

51, 52, 53, 54 Series II

Thermometer

Service Manual

51, 52, 53, 54 Series II Service Manual

⚠ Warning

To avoid shock or injury, do not perform the performance tests or calibration procedures described in this manual unless you are qualified to do so.

Refer to the Safety Information section of this manual before using the Fluke 51, 52, 53, 54 Series II Thermometers.

Caution

The Fluke 51, 52, 53, 54 Series II Thermometers contain parts that can be damaged by static discharge.

Follow the standard practices for handling static sensitive devices.

Introduction

This manual provides the following service information for the 51, 52, 53, and 54 Series II Thermometers, hereafter referred to as “the thermometer”.

- Precautions and safety information
- Specifications
- Performance tests
- Calibration and adjustment
- Basic maintenance
- Replaceable parts

For complete operating instructions, refer to the *51/52 Series II Users Manual* or the *53, 54 Series II Users Manual*, located on the *51/54 Series II CD ROM*, part number 1276106.

Safety Information

⚠ Warning

To avoid electrical shock or personal injury, follow these guidelines:

- Before using the thermometer, inspect the case. Do not use the thermometer if it appears damaged. Look for cracks or missing plastic. Pay particular attention to the insulation around the connectors.
- Disconnect the thermocouple(s) from the thermometer before opening the case.
- Replace the batteries as soon as the low battery indicator (⚡) appears. The possibility of false readings can lead to personal injury.
- Do not use the thermometer if it operates abnormally. Protection may be impaired. When in doubt, have the thermometer serviced.
- Do not operate the thermometer around explosive gas, vapor, or dust.
- Do not apply more than the rated voltage, as marked on the thermometer, between the thermocouple(s), or between any thermocouple and earth ground.
- Models 52 and 54: Measurement errors may occur if voltages on the measurement surfaces result in potentials greater than 1 V between the two thermocouples. When potential differences are anticipated between the thermocouples, use electrically insulated thermocouples.
- When servicing the thermometer, use only specified replacement parts.
- Do not use the thermometer with any part of the case or cover removed.

Caution

To avoid damaging the thermometer or the equipment under test:

- Use the proper thermocouples, function, and range for your thermometer.
- Do not attempt to recharge the batteries.
- To prevent explosion, do not dispose of batteries in fire.
- Follow local laws or regulations when disposing of batteries.
- Match the + and – polarities of the batteries with the battery case markings.

Specifications

General Specifications

Weight	280 g (10 oz)
Dimensions (without holster)	2.8 cm × 7.8 cm × 16.2 cm (1.1 in × 3 in × 6.4 in)
Battery	3 AA batteries
Certification	CE,  (TÜV pending)
Safety	CSA C22.2 No. 1010.1 1992 EN 61010 Amendments 1, 2
CAT I	OVERVOLTAGE (Installation) CATEGORY I, Pollution Degree 2 per IEC1010-1*
* Refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY I is equipment for connection to circuits in which measures are taken to limit the transient over voltages to an appropriate low level.	

Environmental

Operating Temperature	–10 °C to +50 °C (+14 °F to +122 °F)
Storage Temperature	–40 °C to +60 °C (–40 °F to +140 °F)
Humidity	Non Condensing (< +10 °C) (< +50 °F) 95% RH (+10 °C to +30 °C) (+50 °F to +86 °F) 75% RH (+30 °C to +40 °C) (+86 °F to +104 °F) 45% RH (+40 °C to +50 °C) (+104 °F to +122 °F) (Without Condensation)

Electrical

Measurement Range	J-type: –210 °C to +1200 °C (–346 °F to +2192 °F) K-type: –200 °C to +1372 °C (–328 °F to +2501 °F) T-type: –250 °C to +400 °C (–418 °F to +752 °F) E-type: –150 °C to +1000 °C (–238 °F to +1832 °F) N-type: –200 °C to +1300 °C (–328 °F to +2372 °F) R- and S-type: 0 °C to +1767 °C (+32 °F to +3212 °F)
Display Resolution	0.1 °C / °F / K < 1000° 1.0 °C / °F / K ≥ 1000°
Measurement Accuracy	J-, K-, T-, E-, and N-type: ±[0.05 % of reading + 0.3 °C (0.5 °F)] [below –100 °C (–148 °F): add 0.15 % of reading for J, K, E, and N; and 0.45 % of reading for T] R- and S-type: ±[0.05 % of reading + 0.4 °C (+0.7 °F)]
Temperature Coefficient	0.01 % of reading + 0.03 °C per °C (0.05 °F per °F) outside the specified +18 °C to +28 °C (+64 °F to +82 °F) range [below –100 °C (–148 °F): add 0.04 % of reading for J-, K-, E-, and N-type; and 0.08 % of reading for T-type]
Electromagnetic Compatibility	Susceptibility: ± 2 °C (± 3.6 °F) for 80 MHz to 200 MHz in 1.5 v/m field, for 200 MHz to 1000 MHz in 3 V/m field. Emissions: Commercial limits per EN50081-1
Maximum Differential Common Mode Voltage	1 V (Maximum voltage difference between T1 and T2)
Temperature Scale	ITS-90
Applicable Standards	NIST-175
Accuracy is specified for ambient temperatures between +18 °C (+64 °F) and +28 °C (+82 °F) for a period of 1 year. The above specifications do not include thermocouple error.	

Performance Test and Calibration Required Test Equipment

Refer to Table 2 for a list of test equipment used in the performance test and calibration procedures.

Table 2. Recommended Test Equipment

Equipment	Required Characteristics	Recommended Model
DC Voltage Calibrator	Output Voltage: 0-1V Accuracy: 0.0125 % Resolution: 0.1 μ V	Fluke 5700A or equivalent
Thermocouple connector	For K-type thermocouple	Fluke 80CK-M Fluke P/N 779942
Thermocouple connector	Copper	Fluke P/N 601747
K-type Thermocouple wire	Standard	Omega
Dewar Flask/Cap	1- pint, or larger capacity	Thermos
Mercury Thermometer (either °C or °F)	0.02 °C Resolution 0.05 °F Resolution	Princo Model ASTM56C Princo Model ASTM56F
DB9 Adapter Connector		Fluke P/N 804549
IR Adapter		Fluke P/N 690518
PC with Microsoft Windows® installed		

Performance Tests

Performance tests are recommended for incoming inspection, periodic maintenance, and for checking the thermometer's specifications. If the thermometer fails any part of the performance tests, calibration and/or repair is indicated.

Before performing these tests:

1. Allow the thermometer to stabilize to room temperature, $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ ($+73\text{ }^{\circ}\text{F} \pm 9\text{ }^{\circ}\text{F}$).
2. Check the batteries and replace them if necessary.

Display Test

Turn the thermometer on while pressing the **HOLD** button. All display segments are displayed until the **HOLD** button is released. Confirm that all the display segments are showing as in Figure 1.

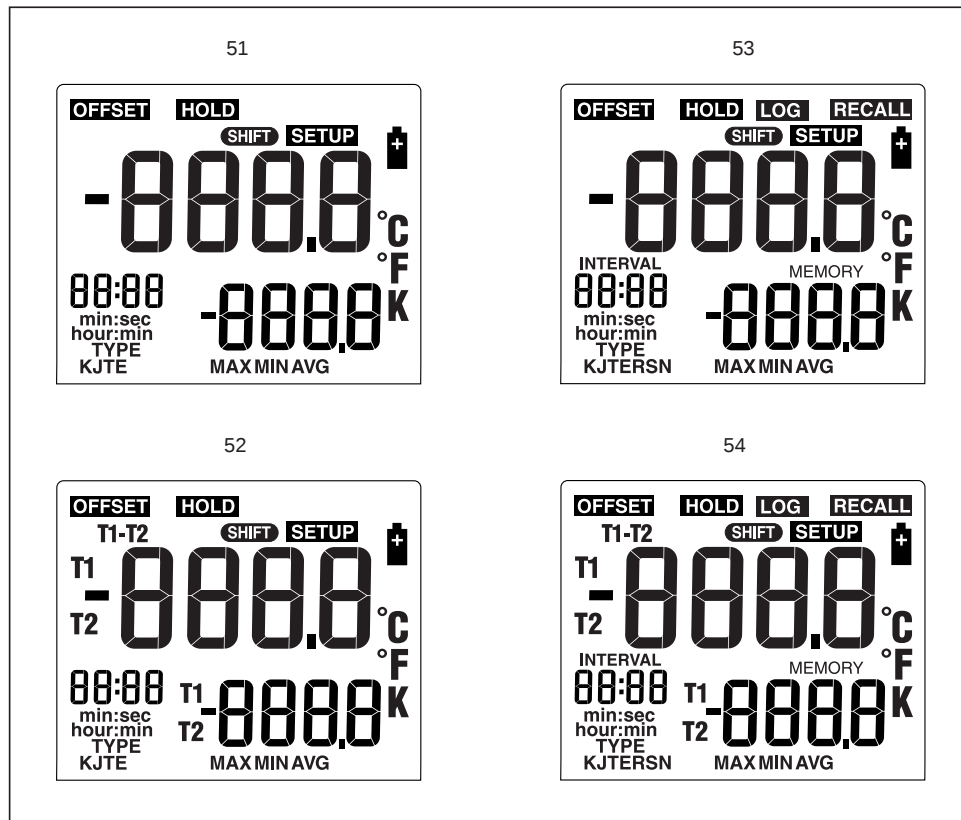


Figure 1. Display Segments

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Keypad Test

Check that all keypad switches are functional by pressing each key and confirming the proper response on the display.

Wide Range Performance Test Procedure

This test verifies the instrument specifications. If the instrument fails this test, perform the calibration procedure. If the unit continues to fail, it should be taken to a Fluke service center.

Ice Bath Construction

To begin the performance test, first construct an ice bath as follows:

1. Prepare a Dewar Flask by drilling two holes in its cap to accept the Mercury thermometer and thermocouple wires, or use a standard laboratory cork.
2. Fill the Dewar Flask with shaved or crushed ice made from distilled water.
3. Fill the Dewar Flask with enough distilled water so that the ice turns to slush, but do not add enough water to float the ice.

Note

As the ice melts, siphon off the excess water and add more ice. Allow approximately 5 to 10 minutes for the water to drop back to the freezing point.

4. Replace the Dewar Flask cap or cork, and insert the thermocouple wires and Mercury thermometer as shown in Figure 2. Insert the Mercury thermometer to the same depth as the thermocouple wire.

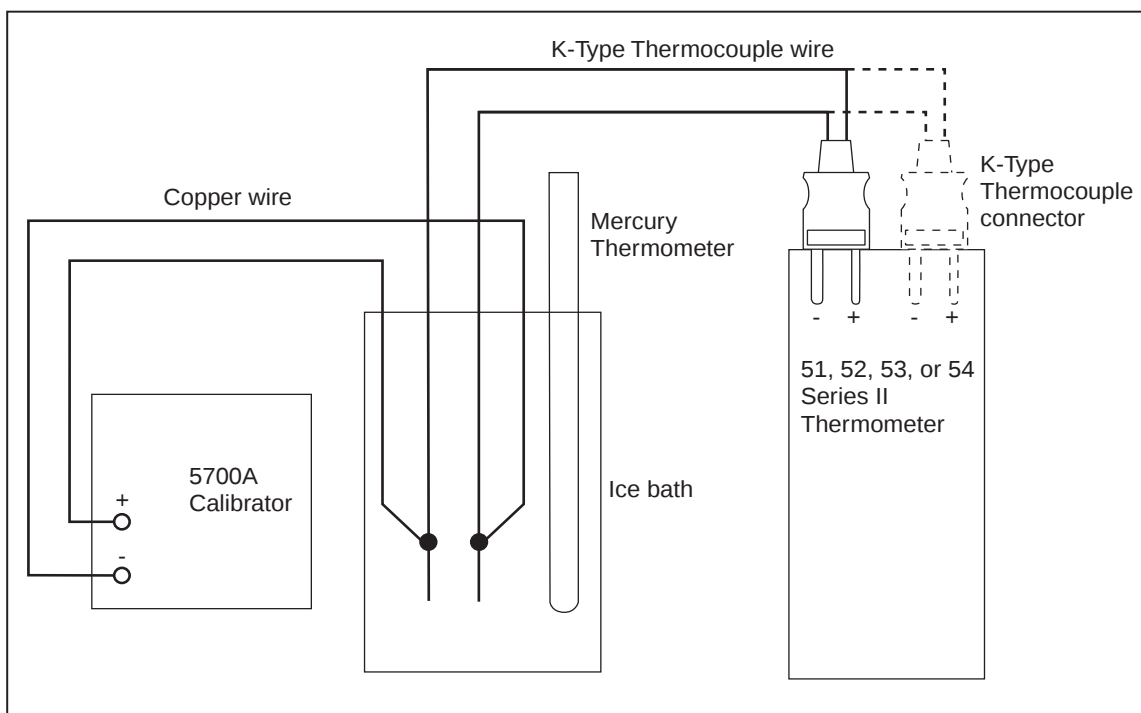


Figure 2. Ice Bath Test Equipment Connections

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Ice Bath Test

Use the following procedure to test the thermometer. If the thermometer has two inputs, this test should be conducted on both thermocouple inputs.

1. If not already selected, select K-type thermocouple on the thermometer using the **SETUP**, **Δ**, **▽**, and **ENTER** buttons.
2. Connect the equipment as shown in Figure 2. Allow the setup to thermally stabilize at least 5 minutes after inserting the thermocouple into the thermometer.
3. Verify that the ice bath temperature reads $0.0\text{ }^{\circ}\text{C} \pm 0.06\text{ }^{\circ}\text{C}$ on the Mercury thermometer.
4. Short (or apply 0 mV) to the copper wires at the Calibrator.
5. Verify the thermometer reads $0.0\text{ }^{\circ}\text{C} \pm 0.3\text{ }^{\circ}\text{C}$.
6. If this test fails, reposition the thermocouple wires and Mercury thermometer to the same depth in the ice bath, and repeat steps 3-5. If the test continues to fail, perform the calibration procedure, located after this procedure.
7. Remove the short applied in step 4.
8. Using Table 3, steps 2-5, obtain an output from the Calibrator equal to the values in the "Input Voltage (mV DC)" column, and verify the thermometer reads within the limits specified. If any step fails, perform the calibration procedure located later in this section.
9. Disconnect the thermocouple from the input terminals. This completes the ice bath test.

Table 3. Performance Test Values (K-Type Thermocouple)

Step	Input Voltage (mV DC)	Equivalent Temperature		Display Reading limits	
				°C	°F
1	0.0000	0.0 °C	32.0 °F	-0.3 to 0.3	31.5 to 32.5
2	0.9193	23.0 °C	73.4 °F	22.7 to 23.3	72.9 to 73.9
3	-5.7297	-190.0 °C	-310.0 °F	-189.3 to -190.7	-308.9 to -311.1
4	40.8853	990.0 °C	1814 °F	989.2 to 990.8	1813 to 1815
5	48.8382	1200 °C	2192 °F	1199 to 1201	2190 to 2194

Verification of IR Communications Port (Fluke 53 and 54)

This section explains how to verify the operation of the IR Communications Port (IR port). Perform the following procedure using a PC and HyperTerminal. The IR port can also be verified using Flukeview™ software.

To set up a HyperTerminal file, follow these steps:

1. Connect the IR adapter cable to the DB9 Adapter connector. Connect the other end of the DB9 Adapter to a COM port of the PC.
2. Place the Fluke 53 or 54 in front of the IR adapter.
3. Open up a HyperTerminal session. Select **Start button, Programs, Accessories, HyperTerminal**.
4. Open up a **New Connection** with a name like "Fluke 54 IR Test".
5. When the **Connect To** box appears, select the COM1 or COM2 (the port that the IR adapter cable is plugged into).
6. Select **Port Settings**: 9600 baud rate, 8 data bits, no parity, 1 stop bit, and no flow control.
7. Under **File**, select **properties**. Verify that the correct port is selected. Click on **Configure**. Verify that port settings are correct (the baud rate may need to be changed to 9600).
8. Select the **Settings** tab then click on **ASCII Setup**. Check the following boxes:
 - Echo typed characters locally
 - Append line feeds to incoming line ends
 - Wrap lines that exceed terminal width

To open a HyperTerminal file to test the IR port, use the following procedure:

1. Under **File**, select **Save As**. Use a file name such as "Fluke 54 IR Test" and then click on **save**.
2. Click on the **phone disconnect** icon.
3. Click on **open folder** or under **File** select **Open**. Double click on Fluke 54 IR Test.
4. Type in "ID" followed by the **Enter** key (notice the "ID" is capitalized).
5. The display of the thermometer now shows the thermometer name (Fluke 53-II or Fluke 54-II), and the units operating software version (e.g. Fluke 54-II, V1.01).

Calibration and Offset Adjustment

Calibration consists of two parts:

1. Calibration of the A/D converter, using the set up shown in Figure 3.
2. Reference junction calibration, using the ice bath test set up shown in Figure 2.

A/D Calibration

To calibrate the A/D portion of the thermometer, follow these steps:

1. Connect the calibrator to the T1 input of the thermometer using copper (non-thermocouple) wire and a copper thermocouple connector. Refer to Figure 3 for proper equipment connections.
2. Turn the thermometer on, with a small, blunt probe, press the calibration button located on the back and in the center of the thermometer. Refer to Figure 4.

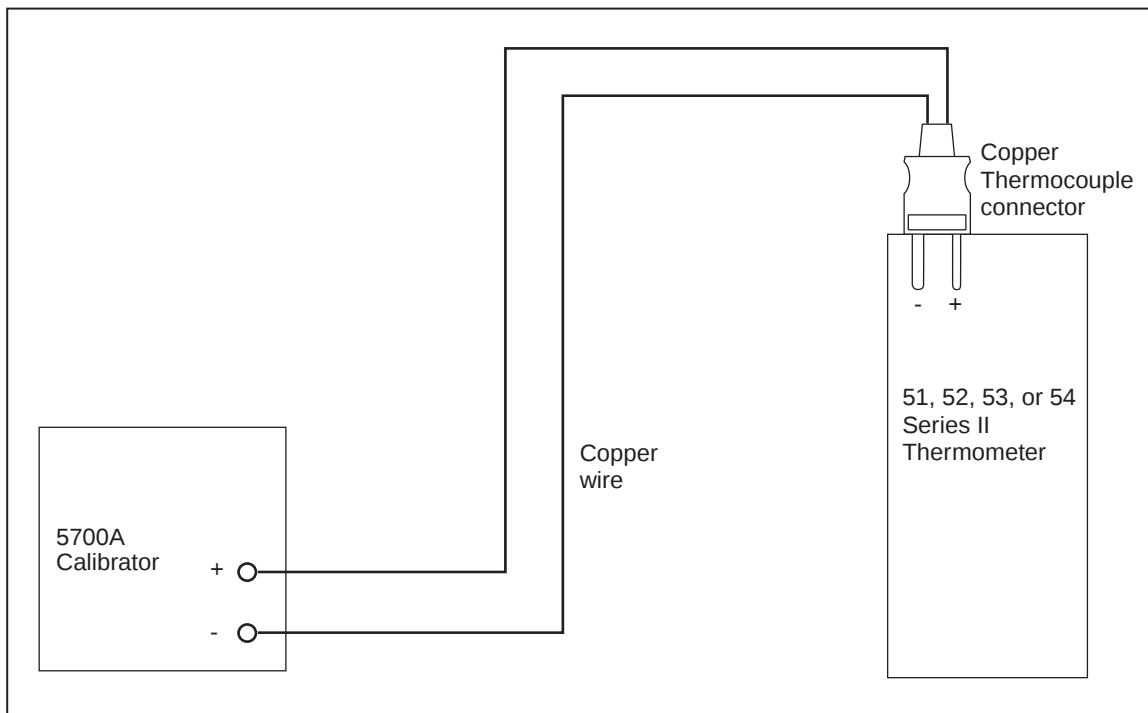
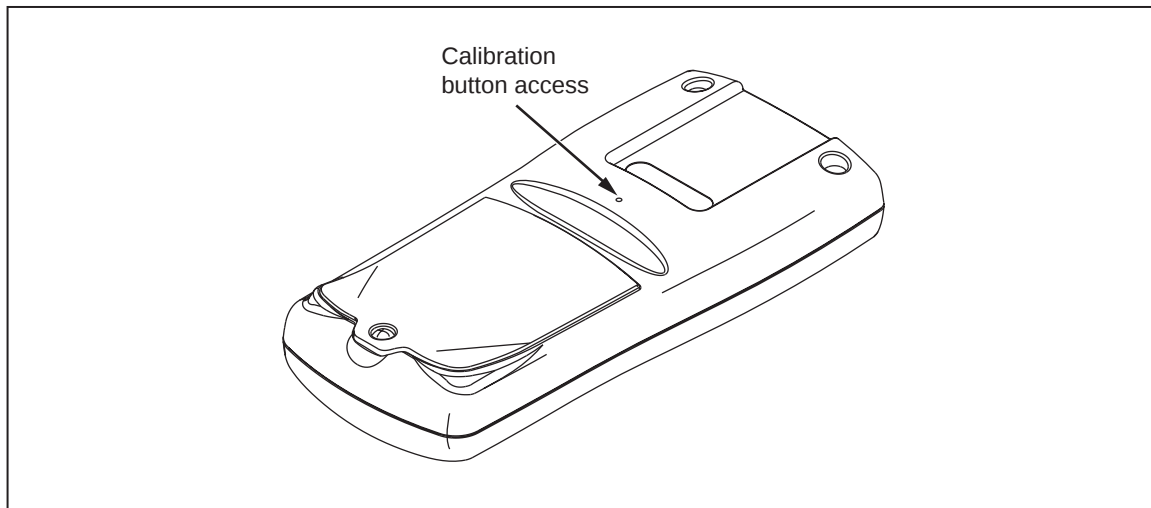


Figure 3. Calibration Connections

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Figure 4. Calibration Button Access

3. The menu on the display changes to “**CAL A-d**”.

Note

Within **CAL** are four menu options that may be accessed by pressing **ENTER**:

- **CAL A-d** prompts the operator for the A/D calibration inputs in mV dc.
 - **CAL rEF** allows the operator to calibrate the reference junction at a known temperature.
 - **CAL donE** saves the new calibration constants in memory.
 - **CAL Abrt** ignores calibration changes (turning the thermometer off while in **CAL** will also ignore calibration changes).
4. Press **△** or **▽** to select different menu options.
 5. With **CAL A-d** selected, press **ENTER**. The thermometer prompts “80”. Set the calibrator to +80.000 mV and allow the output to stabilize.

Note

For steps 6 and 8, keep hand and body motion to a minimum while the thermometer takes A/D readings.

6. Press **ENTER**. Wait while it takes A/D readings.
7. When the thermometer prompts for “-8”, set the Calibrator to -8.0000 mV. Allow the output to stabilize.
8. Press **ENTER** on the thermometer and wait while it takes A/D readings. The thermometer now shows the measured value in the bottom portion of the display. Millivolts appears on the left side and microvolts appears on the right side.
9. If the measurement is from -7 995.0 to -8 005.0, press **ENTER** and the meter will return to the calibration menu and display **CAL rEF**. If the measurement is outside -7995.0 to -8005.0, press **ENTER** once to return to the calibration menu. Using **△** or **▽**, select **CAL A-d** and try the A/D calibration procedure a second time starting at step 5.
10. Using **△** or **▽**, select “**CAL donE**”, then press **ENTER** to store the calibration in memory.

11. To ignore the calibration changes, use or , and select “**CAL Abrt**” and press .
12. Proceed to Reference Junction Calibration.

Reference Junction Calibration

Note

This procedure is described using an ice bath and a K-type thermocouple. It can be performed in °C, °F, or K with any thermocouple and a known, accurate temperature between 0 °C (+32 °F) and +50 °C (+122 °F).

Note

It is important that the temperature of the thermocouple and the internal temperature of the thermometer (the reference junction) have stabilized.

To calibrate the reference junction, follow these steps:

1. Prepare an ice bath (described earlier in this section).
2. Referring to Figure 2, connect the equipment to T1 using K-type thermocouple wire and a K-type thermocouple connector. Allow the setup to thermally stabilize at least 5 minutes after inserting the thermocouple connector into the thermometer.
3. Turn the thermometer on and select the thermocouple type using the , , , and buttons.
4. Enter calibration mode (refer to the “A/D Calibration” section, step 2).
5. Using or , select **CAL rEF** and press .
6. Press or until the upper display matches the known temperature.

Note

Once adjusted, do not change units (°C, °F, or K) until the thermometer is in measurement mode.

7. Press the button.
8. “**CAL done**” appears then press to store the calibration in memory.
9. To ignore the calibration changes, use the or , and select “**CAL Abrt**” and press .

Using the Offset to Adjust for Variation Between Thermocouples

Use the offset option in the thermometer SETUP mode to adjust the thermometer's readings for errors of a specific thermocouple. Use the following procedure:

1. Plug the thermocouple into the thermometer input then allow the setup to thermally stabilize at least 5 minutes.
2. Place the thermocouple in a known, stable temperature environment (such as an ice bath, lag bath, or a dry well calibrator).
3. Allow the readings to stabilize.
4. In SETUP, change the offset until the primary display reading matches the bath temperature. (See “Changing Setup Options” in the *51/52 Series II Users Manual*, and the *53/54 Series II Users Manual*.)

Basic Maintenance

Basic maintenance required by the thermometer is discussed in this section.

Cleaning the Thermometer

Caution

- To avoid damaging the thermometer, do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions react with the plastics used in the thermometer.
- Do not allow the LCD to get wet.
- Do not remove any of the lubricant from the battery/pca connection.

Clean the thermometer case with a mild detergent and water.

The pca may be washed with isopropyl alcohol or deionized water and a soft brush. Dry the pca with clean dry air at low pressure, then bake it at +50 °C (+122 °F) for 24 hours.

Changing the Batteries

⚠ Warning

- Replace the batteries as soon as the low battery indicator (⚡) appears. The possibility of false readings increases when the batteries are low. False readings can lead to personal injury.
- To avoid electrical shock, disconnect the thermocouple(s) before opening the battery door.

Caution

- Do not attempt to recharge the batteries.
- Do not dispose of the batteries by placing them in fire.
- Follow local laws or regulations when disposing of batteries.
- Match the positive (+) and negative (-) polarities of the batteries with the markings located on the case.

To replace the batteries, refer to Figure 5 and use the following procedure:

1. Turn the thermometer off.
2. Loosen the battery compartment door screw and remove the battery door.
3. Replace the three AA batteries. To simplify battery installation, put the new batteries into the unit positive end first.
4. Replace the battery compartment door and tighten the screw.

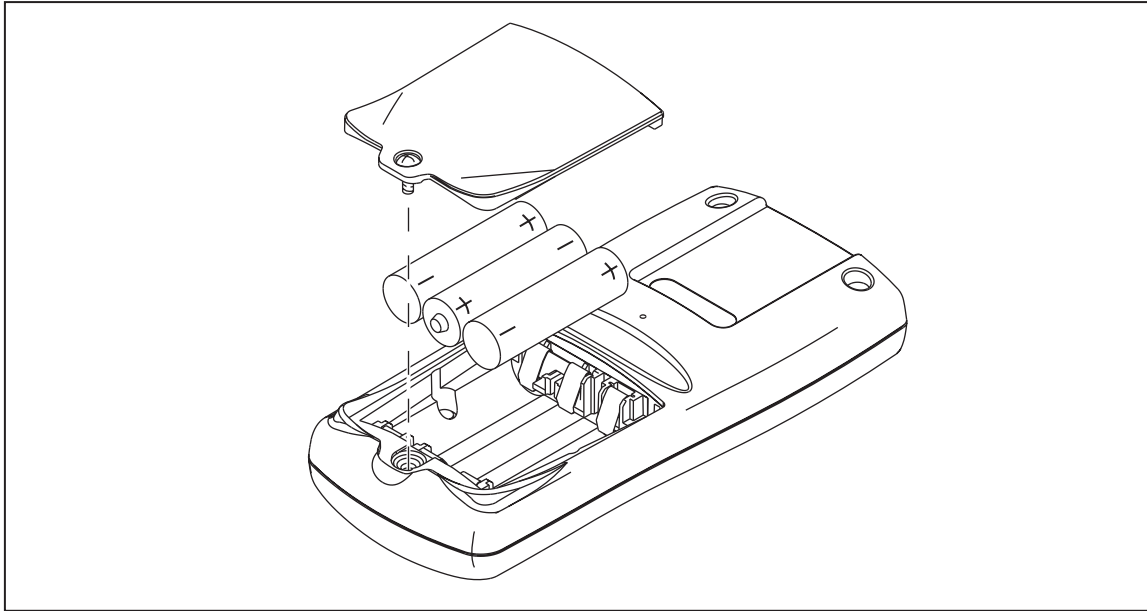


Figure 5. Battery Access

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Disassembly and Reassembly

Disassembly and reassembly of the thermometer may be necessary to replace interior parts. Refer to Figure 6 when disassembling and reassembling the thermometer.

Disassembly

To disassemble the thermometer, follow these steps:

1. Remove the batteries (see “Changing the Batteries” section).
2. Remove the two screws located inside the battery compartment.

Caution

- **Before proceeding, make sure that you are grounded to prevent static discharge, which could damage the thermometer.**
 - **Inside the unit there are parts that can become contaminated by oils from the skin. These parts should not be directly handled. When lifting out the elastomeric connectors and the main switch pad, it is recommended that tweezers or sterile gloves be used.**
3. Remove the two case bottom screws, located at the LCD-end of the unit and separate the bottom case from the top case.
 4. Removing any of the interior components of the unit requires removing the Main PCA. To remove the Main PCA, place the top case face down and remove the two screws that attach the Main PCA to the top case. Gently lift the Main PCA out of the top case. The IR Lens, small Isothermal PCA, backlight, elastomeric connectors, and the LCD may all lift out attached to the Main PCA.
 5. If the Isothermal PCA separates from the Main PCA, the Isothermal PCA, IR Lens, backlight, elastomeric connectors, and the LCD will still be in the top case. Lift them out of the top case after the Main PCA is removed.

6. The LCD decal is now exposed and may be removed.
7. To remove the main switch pad, first remove the small elastomeric connector at the top of the switch pad, and then lift out the entire switch pad.

Reassembly

The reassembly procedure is basically the reverse of the disassembly procedure. However, there are several points in this process that should be explained further.

Note

For reassembly, the thermometer top case should be face down, with the keypad end of the top case facing the user.

Reinstalling the LCD Assembly

Follow these steps to reinstall the LCD assembly:

1. Install the LCD decal.
2. When putting the LCD back into the top case, make sure the LCD is correctly aligned. The edge of the LCD with the bubble in it should be facing the left side of the open, face down top case, and the LCD should be placed into the top case face down.
3. When reinstalling the backlight, the backlight pins should be on the left side of the open top case and they should be facing up. Check that the pins are straight. To make sure that the backlight is centered, line up the bottom left corner of the backlight with the guide that is molded into the top case. The left corner of the backlight should fit directly over this guide and the bottom right side of the backlight should also be lined up with (but not over) a similar guide on the right side of the open top case.
4. Install the two LCD elastomeric connectors.

Rebuilding the Main PCA

When reinstalling the Main PCA, make sure that the Isothermal PCA and the IR Lens are attached to each other first. To do this, follow these directions:

1. Turn the Main PCA over so that the components are face down.
2. Attach the Isothermal PCA to the Main PCA by inserting the pins into the matching holes on the Main PCA.

Note

When putting the Isothermal PCA back onto the Main PCA, do not push the Isothermal PCA all the way down into the contact holes of the Main PCA. If the Isothermal PCA is kept slightly loose, it makes installation of the IR Lens easier.

3. Reinstall the IR Lens by taking the Main PCA (with the Isothermal PCA loosely attached), and with the component side facing down; slide the IR Lens in between the main board and the Isothermal PCA.
4. Line up the tab on the Isothermal PCA and the notch in the IR Lens and push the two together. The contacts of the IR Lens should slide under the Isothermal PCA and they should be making contact with pads on the underside of the Isothermal PCA.

5. Push the Isothermal PCA and the Main PCA together so that the Isothermal PCA pins go deeper into the Main PCA sockets. This holds the IR Lens in place and allows the Main PCA to be reinstalled into the top case.

Reinstalling the Main PCA

1. While holding the IR Lens to the Main PCA, turn the Main PCA over so that the components are facing up.
2. Align the screw holes in the Main PCA with those in the top case.
3. Align the backlight pins with the Main PCA sockets.
4. Align the Main PCA holes with the backlight posts.
5. Gently push the Main PCA down into the top case, making sure that the IR Lens goes into the groove on the LCD-end of the top case. If it does not fit together easily, check to make sure that everything is properly lined up and try again.
6. Reinsert and tighten the two pca screws.

To complete the thermometer reassembly, screw the bottom case to the top case, reinstall the batteries and screw the battery compartment shut.

Replaceable Parts

Refer to Table 4 for all replacement part numbers and Figure 6 for part locations. Unless specified in the “Model Number” column, all parts are for all units. To order replaceable parts, see the “Service Centers” section of this manual.

Table 4. Replaceable Parts

Item Number	Qty.	Fluke Part Number	Description	Model Number
1	3	376756	BATTERY, PRIMARY, 1.5V, 0-150MA, AA ALKALINE	All
2	4	803582	SCREW, PH, P, CAPT, STL, 4-40, .25	All
3	1	642931	BATTERY DOOR: • SCREW, PH, P, AM THD FORM, STL, 4-14, .312	All
4	1	669838	• DOOR, BATTERY	All
5	1	669812 669804 669801 669796	CASE, TOP CASE, TOP CASE, TOP CASE, TOP	51 52 53 54
6	1	1541901	ISOTHERMAL PCA (TESTED)	All
7	2	804713	CONNECTOR, ELASTOMERIC, LCD TO PWB, 2.210 L	All
8A-F	1	1541895	BOTTOM CASE ASSEMBLY Bottom Case Assembly contains:	All
8A	2	666435	• BATTERY CONTACT, DUAL	All
8B	1	674744	• BATTERY CONTACT (POS)	All
8C	1	674770	• BATTERY CONTACT (NEG)	All
8D	1	669819	• CASE, BOTTOM	All
8E	1	658689	• KEYPAD, CALIBRATION	All
8F	1	675009	• SHIELD	All

Table 4. Replaceable Parts (cont.)

Item Number	Qty.	Fluke Part Number	Description	Model Number
9A-B	1	1541912	51/53 SERIES II IR LENS KIT	51, 53
	1	1543462	52/54 SERIES II IR LENS KIT	52, 54
			IR Lens Kit contains:	
9A	2	—	• SPRING, ISOTHERMAL	51, 53
	4			52, 54
9B	1	—	• IR LENS	51, 53
	1		• IR LENS	52, 54
10	1	675017	WINDOW, PROTECTOR	All
11	1	675030	LCD DECAL	51
		675025	LCD DECAL	52
		675022	LCD DECAL	53
		675014	LCD DECAL	54
12	1	674747	BACKLIGHT	All
13	1	1272438	HOLSTER & FLEX STAND ASSEMBLY	All
14	2	643830	SCREW, PH, P, METRIC PT, STL, K35, 14MM	All
15	1	669793	KEYPAD	51
		669788	KEYPAD	52
		669785	KEYPAD	53
		669777	KEYPAD	54
16	1	804705	CONNECTOR, ELASTOMERIC, SWITCH TO PWB, 1.200 L	All
17	1	800836	LCD, MULTIPLEXED	All
Not shown	1	1276106	CD ROM, CD ROM FLUKE 50 SERIES II	All
			CD ROM contains:	
			• 51/52 Series II Users Manual (16 Languages)	
			• 53/54 Series II Users Manual (16 Languages)	
Not shown	1	1276114	FLUKE 51-54 SERIES II PRODUCT OVERVIEW	All
Not shown	1	773135	THERMOCOUPLE ASSY, T/C ASSY, K-TYPE, BEADED, MOLDED-	51, 53
	2		PLUG	52, 54

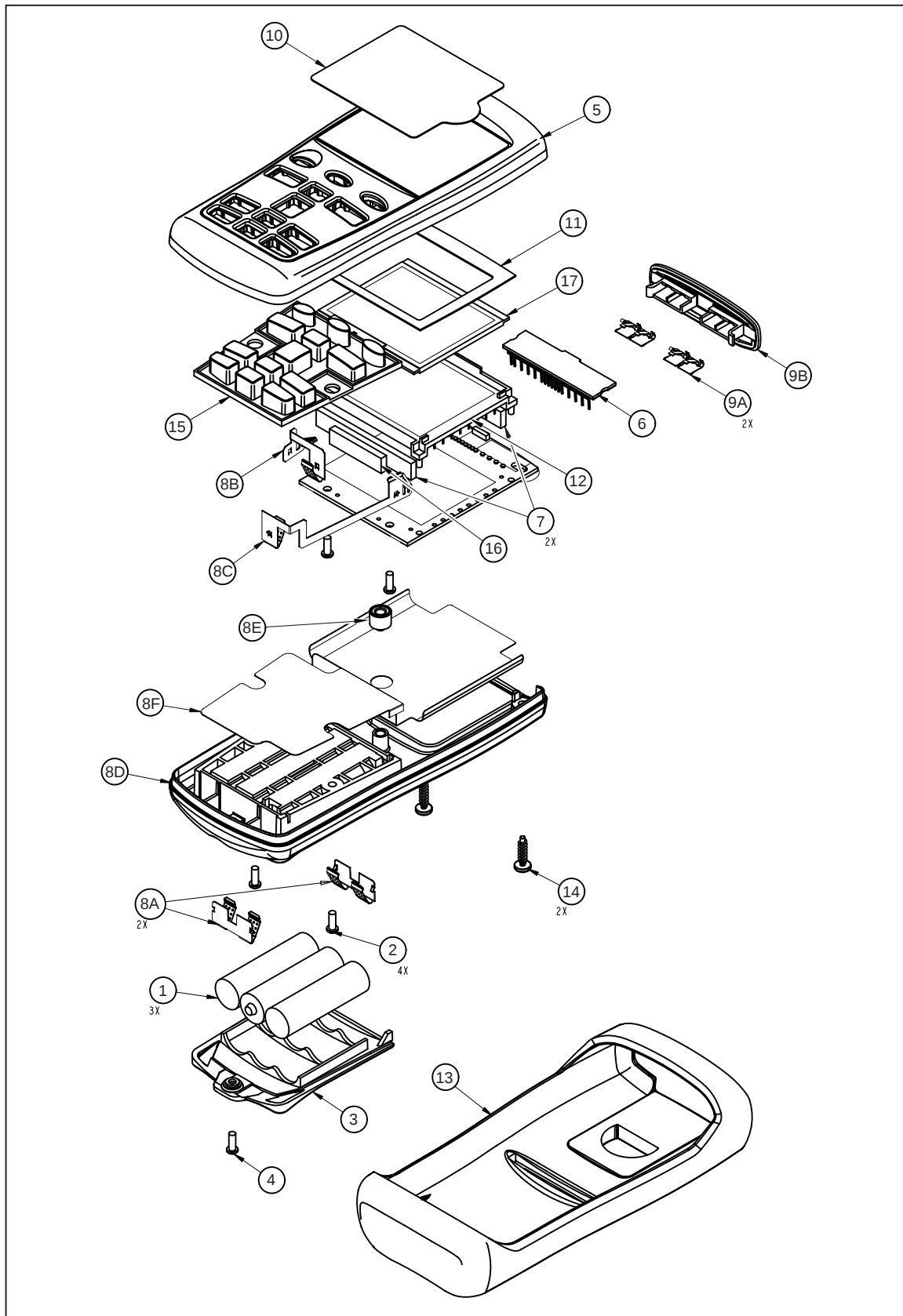


Figure 6. Exploded View (Model 54 is Shown)

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