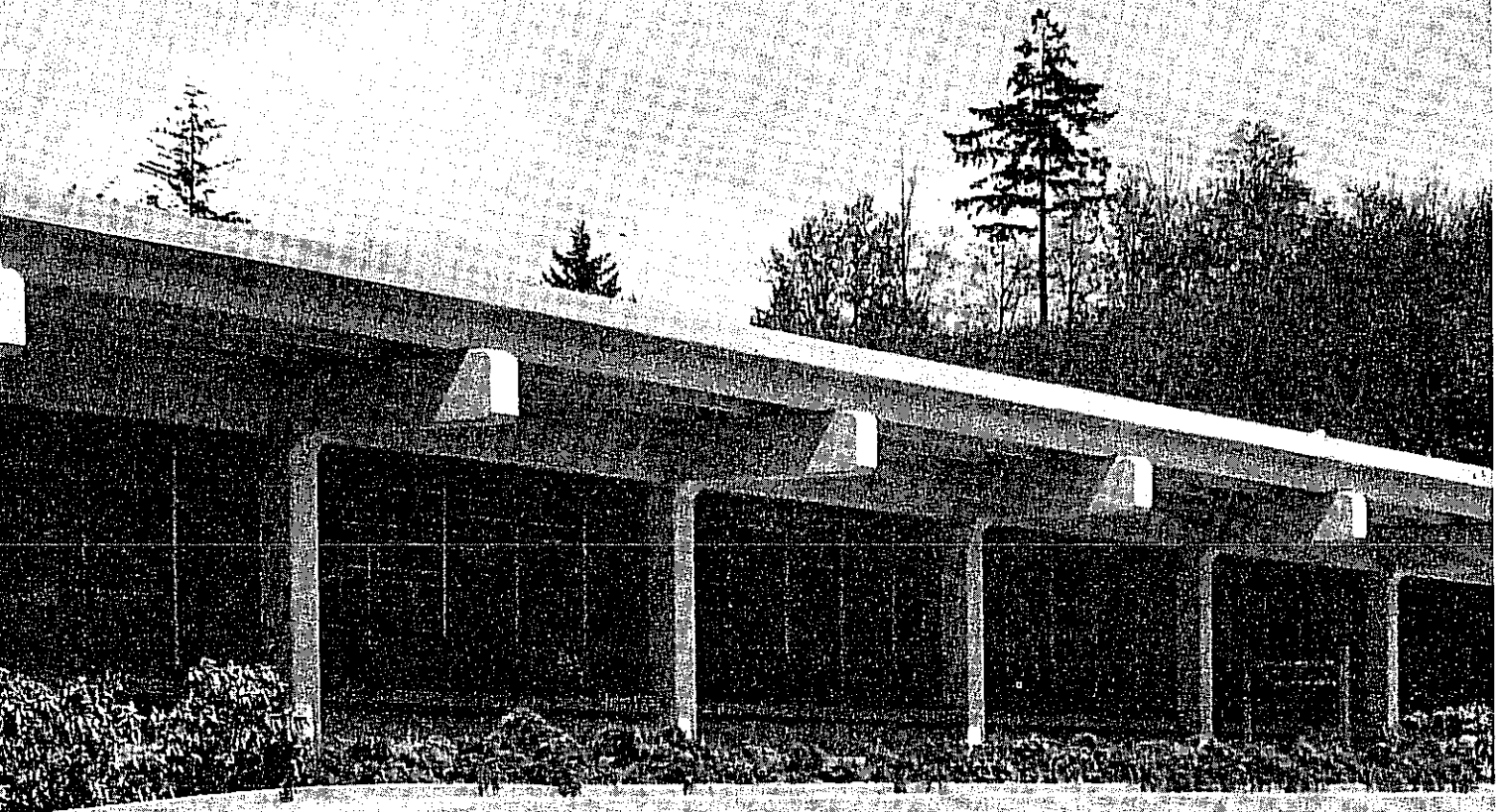


Instruction Manual



MODEL
8800A
DIGITAL MULTIMETER



JOHN FLUKE mfg. co., inc.
SEATTLE WASHINGTON

WARRANTY

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

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

1. Notify the John Fluke Mfg. Co., Inc.,* giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate will be made before the work begins, provided the instrument is not covered by the Warranty.

"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. Fluke shall not be liable for any special, incident or consequential damages."

SHIPPING

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. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc.* Upon receipt of this report, you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc.* will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P.O. Box 43210, MOUNTLAKE TERRACE, WASHINGTON 98043*.

* For European customers: FLUKE (Nederland) B.V.
Ledeboerstraat 27
Tilburg, Netherlands

** For European customers, Air Freight prepaid.

FLUKE TECHNICAL SERVICE CENTERS

Fluke Western Technical Center
2020 North Lincoln St.
Burbank, CA 91504
Tel. 213-849-4641
TWX: 910-497-2086

Fluke Western Technical Center
4805 Mercury St.
San Diego, CA 92111
Tel. 714-565-4455
TWX: 910-337-1273

Fluke Western Technical Center
2359 De La Cruz Blvd.
Santa Clara, CA 95050
Tel. 408-244-1505
TWX: 910-338-0121

Fluke S.W. Technical Center
Unit 4
1980 South Quebec Street
Denver, CO 80231
Tel. 303-750-1228
TWX: 910-320-2263

Fluke S.E. Technical
P.O. Box 6578
940 North Fern Creek Avenue
Orlando, FL 32803
Tel. 305-896-2296
TWX: 810-850-0185

Fluke Midwestern Tech Center
1287 North Rand Road
Des Plaines, IL 60016
Tel. 312-298-7470
TWX: 910-233-4978

Fluke Mideastern Tech Center
11501 Huff Court
Kensington, MD 20795
Tel. 301-881-5300
TWX: 710-825-9645

Fluke N.E. Technical Center
109 Massachusetts Ave.
Lexington, MA 02173
Tel. 617-861-8620
TWX: 710-826-1715

Fluke Midwestern Tech Center
10800 Lyndale Avenue South
Minneapolis, MN 55420
Tel. 612-884-4541
TWX: 910-576-3141

Fluke Eastern Technical Center
500 Union Blvd.
Totowa, NJ 07512
Tel. 201-742-3215
TWX: 710-988-5949

Fluke Eastern Technical Center
4515 Culver Road
Rochester, NY 14622
Tel. 716-342-6940
TWX: 510-253-6145

Fluke S.E. Technical Center
P.O. Box 9619
1310 Beaman Place
Greensboro, NC 27408
Tel. 919-273-1918
TWX: 510-925-1173

John Fluke Mfg. Co., Inc.
7001-220th S.W.
Mountlake Terrace, WA 98043
Tel. 206-774-2238
TWX: 910-449-2850

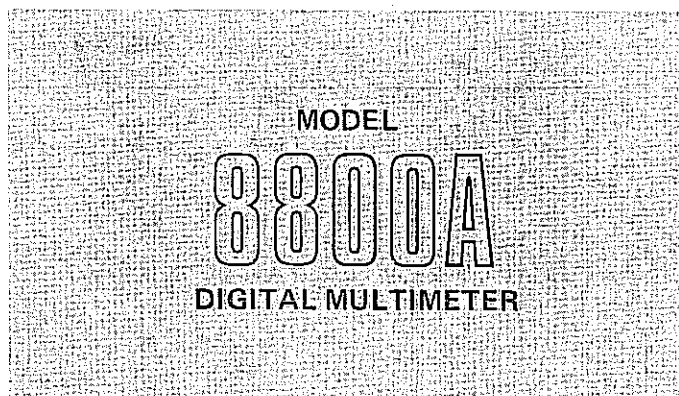
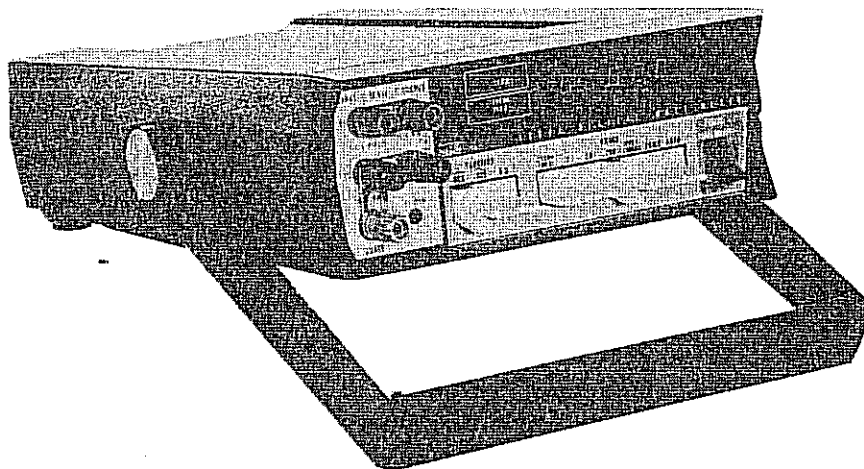
Fluke Canadian Technical Center
640 11th Ave. S.W.
Calgary, Alberta
Tel. 403-261-0780
TWX: 610-821-2233

Fluke Canadian Technical Center
6427 Northam Drive
Mississauga, Ontario
Tel. 416-678-1500
TWX: 610-492-2119

JOHN FLUKE MFG. CO., INC.

P.O. Box 43210

Mountlake Terrace, Washington 98043




REV. 1 - 5/75

369405

NOVEMBER - 1974

CHANGE/ERRATA INFORMATION

MANUAL —  TITLE: 8800A DIGITAL MULTIMETER
ISSUE: Rev. 1 5/75

Please make changes in this manual according to the following change and/or errata information:

On page 5-6, REF DESIG C5, C6, C10, C12 change MFG FED SUPLY CDE from 14655 to 30800 and change MFG PART NO. from CD15FD151J03 to CM05FD151J03.

On page 5-6, REF DESIG C22 change MFG FED SPLY CDE from 25088 to 99392 and change MFG PART NO. from B410104700/10 to 39C10HH43.

On page 5-6, REF DESIG C24 change MFG FED SPLY CDE from 14655 to 30800 and change MFG PART NO. from CD15FD101J03 to CM05FD101F03.

On page 5-6, REF DESIG C29 change MFG FED SPLY CDE from 14655 to 30800 and change MFG PART NO. from CD15FD271J03 to CM05FD271J03.

On page 5-6, REF DESIG C31 change MFG FED SPLY CDE from 32897 to 80031 and change MFG PART NO. from 8121M100C0G680G to 222263110689.

On page 5-7, REF DESIG CR16, CR18, etc. change MFG PART NO. from TD8253 to 1N4148.

On page 5-7, REF DESIG Q10, Q13, etc. change MFG PART NO. from SM07154 to ST07154.

On page 5-8, REF DESIG Q16, Q19, etc. delete Q16.

On page 5-8, REF DESIG Q29, Q31, etc. change MFG FED SPLY CDE from 12040 to 89536 and change MFG PART NO. from KE4416 to 343830.

On page 5-9 REF DESIG R28, R32, change MFG PART NO. from CR251-4-5-P220T to CR251-45P220ET5.

On page 5-10 REF DESIG R41, R43, R116 MFG PART NO. add an S to the end of the part number.

On page 5-10 REF DESIG R42 MFG PART NO. delete the T from the end of the part number and add ETS.

On page 5-10 REF DESIG R45, R56, R117 MFG PART NO. add an S to the end of the part number.

On page 5-10 REF DESIG R74 change MFG PART NO. from CR251-4-5P4.7KT to CR251-45P4K7TS.

On page 5-10 REF DESIG R83 MFG PART NO. add an S after KT.

On page 5-10 REF DESIG R86 change MFG PART NO. from CR251-4-5P3.3KT to CR251-45P3K3TS.

On page 5-10 REF DESIG R87 change MFG PART NO. CR251-4-5P2.7TS to CR251-45P2K7TS.

On page 5-11 REF DESIG R89 MFG PART NO. delete the T on the end of the part number and add ETS.

On page 5-11 REF DESIG R90, R120 change MFG PART NO. from CR251-4-5P2.2KT to CR251-45P2K2TS.

On page 5-11 REF DESIG R113 MFG PART NO. add R1PCT to end of part number.

On page 5-11 REF DESIG R114 MFG PART NO. add R1PCT to end of part number.

On page 5-11 REF DESIG R118, R119 MFG PART NO. add PCT to end of part number.

On page 5-11 REF DESIG U2 change MFG PART NO. from LH0042C to SH29466.

On page 5-11 REF DESIG U3 change MFG PART NO. from LH0042C to SH61140.

On page 5-11 REF DESIG U6 change MFG PART NO. from LM311N8 to LM311PA.

On page 5-11 REF DESIG U12 MFG PART NO. add N to end of part number.

On page 5-12 REF DESIG U19 change MFG PART NO. from UGH7805393 to F7805UC.

On page 5-12 REF DESIG VI change MFG FED SPLY CDE from 75378 to 89536 and change MFG PART NO. from TYPE H17 to 375493.

On page 5-14 ITEM. NO. 3 change FLUKE STOCK NO. from 364711 to 420604 and change MFG PART NO. from 364711 to 420604.

On page 5-15 REF DESIG C1 change MFG PART NO. from HVD3-47-47 $\pm 10\%$ 2KVI to HVD347P10PCT.

On page 5-15 REF DESIG P2 change MFG PART NO. from 380576 to 380568.

On page 5-16 REF DESIG A4 change MFG PART NO. from 377302 to 366302.

On page 5-16 REF DESIG CR4, CR5 change MFG PART NO. from TD8253 to 1N4148.

On page 5-16 REF DESIG Q3, Q7, Q17 change MFG PART NO. from SM07154 to ST07154.

On page 5-16 REF DESIG Q4, Q6, Q8 change MFG FED SPLY CDE from 12040 to 89536 and change MFG PART NO. from KE4416 to 343830.

On page 5-16 REF DESIG R1 MFG PART NO. add 5 to end of part number.

On page 5-16 REF DESIG R2, R16, etc. MFG PART NO. add S to end of part number.

On page 5-16 REF DESIG R3 change MFG FED SPLY CDE from 80031 to 91637 and change MFG PART NO. from CR251-4P562T to MFF1-85620F.

On page 5-17 REF DESIG R19 MFG PART NO. delete KT from end of part number and add ETS.

On page 5-17 REF DESIG R20 MFG PART NO. delete KT from end of part number and add ETS.

Table of Contents


| SECTION | TITLE | PAGE |
|----------|---|------------|
| 1 | INTRODUCTION AND SPECIFICATIONS | 1-1 |
| | 1-1. INTRODUCTION | 1-1 |
| | 1-4. OPTIONS | 1-1 |
| | 1-6. ACCESSORIES | 1-1 |
| | 1-8. SPECIFICATIONS | 1-1 |
| 2 | OPERATING INSTRUCTIONS | 2-1 |
| | 2-1. INTRODUCTION | 2-1 |
| | 2-3. SHIPPING INFORMATION | 2-1 |
| | 2-6. INPUT POWER | 2-1 |
| | 2-8. RACK INSTALLATION | 2-1 |
| | 2-10. OPERATING FEATURES | 2-1 |
| | 2-12. OPERATING NOTES | 2-1 |
| | 2-14. AC Line Connection | 2-1 |
| | 2-16. Operating Instructions | 2-1 |
| | 2-18. Input Terminal Voltage Limits  | 2-3 |
| | 2-20. Guarded Measurements | 2-3 |
| 3 | THEORY OF OPERATION | 3-1 |
| | 3-1. INTRODUCTION | 3-1 |
| | 3-3. OVERALL FUNCTIONAL DESCRIPTION | 3-1 |
| | 3-4. Introduction | 3-1 |
| | 3-6. Input Signal Conditioners | 3-1 |
| | 3-12. A/D Converter | 3-3 |
| | 3-15. Control and Display | 3-3 |
| | 3-18. Data Output Unit (DOU) | 3-3 |
| | 3-20. CIRCUIT DESCRIPTION | 3-4 |
| | 3-23. Input Signal Conditioners | 3-4 |
| | 3-37. A/D Converter | 3-6 |
| | 3-41. Control and Display | 3-7 |

TABLE OF CONTENTS, *continued*

| SECTION | TITLE | PAGE |
|---------|--|------|
| 4 | MAINTENANCE | 4-1 |
| 4-1. | INTRODUCTION | 4-1 |
| 4-3. | SERVICE INFORMATION | 4-2 |
| 4-6. | GENERAL MAINTENANCE | 4-2 |
| 4-7. | Access/Disassembly | 4-2 |
| 4-9. | Cleaning | 4-2 |
| 4-11. | Fuse Replacement | 4-2 |
| 4-13. | LED Replacement | 4-2 |
| 4-15. | Component Modifications | 4-3 |
| 4-18. | Battery Maintenance | 4-3 |
| 4-20. | PERFORMANCE TEST | 4-3 |
| 4-21. | Introduction | 4-3 |
| 4-24. | DC Volts Verification | 4-3 |
| 4-26. | Auto Ranging Verification | 4-3 |
| 4-28. | AC Volts Verification | 4-4 |
| 4-30. | Ohms Verification | 4-4 |
| 4-32. | CALIBRATION | 4-4 |
| 4-33. | Introduction | 4-4 |
| 4-35. | Pre-Calibration Procedure | 4-4 |
| 4-39. | Final Calibration Procedure | 4-5 |
| 4-44. | Selectable Offset Voltage Correction Resistors Procedure | 4-7 |
| 4-48. | Offset Resistor Selection | 4-9 |
| 4-49. | Buffer Amplifier Common Mode Rejection Ratio Test | 4-9 |
| 4-50. | TROUBLESHOOTING | 4-9 |
| 4-54. | Power Supply Check | 4-9 |
| 4-57. | Integrated Circuit Replacement | 4-10 |
| 4-59. | Fault Area Isolation | 4-10 |
| 5 | LIST OF REPLACEABLE PARTS | 5-1 |
| 5-1. | INTRODUCTION | 5-2 |
| 5-4. | HOW TO OBTAIN PARTS | 5-2 |
| 5-7. | USE CODE EFFECTIVITY LIST | 5-2 |
| 6 | OPTIONS & ACCESSORY INFORMATION | 6-1 |
| 6-1. | INTRODUCTION | 6-1 |
| 6-3. | HIGH VOLTAGE PROBE (80K-40) | 6-1 |
| 6-4. | Introduction | 6-1 |
| 6-6. | Specifications | 6-1 |
| 6-7. | Operation | 6-1 |
| 6-9. | HIGH FREQUENCY PROBE (80RF-1) | 6-2 |
| 6-10. | Introduction | 6-2 |
| 6-12. | Specifications | 6-2 |
| 6-13. | Operating Notes | 6-2 |
| 6-15. | Operation | 6-2 |
| 6-18. | Theory of Operation | 6-3 |
| 6-21. | Maintenance | 6-3 |
| 6-30. | HIGH FREQUENCY PROBE (81 RF) | 6-5 |
| 6-31. | Introduction | 6-5 |
| 6-33. | Specifications | 6-5 |

(Continued on page iii)

TABLE OF CONTENTS, *continued*

| SECTION | TITLE | PAGE |
|---------|---|------|
| 6-34. | Operations | 6-5 |
| 6-36. | DELUXE TEST LEAD KIT (A80) | 6-5 |
| 6-38. | RACK MOUNT KIT | 6-6 |
| 6-39. | Introduction | 6-6 |
| 6-41. | Installation Procedure | 6-6 |
| 6-43. | DATA OUTPUT UNIT (Option -02) | 6-6 |
| 6-44. | Introduction | 6-6 |
| 6-46. | Specifications | 6-7 |
| 6-48. | Operation | 6-7 |
| 6-65. | Theory of Operation | 6-8 |
| 7. | GENERAL INFORMATION | 7-1 |
| 8. | SCHEMATIC DIAGRAMS. | 8-1 |

List of Illustrations

| FIGURE | TITLE | PAGE |
|--------|--|-----------|
| 1-1. | Model 8800A Outline Drawing | 1-4 |
| 2-1. | 8800A Control and Indicator Locations | 2-2 |
| 2-2. | Input Terminal Connections For 4-Terminal Measurements | 2-4 |
| 2-3. | Input Terminal Connections For 2-Terminal Measurements | 2-4 |
| 2-4. | Unguarded Measurement Terminal Configuration | 2-4 |
| 2-5. | Guarded Measurement Terminal Configuration | 2-4 |
| 3-1. | Overall Functional Block Diagram | 3-2 |
| 3-2. | Timing Diagram For Dual-Slope A/D Conversion | 3-3 |
| 4-1. | Offset Resistor Selection Procedure | 4-7 |
| 4-2. | Power Supply Voltage Check | 4-9 |
| 4-3. | TP1 Wave Form | 4-13 |
| 4-4. | TP17 Compare Signal | 4-14 |
| 4-5. | A/D Integrator Output | 4-14 |
| 4-6. | A/D Converter Control Signal Timing | 4-14 |
| 5-1. | Final Assembly | 5-4 |
| 5-2. | Main PCB Assembly | 5-12 |
| 5-3. | Front Panel Assembly | 5-13 |
| 5-4. | Display Assembly | 5-14 |
| 5-5. | Ohms Converter Assembly | 5-16 |
| 5-6. | AC Converter Assembly | 5-19 |
| 5-7. | DOU PCB Assembly | 5-21/5-22 |

(Continued on page v)

LIST OF ILLUSTRATIONS, *continued*

| FIGURE | TITLE | PAGE |
|--------|--|-----------|
| 6-1. | High Voltage Probe (80K-40) | 6-1 |
| 6-2. | High Voltage Probe, Schematic | 6-1 |
| 6-3. | 80RF-1, High Frequency Probe | 6-2 |
| 6-4. | 80RF-1, Schematic | 6-3 |
| 6-5. | Low Frequency Response Check | 6-3 |
| 6-6. | High Frequency Response Check | 6-4 |
| 6-7. | High Frequency Probe (81 RF) | 6-5 |
| 6-8. | Deluxe Test Lead Kit (A80) | 6-5 |
| 6-9. | Rack Mount Installation | 6-6 |
| 8-1. | Main PCB 8800A-1001 (2 Sheets) | 8-3/8-4 |
| 8-2. | Display PCB 8800A-1002 | 8-7/8-8 |
| 8-3. | Ohms Converter 8800A-1003 | 8-9/8-10 |
| 8-4. | AC Converter 8800A-1004 | 8-11/8-12 |
| 8-5. | Data Output Unit (Option -02) 8800A-1005 | 8-13/8-14 |

List of Tables

| TABLE | TITLE | PAGE |
|-------|--|------|
| 1-1. | 8800A Accessories | 1-1 |
| 1-2. | Specifications | 1-2 |
| 2-1. | 8800A Control and Indicator Functions | 2-2 |
| 2-2. | Measurement Instructions | 2-3 |
| 4-1. | Required Test Equipment | 4-1 |
| 4-2. | DC Voltage Verification | 4-3 |
| 4-3. | AC Voltage Verification | 4-3 |
| 4-4. | Ohms Verification | 4-4 |
| 4-5. | DCV Linearity Check | 4-5 |
| 4-6. | ACV Final Cal. | 4-6 |
| 4-7. | Offset Voltage Correction Resistors (Coarse) | 4-8 |
| 4-8. | Offset Voltage Correction Resistors (Fine) | 4-8 |
| 4-9. | Problem Area Isolation | 4-11 |
| 4-10. | VDC Buffer Gain Control | 4-12 |
| 6-1. | 8800A Ranges for DC HV Probe (80K-40) | 6-2 |
| 6-2. | DOU Data Identification | 6-7 |
| 7-1. | List of Abbreviations & Symbols | 7-1 |
| 7-2. | Federal Supply Codes for Manufacturers | 7-3 |
| 7-3. | Fluke Technical Centers | 7-10 |
| 7-4. | Sales Representatives - Domestic | 7-11 |
| 7-5. | Sales Representatives - International | 7-13 |

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 8800A Digital Multimeter is a 5½ digit meter providing automatic or manual ranging for five ranges of dc voltage inputs, four ranges of ac voltage inputs and six ranges of resistance measurements. The dual-slope method of analog-to-digital (A/D) conversion, coupled with self zeroing, eliminates the display uncertainties caused by inherent A/D zero offsets. A single, digital integrated circuit uses the A/D output signal to produce the proper digit, decimal point and polarity information applied to the LED display.

1-3. The piano-key type control switches on the front panel make the light weight unit easy to operate. The unit's carrying handle also doubles as a tilt stand to provide convenient viewing angles for bench use. A flashing display of 188888, used for indicating an input overrange condition, also provides a convenient way of checking each digit for proper segment illumination.

1-4. OPTIONS

1-5. The basic 8800A multimeter can be equipped at the factory with a Data Output Unit (DOU) option. The multimeter with the DOU option installed, designated the 8800A-02, allows the unit to supply the display information to data acquisition systems or digital printer equipment.

1-6. ACCESSORIES

1-7. Accessories are available for use with all 8800A digital multimeters. These accessories are listed in Table 1-1.

Table 1-1. 8800A ACCESSORIES

| ACCESSORY MODEL NO. | DESCRIPTION |
|---------------------|---|
| C80 | Carrying Case, Vinyl (7" x 9½") |
| C86 | Carrying Case, Molded Plastic (8½" x 11") |
| M00-100-714 | Front Panel Dust Cover |
| M00-200-611 | Rack Mounting Kit, Center |
| M00-200-612 | Rack Mounting Kit, Left/Right |
| M00-200-613 | Rack Mounting Kit, Side-By-Side |
| A80 | Deluxe Test Lead Kit |
| 80I-600 | AC High Current Probe, Clamp-On (2A-600A) |
| 80K-40 | High Voltage Probe |
| 80RF-1 | High Frequency Probe (100 kHz to 600 MHz) |
| 81RF | High Frequency Probe (100 kHz to 100 MHz) |

1-8. SPECIFICATIONS

1-9. Specifications for the Model 8800A are presented in Table 1-2, under headings of DC VOLTAGE, AC VOLTAGE, OHMS, and GENERAL. Specifications for options are listed under each option heading.

Table 1-2. SPECIFICATIONS

DC VOLTAGE

| | |
|--|---|
| Ranges | $\pm 200 \text{ mV}, \pm 2\text{V}, \pm 20\text{V}, \pm 200\text{V}, \pm 1200\text{V}$ |
| Accuracy: | (24 Hr. $23^\circ\text{C} \pm 1^\circ\text{C}$) |
| 200 mV range | $\pm(0.008\% \text{ of input} + 0.0025\% \text{ of range})$ |
| 2V - 200V range | $\pm(0.005\% \text{ of input} + 0.001\% \text{ of range})$ |
| 1200V range | $\pm(0.005\% \text{ of input} + 0.002\% \text{ of range})$ |
| | (90 days $18^\circ\text{C} - 28^\circ\text{C}$) |
| 200 mV range | $\pm(0.01\% \text{ of input} + 0.005\% \text{ of range})$ |
| 2V - 200V range | $\pm(0.01\% \text{ of input} + 0.0015\% \text{ of range})$ |
| 1200V range | $\pm(0.01\% \text{ of input} + 0.003\% \text{ of range})$ |
| Temperature Coefficient: ($0^\circ\text{C} - 18^\circ\text{C}, 28^\circ\text{C} \text{ to } 50^\circ\text{C}$) | |
| 200 mV range | $\pm(0.0007\% \text{ of input} + 0.0013\% \text{ of range})/^\circ\text{C}$ |
| 2V range | $\pm(0.0007\% \text{ of input} + 0.0003\% \text{ of range})/^\circ\text{C}$ |
| 20V - 200V range | $\pm(0.0007\% \text{ of input} + 0.0002\% \text{ of range})/^\circ\text{C}$ |
| 1200V range | $\pm(0.0007\% \text{ of input} + 0.0003\% \text{ of range})/^\circ\text{C}$ |
| Input Impedance: | |
| 200 mV - 20V range | ≥ 1000 megohms |
| 200V - 1200V range | 10 megohms |
| Normal Mode Noise Rejection | ≥ 60 db @ 50 Hz and 60 Hz |
| Common Mode Noise Rejection | ≥ 120 db @ dc to 60 Hz (with $1\text{k}\Omega$ in either lead) |
| Resolution | 1 μV on 200 mV range |
| Ranging | Full autoranging or manual ranging |
| Polarity | Automatic bipolar, + or - display |
| Overload Protection | 200V, 1200V range; $\pm 1200\text{V}$ dc, 1700V, peak ac 200 mV - 20V range; $\pm 1000\text{V}$ dc, 1400V, peak ac |
| Offset Current (at 23°C) | Less than 15 pA on any range. Temperature coefficient of $\pm 5 \text{ pA}/^\circ\text{C}$ |
| Zero Stability | Better than 10 μV for 90 days after one hour warmup |
| Response Time to Rated Accuracy within Range | 1 second maximum to displayed input |

AC VOLTAGE

| | |
|---|---|
| Ranges | 2V, 20V, 200V, 1200V |
| Accuracy: 2V - 200V ranges (100% to .1% of range) | |
| | (24 Hour, $23^\circ\text{C} \pm 1^\circ\text{C}$) |
| 100 Hz - 10 kHz | $\pm(0.05\% \text{ of input} + 0.005\% \text{ of range})$ |
| 50 Hz - 100 Hz, 10 kHz - 20 kHz | $\pm(0.1\% \text{ of input} + 0.01\% \text{ of range})$ |
| 30 Hz - 50 Hz, 20 kHz - 100 kHz | $\pm(1.0\% \text{ of input} + 0.03\% \text{ of range})$ |

Table 1-2. SPECIFICATIONS

| | |
|--|--|
| (90 days 18°C – 28°C) | |
| 100 Hz - 10 kHz | ±(0.1% of input + 0.005% of range) |
| 50 Hz - 100 Hz, 10 kHz - 20 kHz | ±(0.25% of input + 0.01% of range) |
| 30 Hz - 50 Hz, 20 kHz - 100 kHz | ±(1.0% of input + 0.03% of range) |
| 1200V range (100% to .1% of range) | |
| (90 days 18°C - 28°C) | |
| (1V to 500V input) | |
| 100 Hz - 10 kHz | ±(0.15% of input + 0.01% of range) |
| 30 Hz - 100 Hz, 10 kHz - 20 kHz | ±(0.25% of input + 0.02% of range) |
| (500V to 1200V input) | |
| 100 Hz - 10 kHz | ±(0.3% of input + 0.01% of range) |
| 30 Hz - 100 Hz, 10 kHz - 20 kHz | ±0.5% of input + 0.02% of range) |
| 20 kHz maximum response on 1200V range | |
| Temperature Coefficient: | |
| (0°C - 18°C, 28°C - 50°C) | ±(0.008% of input + 0.001% of range)/°C, 2V - 200V range ±(0.008% of input + 0.002% of range)/°C, 1200V range |
| Input Impedance | 2 megohms shunted by less than 100 pF |
| Response Time to Rated Accuracy within Range | 1.5 second maximum to displayed input |
| Ranging | Full autoranging or manual ranging |
| Overload Protection | 1200V rms maximum, not to exceed 2×10^7 volt hertz product. 20 kHz maximum on 1200V range. |
| Resolution | 10µV on 2V range |
| OHMS | |
| Ranges | 200Ω, 2kΩ, 20kΩ, 200kΩ, 2000kΩ, 20MΩ |
| Resolution | 1mΩ on 200 ohm range |
| Configuration | Four-terminal measurement on all ranges |
| Ranging | Full autoranging or manual range |
| Accuracy: (24 Hr, 23°C ±1°C) | |
| 200Ω range | ±(0.01% of input + 0.0025% of range) |
| 2kΩ - 200kΩ range | ±(0.008% of input + 0.001% of range) |
| 2000kΩ range | ±(0.02% of input + 0.001% of range) |
| 20MΩ | ±(0.05% of input + 0.001% of range) |
| (90 day, 18°C - 28°C) | |
| 200Ω range | ±(0.02% of input + 0.005% of range) |
| 2kΩ - 200kΩ range | ±(0.01% of input + 0.0015% of range) |
| 2000kΩ range | ±(0.05% of input + 0.0015% of range) |
| 20MΩ range | ±(0.2% of input + 0.0015% of range) |
| Temperature Coefficient: | |
| 200Ω range | ±(0.001% of input + 0.0013% of range)/°C |
| 2kΩ - 200kΩ range | ±(0.001% of input + 0.0003% of range)/°C |
| 2000kΩ range | ±(0.005% of input + 0.0003% of range)/°C |
| 20MΩ range | ±(0.02% of input + 0.0003% of range)/°C |

Table 1-2. SPECIFICATIONS

| | | | | | | |
|--|--|------|-------|-------|--------|--------|
| Current Through Unknown; Nominal | 200Ω | 2kΩ | 20kΩ | 200kΩ | 2000kΩ | 20MΩ |
| | 1 mA | 1 mA | 250μA | 25μA | 2.5μA | 0.25μA |
| Overtoltage Protection | 250V rms or dc, applied continuously to any range | | | | | |
| Maximum Open Circuit Voltage | 3.3 volts | | | | | |
| Response Time: | | | | | | |
| 200Ω - 200kΩ range | 1.0 seconds maximum to displayed input | | | | | |
| 1200kΩ and 20MΩ range | 3.0 seconds maximum to displayed input | | | | | |
| GENERAL | | | | | | |
| Function | Selected via front panel controls | | | | | |
| Range | Full autoranging or manually selectable via front panel controls | | | | | |
| Autorange Rate | 600ms maximum per range change | | | | | |
| Display | 7 segment 0.3" LED display, automatic decimal location | | | | | |
| Reading Rate | 2.5 readings per second, within the same range | | | | | |
| Storage Temperature | -40°C to 75°C | | | | | |
| Operating Temperature | 0°C to +50°C | | | | | |
| Humidity Range | 70% R.H., +35°C to +50°C | | | | | |
| | 80% R.H., +5°C to +35°C | | | | | |
| Overload Indication | Flashing Display of +188888 (built-in segment test of LED display) for out of range indication | | | | | |
| Shock and Vibration | Meets pertinent requirements of MIL-T-2100L and MIL-E-16400F | | | | | |
| MTBF | 10,000 hours calculated, minimum | | | | | |
| Maximum Common Mode Voltage | 1000V dc or peak ac | | | | | |
| Maximum LO to GUARD voltage | 100V dc or peak ac | | | | | |
| Power | 110/230V ac ±10%, 50 or 60 Hz, 8 watts | | | | | |
| Size | Maximum deminsions (see Figure 1-1) | | | | | |
| | 3.16" high x 9.0" wide x 14.2" long | | | | | |
| | (8.03 cm x 22.86 cm x 36.07 cm) | | | | | |
| Weight | 6.5 lbs (3.0 kg) | | | | | |

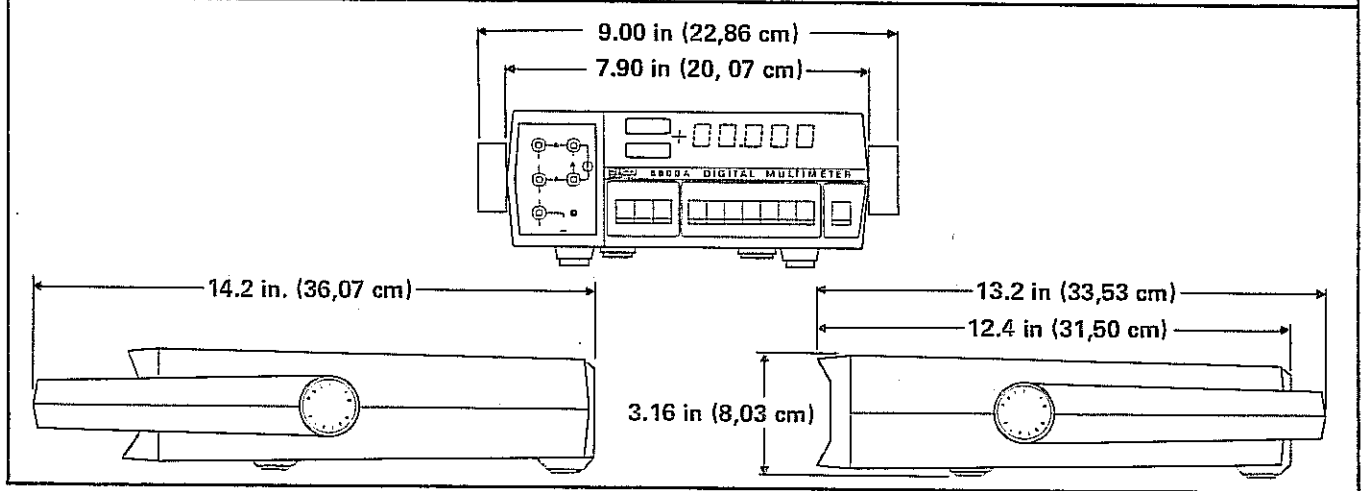


Figure 1-1. MODEL 8800A OUTLINE DRAWING

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding the installation and operation of the Model 8800A. The contents of this section should be read before operating the digital multimeter. Should any difficulties be encountered during operation, contact your nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc. P.O. Box 43210, in Mountlake Terrace, Washington, 98043. Telephone (206) 774-2211. A list of Sales Representatives is located in Section 7 of the manual.

2-3. SHIPPING INFORMATION

2-4. The Model 8800A was packaged and shipped in a foam packed cardboard carton. After unpacking the unit, a thorough inspection should be made to note any damage that may have occurred in transit.

2-5. If reshipment becomes necessary the instrument should be repackaged in the original container. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the model number (8800A) when requesting a new shipping container.

2-6. INPUT POWER

2-7. The Model 8800A may be powered from either 115 volts, 50 or 60 Hz, or 230 volts, 50 or 60 Hz. A slide switch located inside, on the main pcb of the unit, allows either configuration of input voltage to be selected.

2-8. RACK INSTALLATION

2-9. The Model 8800A can be mounted in a standard 19-inch equipment rack. A rack mounting kit (M00-200-625) is available to allow center mounting of the unit. Instructions for attaching the rack mount to the unit are supplied with each kit.

2-10. OPERATING FEATURES

2-11. The function and location of the Model 8800A controls and indicators are provided in Figure 2-1 and Table 2-1.

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which should be considered before operating the Model 8800A.

2-14. AC Line Connection

2-15. The input power cord is a three-prong polarized connector which permits connection to 115 or 230 volts, 50 or 60 Hz line power. Insure that the ground pin on the power cord is connected to a high quality earth ground.

2-16. Operating Instructions

2-17. Five input terminals (INPUT - Ω SENSE, HI and LO; Ω SOURCE, HI and LO; and a GUARD) provided connection to the voltage source or resistance under measurement. Table 2-2 provides instructions for the proper connections and control setting for each multimeter function.

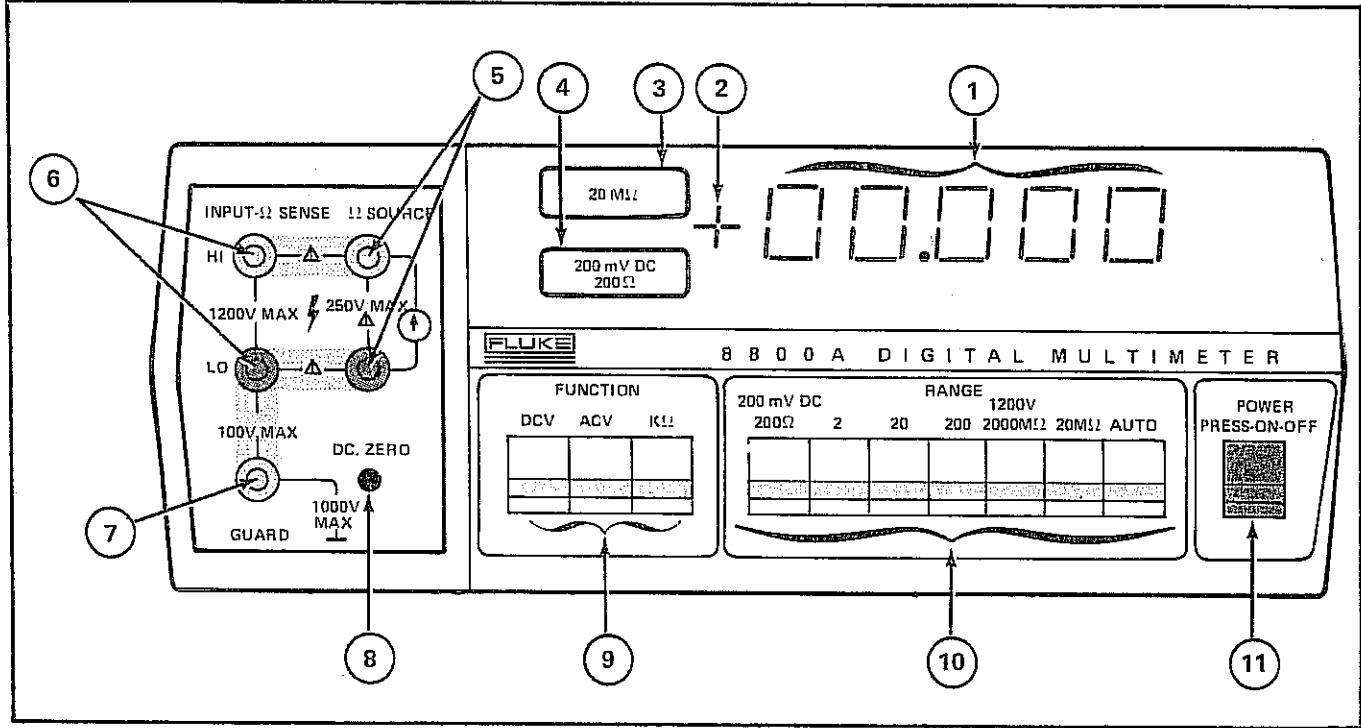


Figure 2-1. 8800A CONTROL AND INDICATOR LOCATIONS

Table 2-1. 8800A CONTROL AND INDICATOR FUNCTIONS

| FIG 2-1 REF. NO. | NAME | FUNCTION |
|------------------|--------------------------------------|--|
| 1 | LED display | Provides a digital readout of the value of applied inputs. |
| 2 | Polarity indicator | Displays a + (positive) or - (negative) polarity indication for corresponding dc voltage inputs. |
| 3 | 20 MΩ indicator | LED indicator lights when 20 MΩ RANGE is selected. |
| 4 | 200 mVDC, 200Ω indicator | LED indicator lights when 200 mVDC, 200Ω range is selected |
| 5 | Ω SOURCE HI and LO terminals | Provide current through unknown resistance to be measured in KΩ FUNCTION. |
| 6 | INPUT - Ω SENSE HI and LO terminals. | Provides connections for ACV and DCV FUNCTION inputs and Ω SENSE input in KΩ FUNCTION. |
| 7 | GUARD terminal | Provides connection to internal voltmeter guard. |
| 8 | DC ZERO adjustment | Adjusts 8800A display for zero reading in ZERO ADJUST procedures. (Par. 4-27) |
| 9 | FUNCTION pushbuttons | Selects the DCV, ACV or KΩ mode of operation. |
| 10 | RANGE pushbuttons | Selects discrete range or AUTO range in each function. |
| 11 | POWER pushbutton | Turns instrument on or off. |

2-18. Input Terminal Voltage Limits



2-19. The maximum voltage limits that may be applied between adjacent input terminals, without causing damage to the 8800A, are provided below. In some cases the inter-terminal voltage limit will change when the function of the multimeter is changed. Do not exceed the limits given.

NOTE!

The symbol indicates that additional information is provided in the manual to prevent damage to the instrument.

- a. INPUT - Ω SENSE HI to INPUT - Ω SENSE LO; 1000V dc max on the 200 mV - 20V ranges DC, 1200V dc max on the 200V - 1200V ranges DC. 1200V rms max on all ranges AC. 250V dc or rms when in the KΩ function.
- b. Ω SOURCE HI to Ω SOURCE LO; When the KΩ function is selected, the maximum voltage that can be applied between the Ω SOURCE HI and LO terminals is 250V. 1200V max. when the VAC or VDC function is selected and the shorting links between the two HI and two LO terminals are used.
- c. INPUT - Ω SENSE HI to Ω SOURCE HI and INPUT - Ω SENSE LO to Ω SOURCE LO; 0.5V max. when shorting links are removed.

CAUTION

Shorting link between INPUT - Ω SENSE HI and Ω SOURCE HI, and shorting link between INPUT - Ω SENSE LO and Ω SOURCE LO must be installed except when making 4 - terminal ohms measurements.

- d. INPUT - Ω SENSE LO to GUARD; 100V max.
- e. GUARD to earth ground; 1000V max.

CAUTION

Shorting link from GUARD to INPUT - Ω SENSE LO must be installed except when making guarded measurements.

2-20. Guarded Measurements

2-21. The 8800A employs a system of shields and guards that function, when properly connected, to minimize common mode to normal mode signal conversion. The common mode signal, represented by Ecm in Figure 2-4, is the difference in potential between the outer case ground of the multimeter and the ground of the voltage source being measured. This common mode potential can be caused by voltage differences in the ground lines or currents induced in them.

2-22. The input lead and terminal link configuration illustrated in Figure 2-4 is for unguarded measurements; the most commonly used method. In this configuration it is possible for the common mode voltage (Ecm) to supply

Table 2-2. MEASUREMENT INSTRUCTION

| MEASUREMENT TO BE MADE | 8800A | | | REMARKS |
|------------------------|----------|---|---------------------------|---|
| | FUNCTION | RANGE | INPUT CONNECTIONS | |
| ± DC Voltage | VDC | 200 mV, 2, 20, 200, 1200 or AUTO | INPUT - Ω SENSE, HI to LO | 8800A automatically selects highest range for chosen function if range is not manually called, or AUTO selected. |
| AC Voltage | VAC | 2, 20, 200, 1200 or AUTO | | |
| RESISTANCE | KΩ | 200Ω, 2, 20, 200, 2000 kΩ 20 MΩ or AUTO | | Use 4-terminal ohms measurement if desired. On all ranges the Ω SOURCE terminals must be connected either remotely (see Figure 2-2) or with shorting links (see Figure 2-3) to the INPUT - Ω SENSE terminals for all resistance measurements. |

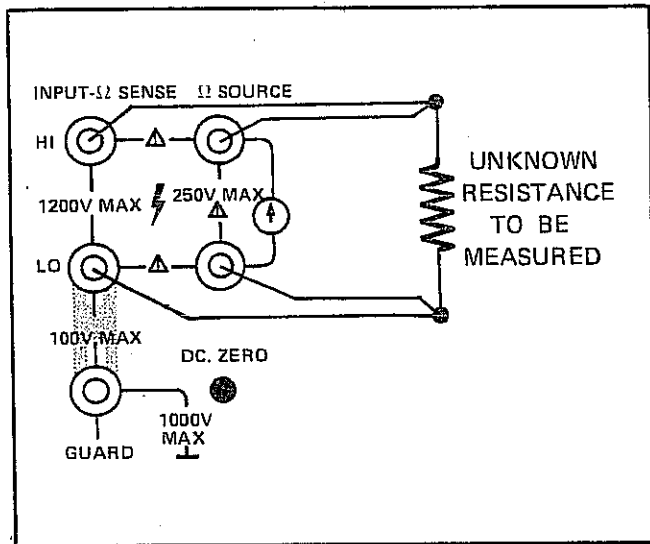


Figure 2-2. INPUT TERMINAL CONNECTIONS FOR 4-TERMINAL MEASUREMENTS

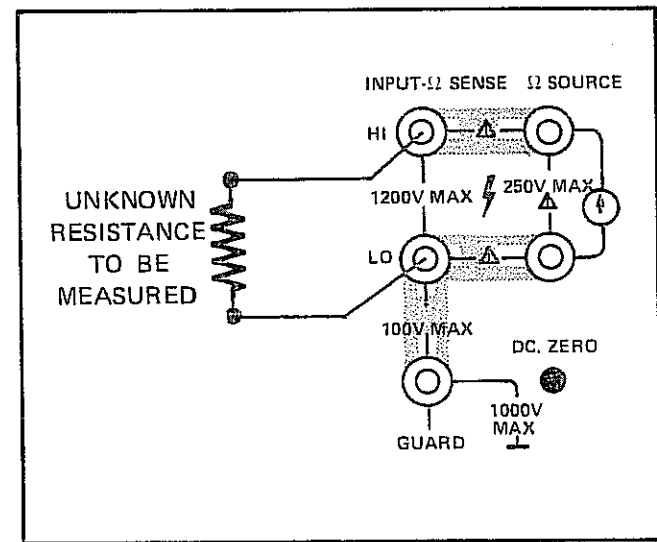


Figure 2-3. INPUT TERMINAL CONNECTIONS FOR 2-TERMINAL MEASUREMENTS

common mode current (I_{cm}) via the test lead on the low input terminal, the guard to low-input shorting link, through the inner guard to outer case stray leakage paths, and back to the common mode source. This common mode current flow will cause a normal mode voltage drop across the lead resistance that will add to or subtract from the input voltage being measured. When the lead resistance increases (caused by long input leads or poor connections) or the common mode voltage increases, the common mode signal converted to a normal mode voltage can cause a noticeable error in the multimeter display.

2-23. The guard terminal on the 8800A front panel can be connected in a way that provides a signal path for the

common mode current that does not go through the input leads carrying the normal mode voltage signal. These terminal connections, illustrated in Figure 2-5, provide for a guarded measurement of the applied input. With the link connecting the low input and guard terminals removed, the guard terminal connected to the shield of the input leads, and the input end of the shield connected to the same point as the input low lead; the inner guard of the instrument is effectively extended out to the end of the input leads. The common mode current will then flow through the shield on the input leads to the guard terminal, across the inner guard to outer case stray leakage paths, and back to ground. The current no longer flows through the low input lead to create the error voltage.

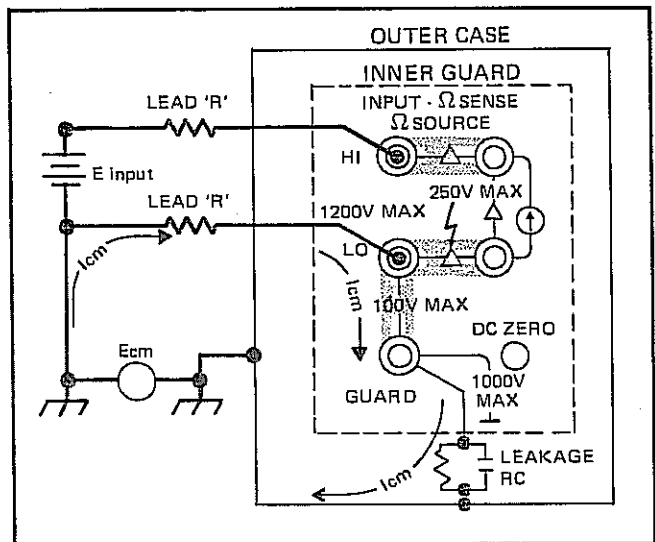


Figure 2-4. UNGUARDED MEASUREMENT TERMINAL CONFIGURATION

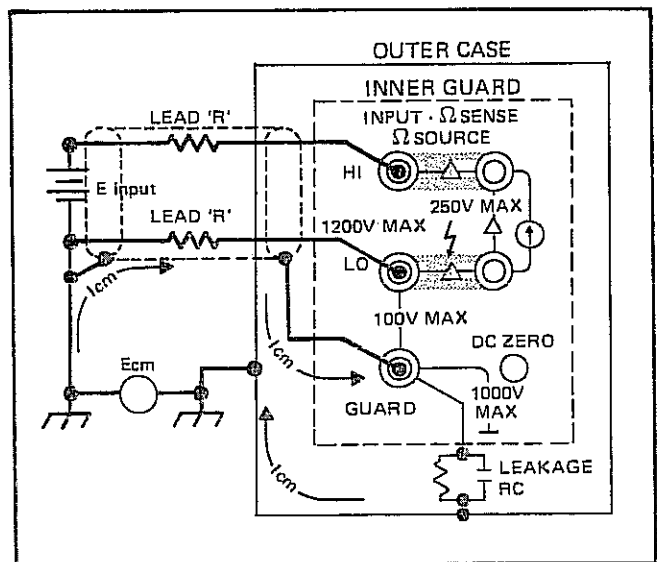


Figure 2-5. GUARDED MEASUREMENT TERMINAL CONFIGURATION

Section 3

Theory of Operation

3-1. INTRODUCTION

3-2. The theory of operation for the Model 8800A is arranged under two major headings. The first, titled **OVERALL FUNCTIONAL DESCRIPTION**, discusses the overall operation of the instrument in terms of the functional relationship of the major circuits. The second heading is titled **SIMPLIFIED CIRCUIT ANALYSIS** and deals with the internal operation of each major circuit in more detail. Block diagrams and simplified circuit diagrams are included in this section. The complete schematic diagrams are located in Section 8 of this manual.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Introduction

3-5. The 8800A circuitry can be divided into three major sections. The first of the three sections, termed the **Input Signal Conditioners**, (see Figure 3-1) comprises the Ohms Converter, VDC Buffer and AC Converter. 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 is shown in Figure 3-1 and 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 three subsections grouped under it. The

ohms converter, AC converter and VDC buffer provided the A/D converter with a dc analog voltage representative of the input (ac volts, dc volts, or resistance) applied to the instrument. The basic path that each input signal follows as it is conditioned for the A/D converter is illustrated in Figure 3-1.

3-8. When making a dc voltage measurement the unknown voltage applied to the **INPUT HI** and **LO** terminals is directed to the **DCV Buffer**. The buffer then either amplifies the input voltage (200 mV range), passes the entire input voltage (2V range) or divides the input voltage by some power of ten (20, 200 and 1200V ranges), so that a "conditioned" signal of two volts dc at the A/D Converter is representative of a full scale instrument input for all ranges.

3-9. AC voltage inputs applied to the **INPUT HI** and **LO** terminals are directed through closed switch contacts to the **AC Converter**. These ac input voltages are then converted to dc voltages so that a full scale ac voltage input on any range will produce an AC Converter output to the A/D Converter of two volts dc.

3-10. When measuring an unknown resistance, the **INPUT HI** and **LO** terminals must be connected to the respective **SOURCE HI** and **LO** terminals. The shorting links provided on the front panel make the connection for two-terminal ohms measurements and the input leads attached to the terminals make the connection during four-terminal ohms measurements.

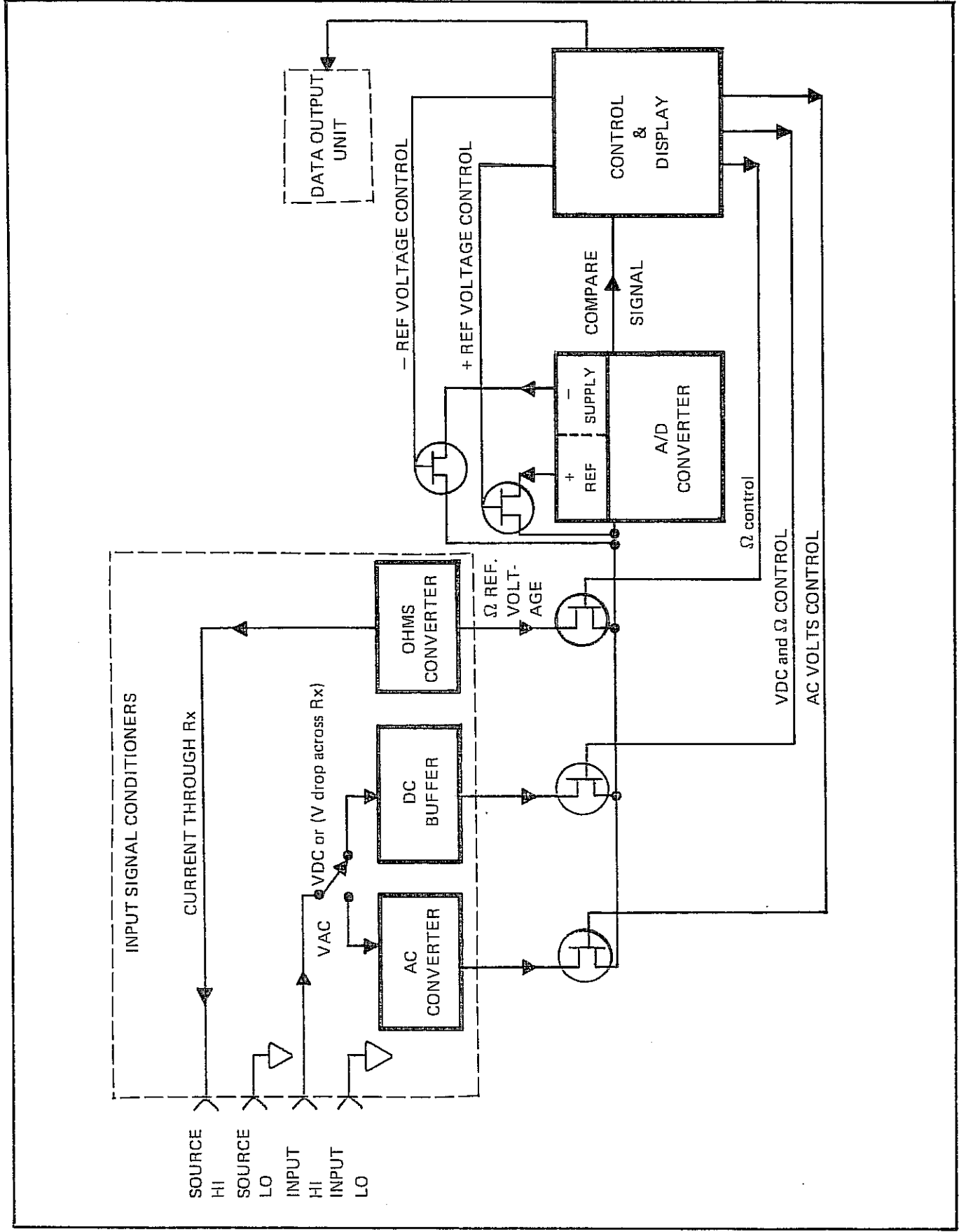


Figure 3-1. OVERALL FUNCTIONAL BLOCK DIAGRAM

3-11. The unknown resistance (RX) is supplied with current from the Ohms Converter while the voltage drop across RX, caused by the current, is applied to the VDC Buffer as a representation of the unknown resistance. The Ohms Converter also applies the same current through a known resistance value to develop a reference voltage used in the A/D Converter in the $K\Omega$ function.

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 A/D integrator. The slope of the integrator output voltage during the Integrate Period is proportional to the input applied to the instrument. At the end of the integrate period the signal conditioner dc voltage is disconnected from the A/D input and a dc reference voltage, of opposite polarity, is connected to the input. The A/D Converter then integrates the reference voltage so that the slope of the Read Period is always constant. Since the read period slope is held constant the time required for the A/D integrator output voltage to return to the zero detect level is then proportional to the instrument input.

3-14. The digital representation of the input is obtained by counting the number of cycles of a clock oscillator 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.

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 the 1 MHz oscillator is used to maintain the proper timing of the control signals.

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 for the selected range, position 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 to indicate that the output data is not valid while the 8800A is taking a new input measurement. A register pulse train plus one of the data strobe signals time the data transfer to ensure that the data supplied to the DOU output is stable and not taken during the transition periods between individual digit information.

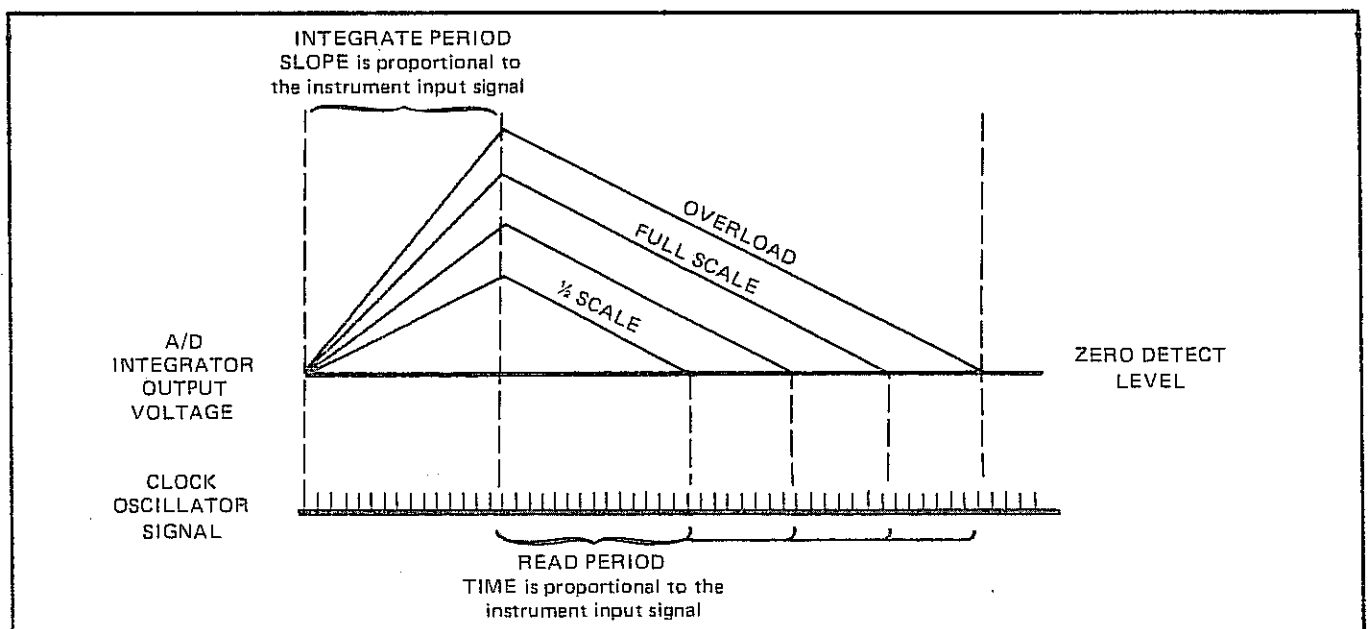


Figure 3-2. TIMING DIAGRAM FOR DUAL-SLOPE A/D CONVERSION

3-20. CIRCUIT DESCRIPTION

3-21. The following paragraphs provide an analysis of the functional areas of the 8800A at a simplified circuit level. The simplified circuits described in these paragraphs correspond to the associated detailed schematic diagrams included at the end of this manual.

3-22. Component reference designators mentioned in the text identify the component on the simplified circuit drawings and on the schematic diagrams. The reference designators for integrated circuits containing two or more gates or functions are presented in text with a numeric suffix. This suffix corresponds to an integrated circuit pin of the particular gate or function. For example, the reference designator U11-6 identifies integrated circuit number 11 and the specific gate or function associated with pin six.

3-23. Input Signal Conditioners

3-24. AC CONVERTER

3-25. The AC Converter produces a dc output voltage proportional to the ac input voltage. The simplified block

diagram of the AC Converter, presented in Figure 3-3, should be referred to when reading the following description of the circuit operation.

3-26. The ac voltage input is capacitively coupled across C1 through input impedance resistor R1 to the inverting input of amplifier Q1, U1. The gain of the amplifier is determined by the ratio of the feed-back resistance, as selected by range relays K6, K7 and K8, to the input resistor R1. The amount of alternating current at the junction point of CR4 and CR5 is therefore proportional to the level of the ac voltage input. One-half of the alternating current passes through CR5 to develop a dc voltage level at the input of Low Pass (L.P.) Filter. The L.P. Filter then filters the ac signal superimposed on the dc voltage to produce a dc output voltage directly proportional to the ac voltage input.

3-27. The AC Converter circuitry creates an offset voltage that, if not compensated for, would create an error in the displayed value of the ac input voltage. The offset voltage, sensed at the junction point of R17, C13, and C14, is applied to C18 when FET switches Q6 and Q9 are turned on; these switches are turned off by an integrate (INT) signal applied

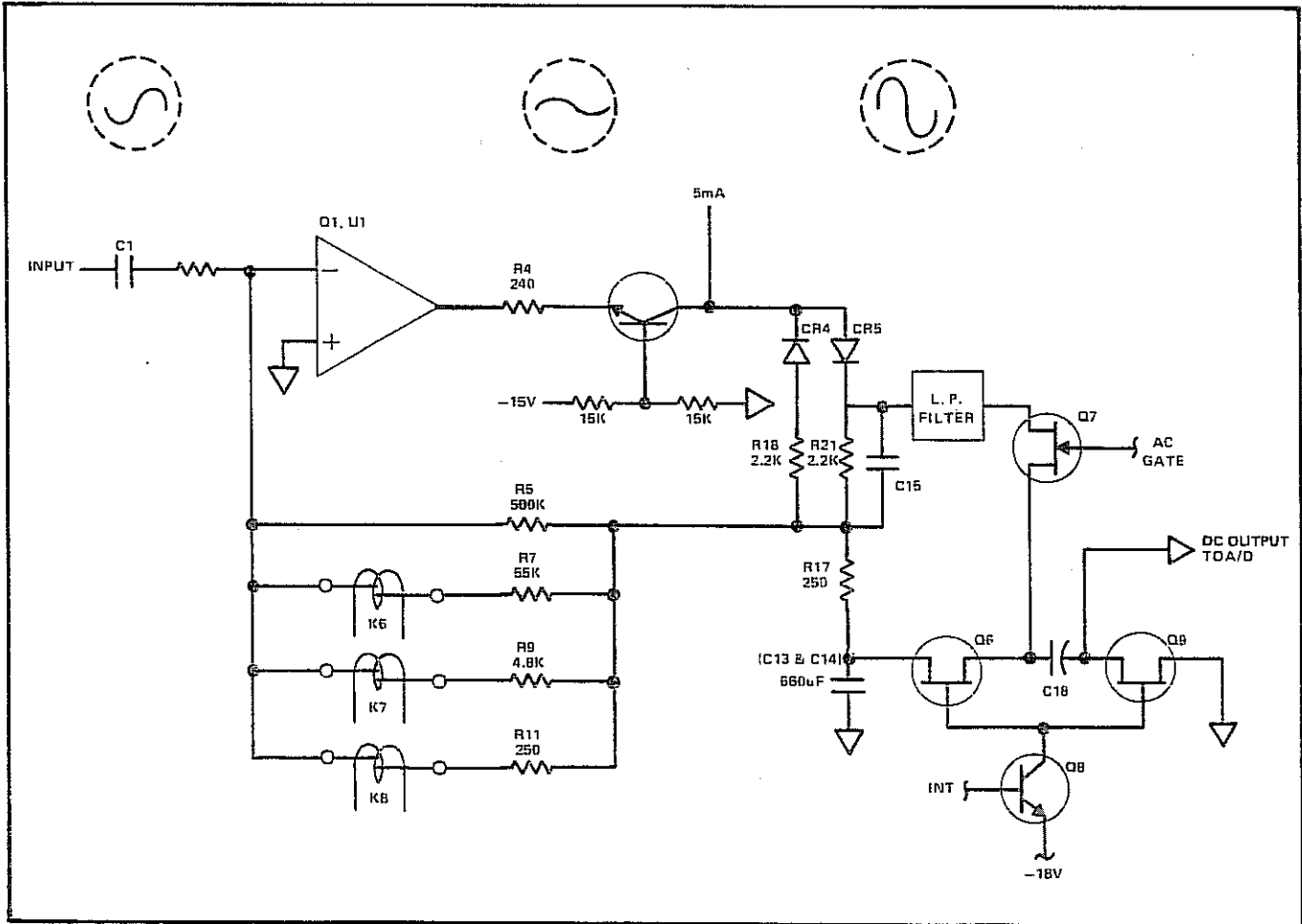


Figure 3-3. AC CONVERTER BLOCK DIAGRAM

to Q8. When the AC GATE command (coincidental with the INT command) turns on Q7, the dc output voltage of the L.P. Filter will be reduced by the value of the feed-back voltage store in C18. The dc voltage output to the A/D Converter is therefore representative of the level of ac voltage input.

3-28. DC BUFFER

3-29. DC voltage inputs applied to the instrument are conditioned by the DC Buffer so that an input within any dc voltage range chosen produces a buffer output of two volts dc or less. The simplified buffer circuit shown in Figure 3-4 will be used to illustrate how the overall gain of the buffer is changed with range selection in order to maintain the required output. The ohms function also uses the DC Buffer when determining the value of an unknown resistance. As indicated by the table in Figure 3-4 the buffer gain is 1 (unity) for the 2K thru 20MΩ ranges and 10 for the 200Ω range.

3-30. When the 200 mV or 200Ω range is selected FET switches Q25 and Q20 close. This configuration produces

a differential amplifier circuit gain of ten by returning only one-tenth of the amplifier output back to the inverting input. The DC Buffer output through Q25 to the A/D Converter will be two volts for a full scale input of 200mV or 200Ω.

3-31. A differential amplifier circuit gain of one is obtained when the 2 or 200 DCV range, or 2k thru 20MΩ range is selected. Range control signals from the Control and Display circuits close switches Q18 and Q25. Direct feedback through Q18 causes the differential amplifier to operate at unity gain. This amplifier circuit configuration produces the required two volt output to the A/D Converter representing a full scale instrument input. Selecting the 200 volt range in the DCV function, in addition to configuring the differential amplifier circuit for unity gain, closes relay K5 to provide a 100:1 voltage divider (RN5-B, R21, and RN5-A) to reduce a full scale 200 volt instrument input to two volts at the amplifier input.

3-32. Switches Q18 and Q23 close when either the 20 volt or 1200 volt range is selected. Selecting the 1200 volt range

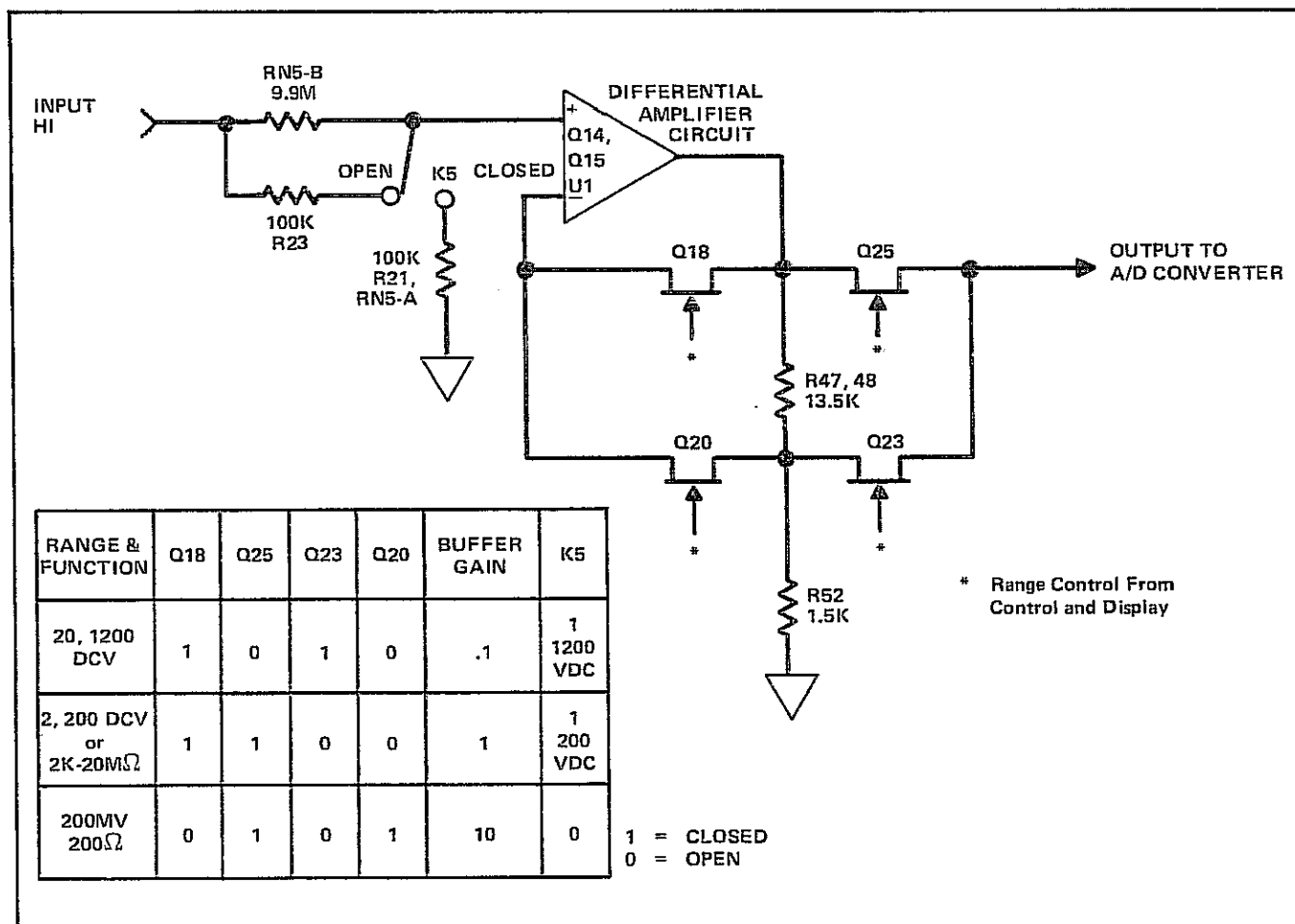


Figure 3-4. VDC BUFFER SIMPLIFIED CIRCUIT

also causes relay K5 to close, again creating a 100:1 voltage divider across RN5-B, R21, and RN5-A. This voltage divider reduces the high instrument input voltages (1200 volts maximum) to 12 volts or less at the differential amplifier circuit input. The output of the differential amplifier circuit is applied to a 10:1 voltage divider consisting of R47, R48, and R52. The differential amplifier circuit, operating at unity gain when Q18 is closed, applies up to 20 volts in the 20 DCV range and 12 volts in the 1200 DCV range to the voltage divider. The voltage divider is tapped, through Q23, to provide one-tenth of the amplifier output to the A/D Converter.

3-33. OHMS CONVERTER

3-34. The Ohms Converter determines the value of an unknown resistance by comparison. When the same current is applied to a resistance of known value and a resistance of unknown value the voltage level developed across each is directly proportional to the value of the resistance. A comparison of the two voltage levels will determine the value of the unknown resistance relative to the value of the known resistance. The block diagram, in Figure 3-5 shows how the Ohms Converter produces the two voltages to be compared by the A/D Converter.

3-35. The current to be applied to the known and unknown resistance is supplied by batteries BT1 and BT2. The overvoltage protection circuit prevents damage to the Ohms Converter should the input leads be inadvertently connected to dc or rms voltages up to 250 volts. The current from the batteries is applied to a series of five parallel resistor networks of known values. The correct value of known resistance is selected by range control relays K1, K2, K3, and K4; corresponding to the 2000K, 200K, 20K, and 2K/200Ω ranges. The current then passes through the SOURCE LO terminal across the unknown resistance R_x to the SOURCE HI terminal and back to the battery.

3-36. During the integrate time period (see Figure 3-2) the DE(-R) · Ω control signal closes switch Q8. The positive voltage developed by the current flow across R_x is applied through the INPUT · Ω SENSE HI terminal to the DC Buffer and A/D Converter. At the end of the integrate period Q8 opens and Q4 and Q6 close. The negative voltage developed across the known resistance, termed ohms output, passes through Q6 to the A/D Converter.

3-37. A/D Converter

3-38. The A/D Converter uses a dual-slope conversion technique. The dc voltage input to the A/D Converter,

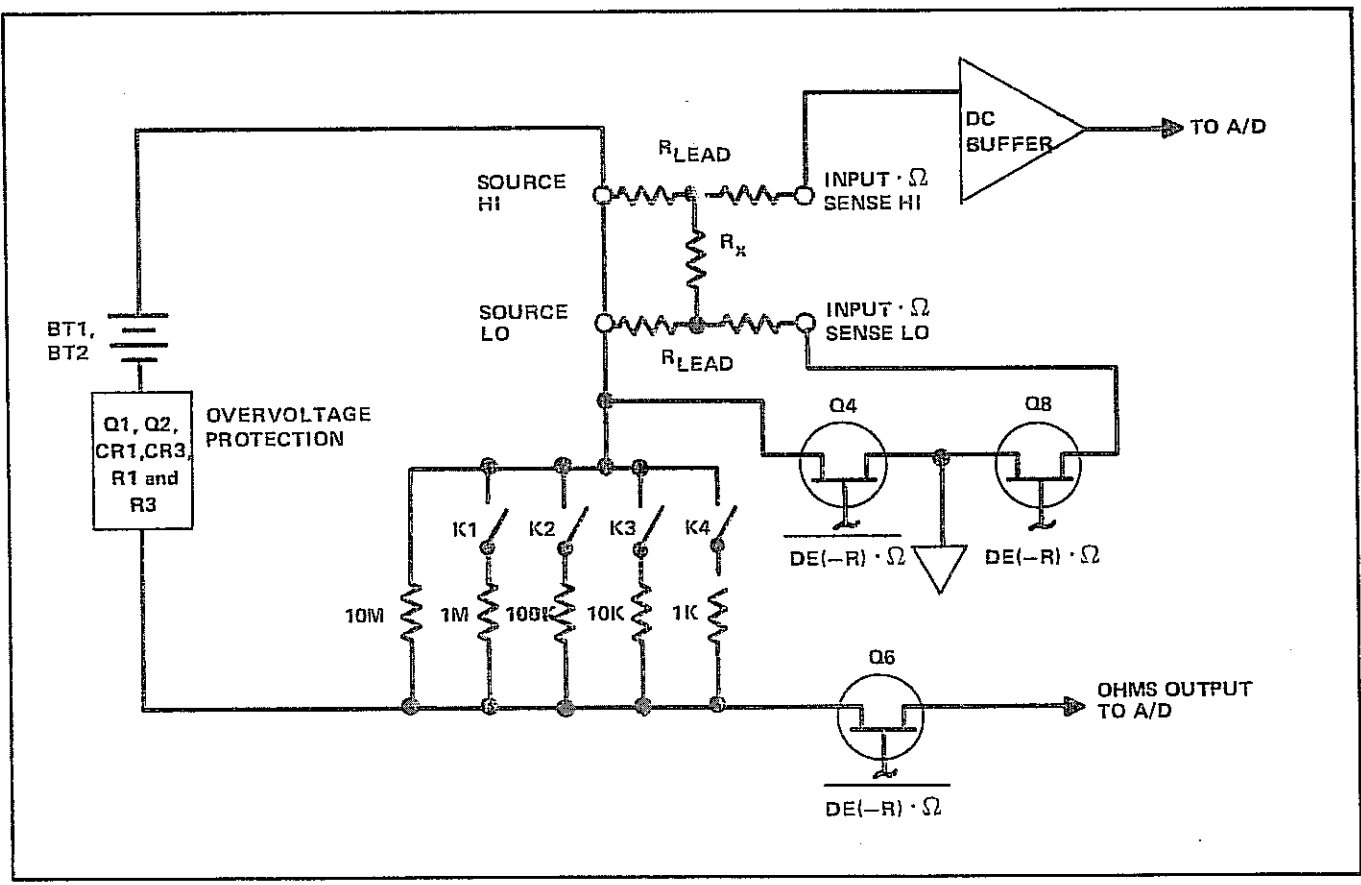


Figure 3-5. OHMS CONVERTER BLOCK DIAGRAM

representing an unknown value of instrument input, is integrated (charges a capacitor) for a controlled length of time (100ms). The level to which the capacitor is charged is directly proportional to the level of the dc voltage at the input. The capacitor is then discharged at a controlled rate so that the discharge time is proportional to the level of charge on the capacitor. A digital representation of the discharge time is obtained by counting the number of cycles of a reference frequency that occur from the start of discharge to the point where the capacitor charge reaches a selected zero detect level. Figure 3-6 is a basic illustration of the A/D Converter circuit.

3-39. The input to the A/D Converter is selected from one of the three input signal conditioners. The selected input is applied to U3, a unity gain input buffer, during the integrate time period. The buffer output passes across Q39 to an integrator the output of which is determined by the level of input applied. The integrator output charges capacitor C9 at a rate determined by the input so that at the end of the 100 ms integrate time period the charge on the capacitor is directly proportional to the input applied. At the end of the integrate time period the integrator is isolated from the buffer when control signal 2 opens Q39 for 1ms. This

allows the input to U3 to be changed from the dc voltage representing the unknown input to the appropriate reference input without affecting the charge stored on C9.

3-40. The reference voltage passes through U3 and Q39 to the input of the integrator. Because the polarity of the reference voltage is opposite that of the unknown; the integrator starts to discharge capacitor C9. The rate of discharge is determined by the value of the reference voltage. The charge on C9 is applied to the input of amplifier U5. The amplified output is applied to one input of comparator U6. A dc voltage level, determined by the differential offset adjustment R88, is connected to the other comparator input. When the decreasing charge on C9 reaches the same level as that provided by the differential offset adjust, U6 will produce a compare (CM) output signal to stop the digital count in the Control and Display circuit.

3-41. Control and Display

3-42. The discussion of the Control and Display circuit operation that follows is referenced to the schematic diagrams in Figures 8-2 and 8-3. These schematics are located in Section 8 of this manual. Operation in the VAC FUNCTION will be used as an example of circuit operation.

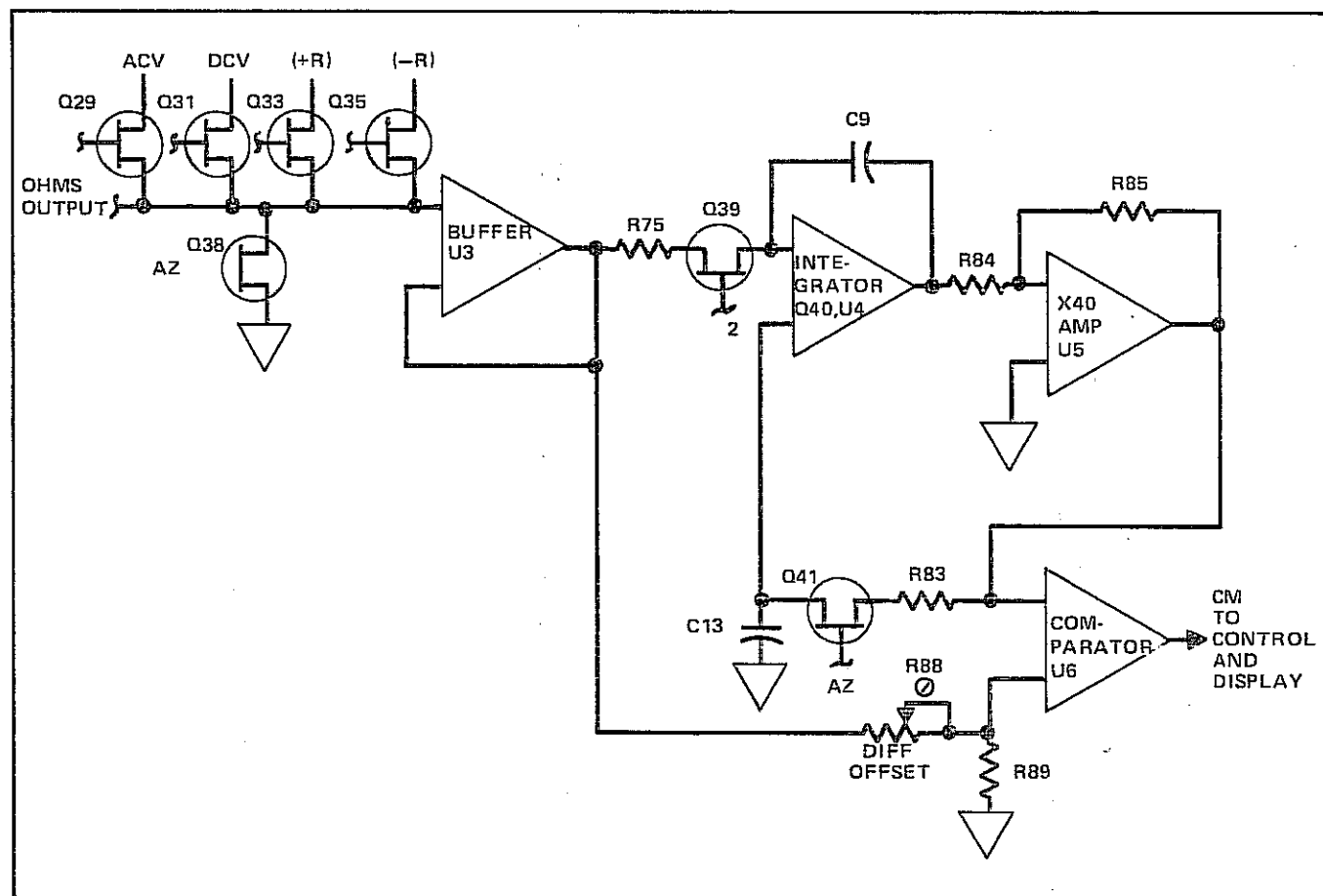


Figure 3-6. A/D CONVERTER BLOCK DIAGRAM

3-43. Selecting the VAC FUNCTION switch S2 (see Figure 8-3) provides the AC control command output at J2 pin 2 and connects the INPUT HI terminal to the AC Converter input. The AC signal is applied to NAND gates in U15 (see Figure 8-2) and to switch U20 where it selects the ST2 signal output for P2 pin 14. With the proper gates enabled by the AC command the outputs from U11, derived from the 1 MHz oscillator signal, provide timing commands to control the multimeter circuits during the ac volts measurement.

3-44. The measurement cycle starts with the INT signal output at U11 pin 40. This signal is inverted by U15-5 to produce the INT command which, when combined with the AC command at U15-9, results in the INT · AC signal used to gate the AC Converter output into the A/D Converter during the integrate time period. As the INT signal U11-40 goes high, indicating the end of the 100ms integrate time period, the $\Delta 2$ signal at U11-3 goes high for 1ms while the input to the A/D Converter is switched from the unknown to the reference voltage. The reference supply signal comes from U11-39, DE(-R). This signal is inverted by U13-14 and applied to U14-3. Since U14 pin 5 is held high, unless the K Ω function is called, the DE(-R) · Ω command will gate the negative one volt reference to the A/D Converter input for the read time period.

3-45. At the end of the $\Delta 2$ signal decade counters within U11 start to count the cycles of the 1 MHz oscillator input

at U11 pin 6. The count accumulation continues until a compare (CM) signal from the A/D Converter is received at U11 pin 5. The total in each decade counter is converted to a bcd format, identified as signals W, X, Y, and Z with corresponding bit weights of 8, 4, 2, and 1. The digit information is strobed out to the display from pins 34, 33, 32, and 31 of U11 one significant digit at a time.

3-46. Eight strobe signals numbered ST0 through ST7, are created within U11 to properly time the transfer of data from U11 to the display. Six strobe signals (ST0, ST1, ST2, ST3, ST4, and ST6) are used to transfer digit information and the remaining two (ST5 and ST7) transfer range, polarity and overload data. The most significant digit of the display is the first to be strobed out of U11. Strobe signal ST7 from U11-22 passes through switch U20 pin 12 to 14 (DCV function causes the switch to shift to pin 13) to the display strobe drivers Q44 and Q45. The DS1 output signal on P1-3 is applied to pins 1 and 14 of the most significant digit LED (DS1), enabling only that LED to display the incoming digit information. The same ST7 strobe signal is used within U11 to cause the bcd information for the most significant digit to be applied, via U11 pins 34, 33, 32, and 31, to the seven segment decoder U16. The bcd code input causes the decoder to illuminate segments of the LED to display the corresponding number. Each LED is individually strobed to display the corresponding significant digit output from U11.

Section 4

Maintenance

4-1. INTRODUCTION

4-2. This section of the manual contains information concerning maintenance and servicing of the Model 8800A Digital Multimeter. A calibration interval of 90 days is rec-

ommended to insure instrument operation within the 90-day 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.

Table 4-1. REQUIRED TEST EQUIPMENT

| NOMENCLATURE | MINIMUM SPECIFICATIONS | RECOMMENDED EQUIPMENT |
|--------------------|---|----------------------------------|
| AC Calibrator | Voltage Range: 0 to 1000V ac Frequency Range: 50 Hz to 100 kHz Voltage Accuracy: 50 Hz to 20 kHz 0.03% 20 kHz to 100 kHz 0.05% | John Fluke Model 5200A and 5205A |
| DC Calibrator | Voltage Range: 0 to 1000V dc Accuracy: 0.003% | John Fluke Model 332B |
| Voltage Divider | Ratio Range: 0 to 1.0 Absolute Linearity: ± 1 ppm of input at dial setting | John Fluke Model 720A |
| Resistor Decade | Resistance Accuracy: 0.005% | ESI 1063B |
| Frequency Counter | Range: 2 MHz Resolution: 100 Hz | John Fluke Model 1941A |
| Oscilloscope | General Purpose with 10M Ω Probe | Tektronics Model 453 |
| Digital Multimeter | Voltage Accuracy: 0.1% Input Impedance: 10M Ω | * John Fluke Model 8000A |

* If the selectable offset voltage correction resistor procedures are performed a DVM with a 1 μ V resolution is required; recommend a John Fluke 8400A or 8800A.

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 service centers is included with the WARRANTY. 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.

4-6. GENERAL MAINTENANCE

4-7. Access/Disassembly

4-8. The following procedure is used to gain access to the interior of the 8800A.

- a. Remove the line power cord from the unit.
- b. Remove the molded plastic outer cover; two screws at the rear of the unit hold it in place. This provides access to the calibration adjustment.
- c. Remove the top and bottom guard covers; slide the covers one-half the distance to the rear of this unit, then lift straight up to remove. This allows access to the components on the various printed circuit boards.

CAUTION!

The area on the Display PCB Assembly where the input terminals extend through, must not be contaminated in any way. The inter terminal leakage caused by contamination will result in calibration errors.

- d. Remove the AC Converter PCB or Ohms Converter PCB by disconnecting the associated wires and pulling the pcb straight away from the Main PCB.

NOTE!

When reinstalling the AC Converter and Ohms Converter PCB's, insure that all connector pins are properly aligned before seating the board.

4-9. Cleaning

4-10. Clean the instrument periodically to remove dust, grease and other contamination. Use the following procedure:

- a. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened with a mild solution of detergent and water.
- b. If cleaning of the interior is necessary use clean, dry air at low pressure (20 psi). If contaminants remain individual pcbs can be cleaned using warm water, however; any items likely to be affected by the water (batteries, meters, etc.) should be removed first. Excess water should be blown free with the clean dry air followed by a thorough drying. Do not use drying temperatures in excess of 50°C. If any solvent is used, such as freon, it should be kept clear of any switches or potentiometers since it removes lubrication and shortens the life span dramatically.

4-11. Fuse Replacement

WARNING!

Line power voltage is present at the fuse holder whenever the power cord is connected. Remove the power cord before servicing the fuse.

4-12. The power fuse (F1) is located in the right rear corner of the instrument, and can be reached by performing the access and disassembly procedure. If replacement is necessary, use an AGC ¼ ampere fuse for either 115V ac or 230V ac power configuration.

4-13. LED Replacement

4-14. The following procedure is used to replace the Display or indicator LEDs.

- a. Perform steps a, b and c of the Access/Disassembly instructions, paragraph 4-8.
- b. Remove the four side screws connecting the Front Panel to the side chassis. Lift the Front Panel away from the main portion of the instrument.
- c. Disconnect, at the main pcb dip sockets, the two flat cables connecting the Front Panel.
- d. Disconnect the wires from the connector posts on the display pcb.
- e. Remove the binding post nuts and the two phillips screws and lift the display pcb away from the Front Panel.
- f. Unsolder the defective display or indicator LED and replace.

- g. Reassemble in the opposite order, insuring the switch pushbutton connects between the crossbar and the lower retaining ring on the switch plunger. An illustration of the switch assembly is shown in the Parts List, Figure 5-3.

4-15. Component Modifications

4-16. On versions of the Main PCB etched with the part number 8800A-3001, Rev. A through Rev. J, U5 is drilled to accept an eight lead dual in-line IC. However, the preferred replacement is the round TO-5 metal package. To fit the round TO package into the rectangular pattern bend the legs into the correct position with a pair of long nosed pliers and insert the legs into the drilled holes, remembering that the TO package is keyed on pin 8 while the drill pattern is keyed with the square marked hole at position 1.

4-17. On versions etched 8800A-3001 Rev. K and on, provisions are made for expansion of the DVM capabilities by providing locations for the future installation of jumper W1 and R121. These components are installed when the P-MOS integrated circuit (part number 407734) is installed as a replacement for the C-MOS IC (part number 354985). Refer to Figure 5-2 for placement of R121 and W1 if installation is required.

4-18. Battery Maintenance

4-19. Two AA Alkaline penlight cells are installed in the Ohms Converter (8800A-400) to provide a floating current source. These batteries should be removed inspected and cleaned during each calibration procedure. The batteries should be changed at least annually. Battery failure is indicated when excessive noise is noted during operation in the $K\Omega$ mode.

4-20. PERFORMANCE TESTS

4-21. Introduction

4-22. The following tests are intended for use in performance testing of the 8800A. 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 $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$, relative humidity less than 70%.

NOTE!

Tolerances and test limits for performance tests are derived from the 90-day instrument specifications.

4-23. Should the 8800A fail this performance test, corrective maintenance or calibration will be required. The troubleshooting information given later in this section will help analyze and isolate the problem. The 8800A performance test will evaluate each of the three multimeter functions using the procedure provided in the following paragraphs. Use the test equipment recommended in Table 4-1.

4-24. DC Volts Verification

4-25. Using the dc calibrator and voltage divider apply the voltages indicated in Table 4-2 to the 8800A input terminals. Select the ranges prescribed and observe the 8800A display for the proper results.

NOTE!

Before starting this procedure, place a good quality shorting link across the INPUT - Ω SENSE terminals HI to LO and adjust the front panel DC ZERO for a display of exactly zero.

Table 4-2. DC VOLTAGE VERIFICATION

| RANGE | INPUT | DISPLAY READING | | LED INDICATION | | |
|----------|----------|-----------------|---|----------------|--|----------|
| 2 VDC | Shorted | -.00001 | - | +0.0001 | | |
| | +1.00000 | +99987 | - | +1.00013 | | |
| | -1.00000 | -1.00013 | - | -99987 | | |
| | +1.90000 | +1.89978 | - | +1.90022 | | |
| | -1.90000 | -1.90022 | - | -1.89978 | | |
| 20 VDC | +19.0000 | +18.9978 | - | +19.0022 | | |
| | -19.0000 | -19.0022 | - | -18.9978 | | |
| 200 VDC | +190.000 | +189.978 | - | +190.022 | | |
| | -190.000 | -190.022 | - | -189.978 | | |
| 1200 VDC | +1000.00 | +999.87 | - | +1000.13 | | |
| | -1000.00 | -1000.13 | - | -999.87 | | |
| 200 mV | +10000 | +99.980 | - | +100.020 | | 200m VDC |
| | -10000 | -100.020 | - | -99.980 | | 200m VDC |
| AUTO | +10000 | +99.980 | - | +100.020 | | 200m VDC |
| | +1.00000 | +99987 | - | +1.00013 | | |
| | +10.0000 | +9.9987 | - | +10.0013 | | |
| | +100.000 | +99.987 | - | +100.013 | | |
| | +1000.00 | +999.87 | - | +1000.13 | | |

4-26. Auto Ranging Verification

4-27. Verify that the Auto Ranging circuitry changes ranges at the proper voltage points using the following procedure:

- Insure the dc calibrator and voltage divider are connected for an input to the 8800A.
- Select AUTO on the front panel.
- Apply +200mV to the 8800A.

- d. Display reads +.19995 to +.20005.
- e. Decrease the applied voltage to 183 mV. Display reads +.18295 to +.18305.
- f. Decrease the applied voltage in 1 millivolt steps until the 8800A autoranges. The 200 mV - 200Ω LED indicator comes on and the applied voltage is between 177.5 and 182.5 millivolts. The display should read the applied voltage in millivolts ±.19 millivolts.
- g. Slowly increase the applied voltage until the 8800A autoranges to the 2 volt range. The 200 mV - 200Ω LED indicator is extinguished, the decimal point on the display moves two positions to the left and the applied voltage is approximately, but greater than 190 millivolts.

Table 4-4. OHMS VERIFICATION

| RANGE | INPUT | DISPLAY READING | LED INDICATION |
|--------|--------------|-------------------|----------------|
| 20MΩ | 10MΩ | 9.9797 - 10.0203 | 20MΩ |
| 2000KΩ | 1000KΩ (1MΩ) | 999.47 - 1000.53 | |
| 200KΩ | 100KΩ | 99.987 - 100.013 | 200Ω |
| 20KΩ | 10KΩ | 9.9987 - 10.0013 | |
| 2KΩ | 1KΩ | .99987 - 1.00013 | |
| 200Ω | 100Ω | 99.970 - 100.030 | |
| 200Ω | 10Ω | 09.988 - 010.012 | |
| AUTO | 10Ω | 09.988 - 010.012 | |
| AUTO | 100Ω | 99.970 - 100.030 | |
| AUTO | 1KΩ | .99987 - 1.00013 | |
| AUTO | 10KΩ | 9.9987 - 10.0013 | |
| AUTO | 100KΩ | 99.9987 - 100.013 | |
| AUTO | 1000KΩ (1MΩ) | 999.47 - 1000.53 | |
| AUTO | 10MΩ | 9.9797 - 10.0203 | 20MΩ |

4-32. CALIBRATION

4-33. Introduction

4-34. The Model 8800A should be calibrated every 90 days or when ever repairs have been made, in order to maintain the instrument within its rated accuracy. The calibration procedure should be performed under the following environmental conditions: Ambient temperature of 23°C ± 1°C, relative humidity less than 80%. Refer to Table 4-1 for the recommended test equipment. Calibration adjustments are identified on the top inner guard cover. Perform the following preliminary steps before calibrating the instrument.

- a. Remove the molded plastic outer cover.
- b. Leave the top and bottom inner guard covers in place.
- c. Connect the 8800A to the appropriate (115V ac or 230V ac) line power.
- d. Turn the instrument on and allow it to warm-up for a minimum of one-half hour.
- e. Insure that the ac and dc calibrators are up to their respective operating temperatures.

Table 4-3. AC VOLTAGE VERIFICATION

| RANGE | VOLTAGE | FRE- QUENCY | DISPLAY READING |
|----------|---------|-------------|------------------|
| 2 VAC | 1.00000 | 400 Hz | .99890 - 1.00110 |
| 2 VAC | 1.0000 | 100 kHz | .98940 - 1.01060 |
| 20 VAC | 10.0000 | 400 Hz | 9.9890 - 10.0110 |
| 20 VAC | 10.0000 | 100 kHz | 9.8940 - 10.1060 |
| 200 VAC | 50.000 | 400 Hz | 49.940 - 50.060 |
| 200 VAC | 50.000 | 100 kHz | 49.440 - 50.560 |
| 1200 VAC | 100.000 | 400 Hz | 99.730 - 100.270 |
| 1200 VAC | 100.000 | 20 kHz | 99.510 - 100.490 |
| AUTO | .100000 | 10 kHz | .09980 - .10020 |
| AUTO | 1.00000 | 10 kHz | .99890 - 1.00110 |
| AUTO | 10.0000 | 10 kHz | 9.9890 - 10.0110 |
| AUTO | 100.000 | 10 kHz | 99.890 - 100.110 |
| AUTO | 1000.00 | 10 kHz | 996.88 - 1003.12 |

4-30. Ohms Verification

4-31. Using the resistor decade, apply the resistance values indicated in Table 4-4, to the 8800A input terminals. Select the range and observe the 8800A display for the proper results.

NOTE!

Use four-terminal ohms measurement method.

4-35. Pre-Calibration Procedure

NOTE!

Use the 720A with the 332B DC Calibrator to source all voltages below 2 volts.

4-36. The transistors Q14 and Q15, the U1 Op Amp, and the selectable resistors R34 and R38 are a matched set installed at the factory. If any one of the five are changed due to calibration requirements or failure the selectable Offset Voltage Correction Resistor procedures outlined later in the calibration procedure paragraph must be performed.

4-37. ZERO ADJUST

- Short the two INPUT terminals together.
- Select the VDC function and 200 mV range.
- Adjust the front panel DC ZERO adjust for an 8800A display of 00.000 ± 1 digit.

4-38. BIAS ADJUST

- Place a 1 megohm resistor across the input terminals.
- Adjust BIAS adjust (R30) for an 8800A display of 00.000 ± 3 digits.

NOTE!

The bias adjustment may cause a change in the zero adjustment. Repeat the zero adjust and bias adjust until no further change in the zero adjustment occurs.

4-39. Final Calibration Procedure

4-40. DCV FINAL CAL

- Select the 2V range; DCV function.
- Alternately apply +1.0 mV and -1.0 mV to the input terminals and adjust the MASTER OFFSET (R78) for the same absolute number (s) in both polarities.
- Apply +1 mV to the input terminals and adjust DIFF OFFSET (R88) for exactly +.00100 on the 8800A display.

NOTE!

Occasional flashing of +.00101 or +.00099 is acceptable.

- Short the input terminals.
- Select the 200 mV and rezero the instrument if necessary.

- Remove the short. Verify steps a through c.
- Select the 2V range.
- Apply +1.00000V and adjust +1V CAL (R99) for an 8800A display of $+1.00000 \pm 1$ digit.
- Increase the input to +1.90000V; Display must be within ± 3 digits.
- Repeat steps h and i using a negative input and adjust -1V CAL (R97).
- Apply the inputs listed in Table 4-5 to the 8800A on the 2V range, DCV function and note that all display readings are within one digit of the applied voltage.

Table 4-5. DCV LINEARITY CHECK

| INPUT | DISPLAY |
|-----------------|---------------------------|
| $\pm .00100$ V | $\pm .00100 \pm 1$ digit |
| $\pm .01000$ V | $\pm .01000 \pm 1$ digit |
| $\pm .10000$ V | $\pm .10000 \pm 1$ digit |
| $\pm .20000$ V | $\pm .20000 \pm 1$ digit |
| $\pm .30000$ V | $\pm .30000 \pm 1$ digit |
| $\pm .40000$ V | $\pm .40000 \pm 1$ digit |
| $\pm .50000$ V | $\pm .50000 \pm 1$ digit |
| $\pm .60000$ V | $\pm .60000 \pm 1$ digit |
| $\pm .70000$ V | $\pm .70000 \pm 1$ digit |
| $\pm .80000$ V | $\pm .80000 \pm 1$ digit |
| $\pm .90000$ V | $\pm .90000 \pm 1$ digit |
| ± 1.00000 V | $\pm 1.00000 \pm 1$ digit |

- Select the 20V range; DCV function
- Apply +10.0000V and adjust the 10VDC adjustment (R47) for an 8800A display of $+10.0000 \pm 1$ digit.
- Apply +100.000 mV to the input terminals.
- Select the 200 mV range and verify the 8800A display is within ± 4 digits.
- Repeat step n with a -100.000 mV input.
- Select the 200V range; DCV function.

- r. Apply +100.000 V and adjust 100 VDC adjustment (R21) for an 8800A display of +100.000 ± 1 digit.
- s. Select the 1200V range; DCV function.
- t. Apply +1000.00V and verify the 8800A display is +1000.00 ± 3 digits.

4-41. AC CONVERTER FINAL CAL

4-42. The AC Converter calibration procedure is presented in Table 4-6. Insure that the ac calibrator used to supply the required voltages, is up to its prescribed operating temperature. Depress the VAC function switch on the 8800A and proceed with the test.

4-43. OHMS CONVERTER FINAL CAL.

NOTE

Remove the shorting links that connect the two HI terminals together and the two LO terminals together. Use the four-terminal measurement technique (as pictured in Figure 2-2) for this procedure.

- a. Select the KΩ function.
- b. Apply a 10 MΩ standard resistance (ESI 1063B resistor decade) to the input.
- c. Select the 20 MΩ range.
- d. Adjust the 10 MΩ cal (R5) for an 8800A display of 10.0000 ±3 digits.
- e. Apply a 100kΩ standard resistance to the input. The display should indicate 0.1000 ±1 digit.
- f. Apply a 1MΩ standard resistance to the input. The display should indicate 1.0000 ±4 digits.
- g. Select the 2000kΩ range and adjust the 1MΩ cal (R6) for an 8800A display of 1000.00 ±1 digit.
- h. Apply a 100kΩ standard resistance to the input. The display should indicate 100.00 ±1 digit.
- i. Select the 200kΩ range.
- j. Adjust the 100kΩ cal (R8) for an 8800A display of 100.000 ±1 digit.
- k. Apply a 10kΩ standard resistance to the input. The display should indicate 10.000 ±1 digit.
- l. Select the 20kΩ range.
- m. Adjust the 10kΩ cal (R10) for an 8800A display of 10.000 ±1 digit.
- n. Apply a 1kΩ standard resistance to the input. The display should be 1.0000 ±1 digit.
- o. Select the 2kΩ range.
- p. Adjust the 1 kΩ cal (R13) for an 8800A display of 1.00000 ± 1 digit.
- q. Apply a 100Ω standard resistance to the input. The display should be .10000 ±1 digit.
- s. Select the 200Ω range.
- t. Verify that the 8800A display is 100.000 ±6 digits.
- u. Select the AUTO pushbutton. AUTO push-
- v. Remove the 100Ω resistance and verify that the unit autoranges to the 20MΩ range.

Table 4-6. ACV FINAL CAL.

| STEP | RANGE | INPUT | FREQ | ADJUST | READING | TOLERANCE |
|------|---------------|-------|--------|-------------------|---------|-------------|
| 1 | 1200V | 500V | 500 Hz | R20 (500V/500 Hz) | 500.00 | ± 3 digits |
| 2 | 200V | 100V | 500 Hz | R10 (100V/500 Hz) | 100.000 | ± 5 digits |
| 3 | 200V | 100V | 50 kHz | C2 (100V/50 kHz) | 100.000 | ± 50 digits |
| 4 | 2V | 1.0 V | 500 Hz | R6 (1.0V/500 Hz) | 1.00000 | ± 5 digits |
| 5 | 2V | 1.0 V | 50 kHz | C7 (1.0V/50 kHz) | 1.00000 | ± 20 digits |
| 6 | Repeat step 3 | | | | | |
| 7 | Repeat step 5 | | | | | |
| 8 | 200V | 100V | 20 kHz | --- | 100.000 | ± 30 digits |
| 9 | 2V | 1V | 20 k | --- | 1.00000 | ± 30 digits |
| 10 | 2V | 1V | 100 k | --- | 1.00000 | ±530 digits |
| 11 | 2V | 1V | 50 Hz | --- | 1.00000 | ± 60 digits |
| 12 | 2V | 1mV | 500 Hz | --- | .00100 | ± 5 digits |
| 13 | 2V | 1mV | 50 kHz | --- | .00100 | ± 10 digits |
| 14 | 20V | 10V | 500 Hz | R8 (10V/500 Hz) | 10.000 | ± 5 digits |
| 15 | 20V | 10V | 50 kHz | C9(10V/50 kHz) | 10.000 | ± 50 digits |
| 16 | 20V | 10V | 20 kHz | --- | 10.000 | ± 30 digits |
| 17 | 1200V | 500V | 20 kHz | --- | 500.00 | ± 70 digits |
| 18 | 1200V | 1000V | 20 kHz | --- | 1000.00 | ±250 digits |

- w. Replace the 100Ω resistance and verify that the unit autoranges to the 200Ω range.

NOTE

Insure the shorting links used to connect the two HI terminals together and the LO terminals together are replaced when the Ohm Converter Final Calibration is completed.

4-44. Selectable Offset Voltage Correction Resistors Procedure

4-45. The following procedures must be performed any-time that Q14, Q15, U1, R34 or R35 are changed during the calibration procedure or troubleshooting. A digital volt-meter with at least 1 microvolt resolution, such as the Fluke 8400A or another 8800A, is required.

4-46. Set-Up:

- a. Select the 1 VDC range on the test equipment DVM.
- b. Connect the LO input to common and the high input to TP13 on the 8800A under test.

- c. Mechanically center the Front Panel DC ZERO control.
- d. Select the 200 mVDC range on the 8800A under test and short the input terminals.
- e. Connect jumpers across the selected resistor positions A and B.
- f. Maximum allowable reading on the test DVM is ±0.05000. Any reading greater is out of the range of the resistor selection tables and the multi-meter must be repaired. Refer to the troubleshooting procedure or return the instrument to an authorized Fluke Service Center.

4-47. Bias Adjust:

- a. Note the reading on the test equipment DVM.
- b. Replace the short across the input terminals with a 1MΩ resistor in parallel with a 0.1μfd capacitor.
- c. Adjust the BIAS ADJ control for the same reading as noted above, plus or minus five digits.

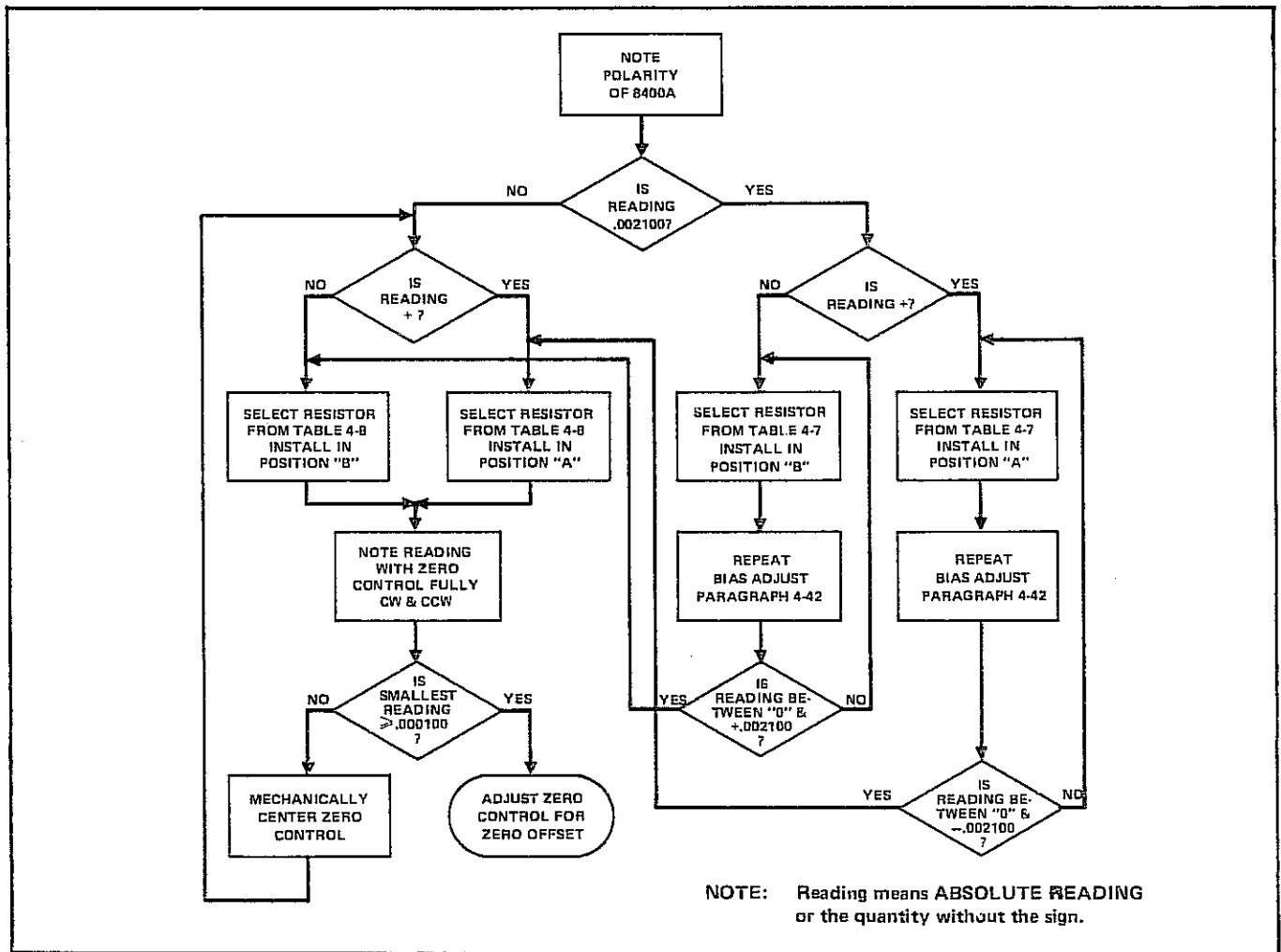


Figure 4-1. OFFSET RESISTOR SELECTION PROCEDURE

Table 4-7. OFFSET VOLTAGE CORRECTION RESISTORS

| OFFSET VOLTAGE | COARSE RESISTOR | J.F. P/N | TOL. % | TEMPERATURE COEFFICIENT |
|-------------------|-----------------|----------|--------|-------------------------|
| 0.00000 - 0.00200 | None | ----- | | |
| 0.00201 - 0.00400 | 31.6k | 261610 | 1% | T0 |
| 0.00401 - 0.00600 | 47.5k | 289546 | 1% | T0 |
| 0.00601 - 0.00800 | 63.4k | 235382 | 1% | T0 |
| 0.00801 - 0.01000 | 80.6k | 281121 | 1% | T0 |
| 0.01001 - 0.01200 | 95.3k | 289561 | 1% | T0 |
| 0.01201 - 0.01400 | 113 k | 379065 | 1% | T2 |
| 0.01401 - 0.01600 | 130 k | 379073 | 1% | T2 |
| 0.01601 - 0.01800 | 147 k | 379081 | 1% | T2 |
| 0.01801 - 0.02000 | 162 k | 379099 | 1% | T2 |
| 0.02001 - 0.02200 | 178 k | 379107 | 1% | T2 |
| 0.02201 - 0.02400 | 196 k | 379115 | 1% | T2 |
| 0.02401 - 0.02600 | 215 k | 379123 | 1% | T9 |
| 0.02601 - 0.02800 | 232 k | 257527 | 1% | T9 |
| 0.02801 - 0.03000 | 249 k | 379131 | 1% | T9 |
| 0.03001 - 0.03200 | 267 k | 379149 | 1% | T9 |
| 0.03201 - 0.03400 | 287 k | 257543 | 1% | T9 |
| 0.03401 - 0.03600 | 301 k | 379156 | 1% | T9 |
| 0.03601 - 0.03800 | 316 k | 379164 | 1% | T9 |
| 0.03801 - 0.04000 | 340 k | 379172 | 1% | T9 |
| 0.04001 - 0.04200 | 357 k | 312793 | 1% | T9 |
| 0.04201 - 0.04400 | 374 k | 379180 | 1% | T9 |
| 0.04401 - 0.04600 | 392 k | 260455 | 1% | T9 |
| 0.04601 - 0.04800 | 412 k | 379198 | 1% | T9 |
| 0.04801 - 0.05000 | 432 k | 379206 | 1% | T9 |

Table 4-8. OFFSET VOLTAGE CORRECTION RESISTORS

| OFFSET VOLTAGE | FINE RESISTOR | J.F. P/N | TOL% | TEMPERATURE COEFFICIENT |
|-------------------|---------------|----------|------|-------------------------|
| 0.00000 - 0.00010 | None | ----- | | |
| 0.00011 - 0.00030 | 1.54k | 289066 | 1% | T0 |
| 0.00031 - 0.00051 | 3.09k | 235150 | 1% | T0 |
| 0.00051 - 0.00071 | 4.75k | 260679 | 1% | T0 |
| 0.00071 - 0.00091 | 6.19k | 283911 | 1% | T0 |
| 0.00091 - 0.00110 | 7.68k | 370999 | 1% | T0 |
| 0.00110 - 0.00130 | 9.31k | 379040 | 1% | T0 |
| 0.00131 - 0.00150 | 10.7k | 293613 | 1% | T0 |
| 0.00151 - 0.00170 | 12.4k | 261644 | 1% | T0 |
| 0.00171 - 0.00191 | 14.0k | 379057 | 1% | T0 |
| 0.00191 - 0.00210 | 16.9k | 267146 | 1% | T0 |

- d. Remove the resistor/capacitor network and reconnect the short.

4-48. Offset Resistor Selection: Perform the test outlined in Figure 4-1 (Resistor Selection Procedure).

4-49. Buffer Amplifier Common Mode Rejection Ratio Test

- Select the 20VDC range on the 8800A under test.
- Connect the test equipment DVM LO input to the HIGH terminal of the 8800A under test.
- Connect the test equipment DVM HIGH to TP6 on the 8800A under test.
- Short the input terminals on the 8800A under test and note the readings.
- Apply +21 volts DC ± 21 mV to the 8800A under test.
- The display on the 8800A under test read 18.8888 and flashes.
- The change in the reading on the test equipment DVM is less than 40 microvolts from the value noted in step d above.
- Repeat steps e thru g applying -21 volts ± 21 mV.
- If the 8800A under test is out of tolerance (a variation in excess of $40\mu\text{V}$) the instrument is in need of repair. Refer to the paragraphs on Troubleshooting or return the instrument to your nearest Fluke Service Center.

4-50. TROUBLESHOOTING

4-51. The information given in the following paragraphs is provided to assist in isolating malfunctions in the 8800A. Before troubleshooting the instrument, however, it should be verified that the cause for the malfunction is actually in the instrument and not caused by faulty external equipments or improper control setting. For this reason, the performance test (paragraph 4-13) is suggested as the first step in troubleshooting. The performance test may also help to localize the trouble to a particular section of the instrument.

4-52. The following reminders of basic fault isolation will help determine if the cause is the result of an internal malfunction or faulty external connection.

- Carefully check the 8800A control settings: some false indications may be caused by an incorrect or overlooked control setting.
- Check associated equipment: insure the associated equipment controls and connections are correct.

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

4-53. When it is determined, by the above checks, that the malfunction is within the 8800A the following procedure can be used to isolate the problem area. The recommended test equipment for troubleshooting is listed in Table 4-1.

4-54. Power Supply Check

4-55. Incorrect output voltages from any of the power supplies may cause the multimeter to exhibit various improper indications. The power supply voltages should be checked in the event of any instrument malfunction. Use the following procedure to check the voltage output of each power supply. Figure 4-2 illustrates where the connections are to be made for checking each supply.

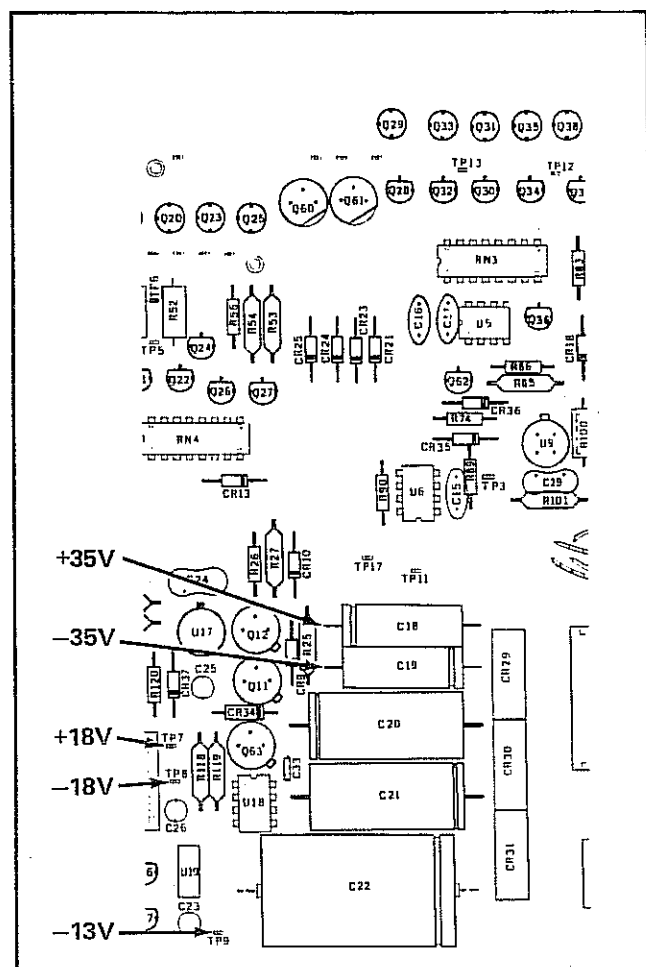


Figure 4-2. POWER SUPPLY VOLTAGE CHECK

- Connect the test equipment voltmeter common lead to INPUT LO terminal.

- b. Connect the test equipment voltmeter high input lead to TP7 (+18 volt supply). The supply output should be $+18.02 \pm 0.05$ volts.
- c. Connect the test equipment voltmeter high input lead to TP8 (-18 volt supply). The supply output should be -18.02 ± 0.10 volts.
- d. Connect the test equipment voltmeter high input lead to the positive end of C18 (+35 volt supply). The supply output should be $+35.0 \pm 5.0$ volts (at 115V ac line voltage)
- e. Connect the test equipment voltmeter high input lead to the negative end of C19 (-35 volt supply). The supply output should be -35.0 ± 5.0 volts (at 115Vac line voltage).
- f. Connect the test equipment voltmeter high input lead to TP9 and low input to TP8. The voltmeter should indicate $+5.0 \pm 0.2$ volts.

4-56. The +18 volt, +7 volt supplies all share a common reference provided by U9. The -18 volt supply receives operating dc voltage from the +18 volt supply. Problems occurring in one supply may cause improper operation of the others. The following procedure provides for open loop operation of the supplies to aid in localizing the defective supply.

- a. Unsolder and lift one end of R120.
- b. Short pins 3 and 4 of U17 together. This will utilize the internal reference of U17 for control.
- c. Check the voltage outputs of the +18 volt supply, TP7 (this supply may be out of prescribed tolerance limits because of the change to the U17 internal reference), +7 volt supply TP11, -7 volt supply TP10 and -18 volt supply TP8.
- d. Repair the faulty supply.
- e. When all supplies are operating properly, remove the short from U17 pins 3 and 4, reconnect R120 and check the supplies for operation within specifications stated in Paragraph 4-50.

4-57. Integrated Circuit Replacement

4-58. CMOS and PMOS type integrated circuits require special handling whenever the IC is not installed in the circuit. This type integrated circuit can be destroyed by

static electricity discharge. To prevent damage due to static discharge, the following precautions should be taken whenever IC's U13, U14, U15 or U20 on the main pcb or any IC on the DOU (-02 option) is handled.

- a. The PMOS or CMOS integrated circuit leads are imbedded in conductive foam. Do not remove the conductive foam from the integrated circuit until ready for installation into the unit.
- b. Be sure the repairing personnel and the unit under repair are commonly grounded before the integrated circuit is put in place in the unit.
- c. Be sure the soldering iron used is grounded to the common ground of the unit under repair.

4-59. Fault Area Isolation

4-60. A malfunction in the 8800A may be isolated to a particular section of circuitry by observing the displayed symptoms during the multimeter operation in each function. The results of the Performance Tests (paragraph 4-15) will indicate the multimeter functions affected by the malfunction. The problem areas, indicated by the various improper functional displays, are presented in Table 4-9. Four vertical columns, describing the 8800A operational status in each of the three functions as being either proper or improper, indicate the functional area of the multimeter where the problem is most likely to be found. Close observation of the symptoms displayed on the front panel coupled with a knowledge of the theory of operation (Section 3) may further define the problem area.

4-61. Troubleshooting information for each functional area is presented in the following paragraphs. Proceed to the paragraphs that provide the troubleshooting information for the problem area indicated by the fault area isolation procedure. Keep in mind, however, that a malfunction within one functional area may affect the operation of another.

4-62. AC CONVERTER

4-63. 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 or 2) not produce the proper dc voltage for the A/D Converter when an ac input signal is applied. A dc output generated by the AC Converter will cause the multimeter display to indicate some value of ac voltage, in the two highest ranges, when a short is placed across the input terminals. When the AC Converter failure causes the display to remain at zero when an ac

Table 4-9. PROBLEM AREA ISOLATION

| 8800A FUNCTION | 8800A OPERATION IN EACH FUNCTION IS – | | | |
|------------------------------|---------------------------------------|---------------|------------------|--|
| DC V | PROPER | IMPROPER | PROPER | IMPROPER |
| AC V | IMPROPER | PROPER | PROPER | IMPROPER |
| OHMS | PROPER | IMPROPER | IMPROPER | IMPROPER |
| PROBLEM AREA INDICATED | AC CONVERTER | VDC BUFFER | OHM CONVERTER | A/D CONVERTER OR CONTROL AND DISPLAY |

signal is applied to the input, the converter is not producing the proper dc voltage output for the A/D Converter.

4-64. The following procedure should be used when troubleshooting those failures that cause an apparent offset voltage from the AC Converter.

- a. Remove the molded plastic outer cover and top guard cover from the 8800A. (See paragraph 4-7 Access/Disassembly)
- b. Remove the Ohms Converter pcb to provide room for troubleshooting the AC Converter. This does not affect the ac operation of the instrument.
- c. Connect the 8800A to ac line power, turn the unit on, and select the VAC function and 2 volt range.
- d. Connect the Low input lead of a test equipment multimeter to the 8800A INPUT - Ω SENSE LO terminal and the high lead to J5 pin 10 (AC Converter output).
- e. Short the 8800A input high to low terminals.
- f. The dc voltage output at J5 pin 10 should be close to zero volts dc.

4-65. A dc voltage output at J5 pin 10 of more than approximately 100 mV, either positive or negative, indicates a failure within the AC Converter. A converter output voltage of two volts dc or greater will cause the 8800A display to read full scale (a flashing display of 188888). Improper output voltage levels approximately equal to the +18 volt or -18 volt supply are generally caused by failures of Q1, Q2, CR6, U1, or there associated components. Lower

level offsets are generally caused by feedback loop failures. Improper operation of Q4, Q5, Q6, or associated components would not only cause a zero offset but would also add the value of that offset to all ranges of ac voltage measurements.

4-66. When the AC Converter failure causes the 8800A display to indicate zero volts when ac inputs are applied to the instrument use the following procedure to locate the malfunction.

- a. Remove the molded plastic outer cover and top guard cover from the 8800A. (See paragraph 4-7 Access/Disassembly)
- b. Remove the Ohms Converter pcb to provide room for troubleshooting the AC Converter. This does not affect the ac operation of the instrument.
- c. Connect the 8800A to ac line power, turn the unit on and select the VAC function and 2 volt range.
- d. Connect the signal return of an oscilloscope to the LO INPUT terminal and the input probe to the connection at either end of the red and white AC Converter input wire.
- e. Apply a one volt rms sinusoidal 10 kHz signal to the 8800A input terminals.
- f. Note the oscilloscope trace (amplitude and frequency).
- g. Move the oscilloscope input probe to the junction point of R17 and R18.
- h. The oscilloscope trace should be approximately one-quarter of the input signal amplitude and 180° out-of-phase.

i. If this signal is not correct move the oscilloscope input probe to the junction point of CR3 and the emitter of Q2.

j. The oscilloscope trace should be as described in step h.

4-67. If the wave forms are correct at both points, the probable cause for the lack of an AC Converter output would be a shorted C16 or C17, or an open Q7. Incorrect wave form; asymmetrical, distorted, or of wrong amplitude, can generally be attributed to improper operation of Q1, Q2, CR6 or U1.

4-68. VDC BUFFER

4-69. The 8800A front panel display will generally indicate a buffer malfunction in one of three ways. First, the display presents an over range indication (flashing +188888) for all inputs applied to the instrument. Second, the display will not indicate any applied dc input; producing a displayed readout of 000000 plus two or three digits of noise. Third, the display indicates that some value of offset is being added to all inputs. This offset malfunction will usually produce a display indication even without an input applied to the instrument.

4-70. Malfunctions within the VDC Buffer may cause the display to be improper on one or two ranges and correct on the others. The overall gain of the buffer is changed for each range. Table 4-10 lists the five dc voltage ranges and the components that control the circuit configuration to produce the proper gain for each range. Noting the range or ranges affected by the malfunction may point to the gain control component or associated circuitry causing the problem.

4-71. If the VDC Buffer malfunction affects all ranges, the following procedure will help isolate the problem. Remove the 8800A outer cover and top guard cover. Select the VDC function and 2V range for this test.

a. Place a short across the 8800A input terminals.

b. Short TP4 and INPUT LO. This will prevent the bootstrap amplifier (U2 and Q16) from driving the buffer into saturation.

c. Using the test equipment multimeter check the voltage drop across CR11, then CR12. The voltage drop should be approximately 6.2V dc each. If the voltage drop is significantly higher or lower across one diode the positive supply (CR9, Q11) or negative supply (CR10, Q12) may be defective.

d. Connect the test equipment multimeter low input to the LO INPUT terminal and the high input to TP6. The voltage level should be about zero. Any voltage present, which cannot be zeroed by the front panel control, is being caused by a malfunction with U1, Q14, Q13, Q15 or associated circuitry.

e. If the voltage level at TP6 is zero, remove the short from the 8800A input terminals and apply +0.2 volts dc to the input. TP6 should provide a +0.2V dc indication also. TP6 should track any change in the input up to about 0.5V dc. Any failure of TP6 to track the input is being caused by U1, Q14, Q13, Q15 and associated circuitry or a short through Q10 or CR6.

f. If all the above indications are correct, the probable cause of the malfunction is Q16, U2, or associated circuitry.

Table 4-10. VDC BUFFER GAIN CONTROL

| RANGE | Q18 | Q25 | Q23 | Q20 | K5 | TOTAL BUFFER GAIN |
|--------|---|--|---|---|--|-------------------|
| 200 mV | open | closed | open | closed | open | 10 |
| 2 V | closed | closed | open | open | open | 1 |
| 20 V | closed | open | closed | open | open | .1 |
| 200 V | closed | closed | open | open | closed | .01 |
| 1200V | closed | open | closed | open | closed | .001 |
| | Q18, closes to provide a gain of one across Q14, Q15 & U1 | Q25, closes to present full buffer output to A/D | Q23, closes to divide the buffer output by 10 | Q20, closes to increase the gain of Q14, Q15 & U1 by 10 | K5, closes to divide the buffer input by 100 | |

4-72. OHMS CONVERTER

4-73. Use the following procedure when troubleshooting malfunctions within the Ohms Converter. Remove the 8800A from the outer case. Remove the top inner guard cover. Select the $k\Omega$ function and the 200Ω range.

- Connect a one ohm resistor across the Ω source terminals.
- Measure the voltage drop across the one ohm resistor. The ohms converter should supply enough current to develop $1 \pm 0.2\text{mV}$ across the resistor.
- If the voltage across the resistor is less than 0.8mV short across Q2 emitter to collector. The voltage across the resistor should now be 0.8mV or greater. If it is Q1, Q2 or CR1 is causing the malfunction.
- Overrange indications in the ohms function can be caused by a failure of Q6 to close and apply the reference voltage to the A/D Converter. Q6 may either be open or the gate signal may not be present during the read period.

4-74. A/D CONVERTER OR CONTROL AND DISPLAY

4-75. If the display symptoms observed during the fault area isolation procedure indicate that the problem is either in the A/D Converter or Control and Display the following procedure should aid in locating the faulty component. Because the timing of the control signals used to process the input signal through the A/D Converter and Display circuits is critical to the proper operation of these sections an oscilloscope should be used to make the voltage and signal checks.

4-76. The A/D Converter operation can be checked using the following procedure.

- Select the VDC function and 2 volt range.
- Apply +1 volt dc to the 8800A input terminals.
- Measure the input to the A/D Converter at TP13. The voltage, TP13 high to the INPUT LO terminal, should be 1 volt dc.

NOTE

Connect the oscilloscope external sync. input via a X10 probe to TP16 during the remainder of this procedure. The scope control settings are provided on the wave shape illustration.

- Connect the scope input to TP1 and return to the INPUT LO terminal. The scope display should be as shown in Figure 4-3.

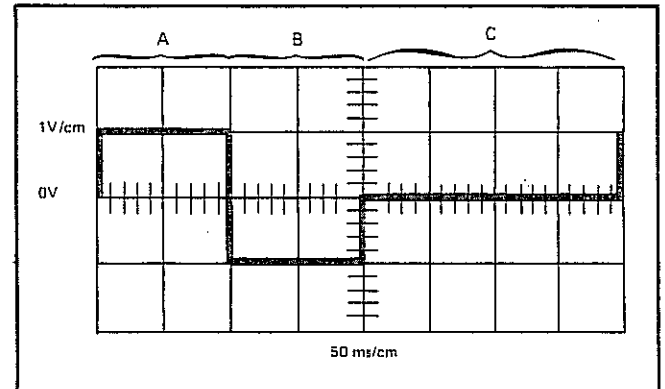


Figure 4-3. TP1 WAVE FORM

4-77. The waveform at TP1 can indicate several possible problems in the circuitry. The 100 ms period designated A is the integrate period during which the unknown 8800A input (in this case 1 volt) is applied to the integrator (Q40 and U4). The 100 ms time designated B is the read period when the reference (in this case -1 volt) is applied to the integrator. The length of period B (read) will change with a change in voltage level applied to the 8800A input within the range selected. The section designated C is the auto-zero period during which the A/D Converter input is shorted to ground, via Q38, to insure that the A/D starts from zero for each new integrate period.

4-78. If the 1 volt input during period A is not present, Q38 may be shorting the input to ground or Q31 may not be closing to apply the buffer output to the A/D. Time period B may indicate that the reference is low by not going to -1 volt. A low reference supply would also cause period B to lengthen. If the voltage level during time period B is unstable, the reference supply input FET Q35 or control Q34 may be faulty.

4-79. If the wave form at TP1 presents the proper 100 ms +1 volt indication during A then drops to -1 volt at the start of B but remains at -1 volt through C, the A/D Converter may not be supplying the control IC (U11) with the compare signal (CM). The compare signal can be checked at TP17 using the following procedure.

- Connect the oscilloscope input to TP17.
- The scope presentation shown in Figure 4-4 represents the proper compare signal for an 8800A input of +1 volt dc.

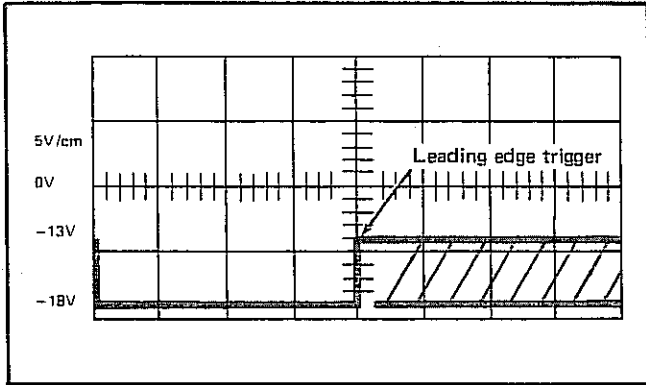


Figure 4-4. TP17 COMPARE SIGNAL

- c. If this signal is present at TP17 proceed to control signal troubleshooting paragraph 4-81.
- d. If the compare pulse is not present or incorrect, either in amplitude or timing of the leading edge make the following check.
- e. Move the oscilloscope input to TP2. The scope presentation should be as shown in Figure 4-5.

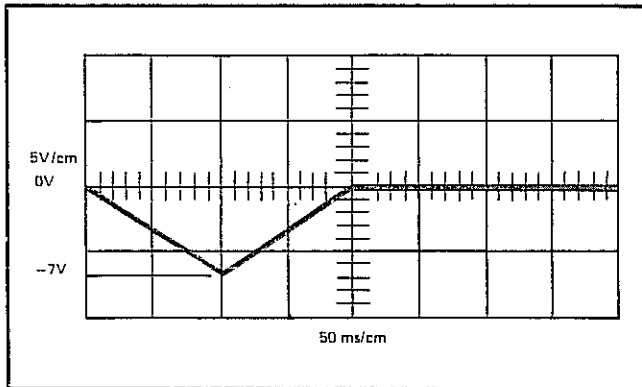


Figure 4-5. A/D INTEGRATOR OUTPUT

4-80. The probable cause for an improper signal at TP2 would be a failure in Q40 or U4. If the voltage level remains at zero volts the protection transistor Q59 may be shorted or input FET Q39 open.

4-81. The timing signals that control the processing of inputs applied to the 8800A are developed within the custom I.C., U11. A 1 MHz crystal (Y1) provides the base frequency from which the timing control signals are produced. Figure 4-6 illustrates the timing relationship between the control signals (INT., DE(+R), AZ, and $\Delta 2$), as they

appear at RN3, and the integrator signal at TP2. An incorrect or missing control signal at RN3 may be caused by a failure in the logic control gates U13, U14, or U15.

4-82. The logic control gates (U13, U14, and U15) and the custom integrated circuit U11 use the 5 volt difference in potential between the -18 volt supply and -13 volt supply for the logic control signal levels. The recommended method for observing the logic signals in this area is to attach the oscilloscope return to the INPUT LO terminal and watch the logic signals for level changes between -18 volt and -13 volt levels.

CAUTION

The oscilloscope return has been connected to the INPUT LO terminal for the waveform checks. For observation of the control signals on the pins of U11 or logic control gates (U13, U14, and U15) the oscilloscope return can be connected to TP8, the -18 volt supply. If this connection is made insure that the oscilloscope return will not ground the -18 volt power supply. Damage to the 8800A circuitry WILL result from grounding TP8.

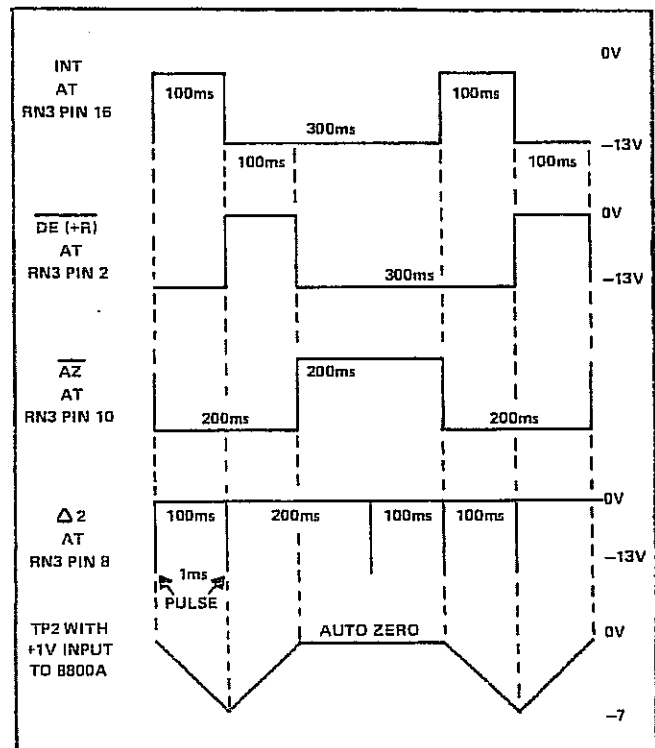


Figure 4-6. A/D CONVERTER CONTROL SIGNAL TIMING

Section 5

Lists of Replaceable Parts

TABLE OF CONTENTS

| TABLE | ASSEMBLY NAME | PART NO. | PAGE |
|-------|--------------------------------|----------|-----------|
| 5-1 | Final Assembly | 8800A | 5-4 |
| 5-2 | Main PCB Assembly | 366245 | 5-12 |
| 5-3 | Front Panel Assembly | | 5-13 |
| 5-4 | Display Assembly | 366278 | 5-14 |
| 5-5 | Ohms Converter PCB | 366302 | 5-16 |
| 5-6 | AC Converter PCB | 366336 | 5-19 |
| 5-7 | DOU PCB | | 5-21/5-22 |

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-Names 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 Effectivity, 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 |

Table 5-1. 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 |
|-----------------------------------|--|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| | FINAL ASSEMBLY | 8800A | | | | | |
| | Figure 5-1 | | | | | | |
| A2 | Main PCB Assembly (Table 5-2) | 366245 | 89536 | 366245 | 1 | | |
| A3 | Front Panel Assembly (Table 5-3) | | | | | | |
| A3A1 | Display Assembly (Table 5-4) | 366278 | 89536 | 366278 | REF | | |
| A4 | Ohms Converter Assembly (Table 5-5) | 366302 | 89536 | 366302 | 1 | | |
| A5 | AC Converter Assembly (Table 5-6) | 366336 | 89536 | 366336 | 1 | | |
| F1 | Fuse, ¼ Amp, 250V (includes spare F1) | 109314 | 71400 | AGC | 2 | | |
| T1 | Xfmr | 373977 | 89536 | 373977 | 1 | | |
| U11 | IC, Universal DVM, LSI  | 354985 | 89536 | 354985 | 1 | | |
| XF1 | Fuseholder | 103283 | 71400 | 4405 | 1 | | |
| 1 | Battery, cover | 395087 | 89536 | 395087 | 1 | | |
| 2 | Case, molded | 363655 | 89536 | 363655 | 1 | | |
| 3 | Chassis, Side Assembly | 372227 | 89536 | 372227 | 1 | | |
| 4 | Chassis, Side | 388264 | 89536 | 388264 | 1 | | |
| 5 | Crank and Rod Assembly | 378968 | 89536 | 378968 | 1 | | |
| 6 | Decal, handle, molded | 381467 | 89536 | 381467 | 1 | | |
| 7 | Decal, Gen, Spec | 380402 | 89536 | 380402 | 1 | | |
| 8 | E Retaining Ring | 168914 | 79136 | 5133-15-MDR | 1 | | |
| 9 | Guard, bottom (Not illustrated) | 364901 | 89536 | 364901 | 1 | | |
| 10 | Guard, insulator | 384289 | 89536 | 384289 | 2 | | |
| 11 | Guard, top | 365189 | 89536 | 365189 | 1 | | |
| 12 | Guard, Xfmr | 365114 | 89536 | 365114 | 1 | | |
| 13 | Handle, molded | 363648 | 89536 | 363648 | 1 | | |
| 14 | Lens | 373704 | 89536 | 373704 | 1 | | |
| 15 | Line cord (Not illustrated) | 343723 | 82839 | TYPE SPH386 | 1 | | |
| 16 | Line switch | 380121 | 89536 | 380121 | 1 | | |
| 17 | Pad, foot | 338632 | 89536 | 338632 | 1 | | |
| 18 | Screw, 6-20 x 3/8 | 288266 | 89536 | 288266 | 2 | | |

Table 5-1. FINAL ASSEMBLY (Continued)

| REF DESIG OR ITEM. NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|--|-----------------------------------|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| 19 | Washer, Flat | 340505 | 89536 | 340505 | 2 | | |
| 20 | Washer, Spring | 228981 | 89536 | 228981 | 2 | | |
| 21 | Washer, squarehole | 370171 | 89536 | 370171 | 2 | | |
| 22 | Test Leads, Set (Not illustrated) | 343657 | 83330 | 21058 | 1 | | |
| <p>⚠ The IC listed below may be shipped as a replacement for U11 (Part Number 354985). If received refer to paragraph 4-17, for installation instructions.</p> | | | | | | | |
| U11 | IC, Universal DVM, P-MOS | 407734 | 89536 | 407734 | 1 | | |

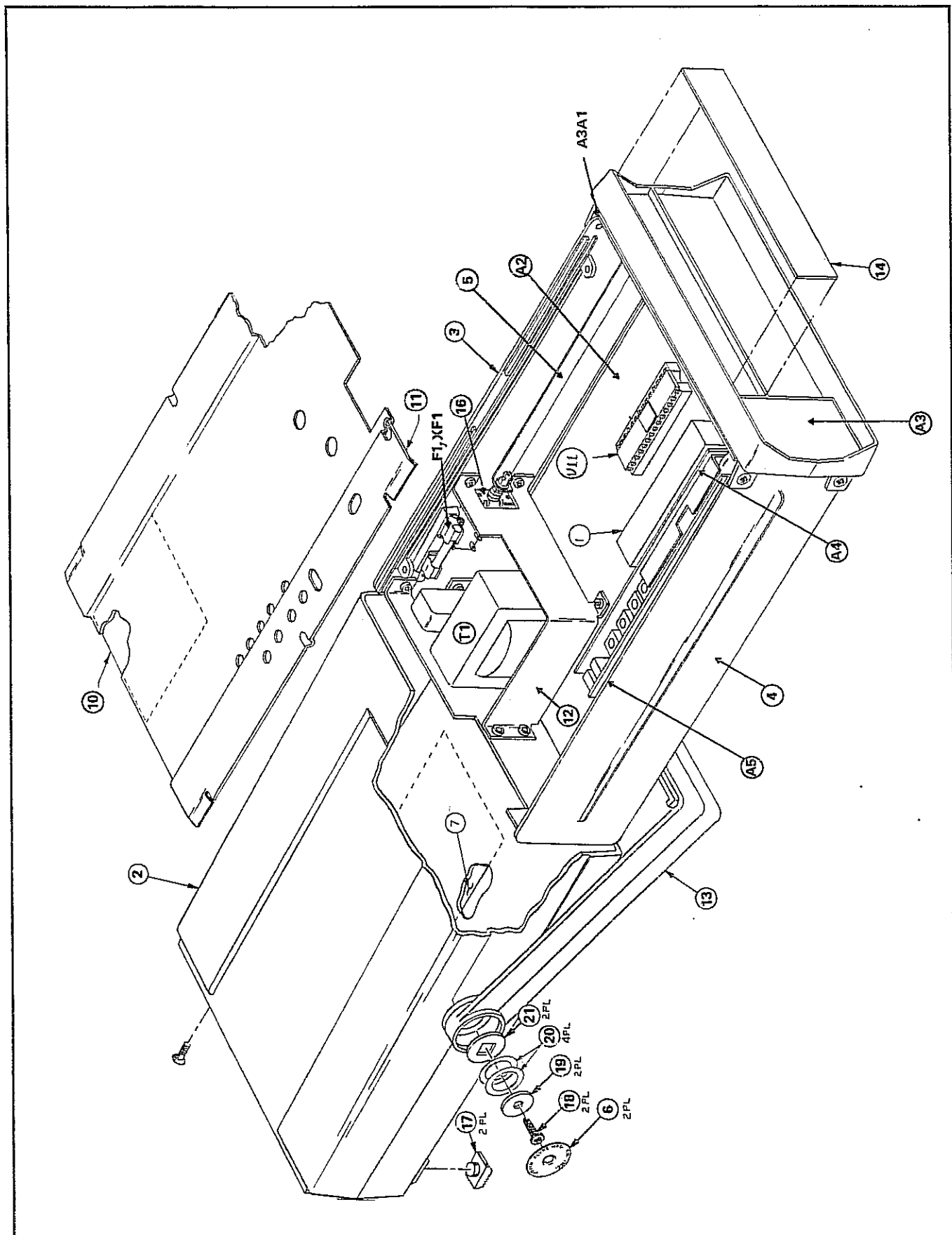


Figure 5-1. FINAL ASSEMBLY

Table 5-2. MAIN 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 |
|-----------------------------------|------------------------------------|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| A2 | MAIN PCB ASSEMBLY Figure 5-2 | 366245 | 89536 | 366245 | REF | | |
| C1,C14 | Not Used | | | | | | |
| C2 | Cap, plstc, 0.022uF ±10%, 100V | 333823 | 84411 | 863UW22391 | 1 | | |
| C3, C4 | Cap, cer, 0.005 uF ±20%, 50V | 175232 | 56289 | C023B101E502 M | 2 | | |
| C5, C6, C10, C12 | Cap, fxd mica, 150 pF ±5%, 500V | 148478 | 14655 | CD15FD151J03 | 4 | | |
| C7,C11, C27, C28, C33 | Cap, cer, 33 pF ±2%, 100V | 354852 | 32897 | 8121A100C0G3 30G | 5 | | |
| C8 | Cap, poly car, 0.10 uF ±10%, 100V | 376251 | 73445 | C280MCH/A100 K | 1 | | |
| C9 | Cap, poly prop, 0.47 uF ±5%, 50V | 364042 | 01281 | JF78B | 1 | | |
| C13 | Cap, poly car, 2.2 uF ±10%, 250V | 306522 | 73445 | C280MCH/A2M 2 | 1 | | |
| C15 | Cap, cer, .0012 uF ±10%, 500V | 106732 | 71590 | CF122 | 1 | | |
| C16, C17 | Cap, cer, 0.22 uF ±20%, 50V | 309849 | 71590 | CW30C224K | 2 | | |
| C18, C19 | Cap, elect, 50 uF +75/-10%, 50V | 105122 | 56289 | 30D506G050D D4 | 2 | | |
| C20, C21 | Cap, elect, 220 uF +50/-10%, 40V | 178616 | 73445 | ET221X040A01 | 2 | | |
| C22 | Cap, elect, 4000 uF +100/-10%, 10V | 330761 | 25088 | B41010-4700/10 | 1 | | |
| C23, C25, C26 | Cap, Ta, 4.7 uF ±20%, 20V | 161943 | 56289 | 196D475X0025 JA1 | 3 | | |
| C24 | Cap, mica, 100 pF ±5%, 500V | 148494 | 14655 | CD15FD101J03 | 1 | | |
| C29 | Cap, mica, 270 pF ±5%, 500V | 148452 | 14655 | CD15FD271J03 | 1 | | |
| C30 | Not Used | | | | | | |
| C31 | Cap, mini cer, 68 pF ±2%, 100V | 362756 | 32897 | 8121M100C0G 680G | 1 | | |

Table 5-2. MAIN PCB ASSEMBLY (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|---|-------------------------------------|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| C32 | Cap, mini cer, 15 pF \pm 2%, 100V | 369074 | 80031 | 222263110159 | 1 | | |
| CR1 thru CR5 | Not Used | | | | | | |
| CR6 | Diode, rect, Si | 180554 | 07910 | TD 12599 | 1 | | |
| CR7, CR8 | Diode, zener, 22V | 181073 | 07910 | 1N969B | 2 | | |
| CR9, CR10 | Diode, Multi-pellet, Si | 375485 | 09214 | MPD300 | 2 | | |
| CR11, CR12, CR35, CR36 | Diode, zener, 6.2V | 325811 | 07910 | 1N735A | 4 | | |
| CR13 | Diode, zener, 13V | 110726 | 07910 | 1N964B | 1 | | |
| CR14, CR15, CR17 | Not Used | | | | | | |
| CR16, CR18 thru CR26, CR32, CR33 | Diode, Si, hi-speed | 203323 | 07910 | TD8253 | 12 | | |
| CR27, CR28 | Not Used | | | | | | |
| CR29, CR30, CR31 | Diode, Bridge | 296509 | 09423 | FB200 | 3 | | |
| CR34, CR38 | Diode, zener, 10V | 113324 | 07910 | 1N961A | 2 | | |
| CR37 | Diode, 2 pellet | 375477 | 09213 | MPD200 | 1 | | |
| K5 | Relay, Telephone type 2 pole | 357707 | 26806 | AZ42012201 | 1 | | |
| Q1 thru Q9 | Not Used | | | | | | |
| Q10, Q13, Q59 | Xstr, NPN | 168716 | 12040 | SM07154 | 3 | | |

Table 5-2. MAIN PCB ASSEMBLY (Continued)

| 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, Q63 | Xstr, PNP | 269076 | 04713 | 2N4890 | 2 | | |
| Q12 | Xstr, NPN | 150359 | 86684 | 2N3053 | 1 | | |
| Q14 | Xstr, NPN, Si, Mono | 295717 | 24355 | AD81100-17 | 1 | | |
| Q15 | Xstr, Dual, NPN | 284075 | 32293 | 1T1099 | 1 | | |
| Q16, Q19, Q21, Q24, Q26, Q28, Q30, Q32, Q34, Q36, Q37, Q43, Q44, Q46, Q48, Q50, Q52, Q54, Q56, Q57 | Xstr, NPN, Si | 218396 | 04713 | 2N3904 | 20 | | |
| Q18, Q20, Q23, Q25 | Xstr, FET, N-channel | 370072 | 12040 | KE4393 | 4 | | |
| Q22, Q27, Q42, Q58 | Xstr, PNP, Si | 195974 | 04713 | 2N3906 | 4 | | |
| Q29, Q31, Q33, Q35, Q38, Q41 | Xstr, FET, N-channel | 343830 | 12040 | KE4416 | 6 | | |
| Q39 | Xstr, FET | 386730 | 12040 | SF51102 | 1 | | |
| Q40 | Xstr, FET, dual | 257501 | 17856 | DN423 | 1 | | |

Table 5-2. MAIN PCB ASSEMBLY (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|---|--|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| Q45, Q47, Q49, Q51, Q53, Q55 | Xstr, PNP, Si | 340026 | 04713 | MPS6563 | 6 | | |
| Q60, Q61 | Xstr, PNP, Si | 203364 | 07263 | 2N3638 | 2 | | |
| Q62 | Xstr, NPN, Si | 218081 | 04713 | MPS6520 | 1 | | |
| RN1 | Res, network, 12 res | 379248 | 89536 | 379248 | 1 | | |
| RN3 | Res, network, 13 res | 379255 | 89536 | 379255 | 1 | | |
| RN4 | Res, network, 11 res | 379230 | 89536 | 379230 | 1 | | |
| RN5 | Res, network, 2 res | 358002 | 01121 | FN260 | 1 | | |
| R1 thru R20 | Not used | | | | | | |
| R21 | Res, var, 200 \pm 10%, $\frac{1}{2}$ W | 275743 | 71450 | 360T200A | 1 | | |
| R23 | Res, fxd comp, 100K \pm 5%, 2W | 285056 | 01121 | HB1045 | 1 | | |
| R25 | Res, met flm, 383 \pm 1%, 1/8W | 375899 | 91637 | MFF1-83830F | 1 | | |
| R26 | Res, fxd car, 62K \pm 5%, $\frac{1}{4}$ W | 348904 | 80031 | CR251-4-5P62K TS | 1 | | |
| R27 | Res, met flm, 205 \pm 1%, 1/8W | 325647 | 91637 | MFF1-82050F | 1 | | |
| R28, R32 | Res, fxd car, 220 \pm 5%, $\frac{1}{4}$ W | 342626 | 80031 | CR251-4-5-P220 T | 2 | | |
| R29 | Res, fxd comp, 100M \pm 10%, $\frac{1}{2}$ W | 190520 | 01121 | EB1071 | 1 | | |
| R30 | Res, var, 100K \pm 10%, $\frac{1}{2}$ W | 369520 | 71450 | 360T104A | 1 | | |
| R31 | Res, met flm, 499K \pm 1%, 1/8W | 268813 | 91637 | MFF1-84993F | 1 | | |
| R33, R36 | Res, met flm, 309K \pm 1%, 1/8W | 235283 | 91637 | MFF1-83093F | 2 | | |
| R35, R39 | Res, set 2 pc | 290320 | 89536 | 290320 | 1 | | |
| R37 | Res, var, 2K \pm 10%, $\frac{1}{2}$ W | 285163 | 71450 | 360S202A | 1 | | |

Table 5-2. MAIN PCB ASSEMBLY (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|--|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| R40 | Res, met flm, 2.8M $\pm 1\%$, $\frac{1}{2}W$ | 236703 | 91637 | MFF1-22804F | 1 | | |
| R41, R43, R116 | Res, fxd, car 10K $\pm 5\%$, $\frac{1}{4}W$ | 348839 | 80031 | CR251-45P10K T | 3 | | |
| R42 | Res, fxd, car, 150 $\pm 5\%$, $\frac{1}{4}W$ | 343442 | 80031 | CR251-4-5P150 T | 1 | | |
| R45, R56, R117 | Res, fxd car, 1M $\pm 5\%$, $\frac{1}{4}W$ | 348987 | 80031 | CR251-4-5P1M T | 3 | | |
| R47 | Res, var, 20 $\pm 20\%$, $\frac{1}{2}W$ | 275727 | 71450 | 360T200B | 1 | | |
| R48, R52 | Res, set, 2 pc | 363788 | 89536 | 363788 | 1 | | |
| R53 | Res, met flm, 100K $\pm 1\%$, 1/8W | 248807 | 91637 | MFF1-81003F | 1 | | |
| R54 | Res, met flm, 9.76K $\pm 1\%$, 1/8W | 241489 | 91637 | MFF1-89761F | 1 | | |
| R55 | Res, comp, 1.5k $\pm 1\%$, $\frac{1}{4}W$ | 148031 | 01121 | CB1525 | 1 | | |
| R74 | Res, fxd car, 4.7K $\pm 5\%$, $\frac{1}{4}W$ | 348821 | 80031 | CR251-4-5P4.7 KT | 1 | | |
| R75 | Res, met flm, 30.9K $\pm 1\%$, 1/8W | 235275 | 91637 | MFF1-83092F | 1 | | |
| R76 | Res, fxd comp, 10M $\pm 5\%$, $\frac{1}{4}W$ | 194944 | 01121 | CB1065 | 1 | | |
| R77, R80 | Res, met flm, 64.9K $\pm 1\%$, 1/8W | 288530 | 91637 | MFF1-86492F | 2 | | |
| R78 | Res, var, 200 $\pm 10\%$, $\frac{1}{2}W$ | 285148 | 71450 | 360S201A | 1 | | |
| R79 | Res, met flm, 46.4K $\pm 1\%$, 1/8W | 188375 | 91637 | MFF1-84642F | 1 | | |
| R83 | Res, fxd car, 51K $\pm 5\%$, $\frac{1}{4}W$ | 376434 | 80031 | CR251-4-5P51 KT | 1 | | |
| R84 | Res, met flm, 4.99K $\pm 1\%$, 1/8W | 168252 | 91637 | MFF1-84991F | 1 | | |
| R85 | Res, met flm, 200K $\pm 1\%$, 1/8W | 261701 | 91637 | MFF1-82003F | 1 | | |
| R86 | Res, fxd car, 3.3K $\pm 5\%$, $\frac{1}{4}W$ | 348813 | 80031 | CR251-4-5P3.3. KT | 1 | | |
| R87 | Res, car, dep, 2.7K $\pm 5\%$, $\frac{1}{4}W$ | 386490 | 80031 | CR251-4-5P2.7 KT | 1 | | |
| R88 | Res, car, 5K $\pm 10\%$, $\frac{1}{2}W$ | 288282 | 71450 | 360S502A | 1 | | |

Table 5-2. MAIN PCB ASSEMBLY (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|---------------------------------------|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| R89 | Res, fxd car, 100 \pm 5%, 1/4W | 348771 | 80031 | CR251-4-5P100 T | 1 | | |
| R90, R120 | Res, fxd car, 2.2K \pm 5%, 1/4W | 343400 | 80031 | CR251-4-5P2.2 KT | 2 | | |
| R91 thru R95, R98 | Res Set, 6 pc | 363804 | 89536 | 363804 | 1 | | |
| R96, R102, U9 | Ref amp, set | 374124 | 89536 | 374124 | 1 | | |
| R97, R99 | Res, var, 20 \pm 20%, 1/2W | 285114 | 71450 | 360S200B | 2 | | |
| R100 | Res, cub mini, ww, 14K \pm 0.1%, 1W | 363770 | 54294 | SP21D22-14KB | 1 | | |
| R101 | Res, met flm, 3.74K \pm 1%, 1/8W | 272096 | 91637 | MFF1-83741F | 1 | | |
| R103 | Res, met flm, 6.34K \pm 1%, 1/8W | 267344 | 91637 | MFF1-86341F | 1 | | |
| R112 | Not Used | | | | | | |
| R113 | Res, met flm, 5.49K \pm 0.1%, 1/8W | 375873 | 91637 | MFF1-85491 | 1 | | |
| R114 | Res, met flm, 3.48K \pm 0.1%, 1/8W | 375881 | 91673 | MFF1-83481 | 1 | | |
| R115 | Res, met flm, 10K \pm 1%, 1/8W | 168260 | 91637 | MFF1-81002F | 1 | | |
| R118, R119 | Res, met flm, 10.08K \pm 0.1%, 1/8W | 346908 | 91637 | MFF1-810R08 R1 | 2 | | |
| S12 | Switch, slide, 115/230V | 376798 | 82389 | 11A1437 | 1 | | |
| TP1 thru TP14, TP16 TP17, Y | Conn, post | 379438 | 00779 | 8619405 | 17 | | |
| U1 | IC, Op amp | 284760 | 12040 | LM308H | 1 | | |
| U2 | IC, Op amp, J-FET, Input | 357830 | 12040 | LH0042C | 1 | | |
| U3 | IC, Op amp, J-FET, Input | 381962 | 12040 | LH0042C | 1 | | |
| U4, U7, U18 | IC, Op amp, ext comp | 363515 | 24355 | AD301AN | 3 | | |
| U5 | IC, Op amp, met can | 329912 | 12040 | LM318H | 1 | | |
| U6 | IC, Linear, vol comparator | 352195 | 12040 | LM311N8 | 1 | | |
| U8 | IC, Op amp | 225961 | 34333 | SG8023 | 1 | | |
| U11 | Part of Final Assembly | | | | | | |
| U12 | IC, BCD-to-Decimal Decoder | 293142 | 01295 | SN7442 | 1 | | |

Table 5-2. MAIN PCB ASSEMBLY (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|-------------------------------|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| U13 | IC, C-MOS, Hex | 355214 | 95303 | CD4009AE | 1 | | |
| U14 | IC, C-MOS, NAND | 375147 | 95303 | CD4023AE | 1 | | |
| U15 | IC, C-MOS, NAND | 355198 | 95303 | CD4011AE | 1 | | |
| U16 | IC, TTL, BCD Decoder/Driver | 340109 | 01295 | SN7447AN | 1 | | |
| U17 | IC, Linear, Vol Reg | 313106 | 07263 | U5R7723393 | 1 | | |
| U19 | IC, Linear, Vol Reg | 355107 | 07263 | UGH7805393 | 1 | | |
| U20 | IC, C-MOS, multi | 375808 | 95303 | CD4053AE | 1 | | |
| W2 | Wire Assy, Black (8800A-4001) | 373779 | 89536 | 373779 | 1 | | |
| W3 | Wire Assy, Blue (8800A-4009 | 378307 | 89536 | 378307 | 1 | | |
| W9 | Wire Assy, Red (8800A-4008) | 378299 | 89536 | 378299 | 1 | | |
| XK5 | Socket relay | 376665 | 12300 | 27E501 | 1 | | |
| Y1 | Crystal Teletype, 2 pole | 375493 | 75378 | TYPE H17 | 1 | | |
| | Conn, post | 376574 | 00779 | 5166-333-68 | 16 | | |
| | Heat Sink, Xstr | 370155 | 05820 | 204-CB | 5 | | |
| | Socket, 40 pin | 376244 | 23880 | TSA3100-40W | 1 | | |
| | Socket, 16 pin | 276535 | 23880 | TSA2900-16W | 3 | | |
| | Socket, 14 pin | 276527 | 23880 | TSA2900-14W | 4 | | |
| | Terminal, feed thru | 281865 | 12615 | SL841-777 | 2 | | |
| | Transipad, Xstr | 152207 | 07047 | 10123-DAP | 5 | | |

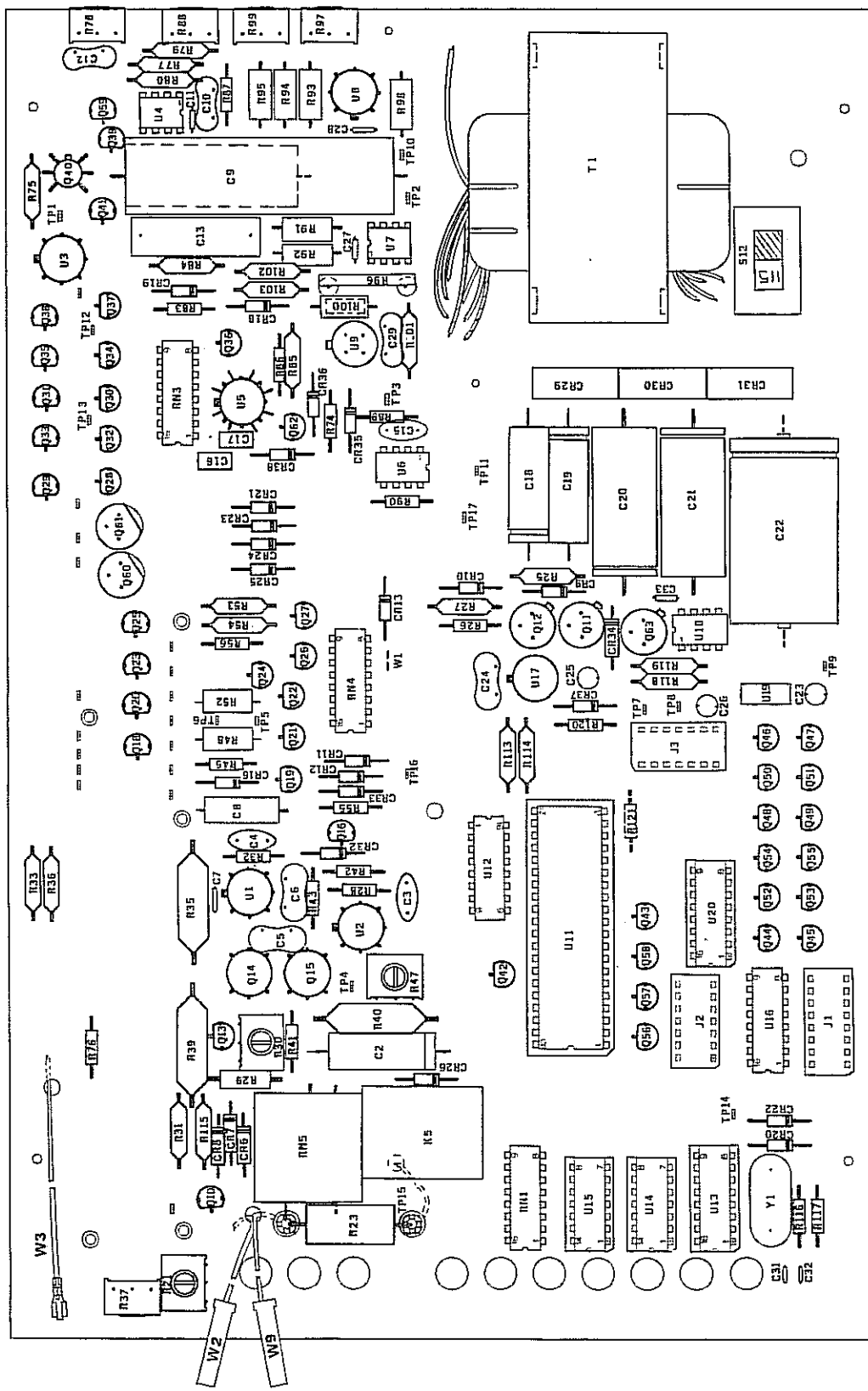


Figure 5-2. MAIN PCB ASSEMBLY

Table 5-3. FRONT PANEL 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 ASSEMBLY Figure 5-3 | | | | | | |
| A3A1 | Display Assembly | 366278 | 89536 | 366278 | 1 | | |
| 2 | Panel, front, molded | 363663 | 89536 | 363663 | 1 | | |
| 3 | Actuator, SW, putty grey | 364711 | 89536 | 364711 | 10 | | |
| 4 | Actuator, SW, green | 364729 | 89536 | 364729 | 1 | | |
| 5 | Binding post, red | 275552 | 32767 | 825-65 | 2 | | |
| 6 | Binding post, black | 275560 | 32767 | 825-45 | 2 | | |
| 7 | Binding post, blue | 275578 | 32767 | 825-55 | 1 | | |
| 8 | Decal I, front panel | 376764 | 89536 | 376764 | 1 | | |
| 9 | Decal II, front panel | 376772 | 89536 | 376722 | 1 | | |
| 10 | Shorting link | 101220 | 24655 | 0938-9712 | 3 | | |
| 11 | Connector Tab | 267609 | 00779 | 60837-1 | 1 | | |

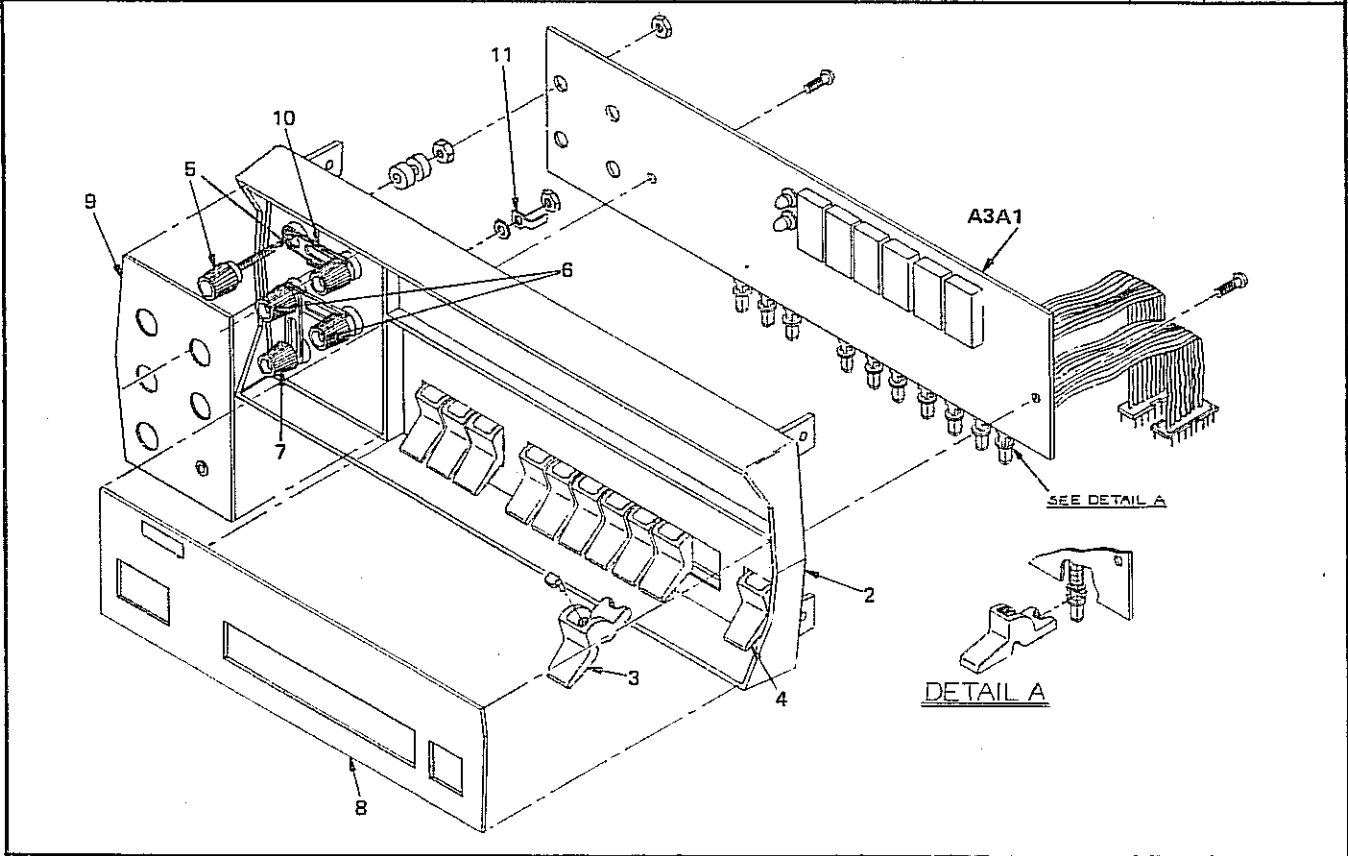


Figure 5-3. FRONT PANEL ASSEMBLY

Table 5-4. DISPLAY 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 |
|-----------------------|---------------------------------------|-----------------|------------------|-----------------------|---------|---------|---------|
| A3A1 | DISPLAY ASSEMBLY Figure 5-4 | 366278 | 89536 | 366278 | REF | | |
| C1 | Cap, cer, 47pF ±10%, 2kV/3.5kV | 282145 | 00656 | HVD3-47±10%, 2KV-I | 1 | | |
| CR2, CR3 | Diode, LED | 385914 | 89536 | 385914 | 2 | | |
| DS1 | Display, LED | 380444 | 50579 | DL707-812 | 1 | | |
| DS2 thru DS6 | Display, LED | 380436 | 50579 | DL707-811 | 5 | | |
| P1 | Cable Assy, 16P | 380576 | 89536 | 380576 | 1 | | |
| P2 | Cable Assy, 14P | 380568 | 89536 | 380576 | 1 | | |
| RN1 | Res, network | 381376 | 89536 | 381376 | 1 | | |
| S1 thru S10 | Switch Assy | 390500 | 89536 | 390500 | 1 | | |
| | Conn, post | 379438 | 00779 | 86144-5 | 9 | | |

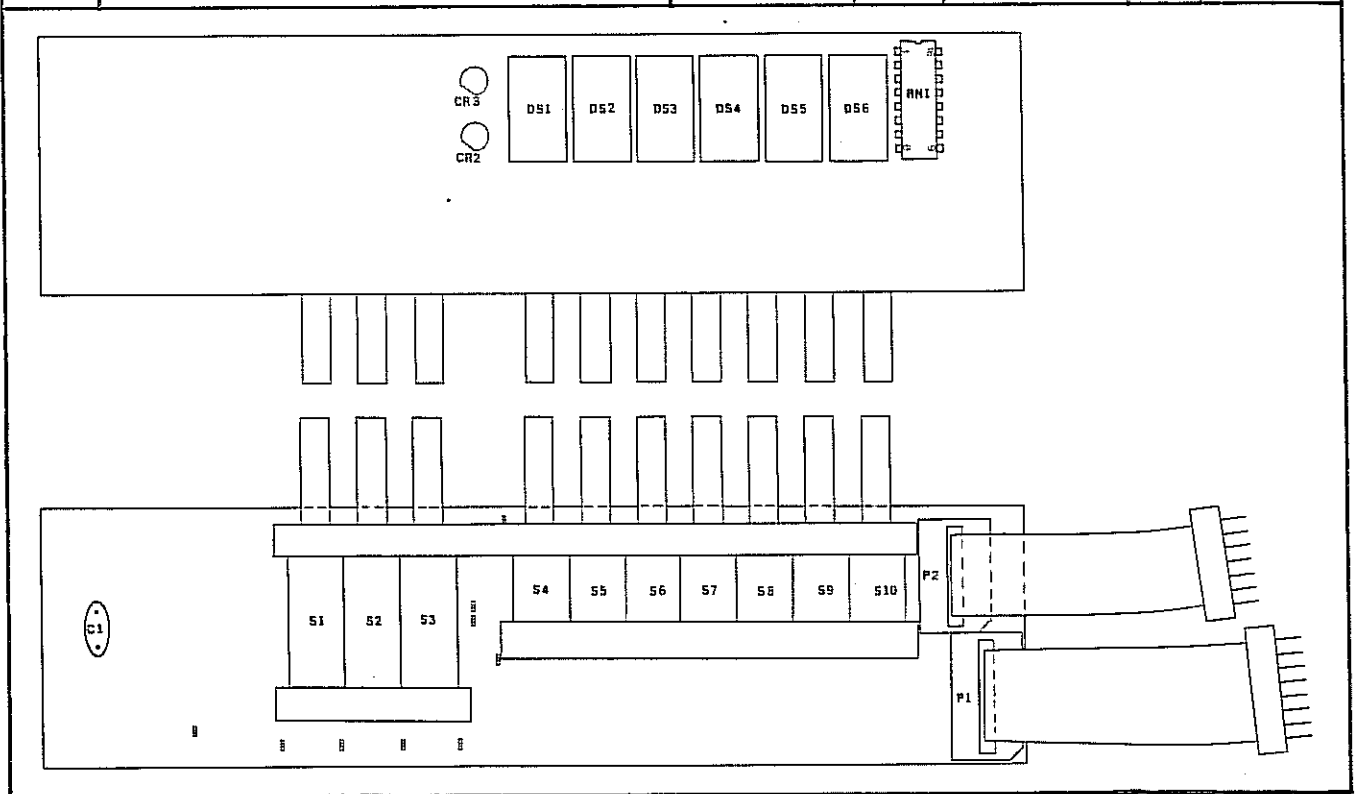


Figure 5-4. DISPLAY ASSEMBLY

Table 5-5. OHMS CONVERTER PCB

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|--|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| A4 | OHMS CONVERTER ASSEMBLY Figure 5-5 | 366302 | 89536 | 377302 | REF | | |
| BT1, BT2 | Battery, Alkaline, 1.5V | 376756 | 90303 | MN1500 | 2 | | |
| C1 | Cap, plstc. .022uF $\pm 10\%$, 100V | 333823 | 84411 | 863UW22391 | 1 | | |
| CR1 | Diode, multi-pellet, Si | 375477 | 09214 | MPD200 | 1 | | |
| CR2 | Not Used | | | | | | |
| CR3 | Diode, rectifier | 112383 | 05277 | SCE6 | 1 | | |
| CR4, CR5 | Diode, Si, hi-speed switching | 203323 | 07910 | TD8253 | 2 | | |
| K1 thru K4 | Relay, reed, spst, 4.5V | 357582 | 71707 | UF40070 | 4 | | |
| Q1 | Xstr, PNP, Si | 195974 | 04713 | 2N3906 | 1 | | |
| Q2 | Xstr, NPN, | 218511 | 09213 | 65120 | 1 | | |
| Q3, Q7, Q17 | Xstr, NPN | 168716 | 12040 | SM07154 | 3 | | |
| Q4, Q6, Q8 | Xstr, J-FET | 343830 | 12040 | KE4416 | 3 | | |
| Q5, Q9 | Xstr, NPN | 218396 | 04713 | 2N3904 | 2 | | |
| RN6 | Res, network | 363796 | 89536 | 363796 | 1 | | |
| R1 | Res, fxd car, 22K $\pm 5\%$, $\frac{1}{4}W$ | 348870 | 80031 | CR251-4-5P22 KT | 1 | | |
| R2, R16 R17, R18 | Res, fxd car, 1M $\pm 5\%$, $\frac{1}{4}W$ | 348987 | 80031 | CR251-45P1MT | 4 | | |
| R3 | Res, mxd car, 562 $\pm 1\%$, $\frac{1}{4}W$ | 340828 | 80031 | CR251-41P562 T | 1 | | |
| R4, R7, R9 | Not Used | | | | | | |
| R5 | Res, var, 50K $\pm 10\%$, $\frac{1}{2}W$ | 288290 | 71450 | 360S503A | 1 | | |
| R6 | Res, var, 2K $\pm 10\%$, $\frac{1}{2}W$ | 285163 | 71450 | 360S202A | 1 | | |
| R8 | Res, var, 100 $\pm 10\%$, $\frac{1}{2}W$ | 285130 | 71450 | 360S101A | 1 | | |
| R10 | Res, var 100K $\pm 10\%$, $\frac{1}{2}W$ | 288308 | 71450 | 360S104A | 1 | | |

Table 5-5. OHMS CONVERTER PCB (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|--|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| R11 | Res, met flm, 1M \pm 1%, 1/8W | 268797 | 91637 | MFF1-81004 F | 1 | | |
| R12 | Res, fxd, car, 33K, 5%, 1/4W | 348888 | 80031 | CR251-45P33K TS | 1 | | |
| R13 | Res, var, 10K \pm 10%, 1/2W | 285171 | 71450 | 360S103A | 1 | | |
| R14 | Res, met flm, 95.3K \pm 1%, 1/8W | 289561 | 91637 | MFF1-89532F | 1 | | |
| R19 | Res, fxd car, 150K \pm 5%, 1/4W | 348938 | 80031 | CR251-45P150 KT | 1 | | |
| R20 | Res, fxd car, 330K \pm 5%, 1/4W | 376640 | 80031 | CR251-45P330 KT | 1 | | |
| W4 | Wire Assy - Brown (8800A-4403) | 373738 | 89536 | 373738 | 1 | | |
| W5 | Wire Assy - Orange/White (8800A-4-410) | 391342 | 89536 | 391342 | 1 | | |
| W6 | Wire Assy - Yellow (8800A-4406) | 373761 | 89536 | 373761 | 1 | | |
| W7 | Wire Assy - Black/White (8800A-4407) | 378281 | 89536 | 378281 | 1 | | |
| | Battery holder (Used on BT1, BT2) | 380600 | 91833 | TYPE 2140 | 1 | | |
| | Conn, plug/jack | 170480 | 74970 | 105-752 | 3 | | |
| | Conn, recpt, mod 2 | 375329 | 00779 | 85863-3 | 8 | | |
| | Transipad, Xstr | 152207 | 07047 | 10123-DAP | 1 | | |

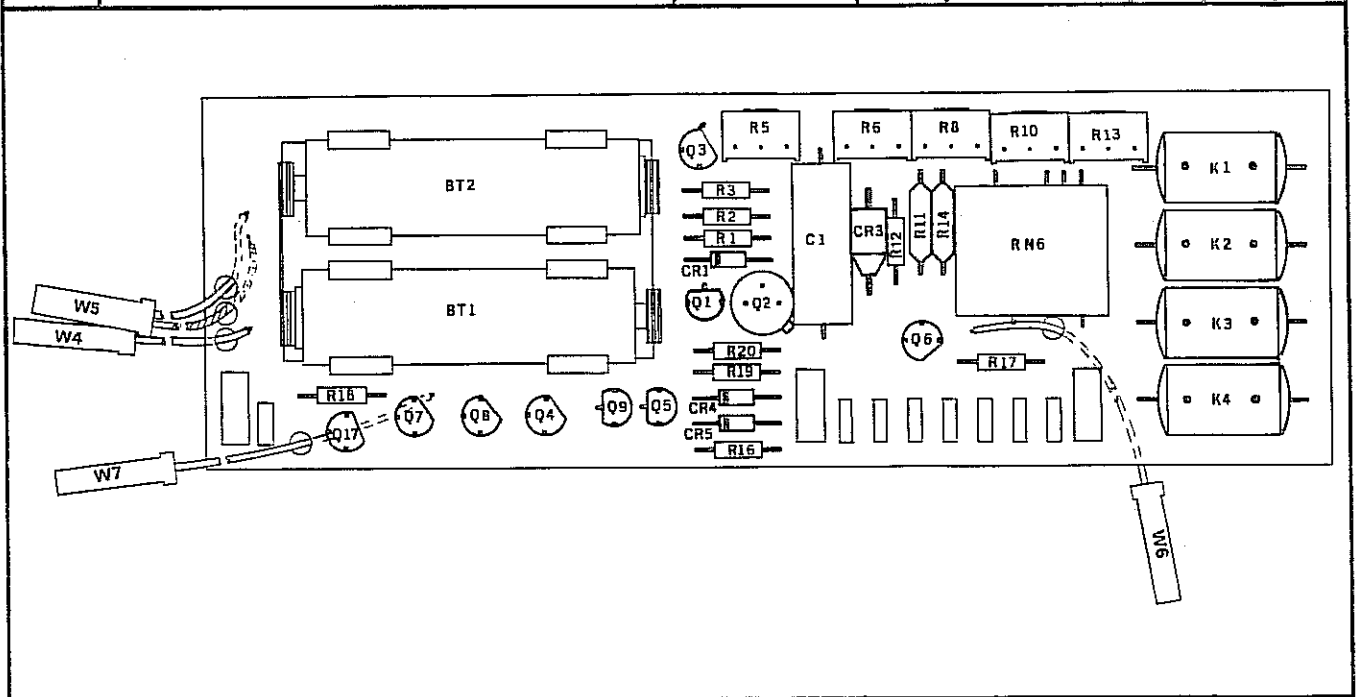


Figure 5-5. OHMS CONVERTER ASSEMBLY

Table 5-6. AC CONVERTER PCB

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|--|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| A5 | AC CONVERTER ASSEMBLY Figure 5-6 | 366336 | 89536 | 366336 | REF | | |
| C1 | Cap, cer, 50,000 pF \pm GMV, 1KV/2KV | 355420 | 56289 | 41C169A3 | 1 | | |
| C2, C7 | Cap, var, trimmer | 273151 | 74970 | 273-0001-002 | 2 | | |
| C3, C5 | Cap, cer, 0.22uF \pm 20%, 50V | 309849 | 71590 | CW30C224K | 2 | | |
| C4 | Cap, cer, mini, 15 pF \pm 2%, 100V | 369074 | 80031 | 2222-631-10159 | 1 | | |
| C6 | Cap, cer, mini, 2.2 pF \pm 0.25 pF, 100V | 362731 | 80031 | 2222-631-09228 | 1 | | |
| C8 | Cap, cer, mini, 27 pF \pm 2%, 100V | 362749 | 80031 | 2222-631-10279 | 1 | | |
| C9 | Cap, var, mini, 1.7 - 10 pF, 250V | 375238 | 91293 | 9331 | 1 | | |
| C10 | Cap, fxd mica, 400 pF \pm 1%, 500V | 385328 | 71236 | DM15F401F | 1 | | |
| C11 | Cap, poly St, 9100 pF \pm 2.5%, 160V | 355321 | 25088 | B31310/9100/ 2.5/160 | 1 | | |
| C12 | Cap, Ta, 10 uF \pm 20%, 15V | 193623 | 56289 | 196D106X0015 JA1 | 1 | | |
| C13, C14, C26 | Cap, Ta, 220 uF \pm 20%, 6V | 408682 | 56289 | 196D227X901 OTE4 | 2 | | |
| C15 | Cap, Ta, 5.6 uF \pm 20%, 25V | 368969 | 56289 | 196D565X0025 JA1 | 1 | | |
| C16,C17 | Cap, plstc, 0.47 uF \pm 10%, 100V | 369124 | 73445 | C280MAH/A47 OK | 2 | | |
| C18 | Cap, Ta, 39 uF \pm 20%, 6V | 163915 | 56289 | 196D396X0006 JA1 | 1 | | |
| C19 | Cap, cer, 180 pF \pm 10%, 1KV/1.3KV | 105890 | 71590 | BB60181KS3N | 1 | | |
| C20, C21, C22 | Cap, cer, 0.01 uF \pm 20%, 100V | 149153 | 56289 | C023B101F10 3M | 3 | | |
| CL1 | Diode, FET, current limiter | 334714 | 07910 | TCR5315 | 1 | | |
| CR1 thru CR5 | Diode, Lo leak, sil, 1.0 pF, .1V | 375907 | 09214 | 1N3062 TYPE | 5 | | |
| K6, K7, K8 | Relay, reed spst, 4.5V | 357566 | 71707 | E8182 | 3 | | |

Table 5-6. AC CONVERTER PCB (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------------------|---|-----------------------|---------------------------|-------------------------------|------------|------------|------------|
| Q1 | Xstr, dual FET | 379321 | 17856 | E7024 | 1 | | |
| Q2, Q8 | Xstr, NPN, Si | 218396 | 04713 | 2N3904 | 2 | | |
| Q4 | Xstr, Selected | 352146 | 89536 | 352146 | 1 | | |
| Q5 | Xstr, NPN | 330803 | 04713 | MPS6560 | 1 | | |
| Q6, Q7, Q9 | Xstr, J-FET, N-channel | 343830 | 12040 | KE4416 | 3 | | |
| R1 | Res, met flm, 2.0M $\pm 0.5\%$, 1W | 354894 | 19701 | MF8CRED | 1 | | |
| R2 | Res, met flm, 78.7K $\pm 1\%$, 1/8W | 289058 | 91637 | MFF1-87872F | 1 | | |
| R3 | Res, met flm, 100K $\pm 1\%$, 1/8W | 248807 | 91637 | MFF1-81003F | 1 | | |
| R4 | Res, car flm, 240 $\pm 5\%$, 1/4W | 376624 | 80031 | CR251-45P240 T | 1 | | |
| R5 | Res, met flm, 498, 890 $\pm 0.1\%$, 1/4W | 357632 | 91637 | MFF1-4498890 R1PCT | 1 | | |
| R6 | Res, var, 2K $\pm 10\%$, 1/2W | 285163 | 71450 | 360S202A | 1 | | |
| R7 | Res, met flm, 55, 151 $\pm 0.1\%$, 1/8W | 357624 | 91637 | MFF1-855151 R1PCT | 1 | | |
| R8 | Res, var, 200 $\pm 10\%$, 1/2W | 285148 | 71450 | 360S201A | 1 | | |
| R9 | Res, met flm, 4787.4 $\pm 0.1\%$, 1/8W | 357616 | 91637 | MFF1-84787R4 R1PCT | 1 | | |
| R10 | Res, var, 20 $\pm 20\%$, 1/2W | 285114 | 71450 | 360S200B | 1 | | |
| R11, R17 | Res, met flm, 250 $\pm 0.1\%$, 1/8W | 357608 | 91637 | MFF1-8251 R1PCT | 2 | | |
| R12 | Res, fxd car, 0.50 $\pm 5\%$, 1/4W | 381954 | 80031 | CR1-45P0.50 Ω S | 1 | | |
| R13 | Res, met flm, 9.09K $\pm 1\%$, 1/8W | 221663 | 91637 | MFF1-89091F | 1 | | |
| R14 | Res, met flm, 33.2K $\pm 1\%$, 1/8W | 291393 | 91637 | MFF1-83322F | 1 | | |
| R15 | Res, fxd car, 220 $\pm 5\%$, 1/4W | 342626 | 80031 | CR251-45P220T | 1 | | |
| R16 | Not Used | | | | | | |
| R18 | Res, fxd car, 3.3K $\pm 5\%$, 1/4W | 348813 | 80031 | CR251-45P3.3 KT | 1 | | |
| R19 | Res, fxd car, 10K $\pm 5\%$, 1/4W | 348839 | 80031 | CR251-45P10K T | 1 | | |
| R20 | Res, var, 50 $\pm 10\%$, 1/2W | 285122 | 71450 | 360S500A | 1 | | |
| R21 | Res, met flm, 2,194 $\pm 0.25\%$, 1/8W | 375345 | 91637 | MFF1-82194 R25PCT | 1 | | |
| R22 | Res, met flm, 68.1K $\pm 1\%$, 1/8W | 236828 | 91637 | MFF1-86812F | 1 | | |

Table 5-6. AC CONVERTER PCB (Continued)

| REF DESIG OR ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG FED SPLY CDE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|-----------------------|-----------------------------------|-----------------|------------------|----------------------|---------|---------|---------|
| R23 | Res, fxd car, 150K \pm 5%, 1/4W | 348938 | 80031 | CR251-45P150 KT | 1 | | |
| R24 | Res, fxd car, 220K \pm 5%, 1/4W | 348953 | 80031 | CR251-45P220 KT | 1 | | |
| R25 | Res, fxd car, 47K \pm 5%, 1/4W | 348896 | 80031 | CR251-45P47K T | 1 | | |
| R26 | Res, fxd car, 22 \pm 5%, 1/4W | 381145 | 80031 | CR251-45P22T | 1 | | |
| R27 | Res, fxd car 75K \pm 5%, 1/4W | 394130 | 80031 | CR251-45P75KT | 1 | | |
| R28 | Res, fxd car 12K \pm 5%, 1/4W | 348847 | 80031 | CR251-45P12K TS | 1 | | |
| R29 | Res, comp 47K \pm 5%, 1/4W | 148163 | 01121 | CB4735 | 1 | | |
| U1 | IC, Op amp | 329912 | 12040 | LM318H | 1 | | |
| WB | Wire Assy, white/red (8800A-4002) | 373688 | 89536 | 373688 | 1 | | |
| | Conn, plug/jack, red | 170480 | 74970 | 105-752 | 2 | | |
| | Conn, rect, mod 2 | 375329 | 00779 | 85863-3 | 8 | | |

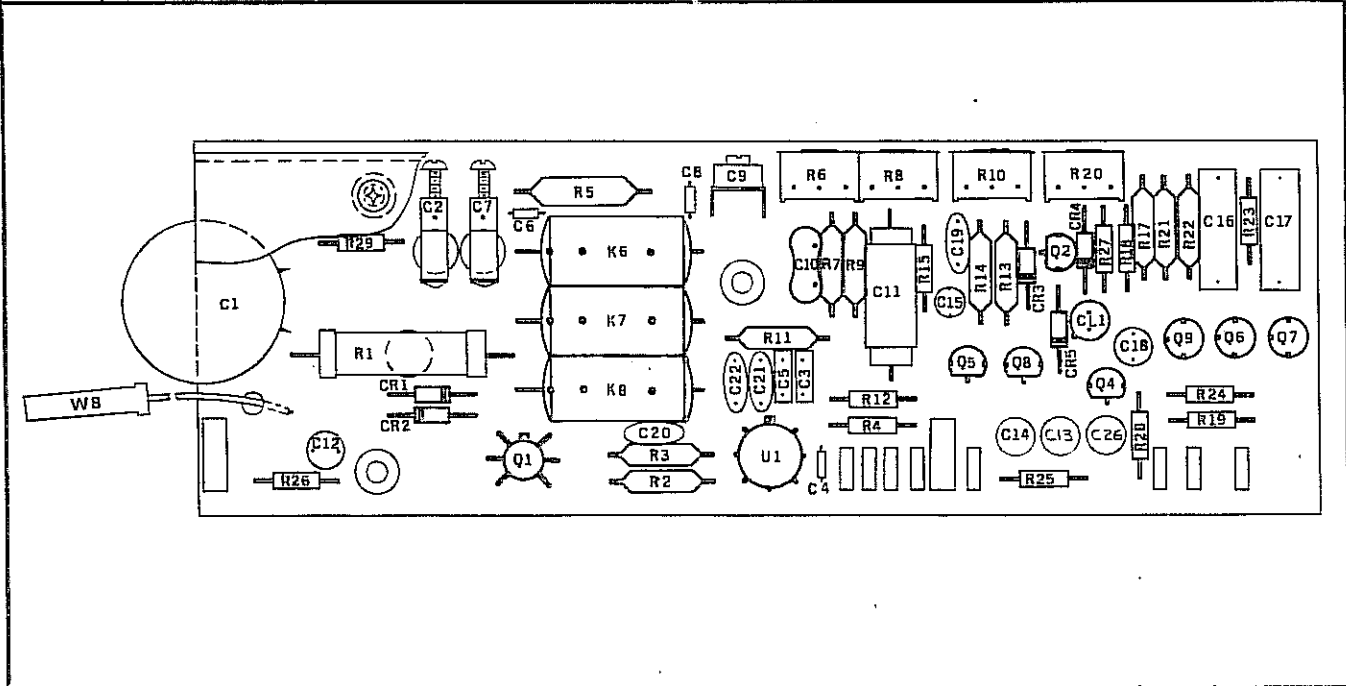


Figure 5-6. AC CONVERTER ASSEMBLY

Table 5-7. DOU PCB

| 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 Figure 5-7 | -02 Option | | | | | |
| C1, C3 | Cap, elect, 200 uF +50/-10%, 10V | 236935 | 73445 | ET221X010A5 | 2 | | |
| C2 | Cap, plstc, 0.022 uF ±10%, 50V | 271577 | 06001 | 75F1R5A222 | 1 | | |
| C4 | Cap, fxd, cer, 0.05 uF +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, fxd, car dep, 1K ±5%, ¼W | 343426 | TOYO | R251025 | 2 | | |
| R17, R18 | Res, fxd, comp, 4.7M ±5%, ¼W | 220046 | 01121 | CB4755 | 2 | | |
| RN1 | Res, network | 385930 | 89536 | 385930 | 1 | | |
| T1 | Xfmr, 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, COS-MOS, NOR Gates | 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 Gates | 363820 | 49671 | CD4002AE | 1 | | |
| U16, U17 | Op to Isolator, photo Xstr | 380014 | 86539 | 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 | | |

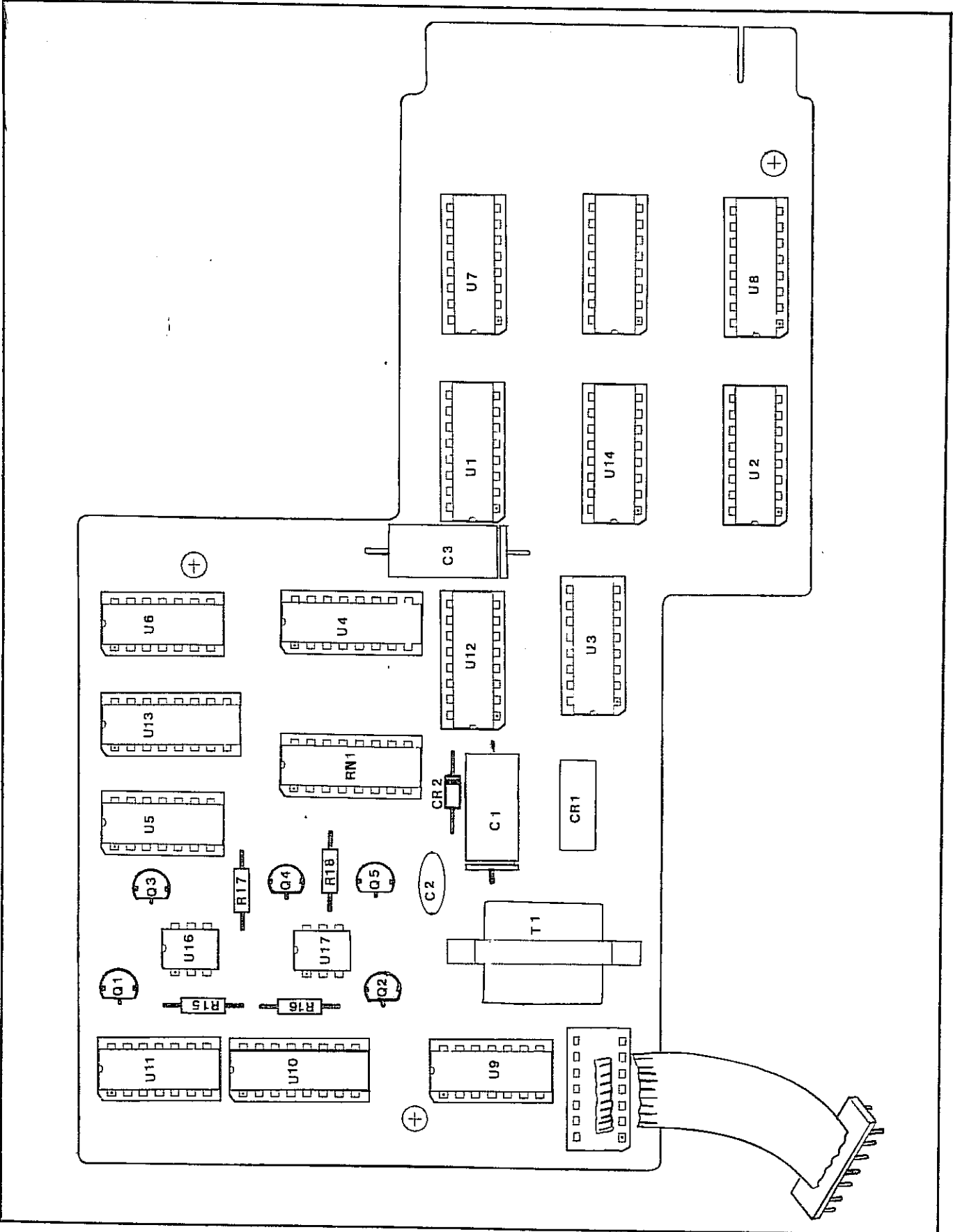


Figure 5-7. DOU PCB ASSEMBLY

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. HIGH VOLTAGE PROBE (80K40)

6-4. Introduction

6-5. 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 8800A up to 40 kV dc. A schematic of the 80K-40 probe is shown in Figure 6-8.

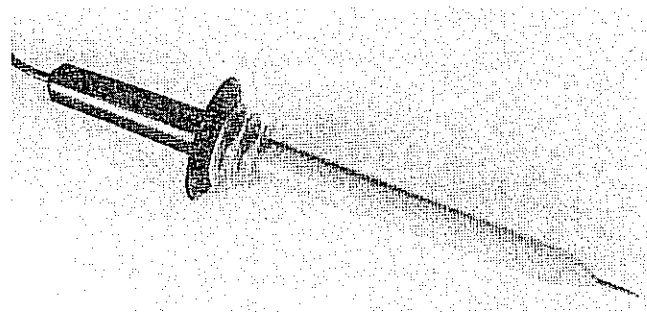


Figure 6-1. HIGH VOLTAGE PROBE (80K-40)

6-6. Specifications

| | |
|-------------------|--|
| Overall Accuracy: | 20kV to 30kV $\pm 2\%$ (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: | 1000M Ω |
| Division Ratio: | 1000:1 |

6-7. Operation

6-8. Use the following procedure for operating the 8800A with the 80K-40 probe:

- Plug the 80K-40 dual-banana plug into the INPUT - Ω SENSE HI and LO terminals on the 8800A.
- Depress the DCV pushbutton (FUNCTION)
- Select the desired voltage range in accordance with Table 6-1.
- Connect the common probe lead to a suitable ground and touch the probe tip to the circuit point to be measured.
- Observe dc voltage reading displayed in kilovolts on the 8800A 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 8800A.

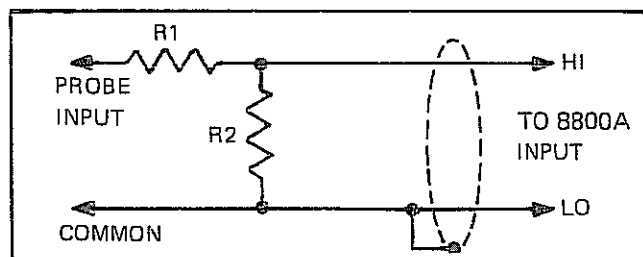


Figure 6-2. HIGH VOLTAGE PROBE, SCHEMATIC

Table 6-1. 8800A RANGES FOR DC HV PROBE (80D-40)

| 8800A RANGE SELECTED | 8800A VOLTAGE RANGE WITH 80K-40 PROBE |
|----------------------|---------------------------------------|
| 200 | 20 to 40 kV |
| 20 | 2 to 20 kV |
| 2 | 1 to 2 kV |

6-9. HIGH FREQUENCY PROBE (80RF-1)

6-10. Introduction

6-11. The Model 80RF-1 High Frequency Probe, Figure 6-9, extends the frequency range of the 8800A 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 8800A using a shielded dual-banana plug and an adapter.

6-12. 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 $\pm 10\%$.

| | 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 3/4-inch dual banana connectors.
 Cable Length: 4 ft.(121,9 cm) minimum
 Weight: 3 1/2 oz. net
 Accessories: Ground lead, straight tip, hook tip, high frequency adapter

6-13. Operating Notes

6-14. 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.

6-15. 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.

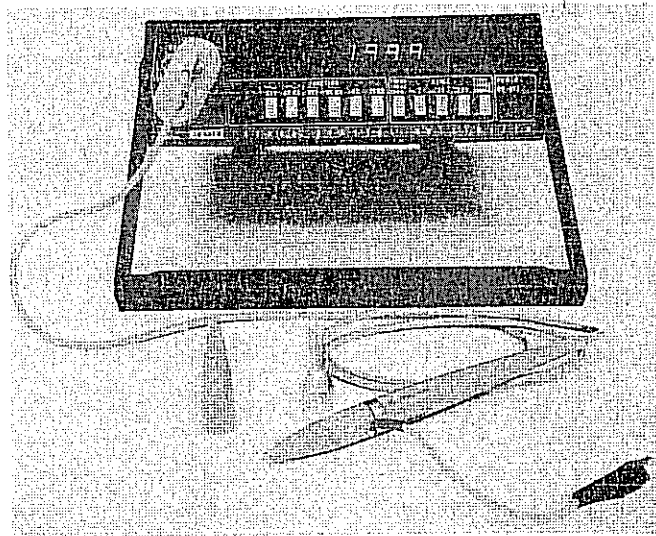


Figure 6-3. 80RF-1, HIGH FREQUENCY PROBE

6-16. Operation

6-17. Use the following procedure for operating the 8800A with the 80RF-1 probe:

- a. Connect the 80RF-1 shielded dual-banana plug to the 8800A V- Ω and COMMON 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 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 8800A readout.

6-18. Theory of Operation

6-19. A schematic diagram of the 80RF-1 High Frequency probe is given in Figure 6-4. 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.

6-20. Diode CR2 compensates for the non-linearity of the detector, and R3 is a selected part having a value of 50 k Ω to 100 k Ω .

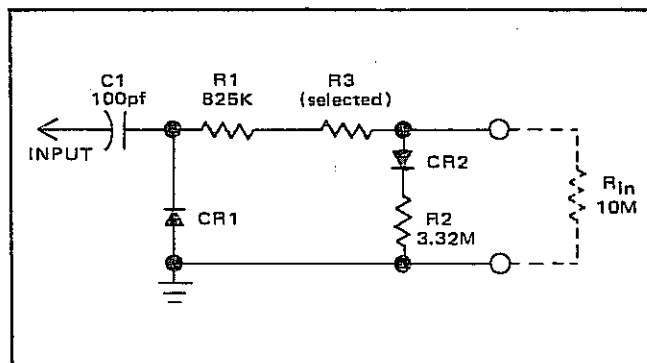


Figure 6-4. 80RF-1 SCHEMATIC

6-21. Maintenance

6-22. PERFORMANCE TEST

6-23. 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.

6-24. Low Frequency Response

6-25. Connect equipment as shown in Figure 6-5, and perform the following steps.

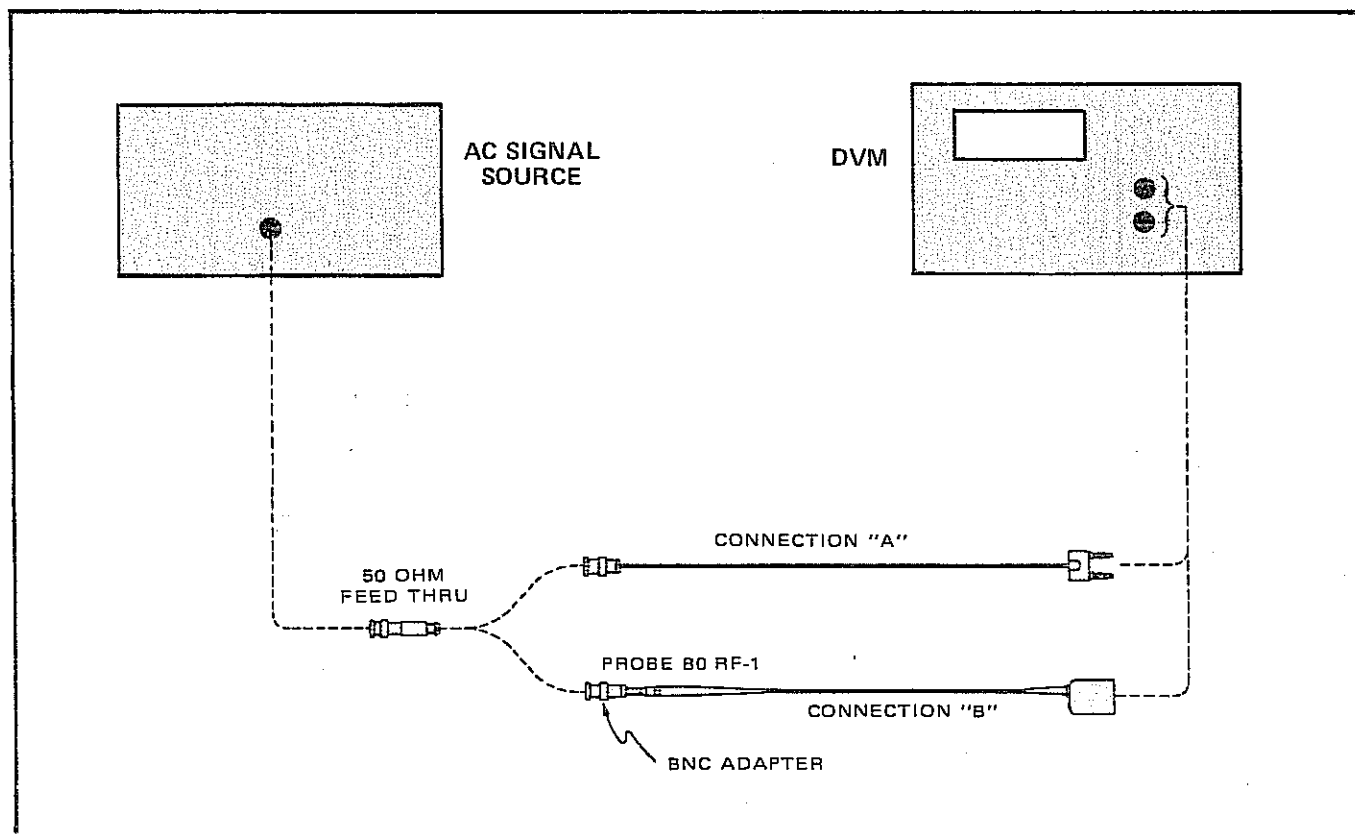


Figure 6-5. LOW FREQUENCY RESPONSE CHECK

- 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.

6-26. High Frequency Response

6-27. Connect equipment to the 80RF-1 probe as shown in Figure 6-6, 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.

6-28. CALIBRATION

6-29. 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 k Ω change in R3 will produce about a 1% deviation in the reading.

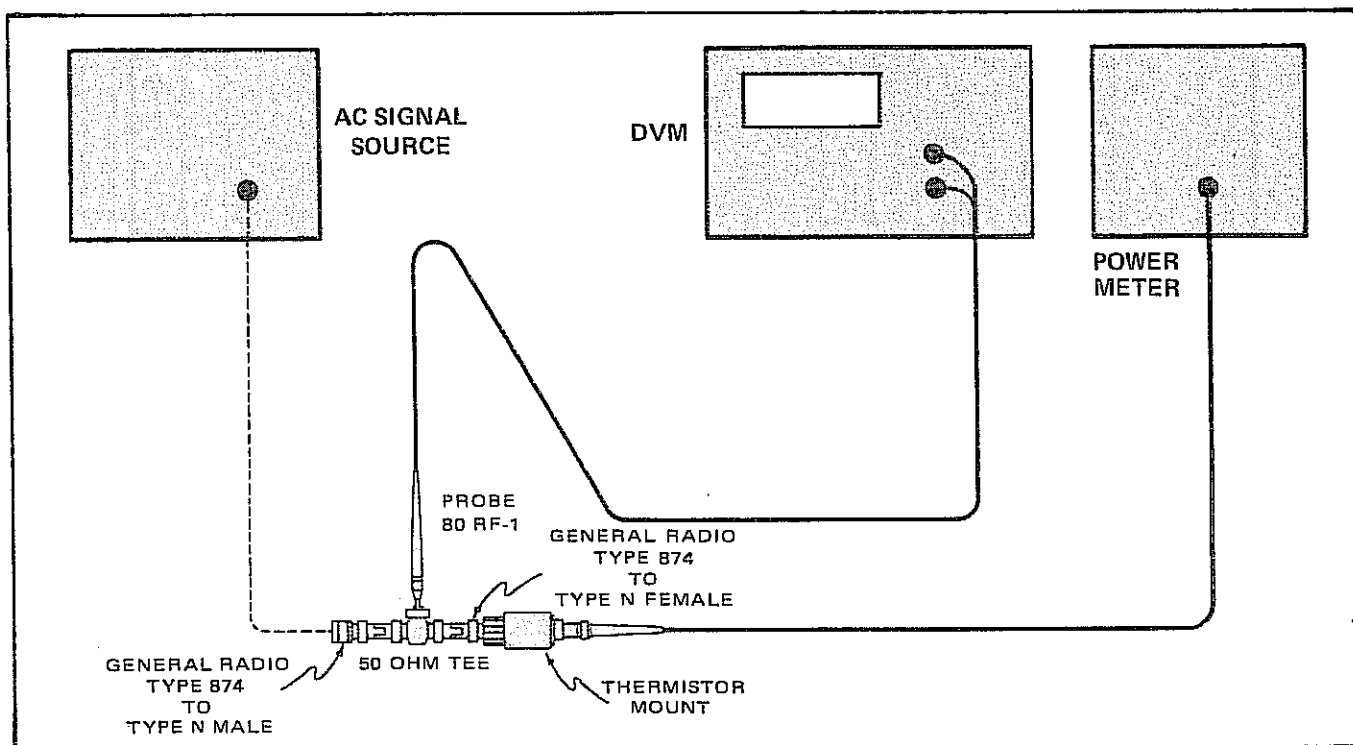


Figure 6-6. HIGH FREQUENCY RESPONSE CHECK

6-30. HIGH FREQUENCY PROBE (81RF)

6-31. Introduction

6-32. The Model 81RF High Frequency Probe, Figure 6-7, extends the frequency range of the 8800A 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 8800A using a shielded dual-banana plug and an adapter.

6-33. Specifications

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

6-34. Operation

6-35. Use the following procedure for operating the 8800A with the 81RF probe:

- a. Connect the 81RF shielded dual-banana plug to the 8800A INPUT $\cdot \Omega$ SENSE HI and LO 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 8800A readout.

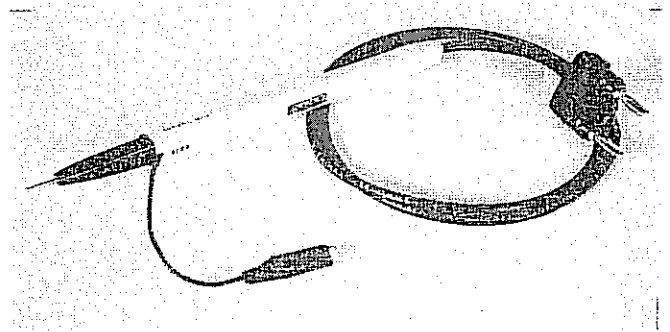


Figure 6-7. HIGH FREQUENCY PROBE (81RF)

6-36. DELUXE TEST LEAD KIT (A80)

6-37. The deluxe test lead kit, shown in Figure 6-8, 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.

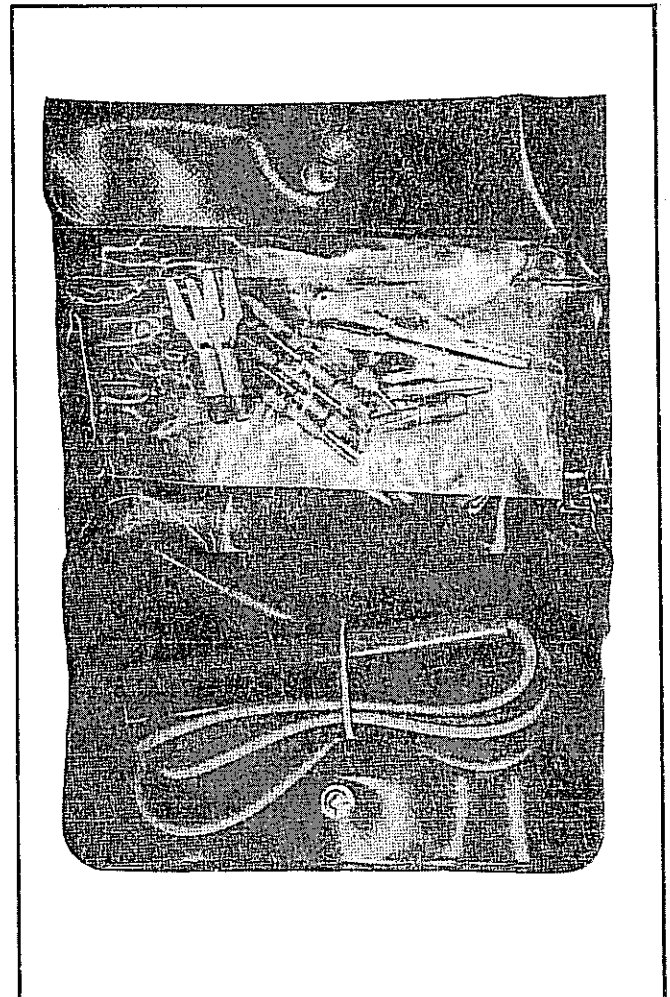


Figure 6-8. DELUXE TEST LEAD KIT (A80)

6-38. RACK MOUNT KIT

6-39. Introduction

6-40. A rack mounting kit is available for mounting the 8800A in a standard 19-inch equipment rack. The rack mounting kit positions the 8800A in the center of the equipment rack.

6-41. Installation Procedure

6-42. Installation instructions for the rack mounting kit are presented below. Refer to Figure 6-9 while performing the steps of the mounting procedure.

- a. Remove the handle disc decal and handle; retain the handle mounting screws.
- b. Remove the instrument retaining screws (rear of the case) and remove the instrument from the case.

- c. Insert the open end of the instrument case into the center rack mount plate until the case is flush with the front surface of the plate. Fasten the rack mount brackets and retainers to the case as shown.
- d. Secure the brackets and retainers to the handle mounting bosses using the handle mounting screws. Take care to avoid stripping the threads.
- e. Position the instrument case on the center rack mount plate and fasten the brackets using the 6-32 nuts.
- f. Re-install the instrument in the case and replace the instrument retaining screw.

6-43. DATA OUTPUT UNIT (OPTION -02)

6-44. Introduction

6-45. The Data Output Unit (DOU) provides digital measurement information to a rear panel output connector

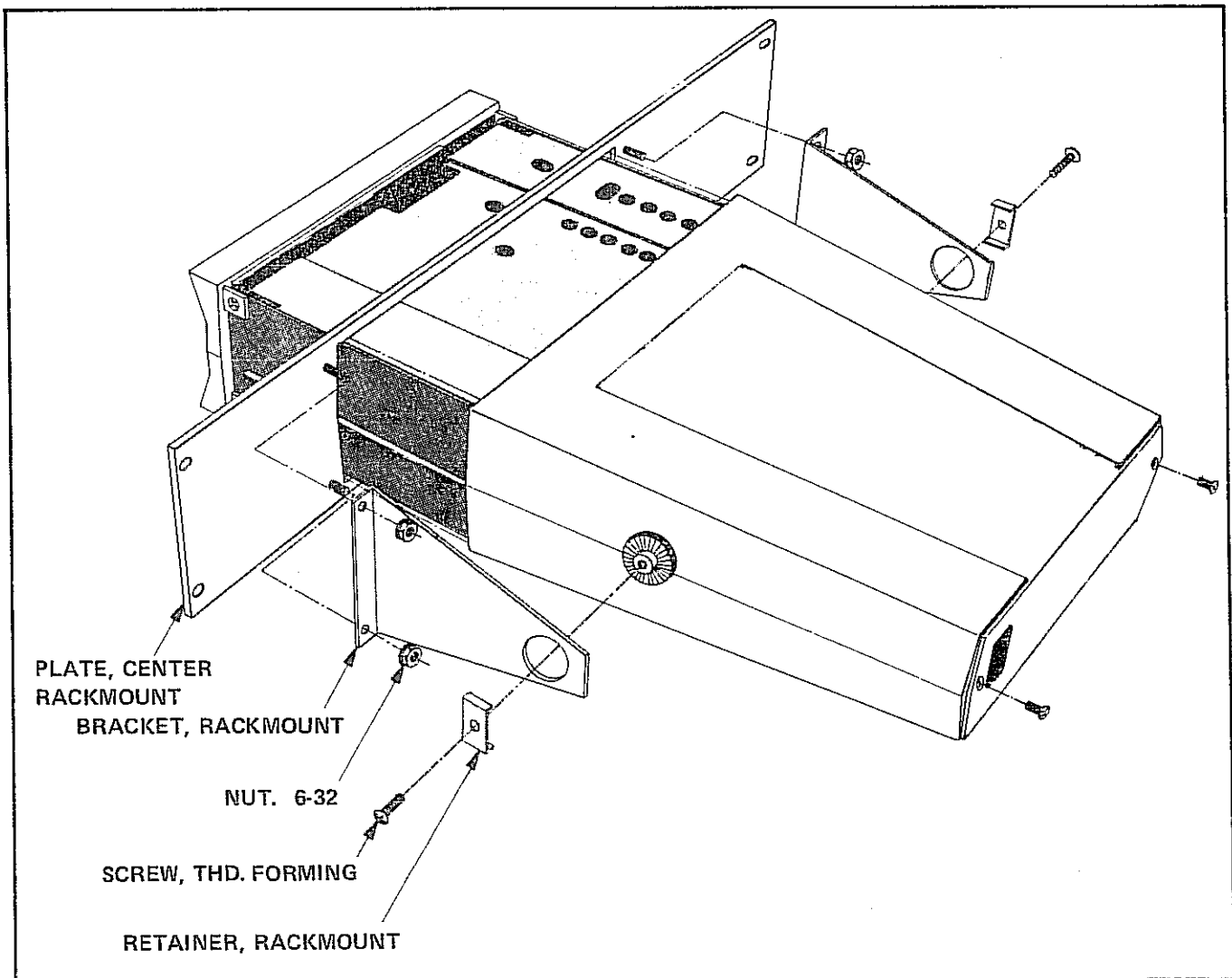


Figure 6-9. RACKMOUNT INSTALLATION

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.

6-46. Specifications

6-47. The specifications for the DOU are presented in Section 1 of this manual.

6-48. Operation

6-49. DOU DATA IDENTIFICATION

6-50. The data available at the rear panel DOU connector is listed in Table 6-2. The connector pin assignment and logic level requirement for each signal is provided.

6-51. DATA UPDATE

6-52. 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 8800A measurement. A logic level 1 (+4.75 to +5.25V) applied to DOU connector pin D will cause the data on the connector to be updated 2.5 times each second. The data

can be updated by an external command by applying a logic 0 (0.0 to +0.4V) to pin D, a logic 1 to pin B (ARM ENABLE) and a positive trigger pulse to pin C (ARM INPUT) each time the data is to be updated.

6-53. BUSY FLAG

6-54. 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.

6-55. POLARITY FLAG

6-56. 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.

Table 6-2. DOU DATA IDENTIFICATION

| DOU DATA NAME | DOU PIN NO. | DOU DATA NAME | REMARKS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|-------------|-----------------------|---|----------------|--|---|-----|---|-----|---|-----|---|-----|-------|------|--|--|---|---|---|------|---|---|---|----|---|---|---|-----|---|---|---|------|---|---|---|-------|---|---|---|------|---|---|---|
| +5V | 1 A | LOGIC RETURN | <table border="1"> <tr> <th colspan="2">BCD BIT WEIGHT</th> </tr> <tr> <td>W</td> <td>= 8</td> </tr> <tr> <td>X</td> <td>= 4</td> </tr> <tr> <td>Y</td> <td>= 2</td> </tr> <tr> <td>Z</td> <td>= 1</td> </tr> </table> <table border="1"> <tr> <th rowspan="2">RANGE</th> <th colspan="3">CODE</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> </tr> <tr> <td>200Ω</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>2K</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>20K</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>200K</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>2000K</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>20MΩ</td> <td>1</td> <td>1</td> <td>0</td> </tr> </table> | 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 |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 @ | 6 F | c RANGE CODE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RANGE CODE b | 7 H | a 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 (8800A) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

6-57. OVERLOAD INDICATION

6-58. 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.

6-59. RANGE CODE

6-60. 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 6-2.

6-61. DISPLAY DIGIT

6-62. 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 6-2. 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.

6-63. DOU INTERFACE CABLE

6-64. 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.

6-65. Theory of Operation

6-66. The DOU receives four lines (W, X, Y, and Z) or data, in character serial format, from the instrument; each line containing eight bits of data. The data lines are sequentially gated, by four successive strobe S signals, across an isolation circuit to a series of shift registers. The data from the shift registers is applied through inverting amplifiers to the DOU output connector. A schematic of the DOU circuitry is provided in Figure 8-7.

6-67. The external trigger synchronizing circuit produces an enabling signal that allows the shift registers to accept new data. When a logic 1 is applied to the DOU connector pin D (FREE RUN) the sync circuit will enable the shift registers to update the data with each new input from the instrument. By applying a logic 0 to pin D and a logic 1 to pin B (ARM ENABLE), a positive trigger at pin C (ARM INPUT) will cause the sync circuit to enable the shift registers for the first complete data input that occurs after the arm-input-trigger.

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the

Lists of Replaceable parts contained in Section 5. The following information is presented in this section:

| TABLE | TITLE | PAGE |
|-------|--|------|
| 7-1. | List of Abbreviations | 7-1 |
| 7-2. | Federal Supply Codes for Manufacturers | 7-3 |
| 7-3. | Fluke Technical Service Centers | 7-10 |
| 7-4. | Sales Representatives - Domestic | 7-11 |
| 7-5. | Sales Representatives - International | 7-13 |

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS

| | | | |
|----------|-----------------------------|-------|-----------------------------|
| A or amp | ampere | cont | continue |
| ac | alternating current | crt | cathode-ray tube |
| af | audio frequency | cw | clockwise |
| a/d | analog-to-digital | d/a | digital-to-analog |
| assy | assembly | dac | digital-to-analog converter |
| AWG | american wire guage | dB | decibel |
| B | bel | dc | direct current |
| bcd | binary coded decimal | dmm | digital multimeter |
| °C | Celsius | dvm | digital voltmeter |
| cap | capacitor | elect | electrolytic |
| ccw | counter clockwise | ext | external |
| cer | ceramic | F | farad |
| cermet | ceramic to metal (seal) | °F | Fahrenheit |
| ckt | circuit | FET | field-effect transistor |
| cm | centimeter | ff | flip-flop |
| cmrr | common mode rejection ratio | freq | frequency |
| comp | composition | FSN | federal stock number |

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS (Continued)

| | | | |
|------------|----------------------------|----------------|--|
| g | gram | opnl ampl. | operational amplifier |
| G | giga (10^9) | p | pico (10^{-12}) |
| gd | guard | para | paragraph |
| Ge | germanium | pcb | printed circuit board |
| GHz | gigahertz | pF | picofarad |
| gmV | guaranteed minimum value | pn | part number |
| gnd | ground | (+) or pos | positive |
| H | henry | pot | potentiometer |
| hd | heavy duty | p-p | peak-to-peak |
| hf | high frequency | ppm | parts per million |
| Hz | hertz | PROM | programmable read-only memory |
| IC | integrated circuit | psi | pound-force per square inch |
| if | intermediate frequency | RAM | random-access memory |
| in | inch(es) | rf | radio frequency |
| intl | internal | rms | root mean square |
| I/O | input/output | ROM | read-only memory |
| k | kilo (10^3) | s or sec | second (time) |
| kHz | kilohertz | scope | oscilloscope |
| k Ω | kilohm(s) | SH | shield |
| kV | kilovolt(s) | Si | silicon |
| lf | low frequency | serno | serial number |
| LED | light-emitting diode | sr | shift register |
| LSB | least significant bit | Ta | tantalum |
| LSD | least significant digit | tb | terminal board |
| M | mega (10^6) | tc | temperature coefficient or temperature compensating |
| m | milli (10^{-3}) | tcxo | temperature compensated crystal oscillator |
| mA | milliamperes(s) | tp | test point |
| max | maximum | u or μ | micro (10^{-6}) |
| mf | metal film | uhf | ultra high frequency |
| MHz | megahertz | us or μ s | microsecond(s) (10^{-6}) |
| min | minimum | uut | unit under test |
| mm | millimeter | V | volt |
| ms | millisecond | v | voltage |
| MSB | most significant bit | var | variable |
| MSD | most significant digit | vco | voltage controlled oscillator |
| MTBF | mean time between failures | vhf | very high frequency |
| MTTR | mean time to repair | vlf | very low frequency |
| mV | millivolt(s) | W | watt(s) |
| mv | multivibrator | ww | wire wound |
| M Ω | megohm(s) | xfmr | transformer |
| n | nano (10^{-9}) | xstr | transistor |
| na | not applicable | xtal | crystal |
| NC | normally closed | x \bar{t} lo | crystal oscillator |
| (-) or neg | negative | Ω | ohm(s) |
| NO | normally open | μ | micro (10^{-6}) |
| ns | nanosecond | | |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS

| | | | |
|-------|---|-------|---|
| 00213 | Sage Electronics Corp. Rochester, New York | 04009 | Arrow Hart and Hegemen Electronic Company Hartford, Connecticut |
| 00327 | Welwyn International, Inc. Westlake, Ohio | 04062 | Replaced by 72136 |
| 00656 | Aerovox Corp. New Bedford, Massachusetts | 04202 | Replaced by 81312 |
| 00686 | Film Capacitors Passaic, New Jersey | 04217 | Essex Wire Corp. Wire & Cable Div. Anaheim, California |
| 00779 | AMP Inc. Harrisburg, Pennsylvania | 04221 | Aemco, Div. of Midtex Inc. Mankato, Minnesota |
| 01121 | Allen-Bradley Co. Milwaukee, Wisconsin | 04222 | Aerovox Corp. (H-Q) Myrtle Beach, South Carolina |
| 01281 | TRW Semiconductors Lawndale, California | 04645 | Replaced by 75376 |
| 01295 | Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas | 04713 | Motorola Semiconductor Products Inc. Phoenix, Arizona |
| 01537 | Motorola Communications & Electrical Inc. Franklin Park, Illinois | 05082 | Replaced by 94154 |
| 01686 | RCL Electronics Inc. Manchester, New Hampshire | 05236 | Jonathan Mfg. Co. Fullerton, California |
| 01730 | Deleted | 05277 | Westinghouse Electric Corp. Semiconductor Dept. Youngwood, Pennsylvania |
| 01884 | Dearborn Electronics Inc. Orlando, Florida | 05278 | Replaced by 43543 |
| 02114 | Ferroxcube Corp. Saugerties, New York | 05397 | Union Carbide Corp. Electronics Div. Cleveland, Ohio |
| 02395 | Rason Mfg. Co. Brooklyn, New York | 05279 | Southwest Machine & Plastic Co. Los Angeles, California |
| 02533 | Snelgrove, C.R. Co., Ltd. Don Mills, Ontario, Canada M3B 1M2 | 05397 | Union Carbide Corp. Electronics Div. New York, New York |
| 02606 | Replaced by 15801 | 05571 | Sprague Electric Co. Pacific Div. Los Angeles, California |
| 02660 | Amphenol-Borg Elect. Corp. Broadview, Illinois | 05574 | Viking Industries Chaisworth, California |
| 02799 | Aero Capacitors, Inc. Torrence, California | 05704 | Alac, Inc. Glendale, California |
| 03508 | General Electric Co. Semiconductor Products Syracuse, New York | 05820 | Wakefield Engineering Ind. Wakefield, Massachusetts |
| 03614 | Replaced by 71400 | 06001 | General Electric Company Capacitor Department Irmo, South Carolina |
| 03651 | Replaced by 44655 | 06136 | Replaced by 63743 |
| 03797 | Eldema Corp. Compton, California | 06383 | Panduit Corp Tinley Park, Illinois |
| 03877 | Transistron Electronic Corp. Wakefield, Massachusetts | 06473 | Amphenol Space & Missile Sys. Chatsworth, California |
| 03888 | Pyrofilm Resistor Co., Inc. Cedar Knolls, New Jersey | 06555 | Beede Electrical Instrument Co. Penacook, New Hampshire |
| 03911 | Clairex Corp. New York, New York | 06739 | Electron Corp. Littleton, Colorado |
| 03980 | Muirhead Instruments, Inc. Mountainside, New Jersey | | |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

| | | | |
|-------|--|-------|---|
| 06743 | Clevite Corp. Cleveland, Ohio | 09969 | Dale Electronics Inc. Yankton, S Dakota |
| 06751 | Semcor Div., Components, Inc. Phoenix, Arizona | 11236 | CTS of Berne Berne, Indiana |
| 06860 | Gould National Batteries Inc. City of Industry, California | 11237 | Chicago Telephone of Calif. Inc., (CTC) Paso Robles, California |
| 06980 | Varian-Eimac San Carlos, California | 11358 | Discontinued |
| 07047 | Ross Milton, Co., The South Hampton, Pennsylvania | 11403 | Best Products Co. Chicago, Illinois |
| 07115 | Replaced by 14674 | 11503 | Keystone Mfg. Div. of Avis Industrial Corp. Warren, Michigan |
| 07138 | Westinghouse Electric Corp., Electronic Tube Division Elmira, New York | 11711 | General Instrument Corp Rectifier Division Hickville, New York |
| 07233 | TRW Electronic Components Cinch Graphic City of Industry, California | 11726 | Qualidyne Corp. Santa Clara, California |
| 07256 | Silicon Transistor Corp. Garden City, New York | 12014 | Chicago River & Machine Co. Bellwood, Illinois |
| 07263 | Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California | 12040 | National Semiconductor Corp. Danbury, Connecticut |
| 07344 | Bircher Co., Inc. Rochester, New York | 12060 | Diodes, Inc. Chatsworth, California |
| 07792 | Lerma Engineering Corp. Northampton, Massachusetts | 12136 | Philadelphia Handle Co. Camden, New Jersey |
| 07910 | Teledyne Corp. (Continental Device) Hawthorne, California | 12300 | Potter-Brumfield Division AMF Canada LTD. Guelph, Ontario, Canada |
| 08225 | Industro Transistor Corp. Long Island City, New York | 12323 | Presin Co., Inc. Shelton, Connecticut |
| 08261 | Spectra Strip Corp Garden Grove, California | 12327 | Freeway Washer & Stamping Co. Cleveland, Ohio |
| 08530 | Reliance Mica Corp. Brooklyn, New York | 12400 | Replaced by 75042 |
| 08792 | Discontinued | 12615 | U.S. Terminals Inc. Cincinnati, Ohio |
| 08806 | General Electric Co. Miniature Lamp Dept. Cleveland, Ohio | 12617 | Hamlin Inc. Lake Mills, Wisconsin |
| 08863 | Nylomatic Corp. Norrisville, Pennsylvania | 12697 | Clarostat Mfg. Co. Dover, New Hampshire |
| 08988 | Skottie Electronics Inc. Archbald, Pennsylvania | 12749 | James Electronics Chicago, Illinois |
| 09214 | G.E. Semi-Conductor Products Dept. Auburn, New York | 12856 | Micrometals Sierra Madre, California |
| 09353 | C and K Components Watertown, Massachusetts | 12954 | Dickson Electronics Corp. Scottsdale, Arizona |
| 09423 | Scientific Components, Inc. Santa Barbara, California | 12969 | Unitrode Corp. Watertown, Massachusetts |
| 09922 | Burndy Corp. Norwalk, Connecticut | 13103 | Themalloy Co. Dallas, Texas |
| | | 13327 | Solitron Devices Inc. Tappan, New York |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

| | | | |
|-------|---|-------|---|
| 13511 | Amphenol Corp. Los Gatos, California | 18083 | Deleted |
| 13606 | Sprague Electric Co. Transistor Div. Concord, New Hampshire | 18178 | Vactec Inc. Maryland Heights, Missouri |
| 13839 | Replaced by 23732 | 18324 | Signetics Corp. Sunnyvale, California |
| 14099 | Semtech Corp. Newbury Park, California | 18612 | Vishay Intertechnology Inc. Malvern, Pennsylvania |
| 14193 | California Resistor Corp. Santa Monica, California | 18736 | Voltronics Corp. Hanover, New Jersey |
| 14298 | American Components, Inc. Conshohocken, Pennsylvania | 18927 | G T E Sylvania Inc. Precision Material Group Parts Division Titusville, Pennsylvania |
| 14655 | Cornell-Dubilier Electronics Newark, New Jersey | 19429 | Discontinued, use 89536 |
| 14674 | Discontinued, see 16299 | 19451 | Perine Machinery & Supply Co. Seattle, Washington |
| 14752 | Electro Cube Inc. San Gabriel, California | 19701 | Electra Mfg. Co. Independence, Kansas |
| 14869 | Replaced by 96853 | 25084 | Enochs Mfg. Co. Indianapolis, Indiana |
| 15636 | Elec-Trol Inc. Northridge, California | 20891 | Self-Organizing Systems, Inc. Dallas, Texas |
| 15801 | Fenwal Electronics Inc. Framingham, Massachusetts | 21604 | Buckeye Stamping Co. Columbus, Ohio |
| 15818 | Amelco Semiconductor Div. of Teledyne Inc. Mountain View, California | 21845 | Solitron Devices Inc. Transistor Division Riviera Beach, Florida |
| 15849 | USECO, Inc. Mt. Vernon, New York | 22767 | ITT Semiconductors Div. of ITT Palo Alto, California |
| 15898 | International Business Machines (IBM) Essex Junction, Vermont | 23050 | Product Comp. Corp. Mount Vernon, New York |
| 15909 | Replaced by 17870 | 23732 | Tracor Rockville, Maryland |
| 16299 | Corning Glass Raleigh, North Carolina | 23880 | Stanford Applied Engrng. Santa Clara, California |
| 16332 | Replaced by 28478 | 23936 | Pamotor Div., Wm. J. Purdy Co. Burlingame, California |
| 16473 | Cambridge Scientific Ind. Inc. Cambridge, Maryland | 24248 | Southco Div. of South Chester Corp. Lester, Pennsylvania |
| 16742 | Paramount Plastics Downey, California | 24355 | Analog Devices Inc. Norwood, Massachusetts |
| 16758 | Delco Radio Div. of General Motors Kokomo, Indiana | 24655 | General Radio Co. West Concord, Massachusetts |
| 17001 | ITT Cannon Santa Ana, California | 24759 | Lenox-Fugle Electronics Plainfield, New Jersey |
| 17069 | Circuit Structures Lab. Upland, California | 25088 | Siemen Corp. Isilen, New Jersey |
| 17338 | High Pressure Eng. Co., Inc. Oklahoma City, Oklahoma | 25403 | Ampere Electronic Corp. Semiconductor & Receiving Tube Division Slatersville, Rhode Island |
| 17856 | Siliconix, Inc. Sunnyvale, California | | |
| 17870 | Daven Div. of Thomas A. Edison Ind. - McGraw - Edison Co. Manchester, New Hampshire | | |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

| | | | |
|-------|---|-------|---|
| 27014 | National Semiconductor Corp. Santa Clara, California | 49671 | Radio Corp. of America New York, New York |
| 27264 | Molex Products Downers Grove, Illinois | 49956 | Raytheon Company Lexington, Maine |
| 28213 | Minnesota Mining & Mfg. Co. Consumer Products Div. St. Paul, Minnesota | 50088 | Mostek Corp. Carrollton, Texas |
| 28425 | Bohannon Industries Fort Worth, Texas | 50579 | Litronix Inc. Cupertino, California |
| 28478 | Deltron Controls, Corp. Milwaukee, Wisconsin | 51605 | Scientific Components Inc. Linden, New Jersey |
| 28480 | Hewlett Packard Co. Palo Alto, California | 53021 | Sanamo Electric Co. Springfield, Illinois |
| 28520 | Heyman Mfg. Co. Kenilworth, New Jersey | 54294 | Shalcross, A Cutler-Hammer Co. Selma North Carolina |
| 29083 | Monsanto, Co., Inc. Santa Clara, California | 55026 | Simpson Electric Company Chicago, Illinois |
| 29604 | Stackpole Components Co. Raleigh, North Carolina | 56289 | Sprague Electric Co. North Adams, Massachusetts |
| 30148 | A B Enterprise Inc. ahoskie, North Carolina | 58474 | Superior Electric Co. Bristol, Connecticut |
| 30323 | Illinois Tool Works, Inc. Chicago, Illinois | 60399 | Torrington Mfg. Co. Torrington, Connecticut |
| 31091 | Optimax Inc. Colmar, Pennsylvania | 62460 | Deleted |
| 32539 | Mura Corp. Great Neck, New York | 63743 | Ward Leonard Electric Co. Mount Vernon, New York |
| 32767 | Griffith Plastic Products Co. Burlingame, California | 64834 | West Mfg. Co. San Francisco, California |
| 32879 | Advanced Mechanical Components Northridge, California | 65092 | Weston Instruments Inc. Newark, New Jersey |
| 32897 | Erie Technological Products, Inc. Frequency Control Div. Carlisle, Pennsylvania | 66150 | Winslow Tele-Tronics Inc. Asbury Park, New Jersey |
| 32997 | Bourns Inc. Trimpot Products Division Riverside, California | 70563 | Amperite Company Union City, New Jersey |
| 33173 | General Electric Co. Tube Dept. Owensboro, Kentucky | 70903 | Belden Mfg. Co. Chicago, Illinois |
| 34333 | Silicon General Westminister, California | 71002 | Birnbach Radio Co., Inc. New York, New York |
| 34335 | Advanced Micro Devices Sunnyvale, California | 71236 | "ELMENCO" Willimantic, Connecticut |
| 37942 | Mallory, P.R. & Co., Inc. Indianapolis, Indiana | 71400 | Bussmann Mfg. Div. of McGray - Edison Co. Saint Louis, Missouri |
| 42498 | National Company Melrose, Massachusetts | 71450 | CTS Corp. Elkhart, Indiana |
| 43543 | Nytronics Inc. Transformer Co. Div. Alpha, New Jersey | 71468 | ITT Cannon Electric Inc. Los Angeles, California |
| 44655 | Ohmite Mfg. Co. Skokie, Illinois | 71482 | Clare, C.P. & Co. Chicago, Illinois |
| | | 71590 | Centralab Div. of Globe Union Inc. Milwaukee, Wisconsin |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

| | | | |
|-------|---|-------|---|
| 71707 | Coto Coil Co., Inc. Providence, Rhode Island | 74306 | Piezo Crystal Co. Carlisle, Pennsylvania |
| 71744 | Chicago Miniature Lamp Works Chicago, Illinois | 74542 | Hoyt Elect. Instr. Works Penacook, New Hampshire |
| 71785 | Cinch Mfg. Co. & Howard B. Jones Div. Chicago, Illinois | 74970 | Johnson. E. F., Co. Waseca, Minnesota |
| 72005 | Driver, Wilber B., Co. Newark, New Jersey | 75042 | IRC Inc. (Div. of TRW) Philadelphia, Pennsylvania |
| 72092 | Replaced by 06980 | 75376 | Kurz-Kasch. Inc. Dayton, Ohio |
| 72136 | Electro Motive Mfg. Co. Williamantic, Connecticut | 75378 | CTS Knights Inc. Sandwich, Illinois |
| 72259 | Nytronics Inc. Berkeley Heights, New Jersey | 75382 | Kulka Electric Corp. Mount Vernon, New York |
| 72354 | Deleted | 75915 | Littlefuse Inc. Des Plaines, Illinois |
| 72619 | Dialight Corp. Brooklyn, New York | 76854 | Oak Mfg. Co. Crystal Lake, Illinois |
| 72653 | G. C. Electronics Rockford, Illinois | 77342 | Potter & Brumfield Div. of Amer. Machine & Foundry Princeton, Indiana |
| 72665 | Replaced by 90303 | 77638 | General Instrument Corp. Rectifier Division Brooklyn, New York |
| 72794 | Dzus Fastener Co., Inc. West Islip, New York | 77969 | Rubbercraft Corp. of Calif. LTD. Torrance, California |
| 72928 | Gudeman Co. (Gulton Ind.) Chicago, Illinois | 78189 | Shakeproof Div. of Illinois Tool Works Elgin, Illinois |
| 72982 | Erie Tech. Products Inc. Erie, Pennsylvania | 78277 | Sigma Instruments, Inc. South Braintree, Massachusetts |
| 73138 | Beckman Instruments Inc. Helipot Division Fullerton, California | 78488 | Stackpole Carbon Co. Saint Marys, Pennsylvania |
| 73293 | Hughes Aircraft Co. Electron Dynamics Div. Torrence, California | 78553 | Tinnerman Products Cleveland, Ohio |
| 73445 | Ampere Electronic Corp. Hicksville, New York | 78136 | Waldes Kohinoor Inc. Long Island City, New York |
| 73559 | Carling Electric Inc. Hartford, Connecticut | 79497 | Western Rubber Company Goshen, Indiana |
| 73586 | Circle F Industries Trenton, New Jersey | 79963 | Zierick Mfg. Corp. New Rochelle, New York |
| 73734 | Federal Screw Products, Inc. Chicago, Illinois | 80031 | Mepco Div. of Sessions Clock Co. Morristown, New Jersey |
| 73743 | Fischer Special Mfg. Co. Cincinnati, Ohio | 80145 | API Instruments Co. Chesterland, Ohio |
| 73899 | JFD Electronics Co. Brooklyn, New York | 80183 | Sprague Products North Adams, Massachusetts |
| 73949 | Guardian Electric Mfg. Co. Chicago, Illinois | 80294 | Bourns Inc. Riverside, California |
| 74199 | Quam Nichols Co. Chicago, Illinois | 80583 | Hammarlund Co., Inc. Mars Hill, North Carolina |
| 74217 | Radio Switch Corp. Marlboro, New Jersey | 80640 | Stevens, Arnold Inc. Boston, Massachusetts |
| 74276 | Signalite Inc. Neptune, New Jersey | | |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

| | | | |
|-------|---|-------|--|
| 81073 | Grayhill, Inc. La Grange, Illinois | 88245 | Litton Products Inc. Van Nuys, California |
| 81590 | Korry Mfg. Co. Seattle, Washington | 88419 | Use 14655 |
| 81312 | Winchester Electronics Div. of Litton Industries Oakville, Connecticut | 88690 | Replaced by 04217 |
| 81439 | Therm-O-Disc Inc. Mansfield, Ohio | 89536 | Fluke, John Mfg. Co., Inc. Seattle, Washington |
| 81483 | International Rectifier Corp. Los Angeles, California | 89730 | Replaced by 08806 |
| 81741 | Chicago Lock Corp. Chicago, Illinois | 90201 | Mallory Capacitor Co. Indianapolis, Indiana |
| 82305 | Palmer Electronics South Gate, California | 90215 | Best Stamp & Mfg. Co. Kansas City, Missouri |
| 82389 | Switchcraft Inc. Chicago, Illinois | 90211 | Square D Co. Chicago, Illinois |
| 82415 | Price Electric Corp. Frederick, Maryland | 90303 | Mallory Battery Co. Tarrytown, New York |
| 82872 | Roanwell Corp. New York, New York | 91293 | Johanson Mfg. Co. Boonton, New Jersey |
| 82877 | Rotron Mfg. Co., Inc. Woodstock, New York | 91407 | Replaced by 58474 |
| 82879 | ITT Wire & Cable Div. Pawtucket, Rhode Island | 91502 | Associated Machine Santa Clara, California |
| 83003 | Varo Inc. Garland, Texas | 91506 | Augat Attleboro, Massachusetts |
| 83298 | Bendix Corp. Electric Power Division Eatontown, New Jersey | 91637 | Dale Electronics Inc. Columbus, Nebraska |
| 83330 | Smith, Herman H., Inc. Brooklyn, New York | 91662 | Elco Corp. Willow Grove, Pennsylvania |
| 83478 | Rubbercraft Corp. of America New Haven, Connecticut | 91737 | Gremar Mfg. Co., Inc. (ITT) Woburn, Massachusetts |
| 83594 | Burroughs Corp. Electronic Components Div. Plainfield, New Jersey | 91802 | Industrial Devices, Inc. Edgewater, New Jersey |
| 83740 | Union Carbide Corp. Consumer Products Div. New York, New York | 91833 | Keystone Electronics Corp. New York, New York |
| 84171 | Arco Electronics, Inc. Great Neck, New York | 91836 | King's Electronics Tuckahoe, New York |
| 84411 | TRW Ogallala, Nebraska | 91929 | Honeywell Inc. Micro Switch Div. Freeport, Illinois |
| 84613 | Fuse Indicator Corp. Rockville, Maryland | 91934 | Miller Electric Co., Inc. Pawtucket, Rhode Island |
| 86577 | Precision Metal Products Stoneham, Massachusetts | 93332 | Sylvania Electric Products Semiconductor Products Div. Woburn, Massachusetts |
| 86684 | Radio Corp. of America Electronic Components & Devices Harrison, New Jersey | 94145 | Replaced by 49956 |
| 86689 | Deleted | 94154 | Tung-Sol Div. of Wagner Electric Corp. Newark, New Jersey |
| 87034 | Marco -Oak Inc. Anaheim, California | 95146 | Alco Electronics Products Inc. Lawrence, Massachusetts |
| | | 95263 | Leecraft Mfg. Co. Long Island City, New York |
| | | 95264 | Replaced by 98278 |

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

| | | | |
|-------|--|-------|---|
| 95275 | Vitramon Inc. Bridgeport, Connecticut | 98278 | Microdot Inc. Pasadena, California |
| 95303 | Radio Corp. of America Solid State & Receiving Tube Div. Cincinnati, Ohio | 98291 | Seaelectro Corp. Conhex Div. Mamaroneck, New York |
| 95354 | Methode Mfg. Corp. Rolling Meadows, Illinois | 98388 | Accurate Rubber & Plastics Culver City, California |
| 95712 | Dage Electric Co., Inc. Franklin, Indiana | 98743 | Replaced by 12749 |
| 95987 | Weckesser Co. Inc. Chicago, Illinois | 98925 | Deleted |
| 96733 | San Fernando Electric Mfg. Co. San Fernando, California | 99120 | Plastic Capacitors, Inc. Chicago, Illinois |
| 96853 | Rustrak Instrument Co. Manchester, New Hampshire | 99217 | Southern Electronics Corp. Burbank, California |
| 96881 | Thomson Industries, Inc. Manhasset, New York | 99392 | STM Oakland, California |
| 97540 | Master Mobile Mounts Div. of Whitehall Electronics Corp. Los Angeles, California | 99515 | Marshall Industries Capacitor Div. Monrovia, California |
| 97913 | Industrial Electronic Hdware Corp. New York, New York | 99779 | Barnes Corp. Lansdowne, Pennsylvania |
| 97945 | White, S.S. Co. Plastics Div. New York, New York | 99800 | American Precision Industries Inc. Delevan Division East Aurora, New York |
| 97966 | Replaced by 11358 | | Toyo Electronics (R-Ohm Corp.) Irvine, California |
| 98094 | Replaced by 49956 | | National Connector Minneapolis, Minnesota |
| 98159 | Rubber-Teck, Inc. Gardena, California | | |

Table 7-3. FLUKE TECHNICAL CENTERS

Fluke Western Technical Center
 2020 North Lincoln St.
 Burbank, CA 91504
 Tel. 213-849-4641
 TWX: 910-497-2086

Fluke Western Technical Center
 2359 De La Cruz Blvd.
 Santa Clara, CA 95050
 Tel. 408-244-1505
 TWX: 910-338-0121

Fluke S.W. Technical Center
 Unit 4
 1980 South Quebec Street
 Denver, CO 80231
 Tel. 303-750-1228
 TWX: 910-320-2263

Fluke S.E. Technical Center
 P.O. Box 6578
 940 North Fern Creek Avenue
 Orlando, FL 32803
 Tel. 305-896-2296
 TWX: 810-850-0185

Fluke Midwestern Technical Center
 1287 North Rand Road
 Des Plaines, IL 60016
 Tel. 312-298-7470
 TWX: 910-233-4978

Fluke Mideastern Technical Center
 11501 Huff Court
 Kensington, MD 20795
 Tel. 301-881-5300
 TWX: 710-825-9645

Fluke N.E. Technical Center
 109 Massachusetts Ave.
 Lexington, MA 02173
 Tel. 617-861-8620
 TWX: 710-826-1715

Fluke Midwestern Technical Center
 10800 Lyndale Avenue South
 Minneapolis, MN 55420
 Tel. 612-884-4541
 TWX: 910-576-3141

Fluke Eastern Technical Center
 500 Union Blvd.
 Totowa, NJ 07512
 Tel. 201-742-3215
 TWX: 710-988-5949

Fluke Eastern Technical Center
 4515 Culver Road
 Rochester, NY 14622
 Tel. 716-342-6940
 TWX: 510-253-6145

Fluke S.E. Technical Center
 P.O. Box 9619
 1310 Beaman Place
 Greensboro, NC 27408
 Tel. 919-273-1918
 TWX: 510-925-1173

John Fluke Mfg. Co., Inc.
 7001 - 220th S.W.
 Mountlake Terrace, WA 98043
 Tel. 206-774-2238
 TWX: 910-449-2850

Fluke Canadian Technical Center
 3829 - 12th St. N.E.
 Calgary Alberta
 Tel. 403-276-9658
 TWX: 610-821-2233

Fluke Canadian Technical Center
 6427 Northam Drive
 Mississauga, Ontario
 Tel. 416-678-1500
 TWX: 610-492-2119

Table 7-4. SALES REPRESENTATIVES — DOMESTIC

ALABAMA

HUNTSVILLE
BCS Associates, Inc.
3322 S. Memorial Parkway
P.O. Box 1273
Tel. (205) 881-6220
Zip 35801

ALASKA

ANCHORAGE
Harry Lang & Associates
1406 W. 47th Ave.
Tel. (907) 279-5741
Zip 99503

ARIZONA

PHOENIX
Barnhill Associates
7319 E. Stetson Dr.
Tel. (602) 947-7841
Scottsdale, AZ 85251

CALIFORNIA

LOS ANGELES
Instrument Specialists, Inc.
2020 N. Lincoln Street
Burbank, CA 91504
Tel. (213) 849-7181

NEWPORT BEACH
Instrument Specialists, Inc.
4120 Birch Street
Suite 119
Tel. (714) 752-6200
Zip 92660

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

SAN DIEGO
Instrument Specialists, Inc.
4805 Mercury St., Ste. 1
Tel. (714) 565-2555
Zip 92111

COLORADO

DENVER
Barnhill Associates, Inc.
1980 South Quebec St.
Tel. (303) 750-1228
Zip 80231

CONNECTICUT

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

FLORIDA

ORLANDO
BCS Associates, Inc.
940 N. Fern Creek Ave.
Tel. (305) 896-4881
(305) 843-1510
Zip 32803

GEORGIA

DECATUR
BCS Associates, Inc.
2522 Tanglewood Road
Tel. (404) 521-0980
Zip 30033

HAWAII

HONOLULU
Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 523-6095
Zip 96817

ILLINOIS

CHICAGO
Cozzens & Cudahy, Inc.
1301 N. Rand Road
Des Plaines, IL 60016
Tel. (312) 298-3600

INDIANA

INDIANAPOLIS
Cozzens & Cudahy, Inc.
Port O'Call Executive Ctr.
21 Beachway Drive
Tel. (317) 244-2456
Zip 46244

KENTUCKY

VALLEY STATION
BCS Associates, Inc.
4506 Freda Way
Tel. (502) 935-9634
Zip 40272

MARYLAND

BALTIMORE
Electronic Marketing Assoc. Inc.
11501 Huff Court
Kensington, MD 20795
Tel. (301) 881-5300, 744-7700

MASSACHUSETTS

BOSTON
Instrument Representatives, Inc.
109 Massachusetts Ave.
Lexington, MA 02173
Tel. (617) 861-8620

MICHIGAN

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

MINNESOTA

MINNEAPOLIS
Cozzens & Cudahy, Inc.
10800 Lyndale Ave. S.
Tel. (612) 884-4336
Zip 55420

MISSOURI

KANSAS CITY
Cozzens & Cudahy, Inc.
4404 Chouteau Traffic Way
Tel. (816) 454-5836
Zip 64117

ST. LOUIS

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

NEW JERSEY

NEWARK
SBM Representatives
1519 Stuyvesant Avenue
Union, NJ 07083
Tel. (201) 687-8737

NEW MEXICO

ALBUQUERQUE
Barnhill Associates
1410 - D Wyoming N.E.
Tel. (505) 299-7658
Zip 87112

NEW YORK

NEW YORK
SBM Representatives
28 Hobby Street
Pleasantville, NY 10570
Tel. (914) 769-1811

ROCHESTER

SBM Representatives
4515 Culver Road
Tel. (716) 226-1400
Zip 14622

NORTH CAROLINA

GREENSBORO
BCS Associates, Inc.
P.O. Box 9619
1310 Beaman Place
Tel. (919) 273-1918
Zip 27408

OHIO

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

DAYTON

WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45459

OREGON

BEAVERTON
Showalter Instruments, Inc.
13485 S.W. Hargis Road
Tel. (503) 646-3004
Zip 97005

PENNSYLVANIA

PHILADELPHIA
Electronic Marketing Assoc.
210 Goddard Blvd., Ste. 100
King of Prussia, PA
Tel. (215) 248-5050
Zip 19406

PITTSBURGH

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

Table 7-4. SALES REPRESENTATIVES – DOMESTIC (Continued)

TEXAS

DALLAS

Barnhill Associates
908 Business Parkway
Richardson, TX 75080
Tel. (214) 231-2573

HOUSTON

Barnhill Associates
10606 Hempstead Hwy.
Suite 132
Tel. (713) 688-9971
Zip 77018

VIRGINIA

WILLIAMSBURG

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

WASHINGTON

SEATTLE

Showalter Instruments, Inc.
1521 - 130 N.E.
Bellevue, WA 98005
Tel. (206) 455-4922
(206) 624-4035

CANADA

BRITISH COLUMBIA

NORTH VANCOUVER

Allan Crawford Associates, Ltd.
234 Brooksbank Ave.
Tel. (604) 980-4831

ALBERTA

CALGARY

Allan Crawford Associates, Ltd.
3829 - 12th St. N.E.
Tel. (403) 276-9658

ONTARIO

MISSISSAUGA

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

OTTAWA, 3

Allan Crawford Associates, Ltd.
1299 Richmond Road
Tel. (613) 829-9651

QUEBEC

LONGUEUIL

Allan Crawford Associates, Ltd.
1330 Marie Victorian Blvd. East
Tel. (514) 670-1212

NOVA SCOTIA

DARTMOUTH

Allan Crawford Associates, Ltd.
St. 201, Townsend Pl.
800 Wind Mill Road
Burns Industrial Park
Dartmouth, N.S. B3B 1L1
Tel. (902) 469-7865

Table 7-5. SALES REPRESENTATIVES – INTERNATIONAL

| | | |
|--|--|--|
| Argentina Coasin S.A. Virrey del Pino 4071 Buenos Aires, Argentina Tel: 523185 | Colombia Asistec Limitada Apartado Aereo 12322 Bogota 1, Colombia Tel: 419331 | Greece Hellenic Scientific Representations Ltd. 10, Nympheou Street Athens 615 Greece Tel: 7792320/705960 |
| Austria Kontron GmbH & Co. KG Ameisgasse 49 1140 - Vienna, Austria Tel: 09-43222945646 | Cyprus Chris Radiovision Ltd. P.O. Box 1989 Nicosia, Cyprus Tel: 66121 | Hong Kong & Macao Gilman & Co., Ltd. P.O. Box 56 Hong Kong Tel: 227011 (14) |
| Australia Elmeasco Instruments Pty Ltd. P.O. Box 334 Brookvale, N.S.W. Australia 2100 Tel: (02) 939-7944 | Denmark Tage Olsen A/S Teglværksgade 37 DK-2100 Copenhagen O Denmark Tel: 01-294800 | India Hinditron Services Pvt Ltd. 69/A. L. Jagmohandas Marg Bombay - 400 006, India Tel: 365344 |
| Belgium C.N. Rood S.A. 37, Place de Jamblinne de Meux B-1040 Brussels, Belgium Tel: 02-27352135 | Eastern Europe Countries Elpro GmbH Molkergasse 4 1080 - Vienna, Austria Tel: 222 424692 | Indonesia P.T. United Dico-Citas Co., Ltd. JLN Penjaringan 39A Jakarta, Indonesia |
| Brazil Ambriex S.A. Rua Ceara, 104 - 2 ^o e 3 ^o Andares ZC-29 Rio de Janeiro GB, Brazil Tel: 264-7406 Ambriex S.A. Rua Tupi, 535 01233 Sao Paulo SP, Brazil Tel: 52-7806 & 0912 | Ecuador Proteco Coasin CIA, Ltda. Apartado 228A Quito, Ecuador Tel: 526759 | Iran Berkeh Company Ltd. 20 Salm Road, Roosevelt Ave. Tehran, Iran Tel: 828294 831564 |
| Caribbean West Indies Sales Co., Ltd. 7360 N.W. 66th St. Miami, FL 33166 Tel: (305) 592-8188 | Egypt Lotus Engineering Organisation P.O. Box 1252 Cairo, Egypt Tel: 71617 | Israel R.D.T. Electronics Engineering Ltd. 46, Sokolov Street Ramat Hasharon 47235 Isreal Tel: 483211 |
| Central America Intermetra Corp 11 Park Place, Suite 2003 New York, NY 10007 Tel: (212) 349-7630, 31, 32 | Finland OY Findip AB Teollisuustie 7 02700 Kauniainen Finland Tel: 502255 | Italy Sistrel S.p.A. Via Giorgio da Sebenico 11-13 00143 Roma, Italy Tel: 06-500-1860 |
| Chile Coasin Chile Ltd. Casilla 14588 - Correo 15 Santiago, Chile Tel: 396713 | France M.B. Electronique S.A. 29, Rue Emile Duclaux 92150, Suresnes France Tel: 7723111 (108) | Japan Toyo Trading Company, Ltd. P.O. Box 5014 International Tokyo Tokyo 100-31, Japan Tel: (03) 279-0771 Toyo Trading Company, Ltd. Suzuki Bldg. 2-38 Junkeicho-dori Minami-ku, Osaka Japan Tel: (06) 262-3471 |
| China May Lee Industries, Inc. 111 Broadway, Suite 510 New York, NY 10006 Tel: (212) 349-5780 | Germany Fluke (Deutschland) GmbH 4-Dusseldorf Meineckestrasse 53 West Germany Tel: 450831 | Kenya Advanced Communications Ltd. City House, Wabera Street P.O. Box 30635 Nairobi, Kenya Tel: 31955 |

Table 7-5. SALES REPRESENTATIVES -- INTERNATIONAL (Continued)

| | | |
|---|--|---|
| <p>Korea Asia Science & Co. International P.O. Box 1250 Seoul, Korea Tel: 76-2761</p> | <p>New Zealand Elmeasco Instruments Pty Ltd. P.O. Box 30515 LOWER HUTT New Zealand Tel: 697566</p> | <p>Spain Ataio Ingenieros S.A. Enrique Larreta 12 Madrid 16, Spain Tel: 7330562</p> |
| <p>Kuwait Tareq Company P.O. Box Safat 20506 Kuwait, Arabian Gulf Tel: 436100, 436045</p> | <p>Nigeria Deemtee Electrotechnics Ltd. P.O. Box 3073 Lagos, Nigeria</p> | <p>Sweden Teleinstrument AB P.O. Box 490 Maltesholmvagen 490 S-162 04 Vallingby Sweden Tel: 08-380370</p> |
| <p>Lebanon General Marketing Trading & Contracting Company Anis Nsouli Street Nsouli Building P.O. Box 155.655 Beirut, Lebanon Tel: 319383, 312061</p> | <p>Norway Morgenstjerne & Co. A/S Konghellegate 3 P.O. Box 6688, Rodelokka Oslo 5, Norway Tel: (02) 372940</p> | <p>Switzerland Kontron Electronic A.G. Bernerstrasse-Sud 169 8048 Zurich Switzerland Tel: 01-628282</p> |
| <p>Malaysia O'Connor's (PTE) Limited P.O. Box 91 Petaling Jaya, Selangor West Malaysia Tel: 51563</p> | <p>Pakistan Pak International Operations 505 Muhammadi House - McLeod Rd. P.O. Box 5323 Karachi, Pakistan</p> | <p>Taiwan Heighten Trading Company, Ltd. P.O. Box 1408 Taipei, Taiwan 100 Republic of China Tel: 5118324 - 5118372</p> |
| <p>Mexico Mexitek, S.A. Eugenia 408 Department 1 Mexico 12, D.F. Mexico Tel: 5360910 - 5239751</p> | <p>Peru Importaciones Y Representaciones Electronicas S.A. Avda. Franklin D. Roosevelt 105 Lima 1, Peru Tel: 27-2078</p> | <p>Thailand Dynamic Supply Engineering R.O.P. No. 56 Ekamai, Sukhumvit 63 Bangkok 11, Thailand Tel: 914434, 928532</p> |
| <p>Morocco S.I.E.E.M. Residence Moulay Ismail Bat. C. Boulevard Moulay Slimane Rabat, Morocco Tel: 276-64</p> | <p>Philippines Brixton Trading Company, Inc. Suite 636 Metropolitan Bank Build. Ayala Avenue Makati, Rizal D-708, Philippines Tel: 88-27-06, 88-58-90</p> | <p>Turkey M. Suheyl Erkmam Necatibey Cad. 92/2 Karakoy/Istanbul Turkey Tel: 441546 - 447651</p> |
| <p>Netherlands C.N. Rood B.V. 13, Cort van der Lindenstraat P.O. Box 42 Rijswijk ZH 2100 Netherlands Tel: 070-996360</p> | <p>Portugal Equipamentos De Laboratorio Lda. P.O. Box 1100 Lisbon 1, Portugal Tel: 976551</p> | <p>The United Kingdom Fluke International Corporation Garnet Close Watford, WD2 4TT England Tel: 0923-33066</p> |
| <p>Fluke (Nederland) B.V. P.O. Box 5053 Zevenheuvelenweg 53 Tilburg, Netherlands Tel: (13) 673973</p> | <p>Singapore O'Connor's (PTE) Limited 98 Pasir Panjang Road Singapore 5, Singapore Tel: 637944</p> | <p>U.S.S.R. Codevintec Pacific Inc. 6263 Variel Woodland Hills, CA 91364 Tel: (213) 348-1719</p> |
| | <p>South Africa Elairco (Pty) Ltd. P.O. Box 13091 Benoni 1511 Transvaal Republic of South Africa Tel: 54-5513 - 547571</p> | |

Table 7-5: SALES REPRESENTATIVE - INTERNATIONAL (Continued)

Uruguay

Coasin Uruguay S.R.L.
Cerrito 617 - 4^o Piso
Montevideo, Uruguay

Venezuela

Coasin C.A.
Apdo. Postal 50939
Sabana Grande No. 1
Caracas 105, Venezuela
Tel: 722311 - 728662

In Europe, contact FLUKE NEDERLAND, B.V., P.O. Box 5053, Industrieterrein Noord, Tilburg, The Netherlands

FLUKE REGIONAL SERVICE CENTER: THE NETHERLANDS

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

FLUKE REGIONAL SERVICE CENTER, UNITED KINGDOM

FLUKE INTERNATIONAL CORP.
GARNETT CLOSE
WATFORD, WD24TT ENGLAND

AUTHORIZED SERVICE LABORATORIES INTERNATIONAL

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

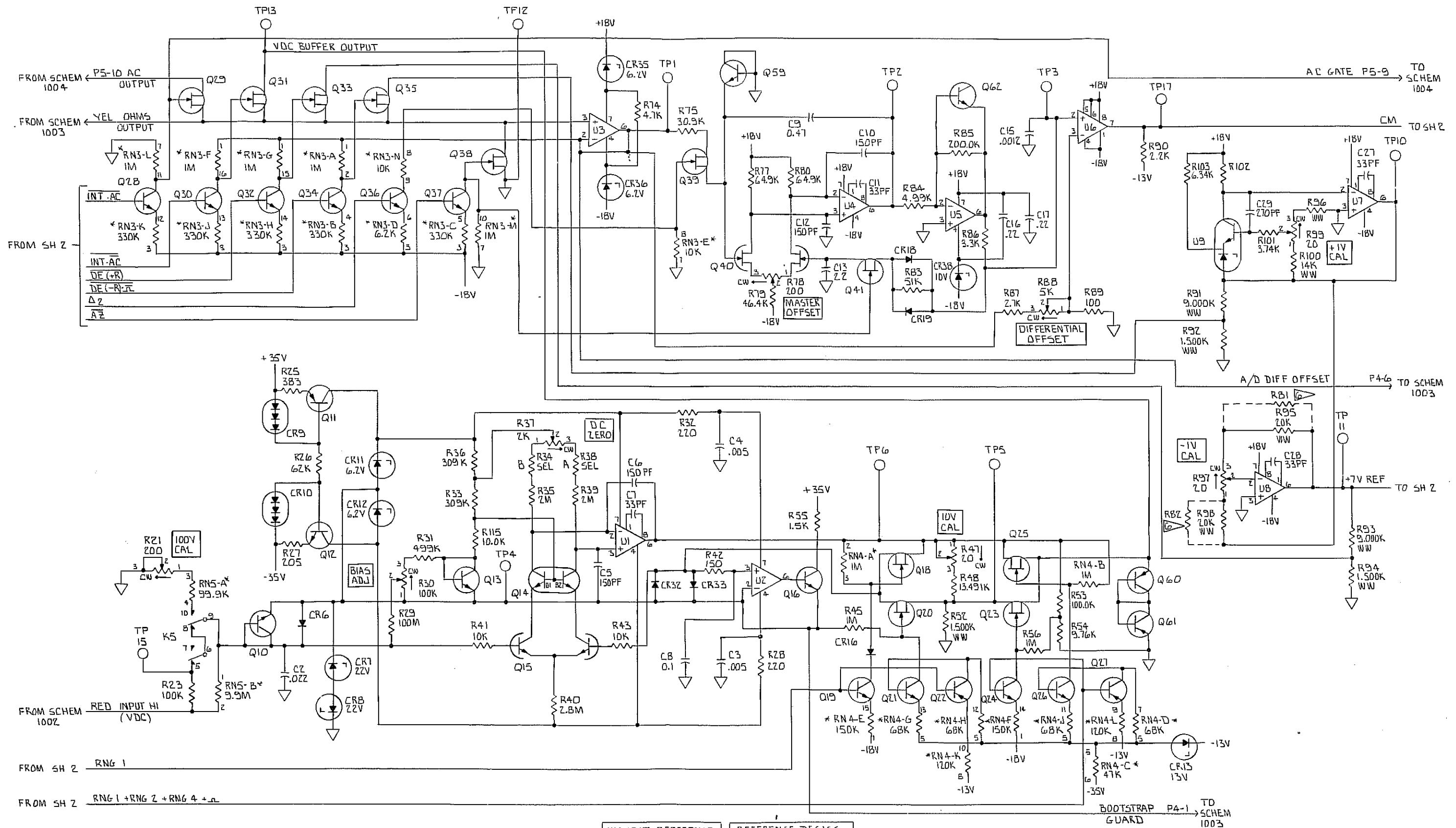


Section 8

Schematic Diagrams

TABLE OF CONTENTS

| FIGURE NO. | NAME | DRAWING NO. | PAGE |
|------------|-----------------------------------|-----------------------|-----------|
| 8-1 | Main PCB Assembly | 8800A-1002 (2 sheets) | 8-3/8-4 |
| 8-2 | Display PCB Assembly | 8800A-1002 | 8-7/8-8 |
| 8-3 | Ohms Converter Assembly | 8800A-1003 | 8-9/8-10 |
| 8-4 | AC Converter Assembly | 8800A-1004 | 8-11/8-12 |
| 8-5 | Data Output Unit (Option -02) . . | 8800A-1005 | 8-13/8-14 |



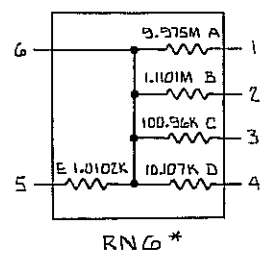
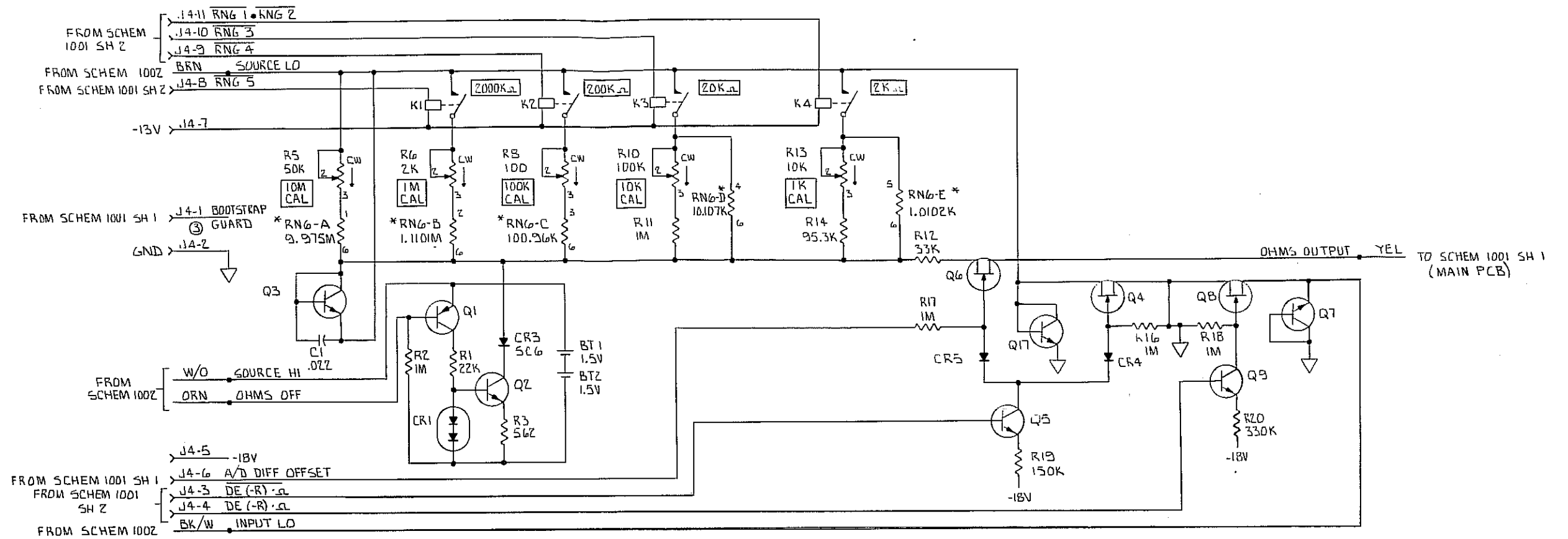
- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS
 2. ALL CAPACITANCE VALUES IN MICROFARADS
 3. CONNECT -13V TO U11-1, -12, -13 & -14, U12-16, U13-14, U14-14, U15-14, U16-16, U20-16.
 4. CONNECT -18V TO U11-4, -8 & -36, U12-8 & -12, U13-8, U14-7, U15-7, U16-B, U20-6, -7 & -B.

5. SEE 8800A-4001 FOR ASSY.
- ▷ FACTORY SELECTED.
 - ▷ WI JUMPER & R121 TO BE INSTALLED WHEN P-MOS STYLE U11 I.C. IS IN USE. FOR C-MOS STYLE U11 I.C. NO CONNECTION IS MADE TO PIN 10 OF U11.

| HIGHEST REFERENCE DESIGNATION | | |
|-------------------------------|------|-----|
| C33 | CR38 | K5 |
| Q63 | R121 | S12 |
| T1 | TP17 | U20 |
| Y1 | | |

| REFERENCE DESIGNS. NOT USED | | |
|-----------------------------|--|--|
| C1, 14, 30, | | |
| CR1-5, 14, 15, 17, 27, 28, | | |
| K1-4, Q1-9, 17, 42, | | |
| R1-20, 22, 24, 44, 46, | | |
| 49-51, 57-73, 76, | | |
| 104-112, S1-10, U10. | | |

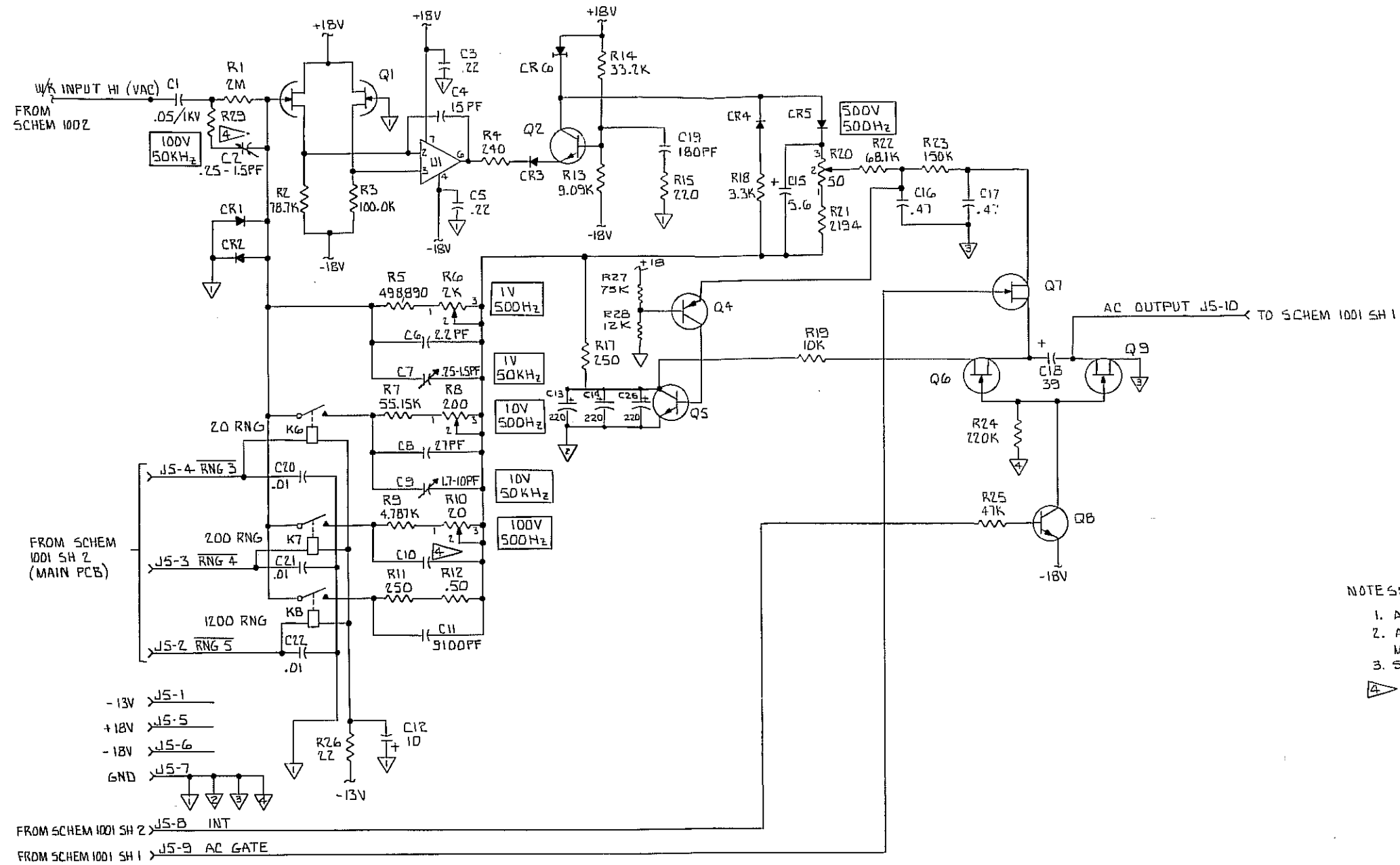
FIGURE 8-1 (1 of 2) MAIN PCB ASSEMBLY 8800A-1001



| | |
|--------------------------------|--------|
| HIGHEST REFERENCE DESIGNATION: | |
| BTZ | K4 RN6 |
| C1 | Q17 |
| CR5 | R20 |
| REFERENCE DESIGNS NOT USED: | |
| CR2 | RN1-5 |
| Q10-16 | |
| R4, 7 & 9 | |

- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS.
 2. ALL CAPACITANCE VALUES IN OHMS.
 3. BUFFER BOOTSTRAP SIGNAL IS USED AS A GUARD IN THE OHMS CONVERTER
 4. SEE 8800A-4003 FOR ASSY.

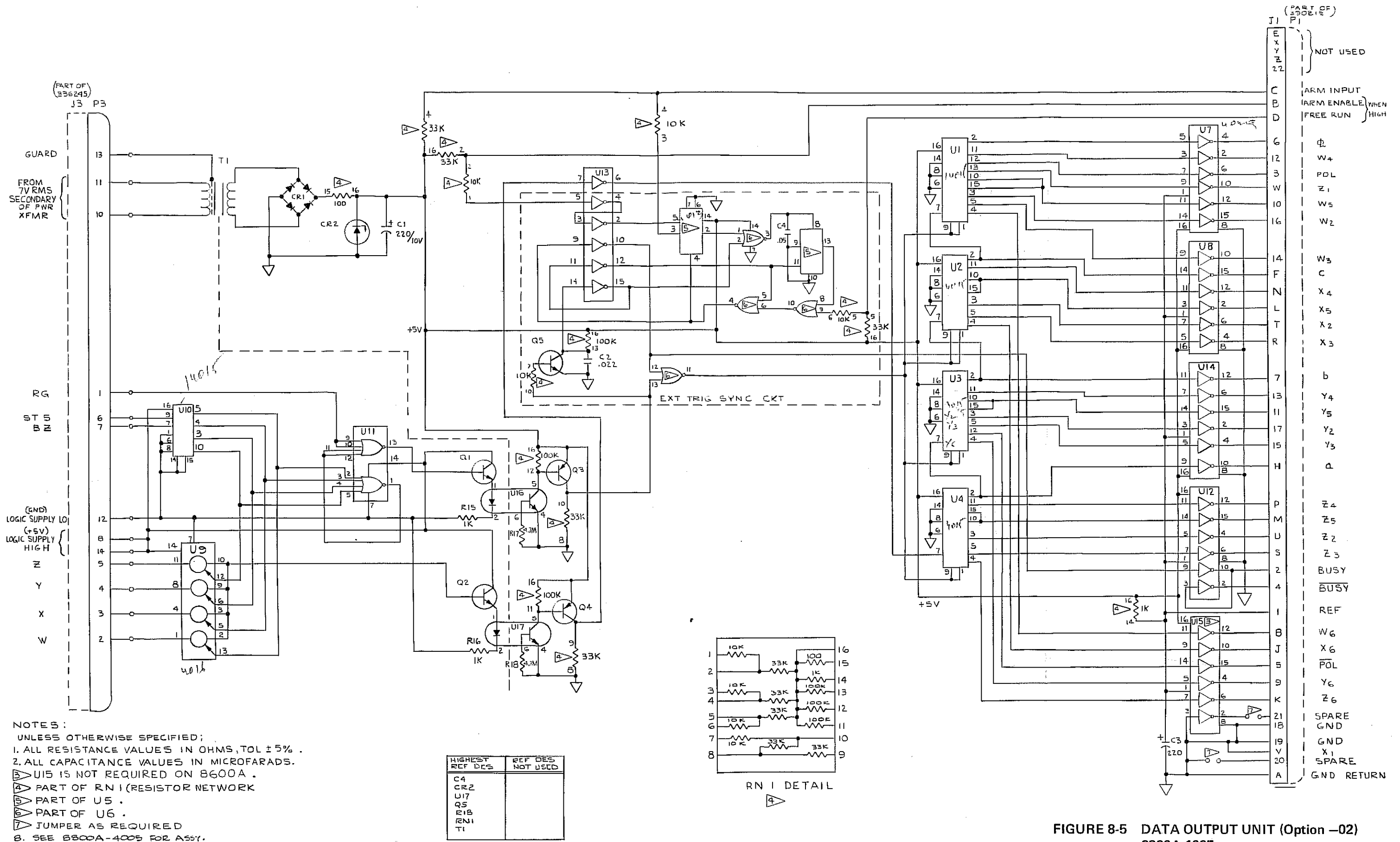
FIGURE 8-3 OHMS CONVERTER ASSEMBLY
8800A-1003



- NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES ARE IN OHMS.
 2. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
 3. SEE 8800A-4004 FOR ASSY
- ▲ FACTORY SELECTED COMPONENTS:
 R29 = 47K NOMINAL
 C10 = 400PF NOMINAL

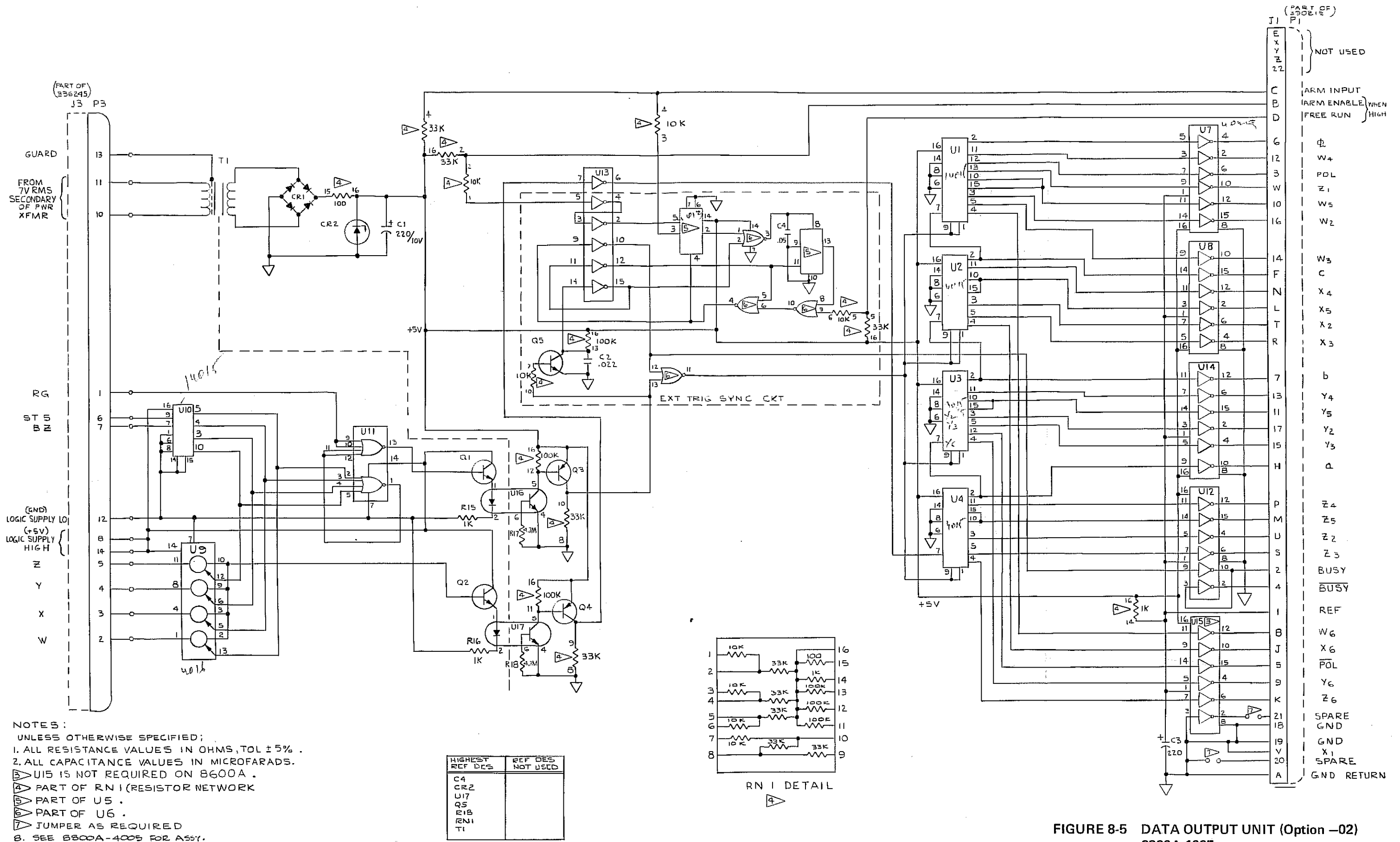
| HIGHEST REFERENCE DESIGNATION | |
|-------------------------------|-----|
| C26 | Q9 |
| CR6 | R29 |
| KB | U1 |
| REFERENCE DESIGNS NOT USED | |
| K1-K5 | R16 |
| Q3 | |

FIGURE 8-4 AC CONVERTER ASSEMBLY
8800A-1004



- NOTES:
- UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTANCE VALUES IN OHMS, TOL $\pm 5\%$.
 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.

FIGURE 8-5 DATA OUTPUT UNIT (Option -02)
8800A-1005



- 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.

FIGURE 8-5 DATA OUTPUT UNIT (Option -02)
8800A-1005