FLUKE®

233

True-rms Remote Display Digital Multimeter

Calibration Information

October 2009 (English) Rev. 1, 2/24

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Introduction

⚠⚠ Warning

To avoid 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.

The *233 Calibration Information* provides the information necessary to adjust and verify the performance of the Fluke Model 233 True-rms Remote Display Digital Multimeter (hereafter known as the Meter).

The following information is included in this document:

- *Fuse Test*
- *Battery Replacement*
- *Fuse Replacement*
- *Cleaning the Meter*
- *Performance Tests*
- *Calibration Adjustment*
- *Replacement Parts*

See the *233 Users Manual* for complete operating instructions.

Contact Fluke

Fluke Corporation operates worldwide. For local contact information, go to our website: www.fluke.com.

To register your product, or to view, print, or download the latest manual or manual supplement, go to our website.

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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.

A **Warning** identifies hazardous conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

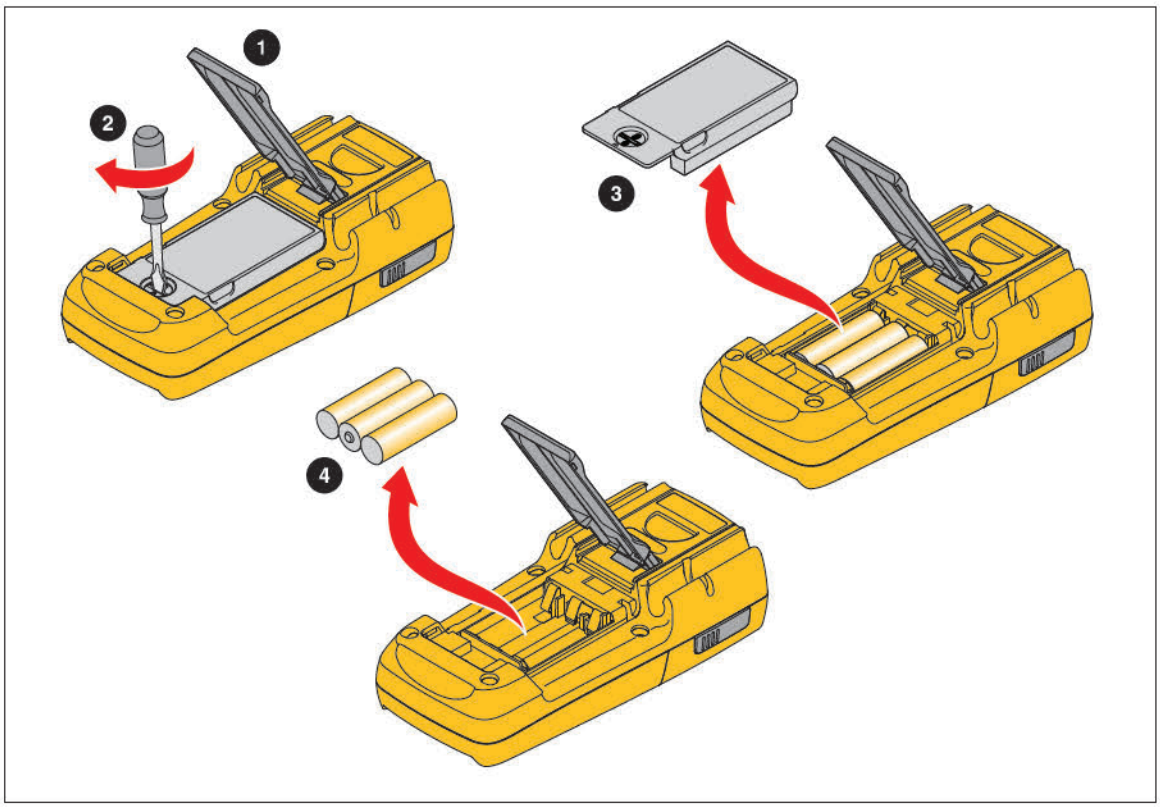
Battery Replacement

⚠⚠ Warning

To prevent incorrect measurements, possible electrical shock, or personal injury, replace the battery when the battery indicator (🔋) appears. If the display shows bAtt dISP, the Meter will not function until the display module batteries are replaced. If the display shows bAtt bASE, the Meter will not function until the Meter-base batteries are replaced.

There are two low-battery indicators in the display: one for the Meter base batteries and one for the display module batteries. Replace the batteries when the low-battery indicator shows.

Figure 1. Meter-Base Battery Replacement



To replace the batteries in the Meter base:

1. Turn the Meter off and remove all test leads.
2. Lift the tilt stand up as shown in Figure 1.
3. Turn the battery-door latch with a standard screwdriver until the unlocked symbol (🔓) aligns with the arrow.
4. Lift off the battery door.
5. Remove the three AA batteries and replace them with new ones. Use the correct battery orientation.
6. Install the battery door.

Turn the battery-door latch until the locked symbol (🔒) aligns with the arrow. When the Meter does not power on, the Meter-base batteries or display-module batteries can be dead.

To find which of the batteries to replace:

1. Dock the display module with the Meter base.
2. Turn the function switch to off and then on.

If the red high-voltage LED on the Meter base flashes, the Meter base batteries are good. Replace the display-module batteries and turn the Meter on.

Remove the Display Module

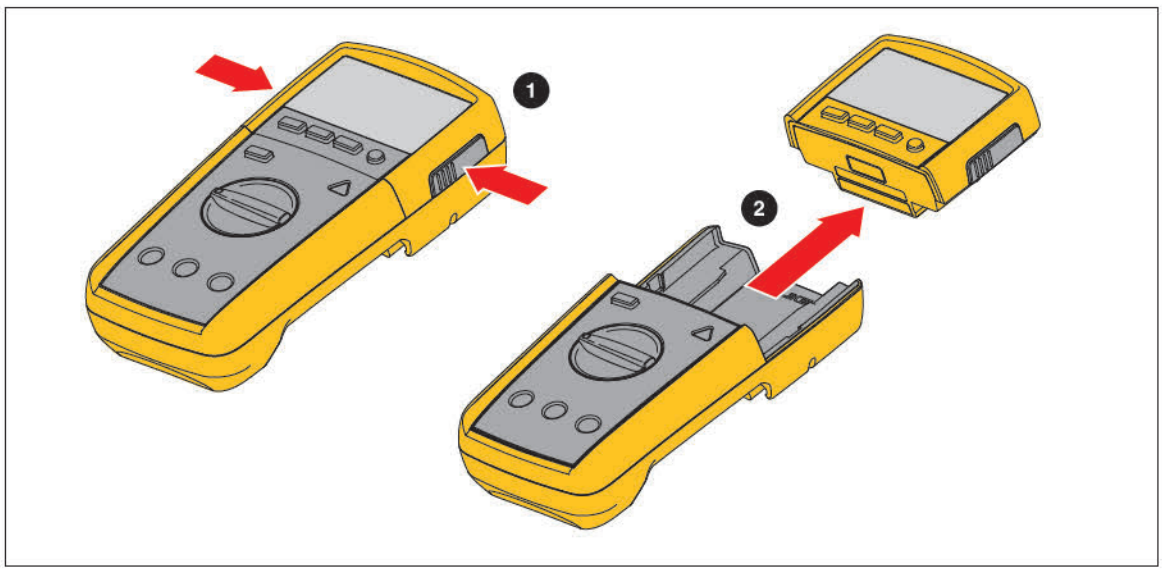
To remove the display module (see Figure 2):

1. Push in on the latches on the sides of the display module.
2. Pull the display module off of the top end of the Meter base.

The Meter base and display module can be a maximum of 10 meters (30 feet) from each other before the radio connection is broken. This distance can change if obstacles are between the Meter base and the display module. There is a radio connection between the display module and Meter base when ((▮)) shows in the display.

When the display module and Meter base lose the radio connection, the display shows dashes and ((▮)) blinks. Possible causes for this loss are the distance is too far for the environment or the batteries in the Meter base are dead. To reconnect, decrease the distance between the display module and Meter base.

Figure 2. Display Module Separation

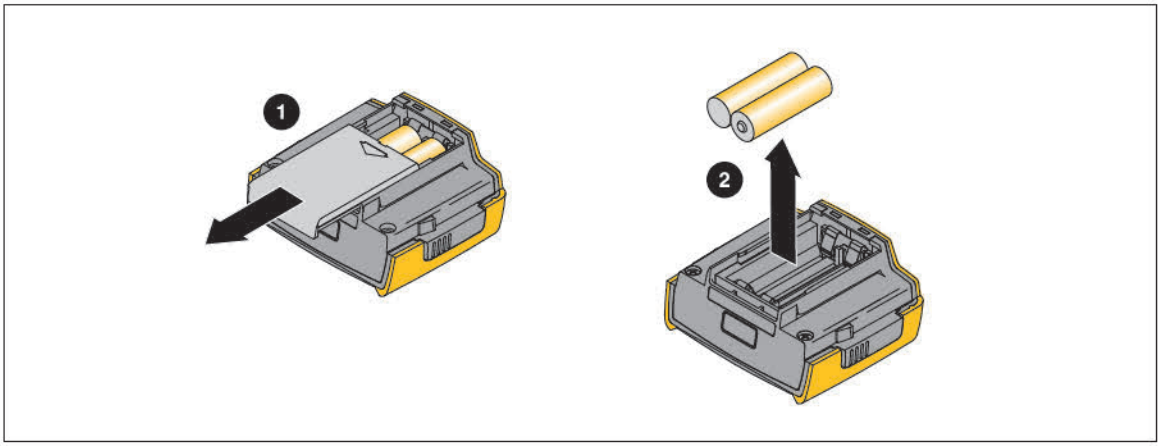


To replace the batteries in the display module:

1. Remove the display module from the Meter base. See *Remove the Display Module*.
2. Remove the battery door of the display module as shown in Figure 3.
3. Remove the two AA batteries and replace them with new ones. Use the correct battery orientation.
4. Replace the battery door on the display module.

Dock the display module with the Meter base and turn the Meter on.

Figure 3. Display-Module Battery Removal



Fuse Test

To test the fuse:

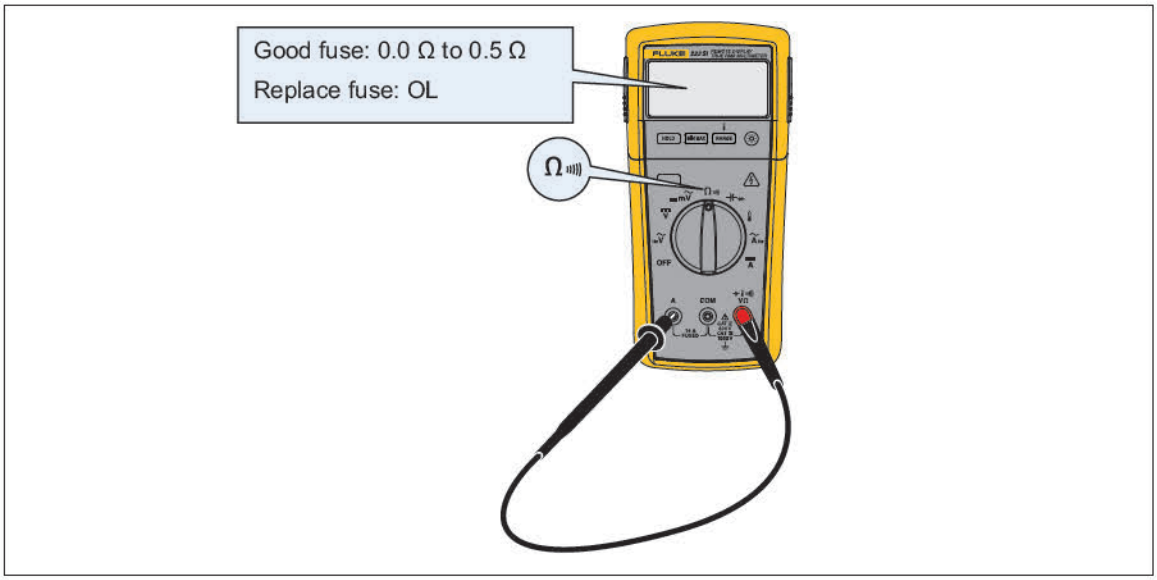
1. Set the rotary switch to **Ω**.
2. Plug a test lead into the $\dashv\!\vdash$ V Ω jack and touch the probe to the 10A jack, as shown in Figure 4.

If the display shows a resistance value in the range of that shown in Figure 4, the fuse is good.

If the display reads OL, replace the fuse and test again.

If the display shows any other value, have the Meter serviced. See *Contact Fluke*.

Figure 4. Fuse Test



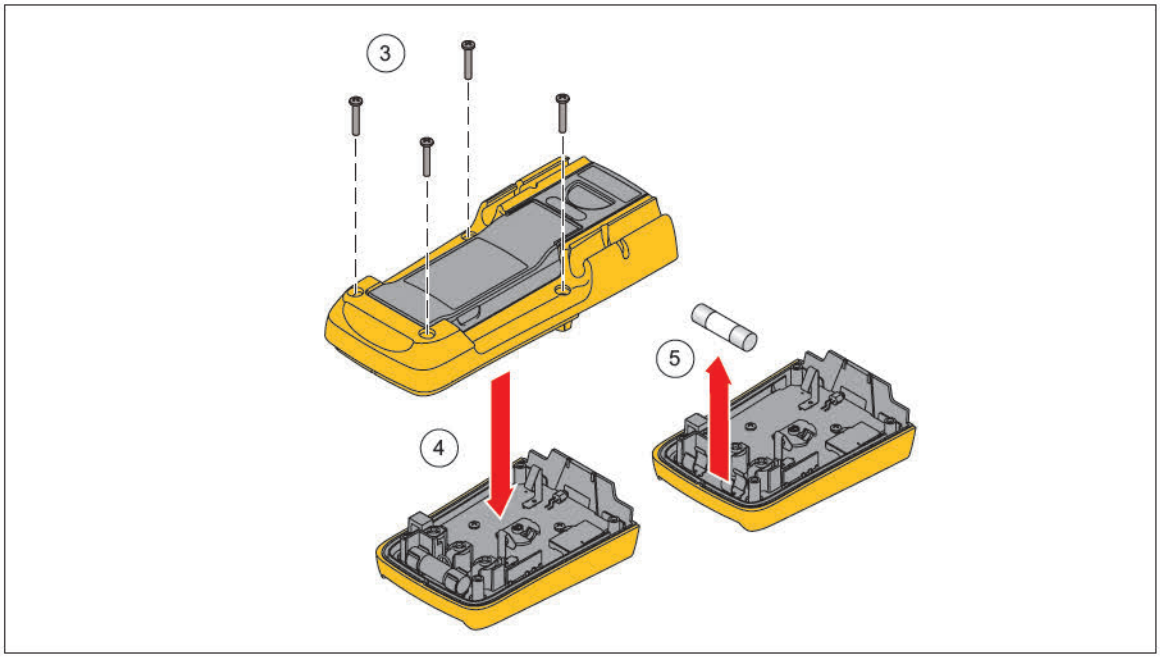
Fuse Replacement

To replace the fuse:

1. Remove the test leads from the Meter.
2. Remove the display module from the Meter base. See *Remove the Display Module*.
3. As shown in Figure 5, remove four screws from the case bottom.
4. Pull the case bottom from the case top.
5. Remove the fuse from its holder and replace it with an 11 A, 1000 V, FAST fuse with a minimum interrupt rating of 17,000 A. Use only Fluke PN 803293.

To re-assemble the Meter, do the steps above in the opposite sequence.

Figure 5. Fuse Replacement



Cleaning the Meter

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.

Performance Tests

⚠⚠ Warning

To avoid 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. The recommended calibration interval is 12 months. 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 is a list of the equipment required to conduct a performance test on the Meter.

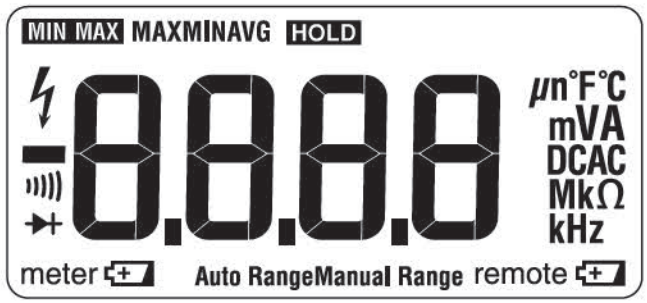
Table 1. Required Equipment

Recommended Equipment	Measurement Function	Accuracy
5500A Multi-product Calibrator (or equivalent)	DC Volts	10 mV to 600 V ±0.0625 %
	DC Current	600 µA to 10 A ±0.25 %
	AC Volts	6 mV to 600 V ±0.25 % @ 45 Hz to 1 kHz
	AC Current	600 µA to 10 A ±0.375 % @ 45 Hz to 1 kHz
	Resistance	0 to 5 MΩ ±0.225 %
		10 to 30 MΩ ±0.39 %
	Capacitance	9 to 900 µF ±0.475 %
	Temperature	0 °C to 400 °C ±0.25 %
5500A Multi-product Calibrator (or equivalent)	Frequency	2 V, 50 kHz ±0.025 %
Fluke 80 AK K-type Thermocouple Adapter Accessory	Temperature	
K-type Thermocouple, mini-plug on both ends	Temperature	

Display Test

Push **HOLD** and turn the rotary switch to the $_{Hz}\widetilde{V}$ position. Compare the display with the example in Figure 6. Check all segments for clarity and contrast.

Figure 6. Display Segments



Backlight Test

To Test the Backlight, press ☼ and verify that the backlight comes on.

Keypad Test

To test the keypad, turn the Meter to ACV and push each button separately. Each button push should cause the Meter to beep and activate a display annunciator.

Reset the Meter by turning it **Off** and then back to an on position.

Preparing for the Performance Tests

⚠⚠ Warning

To avoid possible electric shock or personal injury:

- **Do not perform the following procedures unless qualified to do so. Some procedures involve the use of high voltages.**
- **Before handling the test connections and in between tests, make sure the calibrator is in standby mode (STBY).**

To prepare for the performance test:

1. Make sure that you have the required equipment (refer to Table 1).
2. Warm up the calibrator as required by its specifications.
3. Allow the temperature of the UUT to stabilize at room temperature (23 °C ±5 °C [73 °F ±9 °F]).
4. Check the fuses and Battery, and replace them if necessary. See *Fuse Test* and *Fuse Replacement*.

To verify the accuracy of the Meter functions, do the following:

1. Connect the Calibrator to the VΩ and COM input terminals on the Meter.
2. Turn the rotary switch to the function listed in each step of Table 2.
3. Apply the input level for each step listed in Table 2.
4. Compare the reading on the Meter display with the Display Reading in Table 2.
5. If the display reading falls outside of the range shown in Table 2, the Meter requires calibration adjustment or repair.

Temperature Tests

Connect the K-type thermocouple to the temperature input of the Meter and temperature calibrator. To ensure an accurate measurement, the Meter and the thermocouple connector must be at the same temperature. After connecting the thermocouple to the Meter, allow the junctions to stabilize before recording the displayed reading. This can take several minutes, depending on temperature gradients.

Table 2. Performance Tests

Step	Function	Range	Applied	Display Reading
1	Ω Ohms	600.0	0.0 Ω	0.0 to 0.2
2		600.0	500 Ω	495.3 to 504.7
3		6.000 k	5 kΩ	4.954 to 5.046
4		60.00 k	50 kΩ	49.54 to 50.46
5		600.0 k	500 kΩ	495.4 to 504.6
6		6.000 M	5 MΩ	4.954 to 5.046
7		40.00 M	10 MΩ	9.83 to 10.17
8		40.00 M	30 MΩ	29.53 to 30.47
9	))) Continuity	600 Ω	20 Ω	Beeper On
10		600 Ω	250 Ω	Beeper Off
11	Ṽ AC Volts	6.000 V	5 V, 45 Hz	4.947 to 5.053
12		60.00 V	5 V, 1 kHz	4.897 to 5.103
13		6.000 V	5 V, 45 Hz	49.47 to 50.53
14		60.0 V	5 V, 1 kHz	48.97 to 51.03
15		600.0 V	600 V, 45 Hz	593.7 to 606.3
16		600.0 V	600 V, 1 kHz	587.7 to 612.3
17		1000 V	1000 V, 500 Hz	987 to 1013
18	~ Hz Ṽ AC Volts + Hz	6.000 V	2 V, 50 kHz[1]	49.93 to 50.07

Table 2. Performance Tests (cont.)

Step	Function	Range	Applied	Display Reading
19		6.000 V	0 V	-0.002 to 0.002
20		6.000 V	5 V	4.985 to 5.015
21	V̿ DC Volts	60.00 V	50 V	49.85 to 50.15
22		600.0 V	600 V	598.3 to 601.7
23		600.0 V	-600 V	-598.3 to -601.7
24		1000 V	1000 V	995 to 1005
25	mV~	600.0 mV	6 mV, 45 Hz	5.6 to 6.4
26	AC Millivolts	600.0 mV	600 mV, 1 kHz	587.7 to 612.3
27	mV⎓	600.0 mV	20 mV	
28	DC Millivolts	600.0 mV	600 mV	
29	→|← Diode	2.000 V	1.9 V	1.881 to 1.919
31		1000 nF	30	27 to 33
32	⊣⊢		9 µF	8.81 to 9.19
35	Capacitance		90 µF	88.1 to 91.9
36		9999 µF	900 µF	881 to 919
Set calibrator to standby, reconfigure leads, and program for amps output				
37	A̿ DC Amps	10.00 A	9.5 A	9.37 to 9.63
38	A~ AC Amps	6.000 A	5.0 A, 45 Hz	4.922 to 5.078
39			Open input	OPEn
40	Temperature		0.0 °C	-1.0 to 1.0
41			400 °C	395.0 to 405.0

[1] If using a Fluke 9100 calibrator, the Calibrator Frequency mode must be used to obtain accurate frequency.

Calibration Adjustment

The Meter features closed-case calibration adjustment using known reference sources. The Meter measures the

applied reference source, calculates correction factors, and stores the correction factors in nonvolatile memory.

The following sections present the features and Meter pushbutton functions available during the Calibration Adjustment Procedure. Should the Meter fail any of the performance tests, perform the Calibration Adjustment Procedure.

Use these steps to view the Meter's calibration counter:

1. While pressing **HOLD**, turn the rotary switch from **OFF** to **Ω** function. The Meter should display CAL.
2. Press [ ] once to view the calibration counter. For example, n001.
3. Turn the rotary switch to **OFF**.

Calibration Adjustment Password

To start the Calibration Adjustment Procedure, the correct 4-digit password must be entered. The default password is 1234. The password can be changed or reset to the default as described in following paragraphs.

Changing the Password

Use the following steps to change the Meter's password:

1. While pressing **HOLD**, turn the rotary switch from **OFF** to **Ω** function. The Meter should display CAL.
2. Press [ ] once to see the calibration counter.
3. Press [ ] again to start the password entry. The Meter displays ????.
4. The Meter buttons indicated below represent the numbers 1 through 5 when entering or changing the password:

   HOLD = 1 **MIN MAX** = 2 [RANGE] = 3 [ ] = 4 ☼ = 5

5. Press 4 buttons to enter the current password. If changing the password for the first time, enter:

   HOLD (1), **MIN MAX** (2), [RANGE] (3), and [ ] (4).

6. Press [RANGE] to change the password. The Meter displays ???? if the entered password is correct. If the password is not correct, the Meter emits a double beep, displays ????, and the password must be entered again. Repeat step 5.
7. Press the 4 buttons of the new password.
8. Press [ ] to store the new password.

Restoring the Default Password

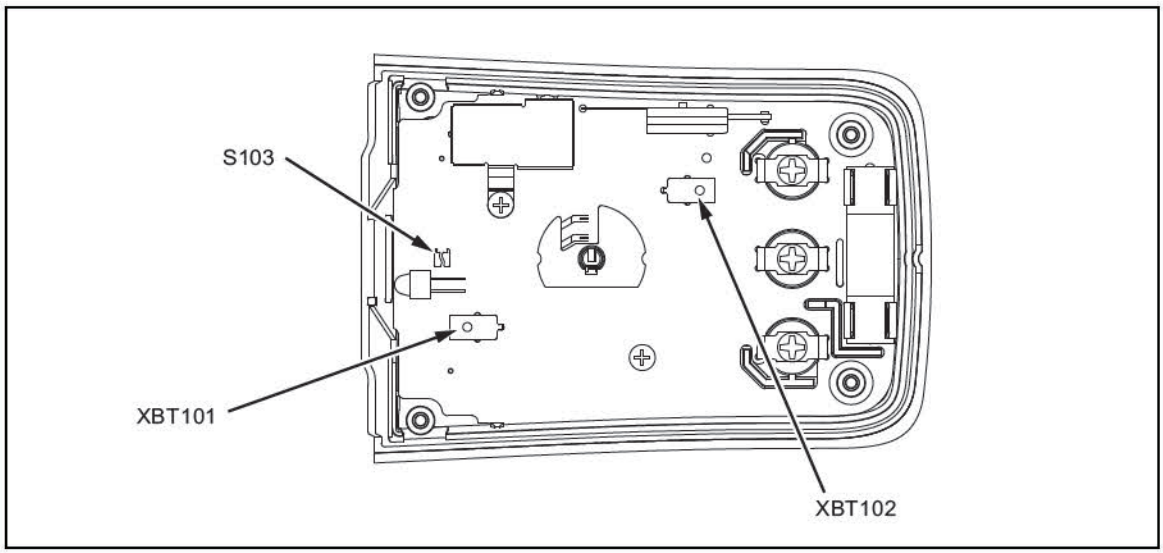
If the calibration password is forgotten, the default password (1234) can be manually restored using the following steps:

⚠⚠ Warning

To avoid electric shock or personal injury, remove the test leads and any input signal before removing the Meter's back case. See *Static Awareness*.

1. Remove the Meter's back case. Leave the PCA in the top case.
2. Apply 4.5 V across the battery contacts (XBT1) + and (XBT2) – on the back of the PCA. See Figure 7.
3. Turn the rotary switch from **OFF** to any on position.
4. Short across the S103 CAL keypad on the back of the PCA. See Figure 7. The Meter should beep. The default password is now restored.
5. Remove the 4.5 V supply and replace the Meter's back case.

Figure 7. Calibration Password Reset



Meter Buttons Used in the Calibration Steps

When performing the Calibration Adjustment Procedure, the Meter buttons behave as follows. This may be of help in determining why a calibration step is not accepted and for determining the input value without referring to Table 3.

1. Press and hold **HOLD** to show the measured value. The measured value is not calibrated so it may not match the input value. This is normal.
2. Press and hold **MIN MAX** to display the required input value.
3. Press [ ] to store the calibration value and advance to the next step. This button is also used to exit calibration mode after the calibration adjustment sequence is complete.
4. Press ☼ to toggle the backlight on and off.

Calibration Adjustment Procedure

To adjust the Meter's calibration, use the following steps:

Note

If the Meter is turned off before completion of the adjustment procedure, the calibration constants are not changed.

1. While holding down **HOLD**, turn the rotary switch from **OFF** to **Ω** function. The Meter should display CAL.
2. Press [ ] once to see the calibration counter.
3. Press [ ] again to start the password entry. The Meter displays ????.
4. Press the 4-button password.
5. Press [ ] to go to the first calibration step. The Meter displays C-01 if the password is correct. If the password is not correct, the Meter emits a double beep, displays ???? and the password must be entered again. Repeat step 4.
6. Apply the input value listed for each calibration adjustment step. For each step, select the rotary switch position and apply the input to the terminals as indicated in the Table 3.

Note

Some adjustment steps require additional wait time after the calibrator settles, as noted in Table 3.

7. After each input value is applied, press [ ] to accept the value and proceed to the next step (C-02 and so forth).

Note

After pressing [ ], wait until the step number advances before changing the calibrator source or turning the Meter's rotary knob. Some adjustment steps can take up to several seconds to execute before moving to the next step.

If the knob is not in the correct position for a given step, the meter will flash the unit annunciators until the knob is put in a valid position. The keys that show the reading and required input values are not allowed until the knob is correct.

Likewise, if the rotary switch is not in the correct position or the measured value is not within the anticipated range of the input value, the Meter will emit a double beep and will not continue to the next step when [ ] is pressed.

8. After the final step, the display shows End to indicate that the calibration adjustment is complete.
9. Press [ ] to return to meter mode.

Note

Set the calibrator to Standby prior to changing the function switch position and after completing adjustment of each function. If the calibration adjustment procedure is not properly completed, the Meter will not operate correctly.

Table 3. Calibration Adjustment Steps

Rotary Switch Position	Calibration Steps	Input Terminals	Calibrator Source Value
mV~	C-01	VΩ/+ and COM	0 V, 0 Hz
	C-02	VΩ/+ and COM	300 mV, 0 Hz
	C-03	VΩ/+ and COM	100 mV, 0 Hz
	C-04	VΩ/+ and COM	-300 mV, 0 Hz
	C-05	VΩ/+ and COM	60 mV, 0 Hz
	C-06	VΩ/+ and COM	600 mV, 0 Hz
	C-07	VΩ/+ and COM	600 mV, 60 Hz
Ω Ohms	C-08	VΩ/+ and COM	600 Ω, 2-wire comp
	C-09	VΩ/+ and COM	6 kΩ
	C-10	VΩ/+ and COM	60 kΩ
	C-11	VΩ/+ and COM	600 kΩ
	C-12	VΩ/+ and COM	6 MΩ[1]
	C-13	VΩ/+ and COM	Short[1]
	C-14	VΩ/+ and COM	40 MΩ[1]
V~	C-15	VΩ/+ and COM	6 V, 60 Hz
	C-16	VΩ/+ and COM	60 V, 60 Hz
	C-17	VΩ/+ and COM	600 V, 60 Hz
	C-18	VΩ/+ and COM	6 V, 0 Hz
	C-19	VΩ/+ and COM	60 V, 0 Hz
	C-20	VΩ/+ and COM	600 V, 0 Hz
Set calibrator to standby, reconfigure leads, and program for amps output.			
A~	C-22	A and COM	6 A, 60 Hz[1]
A⎓	C-23	A and COM	6 A, 0 Hz
[1] Wait an additional 5 seconds after calibrator has settled before pressing [ ].			

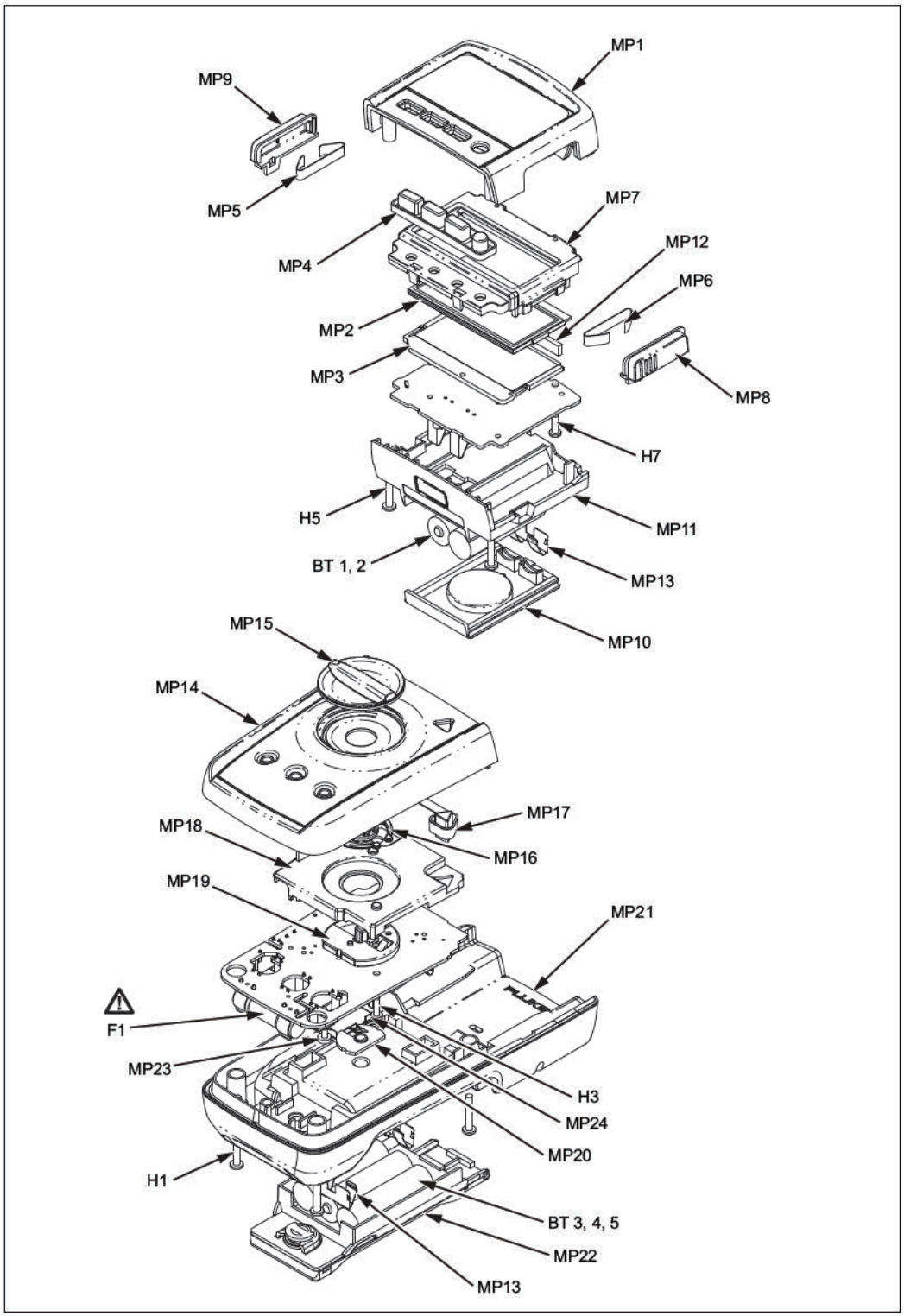
Replacement Parts

Table 4 is a list of the replaceable parts for the Meter identified in Table 8.

Table 4. Replaceable Parts

Item	Description	Part Number	Qty.
BT1 BT2 BT3 BT4 BT5	BATTERY,PRIMARY,ZNMNO2,1.5V,2.24AH,15A,LR6,ALKALINE, AA,14X50MM,BULK	376756	5
F1 ⚠	FUSE,11A,1000V,FAST.406INX1.5IN,BULK	803293	1
H1 H2 H3 H4 H5 H6	SCREW,5-14,.750,PAN,PHILLIPS,STEEL,BLACK (Case Screws) CHROMATE,THD FORMING	832246	6
H7 H8 H9 H10	SCREW,4-14,.375,PAN,PHILLIPS,STEEL,ZINC-ROHS CLEAR,THREAD FORM	448456	4
MP1	FLUKE-233-2003,CASE TOP, DISPLAY	3383743	1
MP2	LCD RDX	3385697	1
MP3	FLUKE-233-8004,BACKLIGHT DIFFUSER	3385715	1
MP3	FLUKE-233-8008,KEYPAD, DISPLAY	3383900	1
MP5 MP6	FLUKE-233-8003,SPRING LATCH	3383917	2
MP7	FLUKE-233-2501,MASK PAD XFER	3383820	1
	FLUKE-233-2501-01,MASK PAD XFER SI (Japan)	3470114	1
MP8	FLUKE-233-2008,BUTTON, LATCH, RIGHT	3383796	1
MP9	FLUKE-233-2008-01,BUTTON, LATCH, LEFT	3383801	1
MP10	FLUKE-233-2006,BATTERY DOOR, DISPLAY	3383770	1
MP11	FLUKE-233-2004,CASE BOTTOM, DISPLAY	3383755	1
MP12	CONNECTOR,ELASTOMERIC,.010 IN CTR,.218 IN HIGH,.090 IN THK,2.284 IN LONG,BULK	2534229	1
MP13	FLUKE 89-4-8012,BATTERY CONTACT, DUAL	666435	3
MP14	FLUKE-233-2503,CASE TOP, MAIN PAD XFER	3476126	1
MP15	FLUKE-15X7-8008,KNOB	2278007	1
MP16	FLUKE-15X7-8010,DETENT SPRING	2278029	1
MP17	FLUKE-233-8002,KEYPAD, MAIN	3383886	1
MP18	FLUKE-233-8001,SHIELD, RSOB	3383858	1
MP19	FLUKE-15X7-8009,HOUSING ASSY,RSOB	2278018	1
MP20	FLUKE 87-8004,CONTACT,PTF	822676	1
MP21	FLUKE-233-2002,CASE BOTTOM,MAIN	3383737	1
MP22	FLUKE-233-2005,BATTERY DOOR, MAIN	3383762	1
MP23	SCREW,M3-0.5X5MM,PHILLIPS PAN HEAD,DIN 7985, STEEL,ZINC,METRIC MACHINE SCREW (Input terminal screws)	3498942	3
MP24	FLUKE-233-8009,SHIELD,LEO	3451924	1
TM3	MANUAL,MAUAL INFO PACK,FLUKE-233	3474766	1
⚠ To ensure safety, use exact replacement only.			

Figure 8. Replaceable Parts



Product Disposal

Dispose of the Product in a professional and environmentally sound manner:

- Delete personal data on the Product before disposal.
- Remove batteries that are not integrated into the electrical system before disposal and dispose of batteries separately.
- If this Product has an integral battery, put the entire Product in the electrical waste.

Static Awareness

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

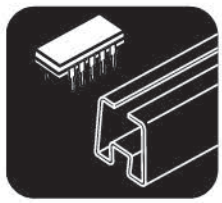
1. Understand the problem.
2. Learn the guidelines for proper handling.
3. Use the proper procedures, packaging, and bench techniques.

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 polystyrene foam 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.