8520A
Digital Multimeter

Service Manual

P/N 541987
September 1980 **Rev 1 8/86**

FLUKE®

WARRANTY

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

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

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

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

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

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

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

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

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

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

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

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

*For European customers, Air Freight prepaid.

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

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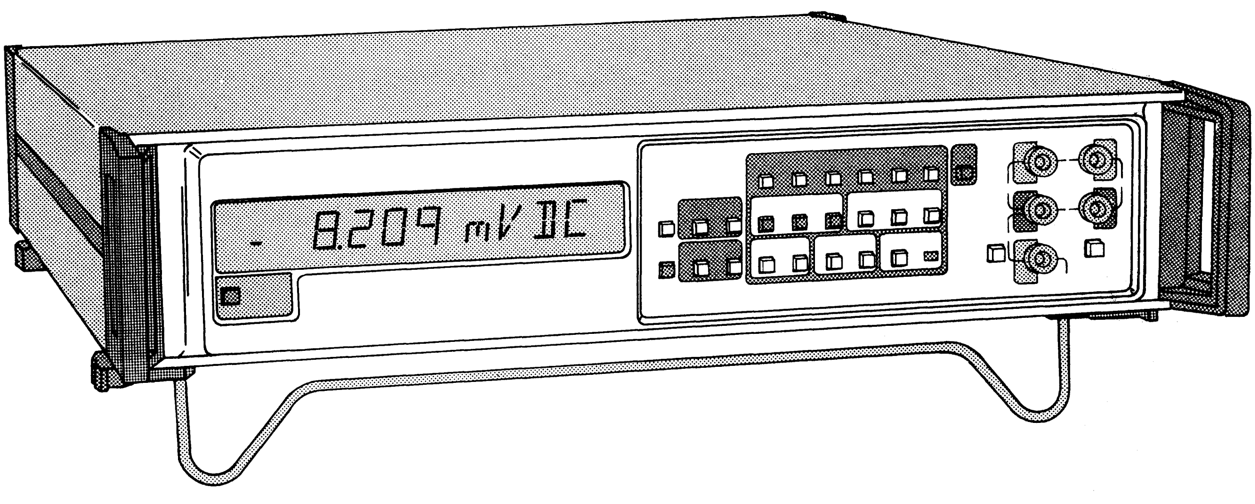


8520A Digital Multimeter

Section 1
Introduction and Specifications

WARNING

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

1-1. THE 8520A INSTRUCTION MANUAL SET

1-2. The John Fluke Model 8520A Digital Multimeter is documented by a set of three manuals: The 8520A Operator Manual, the 8520A Calibration Manual, and the 8520A Service Manual. The 8520A Operator Manual introduces the operator to the 8520A (along with the options and accessories), familiarizes the operator with all instrument controls, connectors, and indicators, and presents detailed local and remote operating information and procedures. The 8520A Calibration Manual provides general maintenance procedures, performance tests, and calibration adjustment procedures. The 8520A Service Manual contains the theory of operation, troubleshooting information, a list of replaceable parts, and schematics.

1-3. The information in this, the 8520A Service Manual, is divided into eight sections:

1 INTRODUCTION AND SPECIFICATIONS
Introduces the 8520A Instruction Manual Set, lists the recommended test equipment necessary to complete the Performance Tests and Calibration Adjustments, and lists the instrument specifications.

2 SHIPPING AND SERVICE INFORMATION
If there is a problem with your 8520A, this section describes how to get it corrected and how to ship the instrument.

3 THEORY OF OPERATION
Describes in detailed block diagrams the operation of the instrument at the block diagram level.

4 INSTRUMENT ASSEMBLY/DISASSEMBLY
Describes how to disassemble and reassemble the instrument.

5 TROUBLESHOOTING
A procedure to isolate faults in the instrument to a circuit or component level.

6 LIST OF REPLACEABLE PARTS
An illustrated list of components contained in the instrument. Includes the reference number, nomenclature, Fluke and Manufactures Part number, Manufactures Code and Quantity.

7 GENERAL INFORMATION AND MANUAL CHANGE INFORMATION
Information allowing the reader to backdate the manual to any previous revision level.

8 SCHEMATICS
Schematic diagrams of the electronic circuits in the instrument.

1-4. LIST OF RECOMMENDED TEST EQUIPMENT

1-5. Table 1-1, lists the test equipment required to complete the Adjustment Procedures described in the

Calibration Manual. Equivalent instruments can be substituted if the recommended models are not available. The Calibration Adjustment procedure is called out as part of the Troubleshooting procedure. The DMM and Oscilloscope are also required for fault isolation; however, in some cases a logic probe, e.g., the Tektronix P6401, may be substituted for the Oscilloscope.

1-6. SPECIFICATIONS

1-7. Table 1-2 lists the 8520A specifications.

Table 1-1. Test Equipment

ITEM	SPECIFICATIONS (MINIMUM)	NOMENCLATURE
DMM	5½ digits 0.005% dc accuracy	FLUKE 8800A
Oscilloscope	General Purpose	TEKTRONIX T900 Series
DC Voltage Standard	0.001% Accuracy	FLUKE 332D or 335D
Ratio Standard	0.1 ppm Resolution, 1 ppm Terminal Linearity	FLUKE 720A
	≥0.03% Accuracy @ 20 kHz	FLUKE 5200A
AC Calibrator	≥0.044% Accuracy @ 20 kHz	FLUKE 5205A or 5215A
Power Amplifier Standard Resistor w/Accessories		ESI 1010 100Ω and 10 kΩ, ESI 1050 1 MΩ. ESI SB103 shorting bars, ESI PC101 Parallel Compensation Network
Load	1 MΩ/1µF	1 MΩ ±1% 1/8 W, mF resistor in parallel with a 1 µF ±20% 10V capacitor

Table 1-2. 8520A Specifications

DC VOLTS

Input Characteristics

RANGE	FULL-SCALE	RESOLUTION	INPUT RESISTANCE
100 mV	199.999	1 μV	⩾10,000 MΩ
1V	1.99999	10 μV	⩾10,000 MΩ
10V	16.0100	100 μV	⩾10,000 MΩ
100V	130.000	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of input + number of digits)

RANGE	24 HOURS 23°C ±1°C	90 DAYS 18°C to 28°C	1 YEAR 18°C to 28°C	PLUS TEMP. COEFFICIENT PER °C *
100 mV	0.003 + 5	0.0065 + 6	0.011 + 10	0.0005 + 0.5
1V	0.003 + 1	0.006 + 2	0.011 + 2	0.0005 + 0.15
10V	0.002 + 1	0.005 + 1	0.009 + 1	0.0004 + 0.10
100V	0.003 + 1	0.007 + 2	0.012 + 2	0.0005 + 0.15
1000V	0.0035 + 1	0.0065 + 1	0.011 + 11	0.0005 + 0.10

**From 22°C to 0°C or 24°C to 50°C, 24 hours specification*
From 18°C to 0°C or 28°C to 50°C, 90 day or 1 year specification

High Speed Accuracy: ±(% of input + least significant bit)*

RANGE	90 DAYS 18°C to 28°C	1 YEAR 18°C to 28°C	PLUS TEMP. COEFFICIENT PER °C
100 mV	0.01 + 1	0.015 + 1	0.001 + .1
1V	0.01 + 1	0.015 + 1	0.001 + .05
10V	0.01 + 1	0.015 + 1	0.001 + .05
100V	0.01 + 1	0.015 + 1	0.001 + .05
1000V	0.01 + 1	0.015 + 1	0.001 + .05

**Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data.*

Typical Normal Mode Rejection

LINE FREQ	FILTER SETTLING TIME					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	*83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	*88 dB	91 dB
400 Hz	53 dB	56 dB	60 dB	120 dB	*123 dB	126 dB

**Guaranteed minimum rejection*

Common Mode Rejection .... True 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR.

Maximum Input .... ±1000V Peak, HI to LO or GUARD to chassis terminals, and ±200V Peak, GUARD to LO terminals, for any range.

Table 1-2. 8520A Specifications (cont)

Maximum Reading Rate

OPERATION	RESOLUTION	LINE	READING RATE
Local/Remote	5½ digits	50 Hz 60 Hz	200 rdgs/sec 240 rdgs/sec
Remote	4½ digits	50 Hz 60 Hz	>500 rdgs/sec >500 rdgs/sec

Input Current ≤50 pA for 30 days @ 18° to 28°C

AC VOLTS (TRUE RMS)

Input Characteristics

RANGE	FULL-SCALE	RESOLUTION	INPUT IMPEDANCE
1V 10V 100V 650V	1.99999 16.0100 130.100 650.000	10 μV 100 μV 1 mV 10 mV	1 MΩ, ≤100 pF at the V/Ω INPUT terminal

Accuracy: ±(% of input + % of full-scale)**
For 650V range multiply % FS

FREQUENCY	24 HOURS 23°C ±1°C			90 DAYS 23°C to 28°C			1 YEAR 18°C to 28°C		
	% of INPUT	+ % FS AC	+ % FS AC+DC	% of INPUT	+ % FS AC	+ % FS AC+DC	% of INPUT	+ % FS AC	+ % FS AC+DC
10 Hz to 20 Hz*	3.0	0.5	0.6	3.0	0.6	0.7	3.5	0.6	0.7
20 Hz to 40 Hz*	0.4	0.3	0.4	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz to 20 kHz	0.08	0.02	0.06	0.1	0.03	0.08	0.15	0.05	0.16
20 kHz to 100 kHz	1.0	0.3	0.4	1.0	0.3	0.4	2.0	0.6	0.8
100 kHz to 300 kHz	2.4	0.6	0.6	2.4	0.6	0.6	4.0	1.0	1.0
300 kHz to 1 MHz	8.0	2.5	2.5	8.0	2.5	2.5	15.0	5.0	5.0

**Assumes smoothing using the Statistics Math Program (~8).*

***From 0.1% of Range to Full Scale*

Temperature Coefficient .... 18°C to 0°C or 28°C to 50°C, to 20 kHz.
AC MODE .... ± (.007% of input + .007% FS)/°C
AC + DC MODE .... ± (.007% of input + .014% FS)/°C

Maximum Input .... ±1000V, Peak HI to LO or GUARD to chassis terminals, and ±200V Peak GUARD to LO terminals for any range.

Volt-Hertz Product .... ≤2x10⁷ (slew rate ≤177V/uSec)

Crest Factor .... Exceeds 4:1 @ full scale, increasing downscale.

Maximum Reading Rate .... 10 rdgs/sec (for <300 Hz use reading rates of 5, 2, or 1 rdg/sec to insure stated accuracy

Table 1-2. 8520A Specifications (cont)

OHMS

Input Characteristics

RANGE	FULL-SCALE	RESOLUTION	CURRENT THRU UNKNOWN	OPEN CURRENT VOLTAGE
10Ω	19.9999	100 μΩ	10 mA	
100Ω	199.999	1 mΩ	10 mA	
1000Ω	1999.99	10 mΩ	1.0 mA	
10 kΩ	19.9999	100 mΩ	0.1 mA	<8V
100 kΩ	199.999	1Ω	14.5 μA(max)	
1 MΩ	1.99999	10Ω	1.5 μA(max)	
10 MΩ	19.9999	1 kΩ	1.5 μA(max)	

Accuracy :±(% of input + number of digits)

RANGE	24 HOURS 23°C ±1°C	90 DAYS 18°C TO 28°C	1 YEAR 18°C TO 28°C	PLUS TEMP. COEFFICIENT PER °C*
10Ω	0.0045 + 6	0.0080 + 7	0.0140 + 12	0.0007 + 0.2
100Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
1000Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
10 kΩ	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
100 kΩ	0.0040 + 2	0.0090 + 2	0.0140 + 3	0.0012 + 0.2
1 MΩ	0.0090 + 2	0.0160 + 2	0.0200 + 3	0.0020 + 0.2
10 MΩ	0.0300 + 1	0.0440 + 1	0.0450 + 3	0.0030 + 0.2

**From 18° C to 0° C or 28° C to 50° C*

Maximum Input .... ±400V peak for any range.

Maximum Reading Rate: 10/sec at 100 KΩ and above.

OPERATION	RESOLUTION	LINE	READING RATE
Local/Remote	5½ digits	50 Hz 60 Hz	200 rdgs/sec 240 rdgs/sec
Remote	4½ digits	50 Hz 60 Hz	>500 rdgs/sec > 500 rdgs/sec

CONDUCTANCE

Range .... 100 nS

Full Scale .... 202.00 nS

Resolution .... 0.01 nS

Accuracy: ±(% of input + number of digits)

24 HOURS 23°C ± 1°C	90 DAYS 18°C to 28°C	1 YEAR 18°C to 28°C	*PLUS TEMP. COEFFICIENT PER °C
0.04 + 5	0.05 + 5	0.06 + 5	0.004 + 1

**From 18° C to 0° C or 28° C to 50° C*

Maximum Input .... ±400V peak

Maximum Reading Rate .... 10 rdgs/sec

Table 1-2. 8520A Specifications (cont)

EXTERNAL REFERENCE

Operating Range .... ±0.5V dc to ±33V dc as long as external reference is within ±16.5V of input LO terminal.

Input Impedance .... 10,000 MΩ between external reference HI or LO terminals and input LO terminals.

Accuracy

X-REF VOLTAGE	ACCURACY
16.5 to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	± A + B + (400 ppm 1Vref 1)

NOTE: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input .... ±180V peak between external reference HI or LO and input LO; ±360V peak between external reference HI and LO.

Transfer Accuracy .... The following accuracy specifications apply when:
Filter settling time is 500 or 1000 ms.
Measurements are made more than 2 hours after warmup.
Measurements are made within one range.
Standard is checked at least every hour.
Ambient temperature stability within ±1°C.

DC VOLTAGE

RANGE	±(% OF INPUT + NUMBER OF DIGITS
100 mV	0.0020 + 4
1V	0.0020 + 1
10V	0.0010 + 1
100V	0.0020 + 1
1000V	0.0020 + 1

AC VOLTAGE (all ranges)

FREQUENCY	±(% OF INPUT + % OF FULL-SCALE)
10 Hz to 20 Hz	1.0 + 0.2
20 Hz to 40 Hz	0.1 + 0.1
40 Hz to 20 kHz	0.005 + 0.007
20 kHz to 100 kHz	0.100 + 0.030
100 kHz to 1 MHz	0.500 + 0.060

AC VOLTAGE, DC COUPLED .... Same as AC Voltage except 40 Hz - 20 kHz, 0.005 + 0.010.

Resistance

RANGE	±(% OF INPUT + NUMBER OF DIGITS)
10Ω	0.0030 + 5
100Ω	0.0020 + 2
1000Ω	0.0020 + 2
10 kΩ	0.0020 + 2
100 kΩ	0.0020 + 2
1 MΩ	0.0050 + 2
10 MΩ	0.0100 + 1

Conductance .... ±(0.02% of input + 0.02 nS)

Table 1-2. 8520A Specifications (cont)

GENERAL	
Interface	IEEE-488 - 1978 is standard.
Temperature	0°C to 50°C operating; -25°C to +75°C non-operating.
Relative Humidity	≤95% at 25°C, ≤75% at 40°C, ≤45% at 50°C.
Shock and Vibration	Meets MIL-T 28800B for type III, Class 5, Style E.
Power	100, 120, 220, or 240V ac, ±10%; 50,60, or 400 Hz ±5%, ≤50W.
Size	8.89 cm H/47.00 cm L/43.18 cm W (3½ in H/18½ in L/17 in W) See Figure 1-2.
Weight	9.56 kg (21 lbs)
Protection Class Code 1	Relates solely to insulation of grounding properties in IEC 348.

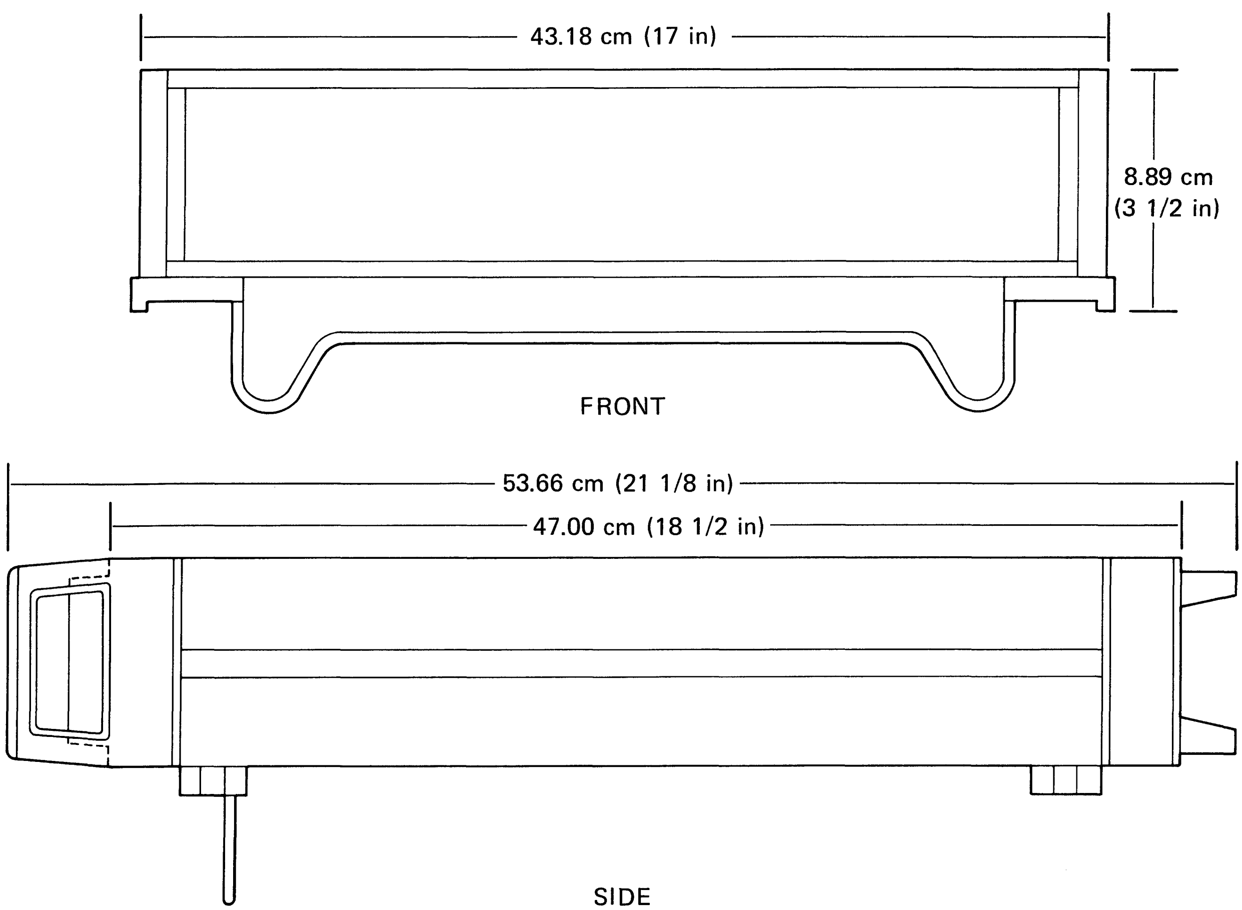
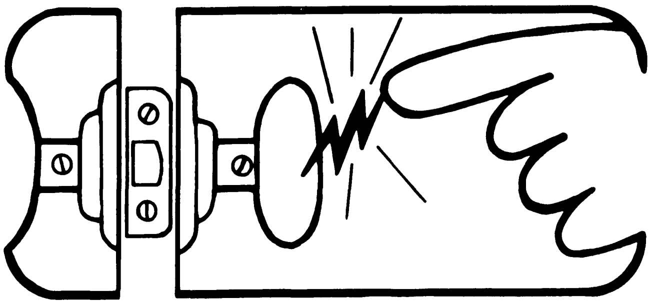


Figure 1-2. Outline Drawing

static awareness

A Message From
John Fluke Mfg. Co., Inc.



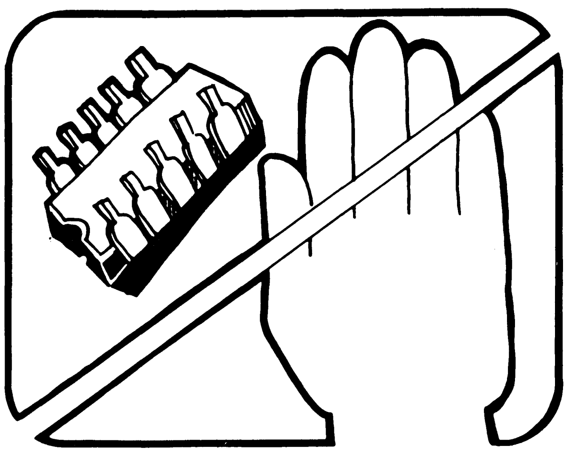
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

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

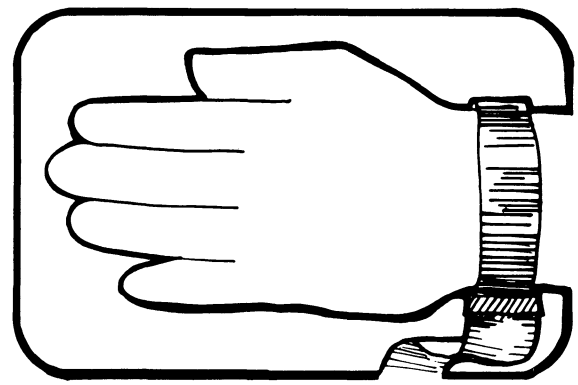
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol

" ⨂ "

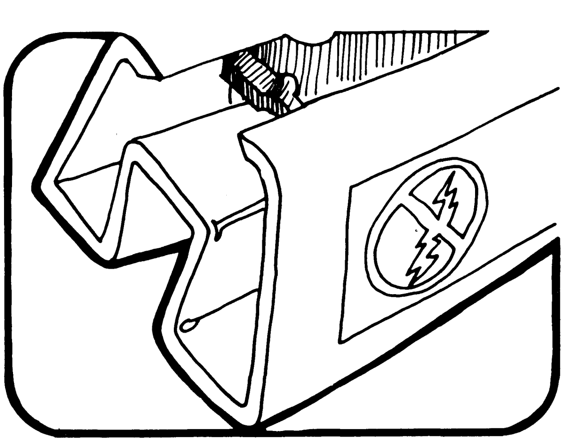
The following practices should be followed to minimize damage to S.S. devices.



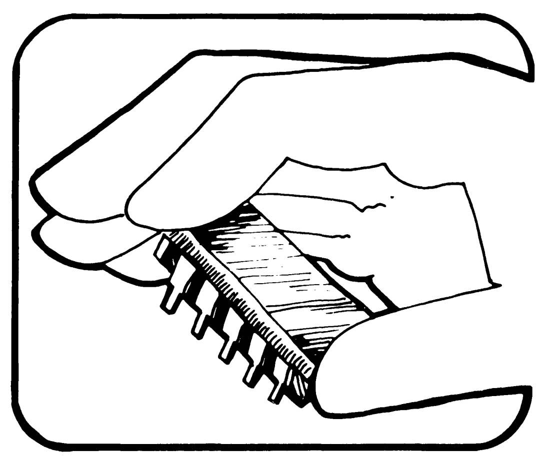
1. MINIMIZE HANDLING



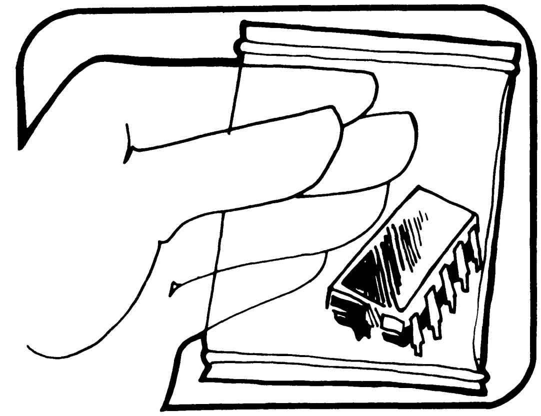
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



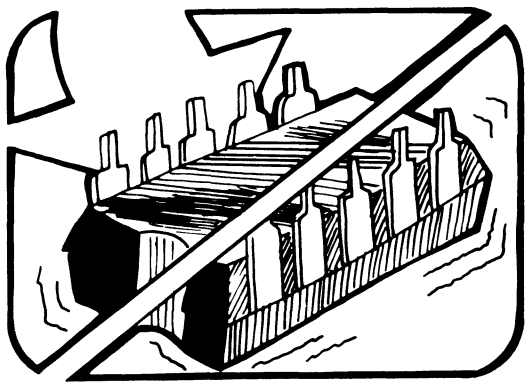
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



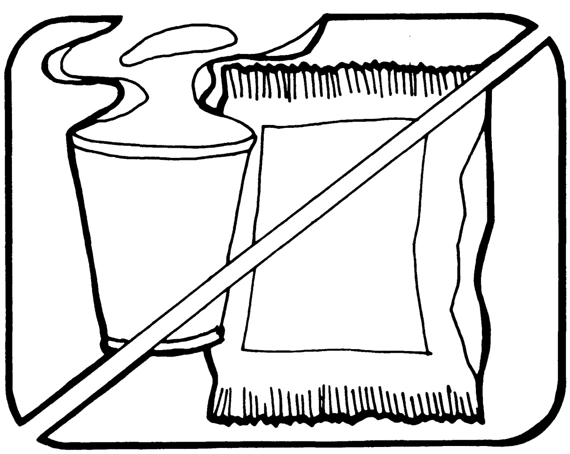
4. HANDLE S.S. DEVICES BY THE BODY



5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT

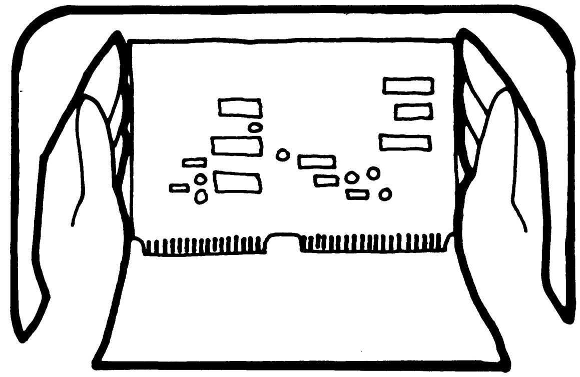


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

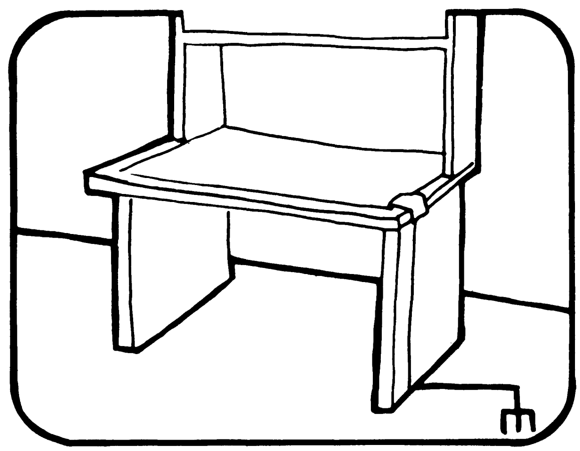


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

PORTIONS REPRINTED
WITH PERMISSION FROM TEKTRONIX, INC.
AND GENERAL DYNAMICS, POMONA DIV.



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



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

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

11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

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

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

® Dow Chemical

Section 2
Shipping and Service Information

2-1. SHIPPING INFORMATION

2-2. The 8520A is packaged and shipped in a foam-packed container. When you receive the 8520A, inspect the instrument thoroughly for possible shipping damage. Special instructions for inspection and claims are included on the shipping container.

2-3. If reshipment is necessary, use the original container. If the original container is not available, order a new one from John Fluke Mfg. Co., Inc. / P.O. Box C9090 / Everett, Washington 98204, Telephone (206) 347-6100.

2-4. SERVICE INFORATION

2-5. Each John Fluke Model 8520A Digital Multimeter is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located at the front of this manual.

2-6. Factory authorized calibration and service for all Fluke products is available at many locations worldwide. A complete list of Fluke service centers is included in Section 7A of this manual. If requested, an estimate will be provided to the customer before any work is begun on an instrument after its warranty period has expired.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual deals with the 8520A theory of operation. It begins with an explanation of the component numbering and placement system, followed by an overall block diagram and then a detailed description of each block.

3-3. COMPONENT NUMBERING SYSTEMS

3-4. The 8520A is laid out on four printed circuit boards designated A1 through A4 plus the switches and connectors mounted on the front and rear panels. The two main boards, which lay flat across the instrument interior, are sectionalized into individual circuits. All components in a section are numbered within a series to identify the section within the assembly. Table 3-1 contains the series identification numbers and their corresponding section titles. A component number A2 R15 identifies resistor R15 in the Digital Controller section of the A2 Digital PCB Assembly. Other examples are: A2 U108 is IC U108 in the IEEE Interface section of the Digital Assembly, A3 BR702 would be bridge rectifier BR702 in the Power Supply section of the A3 Analog Assembly. In many cases the PCB Assembly is identified by name rather than "A" number, but in those cases the component number holds true. Figure 3-1 shows the location placement of the four assemblies within the instrument and of the individual sections on the Digital and Analog Assemblies.

3-5. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION

3-6. Figure 3-2 is a block diagram of the circuits within the 8520A. The path of signal flow through the blocks during each of the functions available with the instrument is described in subsequent paragraphs. The signal path varies for each function until the analog data is changed to digital in the A/D Converter. From that point on, the signal flow is the same for all functions.

Table 3-1. Component Identification

SECTION TITLE	COMPONENT IDENTIFICATION
Digital PCB	A2
Digital Controller	XX
IEEE Interface	1XX
Power Supply	2XX
Analog PCB	A3
I/O Switching	1XX
DC Buffer	2XX
Ohms Converter	3XX
AC Converter	4XX
A/D Converter	5XX
Analog Controller	6XX
Power Supply	7XX

3-7. DC Volts

3-8. With DC Volts selected, an input between zero and 1000V dc can be applied to the Front Panel Input Terminals and applied to the I/O Switching Circuit. In the 100 and 1000 volt ranges, the signal is divided by 64 to bring it within the ±16.5 volt limits of the DC Buffer. The DC Buffer filters the dc input at the selected speed, conditions it to the proper levels and outputs a varying signal, between zero and ±16.5 volts, proportional to the input signal. The proportional analog signal is converted to digital data. The signal flow for a dc voltage input is shown in Figure 3-3.

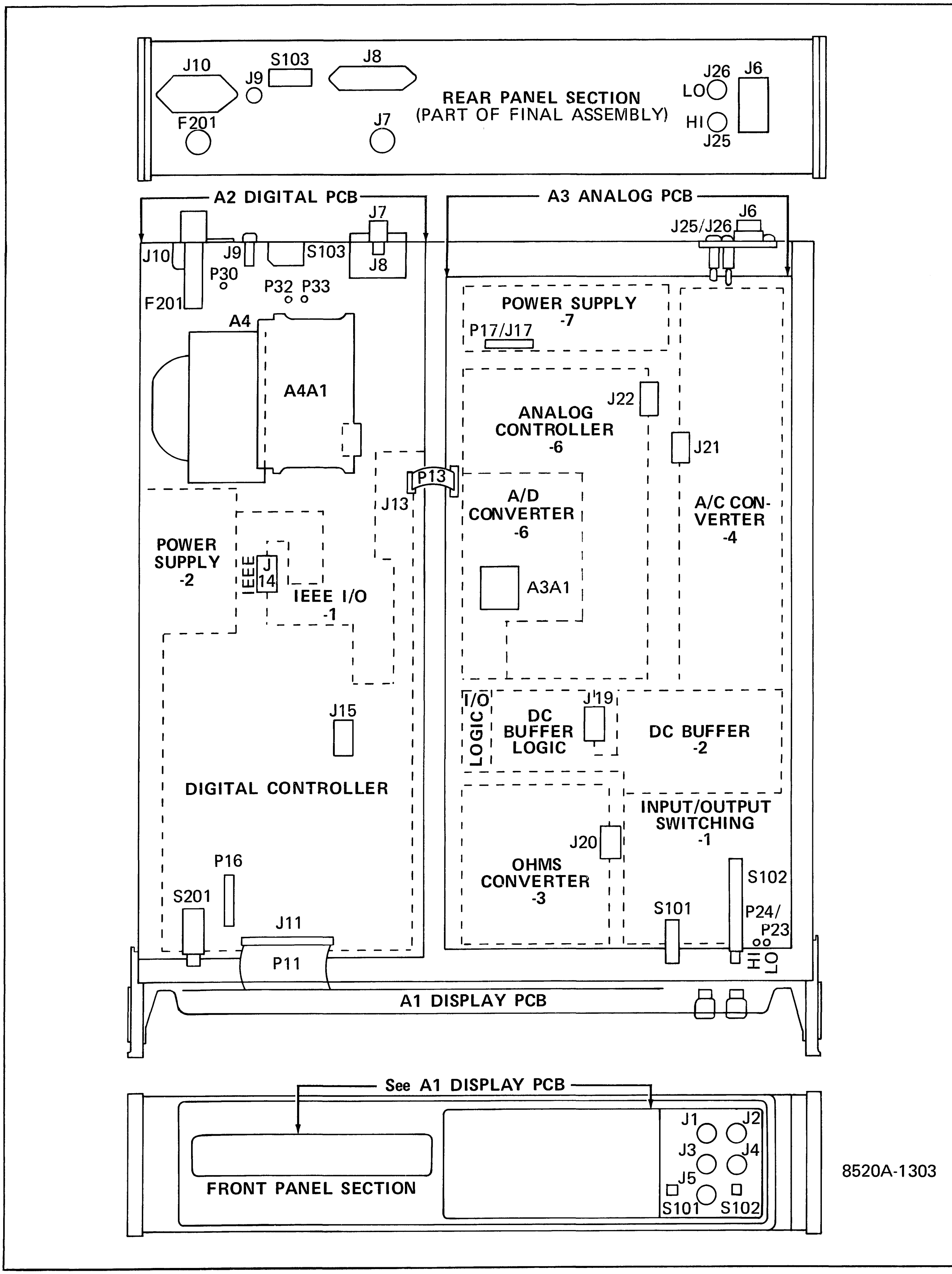


Figure 3-1. Assembly Placement

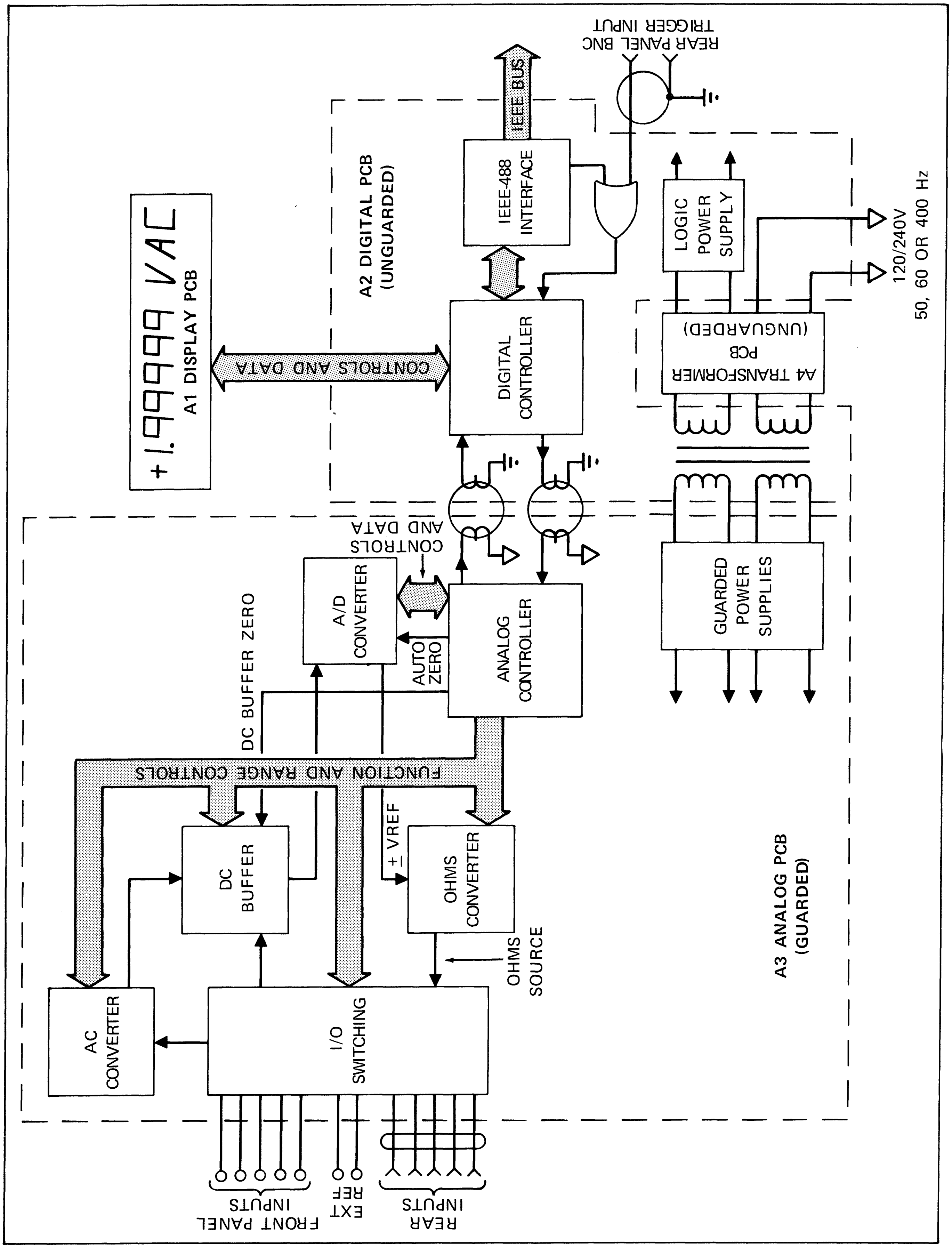


Figure 3-2. 8520A Block Diagram

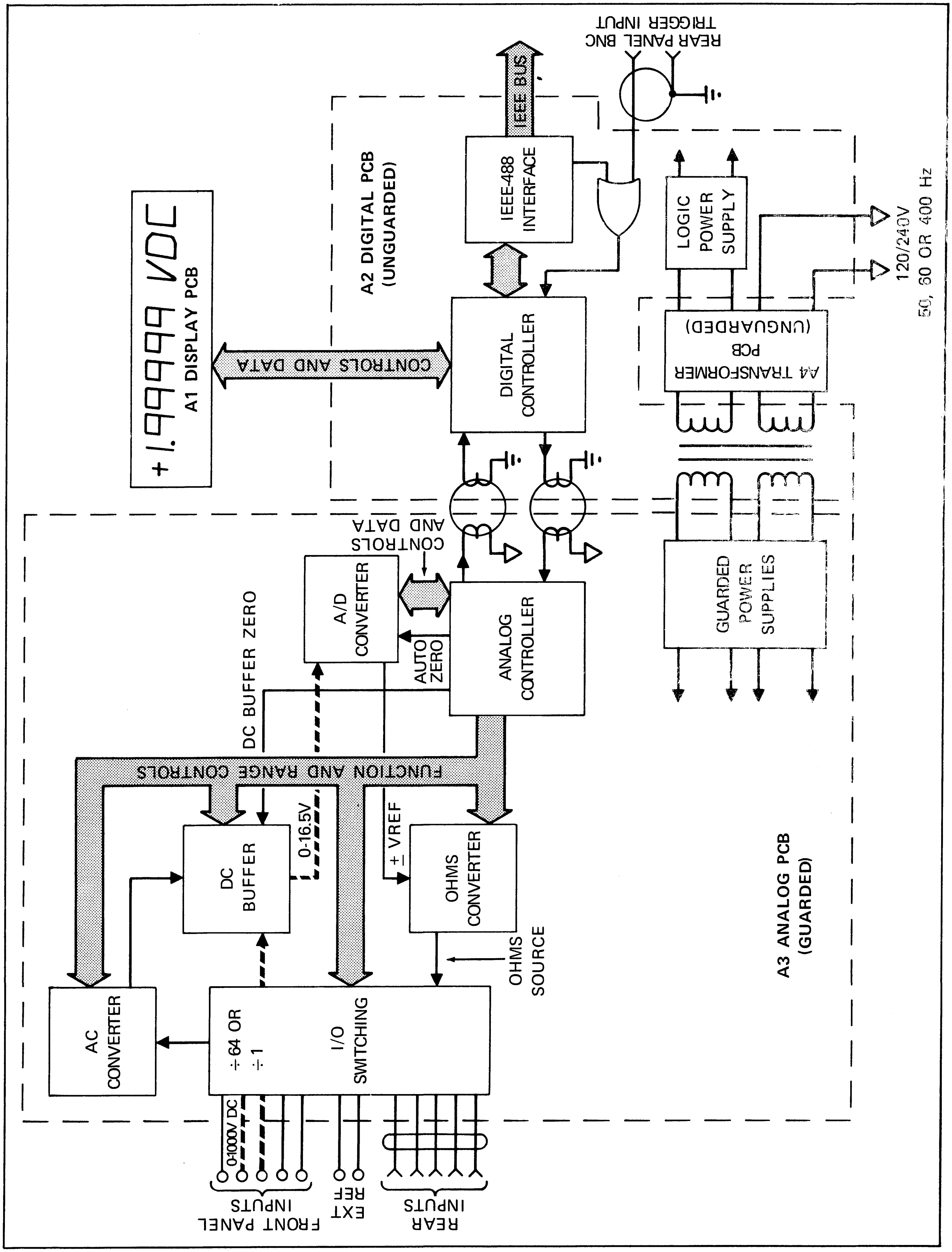


Figure 3-3. DC Volts

3-9. AC and AC + DC Volts

3-10. Figure 3-4 shows the signal path when either AC volts or AC + DC volts are selected. The maximum 650V rms or 1000V peak signal is input to the I/O Switching circuit from the input terminals, but is routed directly to the AC Converter without change. Coupling into the AC Converter varies with the function selected, either through a capacitor for ac or around the capacitor for direct coupling for AC + DC. The AC Converter changes the zero to 650V ac input to a zero to 16.5V dc proportional signal and applies it to the DC Buffer. The DC Buffer treats the input just as it did the dc input, filtering, conditioning, and applying it to the A/D Converter for conversion to a digital signal.

3-11. Ohms and Nanosiemens

3-12. A resistance measurement is input to the I/O Switching section and then routed without change to the applicable portion of the Ohms Converter, low or high ohms. Measurements are made using a current reference for values of 19.9999 kilohms or less (LO OHMS) or a voltage reference and the ratio technique for values of 20 kilohms or greater (HI OHMS). The resulting voltage drop is proportional to the value of the measured resistance and is routed to the DC Buffer, through the I/O Switching section, and to the A/D Converter for conversion to digital data. Conductance measurements in nanosiemens are treated as a high ohms measurement and then inverted to obtain the reciprocal of the value. Figure 3-5 has the signal flow highlighted for a resistance operation.

3-13. External Reference

3-14. Signal flow for an external reference measurement is shown in Figure 3-6. External reference differs from a dc measurement only in the input of the external reference on the rear panel terminals. The input and the reference are multiplexed in the I/O Switching section, and the resultant voltages are sent alternately to the DC Buffer to be conditioned and to the A/D Converter to be changed to digital data. The actual computation of ratio is performed on the two A/D outputs by the Digital Controller.

3-15. External Trigger Inputs

3-16. External triggers may orginate in one of three different locations as shown in Figure 3-7. These are from the Front Panel MANUAL keyswitch, the rear panel BNC connector if enabled, and the IEEE Bus if addressed. Once in the Digital Controller, trigger action does not vary between the external triggers and the internal trigger.

3-17. Digital Data Flow

3-18. Data is converted to a digital format in the A/D Converter which operates in combination with the Analog Controller. Switching signals for control of the analog functions are sent from the Digital Controller to the Analog Controller which latches the information and sends it to the applicable section. A/D Converter outputs are sent over the guard crossing to the Digital Controller and then processed as required for display or transmission over the IEEE-488 Bus.

3-19. DETAILED DESCRIPTION

3-20. A description of each operational section in the block diagram is given in the paragraphs below. The Power Supply circuits are described first, followed by the Display, Digital, and Analog Assemblies. The Power Supply has portions of its circuitry on both the Analog and Digital Assemblies, as well as on the Transformer Assembly. Refer to the schematic listed after the paragraph title during the discussion of the circuit.

3-21. Power Supply (8520A-1023)

3-22. The Power Supply schematic is a combination drawing including components located on the Digital Assembly (A2), the Analog Assembly (A3), the Transformer Assembly (A4), the front and rear panels, and transformer T201. Input line voltage is routed to the transformer primary through the front panel power switch and the line voltage selection switches on the Transformer Assembly.

3-23. Two secondary windings go to the analog assembly for the guarded power supplies. One secondary goes to the regulator through the rectifiersCR703 and CR704 to provide the +5 volts for the logic circuits. This is accomplished by tying -15 volts to logic high which puts logic common at -20 volts with respect to analog common. The other secondary is rectified by the bridge network BR701 for ±15 volt outputs from regulators U705 (+15V) and U706 (-15V). Another tap from the same secondary is rectified in BR702 for ±27 volt outputs from U704 (+27V) and U707 (-27V).

3-24. On the Digital Assembly, the regulator U202 takes the rectified output from CR1 and CR2 on the transformer assembly and, with its associated components, provides the unguarded +5V operating voltage for the logic circuits. The unregulated +5 volt output and its return are sent to the display assembly for use there. Another use for the secondary is 5V XFMR SEC which monitors line frequency. R210, in parallel with U202, provides an increased load capability. Test jumper J201 disconnects the supply, R210, and the load, so that the supply can be checked without a load.

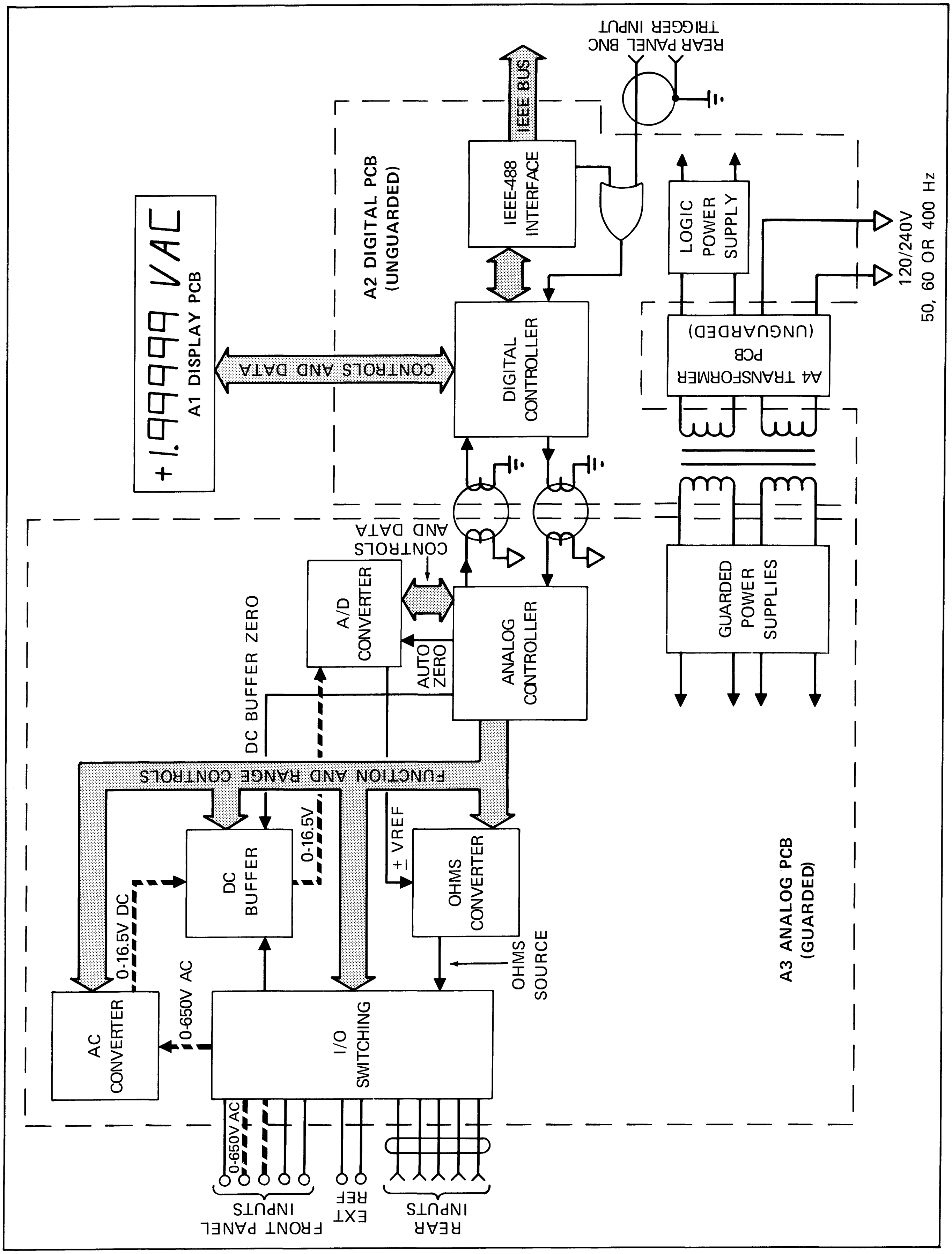


Figure 3-4. AC Volts and AC + DC Volts

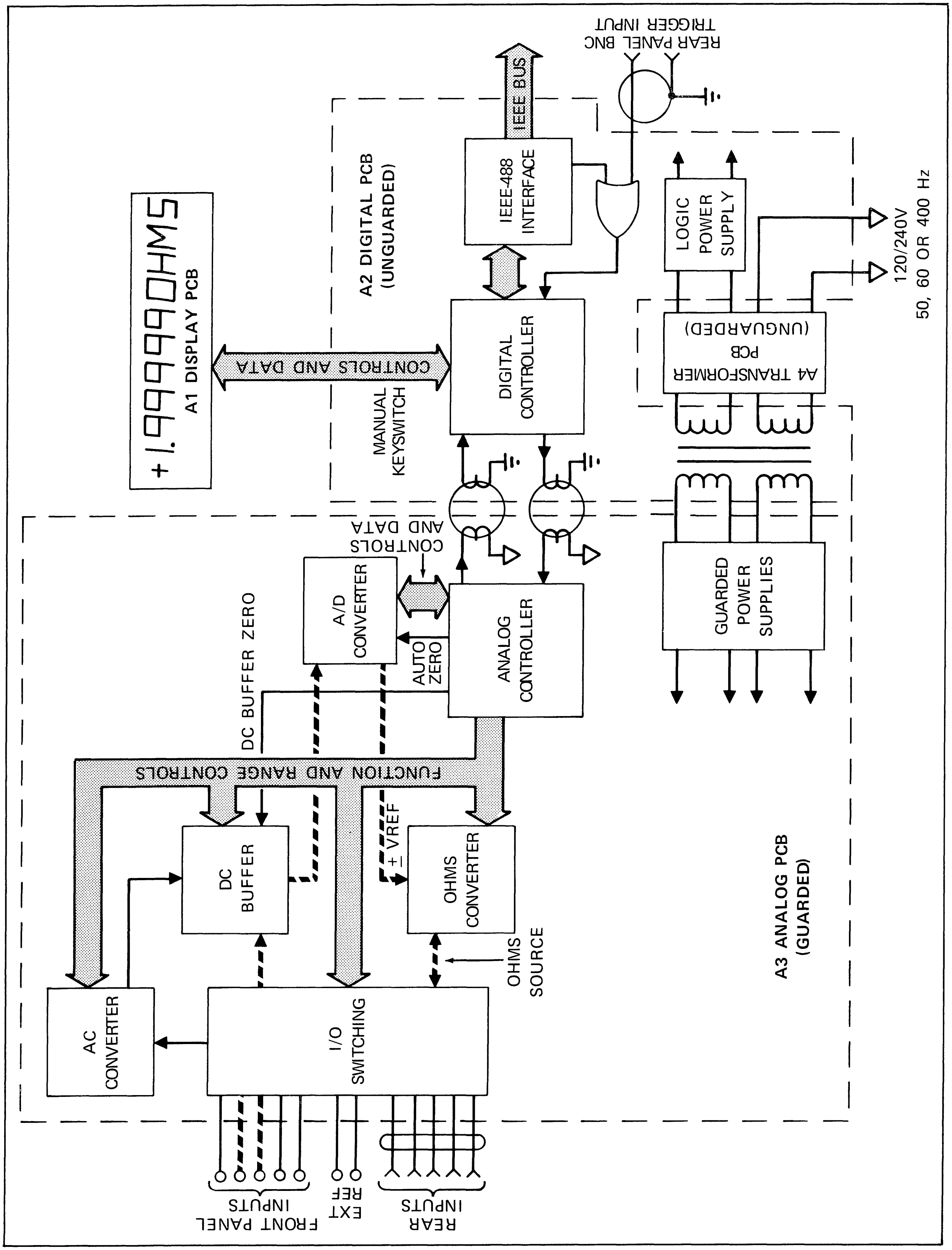


Figure 3-5. Ohms and Nanosiemens

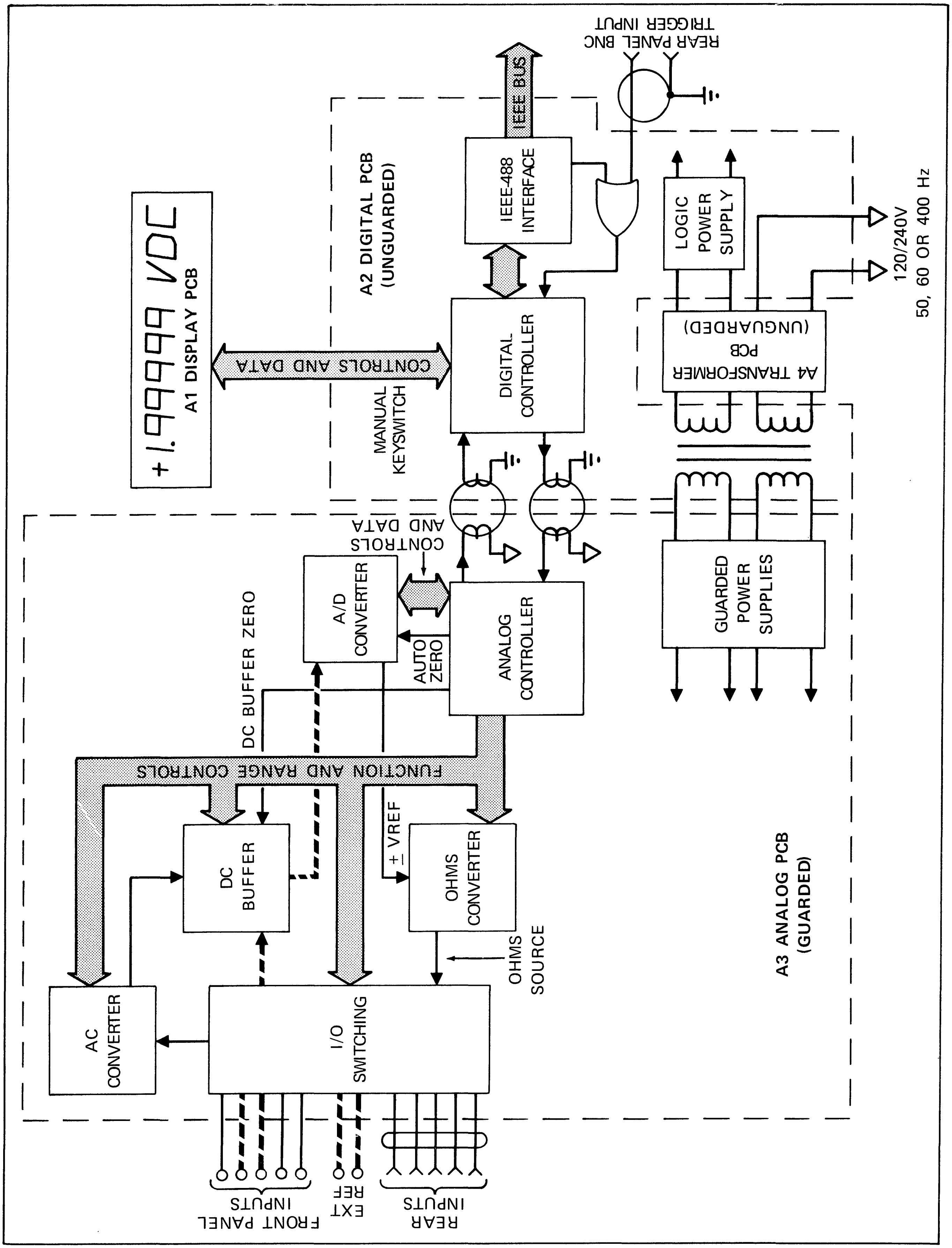


Figure 3-6. External Reference DC Volts

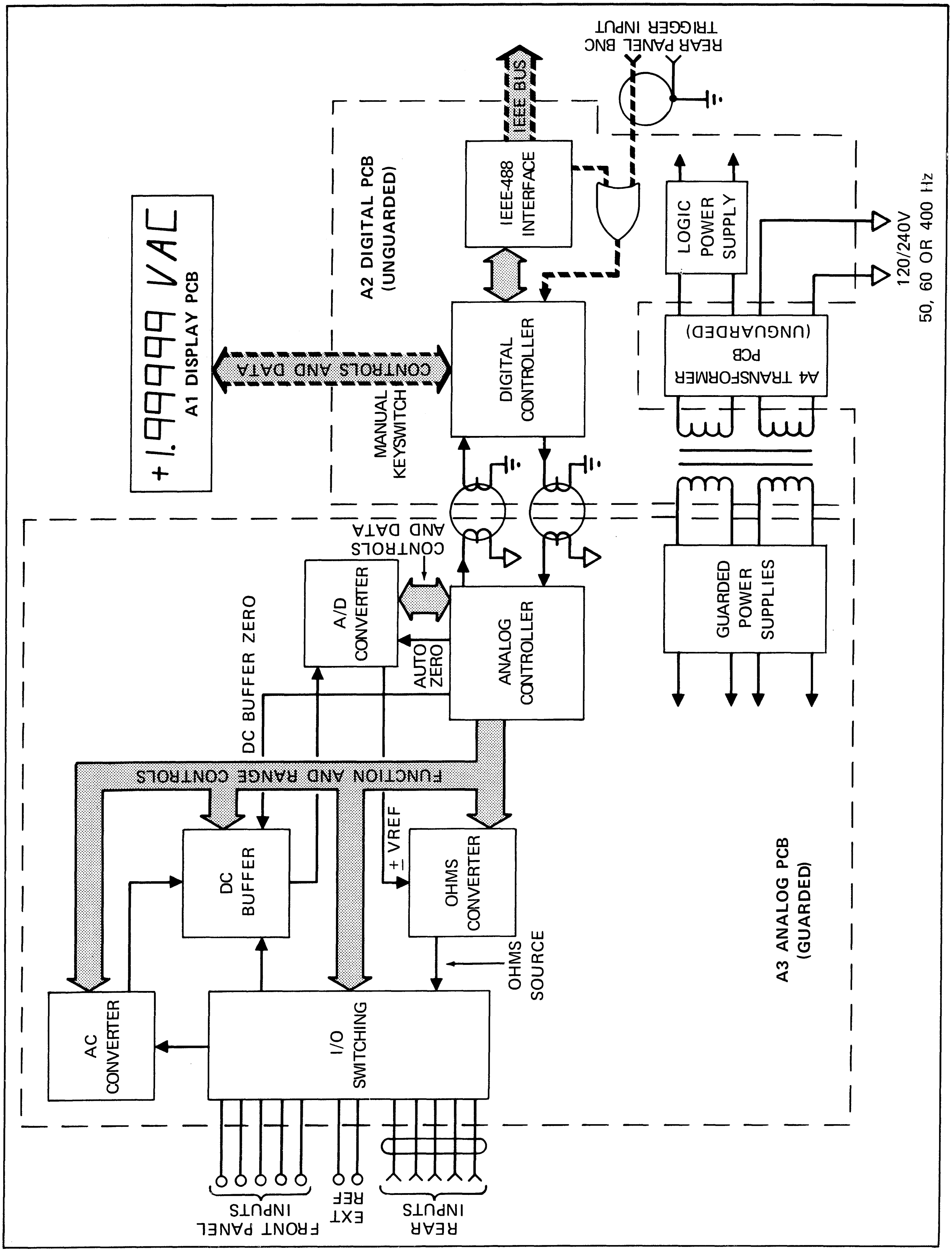


Figure 3-7. External Trigger Inputs

3-25. Display Assembly (8520A-1011)

3-26. Segment control data from the controller is placed in U9 and U12 alternately and applied to the display in parallel through the segment drivers (U10/U11 and U23/U24). The driver outputs are multiplexed for the applicable character. The common cathodes of the display are latched into U1 by the Controller with U2 and U3 acting as the digit drivers. One character from the numeric display (7 segment LEDs) and one-half of one character from the alphanumeric display (14 segment LEDs) are addressed simultaneously. The display can be totally blanked with the DISPBLANK signal to prevent damage to the display. DISPBLANK originates on the Digital Controller and is generated if the switch matrix is not read at least once every 16 ms.

3-27. The switch matrix rows and the display are enabled at the same time. Depression of a switch gives a column signal. Decoding the row/column combination in the Controller identifies the depressed switch for the program.

3-28. The normal sequence for a display assembly operation begins with the clearing of U1 to prevent ghosting on the display. Data for the first numeric and one-half alphanumeric characters are then sent to U9 and U12 respectively and the display is turned "on" for 2 ms from U1. The process is repeated, stepping through the eight possible displays and turning "on" each indicator pair in turn at a 60 times per second refresh rate.

3-29. Digital Assembly

3-30. The digital assembly is divided into three separate sections. The Digital Controller and IEEE Interface are individually covered in subsequent paragraphs. The third section, the Unguarded power Supply was covered previously as part of the composite Power Supply description.

3-31. DIGITAL CONTROLLER (8520A-1021)

3-32. The digital controller section contains the microprocessor, the ROM with the operating program, the RAM for temporary storage and burst memory, and the various control ciruits. Each of these circuits is detailed in sub-paragraphs below.

3-33. Clock Circuit

3-34. The microprocessor is provided with a 4 MHz square wave by the clock circuit. Crystal Y1 is an 8 MHz oscillator that clocks the standard binary counter, U20. Outputs from the counter in addition to the 4 MHz, are 2 MHz for use in the Guard Crossing circuitry and 1 MHz for use in the IEEE circuitry. The parallel inverters at U19-10 and U19-12, with R6, keep the rise and fall time of the clock within specifications. Ringing is kept within acceptable levels by R7.

3-35. Microprocessor

3-36. The microprocessor is a single component with fully decoded and timed output signals to control standard memory or peipheral circuits. Supply voltage for the device is +5V dc and the only clock required is a single-phase, 5V, 4 MHz square wave.

3-37. The internal register configuration of the microprocessor contains 208 bits of Read/Write memory accessible to the program. The registers include two sets of general purpose accumulator and flag registers that may be used as four 16-bit pairs or as eight 8-bit individuals. Also included is a 16-bit stack pointer that allows implementation of multiple level interrupts and unlimited subroutine nesting. Tabular data manipulation and relocatable code implementation is accomplished with the two 16-bit index registers. The Memory Refresh register provides automatic transparent refresh of external dynamic memories. The interrupt vector register forms the upper 8-bits of a pointer to an interrupt service address table during the interrupt response mode, while the lower 8-bits of the pointer are supplied by the interrupting device. An indirect call is made then to the service address formed. The last register is a 16-bit program counter.

3-38. Reset

3-39. The instrument circuitry is automatically reset at power up. When one shot U36-12 is not triggered, it provides U22-13 and 12 with a high and low signal respectively to provide a reset to the controller assembly. Line voltage (FLINE) input from U23-11 (divided by 7 at U32-13 if the line frequency is 400 Hz) triggers U36, releasing the counter U28, which in turn clocks U22 on a count of eight to remove the reset. This places the reset on the circuit for a predetermined time during power up.

3-40. When power is removed, U36-12 times out and sets U22 to apply a reset to the circuitry. Resistor R19 and capacitor C29 provide a timeout for resetting the instrument by shorting test points TP9 and TP10 together.

3-41. Wait

3-42. A WAIT signal is input to the microprocessor at U18-24 to indicate that the addressed memory or I/O device needs an extended bus cycle. It can be generated from the IEEE circuit or by U9 as the result of an M1 output from the microprocessor. M1 is active when the microprocessor is performing an op code fetch cycle. The M1 memory access is shorter than all other cycles, in order to provide for the refresh cycle (not used). One WAIT state is added to allow for the access time of the ROMs.

3-43. Interrupt

3-44. There are three sources of interrupts. These are: the IEEE circuit, the guard crossing circuit, and the phase locked loop circuit. The interrupt signals are combined in a wired OR circuit for an input to the microprocessor at U18-16. R26 is a passive pull-up for the line and, in conjunction with C31, filters high frequency chassis noise (>10 MHz) to prevent spurious interrupts. U17-4 in the OR circuit is active (low) from an interrupt from the IEEE. The UART "data available" output is connected to the interrupt line via U33-2, which is enabled at U33-1 from U8-15, and U17-11. Line synchronous interrupts (MARK) are generated by U17-6 each time the phase-locked loop output has a positive transition. The MARK is enabled and cleared by signal MARK EN at U35-1 from U8-19.

3-45. Phase-Locked Loop

3-46. Digital noise rejection is accomplished by averaging line synchronous samples. A/D samples are synchronized to the AC line by the phase-locked loop (PLL). The line frequency input (U29-14) is multiplied by 8 by the PLL circuitry U29 and U28. The PLL output (U29-4) which is eight times the input frequency (8/7 for 400 Hz line) provides a clock for MARK interrupts (U35-3), display blanking (U21-1), and the guard crossing trigger flip flop (U1-3).

3-47. Guard Crossing

3-48. The Guard Crossing transfers data between the Digital and Analog Controllers using virtually identical circuits on each assembly. On the digital controller it consists of the UART U26, the one-shot U36, the pulse transformer U38, gates from U37 and U30, and their associated components. The UART converts the eight bits of parallel data received on the bus (U26-26 through 33) into a serial data stream, adding parity, start, and stop bits. The 125k baud serial data from U26-25 is inverted (U30-6) to modulate the 2 MHz signal from U20-13. The high voltage driver U37-5 then sends the signal through the pulse transformer U38-3 to the guarded analog controller.

3-49. Modulated 2 MHz data from the analog controller is received by the pulse transformer. The one-shot U36 stretches the 2 MHz bursts into a digital series stream of the original 125k baud rate. The UART converts it to a parallel format and outputs it to the bus on U26-5 through 12.

3-50. Memory Select

3-51. The memory for the digital controller consists of two RAMs (four with Option -010), three ROMs, and their control circuits U2 and U3. Address line A15 from the microprocessor enables either RAM or ROM. If it is high, RAM is addressed, if low, ROM. When MEMREQ is low, both RAM and ROM are enabled.

3-52. When RAM is addressed A10, A11, and A12 select either the standard memory (U6 and U7) or the optional memory (U4 and U5) with A10 low and high, respectively.

3-53. One of the three ROMs (U10, U11, and U12) is enabled by U3 from the decoded A13 and A14 signals. U13 and U14 are not installed; their sockets are left open for special applications or future expansion.

3-54. Display Blank

3-55. The phase locked-loop clocks U21-1 to count toward eight. If it reaches that count without being reset by the SW signal from U25-8, U21-6 goes high and blanks the front panel display.

3-56. Guard Crossing Trigger

3-57. A short pulse is generated in this circuit for the Analog Controller. It is generated at U21-11 and sent through U37-3 to the pulse transformer (U38-6).

3-58. Sources of the trigger are: the external trigger from either the rear panel (U23-2) or the IEEE (U23-1), the MARK trigger U8-6, or the software trigger at U33-13 from the decoded address at U25-10.

3-59. External Trigger

3-60. The external trigger edge is selected by the Schmitt trigger circuit at U39. The external clocks U35-11, if enabled by EXT TRIG EN at U35-13 from U8-16.

3-61. IEEE-488 INTERFACE (8520A-1022)

3-62. All device interface functions defined by the IEEE-488 1978 Interface Standard are performed within U101. The bidirectional data lines (DI01-DI08) from U108 and U109 are normally three-state drivers; however, when parallel poll is selected they change to open collector. The control lines in U110 are bidirectional under the control of U101. Control lines NRFD, NDAC, and SRQ have open collector outputs; the remaining control lines are three-state.

3-63. The interface is addressed from the digital controller with A7 high and A6 low. A0, A1, and A2 are used to address the internal registers in U101. Switches S103 place the instrument IEEE address on the bus when U102 is enabled from U101. Timing is a 1 MHz clock derived from the Digital Controller 4 MHz clock. The 1 MHz clock is synchronized to the microprocessor I/O access cycle by U103, U104, and U105.

3-64. Analog Assembly

3-65. The Analog Assembly is divided into seven separate sections. Six are covered individually in subsequent paragraphs while the seventh, the Guarded Power Supply, was covered previously as part of the composite Power Supply.

3-66. I/O SWITCHING (8520A-1031)

3-67. Manual selection of input terminals and guard source, electrical selection of function, routing of signals, filtering, and multiplexing are performed in the I/O Switching section.

3-68. Switch S102 selects between the front panel input terminals and the rear panel connector. When the switch is out, the front panel terminals are connected through the switch to the internal circuitry. If the switch is depressed, the rear panel connector is used. The guard is controlled by S101. If S101 is pressed in, the front panel guard terminal, and therefore anything connected to it, is connected to the internal V guard. When S101 is out, (NORMAL) the V guard is connected through the switch to chassis ground, and the front panel guard terminal is open circuited.

3-69. After selection at S102, the input signal is routed through the contacts of K103. For all functions except low ohms K103 is de-energized, and the signal is routed to other circuits for further direction. In low ohms (K103 energized) the signal is routed directly to the Ohms Converter. K101 is energized in the 2-terminal ohms function to connect the input terminals to the source terminals.

3-70. AC or AC + DC measurements are routed to the AC Converter through the energized contacts of K104. Relay K102 is energized for the 100 mV and 10V dc ranges, passing through the 150 kΩ current limiting resistor R110 on its path to the DC Buffer. For the 100V and 1000V ranges, the signal is divided by a factor of 64 in R107. With the high input impedance of the DC Buffer, energizing the relay (K102) does not cause any attenuation.

3-71. High voltage transients in excess of 1.6 kV are clamped by R104 and RV101 through RV104. Thermister R103 and RV105 provide high voltage protection between guard and chassis. The transistors Q101 and Q102, and the diodes CR107 and CR108 limit the input to the multiplexer stage to ±18.7 volts.

3-72. Digital signals into the multiplexer stage from the A/D Converter are translated into -27V for a logic high and "Open" for logic low (by U103, U102, and Q110), to operate the applicable FET switch from Q103 through Q108. An "Open" input to the FET gate turns the switch "on" and allows the applicable input signal to pass through to the DC Buffer section.

3-73. DC BUFFER (8520A-1032)

3-74. The DC Buffer section accepts the data input from the I/O Switching section, filters it at the selected speed, and conditions the signal to the proper levels for the A/D Converter. The eventual input to the A/D Converter will be a chopped dc signal, varying between zero and ±16.5 volts, and proportional to the input signal.

3-75. Filter Circuit

3-76. The filtering stage consists of a fast filter which is a single pole RC network and a slow filter which is a three pole active filter. The settling time is determined by the reading rate, which also controls the number of samples averaged. The Analog Controller selects the slow filter on power intitializat on and switches automatically with the reading rate. Table 3-2 gives the settling time, number of samples, and reading rate for each filter.

Table 3-2. Filter Settings

FILTER	SETTLING TIME	NO. OF SAMPLES AVERAGED	READING RATE
Fast	5 ms	1	⩾120/sec
Fast	25 ms	4	40-60/sec
Fast	50 ms	8	20/sec
Fast	100 ms	16	10/sec
Slow	200 ms	16	5/sec
Slow	500 ms	64	2/sec
Slow	1000 ms	128	⩽1/sec

3-77. Buffer Circuit

3-78. The input to the buffer circuit is a unity gain amplifier (U210 and associated components) which establishes the signal $V_{BOOTSTRAP}$ equal to the input signal. This bootstrap voltage is used in the biasing circuits for the FET switches and in the driving circuit. The automatic zero circuit of FET switches Q231 and Q233 is turned on when a measurement is not being taken. When the switches are turned on, the voltage at the junction of Q231/C230 equals the input (V_{in}) plus the offset of U210. The voltage at the junction Q233/C230 equals V_{in}, plus the offset of U210, plus the offset of U211. As a result, the negative of the offset of U211 is stored on C230, and when a measurement cycle takes place and FET switch Q232 is turned on, the stored voltage cancels the offset of U211. The net offset voltage is zero.

3-79. The driving circuit changes the signal from a -15V and -20V logic system into a +2V and -0.5V system for the D-MOS FETS. The signal then passes through the non-inverting output amplifier (U211) with its gain determined by the state of the FET switches in its output. The gain will be either unity with Q236 on for the 10V and 1000V ranges, eight with Q237 onfor the 1V and 100V ranges, or sixty four with Q238 on for the 100 mV range. The end result is dc voltage output to the A/D Analog section that is between zero and ±16.5 volts and proportional to the input.

3-80. OHMS CONVERTER (8520A-1033)

3-81. The ohms converter produces a current in the unknown resistance (Rx) being measured so that the voltage drop is proportional to the value of Rx. The method used varies with the magnitude of the resistance.

3-82. If Rx is ≤19.9999 kΩ, it is placed in the feedback loop of an op amp as shown in Figure 3-8. In this configuration, the voltage at the high input terminal should be at or near zero with an infinite input impedance. As a result, all of the current delivered by the reference current (I_{REF}) flows through Rx which can be computed from the output voltage (Vo) with the formula $Rx = Vo/I_{REF}$.

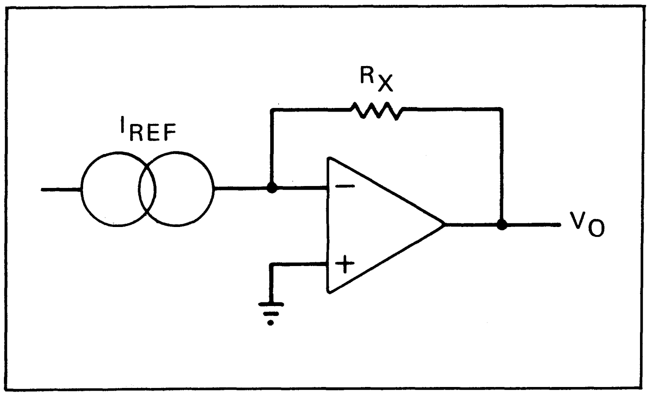


Figure 3-8. Low Ohms Measurement

3-83. With resistances >20.000 kΩ, a voltage reference (V_{REF}) is used in lieu of the I_{REF} as shown in Figure 3-9. With a known reference resistor, the value of Rx can be computed from the formula $Rx = R_{REF}(Vo/V_{REF} - Vo)$.

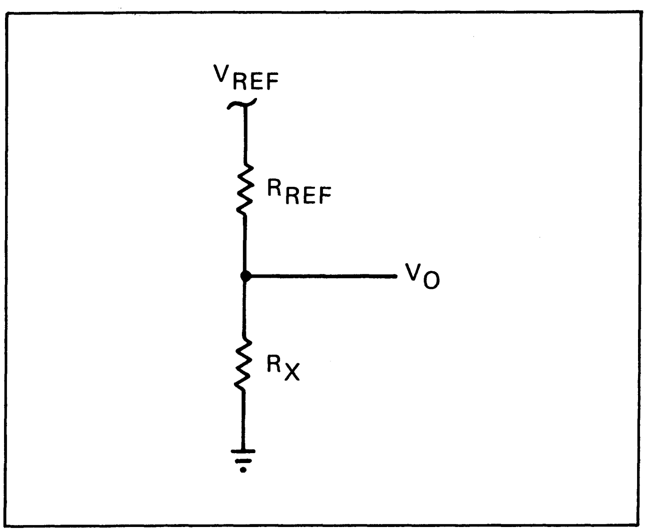


Figure 3-9. High Ohms Measurements

3-84. The output of the ohms amplifier is connected through the I/O Switching section to the DC Buffer and digitized in the A/D Converter. The gain of the DC Buffer varies with the range selected and is 64 for 10Ω, 1 for 10 MΩ, and 100 nS; and 8 for the remainig ranges. Once amplified and digitized Rx is computed using the formulas above.

3-85. Measurements of less than 20 kilohms are made using a precision current reference. Measurements of 20 kilohms, or greater, and conductance are made using a voltage reference. Each method is described in further detail below.

3-86. Low Ohms

3-87. An accurate reference voltage of –6.5V is input to U302 of the current source from the Analog A/D circuit. The 3.077 gain of the inverting op amp places +20V at TP304 and on one side of the precision resistor network (R310, R313, R316). When the low ohms function is selected, that portion of the network applicable to the range selected is held at virtual ground so that $I_{REF} = 20V/R_{REF}$. The value of I_{REF} varies from 0.1 mA for the 10 kΩ range to 1.0 mA for the 1000Ω range with K301 energized, to 10 mA for the 100 and 10Ω ranges with K302 energized. On the three lowest ranges, the relay contact resistance, when taken with the lead resistance, could have a significant effect on I_{REF}. This error is counteracted by the feedback paths through Q305 for the 10 and 100Ω ranges and through Q306 for the 1000Ω range. This constitutes a Howland Current Source which theoretically offers infinite output resistance.

3-88. High Ohms

3-89. Resistances ≥20 kΩ and conductance measurements are made using a reference resistance and VREF of 6.5 volts. The voltage reference is sampled by the I/O Switching section. This ensures that long term variations are removed whenever a high ohms range is selected. The reference resistance is 450 kΩ (R321 and R315) with K303 energized for the 100 kΩ range. For the 1M, 10M, and 100 nS ranges, K303 is de-energized to add R319 and R320 to the circuit and provide a reference of 4.5 MΩ. Relay K304 is energized for all high ohms ranges.

3-90. Input Ohms Amplifier

3-91. The input ohms amplifier has a bi-polar differential input stage (Q309), an op amp (U303) and a large current sink capability with high voltage protection in the transistor array U301. The output is also protected by the posistive temperature coefficient thermistor R101 and the zenor diode CR105 in the I/O Switching section.

3-92. The input stage is protected by current limiting resistor R332, plus Q310 and Q311. If the input terminals are left open in low ohms, Q317, and the divider R113 (I/O Switching section), and R343 clamp the output voltage to less than 8 volts. It also opens the feedback path to the ohms amplifier. For a standby function, a feedback path is provided through a turned on Q308.

3-93. AC CONVERTER (8520A-1034)

3-94. The 8520A AC Converter is a true RMS Converter. It mathematically obtains the conversion by ranging the input to 1 volt full-scale signal, averaging the square value of the signal, and then taking the square root of the averaged squared signal.

3-95. The converter accepts signals from the input terminals through the I/O Switch and converts the signal to a dc level proportionate to the RMS value of the input. The dc output signal will be between zero volts and plus 16.5 volts (full scale reading). The signal is routed through five stages, which are: the ranging amplifier, balance amplifier, squaring amplifier, square root amplifier, and integrator/filter.

3-96. The range and balance amplifiers operate independently, but the remaining three work in conjunction with each other. The range amp brings the input signal within the 1V rms range. The balance amp converts the signal to a dc absolute value. The conversion to rms is performed by the squaring amp, integrator, and square root amp, using a double logarthmic response, i.e., $2 \log X = \log X^2$.

3-97. Range Amplifier

3-98. The range amplifier is an inverting amplifier with four user selectable ranges. They are, at full scale, 2, 16, 128, and 1024 volts (limited to 650V rms or 1000V peak for safety). The three higher ranges are multiples of eight (2^3) for simpler microprocessor implementation in ranging. A full scale output of the range amp is 1 volt.

3-99. Either AC or AC plus DC can be accepted in the range amp. C401 normally blocks dc. However, if the AC + DC funciton is selected, K401 is energized to bypass the capacitor. FET switches Q401 through Q409, and Q421 are turned on by the Analog Controller in the sequence shown in the chart on the schematic diagram.

3-100. Using the 100V range as an example, the schematic chart shows that FETs Q403, Q404, and Q421 are enabled, and the remaining Range Amplifier FETs are disabled. Q403 and Q404 are enabled to route the input signal through the 100V attenuation circuit prior to application to U401. Q421 is enabled to ground out any stray capacitance from the 10V range.

3-101. Amplifier U401 uses both feedback and summing node shunt capacitance to provide for stable operation as an adjustment of high frequency gain. The stray capacitance of the FET switches also provides stability to the amplifier on the 1 volt range. Failure of one of the stabilizing capacitors could result in oscillation within that range.

3-102. All dc adjustments of the Range Amplifier are normalized to the 1 volt range adjustment (R487). The frequency adjustments and capacitive adjustments are normalized to the 1000 volts range adjustment (R438).

3-103. Balance Amplifier

3-104. The balance amp is a precision halfwave rectifier in an inverting unity-gain configuration. It consists of U402 for the gain, and the dual transistor transconductance drivers Q410 and Q411 for fast switching of the rectifier diodes. The current is forced through the hot carrier diodes CR405 or CR406 and through either R454 or R456, as determined by the polartiy of the signal. The output of the balance amplifier can be viewed at TP403.

3-105. Squaring Amplifier

3-106. Outputs of the range amp and balance amp are summed at the input of the squaring amp (U403). The op amp output (J419) represents twice the natural logarithm of the summed current input. The squaring is accomplished using the forword biased PN junctions of a transistor (Q414A, Q415B) and the inverse result from Q415A, as controlled by the output of the Square Root amplifier. Q414 and Q415 are dual transistors designed to provide logarithmic conformity and good frequency characteristics. They are placed in the circuit so their offsets cancel, allowing a tighter gain adjustment with R481. High frequency stabilization between 300 kHz and 1 MHz is provided by R468 and C455.

3-107. Integrator/Filter

3-108. The integrator is a transfer impedance amplifier (U404) which produces a voltage at its output (J420) for a current input. The output of the squaring amp is acted on by the Integrator/Filter and Square Root amplifier to produce a dc voltage that is the RMS value of the signal at the input. The circuit has two selectable filters of 100/200 ms (fast) and 500/1000 ms (slow). The filters are switched on and off with the FET switches, Q416 through Q419. The slow filter is switched in with Q416 and Q417, and the fast filter is switched in with Q418 and Q419. The filter is a three-pole filter with the FET switches shifting the poles lower in frequency (slow) or higher (fast).

3-109. Square Root Amplifier

3-110. The square root amp (U405) operates in conjuction with the integrator in performing the square root function. The squaring amp provides the current drive for Q415A, which is the current source for the integrator. The square root amp is in the feedback loop of the integrator. Any signal at the output of the integrator effects both the square root amplifier and the integrator. The output voltage of the square root amp (TP404) is the natural logarithm of the current through R483.

3-111. Stability for the overall loop is provided by C446. Diode CR408 and R482 prevent the circuit, i.e., square root amp and integrator, from latching.

3-112. Feedforward Temperature Compensation (FTC) Circuit

3-113. The FTC circuit (U408) is not in the signal path for the ac measurement. It is used to correct for dc drift in the balance (U402) and squaring (U403) amplifiers. The result is the excellent high frequency performance of the ac converter while maintaining dc performance.

3-114. A/D CONVERTER (8520A-1035)

3-115. The A/D Converter uses Fluke's patented Recirculating Remainder (R^2) method of converting a dc input signal into a binary, byte-serial, data stream. Operation of the A/D Converter is controlled by the microprocessor in the Analog Controller. The converter consists of five sections, which are: the reference circuit, the polarity detector, the automatic zero, the current ladder, and the X and Y remainders. A sample is generated when five passes through the ladder network have been executed, resulting in 21 bits of binary data. It requires 1.77 ms to complete the five passes (one sample) in the high speed mode.

3-116. The Reference circuit (U501, U502, U503, and associated components) provides a 6.5 volt reference to the current ladder. The reference varies in polarity as the inverse of the input. In some units U501 is replaced with a Ref Amp PCB Assembly (schematic 8520A-1045 or 8520A-1046) that plugs into the Analog Assembly in place of U501. Operation of the ref amp circuit is identical to the discrete component U501, and either may be used as a replacement.

3-117. The first step in the sample process is the autozero. The Analog Controller command makes "AZ" active on the gates of FET switches Q528 and Q532 to zero the circuit in preparation for a new input. When auto zero is complete, the Controller makes "G" and then "I" active to close FET switches Q529 and Q512, repectively. This allows the input to enter U506, which acts as a polarity detector.

3-118. The Reference circuit is assigned the opposite polarity from the input, based on a polarity decision made by the Analog Controller. The correct polartiy reference voltage is applied to the current ladder. Each branch of the current ladder has twice the resistance of the succeeding branch, corresponding to the binary digits 8, 4, 2, 1, and 0.5. The microprocessor closes the FET switches in the ladder, one at a time, starting with Q521 as a pass is made through the ladder. If there is excess current from the ladder, it will flow in CR505. The FET switch remains closed, and the excess current is tried on the next switch in succession. If there is no excess current, or there is a current debt, current flows through CR506 and causes a polarity change in the ladder. The polarity change causes the Controller to re-open the FET switch and try the next switch in seccession. The same process is repeated on the four remaining FET switches to complete the first pass. In most cases there is current remaining after the pass. Switch Q529 opens when the pass is complete and switch Q531 is closed by the controller to store the remainder in the "X"channel.

3-119. The remainder current flows in the loop around U505 where there is a voltage gain of 10, and is stored in C506 when switches Q526 and Q531 are closed by the Analog Controller. Once the remainder is stored, the Controller opens Q512, Q526, and Q531 and closes Q529 and Q525. This returns the current to the ladder with a current gain of 16, in comparison to the original remainder, which is required to continue the 8, 4, 2, 1, 0.5 conversion. Thus, an "error" of 0.5 on the first pass becomes an input of "8" on the next pass.

3-120. The procedure for a pass through the ladder is then repeated, substituting the "Y" channel for the "X" When the pass through the ladder is completed, Q524 and Q530 are closed for the gain in U504, and C505 stores the remainder. Then Q512, Q524, and Q530 open and Q523 closes to retrieve the remainder for another pass. The retrieve "X" switch, Q525, remains closed until Q524 and Q530 close to store the "Y" remainder.

3-121. The process alternates between the "X" and "Y" channels until the five passes through the ladder are complete. Each pass overlaps by one bit, to allow for correction of the bit switch closures that are in error. The analog controller then correlates the data into a three byte word, sends the sample for display, and prepares the circuit for the next sample.

3-122. An example using a DC Buffer output of -10.2 volts follows. The circuit is autozeroed, Q532 closes, then Q512 closes, and the reference voltage is set at +6.5 volts. Q521 turns on, and remains on. When the Controller closes Q519, a polartiy change occurs, and the switch must be reopened. When Q517 is closed, it remains on. Like Q519, Q515 and Q513 are reopened. Thus, the "8" and "2" bits are on. The first pass ends, and there is a remainder of -0.2 volts which is stored in the "X" channel as a voltage of +2.0 volts. It is retrieved with a net gain of sixteen to appear equivalent to an input of -3.2 volts, and the process is repeated. This time only Q517 and Q515 remain closed, and there is again a remainder of -0.2 to be stored in the "Y" channel. The process is repeated three more times. However, the passes will be identical to the second, other than alternating storage channels.

3-123. To review the process, it begins with an autozero followed by setting the reference voltage. The next step is the first pass through the ladder. The remainder is amplified and stored and then sent through the ladder.

This is repeated for five passes and then the sample is sent to be displayed, and the cycle begins again for another sample.

3-124. ANALOG CONTROLLER (8520A-1036)

3-125. Range and function information from the Digital Controller is accepted by the Analog Controller, interpreted, and output to circuits on the Analog PCB. Some signals for the measuring circuits originate with the microcomputer in the Analog Controller. Each of the circuits within the Analog Controller are detailed below.

3-126. Guard Crossing Circuit

3-127. Data from the Digital Controller enters the circuit in serial form at pulse transformer U627. The resultant output fires the "single shot" U609 for a serial input to the UART U602. The data is processed, and output, as parallel data, to the controller bus.

3-128. Data originating in the Analog Controller is transmitted on the bus, in parallel to U602. Then it is translated to bit-serial format and output through U610 and U614 to the crossing and the Digital Controller.

3-129. Microcomputer

3-130. The microcomputer is a mask programmed one-chip microprocessor, complete with its integral RAM and ROM. Under the control of the program, as modified by interrupts from the digital controller, the microcomputer outputs data to the I/O circuits and the data bus.

3-131. Switch S601 is not installed in the circuit. An 8-pin dip socket is available to insert a four-pole dip switch, if desired, for use during troubleshooting. Jumpers may also be used to short across the socket pins when required. Switch 1 would be the two pins toward the front of the instrument if this method is used.

3-132. I/O Circuits

3-133. Data on the bus is latched in U603 and decoded in U604 to provide control signals to the UART U602 or a strobe to one of the following latches or buffers: U607-9, U608-4, U611-1, 15, U612-1, U617-9, U618-11, U619-11, U620-11, and U621-11. Data from the bus is latched into or strobed through the applicable latch or buffer to transmit a command to another circuit or place data on the bus for the microcomputer.

3-134. Interrupt Circuit

3-135. Data on the bus (DB0-DB5) is latched into U607 on the decoded signal from the I/O circuit. A signal at U607-12 and U607-15 are ANDed with TBE and DAV, from the UART, respectively to generate an interrupt at wired OR U615 and at U601-6. The remaining signals at U607 provide enabling signals to monitor the UART S1 and EPE signals, the microcomputer T0 signal, and the trigger circuit.

3-136. Trigger Circuit

3-137. Guard crossing transformer U627 (pins 6, 8, 9, and 11) is bidirectional and receives trigger strobes from the Digital Controller. The interrupt circuit controls the output of the tigger at U608-9 to insure that a trigger interrupt does not interfere with a reading in progress. U608-13 is held low from U607-10 in the interrupt circuit to disable the latch when a reading is in progress. When the reading is complete, U607-10 goes high, enabling the latch to await the next trigger.

3-138. Reset Circuit

3-139. A reset signal is sent to the microcomputer from the Reset Circuit any time that power is applied or lost. Line voltage triggers the retriggerable one shot U609. The one-shot output, in conjunction with a low output at U605-4, enables the counter U605 and allow the line voltage to pulse the counter. When the count sets U605-4 high, the counter is disabled and stays that way until the one-shot U609 is not triggered. Removal of the constantly recurring pulses reset the counter, and the low going output resets U607 and gives a RESET signal to the microcomputer.

Section 4
Instrument Assembly/Disassembly

4-1. INTRODUCTION

4-2. Each of the following procedures deals with the removal/replacement of a single item or feature from the instrument. They are listed in a disassembly sequence, however, all previous steps may not be required to obtain access to the desired part/assembly of the instrument. Reassembly can be accomplished by performing the steps of the applicable procedure in a logically reversed sequence.

4-3. TOP/BOTTOM COVER

4-4. Removal and replacement of both the top and bottom covers is accomplished in the same manner once the desired cover has been placed toward the operator for ready access.

1. Remove the three screws across the front edge of the cover.

2. Remove the three screws across the rear edge of the cover.

3. Lift the cover straight up, guiding it out of the grooves in the front and rear panels.

4-5. TOP ANALOG GUARD COVERS

4-6. The analog section has a top guard cover with access ports for the calibration adjustments. The top cover must be removed to gain access to the instrument compartment prior to beginning the procedure.

1. Remove the screws securing the top guard cover to the internal guard chassis.

2. Remove the side screws, one centered on each side, through the access ports.

3. Lift the rear end of the top guard straight up, then remove it from the instrument compartment by moving it toward the rear to clear the lip on the front of the compartment.

4-7. INTERNAL GUARD COVERS

4-8. The analog assembly has two internal guard covers. One is located over a portion of the AC Converter, and the other over part of the DC Buffer. In both cases, the top cover and the top analog guard cover must be removed to gain access to the internal guards. Separate procedures are given for removing each of the guard covers.

4-9. DC Buffer Guard

1. Press upward on the side of guard at the front right corner until it releases from the studs.

2. Lift the guard up and toward the center of the instrument to clear the wiring harness along the side of the guard.

4-10. AC Converter Guard

1. Press upward on the side of the guard at the front left corner until it releases from the studs.

2. Lift the guard up and away from the enclosed components.

4-11. FRONT PANEL DISPLAY ASSEMBLY

4-12. The Front Panel must be removed to gain access to the Display Assembly and its components. To reach screws required for removal, the top cover must be removed. Removal of the top analog guard cover is not required but removal does improve access to the screw heads.

1. Remove the two screws located on the rear upper corners, attaching the front panel to the frame.

2. Using both hands, squeeze the top and bottom of the panel together to clear the tabs holding the panel in place.

3. Once the panel is clear of the tabs, move the panel forward to clear the tabs.

4. Remove the wires connecting the front panel input connectors to the Analog Assembly using a pair of needle-nose pliers.

NOTE

To facilitate the replacing of wires on terminals during assembly, the color code is molded into the panel next to each terminal.

5. Disconnect the ribbon cable connecting the Display Assembly to J11 on the Digital Assembly.

6. Remove the four screws securing the Display Assembly to the frame and lift the assembly clear of the instrument.

4-13. ANALOG ASSEMBLY

4-14. Remove the Analog Assembly from the instrument compartment using the following procedure. Prior to starting, the top cover, the top analog guard cover, and either the front panel or the five wires to the front panel input terminals must be removed.

1. Disconnect the ribbon cable connecting the Analog Assembly to the Digial Assembly.

2. Loosen the four retaining screws and remove the cover from the transformer and Transformer Assembly.

3. Disconnect the cable connecting the transformer to the Analog Assembly and take it back through the slot in the transformer compartment.

4. Remove the two screws attaching the rear input connector to the rear panel, then push the connector through the rear panel into the instrument compartment.

5. Remove the 11 screws securing the assembly to the instrument frame. Six of the screws are through the PCB to the bottom guard, and the other five fasten the hardware attached to the rear of the assembly to the rear panel.

6. Lift the rear of the assembly and move it out toward the rear of the instrument, exercising caution to prevent damage to the GUARD and REAR INPUT switches that are attached to the front of the assembly.

4-15. TRANSFORMER AND TRANSFORMER ASSEMBLY

4-16. Remove the transformer and Transformer Assembly from the instrument compartment using the following prodecure. Prior to starting, the top cover and the top analog guard cover must be removed from the instrument.

1. Loosen the four retaining screws and remove the cover from the transformer.

2. Disconnect the cable connecting the transformer and Analog Assembly from the Analog Assembly and bring the cable back through the center divider into the transformer compartment.

3. Remove the cable clamp from the transformer compartment frame.

4. Remove the eight screws attaching the transformer compartment to the frame. Four are used on the outside frame and four on the center frame.

5. Lift the transformer compartment containing the transformer and Transformer Assembly straight up and out of the instrument compartment.

4-17. DIGITAL ASSEMBLY

4-18. Remove the Digital Assembly from the instrument compartment using the following procedure. Prior to starting, the top cover, the transformer, and the Transformer Assembly must be removed from the instrument.

1. Disconnect one end of the guard crossing ribbon cable connecting the Analog and Digital Assemblies, and bring the cable through the slot in the center guard and frame.

2. Remove the three screws holding C201 to the outside frame.

3. Remove the three hex-head bolts and nuts securing the IEEE connector to the rear panel.

4. Disconnect the three input line-power wires from the lugs on the assembly.

5. Turn the instrument over, and remove the bottom cover from the instrument if not previously done.

6. Remove the five screws securing the Digital Assembly PCB to the tabs in the instrument compartment.

7. Lift up the front of the assembly and slide the PCB forward and out of the instrument compartment.

4-19. BOTTOM ANALOG SHIELD

4-20. Once all other assemblies have been removed from the instrument compartment, the bottom portion of the analog guard can be removed by taking out the three screws from the outside frame and the three from the center frame. Since this item is hardware with no active components, removal is seldom necessary.

Section 5
Troubleshooting

5-1. INTRODUCTION

5-2. Troubleshooting for the 8520A is contained in Tables 5-1 through 5-9, Figures 5-1 through 5-7, and in the following paragraphs. These tables are tabular flow charts that direct you to another step, as determined by the response to a decision step. If no decision is required perform the next step of the table in sequence.

5-3. The troubleshooting tables are built around the self tests incorporated into the software. However, the tables assume there is some response when the POWER switch is depressed by the Operator. If there is no response from the instrument use the Power On Procedure below before proceeding. If there is a response it may be an Error Code (the display shows "Err XX" with the "XX" representing a two character display). A list of these Error Codes and a brief explanation of each is given in Table 5-4. The tables cover procedures for troubleshooting the Front Panel, the Digital PCB, and the Analog PCB. Until you accumulate sufficient experience you should progress through the tables in sequence. You will either skip rapidly through the table or be referred to another table if the problem is not with the circuit covered.

5-4. POWER ON PROCEDURE

5-5. If the instrument does not respond to the power on command check the power supply test points (TP7XX on the analog pcb and TP201 on the Digital PCB) for the correct voltages as shown on Table 5-5, Typical Voltages and Waveforms. If all voltages are correct, continue with the Front Panel Troubleshooting, Table 5-1.

5-6. If all of the voltage tests are out of tolerance or absent, check the transformer primary inputs, i.e. the line cord, the fuse, the thermal fuse, the voltage selector switches and their settings, the line voltage outlet, the POWER switch, and the connectors to the Transformer PCB. If all of these are good check the transformer itself.

5-7. If part of the voltage tests are within tolerance check the secondaries and/or rectifier circuits for the failed tests. The Digital PCB Power Supply has an adjustment and J201 can be removed to prevent any loading from the digital circuits. There are no adjustments on the Analog PCB Power Supply; however most of the circuits have jumper plugs that can be removed to insure the test does not fail due to loading by the circuits. Remove J19 from the Analog PCB to disable the DC Buffer and I/O Switching circuits, J20 for the Ohms Converter, J21 for the AC Converter, and J22 for the Analog Controller.

5-8. SPECIAL PROCEDURES

5-9. Special procedures are provided for testing the Analog Controller and A/D Converter circuits. The procedures are called out in the Analog PCB Troubleshooting tables when required.

5-10. Analog Controller Tests

5-11. Three test programs are available in the Analog controller microprocessor to test the digital functions of the Analog PCB. These tests may be an aid in troubleshooting the Analog Controller if the instrument consistently displays an error message, fails all steps of Math Program 1 Test #1 (the power supply outputs should be checked first), or consistently reads gross errors during measurements. Prior to beginning the microprocessor tests, the presence of the signals described in the first sub-paragraph below should be verified. An 8-pin dip switch must be installed in the empty S601 socket, next to the analog controller microprocessor, before any of the tests can be selected. In addition, the instrument input terminals must be "open" and the guard crossing cable disconnected. These conditions cause a front panel error display, which should be ignored during these tests. When the instrument operates as a voltmeter, the microprocessor does not check the status of S601; however, if TP607 is shorted to TP608, it resets the analog controller microprocessor and the switch status is "read". When the tests are completed, return the instrument to voltmeter operation by setting all of the switches on S601 to OFF, reconnecting the guard crossing cable, and shorting TP607 to TP608, which forces the microprocessor to check the status of S601. The selection method and operation of each of these tests are described below.

5-12. ANALOG CONTROLLER INPUT SIGNALS

5-13. Verify the presence of the following signals before testing the Analog Controller microprocessor:

1. Readings of -15V dc at TP603 and -20V dc at TP604 for a +5V dc logic signal.
2. A line frequency square wave at U614-4.
3. A 2 MHz square wave clock at TP605.
4. A pulse (ALE) approximately every 12.5 msec at TP602 (variable with the input line frequency).
5. A logic high reading (INT) at TP606.
6. A logic high that goes low at TP601 (RESET) when TP607 is shorted to TP608, and returns high approximately 400 ms (60 ms for a 400 Hz line frequency) after the short is removed.

5-14. LATCH TEST

5-15. This test applies a continuous circulating signal to a component selected by the S601 test switch. The microprocessor checks the status of S601 constantly during the Latch Test to determine which component receives the signal. The output of the selected component can be monitored with an oscilloscope or logic probe. Use the following procedure to perform the latch test:

1. Insure S601 is installed and the guard crossing cable is disconnected.
2. Set switch #1 of S601 to ON and the remaining switches to OFF.
3. Short TP607 to TP608 to reset the Analog Controller.
4. Select the component to be exercised by setting S601 to the position indicated in Table 5-10.
5. Observe the output pins of the selected component for a recurring pulse.

NOTE

An oscilloscope setting of 5 volt/div and 50 us/div should give a display of the recurring pulse.

6. Set the switches on S601 for either the next test or all OFF (to resume voltmeter operations), then short TP607 to TP608 to reset the Analog Controller and make it "read" the switch setting.

5-16. UART TEST

5-17 The UART test checks the response from the transmitted data. Before each test a byte of data is written into Port 1 (U601-27 through 34). An incorrect response stops the test and the failed step can be determined by reading the data byte in Port 1. If the test fails, all of the data bits in the port are at a constant state. If the test passes the test is continuously repeated and the three low order bits are changing states constantly. Use the following procedure to perform the UART test:

1. Insure S601 is installed and the guard crossing cable is disconnected.
2. Set switch #2 on S601 to ON and the remaining switches to OFF.
3. Short TP607 to TP608 to reset the Analog Controller.
4. Monitor the status of Port 1 for a constant level, i.e. either always high or always low, on all eight bits of the port.
5. If the three low order bits (U601-29,28,27) are constantly changing states the instrument passes the test. If all eight bits are at a constant level the controller is locked on the failed test and the missing signal can be identified by decoding the three bits using Table 5-11. Once the missing signal has been identified refer to the UART and Interrrupt Troubleshooting Procedures paragraph that follows the Interrupt Test.
6. Set the switches S601 for either the next test or all OFF (to resume voltmeter operations), then short TP607 to TP608 to reset the Analog Controller and force it to "read" the switchsetting.

5-18. INTERRUPT TEST

5-19. The Analog Controller microprocessor generates a DAV and an external trigger interrupt for use within the instrument. They are tested in a series of six steps, with a byte of data written into Port 1 (U601-27 through 34) at the beginning of each step. If the step fails the byte is locked into Port 1 and it can be decoded to determine the failed step. If the test passes it is continuously repeated and the four low order bits are constantly changing states. Use the following procedure to perform the interrupt test:

1. Insure S601 is installed and the guard crossing cable is disconnected.
2. Set switch #4 of S601 to ON and the remaining switches to OFF.
3. Short TP607 to TP608 to reset the Analog Controller.
4. Monitor the status of Port 1 for a constant level, i.e. either always high or always low, on all eight bits of the port.
5. If the four low order bits (U601-30,29,28,27) are at changing level the instrument passes the test. If all eight bits are at a constant level the controller is locked on the failed test and the missing signal can

be identified by decoding the four bits using table 5-12. Once the missing signal has been identified refer to the UART and Interrupt Troubleshooting Procedures paragraph that follows this test.

6. Set the switches on S601 for either the next test or all OFF (to resume voltmeter operations), then short TP607 to TP608 to reset the Analog Controller and force it to "read" the switch setting.

5-20. UART AND INTERRUPT TROUBLESHOOTING PROCEDURES

5-21. Once the missing signal has been identified the tests in Table 5-13 can be used to locate the defective compontent(s). The table lists only the pertinent IC's; however, associated components should be checked at the same time. Check for missing components, improper values, defective components, shorted inputs or outputs, bent legs that could produce capacitive coupling (CMOS) or thermal problems, shorted bus lines, or lines shorted to logic common or logic ground. Repair or replace the defective component(s) when located then repeat the test during which the fault was found.

5-22. A/D Converter Test

5-23. The A/D Converter test permits the examination of the A/D ladder during a conversion. A known voltage is applied to the terminals and the output monitored for a waveform that can be translated to a digital number corresponding to the most significant digit of the input. Use the following procedure to perform the A/D Converter test:

1. Prepare the instrument for normal operation. Select Volts DC and fix the range at 10 Volts.

2. Apply a known input >0 and <0.2 volts from a variable source to the input terminals.

3. Using a dual trace oscilloscope connect one trace to TP509 for sync and observe the waveform at TP508 with the other.

4. The waveform at TP508 can be decoded to the digital value of the most significant digit. It represents values of 8, 4, 2, 1, and 0.5. In this case all should be high, as shown for 0 volts in Figure 5-8.

5. Vary the source to a known input >1.0 and <1.2 volts.

NOTE

The input must be read by the 8520A as >1 to insure data in the one bit but <1.5 (approximately) to keep data from the 0.5 bit. An input of 1.1 volts insures the correct digital value.

6. The waveform at TP508 changes to that shown in Figure 5-8 for 1 volt.

7. Rotate the source through the remaining voltages in Figure 5-8. Insure the input is greater than the basic so the tolerance of the instrument does not put the input below the basic value.

8. Verify the waveform representing the digital count at TP508 is correct for each input voltage.

9. If the waveform is incorrect for any input check that portion of the ladder.

Table 5-1. Front Panel PCB Troubleshooting

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
	NOTE *All tests are made in relation to ⏚ at TP6 unless otherwise noted.*		
1	Disconnect the instrument from any external controller.		
2	Depress the POWER switch to apply power to the instrument.		
3	Does any portion of the Display or any indicator illuminate?	17	4
4	Is VUNREG present at TP7 (≈8V)?	5	15
5	Are there recurring strobe pulses at U7-11?	7	6
6	Check U7 and its inputs from the digital PCB. Replace or repair as required then resume at step 3.		
7	Is there approximately 4.1V present at TP4. (VUNREG less the 3.9V drop of Zener CR1.)	9	8
8	Check Zener diode CR1 and R2. Repair as required then resume at Step 3.		
9	Is U1-1 High?	10	15
10	Does U1-11 toggle?	11	15

Table 5-1. Front Panel PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
11	Is Vcc1 present at TP5 (≈5Vdc)?	12	15
12	Does at least one input data line (D0-D7) toggle?	13	15
13	Do all the outputs of U1 toggle?	16	14
14	Check U1 and RN1. Repair or replace as required then resume at step 3.		
15	Check the connector, cable, and output from the Digital PCB. Repair as required the resume at step 3.		
16	If all the above checks are good, but none of the display segments are illuminated it indicates a massive failure, i.e. two or more components. Check combinations that would effect both the 7-segment and 14-segment displays, e.g. U2 and U3, etc. Repair as required then resume at step 3.		
17	Is the REMOTE indicator illuminated?	18	19
18	Check for an invalid $\overline{\text{REMOTE}}$ input from the Digital PCB. Repair as required then resume at step 17.		
19	Select Math Program #1 (TEST), Test #3 (Key & LED Tests). Push RESET one time to select the first step of the LED test, i.e. all Segments and indicators illuminated.		
20	Does the display have the same segment blank in all 7-segment displays?	21	26
21	Do all outputs of U9 toggle?	23	22
22	Check U9 and its inputs from the digital PCB. Repair as required then resume at step 19.		
23	Do all inputs to U10/U11 toggle?	25	24
24	Check U21, CR2 and RN3. Repair as required then resume at step 19.		
25	Check for a constant low output from U10/U11. Repair as required then resume at step 19.		
26	Does the display have the same segment blank in all four sections of the two dual 14-segment displays?	27	32
27	Do all outputs of U12 toggle?	29	28
28	Check U12 and its inputs from the digital PCB. Repair as required then resume at step 19.		
29	Do all inputs to U23/U24 toggle?	31	30
30	Check U22 and RN6. Repair as required then resume at step 26.		
31	Check for a constant low output from U23/U24. Repair as required then resume at step 19.		
32	Is one 7-segment display digit and/or one half of a 14-segment display blank?	33	34
33	Check that the output from U2/U3 and U1 that drives that segment or segments toggles. Repair as required then resume at step 19.		
34	Is one segment in one display blank?	35	36
35	Replace the affected LED. If the problem is not corrected check the land pattern leading to the affected LED. Repair as required then resume at step 19.		
36	Depress RESET one time to advance the display.		
37	Do any segment(s) still glow, except the decimal point of the first digit?	38	39
38	Check U5. Repair as required then resume at step 19.		
39	Depress and release the RESET key switch for each step to sequence through every segment of the 7-segment and 14-segment display.		
40	Does more than one segment of the display illuminate during any single step of the sequence?	41	42

Table 5-1. Front Panel PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
41	Check the transistor arrays U10, U11, U23, and U24. Repair as required then resume at step 39.		
42	Depress any Keyswitch except SHIFT to go to the Key portion of Program #1, Test #3.		
43	Sequence through the keys checking for the indication shown in Table 5-6.		
44	Are all indications correct?	50	45
45	Does at least one indicator illuminate?	47	46
46	Check U6-1/15 for a strobe, check the outputs of U5 for a toggling signal, and check the inputs to U6 with the applicable switch depressed for a pulse. Repair or replace as required then resume at step 42.		
47	Are the indicators correct for the keyswitches that have a display?	48	49
48	Check for a row signal on the switches affected from U5. Repair as required then resume at step 42.		
49	Check U6 for incorrect test indications. Repair as required then resume at step 42.		
50	The Front Panel troubleshooting is complete.		

Table 5-2. Digital PCB Troubleshooting

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
1	This test of the Digital PCB assumes that the instrument either does not operate correctly, or if the readings are incorrect an attempted Calibration Procedure was unsucessful. *NOTE* *All measurements made during the procedure are in reference to TP2 (TP10 alternate), unless stated otherwise.*		
2	Is the Front Panel Display illuminated?	21	3
3	Is +5V dc present at TP1 (Vcc)?	7	4
4	Is Vunreg (approx 8V) present at J12-3,6 (or Front Panel TP7)?	5	6
5	Check U202 and its associated circuitry. Repair as required then resume at step 2.		
6	Check the rectifier CR1/CR2, the filter on the Transformer PCB A4, and the transformer T201. Repair as required then resume at step 2.		
7	Is there a high logic level at TP3 ($\overline{\text{RESET}}$)?	9	8
8	Check the RESET circuit U22, U28, U36, U23, and their associated components. Repair as required then resume at step 2.		
9	Is there a 4 MHz clock at TP7?	11	10
10	Check Y1 (8 MHz crystal), U19, U20, and their associated components. Repair as required then resume at step 2.		

Table 5-2. Digital PCB Troubleshooting (cont)

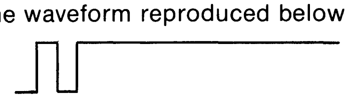
STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
	NOTE *An active signal, as used in the remainder of these tests, means a constantly changing logic level, changing levels at a rate that makes it difficult to interpret the data.*		
11	Is there an active signal present at TP6 ($\overline{INT}$)?	13	12
12	Check U17 and its enabling Interrupt inputs. These include the Phase Lock Loop circuit through U35, DR from the UART through U33-2, and IEEE INTR from the IEEE circuit through U34-12. Repair as required then resume at step 2.		
13	Check the following microprocessor signal points for an active signal: TP5 $\overline{M1}$ (Output) TP8 $\overline{WAIT}$ (Input) U18-20 $\overline{IOREQ}$ (Output) U18-19 $\overline{MEMREQ}$ (Output) U18-28 $\overline{RFSH}$ (Output) U18-21 $\overline{RD}$ (Output) U22 $\overline{WR}$ (Output)		
14	Are all points active?	16	15
15	Check for a WAIT input from U33-4 (IEEE WAIT) and U33-5 (U9 circuit with M1 input). If any of the remaining signals are incorrect check the microprocessor U18 (substitution is normally the best method of checking the microprocessor). Repair as required then resume at step 2.		
16	Is there a high logic level at U18-17 ($\overline{NMI}$)?	18	17
17	Check U1 and its associated components. Repair as required then resume at step 2.		
18	Is U19-8 ($\overline{DISPLAY\ BLANK}$) at a high level?	20	19
19	Check U21, U19, U25, and their controlling inputs. Repair as required then resume at step 2.		
20	Refer to the Front Panel Troubleshooting Table. Repair as required then resume at step 2 of this procedure.		
21	Perform Math Program #1, Test #2.		
22	Does the Front Panel display PASS DGTL only?	33	23
23	Is Err 14 ROM displayed during the test?	24	25
24	Check the decoder U3. Repeat test #2 while checking the data and address lines of U10, U11, and U12 for an active state. Repair as required then resume at step 21.		
25	Is Err 15 RAM displayed during the test?	26	27
26	Check the decoder U2. Repeat test #2 while checking the data and address lines of U4 through U7 for an active state. Repair as required then resume at step 21.		
27	Is Err 17 HDWR displayed during the test?	28	21
28	Perform Math Program #1, Test #4. NOTE *This test program constantly sends a hex 40 (0100 0000) across the guard crossing from the digital microprocessor to the analog microprocessor, and back to the digital microprocessor. This is in addition to the sequential signal sent to the display.*		
29	Is the waveform reproduced below present at U26-20 (UART SI)? 	31	30

Table 5-2. Digital PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
30	Is the waveform above present at U26-25 (UART SO)?	31	32
31	Check the UART U26, the address and data lines, and the microprocessor U18. Repair as required then resume at step 21.		
32	Proceed through the guard crossing circuit checking the waveform at each component. The waveform should be similiar to the one shown below, i.e. the data level a burst of ac; however, the base line level will vary between components due to inverting gates or circuits. Check the signal at U30-4, U37-5, and U38-14 on the digital PCB; U627-3, U602-20, U602-25, U614-12, U610-3, and U627-9 on the Analog PCB; and U38-6 and U36-4 on the digital PCB. If the signal goes into the analog UART but does not come out refer to the Analog PCB troubleshooting table. Repair as required then resume at step 21. 		
33	Does an attempted measurement reading result in an Err 3(X) UART or Err A(X) GARD display?	34	37
34	Check the phase lock loop for the proper signals for the actual input line voltages. Line Freq — U29-14 — U29-4 50 Hz — 50 Hz — 400 Hz 60 Hz — 60 Hz — 480 Hz 400 Hz — 57 Hz — 457 Hz		
35	Are the signals correct for the input line voltage?	37	36
36	Check U29, U28, U32, U23, and their associated components. If the problem is not in the Phase Lock Loop check the UART circuit beginning at step 28. Repair as required then resume at step 33.		
37	Is the instrument used in an IEEE system? *NOTE* *The assumption is made at this time that the instrument can be controlled, and responds correctly, to local commands from the From Panel. Accuracy of the instrument has not, as yet, been verified.*	38	46
38	Connect the instrument to an IEEE Bus and address it from the Bus Controller.		
39	Does the front panel REMOTE indicator iluuminate?	41	40
40	Verify the LED and R1 are good, and that voltage is present on the front panel, then check U8. Repair as required then resume at step 38.		
41	Does the instrument correctly respond to IEEE commands?	46	42
42	Depress Front Panel Local and then the Front Panel RESET switch twice in rapid succession to reset the instrument and observe the Front Panel Display for the correct IEEE address as set on the IEEE Address switches.		
43	Is the correct address displayed?	45	44
44	Check for the following signals: ASE to pulse with the reset, the Data Bus lines, the 1 MHz clock, M1, WR, IOREQ, IEEE WAIT, and IEEE ADDR are active. Check U102, S103, and RN101 for address errors or incorrect data lines. Check U103 through U106 and their associated components for problems in the other lines. If the above signals are correct check U101. Repair as required then resume at step 38.		

Table 5-2. Digital PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
45	Give a command from the system controller while checking gates U107 through U110 for the same response, observing the correct signal flow direction (U108 through U110 are bi-directional). If the signals respond correctly check U101. These components can be checked by substitution or with a static bus controller (e.g. the Ziatech ZT-488). Techniques for troubleshooting using static bus controllers are explained in Fluke TB-13.Repair as required then resume at step 38.		
46	Test of the Digital PCB is complete. If readings are incorrect check the Analog PCB using the Analog Troubleshooting Table.		

Table 5-3. Analog PCB Troubleshooting

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
	NOTE *The test in this table assumes that the instrument reponds to front panel commands and the fault is one of incorrect readings rather than a massive failure. A calibration adjustment procedure should be attempted prior to troubleshooting.*		
1	Remove any leads connected to the instrument input terminals.		
2	Select Math Program #1 (TEST), Test #1 (Analog).		
3	Step completely through the test, recording the number of any sub-tests that fail.		
4	Did any sub-test fail?	5	14
5	Did only one sub-test fail?	9	6
6	Compare the numbers of the failed sub-tests against the examples given in Table 5-7, comparing for a duplicate failure pattern.		
7	Does the failure pattern match one of those in the table?	8	9
8	Check the component indicated and its associated circuitry. Repair of replace as required then resume at step 2.		
9	Check the Analog Controller Ouput latches for the test(s) that failed using the applicable line(s) of Table 5-8.		
10	Are the latches in the states listed for that sub-test in the table?	13	11
11	Perform the analog controller latch test described in the Troubleshooting Paragraph.		
12	Do all the latches perform as required?	13	8
13	Trace the analog signal for the failed subtest through the applicable circuit(s) using the simplified schematics in Figures 5-1 through 5-7, and the typical test point voltages and Waveforms in Table 5-5. If the trouble is isolated to the Analog Controller or A/D Converter refer to the tests in the text portion of the troubleshooting section. Repair as required then resume at step 2.		
14	Is the trouble in low ohms (<20 Kohms)?	15	18

Table 5-3. Analog PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
15	Check the low ohms circuit using Table 5-9.		
16	Are all circuit indications as shown in the Table?	18	17
17	Trace the signal path for the failed low ohms test trough the circuit using Table 5-5, typical Voltages and Waveforms. Repair as required then resume at step 15.		
18	Perform the Calibration Adjustment procedure given in Section 6 of the 8520A Calibration Manual.		
19	Can the Calibration Adjustment procedure be sucessfully completed?	21	20
20	Trace the defective adjustment circuit using the typical voltage and waveform in Table 5-5 and the schematics. Repair as required then resume at step 18.		
21	Troubleshooting the analog circuits is complete.		

Table 5-4. Error Codes

ERROR	DISPLAY	EXPLANATION
00	Blank	No Errors
01	Err01 HV	High Voltage present with ohms function selected
02	None	Syntax error during remote operation
03	Err03 NOVR	Numeric or register overflow
03	Err03 RTD	Failure of RTC algorithm to coverage
04	Err04 KEY	Invalid use of a control
05	Err05 FLTR	Cannot increase filter in ASYNC reading rate
06	Err06 ZERO	ZERO (Math Program #2) cannot be selected with the VAC or VA+D function
07	Err07 IEEE	IEEE-488 input buffer overflow
08	or VXRF	External Reference input $>\pm 16.5$V dc with Math Program #3 selected
09	ur VXRF	± 0.5V dc difference between EXTERNAL REFERENCE HI and LO terminals with Math Program #3 selected.
10	HHHHH (function)	Normal input overrange
11	Err11 HDWR	Improper echo from A/D Microprocessor
12	rrtoo FAST	Reading rate too fast for selected filter and/or Math Program
14	Err14 ROM	ROM checksum error
15	Err15 RAM	RAM does not check out
16	Err16 LINE	Cannot determine line frequency at POWER ON
17	Err17 HDWR	Sync failure between the microprocessor and the A/D Converter
18	OPen INPUT	V/Ω INPUT terminals not open during Analog Test (Math Program #1)
22	Err22 HDWR	Error while measuring volts for ohms change
23	Err23 HDWR	Time error, incorrect response from A/D Converter
24	Err24 HDWR	Resync error: instrument controller to A/D Converter
25	Err25 HDWR	Ohms Reference Error
30	Err30 UART	No A/D response to microprocessor within time limits
31	Err31 UART	Microprocessor detects parity error
32	Err32 UART	Microprocessor detects overrun error
33	Err33 UART	Parity and overrun errors (Error Codes 31 & 32)

Table 5-4. Error Codes (cont)

ERROR	DISPLAY	EXPLANATION
34	Err34 UART	Microprocessor detects framing error
35	Err35 UART	Parity and framing error (Error Codes 31 & 34)
36	Err36 UART	Overrun and framing errors (Error Codes 32 & 34)
37	Err37 UART	Parity, overrun, and framing errors (Error Codes 31, 32, & 34)
A1	ErrA1 GARD	Undefined interrupt at A/D
A3	ErrA3 GARD	Analog interrupt activated
A5	ErrA5 GARD	Parity, overrun, or framing error at A/D
A7	ErrA7 GARD	Illegal command at A/D

Table 5-5. Typical Voltages and Waveforms

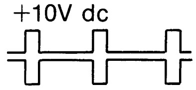
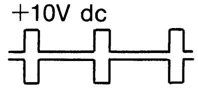
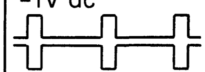
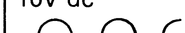
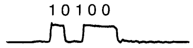
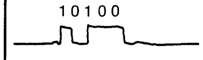
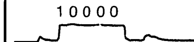
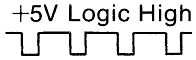
HI TP	LO TP	HI MNEMONIC	TYPICAL READING/WAVEFORM W/INPUT			REMARKS
			10V dc	10V ac @ 400 Hz	1KΩ	
		Analog				
102	103	DC INPUT	+10V dc	N/A	-1V dc	
104	103	MUX OUT	+10V dc	+10V dc	-1V dc	
202	207	BUF INP	+10V dc	+10V dc	-1V dc	
204	207	MEAS				Peak-≈2V+input V
205	207	ZERO				Base-≈-.5V+input V
206	207	BUF OUT	+10V dc	10V dc	+8V dc	
Q227-5	207		+12±2V dc	+12±2V dc	+10±2V dc	
Q234-5	207		+12±2V dc	+12±2V dc	+10±2V dc	
304	302	20V	N/A	N/A	20V dc	
305	302	0V	N/A	N/A	0V dc	
306	302	SRLO	N/A	N/A	-1.3V dc	
U403-7	402	+8V	N/A	+8.0V dc	N/A	
U403-4	402	-8V	N/A	-8.0V dc	N/A	
401	402	AC INP	N/A	10V dc	N/A	
403	402	BAL OUT	N/A		N/A	Peak≈0.9V above baseline
404	402	SQ RT	N/A	-0.57V dc	N/A	
405	402		N/A		N/A	Peak≈0.9V below baseline
502	501	+VREF	+6.5V dc	+6.5V dc	+6.5V dc	
503	501	-VREF	-6.5V dc	-6.5V dc	-6.5V dc	
505	501	A/D INPUT	+10V dc	+10V dc	+8V dc	
508	501	INT OUT	10100 	10100 	10000 	Dependent upon A/D Input Synced to TP 509
603	604		+5V Logic High			-15V to gnd
602	604	$\overline{ALE}$				PERIOD=2.5 μS
605	604	2 MHz				2 MHz Clock
606	604	$\overline{INT}$	+5V Logic High	+5V Logic High	+15V to gnd	-15V to gnd
601	604	$\overline{RESET}$	+5V Logic High	+5V Logic High	+5V Logic High	-15V to gnd
703	705	+27V	+27.6 ±1.1V dc	+27.6 ±1.1V dc	+27.6 ±1.1V dc	
704	705	+15V	+15 ±0.6V dc	+15 ±0.6V dc	+15 ±0.6V dc	
706	705	-15V	-15 ±0.6V dc	-15 ±0.6V dc	-15 ±0.6V dc	
707	705	-27V	-27.6 ±1.1V dc	-27.6 ±1.1V dc	-27±1.1V dc	
701	702	-15 LH	+5 +0.2/-0.1V dc	+5 +0.2/-0.1V dc	+5 +0.2/-0.1V dc	-15V High -20V Low

Table 5-5. Typical Voltages and Waveforms (cont)

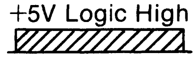
HI TP	LO TP	HI MNEMONIC	TYPICAL READING/WAVEFORM W/INPUT			REMARKS
			10V dc	10V ac @ 400 Hz	1KΩ	
		Digital				
1	2	Vcc	+5+0.2/-0.1V dc			
3	2	$\overline{\text{RESET}}$	+5V Logic High			
4	2		+5V Logic High			
5	2	$\overline{\text{M1}}$				
6	2	$\overline{\text{INT}}$				1 ms
7	2	ϕ				-.1 μs
8	2	$\overline{\text{WAIT}}$				
101	013	IEEE ENABLE				
102	103	IEEE TRIGGER	Logic Low			
201	202	Vcc	+5 +0.2/-0.1V dc			

Table 5-6. Keyswitch Test

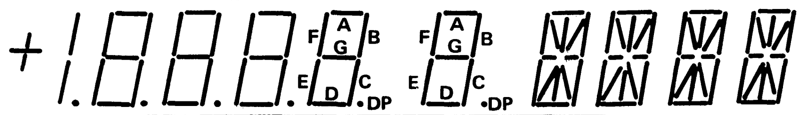
KEYSWITCH 		
VDC (+/-)	D	DP
VAC (7)	C	DP
Ω2 WIRE (8)	DP	E
Ω4 WIRE (8)	G	E
nS (CE)	F	E
PROGRAMS IN USE/OFF	E	E
STATUS (MENU)	G	G
BURST SIZE	F	G
BURST LOCATION	E	G
AUTO RANGE (.)	D	G
▲RANGE (4)	C	G
▼RANGE (5)	DP	D
EXT/AUTP TRIGGER (6)	G	D
ARM BNC TRIGGER (EXP)	F	D
MANUAL TRIGGER	E	D
PROGRAM SELECTION	F	F
PROGRAM DATA	E	F
READING RATE▲(0)	D	F
READING RATE▼(1)	C	F
FILTER▼(2)	DP	C
FILTER▲(3)	G	C
LOCAL(/)	F	C
AT the Same Time: SHIFT and PROGRAM SELECTION	G and F	F
At the Same Time: RESET and nS (CE)	D and F	E

Table 5-7. Analog Test Failure Patterns

FAILED TEST 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	K102 remains energized
			X													K102 does not energize
X			X	X												DC Buffer X1 amplifier
	X				X											DC Buffer X8 amplifier
		X				X	X									DC Buffer X64 amplifier
			X	X	X	X	X					X	X	X	X	Reference Voltage, R321, K103 remains energized, K101 does not energize
			X	X	X	X							X	X	X	K303 does not energize
							X					X				K303 remains energized
								X	X	X	X	X	X	X	X	K104 does not energize, K401 does not energize
								X				X				AC Converter Range 1V (Q401, 408, 409, 421 on)
									X				X			AC Converter Range 10V (Q401, 402, 408, 409 on)
										X				X		AC Converter Range 100V (Q403, 404, 421 on)
											X				X	AC Converter Range 650V (Q405, 406, 407, 421 on)

Table 5-8. Analog Controller Latch Outputs

IC#	PIN#	MNEMONIC	ACTIVE STATE	ANALOG TEST NO. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
U618	2	$\overline{\text{X REF LO}}$	L	H ↔ H
	5	$\overline{\text{X REF HI}}$	L	H ↔ H
	6	$\overline{\text{DC X 1}}$	L	L H H L L H H H L L L L L L L L
	9	$\overline{\text{DC X 8}}$	L	H L H H H L H ↔ H
	12	$\overline{\text{DC X 64}}$	L	H H L H H H L L H ↔ H
	15	$\overline{\text{FAST DC}}$	L	H ↔ H
	16	$\overline{\text{SLOW DC}}$	L	L ↔ L
	19	No Connection	X	L ↔ L
U619	2	LOW DC	H	L L L H L ↔ L
	5	LOW OHMS	H	L ↔ L
	6	2T/4T SEL	H	L L L H H H H H L L L L H H H H
	9	No Connection	X	H ↔ H
	12	$\overline{\Omega\text{REF}}$	L	H ↔ H
	15	$\overline{\text{DC} + \Omega}$	L	L ↔ L H ↔ H
	16	$\overline{\text{AC V}}$	L	H ↔ H L ↔ L
	19	AC V	H	L ↔ L H ↔ H
U620	2	$\overline{\text{SAC}}$	L	L ↔ L
	5	$\overline{\text{FAC}}$	L	H ↔ H
	6	10V AC	H	L ↔ L H L L L H L L
	9	$\overline{\text{100V AC}}$	L	H ↔ H L H H H L H
	12	$\overline{\text{10V AC}}$	L	H ↔ H L H H H L H H
	15	$\overline{\text{1V AC}}$	L	H ↔ H L L H H L L H H
	16	$\overline{\text{1 KV AC}}$	L	L ↔ L H H H L H H H L
	19	K401	H	H ↔ H
U621	2	No Connection	X	L ↔ L H L ↔ L
	5	No Connection	X	L ↔ L
	6	No Connection	X	L → L H L ↔ L
	9	$\overline{\text{HIGH OHMS}}$	L	H H H L L L L L H H H H L L L L
	12	$\overline{\text{200 K}\Omega}$	L	H H H L L L L H H H H H H L L L
	15	20 +200Ω	L	H ↔ H
	16	$\overline{\text{2 K}\Omega}$	L	H ↔ H L H ↔ H
	19	$\overline{\text{OHMS CLAMP}}$	L	L ↔ L H L ↔ L

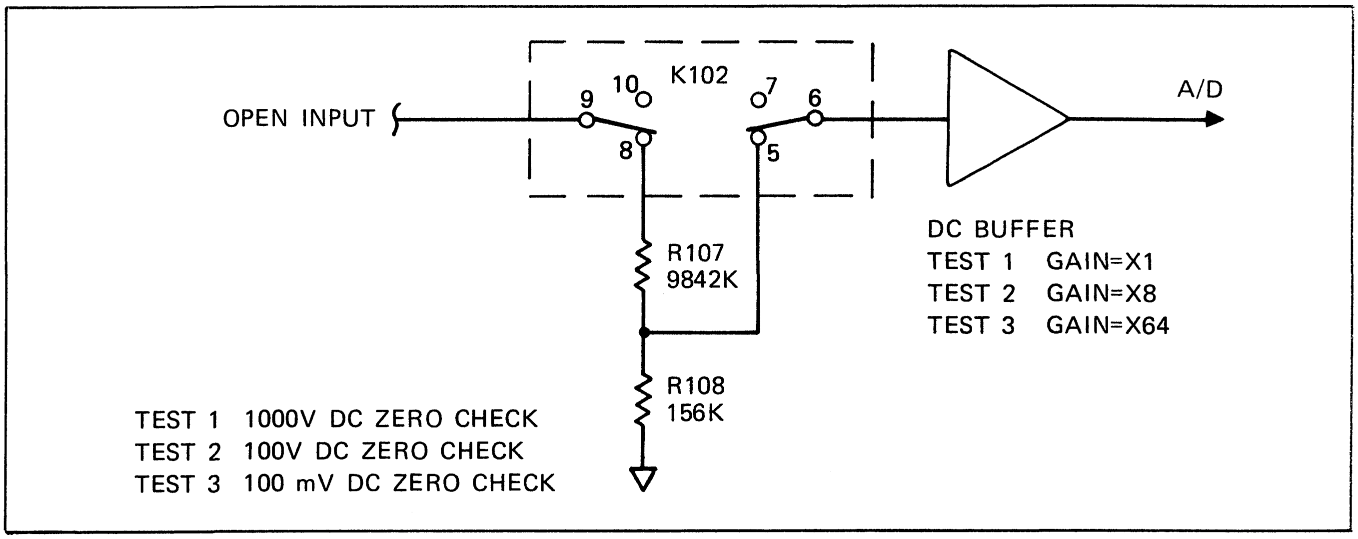


Figure 5-1. Analog Self Tests #1, 2, 3 Simplified Schematic

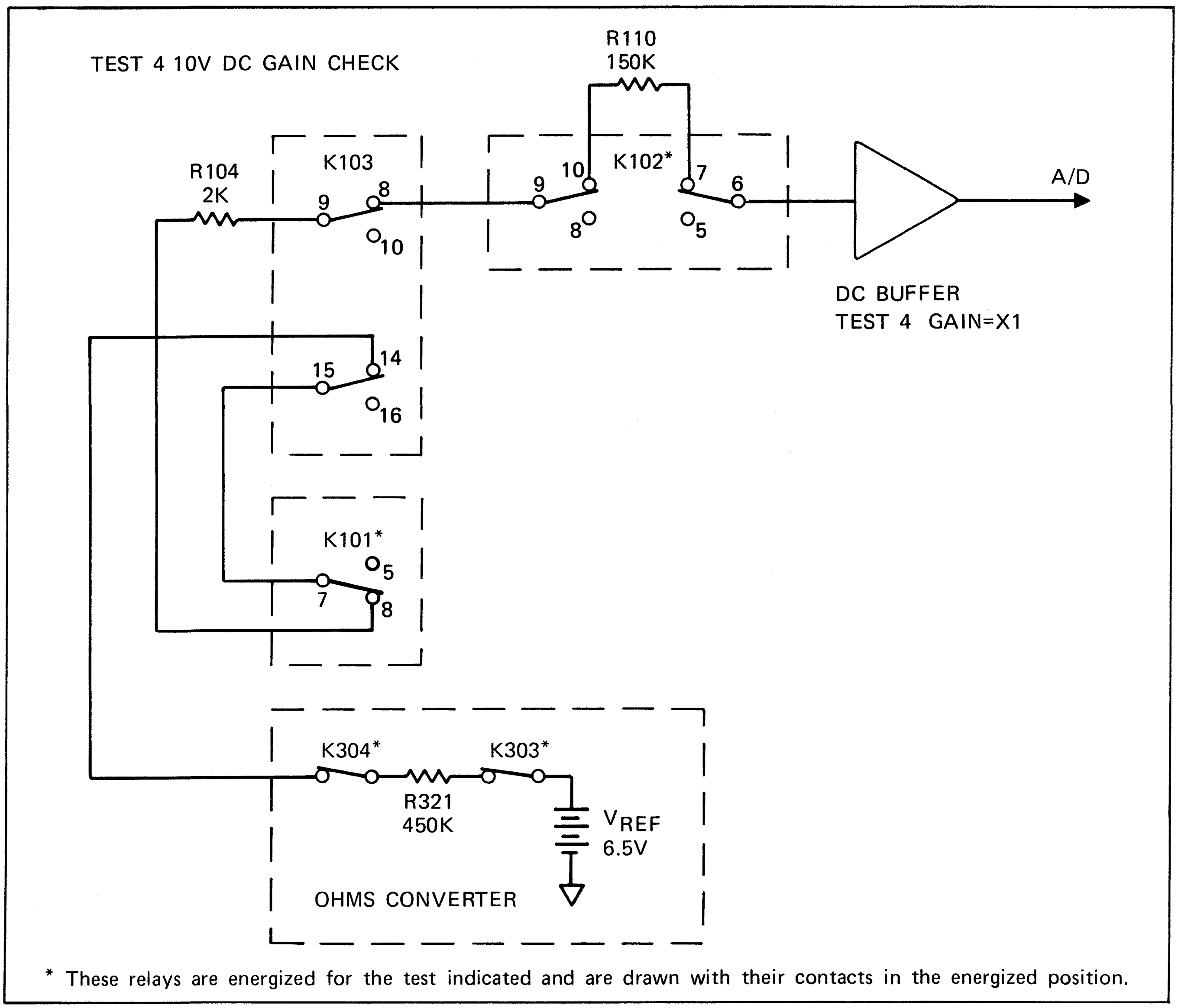
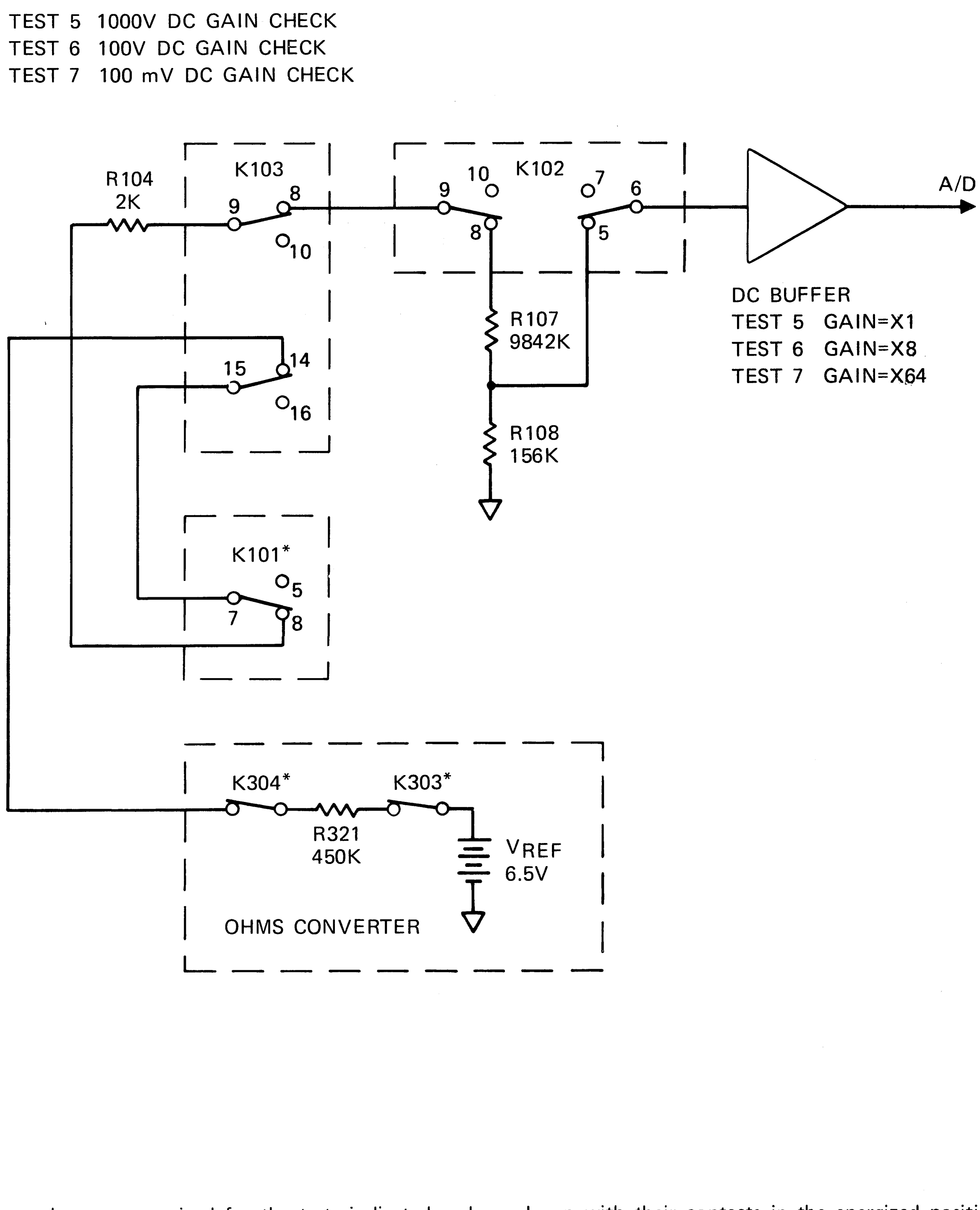
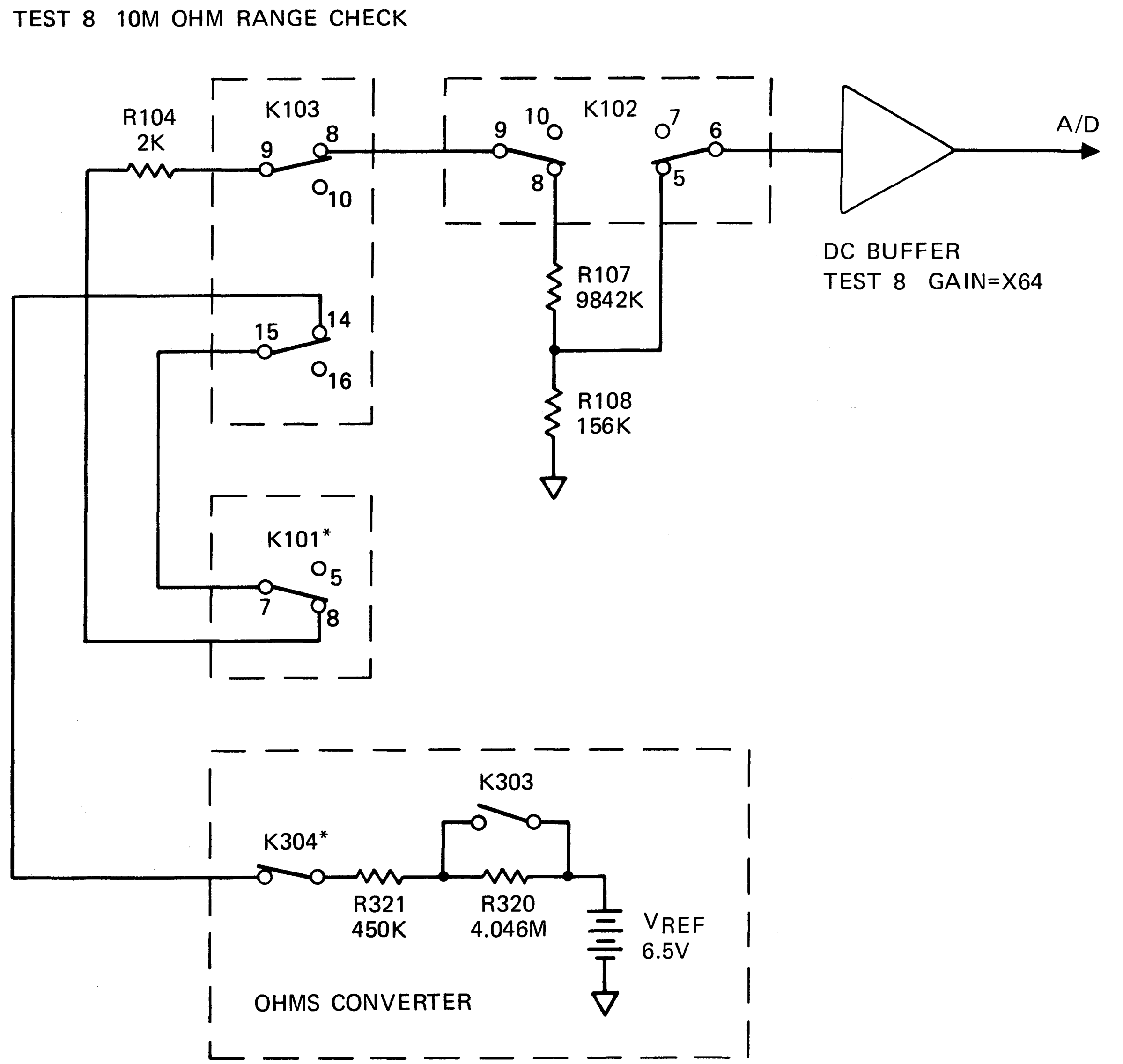


Figure 5-2. Analog Self Test #4 Simplified Schematic



* These relays are energized for the tests indicated and are drawn with their contacts in the energized position.

Figure 5-3. Analog Self Tests #5, 6, 7 Simplified Schematic



* These relays are energized for the test indicated and are drawn with their contacts in the energized position.

Figure 5-4. Analog Self Test #8 Simplified Schematic

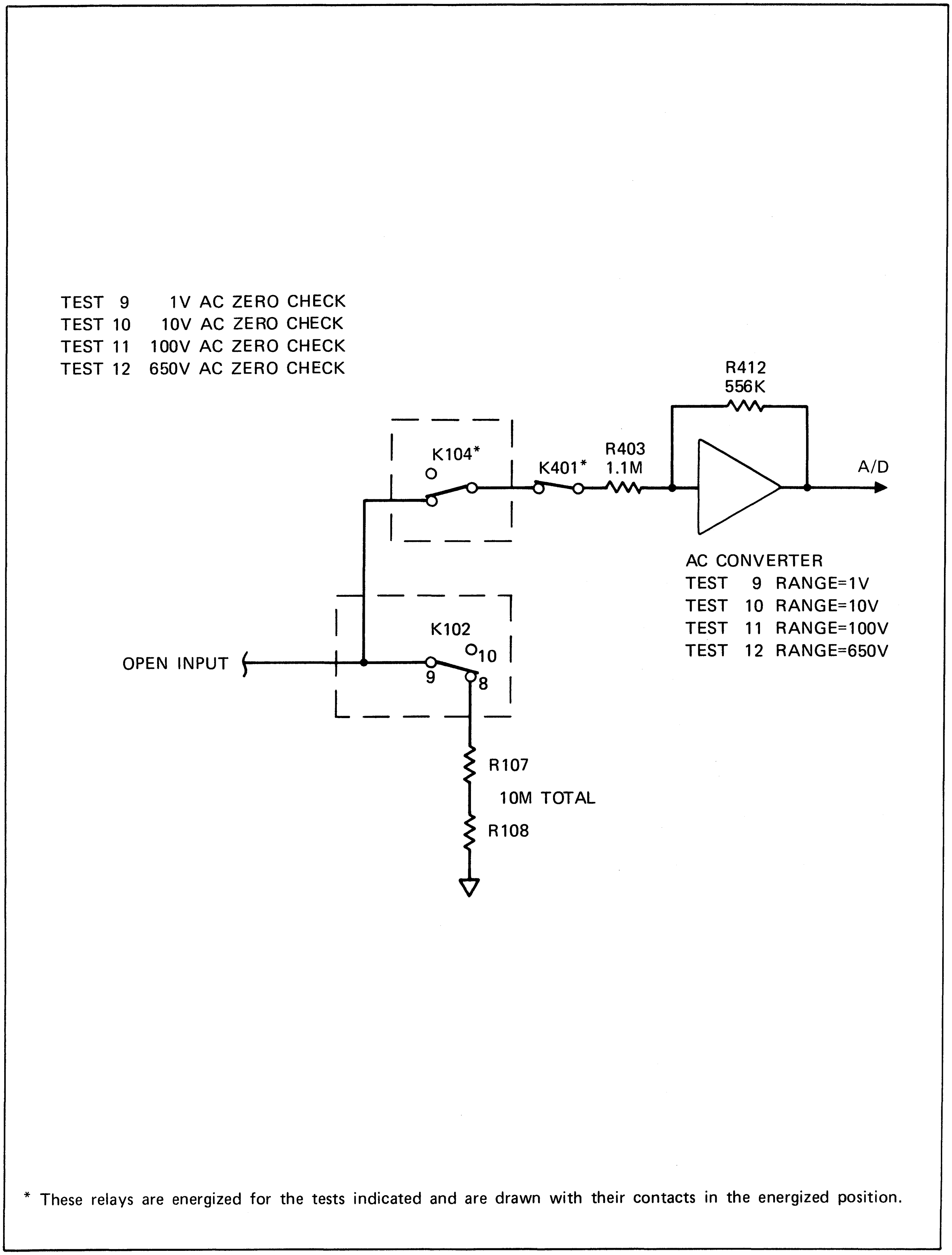
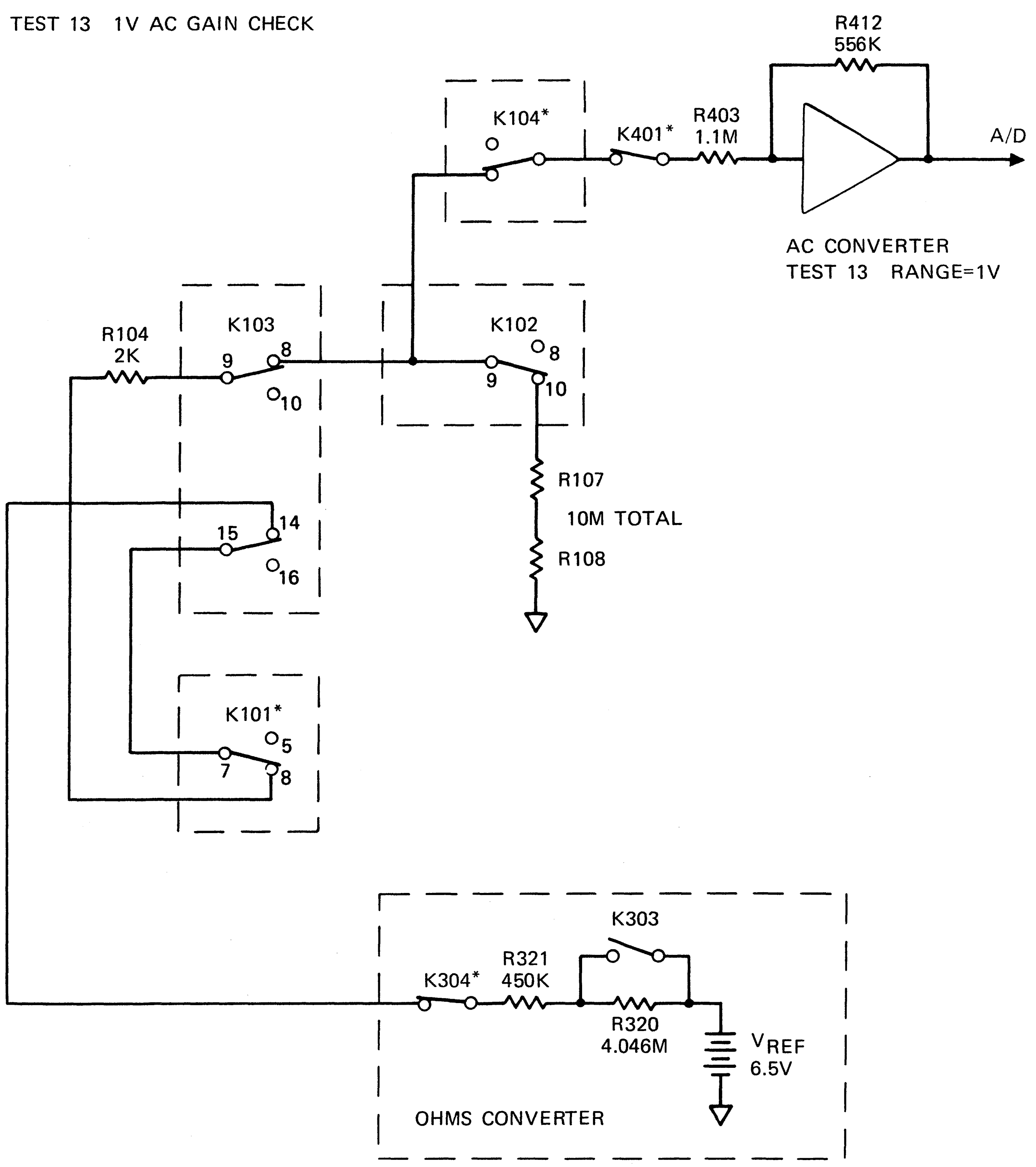
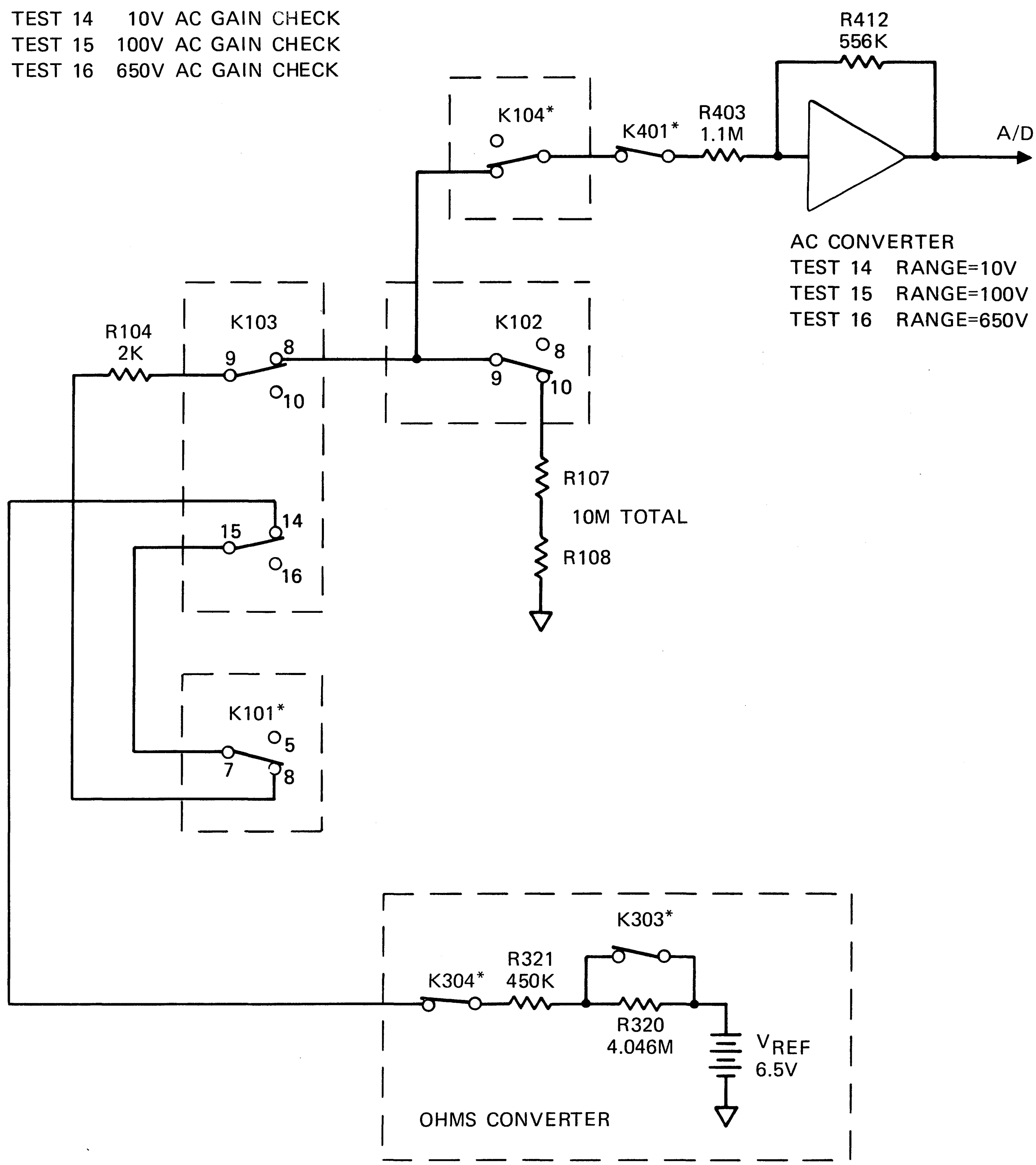


Figure 5-5. Analog Self Tests #9, 10, 11, 12 Simplified Schematic



* These relays are energized for the test indicated and are drawn with their contacts in the energized position.

Figure 5-6. Analog Self Test #13 Simplified Schematic



* These relays are energized for the tests indicated and are drawn with their contacts in the energized position.

Figure 5-7. Analog Self Tests #14, 15, 16 Simplified Schematic

Table 5-9. Low Ohms Tests

	4 TERMINAL 10Ω	4 TERMINAL 100Ω	4 TERMINAL 1000Ω	4 TERMINAL 10 KΩ
K101	OFF	OFF	OFF	OFF
K102	ON	ON	ON	ON
K103	ON	ON	ON	ON
K104	OFF	OFF	OFF	OFF
Q103	OFF	OFF	OFF	OFF
Q104	ON	ON	ON	ON
Q106	OFF	OFF	OFF	OFF
Q107	OFF	OFF	OFF	OFF
Q108	OFF	OFF	OFF	OFF
GAIN DC BUFFER	64	8	8	8
Q236	OFF	OFF	OFF	OFF
Q237	OFF	ON	ON	ON
Q238	ON	OFF	OFF	OFF
Q308	OFF	OFF	OFF	OFF
Q305	ON	ON	OFF	OFF
Q306	OFF	OFF	ON	OFF
K301	OFF	OFF	ON	OFF
K302	ON	ON	OFF	OFF
K304	OFF	OFF	OFF	OFF

Table 5-10. Analog Controller Latch Tests

TESTS	S601 Switch Number				LOCATION
	1	2	3	4	
Port 2	OFF	OFF	OFF	OFF	U601-21-24, 35-38
Port 1	OFF	OFF	OFF	ON	U601-27-34
U617	OFF	OFF	ON	OFF	U617-2, 5, 7, 10, 12
U621	OFF	OFF	ON	ON	U621-2, 5, 6, 9, 12, 15, 16, 19
U620	OFF	ON	OFF	OFF	U620-2, 5, 6, 9, 12, 15, 16, 19
U619	OFF	ON	OFF	ON	U619-2, 5, 6, 9, 12, 15, 16, 19
U618	OFF	ON	ON	OFF	U618-2, 5, 6, 9, 12, 15, 16, 19
U604	OFF	ON	ON	ON	U604-1-11, 13

Table 5-11. Analog Controller UART Test

PORT 1 BYTE	U601 (PORT 1) 29 (2)	28 (1)	27 (0)	RESPONSE
0000 0001	L	L	H	The interrupt mask has been set for local echo and even parity (data 10 Hex) and a data byte (A9 Hex) written into the UART. The software has written 01 Hex into Port 1 and is waiting for the TBE bit (U602-22) to be set true.
0000 0010	L	H	L	After receipt of TBE the software writes a 02 Hex in Port 1 and waits for DAV (U602-19) to be set true.
0000 0011	L	H	H	After receipt of DAV the software writes 03 Hex in Port 1 and compares E3 Hex with the UART status, i.e. U602 pins 24 (EOC), 22 (TBE), and 19 (DAV) high, pins 13 (PE), 14 (FE), and 15 (OR) low, and U601 pins 18 (D6) and 19 (D7) are high. If they are the same the test continues, otherwise it stops with 03 Hex in the Port.
0000 0100	H	L	L	If the status byte matches, the software writes 04 Hex into Port 1 and compares the UART data to A9 Hex. If they are the same the test continues, otherwise it stops with 04 Hex in the Port.

Table 5-12. Analog Controller Interrupt Test

PORT 1 BYTE	U601 (PORT 1) 30 (3)	29 (2)	28 (1)	27 (0)	RESPONSE
0000 0100	L	H	L	L	The software writes 04 Hex in Port 1 and 11 Hex on the data lines for the interrupt mask register (U607) for local echo, even parity, and DAV interrupt enable. Local echo strobes the UART write line (U602-23) and a data byte is transferred out on U602-25 to the digital circuitry and then back on U602-20. The software then waits for U601-6 (INT) to go low before going to the next step.
0000 0101	L	H	L	H	When INT goes low the software writes 05 Hex in Port 1 and compares the interrupt vector with F1 Hex to insure that U601 pins 16, 17, 18, and 19 are high during the interrupt vector strobe (U604-7) and that only the DAV interrupt is active. If they compare the test continues, otherwise it stops with 05 Hex in the port.
0000 0110	L	H	H	L	If there is a match the software writes 06 Hex in port 1 and 10 Hex on the data lines to disable the interrupt. It then verifies that INT on U601-6 goes high.
0000 0111	L	H	H	H	When INT goes high the software writes 07 Hex in Port 1 and F4 Hex in the interrupt mask register (U607). It then strobes the UART write line (U602-23) then clocks U608-9 high through U614-12 and U610-3. When INT (U601-6) goes low it continues with the test, otherwise it stops with 07 Hex in the Port.
0000 1000	H	L	L	L	When INT goes low the software writes 08 Hex in Port 1 and compares the interrupt vector with F4 Hex to verify that U601 pins 16, 17, 18, and 19 are high during the interrupt vector strobe (U604-7) and that only the TRIGGER interrupt (U608-9) is active. If they compare the test repeats itself, otherwise it stops with 08 Hex in the Port.

Table 5-13. UART and Interrupt Troubleshooting Procedures

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
	NOTE *The first 9 steps are the same regardless of the test that failed.*		
1	Check the CPU (U601) for defective pins on the ports or outputs. Repeat the failed test.		
2	Does the test operate satisfactorily?	21	3
3	Check the IC's Connected to the data bus for shorted or defective pins.They are U603, U607, U611, U612, U617, U618, U619, U620, and U621. Repeat the failed test.		
4	Does the test operate satisfactorily?	21	5
5	Check the reset circuitry (U605, U609, and U614), that initiates the test by forcing a reading of the program. Repeat the failed test.		
6	Does the test operate satisfactorily?	21	7
7	Check the address decoding circuitry (U603, U604, U613, and U614). Repeat the failed test.		
8	Does the test operate satisfactorily?	21	9
9	Check the UART (U602).		
10	Does the test operate satisfactorily?	21	11
11	Is the port locked in 02 Hex during the UART Test?	12	14
12	Check U607, U610, and U615. Repeat the failed test.		
13	Does the test operate satisfactorily?	21	20
14	Is the port locked in either 03 Hex or 04 Hex during the UART Test or in one of the Interrupt tests?	15	16
15	Check the UART Transmit/Receive circuitry (U609, U610, U612, and U615). Repeat the failed test.		
16	Does the test operate satiafactorily?	21	20
17	Is the port locked in any of the Interrupt Tests?	18	20
18	Check the Interrupt circuitry (U607, U608, U612, and U613). Repeat the failed test.		
19	Does the test operate satisfactorily?	21	20
20	All checks have been completed; however, the instrument still does not perform the test satisfactorily. Repeat all checks looking for a failure that took place during the checks. Check for open or shorted land patterns and other tests of this type.		
21	Troubleshooting of the UART and Interrupt circuits is complete.		

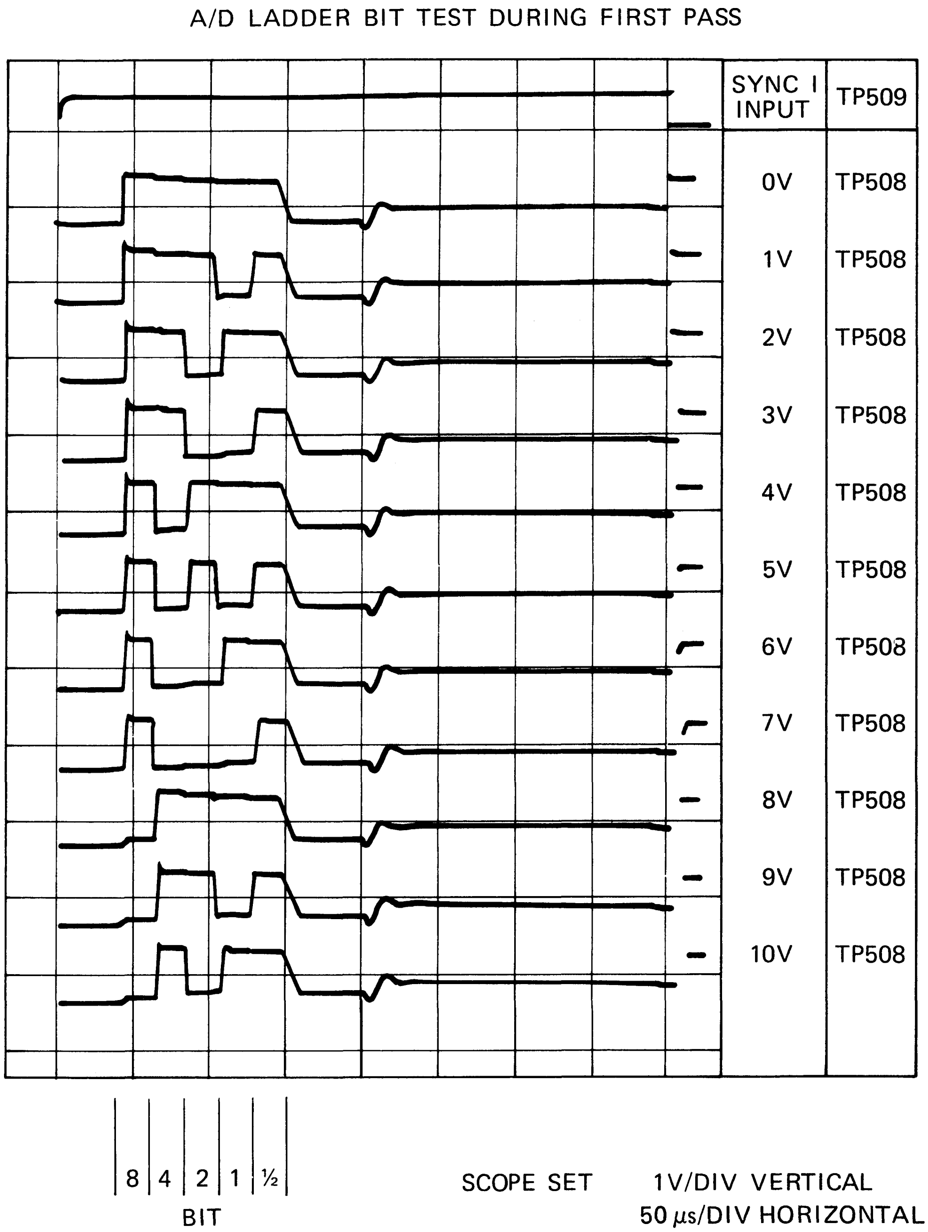


Figure 5-8. A/D Converter Test

Section 6
List of Replaceable Parts

TABLE OF CONTENTS

6-1. INTRODUCTION

6-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the Options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accopmanying illustration.

6-3. Parts lists include the following information:

1. Reference Designation.
2. Description of each part.
3. FLUKE Stock Number.
4. Federal Supply Code for Manufactures. (See Section 7 for Code-to-Name list.)
5. Manufacture's Part Number.
6. Total Quantity of components per assembly.
7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of 2 years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for 1 year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked (see paragraph 5-7). In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended spares quantity for the items in that particular assembly.

6-4. HOW TO OBTAIN PARTS

6-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. or its authorized representatives by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced be a new or improved part, the replacement will be accompied by an explanatory note and installation instructions, if necessary.

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

1. Quantity.
2. FLUKE Stock Number.
3. Description.
4. Reference Designation.
5. Printed Circuit Board Part Number and Revision Letter.
6. Instrument Model and Serial Number.

6-7. A Recommended Spare Parts Kit for your basic instrument is available from the factory. This kit contains those itmes listed in the REC QTY comumn of the parts list in the quantities recommended.

6-8. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representatives. Prices are also available in a Fluke Replacement Parts Catalog, which is available on request.

CAUTION

*****

Indicated devices are subject to damage by static discharge.

TABLE 6-1. 8520A FINAL ASSEMBLY
(SEE FIGURE 6-1.)

REFERENCE DESIGNATOR A->NUMERICS--->		S	----------DESCRIPTION----------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
A	1	*	DISPLAY PCB ASSEMBLY	516625	89536	516625	1		
A	2	*	DIGITAL PCB ASSEMBLY	496828	89536	496828	1		
A	3	*	ANALOG PCB ASSEMBLY	496836	89536	496836	1		
A	4	*	TRANSFORMER PCB ASSEMBLY	496869	89536	496869	1		
F	201		FUSE,1/4 X 1-1/4,SLOW,0.5A,250V	109322	71400	MDL1-2	1		
FL	1		FILTER,LINE,115V/3A,230V/3A,PNL MNT	321273	05245	3EF2	1		
H	1		SCREW,CAP,SCKT,STL,8-32X3/8	295105	89536	295105	4		
H	2		SCREW,MACH,PHP SEMS,STL,6-32X1/2	177030	89536	177030	4		
H	3		SCREW,MACH,PHP,STL,8-32X5/8	114983	89536	114983	4		
H	4		WASHER,LOCK,INTRNL,STEEL,#8	110320	89536	110320	4		
H	5		WASHER,LOCK,SPLIT,S STEEL,#4	147603	89536	147603	2		
H	6		SCREW,MACH,FHP,S.STL,8-32X3/8	320085	89536	320085	8		
H	7		SCREW,MACH,FHP,STL,8-32X1/2	114355	89536	114355	8		
H	8		SCREW,MACH,PHP SEMS,STL,4-40X1/4	185918	89536	185918	8		
H	9		SCREW,MACH,PHP,STL,6-32X1/4	152140	89536	152140	23		
H	10		WASHER,LOCK,SPLIT,S STEEL,#6	403923	89536	403923	17		
H	11		SCREW,MACH,PHP SEMS,STL,6-32X3/8	177022	89536	177022	26		
H	12		NUT,HEX,S.STL,4-40	147611	89536	147611	2		
H	13		WASHER,LOCK,EXTRNL,STEEL,0.500 ID	175943	89536	175943	1		
H	14		WASHER,FLAT,STEEL,#6,0.031 THK	110270	89536	110270	1		
H	15		WASHER,LOCK,INTRNL,STEEL,0.267 ID	110817	89536	110817	2		
H	16		NUT,MACH,HEX,BR,1/4-28	110619	89536	110619	2		
H	17		WASHER,FLAT,MYLAR,#7,0.007 THK	240820	89536	240820	2		
H	18		SCREW,MACH,PHP,STL,4-40X3/16	129882	73734	19022	2		
H	19		SCREW,MACH,FHUP,S.STL,6-32X1/4	320093	89536	320093	12		
H	20		SCREW,MACH,PHP,S.STL,6-32X1/4	385401	89536	385401	4		
J	9		BINDING POST,BRASS,1/4-28	225623	89536	225623	1		
MP	1		COVER,BOTTOM 18" PACKAGE	491191	89536	491191	1		
MP	2		COVER, BOTTOM GUARD	581553	89536	581553	1		
MP	3		CHASSIS SIDE,RIGHT	491092	89536	491092	1		
MP	4		CHASSIS SIDE,LEFT	491084	89536	491084	1		
MP	5		PANEL,FRONT	491175	89536	491175	1		
MP	6		PANEL,REAR	491076	89536	491076	1		
MP	7		BULKHEAD,CENTER	491100	89536	491100	1		
MP	8		COVER PLATE,TRANSFORMER	496893	89536	496893	1		
MP	9		FRONT PANEL,MOLDED	496760	89536	496760	1		
MP	10		LENS,DISPLAY	534479	89536	534479	1		
MP	11		CORNER HANDLE FRONT,3.5INCH	394296	89536	394296	2		
MP	12		CORNER PLASTIC,3.5INCH	394338	89536	394338	2		
MP	13		FOOT,BAIL STAND	292870	89536	292870	4		
MP	14		FOOT REAR PANEL 1-1/4"	307363	89536	307363	4		
MP	15		HLDR PART,FUSE,BODY 1/4X1-1/4,5X20MM	375188	61935	031.1653	1		
MP	16		HLDR PART,FUSE,CAP,1/4 X 1-1/4,GREY	460238	61935	031.1666	1		
MP	17		ACTUATOR,SWITCH	502690	89536	502690	1	5	
MP	18		DECAL, FRONT PANEL	523712	89536	523712	1	1	
MP	19		BUTTON	472316	89536	472316	2		
MP	20		INSULATOR, FASTENER	372342	89536	372342	6		
MP	21		SPACER, INSULATED	372334	89536	372334	6		
MP	22		SLEEV,POLYOL,SHRINK,.250-.125ID,BLACK	113837	89536	113837			
MP	23		GROMMET, RUBBER	100073	83330	2149	1		
MP	24		HLDR,FUSE,1/4 DIA	101352	71400	5681-15	1		
MP	25		NAMEPLATE, SERIAL -REAR PANEL-	472795	89536	472795	1		
MP	26		SLEEV,POLYOL,SHRINK,.125-.062ID,BLACK	149450	89536	149450			
MP	27		SLEEV,POLYOL,SHRINK,.500-.250ID,CLEAR	218529	89536	218529	1		
MP	28		SLEEV,POLYOL,SHRINK,.093-.046ID,BLACK	149443	89536	149443			
MP	29		CABLE TIE,4"L,0.100"W,0.75 DIA	172080	89536	172080	2		
MP	30		CLAMP, CABLE	165951	31827	3-4-1	1		
MP	31		DECAL,PWR/ON-OFF	523704	89536	523704	1		
MP	32		CABLE, ETHYL CELLULOSE, TYPE 3/16-6R	101345	89536	101345	1		
MP	33		COVER,TOP GUARD	490987	89536	490987	1		
MP	34		COVER,TOP 18" PACKAGE	491183	89536	491183	1		
MP	35		M03-800-415 DECAL COVERS PLASTIC	394379	89536	394379	4		
MP	36		SIDE TRIM 18"	525998	89536	525998	2		
MP	37		SCREWDRIVER BLADES, S.S., EXTENDED	520825	89536	520825	1		
MP	38		METL,FAB BAIL,FULL WIDTH	231407	89536	231407	1		
MP	39	*	CHASSIS, ANALOG ASSY	581561	89536	581561	1		
MP	40		BINDING POST PART,HEAD,BRASS,1/4-28	225615	89536	225615	1		
S	201		SWITCH,PUSHBUTTON,DPDT PUSH-PUSH	507871	71468	SCH.1XF.0003-01	1		
TM	1		8520A OPERATOR MANUAL	541979	89536	541979	1	1	
TM	2		8520A SERVICE MANUAL	541987	89536	541987	1		
TM	3		8520A CALIBRATION MANUAL	541995	89536	541995	1		
TM	4		8520A QUICK REFERENCE GUIDE	719336	89536	719336	1		
W	1		CORD,LINE,5-15/IEC,3-18AWG,SVT	284174	89536	284174	1		
W	2		CABLE,POWER SWITCH,ASSY.	496877	89536	496877	1		
W	3		CABLE,REAR INPUT	496885	89536	496885	1		
W	4		CABLE,FLAT,JMPR,4 CONDUCT,0.100 SP	474148	89536	474148	1		
W	5		CABLE ASSY,BNC	515668	89536	515668	1		

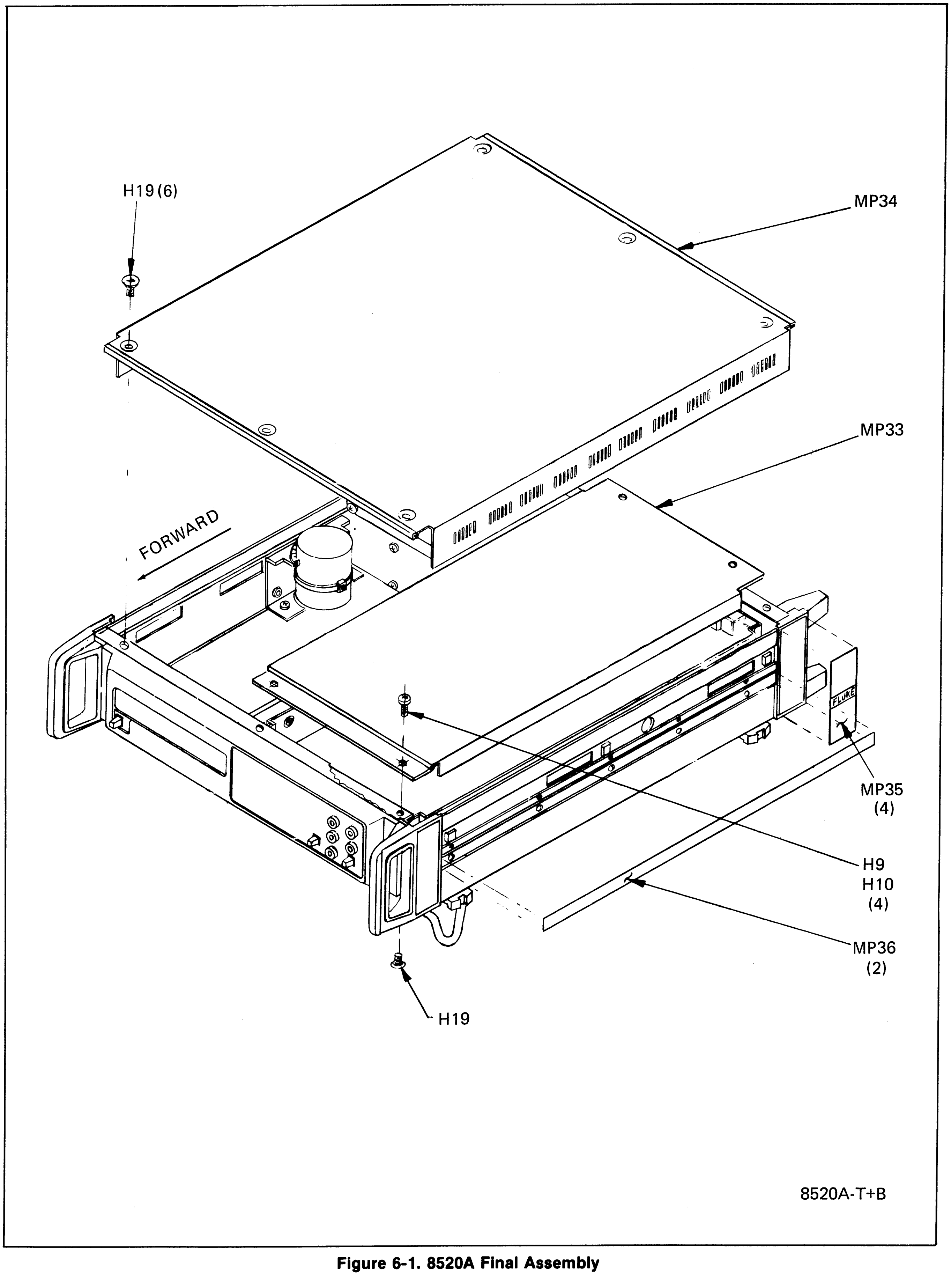


Figure 6-1. 8520A Final Assembly

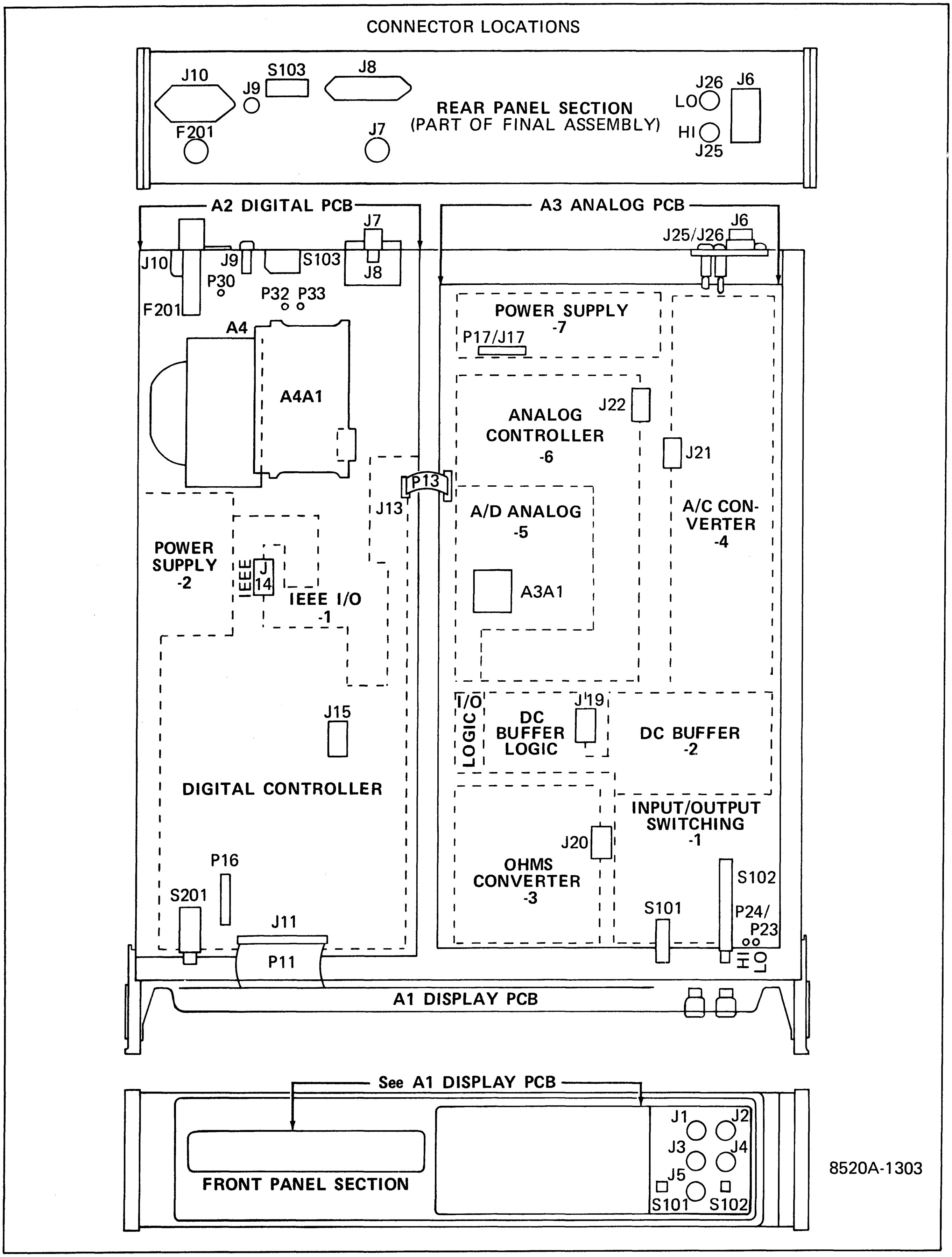


Figure 6-1. 8520A Final Assembly (cont)

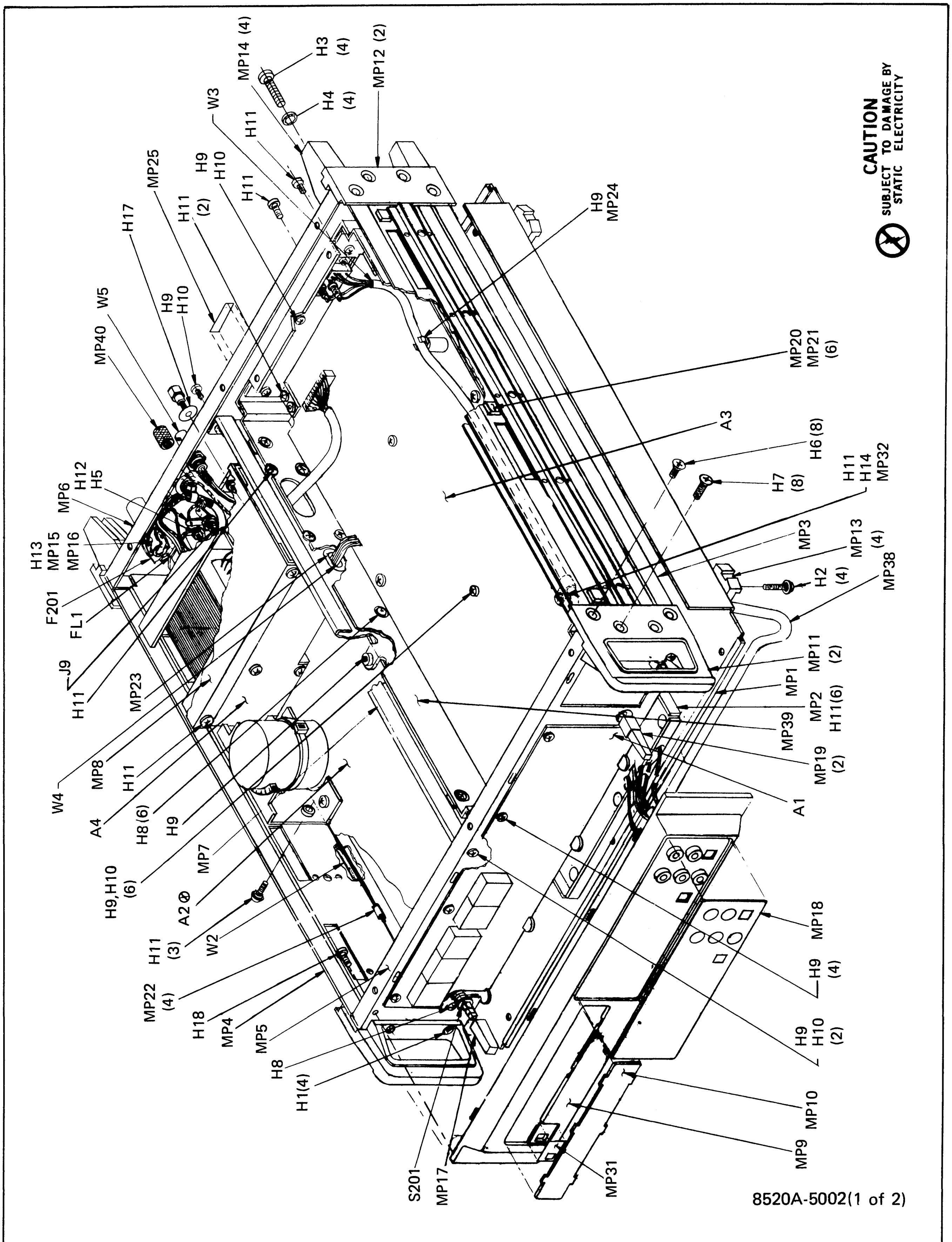
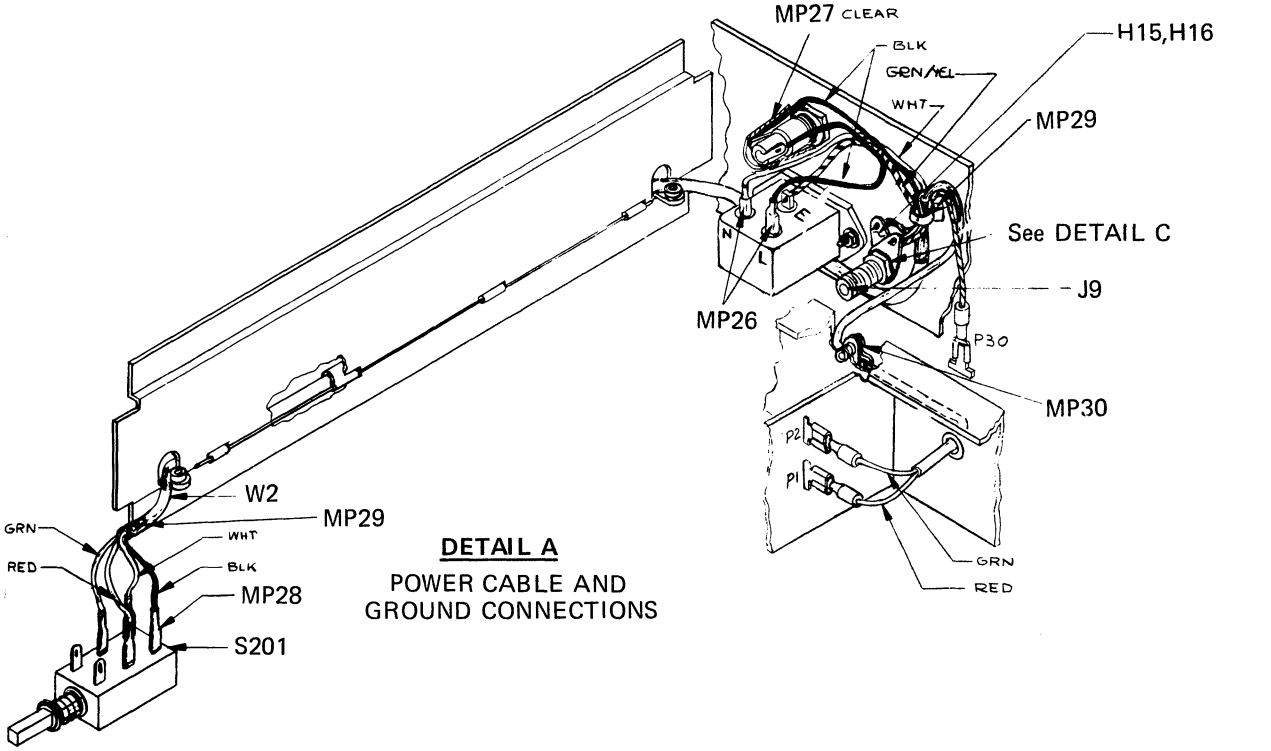
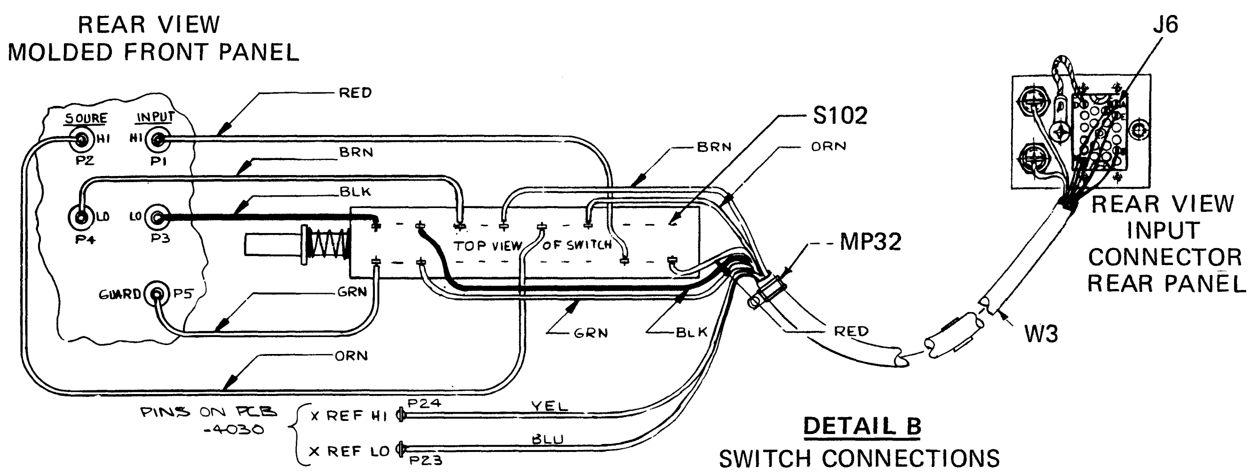


Figure 6-1. 8520A Final Assembly (cont)



DETAIL A

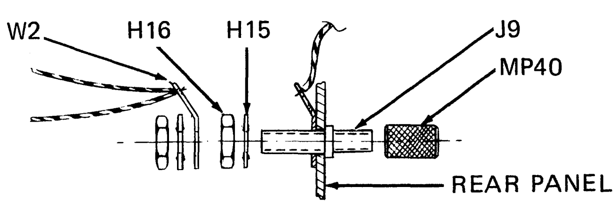
POWER CABLE AND GROUND CONNECTIONS



DETAIL B

SWITCH CONNECTIONS FRONT–REAR INPUT

WIRE LIST	(P/N)
RED	(509216)
BRN	(509208)
BLK	(509190)
GRN	(509182)
ORN	(509125)



DETAIL C

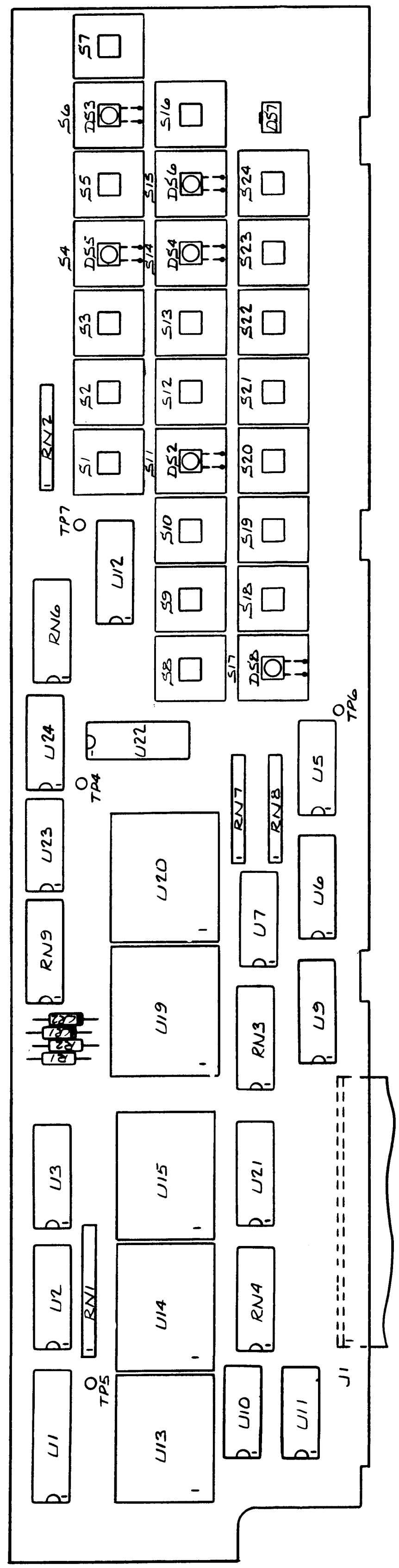
8520A-5002(2 of 2)

Figure 6-1. 8520A Final Assembly (cont)

TABLE 6-2. A1 DISPLAY PCB ASSEMBLY
(SEE FIGURE 6-2.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
CR 2	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	1	1	
DS 7	*	LED,RED,RECTANGLE,PCB MOUNT	504761	14936	MV57124	1	1	
DS 13	*	DIODE,LED,DUAL 7 SEG AND 7 SEG TOVFLO	585422	89536	585422	1		
DS 19, 20	*	DIODE,LED,RED,2 X 14 SEGMENTS	478065	50579	DL02614	2	1	
E 4- 7		TERM,UNINSUL,FEEDTHRU,HOLE,TURRET	179283	88245	2010B-5	4		
J 1		CABLE,FLAT,JMPR,20 CONDUCT,0.100 SP	500975	89536	500975	1		
MP 1		PUSHBUTTON-SQUARE-, LIGHT PUTTY GREY	401307	89536	401307	15	1	
MP 2		PUSHBUTTON-SQUARE-, LIGHT BLUE	406736	89536	406736	1	1	
MP 3		SPACER,LED .125 LG	786707	89536	786707	1		
MP 4		FILTER,LIGHT	578617	89536	578617	2	1	
R 1		RES,CF,270,+-5%,0.25W	348789	80031	CR251-4-5P270E	1	4	
R 2		RES,CF,680,+-5%,0.25W	368779	80031	CR251-4-5P200E	1		
RN 1		RES,NET,SIP,10 PIN,9 RES,2.7K,+-2%	484303	89536	484303	1	1	
RN 2, 7, 8		RES,NEG,SIP,8 PIN,7 RES,1K,+-2%	414557	80031	95081002CL	3		
RN 3, 6		RES,NET,DIP,16 PIN,8 RES,430,+-5%	484295	89536	484295	2		
RN 4, 9		RES,NET,DIP,16 PIN,8 RES,82,+-5%	478859	89536	478859	2		
S 1- 3, 5,		SWITCH,PUSHBUTTON,SPNO MOMENTARY	507319	89536	507319	18		
S 7- 10, 12,			507319					
S 13, 16, 18-			507319					
S 24			507319					
S 4, 6, 14,		SWITCH,PUSHBUTTON,SPNO MOMENTARY	507335	89536	507335	4	1	1
S 15			507335					1
S 11		SWITCH,PUSHBUTTON,SPNO MOMENTARY	525170	89536	525170	1		
S 12, 13		PUSH BUTTON SQUARE	531525	89536	531525	2	1	
S 17		SWITCH,PUSHBUTTON,SPNO MOMENTARY	524082	89536	524082	1		
U 1	*	IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR	454892	01295	SN74LS273N	1		
U 2, 3	*	IC,ARRAY,4 TRANS,NPN,DARLINGTON PAIRS	454306	56289	UNL2064B	2	1	
U 5, 7	*	IC,CMOS,HEX OPEN DRAIN BUFFER	473389	12040	MM74C906N	2	1	
U 6	*	IC,CMOS,HEX BUFFER W/3-STATE OUTPUT	407759	12040	MM80C97N	1	1	
U 9, 12	*	IC,CMOS,8BIT ADDRSBLE LATCH SER INPUT	453258	02735	CD4099BE	2	1	
U 10, 11, 23,	*	IC,ARRAY,4 TRANS,PNP,MEMORY DRIVER	477828	12040	DH3467CN	4	1	
U 24	*		477828					
U 21, 22	*	IC,ARRAY,7 TRANS,NPN,COMMOM EMITTER	407866	49671	CA3081	2	1	
VR 1	*	ZENER,UNCOMP, 3.9V, 5%, 64.0MA, 1.0W	535641	04713	1N4733	1	1	

NOTE 1 = SWITCHES S4,S6,S11,S14,S15 AND S17 COME COMPLETE WITH DIODES.
THESE DIODES CANNOT BE REPLACED. ORDER ONLY AS A COMPLETE UNIT.



8520A-1611

Figure 6-2. A1 Display PCB Assembly

TABLE 6-3. A2 DIGITAL PCB ASSEMBLY
(SEE FIGURE 6-3.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	---------DESCRIPTION---------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1		CAP,TA,10UF,+-20%,10V	176214	56289	196D106X0010KA1	1		
C 2- 11, 14,		CAP,CER,0.025UF,+-20%,100V,Z5W	168435	56289	C023B101H253M	20		
C 16- 18, 21,			168435					
C 24,101-108			168435					
C 12,204		CAP,TA,22UF,+-20%,15V	423012	56289	196D226X0015KA1	2	1	
C 13, 32		CAP,MICA,47PF,+-5%,500V	148536	72136	CM15E470J	2		
C 15		CAP,CER,0.05UF,+80-20%,25V,Y5U	148924	72982	5855-000-Y5U0-503Z	1		
C 19, 22		CAP,CER,0.01UF,+-20%,100V,X7R	407361	72982	8121-A100-W5R-103M	2		
C 20, 27, 28,		CAP,TA,1UF,+-10%,35V	161919	56289	196D010X0035G	4		
C 30			161919					
C 23		CAP,TA,39UF,+-20%,6V	163915	56289	196D394X0020KA1	1		
C 25, 31		CAP,MICA,100PF,+-5%,500V	148494	72136	DM15F101J	2		
C 29,203		CAP,TA,10UF,+-20%,15V	193623	56289	196D106X0015A1	2		
C 109		CAP,CER,0.01UF,+80-20%,100V,Z5V	149153	56289	C023B101F103M	1		
C 201		CAP,AL,22000UF,+75-10%,15V	479220	56289	32DX223G015BA2A	1	1	
C 202		CAP,TA,0.22UF,+-20%,35V	161331	56289	196D224X0035HA1	1		
CR 1, 2	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	2	1	
CR 20	*	LED,RED,LUM INT= 1 MCD,W/STANDOFFS	429555	12040	NLS5053	1	1	
CR 202,203	*	DIODE,SI, 100 PIV, 1.0 AMP	343491	01295	1N4002	2	1	
H 1		SCREW,MACH,PHP,S.STL,4-40X5/16	335141	89536	335141	1		
H 2		SCREW,MACH,PHP,S.STL,4-40X1-7/16	403782	89536	403782	1		
H 3		SCREW,MACH,PHP,STL,10-32X5/16	417105	89536	417105	2		
H 4		WASHER,SHLDR,NYLON,#4	436386	86928	5607-45	1		
H 5		NUT,PRESS,BROACH,STL,4-40	380196	24347	KF2-440	2		
H 6		SCREW,THD FORM,PHPD,STL,5-20X5/16	494641	89536	494641	2		
J 8		CONN,MICRO-RIBBON,PLUG,PWB EDGE,24	485763	00779	552791-1	1		
J 11		SOCKET,1 ROW,PWB,0.100CTR,20 POS	443077	00779	583773-9	1		
J 12		CONN,PWB EDGE,REC,0.150 CTR,8 POS	354951	00779	583407-5	1		
J 13		SOCKET,1 ROW,PWB,0.100CTR,4 POS	461756	00779	583773-1	1		
J 14, 18, 19		HEADER,PROGRAMMED	495507	89536	495507	3		
J 16		HEADER,1 ROW,0.100CTR,11 PIN	494666	00779	1-640456-1	1		
J 17		HEADER,1 ROW,0.100CTR,4 PIN	417329	89536	417329	1		
J 201		SOCKET,1 ROW,PWB,0.100CTR,5 POS	417899	52072	CA-05S-TSD	1		
L 1		CHOKE,6TURN	320911	89536	320911	1		
MP 1		SPACER,RND,SOLUBLE,0.062IDX0.156OD	296319	32559	T0806	2		
MP 2		NAT NYLON 0.090X0.175X0.100X0.155	102277	89536	102277			
MP 3		CABLE TIE,11"L,0.190"W,3.0 DIA	501734	89536	501734	1		
MP 4		INSUL PART,TRANS,SILICONE,POWER	508630	89536	508630	1		
MP 5		BRACKET,CAPACITOR/REGULATOR	490490	89536	490490	1		
P 201		CONNECTING LINK	523167	89536	523167	1		
Q 1	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	64713	2N3906	1		
R 1, 2, 4,		RES,CF,1K,+-5%,0.25W	573170	80031	CR251-4-5P1K	8		
R 5, 8, 14,			573170					
R 15, 26			573170					
R 6		RES,CF,150,+-5%,0.25W	343442	80031	CR251-4-5P150	1		
R 7, 23, 24		RES,CF,51,+-5%,0.25W	572990	89536	572990	3		
R 9, 16, 19,		RES,CF,10K,+-5%,0.25W	573394	80031	CR251-4-5P10K	6		
R 101,102			573394					
R 10		RES,MF,100K,+-1%,0.125W,100PPM	248807	91637	CMF551003F	1		
R 11		RES,MF,681K,+-1%,0.125W,100PPM	381517	91637	CMF556813F	1		
R 12		RES,MF,1.5K,+-1%,0.125W,100PPM	313098	91637	CMF551501F	1		
R 13		RES,MF,10K,+-1%,0.125W,100PPM	168260	91637	CMF551002F	1		
R 17		RES,CF,100K,+-5%,0.25W	573584	80031	CR251-4-5P100K	1		
R 18		RES,MF,28K,+-1%,0.125W,100PPM	291385	91637	CMF552802F	1		
R 21		RES,MF,82.5K,+-1%,0.125W,100PPM	246223	91637	CMF558252F	1		
R 25		RES,CF,270,+-5%,0.25W	573071	89536	573071	1		
R 27		RES,CF,750,+-5%,0.25W	573162	80031	CR251-4-5P750E	1		
R 104		RES,CF,100,+-5%,0.25W	573014	80031	CR251-4-5P100E	1		
R 105		RES,CF,470,+-5%,0.25W	573121	80031	CR251-4-5P470E	1	1	
R 201		RES,WW,FUSIBLE,0.1,+-10%,2W	485672	89536	485672	1		
R 202		RES,MF,249,+-1%,0.125W,25PPM	448043	91637	CMF552490F	1		
R 203		RES,MF,649,+-1%,0.125W,100PPM	309955	91637	CMF556490F	1		
R 204		RES,VAR,CERM,200,+-10%,0.5W	275743	89536	275743	1		
R 205		RES,CF,390,+-5%,0.25W	573105	80031	CR251-4-5P390E	1		
R 209		RES,CC,10K,+-10%,0.5W	108118	01121	EB1031	1		
R 210		RES,WW,13,+-5%,5W	520197	89536	520197	1		
RN 1,101		RES,NET,SIP,10 PIN,9 RES,10K,+-2%	414003	80031	95081002CL	2		
RN 2		RES,NET,DIP,16 PIN,15 RES,10K,+-5%	355305	89536	355305	1		
S 1		SWITCH,PUSHBUTTON,SPNO MOMENTARY	507319	89536	507319	1		
S 103		SWITCH,MODULE,DIP,8 POS	495168	95146	DYS-8	1		
TP 1- 10, 30,		TERM,FASTON,TAB,SOLDR,0.110 WIDE	512889	02660	62395	18	1	
TP 32, 33,101,			512889					
TP 102,201,202			512889					
U 1, 35	*	IC,CMOS,DUAL D F/F,+EDG TRG	418830	12040	MM74C74	2	1	

TABLE 6-3. A2 DIGITAL PCB ASSEMBLY
(SEE FIGURE 6-3.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
U 2, 3	*	IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	01295	SN74LS138N	2		
U 8	*	IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR	454892	01295	SN74LS273N	1	1	
U 9,103,105	*	IC,LSTTL,DUAL D F/F,+EDG TRG,W/CLR	393124	01295	SN74LS74N	3	1	
U 10		I.C., EPROM, PROGRAMMED	729145	89536	729145	1		
U 11		I.C., EPROM, PROGRAMMED	729152	89536	729152	1		
U 12		I.C., EPROM, PROGRAMMED	729160	89536	729160	1		
U 13	*	IC, 2K X 8 STAT RAM	584144	33297	uPD4016C-2	1	1	
U 16	*	IC,LSTTL,QUAD 2 INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U 17	*	IC,LSTTL,HEX INVERTER W/OPEN COLLECT	394536	01295	SN74LS05	1	1	
U 18	*	IC,NMOS,8 BIT MICROCOMPUTER	478073	50088	MK3880-4CPU	1		
U 19	*	IC,TTL,HEX INVERTER	292979	01295	SN7404N	1	1	
U 20	*	IC,LSTTL,SYNC DIV BY 16 BINARY COUNTR	495598	01295	SN74LS163N	1	1	
U 21, 28	*	IC,CMOS,DUAL SYNC BINRY UP CNTR	355164	04713	MC14520BCP	2	1	
U 22	*	IC,CMOS,DUAL D F/F,+EDG TRIG	340117	02735	CD4013AE	1	1	
U 23	*	IC,CMOS,QUAD 2 IN NAND W/SCHMT TRIG	404632	02735	CD4039BE	1	1	
U 24	*	IC,LSTTL,OCTL BUS TRNSCVR W/3-ST OUT	477406	01295	SN74LS245N	1	1	
U 25	*	IC,TTL,4-16 LINE DCDR W/DUAL STROBE	293217	01295	SN74154N	1		
U 26		IC,CMOS,UNIV ASYNC RECEIVER/TRANSMITR	658856	89536	658856	1		
U 27, 31	*	IC,CMOS,HEX BUFFER W/3-STATE OUTPUT	407759	12040	MM80C97N	2	1	
U 29	*	IC,CMOS,PHASE LOCKED LOOP,16 PIN DIP	403584	02735	CD4046AE	1		
U 30	*	IC,LSTTL,QUAD 2 INPUT NOR GATE	393041	01295	SN74LS02N	1	1	
U 32	*	IC,CMOS,PRESETTABLE DIV BY N COUNTER	478313	02735	CD4018BE	1	1	
U 33	*	IC,TTL,QUAD 2 INPUT AND GATE	393066	01295	SN74LS08N	1	1	
U 34,106	*	IC,LSTTL,HEX INVERTER	393058	01295	SN74LS04N	2	1	
U 36	*	IC,LSTTL,RETRG MONOSTAB MULTIVB W/CLR	404186	01295	SN74LS123N	1	1	
U 37	*	IC,TTL,DUAL NAND DRVR W/OPEN COLLECT	329706	01295	SN75452P	1	1	
U 38		PULSE,TRANFORMER	509141	89536	509141	1		
U 39	*	IC,LSTTL,QUAD 2 IN NAND W/SCHMT TRIG	504449	01295	SN74LS132N	1	1	
U 101	*	IC,NMOS,GEN PURPOSE INTERFACE ADAPTOR	477794	04713	MC68488P	1	1	
U 102	*	IC,LSTTL,OCTL BUFFER W/3-ST&NOR ENABL	429902	12040	DM81LS95N	1	1	
U 104	*	IC,LSTTL,QUAD 2 INPUT OR GATE	393108	01295	SN74LS32N	1	1	
U 107	*	IC,LSTTL,QUAD INTERFACE BUS TRANSCVR	428649	04713	MC3446P	1	1	
U 108-110	*	IC,LSTTL,QUAD BUS XCVR W/3-STATE OUT	453480	04713	MC3448P	3	1	
U 202	*	IC,VOLT REG,ADJ,1.2 TO 37 V,1.5 AMPS	460410	12040	LM317T	1	1	
XU 10- 12		SOCKET,IC,28 PIN	448217	91506	328-AG39D	3		
XU 13, 14, 25		SOCKET,IC,24 PIN	376236	91506	324-AG39D	3		
XU 18, 26,101		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	3		
XU 29, 38,110		SOCKET,IC,16 PIN	276535	91506	316-AG39D	7		1
Y 1	*	CRYSTAL,8MHZ,+-0.5%,HC-18/U	485060	89536	485060	1	1	

NOTE 1 = ALSO INCLUDES XJ14,18,19.

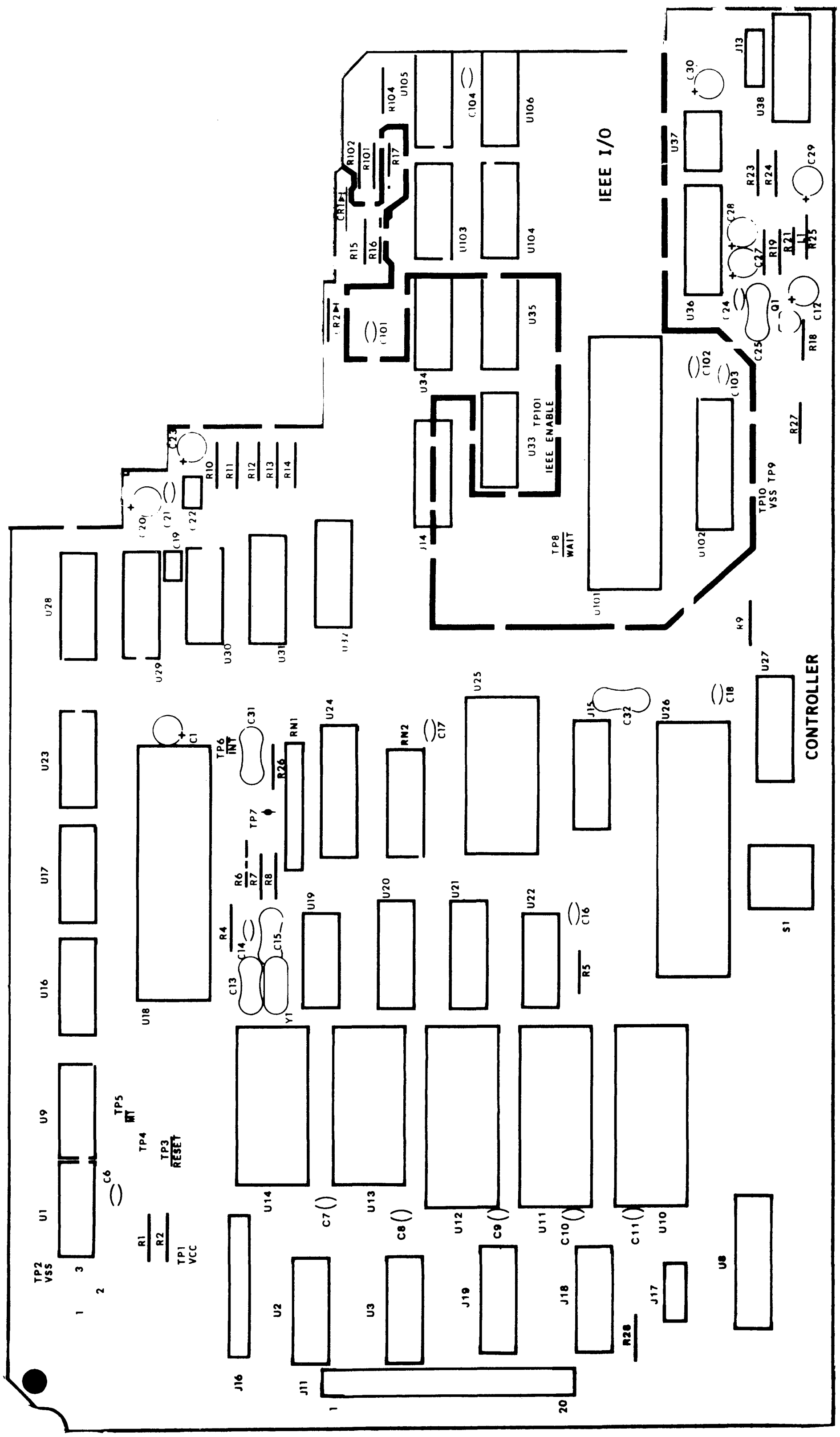
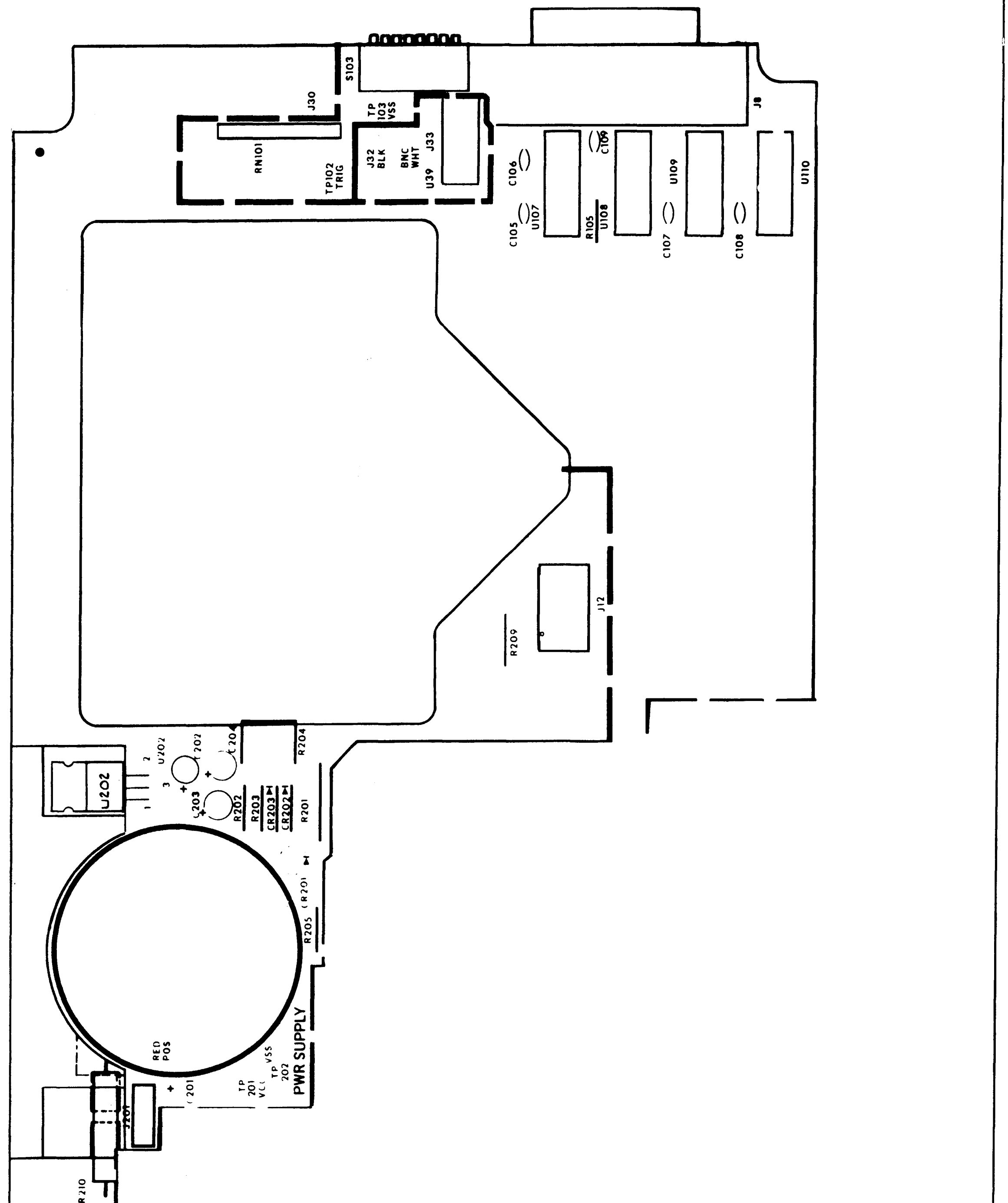


Figure 6-3. A2 Digital (Controller) PCB Assembly



8520A-1620(2 of 2)

Figure 6-3. A2 Digital (Controller) PCB Assembly (cont)

TABLE 6-4. A3 ANALOG PCB ASSEMBLY
(SEE FIGURE 6-4.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	------------DESCRIPTION------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
A 1	*	REFERENCE MODULE PCB (HORIZONTAL)	527994	89536	527994			1
A 1	*	REFERENCE MODULE PCB (VERTICAL)	530626	89536	530626			1
BR 701,702	*	DIODE,SI,RECT,BRIDGE,BV=200V,IO=1.0A	296509	09423	FB200	2	1	
C 101		CAP,MICA,120PF,+-5%,500V	148486	14655	CD15FD121J0	1		
C 221		CAP,POLYPR,4700PF,+-10%,200V	512830	89536	512830	1		
C 222,223		CAP,POLYPR,0.047UF,+-10%,50V	413328	84411	JF86	2		
C 224		CAP,POLYES,0.047UF,+-10%,50V	271858	06001	75F1R5A474	1	1	
C 225,231,403,		CAP,VAR,0.25-1.5PF,1700V,TEFLON	218206	72982	530-000	4		
C 408			218206					
C 226,237-240,		CAP,TA,6.8UF,+-20%,35V	363713	56289	196D685X0035KA1	8		
C 305-307			363713					
C 227,229,233,		CAP,MICA,430PF,+-5%,500V	177980	14655	CD15FD431J0	4		
C 235			177980					
C 230		CAP,POLYCA,1UF,+-10%,50V	271619	84411	X463UW1029,50W	1		
C 236		CAP,MICA,47PF,+-5%,500V	148536	72136	CM15E470J	1		
C 241,308		CAP,TA,39UF,+-20%,6V	163915	56289	196D394X0020KA1	2		
C 243		CAP,CER,0.0012UF,+-10%,500V,Z5R	106732	71590	CF122	1		
C 244		CAP,CER,150PF,+-2%,100V,COG	512988	89536	512988	1		
C 301,303,433,		CAP,MICA,33PF,+-5%,500V	160317	02799	DM15E330J	5		
C 502,503			160317					
C 302,304,510,		CAP,MICA,100PF,+-5%,500V	148494	72136	DM15F101J	5		
C 511,602			148494					
C 310-312,435		CAP,CER,0.22UF,+-20%,50V,Z5U	309849	71590	CW3COC224K	4		
C 314,315		CAP,CER,2200PF,+-20%,100V,X7R	358291	89536	358291	2		
C 401		CAP,POLYES,0.22UF,+-10%,1000V	485797	52763	MKT-1822322/10	1		
C 402		CAP,PORC,2.2PF,+-0.25PF,1700V AC	340273	95275	VY10CA2R2CA	1		
C 404,501		CAP,MICA,15PF,+-5%,500V	148569	72136	DM15C150J	2		
C 409		CAP,CER,6.8PF,+-0.1PF,500V,COJ	485383	56289	561CCOJBA102AE6R8B	1		
C 412		CAP,MICA,390PF,+-5%,500V	148437	72136	DM15F391J	1		
C 414		CAP,MICA,62PF,+-1%,500V	494617	14655	CD15FD620A0	1		
C 415		CAP,MICA,560PF,+-1%,300V	494609	14655	CD15FC561A0	1		
C 416		CAP,CER,6.8PF,+-0.25PF,50V,M7J	715243	89536	715243	1		
C 417		CAP,CER,4700PF,+-20%,100V,X7R	362871	72982	8121-A100-W5R-472M	1		
C 419		CAP,MICA,820PF,+-1%,500V	226167	14655	CD19FD821A0	1		
C 420		CAP,MICA,3600PF,+-1%,500V	529149	14655	CD19FD362A0	1		
C 422		CAP,CER,0.047UF,+-20%,50V,Z5U	460733	71590	CW20C473M	1	1	
C 424-427,431,		CAP,TA,1UF,+-10%,35V	161919	56289	196D010X0035G	12		
C 432,438,447,			161919					
C 448,601,610,			161919					
C 615			161919					
C 428		CAP,MICA,2PF,+-0.5PF,500V	175208	72136	DM15C020E	1		
C 429,430		CAP,CER,0.05UF,+80-20%,25V,Y5U	148924	72982	5855-000-Y5U0-503Z	2		
C 436,441		CAP,POLYPR,0.068UF,+-10%,100V	485441	89536	485441	2		
C 437		CAP,POLYES,0.012UF,+-10%,50V	402883	80031	75F1R5A123	1		
C 440		CAP,POLYES,0.015UF,+-10%,50V	402891	80031	75F1R5A153	1		
C 442,443		CAP,POLYPR,0.047UF,+-10%,100V	446773	89536	446773	2		
C 446		CAP,CER,5000PF,+-20%,100V,Z5V	175232	56289	C023B101H253M	1		
C 450-453		CAP,TA,10UF,+-20%,20V	330662	56289	196D106X0020KA1	4		
C 455		CAP,MICA,51PF,+-5%,500V	277210	14655	CD15ED510J0	1		
C 456,611,612,		CAP,TA,22UF,+-20%,15V	423012	56289	196D226X0015KA1	6		
C 614,616,708			423012					
C 504		CAP,CER,300PF,+-10%,500V,X7W	105734	71590	BB60301KW7W	1		
C 505,506		CAP,POLYPR,0.022UF,+-10%,100V	494948	89536	494948	2		
C 507,508,719,		CAP,TA,4.7UF,+-20%,50V	363721	56289	196D475X9015HA1	4		
C 720			363721					
C 509		CAP,POLYES,0.47UF,+-10%,100V	369124	89536	369124	1		
C 603,619		CAP,CER,100PF,+-10%,100V,COG	557322	89536	557322	2		
C 604-607		CAP,TA,10UF,+-20%,10V	176214	56289	196D106X0010KA1	4		
C 608,609		CAP,TA,10UF,+-20%,15V	193623	56289	196D106X0015A1	2		
C 617		CAP,MICA,5PF,+-0.5PF,500V	148577	89536	148577	1		
C 618		CAP,MICA,22PF,+-5%,500V	148551	02799	DM15C220J	1		
C 706		CAP,AL,10000UF,+30-20%,16V	494831	89536	494831	1		
C 707		CAP,TA,2.2UF,+-20%,20V	161927	56289	196D225X0020HA1	1		
C 709,710		CAP,AL,470UF,+50-20%,50V	478792	89536	478792	2		
C 711,712		CAP,AL,330UF,+50-20%,100V	484436	89536	484436	2		
C 717,718		CAP,TA,22UF,+-20%,35V	394775	56289	196D226X0035TE4	2		
CR 105	*	ZENER,UNCOMP, 16.0V, 5%, 15.5MA, 1.0W	313221	12969	UZ8716	1	1	
CR 107-110	*	ZENER,UNCOMP, 18.0V, 5%, 7.0MA, 0,4W	327973	04713	1N967B	4	1	
CR 215,305-307,	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	12	1	
CR 312,407-410,	*		203323					
CR 501,502,507	*		203323					
CR 218,219,503-	*	DIODE,SI,BV= 90.0V,IO= 75MA,SELCTD IR	260554	07910	CD55105	6	1	
CR 506	*		260554					
CR 220,412,705,	*	DIODE,SI, 100 PIV, 1.0 AMP	343491	01295	1N4002	4	1	

TABLE 6-4. A3 ANALOG PCB ASSEMBLY
(SEE FIGURE 6-4.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	------------DESCRIPTION------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
CR 706	*		343491					
CR 301,304	*	ZENER,UNCOMP, 10.0V,10%, 12.5MA, 0.4W	113324	07910	1N961A	2	1	
CR 313	*	ZENER,UNCOMP, 4.7V,10%, 20.0MA, 0.4W	387084	07910	1N750	1	1	
CR 402	*	DIODE,SI,BV= 20.0V,IO= 50MA,SELCTD IR	348177	07263	FD7223	1	1	
CR 404	*	ZENER,UNCOMP, 6.8V, 5%, 20.0MA, 0.4W	260695	07910	1N754A	1	1	
CR 405,406,408	*	DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	313247	28484	HP5082-6264	3	1	
CR 703,704,707,	*	DIODE,SI, 50 PIV, 2.0 AMP	347559	05277	1N5400	4	2	
CR 709	*		347559					
CR 708	*	LED,RED,LUM INT= 1 MCD,W/STANDOFFS	429555	12040	NLS5053	1	1	
E 1, 2		TERM,INSUL,FEEDTHRU,BIFURCATED	281865	12615	SL-841-777	2		
H 1		NUT,PRESS,BROACH,STL,4-40	380196	24347	KF2-440	2		
H 2		SCREW,MACH,PHP,S.STL,4-40X1/4	256156	89536	256156	2		
H 3		WASHER,SHLDR,NYLON,#4	436386	86928	5607-45	5		
H 4		SCREW,MACH,PHP,STL,4-40X5/16	152116	89536	152116	5		
J 19- 22		HEADER, PROGRAMMED	504373	51167	14-675-191	4		
J 418-420		CONNECTING LINK	523159	89536	523159	3		
J 502		HEADER, PROGRAMMED	495507	51167	16-675-191	1	1	
K 101		RELAY,ARMATURE,2 FORM C,4.5VDC	519710	89536	519710	1		
K 102		RELAY,ARMATURE,2 FORM C,4.5VDC	514240	26806	AZ-420-12-203	1		
K 103		RELAY,ARMATURE,4 FORM C,4.5VDC	422931	77342	RIO-E3713-3	1		
K 104,304,401		RELAY,REED,1 FORM A,5VDC	500132	89536	500132	3		
K 301-303		RELAY,REED,1 FORM A,4.5V	772285	89536	772285	3		
L 201,202		CORE,TOROID,FERRITE,.047X.138X.118	321182	89536	321182	2		
L 601		CHOKE,6TURN	320911.	89536	320911	1		
MP 1		BRACKET,ANALOG HEATSINK	490995	89536	490995	1	1	
MP 2		HEATSINK	347740	05820	260-18D	1		
MP 3		INSUL PART,TRANS,SILICONE,POWER	508630	89536	508630	5		
MP 4		SUPPORT,RESISTOR	545079	89536	545079	1		
MP 5		SHIELD DC BUFFER	496786	89536	496786	1		
MP 6		SHIELD, AC CONVERTER	514984	89536	514984	1		
MP 7		BALL STUD	347542	89536	347542	6		
MP 8		SPACER,RND,SOLUBLE,0.062IDX0.156OD	296319	32559	T0806	2		
MP 9		SPACER,SWAGED,HEX,BRASS,6-32X3/4	194076	89536	194076	2		
P 17		HEADER,1 ROW,0.100CTR,11 PIN	494666	00779	1-640456-1	1		
P 23, 24		PIN,SINGLE,PWB,0.058 DIA	233411	00779	60599-3	2		
Q 103,106-108,	*	TRANSISTOR,SI,N-JFET,TO-92	483099	27014	SF53017	5	1	
Q 224	*		483099					
Q 104,221,223	*	TRANSISTOR,SI,N-JFET,HI-VOLTAGE,TO-92	524157	32293	ITS31250	3	1	
Q 111-114,236-	*	TRANSISTOR,SI,N-JFET,HI-VOLTAGE,TO-92	393314	17856	5T3824	7	1	
Q 238	*		393314					
Q 115,116,310,	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	168716	07263	S19254	4	1	
Q 311	*		168716					
Q 225,226	*	TRANSISTOR,SI,PNP,HI-SPEED SWITCH	369629	07263	S43576	2	1	
Q 227,234	*	TRANSISTOR,SI,N-JFET,DUAL,TO-71	478172	32293	IT502P	2	1	
Q 228-230,235,	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	218396	04713	2N3904	5	2	
Q 304	*		218396					
Q 231-233	*	TRANSISTOR,SI,N-DMOS FET,TO-72	394122	18324	SD210	3	1	
Q 239,240	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	266619	07263	2N4888	2	1	
Q 305,306,528-	*	TRANSISTOR,SI,N-JFET,TO-92	508697	21845	FS933	7	1	
Q 532	*		508697					
Q 308	*	TRANSISTOR,SI,N-JFET,TO-92	343830	12040	NSSF50024	1	1	
Q 309	*	TRANSISTOR,SI,NPN,DUAL,TO-5	478099	12040	LM3940M	1	1	
Q 314,315	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	203489	09214	11C2322	2	2	
Q 317	*	TRANSISTOR,SI,PNP,SM SIG,DARLINGTON	524140	04713	MPS-A63	1	1	
Q 401,403-406	*	TRANSISTOR,SI,N-JFET,TO-92	288324	89536	288324	5	1	
Q 402,407-409,	*	TRANSISTOR,SI,N-JFET,TO-92,SWITCH	261578	15818	U2366J	18	1	
Q 416-419,421,	*		261578					
Q 506-509,514,	*		261578					
Q 516,518,520,	*		261578					
Q 522	*		261578					
Q 410	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	229898	04713	MPS6522	1	4	
Q 411	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	218081	04714	MPS6520	1	1	
Q 411	*	ZENER,UNCOMP, 8.2V, 5%, 20.0MA, 0.4W	386771	04713	1N756A	1	1	
Q 414,415	*	TRANSISTOR,MATCHED	504191	89536	504191	1	1	
Q 501,502,503	*	MATCHED J-FETS	274795	89536	274795	2	1	
Q 316,510,511	*		274795					
Q 504,505	*	TRANSISTOR,SI,N-JFET,SWITCHING,TO-92	370072	15818	U3422J	2	1	
Q 512,513,515,	*	FIELD EFFECT GROUPED N-CHANNEL 10 PCS	492306	89536	492306	1		
Q 517,519,521,	*		492306					
Q 523-526	*		492306					
Q 527	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	64713	2N3906	1	1	
R 101,102		THERMISTOR,RECT.,POS.,500,+-40%,25C	500017	89536	500017	2		
R 103		THERMISTOR,RECT.,POS.,1K,+-40%,25C	494740	50157	180Q10215	1	1	
R 104		RES,WW,2K,+-1%,7W	682328	89536	682328	1		

TABLE 6-4. A3 ANALOG PCB ASSEMBLY
(SEE FIGURE 6-4.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	NOT -E
R 109		RES,VAR,CERM,200,+-10%,0.5W	275743	89536	275743	1		
R 110		RES,CC,150K,+-5%,2W	110122	01121	HB1545	1		
R 111		RES,CF,220K,+-5%,0.25W	573642	80031	CR251-4-5P220K	1		
R 112		RES,CF,150K,+-5%,0.25W	573600	89536	573600	1		
R 113		RES,CC,1M,+-10%,0.5W	108134	01121	EB1051	1		
R 114,115		RES,MF,150K,+-1%,0.125W,100PPM	241083	91637	CMF551503F	2	3	
R 120,121		RES,CF,8.2K,+-5%,0.25W	441675	80031	CR251-4-5P8K2	2		
R 223,252,254		RES,MF,71.5K,+-1%,0.125W,100PPM	291435	91637	CMF557152F	3		
R 224		RES,MF,169K,+-1%,0.125W,100PPM	289454	91637	CMF551693F	1		
R 225,226,240,		RES,MF,1K,+-1%,0.125W,100PPM	168229	91637	CMF551001F	4		
R 241			168229					
R 227,228,231,		RES,MF,20K,+-1%,0.125W,100PPM	291872	91637	CMF552002F	8		
R 243,244,247,			291872					
R 324,326			291872					
R 229		RES,MF,93.1K,+-1%,0.125W,100PPM	223586	91637	CMF559312F	1		
R 230		RES,MF,14.7K,+-1%,0.125W,100PPM	226225	91637	CMF551472F	1		
R 232,237		RES,MF,1.21K,+-1%,0.125W,100PPM	229146	91637	CMF551211F	2		
R 234		RES,MF,1.87K,+-1%,0.125W,100PPM	267229	91637	CMF551871F	1		
R 235		RES,MF,1.47K,+-1%,0.125W,100PPM	293654	91637	CMF551471F	1		
R 236		RES,VAR,CERM,5K,+-10%,0.5W	327569	11236	360T-502A	1		
R 239,462		RES,MF,1.3K,+-1%,0.125W,100PPM	343921	91637	CMF551301F	2		
R 242,712		RES,CF,390,+-5%,0.25W	573105	80031	CR251-4-5P390E	2		
R 251,253,425,		RES,VAR,CERM,100,+-10%,0.5W	275735	11236	360T-101A	6		
R 426,520,527			275735					
R 255,256		RES,CF,15,+-5%,0.25W	348755	80031	CR251-4-5P15E	2		
R 257,258,334-		RES,CF,150,+-5%,0.25W	573030	80031	CR251-4-5P150E	5		
R 336			573030					
R 261,264,312,		RES,CF,10K,+-5%,0.25W	573394	80031	CR251-4-5P10K	6		
R 613,614,621			573394					
R 265,266		RES,CF,4.7K,+-5%,0.25W	573311	80031	CR251-4-5P4K7	2		
R 267,269		RES,MF,2.74K,+-1%,0.125W,100PPM	293761	91637	CMF552741F	2		
R 268		RES,MF,6.65K,+-1%,0.125W,100PPM	294918	91637	CMF551272F	1		
R 270,505		RES,MF,51.1K,+-5%,0.125W,100PPM	289553	91637	CMF555112F	2		
R 271		RES,MF,12.7K,+-1%,0.125W,100PPM	217448	91637	CMF551272F	1		
R 272		THERMISTOR,DISC,NEG.,10K,+-10%,25C	104596	73168	JA41J1	1		
R 273		RES,CC,4700M,+-10%,0.25W	603530	01121	CB477	1	1	
R 280		RES,CC,10,+-10%,0.125W	321125	01121	BB1001	1		
R 303		8520A OHMS REF RES	503821	89536	503821	1		
R 305,512,517,		RES,CF,1K,+-5%,0.25W	573170	80031	CR251-4-5P1K	5		
R 612,622			573170					
R 306		RES,MF,76.8K,+-1%,0.125W,25PPM	257394	91637	CMF557682F	1		
R 307		RES,MF,57.6K,+-1%,0.125W,25PPM	484915	91637	CMF555762F	1		
R 308		RES,MF,25.5K,+-1%,0.125W,25PPM	446666	91637	CMF552552F	1		
R 309,342		RES,CF,100,+-5%,0.25W	573014	80031	CR251-4-5P100E	2		
R 311,422,519		RES,VAR,CERM,500,+-10%,0.5W	325613	89536	325613	3		
R 314,433,521,		RES,VAR,CERM,50,+-10%,0.5W	447862	11236	360T-500A	4		
R 710			447862					
R 315,518		RES,VAR,CERM,1K,+-10%,0.5W	275750	11236	360T-102A	2		
R 317		RES,VAR,CERM,50K,+-10%,0.5W	335778	11236	360T-503A	1		
R 318		RES,MF,191K,+-1%,0.125W,100PPM	375923	91637	CMF551913F	1		
R 319,408,481		RES,VAR,CERM,10K,+-10%,0.5W	485458	32997	3299W-CR2-103	3		
R 320	*	RES,CERM,4.0455M,+-0.1%,0.75W	474932	89536	474932	1		
R 321		RES,CERM,449.55K,+-0.1%,0.33W	478990	89536	478990	1		
R 322		RES,MF,13.7K,+-1%,0.125W,100PPM	236752	91637	CMF551372F	1		
R 323		RES,MF,2K,+-1%,0.125W,100PPM	235226	91637	CMF552001F	1		
R 325		RES,VAR,CERM,25K,+-10%,0.5W	500769	32997	3299W-W-253	1		
R 327,328		RES. SET, 2M T.C. MATCHED	290320	89536	290320	1		
R 329		RES,MF,12.1K,+-1%,0.125W,100PPM	234997	91637	CMF551212F	1		
R 330		RES,MF,3.16M,+-1%,0.125W,100PPM	494815	91637	CMF553164F	1		
R 331,601		RES,CF,10K,+-5%,0.25W	348839	80031	CR251-4-5P10K	2		
R 332		RES,WW,10K,+-5%,6W	500025	89536	500025	1		
R 341		RES,MF,37.4K,+-1%,0.125W,100PPM	226241	91637	CMF553742F	1		
R 343		RES,CF,330K,+-5%,0.25W	641159	89536	641159	1		
R 401		RES,CC,560,+-5%,0.25W	572685	01121	CB5615	1		
R 403		RES,CERM,1.1104M,+-0.05%,0.75W,5PPM	493627	19647	TF050R	1		
R 412		RES,MF,556.39K,+-0.1%,0.125W,25PPM	485367	91637	CMF55	1		
R 421		RES,MF,79.24K,+-0.1%,0.125W,25PPM	485334	89536	485334	1		
R 427,428,488		RES,CF,2K,+-5%,0.25W	573238	80031	CR251-4-5P2K	3		
R 432		RES,MF,8.8091K,+-0.1%,0.125W,25PPM	485342	89536	485342	1		
R 435		RES,CF,62K,+-5%,0.25W	348904	80031	CR251-4-5P62K	1		
R 436		RES,MF,1.1108K,+-0.1%,0.125W,25PPM	485359	91637	485359	1		
R 437		RES,MF,47.5K,+-1%,0.125W,100PPM	289546	91637	CMF554752F	1		
R 438		RES,VAR,CERM,20K,+-10%,0.5W	335760	11236	360T-203A	1		
R 439		RES,CF,51K,+-5%,0.25W	573535	89536	573535	1		

TABLE 6-4. A3 ANALOG PCB ASSEMBLY
(SEE FIGURE 6-4.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
R 440		RES,VAR,CERM,50,+-10%,0.5W	500009	32997	3299W-CR2-500	1		
R 441		RES,MF,4.975K,+-0.1%,0.125W,25PPM	340232	89536	340232	1		
R 442		RES,MF,169,+-1%,0.125W,100PPM	236869	91637	CMF551690F	1		
R 443,461,514		RES,MF,1M,+-1%,0.125W,100PPM	268797	91637	CMF551004F	3		
R 444,528		RES,CF,1.5K,+-5%,0.25W	573212	80031	CR251-4-5P1K5	2		
R 445,463		RES,VAR,CERM,200K,+-10%,0.5W	381921	32997	3299W-CR2-204	2		
R 446,447		RES,CF,2.4K,+-5%,0.25W	573253	89536	573253	2		
R 448,452,482,		RES,CF,510,+-5%,0.25W	573139	89536	573139	4		
R 529			573139					
R 449,451		RES,CF,3K,+-5%,0.25W	441527	80031	CR251-4-5P3K	2		
R 450		RES,CF,9.1K,+-5%,0.25W	441691	80031	CR251-4-5P9K1	1		
R 453		RES,MF,4.99K,+-1%,0.125W,100PPM	168252	91637	MFF1-84991	1		
R 454		RES,CF,750,+-5%,0.25W	573162	80031	CR251-4-5P750E	1		
R 455		RES,MF,5K,+-0.1%,0.125W,25PPM	340240	91637	CMF555001B	1		
R 456		RES,CF,560,+-5%,0.25W	385948	80031	CR251-4-5P560E	1		
R 457		RES,MF,10K,+-0.1%,0.125W,25PPM	435065	89536	435065	1		
R 458		RES,MF,20K,+-0.1%,0.125W,25PPM	340620	91637	CMF55	1		
R 459		RES,CF,240K,+-5%,0.25W	442459	80031	CR251-4-5P240K	1		
R 464		RES,CF,750,+-5%,0.25W	441659	80031	CR251-4-5P750E	1		
R 466		RES,CC,5.1,+-5%,0.25W	281832	01121	CB5R15	1		
R 467,475,476		RES,CF,300K,+-5%,0.25W	573659	89536	573659	3		
R 468		RES,CF,6.8K,+-5%,0.25W	573352	89536	573352	1		
R 470		RES,MF,316K,+-1%,0.125W,100PPM	289496	91637	CMF553163F	1	1	
R 472,473		RES,CF,47K,+-5%,0.25W	573527	80031	CR251-4-5P47K	2		
R 474,477		RES,CF,43K,+-5%,0.25W	573519	89536	573519	2		
R 478		RES,CF,2K,+-5%,0.25W	441469	80031	CR251-4-5P2K	1		
R 479		RES,CF,82,+-5%,0.25W	573006	89536	573006	1		
R 480		RES,MF,315K,+-0.1%,0.125W,25PPM	485375	89536	485375	1		
R 489		RES,CF,5.6,+-5%,0.25W	572917	89536	572917	1		
R 501,508		RES,MF,6.49K,+-1%,0.125W,100PPM	294900	91637	CMF556491F	2		
R 502		RES,MF,100,+-1%,0.125W,100PPM	168195	91637	CMF551000F	1		
R 503,504		RES,VAR,CERM,5K,+-10%,0.5W	493593	32997	3299W-CR2-502	2		
R 506,510		RES,CF,27K,+-5%,0.25W	573477	80031	CR251-4-5P27K	2		
R 507,511		RES,CF,20K,+-5%,0.25W	573444	80031	CR251-4-2P20K	2		
R 513		RES,VAR,CERM,100K,+-10%,0.5W	369520	11236	360T-104A	1		
R 515		RES,MF,133K,+-1%,0.125W,100PPM	289074	91637	CMF551333F	1		
R 516		RES,MF,143,+-1%,0.125W,100PPM	192906	91637	CMF551430F	1		
R 522		RES,VAR,CERM,20,+-20%,0.5W	275727	11236	360T-200B	1		
R 523,532		RES,MF,26.7K,+-1%,0.125W,100PPM	245779	91637	CMF552672F	2		
R 524		RES,MF,28.7K,+-1%,0.125W,100PPM	235176	91637	CMF552872F	1		
R 525		RES,MF,33.2K,+-1%,0.125W,100PPM	291393	91637	CMF553322F	1		
R 526		RES,MF,49.9K,+-1%,0.125W,100PPM	268821	91637	CMF554992F	1		
R 530		RES,CF,15K,+-5%,0.25W	573428	80031	CR251-4-5P15K	1		
R 534,535		RES,CF,47,+-5%,0.25W	572982	80031	CR251-4-5P47E	2		
R 538		RES,MF,130,+-1%,0.125W,100PPM	485698	91637	CMF551300F	1		
R 539		RES,MF,200,+-1%,0.125W,100PPM	245340	91637	CMF552000F	1		
R 602		RES,MF,121K,+-1%,0.125W,100PPM	229369	89536	229369	1		
R 603		RES,MF,28K,+-1%,0.125W,100PPM	291385	91637	CMF552802F	1	1	
R 604		RES,CF,51,+-5%,0.25W	572990	89536	572990	1		
R 606		RES,CF,100K,+-5%,0.25W	573584	80031	CR251-4-5P100K	1		
R 609		RES,CF,1M,+-5%,0.25W	573691	80031	CR251-4-5P1M	1		
R 619		RES,CF,820,+-5%,0.25W	442327	80031	CR251-4-5P820E	1		
R 623		RES,CF,1.2K,+-5%,0.25W	573196	89536	573196	1		
R 709		RES,WW,FUSIBLE,0.1,+-10%,2W	485672	89536	485672	1		
R 711		RES,CF,390,+-5%,0.25W	441543	80031	CR251-4-5P390E	1		
R 713,714		RES,CF,3.3K,+-5%,0.25W	348813	80031	CR251-4-5P3K3	2		
RN 101		RES,NET,SIP,8 PIN,7 RES,200K,+-2%	485128	89536	485128	1		
RN 104	*	RES,NET,CERM,TOL,TC,MATCHED	479287	89536	479287	1		
RN 202,301		RES,NET,DIP,14 PIN,7 RES,100K,+-5%	516930	89536	516930	2		
RN 203	*	RES NET ASSY TESTED (122-6.8K(3))8520	502922	89536	502922	1		
RN 302	*	RES NET ASSY TESTED (2K-200K(4))8520	502971	89536	502971	1		
RN 401		RES,NET,SIP,6 PIN,5 RES,22K,+-2%	520122	89536	520122	1		
RN 402		RES,NET,SIP,8 PIN,7 RES,4.7K,+-2%	412916	80031	95081002CL	1		
RN 501	*	RES NET ASSY TESTED (85-100K(10))8520	502948	89536	502948	1		
RN 502	*	RES NET ASSY TESTED (25K-400K(8))8520	502963	89536	502963	1		
RN 503		RES,NET,SIP,6 PIN,5 RES,100K,+-2%	412726	89536	412726	1		
RN 504		RES,NET,SIP,8 PIN,7 RES,100K,+-2%	412908	89536	412908	1		
RN 505		RES,NET,DIP,16 PIN,8 RES,100K,+-5%	380618	89536	380618	1		
RN 601		RES,NET,SIP,10 PIN,9 RES,10K,+-2%	414003	80031	95081002CL	1		
RN 602,603		RES,NET,SIP,8 PIN,7 RES,10K,+-2%	412924	80031	95081002CL	2		
RV 101,102		VARISTOR,390V,+-10%,1.0MA	423475	09214	V390MAX781	2		
RV 101,102		VARISTOR,390,+-10%,1,MA	697383	89536	697383	2	1	
RV 103-105		VARISTOR,330V,+-20%,1.0MA	520874	09214	V330MA5B	3	1	
RV 701		VARISTOR,33V,+-10%,1.0MA	485391	89536	485391	1	1	

TABLE 6-4. A3 ANALOG PCB ASSEMBLY
(SEE FIGURE 6-4.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
S 101		SWITCH, 2 POLE-2 THROW	504852	89536	504852	1		
S 102		SWITCH, 8 POLE-2 THROW	504845	89536	504845	1	1	
TP		TEST POINTS	512889	02660	62395	42		
U 101	*	IC,ARRAY,7 TRANS,NPN,DARLINGTON PAIRS	483081	01295	ULN2004AN	1	1	
U 102,209	*	IC,BIPLR,5CHNL HI-VOLT DISPLAY DRIVER	504795	56289	UPH-480	2	1	
U 103,206	*	IC,CMOS,HEX OPEN DRAIN P-CHNL BUFFER	418947	12040	MM74C907N	2	1	
U 205	*	IC,OP AMP,JFET INPUT,8 PIN DIP	472779	12040	LF386N	1	1	
U 207	*	IC,LSTTL,HEX INVERTER	393058	01295	SN74LS04N	1	1	
U 208	*	IC,LSTTL,QUAD 2 INPUT NAND GATE	394205	01295	SN74LS03N	1	1	
U 210,211	*	IC,OP AMP,GEN PURPOSE,COMPENSATD,TO-5	392902	12040	LM1436H	2	1	
U 301	*	IC,ARRAY,5 TRANS,5 ISO: 2-PNP,3-NPN	418954	02735	CA3096E	1	1	
U 302,303	*	IC,OP AMP,GENERAL PURPOSE,8 PIN DIP	478107	12040	308AN	2	1	
U 401	*	IC,OP AMP,JFET INPUT,TO-5 CASE	429951	12040	LF357AH	1		
U 402	*	IC,OP AMP,JFET INPUT,TO-5 CASE	477869	12040	LF357H	1	1	
U 403	*	IC,OP AMP,JFET INPUT,TO-5 CASE	429837	12040	LF356F	1	1	
U 404	*	IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495119	12040	LF353BN	1	1	
U 405	*	IC,OP AMP,JFET INPUT,8 PIN DIP	483305	12040	LF351BN	1	1	
U 406	*	IC,BIPLR,7CHNL HI-VOLT DISPLAY DRIVER	504894	56289	UPH481	1	1	
U 407	*	IC,VOLT REG,FIXED,+8 VOLTS,0.1 AMPS	429647	07263	A78L08AWC	1	1	
U 408,502,503	*	IC,OP AMP,GEN PURPOSE,TO-78 METAL CAN	288928	12040	LM308AH	3	1	
U 409	*	IC,VOLT REG,FIXED,-8 VOLTS,1.5 AMPS	407635	04713	MC7908CT	1	1	
U 501		ZENER REF AMP	510669	89536	510669			1
U 504-506	*	IC,OP AMP,JFET IN,COMPENSTD,8 PIN DIP	418780	12040	LF351	3	1	
U 601	*	IC,NMOS,8 BIT MICROCOMPUTR,8520A-8120	524496	89536	524496	1		
U 602	*	IC,CMOS,UNIV ASYNC RECEIVER/TRANSMITR	658856	89536	658856	1		
U 603,607,617	*	IC,CMOS,HEX D F/F,+EDG TRG,W/RESET	404509	12040	MM74C174N	3		
U 604	*	IC,TTL,4-16 LINE DCDR W/DUAL STROBE	293217	01295	SN74154N	1	1	
U 605	*	IC,CMOS,DUAL SYNC BINRY UP CNTR	355164	04713	MC14520BCP	1	1	
U 608	*	IC,CMOS,DUAL D F/F,+EDG TRG	418830	12040	MM74C74	1	1	
U 609	*	IC,LSTTL,RETRG MONOSTAB MULTIVB W/CLR	404186	01295	SN74LS123N	1		
U 610	*	IC,TTL,DUAL NAND DRVR W/OPEN COLLECT	329706	01295	SN75452P	1	1	
U 611,612	*	IC,CMOS,HEX BUFFER W/3-STATE OUTPUT	407759	12040	MM80C97N	2	1	
U 613	*	IC,TTL,QUAD 2 INPUT AND GATE	393066	01295	SN74LS08N	1	1	
U 614,616	*	IC,CMOS,HEX INVERTER	404699	12040	MM74C04N	2	1	
U 615	*	IC,LSTTL,HEX INVERTER W/OPEN COLLECT	394536	01295	SN74LS05	1	1	
U 618-621	*	IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR	454892	01295	SN74LS273N	4	1	
U 622-624	*	IC,BIPLR,8CHNL HI-VOLT DISPLAY DRIVER	504902	56289	UPH-482	3	1	
U 627		TRANSF,PULSE,DIP PACK	500298	32997	4252-1034	1	1	
U 703	*	IC,VOLT REG,FIXED,+5 VOLTS,1.5 AMPS	428847	04713	MC7805CT	1	1	
U 704	*	IC,VOLT REG,FIXED,+12 VOLTS,1.5 AMPS	413195	04713	MC7812TP	1	1	
U 705	*	IC,VOLT REG,FIXED,+15 VOLTS,1.5 AMPS	413187	04713	MC7815CT	1	1	
U 706	*	IC,VOLT REG,FIXED,-15 VOLTS,1.5 AMPS	413179	04713	MC7915CP	1	1	
U 707	*	IC,VOLT REG,FIXED,-12 VOLTS,1.5 AMPS	381665	04713	MC7912CP	1	1	
X 1- 14		SOCKET,SINGLE,PWB,FOR 0.012-0.022 PIN	376418	22526	75060-005	14		
XJ 418-420		SOCKET,1 ROW,PWB,0.100CTR,4 POS	417311	30035	SS-109-1-04	4		
XK 101,103		RELAY SOCKET,4 POLE	441964	77342	R10273606	2		
XK 101,103		RELAY SOCKET,ACCESSORY,SPRING,4 POLE	500108	77342	20C250	2		
XK 102		RELAY SOCKET,ACCESSORY,SPRING,2 POLE	376459	77342	20C249	1		
XK 102		RELAY SOCKET,2 POLE	376665	77342	27E501	1		
XSW601		SOCKET,IC,8 PIN	478016	91506	308-AG39D	1		
XU 103,206,207,		SOCKET,IC,14 PIN	276527	09922	DILB8P-108	10	1	2
XU 608.614,616			276527					2
XU 210,211,402,		SOCKET,IC,TO-99,8 PIN,CIRCULAR	408450	89536	408450	11		4
XU 403,408,502,			408450					4
XU 503			408450					4
XU 601,602		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	2		
XU 603,605,607,		SOCKET,IC,16 PIN	276535	91506	316-AG39D	7		3
XU 611,612,617			276535					3
XU 604		SOCKET,IC,24 PIN	376236	91506	324-AG39D	1		
XU 703-707		SOCKET,TRANS,3 PIN	402958	89536	402958	5		
Y 601	*	CRYSTAL,6MHZ,+-0.01%,HC-18/U	461665	89536	461665	1		

NOTE 1 = ONLY ONE OF THESE ITEMS IS INSTALLED.
NOTE 2 = ALSO INCLUDES XJ19-XJ22.
NOTE 3 = ALSO INCLUDES XJ502.
NOTE 4 = ALSO INCLUDES XQ227,234,414,415.

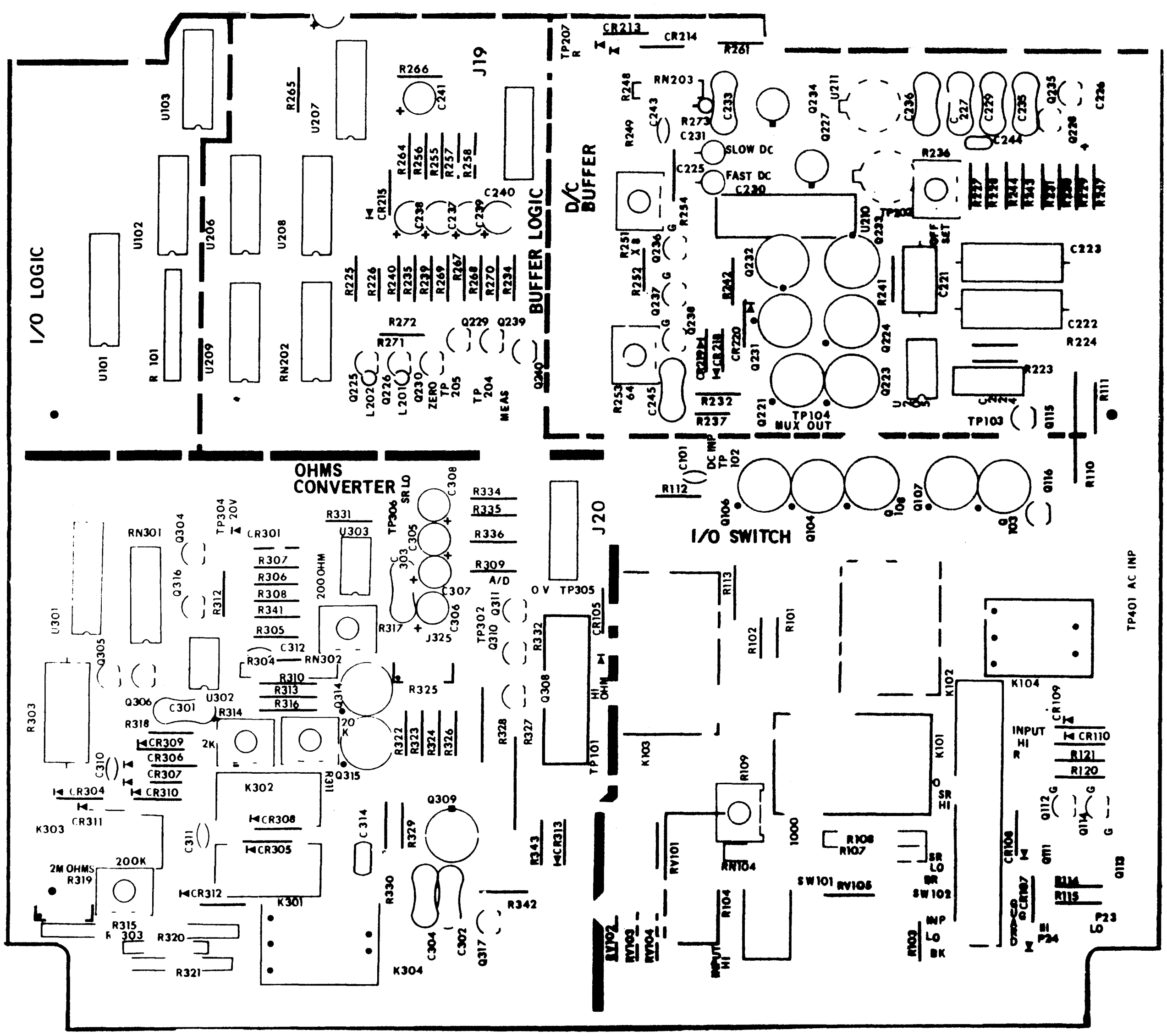
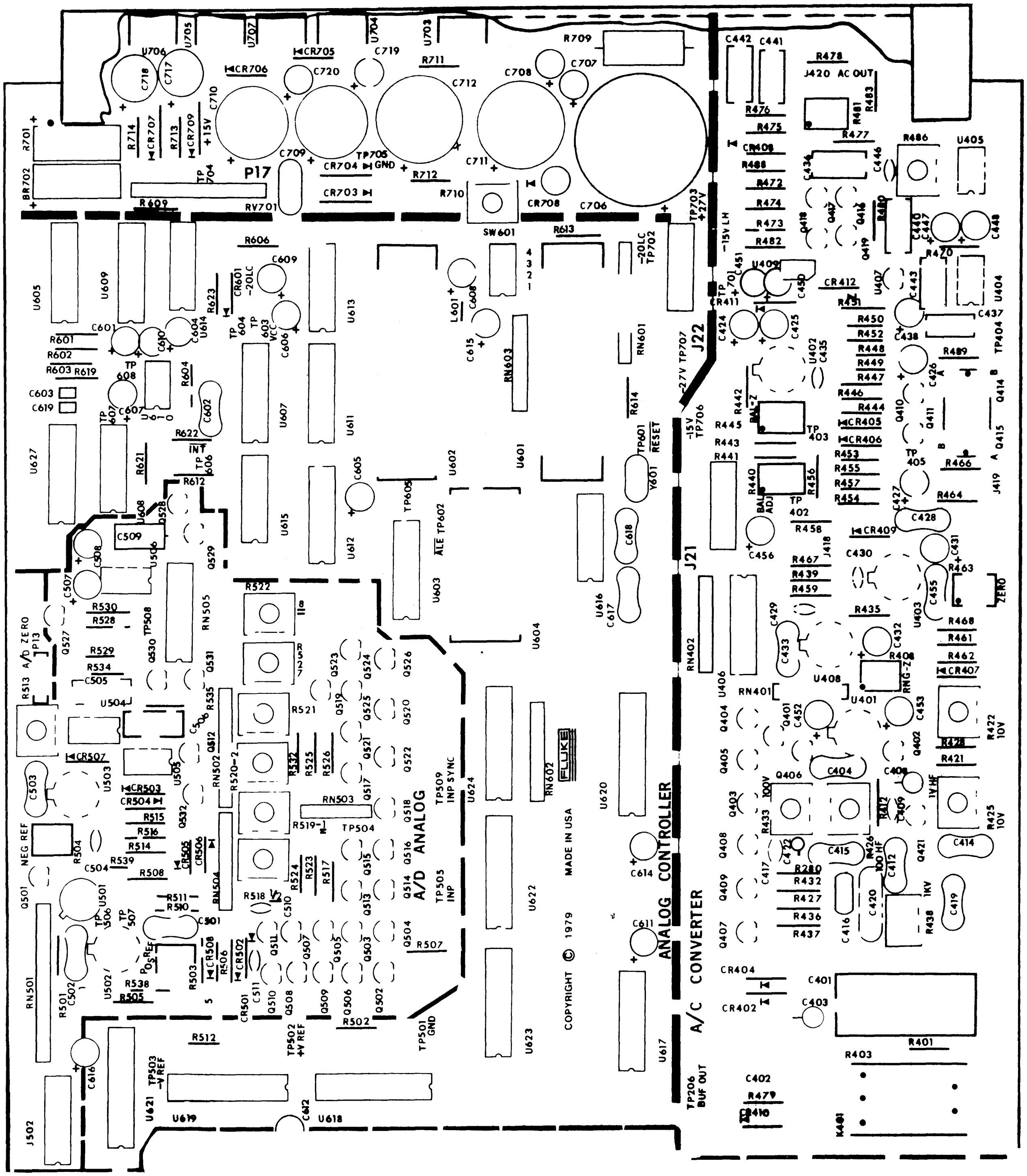


Figure 6-4. A3 Analog PCB Assembly



8520A-1630(2 of 2)

Figure 6-4. A3 Analog PCB Assembly (cont)

TABLE 6-5A. A3A1 REF AMP PCB ASSEMBLY (HORIZONTAL)
(SEE FIGURE 6-5A.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1		CAP,CER,2000PF,+100-0%,1000V,Z5U	105569	71590	DA140-139CB	1		
C 2, 3		CAP,TA,2.2UF,+-20%,20V	161927	56289	196D225X0020HA1	2		
CR 1, 2	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	2	1	
MP 1		SPACER,MOUNT,NYLON	152207	07047	10123-DAP	1	1	
R 1		RES,CF,1M,+-5%,0.25W	348987	80031	CR251-4-5P1M	1		
R 2		RES,MF,3.74K,+-1%,0.125W,25PPM	260547	91637	CMF553741F	1		
R 3		RES,VAR,CERM,2K,+-10%,0.5W	285163	89536	285163	1		
R 5		RES,MF,15.4K,+-0.1%,0.125W,25PPM	340604	91637	CMF551542F	1		
R 6		RES,MF,10.05K,+-0.1%,0.125W,25PPM	340216	89536	340216	1		
R 7		RES,MF,4.02K,+-1%,0.125W,100PPM	235325	91637	CMF554021F	1		
U 1	*	IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495119	12040	LF353BN	1		
U 2	*	REFERENCE-AMP-SET	523407	89536	523407	1	1	1

NOTE 1 = REF AMP SET INCLUDES R15,R16.

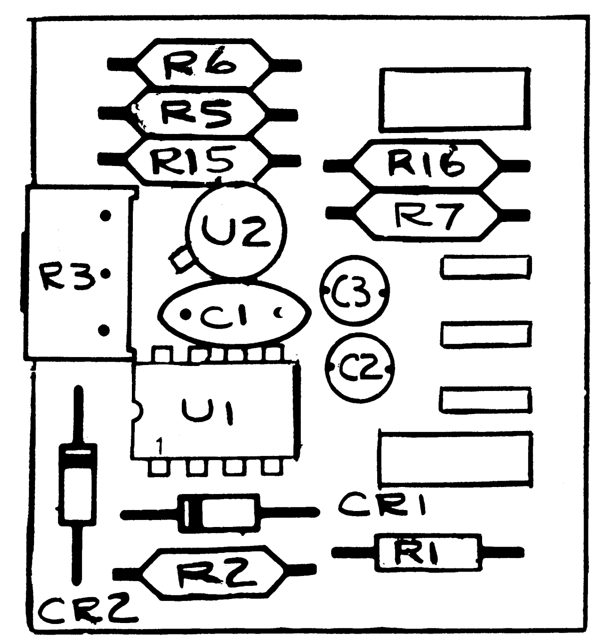
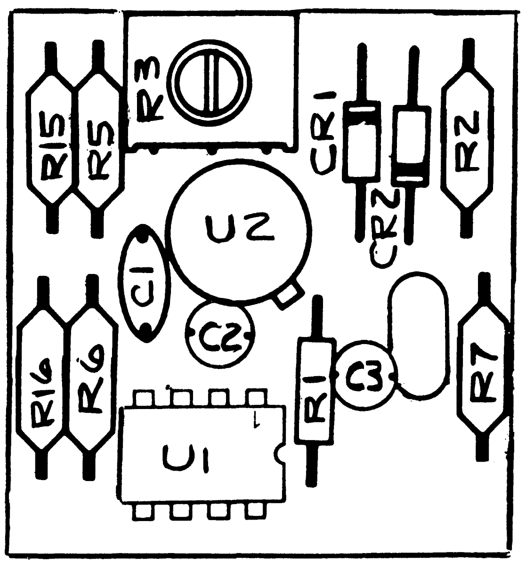


Figure 6-5A. A3A1 Ref Amp PCB Assembly (Horizontal)

TABLE 6-5B. A3A1 REF AMP PCB ASSEMBLY (VERTICAL)
(SEE FIGURE 6-5B.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1		CAP,CER,2000PF,+100-0%,1000V,Z5U	105569	71590	DA140-139CB	1	1	
C 2, 3		CAP,TA,2.2UF,+-20%,20V	161927	56289	196D225X0020HA1	2		
CR 1, 2	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	2	1	
R 1		RES,CF,1M,+-5%,0.25W	348987	80031	CR251-4-5P1M	1		
R 2		RES,MF,3.74K,+-1%,0.125W,25PPM	260547	91637	CMF553741F	1		
R 3		RES,VAR,CERM,2K,+-10%,0.5W	309666	89536	309666	1		
R 5		RES,MF,15.4K,+-0.1%,0.125W,25PPM	340604	91637	CMF551542F	1		
R 6		RES,MF,10.05K,+-0.1%,0.125W,25PPM	340216	89536	340216	1		
R 7		RES,MF,4.02K,+-1%,0.125W,100PPM	235325	91637	CMF554021F	1		
U 1	*	IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495119	12040	LF353BN	1		
U 2	*	REFERENCE-AMP-SET	523407	89536	523407	1	1	1

NOTE 1 = REF AMP SET INCLUDES R15,R16.



8520A-1645

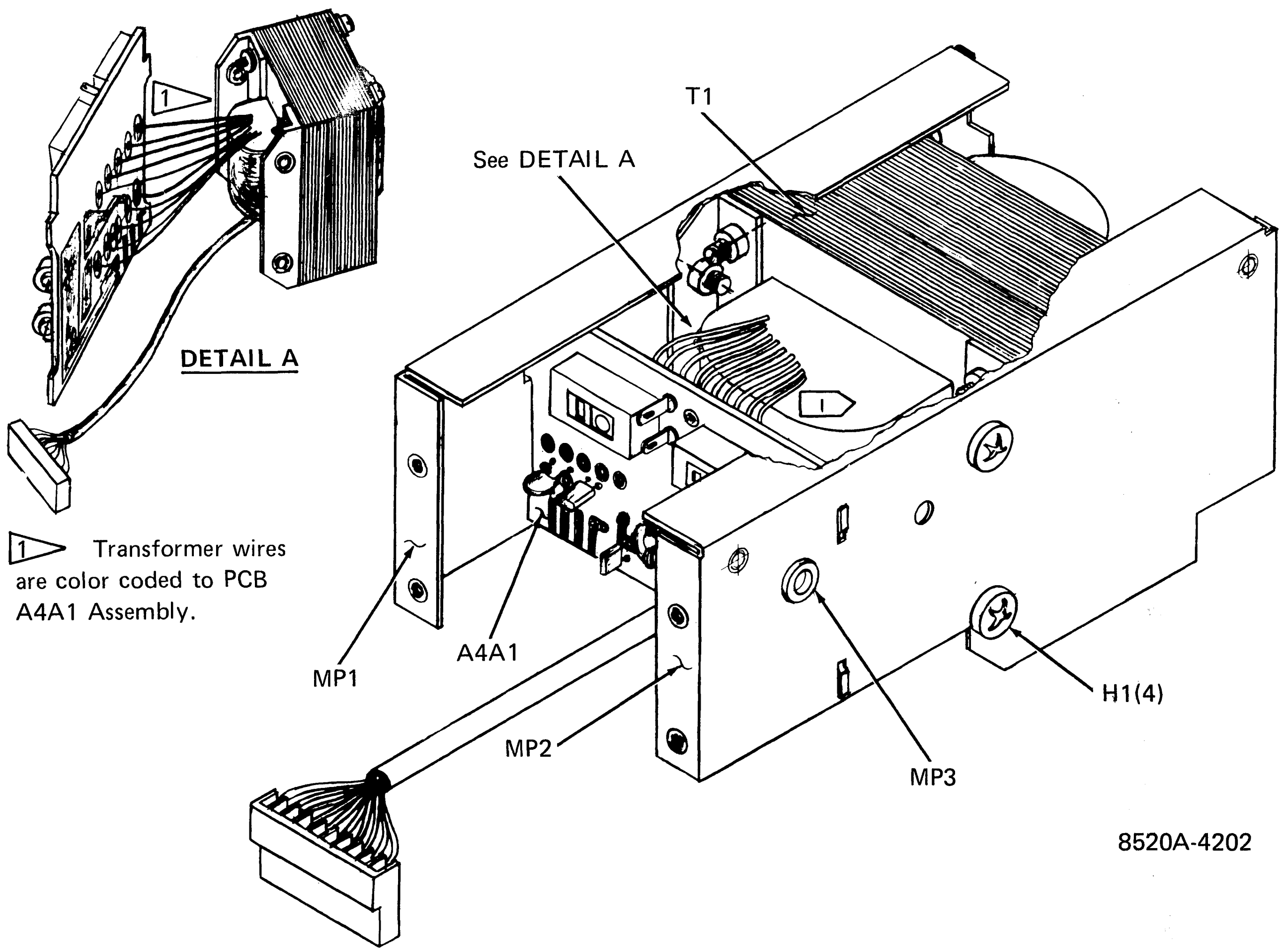
Figure 6-5B. A3A1 Ref Amp PCB Assembly (Vertical)

TABLE 6-6. A4 TRANSFORMER ASSEMBLY
(SEE FIGURE 6-6.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	---------DESCRIPTION---------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
A 1	*	TRANSFORMER PCB ASSEMBLY	496844	89536	496844	1		
H 1		SCREW,MACH,PHP,STL,8-32X1/4	228890	89536	228890	4		
MP 1		BRACKET,TRANSFORMER FRONT	491118	89536	491118	1		
MP 2		BRACKET,TRANSFORMER REAR	491126	89536	491126	1		
MP 3		GROMMET, RUBBER	100065	83330	2174	1		
T 1		TRANSFORMER	490797	89536	490797	1		

TABLE 6-7. A4A1 TRANSFORMER PCB ASSEMBLY
(SEE FIGURE 6-6.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	---------DESCRIPTION---------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1, 2		CAP,CER,0.22UF,+-20%,50V,Z5U	309849	71590	CW3COC224K	2	1	
C 3		CAP,CER,1.0UF,+-20%,50V,Z5U	436782	72982	8131-050-601-105M	1		
CR 1, 2	*	DIODE,SI, 100 PIV, 22.0 AMP	325746	04713	MR751	2	1	
L 1		COMMON MODE CHOKE .200 MH	491043	89536	491043	1		
P 1, 2		TERM,FASTON,TAB,SOLDR,0.110 WIDE	512889	02660	62395	2	1	
RV 1		VARISTOR,33V,+-10%,1.0MA	485391	89536	485391	1	1	
RV 2		VARISTOR,22V,+-20%,1.0MA	500777	03508	V22ZA1	1		
SW 1, 2		SWITCH,SLIDE,DPDT,POWER	234278	89536	234278	2		



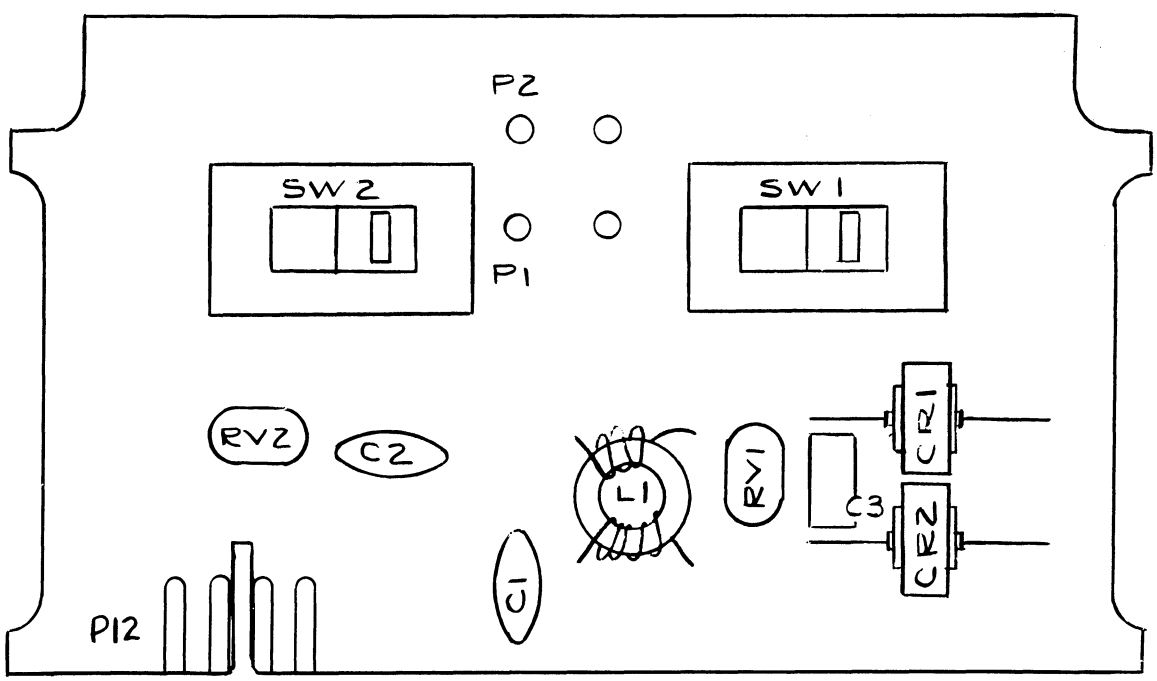


Figure 6-6. A4 Transformer Assembly

Section 7
General Information

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

List of Abbreviations and Symbols

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

Federal Supply Codes for Manufacturers

D9816
Westermann Wilhelm Augusta-Anlage
Mannheim-Nackarau Germany

00199
Marcon Electronics Corp
Kearny, New Jersey

00213
Nytronics Comp. Group Inc.
Darrlingon, South Carolina

00327
Welwyn International Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors Inc.
Passaic, New Jersey

00779
AMP, Inc.
Harrisburg, Pennsylvania

01121
Allen Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronics & Defense Sector
Lawndale, California

01295
Texas Instruments Inc.
Semiconductor Group
Dallas,Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

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

01884
Sprague Electric Co.
(Now 56289)

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

02111
Spectrol Electronics Corp.
City of Industry, California

02114
Amperex Electronic Corp.
Ferrox Cube Div.
Saugerties, New York

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

02395
Sonar Radio Corp.
Hollywood, Florida

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

02606
Fenwal Labs
Division of Travenal Labs
Morton Grove, Illinois

0266
Bunker Ramo-Eltra Corp.
Amphenol NA Div.
Broadview, Illinois

02735
RCA-Solid State Div.
Somerville, New Jersey

02799
Arco Electronics Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products& Batteries
Auburn, New York

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

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

03888
KDI Electronics Inc.
Pyrofilm Div.
Whippany, New Jersey

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

03980
Muirhead Inc.
Mountainside, New Jersey

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

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

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

04222
AVX Corp.
AVX Ceramics Div.
Myrtle Beach, S. Carolina

04423
Telonic Berkley Inc.
Laguna Beach, California

04713
Motorola Inc.
Semiconductor Group
Phoenix, Arizona

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Corcom Inc.
Libertyville, Illinois

05276
ITT Pomona
Electronics Div.
Pomona, California

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

05397
Union Carbide Corp.
Materials Systems Div.
Cleveland. Ohio

05571
Sprague Electric Co.
(Now 56289)

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

05820
EG & G Wakefield Engineering
Wakefield, Massachusetts

05972
Loctite Corp.
Newington, Connecticut

06001
General Electric Co.
Electric Capacitor Product Section
Columbia, S. Carolina

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

06192
La Deau Mfg. Co.
Glendale, California

06229
Electrovert Inc.
Elmsford, New York

06383
Panduit Corp.
Tinley Park, Illinois

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

06555
Beede Electrical Instrument
Penacook, New Hampshire

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

06666
General Devices Co. Inc.
Indianapolis, Indiana

06739
Electron Corp.
Littleton, Colorado

06743
Gould Inc.
Foil Div.
Eastlake, Ohio

06751
Components Inc.
Semcor Div.
Phoenix, Arizona

06776
Robinson Nugent Inc.
New Albany, Indiana

06915
Richco Plastic Co.
Chicago, Illinois

06961
Vernitron Corp.
Piezo Electric Div.
Bedford, Ohio

06980
Varian Associates Inc.
Eimac Div.
San Carlos, California

07047
Ross Milton Co., The
Southampton, Penna.

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

07233
Benchmark Technology Inc.
City of Industry, Calif.

07239
Biddle Instruments
Blue Bell, Penna.

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

07261
Avnet Corp.
Culver City, California

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

07344
Bircher Co. Inc., The
Rochester, New York

Federal Supply Codes for Manufacturers (cont)

07557
Campion Co. Inc.
Philadelphia, Penna.

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

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

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07810
Bock Corp.
Madison, Wisconsin

07933
Raytheon Co.
Semiconductor Div.
Mountain View, Calif.

08235
Industro Transistor Corp.
Long Island City, New York

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

08530
Reliance Mica Corp.
Brooklyn, New York

08718
ITT Cannon Electric
Phoenix Div.
Phoenix, Arizona

08806
General Electric Co.
Minature Lamp Products
Cleveland, Ohio

08863
Nylomatic
Fallsington, Penna.

08988
Skottie Electronics Inc.
Archbald, Pennsylvania

09021
Airco Inc.
Airco Electronics
Bradford, Penna.

09023
Cornell-Dublier Electronics
Fuquay-Varina, N. Carolina

09214
General Electric Co.
Semiconductor Products Dept.
Auburn, New York

09353
C and K Components Inc.
Newton, Massachusetts

09423
Scientific Components Inc.
Santa Barbara, California

09579
CTS of Canada, Ltd
Streetsville, Ontario

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, South Dakota

09975
Burroughs Corp.
Electronics Components
Detroit, Michigan

10059
Barker Engineering Corp.
Kenilworth, New Jersey

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

10582
CTS of Asheville
Skyland, N. Carolina

11236
CTS Corp.
Berne Div.
Berne, Indiana

11237
CTS Corp of California
Paso Robles Div.
Paso Robles, California

11295
ECM Motor Co.
Schaumburg, Illinois

11358
Columbia Broadcasting System
CBS Electronic Div.
Newburyport, Massachusetts

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

11502
TRW Inc.
TRW Resistive Products Div.
Boone, North Carolina

11503
Keystone Columbia Inc.
Freemont, Indiana

11532
Teledyne Relays Teledyne
Industries Inc.
Hawthorne, California

11711
General Instrument Corp.
Rectifier Div.
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Naperville, Illinois

12040
National Semiconductor Corp.
Danbury, Connecticut

12060
Diodes Inc.
Northridge, California

12136
PHC Industries Inc.
Formerly Philadelphia Handle Co.
Camden, New Jersey

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

12323
Practical Automation Inc.
Shelton, Connecticut

12327
Freeway Corp.
Cleveland, Ohio

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

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

12615
US Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co. Inc.
Dover, New Hampshire

12749
James Electronic Inc.
Chicago, Illinois

12856
MicroMetals Inc.
Anaheim, California

12881
Metex Corp.
Edison, New Jersey

12895
Cleveland Electric Motor Co.
Cleveland, Ohio

12954
Microsemi Corp.
Components Group
Scottsdale, Arizona

12969
Unitrode Corp.
Lexington, Massachusetts

13050
Potter Co.
Wesson, Mississippi

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

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

13606
Sprague Electric Co.
(Use 56289)

13689
SPS Technologies Inc.
Hatfield, Pennsylvania

13919
Burr-Brown Research Corp.
Tucson, Arizona

14099
Semtech Corp.
Newbury Park, California

14140
McGray-Edison Co.
Commercial Development Div.
Manchester, New Hampshire

14193
Cal-R-Inc.
Santa Monica, California

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

14298
ACIC Inc.
Sub of Insilco Corp.
Research Triangle Park, NC

14329
Wells Electronics Inc.
South Bend, Indiana

14482
Watkins-Johnson Co.
Palo Alto, California

14552
Microsemi Corp.
Santa Ana, California

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

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

14752
Electro Cube Inc.
San Gabriel, California

14936
General Instrument Corp.
Discrete Semi Conductor Div.
Hicksville, New York

14949
Trompeter Electronics
Chatsworth, California

15412
Amtron
Midlothian, Illinois

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

15636
Elec-Trol Inc.
Saugus, California

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

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

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

15849
Useco Inc.
(Now 88245)

15898
International Business
Machines Corp.
Essex Junction, Vermont

16245
Conap Inc.
Olean, New York

16258
Space-Lok Inc.
Burbank, California

16352
Codi Corp.
Linden, New Jersey

16469
MCL Inc.
LaGrange, Illinois

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

16733
Cablewave Systems Inc.
North Haven, Connecticut

16742
Paramount Plastics
Fabricators Inc.
Downey, California

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

17069
Circuit Structures Lab
Burbank, California

17117
Electronic Molding Corp.
Woonsocket, Rhode Island

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

17545
Atlantic Semiconductors Inc.
Asbury Park, New Jersey

17745
Angstrohm Precision, Inc.
Hagerstown, Maryland

17856
Siliconix Inc.
Santa Clara, California

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

18324
Signetics Corp.
Sacramento, California

18520
Sharp Electronics Corp.
Paramus, New Jersey

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

18565
Chomerics Inc.
Woburn, Massachusetts

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

18632
Norton-Chemplast
Santa Monica, California

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

18736
Voltronics Corp.
East Hanover, New Jersey

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

19315
Bendix Corp., The
Navigation & Control Group
Terboro, New Jersey

19451
Perine Machinery & Supply Co..
Kent, Washington

19613
Minnesota Mining & Mfg. Co.
Textool Products Dept.
Electronic Product Div.
Irving, Texas

19647
Caddock Electronics Inc.
Riverside, California

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

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Cosar Corp.
Dallas, Texas

21317
Electronics Applications Co.
El Monte, California

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Semiconductor Group
Rivera Beach, Florida

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

22767
ITT Semiconductors
Palo Alto, California

22784
Palmer Inc.
Cleveland, Ohio

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Applied Sciences Inc.
Rockville, Maryland

23880
Stanford Applied Engineering
Santa Clara, California

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

24347
Penn Engineering Co.
S. El Monte, California

24355
Analog Devices Inc.
Norwood, Massachusetts

24444
General Semiconductor
Industries, Inc.
Tempe, Arizona

24655
Genrad Inc.
Concord, Massachusetts

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

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

24931
Specialty Connector Co.
Greenwood, Indiana

25088
Siemen Corp.
Isilen, New Jersey

25099
Cascade Gasket
Kent, Washington

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

25706
Daburn Electronic & Cable Corp.
Norwood, New Jersey

26629
Frequency Sources Inc.
Sources Div.
Chelmsford, Massachusetts

26806
American Zettler Inc.
Irvine, California

27014
National Semiconductor Corp.
Santa Clara, California

27167
Corning Glass Works Corning
Electronics
Wilmington, North Carolina

27264
Molex Inc.
Lisle, Illinois

27440
Industrial Screw Products
Los Angeles, California

Federal Supply Codes for Manufacturers (cont)

27745
Associated Spring Barnes Group Inc.
Syracuse, New York

27956
Relcom (Now 14482)

28198
Positronic Industries
Springfield, Missouri

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

28425
Serv-O-Link
Euless, Texas

28478
Deltrol Corporation
Deltrol Controls Div.
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28484
Emerson Electric Co.
Gearmaster Div.
McHenry, Illinois

28520
Heyco Molded Products
Kenilworth, New Jersey

29083
Monsanto Co.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

29907
Omega Engineering Inc.
Stamford, Connnecticut

30035
Jolo Industries Inc.
Garden Grove, California

30146
Symbex Corp.
Painesville, Ohio

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30161
Aavid Engineering Inc.
Laconia, New Hampshire

30315
Itron Corp.
San Diego, California

30323
Illinois Tool Works Inc.
Chicago, Illinois

30800
General Instrument Corp.
Capacitor Div.
Hicksville, New York

31019
Solid State Scientific Inc.
Willow Grove, Pennsylvania

31091
Alpha Industries Inc.
Microelectronics Div.
Hatfield, Pennsylvania

31323
Metro Supply Company
Sacramento, California

31448
Army Safeguard Logistics Command
Huntsville, Alabama

31746
Cannon Electric
Woodbury, Tennessee

31827
Budwig
Ramona, California

31918
ITT-Schadow
Eden Prairie, Minnesota

32293
Intersil
Cupertino, California

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

32559
Bivar
Santa Ana, California

32767
Griffith Plastics Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

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

32997
Bourns Inc.
Trimpot Div.
Riverside, California

33096
Colorado Crystal Corp.
Loveland, Colorado

33173
General Electric Co.
Owensboro, Kentucky

33246
Epoxy Technology Inc.
Billerica, Massachusetts

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

33919
Nortek Inc.
Cranston, Rhode Island

34333
Silicon General Inc.
Garden Grove, California

34225
Advanced Micro Devices
Sunnyvale, California

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

34371
Harris Corp.
Harris Semiconductor
Products Group
Melbourne, Florida

34649
Intel Corp.
Santa Clara, California

34802
Electromotive Inc.
Kenilworth, New Jersey

34848
Hartwell Special Products
Placentia, California

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

36665
Mitel Corp.
Kanata, Ontario, Canada

37942
Mallory Capacitor Corp.
Sub of Emhart Industries
Indianapolis, Indiana

39003
Maxim Industries
Middleboro, Massachusetts

40402
Roderstein Electronics Inc.
Statesville, North Carolina

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.(Now 53342)

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Executive Offices
Lexington, Massachusetts

50088
Thomson Components-Mostek Corp.
Carrollton, Texas

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

50157
Midwest Components Inc.
Muskegon, Mississippi

50541
Hypertronics Corp.
Hudson, Massachusetts

50579
Litronix Inc.
Cupertino, California

51167
Aries Electronics Inc.
Frenchtown, New Jersey

51372
Verbatim Corp.
Sunnyvale, California

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

51499
Amtron Corp.
Boston, Massachusetts

51605
CODI Semiconductor Inc.
Kenilworth, New Jersey

51642
Centre Engineering Inc.
State College, Pennsylvania

51791
Statek Corp.
Orange, California

51984
NEC America Inc.
Falls Church, Virginia

52063
Exar Integrated Systems
Sunnyvale, California

52072
Circuit Assembly Corp.
Irvine, California

52152
Minnesota Mining & Mfg.
Saint Paul, Minnesota

52333
API Electronics
Haugpauge,Long Island,New York

Federal Supply Codes for Manufacturers (cont)

52361
Communication Systems
Piscataway, New Jersey

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

52531
Hitachi Magnetics
Edmore, Missouri

52745
Timco
Los Angeles, California

52763
Stettner-Electronics Inc.
Chattanooga, Tennessee

52769
Sprague-Goodman Electronics Inc.
Garden City Park, New York

52771
Moniterm Corp.
Amatrom Div.
Santa Clara, California

52840
Western Digital Corp.
Costa Mesa, California

53021
Sangamo Weston Inc.
(See 06141)

53217
Technical Wire Products Inc.
Santa Barbara, California

53342
Opt Industries Inc.
Phillipsburg, New Jersey

53944
Glow-Lite
Pauls Valley, Oklahoma

54294
Shallcross Inc.
Smithfield, North Carolina

54453
Sullins Electronic Corp.
San Marcos, California

54473
Matsushita Electric Corp.
(Panasonic)
Secaucus, New Jersey

54583
TDK
Garden City, New York

54869
Piher International Corp.
Arlington Heights, Illinois

54937
DeYoung Mfg.
Bellevue, Washington

54590
RCA Corp.
Electronic Components Div.
Cherry Hill, New Jersey

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

55112
Plessey Capacitors Inc.
(Now 60935)

55261
LSI Computer Systems Inc.
Melville, New York

55285
Bercquist Co.
Minneapolis, Minnesota

55576
Synertek
Santa Clara, California

55680
Michicon/America/Corp.
Schaumburg, Illinois

56282
Utek Systems Inc.
Olathe, Kansas

56289
Sprague Electric Co.
North Adams, Massachusetts

56365
Square D Co.
Corporate Offices
Palatine, Illinois

56375
DAL Industries Inc.
Wescorp Div.
Mountain View, California

56481
Shugart Associates
Sub of Xerox Corp.
Sunnyvale, California

56708
Zilog Inc.
Campbell, California

56856
Vamistor Corp. of Tennessee
Sevierville, Tennessee

56880
Magnetics Inc.
Baltimore, Maryland

57026
Endicott Coil Co. Inc.
Binghamton, New York

57053
Gates Energy Products
Denver, Ohio

58014
Hitachi Magnalock Corp.
(Now 12581)

58104
Simco
Atlanta, Georgia

58474
Superior Electric Co.
Bristol, Connecticut

59124
KOA-Speer Electronics Inc.
Bradford, Pennsylvania

59640
Supertex Inc.
Sunnyvale, California

59660
Tusonix Inc.
Tucson, Arizona

59730
Thomas and Betts Corp.
Iowa City, Iowa

59831
Semtronics Corp.
Watchung, New Jersey

60395
Xicor Inc.
Milpitas, California

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

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

60935
Westlake Capacitor Inc.
Tantalum Div.
Greencastle, Indiana

61804
M/A Com Inc.
Burlington, Massachusetts

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

61935
Schurter Inc.
Petaluma, California

62351
Apple Rubber
Lancaster, New York

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

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

64154
Lamb Industries
Portland, Oregon

64155
Linear Technology
Milpitas, California

64834
West M G Co.
San Francisco, Calif.

65092
Sangamo Weston Inc.
Weston Instruments Div.
Newark, New Jersey

65940
Rohm Corp & Whatney
Irvine, California

65964
Evox Inc.
Bannockburn, Illinois

66150
Entron Inc.
Winslow Teltronics Div.
Glendale, New York

66608
Bering Industries
Fremont, California

70290
Almetal Universal Joint Co.
Cleveland, Ohio

70485
Atlantic India Rubber Works Inc.
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Co. Inc.
Farmingdale, New York

71034
Bliley Electric Co.
Erie, Pennsylvania

71183
Westinghouse Electric Corp.
Bryant Div.
Bridgeport, Connecticut

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

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Div. of ITT
Fountain Valley, California

71482
General Instrument Corp.
Clare Div.
Chicago, Illinois

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

71707
Coto Corp.
Providence, Rhode Island

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

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

71984
Dow Corning Corp.
Midland, Michigan

72005
AMAX Specialty Metals Corp.
Newark, New Jersey

72136
Electro Motive Mfg. Corp.
Florence, South Carolina

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

72259
Nytronics Inc.
New York, New York

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

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

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

72928
Gulton Industries Inc.
Gudeman Div.
Chicago, Illinois

72982
Murata Erie N. America Inc.
Erie, Pennsylvania

73138
Beckman Industrial corp.
Helipot Div.
Fullerton, California

73168
Fenwal Inc.
Ashland, Massachusetts

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

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carlingswitch Inc.
Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cold Spring, Kentucky

73893
Microdot
Mt. Clemens, Mississippi

73899
JFD Electronic Components
Div. of Murata Erie
Oceanside, New York

73905
FL Industries Inc.
San Jose, California

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quam Nichols Co.
Chicago, Illinois

74217
Radio Switch Co.
Marlboro, New Jersey

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

74542
Hoyt Elect.Instr. Works Inc.
Penacook, New Hampshire

74840
Illinois Capacitor Inc.
Lincolnwood, Illinois

74970
Johnson EF Co.
Waseca, Minnesota

75042
TRW Inc.
IRC Fixed Resistors
Philadelphia, Pennsylvania

75297
Litton Systems
Kester Solder Div.
Chicago, Illinois

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

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

75915
Tracor Littlefuse
Des Plaines, Illinois

76854
Oak Switch Systems Inc.
Crystal Lake, Illinois

77122
TRW Assemblies & Fasteners Group
Fastener Div.
Moutainside, New Jersey

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

77542
Ray-O-Vac Corp
Madison, Wisconsin

77638
General Instrument Corp.
Rectifier Div.
Brooklyn, New York

77900
Shakeproof Lock Washer Co.
(Now 78189)

77969
Rubbercraft Corp. of CA Ltd.
Torrance, California

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

78277
Sigma Instruments Inc.
South Braintree, Mass.

78290
Struthers Dunn Inc.
Pitman, New Jersey

78553
Eaton Corp.
Engineered Fastener Div.
Cleveland, Ohio

78592
Stoeger Industries
South Hackensack, New Jersey

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Co.
Goshen, Indiana

79727
C - W Industries
Southampton, Pennsylvania

79963
Zierick Mfg. Corp.
Mount Kisco, New York

80009
Tektronix
Beaverton, Oregon

80031
Mepco/Electra Inc.
Morristown, New Jersey

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

80145
LFE Corp.
Process Control Div.
Clinton, Ohio

80183
Sprague Products
(Now 56289)

80294
Bourns Instruments Inc.
Riverside, California

80583
Hammerlund Mfg. Co. Inc.
Paramus, New Jersey

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

81073
Grayhill Inc.
La Grange, Illinois

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

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Electronics Inc.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82227
Airpax Corp.
Cheshire Div.
Cheshire, Connecticut

82240
Simmons Fastner Corp.
Albany, New York

Federal Supply Codes for Manufacturers (cont)

82305
Palmer Electronics Corp.
South Gate, California

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

82415
Airpax Corp
Frederick Div.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Custom Div.
Woodstock, New York

82879
ITT
Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83014
Hartwell Corp.
Placentia, California

83055
Signalite Fuse Co.
(Now 71744)

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

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

83298
Bendix Corp.
Electric & Fluid Power Div.
Eatonville, New Jersey

83315
Hubbell Corp.
Mundelein, Illinois

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

83478
Rubbercraft Corp. of America
West Haven, Connecticut

83553
Associated Spring Barnes Group
Gardena, California

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

84171
Arco Electronics
Commack, New York

84411
American Shizuki
TRW Capacitors Div.
Ogallala, Nebraska

84613
FIC Corp.
Rockville, Maryland

84682
Essex Group Inc.
Peabody, Massachusetts

85367
Bearing Distributing Co.
San Fransisco, California

85372
Bearing Sales Co.
Los Angeles, California

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

85932
Electro Film Inc.
Valencia, California

86577
Precision Metal Products Co.
Peabody, Massachusetts

86684
Radio Corp. of America
(Now 54590)

86928
Seastrom Mfg. Co. Inc.
Glendale, California

87034
Illuminated Products Inc.
(Now 76854)

88219
GNB Inc.
Industrial Battery Div.
Langhorne, Pennsylvania

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

88486
Triangle PWC Inc.
Jewitt City, Connecticut

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

89020
Amerace Corp.
Buchanan Crimptool Products Div.
Union, New Jersey

89265
Potter-Brumfield
(See 77342)

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

89597
Fredericks Co.
Huntingdon Valley, Penna.

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

89730
General Electric
Lamp Div.
Newark, New Jersey

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

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

90303
Duracell Inc.
Technical Sales & Marketing
Bethel, Connecticut

91094
Essex Group Inc.
Suflex/IWP Div.
Newmarket, New Hampshire

91247
Illinois Transformer Co.
Chicago, Illinois

91293
Johanson Mfg. Co.
Boonton, New Jersey

91462
Alpha Industries Inc.
Logansport, Indiana

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91507
Froeliger Machine Tool Co.
Stockton, California

91637
Dale Electronics Inc.
Columbus, Nebraska

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

91737
ITT Cannon/Gremar
(Now 08718)

91802
Industrial Devices Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

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

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co.
Woonsocket, Rhode Island

91984
Maida Development Co.
Hampton, Virginia

91985
Norwalk Valve Co.
S. Norwalk, Connecticut

92914
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

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

94222
Southco Inc.
Concordville, Pennsylvania

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

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

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

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

Federal Supply Codes for Manufacturers (cont)

95573
Campion Laboratories Inc.
Detroit, Michigan

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

95987
Weckesser Co. Inc.
(Now 85480)

96733
SFE Technologies
San Fernando, California

96853
Gulton Industries Inc.
Measurement & Controls Div.
Manchester, New Hampshire

96881
Thomson Industries Inc.
Port Washington, New York

97525
EECO Inc.
Santa Ana, California

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

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Pennwalt Corp.
SS White Industrial Products
Piscataway, New Jersey

97966
CBS
Electronic Div.
Danvers, Massachusetts

98094
Machlett Laboratories Inc.
Santa Barbara. California

98159
Rubber-Teck Inc.
Gardena, California

98278
Malco A Microdot Co.
South Pasadena, California

98291
Sealectro Corp.
BICC Electronics
Trumbill, Connecticut

98372
Royal Industries Inc.(Now 62793)

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

99120
Plastic Capacitors Inc.
Chicago, Illinois

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

99378
ATLEE of Delaware Inc.
N. Andover, Massachusetts

99392
Mepco/Electra Inc.
Roxboro Div.
Roxboro, North Carolina

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

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

99800
American Precision Industries
Delevan Div.
East Aurora, New York

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

U.S. SALES OFFICE AREAS

AL, Huntsville
John Fluke Mfg. Co., Inc.
4920J Corporate Drive
Huntsville, AL 35805-6202
(205) 837-0581

AZ, Phoenix
John Fluke Mfg. Co., Inc.
2211 S. 48th Street
Suite B
Tempe, AZ 85282
(602) 438-8314

Tucson
(602) 790-9881

CA, Southern
John Fluke Mfg. Co., Inc.
P.O. Box 19676
Irvine, CA 92713-9676
16969 Von Karman
Suite 100
Irvine, CA 92714
(714) 863-9031

Burbank
John Fluke Mfg. Co., Inc.
2020 N. Lincoln Street
Burbank, CA 91504
(213) 849-7181

Northern
John Fluke Mfg. Co., Inc.
2300 Walsh Ave., Bldg. K
Santa Clara, CA 95051
(408) 727-0513

San Diego
(619) 292-7656

CO, Denver
John Fluke Mfg. Co., Inc.
14180 East Evans Ave.
Aurora, CO 80014
(303) 695-1000

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Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manaul to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

Table 7A-1. Manual Status Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in descending order (by no.), ending with change under desired rev. letter																					
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P	AY						
A1	Display PCB Assembly	516625	+	+	+	+	+	+	X															
A2	Digital Controller PCB Assembly	492828	●	●	+	+	+	+	+	+	+	+	+	+	+	+	X							
A3	Analog PCB Assembly	496836	●	●	+	+	+	+	+	+	+	+	+	+	+	+	+	X						
A3A1	Ref Amp PCB Assembly (Horizontal)	527994	X																					
A3A1	Ref Amp PCB Assembly (Vertical)	530626	X																					
A4A1	Transformer PCB Assembly	496844	●	●	+	+	+	X																

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
— = No revision letter on the PCB.
+ = These revision levels are not documented in this manual.

Section 8
Schematic Diagrams

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NOTES

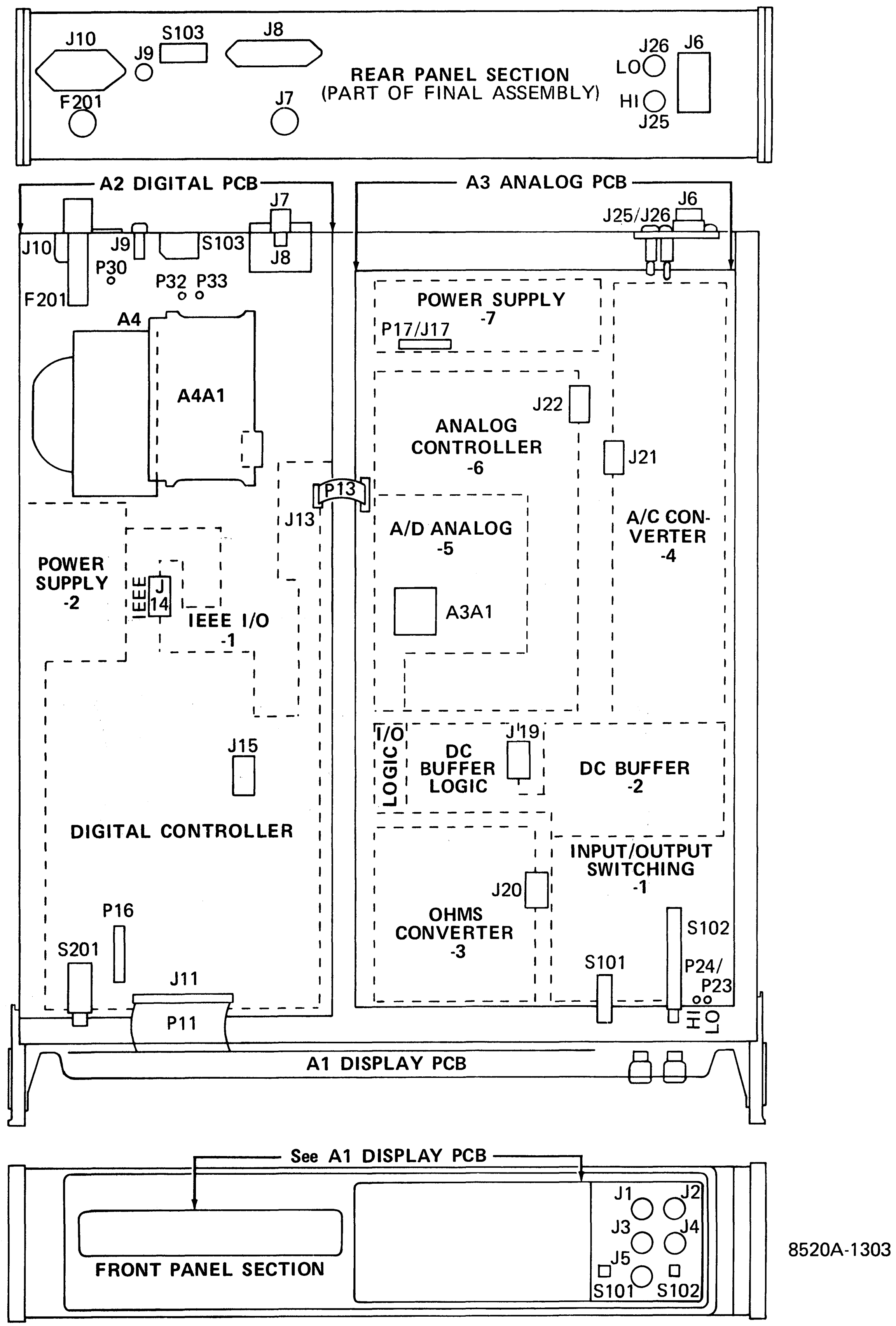
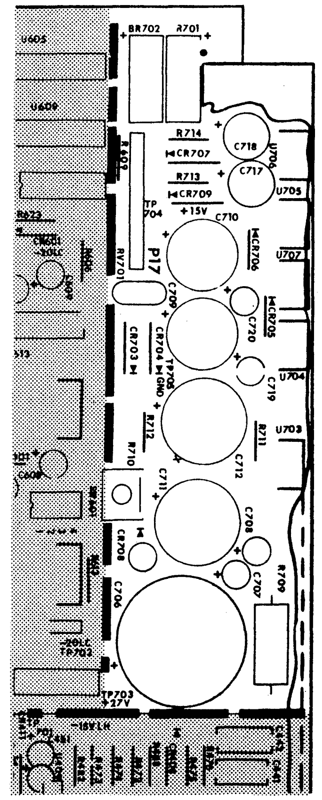
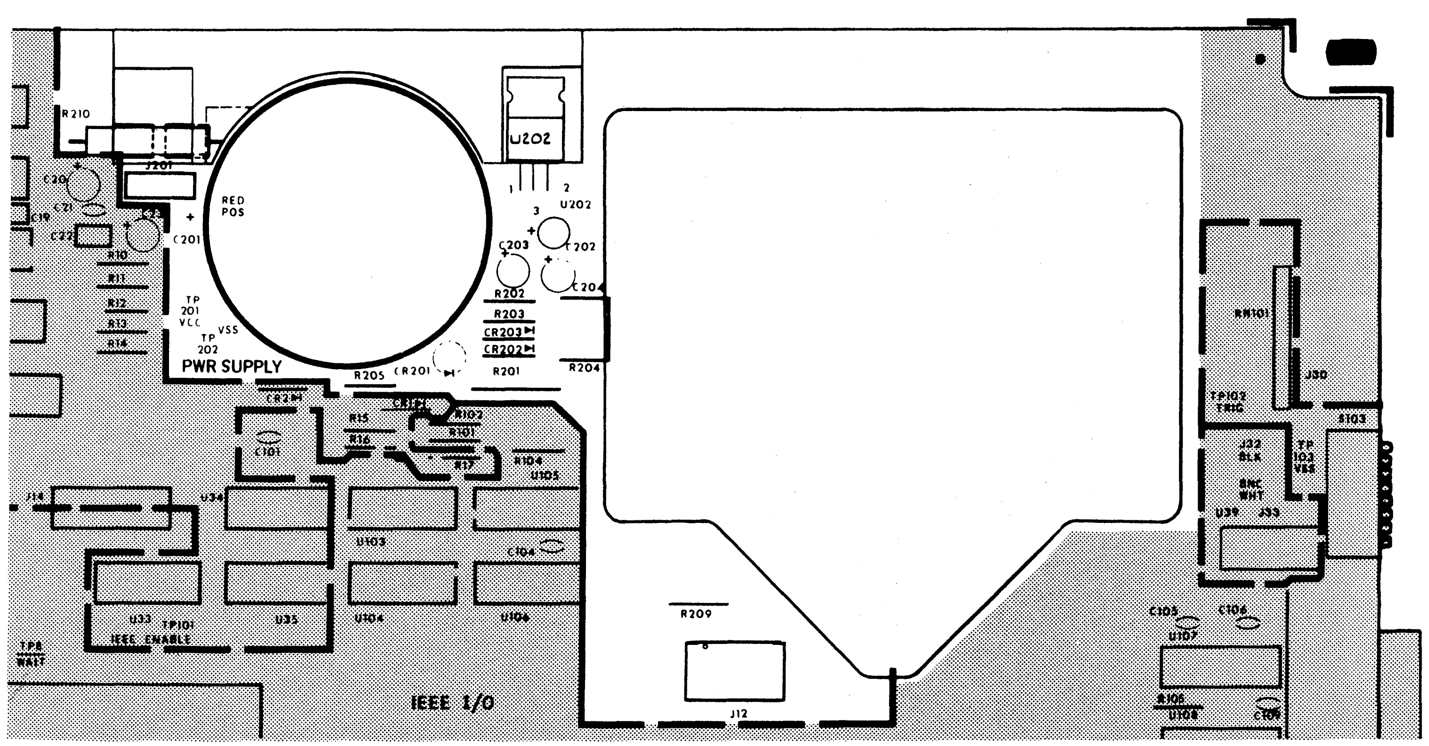


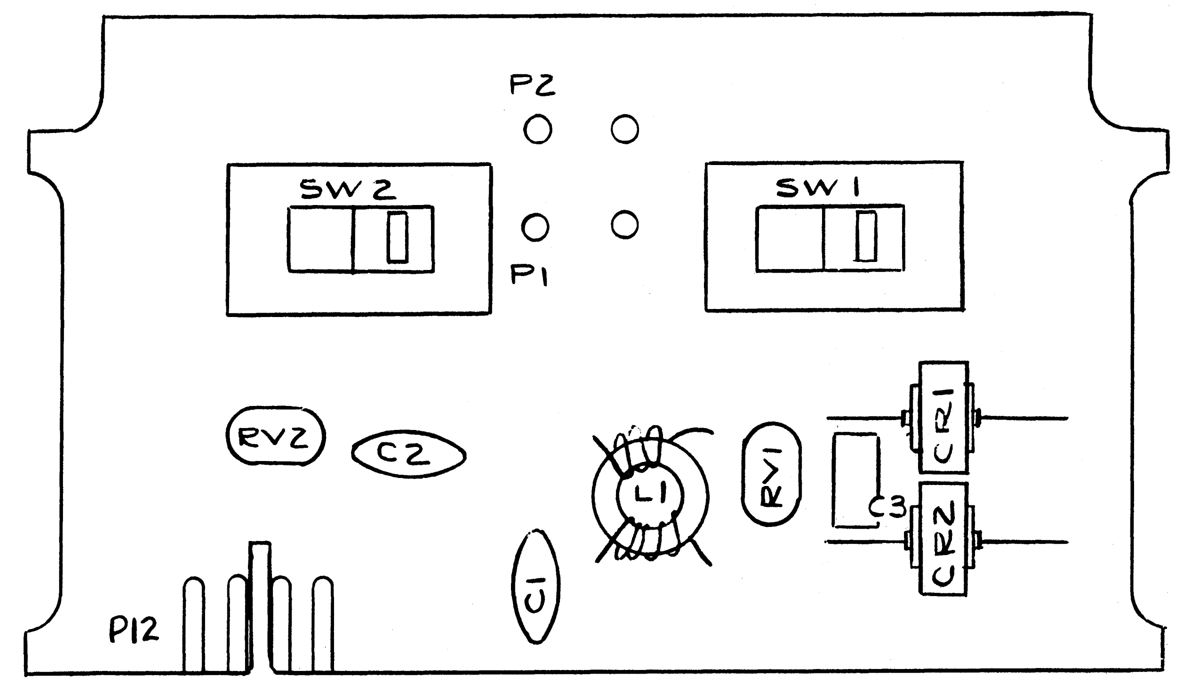
Figure 8-1. Assembly Placement



Part of
8520A-1630

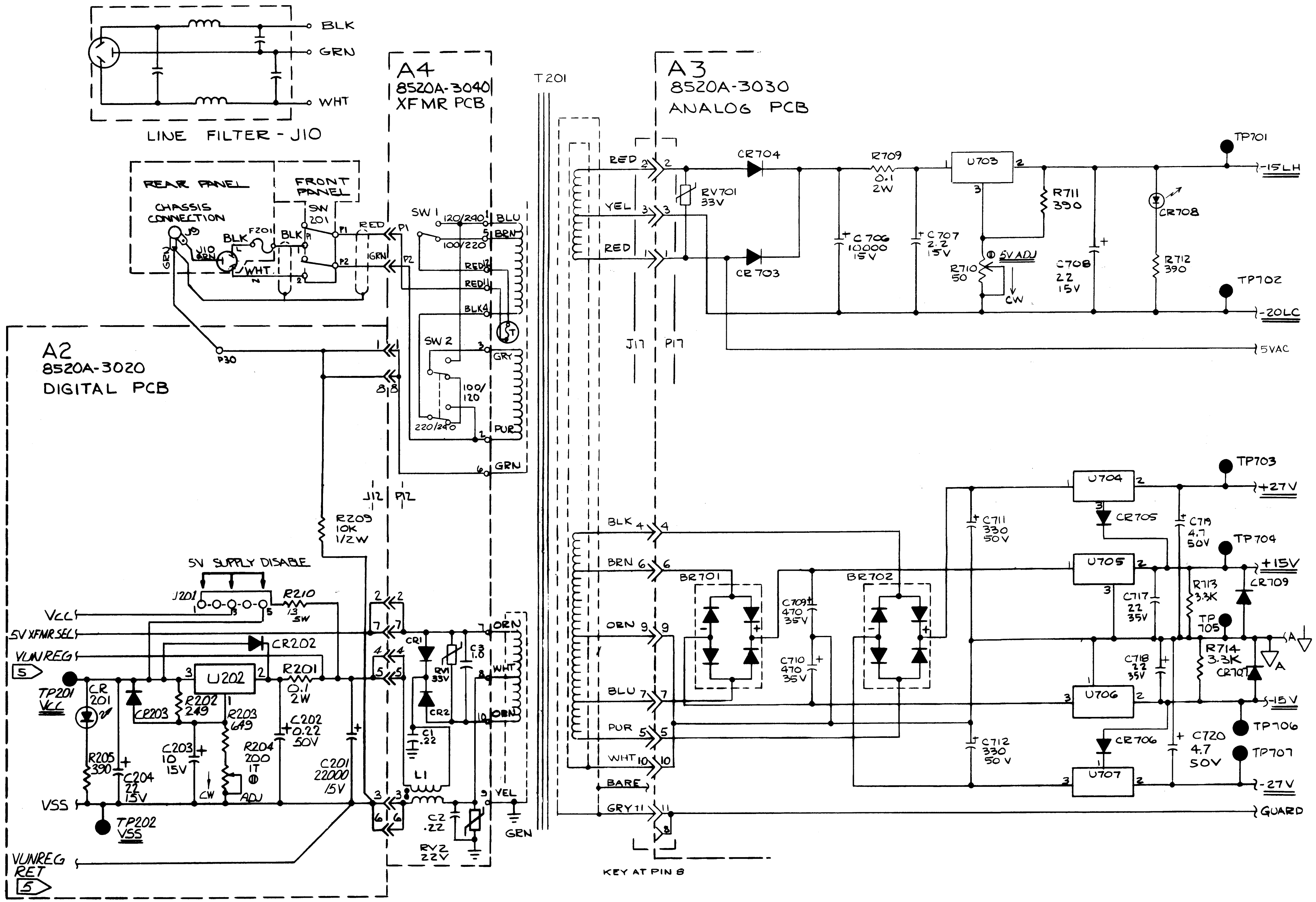


Part of
8520A-1620



8520A-1640

Figure 8-2. Power Supply



NOTES: UNLESS OTHERWISE SPECIFIED:

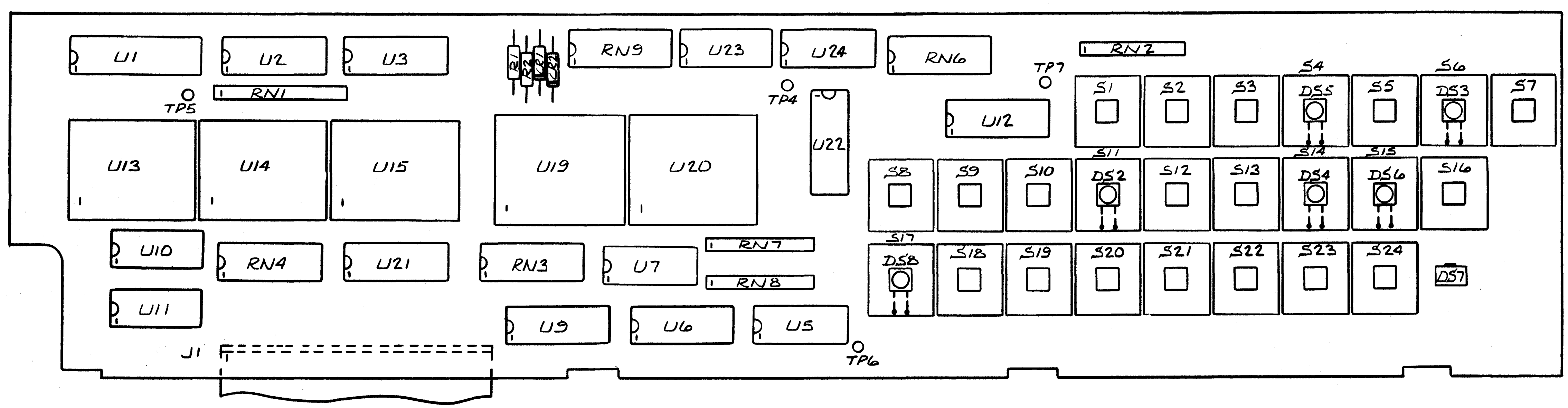
1. ALL RESISTANCE VALUES IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

[5] ONLY TO FRONT PANEL.

VOLTAGE	J19 (DC BUFFER/I/O SW.)	J20 (OHMS)	J21 (AC CONVERTER)	J22 (ANALOG CONTROLLER)
+27 V	7	7	8	7
+15 V	6	6	9	6
−15 V	5	5	10	5
−15LH	4	4	11	4
−20LC	3	3	12	3
−27V	2	2	13	2
	INPUT NO.			

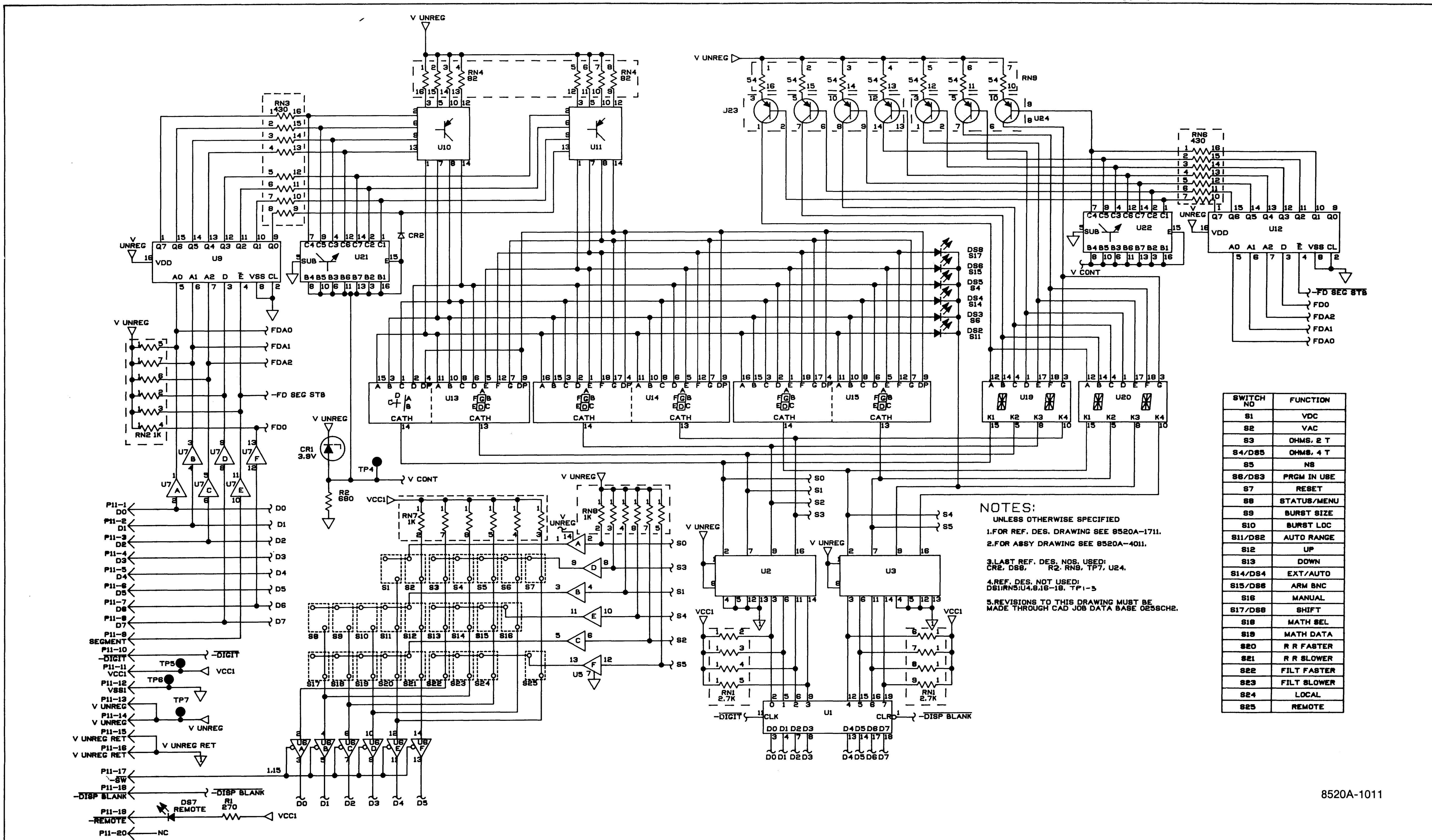
8520A-1023

Figure 8-2. Power Supply (cont)



8520A-1611

Figure 8-3. Display



NOTES:

UNLESS OTHERWISE SPECIFIED

1. FOR REF. DES. DRAWING SEE 8520A-1711.

2. FOR ASSY DRAWING SEE 8520A-4011.

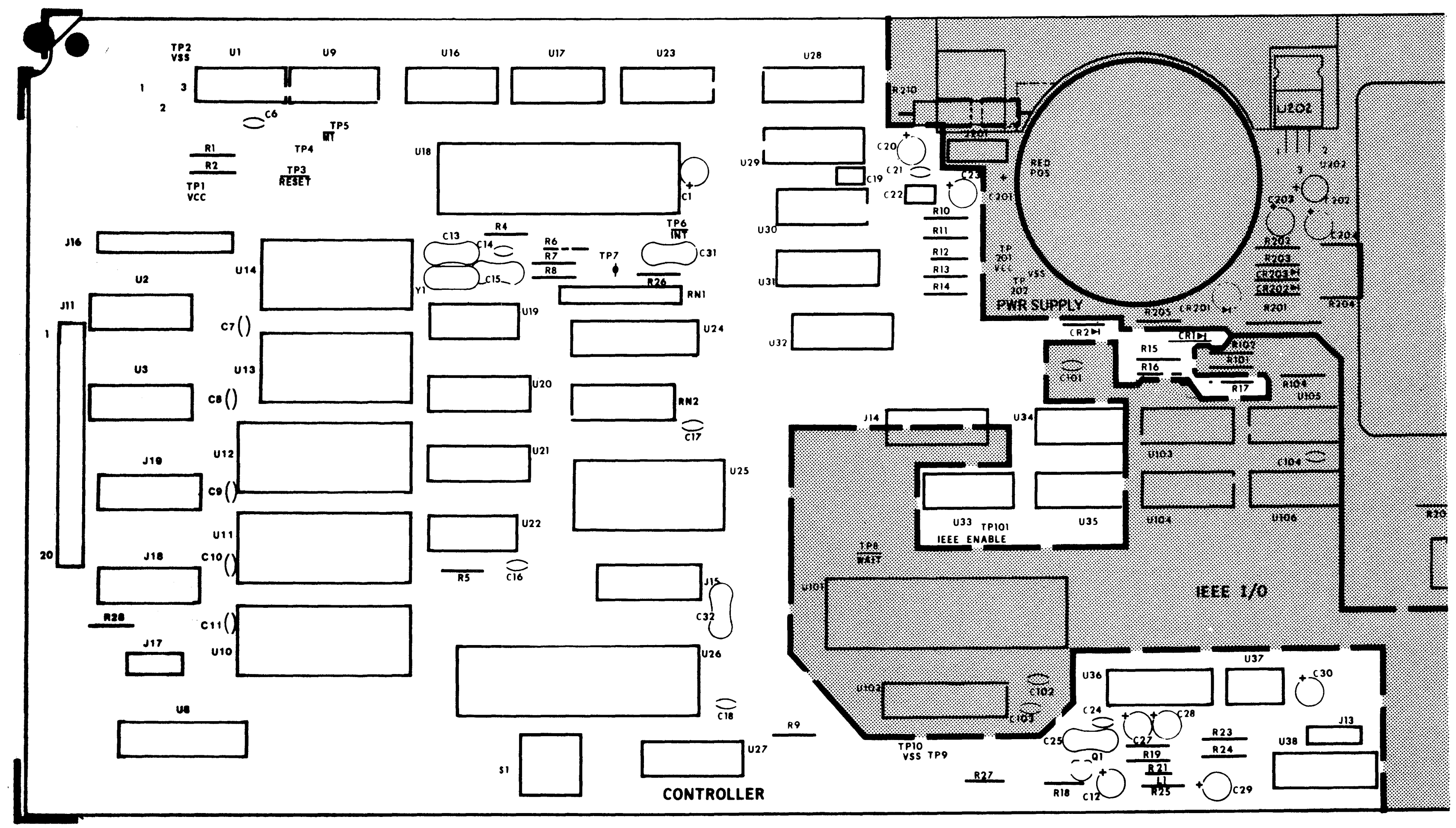
3. LAST REF. DES. NOS. USED:
CR2, DS8, R2, RN9, TP7, U24.

4. REF. DES. NOT USED:
DS1;RN5;U4,8,16-18, TP1-3

5. REVISIONS TO THIS DRAWING MUST BE MADE THROUGH CAD JOB DATA BASE 0258CH2.

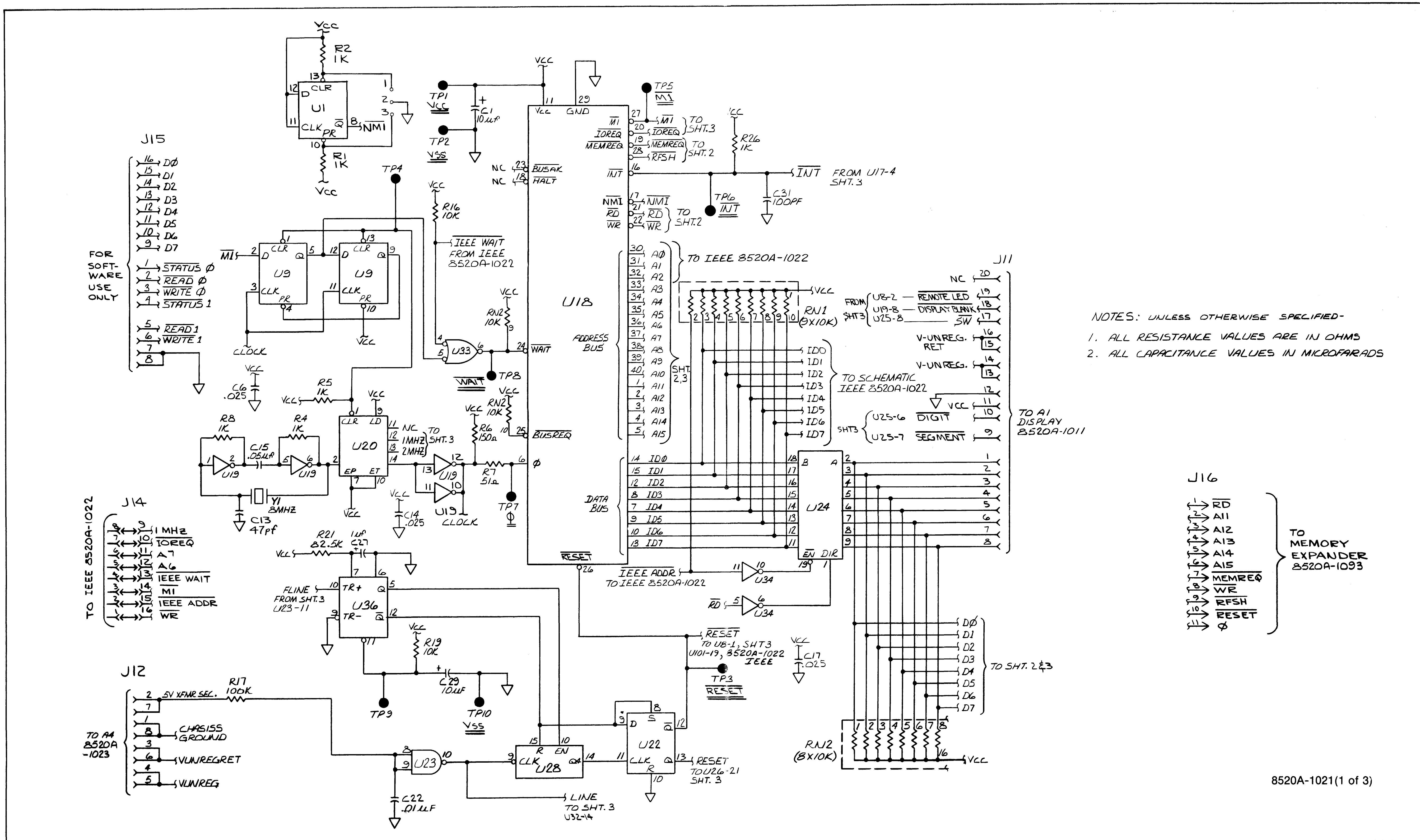
SWITCH NO	FUNCTION
S1	VDC
S2	VAC
S3	OHMS, 2 T
S4/DS5	OHMS, 4 T
S5	NS
S6/DS3	PRGM IN USE
S7	RESET
S8	STATUS/MENU
S9	BURST SIZE
S10	BURST LOC
S11/DS2	AUTO RANGE
S12	UP
S13	DOWN
S14/DS4	EXT/AUTO
S15/DS6	ARM BNC
S16	MANUAL
S17/DS8	SHIFT
S18	MATH SEL
S19	MATH DATA
S20	R R FASTER
S21	R R SLOWER
S22	FILT FASTER
S23	FILT SLOWER
S24	LOCAL
S25	REMOTE

Figure 8-3. Display (cont)



Part of
8520A-1620

Figure 8-4. Digital Controller

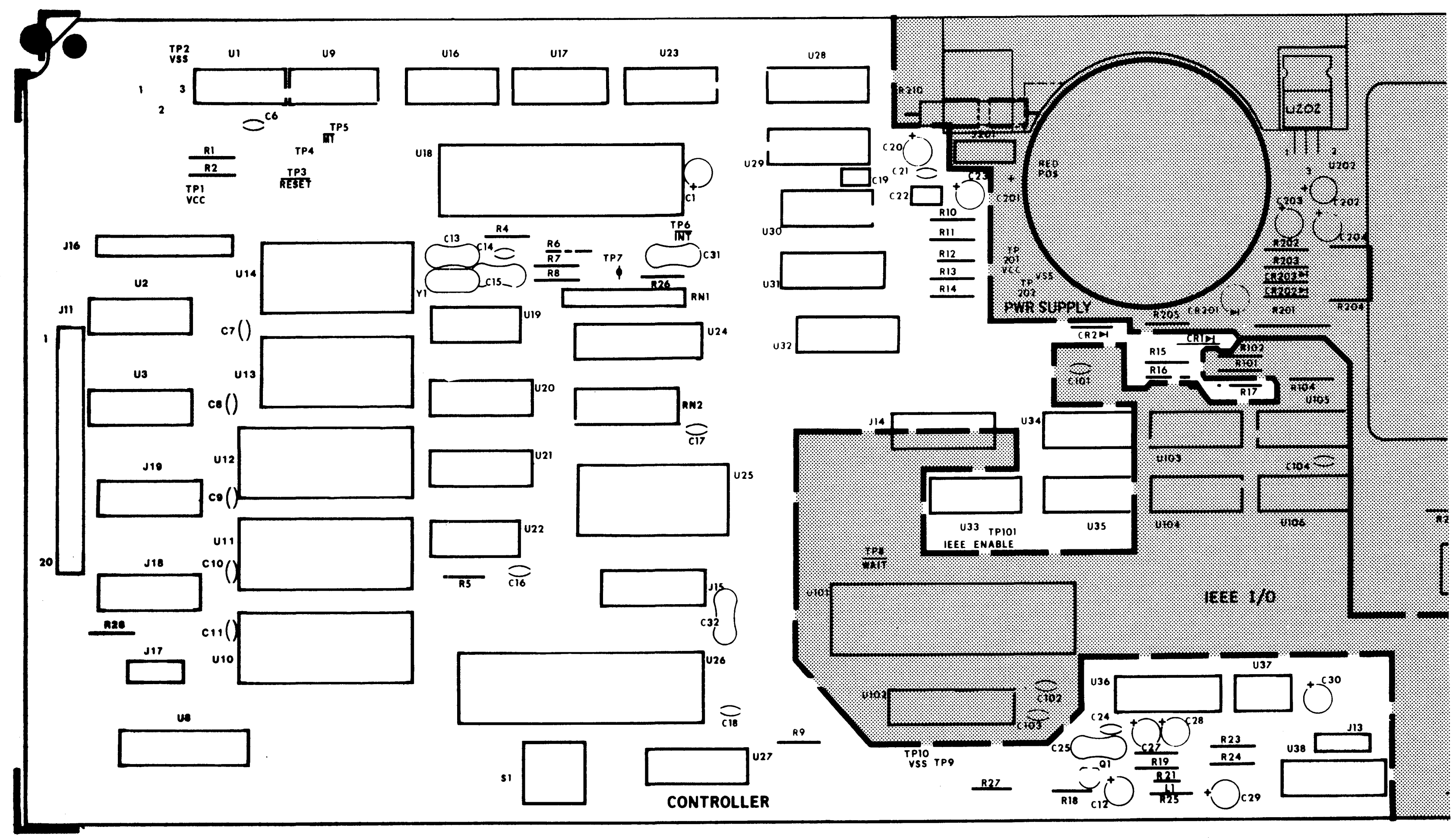


NOTES: UNLESS OTHERWISE SPECIFIED-

1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL CAPACITANCE VALUES IN MICROFARADS

8520A-1021(1 of 3)

Figure 8-4. Digital Controller (cont)



Part of
8520A-1620

Figure 8-4. Digital Controller (cont)

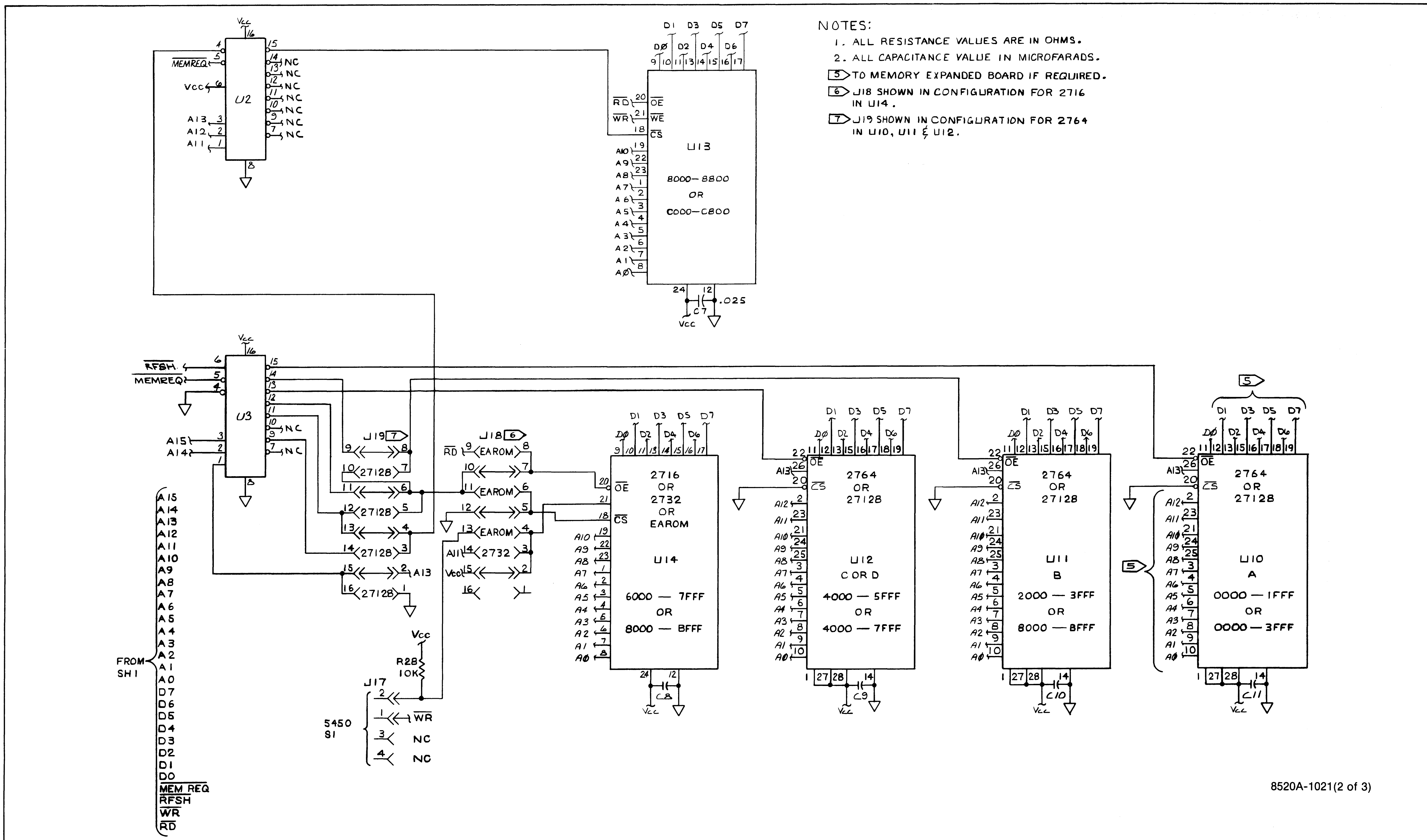
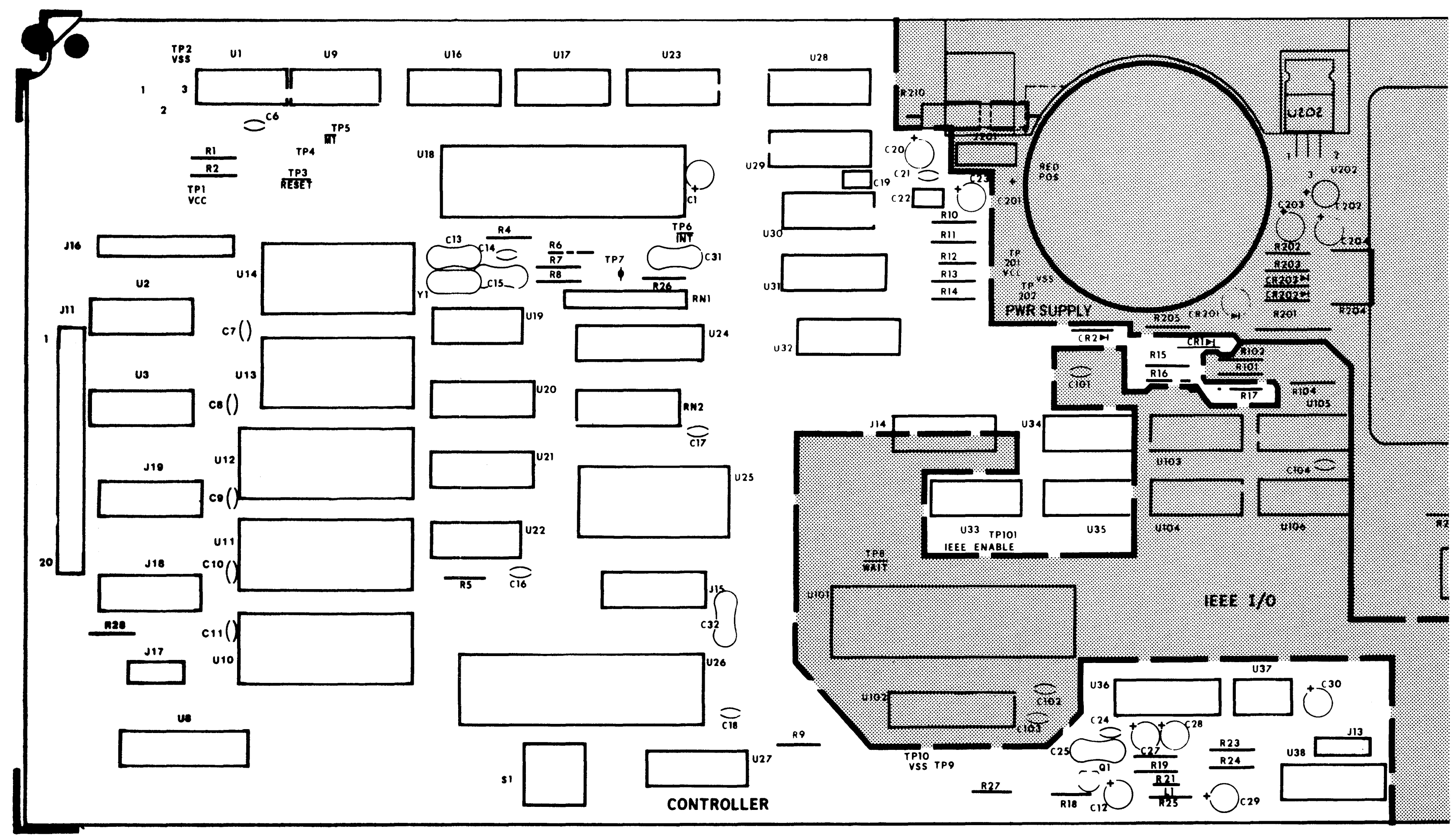


Figure 8-4. Digital Controller (cont)



Part of
8520A-1620

Figure 8-4. Digital Controller (cont)

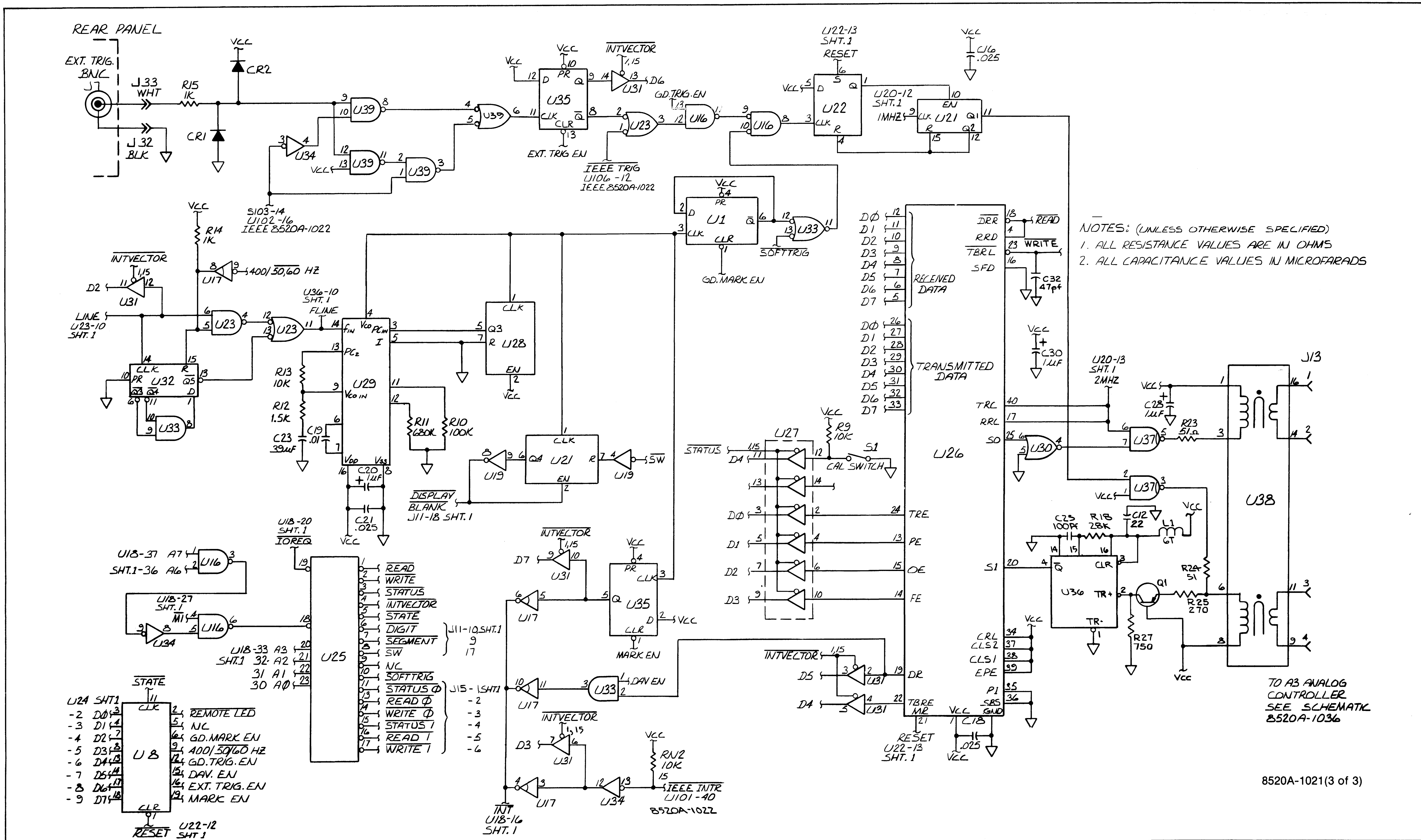
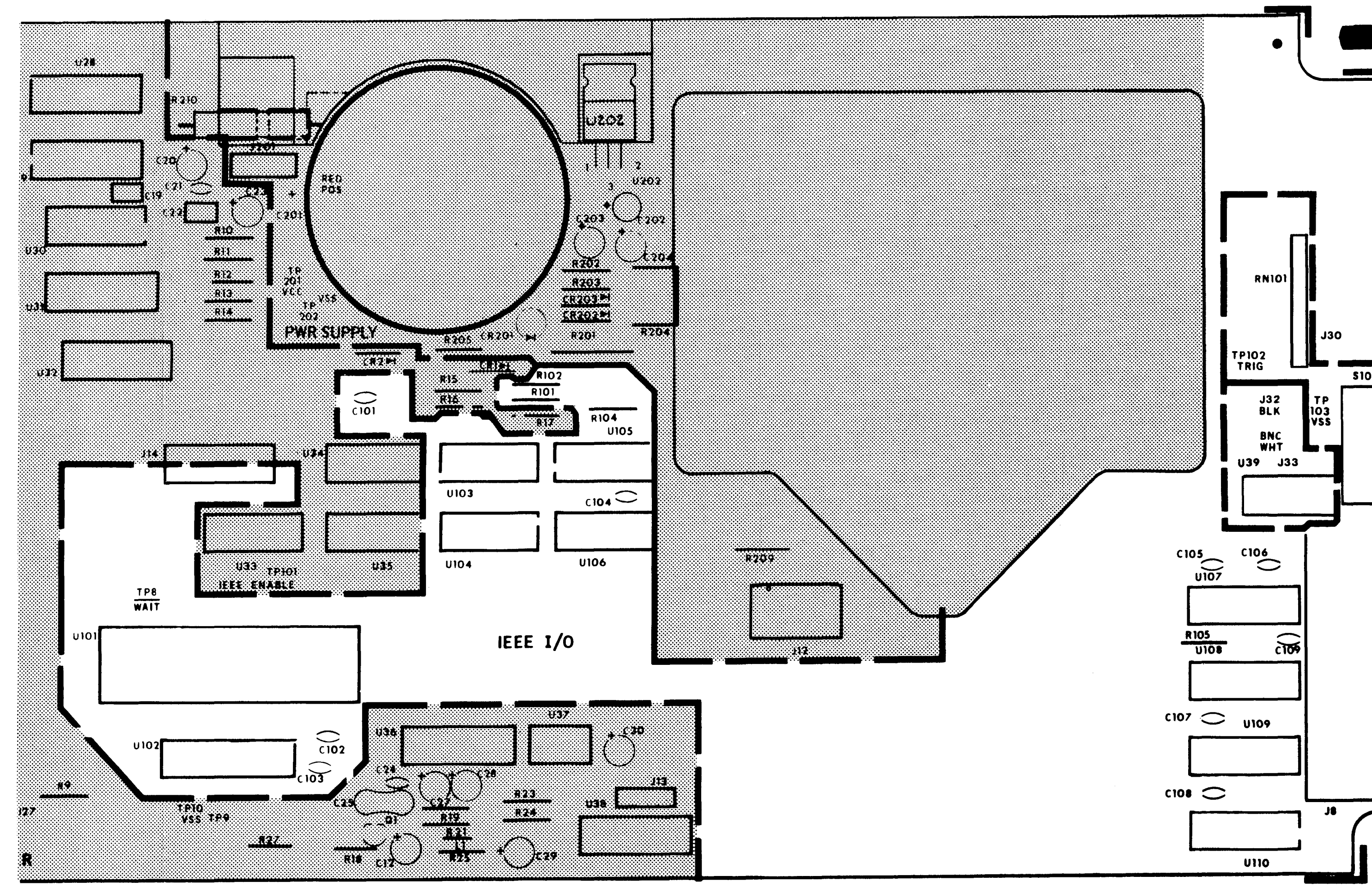


Figure 8-4. Digital Controller (cont)



Part of
8520A-1620

Figure 8-5. IEEE-488 Interface

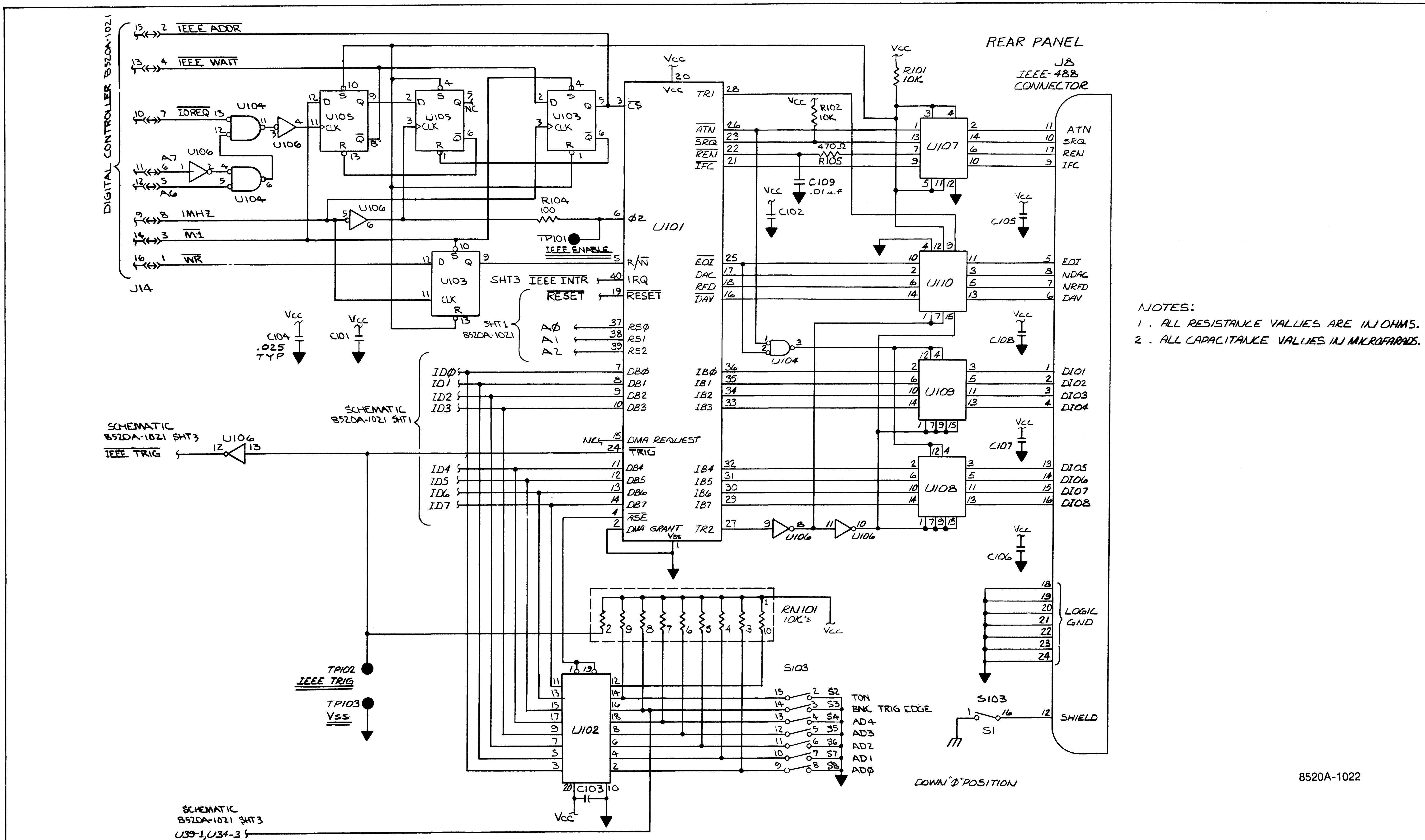
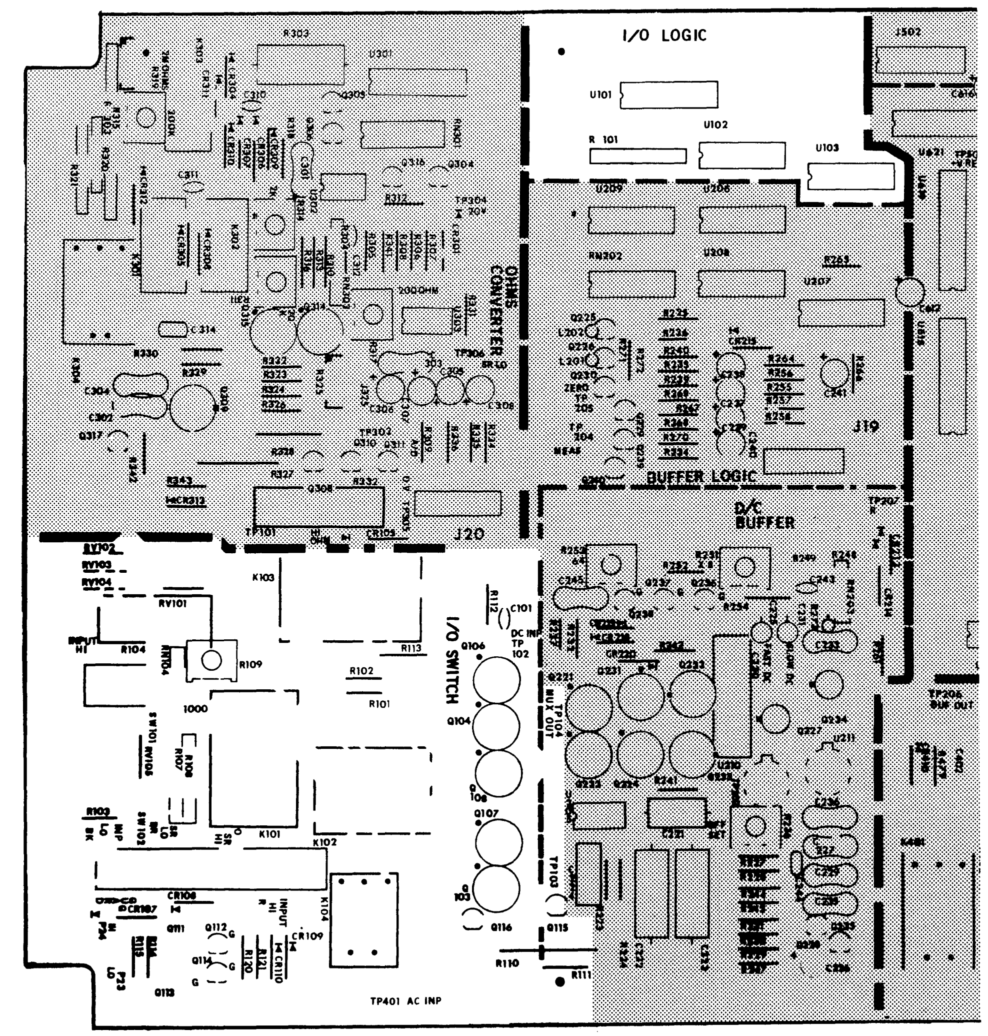


Figure 8-5. IEEE-488 Interface (cont)



Part of
8520A-1630

Figure 8-6. Input/Output SW

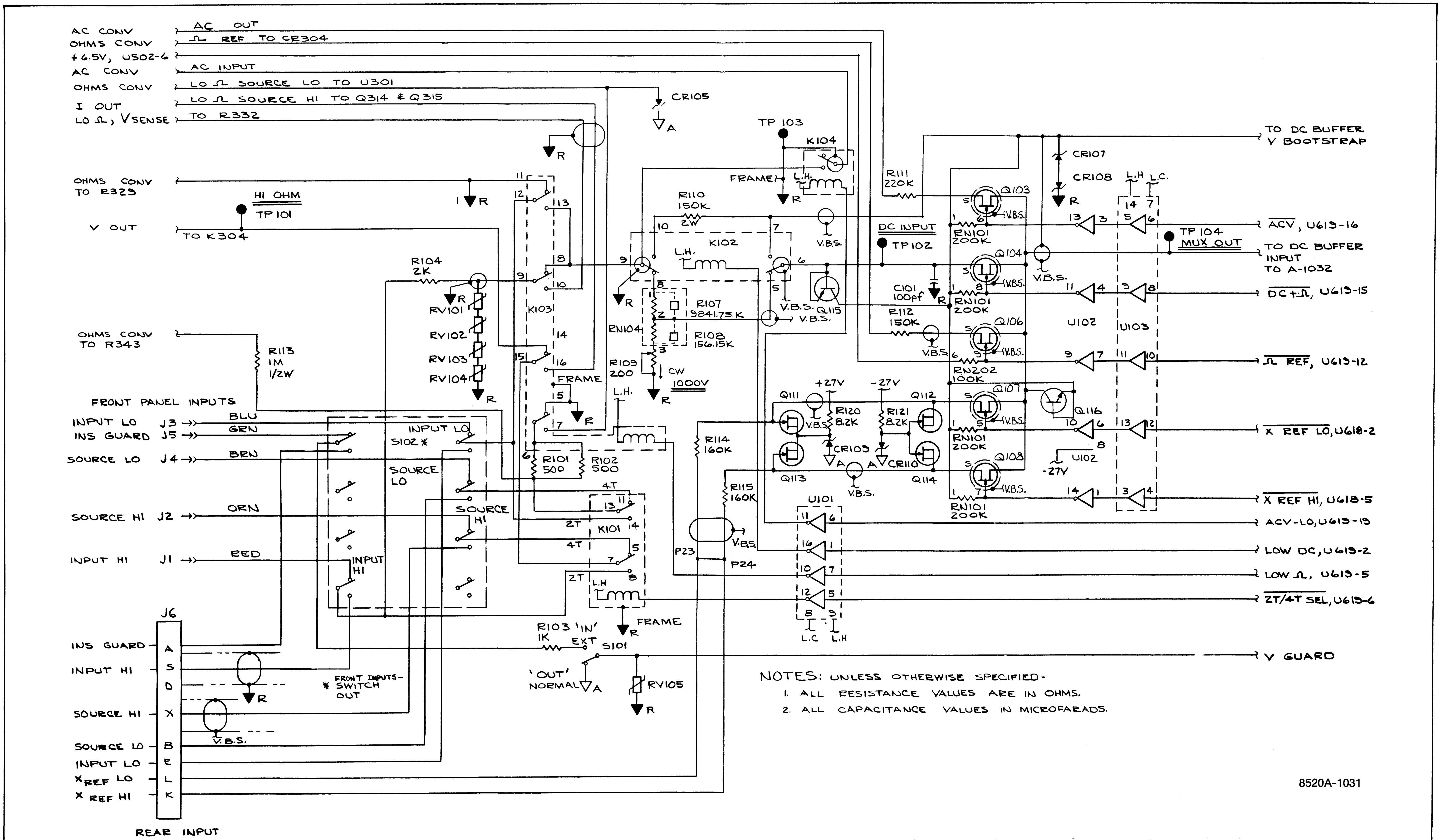
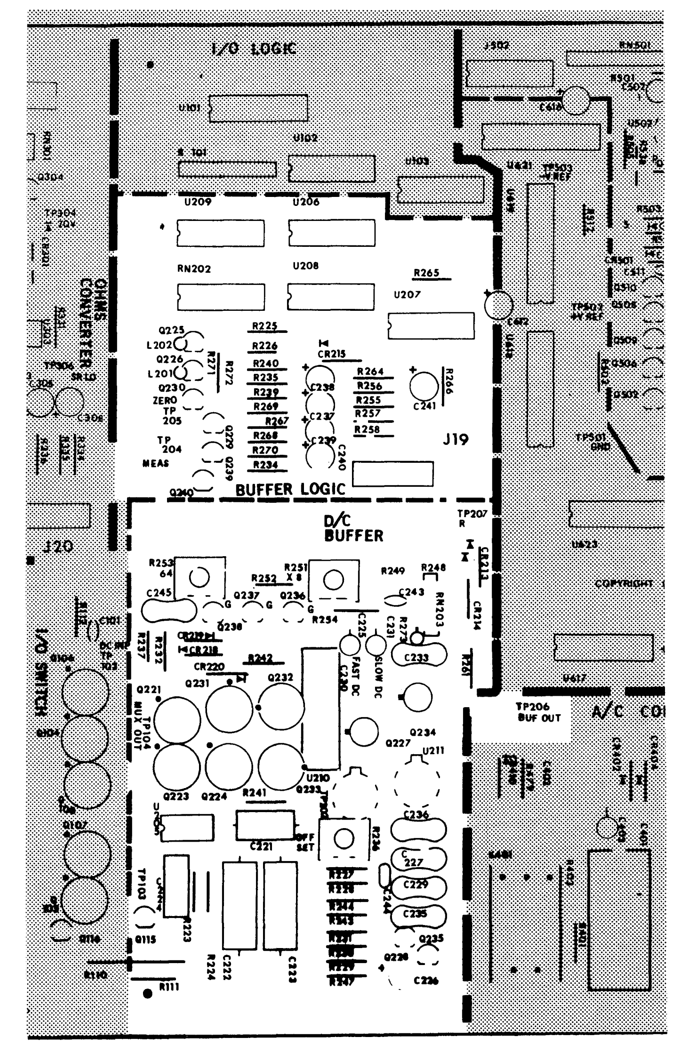
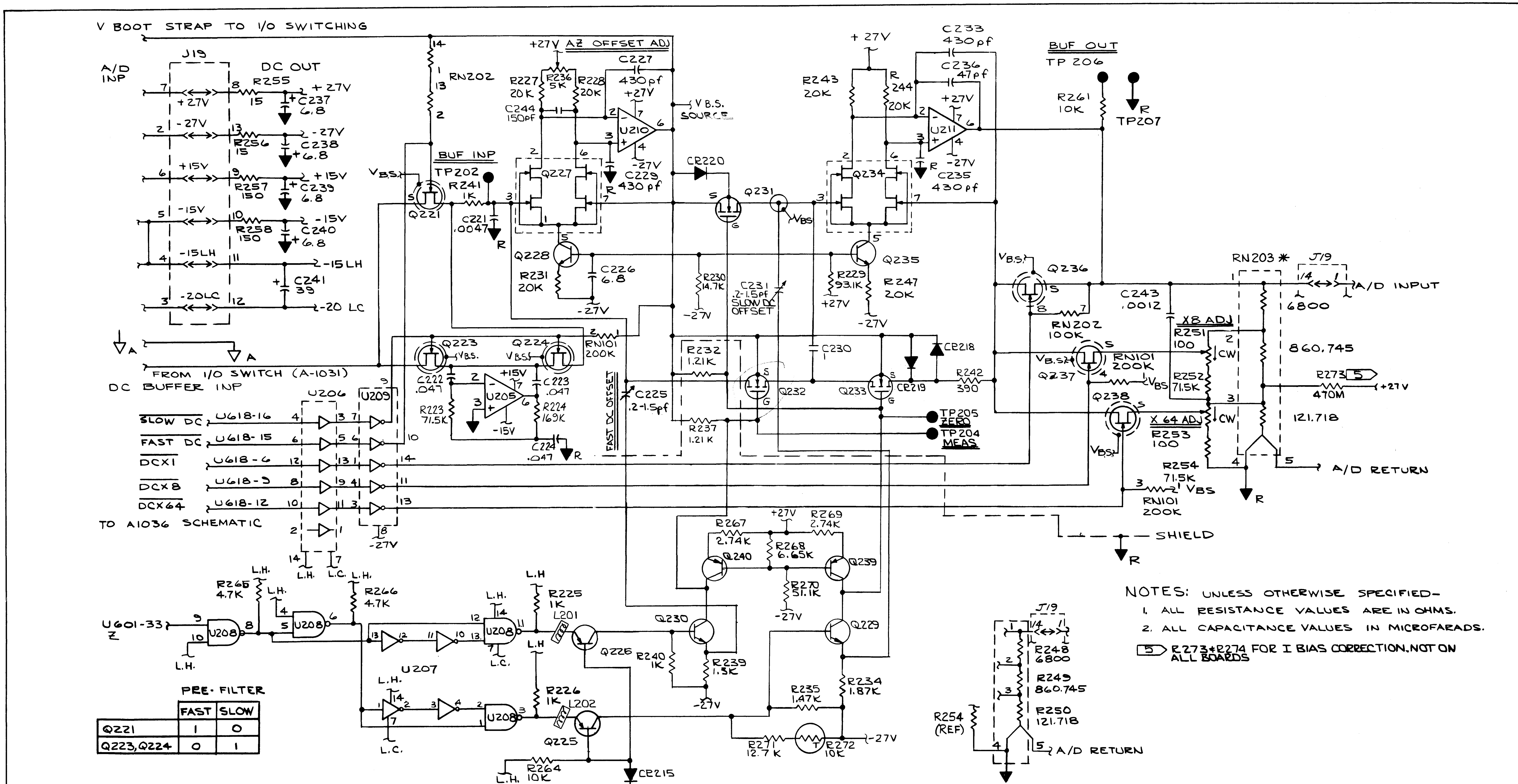


Figure 8-6. Input/Output SW (cont)



Part of
8520A-1630

Figure 8-7. DC Buffer



PRE-FILTER

	FAST	SLOW
Q221	1	0
Q223, Q224	0	1

	DCV					ACV	Ω				nS
	.1	1	10	100	1KV	ALL	10	100-10K	100K-1M	10M	100nS
Q236, A=1	0	0	1	0	1	1	0	0	0	1	1
Q237, A=8	0	1	0	1	0	0	0	1	1	0	0
Q238, A=64	1	0	0	0	0	0	1	0	0	0	0

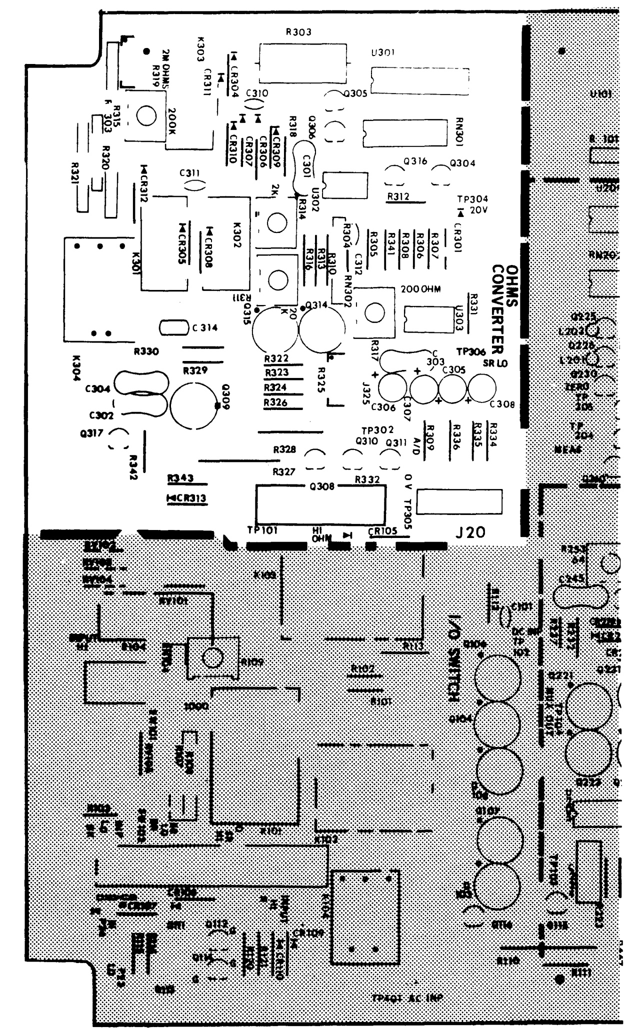
SWITCH CLOSURES

NOTES: UNLESS OTHERWISE SPECIFIED–

1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

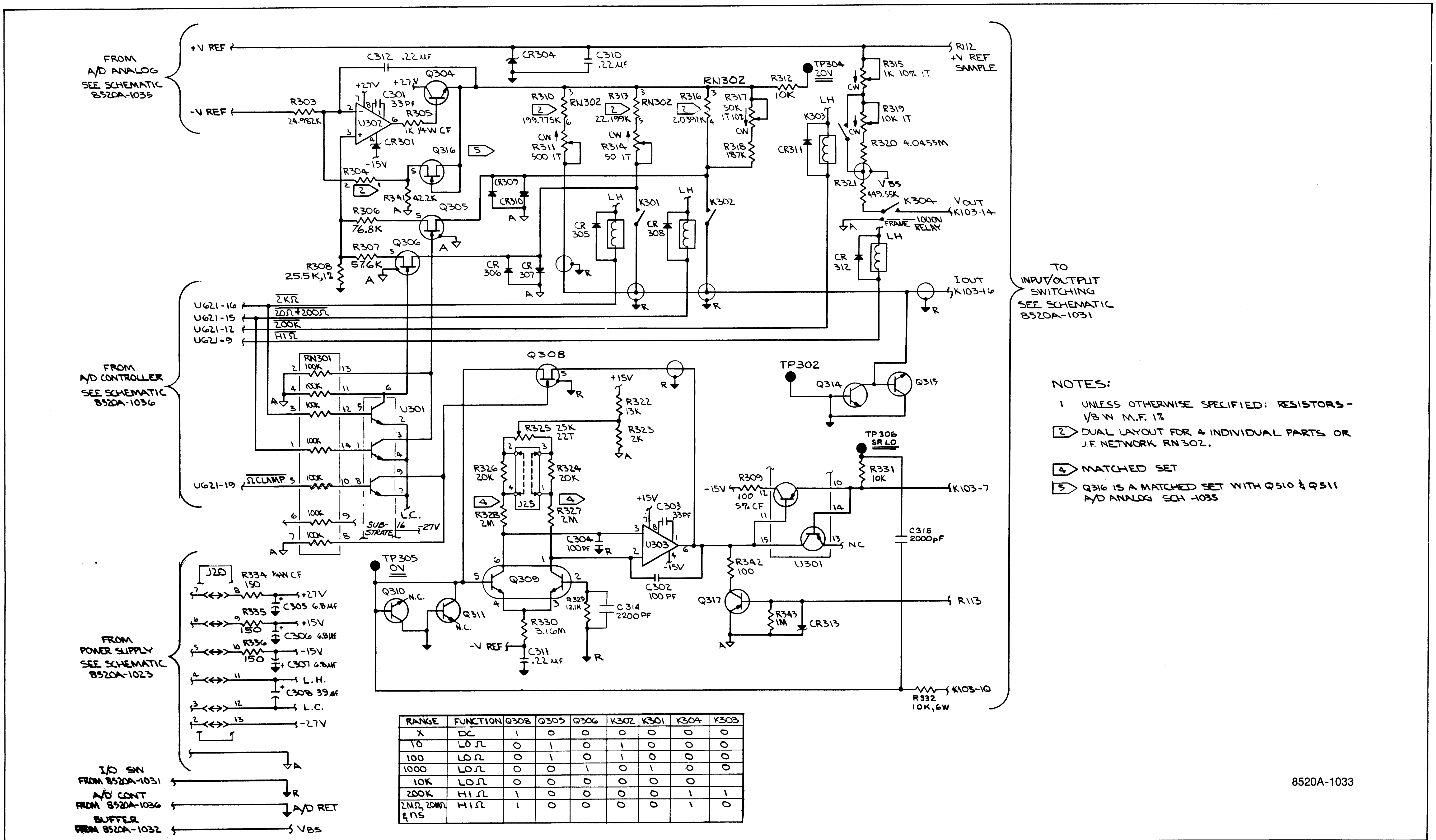
(5) R273+R274 FOR I BIAS CORRECTION. NOT ON ALL BOARDS

Figure 8-7. DC Buffer (cont)



Part of
8520A-1630

Figure 8-8. Ohms Converter



RANGE	FUNCTION	Q308	Q305	Q306	K302	K301	K304	K303
X	DC	1	0	0	0	0	0	0
10	LO Ω	0	1	0	1	0	0	0
100	LO Ω	0	1	0	1	0	0	0
1000	LO Ω	0	0	1	0	1	0	0
10K	LO Ω	0	0	0	0	0	0	
200K	HI Ω	1	0	0	0	0	1	1
2MΩ, 20MΩ & nS	HI Ω	1	0	0	0	0	1	0

NOTES:

1 UNLESS OTHERWISE SPECIFIED: RESISTORS - 1/8 W M.F. 1%

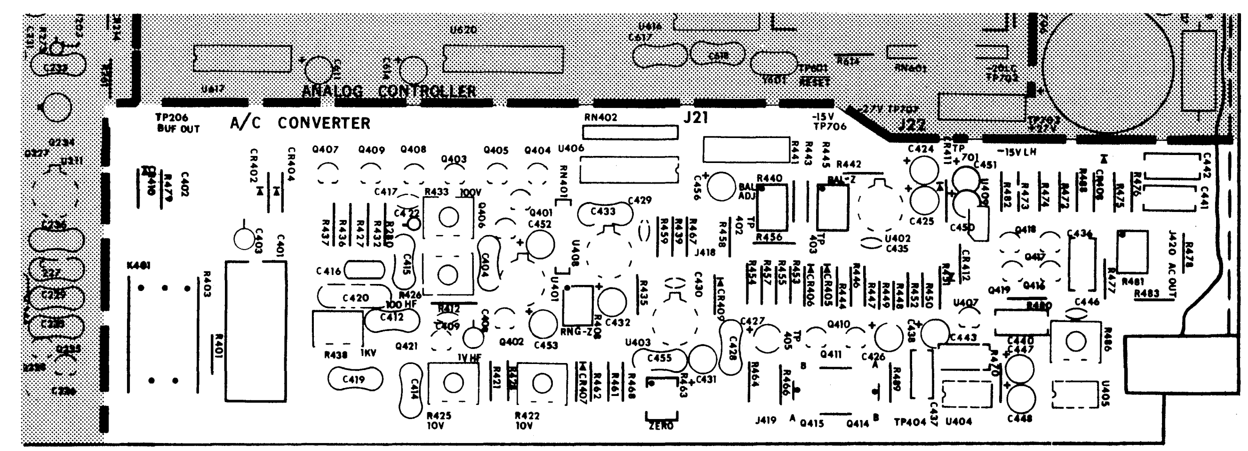
2 DUAL LAYOUT FOR 4 INDIVIDUAL PARTS OR J.F. NETWORK RN302.

4 MATCHED SET

5 Q316 IS A MATCHED SET WITH Q510 & Q511 A/D ANALOG SCH -1035

8520A-1033

Figure 8-8. Ohms Converter (cont)



Part of
8520A-1630

Figure 8-9. AC Converter

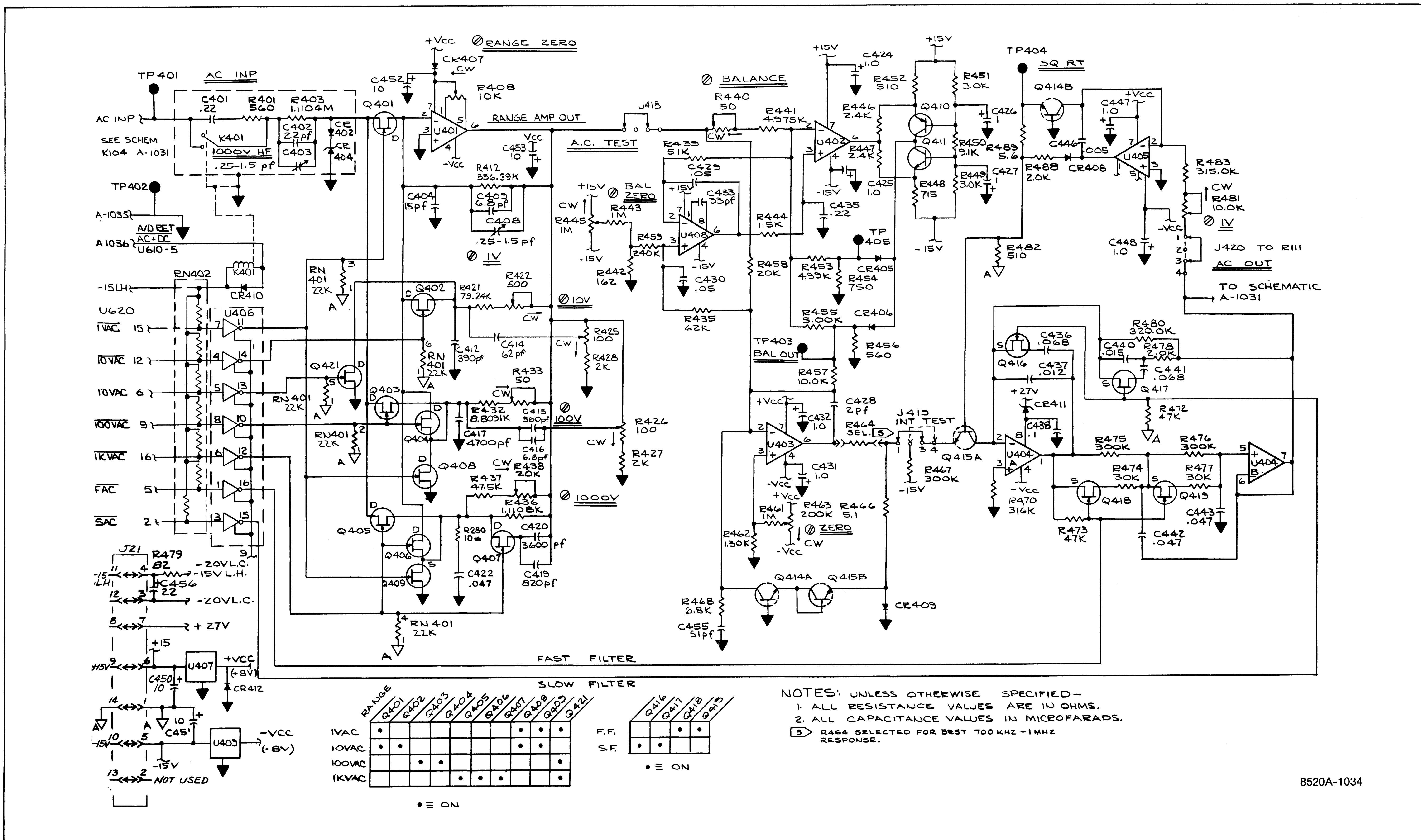
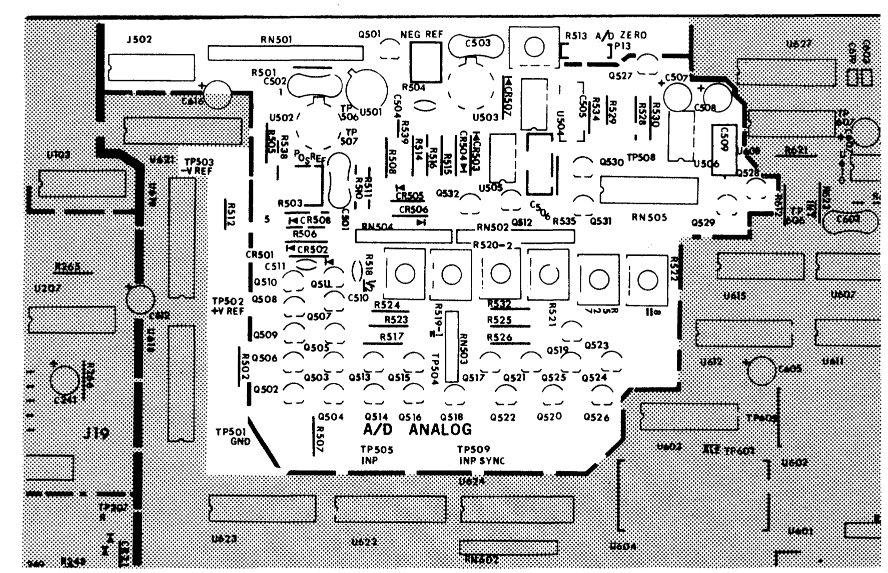


Figure 8-9. AC Converter (cont)



Part of
8520A-1630

Figure 8-10. A/D Analog

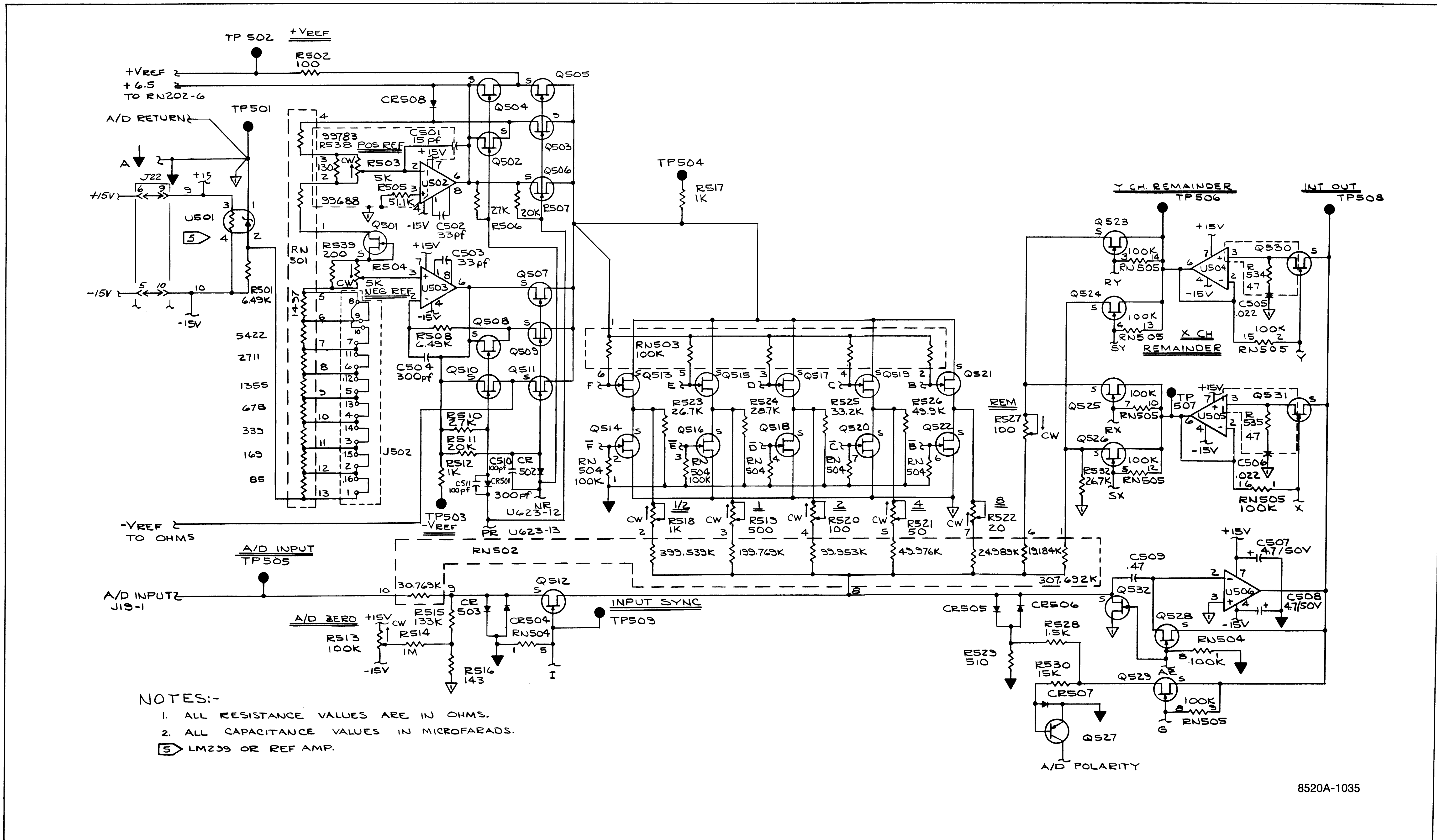
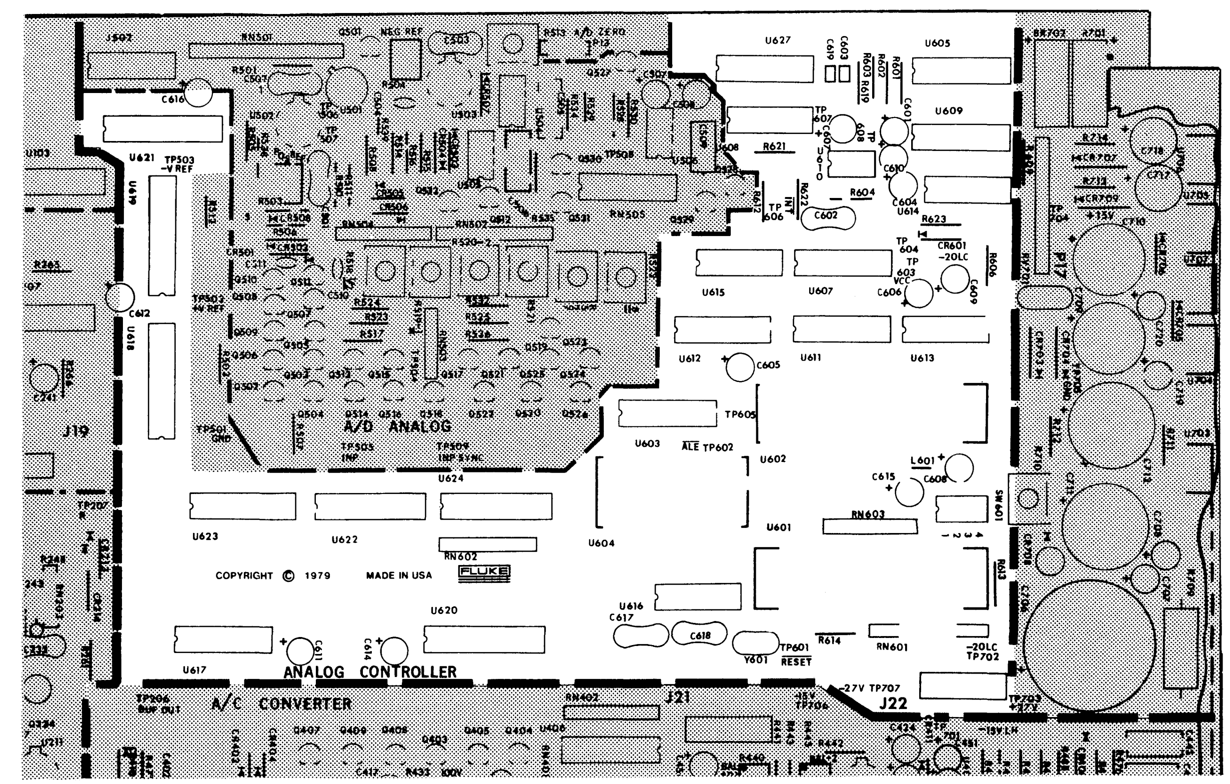


Figure 8-10. A/D Analog (cont)



Part of
8520A-1630

Figure 8-11. Analog Controller

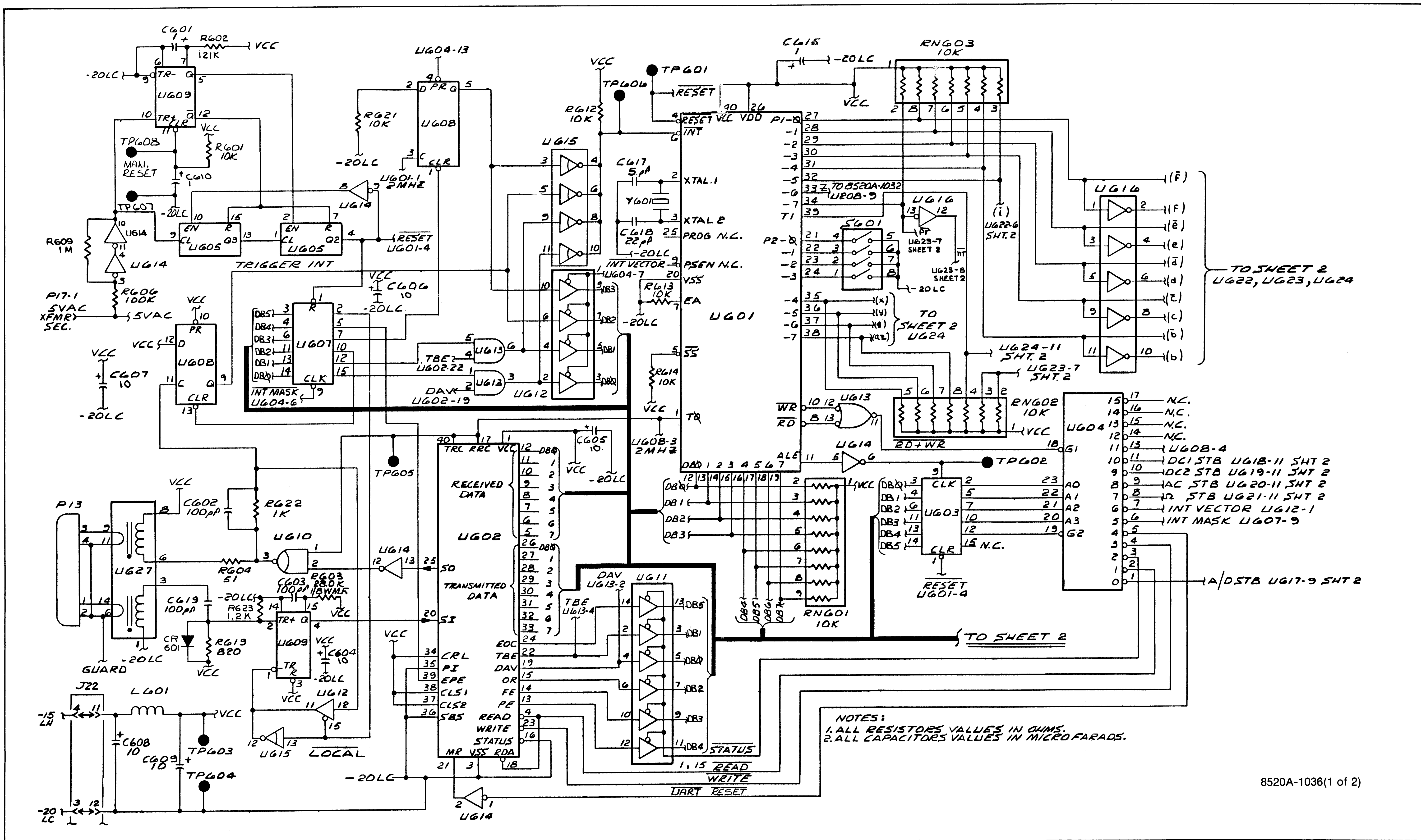
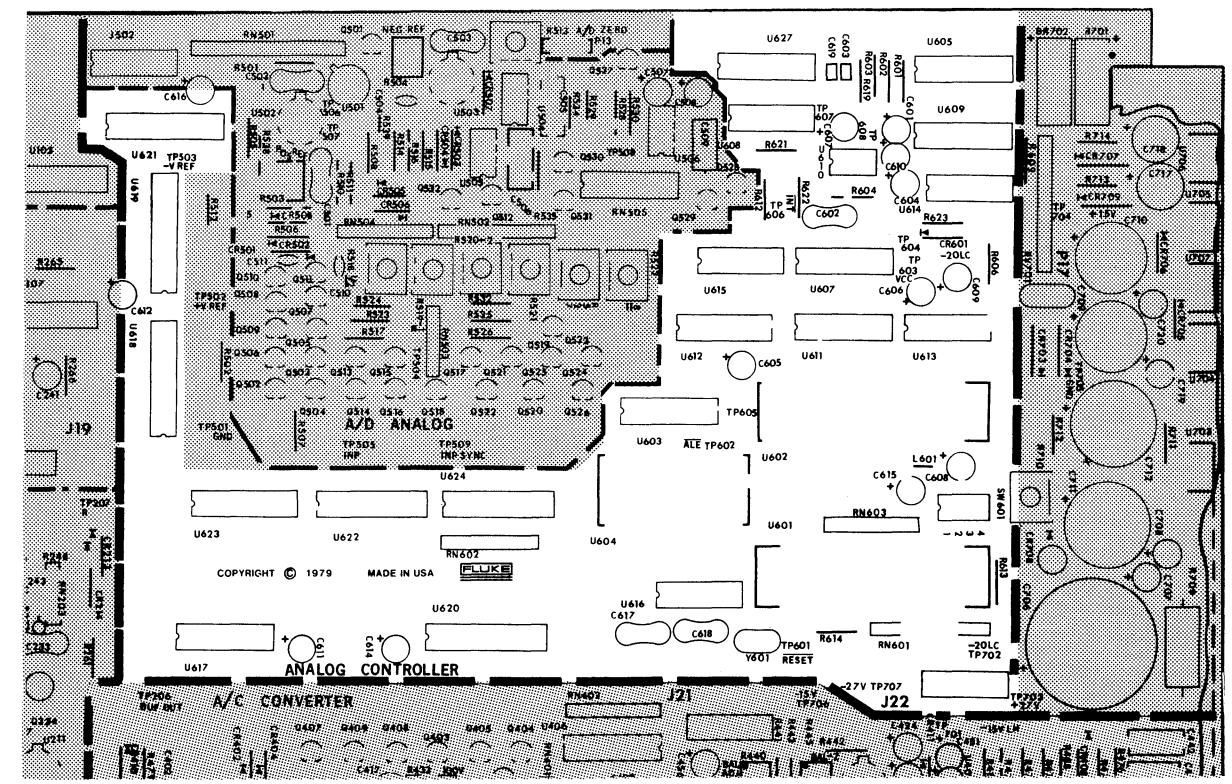


Figure 8-11. Analog Controller (cont)



Part of
8520A-1630

Figure 8-11. Analog Controller (cont)

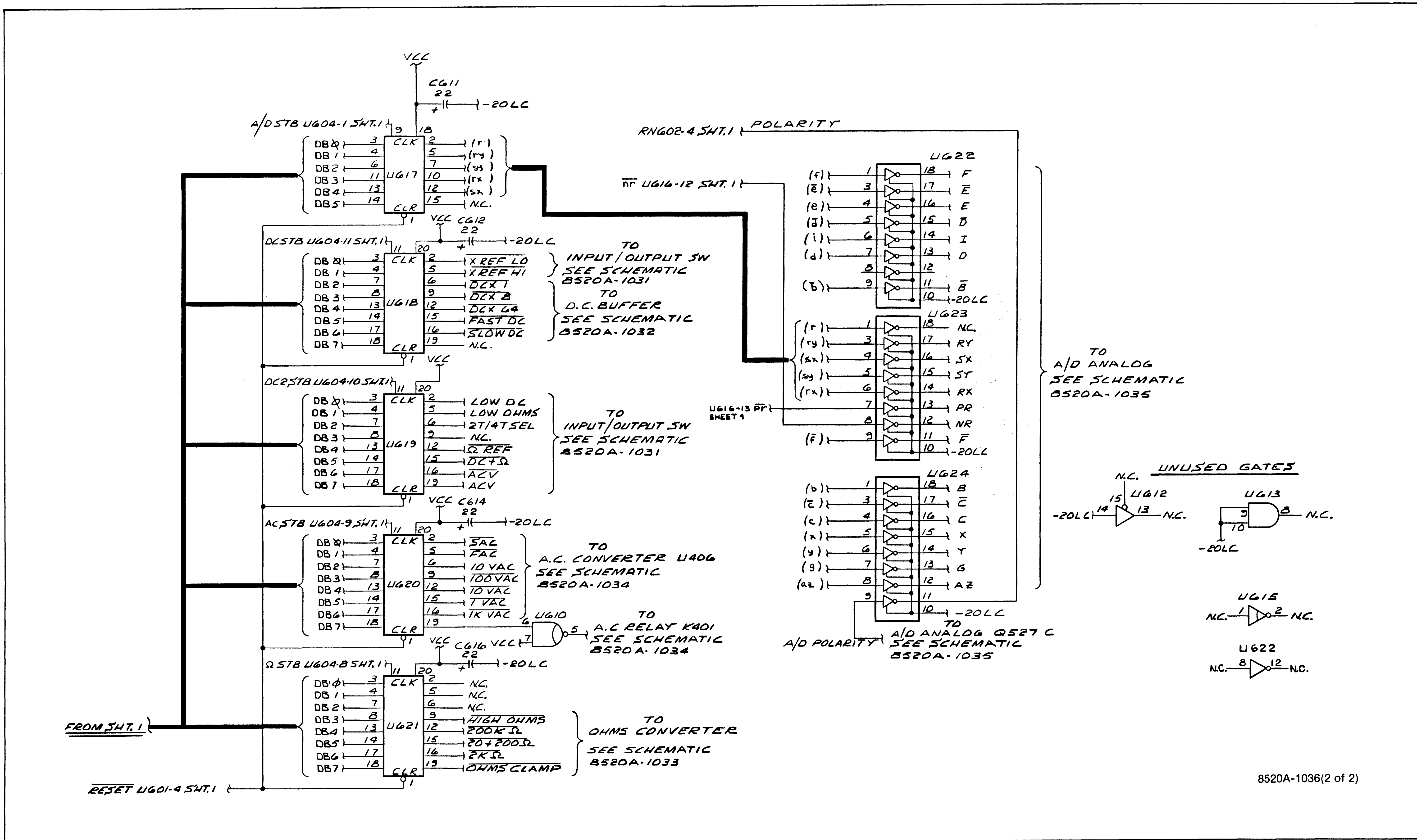
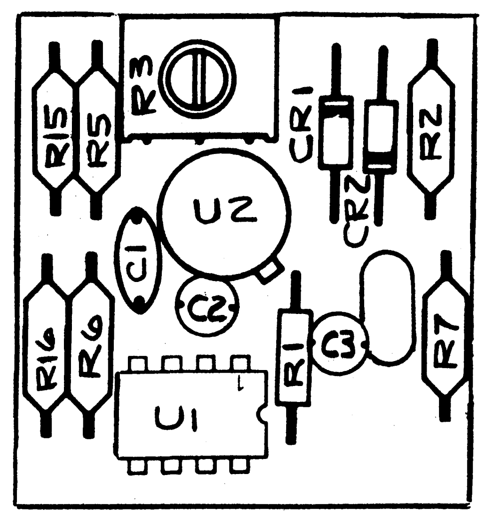
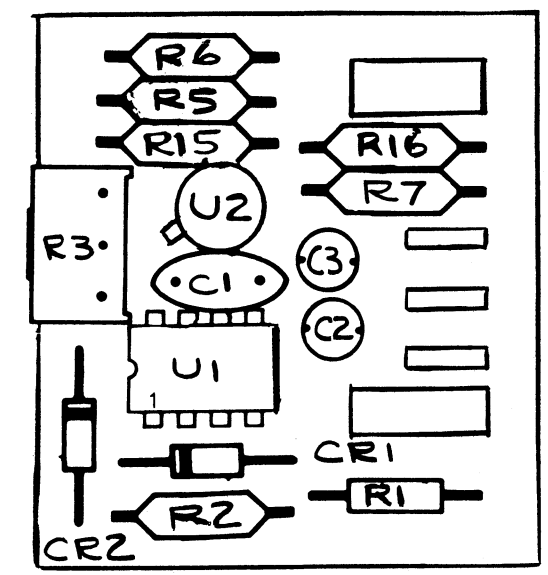


Figure 8-11. Analog Controller (cont)



HORIZONTAL

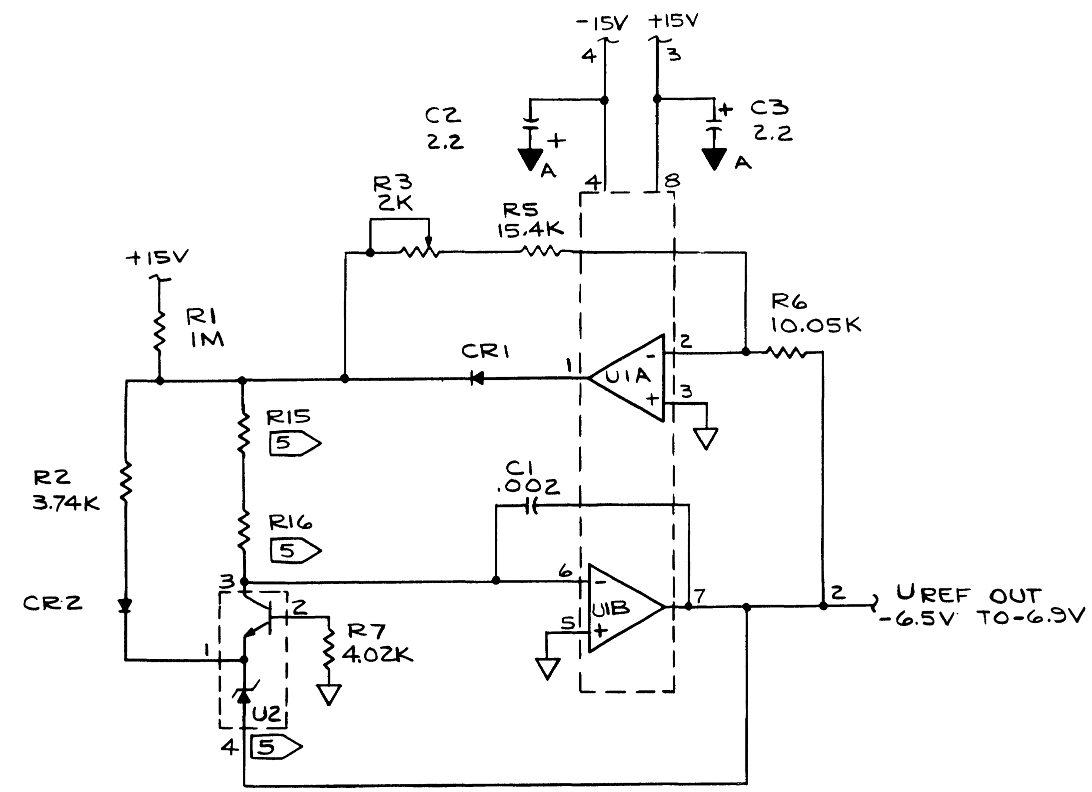
8520A-1645



VERTICAL

8520A-1646

Figure 8-12. Reference Module



NOTES:-

1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

[5] MATCHED SET JF P/N 523407 (8520A-4512).

8520A-1045

Figure 8-12. Reference Module (cont)