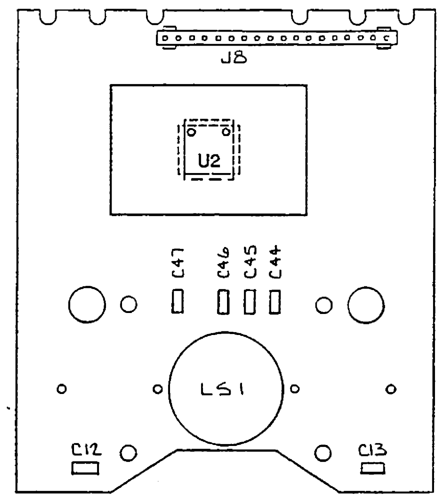
25
27
MULTIMETER

Service Manual

FLUKE



A2 Digital PCB Assembly

8025A-1602

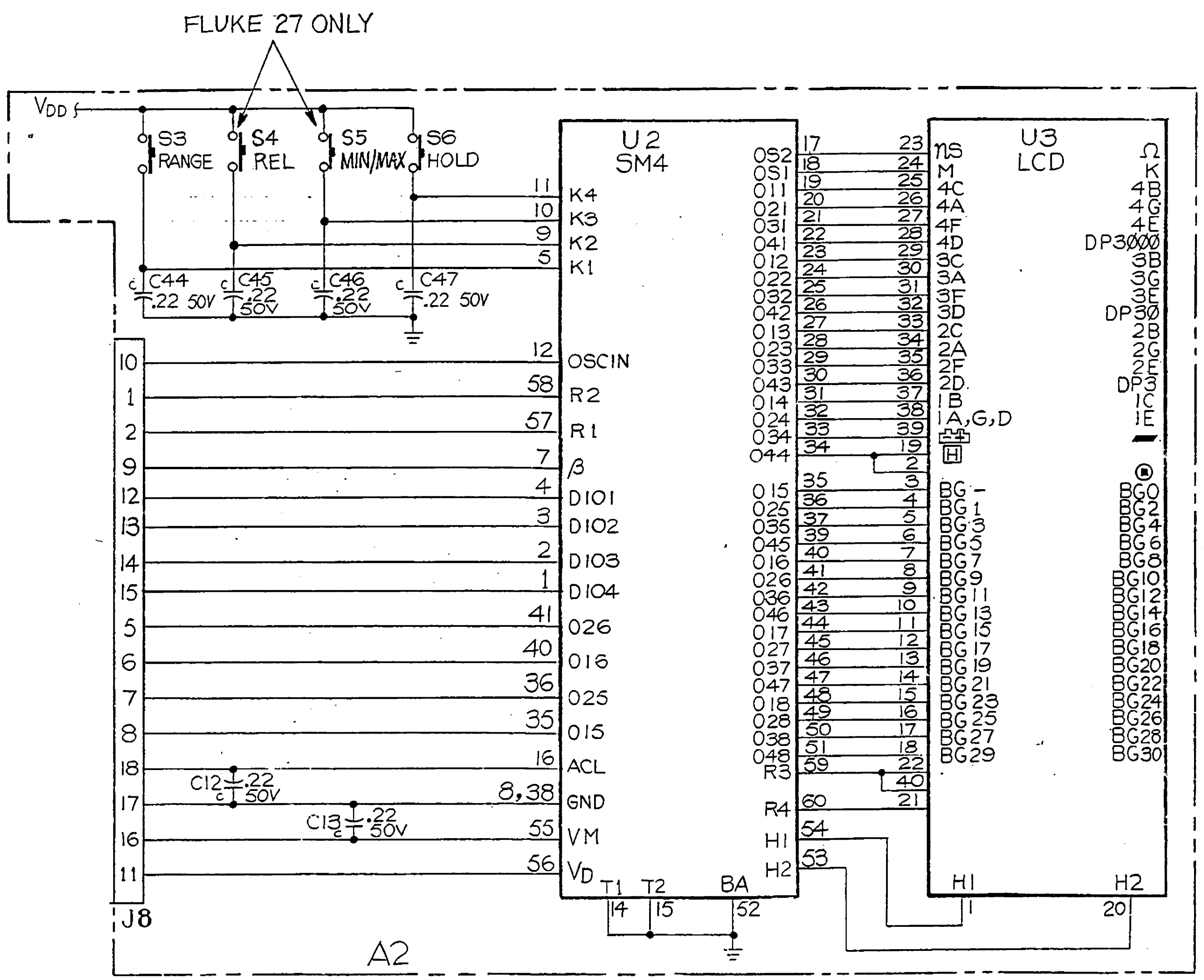


Figure 5-1. A1 Main PCB and A2 Digital PCB Schematic (cont)

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MULTIMETER

Service Manual

PN 738138
October 1984 Rev. 3, 11/94

FLUKE ®

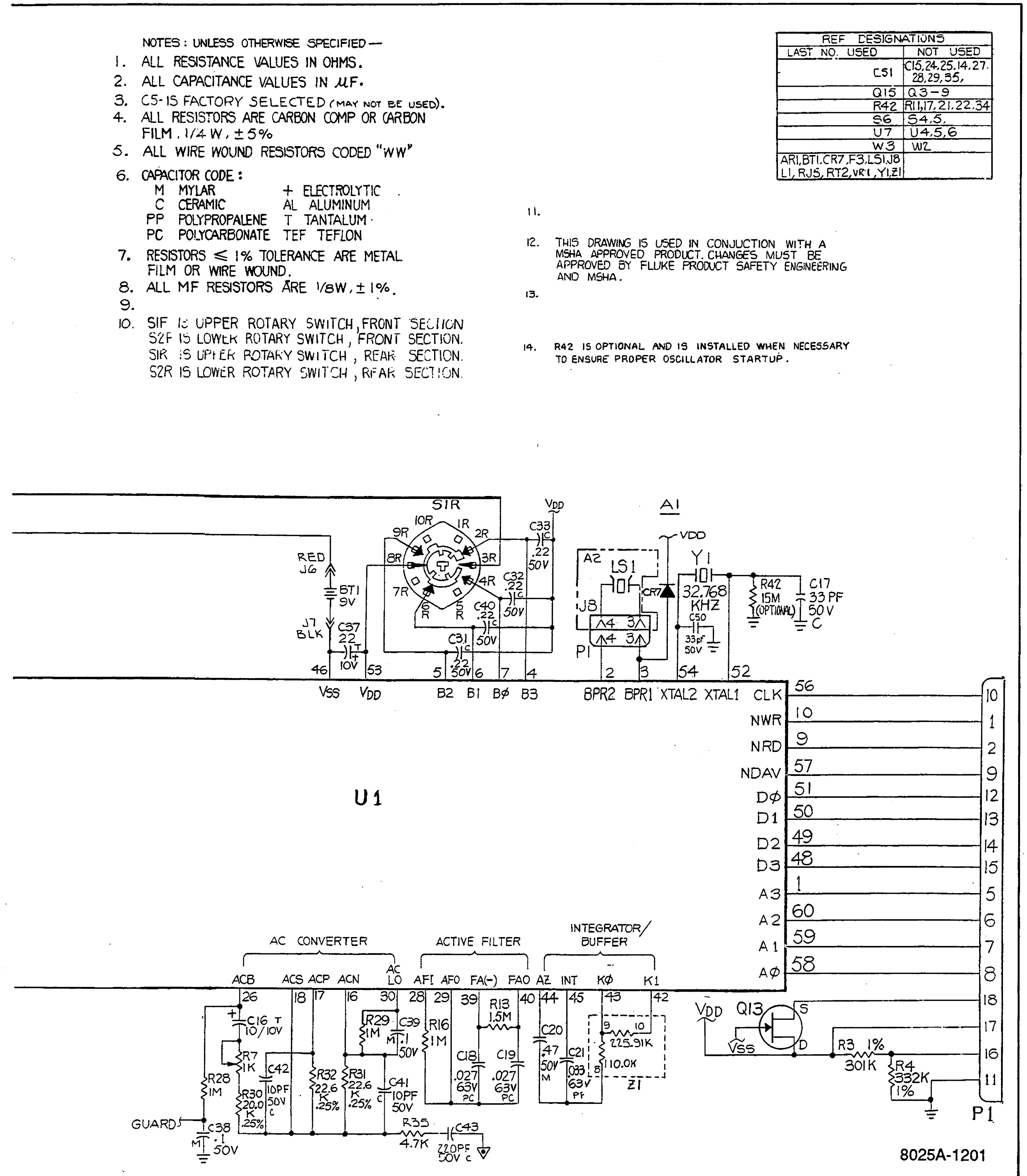

Figure 5-1. A1 Main PCB and A2 Digital PCB Schematic

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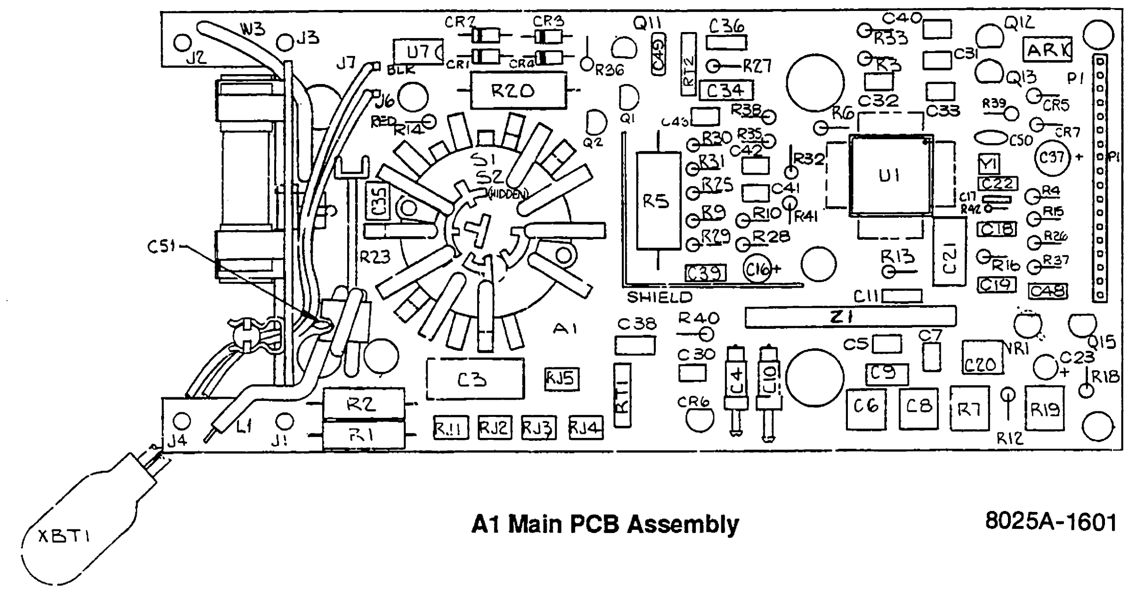
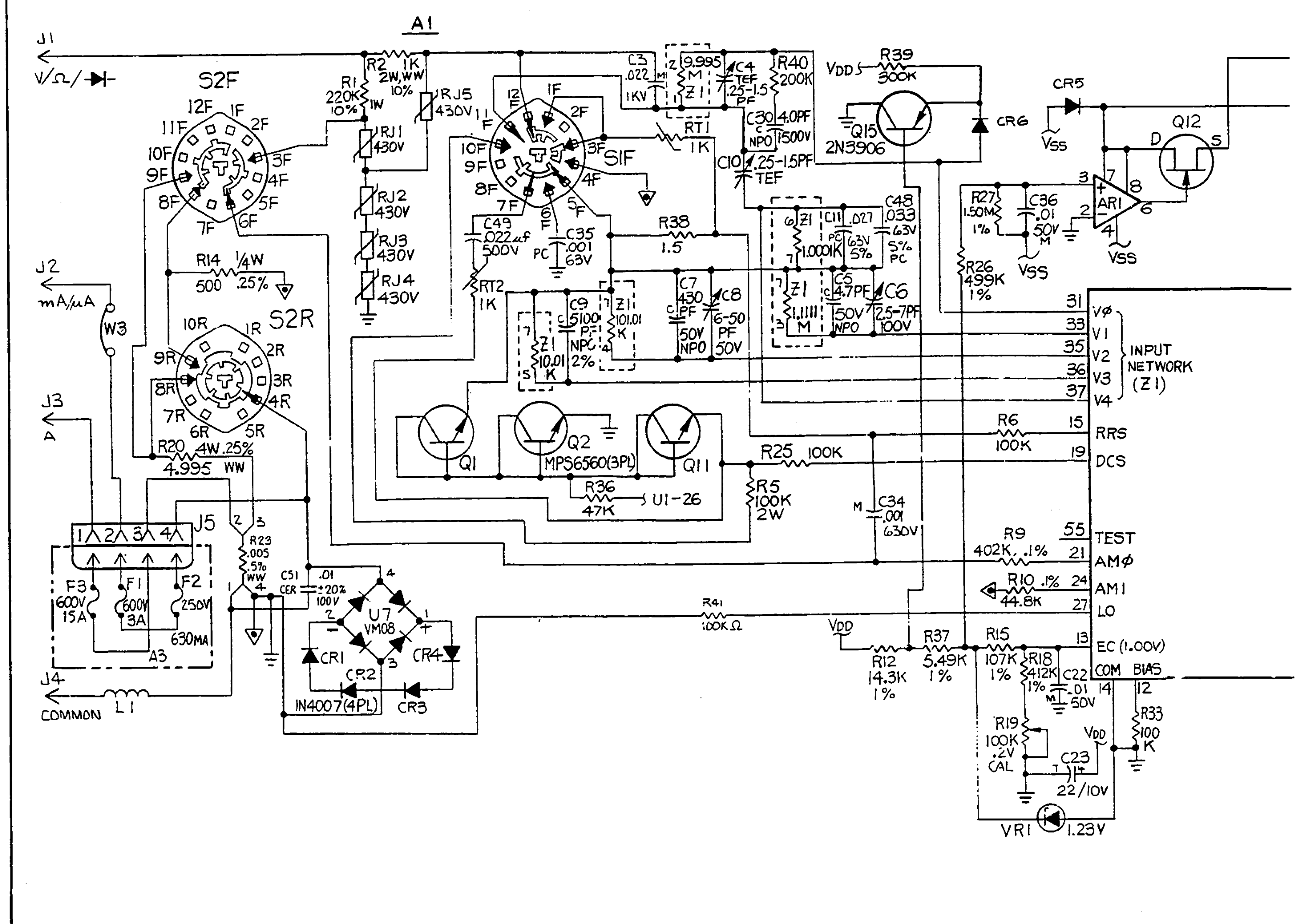


A1 Main PCB Assembly 8025A-1601



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Schematic Diagrams

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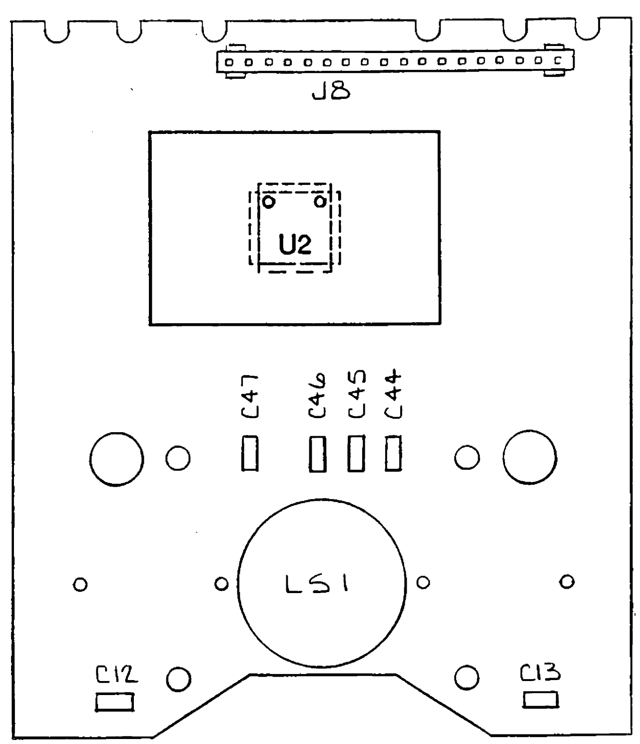
Table 4-3. A2 Digital PCB Assembly

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	--------------DESCRIPTION--------------	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	NOTE -E-
C 12, 13, 44-		CAP,CER,0.22UF,+80-20%,50V,Z5U	733386	04222	SR595E224ZAA	6	
C 47			733386				
J 8		SOCKET,1 ROW,PWB,0.100CTR,18 POS	707026	30035	SS-109-1-18	1	
LS 1		AF TRANSD,PIEZO,24 MM	602490	51406	PKM24-4A1	1	
U 2	*	IC,CMOS,4 BIT MICROCOMPUTER	685628	18520	LU-04126P	1	

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



8025A-1602

Figure 4-3. A2 Digital PCB Assembly

Section 1
Introduction and Specifications

NOTE

This meter has been designed and tested according to IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus. This manual contains information and warnings which must be followed to ensure safe operation and retain the meter in safe condition.

1-1. INTRODUCTION

This manual presents service information for the Fluke 25 and 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 Operator's 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		
⎓V	3.200V	0.001V	±(0.1%+1)		
	32.00V	0.01V	±(0.1%+1)		
	320.0V	0.1V	±(0.1%+1)		
	1000V	1V	±(0.1%+1)		
⎓mV	320.0 mV	0.1 mV	±(0.1%+1)		
Ω (nS)	320.0Ω	0.1Ω	±(0.3%+2)		
	3.200 kΩ	0.001 kΩ	±(0.2%+1)		
	32.00 kΩ	0.01 kΩ	±(0.2%+1)		
	320.0 kΩ	0.1 kΩ	±(0.2%+1)		
	3.200 MΩ	0.001 MΩ	±(0.2%+1)		
	32.00 MΩ	0.01 MΩ	±(1%+1)		
	32.00 nS	0.01 nS	±(2%+10)		
(((→⊢	2.080V	0.001V	±(1%+1) typical		
			40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
~V	3.200V	0.001V	±(0.5%+3)	±(2%+3)	±(4%+10)
	32.00V	0.01V	±(0.5%+3)	±(2%+3)	±(4%+10)
	320.0V	0.1V	±(0.5%+3)	±(2%+3)	±(4%+10)
	1000V	1V	±(1%+3)	±(3%+3)	Not Specified
~mV	320.0 mV	0.1 mV	±(0.5% +3)	±(2%+3)	±(4%+10)

FUNCTION	RANGE	RESOLUTION	ACCURACY	TYPICAL BURDEN VOLTAGE
⎓mA/A	32.00 mA	0.01 mA	±(0.75%+2)	5.6 mV/mA
	320.0 mA	0.1 mA	±(0.75%+2)	5.6 mV/mA
	10.00A	0.01A	±(0.75%+2)	50 mV/A
⎓μA	320.0 μA	0.1 μA	±(0.75%+2)	0.5 mV/μA
	3200 μA	1 μA	±(0.75%+2)	0.5 mV/μA
~mA/A 40-1000 Hz	32.00 mA	0.01 mA	±(1.5%+2)	5.6 mV/mA
	320.0 mA	0.1 mA	±(1.5%+2)	5.6 mV/mA
	10.00A	0.01A	±(1.5%+2)	50 mV/A
~μA 40-1000 Hz	320.0 μA	0.1 μA	±(1.5%+2)	0.5 mV/μA
	3200 μA	1 μA	±(1.5%+2)	0.5 mV/μA

FUNCTION	OVERLOAD PROTECTION	INPUT IMPEDANCE (nominal)	COMMON MODE REJECTION RATIO (1 kΩ unbalance)	NORMAL MODE REJECTION
⎓V	1000V rms	10 MΩ in // with <100 pF	>120 dB at dc, 50 Hz, or 60 Hz	>60 dB at 50 Hz or 60 Hz
⎓mV	500V rms	10 MΩ in // with <100 pF	>120 dB at dc, 50 Hz, or 60 Hz	>60 dB at 50 Hz or 60 Hz
~V	1000V rms (10⁷ V-Hz max)	10 MΩ in // with <100 pF (ac coupled)	>60 dB, dc to 60 Hz	
~mV	500V rms (10⁷ V-Hz max)	10 MΩ in // with <100 pF (ac coupled)	>60 dB, dc to 60 Hz	
Ω	500V rms	OPEN CIRCUIT TEST VOLTAGE	FULL SCALE VOLTAGE	
			Up to 3.2 MΩ	32 MΩ or nS
		<2.8V dc	<420 mV dc	<1.3V dc

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 ±([% of reading] + [number of least significant digits]).

Ranging is either automatic or manual in all functions with more than one range. Test resistance below approximately 150Ω in the (((→⊢ function produces a continuous audible tone.

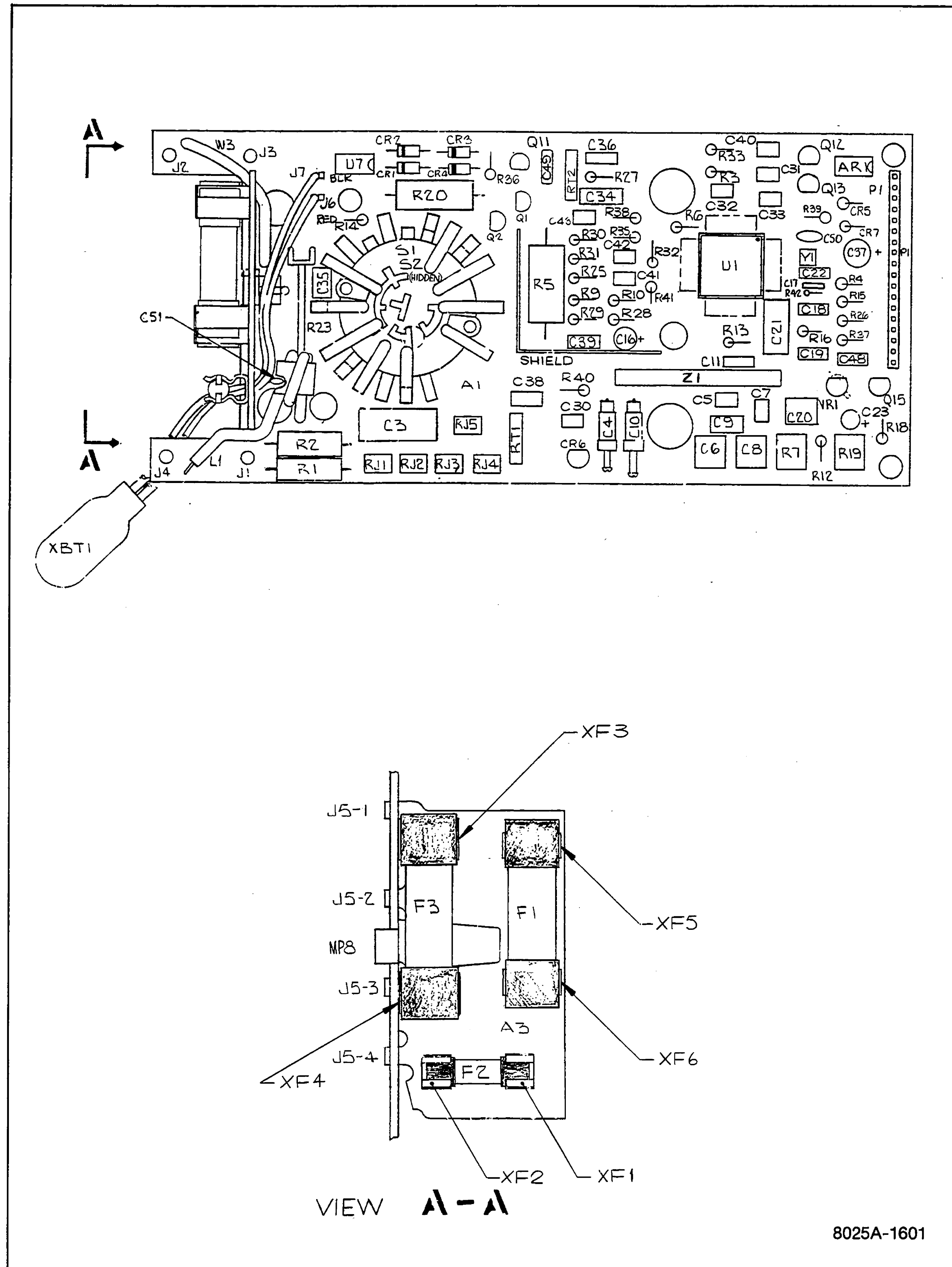


Figure 4-2. A1 Main PCB Assembly

Table 4-2. A1 Main PCB Assembly (cont)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	NOTE
RJ 1- 5		VARISTOR,430V,+-10%,1MA	706838	09214	V264LAX1398	5	
RT 1, 2		THERMISTOR,RECT.,POS.,1K,+-40%,25C	446849	54583	911P84E102YU13	2	
S 1		SWITCH, ROTARY (UPPER)	654301	71590	654301	1	
S 2		SWITCH, ROTARY (LOWER)	654319	71590	654319	1	
U 1		8025 AP25 CHIP ASSEMBLY TESTED	700112	89536	700112	1	
U 7		DIODE,SI,RECT,BRIDGE,BV=50V,IO=1A	418582	14936	DF005M	1	
VR 1	*	IC,1.23V,60PPM TC,BAND-GAP REFERENCE	654707	27014	LM285BXZ-1.2D26Z	1	
W 3		WIRE, MILLIAMP JUMPER	722967	89536	722967	1	
XF 1		CONTACT,600V,FUSE	659524	7G970	659524	2	
XF 2		HLDR,FUSE,5MM X 20MM	697086	61857	H-0011-2	2	
XF 3		600 VOLT FUSE CONTACT	707190	7G970	707190	2	
XBT 1		CONTACT ASSY TERMINATION	651653	89536	651653	1	
Y 1		CRYSTAL,32.768KHZ,+-1%,3 X 8MM	643031	61429	FOX-32.768	1	
Z 1	*	OHMS/INPUT RES NET ASSY TESTED JF25	616938	89536	616938	1	

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

1. Fusible resistor. To ensure safety, use exact replacement only.

Table 1-1. Specifications (cont)

MAXIMUM VOLTAGE BETWEEN ANY TERMINAL AND EARTH GROUND
1000V

FUNCTION	FUSE PROTECTION
mA or µA	630 mA 250V FAST, 3A 600V FAST
A	15A 600V FAST

Digital Display .... 3200 counts, updates 2/sec

Analog Display .... 31 segments, updates 25/sec

Operating Temperature .... -15°C to 55°C, to -40°C for 20 minutes when taken from 20°C

Storage Temperature .... -55°C to 85°C

Temperature Coefficient (<18°C or >28°C) .... 0.1 x (specified accuracy)/°C

Relative Humidity .... 0% to 95% (0°C to 35°C)
0% to 70% (35°C to 55°C)

Battery Type .... 9V, NEDA 1604 or 6F22 or 006P

Battery Life .... 1000 hrs typical

Shock, Vibration and Water Resistance ...... Per MIL-T-28800 for a Style A, Class 2 Instrument

Size (HxWxL) .... 2.2 in x 3.75 in x 8 in (5.6 cm x 9.5 cm x 20.3 cm)

Weight .... 1.6 pounds (0.75 kg)

Safety .... Protection Class II per IEC 348 and ANSI C39.5

Table 4-2. A1 Main PCB Assembly

REFERENCE DESIGNATOR -A>	-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	NOTE -E-
A	3	*	FUSE PCA	830224	89536	830224	1	
AR	1	*	IC, OP AMP, LOW POWER	721928	39003	IC7611DCPA	1	
C	3		CAP,POLYES,0.022UF,+-10%,1000V	448183	37942	160-223K1000AH	1	
C	4, 10		CAP,VAR,0.25-1.5PF,1700V,TEFLON	721480	52769	ER-530-016	2	
C	5		CAP,CER,2.7PF,+-0.25PF,50V,COG	773044	89536	773044	1	
C	6		CAP,VAR,2-7PF,100V,CER	714600	51406	TZ03Z070YR174	1	
C	7		CAP,CER,430PF,+-5%,50V,C0G	732644	04222	SR595A431JAA	1	
C	8		CAP,VAR,6-50PF,50V,CER	714618	51406	TZ03Z500YR174	1	
C	9		CAP,CER,5100PF,+-2%,50V,C0G	732651	04222	SR595A512GAA	1	
C	11		CAP,POLYCA,0.027UF,+-5%,63V	733444	68919	MKC2273J63V	1	
C	16		CAP,TA,10UF,+-20%,10V	714766	56289	199D106X0010BG2	1	
C	17, 50		CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR595A330JAA	2	
C	18, 19		CAP,POLYCA,0.027UF,+-10%,63V	720979	68919	MKC2-272-K-63V	2	
C	20		CAP,POLYES,0.47UF,+-10%,50V	697409	37942	185-2-474K50AAB	1	
C	21		CAP,POLYPR,0.033UF,+-10%,63V	721050	68919	MKP20-333K63V	1	
C	22, 36		CAP,POLYES,0.01UF,+-10%,50V	715037	37942	185-2-103K50A/A	2	
C	23, 37		CAP,TA,22UF,+-20%,10V	658971	56289	199D226X0010CG2	2	
C	30		CAP,CER,4.0PF,+-0.25PF,1500V,C0J	714535	91984	6010C0H4R0C1.5LVT14	1	
C	31- 33, 40		CAP,CER,0.22UF,+80-20%,50V,Z5U	733386	04222	SR595E224ZAA	4	
C	34		CAP,POLYES,1000PF,+-20%,630V	740126	37942	167-102M630AB	1	
C	35		CAP,POLYCA,1000PF,+-20%,100V	721472	68919	FKC2101M100V	1	
C	38, 39		CAP,POLYES,0.1UF,+-10%,50V	649913	37942	185-2-104K50AA	2	
C	41, 42		CAP,CER,10PF,+-20%,50V,C0G	721589	04222	SR595A100MAA	2	
C	43		CAP,CER,220PF,+-20%,50V,C0G	740654	04222	SR595A221MAA	1	
C	48		CAP,POLYCA,0.033UF,+-5%,63V	733451	68919	MKC2333J63V	1	
C	49		CAP,CER,0.022UF,+80-20%,500V,Z5U	740340	51406	RPE113-901E223Z9	1	
C	51		CAP,CER,0.01UF,+-10%,100V,X7R	557587	04222	SR591C103KAA	1	
CR	1- 5		DIODE,SI,1K PIV,1.0 AMP	453399	04713	IN4007	5	
CR	6	*	DIODE,SI,BV=35V, LOW LEAKAGE	723817	17856	J2723TR	1	
CR	7	*	DIODE,SI,BV= 75.0V,RADIAL INSERTED	659516	15238	1N4448	1	
L	1		RF COIL ASSEMBLY	857792	89536	857792	1	
MP	1		SHIELD, FENCE	722280	7G970	722280	1	
MP	8		SUPPORT,PCB	656108	89536	656108	1	
P	1		CONNECTOR,18 PIN	707646	22526	707646	1	
Q	1, 2, 11	*	TRANSISTOR,SI,NPN,SELECTED IEBO,TO-92	685404	27014	SX14073A,SX12398	3	
Q	12	*	TRANSISTOR,SI,N-JFET,TO-92,RAD T&R	721936	17856	J2660	1	
Q	13	*	TRANSISTOR,SI,N-JFET,TO-92	723734	17856	J27138TR	1	
Q	15	*	TRANSISTOR,SI,PNP,T092	698233	04713	2N3906	1	
R	1		RES,CC,220K,+-10%,1W	714485	01121	GB2241	1	
R	2		RES,MF,1K,+-1%,100PPM,FLMPRF,FUSIBLE	650085	91637	CMF-65 69 1K F T-1 B	1	1
R	3		RES,MF,301K,+-1%,0.125W,100PPM	655274	59124	MF50D3013F	1	
R	4		RES,MF,332K,+-1%,0.125W,100PPM	655217	59124	MF50D3323F	1	
R	5		RES,CC,100K,+-5%,2W	285056	01121	HB1045	1	
R	6, 25, 33,		RES,CF,100K,+-5%,0.25W	658963	59124	CF1/4 104J	4	
R	41			658963				
R	7		RES,VAR,CERM,1K,+-20%,0.3W	706655	43744	EVM31G	1	
R	9		RES,MF,402K,+-0.1%,0.125W,100PPM	714329	59124	MF50D4023B	1	
R	10		RES,MF,44.8K,+-0.1%,0.125W,100PPM	714311	59124	MF50D4482B	1	
R	12		RES,MF,14.3K,+-1%,0.125W,100PPM	721803	59124	MF50D1432F	1	
R	13		RES,CF,1.5M,+-5%,0.25W	649962	59124	CF1/4 155J	1	
R	14		RES,MF,500,+-0.25%,0.25W,100PPM	697557	59124	MF55D5000C	1	
R	15		RES,MF,107K,+-1%,0.125W,50PPM	714295	59124	MF50C1073F	1	
R	16, 28, 29		RES,CF,1M,+-5%,0.25W	649970	59124	CF1/4 105J	3	
R	18		RES,MF,412K,+-1%,0.125W,50PPM	714287	59124	MF50C4123F	1	
R	19		RES,VAR,CERM,100K,+-20%,0.3W	658989	51406	RVG0707H100A10-104M	1	
R	20		RES,WW,4.995,+-.25%,4W	658948	91637	RS-2 4.995 C	1	
R	23		RES,WW,.005,+-.5%,.5W	655423	05347	Q375A	1	
R	26		RES,MF,499K,+-1%,0.125W,100PPM	714980	59124	MF50D4993F	1	
R	27		RES,MF,1.5M,+-1%,0.125W,100PPM	714998	59124	MF50D1504F	1	
R	30		RES,MF,20K,+-0.25%,0.125W,50PPM	715029	59124	MF50C2002C	1	
R	31, 32		RES,MF,22.6K,+-0.25%,0.125W,50PPM	715011	59124	MF50C2262C	2	
R	35		RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1/4 472J	1	
R	36		RES,CF,47K,+-5%,0.25W	721787	59124	CF1/4 473J	1	
R	37		RES,MF,5.49K,+-1%,0.125W,100PPM	721795	59124	MF50D5491F	1	
R	38		RES,CF,1.5,+-5%,0.25W	732800	59124	CF1/4 1R5J	1	
R	39		RES,CF,300K,+-5%,0.25W	732818	59124	CF1/4 304J	1	
R	40		RES,CF,200K,+-5%,0.25W	681841	59124	CF1/4 204J	1	
R	42		RES,CC,15M,+-5%,.125W	875112	01121	BB1565	1	

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

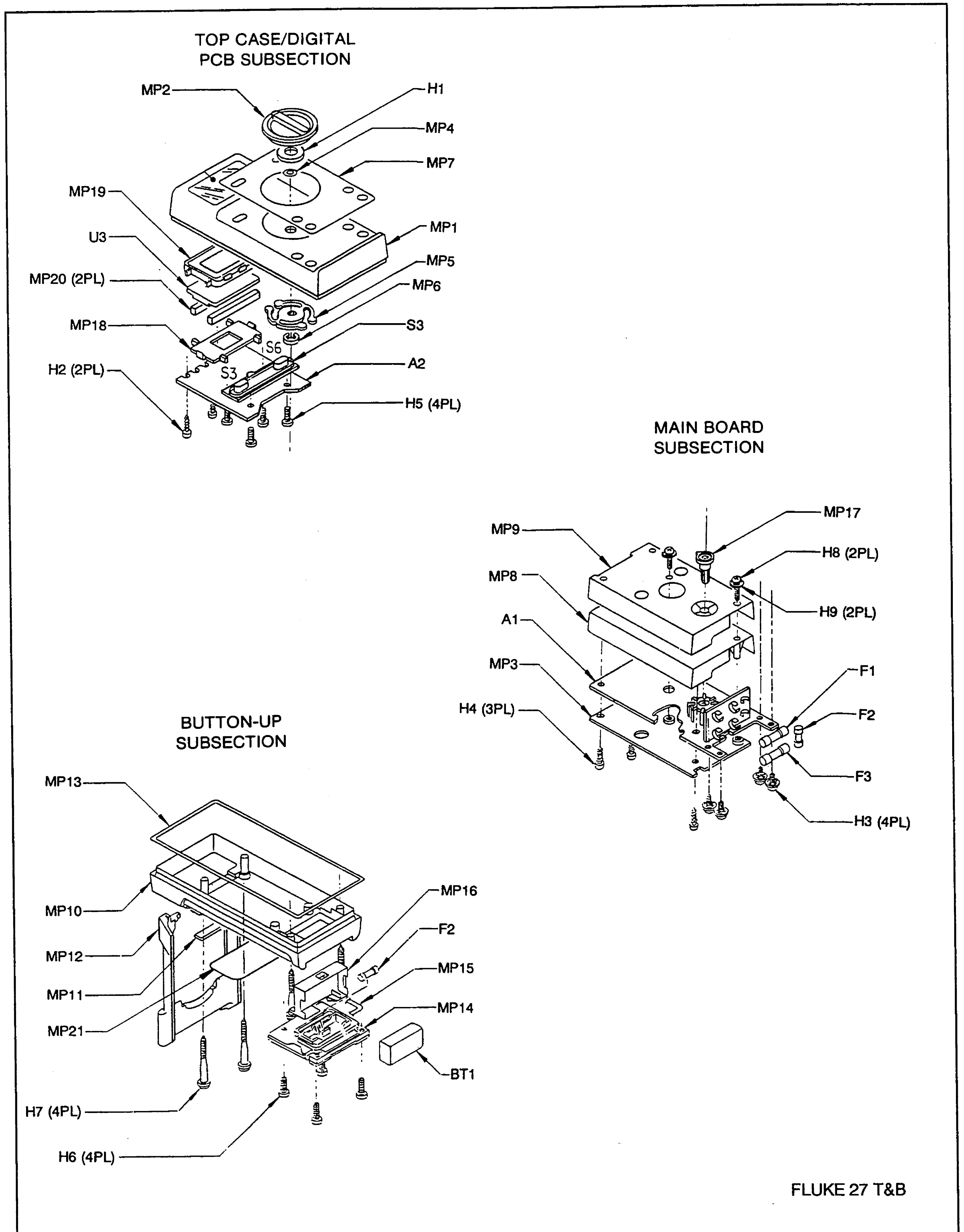


Figure 4-1. 25/27 Final Assembly

Section 2
Theory of Operation

2-1. INTRODUCTION

This section describes how the Fluke 25 and Fluke 27 work. 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. All descriptions apply to both instruments unless specified otherwise. For reference, a detailed schematic diagram is included in Section 5.

2-2. FUNCTIONAL DESCRIPTION

A block diagram of the Fluke 25/27 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).

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 (RJ1 through RJ5) and two current-limiting resistors (R1 and R2). R2 is a 1-kΩ, 2W fusible resistor that will open if an extremely high energy signal is present.

Two fuses in series provide protection for the mA/μA input (J2) current shunts: a 3A, 600V fuse and a 630 mA, 250V fuse. A single 15A, 600V fuse provides protection for the 10A input (J3) current shunt. In addition, for the μA 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 Q11 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 resistor R2, 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/μA input (J2) and the A input (J3) develop a voltage across shunt resistors R14, R20, and R23 (320 μA, 32 mA, and 10A respectively). Resistors R9 and R10 comprise a 10:1 divider for the 3200-μA 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 converter phases, a read counter for A/D samples, 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 25/27 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 following every 10-sample sequence.

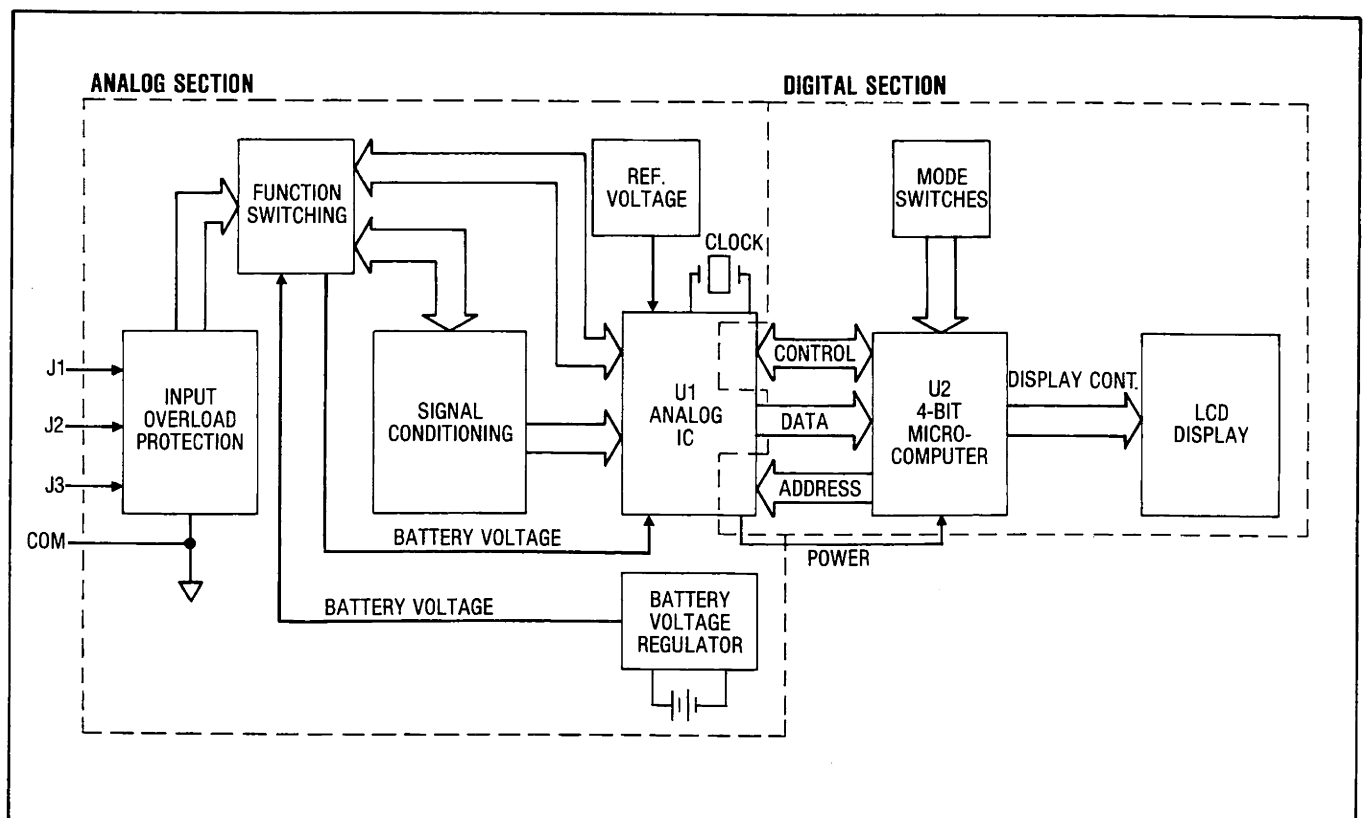


Figure 2-1. Overall Functional Block Diagram

Table 4-1. 25/27 Final Assembly

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	NOTE
A 1		MAIN PCB ASSEMBLY	855726	89536	855726	1	
A 2		DIGITAL PCB ASSEMBLY	654137	89536	654137	1	
BT 1		BATTERY,9V,0-15MA	696534	59717	216	1	
F 1		FUSE,.406X1.375,3A,600V,FAST	756601	71400	BBS-3-600V	1	
F 2		FUSE,5X20MM,0.63A,250V,FAST	845040	75915	216-630MA	2	
F 3		FUSE,.406X1.5, 15A, 600V, FAST	820829	71400	KTK-15	1	
H 1		WASHER,FLAT,TEFLON,0.295 ID,0.020 THK	696591	86928	30-19587	1	
H 2		SCREW,FIH,P,THD FORM,STL,4-20,3.000	682310	89536	682310	2	
H 3		SCREW,PH,P,SEMS,STL,4-40,.312	721670	89536	721670	4	
H 4		SCREW,PH,P,THD FORM,STL,4-14,.375	448456	89536	448456	3	
H 5		SCREW,PH,P,STL,4-40,.250	129890	89536	129890	4	
H 6		SCREW,PH,PO,STL,6-32,.375	682070	89536	682070	4	
H 7		SCREW,PH,PO,STL,6-20,1.256	733394	89536	733394	4	
H 8		SCREW,PH,P,LOCK,STL,4-40,1.000	157008	74594	157008	2	
H 9		WASHER,FLAT,STL,.125,.312,.030	739912		COMMERCIAL	2	
MP 1		CASE TOP				1	1
		FLUKE 25 STD	657486	89536	657486		
		FLUKE 25 YEL	744490	89536	744490		
		FLUKE 27 STD	659946	89536	659946		
		FLUKE 27 YEL	744508	89536	744508		
MP 2		KNOB SWITCH				1	1
		STD	654012	89536	654012		
		YEL	744466	89536	744466		
MP 3		BOTTOM SHIELD ASSEMBLY	654079	89536	654079	1	
MP 4		O-RING,SYN RUBBER,.114 ID,.070 WIDE	705947	2K160	2-006N163-70	1	
MP 5		SPRING,DETENT	654046	89536	654046	1	
MP 6		RING,RET,EXT,FLAT,STL,.188 DIA	697078	79136	X5133-18-ZD	1	
MP 7		DECAL, TOP CASE				1	1
		FLUKE 25 STD	654475	89536	654475		
		FLUKE 25 YEL	744557	89536	744557		
		FLUKE 27 STD	659466	89536	659466		
		FLUKE 27 YEL	744565	89536	744565		
MP 8		SUPPORT, TOP SHIELD	654038	89536	654038	1	
MP 9		SHIELD,TOP	654384	22670	654384	1	
MP 10		CASE BOTTOM				1	1
		STD	830133	89536	830133		
		YEL	830141	89536	830141		
MP 11		FOOT, CASE	654335	25099	654335	1	
MP 12		BAIL, TILT				1	1
		STD	654053	89536	654053		
		YEL	744474	89536	744474		
MP 13		O-RING,SYN RUBBER,6.710,.080	654392	62351	6.710X.080-40BN	1	
MP 14		COVER,BATTERY				1	1
		STD	830158	89536	830158		
		YEL	830166	89536	830166		
MP 15		O-RING,SYN RUBBER,1.612 ID,.103 WIDE	697185	2K160	2-130N545-40	1	
MP 16		RETAINER, BATTERY				1	1
		STD	660985	89536	660985		
		YEL	744615	89536	744615		
MP 17		SHAFT, SWITCH	655894	89536	655894	1	
MP 18		SUPPORT, LCD INTERCONNECT	683664	89536	683664	1	
MP 19		MASK,LCD				1	
		FLUKE 25	654020	89536	654020		
		FLUKE 27	661025	89536	661025		
MP 20		CONN,ELASTOMERIC,LCD TO PWB,1.970 L	682500	0K392	SG	2	
MP 21		DECAL, MSHA APPROVAL, FLUKE 25/27				1	1
		STD	809863	89536	809863		
		YEL	809871	89536	809871		
MP 23		TEST LEADS	855742	89536	855742	1	
MP 24		DECAL, WARNING				1	1
		STD	685719	89536	685719		
		YEL	744607	89536	744607		
MP 25		ALLIGATOR CLIP BLACK	738047	89536	738047	1	
MP 26		ALLIGATOR CLIP RED	738120	89536	738120	1	
S 3		SWITCH, MOMENTARY				1	
		FLUKE 25	654343	89536	654343		
		FLUKE 27	659847	89536	659847		
TM 1		25 27 MANUAL	738088	89536	738088	1	
U 3		LCD,3.75 DIGIT,BAR GRAPH,MULTIPLEXED	654293	18520	LF-7036G	1	

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

NOTES:

1. FLUKE 25/27 MULITMETER STANDARD (STD) OR YELLOW (YEL).
2. 25/27 RECOMMENDED SPARE PARTS KIT, FLUKE STOCK NUMBER 744946. (CUSTOMER OPTION)

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 supplemental change/errata sheet which, when applicable, is included with the manual.

4-5. SERVICE CENTERS

A list of service centers is located at the end of this section.

NOTE

The Fluke 25 and 27 Multimeters have 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 25 AND 27 MULTIMETERS ARE APPROVED (PERMISSIBLE) BY THE UNITES 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 THE FLUKE CORPORATION. ANY CHANGES IN THE INTRINSICALLY SAFE CIRCUITRY OR COMPONENTS MAY RESULT IN AN UNSAFE CONDITION. THE FLUKE 25 AND 27 MULTIMETERS WERE TESTED BY THE MSHA FOR INTRINSIC SAFETY IN METHANE AIR MIXTURES ONLY. THE FLUKE 25 AND 27 MULTIMETERS ARE MSHA APPROVED WITH A 9V 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.

⚠▣ WARNING

WHEN SERVICING, USE ONLY SPECIFIED PARTS.

WARNING

THIS INSTRUMENT CONTAINS A FUSIBLE RESISTOR (PN 650085). TO ENSURE SAFETY, USE EXACT REPLACEMENT ONLY.

Manaul Status Information

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	REVISION LEVEL
A1	Main PCB	855726	A
A2	Digital PCB	654137	E

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.

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. The digital circuitry within U1 is illustrated in Figure 2-3.

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-MΩ range, the battery test, the power-up self test, overload recovery, autoranging, and the Touch-Hold mode all require 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.

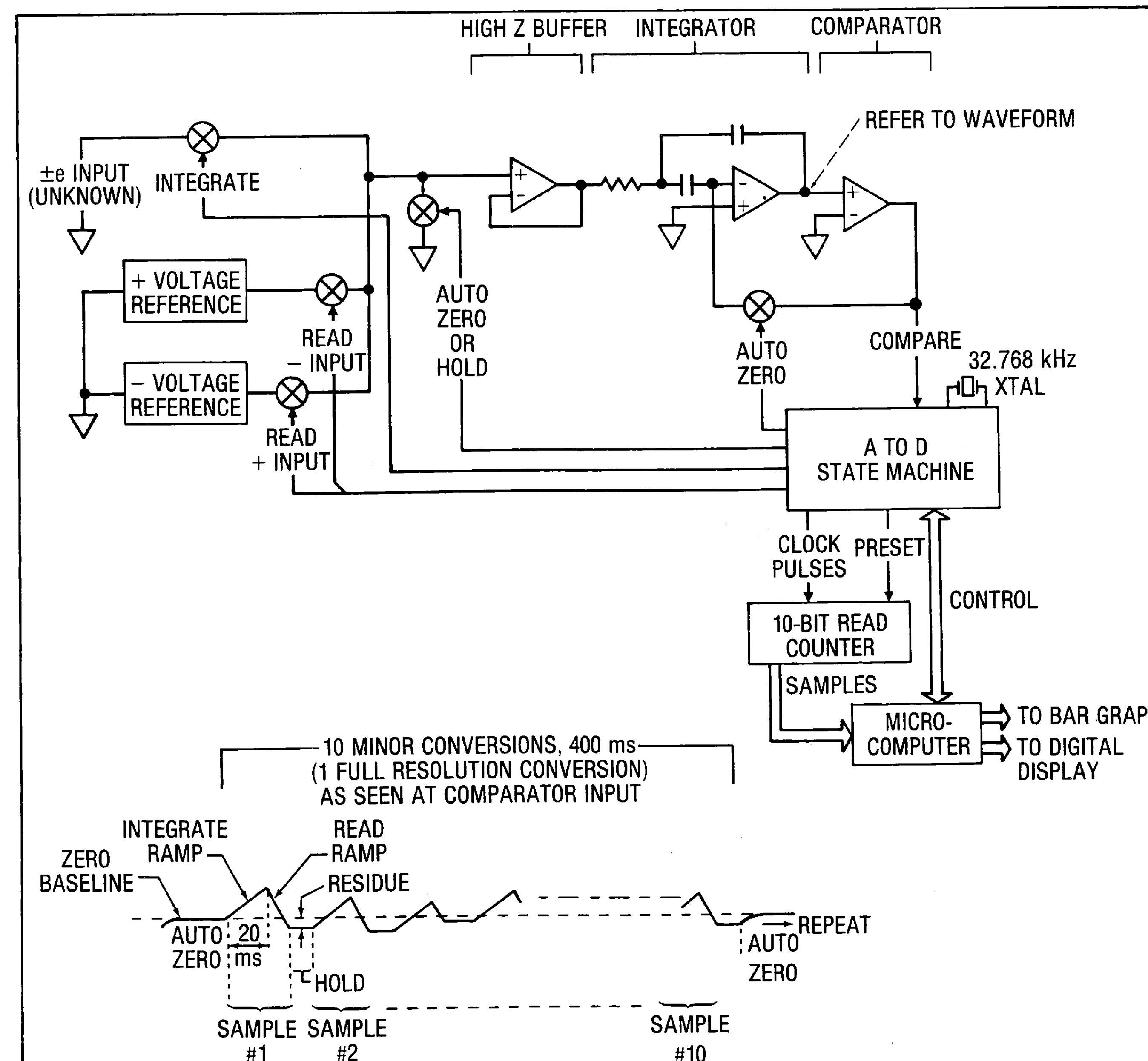


Figure 2-2. A/D Conversion Elements and Waveform

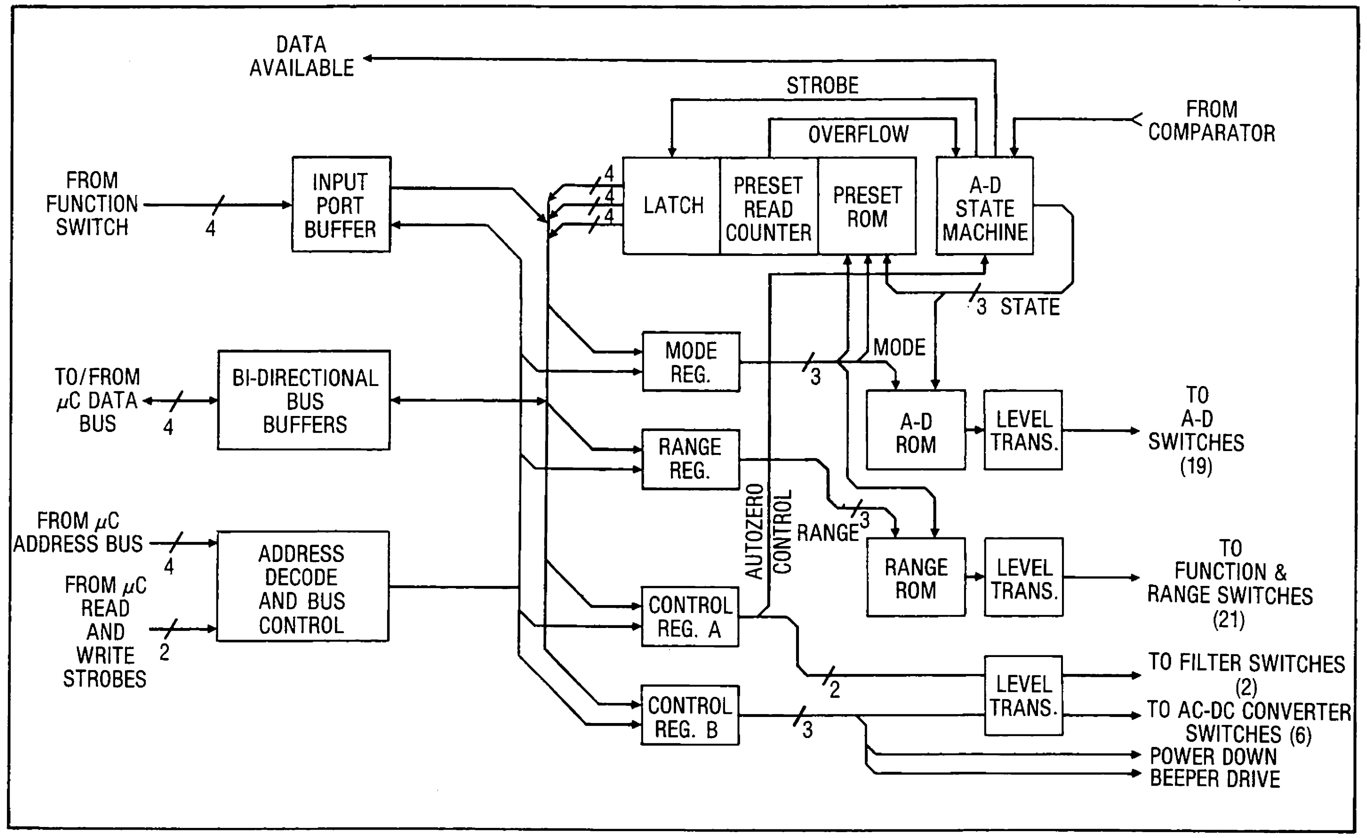


Figure 2-3. Digital Circuitry Within U1

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 1.000V 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 use, 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

Section 4
List of Replaceable Parts

TABLE OF CONTENTS

4-1. INTRODUCTION

This section contains an illustrated list of replaceable parts for the Fluke 25 and 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 discharge
- Description
- Fluke stock number
- Manufacturers supply code (code-to-name list at the end of this section)
- Manufacturers part number or generic type
- 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 manufacturers 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.

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-MΩ 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 25 and 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.

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 functions 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 presse 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 25/27 Operator's Manual for a more detailed description of the display.

d. Perform step 15 of the reassembly procedure to secure the main pcb to the input terminals.

2. Select the dc voltage function (V̄).

3. Use a Digital Voltmeter (DVM) to check the battery voltage at the battery connector (battery voltage must be above 6.3V). If battery voltage is less than 7.5V, battery replacement is advised. Normal current drain is less than 600 μA.

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 (3V 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 1.6V dc$\pm$0.1V. 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 (V̄), then apply a 2V dc input through the volts/ohms/diode-test input terminal.

2. Using a DVM, measure the 2V input at the input terminal (J1).

3. Check pin 1 of the input divider (Z1) for 2V dc. If 2V dc is not present, R2, S1, RJ1, RJ2, RJ3, RJ4, or RJ5 may be defective.

Table 3-3. 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 dc signal tracing in paragraph 3-25.	R2, 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, F3, 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	RJ2-RJ5
Ohms inaccurate		Z1, U1
Intermittent display	Clean connectors and connector strips on LCD and pcb.	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 on scale and OL		R2, RT2

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 25/27 OPERATOR'S MANUAL BEFORE PERFORMING THE FOLLOWING PROCEDURE.

1. Select the ac voltage function ($\tilde{V}$) 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 2.7V ac at 100 Hz.
4. Adjust R7 to obtain a display of 2.700V ac ±0.001V ac.
5. Program the DMM Calibrator output for 270V ac at 10 kHz.
6. Adjust C4 to obtain a display of 270.0V ac ±0.1V ac.
7. Program the DMM Calibrator output for 1000V ac at 10 kHz.
8. Adjust C10 to obtain a display of 1000V ac ±1V ac.
9. Program the DMM Calibrator output for 27.00V ac at 10 kHz.
10. Adjust C8 to obtain a display of 27.00V ac ±0.01V ac.
11. Program the DMM Calibrator output for 2.700V ac at 10 kHz.
12. Adjust C6 to obtain a display of 2.700V ac ±0.001V ac.
13. Program the DMM Calibrator output for 2.700V ac at 100 Hz.
14. Verify that the UUT display indicates 2.700V ac ±0.017V 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 3-10 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 Figure 3-3 and to the schematics in Section 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.

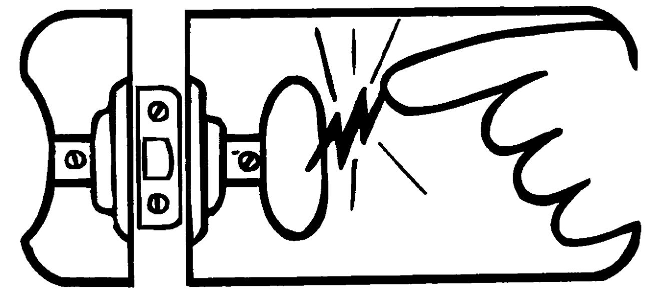
3-24. Overall System Check

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 3-3 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 pcb/shield assembly from the instrument. (Skip step 5.)
   b. Perform steps 21 through 23 of the disassembly procedure to remove the top and bottom shields from the main pcb.
   c. Perform step 14 of the reassembly procedure to install the main pcb in the top case.

static awareness

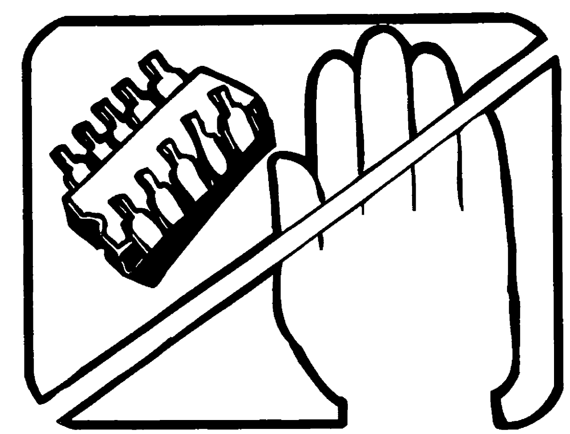
A Message From
Fluke Corporation



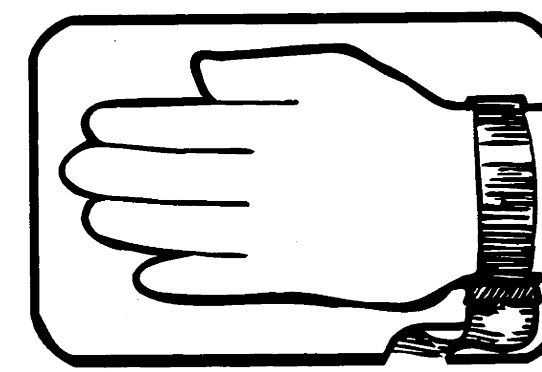
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

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

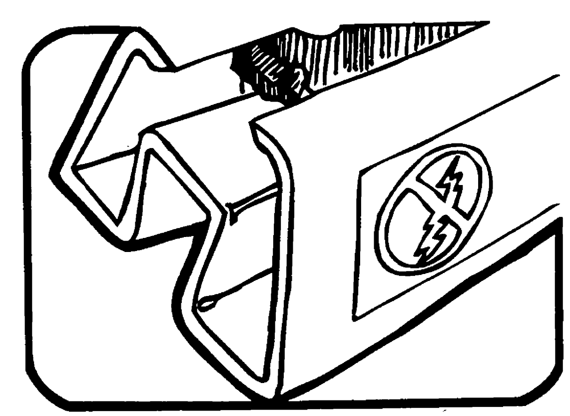
The following practices should be followed to minimize damage to S.S. (static sensitive) devices.



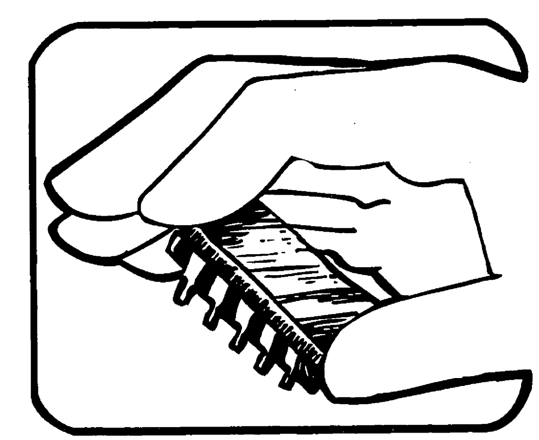
1. MINIMIZE HANDLING



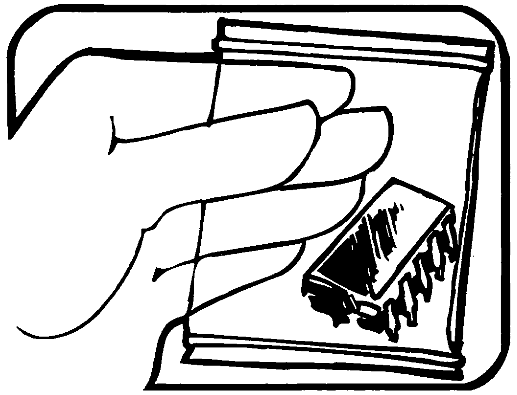
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



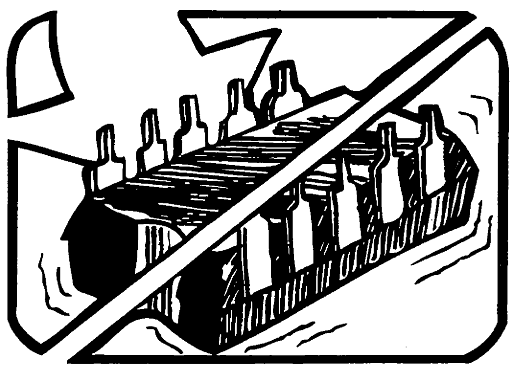
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



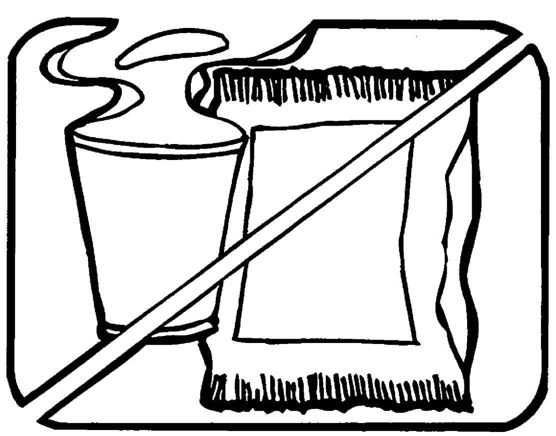
4. HANDLE S.S. DEVICES BY THE BODY.



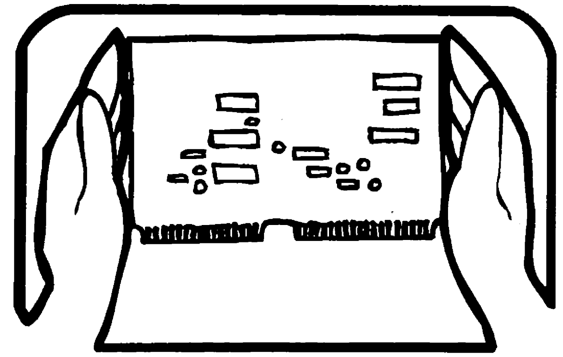
5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT.



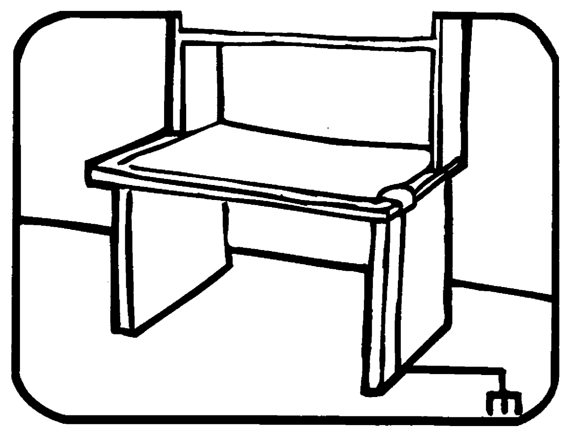
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE.



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



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



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

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

11. ONLY GROUNDED-TIP SOLDERING IRONS SHOULD BE USED.

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 0.090V, then push the 50Ω divider override button on the Calibrator to place the Calibrator in the 2V range.

5. Verify that the UUT indicates approximately 0.090V and the beeper is sounding a continuous tone.

6. Increase the DMM Calibrator output to 0.11V. The beeper should turn off.

7. Increase the Calibrator output to 1.0V, then slowly decrease the Calibrator output to 0.6V. Note that the UUT beeper produces a short beep as the voltage descends through 0.7V (typical silicon diode threshold).

3-18. CALIBRATION ADJUSTMENT

Under normal operating conditions, the Fluke 25 and 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 25 and 27 are 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 section, and then reconnect the battery to the UUT's battery connector.

3-20. DC Voltage Calibration

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 (V̄) on the UUT.

3. Switch on power to the DMM Calibrator, and program the Calibrator output for 2.700V dc.

4. Adjust potentiometer R19 on the UUT for a display indication of 2.700V on the 3V range.

5. Program the DMM Calibrator for zero output, and disconnect the Calibrator from the UUT.

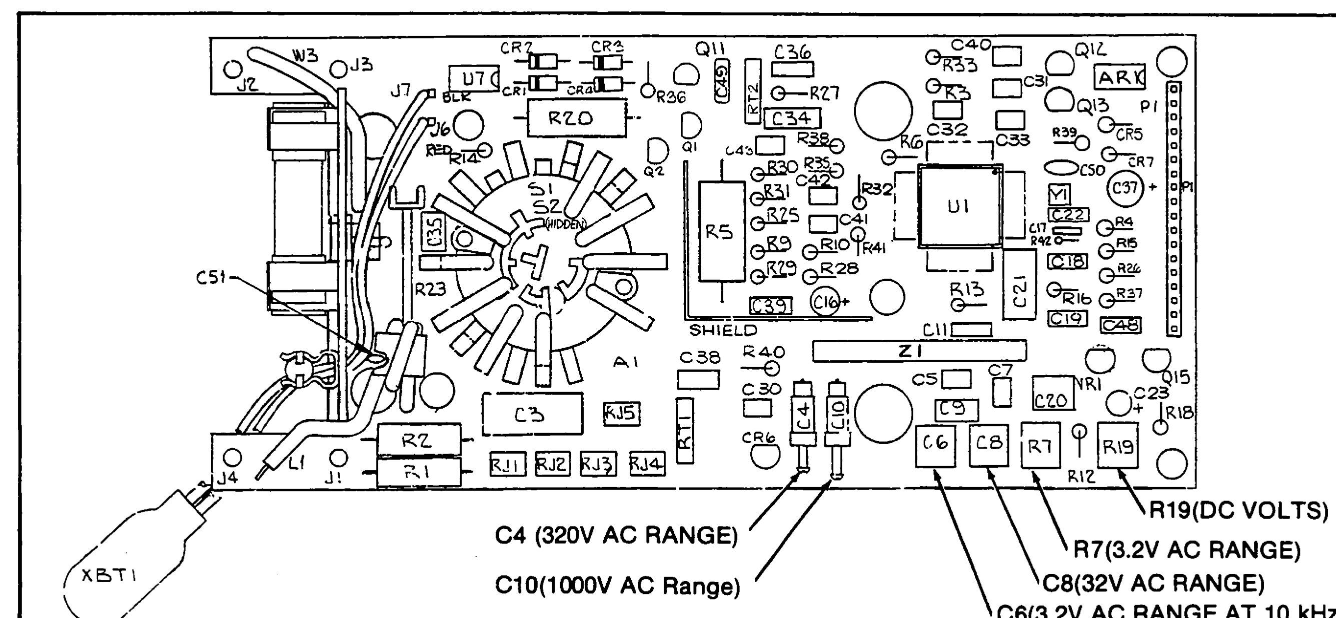


Figure 3-4. Calibration Adjustment Locations

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 μA function (μA), then program the DMM Calibrator output for 2000 μA at 500 Hz.
9. Verify that the UUT indicates between 1968 and 2032 μA.
10. Program the DMM Calibrator output for zero amps.
11. Disconnect the DMM Calibrator from the UUT, connect the DMM Calibrator to the Transconductance Amplifier, then connect the Transconductance Amplifier 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 an output from the Transconductance Amplifier of 5A at 1 kHz.
13. Verify that the UUT indicates between 4.91 and 5.09A. Program the DMM Calibrator to standby.
14. Set the UUT to the dc mA/A function (mA/A).
15. Program the DMM Calibrator output for an output from the Transconductance Amplifier of 5.0A dc.
16. Verify that the UUT indicates between 4.94 and 5.06A.
17. Program the DMM Calibrator to standby.
18. Disconnect the DMM Calibrator from the Transconductance Amplifier.
19. Turn the function switch on the UUT to the dc mA/A position (mA/A).
20. Connect the DMM Calibrator output to the UUT mA/μA input terminal, then program the DMM Calibrator for an output of 27 mA dc.
21. Verify that the UUT indicates between 26.78 and 27.22 mA.
22. Program the DMM Calibrator output for 2700 μA dc. Set the UUT to the dc μA function (μA).
23. Program the DMM Calibrator for 2.7 mA.
24. Verify that the UUT indicates between 2678 and 2722 μA.

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 Ω 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 3-2. Ohm Function Performance Test

STEP	INPUT RESISTANCE	DISPLAY INDICATION
1	100 ohms	99.5 to 100.5
2	1000 ohms	.997 to 1.003k
3	10,000 ohms	9.97 to 10.03k
4	100,000 ohms	99.7 to 100.3k
5	1 megohm	.997 to 1.003M
6	10 megohm	9.89 to 10.11M
*7	open circuit	00.00 to 00.10 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 0.9V.)

1. Turn the UUT function selection switch to the diode test function.
2. The UUT should display OL.

Section 3
Maintenance

WARNING

THESE SERVICE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN OPERATOR MAINTENANCE UNLESS YOU ARE QUALIFIED TO DO SO.

3-1. INTRODUCTION

This section 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-7401, 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.

3-2. SERVICE INFORMATION

The Fluke 25 and 27 are warranted for a period of two years 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 of 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 of instruments that are beyond the warranty period. Upon request, a cost estimate will be provided before work is performed on instruments that are beyond the warranty period.

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.

Table 3-1. Recommended Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
DMM CALIBRATOR	Voltage Range: 0-1000V ac, ±.05% Frequency Range: 40-10,000 Hz, ±1% Voltage Range: 0-1000V dc, Accuracy: ±.05% Current Range: 2 mA-2A Accuracy: ±.2% Values: 100 ohm, 1 kilohm, 10 kilohm, 100 kilohm, 1 megohm, 10 megohm Accuracy: ±.05%	John Fluke Models 5100B, 5101B, 5102B, 5215A
TRANSCONDUCTANCE AMPLIFIER	Output Range: 1-10A Accuracy: ±.1%	Fluke Model 5220A

3-3. OPERATOR MAINTENANCE

WARNING

TO AVOID ELECTRICAL SHOCK, REMOVE THE TEST LEADS AND ANY INPUT SIGNALS BEFORE REPLACING THE BATTERY OR FUSES. CLOSE CASE AND REPLACE SCREWS BEFORE USING METER.

3-4. Battery Replacement

NOTE

The Fluke 25 and 27 Multimeters have 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 25 AND 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 THESE INSTRUMENTS MUST BE MADE USING PARTS EXACTLY LIKE THOSE FURNISHED BY JOHN FLUKE MFG. CO., INC. ANY CHANGES IN THE INTRINSICALLY SAFE CIRCUITRY OR COMPONENTS MAY RESULT IN AN UNSAFE CONDITION.

THE FLUKE 25 AND 27 MULTIMETERS WERE TESTED BY THE MSHA FOR INTRINSIC SAFETY IN METHANE AIR MIXTURES ONLY. THE FLUKE 25 AND 27 MULTIMETERS ARE MSHA APPROVED WITH A 9V 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.

The Fluke 25 and 27 are each powered by a single 9V battery (NEDA 1604, 6F22, or 006P). Referring to the 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.)

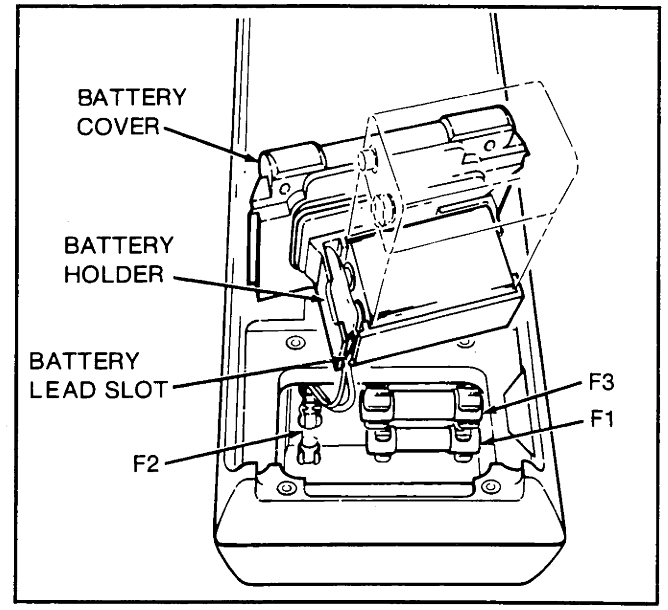


Figure 3-1. Battery and Fuse Replacement

4. Remove the battery from the battery holder, then disconnect the battery connector.
5. Snap the battery connector to the terminals on the new battery, then slide the battery into the battery holder. Slip each battery lead into the slot in the holder.
6. Insert the battery holder/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.

3-5. Fuse Test

1. Turn the function selector switch to the Ω 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 0.1Ω and 0.3Ω. This tests F3 (15A, 600V fast).
4. Move one end of the test lead from the A input terminal to the mA/μA input terminal.
5. The display should indicate between 5.3Ω and 6.0Ω. This tests F1 (3A, 600V fast) and F2 (630 mA, 250V fast).
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 25/27 fuses:

inspection, 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 testing 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 25 and 27 are 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 (Ṽ).
4. Switch on power to the DMM Calibrator, and program it for an output of 2.7V ac, at 100 Hz.
5. Verify that the UUT indicates between 2.684 and 2.716V ac.
6. Program the DMM Calibrator for an output of 27V ac, at 10 kHz.
7. Verify that the UUT indicates between 26.43 and 27.57V ac.
8. Program the DMM Calibrator output for 250V ac, 10 kHz.
9. Verify that the UUT indicates between 244.7 and 255.3V ac.
10. Program the DMM Calibrator for an output of 1000V ac, at 10 kHz.
11. Verify that the UUT indicates between 967 and 1033V ac.
12. Program the DMM Calibrator for an output of zero volts.
13. Turn the UUT function switch to the dc voltage position (V̄).
14. Program the DMM Calibrator output for 2.7V dc.
15. Verify that the UUT indicates between 2.696 and 2.704V dc.
16. Program the DMM Calibrator for an output of 27V dc.
17. Verify that the UUT indicates between 26.96 and 27.04V dc.
18. Program the DMM Calibrator output to 250V dc.
19. Verify that the UUT indicates between 249.6 and 250.4V dc.
20. Program the DMM Calibrator for an output of 1000V dc.
21. Verify that the UUT indicates between 998 and 1002V 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 (mÃ/A).
2. Connect the DMM Calibrator output to the UUT mA/μA input terminal.

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 pcb/shield assembly, fit the top shield (MP9) over the component side of the pcb, taking care not to bend the connector pins. Make sure the shield posts fit through the holes in the pcb, and verify that the rotary switch is in the upper OFF position.

12. Position the bottom shield (MP3) on the back of the pcb with the stand-offs fitted through the pcb, then position the top shield on the top of the pcb with the molded stand-offs fitted through the pcb.

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 pcb/shield assembly into the top case, taking care to ensure that the connector pins on the main pcb are lined up properly with the connector on the digital pcb, and that 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 pcb/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 Posidriv® 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 holder (MP16). Place the wires in the slot in the upper edge of the battery holder.

20. Slide the battery holder/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 Posidriv® 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 pcbs using clean, dry air at low pressure (less than 20 psi). Clean contaminates from the pcbs using isopropyl alcohol and a soft brush, followed by demineralized water and a soft brush (remove the LCD before washing). Dry the pcb 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 TEST

The following procedures allow you to check the performance of the Fluke 25 or 27 against the specifications given in the Fluke 25/27 Operator's Manual. The procedures are recommended for incoming

1. Perform steps 1 through 3 of the battery replacement procedure.

2. Remove the defective fuse (or check continuity through the suspected fuse), and if necessary install a new fuse of the same size and rating. (Remove the battery from the battery holder to gain access to the spare fuse for F2.)

3. Reinstall the battery holder/cover as instructed in step 6 of the battery replacement procedure.

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 pcb (printed circuit board) 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.

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

NOTE

Disassembly requires a number 2 Posidriv ® 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 8025A-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 John Fluke Mfg. Co., Inc. by ordering p/n 812230.

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 Posidriv® machine screws (H6) that hold the battery cover (MP14) to the bottom case, then lift the battery cover and battery holder out of the instrument.

4. Remove the battery and battery connector from the battery holder, then disconnect the battery.

5. Remove the battery holder from the battery cover by tilting the battery holder toward the non-skid foot and sliding it off the battery cover (away from the non-skid foot). 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.

6. Remove the four Posidriv® screws (H7) with rubber washers from the bottom case.

7. 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.)

8. At this point, all calibration adjustments are accessible through the openings in the side of the pcb shield. Refer to the calibration adjustment procedure later in this section to calibrate the instrument.

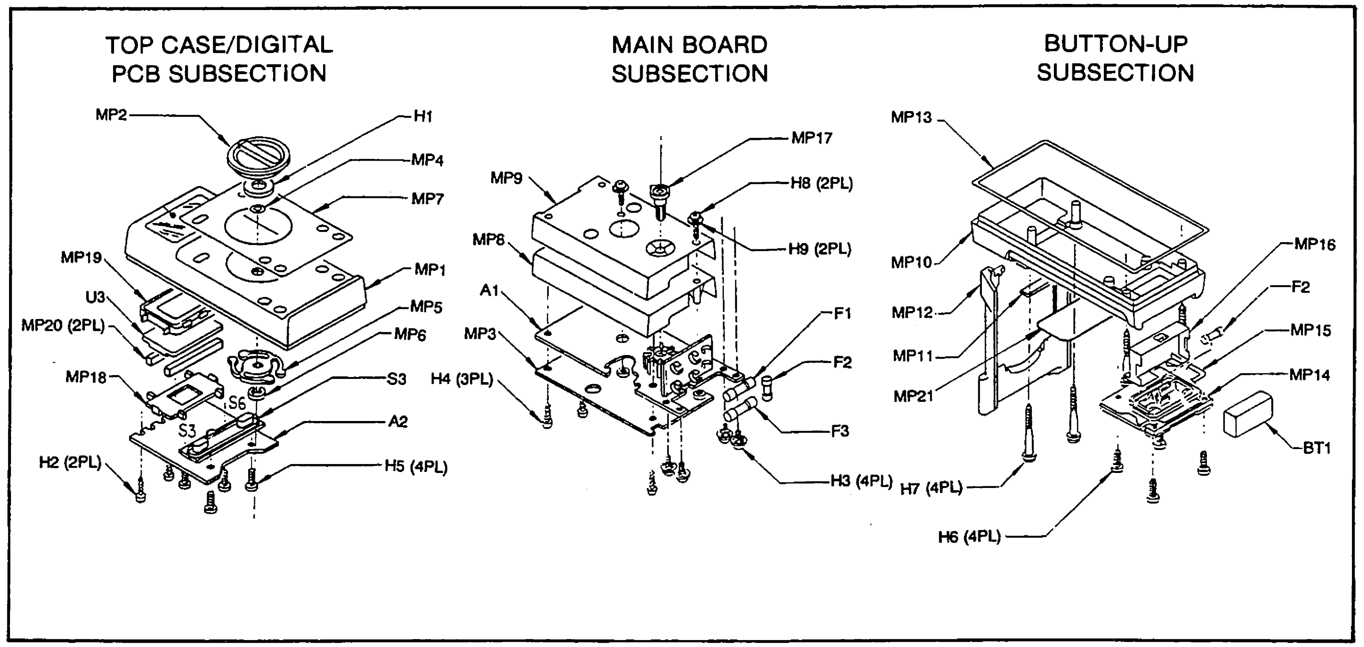


Figure 3-2. Disassembly

9. Remove the four Phillips-head screws (H3) at the bottom of the pcb that connect the pcb to the input terminals molded into the top case.

10. Carefully lift the upper end of the main pcb and shield assembly to disconnect the assembly from the digital pcb, then lift the main pcb and shield assembly clear of the case.

11. 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.

12. Lift the rotary switch extension shaft (MP17) off the rotary switch shaft (the shaft on MP2).

13. Remove the E-ring retainer (MP6) and the detent spring (MP5) from the rotary switch shaft.

14. 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.

15. 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.

16. Remove the four lower Phillips-head screws (H5) that secure the digital pcb 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 pcb, above the connector.

17. Carefully lift the digital pcb 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.

18. Lift the momentary switch (S3-S6) from the top case.

19. Remove the elastomeric LCD contact strips (MP20) and the 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 pcb/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).

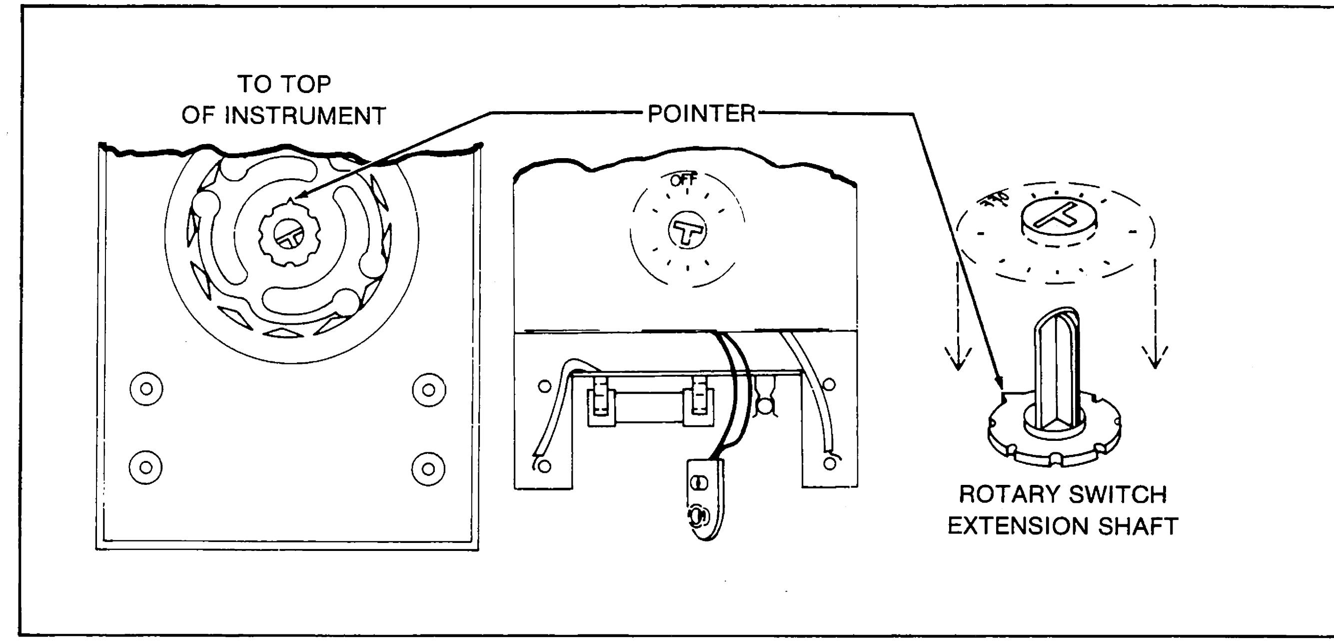


Figure 3-3. Switch Extension Shaft Installation

23. Lay the bottom shield aside, and separate the top shield from the pcb.

24. At this point, all main pcb components are accessible.

3-10. Reassembly

NOTE

Reassembly requires a number 2 Posidriv ® 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 screws and washers for the bottom case. A 2 oz tube of Parker Super-O-Lube can be obtained from the John Fluke Mfg. Co., Inc. 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 one 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 pcb 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 pcb over the momentary switch. Note that the momentary switch provides a seal between the case and the digital pcb. 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 pcb.

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.