

279 FC

True-rms Thermal Multimeter

Calibration Manual

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Introduction

Warning

**To prevent possible electrical shock, fire, or personal injury,
read all safety information before you use the Product.**

This manual contains the verification and calibration adjustment procedures for the 279 FC True-rms Thermal Multimeter (the Multimeter or Product). See the *279 FC Users Manual* for information about how to use the Product.

Contact Fluke

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
- 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

A **Warning** identifies 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.

Warning

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

- Carefully read all instructions.
- Read all safety information before you use the Product.
- Use the Product only as specified, or the protection supplied by the Product can be compromised.
- Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame-resistant clothes) to prevent shock and arc blast injury where hazardous live conductors are exposed.
- Examine the case before you use the Product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.
- Do not use the Flexible Current Probe if it has damaged insulation, exposed metal, or if the wear indicator is visible.
- Do not use test leads if they are damaged. Examine the test leads for damaged insulation, exposed metal, or if the wear indicator shows. Check test lead continuity.
- The battery door must be closed and locked before you operate the Product.
- Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.
- Use Product-approved measurement category (CAT), voltage, and amperage rated accessories (probes, test leads, and adapters) for all measurements.
- Do not exceed the Measurement Category (CAT) rating of the lowest rated individual component of a Product, probe, or accessory.
- Measure a known voltage first to make sure that the Product operates correctly.
- Limit operation to the specified measurement category, voltage, or amperage ratings.
- Do not use the Product above its rated frequency.
- Do not use in CAT III or CAT IV environments without the protective cap installed on test probe. The protective cap decreases the exposed probe metal to <4 mm. This decreases the possibility of arc flash from short circuits.
- Do not apply more than the rated voltage between the terminals or between each terminal and earth ground.
- De-energize the circuit or wear personal protective equipment in compliance with local requirements before you apply or remove the Flexible Current Probe.

Symbols

The symbols in Table 1 are used on the Product or in this manual.

Table 1. Symbols

Symbol	Meaning
	WARNING. RISK OF DANGER.
	Consult user documentation.
	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	Double Insulated
	Battery
	Certified by CSA Group to North American safety standards.
	Conforms to European Union directives.
	Conforms to relevant Australian EMC standards.
	Conforms to relevant South Korean EMC Standards.
CAT II	Measurement Category II is applicable to test and measuring circuits connected directly to utilization points (socket outlets and similar points) of the low-voltage MAINS installation.
CAT III	Measurement Category III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation.
CAT IV	Measurement Category IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation.
 Li-Ion	This product contains a Lithium-ion battery. Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler per local regulations. Contact your authorized Fluke Service Center for recycling information.
	This product complies with the WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste.

Hazardous Voltage

The hazardous voltage warning  shows on the display when the Multimeter detects a voltage ≥ 30 V.

Test Lead Alert

The display shows LEAD for 1 second when you turn the control knob to or from the  ^{Hz} iFlex $\bar{\Delta}$ position. This is a reminder to check that the correct accessory is connected.

Display OL

If the measurement value (does not include temperature measurements) is over the limit, or outside the measurement range, the Multimeter shows **OL** in the display.

Specifications

Maximum Voltage between any

Terminal and Earth Ground 1000 V

Temperature

Operating -10 °C to +50 °C

Storage (without battery) -20 °C to +60 °C

Display (LCD)

Size 8.9 cm (3.5 in.) diagonal

Update rate 4/sec

Volts, amps, ohms 6000 counts

Frequency 10 000 counts

Capacitance 1000 counts

Battery (BP500) Li-ion 7.4 V, 3000 mAh, customer-replaceable

Discharge -10 °C to +50 °C

Charge 0 °C to +40 °C

Storage -20 °C to +35 °C

Battery Life 10 hours minimum

Relative Humidity 0 % to 90 % (0 °C to 35 °C)

0 % to 75 % (35 °C to 40 °C)

0 % to 45 % (40 °C to 50 °C)

Battery Power Supply Input 100-240 Vac (±) 10 %, 50/60 Hz. Output 15 Vdc, 2 A.

Altitude

Operating 2000 m

Storage 12 000 m

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

Size (HxWxL) 5.7 cm x 9.4 cm x 21.6 cm (2.3 in x 3.7 in x 8.5 in)

Weight 0.80 kg (1.75 lb)

Safety

General IEC 61010-1: Pollution Degree 2

Measurement IEC61010-2-032: CAT IV 600 V / CAT III 1000 V

IEC61010-2-033: CAT IV 600 V / CAT III 1000 V

Li-ion Battery IEC 62133

Electromagnetic Compatibility (EMC)

International IEC 61326-1: Portable Electromagnetic Environment

CISPR 11: Group 1, Class A, IEC 61326-2-2

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.

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.

Wireless Radio with Adapter

Frequency Range 2402 MHz to 2480 MHz

Output Power <10 mW

Detailed Specifications

For all specifications: Accuracy is specified for 1 year after calibration, at operating temperatures of 18 °C to 28 °C, with relative humidity at 0 % to 90 %. Accuracy specifications take the form of $\pm$ ([% of Reading] + [Number of least significant digits]).

AC Voltage Measurements

Range ^[1]	Resolution	Measurement ^{[2][3][4]}		
		45 Hz to 65 Hz	65 Hz to 200 Hz	200 Hz to 500 Hz
600.0 mV	0.1 mV	±(1.0 % + 3)		
6.000 V	0.001 V	±(1.0 % + 3)	±(4.0 % + 3) ^[5]	±(15.0 % + 3) ^[5]
60.00 V	0.01 V			
600.0 V	0.1 V			
1000 V	1 V			
[1] All ac voltage ranges are specified from 1 % of range to 100 % of range. [2] Crest factor of ≤3 at 4000 counts, decreasing linearly to 1.5 at full scale. [3] For non-sinusoidal waveforms, add −(2 % of reading + 2 % full scale) typical, for crest factor up to 3. [4] Do not exceed 10⁷ V-Hz. [5] Full-time low-pass filter.				

DC Voltage, Continuity, Resistance, Diode Test, and Capacitance Measurements

Function	Range	Resolution	Measurement
$\overline{\text{mV}}$	600.0 mV	0.1 mV	$0.09 \% + 2$
$\overline{\text{V}}$	6.000 V	0.001 V	$0.09 \% + 2$
	60.00 V	0.01 V	
	600.0 V	0.1 V	
	1000 V	1 V	$0.15 \% + 2$
 	600 Ω	1 Ω	Meter beeps at $<25 \Omega$, beeper detects opens or shorts of 600 μs or longer.
Ω	600.0 Ω	0.1 Ω	$0.5 \% + 2$
	6.000 k Ω	0.001 k Ω	$0.5 \% + 1$
	60.00 k Ω	0.01 k Ω	
	600.0 k Ω	0.1 k Ω	
	6.000 M Ω	0.001 M Ω	
	50.00 M Ω	0.01 M Ω	$1.5 \% + 3$
Diode Test	2.000 V	0.001 V	$1 \% + 2$
⎓	1000 nF	1 nF	$1.2 \% + 2$
	10.00 μF	0.01 μF	
	100.0 μF	0.1 μF	
	9999 $\mu\text{F}^{[1]}$	1 μF	10 % typical
[1] In the 9999 μF range for measurements to 1000 μF , the measurement accuracy is $1.2 \% + 2$.			

AC Current with iFlex i2500

Range 1.0 A ac to 2500 A ac

Resolution

1.0 A to 999.9 A 0.1 A

1000 A to 2500 A 1 A

Measurement 3 % ± 5 digits (45 Hz to 500 Hz)

Crest Factor (50 Hz/60 Hz) add 2 % for C.F. >2

1100 A 3.0

1400 A 2.5

2500 A 1.42

Frequency Measurement

Range	Resolution	Measurement ^[1]
99.99 Hz	0.01 Hz	0.1 % + 1
999.9 Hz	0.1 Hz	0.1 % + 1
[1] Frequency is specified up to 500 Hz. Minimum sensitivity: · 5 % of range in V ac and V dc to 500 Hz · 2 Amps in A ac		

Input Characteristics

Function	Overload Protection	Input Impedance (nominal)	Common Mode Rejection Ratio (1 k Ω unbalance)		Normal Mode Rejection
$\overline{V}$	1100 V rms	>10 M Ω <100 pF	>120 dB at dc, 50 Hz or 60 Hz		>60 dB at 50 Hz or 60 Hz
$\tilde{V}$	1100 V rms	>10 M Ω <100 pF	>60 dB, dc to 60 Hz		
$\tilde{mV}$	1100 V rms	>10 M Ω <100 pF	>120 dB at dc, 50 Hz or 60 Hz		>60 dB at 50 Hz or 60 Hz
		Open Circuit Test Voltage	Full Scale Voltage		Typical Short Circuit Current
			To 6 M	50 M Ω	
Ω / $\text{--}\text{ }\text{--}$	1100 V rms	<2.7 V dc	<0.7 V dc	<0.9 V dc	<350 μ A
 / $\text{--}\text{ }\text{--}$	1100 V rms	<2.7 V dc	2.000 V dc		<1.1 mA

MIN MAX Recording

Function	Measurement
DC Functions	The specified accuracy of the measurement function ± 12 counts for changes >350 ms in duration.
AC Functions	The specified accuracy of the measurement function ± 40 counts for changes >900 ms in duration.

Infrared Camera

Temperature

Temperature Measurement Range-10 °C to +200 °C

Temperature Measurement Accuracy ± 5 °C or ± 5 %, whichever is greater, at 25 °C

Temperature Coefficient.....0.2 °C or 0.2 %, whichever is greater, for each °C from 25 °C

Emissivity.....0.95 fixed

Image Performance

Image Capture Frequency8 Hz

Detector Type.....Uncooled Vanadium Oxide

Thermal Sensitivity (NETD)..... ≤ 200 mK

Infrared Spectral Band7.5 μ m to 14 μ m

IR Image Resolution.....80 x 60 minimum

Field of View.....36 ° (w) x 27 ° (h)

Focus MechanismFixed focus

Distance-to-Spot162:1

Image Presentation

PaletteIronbow

Level and SpanAuto

Image Capture and Data Storage

Image CaptureImage available for review before a save

Storage MediumInternal memory, stores up to 100 images

Image Transfer.....Fluke Connect™ / SmartView®

File Formatis2

Required Equipment

Table 2 is a list of required equipment for performance tests and calibration adjustment.

Table 2. Required Equipment

Recommended Equipment	Measurement Function	Accuracy
5522A Multi-Product Calibrator (or equivalent)	DC Volts	10 mV to 600 V $\pm 0.02\%$
	AC Volts	6 mV to 600 V $\pm 0.25\%$ @ 45 Hz to 1 kHz
	Resistance	0 Ω to 5 M Ω $\pm 0.225\%$ 10 Ω to 30 M Ω $\pm 0.375\%$
	Capacitance	9 μ F to 900 μ F $\pm 0.475\%$
	Frequency	2 V @ 50 kHz $\pm 0.025\%$
4180 Precision IR Calibrator	-5 °C to +120 °C	$\pm 1\text{ }^{\circ}\text{C}$
4181 Precision IR Calibrator	35 °C to +190 °C	$\pm 1\text{ }^{\circ}\text{C}$
Test Lead (PN 650892)	2 mm to 4 mm	NA
Test Lead (PN 1903307)	NA	NA

Performance Tests

Warning

To prevent possible electrical shock, fire, or personal injury, do not start the performance test procedures unless the Product is fully assembled.

The performance tests verify the full operation of the Multimeter and measure the accuracy of each function against product specifications. If the Multimeter fails a part of the test, calibration adjustment or repair is necessary. See *Calibration Adjustment* on page 15.

Display Test

To verify that the display operates correctly:

1. Turn on the Multimeter.
2. Verify that all the icons show correctly on the display.

If not, repair is necessary. See *Contact Fluke* on page 1.

Backlight Test

To verify that the backlight operates correctly:

1. Turn on the Multimeter.
2. Push .

The backlight becomes brighter. If not, repair is necessary. See *Contact Fluke* on page 1.

Keypad Test

To verify that the keypad operates correctly:

1. Turn on the Multimeter.
2. Push each button separately.

Each time you push a button, the Multimeter beeps. If not, repair is necessary. See *Contact Fluke* on page 1.

Function Performance Tests

Before you do the function performance tests:

1. Make sure that you have the necessary equipment. See Table 2.
2. Make sure the battery is fully charged. Charge the battery if necessary. See *Battery Charge* on page 16.
3. Warm up the Calibrator as necessary. Refer to the Calibrator specifications for warm up time.
4. Let the temperature of the Multimeter become stable to room temperature.

Non-Current and Non-Temperature Test

For the non-current and non-temperature tests, make the connections shown in Figure 1.

1. Apply the input level for each step shown in Table 3.
2. Compare the indication on the Multimeter display with the display reading limits in Table 3.
3. If the display indication falls outside of the range shown in Table 3, calibration adjustment or repair is necessary. See *Calibration Adjustment* on page 15.

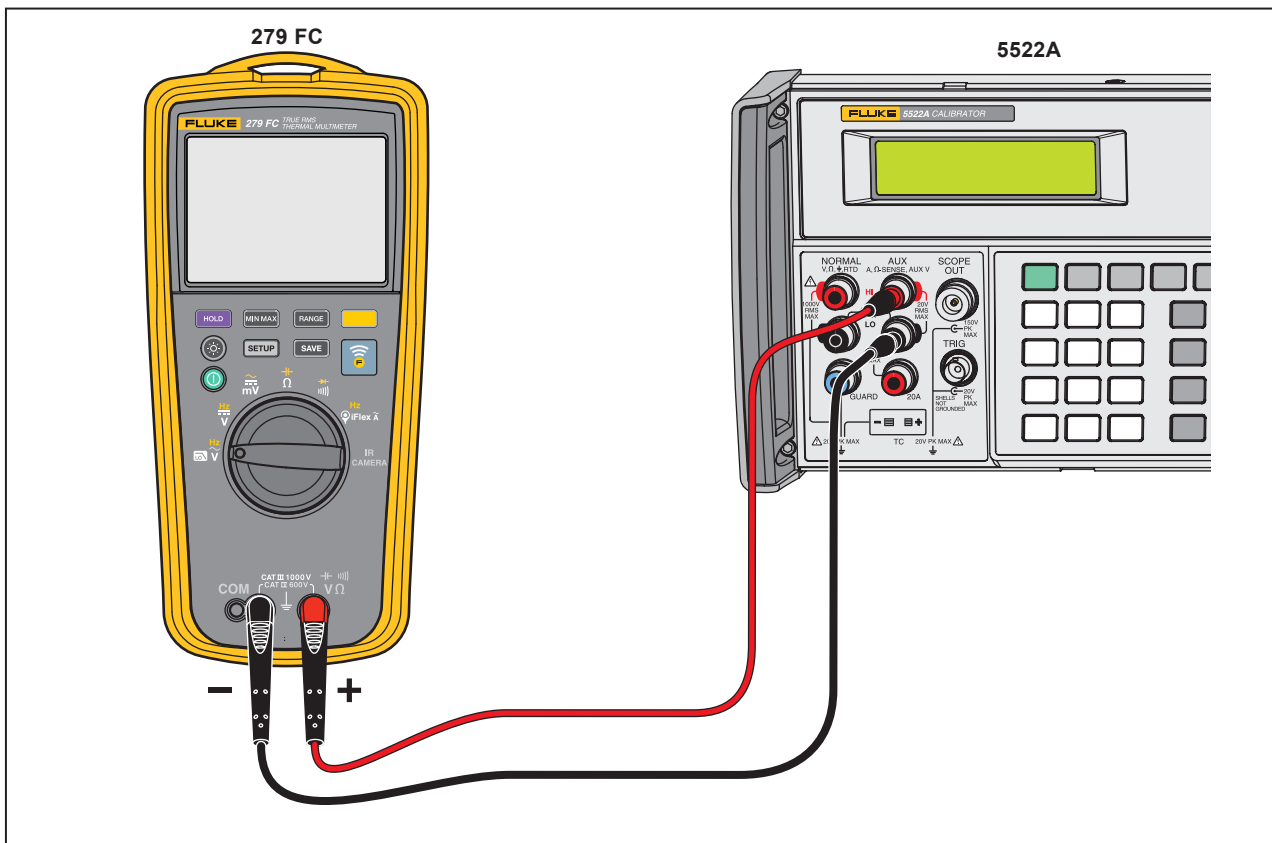


Figure 1. Performance Test Connections for Non-Current and Non-Temperature

Current Tests

For the current tests, make the connections shown in Figure 2.

1. Apply the input level for each step shown in Table 3.
2. Compare the indication on the Multimeter display with the display reading limits in Table 3.
3. If the display indication falls outside of the range shown in Table 3, calibration adjustment or repair is necessary. See *Calibration Adjustment* on page 15.

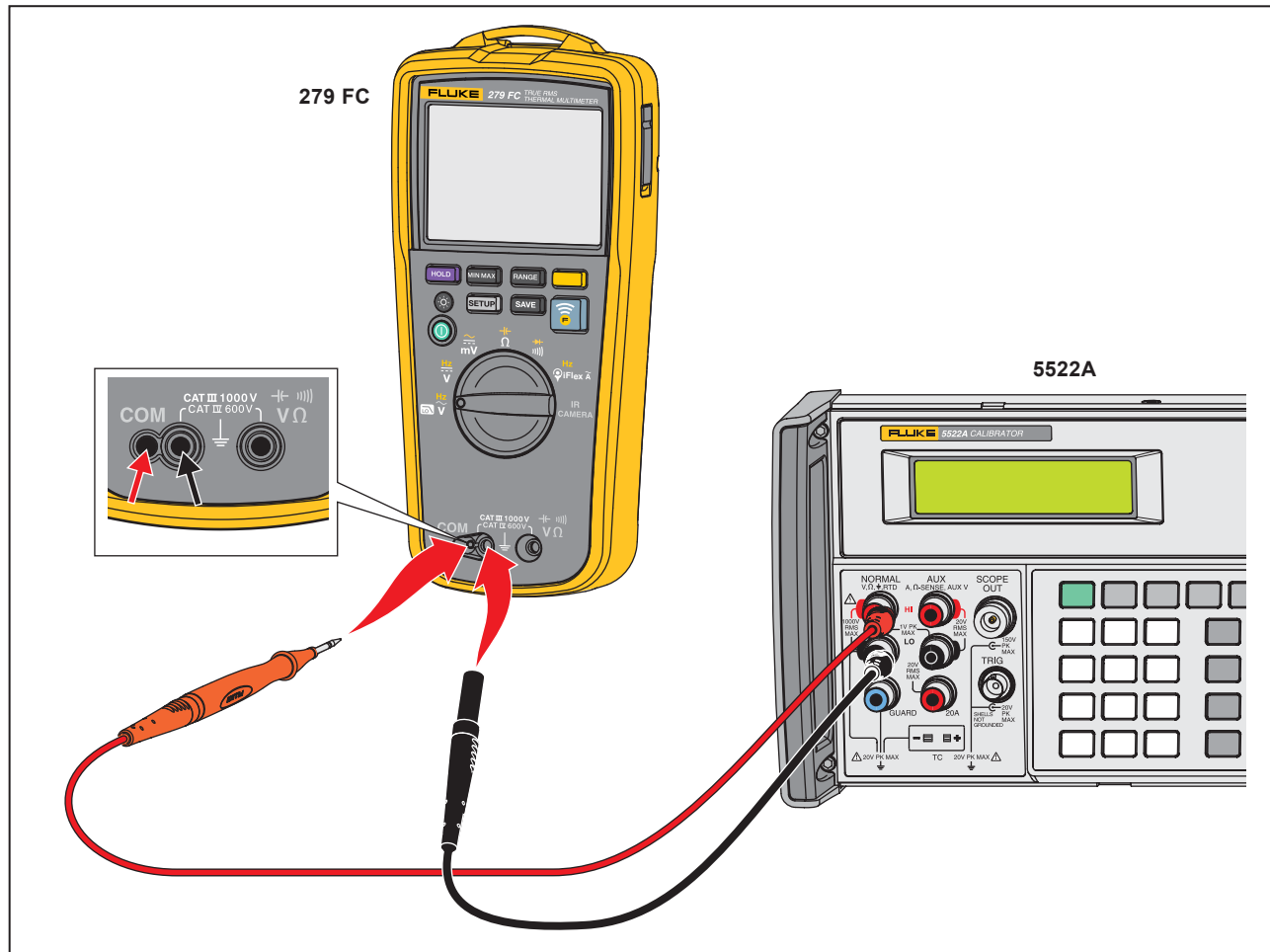


Figure 2. Performance Test Connections for Simulated Current

Ice Buildup and Purge Procedure (4180, below Dew Point)

⚠ Caution

For IR calibration with the Fluke 4180 IR Precision Calibrator, it is critical to assure that the target is free of any ice or moisture. Ice or moisture on the target changes the target emissivity and apparent temperature. If any ice or moisture (even though it is a slight amount) is on the target, the display temperature accuracy is invalid. In addition, ice buildup can damage the surface coating and cause the radiometric calibration to drift.

To avoid ice buildup, the 4180 has a cover with a purge inlet. Fluke recommends that the target cover be used at any set-point below the dew point. Depending on the ambient humidity of the environment where the target is used, the dew point can be as high as the ambient temperature of that environment.

Purge Procedure

The cover allows the target to be used at temperatures below the dew point. The target is less likely to form ice while the target is covered. The target cover has a purge inlet to further prevent ice buildup.

To use the purge:

1. Connect a 6 mm (0.25 in) outside diameter tube to the purge inlet on the target cover.

2. Use a dry gas for the purge.

The gas should have a dew point below -15 °C. Fluke recommends nitrogen or dried air. If the gas contains any water vapor or ice, moisture will form on the target. Use a relatively low flow rate of 2.4 to 4.8 liters/min (5 CFH to 10 CFH) for the purge.

Ice Buildup on the Target

If a small amount of ice forms:

1. Place the cover back on the target and allow the purge gas to sublime the ice.
2. If more ice forms or a purge is not available, change the instrument set-point to a temperature equal to or greater than 50 °C with the target uncovered.
3. Allow all ice to melt and all water to dry before returning target to use.

Caution

DO NOT wipe the target.

IR Temperature (IR Camera) Below Dew Point

Note

For IR temperature settings below dew point, do not leave the target uncovered for more than 5 s, since it can cause ice to form on the target. Temperature measurements above dew point do not require the use of cover.

To make measurements below the dew point:

1. Put the target cover in place.
2. Adjust the set-point to the desired temperature and allow the instrument to stabilize at that temperature.
3. Set IR calibrator emissivity setting to 0.95 to match the emissivity of the Multimeter IR camera settings.
4. Turn the control knob on the Multimeter to **IR CAMERA**.
5. Warm up the Multimeter for 10 minutes.
6. Remove the target cover when the target stabilizes.
7. Place the Multimeter 20 inches (51 cm) from the black body as shown in Figure 3.
8. Compare the indication on the Multimeter display with the display reading limits in Table 3.
9. Replace the target cover.

IR Temperature (IR Camera) Above Dew Point

To make measurements above dew point:

1. Remove the target cover.
2. Adjust to the set-point temperature and allow the instrument to stabilize at that temperature.
3. Place the Multimeter 20 in (51 cm) from the black body. See Figure 3.
4. Compare the indication on the Multimeter display with the display reading limits in Table 3.

If the display indication falls outside of the range shown in Table 3, repair is necessary.

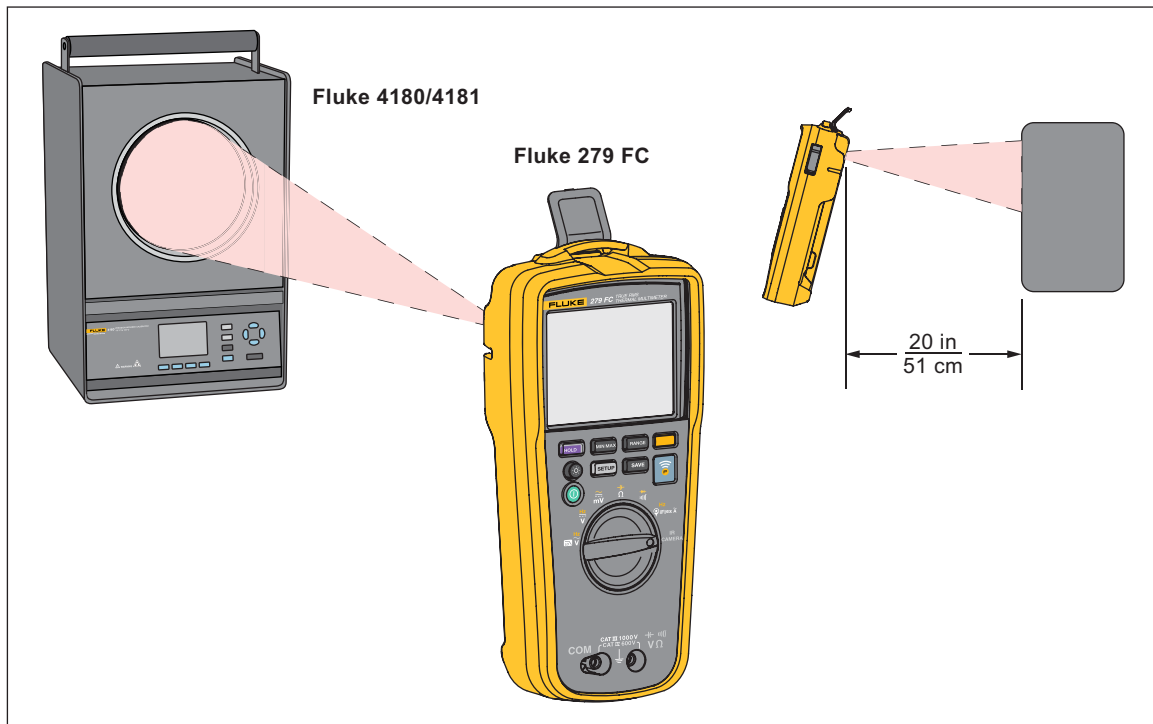


Figure 3. IR Camera Performance Test Configuration

Table 3. Performance Tests

Test (Control Knob Position)	Input	Lower Limit	Upper Limit	Units
$\frac{\text{Hz}}{\sim \text{V}}$ Volts AC	5 V, 45 Hz	4.947	5.053	V ac
	5 V, 500 Hz	4.247	5.753	
	3 V, 45 Hz	2.967	3.033	
	50 V, 45 Hz	49.47	50.53	
	50 V, 500 Hz	42.47	57.53	
	30 V, 45 Hz	29.67	30.33	
	500 V, 45 Hz	494.7	505.3	
	500 V, 500 Hz	424.7	575.3	
	1000 V, 45 Hz	987	1013	
$\frac{\text{Hz}}{\sim \text{V}}$ Volts AC, Frequency	1 V, 900 Hz	899.0	901.0	Hz
	5 V, 50 Hz	49.94	50.06	
$\frac{\text{Hz}}{\text{V}}$ DC Volts	0.01 V	0.008	0.012	V dc
	-5 V	-5.006	-4.994	
	50 V	49.94	50.06	
	10 V	9.97	10.03	
	-500 V	-500.6	-499.4	
	1000 V	997	1003	
$\frac{\sim}{\text{mV}}$ DC Millivolts	3 mV	2.8	3.2	mV dc
	500 mV	499.4	500.6	
	-500 mV	-500.6	-499.4	
$\frac{\sim}{\text{mV}}$ AC Millivolts	30 mV, 60 Hz	29.4	30.6	mV ac
	500 mV, 60 Hz	494.7	505.3	
	500 mV, 500 Hz	494.7	505.3	
$\frac{\sim}{\Omega}$ Ohms	6 Ω	5.8	6.2	Ω
	500 Ω	497.3	502.7	
	0.6 k Ω	0.596	0.604	k Ω
	5 k Ω	4.974	5.026	
	50 k Ω	49.74	50.26	
	500 k Ω	497.4	502.6	
	5 M Ω	4.974	5.026	M Ω
	50 M Ω	49.22	50.78	
$\frac{\sim}{\Omega}$ Capacitance	10 nF	8	12	nF
	900 nF	887	913	
	9 μ F	8.87	9.13	μ F
	90 μ F	88.7	91.3	
	900 μ F	887	913	
$\rightarrow$ Continuity	24 Ω	Beeper On		
	251 Ω	Beeper Off		
$\rightarrow$ Diode	1.95 V	1.928	1.972	V dc
$\frac{\text{Hz}}{\text{iFlex } \sim}$ Simulation	3.6 mV, 60 Hz	96.5	103.5	A ac
	36 mV, 60 Hz	965.0	1035	
	120 mV, 100 Hz	1940	2060	
IR CAMERA	-5 $^{\circ}$ C	-10	0	$^{\circ}$ C
	50 $^{\circ}$ C	+45	+55	
	180 $^{\circ}$ C	+171	+189	

Before Calibration Adjustment

Before you adjust the calibration, go to the Multimeter Calibration menu:

1. Push **SETUP** to open the Setup Menu.
2. Use **▲ ▼** to highlight **Calibration**.
3. Push **SELECT** (Select) to open the submenu.

To enter the password:

1. Push **SELECT**. The Calibration counter is shown, for example: **Cal Count = 4**.
2. Push **SELECT**. The display shows **Password: ????.** The factory default password is **1234**.

The top row of buttons corresponds to a number:

- **HOLD** = 1
- **MINMAX** = 2
- **RANGE** = 3
- **SELECT** = 4

As each number is entered, the cursor automatically moves to the next number.

3. To enter **1234**, push **HOLD**, **MINMAX**, **RANGE**, and **SELECT**.
4. Push **SELECT** (Start) to go to the first calibration point, **C-01**.

If you enter the correct password, **C-01** shows on the display. If the password is incorrect, **????** shows on the display and you must enter the password correctly to go to the first calibration point, **C-01**.

Change the Password

If you change the password and then lose it, see *Restore the Default Password* on page 14.

To change the password:

1. Push **SELECT**. The Calibration counter is shown, for example: **Cal Count = 4**.
2. Push **SELECT**. The display shows **????.**
3. Enter the correct password digits.
4. Push **RANGE** (Change). The display shows **----**.
5. Enter the new password digits.
6. Push **SELECT** (Save) to enter and store the new password.

Restore the Default Password

If the calibration password is lost, use this procedure to restore the default password (1234) manually:

⚠⚠ Warning

To prevent electric shock or personal injury, remove all input signals before you open the Product.

1. Before you start the procedure, make sure the beeper is turned on.
 - a. To open the Setup Menu, push **SETUP**.
 - b. Use the top row of buttons to control actions within the Setup Menu. These buttons correspond to the softkey labels that show on the display.
2. Turn off the Multimeter and remove all test leads.
3. Extend the tilt stand to expose the battery door.
4. Turn the battery-door latch until the unlock symbol (🔓) aligns with the arrow.
5. Lift off the battery door/tilt stand.
6. Remove the battery pack.
7. Remove the holster, starting at the lower left and right corners.
8. With a Phillips screwdriver, remove the bottom case screws (x4).
9. Remove the bottom case from the top case. Keep the PCA in the top case.
10. Connect the battery pack to the J9 battery connector on the PCA. The Multimeter turns on.
11. Short across the keypad (S2) on the PCA for >1 s until you hear a beep. See Figure 4. The default password is restored.
12. Remove the battery pack.
13. Replace the bottom case and screws (x4).
14. In this order, replace the holster, battery pack, and battery door/tilt stand.

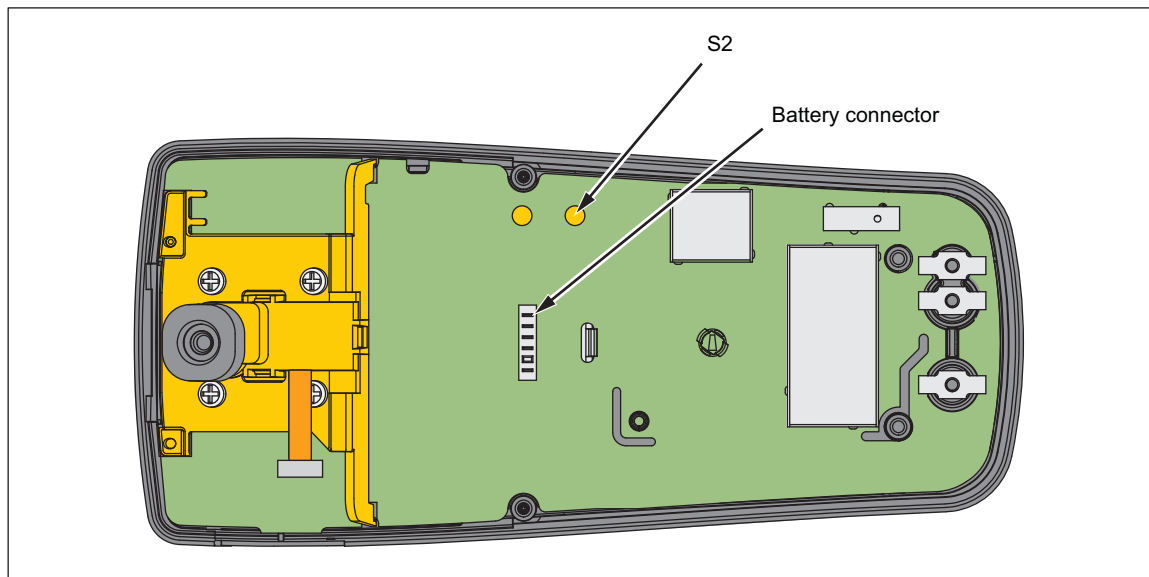


Figure 4. Calibration Password Reset

Calibration Adjustment

The Multimeter features closed-case calibration adjustment and uses known reference sources. The multimeter measures the applied reference source, calculates correction factors, and stores the correction factors in nonvolatile memory.

Note

No adjustment steps are required for temperature measurements.

If the Multimeter fails any of the performance tests, do the Calibration Adjustment procedure.

To adjust:

- For each step, select the control knob position and apply the input value to the terminals as indicated in Table 4.

Note

Some adjustment steps require an additional wait time after the calibrator settles, as noted in Table 4.

- Push and hold **HOLD** to show the measurement.
This measurement is not calibrated so it may not match the input value. This is normal.
- Push and hold **MIN MAX** to display the target input value.
- After each input value is applied, push  to accept the value and proceed to the next step.
- After you push , wait until the step number advances before you change the Calibrator source or turn the Multimeter control knob. An adjustment step can take several seconds to execute before the next step is ready.

Note

If the control knob is not in the correct position or the measured value is not within the anticipated range of the input value for a given step:

- Display shows “- - -”.
- Multimeter emits a double beep
- Softkeys do not show the reading and required input values
- Procedure does not continue to the next step when you push 

- After the final step, the display shows **End** to indicate that the calibration adjustment is complete.
- Push  to return to normal operation.

Table 4. Calibration Adjustment

Calibration Step	Control Knob Position	Jacks	Source Calibrator
C-01		see Figure 1	0 V, 0 Hz
C-02			300 mV, 0 Hz
C-03			60 mV, 0 Hz
C-04			-300 mV, 0 Hz
C-05			600 mV, 60 Hz
C-06			6 V, 0 Hz
C-07			60 V, 0 Hz
C-08			600 V, 0 Hz
C-09			60 V, 60 Hz
C-10			600 Ω
C-11			6 kΩ
C-12			60 kΩ
C-13			600 kΩ
C-14			6 MΩ
C-15			2 V, 0 Hz
C-16 ^[1]		see Figure 2	12 mV, 100 Hz
C-17 ^[1]			120 mV, 100 Hz

[1] Wait 5 s after the Calibrator settles.

[1] Wait 5 s after the Calibrator settles.

Maintenance

Warning

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

- Disconnect the battery charger and move the Product or battery to a cool, non-flammable location if the rechargeable battery becomes hot ($>50\text{ }^{\circ}\text{C}$) during the charge period.
- Replace the rechargeable battery after 5 years of moderate use or 2 years of heavy use. Moderate use is defined as recharged twice a week. Heavy use is defined as discharged to cutoff and recharged daily.
- Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid.
- Do not short the battery terminals together.
- Do not disassemble or crush battery cells and battery packs.
- Do not put battery cells and battery packs near heat or fire. Do not put in sunlight.

Clean the case with a damp cloth and weak detergent. Do not use a solvent or cleaners with abrasives. Dirt or moisture in the terminals can cause incorrect measurements.

To clean the terminals:

1. Turn off the Multimeter and remove all test leads.
2. Shake the Multimeter to remove any possible debris from the terminals.
3. Soak a clean swab with weak detergent and water.
4. Move the swab around in each terminal.
5. Dry each terminal with canned air to push the water and detergent out of the terminals.

Battery Charge

The battery pack must be removed and charged outside of the Multimeter. See Figure 5.

To remove and charge the battery pack:

1. Turn off the Multimeter and remove all test leads.
2. Extend the tilt stand to expose the battery door.
3. Turn the battery-door latch until the unlock symbol () aligns with the arrow.
4. Lift off the battery door/tilt stand.
5. Remove the battery pack and recharge.

After battery is fully recharged :

1. Place the battery pack into the battery compartment.
2. Install the battery door/tilt stand.
3. Turn the battery-door latch until the locked symbol (🔒) aligns with the arrow.

The display shows an icon for the battery status:

 - 100 % charge

 - 50 % charge

 - 0 % charge

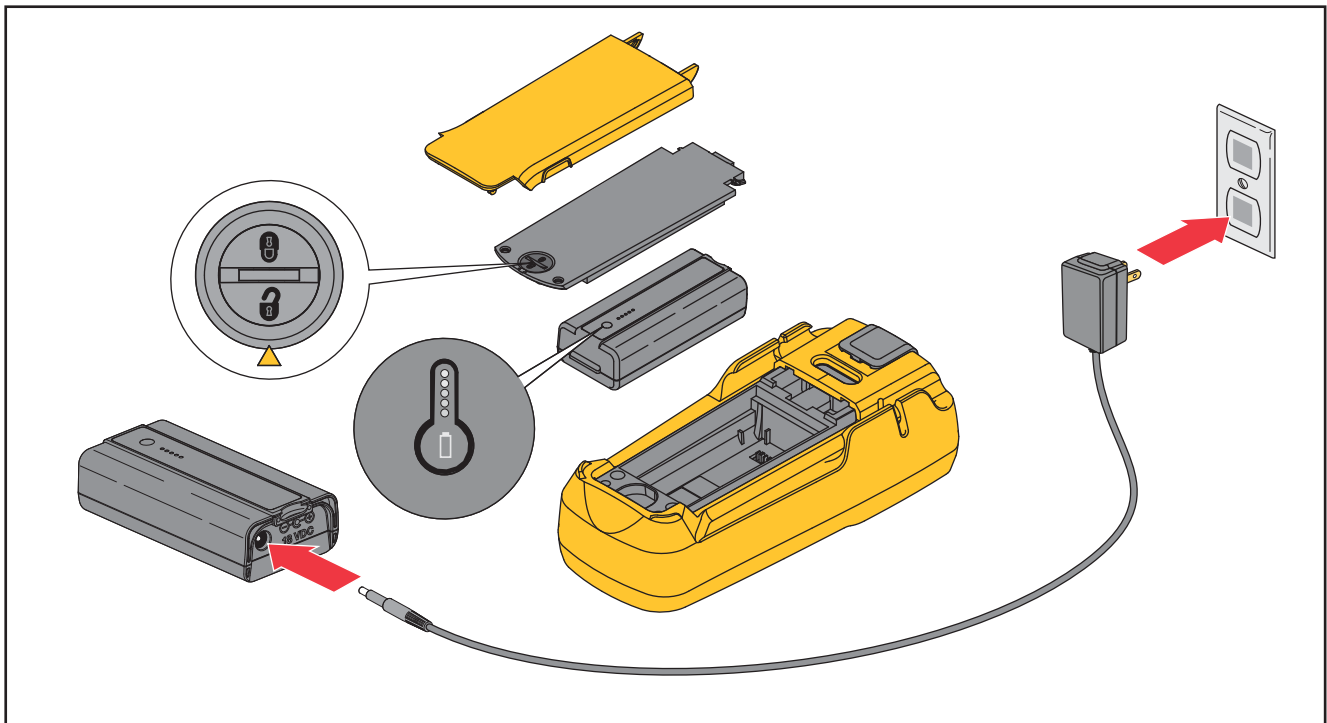
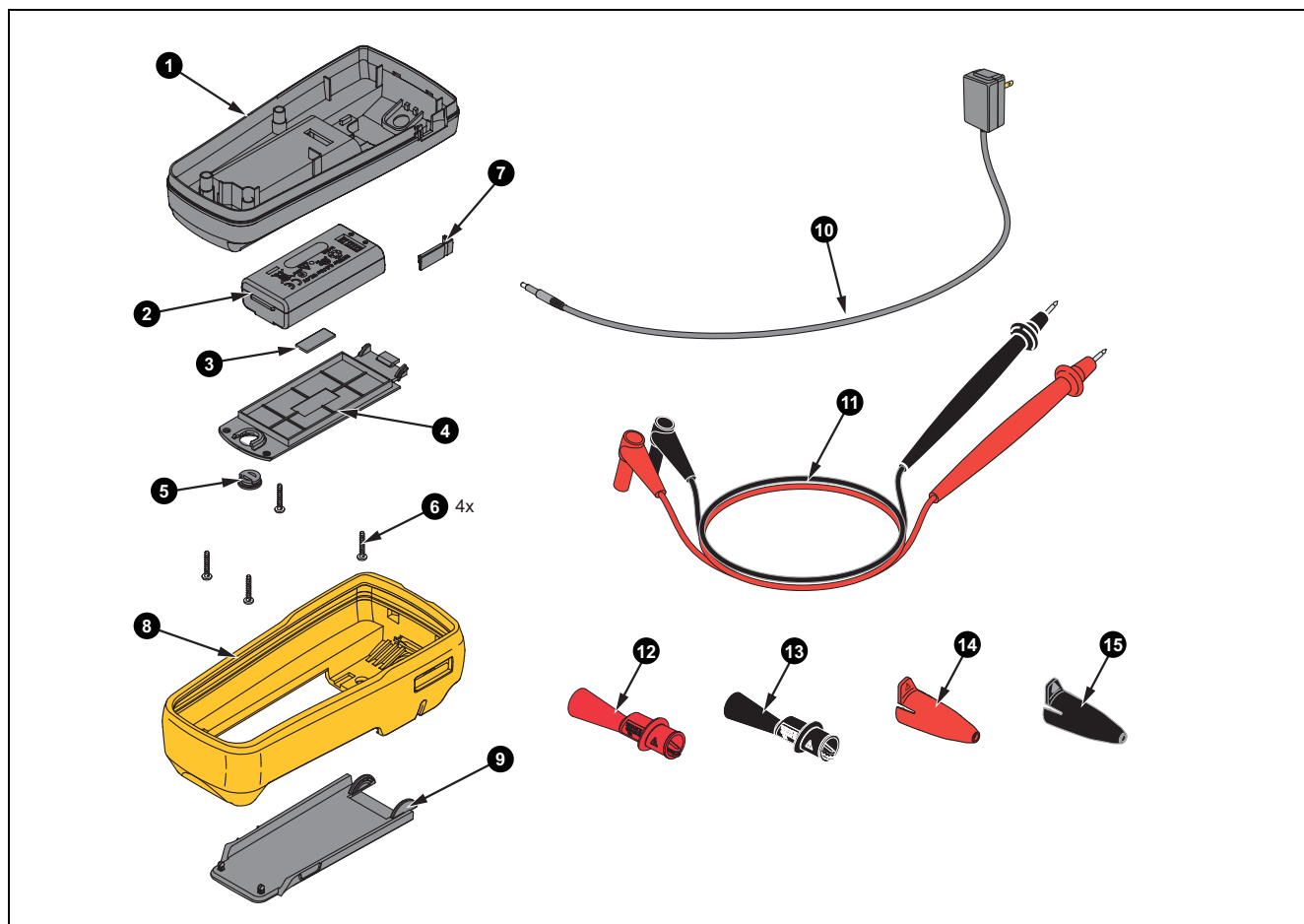


Figure 5. Battery Charge

User-Replaceable Parts

User-replaceable parts are shown in Table 5. For more information about parts or to order, see *Contact Fluke* on page 1.

Table 5. Replacement Parts



Item	Description	Fluke Part or Model Number
1	Case Bottom	4693448
2	7.4 V 3000 mAh Rechargeable Lithium-Ion Battery	4398817
3	Battery Sponge	4381848
4	Battery Door	4693466
5	1/2-turn Fastener	2278155
6	Case Bottom Screws, 5-14 x 3/4" (qty 4)	832246
7	USB Connector Cover	4724737
8	Holster	4693482
9	Tilt Stand	4693475
10	Power Supply with Mains Adapters and Universal Wall Mount	4760480
11	TL175 Test Leads	855742
12	AC175 Alligator Clip, Red	4239050
13	AC175 Alligator Clip, Black	4239092
14	Probe Cap, Red	3986579
15	Probe Cap, Black	3986568