FLUKE ®

867B,863

Graphical Multimeters

Service Manual

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Fluke Corporation
P.O. Box 9090
Everett WA 98206-9090
U.S.A

Fluke Europe B.V.
P.O. Box 1186
5602 B.D.
Eindhoven, The Netherlands

5/94

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Chapter 1
Introduction and Specifications

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Introduction 1-1.

This manual includes the following information:

- Specifications (Chapter 1):
- Theory of Operation (Chapter 2):
- General Maintenance (Chapter 3):
- Performance Testing and Calibration procedures (Chapter 4):
- List of Replaceable Parts (Chapter 5):
- Schematic Diagrams and component locators (Chapter 6):

The information in this manual is applicable to both the 867B and 863 models unless otherwise indicated.

Description 1-2.

The Fluke 867B and 863 Graphical Multimeters (GMMs) provide full digital multimeter (DMM) capabilities along with graphical waveform displays and trend plotting. Model 867B also provides component testing and logic activity testing.

Power Requirements 1-3.

The GMM can be powered with the Battery Eliminator or with 6 “AA” (ANSI/NEDA-L40) alkaline cells. New alkaline batteries provide a minimum of 6 hours of continuous operation. You can also use the NiCd battery pack. Depending on battery condition, a fully charged NiCd battery pack provides 8 hours (typical) or less of continuous operation. Internal charging is available on Model 867B.

Table 1-1. Power Sources

	Model 867B	Model 863
Battery Eliminator Operation	•	•
Alkaline Battery Operation (6 AA, ANSI/NEDA-L40)	•	•
NiCd Battery Pack Operation (with internal charging)	•	
NiCd Battery Pack Operation (with external charging)		•

Options, Accessories and Related Equipment 1-4.

Accessories supplied with Fluke 867B and 863 GMMs are listed in Table 1-2.

Table 1-2. Accessories Included with Each GMM

	Model 867B	Model 863
TL70A Test Leads (2)	•	•
Battery Eliminator	•	
NiCd Battery Pack	•	

Operating Instructions 1-5.

Operating instructions for the Fluke 867B and 863 Graphical Multimeters can be found in the Users Manual. For ordering information, see “How to Obtain Parts” in Chapter 5.

Obtaining Service 1-6.

A GMM under warranty will be promptly repaired or replaced (at Fluke’s option) and returned at no charge. See the registration card for warranty terms. If the warranty has expired, the GMM will be repaired and returned for a fixed fee. Contact the nearest Service Center for information and prices. A list of U.S. and International Service Centers is available on the World Wide Web at www.fluke.com. Refer to Chapter 3 for a list of Fluke telephone numbers.

Conventions Used in This Manual 1-7.

The following conventions are used in this manual:

- "GMM" refers to all Graphical Multimeter models in the 860 Series.
- "863" and "867B" are specifically mentioned where a description does not apply to all models in the 860 Series.
- A "pca" is a printed circuit board and its attached parts.
- A pin or connection on a component is specified by the component reference designator, a dash (-), and a pin number. For example, component U30, pin 92 would be U30-92.

Chapter Contents 1-8.

The chapters in this manual document service for the GMM as follows:

- Chapter 1. Introduction and Specifications describes the Service Manual, explains special terminology and conventions, and provides complete GMM specifications.
- Chapter 2. Theory of Operation describes the GMM's circuitry in terms of functional blocks, with a description of each block's role in overall operation. A detailed circuit description is then given for each block.
- Chapter 3. General Maintenance provides information on general maintenance, handling precautions and disassembly instructions. Instructions covering warranty repairs and shipping the instrument to a service center are also contained in this chapter.
- Chapter 4. Performance Testing and Calibration contains information on required test equipment, performance test procedures and calibration of the GMM.
- Chapter 5. List of Replaceable Parts describes parts used in the GMM along with ordering information.
- Chapter 6. Schematic Diagrams contains a full set of schematic diagrams and component locators.

Specifications 1-9.

General

Display: LCD - Dot Matrix, 240 X 200 pixels
Fluke 867B: Transmissive, Backlit
Fluke 863: Reflective

Temperature Operating: 0°C to 50°C (See Figure 1-1.)
Storage: -20°C to 60°C (Batteries Removed)
Charging: 0 to 45°C

Temperature Coefficient: (0.1 X % Accuracy) per °C (0°C to 18°C and 28°C to 59°C)

Relative Humidity: 0% to 90% non-condensing

Altitude Operating/Non-operating: 6,562 ft. (2,000 meters)/ 40,000 ft. (12,200 meters)

Input Impedance: 10 MΩ

Shock and Vibration: per MIL-T-28800, class 3, sinusoidal, non-operating

Dimensions: 5.4 x 9.7 x 2.7 in. (137 x 246 x 68 mm)

Weight: 3 lbs (1.35 kg)

Battery Operating Time (backlight off or low)
Alkaline: 8 hours typical
NiCd:
863: 10 hours typical
867B: 8 hours typical

Battery Recharge Time: 16 hours minimum from full discharge

Drip Proof Case: per IEC 529; IP 52, Drip Proof

Safety: Designed to meet IEC 1010-1 Category III, UL3111, CSA-C22.2. 1010-1-92, CE and TUV requirements

Certification:

Electromagnetic Interference
RF Emissions EN-50081-1 Commercial Limits
VFG 243-1991
FCC Part 15 Class B,
RF Susceptibility: EN 50082-1 Industrial Limits

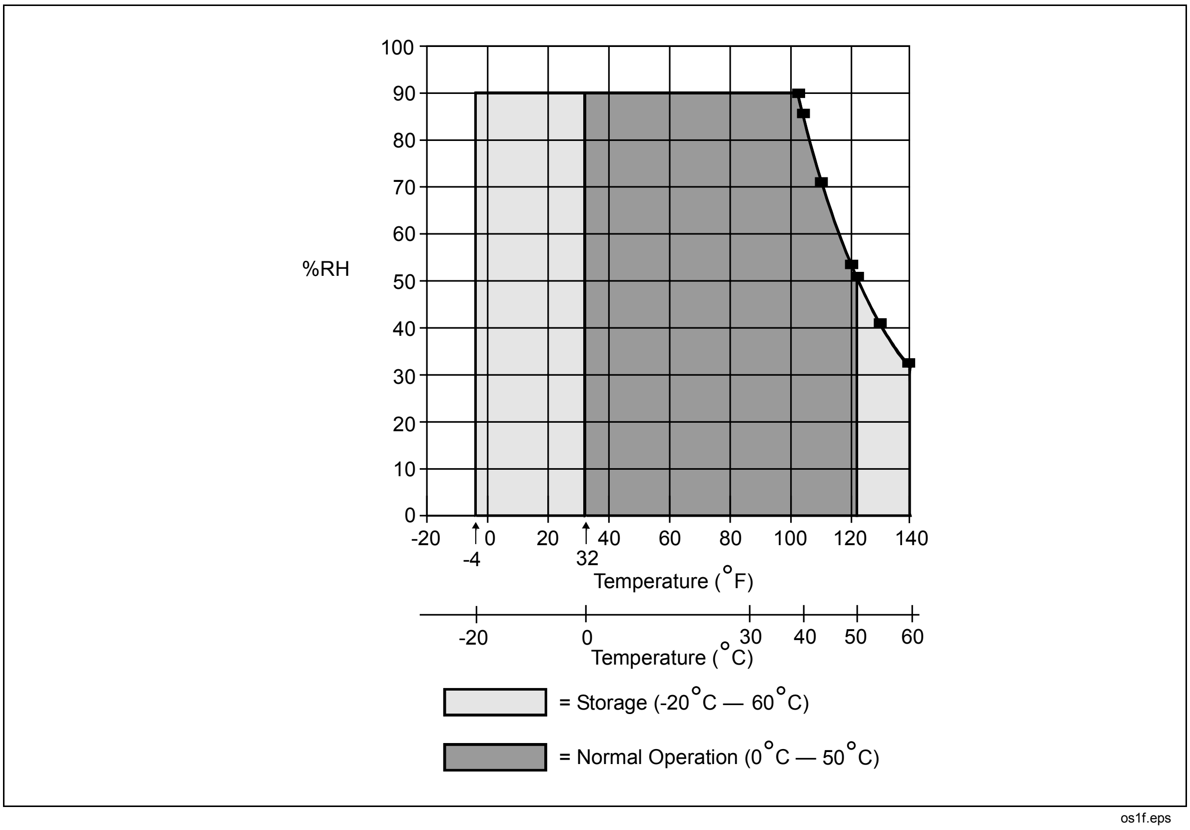

Figure 1-1. Temperature and Humidity

Power

	Fluke 867B	Fluke 863
Battery Eliminator/Charger	Yes	Optional Eliminator only
NiCd Battery Pack	Yes	Optional BP7217 Battery Pack Optional BC7210 Ext. Charger
Alkaline Batteries 6 AA Cells	Optional Customer Supplied	Yes
Battery Life: NiCad Alkaline	≥8 hrs (supplied) ≥8 hrs (optional)	≥10 hrs (optional) ≥8 hrs (supplied)

Resolution and Accuracy

The following specifications apply within 1 year of calibration when operating in a temperature range of 18°C (64°F) to 28°C (82°F).

AC Volts (True RMS, AC-Coupled) [±(percent of reading + counts)]

Range	Res.	Frequency					
		20 - 50 Hz	50 - 1 kHz	1 kHz - 30 kHz	30 kHz- 100 kHz	100kHz- 200kHz	200 kHz- 300 kHz
300.00 mV	0.01 mV	1.5% + 10 0.19 dB	0.5% + 10 0.10 dB	0.5% + 10 0.10 dB	4% + 200 1.39 dB	8% + 200 1.68 dB	10%+ 200 1.82 dB
3.0000V	0.1 mV	1.5% + 10 0.19 dB	0.5% + 10 0.10 dB	0.5% + 10 0.10 dB	4% + 200 1.39 dB	8% + 200 1.68 dB	10%+ 200 1.82 dB
30.000V	1 mV	1.5% + 10 0.19 dB	0.5% + 10 0.10 dB	0.5% + 10 0.10 dB	4% + 200 1.39 dB	8% + 200 1.68 dB	10%+ 200 1.82 dB
300.00V	10 mV	1.5% + 10 0.19 dB	0.5% + 10 0.10 dB	0.5% + 10 0.10 dB	4% + 200 1.39 dB	8% + 200 1.68 dB	10%+ 200 1.82 dB
1000.0V	100 mV	1.5% + 10 0.19 dB	1.5% + 10 0.19 dB	NA	NA	NA	NA
300 mV - 300V ranges ≥3:1, 1000V range ≥3:1 decreasing to ≥1.41:1 as input voltage increases to 1000V (peak voltage not to exceed 1414V). **Measurement Range:** 300 mV range from 10% to 100% of range. 3V - 1000V ranges from 5% to 100% of range. For frequencies > 100 kHz 30% to 100% of range (all ranges).							

AC Volts - Average Responding AC Coupled [±(percent of reading + counts)]

Range	Res.	Frequency			
		20 - 50 Hz	50 - 1 kHz	1 kHz - 30 kHz	30 kH - 50 kHz
300.0 mV	0.1 mV	1.5% + 4 0.25 dB	0.5% + 4 0.16 dB	0.5% + 4 0.16 dB	2% + 4 0.25 dB
3.000V	1 mV	1.5% + 4 0.25 dB	0.5% + 4 0.16 dB	0.5% + 4 0.16 dB	2% + 4 0.25 dB
30.00V	10 mV	1.5% + 4 0.25 dB	0.5% + 4 0.16 dB	0.5% + 4 0.16 dB	2% + 4 0.25 dB
300.0V	100 mV	1.5% + 4 0.25 dB	0.5% + 4 0.16 dB	0.5% + 4 0.16 dB	2% + 4 0.25 dB
1000V	1 V	1.5% + 4 0.25 dB	1.5% + 4 0.25 dB	NA	NA

Input Impedance: 1.11 MΩ ±1% in series with 0.1 µF
Volts-Hertz Product: 2 x 10^7
Common Mode Rejection: >60 dB at 50 Hz and 60 Hz (1 kΩ unbalance)
Common Mode Volts-Hertz Product: 1 x 10^7
dBm Reference: 2, 4, 8, 16, 50, 75, 93, 110, 125, 135, 150, 300, 600, 900, 1000, and 1200Ω
Overload Protection: 1000V rms

DC Volts [±(percent of reading + counts)]

Function	Range	Res.	Fluke 867B	Fluke 863
mV DC	300.00 mV 3000.0 mV	0.01 mV 0.1 mV	0.025% + 2 0.025% + 2	0.04% + 2 0.04% + 2
V DC	30.000V 300.00V 1000.0V	0.001 V 0.01 V 0.1 V	0.025% + 2 0.025% + 2 0.025% + 2	0.04% + 2 0.04% + 2 0.04% + 2

Input Impedance: V DC-10 MΩ, mV DC-10 MΩ, mV DC Hi-Z ->1000 MΩ
Normal Mode Rejection: >60 dB at 50 Hz or 60 Hz
Common Mode Rejection: >120 dB a dc, >90 dB at 50 Hz and 60 Hz (1 kΩ unbalance)
Overload Protection: 1000 V rms
Maximum Allowable Peak AC + DC Voltage (without causing a reading error)
300 mV, 3000 mV ranges: 15V
30V range: 1000V; 300V, 1000V ranges: 1414V

Diode Test (Manual)

Range: 3V
Resolution: 0.0001V
Accuracy: ±0.05% of reading + 2 digits
Open Circuit Voltage: 3.1V

Diode Test (Auto)

Accuracy: 20%

Current Ranges

Ranges for True RMS AC Current and DC Current	True RMS Measurement Range (% Range to % Full Scale)	Ranges for Average Responding AC Current	Maximum Burden Voltage	Fuse Protection
300.00 µA[1]	5% - 100%	300.0 µA	0.03V	440 mA @ 1000V
3000.0 µA[1]	5% - 100%	3000 µA	0.3V	440 mA @ 1000V
30.000 mA	5% - 100%	30.00 mA	0.03V	440 mA @ 1000V
300.00 mA	5% - 100%	300.0 mA	0.3V	440 mA @ 1000V
3.0000A	5% - 100%	3.000A	0.1V	11A @ 1000V
10.000A	5% - 100%	10.00A	0.3V	11A @ 1000V
1. DC ranges available on the Fluke 867B only.				

DC Current Accuracy [±(percent of reading + counts)]

Range	Resolution	Accuracy
300 µA[1]	0.01 µA	0.1% + 15
3000 µA[1]	0.1 µA	0.1% + 2
30 mA[2]	1 µA	0.05% + 15
300 mA	10 µA	0.1% + 2
3A	100 µA	0.2% + 15
10A	1 mA	0.2% + 2
1. Ranges available on the Fluke 867B only. 2. Fluke 863 30 mA DC range accuracy 0.1% + 15.		

AC Current Accuracy [±(percent of reading + counts)]

Range	Resolution		True RMS AC Current Accuracy *(Average AC counts)*[2]			
	True RMS	Avg.	20 Hz to 50 Hz	50 Hz to 3 kHz	3 kHz to 10 kHz	10 kHz to 30 kHz
300 µA[1]	0.01 µA	0.1 µA	1% + 10 *(4)*	0.75% + 10 *(4)*	2% + 20 *(4)*	2% + 40 *(4)*
3000 µA[1]	0.1 µA	1 µA	1% + 10 *(4)*	0.75% + 10 *(4)*	2% + 20 *(4)*	2% + 40 *(4)*
30 mA	1 µA	10 µA	1% + 10 *(4)*	0.75% + 10 *(4)*	2% + 20 *(4)*	2% + 40 *(4)*
300 mA	10 µA	100 µA	1% + 10 *(4)*	0.75% + 10 *(4)*	2% + 20 *(4)*	NA
3A	100 µA	1 mA	1% + 10 *(4)*	0.75% + 10 *(4)*	NA	NA
10A	1 mA	10 mA	1% + 10 *(4)*	0.75% + 10 *(4)*	NA	NA
1. Ranges available on the Fluke 867B only. 2. Replace counts with Average AC counts for Average Responding AC measurements. In 300 µA range, floor count increases to 20 with battery eliminator.						

Conductance [±(percent of reading + counts)]

Range	Resolution	Accuracy	Open Circuit Voltage
300.00 nS	0.01 nS	0.5% + 20	3.2V
3000.0 nS	0.1 nS	0.5% + 20	3.2V
Overload Protection: 1000V rms			

Capacitance [±(percent of reading + counts)]

Range	Resolution	Accuracy
10000 pF[1]	10 pF	1.9% + 20
.1000 µF	100 pF	1.9% + 2
1.000 µF	1 nF	1.9% + 2
10.00 µF	0.01 µF	1.9% + 2
100.0 µF	0.1 µF	1.9% + 2
1000 µF	1 µF	1.9% + 2
10000 µF[2, 3]	100 µF	10% + 900

Overload Protection: 1000V rms

1. 10,000 pF range last digit reads zero.
2. 10,000 µF range last two digits read zero.
3. Using REL to zero internal offset.

Continuity Beeper Values

Range	Beeper On	Beeper Off
300Ω	32Ω	136Ω
3 kΩ	212Ω	725Ω
30 kΩ	1586Ω	4799Ω
300 k Ω	15.3 kΩ	45.5 kΩ
3 MΩ	152.7 kΩ	459.1 kΩ
30 MΩ	66 kΩ	194 kΩ

Resistance [±(percent of reading + counts)]

Range	Resolution	Accuracy	Maximum Current	Open Circuit Voltage
300.00Ω	0.01 Ω	0.07% + 10	1 mA	3.2V
3.0000 kΩ	0.1 Ω	0.07% + 2	120 µA	1.5V
30.000 kΩ	1 Ω	0.07% + 2	14 µA	1.5V
300.00 kΩ	10 Ω	0.07% + 2	1.5 µA	1.5V
3.0000 MΩ	100 Ω	0.15% + 2	150 nA	1.5V
30.000 MΩ	1 kΩ	0.2% + 3	320 nA	3.2V

Frequency

AC Sensitivity

AC Volts		AC Current		
Frequency	**Sine Wave Level**	**Frequency**	**Ranges**	**Sine Wave Level**
2 Hz - 500 kHz	60 mV rms	5 Hz - 30 kHz	300 µA - 300 mA	20% of range
500 kHz - 1 MHz	100 mV rms	5 Hz - 2 kHz	3A	300 mA
1 MHz - 2 MHz*	1V rms	5 Hz - 2 kHz	10A	3A
* Use single trigger mode for inputs above 1 MHz.				

Accuracy [±(percent of reading + counts)]

Range	Resolution	Accuracy
1000.00 Hz	0.01 Hz	0.05% + 2
10.0000 kHz	0.1 Hz	0.05% + 1
100.000 kHz	1 Hz	0.05% + 1
1.00000 MHz	10 Hz	0.05% + 1
2.0000 MHz	100 Hz	0.05% + 1

Duty Cycle

Range: 0.1% to 99.9%

Accuracy: ±(5.2% divided by the pulse width in microseconds + 2 counts) (1 ms = 1000 microseconds).

Period

Ranges: 999.99 µs, 9.999 ms, 99.99 ms, and 999 ms

Accuracy: ±(0.05% of reading + 2 counts)

Pulse Width

Ranges: 999.99 µs, 9.999 ms, 99.99 ms, and 999 ms

Accuracy: ±(5.2% divided by the pulse width in microseconds + 2 counts) (1 ms = 1000 microseconds).

Logic (Fluke 867B Only)

Trigger Levels[1]		
Logic Family	**Low**	**High**
3V CMOS	1.4V	1.7V
5V CMOS	2.6V	2.8V
TTL	1.7V	1.9V

1. Frequency measurements will trigger on the logic family high levels. All measurements are made using the Logic/Ext. Trig. input jack.
2. For frequency > 1 MHz use full logic level.

Frequency Measurements

Frequency	Resolution	Accuracy
1000.00 Hz	0.01 Hz	0.05% + 2
10.0000 kHz	0.1 Hz	0.05% + 1
100.000 kHz	1 Hz	0.05% + 1
1.00000 MHz	10 Hz	0.05% + 1
2.0000 MHz	100 Hz	0.05% + 1
10.0000 MHz	100 Hz	0.05% + 1

Component Test

Frequency	Capacitance
2 Hz	0.72 µF to 72 µF
20 Hz	0.072 µF to 7.2 µF
200 Hz	7200 pF to 0.72 µF
2 kHz	720 pF to 0.072 µF
18.75 kHz	77 pF to 7700 pF

Peak Hold

Captures peak minimums and maximums of signals ≥10 µs.

Accuracy: ±(5% of reading + 30 counts)

MIN/MAX/AVG

Accuracy: add 8 counts to the number of counts in the accuracy table of the selected function.

View Mode Specifications

Horizontal Specifications

Sample Rate: 4.8 Megasamples per second
Sample per Division: 20 per horizontal division
Samples Captured: 512 in Single Shot and Glitch Capture; 256 all other modes

Update Rate: 4 times per second

Time Base

Modes: Single Shot and Recurrent
Ranges: From 4.2 µs per division to 5 seconds per division

Trigger

Types: Internal and External
Coupling: AC, DC and Glitch Capture
External Trigger Impedance: 1 MΩ in parallel with ≤75 pF
External Trigger Input: Logic/External Trigger Terminal
External Trigger Level: ±5V adjustable in ±10 steps

Amplitude Specifications

Amplitude Resolution: 8 bits
Frequency Response (-3 dB)
Volts DC Coupled: DC to 1 MHz
Volts AC Coupled: 3 Hz to 1 MHz

Input Impedance

Refer to the meter mode specifications

Glitch Capture

Glitch Trigger Level: 20% of range 300 mV - 300V
6% of range 1000V

Minimum Glitch Time: 1 µs

Chapter 2
Theory of Operation

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Introduction 2-1.

This chapter describes the functional blocks shown in Figure 2-1. Overall descriptions are broken down into Power Supply, Analog Circuitry, and Digital Circuitry.

For all measurements, inputs (e.g., **VΩ⊣▶⊢** and **COM**) are applied through overvoltage (and overcurrent) protection circuits, switched to an appropriate range, and branched into two signal paths. One path leads first to a Fast A/D Converter (8-bit, 4.8-MHz sample rate) that digitizes the data, then to a digital gate array that stores and processes the data. The other path leads to a Slow A/D Converter (high accuracy, dual slope) in the U30 custom IC. The microprocessor takes data from both the Slow A/D Converter (U30) and the custom digital IC (U24) storage to simultaneously display a waveform and a 4-1/2 digit meter reading. Power supplies include 5.2V dc and -5.2V dc for analog circuitry, 3.3V dc for digital circuits, and VEE (nominally -23V dc) for the LCD module.

Start-Up Sequence 2-2.

The GMM sequences through the following steps when power is applied:

- The 3.3V power supply comes up.
- The reset pin on the microprocessor (U25-1) goes high.
- The microprocessor (U25) begins executing the program stored in EEPROMs U11 and U19.
- LCD controller (U13) data is initialized.
- VEE is turned on (-20V dc), and the display comes on.

Function Selection 2-3.

When the selector is turned to a new function, a rotary switch wiper sets up a resistor divider by grounding the selected resistor in series with R170. The resulting voltage is read by the microprocessor (U25-83).

Power Supply 2-4.

The GMM can be powered with a Fluke BP7217 rechargeable battery pack (6 - 4/3A NiCd cells), 6 AA alkaline batteries, or a battery eliminator. The GMM automatically detects power by source (NiCd battery pack, AA alkaline batteries, or battery eliminator.) Diodes provide reverse polarity protection for the batteries.

The NiCd battery pack recharges in a minimum of 16 hours when the GMM is not operating or at a trickle rate while the GMM is operating. Only cells in the Fluke BP7217 battery pack can be charged internally. Internal charging is not available with Model 863.

Caution

Do not attempt to place other batteries in the BP7217 battery pack; damage to the batteries could result.

A low battery indicator ( ) comes on when battery voltage drops below a preset voltage level. This level is the same for all types of batteries: remaining battery life can vary from minutes to hours, depending on battery type, ambient temperature, and battery history. A low-battery power down can also occur. (No automatic power down occurs when the GMM is powered by the battery eliminator.)

Refer to Chapter 1 for battery and battery eliminator specifications.

Power Supply Input Voltages 2-5.

Refer to Table 2-1.

Table 2-1. Power Supply Inputs

Input Source	Voltage	Lifetime (w/o Backlight)
Line	12 ±5% volts	--
NiCd Battery Pack (Fluke BP7217)	6-10 volts	867B : ≥ 8 hrs typical 863: ≥ 10 hrs typical
Alkaline (6-AA)	5.5-10 volts	≥ 8 hrs typical

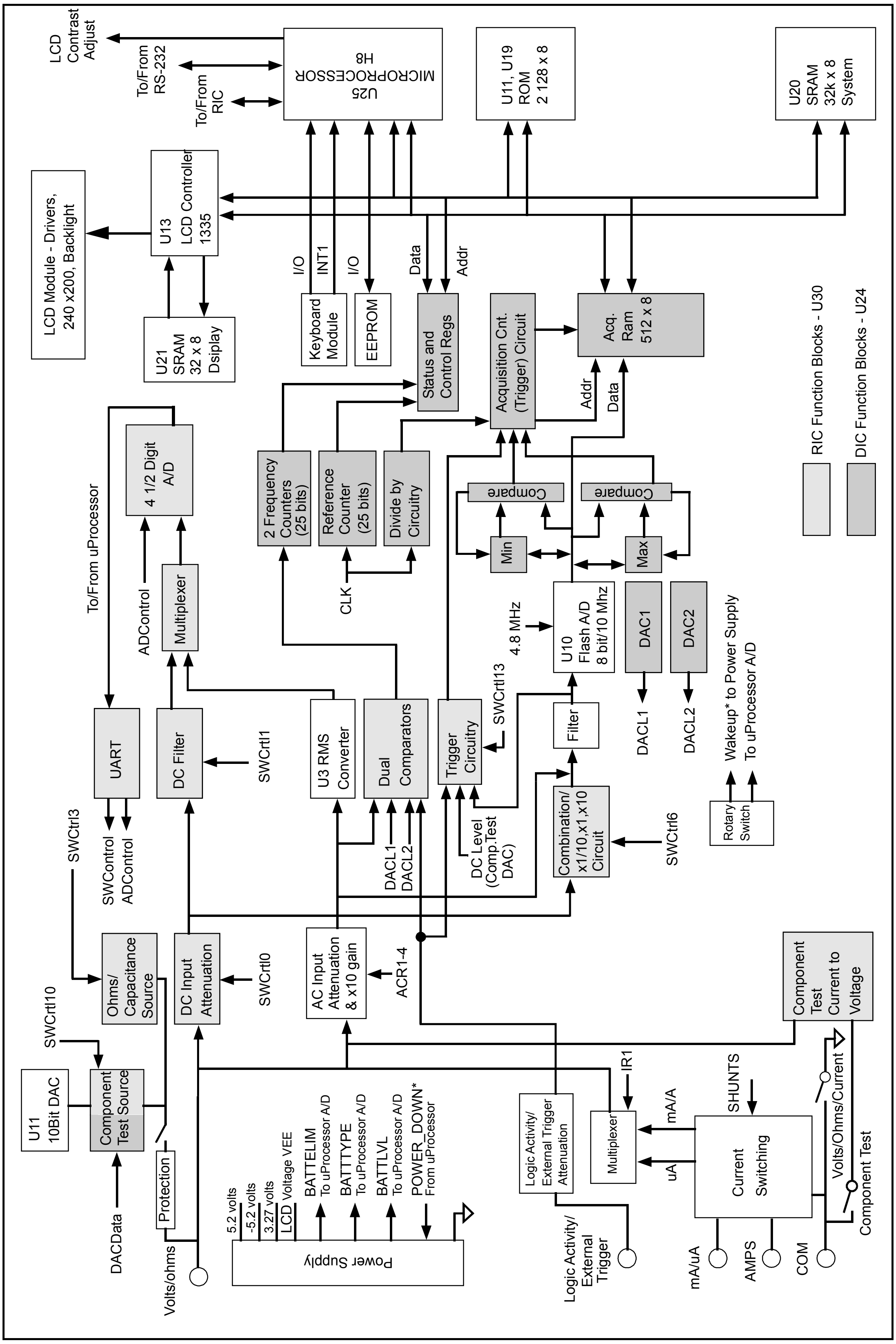

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Figure 2-1. Block Diagram

Power Supply Output Voltages and Currents 2-6.

Refer to Table 2-2.

Table 2-2. Power Supply Outputs

Name	Voltage	Tol ± V	Tol ±%	Ripple (peak to peak)	mA	Power	Notes
VDD	5.2V	0.26	5.0%	50 mV rms**	43 mA	224 mW	0.2V p-p maximum noise to 1 MHz BW
VAD	3.27V	0.07	2.0%	50 mV rms**	12 mA	40 mW	±0.02%/C max
VCC	3.27V	0.07	2.0%	50 mV rms**	82 mA	271 mW	VAD and VCC are tied together, unregulated DC used for IBL+
VSS	-5.2V	0.26	5.0%	50 mV rms**	32 mA	166 mW	0.2V p-p maximum noise to 1 MHz BW
VEE	-20V			na	5 mA	115 mW	TC = -38 mV/°C, center value adjusted and stored at test
IBL+ *	4V		±15%	na	80 mA	264 mW	current for backlight LED, ±15%
IBL-				na			Current Return for IBL+, max 1.5V burden voltage

* IBL is controlled by a linear current source taken from unregulated DC.
** Measured with an 8842A in AC rms mode.

Power Supply Signals 2-7.

Table 2-3. Power Supply Signals

Signal Name	Description
BACKLIGHT_ON*	Control signal generated by U25. In Model 867B, this signal toggles the backlight power levels.
BATT_LVL	Monitors an attenuated (0 to 5V) version of the raw battery voltage. This signal is monitored by the U25 microprocessor A/D Converter. The attenuation factor is 0.0909:1 with an output impedance of approximately 91 kΩ.
BATT_TYPE	Monitors an attenuation level of the battery charging voltage. The attenuation ratio is 0.0901:1 with an output impedance of approximately 91 kΩ. If the measured voltage is greater than 11 volts, the battery is assumed to be an alkaline cell. Voltages 10.5 volts and below indicate that a Fluke BP7217 battery pack has been installed.
BATT_ELIM	This is a contact on the battery eliminator input receptacle. It is pulled to LINE with 5 kΩ and tied to GND4 through 475Ω, forming a 10.51:1 divider. If open (voltage >1.0V), a line-powered battery eliminator has been installed. If closed (shorted to ground), the battery eliminator is not plugged-in or is not powered.
CONTRAST	PWM signal from U25. The frequency is set at U25_SYSCLK/(CLOCK_DIVIDER x COUNTER_LIMIT), yielding 4.8 MHz/(4 x 4096), equaling 293 Hz. The PWM signal has 12-bit resolution, which can vary the duty cycle from 0 to 100%.
IBL+	Current source generated by power supply used to run the LCD backlight. Current source is controlled by the BACKLIGHT_ON* control signal. Typical current level is 80 mA. This is the sourcing node derived from unregulated DC, typically +6.0V (5.8V minimum.)
IBL-	Current return for IBL+, with approximately 1V burden.
POWER_DOWN	Powers down the GMM. Signal is generated by U25. This signal shuts the GMM off completely. Pulled-down to GND with 20 kΩ.
PWR_RESET*	Signal generated by the power supply when the VCC power supply drops below 3.0 volts. The reset lasts 100 milliseconds minimum. If the selector is left in the OFF position or the GMM is powered down, the PWR-RESET* signal restarts the 100 ms time-out period. This signal is pulled up to VCC by 10 kΩ .
VEE_ON	Control signal generated by U25. Turns the VEE power supply on and off. Pulled down to ground by 100 kΩ .
WAKEUP*	This signal is generated by both the rotary selector switch and the WAKEUP button. Upon going LOW, followed by a return to HIGH, the GMM powers up. In the OFF position, this feature is overridden by the OFF switch.

Power ON/OFF Requirements 2-8.

The GMM is turned off when the selector is rotated to OFF. If the selector is immediately rotated beyond OFF, the GMM does not turn off. If the selector remains in OFF for 125 ms, GMM software recognizes a valid OFF signal. If the selector remains in the OFF position for more than 250 ms and an OFF signal is not generated, a hardware timeout occurs and the GMM powers off.

The signal PWR_RESET* goes true (LOW) immediately when a software OFF signal or hardware timeout is generated. This action forces a complete restart sequence, with PWR_RESET* remaining low for at least 100 ms.

After a software OFF signal has occurred, turn the GMM on by rotating the selector to any function or by pressing ☼ (the WAKEUP button.). If a hardware timeout has occurred, pressing ☼ does not turn the GMM on; the selector must be rotated to a new function.

NiCd Charging Requirements 2-9.

Models 867B use an internal two-state charger. The initial charge state is at approximately 170 mA (±30 mA) to allow for full overnight charging (16 hours minimum). The second charge state is at approximately 40 mA (±15 mA) to allow for battery charge maintenance without full charging from a discharged condition.

A timer (reset each time the battery eliminator is plugged in) controls the charge state. The rate shifts to 40 mA after approximately 16 hours of accumulated charge time.

The 40-mA rate is used with batteries below approximately 6 volts to limit the amount of power dissipated when a completely dead battery pack is used. After this 6-volt cutoff point has been reached, the GMM starts charging at 170 mA.

Battery and Line Level Detection 2-10.

The BATT_LVL signal is an attenuated version of the battery and charging voltages. Table 2-4 summarizes the values to be used by the software to control LOW BATTERY detection and SOFT SHUTDOWN. After LOW BATTERY is detected, the backlight is turned off and backlight control is disabled.

Table 2-4. Power Source Detection

POWER TYPE	DETECTION	LOW BATTERY	SOFT POWER-OFF	SCALE FACTOR
Battery Eliminator connected	BATT_ELIM ≥ 1.0 Volts	na	na	0.0951
NiCd Battery Pack installed	BATT_TYPE 5 ≤ V ≤10.5 Volts	6.2V	5.7V	0.0909
Alkaline (AA) Batteries installed	BATT_TYPE V ≤ 4.5 or V ≥ 11 Volts	6.2V	4.8V	0.0909

Power Supply Functional Blocks 2-11.

Refer to the Schematic Diagram in Chapter 7 during the following discussion. The power supply consists of the circuit blocks listed below. Each block is identified with a letter (A-J) keyed to Figure 2-2.

- Input power selector (A)
- Boost Preregulator (B)
- NiCd battery charger and timeout (C)
- DC-DC Converter (D)
- Backlight current sink (E)
- Power switch, wake-up and power down circuitry (F)
- LCD contrast control and temperature compensator (G)
- Power on reset (H)
- Linear post-regulators (I)
- +5 volt bias supply (J)

Input Power Selector (A) 2-12.

The input power selector automatically selects either battery eliminator power (line) or battery. If a battery eliminator is connected to the GMM, +12 volts (±5%) is applied through line filter FL1 to the anode of CR21. This 12 volts turns on Q13, which pulls down the gate of Q14, turning it on. Current can then flow from the battery eliminator to the boost circuit (B). Note that CR22 is back-biased.

If an eliminator is not connected, Q13 is off. Current is not allowed to flow through Q14 until Q12 is turned on. Q12 is turned on when enough voltage remains on the battery to supply the bias regulator (J) and the power wake-up circuitry is enabled. When the GMM is off (with no eliminator connected), Q14 is off and only the bias supply draws current. The maximum off-state current draw is 100 µA.

CR21 and CR22 perform the power selection process.

Boost Preregulator (B) 2-13.

The boost preregulator outputs +15 volts from an input of +12 volts from the battery eliminator or 5.5 to 10 volts from the battery.

U27 provides this boost in conjunction with L1, CR20, and C3. If U27 is not functioning, the voltage at the positive of C3 is approximately 0.4 volts below the voltage on C90. R114 provides peak current limiting to prevent rapid burnout of the boost circuit in the event of an overload. Since R114 requires a functional U27, it does not provide complete protection. R12 and R73 set the output voltage, while the other discrete components provide timing and compensation for the regulator.

The output of this stage is delivered to the NiCd battery charger (C) and to the DC-DC converter (D). R125 allows the charger and boost circuit to be tested independently of the rest of the GMM. R125 is especially useful if a large load causes <15 volts at the cathode of CR20.

Battery Charger (C) 2-14.

The battery charger consists of the following two sections:

- Q22 and its associated components provide a linear current source of either 170 mA or 40 mA to charge the NiCd battery. Transistors Q1, Q2, Q3, Q6, and Q11 provide logic control of the charger state.
- The other part of the circuit is U32 and its associated components, which provide a timeout of at least 16 hours to prevent continuous overcharging of the battery. This circuit is reset each time a battery eliminator is plugged in (via U34, R141, R140 and C91).

A full charge of approximately 170 mA can only be provided to the battery if Q1, Q2, and Q6 are turned on, Q3 is off, and Q11 is off. These states correspond to the GMM being connected to line but turned off and U32 not being timed out. U32 is inhibited from advancing by CR5 when power is on.

VR1 prevents Q2 from turning on until the battery voltage rises above about 5.8 volts. This prevents excessive power dissipation in Q22 with a dead battery or shorted cells.

Note

The Fluke battery pack (BP7217) uses an extra wire to allow charging current to flow. If individual batteries are installed, no connection is made, and no charging current can flow.

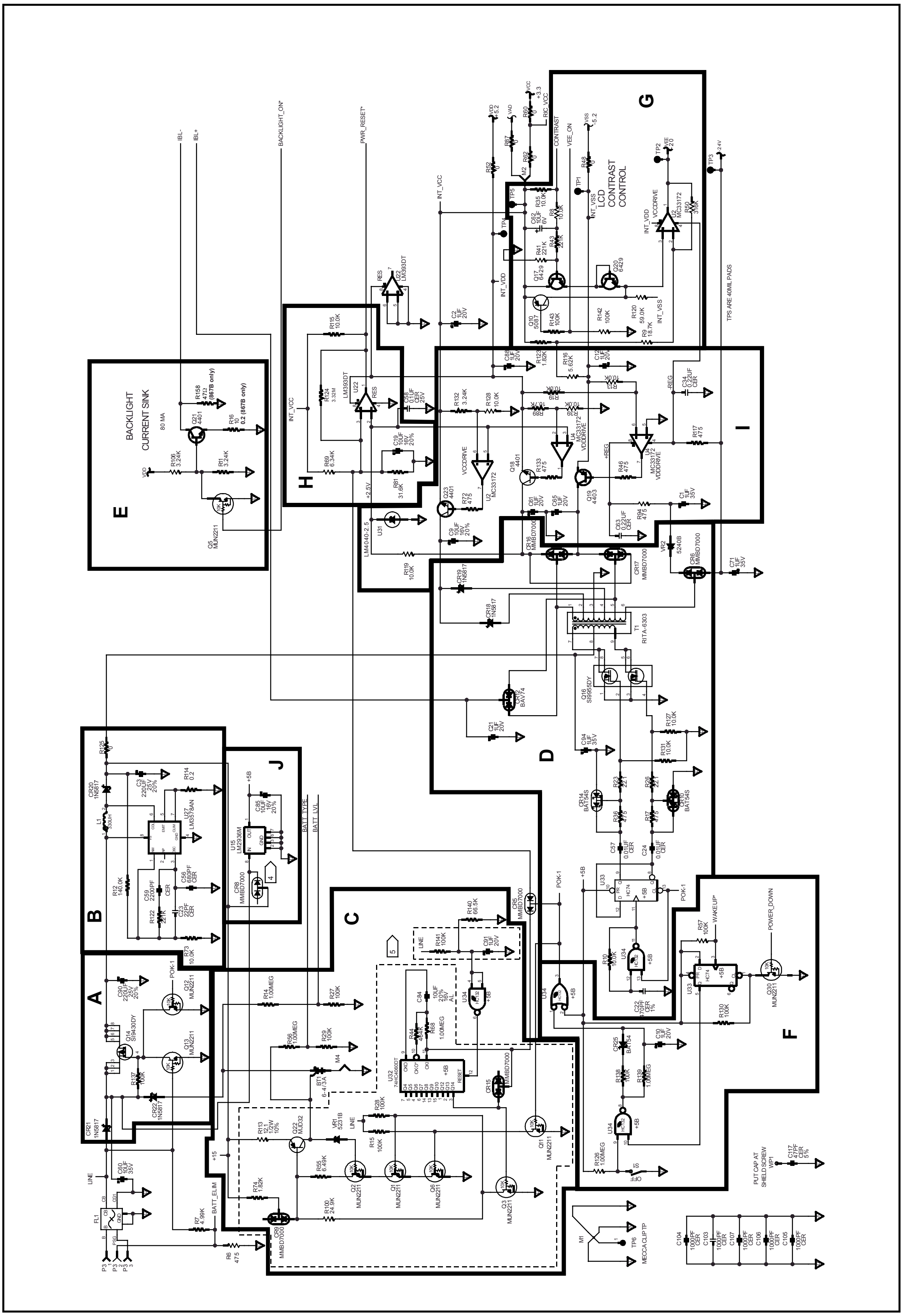

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Figure 2-2. Power Supply Blocks

DC-DC Converter (D) 2-15.

The DC-DC converter is a conventional push-pull transformer couple type. The center tap of T1 is fed from the +15 from the boost preregulator. Q16 drives one side or the other of the primary to ground at the rate of approximately 100 kHz, determined by the oscillator (U34, R10, and C22) and a divide-by-2 flip-flop (U33). This provides a 30-volt peak-peak signal on the primary of T1.

Diodes CR14 and CR10 and associated components use the 50% square wave from U33 to produce non-overlapping signals for the gate drives of Q16. Capacitors C24 and C57 ac couple the drive signal to prevent a stopped clock from causing burn out of Q16.

The outputs of the secondary windings are rectified and filtered to provide the raw DC voltages needed by the linear post-regulators (I). The output of CR12 is filtered by C21 and provides the raw compliance voltage required by the backlight current sink (E).

Backlight Current Sink (E) 2-16.

The backlight current sink is enabled by BACKLIGHT_ON* going low, which turns off Q5, allowing its collector to go open. Voltage is then applied to the base of Q21. R16 turns this voltage, minus one base-emitter drop, into a current. This current flows in the collector circuit of Q21, consisting of the raw voltage from C21 and the LEDs in the LCD backlight. The tolerance on this current is approximately ±33% and is nominally 90 mA.

Power Switch Circuitry (F) 2-17.

S1 (the rotary selector switch) is closed when it is in the OFF position. To turn on the circuitry, U34 and its associated components are used to generate a POK-1 signal, which turns on the GMM. R138, CR25, R139, and C10, in conjunction with U34, provide fast turn-on (R138 and CR25) and slow turn-off (R139 and C10). This slow turn-off time allows you to rotate through the OFF position on the selector without turning the GMM off. If a POWER_DOWN command is sent to Q30, U33 is cleared, overriding the switch command and shutting down the power supply. The WAKEUP* line resets U33, allowing the GMM to restart. Note that this circuitry is powered from the bias supply.

LCD Contrast Control (G) 2-18.

The LCD contrast control is enabled from the microprocessor by a high level (+3.3) on the VEE_ON line. The level of VEE is determined by a pulse-width modulated signal on the CONTRAST line. The voltage at VEE varies from approximately -24 volts to -14 volts as the pulse width is varied from 100% to 0%. This voltage allows control of the LCD contrast.

The actual voltage applied to VEE is the average PWM voltage, minus two diode drops (Q17 and Q20), and times the gain of U2.

Since the voltage required to achieve optimum contrast is a strong function of temperature, the gain of U2 is selected so that the two-diode drop temperature coefficient of about -4.6 mV/C compensates for the change in contrast. This gain is about 16.7, corresponding to a change of about -77 mV/°C at the VEE output.

U2 is provided with power supplies of +5.2 regulated and approximately -24 unregulated.

Power-On Reset Circuit (H) 2-19.

The power-on reset circuit receives a +2.5 reference voltage powered by the unregulated output of the converter. The trip threshold for comparator U22 is set by R69 and R81 for a 3 volt minimum value for VCC. C19 delays this trip for at least 100 ms after power is applied to the GMM. CR5 assures that the cycle is completely repeated by discharging C19 at power down.

Linear Post Regulators (I) 2-20.

The output voltages from the rectifiers on the DC-DC converter are set about 0.6-1.0 volt higher than the required output levels. The linear regulators used here are op amps with transistor emitter follower outputs. The transistors increase the power available to drive the load. Since the op amps are driven from the raw DC voltages (U4) or a combination of the raw voltages (-24) and a higher regulated voltage (+5.2, for U2), the base of the transistors can be driven high enough to allow the transistors to be nearly in saturation. This method allows the circuit to regulate with minimal voltage drop across the regulators, thus saving power.

All of the regulators derive their voltages from U31 (the 2.5-volt reference.) The circuit comprised of U2, Q23, R132, and R128 amplifies by 1.325, giving an output of a nominal 3.31 volts. The circuit of U4, Q18, R89, and R39 amplifies by 2.07, giving an output of a nominal 5.175 volts. The circuit of U4, Q19, R19, and R13 amplify the output of Q18 by -1 (inverting) to provide a nominal -5.175 volts.

The 475Ω resistors in the base circuit of each transistor provide current limit.

Note

The SOT-23 transistors used in this circuitry cannot handle short circuits at their outputs. Momentary shorts due to probing will damage these devices.

Zero ohm resistors R52, R87, R62, R48, and R60 provide isolation of various circuit blocks. R60 can be used to disable most of the digital circuitry if trouble is suspected in the digital hardware. The other resistors allow separation of the analog loads going to the A/D Converter and analog circuits.

Input Overload Protection 2-21.

All ranges and functions of the 860 series are designed to meet or exceed IEC 1010-1, 1000V, CAT III protection.

Volt/Ohms Input Protection 2-22.

The Volt/Ohms input (**VΩ**⊣▶⊢) incorporates three separate protection circuits. In each circuit, a series impedance provides current limitation, and a shunt voltage clamp prevents overvoltage.

- The High Voltage DC Path is used for DC measurements in the 30V, 300V, and 1000V dc ranges. A 10-MΩ resistor in the Z5 resistor network provides current limiting for this path. Internal clamp diodes on U30 hold the low end of this resistor within a diode drop of the ±5V supplies. Zener diodes VR4 and VR5 provide the return path to common from the 5V supplies during an overload.

- The Millivolt Sense Path is used for DC measurements in the 3V and 300 mV dc ranges, and for all Ohms, Diode Test, and Component Test measurements. This path uses two 100-kΩ resistors (R99 and R20), two metal-oxide varistors (RV2 and RV3), and internal clamp diodes (U30).
    1. When S1 is open, the varistors clamp the voltage below 2500V to prevent an arc condition at the rotary selector switch (S1). R99 limits the current in the varistors.
    2. When S1 is closed, the clamp diodes in U30 become the voltage clamps. R99 and R20 are then used to limit current. In mV DC, Diode Test, Ohms, or Component Test, a steady-state high voltage overload encounters a 200-kΩ input impedance.
- The Source Path is used any time the GMM is sourcing current to a device under test and for AC-coupled voltage measurements. R103 and RT1 (in series) provide the current limitation for this path. When S1 is open (volts measurements), two varistors are used as overvoltage clamps (RV1 and RV2). In Component Test, S1 is closed, and Q8 and Q9 become the voltage clamps. In Ohms or Diode Test, S1 closes, and Q7 and Q15 become the voltage clamps. For all of these circuits, the nominal current limiting impedance is 4.6 kΩ. During an overload, however, RT1 transitions to high impedance before the clamp components fail. This circuit has no fusing components, allowing it to fully recover from both high voltage transients and steady-state overloads.

External Trigger and Logic Activity Input Protection 2-23.

The external trigger input receptacle consists of the following two signal paths, each with a separate input protection circuit.

- The DC path is used only for logic activity. A 1.5-MΩ resistor (R91) is used for current limitation. The low end of this resistor is clamped by chip diodes on U30.
- The AC path is used for both logic activity and external trigger signals. The current limitation for this path is provided by R75 (1 MΩ) in parallel with C36 (100 pF). External clamp diodes (CR26) protect U30 from high voltage transients. These clamp diodes hold the low end of R75 within a diode drop from the ±5V supplies. Zener diodes VR4 and VR5 provide the return path to common from the 5V supplies during an overload.

Amps / mA / µA Input Protection 2-24.

Fuses and diode clamps provide overload protection for the Amp and mA/µA input circuits. Both of these circuits are designed to prevent GMM damage from a 1000V unlimited energy source applied at the test leads.

- The Amps input is protected by F1, an 11A, 1000V AC/DC, 17000A breaking capacity fuse.
- The mA/µA input is protected by F2, a 440 mA, 1000V AC/DC, 10000A breaking capacity fuse. Prior to F2 clearing, the clamp diodes CR1 and CR13 protect measurement circuitry from overcurrents.

Input Signal Conditioning 2-25.

AC Volts 2-26.

AC Volts measurements are connected at the **VΩ⊣▶⊢** and **COM** inputs. Input protection is provided by R103 and RT1 for all ranges. Relay K1 connects C31 to the 1.111 MΩ resistor of Z1, which is connected to a virtual ground created by U6. C31 blocks DC voltages. CR3 clamps any over voltages to a safe level for U18. The signal is returned through Ground 3, to TP6, Ground 5, U26, L8, the low leg of R109, and then to the **COM** input.

The following three amplifier stages condition the ac signal for the average and rms converters, the Fast A/D Converter, and the frequency comparators:

- The first amplifier (stage 1) uses op amp U6 in an inverting configuration. The 1.111 MΩ resistor of Z1 is the input. The 111.1-kΩ (0.1 gain) and 1.111-kΩ (0.001 gain) resistors of Z1 are feedback resistors selected by U18 switches. TP25 is the first stage output.
- The second amplifier (stage 2) uses op amp U5 in an inverting configuration. TP25 is the second stage input. U17 selects resistors of Z1 for a gain 1 or 10. TP23 is the second stage output. From TP23 the signal goes through an RC network (C25, R53, and R104) with a gain of either 1 (all ranges except 1000V) or 0.1 (1000V range). The gain is selected by U17.
- The third amplifier (stage 3) uses op amp U8 in a non-inverting configuration. U17-4 is the third stage input. The 3.30-kΩ and 1.18-kΩ resistors of Z3 provide two output gains. The output to the rms converter (TP21) is provided at a gain of 4. The output to the Average converter (U30), the Fast A/D Converter (U10), and the frequency comparators (U30) is provided at a gain of 1.

Starting with the conditioned ac signal, the average converter produces a dc voltage equal to the average value of the full wave rectified ac signal multiplied by 1.111. The average converter uses an op amp in U30 (the analog processor) in an inverting configuration. Direct output from U8 provides the converter input and is routed through dc blocking capacitor C8 and the 20-kΩ resistor of Z3 to U30-97, which is a virtual ground. The 22.2-kΩ resistors of Z3 provide the feedback. The 22.2-kΩ resistor connected to U30-95 provides feedback for the positive portion of the signal and the 22.2-kΩ resistor at U30-94 provides feedback for the negative portion. The dc voltage (the differential across U30-94 and U30-95) is routed to the active filter and the Slow A/D Converter in U30. See Table 2-5.

All VAC ranges use the 300 mV Slow A/D Converter ranges.

Table 2-5. Average Converter (part of U30)

Range	Stage 1 Gain	Stage 2 Gain	RC Net Gain	Stage 3 Gain	Converter Gain	DC Divider Gain	Total Gain
300 mV	0.1	10	1	1	1.111	1	1.111
3V	0.1	1	1	1	1.111	1	0.1111
30V	0.001	10	1	1	1.111	1	0.01111
300V	0.001	1	1	1	1.111	1	0.001111
1000V	0.001	1	0.1	1	1.111	1	0.0001111

The rms converter (U3) provides a dc voltage equal to the rms value of the conditioned ac signal. Input to the rms converter is from TP21 through dc blocking capacitors C69 and C68. Output of the rms converter goes through a dc divider gain of 0.25 created by the 4.95-kΩ and 1.65-kΩ resistors of Z3. The output from this divider is used for precharging the Slow A/D Converter through U30-67 (the analog processor). The output also goes to an RC filter (R30 and C26) and then on to the Slow A/D Converter at U30-66 (TP17). See Table 2-6.

Table 2-6. RMS Converter (U3)

Range	Stage 1 Gain	State 2 Gain	RC Net Gain	Stage 3 Gain	Converter Gain	DC Divider Gain	Total Gain
300 mV	0.1	10	1	4	1	0.25	1
3V	0.1	1	1	4	1	0.25	0.1
30V	0.001	10	1	4	1	0.25	0.01
300V	0.001	1	1	4	1	0.25	0.001
1000V	0.001	1	0.1	4	1	0.25	0.0001

Table 2-7. Test Point Voltages
(Full scale input: 30000 counts, 10000 counts for 1000V range)

Range	AC, TP25	AC, TP23	AC, TP21	DC, TP17	DC (Avg VAC), U30-75
300 mV	30 mV	300 mV	1200 mV	300 mV	300 mV
3V	300 mV	300 mV	1200 mV	300 mV	300 mV
30V	30 mV	300 mV	1200 mV	300 mV	300 mV
300V	300 mV	300 mV	1200 mV	300 mV	300 mV
1000V	1000 mV	1000 mV	400 mV	100 mV	100 mV

DC Volts 2-27.

DC Volts measurements are connected at the **VΩ⏵|** and **COM** inputs. **VΩ⏵|** connects directly to the 10 MΩ resistor of Z5, which is connected in series with the 101.01-kΩ (U30-17), 10.01-kΩ (U30-13), or 1.000-kΩ (U30-12) resistor. These total series resistances divide down the input voltage by 0.01, 0.001 or 0.0001 for the 30V, 300V or 1000V ranges, respectively. Switches in U30 select the resistor and pass the conditioned signal on to the combination circuit and the active filter. The input signal is returned through selector contacts S1-4 and S1-7, through R109, and back to the **COM** input. All VDC ranges use the 300 mV Slow A/D Converter range.

mV DC 2-28.

Millivolt DC measurements are connected at the **VΩ⏵|** and **COM** inputs. The input signal goes through input protection resistors R99 and R20 and into U30-21. U30 routes the signal on to the combination circuit and the active filter.

For normal (low impedance) mode, the 10-MΩ resistor of Z5 is connected between the **VΩ⏵|** input and Ground 1 at U30-23. Ground 1 is connected to L8 and through R109 to **COM**. For high impedance (HiZ) mode, the 10-MΩ resistor of Z5 is not connected to ground.

The 300 mV range uses the 300 mV Slow A/D Converter range. The 3000 mV range uses the 3V Slow A/D Converter range.

Ohms 2-29.

Ohms measurements are connected at the **VΩ⏵|** and **COM** inputs. A ratiometric measurement method is used: the same current is sourced through the unknown resistor and a reference resistor. The Slow A/D Converter first integrates the voltage across the unknown resistor, then deintegrates using the voltage across the reference resistor.

The source voltage of either 1.3V or 3V from U30 is applied to one of the range resistors in Z5 (1.00 MΩ, 101.01 kΩ, 10.01 kΩ, or 1.00 kΩ) and the 10-MΩ resistor of Z5. Current flows through the appropriate range resistor to S1-7 and S1-8, then through the protection resistors RT1 and R103 to **VΩ⏵|**. For the 10-MΩ resistor, the current path is from U30-19 through the 10-MΩ resistor to **VΩ⏵|**.

The 30 MΩ range uses the same range resistor as the 3 MΩ range.

The 300 nS and 3000 nS ranges use the same range resistors as the 3 MΩ and 300 kΩ ranges; however, the Slow A/D Converter first integrates with the voltage across the reference resistor, then deintegrates with the voltage across the unknown.

Table 2-8. Ohms Ratiometric Measurements

Range	Source V from U30	To 10 MΩ (U30-19) and Range Resistor	Slow A/D Converter Range
300Ω	3V	1.00 kΩ (U30-12)	300 mV
3 kΩ	1.3V	10.01 kΩ (U30-13)	300 mV
30 kΩ	1.3V	101.01 kΩ (U30-17)	300 mV
300 kΩ	1.3V	1.00 MΩ (U30-14)	300 mV
3 MΩ	1.3V	(10 MΩ only)	300 mV
30 MΩ	3V	(10 MΩ only)	3V
300 nS	3V	(10 MΩ only)	3V
3000 nS	3V	1.00 MΩ (U30-14)	3V

Diode Test 2-30.

Diode Tests are connected at the **VΩ⏵|** and **COM** inputs. Auto Diode and Component Test use a similar measurement method. An AC current (at 3V) is sourced from U1 through U30-12. The current goes through the 1.00-kΩ resistor of Z5, through S1-7 and S1-8, through RT1, and R103 and out **VΩ⏵|**. The voltage is sensed back through the component test path an and into the Fast A/D Converter. The voltage is sensed through R99 and R20, S1-5 and S1-6, and U30-21. U30 routes the signal to the Slow A/D Converter (3V range used.) Software reads the Fast A/D Converter (U10), decides the polarity of the diode, and displays the forward voltage.

Manual diode applies the 3V-ohms source voltage from U30 across a 1-kΩ resistor of Z5 and out **VΩ⏵|**. Manual diode then uses the Slow A/D Converter to measure the voltage at **VΩ⏵|**.

Capacitance 2-31.

Capacitance and ohms measurements use a common circuit configuration. As the capacitor is being charged, the Slow A/D Converter integrates the voltage across the known resistor. When the integrating cycle stops, the charging stops. The Slow A/D Converter deintegration uses the voltage across the known resistor.

mA/µA 2-32.

Milliamp and microamp measurements are connected at the **mA/µA** and **COM** inputs. For the 300 mA and 30 mA ranges, input current flows through L9, F2, K1-4, K1-5, K1-6, R42, and R109 to **COM**. The voltage developed across R42 and R109 is sensed through R151 by U16.

For 3000 µA and 300 µA ranges, input current flows through L9, F2, R49, R42, and R109 to **COM**. The voltage developed across R49, R42, and R109 is sensed through R151 and R148 by U16.

For DC current (mA and µA), voltage is sensed through R82 to U30-9. U30 routes this voltage to the active filter and the Slow A/D Converter.

For AC current (mA and µA), the voltage is sensed though another switch of U16 and routed to the AC path.

Amps 2-33.

Amps measurements are connected at the **A** and **COM** inputs. The current flows through F1 and R109 to **COM**. The voltage is sensed first though R42, then as described above for mA/µA measurements.

Table 2-9. Amps Measurement Paths

Range	Shunt	Slow A/D Converter Range
300 µA	R49, R42, R109	30 mV
3000 µA	R49, R42, R109	300 mV
30 mA	R42, R109	30 mV
300 mA	R42, R109	300 mV
3A	R109	30 mV
10A	R109	300 mV

Waveform Processing 2-34.

Overview 2-35.

An input signal takes AC and DC paths. With AC voltage or AC current functions, the signal is sent directly to the Fast A/D Converter for digitizing. With DC voltage or DC current functions, signals from the AC path and the DC path are recombined to form an AC + DC signal. This combined signal is then applied to the Fast A/D Converter for digitizing. Data from the Fast A/D Converter is then written into the digital ASIC. The microprocessor controls the movement of this data to the display controller and the LCD display.

Detailed Description 2-36.

The AC and DC components of the input signal are recombined at U9-3. U9 is configured as a bandpass filter with a center frequency of 2 Hz (the crossover frequency for the AC and DC signals.) Since the bandpass filter adds gain to the path at this frequency, the frequency response of the overall circuit is improved. An inductor (formed by C27, C95, C51, R76, R85, and the gyrator op-amp located in U30), R86, and C67 make up the feedback network for the bandpass filter.

The following two analog switches allow for control of the signal flow:

- The first switch (U14-1, U14-2, U14-10, and U14-15) interrupts the AC signal.
- The second switch (U14-6, U14-11, U14-12, and U14-13) removes the inductor (the gyrator circuit) from the feedback of U9.

For the DC path, the input signal conditioning circuitry scales the DC input to match the gain factor used by the Slow A/D Converter. (The Slow A/D Converter uses one of three gain factors, as required by the selected function and range.) As a result, a 30-mV, 300-mV, or 3V full scale signal is provided to the Slow A/D Converter.

The AC path is scaled to output 300-mV full scale for all inputs.

For proper recombination with the AC signal, the DC signal provided to the Slow A/D Converter must be scaled to provide 300 mV for all inputs. The necessary DC restoration path is provided by U30, which contains the active circuitry necessary to scale the Slow A/D Converter input by 0.1, 1, or 10. The DC signal to be scaled appears at the input to the guard amplifier. The guard amplifier drives the compensation amplifier, which can be configured for gain by selecting appropriate resistor pairs in Z6. For a gain of 0.1, 200-kΩ and 20-kΩ resistors are selected. For a gain of 1, two 200-kΩ resistors are selected. For a gain of 10, 200-kΩ and 2-MΩ resistors are selected. For a given function and range, the proper gain is thereby selected to provide identical scaling for the AC and DC paths.

The reconstructed (AC + DC) input signal must be given an additional DC bias to center it in the unipolar input range of the Fast A/D Converter (approximately 0.4V to 1.6V dc). R32 and R24 form a divider across the Fast A/D Converter reference circuitry that establishes the midpoint of the Fast A/D Converter input range. A second divider (R78 and R63) then divides the midpoint divider output by 2 to compensate for a gain of 2 in the next part of the circuit (the sum amplifier.) C89 and circuit resistance provide filtering for the output of the second divider.

The sum amplifier in U30 adds the reconstructed AC + DC input and the midpoint bias signal from the second divider.

When the GMM is displaying waveforms, R145 and C99 form a filter that is selected by the analog switch (U14-3, U14-4, U14-5, and U14-9.) The output of this filter is connected to the input of the Fast A/D Converter.

The DC signal to be recombined with the AC signal can be found on TP29. Without any DC input or with the selector in AC and the GMM input shorted, TP29 should read approximately 1V (the center value of the Fast A/D Converter with zero input.)

Note

Test the operation of the comp amplifier by selecting the 300 mV dc range, applying 300 mV dc to the input, and checking TP29 for 1.3V dc

The reconstructed input signal (to be digitized by the Fast A/D Converter) can be observed on TP19. With either the selector in AC or in DC (with the GMM input shorted), the AC portion of the signal has a 1V bias.

Note

When you use an oscilloscope to view the input of the Fast A/D Converter (U10), use a probe with a short (2 inch) ground lead. View the signal between U10-16 (VIN) and U10-20 (GND).

Waveform Triggering 2-37.

Overview 2-38.

The GMM uses software and hardware triggers to control waveform display and frequency counter operation. A software trigger occurs automatically if no hardware trigger has occurred for a fixed period.

The following types of hardware triggers are available:

- Dual Trigger is the default, providing two adjustable thresholds. Dual triggering thereby allows for adjustment of the hysteresis window.
- Single Trigger can also be selected via the GMM Set Up function. Single trigger incorporates a single adjustable threshold with fixed hysteresis.
- External Trigger allows for an external single trigger input at the center GMM input terminal.
- Fixed-threshold trigger applies predetermined Dual Trigger threshold voltages when the GMM is set for Glitch Capture.
- Component Test uses an internally generated digital trigger.

Dual Trigger 2-39.

The trigger is enabled when the digital ASIC (U24) unasserts the trigger holdoff signal on U24-75. The digital ASIC can then recognize a trigger asserted by the analog ASIC on U30-53. The internal trigger signal is derived from the input measurable at TP19, passes through a filter (R1 and C109), and is routed through U30-56 to two comparators in the U30 analog ASIC.

The threshold levels are established by the following two pulse-width modulated digital-to-analog converters (DACs) in the digital ASIC:

- The upper comparator, controlled by DAC2, recognizes signals crossing the more positive of two thresholds. The DAC2 output passes through filter R67 and C79; the filtered DAC2 output can be observed at TP16.
- The lower comparator, controlled by DAC1, recognizes signals crossing the more negative threshold. The DAC1 output passes through filter R80 and C33; the filtered DAC1 output can be observed at TP20.

Use the following procedure to check either of the DACs:

1. Connect a high impedance voltmeter to one of the two test points mentioned above.
2. Vary the trigger level associated with the DAC you are monitoring and look for a corresponding change in DAC level. In order for the trigger output to be set high, a signal must cross both thresholds; therefore, the hysteresis of the dual threshold trigger is adjustable. Trigger slope can be adjusted by pressing [1].

Single Trigger 2-40.

The single trigger circuit uses a single level comparator with built-in hysteresis. The single trigger circuit and the dual trigger comparator use the same internal input signal (TP19.)

The U1 DAC generates the required single threshold voltage for the comparator; this voltage can range from -3.2V to 3.2V. This range is derived from the DAC output current, converted to a -3.2V to 0V signal by the DAC amplifier (U30), C35, and associated feedback resistor (U1), and level shifted by a CT amplifier (U30), R84, R58, and R129.

Check the Single Trigger circuitry with the following procedure:

1. Rotate the selector to Component Test.
2. Check for a 3.2V peak-to-peak sine wave between **VΩ⊣▶⊢** and **COM**.
3. Rotate the selector to Set Up.
4. Select Single Trigger on the Set Up screen.
5. Rotate the selector to AC Volts.
6. Monitor U30-4 and adjust the single trigger threshold level (press [2] and [3].) . The voltage on U30-4 should change as the trigger level is adjusted. Trigger slope can be selected by pressing [1].

External Trigger 2-41.

The external trigger input uses the single level trigger comparator. External trigger inputs, which can range from 0V to 5V, are applied to the divide-by-3 circuit composed of R75, C36, R59, R157, and C100. Divider output is then routed to the single level trigger comparator in U30-37. External trigger threshold voltage is generated in the U1 DAC.

Note

Use a high impedance voltmeter for viewing divider operation.

Glitch Capture 2-42.

A brief spike (glitch) on the input signal can be used to trigger the GMM for a single waveform acquisition. Glitch capture thresholds are fixed at ±10% of the full scale value of the waveform display. For example, in the 3V range the full scale value of the waveform display is approximately ±5V. Therefore, the glitch capture thresholds are ±0.5V. A positive or negative input glitch crossing either of these thresholds causes a trigger.

The input signal to the glitch capture circuit originates at the second AC amplification stage output (TP23.) This signal is routed to a bandpass filter (R38, C30, C102, and R102), through U30, and on to the comparators. DAC1 and DAC2 generate fixed threshold levels for each comparator. The DAC1 output value is inverted within U30 and applied to the positive input of the comparator; this arrangement sets a negative lower trigger threshold. A trigger is generated when either a positive or negative signal from the bandpass filter crosses the appropriate threshold.

Single Shot 2-43.

Single shot enables the user to capture a single event. Either the single level or dual level trigger circuits can be used. There are no circuit differences external to U30.

Frequency Trigger 2-44.

The trigger circuitry also provides transitions so that the digital ASIC can measure frequency. The dual threshold trigger circuitry is normally used to provide transitions for frequency measurement; the thresholds set for triggering also become the thresholds used for frequency measurement.

If the single threshold trigger has been selected, the thresholds used for frequency measurement are fixed and are not related to the threshold used for triggering the waveform acquisition; fixed levels applied to the dual level trigger circuitry establish the trigger thresholds for frequency measurement only.

Logic Activity Trigger 2-45.

Transitions generated by the dual threshold trigger circuit are used by the digital ASIC to measure logic signal frequency. DAC1 and DAC2 fix the trigger threshold voltages based on the type of logic (TTL, +3V CMOS, or +5V CMOS) you select.

Peak Hold 2-46.

The GMM displays the maximum and minimum readings acquired by the Fast A/D Converter (U10) when Peak Hold is activated. While Peak Hold is active, waveform displays are not available and measurements are limited to a band width of 1 MHz. The Peak Hold filter (R144 and C99) is switched into the signal path by analog switch U14-3, U14-4, U14-5, and U14-9.

Auto Diode 2-47.

In the Auto Diode, the GMM displays the voltage drop across a diode and shows a picture indicating polarity encountered. The Fast A/D Converter records data that describes the waveform of the voltage across the diodes under test. A waveform is not displayed to the user. A software algorithm determines the polarity of the diodes. The AC signal sourced to the input terminal is generated in the same manner as the AC signal used for the Component Test function.

Test the auto diode circuit by placing a diode across the input terminals and viewing the input waveform to the Fast A/D Converter (TP19.) A rectified waveform indicates that the analog circuit is working properly.

Component Test 2-48.

Component Test graphs the current vs. voltage relationship encountered when the test probes are placed across an unknown component. All power in the circuit under test must be off to make this test.

Component Test uses the low impedance source path with a ±3.2 volt frequency-selectable sine wave oscillator to provide the voltage stimulus. This stimulus signal is generated digitally on U24 and converted to an analog signal using a 10-bit current output DAC (U1). Two op amps on U30 convert the current output of the DAC into a 6.4 volt peak-to-peak sine wave voltage at U30-4. U30 also provides a single-pole low-pass filter at 82 kHz to remove glitches on the DAC output. The Component Test source is routed to the **VΩ⊣▶⊢** input through R31, RT1, and R103. This gives a nominal output impedance of 11.1 kΩ. This oscillator allows frequencies from 2 Hz to 18.75 kHz.

Component Test uses the 8-bit Fast A/D Converter (U10) to make the current and voltage readings. The voltage sense path is kelvin connected to the volt/ohm input through R99 and R20. The voltage signal is then routed through U30 and divided by 10 at U30-87. A 1V dc bias is added to the signal at TP29. With the gyrator, AC, and peak circuits turned off (U14-10 and U14-11 asserted high, U14-9 asserted low), the signal is routed through U9 to TP19 and into U10-16.

The current readings are obtained through a virtual ground connection between common and the measurement ground (GND3). Any current that flows through a device under test flows into the I-V amp on U30, creating a voltage proportional to the current. For a short circuit between **VΩ⊣▶⊢** and **COM**, the voltage at TP28 is 309 mV rms ±12%. This voltage is routed through U30-87. Like the voltage measurement, a 1V dc bias is added to the signal at TP29; the gyrator, AC, and peak circuits are turned off, and the signal is routed through U9 to TP19 and U10-16.

The current and voltage readings are taken on separate cycles of the oscillator stimulus. The switching between voltage and current takes place entirely in U30.

The two component test modes are described as follows:

- In normal mode, a lissajous is taken every four cycles (for high frequencies, the lissajous requires more cycles due to settling and processing time). On the first cycle, U30 is configured for voltage, and the front end is allowed to settle. On the next cycle, the voltage scan data is acquired and stored in U24. During the third cycle, the voltage data is read by the microprocessor (U25), U30 is configured for current readings, and the front end is again allowed to settle. The fourth cycle is used for collection of the current data by U24.
- In Touch Hold, an additional two cycles are required to complete an “open leads” check.

Digital Circuitry 2-49.

The H8 microprocessor (U25) provides the core of the digital circuitry. The processor fetches instructions from two 128k x8 ROMs (U11 and U19) in 16-bit words. A single 32k x8 RAM (U20) provides system Read/Write memory. A serial 16k-bit EEPROM (U23) provides nonvolatile data storage (setup information, calibration constants, and saved waveforms).

The keypad interfaces directly to the microprocessor through P2; pressing a key generates an interrupt. The microprocessor determines which key is pressed by setting the interrupt pin as an output port and reading the port pins connected to the keypad.

The digital gate array (U24) performs the following functions:

- Decodes addresses to select the device being addressed.
- Generates clock signals. A 19.2-MHz oscillator is divided down to 9.6 MHz for the microprocessor, 4.8 MHz for the Fast A/D Converter, 3.84 MHz for the U30 IC, and 6.4 MHz for the LCD controller.
- Clocks Fast A/D Converter data into high speed RAM (in U24).
- Detects the minimum and maximum readings over a scan.
- Uses frequency counters to determine frequency, pulse width, duty cycle, and period.
- Outputs threshold signals (DAC1 and DAC2). Two pulse-width modulated signals are output by the DIC and, when RC-filtered, become the DAC1 and DAC2 signals used for thresholds.

Component Test also uses U24 to generate a sine wave at different frequencies.

Display hardware includes an LCD controller ((U13), a Display RAM (U21, 32k x8), and an LCD Module, which incorporates row and column drivers. The display controller and system RAM are on the upper 8 bits of data bus (D8-D15).

RS-232 Serial Port 2-50.

Communications with an external computer or printer is accomplished through an isolated RS-232 channel. Microprocessor serial port 2 (U25-95 and U25-96) provides an amplified signal to a photo diode (CR23) for transmission. A photo transistor (Q31) is used for reception.

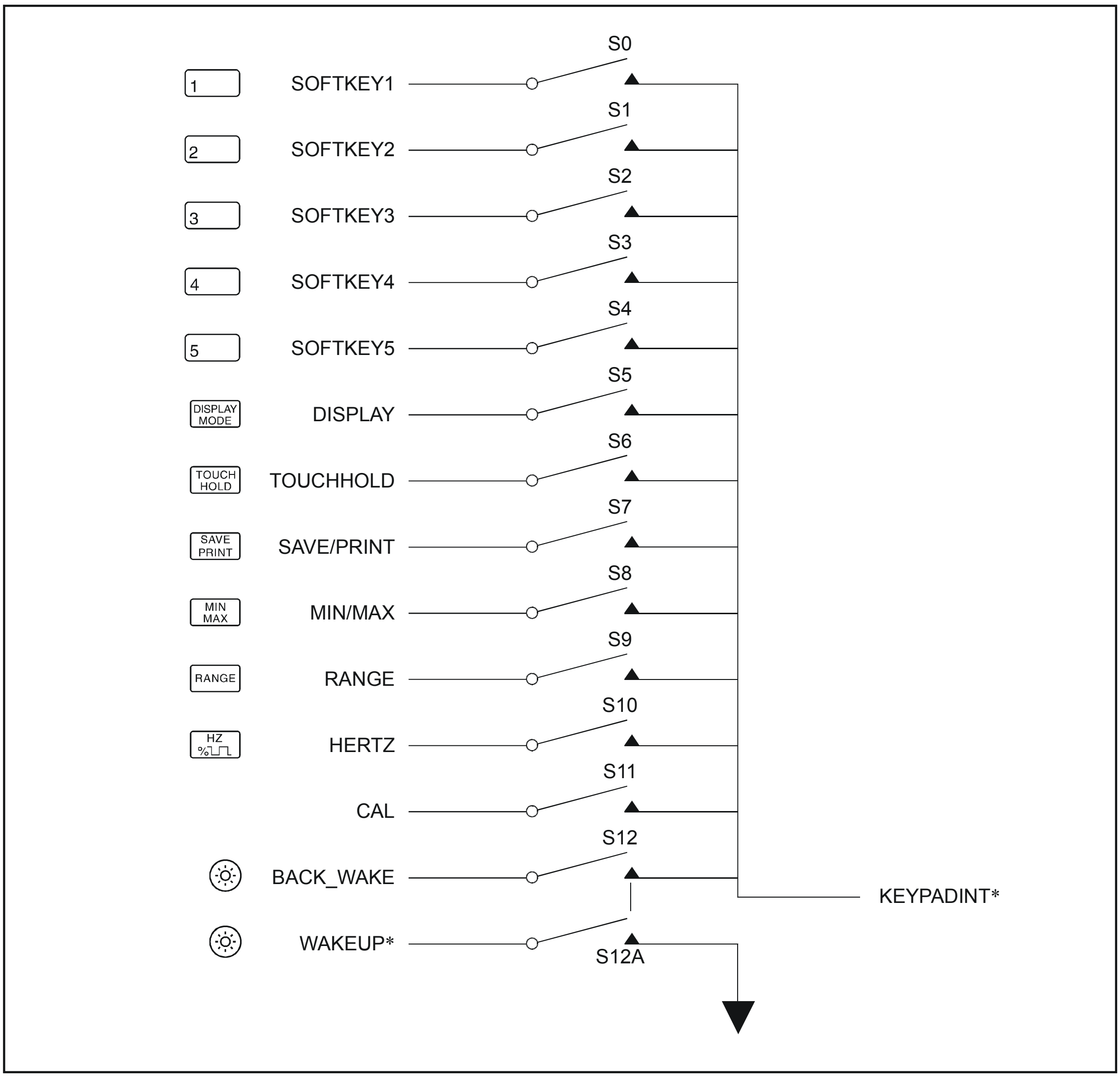

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Figure 2-3. Keypad Connections

Chapter 3
Maintenance

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⚠Warning

Service procedures in this manual should be performed by qualified personnel only. To avoid electrical shock, do not service this product unless you are qualified to do so.

Introduction 3-1.

This chapter provides handling, cleaning, disassembly, and assembly instructions.

Warranty Repairs and Shipping Information 3-2.

If your GMM is still under warranty, see the warranty information at the front of this manual for instructions on returning the unit. To contact Fluke, call one of the following telephone numbers:

USA and Canada: 1-800-44-FLUKE
(1-800-443-5853)

Europe: +31 402-678-200

Japan: +81-3-3434-0181

Singapore: +65-✻-276-6196

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

Or, visit Fluke's Web site at www.fluke.com.

Static-Safe Handling 3-3.

The GMM contains components that are susceptible to damage from electrostatic discharge (ESD). Follow these two rules for handling static-sensitive devices:

HANDLE ALL STATIC-SENSITIVE COMPONENTS AT A STATIC-SAFE WORK AREA.

Use grounded static-control table mats on all repair benches, and always wear a grounded wrist strap. Handle boards by their nonconductive edges only. Store plastic, vinyl, and Styrofoam objects outside the work area.

STORE AND TRANSPORT ALL STATIC-SENSITIVE COMPONENTS AND ASSEMBLIES IN STATIC-SHIELDING BAGS OR CONTAINERS.

Static-shielding bags and containers protect components and assemblies from direct static discharge and external static fields. Store components in their original packages until they are ready for use.

Note

Modern electronic components are sensitive to static voltages under 100V. You can develop a charge of 2,000V by walking across a vinyl tile floor or a charge of 5,000 to 15,000V when polyester clothing moves on your body. Since 30,000 to 40,000V must be generated before you will feel a shock, you will not notice these lower voltage static problems that are so harmful to electronic components. Protection circuits used with these components can only reduce, not eliminate, susceptibility to ESD. You can cause degraded performance or failure by touching a sensitive assembly or by simply exposing the component to the electric field surrounding a charged object. Component failure from ESD may not occur until two hours to six months after the initial damage.

Cleaning 3-4.

⚠Warning

To avoid electrical shock or damage to the GMM, never allow water inside the case. To avoid damaging the GMM's housing, never apply solvents.

Wipe the GMM with a cloth that is lightly dampened with water or a mild detergent. Do not use aromatic hydrocarbons, chlorinated solvents, or methanol-based fluids when you wipe the GMM.

Disassembly 3-5.

Refer to Figure 3-1 throughout this procedure.

1. Set the GMM selector to OFF. Be sure to leave the selector in this position throughout the disassembly and reassembly procedure. Note that you do not need to remove the bail and battery pack to disassemble the GMM.

Note

The low energy fuse (440 mA) can be replaced by removing the battery pack only.

2. Remove the six (torqued) screws attaching the case halves. Detach the case halves.
3. Remove the two screws securing the shield. Then pry the shield loose from two stanchions at the top of the circuit board.
4. Gently pull up on the shield tab and rotate the entire shield away from the circuit board.
5. Remove the three screws securing the circuit board to the front half of the GMM.
6. Dislodge the circuit board by pushing in on the Volts-Ohms input connector from the lower right front of the GMM. See Detail A.
7. Lift the entire circuit board up approximately one inch, dislodging the slotted Battery Eliminator connection (Detail B.)
8. Rotate the circuit board 180 degrees.

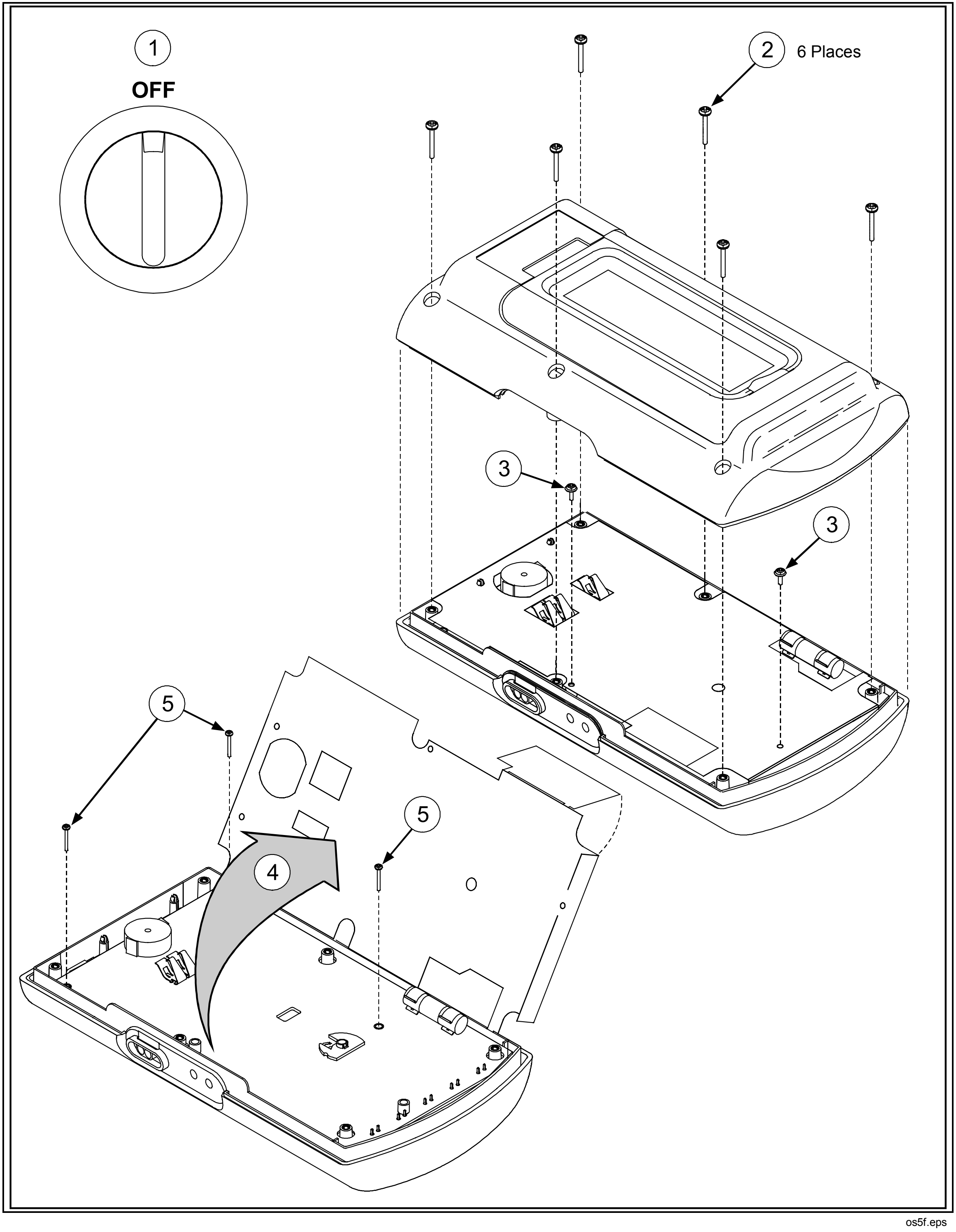

Figure 3-1. Disassembly

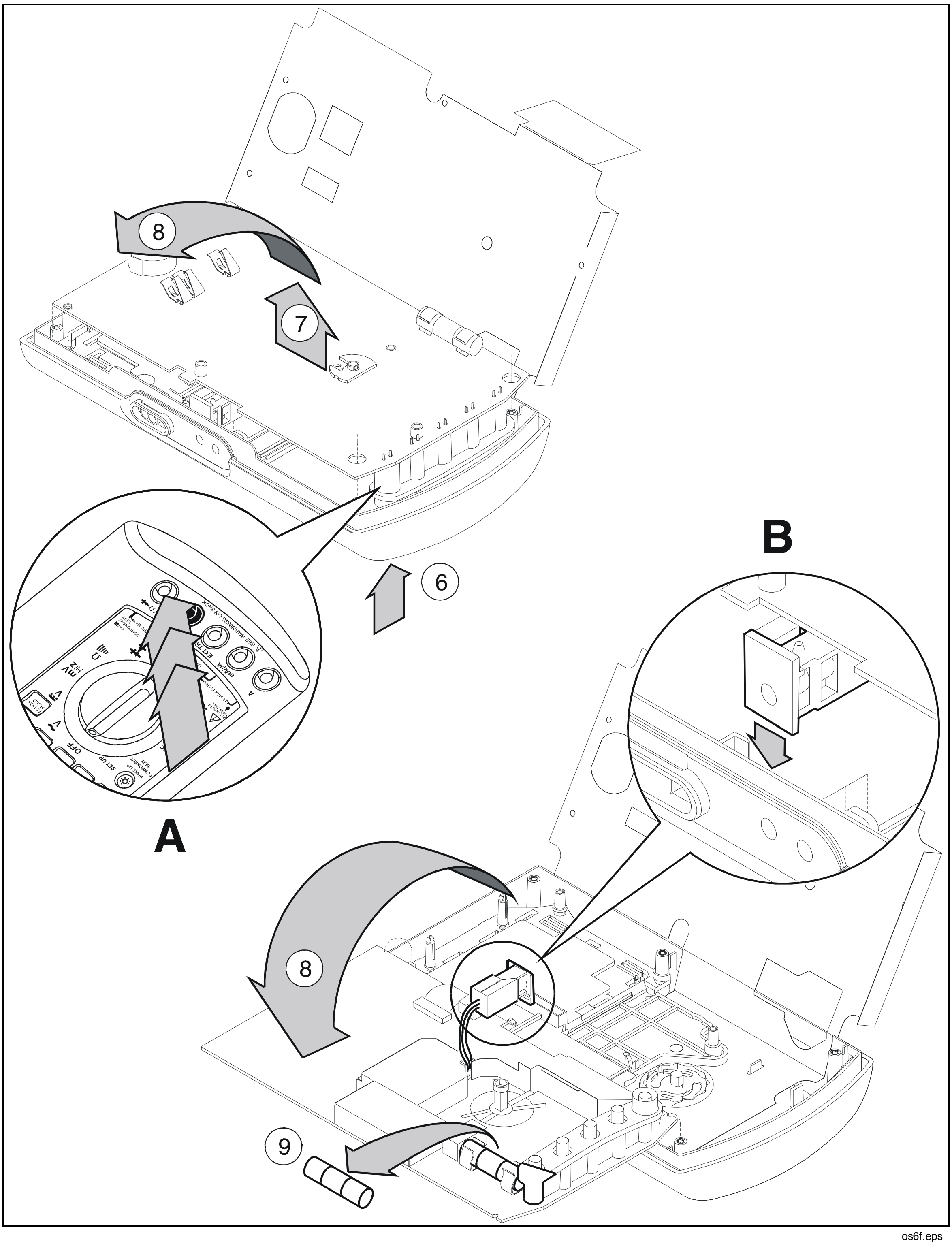

Figure 3-1. Disassembly (cont)

Reasssembly 3-6.

Generally, reassembly reverses the disassembly procedure. Specifically, do the following:

1. Verify that the selector switch still points to “OFF”.
2. Place the case top face down on a non-marring surface.

Note

At all times, avoid stressing the ribbon cable.

3. Grasp the board at the top and bottom so that it can be smoothly lowered into position in the case top.
4. As you begin lowering the board into position, make sure the battery eliminator connection (detail “B” in Figure 3-1) slips into its slot snug against the top case wall.

Gently press the board into position at the top and bottom.

5. Replace the three board-securing screws.
6. Replace the case bottom. Torque the six securing screws to 11-13 inch-pounds in the sequence shown in Figure 3-2.

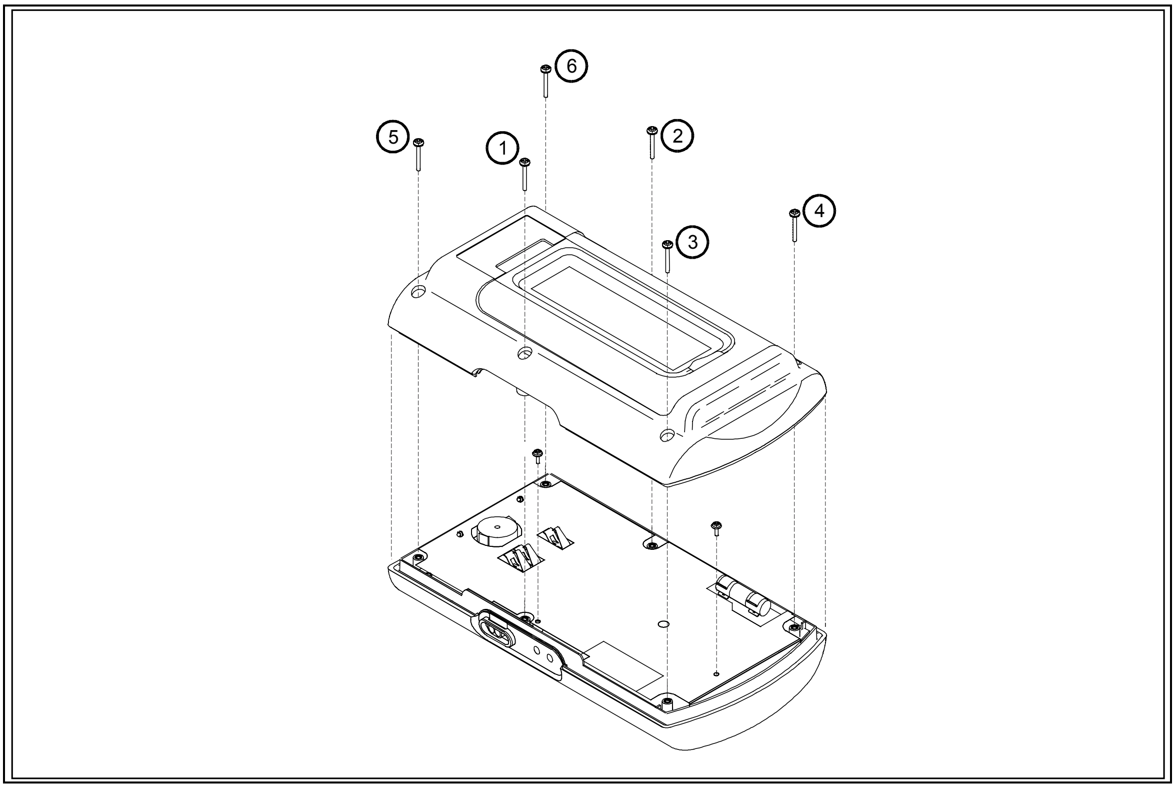

Figure 3-2. Reassembly

Replacing the 440 mA Fuse 3-7.

Refer to Figure 3-3 when replacing the 440 mA fuse.

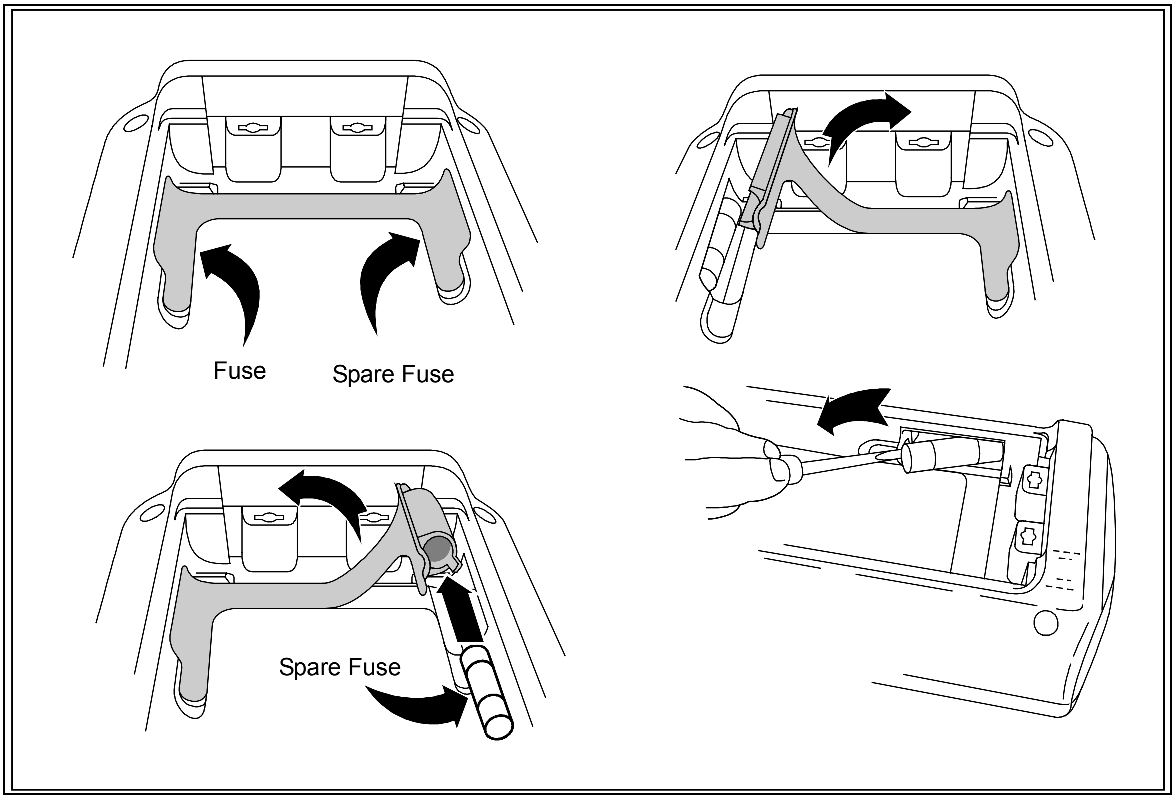

Figure 3-3. Replacing the 400 mA Fuse

Replacing the 11A (High Energy) Fuse 3-8.

Follow the "Disassembly" instructions in this chapter (Figure 3-1). Remove this fuse (shown as step 9 in Figure 3-3.) Check for signs of damage (smoked, arced areas) on the circuit board.

Note

Avoid switching 440 mA and 11A fuses. The 440 mA fuse is accessible through the battery compartment and does not require GMM disassembly. The 11A fuse resides on the opposite side of the GMM circuit and does require disassembly for access.

Chapter 4
Perfomance Testing and Calibration

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⚠Warning

Service procedures should be performed by qualified service personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

Introduction 4-1.

This chapter contains performance testing procedures that can be used to verify GMM operation within customer specifications. A separate set of calibration procedures is also included; use these procedures for closed-case calibration of the GMM. Equipment connections for performance testing and calibration are shown at the end of this chapter. The appropriate connection configuration is referenced in each procedure.

Required Test Equipment 4-2.

Equipment required for performance testing ("P"), calibration ("C) is listed in Table 4-1.

The 5700A is used to calibrate dc volts, ac volts, dc/ac mA/µA, and Ohms. The 5725A driven by the 5700A is used to calibrate dc and ac amps.

⚠Warning

Ensure that the calibrator is in standby mode before making any connection between the calibrator and the GMM. Dangerous voltages may be present on the leads and connectors.

Alternative Test Equipment (Fluke 5500A) 4-3.

The Fluke 5500A can also be used as the source where a calibrator is called for in performance testing and calibration. Some performance test points change when a 5500A is used; these changes are noted in the following tables:

- Table 4-5. AC Volts RMS Performance Test
- Table 4-15. AC Amps RMS Performance Test
- Table 4-16. AC Amps Average Performance Test

In ohms calibration, the 5500A can provide the values called for by the GMM; no value modification is necessary.

For a general discussion of calibrator use and accuracy, refer to *Guardbanding with Confidence* by David Deaver. This publication is available from the Fluke Corporation, Everett, WA and is published in the *1994 NCSL* (National Conference of Standard Laboratories) *Workshop and Symposium Proceedings*, pages 383-394.

Table 4-1. Recommended Test Equipment

P	C	Equipment Description	Usage
●	●	Fluke 5700A Calibrator The 5700A cannot be used to calibrate the 300Ω range, which must be calibrated at near full scale.	ACV, DCV, ACA, DCA, Ohms
●	●	Fluke 5725A Amplifier	ACA, DCA
●		PM5139 Function Generator	Frequency, Duty Cycle, Logic, Glitch Capture, External Trigger
●		Decade Capacitor, GenRad 1412-BC Capacitance: 0-1000 µF, Accuracy ±0.25%	Capacitance, 10 µF range
●	●	Decade Resistance Source, General Resistance Inc. Model RDS 66A (±0.0125%)	300Ω range
●		Fluke 85 DMM	Component Test
Alternative Test Equipment			
●	●	Fluke 5500A Multi Product Calibrator	ACV, DCV, ACA, DCA, Ohms, Capacitance

Performance Tests 4-4.

The following procedures ensure that the 860 Series GMM meets or exceeds all customer specifications. To successfully perform these tests, it is important that you have read the User Manual and know how to make the measurements each specific test calls for.

mV DC Test 4-5.

Connect the GMM and 5700A in Configuration 1 (Figure 4-1). Then perform the three steps called for in Table 4-2. Before proceeding to the next test, place the 5700A in Standby.

Table 4-2. mV DC Performance Test

Step	GMM Range	Input	Input Source	Model 867B		Model 863	
				Lower Limit	Upper Limit	Lower Limit	Upper Limit
1	300.00 mV	Short	Shorting Bar	-0.02	0.02	-0.02	0.02
2	300.00 mV	15.00 mV	5700A	14.98	15.02	14.97	15.03
3	3000.0 mV	-2900.0 mV	5700A	-2900.9	-2899.1	-2901.4	-2898.6

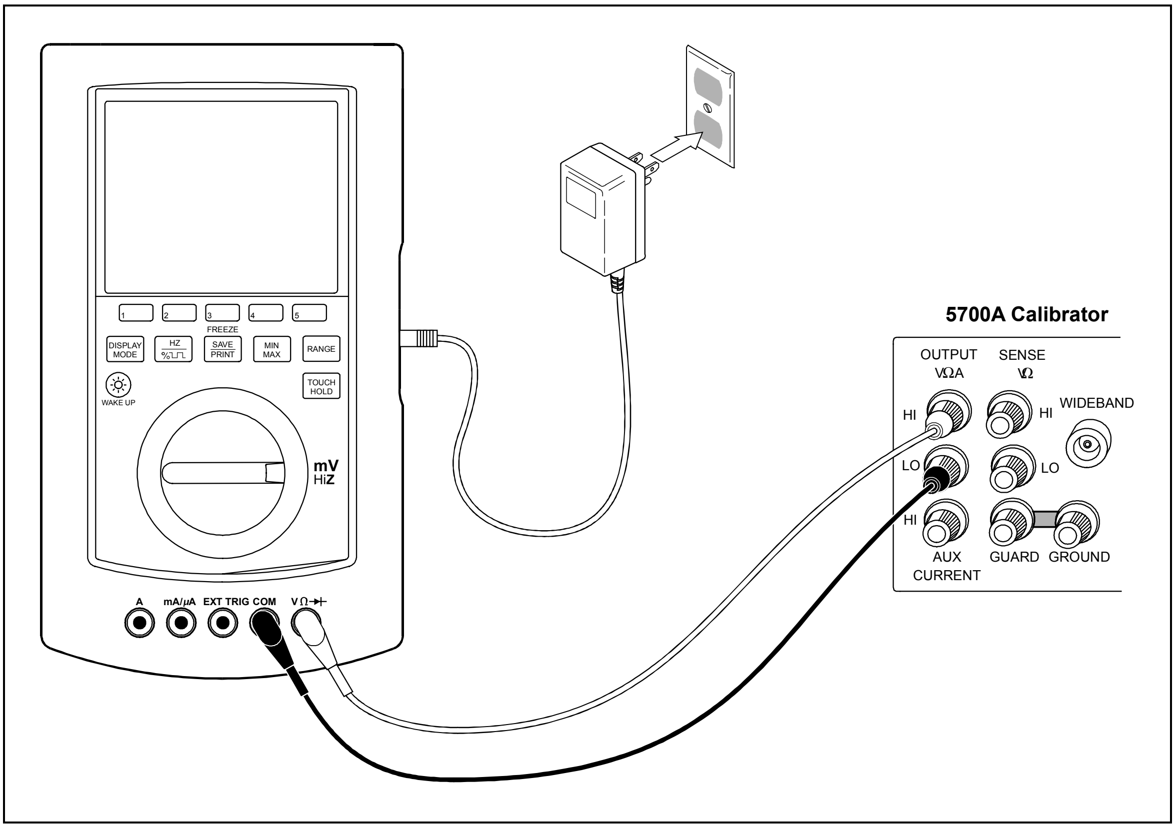

Figure 4-1. Configuration 1 (mV DC)

DC Volts Test 4-6.

Connect the GMM and 5700A in Configuration 2 (Figure 4-2). Then perform the three steps called for in Table 4-3. Before proceeding to the next test, place the 5700A in Standby.

Table 4-3. DC Volts Performance Test

				Model 867B		Model 863	
Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit	Lower Limit	Upper Limit
1	30.000V	29.000V	5700A	28.991	29.009	28.986	29.014
2	300.00V	-290.00V	5700A	-290.09	-289.91	-290.14	-289.86
3	1000.0V	1000.0V	5700A	999.5	1000.4	999.4	1000.6

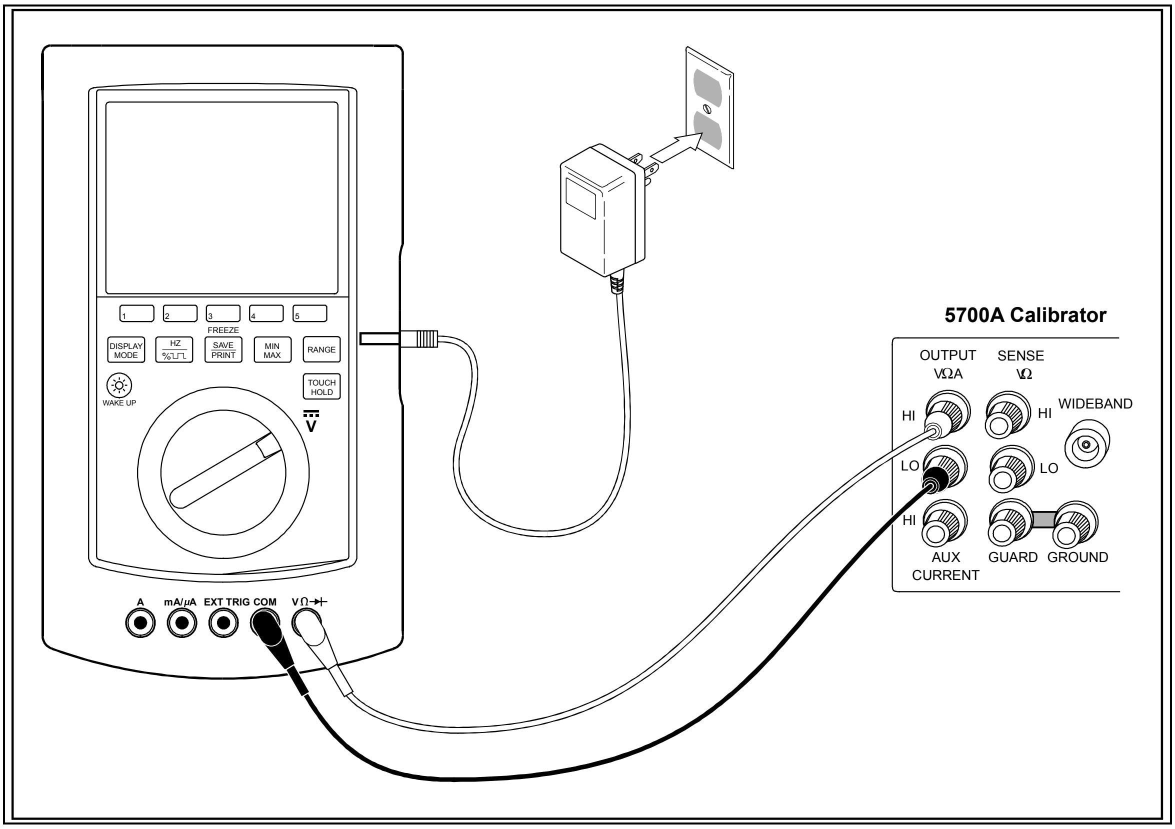

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Figure 4-2. Configuration 2 (DC Volts)

Diode Test ***4-7.***

Rotate the GMM selector to Diode Test (). Connect the GMM and 5700A in Configuration 2 (Figure 4-2, selected). Then perform the three steps called for in Table 4-4.

Before proceeding to the next test, place the 5700A in Standby.

Table 4-4. Diode Test Performance Test

Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit
1	Auto	2.9V	5700A	2.3	3.5
2		-2.9V	5700A	-2.3	-3.5
3	Manual	2.5000V	5700A	2.4986	2.5015

AC Volts Test 4-8.

Rotate the GMM selector to AC Volts (Ṽ). Connect the GMM and 5700A in Configuration 6 (Figure 4-3). Make sure that 'rms' is selected in the display above [3], then perform the 12 steps called for in Table 4-5.

Next, press [3] on the GMM to select 'Average', and perform the four steps called for in Table 4-6.

Before proceeding to the next test, place the 5700A in Standby.

Table 4-5. AC Volts RMS Performance Test

Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit
1	300.00 mV	30.00 mV, 20 Hz	5700A	29.45	30.55
2	300.00 mV	290.00 mV, 30 kHz	5700A	288.45	291.55
3	300.00 mV	100.00 mV, 100 kHz	5700A	94.00	106.00
4	300.00 mV	200.00 mV, 200 kHz	5700A	182.00	218.00
5	300.00 mV	50.00 mV, 300 kHz	5700A	43.00	57.00
6	3.0000V	150.00 mV, 20 Hz	5700A	0.1468	0.1533
7	3.0000V	1.0000V, 300 kHz	5700A	0.8800	1.1200
8	30.000V	29.000V, 10 kHz	5700A	28.845	29.155
9	30.000V	10.000V, 200 kHz *	5700A	9.000	11.000
10	300.00V	15.00V, 20 Hz	5700A	14.68	15.33
11	300.00V	290.00V, 50 kHz **	5725A	276.40	303.60
12	1000.0V	1000.0V, 50 Hz	5725A	984.0	1016.0

* Use 10.00V, 100 kHz with the Fluke 5500A.
** Use 290V, 20 kHz with the Fluke 5500A.

Table 4-6. AC Volts Average Performance Test

Step	Range	Input	Input Source	Lower Limit	Upper Limit
1	300.0 mV	short	Shorting Bar	0.0	0.4
2	300.0 mV	30.00 mV, 30 kHz	5700A	29.4	30.5
3	300.0 mV	290.00 mV, 50 kHz	5700A	283.8	296.2
4	1000V	1000.00V, 1 kHz	5700A	981	1019

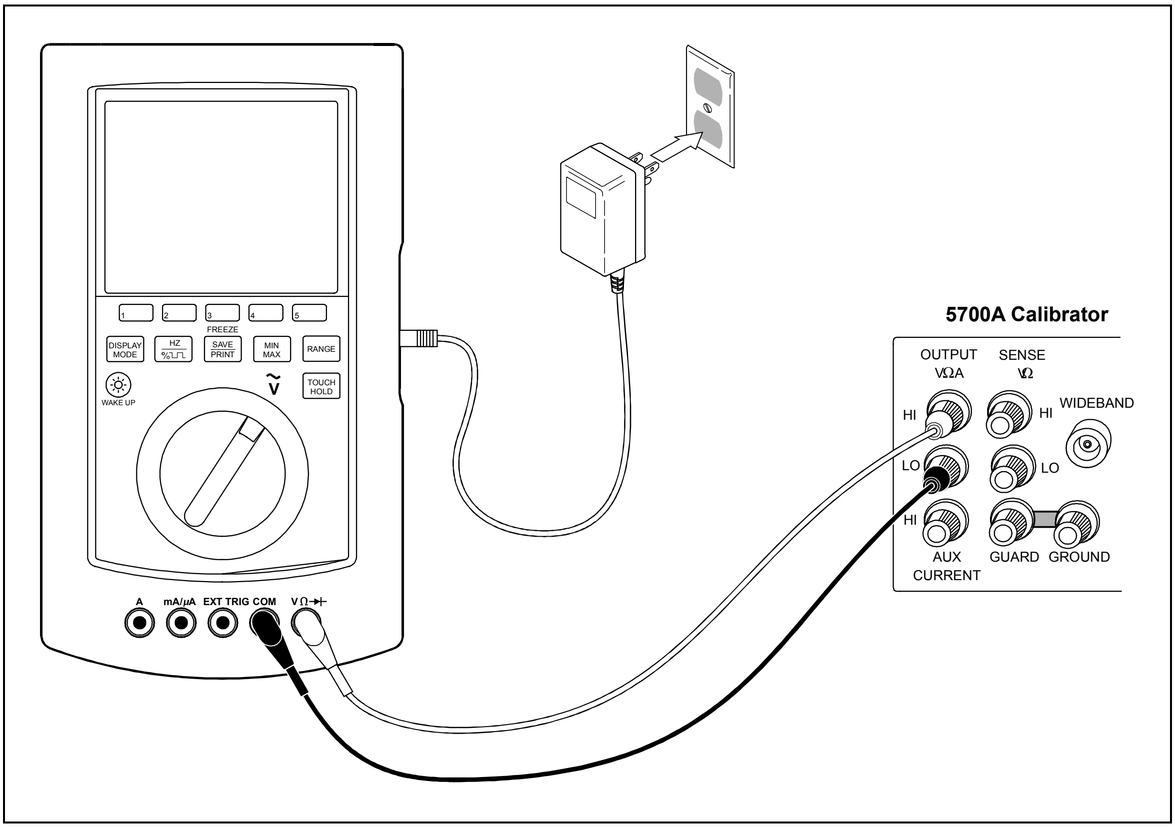

Figure 4-3. Configuration 6 (AC Volts)

Ohms and Conductance Tests 4-9.

Rotate the GMM selector to Ohms (Ω). Connect the GMM and the 5700A in Configuration 5 (Figure 4-4). Then perform the test steps in Table 4-7 (for ohms) and Table 4-8 (for conductance).

Before proceeding to the next test, place the 5700A in Standby.

Table 4-7. Ohms Performance Test

Step	Range	Input	Input Source	Lower Limit	Upper Limit
1	300.00Ω	0.00Ω	Shorting Bar	0.00	0.10
2	300.00Ω	190.00Ω	5700A	189.77	190.23
3	3.0000 kΩ	1.9000 kΩ	5700A	1.8985	1.9015
4	30.000 kΩ	19.000 kΩ	5700A	18.985	19.015
5	300.00 kΩ	190.00 kΩ	5700A	189.85	190.15
6	3.0000 MΩ	1.9000 MΩ	5700A	1.8970	1.9031
7	30.000 MΩ	10.000 MΩ	5700A	9.977	10.023

Table 4-8. Conductance Performance Test

Step	Range	Input	Input Source	Lower Limit	Upper Limit
1	300.00 nS	10.00 MΩ	5700A	99.30	100.70
2	3000.0 nS	1.0000 MΩ	5700A	993.0	1007.0

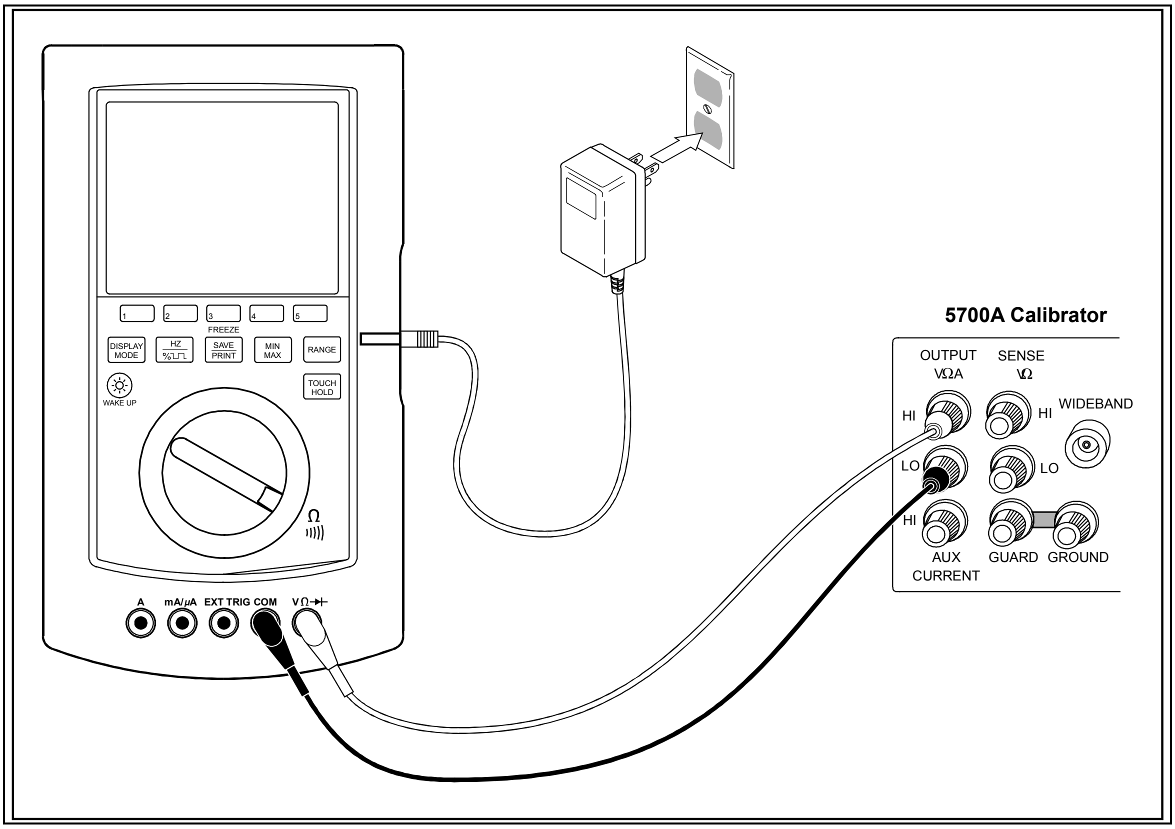

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Figure 4-4. Configuration 5 (Ohms)

Capacitance Test 4-10.

Rotate the GMM selector to Diode/Capacitance Test (). Connect the GMM **VΩ** and **COM** inputs to the GenRad 1412BC. Then perform the test steps in Table 4-9.

Table 4-9. Capacitance Performance Test

Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit
1	10000 pF	open	open	0	130
2	1 µF	0.950 µF	GenRad 1412-BC	0.930	0.970

Frequency Test 4-11.

Rotate the GMM selector to **SET UP** , and check that the 'Trigger' selection is set to 'Single'. To change to 'Single', press [1] (Next Item) to highlight the appropriate selection line; then press [2] or [3] to make the selection. Complete the change by pressing [5] (Save Set Up).

Rotate the GMM selector to AC Volts ( ). If necessary, press [3] to select (highlight) 'Average'. Press [HZ %] .

Connect the GMM and the PM5139 in Configuration 7 (Figure 4-5.) Then perform the steps called for in Table 4-10. Before proceeding to the next test, place the PM5139 in Standby.

Table 4-10. Frequency (AC Volts) Performance Test

Step	Range	Input	Input Source	Lower Limit	Upper Limit
1	Auto	3.00 Hz 0.060V rms sine (170 mV p-p)	PM 5139	2.98	3.02
2	Auto	500.00 kHz, 0.125V p-p sine	PM 5139	499.74	500.26
3	Auto	800.00 kHz, 0.21V p-p square	PM 5139	799.59	800.41
4	Auto	1.5000 MHz, 2.1V p-p sine	PM 5139	1.4991	1.5009

Next, rotate the selector to ≂mA µA (Model 867B only.) If necessary, press [5] to select AC. Connect the 5700A to the **mA/µA** and **COM** GMM inputs. If necessary, press [4] to select µA-100e. Perform step 1 in Table 4-11. Press [4] again to select mA-1e, then perform step 2.

Table 4-11. Frequency (mAµA) Performance Test

Step	Range	Input	Input Source	Lower Limit	Upper Limit
1	1000 Hz (863 na)	10.00 Hz, 60 µA sine applied to mA/µA input, 300 µA range.	5700A	9.98	10.03
2	10 kHz (863 na)	10.000 kHz, 3 mA sine applied to mA/µA input, 3000 µA range.	5700A	9.994	10.006

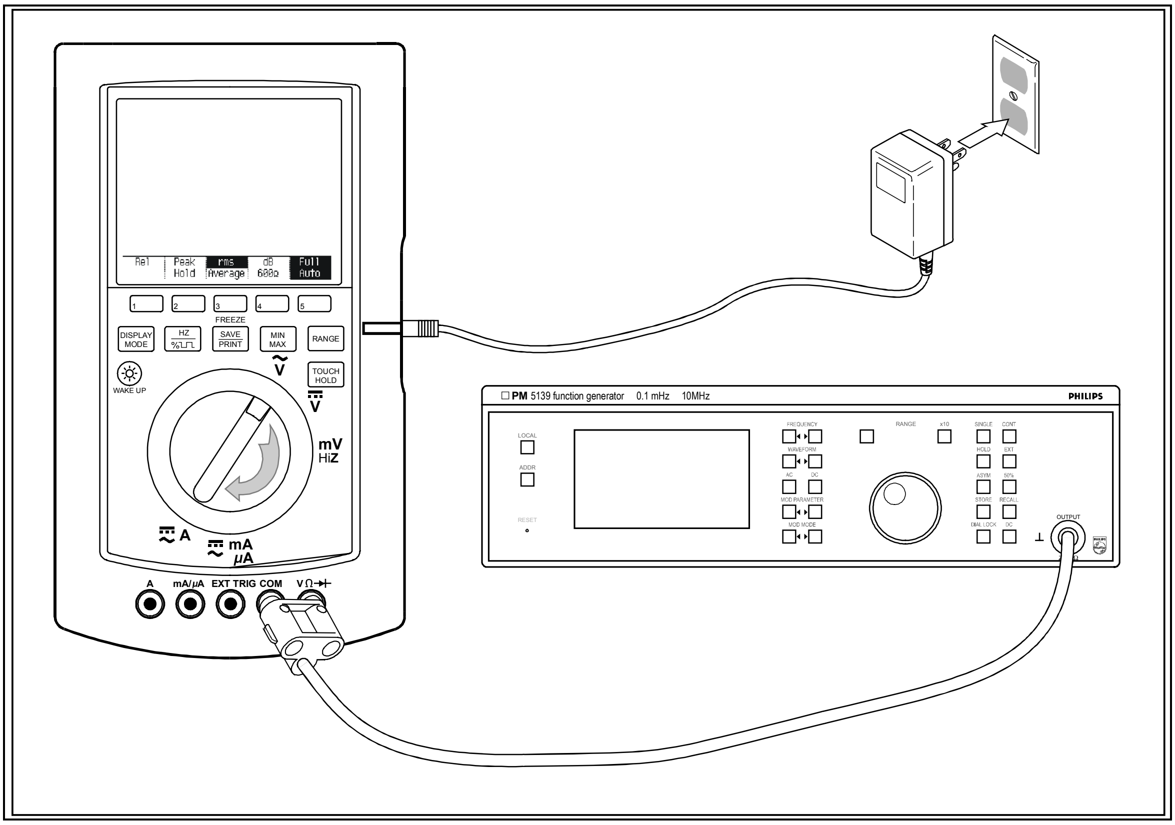

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Figure 4-5. Configuration 7 (PM5139)

Duty Cycle Test 4-12.

Rotate the GMM selector to AC Volts ( ). Check that 'Full Auto' is selected in the display above 5. Select Hz and Duty Cycle. Connect the GMM and the PM5139 in Configuration 10 (Figure 4-6) and perform the test shown in Table 4-12.

Table 4-12. Duty Cycle Performance Test

Range	Input	Input Source	Lower Limit	Upper Limit
AUTO	50.00% 10 kHz, 0.2V p-p square	PM 5139	49.8	50.2

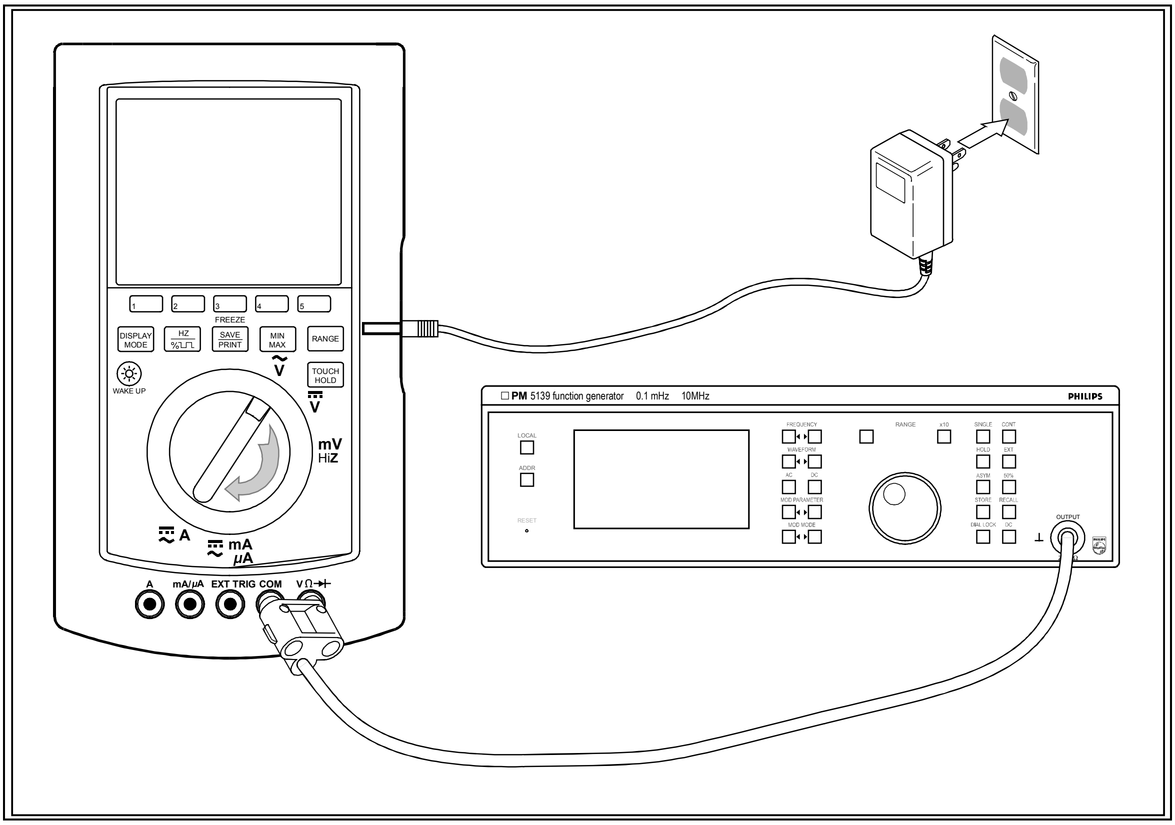

Figure 4-6. Configuration 10 (PM5139)

Logic Test (867B Only) 4-13.

Rotate the GMM selector to LOGIC. If necessary, press [1] so that ‘TTL’ is selected (highlighted). Connect the GMM and the 5139 in Configuration 9 (Figure 4-7.) Then perform the test shown in Table 4-13.

Table 4-13. Logic Performance Test

Range	Input	Input Source	Lower Limit	Upper Limit
na	2.0 MHz, 1.5V p-p pulse, 50% duty cycle, 0.7V dc offset*	PM 5139	1.9989	2.0011
* 1.5V p-p transitioning from 0.7V to 2.2V.				

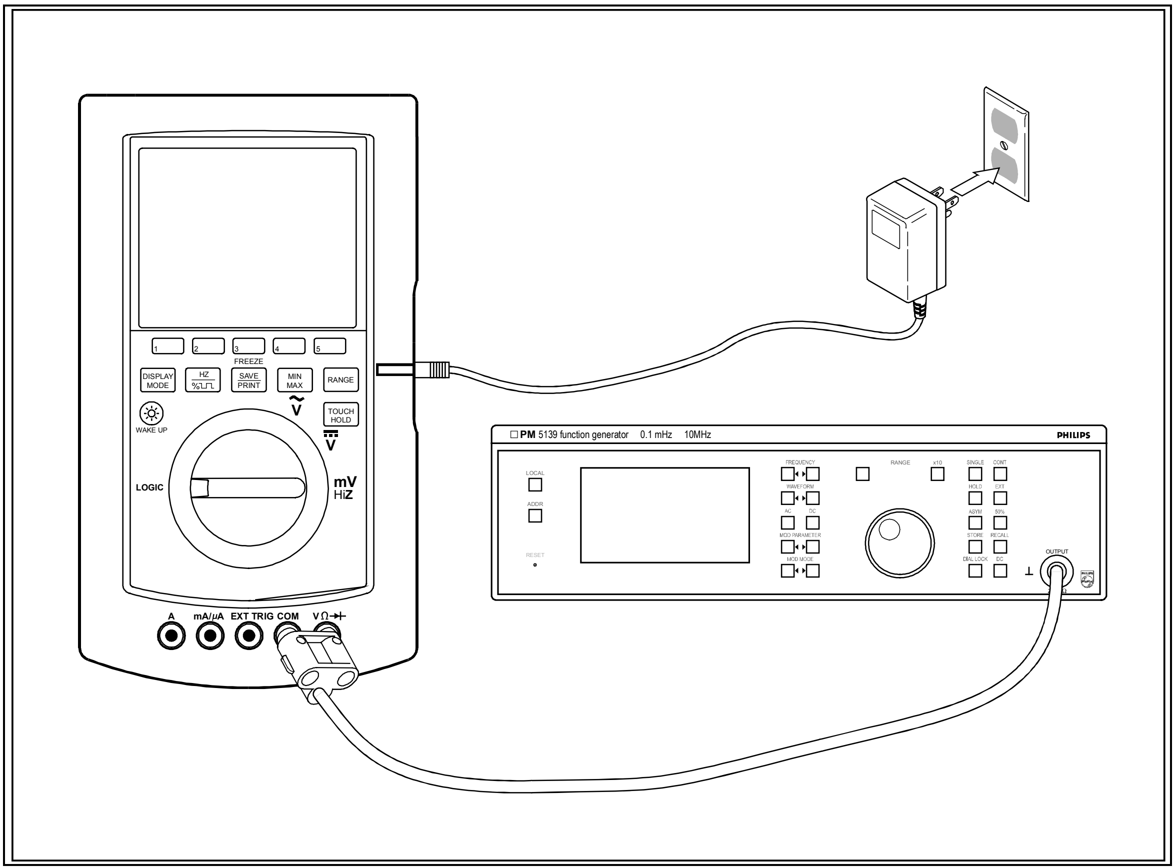

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Figure 4-7. Configuration 9 (PM5139)

Amps Tests 4-14.

⚠Warning

Risk of electric shock. Do not remove connections at the GMM until all DC and AC Amps tests have been performed. Always place the 5700A in Standby prior to swapping 'Input Source' connections between the 5700A and the 5725A.

Note that inputs to the GMM are provided from the 'Input Source' called for in Tables 4-14, 4-15, and 4-16. When '5725A' is the input source, _ must be pressed on the 5700A. Rotate the GMM selector to Milliamps and Microamps (mA µA). Connect the GMM, and 5700A as shown in Configuration 3 (Figure 4-8.)

If necessary, press [5] on the GMM to select 'DC'and [4] to select µA- 100e. Complete the step 1 in Table 4-14 (DC Amps). Press [4] again to select mA-1e, then complete step 2.

Next, press [5] to select 'AC', and, if necessary, press [3] to select 'rms'. Press [4] to select µA-100e and complete step 1 in Table 4-15 (AC Amps RMS). Press [4] to select mA-1e and complete step 2.

Press [3] to select 'Average', and [4] to select µA-100e. Complete steps 1 and 2 in Table 4-16 (AC Amps Average).

Rotate the GMM selector to Amps (A). Connect the GMM, 5700A, and 5725A in Configuration 4 (Figure 4-9.)

If necessary, press [5] on the GMM to select 'DC'. Then complete step 3 called for in Table 4-14 (DC Amps).

Next, press [5] to select 'AC', and, if necessary, press [3] to select 'rms'. Complete steps 3 and 4 called for in Table 4-15 (AC Amps RMS).

Finally, press [3] to select 'Average', and complete step [3] in Table 4-16 (AC Amps Average).

Table 4-14. DC Amps Performance Test

Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit
1	300.00 µA (863 na)	30.00 µA	5700A	29.82	30.18
2	30.000 mA	21.000 mA	5700A	20.975*	21.026*
3	3.0000A	2.9000A	5725A	2.8927	2.9073
* For 863, limits are 20.964 and 21.036.					

Table 4-15. AC Amps RMS Performance Test

Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit
1	300.00 µA (863 na)	30.00 µA, 10 kHz	5700A	29.20	30.80
2	30.000 mA	21.000 mA, 10 kHz	5700A	20.560	21.440
3	3.0000A	2.9000A, 3 kHz *	5725A	2.8773	2.9228
4	10.000A	1.00A, 3 kHz	5725A	0.983	1.018
* Use 2.90A, 1 kHz with the Fluke 5500A.					

Table 4-16. AC Amps Average Performance Test

Step	GMM Range	Input	Input Source	Lower Limit	Upper Limit
1**	300.0 µA (863 na)	short		0.0	0.4
2	300.0 µA (863 na)	210.0 µA, 10 kHz	5700A	205.4	214.6
3	3.000A	2.90A, 3 kHz *	5725A	2.874	2.926

* Use 2.90A, 1 kHz with Fluke 5500A.
** When using the battery eliminator the upper limit for this test is 2.0.

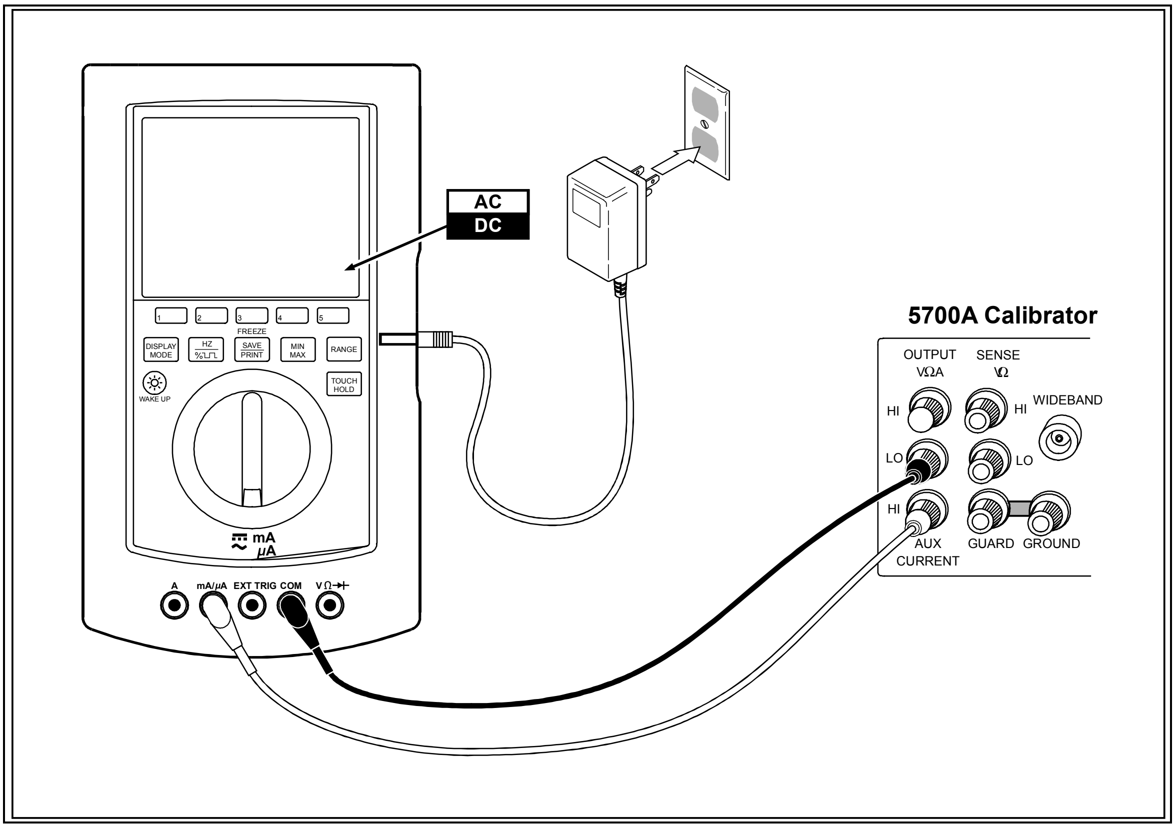

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Figure 4-8. Configuration 3 (mAuA, DC and AC)

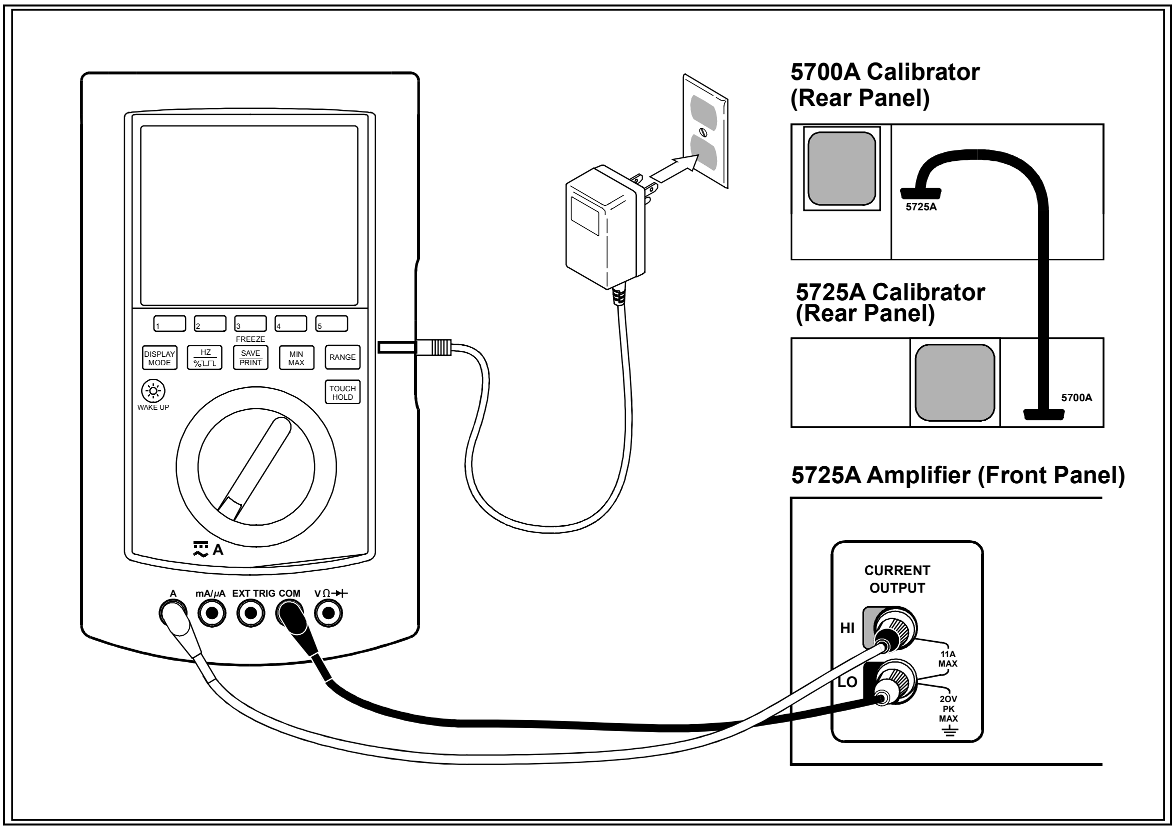

Figure 4-9. Configuration 4 (Amps, DC and AC)

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Peak Hold Test 4-15.

Rotate the GMM selector to AC Volts ($\tilde{V}$). Connect the GMM and the 5700A in Configuration 6 (Figure 4-3). Press [2] to select Peak Hold. Then make the test called for in Table 4-17. Peak maximum and minimum readings should be within the specified limits.

Table 4-17. Peak Hold Performance Test

Range	Input	Input Source	Lower Limit	Upper Limit
3 VAC	2.828V peak (2.0V rms), 10.0 kHz	5700A	2.39	3.27

Component Test (867B Only) 4-16.

Use the Fluke 85 in the tests detailed in Table 4-18 to measure the expected limits at the GMM input jacks (V, e, G, and **COM**). Rotate the GMM selector to Component Test and measure the appropriate signal. See Figure 4-10.

Table 4-18. Component Test Performance Test

Range	GMM Output	Lower Limit	Upper Limit
na	2.2V ac rms, 200 Hz	1.9	2.5
na	0.210 mA ac rms, 200 Hz	0.164	0.256

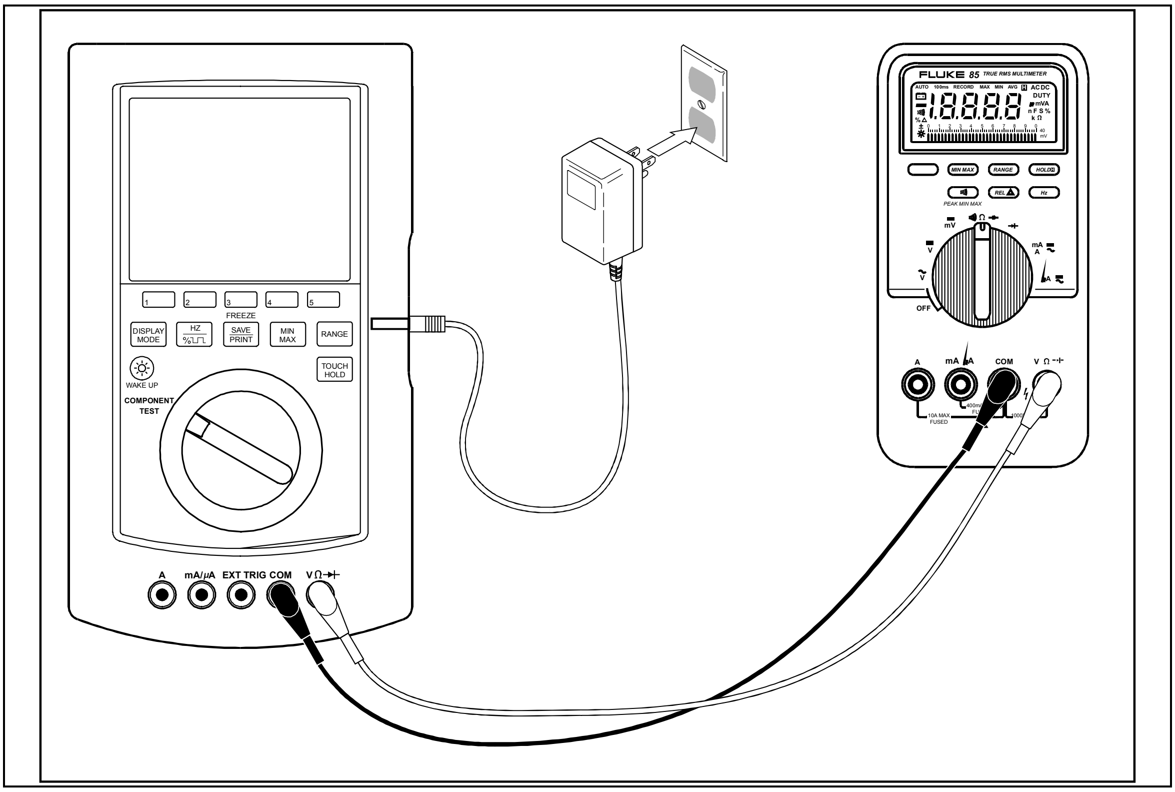

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Figure 4-10. Configuration 8 (Component Test)

Rel Test/Touch Hold Test 4-17.

1. Turn on the GMM to VDC, and apply 1000V dc.
2. Press [1] [Rel].
3. Check for a Rel reading between the limits shown in Table 4-19.

Table 4-19. Rel Performance Test

Input	Input Source	Lower Limit	Upper Limit
1000.0V dc	5700A using GMM volts input	-0.2	0.2

4. Press [TOUCH HOLD].
5. On the 5700A, press I to select Standby.
6. Check for a GMM reading within the limits shown in Table 4-20.

Table 4-20. Touch Hold Performance Test

Input	Input Source	Lower Limit	Upper Limit
0V dc	(open)	-0.2	0.2

Glitch Capture Test 4-18.

1. Turn on the GMM to mV.
2. Press DISPLAY MODE, 3 [View], 4 [Glitch Capture], 1 [Arm].
3. Apply a .070V p-p Pulse 10 kHz Pulse wave.
4. Check for the Glitch Capture PASS/FAIL indications shown in Table 4-21.

Table 4-21. Glitch Capture Performance Test

Input	Input Source	PASS	FAIL
.07V p-p Pulse, 10 kHz, 50% duty	PM5139 to the GMM volts input	Trigger occurs	No Trigger

External Trigger Test 4-19.

1. Turn on the GMM to mV DC.
2. Press: DISPLAY MODE, 3 [View], 2 [Trigger], 4 [Internal/External](to select external), 5 [Exit].
3. Press 3 [Single Shot] , 1 [Arm].
4. Apply a 2V p-p 100 kHz Pulse wave.
5. Check for the PASS/FAIL indications shown in Table 4-22.

Table 4-22. External Trigger Performance Test

Input	Input Source	PASS	FAIL
2.0V p-p, 100 kHz Pulse, 50% duty	PM5139 to the GMM EXT TRIG input.	Trigger occurs	No Trigger

Calibration 4-20.

The calibration procedure involves 40 steps, all of which must be completed for calibration to take effect. Each step, as identified on the GMM screen, is also shown in bold in this manual. For example, “Step 1” as seen on the screen appears as **Step 1** in text.

Measuring the System Resistance 4-21.

Ohms calibration requires that you first measure the system resistance. Use the following procedure:

1. Rotate the GMM selector to Ω (Ohms).
2. Short the test lead ends together.
3. Record the reading (system resistance) shown on the GMM. This data will be used during the ohms calibration procedure.

Starting Calibration Mode on the GMM 4-22.

Connect the Battery Eliminator to the GMM to ensure stable power during calibration. Rotate the selector to mV HiZ (mV DC), and allow for GMM warm up of at least 10 minutes. In all cases, allow the Calibrator and the GMM to settle before starting the actual calibration.

Place the GMM in calibration mode by pressing the calibration button. This button is recessed in a hole on the right side of the GMM; a calibration sticker usually covers this hole and must be broken to gain access. Use a thin, blunt tool to press the calibration button. See Figure 4-11.

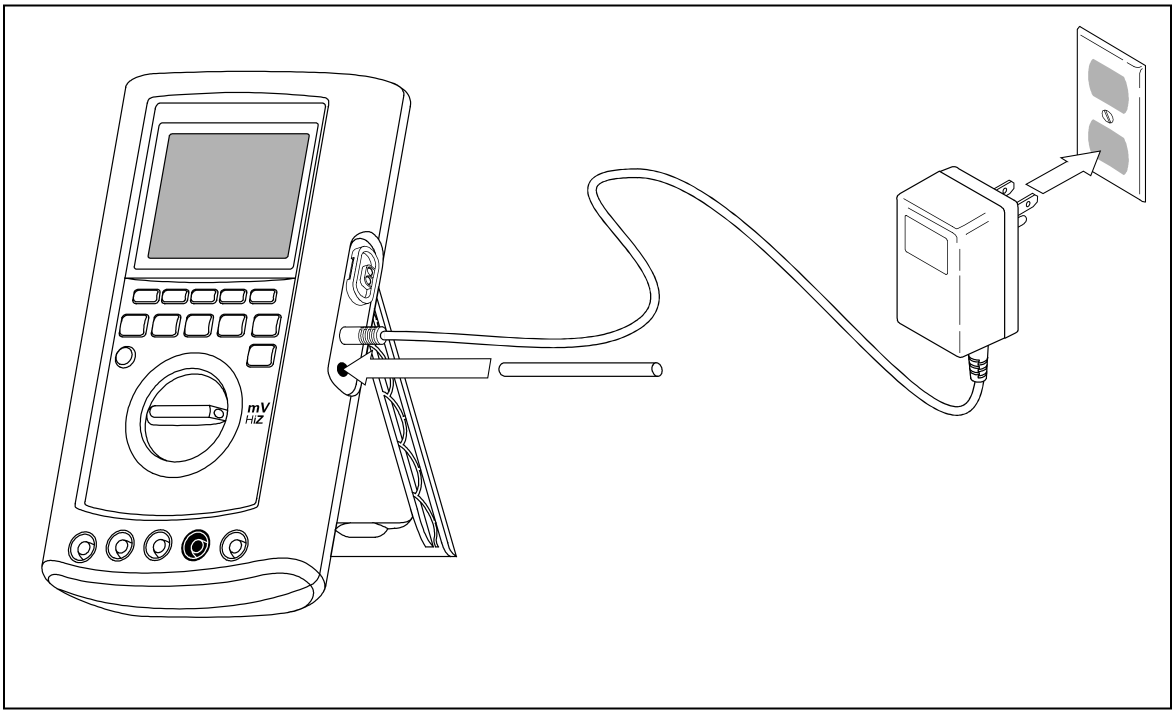

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Figure 4-11. Initiating Calibration

Now refer to Figure 4-12. ‘Warm up time is 10 minutes’ appears on the display when “Step 1” is selected. After 10 minutes, or whenever you proceed to “Step 2”, this message disappears and will only appear again if the calibration procedure is started over.

On the GMM, softkeys ([1], [2], [3], [4], [5]) select menu items shown in the boxes displayed at the bottom of the LCD. For example, press [1] to "Proceed" in the following set of softkeys:

Proceed				Abort Cal
[1]	[2]	[3]	[4]	[5]

You can stop the calibration procedure at any time by pressing [5] (Abort Cal). If the calibration is stopped, all previous calibration constants will be restored when power is cycled off and back on.

Note

Calibration constants are stored permanently only when you press [1] [Save Cal.] after the last calibration step. If you press [5] [Abort Cal] at any time prior to this, the GMM immediately returns to normal operation, and no new calibration constants are retained.

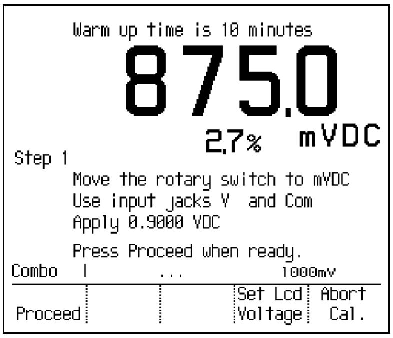

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Figure 4-12. Entering Calibration Mode

mV DC Calibration 4-23.

1. On the GMM, check that the selector is set to mV/Hz (mV DC).
2. Connect the 5700A to the **VΩ** and **COM** inputs on the GMM.
3. **Step 1**: Apply 900.0 mV dc. Allow for settling; then press [1] [Proceed]. (This step will take approximately 1 minute.)
4. **Step 2**: Apply 2.9000V dc. Allow for settling; then press [1] [Proceed].
5. **Step 3:** Apply 290.00 mV dc. Allow for settling; then press [1] [Proceed].
6. **Step 4:** Apply 29.000 mV dc. Allow for settling; then press [1] [Proceed]. (This step is not valid for units with software below version 1.3).

DC Volts Calibration 4-24.

1. Rotate the selector knob to $\overline{V}$ (VDC).
2. **Step 5:** Apply 1000.0V dc. Allow for settling; then press 1 [Proceed].
3. **Step 6:** Apply 290.00V dc. Allow for settling; then press 1 [Proceed].
4. **Step 7:** Apply 29.000V dc. Allow for settling; then press 1 [Proceed].
5. **Step 8:** Apply 2.900V dc. Allow for settling; then press 1 [Proceed]. (This step is not valid for units with software below version 1.3).
6. Set the 5700A to Standby.

DC mAuA Calibration 4-25.

1. Rotate the selector to ≂ mA µA (mAµA). Move the input connection on the GMM from **VΩ→+** to .
2. **Step 9:** Apply 290.00 mA dc. Allow for settling; then press 1 [Proceed].
3. **Step 10:** Apply 29.000 mA dc. Allow for settling; then press 1 [Proceed].
4. **Step 11:** Apply 2.900 mA dc. Allow for settling; then press 1 [Proceed].
5. **Step 12:** Apply 290.00 µA dc. Allow for settling; then press 1 [Proceed].
6. **Step 13:** Apply 29.00 µA dc. Allow for settling; then press 1 [Proceed].
7. Place the 5700A in Standby.

DC Amps Calibration 4-26.

1. Rotate the GMM selector to ≂A (Amps).
2. Connect the 5700A and the 5725A as shown in Figure 4-9
3. Connect the 5725A to the **A** and **COM** inputs on the GMM.
4. **Step 14:** Apply 10.000A dc. Allow for settling; then press 1 [Proceed].
5. **Step 15:** Apply 2.9000A dc. Allow for settling; then press 1 [Proceed].
6. **Step 16:** Apply 0.2900A dc. Allow for settling; then press 1 [Proceed].
7. Set the 5700A to Standby.

Ohms/nS Calibration 4-27.

Modifying the Displayed Value 4-28.

You must modify the calibration constants to compensate for the measured lead resistance. See Figure 4-13. Change the selected digit of the displayed nominal value by pressing 2 [Modify value], 2 [▲], or 3 [▼]. Select the next digit by pressing 1 [Next Digit] and repeating the adjustment. Press 5 [Done] to end the adjustment procedure.

For example, calibration at 190.00 ohms could proceed as follows:

- Source = 190.0732 ohms (at output terminals)
- Leads = 0.123 ohms
- Altered value = source value (190.0732) + lead resistance (0.123) = 190.2962 ohms

The reading will appear as nominal with an arrow pointing to the digit to be adjusted. With the GMM reading 190.00, the altered value should be rounded to 190.30. Use the following key press sequence:

2 [Modify value]

1 [Next digit]

2 [▲] (unit digit = 3)

1 [Next digit]

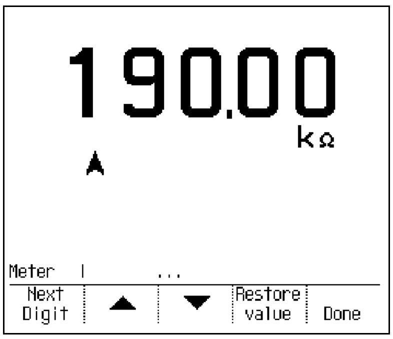
1 [Next digit]

1 [Next digit]

2 [▲] (unit digit = 1)

5 [Done]

The nominal value for calibration has been modified.



os11s.eps

Figure 4-13. Modifying the Displayed Value

Ohms Calibration 4-29.

Refer to Figure 4-14 for an example of the display during ohms calibration.

1. Verify that the 5700A is in Standby.
2. On the GMM, rotate the selector to Ω (Ohms), and remove the **A** connection.
3. Connect the 5700A directly to the **VΩ** and **COM** inputs on the GMM.
4. **Step 17:** Apply 1.9000 MΩ. Modify the value as necessary. (GMMs with version 1.1 or 1.3 software must have 2.9000 MΩ, ±0.025% applied for this step).
5. Allow for settling; then press [1] [Proceed].
6. **Step 18:** Apply 190.00 kΩ. Modify the value as necessary. Allow for settling; then press [1] [Proceed].
7. **Step 19:** Apply 19.000 kΩ. Modify the value as necessary. Allow for settling; then press [1] [Proceed].
8. **Step 20:** Apply 1.9000 kΩ. Modify the value as necessary. Allow for settling; then press [1] [Proceed].
9. **Step 21:** Apply 190.00Ω. Modify the value as necessary. Allow for settling; then press [1] [Proceed].
10. The following steps adjust nS (1/R); the nominal values are 100 nS and 1000 nS, respectively. Use [2] [Modify value] to make adjustments. Remember to use (1/source +Lead resistance).
    a. **Step 22:** Apply 10.000 MΩ. Modify the value as necessary. Allow for settling; then press [1] [Proceed].
    b. **Step 23:** Apply 1.0000 MΩ. Modify the value as necessary. Allow for settling; then press [1] [Proceed].

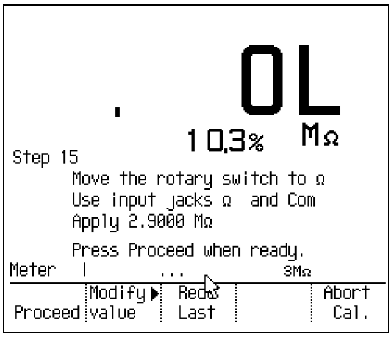


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Figure 4-14. Ohms Calibration

AC Volts Calibration 4-30.

1. Rotate the selector knob to $\tilde{V}$ (VAC). Remove the ohms connection and connect the 5700A to the **VΩ→+** and **COM** inputs on the GMM.
2. **Step 24:** Apply 1000.0V, 1 kHz. Allow for settling; then press 1 [Proceed].
3. **Step 25:** Apply 100.00V, 1 kHz. Allow for settling; then press 1 [Proceed].
4. **Step 26:** Apply 290.00V, 1 kHz. Allow for settling; then press 1 [Proceed].
5. **Step 27:** Apply 29.000V, 1 kHz. Allow for settling; then press 1 [Proceed].
6. **Step 28:** Apply 2.9000V, 1 kHz. Allow for settling; then press 1 [Proceed].
7. **Step 29:** Apply 290.00 mV, 1 kHz. Allow for settling; then press 1 [Proceed].
8. **Step 30:** Apply 29.00 mV, 1 kHz. Allow for settling; then press 1 [Proceed].
9. Set the 5700A to Standby.

AC mAµA Calibration 4-31.

1. Rotate the selector knob to $\overline{\sim}$ mA µA (mAµA).
2. Remove the ac connection and connect the 5700A to the **mA/µA** and **COM** inputs on the GMM.
3. **Step 31:** Apply 290.00 mA, 1 kHz. Allow for settling; then press 1 [Proceed].
4. **Step 32:** Apply 29.000 mA, 1 kHz. Allow for settling; then press 1 [Proceed].
5. **Step 33:** Apply 2.900 mA, 1 kHz. Allow for settling; then press 1 [Proceed].
6. **Step 34:** Apply 290.00 µA, 1 kHz. Allow for settling; then press 1 [Proceed].
7. **Step 35:** Apply 29.00 µA, 1 kHz. Allow for settling; then press 1 [Proceed].

AC Amps Calibration 4-32.

1. Place the 5700A in Standby.
2. Remove the **mA/µA** connection and connect the 5725A to the **A** and **COM** inputs.
3. Rotate the selector to $\overline{\sim}$ **A** (Amps).
4. **Step 36:** Apply 10.00A, 1 kHz. Allow for settling; then press 1 [Proceed].
5. **Step 37:** Apply 1.0000A, 1 kHz. Allow for settling; then press 1 [Proceed].
6. **Step 38:** Apply 2.9000A, 1 kHz. Allow for settling; then press 1 [Proceed].
7. **Step 39:** Apply 0.2900A, 1 kHz. Allow for settling; then press 1 [Proceed].

Internal Constants Calibration 4-33.

1. Place the 5700A in Standby.
2. Rotate the selector to mV HiZ (mV DC).
3. Remove the **A** (Amps) connection and connect the 5700A directly to the **VΩ→+** and **COM** inputs.
4. **Step 40:** Apply 29.00 mV dc. Allow for settling; then press [1] [Proceed].
5. Press [1] [Save Cal.] to complete the calibration procedure. Place the Calibrator in standby; then remove all connections between the Calibrator and the GMM.
6. Finally, rotate the selector to OFF, wait a few seconds, then rotate the selector to any function to allow the GMM to recognize the new calibration constants.

Note

Calibration constants are stored permanently only when you press [1] [Save Cal.]. If you press [5] [Abort Cal] at any time prior to this, the GMM immediately returns to normal operation, and no new calibration constants are retained.

Setting LCD Voltage 4-34.

A separate calibration procedure allows you to establish the existing contrast (SET UP) setting as a new mid-point LCD voltage. A viewable contrast range can therefore be reestablished after GMM repair. Although the calibration button must be pressed during the following procedure, no actual inputs to the GMM are required, and no calibration constants are altered.

Set the user-selectable contrast level with the following procedure:

1. Rotate the selector to SET UP.
2. Press [2] or [3] to set the desired contrast.
3. Press [5] [Save Set Up].
4. Rotate the selector directly to mV HiZ (mVDC).

Now use the following procedure to permanently save this contrast level as the new mid-range LCD voltage:

1. Push the calibration button.
2. Press [4] [Set LCD Voltage]
3. Press [5] [Abort Cal].

Future adjustments of Set Up - Contrast then establish offsets from this new reference point and can be stored as the user-selectable contrast level as described above. You can also restore the GMM to this reference by leaving the selector in SET UP for 15 seconds without pressing any key.

Chapter 5
List of Replaceable Parts

	Title	Page
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5-2.	How To Obtain Parts	5-3
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Introduction 5-1.

This chapter contains an illustrated list of replaceable parts for the 867B and 863 Graphical 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 (for example, “R52”)
- 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.

How To Obtain Parts 5-2.

Electronic components may be ordered directly 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.

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 (printed circuit assembly) containing the part.
- Reference designator
- Fluke stock number
- Description (as given under the Description heading)
- Quantity

Manual Status Information 5-3.

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.

Newer Instruments 5-4.

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 sheet which, when applicable, is included with the manual.

Service Centers 5-5.

A list of service centers is located on the Fluke website (www.fluke.com) or you can reach Fluke at:

USA and Canada: 1-800-44-FLUKE
(1-800-443-5853)

Europe: +31 402-678-200

Japan: +81-3-3434-0181

Singapore: +65-*-276-6196

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

Parts 5-6.

Note

This instrument may contain a Nickel-Cadmium battery. Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler. Contact your authorized Fluke service center for recycling information.

Manual Status Information

Ref or Option number	Assembly name	Fluke Part Number	Revision Level
A1	863 Main PCA	103629	H
A1	867B Main PCA	616570	P

Table 5-1. 860 Series Final Assembly

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
A1	* 863 MAIN PCA	103629	1	
A1	* 867B MAIN PCA	616570	1	
BT1	BATTERY PACK ASSY	938170	1	1
BT2-7	BATTERY,1.5,AA,ALKALINE	376756	6	2
E1	CONTACT,PTF	822676	1	
F2	FUSE, .406x1.375, 0.440A, 1000V FAST	943121	1	
H2	SCREW,PH,P,THD FORM,STL,2-14,.375	821140	1	
H3-5	SCREW,THD FORM,PH,P,STL,2-32,.750	944475	3	
H6	SCREW,PH,P,THD FORM,STL,5-14,.750	832246	6	
H12	SCREW,PH,P,EXT SEMS,STL,4-40,.250	107430	2	
MP1	863 CASE,TOP,ASSEMBLY,(PAD TRANSFER)	949081	1	
MP1	867B CASE,TOP,ASSEMBLY,(PAD TRANSFER)	949086	1	
MP2	863 MASK,LCM,(PAD TRANSFER)	948844	1	
MP2	867B MASK,LCM,(PAD TRANSFER)	615358	1	
MP3	863 LCDMODULE,240X200 GRAPH,TRNSFLECTIVE	928168	1	
MP3	867B LCDMODULE,240X200 GRAPH,TRNSMISSIVE	602430	1	
MP4	CASE,BOTTOM	948575	1	
MP5	SHORTING BAR,BATTERY	948687	1	
MP7	BAIL	948591	1	
MP8	LABEL,ADHES,MYLAR,1.50,.312	943407	1	
MP9	LABEL,CALIBRATION	948674	1	
MP10	TEST LEAD ASSY, TL70A	855820	1	
MP11	SUPPORT,INTERNAL	948625	1	
MP12	ADAPTER,SHAFT	948604	1	
MP13	SHIELD,MAIN	948661	1	
MP14	DOOR,ACCESS	948620	1	
MP20	DC POWER JACK ASSY	948745	1	
MP21	TUBE,CALIBRATION	948864	1	
MP23	FASTENER,ACCESS DOOR	948609	2	
MP40	SEAL,FUSE ACCESS	948935	1	
MP41	CONTACT,BATTERY,AA	948690	2	
P2	CONN,ELASTOMERIC,KEYPAD TO PWB,1.350L	942805	1	
PS2	PWR SUP,3.6W,12V@300MA,CHRGR/CNV USA	942599	1	3
PS3	PWR SUP,3.6W,12V@300MA,CHRGR/CNV EUR	942602	1	4
PS4	PWR SUP,3.6W,12V@300MA,CHRGR/CNV JAP	942610	1	5
PS5	PWR SUP,3.6W,12V@300MA,CHRGR/CNV AUS	944595	1	6
PS6	PWR SUP,3.6W,12V@300MA,CHRGR/CNV UK	942607	1	

Table 5-1. 860 Series Final Assembly (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
S2	863 KEYPAD MODULE	948799	1	
S2	867B KEYPAD MODULE	948641	1	
TM1	86X USER MANUAL,GRP E (ENG,FR,SP,DUTCH)	944178	1	
TM2	86X USER MANUAL,GRP G (GER,ITAL,SWE,NORW)	944181	1	
TM3	86X USER MANUAL,GRP J (ENG,JAPAN)	944710	1	
TM4	860 USER MANUAL	688192	1	

1. 867B only.
2. 863 ONLY.
3. 867BE 120V only.
4. 867BG and 867BE 230V only.
5. 867BJ 100V only.
6. 867BEA 240V only.

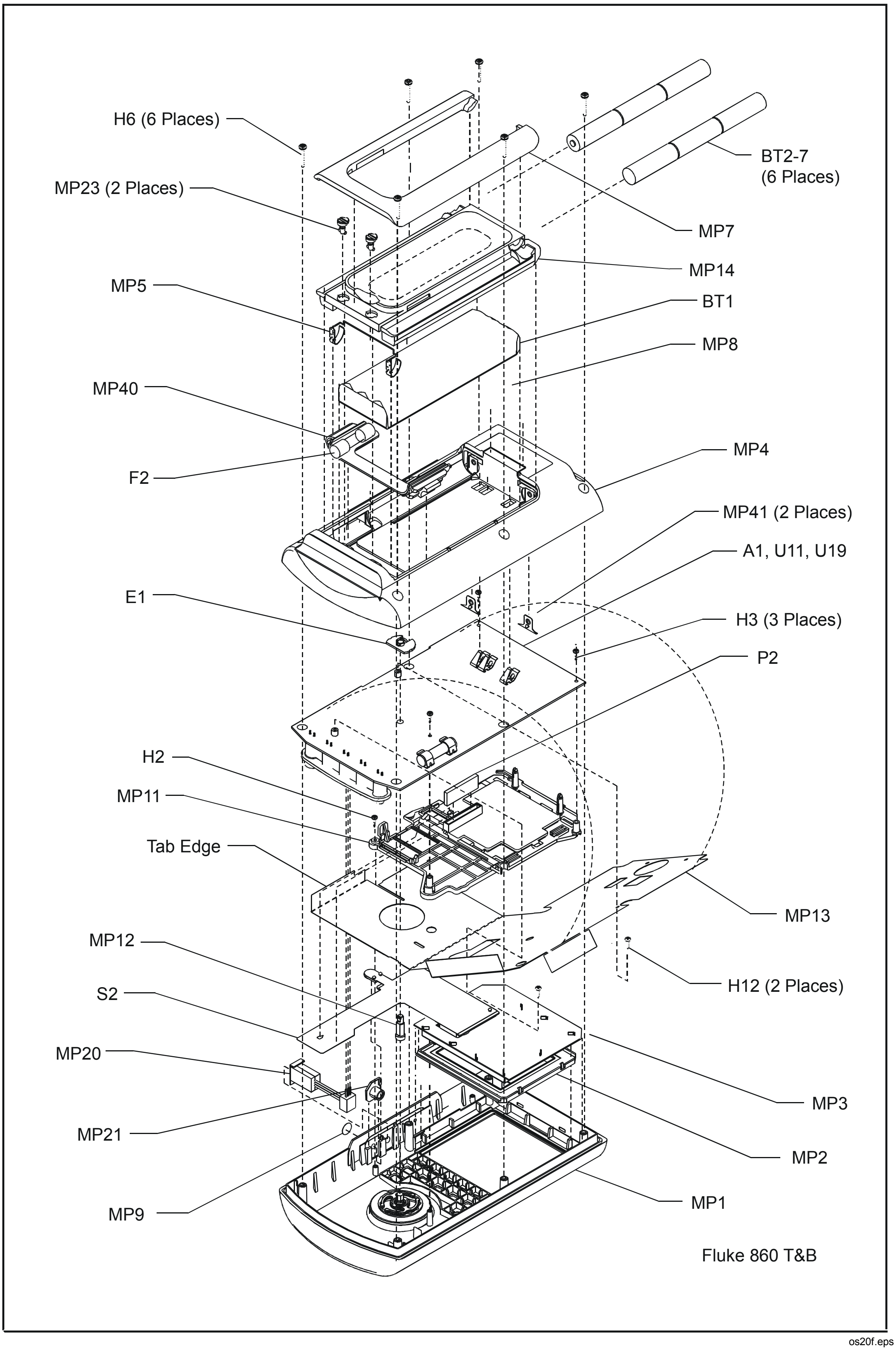


Figure 5-1. 860 Series Final Assembly

Table 5-2. A1 Main PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C1,C89	CAP,TA,1UF,+-20%,35V,3528	866970	2	
C2,C12,C61, C65,C88	CAP,TA,1UF,+-20%,20V,3216	942552 942552	5	
C3,C90	CAP,AL,220UF,+-20%,25V,SOLV PROOF	944686	2	
C4,C6	CAP,TA,2.2UF,+-20%,6V,3216	930248	2	
C5,C11,C14- 16,C18,C28, C29,C32,C33, C39,C44,C58, C64,C66,C74- 83,C87,C92, C93,C101	CAP,CER,0.1UF,+-10%,25V,X7R,0805	942529 942529 942529 942529 942529 942529 942529	29	
C7,C10,C21, C91,C119	CAP,TA,1UF,+-20%,20V,3216	942552 942552	5	1
C8	CAP,TA,100UF,+-20%,10V,7343	929877	1	
C9	CAP,TA,10UF,+-20%,16V,6032	867572	1	
C13,C96,C97	CAP,CER,0.1UF,+-10%,25V,X7R,0805	942529	3	
C17,C22	CAP,CER,470PF,+-1%,50V,C0G,0805	929476	2	
C19,C85	CAP,TA,10UF,+-20%,16V,6032	867572	2	
C20	CAP,CER,2700PF,+-20%,50V,X7R,0805	930149	1	
C23	CAP,CER,22PF,+-10%,50V,C0G,1206	740563	1	
C24,C30,C57	CAP,CER,0.01UF,+-10%,50V,X7R,1206	747261	3	
C25,C26	CAP,POLYES,0.47UF,+-10%,50V	697409	2	
C27,C52,C54	CAP,POLYES,1UF,+-5%,50V	944590	3	
C31	CAP,POLYES,0.1UF,+-5%,1000V	944587	1	
C34,C63	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	2	
C35	CAP,CER,390PF,+-5%,50V,COG,1206	887278	1	
C36	CAP,CER,100PF,+-10%,6000V,X5F	943667	1	
C37,C98	CAP,CER,68PF,+-5%,50V,C0G,0805	573857	2	
C38,C43	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	2	
C40,C49,C51	CAP,POLYPR,0.033UF,+-10%,63V	721050	3	
C41	CAP,CER,22PF,+-5%,50V,C0G,0805	855101	1	
C42	CAP,CER,22PF,+-10%,50V,C0G,1206	740563	1	
C45,C47	CAP,POLYPR,0.1UF,+-10%,100V	942958	2	
C46,C48	CAP,TA,3.3UF,+-20%,6V,3216	942941	2	
C50	CAP,CER,22PF,+-5%,50V,C0G,0805	855101	1	
C53	CAP,CER,3.3PF,+-0.25PF,50V,C0G,0805	942560	1	
C55	* CAP,SILICON,0.2PF,+-0.1PF,50V,0603	106051	1	
C56,C108	CAP,CER,680PF,+-10%,50V,C0G,0805	493908	2	
C59	CAP,CER,2200PF,+-5%,50V,C0G,0805	942524	1	
C60	CAP,TA,10UF,+-20%,35V,7343	930243	1	
C62	CAP,TA,10UF,+-20%,6V,3216	105954	1	

Table 5-2. A1 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
C67		CAP,POLYPR,6800PF,+-5%,50V	706564	1	
C68,C69		CAP,TA,68UF,+-10%,10V,7343	930250	2	
C70,C73		CAP,TA,100UF,+-20%,10V,7343	929877	2	
C71,C94, C110		CAP,TA,1UF,+-20%,35V,3528	866970 866970	3	
C72		CAP,CER,0.01UF,+-10%,50V,X7R,0805	106146	1	
C84		CAP,AL,10UF,+-20%,16V,NP,SOLV PROOF	697177	1	2
C95		CAP,POLYES,2200PF,+-10%,50V	832683	1	
C99		CAP,CER,150PF,+-5%,50V,C0G,0805	866533	1	
C100		CAP,CER,180PF,+-10%,50V,C0G,1206	769778	1	
C102		CAP,CER,270PF,+-1%,50V,C0G,0805	944301	1	
C103-107		CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	5	
C109		CAP,CER,100PF,+-10%,50V,C0G,1206	740571	1	
C111,C112, C114-116		CAP,CER,1000PF,+-10%,50V,C0G,1206	747378 747378	5	
C113		CAP,TA,10UF,+-20%,6V,3216	105954	1	
C117,C118		CAP,CER,47PF,+-5%,50V,C0G,0805	494633	2	
C120,C121		CAP,TA,4.7UF,+-20%,10V	106952	2	
CR1		DIODE,RECT,BRIDGE,BV=50V,IO=1A	912456	1	
CR2-7,CR11, CR15-17, CR26	* * *	DIODE,SI,BV=100,IO=100MA,DUAL,SOT-23	821116 821116 821116	11	3
CR9	*	DIODE,SI,BV=100,IO=100MA,DUAL,SOT-23	821116	1	2
CR10	*	DIODE,SI,SCHOTTKY,DUAL,30V,SOT-23	929745	1	
CR12,CR24	*	DIODE,SI,DUAL,BV=50V,IO=100MA,SOT-23	851659	2	
CR13		DIODE,SI,100 PIV,1 AMP,SURFACE MOUNT	912451	1	
CR14	*	DIODE,SI,SCHOTTKY,DUAL,30V,SOT-23	929745	1	
CR18-22		DIODE,SI,20 PIV,1.0 AMP	559708	5	
CR23		LED,INFRA RED,T1,950 NM	942545	1	
CR25	*	DIODE,SI,SCHOTTKY,30V,200MA,SOT-23	876529	1	
F1		FUSE,.406X1.5,11A,1000V,FAST	943118	1	
F2		FUSE,.406X1.375,0.440A,1000V,FAST	943121	1	
FL1		FILTER,EMI,0.5MHZ TO 1GHZ,50	930057	1	
J1		INPUT RECEPTACLE ASSEMBLY	948666	1	
K1		RELAY,ARMATURE,2 FORM C,5VDC,LATCH	836486	1	
L1		INDUCTOR,330UH,+-10%,0.400ADC	105962	1	
L2,L5,L6		FERRITE CHIP,600 OHM @100 MHZ,1206	943704	3	
L3,L4,L7		FERRITE CHIP,70 OHM @100 MHZ,1206	944558	3	
L8,L9		FERRITE CHIP,95 OHMS @100 MHZ,3612	867734	2	
LS1		AF TRANSD,PIEZO,20MM,2KHZ	876995	1	
MP1		HOLDER,LED	948716	1	

Table 5-2. A1 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
MP2		SHIELD,FENCE	948729	1	
MP3		SHIELD,ANALOG,RIGHT	948737	1	
MP4		SHIELD,ANALOG,LEFT	948682	1	
P1		CONN,FLAT FLEX,1MM CTR,RT ANG,16 POS	945001	1	
P3		HEADER,1 ROW,2MM CTR,3 PIN	944579	1	
Q1-3, Q5, Q6, Q11-13,Q32-34	* * *	TRANSISTOR,SI,NPN,BIASED,SC-59	930052 930052 930052	11	4
Q4,Q18,Q21, Q23,Q26,Q27	* *	TRANSISTOR,SI,NPN,SWITCH,SOT-23	942818 942818	6	
Q7-9,Q15	*	TRANSISTOR,SI,NPN,SELECT IEBO,SOT-23	821637	4	
Q10	*	TRANSISTOR,SI,PNP,50V,0.2W,SOT-23	820910	1	
Q14	*	TRANSISTOR,SI,P-MOS,2.5W,SOIC	930011	1	
Q16	*	TRANSISTOR,SI,N-MOS,DUAL,2W,SOIC	930016	1	
Q17,Q20	*	TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT-23	912469	2	
Q19	*	TRANSISTOR,SI,PNP,40V,0.2W,SOT-23	942511	1	
Q22		TRANSISTOR,SI,BV=40V,15W,D-PAK	930268	1	2
Q24,Q25,Q28	*	TRANSISTOR,SI,PNP,BIAS,50V,0.2W,SC-59	930045	3	
Q30	*	TRANSISTOR,SI,NPN,BIASED,SC-59	930052	1	
Q31	*	TRANSITOR,PHOTO,W/ DAYLIGHT FILTER	942540	1	
R1,R3,R22, R32,R61, R118,R149		RES,CERM,1K,+-1%,0.1W,100PPM,080	928713 928713 928713	8	
R2		RES,CERM,11K,+-1%,0.1W,100PPM,0805	928796	1	
R4		RES,CERM,464K,+-1%,0.1W,100PPM,0805	928903	1	
R5		RES,CERM,150,+-1%,0.1W,100PPM,0805	930086	1	
R6,R17,R36, R46,R72,R94, R117,R133		RES,CERM,475,+-1%,0.1W,100PPM,0805	943642 943642 943642	8	
R7,R162, R166		RES,CERM,4.99K,+-1%,0.1W,100PPM,0805	928767 928767	3	
R8,R10,R13, R19,R25,R35, R39,R58,R71, R73,R102, R105,R115, R119,R127, R128,R131, R135,R136		RES,CERM,10K,+-1%,0.1W,100PPM,0805	928791 928791 928791 928791 928791 928791 928791 928791	19	
R9		RES,CERM,18.7K,+-1%,0.1W,100PPM,0805	930180	1	
R11,R106, R132		RES,CERM,3.24K,+-1%,0.1W,100PPM,080	930102 930102	3	
R12		RES,CERM,140K,+-1%,0.1W,100PPM,0805	942578	1	

Table 5-2. A1 Main PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
R14,R53,R56, R68,R126, R139	RES,CERM,1M,+-1%,0.1W,200PPM,0805	928945 928945 928945	6	5
R15,R18,R27- 29,R57,R63, R78,R130, R13,R138, R141-143	RES,CERM,100K,+-1%,0.1W,100PPM,0805	928866 928866 928866 928866 928866	14	6
R16	RES,CERM,0.2,+-5%,0.1W,100PPM,0805	944439	1	2
R20,R99	RES,CERM,100K,+-5%,3W	820811	2	
R21	RES,CERM,78.7K,+-1%,0.1W,100PPM,0805	930222	1	
R23,R26,R83, R107	RES,CERM,22.1,+-1%,0.1W,100PPM,0805	928932 928932	4	
R30,R67,R80, R82,R95,R98	RES,CERM,200K,+-1%,0.1W,100PPM,0805	928882 928882	6	
R31,R55	RES,CERM,6.49K,+-1%,0.1W,100PPM,0805	930115	2	7
R33,R90, R156	RES,CERM,10K,+-1%,0.1W,100PPM,0805	928791 928791	3	
R34	RES,CERM,9.76K,+-1%,0.1W,100PPM,0805	930128	1	
R37	RES,CERM,61.9K,+-1%,0.1W,100PPM,080	928861	1	
R38	RES,CERM,1K,+-1%,0.1W,100PPM,0805	928713	1	
R40	RES,CERM,1.47K,+-1%,0.1W,100PPM,0805	943613	1	
R41,R43	RES,CERM,221K,+-1%,0.1W,100PPM,0805	928890	2	
R42	RES,WW,1,+-5%,2.5W,15PPM	944363	1	
R44	RES,CERM,464K,+-1%,0.1W,100PPM,0805	928903	1	2
R45,R54,R66, R79,R88,R93, R110,R145, R154,R155, R157,R160	RES,CERM,47,+-5%,.0625W,200PPM,0603	927707 927707 927707 927707 927707	12	
R47	RES,CERM,845,+-1%,0.1W,100PPM,0805	929039	1	
R48,R52,R60, R62,R125	RES,CERM,0,+.05 MAX,.125W,1206	810747 810747	5	
R49	RES,MF,100,+-1%,0.125W,25PPM	460527	1	
R50	RES,CERM,316K,+-1%,0.1W,100PPM,0805	930198	1	
R51,R85, R112	RES,CERM,30.9K,+-1%,0.1W,100PPM,080	928838 928838	3	
R59	RES,CERM,499K,+-1%,0.1W,100PPM,0805	944285	1	
R64,R70	RES,CERM,30.9K,+-1%,0.1W,100PPM,0805	928838	2	
R65	RES,CERM,475,+-1%,0.1W,100PPM,0805	943642	1	
R69	RES,CERM,6.34K,+-1%,0.1W,100PPM,0805	928775	1	
R74,R123	RES,CERM,1.82K,+-1%,0.1W,100PPM,0805	930172	2	8
R75	RES,CERM,1M,+-1%,2W,100PPM	876177	1	

Table 5-2. A1 Main PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
R76	RES,CERM,4.75M,+-1%,0.1W,400PPM,0805	928994	1	
R77	RES,CERM,100,+-1%,0.1W,100PPM,0805	928937	1	
R81	RES,CERM,31.6K,+-1%,0.1W,100PPM,0805	928841	1	
R84	RES,CERM,20K,+-1%,0.1W,100PPM,0805	928820	1	
R86	RES,CERM,133K,+-1%,0.1W,100PPM,0805	928874	1	
R87	RES,CERM,0,+.05 MAX,.125W,1206	810747	1	
R89	RES,CERM,10.7K,+-1%,0.1W,100PPM,0805	930037	1	
R91	RES,CERM,1.5M,+-1%,2W,100PPM	944280	1	
R92,R121, R134	RES,CERM,100K,+-1%,0.1W,100PPM,0805	928866 928866	3	
R96	RES,CERM,16.9K,+-1%,0.1W,100PPM.0805	928817	1	
R97,R147	RES,CERM,10,+-1%,0.1W,100PPM,0805	928924	2	
R100	RES,CERM,24.9K,+-1%,0.1W,0805	928825	1	2
R101	RES,CERM,1.15K,+-1%,0.1W,100PPM,0805	928718	1	
R103	RES,WW,3.5K,+-5%,5W,20PPM	943712	1	
R104	RES,CERM,110K,+-1%,0.1W,100PPM,0805	930230	1	
R108	RES,CERM,1.5M,+-1%,.125W,200PPM,1206	821181	1	
R109	RES,WW,.010,+-5%,1W,100PPM	820845	1	
R111	RES,CERM,10M,+-1%,0.1W,400PPM,080	943659	1	
R113	RES,CERM,12.1,+-1%,.5W,100PPM,2010	944033	1	2
R114	RES,CERM,0.2,+-5%,0.1W,600PPM,0805	944439	1	
R116	RES,CERM,5.62K,+-1%,0.1W,100PPM,0805	930110	1	
R120	RES,CERM,59K,+-1%,0.1W,100PPM,0805	930219	1	
R122	RES,CERM,221K,+-1%,0.1W,100PPM,0805	928890	1	
R124	RES,CERM,3.32M,+-1%,0.1W,400PPM,0805	943639	1	
R129	RES,CERM,19.6K,+-1%,0.1W,100PPM,0805	943618	1	
R140	RES,CERM,66.5K,+-1%,0.1W,100PPM,0805	928908	1	
R144	RES,CERM,470,+-5%,.0625W,200PPM,0603	106143	1	
R146	RES,CERM,150,+-1%,0.1W,100PPM,0805	930086	1	
R148,R150, R151	RES,CERM,100,+-1%,0.1W,100PPM,0805	928937 928937	3	
R152	RES,CERM,22.1,+-1%,0.1W,100PPM,0805	928932	1	
R153	RES,CERM,22.1,+-1%,0.1W,100PPM,0805	928932	1	
R158	RES,CERM, 47, +- 5%, .125W, 200 ppm, 1206	746263	1	2
R163	RES,CERM,13K,+-1%,0.1W,100PPM,0805	930164	1	
R164	RES,CERM,18.2K,+-1%,0.1W,100PPM,0805	930177	1	
R165	RES,CERM,27.4K,+-1%,0.1W,100PPM,0805	930185	1	
R167	RES,CERM,45.3K,+-1%,0.1W,100PPM,0805	930201	1	
R168	RES,CERM,6.04K,+-1%,0.1W,100PPM,0805	928770	1	
R169	RES,CERM,90.9K,+-1%,0.1W,100PPM,0805	930227	1	
R170	RES,CERM,49.9K,+-1%,0.1W,100PPM,0805	928697	1	

Table 5-2. A1 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
R171		RES,CERM,274K,+-1%,0.1W,100PPM,0805	930193	1	
R172		RES,CERM,7.68K,+-1%,0.1W,100PPM,0805	930123	1	
RT1		THERMISTOR,POS,1.1K,+-20%,25 C	867192	1	
RV1-3		VARISTOR,910,+-10%,1.0MA	876193	3	
S1		SWITCH,ROTARY	948646	1	
T1		TRANSORMER,SWITCHING	948658	1	
TP6		JUMPER,WIRE,NONINSUL,0.200CTR	816090	1	
U1	*	IC,CMOS,10 BIT DAC,CUR OUT,SOIC	929984	1	
U2,U4	*	IC,OP AMP,DUAL,LO POWER,SNGL SUP,SO8	928663	2	
U3	*	IC,RMS-DC CONVERTER,WB,PRECISION,SO16	928911	1	
U5,U8	*	IC,OP AMP,DECOMP,HI SR,WIDE BW,SO8	930136	2	
U6	*	IC,OP AMP,HIGH BW,HIGH SLEW RATE,SO8	944681	1	
U9	*	IC,BIFET,OP AMP,HIGH SR,WIDE BW,SO8	929992	1	
U10	*	IC,CMOS,8 BIT A/D W/SAMPLE & HLD,SSOP	929971	1	
U11		EPROM,PROGAMMED	948955	1	
U12	*	IC,OP AMP,DUAL,LOW POWER,SOIC	867932	1	
U13	*	IC,GRAPHIC LCD CONTROLLER,3 V,60QFP	929208	1	
U14		IC,CMOS,TRIPLE 2-1 LINE ANLG MUX,SOIC	929013	1	
U15	*	IC,VOLT REG,FIXED,+5V,UPOWR,LO DO,SO8	929190	1	
U16-18	*	IC,CMOS,TRIPLE 2-1 LINE ANLG MUX,SOIC	929013	3	
U19		EPROM,PROGRAMMED	103655	1	
U20,U21	*	IC,CMOS,SRAM,32K X 8,3.3 V,150NS,SO28	930131	2	
U22	*	IC,COMPARATOR,DUAL,LOW PWR,SOIC	837211	1	
U23	*	IC,EEPROM,SER,LV,1K X 16,16K BIT,SO8	930144	1	
U24	*	IC,GATE ARRAY,12K GATES + RAM,100 QFP	928671	1	
U25	*	IC,MCU,16-BIT,A/D,3.3 V,DUART,PQFP112	930263	1	
U26	*	TRANSISTOR,SI,N/P-MOS,DUAL,2W,SOIC	929997	1	
U27	*	IC,VOLT REG,ADJ,SWITCHING REGULATOR	821215	1	
U30	*	IC TWIN WELL RIC ASSY TESTED	946017	1	
U31	*	IC,V REF,SHUNT,2.5 V,1%,150 PPM,SOT23	930065	1	
U32	*	IC,CMOS,14 STAGE BINARY COUNTER,SOIC	831081	1	2
U33	*	IC,CMOS,DUAL D F/F,+EDG TRG,SOIC	782995	1	
U34	*	IC,CMOS,QUAD 2 IN NAND W/SCHMT,SOIC	837245	1	
VR1		ZENER,UNCOMP,5.1V,5%,20MA,0.2W,SOT-23	837179	1	2
VR2		ZENER,UNCOMP,10V,5%,20MA,0.2W,SOT-2	783704	1	
VR3	*	ZENER,TESTED	857201	1	
VR4,VR5		ZENER,UNCOMP,6.0V,5%,20MA,0.2W,SOT-23	837161	2	
WP1,WP2		SPACER,BROACH,.219 RND,STL,4-40,.125	944702	2	
XBT101-103		CONTACT,PCA	948638	3	
XF101,XF102		600 VOLT FUSE CONTACT	707190	2	
XF201,XF202		CLIP,FUSE,ANGLED	948695	2	

Table 5-2. A1 Main PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
Y1	CRYSTAL,19.2MHZ,50PPM,SURFACE MT	930024	1	
Z1	RNET, CERM, SIP, HI V AMP GAIN	926709	1	
Z2	RES,CERM,SOIC,14 PIN,13 RES,30K,+-2%	930003	1	
Z3	RES,MF,SOIC,14 PIN 7 RES, CUSTOM	943480	1	
Z4	RNET, MF, POLY, SIP, A TO D CONV	926865	1	
Z5	RNET, MF, POLY, SIP, HI V DIVIDER	926857	1	
Z6	RES,MF,SOIC,16 PIN,6 RES,CUSTOM	943477	1	

1. 863 Qty = 4 (C7,C10, C21, C119)
2. 867B only.
3. 863 Qty = 10 (CR2-7, CR16, CR17, CR26)
4. 863 Qty = 6 (Q5, Q12, Q13, Q32-34)
5. 863 Qty = 5 (R14, R53, R56, R126, R139)
6. 863 Qty = 11 (R18, R27, R29, R57, R63, R 78, R139, R137, R138, R142, R143)
7. 863 Qty = 1 (R31)
8. 863 Qty = 1 (R123)

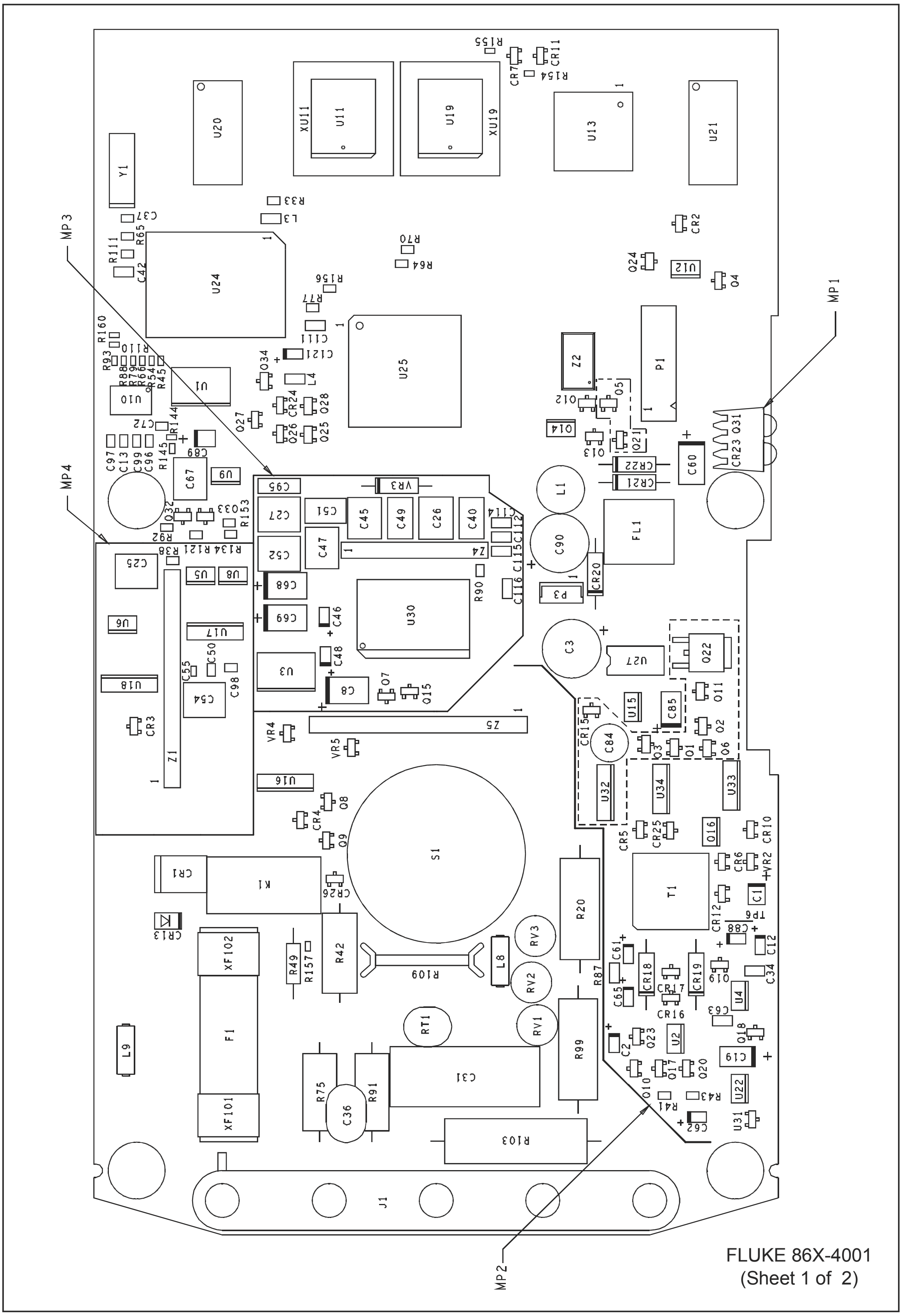


Figure 5-2. A1 Main PCA

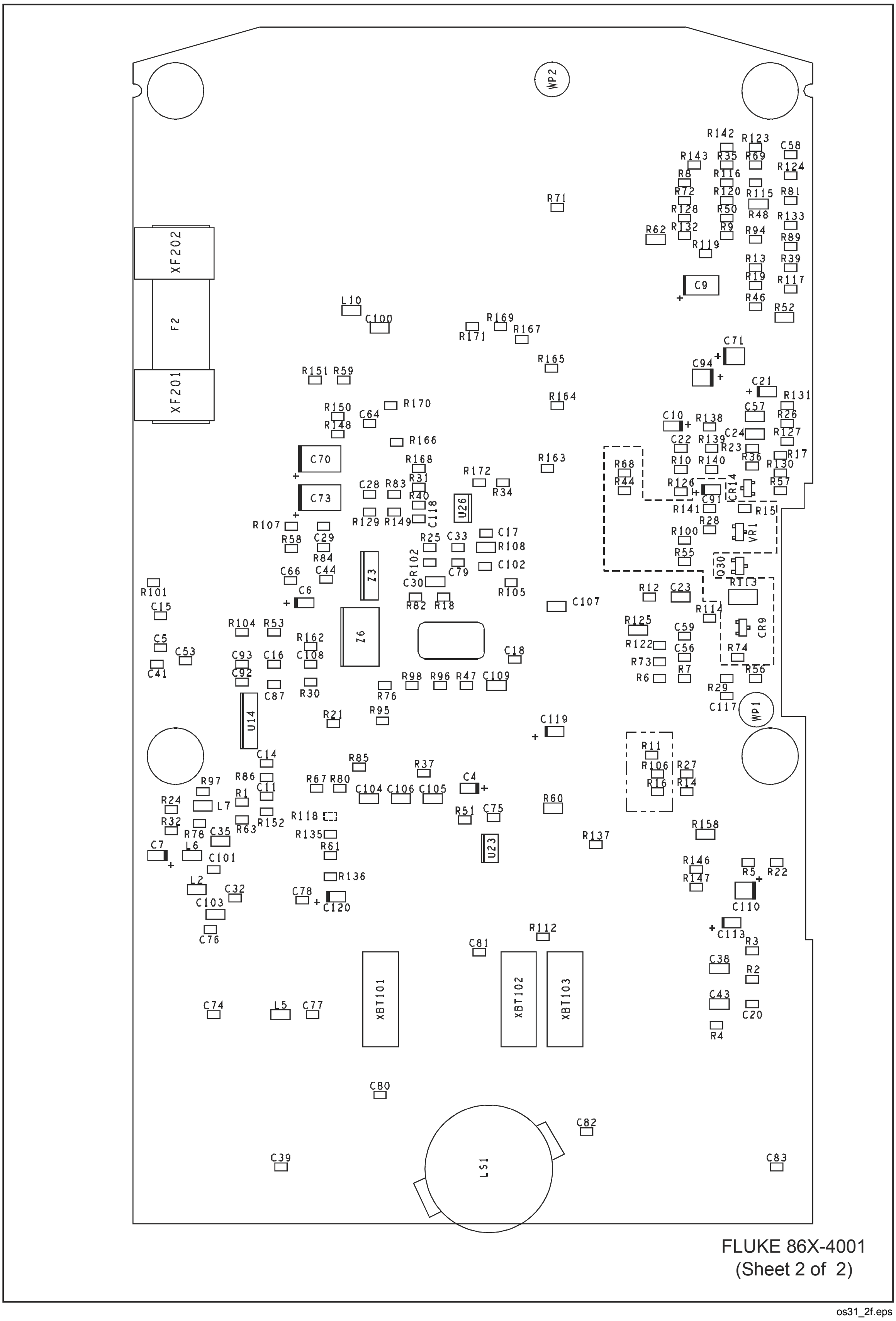


Figure 5-2. A1 Main PCA (cont)

Chapter 6
Schematic Diagrams

Title	Page

6-1. A1 Main PCA Assembly 6-3

NOTES: UNLESS OTHERWISE INDICATED:

1. RESISTORS ARE IN OHMS, 0805 SM CERMET, 1%, 0.100W.
2. NON-POLAR CAPACITORS ARE POLYESTER, 10%, 50V.
3. POLARIZED CAPACITORS ARE TANTALUM, 10%, 35V.
4. CR8 IS NOT INSTALLED.
5. R74, CR9, R113, Q22, R55, R100, Q2, Q1, Q6, Q3, CR15, Q11, U32, R44, C84, R68, C91, R141, VR1, R15, R28, C21, R11, R106, R16, Q5, Q21 AND CR12 ARE NOT LOADED ON THE 863.
6. C86 IS NOT INSTALLED.
9. U28 IS NOT INSTALLED.
10. R16 IS .2 OHMS ON THE 867B AND 10 OHMS ON THE 867.
11. R158 IS ONLY USED ON THE 867B.

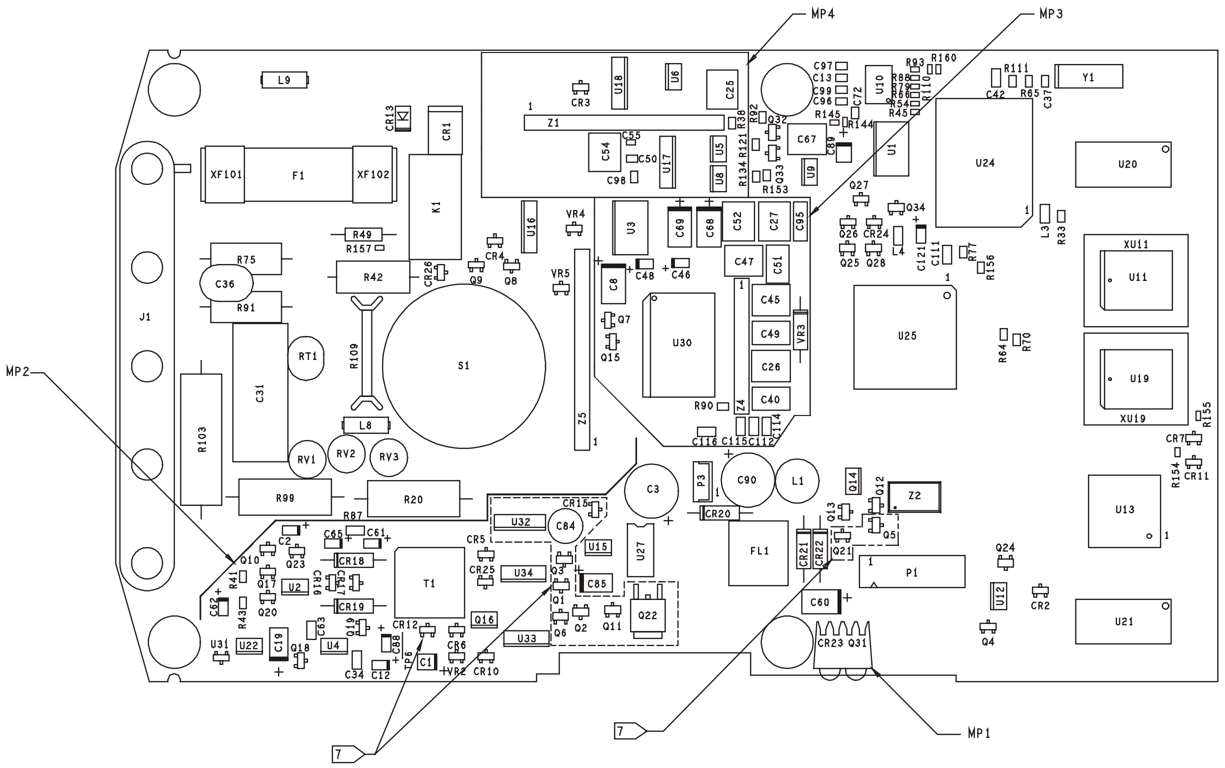
REFERENCE DESIGNATION		
LAST USED		NOT USED
BT	1	
C	121	
CR	26	
F	2	
FL	1	
J	1	
K	1	
L	10	
LS	1	
M	4	
MP	4	
P	3	
Q	34	Q29
R	172	R159,161
RT	1	
RV	3	
S	2	
T	1	
TP	31	
U	34	U7,29
VR	5	
WP	1	
Y	1	
Z	6	

POWER SUPPLIES

VDD	+5.2V +/-5%
VSS	-5.2V +/-5%
VCC	+3.27V +/-2%
VAD	+3.27V +/-2%
VEE	-20V

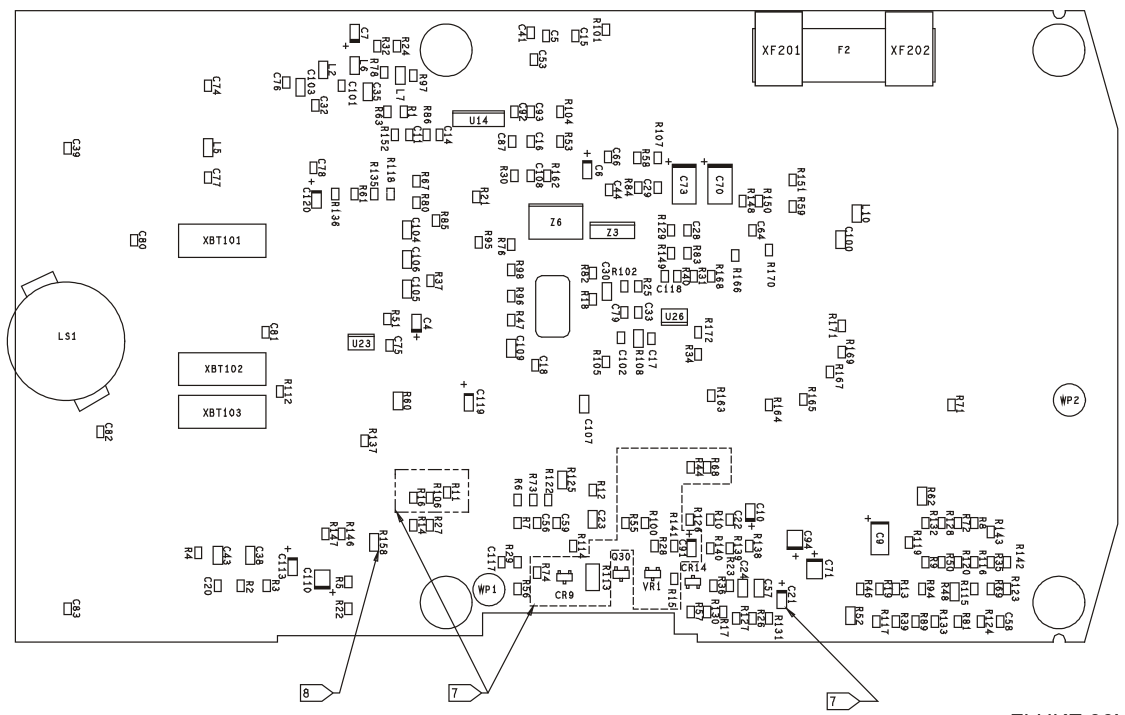
SYSTEM GROUNDS

GND	INPUT SIDE OF CURRENT SHUNT
AGND	SIGNAL CONNECTION TO INPUT SIDE OF SHUNT WITH NO CURRENT FLOW
GND1	QUIET ANALOG GROUND RETURN TO POWER SUPPLY COMMON
GND3	FILTER RETURNS FROM ANALOG SUPPLIES TO POWER SUPPLY COMMON
GND5	QUIET ANALOG GROUND RETURN TO POWER SUPPLY COMMON
DGND	DIGITAL SUPPLIES GROUND RETURN TO POWER SUPPLY COMMON AND POWER SUPPLY GROUND



Top (Ckt 1) Assembly

FLUKE 867-1001
(Sheet 1 of 5)



Bottom (Ckt 1) Assembly

FLUKE 86X-4001

Figure 6-1. A1 Main PCA

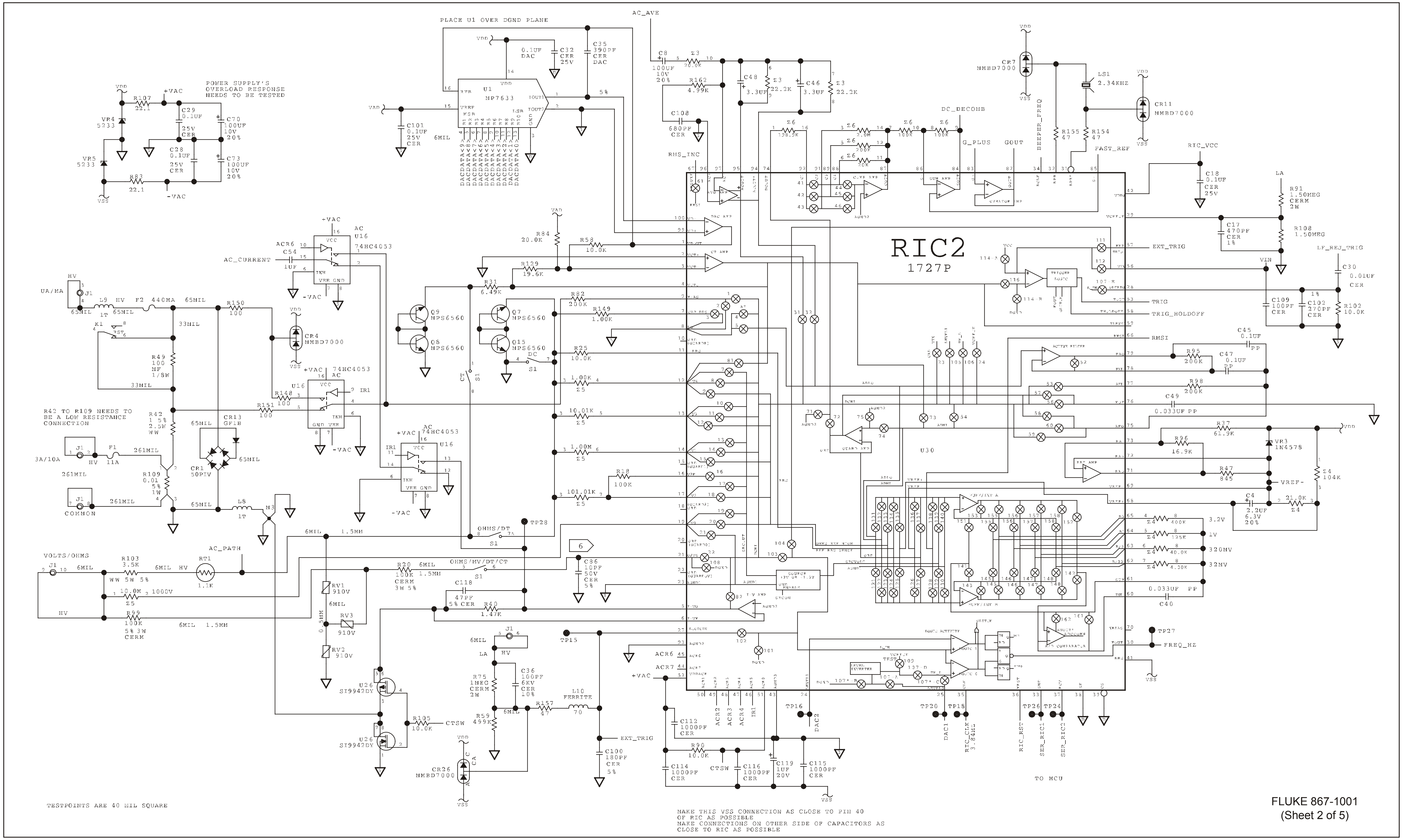


Figure 6-1. A1 Main PCA (cont)

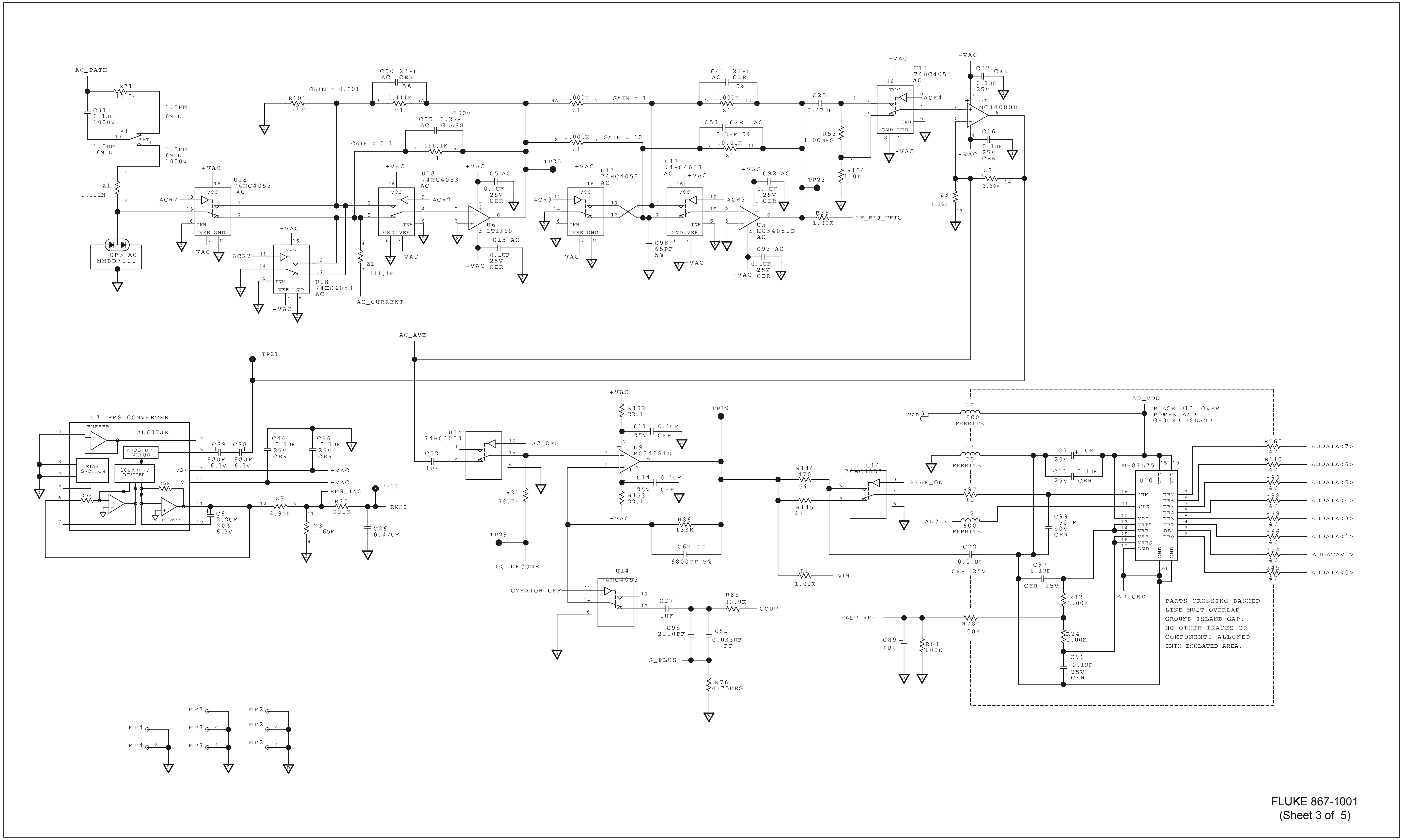


Figure 6-1. A1 Main PCA (cont)

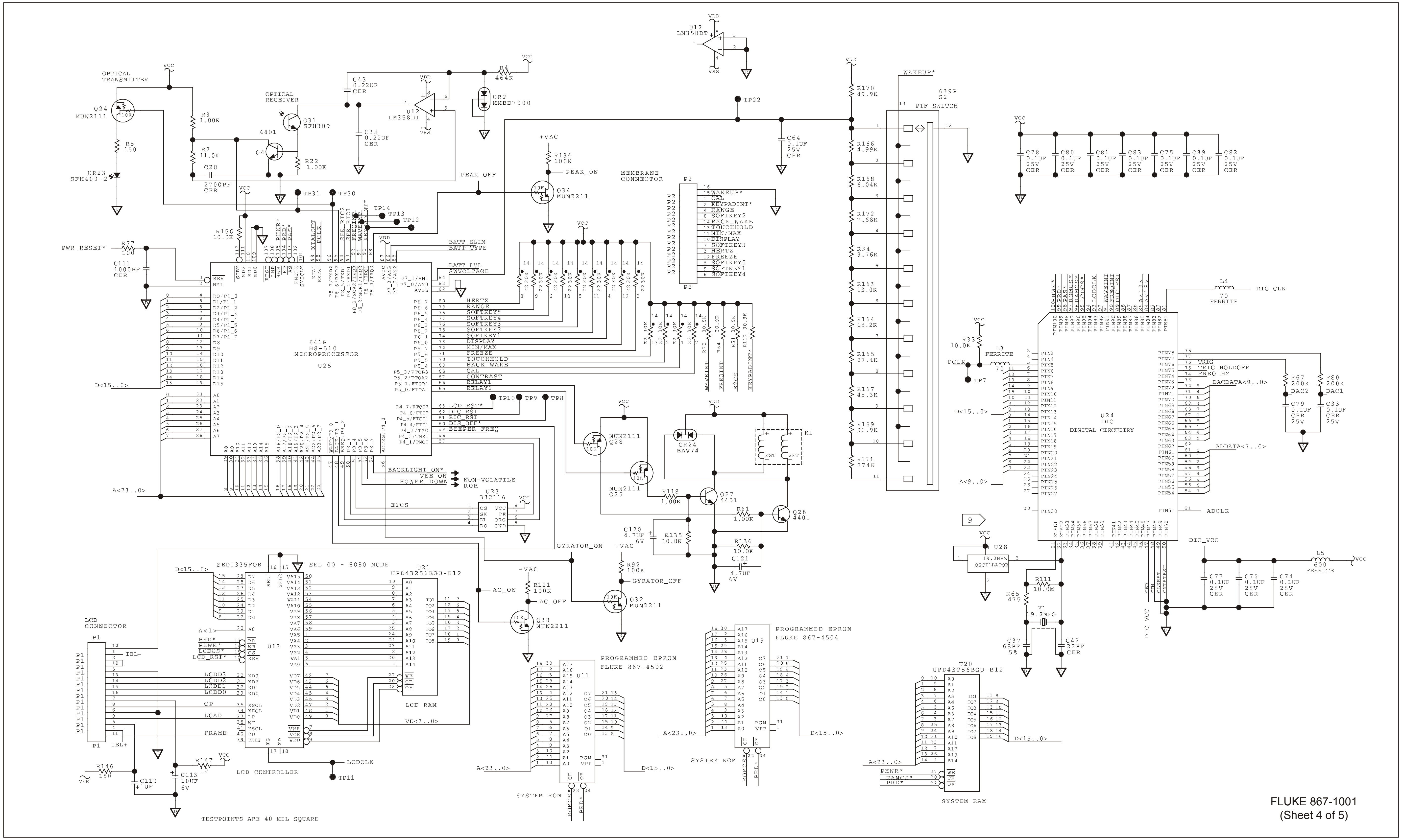


Figure 6-1. A1 Main PCA (cont)

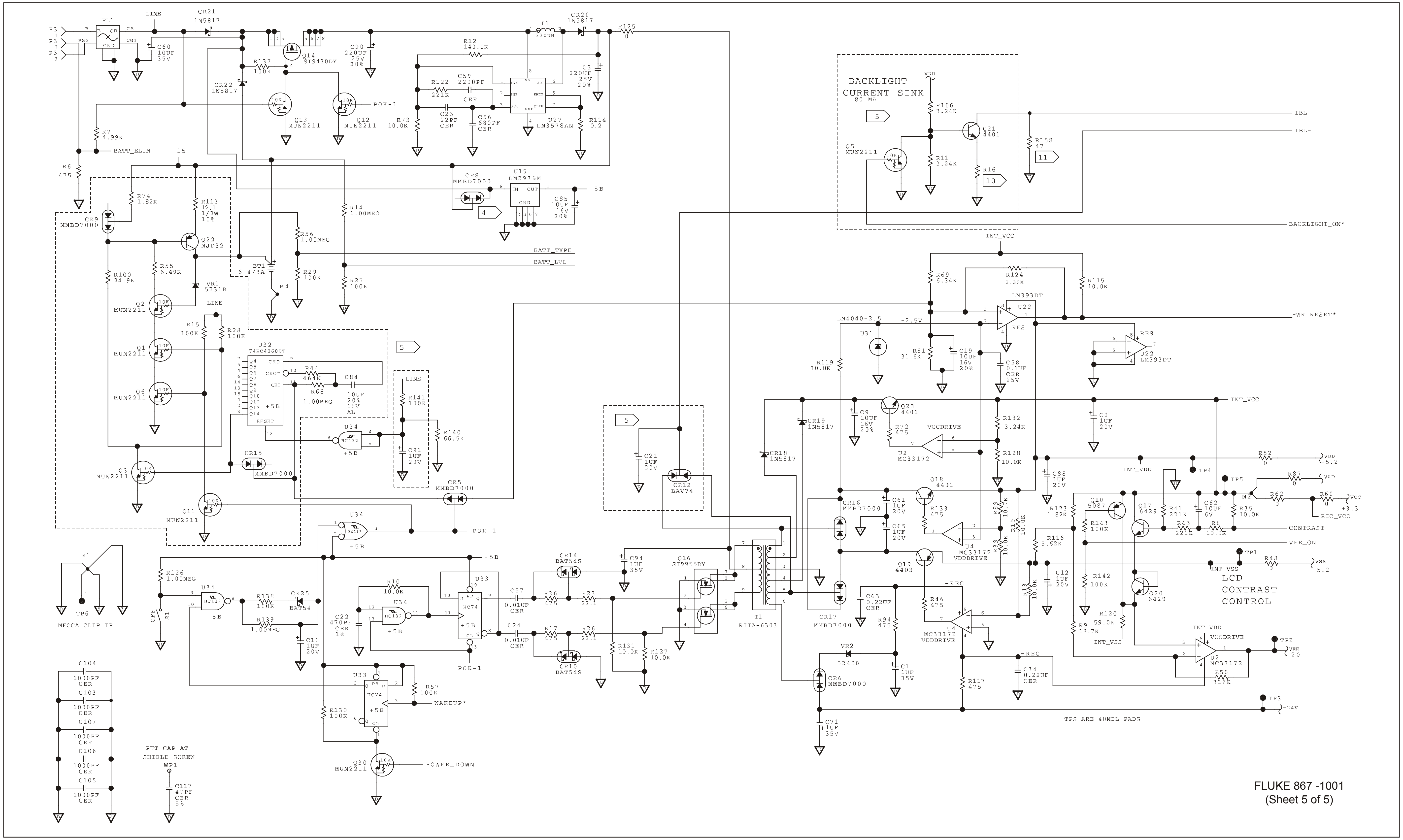


Figure 6-1. A1 Main PCA (cont)