FLUKE®

SMFT-1000

Multifunction PV Analyzer

Calibration Manual

6/2023 (English)
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Introduction

⚠⚠ Warning

Read *Safety Information* before you use the Product.

This manual explains the Performance Tests for the SMFT-1000 (the Product or PV Analyzer). See the *SMFT-1000 Users Manual* for usage information.

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: www.fluke.com/productinfo

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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.

Specifications

Complete specifications are at www.fluke.com. See the *SMFT-1000 Users Manual*.

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.

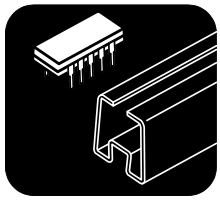
Follow these practices to minimize damage to static sensitive parts.

⚠⚠ 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.

Maintenance

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents. Dirt or moisture in the terminals can affect readings.

⚠⚠ Warning

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

- **Voltages as high as 1 kV are used in this procedure. Handle electrical wires with caution.**
- **Have an approved technician repair the Product.**

Battery Replacement

Replace the batteries with six AA batteries. Alkaline batteries are supplied with the Tester.

⚠⚠ Warning

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

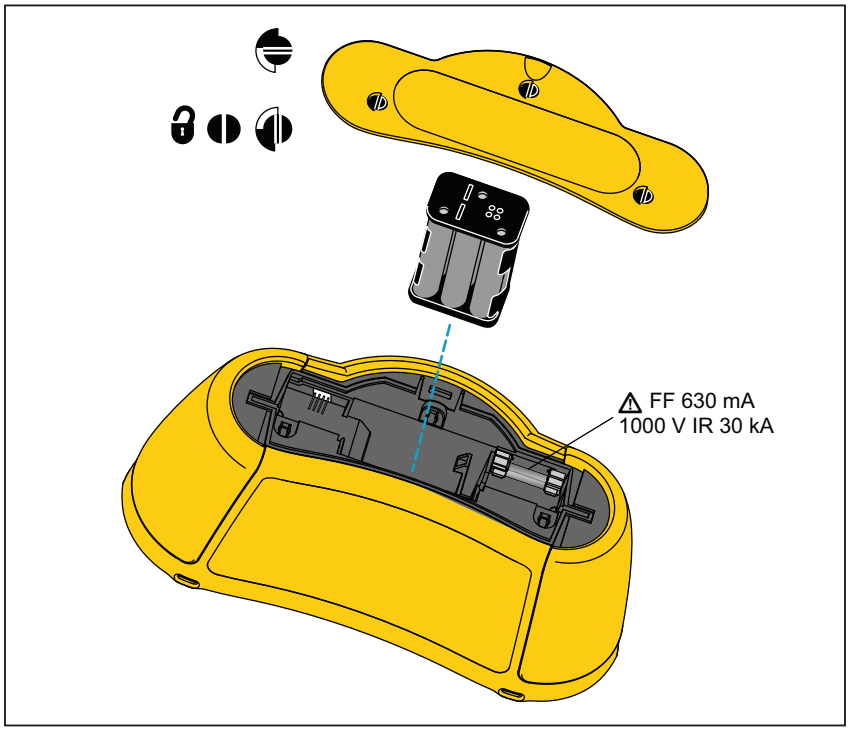
- **Remove the test leads and any input signals before you replace the battery.**
- **Install ONLY specified replacement fuses with the amperage, voltage, and speed ratings shown in the *Specifications* section of the Users Manual.**

To replace the batteries (see Figure 1):

1. Push ⏻ to turn off the PV Analyzer.
2. Remove the test leads from the terminals.
3. To remove the battery door, use a standard-blade screwdriver to turn the battery door screws (x3) one-quarter turn counterclockwise.
4. Push the release latch and slide the battery holder out of the Tester.
5. Replace the batteries.

6. Replace the battery holder and the battery door.
7. Turn the battery door screws one-quarter turn clockwise to fasten the door.

Figure 1. Battery Replacement



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

Equipment Requirements

Table 1 is a list of the standard equipment for the performance tests.

Table 1. Standard Equipment

Equipment	Required Characteristics	Recommended Model/Part Number
Multi-Product Calibrator	4.5-digit resolution, 20 A output	Fluke 552xA, or equivalent
Multifunction Electrical Tester Calibrator	NA	Fluke 532xA
Current Source	20 A output	Keithley 2260B-30-36
Digital Multimeter	5.5-digit dual-display	Fluke 8808A
High Voltage Power Supply	1 kV output	Keithley 2290-5
Wired Coil	25-turn	52120A/COIL3KA
Test Lead	low-thermal EMF (up to 500 mA)	5730A-7002
Test Lead	high current (up to 20 A)	Pomona B-12-X
Test Lead	shielded (up to 1000 V)	Fluke Shielded Calibration Test Leads/PN 216239

Performance Tests

Performance tests make sure that the Product operates within the published specifications. Fluke recommends performance tests periodically.

In this section the Product is called the DUT (device under test). Use these verification performance tests to make sure the values indicated on the DUT correspond, as closely as possible, with the actual measurement values.

If the product fails any part of the performance test, see *Calibration Adjustment and Repair*.

Visual Inspection

Before you do the performance tests:

1. Visually inspect the DUT for signs of physical damage.

   If you find a problem, make notes of the damage and perform the as-found calibration before correction.

2. Examine the test lead sockets for debris or damage. If dirt is found, gently use a cotton swab to remove the contaminants.

3. Make sure the DUT and all test equipment have sufficient warm-up time in accordance with the manufacturer's specifications.

To reduce thermal EMF errors, use low-thermal leads when you calibrate voltage functions and low-resistance functions (<50 kΩ). To calibrate current functions, use the appropriately rated cables for the current. Currents as high as 20 A will be generated. When calibrating high-resistance functions (>50 kΩ), use shielded test leads to reduce electromagnetic interference.

R_{LO}

To verify the resistance of earthing and equipotential bonding conductors:

1. Set all equipment and the DUT to standby mode.
2. Connect two low-thermal EMF test leads to the DUT, one at green connector (ground) and one at yellow connector.
3. Short the two test leads together at the furthest point from the DUT.
4. Disconnect all other test leads.
5. Turn the rotary switch on the DUT to **R_{LO}**.
6. Push (F4) to zero the test leads.

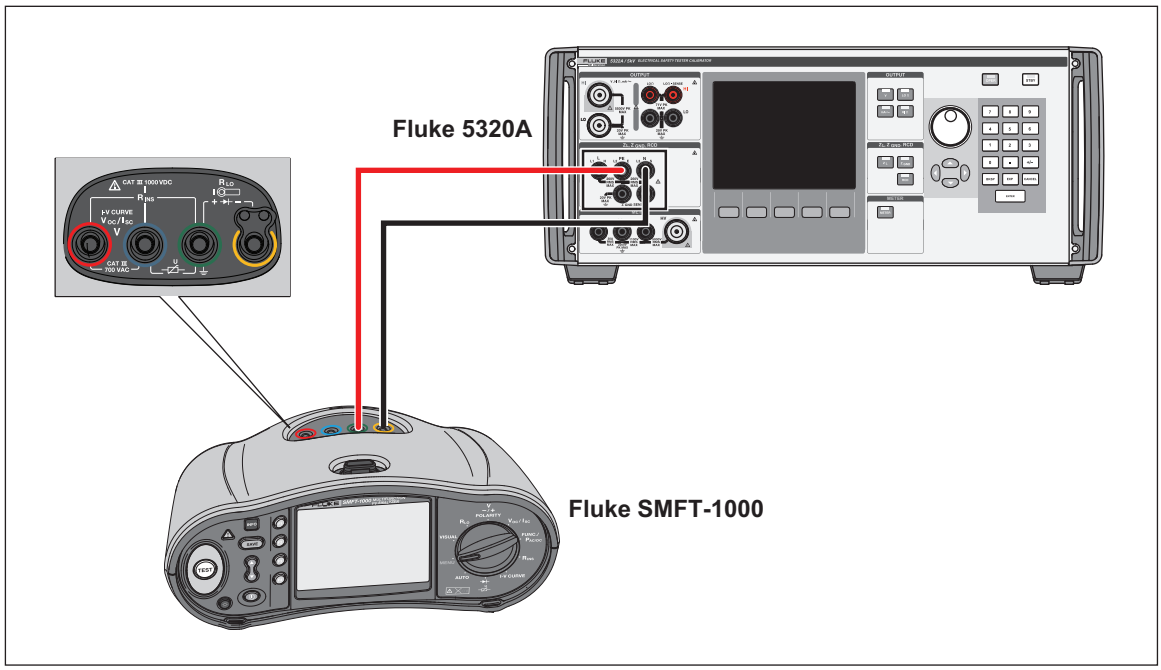
   If the DUT shows an error that the lead resistance cannot exceed 3 Ω, recheck that the leads have good contact and try again.

   Note

   When zeroing and calibrating the R_{LO} function, allow at least 10 seconds for any thermal EMFs to dissipate when you move test leads from one socket to another. Thermal EMFs have a significant contribution to the error present in the lower ohm measurements.

7. Disconnect the test leads from each other and connect the DUT green connector (ground) to the green (PE) port on 532xA and DUT yellow connector to the blue (N) port on 532xA. See Figure 2.

Figure 2. R_{LO} Connections



8. Set the 532xA calibrator to output the first resistance test point (see Table 2) and set to 2-wire, ground bond resistance (Z GND) output mode.

Table 2. R_{LO} Test Points

Range	Test Points [Ω]	Display Reading [Ω]	
		Lower Limit	Upper Limit
0 Ω to 19.99 Ω	0.35	0.32	0.38
	0.96	0.92	1.00
	1.70	1.65	1.75
	17.00	16.64	17.36
20 Ω to 199.0 Ω	90.0	88.0	92.0
	170.0	166.4	173.6
200 Ω to 2000 Ω	470	445	496
	900	853	947
	1700	1613	1787

9. Push (F1) on the DUT to set the **One Shot** mode.
10. Push **OPER** on the 532xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.

11. Momentarily push (TEST) on the DUT.

    Wait for the DUT to finish both the + and - measurements. Record the + and - indications on the DUT in the test record. Also record the nominal value displayed on the 532xA as it may be slightly different from the intended nominal. If applicable, recalculate the limits based on the nominal value and the published specifications.

    Note

    Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.

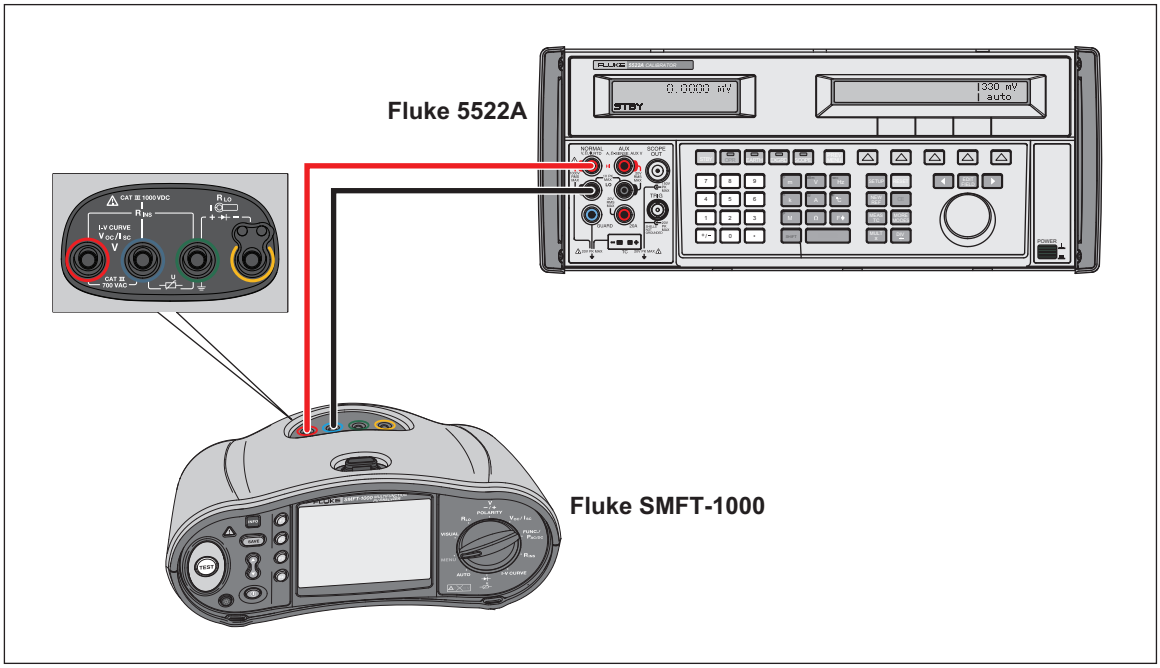
12. Set the 532xA calibrator to output the next resistance test point (see Table 2).
13. Repeat steps 10 through 12 for all test points.
14. Set the 532xA calibrator to standby mode.

V_{OC} (Open-Circuit Voltage)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect low-thermal EMF test leads from DUT red connector to 552xA NORMAL port and DUT blue connector to the 552xA black port below NORMAL port. Disconnect all other test leads (see Figure 3).

Figure 3. V_{OC} (Open-Circuit Voltage) Connections



3. Turn the rotary switch on the DUT to **V_{OC}/I_{SC}**.

4. Set the 552xA calibrator to output the first voltage test point (see Table 3).

Table 3. V_{OC} Test Points

Range	Test Points [V]	Display Reading [V]	
		Lower Limit	Upper Limit
5 V to 99.9 V	5.0	4.8	5.2
	50.0	49.6	50.5
	80.0	79.4	80.6
	99.2	98.5	99.9
100 V to 1000 V	103	100	106
	500	496	505
	990	983	997

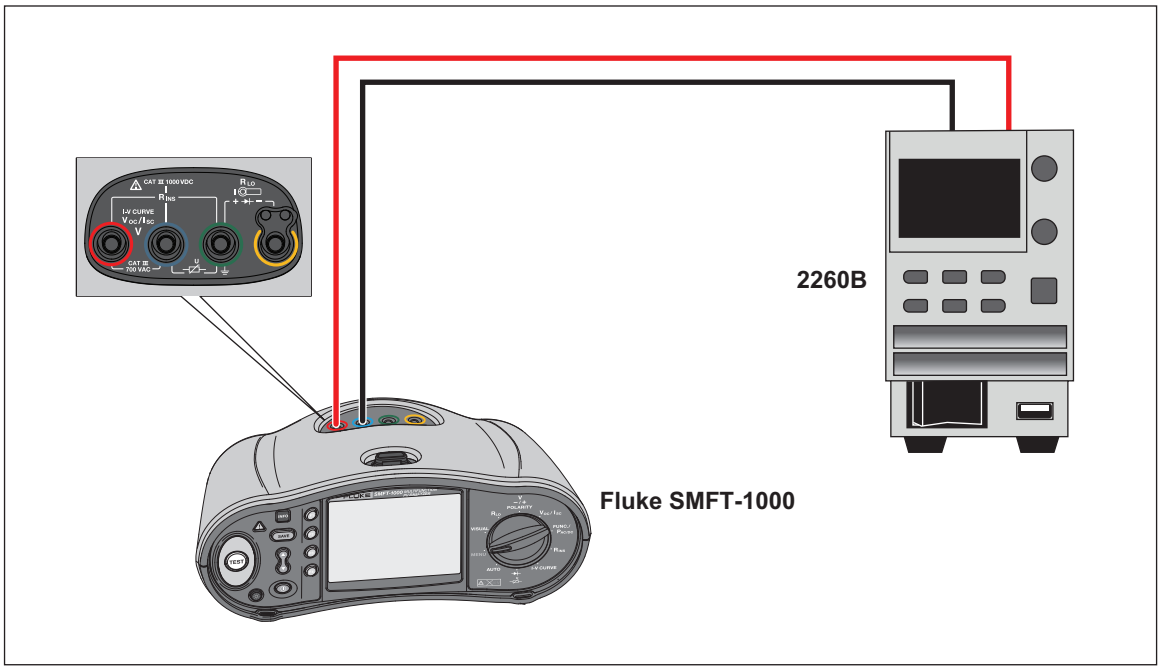
5. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
6. Record the indication from the DUT in the test record.
7. Set the 552xA calibrator to output the next voltage test point (see Table 3).
8. Repeat steps 5 through 7 for all test points.
9. Set the 552xA calibrator to standby mode.

I_{SC} (Short-Circuit Current)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the high current test leads from DUT red connector to the Output Terminal + of the current supply (Keithley 2260B-30-36) and DUT blue connector to the Output Terminal – of the current supply (Keithley 2260B-30-36). See Figure 4.

Figure 4. I_{SC} (Short-Circuit Current) Connections



3. Turn the rotary switch on the DUT to **V_{OC}/I_{SC}**.
4. Set the current supply to output >5 V.

   A minimum of 5 V is needed to allow the DUT to enter into I_{SC} mode. The maximum voltage is critical as it determines the amount of overshoot when the I_{SC} circuit is completed. If the overshoot exceeds 20 A, then no measurement can be made on the DUT.

5. Set the current supply to output the first current test point (see Table 4).

Table 4. I_{SC} Test Points

Range	Test Points [A]	Display Reading [A]	
		Lower Limit	Upper Limit
0 A to 20 A	0.2	0.0	0.4
	6.0	5.7	6.3
	10.0	9.7	10.3
	19.5	19.1	19.9

   Push the Output button, if necessary to verify the current supply is in operate mode.

6. Momentarily push TEST on the DUT.

   Wait for the DUT to complete the measurement. Record the current indication on the DUT in the test record.

   Note

   Watch the current supply during this measurement. If it does not go into constant current mode briefly, then the voltage setting is too low. Increase the voltage of the current supply and retry step 6 until the current supply goes into constant current mode briefly. Additionally, check a range of about 0.1 V to see if the current indication on the DUT stays constant. A constant current indication, even with a change of 0.1 V from the current source, indicates that there is enough voltage output to allow the current source to enter into constant current mode.

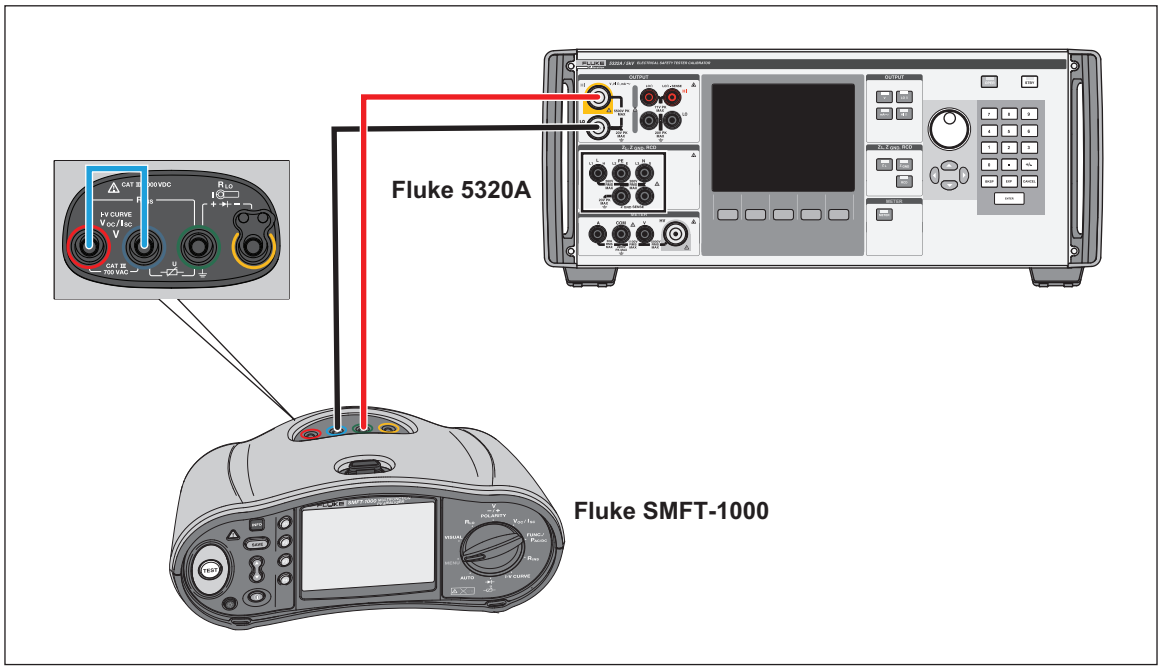
7. Set the current supply to output the next current test point (test points are in Table 4).
8. Repeat steps 6 through 7 for all test points.
9. Set the current supply to standby mode.

R_{INS} Insulation Resistance Method I (No Voltage)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect shielded test leads from DUT blue connector to the 532xA LO Port and DUT green connector to the 532xA HI Port.
3. Connect shielded test leads between DUT red connector and DUT blue connector.
4. Disconnect all other test leads. See Figure 5.

Figure 5. R_{INS} Insulation Resistance Method I (No Voltage) Connections



5. Turn the rotary switch on the DUT to **R_{INS}**.
6. Push (F1) button to select **R_{INS} I** mode.
7. Set the 532xA calibrator to output the first resistance test point and set the voltage output of the DUT to the first voltage setting (see Table 5).

Table 5. R_{INS} Method I (No Voltage) Test Points

Range	Test Voltage [V]	Test Points [MΩ]	Display Readings [MΩ]	
			Lower	Upper
0.2 MΩ to 99.99 MΩ	50	0.25	0.19	0.31
		0.40	0.33	0.47
		1.60	1.47	1.73
		5.00	4.70	5.30
		50.00	47.45	52.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
0.2 MΩ to 99.99 MΩ	100	0.25	0.19	0.31
		0.80	0.71	0.89
		2.00	1.85	2.15
		10.00	9.45	10.55
		50.00	47.45	52.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		150.0	134.5	165.5
		180.0	161.5	198.5
0.2 MΩ to 99.99 MΩ	250	0.25	0.19	0.31
		20.00	18.95	21.05
		50.00	47.45	52.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5

Table 5. R_{INS} Method I (No Voltage) Test Points (cont.)

Range	Test Voltage [V]	Test Points [MΩ]	Display Readings [MΩ]	
			Lower	Upper
0.2 MΩ to 99.99 MΩ	500	0.25	0.19	0.31
		0.50	0.43	0.58
		3.00	2.80	3.20
		30.00	28.45	31.55
		50.00	47.45	52.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
200 MΩ to 999 MΩ		260	203	317
		750	595	905
		830	659	1001
0.2 MΩ to 99.99 MΩ	1000	0.25	0.19	0.31
		1.00	0.90	1.10
		6.00	5.65	6.35
		50.00	47.45	52.55
		90.00	85.45	94.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
200 MΩ to 999 MΩ		260	203	317
		750	595	905
		830	659	1001

Table 5. R_{INS} Method I (No Voltage) Test Points (cont.)

Range	Test Voltage [V]	Test Points [MΩ]	Display Readings [V]	
			Lower	Upper
Voltage Output Accuracy	50	0.25	50.0	62.5
		180	50.0	62.5
	100	0.25	100.0	125.5
		180	100.0	125.5
	250	0.25	250.0	312.5
		180	250.0	312.5
	500	0.50	500.0	625.0
		830	500.0	625.0
	1000	1.00	1000	1250.0
		830	1000	1250.0

8. Verify the calibrator is set to high resistance output mode.
9. Push **OPER** on the 532xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
10. Push and hold (TEST) on the DUT until it beeps (~1 second).

    Wait for the DUT to finish both the + and - measurements. Record both the + and - indication on the DUT in the test record. Also record the maximum voltage measurement indication on the 532xA calibrator in the test record.

    Note

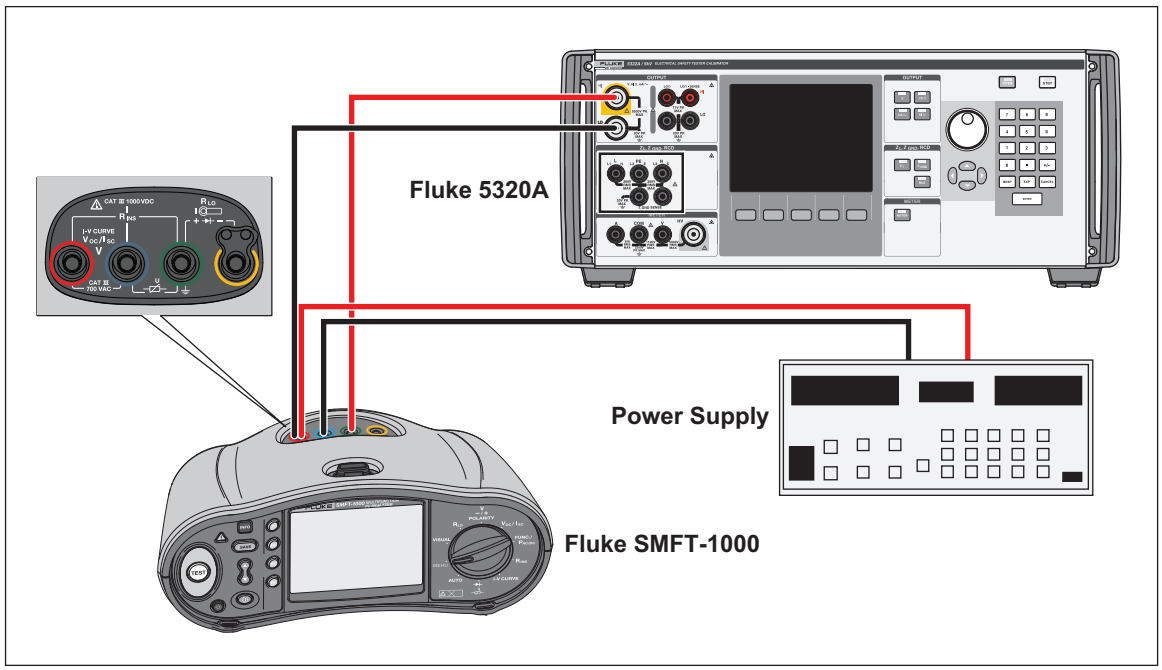
    Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.
11. Set the 532xA calibrator to output the next resistance test point and, if applicable, set the voltage output of the DUT to the next voltage setting (see Table 5).
12. Repeat steps 9 through 11 for all test points.
13. Set the 532xA calibrator to standby mode.

R_{INS} Insulation Resistance Method I (With Voltage)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect shielded test leads from DUT red connector to the 532xA LO Port and DUT green connector to the 532xA HI Port.
3. Connect shielded test leads between DUT red connector to the + voltage output of the 2290-5 and DUT blue connector to the - voltage output of the 2290-5.

Figure 6. R_{INS} Insulation Resistance Method I (With Voltage) Connections



4. Turn the rotary switch on the DUT to **R_{INS}**.
5. Push (F1) to select **R_{INS} I** mode.
6. Set the 532xA calibrator to output the first resistance test point and set the voltage output of the DUT to the first voltage setting (see Table 6).

Table 6. R_{INS} Method I (With Voltage) Test Points

Range	DUT Voltage [V]	Power Supply Voltage [V]	Test Points [MΩ]	Display Readings [MΩ]	
				Lower	Upper
0.2 MΩ to 99.99 MΩ	50	40	50.00	47.45	52.55
		500		47.45	52.55
100 MΩ to 199.9 MΩ	500	40	150.0	134.5	165.5
		500		134.5	165.5
200 MΩ to 999 MΩ	1000	40	500	395	605
		500		395	605

7. Verify the calibrator is set to high resistance output mode.
8. Set the 2290-5 to output the first voltage test point (see Table 6).

   The 2290-5 output must be within 5 % of nominal.
9. Push **OPER** on the 532xA and 2290-5 to set the operate mode, if necessary, and wait for the calibrator to stabilize.
10. Push and hold (TEST) on the DUT until it beeps (~1 second).

    Wait for the DUT to finish both the + and - measurements. Record only the plus indication on the DUT in the test record.

    Note

    Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.
11. Set:
    - 532xA calibrator to output the next resistance test point
    - 2290-5 to output the next voltage setting
    - voltage output of the DUT to the next voltage setting

    See test points in Table 6.

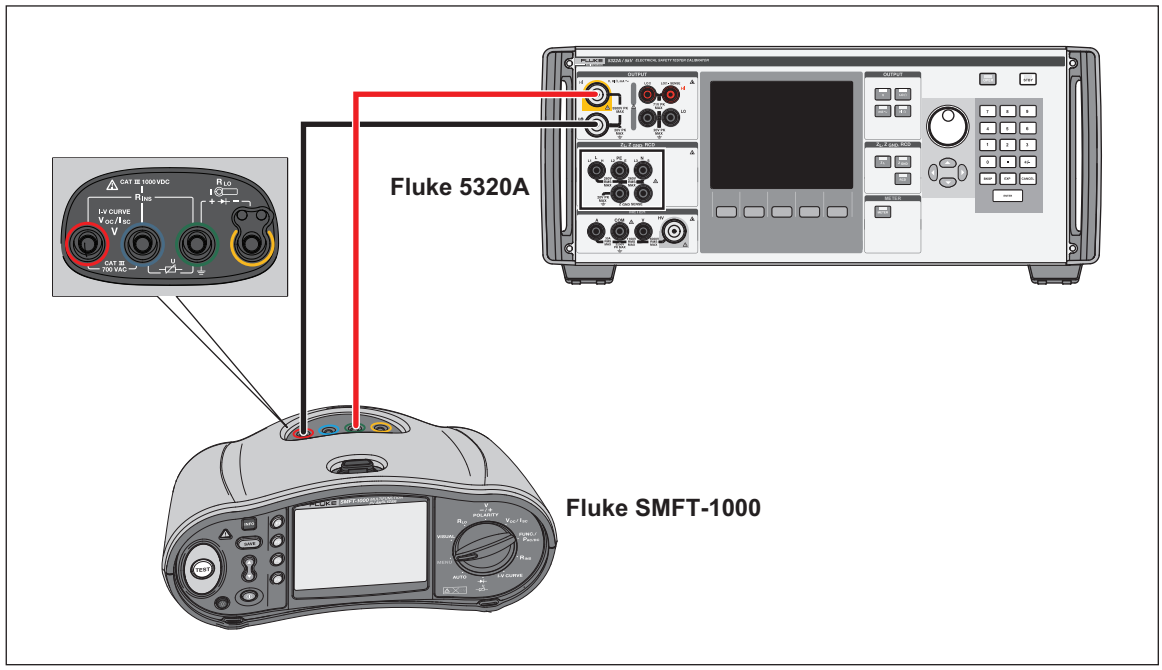
    The 2290-5 output must be within 5 % of nominal.
12. Repeat steps 9 through 11 for all test points.
13. Set the 532xA and 2290-5 to standby mode.

R_{INS} Insulation Resistance Method II (No Current)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect shielded test leads from DUT red connector to the 532xA LO Port and DUT green connector to the 532xA HI Port.
3. Disconnect all other test leads. See Figure 7.

Figure 7. R_{INS} Insulation Resistance Method II (No Current) Connections



4. Turn the rotary switch on the DUT to **R_{INS}**.
5. Push (F2) to select **R_{INS} II** mode.
6. Set the 532xA calibrator to output the first resistance test point and set the voltage output of the DUT to the first voltage setting (see Table 7).

Table 7. R_{INS} Method II (No Current) Test Points

Range	Test Voltage [V]	Test Points [MΩ]	Display Readings [MΩ]	
			Lower	Upper
0.2 MΩ to 99.99 MΩ	50	0.25	0.19	0.31
		0.40	0.33	0.47
		1.00	0.90	1.10
		5.00	4.70	5.30
		10.00	9.45	10.55
		25.00	23.70	26.30
		50.00	47.45	52.55
		70.00	66.45	73.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
0.2 MΩ to 99.99 MΩ	100	0.25	0.19	0.31
		0.80	0.71	0.89
		12.00	11.35	12.65
		50.00	47.45	52.55
		80.00	75.95	84.05
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.0	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5

Table 7. R_{INS} Method II (No Current) Test Points (cont.)

Range	Test Voltage [V]	Test Points [MΩ]	Display Readings [MΩ]	
			Lower	Upper
0.2 MΩ to 99.99 MΩ	250	0.25	0.19	0.31
		20.00	18.95	21.05
		50.00	47.45	52.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
0.2 MΩ to 99.99 MΩ	500	0.25	0.19	0.31
		0.50	0.43	0.58
		3.00	2.80	3.20
		30.00	28.45	31.55
		50.00	47.45	52.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
200 MΩ to 999 MΩ		260	203	317
		750	595	905
		830	659	1001
0.2 MΩ to 99.99 MΩ	1000	0.25	0.19	0.31
		1.00	0.90	1.10
		6.00	5.65	6.35
		50.00	47.45	52.55
		90.00	85.45	94.55
		95.00	90.20	99.80
100 MΩ to 199.9 MΩ		112.0	100.3	123.7
		160.0	143.5	176.5
		180.0	161.5	198.5
200 MΩ to 999 MΩ		260	203	317
		750	595	905
		830	659	1001

Table 7. R_{INS} Method II (No Current) Test Points (cont.)

Range	Test Voltage [V]	Test Points [MΩ]	Display Readings [V]	
			Lower	Upper
Voltage Output Accuracy	50	0.25	50.0	62.5
		180	50.0	62.5
	100	0.25	100.0	125.0
		180	100.0	125.0
	250	0.25	250.0	312.5
		180	250.0	312.5
	500	0.50	500.0	625.0
		830	500.0	625.0
	1000	1.00	1000	1250.0
		830	1000	1250.0

7. Verify the calibrator is set to high resistance output mode.
8. Push **OPER** on the 532xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
9. Push and hold (TEST) on the DUT until it beeps (~1 second).

   Wait for the DUT to finish the measurement. Record the indication on the DUT in the test record. Also record the maximum voltage measurement indication on the 532xA Calibrator in the test record.

   Note

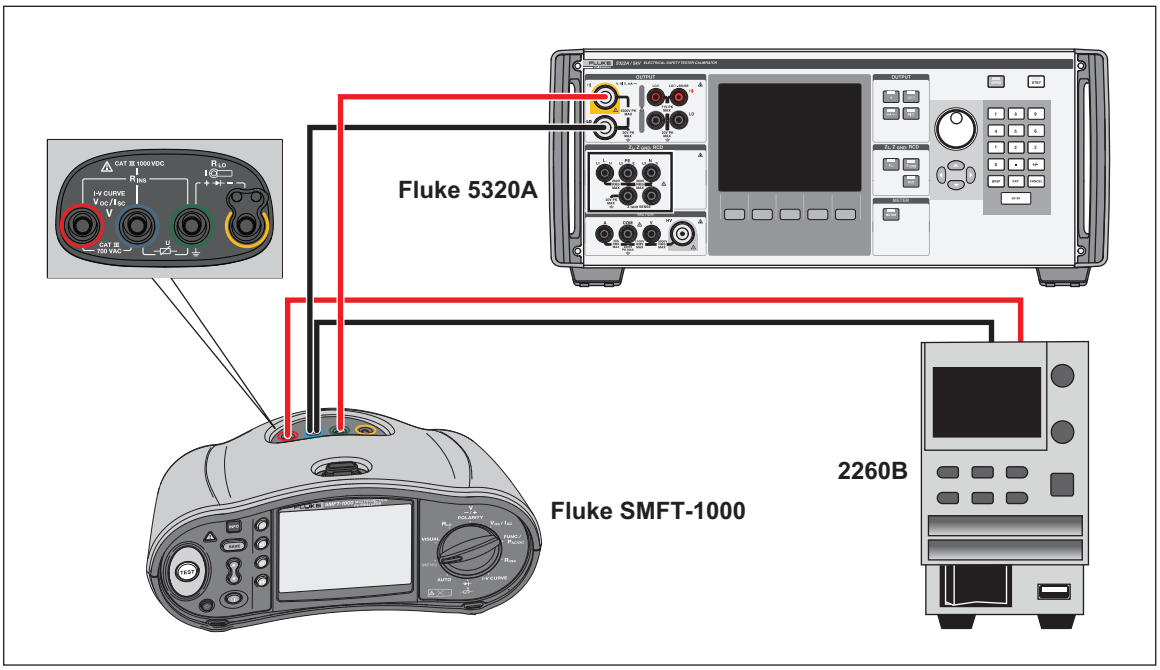
   Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.
10. Set the 532xA calibrator to output the next resistance test point and, if applicable, set the voltage output of the DUT to the next voltage setting (test points are in see Table 7).
11. Repeat steps 8 through 10 for all test points.
12. Set the 532xA calibrator to standby mode.

R_{INS} Insulation Resistance Method II (With Current)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect shielded test leads from DUT blue connector to the 532xA LO Port and DUT green connector to the 532xA HI Port.
3. Connect high-current shielded test leads from DUT red connector to the Output Terminal + of the current supply (Keithley 2260B-30-36) and from DUT blue connector to the Output Terminal - of the current supply.
4. Disconnect all other test leads. See Figure 8.

Figure 8. R_{INS} Insulation Resistance Method II (With Current) Connections



5. Turn the rotary switch on the DUT to **R_{INS}**.
6. Push (F2) to select **R_{INS} II** mode.
7. Set the 532xA calibrator to output the first resistance test point and set the voltage output of the DUT to the first voltage setting (see Table 8).

Table 8. R_{INS} Method I (With Current) Test Points

Range	Test Voltage [V]	Applied Current [A]	Test Points [MΩ]	Display Readings [MΩ]	
				Lower	Upper
0.2 MΩ to 99.99 MΩ	50	2	50	47.45	52.55
		18		47.45	52.55
100 MΩ to 199.9 MΩ	500	2	150	134.5	165.5
		18		134.5	165.5
200 MΩ to 999 MΩ	1000	2	500	395	605
		18		395	605

8. Verify the calibrator is set to high resistance output mode.
9. Set the current supply to output the first current test point (see Table 8).
10. Set the voltage limit on the current supply high enough to allow at least 18 A to go through the DUT during the measurement. The current source output must be within 10 % of nominal.
11. Push **OPER** on the 532xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
12. Push and hold TEST on the DUT until it beeps (~1 second).

    Wait for the DUT to finish the measurement. Record the indication on the DUT in the test record.

    Note

    Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.

13. Set:
    - 532xA calibrator to output the next resistance test point
    - voltage output of the DUT to the next voltage setting
    - current supply to output the next current setting

    See the test points in Table 8.

    The current source output must be within 10 % of nominal.
14. Repeat steps 11 through 13 for all test points.
15. Set the 532xA calibrator and current source to standby mode.

Diode Voltage

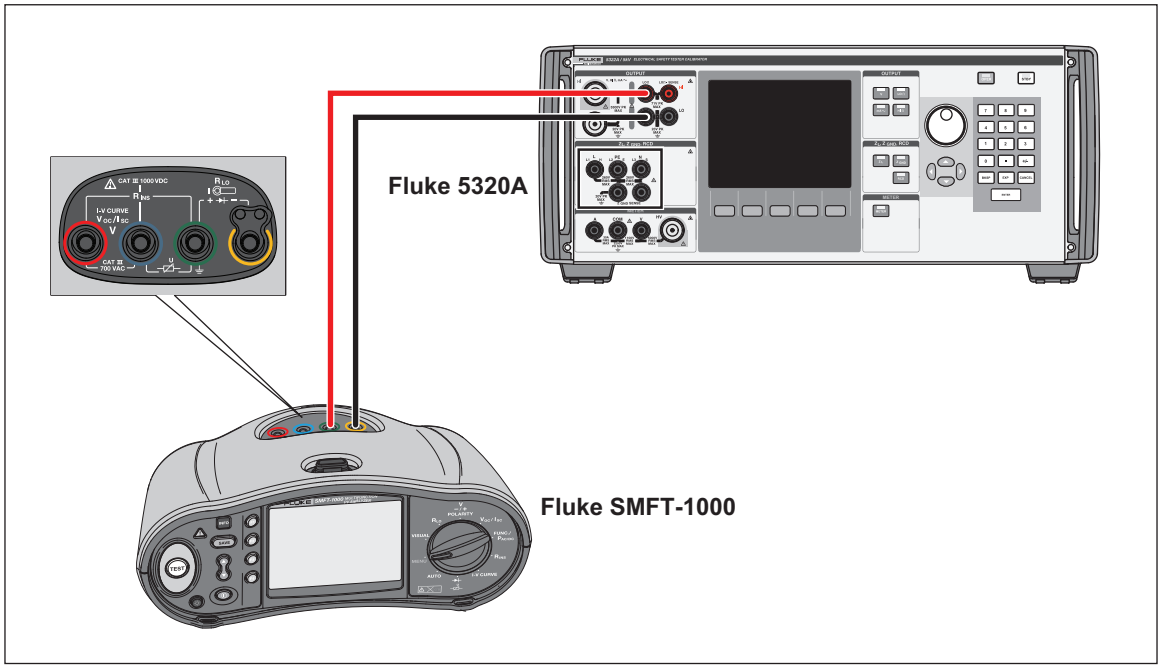
Note

Calibration of one diode function will calibrate all three diode functions. Bypass Diode, Blocking Diode, and Diode functions share the exact same hardware and firmware. Only the procedure for the main diode (V_{DIODE}) function is detailed.

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the low-thermal EMF test leads from DUT green connector to the low ohms 532xA red port and DUT yellow connector to the 532xA black port.
3. Disconnect all other test leads. See Figure 9.

Figure 9. Diode Voltage Connections



4. Set the 532xA calibrator to output the first resistance test point (see Table 9).

Table 9. Diode Voltage Test Points

Range	Reference Resistance [Ω]	Test Points [V]	Display Readings [V]	
			Lower	Upper
0.5 V to 4 V	2.38	0.5	0.38	0.63
	4.46	1.00	0.85	1.15
	6.52	2.00	1.80	2.20
	26.67	5.60	5.22	5.98

5. Verify the calibrator is set to 2-wire, low-resistance output mode.
6. Turn the rotary switch on the DUT to .
7. Push F3 to select **Diode** mode.
8. Push **OPER** on the 532xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
9. Momentarily push TEST on the DUT.

   Wait for the DUT to complete its measurement.
10. Momentarily push TEST on the DUT to stop continuous measurements made by the DUT.

    Record the V_{DIODE} on the DUT and the maximum current value indication on the 532xA (I_D) in the test record. Multiply the I_D value (in Amps) by the resistance output by the 532xA calibrator (in Ohms) and use this as the reference voltage value to compare V_{DIODE}.

    Note

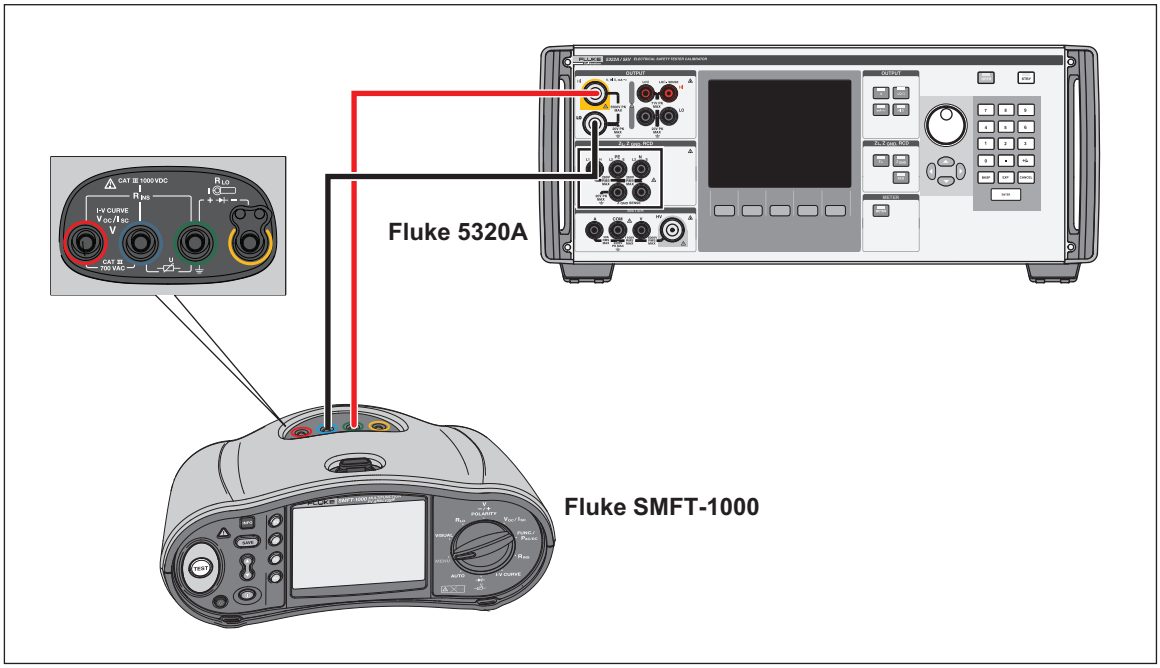
    Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.
11. Set the 532xA calibrator to output the next resistance test point (see Table 9).
12. Repeat steps 8 through 11 for all test points.
13. Set the 532xA calibrator to standby mode.

Surge Protection Device (SPD)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the shielded test leads from DUT blue connector to the 532xA HI port and DUT green connector to the 532xA LO port.
3. Disconnect all other test leads. See Figure 10.

Figure 10. SPD Connections



4. Set the 532xA calibrator to output the first resistance test point (see Table 10).

Table 10. SPD Test Points

Range	Reference Resistance [kΩ]	Test Points [V]	Display Readings [V]	
			Lower	Upper
50 V to 1000 V	50	50	40	60
	500	500	445	555
	900	900	805	995

5. Verify the calibrator is set to high-resistance output mode.
6. Turn the rotary switch on the DUT to .
7. Push F4 to select **SPD** mode.

8. Push **OPER** on the 532xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
9. Push and hold (TEST) on the DUT until it beeps (~1 second).

   Wait for the DUT to finish the measurement. Record the V_{SPD} indication on the DUT in the test record. Also record the maximum voltage measurement indication on the 532xA calibrator in the test record. Multiply the resistance output of the 532xA calibrator (in Ohms) by 0.001 A and use this as the reference voltage value to compare V_{SPD}.

   Note

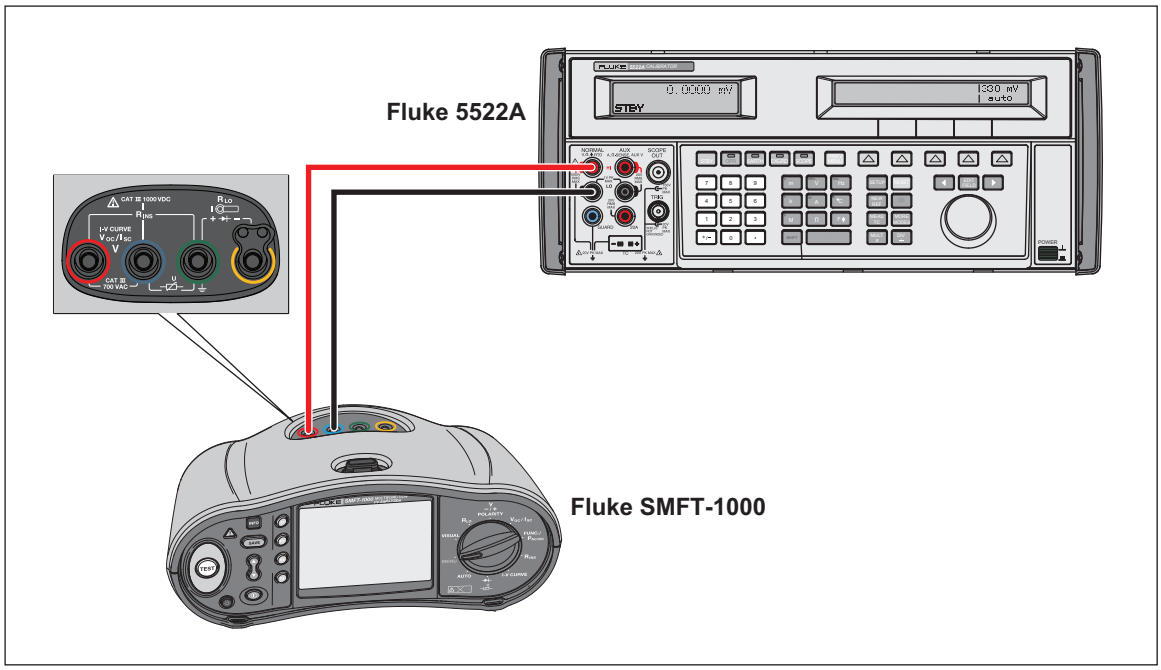
   Ignore the red X or green ✓. They do not indicate a pass or fail for this calibration.
10. Set the 532xA calibrator to output the next resistance test point (see Table 10).
11. Repeat steps 8 through 10 for all test points.
12. Set the 532xA calibrator to standby mode.

AC/DC Voltage

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the low-thermal EMF test leads from DUT red connector to the 552xA NORMAL (red) port and DUT blue connector to the 552xA black port below the NORMAL port.
3. Disconnect all other test leads. See Figure 11.

Figure 11. AD/DC Voltage Connections



4. Turn the rotary switch on the DUT to $\mathbf{P_{AC/DC}}$.

5. Push (F2) until **Voltage** shows in highlight on the left-side menu.
6. Set the 552xA calibrator to output the first voltage test point (see Table 11).

Table 11. AC/DC Voltage Test Points

Range	Frequency [Hz]	Test Points [V]	Display Readings [V]	
			Lower	Upper
0 V to 99.9 V	0	5.0	4.7	5.3
		50.0	48.6	51.5
		75.0	72.9	77.1
		97.0	94.4	99.6
100 V to 1000 V		105	100	110
		120	115	125
		400	388	412
		970	944	996
5 V to 99.9 V	50	5.0	4.7	5.3
		50.0	48.6	51.5
		75.0	72.9	77.1
		97.0	94.4	99.6
100 V to 700 V		105	100	110
		250	242	258
		400	388	412
		680	661	699
5 V to 99.9 V	60	5.0	4.7	5.3
		50.0	48.6	51.5
		75.0	72.9	77.1
		97.0	94.4	99.6
100 V to 700 V		105	100	110
		250	242	258
		400	388	412
		680	661	699

7. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.

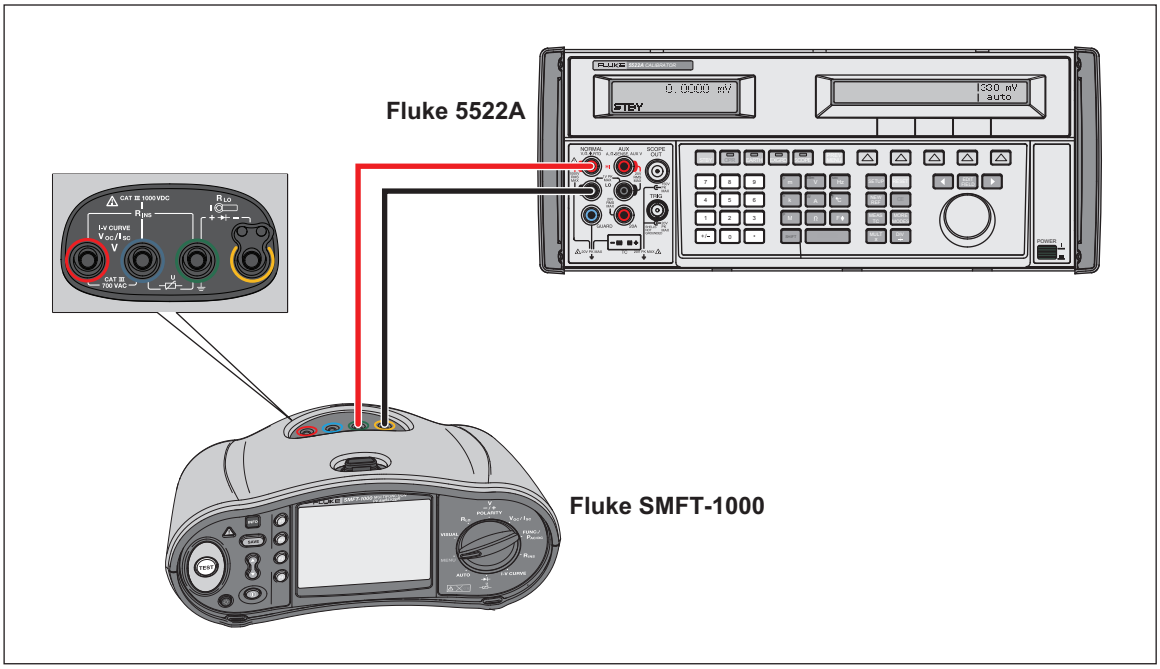
8. Record the indication on the DUT in the test record.
9. Set the 552xA calibrator to output the next voltage test point (see Table 11).
10. Repeat steps 7 through 9 for all test points.
11. Set the 552xA calibrator to standby mode.

AC/DC Current (SMFT only)

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect low-thermal EMF test leads (see Figure 12):
   a. Connect DUT green connector to NORMAL red port on the 552xA and DUT yellow connector to the 552xA black port under NORMAL red port.
   b. Disconnect all other test leads.
3. Turn the rotary switch on the DUT to $\mathbf{P_{AC/DC}}$.
4. Push (F2) until **Current** shows in highlight on the left-side menu.

Figure 12. AC/DC Current Connections (SMFT Only)



5. Set the 552xA calibrator to output the first current test point (see Table 12).

Note

The 552xA output is voltage, not current, for this part of the calibration.

Table 12. AC/DC Current (SMFT only) Test Points

Range	Frequency [Hz]	552xA Voltage [mV]	Test Points [A]	Display Readings [A]	
				Lower	Upper
0 A to 100 A	0	10	1.0	0.8	1.3
		30	3.0	2.7	3.4
		80	8.0	7.4	8.6
		500	50.0	47.3	52.7
		970	97.0	92.0	102.1
		-10	-1.0	-1.3	-0.8
		-500	-50.0	-52.7	-47.3
		-970	-97.0	-102.1	-92.0
	50	10	1.0	0.8	1.3
		500	50.0	47.3	52.7
		750	75.0	71.1	79.0
		970	97.0	92.0	102.1
	60	10	1.0	0.8	1.3
		500	50.0	47.3	52.7
		970	97.0	92.0	102.1

6. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
7. Record the indication on the DUT in the test record.
8. Set the 552xA calibrator to output the next current test point (see Table 12).
9. Repeat steps 6 through 8 for all test points.
10. Set the 552xA calibrator to standby mode.

SMFT-1000 DC and AC Current with Clamp

The i100 current clamp is used with the SMFT-1000 to conduct measurements together. The AC/DC current function of the Analyzer requires use of the i100. Both Ascending and Descending DC measurements depend on the initial current measurements and subsequent measurements. Test both Ascending and Descending measurements. See *Hysteresis* for more information. AC current is also tested for 50 Hz and 60 Hz. All test points are provided in Table 13. The Setup numbers correspond with each of the test points. Refer to Setup #1, Setup #2, Setup #3, and Setup #4 for each point called out in the procedure.

Hysteresis

Hysteresis is the difference in measuring the same value under different prior conditions. Current clamps are sometimes susceptible to hysteresis due to magnetization. Verifying hysteresis requires measuring test points in an ascending order, then a descending order (or vice versa). Next, you take the difference between the same measured values between ascending and descending order. None of the differences should be larger than the maximum hysteresis specification of the i100 clamp.

Setup for Ascending/Descending DC and AC Current Test Procedure

Table 13 is a list of all the test points and setups.

Table 13. AC/DC Current (Clamp only) Test Points

Range	Setup	552xA Current Output [A]	552xA Config.	Test Points [A]	Display Readings [A]	
					Lower	Upper
Ascending						
0 A to 100 A	1	-3.92	25-turn Coil	-98.0	-100.0	-96.0
	1	-3		-75.0	-76.6	-73.4
	2	-2		-50.0	-51.3	-48.8
	3	-3	Single Wire	-3.0	-3.5	-2.5
	4	-1		-1.0	-1.5	-0.5
	4	1		1.0	0.5	1.5
	3	3		3.0	2.5	3.5
	2	2	25-turn Coil	50.0	48.8	51.3
	1	3		75.0	73.4	76.6
	1	3.92		98.0	96.0	100.0

Table 13. AC/DC Current (Clamp only) Test Points (cont.)

Range	Setup	552xA Current Output [A]	552xA Config.	Test Points [A]	Display Readings [A]	
					Lower	Upper
Descending						
0 A to 100 A	1	3.92	25-turn Coil	98.0	96.0	100.0
	1	3		75.0	73.4	76.6
	2	2		50.0	48.8	51.3
	3	3	Single Wire	3.0	2.5	3.5
	4	1		1.0	0.5	1.5
	4	-1		-1.0	-1.5	-0.5
	3	-3		-3.0	-3.5	-2.5
	2	-2	25-turn Coil	-50.0	-51.3	-48.8
	1	-3		-75.0	-76.6	-73.4
	1	-3.92		-98.0	-100.0	-96.0
AC Current						
0 A to 100 A	4	1	Single Wire	1.0	0.5	1.5
	3	3		3.0	2.5	3.5
	2	2	25-turn Coil	50.0	48.8	51.3
	1	3.4		85.0	83.2	86.8
	1	3.92		98.0	96.0	100.0
	4	1	Single Wire	1.0	0.5	1.5
	3	3		3.0	5.2	3.5
	2	2	25-turn Coil	50.0	48.8	51.3
	1	3.4		85.0	83.2	86.8
	1	3.92		98.0	96.0	100.0
	Maximum DC Hysteresis	Absolute maximum difference between like ascending and descending DC test points				

Setup #1

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the leads, see Figure 13.
3. Connect the leads from the current clamp to the DMM, yellow clamp lead to INPUT red port on the 8808A, and black clamp lead to INPUT black port on 8808A.
4. Connect test leads from 552xA 20 A port to the positive (red) terminal of the 25-turn coil and from the AUX LO port to the negative (black) terminal of the 25-turn coil.
5. Clamp the current clamp through the designated area of the 25-turn coil.
6. Be sure to center the current clamp.
7. Set the 8808A DMM to **DC Volts** mode and to the **Slow** measurement mode.
8. Use the dial on the clamp to zero the clamp reading on the DMM.

   The voltage reading on the clamp will swing up and down. The absolute value of the voltage reading should not exceed 0.7 mV while the value swings. If it does, continue to adjust the zero dial on the clamp until the voltage reading stays within 0.7 mV of 0 V over the course of 10 seconds.
9. Set the 552xA calibrator to output and complete the test points (see Table 13):

   Note

   The 552xA setting will be 1/25th the test point value.
10. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
11. Record the voltage indication on the DMM ÷10 in the test record.

    Note

    This conversion only works when reading the DMM indication in millivolts, not volts.

Setup #2

To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the leads, see Figure 14.
3. Connect the leads from the current clamp to the DMM, yellow clamp lead to INPUT red port on the 8808A, and black clamp lead to INPUT black port on 8808A.
4. Connect test leads from 552xA AUX port to the positive (red) terminal of the 25-turn coil and from the AUX LO port to the negative (black) terminal of the 25-turn coil.
5. Clamp the current clamp through the designated area of the 25-turn coil.
6. Be sure to center the current clamp.
7. Set the 8808A DMM to **DC Volts** mode and to the **Slow** measurement mode.
8. Use the dial on the clamp to zero the clamp reading on the DMM.

   The voltage reading on the clamp will swing up and down. The absolute value of the voltage reading should not exceed 0.7 mV while the value swings. If it does, continue to adjust the zero dial on the clamp until the voltage reading stays within 0.7 mV of 0 V over the course of 10 seconds.
9. Set the 552xA calibrator to output and complete the test points (see Table 13):

   Note

   The 552xA setting will be 1/25th the test point value.
10. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
11. Record the voltage indication on the DMM ÷10 in the test record.
12. Set the 552xA calibrator and complete test points in Table 13 for Setup #2 in order of operations from the table. See *Hysteresis*.
13. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
14. Record the voltage indication on the DMM ÷10 in the test record.

   Note

   This conversion only works when reading the DMM indication in millivolts, not volts.

Setup #3

To verify:

1. Install the test lead from the AUX port to AUX LO on 552xA to make a short.
2. Clamp the current clamp around the 552xA AUX port wire.
3. Set the 552xA calibrator to output and complete test points in Table 13 that are provided for Setup #3 in order of operations from the table.
4. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
5. Record the voltage indication on the DMM ÷10 in the test record.

Note

This conversion only works when reading the DMM indication in millivolts, not volts.

Setup #4

To verify:

1. Install the test lead from 20 A port to AUX LO on the 552xA to make a short.
2. Clamp the current clamp around the 552xA port wire.
3. Set the 552xA calibrator to output and complete test points in Table 13 that are provided for Setup #4 in order of operations from the table.
4. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
5. Record the voltage indication on the DMM ÷10 in the test record.

Note

This conversion only works when reading the DMM indication in millivolts, not volts.

Figure 13. Setup 1: AC/DC High Current (Clamp Only) Connections

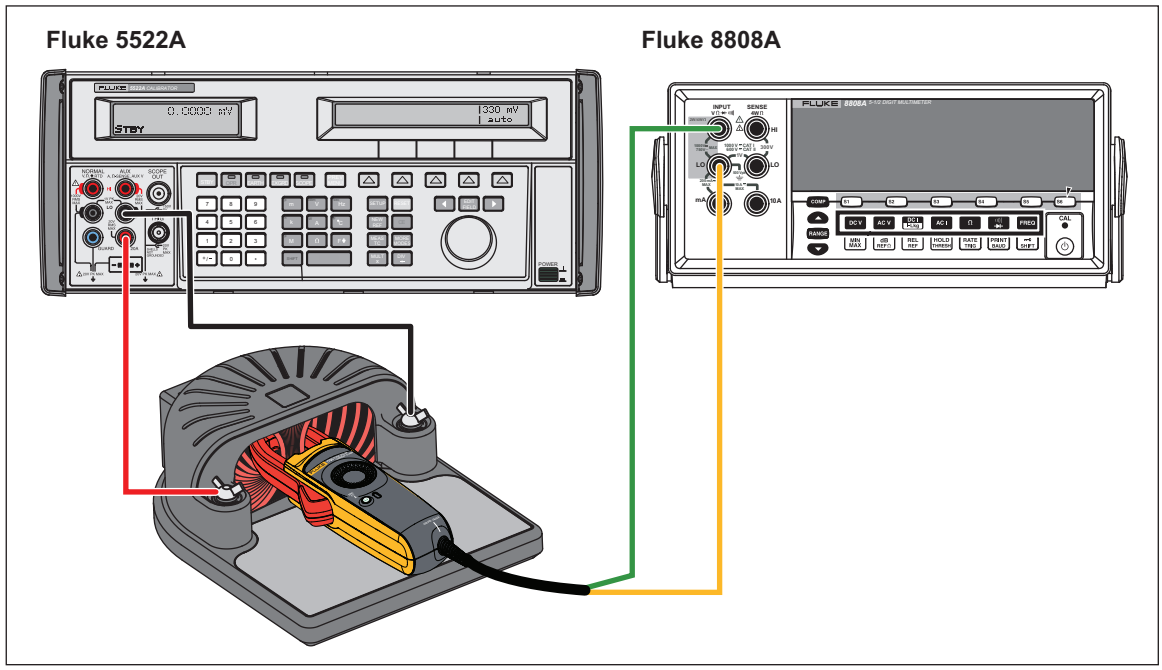
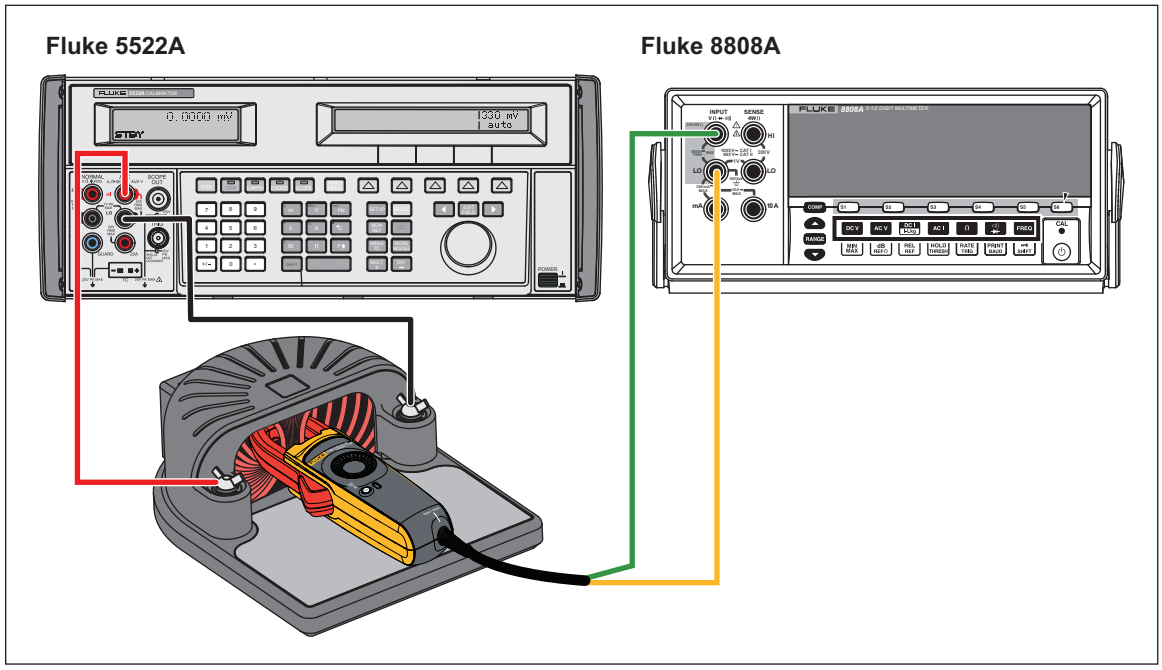


Figure 14. Setup 2: AC/DC Current (Clamp Only) Connections



Ascending DC Test

To perform the Ascending DC test, follow the order of the test points. Any deviation results in repeating the Ascending DC test from step 1. Complete the test points in Table 13 for Ascending DC test points using Setup #1, Setup #2, Setup #3, and Setup #4 procedures in order of operations from the table. See *Hysteresis*.

Descending DC Test

To perform the Descending DC test, follow the order of the test points. Any deviation results in repeating the Descending DC test from step 1. Complete the test points in Table 13 for Descending DC test points using Setup #1, Setup #2, Setup #3, and Setup #4 procedures in order of operations from the table. See *Hysteresis*.

50 Hz and 60 Hz AC Current Test

Complete test points in Table 13 for AC Current test points using Setup #1, Setup #2, Setup #3, and Setup #4 procedures in order of operations from the table. See *Hysteresis*. Make sure to set the 8808A DMM to ACV mode instead of DCV mode.

AC/DC Power

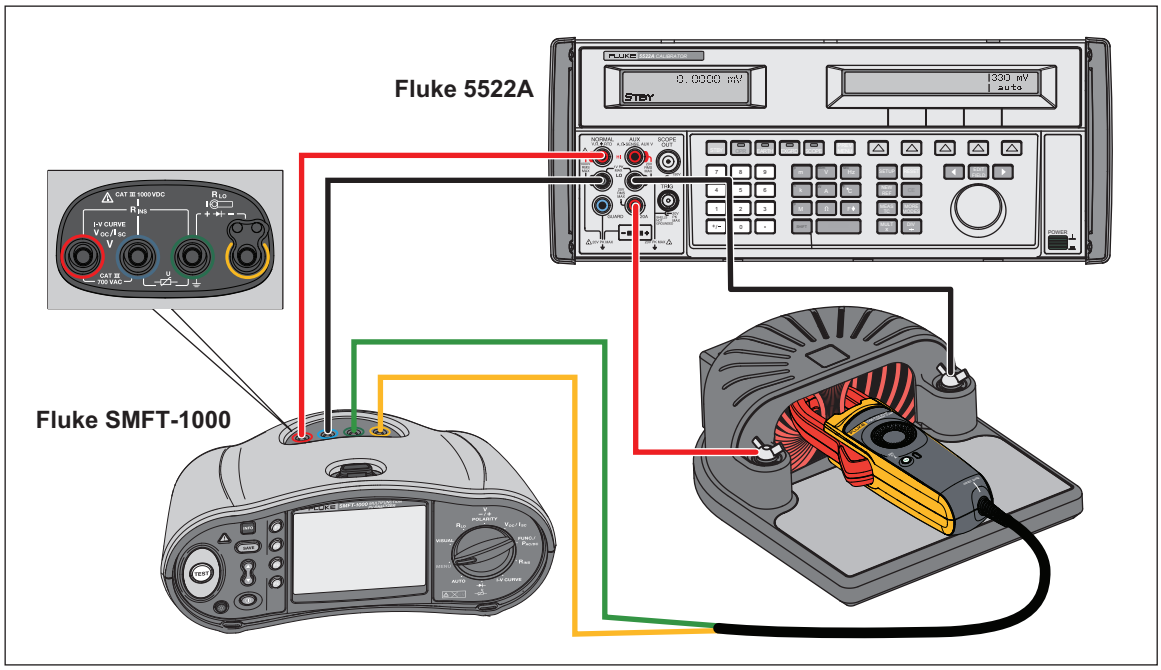
To verify:

1. Set all equipment and the DUT to standby mode.
2. Connect the test leads for high-current test points (see Figure 15):
    a. Connect the green clamp lead to the DUT green connector and the yellow clamp lead to the DUT yellow connector.
    b. Connect the low-thermal EMF test leads from DUT red connector to NORMAL red port on the 552xA and the DUT blue connector to the LO black port below the NORMAL red port.
    c. Connect the high-current test leads from the 20A output of the 552xA calibrator to the terminals of the 25-turn coil.

       These test leads connect the 20 A red port on the 5522A to the positive (red) terminal of the 25-turn coil and the LO black port above the 20 A red port to the negative (black) terminal of the 25-turn coil.
    d. Disconnect all other test leads.
    e. Connect a high-current test lead from NORMAL red port and the Lo Port below Port 30 (552xA).

       This test lead is the **single wire** in the test point table (see Table 14).
    f. Position the current clamp through the designated area of the 25-turn coil for the 95 A test points.
    g. Center the current clamp around the **single wire** test lead for the 1 A test points.

Figure 15. AC/DC Power Connections



3. Turn the rotary switch on the DUT to $\mathbf{P_{AC/DC}}$:
   a. Push (F2) until **Current** shows in highlight on the left-side menu.
   b. Use the dial on the current clamp to zero the clamp I_{DC} reading on the DUT display.

      The absolute value of the DC current reading on the DUT display should not exceed 0.1 A dc.
   c. When the clamp is zeroed, push (F1) to set the DUT to enter **Power** measurement mode.
   d. Momentarily push (TEST) on the DUT to enter **Continuous DC** measurement mode.
4. Set the 552xA calibrator to output the first DC power test point (see Table 14).

Table 14. AC/DC Power Test Points

Range	Frequency [Hz]	552xA Current Output [A]	LCOMP	552xA Config.	Test Points [W]		
					[W]	[A]	[V]
0 W to 100000 W 0 Vdc to 1000 Vdc 0 Vac to 700 Vac 1 A to 100 A	0	1	NA	Single-Wire	5	1	5
		3.8	NA	25-turn Coil	475	95	
		1	NA	Single-Wire	10	1	10
		3.8	NA	25-turn Coil	950	95	
		1	NA	Single-Wire	50	1	50
		3.8	NA	25-turn Coil	4750	95	
		1	NA	Single-Wire	100	1	100
		3.8	NA	25-turn Coil	9500	95	
		1	NA	Single-Wire	500	1	500
		3.8	NA	25-turn Coil	47500	95	
		1	NA	Single-Wire	1000	1	1000
		3.8	NA	25-turn Coil	95000	95	
	50	1	OFF	Single-Wire	5	1	5
		3.8	ON	25-turn Coil	475	95	
		1	OFF	Single-Wire	10	1	10
		3.8	ON	25-turn Coil	950	95	
		1	OFF	Single-Wire	50	1	50
		3.8	ON	25-turn Coil	4750	95	
		1	OFF	Single-Wire	100	1	100
		3.8	ON	25-turn Coil	9500	95	
		1	OFF	Single-Wire	500	1	500
		3.8	ON	25-turn Coil	4750	95	
		1	OFF	Single-Wire	700	1	700
		3.8	ON	25-turn Coil	66500	95	

Table 14. AC/DC Power Test Points (cont.)

Range	Frequency [Hz]	552xA Current Output [A]	LCOMP	552xA Config.	Test Points [W]		
					[W]	[A]	[V]
0 W to 100000 W 0 Vdc to 1000 Vdc 0 Vac to 700 Vac 1 A to 100 A	60	1	OFF	Single-Wire	5	1	5
		3.8	ON	25-turn Coil	475	95	
		1	OFF	Single-Wire	10	1	10
		3.8	ON	25-turn Coil	950	95	
		1	OFF	Single-Wire	50	1	50
		3.8	ON	25-turn Coil	4750	95	
		1	OFF	Single-Wire	100	1	100
		3.8	ON	25-turn Coil	9500	95	
		1	OFF	Single-Wire	500	1	500
		3.8	ON	25-turn Coil	4750	95	
		1	OFF	Single-Wire	700	1	700
		3.8	ON	25-turn Coil	66500	95	

5. Push **OPER** on the 552xA to set the operate mode, if necessary, and wait for the calibrator to stabilize.
6. Record the voltage, current, and power indication on the DUT in the test record.
7. Set the 552xA calibrator to output the next power test point (see Table 14).
8. Repeat steps 5 through 7 for all DC test points.

Note

Do not move on to AC current test points yet.

9. Set the 552xA calibrator into standby mode.
10. Set the 552xA calibrator to output the first AC power test point (see Table 14).

Note

*For AC test points, it may be necessary to have the 552xA LCOMP feature on. The test point table shows when to use LCOMP (*see Table 14*).*

11. Push (F3) on the DUT to switch to **AC** measurement mode.
12. Momentarily push (TEST) on the DUT to enter **Continuous AC** measurement mode.
13. Repeat steps 5 through 7 for all AC power test points.
14. Set the 552xA calibrator to standby mode.

When the calibration is complete, set all equipment to standby and disconnect all test leads.

Calibration Adjustment and Repair

Adjustment and Repair for the SMFT-1000 is only available at a Fluke Service Center or Authorized Service Partner. To send your instrument to Fluke for service, you must have a Return Material Authorization (RMA) number.

To obtain an RMA number:

- Use the Online Service RMA request form

  or

- Contact us at 1-888-99-FLUKE (1-888-993-5853)

Replaceable Parts

Table 15 is a list of replaceable parts for the Product.

Table 15. Replacement Parts

Description	Part Number
⚠ Fuse, FF 630 mA 1000 V IR 30 kA for PV Analyzer	5335526
Battery Holder	1676850
Battery Access Door	5330087