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Section 3
Applications

3-1. INTRODUCTION

With its unique combination of features such as true rms, frequency, dB, relative reference and the 4-1/2 digit display, the 8060A offers a wide variety of measurement capabilities, including measurement of amplifier bandwidth, the Q factor, amplifier stage gain in relative dB, and some other general audio applications. You can also find out how to change the dB reference impedance or how to use the 8060A to measure extremely low currents. These applications may be of immediate use to you, or they may help you discover other ways the 8060A can fill your measurement needs.

3-2. DETERMINING AMPLIFIER BANDWIDTH

The following procedure describes how to use the ac voltage dB, relative, and frequency functions to determine the bandwidth of an amplifier (for frequencies up to 100 kHz):

1. Connect the amplifier, signal generator, load, and 8060A as shown in Figure 3-1.

2. On the 8060A, select the ac voltage function and a range appropriate for the amplifier output.

3. Adjust the signal generator for a signal level that is within the input operating range of the amplifier. Beginning at a low frequency (20 Hz), steadily increase the frequency until the ac voltage reading on the 8060A begins to rise. Typically the ac voltage readings will rise to a peak, level out, and then begin to fall, much like the response curve shown in Figure 3-1. (High quality audio amplifiers will probably not show a rise in readings since they are generally flat from 20 Hz to >20 kHz. In this case, use 1 kHz as a midband reference for 0 dB in Step 4).

4. When the peak or the upper plateau of ac voltage readings has been reached, press the dB button and then the REL (relative) button on the 8060A. This establishes the 0 dB relative reference.

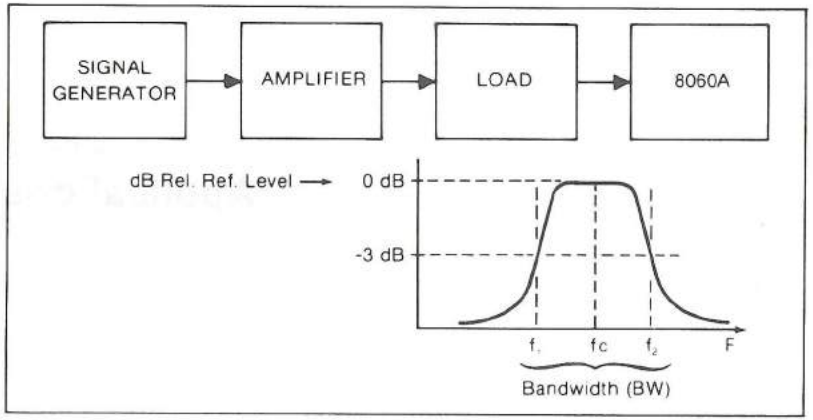


Figure 3-1. Measuring Amplifier Bandwidth

5. Increase the frequency input until the dB readings drop to -3.00 dB. Press the Hz button on the 8060A to read the upper frequency limit of the bandwidth. Press the dB button to restore the dB reading.

6. Decrease the frequency input so the dB readings rise to 0 dB and then drop again to -3.00 dB. Press the Hz button to read the lower frequency limit of the bandwidth.

You can use a similar technique to examine the performance characteristics of frequency-sensitive filters, such as high or low-pass filters, notch filters, etc. With the 4-1/2 digit frequency resolution and the 0.01 dB resolution, you can very accurately determine the rolloff, slope, and bandpass.

3-3. USING THE 8060A AS A Q-METER

You can use the 8060A to determine the Q factor of a tuned circuit (refer to Figure 3-2). First use the technique presented in Section 3-2 to determine the center frequency (fc) and bandwidth of the circuit (for tuned circuits, the center frequency of the bandwidth is found at the peak or midway within the high plateau of the dB readings). Then calculate the Q of the circuit by using the following formula:

$$Q = fc / \text{Bandwidth}$$

3-4. MEASURING AMPLIFIER STAGE GAIN WITH RELATIVE dB

When testing multi-stage amplifiers, we are usually interested in the dB gain or loss at each stage referenced to an initial dB level. Figure 3-3 shows an example of this kind of application with the 8060A. A 20 mV signal is applied to the first stage of a three-stage amplifier. The signal is measured with the 8060A in the ac voltage function. Then the dB button is pressed followed by the REL button which creates the relative reference 0 dB point. Each stage is then measured, and the 8060A displays the dB level with reference to the initial input.

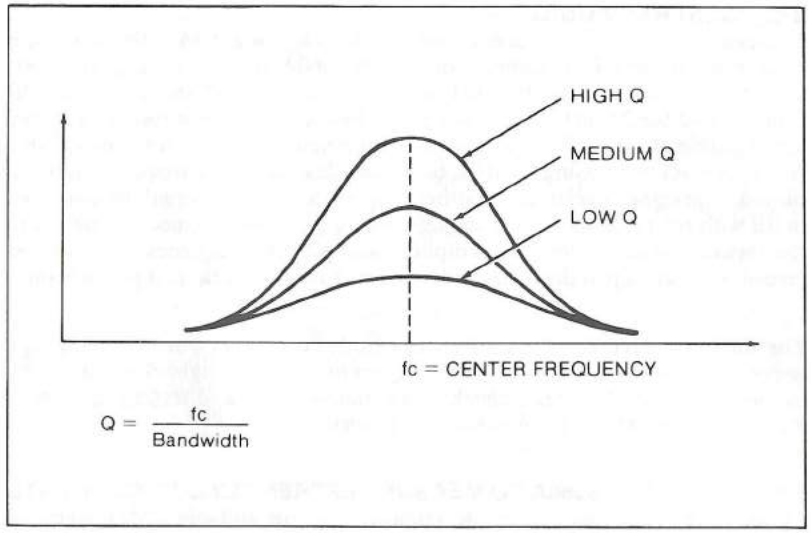


Figure 3-2. Measuring Q with the 8060A

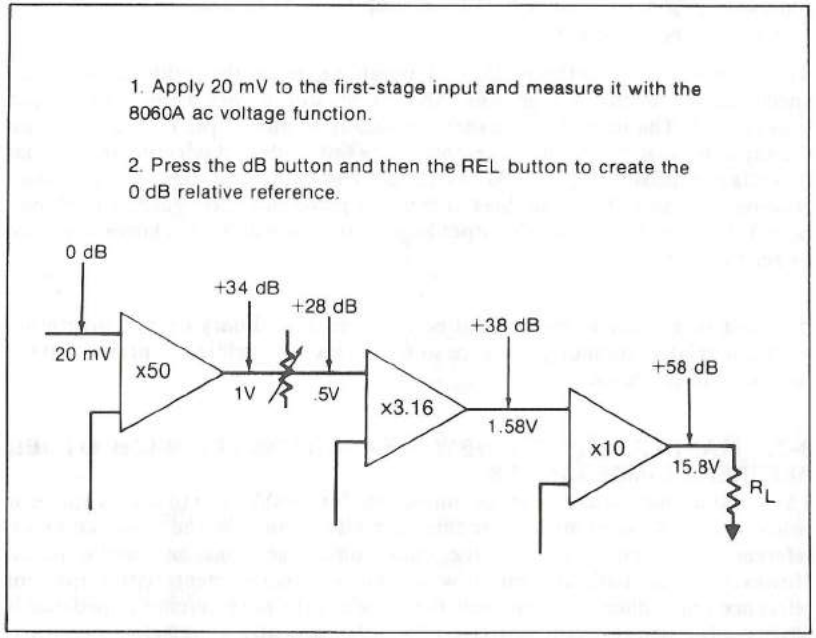


Figure 3-3. Measuring Stage Gain with Relative dB

3-5. GENERAL AUDIO USES

You can perform many audio equipment tests using the 8060A with a minimum of other equipment. For example, connect the 8060A to the tape recorder output sockets of a phono amplifier with a shielded lead. Select the ac voltage dB function and the 200 mV range. Then play a frequency response test record (they are available at some of the larger audio equipment stores). You can establish a reference level by pressing the REL button while a particular frequency is being played. The signal level of all the other frequencies on the disc will be displayed in dB with reference to the original reference level. If you connect the 8060A to the speaker sockets of an audio amplifier and play the frequency response test record, you can adjust the filters and tone controls and check their performance.

The 8060A is also useful for a variety of maintenance tasks when servicing tape decks. Some of these tasks include setting up record and playback levels during calibration, head alignment, checking attenuator pads, and testing equalizers. Refer to manufacturer information for procedures.

3-6. USING THE 8060A TO MEASURE EXTREMELY LOW CURRENTS

By using the high impedance dc voltage function and high MΩ precision resistors, you can use the 8060A to measure extremely low currents. For example, if you place a 100 MΩ resistor across the 8060A and select the high impedance dc voltage function and the 200 mV range, the 8060A will measure a 2 nanoamp (10^{-9}A) current with 0.1 picoamp (10^{-12}A) resolution.

The error sources with this method of measurement are the combined accuracy specifications for the voltage range and the resistor, as well as the 8060A input bias current. The input bias current is typically 10 picoamps. You can measure the input bias current error by removing the test leads and selecting the normal dc voltage function and the 200 mV range. The number of digits in the display reading indicates the input bias current in picoamps (disregard the decimal point). You can correct for the input bias current by using the relative reference to zero the offset.

The best measurement results will be obtained at ordinary room temperature with low relative humidity. Be sure to use adequate shielding to prevent power line or rf interference.

3-7. MAKING dBm OR dBW MEASUREMENTS WITH OTHER REFERENCE IMPEDANCES

The standard power-on reference impedance for 8060A dBm (decibels above or below one milliwatt) measurements is 600Ω, which is the most common reference impedance used in the data communications and audio fields. However, occasionally you might want to make measurements with a different reference impedance. For instance, the standard rf dBm reference impedance is 50Ω. Audio power amplifiers use dBW (decibels above or below one watt) referenced to 2, 4, 8, or 16Ω. The standard method for making these dBm or

dBW measurements is to add or subtract a correction factor. With the 8060A, however, you can set up any of these reference impedances with the relative (REL) function.

To change the reference impedance, select the desired dB function and appropriate range, apply the equivalent voltage level obtained from Table 3-1 (or from the formulas at the bottom of Table 3-1), and press the REL button. The 8060A will store the equivalent voltage level, and subsequent dB measurements will be referenced to the new impedance.

For an example of how to use this feature, let's assume that you want to make ac voltage dBm measurements referenced to 50Ω. First select the 8060A ac voltage dB function and the 2V range. Referring to Table 3-1, we find that the equivalent voltage level for 0 dBm for 50Ω is 0.2236V and the equivalent dB level for 0 dBm referenced to 600Ω is –10.79 dBm. Apply an ac voltage to the 8060A input (VΩS and COMMON) and adjust the applied voltage level until the 8060A displays –10.79. Now press the REL button. The display should read 0.00 (with the dB

Table 3-1. Equivalent Voltage Levels for Modifying the Reference Impedance

REFERENCE IMPEDANCE Z (Ω)	EQUIV. VOLTAGE LEVEL	EQUIV. dB LEVEL FOR 0 dBm REF. TO 600Ω AS SHOWN ON THE 8060A DISPLAY (dBm)
50	FOR 0 dBm (V) 0.2236	-10.79
75	0.2739	-9.03
90	0.3000	-8.23
125	0.3536	-6.81
150	0.3873	-6.02
300	0.5477	-3.01
600 (power-on value)	0.7746	0.00
900	0.9487	1.76
1000 (dBV)	1.0000	2.22
2	FOR 0 dBW (V) 1.4142	5.23
4	2.000	8.24
8	2.828	11.26
16	4.000	14.26

Use the following formulas to calculate equivalent voltage levels for reference impedances not listed.

For dBm: 0 dBm level (V) = $\sqrt{.001 \times \text{desired ref. impedance } (\Omega)}$

600Ω Ref. Equiv. (dBm) = 20 log [0 dBm level (V)/.7746]

For dBW: 0 dBW level (V) = $\sqrt{\text{desired ref. impedance } (\Omega)}$

600Ω Ref. Equiv. (dBm) = 20 log [0 dBW level (V)/.7746]

and REL indicators at the top of the display). Measurements taken with the ac voltage dB function will now read dBm referenced to 50Ω.

Whenever you use Table 3-1, be sure you start with the 600Ω reference impedance selected on the 8060A. Otherwise the values and formulas listed in Table 3-1 will be incorrect because they use the 600Ω reference impedance as a starting point.

After a reference impedance is stored with the REL button, the reference impedance will remain stored until the instrument is turned off or until another relative value is stored. You can cancel the stored reference by pressing the REL button, in which case the REL indicator will disappear and the reference impedance will revert to the power-on value, 600Ω. You can use other functions without losing a stored reference impedance as long as you do not store some other relative value.

3-8. CHANGING AC dB REFERENCE IMPEDANCES WITH A DC SOURCE

The most straightforward method of changing the reference impedance is to select the desired voltage dB function, apply the equivalent voltage, and press the REL button. However, a precision ac voltage source is not always as readily available as a dc voltage source. There is a method for using a variable 0 to 200 mV dc voltage source to set up virtually any reference impedance for ac voltage dB.

To use this method, place the AC/DC switch in the AC position and place the other two function switches in the out position. Find the equivalent dB level in Table 3-1 and select the appropriate range. Press the dB button. Beginning with a 200 mV input signal, slowly decrease the input signal until the proper dB level is displayed on the 8060A. Then press the REL button. Now you can select the ac voltage dB function and subsequent measurements will be referenced to the modified reference impedance.

Note that in this mode the input signal does not go through the voltage divider or the ac rms converter, but is applied directly to the a/d converter. Since the a/d converter inputs are between 0 and 200 mV for all ac ranges, the voltage you apply will always be between 0 and 200 mV, regardless of the range. For example, let's assume you want to use this method to establish a reference impedance of 90Ω. From Table 3-1 you can see this requires an input of 0.3000V. So you select the 2V range, but you only apply 30 mV dc of signal in the 2V range to make the reading appear to be 300 mV ac. Similarly, 30 mV dc of signal in the 20V range will appear to be 3V ac, and in the 200V range will appear to be 30V ac.

Section 4
Theory of Operation

4-1. INTRODUCTION

This section describes how the 8060A works. An overview of the operation is provided first, followed by descriptions of the two major components and the measurement functions. A detailed schematic of the instrument appears in Section 8.

4-2. FUNCTIONAL DESCRIPTION

The major circuits and components of the 8060A are arranged in a block diagram in Figure 4-1. Two major components make up the measurement system: a four-bit CMOS microcomputer, and a CMOS integrated circuit known as the Measurement Acquisition Chip (MAC). The microcomputer selects the appropriate measurement function in the MAC according to the switches or buttons pushed by the operator. The microcomputer also controls the measurement cycles, performs calculations on measured data, and drives the display. The MAC measures the conditioned input signals with the a/d converter or the frequency counter. The MAC also controls the power supply and the continuity tone generator. The microcomputer and the MAC communicate through a four-bit bidirectional bus and four control lines. Both components are described in more detail later in this section.

As shown in Figure 4-1, the input signals are routed by the range and function switches through the appropriate signal conditioners for input filtering and scale changes. Input signals for all measurement functions except frequency are converted to a proportional dc analog voltage that is applied to the a/d converter. The dual-slope a/d converter converts the dc analog voltage to a digital number that is sent to the microcomputer. Input signals for frequency measurement are ac voltages that are buffered by the ac converter and applied to the frequency counter in the MAC. The frequency counter supplies the digital number to the microcomputer. Each of the major measurement functions are described later in this section.

4-3. Microcomputer

The four-bit CMOS microcomputer senses switch positions by reading status registers in the MAC, and senses button pushes through input lines connected

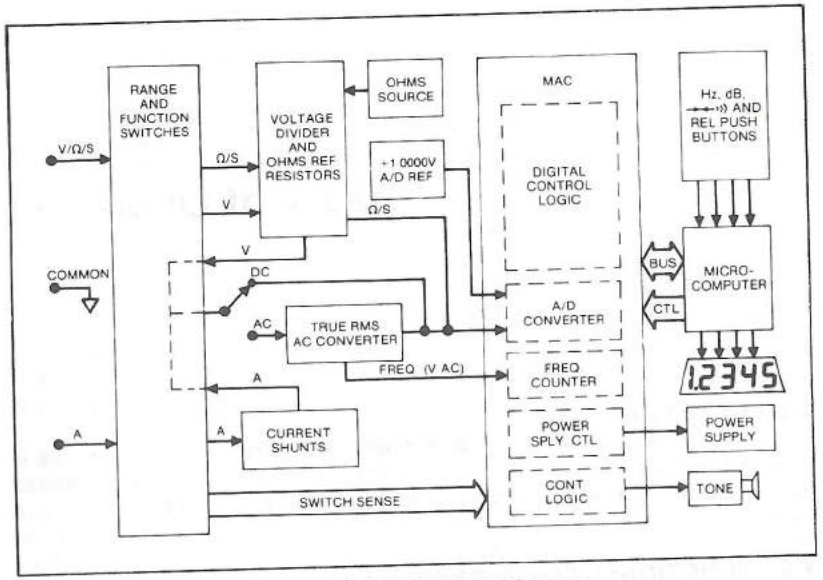


Figure 4-1. 8060A Block Diagram

directly to the microcomputer. The microcomputer processes the information and then selects the appropriate digital and analog configuration in the MAC by writing to an array of MAC control registers.

The operation of the instrument is controlled by software routines that are stored in the microcomputer memory. These routines include the normal operating routine, the power-on self-test, or special self-test routines that may be selected by the operator. When the instrument is first turned on, the microcomputer performs the self-test routine which checks the LCD segments and the interface to the MAC (refer to Section 2 for operating instructions). While the LCD segments are on (a minimum of 1.6 seconds), the microcomputer exercises the bus and checks the internal registers in the MAC to make sure it has control over them. If the microcomputer detects a problem with the MAC interface, it stays in the self-test routine with the LCD segments on until the problem is resolved or the instrument is turned off.

After the power-on self-test routine is successfully completed, the microcomputer checks to see if the operator has selected the ratio self-test or the switch decoding self-test (refer to Section 5 for operating instructions). If neither of the self-tests has been selected, the microcomputer begins the normal operating routine. The operating routine consists of four steps:

1. The microcomputer reads the function and range selections and checks the four push buttons to determine the mode the operator has selected. The microcomputer then selects either the a/d converter (for

measurement of voltage, current, resistance, conductance, continuity, or the diode test) or the frequency counter.

2. The microcomputer initiates either the a/d measurement cycle (approximately 400 ms) or the frequency measurement cycle (approximately 1.0s). The measurement cycles are described later in this section.

3. The microcomputer processes the data obtained in the measurement cycle. This includes calculations for the dB, relative (REL) offset, and MΩ or frequency autoranging.

4. The microcomputer displays the results. The results remain on the display until it is updated.

After the results are displayed, the routine begins again at the first step.

4-4. Measurement Acquisition Chip (MAC)

A block diagram of the MAC is shown in Figure 4-1. The digital control logic includes a buffer and decoder, read and write logic, status and control registers, and logic control for the continuity function. The power supply control uses the calibrated 1V a/d reference voltage obtained from a bandgap reference diode to regulate the 5.2V main power supply for the instrument. When the continuity function is selected and continuity is detected, the MAC generates the tone by supplying a square wave to the external piezoelectic transducer.

4-5. A/D Conversion Cycle

The heart of the MAC is the dual-slope a/d converter. A block diagram of the analog portion of the a/d converter is shown in Figure 4-2. The internal buffer, integrator, and comparators work in conjunction with external resistors and capacitors to convert the dc analog voltage to a digital number. The internal switches are FET switches that are controlled by the microcomputer and the MAC digital control logic. The switchable integrator gain depends on the function and range selected.

The complete a/d measurement cycle is shown in Figure 4-3. It consists of three consecutive time periods: autozero (AZ), integrate (INTEG) and read. A fourth time period, overload (OL) is also used if an overrange reading is taken. The total length of the measurement cycle is 400 ms. The length of the integrate period is fixed at 100 ms. One hundred ms is a multiple of the period of 50 Hz or 60 Hz power, which helps to reduce possible power line noise that might interfere with the measurement. The waveform at the INTEG capacitor is shown for three sample measurement readings: half-scale, full-scale, and overrange.

The measurement cycle begins with the autozero period. The AZ switches close, applying a ground reference as the input to the converter. Under ideal conditions the output of the comparator would also go to zero. However, input-offset voltage errors accumulate in the buffer amplifier loop, and appear at the comparator output as an error voltage. To compensate for this error, the error is

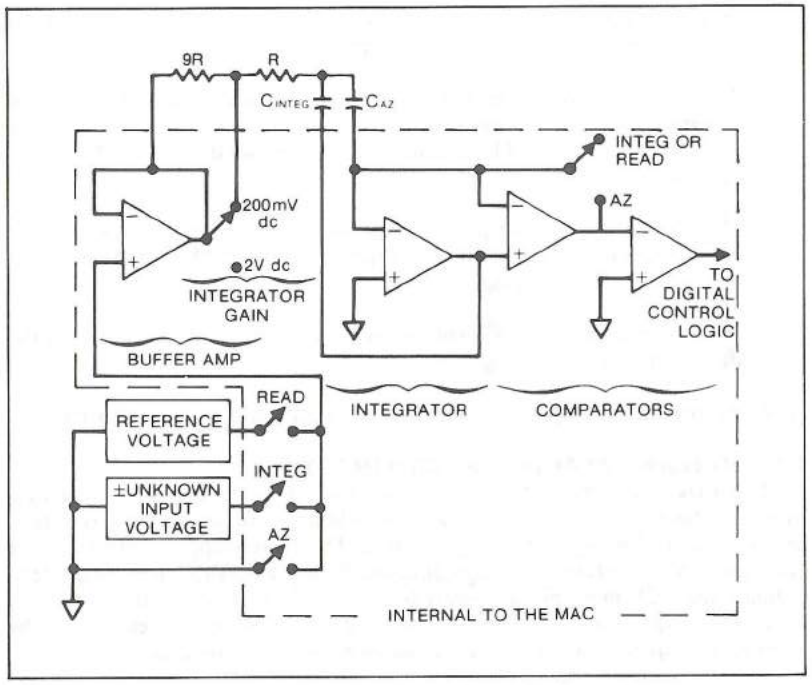


Figure 4-2. Analog Portion of the A/D Converter

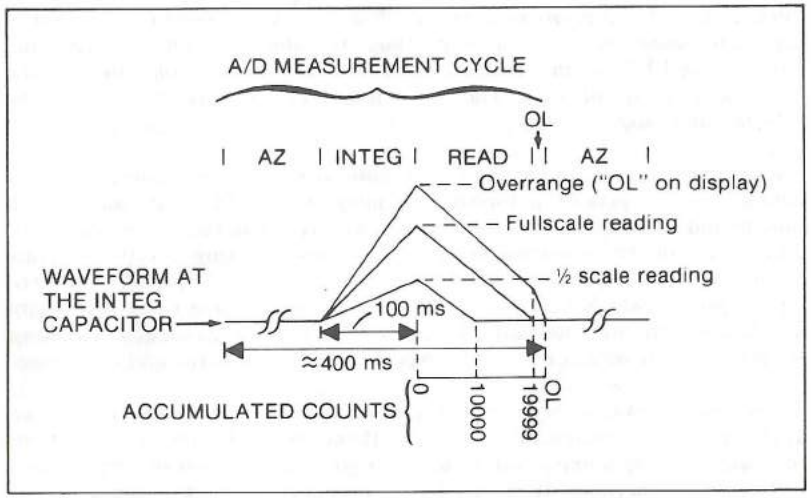


Figure 4-3. A/D Measurement Cycle

impressed across the AZ capacitor where it is stored for the remainder of the measurement cycle. The stored level is used to provide offset voltage correction during the integrate and read periods.

The integrate period begins at the end of the autozero period. As the period begins, the AZ switches open and the INTEG switches close. This applies the unknown input voltage to the input of the converter. The voltage is buffered and then begins charging the INTEG capacitor. The waveform at the INTEG capacitor is a ramp from near zero to some maximum value determined by the amplitude and polarity of the unknown input voltage.

As the read period begins, the INTEG switches open and the READ switches close. This applies the known reference voltage from a "flying" capacitor whose polarity is chosen by the a/d converter to be the opposite of the polarity of the unknown input voltage. The INTEG capacitor begins discharging at a fixed rate while a counter begins counting. The counter stops counting when the INTEG capacitor voltage equals the initial autozero voltage. The count is proportional to the unknown input voltage, and is placed on the display by the microcomputer.

If during the read period the counter counts up to the maximum number of counts for a full-scale reading (19999 counts) and the INTEG capacitor charge has not yet reached the initial autozero voltage, the microcomputer knows an overrange reading has been taken. The microcomputer places "OL" on the display and commands the a/d converter to go into the overload (OL) period which rapidly slews the integrator voltage back to the initial autozero voltage.

The measurement cycle ends at the end of the read period for an on-scale reading, or at the end of the overload period for an overrange reading. A new measurement cycle then begins with the autozero period. The display update rate for measurement functions that use the a/d converter is approximately 0.4s, or about 2-1/2 readings per second.

4-6. Voltage Measurement

Both the ac and dc voltage ranges use an over-voltage-protected 10 MΩ input divider as shown in Figure 4-4. The over-voltage protection includes two 2-watt fusible resistors and four metal-oxide varistors for high voltage clamping. Depending on the range selected, lower leg resistors of the divider are connected to ground to perform the input signal division.

The dc input voltages for all ranges are divided by the appropriate factor of 10 to produce a proportional dc signal which is then filtered and applied to the input to the a/d converter. The dc and ac voltage ranges and division factors are listed in Table 4-1 along with the corresponding range of inputs to the a/d converter. Notice in Table 4-1 that the 2V dc voltage range is divided by 1 (not 10). The microcomputer compensates by decreasing the integrator gain in the a/d converter by a factor of 10 (refer to Figure 4-2). The integrator gain is also reduced by a factor of 10 in the 1000V dc voltage range, which uses the same divider arrangement as the 200V dc voltage range.

The ac input voltages are divided with the same divider arrangement as the dc input voltages, with the exception that the 2V ac voltage range is divided by 10. The divider output signals for ac voltages are ac-coupled to the input of a true rms ac converter which produces a current output. This negative dc representation is applied through a calibrated scaling resistor. The resultant negative voltage is filtered and applied to the input of the a/d converter.

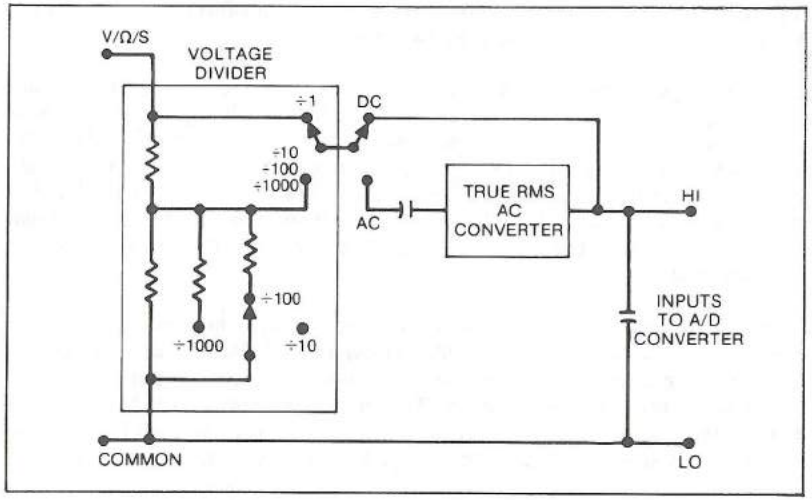


Figure 4-4. Voltage Measurement

Table 4-1. Voltage Input Divider

FUNCTION	RANGE	INPUT DIVIDER	RANGE OF A/D CONVERTER INPUT
DC VOLTAGE	200 mV	1/1	-200 mV to +200 mV
	2V*	1/1	-2V to +2V
	20V	1/100	-200 mV to +200 mV
	200V	1/1000	-200 mV to +200 mV
	1000V*	1/1000	-2V to +2V (1V max. input)
AC VOLTAGE	200 mV	1/1	0 to -200 mV
	2V	1/10	0 to -200 mV
	20V	1/100	0 to -200 mV
	200V	1/1000	0 to -200 mV
	750V*	1/1000	0 to -2V (-0.75V max. input)
*Integrator gain in a/d converter reduced by factor of 10.			

4-7. Current Measurement

Current measurements are made using a double-fuse-protected, switchable, five-terminal current shunt (0.1 ohm, 1 ohm, 10 ohm, 100 ohm or 1 kilohm) to perform the current-to-voltage conversion required by the a/d converter. A block diagram of current measurements is shown in Figure 4-5. When the dc current function is selected, the dc voltage drop across the shunt is filtered and applied to the input of the a/d converter. When the ac current function is selected the ac voltage drop across the shunt is ac-coupled to the input of the true rms ac converter. The dc representation of the ac voltage is filtered and applied to the input of the a/d converter. All current ranges use the ±200 mV a/d converter input range.

4-8. Resistance Measurement

Resistance measurements are made using a ratio technique as shown in Figure 4-6. When the resistance function is selected, a series circuit is formed by the ohms source, a reference resistor from the voltage divider (selected by the range switches), and the external unknown resistor. The ratio of the two resistors is equal to the ratio of the voltage drop across each of them. Since the voltage drop across the reference resistor and the value of the reference resistor are known, the value of the second resistor can be determined. Input protection during resistance measurements consists of a thermistor and a double-transistor clamp.

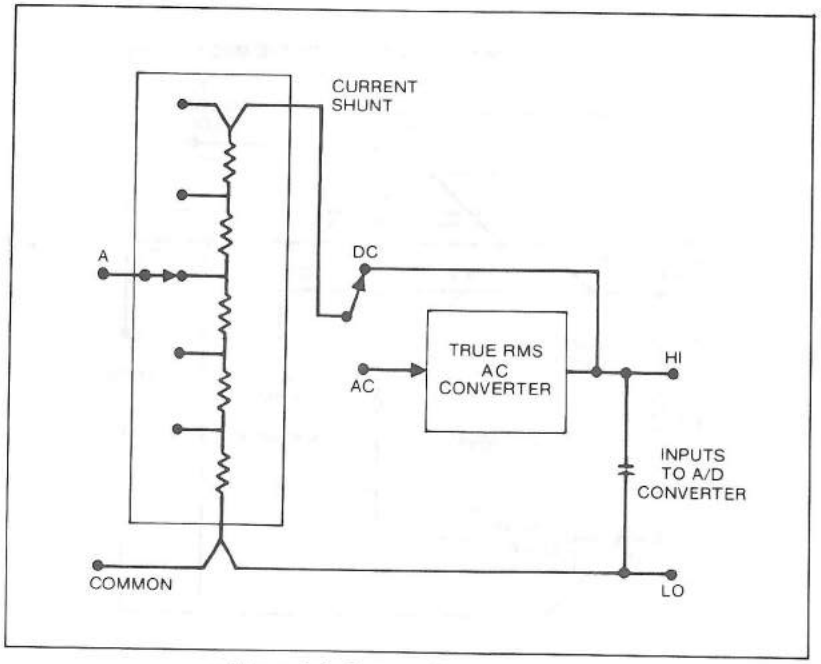


Figure 4-5. Current Measurement

The operation of the a/d converter during a resistance measurement is basically as described earlier in this section, with a few exceptions. During the integrate period the voltage drop across the unknown resistor charges the INTEG capacitor. During the read period, the voltage across the known resistor (stored on the flying capacitor) discharges the INTEG capacitor. The length of the read period is a direct indication of the value of the unknown resistor.

4-9. Conductance Measurement

Conductance measurements are made using a ratio technique similar to that used in making resistance measurements as shown in Figure 4-6. The main difference is that the function of the range and unknown resistors in the a/d measurement cycle is reversed so that the smaller voltage is applied during the integrate period, which minimizes error due to noise. During the integrate period the voltage drop across the known resistor charges the INTEG capacitor. During the read period the voltage drop across the unknown resistor discharges the capacitor. Consequently the display presents a reading that is the reciprocal of resistance, which is conductance.

4-10. Continuity Measurement

Continuity measurement is a voltage comparison made in the resistance mode as illustrated in Figure 4-6. The 8060A determines whether continuity exists in the

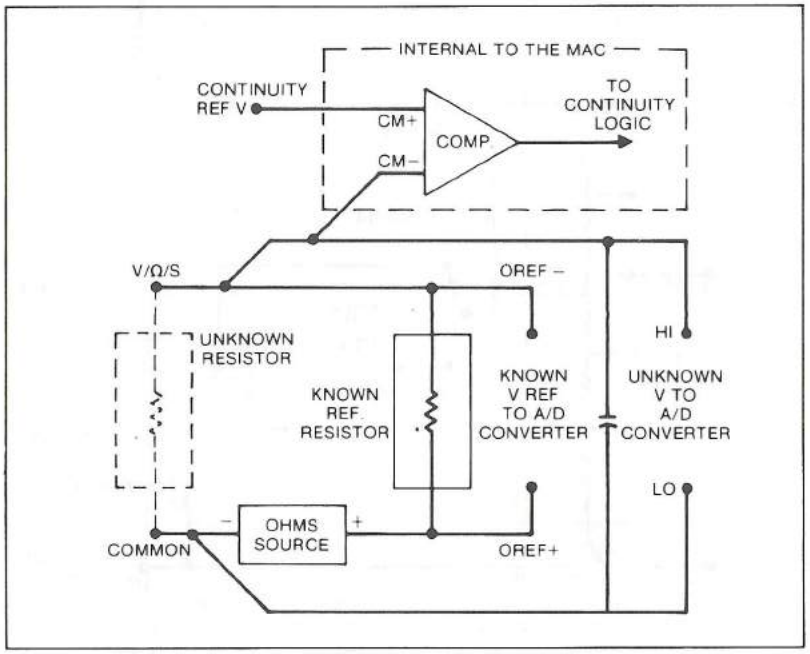


Figure 4-6. Resistance/Conductance/Continuity Measurement

circuit under test by comparing the voltage drop across the external circuit with a continuity reference voltage. If the voltage drop across the external circuit is less than the reference voltage, the comparator sends the appropriate signal to the continuity logic. The continuity logic notifies the microcomputer which turns on the visible indicator (the full-length bar across the top of the display). If the audible indicator is enabled, the continuity logic enables the tone generator.

The detection threshold is typically 10% of the full scale resistance range selected. When the 8060A detects continuity for brief intervals (50 μs or greater), the microcomputer extends the visible and audible indication to a minimum of 200 ms to allow easy perception by the operator.

4-11. Frequency Measurement

Frequency measurement is illustrated in Figure 4-7. The ac input signal is divided by the voltage divider (Figure 4-4) and buffered by the ac rms converter. The signal is then applied to a comparator in the MAC for counting. The counter gate is controlled by the microcomputer, and the range is automatically selected by the software in the microcomputer. For very low frequency input signals, the counter actually measures the period of the input signal which the microcomputer then inverts to derive the corresponding frequency. The display update rate for all ranges is approximately one second (except for frequencies between 12.2 and 16 Hz, which are updated every 1 to 1.3s).

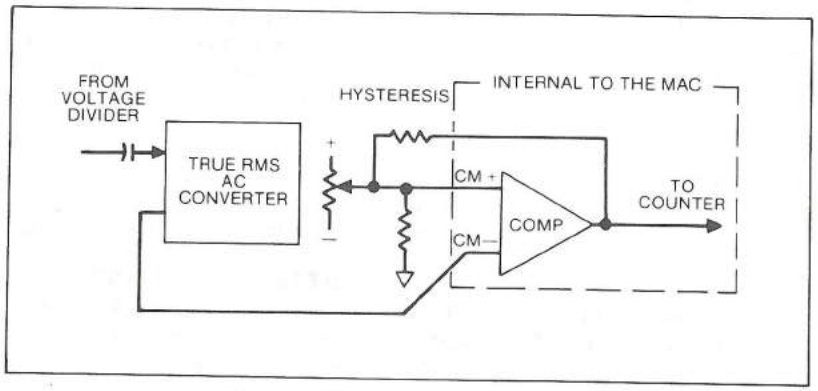


Figure 4-7. Frequency Measurement

Section 5
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.

5-1. INTRODUCTION

This section of the manual contains information regarding the maintenance of your instrument. It includes information about disassembly, performance tests, calibration adjustments, and troubleshooting. The combined performance tests are recommended as an acceptance test when the instrument is first received, and can be used later as a preventive maintenance tool.

A one-year calibration cycle is recommended to maintain the specifications given in Section 1 of this manual. The test equipment required for the performance tests or calibration adjustments is listed in Table 5-1. Test equipment with equivalent specifications may also be used.

5-2. SERVICE INFORMATION

The 8060A is warranted for a period of one year upon shipment of the instrument to the original purchaser. Conditions of the warranty are given at the front of this manual. Malfunctions that occur within the limits of the warranty will be corrected at no cost to the purchaser. For in-warranty repair, call (toll-free) 800 426-0361 for the address of the nearest Fluke Technical Service Center designated to service your instrument. (In Alaska, Hawaii, Washington, or Canada call 206-356-5400.) Ship the instrument postpaid in the original shipping container (if available). Dated proof-of-purchase may be required for in-warranty repairs.

Fluke Technical Service Centers are also available for calibration and/or repair of instruments that are beyond the warranty period. Call the number listed above for shipping information. Ship the instrument and remittance in accordance with instructions received.

Table 5-1. Required Test Equipment

EQUIPMENT	REQUIRED SPECIFICATIONS	RECOMMENDED TYPE
DMM Calibrator	DC Voltage: 0 to 1000V, ±(0.0075%) AC Voltage: 200 Hz to 1 kHz, 0 to 750V, ±(0.06%) 1 kHz to 10 kHz, 0 to 200V, ±(0.06%) 10 kHz to 30 kHz, 0 to 200V, ±(0.1%) 30 kHz to 50 kHz, 0 to 200V, ±(0.25%) 50 kHz to 100 kHz, 0 to 2.0V, ±(0.75%) Resistance: 100Ω to 10.0 MΩ, ±(0.01%)	John Fluke 5100B with Options Y5000, 5100A-03, and John Fluke 5205A Amplifier
	DC Current: 0 to 2000 mA, ±(0.05%) AC Current: 20 Hz to 3 kHz, 0 to 2000 mA, ±(0.25%)	John Fluke 5100B with Option Y5000 and John Fluke 5220A Amplifier
Reference Resistors	40 MΩ and 290 MΩ, ±(0.1%)	Caddock MG750*
Signal Source	Frequency: 25 mV to 200 mV, 100 Hz to 200 kHz, ±(0.01%)	John Fluke 6010A
DMM	DC Voltage: 200 mV to 20V, ±(0.25%) DC Current: 2 mA to 200 mA, ±(0.25%)	John Fluke 8020A
*Precision high MΩ resistors may be ordered from Caddock Electronics, 3127 Chicago Ave., Riverside, CA, 92507. Be sure to specify 0.1% tolerance.		

5-3. GENERAL INFORMATION

5-4. Handling Precautions for Using Static Sensitive Devices

CAUTION

This instrument contains CMOS components which can be damaged by static discharge. Static sensitive components on the main pcb include U3 and U4. The microcomputer pcb includes one static sensitive component, U5, the microcomputer. To prevent damage, take the following precautions when troubleshooting and/or repairing the instrument:

- Perform all work at a static-free work station.
- Do not handle components or pcb assemblies by their connectors.

- Wear static ground straps.
- Use conductive foam to store components.
- Remove all plastic, vinyl and styrofoam from the work area.
- Use a grounded, temperature-regulated soldering iron.

5-5. Disassembly and Reassembly

The instrument has two pcbs: the main pcb and the microcomputer pcb. To gain access to the calibration adjustments, the backup fuse, or the LCD, you have to remove only the top cover. You can also do some troubleshooting with only the top cover and the top ac shield off. For other troubleshooting or to gain access to the microcomputer pcb, you have to remove the main pcb from the case. If you remove the main pcb from the case, you will need to perform the calibration adjustments. Be sure to heed the notes and cautions about special handling requirements.

NOTE

It is not necessary to remove the main pcb from the botton case in order to disassemble or reassemble the LCD. However, because the LCD and the microcomputer require similar special handling, the disassembly and reassembly procedures are described together.

CAUTION

To avoid contaminating the pcbs with oil from the fingers, handle the pcbs by the edges or wear gloves. If a pcb does become contaminated, refer to the cleaning information given later in this section.

5-6. CALIBRATION AND BACKUP FUSE ACCESS

Use the following procedure to gain access to the calibration adjustments or the backup fuse (F2):

1. Disconnect the test leads and battery eliminator, if attached. Turn the power switch off.

2. Remove the three phillips screws from the bottom of the case.

3. Turn the instrument face-up and grasp the top cover at both sides of the input connectors. Then pull the top cover from the unit. The backup fuse and the calibration adjustments are now accessible (Figure 5-1).

CAUTION

The function buttons below the display are part of a single elastomeric strip (Figure 5-1) that is held in place by the top cover. When the top cover is removed, the elastomeric strip will be loose and

may be removed. Do not touch or contaminate the carbon-impregnated switch contacts on the bottom of the strip or the switch contacts on the display pcb. If the contacts do become contaminated, clean them with isopropyl alcohol.

4. To reassemble, position the elastomeric strip on the microcomputer pcb so that the small rubber posts on the bottom of the strip are properly seated. Install the top cover and fasten the three screws on the bottom case.

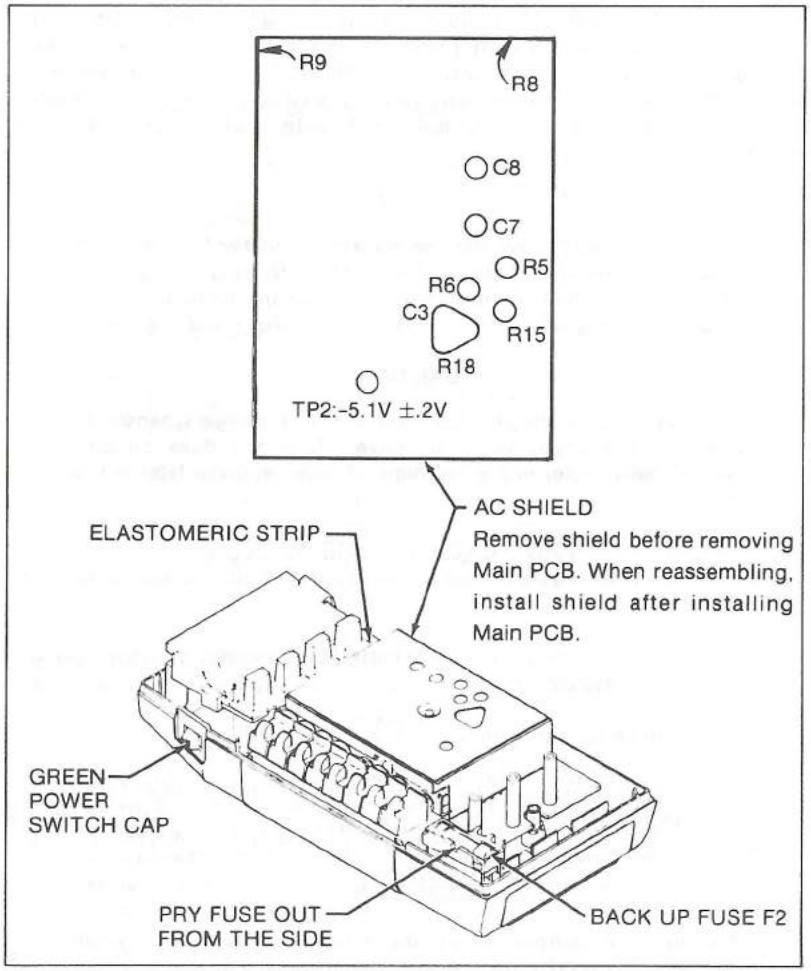


Figure 5-1. Calibration and Backup Fuse (F2) Access

5-7. MAIN PCB ACCESS

Use the following procedure to gain access to the main pcb:

1. Remove the screw in the center of the ac shield and remove the shield.

2. Using your index finger, lift up the lower right corner of the main pcb until it is free. Then pull the pcb to the right until it clears the shelf under the buttons.

CAUTION

Do not touch or contaminate the plastic insulator that is attached to the inside of the case bottom. When the instrument is assembled the insulator makes contact with the leads on the bottom of the main pcb. Contaminants could cause undesirable conduction paths. If the insulator becomes contaminated, clean with isopropyl alcohol.

3. Reassemble in the logical reverse order and heed the following notes:

   a. When reassembling, be sure to put on the ac shield after the main pcb has been placed in the case bottom. The reason for this is that the screw which holds down the ac shield has a spring attached. The spring provides the electrical connection between the top of the ac shield and the bottom of the shield (under the insulator). If the ac shield is attached to the main pcb before the main pcb is in the case, the spring may fold across the insulator and not be in proper position to make the electrical connection.

   b. Be sure to place the green power switch cap over the small black power switch before sliding the main pcb into the case.

   c. Be sure to route the battery-clip wires to the left side of the post under the backup fuse case.

5-8. LCD AND MICROCOMPUTER PCB DISASSEMBLY AND ASSEMBLY

NOTE

This procedure applies to serial number 3995000 and higher.

The procedure for disassembling or assembling the LCD and the microcomputer pcb is not difficult, but the steps must be followed in sequence. Before you try the procedure, examine the components in Figure 5-2 and familiarize yourself with the following handling precautions:

- The microcomputer, U5 (item 4 in Figure 5-2), is a static sensitive CMOS device. Follow standard procedures for handling static sensitive devices.

- The LCD interconnect (item 7) and the microcomputer interconnect (item 5) should not be touched with fingers or contaminated. Handle these items with tweezers and keep them clean.

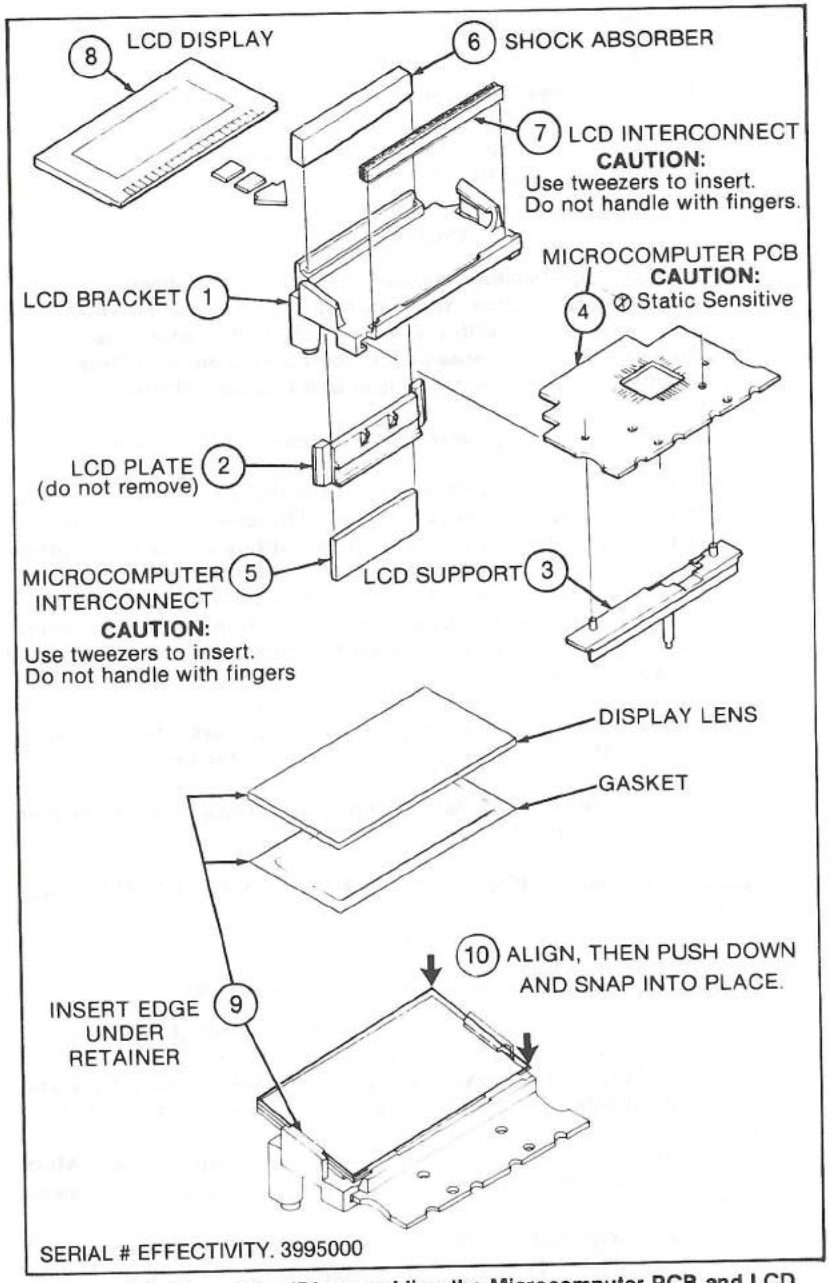


Figure 5-2. Assembling/Disassembling the Microcomputer PCB and LCD

- The microcomputer interconnect (item 5) is susceptible to corrosion caused by the reaction between the metal in the connector and possible contaminates in the air such as smoke or sulfer. Store the connector in an air-tight container if the LCD is disassembled for a long period of time.

- Do not get fingerprints or dirt on the LCD display, the display lens, or the gasket.

- While the LCD and microcomputer pcb are assembled, take care not to press down on the display lens because pressure could damage the LCD.

To disassemble the LCD, use your thumbnails and push on the corners of the LCD display, gasket and display lens so that all three components slide out together as shown in Figure 5-3.

NOTE

It is not necessary to remove the main pcb from the bottom case to disassemble or reassemble the LCD.

To assemble the LCD, use the following procedure:

1. Align the LCD display (item 8) as indicated in Figure 5-2 and slide it into place. The bottom edge of the LCD display should compress the LCD interconnect (item 7) and slide underneath the two plastic notches on the LCD bracket (item 1).

2. Refer to Figure 5-2 and follow steps 9 and 10 to complete assembly.

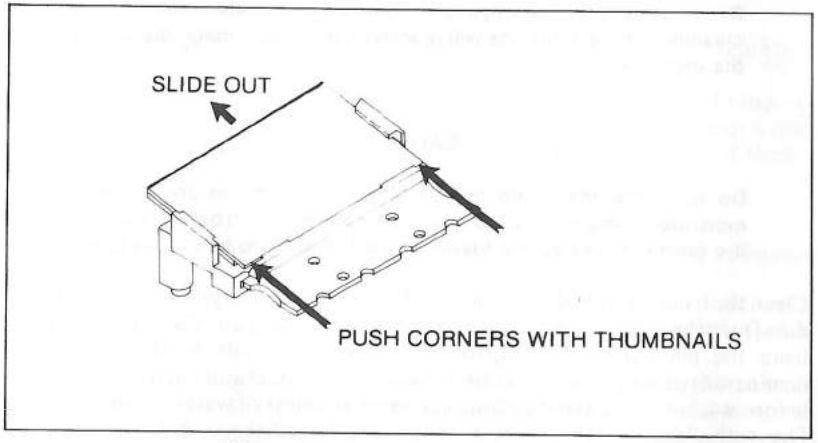


Figure 5-3. Disassembling the LCD

To disassemble the microcomputer pcb, use the following procedure:

1. Turn the main pcb face down and remove the two small screws at the top of the pcb to free the microcomputer pcb.

2. Refer to Figure 5-2. Beginning with item 7, remove items 7 through 3 (leave item 2 attached to item 1). Be sure to observe the handling precautions for items 7, 5, and 4.

To assemble the microcomputer LCD, refer to Figure 5-2. Beginning with item 3, assemble items 3 through 7 (in ascending numerical order). Be sure to follow the handling precautions for items 4, 5, and 7.

5-9. Backup Fuse Replacement

Use the following procedure to replace the backup fuse (F2):

1. Remove the top cover by following the precautions given previously for the calibration and backup fuse access.

2. Use a flat-tipped screwdriver to pry the fuse out of its fuse holder. Pry the fuse from the side as indicated in Figure 5-1.

3. Replace the defective backup fuse with a 3A/600V type BBS-3 (John Fluke 475004). Refer to Section 2-4 for information about replacing fuse F1 (2A/250V; American style: fast acting type AGX2, 1/4 x 1", John Fluke 376582; European style: 5 x 20 mm, John Fluke 460972).

5-10. Cleaning

CAUTION

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

CAUTION

Do not allow the liquid crystal display to come in contact with moisture. Remove the LCD and microcomputer pcb before washing the main pcb and do not install it until the pcb has been fully dried.

Clean the front panel and case with a mild solution of detergent and water. Clean dust from the main pcb with low pressure (<20 psi) dry air. Clean contaminates from the main pcb with isopropyl alcohol and a soft brush, followed by demineralized water and a soft brush (remove the LCD and microcomputer pcb before washing, and avoid getting excessive amounts of water on the switches). Dry with clean, dry air at low pressure, and then bake at 50 to 60°C (124 to 140°F) for 24 hours.

5-11. PERFORMANCE TESTS

The following procedures allow you to compare the performance of your instrument with the specifications listed in Section 1. They are recommended for incoming inspection, periodic calibration, and to verify specifications. If the instrument fails any test, calibration adjustment and/or repair is needed. You do not have to disassemble the instrument to perform the tests. Throughout these procedures, the 8060A being tested is referred to as the UUT (Unit Under Test).

5-12. Initial Procedure

For any of these tests, make sure you do the following:

1. Allow the temperature of the UUT to stabilize in a test environment with an ambient temperature of 23 ±5°C (73 ±9°F) and a relative humidity of less than 80%.

2. Check the fuses and battery and replace them, if necessary.

3. Make sure the leads are disconnected from the UUT. Set the power switch to on and set all other switches to the out (off) position.

5-13. Microcomputer and Display Test

Use the automatic power-on self-test to test the microcomputer and the LCD display. Turn the UUT off, then turn it on while observing the display. All of the LCD segments should turn on. After about one or two seconds, the display should go blank briefly and then respond to switch selections.

5-14. Voltage Test

Use the following procedure to verify proper operation of the dc voltage, ac voltage, and dB functions.

1. Connect the UUT and the DMM Calibrator as shown in Figure 5-4.

2. For each step in Table 5-2, select the UUT function and range as indicated. Program the DMM Calibrator for the specified input signal and verify that the displayed UUT value is within the indicated limits.

5-15. Resistance Test

Use the following procedure to verify proper operation of the resistance function:

1. Connect the UUT and the DMM Calibrator as shown in Figure 5-4.

2. Select the resistance function and follow the steps 1 through 7 as listed in Table 5-3. For each step, select the UUT function and range as indicated. Program the DMM Calibrator for the specified input signal and verify that the displayed UUT value is within the indicated limits.

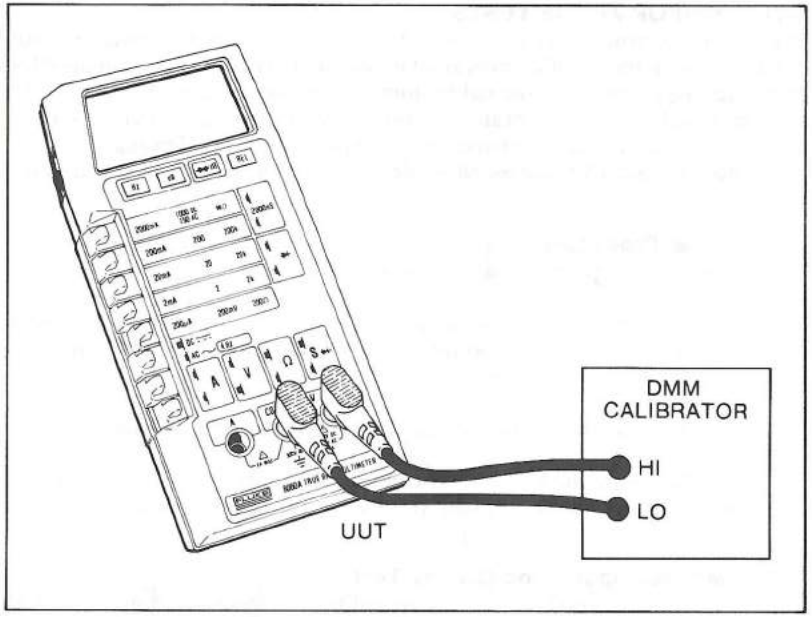


Figure 5-4. General Equipment Connection

NOTE

Most DMM Calibrators do not test resistance values beyond 10 MΩ. To test the resistance function beyond 10 MΩ (optional steps 8 and 9 in Table 5-3), disconnect the DMM Calibrator and connect a precision Reference Resistor for each value.

5-16. Continuity Test

Use the following procedure to verify proper operation of the continuity function:

1. Connect the UUT and the DMM Calibrator as shown in Figure 5-4.

2. Select the resistance function and the 2 kΩ range. Press the ⊶ button once. The ⊶ symbol should appear on the display.

3. Apply a resistance of 100.0Ω. The long bar across the top of the display should appear on the display immediately. A reading of .0997 to .1003 should appear shortly thereafter (negating any test lead resistance).

4. Press the ⊶ button to enable the audible continuity (the 100.0Ω still applied). The symbol should appear on the display with the ⊶ symbol. The tone should sound.

Table 5-2. Voltage Test

STEP	FUNCTION	RANGE	INPUT SIGNAL		DISPLAY LIMITS
			LEVEL	FREQ.	
1	DC Voltage	200 mV	+190.00 mV	dc	189.91 to 190.09
2		200 mV	-190.00 mV		-189.91 to -190.09
3		2V	1.9000V		1.8991 to 1.9009
4		20V	19.000V		18.989 to 19.011
5		200V	190.00V		189.89 to 190.11
6		1000V	1000V		999.3 to 1000.7
7	AC Voltage	200 mV	100.00 mV rms	50 Hz*	99.70 to 100.30
8	AC Voltage		100.00 mV rms	10 kHz	99.60 to 100.40
9	AC dB		2.45 mV rms	1 kHz	-49.0 to -51.0 (dB)
10	AC dB		2.45 mV rms	30 kHz	-47.0 to -53.0(dB)
11	AC dB	2V	1.9000V rms	50 Hz*	7.69 to 7.89 (dB)
12	AC Voltage	2V	1.0000V rms	50 Hz*	.9940 to 1.0060
13			1.0000V rms	1 kHz	.9940 to 1.0060
14			1.0000V rms	10 kHz	.9930 to 1.0070
15			1.0000V rms	30 kHz	.9860 to 1.0140
16			1.0000V rms	100 kHz	.9500 to 1.0500
17			1.0000V rms	20 Hz	.9890 to 1.0110
18			100.0 mV rms	50 Hz*	.0985 to .1015
19			100.0 mV rms	30 kHz	.0950 to .1050
20			100.0 mV rms	100 kHz	.0770 to .1230
21	AC Voltage	20V	10.000V rms	50 Hz*	9.940 to 10.060
22				10 kHz	9.930 to 10.070
23				30 kHz	9.860 to 10.140
24	AC Voltage	20V	10.000V rms	100 kHz	9.500 to 10.500
25		200V	100.00V rms	50 Hz*	99.40 to 100.60
26		200V	100.00V rms	10 kHz	99.30 to 100.70
27		200V	100.00V rms	30 kHz	98.60 to 101.40
28		200V	100.00V rms	100 kHz	95.00 to 105.00
29		750V	750.0V rms	100 Hz	741.5 to 758.5
30		750V	750.0V rms	1 kHz	741.5 to 758.5

*If power line frequency is 50 Hz, use 60 Hz test frequency.

Table 5-3. Resistance Test

STEP	RANGE	INPUT RESISTANCE	DISPLAY LIMITS
1	200Ω	short circuit	0.00 to 0.04
2	200Ω	100.00Ω	99.89 to 100.11
3	2 kΩ	1.0000 kΩ	.9991 to 1.0009
4	20 kΩ	10.000 kΩ	9.991 to 10.009
5	200 kΩ	100.00 kΩ	99.91 to 100.09
6	MΩ	1.0000 MΩ	.9983 to 1.0017
7	MΩ	10.00 MΩ	9.95 to 10.05
8 (optional)	MΩ	40.0 MΩ	39.3 to 40.7
9 (optional)	MΩ	290 MΩ	282 to 298

5. Remove the connections to the input of the UUT. The tone should stop and the bar should disappear from the display. The display should indicate OL (overrange) along with the ⊶ and ⊸ symbols.

5-17. Conductance Test

Use the following procedure to verify proper operation of the conductance function:

1. Connect the UUT and the DMM Calibrator as shown in Figure 5-4.

2. Select the conductance (S) function.

3. Apply a resistance of 1.000 MΩ. A reading of 993.0 to 1007.0 should appear on the display.

4. Remove the resistance from the inputs to the UUT. The display should read 0.0 to 0.2.

5-18. Current Test

Use the following procedures to verify proper operation of the dc and ac current functions:

1. Connect the UUT and the DMM Calibrator as shown in Figure 5-5.

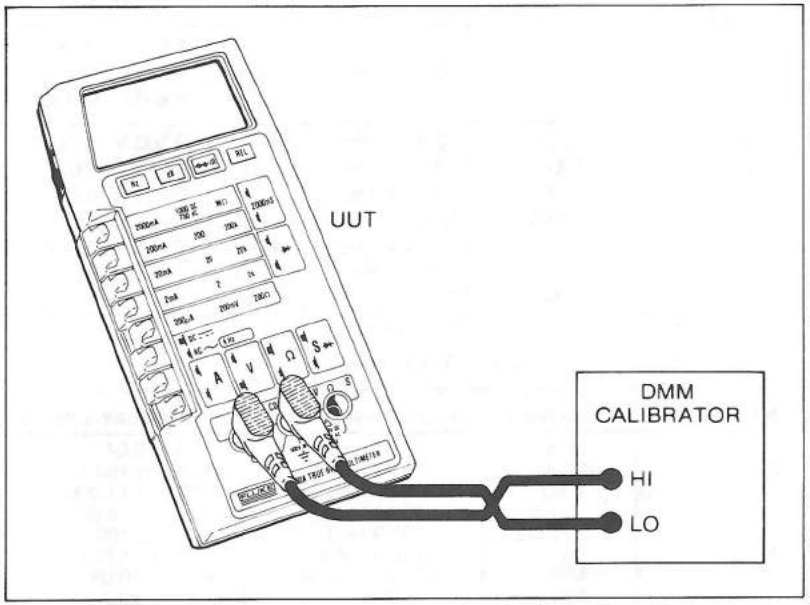


Figure 5-5. Equipment Connection for Current Test

2. For each step in Table 5-4, select the UUT function and range as indicated. Program the DMM Calibrator for the specified input signal and verify that the displayed UUT value is within the indicated limits.

5-19. Diode Test

Use the following precautions to verify proper operation of the diode test:

1. Remove any connections to the inputs of the UUT and select the diode test function. The display should indicate OL (overrange).

2. Connect the UUT and the DMM Calibrator as shown in Figure 5-4 and apply a resistance of 1.000 kΩ. A reading of .9000 to 1.1000 should appear on the UUT display.

3. Using a DMM, measure the output current. The current should be approximately 1 mA ±10%

5-20. Frequency Test

To verify the proper operation of the frequency function, connect the signal source to the V and COMMON inputs of the UUT. Select ac voltage and push the Hz button to select the frequency function. Follow the steps listed in Table 5-5.

Table 5-4. Current Test

STEP	FUNCTION	RANGE	INPUT SIGNAL LEVEL	INPUT SIGNAL FREQ.	DISPLAY LIMITS
1	Current dc	200 μA	190.00 μA	dc	189.60 to 190.40
2		200 μA	-190.00 μA		-189.60 to -190.40
3		2 mA	1.9000 mA		1.8960 to 1.9040
4		20 mA	19.000 mA		18.941 to 19.059
5		200 mA	190.00 mA		189.41 to 190.59
6		2000 mA	1900.0 mA		1894.1 to 1905.9
7		2000 mA	-1900.0 mA		-1894.1 to -1905.9
8	Current ac	20 mA rms	19.000 mA	1 kHz	18.848 to 19.152

Table 5-5. Frequency Test

AC VOLTS RANGE	INPUT SIGNAL LEVEL	INPUT SIGNAL FREQ.	DISPLAY LIMITS
200 mV	20.0 mV	100.00 Hz	99.94 to 100.06 ±3 counts*
200 mV	100.0 mV	190.00 Hz	189.91 to 190.09
2V	200.0 mV	19.000 kHz	18.991 to 19.009
*May be noisy due to low signal level.			

5-21. CALIBRATION ADJUSTMENTS

Under normal operating conditions the 8060A should maintain the specifications given in Section 1 of this manual for at least one year after calibration. If your 8060A has been repaired or if it has failed any of the performance tests, you need to perform the calibration adjustments.

Test equipment needed for the adjustments is listed in Table 5-1. If the test equipment is not available, your nearest John Fluke Service Center will be glad to help. Call the number listed in Section 5-2 of this manual for assistance. After you have completed the calibration adjustments, we recommend that you complete the performance tests to verify proper operation. In the following procedure, the 8060A that is being adjusted is referred to as the UUT (Unit Under Test).

NOTE

The top ac shield should remain installed on the instrument while the calibration adjustments are being performed. The positions of the trimpots and trimcaps are marked on the top ac shield along with a table summarizing the calibration procedures.

NOTE

The performance of the 8060A ac functions is affected by the capacitance between the main pcb and the bottom ac shield, which is dependent on the distance between them. The distance may vary, depending on whether the top cover is installed. To minimize performance variations, press down on the ac shield to simulate top cover installation while you perform the calibration adjustments. After you have performed the adjustments and installed the top cover, if you find that the measurement values obtained for the ac function performance tests are consistently too high or too low, remove the top cover and repeat the adjustments accordingly.

1. Allow the UUT to stabilize with the power off for at least 30 minutes at an ambient temperature of 21 to 25°C (70 to 77°F).

2. Complete the calibration access procedure presented earlier in this section.

3. Connect the equipment as shown in Figure 5-4 and turn on the equipment.

4. On the UUT, select the dc voltage function and the 2 volt range. Turn R6 fully clockwise (CW), and turn R5 fully counterclockwise (CCW).

5. Program the DMM Calibrator for an input of 1.9000V dc. Adjust R5 for a display reading slightly greater than 1.9000. Adjust R6 for a display reading between 1.8999 and 1.9001.

6. On the UUT, select the 200 mV range (dc voltage function).

7. Program the DMM Calibrator for an input of 190.00 mV dc. Adjust R8 for a display reading between 189.99 and 190.01.

8. On the UUT, select the ac voltage function and the 200 mV range. Turn R18 fully CW, and turn R15 fully CCW.

9. Program the DMM Calibrator for an input of 100.00 mV ac at 200 Hz. Adjust R15 for a display reading slightly greater than 100.00. Adjust R18 for a display reading between 99.95 and 100.05.

10. On the UUT, select the 200V range (ac voltage function). Program the DMM Calibrator for an input of 100.00V ac at 10 kHz. Adjust C3 until the display reading is between 99.95 and 100.05.

11. On the UUT, select the 2V range (ac voltage function). Program the DMM Calibrator for an input of 1.0000V ac at 10 kHz. Adjust C7 until the display reading is between .9985 and 1.0015.

12. Repeat steps 10 and 11 before proceeding to step 13.

13. On the UUT, select the 20V range (ac voltage function). Program the DMM Calibrator for an input of 10.000V ac at 10 kHz. Adjust C8 until the display reading is between 9.990 and 10.010.

14. On the UUT, select the 200 mV range (ac voltage function) and press the Hz button under the display. The Hz indicator should appear on the display.

15. Program the DMM Calibrator for an input of 50 mV ac at 100 kHz. Adjust R9 for a stable reading between 99.95 and 100.05.

16. Decrease the signal input by 5 mV and repeat step 15. If the signal level is no longer sufficient to obtain the required reading, leave R9 at the most stable and accurate setting.

5-22. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components U3, U4, and U5. Follow the handling precautions for static sensitive devices previously described in this section. Never remove, install or otherwise connect or disconnect components without first setting the instrument power switch off and disconnecting any inputs to the instrument.

If necessary, refer to Section 2 for operating instructions or Section 4 for the theory of operation. The troubleshooting information is supported by the schematics and tables in Section 8.

5-23. Self-Tests

The 8060A offers three self-tests: power-on self-test, ratio self-test, and switch decoding self-test. The power-on self-test is automatically performed whenever the instrument is turned on. It is described in Sections 2 and 4. The other two tests function as follows:

5-24. RATIO SELF-TEST

The ratio self-test is an operating mode of the 8060A in which the reference voltage for the a/d converter is applied to the a/d converter during both the integrate and the read periods. If the instrument is functioning properly, the display should read 10000 ±10 counts (the decimal point location depends on the range, and does not affect the number of counts).

To select the ratio self-test, select a voltage or current function. Hold down the ⊸⊸ button while you turn on the instrument. After the power-on self-test has been completed (the display is .8.8.8.8), release the ⊸⊸ button. The instrument should now be in the ratio self-test mode. To cancel the ratio self-test, press the ⊸⊸ button or turn off the instrument.

If the count is within tolerance, it gives a strong indication that the a/d converter is working properly. If the count deviates more than 10 counts from 10000, the probable causes are as follows (in order of probability): a/d converter in U3, leakage around or failure of C16, C18, Z3, R8, or the power supply.

5-25. SWITCH DECODING SELF-TEST

To select the switch decoding self-test, hold down the REL button while you turn on the instrument. After the power-on self-test has been completed (the display is .8.8.8.8), release the REL button. The instrument should now indicate the switch decoding. To cancel the switch decoding self-test, turn off the instrument.

The switch decoding self-test indicates how the software in the microcomputer interprets the configuration of the eight switches and four push buttons. Each function or range that may be selected corresponds to a number that appears in one of the digit positions on the display (see Table 5-6). Notice that if no range is selected, the microcomputer assumes the 200 (μA, mV, Ω) range is selected.

In some cases it may be helpful to know that the microcomputer scans the switches in order from SW5 to SW8 (there is no input for switch SW4, the default range). The microcomputer assumes the first range switch detected as being pushed in is the desired range. For example, if you press in both the 200V and 1000V switches while in dc voltage, the microcomputer assumes you want the 200V range. There are two exceptions: diode test and conductance. If the microcomputer detects that the 2 kΩ switch is selected, it checks for the 20 kΩ switch (indicating diode test selection). If the microcomputer detects the 200 kΩ

Table 5-6. Switch Decoding Self-Test

RANGE	DISPLAY DIGIT 0*
200 (μA, mV or Ω)	0 (default if no range selected)
2	1
20	2
200	3
2000	4
PUSH BUTTON	**DISPLAY DIGIT 1***
none	0
REL	1
⊸⊸)))	2
dB	4
Hz	8
FUNCTION	**DISPLAY DIGIT 3***
AC Voltage	1
DC Voltage	2
AC Current	3
DC Current	4
Resistance	5
Conductance	6
Diode Test	7

*Display digits are numbered 0 through 4 from right (LSD) to left (MSD).

switch is selected, it checks for the MΩ switch (indicating conductance selection).

Also during the switch decoding self-test, the continuity indicator (the long bar across the top of the display) indicates the state of the continuity/frequency comparator. When the voltage at U3-4 (CM−) is less than at U3-3 (CM+), the continuity indicator is on. When the voltage at U3-4 is greater than at U3-3, the continuity indicator is off. You can use this feature to check the comparator when troubleshooting the continuity or the frequency functions. R9 controls the setting of the comparator offset.

5-27. Troubleshooting Guide

A troubleshooting guide is presented in Table 5-7. The guide is structured around the performance tests presented earlier in this section. To use this guide, complete the performance tests and note any discrepancies in performance. Then locate the test, symptom, and possible cause of malfunction in Table 5-7. When several possible causes of malfunction are listed, they are listed in order beginning with the most probable to the least probable. A section about troubleshooting the power supply is also included.

The following troubleshooting techniques can be helpful:

- When troubleshooting, remember to use the switch decoding self-test to determine whether the microcomputer properly interprets the function and range selection.
- Do not remove the main pcb from the bottom case unless you must do so to gain electrical access to circuits. You can gain electrical access to almost all of the input circuitry through the switch contact pins on the top of the switch deck (refer to the schematic in Section 8).
- One way to check the input circuitry is to attach a high impedance (>1000 MΩ) DMM at the input of the 8060A a/d converter, U3-6.
- You can do a lot of troubleshooting without the LCD and microcomputer pcb installed. Although there will be no display and the a/d converter and frequency counter will not work, the power supplies still work so you can check the input circuitry, the diode test and ohms sources, and the ac converter. Another advantage is that you gain access to all the pins on U3 without having to turn the main pcb over.
- You can troubleshoot the input circuitry with U3 removed (be sure to disconnect the battery before removing U3). Since U3 controls the power supply, removing U3 will cause the ac converter and diode test source to stop working. However, it will also eliminate any power supply leakages that might be affecting the input circuitry. Since the input protection, input divider and ohms reference resistors, amps protection, current shunts, and a/d input circuits consist of passive components (refer to the schematic in Section 8) you can check them without having U3installed.

Table 5-7. Troubleshooting Guide

TEST AND SYMPTOM	POSSIBLE CAUSE/SUGGESTIONS
POWER ON/ MICROCOMPUTER AND DISPLAY TEST	
No display	Dead battery, battery connections, J4, power supply circuitry.
Missing LCD segments	Display interconnect.
All LCD segments stay on	Microcomputer connector, U5, U3, pcb lands open, C15 shorted.
Entire display is dim	Low battery, power supply low, display interconnect.
Some display segments are dim or ghosting	Display interconnect, contamination on pcb connector or LCD.

Table 5-7. Troubleshooting Guide (cont.)

TEST AND SYMPTOM	POSSIBLE CAUSE/SUGGESTIONS
POWER SUPPLY	
VDD (voltage between TP7 and common) ≠5.2 ± 0.12V	U3, Q1, VR1
VDG (voltage between TP7 and TP8) ≠3.15 ± 0.08V	U3, C12, U5
VSS (voltage between TP2 and common) ≠ -5.1 ± 0.27V	U4, C21, C23
TP4 ≠1.225 ±0.025V	
U3-11 ≠1.0000 ± 0.0004V	
	Hint: If you suspect U3 power supplies are bad, you can drive the 8060A power supplies externally. Remove battery, μC pcb, and U3. Apply +5.2V at TP1—you can then check the ac converter, diode test source, VR2, U4, and the power supply circuitry.
VOLTAGE TEST - DC	
Gross error (constant reading of 0.00 or OL)	Perform ratio self-test in dc volts. If count is good, U3 is good. If count is way off, suspect U3, C9, R33, R8, Z3, C16 or C18.
Ratio self-test passes, but constant reading of 0.00	R1, R2 (fusible resistors—replace with exact equivalent only), RJ1, RJ2, RJ3, RJ4 (varistors turn yellow when shorted), open circuit in front end, bad component in input divider, U3 pins 6 and 7 shorted. (Hint: check high impedance dc voltage first, which bypasses the input divider.) Refer to Table 4-1 for input divide ratios.
High impedance dc readings 0.00, normal dc readings correct	R1
DC readings incorrect for all ranges	Leakage from pcb, U3-6/7, contamination
DC readings correct for 200 mV, 2V—incorrect for 20V, 200V, 1000V	Input divider or input divider switches, R2

Table 5-7. Troubleshooting Guide (cont.)

TEST AND SYMPTOM	POSSIBLE CAUSE/SUGGESTIONS
VOLTAGE TEST - AC	
DC readings correct, ac readings incorrect	Switches S3D, S3B U2: check ac converter power supplies: (U2-4 = 5.2 ± 0.12V U2-8 = -5.1 ± 0.20V). Apply ac signal to input and use ac voltmeter in 200 mV range to check both sides of R13, U2-5, U2-6.
AC readings too high by factor of 1.1	C24
Too much ripple at S3D wiper Poor response at high frequencies	C24, C25 C26, R22, S3C, input divider capacitors.
RESISTANCE/CONDUCTANCE TEST	
All ranges incorrect	Ohms source voltage inadequate—using a voltmeter in the 2V or 20V range, measure ohms source voltage between TP11 and common. Refer to Table 5-8 for correct values. Q3, Q4, RT1, R2, R1, Z5 CR1 not supplying enough current (particularly if 200Ω range noisy). Select diode test, connect an external 1 kΩ resistor across the inputs and measure the voltage drop across the resistor - should be approximately 1V (±10%).
CR1 supplying proper current, but readings off	Check values of the reference resistors for the range not working. Check voltage drops across the known and unknown resistors and make sure the ratio works properly.
Low range readings correct, high range readings off	Q3 and Q4 leak- check by seeing if MΩ reads OL with open input, or conductance reads 0 ± 1.0 nS with open input. Main pcb contaminated - clean carefully and check performance.
MΩ range correct, but conductance not working	U3
Conductance reading >1.0 nS with open input	Main pcb contamination, U3 contamination

Table 5-7. Troubleshooting Guide (cont.)

TEST AND SYMPTOM	POSSIBLE CAUSE/SUGGESTIONS
CURRENT TEST	
Constant reading of 0.00	Check fuses F1 and F2 with fuse check procedure in Section 2-4.
Fuses F1 and F2 good, but current readings off	Switches and resistors in current shunt.
High crest-factor ac current readings off	U1
FREQUENCY TEST	
AC volts readings correct, but frequency readings off	Check to see if ac signal at input arrives at U3-4 (inverting input to the frequency comparator in U3). If it is, check frequency calibration. If it is not, check R31, C27, Z7 and S1A.
Frequency calibration is good and signal present at U3-4, but frequency readings off	Frequency comparator in U3 not responding. To check comparator, select switch-decoding self-test and apply input of 15 mV ac in the 200 mV ac range. Adjust R9 so that the continuity bar at the top of the display flashes off and on. If the bar will not flash, U3 is bad. If the bar flashes, but frequency readings are still off, U3 or U5 are bad. Check oscillation of crystal Y1 by measuring the frequency at U3-38 with another frequency counter - should be 40.000 ±0.020 kHz.
CONTINUITY TEST	
No response	Select switch decoding self-test—check for proper function decoding and also confirm that the continuity comparator responds. R31, S1A
No tone	Q6, R4, LS1. Check U3-1 (tone output) with scope for 2.667 kHz signal.
DIODE TEST	
No readings or very low readings	CR1 (diode test source). To check CR1, select diode test, connect an external 1 kΩ resistor across the inputs and measure the voltage across the resistor — should be approximately 1V (±10%).

Table 5-7. Troubleshooting Guide (cont.)

TEST AND SYMPTOM	POSSIBLE CAUSE/SUGGESTIONS
BT INDICATOR BT indicator not displayed when battery voltage is less than 5.6V	U3, Z4—U3 compares voltage at pin 18 (BTI) with voltage at pin 10 (COM—analog common voltage). BT turns on if U3-18 voltage is greater than common, turns off if it is less (±50 mV)

Table 5-8. Troubleshooting the Resistance Function: Voltage Sources for Ranges

RANGE	VOLTAGE SOURCE (±10%)	COMMENT
200Ω 2 kΩ 20 kΩ 200 kΩ MΩ	4.5V 1.2V 1.2V 1.2V 2.1V	These values should be obtained when no external resistors are connected to the resistance inputs. Measure voltage between common (J2) and TP10. Note that the MΩ and 200 kΩ ranges will be loaded by a 10 MΩ input impedance. Use a high impedance voltmeter for the measurement or decrease the voltage source magnitude appropriately. A DMM with a 10 MΩ input impedance will read approximately 1.9V in the MΩ range.

Table 5-9. U3 (MAC) Pin Descriptions

PIN NO.	MNEMONIC	DESCRIPTION
1	TONE	2.667 kHz square wave to tone generator.
2 3 4	CFO CM+ CM-	Output, + input, - input, respectively, of the frequency/continuity function comparator.
5	VSS	-5.1V supply (externally generated).
6	HI	Input to the a/d converter.
7	LO	Sense ground for the a/d converter.
8 9	FC+ FC-	Connections to the "flying capacitor" which stores the reference voltage applied to the a/d converter during the read period. Plus and minus signs indicate polarity of stored voltage.

Table 5-9. U3(MAC) Pin Descriptions (cont)

PIN NO	MNEMONIC	DESCRIPTION
10	COM	Analog common.
11	VREF+	Input for 1V reference voltage for a/d converter and power supply.
12 13	OREF- OREF+	Reference input to a/d converter during autozero period for resistance and conductance functions.
14 15	BFH BFL	Output of the a/d buffer circuit.
16	AZ	Input for AZ capacitor.
17	INT	Input for INTEG capacitor.
18	BTI	Battery test input.
19	VIA	+5.2V supply feedback (nominally 1V)
20	CV	Gate drive for JFET. Series pass element
21	VDD	+5.2V supply.
22	VID	Reference voltage for the U3 and U5 digital power supply.
23	VDG	Output of the U3 and U5 digital power supply.
24 25 26 27	AD0 AD1 AD2 AD3	Four-bit parallel data bus between U3 and U5. During the first part of a data transfer operation they carry the address of the register being read or written to. During the remainder of the operation they carry data.
28	WR/	Register write strobe.
29	ALE/	Address Latch Enable.
30	RD/	Register read strobe.
31 32 33 34 35 36 37	IN10 IN11 IN12 IN13 IN20 IN21 IN22	SW5 SW6 SW7 SW8 SW1 SW2 SW3 Inputs to U5 indicating the switch positions.
38	CLKO	40 kHz clock which drives the U5 clock input (crystal frequency divided by 80).
39 40	XTALI XTALO	Connections to the crystal oscillator.

Section 6
List of Replaceable Parts

6-1. INTRODUCTION

This section contains an illustrated parts list for the instrument. 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.

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 Table 6-3 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.

6-2. HOW TO OBTAIN PARTS

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.

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.

5-3. MANUAL CHANGE AND BACKDATING INFORMATION

Table 6-4 contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcbs used in your instrument, refer to the revision letter on the non-component side of each pcb assembly.

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.

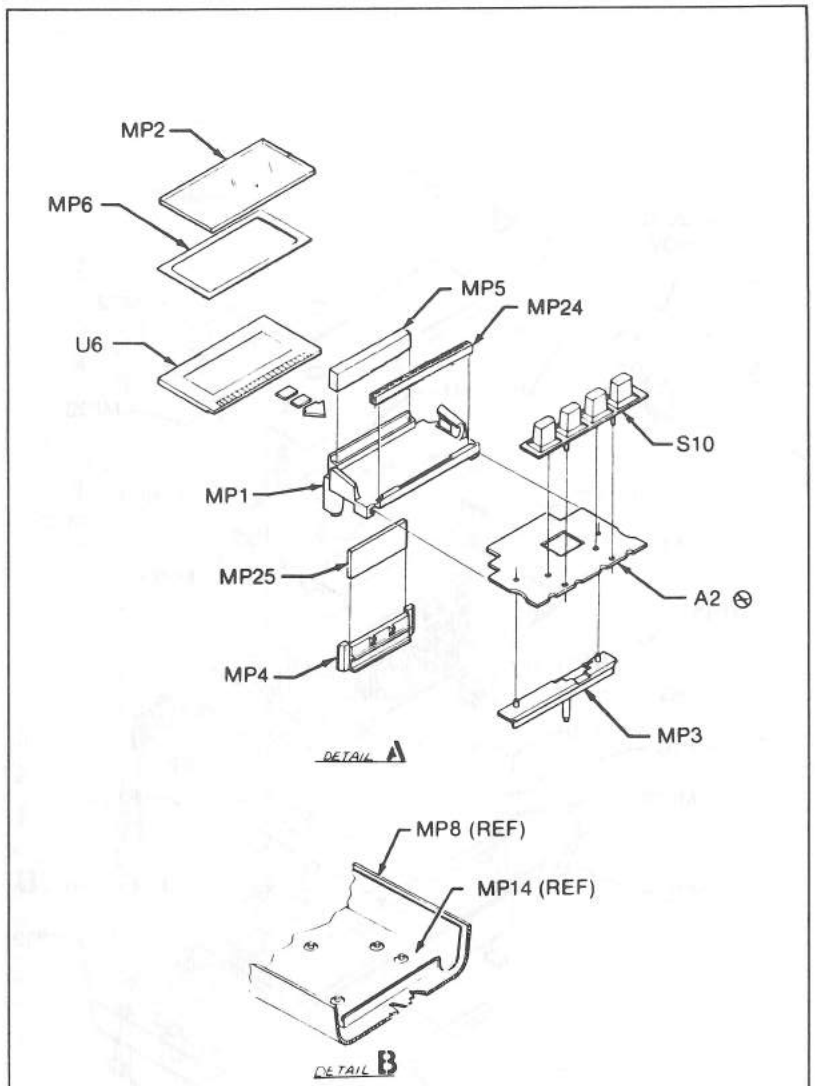
TABLE 6-1. 8060A FINAL ASSEMBLY
(SEE FIGURE 6-1.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY ---	R S -Q --	N O T -E --
A 1		* MAIN PCB ASSEMBLY	642124	89536	642124	1		
A 2		* DIGITAL PCB ASSEMBLY	612721	89536	612721	1		
BT 1		BATTERY,PRIMARY,9V,0-15MA	446823	83740	NEDA #1604	1		
F 1	1A	FUSE,1/4 X 1,FAST,2A,250V	376582	71400	AGX2	1		
F 2		FUSE,13/32 X 1-3/8,FAST,3A,600V	475004	71400	BBS-3	2		
H 1		SCREW, MACH, FHP, 6-32X3/8	114363	89536	114363	1	10	
H 2		WASHER,COUNTER SUNK,STAINLESS STEEL	614529	89536	614529	1		
H 3		SCREW,THD FORM,PHP,STL,4-14X3/8	448456	89536	448456	1		
H 4		SCREW,THD FORM,PHP,STL,7-19X3/4	447953	89536	447953	2		
MP 1		BRACKET,LCD MOUNTING	795112	89536	795112	3		
MP 2		LENS	612747	89536	612747	1		
MP 3		SUPPORT, LCD	612754	89536	612754	1		
MP 4		PLATE, LCD	612762	89536	612762	1		
MP 5		SHOCK ABSORBER,LCD	605188	89536	605188	1		
MP 6		GASKET, LCD	605170	89536	605170	1		
MP 7		SUPPORT, TOP SHIELD	612770	89536	612770	1		
MP 8		CASE BOTTOM	652727	89536	652727	1	1	
MP 9		BAIL MED PEWTER	616961	89536	616961	1		
MP 10		FLANGE, SWITCH	455881	89536	455881	1		
MP 11		BUTTON,FUNCTION SWITCH-DK PEWTER	606889	89536	606889	3		
MP 12		BUTTON,RANGE SWITCH-DK UMBER	606871	89536	606871	5		
MP 13		BUTTON, POWER SWITCH	456491	89536	456491	1		
MP 14		SHIELD, LOWER	587048	89536	587048	1		
MP 15		INSULATOR, SHIELD	604777	89536	604777	1		
MP 16		DECAL, TOP SHIELD	604801	89536	604801	1		
MP 17		FOOT, NON-SKID	604397	89536	604397	4		
MP 18		CONTACT ASSY	817254	89536	817254	1	5	
MP 19		COVER, BATTERY MED PEWTER	637686	89536	637686	1		
MP 20		SPACER, CASE	458588	89536	458588	2		
MP 21		CASE,TOP (573980)	538884	89536	538884	1		
MP 22		DECAL, TOP CASE	535005	89536	535005	1		
MP 23		SHOCK ABSORBER	428441	89536	428441	1		
MP 24		CONN,ELASTOMERIC,LCD TO PWB,2.153 L	783191	89536	783191	1	1	

TABLE 6-1. 8060A FINAL ASSEMBLY
(SEE FIGURE 6-1.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY ---	R S -Q --	N O T -E --
MP 25		INTERCONNECT, PCB	587014	89536	587014	1		
MP 26		TEST LEAD SET	642033	89536	642033	1		
S 10		SWITCH ELASTOMERIC 4 POSITION	587055	89536	587055	1		
TM 1		8060A INSTRUCTION MANUAL	632661	89536	632661	1		
TM 2		8060A OPERATOR GUIDE CARD	632679	89536	632679	1		
U 3	*	FINAL TESTED PLASTIC PKG-8060	612713	89536	612713	1		
U 6		LCD, 4.5 DIGIT, MULTIPLEXED	799973	89536	799973	1		
		RECOMMENDED SPARE PARTS KIT	645705					

Figure 6-1. 8060A Final Assembly



TEST & BUTTON UP (2 OF 2)

Figure 6-1. 8060A Final Assembly (cont)

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

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SFLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	NO. R S -Q -E
C 1, 23, 24,		CAP,AL,100UF,+-20%,63V	615906	89536	615906	5	-- --
C 32, 34			615906				
C 2		CAP,CER,8PF,+-0.25PF,1000V,COH	643551	51406	DD57B10NF08B0C1KV	1	
C 3		CAP,VAR,0.25-1.5PF,1700V,TEFLON	218206	72982	530-000	1	
C 4		CAP,CER,47PF,+-2%,100V,COG	512368	89536	512368	1	
C 5		CAP,CER,0.01UF,+-2%,50V,COG	631044	89536	631044	1	
C 6		CAP,CER,820PF,+-2%,50V,COG	631002	89536	631002	1	
C 7		CAP,VAR,4.2-20PF,100V,CER	631408	89536	631408	1	
C 8		CAP,VAR,9-90PF,50V,CER	643130	73899	DV2SN90D	1	
C 9, 18		CAP,POLYFR,0.22UF,+-10%,100V	446799	89536	446799	2	
C 10, 14		CAP,CER,0.01UF,+-20%,50V,Z5U	659045	89536	659045	2	
C 11, 15, 33,		CAP,CER,0.22UF,+-20%,50V,Z5U	519157	51406	RPE111Z5U224M50V	4	
C 35			519157				
C 12, 21		CAP,AL,10UF,+-20%,16V	602326	89536	602326	2	
C 13, 27, 30,		CAP,CER,0.01UF,+-20%,50V,Z5U	614214	72982	8121-050-651-10NFM	5	
C 31, 37			614214				
C 16		CAP,TA,1UF,+-10%,35V	161919	56289	196D010X0035G	1	
C 17		CAP,POLYES,0.022UF,+-10%,1000V	448183	55112	0.22/10/1000-7	1	
C 19		CAP,AL,47UF,+-20%,16V	613984	89536	613984	1	
C 22		CAP,POLYFR,0.1UF,+-10%,100V	446781	89536	446781	1	
C 25		CAP,TA,5.6UF,+-20%,25V	368969	56289	196D565X0025KA1	1	
C 26		CAP,CER,82PF,+-2%,100V,COG	512350	89536	512350	1	1
C 36		CAP,AL,22UF,+-20%,16V	614750	89536	614750	1	
C 38		CAP,CER,10PF,+-2%,100V,COG	512343	89536	512343	1	
CR 1	*	DIODE,SI,N-JFET,CURRENT REG,IF=1.0 MA	334839	11532	TCR5297	1	1
CR 2	*	DIODE,SI, 100 PIV, 1.0 AMP	343491	01295	1N4002	1	1
CR 3, 4	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	2	1
J 1- 3		RECEPTACLE	508606	89536	508606	3	
J 4		JACK,PWB	423897	89536	423897	1	
J 5		CONTACT ASSY TERMINATION	651653	89536	651653	1	
LS 1		AF TRANSD,PIEZO,24 MM	602490	51406	EFB-RD24C01	1	
MP 1		SPACER,SWAGED,RND,BRASS,6-32X0.687	544254	89536	544254	1	
MP 2		FUSE CLIP	535203	89536	535203	1	

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

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
MP 3		SPRING	535211	89536	535211	1		
MP 4		FUSE CAP	540716	89536	540716	1		
MP 5		FUSE CLIP	534925	89536	534925	1		
Q 1	*	TRANSISTOR,SI,N-JFET,TO-92	604678	17856	J2464	1	1	
Q 3, 4, 6	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	218396	04713	2N3904	3		
Q 5	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	242065	04713	2N5089	1	1	
R 1, 2		RES,WW,FUSIBLE,1K,+-10%,2W	474080	89536	474080	2		
R 3		RES,CC,100M,+-10%,0.5W	190520	01121	EB1075	1		
R 4		RES,CF,5.6K,+-5%,0.25W	442350	80031	CR251-4-5P5K6	1		
R 5		RES,VAR,CERM,2K,+-20%,0.3W	603753	51406	RVS0707-V-100-3-20	1		
R 6		RES,VAR,CERM,200,+-20%,0.3W	603738	51406	RVS0707-V-100-3-20	1		
R 7		RES,MF,154K,+-1%,0.125W,100PPM	289447	91637	CMF551543F	1		
R 8, 15		RES,VAR,CERM,1K,+-20%,0.3W	614065	51406	RVS0707-V-100-3-10	2		
R 9		RES,VAR,CERM,100K,+-5%,0.3W	603761	51406	RVS0707-V-100-3-10	1		
R 10		RES,MF,1.62K,+-1%,0.125W,100PPM	283697	91637	CMF551621F	1		
R 11		RES,MF,147K,+-1%,0.125W,100PPM	291344	91637	CMF551473F	1		
R 13, 32		RES,CC,100K,+-5%,1W	641282	89536	641282	2		
R 14, 31		RES,CC,22M,+-5%,0.25W	221986	01121	CB2265	2		
R 16		RES,MF,383K,+-1%,0.125W,100PPM	288498	91637	CMF553833F	1		
R 18		RES,VAR,CERM,100,+-20%,0.3W	614057	51406	RVS0707-V-100-3-10	1		
R 20		RES,CC,220K,+-10%,1W	109652	01121	GB2241	1		
R 22		RES,CF,240,+-5%,0.25W	376624	80031	CR251-4-5P240E	1		
R 23		RES,CC,4.3,+-5%,0.25W	268912	89536	268912	1		
R 34, 35		RES,CF,12,+-5%,0.25W	442178	80031	CR251-4-5P12E	2		
R 36		RES,CF,51K,+-5%,0.25W	376434	80031	CR251-4-5P51K	1		
R 37		RES,CF,68K,+-5%,0.25W	376632	80031	CR251-4-5P68K	1		
RJ 1- 4		VARISTOR,430V+-10%,1.0MA	447672	09214	V430MA7B	4	1	
RT 1		THERMISTOR,RECT.,POS.,1K,+-40%,25C	446849	50157	180010200	1		
S 1		SWITCH ASSY	535021	89536	535021	1		
S 9		SWITCH,SLIDE,SPDT	453365	34828	G1-116-0001-G20-52	1		
U 1	*	DIODE,SI,RECT,BRIDGE,BV= 50V,IO=1.0A	418582	83003	VM08	1		
U 2	*	IC, RMS SELECTED	637801	89536	637801	1	1	

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

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
U 4	*	IC,VOLTAGE CONVERTER,10.5 V MAX,8 DIP	586248	32293	ICL7660CPA	1	1	
VR 1	*	ZENER,UNCOMP, 6.2V, 5%, 20.0MA. 0.4W	325811	07910	1N753A	1	1	
VR 2	*	IC, 1.22V,25 PPM T.C.,BANDGAP REF	634154	32293	ITS6935-2	1	1	
VR 3	*	ZENER,UNCOMP, 12.0V,10%, 10.5MA, 0.4W	113456	04713	1N963A	1	1	
XU 3		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	1	1	
Y 1	*	CRYSTAL,3.2MHZ,+-0.05%,HC-18/U	513937	89536	513937	1	1	
Z 1	*	RES NET ASSY TESTED-8060 DIVIDER	539213	89536	539213	1		
Z 2	*	RES,NET,WW,TOL,MATCHED	461491	89536	461491	1	1	
Z 3	*	DIVIDER RES NET ASSY TESTED - 8060A	611467	89536	611467	1		
Z 4		RES,NET,CERM,CUSTOM,TOL,TC,MATCHED	614164	89536	614164	1		
Z 5		RES,NET,CERM,CUSTOM,TOL,TC,MATCHED	614149	89536	614149	1		
Z 6		RES NET ASSY TESTED THICKFILM 8060	737569	89536	737569	1		
Z 7		RES,NET,CERM,CUSTOM,TOL,TC,MATCHED	615872	89536	615872	1		

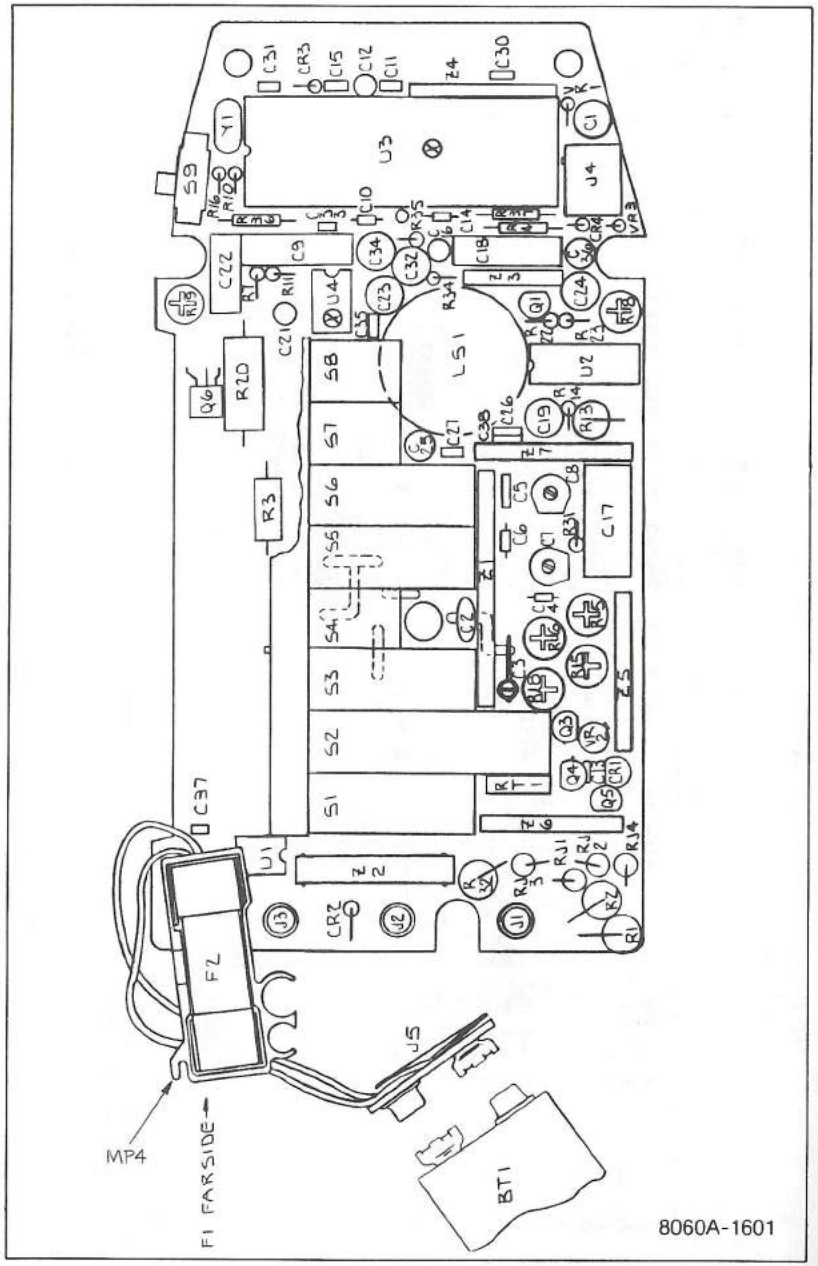


Figure 6-2. A1 Main PCB Assembly

Table 6-3. Federal Supply Codes for Manufacturers

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

04713
Motorola Inc.
Semiconductor Group
Phoenix, Arizona

07910
Replaced by 15818

09214
General Electric Co.
Semiconductor Products
Power Component Operation
Auburn, New York

09922
Burndy Corp.
Norwalk, Connecticut

11532
Teledyne Relays
Hawthorne, California

15818
Teledyne Semiconductors
Formerly Amelco Semiconductor
Mountain View, California

17856
Siliconix, Inc.
Santa Clara, California

19647
Caddock Electronics Inc.
Riverside, California

32293
Intersil
Cupertino, California

51406
Murata Corporation of America
Marietta, Georgia

52763
Stettner-Trush Inc.
Cazenovia, New York

56289
Sprague Electric Co.
North Adams, Massachusetts

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

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

72982
Erie Technical Products Inc.
Erie, Pennsylvania

83003
Varo Inc.
Garland, Texas

79727
C - W Industries
Warminster, Pennsylvania

80031
Mepco/Electra Corp.
Morristown, New Jersey

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

91637
Dale Electronics Inc.
Columbus, Nebraska

Table 6-4. Manual Status Information

Ref Or Option No.	Assembly Name	Fluke Part No.	X The assembly revision levels documented in this manual																				
			A	B	C	D	E	F	G	H	J	K	L	M	N	P							
A1	Main PCB Assembly	538850	•	•	•	+	+	+	+	+	X												

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

Section 7
Schematic Diagrams

FIGURE NO. **TITLE** **PAGE**

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7-3. Test Point Locations 7-4
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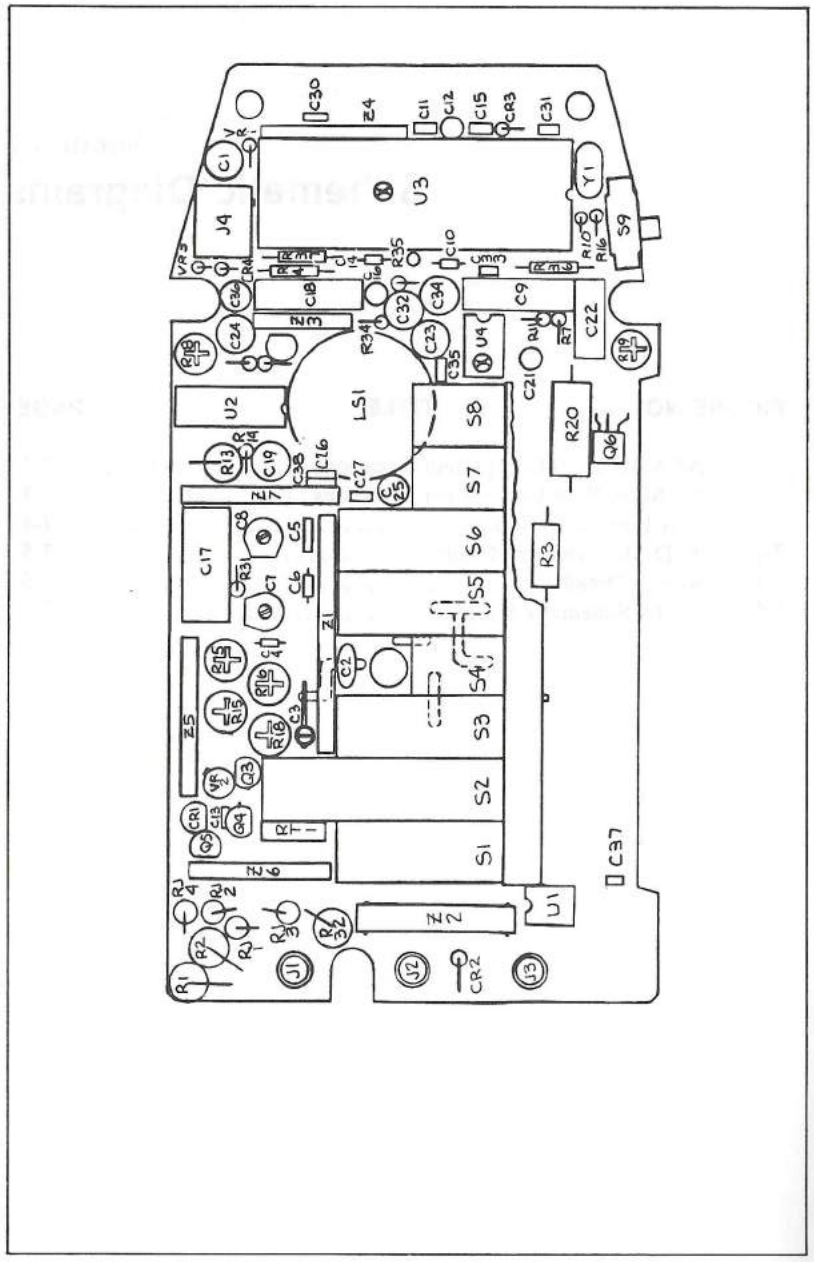


Figure 7-1. A1 Main PCB Component Locations (Bottom View)

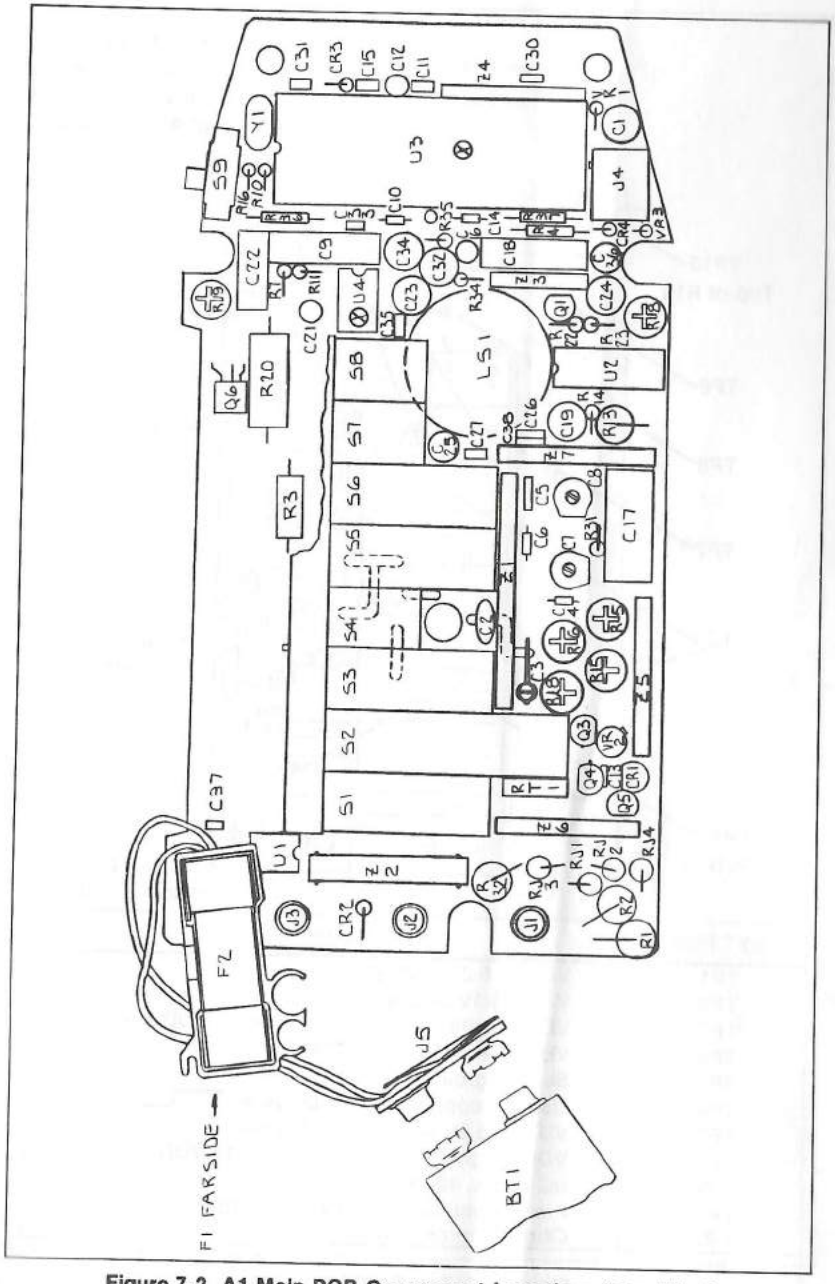
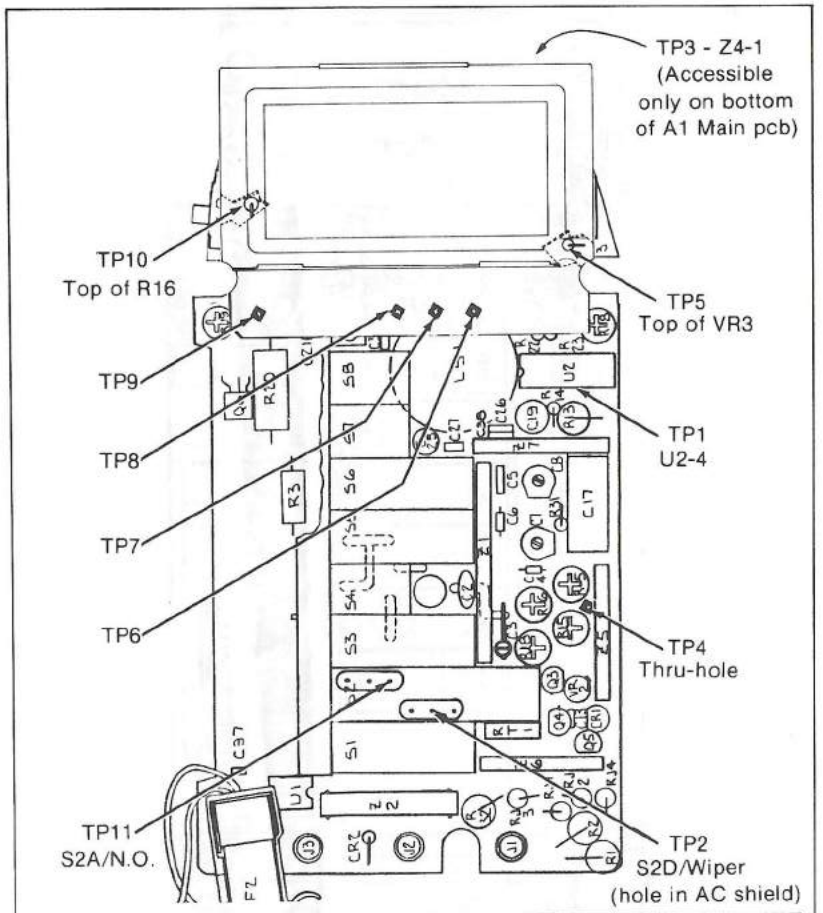
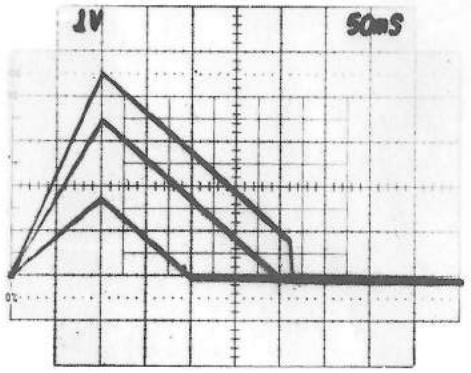


Figure 7-2. A1 Main PCB Component Locations (Top View)



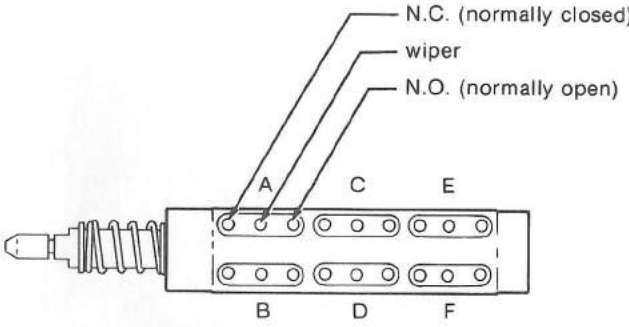
TEST POINT	DESCRIPTION
TP1	VDD, +5.2V supply.
TP2	VSS, -5.1V supply.
TP3	VDG, digital supply, +3.15V ref. to VDD (TP7)
TP4	VBG, bandgap ref., 1.2345V
TP5	Supply ground.
TP6	U5/57, scope trigger, A/D cycle
TP7	VDD, +5.2V supply (on uC pcb)
TP8	VDG, digital supply, +3.15V ref. to VDD (TP7)
TP9	uC clock, 40 kHz nominal
TP10	Freq./Continuity comparator output
TP11	Ohms Source Output

Figure 7-3. Test Point Locations



The photograph shows the a/d measurement cycle for three readings: half-scale, full-scale, and overrange (refer to Figure 4-3 and Section 4 for theory of operation). The three overlaid traces shown were made on a storage oscilloscope connected to U3-17 and triggered by TP6.

Figure 7-4. A/D Measurement Cycle



All switches are shown on the schematic in the "out" position.

Figure 7-5. Switch Detail

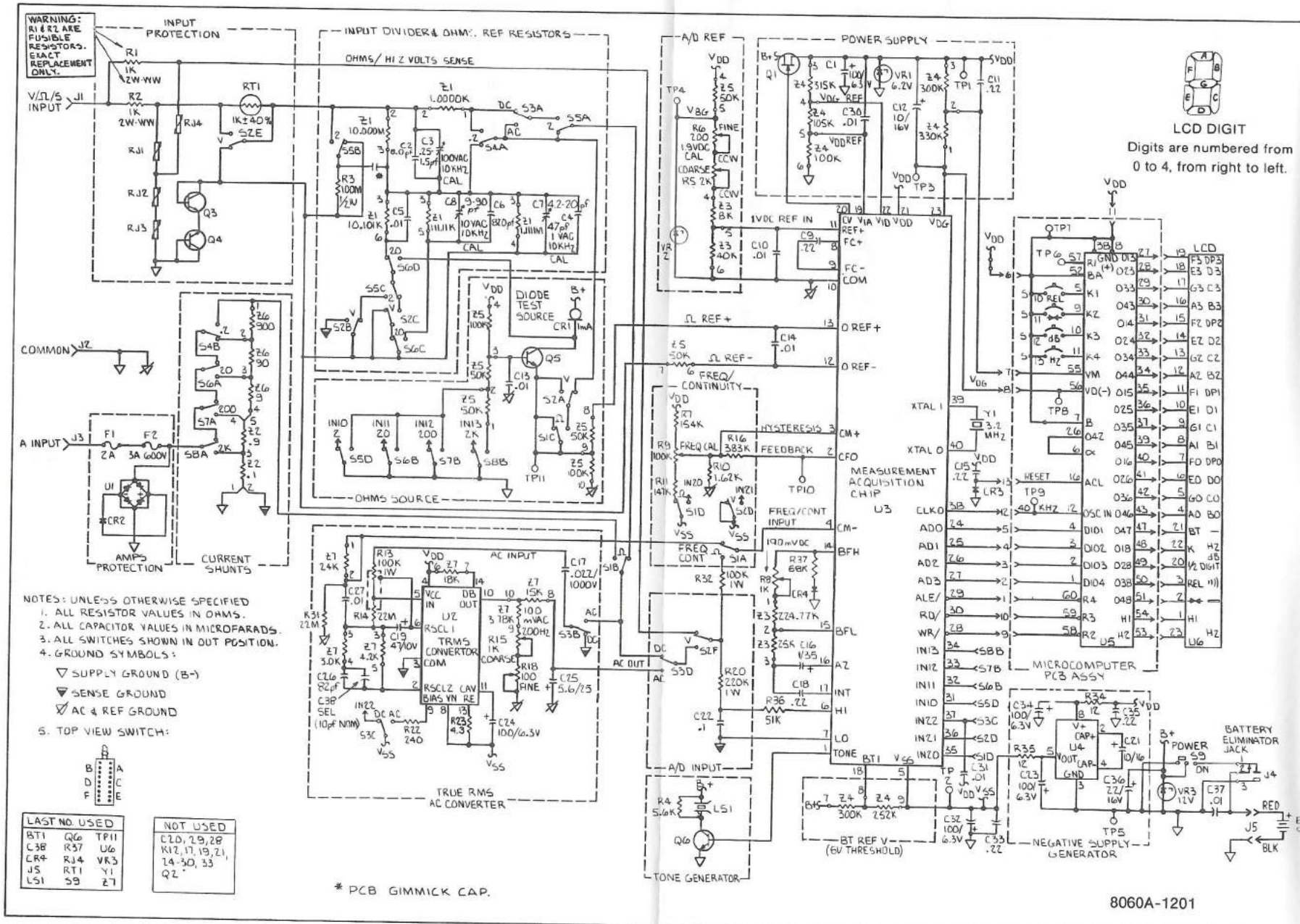


Figure 7-6. 8060A Schematic Diagram

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