NOTE

This manual documents the Model 8922A True RMS Voltmeter and its assemblies at the revision levels shown in Appendix 7A, Table 7A-1. If your instrument contains assemblies with different revision letters it will be necessary to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies or to the backdating sheet (Appendix 7A) for older assemblies.

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8922A
True RMS Voltmeter

Instruction Manual

P/N 522052
June 1979

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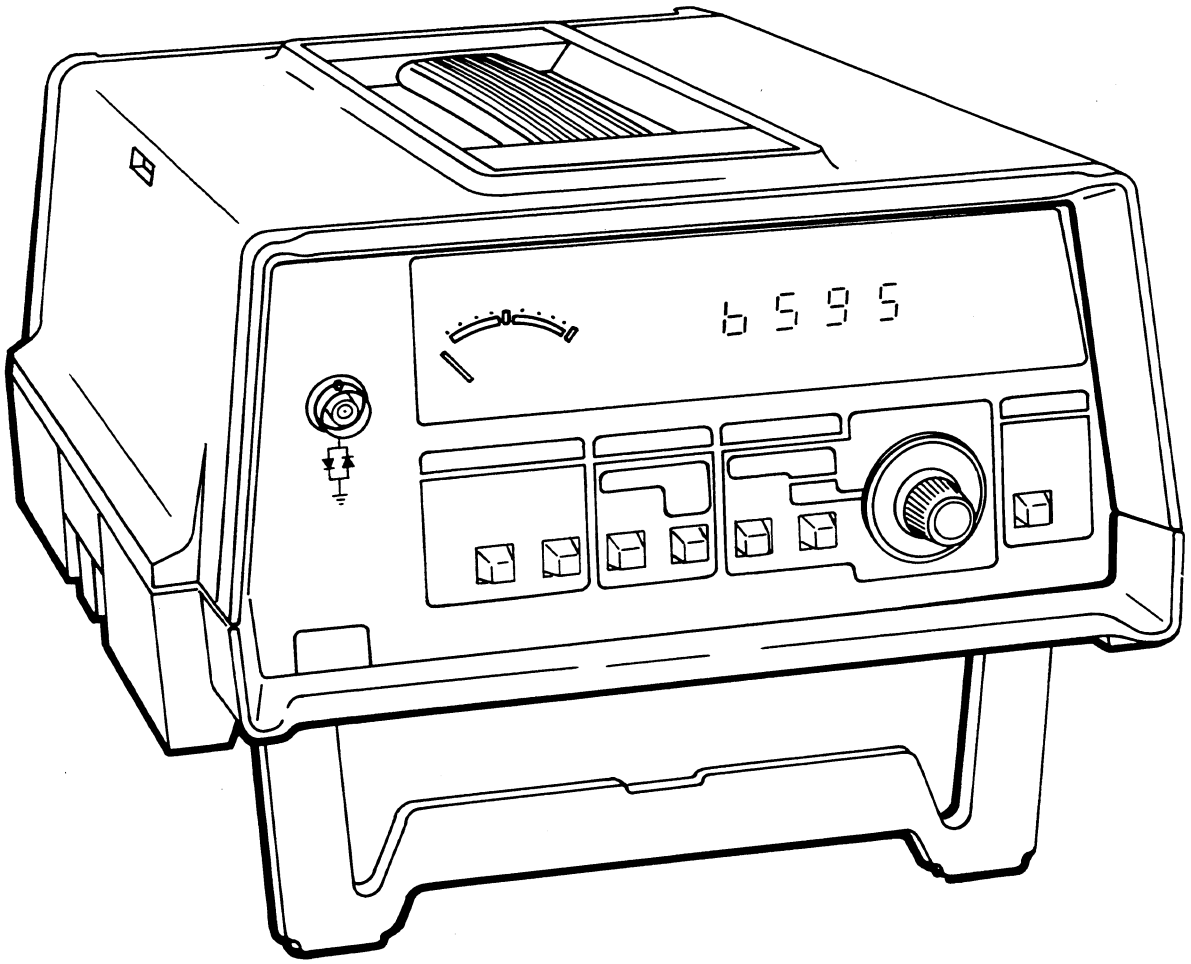


8922A True RMS Voltmeter

Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 8922A is a Digital True RMS Voltmeter, capable of accurately measuring the true rms value of nonsinusoidal signals containing AC or AC + DC components. The instrument has a frequency range of 10 Hz to 11 MHz with a full-scale crest factor of seven, and is capable of displaying measurements in either volts or dB units.

1-3. Selecting the VOLTS position on the dB/VOLTs switch enables the volts display mode and two applicable front panel annunciators (V, mV). In this mode, the instrument displays up to a 3½ digit figure to indicate the true rms value of any AC or AC + DC input signal whose amplitude is between 180 μV and 700V rms (1000V peak).

1-4. The dB display mode (logarithmic) is enabled when dB is selected on the front panel dB/VOLTS display switch. In this mode, the instrument displays up to a 4½ digit dBm value of the input signal referenced to one-of-twelve manually selected impedances (50 to 1200 ohms). The dB display mode also uses two annunciators -- dB and RELATIVE REFERENCE -- and to establish the instrument's operating status. The RELATIVE REFERENCE annunciator lights whenever the REL switch is depressed to indicate that any further dB measurements will be referenced to the voltage present at the time the switch was pressed. An UNCAL annunciator lights with both display modes when internal protection circuits are energized. When AUTO is selected on the AUTO/HOLD switch (the out position) the autorange mode selects one-of-seven input ranges to optimize the display resolution.

1-5. Complementing the instrument's high digital resolution is an analog panel meter for use in applications that require peaking or nulling. This meter does not have calibration markings since it is intended for peaking and nulling indications only.

1-6. Note that the 8922A accomodates floating measurements up to approximately 0.6V peak with respect to earth ground. Isolation of 0.6V peak will accomodate the few hundred millivolts of typical common mode voltage. Full operator protection is maintained since -- under fault conditions -- the diode isolation circuitry conducts to insure that the common mode voltage is never greater than one diode drop.

1-7. Several options and accessories are available for use with the 8922A. The options and accessories are listed and described in Table 1-1. They may be ordered for factory or field installation. Detailed information concerning each option and accessory is given is Section 6 of this manual.

Table 1-1. 8922A Options and Accessories

MODEL NO.	DESCRIPTION
OPTIONS	
8922A-003	Counter Output
8922A-004	Logarithmic Analog Output
8922A-521	DMM Digital Interface
8922A-529	DMM-IEEE-488 Interface
ACCESSORIES	
Y2014	Rack Mounting Kit (single unit)
Y2015	Rack Mounting Kit (double unit)
Y2020	Panel Mount (DIN size)

1-8. The PTI (Portable Test Instrument) case is a family of injection molded, plastic instrument packages of various sizes which may be stacked vertically and latched together to form portable test stations. When instruments are stacked the weight of the stack should be limited to 40 pounds total, and the instrument drawing the most power should be on the top. Stacked instruments have a horizontal air space between them to reduce heat conduction between instruments.

1-9. SPECIFICATIONS

1-10. Detailed specifications for the Model 8922A True RMS Voltmeter are given in Table 1-2. Specifications for the Model 8922A options are given in Table 1-3.

Table 1-2. Specifications

ELECTRICAL (Basic)

The electrical specifications given assume an operating temperature of 23°C ±5°C, relative humidity up to 80% and a minimum 90 day calibration cycle.

FUNCTIONS:	AC true rms, AC + DC true rms (with 2 Hz damping for improved low frequency performance).
DISPLAYS:	Digital Display, Panel selectable for volts or dB. Analog peaking/nulling meter.
RANGING:	Autoranging, HOLD to defeat Autoranging, STEP-UP for manual up-ranging. Ranges up at 2000 counts. Ranges down at 180 counts.
LOW PASS FILTER:	200 kHz Low Pass Filter.
MAXIMUM INPUT:	700V rms or 1000V peak, not to exceed 1 X 10^8 volts-Hz product on any range.
RESPONSE TYPE:	True rms thermal converter will accept: sine, complex, pulse, or random waveforms.
RESPONSE TIME:	
AC:	1.6 seconds typically to rated accuracy within a range, composed of 1 second settling time and 0.6 seconds macimum digitizing time.
AC + DC:	7 seconds maximum to rated accuracy within a range, composed of 5 seconds settling time and 2 seconds maximum digitizing time.
INPUT IMPEDANCE:	2 mV to 700V range = 10 MΩ/shunted by <30 pF.
CREST FACTOR:	7 at full-scale, increasing proportionately as percent of scale decreases. See the Crest Factor portion of the Input Signal Considerations in Section 2.
FREQUENCY RANGE:	2 mV – 20V range = 2 Hz to 11 MHz 200V – 700V range = 2 Hz to 1 MHz

ELECTRICAL (VOLTS Display Mode)

RANGES:	2 mV, 20 mV, 200 mV, 2V, 20V, 200V, and 700V.
RESOLUTION:	0.05% of range. (3½ digits).

Table 1-2. Specifications (cont)

ELECTRICAL (dB Display Mode)

dB RANGE: In the autorange mode the instrument appears as though it has a single range spanning 132 dB. Transients will appear in the readout as the transition through which the analog voltage range points occur.

dB RANGE REFERENCES:

dBm REFERENCES: Twelve manually selectable impedances with which to reference a 0 dBm, 1mW signal level. Impedances are 50, 75, 93, 110, 124, 135, 150, 300, 600, 900, 1000 and 1200 ohms.

RELATIVE dB REFERENCE: A voltage present when this switch is depressed to its REL position is held as 0 dB reference for all other voltages.

dB RESOLUTION: 0.01 dB (4½ digits).

ACCURACY: The accuracy specifications given below apply to the volts and dB display modes at 9% to 100% of full-scale, 23°C ±5°C, 90 day. For 6 month specifications, multiply all values by 1.5.

8922A Voltmeter Specifications 23°C ±5°C, 90 Days

INPUT VOLTAGE	RANGE	AC ACCURACY % OF VOLTAGE READING OR ±dB 2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	11 MHz
180-700V 18.0-199.9V	700V 200V	FILTER IN					FILTER OUT			
1.80-19.99V .180-1.999V 18.0-199.9 mV	20V 2V 200 mV	Damping* (3% or 0.35 dB)	5% or 0.5 dB Damping* (1% or 0.15 dB)	1% or 0.15 dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified	3% or 0.35 dB	
1.80-19.99 mV	20 mV		5% or 0.5 dB Damping* (2% or 0.25 dB)	2% or 0.25 dB	1% or 0.15 dB		2% or 0.25 dB			5% or 0.5 dB
.180-1.999 mV	2 mV	Damping* (5% or 0.5 dB)	5% or 0.5 dB	3% or 0.35 dB	2% or 0.25 dB	4% or 0.4 dB				

AC + DC ACCURACY
(USE 50 Hz - 10 kHz SPEC FOR DC ONLY)

ADD TO AC SPECIFICATION: ±10 Digits or 0.5 dB Above 2 mV.
±100 Digits or 5 dB Below 2 mV.

*Valid When AC + DC (Damping) is Selected and Input is AC Only.

Below 2 mV add: $\frac{5}{\text{mV Input}}$ digits or $\frac{0.05}{(\text{mV Input})^2}$ dB

Table 1-2. Specifications (cont)

TEMPERATURE COEFFICIENTS at 0°C to 18°C, 28°C to 50°C (32 to 64.4°F, 82.4 to 122°F)

FUNCTION

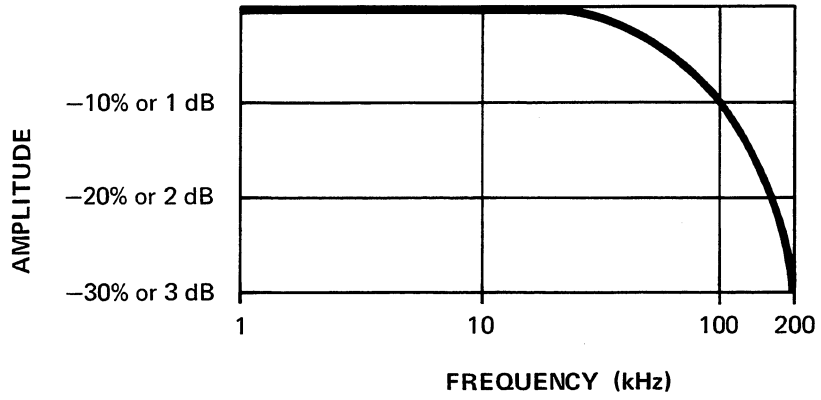
AC

2 Hz	1 MHz	11 MHz
0.07%/°C or 0.006 dB/°C	0.1%/°C or 0.01 dB/°C	

AC + DC

INPUT	ABOVE 2 mV	BELOW 2 mV
AC + DC	±(2 digits/°C or 0.1 dB/°C)	±(20 digits/°C or 1.0 dB/°C)
AC	Same as AC Function	$+\frac{2\text{ digits}}{\text{mV input}}$ /°C or $+\frac{2\text{ digits}}{(\text{mV input})^2}$ /°C

LOW PASS FILTER RESPONSE (Typical)



GENERAL

INPUT: Isolated BNC input floating up to .6V peak.

DISPLAYS: 5 (0.3" high) digit, 7-segment LED's with automatic decimal point location and mV, V, dB, RELATIVE REFERENCE, and UNCAL annunciators. The display also incorporates an uncalibrated analog meter for nulling and peaking.

AUTORANGING RATE:

VOLTS: AC 700 ms max/range change; 2.2 sec max for 6 range changes.
AC + DC 2.5 sec ac max/range change; 10 sec max for 6 range changes.

dB: AC 950 ms max/range change; 2.9 sec max for 6 range changes.
AC + DC 3.5 sec max/range change; 13 sec max for 6 range changes.

READING RATE: AC 2.5 readings per second.
AC + DC 1 reading per second.

OVERRANGE INDICATION: Flashes maximum allowed reading for that range.

UNDERRANGE INDICATION: Flashes decimal point, but continues to display the reading.

Table 1-2. Specifications (cont)

GENERAL (cont):

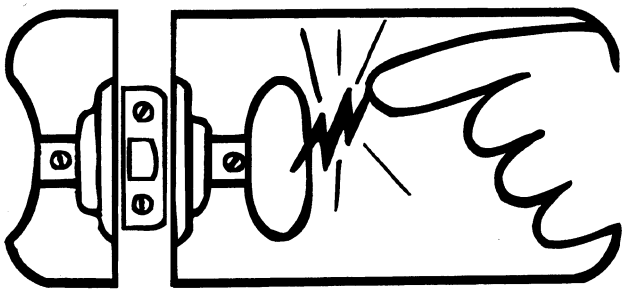
UNCAL INDICATION:	Illuminates to indicate crest factor is exceeded.
MAXIMUM COMMON MODE:	
VOLTAGE:	400 mV rms or 600 mV peak, diode clamped.
INPUT COMMON MODE:	
REJECTION:	> 80 dB @ 50 or 60 Hz (with 100 ohms in either lead).
LINEAR ANALOG OUTPUT:	Each range provides a linear output with 2V dc equal to 2000 counts on the readout, ±1.0% of reading relative to display; essentially 0 ohm output resistance into a > 10 kΩ load; non-isolated with output common the same as input common.
STORAGE TEMPERATURE:	–40°C to +75°C.
OPERATING TEMPERATURE:	0°C to 50°C.
HUMIDITY RANGE:	80% RH.
MTBF:	Greater than 10.000 hours.
POWER:	100V ac ±10%, 120V ac ±10%, 220V ac ±10%, or 240V ac ±10% to 250V ac max. selected by internal switches, 45 to 440 Hz, 10 W max.
DIMENSIONS:	32.7 cm (12.9 in.) L X 20.3 cm (8.0 in.) W X 10.8 cm (4.3 in.) H.
WEIGHT:	2.47 kg (5 lb. 7 oz.).

Table 1-3. Specifications for 8922A Options

OPTION –003, COUNTER OUTPUT OPTION	
OUTPUT VOLTAGE:	100 mV peak square wave.
OUTPUT IMPEDANCE:	50 ohms.
MAXIMUM ISOLATED LEVEL:	Maintains instrument isolation with respect to earth ground.
OPTION –004, LOGARITHMIC ANALOG OUTPUT OPTION	
OUTPUT VOLTAGE DC:	200 μV rms input = 0 dB, 0V dc out. 700V rms input = 131 dB, 13.1V dc out. i.e., 100 mV = 1 dB. Non-isolated, output common is the same as input common.
LINEARITY:	Within each range: ±0.35 dB. Over all seven ranges: ±2 dB.
OUTPUT IMPEDANCE:	1 kΩ.
OPTION –521 DMM DIGITAL INTERFACE	
DESCRIPTION:	Serial BCD output of all digits and annunciators.
OPTICAL ISOLATION:	Transfer reliable up to 500V ac rms common mode from dc to 440 Hz.
OPERATING POWER:	From DMM +5V and GND From external device +5V at less than 10 mA and GND.
OPTION –529 DMM-IEEE-488 INTERFACE	
DESCRIPTION:	Option for interfacing the 8922A to IEEE 488-1978. Package consists of one pcb mounted in the 8922A, one pcb mounted in the 1120A Translator and one interconnect cable. The 1120A must be used to interface to the IEEE 488 General Purpose Bus.
FUNCTION:	Talker.
IEEE REPERTOIRE	SH1, AH1, T3, TE3.

static awareness

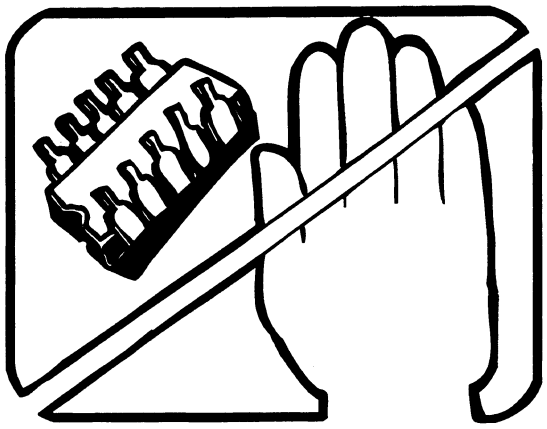
A Message From
Fluke Corporation



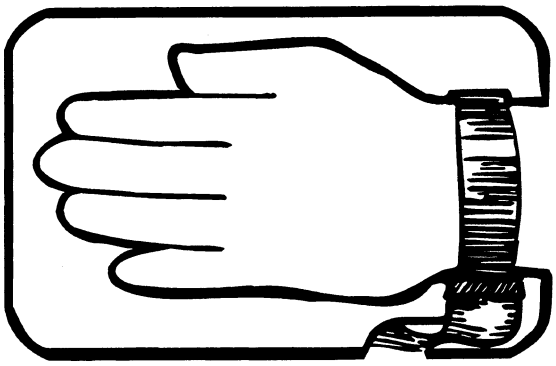
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

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

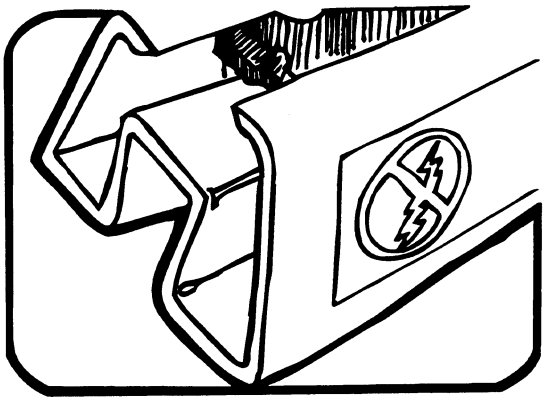
The following practices should be followed to minimize damage to S.S. (static sensitive) devices.



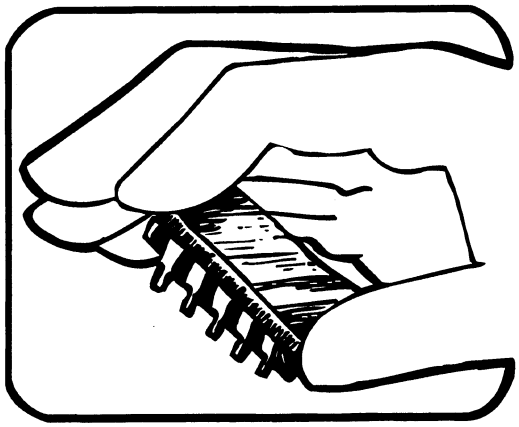
1. MINIMIZE HANDLING



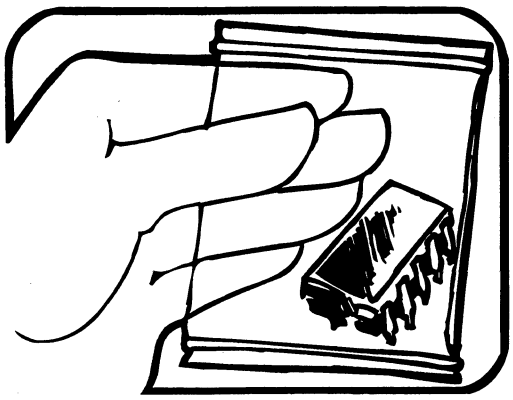
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



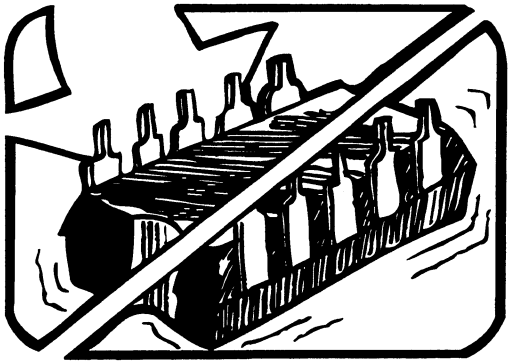
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



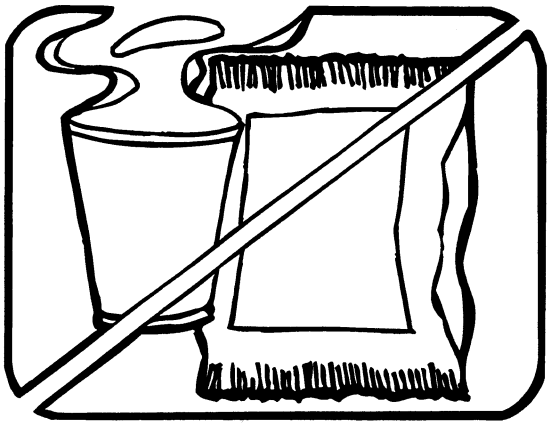
4. HANDLE S.S. DEVICES BY THE BODY.



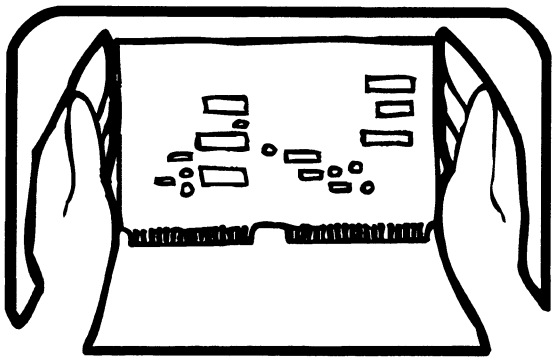
5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT.



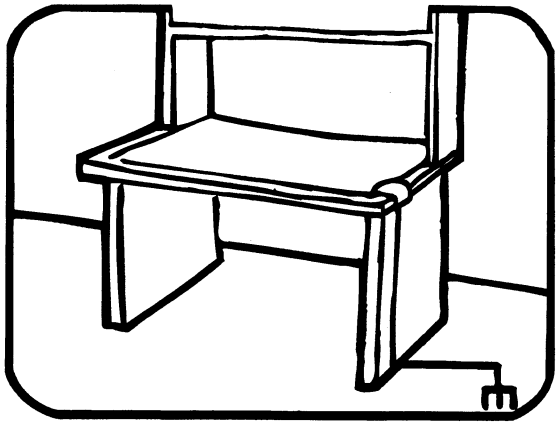
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE.



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



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 PROTECT INSTALLED S.S. 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.

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Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. The information we have presented in this section is intended to familiarize you with the capabilities and limitations of the Model 8922A. We have included instructions for the installation and operation of your 8922A as well as a brief description and identification of each control and indicator on the instrument.

2-3. SHIPPING INFORMATION

2-4. The Model 8922A is packaged and shipped in a protective container. When you receive the equipment, make a thorough inspection for any possible shipping damage. If your 8922A was damaged in shipment contact your nearest John Fluke Service Center immediately. A list of these service centers may be found in Section 7.

2-5. If reshipment of the instrument is necessary, use the original container. If the original container is not available, a new one may be obtained from the John Fluke Mfg. Co., Inc. Please indicate the instrument's model number (8922A) when requesting a new shipping container.

2-6. INSTALLATION

2-7. The 8922A is designed for bench-top use, for installation in a standard 19-inch equipment rack, or for panel mounting into any DIN size opening. Available rack mounting kits are listed in Table 1-2. In bench-top environments the 8922A may be stacked with other Fluke products that use the PTI case. To connect two or more PTI cases, pull the side connectors out, place one case squarely on top of another and press in on the side connectors of the top case until they seat firmly into the slots on the case below. See Figure 2-1.

CAUTION

Before you attempt to lift a series of stacked instruments, check each unit to ensure that its case connectors are properly mated and latched to the next lower instrument.

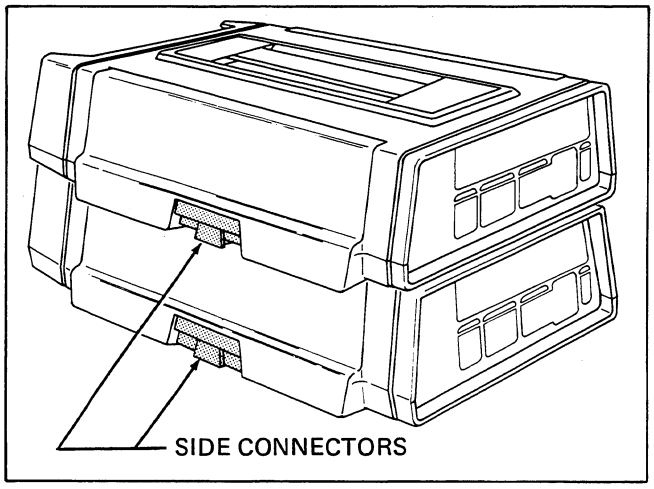


Figure 2-1. PTI Connection

2-8. INPUT POWER

2-9. The 8922A can be operated from one of several line voltages: 120, 100, 220, or 240V. Refer to the procedure in Section 4 to alter the line power configuration of the instrument. We recommend that this procedure be performed by qualified personnel only.

2-10. CONTROLS AND INDICATORS

2-11. The 8922A controls, indicators, and connectors are shown in Figure 2-2 and described in Table 2-1. Locate each feature on your DMM as you read the description.

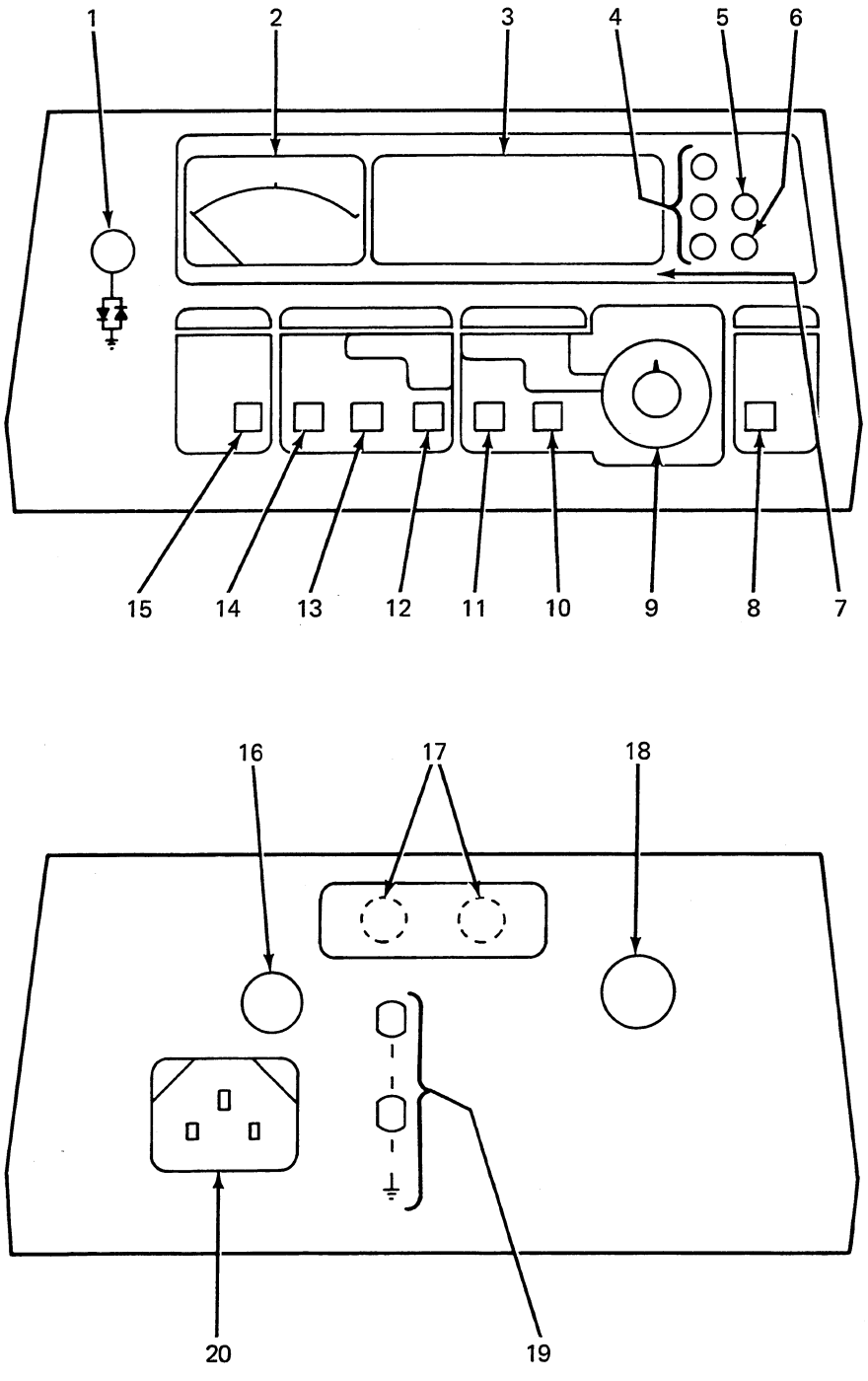


Figure 2-2. Controls, Indicators, and Connectors

Table 2-1. Controls, Indicators, and Connectors (cont)

REF NO.	NAME	FUNCTION
1	INPUT	A BNC input connector. The low side is isolated from power ground through a pair of parallel diodes.
2	Analog Panel Meter	Uncalibrated panel meter provides analog tracking of input level; useful for peaking and nulling indications.
3	Digital Display	LED display provides a direct readout of the input signal level; includes decimal point and polarity.
4	Annuniciators	LED's that light to indicate the selected measurement function V (volts), mV (millivolts) or dB (decibels).
5	UNCAL	An LED that light to indicate that the instrument's internal protection circuitry is energized, see Crest Factor, under operating instructions.
6	RELATIVE REFERENCE	An LED that lights to indicate that the voltmeter is in the dB display mode and using a relative voltage reference.
7	2/20/200/700	Indicate DMM range by decimal point locations.
8	POWER Switch	A push-push switch used to turn the instrument ON (in) and OFF (out).
9	dBm REFERENCE	Rotary switch used to manually select 1-of-12 reference impedances when the dBm and dB display modes are selected.
10	REL/dBm	A push-push switch used to select either the relative dB or the dBm display mode. When REL is depressed, the existing input level is used to establish a 0 dB reference. Subsequent level changes at the input are displayed in dB and referenced to the operator established 0 dB level. When dBm is selected, measurements are displayed in terms of dBm and the dBm REFERENCE setting.
11	dB/VOLTS	A push-push switch used to select either the voltage (out) or dB (in) display mode.
12	STEP UP	A momentary pushbutton switch used to incrementally step the voltmeter to its higher range. This switch is enabled only when the HOLD RANGE mode is selected.
13	HOLD/AUTO	A push-push switch used to select the manual (HOLD) or autorange (AUTO) mode. Selecting HOLD (in) enables manual upranging with the STEP UP switch. Selecting AUTO (out) enables the unit to autorange.
14	FILTER	A push-push switch which, when depressed, engages a single pole filter to reject unwanted high frequency signals. See the Specifications table for effect on accuracy.
15	AC/AC + DC (damping)	A push-push switch used to include (in) or delete (out) dc components as part of the input signal level. When AC + DC is selected (in) damping increases which extends low frequency operation down to 2 Hz. Reading and ranging rates are slower.
16	F1	Line fuse, MDL 1/8A slo-blo.(5 x 20 mm, 1/8A, slow acting for metric.)

Table 2-1. Controls, Indicators, and Connectors (cont)

REF. NO.	NAME	FUNCTION
17	DIGITAL OUTPUT/ LOG-ANALOG OUTPUT	An output port reserved for use with the Logarithmic Output Option-004-521 Option, or the -529 IEEE Interface Option, see Section 6 for details.
18	COUNTER OUTPUT	An output port reserved for use with the Counter Output Option -003. See Section 6 for details.
19	Linear Analog	A pair of banana jacks for output accessing the dc linear analog output voltage. This voltage is proportional to the V rms input and is linearly scaled; 2V dc out equals a 2000 count readout. The scale repeats for each range.
20	Input Power Connector	A 3-prong line power connector for connecting the unit to line power.

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which you should be aware of before attempting to operate the 8922A.

2-14. Fuse Replacement

2-15. The Model 8922A is fuse protected from the power line. You can access the fuse by pressing and turning (CCW) the fuse cap located on the rear panel. When replacement is necessary use an MDL type 1/8 amp slo-blo fuse for all voltage configurations. (For metric fuse, use 1/8A, slow acting, 5 x 20 mm glass tube type.)

2-16. Display Indications

2-17. In addition to the standard digital readout, we have equipped the front panel display with a series of unique visual indicators. These include an overrange/overload indication, an underrange indication, and an analog meter. They function automatically to help you make error free measurements.

2-18. For example, when an input signal level exceeds the display limit for the selected range an overrange will occur. The display digits flash while the overrange is present. Selecting a higher range will eliminate the overrange condition.

2-19. Measurement accuracy is uncertain when the higher voltage ranges are used to measure low level signals. To alert you to this condition, the decimal point will flash when the input is too low for the selected range (less than 180 digits). You may eliminate this underrange indication by manually selecting a lower range or selecting autorange.

2-20. The uncalibrated analog panel meter complements the digital display by linearly tracking the input signal level. It provides a 0-to-100%-of-scale indication for the selected range. This feature will aid you in detecting the peak and null points of inputs having varying levels.

2-21. Measurement Connections

2-22. COAX OR OPEN LEADS

2-23. We recommend that shielded or coax leads be used at the input for low level or high frequency measurements. Open leads (unshielded) may pick up interference from other sources causing errors at low levels. You may reduce high frequency errors by minimizing inductance and capacitance between the source and the 8922A input connector.

2-24. SAFETY CONSIDERATIONS

2-25. Under normal operating conditions, the 8922A will not present a potential electrical shock hazard to the operator. However, careless use of input-lead connectors and/or adapters may create a shock hazard.

2-26. The low input on the 8922A is connected to power ground through a pair of diodes (see front panel connector). These diodes allow the low input terminal to float up to 400 mV rms. Their function is twofold; they provide isolation between input low and power ground, and they protect the operator from the possibility of hazardous voltages existing on the exposed low input connector.

2-27. At first glance, 400 mV of isolation does not appear significant. However, in most cases it provides

enough isolation to prevent ground loop currents and, therefore, measurement errors due to ground loops.

2-28. When you connect the low input of the 8922A to a potential greater than 400 mV above power ground, the diode pair conducts and effectively clamps the input common mode voltage.

WARNING

TO AVOID ELECTRICAL SHOCK HAZARD DO NOT REMOVE OR OTHERWISE DEFEAT THE INPUT DIODE PAIR.

2-29. Under no circumstances should you attempt to defeat the function of the diodes. Specifically, the diodes should not be removed, the ground return on the power cord should not be floated, and an isolation transformer should not be used to power the 8922A. If the diodes are defeated, a shock hazard will exist at the low input connector when the low input lead is floated above 30 volts.

2-30. IMPEDANCE MATCHING

2-31. Two types of ac voltage measurements are typically made; those involving matched impedance systems and those where voltmeter loading is minimized (high impedance measurements) and no impedance matching occurs.

2-32. When matched impedance systems are measured, the input cable should be terminated as close as possible to the 8922A input, thereby minimizing input capacitance and enhancing accuracy at high frequencies. This is accomplished by including the meter as an integral part of the circuit as shown in Figure 2-3A. Notice that the integrity of the 50Ω system is maintained by using a 50Ω broadband matching power splitter. An alternate solution is shown in Figure 2-3B. In this case, the source is alternately connected to the 8922A and the test circuit. This allows the source to be adjusted to a known level before being connected to the test circuit. Since both the meter and the test circuit are 50Ω loads the circuit integrity is maintained. In either method, the accuracy will be determined in part by the accuracy of the source impedance and the accuracy of the termination.

2-33. High impedance measurements are based on the assumption that the voltmeter's fixed 10 MΩ input resistance and low input capacitance will not appreciably load or otherwise affect the circuit being measured. If the measurement frequency is low, this assumption holds true.

2-34. COMMON MODE VOLTAGE MEASUREMENTS

2-35. The 8922A will accomodate common mode voltages as high as 600 mV peak, usually enough to eliminate ground loops in the power connections. Higher common mode voltages will be clamped to 600 mV up to a 25 amp maximum load capability.

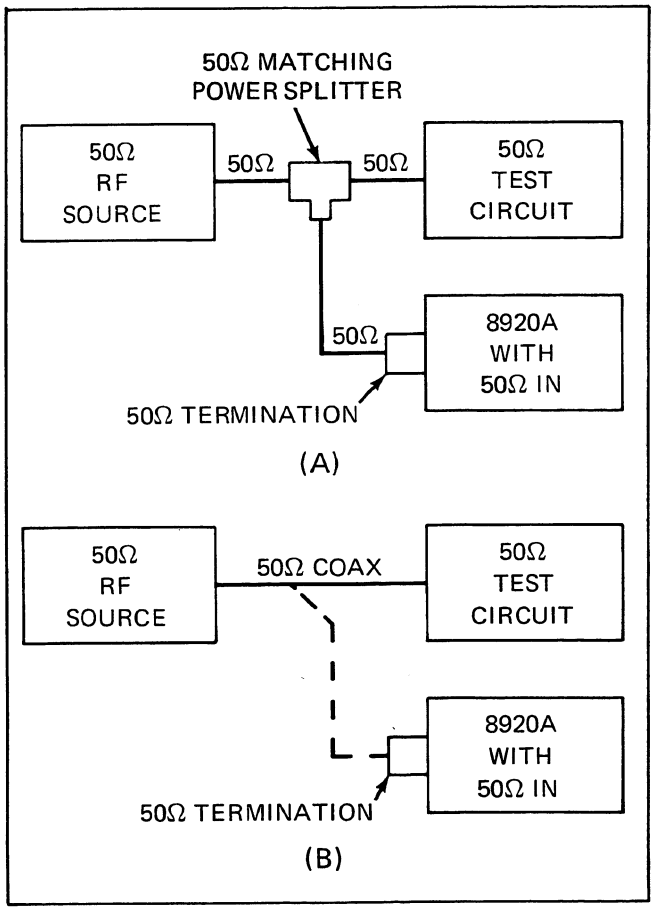


Figure 2-3. Matched Impedance Measurement Techniques

2-36. Input Signal Considerations

2-37. The 8922A is a true rms voltmeter, and as such, is subject to input conditions not encountered with the ordinary average-reading ac voltmeter. Of these, the two most important are crest factor and input coupling.

2-38. CREST FACTOR

2-39. Crest factor is the ratio of the peak voltage to the rms voltage with the dc component removed. Above 10 Hz, the crest factor is limited by the dynamic range of the amplifiers. Crest factor capability in this frequency range will be at least 7 for full-scale inputs and will increase

proportionally as the input goes down-scale. Use the following formula to calculate the crest factor of signals less than full-scale:

$$\text{Crest Factor} = \frac{7\ (\text{Range})}{\text{Input Level}}$$

For example, given the DMM is at the 20V range with a 10V input:

$$\text{Crest Factor} = \frac{>(20\text{V})}{10\text{V}} = \frac{140\text{V}}{10\text{V}} = 14$$

2-40 Below 10 Hz, crest factor is limited by the time required for the internal rms sensor protection circuit to energize and limit the sensor temperture. Typical low frequency crest factor limitation is shown in Figure 2-4. When the protection circuit does not energize, the UNCAL annunciator will light indicating that the protection circuit is introducing measurement errors. When this occurs, manually selecting a higher range may produce a better measurement.

2-41. INPUT COUPLING, AC/DC

2-42. The 8922A is equipped with a FUNCTION switch which allows you to select either AC or AC + DC coupling. When the switch is out, AC coupling is selected. In this function the dc component is removed from the input signal and is not measured or displayed. Depressing the FUNCTION switch selects AC + DC coupling. This function allows the 8922A to measure and display the true rms value for the total input signal; ac components and dc components. You should always consider the dc component when power dissipation is being determined. This function also increases the damping which is required for good performance below 10 Hz. This additional damping may also aid in the measurement of higher frequency signals when the level of the signal fluctuates.

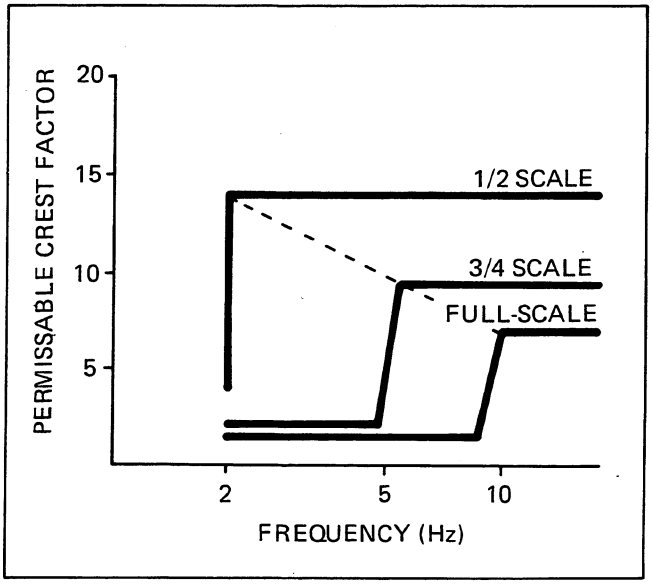


Figure 2-4. Typical 8922A Crest Factor Limitation

2-43. Range Selection

2-44. Seven voltage ranges, and what appears to be a single dB range spanning 132 dB are provided in the instrument. Range selection is normally accomplished automatically. Override switches, however, allow you to interrupt the autorange function and manually increment the range.

2-45. The autorange function optimizes the display reading for a given input. Each reading is displayed complete with decimal point and units' annunciator. The individual ranges are directly defined for the operator by labeled decimal points. Underrange (flashing decimal point) and overrange (flashing digits) indications are provided to indicate when a range change is necessary.

2-46. AUTORANGE

2-47. The proper measurement range is automatically selected when the HOLD/AUTO switch is in the AUTO (out) position. Both decimal point and units' annunciator change automatically with range.

2-48. MANUAL

2-49. Manual range determination is accomplished by selecting a range using the autorange mode and then depressing the HOLD/AUTO switch. The meter will stay in that range regardless of input level changes. If the range becomes invalid for a given input level, an overrange or underrange indication will flash. If an underrange is indicated, select autorange (AUTO). After the proper range is selected, press HOLD. For overrange conditions, momentarily press the STEP UP switch once for each desired range increment. Holding the switch in will increment the meter to the 700V range. Select autorange (AUTO) to downrange.

2-50. Voltage Display Mode

2-51. The 8922A will display a voltage input in one-of-two measurement units; volts or dB. To display the input voltage in units of volts, you must set the dB/VOLTS switch to VOLTS. The instrument will now display all input in units of volts or millivolts, as indicated by the front panel annunciators (V), (mV).

2-52. Two points of interest about the volts display mode are as follows: one, if the input is completely unknown, allow the autoranging circuit to select the appropriate range. Two, the selection of the volts display

mode will not affect any previous reference established in the dB display mode (see following paragraphs for additional information about establishing a dB reference).

2-53. dB Display Mode

2-54. When the instrument is in its dB display mode, all voltage inputs are referenced to a selected level, and displayed as deviations (in dB) above or below that level. If you wish to display the input voltage in dB units, set the dB/VOLTS switch to dB. The instrument's front panel dB annunciator will now light, indicating to you that the display is presenting a measurement in dB units.

2-55. The instrument references all inputs to a selected level. Before a meaningful measurement in dB units can be made, the desired reference level (0 dB) must be established. See RELATIVE REFERENCE Selection and dBm REFERENCE.

2-56. dBm Measurements

2-57. Measurements made to a fixed 1 milliwatt reference are defined as dBm. The 1 milliwatt reference is generally assumed, as indicated by m. However, the system impedance must be specified for a particular measurement. Once the impedance is selected, the instrument will display its measurements in dBm.

2-58. The 8922A is equipped with a rotary switch called dBm REFERENCE (Ω). By setting the switch to 1-of-12 possible standard reference impedances (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) you establish that impedance as a reference. When the system impedance and the reference are the same, the display is in terms of dBm.

NOTE

If the 1000 ohm reference impedance is selected ("dBV" on the rotary switch), the 0 dB point will correspond to 1V.

2-59. dBm REFERENCE SELECTION

2-60. Use the following procedure to select a reference impedance and enable the dBm display mode:

1. Depress the dB/VOLTS switch (in).

2. Release the REL/dBm switch (out).

3. Set the dBm REFERENCE (Ω) switch to correspond with the system impedance.

NOTE

The dBm REFERENCE switch does not affect the fixed 10 MΩ input impedance of the 8922A. All impedance matching terminations must be added externally by the operator.

2-61. Relative Measurements (REL)

2-62. This feature allows you to make any voltage input a "0 dB point" to which all other voltage inputs may be referenced. For measurements at a single test point, press the dB switch, then the REL switch and watch the dB change as you make adjustments or circuit changes.

2-63. A typical application for the dB measurement mode is shown in Figure 2-5. The relative reference (0 dB) has been established at TP2. Subsequent dB measurements at TP1, TP3, TP4, and TP5 are displayed (in dB) as shown.

2-64. RELATIVE REFERENCE SELECTION

2-65. Use the following procedure to enable the relative (REL) display mode and select a relative (0 dB) reference.

1. Connect the reference source to the 8922A input terminals. If desired, measure and adjust the reference supply voltage level.

2. Select the autorange mode (AUTO).

3. Release the REL/dBm switch (out).

4. Depress the dB/VOLTS switch (in).

5. With the reference level still connected to the input terminals, depress the REL switch. The display should now read 0 dB and the RELATIVE REFERENCE annunciator should be lit.

2-66. OTHER dBm REFERENCES

2-67. When a dBm reference, other than those given on the dBm REFERENCE switch is required, use the following procedure to establish the reference:

1. Define the reference impedance (R) and calculate V using the following formula:

$$V = 0.001 \times R$$

2. Apply an adjustable voltage source to the 8922A input and set the dB/VOLTS switch to the VOLTS position. Adjust the voltage source for a display reading equal to the calculated value of V.

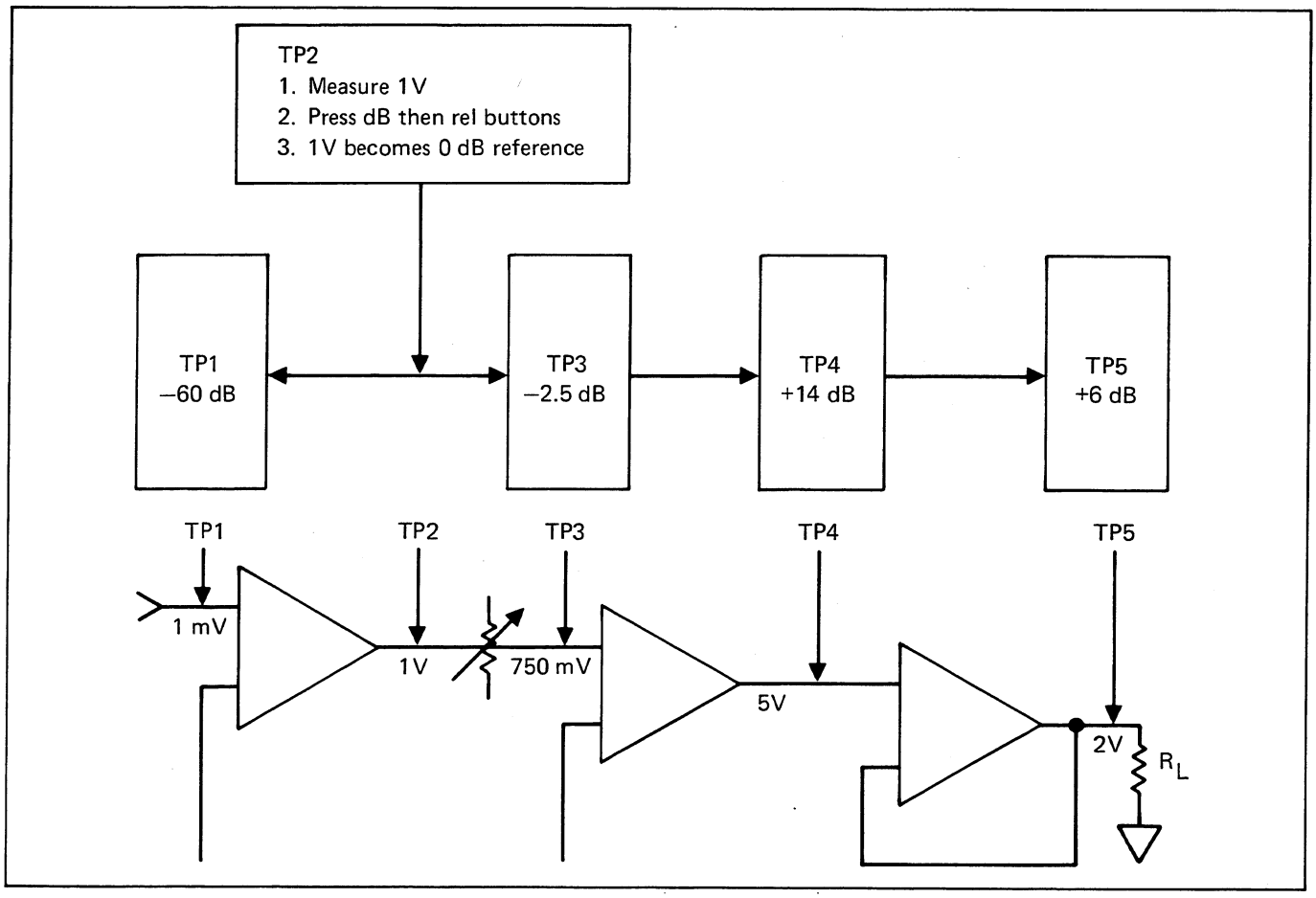


Figure 2-5. Typical Relative dB Measurements

3. Depress the dB/VOLTS switch (in).

4. Depress the REL/dBm switch (in). This establishes the voltage (V) as the 0 dB reference level. Therefore, subsequent dB measurements will be equivalent to dBm measurements as long as the system impedance R is maintained.

NOTE

This reference will hold as long as the REL/dBm switch is at the in position and the instrument is energized.

2-68. Linear Analog Output

2-69. A pair of banana jacks on the rear panel of the 8922A provides access to a linear dc analog output signal. This signal is proportional to the applied input signal and is linearly scaled; a 2V dc output is equal to 2000 counts on the display. Output accuracy is ±1% relative to the front panel reading. The output signal is buffered, and is suitable for driving an external analog meter, recorder, plotter, scope, etc.

2-70. OPERATION

2-71. With reference to the preceding paragraphs, use the following procedure to turn-on and operate the Model 8922A (refer to Section 6 for option and accessory information):

1. Connect the 8922A to line power.

2. Set the front panel POWER switch to ON (in). The front panel display should light.

3. Select the appropriate input leads and connect them to the meter's input terminals. Add terminations as close as possible to the input connector, if impedance matching is required.

4. Select input coupling by setting the FUNCTION switch to AC (out) or AC + DC (in), as desired.

5. Select the desired range. Use automatic or manual method, as desired.

6. Set the DISPLAY switches to select the desired measurement mode: volts, dB, or dBm. If dB is selected, establish a 0 dB reference.

7. Observing safety considerations, connect the test leads to the measurement points. The results are displayed on the 8922A readout.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. The information in this section describes the theory of operation for the 8922A True RMS Voltmeter. The theory has been divided into two major headings; overall functional description and detailed block diagram description. To gain maximum benefit from this section, we recommend that you read each paragraph in the order presented while referring to the associated figure or the appropriate schematic in Section 8.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. As you can see in Figure 3-1, the circuitry of the 8922A can be divided into two sections; analog and digital. An overall functional description of these two sections is presented in the following paragraphs.

3-5. Analog Circuitry

3-6. The analog section comprises the largest portion of the 8922A circuitry. As shown in Figure 3-1, this section is broken down into the following areas: the signal conditioner, the rms converter and the power supply.

3-7. Referring to Figure 3-2, you can see that the signal being measured by the 8922A can be coupled to the signal conditioner in one of two ways (AC or AC + DC). When you place the FUNCTION switch on the front panel to the AC position all input signals are capacitively coupled; when the AC + DC position is selected the input signal is dc, or directly coupled. This feature contributes to the measurement accuracy when dc components are present in the input signal.

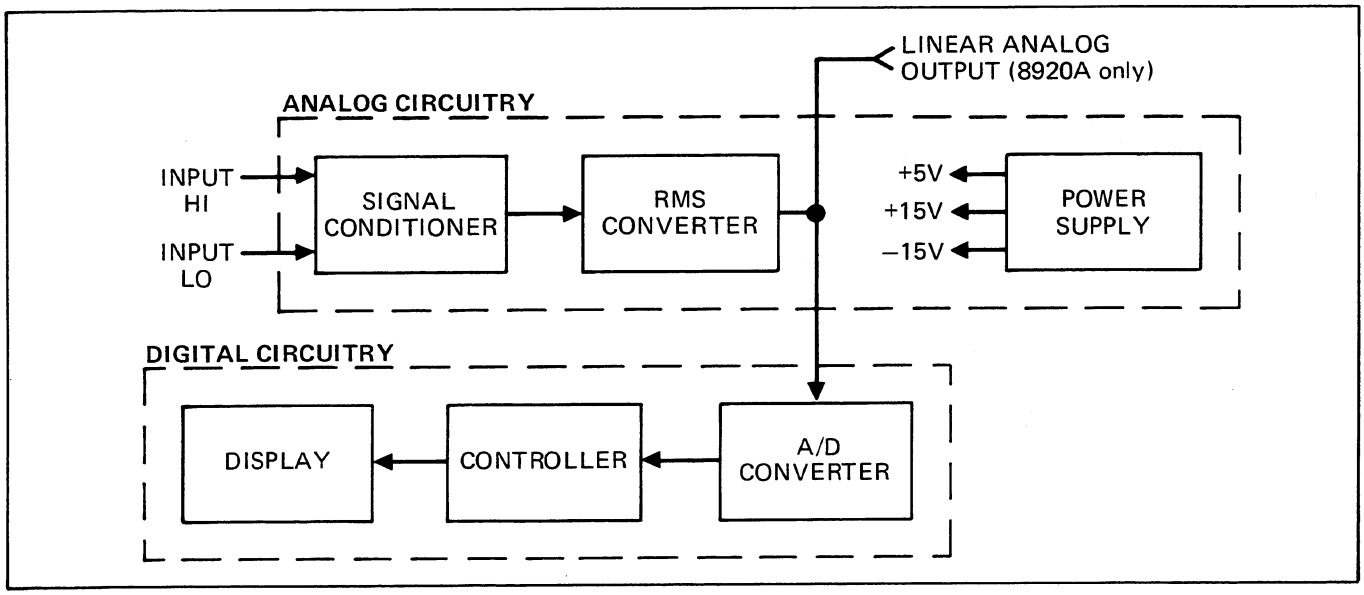


Figure 3-1. Overall Block Diagram

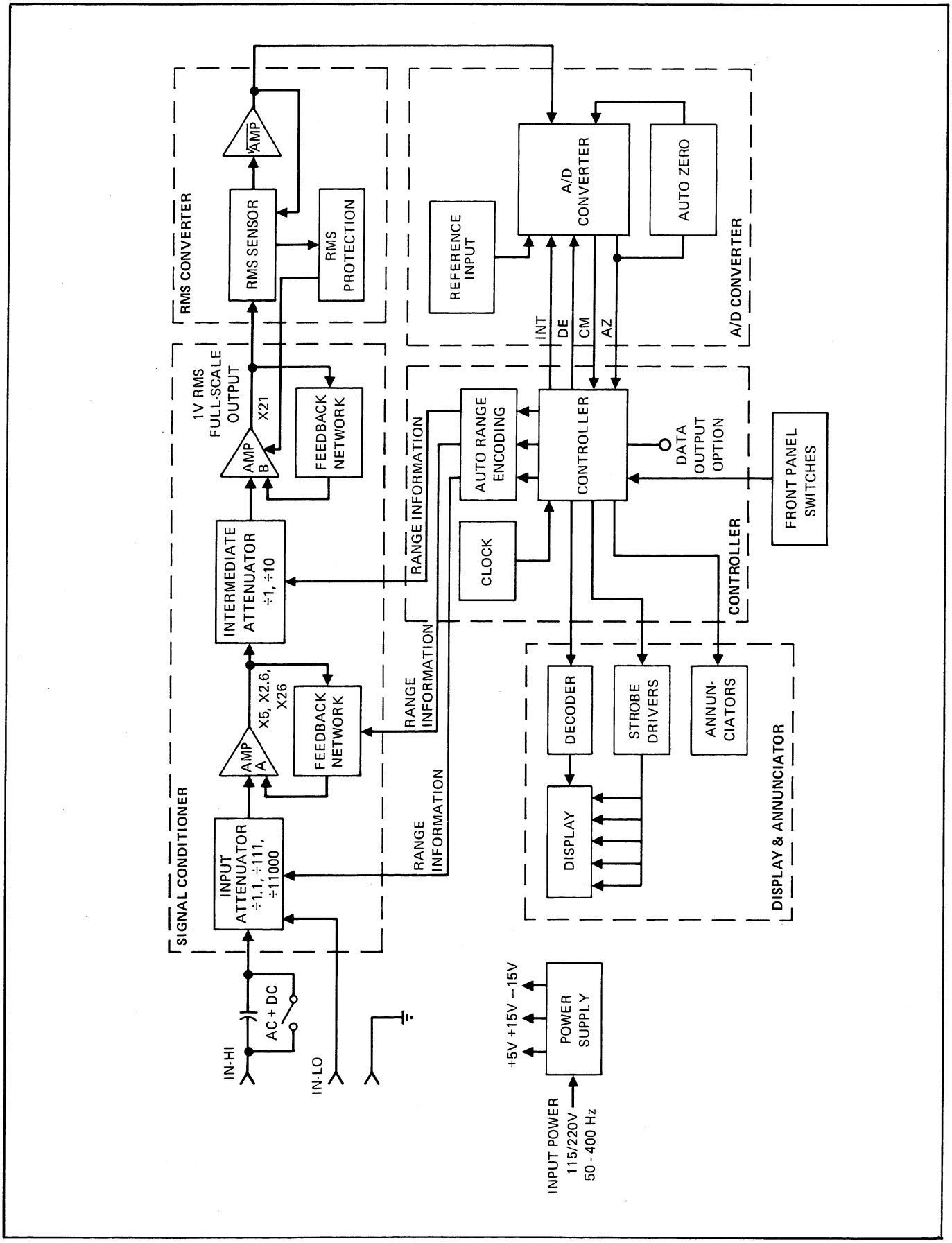


Figure 3-2. Detailed Block Diagram

3-8. The signal conditioner insures that the varying levels of instrument input voltages are properly scaled before being applied to the rms converter. The rms converter works on a thermal sensing principle. Basically, it operates by balancing the heating power of a dc feedback signal to the heating power of the ac input signal. When the two are equal, the circuit is in equilibrium and the dc output voltage applied to the A/D converter is directly representative of the true rms value of the ac input signal. The dc output of the rms converter is also applied to the LINEAR ANALOG OUTPUT terminals on the rear panel of the 8922A, as well as the analog meter on the front panel of the 8922A.

3-9. The last analog circuit we discuss in this section is the power supply. This circuit provides three regulated power supplies (+5V, +15V and -15V) to operate the instrument.

3-10. Digital Circuitry

3-11. The digital circuitry comprises the A/D converter, the controller, and the display. Together these circuits develop a digital representation of the rms value of the input signal, produce the commands that set the range and function of the instrument, and finally display the input value.

3-12. The dc output of the rms converter is translated to a digital representation by the A/D converter. The digital representation is processed by the controller to obtain a bcd output which is proportional to the selected display mode (VOLTS, dB, dBm, REL). The BCD output is decoded and applied to the display.

3-13. DETAILED BLOCK DIAGRAM DESCRIPTION

3-14. In the following paragraphs we discuss, in detail, the individual functions within the major areas of circuitry in the 8922A. Each major circuit area is detailed in Figure 3-2. The description for each circuit is keyed to a separate block diagram, or to the schematics in Section 8.

3-15. Signal Conditioner

3-16. The signal conditioner utilizes an input attenuator, two amplifiers (Amp A and B) and the intermediate attenuator. As shown in Figure 3-3, these circuits are used to scale the varying voltage levels applied to the instrument so that the input to the rms converter is always between 0.09V rms and 1V rms. The diagram in Figure 3-3, illustrates the configuration of the circuitry within the signal conditioner. The controller, through a range decoder network, issues commands which select the appropriate division factor in the attenuators and the correct multiplication factor for amplifier A. Table 3-1, lists each operating range and the corresponding division and multiplication factors for the attenuators and amplifier (note that amplifier B has a fixed gain of X21).

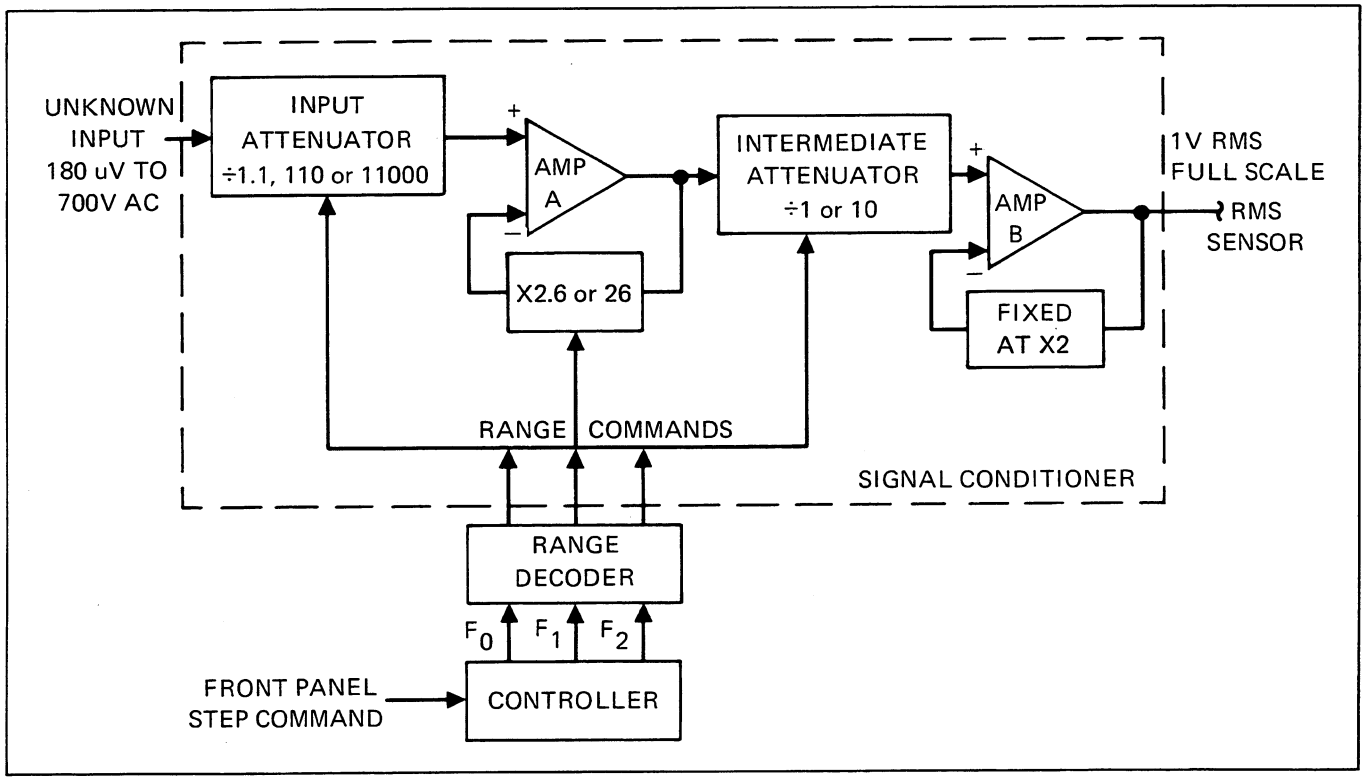


Figure 3-3. Signal Conditioner

Table 3-1. Signal Conditioner Gain Configuration

RANGE	INPUT ATTENUATOR	AMP A	INTERMEDIATE ATTENUATOR	*CONDUCTING COMPONENTS
2 mV	÷1.1	X26	÷1	K1, Q6, Q28, Q32
20 mV	÷1.1	X2.6	÷1	K1, Q6, Q29, Q32, Q57
200 mV	÷1.1	X2.6	÷10	K1, Q6, Q29, Q31, Q57
2V	÷110	X2.6	÷1	K2, Q3, Q5, Q29, Q32, Q57
20V	÷110	X2.6	÷10	K2, Q3, Q5, Q29, Q31, Q57
200V	÷11,000	X2.6	÷1	K2, Q4, Q5, Q29, Q32, Q57
700V	÷11,000	X2.6	÷10	K2, Q4, Q5, Q29, Q31, Q57

*Refer to the schematics in Section 8.

The last column lists the component's FETs and relays, that conduct to establish gain configuration of the circuits (see the schematics for details on components).

3-17. RMS Converter

3-18. The 8922A uses a thermal rms converter circuit which supplies a dc output voltage proportional to the rms value of the ac input. The thermal sensor is a pair of resistor-transistor elements thermally isolated from each other and the case (see Figure 3-4). The ac input signal (Vac from amp B) produces a temperature change in the rms sensor's input resistor which is sensed by the associated transistor and causes a voltage change at the negative input of the integrator. Feedback, through the square root amplifier, provides a dc voltage to the rms sensor's output resistor so that a similar temperature rise occurs in the output resistor. The sensor gain is not constant with changes in input amplitude. These changes in gain are compensated for by the square root amplifier to maintain a constant response time for level changes.

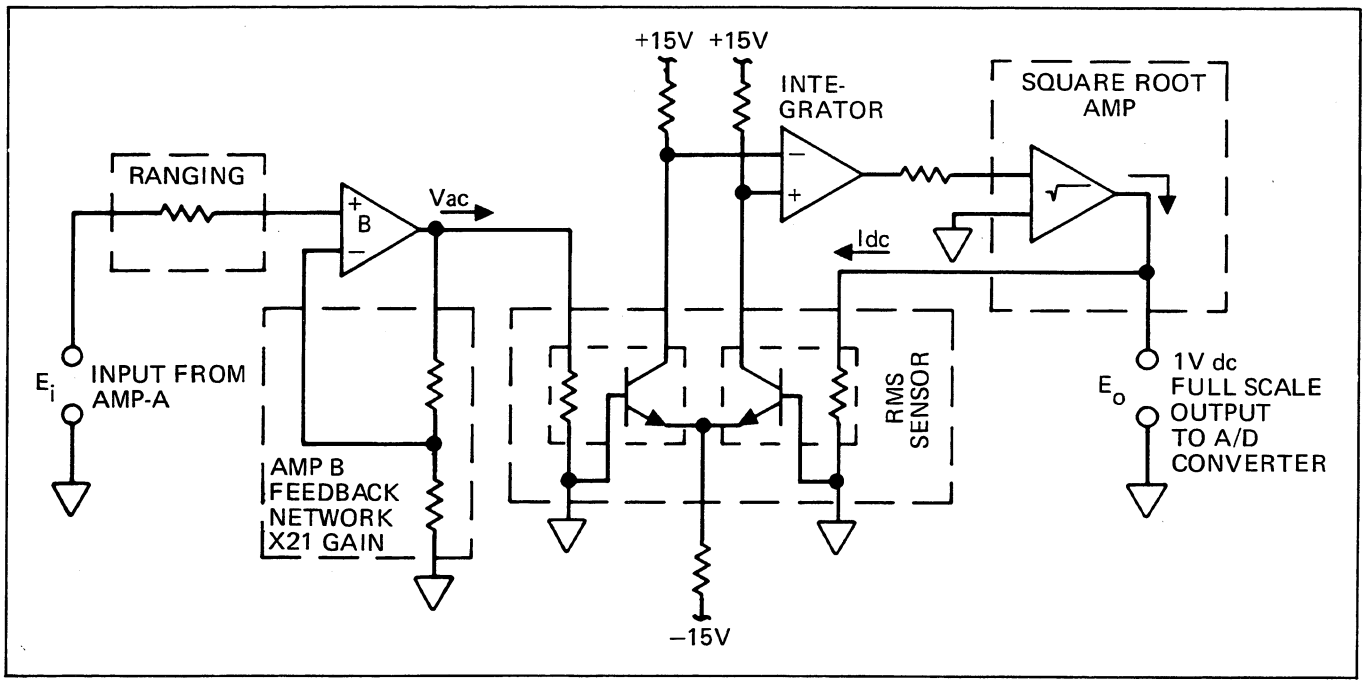


Figure 3-4. RMS Converter

3-19. The rms sensor is susceptible to damage from overvoltage inputs. During an overload condition, the protection circuit will clamp the output of Amplifier B to prevent damage to the sensor. Overload conditions would result during turn on, turn off, or any time the rms value of the applied input exceeds the operating range of the sensor.

3-20. A/D Converter

3-21. A dual-slope integration A/D conversion technique is used in the Model 8922A. This method applies the unknown voltage to a capacitor and allows the capacitor to charge for a specific time interval. At the end of this interval, the unknown voltage is removed (the charge on the capacitor at this time will be proportional to the level of the unknown voltage). Then a known voltage of opposite polarity is applied to the capacitor, and clock pulses are counted while the capacitor discharges. When the capacitor has reached its original charge point, the number of clock pulses counted is a digital construct of the analog voltage input to the A/D converter.

3-22. For the following discussion refer to Figure 3-5, the A/D Converter Simplified Schematic and Timing Diagram, and Figure 3-6, Controller Timing (A/D Converter).

3-23. At the beginning of the measurement cycle, INT goes high and the dc output of the rms sensor is applied to the A/D integrator for 100 msec. Capacitor, C203, charges up from the auto zero level at a rate proportional to the applied input voltage and the comparator's output, CM, is driven low. At the end of the 100 msec integrate period, DE (–) goes high, applying the reference voltage to the integrator. The integrator then discharges at a rate which is constant for all on scale inputs and the controller begins counting clock pulses. When C203 has discharged to the auto zero level, CM will go high, the controller will stop counting and the reading is displayed. This starts the auto zero period which allows the A/D converter circuitry to settle before the next cycle begins. If CM has not occurred before the end of the 200 msec maximum DE (–) period, the input will have exceeded the present range. In this case, the DE period will continue until either CM or the end of the 100 msec AZ1 occurs. When the AC + DC function is selected, all timing increase approximately 2.5 times.

3-24. Controller

3-25. The controller is a custom LSI that controls autoranging, the A/D converter, the display, and annunciators. In addition, the Controller can count in a non-linear (dB) scale and display its count in dB units. A summarized description of each input and output pin used on the controller is give in Table 3-2 and shown in Figure 3-7.

3-26. AUTORANGING

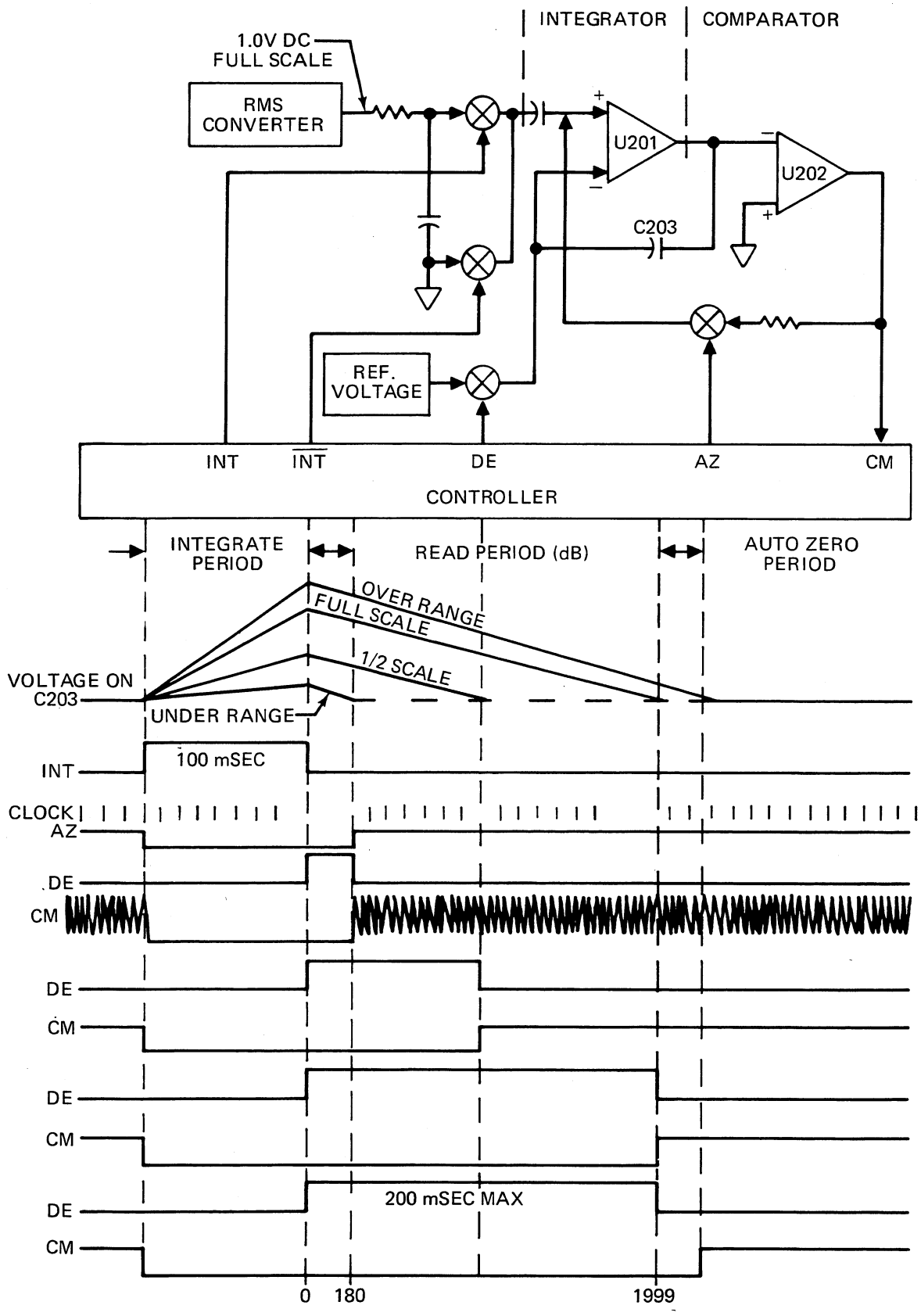
3-27. Autoranging is the automatic selection of the instrument's range by the controller. With the low range enabled, the instrument may range through seven voltage ranges from 2 mV to 700V rms. Autoranging also applies in the dB modes but gives the effect of a single range spanning 132 dB. By coding the logic levels on the three lines, F0, F1, and F2, the controller selects a range (see Table 3-3, Output Range Codes) by setting up the circuit conditions of the input and intermediate attenuators and amplifier A that are necessary for signal conditioning in that range. (See Table 3-1, Signal Conditioner Gain Configuration.) If the controller senses that the input is above or below the selected range (see Table 3-4, Over/Underload Conditions), it shifts up or down one range (depending upon the direction sensed) and halves its cycle time. The controller blanks the display and determines whether the input to the instrument is now in range or if a further change in range is necessary. When the proper range is found, display blanking is removed and the cycle time returns to normal. Use of the HOLD RANGE control will command the Controller to remain at the present range (see Table 3-5, Input Range Codes) via command input line D, E, and F. A signal from the STEP UP RANGE control will increment the instrument one range.

3-28. COMPUTATIONS

3-29. The controller is able to count (compute) in two modes, linear or non-linear. The following paragraphs will explain how the controller obtains its linear (volts) or non-linear (dB) readings.

3-30. Voltage Computations

3-31. To make a voltage measurement the controller must linearly count clock pulses for a time determined by the A/D converter. Referring to Figure 3-7, you can see that when the dB/VOLTS switch is placed in its up (out) position the rate multiplier (RM) will be shunted and the main counter will count the number of clock pulses exactly as they occur (linear). As soon as the integrator in the A/D converter reaches the auto-zero point, CM will go high, commanding the main counter to stop counting and start shifting its count to the data latches. A count of clock pulses, in BCD format, that is proportional to the true rms value of the signal being measured. The BCD data is then shifted out of the controller, to a seven-segment decoder on four lines: W, X, Y and Z.



For AC + DC (damping) Function, times increase by 2.5.

Figure 3-5. A/D Converter Simplified Schematic and Timing

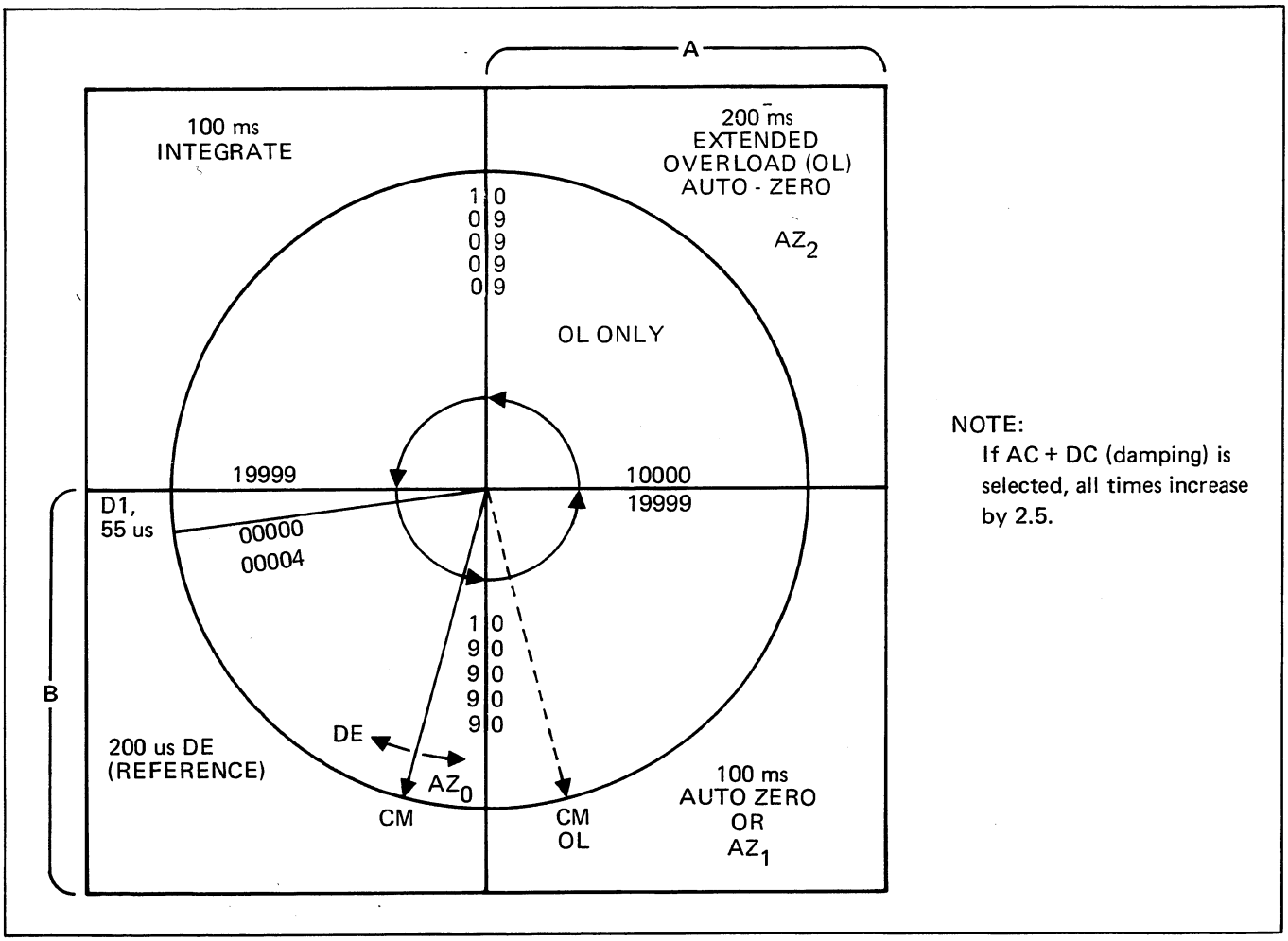


Figure 3-6. Controller Timing (A/D Converter)

Table 3-2. Controller Summary

INPUT/ OUTPUT	PIN #	PIN NAME	PIN DESCRIPTION
Input	1	V_{SS}	+5V supply
Input	2	CM	Compare signal from A/D Converter.
Input	3	CL_1	External Oscillator input.
Input	4	CL_2	400 kHz crystal input for internal oscillator.
Output	5	$\overline{RG}$	Negative going pulse in the middle of each strobe. Insures strobed data for DOU is valid.
Output	6-10, 12-14	ST_0-ST_7	Eight strobes that indicate which LED is to be enabled and accept the data on lines W, X, Y and Z.
Input	11	RD	Impedance reference selection line, in dB.
Output	15-17	F_0-F_2	Encoded range lines, F_0 = MSB, F_2 = LSB, code equals range # + 1, voltage swings from; −15 to 0V.
Input	18	β	Strobe input on this pin determines the lower range limit.
Input	19	α	Strobe input on this pin determines the upper range limit.
Output	20	DP	Enables display decimal point.
Input	21	V_{DD}	Ground, 0V supply.

Table 3-2. Controller Summary (cont)

INPUT/ OUTPUT	PIN #	PIN NAME	PIN DESCRIPTION
Output	22	BZ	Indicates new data is ready for DOU, occurs after CM, one strobe raster long.
Input	23-25	F, E & D	Enables controller ranging, see Table 3-5.
Output	26-29	W, X, Y & Z	BCD data, W = MSB, Z = LSB, TTL compatible.
Output	30	$\overline{BLK}$	Drives blanking input on display decoder driver, TTL compatible.
Input	31	$\overline{K}$	700V range overload enable.
Input	32	V_{GG}	−15V supply.
Input	33	$\overline{J}$	Enables 3½ or 4½ digit display in linear mode and determines (in combination with RD) the fixed reference in dB mode.
Input	34	T_1	Test (not used).
Input	35	dB	Enables dB display mode.
Output	36	$\overline{INT}$	Enables not integrate period of A/D Converter.
Output	37	INT	Enables integrate period of A/D Converter.
Output	38	AZ	Enables auto zero period of A/D Converter.
Output	39	DE (−R)	Enables integrate reference period for positive input of A/D Converter.
Output	40	DE (+R)	Enables integrate reference period for negative input of A/D Converter (not used).

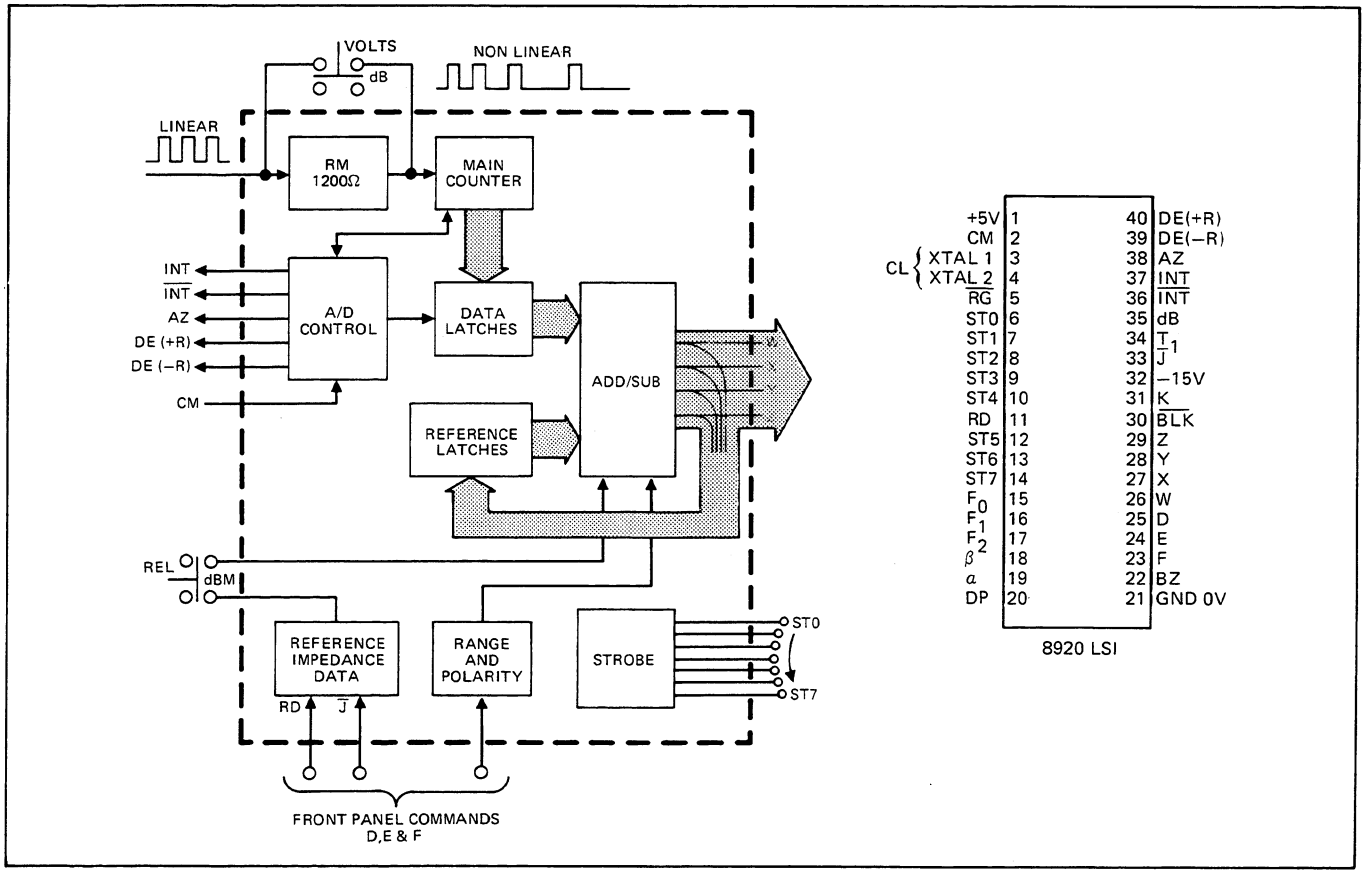


Figure 3-7. Controller Functions

Table 3-3. Output Range Codes

RANGE	DATA LINES		
	F_0	F_1	F_2
2 mV	0	0	1
20 mV	0	1	0
200 mV	0	1	1
2V	1	0	0
20V	1	0	1
200V	1	1	0
700V	1	1	1

Table 3-4. Over/Underload Conditions

	LINEAR	dB*
Overload:	>1999 β	25.30 (20V range)
except for 700 700V range:	>700 α	56.10
Underload:	<180	4.30 (20V range)
minimum input for accurate dB conversion	132	1.60 (20V range)

*dB calculations are based on a 1200 ohm reference impedance and 20V range. The calculation is then corrected for the proper range and the selected impedance by the addition of the appropriate constant, which may be calculated from the following equation:
$20 \log \sqrt{1.2-20} \log \sqrt{0.001R} + N\ (20)$.
Where N = number of ranges above or below the 20V range, i.e., 2 mV range N = X4

Table 3-5. Input Range Codes

COMMAND LINES			8922A CONTROLLER FUNCTION
D	E	F	
0	0	1	Auto range fast range cycle
1	0	0	Hold present range (overridden by α & β)
1	1	0	Range up at CM time (overridden α & β)

3-32. dB Computations

3-33. If the dB/VOLTS switch is in the dB position, a non-linear count of the clock pulses is enabled. The binary rate multiplier (RM) passes only a fraction of the clock pulses on to the controller's main counter (see the illustrated input to the main counter on Figure 3-7). This count approximates the logarithmic curve of the dB scale and, like the VOLTS mode, is stored in the data latches.

3-34. dBm Reference

3-35. Don't let the m confuse you, it simply means that the power level, as measured in "dB Computations", is referenced to 1 mW. In other words, when the instrument reads 0 dB the system being measured will be dissipating 1 mW of power. The following will explain how the controller obtains a measurement of power referenced to 1 mW (dBm).

3-36. In order for the controller to obtain a measurement in dBm, the appropriate reference impedance must be used. A 1200 ohm reference impedance is assumed by the RM. Therefore, if any other reference is desired an appropriate constant must be added or subtracted from the count. The dBm REFERENCE rotary switch connects one of the eight strobes to RD and J. The controller responds by sending the appropriate constant to its ADD/SUB.

3-37. Referring to Figure 3-7, let's assume that a 600 ohm reference impedance is selected and the instrument has previously made a relative measurement. Strobe zero will be applied to RD until the REL/dBm switch is placed in its dBm position. At this time strobe 4 (corresponding to 600 ohms) is applied to RD and causes the controller to select the 600 ohm reference impedance data. This data along with the range and polarity data is then shifted to the ADD/SUB where it is combined with the count referenced to 1200 ohms. The resultant value is now equivalent to a dBm reading referenced to 600 ohms. The range and polarity data is held in the reference latches until RD or J detect a strobe change or unless the instrument is turned off. (Switching to the VOLTS mode will not cause the data in the reference latches to be lost.)

3-38. Relative (REL) Reference

3-39. Relative reference measurements allow any voltage input to become the 0 dB point to which all subsequent voltage inputs are referenced. The controller makes a relative reference computation much the same way it made a dBm computation. However, in the REL mode, 0 dB no longer refers exclusively to 1 mW. The following explains how the controller makes a relative reference measurement.

3-40. Referring the Figure 3-7, you can see that upon selection of the REL mode, the reference impedance data line will be disabled. However, to make a relative

reference measurement the controller must use an initial reading, and to obtain an initial reading it must use a reference impedance. Therefore, before the REL mode can be selected the controller must be allowed to make at least one complete measurement while in the dBm mode. Once the measurement has been completed the REL mode may be selected. The reading will now be fed back to the reference latches and held. The controller will subtract the reading in the reference latches from all subsequent readings. Note that if the instrument is ranged up/down, 20 dB will be added to or subtracted from the reading held in the reference latches. The reading held in the reference latches, however, will be lost any time the instrument is turned off or if the REL switch is released.

3-41. Display and Annunciators

3-42. The computed value of the input to the instrument is transmitted serially as four-bit BCD characters on the W, X, Y, and Z data lines from the controller to the seven-segment-decoder, see Figure 3-8, Display and Annunciators. The output of the seven-segment-decoder drives the Display Data Bus, which is common to the inputs of all five of the display LEDs. Strobe pulses from the controller determine which display LED is enabled to accept the data on the Display Data Bus. ST4 through ST7 strobes the seven-segment LEDs from LSD to MSD, respectively. ST0 gates the ±1 digit. If the volts display mode is selected, 3½ digits will be enabled resulting in a resolution of 0.05%. If the dB display mode is selected, 4½ digits will be enabled and the resolution will be 0.01 dB. The decimal point is enabled separately by the DP line from the controller.

3-43. the annunciators, excepting the UNCAL, are strobed on by ST0 which is routed through two circuits. One path is completed when the dB/VOLTS switch is in the dB position. The dB annunciator DS309 is enabled. If the REL/dBm control is in the REL position, RELATIVE REFERENCE annunciator, DS308, will also be enabled. If the dB/VOLTS switch is in the VOLTS position, ST0 is routed through another path and either the V annunciator, DS307, or the mV annunciator, DS306, is enabled depending upon the current range of the instrument.

3-44. Power Supply

3-45. The power supply section on the Main PCB provides the instrument with operating voltages of +15V, -15V, and +5V.

3-46. Line voltage (100V, 120V, 220V or 240V, as selected by switches S209 and S210) is connected to the primary of the main power transformer, T200 via POWER switch, S208, and fuse, F1. the secondary of T200 contains two windings. One winding drives the +5V power supply, the other drives the ±15V power supply.

3-47 In the +5V power supply, power from the secondary winding is full-wave rectified by CR205, filtered by C211, and regulated by VR203.

3-48. In the ±15V power supply, power from the secondary winding is full-wave rectified by CR204, filtered by C209 and C210, and regulated to +15V by VR202. The -15V is regulated by U211 and Q207.

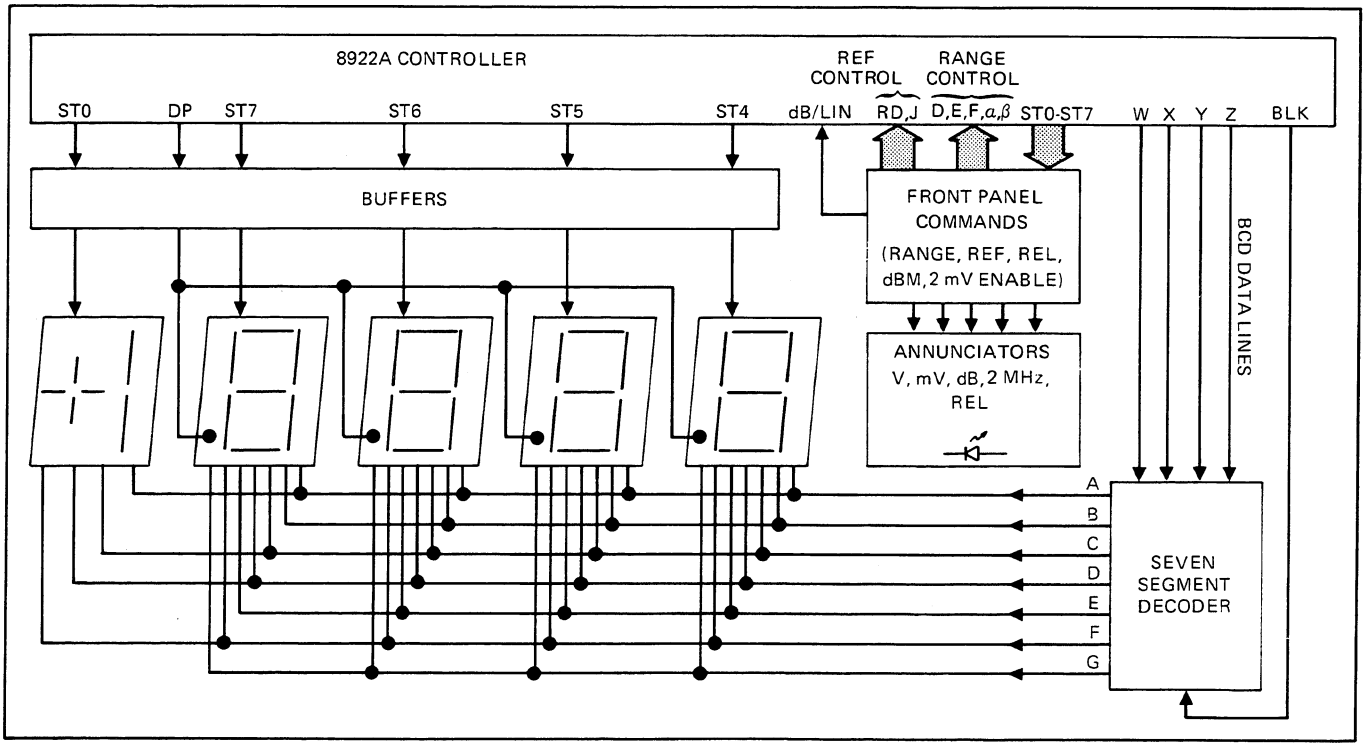


Figure 3-8. Display and Annunciators

Section 4
Maintenance

WARNING

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

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 8922A True RMS Voltmeter. The material is presented under the categories of shipping information, general maintenance, performance test, calibration adjustments, and troubleshooting. The performance test is recommended as an acceptance check when the instrument is first received and as performance verification test at regular intervals. Table 4-1 lists the test equipment required to calibrate your 8922A. If the recommended equipment is not available, you may substitute equivalent equipment that meets the required characteristics.

4-3. SERVICE INFORMATION

4-4. The 8922A is warranted for a period of 1 year upon delivery to the original purchaser. The warranty is located on the back of the title page.

4-5. Factory authorized calibration and service for your 8922A is available at various locations throughout the world. A complete list of these factory authorized service centers is included in Section 7. If requested, an estimate will be provided to you before work is begun on an instrument that is beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Access Information

4-8. To gain access to the interior of the instrument, remove the four screws located on the bottom of the case. The top cover can now be removed.

4-9. INPUT POWER SELECTION

4-10. The 8922A may be operated from any one of the line voltages shown in Table 4-2. Use the following procedure to prepare the instrument for use with the local line power.

1. Disconnect the instrument from the line power and remove its top cover (four screws on the bottom of the unit hold the top cover in place).

2. Set switches, S209 and S210, to the positions indicated in Table 4-2 for the desired line voltage.

3. Install the top cover and connect the unit to line power.

Table 4-1. Recommended Test Equipment

EQUIPMENT NOMENCLATURE	REQUIREMENT	RECOMMENDED EQUIPMENT
Precision AC Calibrator and Power Amplifier	19 mV to 600V 20 Hz-50Hz, ±0.2% 50 Hz-50 kHz, ±0.1%	John Fluke 5200A & John Fluke 5205A
DC Voltage Calibrator	±0.5% ±3 μV (AC Component < 100 μV)	John Fluke 341A
Leveled Generator	Short term stability, drift and adjustment resolution < .1% Freq. range 50 kHz-11 MHz or greater.	Tektronix SG-503/ Series 500 Mainframe
DVM	3½ digits, 0.25% Resolution	JF-8020A
Flat Attenuator, 20 dB (three required)	Flatness 50 kHz-1 MHz, ±0.1% 50 kHz-10 MHz, ±0.5%	GR, 874-G20L
1V Transfer Standard	50 kHz-11 MHz, ±0.1%	JF-A55 1V
GR Tee Adapter Adapter Adapter	874 874-BNC (2 required) 874-BNC Banana-BNC	GR, 874-TL GR, 874-QBPAL GR, 874-QBJAL Pomona 1296
Feed thru 50Ω Termination	1 GHz rated	TEK, 011-0049-01
RMS Voltmeter	2 Hz-10 Hz ±1%	JF-931
Function Generator	2 Hz Sine wave	

Table 4-2. Input Power Selection

SWITCH POSITION (REAR PANEL)	SELECTED LINE SOURCE ac ±10%, 10 WATTS MAX
S209 S210 	120V, 50-400 Hz
	100V, 50-400 Hz
	220V, 50-400 Hz
	240V, 50-400 Hz (250V, MAX)

4-11. Cleaning

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastic materials of the instrument.

4-12. Clean the front panel and case with denatured alcohol or a mild solution of detergent and water. Clean dust from the interior of the instrument with dry, low pressure air (20 psi). Contaminants can be washed from the circuit board with demineralized water and a soft brush (avoid getting excessive amounts of water on the switches).

4-13. Fuse Replacement

4-14. The 8922A has one replaceable fuse located on the rear panel which may be replaced with a 1/8 amp, slo-blo fuse (Metric uses 5x20 mm, 1/8 amp slow acting).

4-15. PERFORMANCE TEST

NOTE

In the following procedures the instrument (8922A) which is being either checked or calibrated is referred to as the UUT (Unit Under Test).

4-16. The following paragraphs comprise a performance verification test which compares the instrument's performance to the specifications given in Section 1 of this manual. The test is recommended as an acceptance test when the instrument is first received and later as a calibration procedure to verify instrument accuracy at the scheduled calibration periods (90-days). It can also be used as an aid in troubleshooting. Test equipment required for the performance test is listed in Table 4-1. If the recommended test equipment is not available, equivalent test equipment may be substituted. To insure optimum results, the test must be performed at an ambient temperature between 18 and 28 degrees Celsius with a relative humidity of 80%. Allow the instrument to warmup at least 30 minutes, with the case cover in place, before attempting the performance test.

4-17. If the instrument fails to meeet the performance test limits, calibration adjustment, troubleshooting, and/or repairs are indicated. Procedures for calibration adjustments and troubleshooting are given later in this section of this manual.

NOTE

In all of the procedures in this section, precautions should be taken to minimize ground currents, stray fields, etc.

4-18. Low and Midband Performance Check (Volts Display Mode)

4-19. This procedure will verify that the UUT's low and midband performance is within the limits specified in Section 1. Set up the test equipment as shown in Figure 4-1, and select the required function and input signal as indicated in Table 4-3. Note any deviation between the UUT performance and the specified limits.

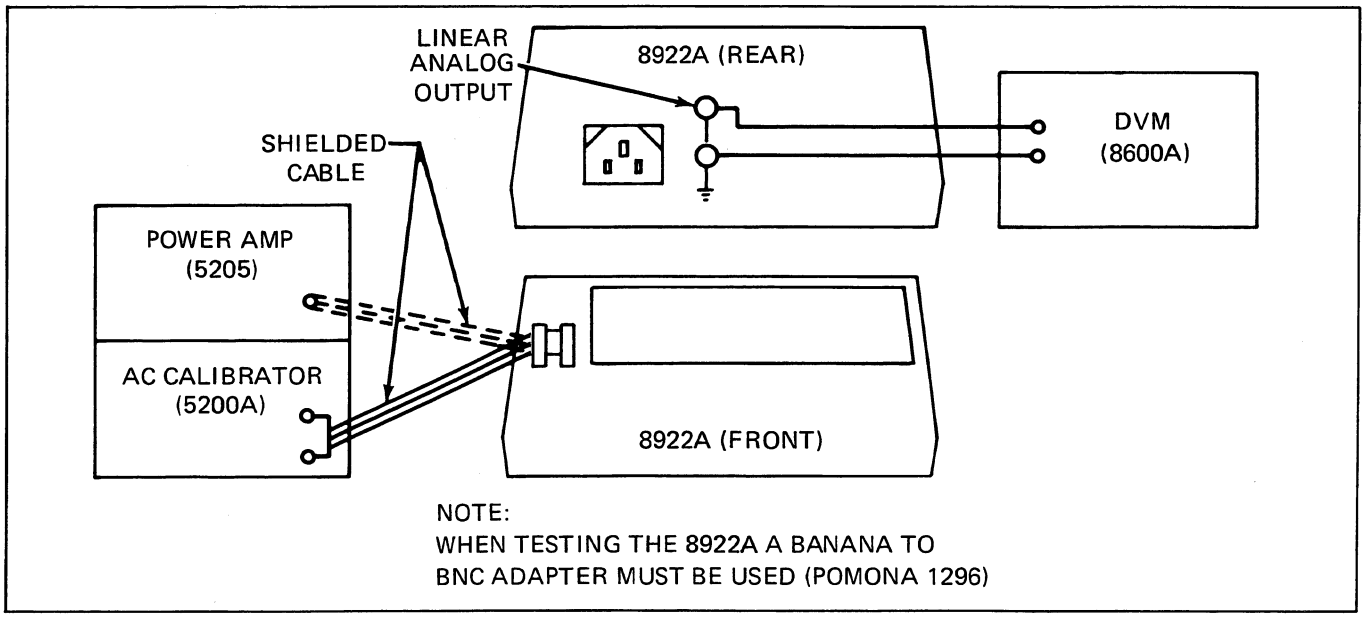


Figure 4-1. Low and Midband Performance Test Set-Up

Table 4-3. Low and Midband Performance Checks (Volts Display Mode)

FUNCTION MODE	RANGE	INPUT		DISPLAY	LIMITS or COUNTS	COMMENTS
		LEVEL	F(Hz)			
AC, AUTORANGE	2 mV	1.9 mV	500	1.000	±38	Note that the mV annunciator is lit.
AC, AUTORANGE	20 mV	10 mV	500	10.00	±10	Note that the mV annunciator is lit.
AC, AUTORANGE	200 mV	100 mV	500	100.0	±5	Note that the mV annunciator remains lit.
AC, HOLD	2V	3V	500	1.999		Verify that display flashes 1.999 signifying overrange.
AC, HOLD	2V	1V	500		±.01V	Measure 1V on the linear analog output. Note that the test instrument's reading is within ±.01V of UUT's displayed reading.
AC, HOLD	2V	.2V	500		±.002V	Measure 0.2V on linear analog output. Note that the test instrument's reading is within ±.002V of UUT's displayed reading.
AC, HOLD	2V	.17V	500	.17		Verify that decimal flashes signifying below 9% of range.
AC, AUTORANGE	2V	1V	500	1.000	±5	Note that the V annunciator is lit.
AC, AUTORANGE	20V	10V	500	10.00	±5	Note that the V annunciator remains lit.
AC, AUTORANGE	200V	100V	500	100.0	±5	Note that the V annunciator remains lit.
AC, AUTORANGE	20 mV	10 mV	50K	10.00	±10	Note that the UUT autoranges down to the 20 mV range.
AC, AUTORANGE	200 mV	100 mV	50K	100.0	±5	
AC, AUTORANGE	2V	1V	50K	1.000	±5	
AC, AUTORANGE	20V	10V	50K	10.00	±5	
AC, AUTORANGE	200V	100V	50K	100.0	±5	
AC, AUTORANGE	700V	600V	500	600	±3	Use the 5205A for this test.
AC, AUTORANGE	2V	1V	2 Hz	1.000	±50 (4 to 7 digit fluctuation)	Use rms voltmeter and function generator.

4-20. dB Display Mode Check

4-21. This procedure will verify that the UUT's dB display mode is functioning properly. Set up the test equipment as shown in Figure 4-1. Depress the RANGE HOLD switch and step up to the 2V range. Select the 1V range on the AC calibrator and adjust its output for 1.000 on the UUT's display. Select the dB display mode and switch through the dBm REFERENCE selection switch, checking the reading at each position against Table 4-4. The readings should not differ by more than ±1 digit from the numbers given in Table 4-4.

4-22. DC Low Level Check

4-23. This procedure will verify correct operation with low level DC inputs. Set up the test equipment as shown in Figure 4-2, and select the required function, range and input signal as indicated in Table 4-5. Note any deviation between the display of the UUT and the specified limits.

4-24. AC Low Level Check

4-25. This procedure will verify that the UUT's low level AC performance meets the specifications of Section 1. Set up the test equipment as shown in Figure 4-3 and complete the AC Low Level Calibration procedure, but replace steps 2-d and 2-e with the following:

d. Note that the UUT's display reads the same error as noted in step 1-f ±38 digits.

e. Note that the UUT's display reads 0.1900 ±4 digits.

4-26. High Frequency Response Check

4-27. This procedure will verify that the UUT's high frequency response meets the specifications of Section 1. Set up the test equipment as shown in Figure 4-4, and select the required input amplitude and frequency as indicated in Table 4-6. Note any discrepancies between the display reading and the limits given.

Table 4-4. dB Display Mode Check

MODE	REFERENCE OHM	SOURCE	DISPLAY READING	COMMENTS
dBm	50	1.000	+13.00	Note that the dB annunciator is lit.
dBm	75	1.000	+11.24	
dBm	93	1.000	+10.31	
dBm	110	1.000	+9.58	
dBm	124	1.000	+9.06	
dBm	135	1.000	+8.69	
dBm	150	1.000	+8.23	
dBm	300	1.000	+5.22	
dBm	600	1.000	+2.21	
dBm	900	1.000	+ .45	
dBm	1000	1.000	− .01	
dBm	1200	1.000	− .80	
REL		1.000	+0.00	Note that the dB and REL annunciators are lit.
REL		10.00	+20.00	Step up to the 20V range (note that the dB and REL annunciators remain lit).

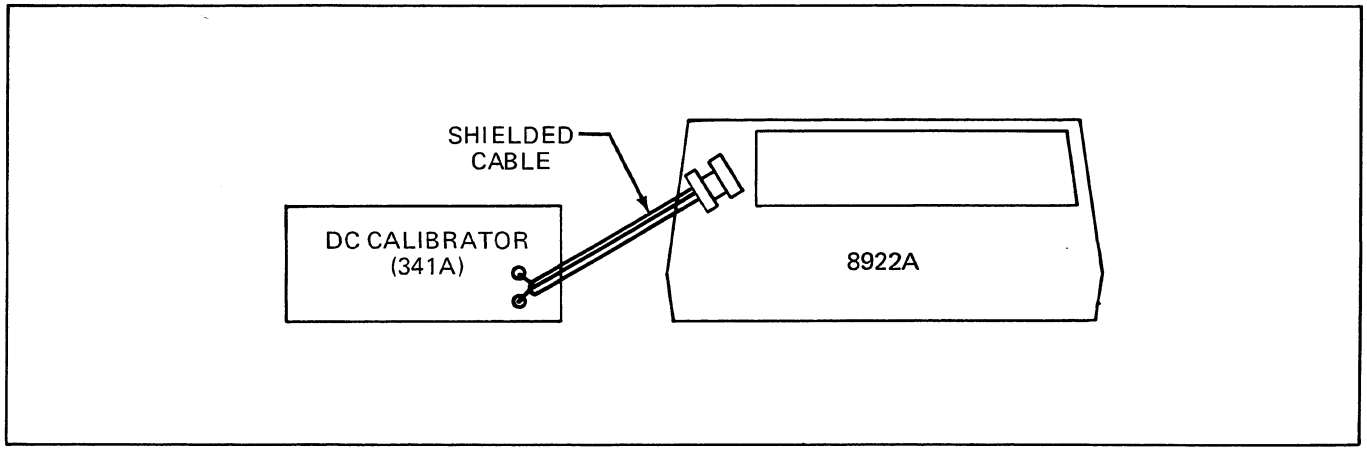


Figure 4-2. DC Low Level Check

Table 4-5. DC Low Level Check

DC INPUT	RANGE	FUNCTION	UUT DISPLAY ±6 COUNTS	COMMENT
1V	2V	AC + DC	1.000 ±30 counts	UUT dc circuitry functioning.
2 mV	AUTO	AC + DC	02.00 or mV rms (see comment) ±6 counts)	The ac input components should be less than 0.2 mV. (To achieve this set the FILTER switch to the IN position.) The mV ac component can be measured by temporarily selecting the AC switch. If it is greater than 0.2 mV; $mV\ rms = \sqrt{(2\ mV\ dc)^2 + (mV\ ac)^2}$

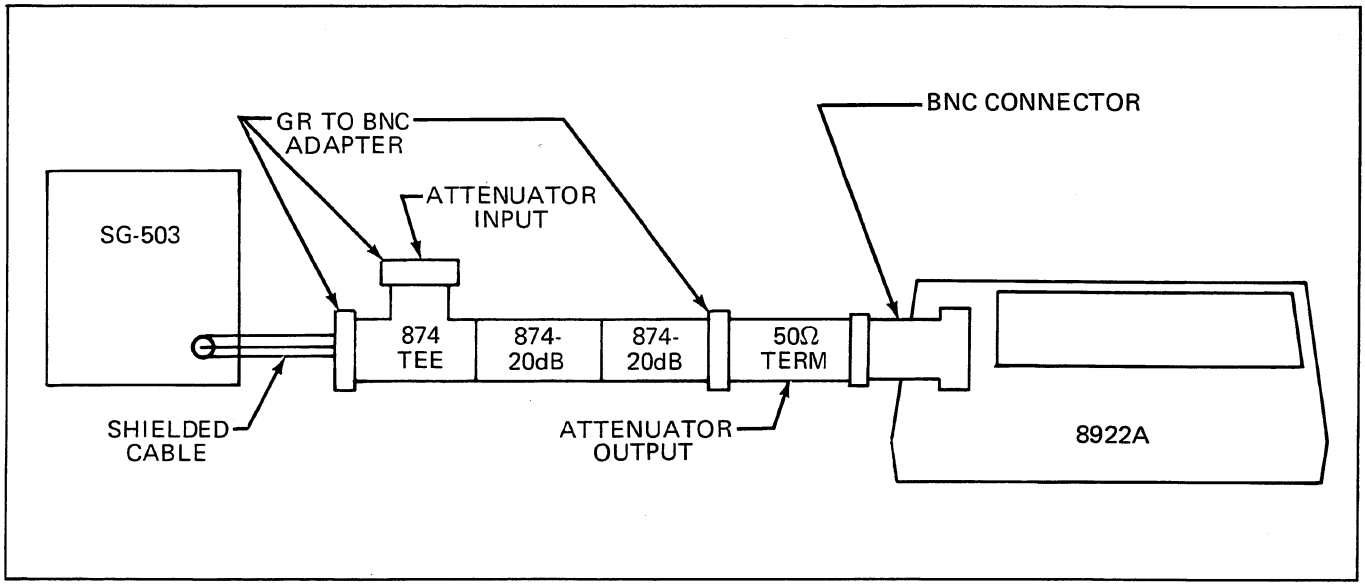


Figure 4-3. AC Low Level Check

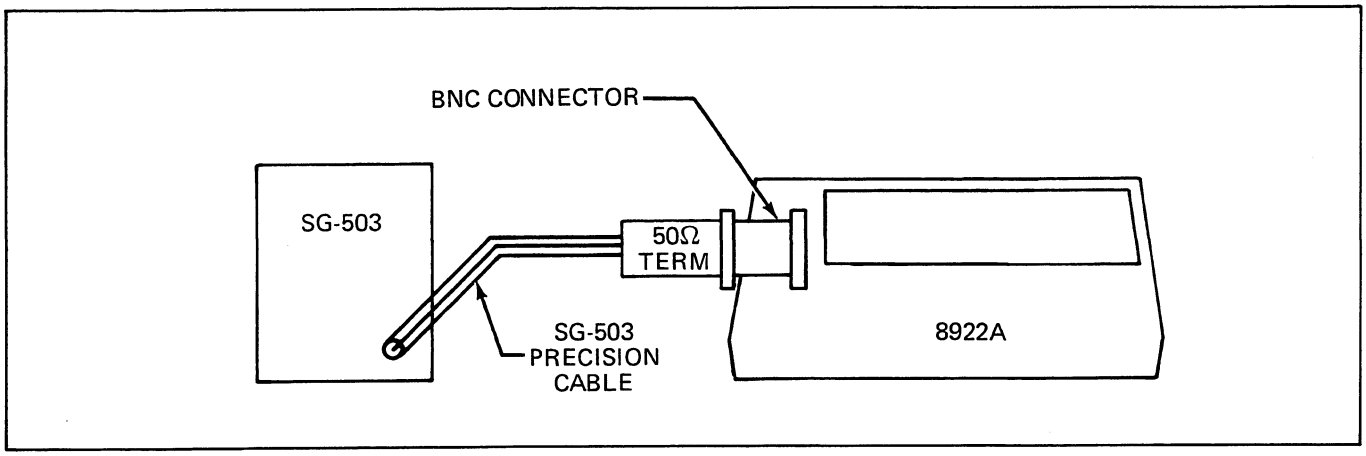


Figure 4-4. High Frequency Response Check

Table 4-6. High Frequency Response Check

FUNCTION MODE	RANGE	INPUT		DISPLAY	LIMITS ±COUNTS	COMMENTS
		LEVEL	F(Hz)			
AC, AUTORANGE	20 mV	17 mV	50K	17.00		Adjust the SG503 amplitude so that the display reads 17.00.
AC, AUTORANGE	20 mV	17 mV	11M	17.00	±85	Readjust the input frequency without changing the amplitude.
AC, AUTORANGE	200 mV	170 mV	50K	170.0		Adjust the SG503 amplitude so the display reads 170.0.
AC, AUTORANGE	200 mV	170 mV	11M	170.0	±85	Readjust the input frequency without changing the amplitude.
AC, AUTORANGE	2V	1.7	50K	1.700		Adjust the SG503 amplitude so the display reads 1.700.
AC, AUTORANGE	2V	1.7	11M	1.700	±85	Readjust the input frequency without changing the amplitude.

4-28. CALIBRATION ADJUSTMENTS

4-29. The calibration adjustment procedures given in the following paragraphs should be performed after repair of the 8922A and/or when the instrument fails the performance test requirements. If the instrument will not respond to or meet the limits of the adjustment procedures, troubleshooting and repair is indicated. Equipment required for the calibration adjustment is listed in Table 4-1.

4-30. All calibration adjustments are accessible when the top case cover is removed from the instrument. Figure 4-5 identifies the location of assemblies, test points, and adjustments that must be accessed to complete the calibration adjustment procedures.

4-31. To ensure optimum results, the calibration adjustments must be performed at an ambient temperature of 18 to 28 degrees Celsius with a relative humidity of less than 80%. Allow the instrument to warmup (with the top case cover in place) for at least 60-minutes before starting the calibration adjustment procedures.

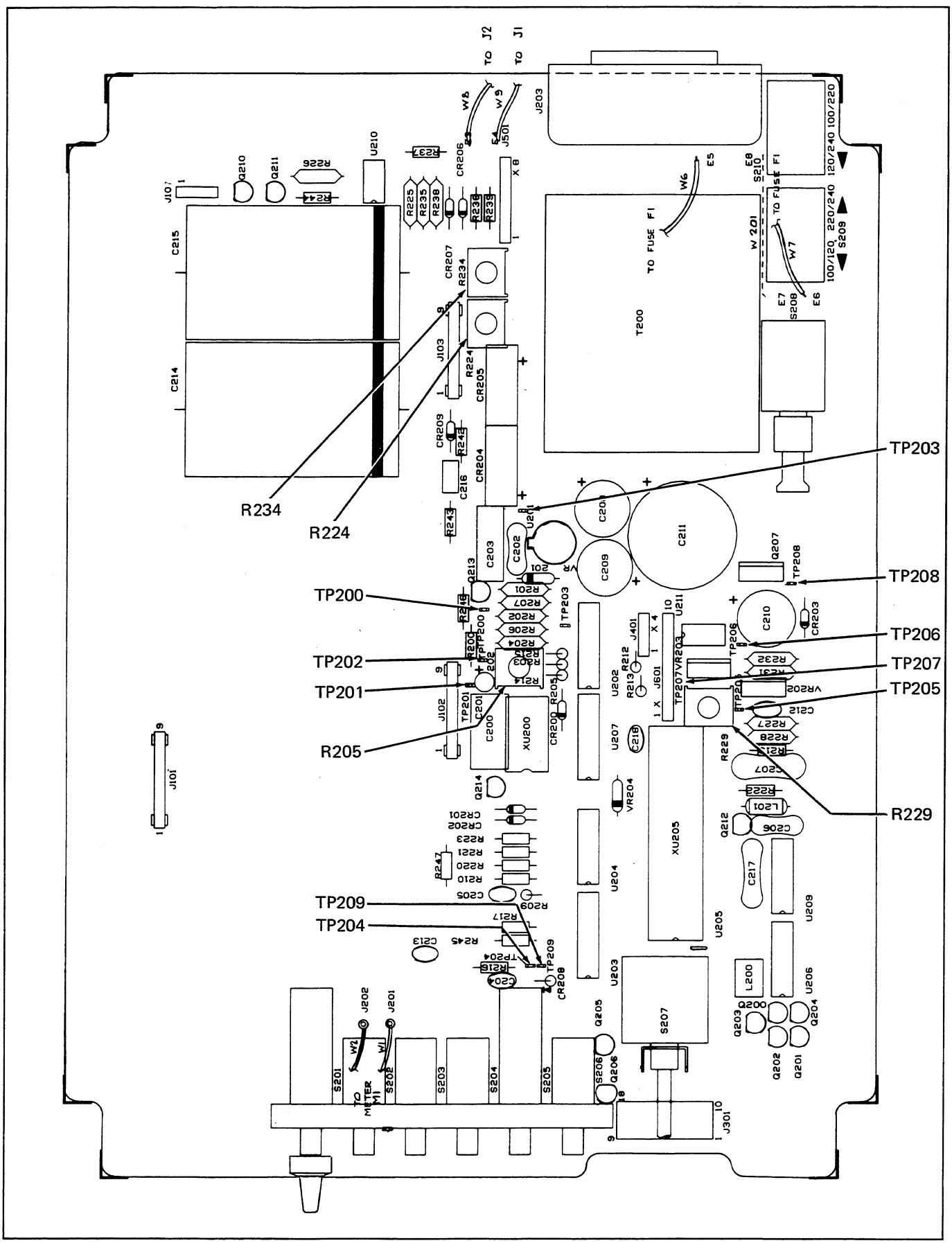


Figure 4-5. Calibration Adjustments and Test Point Locations

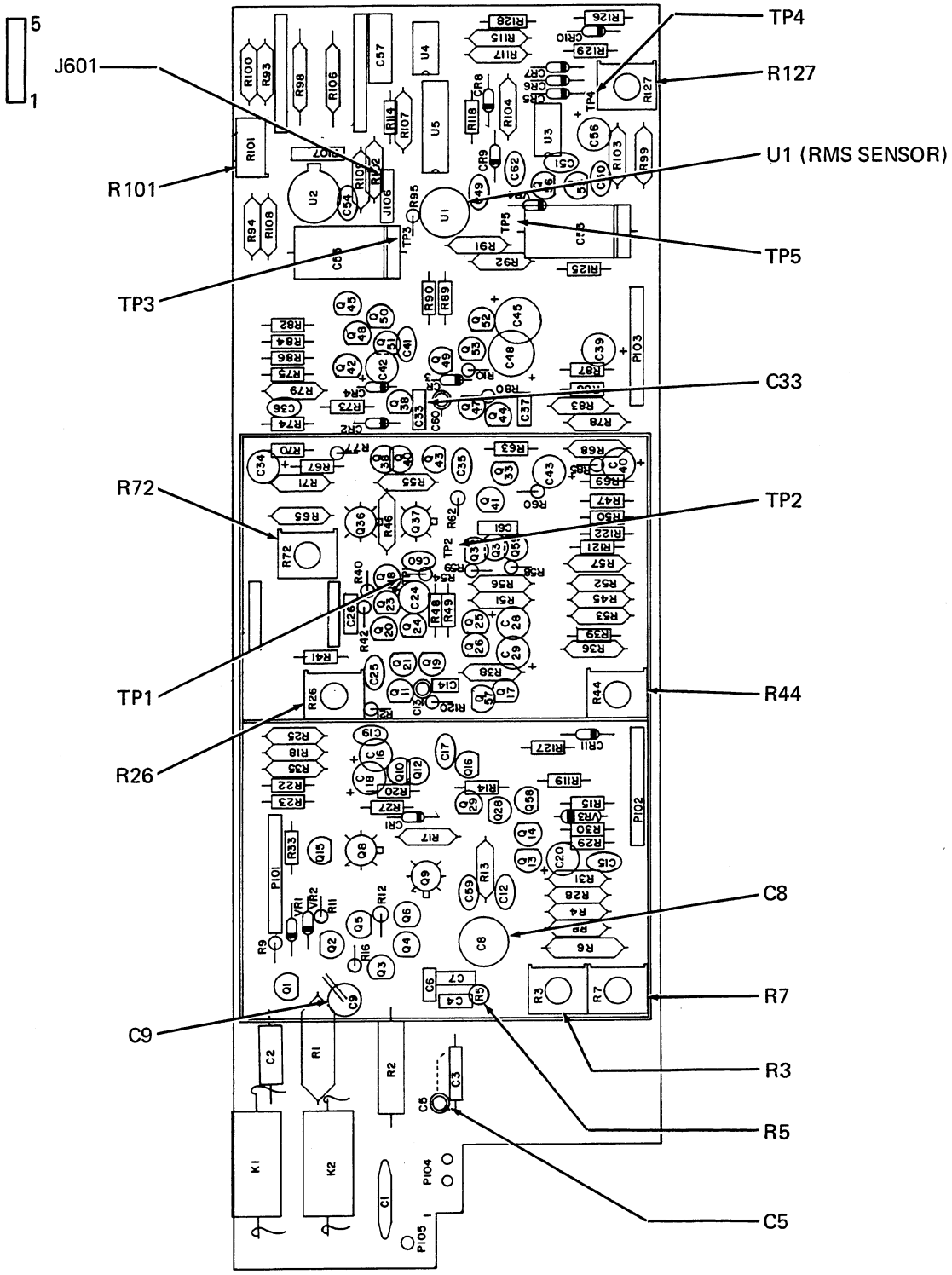


Figure 4-5. Calibration Adjustments and Test Point Locations (cont)

4-32. Power Supply Calibration Adjustment

WARNING

IN ALL PROCEDURES WITH THE TOP COVER REMOVED THE OPERATOR SHOULD BE AWARE THAT THE FOLLOWING POINTS ARE AT LINE POTENTIAL:

1. **POWER LINE CONNECTOR.**
2. **ALL LAND PATTERNS NEAR POWER TRANSFORMER.**
3. **POWER SWITCH.**
4. **FUSE HOLDER.**

4-33. Use the following procedure to calibrate the power supplies of the UUT.

1. Place all front panel switches to the out position.

CAUTION

Certain overload protection depends on the supply voltages. To avoid possibility of damage, DO NOT adjust the ±15V supplies with the UUT in overrange.

2. Monitor TP206 with a DVM using TP205 as a voltmeter common.

3. Adjust R229 for +15V ±0.1V on TP206.

4. Check TP208 for -15V ±0.2V.

5. If TP208 does not comply, recheck TP206 and adjust R229, if necessary.

6. Check TP207 for +5V ±0.25V.

4-34. Low and Midband Accuracy Adjustment

4-35. Use the following procedure to calibrate the low and midband accuracy of the UUT:

1. Place all the front panel switches in the out position.

2. Short TP204 to TP209 to light the 4th display digit.

3. Apply the input voltages and frequencies as listed in Table 4-7, and adjust to the limits given. If any limit cannot be reached, see Troubleshooting.

Table 4-7. Low and Midband Accuracy Adjustments

STEP	INPUT V	RANGE (AC)	FREQ Hz	ADJUST	READ DISPLAY	LIMIT ± of READING
1	1	2V (AC)	500	–	Note reading.	n/a
1a	Select RANGE HOLD.					
1b	0.1	2V	500	R101	1/10 of reading in step 3.	3 digits
1c	Return to step 1 if R101 was readjusted.					
1d	Select AUTORANGE.					
2	2.5V dc	20V (AC+DC)	n/a	R72	2.500	±10 digits
2a	0.25 Vdc	2V (AC+DC)	n/a	R26	.2500	±10 digits
3	Return to step 2 if R26 was readjusted.					
4	100 mV	200 mV	500	R205	100.00	5 digits
5	1.9 mV	2 mV	500	R44	1.9000	40 digits
5c	Return to step 4 if R44 was readjusted.					
6	100 mV	200 mV	50K	C9	100.00	5 digits

Table 4-7. Low and Midband Accuracy Adjustments (cont)

STEP	INPUT V	RANGE (AC)	FREQ Hz	ADJUST	READ	LIMIT ± of READING
7	1	2V	500	R3	1.0000	5 digits
8	1	2V	500	R224	Meter	Mid-scale
9	100	200V	500	R7	100.00	5 digits
10	1	2V	50K	C5	1.0000	5 digits
11	100	200V	50K	C8	100.00	10 digits
11c	Return to step 10 if C8 was readjusted.					
12	10 mV	20 mV	500	Chk	10.000	20 digits
13	10 mV	20 mV	10K	Chk	10.000	20 digits
14	10 mV	20 mV	50K	Chk	10.000	20 digits
15	10	20V	500	Chk	10.000	5 digits
16	10	20V	10K	Chk	10.000	20 digits
17	10	20V	50K	Chk	10.000	5 digits
18	Remove the short between TP204 and TP209.					
19	Autorange into the 20 mV range and push RANGE HOLD.					
20	Apply 22.0 mV at 500 Hz to the input of the UUT. Increase the input voltage in .1 mV steps until the UNCAL annunciator lights. Verify that this occurs with an input voltage between 22.5 and 23.5 mV. If the reading is outside these limits, refer to the "RMS Protection Circuit Calibration".					

4-36. Linear Analog Output

4-37. Use the following procedure to calibrate the 8922A linear analog output.

1. Set up the calibration test equipment as shown in Figure 4-6.

2. Select AC and AUTORANGE.

3. Apply 1.000V, 500 Hz to the input and monitor the dc voltage at the rear panel linear analog output (LAO). Adjust R224 for the same reading as the display ±2 mV.

4. Observe that the null/peak meter reads center of scale ±½ division.

5. Push RANGE HOLD and decrease the input to 0.1V, 500 Hz. The output voltage should read the same as the front panel display ±0.2mV. If it is not within this limit, adjust R234 and go back to step 3.

6. Increase the input to 0.5V. The voltage at the output should be the same as the front panel display ±0.001V.

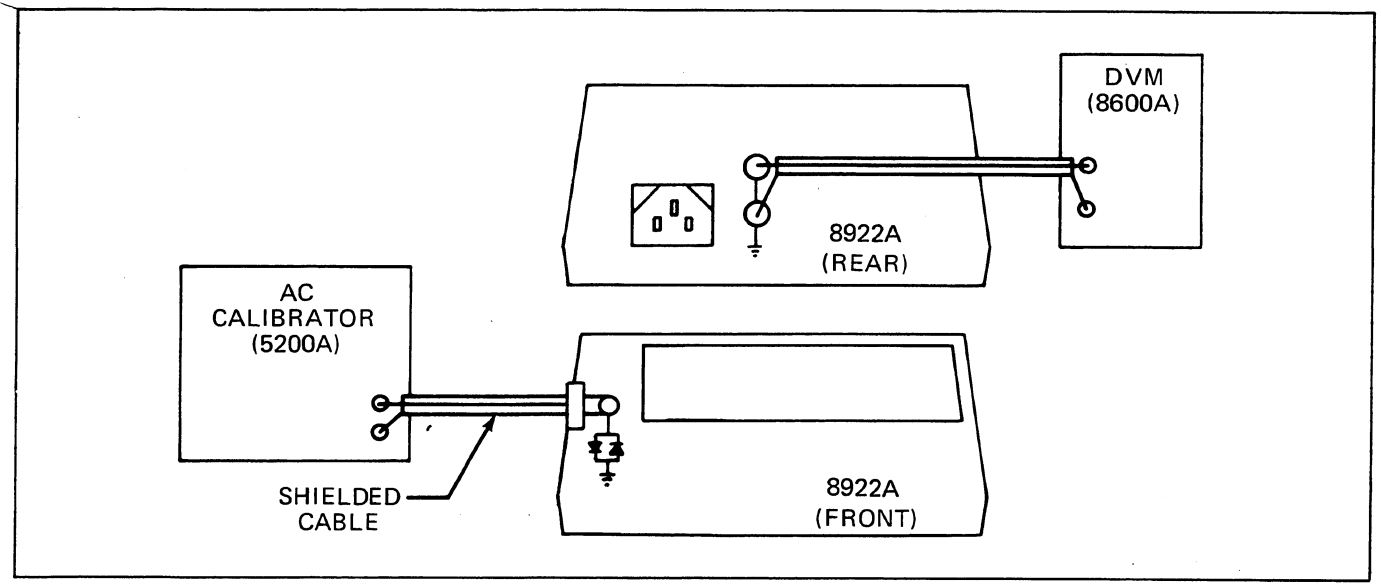


Figure 4-6. Linear Analog Output Check

4-38. AC Low Level Calibration and Filter Check

4-39. Use the following procedure to calibrate the UUT's AC low level performance.

1. Measure the 503 Attenuator Errors (leveled generator).

a. Place all front panel switches out.

b. Set up the test equipment as shown in Figure 4-3.

c. Set the leveled generator to 50 kHz, X1 and connect the 874-20 dB-GR attenuator input to the input of the UUT.

d. Adjust the leveled generator amplitude until a steady reading of 1.000V is obtained on the display of the UUT.

e. Switch the leveled generator to the X.1 setting, observe that the UUT autoranges down to the 100 mV range and note the reading error.

f. Switch the leveled generator to the X.01 setting and note that the reading error is less than 10 digits on the 20 mV range.

2. Calibrate the 2 mV range:

a. Connect the 50 ohm terminated attenuator output to the input of the UUT.

b Switch the leveled generator to the X1 and adjust the amplitude such that a steady reading of 10.00 mV is obtained on the UUT.

c. Switch the leveled generator to the X.1 setting, allowing the UUT to range down to the 2 mV range.

d. Adjust R44 so that the display of the UUT reads the same error as noted in step 1-e. ±1 digit.

e. Depress the RANGE HOLD switch, readjust the leveled generator for a reading of 1.800 ±1 digit and switch down to the X.01 setting. The UUT's display reading should be from 0.180 to 0.186 after settling.

3. Filter check:

a. Set the generator to X1 and adjust output amplitude for a display of 18.00 mV.

b. On the front panel of the UUT, set the FILTER switch to the in position.

c. Verify that the UUT display is between 17.70 and 17.20 mV.

d. On the front panel of the UUT, set the FILTER switch to the out position.

e. Set the generator to X.1 and adjust the output amplitude for a display of 1.800 mV.

f. On the front panel of the UUT, set the FILTER switch to the in position.

g. Verify that the UUT display is between 1.770 and 1.720 mV.

h. Adjust the generator output amplitude for a UUT display of 1.800 mV.

i. Set the generator to X.01.

j. Verify that the UUT display is now between .180 and .182 mV.

4-40. High Frequency Calibration

4-41. Use the following procedure to calibrate the UUT's high frequency response:

1. For the ranges shown in Table 4-8, adjust the amplitude of the leveled generator at 50 kHz to establish a reference (refer to Figure 4-7, for the test setup). Use one 20 dB attenuator for 0.1V, two attenuators for 0.01V, and three attenuators for .001V terminated with 50 ohms. Take care not to overdrive the transfer standard.

2. Note the reading at the output of the A55 transfer standard and maintain this by readjusting the generator's level for other frequencies.

Table 4-8. High Frequency Calibration

STEP	SOURCE LEVEL	UUT RANGE	SOURCE FREQ.	ADJUST	UUT DISPLAY	LIMIT ± COUNTS
1	.001	2 mV	50K	source	1.000	±1
2	.001	2 mV	10M	C13	1.000	±3
3	.001	2 mV	*	Chk	1.000	0 to +20
4	0.01	20 mV	50K	source	10.00	±1
5	0.01	20 mV	10M	C33	10.00	±3
6	If C33 was adjusted, go to step 1					
7	0.01	20 mV	*	Chk	10.00	0 to +20
8	0.01	20 mV	1M	Chk	10.00	±3
9	0.1	200 mV	50K	source	100.0	±1
10	0.1	200 mV	10M	Chk	100.0	±5
11	1.	2	50K	source	1.000	±1
12	1.	2	10M	R5	1.000	±5
13	1.	2	*	Chk	1.000	0 to +20
14	1.	2	1M	Chk	1.000	±3

*Reduce the frequency to the point between 5 and 11 MHz where the maximum reading on the display occurs.

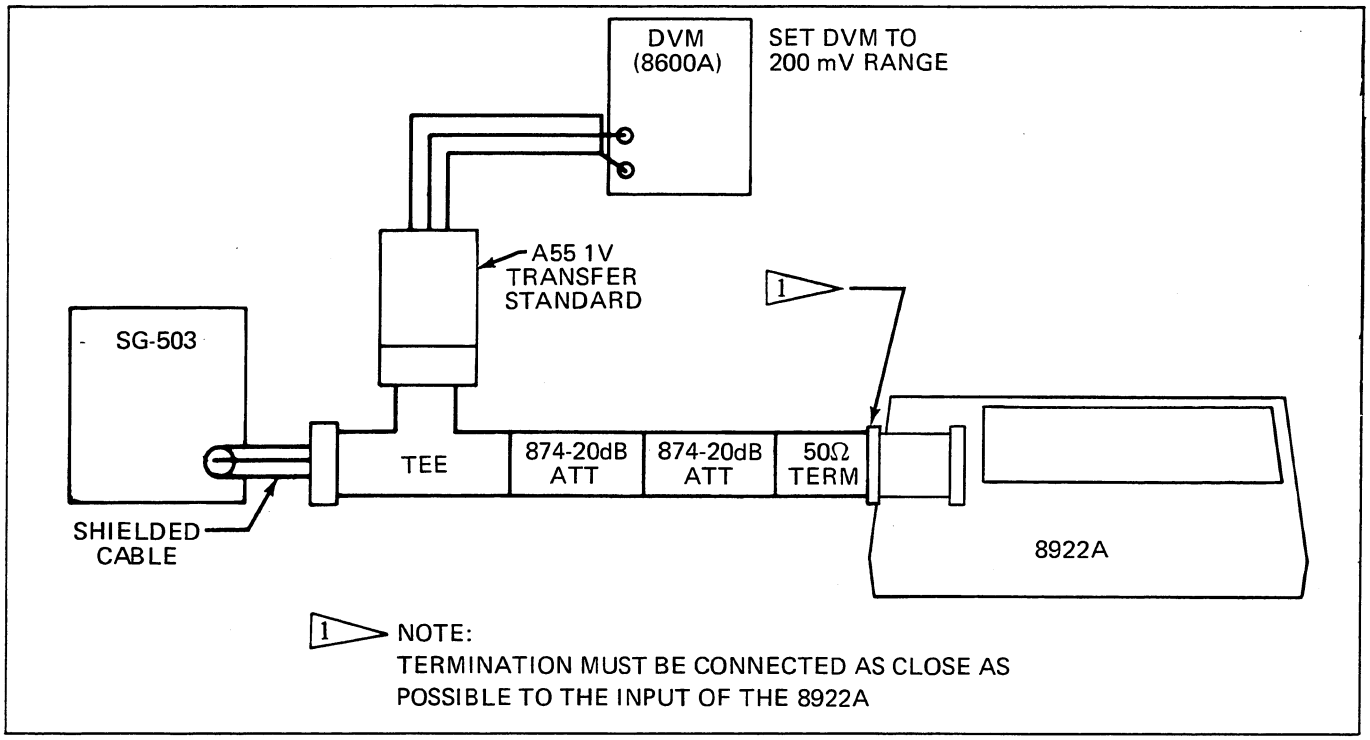


Figure 4-7. High Frequency Calibration

4-42. RMS Protection Circuit Calibration

CAUTION

Resistor, R111, controls the protection circuit for the rms sensor. DO NOT make any adjustments to R111 other than those listed below. Indiscriminate adjustments may cause component damage.

4-43. Use the following procedure to calibrate the protection circuit of the rms sensor. This procedure should be completed only if the rms sensor has been replaced or if the limit in step 20 of Table 4-9, cannot be met.

NOTE

The ambient temperature must be 23° C ±5° C and the ±15V supplies must be calibrated.

1. Remove the tape dot on R111 and turn R111 to its maximum CCW position.

2. Select AC, AUTORANGE then HOLD and STEP UP (as necessary) to lock the UUT in the 20 mV range. Refer to Figure 4-5 for the calibration and test point locations. Monitor the voltage at TP4 with a DVM and apply 24.0 mV, 200 Hz to the input. Observe that the UNCAL annunciator lights up.

3. Turn R111 slowly clockwise until the DVM reading stops decreasing. The UNCAL annunciator should go out. Turn R111 slightly clockwise so that the UNCAL annunciator remains unlit but lights when the input voltage is increased to 24.1 mV. Increase the input voltage to 25.0 mV and note the voltage on TP4. Apply an input signal of 250 mV at 2 kHz. The voltage at TP4 should not change by more than 20 mV.

4. Replace the tape dot on R111 or use Glyptol.

4-44. TROUBLESHOOTING

4-45. This section contains information selected to assist in troubleshooting the Model 8922A. Before attempting to troubleshoot the instrument, verify that the trouble is actually in the instrument and is not caused by faulty external equipment or improper control settings. For this reason, the Performance Check is suggested as a first step in troubleshooting. The Performance Check may also help to localize the trouble to a particular section of the instrument. If the Performance Check fails to localize the trouble, the following information may be helpful. Location of principal circuitry areas, test points, and adjustment locations of the Model 8922A are shown in Figure 4-5.

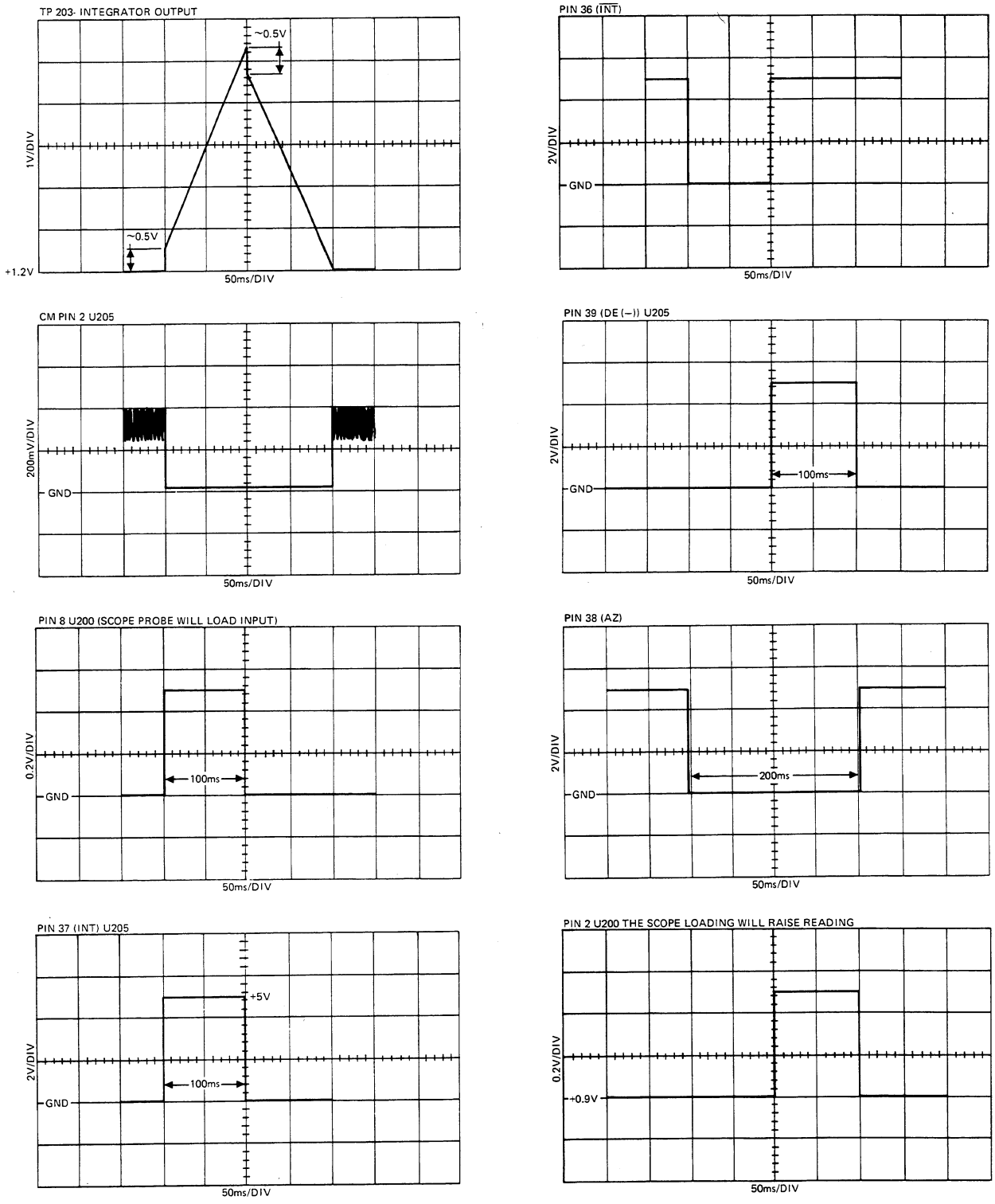
Table 4-9. 8922A Troubleshooting Procedure

STEP NO.	INSTRUCTION	YES	NO	GO TO
1	All front panel switches should be in the out position.			2
2	Connect the UUT (8922A) to appropriate line power and observe the display.		3	
3	Does display light correctly?	4	11	
4	Apply 1V ac input to UUT, select AC function, VOLTS display mode and AUTORANGE.			5
5	Does UUT respond to input?	6	17	
6	Does UUT pass the Low-Midband Check?	7	25	
7	Does UUT pass the Low Level DC Check?	8	26	
8	Does UUT pass the High Frequency Response Check?	9	28	
9	UUT operating properly.			10
10	Apply 1V ac to UUT in the 2V ac range.			17
11	Check appropriate display drivers, Q200-Q204.	12	23	
12	Correct power supply test point voltages are as follows: TP206 = +15V; TP207 = −5V; TP205 = power supply ground.			13
13	Is TP206 at +15V?	14	29	
14	Is TP208 at −15V?	15	31	
15	Is TP207 at +5V?	16	32	
16	Power supply is operating properly.			10
17	Check voltage between TP201 and TP202.			18
18	Is the voltage 0.5V, ±10%?	19	33	
19	Does null/peak meter read approximately ½ scale?	20	40	
20	Check A/D Converter, is it operating correctly?	24	21	
21	Check TP200, is it at +6.4V?	22	42	
22	Check the following for appropriate A/D Converter waveforms: U200-U202, U205 and TP203. Refer to Figure 4-8.			23
23	Replace defective component.			24
24	Repeat Performance Tests and Calibration.			1
25	Check attenuator logic levels using Table 4-10.	10	23	
26	Are S1 and Q33 switching properly?	27	23	
27	Check Amp A & B.			10
28	Check Amp A & B and attenuator network.			10
29	Remove AC PCB, is TP206 at +15V now?	30	43	

Table 4-9. 8922A Troubleshooting Procedure (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
30	Troubleshoot AC pcb assembly.			23
31	Remove AC pcb, is TP208 at −15V?	30	44	
32	Check: VR203, U200-U202, U205, U206, U209, U210, U211, U4 and U302.			23
33	Check TP3.			34
34	Is voltage on TP3 at 0.5V ±10%?	35	45	
35	Turn UUT off, disconnect UUT from line power.			36
	CAUTION **To avoid damage to the RMS sensor, steps 37 and 38 must be performed with a multimeter whose output on the ohms function is no greater than 10 mA.**			
37	Is the resistance of U1-6 to U1-7 (or J106-2 to J106-3) 90 ohms ±8%. (Out of circuit resistance = 100 ohms ±8%.)	38	50	1
38	Is the resistance of U1-8 to U1-9 (J106-4 to J106-3) = 100 ohms ±8%.	39	50	
39	Check U2, U4 and U5.			23
40	Check test point E3, is it at +1V ±5%?	41	51	
41	Check meter and U210B.			23
42	Check VR201.			23
43	Check VR202.			23
44	Check U203 through U207.			23
45	Check TP1.			46
46	Is TP1 at 0.045V ±10%?	47	52	
47	Check TP2.			48
48	Is voltage on TP2 at 0.045V ±10%?	49	54	
49	Check Amp B. Refer to the AC Amplifier schematic for voltage check points.			23
50	Replace rms sensor, refer to RMS Sensor Replacement Procedure.			1
51	Check U201A.			23
52	Check Q3, Q4, Q5 and Q6 (refer to Table 4-10) are they switching properly?	53	23	
53	Check Amp A. Refer to the AC Amplifier schematic for voltage check points.			23
54	Check Q31, Q32 and Q33.			23

A/D WAVEFORMS (GENERAL CONDITIONS) 8922A READING 1000 COUNTS
SCOPE TRIGGERED ON – SLOPE OF A2 (PIN 38) X10 SCOPE PROBE (10 MΩ)



NOTE: All timing is 2.5 times slower when AC + DC (damping) Function is selected.

Figure 4-8. A/D Waveforms (General Condition)

Table 4-10. Attenuator Logic States

RANGE	K1	K2	Q3*	Q4*	Q5*	Q6	Q29*	Q28/Q30	Q31*	Q32
700V	0	1	0	1	1	0	1	0	1	0
200V	0	1	0	1	1	0	1	0	0	1
20V	0	1	1	0	1	0	1	0	1	0
2V	0	1	1	0	1	0	1	0	0	1
200 mV	1	0	0	0	0	1	1	0	1	0
20 mV	1	0	0	0	0	1	1	0	0	1
2 mV	1	0	0	0	0	1	0	1	0	1

LOGIC LEVELS 1 = 0V, 0 = −15V; *1 = −1.9V ±10%, *0 = −14.8V ±10%

4-46. When troubleshooting the UUT, the following points should be kept in mind:

1. Before any troubleshooting is begun, make a visual inspection of the interior of the instrument.

2. When troubleshooting the AC amplifiers, isolate the DVM test lead with a 10 kΩ probe, otherwise capacitive loading may cause the AC Amplifiers to oscillate.

3. MOS type integrated circuits can be damaged by discharging static electricity through the device. All circuits of this type are designated on the schematic with this symbol ⊗ . Use care and always use a grounded soldering iron when removing or installing MOS devices.

4-47. A troubleshooting guide for the 8922A is presented in Table 4-9. This guide is in a tabular flow chart form and is recommended for use in isolating a problem to a functional circuit area. The initial steps in the troubleshooting guide refer to the Performance Check made earlier in this section.

4-48. RMS Sensor Replacement

4-49. Use the following procedure when replacing the rms sensor. This procedure should be completed if the troubleshooting procedure indicates that the rms sensor must be replaced, refer to Figure 4-5.

1. Carefully unsolder the defective sensor from the AC PCB using a grounded soldering iron.

2. Install the new sensor (be sure that the sensor spacer pad is in place) and replace the AC Assembly and shield.

3. Remove R97 or R105, if installed, and replace with the bus wire from the sensor kit.

4. Remove R96 and R110, if installed, and replace R123 and R124 with 20.5k resistors.

5. Plug the protection diode fixture into J106. Note that the fixture is symmetrical.

6. Turn R111 to its maximum counterclockwise position.

7. Place all of the front panel switches to their out position and apply power to the instrument.

8. Select AC + DC, RANGE HOLD, and up range to the 2V range. Monitor TP3 with a DVM, connect a DC calibrator to the input (refer to Figure 4-6) and apply +1.8V dc. The sensor input should now be clamped by the protection circuit and TP3 should read about half the display reading.

9. Turn R111 slowly clockwise and observe that the DVM and instrument display readings increase. The dc voltage at TP3 should stop increasing at around +0.8 to +1.0V. The instrument display should stop increasing around 1.5 to 1.99V, the point at which the protection diodes clamp the input. DO NOT ALLOW THE INSTRUMENT TO GO INTO OVERLOAD. Return R111 to its CCW stop and repeat the procedure with a negative dc input. Turn R111 CCW until TP3 reads about −.5V and remove the calibrator and the protection diode fixture.

10. Short the input, select AC, RANGE HOLD, and step up range to the 2V range. Monitor TP3 and adjust R72 for 0 ±1 mV dc.

11. Select AC + DC and adjust R26 for 0 ±1 mV dc on TP3.

12. Go to the rms protection circuit calibration procedure, "RMS Protection Circuit", and complete the steps as listed. Return to step 13 below.

13. Perform calibration steps 1 through 1c, as listed in Table 4-6, Low and Midband Adjustments. Should R101 not have enough adjustment range, substitute one of the kit resistors (15 kΩ, 30.1 kΩ, or 45.3 kΩ) for R105 if reading is too high, R97 if reading is too low or zero.

14. Monitor the ac voltage at TP5* with a DVM and apply 100 mV, 10 Hz to the input with the instrument in the 200 mV range.

15. If the monitored ac voltage is 70.0 mV or greater, install the 402 kΩ resistors for R96 and R110.**

16. If the monitored ac voltage is still 70.0 mV or greater, install the 158 kΩ resistors for R96 and R110.**

17. Push the AC + DC/AC switch to the in position and apply 100 mV at 2 Hz to the input.

18. If the monitored voltage is 70 mV (100 mV peak) or greater, replace R123 and R124 with 17.1 kΩ metal film resistors.

19. If the monitored voltage is until greater than 70 mV (100 mV peak), then replace R123 and R124 with 13.7 kΩ resistors.

20. If the UUT is operating correctly, repeat the entire CALIBRATION procedure, otherwise return to beginning of Table 4-9.

4-50. A/D Calibration Resistor Selection

4-51. This procedure is used to determine the correct A/D selected resistor, R204, and should be completed whenever VR201 is replaced or when R205 does not have enough range to calibrate the A/D. All possible values for R204, listed in Table 4-11, may be obtained in a set by ordering Part #490722.

NOTE

The UUT may go into overrange with R204 removed.

1. Place all front panel switches in the out position and set R205 to the center of its adjustment range.

2. Apply 100.0 mV, 200 Hz to the input and select resistors R204 from Table 4-11, until the display reads closest to 100.0 mV.

3. Verify that R205 has adjustment range on both sides of the displayed 100.0 mV reading.

4. Perform the instrument calibration.

Table 4-11. R204 Resistive Values (mf ±1%, 1/8W)

VALUE	VALUE
71.5K	39.2K
66.5K	33.2K
61.9K	26.7K
56.2K	20.5K
51.1K	14.0K
43.3K	7.15K

4-52. DC Offset Resistor Selection

4-53. Use this procedure to determine the correct DC offset selected resistors, R19 or R34 for amplifier A, and/or R66 or R76 for amplifier B. Use the procedure when the amplifier offset cannot be adjusted to 0V with R26 and/or R72; usually because one or more of the following have been replaced:

Amplifier A	Q9, Q8, Q10, and Q12.
Amplifier B	Q36, Q37, Q38, and Q40.

All possible values for R19 or R34 (amplifier A) or R66 or R76 (amplifier B), listed in Table 4-12, may be obtained in a set by ordering Part #490730. Two sets will be necessary if both amplifiers require the same selected resistor value.

Table 4-12. R19/R34, R66/R76 Resistive Values (mf, ±1%, 1/8W)

VALUE	VALUE
449K	32.4K
332K	31.6K
169K	30.1K
115K	28.0K
86.6K	26.1K
68.1K	24.3K
57.6K	22.6K
48.7K	21.5K
43.2K	20.5K
38.3K	19.1K
34.8K	

4-54. SET UP

1. Remove the cover shield of the AC Converter PCB.

2. Connect a short jumper between input low and the metal fence on the AC Converter PCB.

4-55. AMPLIFIER B

(must be done before amplifier A)

1. Apply power, short the input, select AC, RANGE HOLD, and step up to the 2V range.

2. Set R72 to the center of its adjustment range and monitor TP3 with a DVM.

3. Select resistors from Table 4-12, starting with the highest value until the DVM reads closest to 0 volts dc. Place the resistor in the socket for R66 if the DVM reads positive, R76 if the reading is negative. Adjust R72 for a DVM reading of less than 1 mV dc at TP3.

4-56. AMPLIFIER A

1. Select AC + DC, set R26 to the center of its adjustment range and monitor TP3 with a DVM.

2. Select resistors from Table 4-12, starting with the highest value until the DVM reads closest to 0 volts dc. Place the resistor in the socket for R19 if the DVM reads positive, R34 if the reading is negative.

3. Adjust R26 for a DVM reading of less the 1 mV dc at TP3.

4. Perform the complete instrument calibration.

Section 5
List of Replaceable Parts

TABLE OF CONTENTS

5-1 INTRODUCTION

5-2. 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 accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation.

2. Description of each part.

3. FLUKE Stock Number.

4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

5. Manufacturer's Part Number.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

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

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

1. Quantity.

2. FLUKE Stock Number.

3. Description.

4. Reference Designation.

5. Printed Circuit Board Part Number.

6. Instrument Model and Serial Number.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 5-1. 8922A Final Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A	8922A FINAL ASSEMBLY FIGURE 5-1						
A1	⊘MAIN PCB ASSEMBLY	ORDER	ONLY	REPLACEABLE PARTS	1		
A2	AC PCB ASSEMBLY	510602	89526	510602	1		
H1	SCREW, FHP, 6-32 X 3/4	114504	89536	114504	4		
H2	SCREW, PHP, 2-56 X 1/4	149534	73734	19002	2		
H3	SCREW, PHP, 4-40 X 1/4	256156	73734	23022	13		
H4	SCREW, FHP, 6-32 X 5/8	335158	89536	335158	2		
MP1	GUARD COVER, C SIZE	464115	89536	464115	1		
MP2	COVER, PLATE DOU	456764	89536	456764	1		
MP3	BAIL	467555	89536	467555	1		
MP4	RETAINER, HANDLE	467563	89536	467563	2		
MP5	DECAL, RETAINER	473645	89536	473645	2		
MP6	COVER, C SIZE	454736	89536	454736	2		
MP7	HANDLE	454751	89536	454751	1		
MP8	COVER,AC SHIELD	456848	89536	456848	1		
MP9	LINE CORD (NOT SHOWN)	343723	89536	343723	1		
MP10	BASE, STANDARD	454702	89536	454702	1		
MP12	DECAL, BASE SIDES	473652	89536	473652	2		
MP13	LATCH	467548	89536	467548	2		
MP14	FOOT	467571	89536	467571	4		
MP15	INSULATOR, GUARD, COVER	492298	89536	492298	1		
MP16	LUG, SOLDER, #141	104091	89536	104091	1		
R19/R34	RES, MTL. FILM, 332K +/-1%, 1/8W	289504	89536	289504	2		1
R66/R76	RES, MTL. FILM, 332K +/-1%, 1/8W	289504	89536	289504	REF		
R96/R110	RES, MTL. FILM, 158K +/-1%, 1/8W	237214	89536	237214	2		1
R97/R105	RES, MTL. FILM, 15K +/-1%, 1/8W	285296	89536	285296	1		1
R123	RES, MTL. FILM, 21.5K +/-1%, 1/8W	168278	89536	168278	2		1
R124	RES, MTL. FILM, 21.5K +/-1%, 1/8W	168278	89536	168278	REF		1
R204	RES, MTL. FILM, 16.5K +/-1%, 1/8W	293696	89536	293696	1		2
U205	IC, LARGE SCALE DIGITAL CHIP	458463	89536	458463	1		3
	INSTRUCTION MANUAL	522052	89536	522052	1		

1 INSTALLED OR JUMPERED AS NECESSARY. SEE AC PCB ASSY. A2 TABLE 5-4.

2 INSTALLED AS NECESSARY. SEE MAIN PCB ASSY. A1 TABLE 5-2.

3 PART OF MAIN PCB ASSY. A1 TABLE 5-2.

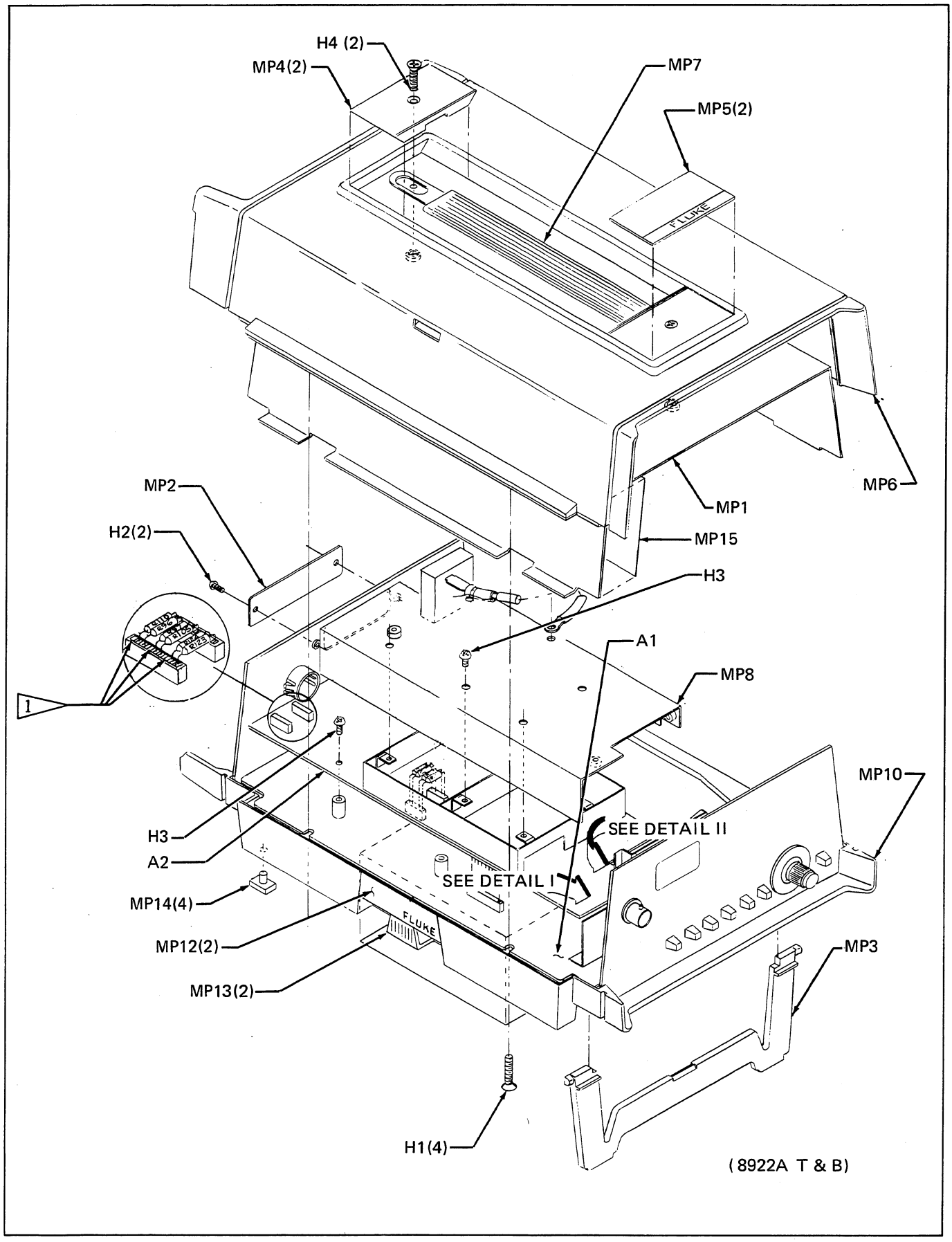
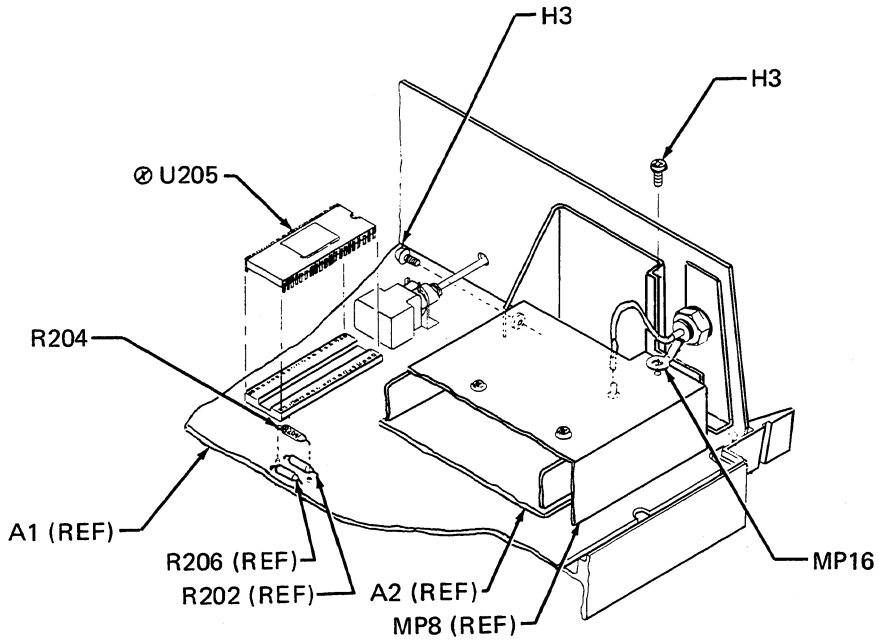
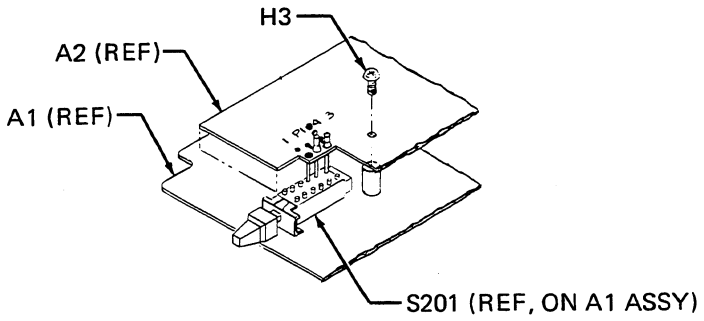


Figure 5-1. 8922A Final Assembly



DETAIL I



DETAIL II

NOTES:

1 #3, #6, and #9 POCKETS OF 9 PIN CONNECTORS NOT USED.

2 WARNING: Ⓧ INDICATES USAGE OF MOS DEVICE(S) WHICH MAY BE DAMAGED BY STATIC DISCHARGE.

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY

Figure 5-1. 8922A Final Assembly (cont)

Table 5-2. A1 Main PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A1	Ø MAIN PCB ASSEMBLY FIGURE 5-2 (8922A-4001/4001S)	ORDER	ONLY	REPLACEABLE PARTS	REF		
A1A1	DISPLAY PCB ASSEMBLY	ORDER	ONLY	REPLACEABLE PARTS	1		
C200	CAP, PLYPRP, 0.47 UF +/-10%, 100V	446807	89536	446807	1		
C201	CAP, TA, 0.47 UF +/-20%, 35V	161349	56289	196D474X0035HA1	1		
C202	CAP, MICA, 150 PF +/-5%, 500V	148478	72136	DMF15151J	1		
C203	CAP, MYLAR, 0.47 UF +/-10%, 100V	369124	73445	C280MAH/470K	1		
C204	CAP, CER, 10,000 PF +/20%, 100V	149153	56289	C023B10F103M	4		
C205	CAP, CER, 10,000 PF +/-20%, 100V	149153	56289	C023B10F103M	REF		
C206	CAP, MICA, 180 PF +/-5%, 500V	148460	72136	DM15F181J	1		
C207	CAP, MICA, 3000 PF +/-5%, 500V	161786	72136	DMF19302J	1		
C208	CAP, ELECT, 220 UF -10/+75%, 35V	460279	89536	460279	3		
C209	CAP, ELECT, 220 UF -10/+75%, 35V	460279	89536	460279	REF		
C210	CAP, ELECT, 220 UF -10/+75%, 35V	460279	89536	460279	REF		
C211	CAP, ELECT, 4700 UF -10/+100%, 15V	460261	80031	3143TS502V015	1		
C212	CAP, CER, 10,000 PF +/20%, 100V	149153	56289	C023B10F103M	REF		
C213	CAP, CER, 10,000 PF +/20%, 100V	149153	56289	C023B10F103M	REF		
C214	CAP, MATCHED PAIR (W/C215)	512210	89536	512210	1		
C215	CAP, PART OF MATCHED PAIR (TO C214)				REF		
C216	CAP, MYLAR, 0.22UF +/-20%, 50V	190314	71590	CW30C224K	1		
C217	CAP, MICA, 1000 PF +/-5%, 500V	148387	72136	DM19F102J	1		
C218	CAP, CER, 100 PF +/-10%, 1K	105593	71590	DD101	1		
CR1	RECTIFIER BRIDGE, 50V, 25A	473520	21845	J775-OLP	1		
CR200	DIODE, MULTI-PELLET	375477	09214	MPD200	1	1	
CR201	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	6	2	
CR202	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR203	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR204	RECTIFIER BRIDGE	296509	21845	F903C-22	2	1	
CR205	RECTIFIER BRIDGE	296509	21845	F903C-22	REF		
CR206	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR207	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR208	DIODE, SI, MULTI-PELLET	375485	09214	MPD300	1	1	
CR209	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	REF		
F1	FUSE	BY	ONLY	APPROPRIATE SOURCE	1	5	
	SLO-BLO, 1/8 AMP	166488	71400	MDL1-8			
	METRIC, SLO-ACT, 5 X 20 MM, GLASS TUBE	467233	89536	467233			
H200	SCREW, RHP, 4-40 X 1/4	256156	73734	22022	10		
H201	LOCKWASHER, FLAT, #4	110395	73734	1355	2		
H202	NUT, HEX, 4-40	184044	73734	8002A-NP	2		
H203	SCREW, PHP, 6-32 X 5/8	152181	73734	19047	1		
H204	NUT, LOCKING, HEX, 6-32	152819	78199	511-061800-00	1		
H205	LOCKWASHER, SPLIT, #5	111328	89536	111328	2		
H206	NUT, HEX	110635	89536	110635	2		
J1	CONNECTOR, BANANA JACK, BLACK	162073	74970	108-0903-001	1		
J2	CONNECTOR, BANANA JACK, RED	162065	74970	108-0902-001	1		
J6	CONNECTOR FEMALE BNC (8920A ONLY)	414201	02660	31-010	1		
J101	SOCKET, IN-LINE	436774	60065	SS-109-1-04	3		
J102	SOCKET, IN-LINE	436774	60065	SS-109-1-04	REF		
J103	SOCKET, IN-LINE	436774	60065	SS-109-1-04	REF		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
J107	SOCKET, 4-PIN, SNGL-IN-LINE	417311	30035	SS-109-1-04	1		
J301	CONNECTOR, MATING	461095	00779	87406-1	1		
J401	POST, CONTACT	417329	22526	65500-104	1		
J501	POST, CONTACT	474213	22526	65500-1081	1		
J601	POST, CONTACT	478693	22526	65500-110	1		
L200	CHOKE, 6-TURN	320911	89536	320911	1		
L201	CHOKE, RF	147819	72259	WEE1000	1		
M1	METER, ANALOG PANEL	478685	32171	OMC-DMA-001-CP2	1		
MP1	BRACKET, SWITCH MOUNTING	475392	89536	475392	1		
MP203	BRACKET, METER MOUNTING	468868	89536	468868	1		
MP204	BRACKET, PUSH ROD	456749	89536	456749	1		
MP205	KNOB, SKIRTED	463224	89536	463224	1		
MP206	SHIELD, TRANSFORMER	467696	89536	467696	1		
MP207	BRACKET, FRONT PANEL	467704	89536	467704	1		
MP208	PANEL, REAR	456780	89536	456780	1		
MP209	PUSH ROD, POWER SWITCH	456731	89536	456731	1		
MP210	COVER, AC SWITCH	475681	89536	475681	1		
MP228	GUARD, BASE	464404	89536	464404	1		
MP231	DECAL, KNOB	473546	89536	473546	1		
MP232	PANEL, FRONT	478156	89536	478156	1		
MP236	HOLE, PLUG	407502	89536	407502	1		
MP237	BUTTON, RANGE	426759	89536	426759	2		
MP238	BUTTON, RANGE	426759	89536	426759	REF		
MP239	BUTTON, FUNCTION	425900	89536	425900	4		
MP240	BUTTON, FUNCTION	425900	89536	425900	REF		
MP241	BUTTON, FUNCTION	425900	89536	425900	REF		
MP242	BUTTON, FUNCTION	425900	89536	425900	REF		
MP243	SPACER, XSTR	175125	07047	10172DAP	1		
Q200	XSTR, SI, PNP	340026	89536	340026	5	1	
Q201	XSTR, SI, PNP	340026	89536	340026	REF		
Q202	XSTR, SI, PNP	340026	89536	340026	REF		
Q203	XSTR, SI, PNP	340026	89536	340026	REF		
Q204	XSTR, SI, PNP	340026	89536	340026	REF		
Q205	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q206	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q207	XSTR, SI, PNP, PWR	325753	03508	D45C5	1	1	
Q210	XSTR, FET, N-CHANNEL	261578	89536	261578	4	1	
Q211	XSTR, FET, N-CHANNEL	261578	89536	261578	REF		
Q212	XSTR, FET, N-CHANNEL	261578	89536	261578	REF		
Q213	XSTR, FET, N-CHANNEL	261578	89536	261578	REF		
Q214	XSTR, FET, GRP, N-CHANNEL	261388	89536	261388	1	1	
R200	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	3		
R201	RES, MTL. FILM, 2.15K +/-1%, 1/8W	293712	91637	CMF552151F	1		
R202	RES, MTL. FILM, 301K +/-1%, 1/8W	379156	91637	CMF553013F	1		
R203	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	3		
R204	SEE FINAL ASSEMBLLY TABLE 5-1.						
R205	RES, VAR, CER, 10K +/-10%, 1/2W	309674	89536	309674	2		
R206	RES, MTL. FILM, 499K +/-1%, 1/8W	349191	91637	CMF554993F	1		
R207	RES, MTL. FILM, 47.5K +/-1%, 1/8W	474585	91637	CMF554752F	1		
R209	RES, COMP, 68K +/-5%, 1/4W	148171	01121	CB6835	1		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
R210	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	2		
R212	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	2		
R213	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	5		
R214	RES, COMP, 330K +/-5%, 1/4W	192948	01121	CB3345	1		
R215	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R216	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB62825	1		
R217	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R219	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	2		
R220	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R221	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R222	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R223	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R224	RES, VAR, CER, 10K +/-10%, 1/2W	309674	89536	309674	REF		
R225	RES, MTL. FILM, 90.9K +/-1%, 1/8W	223537	91637	CMF559092F	1		
R226	RES, MTL. FILM, 953 +/-1%, 1/8W	288555	91637	CMF559530F	1		
R227	RES, MTL. FILM, 909 +/-1%, 1/8W	312629	91637	CMF559090F	1		
R228	RES, MTL. FILM, 8.66K +/-1%, 1/8W	260364	91637	CMF558661F	1		
R229	RES, VAR, CER, 2K +/-10%, 1/2W	309666	89536	309666	1		
R231	RES, MTL. FILM, 11.8K +/-0.25%, 1/8W	325688	91637	CMF551182F	2		
R232	RES, MTL. FILM, 11.8K +/-0.25%, 1/8W	325688	91637	CMF551182F	REF		
R234	RES, VAR, CER, 100K +/-10%, 1/2W	369520	89536	369520	1		
R235	RES, MTL. FILM, 110K +/-1%, 1/8W	234708	91637	CMF551103F	1		
R236	RES, COMP, 82K +/-5%, 1/4W	188458	01121	CB8235	1		
R237	RES, COMP, 100K +/-5%, 1/4W	193342	01121	CB5125	1		
R238	RES, MTL. FILM, 100K +/-1%, 1/8W	248807	91637	CMF551003F	1		
R239	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	REF		
R242	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R243	RES, COMP, 4 7M +/-5%, 1/4W	220046	01121	CB4755	1		
R244	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R245	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R246	RES, COMP, 470K +/-5%, 1/4W	188441	01121	CB4745	1		
R247	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
S201-206	SWITCH, SET	453662	89536	453662	1		
S207	SWITCH, ROTARY	453670	89536	453670	1		
S208	SWITCH, OFF/ON	453605	89536	453605	1		
S208-1	BUTTON SWITCH, GREEN	445197	89536	445197	1		
S209	SWITCH SLIDE	234278	82389	XW1659	2		
S210	SWITCH SLIDE	234278	82389	XW1659	REF		
T200	POWER TRANSFORMER	458349	89536	458349	1		
TP200	CONNECTOR, POST	379438	00779	1-87022-0	11		
TP201	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP202	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP203	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP204	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP205	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP206	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP207	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP208	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP209	CONNECTOR, POST	379438	00779	1-87022-0	REF		
TP210	CONNECTOR, POST	379438	00779	1-87022-0	REF		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
U200	Ø IC, C-MOS, QUAD, BI-LATERAL SWITCH	363838	02735	CD4016AE	1		
U201	IC, LIN, OP-AMP	428862	02735	CA3130	1	1	
U202	IC, LIN, 5-XSTR ARRAY, 2-PNP, 3-NPN	418954	02735	CA30963E	1	1	
U203	Ø IC, C-MOS, HEX, BUFFER	381848	02735	CD4049AE	2	1	
U204	Ø IC, C-MOS, QUAD, 2-INPUT NAND GATE	355198	02735	CD4011AE	1	1	
U205	SEE FINAL ASSEMBLY TABLE 5-1						
U206	IC, LIN, NPN, XSTR ARRAY	419002	02735	CA3086E	1	1	
U207	Ø IC, C-MOS, HEX, BUFFER	381848	02735	CD4049AE	REF		
U209	Ø IC, C-MOS, HEX INVERTER	404681	02735	CD4069UBE	1	1	
U210	IC, LIN, OP-AMP	418566	18324	LM358/CR999	1	1	
U211	IC, LIN, OP-AMP	413740	18324	LM307N	1	1	
VR201	DIODE, ZENER, 6.4V	381988	04713	SZG20120	1		1
VR202	IC, LIN, ADJ-REG	460410	12040	LM317T	1	1	
VR203	IC, LIN, VOL-REG	355107	07236	F78050C	1	1	
VR204	DIODE, ZENER	159798	07910	IN751A	1	1	
W1	WIRE ASSY, FRONT PANEL	486654	89536	486654	1		
W2	WIRE ASSY, FRONT PANEL	486662	89536	476662	1		
W5	WIRE ASSY, FRONT PANEL	486605	89536	486605	1		
W6	WIRE ASSY, FUSE	135541	89536	135541	3		
W7	WIRE ASSY, FUSE	486621	89536	486621	REF		
W8	WIRE ASSY	115733	89536	115733	1		
W9	WIRE ASSY	115717	89536	115717	1		
W10	GROUND STRAP ASSY, BRIDGE RECTIFIER	486647	89536	486647	1		
W11	WIRE ASSY, BRIDGE RECTIFIER	486639	89536	486639	1		
W201	WIRE ASSY, FUSE	135541	89536	135541	REF		
XF1	HOLDER, FUSE	375188	89536	375188	1		
XF1-1	FUSEHOLDER CAP, GREY, 1/4" X 1 1/4"	460238	89536	460238	1		
XR204	SOCKET, RESISTOR	343285	0779	2-33127-6	2		
XU200	SOCKET, IC, 14-PIN	370304	01295	C931402	1		
XU205	SOCKET, IC, 40-PINS	429282	09922	DILB40P-108	1		

1 IF VR201 IS REPLACED, THE A/D CALIBRATION RESISTOR (R204) MAY HAVE TO BE RESELECTED, SEE SECT. 4 A/D CALIBRATION RESISTOR SELECTION.

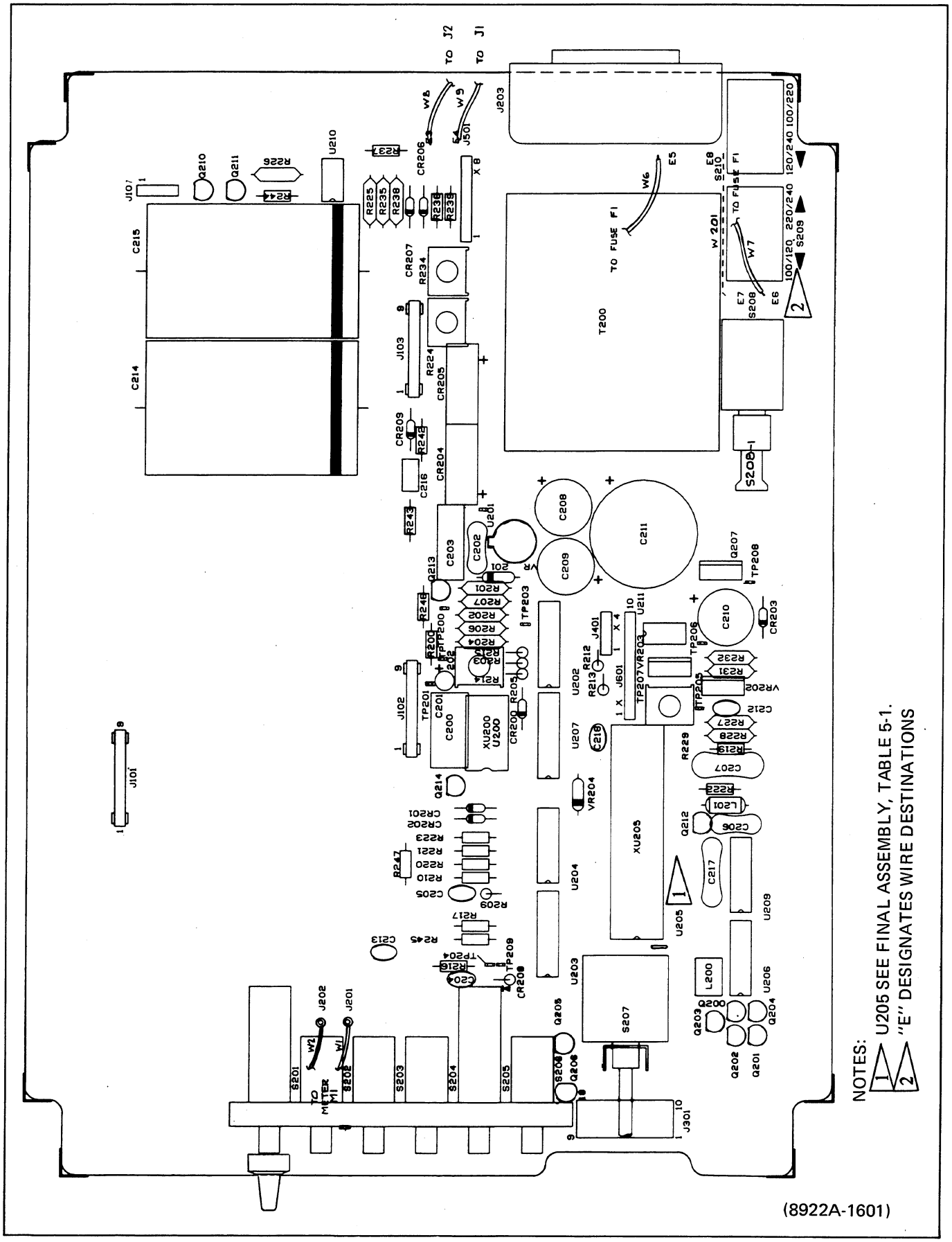


Figure 5-2. A1 Main PCB Assembly

Table 5-3. A1A1 Display PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A1A1	DISPLAY PCB ASSEMBLY FIGURE 5-3 (8920A-4002T)	456921	89536	456921	REF		
C301	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0035JA1	1		
CR301	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	1	1	
DS301	DISPLAY, LED	495457	29083	QDSP3507	1		
DS302	DISPLAY, LED	495440	28480	QDSP3515	4		
DS303	DISPLAY, LED	495440	28480	QDSP3515	REF		
DS304	DISPLAY, LED	495440	28480	QDSP3515	REF		
DS305	DISPLAY, LED	495440	28480	QDSP3515	REF		
DS306	DIODE, LIGHT EMITTING	385898	28480	5082-4887	5		
DS307	DIODE, LIGHT EMITTING	385898	28480	5082-4887	REF		
DS308	DIODE, LIGHT EMITTING	385898	28480	5082-4887	REF		
DS309	DIODE, LIGHT EMITTING	385898	28480	5082-4887	REF		
DS310	DIODE, LIGHT EMITTING	385898	28480	5082-4887	REF		
P301	CONNECTOR, POST	376574	00779	3-87022-1	18		
Q301	XSTR, SI, PNP	340026	89536	340026	1	1	
R301	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	3		
R302	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	1		
R303	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	REF		
R304	RES, COMP, 15K +/-5%, 1/4W	148114	01121	CB1535	1		
R305	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	REF		
U301	RESISTOR NETWORK	461442	89536	461442	1		
U302	IC, TTL, LO-POWER, DECODER DRIVER	418632	01295	SN74L47N	1	1	

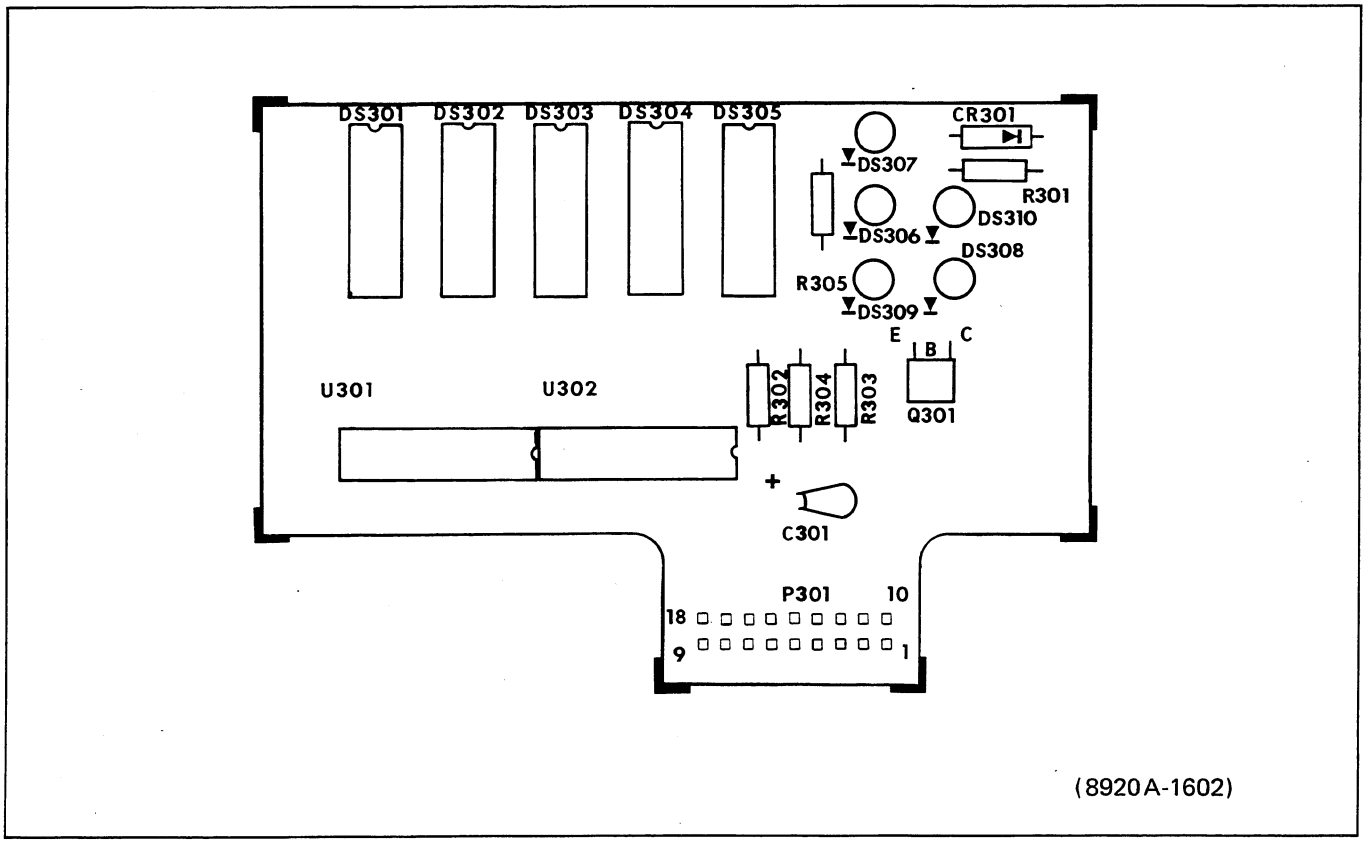


Figure 5-3. A1A1 Display PCB Assembly

Table 5-4. A2 AC PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A2	AC PCB ASSEMBLY FIGURE 5-4 (8922A-4003)	ORDER	ONLY	REPLACEABLE PARTS	REF		
C1	CAP, POLYESTER, 0.022 UF +/-10%, 630V	479519	73445	C280MAG/A22K	1		
C2	CAP, PORC, 180 PF +/-5%, 1 KV	474551	95275	VY15CA181JA	1		
C3	CAP, PORC, 4.3 PF +/-0.25 PF, 1.7 KV	479253	95275	VY10CA4R3	1		
C4	CAP, CER, 510 PF +/-5%, 100V	460832	95275	VK20BA511J	1		
C5	CAP, VAR, 1-5-0.25 PF, 2000V	218206	72982	530-000	3		
C6	CAP, CER, 39 PF +/-5%, 100V	460824	95275	VK20BA390J	1		
C7	CAP, CER, 5100 PF +/-5%, 100V	460840	95275	VK20BA512J	1		
C8	CAP, VAR, 5.5-18 PF, 350V	460170	72982	538-002	1	1	
C9	CAP, VAR, 1.7-6 PF, 250V	460147	91293	9300	1	1	
C12	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	8		
C13	CAP, VAR, 1-5-0.25 PF, 2000V	218206	72982	530-000	REF		
C14	CAP, CER, 4.7 PF +/-0.25PF, 100V	362772	80031	2222-638-09478	1		
C15	CAP, CER, 50,000 PF -20/+80%, 25V	148924	72892	5855-000-Y5UD-503Z	4		
C16	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	11		
C17	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C18	CAP, TA, 1.0 UF +/-20%, 35A	161919	56289	196D105X0035JA1	1		
C19	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C20	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C24	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C25	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C26	CAP, CER, 68 PF +/-2%, 100V	362756	80031	2222-631-10689	1		
C28	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C29	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C31	CAP, CER, 0.22 UF +/-20%, 50V	190314	51642	200-050-601-502M	1		
C33	CAP, VAR, 1-5-0.25 PF, 2000V	218206	72982	530-000	REF		
C34	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C35	CAP, CER, 50,000 PF -20/+80%, 25V	148924	72892	5855-000-Y5UD-503Z	REF		
C36	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C37	CAP, CER, 33 PF +/-2%, 100V	354852	80031	2222-638-10399	1		
C39	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C40	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C41	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C42	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C43	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C45	CAP, TA, 82 UF +/-20%, 20V	357392	56289	196D826X0020TE4	2		
C48	CAP, TA, 82 UF +/-20%, 20V	357392	56289	196D826X0020TE4	REF		
C49	CAP, CER, 1000 PF +/-10%, 500V	357806	56289	C016B102G-102K	2		
C50	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C51	CAP, CER, 10,000 +/-20%, 100V	149153	56289	C023B101F103M	REF		
C53	CAPACITOR SET (C53, C55)	463208	89536	463208	1		
C54	CAP, CER, 1000 PF +/-10%, 500V	357806	56289	C016B102G-102K	REF		
C55	CAPACITOR SET (SEE C53)						
C56	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C57	CAP, MYLAR, 0.027 UF +/-10%, 250V	267120	73445	C280MAE/A47K	1		
C59	CAP, CER, 50,000 PF -20/+80%, 25V	148924	72892	5855-000-Y5UD-503Z	REF		
C60	CAP, CER, 50,000 PF -20/+80%, 25V	148924	72892	5855-000-Y5UD-503Z	REF		
C61	CAP, CER, 0.0068 UF +/-5%, 100V	512244	95275	VK44BA6825	1		

Table 5-4. A2 AC PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
C62	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253M	1		
CR1	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	9	2	
CR2	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR3	DIODE, SI, LO-CAP, LO-LEAK	348177	07263	FD7223	2	1	
CR4	DIODE, SI, LO-CAP, LO-LEAK	348177	07263	FD7223	REF		
CR5	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR6	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR7	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR8	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR9	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR10	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
CR11	DIODE, HI-SPEED SWITCH	203323	07910	IN4448	REF		
J106	SOCKET, SINGLE IN-LINE, 4-POST CONTACT	417311	30035	SS-109-1-04	1		
K1	COIL, REED RELAY	446898	71707	U20134	2		
	REED SWITCH	284091	95348	MR138	2		
K2	COIL, REED RELAY	446898	71707	U20134	REF		
	REED SWITCH	284091	95348	MR138	REF		
MP183	SPACER, XSTR MOUNTING	472969	13103	7717-30	1		
MP187	POST, CONTACT	379438	00779	9-87022-1	3		
MP190	THERMAL EQUALIZER	489179	89536	489179	1		
MP202	SHIELD, AC	456830	89536	456830	1		
P101	POST, CONTACT	474742	22526	65500-109	3		
P102	POST, CONTACT	474742	22526	65500-109	REF		
P103	POST, CONTACT	474742	22526	65500-109	REF		
P104	CONNECTOR, SOCKET	386144	00779	3-332070-4	1		
P107	POST, CONTACT	417329	22526	65500-104	1		
Q1	XSTR, SI, NPN, SELECTED	471565	89536	471565	2	1	3
Q2	XSTR, SI, NPN, SELECTED	471565	89536	471565	REF		3
Q3	XSTR, FET, JCT, N-CHANNEL	477448	89536	477448	1	1	
Q4	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	7	2	
Q5	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	REF		
Q6	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	REF		
Q8	XSTR, SI, PNP	453829	24355	AD821	2	1	
Q9	DUAL FET/RESISTOR SET (Q9, R17)	476788	89536	476788	1	1	2
Q10	XSTR, MATCHED SET (Q10, Q12, Q38, Q40)	463133	89536	463133	1	1	1
Q11	XSTR, SI, PNP	454066	04713	MPSH81	10	2	
Q12	XSTR, MATCHED SET (SEE Q10)				REF		1
Q13	XSTR, SI, NPN	333898	04713	MPSH10	7	1	
Q14	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q15	XSTR, SI, PNP	225599	12040	2N4250	2	1	
Q16	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q17	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q18	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q19	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q20	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q21	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q23	XSTR, SI, NPN	218081	04713	MPS6520	4	1	
Q24	XSTR, SI, PNP	229898	04713	MPS6522	4	1	
Q25	XSTR, SI, NPN	218081	04713	MPS6520	REF		
Q26	XSTR, SI, PNP	229898	04713	MPS6522	REF		

Table 5-4. A2 AC PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
Q28	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	REF		
Q29	XSTR, FET, N-CHANNEL	261578	89536	261578	2	1	
Q31	XSTR, FET, N-CHANNEL	261578	89536	261578	REF		
Q32	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	REF		
Q33	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	REF		
Q36	XSTR, SI, PNP	453829	24355	AD821	REF		
Q37	DUAL FET/RESISTOR SET (Q37, R46)				1		2
Q38	XSTR, MATCHED SET (SEE Q10)				REF		1
Q39	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q40	XSTR, MATCHED SET (SEE Q10)				REF		1
Q41	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q42	XSTR, SI, PNP	225599	12040	2N4250	REF		
Q43	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q44	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q45	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q47	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q48	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q49	XSTR, SI, PNP	454066	04713	MPSH81	REF		
Q50	XSTR, SI, NPN	218081	04713	MPS6520	REF		
Q51	XSTR, SI, PNP	229898	04713	MPS6522	REF		
Q52	XSTR, SI, NPN	218081	04713	MPS6520	REF		
Q53	XSTR, SI, PNP	229898	04713	MPS6522	REF		
Q55	XSTR, SI, NPN	330803	04713	MPS6560	1	1	
Q56	XSTR, SI, PNP	418707	04713	MPS6562	1	1	
Q57	XSTR, FET, JCT, N-CHANNEL	376475	89536	376475	REF		
Q58	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q59	XSTR, FET, N-CHANNEL	507780	89536	507780	1	1	
R1	RES, MTL. FILM, 1M +/-1%, 1/2W	161075	91637	CMF651004F	1		
R2	RES, PRECISION, FILM, 9.91M +/-1%, 1/2W	460121	91637	HFF1-9914F	1		
R3	RES, VAR, CER, 5K +/-10%, 1/2W	327569	89536	327569	1		
R4	RES, MTL. FILM, 96.5K +/-1%, 1/8W	474478	91637	CMF559652F	1		
R5	RES, VAR, 10 +/-20%, 1/2W	479311	80031	ET50W100	1		
R6	RES, MTL. FILM, 1M +/-1%, 1/4W	474486	91637	CMF601004F	1		
R7	RES, VAR, CER, 500 +/-10%, 1/2W	325613	89536	325613	1		
R8	RES, MTL. FILM, 9.76K +/-0.5%, 1/8W	474460	91637	CMF559761D	1		
R9	RES, COMP, 15K +/-5%, 1/4W	148114	01121	CB1535	2		
R10	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	5		
R11	RES, COMP, 15K +/-5%, 1/4W	148114	01121	CB1535	REF		
R12	RES, CERMET, 9.09M +/-1%, 1/4W	459875	89536	459875	1		
R13	RES, MTL. FILM, 19.1 +/-0.5%, 1/8W	494286	91637	CMF5519R1D	2		
R14	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	8		
R15	RES, COMP, 6.2M +/-5%, 1/4W	221960	01121	CB6255	2		
R16	RES, COMP, 22M +/-5%, 1/4W	221986	01121	CB2265	1		
R17	RESISTOR/DUAL FET SET (SEE Q9)				REF		
R18	RESISTOR SET (R18, R35, R65, R79)	463182	89536	463133	1	1	
R19	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R20	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	3		
R21	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	4		
R22	RES, COMP, 8.2K +/-5%, 1/4W	160796	01121	CB8225	2		
R23	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	2		

Table 5-4. A2 AC PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
R25	RES, MTL. FILM, 499K +/-1%, 1/8W	268813	91637	CMF554993F	3		
R26	RES, VAR, CER, 100K +/-10%, 1/2W	369520	89536	369520	2		
R27	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	REF		
R28	ZENER RESISTOR SET (R28/VR3)	515197	89536	515197	1	1	
R29	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R30	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R31	RES, MTL. FILM, 8.06K +/-1%, 1/8W	294942	91637	CMF558061F	1		
R33	RES, COMP, 33 +/-5%, 1/4W	175034	01121	CB3305	4		
R34	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R35	RESISTOR SET (SEE R18)				REF		
R36	RES, MTL. FILM, 619 +/-1%, 1/8W	313072	91637	CMF556190F	4		
R38	RES, MTL. FILM, 619 +/-1%, 1/8W	313072	91637	CMF556190F	REF		
R39	RES, COMP, 33 +/-5%, 1/4W	175034	01121	CB3305	REF		
R40	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	2		
R41	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	2		
R42	RES, COMP, 160 +/-5%, 1/4W	261859	01121	CB1615	2		
R44	RES, VAR, CER, 50 +/-10%, 1/2W	447862	89569	447862	1		
R45	RES, MTL. FILM, 121 +/-1%, 1/8W	343160	91637	CMF551210F	1		
R46	RESISTOR/DUAL FET SET (SEE Q37)				REF		
R47	RES, COMP, 300 +-5%, 1/4W	348276	01121	CB3015	4		
R48	RES, COMP, 18 +/-5%, 1/4W	219022	01121	CB1805	4		
R49	RES, COMP, 18 +/-5%, 1/4W	219022	01121	CB1805	REF		
R50	RES, COMP, 300 +-5%, 1/4W	348276	01121	CB3015	REF		
R51	RES, MTL. FILM, 442 +/-1%, 1/8W	474452	91637	CMF554420F	1		
R52	RES, MTL. FILM, 243 +/-1%, 1/8W	512228	91637	CMF552430F	1		
R53	RES, MTL. FILM, 33.2 +/-1%, 1/8W	296681	91637	CMF5533R2F	1		
R54	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	2		
R55	RES, MTL. FILM, 20 +/-0.5%, 1/8W	494286	91637	CMF5519R1D	REF		
R56	RESISTOR PAIR (R56 & R57)	467662	89536	467662	1	1	
R57	RESISTOR PAIR (SEE R56)				REF		
R58	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R59	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R60	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R62	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R63	RES, COMP, 6.2M +/-5%, 1/4W	221960	01121	CB6255	REF		
R65	RESISTOR SET (SEE R18)				REF		
R66	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R67	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R68	RES, MTL. FILM, 3.48K +/-1%, 1/8W	260687	91637	CMF553481F	1		
R69	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R70	RES, COMP, 33 +/-5%, 1/4W	175034	01121	CB3305	REF		
R71	RES, MTL. FILM, 499K +/-1%, 1/8W	268813	91637	CMF554993F	REF		
R72	RES, VAR, CER, 100K +/-10%, 1/2W	369520	89536	369520	REF		
R73	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	REF		
R74	RES, COMP, 8.2K +/-5%, 1/4W	160796	01121	CB8225	REF		
R75	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R76	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R77	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	REF		
R78	RES, MTL. FILM, 619 +/-1%, 1/8W	313072	91637	CMF556190F	REF		
R79	RESISTOR SET (SEE R18)				REF		

Table 5-4. A2 AC PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
R80	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R82	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	REF		
R83	RES, MTL. FILM, 619 +/-1%, 1/8W	313072	91637	CMF556190F	REF		
R84	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R85	RES, COMP, 33 +/-5%, 1/4W	175034	01121	CB3305	REF		
R86	RES, COMP, 160 +/-5%, 1/4W	261859	01121	CB1615	REF		
R87	RES, COMP, 300 +-5%, 1/4W	348276	01121	CB3015	REF		
R88	RES, COMP, 300 +-5%, 1/4W	348276	01121	CB3015	REF		
R89	RES, COMP, 18 +/-5%, 1/4W	219022	01121	CB1805	REF		
R90	RES, COMP, 18 +/-5%, 1/4W	219022	01121	CB1805	REF		
R91	RES, MTL. FILM, 1K +/-1%, 1/8W	474445	91637	CMF551001F	1		
R92	RES, MTL. FILM, 49.9 +/-0.1%	512236	91637	CMF5549R9B	1		
R93	RES, MTL. FILM, 7.50K +/-1%, 1/8W	223529	91637	CMF557501F	1		
R94	RES, MTL. FILM, 51.1K +/-1%, 1/8W	289553	91637	CMF555112F	1		
R95	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R96	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R97	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R98	RES, MATCHED PAIR (R98, R106)	458299	89536	458299	1	1	
R99	RES, MTL. FILM, 20.5K +/-1%, 1/8W	261669	91637	CMF552052F	2		
R100	RES, MTL. FILM, 499K +/-1%, 1/8W	268813	91637	CMF554993F	REF		
R101	RES, VAR, CER, 10K +/-10%, 1/2W	309674	89536	309674	2		
R102	RES, MTL. FILM, 357K +/-1%, 1/8W	235002	91637	CMF553573F	1		
R103	RES, MTL. FILM, 110K +/-1%, 1/8W	234708	91637	CMF551103	1		
R104	RES, MTL. FILM, 20.5K +/-1%, 1/8W	261669	91637	CMF552052F	REF		
R105	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R106	RES, MATCHED PAIR (SEE R98)				REF		
R107	RES, MTL. FILM, 82.5K +/-1%, 1/8W	246223	91637	CMF558252F	2		
R108	RES, MTL. FILM, 82.5K +/-1%, 1/8W	246223	91637	CMF558252F	REF		
R109	RES, MTL. FILM, 2K +/-1%, 1/8W	235226	91637	CMF552001F	1		
R110	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R114	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R115	RES, MTL. FILM, 14.3K +/-1%, 1/8W	291617	91637	CMF551432F	1		
R117	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	1		
R118	RES, COMP, 150K +/-5%, 1/4W	275685	01121	CB1545	1		
R119	RES, COMP, 270K +/-5%, 1/4W	220061	01121	CB2745	1		
R120	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R121	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R122	RES, COMP, 10M +/-5%, 1/4W	194944	01121	CB1065	1		
R123	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R124	RESISTOR (SEE FINAL ASSEMBLY TABLE 5-1)						
R125	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	2		
R126	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R127	RES, VAR 150K +/-10%, 1/2W	519199	11236	360T-154A	1		
R128	RES COMP, 5.6M +/-5%, 1/4W	358077	01121	CB5655	1		
R129	RES, COMP, 5.1K +/-5%, 1/4W	193342	01121	CB5125	1		
R130	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
U1	RMS SENSOR	433839	89536	433839	1	1	
U2	IC OP AMP, J-FET	357830	12040	LH0042C	1	1	
U3	IC, LINEAR, OP AMP	418566	18324	LM358/CR3999	2		
U4	IC, LINEAR, OP AMP	418566	18324	LM358/CR3999	REF		

Table 5-4. A2 AC PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
U5	IC, LINEAR, 5-XSTR ARRAY	248906	02735	CA3046	1	1	
VR1	DIODE, ZENER, 5.6V	277236	07910	IN752A	2	1	
VR2	DIODE, ZENER, 5.6V	277236	07910	IN752A	REF		
VR3	PART OF ZENER RESISTOR SET (SEE R28)				REF		
VR4	DIODE, ZENER 13V	110726	07910	IN964B	1	1	
XR18	SOCKET, IN-LINE, 5-PIN (NOT SHOWN)	417899	52072	CA-05S-TSD	2		
XR35	SOCKET, IN-LINE, 5-PIN (NOT SHOWN)	417899	52072	CA-05S-TSD	REF		
XR65	SOCKET, IN-LINE, 9-PIN (NOT SHOWN)	436774	52072	CA-09S-TSD	2		
XR79	SOCKET, IN-LINE, 9-PIN (NOT SHOWN)	436774	52072	CA-09S-TSD	REF		

1 IF ANY ONE OF THE FOUR MATCHED XSTRS ARE DAMAGED ALL FOUR WILL HAVE TO BE REPLACED AND THE DC OFFSET RESISTORS FOR AMP-A AND AMP-B WILL HAVE TO BE RESELECTED. THEREFORE, IT WILL BE NECESSARY TO ORDER TWO RESISTOR SETS. SEE SECT. 4 "DC OFFSET RESISTOR SELECTION".

2 IF THIS PART IS REPLACED, THE DC OFFSET RESISTOR FOR THE CORRESPONDING AMPLIFIER (AMP-A, AMP-B) MAY HAVE TO BE RESELECTED. SEE SECT. 4 "DC OFFSET RESISTOR SELECTION". (Q9 AND R17, Q37 AND R46) MATCHED PAIRED SETS, PART NUMBER 476700.

3 Q1, AND Q2, XSTR MUST BE COLOR MATCHED.

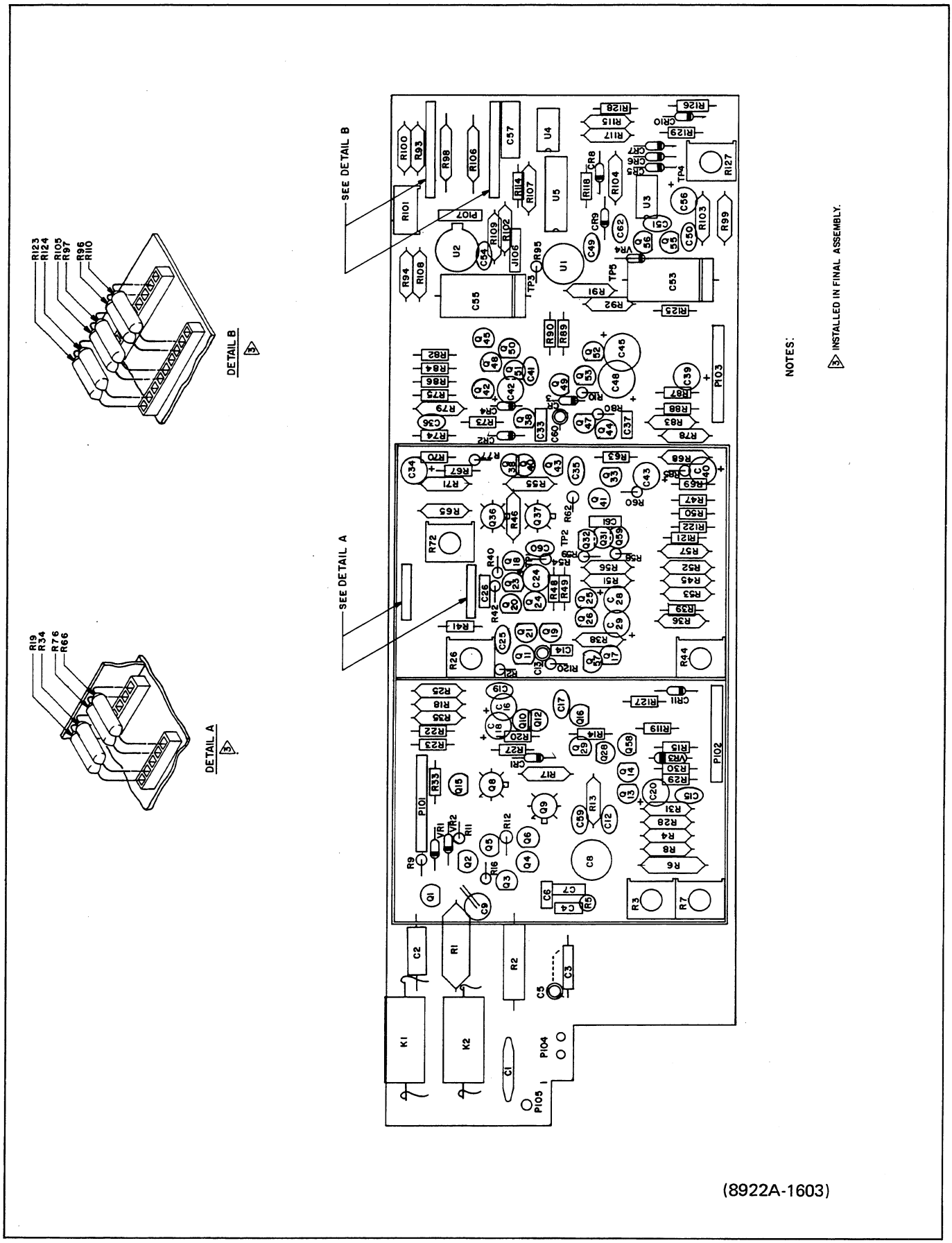


Figure 5-4. A2 AC PCB Assembly

Section 6
Option & Accessory Information

TABLE OF CONTENTS

6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 8922A. This section consists of an introductory section, an accessories subsection and a series of option subsections. All options and accessories are listed by model or option number in the table of contents included in this section.

6-3. ACCESSORIES

6-4. Hardware type accessories, i.e., rack mounting kits and cables, are documented in the accessories subsection. While option numbers (-003, -004) are documented as individual subsections. Each subsection contains all of the information necessary to install, operate and maintain each option and accessory. This includes a list of replaceable parts and a schematic (when applicable).

6-5. OPTIONS

6-6. The location of a particular subsection is facilitated by the use of unique page and paragraph numbering which corresponds to the option or accessory in question. For example, a 600-X series identifies the general accessories subsection and a 604-X series identifies the subsection for the -004 Option (where X is the individual page or paragraph number).

Accessories

600-1. RACK MOUNTING KITS

600-2. Kits are available that allow your DVM to be mounted either in a standard 19-inch equipment rack or panels with DIN size openings. The Y2014 allows one instrument to be offset-mounted on the right side in a 19-inch equipment rack (Figure 600-1). The Y2015 allows two instruments to be mounted side-by-side in a 19-inch equipment rack (Figure 600-2). The Y2020 allows one instrument to be panel mounted in a DIN size opening. With the appropriate mounting kit installed, you can easily remove your DVM for portable operation and easily mount the DVM back in the permanent installation.

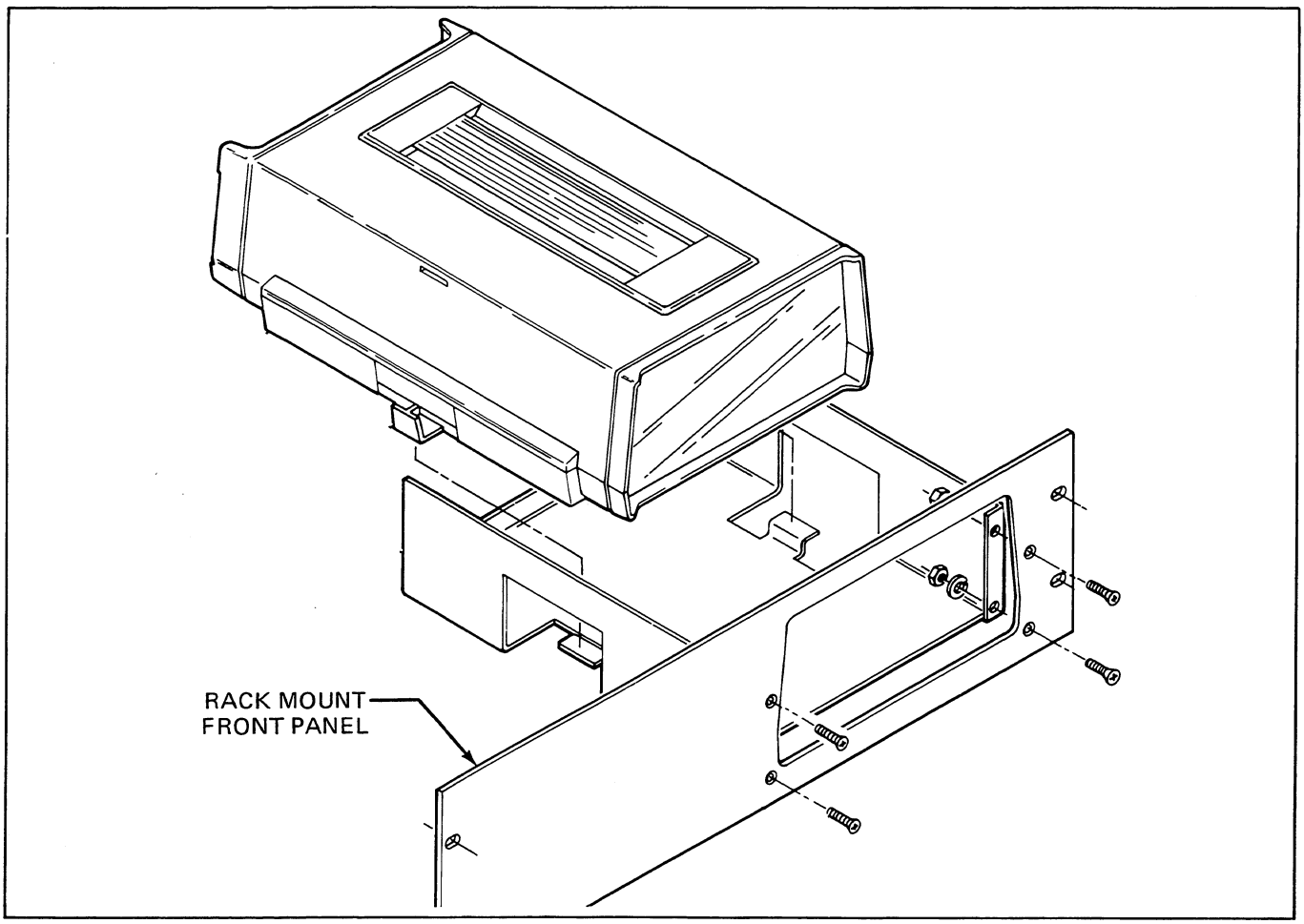


Figure 600-1. Y2014 Offset-Right Rack Mount

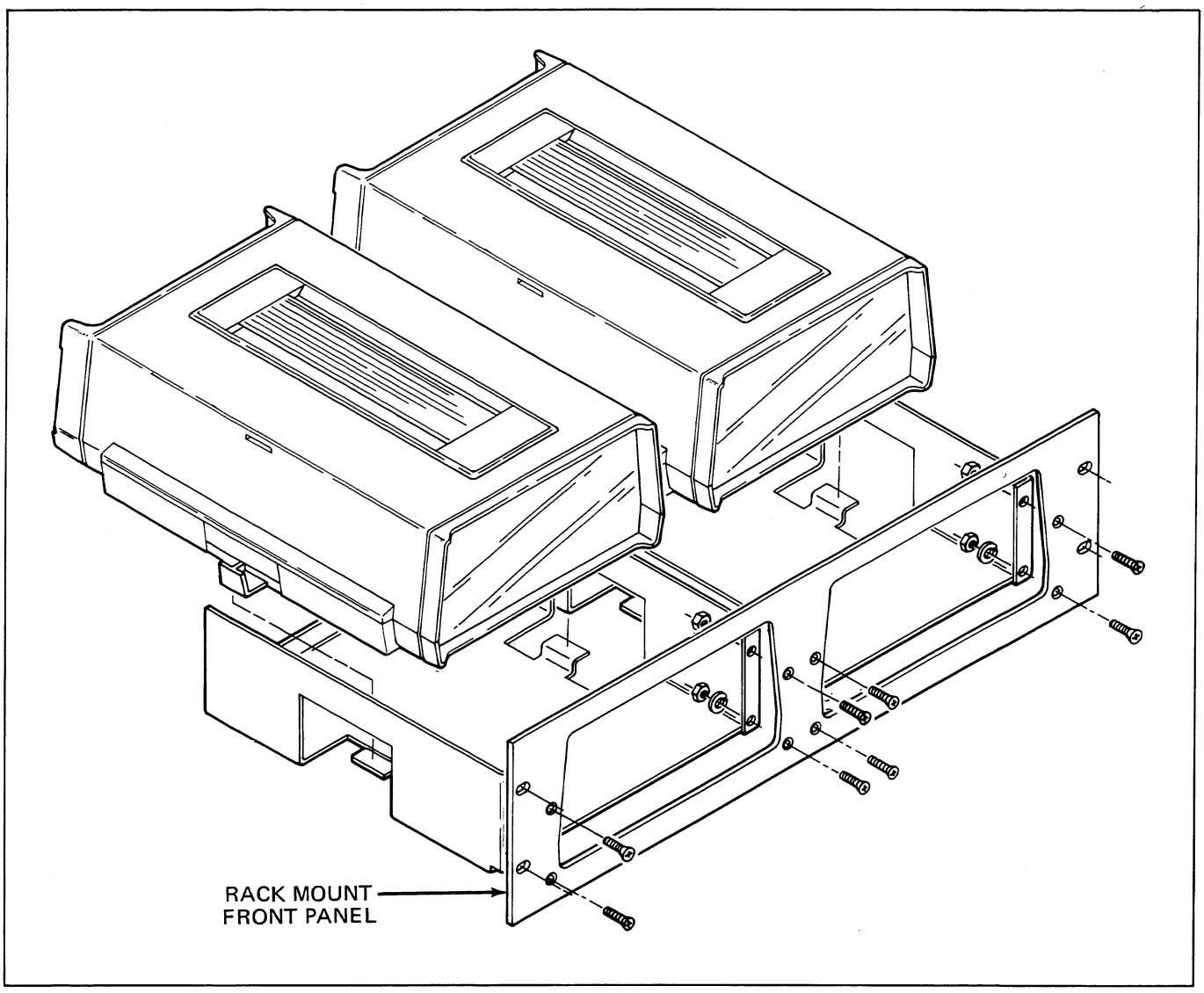


Figure 600-2. Y2015 Double Offset Rack Mount

-003 Option
Counter Output

603-1. INTRODUCTION

603-2. The -003 Counter Output Option converts an rms input signal into an isolated 100 mV peak, squarewave suitable for triggering a counter. There are several advantages as opposed to using separate inputs for the DVM and the counter. First, the 8922A autoranged input has a much greater dynamic range than a counter. This means that input sensitivity is increased to 180 μV while, on the other hand, DVM inputs as large as 700V rms will not overload the counter. In practice, inputs should be 1.8 mV or greater due to possible false triggering effects of noise riding on lower level inputs. Secondly, because the counter output is isolated, the diode isolation from earth ground is not defeated if the counter low input is earth ground. Third, only one probe is needed to make simultaneous voltage and frequency measurements.

603-3. SPECIFICATIONS

603-4. Specifications for the Counter Output Option are given in Section 1 of this manual.

603-5. INSTALLATION

603-6. Use the following procedure to install the Counter Output Option. Refer to Figure 603-1 for illustration.

1. Remove 8922A top cover (see Access Information).

2. Plug Counter Output Option into J106-1, J106-3 of the A2 AC PCB Assembly and mechanically secure with the three screws provided; one on the AC Assy shield and two on the rear panel.

3. Connect the 3-wire cable (P401) to J401 on the A1 Main PCB Assembly.

4. Verify operation using the calibration procedure.

5. Replace the shields.

603-7. OPERATION

603-8. Once installed, the Counter Output Option requires no operator attention other than ensuring that no voltage is ever applied to the option's rear panel BNC output (J102).

603-9. THEORY OF OPERATION

603-10. As shown in Figure 603-2, the Counter Output Option utilizes an isolation amplifier, two Schmitt triggers, pulse transformer, and a DC-DC power supply to provide an isolated output suitable for triggering a counter. The isolation amp is used as a buffer between amplifier B's output and the first Schmitt trigger. The Schmitt trigger drives the pulse transformer with a square wave at the same frequency as the sine wave input. The pulse transformer provides isolation between the input common and output common. The second Schmitt trigger is used to convert the pulse transformer output to the 100 mV square wave output at the same frequency as the sine wave input. The DC-DC power supply provides isolated +5.3V and -6.5V for the second Schmitt trigger.

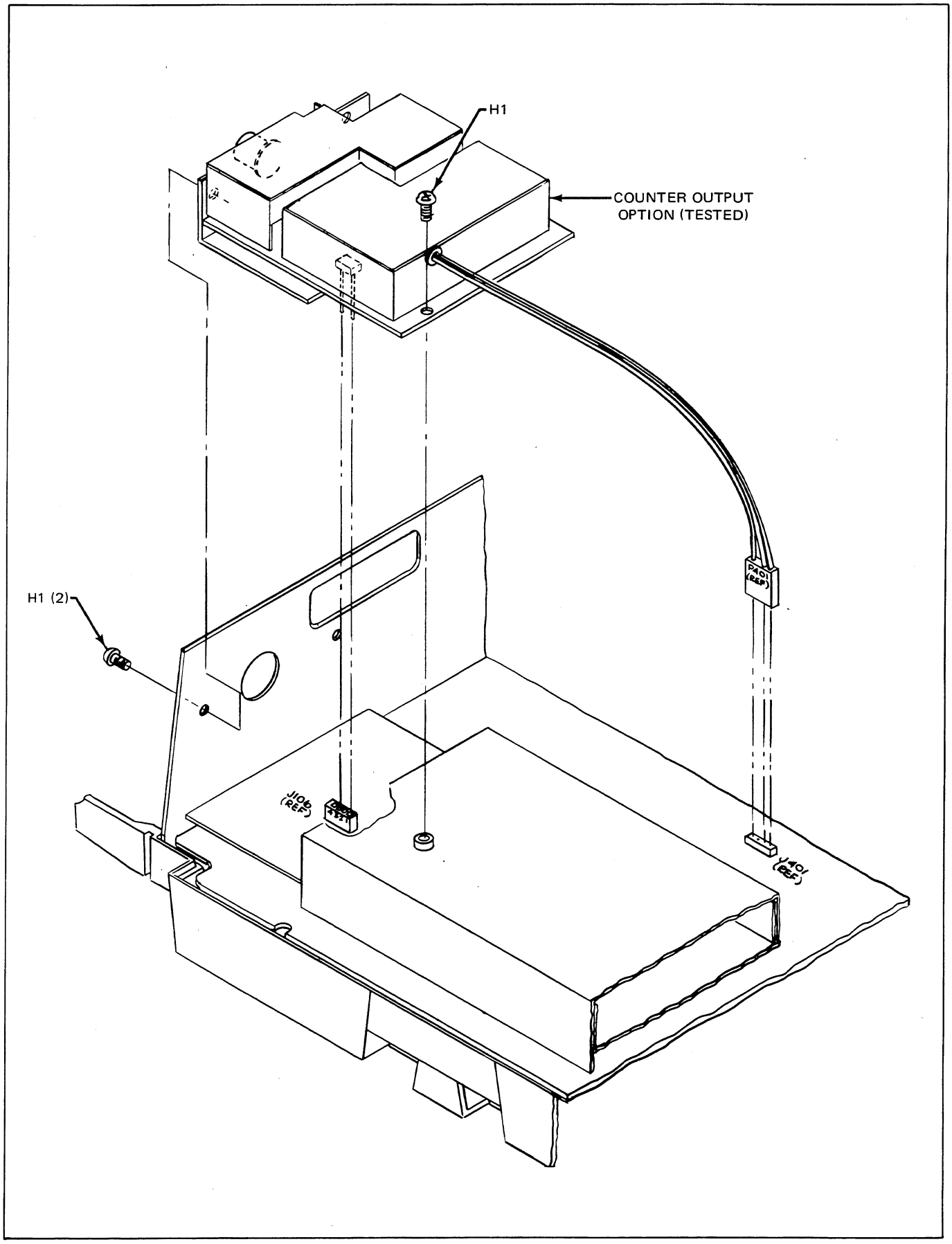


Figure 603-1. Counter Output Option Installation

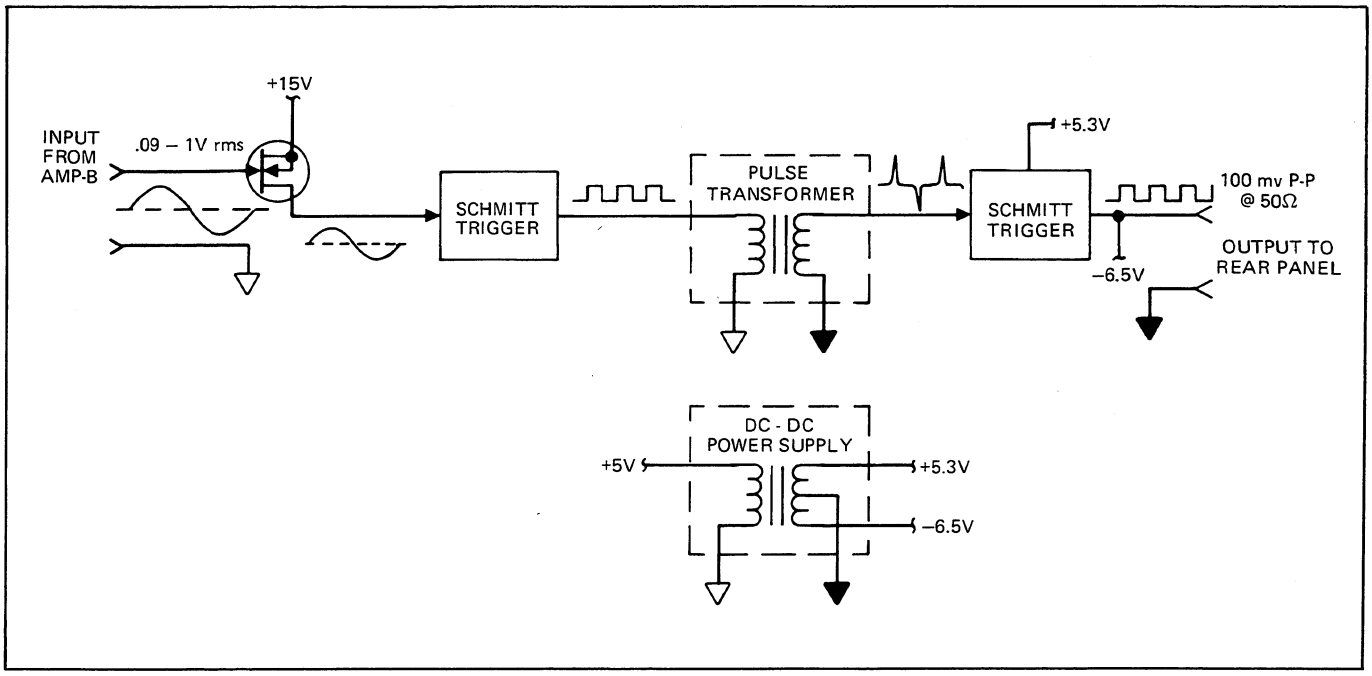


Figure 603-2. Counter Output Option Simplified Schematic

603-11. MAINTENANCE

603-12. The following maintenance information covers three areas; performance testing, calibration and troubleshooting of the -003 Counter Output Option. However, before any of these procedures can be started, the calibration of the mainframe instrument (8922A) must be successfully completed. The table of recommended test equipment in Section 4 lists all of the equipment necessary to calibrate, adjust, and troubleshoot the mainframe instrument. Any additional equipment required to check and calibrate the -003 Option is listed in Table 603-1. If you are unable to obtain the recommended test equipment, insure that the substitute has equal or better performance specifications.

NOTE

For the following procedures the 8922A will be referred to as the UUT (Unit Under Test).

Table 603-1. Recommended Test Equipment

QTY	EQUIPMENT NOMENCLATURE	REQUIREMENT	RECOMMENDED EQUIPMENT
1	Universal Counter Timer	100 Hz-20 MHz	Fluke 1953A
2	Oscilloscope	DC to 200 MHz 1.8 ns	Tektronix 475

603-13. Performance Test

603-14. The following procedure will verify that the Counter Output Option is operating within the specification limits stated in Section 1.

1. Connect the AC calibrator, UUT, oscilloscope and termination as shown in Figure 603-3.

2. Set the AC calibrator to its 10V range, set the UUT to AC FUNCTION, VOLTS DISPLAY MODE, and 2V range, HOLD and set the oscilloscope's time base to 0.2 sec/div and Vert on 50 mV/div.

3. Referring the Table 603-2, change input to UUT as indicated, and note that display values are within indicated tolerances.

4. Disassemble the setup as shown in Figure 603-3, and connect the SG503, UUT, and Universal Counter-Timer and terminations, as shown in Figure 603-4.

5. Set the SG503 to its 10-25 MHz range, set the Universal Counter-Timer for frequency ratio measurement with 10 sec gate interval, and the UUT set to AC FUNCTION, VOLTS DISPLAY MODE, and 200 MV RANGE HOLD.

6. Referring to Table 603-3, change input to UUT as indicated, and note that display values are within indicated tolerances.

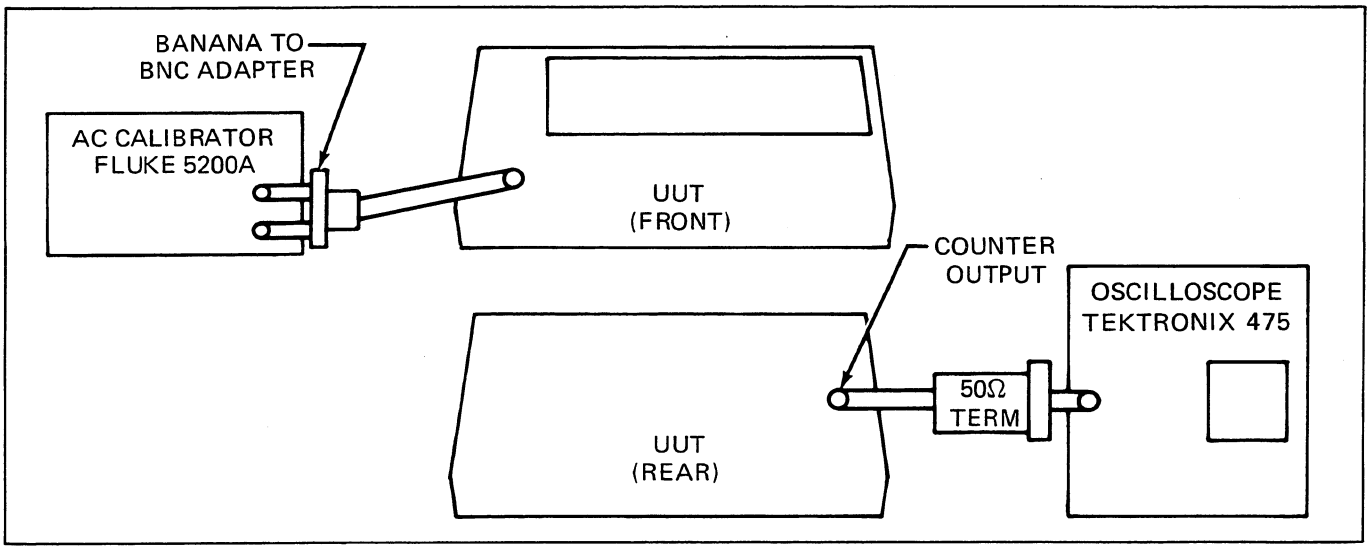


Figure 603-3. Counter Output Performance Set-Up

Table 603-2. Counter Output Amplitude

AC CALIBRATOR OUTPUT	UUT DISPLAY	OSCILLOSCOPE DISPLAY ±20%	COMMENTS
1.9V, 1 kHz	1.900	Observe 100 mV squarewave	Adjust calibrator output to obtain UUT display.
0.18V, 1 kHz	.180	Observe 100 mV squarewave	Adjust calibrator output to obtain UUT display.

Table 603-3. Counter Output Frequency Response

SG503 OUTPUT	UUT DISPLAY	COUNTER-TIMER DISPLAY ±1 DIGIT	COMMENTS
18 mV, 20 MHz	18.0	1.00000	Adjust the SG503 output to obtain UUT display.
180 mV, 20 MHz	180.0	1.00000	Adjust the SG503 output to obtain UUT display.

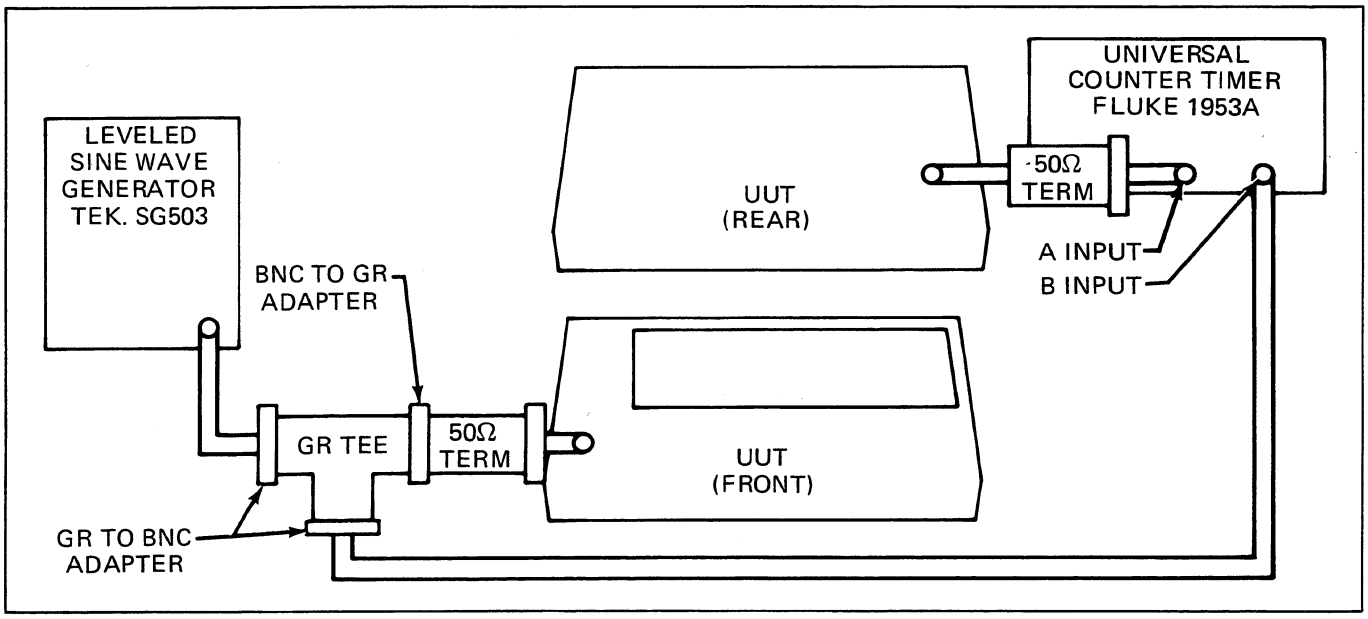


Figure 603-4. Counter Output Performance Test Set-Up

603-15. CALIBRATION ADJUSTMENT

603-16. The Counter Output Option should be adjusted when it is first installed or if the limits, as stated in the performance test, cannot be met. Use the following procedure to calibrate the Counter Output Option. If it is not possible to obtain the limits as stated in the following procedure, then the option will require troubleshooting. If, however, the limits are met, then we recommend that the performance test be completed as a check.

1. Remove the UUT's top cover and measure the inverter power supply voltages:

MEASURE BETWEEN	DVM DISPLAY
C413 and Ground	5.0V, ±0.3V
C414 and Ground	-6.2V, ±0.3V

2. Connect the AC calibrator, UUT, oscilloscope, and terminations as shown in Figure 603-3.

3. Set the AC calibrator to its 1V range at 10 kHz, set the oscilloscope time base to 20 μsec/div. and Vert to 50 mV/div. and set the UUT to AC FUNCTION, VOLTS DISPLAY MODE, and 2V range HOLD.

4. Apply 180 mV/10 kHz from the AC calibrator to the input of the UUT. Using the oscilloscope check the UUT's counter output and adjust R404 until a symmetrical square wave is obtained. The amplitude of the square wave should be 100 mV peak, ±20% and must not change as the input to the UUT is increased up to 18V.

5. Disassemble the set up as shown in Figure 603-3 and connect the SG503, UUT, Universal Counter-Timer, and terminations as shown in Figure 603-5.

6. Set the SG503 to its 11 MHz range, set the Counter-Timer for frequency ratio measurement with a 10 sec gate time and set the UUT to AC FUNCTION, VOLTS DISPLAY MODE, and 200 mV range HOLD.

7. Select an 11 MHz output on the SG503 and adjust its amplitude with the vernier control until the UUT reads 18.0 mV. At this point, the Counter-Timer should display a stable reading of 01.00000 ±1 digit.

8. Reduce the output amplitude of the SG503 until the Counter-Timer display limit of step 7 cannot be met.

9. Adjust R404 until the Counter-Timer display limit of step 7 is met.

10. Repeat steps 8 and 9 until the Counter-Timer display limit can be met at the lowest possible input level.

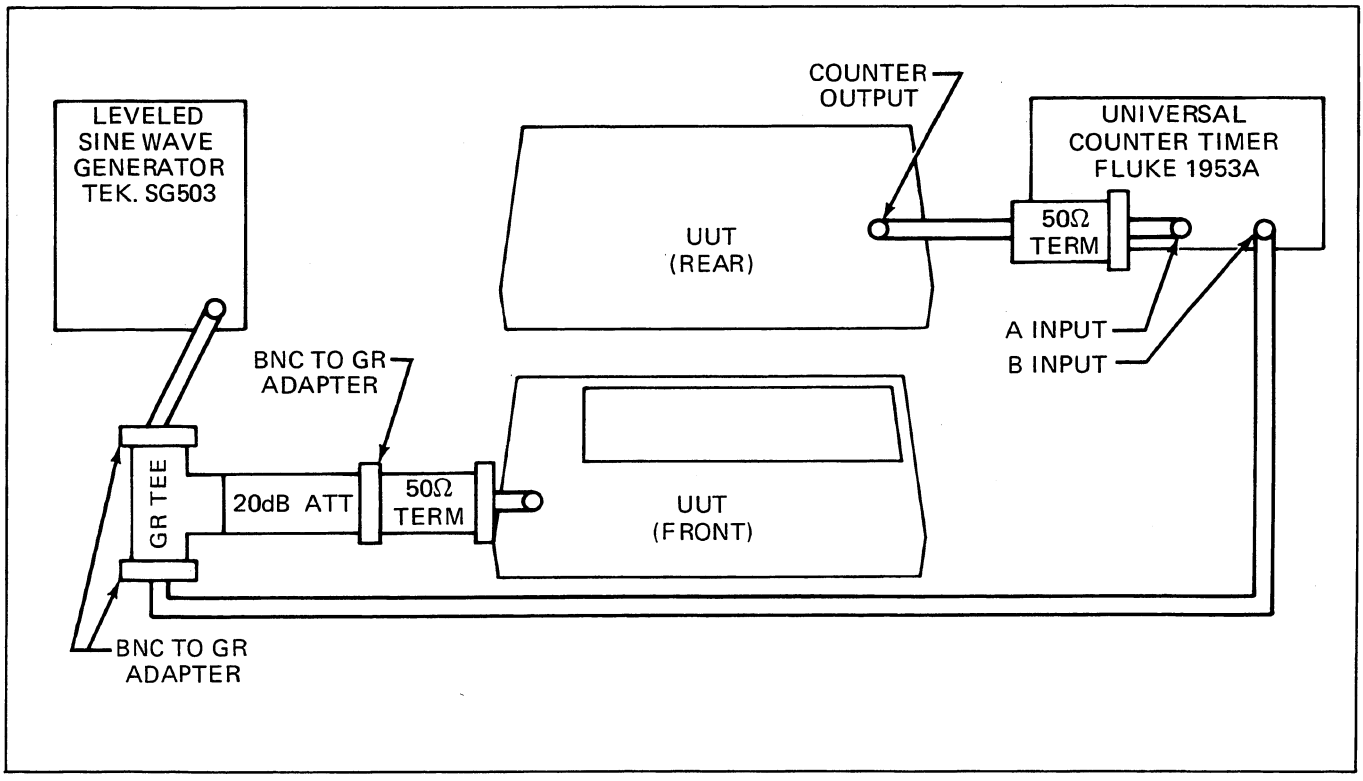


Figure 603-5. Calibration Set-Up

603-17. TROUBLESHOOTING

603-18. Table 603-4 should be completed ONLY if the performance test and calibration procedure indicate the the -003 Counter Output Option IS NOT operating correctly. This table includes voltage levels and waveforms of a properly functioning -003 Option. If you are unable to obtain any value (±15%) then you should replace the defective component and repeat the entire troubleshooting procedure. However, if all values are obtained then the performance test and calibration procedure must be repeated.

603-19. LIST OF REPLACEABLE PARTS

603-20. A list of replaceable parts for the Counter Output Option is given in Table 603-5 and shown in Figure 603-6. Refer to Section 5 of this manual for ordering information.

Table 603-4. Counter Output Option Troubleshooting

1. Using the 8020A or any compatible 3 1/2 digit meter, measure the following supply voltages.

SUPPLY VOLTAGE	MEASURE BETWEEN HIGH TERMINAL AND LOW TERMINAL	DVM DISPLAY (8020A)
+15	U401-1 and Input Common*	+15.00, ±0.1V
−15	U401-6 and Input Common*	−15.00 ±0.2V
+5	T402-2 and Input Common*	+5.00 ±0.25V
+5.3	U401-1 and Chassis Ground*	+5.3 ±0.3V
−6.5	U401-6 and Chassis Ground*	−6.5 ±0.3V

2. Using an oscilloscope (with x10 probe) Tek 475 or equivalent, check the following points for the indicated waveforms.

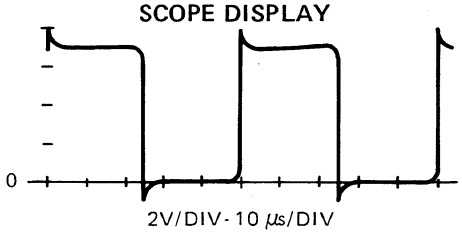
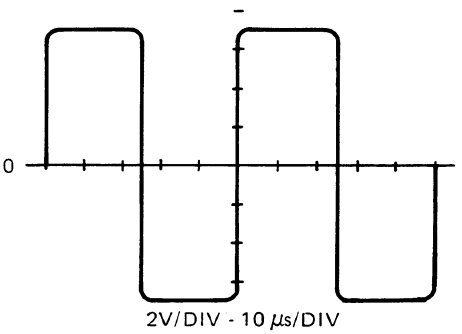
MEASURE BETWEEN HIGH TERMINAL - LOW TERMINAL	SCOPE DISPLAY
T402-1 and Input Common* T402-3 and Input Common*	 2V/DIV - 10 μs/DIV
T402-6 and Input Common* T402-8 and Input Common*	 2V/DIV - 10 μs/DIV

Table 603-4. Counter Output Option Troubleshooting (cont)

2a. Using Fluke 5200A or equivalent, apply 1V/10 kHz signal to input of UUT.

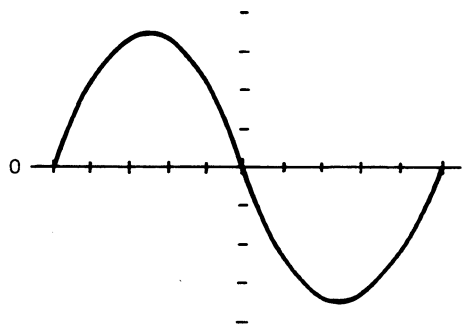
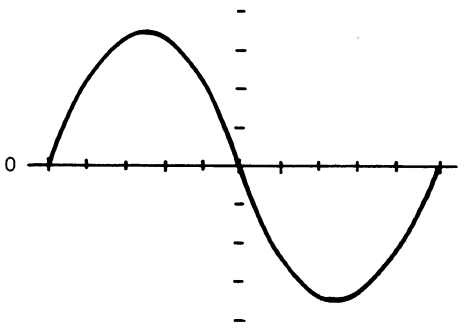
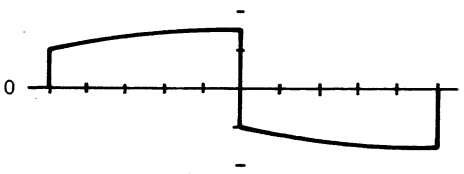
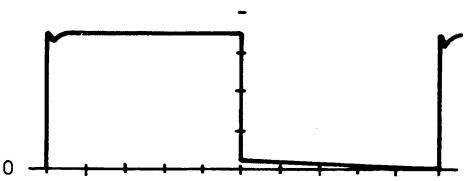
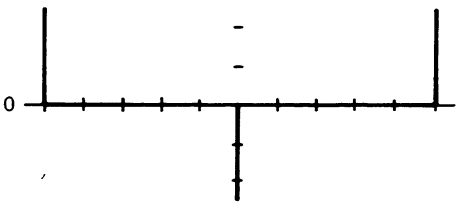
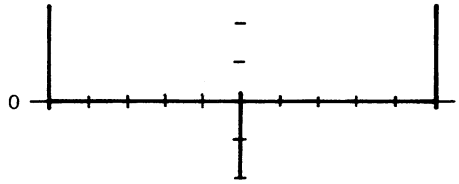
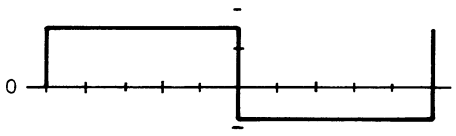
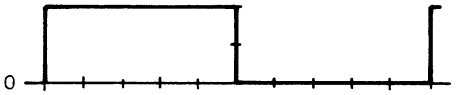
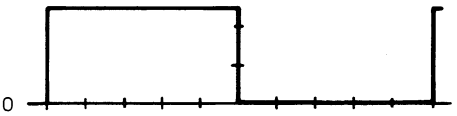
MEASURE BETWEEN HIGH TERMINAL - LOW TERMINAL	SCOPE DISPLAY
Gate of Q401A and Input Common*	 .2/DIV - 10 μs/DIV
Drain of Q401B and Input Common* U401-3 and Input Common*	 .2V/DIV - 10 μs/DIV
U401-4 and Input Common*	 50 mV/DIV - 10 μs/DIV
U401-9 and Input Common*	 1V/DIV - 10 μs/DIV
T401 input and Input Common*	 .5V/DIV - 10 μs/DIV

Table 603-4. Counter Output Option Troubleshooting (cont)

MEASURE BETWEEN HIGH TERMINAL—LOW TERMINAL	SCOPE DISPLAY
T401 output and Chassis Ground*	 .5V/DIV - 10 μs/DIV
U402-4 and Chassis Ground*	 .5V/DIV - 10 μs/DIV
U402-9 and Chassis Ground*	 2V/DIV - 10 μs/DIV
J402 and Chassis Ground*	 100 mV/DIV - 10 μs/DIV

*Input Common = ▽ see schematic at end of this manual, Section 8.

*Chassis Ground = ⏚ see schematic at end of this manual, Section 8.

5. Press the 8922A dB/VOLTS switch to the dB position then the REL/dBm switch to the REL position. The 8922A display will be ±0.00 dB.

6. Select the 20 volt range on the DVM.

7. Use the decade switch on the ac source to increase the 8922A input to the levels indicated in Table 604-1. Nore the DVM and 8922A displays to be within the tolerances given.

Table 603-5. Counter Output Option PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
-003	COUNTER OUTPUT OPTION FIGURE 603-4 (892X-4013)	ORDER	-003	OPTION	AR		
C401	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C2241K	5		
C402	CAP, CER, 430 PF +/-5%, 500V	177980	72136	DM15F431J	1		
C403	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C2241K	REF		
C404	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C2241K	REF		
C405	CAP, INSTALLED AT TEST LEVEL IF REQUIRED				AR		
C406	CAP, TA, 47 UF +/-20%, 20V	348516	56289	196D476X0020TE4	1		
C407	CAP, CER, 0.005 UF +/-20%, 100V	175232	56289	C023B101E502M	1		
C408	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C2241K	REF		
C409	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	1		
C410	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C2241K	REF		
C411	CAP, TA, 220 UF +/-20%, 10V	474288	56289	196D227X0010TE4	2		
C412	CAP, TA, 220 UF +/-20%, 10V	474288	56289	196D227X0010TE4	REF		
C413	CAP, CER, 4.7 UF +/-20%, 50V	363721	56289	196D475X0050PE4	2		
C414	CAP, CER, 4.7 UF +/-20%, 50V	363721	56289	196D475X0050PE4	REF		
C415	CAP, CER, 300 PF 3 KV	485250	56289	C028B02E301M	1		
C416	CAP, INSTALLED AT TEST LEVEL IF REQUIRED				AR		
CR401	DIODE, SI, HI-SPEED, SWITCH	203323	07910	1N4448	7	2	
CR402	DIODE, SI, HI-SPEED, SWITCH	203323	07940	1N4448	REF		
CR403	DIODE, SI, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
CR404	DIODE, SI, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
CR405	DIODE, SI, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
CR406	DIODE, SI, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
CR407	DIODE, SI, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
H1	SCREW, FHP, 4-40 X 1/4, SS (NOT SHOWN)	256156	73734	23022	8		1
J402	CONNECTOR, BNC, FEMALE	152033	95712	30355-1	1		
L401	CHOKE, 6-TURN	320911	89536	320911	3		
L402	CHOKE, 6-TURN	320911	89536	320911	REF		
L403	CHOKE, 6-TURN	320911	89536	320911	REF		
L404	INDUCTOR SHEILDED, 0.27 UH	313031	24859	MR-0.27	1		
MP1	SHIELD	475491	89536	475491	1		
MP2	SHIELD	475483	89536	475483	1		
MP3	SHIELD	475376	89536	475376	1		
MP4	COVER	475509	89536	475509	1		
MP5	COVER	475400	89536	475400	1		
MP6	BRACKET	456723	89536	456723	1		
MP7	SHIELD	475384	89536	475384	1		
P106	POST, CONTACT	474809	22526	65505-136	3		
P401	CABLE ASSEMBLY (-003 OPTION)	486670	89536	486670	1		
Q401	XSTR,DUAL FET	454637	89536	454637	1	1	
Q402	XSTR, SI, NPN	272237	89536	272237	2	1	
Q403	XSTR, SI, NPN	272237	89536	272237	REF		
R402	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	2		
R403	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	REF		
R404	RES, VAR, 100K +/-10%, 1/2W	369520	89536	369520	1		
R405	RES, COMP, 20K +/-5%, 1/4W	221624	01121	CB2035	1		
R406	RES, COMP, 9.1K +/-5%, 1/4W	193318	01121	CB9125	1		
R407	RES, COMP, 51, +/-55%, 1/4W	221879	01121	CB5105	2		
R408	RES, COMP, 1.2K +/-5%, 1/4W	190371	01121	CB1225	1		

Table 603-5. Counter Output Option PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
R409	RES, COMP, 15K +/-5%, 1/4W	148114	01121	CB1535	1		
R410	RES, COMP, 220 +/-5%, 1/4W	147959	01121	CB2215	1		
R411	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	1		
R412	RES, COMP, 680 +/-5%, 1/4W	148007	01121	CB6815	2		
R413	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	1		
R414	RES, COMP, 5.1K +/-5%, 1/4W	193342	01121	CB5125	1		
R415	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	1		
R416	RES, COMP, 680 +/-5%, 1/4W	148007	01121	CB6815	REF		
R417	RES, COMP, 51 +/-5%, 1/4W	221879	01121	CB5105	REF		
T401	TRANSFORMER	461863	89536	461864	1		
T402	TRANSFORMER	472798	89536	472498	1		
U401	IC, LIN, HI-SPEED ANALOG VOL COMPARATOR	386920	12040	LM361N	2	1	
U402	IC, LIN, HI-SPEED ANALOG VOL COMPARATOR	386920	12040	LM361N	REF		

1 Refer to Figure 603-1

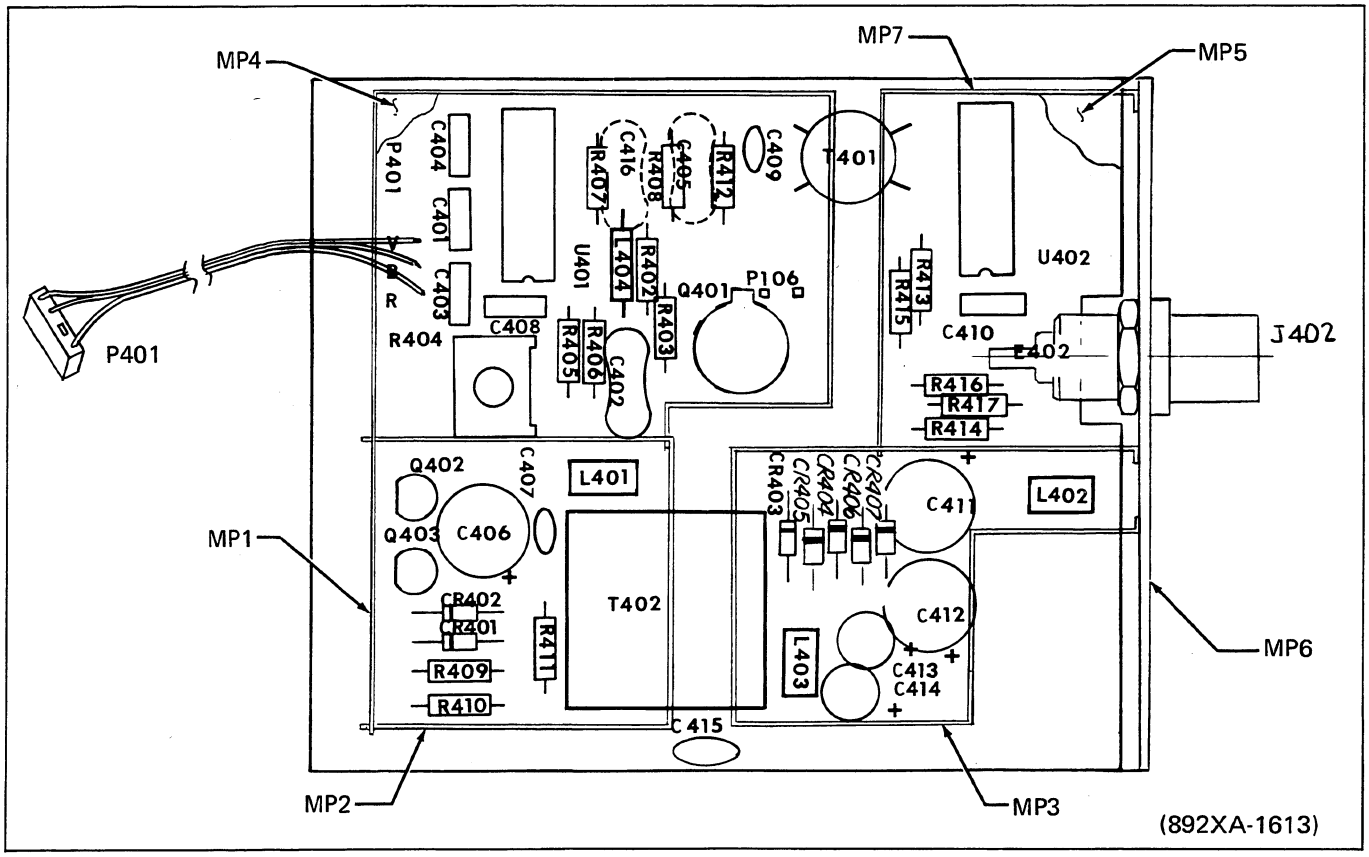


Figure 603-6. Counter Output Option PCB Assembly

-004 Option
Logarithmic Analog Output

604-1. INTRODUCTION

604-2. The Logarithmic Analog Output Option provides a non-isolated output voltage which varies continuously as the logarithm of the rms input. Scaling is: 0V dc output corresponds to 0 dB which is 200 μV rms input to the 8922A while 13.1V dc output = 131 dB = 700V rms input. A continuous frequency response of circuits with a wide dynamic output is easily plotted on an XY recorder using this option. The option's output is non-isolated.

604-3. SPECIFICATIONS

604-4. Specifications for the Logarithmic Analog Output Option are given in Section 1 of this manual.

604-5. INSTALLATION

604-6. Install the option as follows, referring to Figure 604-1.

1. Remove the top cover (see Access Procedures).

2. Remove the plate located at the top of the 8922A's rear panel.

3. Install the banana jack plate with the red banana jack to the right (when viewing the 8922A from the rear).

4. Secure the Logarithmic Analog Output Assembly to the top of the transformer bracket (see Figure 604-1) using the two screws provided.

5. Plug P501 into J501 (located on the Main PCB Assembly).

6. Solder the Logarithmic Analog Output Assembly's red output lead to the red banana jack, and the black lead to the black banana jack.

7. Verify operation using the calibration procedure presented in Section 4 of this manual.

604-5. OPERATION

604-6. Once installed, the Logarithmic Analog Output Option requires no operator attention other than ensuring that no voltage is ever applied to the option's output banana jacks.

604-7. THEORY OF OPERATION

604-8. The Logarithmic Analog Output Option, illustrated in Figure 604-2, utilizes the logarithmic characteristics of a P-N junction to develop an output proportional to the logarithm of the dc input from the thermal sensor.

604-9. The dc output voltage of the thermal sensor develops a collector current in one-half of a dual transistor. The resulting emitter base voltage is compared to the reference Vbe of the second half and scaled up accordingly. This voltage in turn develops a current which is summed with range information to produce the logarithmic output.

604-10. The output of the sensor covers one decade (.1 to 1V) in any one range. Scaling is such that one decade corresponds to 2V or 20 dB (.1V = 1 dB) at the output. "0" dB corresponds to 200 μV and each range increase produces an additional 2V at the output. Transients during range changes are eliminated by a sample and hold circuit.

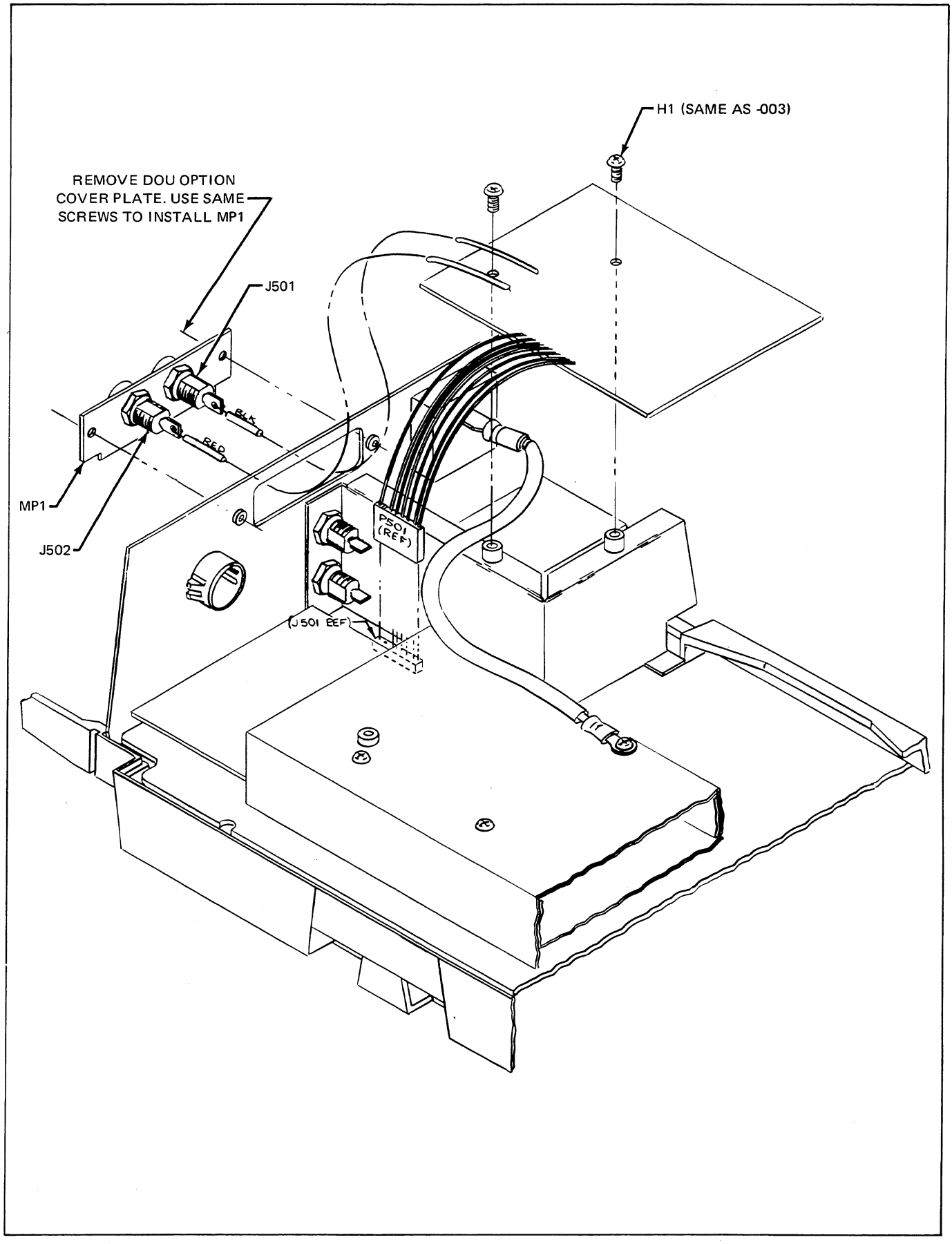


Figure 604-1. Logarithmic Analog Output Option Installation

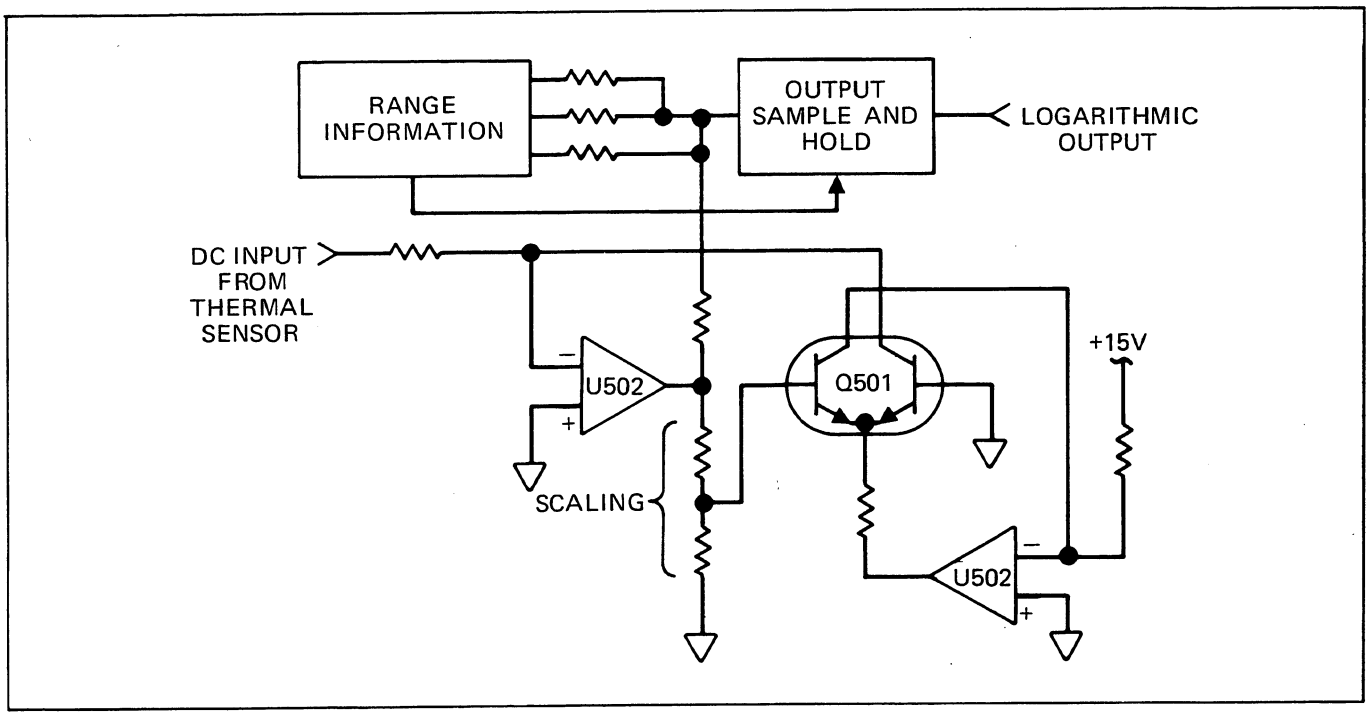


Figure 604-2. Logarithmic Analog Output Option Simplified Schematic

604-11. MAINTENANCE

604-12. The following maintenance information covers three areas; performance testing, calibration and troubleshooting of the -004 Logarithmic Analog Output Option. However, before any of these procedures can be started, the calibration of the mainframe instrument must be successfully completed. The table of recommended test equipment in Section 4 lists all of the equipment necessary to calibrate the mainframe instrument. No additional equipment is required to check, calibrate, and troubleshoot the -004 Option.

NOTE

For the following procedures, the 8922A will be referred to as the UUT (Unit Under Test).

604-13. PERFORMANCE TEST

604-14. The following procedure will verify that the Logarithmic Analog Output Option is operating within the specification limits stated in Section 1.

1. Select the AC function, LO RANGE ENABLE, and AUTO range on the UUT.

2. Apply 1.0 mV, 500 Hz to the UUT INPUT connector.

3. Select the DC Volts function and 2 volt range on the DVM; connect it to the LOGARITHMIC ANALOG OUTPUT jacks on the rear panel of the UUT.

4. Adjust the vernier control on the AC source of a voltage reading on the DVM of 1.400 ±.002V dc.

5. Press the UUT dB/VOLTS switch to the dB position then the REL/dBm switch to the REL position. The UUT display will be ±0.00 dB.

6. Select the 20 volt range on the DVM.

7. Use the decade switch on the ac source to increase the 8922A input to the levels indicated in Table 604-1. Note the DVM and 8922A display to be within the tolerances given.

Table 604-1. Performance Test

8922A INPUT	8922A DISPLAY	DVM DISPLAY*
10 mV, 500 Hz	20.00 ±0.25 dB	3.4 ±0.24V
100 mV, 500 Hz	40.00 ±0.25 dB	5.4 ±0.24V
1V, 500 Hz	60.00 ±0.25 dB	7.4 ±0.24V
10V, 500 Hz	80.00 ±0.25 dB	9.4 ±0.24V
100V, 500 Hz	100.00 ±0.25 dB	11.4 ±0.24V

* The tolerance limit represents total system inaccuracies.

604-15. CALIBRATION

604-16. The Logarithmic Analog Option should be calibrated when it is first installed or if the limits as stated in the performance test cannot be met. Use the following procedure to calibrate the Logarithmic Analog Option. If it is not possible to obtain the limits as stated in the following procedure then the option will require troubleshooting. If, however, the limits are met then we recommend that the performance test be completed as a check.

1. Remove the 8922A's top cover, and set up the test equipment as shown in Figure 604-3.

2. Set the 8922A at AC, AUTO. Now apply 1.0 mV ac, 500 Hz. Observe the option's output to be approximately 1.4 ±0.2V dc. (TP504 is Ground, TP503 is the option's output.)

3. Apply 20.0 mV, 500 Hz to the UUT and select its HOLD RANGE. Monitor the voltage TP502 and adjust R501 for a 0 ±0.0005V dc on the DVM.

4. Monitor TP501 and note the magnitude and polarity of the offset from 0V to the nearest 0.01V.

5. While still monitoring TP501 adjust R512 for a reading of -10V +OFFSET of step 3 ±0.01V.
Example:

Initial Offset	Final Reading
-.03V	-10 -.03 = 10.03 ±.01V
+.14V	-10 +.14 = -9.86 ±.01V

6. Monitor TP503 and note the offset from +6.00V to the nearest 0.01V.

7. Decrease the input to 100 mV, 500 Hz and observe that the DMM reads +5.4V ±0.01V plus the offset noted in step 5.

8. Decrease the input to 20 mV, 500 Hz and observe that the DMM reads +4.00V ±0.01V plus the offset noted in step 5.

604-17. TROUBLESHOOTING

604-18. To troubleshoot the -004 Option read the theory of operation for this option and then check the actual voltage levels against those indicated on the -004 schematic, located in Section 8. If there are any descrepancies, simply replace the defective component and repeat the performance test and calibration procedure.

604-19. LIST OF REPLACEABLE PARTS

604-20. A list of replaceable parts for the Logarithmic Analog Output Option is given in Table 604-2 and shown in Figure 604-4. Refer to Section 5 of this manual for ordering information.

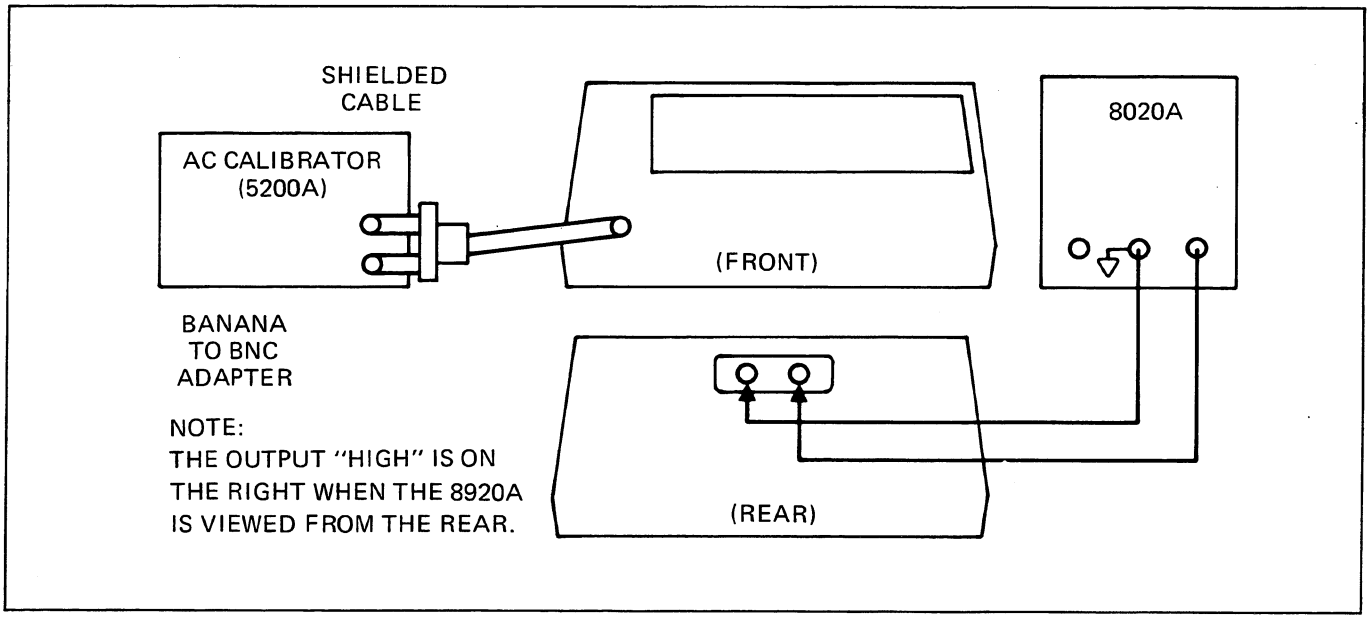
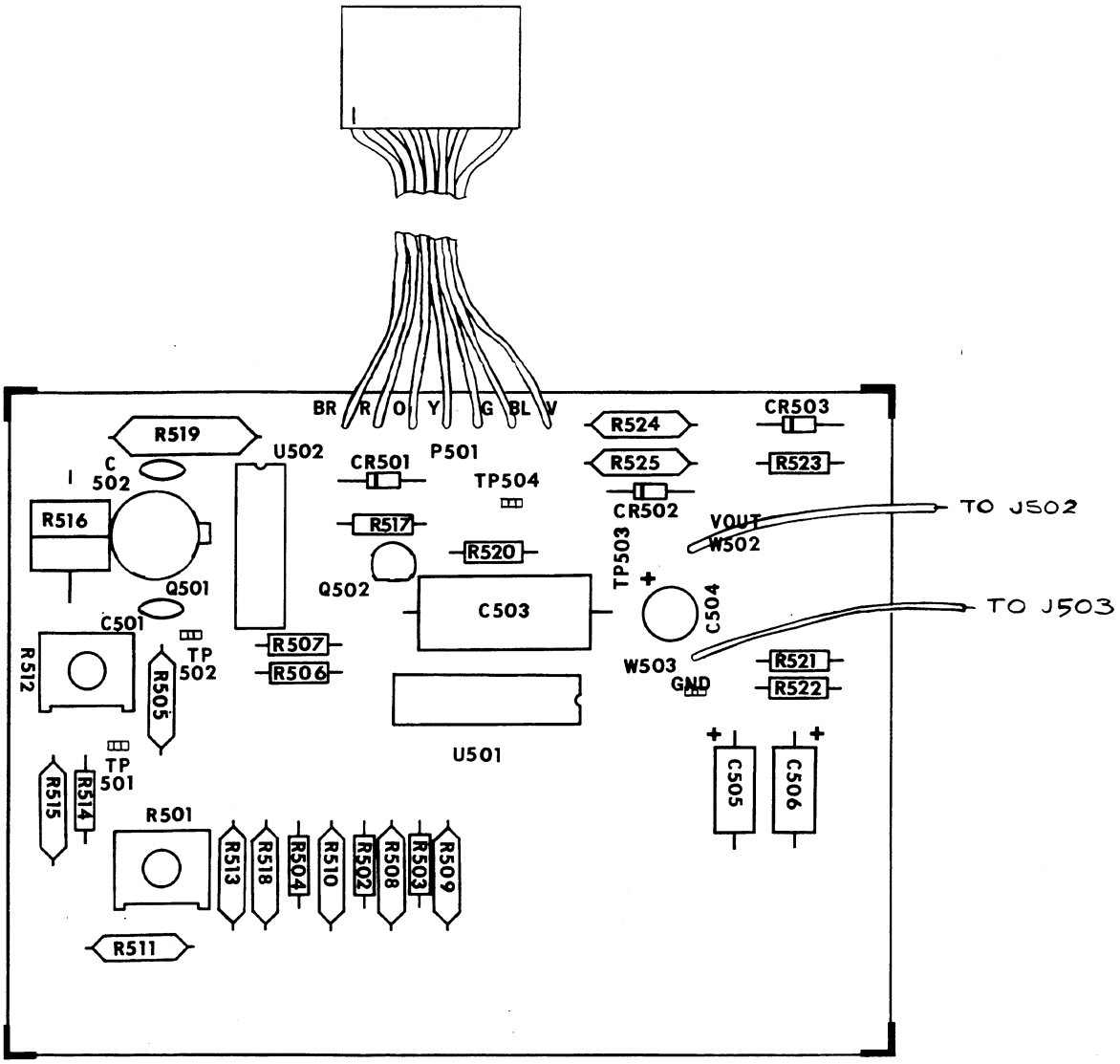


Figure 604-3. Logarithmic Analog Output Option Test Set-Up

Table 604-2. Logarithmic Analog Output Option PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
-004	LOGARITHMIC ANALOG OUTPUT OPTION FIGURE 606-4 (8920A-4014)	ORDER	-004	OPTION	AR		
C501	CAP, CER, 1000 PF +/-10%, 500V	357806	56289	C016B102G102K	1		
C502	CAP, CER, 100 PF +/-10%, 1000V	105593	71590	DD-101	1		
C503	CAP, MYLAR, 2.0 UF +/-20%, 100V	334185	14752	230B1B105	1		
C504	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X00154A1	1		
C505	CAP, ELECT, TA, 2.2 UF +/-10%, 20V	160226	56289	150D225X9020A	2	1	
C506	CAP, ELECT, TA, 2.2 UF +/-10%, 20V	160226	56289	150D225X9020A	REF		
CR501	DIODE, HI-SPEED, SWITCH	203323	07910	1N4448	3	1	
CR502	DIODE, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
CR503	DIODE, HI-SPEED, SWITCH	203323	07910	1N4448	REF		
J501	BANANA JACK, BLACK	162073	74970	108-0903-001	1		
J502	BANANA JACK, RED	162065	74970	108-0902-001	1		
MP1	COVER PLATE, LOG ANALOG OPTION	456772	89536	456772	1		
P501	CABLE, LOGARITHMIC ANALOG OUTPUT	486688	89536	486688	1		
Q501	XSTR, DUAL, SI, NPN	295717	24355	AD811-00/17	1	1	
Q502	XSTR, FET, JNCT, N-CHANNEL	376475	89536	376475	1	1	
R501	RES, VAR, 100K +/-10%, 1/2W	369520	89536	369520	1	1	
R502	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	7		
R503	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R504	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R505	RES, MTL. FILM, 10K +/-1%, 1/8W	168260	91637	CMF551002F	1		
R506	RES, COMP, 15M +/-5%, 1/4W	381491	01121	CB1565	1		
R507	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	1		
R508	RES, MTL. FILM, 37.5K +%, 1/8W	442947	91637	CMF553752B	1		
R509	RES,MF,75K +/-0.1%,1/8W	370916	91637	CMF557502B	1		
R510	RES, MTL. FILM, 150K +/-0.25%, 1/8W	442707	91637	CMF551503C	2		
R511	RES, MTL. FILM, 100K +/-0.1%, 1/8W	370775	91637	CMF551003B	1		
R512	RES, VAR, 20K +/-10%, 1/2W	335760	89536	335760	1	1	
R513	RES, MTL. FILM, 150K +/-0.25%, 1/8W	442707	91637	CMF551503C	REF		
R514	RES, COMP, 45%, 1/4W	148163	01121	CB4735	1		
R515	RES, MTL. FILM, 158K +/-1%, 1/8W	237214	91637	CMF551583F	1		
R516	RES, WW, 994 +/-2%, 1/2W	477018	89536	477018	1	1	
R517	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R518	RES, MTL. FILM, 20K +/-0.1%, 1/8W	446443	91637	CMF552002B	1		
R519	RES, MTL. FILM, 1.5M +/-1%, 1/2W	284976	91637	CMF651504F	1		
R520	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	1		
R521	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R522	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R523	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	REF		
R524	RES, MTL. FILM, 100K +/-5%, 1/8W	248807	91637	CMF551003F	1		
R525	RES, MTL. FILM, 143K +/-1%, 1/8W	291336	91637	CMF551433F	1		
TP501	CONNECTOR POST	379438	00779	1-87022-0	4		
TP502	CONNECTOR POST	379438	00779	1-87022-0	REF		
TP503	CONNECTOR POST	379438	00779	1-87022-0	REF		
TP504	CONNECTOR POST	379438	00779	1-87022-0	REF		
U501	IC, C-MOS, HEX BUFFER/INVERTER	381848	02735	CD4049UBE	1	1	
U502	IC, LINEAR, OP AMP	402669	02735	CA324E	1	1	
W502	WIRE ASSEMBLY	488163	89536	488163	1		



(8920A-1614)

Figure 604-4. Logarithmic Analog Output Option PCB Assembly

-521 Option
DMM Digital Interface

6521-1. INTRODUCTION

6521-2. The DMM Digital Interface provides optically isolated DMM data to a compatible external unit -- such as the DMM-1120A Interface PCB. (Note: The DMM Digital Interface connected to the DMM-1120A Interface PCB mounted in an 1120A Translator is the -529 Option.) Compatability requirements for the external unit are presented below. All additional information -- such as theory of operation, installation, operation, etc. -- is presented in supplemental documentation. If you order the DMM Digital Interface, either as an installed option or as a field installable kit, a copy of this manual will be provided. Order the 892XA-521K when ordering this option at the same time you order your 8922A. Order the 892XA-521 if you want a field installable kit.

6521-3. THE EXTERNAL UNIT

6521-4. The compatibility requirements for the external unit are listed below. Pin assignment on the interface cable is shown in Figure 6521-1. The cable connector type is a male 36-pin AMP "Blue Ribbon Type" series.

1. The external unit must provide:

   a. Operating Power: GND and +5V dc at 10 mA.

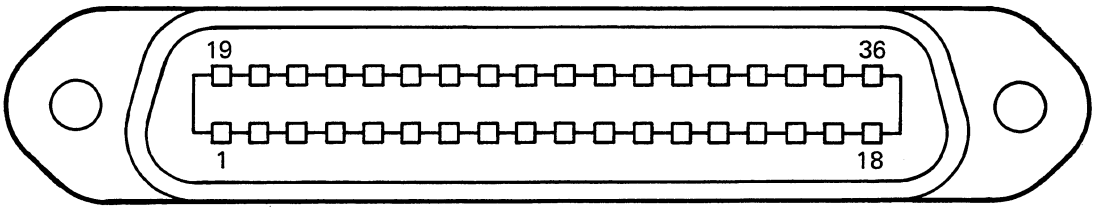
   b. DMM address: When reading DMM data the proper DMM address must be sent continuously on the A0 through A3 address lines. Resistive termination is 100 kΩ tied to +5V only. Logic high is 3.5 to 5.0V. Logic level low is 0 to 1.5V. Negative true logic.

2. The external unit must be able to accept:

   a. Not Address Valid (AV): Signal line goes from logic high (3.5 to 5V) to a logic level low (0 to 1.0V) to indicate that the DMM has received the correct DMM address.

   b. DMM data: BCD DMM data presented nibble serial -- 4-bit parallel -- on the W, X, Y, Z lines in the same sequence that data is presented to the DMM display. The format of this data is presented in Table 6521-1. The external unit must be capable of using the DMM data in this format. Logic high level is 4.6 to 5V at -0.14 mA. Logic level low is 0 to 0.7V at +0.36 mA.

   c. Not Data Valid (DV): The external unit must accept data only when DV goes to a logic level low (0 to 1.0V) from a logic level high (3.5 to 5V). If the DMM is not autoranging and if the data is valid and new, then DV will go low in the middle of each data nibble to indicate to the external unit that this nibble is valid and settled.



PIN NO.	MNEMONIC	SOURCE		DESCRIPTION
		DMM	EXT UNIT	
1	$\overline{AV}$	X		Not Address Valid - Low indicates DMM is responding to a valid address.
2	$\overline{DV}$	X		Not Data Valid - Low indicates that DMM data on the W, X, Y, Z lines is valid, new and settled.
3	A0		X	LSB
4	A1		X	DMM ADDRESS
5	A2		X	
6	A3		X	MSB
7 & 8		NOT USED		
9	Z	X		LSB
10	Y	X		
11	X	X		BCD DMM data transmitted nibble serial.
12	W	X		MSB
13-16		NOT USED		
17	GND		X	Operating voltages for the interface side of the DMM Digital Interface PCB circuitry.
18	+5V		X	
19-36		NOT USED		

Figure 6521-1. Interface Cable Pin Assignment

Table 6521-1. DMM Data Format on the DMM Digital Interface

dB Reference Table

J	0	1
LMN	IMPEDANCE	
000	REL	REL
001	72	52
010	150	50
011	300	75
100	600	93
101	900	110
110	1000	124
111	1200	135

Range Table

abc	RANGE
000	2 mV
001	20 mV
010	200 mV
011	2V
100	20V
101	200V
110	700V
111	Not Used

Table 6521-1. DMM Data Format on the DMM Digital Interface (cont)

SEQUENCE NO.	W	X	Y	Z	MEANING
1	J	L	M	N	dB Reference/Status
2	K	a	b	c	Range/Status
3	0	dB	OL	UL	Status
4	B	B	B	B	LSD
5	B	B	B	B	4SD
6	B	B	B	B	3SD
7	B	B	B	B	2SD
8	$\overline{P}$	1	0	Z1	Polarity/MSD

0	Binary bit:	Logic 0, low
1	Binary bit:	Logic 1, high
B	Binary data bit:	0 or 1
abc	Binary range code:	See inset Range Table
dB	If dB = 1:	DMM reading is in dB
	If dB = 0:	DMM reading is in volts
$\overline{DV}$	Not Data Valid:	Low indicates valid data on WXYZ
J LMN	If dB = 0:	J indicates the number of display digits J = 0 is 3½ digits J = 1 is 4½ digits
	If dB = 1:	J LMN indicate dB reference selected -- see inset 892XA dB Reference Table
K	If K = 1:	DVM will flash decimal point for underload and flash all digits for inputs greater than 700V
MSD	Most Siginificant Digit	
LSD	Least Dignificant Digit (2SD follows MSD in sequence)	
OL	If OL = 1:	Overload: DMM input has exceeded DMM capacity for that range
UL	If UL = 1:	Underload: DMM input is below optimum for that range -- reading may not be accurate
P	Polarity bit	
Z1	Z1 = 1:	Most Significant Digit is 1
	Z1= 0:	Most Significant Digit is 0

-519 Option
DMM-IEEE-488 Interface

6529-1. INTRODUCTION

6529-2. The DMM-IEEE-488 Interface Translates between the 8922A and the General Purpose Interface Bus (GPIB) as defined by the IEEE 488-1978. The interface is composed of one DMM-1120A Interface PCB -- mounted in and 1120A Translator -- and one or more DMM Digital Interface(s) (-521K Option). The interface implements the following IEEE functions: SH1, AH1, T3, TE3. All additional information is contained in supplemental literature. If you order the DMM-IEEE-488 Interface either as an installed option or as a field installable kit, a copy of this manual will be provided. Order the 892XA-529 when ordering this option at the same time you order your 8922A. Order 892X-A529 if you already have an 8922A and want a field installable kit.

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.

Federal Supply Codes for Manufacturers

D9816
Westermann Wilhelm Augusta-Anlage
Mannheim-Nackarau Germany

S0482
Sony Corp.
Tokyo, Japan

S3774
Oshino Electric Lamp Works
Tokoyo, Japan

0AD86
IN General
El Paso, TX

0AE89
Autosplice Inc.
Woodside, NY

0BW21
Noritake Co. Inc.
Burlington, MA

0ANF0
Topaz Semiconductor Inc
San Jose, CA

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

0CLN7
Emhart Fastening Group
Shelton, CT

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

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

00199
Marcon Electronics Corp
Keamy, NJ

00213
Nytronics Comp. Group Inc.
Darrlington, NC

00327
Welwyn International Inc.
Westlake, OH

00656
Aerovox Corp.
New Bedford, MA

00686
Film Capacitors Inc.
Passaic, NJ

00779
AMP, Inc.
Harrisburg, Pennsylvania

00853
Sangamo Weston Inc
Components Div
Pickens, NC

01091
Allied Plastics Co.
Los Angeles, CA

01101
Wabash Inc
(Formerly Wabash Magnetics)
Wabash, IN

01121
Allen Bradley Co.
Milwaukee, WI

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

01295
TX Instruments Inc.
Semiconductor Group
Dallas, TX

01526
Genicom
Waynesboro, VA

01537
Motorola Communications &
Electronics Inc.
Franklin Park, IL

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

01884
Sprague Electric Co.
(Now 56289)

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

01963
Cherry Electrical Products Corp
Waukegan, IL

02111
Spectrol Electronics Corp.
City of Industry, CA

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

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

02395
Sonar Radio Corp.
Hollywood, FL

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

02606
Fenwal Labs
Division of Travenal Labs
Morton Grove, IL

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

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

02735
RCA-Solid State Div.
Somerville, NJ

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

02799
Arco Electronics Inc.
Chatsworth, CA

03296
Nylon Molding Corp.
Monrovia, CA

03445
Lercon Electronics Inc
Burbank, CA

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

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

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

03888
KDI Electronics Inc.
Pyrofilm Div.
Whippany, NJ

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

03980
Muirhead Inc.
Mountainside, NJ

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

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

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

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

04423
Telonic Berkley Inc.
Laguna Beach, CA

04713
Motorola Inc.
Semiconductor Group
Phoenix, AZ

04946
Standard Wire and Cable
Rancho Dominquez, CA

05173
General Radio
NY,NY.
Replaced by:

24655
Genrad,INC.
Concord, MA

05236
Jonathan Mfg. Co.
Fullerton, CA

05245
Corcom Inc.
Libertyville, IL

05276
ITT Pomona
Electronics Div.
Pomona, CA

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

05347
Ultronix Inc
Grand Junction, CO

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

05571
Sprague Electric Co.
(Now 56289)

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

05791
LYN-TRON
Burbank, CA

05820
EG & G Wakefield Engineering
Wakefield, MA

05839
Advance Electrical
Chicago, IL

05972
Loctite Corp.
Newington, CT

Federal Supply Codes for Manufacturers (cont)

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

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

06192
La Deau Mfg. Co.
Glendale, CA

06229
Electrovert Inc.
Elmsford, NY

06383
Panduit Corp.
Tinley Park, IL

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

06540
Mite Corp
Amatom-Electrical Div

06555
Beede Electrical Instrument
Penacook, NH

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

06666
General Devices Co. Inc.
INpolis, IN

06739
Electron Corp.
Littleton, CO

06743
Gould Inc.
Foil Div.
Eastlake, OH

06751
Components Inc.
Semcor Div.
Phoenix, AZ

06776
Robinson Nugent Inc.
New Albany, IN

06915
Richco Plastic Co.
Chicago, IL

06961
Vernitron Corp.
Piezo Electric Div.
Bedford, OH

06980
EIMAC
(See Varian)
San Carlos, CA

07047
Ross Milton Co., The
Southampton, PA

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

07233
Benchmark Technology Inc.
City of Industry, CA

07239
Biddle Instruments
Blue Bell, PA

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

07261
Avnet Corp.
Culver City, CA

07263
Fairchild Semiconductor
North American Sales
Ridgeview, CT

07344
Bircher Co. Inc., The
Rochester, NY

07374
Optron Corp
Woodbridge, CT

07557
Campion Co. Inc.
Philadelphia, PA

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

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

07792
Lemma Engineering Corp.
Northampton, MA

07810
Bock Corp.
Madison, WI

07910
Teledyne Semiconductor
Mtn. View, CA

07933
Raytheon Co.
Semiconductor Div.
Mountain View, CA

08FG6
Calmos Systems Inc.
Kanata, Ont. Canada

080A9
Dallas Semiconductor
Dallas, TX

08111
MF Electronics
New Rochelle, NY

08235
Industro Transistor Corp.
Long Island City, NY

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

08445
Electri-Cord Mfg., Inc
Westfield, PA

08530
Reliance Mica Corp.
Brooklyn, NY

08718
ITT Cannon Electric
Phoenix Div.
Phoenix, AZ

08806
General Electric Co.
Minature Lamp Products
Cleveland, OH

08863
Nylomatic
Fallsington, PA

08988
Skottie Electronics Inc.
Archbald, PA

09021
Airco Inc.
Airco Electronics
Bradford, PA

09023
Cornell-Dublier Electronics
Fuquay-Varina, NC

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

09353
C and K Components Inc.
Newton, MA

09423
Scientific Components Inc.
Santa Barbara, CA

09922
Burndy Corp.
Norwalk, CT

09969
Dale Electronics Inc.
Yankton, SD

09975
Burroughs Corp.
Electronics Components
Detroit, MI

1A791
LFE Electronics
Danvers, MA

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

10059
Barker Engineering Corp.
Kenilworth, NJ

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

11236
CTS Corp.
Resistor Products Div.
Berne, IN

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

11295
ECM Motor Co.
Schaumburg, IL

11358
Columbia Broadcasting System
CBS Electronic Div.
Newburyport, MA

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

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

11503
Keystone Columbia Inc.
Freemont, IN

11532
Teledyne Relays Teledyne
Industries Inc.
Hawthorne, CA

11711
General Instrument Corp.
Rectifier Div.
Hicksville, NY

11726
Qualidyne Corp.
Santa Clara, CA

12014
Chicago Rivet & Machine Co.
Naperville, IL

12020
Ovenaire
Div. of Electronic Technologies
Charlottesville, VA

12038
Simco
(Div of Ransburg Corp)
Hatfield, PA

12040
National Semiconductor Corp.
Danbury, CT

Federal Supply Codes for Manufacturers (cont)

12060
Diodes Inc.
Northridge, CA

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

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

12323
Practical Automation Inc.
Shelton, CT

12327
Freeway Corp.
Cleveland, OH

12406
Elpac Electronics Inc.
Santa Ana, CA

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

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

12615
US Terminals Inc.
Cincinnati, OH

12617
Hamlin Inc.
LaKe Mills, WI

12673
Wesco Electrical
Greenfield, MA

12697
Clarostat Mfg. Co. Inc.
Dover, NH

12749
James Electronic Inc.
Chicago, IL

12856
MicroMetals Inc.
Anaheim, CA

12881
Metex Corp.
Edison, NJ

12895
Cleveland Electric Motor Co.
Cleveland, OH

12954
Microsemi Corp.
Components Group
Scottsdale, AZ

12969
Unitrode Corp.
Lexington, MA

13050
Potter Co.
Wesson, MS

13103
Thermalloy Co., Inc.
Dallas, TX

13327
Solitron Devices Inc.
Tappan, NY

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

13606
Sprague Electric Co.
(Use 56289)

13689
SPS Technologies Inc.
Hatfield, NJ

13764
Micro Plastics
Flippin, AZ

13919
Burr-Brown Research Corp.
Tucson, AZ

14099
Semtech Corp.
Newbury Park, CA

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

14189
Ortronics, Inc.
Orlando, FL

14193
Cal-R-Inc.
Santa Monica, CA

14301
Anderson Electronics
Hollidaysburg, PA

14329
Wells Electronics Inc.
South Bend, IN

14482
Watkins-Johnson Co.
Palo Alto, CA

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

14604
Elmwood Sensors, Inc
Pawtucket, RI

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

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

14752
Electro Cube Inc.
San Gabriel, CA

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

14949
Trompeter Electronics
Chatsworth, CA

15412
Amtron
Midlothian, IL

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

15636
Elec-Trol Inc.
Saugus, CA

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

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

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

15849
Useco Inc.
(Now 88245)

15898
International Business
Machines Corp.
Essex Junction, VT

16068
International Diode Div.
Harrison, NJ

16162
MMI
Southfield, MI

16245
Conap Inc.
Olean, NY

16258
Space-Lok Inc.
Burbank, CA

16352
Codi Corp.
Linden, NJ

16469
MCL Inc.
LaGrange, IL

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

16733
Cablewave Systems Inc.
North Haven, CT

16742
Paramount Plastics
Fabricators Inc.
Downey, CA

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

17069
Circuit Structures Lab
Burbank, CA

17117
Electronic Molding Corp.
Woonsocket, RI

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

17504
Aluminum Filter Co.
Carpinteria, CA

17545
Atlantic Semiconductors Inc.
Asbury Park, NJ

17745
Angstrohm Precision, Inc.
Hagerstown, MD

17856
Siliconix Inc.
Santa Clara, CA

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

18235
KRL/Bantry Components Inc.
Manchester, NH

18310
Concord Electronics
New York, NY

18324
Signetics Corp.
Sacramento, CA

18377
Parlex Corp.
Methuen, MA

18520
Sharp Electronics Corp.
Paramus, NJ

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

Federal Supply Codes for Manufacturers (cont)

18565
Chomerics Inc.
Woburn, MA

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

18632
Norton-Chemplast
Santa Monica, CA

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

18736
Voltronics Corp.
East Hanover, NJ

18786
Micro-Power
Long Island City, NY

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

19080
Robinson Electronics Inc.
San Luis Obispo, CA

19112
Garry Corp.
Langhorne, PA

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

19451
Perine Machine Tool Corp.
Kent, WA

19482
Delta Electronics
Alexandria, VA

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

19647
Caddock Electronics Inc.
Riverside, CA

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

2B178
Wire Products
Cleveland, OH

2K262
Boyd Corporation
Portland, OR

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

20584
Enochs Mfg. Inc.
INpolis, IN

20891
Cosar Corp.
Dallas, TX

21317
Electronics Applications Co.
El Monte, CA

21604
Buckeye Stamping Co.
Columbus, OH

21845
Solitron Devices Inc.
Semiconductor Group
Rivera Beach, FL

21847
Aertech
Now TRW Microwave Inc.
Sunnyvale, CA

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

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

22626
Micro Semiconductor
(Now 14552)

22670
GM Nameplate
Seattle, WA

22767
ITT Semiconductors
Palo Alto, CA

22784
Palmer Inc.
Cleveland, OH

23050
Product Comp. Corp.
Mount Vernon, NY

23223
CTS Microelectronics
Lafayette, NY

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

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

23730
Mark Eyelet and Stamping Inc.
Wolcott, CT

23732
Tracor Applied Sciences Inc.
Rockville, MD

23880
Stanford Applied Engineering
Santa Clara, CA

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

24347
Penn Engineering Co.
S. El Monte, CA

24355
Analog Devices Inc.
Norwood, MA

24444
General Semiconductor
Industries, Inc.
Tempe, AZ

24546
Bradford Electronics
Bradford, PA

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

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

24759
Lenox-Fugle Electronics Inc.
South Plainfield, NJ

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

24931
Specialty Connector Co.
Greenwood, IN

24995
ECS
Grants Pass, OR

25088
Siemen Corp.
Isilen, NJ

25099
Cascade Gasket
Kent, WA

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

25435
Moldtronics, Inc
Downers Grove, IL

25706
Dabum Electronic & Cable Corp.
Norwood, NJ

26402
Lumex,Inc.
Bayshore, NY

26629
Frequency Sources Inc.
Sources Div.
Chelmsford, MA

26806
American Zettler Inc.
Irvine, CA

27014
National Semiconductor Corp.
Santa Clara, CA

27167
Corning Glass Works Corning
Electronics
Wilmington, NC

27264
Molex Inc.
Lisle, IL

27440
Industrial Screw Products
Los Angeles, CA

27494
Staffall, Inc.
Providence, RI

27745
Associated Spring Barnes Group Inc.
Syracuse, NY

27918
Component Parts Corp.
Bellmore, NY

27956
Relcom (Now 14482)

28175
Alpha Metals
Chicago, IL

28198
Positronic Industries
Springfield, MO

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

28309
Kaiser
Minette,AL.

28425
Serv-O-Link
Euless, TX

28478
Deltrol Corporation
Deltrol Controls Div.
Milwaukee, WI

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, CA

Federal Supply Codes for Manufacturers (cont)

28484
Emerson Electric Co.
Gearmaster Div.
McHenry, IL

28520
Heyco Molded Products
Kenilworth, NJ

28932
Lumax Industrials, Inc
Altoona, PA

29083
Monsanto Co.
Santa Clara, CA

29604
Stackpole Components Co.
Raleith, NC

29907
Omega Engineering Inc.
Stamford, CT

3D536
Aimsco Inc.
Seattle, WA

30035
Jolo Industries Inc.
Garden Grove, CA

30045
Solid Power Corp.
Farmingdale, NY

30146
Symbex Corp.
Painesville, OH

30148
AB Enterprise Inc.
Ahoskie, NC

30161
Aavid Engineering Inc.
Laconia, NH

30315
Itron Corp.
San Diego, CA

30323
IL Tool Works Inc.
Chicago, IL

30800
General Instrument Corp.
Capacitor Div.
Hicksville, NY

30838
Fastec
Chicago,ILL

31019
Solid State Scientific Inc.
Willow Grove, PA

31091
Alpha Industries Inc.
Microelectronics Div.
Hatfield, PA

31323
Metro Supply Company
Sacramento, CA

31433
Kemet Electonics Corp.
Simpsonville, NC

31448
Army Safeguard Logistics Command
Huntsville, AL

31471
Gould Inc
Semiconductor Div
Santa Clara, CA

31522
Metal Masters Inc.
Baldwin, MS

31746
Cannon Electric
Woodbury, TN

31827
Budwig
Ramona, CA

31918
ITT-Schadow
Eden Prairie, MN

32293
Intersil
Cupertino, CA

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

32559
Bivar
Santa Ana, CA

32719
Siltronics
Santa Ana, CA

32767
Griffith Plastics Corp.
Burlingame, CA

32879
Advanced Mechanical Components
Northridge, CA

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

32997
Bourns Inc.
Trimpot Div.
Riverside, CA

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

33096
CO Crystal Corp.
Loveland, CO

33173
General Electric Co.
Owensboro, KY

33246
Epoxy Technology Inc.
Billerica, MA

33292
Pioneer Sterilized Wiping Cloth Co.
Portland, OR

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

33919
Nortek Inc.
Cranston, RI

34114
Oak Industries
Rancho Bernardo, CA

34263
CTS Electronics Corp.
Brownsville,TX

34333
Silicon General Inc.
Garden Grove, CA

34335
Advanced Micro Devices (AMD)
Sunnyvale, CA

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

34371
Harris Corp.
Harris Semiconductor
Products Group
Melbourne, FL

34576
Rockwell International Corp.
Newport Beach, CA

34641
Instrument Specialties
Euless, TX

34649
Intel Corp.
Santa Clara, CA

34802
Electromotive Inc.
Kenilworth, NJ

34848
Hartwell Special Products
Placentia, CA

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

35986
Amrad
Melrose Park, IL

36665
Mitel Corp.
Kanata, Ontario, Canada

36701
Van Waters & Rogers
Valley Field, Quebec, Canada

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

39003
Maxim Industries
Middleboro, MA

4F434
Plastic Sales
Los Angeles, CA

40402
Roderstein Electronics Inc.
Statesville, NC

42498
National Radio
Melrose, MA

43543
Nytronics Inc.(Now 53342)

43744
Panasonic Industrial Co.
San Antonio, TX

43791
Datron Systems
Wilkes Barre, PA

44655
Ohmite Mfg. Co.
Skokie, IL

47001
Lumberg Inc.
Richmond, VA

47379
ISOCOM
Campbell, CA

49569
IDT (International Development & Trade)
Dallas, TX

49671
RCA Corp.
New York, NY

49956
Raytheon Company
Executive Offices
Lexington, MA

5D590
Mostek Corp.
Replaced by: SGS Thompson Microelectronics

5F520
Panel Components Corp.
Santa Rosa, CA

5P575
Nobel Electronics
Suffern, NY

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

Federal Supply Codes for Manufacturers (cont)

5U802
Dennison Mfg. Co.
Framingham, MA

50088
SGS - Thomson Microelectronics Inc.
Carrollton, TX

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

50157
Midwest Components Inc.
Muskegon, MS

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

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

50472
Metal Masters, Inc.
City of Industry, CA

50541
Hypertronics Corp.
Hudson, MA

50558
Electronic Concepts, Inc.
Eatontown, NJ

50579
Litronix Inc.
Cupertino, CA

50891
Semiconductor Technology
Stuart, FL

50934
Tran-Tec Corp
Columbus, NE

51167
Aries Electronics Inc.
Frenchtown, NJ

51284
Mos Technology
Norristown, PA

51249
Heyman Mfg. Co.
Cleveland, OH

51372
Verbatim Corp.
Sunnyvale, CA

51398
MUPAC Corp.
Brockton, MA

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

51499
Amtron Corp.
Boston, MA

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

51605
CODI Semiconductor Inc.
Kenilworth, NJ

51642
Centre Engineering Inc.
State College, PA

51705
ICO/Rally
Palo alto, CA

51791
Statek Corp.
Orange, CA

51984
NEC America Inc.
Falls Church, VA

52063
Exar Integrated Systems
Sunnyvale, CA

52072
Circuit Assembly Corp.
Irvine, CA

52152
MN Mining & Mfg.
Saint Paul, MN

52333
API Electronics
Haugpauge,Long Island,NY

52361
Communication Systems
Piscataway, NJ

52500
Amphenol, RF Operations
Burlington, MA

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

52531
Hitachi Magnetics
Edmore, MO

52745
Timco
Los Angeles, CA

52763
Stettner-Electronics Inc.
Chattanooga, TN

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

52771
Monitern Corp.
Amatrom Div.
Santa Clara, CA

52840
Westem Digital Corp.
Costa Mesa, CA

53021
Sangamo Weston Inc.
(See 06141)

53036
Textool Co.
Houston, TX

53184
Xciton Corp.
Lathan, NY

53217
Technical Wire Products Inc.
Santa Barbara, CA

53342
Opt Industries Inc.
Phillipsburg, NJ

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

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

53848
Standard Microsystems
Hauppauge, NY

53894
AHAM Inc.
RanchoCA, CA

53944
Glow-Lite
Pauls Valley, OK

54178
Plasmetex Industries Inc.
San Marcos, CA

54294
Shallcross Inc.
Smithfield, NC

54453
Sullins Electronic Corp.
San Marcos, CA

54473
Matsushita Electric Corp.
(Panasonic)
Secaucus, NJ

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

54583
TDK
Garden City, NY

54590
RCA Corp
Distribution & Special Products
Cherry Hill, NY

54869
Piher International Corp.
Arlington Heights, IL

54937
DeYoung Mfg.
Bellevue, WA

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

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

55112
Plessey Capacitors Inc.
(Now 60935)

55261
LSI Computer Systems Inc.
Melville, NY

55285
Bercquist Co.
Minneapolis, MN

55322
Samtech Inc.
New Albany, IN

55408
STI-CO Industries Co
Buffalo, NY

55464
Central Semiconductor Corp.
Hauppauge, NY

55557
Microwave Diode Corp.
W.Stewarstown, NH

55566
R A F Electronic Hardware Inc.
Seymour, CT

55576
Synertek
Santa Clara, CA

55680
Nichicon/America/Corp.
Schaumburg, IL

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

56282
Utek Systems Inc.
Olathe, KS

56289
Sprague Electric Co.
North Adams, MA

56365
Square D Co.
Corporate Offices
Palatine, IL

56375
WESCORP
Div. Dal Industries Inc
Mountain View, CA

Federal Supply Codes for Manufacturers (cont)

56481
Shugart Associates
Sub of Xerox Corp.
Sunnyvale, CA

56637
RCD Components Inc.
Manchester, NH

56708
Zilog Inc.
Campbell, CA

56856
Varistor Corp. of TN
Sevierville, TN

56880
Magnetics Inc.
Baltimore, MD

57026
Endicott Coil Co. Inc.
Binghamton, NY

57053
Gates Energy Products
Denver, CO

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

57668
R-ohm Corp
Irvine, CA

57962
SGS - Thomson Microelectronics Inc
Montgomeryville, PA

58014
Hitachi Magnalock Corp.
(Now 12581)

58104
Simco
Atlanta, GA

58364
BYCAP Inc.
Chicago, IL

58451
Precision Lamp
Cotat, CA

58474
Superior Electric Co.
Bristol, CT

58614
Communications Instruments Inc.
Fairview, NC

59124
KOA-Speer Electronics Inc.
Bradford, PA

59422
Holmberg Electronics
Irvine, CA

59610
Souriau Inc
Valencia, CA

59635
HV Component Associates
Howell, NJ

59640
Supertex Inc.
Sunnyvale, CA

59660
Tusonix Inc.
Tucson, AZ

59730
Thomas and Betts Corp.
IA City, IA

59831
Semtronics Corp.
Watchung, NJ

6H053:
American Components Inc.
an Insilco Co. RPC Div.
Hayesville, NC

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

6U850
Burgess Switch Co., Inc
Northbrook, IL

6U095
AMD Enterprises, Inc.
Roswell, GA

6X403
SGS/ATES Semiconductor Corp.
INpolis, IN

6Y440
Micron Technology Inc.
Boise, ID

60046
Power Dynamics Inc
West Orange, NJ

60197
Precicontact Inc.
Langhorne, PA

60386
Squires Electronics Inc
Cornelius, OR

60395
Xicor Inc.
Milpitas, CA

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

60496
Micrel Inc.
Sunnyvale, CA

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

60911
Inmos Corp.
CO Springs, CO

60935
Westlake Capacitor Inc.
Tantalum Div.
Greencastle, IN

60958
ACIC
Intercomp Wire & Cable Div.
Hayesville, NC

61271
Fujitsu Microelectronics Inc
San Jose, CA

61394
SEEQ Technology Inc.
San Jose, CA

61429
Fox Electronics
Cape Coral, FL

61529
Aromat Corp.
New Providence, NJ

61752
IR-ONICS Inc
Warwick, RI

61772
Integrated Device Technology
Santa Clara, CA

61802
Toshiba
Houston, TX

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

61935
Schurter Inc.
Petaluma, CA

62351
Apple Rubber
Lancaster, NY

62643
United Chemicon
Rosemont, IL

62712
Seiko Instruments
Torrance, CA

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

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

64154
Lamb Industries
Portland, OR

64155
Linear Technology
Milpitas, CA

64537
KDI Electronics
Whippany, NJ

64782
Precision Control Mfg. Inc.
Bellevue, WA

64834
West M G Co.
San Francisco, CA

64961
Electronic Hardware LTD
North Hollywood, CA

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

65786
Cypress Semi
San Jose, CA

65940
Rohm Corp & Whatney
Irvine, CA

65964
Evox Inc.
Bannockburn, IL

66150
Entron Inc.
Winslow Teltronics Div.
Glendale, NY

66302
VLSI Technology Inc.
San Jose, CA

66419
Exel
San Jose, CA

66450
Dyna-Tech Electronics, Inc
Walled Lake, MI

66608
Bering Industries
Freemont, CA

66891
BKC International Electronics
Lawrence, MA

66958
SGS Semiconductor Corp.
Phoenix, AZ

66967
Powerex Inc
Auburn, NY

67183
Altera
Santa Clara, CA

68919
WIMA
% Harry Levinson Co.
Seattle, WA

Federal Supply Codes for Manufacturers (cont)

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

7F844
Moore Business Forms, Inc
Seattle, WA

7G902
Textron Inc.
Camcar Div.
Rockford, IL

7J395
Universal Plastics
Welshpool, WA

7J696
AMD Plastics
East Lake, OH

7K354
Omni Spectra Inc
Los Altos, CA

7Z884
ALPS
Seattle, WA

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

70290
Almetal Universal Joint Co.
Cleveland, OH

70485
Atlantic India Rubber Works Inc.
Chicago, IL

70563
Amperite Company
Union City, NJ

70903
Cooper-Belden Corp.
Geneva, IL

71002
Bimbach Co. Inc.
Farmingdale, NY

71034
Bliley Electric Co.
Erie, PA

71183
Westinghouse Electric Corp.
Bryant Div.
Bridgeport, CT

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

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

71450
CTS Corp.
Elkhart, IN

71468
ITT Cannon Div. of ITT
Fountain Valley, CA

71482
General Instrument Corp.
Clare Div.
Chicago, IL

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

71707
Coto Corp.
Providence, RI

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

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

71984
Dow Corning Corp.
Midland, MI

72005
AMAX Specialty Metals Corp.
Newark, NJ

72136
Electro Motive Mfg. Corp.
Florence, NC

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

72259
Nytronics Inc.
New York, NY

72619
Amperex Electronic Corp.
Dialight Div.
Brooklyn, NY

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

72794
Dzus Fastner Co. Inc.
West Islip, NY

72928
Gulton Industries Inc.
Gudeman Div.
Chicago, IL

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

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

73138
Beckman Industrial corp.
Helipot Div.
Fullerton, CA

73168
Fenwal Inc.
Ashland, MA

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

73445
Amperex Electronic Corp.
Hicksville, NY

73559
Carlingswitch Inc.
Hartford, CT

73586
Circle F Industries
Trenton, NJ

73734
Federal Screw Products Inc.
Chicago, IL

73743
Fischer Special Mfg. Co.
Cold Spring, KY

73893
Microdot
Mt. Clemens, MS

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

73905
FL Industries Inc.
San Jose, CA

73949
Guardian Electric Mfg. Co.
Chicago, IL

74199
Quam Nichols Co.
Chicago, IL

74217
Radio Switch Co.
Marlboro, NJ

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

74445
Holo-Krome Co.
Elmwood, CT

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

74840
IL Capacitor Inc.
Lincolnwood, IL

74970
Johnson EF Co.
Waseca, MN

75042
TRW Inc.
IRC Fixed Resistors
Philadelphia, PA

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

75376
Kurz-Kasch Inc.
Dayton, OH

75378
CTS Knights Inc.
Sandwich, IL

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

75569
Performance Semiconductor Corp.
Sunnyvale, CA

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

76854
Oak Switch Systems Inc.
Crystal Lake, IL

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

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

77542
Ray-O-Vac Corp
Madison, WI

77638
General Instrument Corp.
Rectifier Div.
Brooklyn, NY

77900
Shakeproof Lock Washer Co.
(Now 78189)

77969
Rubbercraft Corp. of CA Ltd.
Torrance, CA

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

78277
Sigma Instruments Inc.
South Braintree, MA

78290
Struthers Dunn Inc.
Pitman, NJ

78553
Eaton Corp.
Engineered Fastener Div.
Cleveland, OH

Federal Supply Codes for Manufacturers (cont)

78592
Stoeger Industries
South Hackensack, NJ

79497
Western Rubber Co.
Goshen, IN

79727
C - W Industries
Southampton, PA

79963
Zierick Mfg. Corp.
Mount Kisco, NY

8C798
Ken-Tronics, Inc.
Milan, IL

8D528
Baumgartens
Atlanta, GA

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

8T100
Tellabs Inc.
Naperville, IL

80009
Tektronix
Beaverton, OR

80031
Mepco/Electra Inc.
Morristown, NJ

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

80145
LFE Corp.
Process Control Div.
Clinton, OH

80183
Sprague Products
(Now 56289)

80294
Bourns Instruments Inc.
Riverside, CA

80583
Hammerlund Mfg. Co. Inc.
Paramus, NJ

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

81073
Grayhill Inc.
La Grange, IL

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

81439
Therm-O-Disc Inc.
Mansfield, OH

81483
International Rectifier Corp.
Los Angeles, CA

81590
Korry Electronics Inc.
Seattle, WA

81741
Chicago Lock Co.
Chicago, IL

82227
Airpax Corp.
Cheshire Div.
Cheshire, CT

82240
Simmons Fastner Corp.
Albany, NY

82305
Palmer Electronics Corp.
South Gate, CA

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

82415
Airpax Corp
Frederick Div.
Frederick, MD

82872
Roanwell Corp.
New York, NY

82877
Rotron Inc.
Custom Div.
Woodstock, NY

82879
ITT
Royal Electric Div.
Pawtucket, RI

83003
Varo Inc.
Garland, TX

83014
Hartwell Corp.
Placentia, CA

83055
Signalite Fuse Co.
(Now 71744)

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

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

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

83315
Hubbell Corp.
Mundelein, IL

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

83478
Rubbercraft Corp. of America
West Haven, CT

83553
Associated Spring Barnes Group
Gardena, CA

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

84171
Arco Electronics
Commack, NY

84411
American Shizuki
TRW Capacitors Div.
Ogallala, NE

84613
FIC Corp.
Rockville, MD

84682
Essex Group Inc.
Peabody, MA

84830
Lee Spring Co. Inc
Brooklyn, NY

85367
Bearing Distributing Co.
San Fransisco, CA

85372
Bearing Sales Co.
Los Angeles, CA

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

85840
Brady WH Co
Industrial Products Div
Milwaukee, WI

85932
Electro Film Inc.
Valencia, CA

86577
Precision Metal Products Co.
Peabody, MA

86684
Radio Corp. of America
(Now 54590)

86928
Seastrom Mfg. Co. Inc.
Glendale, CA

87034
Illuminated Products Inc.
(Now 76854)

87516
Standard Crystal
KS City, KS

88044
Aeronautical Standards Group
Dept. of Navy & Air Force

88219
GNB Inc.
Industrial Battery Div.
Langhorne, PA

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

88486
Triangle PWC Inc.
Jewitt City, CT

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

88786
Atlantic India Rubber Co.
Goshen, IN

88978
Philips (Now Fluke)
Mahwah, NJ

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

89265
Potter-Brumfield
(See 77342)

89462
Waldes Truarc, Inc.
Long Island, NY

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

89597
Fredericks Co.
Huntingdon Valley, PA

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

89730
General Electric
Lamp Div.
Newark, NJ

9R216
Data Composition Svc, Inc
Laurel, MD

9S171
Port Plastics
Tukwila, WA

Federal Supply Codes for Manufacturers (cont)

9W423
Amatom
El Mont, CA

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

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

90303
Duracell Inc.
Technical Sales & Marketing
Bethel, CT

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

91247
IL Transformer Co.
Chicago, IL

91293
Johanson Mfg. Co.
Boonton, NJ

91462
Alpha Industries Inc.
Logansport, IN

91502
Associated Machine
Santa Clara, CA

91506
Augat Alcoswitch
N. Andover, MA

91507
Froeliger Machine Tool Co.
Stockton, CA

91637
Dale Electronics Inc.
Columbus, NE

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

91737
ITT Cannon/Gremar
(Now 08718)

91802
Industrial Devices Inc.
Edgewater, NJ

91833
Keystone Electronics Corp.
NY, NY

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

91929
Honeywell Inc.
Micro Switch Div.
Freeport, IL

91934
Miller Electric Co.
Woonsocket, RI

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

91984
Maida Development Co.
Hampton, VA

91985
Norwalk Valve Co.
S. Norwalk, CT

92218
Wakefield Corp., The
Wakefield, ME

92527
VTC Inc.
Bloomington, MN

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

92914
Alpha Wire Corp.
Elizabeth, NJ

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, MA

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

94222
Southco Inc.
Concordville, PA

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

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

95263
Leecraft Mfg. Co.
Long Island City, NY

95275
Vitramon Inc.
Bridgeport, CT

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, OH

95348
Gordo's Corp.
Bloomfield, NJ

95354
Methode Mfg. Corp.
Rolling Meadows, IL

95573
Campion Laboratories Inc.
Detroit, MI

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

95987
Weckesser Co. Inc.
(Now 85480)

96733
SFE Technologies
San Fernando, CA

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

96881
Thomson Industries Inc.
Port WA, NY

97464
Industrial Retainer Ring
Irvington, NJ

97525
EECO Inc.
Santa Ana, CA

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

97913
Industrial Electronic
Hardware Corp.
NY, NY

97945
Pennwalt Corp.
SS White Industrial Products
Piscataway, NJ

97966
CBS
Electronic Div.
Danvers, MA

98094
Machlett Laboratories Inc.
Santa Barbara. CA

98159
Rubber-Teck Inc.
Gardena, CA

98278
Malco A Microdot Co.
South Pasadena, CA

98291
Sealectro Corp.
BICC Electronics
Trumbill, CT

98372
Royal Industries Inc.
(Now 62793)

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

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

99120
Plastic Capacitors Inc.
Chicago, IL

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

99378
ATLEE of DE Inc.
N. Andover, MA

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

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

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

99800
American Precision Industries
Delevan Div.
East Aurora, NY

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

Service Centers

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Fluke Calibration Center
C/o FLW Service Corporation
3505 Cadillac Ave., Bldg E
Costa Mesa, CA 92626
TEL: (714) 863-9031
FAX: (714) 751-0213

Fluke Service Center
42711 Lawrence Place
Fremont, CA 94538
TEL: (510) 651-5112
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Fluke Service Center
1150 W. Euclid Avenue
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FAX: (708) 705-9989

New Jersey
Fluke Service Center
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TEL: (214) 406-1000
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Fluke Service Center
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INTERNATIONAL

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TEL: 61-3-881-3666
FAX: 61-3-881-3636

Phil. Sci. & Ind. Blk F, Centrecrt.
34 Waterloo Road
North Ryde, N.S.W. 2113
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FAX: 61-2-888-0440

Austria
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Sales & Service Dept.
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P.Basteleusstraat 2-4-6
1600 St. Pieters - Leeuw
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FAX: 32-2-331-1489

Bolivia
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FAX: 591-2-317545

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Philips Medical Systems, LTDA
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04661-200 Sao Paulo S.P.
TEL: 55-11-523-4811
FAX: 55-11-524-4873 (ID 2148)

Sigtron Instrumentos E. Servicos
Rua Alvaro Rodriques
269 - Brooklin
Sao Paulo, Sp
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FAX: 55-11-533-3749

Sistest
Sist. Instr. Testes Ltda
Av. Ataulfo De Paiva
135 S/ 1117 - Leblon 22.449-900
Rio De Janeiro, Rj, Brazil
TEL: 55-21-259-5755 or 512-3679
FAX: 55-21-259-5743

Bulgaria
Ac Sophilco, Cust. Supp. Serv.
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1309 Sofia, Bulgaria
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FAX: 359-2-220910

C.S.F.R.
Elso
NA. Berance 2
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Data Elektronik BRNO
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61300 Brno
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FAX: 42-5-574002

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L4Z 1X9
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FAX: 905-890-6866

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Casilla 16500, Santiago 9
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FAX: 56-2-231-6700

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Carretera de Circunvalacion
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Fluke Sls & Serv. Draga 8
41425 Sveta Jana
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FAX: 385-41-837237

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FAX: 593-2-561980

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EEMCO
Electronic Equipment Mkting Co.
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P.O. Box 2009
St. Heliopolis 11361
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FAX: 20-2-417-8296

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Fluke Deutschland Gmbh
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85737 Ismaning/Munich
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FAX: 49-89-9961-1270

Fluke Deutschland
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22145 Hamburg
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FAX: 49-40-679-7653

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SF 02631 Espoo
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FAX: 358-0-6152-5630

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BP 112, 93700 Drancy, Cedex
TEL: 33-1-4896-6300
FAX: 33-1-4896-6330

Greece
Philips S.A. Hellenique
Fluke Sales & Service Manager
15, 25th March Street, P.O. Box
3153, 177 78 Tavros Athens
TEL: 30-1-489-4911 or 4262
FAX: 30-1-481-8594

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Schmidt & Co, Ltd. 1st Floor
323 Jaffe Road
Wanchai
TEL: 852-9223-5623
FAX: 852 834-1848

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MTA MMSZ KFT, Srv. / Gen. Mgr
Etele Ut. 59 -61
P.O. Box 58
H 1502 Budapest
TEL: 361-186-9589 or 209-3444
FAX: 361-161-1021

Iceland
Taeknival HF
P.O. Box 8294, Skeifunni 17
128 Reykjavik
TEL: 354-1-681665
FAX: 354-1-680664

India
Philips India Limited
Band Box House
254 Dr. Annie Besant Road
Bombay 400 025
TEL: 91-22-493-0311
FAX: 91-22-495-0498

Hinditron Services Pvt. Inc.
33/44A 8th Main Road
Raj Mahal Vilas Extension
Bangalore 560 080
TEL: 91-80-334-8266 or 0068
FAX: 91-80-334-5022

Hinditron Services Pvt. Ltd
Hinditron House, 23-B
Mahal Industrial Estate
Mahakali Caves Rd, Andheri East
Bombay 400 093
TEL: 91-22-836-4560, 6590
FAX: 91-22-836-4682

Hinditron Services Pvt. Ltd
Castle House, 5th Floor
5/1 A, Hungerford Street
Calcutta 700 017
TEL: 91-33-400-194
FAX: 91-33-247-6844

Hinditron Services Pvt. Ltd
204-206 Hemkunt Tower
98 Nehru Place
New Delhi 110 019
TEL: 91-11-641-3675 or 643-0519
FAX: 91-11-642-9118

Hinditron Services Pvt. Ltd.
Field Service Center
Emerald House, 5th Floor
114 Sarojini Devi Road
Secunderabad 500 003
TEL: 91 40-844033 or 843753
FAX: 91-40-847585

Indonesia
P. T. Daeng Bro, Phillips House
J/n H.R. Rasuna Said Kav. 3-4
Jakarta 12950
TEL: 62-21-520-1122
FAX: 62-21-520-5189 or 62-21-520-5189

Israel
R.D.T Equipment & Sys, Ltd.
P.O. Box 58072
Tel-Aviv 61580
TEL: 972-3-645-0745
FAX: 972-3-647-8908

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Fluke Italia S.R.L., CSS
Viale Delle Industrie, 11
20090 Vimodrone (MI)
TEL: 39-2-268-434-203 or 4341
FAX: 39-2-250-1645

Japan
Fluke Corp., Sumitomo Higashi
Shinbashi Bldg.
1-1-11 Hamamatsucho
Minato-ku, Tokyo 105
TEL: 81-3-3434-0188 or 0181
FAX: 81-3-3434-0170

Kenya
Walterfang
P.O. Box 14897
Nairobi, Kenya
TEL: 254-2
FAX: 254-2

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B&P International Co., Ltd.
Geopung Town A-303
203-1 Nonhyun-Dong
Kangnam-Ku
Seoul 135-010
TEL: 82 12 546-1457
FAX: 82 12 546-1458

IL MYOUNG, INC.
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780-46, Yeogsam-Dong
Kangnam-Ku, Seoul
TEL: 82 2 552-8582-4
FAX: 82 2 553-0388

Kuwait
Yusuf A. Alghanim & Sons W.L.L.
P.O. Box 223 Safat
Alghanim Industries
Airport Road Shuwaikh
13003 Kuwait
TEL: 965-4842988
FAX: 965-4847244

Malaysia
CNN. SDN. BHD.
17D, 2nd Floor
Lebuhraya Batu Lancang
Taman Seri Damai
11600 Jelutong Penang
TEL: 60-4-657-9584
FAX: 60-4-657-0835

Mexico
Metro. Y Calibraciones Ind., S.A.
Diagonal No. 17 - 3 Piso
Col. Del Valle
C.P. 03100, Mexico D.F.
TEL: 52-5-682-8040
FAX: 52-5-687-8695

Netherlands
Fluke Nederland B.V. (CSS)
Afdeling Service
Science Park Einhoven 5108
5692 EC Son
TEL: 31-40-2678300 or 2678311
FAX: 31-40-2678321

New Zealand
Phillips Scientific & Ind., Pty., L.
Private Bag 41904,
St. Lukes, 2 Wagener Place
Mt. Albert, Auckland 3
TEL: 64-9-894-4160
FAX: 64-9-849-7814

Nigeria
Philips Projects Centre
Resident Delegate / PMB 80065
8, Kofo Abayomi Street
Victoria Island, Nigeria
TEL: 234-1-262-0632
FAX: 234-1-262-0631

Norway
Fluke Norway A/S, Cust. Support
P.O. Box 6054 Etterstad
N-0601 Oslo
TEL: 47-22-653400
FAX: 47-22-653407

Pakistan (Philips)
Philips Elec. Ind. of Prof. Sys. Div.
Islamic Cham. of Commerce
St-2/A, Block 9, KDA Scheme 5,
Clifton, Karachi-75600
TEL: 92-21-587-4641 or 4649
FAX: 92-21-577-0348

Peru
Impor. & Repres. Electronicas
S.A., JR. Pumacahua 955
Lima 11
TEL: 51-14-23-5099
FAX: 51-14-31-0707

Philippines
Spark Electronics Corp.
P.O. Box 610, Greenhills
Metro Manila 1502
TEL: 63-2-700-621
FAX: 63-2-721-0491 or 700-709

Poland
Elec. Instr. Srv. Philips Cons.
UL. Malechowska 6
60 188 Poznan
TEL: 48-61-681998
FAX: 48-61-682256

Portugal
Fluke Iberica S.L.
Sasles Y Services Dept
Campo Grande 35 - 7b
1700 Llsboa
TEL: 351-1-795-1712
FAX: 351-1-795-1713

Romania
Ronex S.R.L., Cust. Supp. Serv.
Str. Transilvaniei Nr. 24
70778 Bucharest - I
TEL: 40-1-614-3597 or 3598
FAX: 40-1-659-4468

Russia
Infomedia
UL. Petrovsko Razumovsky
Proezd. 29
103287 Moscow
TEL: 7-95-212-3833
FAX: 7-95-212-3838

Saudi Arabia
A. Rajab & Silsilah Co. S&S Dept.
P.O. Box 203
21411 Jeddah
TEL: 966-2-661-0006
FAX: 966-2-661-0558

Singapore
Fluke Singapore Pte., Ltd.
Fluke ASEAN Regional Office
#27-03 PSA Building
460 Alexandra Road
Singapore 119963
TEL: 65-276-5161
FAX: 65-*-276-5929

South Africa
Spescom Measure. (PTY) Ltd.
Spescom Park
Crn. Alexandra Rd. & Second St.
Halfway House, Midrand 1685
TEL: 27-11-315-0757
FAX: 27-11-805-1192

Spain
Fluke Iberica S.L.
Centro Empresarial Euronora
c/Ronda de Poniente, 8
28760-Tres Cantos
Madrid, Spain
TEL: 34-1-804-2301
FAX: 34-1-804-2496

Sweden
Fluke Sverige AB, (CSS)
P.O. Box 61
S-164 94 Kista
TEL: 46-8-751-0235 or 0230
FAX: 46-8-751-0480

Switzerland
Fluke Switzerland AG, (CSS)
Rutistrasse 28
CH 8952 Schlieren
Switzerland
TEL: 41-1-730-3310 or 730-3932
FAX: 41-1-730-3932

Taiwan
Schmidt Scientific Taiwan, Ltd.
6th Floor, No. 109,
Tung Hsing Street
Taipei, Taiwan
TEL: 886-2-767-8890 or 501-5737
FAX: 886-2-767-8820 or 765-3717

Thailand
Measuretronix Ltd.
2102/31 Ramkamhang Road
Bangkok 10240
TEL: 66-2-375-2733 or 2734
FAX: 66-2-374-9965

Turkey
Pestas Prof. Elektr. Sist. Tic. V
Selcuklar Caddesi
Meydan Apt. No. 49, Daire 23
Akatlar 80630 Istanbul
TEL: 90-212-282-7838
FAX: 90-212-282-7839

U.A.E.
Haris Al Afaq Ltd.
P.O. Box 8141
Dubai
TEL: 971-4-283623 or 283624
FAX: 971-4-281285

United Kingdom
Fluke U.K. LTD. (CSS)
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Watford, Hertfordshire WD2 4TT
TEL: 44-923-240511
FAX: 44-923-225067

Uruguay
Coasin Instromontos S.A.
Casilla de Correo 1400
Libertad 2529, Montevideo
TEL: 598-2-492-436, 659
FAX: 598-2-492-659

Venezuela
Coasin C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Piso-3
La Urbina
Caracas 1070-A, Venezuela
TEL: 58-2-241-6214
FAX: 58-2-241-1939

Vietnam
Schmidt-Vietnam Co., Ltd.
8/Fl. Schmidt Tower
Hanoi International Tech. Ctr
KM8, Highway 32, Cau Giay
Tu Liem, Hanoi
Vietnam
TEL: 84-4-346186 or 346187
FAX: 84-4-346-188

West Indies
Western Scientific Co., Ltd.
Freeprot Mission Road
Freeport, Trinidad
West Indies
TEL: 809-673-0038
FAX: 809-673-0767

Yugoslavia
Jugoelektro Beograd
T & M Customer Support
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11070 Novi
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FAX: 38-11-638209

Zimbabwe
Field Technical Sales
45, Kelvin Road North
P.O. Box Cy535 Causeway
Harare, Zimbabwe
TEL: 263-4-750381 or 750382
FAX: 263-4-729970

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 manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

Table 7A-1. Manual Status and Backdating 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								
A1	Main PCB Assembly	510594	X																						
A1A1	Display PCB Assembly	456921					X																		
A2	AC PCB Assembly	510602	X																						
-003	Counter Output PCB Assembly	471672					X																		
-004	Logarithmic Analog Output PCB Assembly	471680		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.

Section 8
Schematic Diagrams

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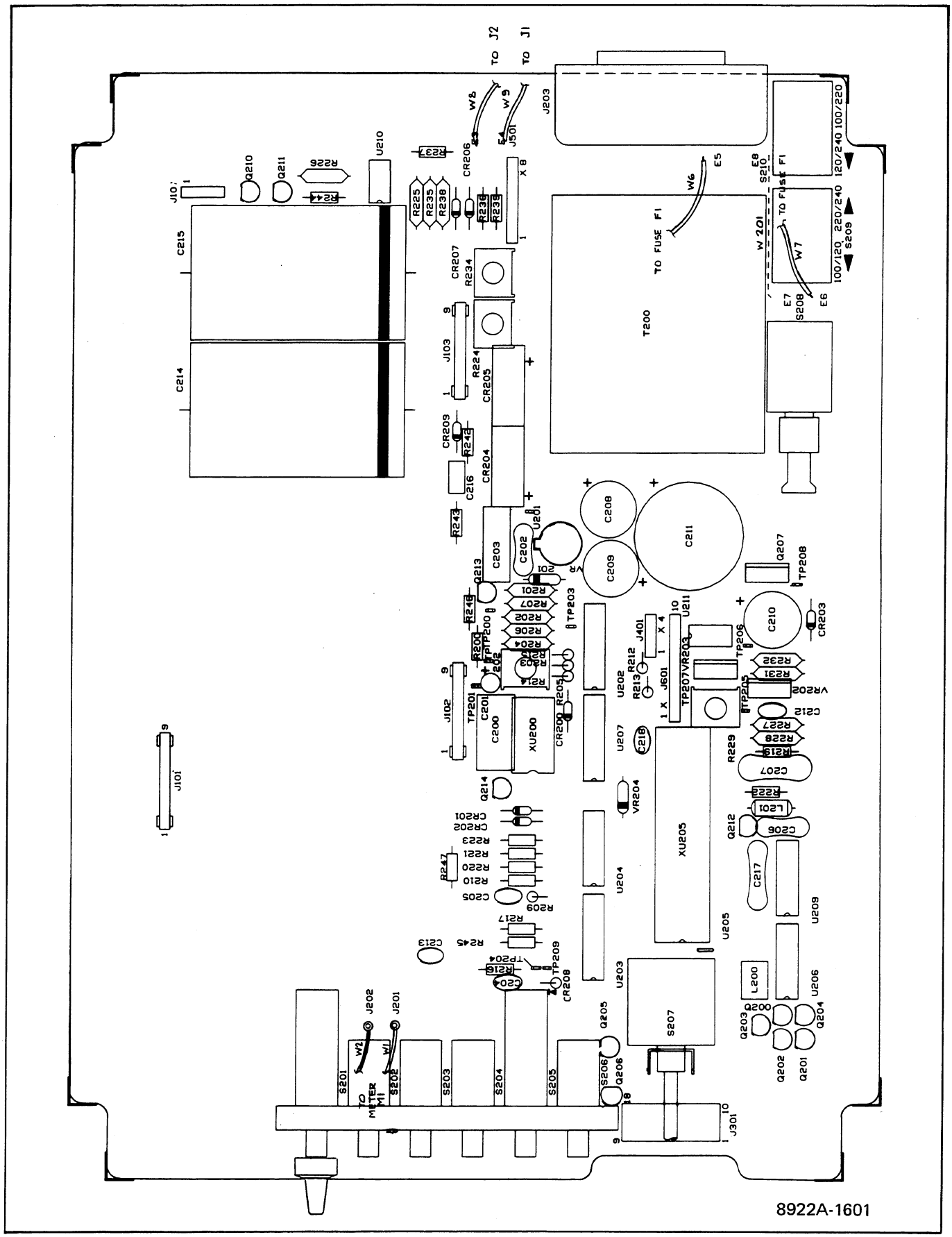
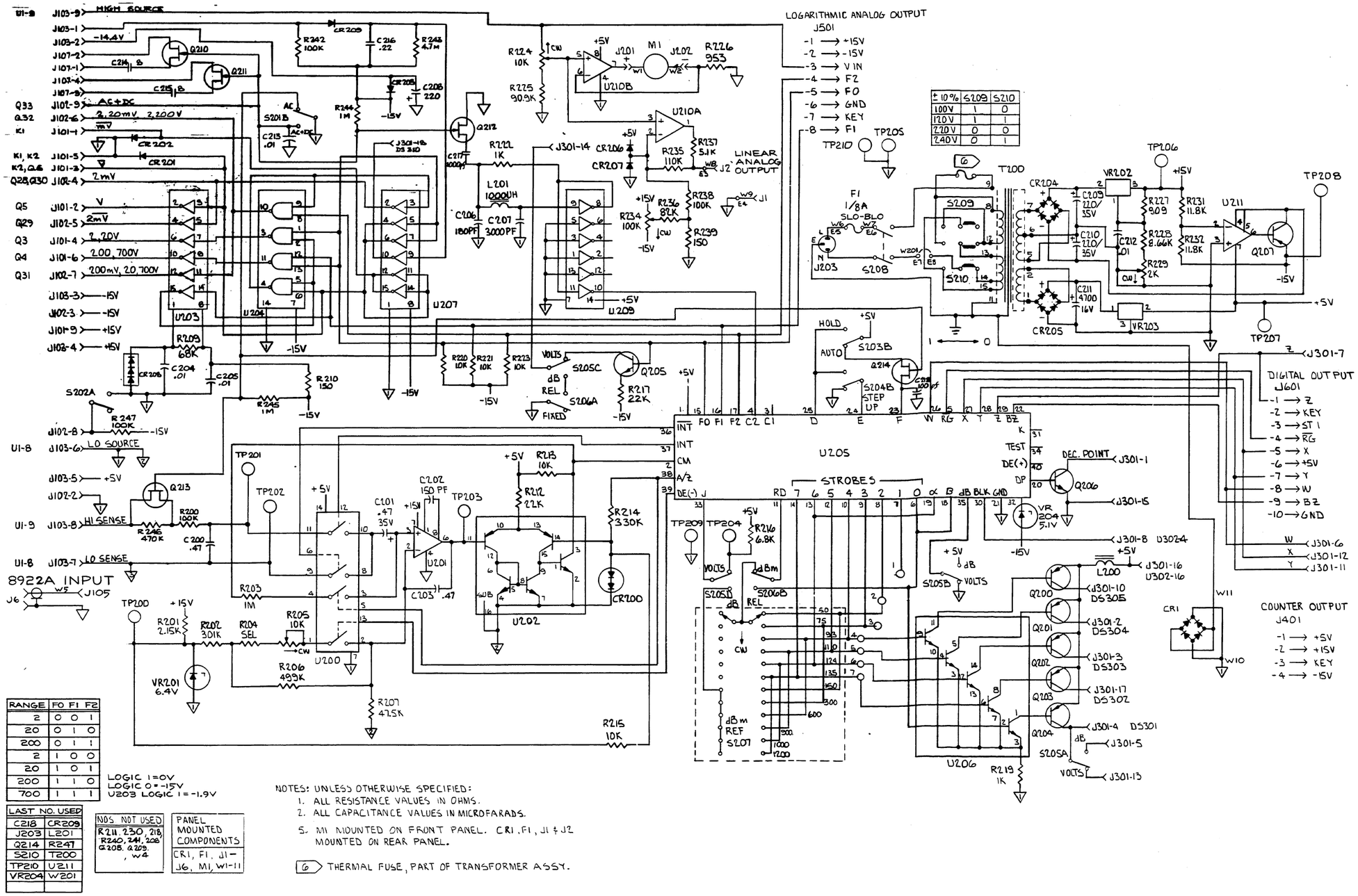


Figure 8-1. A1 Main PCB Assembly



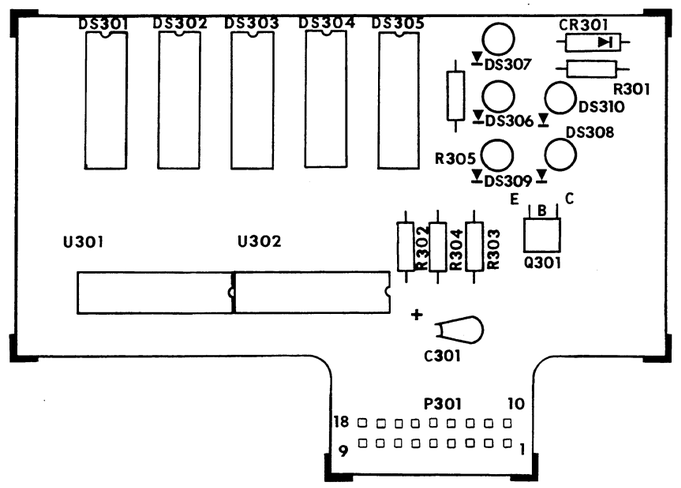
± 10%	S209	S210
100V	1	0
120V	1	1
220V	0	0
240V	0	1

RANGE	F0	F1	F2
2	0	0	1
20	0	1	0
200	0	1	1
2	1	0	0
20	1	0	1
200	1	1	0
700	1	1	1

LAST NO. USED	
C218	CR209
J203	L201
Q214	R247
S210	T200
TP210	U211
VR204	W201

NOS NOT USED
R211, 230, 218, R240, 241, 208 Q208, Q209, W4

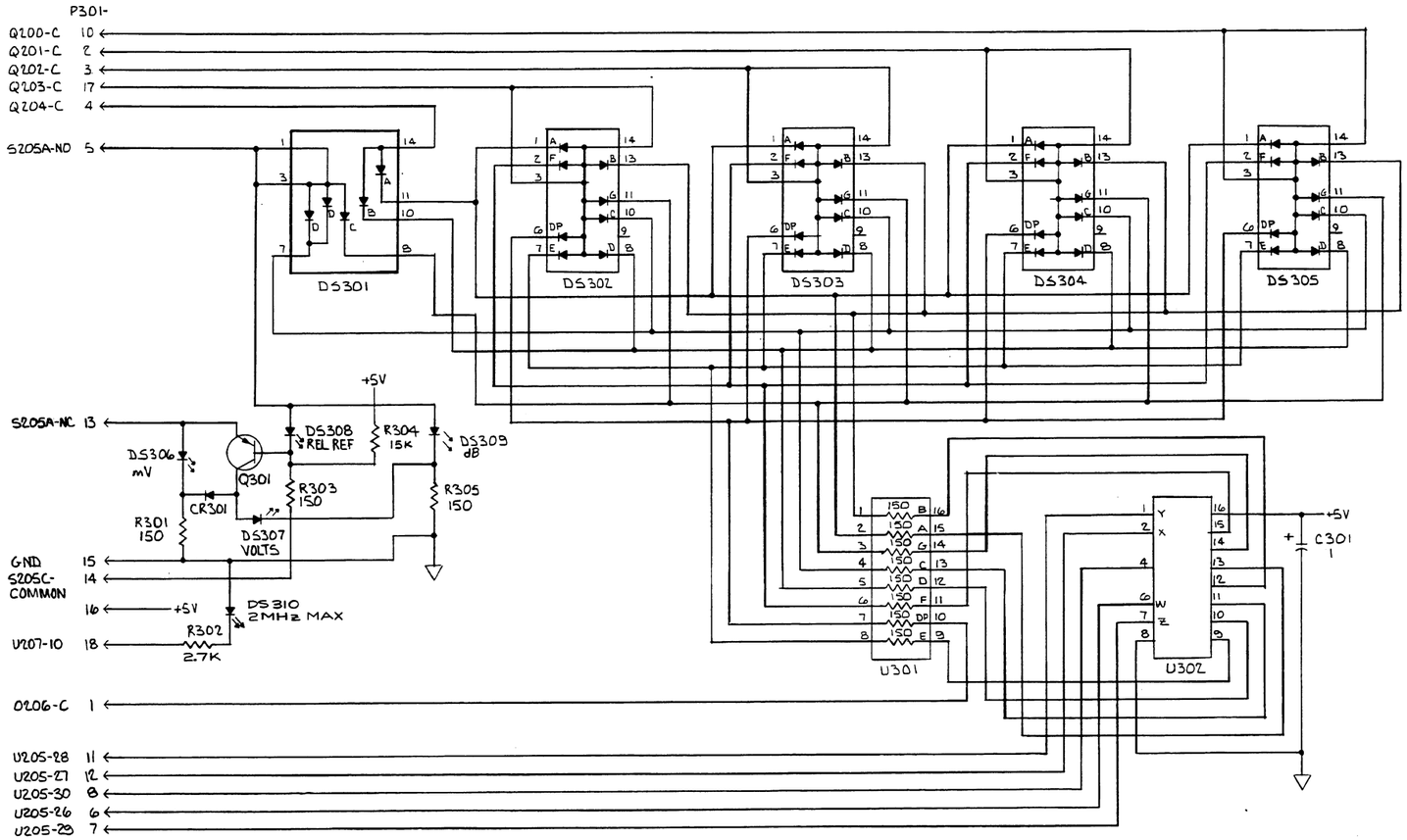
PANEL MOUNTED COMPONENTS
CR1, F1, J1-J6, M1, W1-11



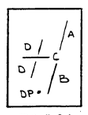
8920A-1602

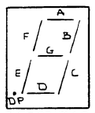
Figure 8-2. A1A1 Display PCB Assembly

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.



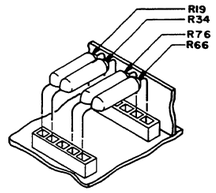
LAST NO. USED	
C301	Q301
CR301	R305
DS310	



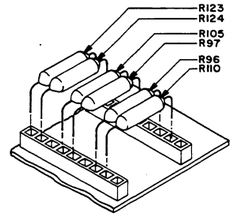


8920A-1002

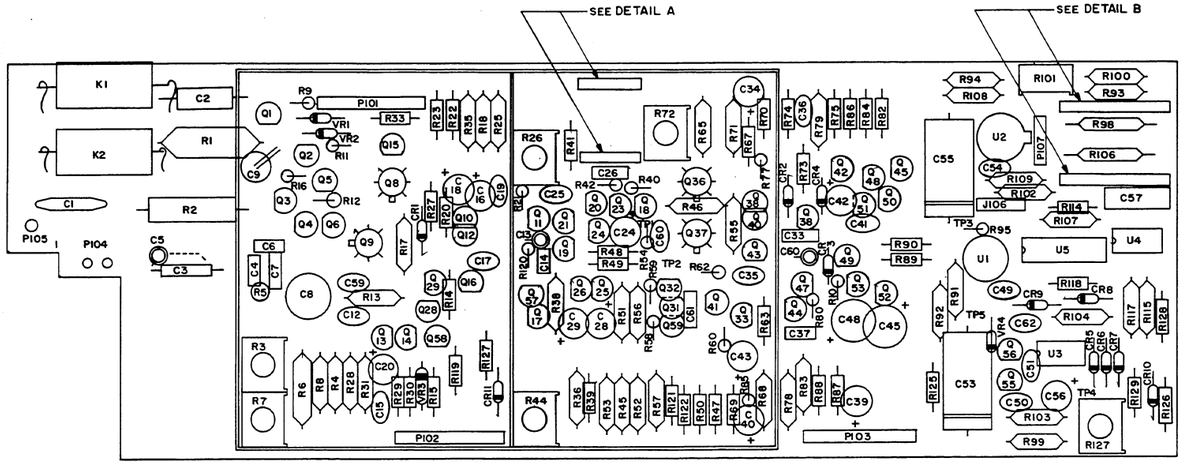
Figure 8-2. A1A1 Display PCB Assembly (cont)



DETAIL A
3



DETAIL B
3

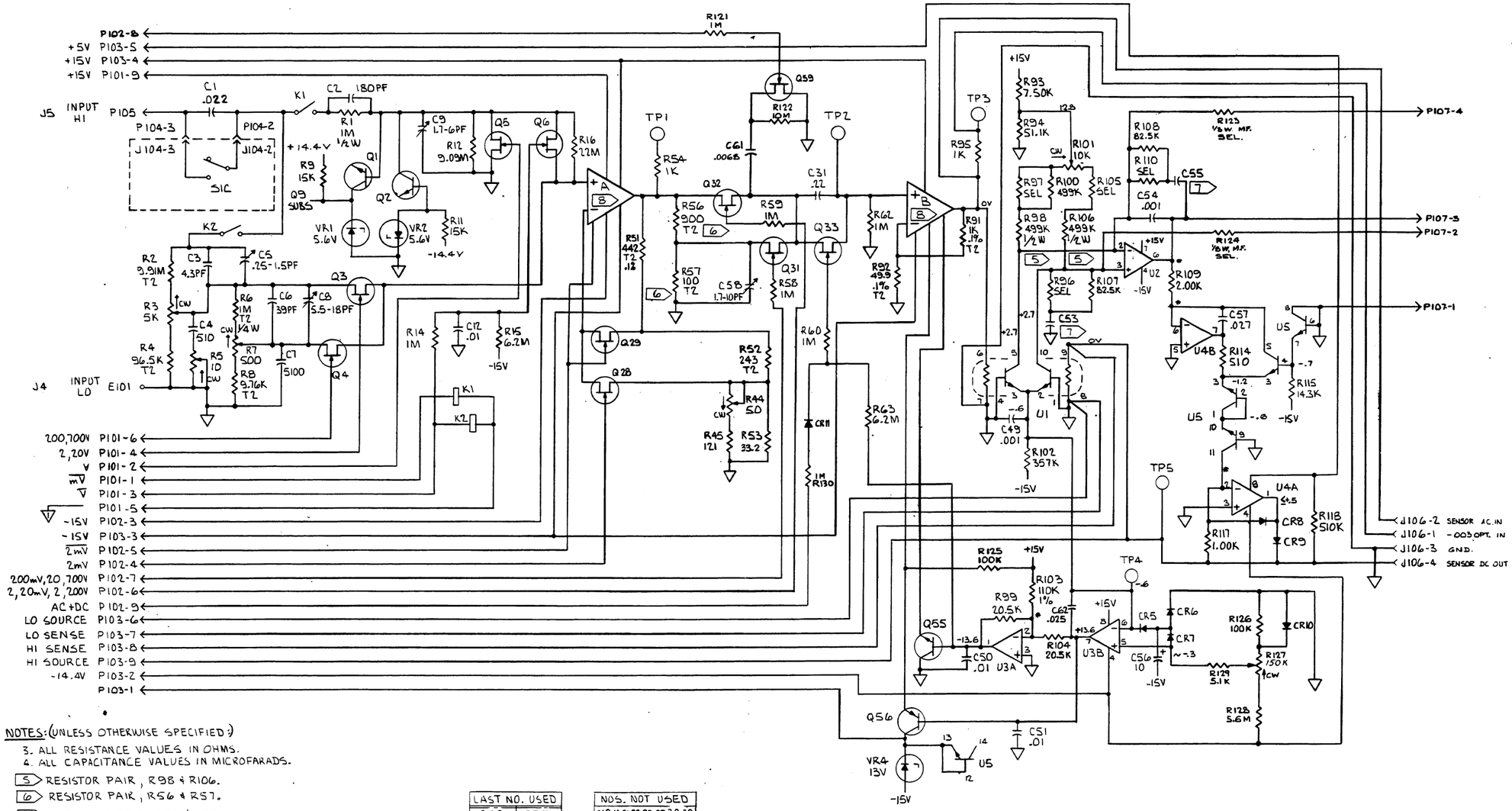


NOTES:

3 INSTALLED IN FINAL ASSEMBLY.

8922A-1603

Figure 8-3. A2 AC PCB Assembly



NOTES: (UNLESS OTHERWISE SPECIFIED:)

3. ALL RESISTANCE VALUES IN OHMS.
4. ALL CAPACITANCE VALUES IN MICROFARADS.
5. RESISTOR PAIR, R98 & R106.
6. RESISTOR PAIR, RS6 & RS7.
7. CAPACITOR PAIR, C53 & C55.
8. REPRESENTS AMPLIFIERS A & B. SEE SH 2 FOR DETAILS.
9. VOLTAGES MEASURED WITH 8922A INPUT SHORTED, 1 VAC RANGE.
10. VOLTAGES ARE TYPICAL, MAY VARY ± 10%. # VOLTAGES PRESENT UNDER QUIESCENT CONDITIONS ARE OFFSET DEPENDENT.
11. ANALOG COMMON, LOGIC COMMON.

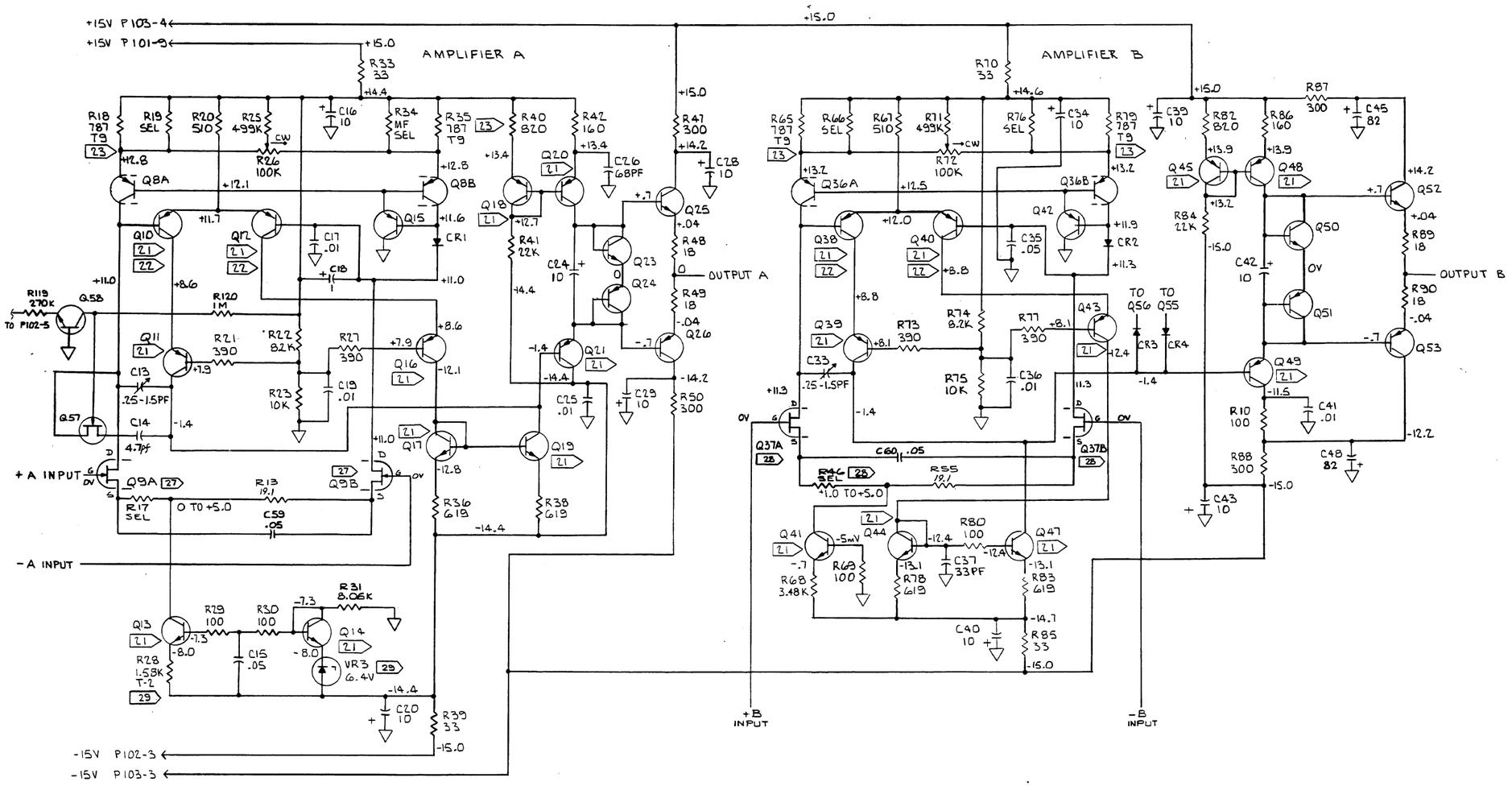
[NOTES CONTINUED ON SHEET 2]

LAST NO. USED	
C62	CR11
K2	Q59
R129	TP5
U5	VR4

NOS. NOT USED
C10,11,21,22,23,27,30,32, 38,44,46,47,52 & 53
Q7, 22, 27, 34, 35, 46, 54 & 30
R24, 32, 61, 64, 81, 37, 43, 111, 112, 113 & 116

8922A-1003 (Sheet 1 of 2)

Figure 8-3. A2 AC PCB Assembly (cont)



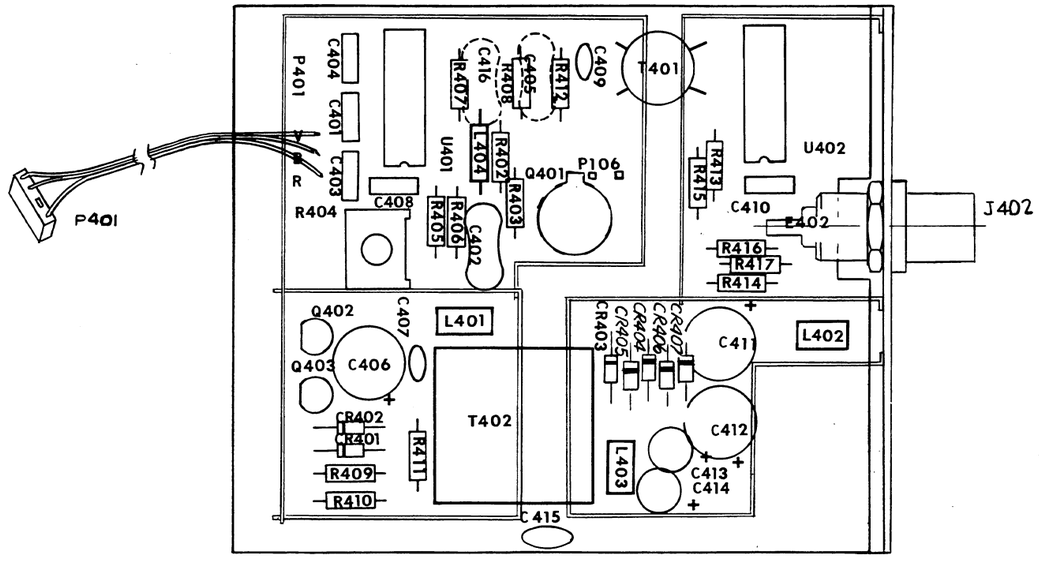
NOTES: UNLESS OTHERWISE SPECIFIED.

21. NON-STANDARD PIN-OUT; EMITTER & BASE LEGS REVERSED.
22. TRANSISTOR SET: Q10, 12, 38 & 40.
23. RESISTOR SET: R18, 35, 65 & 79.
24. VOLTAGES MEASURED WITH 8922A INPUT SHORTED, 1 VAC RANGE.
25. ALL VOLTAGES MEASURED WITH A HIGH IMPEDANCE (100 MΩ) VOLTMETER WITH A 10K RESISTOR ISOLATING THE HIGH TEST PROBE. VOLTAGES ARE TYPICAL, MAY VARY ± 10%.

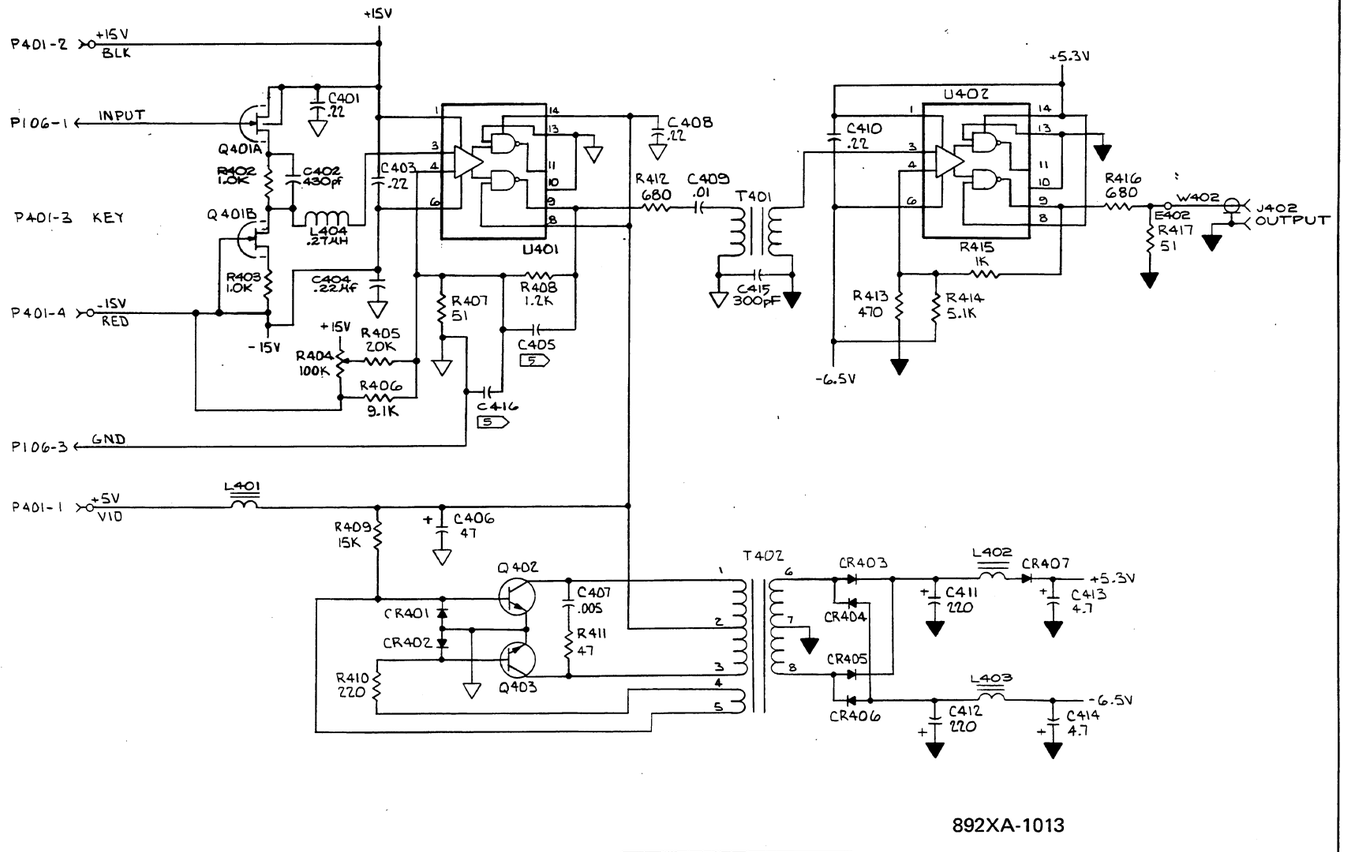
27. Q9 & R17 ARE SELECTED AS A SET.
28. Q37 & R46 ARE SELECTED AS A SET.
29. VR3 & R28 ARE SELECTED AS A SET.

8922A-1003 (Sheet 2 of 2)

Figure 8-3. A2 AC PCB Assembly (cont)



892XA-1613



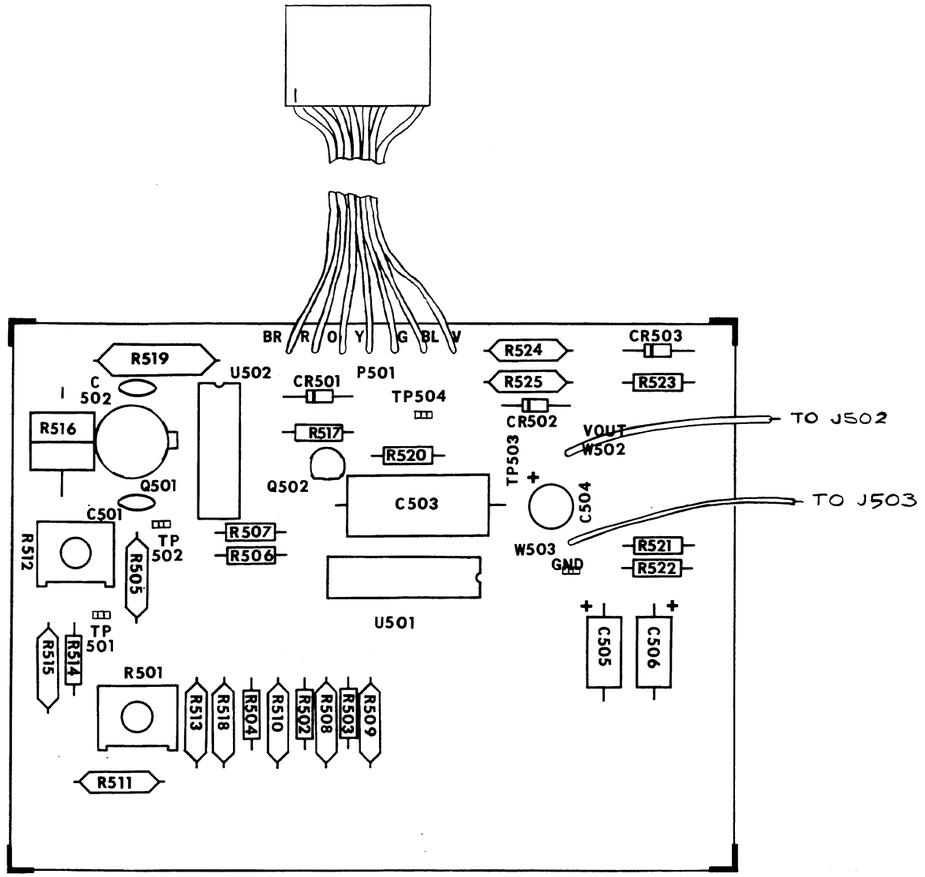
892XA-1013

NOTES- UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS.

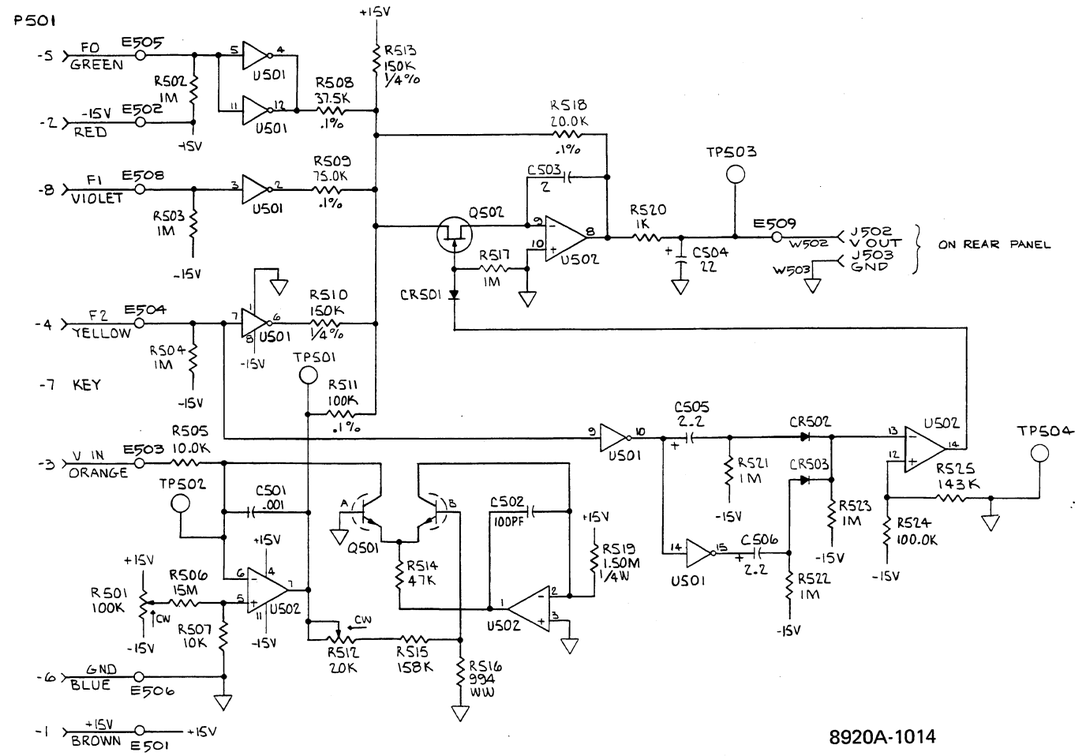
[5] C405 & C416 VALUES ARE SELECTED AND ARE USUALLY OPEN (NOT INSTALLED)

REFERENCE DESIGNATIONS		
HIGHEST USED		NOT USED
C416	R417	R401
CR407	T402	
L404	U402	
Q403	E402	E401
W402		W401

Figure 8-4. -003 Counter Output Option Assembly



8920A-1614



8920A-1014

LAST NO. USED	
C506	R525
CR503	TP503
Q502	U502

RANGE	F0	F1	F2
2mV	0	0	1
20mV	0	1	0
200mV	0	1	1
2V	1	0	0
20V	1	0	1
200V	1	1	0
700V	1	1.	1

LOGIC 1 = 0V
LOGIC 0 = -15V

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS

Figure 8-5. -004 Logarithmic Analog Output Option