8600A

Digital Multimeter

Instruction Manual

P/N 391409
NOVEMBER 1974 Rev. 3, 1/77

FLUKE ®

WARRANTY

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

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

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

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

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

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

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

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

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

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

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

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Table of Contents

(continued on page ii)

TABLE OF CONTENTS, *continued*

(continued on page iii)

TABLE OF CONTENTS, *continued*

List of Illustrations

(continued on page v)

LIST OF ILLUSTRATIONS, *continued*

List of Tables

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 8600A is a compact and light-weight digital multimeter (DMM). It features a 4½ digit display, push-button selection of range and function, auto polarity, self locating decimal point, self zeroing to eliminate offset uncertainties, and overload protection for all ranges. Auto-ranging can be selected when the ac volts, dc volts or kil-ohms functions are selected. Several options and accessories for the 8600A are available (see Section 6).

1-3. Push-button controls allow the selection of five ac and dc voltage ranges, five ac and dc current ranges, and six resistance ranges. The measurement capabilities of the 8600A range from 10 microvolts to 1199.9 volts ac and dc, 10 nanoamperes to 1.9999 amperes ac and dc, and 10 milliohms to 19.999 megohms.

1-4. The front-panel readout features a 4½ digit display using light emitting diodes (LED's). The display includes a self locating decimal point and a + or – polarity indicator. Full-scale readout is 19999 for all ranges and functions except the 1200 volt ac and dc range, which is 11999. A blinking 18888 readout indicates that the 8600A is being operated in an overload condition and provides a test for all segments in the display.

1-5. Front panel input connectors are banana type and provide separate connections for current, and volt-ohm inputs. Both the current and volt-ohm inputs are referenced to a common input which is isolated from earth ground and can operate at a potential of up to ±1000V dc or peak V ac with reference to earth ground.

1-6. The overload features of the 8600A include a fused current input and an overvoltage protected volt-ohm input. This protection applies for any function and range selected.

1-7. Several options and accessories are available for use with the 8600A. The options are listed and described in Table 1-1, and must be specified at time of purchase. The accessories are listed and described in Table 1-2. Accessories are compatible with all options and can be ordered at time of purchase or after purchase. Detailed information concerning each option and accessory is given in Section 6 of this manual.

Table 1-1. 8600A OPTIONS

MODEL NO	DESCRIPTION
8600A-01	Basic unit w/battery option
8600A-02	Basic unit w/data output unit

Table 1-2. 8600A ACCESSORIES

MODEL NO.	DESCRIPTION
C80	Vinyl Carrying Case w/strap
C86	Molded Hard-Shell Carrying Case
A80	Deluxe Test Lead Kit
801–600	Clamp-on AC Current Probe (2A to 600A)
80K–40	High Voltage Probe; 1kV to 40kV
81RF	RF Probe: 100kHz to 100 MHz
80RF–1	RF Probe 100 kHz to 500 MHz
M00-100-714	Front Panel Cover
M00-200-611	Rack Mount, Center
M00-200-612	Rack Mount, Offset Left or Right
M00-200-613	Rack Mount, Side-by-Side

1-8 Input power for the 8600A is switch selectable to provide operation at either 115 Vac or 230 Vac, 50 Hz or 60 Hz. The 8600A will also operate from 100 Vac, 50 Hz or 60 Hz, when in the 115V switch position. The 8600A-01 (battery power option) is configured at the factory for 115 Vac, or 230 Vac, 50 Hz or 60 Hz line power operation. The battery power option must not be operated from any other line voltage or frequency than that for which it is configured (see decal on bottom of case). The operation of the front panel controls is the same for all power configurations of the 8600A, 8600A-01, and 8600A-02 instruments.

1-9. SPECIFICATIONS

1-10. Specifications for the Model 8600A are presented in Table 1-3, under headings of DC VOLTAGE, AC VOLTAGE, DC CURRENT, AC CURRENT, OHMS, and GENERAL. Specifications for each option are listed under the option heading.

Table 1-3. MODEL 8600A SPECIFICATIONS

DC VOLTAGE	
Ranges	±200 mV, ±2V, ±20V, ±200V, ±1200V
Accuracy:	6 Months (15°C to 35°C)
200 mV range	±(0.04% of input +0.01% of range)
2V, 20V, and 200V ranges	±(0.02% of input +0.005% of range)
1200V range	±(0.02% of input +0.008% of range)
Temperature Coefficient:	
200 mV range	±(0.003% of input +0.001% of range)/°C
2V to 1200V ranges	±(0.001% of input +0.0005% of range)/°C
Input Impedance:	
200 mV and 2V ranges	> 1000 megohms
20V, 200V and 1200V ranges	10 megohms
Normal Mode Rejection	60 dB minimum @ 50 Hz, 60 Hz
Common Mode Rejection	120 dB minimum @ dc and 50 Hz, 60 Hz (with 1kΩ in either lead)
Zero Stability	Auto zeroed on all ranges
Ranging	Full autoranging, or manual ranging
Polarity	Automatic bipolar, + or — display
Overload	±1200V dc or 1700V peak ac applied continuously to any range.
Response Time to Rated Accuracy Within Range	1 second maximum to displayed input
AC VOLTAGE	
Ranges	200 mV, 2V, 20V, 200V, 1200V
Accuracy:	6 Months (15°C to 35°C)
200 mV range (100% to 1% of range)	30 Hz - 50 Hz; ±(0.5% of input +0.10% of range) 50 Hz - 10 kHz; ±(0.2% of input +0.08% of range) 10 kHz - 50 kHz; ±(0.5% of input + 0.10% of range) 50 kHz - 100 kHz; ±(0.5% of input + 0.5% of range)
2V, 20V and 200V ranges (100% to 1% of range)	50 Hz - 10 kHz; ±(0.2% of input + 0.015% of range) 30 Hz - 50 Hz and 10 kHz - 50 kHz; ±(0.5% of input + 0.025% of range) 50 kHz - 100 kHz; ±(1.0% of input + 0.05% of range)

Table 1-3. MODEL 8600A SPECIFICATIONS

1200V range (100% to 1% of range)		10V to 500V, 50 Hz - 10 kHz; ±(0.2% of input +0.03% of range) 500V - 1200V, 50 Hz - 10 kHz; ± (0.37% of input + 0.03%) or range) 10V to 1200V, 30 Hz to 50 Hz, 10 kHz to 20 kHz, ±(0.5% of input +0.08% of range)
Temperature Coefficient:		
200 mV range		±(0.015% of input + 0.005% of range)/°C
2V to 1200V ranges		±(0.01% of input + 0.002% of range)/°C
Input Impedance		2 megohms shunted by less than 100 pf
Response Time to Rated Accuracy Within Range		1.5 seconds maximum to displayed input
Overload		1200V rms, 1700V peak ac applied continuously to any range - not to exceed 2×10^7 V Hz product (20 kHz max at 1000V)
Ranging		Full autoranging, or manual ranging
DC CURRENT		
Ranges		200 μA, 2 mA, 20 mA, 200 mA, 2000 mA
Ranging		Manual ranging
Accuracy:	6 Months (15°C to 35°C)	
All Ranges		±(0.1% of input + 0.01% of range) on all ranges
Temperature Coefficient:		
All Ranges		±(0.003% of input + 0.001% of range)/°C
Voltage Burden		0.25V maximum up to 200mA: 0.5V maximum up to 2A
Overload		Protected to 2A on all ranges: fused above 2A
Response Time to Rated Accuracy Within Range		1 second maximum to displayed input
AC CURRENT		
Ranges		200μA, 2 mA, 20 mA, 200 mA, 2000 mA
Ranging		Manual ranging
Accuracy:	6 Months (15°C to 35°C)	
		50 Hz - 10 kHz; ±(0.3% of input + 0.08% of range) all ranges (except 2000 mA range 50 Hz - 5 kHz) 30 Hz - 50 Hz; ±(0.6% of input + 0.1% of range) all ranges
Temperature Coefficient:		
All Ranges		±(0.015% of input + 0.005% of range)/°C
Voltage Burden		0.25V maximum up to 200mA: 0.5V maximum at 2A
Overload		Protected to 2A on all ranges, fused above 2A
Response Time		1 sec. max. to rated accuracy
OHMS		
Ranges		200Ω, 2kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ
Ranging		Full autoranging, or manual ranging

Table 1-3. MODEL 8600A SPECIFICATIONS

Accuracy:	6 Months (15°C to 35°C)
200Ω range	±(0.1% of input + 0.015% of range)
2kΩ	±(0.1% of input + 0.005% of range)
20 kΩ to 2000 kΩ ranges	±(0.05% of input + 0.005% of range)
20 MΩ	±(0.2% of input + 0.005% of range)
Temperature Coefficient:	
2kΩ to 2000 kΩ ranges	±(0.003% of input +0.0005% of range)/°C
200 Ω and 20 MΩ range	±(0.005% of input + 0.001% of range)/°C
Configuration	Two wire
Overvoltage Protection	250V rms or dc, applied continuously
Maximum Open Circuit Voltage	5 volts
Response Time:	
200 Ω to 2000 kΩ ranges	1 second maximum to displayed input
20 MΩ range	4 seconds maximum to displayed input

Current Through Unknown

200Ω	2kΩ	20 kΩ	200 kΩ	2000 kΩ	20 MΩ
1mA	1mA	100μA	10μA	1μA	0.1μA

GENERAL

Display	Seven-segment LED .3" character height, automatic decimal location
Size	8.55" wide x 2.52" high x 10.65" deep (See Figure 1-1) 21.72 cm x 6,40 cm x 27,05 cm
Weight	3.5 lbs. (1.6 kg) line power, 4.5 lbs. (2.1 kg) with batteries
Operating Temperatures	0°C to +50°C
Storage Temperature	–40°C to +75°C (–40°C to + 60°C with batteries)
Humidity Range	80% RH, +5°C to +35°C 70% RH, +35°C to +50°C
Overload Indication	Flashing display of +18888 (built in segment test of LED display) for out of range indication
Maximum Common Mode Voltage	±1000V, dc or peak ac
Power	100/115/230V ac ±10% 50 or 60 Hz, 7 watts line powered 10 watts battery powered

BATTERY PACK, OPTION –01

Continuous Operation	8 hours typical (6 hours minimum)
Charge Time	16 hours maximum (@ < 30°C ambient to achieve full charge).

DATA OUTPUT UNIT (DOU), OPTION –02

Available Data	Digits, polarity (both logic senses), range, and reference output
Data Coding	8-4-2-1 BCD positive true parallel
Logic Levels	1 = +5V, 0 = 0V
Drive Capability	All output can drive a minimum of two TTL loads. (i.e. sink 3.2 mA)
Flags	Busy, $\overline{\text{busy}}$, and overload
Controls	External trigger (positive going edge trigger), and External trigger enable

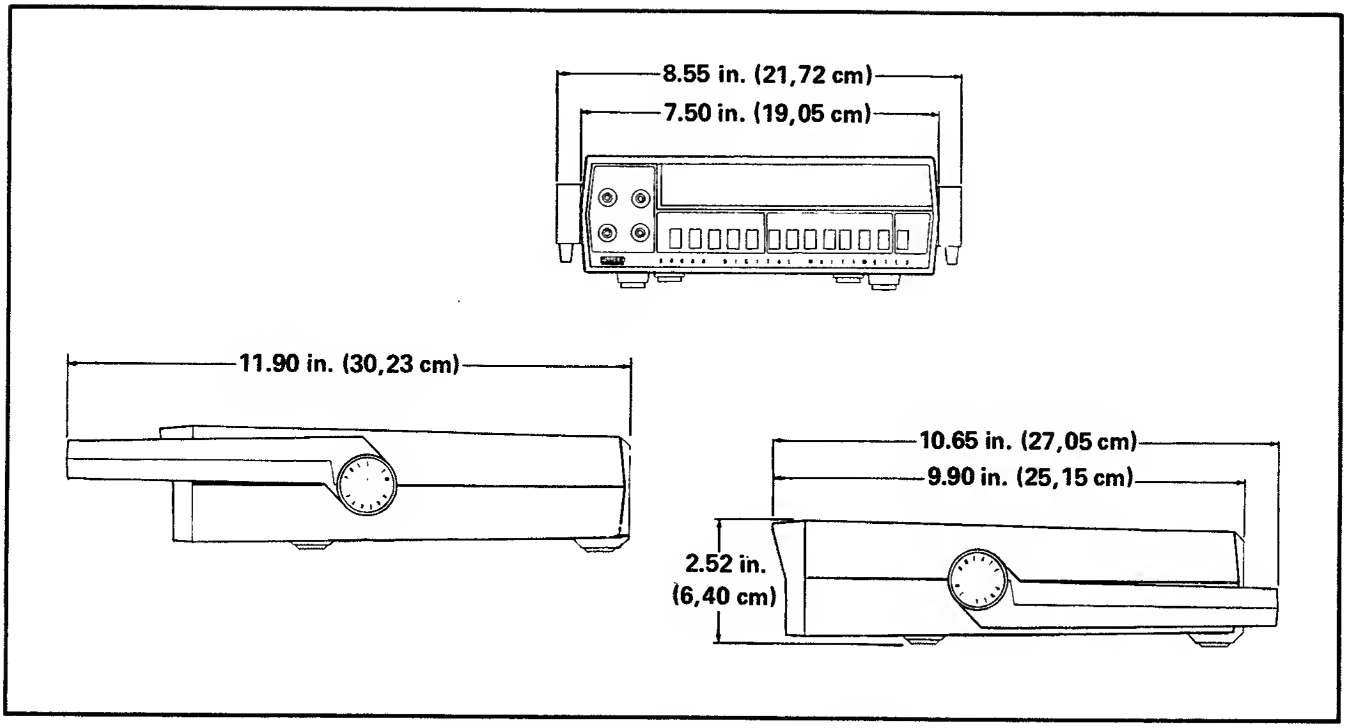


Figure 1-1. MODEL 8600A OUTLINE DRAWING

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information regarding installation and operation of the Model 8600A DMM. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation, please contact your nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of Sales Representatives is located in Section 7 of this manual.

2-3. SHIPPING INFORMATION

2-4. The 8600A is packaged and shipped in a foam-packed container. Upon receipt of the instrument, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5. If reshipment of the instrument is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The 8600A can be operated from 100, 115, or 230V ac 50 or 60 Hz power lines, as selected by line power select switch S14. Before connecting the instrument to line power, check and, if necessary, set the instrument for operation at local line voltage as follows: (the following procedure should be carried out only by qualified personnel)

CAUTION!
Refer to Section 6 Option –01 for requirements of line voltage change for 8600A –01 instruments.

a. Remove the phillips screw from the rear of the instrument.

b. Remove the case; pull it straight back from the front panel.

c. Locate the power selection switch; near the rear or the main pcb assembly.

d. For 100 or 115V ac operation position the slide switch so that 115 appears in the slide aperture. For 230V/240V ac operation set the switch so 230 appears.

e. Replace the case and phillips screw.

2-8. The rear panel power input connector is a three-prong, U-ground connector which permits the instrument to be connected, via the power cord, to the appropriate line power. The offset prong on this connector is connected to the 8600A power supply, and should be connected, via the power cord, to a high quality earth ground.

2-9. RACK INSTALLATION

2-10. The 8600A is designed for either bench-top use or for installation in a standard 19-inch equipment rack using an optional accessory rack mounting kit. Rack mounting kits are available for left, right, center, or side-by-side mounting of the 8600A. Information regarding installation of the rack-mounting accessories is given in Section 6 under Rack Installation.

2-11. OPERATING FEATURES

2-12. The location of all 8600A controls, indicators and connectors are shown in Figure 2-1, and described in Table 2-1.

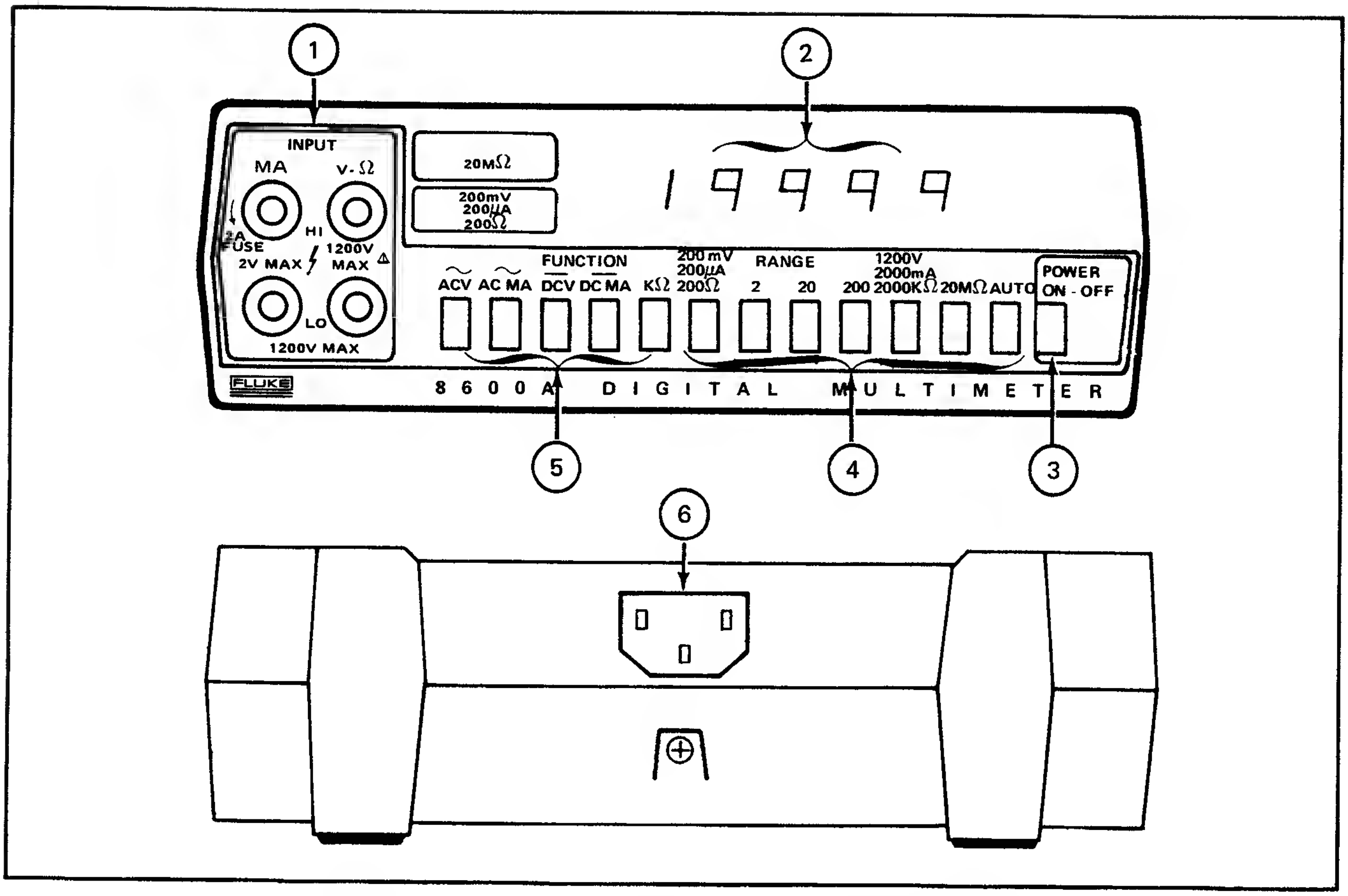


Figure 2-1. 8600A CONTROLS, INDICATORS AND CONNECTORS

Table 2-1. 8600A CONTROLS, INDICATORS AND CONNECTORS

FIG. 2-1 REF. NO.	NAME	FUNCTION
1	INPUT Connectors	Provides the input connections necessary to make current (MA), voltage (V), or resistance (Ω) measurements. All measurements are referenced to the LO INPUT terminals.
2	Digital Readout	Provides a 4½ digit display (19999 maximum) or the measured input. The readout also includes a properly positioned decimal point, and a + or − sign for dc voltage and current measurements.
3	POWER Switch	Switches the instrument on or off. The instrument is turned on when the switch is depressed.
4	RANGE Switches	Provide pushbutton selection of ranges which correspond to the selected function (current, voltage, or resistance). The available ranges are: Voltage: 200 MV, 2, 20, 200, 1200V and AUTO Current: 200μA, 2, 20, 200, 2000 MA Resistance: 200Ω, 2, 20, 200, 2000kΩ, 20MΩ, and AUTO
5	FUNCTION Switches	Provide pushbutton selection of one-of-five measurement functions; ACV, AC MA, DCV, DC MA, or KΩ.
6	Input Power Connector	Provides the means of connecting the instrument through the power cord to the ac power line.

2-13. OPERATING NOTES

2-14. The following paragraphs describe various conditions which should be considered before operating the 8600A.

2-15. Option Information

2-16. Supplementary information is necessary when operating an 8600A which is equipped with one of the available options. Detailed information regarding the operation of each available option is given in Section 6, Options and Accessories.

2-17. Fuses

2-18. The 8600A is equipped with a line power fuse, and a current overload fuse for the current measuring function. The line fuse is located near the transformer on the inside of the instrument. The following procedure should be carried out only by qualified personnel. To gain access, remove ac power, remove the retaining screw on the rear of the case and remove the instrument from the case. When replacement is necessary, use an AGC 1/8A fuse. The current input fuse is located behind the front-panel MA INPUT terminal, and is accessed by turning (ccw) and removing the MA INPUT terminal. Use a John Fluke 376582 replacement fuse or equivalent 2A fast-blo fuse (AGX) 1 inch in length.

2-19. Overrange Indication

2-20. The front panel display, in addition to providing a measurement reading, is designed to serve as an overrange indicator. When the full scale capability of the selected range for any function is exceeded, the display will blink while indicating a 18888 reading. The presence of an overrange indication does not necessarily mean that the instrument is being exposed to a damaging input condition.

2-21. Input Overload Protection ⚠

CAUTION

Exceeding the maximum input overload conditions can damage the 8600A.

2-22. Each range and function of the 8600A is equipped with input overload protection. The maximum allowable input overload conditions for each function and range are given in Table 2-2.

2-23. Autoranging

2-24. Autoranging can be selected when the 8600A is in the VDC, VAC, or KΩ functions. When the AUTO pushbutton is depressed the 8600A will select the lowest range that will display the value of the input signal without causing an overrange indication.Autoranging stops when one of the individual range pushbuttons is depressed.

Table 2-2. BASIC MEASUREMENT INSTRUCTIONS

DESIRED MEASUREMENT	8600A				REMARKS
	SELECT FUNCTION	SELECT RANGE	INPUT CONNECTION	MAXIMUM INPUT	
DC Volts	DCV	200 MV, 2, 20 200, or 1200V	V-Ω and V-Ω LO	1200V dc or 1700V peak ac, any range	Auto-polarity Auto-ranging
DC Milliamperes	DC MA	200 μA, 2, 20 200 or 2000MA	MA and MA LO*	2A (Fuse Protected)	Manual-ranging Auto-polarity
AC Volts	ACV	200 MV, 2, 20	V-Ω and V-Ω LO	1200V rms (sinusoidal), 1700V peak ac, any range	Auto-ranging Average Responding calibrated to read rms ac volts
AC Milliamperes	AC MA	200 μA, 2, 20 200, or 2000 MA	MA and MA LO*	2A (Fuse Protected)	Manual-ranging Average Responding
Kilohms	kΩ	200Ω, 2, 20, 200, 2000 kΩ or 20 MΩ	V-Ω and V-Ω LO	250V dc or 250V ac peak, any range	Auto-ranging

**CAUTION: Do not use V-Ω LO for current measurements, as damage to the multimeter may result.*

2-25. OPERATION

2-26. Use the following procedure for initial turn-on of the 8600A;

a. Connect the instrument to ac line power. (See Paragraph 2-6)

b. Depress the POWER switch.

c. In accordance with Table 2-2, select the desired function and range; connect the test leads to the corresponding input connectors.

NOTE

Supplemental instructions may be required for instruments with options installed. These instructions, if any, are given in Section 6, Options and Accessories.

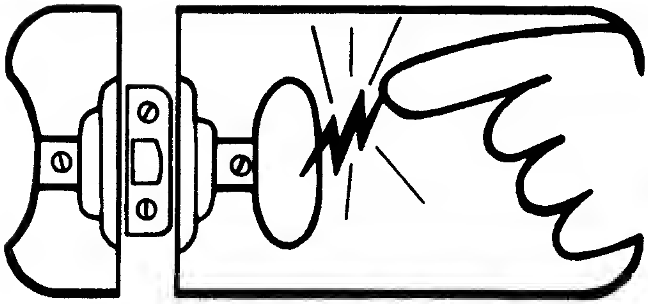
CAUTION!

Do not use VΩ LO for current measurements as damage to the 8600A may result.

static awareness

A Message From

John Fluke Mfg. Co., Inc.



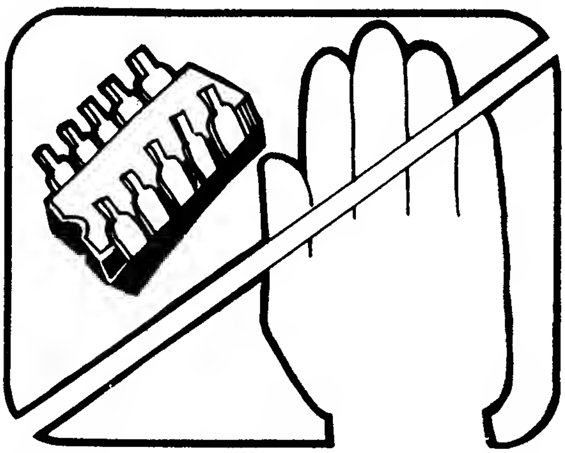
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

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

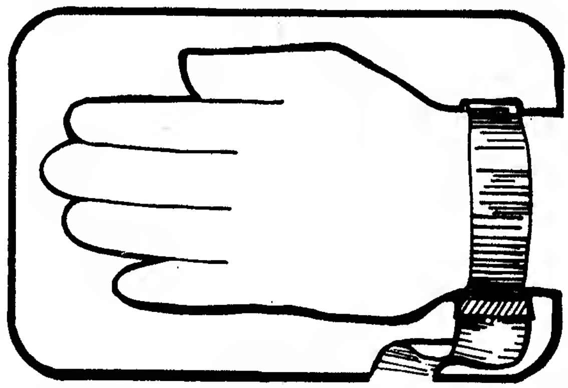
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol

"  "

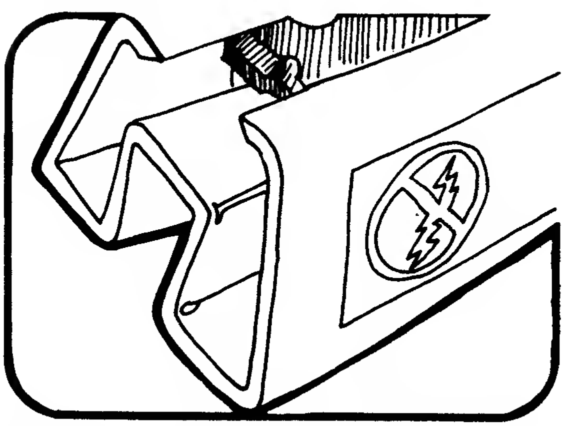
The following practices should be followed to minimize damage to S.S. devices.



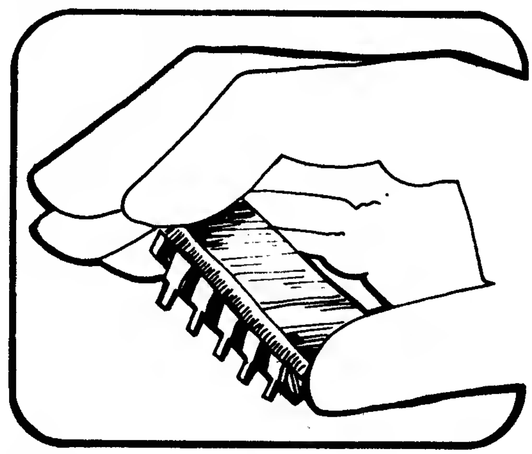
1. MINIMIZE HANDLING



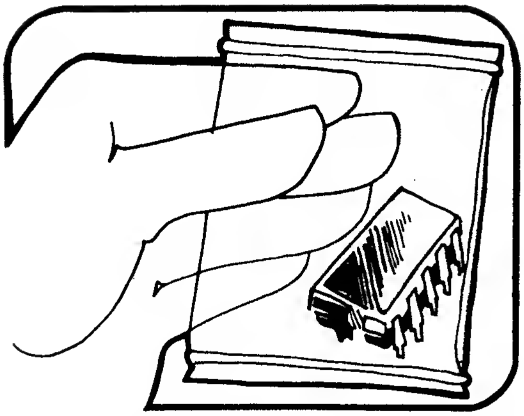
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



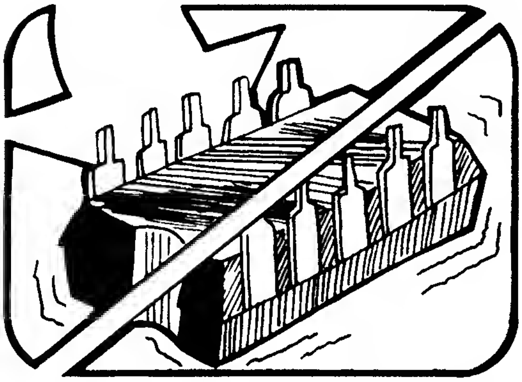
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



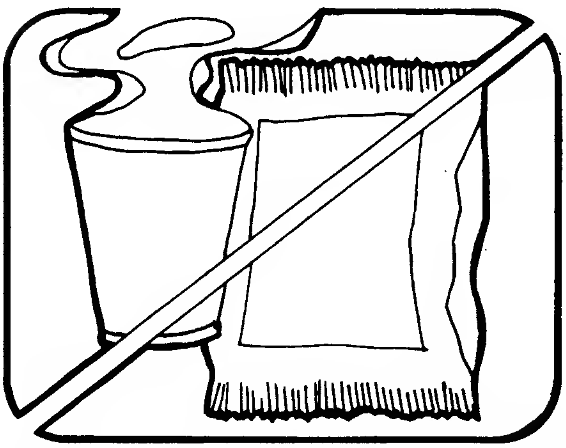
4. HANDLE S.S. DEVICES BY THE BODY



5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT



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



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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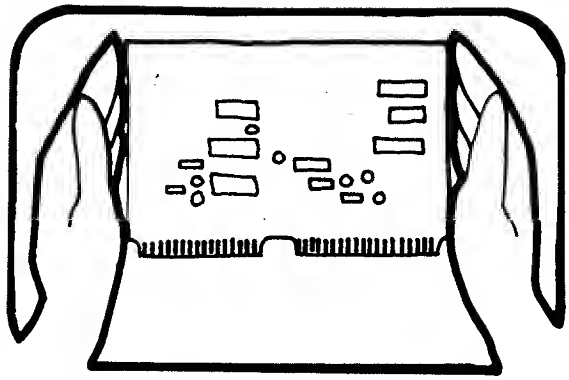
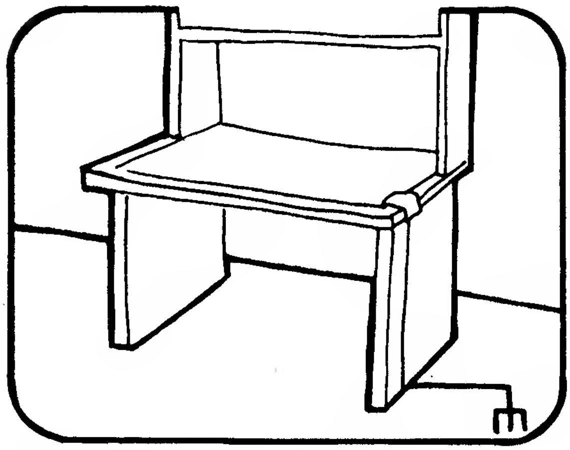


8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS TO PROTECT INSTALLED SS DEVICES.



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

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

11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

A complete line of static shielding bags and accessories is available from Fluke Parts Department, Telephone 800-526-4731 or write to:

JOHN FLUKE MFG. CO., INC.
PARTS DEPT. M/S 86
9028 EVERGREEN WAY
EVERETT, WA 98204

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Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. The theory of operation for the Model 8600A is arranged under two major headings. The first, titled OVERALL FUNCTIONAL DESCRIPTION, discusses the overall operation of the instrument in terms of the functional relationships of the major circuits. The second section is titled CIRCUIT DESCRIPTION and deals with the internal operation of each major circuit in more detail. Block diagrams and simplified circuit diagrams are included in these sections. The complete schematic diagrams are located in Section 8 of this manual.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Introduction

3-5. The 8600A circuitry can be divided into three major sections. The first of the three sections, termed Input Signal Conditioners, (see Figure 3-1) comprises the Input Divider, Ohms Converter, AC Converter and Current Shunt. The second section is the A/D (analog-to-digital) Converter and the third is the Control and Display section. The basic operational relationship of these functional areas will be discussed in the following paragraphs.

3-6. Input Signal Conditioners

3-7. The term, input signal conditioner, describes the basic function of the four subsections grouped under it. The input divider, current shunts,ohms converter, and ac converter provide the A/D converter with a dc analog voltage representative of the input (ac volts, dc volts, ac current, dc current, or resistance) applied to the instrument. The path that each input signal follows as it is conditioned for the A/D converter is illustrated in Figure 3-1.

3-8. DC voltages applied to the input terminals are directed via function switch contacts directly to the A/D converter in the 200 mV and 2V ranges but to the input divider in higher ranges. The input divider divides it by 10, 100 or 1000 in the 20, 200 and 1200 volt ranges respectively. The A/D converter is provided with a dc voltage level, representing full scale, of 200 mV for the 200 mV range and two volts for the 2V through 1200V ranges.

3-9. An ac voltage input to the instrument is applied through switch contacts to the ac converter. The converter then changes the ac input to an equivalent dc voltage for the 200 mV and 2V ranges. In the 20 V through 1200 V ranges the feedback within the ac converter is changed by reed relays so that the dc voltage output to the A/D converter is two volts for a full scale indication on the 20 V and 200 V ranges and 1.2 volts on the 1200 V range.

3-10. When making a resistance measurement the unknown resistance, connected across the input, is supplied with a known value of current by the ohms converter and input divider. The voltage drop across the unknown resistance is then applied to the A/D converter as a direct representation of that resistance. The input divider is used to change the amount of current applied to the unknown resistance when different ranges are selected.

3-11. When making current measurements (ac or dc) the unknown current is applied directly, via the MA INPUT terminals, to the current shunt. The unknown current is directed, via the range switch contacts, through a precision resistor network so that the voltage developed

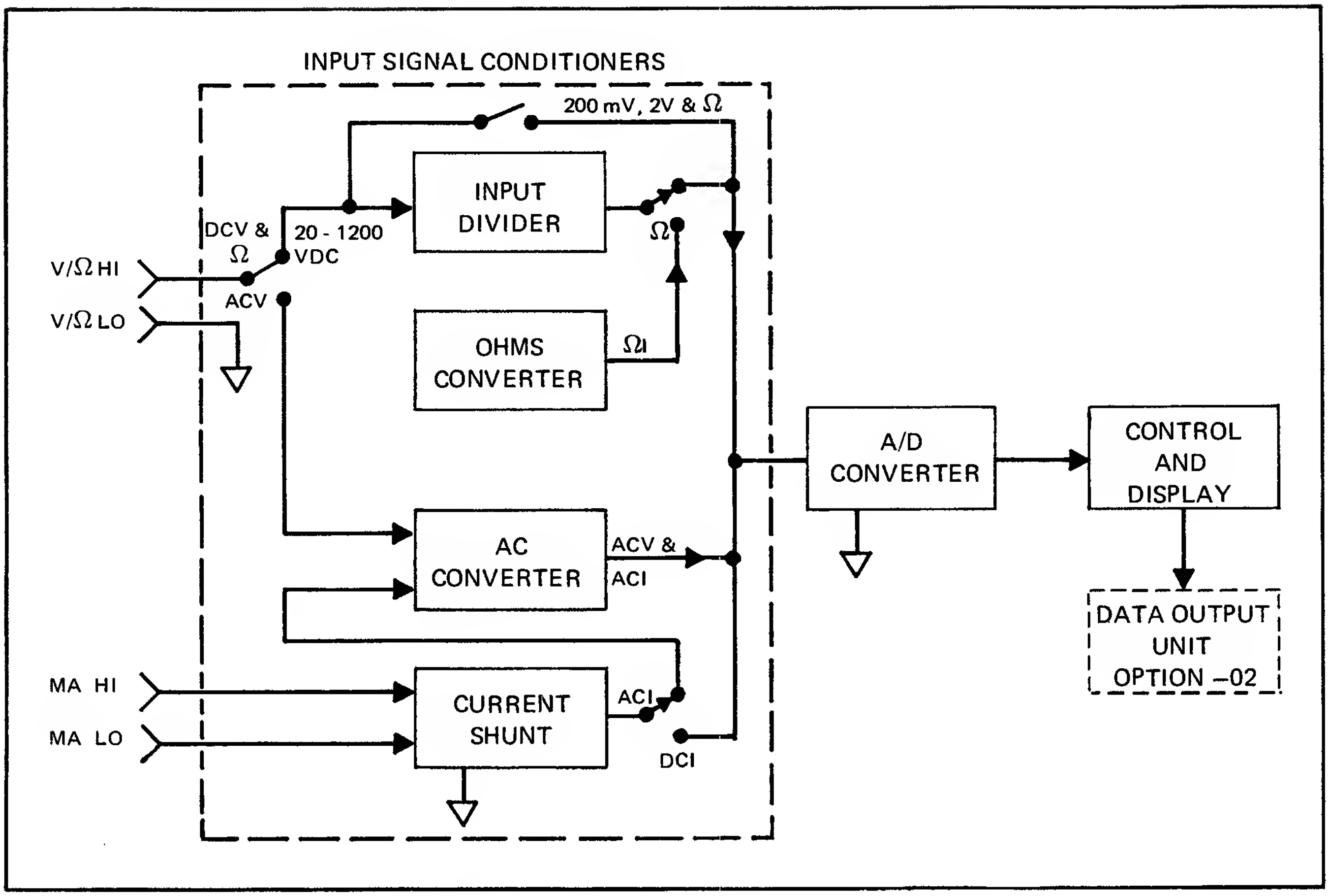

Figure 3-1. OVERALL FUNCTIONAL BLOCK DIAGRAM

across the known resistance is representative of the unknown current. In the case of dc current inputs the representative dc voltage is applied directly to the A/D converter, while in the case of ac current inputs the representative ac voltage is directed to the ac converter first and then to the A/D converter as an equivalent dc voltage.

3-12. A/D Converter

3-13. The A/D Converter receives the dc voltage output from one of the Input Signal Conditioners and integrates it for 100 mS. Figure 3-2 is an illustration of the output of the integrator. The slope of the integrator output voltage during the Integrate Period is directly proportional but opposite in polarity to the A/D Converter input. At the end of the integrate period the signal conditioner output is disconnected from the A/D input and a dc reference voltage is connected to the input. The A/D converter then integrates the reference voltage, of opposite polarity, which results in a constant slope returning the integrator output toward zero (Read Period). Since the read period slope is held constant the time required for the A/D integrator output voltage to return to zero is proportional to the instrument input.

3-14. The digital representation of the input is obtained by counting the number of cycles of a clock frequency that occur from the start of the read period to the point where the A/D integrator output voltage returns to the zero detect level. The A/D Converter supplies the Control and Display section with a compare signal at the end of the read period. The compare signal stops the counting of the clock oscillator pulses so that the analog value of the instrument input is now digitally represented by the number of oscillator pulses counted in the 4½ digit counter.

3-15. Control and Display

3-16. The Control and Display section provides the properly timed signals that direct the correct Input Signal Conditioner output to the A/D Converter during the integrate period. At the end of integrate time period the Control and Display section connects the appropriate reference supply to the A/D Converter input for the read period. The output of a 1 MHz oscillator is used to maintain the proper timing of the control signals as well as provide the base frequency from which the 100 kHz clock signal for the read period is produced.

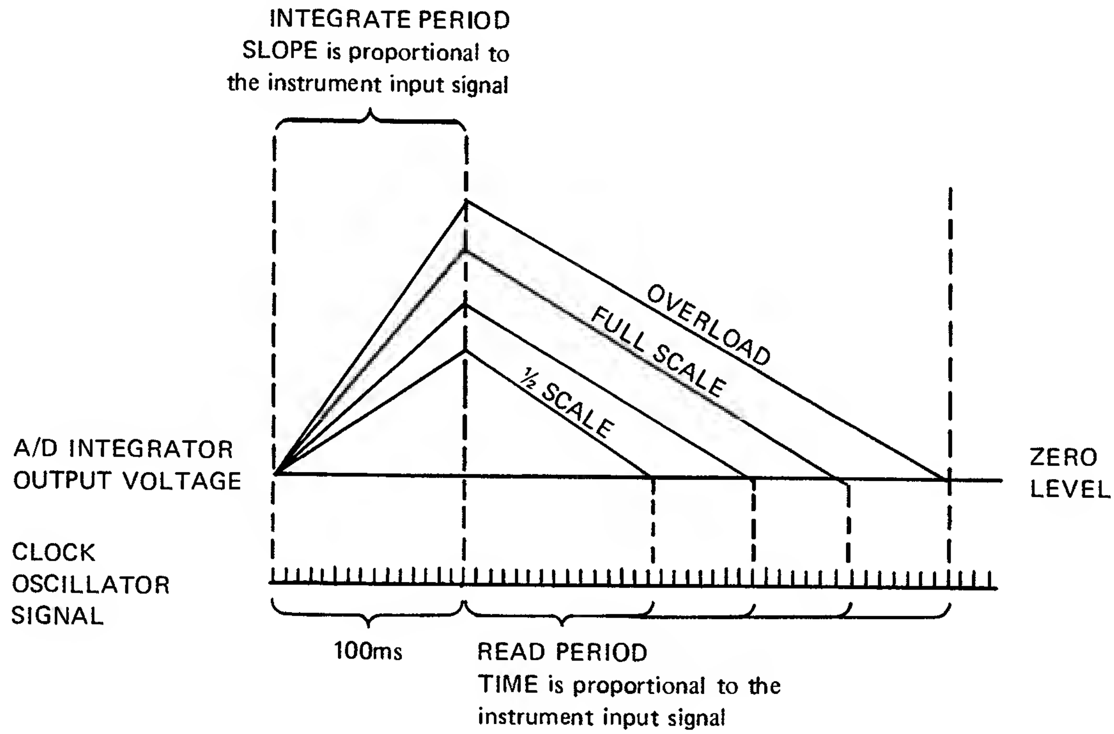

Figure 3-2. TIMING DIAGRAM FOR DUAL-SLOPE A/D CONVERSION

3-17. The clock oscillator pulse count, accumulated during the read period, is applied to the LED display to produce the digital readout of the instrument input signal. The range information from the selected range switch positions the decimal point and illuminates the proper display annunciator.

3-18. Data Output Unit (DOU)

3-19. The DOU provides the display data as a rear panel card-edge output. The bcd information presented to the instrument display (polarity, overload, range code, and digit) is also applied to the DOU input. A busy flag is provided so that the output data may not be used while the 8600A is feeding a new input measurement to the DOU. A register pulse train plus one of the data strobe signals time the data transfer to insure that all the data supplied to the DOU output is stable and not taken during transition periods. For detailed information refer to Section 6.

3-20. CIRCUIT DESCRIPTION

3-21. The following circuit descriptions are keyed to the functional blocks defined in the overall functional block diagram of Figure 3-1. Corresponding functional blocks are defined in more detail using either simplified block diagrams or by referring to the schematics. Schematics for the 8600A circuits are provided in Section 8.

3-22. Input Signal Conditioners

3-23. INPUT DIVIDER

3-24. The Input Divider comprises a series connected resistor network (R3, R4, R5, R6, R7, and R8) totaling approximately ten megohms. This network is tapped at three points to provided division ratios of 10:1, 100:1, and 1000:1. Relays K2, K3, and K4 each select one of the division ratios; as directed by the range switches.

3-25. OHMS CONVERTER

3-26 The Ohms Converter produces a known amount of current that, when applied to an unknown resistance (Rx) connected across the VΩ terminals, will develop a voltage (Vx) proportional to the value of Rx. Producing the known amount of current is accomplished with a current follower, U1, two feedback loops, and a current source (U3 and Q3). One feedback loop is from the VΩ HI terminal to the non-inverting input of U1 (Pin 3). The voltage of this loop is applied to the A/D Converter. The other feedback loop is from the output of U1 through R20 and R90 to the inverting input of U1 (Pin 2). The current source (U3 and Q3) controls the loop and consequently the bias on U1. The current output from U1 changes for each range (refer to table 3-1) but is constant within each range. Figure 3-3 is a simplified circuit diagram.

3-27. With Rx = 0 (VΩ HI shorted to VΩ LO) there is OV at the noninverting input of U1. U3 has a negative reference voltage applied to its noninverting input and a greater negative voltage applied to its inverting input. This produces a positive output from U3 and allows Q3 to conduct. Q3 conducts an amount of current such that the voltage drop on R35 equalizes the input voltages on Pins 2 and 3 of U3. The amount of current required by Q3 is constant in all operating conditions. As Q3 is turned on, a negative voltage is applied to the inverting input of U1. The negative input causes the output of U1 to go positive until the current through R20 and R90 satisfies the current requirement of Q3. The voltages at that point are +10V out of U1, and OV at the inverting input of U1, matching the OV at the noninverting input of U1. The 10V out of U1 is dropped across the input divider network. Ten volts is maintained across the input divider in all ranges except the 20 MΩ range. Relay K5 energizes in the 20 MΩ range to change the feedback loop (R20 and R90) by a factor of ten with R22 and R41. The output of U1 changes from 10V to 1V and only 1V is dropped by the input divider. The value of Ix is dependent on the range relays.

3-28 As Rx increases from 0, Vx (at the VΩ HI terminal) also increases from OV proportional to the value of Rx. Vx appears at the noninverting input of U1 and at the input to the A/D Converter. U1 is turned on more and the output voltage increases until the voltage at the inverting input of U1 equals Vx at the noninverting input. The output voltage of U1 equals 10V + Vx. Since the current drawn by U3 and Q3 is constant, 10V is always dropped by R20 and R90 (except in the 20 MΩ range) and the voltages at the output of U1 and the inverting input of U1 track any changes in Vx (and Rx) at the inverting input of U1. So within each range the current is constant and the voltage, Vx, at the VΩ terminals is proportional to Rx.

3-29 If the voltage at the input terminals is too small or exceeds 2V, autoranging is initiated in the DVM IC (U8). The voltage, (Vx) is held below a maximum of 5V. As Vx increases toward 5V, Q13 and Q12 begin to conduct, holding the voltage at the inverting input of U1 below 5V. Q11 serves as a current sink and holds the noninverting input of U1 below 5V.

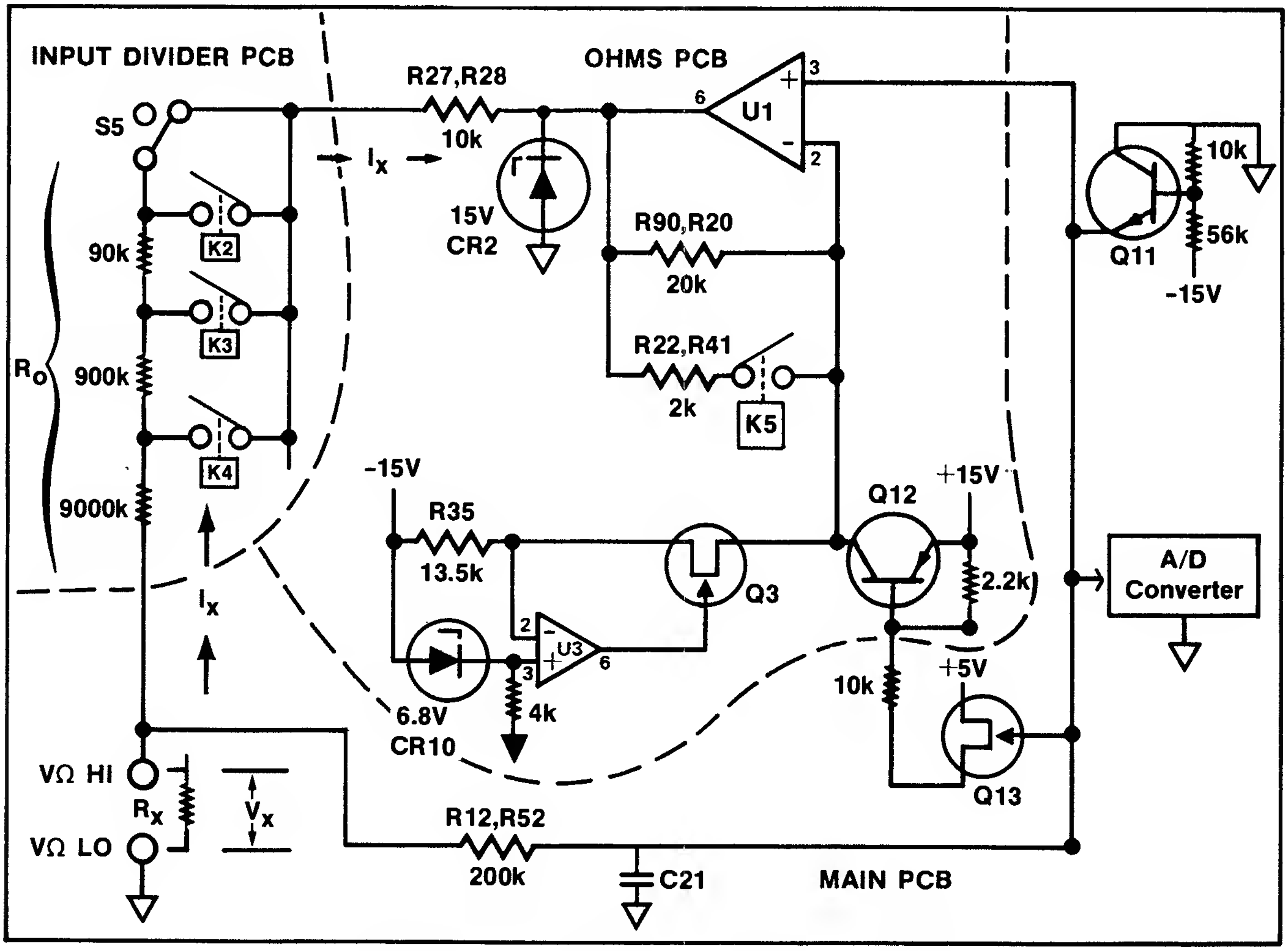

Figure 3-3 OHMS CONVERTER BLOCK DIAGRAM

Table 3-1. OHMS CONVERTER OPERATING CONDITIONS

8600A RANGE	Ro	Ro + 10KΩ	Ix	Rx Max.	RANGE RELAY K2	K3	K4	K5	A–D RANGE
20MΩ	9990KΩ	10,000KΩ	0.1μA	20MΩ				X	2V
2000KΩ	9990KΩ	10,000KΩ	1μA	2000KΩ					2V
200	990KΩ	1,000KΩ	10μA	200KΩ	X				2V
20	90KΩ	100KΩ	100μA	20KΩ		X			2V
2	0Ω	10KΩ	1000μA	2KΩ			X		2V
200Ω	0Ω	10KΩ	1000μA	200Ω			X		0.2V

Table 3-2. AC CONVERTER RELAY OPERATION

8600A RANGE	K4	K6	K7	K8	A–D RANGE
1200VAC	X			X	2V
200VAC	X		X		2V
20VAC	X	X			2V
2VAC	X				2V
200mVAC	X				0.2V

3-30. AC CONVERTER

3-31. The AC Converter produces a dc output voltage proportional to the ac input voltage. Table 3-2 presents the relay conditions for each ac volts range; relay K4 is located on the Input Divider pcb and closes to apply the AC Converter output to the A-D Converter. Figure 3-4 is a simplified circuit diagram of the AC Converter.

3-32 With no ac signal applied to the VΩ terminals, Q1, U1, and Q7 are biased on such that the current flowing through CL1 and Q7 produces OV at the collector of Q7. An ac signal is coupled by C1 from the VΩ terminals to input impedance resistor, R17. The ac signal is then applied to the inverting input of Q1 and U2. The network composed of Q1, U2, CR5, Q7, CR11, CR12, and R46 (or R37, R47, and R38 depending on the range selected) is a form of logarithmic amplifier. The net result is that the dc level detected by CR12 and filtered by the low pass (L.P.) filter is proportional to the RMS equivalent of the ac voltage applied to the VΩ terminals. The dc level from the L.P. filter is applied to the A/D Converter. The degree of logarithmic response is determined by the feedback resistance

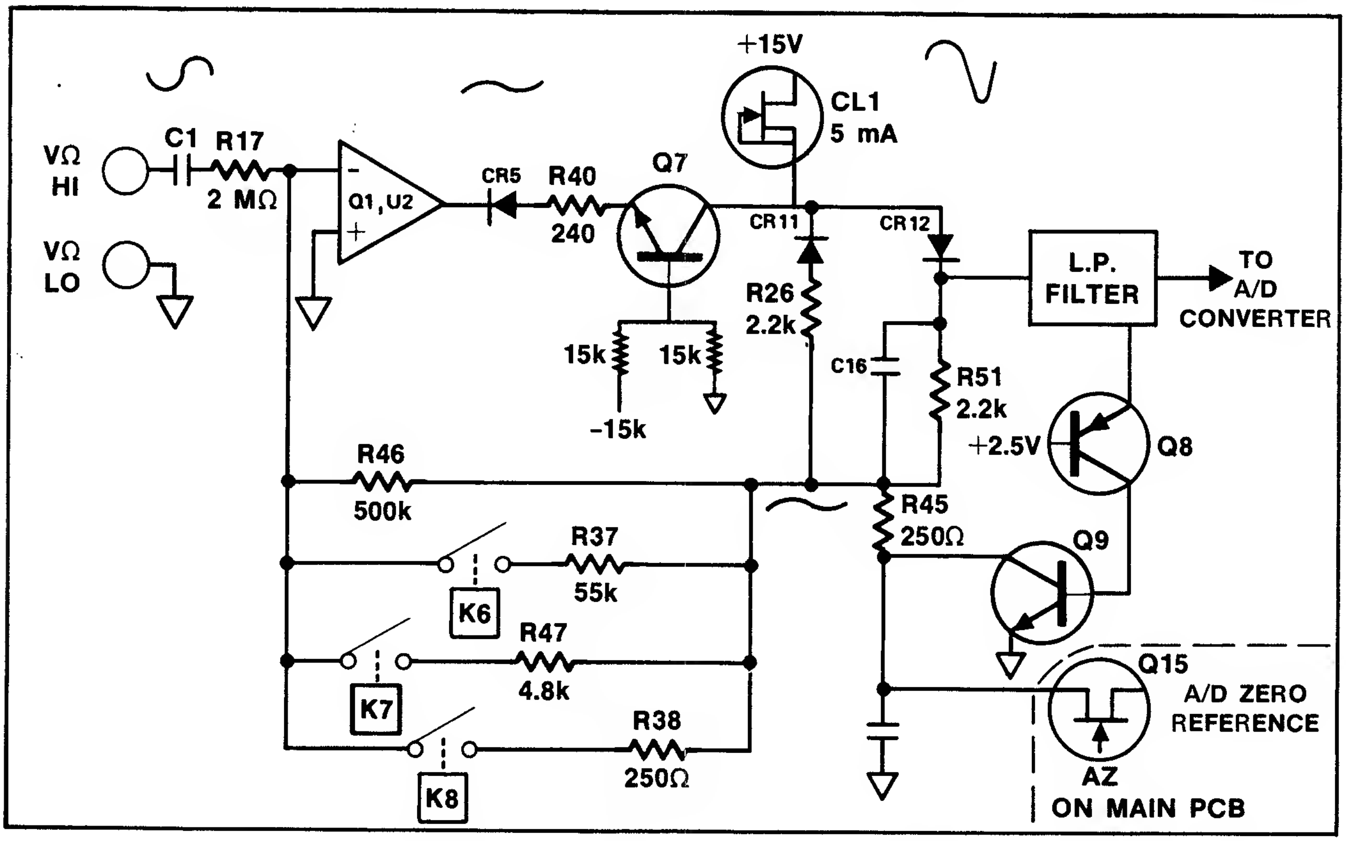

Figure 3-4 AC CONVERTER BLOCK DIAGRAM

(R46, R37, R47, and R38) selected by the range relays. The positive half of the signal applied to CR12 is distorted by the action of Q7 and CL1. CL1 presents a variable load to Q7 so that for the positive half cycle, as Q7 draws less current, the voltage on the collector of Q7 rises more rapidly than it would with a purely resistive load. The distortion is introduced to minimize errors in small signal measurements caused by the turn-on time of CR12. The distortion is removed for feedback purposes by the arrangement of R51, C16, and R26. During autozero the A/D Converter is referenced to the offset voltage (stored on capacitors) created by the bias requirements of the circuit. The offset voltage reference is protected from over-voltage conditions by Q8 and Q9.

3-33. CURRENT SHUNT

3-34. The Current Shunt produces an output voltage (ac or dc) proportional to the current (ac or dc) applied to the input. A schematic diagram of the Current Shunt is located in Figure 8-1.

3-35. The Current Shunt consists of series connected shunt resistors R13, R14, R15, R16, and R2, contacts of range switches S6 through S10, and input protection components F1, CR1, CR2, CR6 and CR8. The input current is applied across a portion of the shunt resistor network via contacts of the selected range switch. The voltage developed by the current flow through the shunt resistance for direct current inputs is applied to the A-D Converter; for alternating current the developed ac voltage is applied to the AC Converter.

3-36. The Current Shunt is not only protected against inputs exceeding two amperes, as provided by fuse F1, it is also protected from possible damage caused by an overrange input. Diodes CR1, CR2, CR6, and CR8 will start to conduct if the voltage drop across the shunt resistors exceeds 1.2 volts.

3-37. A/D Converter

3-38. The A-D Converter uses a dual-slope conversion technique. The dc voltage at the input of the A-D Converter is integrated (charges a capacitor) for a controlled amount of time (100 ms). The level to which the capacitor is charged is directly proportional to the level of dc voltage applied to the input. The charged capacitor is then discharged at a controlled rate so that the discharge time is proportional to the level of charge on the capacitor. The discharge time is measured by counting the number of cycles of a reference frequency that occur from the start of discharge to the point where the capacitor reaches a selected zero detect level. Figure 3-5 is a basic illustration of the A-D Converter. The Input Divider is shown as the A-D Converter input voltage source.

3-39 The dc voltage from the input divider is gated through Q14 to the noninverting input of buffer, U4, by the 100msec integrate (INT) control signal. The output of U4 is applied to the inverting input of integrator, U5. C28 is charged by U5 and U4 through R80, except that in the lowest range the charge path is through R66 and R80. The slope of the output voltage from U5 is proportional and opposite in polarity to the level of the dc voltage from the input divider. The output of U5 is applied to the input of comparator, U6. As the output of U5 changes away from OV, the output of U6 changes from random noise to a steady state of either OV or +5V, depending on the polarity of the dc voltage from the input divider. At the end of the integrate period Q14 is turned off, U4 and U5 no longer charge C28, and the charge on C28 is held. Also at the end of the integrate period, the state of the output of U6 is memorized in the DVM IC, U8. An appropriate read reference is selected in U8. DE(+R) is selected for negative voltages from the input divider, or DE(−R) is selected for positive voltages. DE(+R) enables Q16, which applies the +1V reference from U17 to the input of U4. DE(−R) enables Q21, which applies the −1V charge on C22 to the input of U4 (in the lowest range ±.1V is selected as the reference). A delay of 15 μsec is introduced in U8 between application of the read reference and the start of the counter. The delay allows adjustment of the zero detect level for comparator, U6. The read reference voltage applied to U4 allows U4 and U5 to discharge C28. The slope of the output of U5 is always the same for the reference applied (1V or .1V). The charge on C28 is proportional to the voltage from the input divider. Therefore the time required to discharge C28 is proportional to the voltage from the input divider. When the output of U5 crosses the zero detect level, the output of U6 changes state, producing the compare output applied to U8. The compare signal stops the counter in U8. The number of counts is proportional to the voltage from the input divider.

3-40. After the A-D Converter has integrated the unknown input voltage, integrated the reference voltage, and produced the compare output; the circuits of the converter are zeroed for a new measurement. An auto zero (AZ) control signal from U8 will enable Q15 and Q22 to zero the comparator circuits. The AZ control signal will also enable Q17 to charge capacitor C22 to the reference voltage level. This provides the negative reference voltage, when Q21 is enabled, needed to process a positive input voltage.

3-41 The different zero detect levels applied to U6 compensate for the 15 μsec delay introduced at the end of the integrate period. The delay and subsequently different zero detect levels are used to facilitate a solid zero display in the presence of noise with no input. Also errors due to noise are minimized. The zero detect levels are determined by the logic levels of the read reference switches and the associated resistive network.

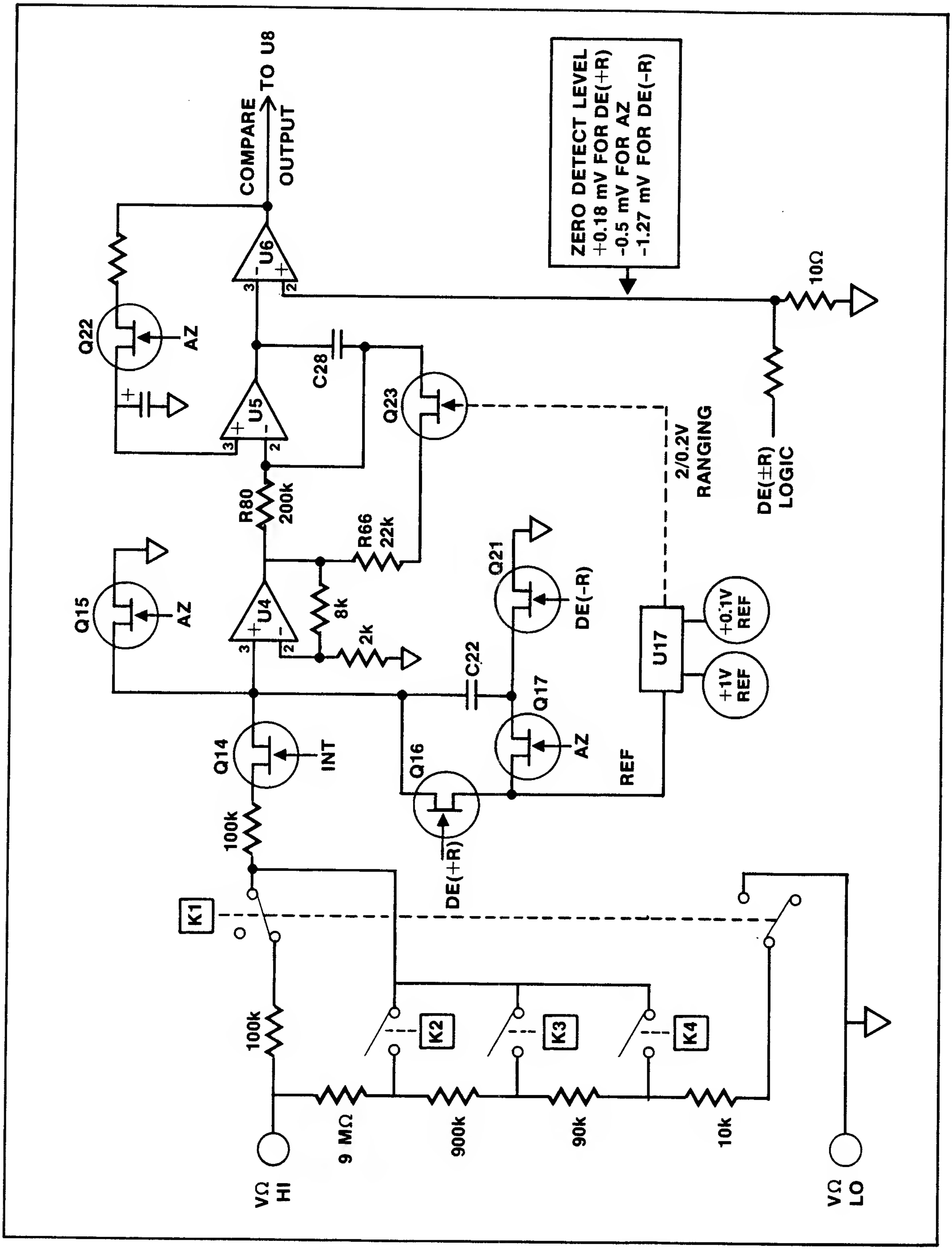

Figure 3-5 A/D CONVERTER BLOCK DIAGRAM

3-42. Control and Display

3-43. The control portion of the instrument consists of contacts of the range and function switches, a three-pole-double-throw switch U16, a bipolar ROM U9, and custom integrated circuit U8. The range and function switch positions in conjunction with strobe signal inputs to U16, control the illumination of the polarity indicator on the display and the selection of five or six ranges for the autorange feature. Refer to Figure 8-1 for the schematic diagram of the control circuits.

3-44 All timing and control information is developed in the DVM IC, U8, from an external clock consisting of Y1 and U7. Range information can be manually programed by the front panel range and function switches, or automatically programed by U8. Eight strobe signals (STO-ST7) are developed in U8 and are used for range programming and display timing. Digit information from the counter is strobed out in bcd format on lines W,X,Y, and Z (weighted 8, 4, 2, and 1 respectively). The strobe signals are strobed sequentially but the digit information presented on W, X, Y, and Z is interleaved. The main significant digit (MSD) without polarity appears at STO. The MSD with polarity is presented at ST7. For the display, either STO or ST7 is selected by U16, which is programed by the function switches. The second significant digit (2SD) appears on W, X, Y, and Z at ST2, the 3SD at ST4, the 4SD, at ST6, and the 5SD at ST1. W, X, Y, and Z present the digit information to a seven segment decoder, U10. The strobe signals light the appropriate display LED, U11-U15, through the strobe drivers, Q29-Q39. The decimal point logic (DPL) from U8 outputs a signal at the appropriate strobe signal. For the lowest range and the 20 MΩ range, lower or upper annunciators will light.

3-45 Range information outputs from U8 appear at a, b, and c (pins 29, 28, and 30) which are weighted 4, 2, and 1 respectively. The range information is also presented on W, X, Y, and Z at ST5 for the DOU output. The outputs at a, b, and c are steady state outputs applied to U9. U9 interprets the information and selects the appropriate relays. Range truth tables are included in table 4-12. In all cases the output of U9 goes low to select a relay because Relay Common is connected to +5V through S4A (DCmA). Relay, K1, is energized only in the 20V, 200V and 1200V ranges of the DCV function. K1 inserts the Input Divider between VΩ HI terminal and the A/D Converter. The lower two ranges are applied directly to the A/D Converter. In the lowest range for all functions U17 selects the .1V reference and switches R66 into the charge path of C28. In range programming U8 the α input sets the upper range limit and the β input sets the lower limit. Strobe signals are applied through U16 and the range switches to the α and β inputs. For manual range programming α and β are tied together by U16. S6-S11 apply the appropriate ST signal (ST3 for the 20V range etc.). In autoranging β is always connected to ST1 as the lower limit and α is connected to ST5 (5 ranges) for DCV and ACV functions and to ST6 for the Ohms function.

3-46 For A/D Converter timing all outputs (INT, AZ, DE(+R), and DE(–R)) from U8 are logic NOT outputs. For example the INT output (pin 40) varies between OV and –15V. During the integrate signal pin 40 stops conducting and goes to –15V, biasing the driver, Q10, off. The gate of Q14 goes to –2V allowing it to conduct. At the end of the integrate signal pin 40 conducts and goes to OV, biasing Q10 on which drives the gate of Q14 to –15V, cutting Q14 off. The other control signals work the same way except that the gates of the FETs go to OV during their signal on times.

Section 4
Maintenance

WARNING!

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains information concerning maintenance and servicing of the Model 8600A Digital Multimeter. A calibration interval of 6 months is recommended to insure instrument operation within the 6 month specifications. Test equipment recommended for performance tests, calibration adjustments and troubleshooting is listed in Table 4-1. If the recommended equipment is not available, equipment of equivalent specifications may be used.

4-3. SERVICE INFORMATION

4-4. Each instrument manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is printed on the back of the title page located at the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various world wide locations. A complete list of these Technical Centers is included in Section 7. Shipping information is given in Section 2 of this manual. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

Table 4-1. REQUIRED TEST EQUIPMENT

NOMENCLATURE	MINIMUM USE SPECIFICATIONS	RECOMMENDED EQUIPMENT
AC Calibrator	Voltage Range: 0 to 1000V ac Frequency Range: 30Hz to 100 kHz Voltage Accuracy: 30 Hz to 50 Hz...... 0.05% 50 Hz to 10 kHz..... 0.02% 10 kHz to 100 kHz... 0.05%	John Fluke Model 5200A and 5205A
DC Calibrator	Voltage Range: 0 to 100V dc Accuracy: ±0.003%	John Fluke Model 343A
DC Current Calibrator	Current Range: 0 to 2 mA Accuracy: 0.006%	John Fluke Model 382A
DC Current Calibrator	Current Range: 2 mA to 2A Accuracy: 0.02%	John Fluke Model 382A
Digital Multimeter	Voltage Accuracy: 0.1% Input Impedance: 1000MΩ	John Fluke Model 8600A
Resistor Decade	Resistance Accuracy: ±0.01%	ESI 1063B
Oscilloscope	General Purpose with 10 MΩ probe	Tektronix 465

4-6. GENERAL MAINTENANCE

4-7. Access/Disassembly

4-8. Use the following procedure to gain access to the interior of the 8600A.

a. With the power switch in the OFF position, disconnect the line cord.

b. Remove the Phillips screw from the rear of the instrument case.

c. Remove the instrument from the case.

4-9. The ohms converter, ac converter and input divider printed circuit boards can be removed from the main board. The ohms converter and input divider boards can be removed by pulling them straight up from the main board until they are free of the connector pins. The ac converter, however, must be removed with care because of a wire connection to the ACMA switch. When the ac converter is free of the connector pins it should then be held to one side so the buss wire can be disconnected.

NOTE!

When reinstalling the plug-in boards, insure that all connector pins are properly aligned before seating the board.

4-10. Cleaning

4-11. Clean the instrument periodically to remove dust, grease and other contamination. Use the following procedure:

a. Clean the interior with clean, dry air at low pressure (20 psi). The contaminants on printed circuit boards can first be loosened by spraying them with Freon T.F. Degreaser (MS 180), then removed with low pressure air.

b. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened with a mild solution of detergent and water.

4-12. Fuse Replacement

4-13. The power fuse (F2) is located on the main printed circuit board near the power transformer. Access to the fuse is accomplished by following the Access/Disassembly procedure found in this section of the manual. If replacement is necessary, use a 1/8 ampere fuse for either 115V ac or 230V ac power configuration (½ ampere fuse for 8600A–01). The MA HI terminal is a fuse holder for current overload protection. Using a screwdriver, turn the terminal ¼ turn counterclockwise. Replace the fuse with a 2A AGX, fast blow, fuse.

4-14. PERFORMANCE TESTS

4-15. The following tests are intended for use in performance testing of the 8600A. The tests compare the instrument performance to the accuracy specifications and are especially suited to acceptance testing of new instruments. Tests should be conducted under the following conditions: ambient temperature 23°C ±5°C, relative humidity less than 80%.

NOTE!

Tolerances and test limits for performance tests are derived from the 6 month instrument specifications.

4-16. DC Voltage Test

4-17. Using the dc voltage calibrator, sequentially apply the voltages indicated in Table 4-2 to the 8600A V-Ω input terminals and select the ranges prescribed. The 8600A should display a reading within the indicated limits.

4-18. Ohms Test

4-19. Using the resistor decade, sequentially apply the resistance values indicated in Table 4-3 to the 8600A V-Ω input terminals, and select the ranges prescribed. The 8600A should display a reading within the indicated limits.

Table 4-2. DCV PERFORMANCE TEST

8600A RANGE	INPUT REQUIRED	8600A DISPLAY LIMITS
200mV	+190.00mV	+189.90 to 190.10mV
200mV	–19.000mV	–18.97 to 19.03mV
2V	+1.9000V	+1.8995 to 1.9005V
2V	–1.9000V	–1.8995 to 1.9005V
2V	+ .9000V	+.8997 to .9003V
20V	+19.000V	+18.995 to 19.005V
20V	–19.000V	–18.995 to 19.005V
200V	+190.00V	+189.95 to 190.05V
1200V	+1000.0V	+999.7 to 1000.3V
AUTO	– .17000V	–169.91 to 170.09mV
AUTO	–1.7000V	–1.6996 to 1.7004V
AUTO	–17.000V	–16.996 to 17.004V
AUTO	–170.00V	–169.96 to 170.04V
AUTO	–1000.0V	–999.7 to 1000.3V

Table 4-3. OHMS PERFORMANCE TEST

8600A RANGE	INPUT REQUIRED	8600A DISPLAY LIMITS
AUTO	SHORT	00.00 to 00.03
AUTO	100.00Ω	99.87 to 100.13
AUTO	1.0000kΩ	.9989 to 1.0011
AUTO	10.000kΩ	9.994 to 10.006
AUTO	100.00kΩ	99.94 to 100.06
AUTO	1000.0kΩ	999.4 to 1000.6
AUTO	10.000MΩ	9.979 to 10.021
AUTO	OPEN	18.888 Flashing (20MΩ LED lit)

4-20. DC Current Test

4-21. Using the dc current calibrator (check Table 4-1 for correct calibrator) sequentially apply the values of dc current indicated in Table 4-4 to the 8600A MA input terminals and select the ranges prescribed. The 8600A should display a reading within the indicated limits.

Table 4-4. DC CURRENT PERFORMANCE TEST

RANGE	INPUT	READING
200 μA	Open	–00.05 to +00.05
200 μA	+190.00 μA	+189.79 to +190.21
2 mA	+1.9000 mA	+1.8979 to +1.9021
20 mA	+19.000 mA	+18.979 to +19.021
200 mA	+190.00 mA	+189.79 to +190.21
2000 mA	+1.9000 A	+1897.9 to +1902.1

NOTE!

Because the current measurements of ac and dc are made using the same shunt resistors; a check of ac current is not made.

4-22. AC Voltage Test

4-23. Using the ac voltage calibrator, apply the ac voltages indicated in Table 4-5 to the 8600A V-Ω input terminals and select the ranges prescribed. The 8600A should display a reading within the indicated limits.

4-24. CALIBRATION

4-25. Introduction

4-26 The 8600A should be calibrated every 6 months or whenever repairs have been made, to insure the instrument continues to operate at its rated accuracy. After calibration is completed, the DC current performance test, paragraph 4-20 should be run through to verify the functioning and accuracy of the current dividers. The calibration should be performed under the following environmental conditons; ambient temperature of 23°C ±5°C and a relative humidity of less than 80%. Refer to Table 4-1 for the recommended test equipment. Calibration adjustment locations are pictured in Figure 4-1. Perform the following preliminary steps before calibrating the instrument.

a. Remove the instrument from the case.

b. Connect the 8600A to the appropriate (115V ac or 230V ac) line power.

c. Turn the instrument on and allow it to warm-up for a minimum of 15 minutes.

d. Insure that the ac and dc calibrators are up to their normal operating temperatures.

NOTE!

Use only non-metalic adjustment tools.

Table 4-5. ACV PERFORMANCE TEST

8600A RANGE	INPUT REQUIRED	FRE-QUENCY Hz	8600A DISPLAY LIMITS
200 mV	190.00 mV	70 kHz	188.05 to 191.95 mV
200 mV	190.00 mV	500 Hz	189.46 to 190.54 mV
200 mV	39.00 mV	30 kHz	38.60 to 39.40 mV
2 V	1.9000 V	500 Hz	1.8959 to 1.9041 V
2 V	.9000 V	500 Hz	.8979 to .9021 V
2 V	1.9000 V	50 kHz	1.8900 to 1.9100 V
2 V	1.9000 V	100 kHz	1.8800 to 1.9200 V
2 V	1.0000 V	30 Hz	.9945 to 1.0055 V
20 V	19.000 V	500 Hz	18.959 to 19.041 V
20 V	19.000 V	70 kHz	18.800 to 19.200 V
200 V	190.00 V	500 Hz	189.59 to 190.41 V
200 V	100.00 V	30 kHz	99.45 to 100.55 V
1200 V	1000.0 V	500 Hz	996.9 to 1003.1 V
1200 V	1000.0 V	20 kHz	994.0 to 1006.0 V

4-27. DC Volts Calibration

4-28. The calibration procedure for the DCV FUNCTION of the 8600A is presented in Table 4-6. Use the recommended dc voltage calibrator (see Table 4-1) to apply the prescribed dc voltages to the V-Ω INPUT terminals and, where required, make the adjustments to meet the specified display limits.

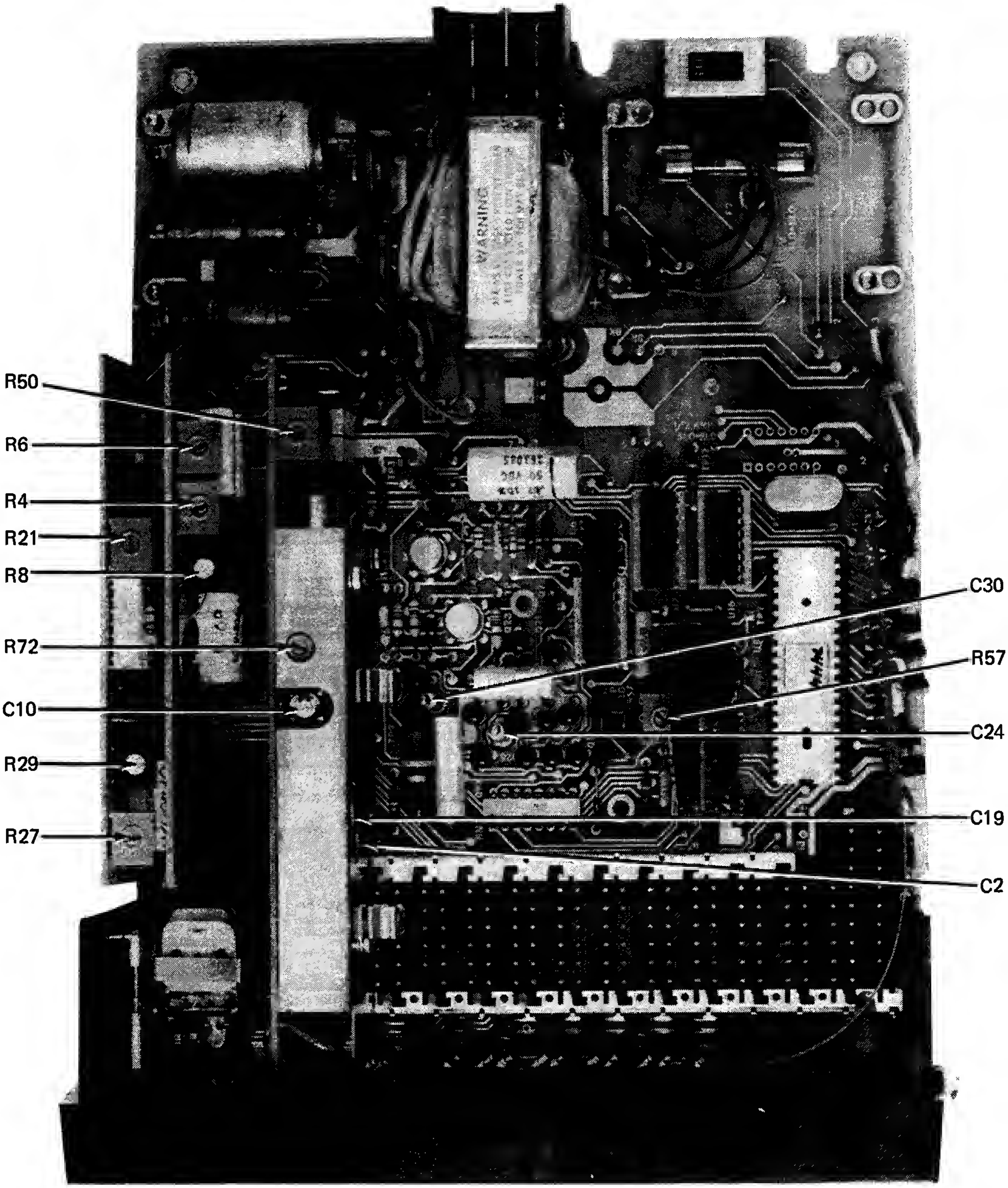

Figure 4-1. CALIBRATION ADJUSTMENT LOCATIONS

Table 4-6. DC VOLTS CALIBRATION PROCEDURE

STEP	8600A RANGE	INPUT REQUIRED	ADJUSTMENT	8600A DISPLAY LIMITS
1	Select the VDC FUNCTION switch on the front panel.			
2	200mV	Short	none	−00.01 to +00.01
3	200mV	1MΩ*	C24	−00.01 to +00.01
4	200mV	+.19V	none	note display reading
5	200mV	−.19V	C30	within 1 digit of step 4 display
6	(Repeat steps 3, 4, and 5 until each step is within limits)			
7	20V	open	none	±00.00 to +00.61
8	2V	+1.9000V	R57	+1.8999 to +1.9001
9	2V	−1.9000V	R57	−1.8999 to −1.9001
10	(Repeat steps 8 and 9 until both are within limits)			
11	2V	+0.9000V	none	+0.8999 to +0.9001
12	200mV	+190.00mV	none	+189.95 to +190.05**
13	200mV	−190.00mV	none	−189.95 to −190.05**
14	20V	+19.000V	R4	+18.999 to +19.001
15	20V	−19.000V	R4	−18.999 to −19.001
16	(Repeat steps 14 and 15 until both are within limits)			
17	200V	+190.00V	R6	+189.99 to +190.01
18	1200V	+1000.0V	R8	+999.9 to +1000.1

* Place a 1MΩ resistor across the V-Ω INPUT.
** 200mV LED on the display should be on.

4-29. Ohms Calibration

4-30. The calibration procedure for the KΩ function of the 8600A is presented in Table 4-7. Use the recommended resistor decade (see Table 4-1) to apply the prescribed resistances to the VΩ INPUT terminals and, where required, make the adjustments to meet the specified display limits.

CAUTION!

Remove any applied voltage from the 8600A input terminals before starting the Ohms Calibration.

4-31. AC Volts Calibration

4-32. The calibration procedure for the ACV FUNCTION of the 8600A is presented in Table 4-8. Use the recommended ac voltage calibrator (see Table 4-1) to apply the prescribed ac voltages at the indicated frequencies to the VΩ INPUT terminals and, where required, make the adjustments to meet the specified display limits.

4-33. TROUBLESHOOTING

4-34. The following information is provided to assist in locating malfunctions in the 8600A. It is recommended that the theory of operation in Section 3 be read completely before attempting to troubleshoot the instrument.

Table 4-7. OHMS CALIBRATION PROCEDURE

STEP	8600A RANGE	INPUT REQUIRED	ADJUSTMENT	8600A DISPLAY LIMITS
1	Depress the KΩ FUNCTION switch on the front panel.			
2	200	Short	none	0.00 to 00.02
3	2000kΩ	1000.0kΩ	R21	999.9 to 1000.1
4	2	1.0000kΩ	R27	.9999 to 1.0001
5	20MΩ	10.000MΩ	R29	9.997 to 10.003MΩ

Table 4-8. AC VOLTS CALIBRATION PROCEDURE

STEP	8600A RANGE	INPUT VOLTAGE REQUIRED	INPUT FREQUENCY REQUIRED	ADJUSTMENT	8600A DISPLAY LIMITS
1	Simultaneously select the ACMA and DCV FUNCTION switches. *				
2	1200V	none	none	R72	–20.0 to –30.0
3	Select the VAC FUNCTION switch on the front panel.				
4	2	1.9000V	500Hz	R50	1.8998 to 1.9002
5	2	0.9000V	500Hz	none	.8997 to .9003
6	200	190.00V	500Hz	none	189.90 to 190.10
7	200	190.00V	50kHz	C2	189.95 to 190.05
8	2	1.9000V	50kHz	C19	1.8995 to 1.9005
9	Repeat steps 7 and 8 until both are within limits				
10	2	1.9000V	100kHz	none	1.8875 to 1.9125
11	2	1.9000V	30Hz	none	1.8950 to 1.9050
12	20	19.000V	500Hz	none	18.990 to 19.010
13	20	19.000V	50kHz	C10	18.990 to 19.010
14	200mV	190.00mV	50kHz	none	189.80 to 190.20**
15	200mV	190.00mV	500Hz	none	189.85 to 190.15**
16	200mV	39.00mV	500Hz	none	38.90 to 39.10**
17	1200V	1000.0V	500Hz	none	998.0 to 1002.0
18	1200V	1000.0V	20kHz	none	996.0 to 1004.0

* Simultaneous selection of both function switches connects the positive 25mV AC Converter offset to the A-D Converter auto zero input. The A-D Converter action causes the negative display of STEP 2.

** 200MV LED on the display should be on.

4-35. Initial Troubleshooting

4-36. The troubleshooting techniques given below should be completed as the first step toward repairing any apparent malfunction in the unit. Improper operation may not always be caused by failures within the 8600A. The following reminders of basic fault isolation techniques will help determine if the cause is the result of an internal failure or faulty external connection.

a. Carefully check the 8600A control settings: some false indications may be caused by an incorrect or overlooked control setting.

b. Check associated equipment: insure that associated equipment controls and connections are correct.

c. Check the 8600A performance: the performance test (par. 4-14) will determine if the malfunction is in the 8600A.

d. Carefully inspect the interior of the instrument: check for physically damaged parts, loose or broken wires, and improperly seated plug-in assemblies.

4-37 When it has been determined by the above checks that the malfunction is within the 8600A multimeter, the following procedure should be used to isolate the problem area. The recommended test equipment for troubleshooting this instrument is listed in table 4-1. A troubleshooting flow chart is included in figure 4-2 as an aid in repairing the instrument. Performance tests given in the beginning of this section are referred to by paragraph number and table number. Tests contained in the following sections are referred to by paragraph number. In addition portions of the theory of operation section relevant to the correct operation of the circuitry in question are referred to by paragraph number.

NOTE

Refer to the appropriate schematic for the electrical location of test points specified. Physical test point connectors may not appear on some pcbs.

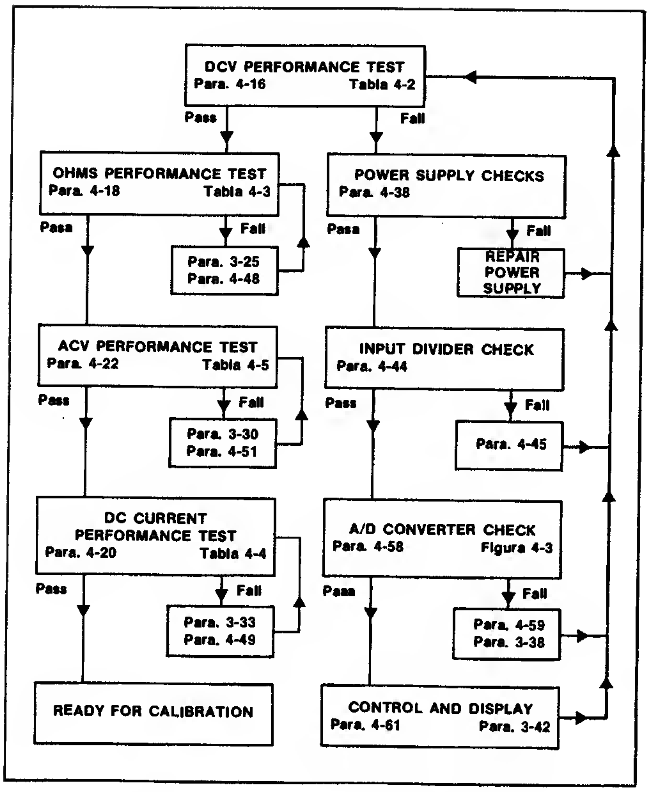

Figure 4-2 TROUBLESHOOTING FLOW CHART

4-38. Power Supply Checks

4-39. Incorrect output voltages from the +5 volt, +15 volt, or −15 volt supplies may cause the unit to exhibit various improper indications. Because of this the power supplies should be checked in the event of any 8600A malfunction. Use the following procedure to check the power supply output voltages.

a. Connect the test equipment multimeter return lead to the V-Ω LOW input terminal.

b. Connect the high input lead to TP12, the +5 volt supply. The power supply voltage should be +4.75V to +5.75.

c. Connect the high input lead to TP4, the −15 volt supply. The power supply voltage should be −15.0 ±0.5 volts.

d. Connect the high input lead to TP5, the +15 volt supply. The power supply voltage should be +15.0 ±0.5 volts.

4-40. Fault Area Isolation

4-41. A malfunction in the 8600A may be isolated to a particular section of the circuitry by observing the front panel display during each mode of operation. The performance tests (par. 4-14) will exercise the 8600A in each function in order to determine the functional operations of the unit affected by the failure.

4-42. The indications observed during the 8600A operation in each of four functions (VDC, VAC, Ohms, and DC current) may isolate the failure to a particular area. Table 4-9 lists the fault area indicated by various combinations of proper or improper 8600A operation in each of the four functions exercised in the performance test.

4-43. Troubleshooting information for the indicated fault area is presented in the following paragraphs. Proceed to the troubleshooting information for the indicated failure area. It should be kept in mind that some failures may cause improper operation of functional areas other than the one actually containing the problem.

4-44. INPUT DIVIDER

4-45 Problems in the Input Divider will generally give improper operation in the DCV and OHMS functions, leaving other functions unaffected. There are exceptions, however. For example the relay, K4, must be energized in all ACV ranges to connect the output of the AC Con-

Table 4-9. FAULT AREA INDICATION

8600A FUNCTION	8600A OPERATION – PROPER OR IMPROPER				
VDC	IMPROPER	PROPER	PROPER	PROPER	IMPROPER
OHMS	IMPROPER	IMPROPER	PROPER	PROPER	IMPROPER
DCI	PROPER	PROPER	IMPROPER	PROPER	IMPROPER
VAC	PROPER	PROPER	PROPER	IMPROPER	IMPROPER
FAULT AREA INDICATED	INPUT DIVIDER	OHMS CONVERTER	CURRENT SHUNT	AC CONVERTER	A/D CONVERTER OR CONTROL AND DISPLAY

verter to the input of the A/D Converter. By inserting a voltage at TP11, all input signal conditioners will be bypassed. The operation of the A/D Converter and the Control and Display sections (with the exception of the range controls) can be checked with the following test. If the instrument passes this test, the indication is that the fault is in the Input Divider or in the range selection.

a. Select the DCV function and the 200mV range.

b. With no input to the VΩ terminals, check the voltage at TP11, and at buffer input (U4 pin 3). If it is OV proceed to the next step. A voltage on TP11 or at the buffer input indicates that one of the control FETs (Q14, Q15, Q16, Q17, Q21) or Q13 or Q11 may be shorted or leaky.

c. Connect +190mV to TP11 and the return lead to TP3. Refer to table 4-10 and observe the front panel display as the front panel range switches are changed.

RANGE SETTING	DISPLAY
200 mV	+190.00
2V	+ .19
20V	+ 1.90
200V	+ 19.00
1200V	+190.00
AUTO	DECIMAL MAY BE ANYWHERE
REPEAT FOR NEGATIVE INPUT	

Table 4-10 INPUT DIVIDER TEST

4-46. OHMS CONVERTER

4-47. An instrument malfunction affecting only the ohms mode of operation is generally the result of the ohms converter producing an improper level of current for the particular resistance range being used. The following procedure should be used to evaluate the operation of the ohms converter.

a. Select the KΩ function and 20 K range.

b. Place a good quality short across the V-Ω input terminals.

c. Measure the voltage level at the cathode of CR2. It should be +10 ±0.1V dc.

d. If the voltage is incorrect measure the voltage at pin 3 of U1. This point should be 0.00 volts ±100 microvolts.

e. A voltage level greater than ten volts at CR2 and zero volts at pin 3 of U1 would indicate that the current source (Q3, U3 and associated components) is supplying more current than normal. If the voltage at CR2 were less than ten volts the current from Q3 would probably be less than normal.

4-48. The operation of the current source can be checked by measuring the voltage at pins 2 and 3 of U3. The voltage on both pins should be approximately –8.6 volts. Uneven voltages may be caused by improper resistance value of R35 or R91, or a failure in CR10. The voltages at pin 2 and 3 of U3 may be proper and the current supply from Q3 improper if the gate of Q3 were leaking current back to pin 6 of U3.

4-49. CURRENT SHUNTS

4-50. Failures in the current mode of operation affecting all current ranges would probably be attributed to a failure in one of the following areas: 1) the input fuse (F1) open, 2) one or more of diodes CR1, CR6, CR7, or CR8 shorted, or 3) improper connection in the contacts of function switch S2 (ACI), or S4 (DCI) or range switches S6-S10.

4-51. AC CONVERTER

4-52. Generally a failure in the ac converter will do one of two things: 1) create a dc voltage output without an ac input signal applied to the 8600A input terminals or 2) not produce the proper dc voltage output when an ac input is applied to the unit. A dc offset voltage created within the ac converter may cause the multimeter display to indicate some substantial value of ac voltage when a short is placed across the input terminals. When the ac converter failure causes the display to remain at zero when an ac signal is applied to the input, the converter is not producing the proper dc voltage output for the A/D converter.

4-53. The operation of the ac converter can be checked for the dc voltage offset by performing the following procedure.

a. Remove the molded plastic outer case from the 8600A (see par. 4-7 Access/Dissassembly).

b. Remove the ac converter pcb, take the metal shield off the side and reinstall the board into mainframe.

NOTE!

Take care that all the connector pins on the board are properly aligned before seating the pcb.

c. Short the V-Ω INPUT terminal HI to LO. Select the 200V RANGE and VAC FUNCTION.

d. Connect the return lead of the test equipment voltmeter to the 8600A V/Ω LO input terminal.

e. Connect the high input lead to the ac converter output at pin 9. Note the voltage level.

f. Move the high input lead to pin 10. The voltage level should be the same as that noted in step e.

4-54. A difference in voltage levels between the two pins would be displayed as an offset on the front panel readout. The level at either pin should not exceed +30 millivolts nor be less than +20 millivolt. If the voltage level is too high or there is a difference in voltage level between the two, check current source CL1 or transistors Q1, Q7, and Q9, or capacitors C12 and C13.

4-55. The operation of the ac converter with an ac input applied, observed at the circuit locations described below, may indicate the fault area. With the 8600A in the 2V range and AC V function apply a 1V rms 500 Hz signal to the V/Ω INPUT terminals and proceed as described below.

a. Connect the input return lead of an oscilloscope to the 8600A MA LO terminal.

b. Connect the scope input probe to the ac converter input at the wire connection on S2A. Note the amplitude of the signal; it should be 2.8 volts peak-to-peak.

c. Move the scope input probe to U2 pin 6. The ac signal at this point should be about one-quarter of the amplitude of the input signal, or about 0.7 volts peak-to-peak. If correct go to step e.

d. If the signal is not present at this point or the dc voltage level is close to either the −15 volt or +15 volt supply, U2, Q7, or CL1 are probably defective. If the signal is distorted check the operation of Q1.

e. Connect the scope input probe to the base of Q7, the signal here should be one-quarter of the amplitude of the input signal.

f. The ac converter output at pin 9 should be one volt dc plus the dc voltage offset level at pin 10.

4-56. A/D CONVERTER OR CONTROL AND DISPLAY

4-57. An A/D converter or control and display failure will generally affect the operation of the 8600A in all functions. The exceptions to this would be a malfunction in an individual function's control signal or range relay signal. The following information is provided to aid in isolating problems within the A/D converter and control and display circuitry.

4-58. The A/D Converter can be checked by using the following procedure.

a. Select the DCV function and the 2V range.

b. Apply +1V dc to 8600A VΩ terminals.

c. Connect the oscilloscope probe to TP2. The probe ground return may be connected to TP3 or the mA LO terminal.

d. The signal at TP2 should be as shown in figure 4-3.

4-59. The stable +5V section of the waveform shown in figure 4-3 should be 200msec long for a +1V dc input. If the dc input voltage is increased to 2V, the stable portion of the waveform should be 300msec long. If the waveform is correct, the problem is in the display section. If the waveform is incorrect, refer to figure 4-4 for further test points and waveforms in the A/D Converter. Check the waveforms at the buffer, U4, for the correct voltage from Q14 and the appropriate reference (U17, Q17, and Q21). U4 has a gain of 5 so the waveform at its output should be 5 times its input (not inverted). The output of U5 should be triangular as shown and opposite in polarity to the buffer input.

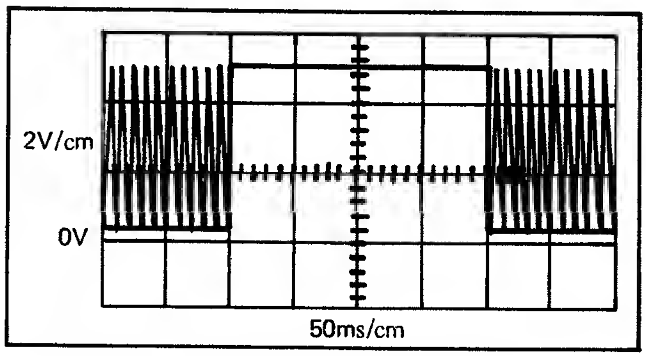

Figure 4-3. A/D CONVERTER OUTPUT SIGNAL

4-60. The control waveforms and timing are important to the correct operation of the A/D Converter. The waveforms and test points are shown in figure 4-4. Continue with the test setup in 4-58. First check the signal at the gate of the FET. If absent or wrong, check that output from U8, keeping in mind that the driver transistors act as inverters. The operation of U8 with respect to the A/D Converter may be checked as follows.

a. Select DCV function and 2V range.

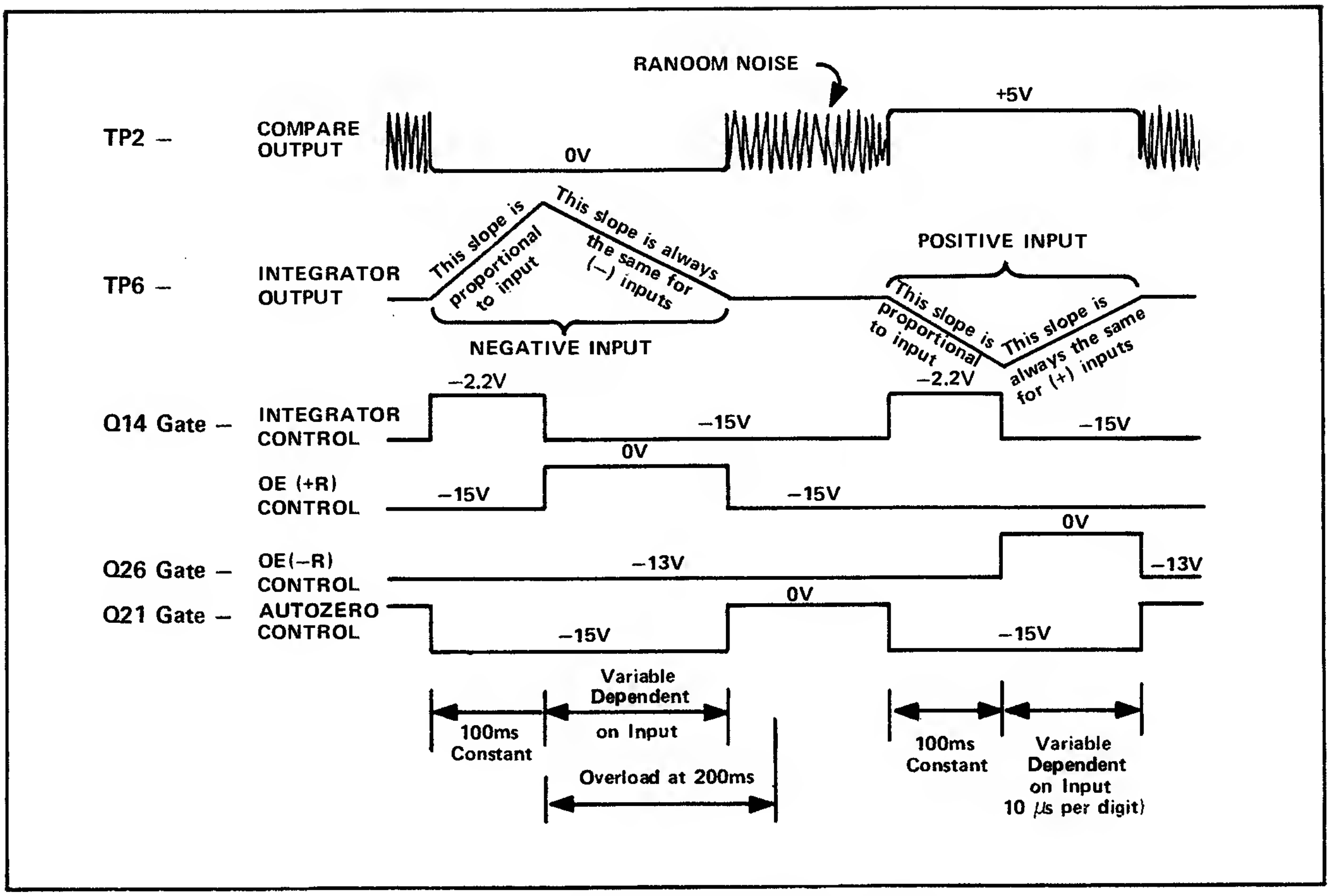

Figure 4-4. A/D CONVERTER CONTROL SIGNALS

b. Apply OV dc to TP2 by connecting it to TP3 (ground). Refer to table 4-11 for test points and indications.

c. Apply +5V dc to TP2 by connecting it to TP12 (+5V supply). Refer to table 4-11 for test points and indications.

4-61. The operation of the range control system can be checked by observing the interaction of U8, U9, U16, and the function switches. For switching between the lowest range and the higher ranges, U17 changes the reference applied to U4 and the charge path of C28. Table 4-12 contains truth tables for U8 and U9. It also shows which relays are energized in each range and the internal switching arrangements for U16 and U17. To check a questionable range, select the range manually and check the inputs and outputs given in Table 4-12 that affect that range. Keep in mind that relay common is +5V so in all cases the output of U9 goes low to select a relay. The strobe signals are used to program U8 for the different ranges. U16 together with the range switches apply the ST signals to U8 as explained in Theory of Operation.

TP2 INPUT	FRONT PANEL DISPLAY	AZ U8 PIN 2	INT U8 PIN 40	DE(+R) U8 PIN 38	DE(–R) U8 PIN 39
OV dc	OVERRANGE	PULSE	PULSE	OV dc	PULSE
+5V dc	OVERRANGE	PULSE	PULSE	PULSE	OV dc
		PULSE AMPLITUDE SHOULD BE 15V (FROM OV dc to –15V dc)			

Table 4-11 OPERATION OF U8 WITH RESPECT TO A/D CONVERTER

RANGE SELECTED	U8 OUTPUT PINS			FUNCTION	U9 INPUT PINS	
	29 (a)	28 (b)	30 (c)		10	11
200 mV	0	0	1	ACV	1	0
2V	0	1	0	AC MA	1	1
20V	0	1	1	DCV	0	1
1200V	1	0	1	DC MA	1	0
20 MΩ	1	1	0	KΩ	0	0

LOGIC 1 = +5V LOGIC 0 = 0V
IN DC mA FUNCTION U9 AND RELAYS INACTIVE

ACV FUNCTION		DCV FUNCTION	
RANGE	RELAY ENERGIZED	RANGE	RELAY ENERGIZED
200 mV, 2V	K4	200 mV, 2V	None
20V	K4, K6	20V	K1, K2
200V	K4, K7	200V	K1, K3
1200V	K4, K8	1200V	K1, K4

OHMS FUNCTION	
RANGE	RELAY ENERGIZED
200Ω	K4
2KΩ	K4
20KΩ	K3
200KΩ	K2
2000KΩ	None
20MΩ	K5

AC MA FUNCTION
K4 ENERGIZED IN ALL RANGES

DC MA FUNCTION
U9 AND RELAYS DEENERGIZED

U17 4PST	INTERNAL SWITCH	A	B	C	D	+5V TO CONTROL PIN CLOSES SWITCH (ON) OV OPENS SWITCH (OFF)
	SWITCH CONTROL PIN	13	5	6	12	
	PINS SWITCHED	1 / 2	3 / 4	8 / 9	10 / 11	

U16 3PDT	INTERNAL SWITCH	A	B	C	SWITCHES ARE AS SHOWN FOR OV ON CONTROL PIN +5V ON CONTROL PIN SWITCHES CENTER ROW FROM TOP TO BOTTOM
	SWITCH CONTROL PIN	11	10	9	
	PINS SWITCHED	12 / 14 / 13	2 / 15 / 1	5 / 4 / 3	

Table 4-12 RANGE INFORMATION

4-62. Errors in the display concerning decimal point location and upper or lower annunciators can be the result of range control problems. A +5V is required from U8 to turn on the annunciators. Decimal point logic is a positive pulse output from U8 occuring at the same time as the appropriate strobe signal. Either STO or ST7 is selected by U16 before being applied to the display board. The digit information to be presented on the front panel is delivered by U8 in BCD format on lines W, X, Y, and Z.

4-63. A malfunction caused by the display section of the circuitry will generally cause the 8600A display to indicate the failure in one of five ways; 1) all LED's are dark, 2) one segment of any one or all LED displays are dark, 3) any single LED display is dark, 4) the numbers containing a particular binary code (1, 2, 4 or 8) will not display or 5) one digit is brighter than normal and all others are off. The probable cause for each possible failure indication is given below.

4-64. When all LED's are dark, check for +5 volts at the emitter of Q30. Using an oscilloscope check U10 pins 9 through 15, LED segment drive signals, for a squarewave signal alternating between +3.5 volts and +0.4 volts.

4-65. When a segment of only one LED is dark the LED is the probable cause of the failure. If, however, the same segment in all LED' s is out the particular segment drive signal, U10 pins 13, 12, 11, 10, 9, 15, or 14 corresponding to segments A, B, C, D, E, F, and G respectively, can be checked for the required voltage change from +3.5 volts to +0.4 volts as the segment lights.

4-66. When one digit in the display remains dark the strobe signal for that digit should be checked. The base of Q37 (MSD), Q29 (2SD), Q31 (3SD), Q33 (4SD) and Q35 (LSD) should go to +5 volts as each is strobed on for 300μs.

4-67. When the display indicates that one of the binary codes (1, 2, 4, or 8) is missing; the bcd output from U8 can be observed at pin 31 (1), 32 (2), 33 (4) and 35 (8). The output at each pin should drop from +5 volts to about zero volts when that code is used to produce the digit being displayed. If the bcd information at U8 is correct the probable cause of the failure is U10.

4-68. When one display digit is bright and all others are off, the clock oscillator is the probable cause. Check the operation of U7, U8, and the 1 MHz crystal Y1.

Section 5

Lists of Replaceable Parts

TABLE OF CONTENTS

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number

b. Description of each part

c. Fluke Stock Number

d. Federal Supply Code for Manufacturers. See Appendix A for Code-to-Name list.)

e. Manufacturer's part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates 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 in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production 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 Use Code Effectifity, paragraph 5-7.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

a. Quantity

b. FLUKE Stock Number

c. Description

d. Reference Designation or Item Number

e. Printed Circuit Board Part Number

f. Instrument model and Serial number

5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY
	For U8, page 5-3
A	Up to 42560 order CMOS
B	42560 and above order PMOS

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, MODEL 8600A						
	Figure 5-1						
	Front Panel and Main PCB Assembly						
1	8600A (Line power only)	365866	89536	365866	1		
2	8600A–01 (Battery Power)	366906	89536	366906	1		
3	Battery Power Supply PCB Assembly (–01 Option)						
	100Vac version	378380	89536	378380	1		
	115Vac version	373837	89536	373837	1		
	230Vac version	378372	89536	378372	1		
4	AC Converter Assembly	373852	89536	373852	1		
5	Ohms Converter Assembly	373845	89536	373845	1		
6	Input Divider Assembly	397463	89536	397463	1		
7	DOU PCB Assembly (8600A–02)	366369	89536	366369	1		
8	Case, molded	330076	89536	330076	1		
9	Case, molded, DOU (8600-02)	384800	89536	384800	1		
10	Decal, knob	347401	89536	347401	2		
11	Decal, name plate	380667	89536	380667	1		
12	Handle, molded	330092	89536	330092	1		
13	Pad, foot	338632	89536	338632	2		
14	Fuse, slo-blo, 1/8A, spare	166488	71400	MDL	1	5	
15	Socket, DIP, 14-pin (8600A–02)	291542	00779	583527-1	1		
	Line cord	343723	89536	343723	1		
	Test lead, pair	343657	83330	21058	1		
	Fuse, fast acting, ¼A spare (8600A–01)	109322	71400	MDL	1		
U8	IC, 3, 4, 5 Digit, C-MOS, 40 pin	354985	89536	354985	1	1	A
U8	IC, dig, P-MOS, univ auto-ranging, DVM logic	407734	70203	C2506/ 407734	1	1	B

Indicates MOS device which may be damaged by static discharge.

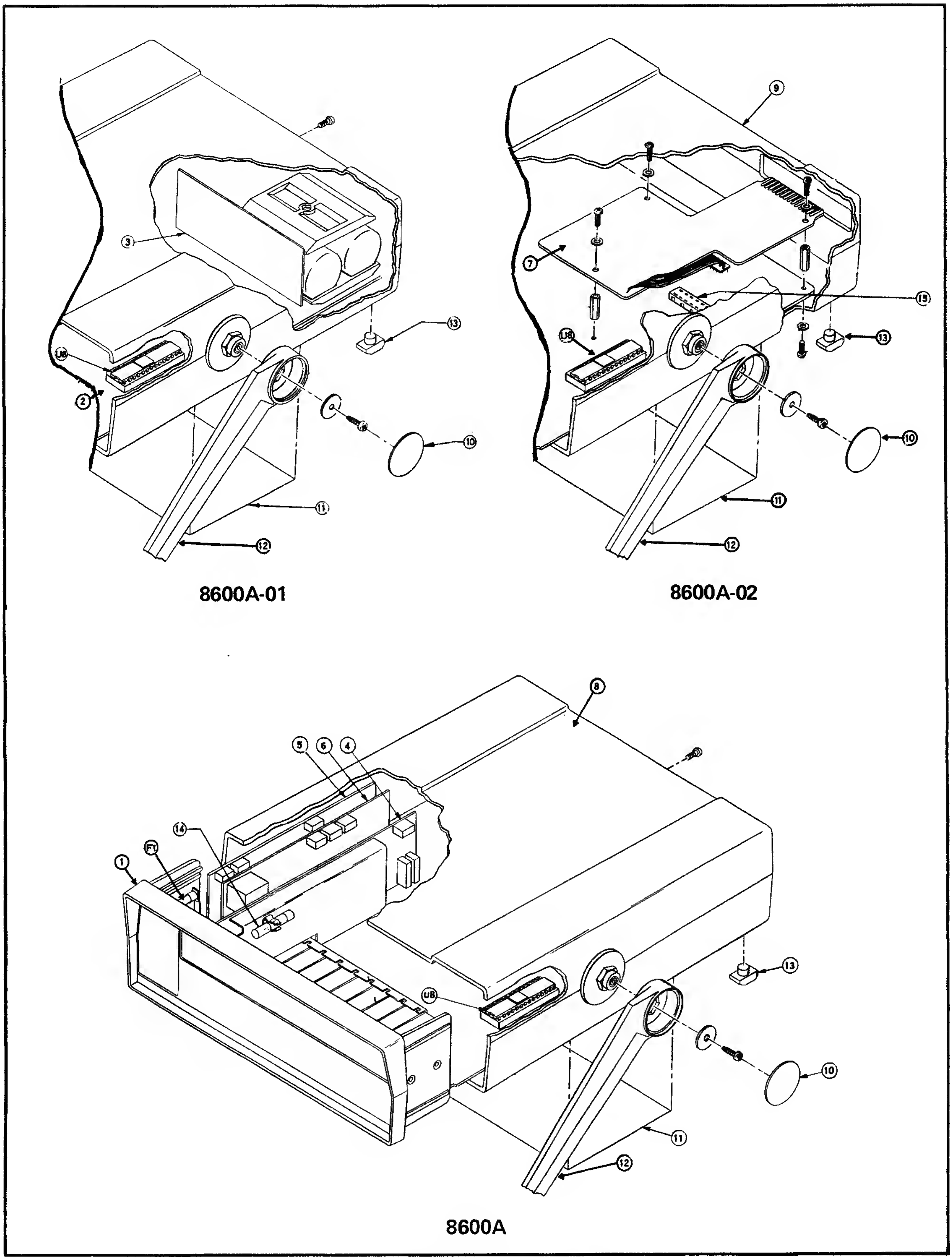

Figure 5-1. 8600A FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FRONT PANEL AND MAIN PCB ASSY. (8600A Line Power)	365866	89536	365866	REF		
	Main PCB Assy. Figure 5-2						
C21	Cap, polystyrene, 0.022 μF ± 10%, 100V	333823	02799	1PJ223K	1		
C22	Cap, polycarbonate, 0.47uF ±10%, 100V	288860	01281	X463VW04791 W	1		
C23	Cap, cer, 2.7pF ±0.25pF, 100V	363705	80031	2222-631-09278	1		
C24, C30	Cap, var, 0.25 – 1.5pF ±0.25pF, 2000V	218206	72982	530-000	2	1	
C25, C26, C27, C35	Cap, Ta, 10uF ±20%, 20V	330662	56289	196D106X0020 JA1	4		
C28	Cap, polypropylene, 0.47uF ±10%, 50V	363085	01281	JF86	1		
C31	Cap, cer, 0.001uF ±20%, 3KV/5.25K	105635	56289	29C300	1		
C39	Cap, mylar, 0.01uF ±20%	159996	01281	6634W103-010 W	1		
C101, C102	Cap, elect, 220uF +50/–10%, 40V	178616	25403	ET221X040A01	2	1	
C103	Cap, elect, 2000uF +100/–10%, 15V	364182	25088	B4101-2200/15	1	1	
CR1, CR2, CR6, CR8	Diode, Si, 2A, 50V	347559	14099	1N5400	4	1	
CR9, CR15, CR20, CR21, CR24	Diode, Si, 150 mA	203323	07910	1N4448	5	1	
CR14, R56, R60	Zener, reference set	377283	89536	377283	1	1	
CR101, CR102	Rectifier, bridge, 2 amp, 100V	296509	09423	FB100	2	1	
CR103	Zener, 6.8V, 1 mA	352898	99942	R4852	1	1	
F2	Fuse, Slo-Blo, 1/8A	166488	71400	MDL	1	5	
K1	Relay, Telephone, DPDT	357707	12300	R10E2662-2	1		
L1	Choke, RF, 100uh	111542	99800	1537-76	1		
Q2,Q6	Xstr, Si, PNP	195974	04713	2N3906	2	1	
Q10, Q26, Q27, Q28	Xstr, Si, NPN	159855	07910	CS23030	4	1	

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q11	Xstr, Si, NPN, Selected	352138	89536	352138	1	1	
Q16, Q17, Q21, Q22	Xstr, J-FET, N-channel	357889	21845	F2692	4	1	
Q14, Q15	Xstr, J-FET, N-channel	357897	21845	F2691	2	1	
Q13, Q23	Xstr, J-FET, N-channel	370072	12040	TYPE KE4393	2	1	
R1	Res, comp, 100K ±5%, ¼W	148189	01121	CB1045	1		
R2	Res, WW, card, 0.1 ± 0.05%	374611	89536	374611	1	1	
R10, R11, R83	Res, comp, 470K ±5%, ¼W	188441	01121	CB4745	3		
R12, R52	Res, comp, 100K ±5%, 2W	285056	01121	HB1045	2		
R13	Res, WW, 900 ±0.05%, 1/10W	357483	89536	357483	1	1	
R14	Res, WW, 90 ±0.05%, 1/10W	357517	89536	357517	1	1	
R15	Res, WW, 9 ±0.05%, 1/10W	357525	89536	357525	1	1	
R16	Res, WW, card, 1.0 ± 0.05%	356097	89536	356097	1	1	
R18	Res, met film, 60.4K ±1%, 1/8W	291419	91637	MFF1-86042F	1		
R23	Res, met film, 30.1K ±1%, 1/8W	168286	91637	MFF1-83012F	1		
R24	Res, met film, 90.9K ±1%, 1/8W	223537	91637	MFF1-89092F	1		
R57	Res, var, cer, 500 ±10%, ½W	325613	71450	360T501A	1	1	
R62, R65, R67	Res, match set, 3 pc	375782	89536	375782	1	1	
R63, R76	Res, comp, 10K ±5%, ¼W	148106	01121	CB1035	2		
R66	Res, met film, 22.1K ±1%, 1/8W	235234	91637	MFF1-82212F	1		
R68	Res, comp, 56K ±5%, ¼W	170738	01121	CB5635	1		
R70	Res, met film, 8.06K ±1%, 1/8W	294942	91637	MFF1-88061F	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R71	Res, met film, 2.0K ±1%, 1/8W	235226	91637	MFF1-8202F	1		
R74	Res, comp, 4.7M ±5%, ¼W	220046	01121	CB4725	1		
R80	Res, met film, 200K ±1%, 1/8W	261701	91637	MFF1-8204F	1		
R81	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	1		
R82	Res, comp, 2.7M ±5%, ¼W	193490	01121	CB2755	1		
R84 R103	Res, comp, 2.2K ±5%, ¼W	148049	01121	CB2225	2		
R87	Res, comp, 4.7K ±5%, ¼W	148072	01121	CB4725	1		
R94	Res, comp, 1K ±5%, ¼W	148023	01121	CB1025	1		
R98	Res, comp, 220 ±5%, ¼W	147959	01121	CB2215	1		
RN1	Res, network, 15 pc	385815	89536	385185 TYPE 760	1	1	
S1 thru S13	Switch Assembly, pushbutton	390948	89536	390948	1	1	
S14	Switch, Slide, DPDT 115/230	376789	89536	376798	1	1	
T1	Xfmr, power	374264	89536	374264	1	1	
U4	IC, Op, Amp (yellow dot)	381962	12040	LH0042C	1	1	
U5	IC, Op, Amp (red dot)	385450	89536	385450	1	1	
U6	IC, linear, opnl ampl	352195	12040	LM311N8	1	1	
U7	IC, hex, buffer/conv	355214	04713	MC14009CP	1	1	
U8	(See Final Assembly)						
U9	IC, bipolar ROM	376061	01295	SN7488AN	1	1	
U16	IC, digital, C-MOS, 2-channel multiplexer	375808	49671	CD4053AE	1	1	
U17	IC, digital, C-MOS, quad switch	363838	49671	CD4016AE	1	1	
U102	IC, voltage regulator	355107	12040	LM340T5	1	1	
U103	IC, voltage regulator	413187	04713	MC7815CP	1	1	
U104	IC, voltage regulator	413179	04713	MC7915CP	1	1	
XF2	Fuseholder, clip	284984	84613	3621-2	2	1	
Y1	Crystal, 1.000 MHz	358069	30148	TYPE 815A	1	1	
	Connector, post	376574	00779	5166-333-68	24		
	Connector, post	379438	00779	86144-5	7		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Contact, fuse	397992	89536	397992	1		
	Receptacle, power, 3 prong						
	Insulator, receptacle	338624	89536	338624	1		
	Contact, earth common	338640	89536	338640	1		
	Contact, voltage	338657	89536	338657	2		
	Pushbutton, grey	369546	71590	J52305-J31753	12		
	Pushbutton, green	352211	71590	J52305-J71449	1		
	Socket, IC, 14-pin	291542	00779	583527-1	1		
	Socket, IC, 16-pin	291534	00779	583529-1	3		
	Socket, IC, 40-pin	376244	23880	TSA3100-40W	1		
	Socket, relay, 2-poles	376665	77342	27E501	1		
	Strap, relay retainer	381624	77342	P49	1		
	Front Panel Assembly (Not Illustrated)						
	Display PCB Assembly	373860	89536	373860	1		
C38	Cap, cer, 47 pF ±10%, 2kV	282145	00656	HVD3-47 +10% 2KV-I	1		
F1	Fuse, fast acting, 2A	376582	71400	AGX	1	5	
J1	Jack, banana, red	162065	74970	108902	1		
J2, J3	Jack, banana, black	162073	74970	108903	2		
XF1	Fuseholder	345611	89536	345611	1		
	Lens, display	367920	89536	367920	1		
	Panel, molded	369041	89536	369041	1		
	Decal, panel	375865	89536	375865	1		
	Retainer, neoprene	352484	77969	9109E	2		

Indicates MOS device which may be damaged by static discharge.

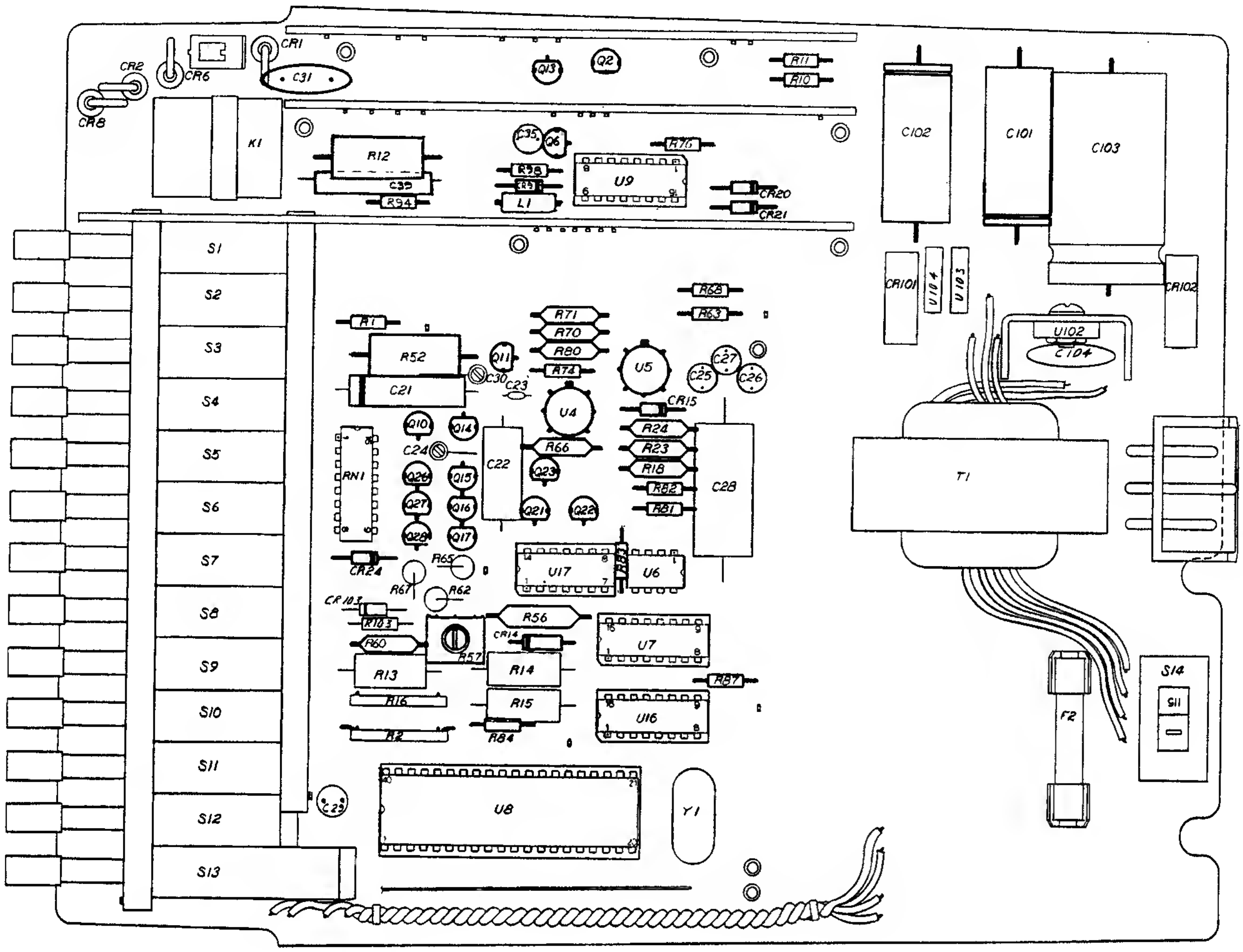

Figure 5-2. FRONT PANEL AND MAIN PCB ASSEMBLY (8600A Line Power)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FRONT PANEL AND MAIN PCB ASSY (8600A–01 Battery Power)	366906	89536	366906	REF		
	Main PCB Assembly - Figure 5-3						
BT1 thru BT4	Battery Ni-Cad, 1.2V	346924	89536	346924	4		
C21	Cap, polystyrene, 0.022uF ±10%, 100V	333823	01281	863VW22391	1		
C22	Cap, polycarbon, 0.47uF ±10%, 100V	288860	01281	X463VW47491	1		
C23	Cap, cer, 2.7pF ±0.25pF, 100V	363705	80031	2222-631-09278	1		
C24, C30	Cap, var, 0.25 - 1.5pF ±0.25pF, 200V	218206	72982	530-000	2	1	
C25, C26, C27, C29, C35	Cap, Ta, 10uF ±20%, 20V	330662	56289	196D106X0020 JA1	5		
C28	Cap, polypropylene, 0.47uF ±10%, 20V	363085	01281	JF86	1		
C31	Cap, cer, 0.001uF ±20%, 3KV/5.25KV	105635	56289	29C300	1		
C39	Cap, mylar, 0.01uF ±20%	159996	01281	663UW103-010 W	1		
CR1, CR2, CR6, CR8	Diode, rectifier, Si, 2A, 50V	347559	14099	1N5400	4	1	
CR9, CR15, CR20, CR21, CR24	Diode, Si, 150 mA	203323	07910	1N4448	5	1	
CR14, R56, R60	Zener, reference set	377283	89536	377283	1	1	
CR22, CR23	Diode, zener	291575	12969	UZ8720	2	1	
CR27	Diode, zener	256446	07910	1N755A	1	1	
CR201, CR204	Diode, Si, rectifier, 1A, 100V	343491	01295	1N4002	2	1	
F2	Fuse, Slow blow, ½A	109322	71400	MDL	1	5	
K1	Relay, telephone, DPDT	357707	12300	R10E2662-2	1		
L1	Choke, rf, 100uH	111542	99800	1537-76	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
L2	Inductor, 6 turn	320911	89536	320911	1		
Q2, Q6	Xstr, Si, PNP	195974	04713	2N3906	2	1	
Q10, Q26, Q27, Q28	Xstr, Si, NPN	159855	07910	CS23030	4	1	
Q11	Xstr, Si, NPN, selected	352138	89536	352138	1	1	
Q13,Q23	Xstr, J-FET, N-channel	370072	12040	TYPE KE4393	2	1	
Q14, Q15	Xstr, J-FET, N-channel	357897	21845	F2691	2	1	
Q16, Q17, Q21, Q22	Xstr, J-FET, N-channel	357889	21845	F2692	4	1	
Q43	Triac	413013	89536	413013	1	1	
R1	Res, fxd, comp, 100K ±5%, ¼W	148189	01121	CB1045	1		
R2	Res, fxd, WW, card, 0.1 ±0.05%	374611	89536	374611	1	1	
R10, R11, R83	Res, comp, 470K ±5%, ¼W	188441	01121	CB4745	3		
R12, R52	Res, comp, 100K ±5%, 2W	285056	01121	HB1045	2		
R13	Res, WW, 900 ±0.05%, 1/10W	357483	89536	357483	1	1	
R14	Res, WW, 90 ±0.05%, 1/10W	357517	89536	357517	1	1	
R15	Res, WW, 9 ±0.05%, 1/10W	357525	89536	357525	1	1	
R16	Res, WW, card 1 ±0.05%	356097	89536	356097	1	1	
R18	Res, met film, 60.4K ±1%, 1/8W	291419	91637	MFF1-86042F	1		
R23	Res, met film, 30.1K ±1%, 1/8W	168286	91637	MFF1-83012F	1		
R24	Res, met, film, 90.9K ±1%, 1/8W	223537	91637	MFF1-89092F	1		
R57	Res, var, cer, 500 ±10%, ½W	325613	71450	360T501A	1	1	
R62, R65, R67	Res, matched set, 3 piece	375782	89536	375782	1	1	
R63, R76	Res, comp, 10K ±5%, ¼W	148106	01121	CB1035	2		
R66	Res, met film, 22.1K ±1%, 1/8W	235234	91637	MFF1-82212F	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R68	Res, comp, 56K ±5%, ¼W	170738	01121	CB5635	1		
R70	Res, met film, 8.06K ±1%, 1/8W	294942	91637	MFF1-88061F	1		
R71	Res, met film, 2K ±1%, 1/8W	235226	91637	MFF1-8203F	1		
R74	Res, comp, 4.7M ±5%, ¼W	220046	01121	CB4755	1		
R80	Res, met film, 200K ±1%, 1/8W	261701	91637	MFF1-8204F	1		
R81	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	1		
R82	Res, comp, 2.7M ±5%, ¼W	193490	01121	CB2745	1		
R84	Res, comp, 2.2K ±5%, ¼W	148049	01121	CB2225	1		
R87	Res, comp, 4.7K ±5%, ¼W	148072	01121	CB4725	1		
R94	Res, comp, 1K ±5%, ¼W	148023	01121	CB1025	1		
R98	Res, comp, 220 ±5%, ¼W	147959	01121	CB2215	1		
RN1	Res, network, 15 piece	385815	89536	385815	1	1	
S1 thru S13	Switch assembly, push-button	390948	89536	390948	1	1	
T1	Xfmr, power	372003	89536	372003	1		
U4	IC, operational amp, yellow dot	381962	89536	381962	1	1	
U5	IC, operational amp, red dot	385450	89536	385450	1	1	
U6	IC, linear opnl ampl	352195	12040	LM811N8	1	1	
U7	IC, hex, buffer/converter	355214	12040	MC14009CP	1	1	
U8	(See Final Assembly)						
U9	IC, bipolar ROM	376061	01295	SN7488AN	1	1	
U16	IC, digital, C-MOS, 2-channel, multiplexer	375808	49671	CD4053AE	1	1	
U17	IC, digital, C-MOS, Quad, switch	363838	49671	CD4016AE	1	1	
XBT	Battery holder	390450	89536	390450	4		
XF2	Fuse holder	103283	71400	4405	1	5	
Y1	Crystal, 1.000 MHz	358069	30148	TYPE 815A	1	1	
	Battery polarity label	380675	89536	380675	2		
	Connector, post	379438	00779	86144-5	7		
	Connector, post	376574	00779	5166-333-68	29		
	Contact, battery	344200	89536	344200	8		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Contact, fuse	397992	89536	397992	1		
	Rectacle, power, 3 prong						
	Insulator, receptacle	338624	89536	338624	1		
	Contact, earth common	338640	89536	338640	1		
	Contact, voltage	338657	89536	338657	2		
	Pushbutton, grey	369546	71590	J52305-J31753	12		
	Pushbutton, green	352211	71590	J52305-J71449	1		
	Socket, IC, 14 pin	291542	00779	583527-1	1		
	Socket, IC, 16 pin	291534	00779	583529-1	3		
	Socket, IC, 40 pin	376244	23880	TSA3100-40W	1		
	Socket, relay, 2 poles	376665	77342	27E501	1		
	Strap, relay retainer	381624	77342	P49	1		
	Front Panel Assembly (Not Illustrated)						
	Display PCB Assembly	373860	89536	373860	1		
C38	Cap, cer, 47pF ±10%, 2kV	282145	00656	HVD3 47±10%, 2KV-I	1		
F1	Fuse, fast acting, 2A	376582	71400	AGX	1	5	
J1	Jack, banana, red	162065	74970	108902	1		
J2, J3	Jack, banana, black	162073	74970	108903	2		
XF1	Fuseholder	345611	89536	345611	1		
	Lens, display	367920	89536	367920	1		
	Panel, molded	369041	89536	369041	1		
	Decal, panel	375865	89536	375865	1		
	Retainer, neoprene	352484	77969	9109E	2		

Ⓧ Indicates MOS device which may be damaged by static discharge.

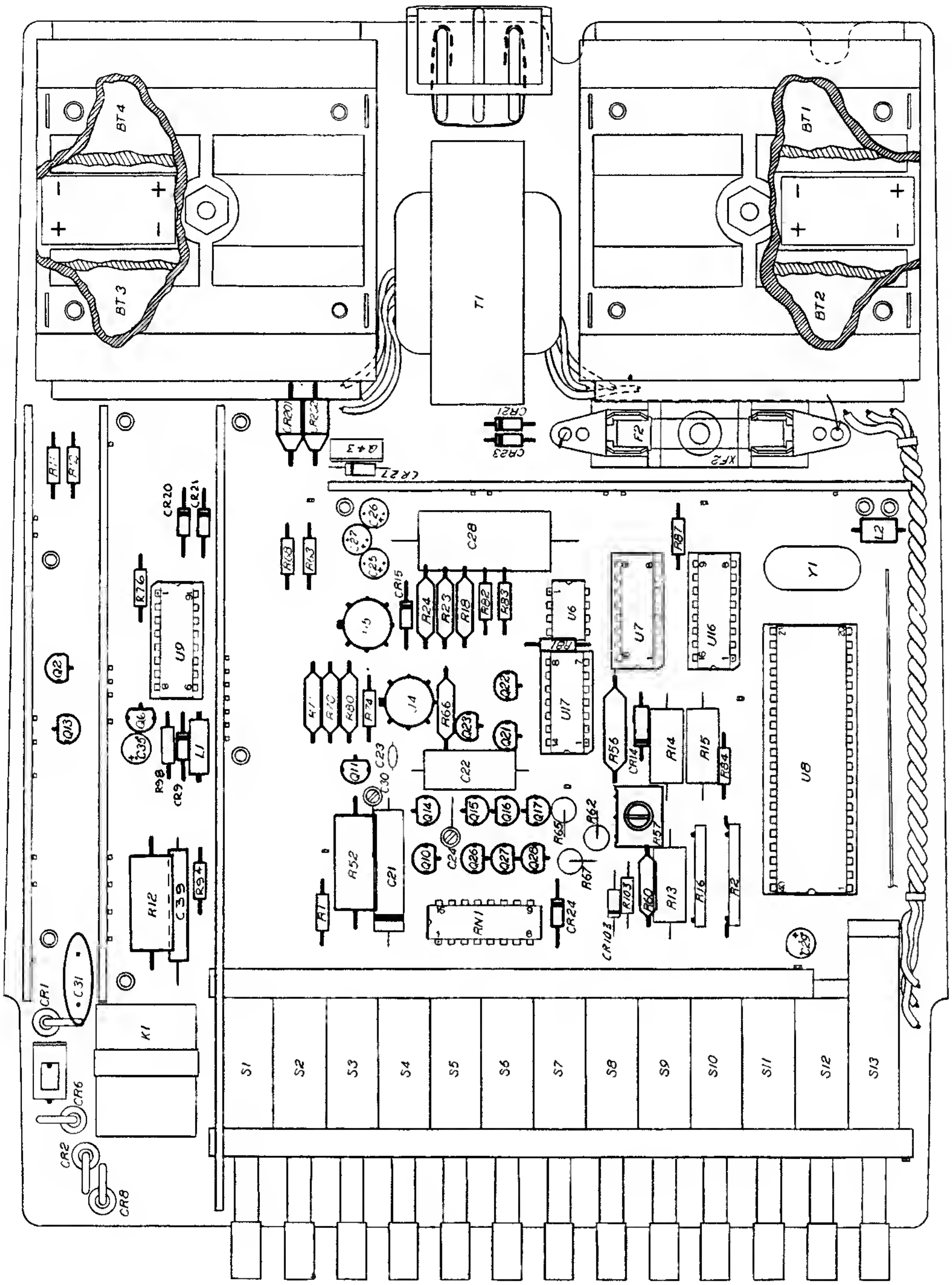

Figure 5-3. FRONT PANEL AND MAIN PCB ASSEMBLY (8600A–01 Battery Power)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DISPLAY PCB ASSEMBLY (8600A-4002) **Figure 5-4**	373860	89536	373860	REF		
CR3, CR4	Diode, light emitting, red	385914		SSL22	2	1	
Q29, Q31, Q33, Q35, Q37, Q39, Q40, Q41	Xstr, Si, NPN	218396	04713	2N3904	8	2	
Q30, Q32, Q34, Q36, Q38	Xstr, Si, PNP	340026	07263	MPS6563	5	1	
Q42	Xstr, Si, PNP	195974	04713	2N3906	1		
R85	Res, comp, 560 ±5%, ¼W	147991	01121	CB5615	1		
R86	Res, comp, 68 ±5%, ¼W	147918	01121	CB6805	1		
RN2	Res, network	381376	89536	381376	1	1	
U10	IC, TTL, decoder/driver	340109	01295	SN7447AN	1	1	
U11	Display. LED	429936	29083	MAN73/Q3033	1		
U12 thru U15	Display, LED	429928	29083	MAN72/Q3032	4		

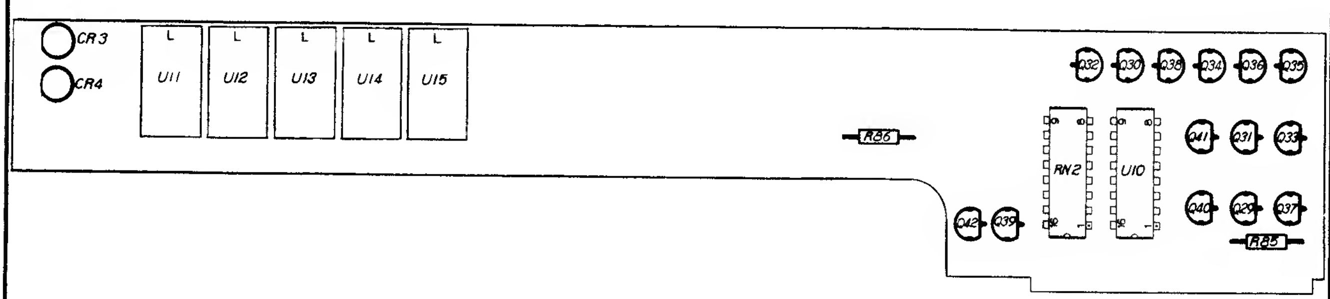

Figure 5-4. DISPLAY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	BATTERY POWER SUPPLY PCB ASSY (–01 Option) (8600A–4006)						
	100VAC Version	378380	89536	378380	REF		
	115VAC Version	373837	89536	373837	REF		
	230VAC Version	378372	89536	378372	REF		
	Figure 5-5						
C201	Cap, mylar, 5.0uF ±5%, 150V (Used on 115V ac version)	364190	56289	TYPE 439 P	1		
C201	Cap, mylar 6.6uF ±5%, 135V (Used on 100V ac version)	394189	56289	TYPE 439P	1		
C201	Cap, metalized polypropylene 2.8uF ±5%, 300V (Used on 230V ac version)	394197	89536	394197	1		
C203, C204	Cap, Ta, 6.8uF ±20%, 35V	363713	56289	196D685X0035 KA1	2		
C204	Cap, Ta, 22uF ±10%, 15V	182816	56289	150D226X9015 B2	1		
C205	Cap, cer, 0.01uF +80/–20%, 500V	105668	56289	33C4186	1		
CR203 thru CR206	Diode, Hi-speed, switching	203323	07910	1N4148	4		
L201	Choke, 6 turn	320911	89536	320911	1		
Q201, Q202	Xstr, Si, NPN	330803	07263	MPS6560	2		
Q203	Xstr, Si, PNP	195974	04713	2N3906	1		
R201	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	1		
R202	Res, comp, 1.2K ±5%, ¼W	190371	01121	CB1225	1		
R204	Res, comp, 22 ±5%, ¼W	147884	01121	CB2205	1		
R207	Res, comp, 8.2K ±5%, ¼W	160796	01121	CB8225	1		
R208	Res, met film, 4.53K ±1%, 1/8W	260331	91637	MFF1-84531F	1		
R209	Res, met film, 16.9K ±1%, 1/8W	267146	91637	MFF1-81692F	1		
T2	Xfmr, inverter	372011	89536	372011	1		
U202	IC, voltage regulator	413187	04713	MC7815CP	1	1	
U203	IC, voltage regulator	413179	04713	MC7915CP	1	1	
1	Connector, plug/jack, red	170480	74790	105-752	3		
2	Receptacle, Amp Mode II	375329	00779	85863-3	5		

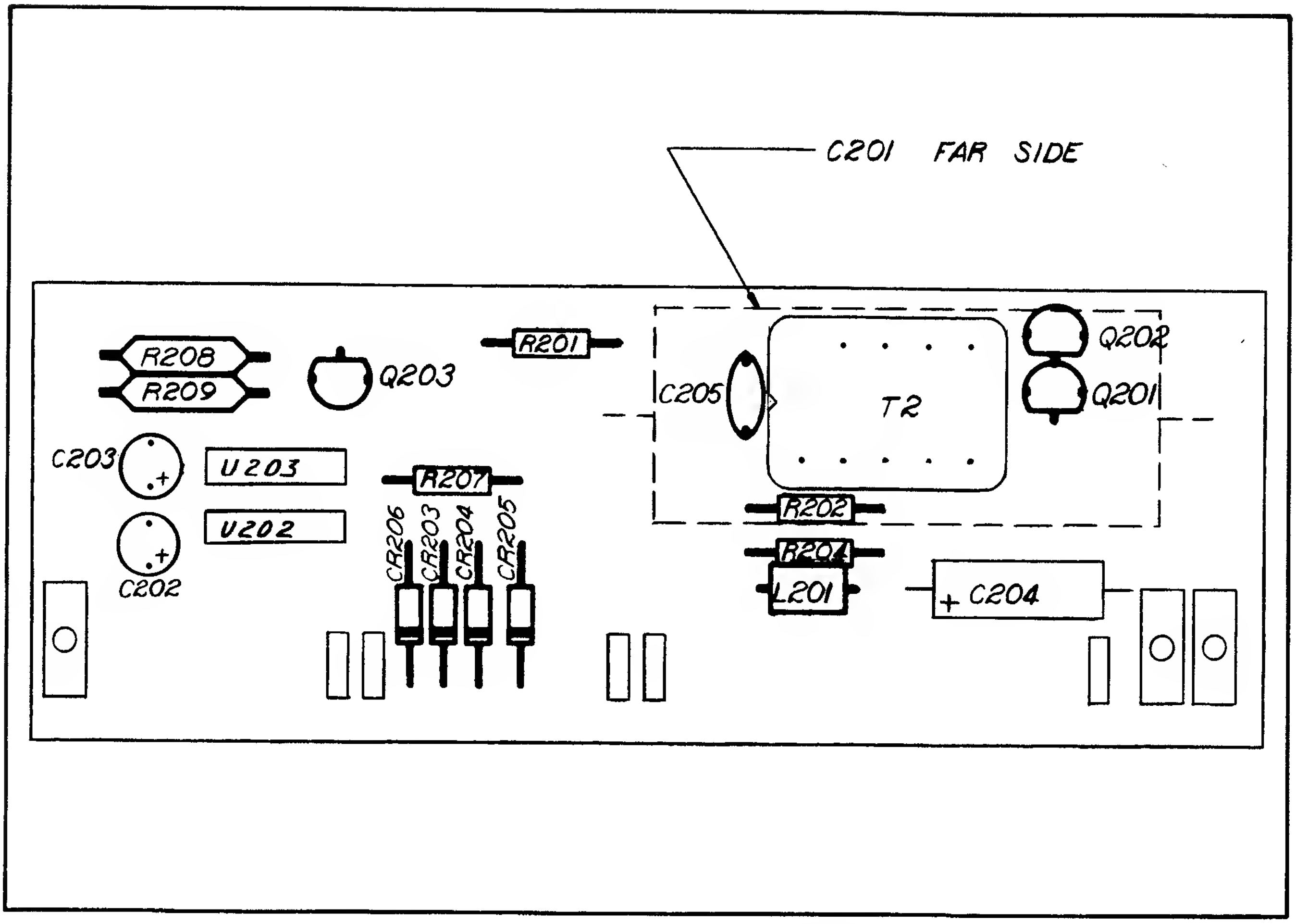

Figure 5-5. BATTERY POWER SUPPLY PCB ASSEMBLY (–01 Option)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	AC CONVERTER PCB ASSEMBLY (8600A–4003)	373852	89536	373852	REF		
	Figure 5-6						
C1	Cap, cer, 0.05uF GMV, 1KV/2KV	355420	71590	2DD65N5032	1		
C2,C19	Cap, var, 0.25 - 1.5pF, 2000VDC	218206	72982	530-000	2		
C5	Cap, cer, 15pF ±2%, 100V	369074	80031	2222-631-10159	1		
C6,C7, C32, C33, C34	Cap, cer, 0.025uF ±20%, 100V	168435	56289	C023B101H253 M	5		
C9	Cap, cer, 27pF ±2%, 100V	362749	80031	2222-631-10279	1		
C10	Cap, var, cer, 1.7 10 pF, 250V	375238	91293	9931	1		
C11	Cap, polystyrene, 9100pF	355321	91590	2DRP00J912GA A	1		
C12, C13	Cap, Ta, 330uF ±20%, 3V	385963	56289	196D337X0004 LA3	2		
C14, C20	Cap, mylar, 0.47uF ±10%, 100V	369124	73445	C280MAHA470 K	2		
C15	Cap, Ta, 39uF ±20%, 6V	163915	56289	196D396X0006 JA1	1		
C16	Cap, Ta, 5.6uF ±20%, 20V	368969	56289	196D565X0020	1		
C17	Cap, mica, 400pF ±1%, 500V	385328	71236	DM15F401F	1		
C18	Cap, cer, 2.2pF ±0.25pF, 100V	362731	80031	2222-631-09228	1		
CL1	Current limiter, regulator	334714	07910	TCR5315	1		
CR5, CR11, CR12, CR16, CR17	Diode, low cap	375907	07263	TYPE FD700	5		
K6,K7, K8	Relay, reed, SPST	357566	71707	E8182	3		
Q1	Xstr, dual FET	379321	17856	E7024	1		
Q7	Xstr, Si, NPN	218396	04713	2N3904	1		
Q8	Xstr, Si, PNP	352146	89536	352146	1		
Q9	Xstr, Si, NPN	330803	07263	MPS6560	1		
R17	Res, met film, 2M ±0.5%, 1W	354894	80031	MF8C205	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R25	Res, deposited carbon, 10K ±5%, ¼W	348839	TOYO	R251-41035	1		
R26	Res, deposited carbon, 2.2K ±5%, ¼W	343400	TOYO	R251-42225	1		
R32, R33	Res, comp, 15K ±5%, ¼W	148114	01121	CB1535	2		
R37, R38, R45, R46, R47	Res, matched set, 5 pc	426544	89536	426544	1	1	
R40	Res, comp, 240 ±5%, ¼W	221895	01121	CB2415	1		
R43	Res, comp, 150K ±5%, ¼W	182212	01121	CB1545	1		
R49, R89	Res, met film, 68.1K ±1%, 1/8W	236828	91637	MFF1-86812F	2		
R50	Res, var, cermet, 50 ± 10%, ½W	285122	71450	360S500A	1		
R51	Res, met film, 2.194K ±0.25%, 1/8W	375345	91637	MFF1-82R194P	1		
R72	Res, var, cermet, 20K ±10%, ½W	291609	71450	360S203A	1		
R75	Res, comp, 120K ±5%, ¼W	193458	01121	CB1245	1		
R77	Res, deposited carbon, 62K ±5%, ¼W	384904	TOYO	R251-46235	1		
R79	Res, deposited carbon, 12K ±5%, ¼W	348847	TOYO	R251-41235	1		
R88	Res, met film, 59.0K ±1%, 1/8W	261677	91637	MFF1-8593F	1		
U2	IC, Operational Amplifier	329912	12040	LM318H	1		
	Connector, plug/jack, red	170480	74970	105-752	2		
	Shield	388314	89536	388314	1		
	Receptacle, Amp MOD II	375329	00779	85863-3	7		

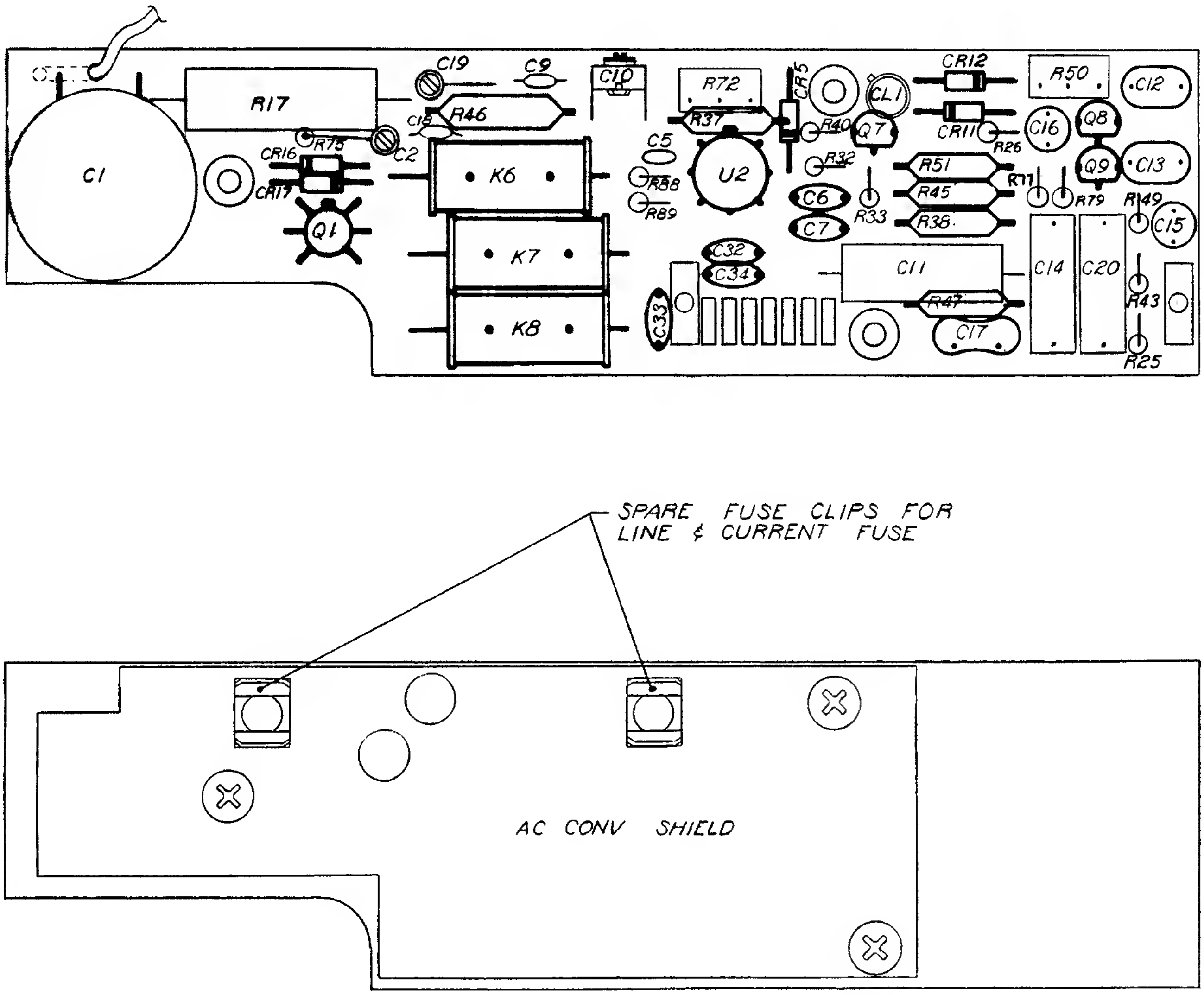

Figure 5-6. AC CONVERTER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	OHMS CONVERTER ASSEMBLY (8600A–4004)	373845	89536	373845	REF		
	Figure 5-7						
C3	Cap, mylar, 0.022uF ±20%, 250V	369165	25403	C281A/A22K	1		
C8	Cap, cer, 33pF ±2%, 100V	354852	80031	2222-638-10339	1		
CR2	Diode, zener	266601	07910	1N965B	1		
CR10	Diode, zener [1]				1		
CR22	Diode, Si, hi-speed, switch	203323	03508	1N4148	1		
K5	Relay, reed, SPST	357582	71707	UF40070	1		
Q2,Q12	Xstr, Si, PNP	195974	04713	2N3906	2		
Q3	Xstr, FET, N-channel	357905	21845	F2690	1		
R19	Res, comp, 220 ±5%, ¼W	147959	01121	CB2215	1		
R21	Res, var, cermet, 200 ±10%, ½W	285148	71450	360S201A	1		
R22	Res, met film, 2K ±1%, 1/8W	335422	91637	MFF1-8202F	1		
R27	Res, var, cermet, 100 ±10%, ½W	285130	71450	360S101A	1		
R28	Res, WW, power, 9.95K ±0.1%, 5W	363275	ARC 1DY	160-9950-1	1		
R29	Res, var, cermet, 50 ±10%, ½W	285122	71450	360S500A	1		
R35	Res, WW bobbin, 13.5K ±0.1%, 0.15W	363119	54294	SP21	1		
R41	Res, selected [1]				1		
R42, R99	Res, comp, 10K ±5%, ¼W	148106	01121	CB1035	2		
R48	Res, comp, 2.2K ±5%, ¼W	148049	01121	CB2225	1		
R90	Res, selected [1]				1		
R91	Res, met film, 4.22K ±1%, 1/8W	168245	91637	MFF1-84221F	1		
U1	IC, operational amplifier	357830	12040	LH0042C	1		
U3	IC, linear, operational amplifier	363515	24355	AD301AN	1		
	Connector, plug/jack, red	170480	74970	105-752	2		
	Receptacle, Amp, MODII	375329	00779	8586303	8		
	Socket, IC, 14-pin DIP	276527	23880	TSA2900-14W	1		
[1]	CR10, R90, and R41 are matched components. Order Part No. 458760		89536				

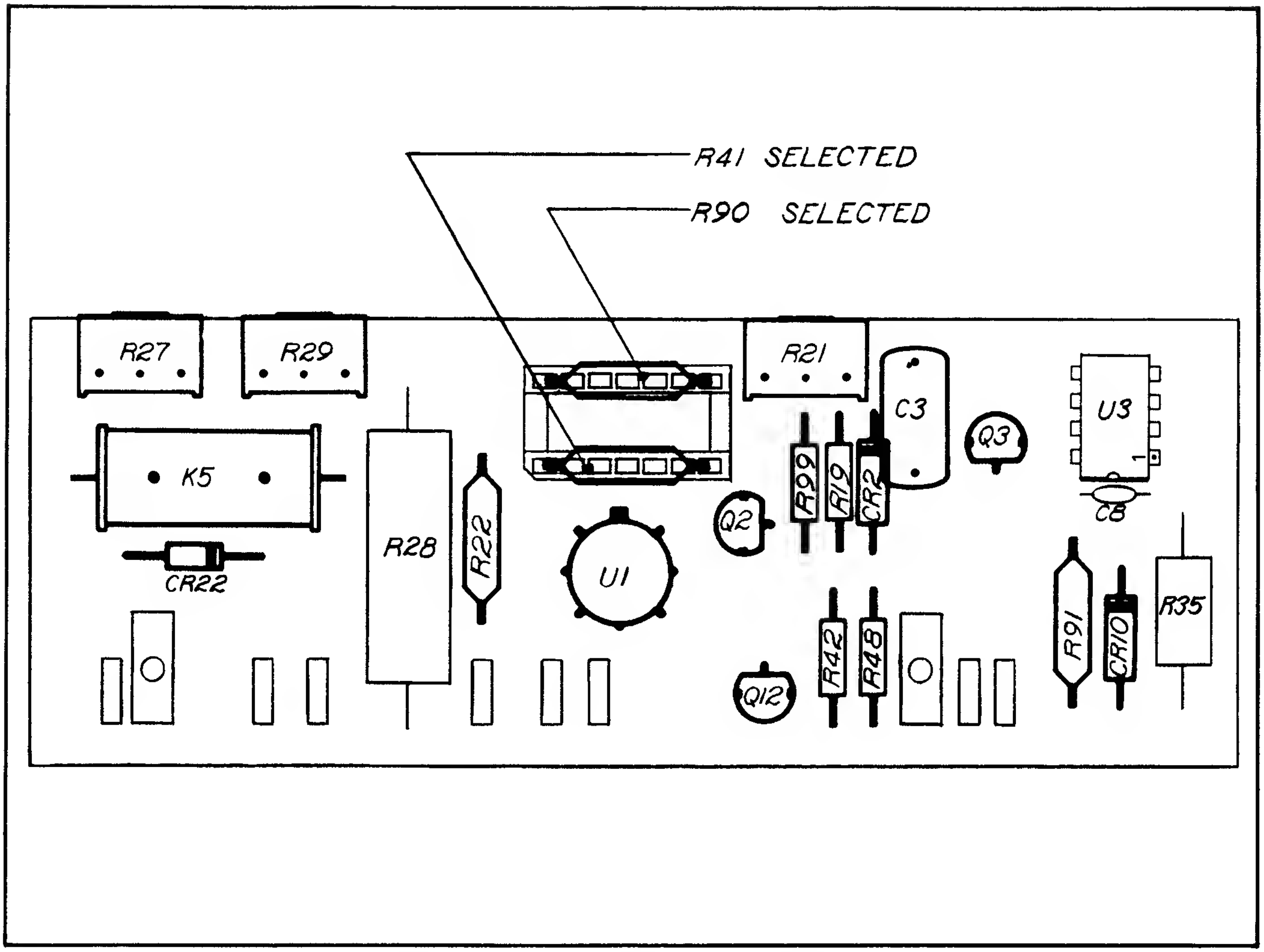

Figure 5-7. OHMS CONVERTER ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	INPUT DIVIDER PCB ASSEMBLY (8600A–4005) **Figure 5-8**	397463	89536	397463	REF		
CR13, CR18, CR19	Diode, Si, 150 mA	203323	03508	1N4148	3		
K2, K3	Relay, dry reed, SPST	357582	71707	UF40070	2		
K4	Coil, reed relay	269019	71707	U6P	1		
	Dry reed, SPST	289850	71707	289850	1		
R4	Res, var, cermet, 5K ±10%, ½W	288282	71450	360S502A	1		
R6	Re, var, cermet, 500 ±10%, ½W	291120	71450	360S501A	1		
R8	Res, var, cermet, 50 ±10%, ½W	285122	71450	360S500A	1		
RN3	Res, network, 5 pc	375105	01281	JF002	1		
	Connector, plug/jack, red	170480	74970	105-752	2		
	Receptacle, Amp, MODII	375329	00779	85836-3	9		

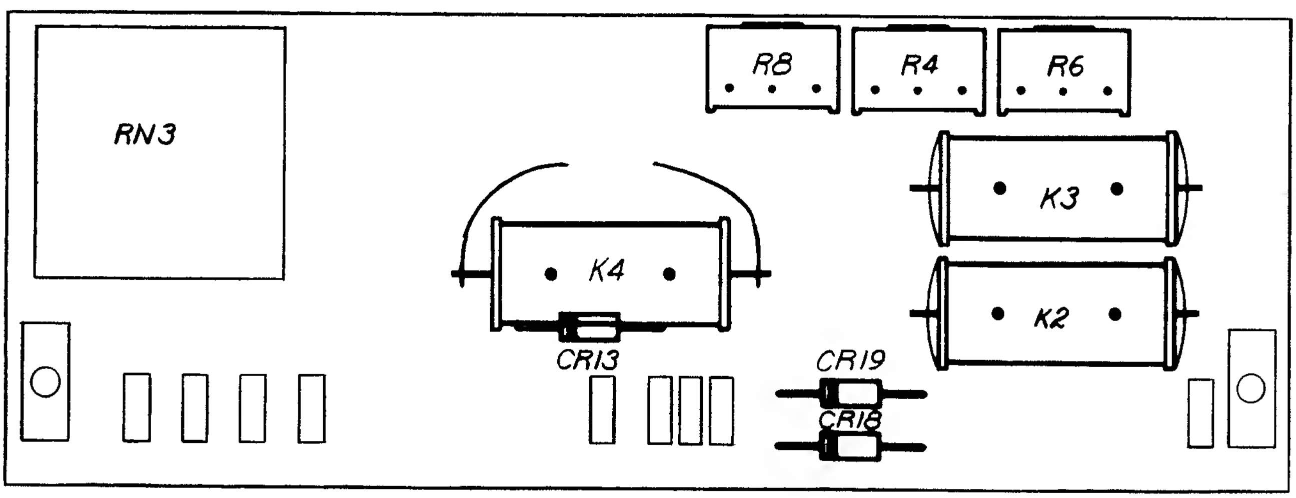

Figure 5-8. INPUT DIVIDER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DOU PCB ASSEMBLY –02 Option (8800A-4005)	366369	89536	366369	1		
	Figure 5-9						
C1, C3	Cap, elect, 220uF +50/–10%, 10V	236935	73445	ET221X010A5	2		
C2	Cap, plstc, 0.022uF ±10%, 50V	271577	06001	75F1R5A222	1		
C4	Cap, cer, 0.05uF +80/–10%, 25V	148924	32897	5855Y5U503Z	1		
CR1	Rectifier, bridge	296509	51605	FB100	1		
CR2	Diode, zener, 5.6V	277236	07910	1N752A	1		
Q1, Q2, Q5	Xstr, Si, NPN	218396	04713	2N3904	3		
Q3, Q4	Xstr, Si, PNP	195974	04713	2N3906	2		
R15, R16	Res, desposited carbon, 1K ±5%, ¼W	343426	TOYO	R251025	2		
R17, R18	Res, comp, 4.7M ±5%, ¼W	220046	01121	CB4755	2		
RN1	Res, network	385930	89536	385930	1		
T1	Xfrm, power	374652	89536	374652	1		
U1 thru U4, U10	IC, C-MOS, dual 4-bit static shift register	340125	04713	MC14015CP	5		
U5	IC, C-MOS, dual, type D flip-flop	340117	04713	MC14013CL	1		
U6	IC, C-MOS, NOR Gate	355172	04713	MC14001CL	1		
U7, U8, U12, U13, U14	IC, C-MOS, hex, buffer/inverter	381848	49671	CD4049AE	5		
U9	IC, DTL, C-MOS, quad, bilateral SW	363838	49671	CD4016AE	1		
U11	IC, C-MOS, dual 4-input NOR gate	363820	49671	CD4002AE	1		
U16, U17	Opto-Isolator, photo Xstr	380014	89536	MCT2	2		
	Cable, flat	385922	08261	5112-007.25X	1		
	Socket, IC, 14 pin	276527	23880	TSA2900-14W	4		
	Socket, IC 16 pin	276535	23880	TSA2900-16W	11		
	Indicates MOS device which may be damaged by static discharge.						

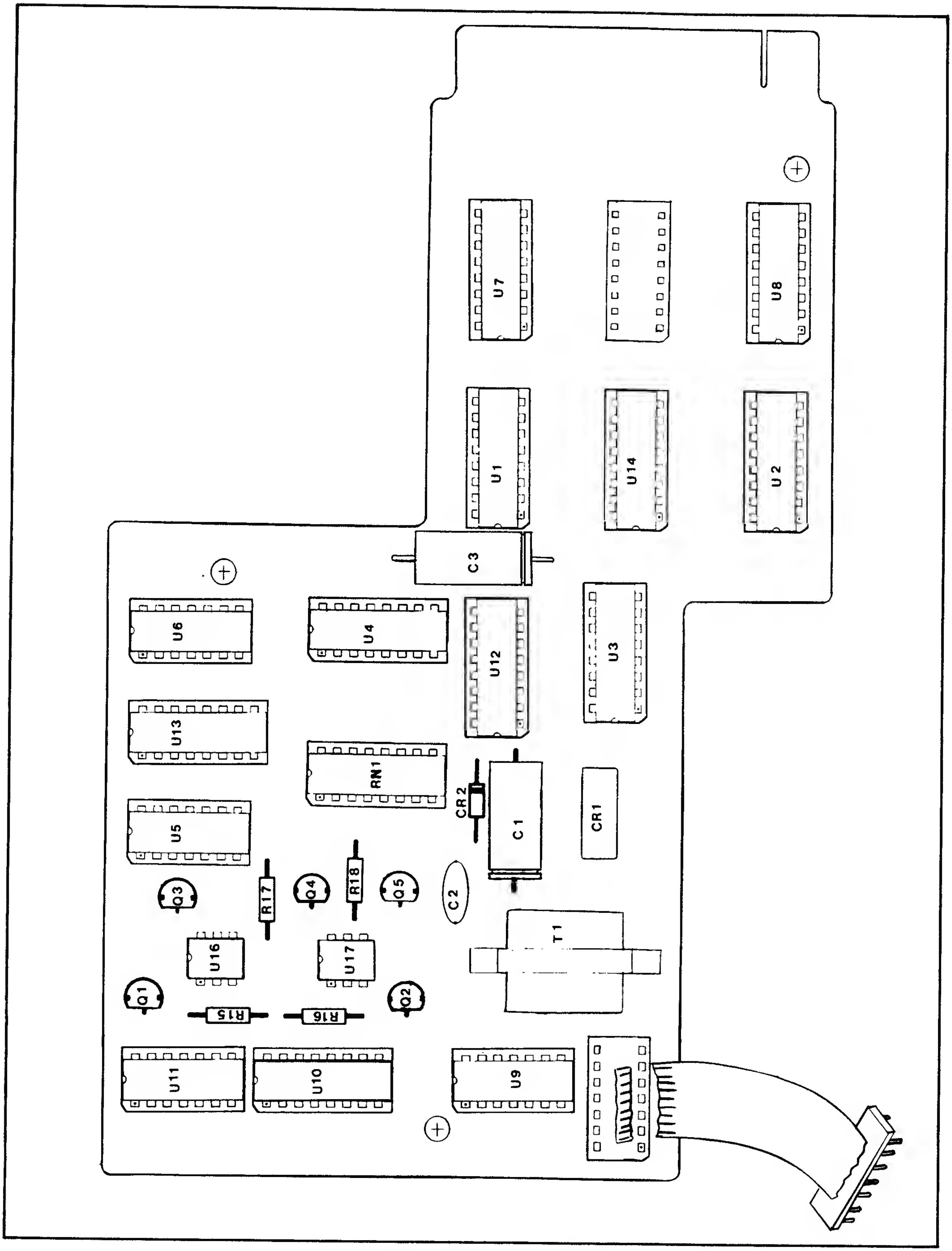

Figure 5-9. DOU PCB ASSEMBLY –02 Option

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the options and accessories available for your instrument. Each of the options and accessories are described under separate major headings containing the model or option number. The option descriptions contain applicable operating and maintenance instruction, and field installation procedures. Replaceable parts and schematics for all options are given in Sections 5 and 8, respectively.

6-3. CARRYING CASE (C80)

6-4. The Model C80 Carrying Case, Figure 6-1, is a soft vinyl plastic container, designed for the storage and transport of the 8600A. The case provides the 8600A with adequate protection against normal handling and storage conditions. A separate storage compartment is provided for test leads, power cord, and other compact accessories.

6-5. CARRYING CASE (C86)

6-6. The Model C86 Carrying Case, Figure 6-2, is a molded polyethylene container, with handle, designed for use in transporting the 8600A. This rugged case provides the 8600A with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads, power cord, and other compact accessories.

6-7. FRONT PANEL DUST COVER (M00-100-714)

6-8. The front panel dust cover is a molded plastic snap-on accessory which fits over the front panel of the 8600A. The dust cover provides protection for the front panel controls, and is useful when storing or transporting the 8600A.

6-9. RACK MOUNTING KITS

6-10. Introduction

6-11. Three rack mounting kits are available for mounting the 8600A in a standard 19-inch equipment rack. The kits, listed in Table 6-1, provide the option of either offset mounting (left/right), center mounting or side-by-side mounting.

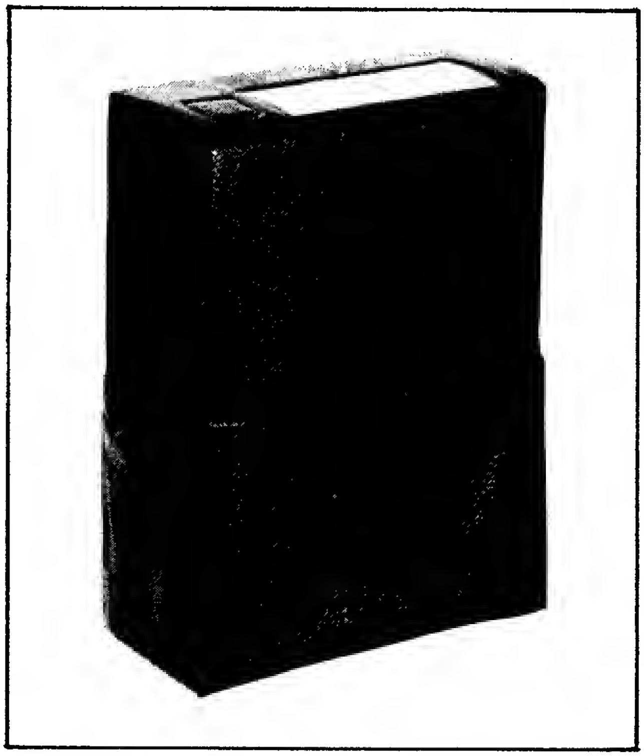

Figure 6-1. MODEL C80 CARRYING CASE

Figure 6-2. MODEL C86 CARRYING CASE

6-12. Installation Procedure

6-13. Installation instructions for each of the rack mounting kits is given in the following paragraphs. Use the procedure which corresponds to the model number of the kit being installed.

6-14. OFFSET AND CENTER MOUNTING KITS (M00-200-611 and M00-200-612)

a. Remove 8600A carrying handle by removing the handle disc decals and the handle mounting screws.

b. Remove screw from rear of case and separate the case from the 8600A.

c. Install the side mounting brackets, as shown in Figure 6-3, and secure them to the mounting panel using the nuts provided.

d. Insert the front of the 8600A case through the opening on the back side of the mounting panel.

e. Install the handle mounting screws through the side brackets into the handle mounting bosses. Don't over tighten these screws.

f. Slide the 8600A through the mounting panel and into the case. Install and tighten the retaining screw at the rear of the case.

6-15. SIDE–BY–SIDE MOUNTING KIT (M00-200-613)

a. Remove the carrying handles from both 8600A's by removing the handle disc decals and the handle mounting screws.

b. Remove the retaining screw from the rear of the cases and separate the instruments from their cases.

c. Install the center mounting bracket, as shown in Figure 6-4, and secure it to the mounting panel using the nuts provided.

d. Install the clamp screw in the center mounting bracket using the nuts and washers provided.

e. Insert the front of the 8600A cases through the openings on the back side of the mounting panel. Make sure the case's handle mounting bosses are inserted into the clamp hole of the center mounting bracket

f. Tighten the clamp screw.

g. Install the side mounting brackets and secure them to the front panel using the nuts provided.

h. Install the handle mounting screws through the side brackets into the handle mounting bosses. Don't over tighten these screws.

Slide the 8600A's through the mounting panel and into their cases. Install and tighten the retaining screw at the rear of both cases.

Table 6-1. RACK MOUNTING KITS

MOUNTING STYLE	MODEL NUMBER
Offset	M00-200-611
Center	M00-200-612
Side-By-Side	M00-200-613

6-16. DELUXE TEST LEAD KIT (A80)

6-17. The deluxe test lead kit, shown in Figure 6-5, contains two test leads with probes (red and black), and five pairs of universal probe tips. The probe tips include: alligator clips, test prod tips, pin tips, banana plug tips, and binding post lugs. A convenient plastic pouch is provided for storing the contents of the test lead kit.

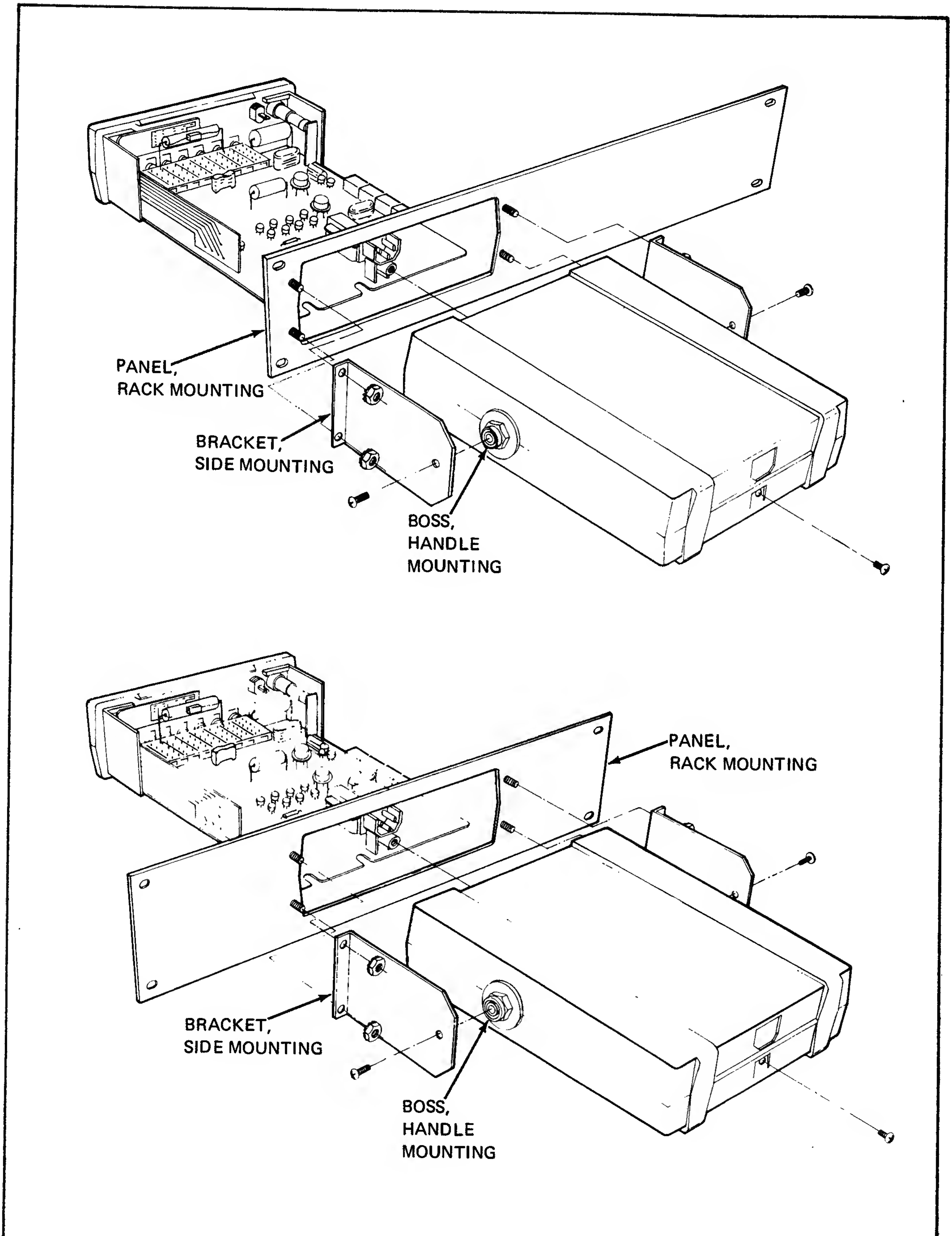

Figure 6-3. RACK MOUNTING KITS, OFFSET AND CENTER MOUNTING

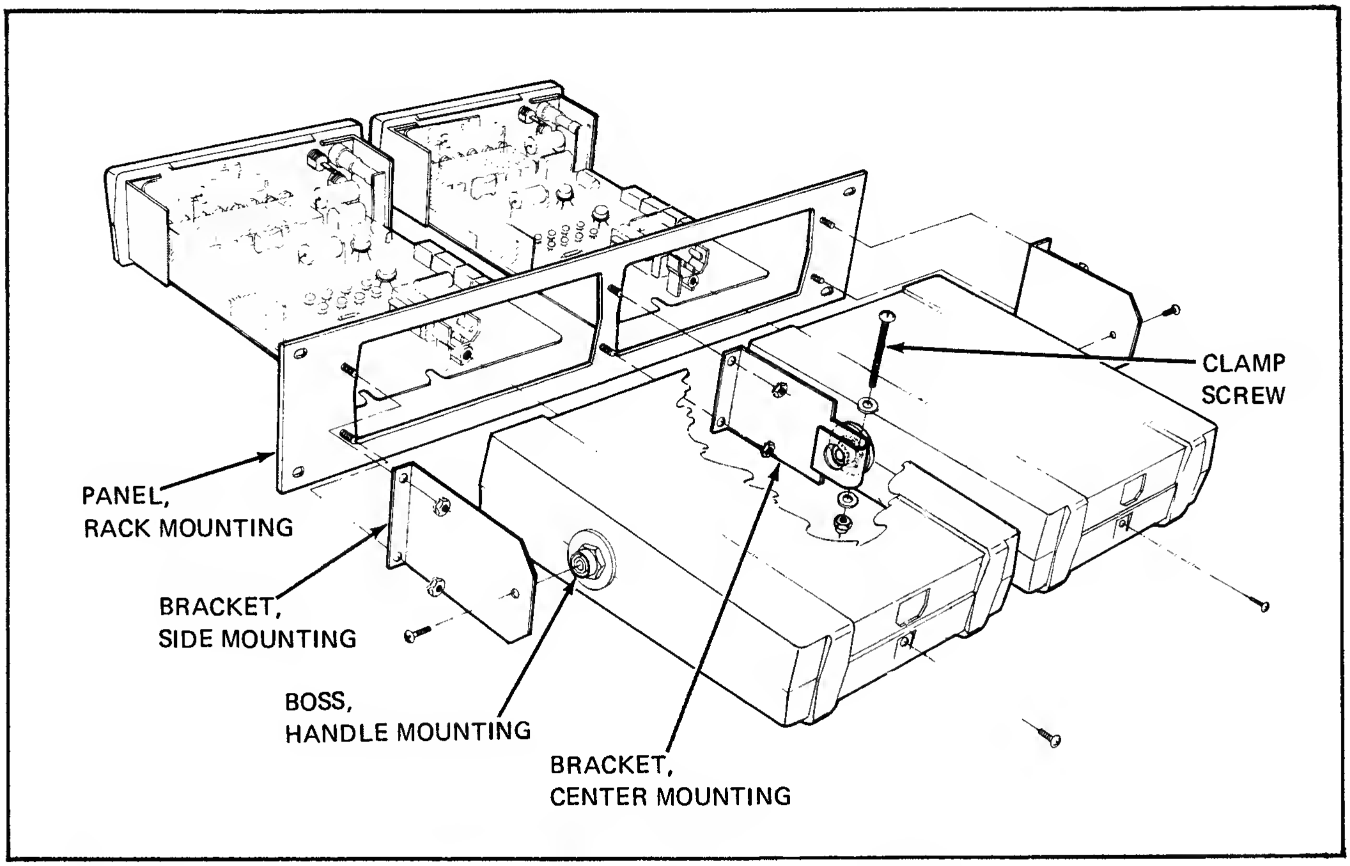

Figure 6-4. RACK MOUNTING KIT, SIDE-BY-SIDE MOUNTING

Figure 6-5. DELUXE TEST LEAD KIT (A80)

6-18. CURRENT PROBE, CLAMP-ON (801-600)

6-19. Introduction

6-20. The Model 801-600, as shown in Figure 6-6, is a clamp-on current probe which is used to extend the current measurement capabilities of the 8600A. The probe is designed to measure currents of 2 to 600 amperes at frequencies of up to 400 Hz with ±3% accuracy. The clamp-on feature allows current to be measured without breaking the circuit under test.

6-21. Operation

6-22. Use the following procedure for operating the 8600A with the 801-600 probe:

a. Plug the 801-600 dual-banana plug into the MA and COMMON INPUT terminals on the 8600A.

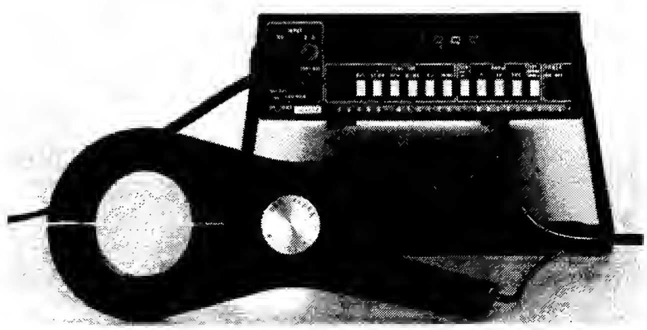

Figure 6-6. AC CURRENT PROBE, CLAMP-ON (801-600)

b. Depress the AC MA pushbutton (FUNCTION)

c. Select the desired current range in accordance with Table 6-2.

d. Clamp probe around current carrying conductor to be measured.

e. Observe ac current reading in amperes on the 8600A readout.

NOTE

Clamping the probe around more than one current carrying conductor at a time produces a reading that is the vector sum of the currents in the conductors.

Table 6-2. 8600A RANGES FOR CURRENT PROBE (801-600)

RANGE SELECTED	CURRENT RANGE WITH 801-600 PROBE
2000 MA	200A to 600A
200	20A to 200A
20	2A to 20A

6-23. HIGH VOLTAGE PROBE (80K40)

6-24. Introduction

6-25. The Model 80K-40 High Voltage Probe as shown in Figure 6-7, provides the 1000X attenuation necessary to extend the dc voltage measuring capabilities of the 8600A up to 40 kV dc. A schematic of the 80K-40 probe is shown in Figure 6-8.

6-26. Specifications

Overall Accuracy:	20kV to 30kV ±2% (Calibrated 1% at 25kV)
Upper Limit:	Changes linear from 2% at 30kV to 4% at 40kV
Lower Limit:	Changes linear from 2% at 20kV to 4% at 1kV
Voltage Range:	1kV to 40kV
Input Resistance:	1000MΩ
Division Ratio:	1000:1

Figure 6-7. HIGH VOLTAGE PROBE (80K-40)

6-27. Operation

6-28. Use the following procedure for operating the 8600A with the 80K-40 probe:

a. Plug the 80K-40 dual-banana plug into the V-Ω and LO INPUT terminals on the 8600A.

b. Depress the DCV pushbutton (FUNCTION)

c. Select the desired voltage range in accordance with Table 6-3.

d. Connect the common probe lead to a suitable ground and touch the probe tip to the circuit point to be measured.

e. Observe dc voltage reading displayed in kilovolts on the 8600A readout.

CAUTION

Before touching probe tip to a high voltage source, always connected probe common lead to circuit common. Removal of the probe common connection during a measurement may result in damage to the 8600A.

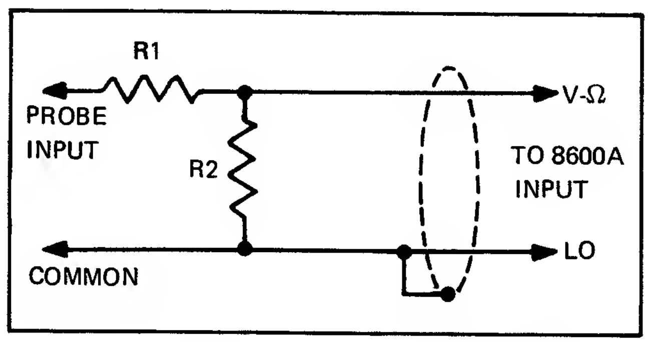

Figure 6-8. HIGH VOLTAGE PROBE, SCHEMATIC

Table 6-3. 8600A RANGES FOR DC HV PROBE (80K-40)

RANGE SELECTED	VOLTAGE RANGE WITH 80K-40 PROBE
200	20 to 40 kV
20	2 to 20 kV
2	1 to 2 kV

6-29. HIGH FREQUENCY PROBE (80RF-1)

6-30. Introduction

6-31. The Model 80RF-1 High Frequency Probe, Figure 6-9, extends the frequency range of the 8600A to include 100 kHz to 500 MHz for ac voltage measurements from 0.25 to 30V rms. The 80RF-1 operates in conjunction with the dc voltage ranges, and is connected to the 8600A using a shielded dual-banana plug and an adapter.

6-32. Specifications

Voltage: 0.25V to 30V

Response: Responds to peak value of input. Calibrated to read rms value of a sine wave input.

AC to DC Transfer Accuracy: Loaded with 10 megohms ±10%.

	100 kHz– 100 MHz	100 MHz– 500 MHz
+10°C to +30°C	+5%	+7%
–10°C to +40°C	+7%	+15%

<±3 db at 10 kHz and 700 MHz

Input Impedance:	4 megohms shunted by 2 ±0.5 pf
Maximum Input:	30 volts rms ac, 200 volts dc
Cable Connections:	Shielded dual banana plug fits all standard ¾-inch dual banana connectors.
Cable Length:	4 ft. (121.9 cm) minimum
Weight:	3½ oz. net
Accessories:	Ground lead, straight tip, hook tip, high frequency adapter

6-33. Operating Notes

6-34. The straight and the hooked tips supplied with the probe are useful for making voltage measurements up to 100 MHz. For measurements above 100 MHz use the high frequency adapter tip with mating connector and 50 ohm terminations.

6-35. The maximum input to the probe is 30V rms or 200V dc. These voltage limits may be used in combination so that the ac component of an ac signal superimposed on dc level can be measured.

CAUTION

Changing the dc level of the input signal by more than 200 volts will damage the probe.

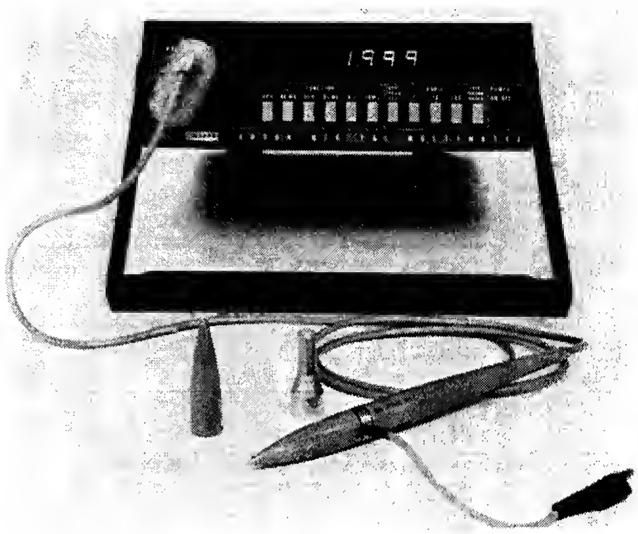

Figure 6-9. 80RF—1, HIGH FREQUENCY PROBE

6-36. Operation

6-37. Use the following procedure for operating the 8600A with the 80RF-1 probe:

a. Connect the 80RF-1 shielded dual-banana plug to the 8600A V-Ω and LO INPUT terminals.

b. Attach the desired probe tip to the probe body.

c. Depress the DCV pushbutton (FUNCTION)

d. Select the 20, 200, or 1200V range.

NOTE

The probe loading error caused by the 1000MΩ input impedqnce on the 8600A 200 mV and 2V ranges can be corrected by placing a 10MΩ ±5% resistor across the dual-banana plug terminals.

e. Connect the probe's ground lead to a suitable ground when using the straight or hooked probe tip. The ground clip is not required when using the high frequency adapter with an appropriate 50 ohm termination.

f. Touch the probe tip to the circuit point to be measured.

g. Observe the voltage reading displayed in volts rms on the 8600A readoug.

6-38. Theory of Operation

6-39. A schematic diagram of the 80RF-1 High Frequency probe is given in Figure 6-10. Capacitor C1 is used as a dc blocking capacitor, diode CR1 is used as a detector, and resistors R1, R2, R3 and R_{in} form a divider network. During the negative half cycle of the ac input voltage, C1 charges through CR1 to the negative peak value of the input signal. This negative charge path provides the zero reference for the dc output signal. During the positive half cycle of the input signal the charge on C1 is added to the peak value of the positive input to produce a positive peak-peak voltage at the junction of C1 and CR1. The divider network scales this voltage to provide a dc output voltage which is equal to the rms value of the input signal.

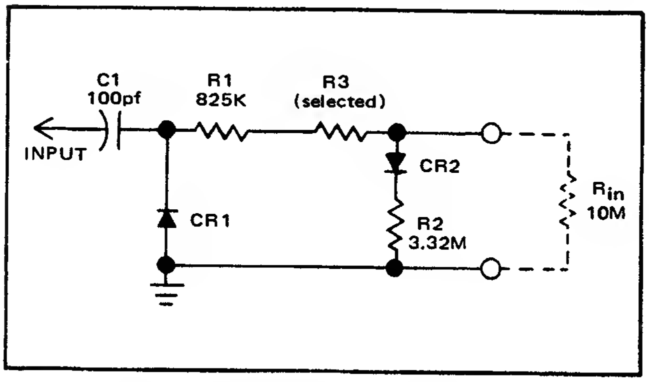

Figure 6-10. 80RF–1 SCHEMATIC

6-40. Diode CR2 compensates for the non-linearity of the detector, and R3 is a selected part having a value of 50 kΩ to 100 kΩ.

6-41. Maintenance

6-42. PERFORMANCE TEST

6-43. The low and high frequency tests given below are used to verify the ac-to-dc transfer accuracy of the 80RF-1 High Frequency Probe.

6-44. LOW FREQUENCY RESPONSE

6-45. Connect equipment as shown in Figure 6-11, and perform the following steps.

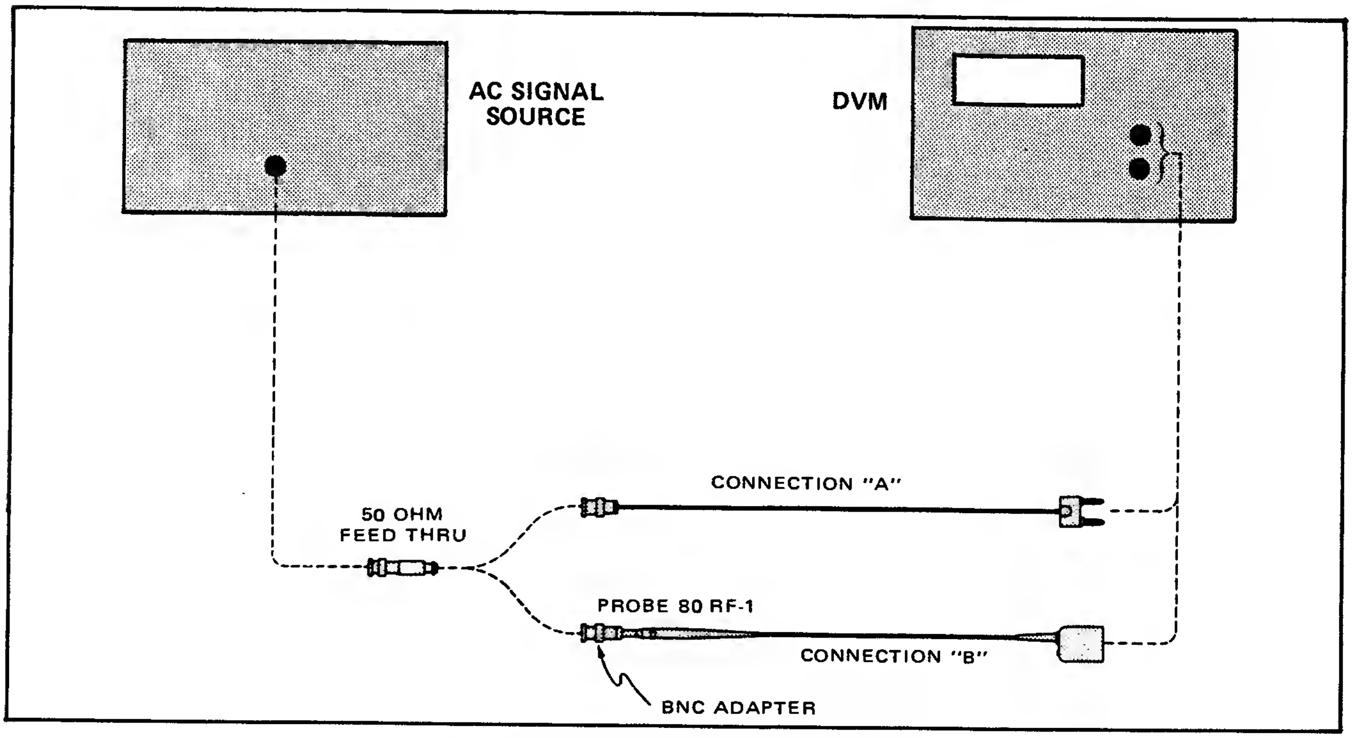

Figure 6-11. LOW FREQUENCY RESPONSE CHECK

a. With equipment as shown in connection "A" adjust the ac signal source for an output of 3.000V rms at 100 kHz as measured on the DVM.

b. In connection "B" with the DVM set to measure V dc, observe a probe output of 3.15 to 2.85V dc.

c. Placing cables back in connection "A", decrease the ac signal source by 10 db (0.95V rms).

d. Moving back to connection "B", observe a voltmeter indication of between 1.00 and 0.90V dc (10 db down from 3.0V dc).

e. In connection "A", decrease the ac signal source an additional 10 db (to 0.3V rms) as indicated by the voltmeter in its ac function.

f. Back to "B", observe a voltmeter reading of .315 to .285V dc.

g. Return the ac signal source back to 3.000V rms.

h. Repeat steps a through g with frequencies of 500 kHz, 1 MHz, and 10 MHz.

6-46. HIGH FREQUENCY RESPONSE

6-47. Connect equipment to the 80RF–1 probe as shown in Figure 6-12, and perform the following steps:

a. Set the ac signal source to 100 MHz with an output level of 10 milliwatts as indicated on the power meter. Ensure that the ac signal source has stabilized at the 10 milliwatt output.

b. Observe that the voltmeter indication is between 0.757 and 0.657V dc, (0.707V dc corresponds to 10 milliwatts into 50 ohms.)

c. Repeat the above for frequencies of 200 MHz, 300 MHz, 400 MHz, and 480 MHz.

6-48. CALIBRATION

6-49. Should the 80RF–1 require recalibration, perform the following steps:

a. Perform steps a and b in paragraph 6-44, with a frequency of 1 MHz.

b. Observe the dc voltmeter; a reading below 3V dc calls for a decrease in the value of R3, a reading above 3V dc calls for an increase in R3. Resistor R3 should be a 1/8W metal film type. In a probe that is working properly, a 30 kΩ change in R3 will produce about a 1% deviation in the reading.

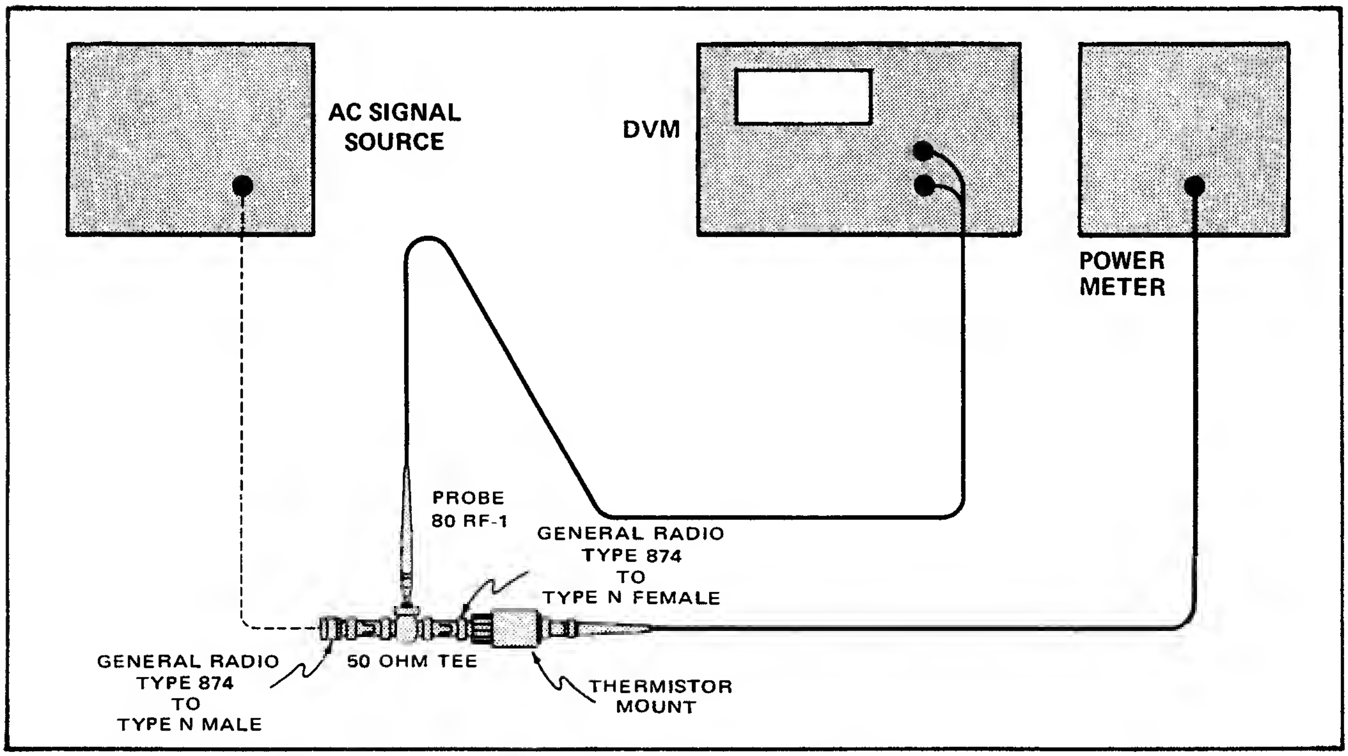

Figure 6-12. HIGH FREQUENCY RESPONSE CHECK

6-50. HIGH FREQUENCY PROBE (81RF)

6-51. Introduction

6-52. The Model 81RF High Frequency Probe, Figure 6-13, extends the frequency range of the 8600A to include 100 kHz to 100 MHz for ac voltage measurements from 0.25 to 30V rms. The 81RF operates in conjunction with the dc voltage range, and is connected to the 8600A using a shielded dual-banana plug and an adapter.

6-53. Specifications

Transfer Accuracy:	±1 dB from 100 kHz to 100 MHz
Voltage Range:	.25V rms to 30V rms (operated into a 10 MΩ input resistance voltmeter). Peak responding calibrated to read rms value of a sinewave.
Maximum DC Input:	350V
Input Impedance:	12MΩ shunted by ≈ 15 pf maximum

6-54. Operation

6-55. Use the following procedure for operating the 8600A with the 81RF probe:

a. Connect the 81RF shielded dual-banana plug to the 8600A V-Ω and LO INPUT terminals.

b. Attach the desired probe tip to the probe body.

c. Depress the DCV pushbutton (FUNCTION)

d. Select the desired voltage range.

e. Connect the probe's ground lead to a suitable ground.

f. Touch the probe tip to the circuit point to be measured.

g. Observe the voltage reading displayed in volts rms on the 8600A readout.

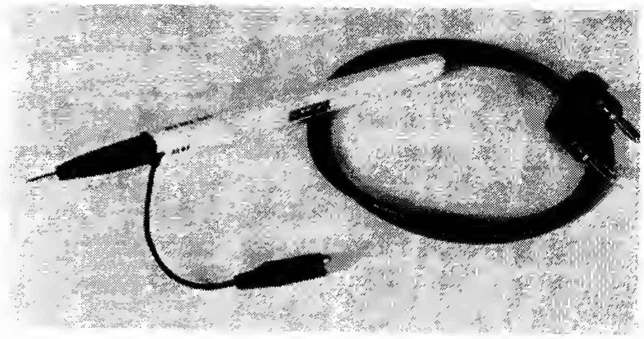

Figure 6-13. HIGH FREQUENCY PROBE (81RF)

6-56. TEMPERATURE PROBE (80T-150)

6-57. The Model 80T-150 Temperature Probe is a self-contained temperature-to-voltage converter. It is designed to provide a direct temperature reading on the display of any high impedance voltmeter (1MΩ) capable of 1 mV resolution, and at least 300 mV full-scale readout. The probe can be configured to provide either one of two temperature displays: –50 to +150°C or –58 to +300°F.

6-58. Operating power for the probe is provided by an internal lithium battery. Typically, the battery will provide up to 1000 hours of continuous operation before replacement is necessary. An on/off switch is provided to conserve the battery when not in use.

6-59. BATTERY PACK, OPTION –01

6-60. Introduction

6-61. The Battery Pack provides the 8600A with the capability of operating as a portable (battery-operated) instrument. Four nickle cadmium (Ni-cad) batteries allow, typically 8 hours of portable operation before recharging is necessary. The batteries are recharged by connecting the 8600A to the ac power line. If desired, the 8600A can be operated during the charging process, however, the charging time will be increased.

6-62. Specification

6-63. The specifications for the Battery Pack are given in Section 1 of this manual.

6-64. Operation

CAUTION!

Damage may result if alkaline, zinc-carbon, or mercury batteries are charged in the 8600A.

6-65. With a fully charged battery pack, the 8600A can be disconnected from line power and operated for typically 8 hours, as a portable instrument. When all the display decimal points flash on and off, the battery pack should be recharged by switching the POWER switch to OFF and connecting the instrument to the ac power line. The total charge time is approximately 16 hours. If desired, the 8600A can be operated during the charging process, however, the charge time will be extended to approximately 43 hours.

NOTE

Battery manufacturers recommend that Ni-cad batteries be recharged at least every 90 days. Storage temperatures below +25°C are recommended.

6-66. Theory of Operation

6-67. The 8600A equipped with the battery pack option (–01) uses the power transformer configuration shown in Figure 7-2 and the battery power supply pcb shown in Figure 7-6. With the POWER switch in the ON position, the batteries are connected to the input of the battery power supply pcb, a dc-to-dc converter.

6-68. The +5 volts from the battery is applied to the primary windings of T201, causing transistors Q201 and Q202 to alternately conduct. The alternating current in the primary windings is stepped up by the secondary winding and applied to a bridge rectifier consisting of CR203 through CR206. The two halves of the rectifier output are applied to two voltage regulators, U202 and U203. The resulting +15V and –15V power supply voltages provide the operating power for the instrument.

6-69. Maintenance

6-70. INPUT POWER

6-71. The 8600A–01, in addition to battery operation, is capable of operating from either 100, 115, or 230V ac, 50 or 60 Hz line power. Before connecting the instrument to line power, check and, if necessary, use the following procedure to prepare the unit for operation at the local line voltage:

a. Remove the phillips screw from the rear of the instrument.

b. Remove the case from the unit by pulling it straight back from the front cover.

c. Locate the Battery Power Supply PCB Assembly (See Figure 5-1) and determine the size of the large capacitor C201 on the pcb (See Figure 5-5). The relationship of this capacitor to line power is as follows:

1. 5.0uF - 115V ac 60 Hz
2. 6.6uF - 100V ac 50 Hz
3. 2.8uF - 230V ac 50 Hz

d. Install the appropriate capacitor. The capacitors specifications and John Fluke part numbers are given in the Lists of Replaceable Parts, Section 5. (Battery Power Supply PCB Assembly).

e. Install the unit in its case and insert the phillips screw.

6-72. CHARGING NI-CAD BATTERIES

6-73. With regard to the charging of nickel-cadmium batteries, there are some phenomena which should be considered. For instance, charging Ni-Cad batteries with cell case temperatures above 25°C will cause the cell's charge capacity to decrease. The decrease in capacity is linear from 100% of rated capacity at 25°C to only 60% of rated capacity at 50°C, and as low as 45% at 60°C. Cell case temperatures typically run from 5°C to 10°C above ambient temperature during charging due to heat dissipated by the charging circuit. Due to the enclosed nature of the light-weight case on the 8600A, the temperature inside the case typically runs an additional 10° to 15°C above ambient temperature. For most complete charging and longest battery life, the 8600A-01 should be charged at less than 23°C ambient. Cell charge times are also affected by low temperatures. Charging the batteries at less than 5°C will reduce charge storage capacity and reduce battery life. The battery manufacturer recommends allowing the instrument to warm up to room temperature before charging the unit.

6-74. Charge capacity may also be affected by a cell's charging-discharging routine, due to a memory-type phenomenon. For instance, if a Ni-Cad battery pack is used in a daily routine where it is allowed to discharge by only 30% before being fully recharged again, it will eventually become a battery pack capable of delivering only 30% of its rated capacity. To return such a battery pack to its rated capacity, connect an external load which will discharge the battery completely at a rate equal to its capacity divided by 20. For example, a pack of four series-connected 1.2-volt cells having individual capacity ratings of 3.5 ampere hours should be discharged at a rate of 3.5A ÷ 20 = .175A. This requires a load resistor of 4.8V ÷ .175A = 27.5 ohms (approximate) with a power rating of at least (4.8V) (.175A) = .85W. (A 2-watt carbon composition resistor is suitable.)

6-75. Allow the battery pack to discharge for 30 hours, then charge the battery pack at twice the discharge rate for 20 hours. (In the example, the charging rate would be 0.35 amperes at 4.8 volts.) When charging is complete, discharge the pack at the capacity-divided-by-20 rate for 30 hours, then recharge at twice the discharge rate for a period of 20 hours. The battery pack should now be restored to its rated capacity.

6-76. BATTERY REPLACEMENT

6-77. Use the following procedure for removing and replacing batteries:

CAUTION!

Do not attempt to charge alkaline, zinc-carbon or mercury batteries in the 8600A.

a. Disconnect line cord. Remove retaining screw at rear of instrument case, and remove instrument from case.

b. On the underside of the pcb, remove the two threaded bolts securing the battery holders.

c. Remove the holder tops and batteries.

d. Replace the batteries with 1.2 volt nickel-cadmium batteries (JF Part No. 346924). Install the batteries in the direction indicated by the polarity markings on the battery holder.

6-78. FUSE REPLACEMENT

6-79. The input power fuse F1 is located on the interior of the instrument near the power transformer. If replacement is necessary, use an MDL 1/8A (slo-blo) for battery powered instruments.

CAUTION!

Line potential exists on the fuseholder whenever the instrument is plugged into the line.

6-80. DATA OUTPUT UNIT (OPTION –02)

6-81. Introduction

6-82. The Data Output Unit (DOU) provides digital measurement information to a rear panel output connector for use by remote display instruments or data printers. The output data is in parallel bcd format and is compatible with the Fluke Model 2010A Digital Printer.

6-83. Specifications

6-84. The specifications for the DOU are presented in Section 1 of this manual.

6-85. Operation

6-86. DOU DATA IDENTIFICATION

6-87. The data available at the rear panel DOU connector is listed in Table 6-4. The connector pin assignment and logic level requirement for each signal is provided.

6-88. DATA UPDATE

6-89. Refer to figure 8-6 and the timing diagram (figure 6-14) for the following discussion. The DOU output can be updated by an external command (ARM ENABLE, ARM INPUT) or allowed to update automatically (FREE RUN) at the end of each new instrument measurement. A logic level 1 (+4.75 to +5.25V) applied to ARM ENABLE (pin B) and a logic level 0 applied to FREE RUN will prevent acquisition of new data by the DOU. A positive going trigger applied to ARM INPUT (pin C) will enable the DOU to acquire data. New data will start to load into the DOU after the next measurement is complete. BZ (from the instrument to the DOU) occurs synchronously with the second STO signal affer a measurement is complete and lasts for one strobe cycle. BZ is presented to U10 as a data input. ST5 clocks the data into U10. As soon as data appears in U10, RG is applied through U11 and the isolation circuit to U4, U3, U2, and U1. At this time the busy flags are applied to the DOU output signifying that data is being changed. U10 enables the data on W to be serially loaded into the bottom of U4 during the first strobe cycle. When ST5 occurs again, the data in U10 is shifted to enable the data on X to be loaded into U4. Four strobe cycles are required to load the new data. When the fifth ST5 signal occurs, U10 is emptied of data and all its outputs are 0. RG is then inhigited by U11 and the clocking of data ceases. The busy flags are cleared from the DOU output and the data can be read. ARM INPUT may go to 0 at any time in the cycle but it must go to 0 before a data update can be externally commanded. If desired the DOU will automatically update at the end of each instrument measurement. If FREE RUN is allowed to be high, the DOU will automatically update the data after each measurement.

6-90. BUSY FLAG

6-91. The updating period of the DOU is signified by the BUSY (pin 2) and BUSY (pin 4) outputs from the DOU. During this period the data on the output connector pins will be changing to reflect the updated input. Either the positive true BUSY or negative true BUSY flag can be used to inhibit the data recording instrument during this time period.

Table 6-4. DOU DATA IDENTIFICATION

DOU DATA NAME	DOU PIN NO.		DOU DATA NAME	
+5V	1	A	LOGIC RETURN	
BUSY FLAG	2	B	ARM ENABLE	
POL FLAG	3	C	ARM INPUT	
BUSY FLAG	4	D	FREE RUN	
(8800A) POL FLAG	5	E	NOT USED	
OVERLOAD Q	6	F	a RANGE CODE	
RANGE CODE b	7	H	c RANGE CODE	
W6	8	J	X6	4 BITS
Y6	9	K	Z6	LSD (8800A)
W5	10	L	X5	4 BITS
Y5	11	M	Z5	LSD (8600A)
W4	12	N	X4	4 BITS
Y4	13	P	Z4	4SD
W3	14	R	X3	4 BITS
Y3	15	S	Z3	3SD
W2	16	T	X2	4 BITS
Y2	17	U	Z2	2SD
(GND) W1	18	V	X1 (GND	4 BITS MSD
(GND) Y1	19	W	Z1	ONE ACTIVE
	20	X	NOT USED	
	21	Y	NOT USED	
NOT USED	22	Z	NOT USED	

REMARKS

BCD BIT WEIGHT
W = 8
X = 4
Y = 2
Z = 1

RANGE	CODE		
	a	b	c
200Ω	0	0	1
2K	0	1	0
20K	0	1	1
200K	1	0	0
2000K	1	0	1
20MΩ	1	1	0

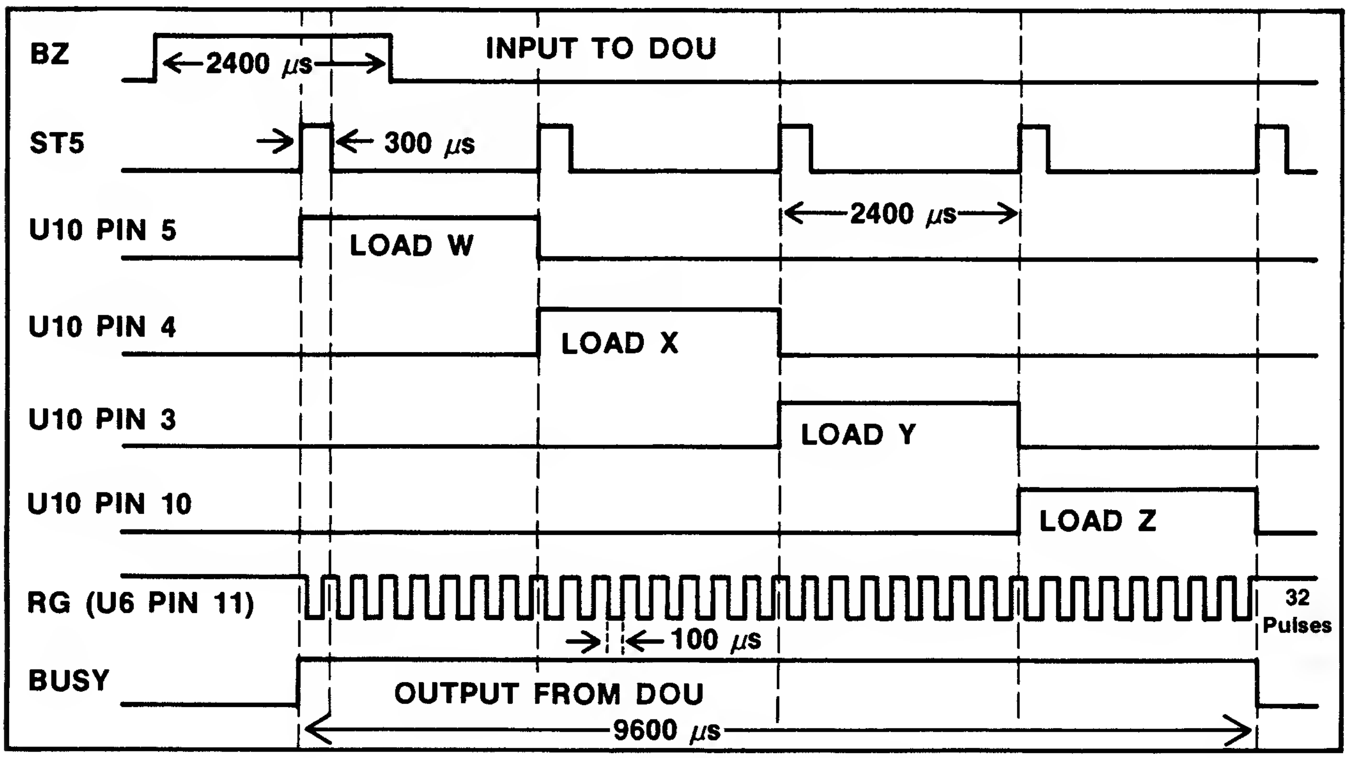

Figure 6-14 DOU TIMING DIAGRAM

6-92. POLARITY FLAG

6-93. The polarity of the dc voltage input to the A-D Converter determines which polarity sign will be presented at DOU output pin 3; pin 5 provides POL in Model 8800A only. A positive dc level at the converter will cause DOU output pin 3 to go to logic 1 and pin 5 (8800A) to go to logic 0. A negative converter input will cause the opposite logic level output from each pin.

6-94. OVERLOAD INDICATION

6-95. The DOU provides a single-bit output indication of a display overload condition. When the digit count exceeds the display capacity pin 6 of the DOU output connector changes from a logic 0 to logic 1.

6-96. RANGE CODE

6-97. The instrument range is presented in a three-bit bcd format at DOU output connector pins H, 7, and F. The output code representing each range is presented in Table 6-4.

6-98. DISPLAY DIGIT

6-99. The numerical value of each digit of the instrument display is presented in a four-bit bcd format at the DOU output connector. The connector pin assignments for each significant digit of the display are provided in Table 6-4. The most significant digit (DOU connector pins 18, 19, V, and W) needs only one active bit to represent the two display digits, 1 or 0. The three remaining bits are connected to ground in the DOU and, in most cases, the corresponding bits in the remote display unit must also be grounded to represent a logic 0.

6-100. DOU INTERFACE CABLE

6-101. A mating DOU connector is supplied with the DOU option for fabrication of a custom interface cable. Use the following procedure when constructing the interface cable.

a. Assemble the following equipment:

1. Teflon or vinyl insulated wire, 26 gauge, 31 pieces cut to the desired length.
2. Sleeving, # 16 for vinyl wire, or # 18 for teflon.
3. Rosin core solder, 60/40.
4. Wire strippers.
5. Soldering iron, pencil-type (45 W max.)
6. DOU mating connector.
7. Mating connector for interface instrument.

b. Strip one-half inch of insulation from the DOU connector end of the wires and tin each wire.

c. Cut 31 pieces of sleeving one-half inch long.

d. Place one piece of sleeving over each prepared wire.

e. Solder a connector contact pin to each wire.

f. Slide the sleeving over each solder connection.

g. Insert one connector contact pin into each DOU mating connector position corresponding to the desired data output.

h. Prepare the mating connector for the interface instrument. Ensure that the data line connections, at the interface instrument mating connector, place the DOU data on the correct pins.

Section 7
General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

D9816
Westermann Wilhelm Augusta-Anlage
Mannheim-Nackarau Germany

S0482
Sony Corp.
Tokyo, Japan

S3774
Oshino Electric Lamp Works
Tokoyo, Japan

0AD86
IN General
El Paso, TX

0AE89
Autosplice Inc.
Woodside, NY

0BW21
Noritake Co. Inc.
Burlington, MA

0ANF0
Topaz Semiconductor Inc
San Jose, CA

0DSM7
Conductive (Pkg) Containers Inc.
Brookfield, WI

0CLN7
Emhart Fastening Group
Shelton, CT

0FB81
S-Mos Systems Inc.
San Jose, CA

0FFP1
Eveready LTD
Ever Ready Special Battery Div.
Dawley Telford Salop UK

00199
Marcon Electronics Corp
Keamy, NJ

00213
Nytronics Comp. Group Inc.
Darrlingon, NC

00327
Welwyn International Inc.
Westlake, OH

00656
Aerovox Corp.
New Bedford, MA

00686
Film Capacitors Inc.
Passaic, NJ

00779
AMP, Inc.
Harrisburg, Pennsylvania

00853
Sangamo Weston Inc
Components Div
Pickens, NC

01091
Allied Plastics Co.
Los Angeles, CA

01101
Wabash Inc
(Formerly Wabash Magnetics)
Wabash, IN

01121
Allen Bradley Co.
Milwaukee, WI

01281
TRW Electronics & Defense Sector
R F Devices
Lawndale, CA

01295
TX Instruments Inc.
Semiconductor Group
Dallas, TX

01526
Genicom
Waynesboro, VA

01537
Motorola Communications &
Electronics Inc.
Franklin Park, IL

01686
RCL Electronics/Shallcross Inc.
Electro Components Div.
Manchester, NH

01884
Sprague Electric Co.
(Now 56289)

01961
Varian Associates Inc.
Pulse Engineering Div.
Convoy, CT

01963
Cherry Electrical Products Corp
Waukegan, IL

02111
Spectrol Electronics Corp.
City of Industry, CA

02114
Amperex Electronic Corp.
Ferrox Cube Div.
Saugerties, NY

02131
General Instrument Corp.
Government Systems Div.
Westwood, MA

02395
Sonar Radio Corp.
Hollywood, FL

02533
Leigh Instruments Ltd.
Frequency Control Div.
Don Mills, Ontario, Canada

02606
Fenwal Labs
Division of Travenal Labs
Morton Grove, IL

02660
Bunker Ramo-Eltra Corp.
Amphenol NA Div.
Broadview, IL

02697
Parker-Hannifin Corp.
O-Ring Div
Lexington, KY

02735
RCA-Solid State Div.
Somerville, NJ

02768
ITW (IL Tool Works)
Fastex Division
Des Plaines, IL

02799
Arco Electronics Inc.
Chatsworth, CA

03296
Nylon Molding Corp.
Monrovia, CA

03445
Lercon Electronics Inc
Burbank, CA

03508
General Electric Co.
Semiconductor Products
& Batteries
Auburn, NY

03797
Genisco Technology Corp.
Eltronics Div.
Rancho Dominquez, CA

03877
Gilbert Engineering Co.Inc
Incon Sub of Transitron
Electronic Corp.
Glendale, AZ

03888
KDI Electronics Inc.
Pyrofilm Div.
Whippany, NJ

03911
Clairex Corp.
Clairex Electronics Div.
Mount Vernon, NY

03980
Muirhead Inc.
Mountainside, NJ

04009
Cooper Industries, Inc.
Arrow Hart Div.
Hartford, CT

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

04221
Midland-Ross Corp.
Midtex Div.
N. Mankato, MN

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

04423
Telonic Berkley Inc.
Laguna Beach, CA

04713
Motorola Inc.
Semiconductor Group
Phoenix, AZ

04946
Standard Wire and Cable
Rancho Dominquez, CA

05173
General Radio
NY,NY.
Replaced by:

24655
Genrad,INC.
Concord, MA

05236
Jonathan Mfg. Co.
Fullerton, CA

05245
Corcom Inc.
Libertyville, IL

05276
ITT Pomona
Electronics Div.
Pomona, CA

05277
Westinghouse Elec. Corp.
Semiconductor Div.
Youngwood, PA

05347
Ultronix Inc
Grand Junction, CO

05397
Union Carbide Corp.
Materials Systems Div.
Cleveland, OH

05571
Sprague Electric Co.
(Now 56289)

05574
Viking Connectors Inc
Sub of Criton Corp.
Chatsworth, CA

05791
LYN-TRON
Burbank, CA

05820
EG & G Wakefield Engineering
Wakefield, MA

05839
Advance Electrical
Chicago, IL

05972
Loctite Corp.
Newington, CT

06001
General Electric Co.
Electric Capacitor Product
Section
Columbia, SC

06141
Fairchild Weston Systems Inc.
Data Systems Div.
Sarasota, FL

06192
La Deau Mfg. Co.
Glendale, CA

06229
Electrovert Inc.
Elmsford, NY

06383
Panduit Corp.
Tinley Park, IL

06473
Bunker Ramo Corp.
Amphenol NA Div.
SAMS Operation
Chatsworth, CA

06540
Mite Corp
Amatom-Electrical Div

06555
Beede Electrical Instrument
Penacook, NH

06665
Precision Monolithics
Sub of Bourns Inc.
Santa Clara, CA

06666
General Devices Co. Inc.
INpolis, IN

06739
Electron Corp.
Littleton, CO

06743
Gould Inc.
Foil Div.
Eastlake, OH

06751
Components Inc.
Semcor Div.
Phoenix, AZ

06776
Robinson Nugent Inc.
New Albany, IN

06915
Richco Plastic Co.
Chicago, IL

06961
Vemitron Corp.
Piezo Electric Div.
Bedford, OH

06980
EIMAC
(See Varian)
San Carlos, CA

07047
Ross Milton Co., The
Southampton, PA

07138
Westinghouse Electric Corp.
Industrial & Government
Tube Div.
Horseheads, NY

07233
Benchmark Technology Inc.
City of Industry, CA

07239
Biddle Instruments
Blue Bell, PA

07256
Silicon Transistor Corp.
Sub of BBF Inc.
Chelmsford, MA

07261
Avnet Corp.
Culver City, CA

07263
Fairchild Semiconductor
North American Sales
Ridgeview, CT

07344
Bircher Co. Inc., The
Rochester, NY

07374
Optron Corp
Woodbridge, CT

07557
Campion Co. Inc.
Philadelphia, PA

07597
Burndy Corp.
Tape/Cable Div.
Rochester, NY

07716
TRW Inc. (Can use 11502)
IRC Fixed Resistors/
Burlington
Burlington, VT

07792
Lerma Engineering Corp.
Northampton, MA

07810
Bock Corp.
Madison, WI

07910
Teledyne Semiconductor
Mtn. View, CA

07933
Raytheon Co.
Semiconductor Div.
Mountain View, CA

08FG6
Calmos Systems Inc.
Kanata, Ont. Canada

080A9
Dallas Semiconductor
Dallas, TX

08111
MF Electronics
New Rochelle, NY

08235
Industro Transistor Corp.
Long Island City, NY

08261
Spectra-Strip
An Eltra Co.
Garden Grove, CA

08445
Electri-Cord Mfg., Inc
Westfield, PA

08530
Reliance Mica Corp.
Brooklyn, NY

08718
ITT Cannon Electric
Phoenix Div.
Phoenix, AZ

08806
General Electric Co.
Minature Lamp Products
Cleveland, OH

08863
Nylomatic
Fallsington, PA

08988
Skottie Electronics Inc.
Archbald, PA

09021
Airco Inc.
Airco Electronics
Bradford, PA

09023
Cornell-Dublier Electronics
Fuquay-Varina, NC

09214
General Electric Co.
Semiconductor Products Dept.
Auburn, NY

09353
C and K Components Inc.
Newton, MA

09423
Scientific Components Inc.
Santa Barbara, CA

09922
Burndy Corp.
Norwalk, CT

09969
Dale Electronics Inc.
Yankton, SD

09975
Burroughs Corp.
Electronics Components
Detroit, MI

1A791
LFE Electronics
Danvers, MA

1B715
(United Shoe & Nylock Corp)
-Nylock Fastener Corp.-
Paramus, NJ

10059
Barker Engineering Corp.
Kenilworth, NJ

10389
IL Tool Works Inc.
Licon Div.
Chicago, IL

11236
CTS Corp.
Resistor Products Div.
Berne, IN

11237
CTS Corp of CA
Electro Mechanical Div.
Paso Robles, CA

11295
ECM Motor Co.
Schaumburg, IL

11358
Columbia Broadcasting System
CBS Electronic Div.
Newburyport, MA

11403
Vacuum Can Co.
Best Coffee Maker Div.
Chicago, IL

11502 (can also use 35009)
TRW Inc.
TRW Resistive Products Div.
Boone, NC

11503
Keystone Columbia Inc.
Freemont, IN

11532
Teledyne Relays Teledyne
Industries Inc.
Hawthorne, CA

11711
General Instrument Corp.
Rectifier Div.
Hicksville, NY

11726
Qualidyne Corp.
Santa Clara, CA

12014
Chicago Rivet & Machine Co.
Naperville, IL

12020
Ovenaire
Div. of Electronic Technologies
Charlottesville, VA

12038
Simco
(Div of Ransburg Corp)
Hatfield, PA

12040
National Semiconductor Corp.
Danbury, CT

12060
Diodes Inc.
Northridge, CA

12136
PHC Industries Inc.
Formerly Philadelphia Handle Co.
Camden, NJ

12300
AMF Canada Ltd.
Potter-Brumfield
Guelph, Ontario, Canada

12323
Practical Automation Inc.
Shelton, CT

12327
Freeway Corp.
Cleveland, OH

12406
Elpac Electronics Inc.
Santa Ana, CA

12443
Budd Co.,The
Plastics Products Div.
Phoenixville, PA

12581
Hitachi Metals Inernational Ltd.
Hitachi Magna-Lock Div.
Big Rapids, MO

12615
US Terminals Inc.
Cincinnati, OH

12617
Hamlin Inc.
LaKe Mills, WI

12673
Wesco Electrical
Greenfield, MA

12697
Clarostat Mfg. Co. Inc.
Dover, NH

12749
James Electronic Inc.
Chicago, IL

12856
MicroMetals Inc.
Anaheim, CA

12881
Metex Corp.
Edison, NJ

12895
Cleveland Electric Motor Co.
Cleveland, OH

12954
Microsemi Corp.
Components Group
Scottsdale, AZ

12969
Unitrode Corp.
Lexington, MA

13050
Potter Co.
Wesson, MS

13103
Thermalloy Co., Inc.
Dallas, TX

13327
Solitron Devices Inc.
Tappan, NY

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

13606
Sprague Electric Co.
(Use 56289)

13689
SPS Technologies Inc.
Hatfield, NJ

13764
Micro Plastics
Flippin, AZ

13919
Burr-Brown Research Corp.
Tucson, AZ

14099
Semtech Corp.
Newbury Park, CA

14140
McGray-Edison Co.
Commercial Development Div.
Manchester, NH

14189
Ortronics, Inc.
Orlando, FL

14193
Cal-R-Inc.
Santa Monica, CA

14301
Anderson Electronics
Hollidaysburg, PA

14329
Wells Electronics Inc.
South Bend, IN

14482
Watkins-Johnson Co.
Palo Alto, CA

14552
Microsemi Corp.
(Formerly Micro-Semiconductor)
Santa Ana, CA

14604
Elmwood Sensors, Inc
Pawtucket, RI

14655
Cornell-Dublier Electronics
Div. of Federal Pacific
Electric Co. Govt Cont Dept.
Newark, NJ

14704
Crydom Controls
(Division of Int Rectifier)
El Segundo, CA

14752
Electro Cube Inc.
San Gabriel, CA

14936
General Instrument Corp.
Discrete Semi Conductor Div.
Hicksville, NY

14949
Trompeter Electronics
Chatsworth, CA

15412
Amtron
Midlothian, IL

15542
Scientific Components Corp.
Mini-Circuits Laboratory Div.
Brooklyn, NY

15636
Elec-Trol Inc.
Saugus, CA

15782
Bausch & Lomb Inc.
Graphics & Control Div.
Austin, TX

15801
Fenwal Eletronics Inc.
Div. of Kidde Inc.
Framingham, MA

15818
Teledyne Inc. Co.
Teledyne Semiconductor Div.
Mountain View, CA

15849
Useco Inc.
(Now 88245)

15898
International Business
Machines Corp.
Essex Junction, VT

16068
International Diode Div.
Harrison, NJ

16162
MMI
Southfield, MI

16245
Conap Inc.
Olean, NY

16258
Space-Lok Inc.
Burbank, CA

16352
Codi Corp.
Linden, NJ

16469
MCL Inc.
LaGrange, IL

16473
Cambridge Scientific Industries
Div. of Chemed Corp.
Cambridge, MD

16733
Cablewave Systems Inc.
North Haven, CT

16742
Paramount Plastics
Fabricators Inc.
Downey, CA

16758
General Motors Corp.
Delco Electronics Div.
Kokomo, IN

17069
Circuit Structures Lab
Burbank, CA

17117
Electronic Molding Corp.
Woonsocket, RI

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

17504
Aluminum Filter Co.
Carpinteria, CA

17545
Atlantic Semiconductors Inc.
Asbury Park, NJ

17745
Angstrohm Precision, Inc.
Hagerstown, MD

17856
Siliconix Inc.
Santa Clara, CA

18178
E G & Gvactee Inc.
St. Louis, MO

18235
KRL/Bantry Components Inc.
Manchester, NH

18310
Concord Electronics
New York, NY

18324
Signetics Corp.
Sacramento, CA

18377
Parlex Corp.
Methuen, MA

18520
Sharp Electronics Corp.
Paramus, NJ

18542
Wabash Inc.
Wabash Relay & Electronics Div.
Wabash, IN

18565
Chomerics Inc.
Woburn, MA

18612
Vishay Intertechnology Inc.
Vishay Resistor Products Group
Malvem, PA

18632
Norton-Chemplast
Santa Monica, CA

18677
Scanbe Mfg. Co.
Div. of Zero Corp.
El Monte, CA

18736
Voltronics Corp.
East Hanover, NJ

18786
Micro-Power
Long Island City, NY

18927
GTE Products Corp.
Precision Material Products
Business Parts Div.
Titusville,PA

19080
Robinson Electronics Inc.
San Luis Obispo, CA

19112
Garry Corp.
Langhome, PA

19315
Bendix Corp., The
Navigation & Control Group
Terboro, NJ

19451
Perine Machine Tool Corp.
Kent, WA

19482
Delta Electronics
Alexandria, VA

19613
MN Mining & Mfg. Co.
Textool Products Dept.
Electronic Product Div.
Irving, TX

19647
Caddock Electronics Inc.
Riverside, CA

19701
Mepco/Centralab Inc.
A N. American Philips Co.
Mineral Wells, TX

2B178
Wire Products
Cleveland, OH

2K262
Boyd Corporation
Portland, OR

2Y384
North American Philips Lighting Corp.
Van Wert, OH

20584
Enochs Mfg. Inc.
INpolis, IN

20891
Cosar Corp.
Dallas, TX

21317
Electronics Applications Co.
El Monte, CA

21604
Buckeye Stamping Co.
Columbus, OH

21845
Solitron Devices Inc.
Semiconductor Group
Rivera Beach, FL

21847
Aertech
Now TRW Microwave Inc.
Sunnyvale, CA

21962
Vectron Corp.
Replaced by: S.W. Electronics

22526
DuPont, EI DeNemours & Co. Inc.
DuPont Connector Systems
Advanced Products Div.
New Cumberland, PA

22626
Micro Semiconductor
(Now 14552)

22670
GM Nameplate
Seattle, WA

22767
ITT Semiconductors
Palo Alto, CA

22784
Palmer Inc.
Cleveland, OH

23050
Product Comp. Corp.
Mount Vernon, NY

23223
CTS Microelectronics
Lafayette, NY

23237
I.R.C., Inc.
Microcircuits Divison
Philadelphia, PA

23302
S.W. Electronics & Mfg. Corp.
Cherry Hill, NJ

23730
Mark Eyelet and Stamping Inc.
Wolcott, CT

23732
Tracor Applied Sciences Inc.
Rockville, MD

23880
Stanford Applied Engineering
Santa Clara, CA

23936
William J. Purdy Co.
Pamotor Div.
Burlingame, CA

24347
Penn Engineering Co.
S. El Monte, CA

24355
Analog Devices Inc.
Norwood, MA

24444
General Semiconductor
Industries, Inc.
Tempe, AZ

24546
Bradford Electronics
Bradford, PA

24618
Transcon Mfg.
Now: D.J. Associates Inc.

24655
Genrad Inc.
(Replaced General Radio 05173)
Concord, MA

24759
Lenox-Fugle Electronics Inc.
South Plainfield, NJ

24796
AMF Inc.
Potter & Brumfield Div.
San Juan Capistrano, CA

24931
Specialty Connector Co.
Greenwood, IN

24995
ECS
Grants Pass, OR

25088
Siemen Corp.
Isilen, NJ

25099
Cascade Gasket
Kent, WA

25403
Amperex Electronic Corp.
Semiconductor & Micro-Circuit Div.
Slatersville, RI

25435
Moldtronics, Inc
Downers Grove, IL

25706
Daburn Electronic & Cable Corp.
Norwood, NJ

26402
Lumex,Inc.
Bayshore, NY

26629
Frequency Sources Inc.
Sources Div.
Chelmsford, MA

26806
American Zettler Inc.
Irvine, CA

27014
National Semiconductor Corp.
Santa Clara, CA

27167
Corning Glass Works Corning
Electronics
Wilmington, NC

27264
Molex Inc.
Lisle, IL

27440
Industrial Screw Products
Los Angeles, CA

27494
Staffall, Inc.
Providence, RI

27745
Associated Spring Barnes Group Inc.
Syracuse, NY

27918
Component Parts Corp.
Bellmore, NY

27956
Relcom (Now 14482)

28175
Alpha Metals
Chicago, IL

28198
Positronic Industries
Springfield, MO

28213
MN Mining & Mfg. Co.
Consumer Products Div.
3M Center
Saint Paul, MN

28309
Kaiser
Minette,AL

28425
Serv-O-Link
Euless, TX

28478
Deltrol Corporation
Deltrol Controls Div.
Milwaukee, WI

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, CA

28484
Emerson Electric Co.
Gearmaster Div.
McHenry, IL

28520
Heyco Molded Products
Kenilworth, NJ

28932
Lumax Industrials, Inc
Altoona, PA

29083
Monsanto Co.
Santa Clara, CA

29604
Stackpole Components Co.
Raleith, NC

29907
Omega Engineering Inc.
Stamford, CT

3D536
Aimsco Inc.
Seattle, WA

30035
Jolo Industries Inc.
Garden Grove, CA

30045
Solid Power Corp.
Farmingdale, NY

30146
Symbex Corp.
Painesville, OH

30148
AB Enterprise Inc.
Ahoskie, NC

30161
Aavid Engineering Inc.
Laconia, NH

30315
Itron Corp.
San Diego, CA

30323
IL Tool Works Inc.
Chicago, IL

30800
General Instrument Corp.
Capacitor Div.
Hicksville, NY

30838
Fastec
Chicago,ILL

31019
Solid State Scientific Inc.
Willow Grove, PA

31091
Alpha Industries Inc.
Microelectronics Div.
Hatfield, PA

31323
Metro Supply Company
Sacramento, CA

31433
Kemet Electonics Corp.
Simpsonville, NC

31448
Army Safeguard Logistics Command
Huntsville, AL

31471
Gould Inc
Semiconductor Div
Santa Clara, CA

31522
Metal Masters Inc.
Baldwin, MS

31746
Cannon Electric
Woodbury, TN

31827
Budwig
Ramona, CA

31918
ITT-Schadow
Eden Prairie, MN

32293
Intersil
Cupertino, CA

32539
Mura Corp.
Westbury, Long Island, N.Y.

32559
Bivar
Santa Ana, CA

32719
Siltronics
Santa Ana, CA

32767
Griffith Plastics Corp.
Burlingame, CA

32879
Advanced Mechanical Components
Northridge, CA

32897
Murata Erie North America Inc.
Carlisle Operations
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Div.
Riverside, CA

33025
M/A ComOmni Spectra, Inc. (Replacing Omni Spectra)
Microwave Subsystems Div.
Tempe, AZ

33096
CO Crystal Corp.
Loveland, CO

33173
General Electric Co.
Owensboro, KY

33246
Epoxy Technology Inc.
Billerica, MA

33292
Pioneer Sterilized Wiping Cloth Co.
Portland, OR

33297
NEC Electronics USA Inc.
Electronic Arrays Inc. Div.
Mountain View, CA

33919
Nortek Inc.
Cranston, RI

34114
Oak Industries
Rancho Bernardo, CA

34263
CTS Electronics Corp.
Brownsville,TX

34333
Silicon General Inc.
Garden Grove, CA

34335
Advanced Micro Devices (AMD)
Sunnyvale, CA

34359
MN Mining & Mfg. Co.
Commercial Office Supply Div.
Saint Paul, MN

34371
Harris Corp.
Harris Semiconductor
Products Group
Melbourne, FL

34576
Rockwell International Corp.
Newport Beach, CA

34641
Instrument Specialties
Euless, TX

34649
Intel Corp.
Santa Clara, CA

34802
Electromotive Inc.
Kenilworth, NJ

34848
Hartwell Special Products
Placentia, CA

35009
Renfrew Electric Co. Ltd.
IRC Div.
Toronto, Ontario, Canada

35986
Amrad
Melrose Park, IL

36665
Mitel Corp.
Kanata, Ontario, Canada

36701
Van Waters & Rogers
Valley Field, Quebec, Canada

37942
Mallory Capacitor Corp.
Sub of Emhart Industries
INpolis, IN

39003
Maxim Industries
Middleboro, MA

4F434
Plastic Sales
Los Angeles, CA

40402
Roderstein Electronics Inc.
Statesville, NC

42498
National Radio
Melrose, MA

43543
Nytronics Inc.(Now 53342)

43744
Panasonic Industrial Co.
San Antonio, TX

43791
Datron Systems
Wilkes Barre, PA

44655
Ohmite Mfg. Co.
Skokie, IL

47001
Lumberg Inc.
Richmond, VA

47379
ISOCOM
Campbell, CA

49569
IDT (International Development & Trade)
Dallas, TX

49671
RCA Corp.
New York, NY

49956
Raytheon Company
Executive Offices
Lexington, MA

5D590
Mostek Corp.
Replaced by: SGS Thompson Microelectronics

5F520
Panel Components Corp.
Santa Rosa, CA

5P575
Nobel Electronics
Suffern, NY

5W664
NDK
Div. of Nihon Dempa Kogyo LTD
Lynchburg, VA

5U802
Dennison Mfg. Co.
Framingham, MA

50088
SGS - Thomson Microelectronics Inc.
Carrollton, TX

50120
Eagle-Picher Industries Inc.
Electronics Div.
CO Springs, CO

50157
Midwest Components Inc.
Muskegon, MS

50356
Teac Corp. of America
Industrial Products Div
Montebello, CA

50364
MMI, Inc.(Monolithic Memories Inc)
Military Products Div.
Santa Clara, CA

50472
Metal Masters, Inc.
City of Industry, CA

50541
Hypertronics Corp.
Hudson, MA

50558
Electronic Concepts, Inc.
Eatontown, NJ

50579
Litronix Inc.
Cupertino, CA

50891
Semiconductor Technology
Stuart, FL

50934
Tran-Tec Corp
Columbus, NE

51167
Aries Electronics Inc.
Frenchtown, NJ

51284
Mos Technology
Norristown, PA

51249
Heyman Mfg. Co.
Cleveland, OH

51372
Verbatim Corp.
Sunnyvale, CA

51398
MUPAC Corp.
Brockton, MA

51406
Murata Erie, No. America Inc.
(Also see 72982)
Marietta, GA

51499
Amtron Corp.
Boston, MA

51506
Accurate Screw Machine Co.
(ASMCO) Nutley, NJ

51605
CODI Semiconductor Inc.
Kenilworth, NJ

51642
Centre Engineering Inc.
State College, PA

51705
ICO/Rally
Palo alto, CA

51791
Statek Corp.
Orange, CA

51984
NEC America Inc.
Falls Church, VA

52063
Exar Integrated Systems
Sunnyvale, CA

52072
Circuit Assembly Corp.
Irvine, CA

52152
MN Mining & Mfg.
Saint Paul, MN

52333
API Electronics
Haugpauge,Long Island,NY

52361
Communication Systems
Piscataway, NJ

52500
Amphenol, RF Operations
Burlington, MA

52525
Space-Lok Inc.
Lerco Div.
Burbank, CA

52531
Hitachi Magnetics
Edmore, MO

52745
Timco
Los Angeles, CA

52763
Stettner-Electronics Inc.
Chattanooga, TN

52769
Sprague-Goodman Electronics Inc.
Garden City Park, NY

52771
Moniterm Corp.
Amatrom Div.
Santa Clara, CA

52840
Western Digital Corp.
Costa Mesa, CA

53021
Sangamo Weston Inc.
(See 06141)

53036
Textool Co.
Houston, TX

53184
Xciton Corp.
Lathan, NY

53217
Technical Wire Products Inc.
Santa Barbara, CA

53342
Opt Industries Inc.
Phillipsburg, NJ

53673
Thompson CSF Components Corp.
(Semiconductor Div)
Conaga Park, CA

53718
Airmold/W. R. Grese & Co.
Roanoke Rapids, NC

53848
Standard Microsystems
Hauppauge, NY

53894
AHAM Inc.
RanchoCA, CA

53944
Glow-Lite
Pauls Valley, OK

54178
Plasmetex Industries Inc.
San Marcos, CA

54294
Shallcross Inc.
Smithfield, NC

54453
Sullins Electronic Corp.
San Marcos, CA

54473
Matsushita Electric Corp.
(Panasonic)
Secaucus, NJ

54492
Cinch Clamp Co., Inc.
Santa Rosa, CA

54583
TDK
Garden City, NY

54590
RCA Corp
Distribution & Special Products
Cherry Hill, NY

54869
Piher International Corp.
Arlington Heights, IL

54937
DeYoung Mfg.
Bellevue, WA

54590
RCA Corp.
Electronic Components Div.
Cherry Hill, NJ

55026
American Gage & Machine Co.
Simpson Electric Co. Div.
Elgin, IL

55112
Plessey Capacitors Inc.
(Now 60935)

55261
LSI Computer Systems Inc.
Melville, NY

55285
Bercquist Co.
Minneapolis, MN

55322
Samtech Inc.
New Albany, IN

55408
STI-CO Industries Co
Buffalo, NY

55464
Central Semiconductor Corp.
Hauppauge, NY

55557
Microwave Diode Corp.
W.Stewarstown, NH

55566
R A F Electronic Hardware Inc.
Seymour, CT

55576
Synertek
Santa Clara, CA

55680
Nichicon/America/Corp.
Schaumburg, IL

55943
D J Associates, Inc
(Replaced Transcon Mfg.-24618)
Fort Smith, AZ

56282
Utek Systems Inc.
Olathe, KS

56289
Sprague Electric Co.
North Adams, MA

56365
Square D Co.
Corporate Offices
Palatine, IL

56375
WESCORP
Div. Dal Industries Inc
Mountain View, CA

56481
Shugart Associates
Sub of Xerox Corp.
Sunnyvale, CA

56637
RCD Components Inc.
Manchester, NH

56708
Zilog Inc.
Campbell, CA

56856
Vamistor Corp. of TN
Sevierville, TN

56880
Magnetics Inc.
Baltimore, MD

57026
Endicott Coil Co. Inc.
Binghamton, NY

57053
Gates Energy Products
Denver, CO

57170
Cambridge Thermionic
Cambridge, MA
Replaced by:
71279
Interconnection Products Inc.

57668
R-ohm Corp
Irvine, CA

57962
SGS - Thomson Microelectronics Inc
Montgomeryville, PA

58014
Hitachi Magnalock Corp.
(Now 12581)

58104
Simco
Atlanta, GA

58364
BYCAP Inc.
Chicago, IL

58451
Precision Lamp
Cotat, CA

58474
Superior Electric Co.
Bristol, CT

58614
Communications Instruments Inc.
Fairview, NC

59124
KOA-Speer Electronics Inc.
Bradford, PA

59422
Holmberg Electronics
Irvine, CA

59610
Souriau Inc
Valencia, CA

59635
HV Component Associates
Howell, NJ

59640
Supertex Inc.
Sunnyvale, CA

59660
Tusonix Inc.
Tucson, AZ

59730
Thomas and Betts Corp.
IA City, IA

59831
Semtronics Corp.
Watchung, NJ

6II053:
American Components Inc.
an Insilco Co. RPC Div.
Hayesville, NC

6L611
Allen, Robert G. Inc.
Van Nuys, CA

6U850
Burgess Switch Co., Inc
Northbrook, IL

6U095
AMD Enterprises, Inc.
Roswell, GA

6X403
SGS/ATES Semiconductor Corp.
INpolis, IN

6Y440
Micron Technology Inc.
Boise, ID

60046
Power Dynamics Inc
West Orange, NJ

60197
Precicontact Inc.
Langhome, PA

60386
Squires Electronics Inc
Cornelius, OR

60395
Xicor Inc.
Milpitas, CA

60399
Torin Engineered Blowers
Div. of Clevepak Corp.
Torrington, CT

60496
Micrel Inc.
Sunnyvale, CA

60705
Cera-Mite Corp.
(formerly Sprague)
Grafton, WI

60911
Inmos Corp.
CO Springs, CO

60935
Westlake Capacitor Inc.
Tantalum Div.
Greencastle, IN

60958
ACIC
Intercomp Wire & Cable Div.
Hayesville, NC

61271
Fujitsu Microelectronics Inc
San Jose, CA

61394
SEEQ Technology Inc.
San Jose, CA

61429
Fox Electronics
Cape Coral, FL

61529
Aromat Corp.
New Providence, NJ

61752
IR-ONICS Inc
Warwick, RI

61772
Integrated Device Technology
Santa Clara, CA

61802
Toshiba
Houston, TX

61857
SAN-O Industrial Corp.
Bohemia, Long Island, NY

61935
Schurter Inc.
Petaluma, CA

62351
Apple Rubber
Lancaster, NY

62643
United Chemicon
Rosemont, IL

62712
Seiko Instruments
Torrance, CA

62793
Lear Siegler Inc.
Energy Products Div.
Santa Ana, CA

63743
Ward Leonard Electric Co.Inc.
Mount Vernon, NY

64154
Lamb Industries
Portland, OR

64155
Linear Technology
Milpitas, CA

64537
KDI Electronics
Whippany, NJ

64782
Precision Control Mfg. Inc.
Bellevue, WA

64834
West M G Co.
San Francisco, CA

64961
Electronic Hardware LTD
North Hollywood, CA

65092
Sangamo Weston Inc.
Weston Instruments Div.
Newark, NJ

65786
Cypress Semi
San Jose, CA

65940
Rohm Corp & Whatney
Irvine, CA

65964
Evox Inc.
Bannockburn, IL

66150
Entron Inc.
Winslow Teltronics Div.
Glendale, NY

66302
VLSI Technology Inc.
San Jose, CA

66419
Exel
San Jose, CA

66450
Dyna-Tech Electronics, Inc
Walled Lake, MI

66608
Bering Industries
Freemont, CA

66891
BKC International Electronics
Lawrence, MA

66958
SGS Semiconductor Corp.
Phoenix, AZ

66967
Powerex Inc
Auburn, NY

67183
Altera
Santa Clara, CA

68919
WIMA
% Harry Levinson Co.
Seattle, WA

7F361
Richmond-Division of Dixico
% Zellerbach Paper Co.
Seattle, WA

7F844
Moore Business Forms, Inc
Seattle, WA

7G902
Textron Inc.
Camcar Div.
Rockford, IL

7J395
Universal Plastics
Welshpool, WA

7J696
AMD Plastics
East Lake, OH

7K354
Omni Spectra Inc
Los Altos, CA

7Z884
ALPS
Seattle, WA

7X634
Duracell USA
Div. of Dart & Kraft Inc.
Valdese, NC

70290
Almetal Universal Joint Co.
Cleveland, OH

70485
Atlantic India Rubber Works Inc.
Chicago, IL

70563
Amperite Company
Union City, NJ

70903
Cooper-Belden Corp.
Geneva, IL

71002
Bimbach Co. Inc.
Farmingdale, NY

71034
Bliley Electric Co.
Erie, PA

71183
Westinghouse Electric Corp.
Bryant Div.
Bridgeport, CT

71279
Interconnection Products Inc.
Formerly Midland-Ross Cambion Div.
Santa Ana, CA

71400
Bussman Manufacturing
Div. McGraw-Edison Co.
St. Louis, MO

71450
CTS Corp.
Elkhart, IN

71468
ITT Cannon Div. of ITT
Fountain Valley, CA

71482
General Instrument Corp.
Clare Div.
Chicago, IL

71590
Mepco/Centralab
A North American Philips Co.
Fort Dodge, IA

71707
Coto Corp.
Providence, RI

71744
General Instrument Corp.
Lamp Div/Worldwide
Chicago, IL

71785
TRW Inc.
Cinch Connector Div.
Elk Grove Village, IL

71984
Dow Corning Corp.
Midland, MI

72005
AMAX Specialty Metals Corp.
Newark, NJ

72136
Electro Motive Mfg. Corp.
Florence, NC

72228
AMCA International Corp.
Continental Screw Div.
New Bedford, MA

72259
Nytronics Inc.
New York, NY

72619
Amperex Electronic Corp.
Dialight Div.
Brooklyn, NY

72653
G C Electronics Co.
Div. of Hydrometals Inc.
Rockford, IL

72794
Dzus Fastner Co. Inc.
West Islip, NY

72928
Gulton Industries Inc.
Gudeman Div.
Chicago, IL

72962
Elastic Stop Nut
Div. of Harrard Industries
Union, NJ

72982
Erie Specialty Products, Inc
Formerly: Murata Erie
Erie, PA

73138
Beckman Industrial corp.
Helipot Div.
Fullerton, CA

73168
Fenwal Inc.
Ashland, MA

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, CA

73445
Amperex Electronic Corp.
Hicksville, NY

73559
Carlingswitch Inc.
Hartford, CT

73586
Circle F Industries
Trenton, NJ

73734
Federal Screw Products Inc.
Chicago, IL

73743
Fischer Special Mfg. Co.
Cold Spring, KY

73893
Microdot
Mt. Clemens, MS

73899
JFD Electronic Components
Div. of Murata Erie
Oceanside, NY

73905
FL Industries Inc.
San Jose, CA

73949
Guardian Electric Mfg. Co.
Chicago, IL

74199
Quam Nichols Co.
Chicago, IL

74217
Radio Switch Co.
Marlboro, NJ

74306
Piezo Crystal Co.
Div. of PPA Industries Inc.
Carlisle, PA

74445
Holo-Krome Co.
Elmwood, CT

74542
Hoyt Elect.Instr. Works Inc.
Penacook, NH

74840
IL Capacitor Inc.
Lincolnwood, IL

74970
Johnson EF Co.
Waseca, MN

75042
TRW Inc.
IRC Fixed Resistors
Philadelphia, PA

75297
Kester Solder Div.
Litton Systems, Inc
Des Plaines, IL

75376
Kurz-Kasch Inc.
Dayton, OH

75378
CTS Knights Inc.
Sandwich, IL

75382
Kulka Electric Corp.
(Now 83330)
Mount Vernon, NY

75569
Performance Semiconductor Corp.
Sunnyvale, CA

75915
Littelfuse Tracor
(Formerly: Tracor-Littelfuse)
Des Plaines, IL

76854
Oak Switch Systems Inc.
Crystal Lake, IL

77122
TRW Assemblies & Fasteners Group
Fastener Div.
Moutainside, NJ

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

77542
Ray-O-Vac Corp
Madison, WI

77638
General Instrument Corp.
Rectifier Div.
Brooklyn, NY

77900
Shakeproof Lock Washer Co.
(Now 78189)

77969
Rubbercraft Corp. of CA Ltd.
Torrance, CA

78189
IL Tool Works Inc.
Shakeproof Div.
Elgin, IL

78277
Sigma Instruments Inc.
South Braintree, MA

78290
Struthers Dunn Inc.
Pitman, NJ

78553
Eaton Corp.
Engineered Fastener Div.
Cleveland, OH

78592
Stoeger Industries
South Hackensack, NJ

79497
Western Rubber Co.
Goshen, IN

79727
C - W Industries
Southampton, PA

79963
Zierick Mfg. Corp.
Mount Kisco, NY

8C798
Ken-Tronics, Inc.
Milan, IL

8D528
Baumgartens
Atlanta, GA

8F330
Eaton Corp.
Cutler Hammer Product Sales Office
Mountain View, CA

8T100
Tellabs Inc.
Naperville, IL

80009
Tektronix
Beaverton, OR

80031
Mepco/Electra Inc.
Morristown, NJ

80032
Ford Aerospace &
Communications Corp.
Western Development
Laboratories Div.
Palo Alto, CA

80145
LFE Corp.
Process Control Div.
Clinton, OH

80183
Sprague Products
(Now 56289)

80294
Bourns Instruments Inc.
Riverside, CA

80583
Hammerlund Mfg. Co. Inc.
Paramus, NJ

80640
Computer Products Inc.
Stevens-Arnold Div.
South Boston, MA

81073
Grayhill Inc.
La Grange, IL

81312
Litton Systems Inc.
Winchester Electronics Div.
Watertown, CT

81439
Therm-O-Disc Inc.
Mansfield, OH

81483
International Rectifier Corp.
Los Angeles, CA

81590
Korry Electronics Inc.
Seattle, WA

81741
Chicago Lock Co.
Chicago, IL

82227
Airpax Corp.
Cheshire Div.
Cheshire, CT

82240
Simmons Fastner Corp.
Albany, NY

82305
Palmer Electronics Corp.
South Gate, CA

82389
Switchcraft Inc.
Sub of Raytheon Co.
Chicago, IL

82415
Airpax Corp
Frederick Div.
Frederick, MD

82872
Roanwell Corp.
New York, NY

82877
Rotron Inc.
Custom Div.
Woodstock, NY

82879
ITT
Royal Electric Div.
Pawtucket, RI

83003
Varo Inc.
Garland, TX

83014
Hartwell Corp.
Placentia, CA

83055
Signalite Fuse Co.
(Now 71744)

83058
TRW Assemblies & Fasteners Group
Fasteners Div.
Cambridge, MA

83259
Parker-Hannifin Corp.
O-Seal Div.
Culver City, CA

83298
Bendix Corp.
Electric & Fluid Power Div.
Eatonville, NJ

83315
Hubbell Corp.
Mundelein, IL

83330
Kulka Smith Inc.
A North American Philips Co.
Manasquan, NJ

83478
Rubbercraft Corp. of America
West Haven, CT

83553
Associated Spring Barnes Group
Gardena, CA

83740
Union Carbide Corp.
Battery Products Div.
Danbury, CT

84171
Arco Electronics
Commack, NY

84411
American Shizuki
TRW Capacitors Div.
Ogallala, NE

84613
FIC Corp.
Rockville, MD

84682
Essex Group Inc.
Peabody, MA

84830
Lee Spring Co. Inc
Brooklyn, NY

85367
Bearing Distributing Co.
San Fransisco, CA

85372
Bearing Sales Co.
Los Angeles, CA

85480
W. H. Brady Co.
Industrial Product
Milwaukee, WI

85840
Brady WH Co
Indusrial Products Div
Milwaukee, WI

85932
Electro Film Inc.
Valencia, CA

86577
Precision Metal Products Co.
Peabody, MA

86684
Radio Corp. of America
(Now 54590)

86928
Seastrom Mfg. Co. Inc.
Glendale, CA

87034
Illuminated Products Inc.
(Now 76854)

87516
Standard Crystal
KS City, KS

88044
Aeronautical Standards Group
Dept. of Navy & Air Force

88219
GNB Inc.
Industrial Battery Div.
Langhorne, PA

88245
Winchester Electronics
Litton Systems-Useco Div.
Van Nuys, CA

88486
Triangle PWC Inc.
Jewitt City, CT

88690
Essex Group Inc.
Wire Assembly Div.
Dearborn, MI

88786
Atlantic India Rubber Co.
Goshen, IN

88978
Philips (Now Fluke)
Mahwah, NJ

89020
Amerace Corp.
Buchanan Crimptool Products Div.
Union, NJ

89265
Potter-Brumfield
(See 77342)

89462
Waldes Truarc, Inc.
Long Island, NY

89536
John Fluke Mfg. Co., Inc.
Everett, WA

89597
Fredericks Co.
Huntingdon Valley, PA

89709
Bunker Ramo-Eltra Corp.
Amphenol Div.
Broadview, IL

89730
General Electric
Lamp Div.
Newark, NJ

9R216
Data Composition Svc, Inc
Laurel, MD

9S171
Port Plastics
Tukwila, WA

9W423
Amatom
El Mont, CA

90201
Mallory Capacitor Co.
Sub of Emhart Industries Inc.
Indianapolis, IN

90215
Best Stamp & Mfg. Co.
KS City, MO

90303
Duracell Inc.
Technical Sales & Marketing
Bethel, CT

91094
Essex Group Inc.
Suflex/IWP Div.
Newmarket, NH

91247
IL Transformer Co.
Chicago, IL

91293
Johanson Mfg. Co.
Boonton, NJ

91462
Alpha Industries Inc.
Logansport, IN

91502
Associated Machine
Santa Clara, CA

91506
Augat Alcoswitch
N. Andover, MA

91507
Froeliger Machine Tool Co.
Stockton, CA

91637
Dale Electronics Inc.
Columbus, NE

91662
Elco Corp.
A Gulf Western Mfg. Co.
Connector Div.
Huntingdon, PA

91737
ITT Cannon/Gremar
(Now 08718)

91802
Industrial Devices Inc.
Edgewater, NJ

91833
Keystone Electronics Corp.
NY, NY

91836
King's Electronics Co. Inc.
Tuckahoe, NY

91929
Honeywell Inc.
Micro Switch Div.
Freeport, IL

91934
Miller Electric Co.
Woonsockct, RI

91967
National Tel-Tronics
Div. of electro Audio Dynamics Inc
Meadville, PA

91984
Maida Development Co.
Hampton, VA

91985
Norwalk Valve Co.
S. Norwalk, CT

92218
Wakefield Corp., The
Wakefield, ME

92527
VTC Inc.
Bloomington, MN

92607
Tensolite Co.
Div. of Carlisle Corp.
Buchanan, NY

92914
Alpha Wire Corp.
Elizabeth, NJ

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, MA

94144
Raytheon Co.
Microwave & Power Tube Div.
Quincy, MA

94222
Southco Inc.
Concordville, PA

94988
Wagner Electric Corp.
Sub of Mcgraw-Edison Co.
Whippany, NJ

95146
Alco Electronic Products Inc.
Switch Div.
North Andover, MA

95263
Leecraft Mfg. Co.
Long Island City, NY

95275
Vitramon Inc.
Bridgeport, CT

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, OH

95348
Gordo's Corp.
Bloomfield, NJ

95354
Methode Mfg. Corp.
Rolling Meadows, IL

95573
Campion Laboratories Inc.
Detroit, MI

95712
Bendix Corp.
Electrical Comp. Div.
Franklin, IN

95987
Weckesser Co. Inc.
(Now 85480)

96733
SFE Technologies
San Fernando, CA

96853
Gulton Industries Inc.
Measurement & Controls Div.
Manchester, NH

96881
Thomson Industries Inc.
Port WA, NY

97464
Industrial Retainer Ring
Irvington, NJ

97525
EECO Inc.
Santa Ana, CA

97540
Whitehall Electronics Corp.
Master Mobile Mounts Div.
Fort Meyers, FL

97913
Industrial Electronic
Hardware Corp.
NY, NY

97945
Pennwalt Corp.
SS White Industrial Products
Piscataway, NJ

97966
CBS
Electronic Div.
Danvers, MA

98094
Machlett Laboratories Inc.
Santa Barbara. CA

98159
Rubber-Teck Inc.
Gardena, CA

98278
Malco A Microdot Co.
South Pasadena, CA

98291
Sealectro Corp.
BICC Electronics
Trumbill, CT

98372
Royal Industries Inc.
(Now 62793)

98388
Lear Siegler Inc.
Accurate Products Div.
San Deigo, CA

98978
IERC
(International Electronic Research Corp.)
Burbank, CA

99120
Plastic Capacitors Inc.
Chicago, IL

99217
Bell Industries Inc.
Elect. Distributor Div.
Sunnyvale, CA

99378
ATLEE of DE Inc.
N. Andover, MA

99392
Mepco/Electra Inc.
Roxboro Div.
Roxboro, NC

99515
Electron Products Inc.
Div. of American Capacitors
Duarte, CA

99779
Bunker Ramo- Eltra Corp.
Barnes Div.
Lansdown, PA

99800
American Precision Industries
Delevan Div.
East Aurora, NY

99942
Mepco/Centralab
A North American Philips Co.
Milwaukee, WI

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SF-02630 ESPOO
Tel: 358-0-52572

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et Comerciale,
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Hindtron Services Pvt. Ltd.
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Panchshila Park
New Delhi 110 017
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Seoul 150
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46700 Petaling Jaya
Selangor
Tel: 60 3 774-3422

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Instrumentacion y Perifericos
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Col. Mixcoac
Mexico D.F.
Tel: 52-5-563-5411

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San Juan, Metro-Manila Zip 3113
Tel: 63-2-775192

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Lote 102B, Miraflores/Alges
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Service Department
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Customer Support
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S-16493 Kista

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Istanbul
Tel: 90 1 1435891

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Casilla de Correo 1400
Libertad 2525
Montevideo
Tel: 598-2-789015

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Coasin C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Apartado de Correos Nr-70-136
Los Ruices
Caracas 1070-A
Tel: 58 2 241-0309, 241-1248

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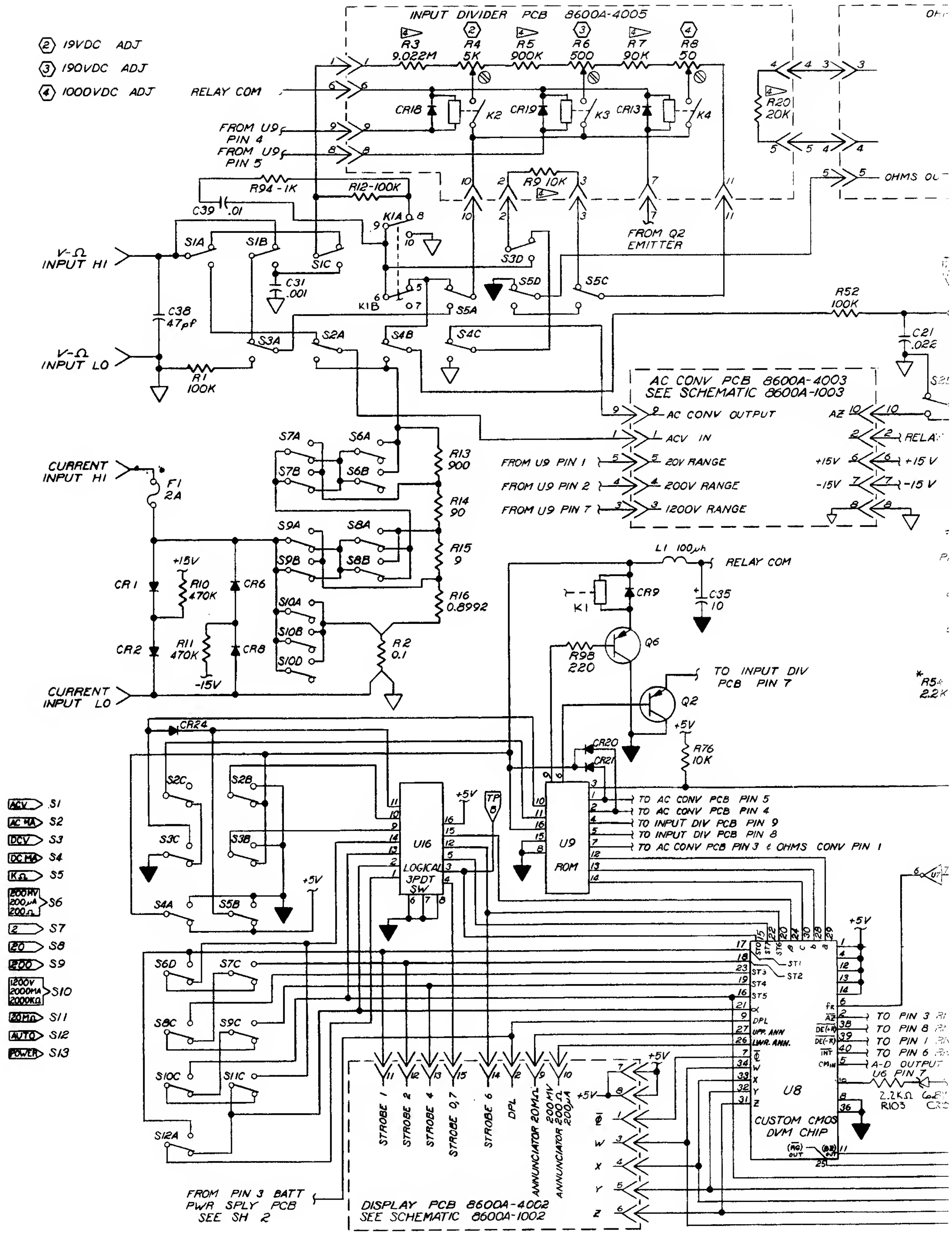
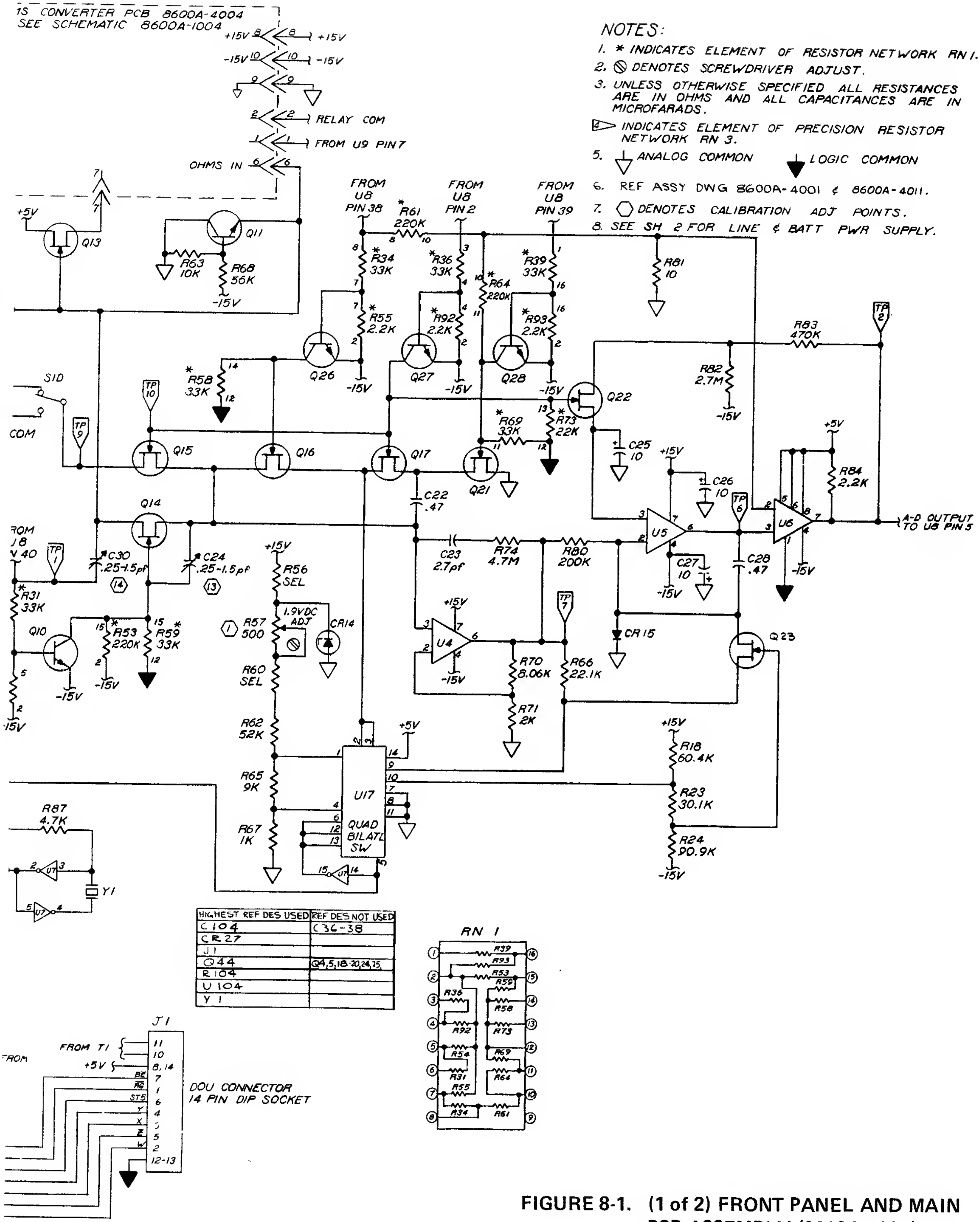
Philips GmbH
Department VSF
Service fuer FLUKE - Produkte
Oskar - Messter - Strasse 18
D-8045 Ismaning / Munich
Tel: 49 089 9605-260

Section 8
Schematic Diagrams

TABLE OF CONTENTS



INPUT DIVIDER PCB 8600A-4005
19VDC ADJ
190VDC ADJ
1000VDC ADJ
RELAY COM
R3 9.022M
R4 5K
R5 900K
R6 500
R7 90K
R8 50
R20 20K
FROM U9 PIN 4
FROM U9 PIN 5
R94 - 1K
R12 - 100K
R9 10K
C39 .01
FROM Q2 EMITTER
OHMS OUT
V-Ω INPUT HI
V-Ω INPUT LO
C38 47pf
C31 .001
R1 100K
R52 100K
C21 .022
AC CONV PCB 8600A-4003
SEE SCHEMATIC 8600A-1003
AC CONV OUTPUT
ACV IN
FROM U9 PIN 1
20V RANGE
FROM U9 PIN 2
200V RANGE
FROM U9 PIN 7
1200V RANGE
+15V
-15V
CURRENT INPUT HI
CURRENT INPUT LO
F1 2A
R13 900
R14 90
R15 9
R16 0.8992
R2 0.1
R10 470K
R11 470K
L1 100μh
C35 10
R98 220
TO INPUT DIV PCB PIN 7
R76 10K
U16 LOGICAL 3PDT SW
U9 ROM
TO AC CONV PCB PIN 5
TO AC CONV PCB PIN 4
TO INPUT DIV PCB PIN 9
TO INPUT DIV PCB PIN 8
TO AC CONV PCB PIN 3 & OHMS CONV PIN 1
ACV S1
AC MA S2
DCV S3
DC MA S4
KΩ S5
200MV 200μA 200Ω S6
2 S7
20 S8
200 S9
1200V 2000MA 2000KΩ S10
20MΩ S11
AUTO S12
POWER S13
U8 CUSTOM CMOS DVM CHIP
TO PIN 3
TO PIN 8
TO PIN 1
TO PIN 6
A-D OUTPUT
U6 PIN 7
2.2KΩ R103
STROBE 1
STROBE 2
STROBE 4
STROBE 0,7
STROBE 6
DPL
ANNUNCIATOR 20MΩ
200 MV 200 Ω 200 μA ANNUNCIATOR
DISPLAY PCB 8600A-4002
SEE SCHEMATIC 8600A-1002
FROM PIN 3 BATT PWR SPLY PCB SEE SH 2

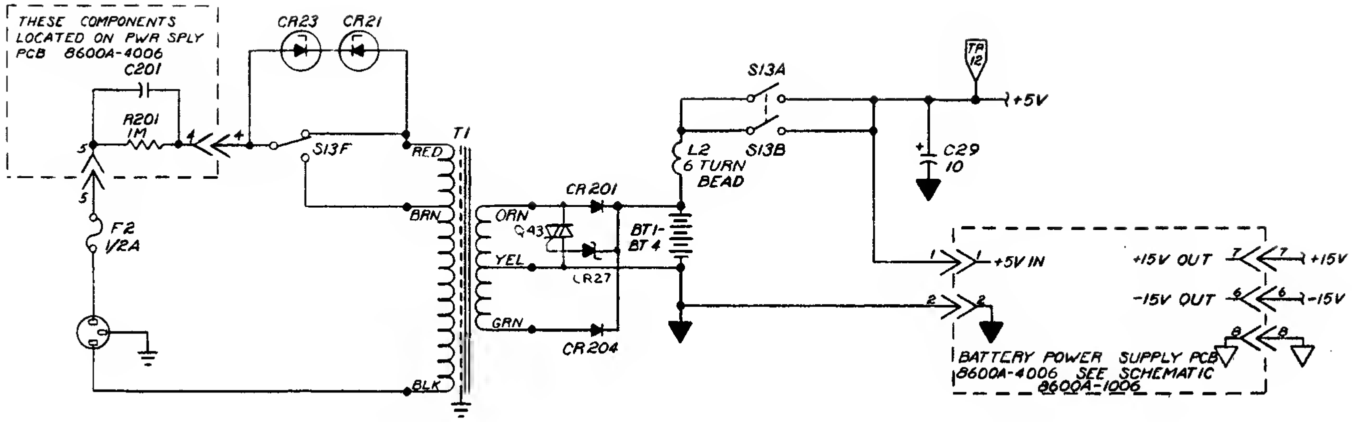


NOTES:

1. * INDICATES ELEMENT OF RESISTOR NETWORK RN 1.
2. ⊘ DENOTES SCREWDRIVER ADJUST.
3. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
4. ▷ INDICATES ELEMENT OF PRECISION RESISTOR NETWORK RN 3.
5. ANALOG COMMON LOGIC COMMON
6. REF ASSY DWG 8600A-4001 & 8600A-4011.
7. ⬡ DENOTES CALIBRATION ADJ POINTS.
8. SEE SH 2 FOR LINE & BATT PWR SUPPLY.

HIGHEST REF DES USED	REF DES NOT USED
C104	C36-38
CR27	
J1	
Q44	Q4,5,18-20,24,25,
R104	
U104	
Y1	

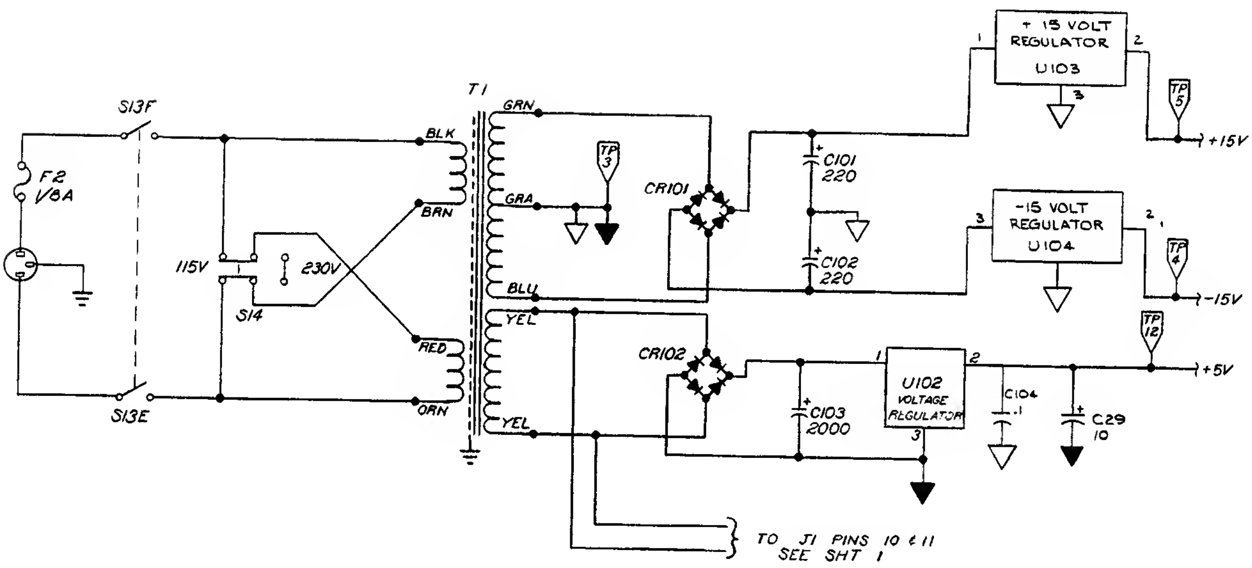
FIGURE 8-1. (1 of 2) FRONT PANEL AND MAIN PCB ASSEMBLY (8600A-1001)



BATTERY POWER SUPPLY

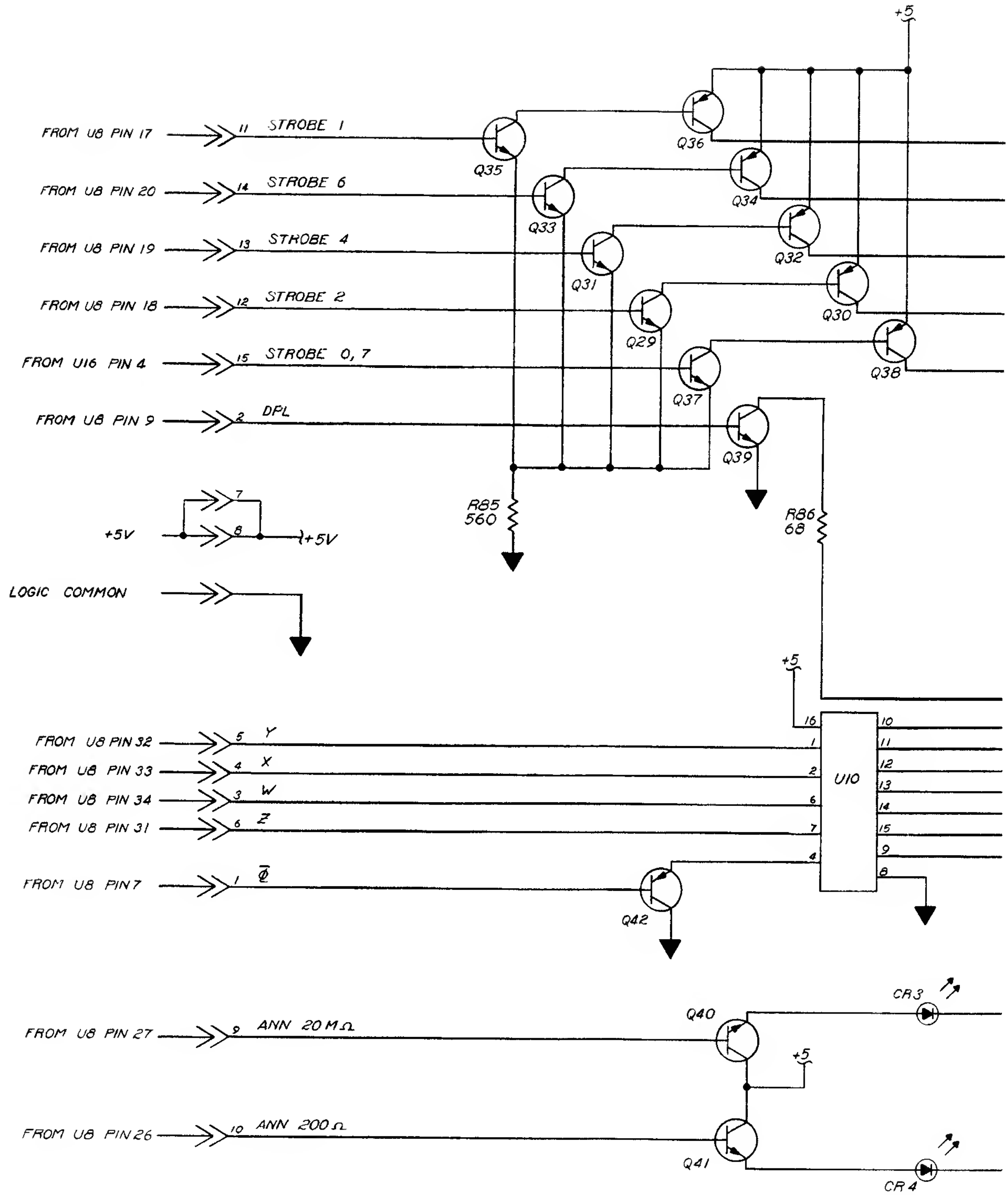
NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS
2. ⏚ EARTH GROUND
3. ▽ ANALOG COMMON ▼ LOGIC COMMON
4. REF ASSY DWG 8600A-4001 & 8600A-4011
5. SEE SH 1 FOR ALL OTHER MAIN PCB CKTY

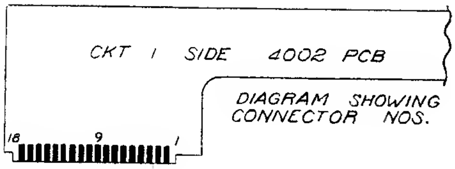


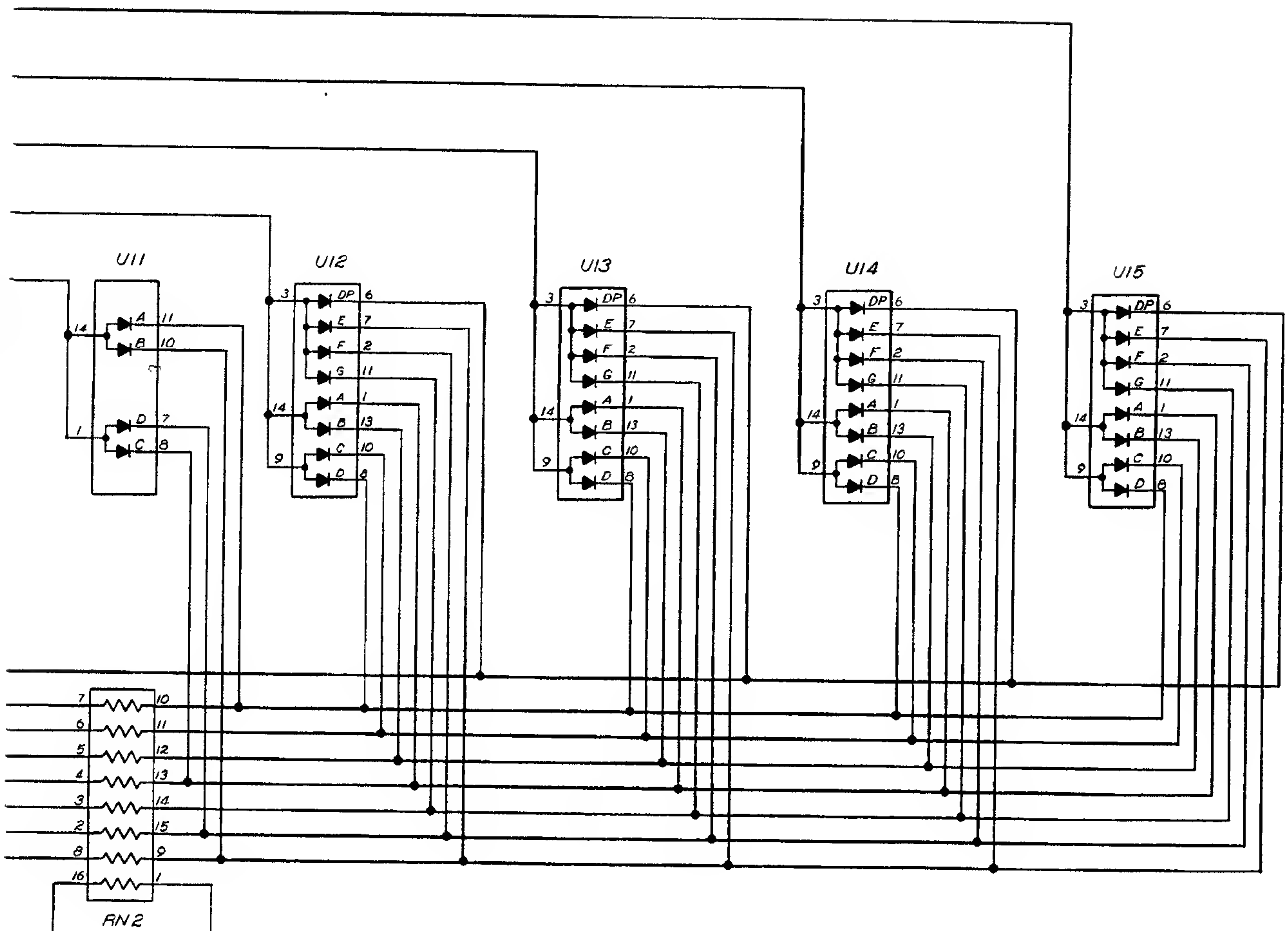
LINE ONLY POWER SUPPLY

FIGURE 8-1. (2 of 2) FRONT PANEL AND MAIN PCB ASSEMBLY (8600A-1001)



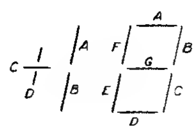
FROM U8 PIN 17
11 STROBE 1
FROM U8 PIN 20
14 STROBE 6
FROM U8 PIN 19
13 STROBE 4
FROM U8 PIN 18
12 STROBE 2
FROM U16 PIN 4
15 STROBE 0, 7
FROM U8 PIN 9
2 DPL
+5V
7
8
+5V
LOGIC COMMON
Q35
Q36
Q33
Q34
Q31
Q32
Q29
Q30
Q37
Q38
Q39
+5
R85
560
R86
68
FROM U8 PIN 32
5 Y
FROM U8 PIN 33
4 X
FROM U8 PIN 34
3 W
FROM U8 PIN 31
6 Z
FROM U8 PIN 7
1 Φ
Q42
U10
+5
FROM U8 PIN 27
9 ANN 20 MΩ
FROM U8 PIN 26
10 ANN 200 Ω
Q40
Q41
CR3
CR4





RESISTANCE VALUES FOR RN2

PINS	VALUE
7-10	68
6-11	68
5-12	68
4-13	68
3-14	68
2-15	68
8-9	68
16-1	270

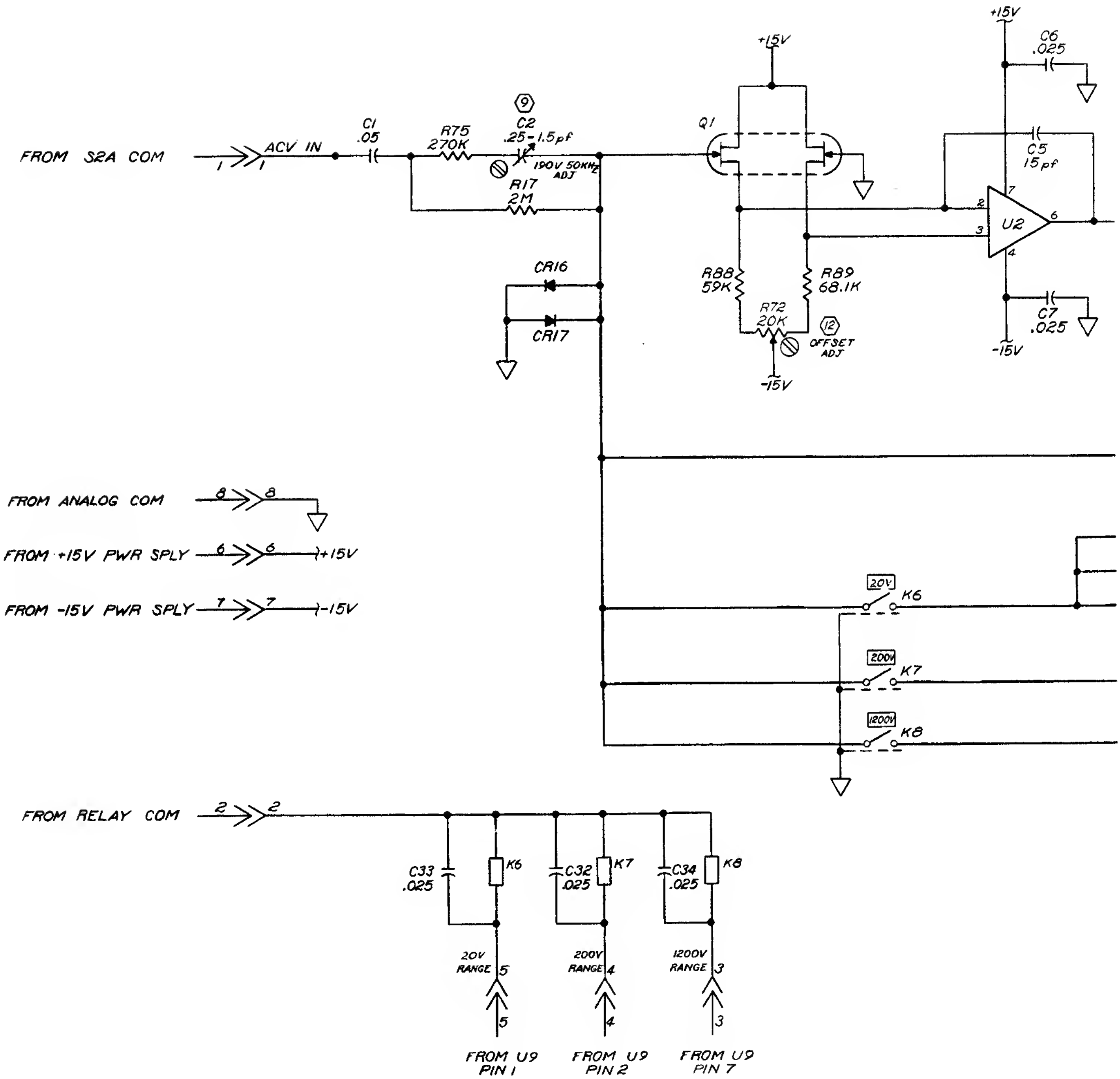


DISPLAY SEGMENTATION

NOTE:

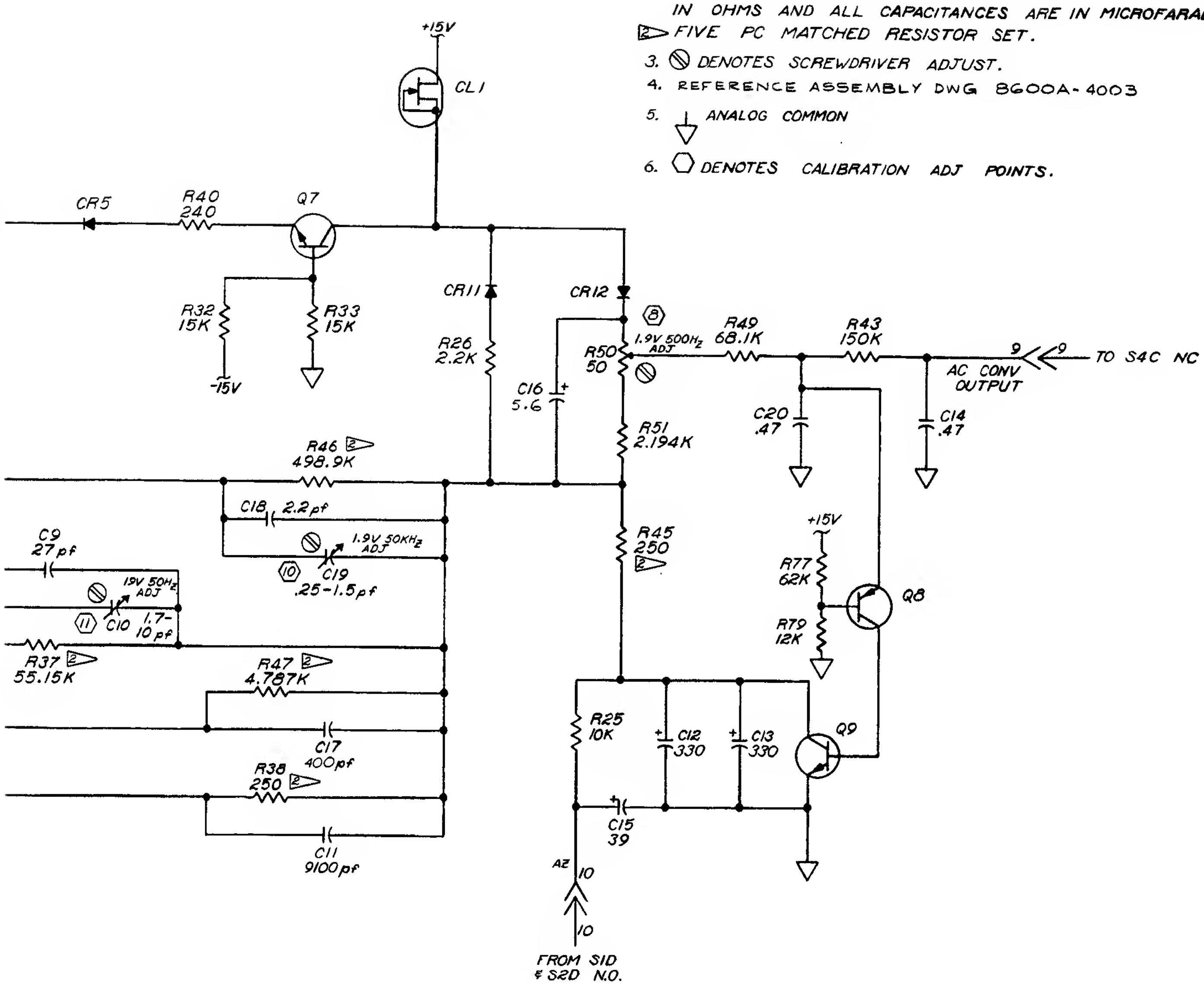
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS.
2. REFERENCE ASSY DWG 8600A-4002.

FIGURE 8-2. DISPLAY PCB ASSEMBLY (8600A-1002)


FROM S2A COM
ACV IN
C1 .05
R75 270K
C2 .25-1.5pf
190V 50KHz ADJ
R17 2M
Q1
+15V
C6 .025
C5 15pf
U2
R88 59K
R89 68.1K
R72 20K
OFFSET ADJ
-15V
C7 .025
CR16
CR17
FROM ANALOG COM
FROM +15V PWR SPLY
FROM -15V PWR SPLY
20V
K6
200V
K7
1200V
K8
FROM RELAY COM
C33 .025
C32 .025
C34 .025
20V RANGE
200V RANGE
1200V RANGE
FROM U9 PIN 1
FROM U9 PIN 2
FROM U9 PIN 7

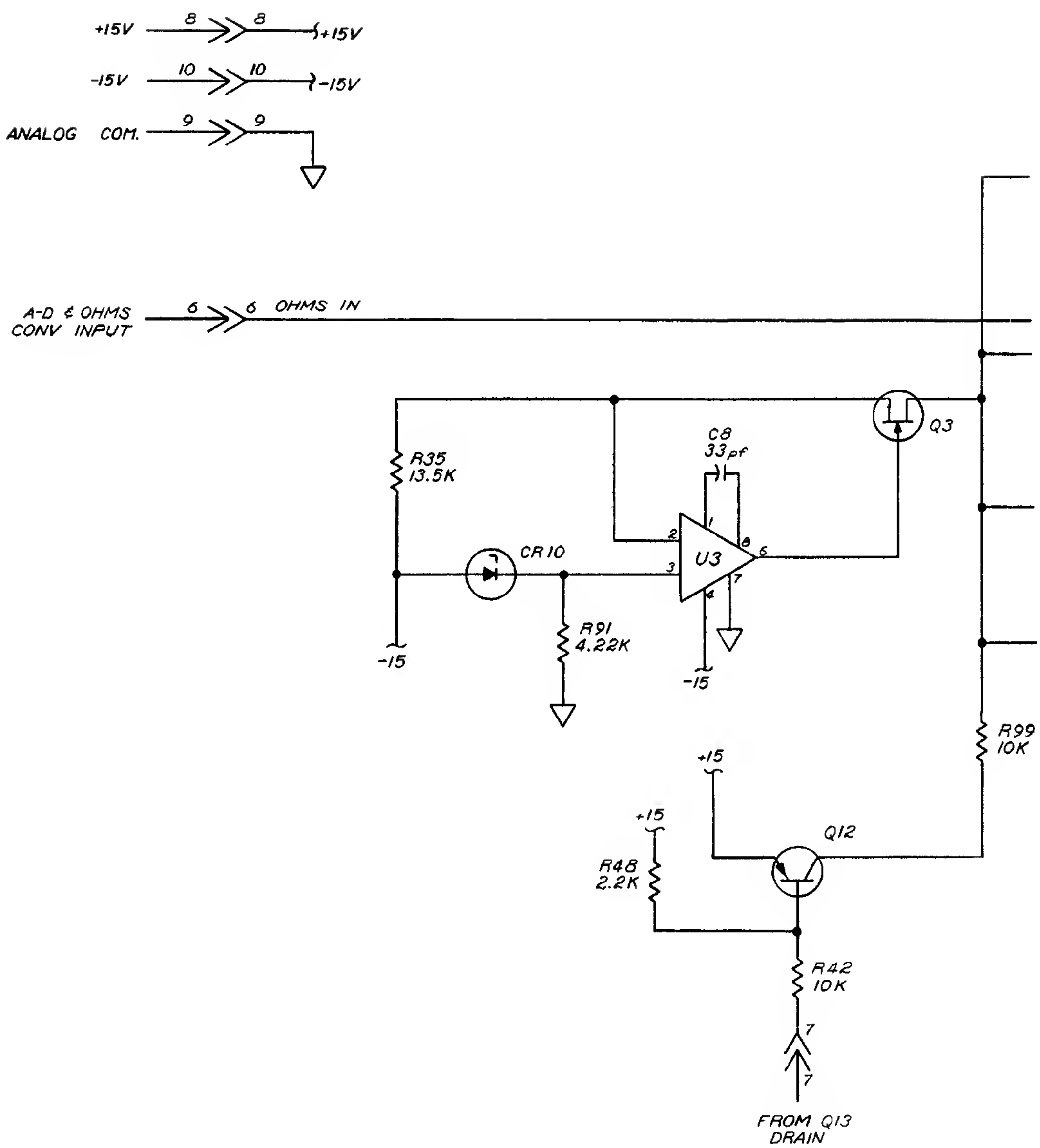
NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ▷ FIVE PC MATCHED RESISTOR SET.
3. ⊘ DENOTES SCREWDRIVER ADJUST.
4. REFERENCE ASSEMBLY DWG 8600A-4003
5. ⏚ ANALOG COMMON
6. ⬡ DENOTES CALIBRATION ADJ POINTS.



HIGHEST REF DES	REF DES NOT USED
C34	C3,4,8,21-31
CL1	
CR17	CR1-4,6-10,13-15
K8	K1-5
R89	R1-16,18-24,27-31,34-36,39,41,42,44,48,52-71,73,74,76,78,80-87
Q9	Q2-6
U2	U1

FIGURE 8-3. AC CONVERTER PCB ASSEMBLY (8600A-1003)


+15V
8
8
+15V
-15V
10
10
-15V
ANALOG COM.
9
9
A-D & OHMS CONV INPUT
6
6
OHMS IN
R35 13.5K
C8 33pf
Q3
U3
CR10
R91 4.22K
-15
-15
R99 10K
+15
+15
Q12
R48 2.2K
R42 10K
7
7
FROM Q13 DRAIN

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ⊘ DENOTES SCREWDRIVER ADJUST.
3. ▷1 ▷2 FACTORY SELECTED VALUE.
4. ⏚ ANALOG COMMON
5. ⬡ DENOTES CALIBRATION ADJ POINTS.
6. REFERENCE ASSY DWG 8600A-4004

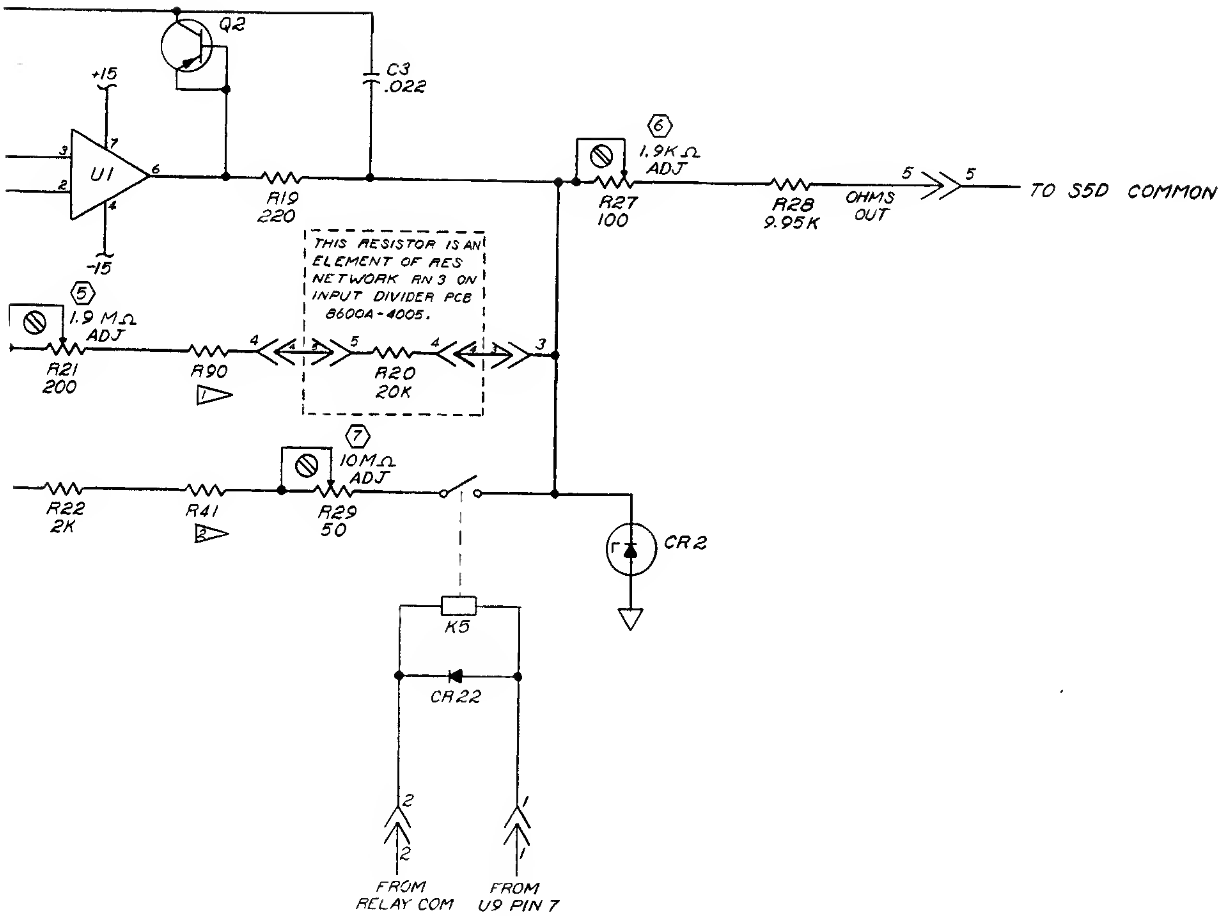
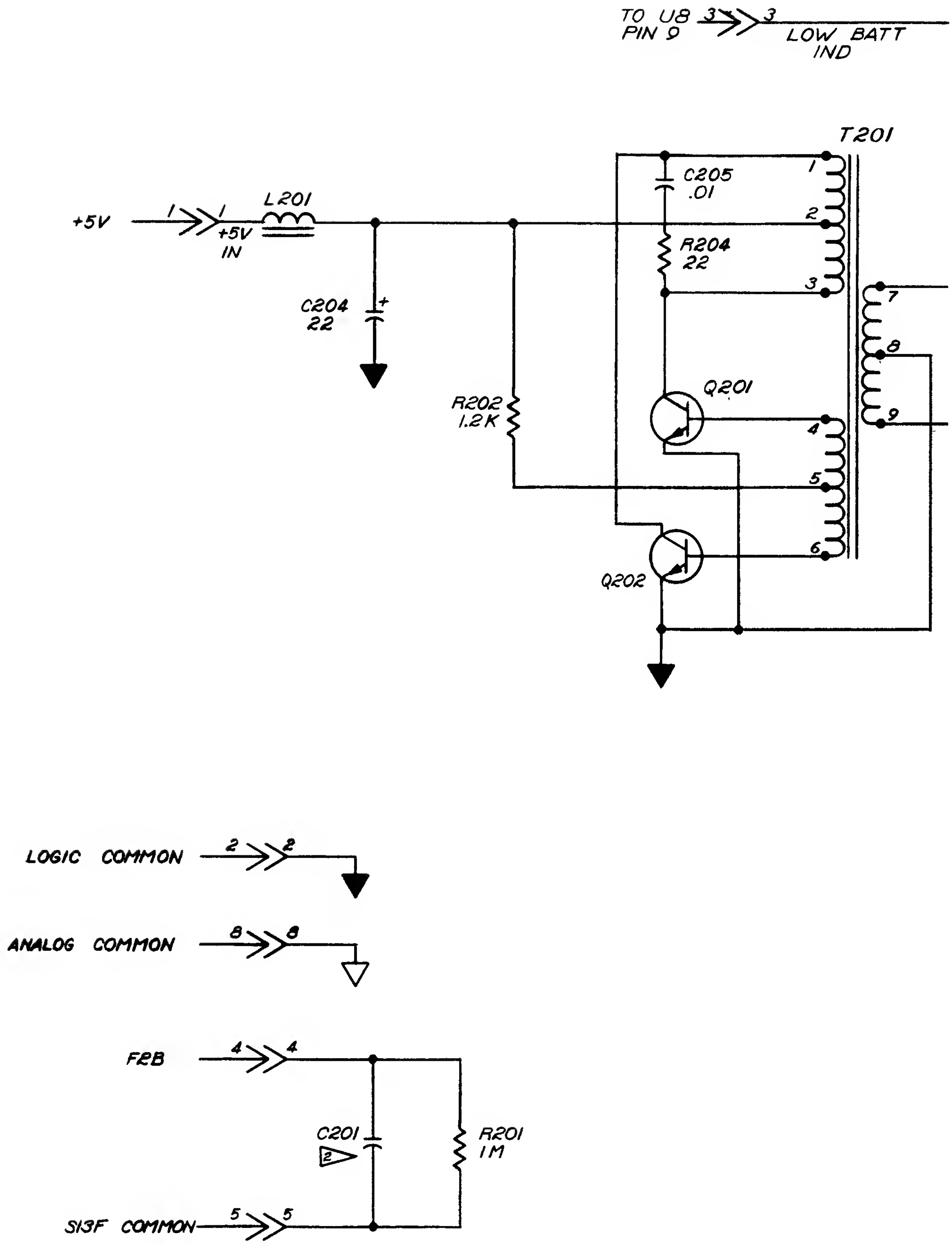
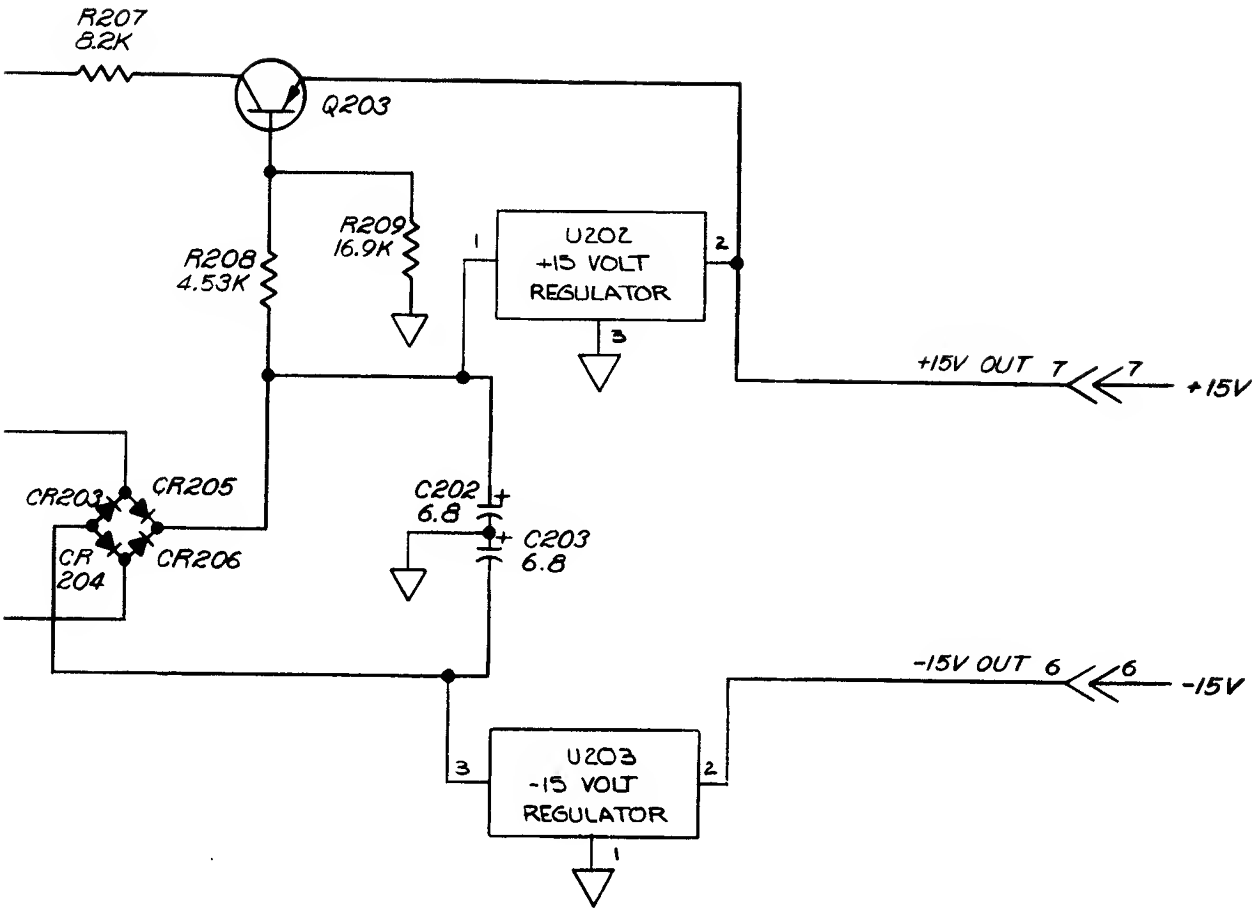


FIGURE 8-4. OHMS CONVERTER PCB ASSEMBLY (8600A-1004)


TO U8 PIN 9
3
3
LOW BATT IND
T201
C205 .01
+5V
1
1
L201
+5V IN
2
R204 22
1
3
7
C204 22
8
Q201
R202 1.2K
4
9
5
6
Q202
LOGIC COMMON
2
2
ANALOG COMMON
8
8
F2B
4
4
C201
2
R201 1M
SI3F COMMON
5
5

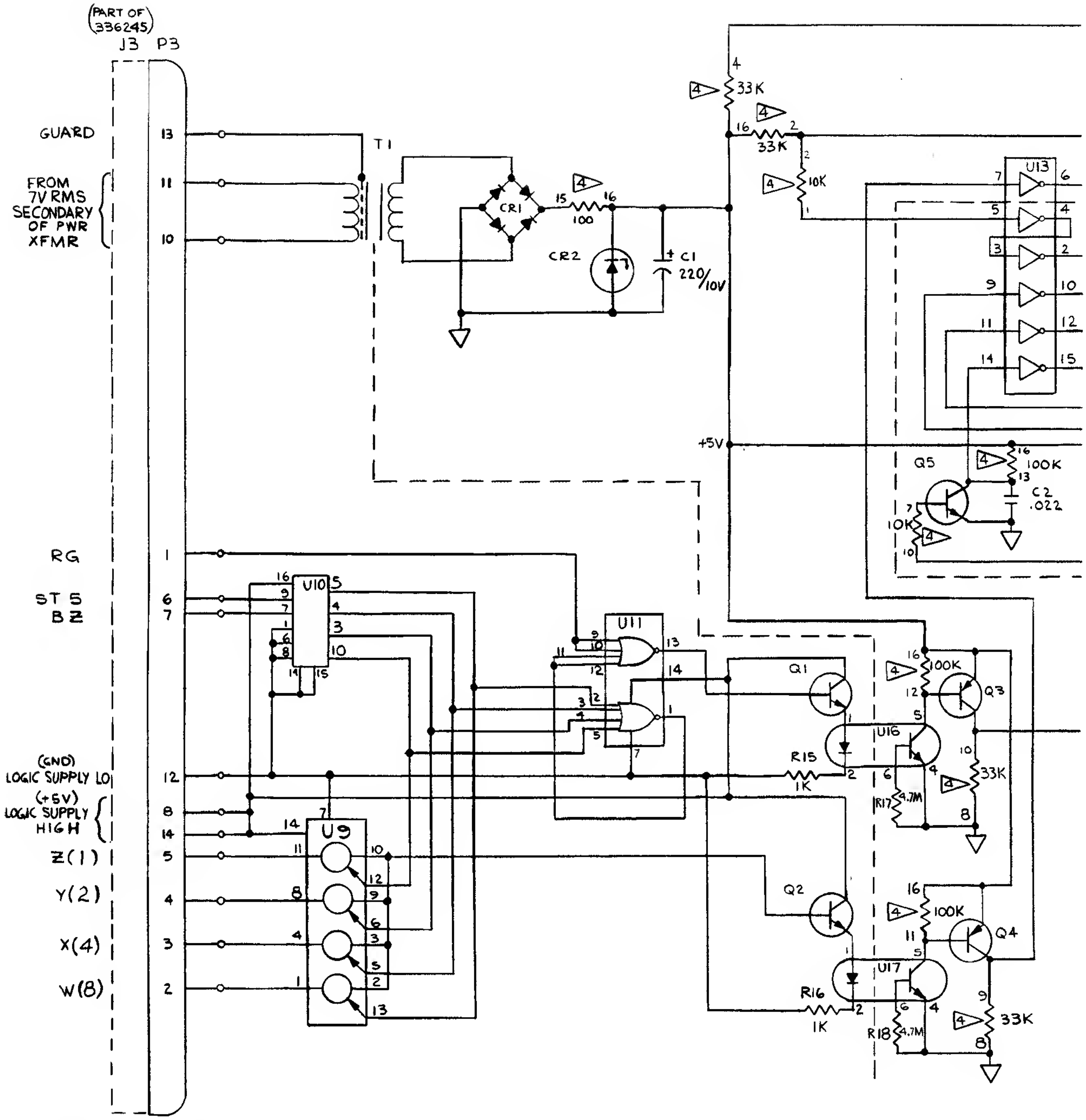


NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. CAPACITOR VALUE SELECTED FOR AC LINE VOLTAGE (i.e. 115, 230, etc.).
3. REF ASSY DWG 8600A-4006.
4. ANALOG COMMON — LOGIC COMMON

HIGHEST REF DES	REF DES NOT USED
C 205	
CR 206	CR201, 202
L 201	
Q 203	
R209	R203
T 201	
U 203	

FIGURE 8-5. BATTERY POWER SUPPLY PCB ASSEMBLY, OPTION –01 (8600A-1006)



NOTES:

UNLESS OTHERWISE SPECIFIED;

1. ALL RESISTANCE VALUES IN OHMS, TOL ±5%.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

3▷ U15 IS NOT REQUIRED ON 8600A.

4▷ PART OF RN1 (RESISTOR NETWORK

5▷ PART OF U5.

6▷ PART OF U6.

7▷ JUMPER AS REQUIRED

8. SEE 8800A-4005 FOR ASSY.

HIGHEST REF DES	REF DES NOT USED
C4 CR2 U17 Q5 R18 RN1 T1	

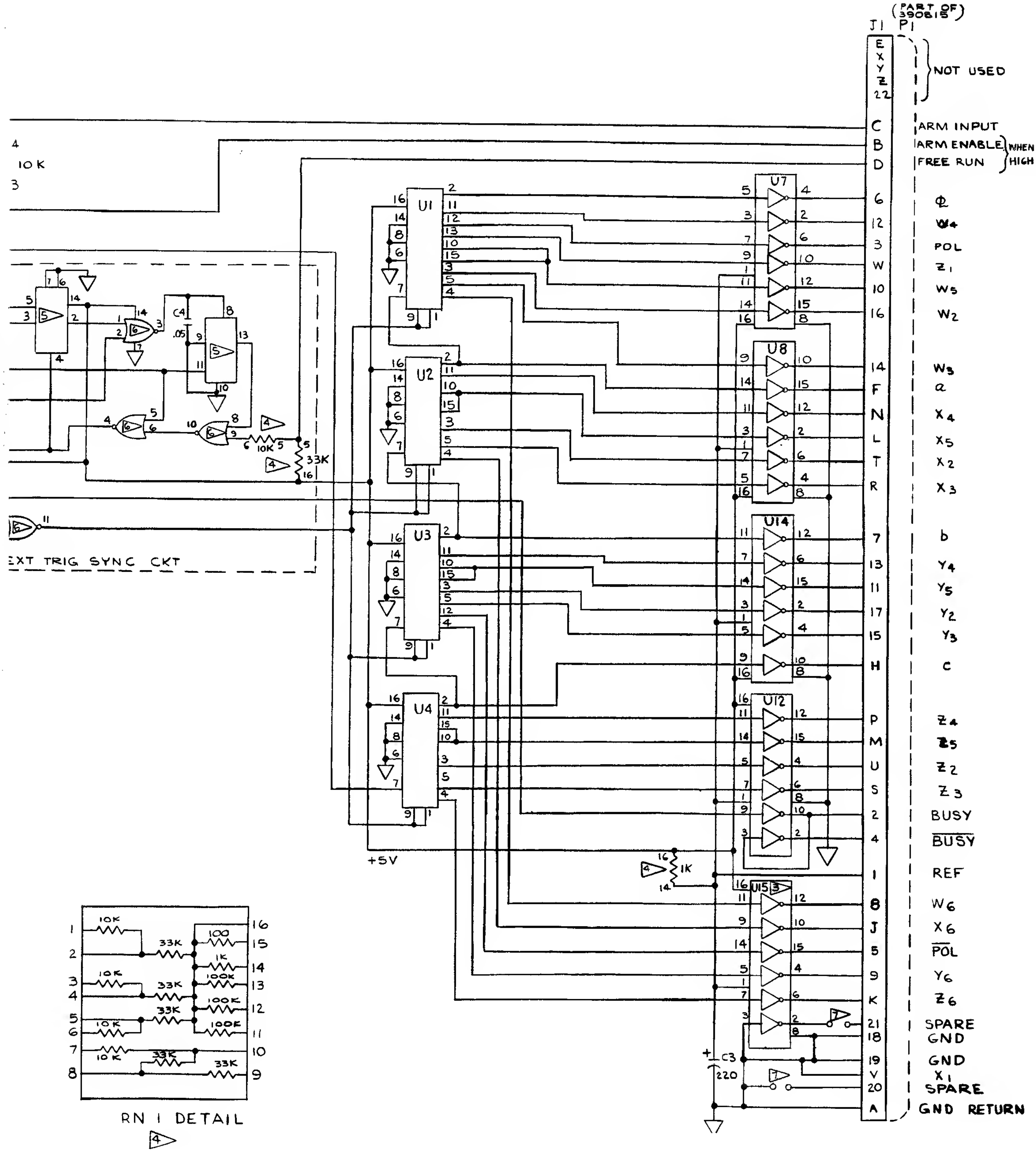


FIGURE 8-6. DATA OUTPUT UNIT PCB ASSEMBLY, —02 OPTION (8800A-1005)