FLUKE®

1630-2/1630-2 FC

Earth Ground Clamp

Calibration Manual

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Introduction

⚠⚠ Warning

To prevent electric shock or personal injury, do not perform the calibration verification tests or calibration procedures described in this manual unless you are qualified to do so. The information provided in this manual is for the use of qualified personnel only.

The Fluke 1630-2/1630-2FC Earth Ground Clamp (the Product or Clamp) is a hand-held, battery-operated clamp that measures the ground resistance without auxiliary ground rods and AC leakage current. The Clamp is used in multi-grounded systems without disconnecting the ground under test.

For complete operating instructions, refer to the *Users Manual* at www.fluke.com.

How to Contact Fluke

Fluke Corporation operates in more than 50 countries worldwide. For more contact information, go to our website: www.fluke.com.

To register your product, view, print, or download the latest manual or manual supplement, go to www.fluke.com.

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Safety Information

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.

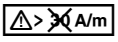
⚠⚠ Warning

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

- **Carefully read all instructions.**
- **Read all safety information before you use the Product.**
- **Do not alter the Product and use only as specified, or the protection supplied by the Product can be compromised.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Before each use, examine the Product. Look for cracks or missing pieces of the clamp housing or output cable insulation. Also look for loose or weakened components. Carefully examine the insulation around the jaws.**
- **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.**
- **Use Product-approved measurement category (CAT), voltage, and amperage rated accessories (probes, test leads, and adapters) for all measurements.**
- **Do not use the Product if it is altered or damaged.**
- **Disable the Product if it is damaged.**
- **Do not use the Product if it operates incorrectly.**
- **Do not use the Product above its rated frequency.**
- **Limit operation to the specified measurement category, voltage, or amperage ratings.**
- **Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Hold the Product behind the tactile barrier.**
- **The battery door must be closed and locked before you operate the Product.**
- **Replace the batteries when the low battery indicator shows to prevent incorrect measurements.**
- **Remove the batteries if the Product is not used for an extended period of time, or if stored in temperatures above 50 °C. If the batteries are not removed, battery leakage can damage the Product.**
- **Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Repair the Product before use if the battery leaks.**
- **Use only specified replacement parts.**
- **Have an approved technician repair the Product.**
- **Remove the input signals before you clean the Product.**
- **Do not operate within external low frequency magnetic fields >30A/m.**

Symbols used on the Product and in this manual are explained in Table 1.

Table 1. Symbols

Symbol	Description
	Consult user documentation.
	WARNING. RISK OF DANGER.
	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	Application around and removal from uninsulated hazardous live conductors is permitted.
	Double Insulated
	Do not operate within external low frequency magnetic fields >30A/m.
	Battery
	Conforms to relevant South Korean EMC standards.
	Conforms to relevant Australian EMC standards.
	Certified by CSA Group to North American safety standards.
	Conforms to European Union directives.
	China metrology certification mark for measuring instruments manufactured in the People's Republic of China (PRC).
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.
	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.

Electrical Specifications

Maximum Voltage to Earth Ground . . . . . 1000 V

Battery Type . . . . . AA alkaline IEC LR6 (x4)

Battery Life . . . . . >15 hours in Ground Resistance measurement mode, with backlight turned off, and RF mode turned off

Frequency Range

Filter OFF . . . . . 40 Hz to 1 kHz

Filter ON . . . . . 40 Hz to 70 Hz

Ingress Protection . . . . . IEC 60529: IP30 with jaw closed

LCD

Digital Reading . . . . . 9999 counts

Refresh Rate 4/second

Temperature

Operating . . . . . -10 °C to +50 °C

Storage . . . . . -20 °C to +60 °C

Operating Humidity . . . . . Non condensing (<10 °C)
≤90 % RH (at 10 °C to 30 °C)
≤75 % RH (at 30 °C to 40 °C)
≤45 % RH (at 40 °C to 50 °C)
(noncondensing)

Altitude

Operating . . . . . 2000 m

Storage . . . . . 12 000 m

Reference Temperature . . . . . 23 °C ±5 °C (73 °F ±9 °F)

Temperature Coefficient . . . . . 0.15 % x reading/ °C (<18 °C or >28 °C)

Overload Indication . . . . . OL

Data Logging Capacity . . . . . >2000 data points

Data Logging Interval . . . . . 1 second to 59 minutes and 59 seconds

Safety

General . . . . . IEC 61010-1: Pollution Degree 2
IEC 61557-1

Measurement . . . . . IEC 61010-2-032: CAT IV 600 V / CAT III 1000 V

Current Clamp for Leakage Current Measurements . . . . . IEC 61557-13: Class 2, ≤30 A/m

Resistance to Earth . . . . . IEC 61557-5

Effectiveness of the Protective Measures . . . . . IEC 61557-16: cutoff frequency 20 kHz (-3 dB)

Electromagnetic Compatibility (EMC)

International . . . . . IEC 61326-1: Portable Electromagnetic Environment
CISPR 11: Group 1, Class B, 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 B: Equipment is suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

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 Broadcast & Communications 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.

Wireless Radio

Frequency Range . . . . . 2412 MHz to 2462 MHz

Output Power . . . . . <10 mW

Radio Frequency Certification . . . . . FCC ID:T68-FBLE IC:6627A-FBLE

General Specifications

Conductor Size . . . . . 40 mm approximately
Dimensions (L x W x H) . . . . . 283 mm x 105 mm x 48 mm
Weight . . . . . 880 g

Ground Loop Resistance

Frequency of measurement: 3.333 kHz.

Range	Accuracy [1] ± (% of reading + Ω)
0.025 Ω to 0.249 Ω	1.5 % + 0.020 Ω
0.250 Ω to 0.999 Ω	1.5 % + 0.050 Ω
1.000 Ω to 9.999 Ω	1.5 % + 0.100 Ω
10.00 Ω to 49.99 Ω	1.5 % + 0.30 Ω
50.00 Ω to 99.99 Ω	1.5 % + 0.50 Ω
100.0 Ω to 199.9 Ω	3.0 % + 1.0 Ω
200.0 Ω to 399.9 Ω	5.0 % + 5.0 Ω
400 Ω to 599 Ω	10.0 % + 10 Ω
600 Ω to 1500 Ω	20.00 %
[1] Loop resistance with no inductance, conductor centered.	

AC Leakage Current mA

True rms, crest factor CF ≤3

Range	Resolution	Accuracy [1] ± (% of reading + mA)
0.200 mA to 3.999 mA	1 µA	2.0 % + 0.05 mA
4.00 mA to 39.99 mA	10 µA	2.0 % + 0.03 mA
40.0 mA to 399.9 mA	100 µA	2.0 % + 0.3 mA
0.400 A to 3.999 A	1 mA	2.0 % + 3 mA
4.00 A to 39.99 A	10 mA	2.0 % + 30 mA
[1] Applies to signal frequency: • 40 Hz to 1 kHz with Filter set to OFF • 40 Hz to 70 Hz with Filter set to ON		

Operational Error for Ground Resistance Measurement

Parameter	Specification	Typical	Max[1]
Intrinsic uncertainty	IEC 61557-5 A Reference conditions	2.11 %	4.90 %
Conductor Position	IEC 61557-5 E1 ±30°	0.00 %	0.00 %
Battery Voltage	IEC 61557-5 E2 4.4 V to 6.4 V	0.00 %	0.00 %
Temperature	IEC 61557-5 E3 -10 °C to 50 °C	4.75 %	10.28 %
Series interference voltage	IEC 61557-5 E4 3 V rms 400 Hz, 60 Hz, 50 Hz, 16-2/3 Hz, and ±3 V dc	2.45 %	5.35 %
Uncertainty	IEC 61557-5 B	8.26 %	18.23 %

[1] Confidence level: 95 %.

Operational Error for Leakage Current Measurement

Parameter	Specification	Typical	Max[1]
Intrinsic uncertainty	IEC 61557-13 A Reference conditions	0.06 %	0.20 %
Conductor Position	IEC 61557-13 E1 ±30°	0.06 %	0.20 %
Battery Voltage	IEC 61557-13 E2 4.4 V to 6.4 V	0.07 %	0.20 %
Temperature	IEC 61557-13 E3 -10 °C to 50 °C	0.25 %	0.47 %
Distortion	IEC 61557-13 E9	0.10 %	0.25 %
Magnetic Field	IEC 61557-13 E11 (15 Hz to 400 Hz) 10A/m Class 3 30A/m Class 2	 2.58 % 7.55 %	 4.87 % 13.45 %
Load Current	IEC 61557-13 E12 40 Arms max (50 Hz and 60 Hz)	4.72 %	9.02 %
Touch Current	IEC 61557-13 E13 CAT III 1000 V/ 60 Hz	0.06 %	0.20 %
Frequency	IEC 61557-13 E14 40 Hz to 1 kHz	0.40 %	0.95 %
Repeatability	IEC 61557-13 E15	0.06 %	0.20 %
Uncertainty	IEC 61557-13 B 10 A/m Class 3 30 A/m Class 2	 6.28 % 12.06 %	 10.32 % 18.87 %

[1] Accuracy guaranteed for 50 Hz and 60 Hz. Confidence level: 95 %.

Equipment and Environment

For the ac leakage current verification, adjustment, and performance test, use the Fluke 5522A with a 2-turn current loop. Connect the AUX terminal or 20 A terminal to the LO terminal. To short the two terminals, use a conductor with two banana jacks at both ends.

For the Ω verification, adjustment, and performance test, use the precision decade resistance box with a 1-loop short copper wire to form a resistance loop.

Table 2 is a list of specifications.

Table 2. Environment Specifications

CAL Point	Accuracy			Unit	Minimum Required Characteristics	IET 1433-20
0.100	1.5 %	0.020	0.022	Ω	5.38 %	2.01 %
0.250	1.5 %	0.020	0.024		2.38 %	0.81 %
0.500	1.5 %	0.050	0.058		2.88 %	0.41 %
1.000	1.5 %	0.050	0.065		1.63 %	0.21 %
2.000	1.5 %	0.100	0.130		1.63 %	0.11 %
5.000	1.5 %	0.100	0.175		0.88 %	0.05 %
10.00	1.5 %	0.10	0.25		0.63 %	0.03 %
20.00	1.5 %	0.30	0.6		0.75 %	0.02 %
50.00	1.5 %	0.30	1.05		0.53 %	0.01 %
100.0	1.5 %	0.50	2.0		0.50 %	0.01 %
200.0	3 %	1.0	7.0		0.88 %	0.01 %
400	5 %	5.0	25		1.56 %	0.01 %
600	10 %	10	70		2.92 %	0.01 %
1000	20 %	0	200		5.00 %	0.01 %

Setup

Before you start the verification procedures or make calibration adjustments, refer to this section for the equipment, system, and setup requirements.

See Table 3 for a list of requirements for the verification tests and calibration adjustment.

Table 3. Equipment Requirements

Equipment	Description	Recommended Model	Used on:	
			Verification Tests	Calibration Adjustment
Current Calibrator	Calibrator	Fluke 5522A	X	X
Current Wired Coil	2-Turn Loop insulated copper wire		X	X
OHM Calibrator	Precision decade resistance box	IET 1433-20 or equivalent	X	X
OHM Wired Coil	1-Loop short copper wire		X	X

Performance Verification

Before you do the verification:

1. Make sure that you have the required equipment. See Table 4.
2. Make sure the Product battery is good and replace it if necessary.
3. Warm up the Calibrator as necessary. Refer to its specifications.
4. Let the temperature of the unit under test (UUT) become stable to room temperature.
5. Use the loop of wire to apply signals to the 1630-2. The loop should have a straight section that goes through the jaws. A 2-foot section of 16-gauge copper wire makes a good, stable loop.

Note

The loop has resistance that will have to be included in the applied resistance. The 2-foot section of 16-gauge copper wire adds about 0.01 Ω. Make a 4-wire measurement of the loop to include in the applied resistance.

Table 4. Performance Test Points for Resistance

Function	Test Point		Applied Resistance	Display Reading	
	Value	Unit		Lower Limit	Upper Limit
OHM	0.080	Ω	0.080 – Loop Ω	0.059	0.101
	0.120		0.120 – Loop Ω	0.098	0.142
	0.230		0.230 – Loop Ω	0.207	0.253
	0.280		0.280 – Loop Ω	0.226	0.334
	0.450		0.450 – Loop Ω	0.393	0.507
	0.550		0.550 – Loop Ω	0.492	0.608
	0.900		0.900 – Loop Ω	0.837	0.964
	1.100		1.100 – Loop Ω	0.984	1.217
	1.800		1.800 – Loop Ω	1.673	1.927
	2.300		2.300 – Loop Ω	2.166	2.435
	4.500		4.500 – Loop Ω	4.333	4.668
	5.500		5.500 – Loop Ω	5.318	5.683
	8.000		8.000 – Loop Ω	7.780	8.220
	11.00		11.00 – Loop Ω	10.54	11.47
	18.00		18.00 – Loop Ω	17.43	18.57
	23.00		23.00 – Loop Ω	22.36	23.65
	40.00		40.00 – Loop Ω	39.10	40.90
	60.00		60.00	58.60	61.40
	90.00		90.00	88.15	91.85
	120.0		120.0	115.4	124.6
	180.0		180.0	173.6	186.4
	220.0		220.0	204.0	236.0
	360.0		360.0	337.0	383.0
	450		450	395	505
	550		550	485	615
	700		700	560	840
	900		900	720	1080
	1300		1300	1040	1560

6. Use the 2-turn coil connected to the 5522 for the current steps. See Table 5.

Table 5. Performance Test Points for Current

Function	Test Point		Calibrator Output	Display Reading	
	Value	Unit		Lower Limit	Upper Limit
Current	0.200	mA, 60 Hz	0.100	0.146	0.254
	0.380		0.190	0.3224	0.4376
	0.440		0.220	0.3812	0.4988
	3.800		1.900	3.674	3.926
	4.40		2.2	4.28	4.52
	38.00		19.0	37.21	38.79
	44.0		22.0	42.8	45.2
	380.0		190.0	372.1	387.9
	0.440	A, 60 Hz	0.220	0.428	0.452
	3.800		1.900	3.721	3.879
	4.40		2.20	4.28	4.52
	38.00		19.00	37.21	38.79

Calibration Procedure

Before you do the verification:

1. Make sure that you have the required equipment. See Table 3.
2. Make sure the Product battery is good or replace it if necessary.
3. Warm up the Calibrator as necessary. Refer to its specifications.
4. Let the temperature of the unit under test (UUT) become stable to room temperature.

To do the verification:

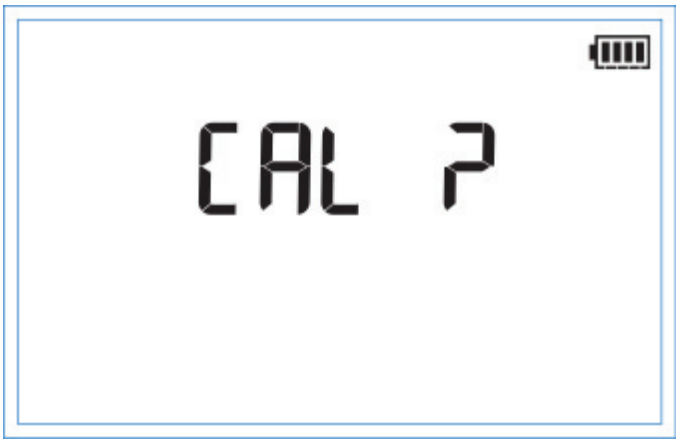
1. Power on 1630-2 FC.
2. Open the clamp and make sure the surfaces fit together properly and are free of dust, dirt, or any foreign substances. Then close the clamp. Do not attach the Clamp to a conductor or open the clamp during self-calibration.
3. Push and hold ⏻ >2 s to turn on the Clamp. The meter will enter self-calibration mode when power on. Self-calibration mode ends in 5 seconds. After self-calibration, the meter enters measurement mode.

To enter calibration mode:

1. In measurement mode, push and hold ENTER.
2. Push and hold SETUP and A/Ω until the CAL screen shows on the display.
3. To continue in calibration mode, push ENTER to confirm.

   The first calibration step shows in the display.

4. Push A/Ω to cancel calibration and go back to the measurement mode.

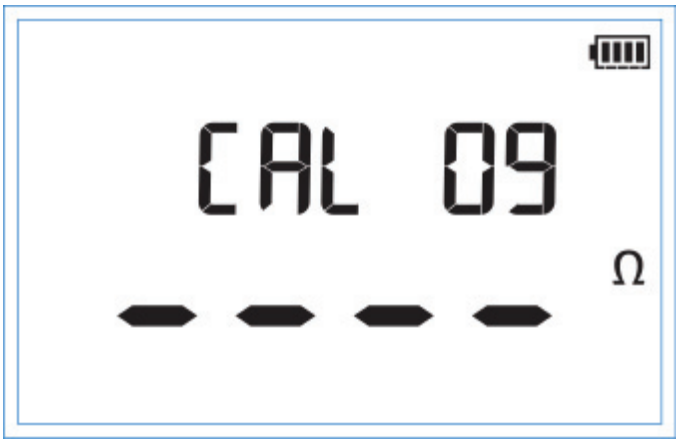


To confirm calibration points:

1. At each calibration step, apply the input signal according to the indication on the lower portion of the screen. Table 6 is a list of the calibration points:
   - 8 calibration points for ac leakage current verification and adjustment
   - 15 calibration points for Ω verification and adjustment

   If the screen shows "- - - -", do not apply any signal to jaw, attach the Clamp to a conductor, or open the clamp.





2. At the next calibration step, if the screen shows "mA" and "AC", apply an AC current to jaw with a 2-turn current loop. See Figure 1. The calibrator output value should be half of the value shown on the screen. For example, the calibrator output should be 0.100 mA for the calibration point shown on the screen below. The current frequency should be 60 Hz.



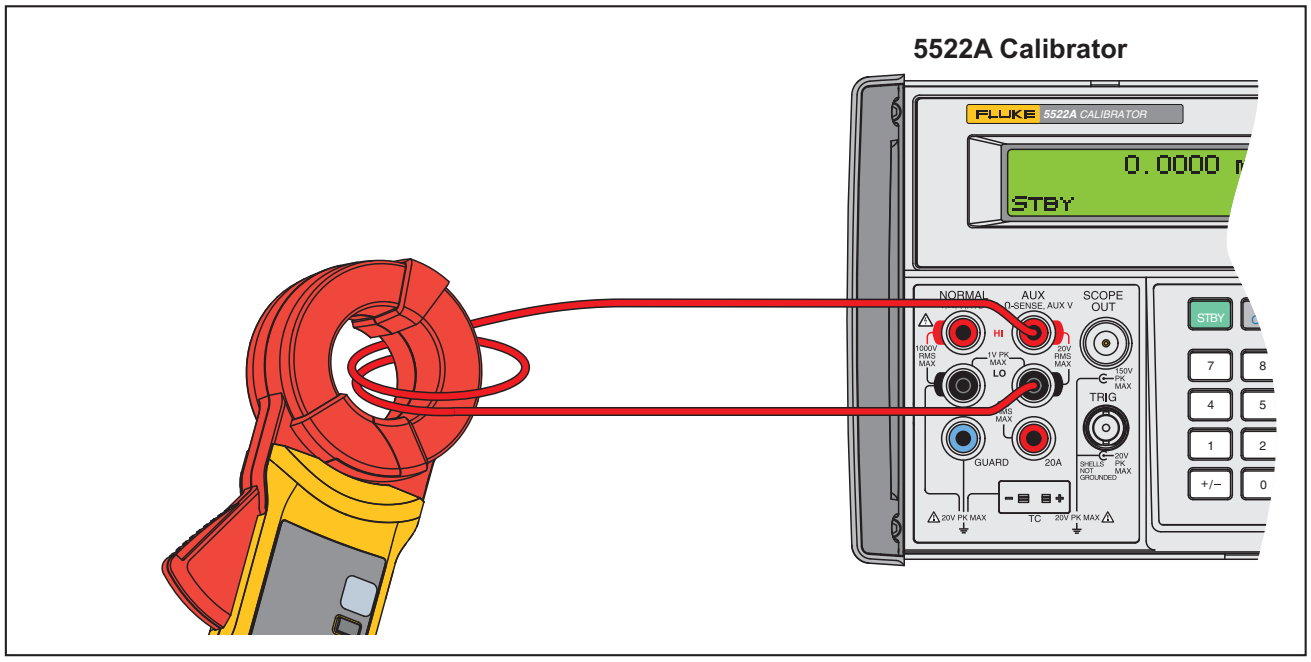


Figure 1. Calibration with 2-Turn Current Loop

3. At the next calibration step, if the screen shows Ω, apply a resistance loop to the jaw with the precision decade resistance box an a 1-loop short copper wire. See Figure 2. The applied resistance value should be the same on the calibrator as the value on the screen below.



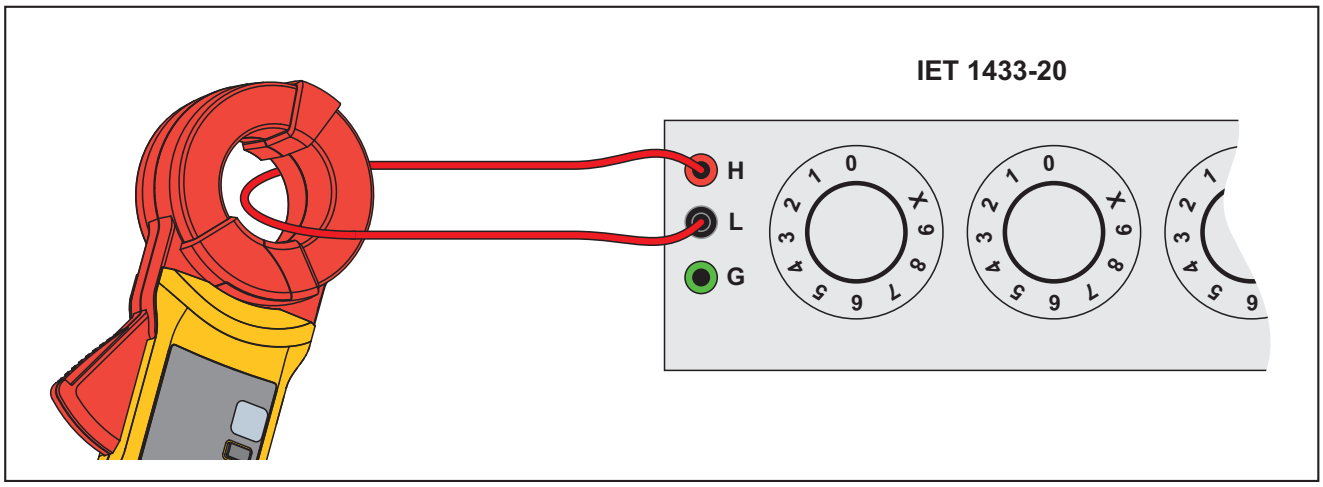
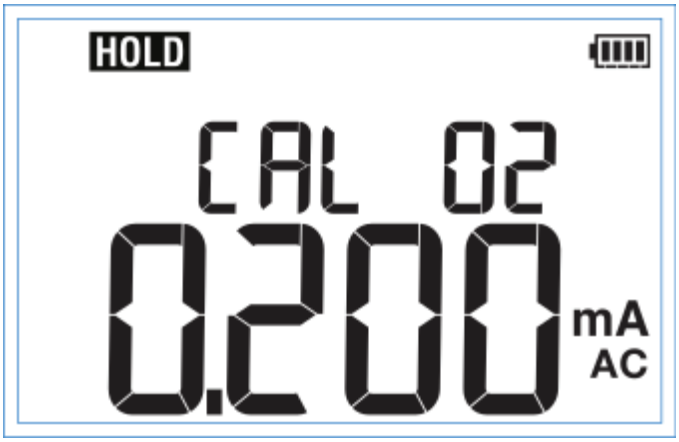


Figure 2. Calibration with 1-Loop Short Copper Wire

4. When calibration signal is ready, push ENTER to confirm the current calibration point.
   As the system calibrates, HOLD shows on the the screen.

   When HOLD symbol turns off, the next calibration point shows on the display.





Finish Calibration:

When calibration is successful, the Clamp exits the calibration mode and goes to the measurement mode.

Table 6. Calibration Points

Step	Display			Calibrator Output Value		
1	CAL 01	---	mA AC			
2	CAL 02	0.200		0.100	mA	60 HZ
3	CAL 03	0.400		0.200		
4	CAL 04	4.000		2.000		
5	CAL 05	40.00		20.00		
6	CAL 06	400		200.0		
7	CAL 07	4000		2000		
8	CAL 08	40.00	A AC	20.00	A	
9	CAL 09	---	Ω			
10	CAL 10	0.100		0.100	Ω	
11	CAL 11	0.250		0.250		
12	CAL 12	0.500		0.500		
13	CAL 13	1.000		1.000		
14	CAL 14	2.000		2.000		
15	CAL 15	5.000		5.000		
16	CAL 16	10.00		10.00		
17	CAL 17	20.00		20.00		
18	CAL 18	50.00		50.00		
19	CAL 19	100		100.0		
20	CAL 20	200		200.0		
21	CAL 21	400		400		
22	CAL 22	600		600		
23	CAL 23	1000		1000		

Maintenance

⚠⚠ Warning

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

- **Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Repair the Product before use if the battery leaks.**
- **Use only specified replacement parts.**
- **Have an approved technician repair the Product.**
- **Remove the input signals before you clean the Product.**
- **Do not use the HOLD function to measure unknown potentials. When HOLD is turned on, the display does not change when a different potential is measured.**

Clamp Care

⚠ Caution

To avoid damaging the Clamp, do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastics used in the Clamp.

Clean the case with a damp cloth and weak detergent. Do not use a solvent or cleaners with abrasives.

Battery Replacement

⚠⚠ Warning

To prevent false readings that could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator (▭) appears.

To replace the battery:

1. Push and hold ⏻ >2 s to turn off the Clamp.
2. See Table 7 for details on how to replace the battery.

Replacement Parts

Replacement parts are listed in Table 7. See also Figure 3. To order parts, see *How to Contact Fluke*.

Table 7. Replacement Parts

Item	Description	Fluke Part or Model Number
1	Decal, Basic	4778372
	Decal, FC	4778385
2	Sub Assembly, Top Case	part of item 10
3	Keypad, Hold, Basic	4778313
	Keypad, Hold, FC	4778324
4	Rubber, LCD	4778349
5	LCD Subassembly For Service	4902813
6	Rubber, PCA	4778336
7	Copper Foil, PCA, Top	part of item 8
8	PCA Subassembly for Service, 1630-2 FC	4902795
	PCA Subassembly for Service, 1630-2	4902808
9	Copper Foil, PCB, Bottom	part of item 8
10	Jaw Subassembly, with Top Case For Service, Non-FC	4902824
	Jaw Subassembly, with Top Case For Service, FC	4902836
11	Screw, M3, 13.5 mm, Pan, Phillips, Steel, Black	2388382

Table 7. Replacement Parts (cont.)

Item	Description	Fluke Part or Model Number
12	Screw, M3x0.5, 5 mm, Pan, Phillips	2032811
13	Screw, M2.2x0.8, 5 mm, Pan, Phillips	2032777
14	Cover, Slider, Trigger Lock	4778360
15	Slider, Trigger Lock	4778296
16	Spring, Compress, Slider	4717521
17	Case, Bottom	4778281
18	Decal, Operation Class	4787109
19	Sticker. Case Bottom	4825138
	Sticker. Case Bottom, FC	4798747
	Sticker. Case Bottom, FC	4811402
	Sticker. Case Bottom, FC, China	4877789
	Sticker. Case Bottom, China	4881949
20	Battery, Primary, Zn-Mn02,1.5 V, 2.24 ah, Alkaline, AA	376756
21	Battery Door, Assembly	4779851
22	Dual Battery Contact	4386306
23	Contact Battery Cathode	4304552
24	Contact Battery Anode	4304565
25	Foam Pad, 10 mm x 0.6 mm, 2.5 mm, includes Adhesive	4235667
26	Copper Foil, Case, Bottom	4870820
27	Heat Shrink, 2.5 mm ∅, 2 mm Length, 600	part of item 10
28	Radio Module, PCA	4320952
29	Copper Foil, LCD, Bottom	part of Item 5
30	Gasket, Shielding, Fabric Over Foam, 10 mm x 6 mm x 5 mm	part of Item 5 or 8
31	Conductive Fabric, LCD, Top	part of Item 5
32	Keypad Bracket	4778308
33	Keypad, Main	4778351

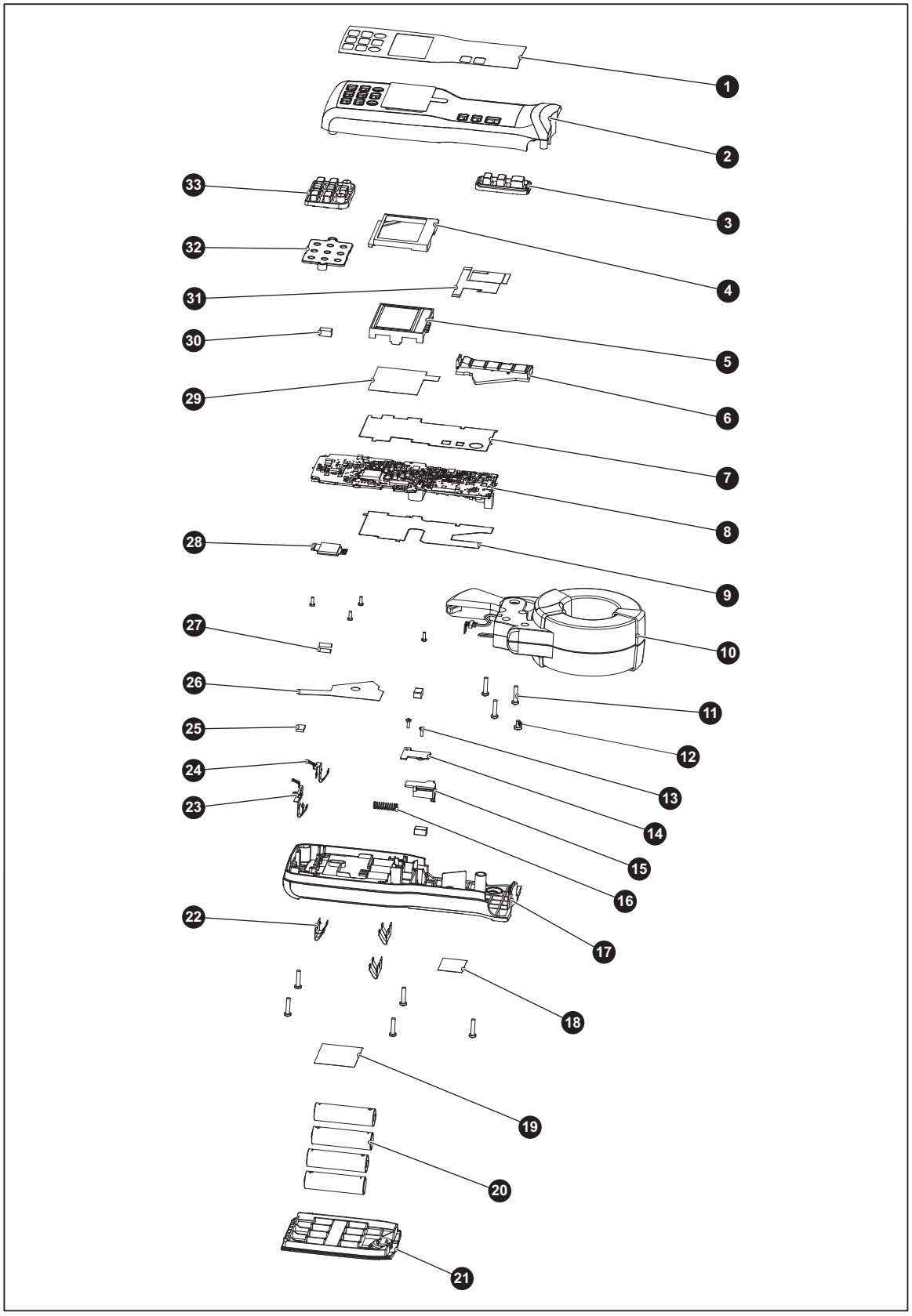


Figure 3. Replacement Parts