charge batteries as in paragraph 2-9. |
| Noise on 1, 3, and 10 uv ranges | Dirty or defective Q101, or defective Q102<br><br>Defective Chopper | Measure waveform at TP2. Figure 4-9 waveform shown in 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 4-10:<br>(a) Excessive noise can be caused by poor positioning of neon lamps.<br>(b) Smaller waveform can be caused by slow response of photocells; if so, replace cells. |
| Unguarded leakage poor | Dirty grommets<br><br>Leakage in T202 or T203 | Clean according to paragraph 4-18.<br><br>Test and replace if necessary. |
| Guarded leakage poor | Leakage in T202 or T203, or pins touching circuit board<br><br>Contaminated binding posts | Test and repair as necessary.<br><br>Clean according to paragraph 4-18. |
| Poor overload recovery | Defective C101, C102, C103, C120, CR101, CR102, or R110 | Test and replace as necessary. |

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

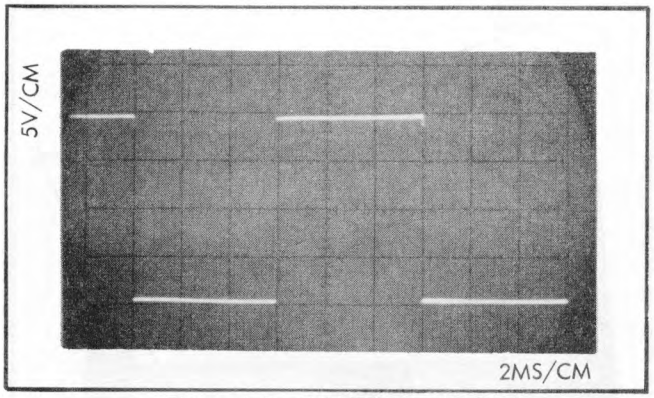


Figure 4-5. WAVEFORM AT TP10

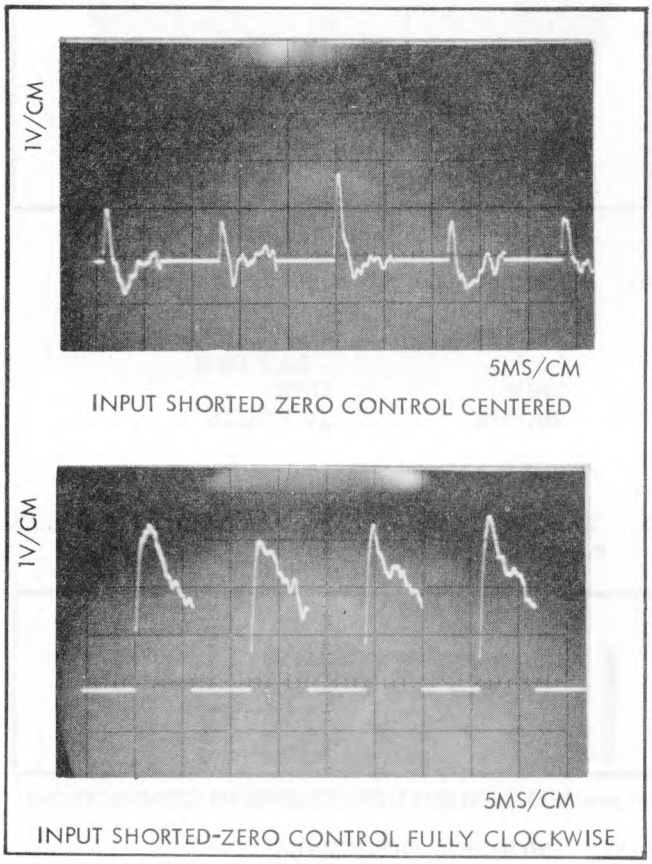


Figure 4-6. WAVEFORMS AT TP6

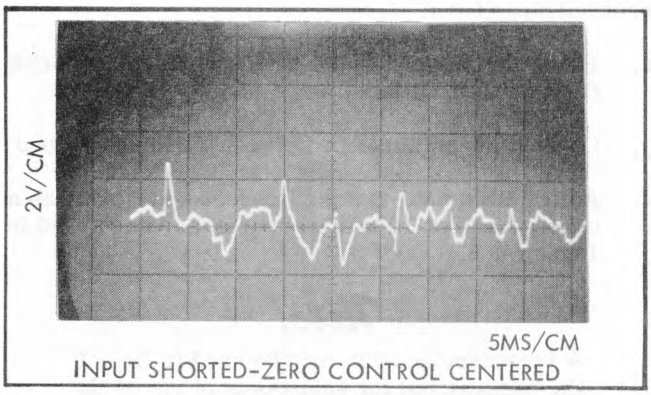


Figure 4-7. WAVEFORM AT TP7

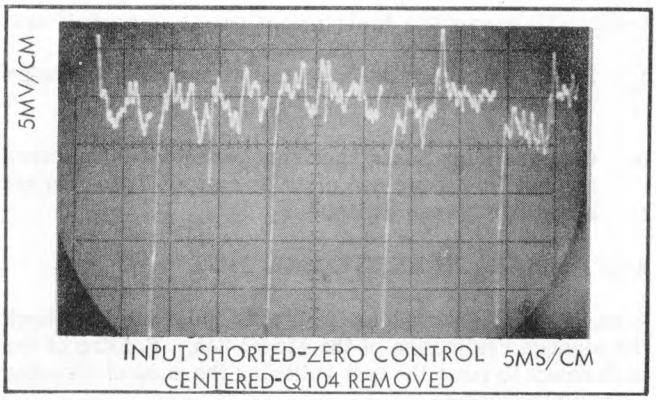


Figure 4-8. WAVEFORM AT TP2-Q104 REMOVED

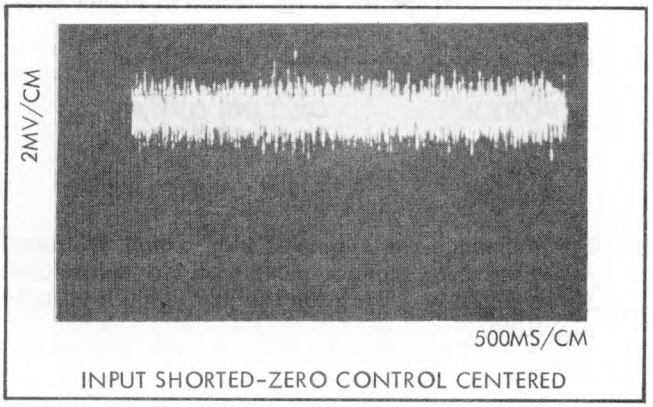


Figure 4-9. WAVEFORM AT TP2

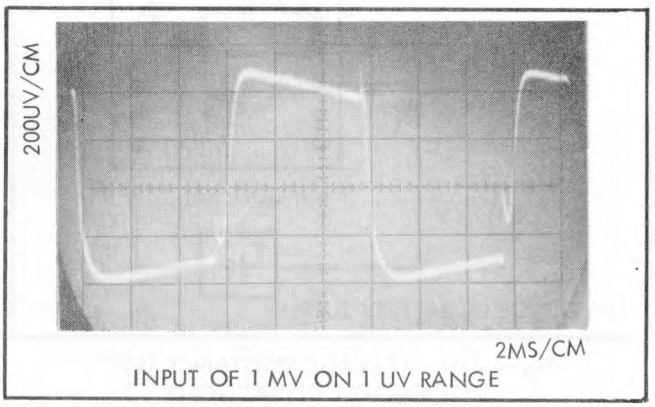


Figure 4-10. WAVEFORM AT TP1

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.

## 4-18. PERIODIC MAINTENANCE

4-19. Periodic maintenance consists of occasional cleaning to remove dust, grease, and other contaminations.

4-20. 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, using a clean cloth or cotton swab. Do not attempt to clean switches.

4-21. LEAKAGE RESISTANCE TEST

4-22. 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 4-11.

b. Place the Model 845 controls as follows:

| | |
|---|---|
| POWER | ON/LINE OPR or BAT OPR |
| OPR | 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.

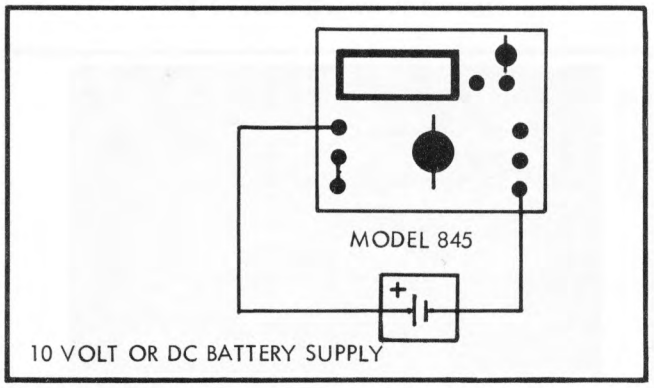


Figure 4-11. LEAKAGE RESISTANCE TEST EQUIPMENT CONNECTIONS

## 4-23. CALIBRATION PROCEDURES

4-24. 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 4-12.

4-25. METER CALIBRATION

4-26. Connect the equipment as illustrated in Figure 4-13 and proceed as follows:

*Note!*

Allow equipment to warm up for at least 5 minutes.

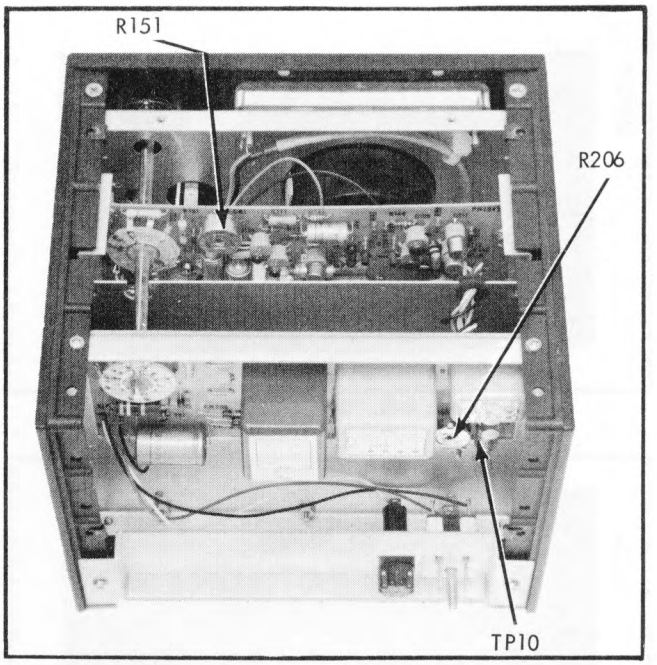


Figure 4-12. TEST AND ALIGNMENT POINTS

a. Place the Model 845 controls as follows:

| | |
|---|---|
| POWER | ON/LINE OPR or BAT OPR |
| OPR | OPR |
| RANGE | 10 VOLTS |

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

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

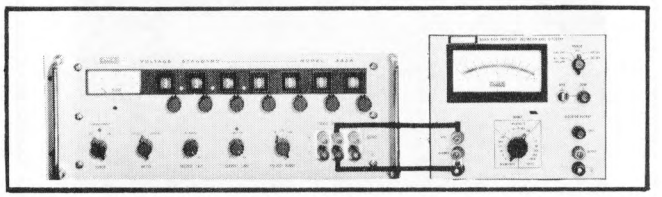

Figure 4-13. CALIBRATION EQUIPMENT CONNECTIONS

4-27. CHOPPER FREQUENCY

4-28. To adjust the 84 Hz multivibrator frequency, proceed as follows:

a. Place the Model 845 POWER switch to ON/LINE OPR or BAT OPR.

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.

# 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). Parts not appearing on the schematic diagram are identified by only a location index number. Flagnotes are used throughout the parts list and refer to ordering explanations. The flagnote explanations appear at the end of the parts list.

## 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 INDEX NO. column lists coordinates which locate the designated part on the associated illustration.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

h. 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.

i. 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 part 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 | ultr high 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 |

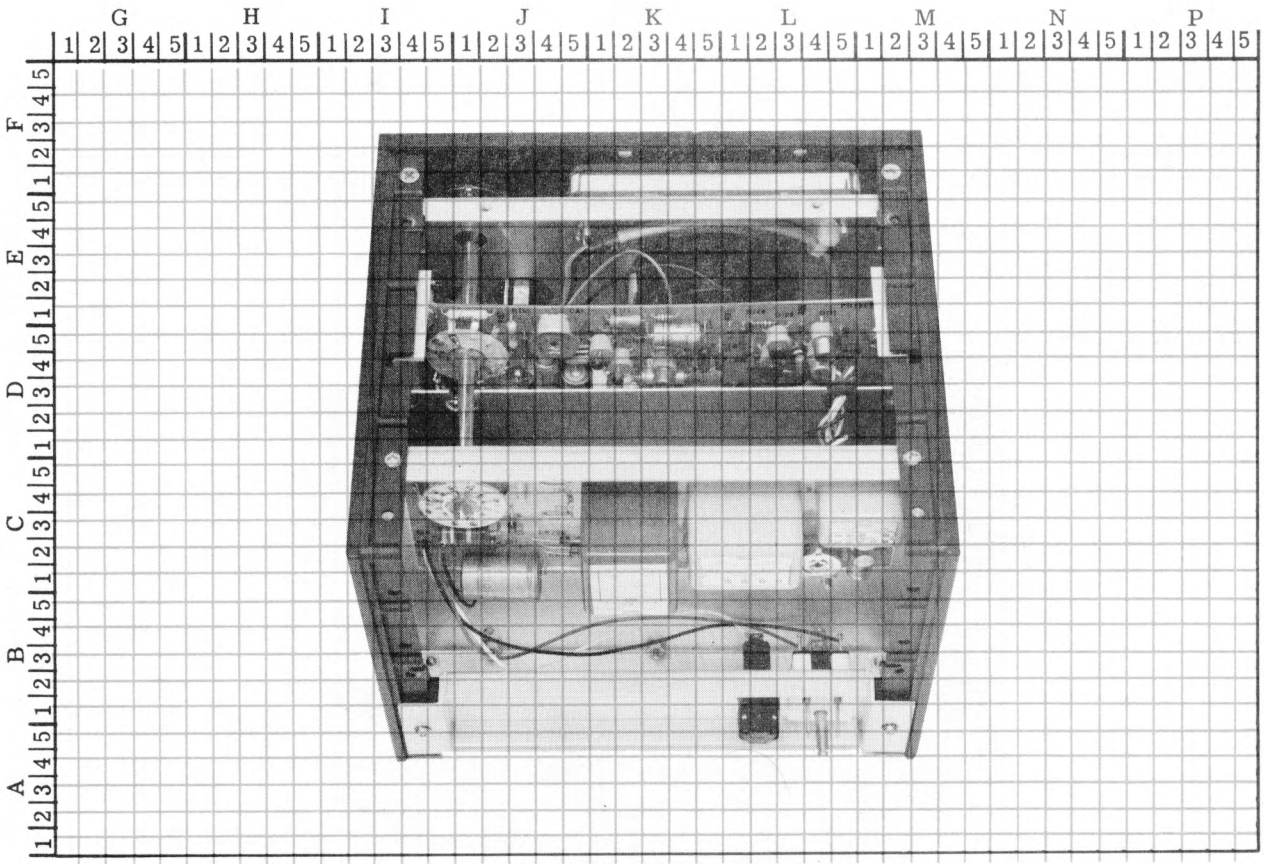

Figure 5-1. FINAL ASSEMBLY

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| | | **FINAL ASSEMBLY - Figure 5 - 1** | | | | | | |
| | | Line-powered model | 845A | | | | | |
| | | Battery/line-powered model | 845AB | | | | | |
| A1 | D3-M3 | Chassis Assembly (See Figure 5-2) | | | | | | |
| A2 | F1-J4 | Front Panel Assembly (See Figure 5-3) | | | | | | |
| A3 | D5-L1 | Amplifier P/C Assembly (See Figure 5-4) | 1702-194399 (845A-401) | 89536 | 1702-194399 | 1 | | |
| A4 | C4-J4 | Power Supply P/C Assembly (See Figure 5-5) | | | | | | |
| | | Model 845A | 1702-194407 (845A-402) | 89536 | 1702-194407 | 1 | | |
| | | Model 845AB | 1702-194555 (845AB-402) | 89536 | 1702-194555 | 1 | | |

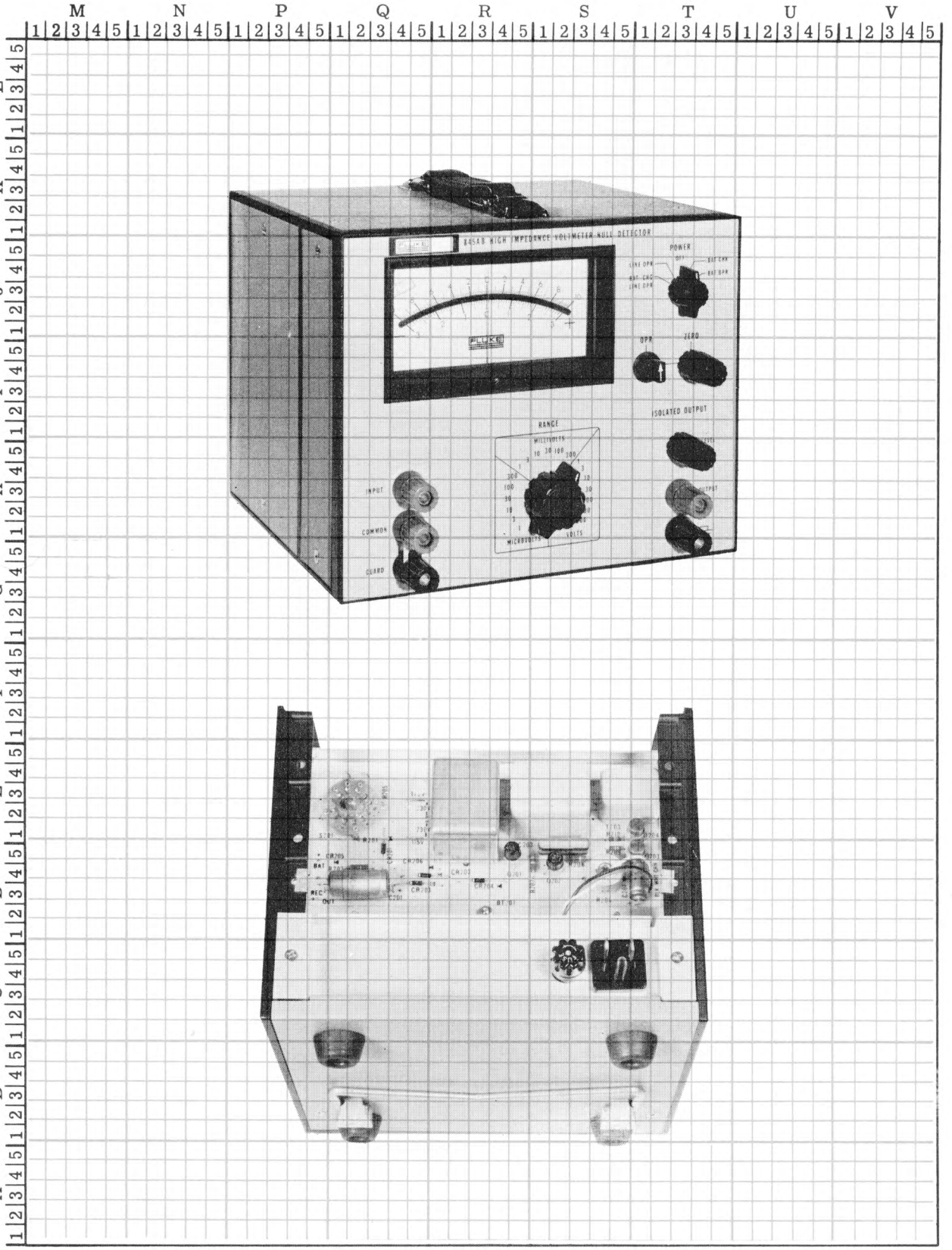


Figure 5-2. CHASSIS ASSEMBLY

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| A1 | | **CHASSIS ASSEMBLY - Figure 5-2** | | | | | | |
| BT201 | | Battery, 1.2v, Ni-Cad, (not illustrated) | 4002-160390 | 05397 | C1.2J | 8 | | |
| C4, C5 | | Cap, mica, 0.001 uf ±5%, 500v (not illustrated) | 1504-148387 | 88419 | CD19F102J | 2 | | B |
| 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 | |
| P1 | C5-S5 | Connector, male, 3 prong chassis mount | 2109-160275 | 73586 | M-1548-GS | 1 | | |
| XBT201 | | Holder, battery (not illustrated) | 3155-194530 | 89536 | 3155-194530 | 1 | | |
| XF1 | C5-S2 | Holder, fuse | 2102-160846 | 75915 | 342004 | 1 | | |
| | | Coupler, 1/4 to 1/4 (not illustrated) | 2402-104505 | 89536 | 2402-104505 | 1 | | |
| | | Coupler, 1/8 to 1/4 (not illustrated) | 2402-193557 | 89536 | 2402-193557 | 1 | | |
| | C1-R3 | Cover, bottom | 3156-194233 | 89536 | 3156-194233 | 1 | | |
| | I2-P2 | Cover, side | 3156-194290 | 89536 | 3156-194290 | 2 | | |
| | | Cover, side (not illustrated) | 3156-194290 | 89536 | 3156-194290 | REF | | |
| | I2-P5 | Cover, side front | 3156-162164 | 89536 | 3156-162164 | 2 | | |
| | | Cover, side front (not illustrated) | 3156-162164 | 89536 | 3156-162164 | REF | | |
| | K2-Q2 | Cover, top | 3156-194225 | 89536 | 3156-194225 | 1 | | |
| | B5-Q1 | Foot, rubber | 2819-103309 | 77969 | 9102-W | 4 | | |
| | B1-Q2 | Foot, rubber | 2819-103309 | 77969 | 9102-W | REF | | |
| | B5-S5 | Foot, rubber | 2819-103309 | 77969 | 9102-W | REF | | |
| | B1-S4 | Foot, rubber | 2819-103309 | 77969 | 9102-W | REF | | |
| | K3-R2 | Handle, black vinyl | 2404-166280 | 12136 | 919-415-173 | 1 | | |
| | | Line cord (not illustrated) | 6005-161638 | 91934 | 107-1, SVT | 1 | | |
| | | Shaft, zero (not illustrated) | 3156-194365 | 89536 | 3156-194365 | 1 | | |
| | | Shaft, range switch (not illustrated) | 2814-203299 | 89536 | 2814-203299 | 1 | | |
| | B3-R3 | Tilt stand | 3156-194282 | 89536 | 3156-194282 | 1 | | |

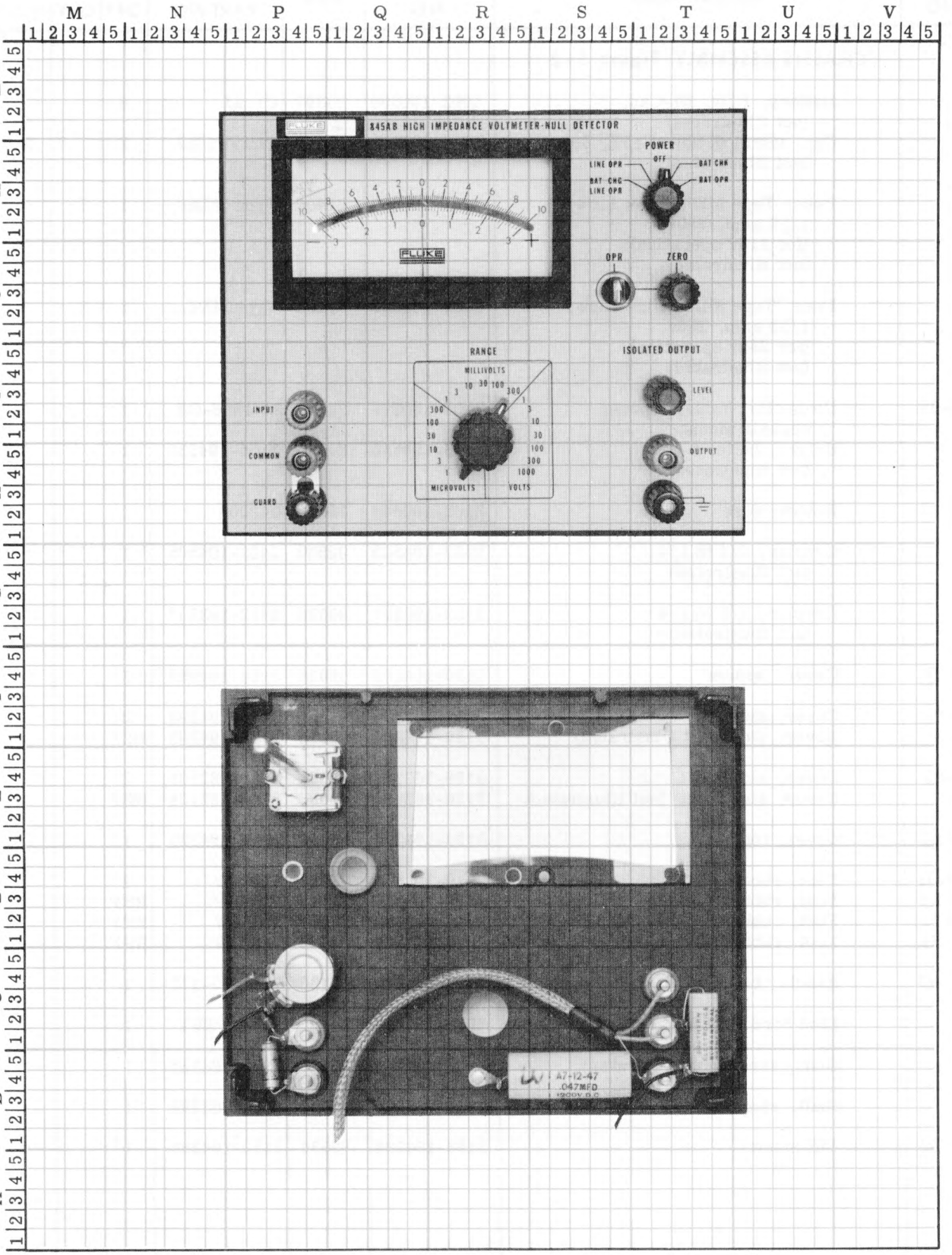


Figure 5-3. FRONT PANEL ASSEMBLY

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| A2 | | **FRONT PANEL ASSEMBLY Figure 5-3** | | | | | | |
| C1 | C1-T4 | Cap, mylar, 0.047 uf ±20%, 1200v | 1507-182683 | 72928 | 343-087M | 1 | | |
| C2 | B4-S3 | Cap, poly, 0.047 uf ±20%, 1200v | 1507-190561 | 84411 | JF-7 | 1 | | |
| C3 | B5-P3 | Cap, elect, 10 uf +50/-10%, 25v | 1502-170266 | 73445 | C426ARF10 | 1 | 1 | A |
| J1 | I2-P4 | Binding post, red | 2811-149856 | 58474 | BHB-10208-G22 | 2 | | |
| J2 | H5-P4 | Binding post, red | 2811-149856 | 58474 | BHB-10208-G22 | REF | | |
| J3 | H2-P4 | Binding post, black | 2811-142984 | 58474 | DF31BC | 2 | | |
| J4 | H5-T2 | Binding post, red | 2811-142976 | 58474 | DF31RC | 1 | | |
| J5 | H3-T2 | Binding post, black | 2811-142984 | 58474 | DF31BC | REF | | |
| M1 | K2-Q2 | Meter, 100-0-100 ua, 650Ω (845A only) | 2901-192310 | 89536 | 2901-192310 | 1 | | |
| | K2-Q2 | Meter, 100-0-100 ua, 650Ω (845AB only) | 2901-192294 | 89536 | 2901-192294 | 1 | | |
| R1 | C4-P4 | Res, var, comp, 10k ±30%, 1/3w | 4701-192344 | 71450 | WF-45 | 1 | | |
| R2 | C2-P2 | Res, comp, 4.7k ±10%, 1/2w | 4704-108381 | 01121 | EB4721 | 1 | | |
| S201 | E3-P3 | Switch, detent, dual index ball (845A only) | 5108-193573 | 76854 | Type F | 1 | | |
| S201 | E3-P3 | Switch, detent, dual index ball (845AB only) | 5108-193565 | 76854 | Tyep F | 1 | | |
| | I3-T2 | Knob, LEVEL | 2405-158949 | 89536 | 2405-158949 | 2 | | |
| | K3-T2 | Knob, POWER | 2405-158956 | 89536 | 2405-158956 | 1 | | |
| | I1-R3 | Knob, RANGE | 2405-170035 | 89536 | 2405-170035 | 1 | | |
| | J3-T3 | Knob, ZERO | 2405-158949 | 89536 | 2405-158949 | REF | | |
| | I5-P4 | Panel, front (845A only) | 1406-194209 | 89536 | 1406-194209 | 1 | | |
| | I5-P4 | Panel, front (845AB only) | 1406-194522 | 89536 | 1406-194522 | 1 | | |
| | H4-P5 | Shorting link | 2811-190728 | 24655 | 938LG | 1 | | |

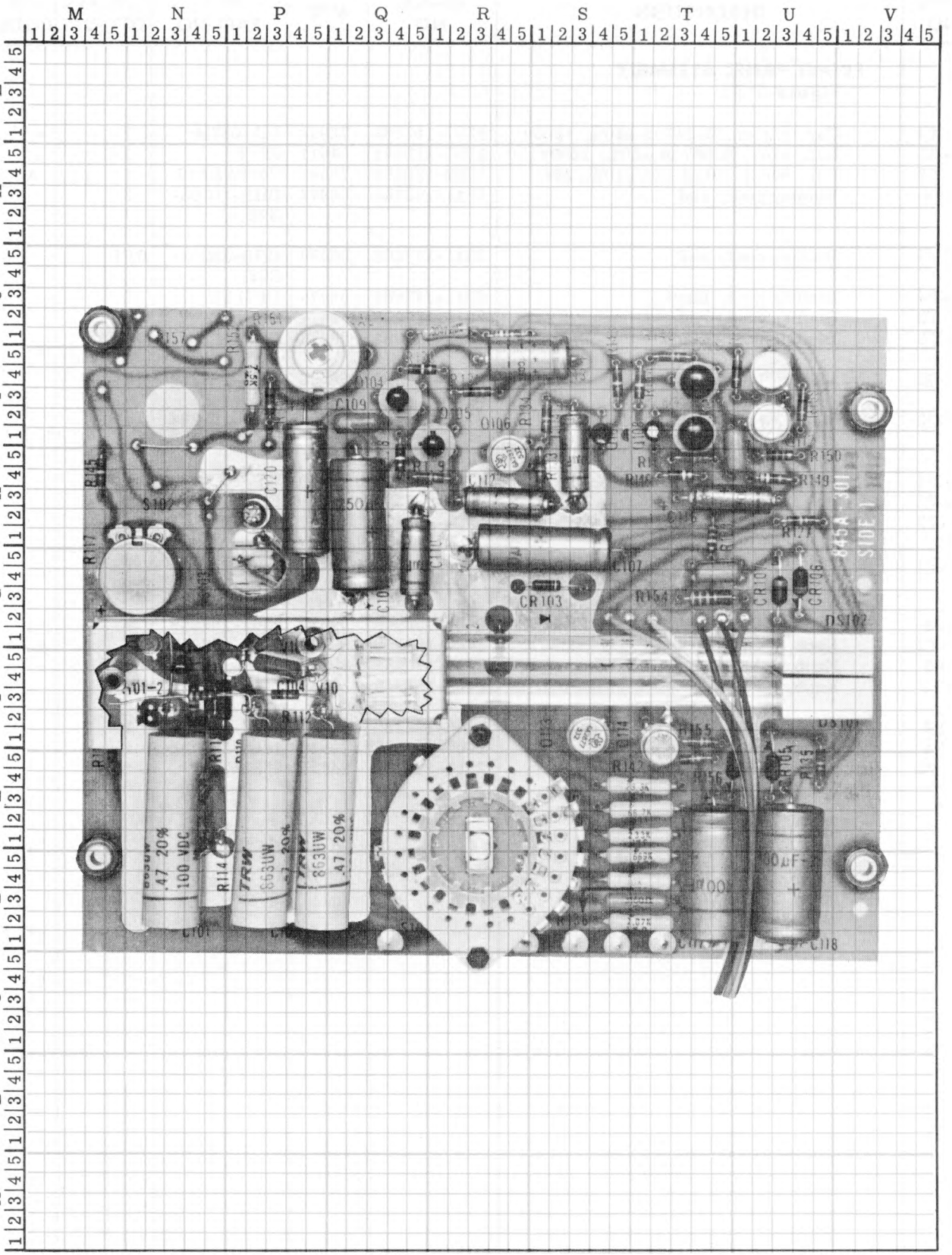


Figure 5-4. AMPLIFIER P/C ASSEMBLY ( SHEET 1 OF 2)

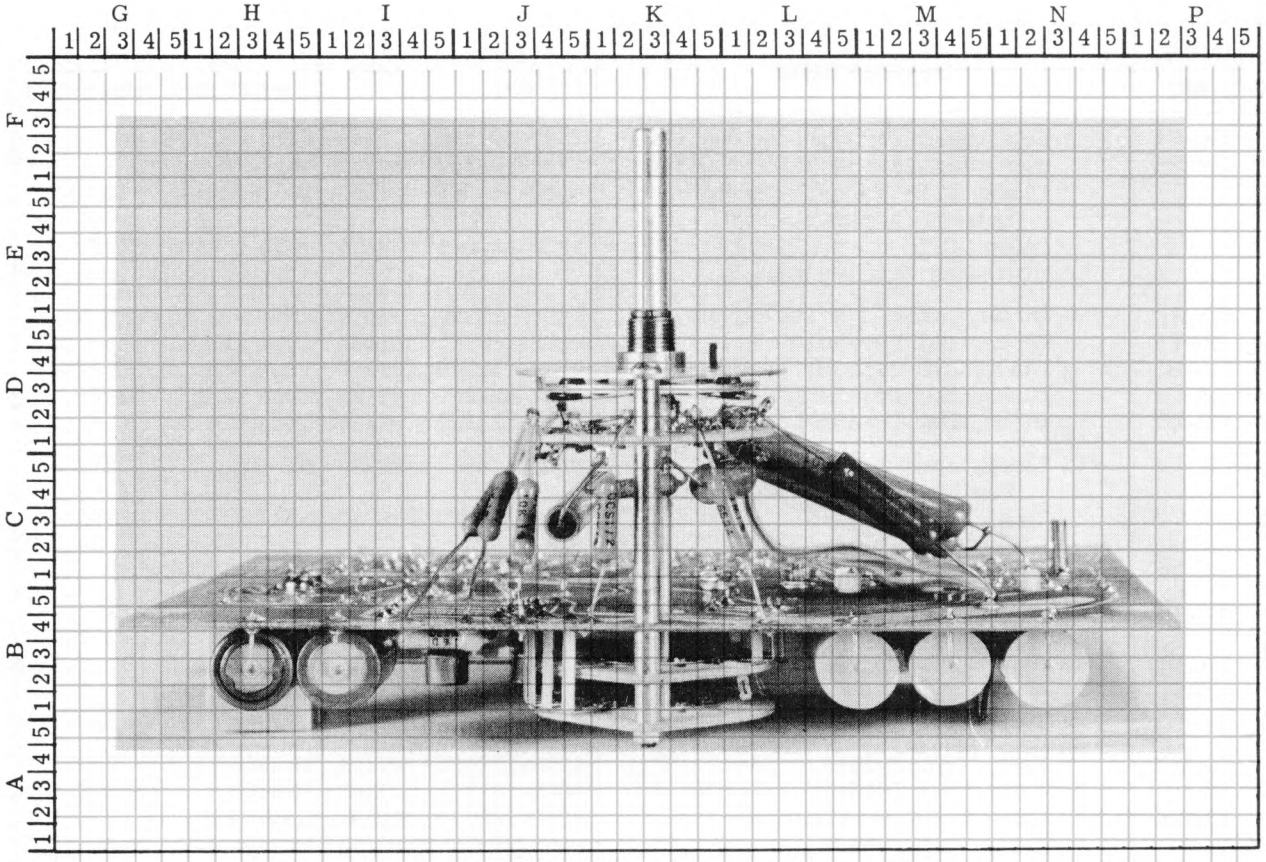

Figure 5-4. AMPLIFIER P/C ASSEMBLY (Sheet 2 of 2)

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| A3 | | **AMPLIFIER P/C ASSEMBLY** **Figure 5-4** | 1702-194399 (845A-401) | 89536 | 1702-194399 | REF | | |
| C101 | E1-N3 | Cap, plstc, 0.47 uf ±20%, 100v | 1507-190553 | 84411 | JF-36 | 3 | | |
| C102 | E1-P2 | Cap, plstc, 0.47 uf ±20%, 100v | 1507-190553 | 84411 | JF-36 | REF | | |
| C103 | E1-P5 | Cap, plstc, 0.47 uf ±20%, 100v | 1507-190553 | 84411 | JF-36 | REF | | |
| C104 | F5-P3 | Cap, plstc, 0.1 uf ±20%, 250v | 1507-161992 | 73445 | C280AE/P100K | 3 | | |
| C105 | G1-P3 | Cap, cer, 300 pf ±10%, 500v | 1501-105734 | 71590 | BB60301KW7W | 2 | | |
| C106 | H1-Q2 | Cap, elect, 1250 uf +50/-10%, 4v | 1502-166330 | 73445 | C437ARB1250 | 1 | 1 | |
| C107 | G5-S1 | Cap, elect, 250 uf +50/-10%, 16 | 1502-187765 | 73445 | C437ARE250 | 2 | 1 | A |
| C108 | G1-N4 | Cap, cer, 300 pf ±10%, 500v (underneath cover) | 1501-105734 | 71590 | BB60301KW7W | REF | | |
| C109 | I2-Q2 | Cap, plstc 0.1 uf ±20%, 250v | 1507-161992 | 73445 | C280AE/P100K | REF | | |
| C110 | G5-Q5 | Cap, elect, 10 uf +50/-10%, 25v | 1502-170266 | 73445 | C426ARF10 | 2 | 1 | |
| C111 | J1-R1 | Cap, mylar, 0.0047 uf ±20%, 200v | 1507-106054 | 72928 | C472M | 1 | | |
| C112 | H3-R4 | Cap, elect, 10 uf +50/-10%, 25v | 1502-170266 | 73445 | C426ARF10 | REF | | |
| C113 | I5-S1 | Cap, elect, 400 uf +50/-10%, 4v | 1502-187773 | 73445 | C426ARE400 | 2 | 1 | |
| C114 | H5-S3 | Cap, Ta, 10 uf ±10%, 20v | 1508-160259 | 05397 | K10C20K | 1 | | A |
| C114 | H5-S3 | Cap, Ta, 6.8 uf ±10%, 35v | 1508-182782 | 88411 | Type 901 | 1 | | B |
| C115 | H5-U1 | Cap, plstc, 0.1 uf ±20%, 250v | 1507-161992 | 73445 | C280AE/P100K | REF | | |
| C116 | H3-T5 | Cap, Ta, 22 uf ±10%, 15v | 1508-182816 | 05397 | K22C15K | 1 | | A |
| C116 | H3-T5 | Cap, Ta, 15 uf ±10%, 20v | 1508-153056 | 05397 | K15C20K | 1 | | B |
| C117 | D5-T5 | Cap, elect, 400 uf +50/-10%, 25v | 1502-168153 | 73445 | C437ARF400 | 3 | 1 | |
| C118 | D5-U3 | Cap, elect, 400 uf +50/-10%, 25v | 1502-168153 | 73445 | C437ARF400 | REF | | |
| C119 | G4-T5 | Cap, plstc, 0.22 uf ±20%, 230v | 1507-194803 | 73445 | C280AE/P220K | 1 | | |

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| C120 | H4-P4 | Cap, elect, 250 uf +50/-10%, 16v | 1502-187765 | 73445 | C437ARE250 | REF | | A |
| C120 | H4-P4 | Cap, elect, 150 uf +75/-10%, 15v | 1502-150292 | 80183 | TE 1163 | 1 | 1 | B |
| CR101 | | Diode, C.D. Type CD12599 treated (not illustrated) | 4802-180885 | 89536 | 4802-180885 | 2 | 1 | |
| CR102 | | Diode, C.D. Type CD12599 treated (not illustrated) | 4802-180885 | 89536 | 4802-180885 | REF | | |
| CR103 | G4-S1 | Diode, zener, 10v Type 1N961A | 4803-113324 | 07910 | 1N961A | 1 | 1 | |
| CR104 | E5-T5 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | 8 | 2 | |
| CR105 | E5-U3 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR106 | G4-U4 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR107 | G3-U3 | Diode, IRC,Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| DS101 | | Lamp, neon, NE-2U (not illustrated) | 3902-162602 | 89730 | NE-2U | 2 | 5 | |
| DS102 | | Lamp, neon, NE-2U (not illustrated) | 3902-162602 | 89730 | NE-2U | REF | | |
| FL1 | F5-P3 | Bead, Ferrite choke | 2503-219535 | 02214 | 56-060-85-3B | 1 | | B |
| Q101 | F5-P1 | Tstr, selected Transitron Type ST-1750T | 4805-194456 | 89536 | 4805-194456 | 1 | 1 | |
| Q102 | G1-N2 | Tstr, selected Transitron Type ST-1750T | 4805-198812 | 89536 | 4805-198812 | 1 | 1 | |
| Q103 | F5-N3 | Tstr, Type 2N3391 | 4805-168708 | 89730 | 2N3391 | 3 | 1 | |
| Q104 | I3-Q4 | Tstr, Type 2N3565 | 4805-177105 | 07263 | 2N3565 | 2 | 1 | |
| Q105 | I1-R1 | Tstr, Type 2N3565 | 4805-177105 | 07263 | 2N3565 | REF | | |
| Q106 | H5-R4 | Tstr, T.I. Type GA2877 | 4805-182709 | 01295 | GA2877 | 2 | 1 | |
| Q107 | I1-S4 | Tstr, Type 2N3391 | 4805-168708 | 89730 | 2N3391 | REF | | |
| Q108 | I1-T2 | Tstr, Type 2N3391 | 4805-168708 | 89730 | 2N3391 | REF | | |
| Q109 | I4-T4 | Tstr, Motorola Type MPS3638 | 4805-169375 | 04713 | MPS3638 | 2 | 1 | |
| Q110 | I1-T4 | Tstr, Motorola Type MPS3638 | 4805-169375 | 04713 | MPS3638 | REF | | |
| Q111 | I4-U2 | Tstr, Type 2N1304 | 4805-117127 | 01295 | 2N1304 | 1 | 1 | |
| Q112 | I2-U2 | Tstr, Type 2N1305 | 4805-190298 | 95303 | 2N1305 | 1 | 1 | |
| Q113 | F1-S3 | Tstr, T.I. Type GA2875 | 4805-182691 | 01295 | GA2875 | 3 | 1 | |
| Q114 | F1-T2 | Tstr, T.I. Type GA2877 | 4805-182709 | 01295 | GA2877 | REF | | |
| R101 | C5-L1 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R102 | C4-K2 | Res, car flm, 900k ±1/2%, 1/2w (sheet 2 of 2) | 4703-107391 | 19701 | DC1/2A | 1 | | |
| R103 | C3-J5 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R104 | C3-M2 | Res, car flm, 10M ±1/2%, 1w (sheet 2 of 2) | 4703-107748 | 19701 | DC1 | 1 | | |
| R105 | C3-L1 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R106 | C2-K1 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R107 | C3-J3 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R108 | C3-J2 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R109 | C3-J1 | Res, car flm, matched set (sheet 2 of 2) | 1 | | | | | |
| R110 | C5-L3 | Res, car flm, 300k ±1%, 2w (sheet 2 of 2) | 4703-107425 | 12400 | Type C30 | 2 | | |
| R111 | F3-N4 | Res, comp, 47k ±5%, 1/4w | 4704-148163 | 01121 | CB4735 | 2 | | |
| R112 | F3-P3 | Res, comp, 100k ±5%, 1/4w | 4704-148189 | 01121 | CB1045 | 4 | | |
| R113 | E5-M5 | Res, comp, 470Ω ±5%, 1/4w | 4704-147983 | 01121 | CB4715 | 1 | | |

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| R114 | E1-N5 | Res, ww, 10Ω ±1%, 1/2w | 4707-193946 | 19429 | 4707-193946 | 1 | 1 | |
| R115 | G1-P1 | Res, comp, 1.2M ±10%, 1/2w (underneath cover) | 4704-108407 | 01121 | EB1251 | 1 | | |
| R116 | F3-M4 | Res, comp, 680k ±5%, 1/4w (underneath cover) | 4704-188433 | 01121 | CB6845 | 1 | | |
| R117 | G4-N1 | Res, var, comp, 5M ±30%, 0.2w | 4701-193086 | 71450 | U-70 | 1 | | |
| R118 | F3-P1 | Res, comp, 10M ±10%, 1/2w | 4704-108142 | 01121 | EB1061 | 1 | | |
| R119 | F3-N5 | Res, comp, 2.2M ±10%, 1/4w | 4704-198390 | 01121 | CB2255 | 1 | | |
| R120 | F2-N4 | Res, comp 47k ±5%, 1/4w | 4704-148163 | 01121 | CB4735 | REF | | |
| R121 | E4-R1 | Res, comp, 10Ω ±5%, 1/4w (underneath switch wafers) | 4704-147868 | 01121 | CB1005 | 1 | | |
| R122 | G1-R4 | Res, comp, 68k ±5%, 1/4w | 4704-148171 | 01121 | CB6835 | 2 | | |
| R123 | H1-T4 | Res, comp, 82k ±5%, 1/4w | 4704-188458 | 01121 | CB8235 | 1 | | |
| R124 | E2-Q5 | Res, comp, 22Ω ±5%, 1/4w (underneath switch wafers) | 4704-147884 | 01121 | CB2205 | 1 | | |
| R125 | E1-Q4 | Res, comp, 68Ω ±5%, 1/4w (underneath switch wafers) | 4704-147918 | 01121 | CB6805 | 1 | | |
| R126 | D5-Q4 | Res, comp, 220Ω ±5%, 1/4w (underneath switch wafers) | 4704-147959 | 01121 | CB2215 | 1 | | |
| R127 | H2-U4 | Res, comp, 10k ±5%, 1/4w | 4704-148106 | 01121 | CB1035 | 2 | | |
| R128 | H5-Q4 | Res, comp, 100k ±5%, 1/4w | 4704-148189 | 01121 | CB1045 | REF | | |
| R129 | H4-R1 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | 7 | | |
| R130 | I4-Q5 | Res, comp, 100k ±5%, 1/4w | 4704-148189 | 01121 | CB1045 | REF | | |
| R131 | I3-R3 | Res, comp, 100Ω ±5%, 1/4w | 4704-147926 | 01121 | CB1015 | 1 | | |
| R132 | J1-R4 | Res, comp, 39k ±5%, 1/4w | 4704-188466 | 01121 | CB3935 | 1 | | |
| R133 | H5-S1 | Res, comp, 10k ±5%, 1/4w | 4704-148106 | 01121 | CB1035 | REF | | |
| R134 | I2-S1 | Res, comp, 15k ±5%, 1/4w | 4704-148114 | 01121 | CB1535 | 2 | | |
| R135 | E5-U5 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | REF | | |
| R136 | D2-T1 | Res, met flm, 1.07k ±1%, 1/2w | 4705-187930 | 12400 | Type CEC-TO | 1 | | |
| R137 | D3-T1 | Res, met flm, 3.16k ±1%, 1/2w | 4705-187781 | 12400 | Type CEC-TO | 1 | | |
| R138 | D4-T1 | Res, met flm, matched set | 2 | | | | | |
| R139 | D5-T1 | Res, met flm, matched set | 2 | | | | | |
| R140 | E1-T1 | Res, met flm, matched set | 2 | | | | | |
| R141 | E2-T1 | Res, met flm, matched set | 2 | | | | | |
| R142 | E4-T1 | Res, met flm, matched set | 2 | | | | | |
| R143 | I4-S5 | Res, comp, 150k ±5%, 1/4w | 4704-182212 | 01121 | CB1545 | 3 | | |
| R144 | I4-T1 | Res, comp, 150k ±5%, 1/4w | 4704-182212 | 01121 | CB1545 | REF | | |
| R145 | H4-M4 | Res, comp, 150k ±5%, 1/4w | 4704-182212 | 01121 | CB1545 | REF | | |
| R146 | H4-T3 | Res, comp, 100k ±5%, 1/4w | 4704-148189 | 01121 | CB1045 | REF | | |
| R147 | H5-T4 | Res, comp, 15k ±5%, 1/4w | 4704-148114 | 01121 | CB1535 | REF | | |
| R148 | I5-T3 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | REF | | |
| R149 | H4-U3 | Res, comp, 3.9M ±5%, 1/4w | 4704-188417 | 01121 | CB3955 | 1 | | |
| R150 | H5-U3 | Res, comp, 68k ±5%, 1/4w | 4704-148171 | 01121 | CB6835 | REF | | |
| R151 | J1-P5 | Res, var, ww, 2k ±5%, 1-1/4w | 4702-160705 | 11237 | Type 110 | 2 | | |
| R152 | I4-P2 | Res, met flm, 7.5k ±1%, 1/2w | 4705-192161 | 12400 | Type CEC-TO | 1 | | |
| R153 | I3-P3 | Res, comp, 1k ±5%, 1/4w | 4704-148073 | 01121 | CB1025 | 3 | | |
| R154 | G3-T4 | Res, comp, 33k ±5%, 1/2w | 4704-108761 | 01121 | EB3335 | 1 | | |

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| R155 | F1-T4 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | REF | | |
| R156 | E5-T4 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | REF | | |
| R157 | | Res, met flm, 825Ω ±1%, 1/2w (not illustrated) | 4705-155119 | 19701 | MF7C-TO | 1 | | |
| R158 | I4-U1 | Res, comp, 1k ±5%, 1/4w | 4704-148023 | 01121 | CB1025 | REF | | |
| R159 | I3-U4 | Res, comp, 1k ±5%, 1/4w | 4704-148023 | 01121 | CB1025 | REF | | |
| S101 | D4-K3 | Switch, rotary, 4p, 19 pos, 3 sect (sheet 2 of 2) | 5105-194589 | 89536 | 5105-194589 | 1 | | |
| S102 | | Switch, section (not illustrated) | 5107-194027 | 76854 | Type FV | 1 | | |
| S103 | G5-P2 | Switch, twist, spdt | 5105-194936 | 89536 | 5105-194936 | 1 | | |
| V101, V102 | F4-Q3 | Photocell assembly | 3700-194449 | 89536 | 3700-194449 | 1 | | |
| | J2-M4 | Grommet, 3/8" | 2807-171876 | 89536 | 2807-171876 | 4 | 1 | |
| | E1-M4 | Grommet, 3/8" | 2807-171876 | 89536 | 2807-171876 | REF | | |
| | I3-V3 | Grommet, 3/8" | 2807-171876 | 89536 | 2807-171876 | REF | | |
| | D5-V3 | Grommet, 3/8" | 2807-171876 | 89536 | 2807-171876 | REF | | |
| | F3-S1 | Rod, optical | 3800-168047 | 89536 | 3800-168047 | 2 | | |
| | F5-S1 | Rod, optical | 3800-168047 | 89536 | 3800-168047 | REF | | |

These resistors are factory matched. If any replacement is required, an entire set, part number 4710-194415, must be ordered.

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

| REF DESIG | INDEX NO | DESCRIPTION | STOCK NO | MFR | MFR PART NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|---|---|---|
| A4 | | **POWER SUPPLY P/C ASSEMBLY** | | | | | | |
| | | **Figure 5-5** | | | | | | |
| | | Model 845A | 1702-194407 (845A-402) | 89536 | 1702-194407 | REF | | |
| | | Model 845AB | 1702-194555 (845AB-402) | 89536 | 1702-194555 | REF | | |
| C201 | G2-N5 | Cap, elect, 400 uf +50/-10%, 25v | 1502-168153 | 73445 | C437ARF400 | REF | | |
| C203 | H2-T1 | Cap, plstc, 1 uf ±20%, 250v | 1507-190330 | 73445 | C280AE/P1M | 1 | | |
| C204 | G4-U3 | Cap, elect, 400 uf +50/-10%, 4v | 1502-187773 | 73445 | C426ARE400 | REF | | |
| CR201 | H2-P3 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR202 | G3-Q1 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR203 | G4-Q2 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR204 | G4-R3 | Diode, IRC Type 4D4 | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR205 | H1-N4 | Diode, IRC Type 4D4 (845AB only) | 4802-180240 | 81483 | Type 4D4 | 2 | | |
| CR206 | G5-Q1 | Diode, IRC Type 4D4 (845AB only) | 4802-180240 | 81483 | Type 4D4 | REF | | |
| CR207 | | Diode, Type 1N961A (845A only) (not illustrated) | 4803-113324 | 07910 | 1N961A | 1 | 1 | |
| Q201 | H1-S1 | Tstr, T.I. Type GA2817 | 4805-182600 | 01295 | GA2817 | 2 | 1 | |
| Q202 | G5-S5 | Tstr, T.I. Type GA2817 | 4805-182600 | 01295 | GA2817 | REF | | |
| Q203 | H2-U4 | Tstr, T.I. Type GA2875 | 4805-182691 | 01295 | GA2875 | REF | | |
| Q204 | H4-U3 | Tstr, T.I. Type GA2875 | 4805-182691 | 01295 | GA2875 | REF | | |
| R201 | H2-N4 | Res, comp, 39Ω ±10%, 2w (845AB only) | 4704-144378 | 01121 | HB3901 | 1 | | |
| R202 | G5-N5 | Res, comp, 150Ω ±5%, 1w | 4704-178566 | 01121 | GB1515 | 1 | | |
| R205 | I3-P4 | Res, met flm, 9.53k ±1%, 1/2w (845AB only) | 4705-159442 | 12400 | Type CEC-TO | 1 | | |
| R206 | G4-T5 | Res, var, ww, 2k ±5%, 1-1/4w | 4702-160705 | 11237 | Type 110 | REF | | |
| R207 | H1-S3 | Res, comp, 5.1k ±5%, 1/2w | 4704-109108 | 01121 | EB5125 | 2 | | |
| R208 | H1-T2 | Res, comp, 5.1k ±5%, 1/2w | 4704-109108 | 01121 | EB5125 | REF | | |
| R209 | H3-U1 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | REF | | |
| R210 | H4-U1 | Res, comp, 22k ±5%, 1/4w | 4704-148130 | 01121 | CB2235 | REF | | |
| S201 | H5-N3 | Switch section (845A only) | 5107-194035 | 76854 | Type F | 1 | | |
| S201 | H5-N3 | Switch section (845AB only) | 5107-194019 | 76854 | Type FE | 1 | | |
| T201 | H5-R1 | Transformer, power | 5600-192724 | 89536 | 5600-192724 | 1 | | |
| T202 | I2-S4 | Transformer, drive | 5600-192708 | 89536 | 5600-192708 | 1 | | |
| T203 | I3-U3 | Transformer, isolation | 5600-192716 | 89536 | 5600-192716 | 1 | | |

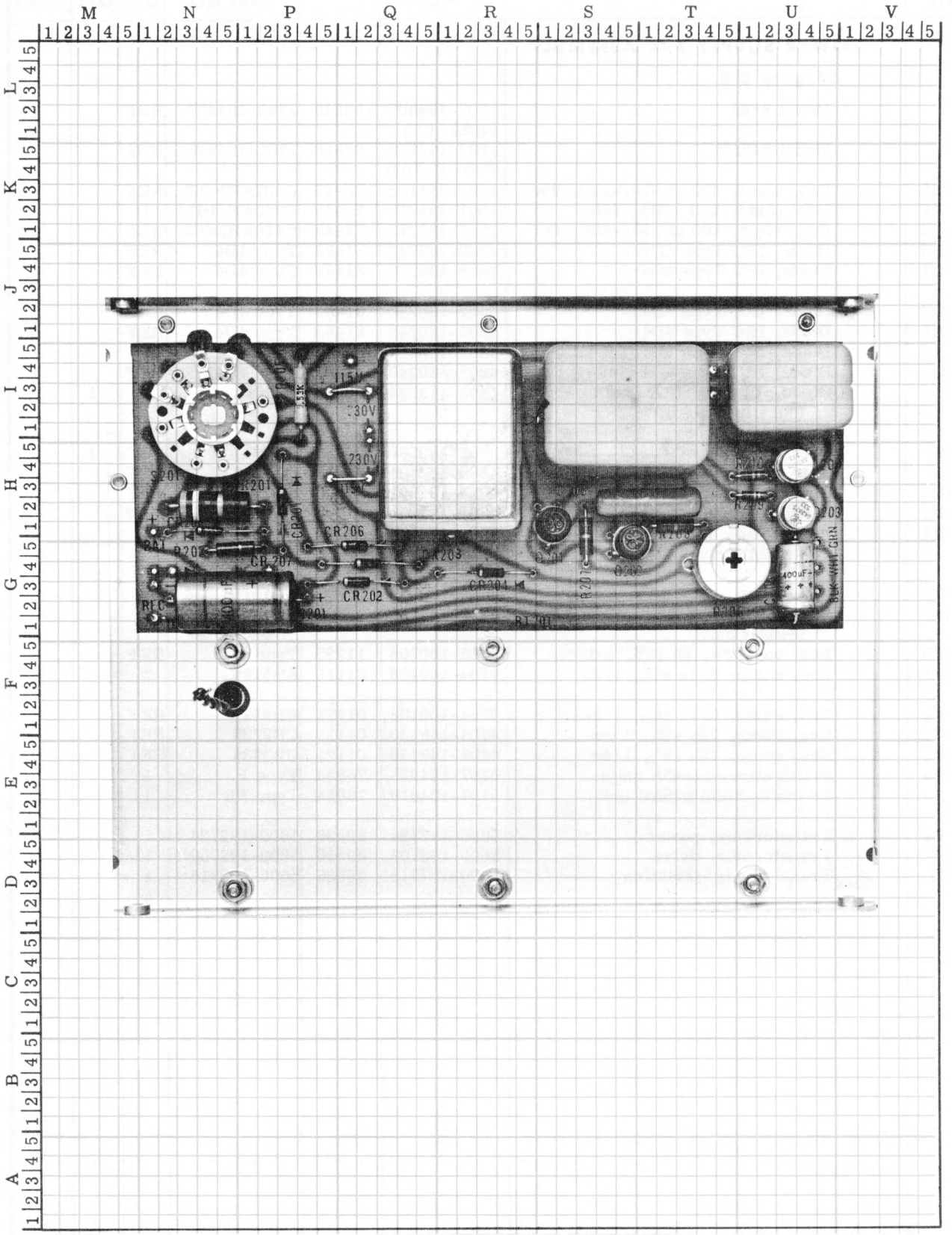


Figure 5-5. POWER SUPPLY P/C ASSEMBLY

## 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 845. 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 |
|---|---|
| A | Model 845A and 845AB, serial number 123 to 1011. |
| B | Model 845A and 845AB, serial number 1012 and on. |

# Appendix A
# Federal Supply Code for Manufacturers

## A-1. CODE TO NAME

A-2. The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213 Sage Electronics Corp.
Rochester, New York

00327 Welwyn International, Inc.
Westlake, Ohio

00656 Aerovox Corp.
New Bedford, Massachusetts

00779 AMP Inc.
Harrisberg, Pennsylvania

01121 Allen-Bradley Co.
Milwaukee, Wisconsin

01281 TRW Semiconductors
Lawndale, California

01295 Texas Instruments, Inc.
Semiconductor Components Div.
Dallas, Texas

01686 RCL Electronics Inc.
Manchester, New Hampshire

01730 Deleted

01884 Dearborn Electronics Inc.
Orlando, Florida

02114 Ferroxcube Corp.
Saugerties, New York

02606 Replaced by 15801

02660 Amphenol-Borg Elect. Corp.
Broadview, Illinois

02799 Arco Capacitors, Inc.
Los Angeles, California

03614 Replaced by 71400

03651 Replaced by 44655

03797 Eldema Corp.
Compton, California

03877 Transitron Electronic Corp.
Wakefield, Massachusetts

03888 Pyrofilm Resistor Co., Inc.
Cedar Knolls, New Jersey

03911 Clairex Corp.
New York, New York

03980 Muirhead Instruments, Inc.
Mountainside, New Jersey

04009 Arrow Hart and Hegemen
Electronic Company
Hartford, Connecticut

04062 Replaced by 72136

04202 Replaced by 81312

04217 Essex Wire Corp.
Wire & Cable Div.
Anaheim, California

04221 Aemco
Div. of Midtex Inc.
Mankato, Minnesota

04645 Replaced by 75376

04713 Motorola Semiconductor
Products Inc.
Phoenix, Arizona

05082 Replaced by 94154

05236 Jonathan Mfg. Co.
Fullerton, California

05277 Westinghouse Electric Corp.
Semiconductor Dept.
Youngwood, Pennsylvania

05278 Replaced by 43543

05397 Union Carbide Corp.
Electronics Div.
Cleveland, Ohio

05571 Sprague Electric Co
Pacific Div.
Los Angeles, California

05704 Alac, Inc.
Glendale, California

05820 Wakefield Engineering Ind.
Wakefield, Massachusetts

06001 General Electric Company
Capacitor Department
Irmo, South Carolina

06136 Replaced by 63743

06473 Amphenol Space & Missile Sys.
Chatsworth, California

06555 Beede Electrical Instrument Co.
Penacook, New Hampshire

06739 Electron Corp.
Littletown, Colorado

06743 Clevite Corp.
Cleveland, Ohio

06751 Semcor Div. Components
Phoenix, Arizona

06860 Gould National Batteries Inc.
City of Industry, California

06980 Eitel-McCullough, Inc.
San Carlos, California

07115 Replaced by 14674

07138 Westinghouse Electric Corp.
Electronic Tube Div.
Elmira, New York

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

07344 Bircher Co., Inc.
Rochester, New York

07792 Lerma Engineering Corp.
Northampton, Massachusetts

07910 Continental Device Corp.
Hawthorne, California

08530 Reliance Mica Corp.
Brooklyn, New York

08792 CBS Electronics Semiconductor
Operations-Div. of CBS Inc.
Lowell, Massachusetts

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

08863 Nylomatic Corp.
Norrisville, Pennsylvania

08988 Skottie Electronics Inc.
Archbald, Pennsylvania

09922 Burndy Corp.
Norwalk, Connecticut

11237 Chicago Telephone of Calif. Inc.
South Pasadena, California

11358 CBS Electronics
Div. of CBS Inc.
Newburyport, Massachusetts

11403 Best Products Co.
Chicago, Illinois

11503 Keystone Mfg.
Div. of Avis Industrial Corp.
Warren, Michigan

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

12323 Presin Co., Inc.
Shelton, Connecticut

12327 Freeway Washer & Stamping Co.
Cleveland, Ohio

12400 Replaced by 75042

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

13606 Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839 Replaced by 23732

14099 Semtech Corp.
Newbury Park, California

14193 California Resistor Corp.
Santa Monica, California

14298 American Components, Inc.
Conshohocken, Pennsylvania

14655 Cornell-Dubilier Electronics
Newark, New Jersey

14674 Corning Glass Works
Corning, New York

14752 Electro Cube Inc.
San Gabriel, California

14869 Replaced by 96853

15636 Elec-Trol Inc.
Northridge, California

15801 Fenwal Electronics Inc.
Framingham, Massachusetts

15818 Amelco Semiconductor
Div. of Teledyne Inc.
Mountain View, California

15849 Useco, Inc.
Mt. Vernon, New York

15909 Replaced by 17870

16332 Replaced by 28478

16473 Cambridge Scientific Ind. Inc.
Cambridge, Maryland

16742 Paramount Plastics
Downey, California

16758 Delco Radio
Div. of General Motors
Kokomo, Indiana

17069 Circuit Structures Lab.
Upland, California

17856 Siliconix, Inc.
Sunnyvale, California

17870 Daven-Div. of Thomas A. Edison
Ind. --McGraw-Edison Co.
Manchester, New Hampshire

18083 Deleted

18178 Vactec Inc.
Maryland Heights, Missouri

18736 Voltronics Corp.
Hanover, New Jersey

19429 Montronics, Inc.
Seattle, Washington

19451 Perine Machinery & Supply Co.
Seattle, Washington

19701 Electra Mfg. Co.
Independence, Kansas

20584 Enochs Mfg. Co.
Indianapolis, Indiana

22767 ITT Semiconductors
Div. of ITT
Palo Alto, California

23732 Tracor
Rockville, Maryland

24248 Southco
Div. of South Chester Corp.
Lester, Pennsylvania

24655 General Radio Co.
West Concord, Massachusetts

25403 Amperex Electronic Corp
Semiconductor & Receiving
Tube Division
Slatersville, Rhode Island

28478 Deltrol Controls Corp.
Milwaukee, Wisconsin

28520 Heyman Mfg. Co.
Kenilworth, New Jersey

30323 Illinois Tool Works Inc.
Chicago, Illinois

33173 General Electric Co.
Tube Dept.
Owensboro, Kentucky

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

38315 Honeywell Inc.
Precision Meter Div.
Manchester, New Hampshire

42498 National Company
Melrose, Massachusetts

43543 Nytronics Inc.
Transformer Co. Div.
Alpha, New Jersey

44655 Ohmite Mfg. Co
Skokie, Illinois

49671 Radio Corp. of America
New York, New York

49956 Raytheon Company
Lexington, Maine

53021 Sangamo Electric Co.
Springfield, Illinois

55026 Simpson Electric Company
Chicago, Illinois

56289 Sprague Electric Co.
North Adams, Massachusetts

58474 Superior Electric Co.
Bristol, Connecticut

60399 Torrington Mfg. Co.
Torrington, Connecticut

62460 Deleted

63743 Ward Leonard Electric Co.
Mount Vernon, New York

64834 West Mfg. Co.
San Francisco, California

65092 Weston Instruments Inc.
Newark, New Jersey

66150 Winslow Tele-Tronics Inc.
Asbury Park, New Jersey

70563 Amperite Company
Union City, New Jersey

70903 Belden Mfg. Co.
Chicago, Illinois

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

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

71450 CTS Corp.
Elkhart, Indiana

71468 ITT Cannon Electric Inc.
Los Angeles, California

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

71590 Centralab
Div. of Globe Union Inc.
Milwaukee, Wisconsin

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

71744 Chicago Miniature Lamp Works
Chicago, Illinois

71785 Cinch Mfg. Co. & Howard
B. Jones Div.
Chicago, Illinois

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

72092 Replaced by 06980

72136 Electro Motive Mfg. Co.
Willimantic, Connecticut

72259 Nytronics Inc.
Berkeley Heights, New Jersey

72354 Deleted

72619 Dialight Corp
Brooklyn, New York

72653 G. C. Electronics
Rockford, Illinois

72665 Replaced by 90303

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

72928 Gudeman Co.
Chicago, Illinois

72982 Erie Tech. Products Inc.
Erie, Pennsylvania

73138 Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293 Hughes Aircraft Co.
Electron Dynamics Div.
Newport Beach, California

73445 Amperex Electronic Corp.
Hicksville, New York

73559 Carling Electric Inc.
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.
Brooklyn, New York

73949 Guardian Electric Mfg. Co.
Chicago, Illinois

74199 Quam Nichols Co.
Chicago, Illinois

74217 Radio Switch Corp.
Marlboro, New Jersey

74276 Signalite Inc.
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 IRC Inc.
Philadelphia, Pennsylvania

75376 Kurz-Kasch, Inc.
Dayton, Ohio

75382 Kulka Electric Corp.
Mt. Vernon, New York

75915 Littlefuse Inc.
Des Plaines, Illinois

76854 Oak Mfg. Co.
Crystal Lake, Illinois

77342 Potter & Brumfield
Div. of Amer. Machine & Foundry
Princeton, Indiana

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

78189 Shakeproof
Div. of Illinois Tool Works
Elgin, Illinois

78277 Sigma Instruments, Inc.
South Braintree, Massachusetts

78488 Stackpole Carbon Co.
St. Marys, Pennsylvania

78553 Tinnerman Products
Cleveland, Ohio

79136 Waldes Kohinoor Inc.
Long Island City, New York

79497 Western Rubber Company
Goshen, Indiana

79963 Zierick Mfg. Corp.
New Rochelle, New York

80031 Mepco
Div. of Sessions Clock Co.
Morristown, New Jersey

80145 API Instruments Co.
Chesterland, Ohio

80183 Sprague Products
North Adams, Massachusetts

80294 Bourns Inc.
Riverside, California

80583 Hammarlund Co., Inc.
Mars Hill, North Carolina

80640 Stevens, Arnold Inc.
Boston, Massachusetts

81073 Grayhill Inc.
La Grange, Illinois

81312 Winchester Electronics
Div. of Litton Industries
Oakville, Connecticut

81439 Therm-O-Disc Inc.
Mansfield, Ohio

81483 International Rectifier Corp.
El Segundo, California

81590 Korry Mfg. Co.
Seattle, Washington

82376 Deleted

82389 Switchcraft Inc.
Chicago, Illinois

82415 Price Electric Corp.
Frederick, Maryland

82872 Roanwell Corp.
New York, New York

82877 Rotron Mfg. Co., Inc.
Woodstock, New York

82879 ITT Wire & Cable Div.
Pawtucket, Rhode Island

83003 Varo Inc.
Garland, Texas

83298 Bendix Corp.
Electric Power Division
Eatontown, New Jersey

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

83478 Rubbercraft Corp. of America
New Haven, Connecticut

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

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

84171 Arco Electronics, Inc.
Great Neck, New York

84411 TRW
Ogallala, Nebraska

86577 Precision Metal Products
Stoneham, Massachusetts

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

86689 Deleted

87034 Marco-Oak Inc.
Anaheim, California

88419 Use 14655

88690 Replaced by 04217

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

89730 Replaced by 08806

90201 Mallory Capacitor Co.
Indianapolis, Indiana

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

90211 Square D Co.
Chicago, Illinois

90303 Mallory Battery Co.
Tarrytown, New York

91293 Johanson Mfg. Co.
Boonton, New Jersey

91407 Replaced by 58474

91637 Dale Electronics Inc.
Columbus, Nebraska

91662 Elco Corp.
Willow Grove, Pennsylvania

91737 Gremar Mfg. Co., Inc.
Wakefield, Massachusetts

91802 Industrial Devices, Inc.
Edgewater, New Jersey

91836 King's Electronics
Tuckahoe, New York

91929 Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934 Miller Electric Co., Inc.
Pawtucket, Rhode Island

93332 Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145 Replaced by 49956

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

95146 Alco Electronics Products Inc.
Lawrence, Massachusetts

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

95264 Replaced by 98278

95275 Vitramon Inc.
Bridgeport, Connecticut

95303 Radio Corp. of America
Solid State & Receiving Tube Div.
Cincinnati, Ohio

95354 Methode Mfg. Corp.
Rolling Meadows, Illinois

95712 Dage Electric Co., Inc.
Franklin, Indiana

95987 Weckesser Co., Inc.
Chicago, Illinois

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

96853 Rustrak Instrument Co.
Manchester, New Hampshire

96881 Thomson Industries, Inc.
Manhasset, New York

97540 Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Los Angeles, California

97913 Industrial Electronic Hdware Corp.
New York, New York

97945 White, S. S. Co.
Plastics Div.
New York, New York

97966 Replaced by 11358

98094 Replaced by 49956

98278 Microdot Inc.
Pasadena, California

98291 Sealectro Corp.
Conhex Div
Mamaroneck, New York

98388 Accurate Rubber & Plastics
Culver City, California

98743 Replaced by 12749

98925 Deleted

99120 Plastic Capacitors, Inc.
Chicago, Illinois

99217 Southern Electronics Corp.
Burbank, California

99515 Marshall Industries
Capacitor Div.
Monrovia, California

Appendix C

# Sales Representatives & Service Centers

**ALABAMA**

**HUNTSVILLE**
BCS Associates, Inc.
2317 Bob Wallace Ave.
P.O. Box 1273
Tel. (205) 881-6220
Zip 35807

**ALASKA**

**SEATTLE**
Showalter-Judd, Inc.
1806 S. Bush Place
Seattle, Washington 98144
Tel. (206) 324-7911

**ARIZONA**

***PHOENIX**
Barnhill Associates
537 E. Osborn Road, Suite 4
Tel. (602) 263-1250
Zip 85012

**CALIFORNIA**

****LOS ANGELES**
Instrument Specialists, Inc.
1109 S. Central Ave.
Glendale, California 91204
Tel (213) 245-9404

***SANTA CLARA**
Instrument Specialists, Inc.
2359 De La Cruz Blvd.
Tel. (408) 244-1505
Zip 95050

**SAN DIEGO**
Instrument Specialists, Inc.
1901 State St.
Tel. (714) 232-2017
Zip 92101

**COLORADO**

***DENVER**
Barnhill Associates
1170 S. Sheridan Blvd.
Tel. (303) 934-5505
Zip 80226

**CONNECTICUT**

**HARTFORD**
Instrument Representatives, Inc.
P. O. Box 165
Glastonbury, Connecticut 06033
Tel (203) 633-0777

**FLORIDA**

****ORLANDO**
BCS Associates, Inc.
940 N. Fern Creek Ave.
P.O. Box 6578
Tel. (305) 843-1510
Zip 32803

**GEORGIA**

**ATLANTA**
BCS Associates, Inc.
1230 Briar Hill Dr.
Tel. (404) 874-9925
Zip 30306

**HAWAII**

**HONOLULU**
Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 533-6095
Zip 96817

**ILLINOIS**

****CHICAGO**
Cozzens & Cudahy, Inc.
9501 W. Devon Ave.
Rosemont, Illinois 60018
Tel. (312) 825-1144

**INDIANA**

**INDIANAPOLIS**
Cozzens & Cudahy, Inc.
Port O'Call Executive Ctr.
21 Beachway Drive
Tel. (317) 244-2456
Zip 46234

**MARYLAND**

****BALTIMORE**
Electronic Marketing Assoc. Inc.
11501 Huff Court
Kensington, Maryland 20795
Tel. (301) 881-5300

**MASSACHUSETTS**

****BOSTON**
Instrument Representatives, Inc.
1046 Massachusetts Avenue
Arlington, Massachusetts 02174
Tel. (617) 646-1034

**MICHIGAN**

**DETROIT**
WKM Associates, Inc.
1474 East Outer Dr.
Tel. (313) 892-2500
Zip 48234

**MINNESOTA**

**MINNEAPOLIS**
Cozzens & Cudahy, Inc.
7450 France Ave. So.
Tel. (612) 920-1022
Zip 55435

**MISSOURI**

**ST. LOUIS**
Cozzens & Cudahy, Inc.
P. O. Box 10013
Lambert Field - Zip 63145
Tel. (314) 423-1234

**NEW JERSEY**

****NEWARK**
SBM Associates, Inc.
1519 Stuyvesant Avenue
Union, New Jersey 07083
Tel. (201) 687-8737

**NEW MEXICO**

***ALBUQUERQUE**
Barnhill Associates
1410—D Wyoming N.E.
Tel. (505) 299-7658
Zip 87110

**NEW YORK**

***NEW YORK**
SBM Associates, Inc.
28 Hobby Street
Pleasantville, N. Y. 10570
Tel. (914) 769-1811

****ROCHESTER**
SBM Associates, Inc.
4515 Culver Rd.
Tel. (716) 266-1400
Zip 14622

**NORTH CAROLINA**

**GREENSBORO**
BCS Associates, Inc.
1039 E. Wendover Ave.
P.O. Box 6426
Tel. (919) 273-1918
Zip 27405

**OHIO**

***CLEVELAND**
WKM Associates, Inc.
16141 Puritas Ave.
Tel. (216) 267-0445
Zip 44135

***DAYTON**
WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45429

**OREGON**

**PORTLAND**
Showalter-Judd, Inc.
1445 N. E. Arrington
Hillsboro, Oregon 97123
Tel. (503) 648-6372

**PENNSYLVANIA**

**PHILADELPHIA**
Electronic Marketing Assoc.
210 Goddard Blvd.—Suite 100
King of Prussia, Pennsylvania
Tel (215) 248-5050
Zip 19406

**PITTSBURGH**
WKM Associates, Inc.
90 Clairton Blvd.
Tel. (412) 892-2953
Zip 15236

**TEXAS**

***DALLAS**
Barnhill Associates
Suite 220
312 N. Central Express Wy.
Richardson, Texas 75080
Tel. (214) 231-2573

***HOUSTON**
Barnhill Associates
Suite 332
3810 Westheimer
Tel. (713) 621-0040
Zip 77027

**EAST VIRGINIA**

**WILLIAMSBURG**
BCS Associates, Inc.
107 Rich Neck Road
Tel. (703) 229-5108
Zip 23185

**WASHINGTON**

**SEATTLE**
Showalter-Judd, Inc.
1806 S. Bush Place
Seattle, Washington 98144
Tel. (206) 324-7911

## CANADA

**BRITISH COLUMBIA**

**VANCOUVER**
Allan Crawford Associates, Ltd.
1820 Pandora St.
Tel. (604) 253-7136

**ONTARIO**

***MALTON**
Allan Crawford Associates, Ltd.
6427 Northam Drive.
Tel. (416) 678-1500

**OTTAWA, 3**
Allan Crawford Associates, Ltd.
376 Churchill Ave. — Suite 106
Tel. (613) 725-3354

**QUEBEC**

**LONGUEUIL**
Allan Crawford Associates, Ltd.
157 (rue) St. Charles Street W.
Tel. (514) 670-1212

**DOMESTIC SERVICE CENTERS**

*** DESIGNATES FLUKE REGIONAL SERVICE CENTER
** DESIGNATES REPRESENTATIVE OFFICES WITH SERVICE CENTERS
* DESIGNATES REPRESENTATIVE OFFICES SERVED BY AUTHORIZED CONTRACT SERVICE LABORATORIES

# INTERNATIONAL REPRESENTATIVES

**ARGENTINA**

Coasin S.A.
Virrey del Pino 4071
Buenos Aires, Argentina

**AUSTRALIA**

Elmeasco Instruments
7 Chard Road
P.O. Box 324
Brookvale, N.S.W. Australia 2100

**AUSTRIA**

Kontron GMBH & Co., Kg.
Lederergasse 16
1080 Wien
Austria

**BELGIUM**

C. N. Rood S/A
37, Place de Jamblinne de Meux
B-1040 Brussels, Belgium

**BRAZIL**

AMBRIEX S.A.
Av. Graca Aranha
226—6° And.
Rio De Janeiro, Brazil

AMBRIEX S.A.
Av. Pacaembu, 811
Sao Paulo, Brazil

**CHILE**

Coasin Chile Ltd.
Casilla 14588
Correo 15
Santiago, Chile

**DENMARK**

Tage Olsen A/S
1, Ronnegade
Copenhagen 0, Denmark

**FINLAND**

Oy Findip AB
Postbox 52025
Helsinki 52, Finland

**FRANCE**

Radio Equipment Antares
9, Rue Ernest Cognacq
92 Levallois — Perret
France

**HONG KONG**

Gilman & Co. Ltd.
P.O. Box 56
Hong Kong

**INDIA**

Hinditron Services Pvt. Ltd.
69/A Nepean Sea Road
Bombay 6, India

**ISRAEL**

R.D.T. Electronics Eng'r. Ltd.
P.O. Box 21082
Tel-Aviv, Israel

**ITALY**

Elettronucleonica S.P.A.
7, P.zza De Angeli
20146 Milano, Italy

**JAPAN**

Toyo Trading Co., Ltd.
P.O. Box 5014
International Tokyo
Japan

2-38 Junkeicho-dori
Minami-ku, Osaka, Japan

**KOREA**

M-C International
I.P.O. Box 1355
Seoul, Korea

**MALAYSIA**

O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu
East Malaysia

P.O. Box 91
Pataling Jaya
West Malaysia

**MEXICO**

Mexitek, S.A.
Eugenia 408
Departments 1 y 5
Mexico 12, D.F.

**THE NETHERLANDS**

C.N. Rood N.V.
Post Office Box 4542
Rijswijk (Z.H.) 2100
The Netherlands

Fluke (Nederland) N.V.
Post Office Box 5053
Industrieterrein Noord
Tilburg, The Netherlands

**NEW ZEALAND**

Elmeasco Instruments (Pty) Ltd.
P.O. Box 213
Mt. Waverley, Vic. 3149
Australia

**NORWAY**

Morgenstierne & Co. A/S
P.B. 6688 Rodelokka
Oslo 6, Norway

**SINGAPORE**

O'Connor's (Pte) Ltd.
Maybank House 124-126
Robinson Road
Singapore 1, Singapore

**SOUTH AFRICA**

K. Baker (Pty.) Ltd.
P.O. Box 1257
Johannesburg, So. Africa

P.O. Box 3641
Cape Town, So. Africa

P.O. Box 2143
Durban, So. Africa

**SPAIN**

Rema Leo Haag, S.A.
General Sanjurjo 18
Madrid 3, Spain

**SWEDEN**

Erik Ferner AB
Box 56
161.26 Stockholm-Bromma,
Sweden

**SWITZERLAND**

Kontron Electronic A.G.
Hardstrasse 235
P.O. Box 193
8031 Zurich
Switzerland

**TAIWAN-REPUBLIC OF CHINA**

Heighten Trading Co., Ltd.
P.O. 1408
Taipel, Taiwan, 104

**THAILAND**

G.Simon Radio Ltd.
30 Patpong Avenue
Suriwong
Bangkok, Thailand

**THE UNITED KINGDOM**

Fluke International Corp.
Garnet Close
Watford, WD2 4TT
England

**URUGUAY**

Coasin Uruguaya S.A.
Cerrito 617 - 4° Piso
Montevideo, Uruguay

**VENEZUELA**

Coasin C.A.
APDO, Postal 50939
Sabana Grande No. 1
Caracas, Venezuela

**WEST GERMANY**

Fey Elektronische Messgeraete
8000 Muenchen 2
Horemansstrasse 28
West Germany

*In Europe, contact FLUKE NEDERLAND, N.V., POST OFFICE BOX 5053, INDUSTRIETERREIN NOORD, TILBURG, THE NETHERLANDS*

**FLUKE REGIONAL SERVICE CENTER; THE NETHERLANDS**

FLUKE (NEDERLAND) N.V.
P. O. BOX 5053
TILBURG, THE NETHERLANDS

**FLUKE REGIONAL SERVICE CENTER, UNITED KINGDOM**

FLUKE INTERNATIONAL CORP.
GARNET CLOSE
WATFORD, WD2 4TT
ENGLAND

**AUTHORIZED SERVICE LABORATORIES INTERNATIONAL**

EACH INTERNATIONAL REPRESENTATIVE IS EQUIPPED WITH AN AUTHORIZED SERVICE LABORATORY. PLEASE REFER TO THE INTERNATIONAL REPRESENTATIVE LISTING FOR YOUR SERVICE NEEDS.