

**27**  
Multimeter

**Service Manual**

For IEC 61010 CAT III Meters Only

PN 690206

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# **Chapter 1**

## ***Introduction and Specifications***

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## 1-1. Using the Meter Safely

Use the meter as described in this manual. Otherwise the safety features provided by the meter might be impaired. A **Warning** identifies conditions and actions that pose hazards to the user; a **Caution** identifies conditions and actions that might damage the meter.

Read First: Safety Information.

### Read First: Safety Information

This meter complies with EN 61010-1:1993, ANSI/ISA S82.01-1994 and CAN/CSA C22.2 No. 1010.1-92 Overvoltage Category III. Use the meter only as specified in the Users Manual, otherwise the protection provided by the meter may be impaired.

#### Warning

To avoid possible electric shock or personal injury:

- Do not use the meter if it is damaged. Before use, inspect the case for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Inspect the test leads for damaged insulation or exposed metal. Check test lead continuity. Replace damaged leads.
- Do not use the meter if it operates abnormally. Protection may be impaired. When in doubt, have the meter serviced.
- Do not operate the meter around explosive gas, vapor or dust.
- Do not apply more than the rated voltage, as marked on the meter, between terminals or between any terminal and earth ground.
- Before each use, verify the meter's operation by measuring a known voltage.
- When servicing the meter, use only specified replacement parts.
- Use caution when working above 30 V ac rms, 42 V ac peak, or 60 V dc. Such voltages pose a shock hazard.
- Keep your fingers behind the finger guards on the probe when making measurements.
- Connect the common test lead before connecting the live test lead. Disconnect the live test lead first.
- Remove test leads from the meter before opening the battery door.
- Make sure the battery door is closed and latched before operating the meter.
- Use only a single 9 V battery, properly installed in the meter case, to power the meter.
- Follow all equipment safety procedures.

- **Before measuring current, check the meter's fuses (see "How to Test the Fuse").**
- **Never touch the probe to a voltage source when the test leads are plugged into the 10 A or 40 mA input jacks.**
- **To avoid false readings, which could lead to possible electric shock or personal injury, replace the meter's battery as soon as the low battery indicator ( $\text{[L-BATT]}$ ) appears.**
- **Avoid working alone.**

### **Caution**

**To avoid possible damage to the meter or to equipment under test:**

- **Disconnect the power to the circuit under test and discharge all high voltage capacitors before testing resistance, continuity or diodes.**
- **Use the proper function and range for your measurement applications.**
- **When measuring current, turn off circuit power before connecting the meter in the circuit. Remember to place the meter in series with the current.**

This manual presents service information for the Fluke 27 Multimeters. Included are a theory of operation, general maintenance procedures, performance tests, calibration procedures, troubleshooting information, a list of replaceable parts, and a schematic diagram.

## **1-2. Operating Instructions**

For operating instructions, refer to the Users Manual provided with the instrument at time of purchase.

### 1-3. Specifications

Instrument specifications are presented in Table 1-1.

**Table 1-1. Specifications**

Function	Range	Resolution	Accuracy		
$\overline{V}$	3.200 V	0.001 V	$\pm(0.1\%+1)$		
	32.00 V	0.01 V	$\pm(0.1\%+1)$		
	320.0 V	0.1 V	$\pm(0.1\%+1)$		
	1000 V	1 V	$\pm(0.1\%+1)$		
$\overline{mV}$	320.0 mV	0.1 mV	$\pm(0.1\%+1)$		
$\Omega$ (nS)	320.00 $\Omega$	0.1 $\Omega$	$\pm(0.3\%+3)^*$		
	3.200 k $\Omega$	0.001 k $\Omega$	$\pm(0.2\%+1)$		
	32.00 k $\Omega$	0.01 k $\Omega$	$\pm(0.2\%+1)$		
	320.0 k $\Omega$	0.1 k $\Omega$	$\pm(0.2\%+1)$		
	3.200 M $\Omega$	0.001 M $\Omega$	$\pm(0.2\%+1)$		
	32.00 M $\Omega$ 32.00 nS	0.01 M $\Omega$ 0.01 nS	$\pm(1\%+1)$ $\pm(0.2\%+10)$		
$\overline{I}$	2.080 V	0.001 V	$\pm(1\%+1)$ typical		
$\tilde{V}$	3.200 V 32.00 V 320.0 V 1000 V	0.001 V 0.01 V 0.1 V 1 V	40 Hz-2 kHz	2 kHz -10 kHz	10 kHz -30 kHz
			$\pm(0.5\%+3)$	$\pm(2\%+3)$	$\pm(4\%+ 10)$
			$\pm(0.5\%+3)$	$\pm(2\%+3)$	$\pm(4\%+ 10)$
			$\pm(0.5\%+3)$	$\pm(2\%+3)$	$\pm(4\%+ 10)$
			$\pm(1\%+3)$	$\pm(3\%+3)$	Not Specified
$\tilde{mV}$	320.0 mV	0.1 mV	$\pm(0.5\% +3)$	$\pm(2\%+3)$	$\pm(4\%+10)$

\* When using the REL  $\Delta$  function to compensate for offsets.

Function	Range	Resolution	Accuracy	Typical Burden Voltage
$\overline{mA/A}$	32.00 mA	0.01 mA	$\pm(0.75\%+2)$	5.6 mV/mA
	320.0 mA	0.1 mA	$\pm(0.75\%+2)$	5.6 mV/mA
	10.00 A	0.01 A	$\pm(0.75\%+2)$	50 mV/A
$\overline{\mu A}$	320.0 $\mu A$	0.1 $\mu A$	$\pm(0.75\%+2)$	0.5 mV/ $\mu A$
	3200 $\mu A$	1 $\mu A$	$\pm(0.75\%+2)$	0.5 mV/ $\mu A$
$\sim mA/A$ 40-1000 Hz	32.00 mA	0.01 mA	$\pm(1.5\%+2)$	5.6 mV/mA
	320.0 mA	0.1 mA	$\pm(1.5\%+2)$	5.6 mV/mA
	10.00 A	0.01 A	$\pm(1.5\%+2)$	50 mV/A
$\sim \mu A$ 40-1000 Hz	320.0 $\mu A$	0.1 $\mu A$	$\pm(1.5\%+2)$	0.5 mV/ $\mu A$
	3200 $\mu A$	1 $\mu A$	$\pm(1.5\%+2)$	0.5 mV/ $\mu A$

Table 1-1. Specifications (cont)

Function	Overload Protection**	Input Impedance (nominal)	Common Mode Rejection Ratio (1 k $\Omega$ unbalance)	Normal Mode Rejection
$\bar{V}$	1000 V rms	10 M $\Omega$ in // with <100pF	>120 dB at dc, 50 Hz, or 60 Hz	>60 dB at 50 Hz or 60 Hz
$\bar{mV}$	1000 V rms	10 M $\Omega$ in // with <100pF	>120 dB at dc, 50 Hz, or 60 Hz	>60 dB at 50 Hz or 60 Hz
$\tilde{V}$	1000 V rms	10 M $\Omega$ in // with <100pF (ac coupled)	>60 dB, dc to 60 Hz	
$\tilde{mV}$	1000 V rms	10 M $\Omega$ in // with <100pF (ac coupled)	>60 dB, dc to 60 Hz	
$\Omega$	1000 V rms	<b>Open Circuit Test Voltage</b>	<b>Full Scale Voltage</b>	
		<2.8 V dc	Up to 3.2 M $\Omega$	32 M $\Omega$ or nS
			<420 mV dc	<1.3 V dc
<p>** 10<sup>7</sup> V Hz Max</p> <p>Basic electrical accuracy is specified from 18°C to 28°C with relative humidity up to 95%, for a period of one year after calibration. All ac conversions are ac coupled, average responding, and calibrated to read the true rms value of a sine wave input. Accuracy is specified as <math>\pm</math>([% of reading] + [number of least significant digits]).</p> <p>Ranging is either automatic or manual in all functions with more than one range. Test resistance below approximately 270 <math>\Omega</math> in the <math>\rightarrow</math> function produces a continuous audible tone.</p>				
<b>Maximum voltage between any terminal and earth ground</b>		1000 V		
<b>Fuse protection mA or <math>\mu</math>A</b>		44/100 A 1000 V Fast 11 A 1000 V Fast		
<b>Digital Display</b>		3200 counts, updates 2/sec		
<b>Analog Display</b>		31 segments, updates 25/sec		
<b>Operating Temperature</b>		-150°C to 55°C, to -40°C for 20 minutes when taken from 20°C		
<b>Storage Temperature</b>		-55°C to 85°C without battery, to 60°C with battery		
<b>Electromagnetic Compatibility</b>		In an RF field of 2 V/m on all ranges and functions (except mVac), total accuracy = specified accuracy + 1.0% or range. For mVac, total accuracy = specified accuracy + 1.5% or range. EN 61326-1:1997.		
<b>Temperature Coefficient</b>		0.1 x (specified accuracy)/°C (18°C or >28°C)		
<b>Relative Humidity</b>		0% to 95% (0°C to 35°C) 0% to 70% (35°C to 55°C)		
<b>Altitude</b>		2000 meters		
<b>Battery Type</b>		9 V, NEDA 1604 or 6F22 or 006P		
<b>Battery Life</b>		1000 hrs typical		
<b>Shock, Vibration and Water Resistance</b>		Per MIL-T-28800 for a Style A, Class 2 Instrument		
<b>Size (HxWxL)</b>		2.2 in x 3.75 in x 8 in (5.6 cm x 9.5 cm x 20.3 cm)		
<b>Weight</b>		1.6 pounds (0.75 kg)		
<b>Safety</b>		Complies with ANSI/ISA S82.01-1994, CAN/CSA 22.2 NO. 1010.1:1992 to 1000 V Overvoltage Category III. UL License pending to UL3111-1. TUV License pending to EN61010-1.		

## **Chapter 2**

# **Theory of Operation**

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## 2-1. Introduction

This chapter describes how the Fluke 27 works. First, a functional description presents an overview of operation. This is followed by a block diagram description, which describes the major circuit functions in more detail. For reference, a detailed schematic diagram is included in Chapter 5.

## 2-2. Functional Description

A block diagram of the Fluke 27 circuitry is shown in Figure 2-1. As this figure shows, the instrument is composed of two major functional sections: the analog section and the digital section. Each section contains one major active component and one or more peripheral circuits. Most analog functions are performed by a custom analog IC (U1) and analog peripherals to U1. Digital functions are performed by a CMOS, 4-bit microcomputer, U2.

The custom analog IC contains the A/D converter, signal conditioning circuits, and the digital control circuitry required for communication with the microcomputer. Although the custom IC is primarily analog, digital circuits provide state machine control for the A/D converter, a read counter for A/D samples, decoding ROMs for analog switch drive, and bus control for communication with the microcomputer.

The microcomputer controls the A/D converter, initiates the range and function switching, formats data for display, and drives the display. The mode push buttons supply input to the microcomputer to initiate various modes. Output from the microcomputer is displayed on the liquid crystal display (LCD).

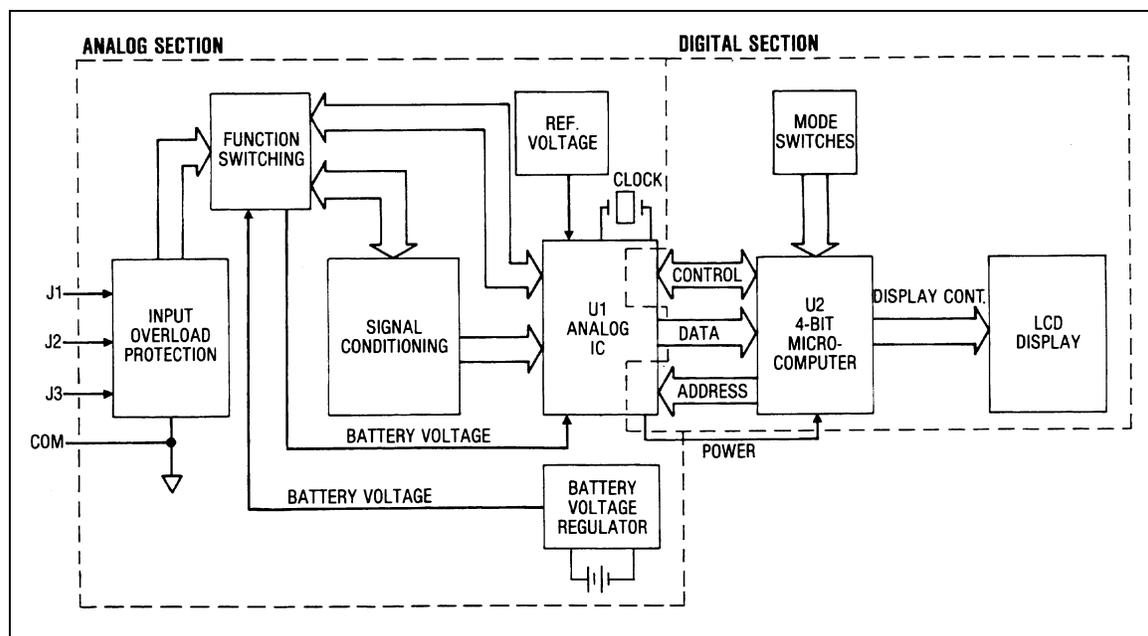


Figure 2-1. Overall Functional Block Diagram

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### **2-3. Block Diagram Description**

Each of the blocks in the Figure 2-1 is discussed in the following paragraphs. In many cases, circuit sections are described in greater detail than is shown in the Figure 2-1; therefore, it may be helpful to refer to the schematic located near the back of this manual.

### **2-4. Input Overload Protection**

Overload protection for the volts/ohms/diode-test input (J1) is provided by a network of five metal-oxide varistors (RV1 through RV5) a current-limiting resistor (R2) and a thermistor (RT1).

A 44/100A, 1000 V fuse provides protection for the mA/ $\mu$ A input (J2) current shunts. An 11 A, 1000 V fuse provides protection for the 10 A input (J3) current shunt. In addition, for the  $\mu$ A and mA ranges, a bridge rectifier (U7) and four diodes (CR1, CR2, CR3, CR4) ensure that the fuses (instead of the shunts) open in very high current overload conditions.

Transistors Q1, Q2, and Q1 provide additional overload protection for the millivolt and ohms functions. If sufficient overload voltage is present, the transistors turn on and connect that input to common through limiting resistors R2 and RT1, thereby protecting the circuitry in U1. A clamp circuit (CR6 and Q15) connected to the volt/ohms/diode-test input through Z1 and C3 provides similar protection for the volts/ohms/diode-test input.

### **2-5. Function Switching Circuits**

Input signals are routed from the overload protection circuits to the function switch. The function switch is a rotary switch with two double-sided wafers which provide the necessary switching to select each of the various functions. In addition, battery voltage is routed through the function switch from the battery voltage regulator to U1, and from U1 to U2.

### **2-6. Signal Conditioning Circuits**

Each input signal is routed through signal conditioning circuitry before reaching U1. Input signals received through the volts/ohms/diode-test input (J1) are routed through Z1, a precision resistor network. The resistor network provides precise input scaling for the various voltage ranges, and it provides precision reference resistors for the ohms function. The capacitors in parallel with the various resistors in Z1 are used in the ac voltage functions; the variable capacitors provide calibration adjustment for the high frequency ac ranges.

Current inputs received through the mA/ $\mu$ A input (J2) and the A input (J3) develop a voltage across shunt resistors R14, R20, and R23 (320  $\mu$ A, 32 mA, and 10 A respectively). Resistors R9 and R10 comprise a 10:1 divider for the 3200- $\mu$ A and 320-mA current ranges.

### **2-7. Custom Analog IC (U1)**

The analog-to-digital converter, autorange switching, and most of the remaining active analog circuitry (including additional signal conditioning) are contained in U1, a custom LSI package. Peripherals to U1 include the system clock, the reference voltage regulator for the A/D converter, and some filtering and amplifier stabilization components. U1 also contains digital circuitry for state machine control over the A/D decoding ROMs for analog switch drive and read counter preset, and registers to store control outputs from the microcomputer.

Analog-to-digital conversion is accomplished within U1 using a modified dual-slope A/D converter circuit, as shown in Figure 2-2. The conversion method in the Fluke 27 can be described as a charge-coupled, multiple-slope technique. A series of 10 minor conversions occur every 40 ms (each at 1/10th the desired resolution) without taking time for an autozero phase between the conversions. These minor conversions (or samples, as they are called in the following discussion) occur at a rate of 25 per second, and are used to provide the fast response bar-graph display and fast autoranging.

New samples are taken every 40 ms. Ten samples are summed to produce a full-resolution digital display, with full scale greater than 3200 counts. A 100 ms autozero phase occurs every 10-sample sequence.

Basic A/D conversion elements and waveforms are illustrated in Figure 2-2. As this figure shows, a residual charge is retained by the integrator capacitor due to the overshoot past the true-zero base line. In the absence of an autozero phase, the residual charge would normally produce a significant error in the sample next taken. However, a digital algorithm eliminates the error and accounts for the residue as it propagates through all 10 samples.

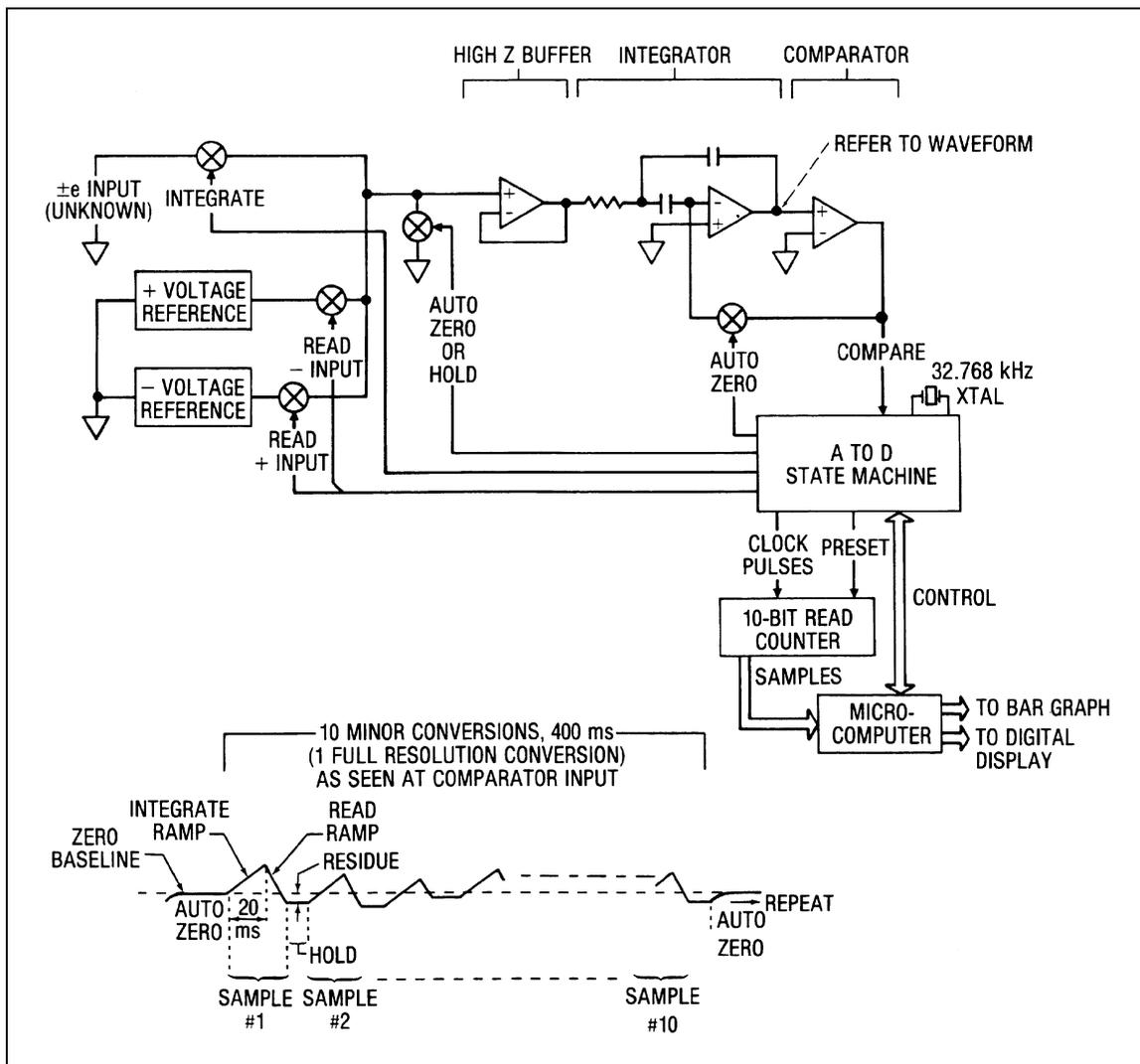


Figure 2-2. A/D Conversion Elements and Waveform

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Digital circuitry in U1 provides state machine control for the A/D converter, a read counter for A/D samples, decoding ROMs for analog switch drive and for read counter preset, and bi-directional bus control for storing control outputs from the microcomputer and for transferring data to the microcomputer.

Basic timing for the A/D converter is defined as a series of 10 integrate/read cycles (samples), followed by a 100 ms autozero phase. However, the diode test and continuity function, the 32 M $\Omega$  range, the battery test, the power-up self test, overload recovery, autoranging, and the Touch-Hold<sup>®</sup> mode all required variations from the basic timing. The state machine, in combination with the ROM and preset read counter, plus an autozero flag under computer control, establishes the timing variances necessary for the various functions.

### **2-8. Peripherals to U1**

Circuitry peripheral to U1 provides regulated battery voltage to power U1, a regulated reference voltage for the A/D converter, a system clock, signal conditioning, and amplifier stabilization. The battery voltage regulator consists of AR1, Q12, and associated components; the regulator circuit supplies consistent operating power to U1 and, through a second regulator circuit in U1, to the microcomputer (U2). Voltage regulator VR1 (and associated components) supplies a regulated 1.000 V reference voltage for the A/D converter. Potentiometer R19 provides for calibration adjustment of the reference voltage.

Additional circuits are necessary for the active filter, integrator, and buffer in U1. The active filter response is determined by R13, R16, C18, and C19. Integrator and buffer signal characteristics are determined by C20, C21, and two resistors in Z1. Several components external to U1 provide for ac-to-dc conversion; they are C41, C42, C43, R35, R7, C16, R30, R31, and R32.

The system clock, with a frequency of 32.768 kHz, controls all timing synchronization for the instrument. Y1 is a quartz crystal which determines the frequency of the clock oscillator circuit.

### **2-9. Microcomputer Control**

A CMOS, 4-bit microcomputer (U2) controls the various instrument functions and drives the LCD display. The microcomputer reads and processes data samples from the A/D converter, sends a code to U1 which represents the operator-selected function, performs the Touch-Hold algorithm, selects the correct A/D mode for the function in used, controls range, sets the autozero flag, and disables the analog filter during autoranging.

In reading and processing A/D samples, the computer accepts raw sample data, applies necessary corrections as described in the preceding discussion of U1, and accumulates 10 samples which then become the full resolution conversion for digital display. Each minor conversion is also processed for the bar-graph display. For the diode test and continuity function, the microcomputer evaluates the data and determines whether or not the beeper should be switched on.

Touch-Hold operation requires the microcomputer to perform a different algorithm. The microcomputer does not allow a full-resolution conversion to be completed unless the input signal is stable. When a stable reading occurs, the conversion is completed and the microcomputer generates the corresponding display and freezes it. The microcomputer then waits for a change in the signal to exceed a certain threshold, and then begins watching for a stable reading again. There are two exceptions to this simple algorithm: First, open test lead indication does not allow a full-resolution conversion to be completed either; the microcomputer continues to wait for a stable signal which is outside the open test lead region. (Open test leads in voltage or current function result in low

readings; open test leads in resistance or diode test functions result in off-scale readings) Second, if the Touch-Hold button is momentarily pressed at any time, then the full-resolution conversion is forced to complete in spite of input or test lead conditions.

The microcomputer also sets the required A/D converter mode. A single mode is used in all voltage and current conversions, but there are three ohms function A/D converter modes, a diode test mode, and two power-up test modes (battery test and self test). The microcomputer sends the proper code to U1 to select the required A/D converter mode. Following each group of 10 samples, in normal operation, the microcomputer sets the autozero flag.

Both manual and autoranging are controlled by the microcomputer. The microcomputer loads a range register in U1 in conjunction with a mode-dependent map. In autorange, the analog filter is disabled to increase the autoranging speed.

Peripheral components Q13 and C12 force the microcomputer to reset when the function switch is moved to OFF. A voltage-divider network (R3, R4, and C13) supplies a mid-level voltage to drive the multiplexed display.

### **2-10. Display**

The liquid crystal display (LCD) operates under direct control of the microcomputer. Characters are generated by the computer and displayed on the LCD. Both digital readings and an analog bar-graph display are presented, in conjunction with annunciators and decimal points. Refer to the Fluke 27 Users Manual for a more detailed description of the display.



# **Chapter 3**

## **Maintenance**

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**⚠ Warning**

To avoid electric shock or personal injury:

- Do not perform any servicing other than operator maintenance unless you are qualified to do so. These service instructions are for used by qualified personnel only.
- Do not allow water to get inside case.
- Remove any input signals prior to removing test leads and opening case.
- When servicing the meter, use only specified replacement parts.
- Make sure the battery door is closed and latched before you operate the meter.
- To prevent arc blast and resulting injury, install only specified replacement fuses with the speed, amperage, interrupt rating and voltage rating listed in Fuse Replacement Maintenance section.

**3-1. Introduction**

This chapter presents instructions for disassembly, performance tests, calibration adjustment, and troubleshooting. The performance tests may be used as an acceptance test when the instrument is first received, and can be used later as a preventive maintenance tool.

A 1-year calibration cycle is recommended to maintain the instrument’s specifications. In addition, the seals should be replaced during servicing to maintain the environmental specifications stated in that manual. A seal kit is available from the factory. The seal kit (Model 8025A-740 1, part number 738112) contains a complete set of seals and four replacement screws and washers for the bottom case.

The test equipment required for the performance tests and calibration adjustments is listed in Table 3-1. Test equipment with equivalent specifications may be used if the recommended models are unavailable.

**Table 3-1. Recommended Test Equipment**

Instrument Type	Required Characteristics	Recommended Model
DMM Calibrator	Voltage Range: 0-1000 V ac, $\pm 0.05\%$ Frequency Range: 40 - 10,000 Hz, $\pm 1\%$ Voltage Range: 0-1000 V dc Accuracy: $\pm 0.05\%$ Current Range: 2 mA - 5 A Accuracy: $\pm 0.2\%$ Values: 100 ohm, 1 kilohm, 10 kilohm, 100 kilohm, 1 megohm, 10 megohm Accuracy $\pm 0.06\%$	Fluke Model 5500A

### 3-2. Service Information

The Fluke 27 has a lifetime warranty upon shipment of the instrument to the original purchaser. Conditions of the warranty are described on the registration card. Malfunctions that occur within the limits the warranty will be corrected at no cost to the purchaser. For in-warranty service, ship the instrument post-paid to the Fluke Service Center nearest you. A list of service centers is included at the back of this manual.

Fluke Service Centers are also available for calibration or repair. Upon request, a cost estimate will be provided before work is performed on instruments.

If reshipment is necessary, please use the original shipping container. If the original container is not available, be sure that adequate protection is provided to prevent damage during shipment. It is recommended that the instrument be surrounded by at least 3 inches of shock absorbing material in the shipping container.

To contact Fluke, call one of the following telephone numbers:

USA and Canada: 1-888-99-FLUKE (1-888-993-5853)

Europe: +31 402-678-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-356-5500

Or, visit Fluke's Web site at [www.fluke.com](http://www.fluke.com).

### 3-3. Operator Maintenance

#### *Note*

*The Fluke 27 Multimeter has been designed to meet the requirements of the United States Department of Labor Mine Safety and Health Administration for use in mines. If your instrument has MSHA approval, a decal stating so will be present on the bottom of your instrument. The following Warning applies only if the decal is present.*

#### **⚠ Warning**

**The Fluke 27 multimeter is approved (permissible) by the United States Department of Labor Mine Safety and Health Administration (MSHA) for use in mines (approval 2G-3665-0). To maintain MSHA permissibility, repairs to these instruments must be made using parts exactly like those furnished by Fluke Corporation. Any changes in the intrinsically safe circuitry or components may result in an unsafe condition.**

**The Fluke 27 multimeter was tested by the MSHA for intrinsic safety in methane air mixtures only. The Fluke 27 multimeter is approved with a 9 V NEDA 1604 (carbon zinc) battery only. Do not use to check electrical blasting circuits. Do not connect to an electrically energized circuit in a hazardous area.**

### 3-4. Battery Replacement

#### ⚠ Warning

To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator (E+) appears.

The Fluke 27 is powered by a single 9 V battery (NEDA 1604, 6F22, or 006P). Referring to Figure 3-1, use the following procedure to replace the battery:

1. Turn the rotary switch to OFF, and remove the test leads.
2. Lift the instrument stand on the back of the instrument, then remove the four #6 X 32, Pozidriv® screws from the battery cover.
3. Pull the battery cover straight out from the back of the instrument. (A coin-slot in the side of the battery cover facilitates removal.)

#### ⚠ Warning

To avoid electrical shock or personal injury, remove the test leads and any input signals before replacing the battery or fuses. Make sure the battery door is closed and latched before you operate the meter.

4. Disconnect and remove the battery.
5. Snap the battery connector to the terminals on the new battery, then slide the battery into the battery compartment.
6. Insert the battery spacer/cover into the instrument, then start the four screws removed in step 2. Press firmly on the battery cover while tightening the screws in a diagonal pattern.

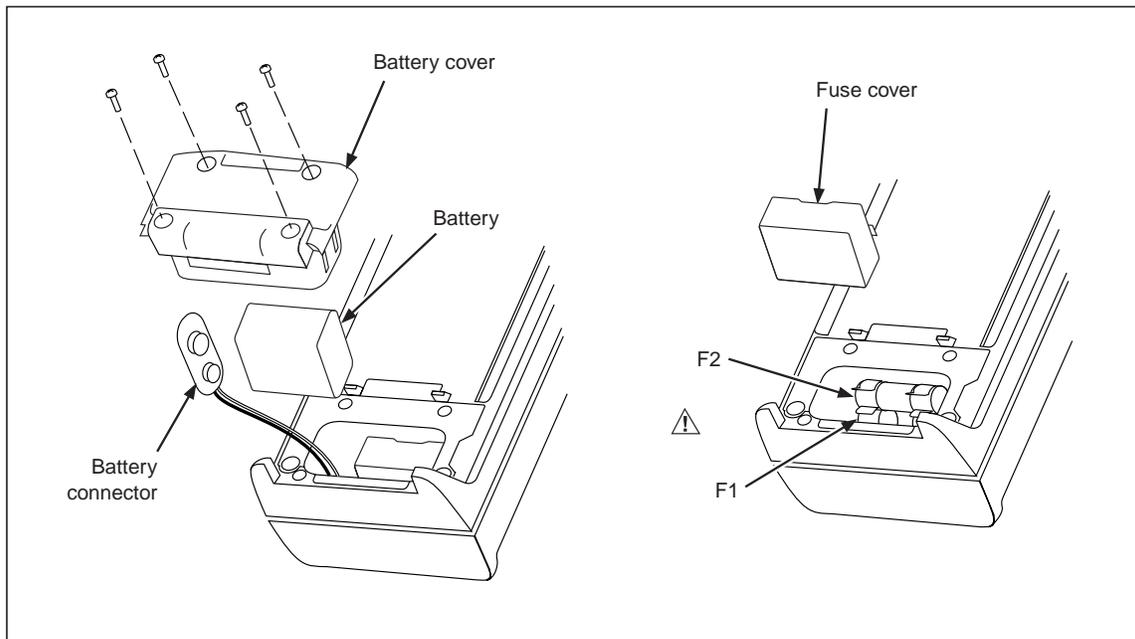


Figure 3-1. Battery and Fuse Replacement

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### 3-5. Fuse Test

#### **⚠ Warning**

**To avoid electrical shock or personal injury, remove the test leads and any input signals before replacing the battery or fuses. Make sure the battery door is closed and latched before you operate the meter.**

**To prevent equipment damage or injury, install ONLY specified replacement fuses with the amperage, voltage, interrupt, and speed ratings listed in the Fuse Replacement Maintenance section.**

1. Turn the function selector switch to the  $\Omega$  position.
2. Connect a test lead from the volts/ohms/diode-test input terminal to the A input terminal.
3. The display should indicate between 0.1  $\Omega$  and 0.3  $\Omega$ . This tests F2 (11 A, 1000 V fast).
4. Move one end of the test lead from the A input terminal to the mA/ $\mu$ A input terminal.
5. The display should indicate between 5.3  $\Omega$  and 6.0  $\Omega$ . This tests F1 (44/100 A, 1000 V).
6. If either of the above display indications is OL (overload), replace the appropriate fuse.

### 3-6. Fuse Replacement

Referring to Figure 3-1, use the following procedure to check or replace the Fluke 27 fuses:

1. Perform steps 1 through 4 of the battery replacement procedure.
2. Pull the fuse cover down, then out of the meter.
3. Remove the defective fuse (or check continuity) through the suspected fuse), and if necessary install a new fuse of the same size and rating.
4. Snap the fuse cover back into place.
5. Reinstall the battery/cover as instructed in step 6 of the battery spacer replacement procedure.

**Table 3-2. Replacement Fuses**

Item	Description	Fluke Part Number	Quantity
F1 $\Delta$	Fuse, F44/100 A, 1000 VAC/DC	943121	1
F2 $\Delta$	Fuse, 11 A, 1000 VAC/DC	943118	1
$\Delta$ To ensure safety, use exact replacement only			

## 3-7. General Maintenance Information

### 3-8. Handling Precautions for Static-Sensitive Devices

#### Caution

This unit contains CMOS components which can be damaged by static discharge. Static-sensitive components include U1 (the custom analog IC), U2 (the microcomputer), and op amp AR1. To prevent static discharge damage, take the following precautions when servicing the instrument.

- Perform all work at a static-free work station.
- Do not handle components or pca (printed circuit assembly) 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.

### 3-9. Disassembly

#### ⚠ Warning

To avoid the possibility of electric shock, remove the test leads prior to disassembly.

#### Caution

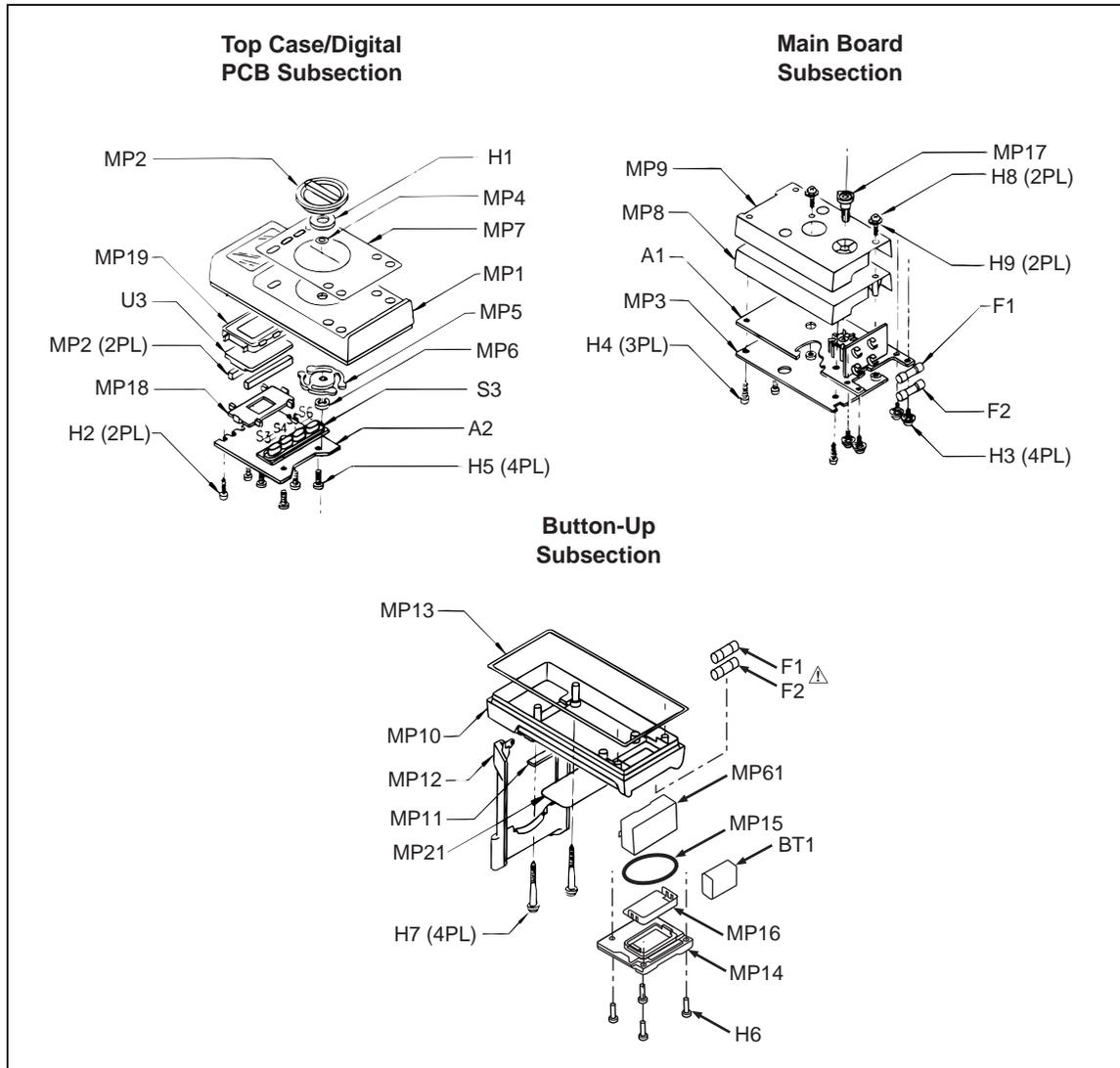
Opening the instrument case in damp, humid environments followed by moving the instrument to a cooler environment could cause condensation inside the case. Instrument performance may be adversely affected by condensation.

#### Caution

To avoid contaminating the pcas with oil from the hands (or O-ring lubricant), handle the pcas by the edges or wear gloves. If a pca does become contaminated, refer to the cleaning instructions given later in this chapter. Do not allow the LCD to come in contact with moisture.

#### *Note*

*Disassembly requires a number 2 Pozidriv<sup>®</sup> screwdriver for all exterior screws and a number 1 Phillips-head screwdriver for all interior screws. Reassembly requires silicone lubricant (Parker Super O-Lube is recommended) and new seals. A Fluke seal kit (Model 8025 A-7401, Fluke Part Number 738112) provides a complete set of seals and four replacement screws and washers for the bottom case. A 2 oz tube of Parker Super O-Lube can be obtained from the Fluke Corporation by ordering p/n 812230.*



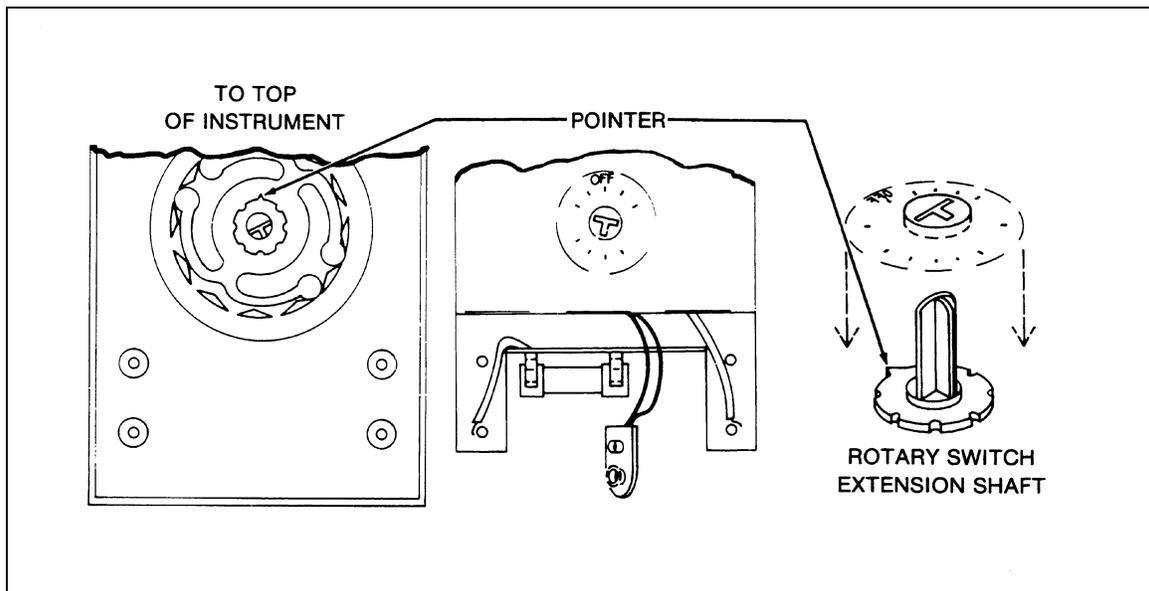
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Figure 3-2. Disassembly

Most maintenance procedures require at least partial instrument disassembly. The following procedure (illustrated in Figure 3-2) provides complete step-by-step disassembly instructions to gain access to any assembly. Complete disassembly is not required to gain access to most assemblies; the following procedure contains notes that explain which maintenance procedures are possible at various levels of disassembly.

1. Turn the function switch to the upper OFF position.
2. Lift the tilt bail up about 1 inch up from the back of the instrument, then gently pull out the ends of the tilt bail and remove it.
3. Remove the four Pozidriv<sup>®</sup> machine screws (H6) that hold the battery cover (MP14) to the bottom case, then lift the battery cover and battery spacer out of the instrument.
4. Disconnect and remove the battery.
5. Unsnap the battery spacer from the battery cover.

6. Remove the old O-ring (MP15). Clean the O-ring surfaces of the battery cover and the instrument case. Install the battery holder on the battery cover, then install the new O-ring.
7. Remove the four Pozidriv® screws (H7) and rubber washers from the bottom case.
8. Lift the bottom case off the instrument, and remove the O-ring (MP13) between the top and bottom cases. (Always install a new O-ring prior to reassembly.)
9. At this point, all calibration adjustments are accessible through the openings in the side of the pca shield. Refer to the calibration adjustment procedure later in this chapter to calibrate the instrument.
10. Remove the four Phillips-head screws (H3) at the bottom of the pca that connect the pca to the input terminals molded into the top case.
11. Carefully lift the upper end of the main pca and shield assembly to disconnect the assembly from the digital pca, then lift the main pca and shield assembly clear of the case.



**Figure 3-3. Switch Extension Shaft Installation**

aac05s.tif

12. Note the position of the rotary switch extension shaft (MP17). With the rotary switch in the OFF position, the single small pointer on the base of the extension shaft is pointed toward the top of the instrument. Refer to Figure 3-3.
13. Lift the rotary switch extension shaft (MP17) off the rotary switch shaft (the shaft on MP2).
14. Remove the E-ring retainer (MP6) and the detent spring (MP5) from the rotary switch shaft.
15. Pull the rotary switch knob (MP2) out from the front of the top case (MP1). Take care not to loose the Teflon bearing washer (H1) under the knob.
16. To replace the O-ring (MP4) on the rotary switch shaft, cut off the existing O-ring without scratching the metal shaft. Clean the shaft thoroughly, and slide a new O-ring over the shaft into the groove on the shaft.

17. Remove the four lower Phillips-head screws (H5) that secure the digital pca to the top case using a diagonal pattern (i.e., remove the upper-right screw, then the lower-left, then the upper-left, and last the lower-right). Then remove the two Phillips-head screws (H2) at the top of the digital pca, above the connector.
18. Carefully lift the digital pca straight up from the top case and remove it.

#### Caution

**Do not touch the elastomeric LCD contact strips (MP20) or contacts of the momentary switch (S3-S6) with bare hands. Wear gloves or remove the contact strips using clean pliers or tweezers. Avoid contaminating the contact strips.**

19. Lift the momentary switch (S3-S6) from the top case. Remove the elastomeric LCD contact strips (MP20) and LCD interconnect support (MP18), located on the back of the LCD.
20. Remove the LCD (U3) and the LCD mask (MP19) from the case.
21. To disassemble the main pca/shield assembly, first remove the two Phillips-head screws (H8) from the top shield (MP9). Take care not to lose the flat washers under the screw heads.
22. Turn the assembly over and remove the three thread-forming, Phillips-head screws (H4) that secure the bottom shield (MP3).
23. Lay the bottom shield aside, and separate the top shield from the pca.
24. At this point, all main pca components are accessible.

### 3-10. Reassembly

#### Note

*Reassembly requires a number 2 Pozidriv® screwdriver for all external screws, a number 1 Phillips-head screwdriver for all internal screws, silicone lubricant (Parker Super-O-Lube is recommended), and new seals. A Fluke seal kit (Model 8025A-7401, Fluke Part Number 738112) provides a complete set of seals and four replacement screw and washers for the bottom case. A 2-oz tub of Parker Super-O-Lube can be obtained from the Fluke Corporation by ordering p/n 812230.*

Reassembling the instrument is primarily a reversal of the disassembly procedure. However, some precautions are necessary to ensure proper sealing and to maintain water-tight integrity. Use the following procedure to reassemble the instrument:

#### Caution

**Do not touch the elastomeric LCD contact strips (MP20) or contacts of the momentary switch (S3-S6) with bare hands. Wear gloves or remove the contact strips using clean pliers or tweezers. Avoid contaminating the contact strips.**

1. Position the LCD mask (MP19) in the top case (MP1), then place the LCD (U3) in the LCD mask with the Fluke part number toward the top of the instrument, pressing the LCD lightly to engage the spring action of the LCD mask. Place the LCD interconnect support (MP18) over the LCD, then place the elastomeric connector strips (MP20) at the top and bottom of the LCD interconnect support with the black connection strip against the LCD.

2. Note the small bump at the center of tone edge of the momentary switch (S3-S6). Place the momentary switch in the case with the bump toward the LCD display.
3. Place the digital pca in the top case with the connector toward the back of the instrument and at the top of the case.
4. Install the four lower Phillips-head screws (H5) that secure the digital pca over the momentary switch. Note that the momentary switch provides a seal between the case and the digital pca. Install the screws using a diagonal sequence (i.e., upper-right, then lower-left, then upper-left, then lower-right).
5. Install the two thread-forming, Phillips-head screws (H2) above the connector that hold the top of the digital pca.
6. Install a new O-ring (MP4) on the rotary switch shaft (if not previously installed), then place the Teflon washer (H1) on the rotary switch shaft, then install the rotary switch knob in the front of the top case.
7. Lubricate the outer edges of the detent spring (MP5) with a very thin layer of silicon lubricant, then install the detent spring over the rotary switch shaft. Detent spring orientation is not critical.
8. Install the E-ring retainer (MP6) on the rotary switch shaft.
9. Rotate the rotary switch to the upper OFF position.
10. Place the rotary switch extension shaft (MP17) on the rotary switch shaft. Note the small pointer on the base of the extension shaft. Place the pointer toward the center of the display while the rotary switch knob is in the upper OFF position.
11. To reassemble the main pca/shield assembly, fit the top shield (MP9) over the component side of the pca, taking care not to bend the connector pins. Make sure the shield posts fit through the holes in the pca, and verify that the rotary switch is in the upper OFF position.
12. Position the bottom shield (MP3) on the back of the pca with the stand-offs fitted through the pca, then position the top shield on the top of the pca with the molded stand-offs fitted through the pca.
13. Install the two Phillips-head machine screws (H8) and flat washers through the top shield into the bottom shield. Install the three thread-forming Phillips-head screws (H4) through the bottom shield into the top shield.
14. Carefully fit the main pca/shield assembly into the top case, taking care to ensure that the connector pins on the main pca are lined up properly with the connector on the digital pca, and the switch shaft extension aligns with the two rotary switch wafers in the OFF position (do not use force). Engage the connector by pressing lightly on the bottom shield at the case screw holes.
15. Install the four Phillips-head machine screws (H3) with lock washers that secure the main pca/shield assembly to the back of the input terminals, again using a diagonal pattern.
16. Install a new O-ring (MP13) on the bottom case (MP10), if it was not replaced during disassembly, and position it at the beginning of the tapered area.
17. Place the bottom case on the top case, then start four new thread-forming screws (H7) with rubber washers. (The new screws and washers are provided in the seal kit.) Press the case halves firmly together, and using a number 2 Pozidriv® screwdriver, tighten the screws in a diagonal pattern (lower-right, upper-left, upper-right, lower left), to ensure a proper seal.

18. If the battery compartment O-ring (MP15) was not replaced during disassembly, it should be replaced before reassembly. Use the procedure given in step 5 of the disassembly procedure.
19. Connect the battery to the battery terminal connector, then slide the battery into the battery compartment.
20. Slide the battery spacer/cover assembly into the back of the instrument.
21. Start the four screws (H6) that secure the battery cover. Press firmly on the battery cover while tightening the screws in a diagonal pattern using a number 2 Pozidriv® screwdriver.
22. Move the rotary switch knob from OFF to any function. All segments of the LCD should illuminate briefly if the instrument has been properly assembled.

### 3-11. *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 LCD to come in contact with moisture.**

Clean the exterior plastic parts using a mild solution of detergent and water on a soft cloth. Clean dust from the pcas using clean, dry air at low pressure (less than 20 psi). Clean contaminants from the pcas using isopropyl alcohol and a soft brush, followed by demineralized water and a soft brush (remove the LCD before washing). Dry the pca at 50 to 60 degrees Celsius for 24 hours after washing (and before reassembly ) to assure that no moisture is sealed in the instrument.

### 3-12. *Performance Tests*

The following procedures allow you to check the performance of the Fluke 27 against the specifications given in the Fluke 27 Users Manual. The procedures are recommended for incoming inspections, periodic calibration verification, and as an aid in troubleshooting. If the instrument fails any test, calibration adjustment or repair is needed.

Prior to performing any of the sting procedures, allow the instrument to stabilize to room temperature (18 to 28 degrees Celsius). Also, check the fuses and if the battery annunciator is displayed, change the battery.

#### *Note*

*In the following procedures, the Fluke 27 is referred to as the unit under test, or UUT.*

### 3-13. *Display Test*

When the function switch is moved from the OFF position to any other position, the instrument performs a power-up self test. All LCD segments in the display are switched on while the test is in progress, then the instrument commences normal operation. This automatic self test verifies that the instrument is functional and that all LCD segments are functioning.

### 3-14. Voltage Functions Performance Verification

The following procedure may be used to verify proper operation and calibration of the ac and dc voltage measurement functions. Required test equipment is listed in Table 3-1.

#### **Caution**

#### **Connect the common terminal of the Digital Multimeter Calibrator to the COM terminal on the UUT.**

1. Verify that both the Digital Multimeter Calibrator (hereafter referred to as the DMM Calibrator) and the UUT are off.
2. Connect the UUT, using the volts/ohms/diode-test input terminal, to the ac output connections of the DMM Calibrator.
3. Turn the function switch on the UUT to the ac voltage position ( $\tilde{V}$ ).
4. Switch on power to the DMM Calibrator, and program it for an output of 2.7 V ac, at 100 Hz.
5. Verify that the UUT indicates between 2.684 and 2.716 V ac.
6. Program the DMM Calibrator for an output of 27 V ac, at 10 kHz.
7. Verify that the UUT indicates between 26.43 and 27.57 V ac.
8. Program the DMM Calibrator output for 250 V ac, at 10 kHz.
9. Verify that the UUT indicates between 244.7 and 255.3 V ac.
10. Program the DMM Calibrator for an output of 1000 V ac, at 10 kHz.
11. Verify that the UUT indicates between 967 and 1033 V ac.
12. Program the DMM Calibrator for an output of zero volts.
13. Turn the UUT function switch to the dc voltage position ( $\bar{V}$ ).
14. Program the DMM Calibrator output for 2.7 V dc.
15. Verify that the UUT indicates between 2.696 and 2.704 V dc.
16. Program the DMM Calibrator for an output of 27 V dc.
17. Verify that the UUT indicates between 26.96 and 27.04 V dc.
18. Program the DMM Calibrator output to 250 V dc.
19. Verify that the UUT indicates between 249.6 and 250.4 V dc.
20. Program the DMM Calibrator for an output of 1000 V dc.
21. Verify that the UUT indicates between 998 and 1002 V dc.
22. Switch off the DMM Calibrator. Disconnect the Calibrator from the UUT.

### 3-15. AC and DC Current Performance Verification

The following procedure may be used to test the ac and dc current functions, and to verify current measurement accuracy.

1. Turn the UUT function switch to the ac mA/A position ( $m\tilde{A}/A$ ).
2. Connect the DMM Calibrator output to the UUT mA/ $\mu$ A input terminal.
3. Switch on power to the DMM Calibrator and program the DMM Calibrator output for 27 mA at 50 Hz.
4. Verify that the UUT indicates between 26.58 and 27.42 mA.
5. Program the DMM Calibrator output for 200 mA at 50 Hz.

6. Verify that the UUT indicates between 196.8 and 203.2 mA.
7. Program the DMM Calibrator output for zero amps.
8. Switch the UUT to the ac  $\mu\tilde{A}$  function ( $\mu\tilde{A}$ ), then program the DMM Calibrator output for 2000  $\mu\tilde{A}$  at 500 Hz.
9. Verify that the UUT indicates between 1968 and 2032  $\mu A$ .
10. Program the DMM Calibrator to standby.
11. Connect the DMM Calibrator output to the UUT amp (A) and common (COM) input terminals.
12. Switch the UUT to the AC mA/A function, then program the DMM Calibrator output for 5 A at 1 kHz.
13. Verify that the UUT indicates between 4.91 and 5.09 A. Program the DMM Calibrator to standby.
14. Set the UUT to the dc  $m\bar{A}/A$  function( $m\bar{A}/A$ ).
15. Program the DMM Calibrator output for an output of 5.0 A dc.
16. Verify that the UUT indicates between 4.94 and 5.06 A.
17. Program the DMM Calibrator to standby.
18. Turn the function switch on the UUT to the dc  $m\bar{A}/A$  position ( $m\bar{A}/A$ ).
19. Connect the DMM Calibrator output to the UUT mA/ $\mu A$  input terminal, then program the DMM Calibrator for an output of 27 mA dc.
20. Verify that the UUT indicates between 26.78 and 27.22 mA.
21. Program the DMM Calibrator output for 2700  $\mu\bar{A}$  dc. Set the UUT to the dc  $\mu\bar{A}$  function ( $\mu\bar{A}$ ).
22. Program the DMM Calibrator for 2.7 mA.
23. Verify that the UUT indicates between 2678 and 2722  $\mu A$ .

### **3-16. Ohms Function Performance Verification**

The following test may be used to verify correct ohms function operation and to verify UUT accuracy in the various ohms ranges.

1. Connect the DMM Calibrator to the UUT using the volts/ohms/diode-test input terminal and common.
2. Turn the function switch to the  $\Omega$  position.
3. Switch on power to the DMM Calibrator. Program the DMM Calibrator to the resistance values indicated in Table 3-2, and verify that the UUT indication is within the tolerances given for each input value.

**Table 3-3. Ohm Function Performance Test**

Step	Resistance	Indication
1	100 Ω	99.5 to 100.5
2	1.000 kΩ	.997 to 1.003 k
3	10.00 kΩ	9.97 to 10.03 k
4	100.0 kΩ	99.7 to 100.3 k
5	1 MΩ	.997 to 1.003 M
6	10 MΩ	9.89 to 10.11 M
*7	open circuit	-00.10 to .0010 nS

\*Note: Conductance (nS) range must be entered using manual range selection.

**3-17. Diode Test Performance Verification**

The following procedure may be used to verify proper operation of the diode test function. (This test can not be performed unless the source can sink 0.6 mA at 0.9 V.)

1. Turn the UUT function selection switch to the diode test function.
2. The UUT should display OL.
3. Connect the DMM Calibrator to the UUT volt/ ohms/ diode-test input terminal and common, and switch on Calibrator power.
4. Program the DMM Calibrator output for 1.00 V, then push the Range Lock button on the Calibrator to place the Calibrator in the 3.3V range.
5. Program the DMM Calibrator output for 0.090 V and verify that the UUT indicates approximately 0.090 V and the beeper is sounding continuous tone.
6. Increase the DMM Calibrator output to 0.11 V. The beeper should turn off.
7. Increase the Calibrator output to 1.0V, then slowly decrease the Calibrator output to 0.6 V. Note that the UUT beeper produces a short beep as the voltage descends through 0.7 V (typical silicon diode threshold).
8. Push the DMM Calibrator Range Lock button to return to Autorange operation.

**3-18. Calibration Adjustment**

Under normal operating conditions, the Fluke 27 should maintain its specifications for a period of one year after calibration. If the instrument has been repaired, or if it has failed any of the performance tests, the following calibration adjustment procedures must be performed. Use a non-conductive tool for adjustments.

*Note*

*In the following procedures, the Fluke 27 is referred to as the unit under test, or UUT.*

**3-19. Calibration Preparation**

Allow the UUT to stabilize at an ambient temperature of 21 to 25 degrees Celsius (70 to 77 degrees Fahrenheit) and at a relative humidity of less than 80% with the power off for at least 30 minutes before beginning calibration. Calibration adjustments require removal of the bottom cover. Complete steps 1 through 7 of the disassembly procedure given earlier in this chapter, and then reconnect the battery to the UUT's battery connector.

### 3-20. DC Voltage Connection

The dc voltage function must be calibrated before calibrating the other functions. Use the following procedure to calibrate the dc voltage function.

1. Connect the DMM Calibrator to the UUT volts/ohms/diode-test input terminal and common. Refer to Figure 3-4 for calibration component locations.
2. Select the dc voltage function ( $\bar{V}$ ) on the UUT.
3. Switch on power to the DMM Calibrator, and program the Calibrator output for 2.700 V dc.
4. Adjust potentiometer R19 on the UUT for a display indication of 2.700 V on the 3 V range.
5. Program the DMM Calibrator for zero output, and disconnect the Calibrator from the UUT.

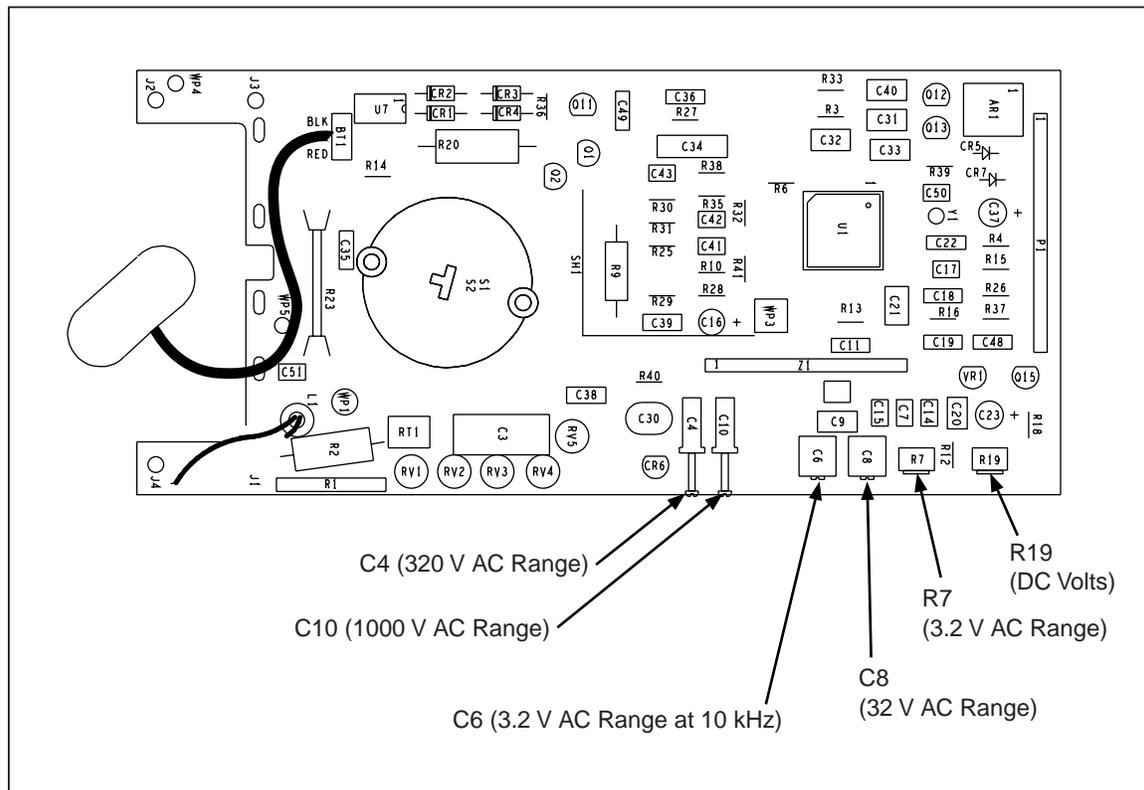


Figure 3-3. Calibration Adjustment Locations

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### 3-21. AC Voltage Calibration

There is a single ac-to-dc converter adjustment for basic ac voltage accuracy. However, each ac voltage range must be calibrated independently for high frequency accuracy. Variable capacitors provide these high frequency adjustments. There should be no interaction between the various ranges when adjustments are made in the specified order. Use the following procedure to calibrate the ac voltage ranges.

**⚠ Warning**

**The following procedure requires that high voltages be supplied to the UUT for calibration. Read the safety precautions in the Fluke 27 Users Manual before performing the following procedure.**

1. Select the ac voltage function ( $\widehat{V}$ ) on the UUT.
2. Connect the DMM Calibrator to the volts/ohms/diode-test input terminal on the UUT.
3. Program the DMM Calibrator output for 2.7 V ac at 100 Hz.
4. Adjust R7 to obtain a display of 2.700 V ac  $\pm 0.001$  V ac.
5. Program the DMM Calibrator output for 270 V ac at 10 kHz.
6. Adjust C4 to obtain a display of 270.0V ac  $\pm 0.1$  V ac.
7. Program the DMM Calibrator output for 1000 V ac at 10 kHz.
8. Adjust C10 to obtain a display of 1000 V ac  $\pm 1$  V ac.
9. Program the DMM Calibrator output for 27.00 V ac at 10 kHz.
10. Adjust C8 to obtain a display of 27.00 V  $\pm 0.01$  V ac.
11. Program the DMM Calibrator output for 2.700 V ac at 10 kHz.
12. Adjust C6 to obtain a display of 2.700 V ac  $\pm 0.001$  V ac.
13. Program the DMM Calibrator output for 2.700 ac at 100 Hz.
14. Verify that the UUT display indicates 2.700 V ac  $\pm 0.017$  V ac.
15. Switch off both the DMM Calibrator and the UUT. Disconnect the DMM Calibrator from the UUT.
16. Refer to the instructions in paragraph 30-10 to reassemble the UUT after calibration.

## **3-22. Troubleshooting**

**Caution**

**Static discharge can damage CMOS components U1 and U2. Follow the handling precautions for static sensitive components given previously. Never remove or install components without first disconnecting all inputs to the instrument and turning the function selector switch to OFF.**

Refer to Table 3-4 and to the schematics in Chapter 5 of this manual as necessary during the following troubleshooting procedures.

### **3-23. Power-Up Self Test**

When the function switch is moved to any position from the OFF position, the instrument performs a power-on self test. All LCD segments are switched on while the test is being performed (about 1 second), then the unit commences normal operation.

### **3-24. Overall System Check**

If the LCD display segments do not light, or if other malfunction indications occur during power-up or operation, perform the following overall system check.. All measurements are taken with respect to common. The overall system check is helpful in isolating a

malfunction to the component area, and Table 3-4 provides further fault isolation within the component area. Refer to the disassembly and reassembly procedures as necessary (paragraphs 3-9 and 3-10).

1. Set up the instrument as follows:
  - a. Perform steps 1 through 10 of the disassembly procedure to remove the battery cover, bottom case, and main pca/shield assembly from the instrument.
  - b. Perform steps 21 through 23 of the disassembly procedure to remove the top and bottom shields from the main pca.
  - c. Perform step 14 of the reassembly procedure to install the main pca in the top case.
  - d. Perform step 15 of the reassembly procedure to secure the main pca to the input terminals.
2. Select the dc voltage function ( $\overline{V}$ ).
3. Use a Digital Voltmeter (DVM) to check the battery voltage at the battery connector (battery voltage must be above 6.3 V). If battery voltage is less than 7.5 V, battery replacement is advised. Normal current drain is less than 600  $\mu$ A.
4. Connect either an oscilloscope or frequency counter, using a low-capacitance probe, to pin 54 of U1 or to the junction of C17 and Y1 (the crystal). A 32.768 kHz sine wave with an amplitude of approximately 600 mV peak-to-peak should be present at the junction of C17 and Y1 (3 V peak-to-peak at U1 pin 54). Note that U2 and the display will not operate if the clock signal is not present. If the clock signal is not present, the most likely causes are U1, Y1 or C17.
5. Use a DVM to check for a reference voltage of 1.00V dc (adjustable through R19) at pin 13 of U1 or at the junction of R15 and R18. If the reference voltage is not present, the most likely causes are VR1, R12, R15, R18, R19, R37, or U1.
6. Use a DVM to check for Vm (voltage middle) at pin 55 of U2, pin 16 of J8, or at the junction of R3 and R4. Vm should be 1.6 V dc  $\pm$ 0.1 V. If Vm is not present, the most likely causes are R3, R4, or C13.

### 3-25. DC Voltage Signal Tracing

The following procedure is a step-by-step method of tracing a dc voltage input through the instrument's circuits to the output of the active filter. Faulty components in the input signal path can be identified using this procedure. All measurements are taken with respect to common.

1. Select the dc voltage function ( $\overline{V}$ ), then apply a 2 V dc input through the volts/ohms/diode-test input terminal.
2. Using a DVM, measure the 2 V input at the input terminal (J1).
3. Check pin 1 of the input divider (Z1) for 2 V dc. If 2 V dc is not present, R2, S1, RV1, RV2, RV3, RV4, or RV5 may be defective.
4. Check pin 3 of Z1 for approximately 200 mV dc. If 200 mV is not present, either Z1 or U1 may be defective. (Measurement may be approximately 10% low if a 10 M $\Omega$  input impedance DVM is being used for signal tracing.)
5. Check the active filter input (pin 28 of U1) for approximately 200 mV dc. If 200 mV is not present, U1 may be defective. (Measurement may be affected by loading.)

6. Check the active filter output (pin 29 of U1) for approximately 200 mV dc. If 200 mV is not present, R13, R16, C18, or C19 may be defective. (Measurement may be affected by loading.)

### 3-26. **Fault Diagnosis Guide**

Table 3-3 presents a fault diagnosis guide for the Fluke 27. The left column lists various malfunction symptoms. The center column recommends actions to determine the exact problem. The right column lists the components most likely to be defective.

**Table 3-4. Fault Diagnosis Guide**

Symptom	Recommended Action	Possible Component
Blank display	Do system check given in paragraph 3-24.	BT1, U1,U2,Y1,C13
Display reads zero in volt dc	Do do signal tracing in paragraph 3-25.	RT1,Z1,U1,S1
Display hangs up in self-test mode	Do system check given in paragraph 3-24.	R15, R18, R19, R12, R37, VR1, Z1, U1, C20, C21
Display reads OL or 0 in 320 mA range		R9, R10, U1
Display reads 0 in 320 mA or 10A ranges		F1, F2, R9, R20, R14
AC volts is inaccurate	Check calibration	R31, R32, R29, R30
320 mV range reads OL		Q11, U1
AC volts measurement noisy at 50-60 Hz		R13, R16, C18,C19
Wrong annunciator displayed		S1R, U1
Volts inaccurate	Check calibration	RV2-RV5
Ohms inaccurate		Z1, U1
Intermittent display	Clean connectors and connector strips on LCD and pca	Display Assembly
Display reads constant offset in volts		C18, C19, C20 shorted
Ohms reads low or will not read OL		Q1,Q2 shorted or leaky
Ohms reads random or alternates between		R2, RT1



**Chapter 4**  
***List of Replaceable Parts***

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## 4-1. Introduction

This chapter contains an illustrated list of replaceable parts for the Fluke 27 Multimeters. Parts are listed by assembly; alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator
- An indication if the part is subject to damage by static.
- Description
- Fluke stock number
- Total quantity
- Any special notes (i.e., factory-selected part)

### Caution

**A \*** symbol indicates a device that may be damaged by static discharge.

## 4-2. How to Obtain Parts

Electrical components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the Fluke Corporation and its authorized representatives by using the part number under the heading FLUKE STOCK NO. In the U.S., order directly from the Fluke Parts Dept. by calling 1-800-526-4731. Parts price information is available from the Fluke Corporation or its representatives. Prices are also available in a Fluke Replacement Parts Catalog which is available on request.

In the event that the part ordered 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 delivery of the correct part, include the following information when you place an order:

- Instrument model and serial number
- Part number and revision level of the pca containing the part.
- Reference designator
- Fluke stock number
- Description (as given under the DESCRIPTION heading)
- Quantity

## 4-3. Manual Status Information

The Manual Status Information table that precedes the parts list defines the assembly revision levels that are documented in the manual. Revision levels are printed on the component side of each pca.

#### 4-4. **Newer Instruments**

Changes and improvements made to the instrument are identified by incrementing the revision letter marked on the affected pca. These changes are documented on a manual supplement which, when applicable, is included with the manual.

#### 4-5. **Service Centers**

To contact Fluke, call one of the following telephone numbers:

USA and Canada: 1-888-99-FLUKE (1-888-993-5853)

Europe: +31 402-678-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-356-5500

Or, visit Fluke's Web site at [www.fluke.com](http://www.fluke.com).

##### *Note*

*The Fluke 27 Multimeter has been designed to meet the requirements of the United States Department of Labor Mine Safety and Health Administration for use in mines. If your instrument has MSHA approval, a decal stating so will be present on the bottom of your instrument. The following Warning applies only if the decal is present:*

##### **⚠ Warning**

**The Fluke 27 multimeters are approved (permissible) by the United States Department of Labor Mine Safety and Health Administration (MSHA) for use in mines (approval 2G-3665-0). To maintain MSHA permissibility, repairs to this instrument must be made using parts exactly like those furnished by the Fluke Corporation. Any changes in the intrinsically safe circuitry or components may result in an unsafe condition. The Fluke 27 multimeter was tested by MSHA for intrinsic safety in methane air mixtures only. The Fluke 27 multimeter is MSHA approved with a 9 V NEDA 1604 (carbonzinc) battery only. Do not use to check electrical blasting circuits. Do not connect to an electrically energized circuit in a hazardous area.**

##### **⚠ Warning**

**When servicing, use only specified parts.**

##### **⚠ Warning**

**To ensure safety, use exact replacement parts where specified.**

## 4-6. Parts Lists

The following tables list the replaceable parts for the 45 Multimeter. Parts are listed by assembly; alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator
- An indication if the part is subject to damage by static discharge
- Description
- Fluke stock number
- Total quantity
- Any special notes (i.e., factory-selected part)

### Caution

**A \* symbol indicates a device that may be damaged by static discharge.**

**Manual Status Information**

Ref or Option Number	Assembly Name	Fluke Part No.	Revision Level
A1	Main PCA	665007	A
A2	Digital PCA	665067	E

Table 4-1. Final Assembly

Reference Designator	Description	Fluke Stock Number	Total Qty
A 1	MAIN PCA	665007	1
A 2	DIGITAL PCA	665067	1
BT 1	BATTERY,9 V,0-15 MA	696534	1
△F 1	FUSE, F44/100A, 1000 VAC/DC	943121	1
△F 2	FUSE, 11 A, 1000 VAC/DC	943118	1
H 1	WASHER,FLAT,TEFLON,0.295 ID,0.020 THK	696591	1
H 2	SCREW,FIH,P,THD FORM,STL,4-20,3.000	682310	2
H 3	SCREW,PH,P,SEMS,STL,4-40,.312	721670	4
H 4	SCREW,PH,P,THD FORM,STL,4-14,.375	448456	3
H 5	SCREW,PH,P,STL,4-40,.250	129890	4
H 6	SCREW,PH,PO,STL,6-32,.375	682070	4
H 7	SCREW,PH,PO,STL,6-20,1.256	733394	4
H 8	SCREW,PH,P,LOCK,STL,4-40,1.000	157008	2
H 9	WASHER,FLAT,STL,.125,.312,.030	739912	2
MP 1	CASE TOP, FLUKE 27 YEL	744508	1
MP 2	KNOB SWITCH, YEL	744466	1
MP 3	BOTTOM SHIELD ASSEMBLY	654079	1
MP 4	O-RING,SYN RUBBER,.114 ID,.070 WIDE	705947	1
MP 5	SPRING,DETENT	654046	1
MP 6	RING,RET,EXT,FLAT,STL,.188 DIA	697078	1
MP 7	DECAL, TOP CASE, FLUKE 27 YEL	744565	1
MP 8	SUPPORT, TOP SHIELD	654038	1
MP 9	SHIELD, TOP	654384	1
MP 10	CASE BOTTOM, YEL	203091	1
NP 11	FOOT, CASE	654335	1
MP 12	BAIL, TILT, YEL	744474	1
MP 13	O-RING,SYN RUBBER,6.710,.080	654392	1
MP 14	COVER,BATTERY, YEL	830166	1
MP 15	O-RING,SYN RUBBER,1.612 ID,.103 WIDE	697185	1
MP 16	RETAINER, BATTERY, YEL	744615	1
MP 17	SHAFT, SWITCH	655894	1
MP 18	SUPPORT, LCD INTERCONNECT	683664	1
MP 19	MASK,LCD, FLUKE 27	661025	1
MP 20	CONN,ELASTOMERIC, LCD TO PWB,1.970 L	682500	2
MP 21	DECAL, MSHA APPROVAL, FLUKE 27	809871	1
MP 23	TEST LEADS	855742	1
MP 24	DECAL YEL, WARNING	744607	1
MP25	ALLIGATOR CLIP BLACK	738047	1
MP26	ALLIGATOR CLIP RED	738120	1
MP 61	COVER, FUSE	665031	1
S3	SWITCH, MOMENTARY	659847	1
TM 1	27 USERS MANUAL	738088	1
TM 2	27 SERVICE MANUAL	690206	1
U 3	LCD,3.75 DIGIT,BAR GRAPH,MULTIPLEXED	654293	1

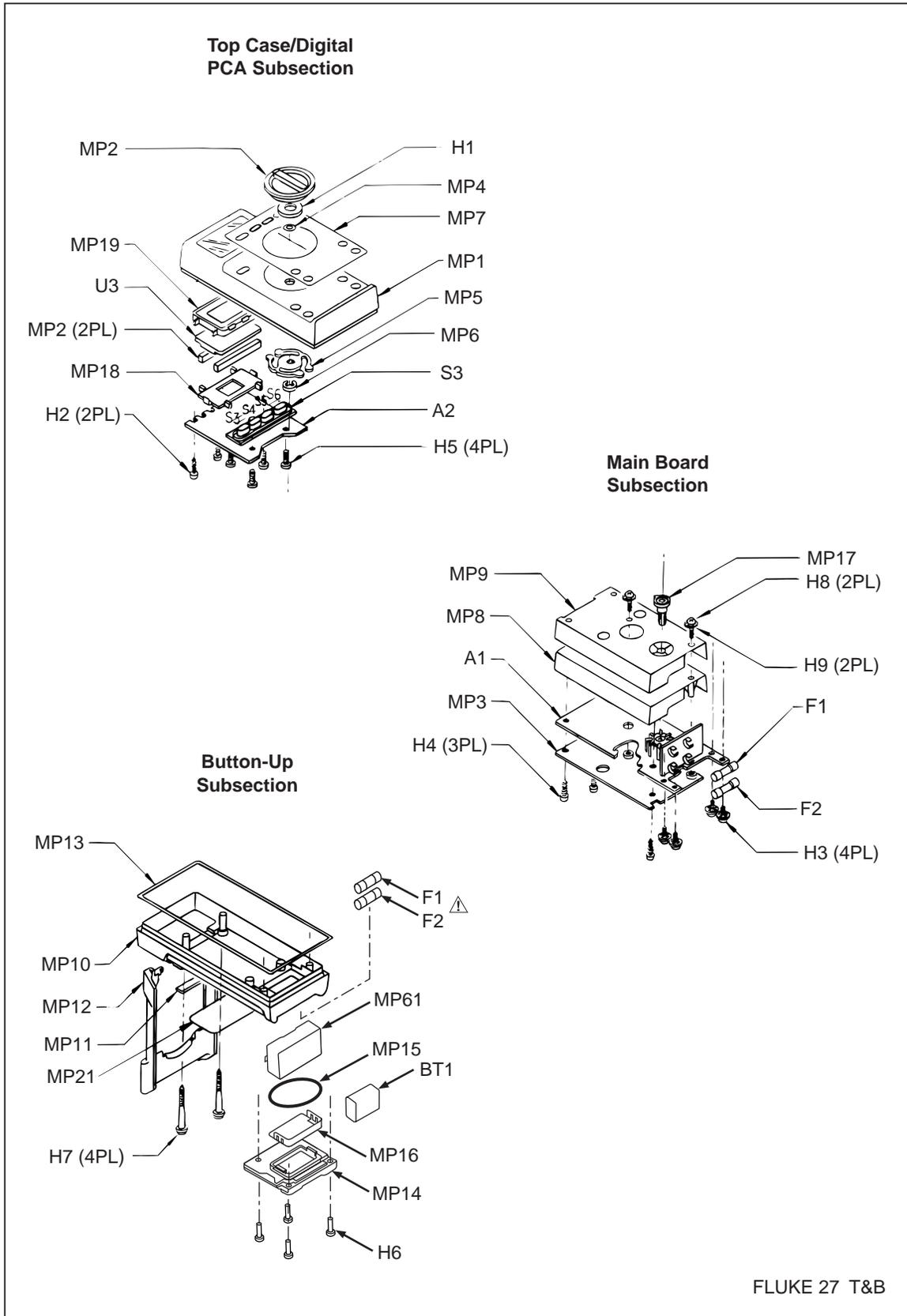


Figure 4-1. Final Assembly

Table 4-2. A1 Main PCA

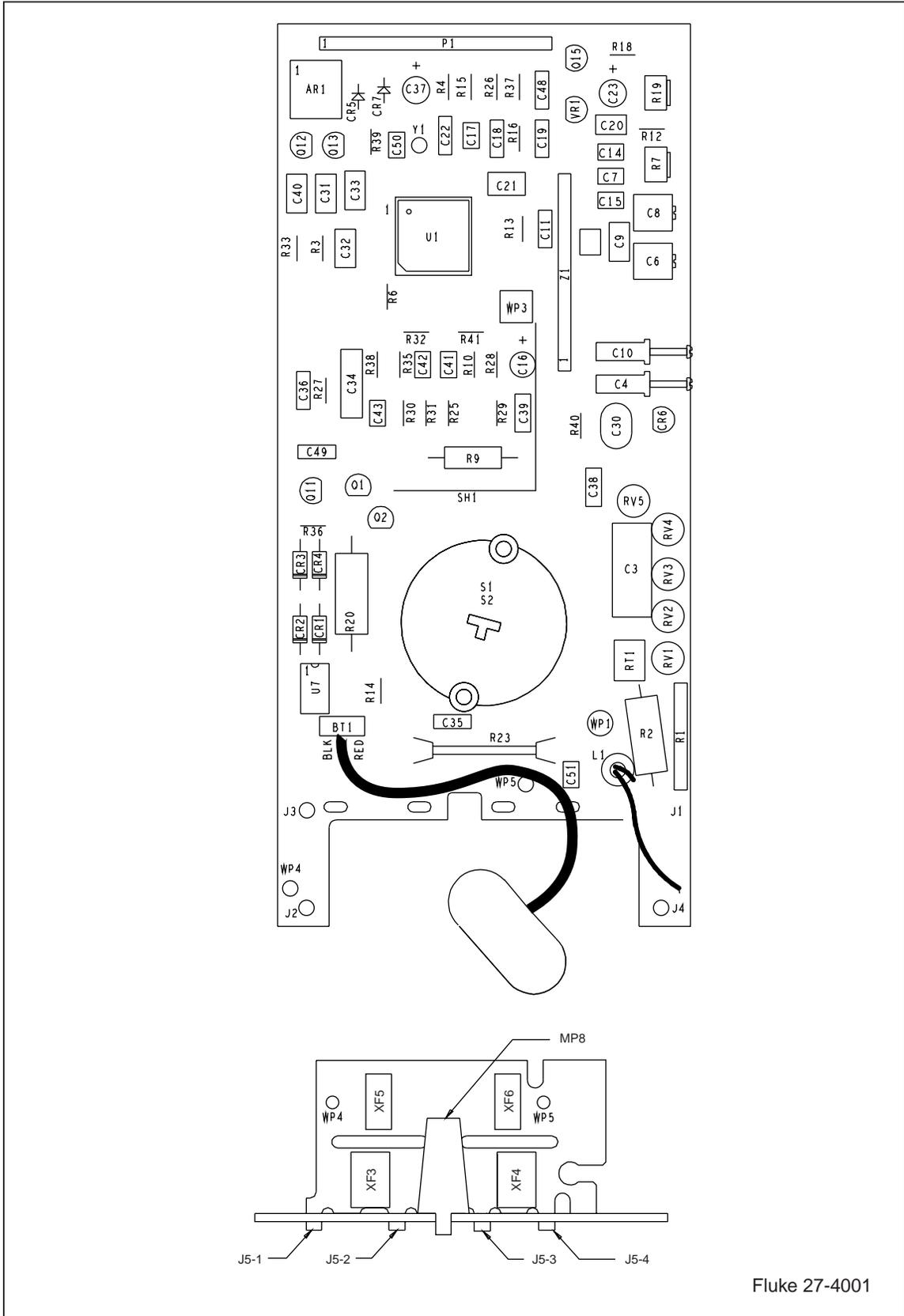
Reference Designator	Description	Fluke Stock Number	Total Qty
A 3	* FUSE PCA	665015	1
AR 1	* IC, OP AMP, LOW POWER	721928	1
C 3	CAP,POLYES,0.022 UF,+/-10%,1000 V	448183	1
C 4, 10	CAP,VAR,0.25-1.5 PF,1700 V,TEFLON	721480	2
C 5	CAP,CER,2.7 PF,+/-0.25 PF,50V,COG	773044	1
C 6	CAP,VAR,2-7 PF,100 V,CER	714600	1
C 7	CAP,CER,430 PF,+/-5%,50 V,COG	732644	1
C 8	CAP,VAR,6-50PF,50 V,CER	714618	1
C 9	CAP,CER,5100 PF,+/-2%,50 V,COG	732651	1
C 11	CAP,POLYCA,0.027 UF,+/-5%,63 V	733444	1
C14	CAP	714550	1
C15	CAP	740654	1
C 16	CAP,TA,IOUF,+/-20%,10 V	714766	1
C 17, 50	CAP,CER,33 PF,+/-5%,50 V,COG	714543	2
C 18, 19	CAP,POLYCA,0.027 UF,+/-10%,63 V	720979	2
C 20	CAP,POLYES,0.47 UF,+/-10%,50 V	697409	1
C 21	CAP,POLYPR,0.033 UF,+/-10%,63 V	721050	1
C 22, 36	CAP,POLYES,0.01 UF,+/-10%,50 V	715037	2
C 23, 37	CAP,TA,22 UF,+/-20%,10 V	658971	2
C 30	CAP,CER,4.0 PF,+/-0.25 PF,1500 V,COJ	714535	1
C 31- 33,40	CAP,CER,0.22 UF,+80-20%,50V,Z5U	733386	4
C 34	CAP,POLYES,1000 PF,+/-20%,630 V	740126	1
C 35	CAP,POLYCA,1000 PF,+/-20%,100 V	721472	1
C 38, 39	CAP,POLYES,O.I UF,+/-10%,50 V	649913	2
C 41, 42	CAP,CER,10 PF,+/-20%,50V,COG	721589	2
C 43	CAP,CER,220 PF,+/-20%,50 V,COG	740654	1
C 48	CAP,POLYCA,0.033 UF,+/-5%,63 V	733451	1
C 49	CAP,CER,0.022 UF,+80-20%,500 V,Z5U	740340	1
C 51	CAP,CER,0.01 UF,+/-10%,100 V,X7R	557587	1
CR 1-5	DIODE,SI,1 K PIV,1.0 AMP	453399	5
CR 6	* DIODE,SI,BV=35 V, LOW LEAKAGE	723817	1
CR 7	* DIODE,SI,BV= 75.0 V,RADIAL INSERTED	659516	1
L 1	RF COIL ASSEMBLY	857792	1
MP 1	SHIELD, FENCE	722280	1
MP 8	SUPPORT,PCA	656108	1
P 1	CONNECTOR,18 PIN	707646	1
Q 1, 2, 11	* TRANSISTOR,SI,NPN,SELECTED IEBO,TO-92	685404	3
Q 12	* TRANSISTOR,SI,N-JFET,TO-92,RAD T&R	721936	1
Q 13	* TRANSISTOR,SI,N-JFET,TO-92	723734	1
Q 15	* TRANSISTOR,SI,PNP,T092	698233	1
R 1	RES,CC,220 K,+/-10%,1 W	714485	1
R 2	RES,MF,1 K,+/-1%,100 PPM,FLMPRF,FUSIBLE	650085	1
R 3	RES,MF,301 K,+/-1%,0.125 W, 100 PPM	655274	1
R 4	RES,MF,332 K,+/-1%,0.125 W,100 PPM	655217	1
R 6, 25, 33, 41	RES,CF,100 K,+/-5%,0.25 W	658963	4
R 7	RES,VAR,CERM,1K,+/-20%,0.3 W	706655	1
R 9	RES,MF,402 K,+/-0.1%,0.125 W,100 PPM	714329	1
R 10	RES,MF,44.8 K,+/-0.1%,0.125 W,100 PPM	714311	1
R 12	RES,MF,14.3 K,+/-1%,0.125 W, 100 PPM	721803	1
R 13	RES,CF,1.5 M,+/-5%,0.25 W	649962	1
R 14	RES,MF,500,+/-0.25%,0.25 W,100 PPM	697557	1
R 15	RES,MF,107 K,+/-1%,0.125 W,50 PPM	714295	1

An \* indicates a static-sensitive part.

Table 4-2. A1 Main PCA (cont)

Reference Designator	Description	Fluke Stock Number	Total Qty
R 16, 28, 29	RES,CF,1 M,+5%,0.25 W	649970	3
R 18	RES,MF,412 K,+1%,0.125 W,50 PPM	714287	1
R 19	RES,VAR,CERM,100 K,+20%,0.3 W	658989	1
R 20	RES,WW,4.995,+-.25%,4 W	658948	1
R 23	RES,WW,.005,+-.5%,.5 W	655423	1
R 26	RES,MF,499 K,+1%,0.125 W,100 PPM	714980	1
R 27	RES,MF,1.5 M,+1%,0.125 W,100 PPM	714998	1
R 30	RES,MF,20 K,+0.25%,0.125 W,50 PPM	715029	1
R 31, 32	RES,MF,22.6 K,+0.25%,0.125 W,50PPM	715011	2
R 35	RES,CF,4.7 K,+5%,0.25 W	721571	1
R 36	RES,CF,47 K,+5%,0.25 W	721787	1
R 37	RES,MF,5.49 K,+1%,0.125 W,100 PPM	721795	1
R 38	RES,CF,1.5,+5%,0.25 W	732800	1
R 39	RES,CF,300 K,+5%,0.25 W	732818	1
R 40	RES,CF,200 K,+5%,0.25 W	681841	1
R 42	RES,CC,15 M,+5%,.125 W	875112	1
RV 1-5	VARISTOR,430 V,+10%,1 MA	706&38	5
RT 1, 2	THERMISTOR,RECT.,POS.,1 K,+40%,25 C	602995	2
S 1	SWITCH, ROTARY (UPPER)	654301	1
S 2	SWITCH, ROTARY (LOWER)	654319	1
U 1	8025 AP25 CHIP ASSEMBLY TESTED	665059	1
U 7	DIODE,SI,RECT,BRIDGE,BV=50 V,10 =1A	418582	1
VR 1	* IC,1.23 V,60 PPM TC,BAND-GAP REFERENCE	654707	1
W 3	WIRE, MILLIAMP JUMPER	722967	1
XF 1	CONTACT,600 V,FUSE	659524	2
XF 2	HLDR,FUSE,5 MM X 20 MM	697086	2
XF 3	600 VOLT FUSE CONTACT	707190	2
XBT 1	CONTACT ASSY TERMINATION	651653	1
Y 1	CRYSTAL,32.768 KHZ,+1%,3 X 8 MM	643031	1
Z 1	* OHMS/INPUT RES NET ASSY TESTED JF25	616938	1

An \* indicates a static-sensitive part.



Fluke 27-4001

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Figure 4-2. A1 Main PCA

Table 4-3. A2 Digital PCA

Reference Designator	Description	Fluke Stock Number	Total Qty
C 12, 13, 44-47	CAP,CER,0.22 UF,+80-20%,50 V,Z5U	733386	6
J 8	SOCKET,1 ROW,PWB,0.100 CTR,18 POS	707026	1
LS 1	AF TRANSD,PIEZO,24 MM	602490	1
U 2	* IC,CMOS,4 BIT MICROCOMPUTER	685628	1

An \* in 'S' column indicates a static-sensitive part.

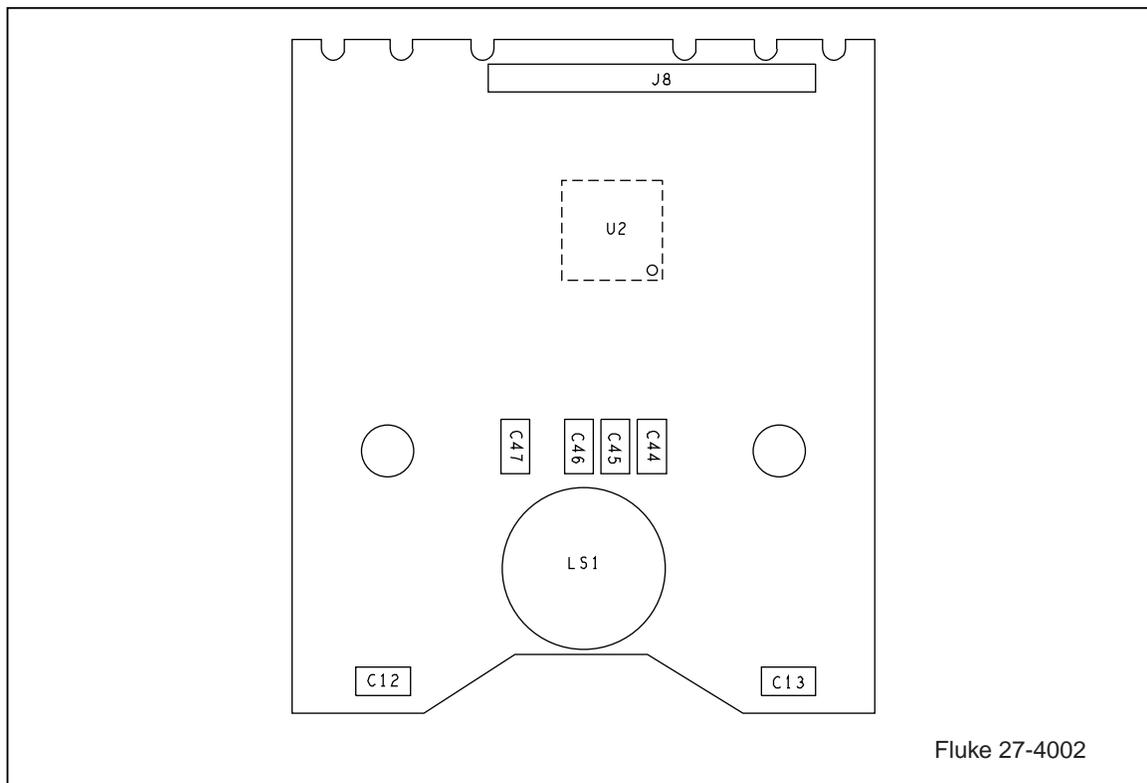


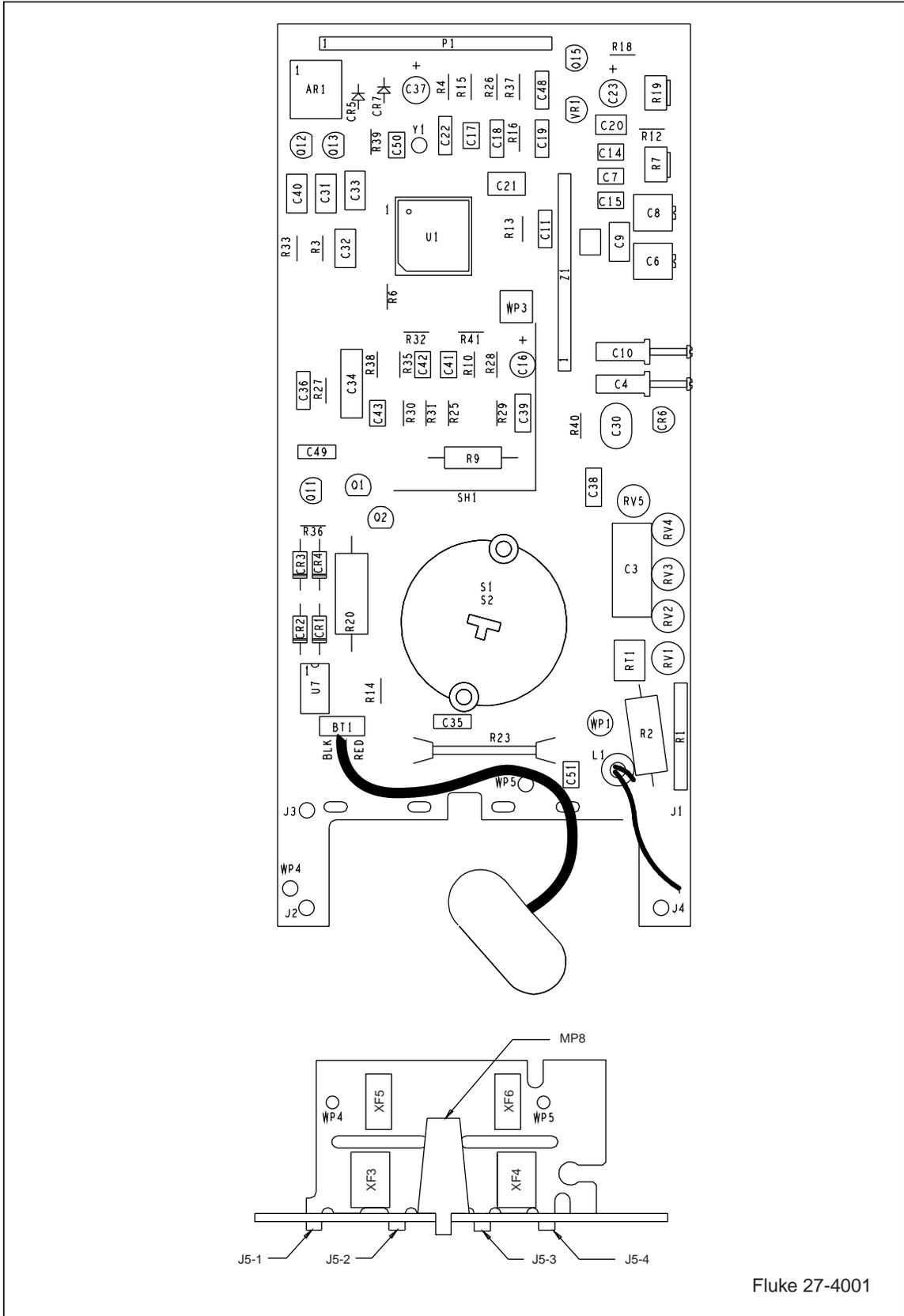
Figure 4-3. A2 Digital PCA

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***Chapter 5***  
***Schematic Diagrams***





Fluke 27-4001

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Figure 5-1. A1 Main PCA and A2 Digital PCA

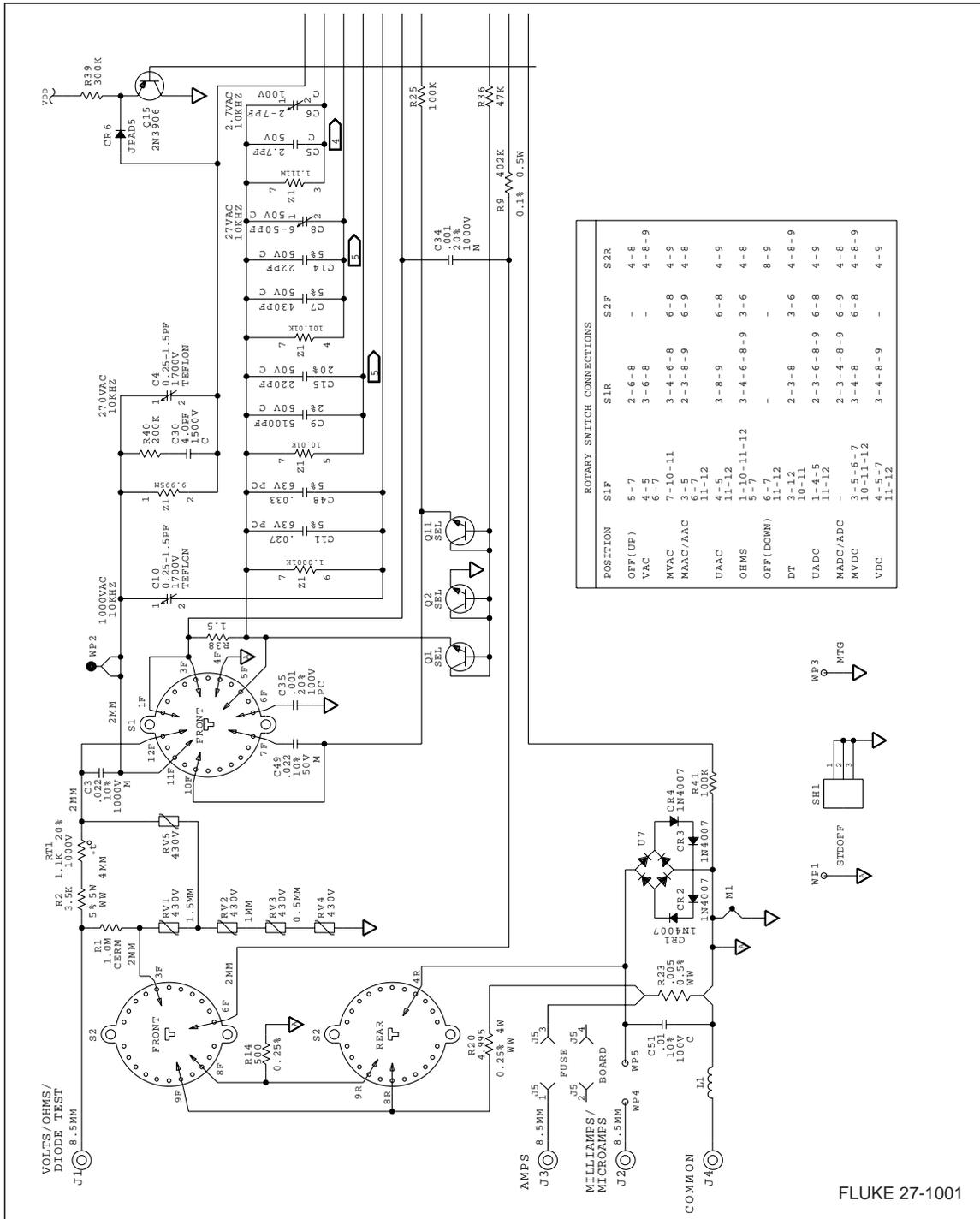
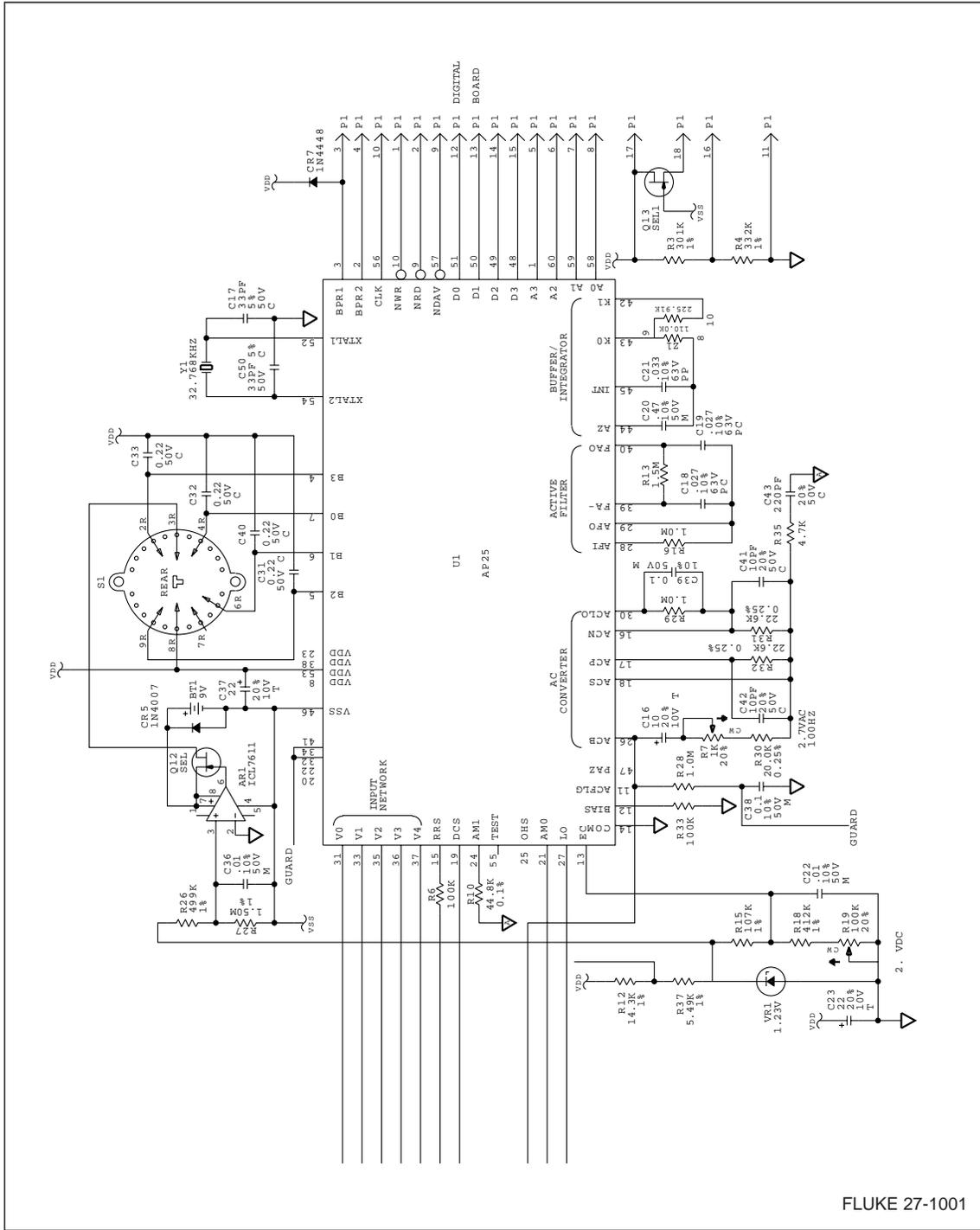


Figure 5-1. A1 Main PCA and A2 Digital PCA (cont)

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Figure 5-1. A1 Main PCA and A2 Digital PCA (cont)

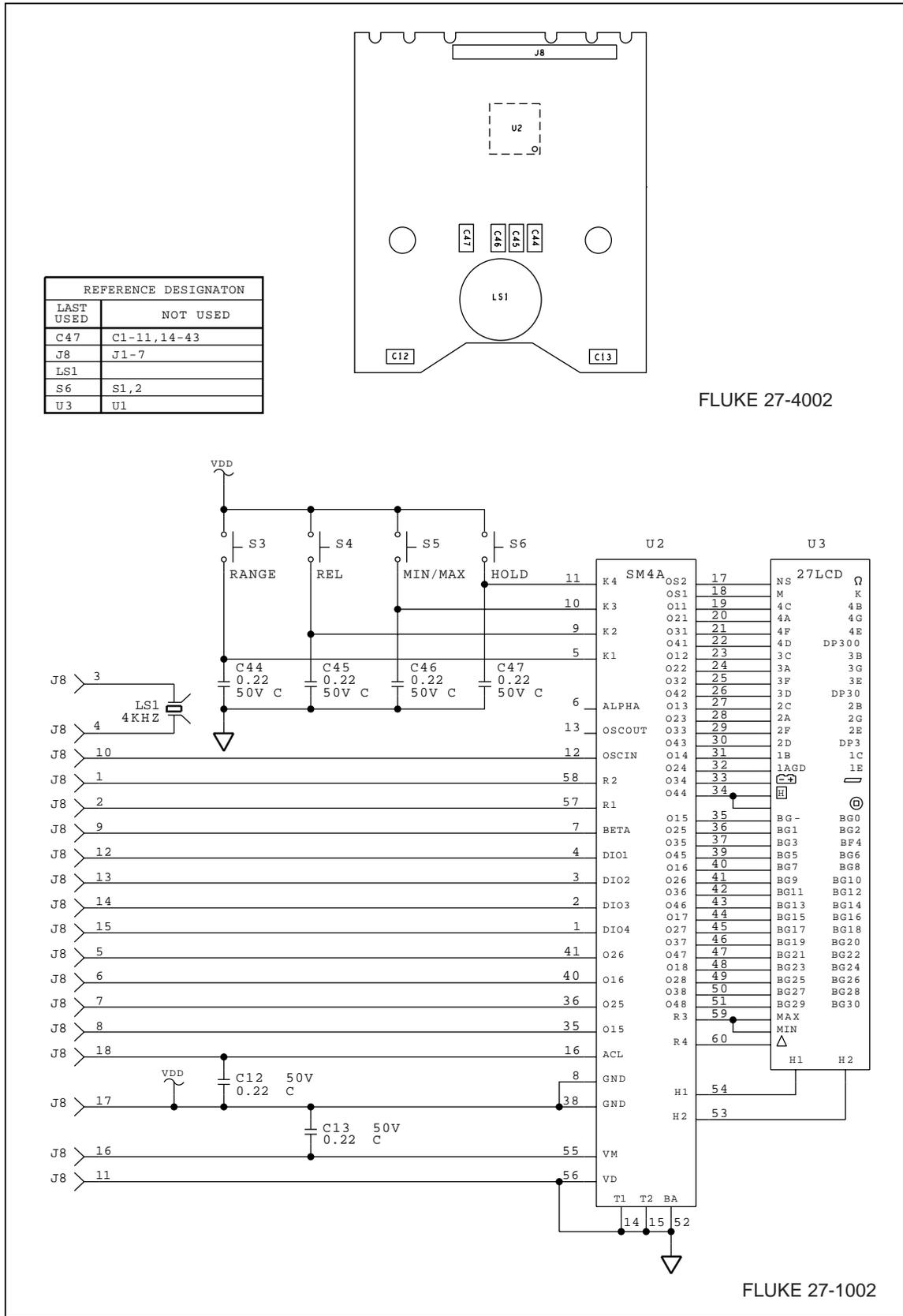


Figure 5-1. A1 Main PCA and A2 Digital PCA (cont)

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