FLUKE®

# 87V MAX

## *Digital Multimeter*

Calibration Information

## *Introduction*

**⚠⚠Warning**

**To prevent electric shock or injury, do not perform the performance tests or calibration adjustment procedures unless qualified to do so.**

**The information provided in this document is for the use of qualified personnel only.**

This document provides adjustment and performance test procedures for the Fluke 87V MAX Digital Multimeter (the Meter).

See the *87V MAX Users Manual* for complete operating instructions.

## *Contact Information*

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

- Technical Support USA: 1-800-44-FLUKE (1-800-443-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200
- Japan: +81-3-6714-3114
- Singapore: +65-6799-5566
- China: +86-400-921-0835
- Brazil: +55-11-3530-8901
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at www.fluke.com.

To register your product, visit http://register.fluke.com.

To view, print, or download the latest manual supplement, visit http://us.fluke.com/usen/support/manuals.

## *Safety Information*

General Safety Information is in the printed Safety Information document that ships with the Product and at www.fluke.com. More specific safety information is listed where applicable.

January 2020

# General Specifications

**Maximum voltage between any terminal and earth ground** ..... 1000 V rms

**Fuse Protection for mA or µA inputs** ..... 0.44 A, 1000V, IR 10kA

**Fuse Protection for A inputs** ..... 11 A, 1000 V, IR 17 kA

**Display**

Digital ..... 6000 counts, updates 4/sec / 19,999 counts in high-resolution mode

Bargraph ..... 33 segments; updates 40/sec

**Altitude**

Operating ..... 2000 meters

Storage ..... 10 000 meters

**Temperature**

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

Storage ..... -55 °C to 85 °C (without battery)
-55 °C to 60 °C (with battery)

**Temperature coefficient** ..... 0.05 X (specified accuracy) / °C (<18 °C or >28 °C)

**Safety** ..... IEC 61010-1: Pollution Degree 2
IEC 61010-2-033: CAT III 1000 V, CAT IV 600 V

**Electromagnetic Compatibility (EMC)** ..... In an RF field of 3 V/m, accuracy = specified accuracy +20 counts, except 600 µA dc range total accuracy = specified accuracy +60 counts. Temperature not specified.

International ..... IEC 61326-1: Portable Electromagnetic Environment
CISPR 11: Group 1, Class A

*Group 1: Equipment has intentionally generated and/or uses conductively coupled radio frequency energy that is necessary for the internal function of the equipment itself.*

*Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.*

*Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.*

*Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.*

Korea (KCC) ..... Class A Equipment (Industrial Broadcasting & Communication Equipment)

*Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.*

USA (FCC) ..... 47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103. In an RF field of 3 V/M, accuracy = specified accuracy +20 counts, except 600 µA dc range total accuracy = specified accuracy +60 counts. Temperature not specified

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

**Battery Type** ..... 3 AA Alkaline batteries, NEDA 15A IEC LR6
**Battery Life** ..... 800 hr typical without backlight (Alkaline)
**Vibration** ..... Per MIL-PRF-28800 for a Class 2 instrument
**Size (H x W x L)** ..... 1.8 in x 3.7 in x 7.7 in (4.6 cm x 9.4 cm x 19.7 cm)
**Size with Holster** ..... 2.4 in x 4.3 in x 8.5 in (6.0 cm x 10.1 cm x 21.5 cm)
**Weight** ..... 1.14 lb (517.1 g)
**Weight with Holster and Flex-Stand** ..... 1.54 lb (698.5 g)
**IP Rating** ..... IEC 60529: IP67

# Detailed Specifications

For all detailed specifications:

Accuracy is specified for 2 years after calibration, at operating temperatures of 18 °C to 28 °C, with relative humidity at 0 % to 95 %. Accuracy specifications take the form of ±([% of Reading] + [Number of least-significant digits]).
For the 4 ½-digit mode, multiply the number of least-significant digits (counts) by 10.

## AC Voltage

AC conversions are ac-coupled and valid from 3 % to 100 % of range.

<table>
<tr><th rowspan="2">Range</th><th rowspan="2">Resolution</th><th colspan="6">Accuracy</th></tr>
<tr><th>45 – 65 Hz</th><th>15 – 200 Hz</th><th>200 – 440 Hz</th><th>440 Hz – 1 kHz</th><th>1 – 5 kHz</th><th>5 – 20 kHz</th></tr>
<tr><td>600.0 mV</td><td>0.1 mV</td><td rowspan="2">±(0.7 % + 4)</td><td colspan="3" rowspan="3">±(1.0 % + 4) [1]</td><td rowspan="2">±(2 % + 4)</td><td rowspan="2">±(2 % + 20) [2]</td></tr>
<tr><td>6.000 V</td><td>0.001 V</td></tr>
<tr><td>60.00 V</td><td>0.01 V</td><td rowspan="4">±(0.7 % + 2)</td><td rowspan="3">±(2 % + 4) [3]</td><td>Unspecified</td></tr>
<tr><td>600.0 V</td><td>0.1 V</td><td>Unspecified</td></tr>
<tr><td>1000 V</td><td>1 V</td><td colspan="3">Unspecified</td><td>Unspecified</td></tr>
<tr><td colspan="2">Low-Pass Filter</td><td>±(1.0 % + 4) [1]</td><td>+1.0 % + 4<br>-6.0 % - 4 [4]</td><td>Unspecified</td><td>Unspecified</td><td>Unspecified</td></tr>
</table>

[1] Below 30 Hz, use smoothing function. Below 20 Hz add 0.6 %.
[2] Below 10 % of range, add 12 counts.
[3] Frequency range: 1 to 2.5 kHz
[4] Specification increases from -1 % to -6 % at 440 Hz when filter is used.

## DC Voltage, Conductance, and Resistance

| Function | Range | Resolution | Accuracy |
|---|---|---|---|
| **mV dc** | 600.0 mV | 0.1 mV | ±(0.1 % + 1) |
| **V dc** | 6.000 V | 0.001 V | ±(0.05 % + 1) |
| | 60.00 V | 0.01 V | |
| | 600.0 V | 0.1 V | |
| | 1000 V | 1 V | |
| **Ω** | 600.0 Ω | 0.1 Ω | ±(0.2 % + 2) [2] |
| | 6.000 kΩ | 0.001 kΩ | ±(0.2 % + 1) |
| | 60.00 kΩ | 0.01 kΩ | |
| | 600.0 kΩ | 0.1 kΩ | |
| | 6.000 MΩ | 0.001 MΩ | |
| | 50.00 MΩ | 0.01 MΩ | ±(1.0 % + 1) [1] |
| **nS** | 60.00 nS | 0.01 nS | ±(1.0 % + 10) [1,2] |

[1] Add 0.5 % of reading when measuring above 30 MΩ in the 50 MΩ range, and 20 counts below 33 nS in the 60 nS range.
[2] When using the rel function to compensate for offsets.

## Temperature

| Range | Resolution | Accuracy [1,2] |
|---|---|---|
| -200 °C to +1090 °C<br>-328 °F to +1994 °F | 0.1 °C<br>0.1 °F | ±(1.0 % + 10)<br>±(1.0 % + 18) |

[1] Does not include error of the thermocouple probe.

[2] Accuracy specification assumes ambient temperature stable to ± 1 °C. For ambient temperature changes of ± 5 °C, rated accuracy applies after 2 hours.

## AC Current

| Function | Range | Resolution | Burden Voltage | Accuracy[1] (45 Hz – 2 kHz) |
|---|---|---|---|---|
| **µA ac** | 600.0 µA | 0.1 µA | 100 µV/µA | ±(1.0 % + 2) |
| | 6000 µA | 1 µA | 100 µV/µA | |
| **mA ac** | 60.00 mA | 0.01 mA | 1.8 mV/mA | |
| | 400.0 mA [2] | 0.1 mA | 1.8 mV/mA | |
| **A ac** | 6.000 A | 0.001 A | 0.03 V/A | |
| | 10.00 A [3,4] | 0.01 A | 0.03 V/A | |

[1] AC conversion are ac coupled and calibrated to the rms value of a sine wave input.

[2] 400 mA continuous. 600 mA for 18 hr maximum.

[5] ⚠ 10 A continuous up to 35 °C. <20 minutes on, 5 minutes off at 35 °C to 55 °C. >10 A to 20 A for 30 seconds maximum, 5 minutes off.

[6] >10 A accuracy unspecified.

## DC Current

| Function | Range | Resolution | Burden Voltage | Accuracy |
|---|---|---|---|---|
| **µA dc** | 600.0 µA | 0.1 µA | 100 µV/µA | ±(0.2 % + 4) |
| | 6000 µA | 1 µA | 100 µV/µA | ±(0.2 % + 2) |
| **mA dc** | 60.00 mA | 0.01 mA | 1.8 mV/mA | ±(0.2 % + 4) |
| | 400.0 mA [1] | 0.1 mA | 1.8 mV/mA | ±(0.2 % + 2) |
| **A dc** | 6.000 A | 0.001 A | 0.03 V/A | ±(0.2 % + 4) |
| | 10.00 A [2,3] | 0.01 A | 0.03 V/A | ±(0.2 % + 2) |

[1] 400 mA continuous. 600 mA for 18 hr maximum.

[2] ⚠ 10 A continuous up to 35 °C. <20 minutes on, 5 minutes off at 35 °C to 55 °C. >10 A to 20 A for 30 seconds maximum, 5 minutes off.

[3] >10 A accuracy unspecified.

## Capacitance

| Range | Resolution | Accuracy |
|---|---|---|
| 10.00 nF | 0.01 nF | ±(1.0 % + 2) [1] |
| 100.0 nF | 0.1 nF | |
| 1.000 µF | 0.001 µF | ±(1.0 % + 2) |
| 10.00 µF | 0.01 µF | |
| 100.0 µF | 0.1 µF | |
| 9999 µF | 1 µF | |

[1] With a film capacitor or better, using the rel mode to zero residual.

## Diode

| Range | Resolution | Accuracy |
|---|---|---|
| 2.000 V | 0.001 V | ±(1.0 % + 1) |

## Frequency

| Range | Resolution | Accuracy |
|---|---|---|
| 199.99 Hz | 0.01 Hz | ±(0.005 % + 1) [1] |
| 1999.9 Hz | 0.1 Hz | |
| 19.999 kHz | 0.001 kHz | |
| 199.99 kHz | 0.01 kHz | |
| >200 kHz | 0.1 kHz | Unspecified |

[1] From 0.5 Hz to 200 kHz and for pulse widths >2 µs.

## Frequency Counter Sensitivity and Trigger Levels

| Input Range | Minimum Sensitivity (RMS Sine Wave) | | Approximate Trigger Level (DC Voltage Function) |
|---|---|---|---|
| | 5 Hz – 20 kHz | 0.5 Hz – 200 kHz | |
| 600 mV dc | 70 mV (to 400 Hz) | 70 mV (to 400 Hz) | 40 mV |
| 600 mV ac | 150 mV | 150 mV | - |
| 6 V | 0.3 V | 0.7 V | 1.7 V |
| 60 V | 3 V | 7 V (≤140 kHz) | 4 V |
| 600 V | 30 V | 70 V (≤14.0 kHz) | 40 V |
| 1000 V | 100 V | 200 V (≤1.4 kHz) | 100 V |

## Duty Cycle (Vdc and mVdc)

| Range | Accuracy |
|---|---|
| 0.0 % to 99.9 % [1] | Within ± (0.2 % per kHz + 0.1 %) for rise times < 1 µs. |

[1] 0.5 Hz to 200 kHz, pulse width >2 µs. Pulse width range is determined by the frequency by the frequency of the signal.

## Input Characteristics

| Function | Overload Protection[1] | Input Impedance (nominal) | Common Mode Rejection Ratio (1 kΩ unbalance) | Normal Mode Rejection |
|---|---|---|---|---|
| V⎓ | 1000 V rms | 10 MΩ <100 pF | > 120 dB at dc, 50 Hz or 60 Hz | > 60 dB at 50 Hz or 60 Hz |
| mV⎓ | 1000 V rms | | > 120 dB at dc, 50 Hz or 60 Hz | > 60 dB at 50 Hz or 60 Hz |
| V~ | 1000 V rms | 10 MΩ < 100 pF (ac-coupled) | > 60 dB, dc to 60 Hz | |

| | | Open Circuit Test Voltage | Full Scale Voltage | | Typical Short Circuit Current | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | To 6 MΩ | 50 MΩ or 60 nS | 600 Ω | 6 kΩ | 60 kΩ | 600 kΩ | 6 MΩ | 50 MΩ |
| Ω | 1000 V rms | <2.8 V dc | <850 mV dc | <1.3 V dc | 500 µA | 100 µA | 10 µA | 1 µA | 0.2 µA | 0.1 µA |
| ⏚ | 1000 V rms | <2.8 V dc | 2.200 V dc | | 1.0 mA typical | | | | | |

[1] $10^6$ V Hz Max

### MIN MAX Recording

| Nominal Response | Accuracy |
|---|---|
| 100 ms to 80 %<br>(dc functions) | Specified accuracy ±12 counts for changes >200 ms in duration |
| 120 ms to 80 %<br>(ac functions) | Specified accuracy ±40 counts for changes >350 ms and inputs >25 % of range |
| 250 µs (peak) [1] | Specified accuracy ±100 counts for changes >250 µs in duration<br>(add ±100 counts for readings over 6000 counts)<br>(add ±100 counts for readings in Low Pass mode) |
| [1] For repetitive peaks: 1 ms for single events. | |

## Basic Maintenance

**⚠⚠Warning**

**To prevent possible electrical shock, fire, or personal injury:**

- **Remove the input signals before you clean the Product.**
- **Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Use only specified replacement parts.**
- **Have an approved technician repair the Product.**

### General Maintenance

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents.

Dirt or moisture in the terminals can affect readings and can falsely activate the Input Alert feature. Clean the terminals as follows:

1. Turn the Meter off and remove all test leads.
2. Shake out any dirt that may be in the terminals.
3. Soak a clean swab with mild detergent and water. Work the swab around in each terminal. Dry each terminal using canned air to force the water and detergent out of the terminals.

# Static Awareness

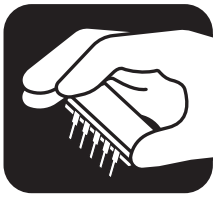
Semiconductors and integrated circuits can be damaged by electrostatic discharge during handling. This notice explains how to minimize damage to these components.

1. Understand the problem.
2. Learn the guidelines for proper handling.
3. Use the proper procedures, packaging, and bench techniques.

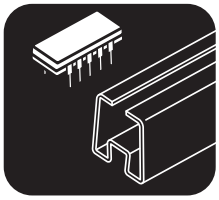
Follow these practices to minimize damage to static sensitive parts.

**⚠⚠ Warning**

**To prevent electric shock or personal injury. De-energize the product and all active circuits before opening a product enclosure, touching or handling any PCBs or components.**



- Minimize handling.
- Handle static-sensitive parts by non-conductive edges.
- Do not slide static-sensitive components over any surface.
- When removing plug-in assemblies, handle only by non-conductive edges.
- Never touch open-edge connectors except at a static-free work station.



- Keep parts in the original containers until ready for use.
- Use static shielding containers for handling and transport.
- Avoid plastic, vinyl, and Styrofoam® in the work area.

- Handle static-sensitive parts only at a static-free work station.
- Put shorting strips on the edge of the connector to help protect installed static-sensitive parts.
- Use anti-static type solder extraction tools only.
- Use grounded-tip soldering irons only.

## Fuse Test

As shown in Figure 1, with the Meter in the Ω function, insert a test lead into the jack and place the probe tip on the other end of the test lead against the metal of the current input jack. If "LEAd" appears in the display, the probe tip has been inserted too far into the amps input jack. Back the lead out a bit until the message disappears and either OL or a resistance reading appears in the display. The resistance value should be as shown in Figure 1. If the tests give readings other than those shown, have the Meter serviced.

**⚠⚠Warning**

**To prevent possible electrical shock, fire, or personal injury:**

- **Replace a blown fuse with exact replacement only for continued protection against arc flash.**
- **Use only specified replacement fuses.**

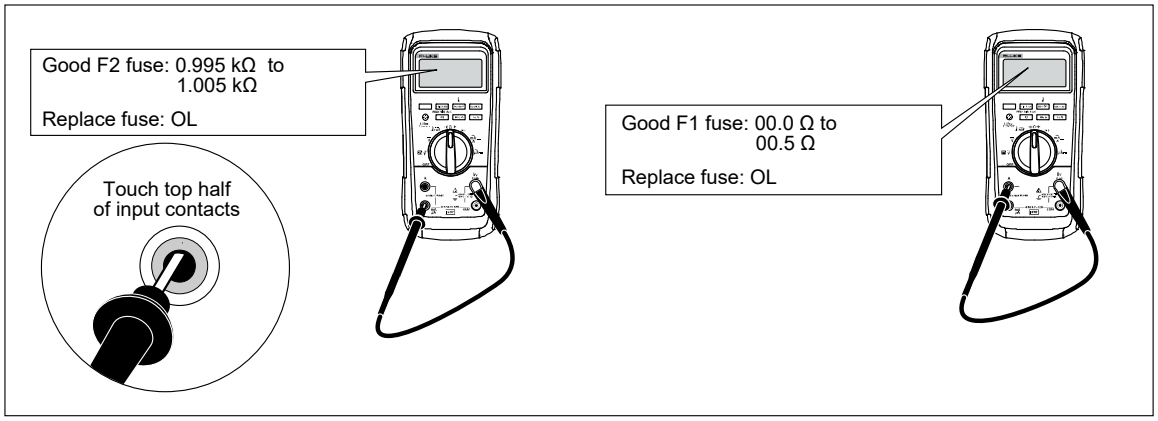



**Figure 1. Current Fuse Test**

## How to Replace the Batteries

Replace the batteries with three AA batteries (NEDA 15A IEC LR6).

**⚠⚠Warning**

**To prevent possible electrical shock, fire, or personal injury:**

- **Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid.**
- **Repair the Product before use if the battery leaks. Battery leakage may create a shock hazard or damage the Product.**
- **Do not put battery cells and battery packs near heat or fire. Do not put in sunlight.**
- **MSHA approved for use with three Energizer P/N E91 or three Duracell P/N MN1500 1.5 volt, "AA" alkaline batteries only. All cells are to be replaced at the same time with identical part number cells in fresh air locations only.**

Replace the battery as follows, refer to Figure 2:

1. Turn the rotary switch to OFF and remove the test leads from the terminals.
2. Remove the six Phillips-head screws from the case bottom and remove the battery door (①).

*Note*

*While lifting the battery door, ensure the rubber gasket stays attached to the battery compartment barrier.*

3. Remove the three batteries and replace all three with AA Alkaline batteries (②).
4. Ensure the battery compartment gasket (③) is properly installed around the outside edge of the battery compartment barrier.
5. Replace the battery door by aligning the battery compartment barrier with battery compartment.
6. Secure the door with the six Phillips-head screws.

## How to Replace the Fuses

Referring to Figure 2, examine or replace the Meter's fuses as follows:

1. Turn the rotary switch to OFF and remove the test leads from the terminals.
2. Refer to step 2 under the How to Replace the Batteries section above to remove the battery door.
3. Remove the fuse compartment seal (④) from the fuse compartment.
4. Gently lift out the fuse compartment door (⑤) from the fuse compartment.
5. Remove the fuse by gently prying one end loose, then sliding the fuse out of its bracket (⑥).
6. Install ONLY specified replacement fuses with the amperage, voltage, and speed ratings shown in Table 5. The 440-mA fuse is shorter than the 10-A fuse. For correct placement of each fuse, note the marking on the printed circuit board under each fuse.

7. Replace the fuse compartment door by aligning the arrow on the fuse door with the arrow on the case bottom and lowering the door into the fuse compartment.
8. Replace the fuse compartment seal by aligning the tab on the seal with the outline on the case bottom. Ensure the seal (④) is properly seated.
9. Refer to steps four through six under the Replacing the Batteries section above to reinstall the battery door.

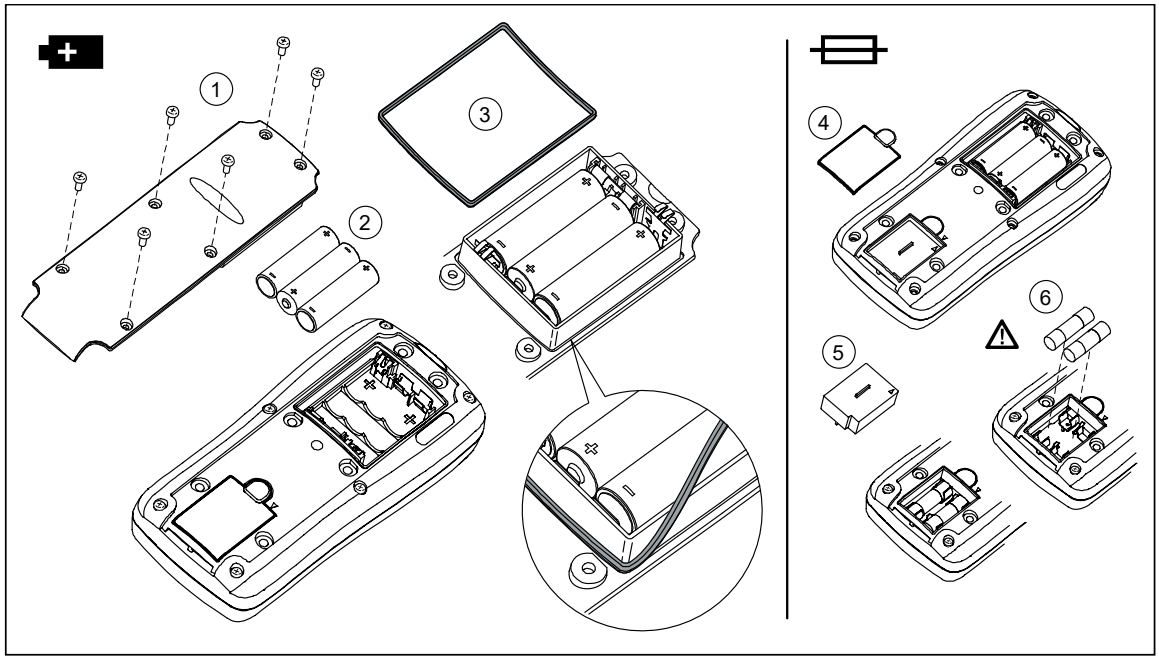



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**Figure 2. Battery and Fuse Replacement**

# Performance Tests

**⚠⚠Warning**

**To prevent electric shock, do not perform the performance test procedures unless the Meter is fully assembled.**

The following performance tests verify the complete operation of the Meter and check the accuracy of each Meter function against its specifications. Performance tests should be performed bi-annually to ensure that the Meter is within accuracy specifications. If the Meter fails any part of the test, calibration adjustment and/or repair is indicated.

In the performance tests, the Meter is referred to as the device under test (DUT).

## Required Equipment

Table 1 lists the equipment required to conduct a performance test on the Meter.

**Table 1. Required Equipment**

| Recommended Equipment | Measurement Function | Accuracy |
|---|---|---|
| 5520A Multi-product Calibrator (or equivalent) | DC Volts | 0 to 1000 V<br>±0.012 % |
| | DC Current | 350 µA to 2 A<br>±0.05 % |
| | AC Volts | 0 to 1000 V<br>±0.15 % @ 60 Hz to 20 kHz ±3 % |
| | AC Current | 350 µA to 2 A<br>±0.39 % @ 60 Hz to 1 kHz |
| | Resistance | 1 Ω to 100 MΩ<br>±0.06 % |
| | Capacitance | 9 to 900 µF<br>±0.475 % |
| | Frequency | 19.999 to 199.99 kHz, ±0.0137 %<br>150 mV to 6 Vrms, ±5 % |
| K-type Thermocouple, mini-plug on both ends | Temperature | |

## Testing Meter Accuracy

To test the accuracy of the Meter, perform the steps in Table 2.

**Table 2. Accuracy Tests**

| Step | Test Function | Range | 5520A Output | Display Reading |
|---|---|---|---|---|
| 1 | LO Ṽ AC Volts | 600 mV | 60 mV, 60 Hz | 59.2 to 60.8 |
| 2 | | 600 mV | 330 mV, 60 Hz | 327.3 to 332.7 |
| 3 | | 600 mV | 600 mV, 13 kHz | 586.0 to 614.0 |
| 4 | | 6 V | 675 mV, 60 Hz | 0.666 to 0.684 |
| 5 | | 6 V | 3.3 V, 60 Hz | 3.273 to 3.327 |
| 6 | | 6 V | 3.3 V, 20 kHz | 3.214 to 3.386 |
| 7 | | 60 V | 6.75 v, 60 Hz | 6.68 to 6.82 |
| 8 | | 60 V | 33 V, 60 Hz | 32.75 to 33.25 |
| 9 | | 60 V | 33 V, 20 kHz | N/A |
| 10 | | 60 V | 33 V, 5 kHz | N/A |
| 11 | | 600 V | 67.5 V, 60 Hz | 66.8 to 68.2 |
| 12 | | 600 V | 330 V, 60 Hz | 327.5 to 332.5 |
| 13 | | 600 V | 330 V, 2.5 kHz | 323.0 to 337.0 |
| 14 | | 1000 V | 100 V, 60 Hz | 97 to 103 |
| 15 | | 1000 V | 1000 V, 1 kHz | 986 to 1014 |
| 16 | LO Ṽ AC Volts Frequency | 600 mV | 150 mV, 99.95 kHz | 99.93 to 99.97 |
| 17 | | 600 mV | 150 mV, 199.50 kHz | 199.48 to 199.52 |
| 18 | Sensitivity | 6 V | 0.7 V, 99.95 kHz | 99.93 to 99.97 |
| 19 | | 60 V | 7 V, 99.95 kHz | 99.93 to 99.97 |
| 20 | V⎓ Hz % Trigger level | 6 V | 3.4 V, 1 kHz Sq. Wave | 999.8 to 1000.2 |
| 21 | V⎓ Hz % Duty Cycle | 6 V | 5 V, 1 kHz, DC offset 2.5 V Sq. Wave | 49.7 % to 50.3 % |
| 22 | V⎓ DC Volts | 6 V | 3.3 V dc | 3.297 to 3.303 |
| 23 | | 60 V | 33 V dc | 32.97 to 33.03 |
| 24 | | 600 V | 330 V dc | 329.7 to 330.3 |
| 25 | | 1000 V | 1000 V dc | 998 to 1002 |

**Table 2. Accuracy Tests (cont.)**

| Step | Test Function | Range | 5520A Output | Display Reading |
|---|---|---|---|---|
| 26 | mV DC Volts | 600 mV | 50 mV dc | 49.8 to 50.2 |
| 27 | | 600 mV | 330 mV dc | 329.6 to 330.4 |
| 28 | Ω Ohms | 600 Ω | 330 Ω (Use 2 wire Comp) | 329.1 to 330.9 |
| 29 | | 6 kΩ | 3.3 kΩ (Use 2 wire Comp) | 3.292 to 3.308 |
| 30 | | 60 kΩ | 33 kΩ | 32.92 to 33.08 |
| 31 | | 600 kΩ | 330 kΩ | 329.2 to 330.8 |
| 32 | | 6 MΩ | 3.3 MΩ | 3.292 to 3.308 |
| 33 | | 50 MΩ | 30 MΩ | 29.69 to 30.31 |
| 34 | **nS** Conductance | 60 nS | 100 MΩ | 9.60 to 10.40 |
| 35 | Diode | 6 V | 2.0 V dc | 1.979 to 2.021 |
| 36 | AC Amps | 6 A | 3.0 A, 60 Hz | 2.968 to 3.032 |
| 37 | DC Amps | 6 A | 3.0 A | 2.990 to 3.010 |
| 38 | AC Milliamps | 60 mA | 33 mA, 60 Hz | 32.65 to 33.35 |
| 39 | | 400 mA | 330 mA, 60 Hz | 326.5 to 333.5 |
| 40 | DC Milliamp | 60 mA | 33 mA | 32.89 to 33.11 |
| 41 | | 400 mA | 330 mA | 329.1 to 330.9 |
| 42 | AC Microamps | 600 µA | 330 µA, 60 Hz | 326.5 to 333.5 |
| 43 | | 6000 µA | 3300 µA, 60 Hz | 3265 to 3335 |
| 44 | DC Microamps | 600 µA | 330 µA | 328.9 to 331.1 |
| 45 | | 6000 µA | 3300 µA | 3291 to 3309 |
| 46 | Capacitance | 10 nf | Open input [1] | 0.28 to 0.48 |
| 47 | | 100 nf | 5 nf [2] | 4.7 to 5.3 |
| 48 | | 100 µf | 9.5 µf | 9.2 to 9.8 |
| 49 | LO V Low Pass Filter | 1000 V | 400 V, 400 Hz | 372 to 408 |
| 50 | | 1000 V | 400 V, 800 Hz [3] | 226 to 340 |
| 51 | **VDC** Peak Min/Max | 6 V | 8 Vpp, 2 kHz Sq. Wave, DC offset 2 V | Min = -1.898 to -2.102<br>Max = 5.896 to 6.104 |

**Table 2. Accuracy Tests (cont.)**

| Step | Test Function | Range | 5520A Output | Display Reading |
|---|---|---|---|---|
| 52 | mVdc Temperature [4] | | 0 °C | -1.0 to 1.0 |
| 53 | | | 100 °C | 98.0 to 102.0 |
| 54 | Backlight | | Press backlight button | Backlight comes on |
| 55 | | | Press backlight button | Backlight intensifies |
| 56 | | | Press backlight button | Backlight goes off |

[1] Remove test leads from unit.
[2] Use REL to compensate for internal Meter and lead capacitance (must disconnect test leads from calibrator before pushing REL)
[3] The Meter accuracy is not specified at this input signal frequency with Low-pass filter selected. The display reading shown, checks that the Low-pass filter is active and follows an expected roll-off curve.
[4] To ensure accurate measurement, the Meter and thermocouple adapter must be at the same temperature. After connecting the thermocouple adapter to the Meter allow for reading to stabilize before recording display reading.

# Calibration Adjustments

Perform the Calibration Adjustment Procedure if the Meter fails any performance tests. If the adjustment routine is discontinued prior to completion, no changes are made to the calibration constants that are stored in memory. The following is an explanation of the pushbutton features and requirements to enter the CAL mode.

## Cal Mode Pushbutton Functions

- The CAL mode will be initiated by holding down the MINMAX pushbutton at power up and entering a four-digit password.
- The AutoHOLD pushbutton will act as an "ENTER" key and will advance through the CAL initiation and adjustment procedure steps.
- The pushbuttons are used to select a four-digit password.

During initiation of the CAL mode, a display count will show how many times calibration constants have been written to memory.

## Entering and Displaying the Four-Digit Password

When the Meter was manufactured it was given a default password of 1234. The following pushbuttons are used to select the password. Each pushbutton represents the indicated digit.

| | | | |
|---|---|---|---|
| Yellow = 1 | MINMAX = 2 | RANGE = 3 | AutoHOLD = 4 |
| Backlight = 5 | Continuity = 6 | REL = 7 | Hz = 8 |

After selecting the password, the user has two choices:

Pressing AutoHOLD will display "[-0]" which indicates correct password and successful entry. You may now proceed with the first calibration step.

Pressing RANGE will display "----", which indicates correct password, proceed to select a new password.

If the password is incorrect, the concluding AutoHOLD or RANGE pushbutton press will instead cause the Meter to double beep and the display will show "????". The password entry process was unsuccessful and can be tried again or you may exit this mode by turning the Meter off.

### Changing the Password

To change the password in the Meter:

1. Turn the Meter Rotary Switch from OFF to VAC mode while holding down the MINMAX pushbutton at the same time. The Meter will display ϟ CAL.
2. Press the AutoHOLD pushbutton twice. The display should show "????"
3. Using the pushbuttons select the old password (do not use AutoHOLD to save the password)
4. Press the RANGE pushbutton. The Meter should display "_ _ _ _".
5. Use the pushbuttons to select a desired new password.
6. Press AutoHOLD to save the new password.

### Restoring the Default Password

If the password has been forgotten, the default password (1234) can be restored by performing the following:

1. Turn the rotary switch of the Meter to **OFF**.
2. Remove the bottom case and bottom shield of the Meter.
3. Check the revision number on the PCB. Board revision location is identified in Figures 3 and 4 below.

If the revision number is 010:

4. Remove the PCB from the top case.
5. Apply power to the PCB by clipping on a dc voltage between 3.5 V and 5 V at the test points marked “+” and “-” at the edge of the board. See Figure 3.

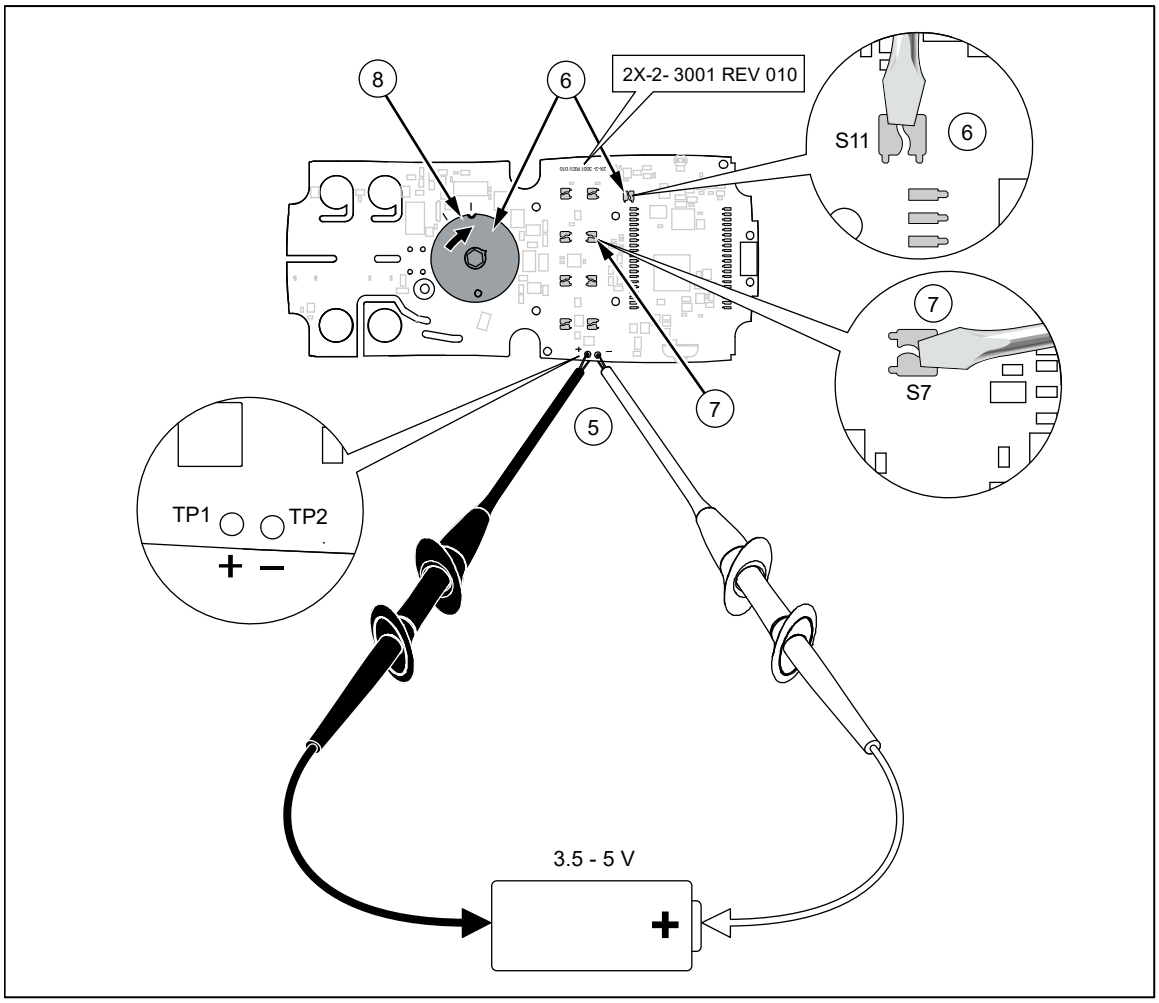
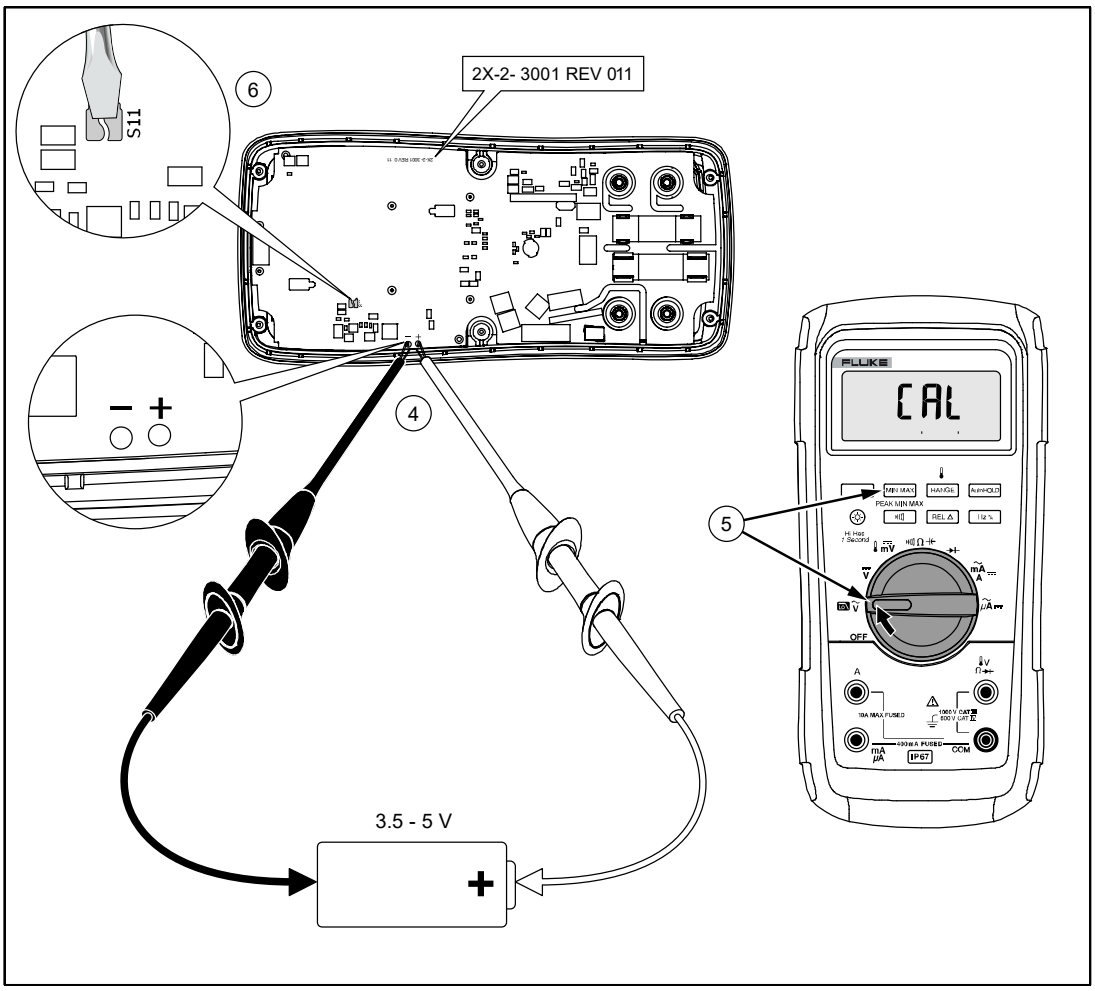



**Figure 3. Revision 010 Board Layout**

6. While shorting across keypad button S7, turn the rotary switch one position clockwise. See Figure 3.
7. Short across keypad button S11. See Figure 3.
8. Turn the rotary switch one position counterclockwise, back to its original position.
9. The default password is now restored.
10. Reassemble the Meter before performing adjustments or testing.

If the revision number is 011 or higher:

4. Apply power to the PCB by clipping on a dc voltage between 3.5 V and 5 V at the test points marked “+” and “-” at the edge of the board. See Figure 4.




gaq102.emf

**Figure 4. Revision 011 Board Layout**

5. Turn the rotary switch from **OFF** to ṽ while holding down MIN MAX at the same time. The Meter should display CAL.
6. Short across keypad button S11 on the back of the PCB. See Figure 4. The Meter should beep.
7. Turn the rotary switch one position counterclockwise, back to the OFF position.
8. The default password is now restored.
9. Reassemble the Meter before performing adjustments or testing.

## Other Pushbutton Functions

Table 3 list the button on the Meter and describes what the button does when pressed after the password has been entered and AutoHOLD pressed.

**Table 3. Pushbutton Functions During Cal Mode**

| Button | Cal Mode Description |
|---|---|
| (yellow) | Press and hold to test the present function. The measurement is not calibrated so it may be inaccurate. This is normal. |
| MIN MAX | Press and hold to display the required input level. |
| Hz % | Press and hold to display the frequency of the input signal. |
| AutoHOLD | Press to store the new calibration adjustment value and advance to the next step. This pushbutton is also used to exit calibration adjustment mode after the calibration adjustment sequence is complete. |

## Calibration Adjustment Procedure

In the following procedure, some adjustment steps take longer to execute than others (10 to 15 Seconds). For some of these steps the Meter gives a double beep to indicate completion. Not all steps have this feature.

1. Turn the rotary switch of the Meter from **OFF** to LO $\widetilde{V}$ while holding down MIN MAX at the same time. The Meter should display CAL.
2. Press AutoHOLD once to see the number of calibrations that have been completed. Press AutoHOLD again to enable password entry. The Meter should display "0000".
3. Use the keypad pushbuttons to enter the existing password and press AutoHOLD. The Meter should display C-01.
4. Apply the value listed in Table 4 for each calibration step, and/or (optional) press the MIN MAX to display the required input signal level and press Hz % to display the required input signal frequency.

*Note*

*After pressing AutoHOLD, wait until the step number advances before changing the calibrator source or turning the rotary switch of the Meter. If the reference source input is not within an anticipated range of the required value, the Meter will emit a double beep and not allow completion of the step. Set the calibrator to standby prior to changing the function switch position and or after completing adjustment of each function. If the calibration adjustment is not completed correctly, the Meter will not operate correctly.*

**Table 4. Calibration Adjustment Steps**

| Function (Switch Position) | Adjustment Step | Input Value |
|---|---|---|
| LO ~V (AC Volts) | C-01 | 600.0 mV, 60 Hz |
| | C-02 | 600.0 mV, 20 kHz |
| | C-03 | 6.000 V, 60 Hz |
| | C-04 | 6.000 V, 20 kHz |
| | C-05 | 60.00 V, 60 Hz |
| | C-06 | 60.00 V, 20 kHz |
| | C-07 | 600.0 V, 60 Hz |
| | C-08 | 600.0 V, 10 kHz |
| ⎓V (DC Volts) | C-09 | 6.000 V |
| | C-10 | 60.00 V |
| | C-11 | 600.0 V |
| ⎓mV (DC Millivolts) | C-12 | 600.0 mV |
| | C-13 | 60.00 mV |
| Ω (Ohms) | C-14 | 600.0 Ω |
| | C-15 | 6.000 kΩ |
| | C-16 | 60.00 kΩ |
| | C-17 | 600.0 kΩ |
| | C-18 | 6.000 MΩ |
| | C-19 | 0.000 Ω |
| | C-20 | 50.0 MΩ |
| ⊣▶ (Diode Test) | C-21 | 3.000 V |
| mA A ~⎓ (Amps) | C-22 | 6.000 A, 60 Hz |
| | C-23 | 6.000 A dc |
| mA A ~⎓ (Amps) | C-24 | 60.00 mA, 60 Hz |
| | C-25 | 400.0 mA, 60 Hz |
| | C-26 | 60.00 mA dc |
| | C-27 | 400.0 mA dc |
| μA ~⎓ (Microamps) | C-28 | 600.0 μA, 60 Hz |
| | C-29 | 6000 μA, 60 Hz |
| | C-30 | 600.0 μA dc |
| | C-31 | 6000 μA dc |

## Disassembling the Meter

To disassemble the Meter:

1. Use a Philips screwdriver to remove the six battery-door screws (H1).
2. Lift the battery door (MP1) at the top end of the Meter and remove it from the case back.
3. Remove three AA batteries.
4. Remove the fuse access door (MP4).
5. Remove the fuse cap (MP5).
6. Use a Philips screwdriver to remove the bottom-case screws (H2) with their 0-rings (H3).
7. Separate the bottom case (MP6) from the top case (MP19).
8. Use a Philips screwdriver to remove the bottom-shield screw (H4).
9. Remove the bottom shield (MP9) from the Meter.
10. Use a Philips screwdriver to remove four PCA input screws (H5).
11. Use a Philips screwdriver to remove six PCA screws (H4) from the board.
12. Remove the PCA from the top case.
13. Remove the top shield (MP13) from the top case.
14. Remove the elastomeric (MP10) from the top shield.
15. Unsnap mask (MP15) from the top shield (MP13).
16. Remove the LCD (DS1) from the top shield.
17. Remove the backlight (MP14) from the top shield.
18. Remove the keypad (MP18) from the top case.
19. Remove the RSOB spacer (MP16) from the top case.
20. Remove the E-clip holding the spring detent (MP17) from the top case.
21. Remove the sprint detent from the top case.
22. Remove the knob (MP20) from the top case.

## Reassembling the Meter

*Note*

*Before reassembling the Meter, read the How to Retain the IP67 Rating section first.*

To reassemble the Meter, perform the disassembly steps in reverse order.

## How to Retain the IP67 Rating

The following items identify parts of the Meter that can compromise the IP67 rating by leaking if assembly instructions are not followed carefully.

1. Knob: The knob has an overmold seal that fits tight against the top case. This area must be lubed, and the lube must be spread evenly around the seal area.
2. E-clip: Make sure it is installed correctly.
3. Keypad: The keypad must be correctly seated, and all six board screws tightened to 6 in-lbs torque.
4. Bottom case gasket: The gasket must be installed so that the gasket does not have any twists, bends, waves, etc. The gasket must be completely flat in the bottom case groove. This can be accomplished by using a modified top case to push the gasket into position.
5. Battery door gasket: Place over battery compartment walls and push each corner down as far as they will go. Install battery door screws with 6 in-lbs torque.
6. Fuse access door: Place onto bottom case and wiggle it to make sure it is fully seated. Install the battery door screws with 6 in-lbs torque.
7. Case screw o-ring: Torque case screws to 12 in-lbs torque. Verify that the o-rings are not sticking out of the sides of the screw head.

*Note*

*If you want to ensure your Meter meets the IP67 rating, return the Meter to a qualified Fluke Service center.*

## Replacement Parts

Table 5 lists the Meter's replaceable parts identified in Figure 5.

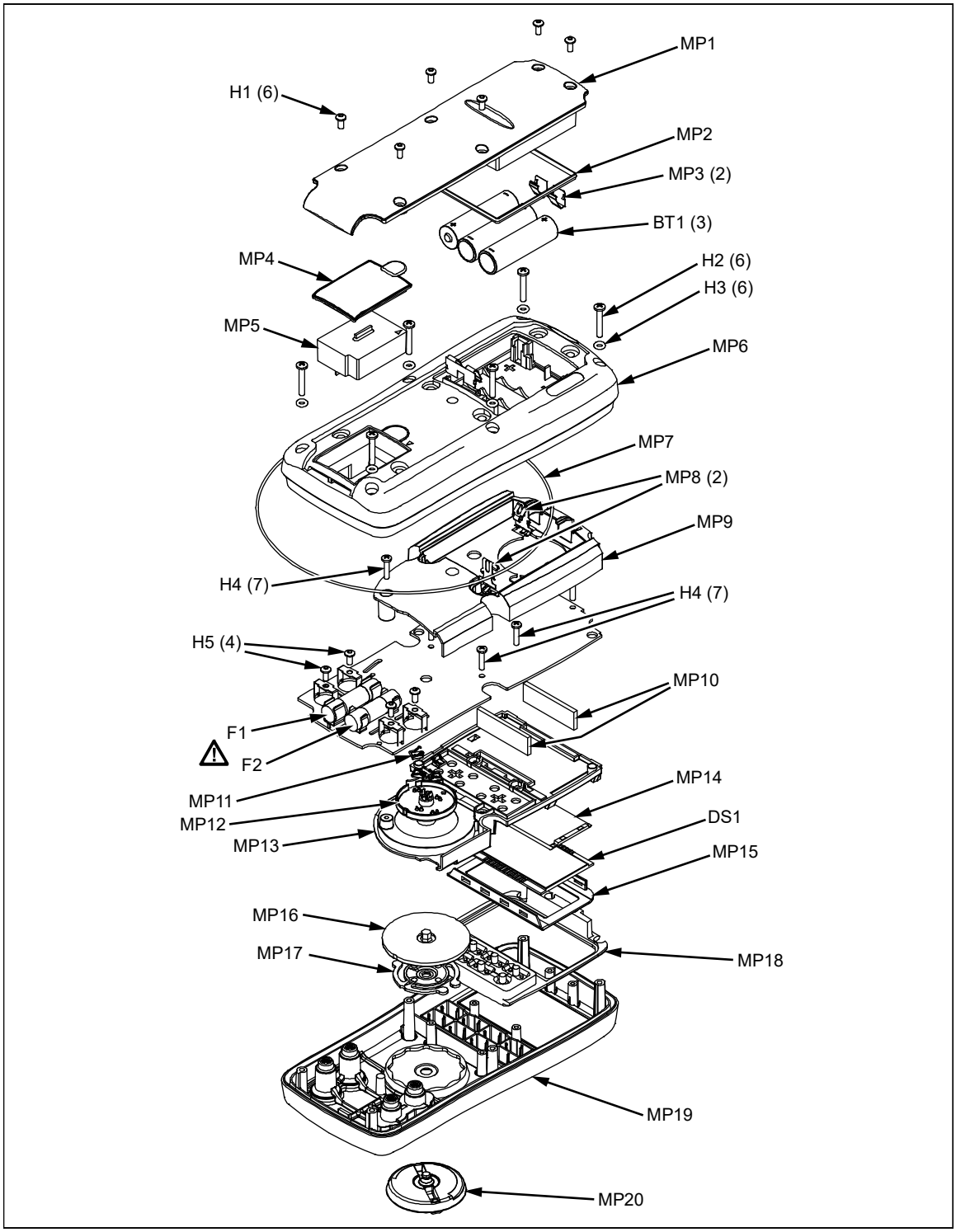



**Figure 5. Exploded View of Meter**

**Table 5. Replaceable Parts List**

| Item | Description | Part Number | Qty. |
|---|---|---|---|
| BT1 | BATTERY, PRIMARY, ZNMNO2, 1.5V, 2.24AH, 15A, LR6, ALKALINE, AA, 14X50MM, BULK | 376756 | 3 |
| DS1 | LCD,4.5 DIGIT, TN, TRANSFLECTIVE, BAR GRAPH, OSPR80, FLUKE-87-5 | 2065213 | 1 |
| F1 | ⚠FUSE,11A,1000V, FAST.406INX1.5IN, BULK | 803293 | 1 |
| F2 | ⚠FUSE,.440 A,1000V, FAST.406INX1.5IN, BULK | 943121 | 1 |
| H1 | SCREW, M3-0.5 X 6 MM L, PAN HEAD, STEEL, BLACK ZINC, TORX DRIVE, MACHINE SCREW | 3861068 | 6 |
| H2 | SCREW,5-14,.750, PAN, HEXALOBULAR, STEEL, ZINC-BLK CHROMATE, BLUNT PT, THREAD FORM | 1558745 | 6 |
| H3 | O-RING, NITRILE, INT LUBE, SHORE A 70, AS 568A-006, 0.114 ID, 0.070 W | 705947 | 6 |
| H4 | SCREW,4-14,.510, PAN, PHILLIPS, STEEL, ZINC-CHROMATE, THREAD CUT | 853668 | 7 |
| H5 | SCREW, M3X0.5,6MM, PAN, PHILLIPS, STEEL, ZINC-CHROMATE | 2743764 | 4 |
| MP1 | FLUKE-2X-2-2010, BATTERY DOOR, WITHOUT BATTERY CONTACTS | 3321030 | 1 |
| MP2 | FLUKE-2X-II-8007, GASKET, BATT DOOR, FLUKE 27-II AVG AND FLUKE 28-II TRMS METERS | 3439087 | 1 |
| MP3 | FLUKE 89-4-8012, BATTERY CONTACT, DUAL | 666435 | 2 |
| MP4 | FLUKE-2X-2-2014, FUSE ACCESS DOOR, 27-2 AVG AND 28-2 TRMS MULTIMETER | 3400480 | 1 |
| MP5 | FLUKE-2X-2-2015, FUSE CAP | 3440546 | 1 |
| MP6 | FLUKE-2X-2-2004, CASE, BOTTOM WITHOUT BATTERY CONTACTS | 3320869 | 1 |
| MP7 | FLUKE 2X-II-8006, GASKET, TOP CASE, FLUKE-27-II AVG AND FLUKE-28-II TRMS METERS | 3439079 | 1 |
| MP8 | SHENGUANG-8012, BATTERY CONTACT SHENGUANG | 3324731 | 2 |
| MP9 | FLUKE-2X-2-8002, BOTTOM SHIELD, FLUKE 27-2 AVG / FLUKE 28-2 TRMS MULTIMETER | 3371942 | 1 |
| MP10 | CONNECTOR, ELASTOMERIC, 0.375 HIGH, 0.10 THICK,1.59 LONG, BULK | 3440661 | 2 |
| MP11 | FLUKE-17X-8001, CONTACT, RSOB | 3084560 | 4 |
| MP12 | FLUKE 87-5-2009, HOUSING, RSOB | 2073945 | 1 |
| MP13 | FLUKE-2X-2-8001, TOP SHIELD, FLUKE 27-2 AVG / FLUKE 28-2 TRMS MULTIMETER | 3371939 | 1 |
| MP14 | FLUKE-2X-2-8009, BACKLIGHT, FLUKE 27II / FLUKE 28II MULTIMETER | 3471251 | 1 |

**Table 5. Replaceable Parts List (cont.)**

| Item | Description | Part Number | Qty. |
|---|---|---|---|
| MP15 | FLUKE-87V-MAX-2501, MASK, LCD (PAD XFER) 87V-MAX | 5161521 | 1 |
| MP16 | FLUKE-2X-2-2007, SPACER, RSOB | 3320891 | 1 |
| MP17 | FLUKE-2X-2-2008, DETENT, SPRING | 3320905 | 1 |
| MP18 | FLUKE-2X-8003, KEYPAD, FLUKE 27-2 AND FLUKE 28-2 | 3359962 | 1 |
| MP19 | FLUKE-28-2-2502, TOP CASE, PAD XFER (for 28-2) | 3320857 | 1 |
| MP20 | FLUKE-2X-2-2009, ROTARY KNOB | 3320922 | 1 |
| Not Shown | FLUKE-2X-2-2011, HOLSTER w/Tilt Stand | 3321048 | 1 |
| Not Shown | Alligator Clips | variable [1] | 1 (set of 2) |
| Not Shown | TEST LEADS | variable [1] | 1 (set of 2) |
| Not Shown | 80BK-A-8001, TYPE K THERMOCOUPLE ASSEMBLY | 2747900 | 1 |
| Not Shown | FLUKE 87-5-8009, TILTSTAND | 2074040 | 1 |
| Not Shown | Quick Reference Guide | 1 | 5160944 |
| Not Shown | Safety Information | 1 | 5160959 |
| [1] See www.fluke.com for more information about test leads and alligator clips available for your region. | | | |

## Lifetime Limited Warranty

Each Fluke 20, 70, 80, 170, 180 and 280 Series DMM will be free from defects in material and workmanship for its lifetime. As used herein, “lifetime” is defined as seven years after Fluke discontinues manufacturing the product, but the warranty period shall be at least ten years from the date of purchase. This warranty does not cover fuses, disposable batteries, damage from neglect, misuse, contamination, alteration, accident or abnormal conditions of operation or handling, including failures caused by use outside of the product’s specifications, or normal wear and tear of mechanical components. This warranty covers the original purchaser only and is not transferable. For ten years from the date of purchase, this warranty also covers the LCD. Thereafter, for the lifetime of the DMM, Fluke will replace the LCD for a fee based on then current component acquisition costs.

To establish original ownership and prove date of purchase, please complete and return the registration card accompanying the product or register your product on http://www.fluke.com. Fluke will, at its option, repair at no charge, replace or refund the purchase price of a defective product purchased through a Fluke authorized sales outlet and at the applicable international price. Fluke reserves the right to charge for importation costs of repair/replacement parts if the product purchased in one country is sent for repair elsewhere.

If the product is defective, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke assumes no risk for damage in transit. Fluke will pay return transportation for product repaired or replaced in-warranty. Before making any non-warranty repair, Fluke will estimate cost and obtain authorization, then invoice you for repair and return transportation.

THIS WARRANTY IS YOUR ONLY REMEDY. NO OTHER WARRANTIES, SUCH AS FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSED OR IMPLIED. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY. AUTHORIZED RESELLERS ARE NOT AUTHORIZED TO EXTEND ANY DIFFERENT WARRANTY ON FLUKE’S BEHALF. Since some states do not allow the exclusion or limitation of an implied warranty or of incidental or consequential damages, this limitation of liability may not apply to you. If any provision of this warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

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